The family Turridae *s.l.* (Mollusca, Gastropoda) in Angola (West Africa), 1. Subfamily Daphnellinae

La familia Turridae *s.l.* (Mollusca, Gastropoda) en Angola (África occidental), 1. La Subfamilia Daphnellinae

Emilio ROLÁN*, Jorge OTERO-SCHMITT** and Francisco FERNANDES***

Recibido el 22-VIII-1996. Aceptado el 17-II-1997

ABSTRACT

A total of 12 species belonging to the subfamily Daphnellinae (family Turridae s.l.) collected from the coast of Angola have been studied. Six of these species are described as new, while the other six are recorded for the first time from Angola (*Diaugasma machadi*, *Raphitoma cerdeira*, *R. purpurea*, *R. leufroyi*, *Kermia alveolata* and *Gymnobela dautzenbergi*). The suprespecific taxa *Diaugasma*, *Philbertia*, *Raphitoma*, *Clathurella*, *Daphnella*, *Cythara*, *Propebela*, *Pleurotomoides*, *Kermia* and *Gymnobela* are commented on or discussed. In addition, *Cordieria*, *Pseudodaphnella* and *Asperdaphne* are considered as synonyms of *Raphitoma*, and *Clathurina* a synonym of *Kermia*. *Diaugasma* is recognized as a generic level, *Kermia* is considered to be present in the Atlantic ocean, and the taxa *Kermia alveolata* and *K. mehesh* are considered to be conspecific.

Some comments are made on the geographic distribution of the turrid fauna of Angola.

RESUMEN

Son estudiadas un total de 12 especies incluidas en la subfamilia Daphnellinae (familia Turridae s.l.) y recolectadas en Angola. Seis de estas especies son descritas como nuevas, y otras seis son citadas por vez primera para Angola (*Diaugasma machadi*, *Raphitoma cerdeira*, *R. purpurea*, *R. leufroyi*, *Kermia alveolata* y *Gymnobela dautzenbergi*). Los taxones suprespecíficos *Diaugasma*, *Philbertia*, *Raphitoma*, *Clathurella*, *Daphnella*, *Cythara*, *Propebela*, *Pleurotomoides*, *Kermia* y *Gymnobela* son comentados y discutidos. Además *Cordieria*, *Pseudodaphnella* y *Asperdaphne* son considerados sinónimos de *Raphitoma* y *Clathurina* sinónimo de *Kermia*. *Diaugasma* es elevado a nivel genérico, el género *Kermia* se considera que está presente en el Océano Atlántico, y los taxones conespecíficos los taxones *Kermia alveolata* y *K. mehesh*.

Se hacen comentarios sobre la distribución geográfica de la fauna de Turridae de Angola.

KEY WORDS: Turridae, Daphnellinae, *Raphitoma*, *Kermia*, *Diaugasma*, *Gymnobela*, Angola, new species.

PALABRAS CLAVE: Turridae, Daphnellinae, *Raphitoma*, *Kermia*, *Diaugasma*, *Gymnobela*, Angola, especies nuevas.

* Cánovas del Castillo, 22, 36202 Vigo, Spain.

** Avenida de las Ciencias s/n, 15706 Santiago de Compostela, Spain.

*** now deceased.

INTRODUCTION

The family Turridae s.l., is one of the most complex, confused and diverse in taxa among the Mollusca, with many species still to be studied and described.

More than 600 supraspecific taxa have been described within this family, many of which have inadequate descriptions, others are fossil, and there are usually few data about their anatomy, opercula and radulae. Therefore, the systematic arrangement of this family becomes very difficult.

Recently, Taylor, Kantor and Sysoev (1993) have revised the Conoidea Rafinesque, 1815, based upon the foregut anatomy and feeding mechanisms, proposing important supragenetic changes. As a result they propose the inclusion of the subfamily Daphnellinae Deshayes, 1863 in the family Conidae Fleming, 1822. Until this opinion meets with general acceptance, we prefer to continue employing the family name Turridae in the traditional sense.

There are several descriptions of species of Turridae s.l. in general works dealing with West Africa coasts (Reeve, 1843-46; Thiele, 1925; Martens, 1903), as well as in local works (Lamy, 1923; Petit, 1839; Dautzenberg, 1910 and 1913; Strebel, 1912, 1914; Knudsen, 1952, 1956). Kilburn (1983, 1985, 1986, 1988a, 1988b, 1989, 1991, 1992, 1993, 1994) is engaged in an extensive revision of this family from South African coasts, although mainly from the Indian Ocean side. Recently Gofas (1991), Rolán and Fernandes (1993), Rolán, Otero-Schmitt and Fernandes (1994) and Fernandes, Rolán and Otero-Schmitt (1996) have revised and described new species from different areas of the West African coast.

Our revision of the bibliography on West African molluscs showed that most studies deal with larger species (mainly of the genera *Clavatula, Gemmula, Pusionella*, etc.), however even these require some taxonomical corrections. The generic position of several species is confused, so we are attempting to revise some genera and species of West African turrids based upon the material collected in Angola.

Previous interpretations of the subfamily Daphnellinae Hedley, 1922 have been confusing, with its species included in part in Raphitominae Bellardi, 1875, Belfranciinae H. and A. Adams, 1858 and Cytharinae Thiele, 1925 (Powell, 1966).

MATERIAL AND METHODS

The authors have studied material collected in Angola mainly by the third author. Most of this material was collected by diving or by dredgings. Small shells were obtained from sediment samples under magnification. Other material was borrowed from MNHN (collected by S. Gofas). Additional material from other East Atlantic areas was used for comparison purposes, from the collections of MNCN, F. Fernandes, F. Rolan, J. Otero-Schmitt, P. Ryall, M. Pin, F. E. Hattenberger and L. Dantart (see below). Type material was studied from several museums (mentioned in acknowledgements).

The SEM studies were made by José Redova of the MNCN, Madrid, Bernardo Fernandez Souto of the Servicios Generales de Apoyo a la Investigación, A Coruña University and Jesús Méndez of Centro de Apoyo Científico a la Investigación (CACTI), Vigo University.

Radula studies were not carried out in the present work because we wanted to avoid damaging our few live-collected specimens, these being examples of species for which we had only limited material. Also, because the radula of most of the European species with which they were compared was unknown, while on the other hand the new species showed clear conchological differences.

Abbreviations used:

AMNH: American Museum of Natural History, New York, USA

BMNH: The Natural History Museum, London, United Kingdom
CER: collection of Emilio Rolan, Vigo, Spain
CEF: collection of Francisco Fernandes, Luanda, Angola
CMP: collection of Marcel Pin, Dakar, Senegal
COS: collection of Jorge Otero Schmitt, Santiago de Compostela, Spain
CPH: collection of Paul Henry Hattenberger, Pointe Noire, Congo
CFR: collection of Peter Ryall, Takoradi, Ghana
IRSN: Institute Royal des Sciences Naturelles, Bruxelles, Belgique
MNCN: Museo Nacional de Ciencias Naturales, Madrid, Spain
MNHN: Museum National d'Histoire Naturelle, Paris, France
ZMC: Zoologisk Museum of Copenhagen, Denmark

When the source of the material is not indicated, it is from CER

RESULTS

Subfamily DAPHNELLINAE Hedley, 1922

Shells small or not. Protoconch usually cancellated, a sutural sinus like a reversed letter L, a radula of awl-shaped marginals, and the operculum absent or vestigial. Very numerous in genera and species, with a world-wide distribution ranging in time back to the Eocene, but the greatest development is late Tertiary and Recent (POWELL, 1966).

Genus *Diaugasma* Melvill, 1917

Melvill described the taxon *Diaugasma* as a subgenus of *Daphnella* Hinds, 1844, but the features of the type species *Daphnella epicharta* Melvill and Standen, 1903 (see POWELL, 1966, p. 123, pl. 19, fig. 17) do not fit well with those of the type species of *Daphnella*, *Fleuriotoma hymneiformis* Kiener, 1839-40 (see POWELL, 1966, pl. 19, fig. 16). *Diaugasma* has a narrowly ovate aperture that reaches up to nearly half the length of the shell, the spire whorls are almost flat-sided, and the siphonal canal is narrower. Therefore, we think that these differences could be enough to consider both taxa as different genera, raising up *Diaugasma* to generic level. Type species from the Gulf of Oman.

Diaugasma marchadi (Knudsen, 1956) (Figs. 1-4)

Philbertia marchadi Knudsen, 1956. *Bull. I.F.A.N.*, 18, ser. A, 2: p. 526, pl. 1, fig. 9.

Material studied: Angola. 1 shell, 40-60 m, Ilha de Luanda (MNHN); 1 shell, 50-60 m, Mussulo, Luanda (MNHN); 46 shells, 90-100 m, Mussulo, Luanda (MNHN); 30 shells in sediment, 20 m off Luanda; 29 shells, 50 m, off Luanda; 45 shells, 100 m, off Luanda; 5 shells, 5 m, Cacuaco, province of Luanda. French Guinea: holotype, 8-18 m, Ile de Los (ZMC).

Description: Shell, see KNUDSEN (1556) and Figs. 1-3.

In the original description, the protoconch is described as having 2 ½ smooth whorls followed by the beginning of the teleoconch with several curved ribs. This last part (Fig. 4), in our opinion, should be considered the last whorl of the protoconch, which then has about 3 whorls.

Habitat: Only empty shells have been found on sandy bottoms.

Geographical distribution: Known from French Guinea to Angola.

Remarks: *Diaugasma marchadi* lacks the main characteristics of the genus *Philbertia* (type species *Pleurotoma philberti* Michaud, 1830), whose shell has a more prominent spire, deeper suture and stronger sculpture. Therefore, we include the present species in the genus *Diaugasma* because of the similarity of the shell to the type species of this genus. A problem for this inclusion is that the protoconch of *D. marchadi* (Fig. 4) lacks the reticulated sculpture typical of the Daphnellidae, but has a common form that is present in several different genera. On the other hand, POWELL (1966) notes some variability of the protoconch saying that "... the protoconch varies from tall, diagonally cancellated, polygyrate to paucispiral and almost smooth". As we had no information on soft parts from the type or from our material, we had no other possibility of comparison. So we have decided to give more importance to the shell characters and consider this kind of protoconch, which is present in several genera, as not being a distinguishing factor in this case.

Genus *Raphitoma* Bellardi, 1847

POWELL (1966) mentions several dissimilar interpretations of this genus due to conflicting opinions regarding the type species. The type species designated by Monterosato is a fossil species, *Pleurotoma hystrix* Bellardi, 1847, with paucispiral protoconch. Some authors (references in BOUCHET, 1990) have separated similar species into different genera because of their different kinds of protoconch. A problem arises within this group (as commented on by POWELL, 1966) since Sykes claimed that *R. hystrix* and *R. pseudohystrix* had different kinds of protoconch. The species described below have a protoconch similar to that of *R. pseudohystrix*, and so they should not be included in the genus *Raphitoma* according to this criterion. Nevertheless, we agree with BOUCHET (1990), who has already stated that different types of protoconch may occur within the same genus. Pliocene of Europe and Recent Mediterranean and Atlantic.

Raphitoma cordieri (Payraudeau, 1826) (Figs. 5-7)

Pleurotoma cordieri Payraudeau, 1826, *Moll. de Corse*, p. 144, pl. 7, fig. 11.

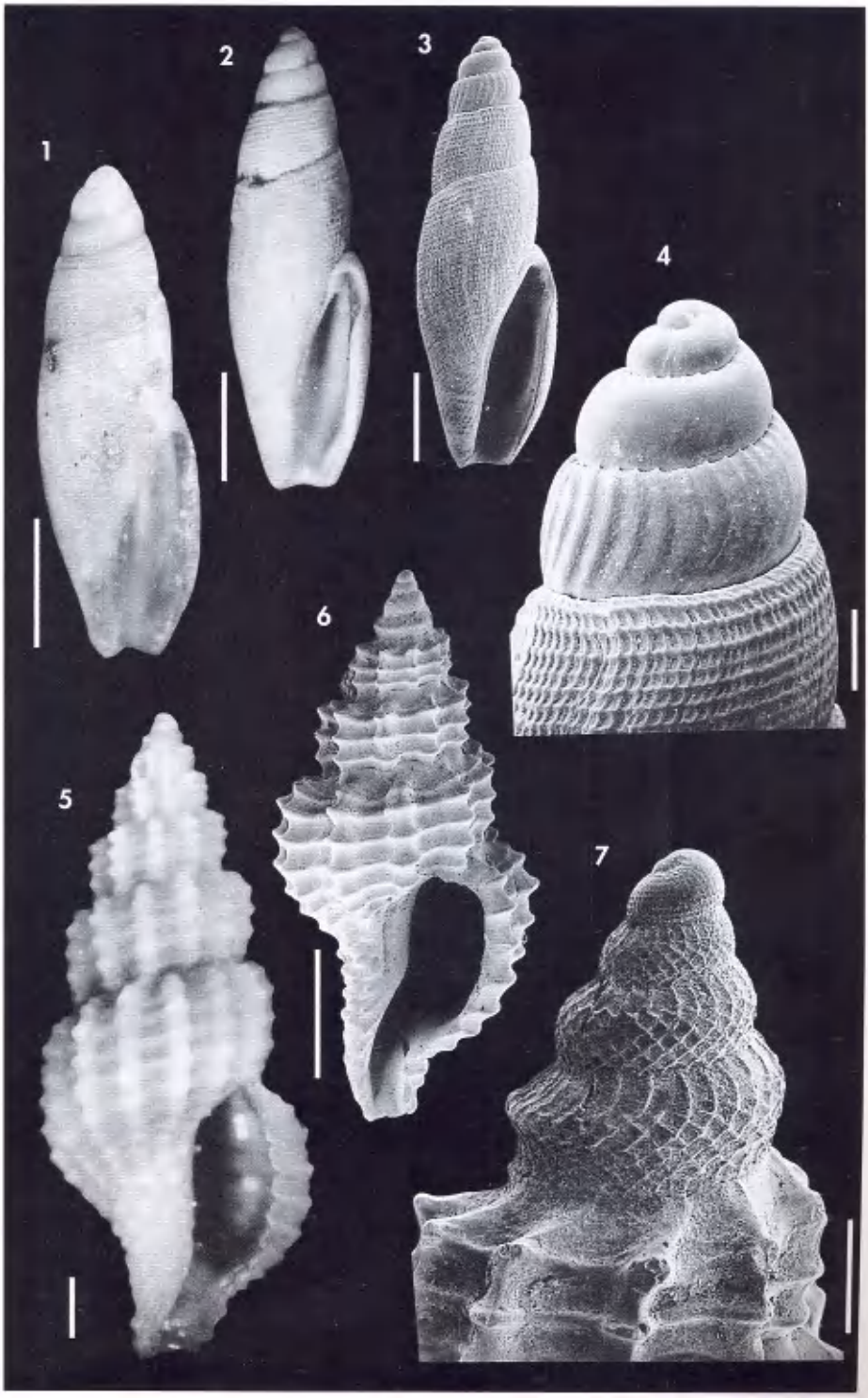
Material studied: Angola: 1 specimen, 20 m, Comuba, Luanda; 2 specimens and 27 shells, 40-60 m, off Luanda; 2 shells, 100 m, off Luanda; 1 specimen and 5 shells, 60 m, Ilha de Luanda (MNHN); Ghana: 6 fragments, 20 m, Miamia (CPR). Mauritania: 1 shell, intralittoral, Nouadhibou. Morocco: 1 shell, intertidal, Oualidh a.

Description: Shell (Figs. 5, 6) fusiform, with around 5 whorls with prominent axial ribs crossed by spiral threads, 3-4 on the first whorl, 5 on the penultimate and up to 18 on the body whorl, the 6 lower being nodulose.

Protoconch (Fig. 7) with 4 whorls; sculpture of axial ribs crossed by spiral

(Right page). Figures 1-4. *Diaugasma marchadi*. 1: holotype, Ile de Los (ZMC); 2-3: shells from Luanda (optical and SEM photographs respectively); 4: protoconch. Figures 5-7. *Raphitoma cordieri*. 5, 6: shells from Luanda (MNHN); 7: protoconch. Scale bars: shells: 1 mm; protoconchs: 0.2 mm.

(Página derecha). Figuras 1-4. Diangasma marchadi. *1: holotipo, Ile de Los (ZMC); 2-3: conchas de Luanda (fotografías de microscopía óptica y electrónica respectivamente), 4: protoconcha. Figuras 5-7*. Raphitoma cordieri. *5, 6: conchas de Luanda (MNHN), 7: protoconcha. Escalas: conchas: 1 mm; protoconchas: 0.2 mm.*


1
2
3
4
5
6
7

threads, with elevations at the crosspoints; the subsutural part without spiral sculpture. A distinct peripheral shoulder at the end of last whorl.

Teleoconch with suture well-marked, with scalariform whorls.

Aperture rectangular-ovoid with a short siphonal canal and a deep sinus.

Cream colour with light brown at the base and suture. Size up to 10 mm.

Animal translucent white with milk white or slightly yellowish spots on the cephalic tentacles, siphon and the whole dorsum of the foot.

Habitat: Infralittoral on rocky and sandy bottoms.

Geographical distribution: Known from the Mediterranean Sea to Angola.

Remarks: This species is the type species (by monotypy) of the genus *Cordieria* Monterosato, 1884. This genus is considered a synonym of *Philbertia* Monterosato, 1884 by POWELL (1966). However the genus *Philbertia* is difficult to evaluate nomenclaturally (POWELL, 1966) because its type species, *Pleurotoma philberti* Michaud, 1830, lacks the distinguishing characteristics of other species previously included in the genus *Raphitoma* Bellardi, 1848. The subsequent designation by CROSSE (1884) of *Fusus rotatus bicolor* Risso, 1826 as type species of *Philbertia* does not change the situation, because this species is evidently a *Raphitoma*. Therefore we prefer to keep this species in *Raphitoma* and, unlike AARTSEN ET AL. (1984), we regard *Philbertia* as a dubious genus.

The material studied shows shells slightly different in size and colour than those of the Mediterranean but these differences are compatible with geographic variations.

Raphitoma purpurea (Montagu, 1803) (Figs. 8-12)

Murex purpureus Montagu, 1803. Test. Brit., p. 260, pl. 9, fig. 3.

Material studied: Angola: 10 specimens and 2 shells, 20 m, Corimba, Luanda; 2 shells, 50 m, off Luanda; 3 shells, 20 m, Palmeirinhas, 1 shell, 20 m, Palmeirinhas (all CFR ex CFF). Ghana: 1 shell, 4 m, Busua I. Spain: more than 100 specimens and shells, from several localities of west Galicia (Vigo, Sanxenxo, Beluso, Ons, Cies, Puehla del Carem final, Corrubedo, Ramña, Muros, Camota, etc.) (CFR and COS). Portugal: 4 shells, 3 m, Sesimbra. England: lectotype (here designated, Fig. 8) and 2 paralectotypes, (BMNH, n° 1995099). Salcombe Bay, British coast.

Description: Shell: see Figs. 8-10 and JEFFREYS (1867), NORDSIECK (1977), ROLÁN (1983), FRETTER AND GRAHAM (1984) and GRAHAM (1988).

Protoconch (Figs. 11, 12) of 4 whorls, the first with reticulated sculpture formed by the crossing of axial and spiral threads, the others convex, with axial threads which are curved at the shoulder and crossed by others which are oblique; on the last whorl the peripheral angle is very prominent.

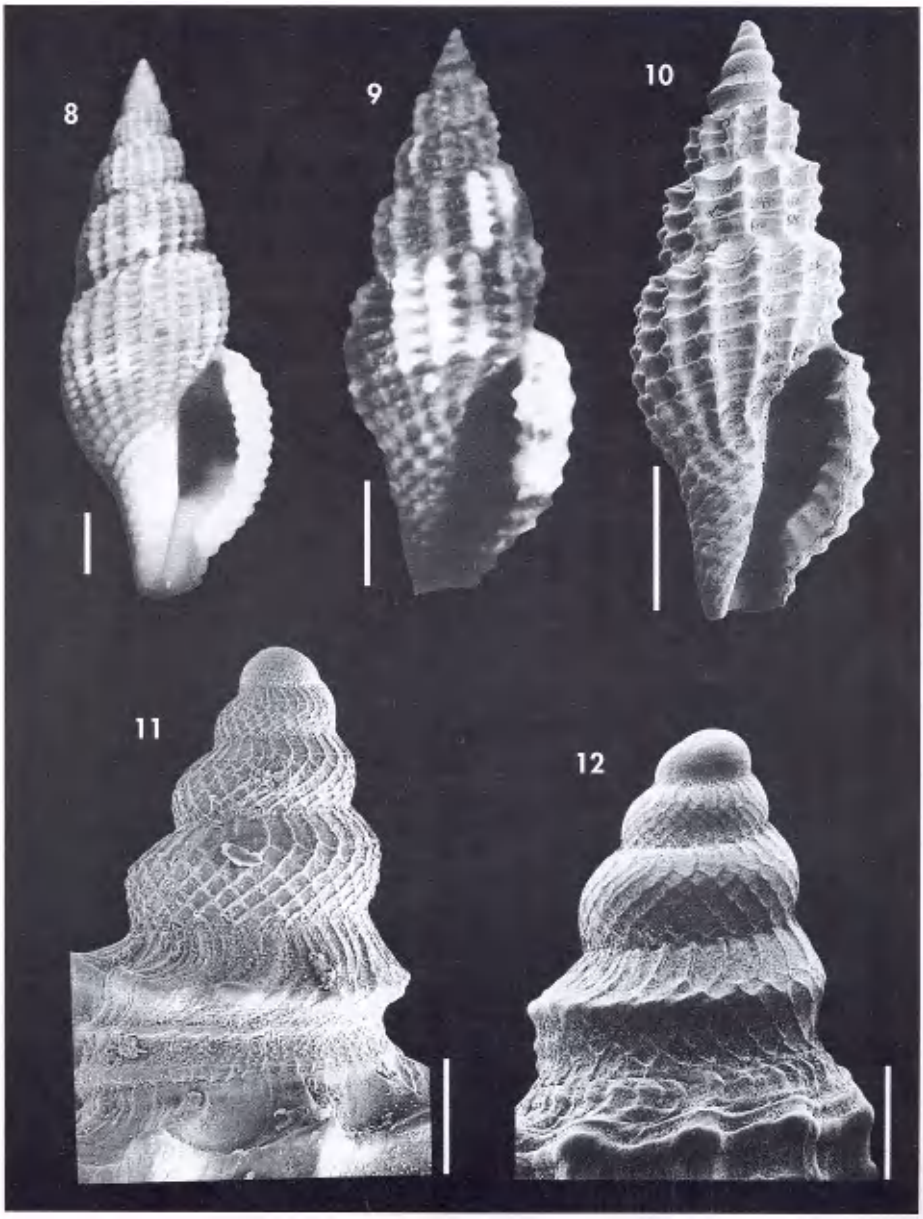
Animal (from Angolan specimens) with translucent-cream foot with little milk-white spots; siphon black, white at its extremity; a black area at the base of the tentacles, covering almost all the head.

Animal from specimens from Vigo (NW Spain) is translucent white with numerous little milk-white spots. The siphon is grayish, but nearly white on animals with lighter shells.

Operculum oval-elongated, brown, with the nucleus in its upper extremity.

Habitat: Found on rocky bottom, down to 20 m deep. Some were found eating small polychaete worms which were much bigger than them.

Geographical distribution: *R. purpurea* is known in the north Atlantic from Norway to Lusitanic Province and the Mediterranean Sea (JEFFREYS, 1867; FRETTER AND GRAHAM, 1984; GRAHAM, 1988). It is also known from the Canary Islands (NORDSIECK AND GARCIA-TALAVERA, 1979). There are no records from West African continental coasts, and the present one extends its known distribution area to Angola.



Figures 8-12. *Raphitoma purpurea*. 8: syntype (BMNH); 9, 10: shells from Luanda (CFR); 11: protoconch from Luanda; 12: protoconch from Vigo. Scale bars, shells: 1 mm; protoconchs: 0.2 mm.
Figuras 8-12. Raphitoma purpurea. *8: síntipo (BMNH). 9, 10: conchas de Luanda (CFR); 11: protoconcha de Luanda; 12: protoconcha de Vigo. Escalas: conchas: 1 mm, protoconchas: 0,2 mm.*

Remarks: It is possible that the forms usually included within the taxon *R. purpurea* embrace more than one species because there are populations with very different morphology and habitat. ROLÁN (1989) compares specimens li-

ving intertidally among boulders and algae from the Ria de Vigo having very dark brown shells with white spots. In others living on sand or rubble at a depth of 10 m. These larger specimens can reach 23 mm, and have cream or slightly dark shells. There are also some questionable close forms in the Mediterranean. The specimens from Angola are smaller (around 5 mm), very solid, dark brown in colour and with subsutural white spots, but they do not differ in the main characters. A few shells from Corimba are slender and almost uniformly brown, which means that a complex of species may also exist in Angola.

Raphitoma zelotypa spec. nov. (Figs. 13-15)

Material studied: Angola: 1 shell, 3 m, Palmeirinhas; 1 specimen and 1 shell, 20 m, Palmeirinhas; 1 shell, 30 m, Palmeirinhas (MNHN); 2 specimens and 3 shells, 40-60 m, off Luanda. Congo: 2 juveniles, Point-Noire (CPH). Ghana: 2 fragments, 20 m, Miamia.

Type material: Holotype (Fig. 13) of 7.4 mm deposited in MNCN (nº 15.05/20541). Paratypes in the following collections: AMNH (1), MNHN (1), CDS (1) from type locality, and CFR (3) from Luanda.

Type locality: Palmeirinhas, south Angola.

Etymology: The specific name is derived from the latin word *zelotypa* which means "invidious", alluding to its similarity with *R. purpurea*.

Description: Shell (Figs. 13, 14) turriculate fusiform, elongated, with stepped whorls, distinct suture and pointed apex.

Protoconch (Fig. 15) with the first whorl appearing smooth, but with SEM it is possible to see a fine reticulation; there are 3 further whorls with the upper middle bearing curved axial riblets while the lower part has a reticulated surface being crossed by fine oblique threads.

Teleoconch of 4-5 whorls with many axial ribs, about 20 on the body whorl, crossed by fine spiral threads which form nodules at the cross points; there are 15 on the body whorl and those on the base are somewhat granulated. Aperture elongated, with teeth inside the slightly thickened outer lip; siphonal canal short, broad and only slightly curved; sinus quite deep, located at the level of the suture. Whitish ground colour, with big brown subsutural spots. Size to 8.5 mm.

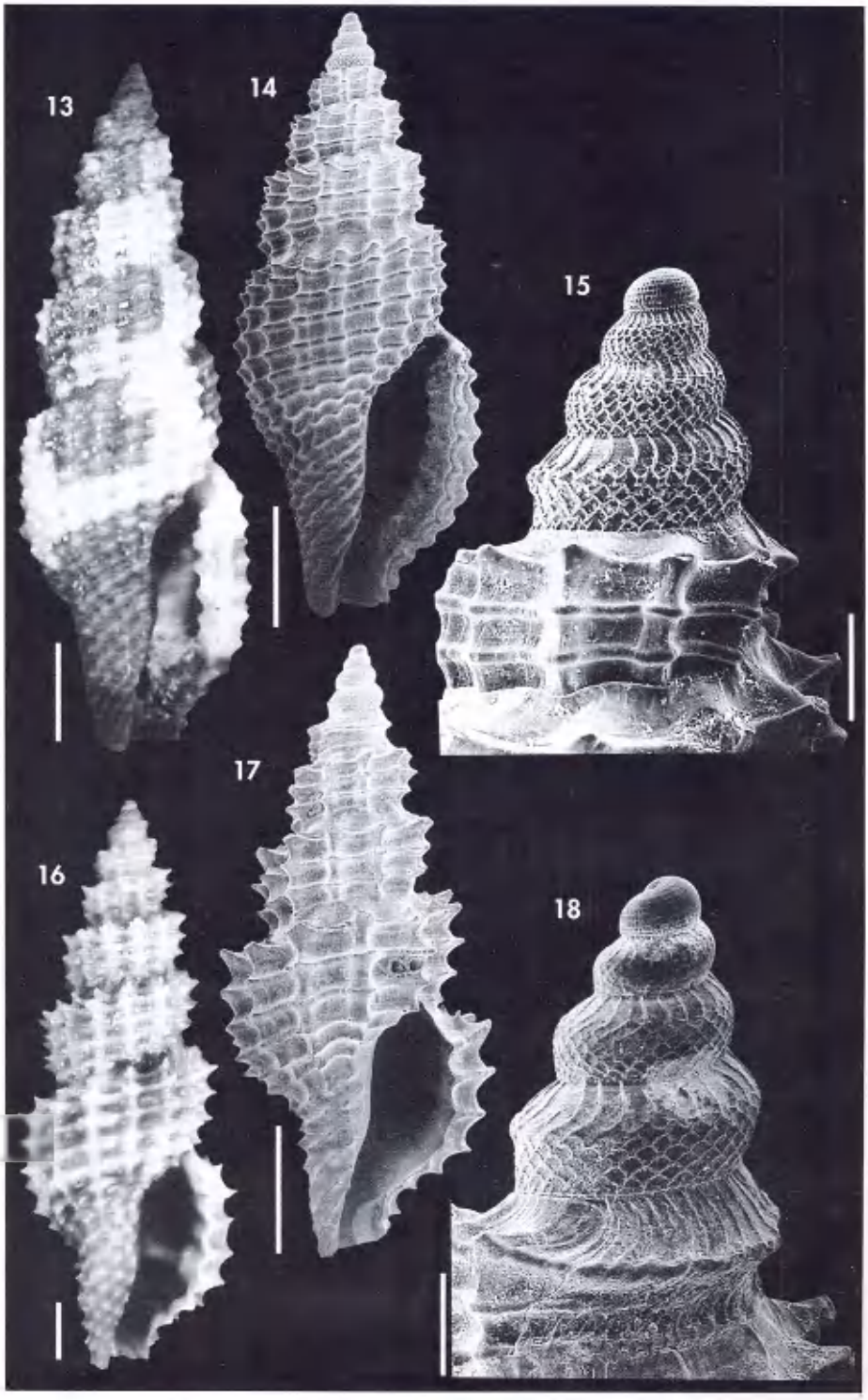
Habitat: Found on rocky bottoms between 3 and 30 m.

Geographical distribution: Known from Ghana to Angola.

Remarks: The present species is quite similar to *Fleuriotoma foraminata* Reeve, 1845, type species (by original designation) of the genus *Clathurina* Melvill, 1917, a synonym of *Kermia* Oliver, 1915 according to Powell (1966). In our opinion, *R. zelotypa* spec. nov. should not be included in the genus *Kermia*, because its spiral sculpture is more densely disposed than that of the type species of *Kermia*, *K. benhami* Oliver, 1915, and also its sinus lacks a subsutural varix on the upper part of the inner lip. However, *R. zelotypa* spec. nov. is quite similar to most species included in the genus *Raphitoma*.

(Right page). Figures 13-15. *Raphitoma zelotypa* spec. nov. 13: holotype, Palmeirinhas (MNCN). 14: paratype (CFR). 15: protoconch. Figures 16-18. *Raphitoma chrisdinedi* spec. nov. 16: holotype, Palmeirinhas (MNHN); 17: shell, Luanda; 18: protoconch. Scale bars: shells 1 mm; protoconchs 0.2 mm.

(Página derecha). Figuras 13-15. Raphitoma zelotypa spec. nov. 13: holotipo, Palmeirinhas (MNCN). 14: paratipo (CFR). 15: protoconcha. Figuras 16-18. Raphitoma chrisdinedi spec. nov. 16: holotipo, Palmeirinhas (MNHN); 17: concha, Luanda; 18: protoconcha. Escalas, conchas: 1 mm; protoconchas: 0,2 mm.


13
14
15
16
17
18

R. zelotypa spec. nov. is rather similar to *Raphitoma purpurea* (Montagu, 1803) but it is smaller and more slender than European specimens, although it is similar in size to those from Angola. The shells of *R. zelotypa* of the same length as the Angolan *R. purpurea* are more slender, its aperture is more rectangular and its colour is white with subsutural dark brown spots instead of dark-brown with subsutural axial white lines as in *R. purpurea*.

Raphitoma christfriedi spec. nov. (Figs. 16-18)

Material studied: Angola: 2 specimens, 3 m, Pt. Mesombas; 2 shells, 20 m, Palmeirinhas, 1 specimen and 12 shells, 60 m, off Luanda, 5 shells and several fragments with protoconch, 90-100 m, Mussulo (MNHN), 1 specimen, 60 m, Ilha de Luanda (MNHN); 2 specimens, Praia Santiago, 1 specimen and 2 shells, 20 m, Corimba, Luanda.

Type material: Holotype (Fig. 16) of 11 mm deposited in MNHN. Paratypes in the following collections: MNHN (6), MNCN (2; 15.05/20542), AMNH (2), BMNH (1), CBR (17), COS (2), CPR (1).

Type locality: Palmeirinhas, south Angola.

Etymology: The species is named after Christfried Schoenherr, a friend and malacologist who helped in field collecting.

Description: Shell (Figs. 16, 17) solid, ovoid-fusiform, with pointed apex.

Protoconch turriculated (Fig. 18), between 4 to 4 1/2 whorls, the first slightly reticulated, the others with oblique axial threads, crossed in the middle and lower part by other threads forming a net, last whorl with distinct peripheral shoulder.

Teleoconch of 5.6 whorls, with 10-13 axial ribs crossed by 3-5 spiral threads uniformly spaced, except for the 2 upper ones, which may be nearly fused. Where they cross the ribs, they form a sharp prominence with one or several points. Last whorl with 14 spiral threads, the basal ones tuberculated. Aperture oval elongated, nearly rectangular, with a deep sinus at the suture. Base of aperture with a short, opened and slightly curved canal. Inner part of the outer lip with about 7 prominent teeth. Protoconch brown in colour with lighter cream circular blotches arranged in two spiral rows; teleoconch light brown with axial ribs lighter and a brown band on the body whorl, at the level of the upper part of the aperture, the base being lighter. Size 10-14 mm.

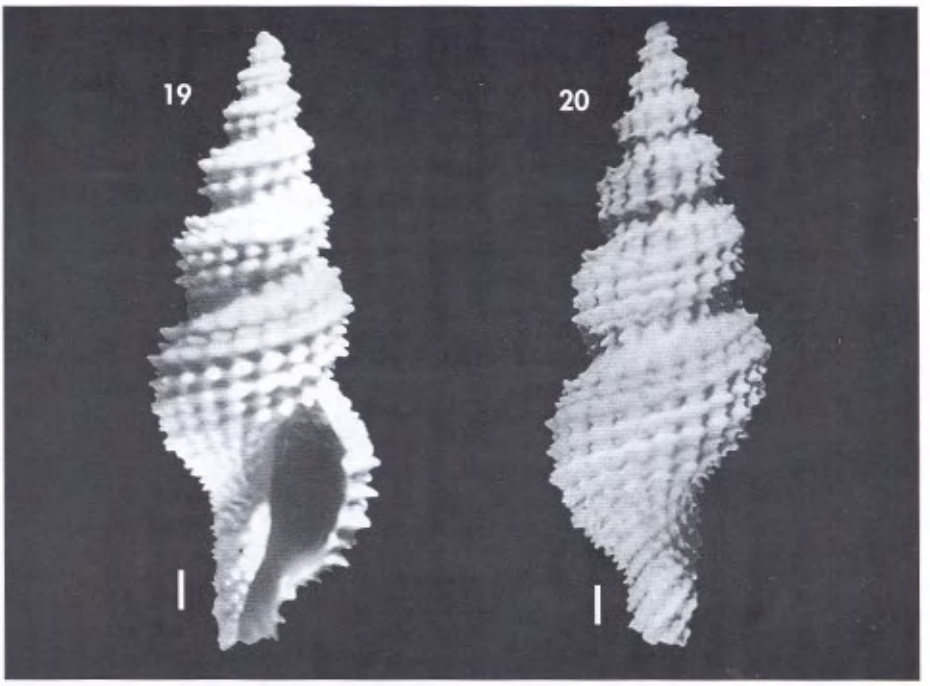
Animal white, with opaque white yellowish spots at the base of the siphon, 1-2 on the tentacles and a few on the body. One specimen showed a greyish spot at the base of the siphon and some isolated black dots.

Habitat: Found on dead coral, 20-90 m deep.

Geographical distribution: Only known from Angola.

Remarks: *R. hystrix* De Cristofori and Jan, 1832 or *R. histrix* Bellardi, 1847 are names for a fossil species of the Italian Pliocene, which is also recorded as living in the Mediterranean Sea and in West Africa (Carrozza, 1964). About the nomenclatural problems with this taxa see Aartsen et al. (1984: p. 88-90). We have examined photographs of *R. hystrix* (Figs. 19, 20) in the Jan collection, located in the Dipartamento di Scienze della Terra di Torino, which are similar to the figure of Bellardi (1847). Comparison of these shells with *R. christfriedi* spec. nov. shows the following differences: *R. hystrix* is less spiny, with spiral threads of uneven size, showing 7 on the penultimate whorl, while *R. christfriedi* spec. nov. has no more than 5 threads, which are uniform in strength. *R. hispidula* (Bellardi, 1847), regarded by several authors as a form of *R. hystrix*, also has more numerous spiral threads, which are of different strength.

Rocci, Coppini and Margelli (1980a, p. 19, fig. 6) show a *Raphitoma* sp. very similar to the present species, under the name of *R. mirabilis* (Pallary, 1904), but this name is not usable because it is preoccupied by *Clathurella mirabilis* Locard, 1892, which is in our opinion a species of



Figures 19, 20. *Raphitoma hystrix* (Università degli Studi di Terra, Torino). Scale bars 1 mm.
Figures 19, 20. Raphitoma hystrix *(Università degli Studi di Terra, Turin). Scales 1 mm.*

Raphitoma, in contrast to the opinion of SABELLI, GIANNUZZI SAVELLI AND BEDULLI (1992), who consider it within *Philbertia*. Anyway, its presence in the Mediterranean Sea should be confirmed in the future.

The present species is not *R. pseudohystrix* (Sykes, 1906), which has a paucispiral protoconch. *R. echinata* (Brocchi, 1814) has more spiral threads and its aperture is more rounded.

Raphitoma kahuli spec. nov. (Figs. 22–24)

Material studied. Angola: 1 specimen, 40 m, ilha de Luanda (MNHN). 16 specimens and 17 shells, 20 m, Corimba; 2 shells, 20 m, Corimba (MNHN); 1 specimen, 7 m, Cacuaco, province of Luanda; 1 shell, 10 m, Cacuaco, province of Luanda (MNHN); 1 shell, Ambrizete (Phare) (MNHN); 2 shells, Barra do Dande (Bengo) (MNHN); 3 shells, intertidal level, Praia Santiago (MNHN); 2 specimens, Praia Santiago; 5 specimens and 32 shells, 3 m, Palmeirinhas; 13 specimens, 15 m, Palmeirinhas; 2 shells, 30 m, Palmeirinhas; 8 specimens, 3 m, Buraco, Palmeirinhas; 1 shell, 2 m, Praia Amelia; 2 shells, 100 m, off Luanda; 25 shells, 40 m, off Luanda; 6 shells, 20 m, Corimba, Luanda. Congo: 8 shells, Pointe Noire (CPH); Ghana: 11 shells and 25 fragments, 20 m, Miamia (CPR). Cape Verde Islands: 1 shell, 1 juvenile and 3 fragments, Sal Rei, Boavista.
Type material. Holotype (Fig. 22) of 6.2 mm deposited at the MNCN (15.05/20543). Paratypes in the following collections: MNHN (4), BMNH (2), AMNH (2), IRSN (2), ZMC (2), CER (19), CCS (2), all from the type locality.
Type locality. Corimba, Luanda.
Etymology. It is named after Nelson Casimiro (Kahulo or Kabu), a young boy who helped us a lot on collecting trips.

Description: Shell (Figs. 22, 23) solid, ovoid-fusiform, with a well marked suture, scalariform spire and pointed apex.

Protoconch turriculated (Fig. 24), with 4 whorls, the first slightly reticulated, the others with oblique axial threads, crossed in the middle and lower part by other threads to form a net; body whorl with a distinct peripheral shoulder.

Teleoconch with 2 to 3 1/2 whorls. Sculpture of 8-9 strong axial ribs crossed by thin spiral threads which are slightly serrated, the upper ones sometimes with prominent spines at the cross-points; the number of spiral threads is 2 on the first whorl of the teleoconch, 4 on the following, and 14-15 on the body whorl, where the lower threads are nodulose. Under magnification, fine axial lines, corresponding with the serration of the spiral threads, can be seen and, between them, a dense microsculpture of very small granules (Fig. 23). Aperture oval elongated, with a sharp outer lip, and a callus corresponding to the last rib; there are 2 prominent teeth on the inner surface, one near the siphon and the other near the sinus; there are 3-4 smaller teeth between them. Siphonal canal short, broad and slightly curved. U-shaped sinus in the upper part of the aperture.

Colour: protoconch light brown; teleoconch with creamy white ground colour; the spiral threads are brown, and this colour is lost on the alternate cross-points; the thread which is a continuation of the suture on the body whorl is entirely white and the upper and the basal ones are entirely brown. Two shells from the Cape Verde Islands supposedly belonging to this species, have a brown base.

Size: 4-6 mm.

Animal: milk white.

Habitat: Found on sandy bottom, on stones, from 1-2 m down to 30 m in depth.

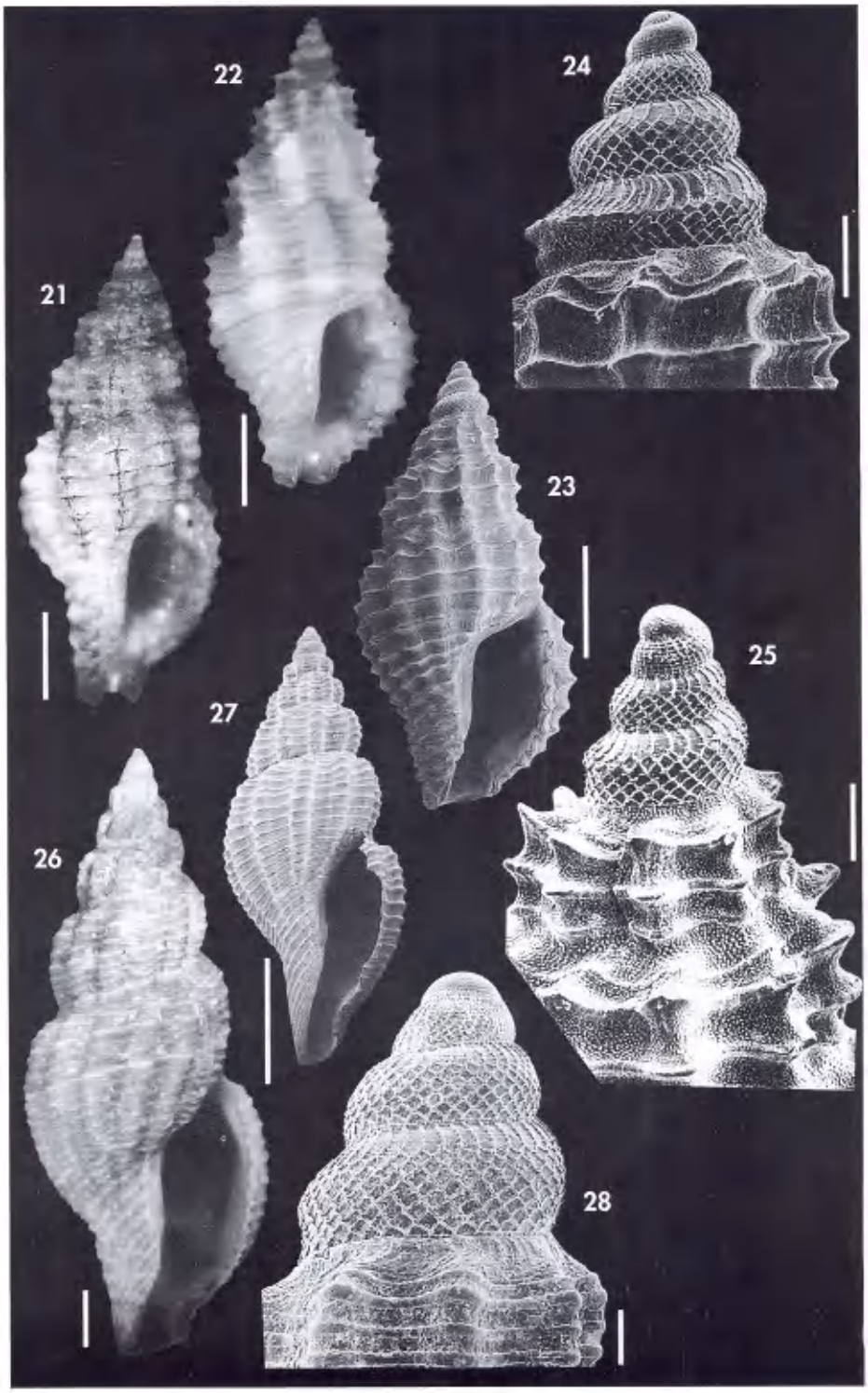
Geographical distribution: Known from Ghana to Angola. A few shells collected in Cape Verde Islands may belong to this species though they have small differences.

Remarks: This species, because of its morphological features, could be close to *Clavatula raza* Hinds, 1843, type species of the genus *Clathurella* Carpenter, 1857. Moreover, the surface pebbled in places with minute pustules is a characteristic present in *R. linearis* (Montagu, 1803) and *R. kabuli* spec. nov. as well as in *Clathurella*. Nevertheless, there are conflicting opinions regarding the status of the taxon *Clathurella* and details of the protoconch of the type species are unknown (Powell, 1966). So considering its similarity with the type species of the genus *Raphitoma*, we prefer to include *R. kabuli* in this genus, as has been done with its most similar species, *R. linearis* (Bogi et al., 1980b; Poppe and Goto, 1991).

The shell of this species is close to *R. linearis*. Syntypes of the latter species are in BMNH reg. nº 1995050, being the shell with better protoconch represented in Figure 21. Comparison with this species shows their differences: *R. kabuli* is smaller and shorter (usually smaller than 6 mm, *R. linearis* can reach 12 mm) and its siphonal canal is less prominent; the protoconch of *R. kabuli* has a nucleus of 0.082 mm and a first half whorl of 0.198 mm, instead of 0.103 and 0.179

(Right page): Figure 21. *Raphitoma linearis*, lectotype (BMNH). Figures 22-24. *Raphitoma kabuli* spec. nov. 22: holotype, Corimba (MNCN); 23: paratype (CER); 24: protoconch (CER). Figure 25. Protoconch of *Raphitoma linearis*, Canary Is. (CER). Figures 26-28. *Raphitoma leufroyi*. 26, 27: shells from Angola (CER); 28: protoconch (CER). Scale bars: shells: 1 mm; protoconchs: 0.2 mm.

(Página derecha) Figura 21. Raphitoma linearis, *lectotipo (BMNH). Figuras 22-24.* Raphitoma kabuli *spec. nov. 22: holotipo, Corimba (MNCN); 23: paratipo (CER); 24: protoconcha (CER). Figura 25. Protoconcha of* Raphitoma linearis, *Islas Canarias (CER). Figuras 26-28.* Raphitoma leufroyi. *26, 27: conchas de Angola (CER); 28: protoconcha (CER). Escalas: conchas: 1 mm; protoconchas: 0,2 mm.*


22
24
21
23
25
27
26
28

mm as in the lectotype of *R. linearis*. We have examined the protoconch of a specimen from Canary Is. (Fig. 25), which is shown to be shorter than the protoconch of *R. kabuli*. Also *R. linearis* is purple tinged on the first whorls of the teleoconch, while *R. kabuli* has a light brown protoconch and the first whorls of its teleoconch are white; the brown colour differs in intensity on the spiral threads of the two species, being very dark on *R. linearis* but light brown on *R. kabuli*. The aperture of *R. kabuli* shows that the upper tubercle near the sinus is bigger than that of *R. linearis*. The animal of the latter species is yellowish with white markings (FRETTER AND GRAHAM, 1984 and GRAHAM, 1988), but we found totally white animals in the Mediterranean (l'Escala, Girona), indicating that it probably has some variability.

R. linearis var. *aequalis* (JEFFREYS, 1867) is cited in its original description as a shell with yellowish white apex, paler hue and the animal with white body. These characters may be coincident with *R. kabuli*, but they do not have the coloured lines regularly distributed, spiral striae are closer and finer and they have more numerous ribs. Types of this variety were not found (see WARÉN, 1980).

Raphitoma leufroyi (Michaud, 1828) (Figs. 26-28)

Pleurotoma leufroyi Michaud, 1828. *Bull. Soc. Linn. Bordeaux*, 2, p. 121, pl. 1, fig. 5-6.

Material studied: Angola: 4 shells, 40 m, Luanda; 2 shells, 100 m, off Luanda; 1 specimen and 1 shell, 60 m, off Luanda; 1 specimen, 20 m, Buraco; 2 shells, 40 m, off Luanda (all CER ex CFB); 2 shells, 40-60 m, ilha de Luanda, Luanda (MNHN). Cape Verde Islands: 1 shell, 8 m, Palmeira, Sal. Spain: 50 specimens from several locations in Galicia (Sisargas, Bueu, Corrubedo, Vigo, Baiona, Carnota) (CER and COS); Italy: 3 shells, Castiglioncel.

Description: See FRETTER AND GRAHAM, 1984; GRAHAM (1988); JEFFREYS (1867); BOGI ET AL. (1990b).

Most of the specimens collected in Angola (Figs. 26, 27) do not reach 11 mm, being smaller than those from Europe. The shell sculpture is formed by oblique axial ribs and thinner uniform spiral threads. Fine growth striae are also evident. The shell has a light brown ground colour, each whorl is divided into two parts, the upper darker and the lower lighter. The body whorl has these two colour zones plus a brown band below, the base being lighter. There are brown spots on the spiral threads. Protoconch (Fig. 28) with 3 1/2 whorls, with similar sculpture to that of the other species in the genus: reticulate on the first whorl, followed on the next 3 with axial subsutural lines and oblique reticulation.

Animal of Angolan specimens of cream colour, with many small white spots; siphon clear orange, with many light coloured spots.

Habitat: After FRETTER AND GRAHAM, 1984 and GRAHAM (1988) this species lives on sandy or stony bottoms from low tide to depths of 150 m. The specimens collected by us in Angola and in European waters were found on similar bottoms.

Geographical distribution: Known from the North Sea to the Mediterranean and Canary Islands (NORDSIECK AND GARCIA-TALAVERA, 1979). There are no records from the tropical West African shores and this could prove a disjunct distribution for this species.

Remarks: AARTSEN ET AL. (1984) view as different species the Mediterranean and Atlantic specimens usually considered within *R. leufroyi*. We prefer to consider them both as ecological forms of one species.

R. leufroyi has a form similar to the next 3 species and its generic position will be dealt with under the last one.

This is the first record of this species from Angola.

Raphitoma hernardoi spec. nov. (Figs. 29-31)

Material studied: Angola: 3 shells, Praia de Santiago; 7 specimens and 3 shells, 20 m, Corimba, Luanda; 1 shell, 100 m, off Luanda; 2 shells, 20 m, Palmeirinhas (all ex CFR); 1 specimen, 20 m, Corimba, Luanda (MNHN); 1 specimen, 30 m, Palmeirinhas (MNHN); Ghana: 1 shell and 2 fragments, Takoradi.

Type material: Holotype (Fig. 29) of 7.5 mm deposited at the MNHN. Paratypes in the following collections: MNHN (1), MNCN (15.05/20544) (1), AMNH (1), BMNH (1), CFR (12), COS (1).

Type locality: Corimba, Luanda, Angola.

Etymology: The species is named after Bernardo Fernandez Soule, biologist of the Servicios Generales de Apoyo a la Investigación (A Coruña University).

Description: Shell elongated-fusiform (Figs. 29, 30), pointed, with the body whorl reaching more than half the length of the shell; whorls slightly convex, suture little marked.

Protoconch (Fig. 31) similar to that of the other species of the genus, with the apex bearing reticulate sculpture followed by reticulation where the threads are oblique; axial lines in the subsutural area are more elongated on the last whorl, reaching the peripheral angulation.

Teleoconch of about 4 whorls, the first with strong axial ribs which disappear on the last whorl or just before; 4-5 spiral threads on the first whorls, about 7 main ones on the penultimate whorl with several additional thinner threads between; there are a total of 36-39 spiral threads on the body whorl. Aperture ovoid elongate; outer lip sharp, denticulated, sinus shallow and located just below the suture. Siphonal canal short and broad.

Colour pattern very constant, brown ground colour, with irregular white spots on the spiral threads, mainly on one located just below the middle of each whorl. Size 8-11 mm.

Habitat: Found on bottoms with small rocks (to which are attached species of *Arca* and *Anadara*), with sand among them.

Geographical distribution: Known from Ghana to Angola.

Remarks: *Raphitoma hernardoi* spec. nov. differs from *R. leufroyi* in being smaller, without prominent axial ribs on the body whorl, and with a different colour pattern. Both species live sympatrically with *R. leufroyi* in Angola.

Raphitoma corimbensis spec. nov. (Figs. 32-34)

Material studied: Angola: 9 specimens, 3 shells and 2 juveniles at 20 m, Corimba, Luanda (ex CFR); Cape Verde Islands: 6 specimens, 6 m, Farrafal, Santiago; 3 juveniles, 30 m, Furna, Brava.

Type material: Holotype (Fig. 32) of 14.2 mm deposited in MNCN (15.05/20546). Paratypes in MNHN (1), BMNH (1), ZMC (1), CFR (3) and COS (1).

Type locality: Corimba, Luanda, Angola.

Etymology: The specific name refers to the place where the species was collected for the first time.

Description: Shell (Fig. 32) elongate-fusiform, pointed, with the body whorl reaching more than 2/3 of the shell length; whorls slightly convex, suture little marked.

Protoconch (Fig. 34) with reticulate sculpture at the apex followed by further reticulation where the threads are oblique, although some of them finish perpendicularly to the upper suture while others are parallel; there is no peripheral angulation.

Teleoconch of around 4 whorls, all them with fine spiral threads crossed by slightly finer axial ones (Fig. 33), which give the shell a reticulated aspect; 5-6 spiral threads on the first whorls, about 12-14 main ones on the penultimate whorl, some

slightly thicker than others. There are a total of 50-65 spiral threads on the body whorl, some slightly thicker than others. There is a spiral microsculpture between the spiral threads. The cross-points of axial and spiral threads have prominent tubercles, mainly in the subsutural area, where these can be spinose. Aperture ovoid-elongated; outer lip thin, sharp, not denticulated. Sinus becomes deeper towards the suture. Siphonal canal short and broad.

Colour pattern quite constant: brown and white, with irregular spots splashing on the spiral threads, and with a brownish band on the body whorl, with zig-zag borders. Size 14-15 mm. The colour of the protoconch is brown with a spiral row of lighter spots only noticeable on fresh shells.

Animal uniform whitish, with milk-white spots.

Habitat: The specimens were collected on infralittoral rocky bottoms, living sympatrically with *R. bernardoi*, *R. leufroyi* and *R. bedoyai*.

Geographical distribution: Only known from Angola and Cape Verde Islands.

Remarks: *R. corimbensis* differs from *R. leufroyi* in lacking axial ribs. At first glance it is similar to *R. bernardoi* but *C. corimbensis* is broader and lacks the axial ribs, though there are many axial threads. It is also related to *R. bedoyai* (see below).

Raphitoma bedoyai spec. nov. (Figs. 35-37)

Material studied: Angola: 1 specimen and 1 shell, 25 m, Corimba, Luanda (MNHN); 1 specimen, 2 shells and 4 juveniles, 20 m, Corimba; 2 fragments, 3 m, Palmeirinhas.

Type material: Holotype (Fig. 35) of 12.0 mm deposited in MNHN. Paratypes in MNCN (15.05/20545) (1), MNHN (1) and CFR (4 juveniles and 2 fragments).

Type locality: Corimba, Luanda, Angola.

Etymology: The species is named after José Bedoya, of MNCN for his help with the SEM work in the present study.

Description: Shell (Figs. 35, 36) ovoid-elongate, whorls slightly convex, apex pointed and body whorl reaching 7/11 of the total length. Protoconch (Fig. 36) similar to other species of the genus, apex with a reticulate sculpture followed by further reticulation where the threads are oblique; in the subsutural area there are axial lirae which are more elongated, on the last whorl reaching the peripheral angulation.

Teleoconch with 5 whorls, the first 3 with strong axial sculpture, which disappears on the following whorls. Spiral threads cross the axial ribs, 4 on the first whorl, 6 or 7 on the second, reaching 8 on the third, with finer intermediary threads. Body whorl with the area below the suture with around 6 spiral threads and below this area, 25 more main spiral threads with other (between 2-4) much finer threads between them. Aperture oval-elongate, sinus well marked, siphonal notch short and broad. Outer lip without varix. Microsculpture formed by numerous granules on the spiral threads and in the interspaces.

Uniform cream colour, with several white spots on the main spiral threads. Size 15 mm.

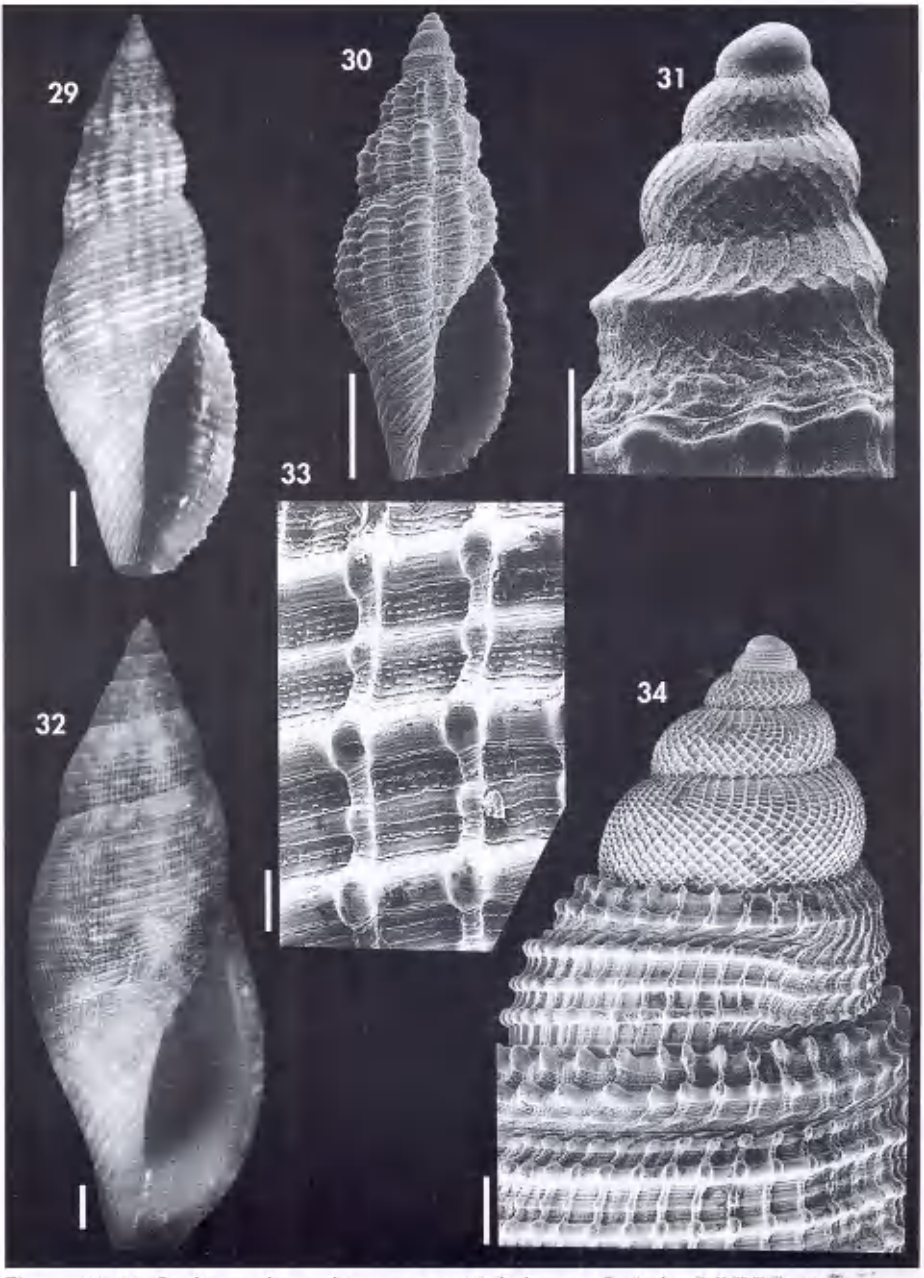
Animal whitish, with a cream yellowish siphon.

Habitat: The specimens were collected on infralittoral rocky bottoms, living sympatrically with *R. bernardoi*, *R. corimbensis* and *R. leufroyi*.

Geographical distribution: Only known from Angola. Some fragments from Senegal (CMP) could be of this species.

Remarks: The generic position of *R. leufroyi*, *R. bernardoi*, *R. corimbensis* and *R. bedoyai* is quite similar. The last one somewhat resembles the type species of *Daphnella*, *Pleurotoma lymneiformis* Kiener, 1839-40, but the others have intermediate forms between this taxon and *Raphitoma*. So, at present, we prefer to keep these last three species in the genus *Raphitoma*.

The genera *Pseudodaphnella* Boettger, 1895 and *Asperdaphne* Hedley, 1922 have



Figures 29-31. *Raphitoma bernardoi* spec. nov. 29: holotype, Corimba (MNHN); 30: paratype (CER); 31: protoconch (CER). Figures 32-34. *Raphitoma corimbensis* spec. nov. 32: holotype, Corimba (MNCN); 33: microsculpture; 34: protoconch (CER). Scale bars, shells: 1 mm; protoconchs: 0.2 mm; microsculpture: 0.05 mm.

Figuras 29-31. Raphitoma bernardoi *spec. nov. 29: holotipo, Corimba (MNHN); 30: paratipo (CER); 31: protoconcha (CER). Figuras 32-34.* Raphitoma corimbensis *spec. nov. 32: holotipo, Corimba (MNCN); 33: microescultura; 34: protoconcha (CER). Escalas, conchas: 1 mm; protoconchas: 0,2 mm, microescultura: 0,05 mm.*

a similar form, but the only given difference of protoconch microsculpture is considered inadequate for separating them as different genera.

Raphitoma bedoyai differs from *R. lenfanti* and *R. bernardoi* in its broader form, larger body whorl, colour pattern and microsculpture, with a greater number of intermediate spiral threads between the main lirae, and the presence of numerous microgranules. It is quite similar to *R. corimbensis*, but the latter has fine reticulation and prominent tubercles, like spines, in the subsutural area, and their microsculptures are different (see Figs. 39 and 37).

Genus *Kermia* Oliver, 1915

According to POWELL (1966), the shells of this genus are small, elongate-cylindrical, with the body whorl reaching more than half the length of the shell. Protoconch from 2 to 2 ½ whorls, the first smooth, the remainder with axial threads reticulated over the lower half of the whorls by spiral threads. Outer lip strongly varicose, denticulated within; sinus deep, u shaped. Inner lip smooth. Recent Indo Pacific.

Kermia alveolata (Dautzenberg, 1913) (Figs. 38-41)

Clathurella alveolata Dautzenberg, 1913. Mission Gruvel sur la côte occidental d'Afrique, fome 5, fasc. 3, 16, p. 1.

Material studied: Angola: 1 specimen, 100 m, Mussulo, Macon (MNHN); 1 shell, 20 m, Mussulo, Macon (MNHN); 4 specimens and 1 shell, 20 m, Corimba (MNHN); 4 specimens, 2 juveniles and 5 shells, 20 m, Corimba; 1 shell, 40 m, Santa Maria, Luiria, Nambe (MNHN); 1 shell, infralittoral, Barra de Dande, Bengo (MNHN); 2 fragments, 45 m, Ambrizete, (MNHN); 12 shells, 60 m, off Luanda; 2 shells, 3 m, Palmeirinhas. French Guinea: Ile de Los, holotype of *Clathurella alveolata* Dautzenberg, 1913 (Mission Gruvel, MNHN); Ile de Los, syntype of *Clathurella meheusi* Dautzenberg, 1913 (Mission Gruvel, MNHN); Ghana: 9 fragments at 2-3 m, Tekeradi; 2 shells, Miamia Conec; 2 shells, Pointe Indienne, Poirie Noire (CPH). Senegal: 1 shell, 15-20 m, Goree Bay (CMP).

Description: See shell in Figs. 38-40 and in DAUTZENBERG (1913).

This species was originally described as having a protoconch with 2 smooth whorls. Our specimens have a protoconch (Fig. 41) with one apparently smooth whorl, although reticulated sculpture is visible with the SEM, followed by another 3 whorls with small axial ribs on their upper half, crossed on the lower half by oblique ribs to form a reticulated surface.

The animal is uniform milk-white in colour, except the siphon, which is cream.

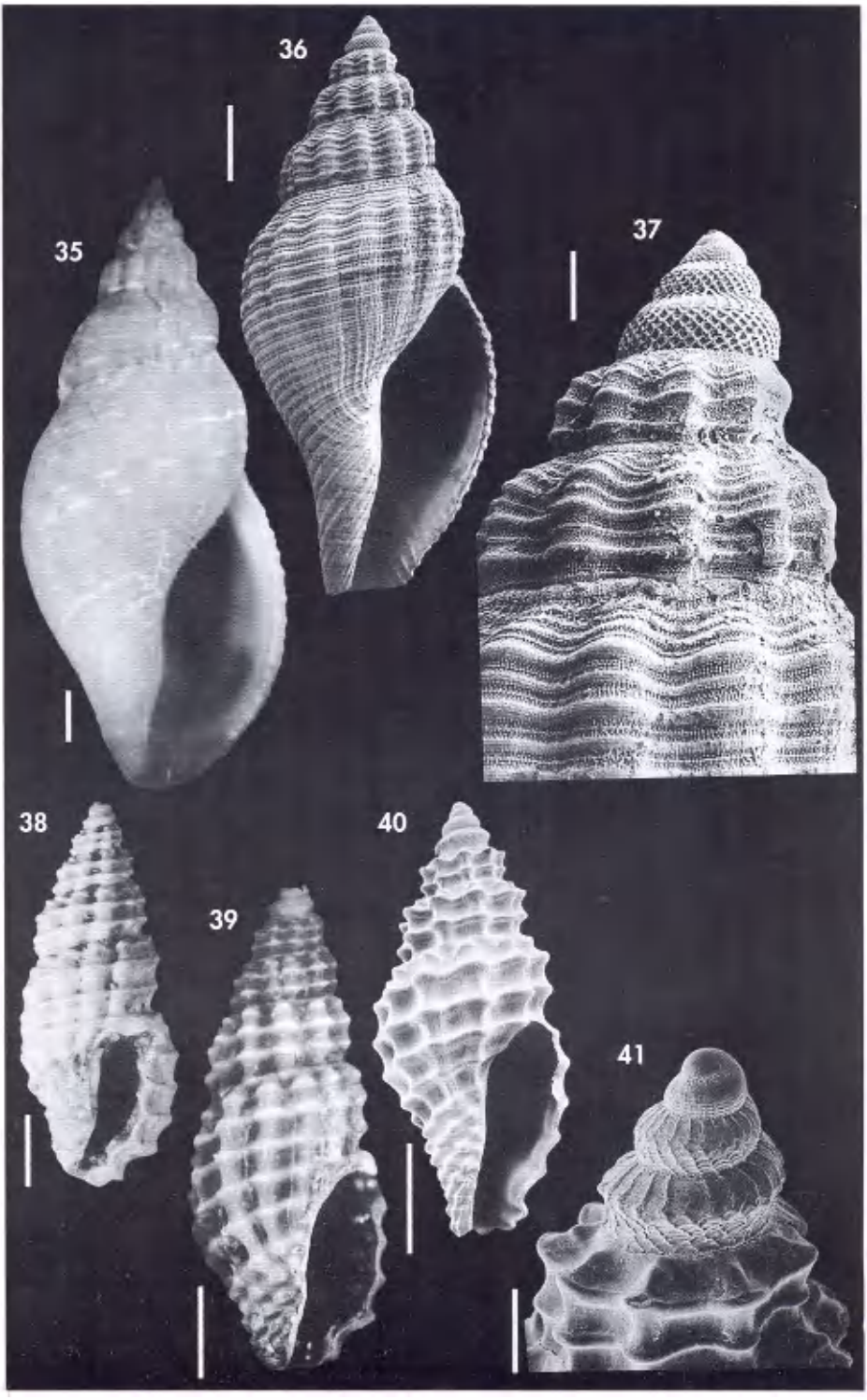
Habitat: Found on infralittoral rocky bottoms.

Geographical distribution: Known from Senegal to Angola.

Remarks: Our material, compared with the holotype of *Clathurella alveolata*, proved to be the same species. This species was described in the genus *Clathurella* Carpenter, 1857, but we prefer to

(Right page). Figures 35-37. *Raphitoma bedoyai* spec. nov. 35: holotype, Corimba (MNHN); 36: paratype (CER); 37: protoconch (MNCN). Figures 38-41. *Kermia alveolata*: 38: holotype, Ile de Los (MNHN); 39, 40: shells from Luanda (CER); 41: protoconch (CER). Scale bars, shells: 1 mm; protoconchs: 0.2 mm.

(Página derecha). Figuras 35-37. Raphitoma bedoyai spec. nov. 35: holotipo, Corimba (MNHN); 36: paratipo (CER); 37: protoconcha (MNCN). Figuras 38-41. Kermia alveolata. 38: holotipo, Ile de Los (MNHN); 39, 40: conchas de Luanda (CER); 41: protoconcha (CER). Escala: conchas 1 mm, protoconchas 0,2 mm.


36
35
37
38
40
39
41

include it in the genus *Kermia* because of the following considerations: 1) the generic name *Clathurella*, although quite often used, is one of the most frequently misapplied generic names (POWELL, 1966); 2) the details of the morphology of the protoconch of the type species (*Clathurella tryoni* Hinds, 1843) are unknown; 3) *K. alveolata* lacks the narrow lip strengthened behind by a strong varix, and its spiral sculpture is stronger than that of *C. rava*; 4) *K. alveolata* is very similar to the type species of the genus *Kermia*, *K. benhami* Oliver, 1915, in the sculpture, aperture, and other features. This genus was only previously known from the Indo Pacific region. Another option could be to include it in the genus *Clathromangelia* Monterosato, 1884, due the similarity with the shell of the type species, *Pleurotoma granum* Philippi, 1844. But the protoconch of *K. alveolata* is closer to that of the genus *Kermia*.

Comparison of the holotype of *K. meheusti* (Dautzenberg, 1913) with that of *K. alveolata* (Fig. 37) shows no differences to support the specific separation of both taxa, the former being only somewhat smaller than the latter. The holotype of *K. alveolata* is in better condition than that of *K. meheusti* with a larger and less eroded shell and protoconch. Therefore, we regard this last species as a synonym and *K. alveolata* as the valid name of the species, in accordance with Article 24 of the ICZN.

The present records expand its geographical distribution, as it was previously only known from the type locality, Ile de Los (Sierra Leone).

Genus *Gymnobela* Verrill, 1884

According to POWELL (1966), the shells of this genus are "... small or moderate in size, thin-shelled, ovate-biconical, with a broad conical tabulate relatively short spire, and an inflated body-whorl, only weakly excavated over the neck, and terminated in a short spout-like anterior canal. Protoconch broadly conical of 2 1/2 – 3 finely diagonally cancellated whorls. There is a pronounced angulation of the whorls...". Recent, Atlantic and Pacific.

Gymnobela dautzenbergi (Knudsen, 1952) (Figs. 42-45)

Cythara dautzenbergi Knudsen, 1952. *Vidensk. Meddr. Fra Dansk Naturh. Foren.*, vol. 114: 170-171, pl. 1, fig. 4.

Material studied: Ivory Coast: Holotype, Atlantide Exp. (ZMC. GAS 178). Angola: 2 shells, 100 m, off Luanda (CER); 4 shells, 40-60 m off Luanda (CER).

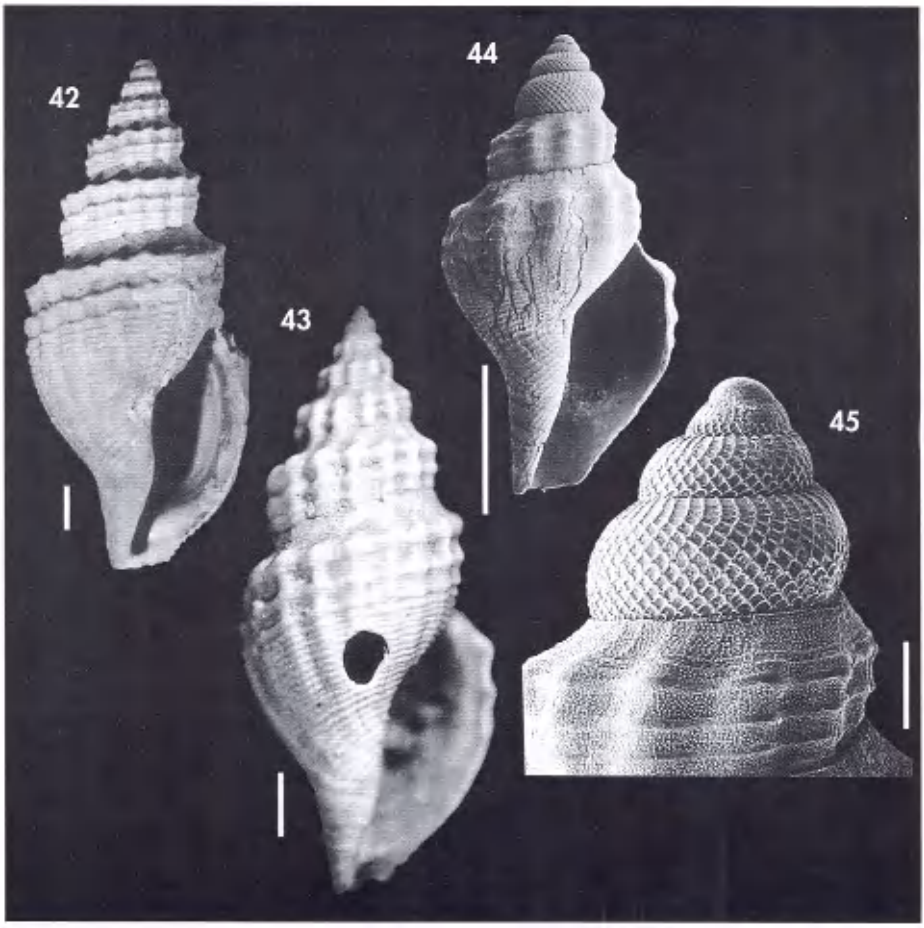
Description: See KNUDSEN (1952). Shell: (Figs. 42-44).

Protoconch (Fig. 45) similar to that of the other species of the Raphitomidae, with reticulated sculpture on the apex followed by further reticulation where the threads are oblique, except in the subsutural area, where the lines are axial and spiral.

Geographical distribution: Only known from the Ivory Coast and Angola.

Remarks: This species was described in the genus *Cythara* Schumacher, 1817. After POWELL (1956) this taxon is considered as valid nomenclaturally but its identity remains obscure.

At first sight, by its peripheral angulation, the shell might appear to belong to the genus *Propebela* Iredale, 1918 but the type species, *Murex turricula* Montagu, 1803, has a smooth or axially ribbed protoconch; for similar reasons it was not included in the genus *Pleuromoides* Bronn, 1831, in spite of having similar shell features. On the other hand, the genus *Gymnobela* has a shell and protoconch that conform to the characters of the present species.



Figures 42-45. *Gymnobela dautzenbergi*. 42: holotype, Ivory Coast (7MC); 43, 44: shell from Luanda (CER); 45: protoconch (CFR). Scale bars, shells: 1 mm; protoconchs: 0.2 mm.
Figuras 42-45. Gymnobela dautzenbergi. *42, holotipo, Costa de Marfil (7MC); 43, 44, concha de Luanda (CFR); 45: protoconcha (CFR). Escalas, conchas: 1 mm, protoconchas: 0.2 mm.*

CONCLUSIONS AND BIOGEOGRAPHIC REMARKS

GOFAS *ET AL.* (1985) discussed the Angola fauna and concluded that Angola has a malacological fauna related to that of tropical west Africa and Europe.

Since the Pliocene, the West Africa shores have been a refuge during the coldest periods for European fauna with tropical affinities. After these periods, these fauna expanded again, with many species retaining a wide distribution.

There are important differences between the northern and southern marine fauna of Angola. The tropical north fauna is similar to that of Congo and Gabon since the Miocene. Towards the north, dispersal is limited because biogeographical barriers exist, like the Guinean Gulf and Niger Estuary. Due to these limitations, faunal elements from northwest Africa are poorly represented.

The southern fauna has affinities with the Mediterranean and temperate north Atlantic faunas due to the influence of the cold Benguela current. Contrary to this most of the Daphnellidae studied were represented in the north as well as in the south of Angola.

In the present work on the subfamily Daphnellinae we have studied 4 genera and 12 species found in Angola. Six of these were previously known and 6 are species new to science.

Of the 12 species studied, only 2 (*R. christfriedi* and *R. bedoyai*) have been found exclusively in Angola, but having multispiral protoconchs their distribution may prove to be broader (some fragments found in Senegal could be of the latter species). Another species (*R. coimbensis*) has been collected in Coimba and also in Cape Verde Islands. 8 species (*R. cordieri*, *R. purpurea*, *R. zelotypa*, *R. kakuli*, *R. bernardoi*, *Kermia alveolata*, and *Gymnobela dautzenbergi*) are apparently distributed all along the West African coast, reaching up to the Guinean gulf as far north as Ghana, 3 of them (*R. cordieri*, *R. purpurea* and *R. leufroyi*) having also been found in the Mediterranean and the last two also on the Atlantic coast of Europe. *R. leufroyi* has been collected only at both extremes of its geographical range, possibly indicating a disjunct or bipolar distribution.

Some of the species studied are clearly related to other European taxa, which may prove to be sister species: thus, *R. zelotypa* is close to *R. purpurea*; *R. kakuli* is close to *R. lineata*; *R. christfriedi* is close to *R. hystrix*; and finally *R. bernardoi*, *R. coimbensis* and *R. bedoyai* are related to *R. leufroyi*. Curiously some of these European species, such as *R. purpurea* and *R. leufroyi*, are also present in the Angolan fauna.

Most of the European species of *Raphitoma* are supposedly precursors of polychaetes (Fretter and Graham, 1984 and Graham, 1988), and live on rocky bottoms with sand and rubble. This habitat was the same in Angola for those collected alive, and they probably have the same diet. The scarcity of some species could be related to the difficulty in collecting on a rocky bottom at 20 m deep, and not because they are really uncommon.

The presence of white sand on bottoms where *Raphitoma* were collected in Angola could explain the light pattern and colour of the shell of most of the Angolan species.

ACKNOWLEDGEMENTS

We are grateful to the staff of the Museo Nacional de Ciencias Naturales de Madrid for their help, especially to José Templado for his critical revision of the manuscript. The SEM photographs were taken by José Bedoya of the MNCN, by Bernardo Fernández Seijo of the Servicios Generales de Apoyo a la Investigación (A Coruña University) and by Jesús Méndez of the Centro de Apoio Científico e Tecnolóxico a Investigación (CACTI) (Vigo University); to Angel Guerra of the Instituto de Investigaciones Marinas of Vigo, who allowed us to take the optical microscope photographs; to Serge Gofas for the loan of material from Angola deposited at the MNHN of Paris, and for his comments on the group; to Christfried Schoenherr for the loan of turrid material; to Franca Campanino, curator of the Dipartamento di Scienze delle Terra, Universitá degli Studi di Torino, for his information on Mediterranean species; to Kathie Way of the BMNH, and to T. Schiotte of the ZMC, for the loan of type material; to the late Walter F. Sage of the AMNH for his help with the bibliography; to R. N. Kilburn of the Natal Museum for his help with the bibliography and his valuable critical revision of the manuscript.

BIBLIOGRAPHY

Aartsen, J. J. Van, Menkhorst, H. P. M. G. and Gittenberger, E., 1984. The marine Mollusca of the Bay of Algeciras, Spain, with general notes on *Mutrella*, Marginellidae and Turridae. *Basteria*, suppl. 2: 1-135.

Bellardi, L., 1847. Monografia delle pleurotome fossili del Piemonte. *Memorie della Reale Accademia delle Scienze di Torino* (ser. 2), 9: 1-132, pp. 4 pl.

BOGI, C., COPPINI, M. AND MARGELLI, A., 1980a. Molluscan fauna of the central Tyrrhenian sea. Part III. *La Conchiglia*, 12 (134-135): 18-19.

BOGI, C., COPPINI, M. AND MARGELLI, A., 1980b. Molluscan fauna of the central Tyrrhenian sea. Part IV. *La Conchiglia*, 12 (136-137): 14-15.

BOUCHET, P., 1990. Turrid genera and mode of development: the use and abuse of protoconch morphology. *Malacologia*, 32 (1): 69-77.

CARROZZA, F., 1984. *Raphitoma dimorpha* n. sp. *Bollettino Malacologico*, 20 (5-8): 151-154.

DAUTZENBERG, P., 1910. Contribution à la faune malacologique de l'Afrique occidentale. *Actes de la Société Linnéenne de Bordeaux*, 64: 1-174, 4 pls.

DAUTZENBERG, P., 1912 (1913). *Mission Gruvel sur la côte occidentale d'Afrique*, tome 5, fasc. 3: 1-110, 5 pls.

FERNANDES, F., ROLAN, E. AND OTERO-SCHMITT, J., 1996. The genus *Crassispira* (Gastropoda, Turridae) in West Africa. *Journal of Conchology*, 35 (4): 289-301.

FRETTER, V. AND GRAHAM, A., 1984. The prosobranch molluscs of Britain and Denmark. Part 6. Neogastropoda. *The Journal of Molluscan Studies*, supl. 15: 435-556.

GOFAS, F., 1991. *Spaniotoma* n. gen., a sinistral Clavatuline turrid from west Africa. *Archiv für Molluskenkunde*, 120 (1-3): 11-22.

GOFAS, S., FONTE-ARONSEN, J. AND BRANCÃO, M., 1985. *Conchas e moluscos de Angola*. Universidade Agostinho Neto, Luanda. 144 pp.

GRAHAM, A., 1988. *Molluscs: Prosobranch and Pyramidellid Gastropods*. Synopses of the British Fauna (new series). 662 pp.

JEFFREYS, J. G., 1867. *British Conchology*. Vol. 4. J. van Voorst, London. 487 pp.

KILBURN, R. N., 1983. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. part 1. Subfamily Turrinae. *Annals of the Natal Museum*, 25 (2): 549-585.

KILBURN, R. N., 1985. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. Part 2. Subfamily Clavatulinae. *Annals of the Natal Museum*, 26 (2): 417-470.

KILBURN, R. N., 1986. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. part 3. Subfamily Borsoniinae. *Annals of the Natal Museum*, 27 (2): 633-720.

KILBURN, R. N., 1988a. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. part 4. Subfamilies Drilliinae, Crassispirinae and Strictispirinae. *Annals of the Natal Museum*, 29 (1): 167-320.

KILBURN, R. N., 1988b. Type designation for *Acamarullia* Kilburn, 1988. *Annals of the Natal Museum*, 29 (2): 557.

KILBURN, R. N., 1989. Notes on *Ptychobela* and *Brachytoma*, with description of a new species from Mozambique (Mollusca: Gastropoda: Turridae). *Annals of the Natal Museum*, 30: 185-198.

KILBURN, R. N., 1991. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. Part 5. Subfamily Taraninae. *Annals of the Natal Museum*, 32: 325-335.

KILBURN, R. N., 1992. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. Part 6. Subfamily Mangeliinae, section 1. *Annals of the Natal Museum*, 33 (2): 461-575.

KILBURN, R. N., 1994. Turridae (Mollusca: Gastropoda) of southern Africa and Mozambique. Part 6. Subfamily Mangeliinae, section 2. *Annals of the Natal Museum*, 34 (2): 317-467.

KILBURN, R. N., 1994. Turridae s.l. (Mollusca: Gastropoda) of southern Africa and Mozambique. Part 7. Subfamily Crassispirinae, section 2. *Annals of the Natal Museum*, 35: 177-228.

KNUDSEN, J., 1952. Marine prosobranchs of tropical West Africa collected by the "Atlantide" expedition 1945-46. Part I. *Videsk. Meddr. fra Dansk naturh. Foren.*, 114: 125-185, 3 pls.

KNUDSEN, J., 1956. Marine prosobranchs of tropical West Africa (Senegal to Cape Palmas). *Atlantide report*, 4: 1-110, 4 pls.

LAMY, M. E., 1922. *Campagne du Sylvana. Mollusques testacés*. Comptes rendus de congrès des societés savantes en 1922: 16 pp.

MARTENS, E. VON, 1903. *Die beschalten Gastropoden der deutschen Tiefsee Expedition 1898-1899. A Systematisch-geographischer Teil*. Deutsche Tiefsee Expedition, 7: 1-175, 2 pls.

NICKLES, M., 1950. *Mollusques testacés marins de la côte occidentale d'afrique*. Lechevalier, Paris. 270 pp.

NORDSIECK, F., 1977. *The Turridae of the European seas*. La piramide per la Conchiglia, Roma. 131 pp.

NORDSIECK, F. AND GARCIA-TALAVERA, F., 1979. *Moluscos marinos de Canarias y Madera (Gastropoda)*. Aula de Cultura de Tenerife, 208 pp., 46 pls.

PETIT DE LA SAUSSAYE, S., 1836. *Pleurotoma sinistrales*. Magasin de Zoologie, 6: 7-8.

POPPE, G. T. AND GOTO, Y., 1991. *European seashells*. Vol. 1. Verlag Christa Hemmen, Wiesbaden. 352 pp.

POWELL, A. W. B., 1966. The molluscan families Speightiidae and Turridae. *Bulletin Auckland Institute and Museum*, 5: 1-184, 23 pls.

REEVE, L. A., 1843-46. *Monograph of the genus Pleurotoma*. Conchology Iconica, London. 369 pp.

ROLÁN, E., 1983. *Moluscos de la Ría de Vigo I. Gasterópodos*. Velograf, Santiago de Compostela, 383 pp.

ROLAN, E. AND FERNANDES, F., 1992. Nuevas especies de la familia Turridae Swainson, 1840 del archipiélago de Sao Tome y Principe. *Nova Acta Científica Compostelana (Bioloxía)*, 3: 135-143.

Rolán, E., Otero-Schmitt, J. and Fernandes, F., 1994. El género *Rectacyllina* (Gastropoda Turridae: Mangeliinae) en Africa occidental, con descripción de una nueva especie. *Boletín Malacológico*, 29 (9/12): 243-248.

Sabelli, B., Giannuzzi-Savelli, R. and Bedulli, D., 1992. *Catalogo annotato dei molluschi marini del Mediterraneo*. Vol. 2. Società Italiana di Malacologia, Bologna, 349-458 pp.

Strebel, H., 1912. Bemerkungen zu den *Clavatula*-gruppen, *Perrona* und *Tomella*. *Mitteilungen aus dem Naturhistorischen Museum in Hamburg*, 29: 1-24, 1 pl.

Strebel, H., 1914. *Mollusca I, gen. Pusionella*. *Beiträge zur kenntnis der Meeresfauna Westafrikas*. Hamburg, Friederichsen and Co.: 87-125, 1 pl.

Taylor, J. D., Kantor, Y. I. and Sysoev, A. V., 1993. Foregut anatomy, feeding mechanisms, relationships and classification of the Conoidea (= Toxoglossa) (Gastropoda). *Bulletin Natural History Museum London (Zoology)*, 59 (2): 125-170.

Thiele, J., 1925. Gastropoda der deutschen tiefsee expedition. *Wissenschaftliche Ergebnisse der Deutsche Tiefsee Expedition*, 17 (2): 1-382.

Warén, A., 1980. Marine mollusca described by John Gwyn Jeffreys, with the location of the type material. *Conchological Society Special Publication*, 1: 1-60, 8 pls.