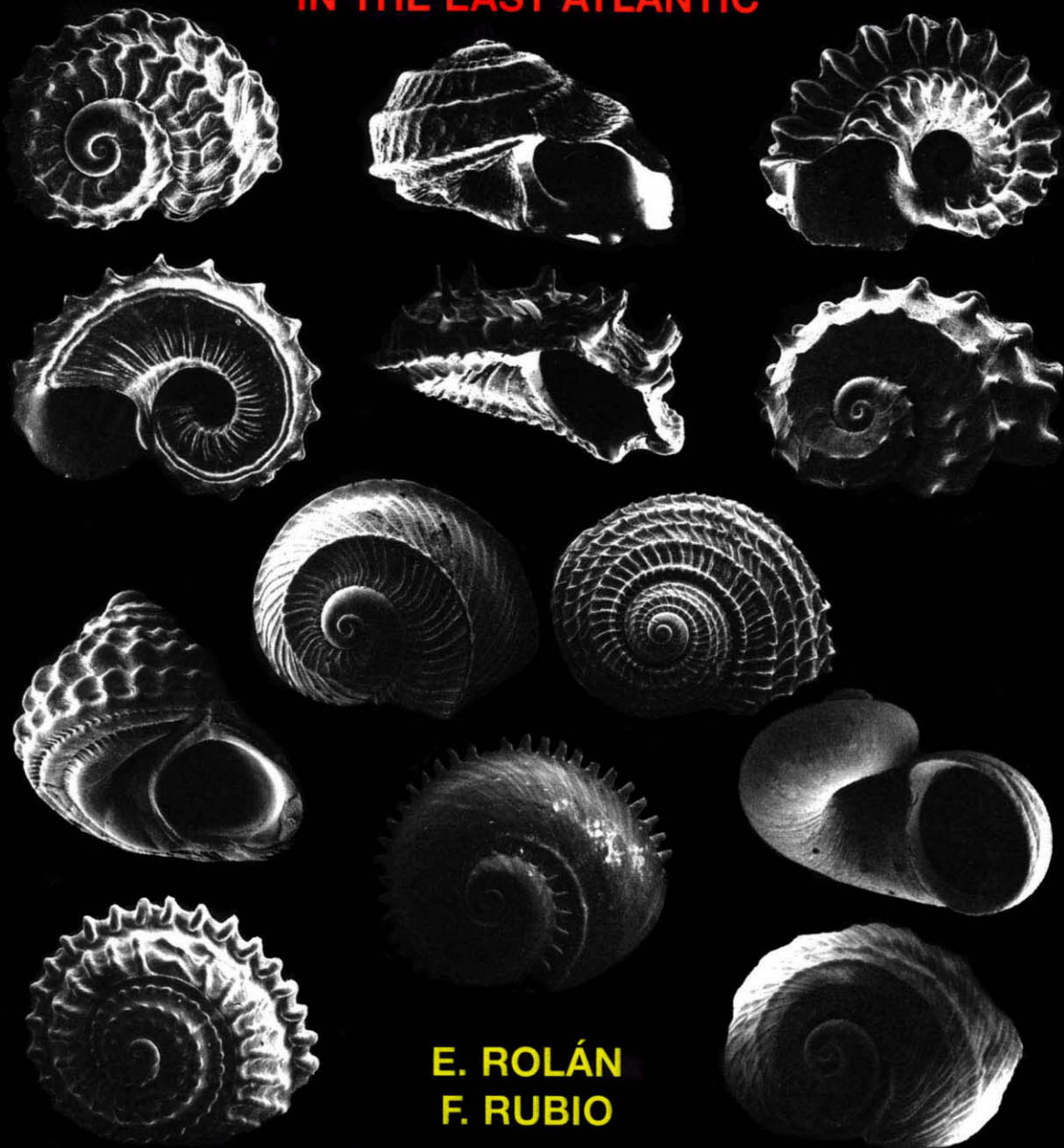


**THE FAMILY TORNIDAE
(GASTROPODA, RISSOOIDEA)
IN THE EAST ATLANTIC**



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THE FAMILY TORNIDAE (GASTROPODA, RISSOOIDEA) IN THE EAST ATLANTIC

The genera *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* and *Pseudoliotia*,
with the description of 23 new species

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ABSTRACT

Thirty nine species of West African Gastropoda belonging to the family Tornidae are studied. They are included in the genera *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* and *Pseudoliotia*. The placement of these two last genera in Tornidae is provisional. From the 39 studied species, 13 are included in the genus *Tornus*, 1 in *Sigaretornus*, 5 in *Ponderinella*, 17 in *Discopsis*, 2 in *Naricava* and 1 in *Pseudoliotia*. Of all those, 23 are described as new species: 7 in the genus *Tornus*, 1 in *Sigaretornus*, 4 in *Ponderinella*, 8 in *Discopsis*, 2 in *Naricava*, and 1 in *Pseudoliotia*. One species of *Discopsis* is kept without name due the bad condition of the studied material. The genus *Cochliolepis* Stimpson, 1858, long used for African species, is considered as belonging in the family Vitrinellidae and the genus *Discopsis* De Folin, 1869 is employed for the Tornidae species previously attributed to it. New anatomical and radular information is presented for some species, and a key for generic and specific identification is proposed.

RIASSUNTO

Sono studiate 39 specie di gasteropodi dalla costa occidentale dell'Africa, appartenenti alla famiglia Tornidae, nei generi *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* e *Pseudoliotia*. La collocazione degli ultimi due generi nei Tornidae è da considerarsi provvisorio.

Delle 39 specie studiate, 13 sono del genere *Tornus*, 1 di *Sigaretornus*, 5 di *Ponderinella*, 17 di *Discopsis*, 2 di *Naricava* e 1 di *Pseudoliotia*. Delle 23 specie descritte come nuove per la Scienza, 7 sono incluse nel genere *Tornus*, 1 in *Sigaretornus*, 4 in *Ponderinella*, 8 in *Discopsis*, 2 in *Naricava* e 1 in *Pseudoliotia*. Una specie di *Discopsis* è rimasta senza nome a causa del cattivo stato di conservazione del materiale esaminato. Si considera che *Cochliolepis* Stimpson, 1858, impiegato a lungo per specie africane, è un genere appartenente alla famiglia Vitrinellidae e viene qui sostituito nell'uso da *Discopsis* De Folin, 1869. Si apportano dati anatomici e radulari di alcune specie, e si propone una chiave per l'identificazione sia generica sia specifica delle specie studiate.

RÉSUMÉ

39 espèces de gastéropodes ouest-africains appartenant à la famille Tornidae sont étudiées. Elles se répartissent dans les genres *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* et *Pseudoliotia*. Le placement de ces deux derniers genres dans les Tornidae est considéré comme provisoire. Parmi les 39 espèces étudiées, 13 sont placées dans le genre *Tornus*, 1 dans *Sigaretornus*, 5 dans *Ponderinella*, 17 dans *Discopsis*, 2 dans *Naricava* et 1 dans *Pseudoliotia*. 23 de ces espèces sont décrites comme nouvelles pour la science: 7 dans le genre *Tornus*, 1 dans *Sigaretornus*, 4 dans *Ponderinella*, 8 dans *Discopsis*, 2 dans *Naricava* et 1 dans *Pseudoliotia*. Une espèce de *Discopsis* n'est pas dénommée, du fait de la mauvaise condition du matériel étudié. Le genre *Cochliolepis* Stimpson, 1858, longtemps employé pour des espèces africaines, est considéré comme appartenant à la famille Vitrinellidae et le genre *Discopsis* De Folin, 1869 lui est substitué pour les espèces de Tornidae qui lui étaient jusqu'alors attribuées. De nouvelles informations sur l'anatomie et la radula sont présentées pour quelques espèces, et une clef d'identification aux niveaux générique et spécifique sont proposées.

RESUMO

Estudam-se 39 espécies de Gastrópodes da costa ocidental da África, pertencentes à família Tornidae e pertencentes aos géneros *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* e *Pseudoliotia*. A situação dos últimos dois géneros no seio da família Tornidae é provisória. Das 39 espécies estudadas, 13 são do género *Tornus*, 1 do *Sigaretornus*, 5 do *Ponderinella*, 17 do *Discopsis*, 2 do *Naricava* e 1 do *Pseudoliotia*. Do total das espécies, 23 são novas para a Ciência, descrevem-se 7 para o género *Tornus*, 1 para *Sigaretornus*, 4 para *Ponderinella*, 8 para *Discopsis*, 2 para *Naricava* e 1 para o género *Pseudoliotia*. Uma espécie de *Discopsis* permanece ainda sem nome devido ao mau estado do material obtido. Considera-se que o género *Cochliolepis* Stimpson, 1858, empregado durante muito tempo para as espécies africanas, é um género pertencente a Vitrinellidae e substitui-se o dito género por *Discopsis* De Folin, 1869. Apresentam-se dados anatómicos e radulares de algumas espécies, proporcionando uma chave para a identificação tanto genérica como específica das espécies estudadas.

RESUMEN

Se estudian 39 especies de gasteropodos de la costa occidental de África pertenecientes a la familia Tornidae y que hemos situado en los generos *Tornus*, *Sigaretornus*, *Ponderinella*, *Discopsis*, *Naricava* y *Pseudoliotia*. El emplazamiento de estos dos ultimos géneros en Tornidae es provisional.

En la introducción se comenta la carencia de estudios anatómicos sobre las partes blandas de las especies de Tornidae y se refieren los trabajos publicados sobre las del Atlántico oriental, la secuencia de descripción de estas especies y la situación de algunos taxones erroneamente atribuidos a Tornidae.

En el apartado de resultados se señalan las descripciones de cada género, su diagnóstico y se hacen comentarios sobre su posición sistemática.

De las 39 especies estudiadas, 13 son del género *Tornus*, 1 de *Sigaretornus*, 5 de *Ponderinella*, 17 de *Discopsis*, 2 de *Naricava* y 1 de *Pseudoliotia*. En cada especie se muestra la literatura previamente existente sobre la misma, el material tipo, la descripción de la concha (y del animal y rádula, cuando se conoce). Se aportan dimensiones, área de distribución conocida, hábitat en algún caso, y se hace comparación de cada especie con las morfológicamente más próximas.

De todas las especies estudiadas 23 son nuevas para la ciencia, 7 del género *Tornus*, 1 de *Sigaretornus*, 4 de *Ponderinella*, 8 de *Discopsis*, 2 de *Naricava* y 1 de *Pseudoliotia*. Una especie de *Discopsis* permanece sin nombre debido al mal estado del material obtenido.

Se considera que *Cochliolepis* Stimpson, 1858, género empleado tradicionalmente para diversas especies africanas, es un género perteneciente a Vitrinellidae y se sustituye dicho género por *Discopsis* De Folin, 1869 para tales especies.

The Family Tornidae in the East Atlantic

Se aportan datos anatómicos y radulares de algunas especies, representando algunas figuras de rádulas y opérculos, así como dibujos de las partes blandas.

Se comenta la abundancia de esta familia en las costas de África occidental, estando en cambio menos representada en el Indo-Pacífico y apenas presente en el Atlántico americano.

Se muestra una clave esquematizando los caracteres morfológicos de la concha más importantes en la separación de especies

Asimismo, se presentan claves dicotómicas para la identificación de géneros y de especies.

Finalmente, se muestra una tabla con las áreas de distribución conocida de las especies estudiadas, advirtiendo que probablemente estas extensiones puedan ser ampliadas en futuros estudios.

Se comentan las características de *Cyclostremiscus calameli* que morfológicamente podría parecer un *Tornus*, pero se mencionan y se muestran las diferencias de esta especie con las de la familia Tornidae.

INTRODUCTION

We have only scant information about most of the species of the family Tornidae Sacco, 1896, with the exception that it is a heterogeneous group of species linked together on the basis of some shell similarities. The lack of knowledge about the anatomy of the soft parts and the radula of most of the species described to date makes it difficult for generic and subgeneric placement. Similarly, the relationship with close families such as Vitrinellidae or Adeorbidae is unclear. The only anatomical studies published about these groups concern the type species of the genera *Circulus* Jeffreys, 1865 [*C. striatus* (Philippi, 1836) in FRETTER, 1956], *Cochliolepis* Stimpson, 1858 (*C. parasitica* Stimpson, in MOORE, 1972) and *Tornus* Turton & Kingston, 1830 [*T. subcarinatus* (Montagu, 1803), in GRAHAM, 1982]. This is a very low percentage if we consider the high number of species that these families encompass.

MOORE (1972) after a detailed anatomical examination of live specimens of *Cochliolepis parasitica*, type species of the genus, placed *Cochliolepis* in Vitrinellidae due their anatomical similarity. He noted that the relationship of *Cochliolepis* with *Tornus* and the family Tornidae is not close in spite of the fact that some of the species are most similar to those of *Tornus*.

PONDER (1988), in his study of the phylogeny of Truncatelloidea (= Rissoidae), completed the available studies (FRETTER, 1956; MOORE, 1972; GRAHAM, 1982) with his own data, apparently unpublished, on the tornids-vitrinellids-adeorbids (=circulids) complex, as a separate family, which refers to Tornidae, but pointed out that this group could be separated into two or more families. That author affirmed that the species of Tornidae (including vitrinellids for this analysis) have some common characters, but in its general features are like those of the group hydrobids-truncatellids, and more related to Irvadiidae and Elachisinidae. Even PONDER & KEYZER (1998) mention that Tornidae may not be separable from Vitrinellidae.

The oldest species of the genus *Tornus* Turton & Kingston, 1830 from European and West African coasts was described by MONTAGU (1803): *Helix subcarinatus*. There was no new information about this genus from the West African coast until 160 years later, with the work of ADAM & KNUDSEN (1969) in which new species of *Tornus* were described: *T. africanus*, *T. cancellatus*, *T. garrawayi*, *T. jullieni* and *T. leloupi*. More recently, MOOLENBEEK & HOENSELAAR (1995) described a new species, *T. tornaticus* from Mauritania. AARTSEN, CARROZZA & MENKHORST (1998) described *T. mienisi* from the Mediterranean of Israel, but that species is not a *Tornus* but a *Discopsis*. At same time, those authors commented on some characters of *Tornus subcarinatus*.

As we have pointed out in the past, and continue to believe, the molluscs of the West African coast are far from completely known, and therefore the large quantity of material collected by us and other malacologists in the last several years included many apparently undescribed species.

Some European taxa were placed erroneously in the genus *Tornus* (see for example RODRÍGUEZ BABIO & THIRIOT-QUIÉVREUX, 1974 and FRETTER & GRAHAM, 1978): *Tornus unisulcatus* (Chaster, 1897) or *T. imperspicuus* Monterosato, 1875 [= *Tjaernoieia exquisita* (Jeffreys, 1883)]. Both are now placed in the genus *Tjaernoieia* Warén, 1991, after study of live animals (RODRIGUEZ BABÍO & RUBIO, 1993). Besides *Adeorbis supranitidus* (Wood, 1872) was included in this genus, for example, in PALLARY (1912), but it must be an error for *Omalaxis supranitida* Wood, 1848, as it appears in LOCARD (1898: 12). *Tornus fragilis* (G. O. Sars, 1878), mentioned in MACEDO ET AL. (1999), is considered to be a synonym of *Laona finmarchica* (Sars, 1858) and to belong in the family *Philinidae* (see SABELLI ET AL., 1990). On the other hand *Adeorbis umbilicatus* Jeffreys, 1880 *nom. nud.*, mentioned by DE FOLIN (1883: 143) and by LOCARD (1898: 11, pl. 2, figs. 1-4) is a minute shell from deep water whose status was not yet established. *Delphinula pusilla* Calcara, 1839, mentioned as a synonym of *Tornus subcarinatus* by SABELLI ET AL. (1990) is considered by AARTSEN ET AL. (1998) a synonym of *Delphinula laevis* Philippi, 1844).

The first species of the genus *Discopsis* from West African and European coasts was described by DE FOLIN (1869) as *Discopsis costulatus*. The following descriptions of new species from this area were made by JOUSSEAUME (1872): *Cyclostrema militare*, and DAUTZENBERG (1912): *Discopsis gruveli*. The next descriptions appeared in ADAM & KNUDSEN (1969) who included in the genus *Cochliolepis* those species previously described in *Discopsis*, and new species described as *Cochliolepis dautzenbergi* and *C. jullieni*. The most recent species of this genus were described by ROLÁN & RUBIO (1990): *Cochliolepis radians* and *C. reductus*. The use of this genus for the West African species is discussed below. We have also mentioned above the species *Discopsis mienisi*, described from Israel.

GOFAS ET AL. (1985) listed 2 species of *Tornus* and 2 of *Cochliolepis* from Angola, mentioning that there are at least 2 more undescribed species of *Tornus*. They illustrated the shells of *Tornus leloupi* and *Cochliolepis* sp., showing a drawing of the animal of *Tornus leloupi*. BERNARD (1984) showed photographs of some species of Tornidae, but without names or with erroneous ones.

In spite of these works, in the present revision based on the material collected by the authors and other malacologists in last few years, several unnamed species were found. The study of the large quantity of material available in the MNHN increased our information and allowed us to better define some known species. All this led to the present review of these genera, describing 23 new species.

MATERIAL AND METHODS

The material for this revision was obtained during several expeditions to West Africa (Canary, Morocco, Mauritania, Senegal, Ghana, São Tomé, Príncipe and Angola). No species of Tornidae were found in the Cape Verde Archipelago and Annobon Island. In those expeditions, the material was collected mainly from sediments dredged from sandy or muddy bottoms from intertidal down to 65 m. It was also obtained by diving with snorkel down to 10 m, and later sorted under magnification. Further material was studied from Morocco, Mauritania, Ghana, Congo, Angola, etc., and from several private collections mentioned in the abbreviations and acknowledgements below. Finally, we studied the large quantity of material from the MNHN collections during an extended visit by the senior author supported by the project PARSYST. The material in that museum was collected mainly by Gofas (Angola) and von Cosel during several expeditions (Sedigui, Chalghi, Benchaci, etc.) from ships and by dredging.

Abbreviations:

AMNH	American Museum of Natural History, New York
BMNH	The Natural History Museum, London
MNCN	Museo Nacional de Ciencias Naturales, Madrid
MNHN	Muséum National d'Histoire Naturelle, Paris
NNM	National Natuurhistorisch Museum, Leiden
CAP	collection A. Peñas, Vilanova i la Geltrú, Spain
CCS	collection C. Schrönher, Luanda, Angola
CER	collection E. Rolán, Vigo, Spain
CFF	collection F. Fernandes, Cacelas, Portugal
CFR	collection F. Rubio, Valencia, Spain
CFS	collection F. Swinnen, Lommel, Belgium
CJP	collection J. Pelorce, Le Grau du Roi, France
COS	collection J. Otero Schmitt, Santiago de Compostela, Spain
CPH	collection P. H. Hattenberger, St. Jean de Blaignac, France
CPR	collection P. Ryall, Maria Rain, Austria
sp	specimen with soft parts
s	empty shell
j	juvenile
f	fragment

RESULTS

Superfamily RISSOOIDEA Gray, 1847

Family TORNIDAE Sacco, 1896

The shells of this family appear to be vitrinellids due to being small, white and usually depressed with wide umbilicus, but the operculum is oval and paucispiral; there is a penis and the branchiae are extended at the right side of the aperture. The radula is taenioglossate.

Genus *Tornus* Turton & Kingston, 1830

Tornus Turton & Kingston, 1830. Type species by monotypy: *Helix subcarinata* Montagu, 1803. *Testacea Britanica*, pp. 438, pl. 7, fig. 9. Recent. Europe.

Adeorbis S. Wood, 1842. *Ann. Mag. Nat. History*, 9: 530. Type species: *Adeorbis subcarinatus* (Montagu, 1803).

Diagnosis: Shell of small size (2-3 mm), solid, usually depressed, spire with 3–4 whorls. Protoconch smooth, between 1-2 whorls (most frequently 1³/₄), not elevated. Teleoconch with strong spiral cords crossed by strong axial ribs. External lip crenulated. Aperture subtrigonal. Operculum ovoid, paucispiral and chitinous.

Remarks: According to FRETTER & GRAHAM (1978) and GOFAS, PINTO AFONSO & BRANDÃO (1985), the true *Tornus* live deeply buried in sand under stones, but they need clean sand through which the water circulates and allows good oxygenation.

Tornus subcarinatus (Montagu, 1803) (Plates 1 and 2)

(Figs. 1-14, 240-241, 249-250)

Helix subcarinata Montagu, 1803. *Test. Brit.*: 438, pl. 7, fig. 9. [Type locality: British Islands].

Cyclostrema miranda Bartsch, 1911. *Proc. U. S. Nat. Mus.*, 39: 229-234.

Adeorbis subcarinatus var. *interrupta* Marshall, 1902. *J. Conch.*, 10: 192.

Adeorbis subcarinatus var. *robustior* Dautzenberg, 1912. *Ann. Inst. océan, Monaco*, 5(3): 53. [Type locality: Senegal].

Adeorbis subcarinatus (Montagu): HIDALGO, 1917: 118.

Adeorbis subcarinatus (Montagu): NOBRE, 1938-1940: 343, pl. 31, figs. 6.

Adeorbis subcarinatus Montagu: NICKLÈS, 1950: 52, fig. 48.

Tornus subcarinatus Montagu: MOORE, 1969. *Veliger*, 12(2): 169, fig. 1.

Tornus subcarinatus (Montagu, 1803): GIANNUZZI-SAVELLI ET AL. 1997, figs. 552, 554.

Tornus subcarinatus (Montagu, 1803): AARTSEN, CARROZZA & MENKHORST, 1998: 135-138.

Type material: Not examined.

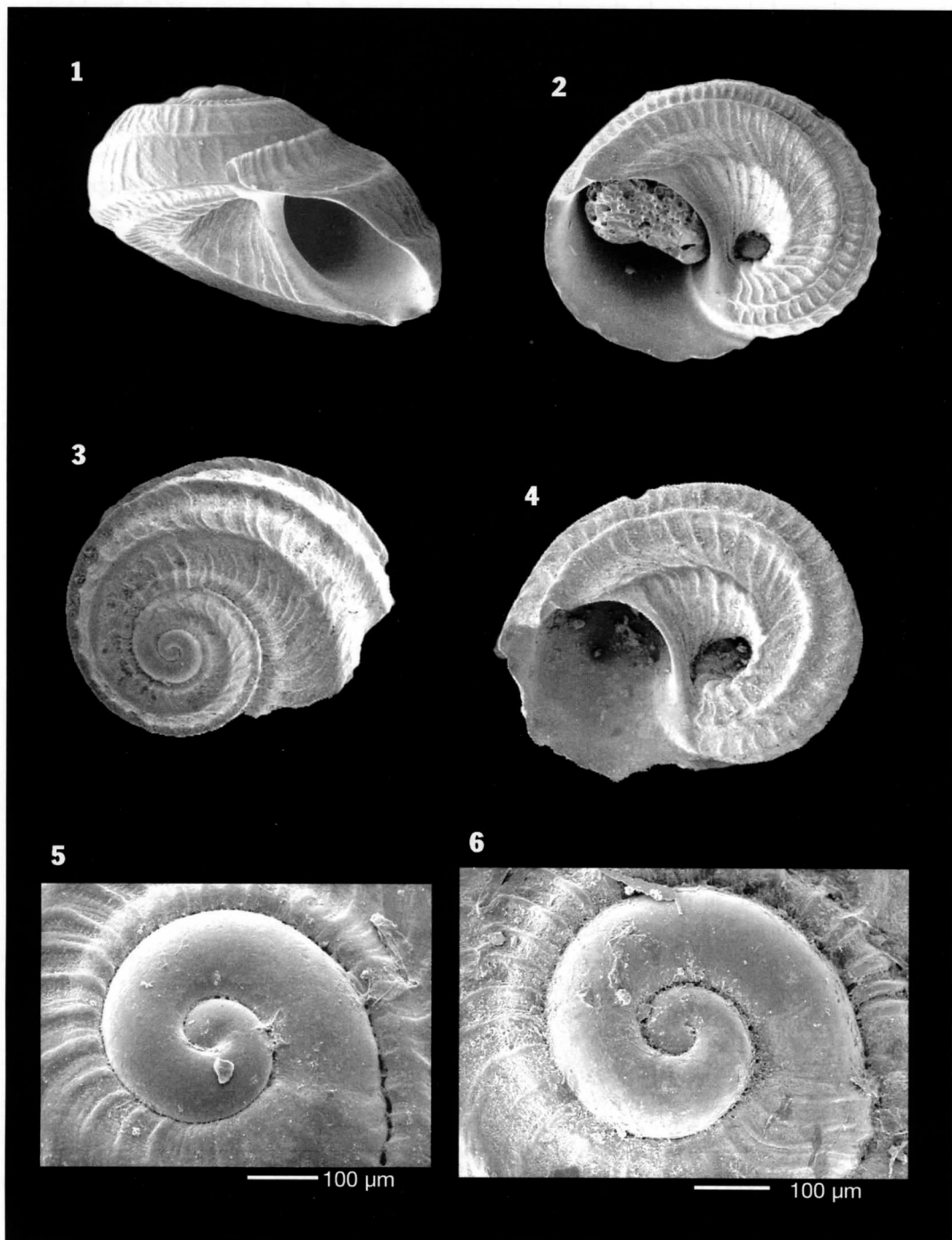
Other material examined: Spain: 1 sp, Portosin, Ría de Muros (COS); 5 sp, Islas Sisarga, A Coruña (COS); 3 sp, Melide, Isla de Ons, Pontevedra (COS); 5 sp, 35 s, Ría de Vigo, Canido, 1-2 m (CER); 7 s, Islas Cies, 14 m (CER); 2 s, Mourisca, Bueu, Pontevedra (COS); 6 sp, Tarifa, intertidal (CFR); 5 s, Tarifa, 2 m (CFR); 12 c, Mijas Costa, Andalucía (CAP); 3 s, La Herradura, Málaga (CAP); 4 sp, 0.5 m, Fuengirola (CFR); 15 s, Mar de Alborán, 70 m (CFR); 50 s, Es Caló, Formentera (CAP); 14 s, Cabo de Creus, Cataluña (CAP); 3 c, Cala Giberola, Girona (CAP); 550 s, Sitges, Barcelona (CAP); 8 c, Getarés (CAP). Italy: 3 s, Lampedusa (CAP). Turkey: 3 s, Kusadasi, 10 m (CER). Portugal: 15 s, Lisboa, 10 m (CER). Algeria: 10 s, Oran, 10 m (CER). Morocco: 1 s, Rabal, beach sediments (MNHN); 4 s, El Jadida, beach (CER). Sahara: 2 s, Dakhla, 50-60 m (CFR). Mauritania: 23 s, Cape Rouge, Baie de Cansado (MNHN); 4 s, 1 f, Bahía de l'Etoile, Nouadhibou, intertidal (CER). Senegal: 1 s, Madeleines, 35 m (CER); 84 s, large de Saloum, Dakar, 50 m (MNHN); 9 s, Dakar (MNHN); 1 s, S of Gorée, 95 m (MNHN).

Description: Shell (Figs. 1-4, 7-11) orbicular depressed, nearly lenticular, very solid. Protoconch (Figs. 5-6) of about 1³/₄ smooth whorls, of about 430-440 µm diameter, and a nucleus of about 37 µm for the Atlantic specimens; the Mediterranean specimens have a protoconch (Fig. 13-14) with a little more than 1 whorl, of about 350 µm diameter and 65 µm diameter of the nucleus. Teleoconch of about 1¹/₂ whorls, with not very rapidly increasing, sculpture consisting usually of few spiral cords and numerous axial ribs; the adapical cord is in subsutural position; the two next ones are in the convexity of the whorl, the following one forms the angulation of the periphery, and there are two more below, the lowest one delimiting the umbilicus. The axial sculpture is formed by irregular, sometimes curved, nearly orthocline narrow ribs. Under magnification, the whole shell surface is covered with microtubercles (Fig. 12) disposed in spiral rows. The umbilicus is deep, narrow and with a wide infundibulum. Aperture rounded and a little depressed, columella curved, nearly vertical, the upper part of the outer lip sharp and extended dorsally, undulating by the end of the spiral cords.

Dimensions: Usually between 2.0 and 3.0 mm of maximum diameter.

Animal (Fig. 249) was already described by FRETTER & GRAHAM (1978): "The head has a long, narrow snout with the mouth a longitudinal, subterminal and ventral slit. The tentacles are also long. The pallial edge is simple but carries 2 finger-like tentacles on the right; the attachment is well within the edge". The color is yellowish with reddish-orange tinge and semitransparent appearance. The long cephalic tentacles dorsoventrally flattened, not ciliated; black eyes hardly visible. Two pallial tentacles

PLATE 1



Figures 1-6. *Tornus subcarinatus*. Figs. 1-2. Shells, 2.2 and 2.0 mm, Lisbon, Portugal (CER). Figs. 3-4. Shells, 1.9, 2.0 mm, Dakar, Senegal (MNHN). Fig. 5. Protoconch of Lisbon shell. Fig. 6. Protoconch of Dakar shell.

arise from the inner surface of the mantle skirt near its right margin. The gill is partly bipectinate and may project from the mantle cavity. The foot has a straight anterior edge and two opercular rear lobes; there is no metapodial tentacle. In the male, a penis arises from the dorsal surface of the head behind the right cephalic tentacle.

Radula (Figs. 240-241) taenioglossate, formula 2-1-R-1-2. Rachidian tooth wide, base with a pair of denticles, ventral enlargement with a well-developed U-like shape, lateral margins expanded; margin area with a main cusp and 4-5 smaller denticles at each side. Lateral tooth similar to the central one, but narrower basally, border area with a central cusp and 4 smaller denticles at each side. Marginal teeth elongate, the internal one with 8-10 small denticles on the upper third of its right margin. The external marginal tooth is sickle-like, strongly inclined towards the outer side and presenting 2-3 slight denticles on the upper end of its internal margin.

Operculum (Fig. 250) fine, transparent, with an irregular border and subcentral nucleus.

Distribution: European Atlantic from Norway (POPPE & GOTO, 1991), British Islands (FRETTER & GRAHAM, 1978), North Spain (HIDALGO, 1917, ROLÁN, 1983), Portugal (NOBRE, 1938-40) and Mediterranean (HIDALGO, 1917, POPPE & GOTO, 1991) to the Black Sea (MACEDO *ET AL.*, 1999). NORDSIECK & GARCÍA-TALAVERA (1979) cited it from Canary Islands. NICKLÈS (1950) and ADAM & KNUDSEN (1969) also mentioned Morocco, Mauritania (PALLARY, 1912 also), Ivory Coast up to Gabon, and DAUTZENBERG (1912) mentioned it from Congo. We have collected it as far south as Senegal. Perhaps, that range must be reduced because some of the records, such as those from Ivory Coast and Congo may be due to misidentification of other species (see below, *T. attenuatus* spec. nov.).

Habitat: HIDALGO (1917) mentioned that he found two live specimens in Luaña, North Spain, attached to rocks at low tide. GOFAS & PONDER (1991) give complete information on the habitat of this species, attached to the surface of stones buried in sand down to 30 cm, in pure sand without any silty/muddy deposits, where the water can have sufficient circulation and is clean and oxygenated. In this habitat, it lives with other species such as: *Onoba semicostata*, *Alvania lactea*, *Plagystola asturiana*, *Striarca lactea*, and *Caecum* sp. In Fuengirola, Alboran Sea it lives attached under stones buried in sand together with *Alvania lactea* (Michaud, 1832), *Bornia sebetia* (O.G. Costa, 1829) and *Pseudophitina macandrewi* (P. Fischer, 1867). In Tarifa, Gibraltar Straight, it lives in sandy bottom with boulders and stones partially buried, in places of strong waves and currents with the same species previously mentioned. In Galicia, North Spain, specimens of *T. subcarinatus* have been collected in rocky bottom under stones with *Lithophyllum tortuosum* and *Hymeniacion sanguinea*. In this habitat, *Cingula cingillus* (Montagu, 1803), and *Bittium reticulatum* (Da Costa, 1778) were also collected.

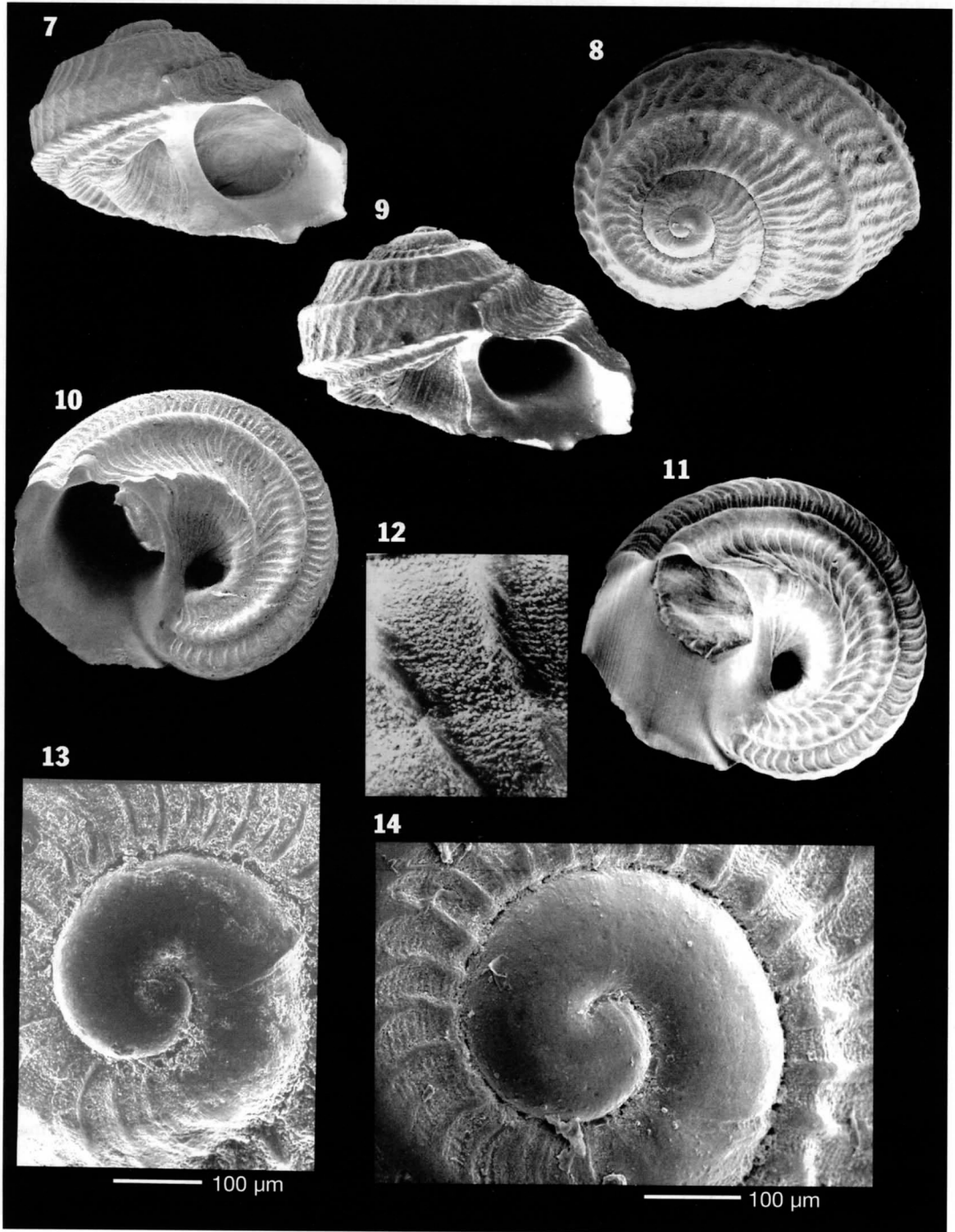
Remarks: The shells shown with this name in BERNARD (1984) are not that species but *Tornus jullieni*.

T. subcarinatus var. *interrupta* described by MARSHALL (1902) and commented on in AARTSEN *ET AL.* (1998) is probably a variation of the Atlantic shells.

The form *robustior* mentioned by DAUTZENBERG (1912) and commented on and illustrated in ADAM & KNUDSEN (1969) is really the European form. This form is mentioned in contrast to other more attenuated African forms, which we consider a different species (see *Tornus attenuatus*). Also the British shells shown in FRETTER & GRAHAM (1978) are more attenuate in shell sculpture, but conspecific in our opinion.

As pointed out by AARTSEN *ET AL.* (1998) the specimens from the Mediterranean (Figs. 7-11) (our material is from Tarifa, Gibraltar Straight in Spain, Algeria up to Kusadasi, Turkey) have a shorter protoconch (Figs. 13-14) (with only a little more than 1 whorl and a smaller diameter) than the

PLATE 2



Figures 7-14. *Tornus subcarinatus*. Figs. 7-11. Specimens, 1.9, 2.0, 2.0, 2.2 and 1.9 mm, Tarifa, South Spain (CFR). Fig. 12. Microsculpture of the teleoconch. Fig. 13. Protoconch of Tarifa shell. Fig. 14. Protoconch of Kusadasi shell, Turkey (CER).

shells described by FRETTER & GRAHAM (1978) and ADAM & KNUDSEN (1969) (see dimensions in the description) and those studied in the present work from the Atlantic (Figs. 1-4), with a larger protoconch (Figs. 5-6). Anyway, *T. subcarinatus* is a variable species living in a wide range of water temperature and that may change the rate of development, as seems to occur in other species, such as Nassaridae (ROLÁN, 1986). Thus, we consider all of them conspecific, although these differences and the reasons for them should be studied in the future.

FRETTER & GRAHAM (1978) studied and measured the eggs of *Tornus subcarinatus* in the ovary, and commented "...but are otherwise unknown, as are the capsules in which they are presumably laid". We have observed in the populations of South Spain, that the eggs are laid into its umbilicus and remain there until hatching (pers. inf.) (Fig. 249). Such umbilical brood protection appears to be adequate for guaranteeing the fitness of the species. This is of importance in the unstable substrate they inhabit: sandy bottom with boulders and partially buried stones, in places of strong waves and currents.

Tornus cancellatus Adam & Knudsen, 1969 (Plate 3)
(Figs. 15-21)

Tornus cancellatus Adam & Knudsen, 1969. *Bull. Inst. r. Sci. nat. Belg.*, 44: 46-47, figs. 25-26. [Type locality: Boulbiné, Mission Gruvel, Dahomey].

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 26). Not examined.

Other material examined: Gambia: 11 s, Kololi Beach, beach (CFS); Ghana: 10 s, Miamia, 35-40 m (CER); 1 s, 2 j, Cape Three Points, 35-65 m (CER). Congo: 4 s, Pointe Noire (CPH).

Description: Shell (Figs. 15-19) orbicular or subconical, solid, slightly depressed, nodulous. Protoconch (Fig. 20) hyperstrophic of about $1\frac{3}{4}$ whorls, smooth, and about 400 μ m. Teleoconch of about $1\frac{1}{4}$ whorls, rapidly increasing; slightly convex dorsally, with 5-6 strong spiral cords on the last whorl (only 2 at the beginning) which are crossed by 17-24 slightly prosocline strong axial ribs forming nodules at the crossing points; slightly concave ventrally with two spiral cords, one near the periphery and another around the umbilicus, also crossed by the axial ribs forming nodules at the crossing points. Umbilicus wide and deep. With magnification, a microsculpture formed by very dense tubercles can be seen (Fig. 21). Aperture rounded with the upper part of the outer lip sharp and extended dorsally.

Dimensions: Holotype is 1.4 mm maximum dimensions (diameter).

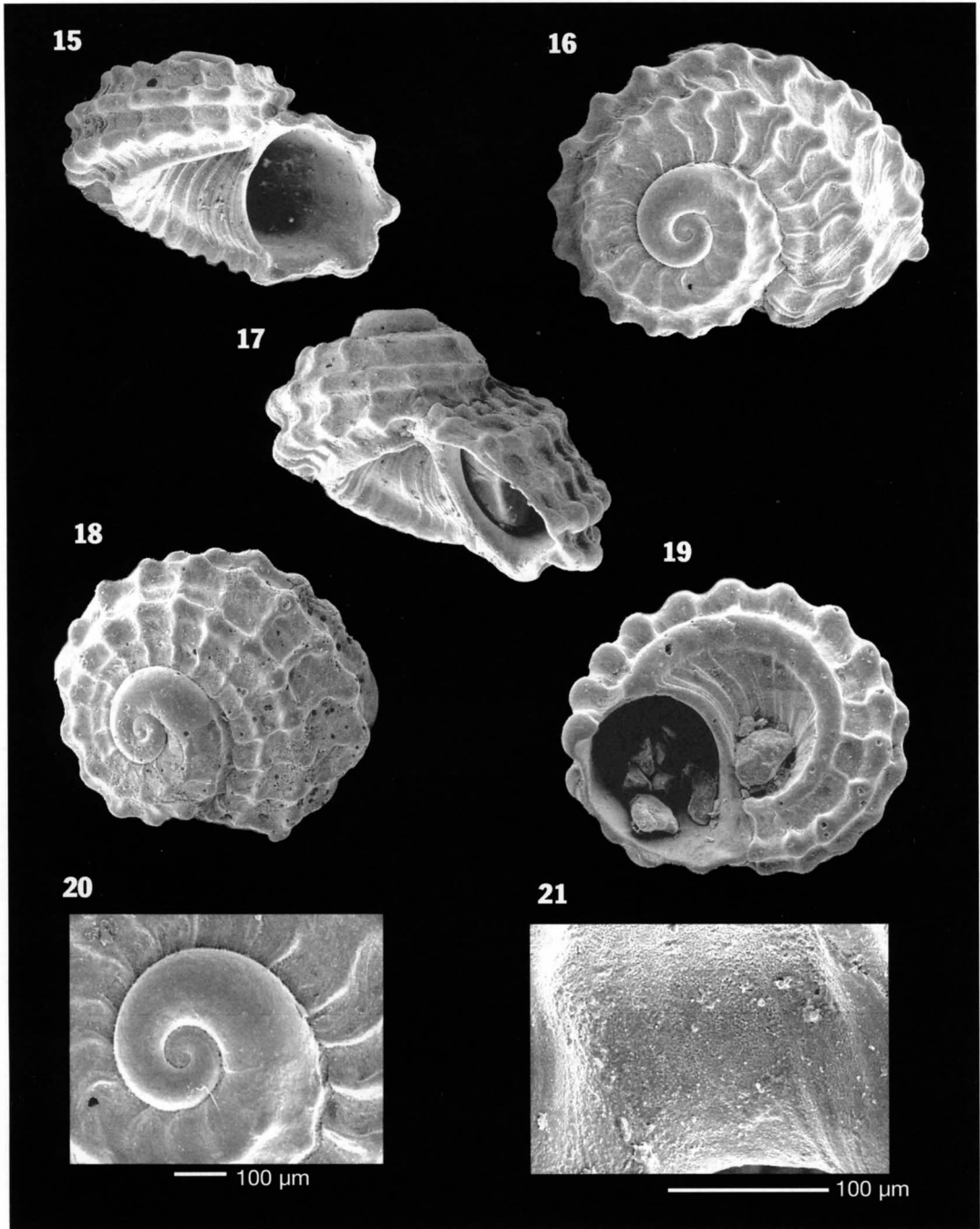
Distribution: Dahomey in the original description. We have examined material collected in Gambia, Ghana and in Congo. Apparently, it is one of the rarest *Tornus*, rarely collected in West Africa.

Remarks: It is easy to differentiate this species from the most similar, *T. subcarinatus*, because the latter has more numerous axial ribs and denser sculpture, spiral cords have only small nodules or the nodules are absent.

Some populations, such as shells collected in Cape Three Points, Ghana and in Congo may have more spiral cords and denser axial ribs.

The most similar species are *T. leloupi* and *T. attenuatus* spec. nov., and the comparison with both of them is made below.

PLATE 3



Figures 15-21. *Tornus cancellatus*. Figs. 15-16. Shells, 1.5 and 1.6 mm, Agazobil, Senegal (MNHN). Figs. 17-19. 1.5, 1.3 and 1.2 mm, Kololi Beach, Gambia (CFS). Fig. 20. Protoconch, Senegal. Fig. 21. Microsculpture of the teleconch.

Tornus leloupi Adam & Knudsen, 1969 (Plate 4)

(Figs. 22-28, 245-246, 251, 254-255)

Tornus leloupi Adam & Knudsen, 1969. *Bull. Inst. r. Sci. nat. Belg.*, 44: 45-46, fig. 24. [Type locality: Ile d'Arguin, Mauritania].

Tornus leloupi Adam & Knudsen, 1969: GOFAS, PINTO AFONSO & BRANDÃO, 1985. *Conchas e Moluscos de Angola*: 44, figs. 13a, b and c.

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 24). Not examined.

Other material examined: Mauritania: 9 s, 1 f, Banc d'Arguin, beach sediments (CER); 12 s, Banc d'Arguin (CAP). Senegal: 10 s, Ngazobil (MNHN); 1 f, M'Bao, Dakar (CJP). Gambia: 1 s, Kaloli Beach (CFS). Guinea Conakry: 1 s, W Ile Kabak, N/O André Nizery SEDIGUI I, stn. 159, 21 m 9°18'N 13°45'W (MNHN); 1 s, W Ile Tannah, N/O André Nizery SEDIGUI I, stn. 80, 16 m 9°12.3'N 13°37'W (MNHN); 1 s, W Rio Morébaya, N/O André Nizery SEDIGUI I, stn. 170, 17 m 9°24'N 13°45'W (MNHN); 2 s, W Rio Nuñez, N/O André Nizery SEDIGUI II, stn. 804, 10°35.5'N 53°26'W, 9 m (MNHN). Ghana: 20 s, Miamia, 38-40 m (CER); 3 s, Miamia, 48-50 m (CER); 21 s, 2 j, Cape Three Points, 35-65 m (CER). Equatorial Guinea: 1 s, 01°40'S 09°25'E, 150 m (MNHN). Congo: 4 s, Pointe Noire (CPH). Angola: 17 s, Ambrizete region, Bengo province, 07°20.19'S 12°55.09E, beach deposits (MNHN); 4 s, 10 kms S Ambrizete, beach sediment (MNHN); 6 s, Faro, Ambrizete region, 07°17.49'S 12°53.09E, beach deposits (MNHN); 4 s, Cacucaco, 7 m (CER); 5 sp, 6 s, Cacucaco, Bengo, infralittoral rocks (MNHN); 5 sp, 2 s, Barra do Dande, Bengo, infralittoral rocks (MNHN); 11 s, São Nicolau, Namibe province (older Moçamedes), beach sediments (MNHN).

Description: Shell (Figs. 22-25) rounded depressed, relatively solid, nearly lenticular with prominent sculpture, whitish with a serrated peripheral border. Protoconch (Figs. 26-27) hyperstrophic, of about 1¾ whorls, smooth, and about 390 µm in diameter. Teleoconch of a little more than 1 whorl with 4 strong spiral cords, an additional one appearing close to the suture on the last quarter of the whorl. There are about 14 fine curved prosocline axial ribs, which cross the spiral cords forming prominent scales at the crossings. At the base, the axial ribs are wider and more irregular, curved on the lower cord, and narrower into the umbilicus. This is wide open showing the previous whorls. Under magnification, it can be seen that the entire surface is covered by microtubercles (Fig. 28). Aperture rounded, the external lip sharp with prominences where the spiral ribs end.

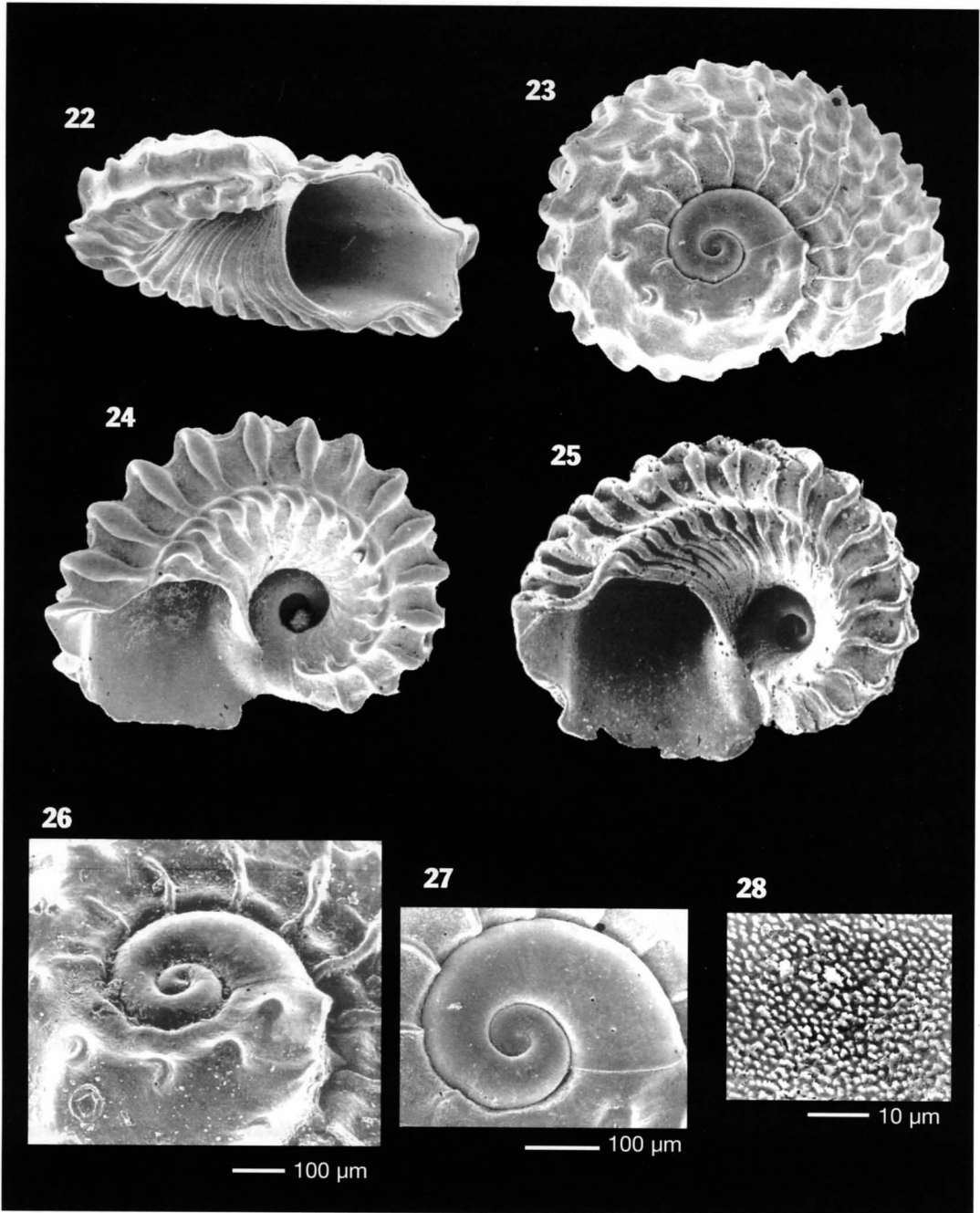
Dimensions: Holotype is 2.2 mm maximum dimension (diameter), which is the largest dimension for this species.

Animal (Figs. 254-255) very similar to that described for *T. subcarinatus*: the snout is very large and bilobed at its end; the cephalic tentacles are very long, not flattened dorsoventrally, not ciliated; eyes visible. The gill extends from the mantle cavity. Two pallial tentacles are evident. The color is light pink with the reddish buccal bulb visible by transparency. Small opercular lobes, no metapodial tentacle.

Radula (Fig. 245-246) similar to that of *T. subcarinatus*: formula 2-1-R-1-2. Rachidian tooth wide, base with a pair of denticles, ventral enlargement with a U-like shape, lateral margins expanded; margin area with a main cusp and 3 smaller denticles at each side. Lateral tooth similar to the central one but narrower basally, border area with a central cusp and 4-5 smaller denticles at each side. Marginal teeth elongate; the internal one with 6-8 small denticles on the upper third of its right margin. The outer marginal tooth is sickle-like, strongly inclined outwards.

Operculum (Fig. 251) paucispiral, fine, transparent, with irregular margin and subcentral nucleus.

PLATE 4



Figures 22-28. *Tornus leloupi*. Figs. 22-25. Shells, 1.4, 1.3, 1.0, and 1.4 mm, Miamia, Ghana (CER). Figs. 26-27. Protoconchs. Fig. 28. Microsculpture of the teleoconch.

Distribution: In the original description, Mauritania and Guinea Conakry are mentioned. GOFAS *ET AL.* (1985) enlarged its range southward to Angola.

Habitat: Under rocks buried in sand (Gofas, pers. comm.).

Remarks: This species was illustrated in GOFAS *ET AL.* (1985: 44 and 45), even with a drawing of the soft parts (Fig. 254). The shell of this species is more fragile and depressed than those previously mentioned in this genus. Also, in this species, the short prominences on the spiral cords are very characteristic and differentiate it from any other of the genus. The species is rather variable but must not be confused with other similar ones (see below *T. rachelae* spec. nov.).

Tornus rachelae spec. nov. (Plate 5)

(Figs. 29-33)

Type material: Holotype (Fig. 29) in the MNCN (n° 15.05/46467). Paratypes in the following collections: AMNH (1), BMNH (1), MNHN (1, Fig. 30), CER (9, Fig. 32), CFR (1), CAP (1) and CPR (1).

Material examined: Mauritania: 1 s, Banc d'Arguin, intertidal. Senegal: 1 s, M'Bao, 8.5 m (CJP). Ghana: 1 f, Miamia, 38-40 m (CER); 2 s, Cape Three Points, 39-65 m (CER).

Type locality: Miamia, Ghana, in sediments dredged from between 38-40 m.

Etymology: The species is named for Rachel Collin, an expert American malacologist, who also accompanied us on an expedition to Africa.

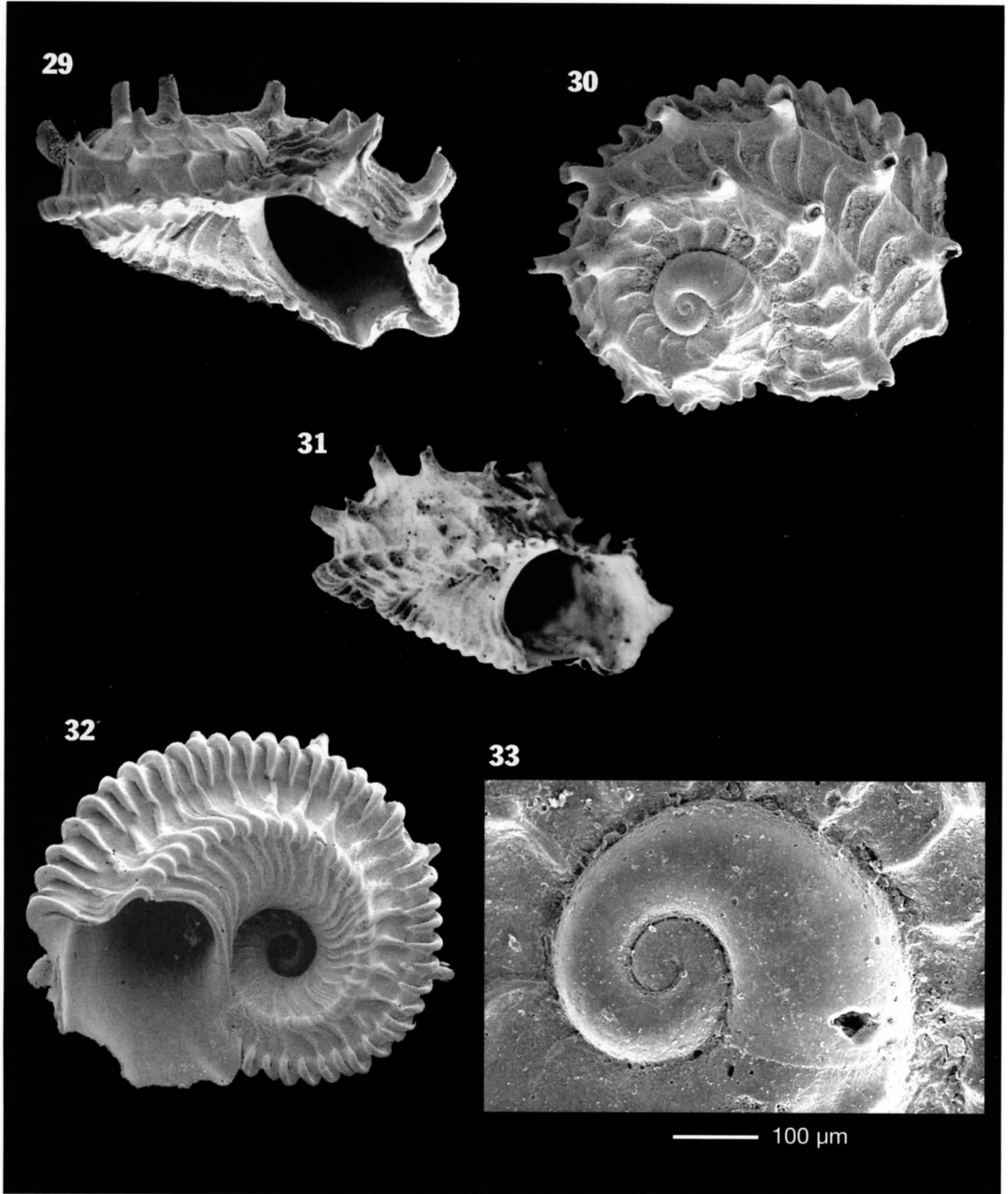
Description: Shell (Figs. 29-32) rounded depressed, nearly lenticular, solid, whitish, with prominent sculpture which is also present in the peripheral border as a serration. Protoconch (Fig. 33) hyperstrophic, of about 1³/₄ smooth whorls, about 400 µm in diameter. Teleoconch of a little more than 1 whorl, with 4 strong spiral cords and fine curved and prosocline axial ribs which cross the spiral cords. On those, 8-9 prominent tubular extensions arise, distant from each other and coincident with the crossing points of the axial ribs but only with every two or three one. Peripheral cord with 33-38 curved wider scales, which continue down to the base forming axial ribs which become narrower into the umbilicus. Aperture rounded, the outer lip sharp with prominences where the spiral cords end.

Dimensions: The holotype is 1.5 mm in diameter; other shells were measured to 2.1 mm.

Distribution: The species is known from Mauritania to Ghana.

Discussion: *Tornus rachelae* spec. nov. can resemble *T. leloupi* and *T. cancellatus*, but they have important differences: the elevations in the dorsal cord are tubular and distant in *T. rachelae* whereas they are squamous in *T. leloupi* and nodulous in *T. cancellatus*; on the base, the peripheral prominences are more numerous (about 36) in *T. rachelae*, being squamous as in *T. leloupi* (with only about 20) and nodulous in *T. cancellatus* (about 18); in *T. rachelae*, the ribs arising from these peripheral prominences up to the basal cord are not lined up with the ribs, there occur prominences without ribs and ribs without prominences (this is not so in *T. leloupi* and in *T. cancellatus* where they correspond one to one).

PLATE 5



Figures 29-33. *Tornus rachelae* spec. nov. Fig. 29. Holotype, 1.5 mm, Miaamia (MNCN). Fig. 30. Paratype, 1.6 mm (MNHN). Fig. 31. Shell, 1.3 mm, Miaamia. Fig. 32. Paratype, 1.9 mm (CER). Fig. 33. Protoconch of a paratype (CER).

Tornus attenuatus spec. nov. (Plate 6)

(Figs. 34-41)

Adeorbis subcarinatus (Montagu): DAUTZENBERG, 1912. *Ann. Inst. Océan.*, tome 5, fasc., 3: 53.

Tornus subcarinatus (Montagu, 1803) in ADAM & KNUDSEN, 1969 (pars). *Bull. Inst. r. Sci. nat. Belg.* 44(27): 42-44, figs. 23.

?*Cochliopsis* sp.: BERNARD, 1984, pl. 72, fig. 2; pl. 73, fig. 2.

Tornus subcarinatus (Montagu, 1803): GIANNUZZI-SAVELLI *ET AL.* 1997, figs. 553.

Type material: Holotype (Fig. 34-35) in MNHN, ex-CPH and 1 paratype from along Konkouati, Kounde, 17-19 m, and 10 more from Bango, Ambrizete region, 07°20.19'S 12°55.09E, beach deposits (MNHN). Other paratypes in the following collections: MNCN (1, n° 15.05/46468), CER (1), CFR (1) all from Ambrizete region, and CPH (1, Figs. 36-37).

Other material examined: Senegal: 3 s, S. Casamance, Cap Roxo, 12°20.7'N 16°53.1'W, 15 m (MNHN). Guinea Conakry: 1 s, Tannah (MNHN). Ghana: 2 s, Miamia, 8-25 m (CAP); 14 s, 1 f, 3 j, Miamia, 38-40 m (CER); 4 s, 2 j, 300° off Cape Three Points, 35-65 m (CER); 1 s, Miamia, 40-46 m (CER). Congo: 1 s (lost during study), Pointe Noire (CPH). Angola: 3 s, 10 kms S Ambrizete, Luanda (MNHN); 3 s, Cacuaco, Bengo (MNHN); 1 s, Pointe de Mussulo, beach sediment (MNHN); 1 s, Corimba, Luanda, 10-20 m (MNHN).

Type locality: Pointe Noire, Congo.

Etymology: The specific name alludes to the sculpture which is more attenuate in this species than in others of the genus.

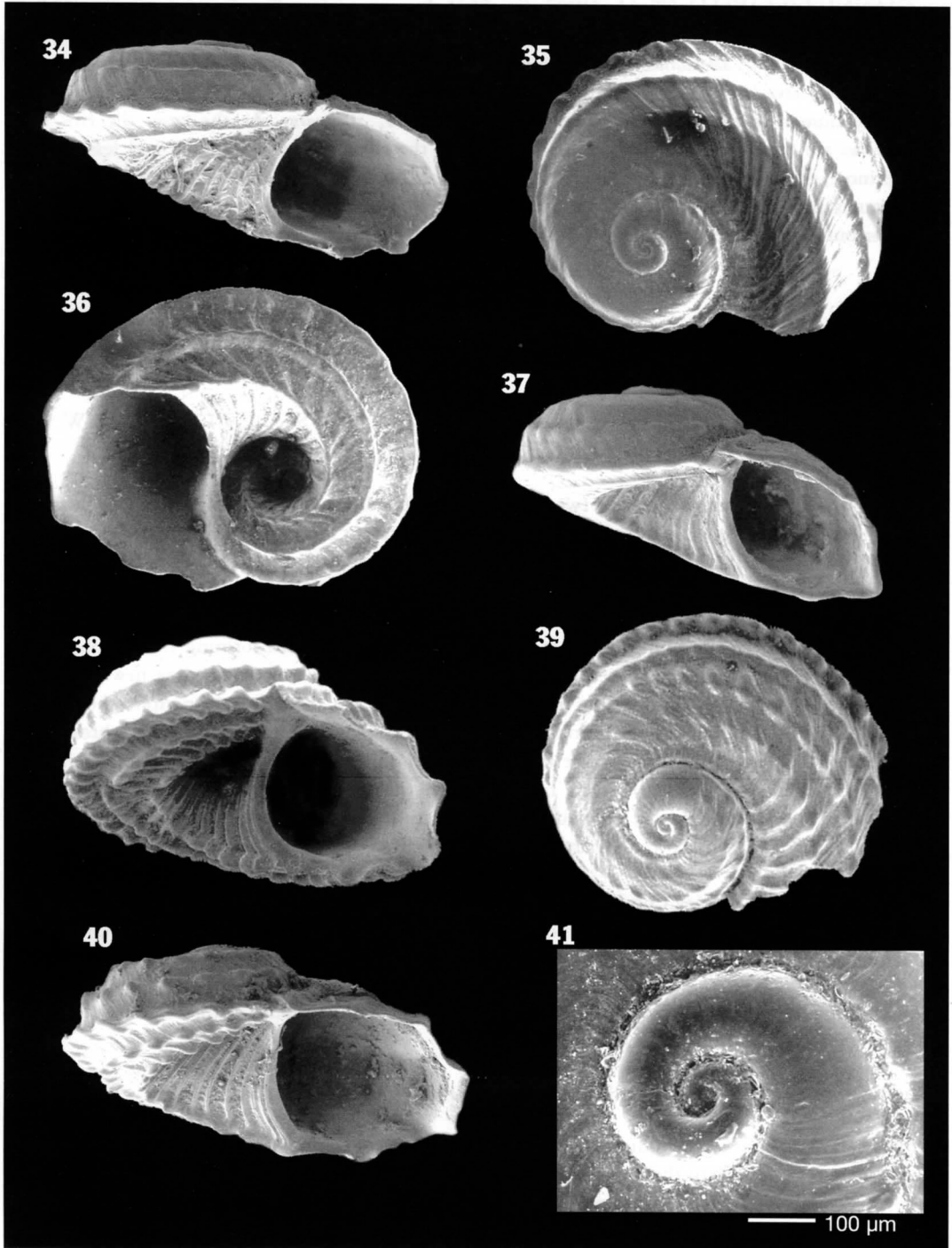
Description: Shell (Figs. 34-40) rounded, rather depressed, somewhat fragile, whitish, with a convex dorsal part and a flat base. Protoconch (Fig. 41) hyperstrophic, of nearly 2 smooth whorls of about 390 µm diameter. Teleoconch of about 1-1½ whorls, with only 1 suprasutural cord at the beginning, which forms the peripheral angulation. Three more cords appear in the middle of the first whorl, being more or less granulous; one more appears at the end of the spire in subsutural position. The total dorsal surface is crossed by numerous fine curved prosocline threads; ventrally, slightly concave with some irregular curved oblique threads which change into nodules on the peripheral keel. Two prominent cords run from the umbilicus up to the base of the aperture. The lower one represents the border of the umbilical infundibulum. The axial sculpture is variable, sometimes appearing as ribs and sometimes only growth lines. The aperture is ovoid depressed with the upper part of the outer lip sharp and advanced dorsally. Umbilicus wide and open showing the previous whorls.

Dimensions: The holotype is 1.9 mm in diameter. Other shells can reach 3.0 mm.

Distribution: The species is known from Senegal to Angola.

Discussion: Some variability exists in the shells of this species, mainly in the sculpture of the dorsum and the peripheral cord. The shells with the morphology of the holotype (Figs. 34-37) have an attenuate sculpture and the peripheral cord undulates. Other shells (Figs. 38-40) have a more prominent dorsal sculpture which is also more evident on the peripheral cord. Those spiral cords may be even more numerous (see the following, Figs. 47-48) being formed by prominent and nodulous spiral cords and by fine prosocline axial ribs. The last whorl has 5 spiral cords at the periphery and 2 on the base. There are strong axial ribs between the basal cords, but there are no axial ribs between the outer basal cord and the peripheral cord. The base is slightly convex. Anyway, we think that this form here commented is an extreme in some characters.

PLATE 6



Figures 34-41. *Tornus attenuatus* spec. nov. Figs. 34-35. Holotype, 1.9 mm, Congo, (MNHN). Figs. 36-37. Paratype, 2.1 mm, Congo (CPH). Figs. 38-40. Shells, 1.7, 2.2 and 2.0 mm, Miamia, Ghana (CER). Fig. 41. Protoconch of the holotype.

ADAM & KNUDSEN (1969: 43-44, fig. 23) considered the shells with morphology similar to the holotype of this species as an attenuate form of *Tornus subcarinatus*. Those figures were reproduced by GIANNUZZI-SAVELLI *ET AL.* (1997, fig. 553). In our opinion, *T. subcarinatus* is present from Europe south to Senegal, and the shells from this last area have morphology identical to those from the European Atlantic. *T. attenuatus* occurs also in Senegal with its typical sculpture, and no intergrades between them have been observed. *T. subcarinatus* has a more solid shell, a more prominent sculpture with very numerous axial ribs, which do not appear in *T. attenuatus*. At the base, the ribs of *T. subcarinatus* are more numerous, while in *T. attenuatus* the ribs are low in number and less evident. Furthermore, the axial sculpture of *T. subcarinatus* is orthocline or slightly opisthocline, while that of *T. attenuatus* is prosocline. Finally, the protoconch of *T. subcarinatus* in the Senegal shells has a larger diameter but the rate of increase in size is less than in *T. attenuatus*.

Tornus cf. attenuatus (Plate 7)
(Figs. 42-48)

Material examined: Guinea Conakry: 1 s, W of Tannah, Sedigui I., Sn. 79, 9°12'N 13°34.5'W, 15 m (MNHN). Ghana: 1 s, Miamia, 38-40 m (CER).

Description: In this part, we include two shells which differ from the previous species (*T. attenuatus*), but also show some differences from each other and may represent more than one species. One of them, from Miamia (Ghana) is as follows: Shell (Figs. 42-44) rounded depressed, relatively solid, whitish, with small sharp extensions on a keel in the periphery. Protoconch (Fig. 45) of about 1½ smooth whorls, of about 384 µm in diameter. Teleoconch a little more than 1 whorl, increasing rapidly; dorsally there is a strong cord from the beginning which is near another prominent cord forming the periphery; two more spiral cords begin in the subsequent ½ whorl; on the last quarter whorl, one new small cord appears close to the suture, thus totaling five at the end of the spire, including the peripheral one which nearly makes a keel. The entire dorsal surface is crossed by numerous fine curved prosocline threads (Fig. 46); slightly concave ventrally with some irregular curved oblique threads which change into nodules on the peripheral keel. Two prominent ribs run from the umbilicus to the base of the aperture. Umbilicus wide open showing the previous whorls. Aperture depressed rounded with the upper part of the outer lip sharp with its posterior part extending dorsally farther than the anterior portion.

The other shell, from Guinea Conakry, is as follows: Shell (Figs. 47-48) similar to that of *T. attenuatus* but larger, more solid, the nodules of the dorsal cords are more numerous and the peripheral cord has numerous nodules.

Dimensions: The size for the first shell is 1.7 mm maximum dimensions (diameter). The other shell diameter measures 2.5 mm.

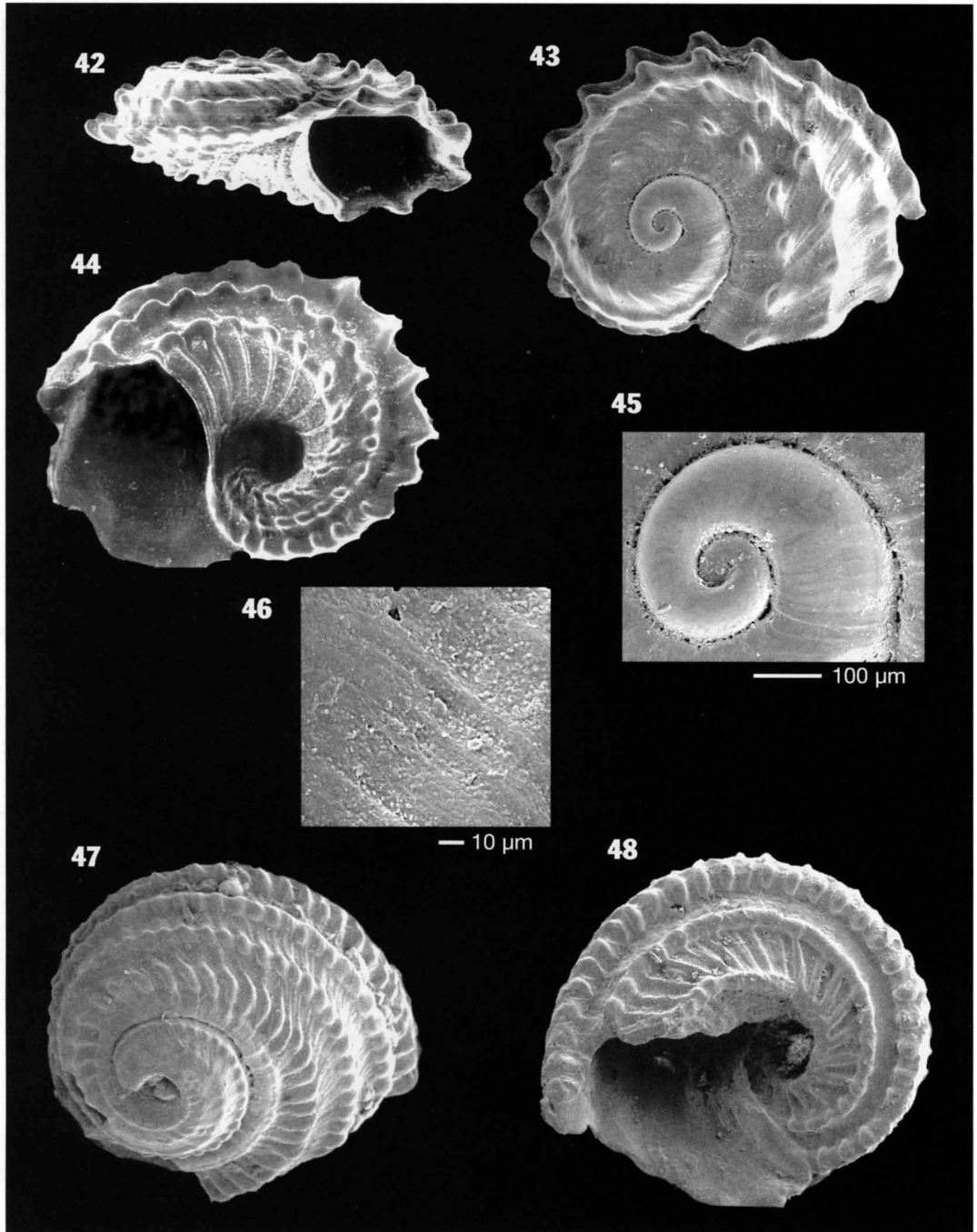
Distribution: The first morph studied is from Ghana; the other from Guinea Conakry

Remarks: These shells were studied separately only for a better commenting. We assigned with some doubts these scarce shells to the taxon *T. cf. attenuatus*, in spite the differences between them.

The comparison of the holotype of *T. attenuatus* with the shell from Ghana here described showed us the differences in the peripheral keel nearly smooth with small nodules (Figs. 34-37) or with nodules more evident (Figs. 38-40) as contrasted with the pointed teeth of this first morph (Figs. 42-44). Besides, this shell is more nodulous dorsally.

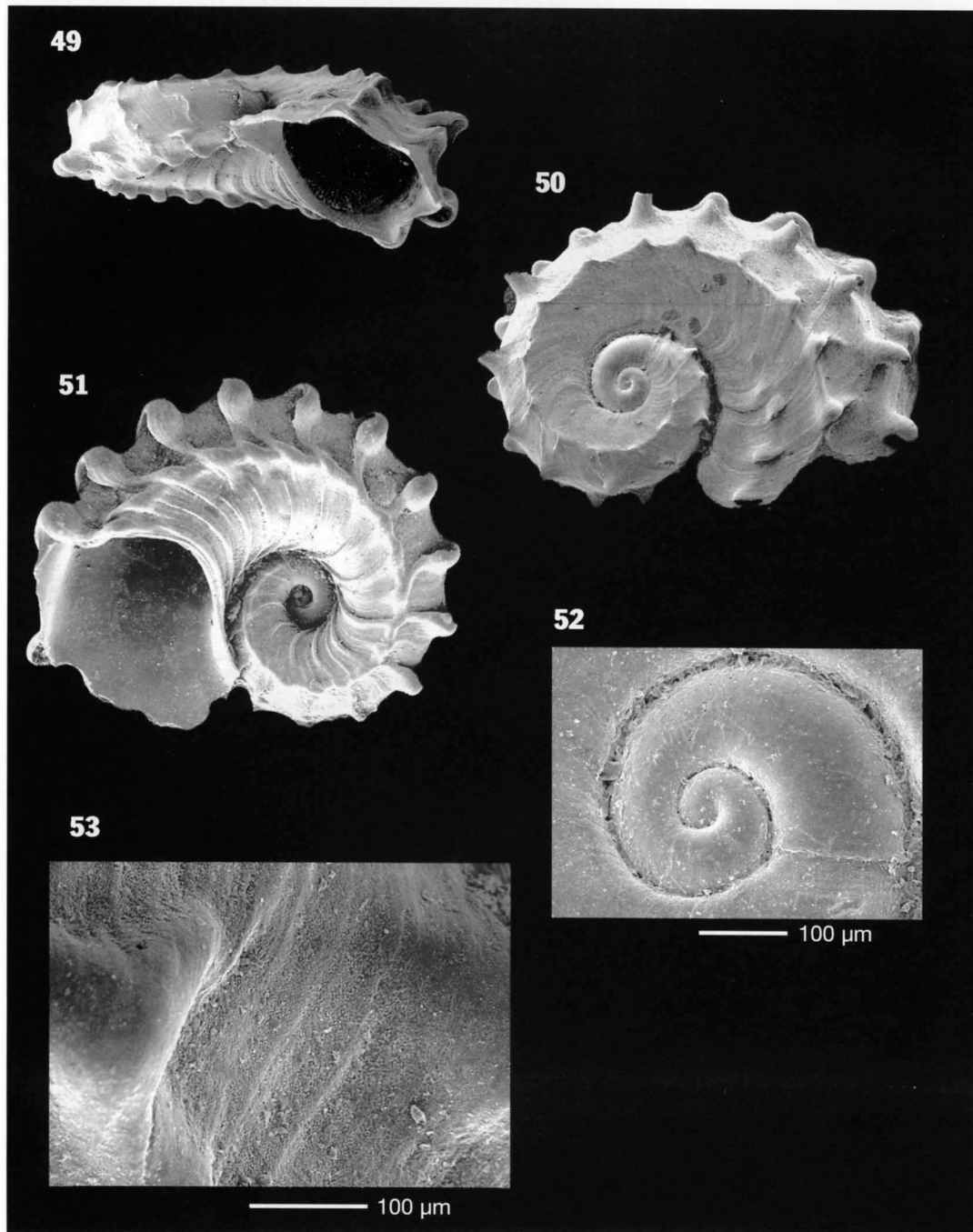
The shell from Guinea (Figs. 47-48) presents differences already mentioned in the description of this morph, being more similar with some shells (Figs. 38-40) considered to be *T. attenuatus*.

PLATE 7



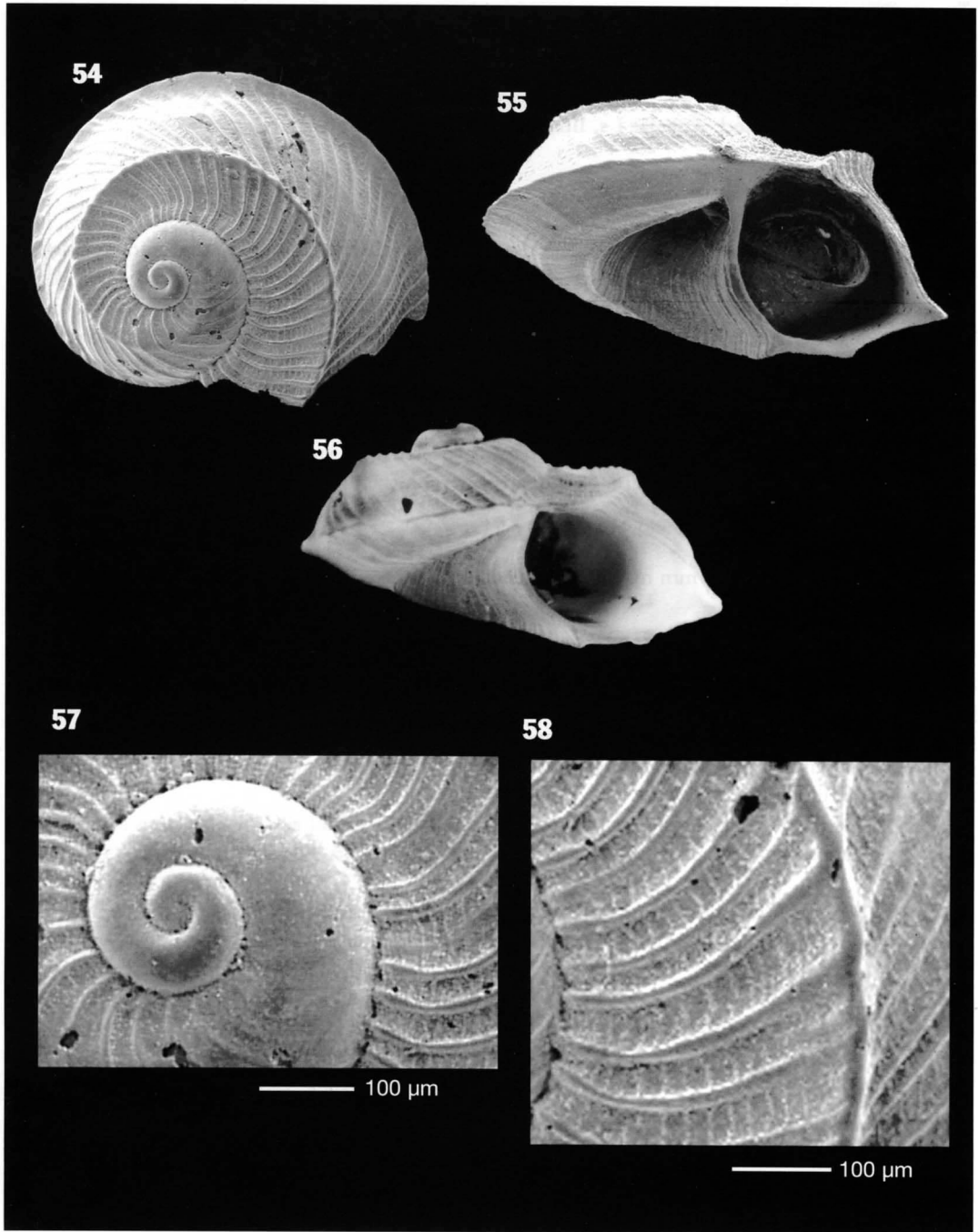
Figures 42-48. *Tornus cf. attenuatus*. Figs. 42-44. Shell, 1.7 mm, Miamia, Ghana (CER). Fig. 45. Protoconch. Fig. 46. Microsculpture. Figs. 47-48. Shell, 2.5 mm, Tannah, Guinea Conakry (MNHN).

PLATE 8



Figures 49-53. *Tornus ryalli* spec. nov. Fig. 49. Holotype, 1.9 mm, Miamia, Ghana (MNCN). Fig. 50. Paratype, 2.0 mm, Miamia (MNHN). Fig. 51. Paratype, 2.0 mm, Miamia (AMNH). Fig. 52. Protoconch, paratype (CER). Fig. 53. Microsculpture, paratype (CER).

PLATE 9



Figures 54-58. *Tornus garrawayi*. Figs 54-55. Shells, 1.5 and 1.8 mm, Miami, Ghana (CER). Fig. 56. Shell, 1.5 mm, Takoradi, Ghana. Fig. 57. Protoconch. Fig. 58. Microsculpture.

Tornus ryalli spec. nov. (Plate 8)

(Figs. 49-53)

Type material: Holotype (Fig. 49) in MNCN (n° 15.05/46469). Paratypes: AMNH (1, Fig. 51), MNHN (1, Fig. 50), CER (6), CFR (1) and CPR (1), all from the type locality.

Other material examined: Angola: 1 s, Ilha de Luanda, 40-60 m (MNHN).

Type locality: Miamia, Ghana, 38-40 m.

Description: Shell (Figs. 49-51) rounded depressed, rather fragile, white, with several spiral cords with tubular nodules. Protoconch (Fig. 52) hyperstrophic of nearly 1³/₄ smooth whorls, of about 394 µm diameter. Teleoconch of about 1¹/₄ whorls, rapidly increasing; dorsally, two spiral cords appear at the beginning of the teleoconch, the lower one above the suture; one more appears below the suture from the end of the spire forming the peripheral angulation. Those cords have spaced nodules, the dorsal ones are higher and nearly cylindrical. The outermost cord has prominent strong scales, about 12 on the last whorl. Ventrally, there is another small cord between the periphery and the wide umbilicus. Under high magnification, it can be seen that the shell surface is covered with small prosocline growth lines and microtubercles on the entire shell (Fig. 53). Aperture ovoid, the upper part of the outer lip sharp and extended dorsally.

Dimensions: Holotype is 1.9 mm maximum dimension (diameter).

Distribution: Known from Ghana and Angola.

Discussion: This species has some similarity with *T. leloupi*, because the peripheral nodules of both species are scale-like but they are more numerous in *T. leloupi*. Dorsally, the ribs in *T. leloupi* are numerous while in *T. ryalli* they are not evident; the spiral cords have squamous nodules in *T. leloupi* and are nearly tubular in *T. ryalli*.

T. cancellatus is more solid, usually less depressed and its axial ribs are numerous and evident.

T. attenuatus is dorsally more uniformly convex, and its peripheral cord has a different sculpture.

T. rachelae is more convex dorsally and has evident and numerous axial ribs, the spiral cords have more tubular nodules, and the peripheral cord has more numerous scales.

Tornus garrawayi Adam & Knudsen, 1969 (Plate 9)

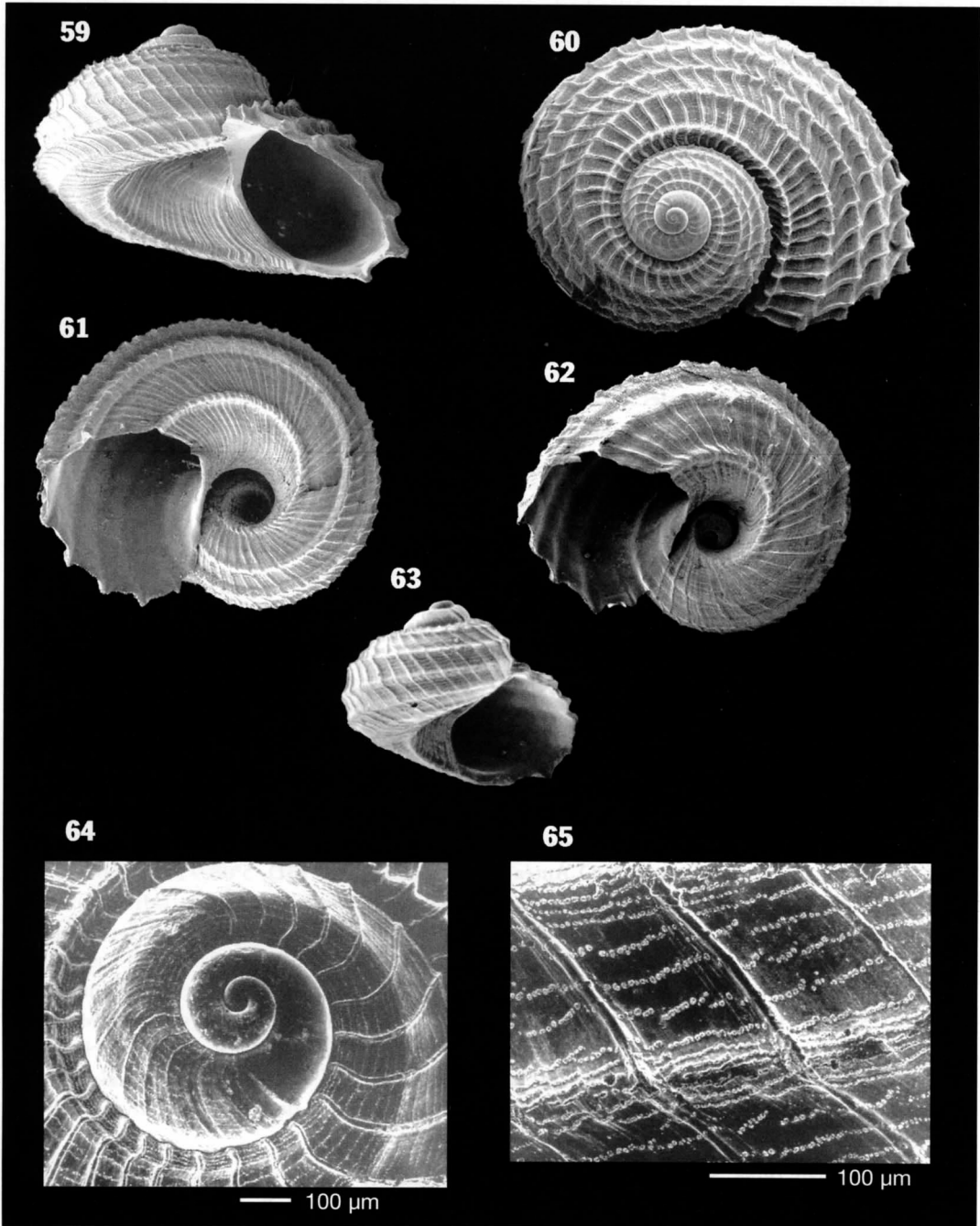
(Figs. 54-58)

Tornus garrawayi Adam & Knudsen, 1969. *Bull. Inst. r. Sci. nat. Belg.*, 44: 48-49, fig. 27. [Type locality: Garraway, Liberia].

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 27). Not examined.

Other material examined: Mauritania: 2 s, Banc d'Arguin, sediments (CER). Guinea Conakry: 1 s, W Cape Verga, Exp. "Sedigui II", est. 595, 10°12'N 14°56.5'W, 38 m (MNHN); 1 s, dredged, 50 m, (CFR). Ghana: 9 s, 1 f, Miamia, 38-40 m (CER). Angola: 3 sp, 7 s, along Mussulo, 90-100 m (MNHN); 2 s, off Luanda, 50-100 m (CER).

PLATE 10



Figures 59-65. *Tornus africanus*. Figs. 59-62. Shells, 3.1, 4.3, 3.5 and 2.0 mm, Adbijan region, Ivory Coast, dredged on continental shelf, 70 m (MNHN). Fig. 63. Shell, 1.8 mm, Luanda, Angola, 80-100 m (CER). Fig. 64. Protoconch, Luanda. Fig. 65. Microsculpture, Luanda.

Description: Shell (Figs. 54-56) with the shape of a truncate cone, fragile, with a very evident peripheral keel. Protoconch (Fig. 57) hyperstrophic of about $1\frac{3}{4}$ smooth whorls, and of about 380 μm diameter. Teleoconch of about $1\frac{1}{4}$ - $1\frac{1}{2}$ whorls, increasing rapidly; there are three spiral nodulous cords: one of them forms a peripheral keel; another is in the upper part of the spire between the peripheral one and the suture, and the third rounding the umbilical infundibulum. At the end of the spire, a new cord begins between the two upper ones. The surface has numerous fine curved prosocline threads that continue into the umbilicus, and under magnification, fine spiral rows of microtubercles appear between the ribs. The umbilicus is wide showing the previous whorls. Aperture ovoid-rounded with the upper part of the outer lip sharp and extended dorsally.

Dimensions: Holotype is 2.0 mm maximum dimension (diameter).

Distribution: In the original description, this species was known only from Liberia. We extend its range from Mauritania to Ghana and Angola.

Remarks: There is no other species in the genus with this characteristic shell morphology, with many axial threads and especially the single dorsal prominent cord which produces an important angulation.

Tornus africanus Adam & Knudsen, 1969 (Plate 10)

(Figs. 59-65)

Tornus africanus Adam & Knudsen, 1969. *Bull. Inst. r. Sci. nat. Belg.*, 44: 50-51, fig. 29. [Type locality: Pointe Noire, Congo. 6°28'S-12°05'03"E, 63m.].

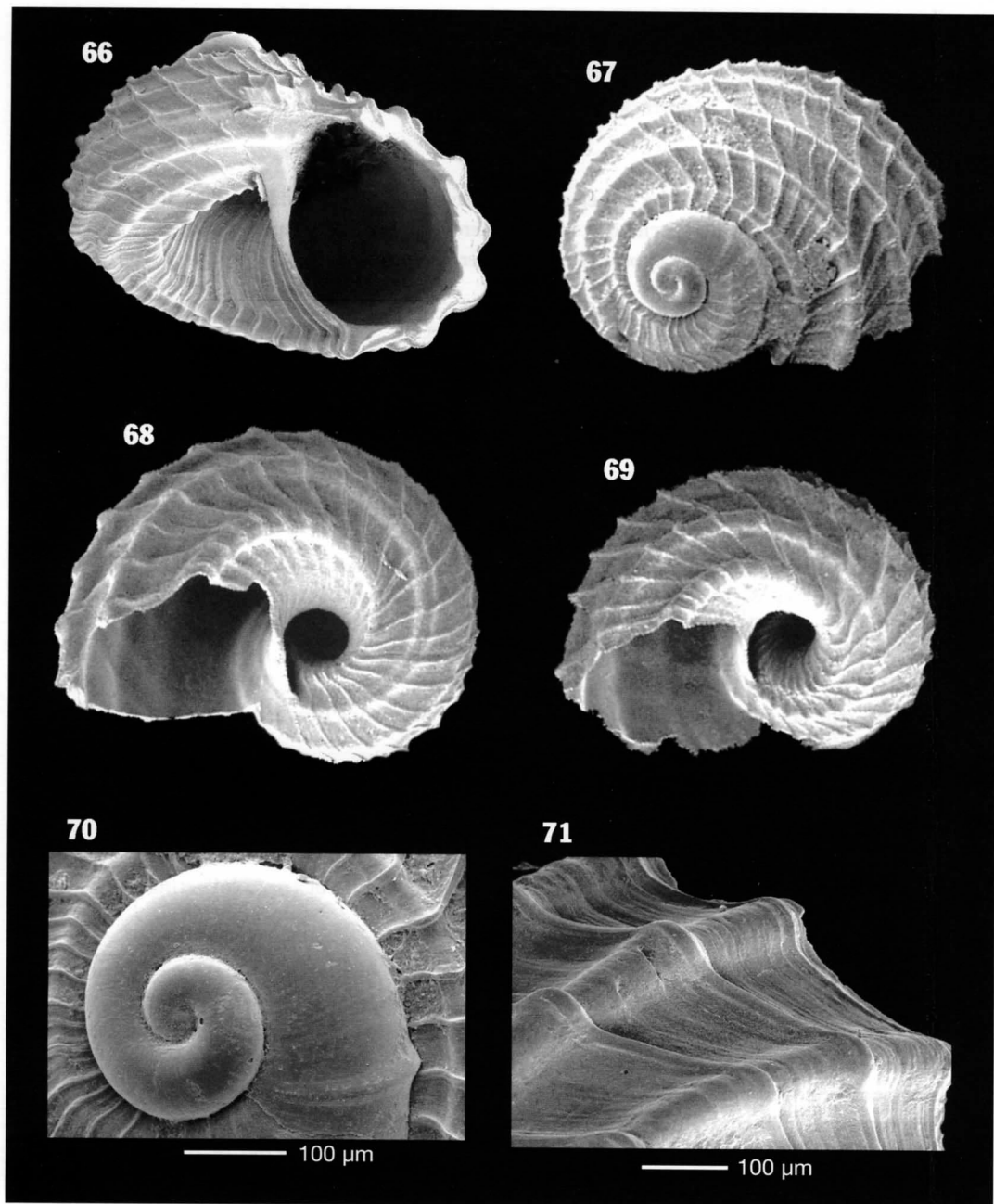
Tornus jullieni Adam & Knudsen, 1969: GIANNUZZI-SAVELLI *ET AL.*, 1997: fig. 555.

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 29). Not examined.

Other material examined: Guinea Conakry: 5 s, W Dwendi-Taboria, N/O André Nizery, CHALGUI 7, 9°55'N 14°17'W, 17 m (MNHN); 1 s, Grand Bassam N/O Antéa BENCHACI I, stn. 6B, Berthois, 50 m (MNHN); 2 s, Grand Bassam N/O Antéa BENCHACI I, stn. 13D, 5°08.9'N 3°48.6'W, 35 m (MNHN). Ivory Coast: 11 s, Abidjan, Centre de Recherches Oceanographiques (MNHN); 83 s, Abidjan, Orstom, continental plateau (MNHN). Ghana: 3 s, Miamia, 8-25 m (CAP); 36 s, 11 j, 3 f, Miamia, 38-40 m (CER); 14 s, 4 j, 4 f, 210° off Miamia, 45-50 m (CER); 7 s, 300° off Cape Three Points, 35-65 m (CER); 1 s, 300° off Cape Three Points, 35-57 m (CAP). Congo: 7 s, Pointe Noire (CPH); 1 s, stn. 196 (MNHN); 1 s, stn. 758 (MNHN); 6 s, stn. 916 (MNHN); 1 s, stn. 966 (MNHN). Angola: 3 s, Cabinda W Landana N/O André Nizery, stn. 932, 5°07'S 12°01'E, 9 m (MNHN); 1 s, Luanda, 50 m (CER); 10 s, off Luanda, 80-100 m (CER); 6 s, 3 j, 3 f, along Mussulo, Luanda, 90-100 m (MNHN); 1 s, 2 j, Ilha de Luanda, 40-60 m (MNHN); 2 s, 1 f, Ilha de Luanda, 120 m (MNHN).

Description: Shell (Figs. 59-63) rounded depressed, relatively fragile, whitish, with a reticulated surface. Protoconch (Fig. 64) hyperstrophic with 1-2 interruptions, and a little more than $1\frac{3}{4}$ smooth whorls, of about 320-350 μm diameter, and a thickened rib near the start of the teleoconch. Teleoconch of about $2\frac{1}{2}$ whorls, with only 2 spiral cords at the beginning, which increase up to 8, the 6th being the most peripheral and the lowest one bordering the umbilical infundibulum. Those cords are crossed by narrow prosocline axial ribs which number about 40 on the last whorl. Umbilicus wide and deep. Under magnification, a microsculpture of irregular lines formed by microtubercles appears between the cords and on them (Fig. 65). Aperture ovoid, columella curved, outer lip sharp.

PLATE 11



Figures 66-71. *Tornus aemilii* spec. nov. Fig. 66. Holotype, 1.8 mm, Miamia, Ghana (MNCN). Fig. 67. Paratype, 1.2 mm, (MNHN). Fig. 68. Paratype, 1.5 mm, (CER). Fig. 69. Paratype, 1.0 mm (AMNH). Fig. 70. Protoconch of a paratype (MNHN). Fig. 71. Microsculpture.

Dimensions: The holotype is 3.0 mm in maximum dimension, but the largest shells can reach 4.0 mm.

Distribution: In ADAM & KNUDSEN (1969) this species is referred from Guinea Conakry, Ivory Coast and Gabon. We enlarge this range from Senegal to Angola.

The shell illustrated in GIANNUZZI-SAVELLI *ET AL.* (1997: fig. 555) appears to be this species, and it was collected in north Morocco; so, if this is confirmed, its distribution area would be enlarged to the north.

Remarks: The species appears to be rather common having been collected in many places. It can be differentiated from the previous species due to its numerous axial ribs and spiral cords forming a reticle. Some other species have a similar appearance but differences are pointed out in their description (see below).

Tornus aemilii spec. nov. (Plate 11)

(Figs. 66-71)

Type material: Holotype (Fig. 66) in MNCN (n° 15.05/46470). Paratypes: AMNH (1, Fig. 69), MNHN (1, Fig. 67), CER (2, Fig. 68), CFR (1), and CPR (1); all from the type locality.

Other material examined: Guinea Conakry: 1 s, W Rio Morébaya, N/O André Nizery SEDIGUI I, stn. 172, 9°24'N 13°51'W, 15 m (MNHN). Ivory Coast: 5 s, Grand Bassam, N/O Antéa, BANCHACI I, stn. 12D, 30 m (MNHN); 3 s, Grand Bassam, N/O Antéa, BANCHACI I, stn. 13D 5°08.9'N 3°48.6'W, 35 m (MNHN); Ghana: 4 j, 1 f, Miamia, 38-40 m (CER); 3 s, 5 j, 3 f, 300° out of Cape Three Points, 35-65 m (CER); 1 s, 300° off Cape Three Points, 35-57 m (CAP). Congo: 2 s, stn. 964 (MNHN); 1 s, stn. 911, 90 m (MNHN); 3 c, Pointe Noire, Mondaine Beach, beach sediment (MNHN). Angola: 2 s, Corimba, Luanda, 10-20 m (MNHN)

Type locality: Miamia, Ghana.

Etymology: The species is named for Emilio Rolán Álvarez, son of the senior author, Professor of Genetics at the University of Vigo, for his help during many years of trips, collecting, and actually being a colleague in research projects.

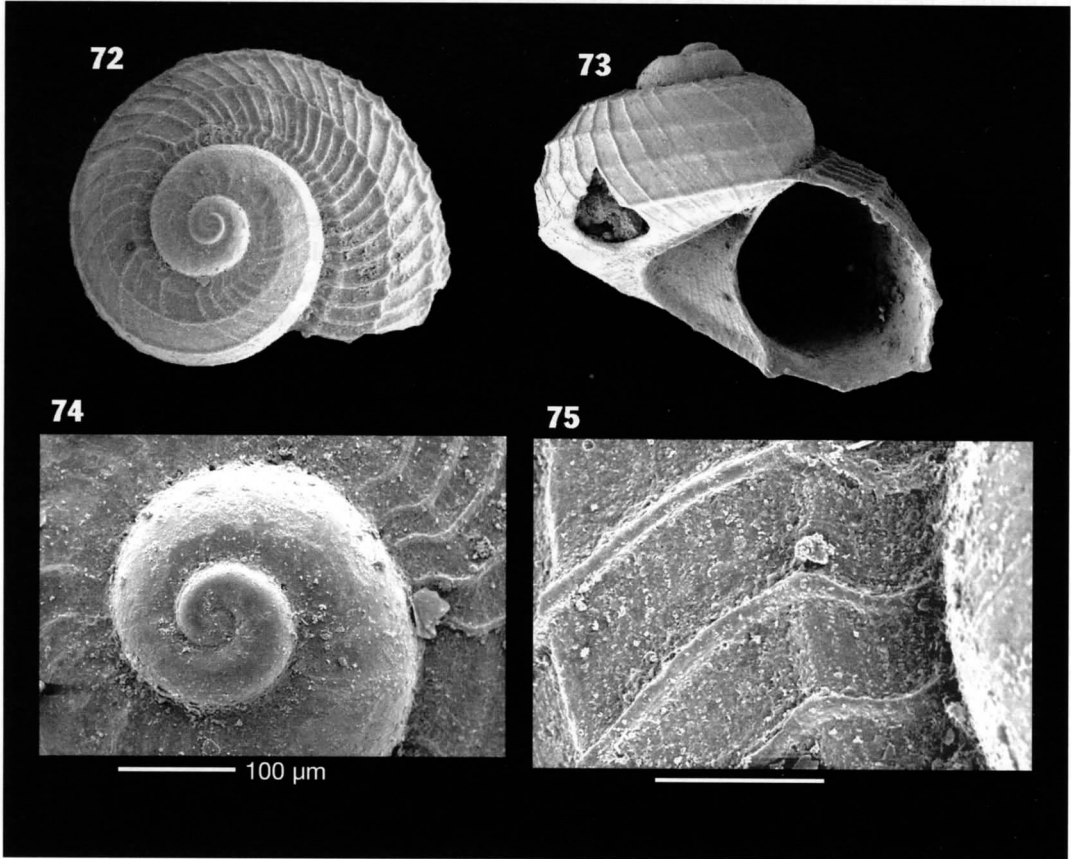
Description: Shell (Figs. 66-69) rounded orbicular, relatively fragile, scarcely depressed, whitish in color and with a reticulated surface. Protoconch (Figs. 70) hyperstrophic with 1^{3/4} smooth whorls of about 385 µm diameter, and with a thick rib at the start of the teleconch. Teleoconch of about 1^{1/4} whorls, with only 2 spiral cords at the beginning, which increase up to 7, the 5th being the most peripheral and the lowest one bordering the umbilical infundibulum. Those cords are crossed by narrow strongly prosocline axial ribs which number about 30-35 in the last whorl. Under magnification the surface between the cords is smooth, it not being possible to see any kind of tubercles (Fig. 71). Umbilicus wide and deep. Aperture ovoid, columella curved, outer lip sharp.

Dimensions: The holotype is 1.8 mm maximum dimension (diameter).

Distribution: Known from Guinea Conakry to Angola.

Discussion: The species is rather similar to *T. africanus*, but this latter species has more numerous axial ribs and the basal cords are more widely separated, furthermore it has a microsculpture of tubercles in lines which is not present in *T. aemilii*.

PLATE 12



Figures 72-75. *Tornus erici* spec. nov. Figs. 72-73. Holotype, 2.0 mm, Miamia, Ghana (MNCN). Fig. 74. Protoconch holotype (MNHN). Fig. 75. Microsculpture.

There is also some similarity with *T. jullieni*, but this latter species has more numerous axial ribs and the basal cords are more prominent and closer, and it has a microsculpture formed by tubercles in lines.

Two other similar species are *T. erici* spec. nov. and *T. umbilicorda* spec. nov., and their differences are pointed out below, in the discussion of both species.

Tornus erici spec. nov. (Plate 12)
(Figs. 72-75)

Type material: Holotype (Fig. 72-73) in MNCN (n° 15.05/46471). Paratypes in the following collections: MNHN (1, Congo, stn. 758), CPH (1, Pointe Noire); from type locality: AMNH (1), BMNH (1), CER (5 s, 2 f), CFR (2) and CPR (1),

Other material examined: Ivory Coast: 3 s, region of Abidjan (MNHN). Congo: 1 s, (CPH); Angola: 2 f, off Luanda, 120 m (CER); 1 s, off Luanda, 50 m (CFR).

Type locality: Luanda, Angola.

Etymology: The species is named for Eric Domínguez, the grandson of the senior author for his past help on many occasions and more expected in the future.

Description: Shell (Figs. 72-73) rounded, scarcely depressed, relatively fragile, whitish and with a reticulated surface. Protoconch (Fig. 74) hyperstrophic, with 2 smooth whorls, of about 460 µm diameter, and a slight thickening at the start of the teleoconch. Teleoconch of about 1³/₄ whorls increasing slowly, and with only 2 narrow spiral cords at the beginning, which increase to 7, the 5th being the most peripheral and the lowest one, which is the strongest, bordering the umbilical infundibulum. Those cords are crossed by narrow strongly prosocline axial ribs which number about 40 on the last whorl. With magnification one can see that the surface between the cords presents small separated rows of tubercles (Fig. 75). Umbilicus wide and deep. Aperture ovoid, columella curved, outer lip sharp.

Dimensions: The holotype is 2.0 mm in diameter. Largest shell, a paratype in MNHN, is 3.2 mm in diameter.

Distribution: Known only from Ivory Coast, Congo and Angola.

Discussion: The new species must be compared with the following:

T. africanus is more depressed, the spiral cords are stronger and 8 in number (instead of 7), its perumbilical cord is similar in size to the other basal cords, whereas in *T. erici*, the perumbilical cord is stronger than the others.

T. jullieni is more globose, the spiral cords are stronger and more prominent, and those on the base are of similar size and closer.

T. aemilii spec. nov. is more globose, the spiral cords are stronger, the basal ones are equal and, under high magnification, the shell has no microtubercles.

Tornus jullieni Adam & Knudsen, 1969 (Plate 13)

(Figs. 76-82)

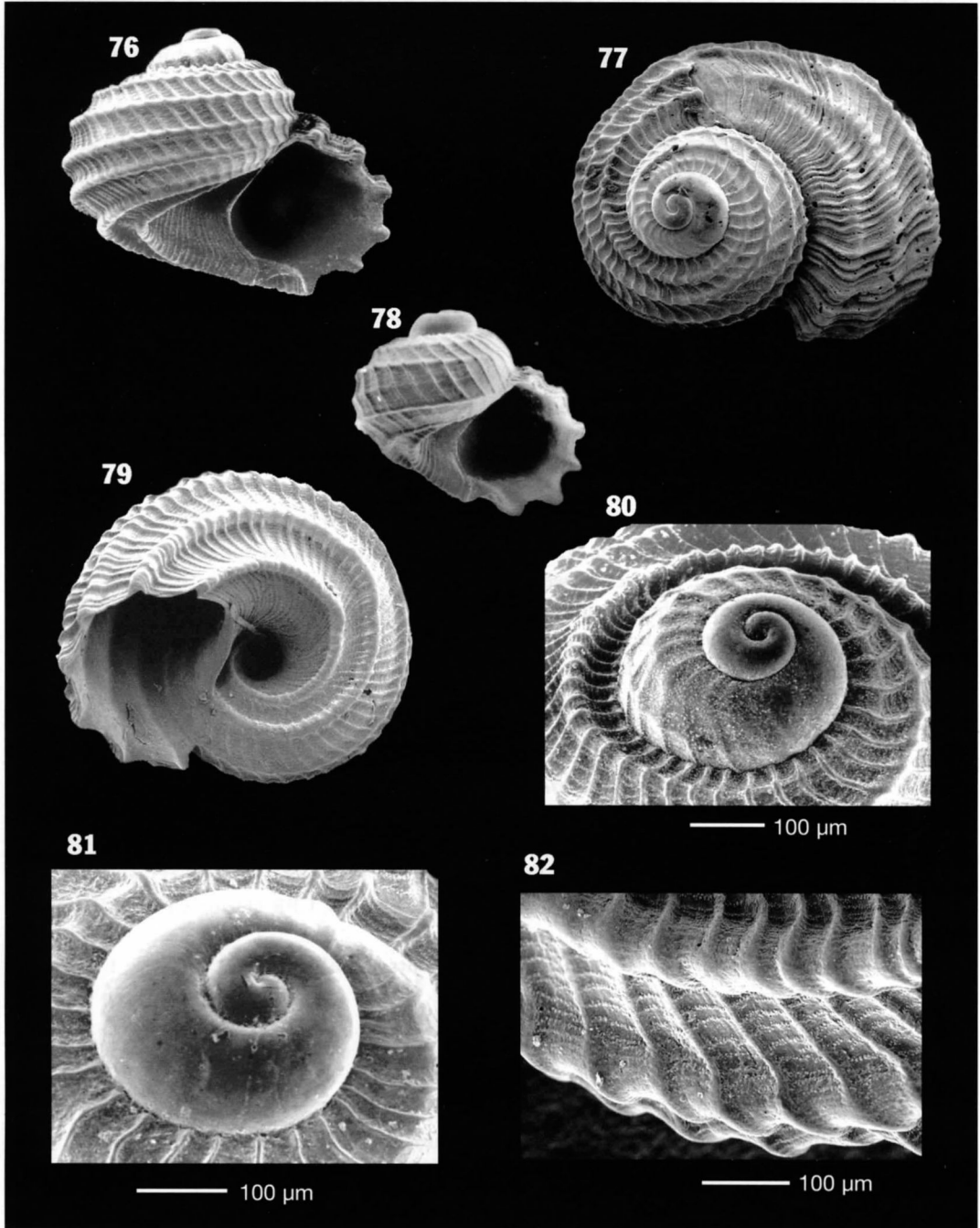
Tornus jullieni Adam & Knudsen, 1969. *Bull. Inst. r. Sci. nat. Belg.*, 44: 49-50, fig. 28. [Type locality: Garraway, Liberia].

Tornus subcarinatus: BERNARD, 1984, pl. 71, figs. 3.

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 28). Not examined.

Other material examined: Senegal: 1 s, Gorée Bay, 30 m (MNHN); 1 s, Cap Vert, 34 m (CJP); 2 s, large de Saloum, Dakar, 50 m (MNHN). Guinea Conakry: 1 s, W Ile Quito, N/O André Nizery, SEDIGUI II, stn. 520, 34 m (MNHN); 1 j, W rio Yomponi, André Nizery, SEDIGUI II, stn. 688, 10°24'N 14°50'W, 22 m (MNHN). Ivory Coast: 1 j, Grand Bassam, N/O Antéa, BANCHACI I, stn. 12D, 30 m (MNHN); 1 j, W ile Tannah, N/O André Nizery, 9°12.3'N 13°37'W, 16 m (MNHN). Ghana: 3 j, Miamia, 8-25 m (CAP); 32 s, 21 j, 5 f, Miamia, 38-40 m (CER); 3 s, 5 j, 3 f, 300° out of Cape Three Points, 35-65 m (CER). Congo: 1 s, stn. 1027 (MNHN); 3 s, Pointe Noire (CPH); 1 f, stn. 762 (MNHN). Angola: 1 s, Ambrizete region, Bengo, 07°20.19'S 12°55.09E, beach deposits (MNHN); 1 s, off Luanda, 50 m (CER); 4 s, off Luanda, 80-100 m (CER); 7 s, along Mussulo, Luanda, 90-100 m (MNHN); 2 s, 1 j, Ilha de Luanda, 40-60 m (MNHN).

PLATE 13



Figures 76-82. *Tornus jullieni*. Figs. 76-79. Shells, 1.6, 1.7, 1.0 and 1.6 mm, Miaamia, Ghana (CER). Figs. 80. Detail of the apex. Fig. 81. Protoconch. Fig. 82. Microsculpture.

Description: Shell (Figs. 76-79) nearly spherical, relatively solid, whitish and with a reticulated surface. Protoconch (Figs. 80-81) hyperstrophic, of about 1³/₄ smooth whorls, of about 330 µm diameter, and a thick rib at the start of the teleoconch. Teleoconch of about 2¹/₄ whorls, increasing slowly; the sculpture is formed by prominent spiral cords (only 2 at the beginning and 7 on the last whorl), which are crossed by numerous narrow prosocline axial ribs, about 50 in number on the last whorl; the adapical cord is the most elevated, appearing close to the suture, and the lowest one borders the umbilical infundibulum; the spiral cords on the base are also elevated. Under magnification, it can be seen that the entire surface is covered by numerous fine spiral threads of microtubercles (Fig. 82). Umbilicus wide and deep. Aperture rounded with the outer lip with seven prominences caused by ends of the spiral cords.

Dimensions: Holotype is 2.0 mm maximum dimension (diameter).

Distribution: In the original description it is mentioned only from Liberia. We have found this species from Senegal to Angola.

GIANNUZZI-SAVELLI *ET AL.* (1997, fig. 556, reproduced from ADAM & KNUDSEN, 1969) recorded this species for the Mediterranean, but fig. 555, which is that found in this area is probably *Tornus africanus* and not *T. jullieni*. So, this species has not been collected in the Mediterranean yet.

Remarks: The present species has some similarity with *T. africanus*, but can be differentiated because in the latter, the spire is less elevated, the axial ribs are less numerous and the spiral cords less prominent in the ventral part, with more distance between them.

The differences from other previously mentioned similar species are: *T. erici* spec. nov. has a less prominent sculpture, the spiral cords are narrower and scarcely prominent, and the protoconch has 2 whorls; *T. aemilii* spec. nov. has a more depressed shell with more prominent spiral cords, and lacks any microsculpture.

Tornus umbilicorda spec. nov. (Plate 14)

(Figs. 83-86)

Type material: Holotype (Fig. 83) in MNCN (15.05/46472). Paratypes: MNHN (1) from Mussulo, Luanda, Angola 90-100 m, and from type locality: CER (3, Fig. 84), CPR (1) and CFR (1, Fig. 85).

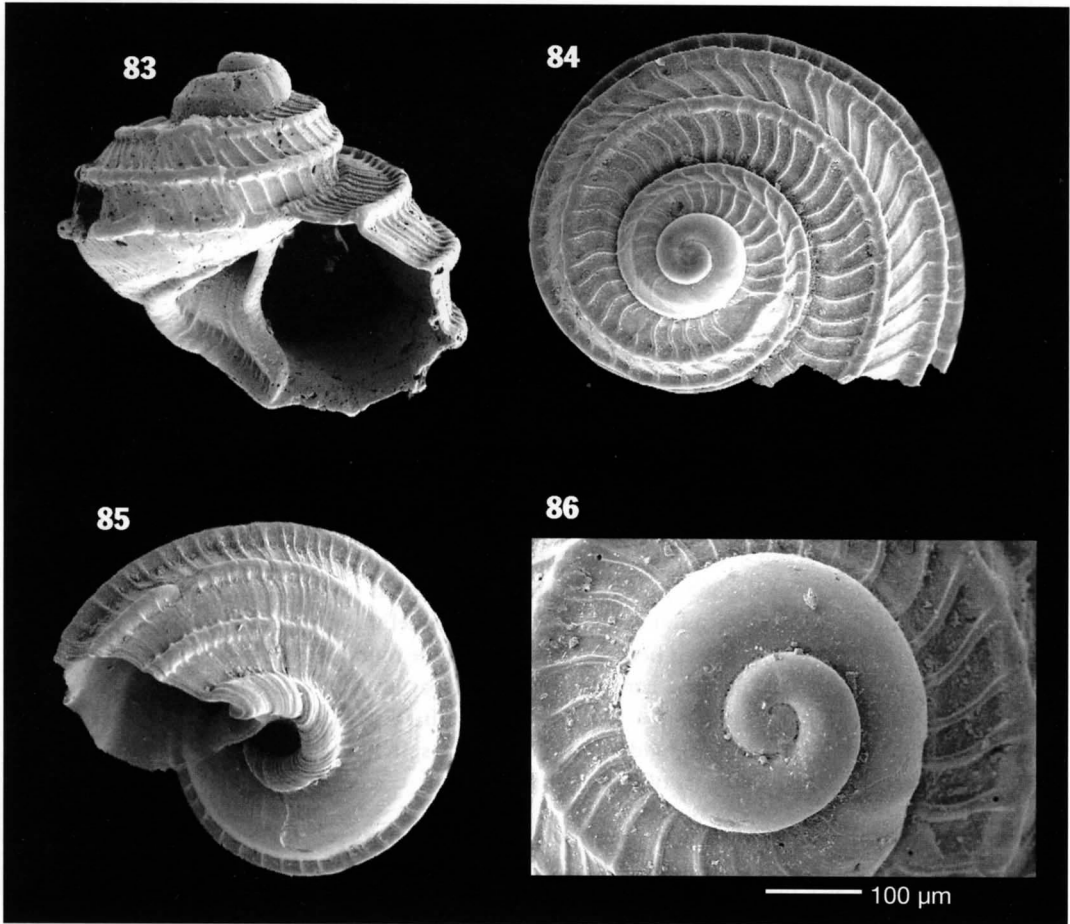
Other material examined: Ghana: 2 j, Cape Three Points, 35-65 m (CER). Angola: 1 j, Ilha de Luanda, 120 m (MNHN).

Type locality: Miamia, Ghana, 35-40 m.

Etymology: The specific name is formed by a fusion of the Latin word "umbilicus" and the Galician word "corda", alluding to the characteristic strong cord around the umbilicus.

Description: Shell (Figs. 83-85) rounded, nearly spherical, relatively solid, whitish, and with a keel at the periphery. Protoconch (Fig. 86) smooth, hyperstrophic, of 2 whorls with a diameter of about 340 µm and a thick rib at the start of the teleoconch. Teleoconch of about 2 whorls, increasing not very rapidly. Dorsally, two strong cords begin at the end of the protoconch, the lowest one near the suture, increasing to three in the last whorl, the lowest one at the periphery; those cords are crossed by finer axial prosocline threads which do not reach the base. Below the periphery, there is a strong cord near the umbilicus. The rest of the surface is slightly concave and smooth at the beginning, but in the last

PLATE 14



Figures 83-86. *Tornus umbilicorda* spec. nov. Fig. 83. Holotype, 1.7 mm, Miamia, Ghana (MNCN); Fig. 84. Paratype, 1.5 mm, Miamia (CER). Fig. 85. Paratype, 1.5 mm, Miamia (CFR). Fig. 86. Protoconch.

half-whorl, two new spiral cords appear between the perumbilical and the peripheral ones (Fig. 85). The dorsal surface between cords and threads is rough but there are no tubercles even under high magnification; ventrally, there are some irregular curved oblique threads which become nodules on the peripheral keel. Umbilicus narrow. Aperture rounded with the upper part of the outer lip sharp with nodules due the end of the spiral cords.

Dimensions: Holotype is 1.7 mm maximum dimension (diameter).

Distribution: Known from Ghana and Angola.

Discussion: This species differs from the following similar ones:

T. jullieni has more spiral cords, which are smaller, the axial ribs are more numerous, the area below the periphery is strongly sculptured and has microscopic tubercles visible only under magnification.

T. africanus has a more depressed shell, the spiral cords are weaker and more numerous, it has constant sculpture towards the base, and the perumbilical cord is smaller and separated more from the umbilicus.

T. erici spec. nov. and *T. aemilii* spec. nov. have more depressed shells, with more spiral cords, and with several narrow cords present in the base of the last whorl, the perumbilical one being narrower.

Tornus anselmoi spec. nov. (Plate 15)
(Figs. 87-91)

Type material: Holotype (Fig. 87) in MNCN (15.05/46466). One Paratype in MNHN (Figs. 88-89).

Type locality: Banc d'Arguin, Mauritania.

Etymology: The species is named for Anselmo Peñas, malacologist of Vilanova i la Geltrú, student of the micromolluscs, who found the type material in sediments collected by the authors.

Description: Shell (Figs. 87-89) orbicular depressed, nearly lenticular, rather solid, with a rounded periphery scarcely angulated. Protoconch (Figs. 90) of about 1½ smooth whorls, of about 360 µm in diameter. Teleoconch of about 1 - 1¼ whorls, increasing not very rapidly; dorsal sculpture formed by one spiral cord which forms a slight angulation. There are numerous strong proxocline poorly delimited axial ribs. Ventrally, there are two spiral cords, the lowest one delimiting the umbilical infundibulum. The other one, similar in size, is placed between the first and the rounded periphery. The axial sculpture is formed by irregular prosocline ribs narrower than interspaces. The whole shell surface examined under magnification (Fig. 91) presents a rough surface with spiral sculpture but no microtubercles could be seen. The umbilicus is deep, wide and limited by a spiral cord. Aperture rounded, columella curved, nearly vertical, the upper part of the outer lip sharp.

Dimensions: The holotype is 1.0 mm in maximum dimension (diameter).

Distribution: The scarce material studied came only from Mauritania.

Discussion: The species was described in spite of the scarcity of the material collected because is very different from any other known species.

The most similar could be *T. garrawayi*, but this latter species is larger, the periphery more keeled, the microsculpture formed by aligned rows of tubercles and the protoconch has 1¾ whorls, with slowly increasing diameter and a rib at its end.

In lateral view, it can have some similarity with *Discopsis militare* (see below), but this latter species is larger, the axial sculpture is minute, and the protoconch has 2 whorls and larger diameter.

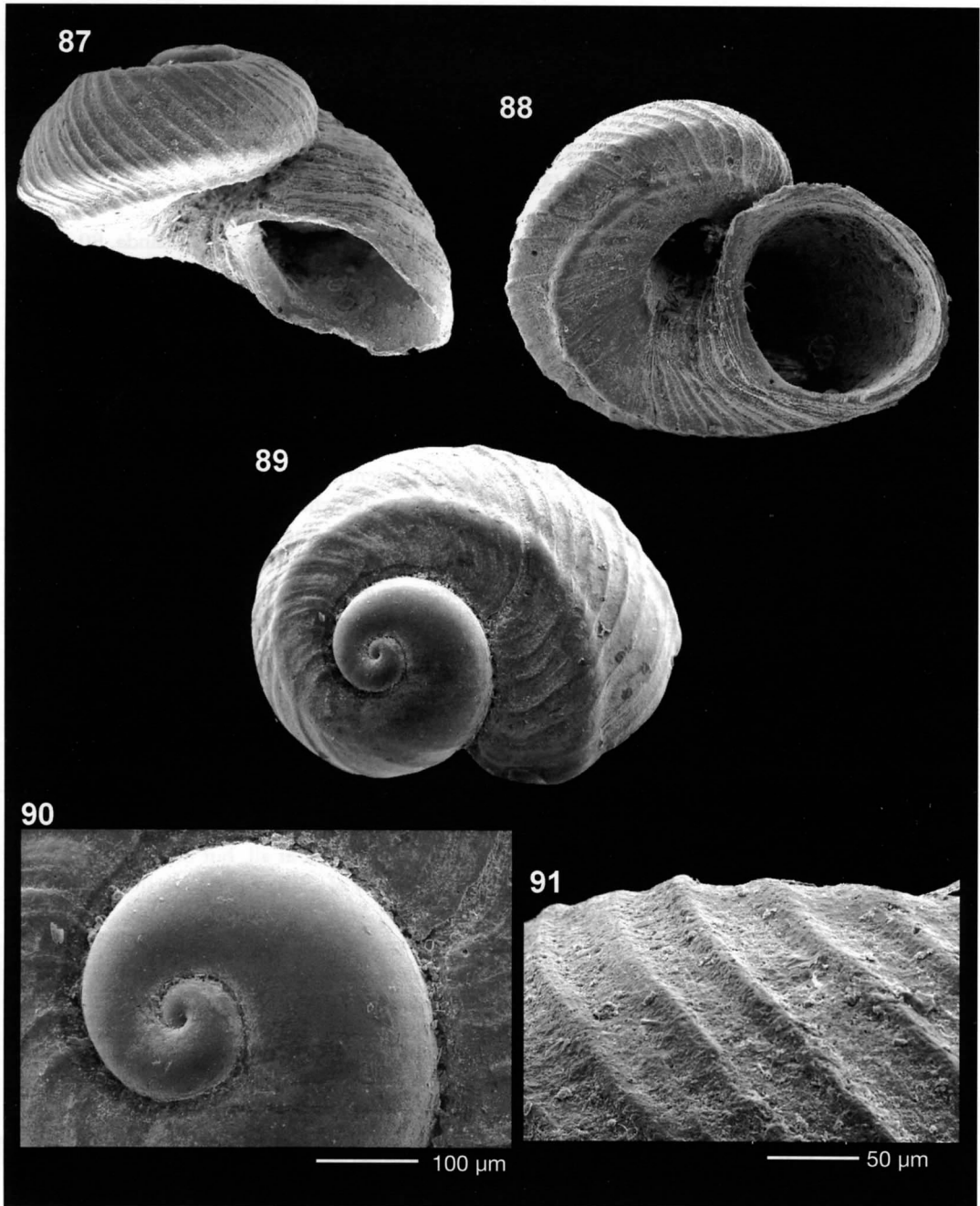
Genus *Sigaretornus* Iredale, 1936

Sigaretornus Iredale, 1936. Australian Molluscan notes, 2. *Records of the Australian Museum*, 19: 267-340.
Type species: *Adeorbis sigaretinus* Pilsbry, 1897. Recent. Australia.

Diagnosis: Shell discoidal, rather thin, whorl surface smooth or sculptured with many narrow spiral ribs. Umbilicus wide open.

Remarks: Few Pacific species of this genus are known, they are circalittoral and there is at present no information about the animal, radula and operculum. The single species we include in this genus has a

PLATE 15



Figures 87-91. *Tornus anselmoi* spec. nov. Fig. 87. Holotype, 1.0 mm, Banc d'Arguin, Mauritania (MNCN). Figs. 88-89. Paratype, 1.1 mm (MNHN). Fig. 90. Protoconch holotype. Fig. 91. Microsculpture.

smooth shell, while the type species is sculptured, but the type species characters may be not all be representatives for the genus.

Sigaretornus disjunctus spec. nov. (Plate 16)
(Figs. 92-100)

Type material: Holotype (Fig. 92) and 3 paratypes in MNHN. Other paratypes in the following: MNCN (1, n° 15.05/46473, Fig. 93), CER (3, Fig. 94), CFR (1), all from Luanda.

Other material examined: Ghana: 1 s, Miamia, 38-40 m (CER). Angola: 2 s, off Luanda, 80-100 m (CER); 2 j, 2 f, along Mussulo, 90-100 m (CER).

Type locality: Mussulo, Luanda, Angola, 90-100 m.

Etymology: The specific name alludes to the characteristic of the species to have a separation between the last whorl and the previous one.

Description: Shell (Figs. 92-96) rounded depressed, nearly lenticular, relatively solid, smooth and whitish, with the end of the spire separate from the previous whorl. Protoconch (Figs. 97-100) hypertrophic, of about 2 whorls about 400 µm in diameter, presenting a thick rib near its end; the beginning of the protoconch has a rough irregular sculpture, which disappears in the subsequent smooth part. Teleoconch of about 1½ convex whorls, increasing slowly; the surface is smooth. Under magnification, the sculpture appears formed only of irregular growth lines. Suture impressed. There is no umbilicus because the whorls are separated. Aperture nearly rounded. Peristome sharp.

Dimensions: Holotype is 2.2 mm maximum dimension (diameter).

Distribution: Known from Angola, and a single shell from Ghana, which is a little different.

Discussion: The placement of our species in the genus *Sigaretornus* is tentative, because not all the characters of the genus are present on it: spiral sculpture is not present at all, but because of the other characters, it may be considered as a *Sigaretornus*. Only after study of the soft parts can this assignment be confirmed.

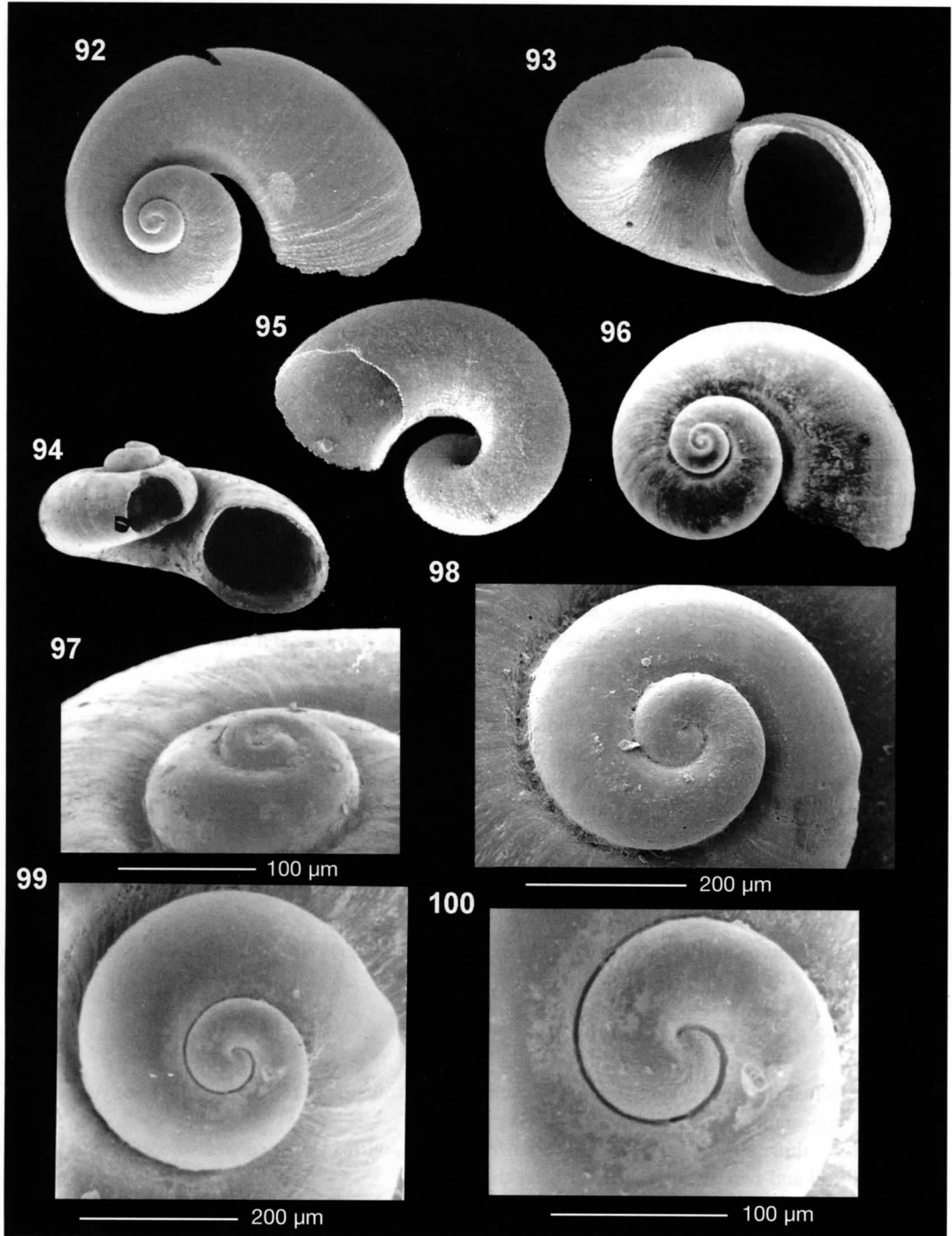
No African species are similar to the present species due to the separation of the last whorl from the previous one. The single shell collected in Ghana does not have this separation, but it is equal in all other characters to the Angolan shell, and so, we considered it as probably conspecific.

Genus *Ponderinella* Marshall, 1988

Ponderinella Marshall, 1988. Type species (by original designation) *Ponderinella lignicola* Marshall, 1988. *Journal of Natural History*, 22: 949-1004. Recent. New Zealand.

Diagnosis: Shell minute, depressed-turbiniiform, thin, glassy, smooth, umbilicate. Protoconch of about 1.3 convex whorls. Teleoconch whorls convex, base and umbilical rim angulate. Operculum paucispiral. Radula: Central tooth with the cutting edge broadly "V" shaped, serrated, 2 basal denticles, ventral process U-shaped. Lateral tooth cutting area at inner third, broadly angulated and serrated. Inner marginal cutting area very broad, comb-like. Outer marginal cutting area short.

PLATE 16



Figures 92-100. *Sigaretornus disjunctus* spec. nov. Fig. 92. Holotype, 2.2 mm, Mussulo, Luanda (MNHN). Fig. 93. Paratype, 2.0 mm, Mussulo (MNCN). Fig. 94. Paratype, 1.7 mm, Mussulo (CER). Figs. 95-96. Shells, 1.7 and 1.8 mm, off Luanda (CER). Figs. 97-100. Protoconch and details, Luanda.

Remarks: MARSHALL (1988) described the genus *Ponderinella* and it was placed in the family Vitrinellidae Bush, 1897, after comparison of the conchological characters of *Ponderinella lignicola* with the vitrinellid species of the genera *Anulicallus* Pilsbry & McGinty (1946), *Eurelema* Pilsbry & Olsson (1952), *Tomura* Pilsbry & McGinty (1946) and *Vitrinella* C.B. Adams, 1850. No comparison of the radula and operculum was made. HASEGAWA (1997) described *Ponderinella major*, keeping it in Vitrinellidae, but the author mentioned that the operculum is paucispiral, which is not the case in any known vitrinellid species. On the contrary, this type of operculum exists in *Tornus subcarinatus* (see FRETTER & GRAHAM, 1978), which is the type species of the genus *Tornus*, after PONDER (1994). Because the species included in *Ponderinella* are very similar in radula and operculum to those of *Tornus* and they do not present important anatomical differences, we consider *Ponderinella* belonging to Tornidae instead of Vitrinellidae.

Ponderinella tornatica (Moolenbeek & Hoenselaar, 1995) (Plate 17)
(Figs. 101-106)

Tornus tornaticus Moolenbeek & Hoenselaar, 1995. *Apex*, 10(1): 5-6, figs. 1-3. [Type locality: Banc d'Arguin, Mauritania (19°34'N 16°55'W)].

Type material: Illustrated in MOOLENBEEK & HOENSELAAR (1995). Not examined.

Other material examined: Sahara: 2 s, Dakhla, 50-60 m (CFR). Ghana: 5 s, Miamia, 45-50 m (CER); 1 j, 300° out of Cape Three Points, 35-65 m (CER). Angola: 1 s, Reineck, Ambrizete region, 07°00'S 12°20'E, 60 m (MNHN); 10 s, along Mussulo, 90-100 m (MNHN); 5 s, 1 j, Ilha de Luanda, 40-60 m (MNHN); 52 s, 70 j, Ilha de Luanda, 120 m (MNHN); 5 s, 4 j, between Baia dos Tigres and Ponta Albina, Namibe Province, 40 m (MNHN); 4 s, 2 j, Off Luanda, 50-60 m (CER).

Description: Shell (Figs. 101-104) subconical depressed, solid, whitish and with a strong keel at the periphery. Protoconch (Figs. 105-106) heterostrophic of about 1³/₄ whorls, with a rough surface at its beginning and smooth in the subsequent part, of about 308 µm diameter. Teleoconch of about 1 whorl, increasing rapidly; dorsally convex and smooth, with a prominent cord keel at the periphery. Ventrally, slightly concave with another prominent spiral cord which delimits a wide infundibulum of the deep umbilicus. Aperture rounded depressed with the upper part of the outer lip sharp and extended dorsally; there is an inner canal on a prominence caused by the end of the peripheral keel.

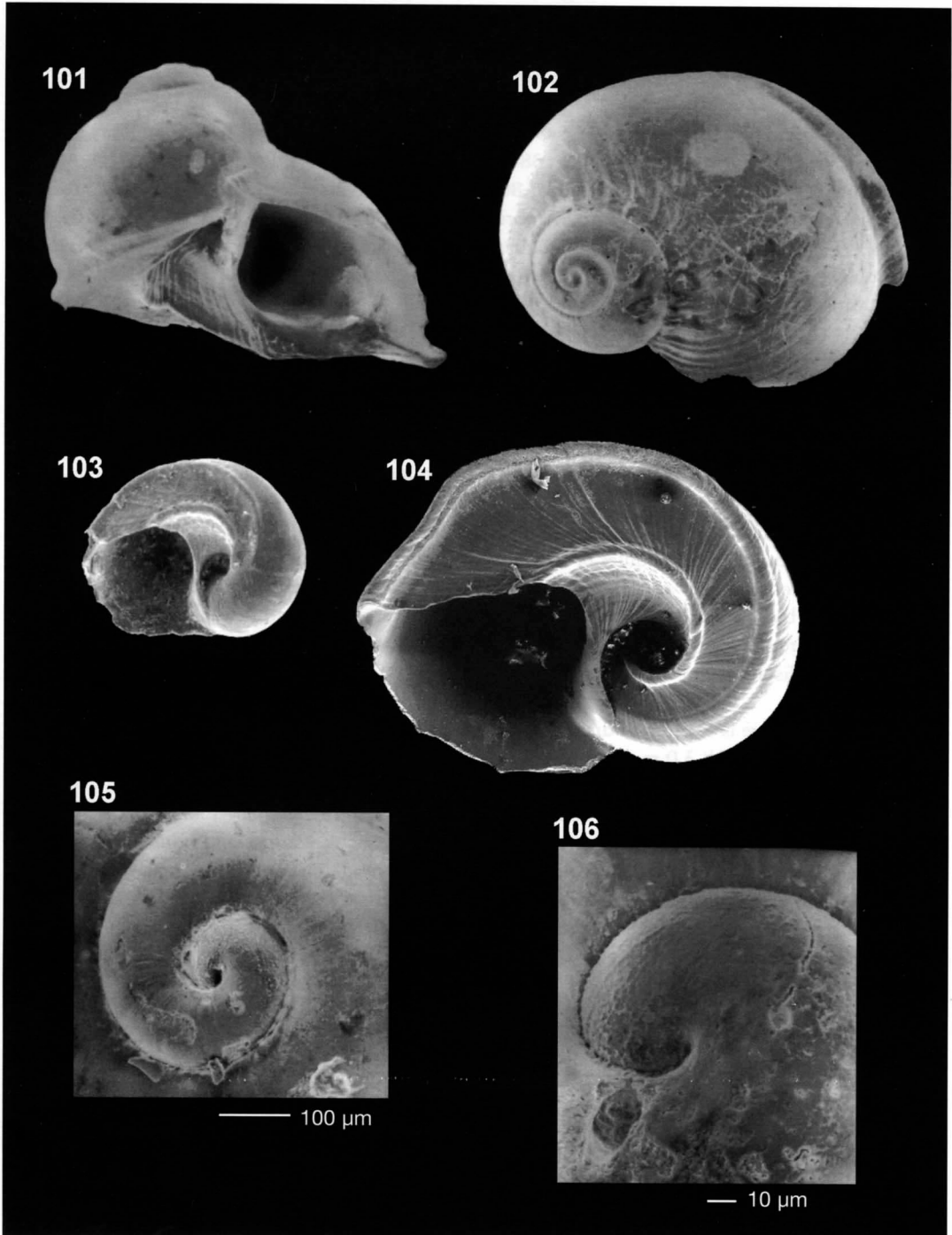
Dimensions: Holotype is 1.59 mm maximum dimension (diameter). We have shells with about 2.5 mm diameter.

Distribution: Known from Sahara to Angola.

Remarks: When the shell is very young, the canal which is outside of the umbilicus is not yet created, giving the appearance of a small *Natica*.

No similar species exist on the West African coast, with a rather convex smooth dorsal part, a peripheral keel and two distant spiral cords on the base.

PLATE 17



Figures 101-106. *Ponderinella tornatica*. Figs. 101-102. Shells, 1.6 and 1.5 mm, off Luanda, Angola (CER). Fig. 103. Juvenile, 0.8 mm, Luanda, Angola (CER). Fig. 104. Shell, 2.0 mm, Baia dos Tigres, Angola (MNHN). Figs. 105-106. Protoconch and details, Luanda.

Ponderinella skeneoides spec. nov. (Plate 18)

(Figs. 107-117, 253, 256)

Type material: Holotype (Fig. 107) in MNHN. Paratypes: AMNH (1), BMNH (1) MNCN (1, n° 15.05/46474), CER (6, Fig. 109), CFR (1), CPR (1), all from type locality.

Other material examined: Mauritania: 2 s, Banc d'Arguin, intertidal sediment (CER). Ivory Coast: 1 s, Abidjan (MNHN). Ghana: 12 s, Miamia, 38-40 m (CER). Congo: 7 s, Pointe Noire (CPH). Angola: 2 s, Corimba, 20 m (CER); 1 s, off Luanda, 80-100 m (CER); 2 sp, 2 s, Cacuaco, Bengo province, infralittoral rocks (MNHN); 8 s, Faro, Ambrizete region, 07°17.49'S 12°53.05'E, beach deposits (MNHN); 9 s, Ambrizete region, Bengo province, 07°20.19'S 12°55.09'E, beach deposits (MNHN); 2 s, Corimba, 20 m (CER); 8 s, Cacuaco, Bengo province, Angola, infralittoral (MNHN); 1 s, São Nicolau, Moçamedes province, beach sediments (MNHN).

Type locality: Luanda, Angola.

Description: Shell (Figs. 107-110, 112-115) ovoid-conic depressed, relatively fragile, whitish, without dorsal sculpture and with a rounded periphery. Protoconch (Figs. 111, 117) hyperstrophic of about 2 whorls, with a rough surface at the beginning, later becoming smooth of about 340 µm diameter; there is a thick axial rib at the end of the protoconch. Teleoconch of 1½ whorls, increasing not very rapidly; whorls convex, smooth, with an impressed suture. At the base, a strong nodulous cord delimits a wide umbilical infundibulum. The nodules of this cord continue into the infundibulum via small ribs. The microsculpture consists only of prosocline growth lines. In some shells (Figs. 108, 114) the small nodules on the basal spiral cord, become fine folds outside of the umbilicus, but only for a short distance. Aperture rounded with a continuous and sharp peristome, in contact with the previous whorl for only a short distance, and somewhat extended dorsally.

Dimensions: Holotype is 1.3 mm in diameter and 1.2 in height. There are shells from populations with larger size which can reach 3.0 mm in maximum dimension (diameter).

Animal (Fig. 256): Cephalic tentacles elongate, close proximally, finely ciliated and a little flattened, somewhat wider at the extremes, and with some white spots. Snout elongate and bilobed, buccal bulb reddish, visible by transparency. Penis coiled and behind the head. The branchiae are large and visible when the animal is moving. There are two pallial tentacles with a white spot at their base arising from the right margin of the mantle skirt. Around the eyes, there are some white opaque blotches. Anterior end of the foot very flexible and elongate. No metapodial tentacle. Wide opercular lobes.

Operculum (Fig. 253), fine, transparent, paucispiral and with a subcentral nucleus.

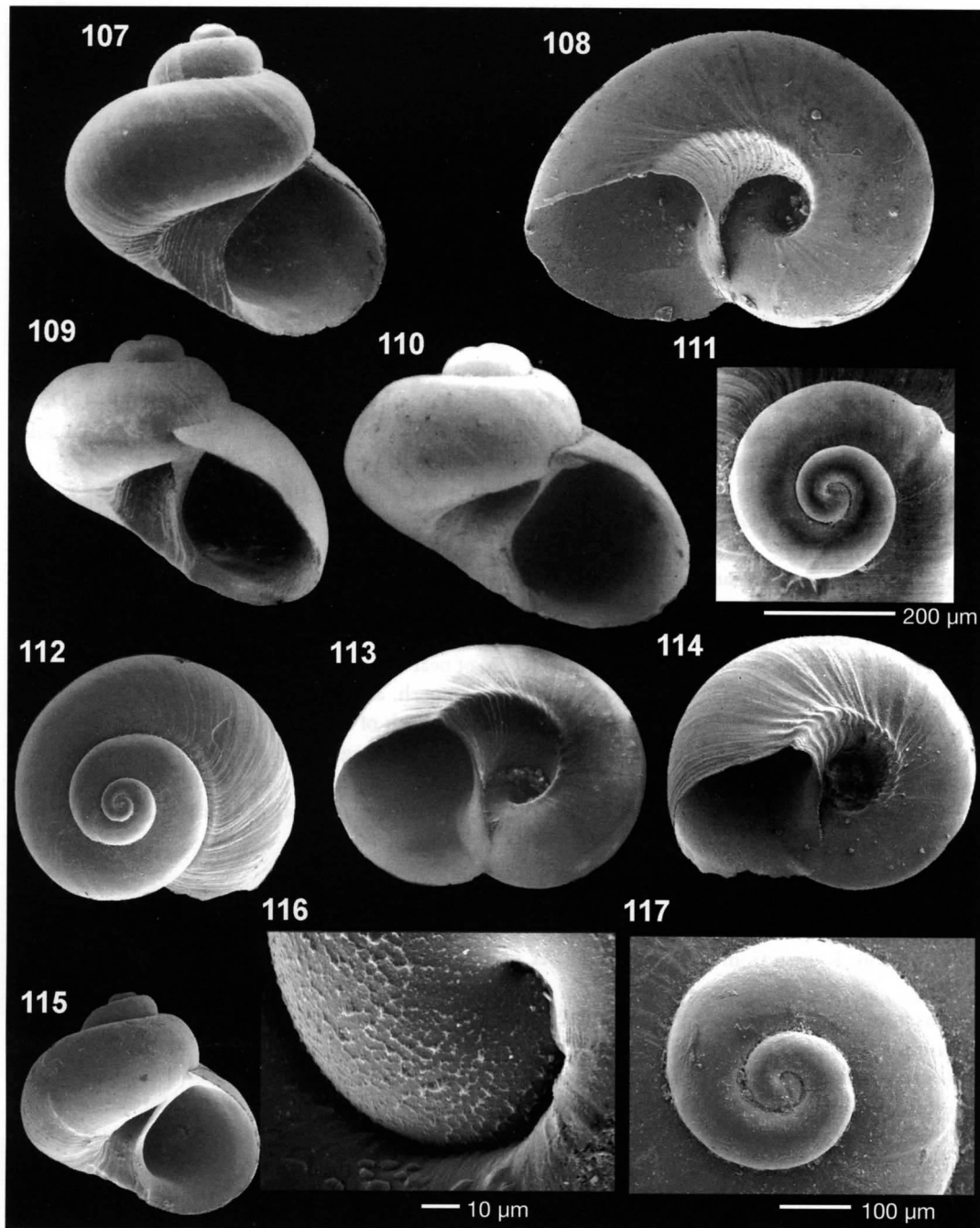
Distribution: Known from Mauritania to Angola.

Habitat: Two specimens (MNHN) were collected under a rock buried in sand (S. Gofas, pers. comm.).

Discussion: We have included in this taxon shells which are depressed along with others with a more elevated profile. Usually, the depressed shells (Figs. 108-110) are larger while the highest (Figs. 107, 115) are smaller in diameter. We also found other differences in the umbilicus: wide in some shells (Figs. 107, 108, 110, 113) and narrow in others (Fig. 115). Even the protoconchs in the smaller and more elevate shells appear to be also more elevate than in the wider shells.

These differences could be an ecological adaptation to different habitats, though we have found shells of both morphs sympatrically in some places like Congo and Angola. The other characters were

PLATE 18



Figures 107-117. *Ponderinella skeneoides* spec. nov. Fig. 107. Holotype, 1.3 mm diameter, Luanda, Angola (MNHN). Fig. 108. Shell, 3.4 mm, Banc d'Arguin, Mauritania (CER). Fig. 109. Paratype, 1.5 mm, off Luanda, Angola (CER). Fig. 110. Shell, 1.6 mm, Luanda Angola (CER). Fig. 111. Protoconch, Luanda, Angola. Fig. 112. Shell, 1.7 mm, Miamia, Ghana (CER). Figs. 113. Shell, 2.3 mm, Banc d'Arguin, Mauritania (CER). Fig. 114. Shell, 1.6 mm, Miamia (CER). Fig. 115. Shell, 1.3 mm, Cacuo, Angola (MNHN). Fig. 116. Protoconch, Miamia, Ghana. Fig. 117. Detail of the protoconch, Cacuo, Angola.

similar and thus, lacking soft parts to make a more complete comparison, we provisionally consider all these morphs conspecific.

P. skeneoides spec. nov. can be differentiated from *P. tornatica*, because the latter species has a concave base and a peripheral keel.

It can be differentiated from *P. minutissima* (see below) because the latter has a narrower umbilicus, and strong perumbilical cord; other species of the genus in the studied area (see below) have axial sculpture.

Ponderinella minutissima spec. nov. (Plate 19)

(Figs. 118-126)

Type material: Holotype (Fig. 118) in MNCN (n° 15.05/46475). Paratypes: AMNH (1, Fig. 123), MNHN (1, Fig. 120), CER (21, Figs. 119, 121), CPR (1, Fig. 122) and CFR (1).

Other material examined: Ivory Coast: 4 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 12D, 30 m (MNHN). Ghana: 22 s, Cape Three Points, 35-65 m (CER); 6 s, Miamia, 38-40 m (CER). Angola: 4 s, Cacucaco, Bengo province, infralittoral rocks (MNHN).

Type locality: Miamia, Ghana, in 35-50 m.

Etymology: The specific name alludes to the small size of the shell of the present species.

Description: Shell (Figs. 118-123) ovoid conic, solid, not depressed, white, apparently smooth and with a rounded periphery. Protoconch (Figs. 124-125) of near 1³/₄ whorls and of about 338 µm diameter, with a rough surface at the beginning, the rest being smooth, and presenting a thicker band near the beginning of the teleoconch which is well defined. Teleoconch of about 1¹/₂ whorl, increasing slowly; the whorls are convex and smooth, the suture impressed; with magnification (Fig. 126), it is possible to see in fresh shells that the dorsal surface is crossed by numerous spiral lines formed by tubercles; ventrally, it is less convex with a prominent cord near the narrow umbilicus. Aperture nearly rounded with a notch where the perumbilical cord ends.

Dimensions: Holotype is 1.2 mm in height x 1.0 in diameter.

Distribution: Known from Ivory Coast, Ghana, and Angola.

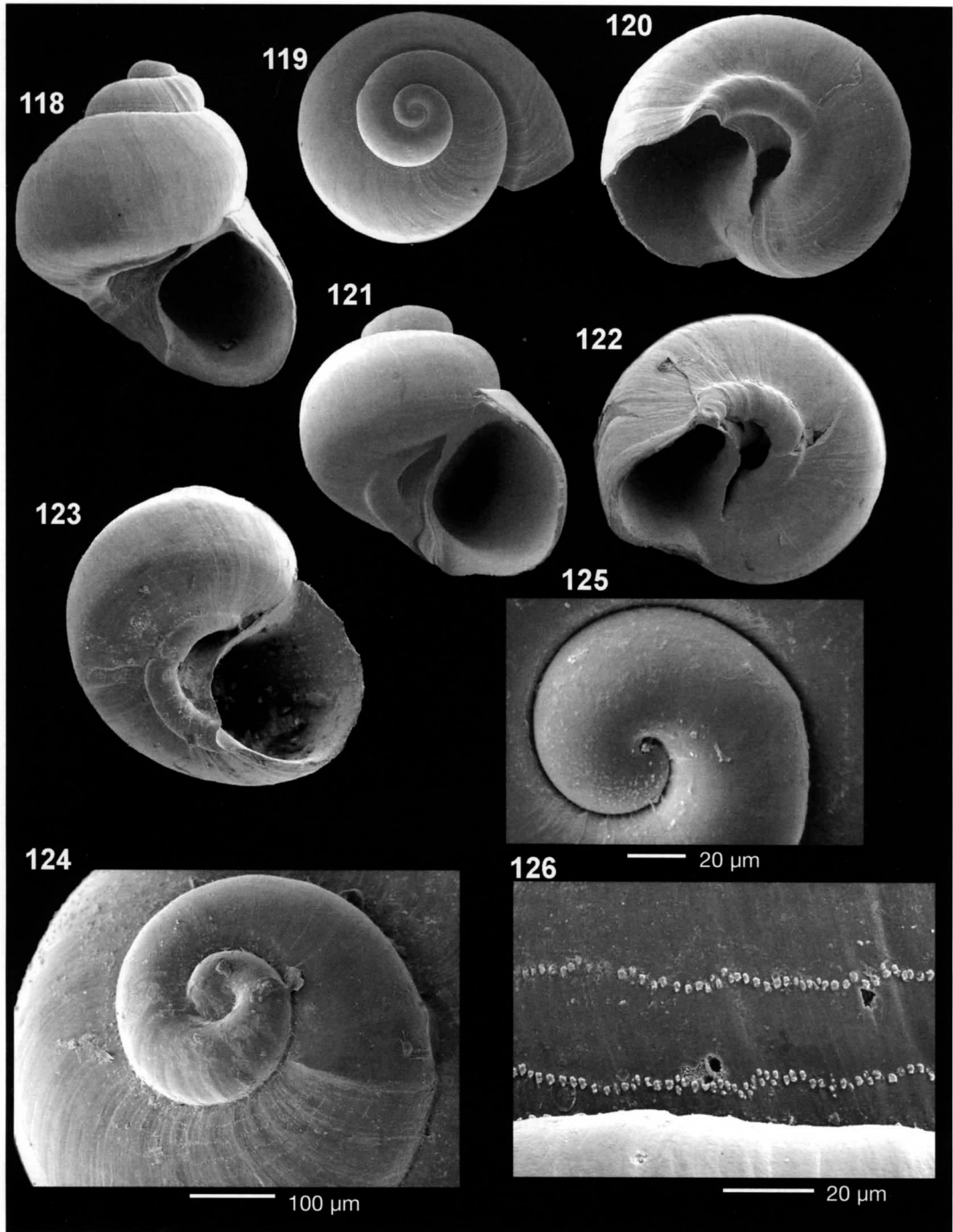
Discussion: This species is smaller and more elevated than the previous ones included in the genus. In addition, *P. tornatica* has a strong peripheral cord and no microsculpture, while the umbilicus is wider; *P. skeneoides* is larger, more depressed, the umbilicus is wider and the perumbilical cord is nodulous and delimits a wider infundibulum, even in those shells which have a smaller umbilicus; furthermore, the shell has no microsculpture. *P. finalis* spec. nov. (see below) is larger, with axial ribs and denser microsculpture.

Ponderinella carlosi spec. nov. (Plate 20)

(Figs. 127-132)

Type material: Holotype (Fig. 127) and 13 paratypes (Fig. 128) from Adbijan, Ivory Coast and 1 paratype from Grand Bassam N/O Antéa BENCHACI I, stn. 6B, 50 m, Ivory Coast, in MNHN. Other

PLATE 19



Figures 118-126. *Ponderinella minutissima* spec. nov. Fig. 118. Holotype, 1.2 mm, Miamia, Ghana (MNCN). Fig. 119. Paratype, 1.0 mm, (CER). Fig. 120. Paratype, 1.0 mm, Miamia (MNHN). Figs. 121. Paratype, 1.0 mm, Miamia (CER). Fig. 122. Paratype, 1.1 mm, Miamia (CPR). Fig. 123. Paratype, 1.1 mm, Miamia (AMNH). 124. Protoconch. Fig. 125. Detail of the protoconch. Fig. 126. Microsculpture.

paratypes: from Abidjan: CFR (1), and from Luanda: AMNH (1), MNCN (1, n° 15.05/46476, Fig. 129), CER (2, Fig. 130), CPR (1).

Other material examined: Ivory Coast: 2 f, Grand Bassam N/O Antéa BENCHACI I, stn. 7D, 55 m (MNHN). Ghana: 4 s, Miamia, 38-40 m (CER); 3 s, 4 j, 2 f, 210° off Miamia, 45-50 m (CER). Gabon: 1 s, N'kondo I, 2°34.1'S 9°00'E, 120 m (MNHN). Congo: 2 s, Pointe Noire, (CPH); 2 s, stn. 916 (MNHN). Angola: 1 s, Cabinda, W Landana N/O André Nizery, Stn 932, 5°07'S 12°01'E, 9 m (MNHN); 1 j, Ambrizete region, 06°57'S 12°23'E, 45 m (MNHN); 1 s, 6 j, along Mussulo, 90-100 m (MNHN); 1 s, 1 f, Ilha de Luanda, 40-60 m (MNHN); 1 j, off Luanda, 90-100 m (CER).

Type locality: Abidjan, Centre de Recherches Oceanographiques, Ivory Coast.

Etymology: The species is named for Carlos Rolán, grandson of the senior author who, in spite of his young age (5), is an active shell collector and observer of Nature.

Description: Shell (Figs. 127-130) globose, relatively solid, whitish and sculptured. Protoconch (Fig. 131) of about 1¾ whorls, smooth, and of about 413 µm diameter. Teleoconch of about 2 whorls, increasing slowly; at the beginning, there are 2 spiral cords, crossed by axial prosocline ribs, narrower than the interspaces; these ribs number about 20 in the first whorl and about 25 in the last one. On this last whorl, those 2 spiral cords on the subsutural area continue, one of them close to the suture; below, there is a space with only axial sculpture; at the level of the end of the spire, two more smaller cords appear, and 2 additional are near the umbilicus which is elongate, narrow and curved. Aperture rounded, columella semicircular, peristome simple. With magnification it is possible to see that there are numerous spiral threads formed by very small tubercles (Fig. 132), which are more numerous and closer on the two cords of the periphery

Dimensions: Holotype is 3.0 mm in height and 2.6 mm in diameter.

Distribution: Know from Ivory Coast to Angola.

Discussion: This species is the most globose in West Africa, and the comparison with the other species included in the genus is as follows:

P. skeneoides spec. nov. is globose but smooth.

P. minutissima spec. nov. is globose, apparently smooth, lacking axial sculpture, and with only microscopic spiral sculpture, except for the spiral cord near the umbilicus.

P. finalis spec. nov. (see below) has a wider umbilicus and its axial sculpture is reduced to the subsutural area.

Ponderinella finalis spec. nov. (Plate 21)

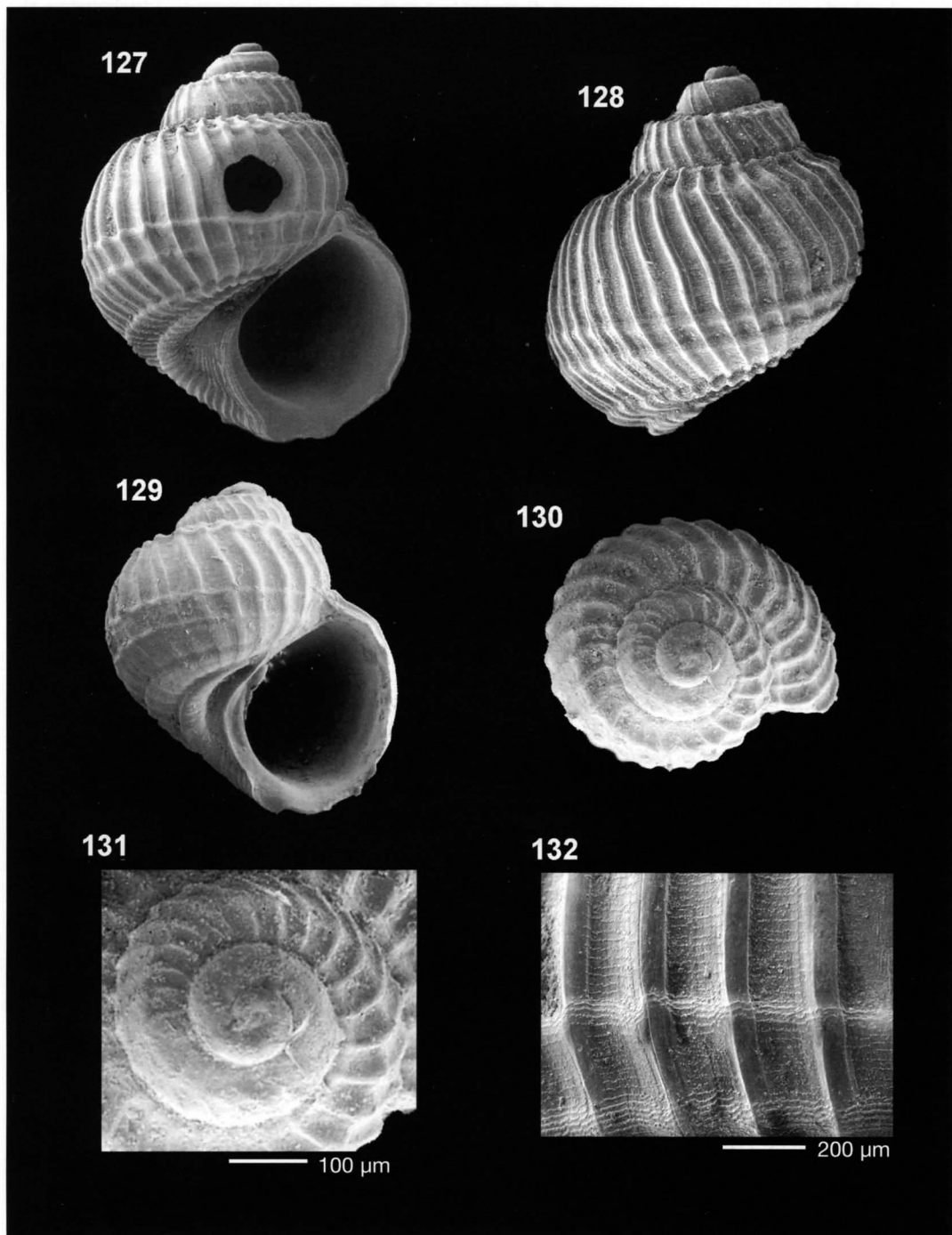
(Figs. 133-137)

Type material: Holotype (Fig. 133) and three paratype (Fig. 134) in MNHN. One paratype (f) in CER, from Ghana.

Type locality: Abidjan, Ivory Coast.

Etymology: The specific name alludes to be the last species found mixed with other different, even when the work was nearly finished.

PLATE 20



Figures 127-132. *Ponderinella carlosi* spec. nov. Fig. 127. Holotype, 3.0 mm, Abidjan, Ivory Coast (MNHN). Fig. 128. Paratype, 2.5 mm, Abidjan (MNHN). Fig. 129. Paratype, 2.5 mm high, Luanda (MNCN). Fig. 130. Paratype, 1.5 mm diameter, Luanda (CER). Fig. 131. Protoconch. Fig. 132. Detail of the microsculpture.

Description: Shell (Figs. 133-134) rounded, naticiform, nearly spherical, relatively solid for its size, with short spire, milk-white and with an enlarged last whorl. Protoconch (Fig. 135) of about $1\frac{3}{4}$ smooth whorls, of about 394 μm maximum diameter but with an evident thickening a little before the beginning of the teleoconch. Most of the protoconch is smooth except the start where a rough surface can be seen (Fig. 136). Teleoconch of 2 convex whorls, increasing not very rapid; dorsally, the first whorl is nearly smooth and the second presents numerous fine prosocline curved axial ribs, which are more evident near the suture, and barely visible at the base. A deep umbilicus fairly narrow, which is extended up to the base by a sulcus. Under magnification numerous tubercles can be seen mainly on the dorsal part, few at the start of the teleoconch becoming more numerous and disposed in spiral rows at the end (Fig. 137). Aperture rounded, with a sharp outer lip and a small extension towards the base.

Dimensions: Holotype is 1.8 mm in height x 1.8 in diameter.

Distribution: Only known from the type material, Ivory Coast and Ghana.

Discussion: This species was placed in the genus *Ponderinella* because of its peculiar protoconch, with a rough embryonic part and a thickening near the beginning of the teleoconch; also, the microsculpture of the teleoconch is similar to that of other species of Tornidae, but not in *Ponderinella*.

In relation to the other species of the genus in the area under study, *P. finalis* spec. nov. has some similarity only with *P. skeneoides* spec. nov., but this latter species has no axial sculpture on the dorsum and the umbilicus is wider and delimited by a nodulous cord.

P. minutissima spec. nov. is smaller, without any axial sculpture, the umbilicus is narrower and has a strong cord around it.

P. carlosi spec. nov. is more globose and has more evident axial sculpture.

Genus *Discopsis* De Folin, 1869

Discopsis De Folin, 1869. *Les Fonds de la Mer*. Tomo I: 316 pp. Type species by original designation: *Discopsis omalos* De Folin, 1869. Recent. Gulf of Mexico.

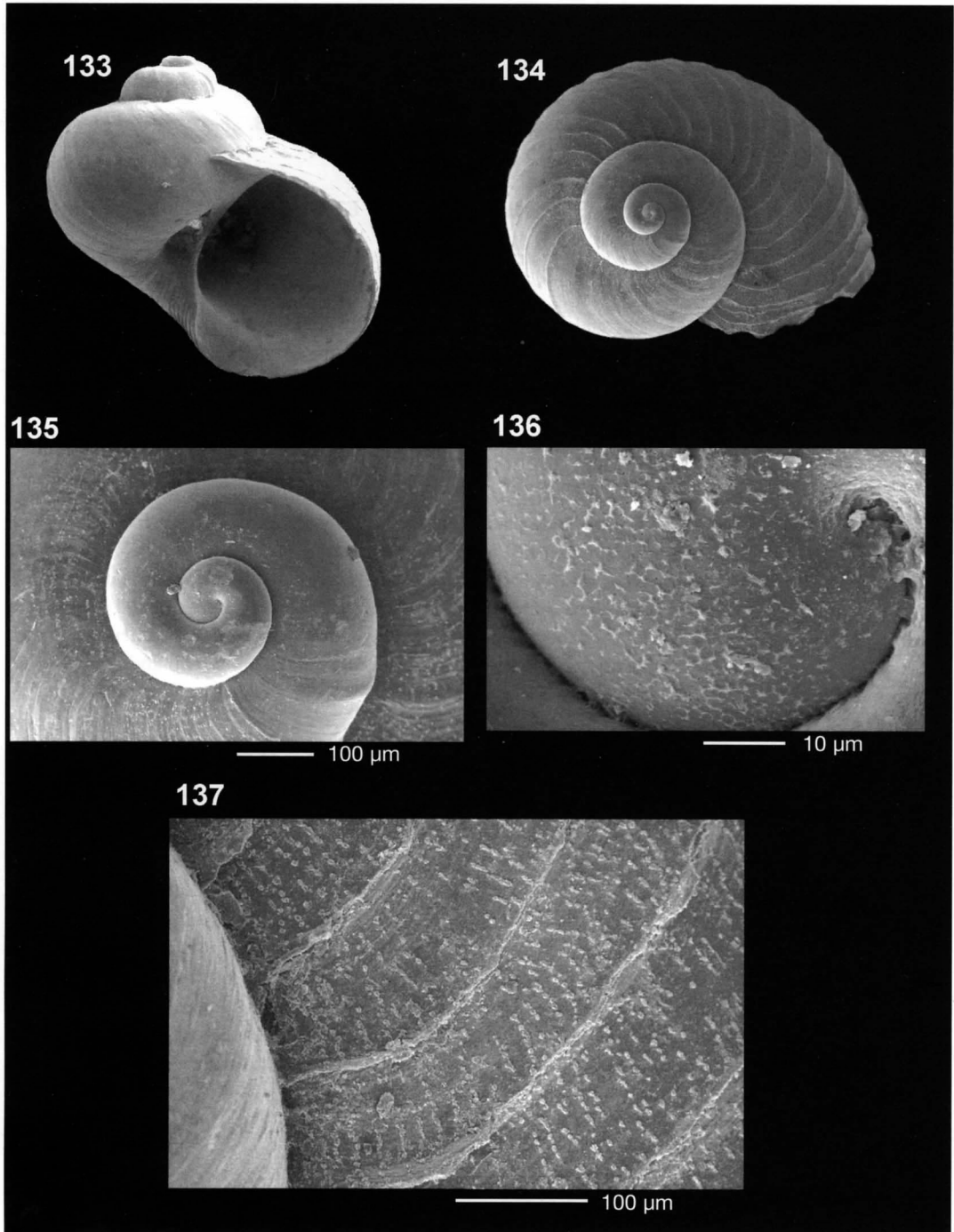
Diagnosis: The shells of this genus can be described as: minute and depressed, discoidal, rapidly increasing whorls; dorsal shell surface smooth or with axial ribs and only one prominent peripheral carina, ventral surface with axial ribs and one or more spiral cords and a wide umbilicus. Operculum paucispiral. The radula is taenioglossate.

Remarks: THIELE (1929) considers *Discopsis* as well *Naricava* Hedley, 1913, synonyms of *Cochliolepis*. WENZ (1939) placed *Discopsis* as a subgenus of *Cochliolepis* as well as *Naricava*, *Tropidorbis*, *Laciniorbis* and *Cochliolepis* s.s.

Since *Cochliolepis* is considered to be in Vitrinellidae (MOORE, 1972), only *Discopsis*, *Laciniorbis* and *Tropidorbis* may possibly be valid genera in Tornidae. The genus *Naricava* will be commented on below.

DE FOLIN (1869) described *Discopsis costulatus*, a new species from the West Africa coast. As this species has a great similarity with the other species known in the West African coast, we employ this genus to include these species previously included in *Cochliolepis*, as well as the new species here described.

PLATE 21



Figures 133-137. *Ponderinella finalis* spec. nov. 133. Holotype, 1.8 mm, Abidjan, Ivory Coast (MNHN). Fig. 134. Paratype, 1.9 mm, Abidjan (MNHN). Fig. 135. Protoconch, paratype. Fig. 136. Detail of the protoconch. Fig. 137. Microsculpture.

Discopsis costulatus De Folin, 1869 (Plate 22)

(Figs. 138-144)

Discopsis costulatus De Folin, 1869. *Les Fonds de la Mer*, I: 205, pl. 29, fig. 4. [Type locality: Cap Sainte-Anne, Mauritania].

Tinostoma costulatum (De Folin): TRYON, G.B., 1888:

Tinostoma (Discopsis) costulatum (De Folin): DAUTZENBERG, Ph. 1912: 78.

Cochliolepis costulatus (De Folin): ADAM & KNUDSEN, 1969: 55-57.

Cochliopsis sp.: BERNARD, 1984, pl. 73, figs. 5.

Cochliolepis costulatus (De Folin, 1870): GIANNUZZI-SAVELLI ET AL., 1997, figs. 557a, 557b, 558.

Type material: Not examined.

Other material examined: Mediterranean: 1 s (CAP). Mauritania: 2 s, 1 f, Baie de Cansado (MNHN); 2 s, 3 f, 3 m, Baie de l'Etoile, Nouadibou (CER); 3 s, Baie de L'Etoile, intertidal (MNHN); 30 s, Banc d'Arguin, beach sediments (CER); 2 s, Banc d'Arguin, beach sediments (CAP). Senegal: 3 s, Ngazobil (MNHN). Gambia: 2 s, Kaloli (CFS). Congo: 5 s, Pointe-Noire (CPH). Angola: 6 s, 3 j, 10 Kms S Ambrizete, prov. Zaire (MNHN); 20 s, Bango, region of Ambrizete 07°20.19'S 12°55'E, littoral (MNHN); 1 f, off Luanda, 100 m (CER).

Description: Shell (Figs. 138-142) discoid, planispiral, hardly depressed, relatively fragile, without prominences on a keeled periphery. Protoconch (Figs. 143) of about 1¼ smooth whorls, of about 443 µm diameter. Teleoconch of about 1¼ whorls, with a rapid increasing, dorsally with only numerous fine oblique ribs; ventrally (Fig. 144) with the same ribs and one spiral cord near the peripheral angulation, delimiting a depressed area. Sometimes there is another weakly prominent cord. Umbilicus very wide showing the previous whorls. Aperture oblique, with a sharp border in the outer lip and a continuous peristome.

Dimensions: ADAM & KNUDSEN (1969) mention that 2.7 mm is the largest shell in their material. In our material some shells reach 3.0 mm.

Distribution: Mediterranean, Mauritania and Liberia (after ADAM & KNUDSEN, 1969). We enlarge the range of this species to Senegal, Gambia, Congo and Angola, but it is not very common in these last countries.

GIANNUZZI-SAVELLI ET AL. (1997) mention Oran, Algeria, illustrating a shell from that area. It has been recorded from Israel by MIENIS (1981).

Remarks: There is no problem in the diagnosis of this species because it has the most depressed shell of the group. The most similar species are *D. militare*, *D. radians*, and *D. exmilitare* spec. nov. (see below), but none of them are so depressed and they have more prominent axial sculpture. *D. mienisi* has axial and spiral sculpture.

Discopsis mienisi Aartsen, Carrozza & Menkhurst, 1998 (Plate 23)

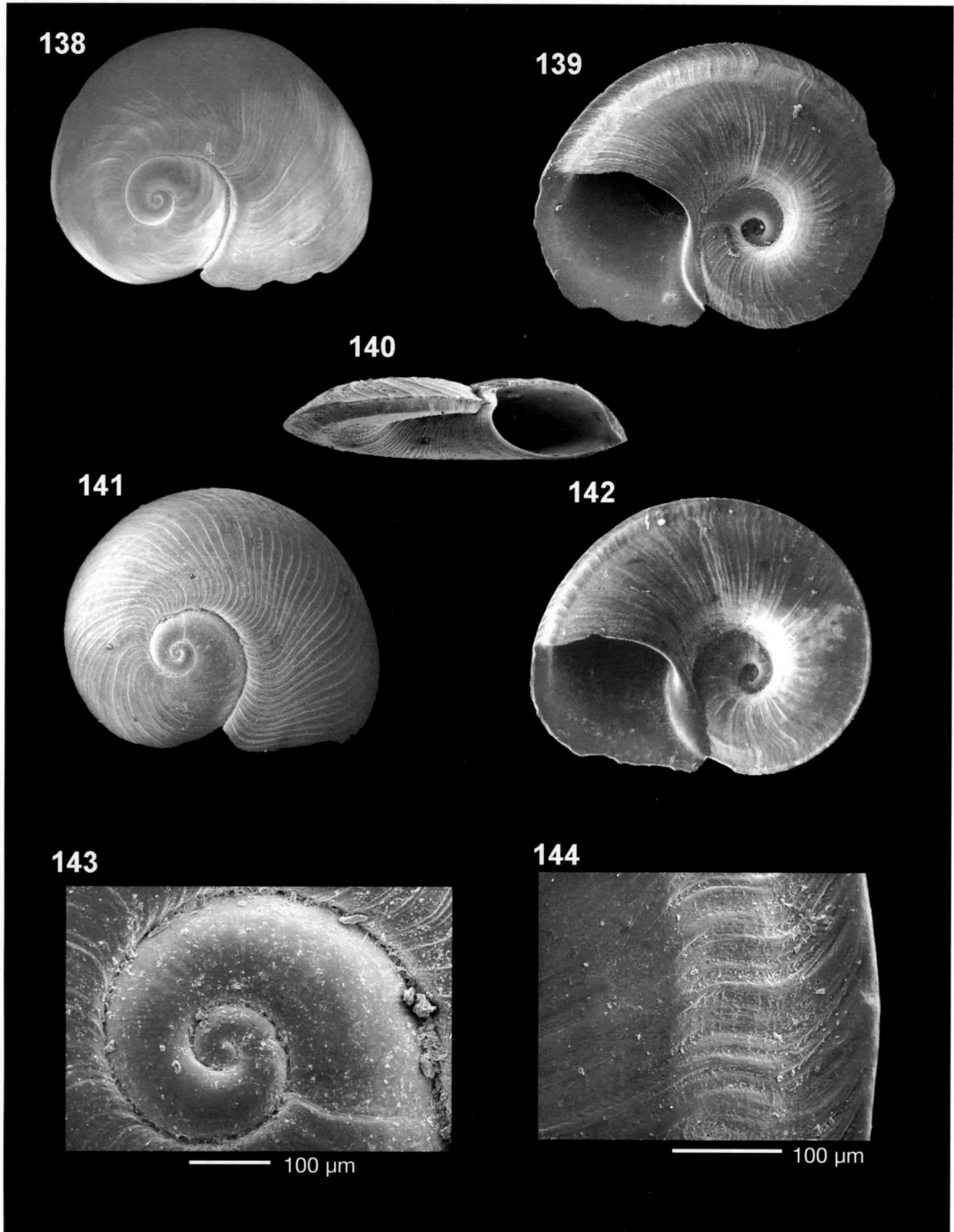
(Figs. 145-150)

Cochliolepis spec. Mienis, 1973. *Argamon*, 4(1): 18.

Discopsis mienisi Aartsen, Carrozza & Menkhurst, 1998. *Boll. Malac.*, 33(9-12): 135-138, figs. 2, 4 and 5.

Type material: Holotype (illustrated in AARTSEN ET AL., 1998) in NNM.

PLATE 22



Figures 138-144. *Discopsis costulatus*. Fig. 138. Shell, 2.3 mm, Banc d'Arguin, Mauritania (CER). Fig. 139. Shell, 1.8 mm, Kololo Beach, Gambia (CFS). Figs. 140-141. Shells, 2.1 and 1.7 mm, Banc d'Arguin, Mauritania (CER). Fig. 142. Shell, 2.2 mm, Ambrizete, Angola (MNHN). Fig. 143. Protoconch, Congo. Fig. 144. Microsculpture, Angola.

Material examined: Israel: 3 s, Haifa Bay, 9 m (CAP); 6 s, Herzliyya (CAP).

Description: Shell (Figs. 145-148) discoid, depressed, almost planispiral, fragile, with very small prominences on a keeled periphery. Protoconch (Figs. 149) of about 1½ smooth whorls, between 410-450 µm diameter, as mentioned in the original description, but we have a shell with a diameter of 470 µm. Teleoconch of about 1½ whorls, increasing rapidly, dorsally with numerous fine oblique axial ribs and two spiral cords, one of them always well-marked; ventrally (Figs. 147-148) the axial ribs are very prominent and sharp, one spiral cord is near the peripheral keel, delimiting a depressed area. Another slight cord, sometimes little evident, is between that one and the umbilicus, which is very wide showing the previous whorls. Aperture oblique, with a sharp edge in the outer lip and a continuous peristome. Under magnification (Fig. 150) can be seen tubercles grouped in bands.

Dimensions: The holotype is 3.0 mm in diameter. In our material, the largest are of that size.

Distribution: Known only from Israel and Turkey (AARTSEN *ET AL.*, 1998).

Remarks: The shell of *D. mienisi* is rather similar to that of *D. costulatus*, but is not so depressed, the dorsum presents two spiral cords, one of them always well-marked and there are another two on the ventral part. The basal axial ribs are very prominent in *D. mienisi* but not in *D. costulatus*. Furthermore, the peripheral border is not regular and has very small prominences in *D. mienisi*.

Discopsis apertus spec. nov. (Plate 24)

(Figs. 151-156, 243-244, 252)

Type material: Holotype (Figs. 151), and 3 paratypes (Figs. 152-153), from the type locality, in MNHN. Other paratypes: 6 s, ORSTOM, dredgings from continental shelf (MNHN).

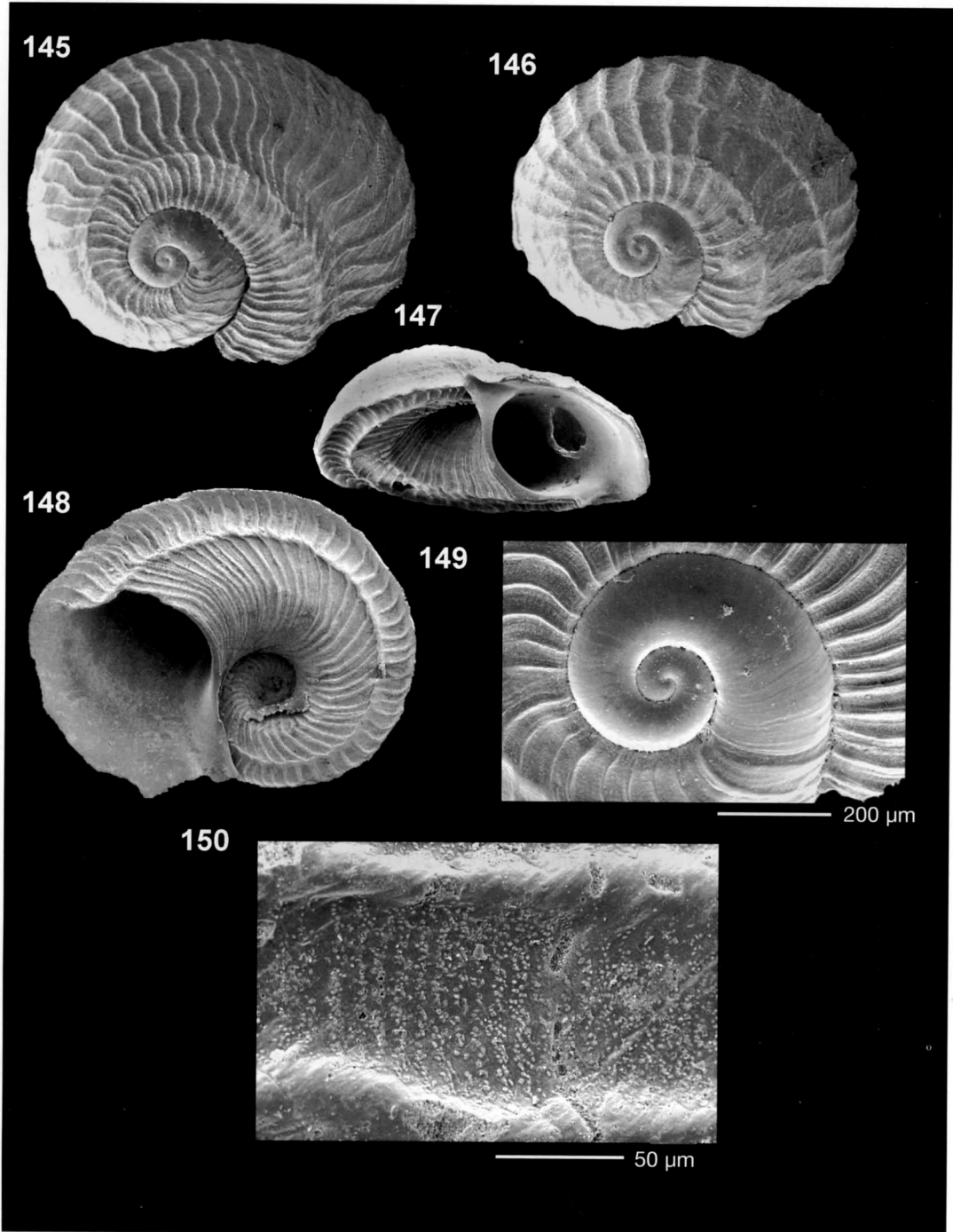
Other material examined: Guinea Conakry: 1 s, W Kaporó, N/O André Nizery SEDIGUI I stn. 273, 9°36'N 13°54'W, 21 m (MNHN); 2 f, W Ile Quito, N/O André Nizery SEDIGUI I stn. 487, 10°00'N 14°17.3'W, 8 m (MNHN). Ivory Coast: 1 sp, 1 s, ORSTOM, Abidjan region, 35-40 m (MNHN). Ghana: 5 j, Miamia, 38-40 m (CER); 1 s, 2 j, Cape Three Points, 35-60 m (CER). Congo: 1 s, Pointe Noire (CPH); 1 s, stn. 954 (MNHN). Angola: 1 j, Bango, Region Ambrizete, 07°20.19'S 12°55.09'E, beach (MNHN); 1 j, 10 Km S Ambrizete, beach (MNHN); 1 s, Cabo Ledo, Luanda, Angola, 40 m (MNHN); 2 s, Cacucaco, Bengo, beach (MNHN); 1 s, Palmeirinhas, 20 m (CER).

Type locality: Radiale Grand Bassam, 5°08.9'N 3°48.6'W, 35 m, Ivory Coast.

Etymology: The specific name alludes to the large aperture.

Description: Shell (Figs. 151-153) rounded, rather depressed, fragile, with a small keel at the periphery. Protoconch (Figs. 154-155) of about 1¼ smooth whorls, of about 460 µm diameter. It continues to the teleoconch with a scarcely evident separation. Teleoconch of about 1½ whorls, with rapid increase. Dorsally, the whorls are evidently convex with very numerous curved, prosocline growth lines; ventrally, very slightly convex, with the same growth lines, which are more evident and form an S-shaped part near the periphery. A spiral depression is close to the peripheral keel. With magnification it is possible to see very small tubercles (Fig. 156) on the uneroded parts. Umbilicus wide, showing the previous whorls. Aperture nearly ovoid a little extended dorsally. Columella curved, nearly vertical, outer lip sharp, with a small notch where the peripheral border ends.

PLATE 23



Figures 145-150. *Discopsis mienisi*. Figs. 145-148. Shells, 1.9, 1.8, 1.9, and 2.2 mm, Haifa, Israel. Fig. 149. Protoconch. Fig. 150. Microsculpture.

Dimensions: Holotype is 3.7 mm in maximum dimension (diameter). The largest shell examined was 5 mm.

Animal: not observed alive. Only one dried animal was found in a shell. Apparently, its morphology is similar to other Rissoidae.

Operculum (Fig. 252) a little ovoid, paucispiral and with a subcentral nucleus.

Radula taenioglossate (Fig. 243-244). Central tooth very wide with its lateral parts expanded, 2 basal sharp denticles, ventral margin wide U-shaped; cutting area with a prominent main cusp and 5-6 smaller denticles at each side. Lateral teeth with a large cusp and 4-6 small sharp denticles at each side. Marginal teeth large and narrow; the inner marginal tooth with 8-10 very small denticles on its outer margin; the marginal outer tooth sickle-like, very narrow and sharpened distally, without apparent denticulation.

Distribution: The species was collected from Guinea Conakry to Angola, excluding the islands of the Gulf of Guinea.

Discussion: *D. apertus* is easily differentiated from the other species of the genus known from West Africa, because it is larger, more rounded, and its basal growth lines have a spiral depression at the periphery. Comparisons with the closest species are as follows:

D. costulatus is more depressed, with smaller aperture, the rate of increase of the shell more rapid, the growth lines less curved, and more evident dorsally.

D. militare is smaller and with a spiral cord in the base near the periphery and sometimes others less evident. The periphery is more rounded.

D. radians is very small, with numerous axial ribs and one basal spiral cord.

D. exmilitare spec. nov. (see below) also has one spiral cord on the dorsum and in the base.

Discopsis irregularis spec. nov. (Plate 25)

(Figs. 157-162)

Type material: Holotype (Fig. 160) and 5 paratypes (Fig. 159), from the type locality, in MNHN. Other paratypes: 1 s, São Nicolau, Moçâmedes, beach (MNHN); 1 s, Praia Santiago, Bengo, low tide (MNHN).

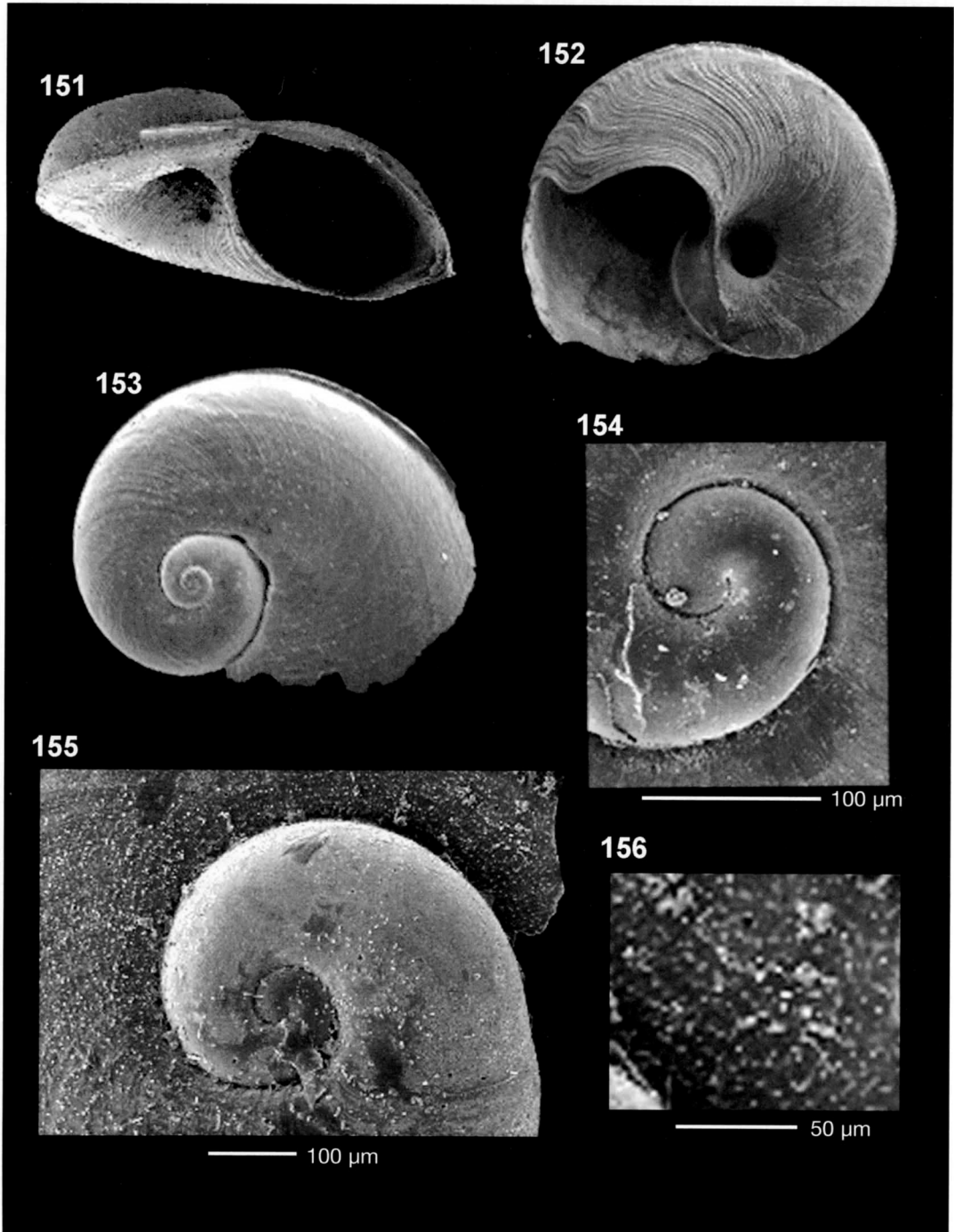
Other material examined: Congo: 3 s (Figs. 157-158), Pointe-Noire (CPH).

Type locality: Barra do Dande, 0-2 m, Bengo, Angola.

Etymology: The specific name alludes to the presence of an irregular peripheral keel, which modifies the profile of the shell.

Description: Shell (Figs. 157-160) rounded, hardly depressed, relatively fragile, whitish, with an irregular prominent keel at the periphery. Protoconch (Fig. 161) of about 1¾ smooth whorls, of about 472 µm diameter; there is a thick rib at the start of the teleoconch. Teleoconch of a little more than one whorl, increasing rapidly; dorsally, slightly convex with a spiral elevation near the suture and about 22 narrow, curved, prosocline axial ribs. At the periphery, the border has an irregular and prominent keel; ventrally nearly concave, with numerous growth lines (Fig. 162) and one spiral depression near the outer border and a slight cord only observable in the first half of the last whorl. Umbilicus wide, with the previous whorls visible. Aperture ovoid depressed, with a sharp outer lip.

PLATE 24



Figures 151-156. *Discopsis apertus* spec. nov. Fig. 151. Holotype, 3.7 mm, Grand Bassam, Abidjan, Ivory Coast (MNHN). Figs. 152-153. Paratypes, 3.4 and 3.8 mm, Grand Bassam, Abidjan, Ivory Coast (MNHN). Fig. 154. Protoconch, Miamia, Ghana. Fig. 155. Detail of the protoconch. Fig. 156. Detail of the microsculpture.

Dimensions: Holotype is 2.0 mm maximum dimension (diameter).

Distribution: Known only from Congo and Angola.

Discussion: *D. similis* spec. nov. (see below) appears similar, but this latter species has more numerous axial ribs, separated more irregularly, two spiral ribs on the base which are more evident, several dorsal cords, and a more defined tuberculated microsculpture; furthermore, the protoconch is smaller in diameter.

Another species of this group is *D. nodulosus* spec. nov. (see below), but its dorsal sculpture is very different, formed by nodules.

Discopsis similis spec. nov. (Plate 26)

(Figs. 163-166)

Type material: Holotype (Figs. 163-164) in MNHN (ex CER). Paratype: CER (1) from Miamia, Ghana.

Other material examined: Guinea Conakry: 1 s, N/O André Nizery (SEDIGUI I), 09°13.3 W 13°37'W, 16 m (MNHN).

Type locality: Off Luanda, Angola, dredged at 60 m.

Etymology: The name alludes to the apparent similarity with the previously described species.

Description: Shell (Figs. 163-164) rounded irregularly, depressed, relatively solid, whitish, the outer border sharp and with an irregular profile. Protoconch (Fig. 165) of 1¼ smooth whorls, and about 380 µm diameter; there is a thick rib at the start of the teleoconch. Teleoconch of about one whorl or a little more, increasing rapidly, dorsally with 1-2 cords at the beginning which increase to 4-5 at the end; they are not prominent and in the last whorl are crossed by about 51 curved prosocline and irregularly disposed axial ribs; ventrally slightly concave, umbilicus amply open, making the previous whorls visible. Two spiral cords are present, one near the peripheral border and the other a little below, but far from the umbilicus. There are also numerous very variable axial ribs. With magnification very small irregularly disposed tubercles can be seen between the axial ribs (Fig. 166). Aperture ovoid, outer lip sharp.

Dimensions: Holotype is 1.6 mm, in maximum dimension (diameter).

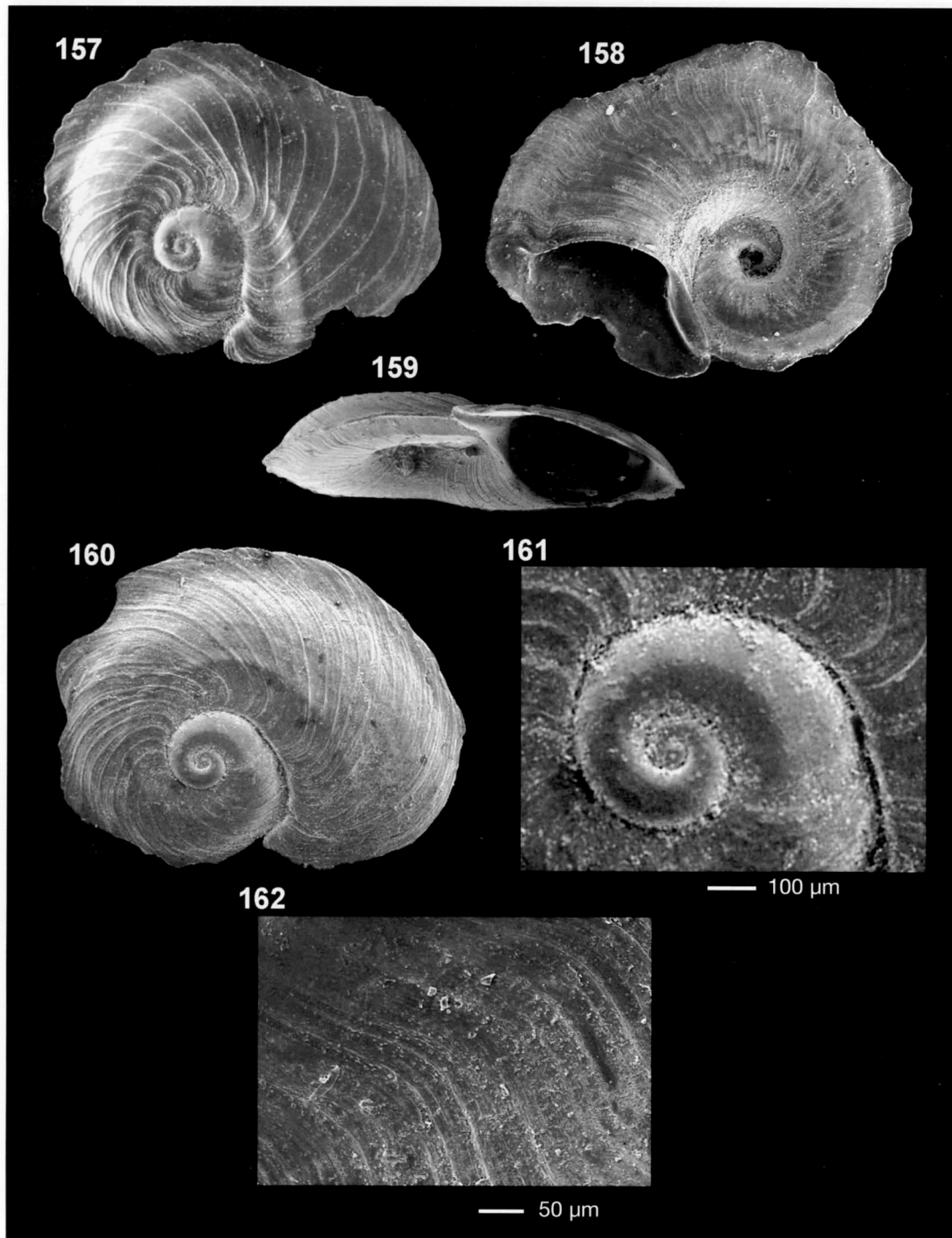
Distribution: Known only from Guinea Conakry, Ghana and Angola.

Discussion: The characters of this species are very different from most of the others of the area of study. The most similar with an irregular peripheral keel are the following:

D. irregularis spec. nov. has a similar shape but has numerous differences (see above) in the axial and spiral sculpture, microsculpture and size of the protoconch. Because of these numerous differences we have described this species in spite of the scarce material available.

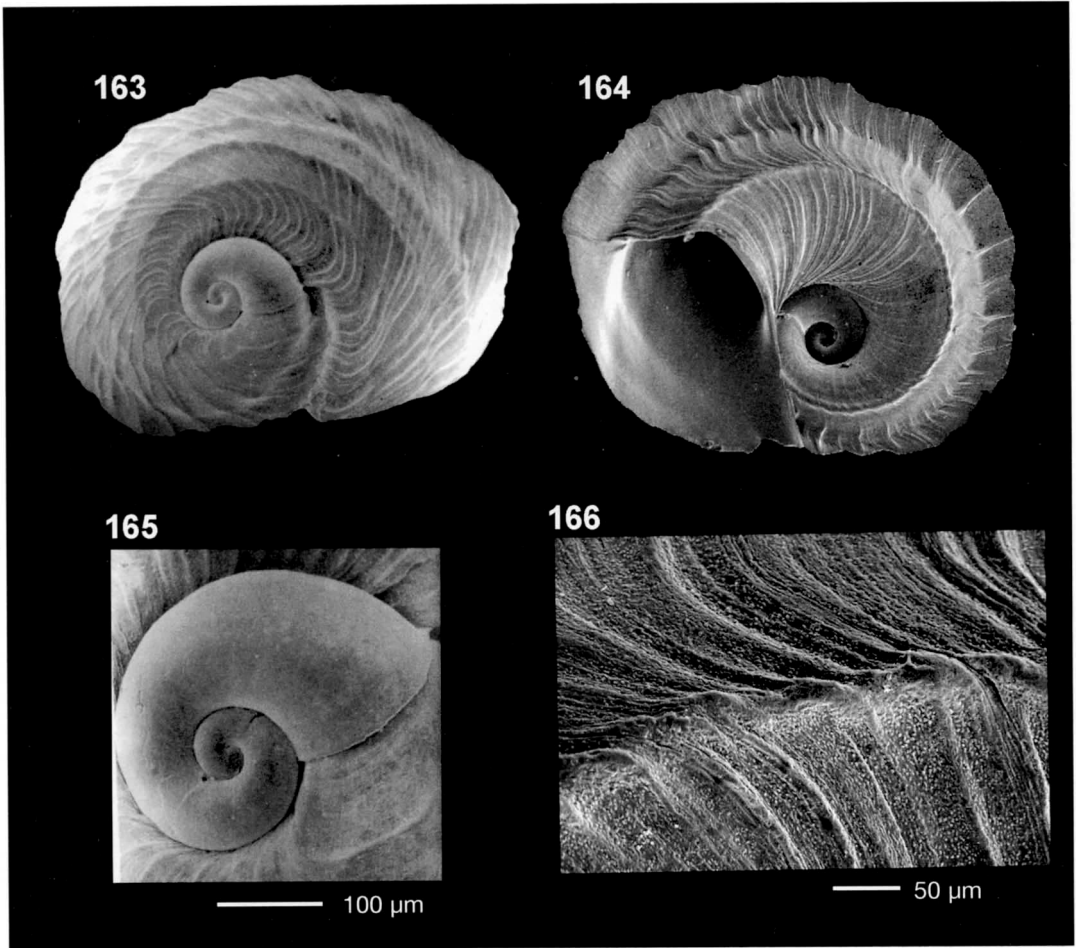
D. nodulosus spec. nov. (see below) is dorsally strongly nodulous, and the microsculpture has fewer tubercles.

PLATE 25



Figures 157-162. *Discopsis irregularis* spec. nov. Figs. 157-158. Shell, 2.2 mm, Pointe Noire, Congo (CPH). Fig. 159. Paratype 2.0 mm, Barra do Dande, Angola (MNHN). Fig. 160. Holotype, 2.0 mm, Barra do Dande, Angola (MNHN). Fig. 161. Protoconch of the holotype. Fig. 162. Microsculpture.

PLATE 26



Figures 163-166. *Discopsis similis* spec. nov. Figs. 163-164. Holotype, 1.6 mm, Luanda, Angola (MNHN). Fig. 165. Protoconch, Angola. Fig. 166. Microsculpture, Angola.

Discopsis nodulosus spec. nov. (Plate 27)
(Figs. 167-170)

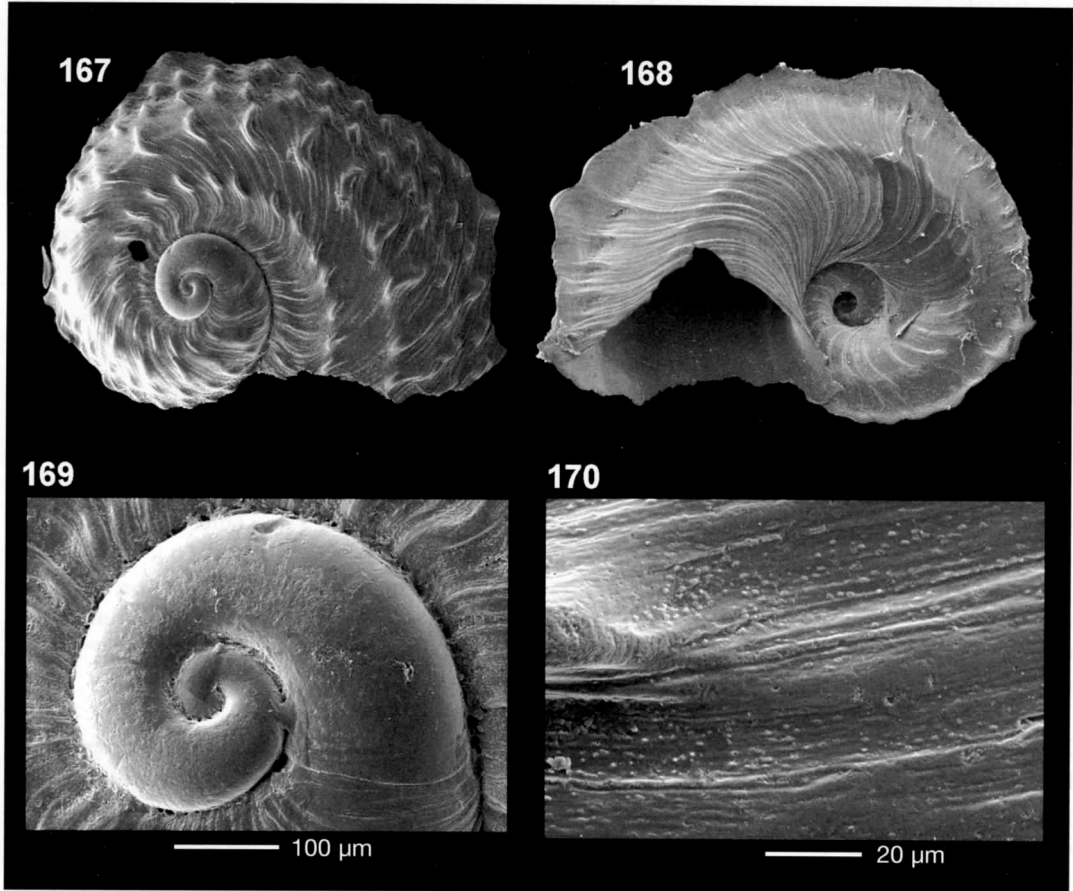
Type material: Holotype (Figs. 167-168) in MNHN (exCPH).

Type locality: Pointe Noire, Congo.

Etymology: The specific name alludes to the strong nodules on the dorsum of the shell.

Description: Shell (Figs. 167-168) rounded, depressed, relatively solid, with an irregular pronounced keel at the periphery. Protoconch (Fig. 169) of about $1\frac{3}{4}$ smooth whorls, of about 409 µm diameter. Teleoconch of about $1\frac{1}{4}$ whorls, increasing rather rapidly; dorsally, slightly convex with 5 spiral rows

PLATE 27



Figures 167-170. *Discopsis nodulosus* spec. nov. Figs. 167-168. Holotype, 2.0 mm, Pointe Noire, Congo (MNHN). Fig. 169. Protoconch of the holotype. Fig. 170. Microsculpture.

of nodules; in the row closest to the suture, the nodules are very small and difficult to see at the beginning of the teleoconch; in the following row, the nodules are small and about 21; in the next one, there are about 17 nodules and they are larger, in the two more peripheral rows, they become smaller again. Ventrally, the teleoconch is slightly convex, also with a spiral angulation at the middle, and a wide umbilicus showing the previous whorls. At the periphery a lamellose keel is irregularly broken in many places. Under magnification can be seen numerous growth lines with sparse small tubercles (Fig. 170). Aperture near rectangular, columella vertical, outer lip sharp and extended dorsally.

Dimensions: Holotype is 2.0 mm maximum dimension (diameter).

Distribution: Known only from Congo.

Discussion: This species must be differentiated from *D. irregularis* which has similar shape and

irregular peripheral keel, but the dorsal sculpture is formed by one cord without nodules, and the axial curved ribs are evident and regular; furthermore, the basal cord is closer to the periphery and the protoconch is smaller in diameter. It can be differentiated from *D. similis*, because this latter species has several, dorsal spiral cords without nodules and denser microsculpture.

Discopsis militare (Jousseume, 1872) (Plate 28)

(Figs. 171-175)

Cyclostrema militare Jousseume, 1872. *Rev. et Mag. Zool.* (2) 23: 394, pl. 19, fig. 6. [Type locality: Principe I., Guinean Gulf.]

Cyclostrema militaris Jousseume: TRYON, 1888: 90.

Cyclostrema militare Jousseume: MARCHE-MARCHAD, 1958: 15.

Cochliolepis militare (Jousseume): ADAM & KNUDSEN, 1969: 62-63.

Cochliopsis sp.: BERNARD, 1984, pl. 72, figs. 3.

Type material: Not examined.

Other material examined: Senegal: 3 s, Ngazobil (MNHN). Ghana: 2 s, Cape Three Points, 35-60 m (CER). Congo: 5 s, Pointe Noire T2 (CPH); 7 s, Pointe Noire (CPH). Angola: 20 s, 50 j, 10 Kms S of Ambrizete, prov. Zaire, litoral (MNHN); 5 j, Barra do Dande, Bengo, subtidal (MNHN); 1 s, Corimba, 0-1 m (MNHN); 73 s, 4 j, Corimba, Luanda, 10-20 m (MNHN); 88 s, 57 j, Bango, Ambrizete, 07°20.19'S 12°55.09'E, in beach (MNHN); 11 s, 32 j, Faro, Ambrizete region, 07°17.49S 12°53.05E (MNHN); 6 s, Luanda, 80-100 m (CER).

Description: Shell (Figs. 171-173) rounded, depressed, fragile, whitish, with a rounded peripheral border. Protoconch (Fig. 174) of a little more than 2 whorls, smooth, increasing rapidly, of about 590 µm diameter. As the start of the teleoconch is not well defined, this size could be erroneous. Teleoconch of about 1½ whorls, dorsally convex, with a few prosocline threads in evidence. With magnification can be seen growth lines and very small spiral lines of tubercles between them (Fig. 175); ventrally there is the same microsculpture and a well-evident spiral cord closer to the peripheral border. Umbilicus wide, showing the previous whorls. Aperture ovoid, outer lip sharp and extended dorsally.

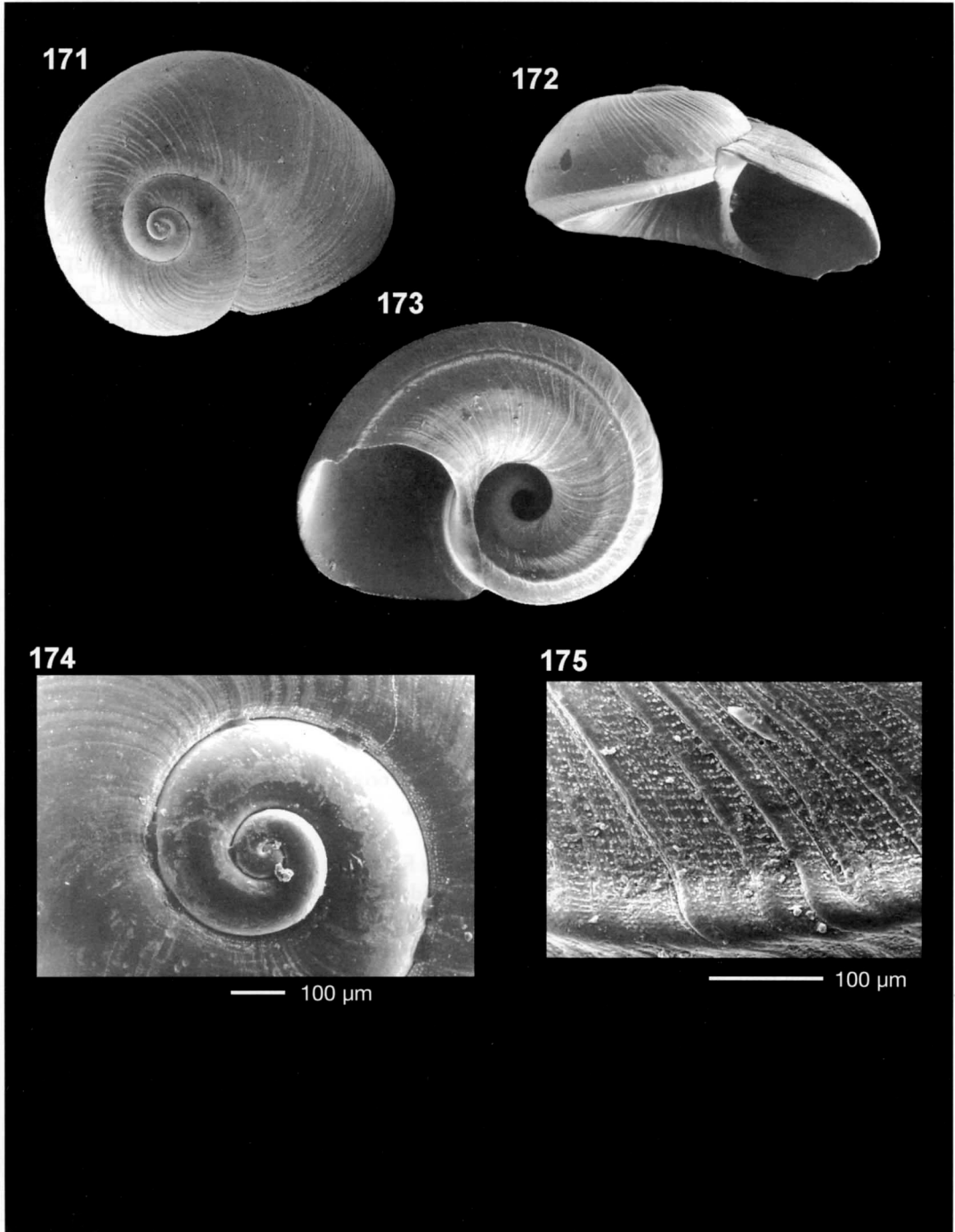
Dimensions: Holotype is 2.7 mm in diameter.

Distribution: ADAM & KNUDSEN (1969) refers to Senegal and Principe Islands as its range. We enlarge it to Ghana, Congo and Angola.

Remarks: The species is illustrated in TRYON (1888, pl. 31, figs. 43-45), and it is perfectly concordant with the shells we have illustrated here. It has some resemblance to *Tornus europaeus* (De Stafani) from the Pliocene of Astigiano (see FERRERO & MARLINO, 1992)

ADAM & KNUDSEN (1969) mention the similarity of this species with *D. costulatus*. The differences with this species are the following: *D. costulatus* is larger, more depressed, the spiral cord at the base is closer to the periphery and the axial ribs and microsculpture less evident. *D. radians* is smaller and its axial sculpture stronger. The differences with *D. exmilitare* spec. nov. are explained in detail in the discussion of that species (see below).

PLATE 28



Figures 171-175. *Discopsis militare*. Figs. 171-173. Shells, 2.5, 2.7 and 3.0 mm, Pointe Noire, Congo (CPH). Fig. 174. Protoconch, Congo. Fig. 175. Microsculpture, Congo.

Discopsis radians (Rubio & Rolán, 1990) (Plate 29)

(Figs. 176-183)

Cochliolepis radians Rolán & Rubio, 1990. *Iberus*, 9(1-2): 183-184, pl. 2, figs. 1.4. [Type locality: Praia Emilia, São Tomé].

Type material: Holotype illustrated in ROLÁN & RUBIO (1990, figs. 1-3) in MNCN (15.05/1114. Paratypes in CER, CFR and CFF.

Other material examined: Sahara: 1 s, Dakhla, 50-60 m (CFR). Senegal: 1 s, Cap Vert, 15 m, Dakar (CER); 1 s, La Tacoma, 15 m (CJP). Guinea Conakry: 3 s, W of Tannah, N/O André Nizery, SEDIGUI I, stn. 80, 9°12.3'N 13°37'W, 16 m (MNHN); 1 j, W of Tannah, N/O André Nizery, SEDIGUI I, stn. 81, 9°12'N 13°40.5'W, 20 m (MNHN). Ghana: 1 s, Cape Three Point, 45-60 m (CER). São Tomé and Príncipe: 1 s, Praia Emilia, intertidal (CER). Congo: Pointe-Noire, Plage Mondaine, low tide (MNHN). Angola: 2 s, Corimbo Bay, 10-20 m, Luanda (MNHN); 1 s, Luanda (CAP); 1 s, 1 j, Barra do Dande, Bengo, 0-2 m (MNHN); 2 s, Cacucaco, Luanda, 10-20 m (MNHN); 2 s, São Nicolau, Moçamedes, intertidal (MNHN).

Description: Shell (Figs. 176-181) rounded depressed, relatively solid, dorsally convex and ventrally concave, without prominences on the outer periphery. Protoconch (Fig. 182) of near 1³/₄ whorls, smooth, and of about 352 µm diameter. Teleoconch of a little more than one whorl, increasing rapidly, dorsally with regular oblique, close ribs, about 55 in the last whorl, wider than the interspaces; ventrally with the same axial undulating ribs and a peripheral angulation and a spiral cord below its margin. Under magnification numerous small tubercles can be seen between the axial ribs (Fig. 183). Umbilicus deep but not wide. Aperture depressed, rectangular nearly rounded in the outer border, outer lip sharp.

Dimensions: Holotype is 0.9 mm maximum dimension (diameter). Most of the shells examined are hardly larger than 1 mm.

Distribution: Archipelago of São Tomé and Príncipe in the original description work. We enlarge its range up to Sahara in the north and to Angola in the south.

Remarks: This species can have some similarity with the following:

D. militare, which is larger, the axial ribs less evident, the microtubercles are disposed in rows and not irregularly.

D. exmilitare spec. nov., (see below) which is larger, the axial sculpture is reduced towards the periphery, a dorsal cord, and the protoconch has a thick rib near the contact with the teleoconch.

Discopsis exmilitare spec. nov. (Plate 30)

(Figs. 184-188)

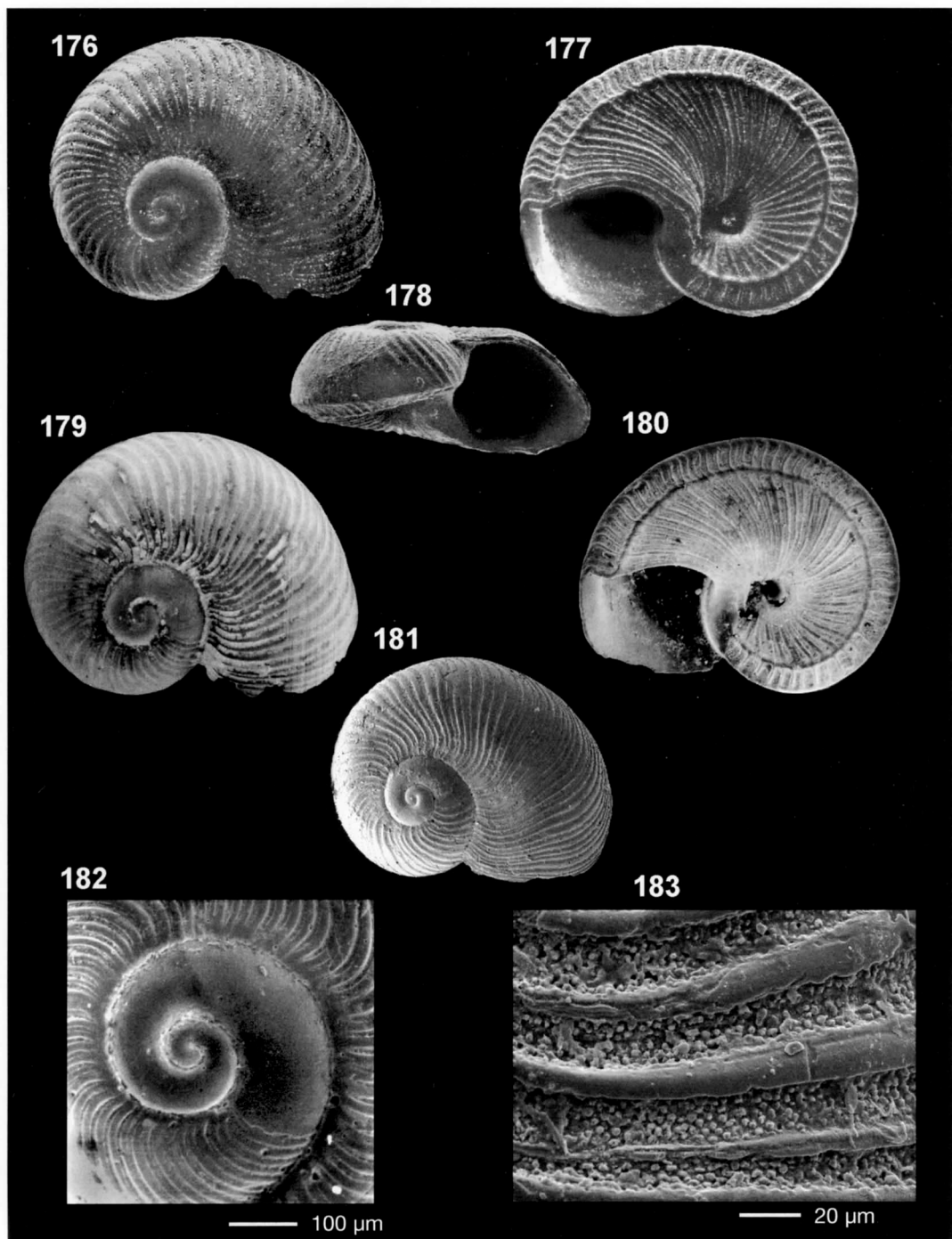
Cochliopsis costolatus (sic!): BERNARD, 1984, pl. 73, figs. 1.

Type material: Holotype (Fig. 184) in MNHN. Paratypes: CPH (5) from the type locality.

Other material examined: Ghana: 3 s, Miamia, 38-40 m (CER); 3 s, Cape Three Points, 45-60 m. Angola: 1 s, Barra do Dande, Bengo prov., 0-2 m (MNHN); 1 s, Cacucaco, Bengo, beach (MNHN).

Type locality: Pointe Noire, Congo.

PLATE 29



Figures 176-183. *Discopsis radians*. Figs. 176-181. Shells, 1.1, 1.2, 1.0, 1.0, 1.1 and 1.1 mm, Lagoa Azul, São Tomé (CER). Fig. 182. Protoconch, São Tomé. Fig. 183. Microsculpture, São Tomé.

Etymology: This species was confused at the beginning of this work with *D. militare*. Later, it was named "*exmilitare*" alluding to a difference from that taxon.

Description: Shell (Figs. 184-186) rounded depressed, fragile, whitish, with a smooth peripheral angulation. Protoconch (Fig. 187) of about 1³/₄ smooth whorls, and about 386 µm diameter; near the end of the protoconch, a thicker rib appears. Teleoconch of about 1¹/₄ whorls, well separated due to the beginning of prosocline axial ribs which are curved and a little irregular in the interspaces. Dorsally, the axial ribs sometimes disappear near the periphery. In larger shells, the sculpture is usually smaller. A spiral cord is very evident on the dorsal surface except in the first half whorl, where it is scarcely visible. Under magnification, small irregularly spaced tubercles can be seen in the interspaces between the ribs (Fig. 188). Ventrally, the ribs are well marked and a spiral cord appears closer to the peripheral border. Umbilicus wide showing the previous whorls. Aperture rounded, outer lip sharp and somewhat extended dorsally.

Dimensions: Holotype is 1.6 mm in diameter. Some shells examined can reach 2 mm.

Distribution: Known from Ghana to Angola.

Discussion: The most similar species are *D. radians* and *D. militare*.

D. radians is smaller, the protoconch more convex, the number of axial ribs is lower, and they are more regular, wider and more undulating. Instead, in the largest shells of *D. exmilitare* spec. nov., these ribs nearly disappear on the periphery or in the entire surface, while in *D. radians*, they are always well defined; also, in *D. exmilitare* there is a prominent spiral nodulous cord on the dorsal surface of the teleoconch, never present in *D. radians*. In the microsculpture, *D. exmilitare* has fewer tubercles in the interspaces between the ribs. Finally, the protoconch of *D. exmilitare* has an enlargement near its end, which is not present in *D. radians*.

D. militare is larger in diameter, the axial ribs uniform and more attenuated, on the base there is a second less evident spiral cord, and the protoconch is larger and no thickening is present at the start of the teleoconch.

Discopsis reductus (Rolán & Rubio, 1990) (Plate 31)

(Figs. 189-192)

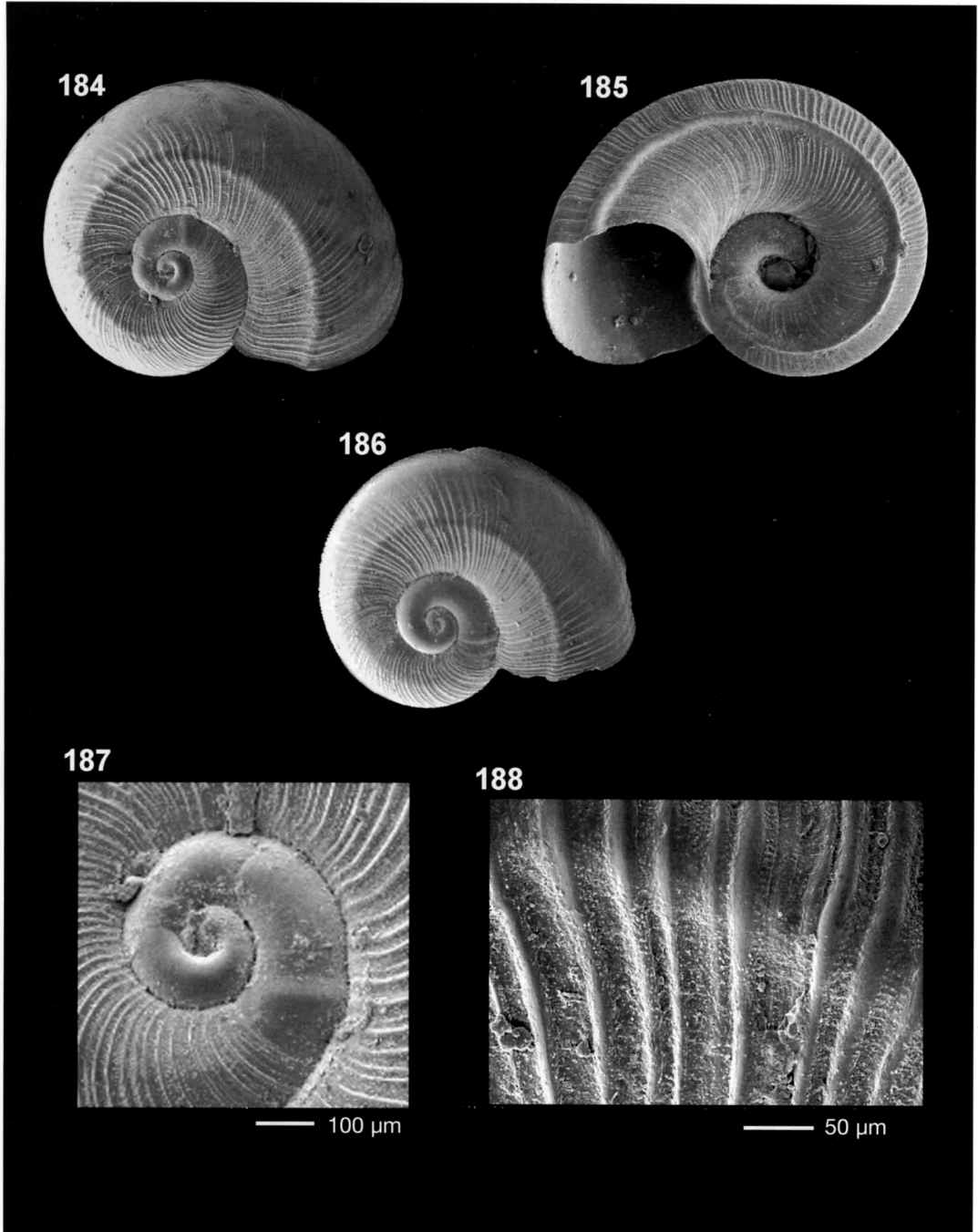
Cochliolepis reductus Rolán & Rubio, 1990. *Iberus*, 9(1-2): 183, pl. 2, figs. 5-7. [Type locality: Baía de Santo Antonio, Príncipe].

Type material: Holotype (illustrated in ROLÁN & RUBIO, 1990, figs. 5-6) in MNCN. Paratypes in MNHN, AMNH, CFF, CFR and CER.

Other material examined: Gambia: 3 j, Kololi Beach (CFS). Ghana: 1 s, Cape Three Points, 35-47 m (CER); 7 j, Miamia, 8-25 m (CAP). São Tomé e Príncipe: about 140 s, Santo Antonio, Príncipe (CER). Congo: 2 s, Pointe Noire, (CPH).

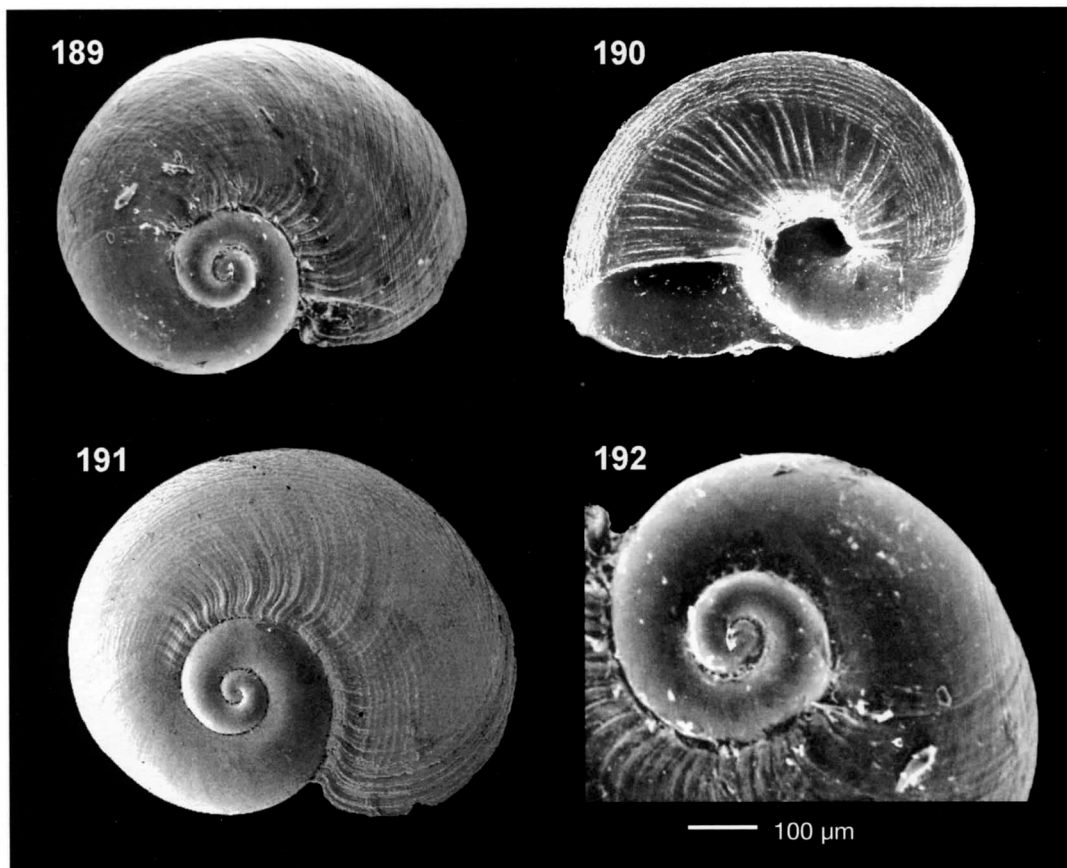
Description: Shell (Figs. 189-191) rounded depressed, small for the genus, fragile, whitish and with a smooth rounded periphery. Protoconch (Fig. 192) of about 2 smooth whorls, and about 502 µm diameter. Teleoconch of about 1/2 - 3/4 whorls increasing rapidly, dorsally with growth lines crossed by fine scarcely visible striae; ventrally, with about 9-10 striae on its outer part, only a few near the

PLATE 30



Figures 184-188. *Discopsis exmilitare* spec. nov. Fig. 184. Holotype, 1.6 mm, Pointe Noire, Congo (MNHN). Figs. 185-186. Paratypes, 1.3 mm and 1.2 mm, Pointe Noire, Congo (CPH). Fig. 187. Protoconch of the holotype. Fig. 188. Microsculpture.

PLATE 31



Figures 189-192. *Discopsis reductus*. Figs. 189-190. Shells, 0.9 and 1.0 mm, Santo Antonio, Principe (CER). Fig. 191. Shell, 2.0 mm, Cape Three Points, Ghana. Fig. 192. Protoconch, Principe.

umbilicus and irregular axial folds in the interspaces between these two areas. Umbilicus deep, but not wide. Aperture nearly ovoid with a sharp outer lip.

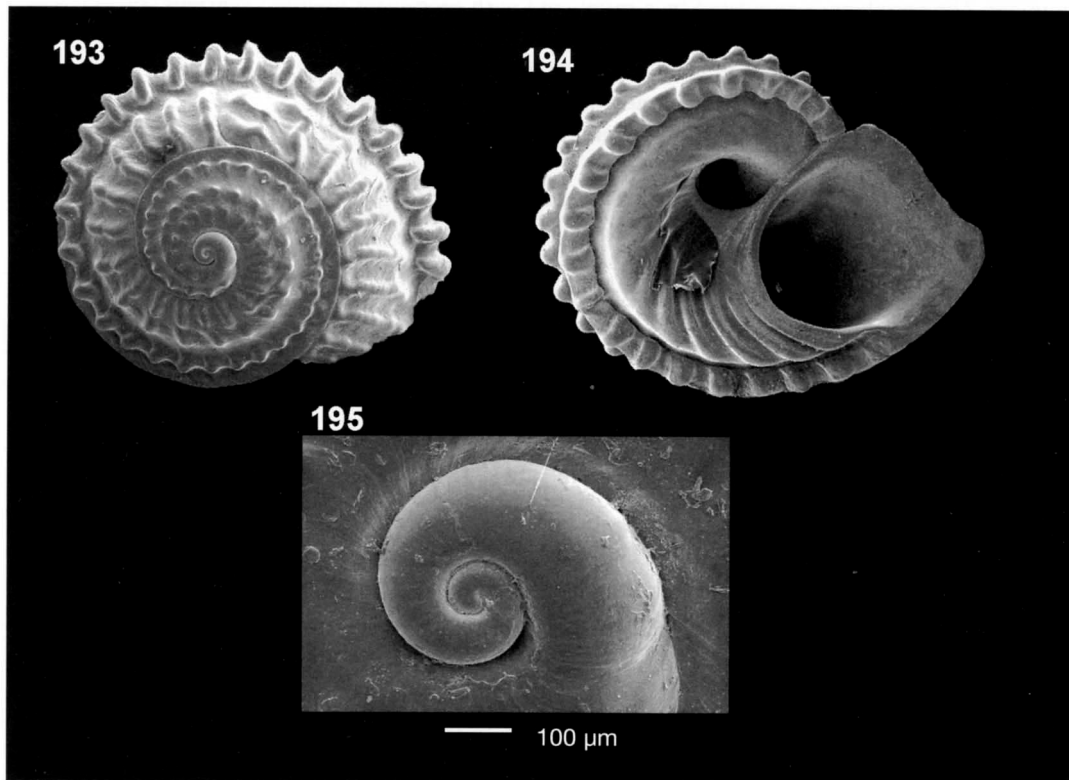
Dimensions: Holotype is 0.9 mm in maximum dimension (diameter), the largest shells are about 1.2 mm.

Distribution: Known from Ghana, Archipelago of São Tomé and Príncipe, and Congo.

Remarks: At first impression, the profile and size make this species similar to *D. radians*, but the latter has more evident axial sculpture, mainly on the dorsum, and ventrally a spiral rib near the periphery.

D. militare and *D. exmilitare* spec. nov. are very large in comparison with this species, besides both having a spiral cord on the base.

PLATE 32



Figures 193-195. *Discopsis dautzenbergi*. Figs. 193-194. Shells, 4.2 and 4.4 mm, Pointe Noire, Congo (CPH). Fig. 195. Protoconch, Congo.

Discopsis dautzenbergi Adam & Knudsen, 1969 (Plate 32)
(Figs. 193-195)

Cochliolepis dautzenbergi Adam & Knudsen, 1969. *Bull. Insti. r. Sci. nat. Belg.*, 44: 59-61, fig. 34. [Type locality: West of Banc de Crawford, Iles de Los].

Type material: Holotype illustrated in ADAM & KNUDSEN (1969, fig. 34).

Other material examined: Ghana: 1 s, Miamia, 30 m. Congo: 5 s, Pointe Noire (CPH); 1 s, Pointe Noire, Mondaine beach (MNHN). Angola: 1 s, Pambala, Bengo province, 0-2 m (MNHN); 1 s, Pointe de Mussulo, Luanda, beach (MNHN); 1 s, Luanda, 10 m (CCS).

Description: Shell (Figs. 193-194) rounded, discoid, hardly depressed, solid, whitish a little transparent, with prominences on the peripheral border. Protoconch (Fig. 195) of about $1\frac{3}{4}$ smooth

whorls, of about 465 μm diameter. Teleoconch of about $1\frac{1}{2}$ whorls, increasing rapidly, dorsally with three nodulous spiral cords. On the last whorl, the nodules change to strong ribs, about 20-24 in number. The periphery is angulated by a spiral cord with prominent nodules; ventrally, there is also a wide spiral cord with nodules on the outer part, mid-whorl oblique axial ribs more evident at the end of the spire. Umbilicus wide and deep. Aperture oblique, with a sharp outer lip which is extended dorsally where in contact with the previous whorl and in the periphery.

Dimensions: The holotype is 3.0 mm in maximum dimension (diameter).

Distribution: In the original description, it was known only from Guinea Conakry. In the present work we enlarge its range to Ghana, Congo and Angola.

Remarks: This species is very solid and strongly sculptured in comparison with those previously mentioned. Its morphological sculpture is very characteristic and no confusion is possible with any others within this genus in West Africa.

Discopsis ferreirorum spec. nov. (Plate 33)

(Figs. 196-200)

Type material: Holotype (Figs. 196-197) in MNCN (n° 15.05/46480). Paratypes: MNHN (1, Fig. 198), CER (1, Fig. 199), CFR (1), all from type locality.

Other material examined: 1 j, Miamia, (CER).

Type locality: Miamia, Ghana, 38 m.

Etymology: The specific name is dedicated to the brothers Agustín and Antón Ferreira Lorenzo, from A Guarda, Pontevedra, for their excellent work with the Asociación Naturalista do Baixo Miño, ANABAM, in the protection of the wildlife of this area.

Description: Shell (Figs. 196-199) conical depressed, solid, whitish, with an irregular pronounced keel at the periphery. Protoconch (Figs. 200) of about $1\frac{1}{4}$ smooth whorls, about 352 μm diameter. Teleoconch of about $1\frac{1}{2}$ whorls, increasing not rapidly; dorsally slightly convex with about 70 regular, curved, prosocline ribs, wider than the interspaces; ventrally, slightly convex, also with the same ribs and a depressed part near the periphery. Umbilicus wide, showing the previous whorls. Aperture near rectangular, columella vertical, outer lip sharp and extended dorsally.

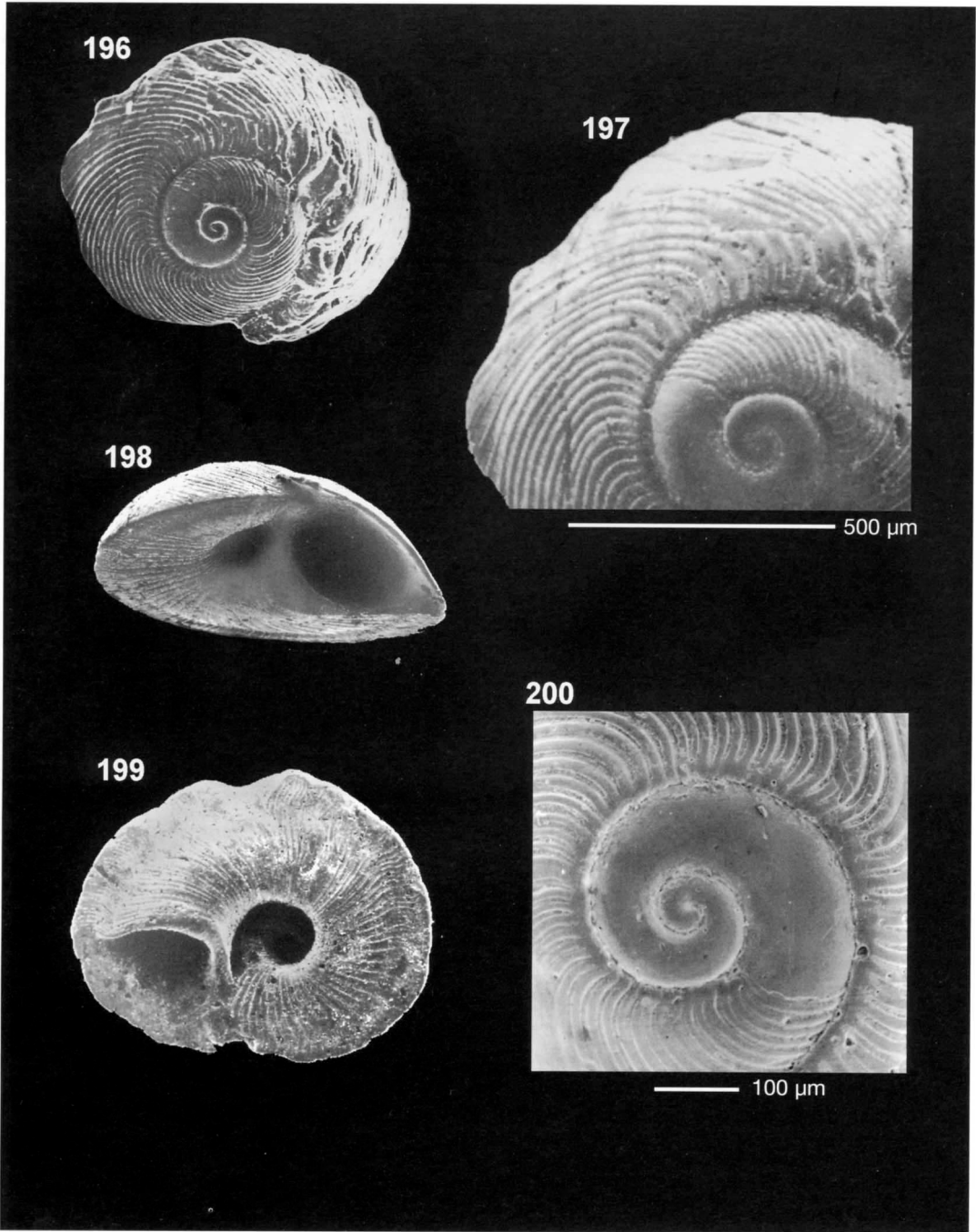
Dimensions: The holotype is 1.5 mm maximum dimension (diameter).

Distribution: Known only from Ghana.

Discussion: This species is more solid than other congeners in West Africa. *D. irregularis* spec. nov., *D. similis* spec. nov. and *D. nodulosus* spec. nov. have a similar profile, but they are more fragile, the peripheral keels are thinner and more irregular. Also, *D. ferreirorum* has no basal spiral cord, present in the other species.

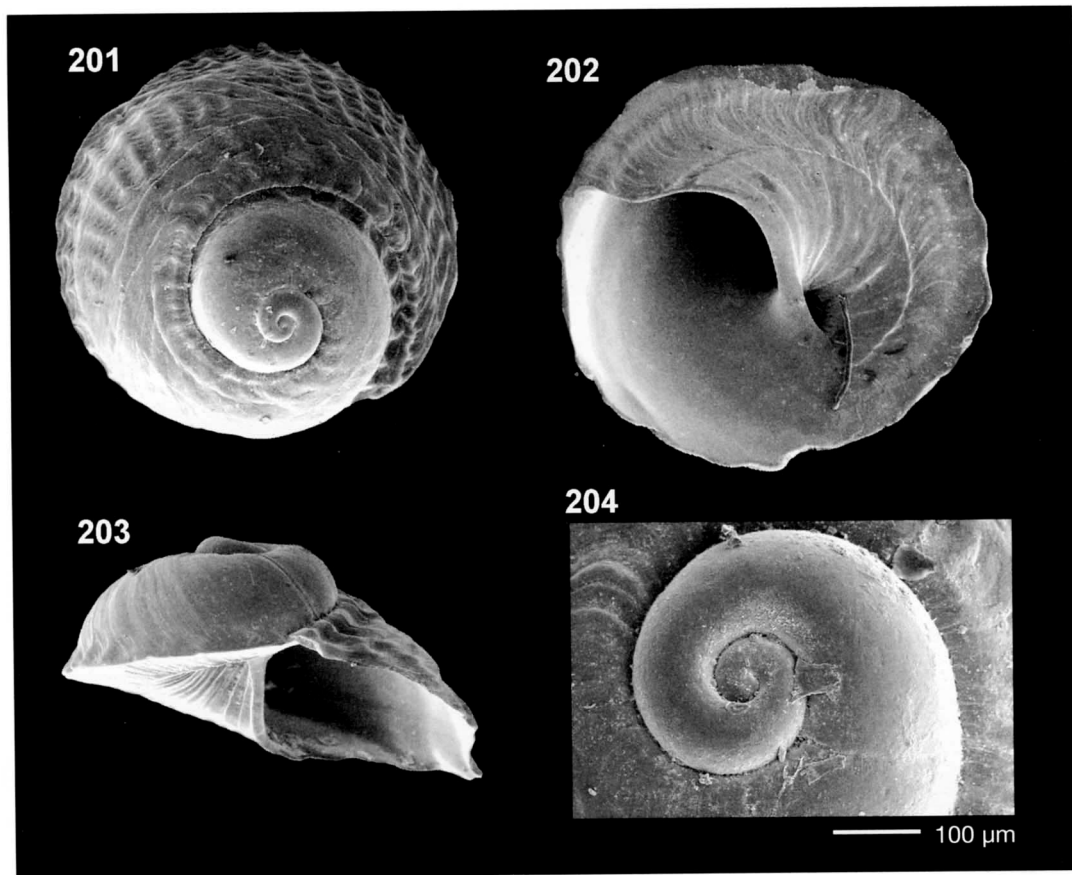
D. jullieni is more conical and the axial sculpture is wider and orthocline.

PLATE 33



Figures 196-200. *Discopsis ferreirorum* spec. nov. Figs. 196-197. Holotype, 1.5 mm, Miamia, Ghana (MNCN). Fig. 198. Paratype, 1.6 mm, Miamia, Ghana (MNHN). Fig. 199. Paratype, 0.9 mm, Miamia, Ghana (CER). Fig. 200. Protoconch of the holotype.

PLATE 34



Figures 201-204. *Discopsis jullieni*. Figs. 201-203. Shells, 1.8, 1.3 and 1.0 mm, Ambrizete, Angola (MNHN). Fig. 204. Protoconch, Angola.

Discopsis jullieni (Adam & Knudsen, 1969) (Plate 34)

(Figs. 201-204)

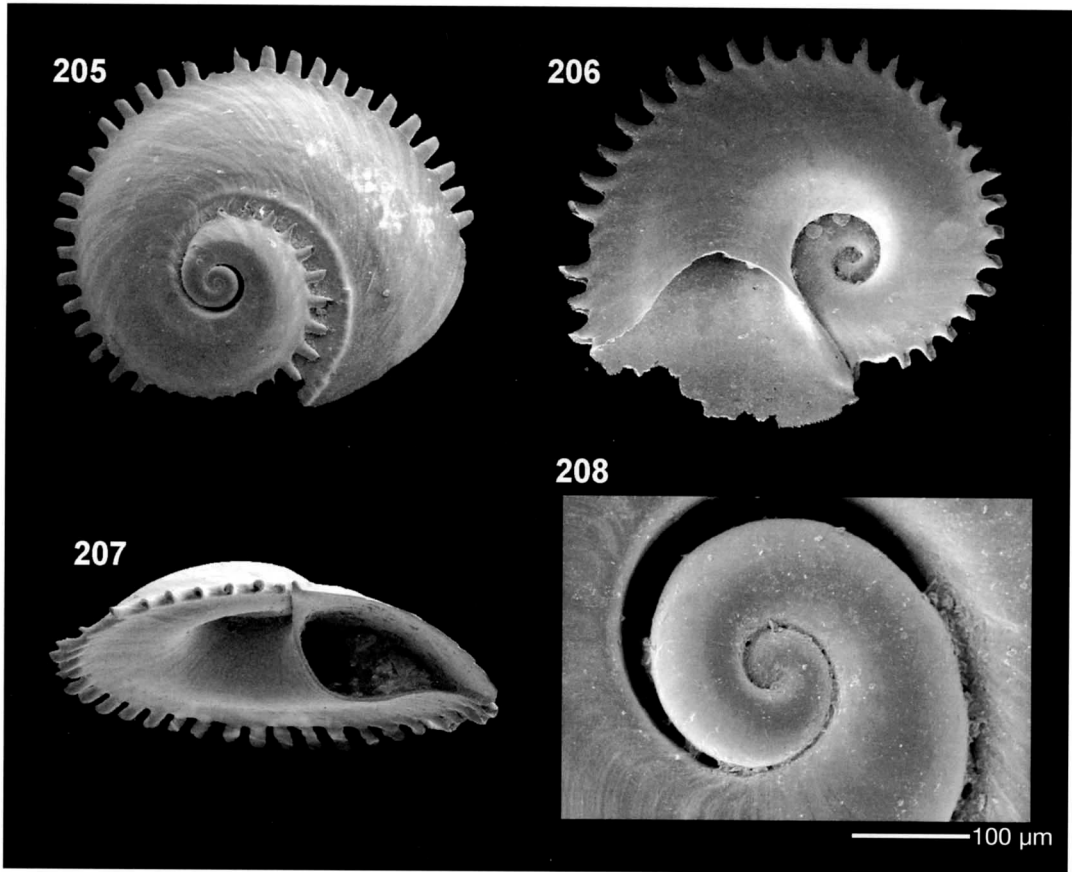
Cochliolepis jullieni Adam & Knudsen, 1969. *Bull. Insti. r. Sci. nat. Belg.*, 44: 61-62, fig. fig. 35). [Type locality: Port Taou, Ivory Coast].

Type material: Illustrated in ADAM & KNUDSEN (1969, fig. 35). Not examined.

Other material examined: Ghana: 4 s, 1 f, Miamia, 38-40 m (CER); 2 s, Cape Three Points, 35-65 m. Congo: 5 s, Point Noire (CPH). Angola: 4 s, Bengo, Ambrizete region, 07°20.19'S 12°55.09E, beach deposits (MNHN).

Description: Shell (Figs. 201-203) conical depressed, transparent, relatively fragile, with an irregular peripheral keel. Protoconch (Fig. 204) of about 1 $\frac{3}{4}$ whorls, smooth, and about 417 μ m diameter.

PLATE 35



Figures 205-208. *Discopsis gruveli*. Fig. 205-207. Shells, 2.5, 2.6 and 2.3 mm, Miamia, Ghana (CER). Fig. 208. Protoconch, Ghana.

Teleoconch of about $1\frac{1}{2}$ - 2 whorls, increasing rapidly, dorsally with numerous irregularly disposed axial ribs, crossed by one or several grooves, one of them subsutural; sometimes, this sculpture appears very attenuated; ventrally, it is a little concave and there is a peripheral cord and another closer to the umbilicus, as well as numerous fine axial undulating ribs. Umbilicus deep but not very wide, partially closed by the columella. Aperture obliquely rectangular, with an outer lip sharp and extended dorsally.

Dimensions: The holotype is 2.00 mm maximum dimension (diameter).

Distribution: Ivory Coast in the original description (ADAM & KNUDSEN, 1969). We enlarge its range greatly to Ghana, Congo and Angola.

Remarks: The conical shape and the relatively small umbilicus differentiate this species from others of the genus in the area of study.

Discopsis gruveli (Dautzenberg, 1912) (Plate 35)

(Figs. 205-208)

Tinostoma (Discopsis) gruveli Dautzenberg, 1912. *Ann. Inst. océan. Monaco*. 5(3): 78, pl. 3, figs. 35-37.

[Type locality: Banc de Crawford, Iles de Los, Guinea Conakry].

Cochliolepis gruveli (Dautzenberg): NICKLÈS, 1950: 52, figs. 47.

Cochliolepis gruveli (Dautzenberg): MARCHE-MARCHAD, 1958: 15.

Cochliolepis gruveli (Dautzenberg): ADAM & KNUDSEN, 1969: 58-59.

Cochliopsis gruveli: BERNARD, 1984, pl. 7, figs. 1.

Type material: Illustrated in DAUTZENBERG (1912, plate 3, figs. 35-37). Not examined.

Other material examined: Senegal: 10 s, S. Takoma, 25 m, Dakar (MNHN); 1 s, Casamance, Cap Roxo, 12°20'N 16°53'W, 15 m (MNHN). Guinea Conakry: 1 s, W Ouendi-Tabori, CHALGUI 7, T 41, 17 m (MNHN); 1 s, I. de Los, N/O André Nizery, SEDIGUI I, stn. 261, 9°30'N 14°02'W, 25 m (MNHN); 1 s, Rio Morebaya, N/O André Nizery, SEDIGUI I, stn. 170, 9°24'N 13°45'W, 17 m (MNHN); 1 s, Ile Kabak, N/O André Nizery, SEDIGUI I, stn. 159, 9°18'N 13°45'W, 21 m (MNHN); 1 s, W of Tannah, N/O André Nizery, SEDIGUI I, stn. 80, 9°12.3'N 13°37'W, 16 m (MNHN); 1 s, W frontier Sierra Leona, N/O André Nizery, SEDIGUI I, stn. 10, 9°03.4'N 13°26'W, 10 m (MNHN). Ivory Coast: 3 s, Abidjan, Orstom, Centre de Recherches Oceanographiques (MNHN); 4 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 11B, 5°11.5'N 3°48.2'W, 25 m (MNHN); 12 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 12D, 5°09.2'N 3°47.2'W, 30 m (MNHN); 16 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 13D, 5°08.9'N 3°48.6'W, 35 m (MNHN); 4 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 4D, 5°06.4'N 3°45.9'W, 45 m (MNHN); 1 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 6B, 5°06'N 3°46.6'W, 50 m (MNHN); 1 s, Grand Bassam, N/O Antéa, BENCHACI I, stn. 7D, 5°05.1'N 3°46.2'W, 55 m (MNHN). Ghana: 2 j, Miamia, 8-25 m (CAP); 74 s, Miamia (near Mudrachmi Point), 38-40 m (CER); 10 s, Miamia, 44-46 m (CER); 6 s, 300° out Cape Three Points, 35-65 m (CER). Equatorial Guinea: 1 s, sediment (carottes Reineck) 1°40'S 9°25'E, 150 m (MNHN). Congo: 6 s, Pointe Noire (CPH); 2 s, stn. 916 (MNHN); 1 s, stn. 762 (MNHN).

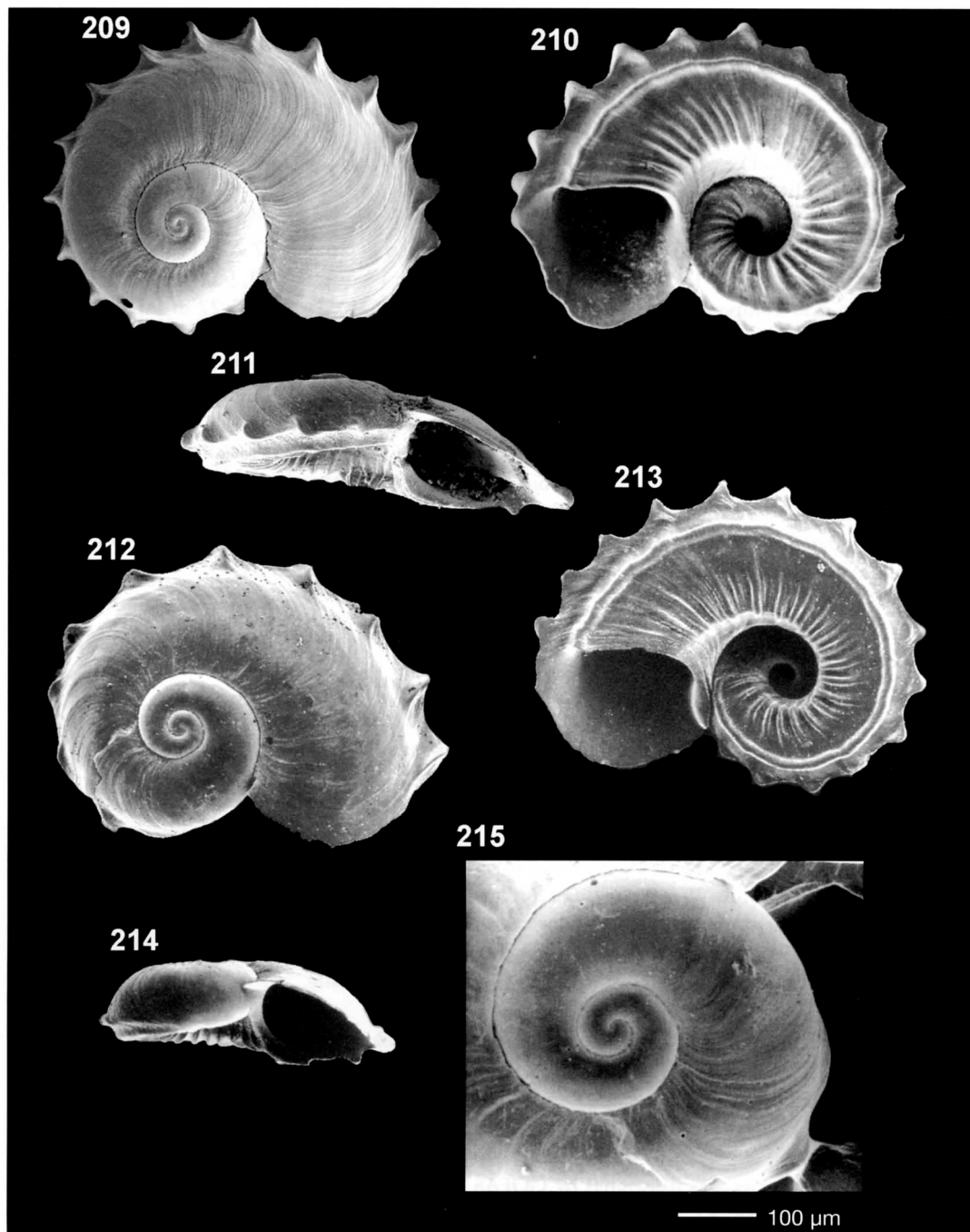
Description: Shell (Figs. 205-207) rounded, discoid, very depressed, fragile, whitish, with numerous sharp extensions on its outer border. Protoconch (Fig. 208) of about 2 whorls, smooth; usually the protoconch is a little separated from the first whorl of the teleoconch for half a whorl by a space smaller than the diameter of the nucleus of the protoconch; the maximum diameter of the protoconch is about 326 µm, but its separation from the teleoconch is not well defined. Teleoconch of about 1½ whorls, increasing rapidly, dorsally smooth, with a sharp outer border on which there are numerous prominent teeth with a narrow triangular shape, numbering about 30-40 on the last whorl. The extensions of the beginning of the teleoconch are visible on the last whorl; on the last half-whorl, a spiral subsutural cord near the end of the outer extensions of the previous whorl is evident; ventrally smooth with a depressed area near the peripheral border. Umbilicus wide open making the previous whorls visible. Aperture flat, oblique, nearly triangular, extended dorsally, with a prominent extension closer to the suture.

Dimensions: The holotype is 3.0 mm, which is the size of the largest shells.

Distribution: Guinea Conakry and Ivory Coast (after ADAM & KNUDSEN, 1969). We enlarge its range to Senegal in the north and southward to Ghana and Congo.

Remarks: There is no problem in differentiating this species from others of the genus due to its depressed form, a little less than *D. costulatus*, and the typical prominent extensions along the peripheral border.

PLATE 36



Figures 209-215. *Discopsis liliae* spec. nov. Fig. 209. Holotype, 2.0 mm, Miamia, Ghana (MNCN). Fig. 210. Paratype, 1.8 mm, (MNHN). Fig. 211. Paratype, 1.3 mm, (CER). Fig. 212. Paratype, 1.6 mm (CFR). Fig. 213. Paratype, 1.6 mm, (BMNH). Fig. 214. Juvenile, Miamia (CER). Fig. 215. Protoconch, Ghana.

Discopsis liliae spec. nov. (Plate 36)

(Figs. 209-215)

Cochliopsis sp.: BERNARD, 1984, pl. 73, figs. 3.

Cochliolepis sp.: GOFAS, PINTO AFONSO & BRANDÃO, 1985: 44, figs. 13 d, e and f.

Type material: Holotype (Figs. 209) in MNCN (n° 15.05/46477). Paratypes: AMNH (1), BMNH (1, Fig. 213), MNHN (1, Fig. 210), CER (115, Fig. 211), CFR (15, Fig. 212), CAP (2) and CPR (12), all from the type locality.

Other material examined: Senegal: 1 s, Cape Roxo, Drag. Louis Sauger, 12°20.7'N 16°53.1'W, 15 m (MNHN). Guinea Conakry: 1 s, W frontier Sierra Leona, stn. 74 SEDIGUI I, 9°06'N 13°25.7'W, 7 m (MNHN); 1 s, Rio Yomponi, Stn 688, N/O André Nizery, 10°24'N 14°50'W, 22 m (MNHN). Ivory Coast: 1 s, Grand Bassam, 35 m (MNHN); 3 s, Côte Berthois, Stn 11B, N/O ANTÉA BENCHACI I, 5°11'N 3°48.2'W, 25 m (MNHN); 35 s, Grand Bassam, stn. 13D, N/O ANTÉA BENCHACI I, 5°09.2'N 3°47.2'W, 30 m (MNHN); 7 s, Grand Bassam, stn. 12D, N/O ANTÉA BENCHACI I, 5°08.9'N 3°48.6'W, 35 m (MNHN). Ghana: 6 j, Miamia, 8-25 m (CAP); 1 s, 10 j, Miamia, 38-40 m (CER); 1 s, Miamia, 50 m (CER); 1 f, Miamia, 40-46 m (CER); 100 s, 35 j, 300° out of Cape Three Points, 35-65 m (CER). Congo: 7 s, Pointe-Noire (CPH); 1 s, Plage Mondaine, N of Faro, Pointe-Noire, beach (MNHN); 16 s, Region de Conkuati, Chalutier "Kounda", 4°00'S 10°59'E, 19 m (MNHN). Angola: 17 s, Bango, Region de Ambrizete, 07°20.19'S 12°55.09'E, intertidal (MNHN); 13 s, 10 Kms S of Ambrizete, intertidal (MNHN); 1 s, along Mussulo, 90-100 m (MNHN); 1 s, Corimba, Luanda, 10-20 m (MNHN).

Type locality: Miamia, Ghana, 30-50 m.

Etymology: The species is named for Liliam María Díaz "Lili", daughter-in-law of the senior author, for her help in many informatics and statistical problems during our research studies.

Description: Shell (Figs. 209-214) rounded, very depressed, relatively solid for its size, with flat spire, and spaced triangular extensions on the outer border. Protoconch (Fig. 215) of about 1¼ smooth whorls, about 394 µm maximum diameter but without any evident separation from the teleoconch. Teleoconch of about 1 whorl (maximum 1½), increasing rapidly; dorsally, convex and smooth, with only fine curved prosocline growth lines; ventrally slightly concave, with a strong cord near the outer border, where there appear about 15-17 prominent triangular prominences. Umbilicus very wide, showing the previous whorls. Aperture ovoid, with the outer lip sharp and extended dorsally.

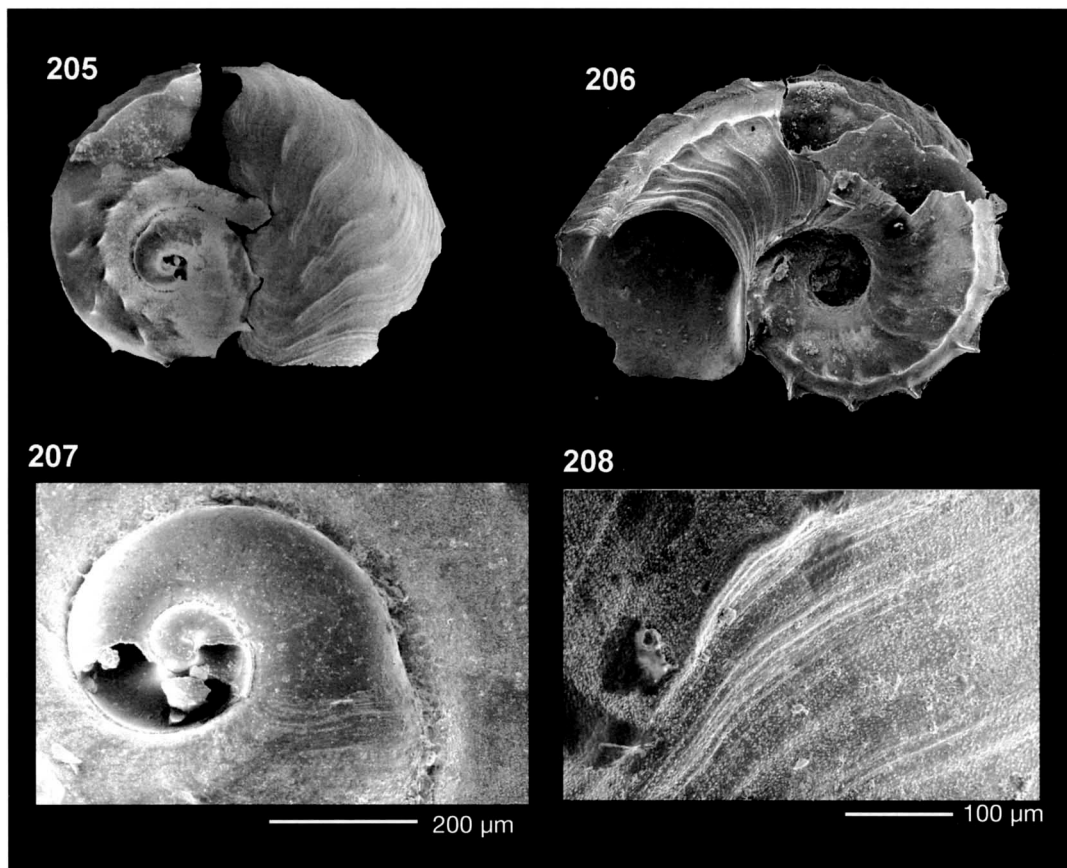
Dimensions: The holotype is 2.0 mm maximum dimension (diameter).

Distribution: The species was collected from Senegal to Angola, but not in the São Tomé and Príncipe Archipelago.

Discussion: This species was illustrated by GOFAS ET AL. (1985) as *Cochliolepis* sp.; the specimens shown were weakly juvenile.

There is no known species in West Africa similar to *D. liliae*. Other species have prominences on their periphery (*Tornus leloupi*, *T. ryalli*, *Discopsis gruveli* and *D. rarus*), but very different from the present species. The only similar species is *Discopsis* sp. (see below).

PLATE 37



Figures 216-219. *Discopsis* sp. Fig. 216-217. Shell, 2.8 mm, Mussulo, Luanda, Angola. Fig. 218. Protoconch. Fig. 219. Microsculpture.

Discopsis sp. (Plate 37)
(Figs. 216-219)

Material studied: 1 s (broken into three fragments), along Mussulo, Luanda, Angola, 90-100 m (MNHN).

Description: Shell (Figs. 216-217) rounded, hardly depressed, fragile, with flat spire, and spaced triangular extensions on the outer border. Protoconch (Fig. 218) of $1\frac{3}{4}$ smooth whorls, about 478 µm maximum diameter; its junction with the teleoconch shows an appreciable increase in the width of the whorl. Teleoconch of about 1½ whorls, increasing rapidly; dorsally, slightly concave presenting two rows of prosocline prominences, about 15 on the last whorl, with numerous, fine undulating and prosocline growth lines. On the periphery, there are pointed triangular prominences, numbering about 15 on the last whorl. ventrally slightly concave, with a narrow cord near the outer border, with curved axial ribs forming pointed prominences on the cord where they finish. Under magnification, numerous tubercles can be seen on the entire dorsal surface (Fig. 219). Umbilicus very wide, showing the previous whorls.

Aperture ovoid, with the outer lip sharp and extended dorsally.

Dimensions: The single known shell, broken is three fragments, might be 2.8 mm maximum dimension (diameter).

Distribution: Single shell found in Angola.

Remarks: The most similar species is *D. liliae*, but that species is smaller, dorsally smooth with only growth lines, and lacking tubercles in its microsculpture. On the base, it has only a rather uniform cord near the periphery and the peripheral points are wider. Besides, the protoconch is $\frac{1}{4}$ whorl longer and about 84 μm smaller in diameter.

Discopsis rarus spec. nov. (Plate 38)
(Figs. 220-227)

Type material: Holotype (Figs. 220-223) in MNHN (from coll. Le Loeuf-ORSTOM). One paratype (Figs. 224-225) in MNCN (n° 15.05/46479) from Miamia, Ghana, 38-40 m (broken during the study).

Type locality: Region of Abidjan, dredged in the continental plateau, Ivory Coast.

Etymology: The specific name alludes the extreme rarity of this species.

Description: Shell (Fig. 220-225) ovoid, dorsally depressed, nearly planispiral, very fragile, whitish. Protoconch (Figs. 226-227) of $1\frac{3}{4}$ smooth whorls, about 434 μm diameter. The beginning of the teleoconch is marked by increasing of the width of the whorl. The teleoconch has 1-2 whorls, increasing rapidly, a flat dorsal part, elevated a little above the level of the protoconch which appears a little depressed (Figs. 223-224) In the first whorl of the teleoconch there is a peripheral keel with some pointed extensions. In the last whorl, the peripheral keel is attenuated then becoming rounded, and the peripheral extensions disappear. On the entire surface of the shell numerous curved and prosocline growth lines are present. The aperture is large, obliquely rounded and with a dorsal extension adherent to the previous whorl. Columella curved and nearly vertical. Aperture border simple and sharp. Umbilicus very wide, making the previous whorls visible.

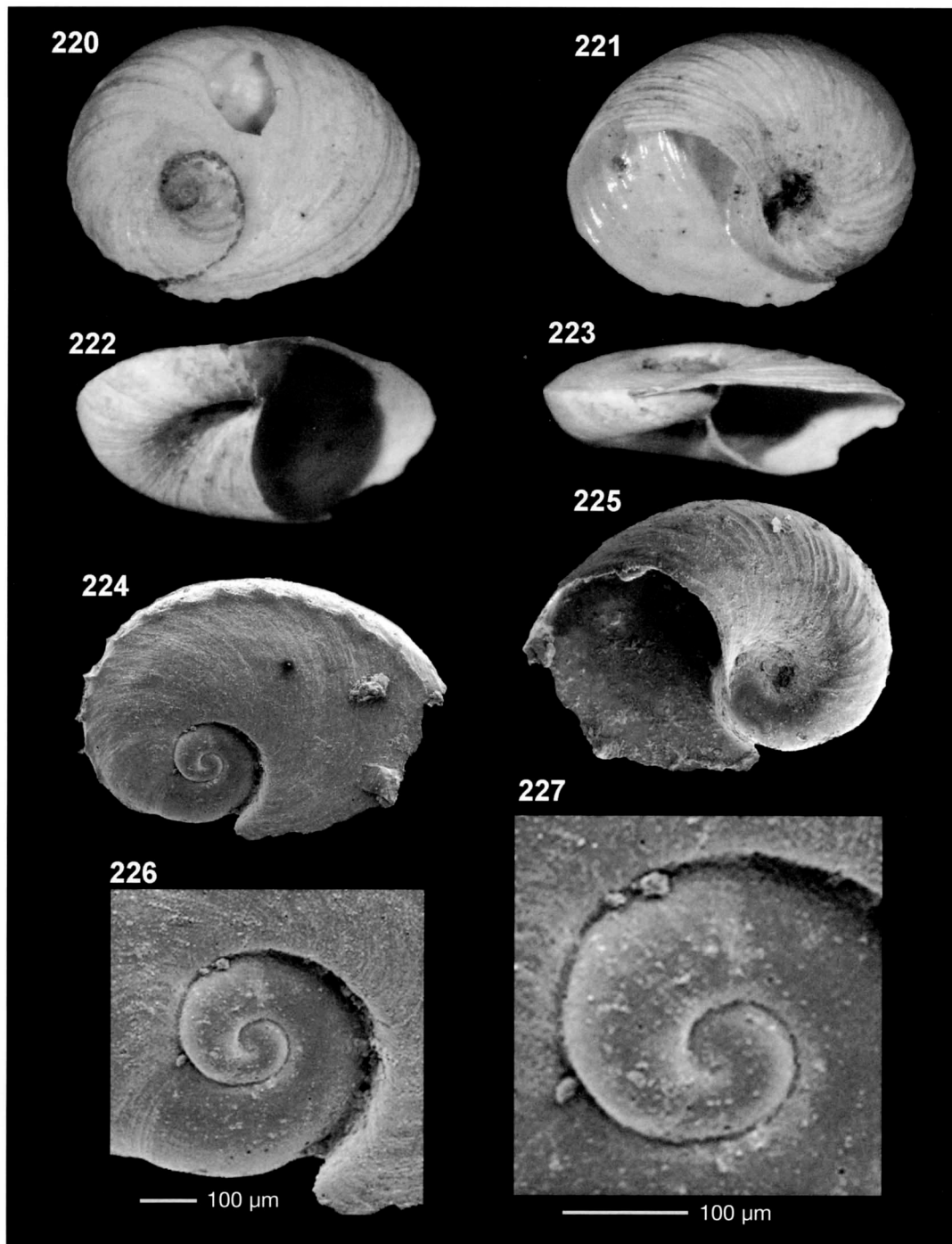
Dimensions: The holotype is 6.2 mm in maximum dimension (diameter). The paratype reaches only 1.4 mm, being a little juvenile.

Distribution: Known only from the type material, from Ivory Coast and Ghana.

Discussion: The peculiar shape of this species differs from all other species in the studied area. Its shape is unusual, but the protoconch and its separation from the first whorl of the teleoconch occurs in other species, and for this reason, we consider it congeneric.

In other way, *D. rarus* spec. nov. is very different from other species of the genus. The only species which have extensions on the periphery are *D. gruveli*, *D. liliae* spec. nov. and *Discopsis* sp., but the extensions of all those are more numerous, more elongate, and present on the entire periphery. Another difference is that *D. rarus* spec. nov. has no spiral cord on the base.

PLATE 38



Figures 220-227. *Discopsis rarus* spec. nov. Figs. 220-223. Holotype, 6.2 mm, Abidjan, Ivory Coast (MNHN). Figs. 224-225. Paratype, 1.4 mm, Miamia, (MNCN). Figs. 226-227. Protoconch of the paratype.

Genus *Naricava* Hedley, 1913

Naricava Hedley, 1913. Type species by original designation: *Adeorbis angasi* Adams and Angas, 1864. Recent and fossil from the Miocene of New Zealand.

Tropidorbis Iredale, 1936. Type species by original designation: *Tropidorbis mendicus* Iredale, 1936. Recent. Pacific.

Diagnosis: This is the description of this genus in POWELL (1979): "Shell rather large for the family, thin, auriliform, with very rapidly increasing whorls, the periphery angled or carinated; umbilicus very wide and perspective. Aperture large, D-shaped, very oblique, its top edge greatly in advance of the lower edge; columella edge straight".

Remarks: HEDLEY (1913) described *Naricava* in substitution of *Adeorbis angasi* (Adams & Angas, 1864) and placed it in Adeorbidae. THIELE (1929: 174) considered *Naricava* a synonym of *Cochliolepis*. WENZ (1938: 643) mentioned it as a subgenus of *Cochliolepis*, also placing it in Tornidae (=Adeorbidae). More recently, POWELL (1940) described a new species, *Naricava neozelanica*, and (POWELL, 1979) also considered it as a valid genus of Tornidae. PONDER (1994) observed live animals of *Naricava angasi* and concluded that it is a Vanikoridae and for this reason it must be removed from Tornidae. Our personal observations on species of *Macromphalina* and *Macromphalus* (Vanikoridae) from the west African coast, showed us an animal very similar to a those of Tornidae in its general appearance but with a very different radula. Since the radula described for the West African species which we placed in *Naricava* correspond to the appearance of those described for Tornidae, we provisionally keep *Naricava* in this family until future anatomical studies of this species confirm or refute its pertaining to Vanikoridae.

Naricava dilatata spec. nov. (Plate 39)
(Figs. 228-232)

Type material: Holotype (Figs. 228-230) in MNCN (n° 15.05/46481).

Type locality: Miamia, Ghana, in sediments at 38-40 m.

Etymology: The specific name alludes to the size of the aperture being larger than most of the studied species.

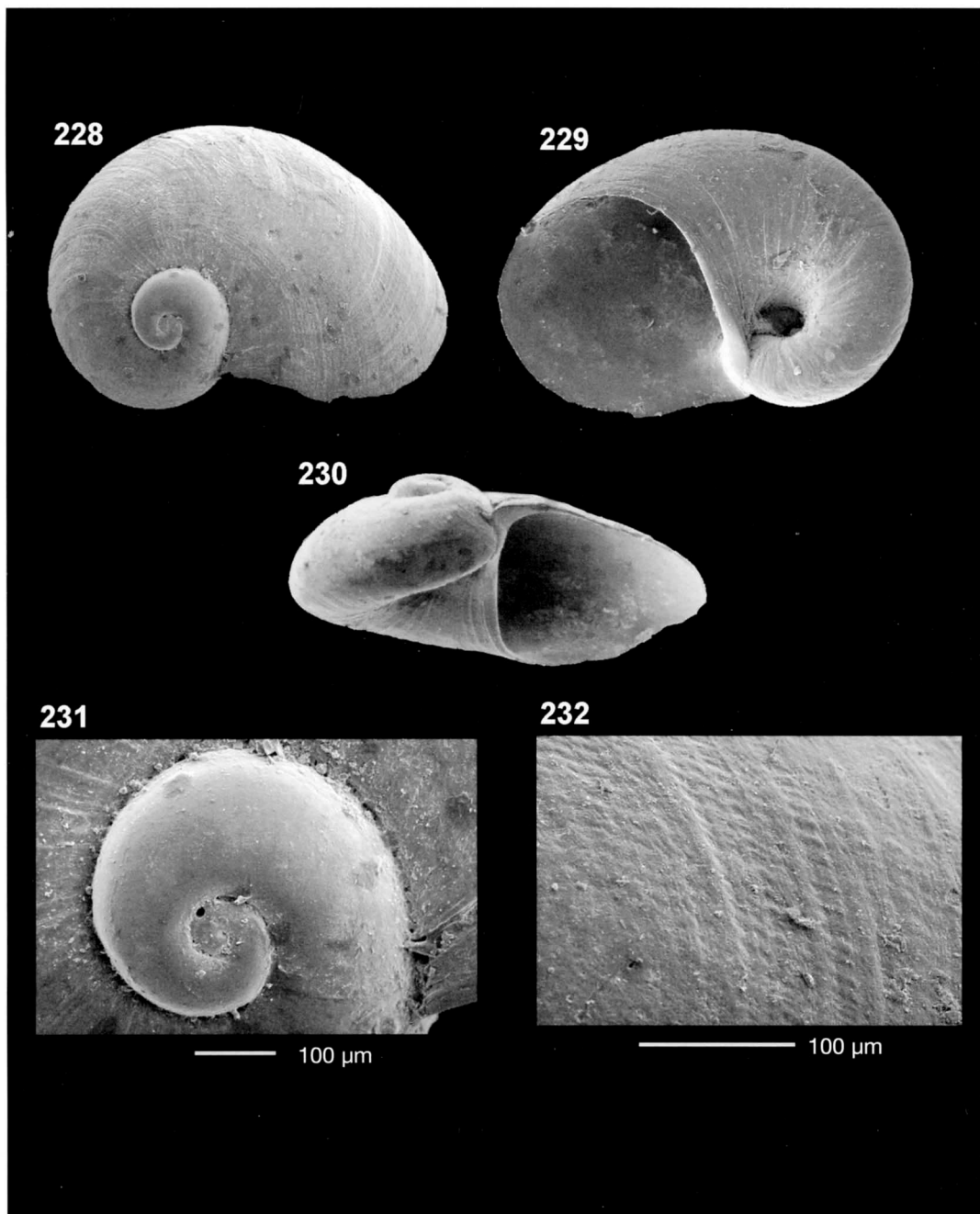
Description: Shell (Figs. 228-230) ovoid, hardly depressed, relatively fragile, with a rounded periphery. Protoconch (Fig. 231) of about 1¼ smooth whorls, increasing rapidly of about 437 µm diameter. Teleoconch with about one whorl, also increasing rapidly, dorsally slightly concave, Under magnification there are no tubercles but scarcely evident spiral striae crossed by growth lines; ventrally, the same sculpture (Fig. 232). Suture impressed. Umbilicus wide showing the previous whorls. Aperture relatively wide with a triangular profile, the columella being nearly straight and vertical, and with only a small contact with the previous whorl. A sharp outer lip, extended dorsally.

Dimensions: The holotype is 1.7 mm maximum diameter.

Distribution: Known only from the holotype.

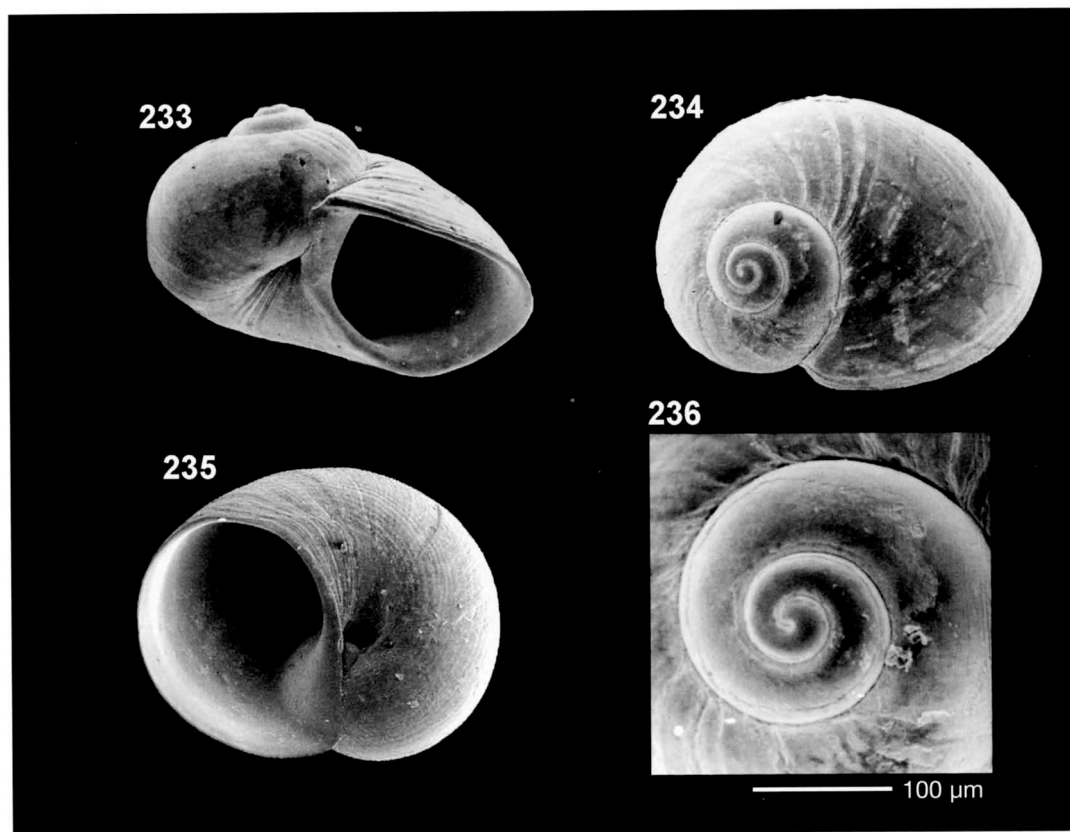
Discussion: The species can be differentiated from *D. costulatus* by its ovoid form and microsculpture;

PLATE 39



Figures 228-232. *Navicava dilatata* spec. nov. Figs. 228-230. Holotype, 1.7 mm, Miamia, Ghana (MNCN). Fig. 231. Protoconch, Ghana. Fig. 232. Microsculpture, Ghana.

PLATE 40



Figures 233-236. *Naricava discreta* spec. nov. Fig. 233. Shell, 1.3 mm, Luanda, Angola (CFR). Fig. 234. Shell, 1.2 mm, Luanda (CER). Fig. 235. Holotype, 1.5 mm, Luanda, Angola (MNHN). Fig. 236. Protoconch.

the latter also has small oblique axial ribs, and a cord ventrally near the outer border, the aperture less high. Most species of *Discopsis* also differ for the same reasons, and because the rate of whorls increasing is not so rapid. Furthermore, *Naricava dilatata* has a microsculpture formed by spiral lines and not by rows of tubercles.

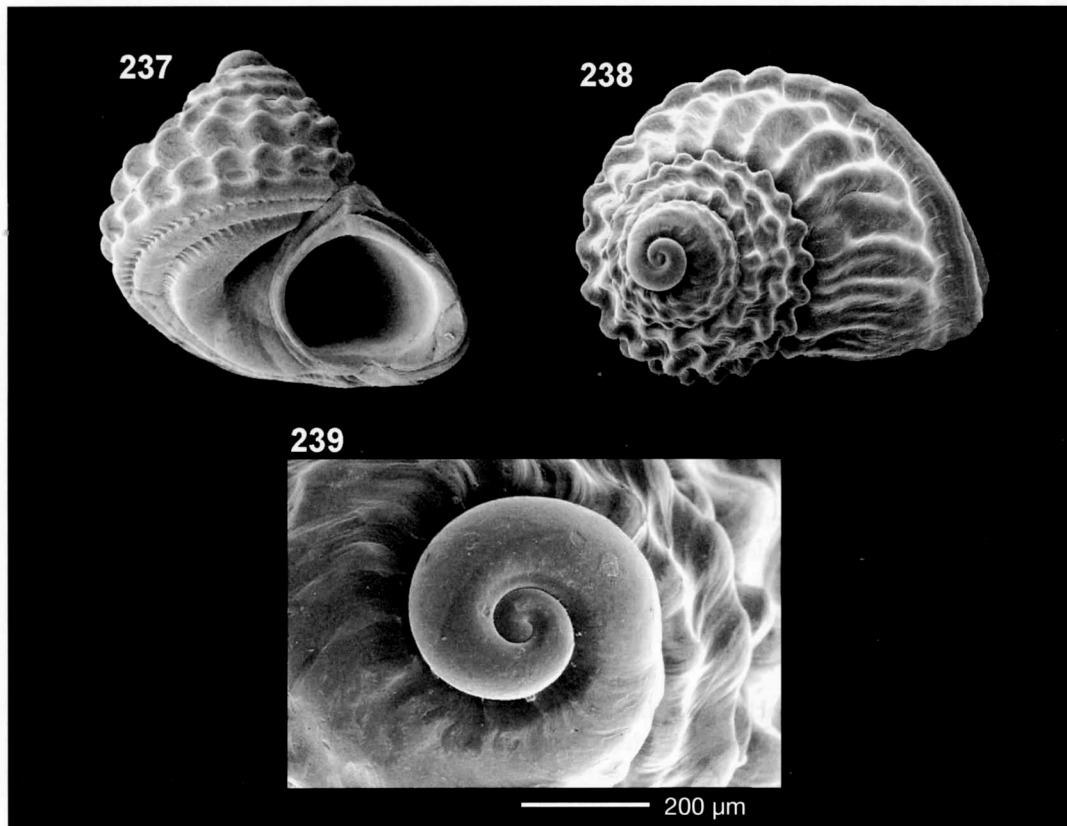
Naricava discreta spec. nov. (Plate 40)

(Figs. 233-236, 242, 247-248)

Type material: Holotype (Fig. 235) and 9 paratypes in MNHN from the type locality. Other paratypes: AMNH (1), MNCN (2, n° 15.05/46478), CER (9), CFR (1) and CPR (1), all from Luanda, Angola.

Other material examined: Ghana: 26 s, Miamia, 8-25 m (CAP); 41 s, 6 j, 6 f, Miamia, 38-40 m (CER); 12 s, 1 f, Miamia, 48-50 m (CER); 25 s, 6 j, 5 f, Cape Three Points, 35-65 m (CER). Angola:

PLATE 41



Figures 237-239. *Pseudoliotia battenbergi* spec. nov. Fig. 237. Holotype, 2.7 mm, Pointe-Noire, Congo (MNHN). Fig. 238. Paratype, 2.5 mm, Pointe Noire, Congo (CPH). Fig. 239. Protoconch of the paratype.

1 s, Ambrizete region, 07°17.49'S 12°53.05'E, beach sediment (MNHN); 2 s, Bango, Ambrizete region, 07°20.19'S 12°55.09E, beach deposits (MNHN); 8 s, Cacuaco, Bengo, infralittoral rocks (MNHN); 1 sp, Ilha de Luanda, 75-80 m (MNHN).

Type locality: Along Mussulo, prov. Luanda, Angola, 90-100 m.

Etymology: The specific name alludes to the scarce evidence of the characters of the shell.

Description: Shell (Figs. 233-235) ovoid, solid, whitish, slightly depressed with a low spire, with an uniformly rounded periphery. Protoconch (Fig. 236) of about $2\frac{1}{4}$ whorls, smooth, about 378 μ m diameter. Teleoconch of about $1-1\frac{1}{2}$ whorls, increasing rapidly in the last quarter, dorsally smooth but with evident prosocline growth lines and some scarcely evident striae; ventrally smooth with fine folds into the umbilicus, which is relatively wide and deep. Aperture ovoid with a curved columella which has a short contact with the previous whorl, the dorsal part of the outer lip extended.

Dimensions: The holotype is 1.5 mm maximum dimension (diameter).

Periostracum fine, yellowish.

Radula (Figs. 242, 247-248) taenioglossate, with formula $2+1+R+1+2$. Central tooth wide basally, the ventral margin well developed, U-shaped, two large denticles and the lateral margins strongly expanded. The cutting area is formed by a main large and sharp cusp and 3 denticles of medium size at each side, with the extremes towards the center. Lateral teeth similar to the central one, but the base is narrower and without denticles. Marginal teeth narrow and elongate; the innermost with 16-18 sharp denticles on the upper outer margin; the outer marginal teeth are hook-like strongly inclined outward in their upper third and without apparent denticulation.

Operculum ovoid, paucispiral and with the nucleus subcentral, very similar to that of *Ponderinella skeneoides* spec. nov.

Distribution: The species is known only from Ghana to Angola.

Discussion: We assigned the species to *Naricava* tentatively, because we have no information on its soft parts and in spite of the general morphology of the shell, it is not totally similar to other species included in the genus. Our decision is based on the following characters: the shell is depressed, the protoconch has smooth whorls, the growth lines are prosocline, the aperture has an oblique shape and the contact with the previous whorls is very small. Furthermore, its radula is similar to that described for those species in the genera *Tornus*, *Discopsis* and *Ponderinella*, all of those having a characteristic radular pattern.

The other species included in the genus *Naricava* do not have similar characters, being larger, more depressed and with a wider umbilicus.

Genus *Pseudoliotia* Tate, 1898

Pseudoliotia Tate, 1898. *Trans. roy. Soc. South Australia*, 22: 65-71. Type species: *Cyclostoma micans* A. Adams. Recent. Indo-Pacific.

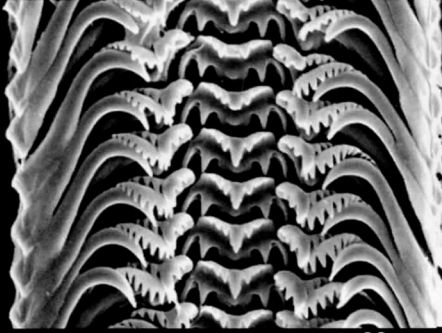
Diagnosis: Shell solid, discoidal with small and low spire and wide umbilicus which lacks an angulation. Aperture with thick callus on the columella.

Remarks: This genus was up to now known only from the Indo-Pacific.

Figures 240-248. Radula of Tornidae. Figs. 240-241 Radula of *Tornus subcarinatus*, Tarifa. Fig. 242. Radula of *Naricava discreta*. Fig. 243-244. Radula of *Discopsis apertus*. Fig. 245-246. Radula of *Tornus leloupi*. Figs. 247-248. Radula of *Naricava discreta*, Angola.

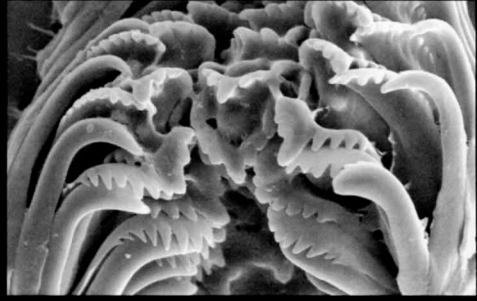
PLATE 42

240



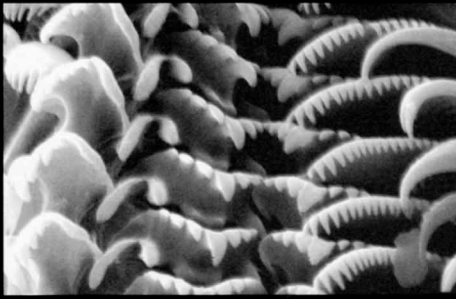
20 μ m

241



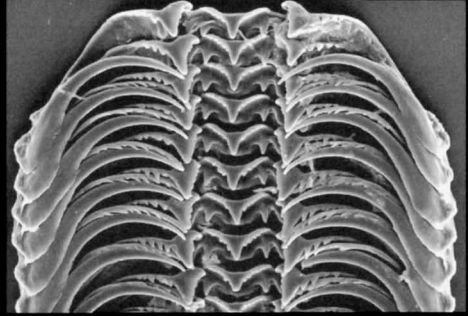
10 μ m

242



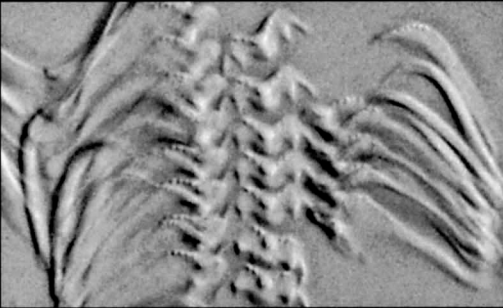
5 μ m

243



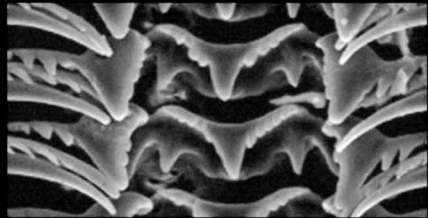
20 μ m

245



20 μ m

244

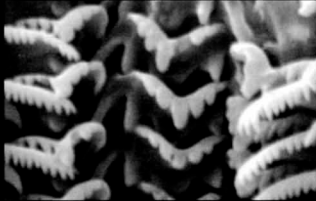


10 μ m

246

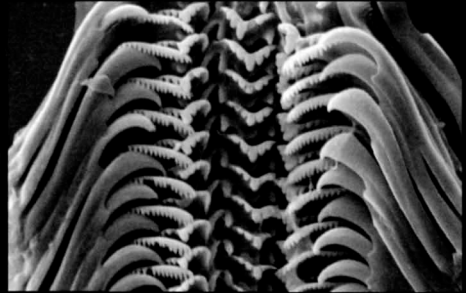


247



10 μ m

248



10 μ m

PLATE 43

249



Figure 249. Specimen of *Tornus subcarinatus* with eggs inside the umbilicus, Tarifa, Spain (photo L. Dantart).

Pseudoliotia battenbergeri spec. nov. (Plate 41)
(Figs. 237-239)

Type material: Holotype (Fig. 237) in MNHN (ex CPH). Paratypes: CPH (3, Fig. 238) from the type locality.

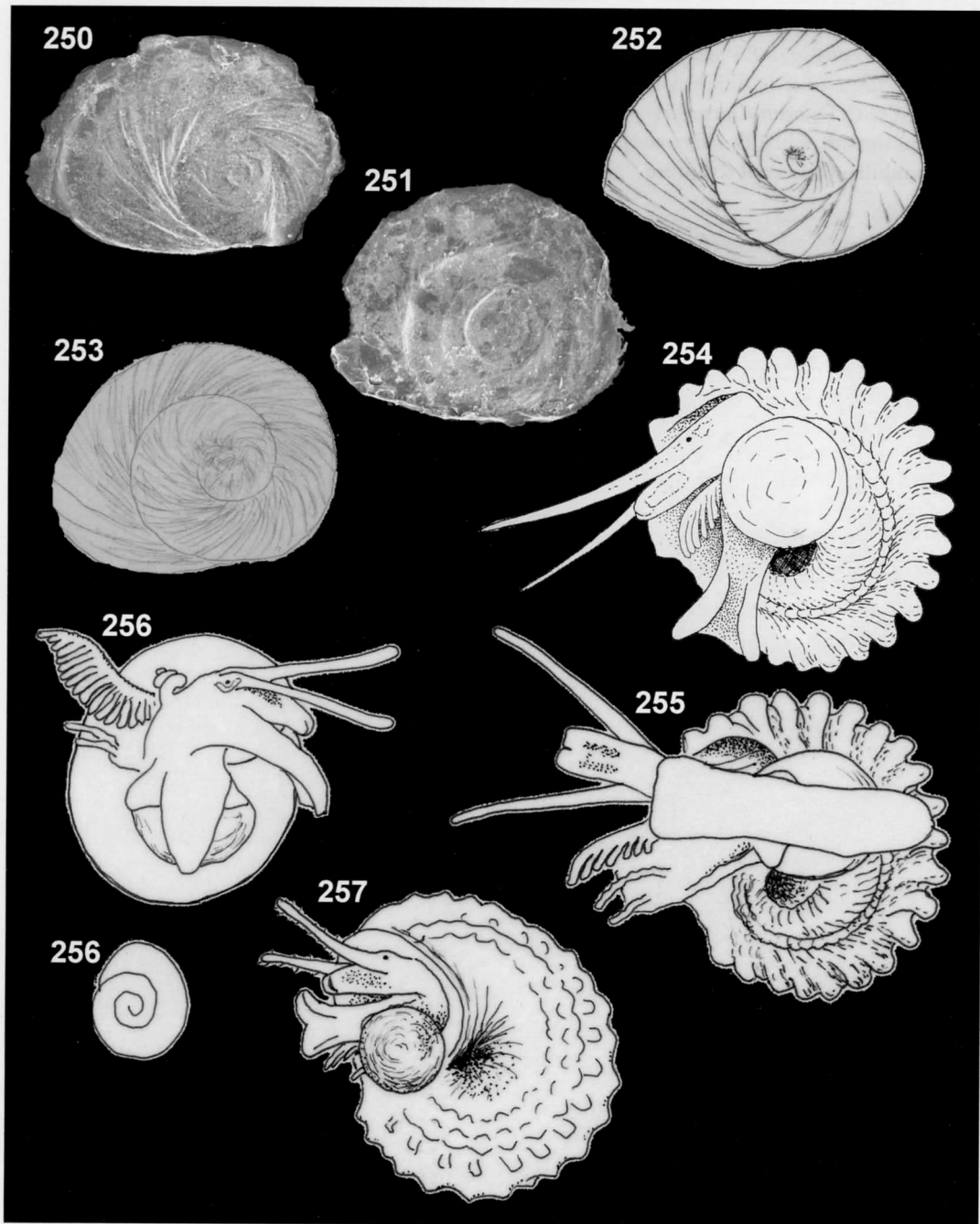
Type locality: Pointe-Noire, Congo.

Description: Shell (Figs. 237-238) conic, very solid, only slightly depressed, whitish, a little transparent, with small depressed nodules on a keel on the periphery. Protoconch (Fig. 239) with $1\frac{3}{4}$ smooth whorls, 383 μ m maximum diameter. Teleoconch of about $2\frac{1}{2}$ whorls, increasing slowly; 3 strong nodulous cords appear at the beginning and they continue to the last half-whorl until they become fused into very strong and prominent axial ribs, about 12 in number. Another three cords without nodules start below the periphery, the lowest one, wider and stronger, rounds the umbilicus. Between them, axial lines are visible. Umbilicus not very wide. Aperture rounded depressed with the outer lip sharp and extended dorsally.

Dimensions: The holotype is 2.7 mm in diameter x 2.3 mm in height.

Distribution: Known only from the type locality.

PLATE 44



Figures 250-257. Opercula and animal drawings. Fig. 250. Operculum of *Tornus subcarinatus*. Fig. 251. Operculum of *Tornus leloupi*, Angola. Fig. 252. Operculum of *Discopsis apertus* (sp. 5 mm, operculum 2 mm), Ivory Coast. Fig. 253. Operculum of *Ponderinella skeneoides*, Angola. Fig. 254. Animal of *Tornus leloupi* (drawing from GOFAS ET AL. 1985). Fig. 255. Animal of *Tornus leloupi*, Cacuaço, Angola (drawing S. Gofas). Fig. 256. Animal of *Ponderinella skeneoides* and its operculum, Cacuaço, Angola (drawing S. Gofas). Fig. 257. Animal of *Cyclostremiscus calameli*, Cacuaço, Angola (drawing S. Gofas).

Discussion: The shell here described has some characters somewhat different from the type species: the spire is more elevated, conical, and the umbilicus is smaller. But it is solid, with prominent axial and spiral sculpture and a thickening on the aperture and columella. Due to these last reasons we prefer to keep it provisionally in the genus *Ponderinella* that to create a new genus.

This species is different from any other in the area of study. By its solidity it can only be compared with *Discopsis dautzenbergi*, but its spire is more elevated, and the spiral cords in the base are three and smooth, while *D. dautzenbergi* has only one nodulous nearly peripheral cord, and the area close to the umbilicus has axial sculpture.

CONCLUSIONS

General information

The number of species of Tornidae studied in the present work is 39, not including some forms assigned to a previously known species. Of these, 15 were previously known and 23 are described as new. One more species is new, but was not named because the single shell collected is in bad condition.

This high number of species of Tornidae is apparently only found on the West African coast. Few species are known from European coasts, and fewer on the other side of the Atlantic, as it can be seen in an examination of the literature from North America (MORRIS, 1973, ABBOTT, 1974), Caribbean (WARMKE & ABBOTT, 1961, DE JONG & COOMANS, 1988, ESPINOSA, J., FERNÁNDEZ-GARCÉS, R. & ROLÁN, E. 1988, REDFERN, 2001), Mexico (VOKES & VOKES, 1983), Colombia (DIAZ MERLANO & PUYANA HEGEDUS, 1994), Brazil (LEAL, 1991, RIOS, 1994), and Argentina (AGEITOS DE CASTELLANOS, 1989). When in some of these works the family Tornidae is mentioned, it is for *Cochliolepis parasitica* or for *Macromphalina* sps., which are actually included in the family Vitrinellidae and Vanikoridae respectively.

Even examining some extensive revisions of the fossil micromolluscs with depressed shells (such as of GARDNER, 1948, PILSBRY, 1953, ALTENA, 1966, for example), few species appeared which could be included in the genera here studied.

Also in the Pacific, few species were referred to this family: OKUTANI (2000) mention only 1 *Ponderinella*, 1 *Sigaretornus* and 2 *Pseudoliotia* from the Japanese fauna. WILSON (1993) cited 4 species of *Tornus* in Australia and also comments that *Naricava* should be placed in this family. But PONDER & KEYZER (1998) pointed out that the family Tornidae has not been recognized in Australia. POWELL (1979) mentioned 2 species of *Tornus* for the New Zealand fauna, 1 of *Cochliolepis* and 1 of *Naricava*. It is possible that the smaller species from these areas have not been thoroughly studied, but anyhow, it seems to be less numerous in species than in the East Atlantic, mainly West Africa.

Morphology of the shell

The main characters of the shell are abstracted in Table I.

After study of the characters of the species of Tornidae included in the present work, keys for genera and for species were devised.

Table I. Scheme of the main characters of the shell of West African Tornidae:

- 1-protoconch whorls number
 2-rib at the protoconch end
 3-shell more or less depressed
 4-axial sculpture (in relation to the number of ribs)
 5-spiral sculpture (in relation to the number of cords).
 6-periphery: rounded, nodulous, keeled, scaled, sharp pointed
 7-umbilicus: wide, medium, narrow
 8-number of cords at the base

<i>Tornus:</i>	1	2	3	4	5	6	7	8
<i>T. subcarinatus</i>	1-1 $\frac{3}{4}$	no	+	++	+	corded	wide	2
<i>T. cancellatus</i>	1 $\frac{3}{4}$	no	+	+	+	nodulous	wide	1
<i>T. leloupi</i>	1 $\frac{3}{4}$	no	+	+	+	scaled	wide	1
<i>T. rachelae</i>	1 $\frac{3}{4}$	no	+	+	+	scaled	wide	1
<i>T. attenuatus</i>	2	no	+	+-	+	nodulous	wide	2
<i>T. ryalli</i>	1 $\frac{3}{4}$	no	+	-	+	scaled	wide	1
<i>T. garrawayi</i>	1 $\frac{3}{4}$	yes	+	+++	+	keeled	wide	2
<i>T. africanus</i>	1 $\frac{3}{4}$	yes	+	++	++	corded	wide	2
<i>T. aemilii</i>	1 $\frac{3}{4}$	yes	+	++	++	corded	wide	2
<i>T. erici</i>	2	yes	+	+++	++	corded	medium	2
<i>T. jullieni</i>	1 $\frac{3}{4}$	yes	+	+++	++	corded	medium	2
<i>T. umbilicorda</i>	2	yes	no	++	+	corded	medium	3
<i>T. anselmoi</i>	1 $\frac{1}{2}$	no	+	++	+	rounded	medium	2
<i>Sigaretornus:</i>								
<i>S. disjunctus</i>	2	yes	+	-	-	rounded	wide	0
<i>Ponderinella:</i>								
<i>P. tornatica</i>	1 $\frac{3}{4}$	no	+	-	-	keeled	wide	1
<i>P. skeneoides</i>	2	yes	no	+ -	-	rounded	medium	1
<i>P. minutissima</i>	1 $\frac{3}{4}$	yes	no	-	-	rounded	narrow	1
<i>P. carlosi</i>	1 $\frac{3}{4}$	no	no	++	+	corded	narrow	2
<i>P. finalis</i>	1 $\frac{3}{4}$	yes	no	+	-	rounded	narrow	0
<i>Discopsis:</i>								
<i>D. costulatus</i>	1 $\frac{3}{4}$	no	+++	+-	+-	keeled	wide	1-2
<i>D. mienisi</i>	1 $\frac{1}{2}$	no	++	++	+	keeled	wide	2
<i>D. apertus</i>	1 $\frac{3}{4}$	no	++	-	-	keeled	wide	0
<i>D. irregularis</i>	1 $\frac{3}{4}$	yes	++	++	+-	keeled	wide	1
<i>D. similis</i>	1 $\frac{3}{4}$	yes	++	+++	+	keeled	wide	1
<i>D. nodulosus</i>	1 $\frac{3}{4}$	no	++	-	+	keeled	wide	1
<i>D. militare</i>	2	no	+	+	+-	rounded	wide	1-2
<i>D. radians</i>	1 $\frac{3}{4}$	no	++	+++	+-	corded	wide	1
<i>D. exmilitare</i>	1 $\frac{3}{4}$	yes	+	+++	+	corded	wide	1
<i>D. reductus</i>	2	no	++	+-	+-	rounded	wide	0
<i>D. dautzenbergi</i>	1 $\frac{3}{4}$	no	++	+	+	nodulous	wide	1
<i>D. ferreirorum</i>	1 $\frac{3}{4}$	no	+	+++	-	keeled	wide	0
<i>D. jullieni</i>	1 $\frac{3}{4}$	no	+	++	-	keeled	wide	2
<i>D. gruveli</i>	2	no	+++	++	-	sharp pointed	wide	0
<i>D. liliae</i>	1 $\frac{3}{4}$	no	++	++	+-	sharp pointed	wide	1
<i>D. sp.</i>	1 $\frac{3}{4}$	no	++	++	+-	sharp pointed	wide	1
<i>D. rarus</i>	1 $\frac{3}{4}$	no	++	-	-	rounded	wide	0
<i>Naricava:</i>								
<i>N. dilatata</i>	1 $\frac{3}{4}$	no	++	-	-	rounded	wide	0
<i>N. discreta</i>	2 $\frac{1}{4}$	no	+	-	-	rounded	medium	0
<i>Pseudoliotia:</i>								
<i>P. battenbergi</i>	1 $\frac{3}{4}$	no	no	+	+	nodulous	narrow	2

Genera:

- 1 Shell solid or somewhat solid; periphery rounded with a cord, sometimes somewhat keeled 2
Shell fragile; periphery smooth rounded or strongly keeled 4
- 2 Shell depressed; umbilicus wide 3
Shell scarcely depressed, solid, umbilicus relatively small *Pseudoliotia*
- 3 Shell sculptured dorsally and ventrally with 1-2 strong spiral cords, one near the umbilical infundibulum, and a peripheral nodulous or scaled prominent cord *Tornus*
Shell smooth without sculpture nor peripheral cord *Sigaretornus*
- 4 Shell not very depressed with prominent spire, rounded periphery and a cord around the umbilical infundibulum *Ponderinella*
Shell strongly depressed, with a prominent peripheral border, with a very wide umbilical aperture 5
- 5 Shell with aperture smaller than the diameter of the middle of shell, ventrally with 1-2 spiral cords one of them being close to the periphery *Discopsis*
Shell with aperture larger than the middle of the diameter of the shell, without apparent sculpture *Naricava*

Key to the species:

Genus *Tornus*:

- 1 entire teleoconch surface covered by microtubercles 2
teleoconch surface with fine spiral threads of microtubercles or lines 7
- 2 last whorl with tubular extensions 3
last whorl without tubular extensions 4
- 3 last whorl with axial ribs and 8-9 evident tubular extensions on the spiral cords *T. rachelae*
last whorl with 5 spiral cords with scales and nodules, only a few as tubular extensions. . *T. ryalli*
- 4 axial ribs numerous (more than 30) *T. subcarinatus*
axial ribs less than 30 5
- 5 last whorl with 6 spiral cords and complete axial ribs not evident *T. attenuatus*
last whorl with evident axial ribs 6
- 6 last whorl with 4 spiral cords and 14 axial ribs *T. leloupi*
last whorl with 5-6 spiral cords crossed by 17-24 axial ribs forming nodules *T. cancellatus*
- 7 last whorl with more than 5 spiral cords 8
last whorl with 4 or less spiral cords 12
- 8 last whorl with 6 spiral cords and 3 at the base *T. umbilicorda*
last whorl with more than 6 spiral cords and 2 at the base 9

9	last whorl with 8 spiral cords	<i>T. africanus</i>
	last whorl with 7 spiral cords	10
10	last whorl about 50 axial ribs	<i>T. jullieni</i>
	last whorl with less than 45 axial ribs	11
11	spiral cords fine and scarcely elevated	<i>T. erici</i>
	spiral cords prominent and wider than ribs	<i>T. aemilii</i>
12	one spiral cord on the base	<i>T. garrawayi</i>
	two spiral cords on the base	<i>T. anselmoi</i>

Genus *Ponderinella*

1	Shell with evident axial sculpture	2
	Shell without evident axial sculpture	3
2	Shell with fine axial ribs, prosocline and curved, which nearly disappear on the base	<i>P. finalis</i>
	Shell with evident axial ribs on the entire shell	<i>P. carlosi</i>
3	Shell with a prominent peripheral keel	<i>P. tornatica</i>
	Shell with rounded periphery	4
4	Shell higher than wide; umbilicus narrow with a cord without nodules	<i>P. minutissima</i>
	Shell as high as wide and with a wide infundibulum and nodulose perumbilical cord	<i>P. skeneoides</i>

Genus *Discopsis*

1	Teleoconch with peripheral prominences	2
	teleoconch without peripheral prominences	6
2	periphery with nodules	<i>D. dautzenbergi</i>
	periphery with sharp prominences	3
3	periphery with prominences only in first part of the shell	<i>D. varus</i>
	prominences on the periphery of the entire shell	4
4	30-40 prominences on the periphery of the last whorl, on one level only	<i>D. gruvelli</i>
	13-17 triangular prominences on the periphery of the last whorl	5
5	dorsal part smooth	<i>D. liliae</i>
	dorsal part with axial ribs and prominences	<i>D. sp</i>
6	periphery with an irregular keel	7
	periphery with a regular profile	10
7	five nodulose cords on the dorsal part	<i>D. nodulosus</i>
	dorsal part without nodules	8

8	dorsal part without any spiral sculpture.....	<i>D. ferreirorum</i>
	dorsal part with spiral cords.....	9
9	dorsal part with 4-5 fine cords crossed by ± 50 axial ribs	<i>D. similis</i>
	dorsal part with 1 fine cord, ± 22 axial ribs	<i>D. irregularis</i>
10	shell with conical profile.....	<i>D. jullieni</i>
	shell depressed	11
11	shell not strongly depressed	12
	shell strongly depressed,	16
12	shell with a spiral basal depression close to the periphery.....	<i>D. apertus</i>
	shell without a spiral basal depression.....	13
13	base with scarce spiral striae near the periphery and no spiral cord	<i>D. reductus</i>
	base with at least one spiral cord evident	14
14	dorsum without any spiral cord	15
	dorsum with one spiral cord.....	<i>D. exmilitare</i>
15	shell with very numerous (around 100) scarcely evident axial ribs	<i>D. militare</i>
	shell with less numerous (50-70) but very evident axial ribs	<i>D. radians</i>
16	shell with axial sculpture little evident.....	<i>D. costulatus</i>
	shell with axial sculpture rather evident.....	<i>D. mienisi</i>

Range of Distribution

Most of the species studied are exclusively from West African tropical and subtropical waters. Only *Tornus subcarinatus* reaches the north of Europe, and that species, *Tornus africanus*, *Discopsis costulatus* and *D. mienisi* are present in the Mediterranean area. In the Moroccan Atlantic, there are no other species than those occurring in the Mediterranean. In the Canary Islands only *Tornus subcarinatus* has been recorded. By Western Sahara and Mauritania, new species appear: *Tornus leloupi*, *T. rachelae*, *T. garrawayi*, *Ponderinella tornatica*, *P. skeneoides*, etc. up to a total of 9. Towards the south of the studied area, the number of species increases, there being 31 in Ghana (perhaps because this area has been sampled better), 22 in Congo, and 26 in Angola.

The geographical range is variable for the studied species. Only for some of them is the material from a limited area, but this concerns those species rarely found. Probably, all of them have large ranges of distribution, conjectured because of their protoconchs of several whorls, and probable planktotrophic larval development.

Curiously, no species of the studied group has been found in the Cape Verde Archipelago (pers. inform.) or in Annobón Island (pers. inform.). Also, no species were recorded in Santa Helena by SMITH (1890, 1892).

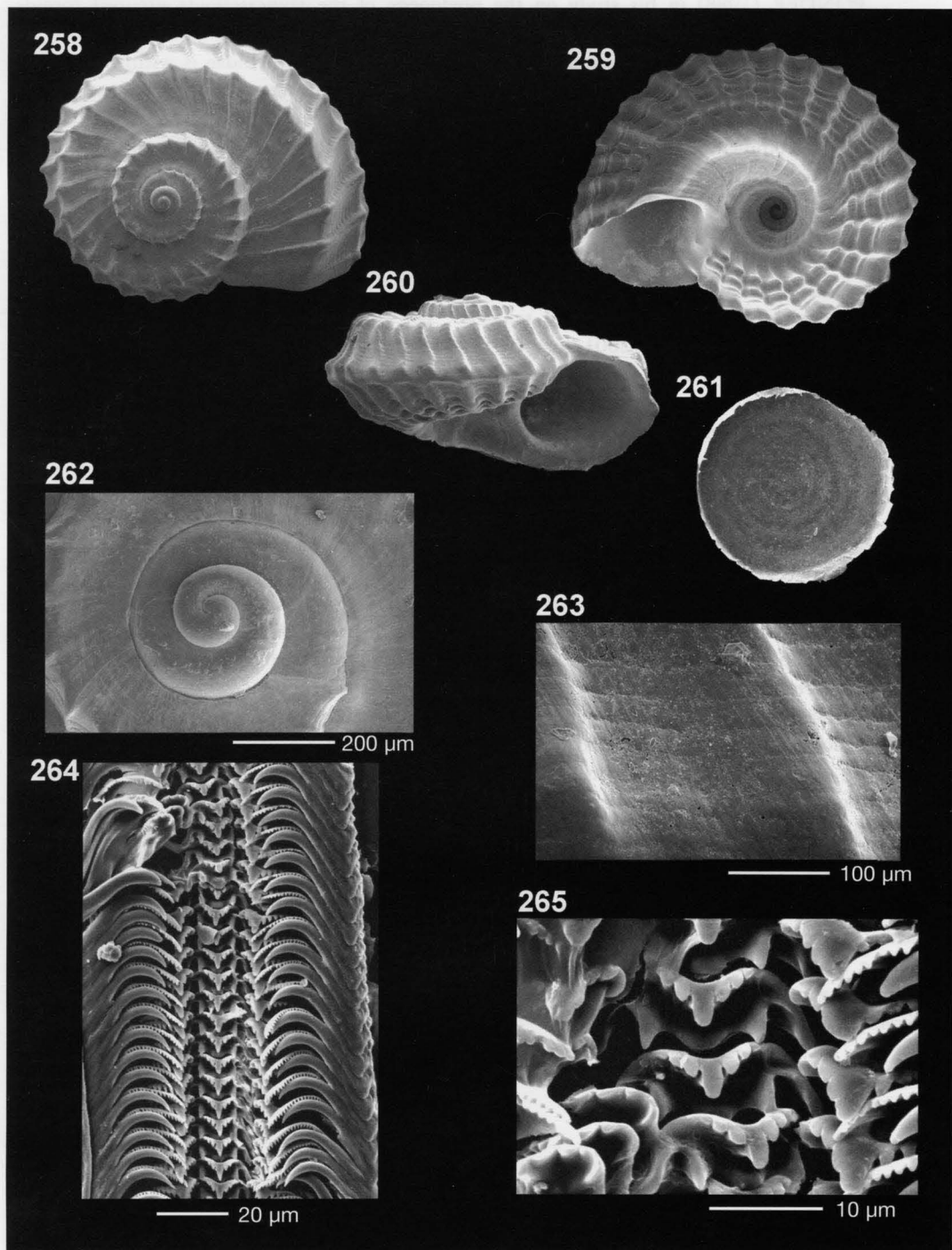
The information on the range of distribution of the studied species is summarized in Table II.

Table II. Range of distribution of the West African species of Tornidae. Atl: European Atlantic; Med: Mediterranean; Mor: Morocco; Mau: Sahara and Mauritania; Sen: Senegal; Gha: Guinea Bissau to Ghana; STP: São Tomé and Príncipe; Gui: other countries of the Guinean Gulf; Con: Congo; Ang: Angola.

<i>Tornus:</i>	Atl	Med	Mor	Mau	Sen	Gha	STP	Gui	Con	Ang
<i>T. subcarinatus</i>	■	■	■	■	■					
<i>T. cancellatus</i>					■	■			■	
<i>T. leloupi</i>				■	■	■		■	■	■
<i>T. rachelae</i>				■	■	■				
<i>T. attenuatus</i>					■	■			■	■
<i>T. ryalli</i>						■				■
<i>T. garrawayi</i>				■		■				■
<i>T. africanus</i>		?				■		■	■	■
<i>T. aemilii</i>						■			■	■
<i>T. erici</i>						■			■	■
<i>T. jullieni</i>					■	■			■	■
<i>T. umbilicorda</i>						■				■
<i>T. anselmoi</i>				■						
<i>Sigaretornus:</i>										
<i>S. disjunctus</i>						■				■
<i>Ponderinella:</i>										
<i>P. tornatica</i>				■		■				■
<i>P. skeneoides</i>				■		■			■	■
<i>P. minutissima</i>						■				■
<i>P. carlosi</i>						■		■	■	■
<i>P. finalis</i>						■				
<i>Discopsis:</i>										
<i>D. costulatus</i>		■		■	■				■	■
<i>D. mienisi</i>		■								
<i>D. apertus</i>						■			■	■
<i>D. irregularis</i>									■	■
<i>D. similis</i>						■				■
<i>D. nodulosus</i>									■	
<i>D. militare</i>					■	■	■		■	■
<i>D. radians</i>				■	■	■	■		■	■
<i>D. exmilitare</i>						■			■	■
<i>D. reductus</i>					■	■	■		■	
<i>D. dautzenbergi</i>						■			■	■
<i>D. ferreirorum</i>						■				
<i>D. jullieni</i>						■			■	■
<i>D. gruveli</i>					■	■		■	■	■
<i>D. liliae</i>					■	■			■	■
<i>D. sp.</i>										■
<i>D. rarus M</i>						■				
<i>Naricava:</i>										
<i>N. dilatata</i>						■				
<i>N. discreta</i>						■				■
<i>Pseudoliotia:</i>										
<i>P. battenbergi</i>									■	

PLATE 45

Relationship with other genera



Figures 258-265. *Cyclostremiscus calameli*. Figs. 258-260. Shells, 3.0 mm, 3.1 mm and 2.6 mm, Port Gentil, Gabón (MNHN). Fig. 261. Operculum. 0.8 mm. Fig. 262. Protoconch. Fig. 263. Microsculpture. Figs. 264-265. Radula.

Relationship with other groups:

PONDER (1988) in his study on the phylogeny of the truncatelloids grouped tornids-vitrinellids-circulids as a single family, in order to make the proposal/conclusions of his work easier, but the systematic status of these groups must be made more precise. Vitrinellidae is within Rissooidea which have the animals close to Tornidae, but both families must continue separated, because there are opercular, radular and anatomic characters sufficient for their differentiation. Anyhow, PONDER & WARREN (1988) commented that there is some evidence to suggest that the family Tornidae is different from Vitrinellidae and Adeorbidae.

The species of Tornidae studied, in contrast to those of Vitrinellidae, have a paucispiral operculum with the nucleus subcentral; radula taenioglossate formula 2-1-R-1-2, with a rachidian tooth with lateral margins expanded, ventral margin U-like and a denticle at each side; the animal lacks metapodial tentacles and ciliated cephalic tentacles. For these reasons and due their sculptured protoconch (shown in REDFERN, 2001, figs. 197c, 197d) we have considered that *Cochliolepis* must be included in Vitrinellidae, moving to *Discopsis* those West African species included in that genus.

The radula of some New Zealand species of the genus *Nozeba* Iredale, 1915, belonging to Iravadiidae, is identical to that of the species studied in Tornidae.

Regarding the relationship of Tornidae with other groups, the animal of *Tornus* is in a general appearance very similar to that of the African species of *Macromphalina* and *Macromphalus* (Vanikoridae).

Some other species appear to be related to the studied groups. One close species seems to be *Cyclostremiscus calameli* (Jousseume, 1872). This species has a depressed shell, solid, spirally and axially sculptured, with microsculpture of spiral grooves, and a smooth protoconch of several whorls. All these, represent characters similar to those of Tornidae, especially, of the genus *Pseudoliotia* (see OKUTANI, 2000). We have figured this species in plate 43 (shell, Figs. 258-260; operculum, Fig. 261, protoconch, Fig. 262; microsculpture, Fig. 263; and radula, Figs. 264-265); also a drawing (by S. Gofas) of the animal (Fig. 257). This animal presents clearly ciliated cephalic tentacles, and somewhat flattened in their proximal part, where they are very close. The ctenidium is visible laterally, with only one pallial right tentacle. The color of the soft parts is pink with reddish at the base of the tentacles and in the snout, by transparence.

The differences between *C. calameli* and the species included in Tornidae are in several characters: the operculum, which is multispiral with central nucleus, the cephalic tentacles are more ciliated, a single pallial tentacle, not two, as was observed in *Tornus subcarinatus* and *Ponderinella skeneoides*. Nevertheless, the radula has the same pattern as those of the genera *Tornus*, *Discopsis*, *Ponderinella* and *Naricava*.

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REFERENCES

- AARTSEN, J. J. VAN, CARROZZA, F. & MENKHORST, H. P. M. G., 1998. *Tornus mienisi*, a new species of *Tornus* from the Eastern Mediterranean (Mollusca: Prosobranchia). *Bollettino Malacologico*, 33(9-12): 135-138.
- ABBOTT, J. T., 1974. *American Seashells*. Van Nostrand Reinhold Company, New York. 663 pp., 23 pls.
- ADAM, W. & KNUDSEN, J., 1969. Quelques genres de mollusques prosobranches marins inconnus ou peu connus de l'Afrique occidentale. *Bulletin Institut royal des Sciences naturelles de Belgique*, 44(27): 1-69.
- AGEITOS DE CASTELLANOS, Z. J., 1989. *Catálogo descriptivo de la malacofauna marina magallánica 4*. CIC, Buenos Aires. 44 pp.
- ALTENA, C. O. VAN R., 1966. Vitrinellidae (Marine Molluscs Gastropoda) from holocene deposits in Surinam (Dutch Guiana). *Zoologische Mededelingen*, 41(16): 233-241.
- BERNARD, P. A., 1984. *Coquillages du Gabon*. P. A. Bernard, Libreville. 140 pp.
- DAUTZENBERG, P., 1912. Mission Gruvel sur la côte occidentale d'Afrique (1906-10). Mollusques marins. *Ann. Inst. Océanogr. Monaco*, 5(3): 1-111, pls. 1-3.
- DE JONG, K. M. & COOMANS, H. E., 1988. *Marine gastropods from Curaçao. Aruba and Bonaire*. E. J. Brill, Leiden, 261 pp., 47 pls.
- DÍAZ MERLANO, J. M. & PUYANA HEGEDOS, M., 1994. *Moluscos del Caribe colombiano*. Colciencias y Fundación Natura, Bogotá, 291 pp., 74 pls.
- ESPINOSA, J., FERNÁNDEZ-GARCÉS, R. & ROLÁN, E., 1988. Catálogo actualizado de los moluscos marinos actuales de Cuba. *Reseñas Malacológicas*, 11: 1-90.

- FERRERO, E. & MERLINO, B., 1992. Ricostruzione paleoecologica di una malacofauna del bacino pliocenico astigiano (Italia N.W.). *Bollettino Malacologico*, 28(5-12): 101-138.
- FOLIN, L. DE, 1867-1871. *Les Fonds de la Mer*, I. Paris. 316 pp.
- FRETTER, V., 1956. The anatomy of the prosobranch *Circulus striatus* (Philippi) and review of its systematic position. *Proceedings Zoological Society of London*, 126(3): 369-381.
- FRETTER, V. & GRAHAM, A., 1978. The prosobranch Molluscs of Britain and Denmark. Part 4. Marine Rissoacea. The *Journal of Molluscan Studies*. Supl. 6: 153-241.
- GARDNER, J., 1948. *Mollusca from the Miocene and Lower Pliocene of Virginia and North Carolina. Part. 2 Scaphopoda and Gastropoda*. Government Printing Office, Washington. 283 pp.
- GIANNUZZI-SAVELLI, R., PUSATERI, F., PALMERI, A. & EBREO, C., 1997. *Atlante delle conchiglie marine del Mediterraneo*. vol. 2. La Conchiglia, Roma. 258 pp.
- GOFAS, S., PINTO AFONSO, J. & BRANDÃO, M., 1985. *Conchas e moluscos de Angola*. Universidad de Agostinho Neto/Elf Aquitaine. Angola. 139 pp.
- GOFAS, S. & PONDER, W., 1991. The habitat and relationships of *Plagyostila asturiana* (Gastropoda, Rissoidae). *Bull. Mus. natl. Hist. nat. Paris*, 4^e sér., 13, section A, n^{os} 1-2: 39-47.
- GRAHAM, A., 1982. *Tornus subcarinatus* (Prosobranchia, Rissoacea) anatomy and relationships. *Journal of Molluscan Studies*, 48: 144-147.
- HASEGAWA, K., 1997. Sunken Wood-Associated Gastropods collected from Saruga Bay, Pacific Side of the Central Honshu, Japan, with descriptions of 12 new species. *National Science Museum Monographs*, 12: 59-123.
- HEDLEY, C. 1913. Studies of Australian mollusca, xi. *Proceedings Linnean Society of New South Wales*, 38.
- HIDALGO, J. G., 1917. *Fauna malacológica de España, Portugal y las Baleares. Moluscos Testáceos marinos*. Trabajos del Museo de Ciencias Naturales, Ser. Zoológica n^o 30, Madrid, 752 pp.
- JOUSSEAUME, F., 1867-1871. Etudes des genres *Teinostoma*, *Cyclostrema* et *Skenea*. *Revue Magazine Zoologie*, 2^eserie, XX: 331-338 and 388-396.
- LEAL, J. H., 1991. *Marine Prosobranch Gastropods from Oceanic Islands off Brazil*. W. Backhuys, Oegstgeest. 419 pp.
- LOCARD, A., 1898. *Expéditions scientifiques du "Travailleur" et du "Talisman"*. Vol. 2. Mason et Cie., Paris. 515 pp, 18 pls.
- MACEDO, M. C. C., MACEDO, M. I. C. & BORGES, J. P., 1999. *Conchas marinhas de Portugal*. Verbo, Lisboa. 516 pp.
- MARCHE-MARCHAD, I., 1958. Nouveau catalogue de la collection de Mollusques testacés de l'IFAN. *Catalogues IFAN*, 14: 1-84.
- MARSHALL, B. A., 1988. Skeneidae, Vitrinellidae and Orbitestellidae (Mollusca, Gastropoda) associated with biogenic substrata from bathyal depths off New Zealand and New South Wales. *Journal of Natural History*, 22: 949-1004.
- MARSHALL, J. T. 1902. Additions to "British Conchology". *Journ. Conch.*, 10: 190-193.

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- MIENIS, H. K., 1981. New or little known molluscs from the Eastern Mediterranean, 1-3. *Levantina*, 32: 387, 388.
- MONTAGU, G., 1803-1808. *Testacea Britanica, or natural history of British Shells*. Romsey, London. 606 pp, 16 pls. Supl. 183 pp, 17-30 pls.
- MOOLENBEEK, R. & HOENSELAAR, H. J., 1995. *Tornus tornaticus*, a new species from Mauritania, West Africa (Gastropoda; Tornidae). *Apex*, 10(1): 5-7.
- MOORE, D. C. 1969. *Cyclostrema miranda* Bartsch, a synonym of *Tornus subcarinatus* (Montagu). *Veliger*, 12(2): 169, 170.
- MOORE, D. R., 1972. *Cochliolepis parasitica* a non-parasitic marine gastropod and its place in the Vitrinellidae. *Bulletin of Marine Science*, 22(1): 100-112.
- MORRIS, P. A., 1973. *A field guide to shells of the Atlantic and Gulf Coast and the West Indies*. Houghton Mifflin Company, Boston. 330 pp, 76 pls.
- NICKLÈS, M., 1950. *Mollusques testacés marins de la Côte occidentale d'Afrique*. Paul Lechevalier, Paris. 269 pp.
- NOBRE, A., 1938-40. *Fauna malacológica de Portugal. 1. Moluscos marinhos e das águas salobras*. Companhia Editora do Minho, Porto. 807 pp, 87 pls.
- NORDSIECK, F. & GARCÍA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*. Aula de Cultura de Tenerife. 208 pp, 46 pls.
- OKUTANI, T., 2000. *Marine Mollusks in Japan*. Yokai, University Press, Tokyo. 1173 pp.
- PALLARY, P., 1912. *Exploration scientifique du Maroc. 2 fasc. Malacologie*. E. Larose, Paris. 108 pp, 1 pl.
- PILSBRY, H. A., 1953. Vitrinellidae, pp 411-447, pls. 49-56. In Olsson, A. & Harbison, A. *Pliocene Mollusca of Southern Florida*. The Academy of Natural Sciences of Philadelphia, Monographs 8 (reprint of 1990). 457 pp, 65 pls.
- PONDER, W. F., 1988. The Truncatelloidean (=Rissoacean) Radiation. A preliminary Phylogeny. *Malacological Review*. Suppl. 4: 129-164.
- PONDER, W. F., 1994. The anatomy and relationships of three species of vitrinelliform gastropods (Caenogastropoda: Rissoidea) from Hong Kong. In *The Malacofauna of Hong Kong and Southern China III* (ed. B. Morton), pp. 243-281. Hong Kong University Press, Hong Kong.
- PONDER, W. F. & KEYZER, R. G. DE, 1998. Superfamily Rissooidea, pp. 745-766 in Beesley, P. L., Ross, G. J. B. & Wells, A. (eds.) *Mollusca: The Southern Synthesis. Fauna of Australia*. Vol. 5. CSIRO Publishing: Melbourne, part B viii 565-1234 pp.
- PONDER, W. F. & WARÉN, A., 1988. Appendix. Classification of the Caenogastropoda and Heterostropha – A list of the family-group names and higher taxa. *Malacological Review*. Suppl. 4: 288-326.
- POPPE, G. T. & GOTO, Y., 1991. *European Seashells*. vol 1. Christa Hemmen, Darmstadt. 352 pp.
- POWELL, A. W. B., 1940. The Marine Mollusca of the Aupourian Province, New Zealand. *Trans. Roy. Soc. N. Z.*, 70(3): 205-248.
- POWELL, A. W. B., 1979. *New Zealand Mollusca*. Marine, land and freshwater shells. Collins. Auckland, Sydney, London. 500 pp.

- REDFERN, C., 2001. *Bahamian Seashells. A thousand species from Abaco, Bahamas*. Bahamianseashells, Boca Raton, 280 pp.
- RIOS, E., 1994. *Seashells of Brazil*. Editora de Furg, Rio Grande. 368 pp, 113 pls.
- RODRIGUEZ BABÍO, C. & RUBIO, F., 1993. Contribución al conocimiento de *Tjaernoia unisulcata* (Chaster, 1896)(Gastropoda, Heterobranchia, *Tjaernoia*). *Iberus*, 11(2): 75-77.
- RODRIGUEZ BABÍO, C. & THIRIOT-QUIÉVREUX, C., 1974. Gastéropodes de la region de Roscoff. Etude particuliere de la protoconque. *Cahiers de Biologie Marine*, 15: 531-549.
- ROLÁN, E., 1983. Moluscos de la Ría de Vigo, 1 Gasterópodos. *Tbalassas*, 1 (1), supl. 1: 1-383 pp.
- ROLÁN, E., 1986. Estudio comparado de las protoconchas de las especies del género *Hinia* Leach in Gray, 1857 (Gastropoda, Nassaridae) de los mares de Europa. *Iberus*, 6: 125-130.
- ROLÁN, E. & RUBIO, F., 1990. Aportaciones al conocimiento sobre los micromoluscos de África Occidental. 1. Tornidae de Sao Tomé y Príncipe. *Iberus*, 9(1-2): 181-186.
- SABELLI, B., GIANNUZZI-SAVELLI, R. & BEDULLI, D., 1990. *Catalogo annotato deo moluschi marini del Mediterraneo*. vol. 1. Librería Naturalistica Bolognesa, Bologna. 348 pp.
- SMITH, E. A., 1890. Report on the marine Molluscan fauna of the island of St. Helena. *Proz. Zool. Soc. London*, 1890: 247-317, pls. 21-24.
- SMITH, E. A., 1892. Further additions to the known marine Molluscan fauna of St. Helena. *Ann. Mag. Nat. Hist.* 1892: 129-135, pl. 12.
- THIELE, J., 1929. *Handbuch der Systematischen Weichtierkunde*. I. Gustav Fischer, Jena (Stuttgart), 376 pp.
- TRYON, G. W., 1888. Neritidae, Adeorbidae, Cyclostrematidae, Liotiidae. *Manual of Conchology*, 10: 10-160.
- VOKES, H. E. & VOKES, E. H., 1983. Distribution of shallow-water marine Mollusca, Yucatan Peninsula, Mexico. *Mesoamerican Ecology Institute, Monograph 1*: 1-183, 50 pls.
- WARMKE, G. L. & ABBOTT, R. T., 1961. *Caribbean Seashells*. Livingston Publishing Co, Wynnewood, Pennsylvania, 348 pp, 43 pls.
- WENZ, W., 1938-1944. *Handbuch der Palaozoologie*. 6. Gastropoda, I. Allgemeiner Teil und Prosobranchia. Gebrüder Borntraeger, Berlin. 1638 pp.
- WILSON, B., 1993. *Australian Marine seashells*. vol. 1. Odyssey, Kallaroo. 408 pp.

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