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New information on the malacological fauna (Mollusca, Gastropoda) of the Cape Verde Archipelago, with the description of five new species

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KEYWORDS. *Parviturbo*, *Eatonina*, *Obtusella*, *Megalomphalus*, *Vitrinella*, *Mareleptopoma*, *Tomura*, Cape Verde archipelago, new species.

ABSTRACT. New information on the Cape Verde molluscan fauna is reported in the present work. Additional information for some previously known species is presented, and the radulae of *Parviturbo insularis* and *Eatonina martae* are illustrated. Five species new for science are described, which are included in the following genera: *Obtusella lata*, *Megalomphalus serus*, *Vitrinella politurae*, *Mareleptopoma verdensis* and *Tomura abscondita*.

RÉSUMÉ. De nouvelles données sur la faune malacologique de l'Archipel du Cap Vert sont signalées. Des informations complémentaires pour des espèces connues sont présentées et les radulas de *Parviturbo insularis* et *Eatonina martae* sont illustrées. Cinq nouvelles espèces sont décrites:*Obtusella lata*, *Megalomphalus serus*, *Vitrinella politurae*, *Mareleptopoma verdensis* et *Tomura abscondita*.

RESUMEN. En el presente trabajo se aporta nueva información a la fauna de moluscos del archipiélago de Cabo Verde. Por un lado, se mencionan datos adicionales para algunas especies ya conocidas, como las rádulas de *Parviturbo insularis* y *Eatonina martae*. Por otra parte, se describen cinco especies nuevas para la ciencia, que están incluidas en los géneros que se mencionan a continuación: *Obtusella lata*, *Megalomphalus serus*, *Vitrinella politurae*, *Mareleptopoma verdensis* y *Tomura abscondita*.

INTRODUCTION

The Cape Verde archipelago is inhabited by a very peculiar mollusc fauna with a high number of endemic species which even today remain poorly known (ROLÁN, 1992a). In previous molluscan inventaries written by BURNAY & MONTEIRO (1977), SAUNDERS (1978), and VON COSEL (1982a, 1982b, 1982c) there is little information on the small gastropods.

Recently, small species have been published from Cape Verde Islands, most of them endemic to this archipelago (FERNANDES & ROLÁN, 1988, ROLÁN, 1988, 1991, 1992b, MOOLENBEEK & ROLÁN, 1988, ROLÁN & FERNANDES, 1989, BURNAY & ROLÁN, 1990, ROLÁN & RUBIO, 1992, ROLÁN & TEMPLADO, 1993, TEMPLADO & ROLÁN, 1994, PEÑAS & ROLÁN, 1997a, 1997b, 1998 and HOENSELAAR & GOUD, 1998). Further researches are actually in progress (PEÑAS & ROLÁN, in preparation, and ROLÁN & LUQUE, in press) but curiously no species in the genera *Obtusella*, *Megalomphalus*, *Vitrinella*, *Mareleptopoma* or *Tomura* have been mentioned from these islands.

Nevertheless, in the study of sediment material collected from several trips between 1978 and 1988, as well as in the expedition Macaronesia 2 in 1997, some small shells new for science were found and are described in this present work.

At the same time live material of other species has been collected which allows us to add new information concerning living animal and anatomy.

Abbreviations

AMNH: American Museum of Natural History, New York.
MNCN: Museo Nacional de Ciencias Naturales, Madrid.
MNHN: Muséum National d'Histoire Naturelle, Paris.
NNM: Nationaal Natuurhistorisch Museum, Leiden.
USNM: The National History Museum, Washington.
CFR: collection Federico Rubio, Valencia
CER: collection Emilio Rolán, Vigo.

RESULTS

Subclass ARCHAEOGASTROPODA

Superfamily TROCHOIDEA

Family SKENEIDAE Clark, 1851

Genus *Parviturbo* Pilsbry & McGinty, 1945

Type species, by original designation: *Parviturbo rehderi* Pilsbry & McGinty, 1945. Florida.

Parviturbo insularis Rolán, 1988
Figs. 1-4

Material examined. See ROLÁN (1988). More recent material: 4 specimens, in Rabo de Junco, Sal, intertidal; many empty shells from other places (Boa Vista: Morro de Areia, Porto da Cruz; Santiago: Prainha, Ponta Geneanes, Tarrafal; Brava: Porto do Ancião, Furna, etc.).

Description. See ROLÁN (1988). New information on the species can now be reported. The operculum (Figs. 1-2) is corneus, yellowish, rounded; the edge is very thin. It is multispiral, but its spire is not easily visible and only then in its inner part, being uniform on the outer part.

The animal was observed and it is cream-white with elongate ciliated cephalic tentacles; small black eyes, not pedunculated, and a big parapodial tentacle in the right side, between the eye and the epipodium; mouth bilobulated; epipodium with three pairs of tentacles, not very long, being two of them on the opercular lobule. The observation of the rest of the body characters was impossible because the animal was very shy and it was almost all the time withdrawn into the shell.

The radula (Figs. 3-4) has a formula of n.5.1.5.n. The rachidian tooth is very broad with quadrangular shape and the lateral edges strongly expanded and with a smooth cusp. The lateral teeth are of similar size, overlapping on the inner part, with the characteristic bend in the middle shaft and with long denticulated cusps overhanging the outer part. A well-developed lateromarginal plate is visible. This plate extends behind and in front of the inner marginals. The marginal teeth are long and narrow with denticulated cusps which are strongly overhanging.

Habitat. The live specimens of *Parviturbo insularis* from Rabo de Junco, north of the Mordeira Bay, in Sal Island, were collected under stones in the upper high tide level.

Remarks. ROLÁN (1988) described *Parviturbo insularis* studying some shells collected in sediment samples from the Cape Verde Islands. These samples were collected from depths of between 4 and 30 m. No live animals were known. So the placement of this species in the genus *Parviturbo* was made only tentatively on the basis of the shell characteristics. Having been collected only in the Cape Verde archipelago, it was assumed that *P. insularis* was an species endemic to these islands.

The radula of *Parviturbo insularis* is very similar to that of *Parviturbo acuticostatus* (Carpenter, 1864) which is figured by HICKMAN & MCLEAN (1990, fig. 97A) in their description of *Parviturbo-Haplocochlias* group and by WARÉN (1992, fig. 2A). After comparing these characters, we conclude that this species was correctly placed in the genus *Parviturbo*.

Superfamily CINGULOPSOIDEA

Family CINGULOPSIDAE Fretter & Patil, 1958

Genus *Eatonina* Thiele, 1912

Type species, by monotypy: *Eatonina pusilla* Thiele, 1912.

Subgenus *Coriandria* Tomlin, 1917

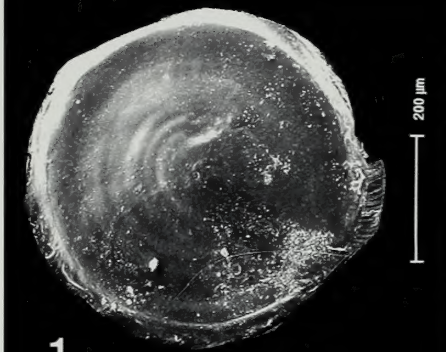
Eatonina (Coriandria) martae
Rolán & Templado, 1993
Fig. 5

Material examined. See ROLÁN & TEMPLADO (1993). Additionally from our last trips: 25 specimens, from Furna, Brava, and 10 more from Punta Geneanes, Santiago; several hundred empty shells from sediment collected at Brava, Ilheus Rombos, Santiago, Fogo, etc.

Description. See ROLÁN & TEMPLADO (1993). Further to this description it can be added the following: the radula (Fig. 5) is typical of the subgenus; it is very small in size being only 35 µm in width. It has a central tooth with two small denticles on its border, lateral folds which completely lacks any denticle in its inner face. The lateral tooth is quadrangular, with its upper bord uniformly convex and the external margin with four denticles, the outside one smaller. The inner marginal tooth has three elongate denticles at its apex, of which the central one is the most prominent. The marginal external tooth has a wide base and three sharp slightly curved denticles at its extremity.

Remarks. *E. martae* was described without any subgeneric assignment due to the fact that only empty shells were studied. The collection of several live specimens allowed us the complete radular study and therefore we can now confirm its location in the family Cingulopsidae and in the subgenus *Coriandria*.

Figs. 1-4. *Parviturbo insularis*. Figs. 1-2. Operculum. Figs. 3-4. Radula. **Fig. 5**. *Eatonina (Coriandria) martae*. Radula. **Figs. 6-8**. *Obtusella lata* n. sp. Fig. 6. Holotype (MNCN). Fig. 7. Microsculpture. Fig. 8. Protoconch.



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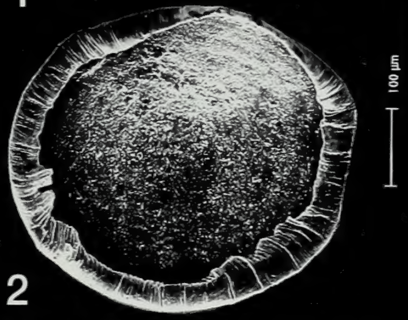

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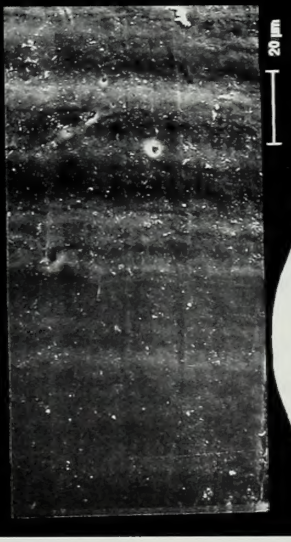

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Superfamily **RISSOIDEA**

Family **RISSOIDAE** Tomlin, 1917

Genus ***Obtusella*** Cossmann, 1921

Type species, by monotypy: *Obtusella intersecta* (S. W. Wood, 1857) (= *Rissoa obtusa* Cantraine). Europe.

Obtusella lata n. sp.

Figs. 6-8

Type material. Holotype (Fig. 6) of 1.11 x 0.84 mm, and 7 paratypes in MNCN (n° 15.05/32185), all from type locality. Other paratypes: 2 in MNHN, AMNH, USNM, NNM and CFR; 14 in CER (Fig. 8); all from type locality, collected between 15-30 m.

Other material studied. 9 shells, Porto Mindelo, 25 m, São Vicente.

Type locality. Off Pau Seco, Maio.

Etymology. The specific name is derived of the latin word *latus,* which means wide, alluding to be the wider dimension consistantly above the known size relevant to the European species *Obtusella intersecta* (Wood, 1857), at least in the Spain populations.

Description. Shell (Fig. 6) of very small size, milk-white in colour, globose, thin, a little higher than wide, spire formed by 3 ½ convex whorls, separating by a fine suture. Protoconch (Fig. 8) probably planktotrophic type, with 1 3/4 whorls and a maximum diameter of 310 µm. The embryonic protoconch (protoconch I) has a ½ spiral whorl scaring 3-4 spiral threads, which disappear at the beginning of the larvl phase (protoconch II); this is totally smooth with the exception of a spiral thread above the suture. Teleoconch consists of up to 2 spiral whorls, covered completelly by fine, very depressed spiral threads (Fig. 7), inequal in size and crossed by very fine scarcely prosocline growth lines. Aperture ovoid, ortocline, inner lip and external border sharp, columela curved, reflected towards the umbilicus, which is relatively wide and deep.

Dimensions. Usually, 1.0 mm in height and 0.8 mm in width. Some shells from Porto Mindelo can reach 1.2 mm.

Distribution. It has been collected in muddy substrata in Maio and São Vicente islands, but it is probably present in the rest of the archipelago.

Remarks. *Obtusella lata* spec. nov. has some similarity with the species of the European waters *Obtusella intersecta*. Both have a similar protoconch, but the shell is different because the Cape Verde ones are milk-white in colour, more globose, with a wider last whorl, the spiral threads are of unequal size, and the umbilicus is wider. *O. intersecta* is whitish-cream in colour, narrower profile, the spiral threads are uniform, and the umbilicus is always narrower. Also, the protoconch of *O. lata* has 1 3/4 whorls, while most the spp of *O. intersecta* studied from Vigo Bay have 2 whorls, although some are a little shorter.

O. intersecta has been cited with its southern distribution being the Maroccan coast (VERDUIN, 1984, Cancap 1 stn. 132 and 147) but, probably it must be considered as a species with a wide distribution along the entire West African. Recently the authors have found this species in sediment samples from Angola. In spite *O. lata* being in the middle of the distribution area of *O. intersecta*, the oceanic islands often present this kind of isolation for species ancestrally related.

Family **VANIKORIDAE** Gray, 1840

Genus ***Megalomphalus*** Brusina, 1871

Type species, by monotypy: *Stomatia azonea* Brusina, 1864.

Megalomphalus serus n. sp.

Figs. 9-13

Type material. Holotype (Figs. 9-10) of 1.92 x 1.45 mm, deposited in MNCN (n° 15.05/32186). One paratype in MNHN collected in the same locality, in sediment dredgings at 30 m.

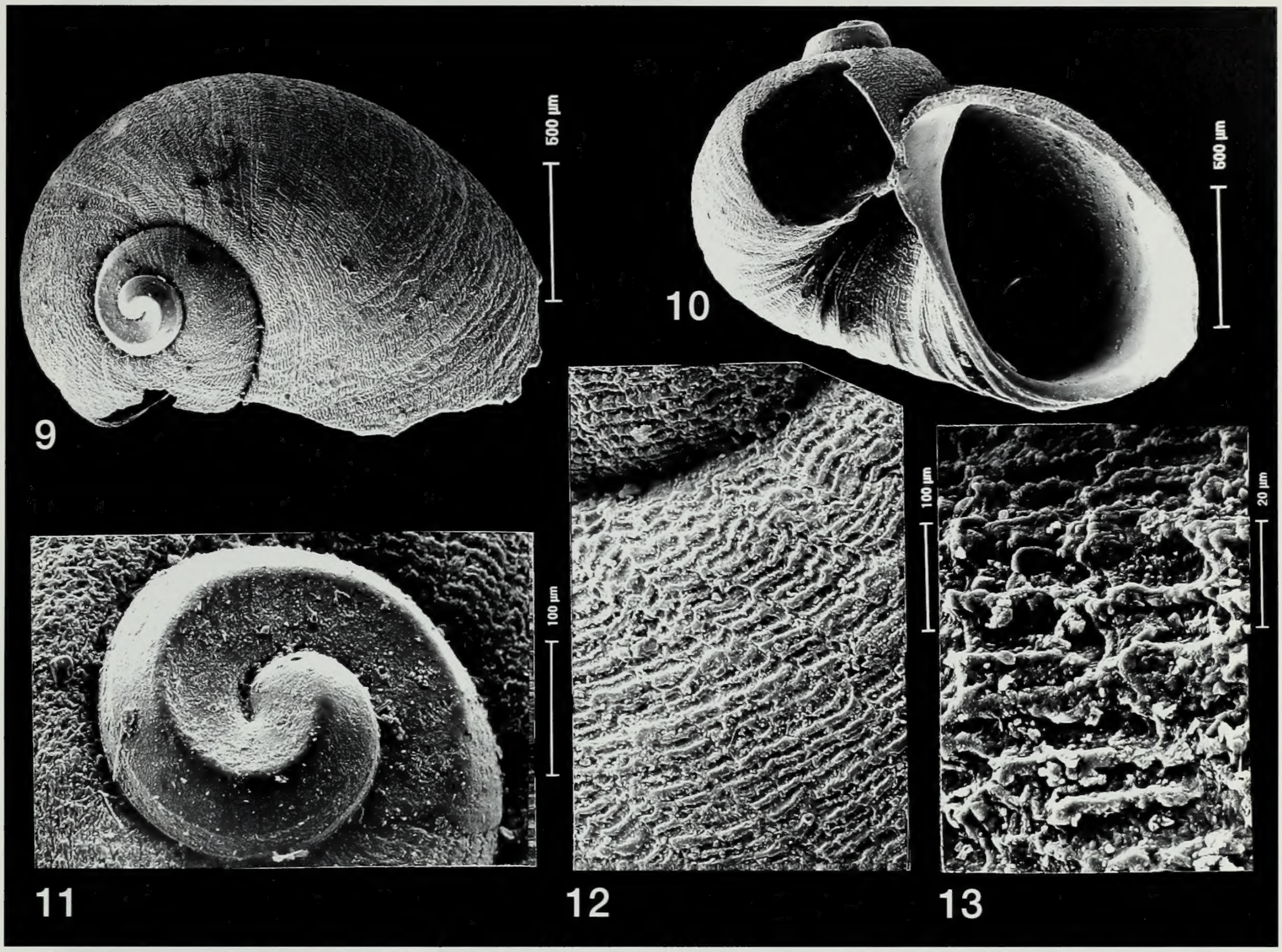
Type locality. Off Pau Seco, Maio Island.

Etymology. The specific name is derived of the latin name *serus* which means late, in allusion to it being found for the first time after many years of examining sediment samples.

Description. Shell (Figs. 9-10) of small size (maximum diameter 2.5 mm), depressed, fragile, spire formed by 2 ½ whorls of quick development, with a evident suture. The protoconch (Fig. 11) of the holotype has a maximum diameter of 315 µm, with a little more than one whorl, whose surface is aparently covered by very fine granules, and with a strong spiral cord which begins in the nucleus and continue as a keel until the end of the protoconch.

The teleoconch has 1 1/2 spiral whorls which enlarge in size quickly and has a surface totally covered by very small and irregular undulating spiral threads crossed by growth lines (Figs. 12-13). Aperture quadrangular, slightly prosocline. Base with a wide umbilicus bordered by a few prominent part where there are well marked axial ribs.

Animal, radula and operculum are unknown.



Figs. 9-13. *Megalomphalus serus* n. sp. Figs. 9-10. Holotype (MNCN). Fig. 11. Protoconch. Figs. 12-13. Microsculpture.

Distribution. Only know from the type locality.

Remarks. The generic assignation has been made because of its similarity with the type species of the genus, *M. azonea*.

M. serus n. sp. can be differentiated *from M. disciformis* and *M. mercatoris* by its keeled protoconch, the lack of axial sculpture and the very fine undulating spiral threads.

Anyway, WARÉN & BOUCHET (1988) indicate having seen the holotype of *Megalomphalus mercatoris* Adams & Knudsen, 1969 and they did not find any differences with the specimen of *Megalomphalus disciformis* identified by Monterosato as *M. depressus* Seguenza.

Some species of the genus *Macromphalina* Cossman, 1888 from West Africa can have similar morphological features (*M. boury* Dautzenberg, 1910 and *M. gofasi* Rubio & Rolán, 1994), but both have multispiral protoconch.

A recent revision (ROLÁN & RUBIO, 1998) of the Caribbean species of *Megalomphalus* and *Macromphalina* shows that all species differ in shell shape and protoconch from *M. serus* n. sp.

Family **VITRINELLIDAE**

Genus *Vitrinella* C. B. Adams, 1850

Type species, by original designation: *V. helicoidea* C. B. Adams, 1850.

Vitrinella politurae n. sp.

Figs. 14-19

Type material. Holotype (Fig. 18) of 0.88 x 0.44 mm, and 4 paratypes deposited in MNCN (n° 15.05/32188), all from the type locality. Paratypes: 1 (Fig. 17) in MNHN, 1 in CFR, 1 in AMNH and 1 in USNM, all from type locality, collected at 4 m; 5 paratypes (Fig. 15) in CER, 1 from Baia Teodora, 4 m, Boa Vista, and 4 from Regona, 3 m, Sal; 2 more from Sal Rei Bay, in CFR.

Other material studied. 2 shells, Porto Mindelo, 15 m, São Vicente; 1 shell, 1 juvenile and 1 fragment, Baia Teodora, 4 m, Boa Vista; 3 shells, Baia da Pedrinha, 8 m, Brava; 2 shells, Furna, 15 m, Brava.

Type locality. Baia da Mordeira, Sal Island.

Etymology. The specific name is derived from the latin word *politura*, which means polish, in allusion to the surface of the shell.

Description. Shell (Figs. 14-18) very small in size, whitish, apically planispiral, with 2 spiral whorls of relatively quick development, and a few impressed sutures. Protoconch (Fig. 19) of one spiral whorl, smooth. Teleoconch totaly smooth, except for growth lines which are more evident in the umbilical zone. Aperture rounded, prosocline, with thicked columela expanded on the previous whorl forming a small callous in front of the aperture. Periostracum fine, cream in colour.

Dimensions. The shells can reach maximum dimension of 1.3 mm.

Distribution. So far only know from the Cape Verde archipelago, the islands of Sal, Boavista, São Vicente and Brava, but probably present in all islands of this group.

Remarks. *Vitrinella politurae* n. sp. can be differentiated from its congeneric species of the West African coast because by its smaller size and the fact that it is totally smooth: *V. bushi* Dautzenberg, 1913 is almost smooth but has evident growth lines, and the umbilicus is narrowed by a thick columelar callous. *V. annulifera* Dautzenberg, 1910 has spiral cords and striae.

Most of the Caribbean species has some kind of spiral sculpture; only three species are smooth: *V. helicoidea* C. B. Adams, 1850 has the umbilicus rounded by a smooth spiral cord; *V. floridana* Pilsbry & McGinty, 1946, can seem similar but it is not dorsally planispiral, and its size is bigger (the holotype, in ANSP, figured by Vokes & Vokes, 1983 has 1.95 mm).

Family **PICKWORTHIIDAE** Iredale, 1917

Genus ***Mareleptopoma*** Moolenbeek & Faber, 1984

Type species, by monotypy: *Mareleptopoma karpatensis* Moolenbeek & Faber, 1984. Caribbean.

Mareleptopoma verdensis n. sp.

Figs. 20-22

Type material. Holotype (Fig. 20) of 1.2 x 0.8 mm, deposited in MNCN (n° 15.05/32189). One paratype in each of the following. MNHN (Fig. 21), AMNH, USNM and 5 in CER, all from type locality; 2 in CFR, one from Baixos de João Valente and other from Prainha, Santiago.

Type locality. Praia da Cruz, north of Sal Rei, Boa Vista Island.

Etymology. The specific name refers to the archipelago where it was collected.

Description. Shell (Figs. 20-21) of small size, thick, conoid-elongate, with 3 1/2 spiral whorls, separated by a deep and canaliculated suture. The last whorl represents 65% of its height. Protoconch paucispiral, with only one whorl, apparently smooth. The teleoconch has 2 spiral whorls which have a strong spiral cord like a keel, forming an angle at the periphery. Other smaller flattened spiral cords are present on the last whorl, 5 above and 8-9 below the first one. These smaller cords as well as the interspaces have very punctiform fine sulcii (Fig. 22). There are also growth lines. The cord at the base is the strongest and it borders the umbilical infundibulum. This umbilicus has other strong cord into. The contact of the aperture with the previous whorl is only in a short area. Aperture oval, almost rounded, scarcely prosocline, with a thick external varix. Peristome continuous, wide, flat, with the border of the inner lip everted. The external border is undulating due the spiral cords on the base caused by the umbilical cords.

Animal, radula and operculum are unknown.

Figs. 14-19. *Vitrinella politurae* n. sp. Fig. 14. Bahía Teodora, Boa Vista. Fig. 15. Paratype (CER), Furna, Brava. Fig. 16. Furna, Brava. Fig. 17. Paratype (MNHN). Fig. 18. Holotype (MNCN). Fig. 19. Protoconch. **Figs. 20-22.** *Mareleptopoma verdensis* n. sp. Fig. 20. Holotype (MNCN). Fig. 21. Paratype (MNHN). Fig. 22. Detail of the sculpture.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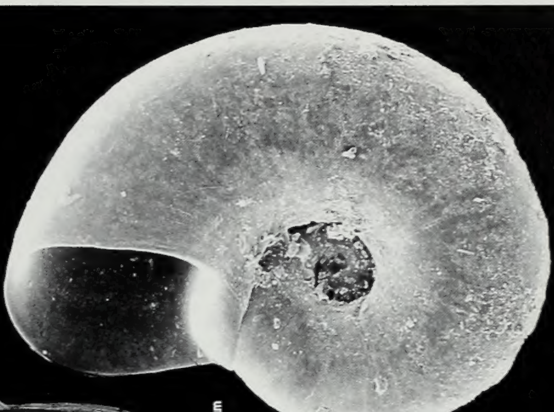
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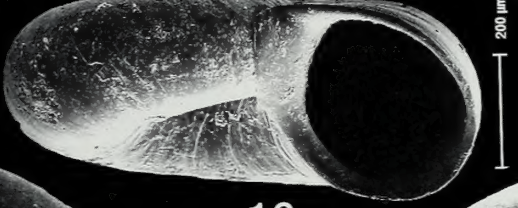

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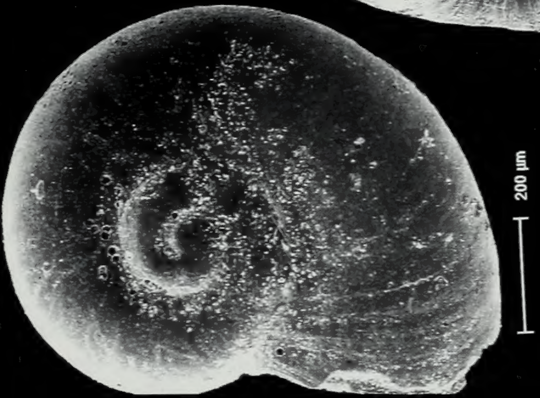

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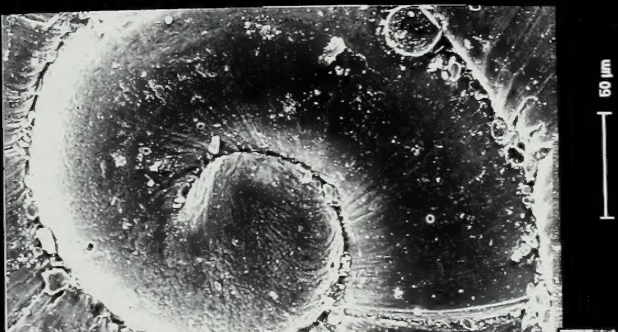

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Distribution. Only know from Boa Vista and Santiago Islands, and the Baixos de João Valente.

Remarks. There is no species of the genus *Mareleptopoma* known from the West Atlantic coast. Most of the Caribbean species have very wide shells which for this reason are very much different from *M. verdensis* n. sp. The only elongate species is *M. katyae* Rolán, Espinosa & Fernández-Garcés, 1990, but it is different because the less numerous spiral cords on the last whorl and the three sculptured whorls of the protoconch.

Subclass **HETEROBRANCHIA**

Superfamily **VALVATOIDEA**

Family **CORNIROSTRIDAE** Ponder, 1990

Genus ***Tomura*** Pilsbry & McGinty, 1946

Type species, by monotypy: *Vitrinella (Tomura) bicaudata* Pilsbry & McGinty, 1946. Florida.

Tomura abscondita n. sp.

Figs. 23-30

Type material. Holotype (Fig. 23) of 0.75 x 0.66 mm, deposited in MNCN (nº 15.05/32190). One paratype in each of the following: MNHN (Fig. 24), USNM (Fig. 29), AMNH (Fig. 26), all from type locality, collected in sediments of 30 m; 3 more in CER and 1 in CFR, from Porto Mindelo, São Vicente.

Type locality. Tarrafal, Santiago Island.

Etymology. The specific name is derived from the latin word *absconditus*, which means hidden, and alludes to the long time in which it was not found during our previous studies of sediment samples from this area.

Description. Shell (Figs. 23-26) very small, whitish, translucent, almost spherical, fragile, with a naticiform aspect. Protoconch (Figs. 27-28) hiperstrophic, with less that one spiral whorl visible and a maximum diameter of 157 µm, smooth, except for the nucleus which seems to have small granulations. The teleoconch has 2 spiral whorls, and a microsculpture formed by very small and numerous spiral threads of variable size, which extend also into the umbilicus (Figs. 25-26). There are numerous very small growth lines. The spiral microsculpture is more attenuated in most shells in the upper part (Fig. 29) whilst being more evident in the lower part of the shell where more prominent threads alternate with 1-3 smaller (Fig. 30).

Aperture rounded, prosocline with a right columela; the last whorl contacts only in a short part with the previous whorl. The external lip is fine, sharp; the internal lip is reflected towards the umbilicus forming a small callous.

Animal, radula and operculum are unknown.

Distribution. Only known from the Cape Verde archipelago, where it has been collected in Santiago and São Vicente islands.

Remarks. Generic assignation is made tentatively because no live animal has been collected. This placement is based on its similarity with *T. depressa* from Europa.

Tomura abscondita n. sp. can be differentiated from *T. depressa* (Granata, 1877) because its shell is a little more globose, is totally covered by spiral threads and the callous formed by the enlargement of the internal lip does not cover the umbilicus. From the Caribbean, RUBIO & ROLÁN (1998) described *T. xenoskeneoides*, which is differentiated because this species has a valvatoid shell lacking any spiral sculpture and enlargement of the internal lip. From *T. bicaudata* it can be separated because this species has a convex base, becoming a little concave near the strong angle or cord which overhangs the umbilicus, also being smooth.

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Figs. 23-30. *Tomura abscondita* n. sp. Fig. 23. Holotype (MNCN). Fig. 24. Paratype (MNHN). Fig. 25. Paratype (USNM). Fig. 26. Paratype (AMNH). Figs. 27-28. Protoconch. Figs. 29-30. Microsculpture.


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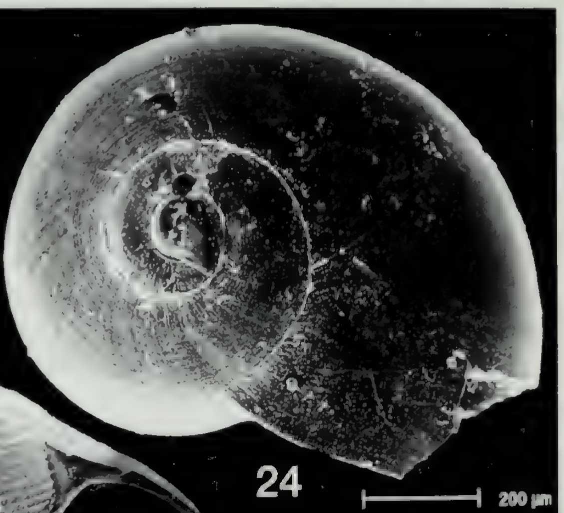
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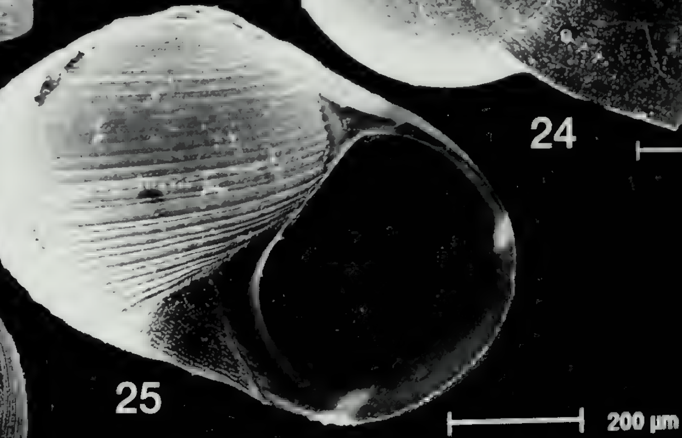
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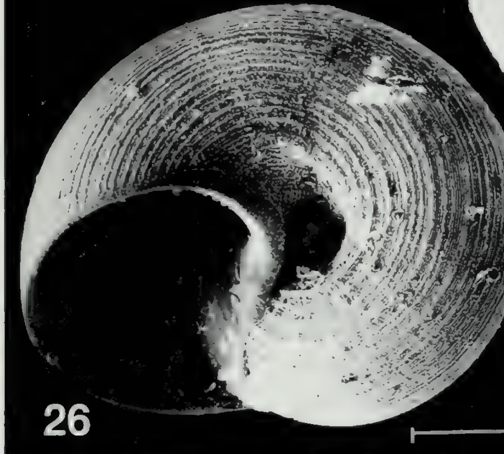
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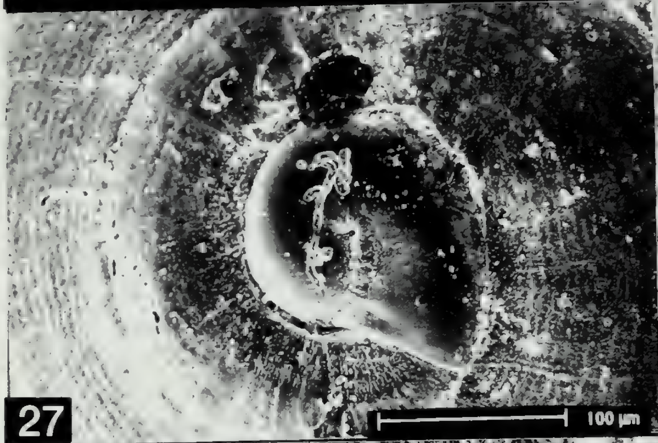
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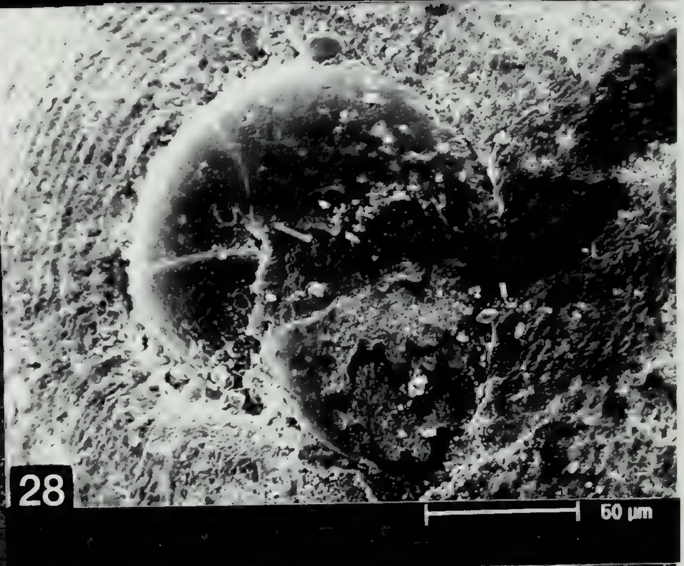
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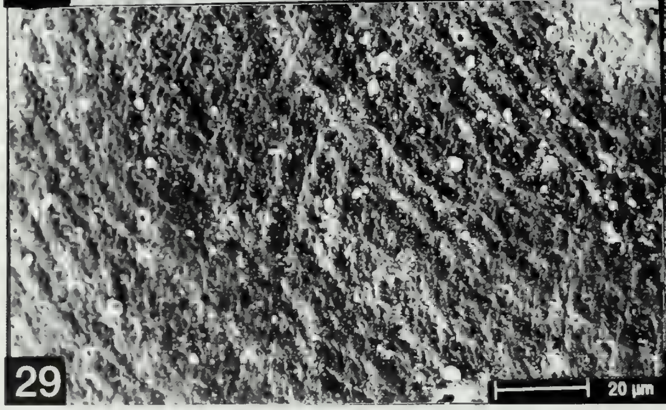
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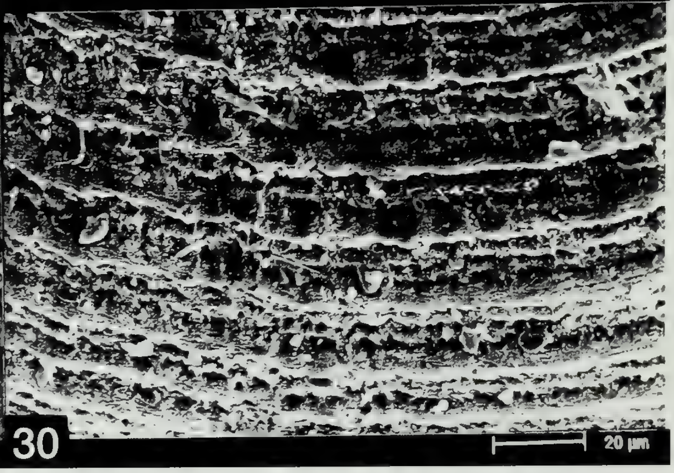
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A new species of *Fulgoraria* (Gastropoda: Volutidae) from the East China Sea

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KEYWORDS. Gastropoda, Volutidae, East China Sea, *Fulgoraria isabelae* nov. sp.

ABSTRACT. *Fulgoraria isabelae* nov. sp. is described from the south of East China Sea. It is compared with related species and particularly with *Fulgoraria* (*Saotomea*) *delicata* (Fulton, 1940).

INTRODUCTION

No paper on the genus *Fulgoraria* Shumacher, 1817 was written since the comprehensive work of SHIKAMA (1967). Even WEAVER & DU PONT (1970) brought only some additional confusions. Only recently, extension of fishing zones as well as deeper dredgings led to the discovery of four new species: one from Viet-Nam waters, *F.* (*F.*) *ericarum* Douté, 1997, the second from the South China Sea, *F. minima* Bondarev, 1994, this latter may be linked with the subgenus *Psephaea* Crosse, 1871. The third, still unnamed species, from southern Kyushu, Japan, belongs to the subgenus *Musashia* Hayashi, 1960. The shell characters of the last one, here described as *F. isabelae* nov. sp., seem very close to the monospecific subgenus *Saotomea* Habe, 1943, represented by *F. delicata* (Fulton,1940).

SYSTEMATICS

Family **VOLUTIDAE** Rafinesque, 1815
Subfamily **Fulgorarinae** Pilsbry & Olsson, 1954
Genus **Fulgoraria** Schumacher, 1817

Fulgoraria isabelae nov. sp.

Figs. 1-6, 10, 12

Type Material.

Holotype: length (L): 49.5 mm ; width (W): 17.6 mm, Museum National d'Histoire Naturelle, Paris. (Figs.1-2)
Paratype 1. L: 46.4 mm. W: 17.2 mm. Bondarev coll.
Paratype 2. L: 48.2 mm. W: 17.9 mm. Bail coll. (Figs. 3-4).
Paratype 3. L: 44.9 mm. W: 17.6 mm. Bail coll. (Figs. 3-4c).
Paratype 4. L: 51.9 mm. W: 16.5 mm. Douté coll.[1]

Type locality.

Off Okinawa. The exact type locality still remains uncertain.

According to oral information, specimens have been collected by Japanese fishermen trawling off Okinawa in the south of the East China Sea. The exact geographical range extends probably southwards as it seems to be for *Fulgoraria minima*.

Habitat.

Between 100 and 400 m, on the usual fishing banks of the region. No more accurate information is currently available.

Description.

Shell small (average length: 46 mm) light, elongate-fusiform. Protoconch small (diameter: 2.3 mm) of two often corroded round whorls slighty tilted from the axis of the shell.

Teleoconch of 4 or 5 convex whorls sculptured with numerous weak axial ribs and hardly visible fine spiral striae.

Axial ribs conspicious from the suture to the shoulder, disappearing at the mid body whorls: 24-26 faint ribs on the penultimate, 27-29 on the last whorl. Suture indented with very narrow, slightly concave subsutural ramp. Aperture semi-ovate, with lustrous light cream surface inside. Outer lip whitish, smooth and simple. Columella straight, with one oblique distinct plait, a barely visible second adapical one found in one specimen. Siphonal notch and fasciole absent.

Surface uniform, beige or light brown, contrasting with the white columella.

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Discussion.

Fulgoraria isabelae may be easily separated from all species of genus *Fulgoraria* except one.

The genus *Fulgoraria* comprises twenty-five species. It is divided in six subgenera.

Five of these subgenera have large shells (from 100 to 250 mm) with very different morphology from *F. isabelae*:

*** Subgenus *Fulgoraria* s.s.:**

Type species: *F.* (*F.*) *rupestris* (Gmelin, 1791).

The shells included in *Fulgoraria* s.s. differ from *F. isabelae* in their elongate shape, globose protoconch, 6-9 columellar plaits, and a pattern of well-defined straight or weavy axial lines.

*** Subgenus *Kurodina* Rehder, 1969:**

Type species: *F.* (*Kurodina*) *smithi* (Sowerby III, 1901).

The species of the subgenus *Kurodina* differ in their large and thin shell with one strong columellar plait. No pattern.

*** Subgenus *Musashia* Hayashi, 1960:**

Type species: *F.* (*Musashia*) *hirasei* (Sowerby III, 1912).

The shells included in *Musashia* have a variable shape, a small protoconch, 1-3 columellar plaits, and a cancellate sculpture. No pattern.

*** Subgenus *Nipponomelon* Shikama, 1967:**

Type species: *F.* (*Nippomelon*) *prevostiana* (Crosse, 1878).

The shells included in the subgenus *Nipponomelon* have a variable shape, a small protoconch, 2-4 columellar plaits, and a pattern of irregular bad-defined weavy axial lines divided into three bands on the body whorl.

*** Subgenus *Psephaea* Crosse, 1871:**

Type species: *F.* (*Psephaea*) *concinna* (Broderip, 1836).

The shells belonging to *Psephaea* have an elongate shape, a medium sized protoconch, 3-5 Columellar plaits, and a colour pattern of irregular blotches or short axial bands divided into three bands on the body whorl, or reduced to a white central band.

*** Subgenus *Saotomea* Habe, 1943:**

Fulgoraria isabelae nov. sp. and *F.* (*Saotomea*) *delicata* (Fulton, 1940), the only species in the subgenus *Saotomea* up to now, are characterized by their similar size, uniform colour, light structure and by the unique (rarely two) columellar plait. However, *F.* (*S.*) *delicata* (Figs. 7-9, 12) is easy to separate from *F. isabelae* by the grey-white duller surface, the deep suture with a narrow flat ramp, slighty angulate shoulders with 15-17 keen axial ribs on the last whorl. The protoconch is narrow (average diameter: 1.8 mm), coarsely subconical (Fig. 11).

F. isabelae has a beige to brown glossy surface, suture just indented with a slightly concave ramp, rounded shoulders with 26-29 faint axial ribs on the last whorl. The protoconch is rounded, domeshaped (average diameter: 2.1 mm) (Fig. 12).

F. isabelae occurs in the southern East China Sea. It is separated from *F. delicata* by a large gap, which is considerable for the Fulgorarinae whose geographical extension is limited due to the non-planktotrophic larval development.

The sympatric *F. minima* Bondarev, 1994 is also small with numerous axial ribs (24 on the penultimate, 25 on the last whorl), but it differs in its strong spiral striae on the whole shell, in its deep brown-orange colour whith a conspicuous white central band, and in the columella with two to four prominent oblique plaits.

Etymology.

This taxon is dedicated to the wife of the second author, Isabel Bail whose patience is worthy of great collaboration.

CONCLUSION

Fulgoraria isabelae nov. sp. is in some characters such as size, shape, texture, and columellar fold, closer to the monospecific subgenus *Saotomea* than to any other subgenus of *Fulgoraria*. It is most probable that *F. isabelae* may belong to this subgenus.

However, the *Saotomea* diagnosis is mainly based on the presence of an operculum. Without animal available for study, allocation to this subgenus is thus only tentative.

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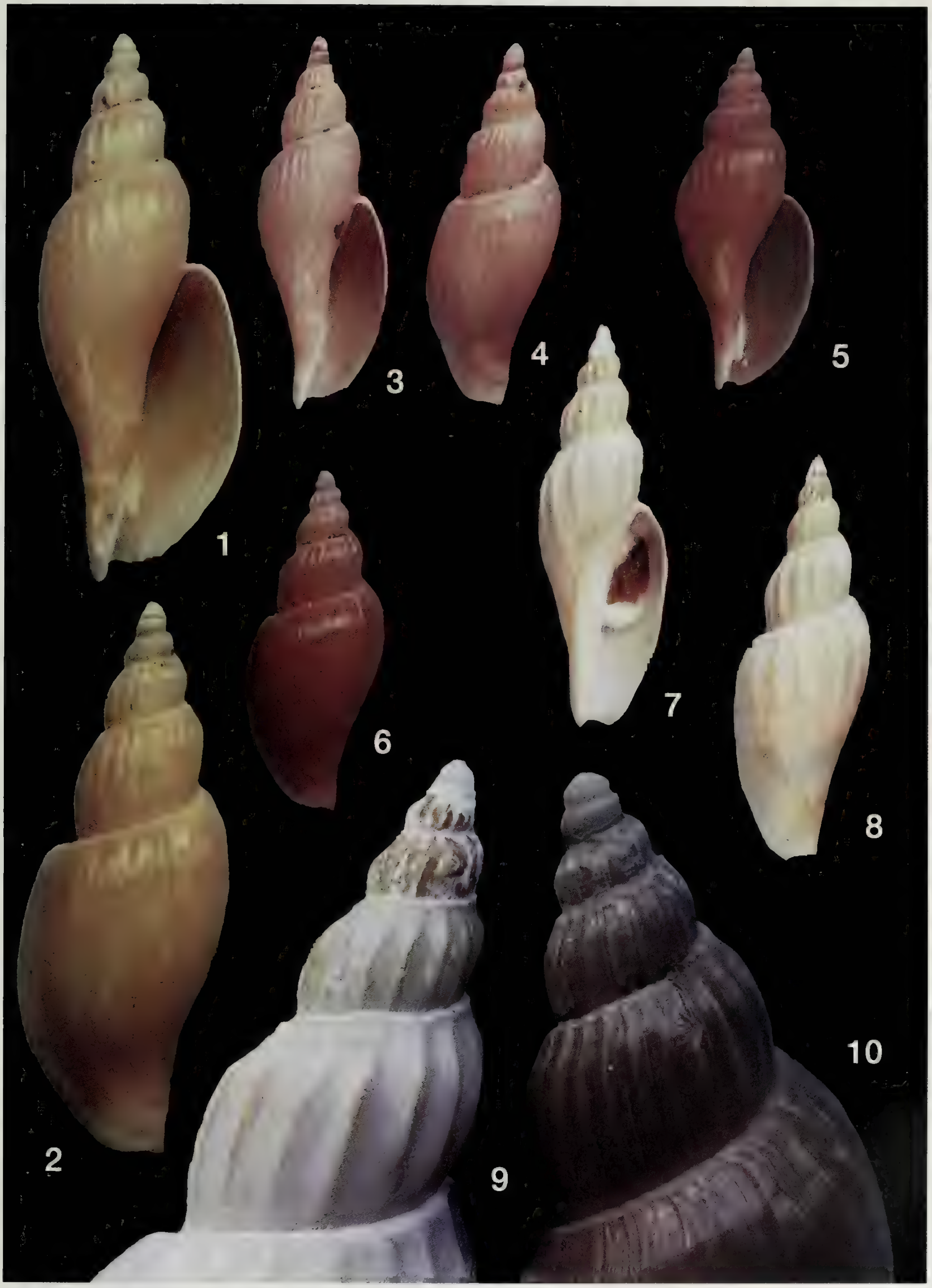
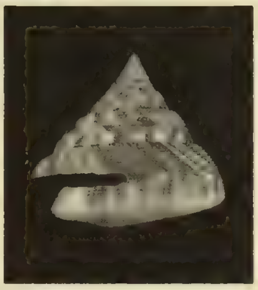


Figs. 1-6. *Fulgoraria isabelae* n. sp. Figs. 1-2. Holotype. L: 49.5 mm. W: 17.6 mm. Museum National d'Histoire Naturelle, Paris. Figs. 3-4. Paratype 2. L: 48.2 mm. W: 17.9 mm. Bail coll. Figs. 5-6. Paratype 3. L: 44.9 mm. W: 17.6 mm. Bail coll. **Figs. 7-9.** *Fulgoraria* (*Saotomea*) *delicata* (Fulton, 1940). L: 51.5 mm. W: 26.2 mm, Shikoku island, Japan. Bail coll. **Fig. 10.** *Fulgoraria isabelae* n. sp. Paratype 3.

Fig. 11. *Fulgoraria isabelae* n. sp. Paratype 3. **Fig. 12.** *Fulgoraria (Saotomea) delicata* (Fulton, 1940).



Gauguini

Distribution géographique.

Philippines, Bohol (Balicasag et Panglao), par 146-480 m., et Cebu.

Description.

Coquille de taille moyenne pour le sous-genre, atteignant 35 mm de hauteur, fusiforme, allongée, tours peu convexes, sutures incisées, subangulées à l'épaulement. Protoconque conique, composée de 2,75 tours lisses. Téléoconque composée de 9 ou 10 tours. Avant-dernier tour possédant 19 ou 20 côtes axiales et 10 ou 11 cordons spiraux. Dernier tour avec 25 ou 26 côtes axiales et 19 ou 20 cordons spiraux. Côtes axiales triangulaires, entrecroisées par des cordons spiraux régulièrement espacés, lisses, plats. Ouverture ovoïde, plus courte que la spire, environ 40% de la longueur totale; lèvre crenelée, présence de 4 plis columellaires; canal siphonal allongé, étroit. Renflement siphonal droit comportant 8 ou 9 costules obliques noduleuses à la base.

Coquille blanche. Ceinture brune-orangée subsuturale, à l'exception des deux premiers tours de téléoconque. Dernier tour possédant une ceinture brune-orangée au niveau de l'angle pariétal, parfois absente chez certains spécimens, et une large ceinture de même couleur au niveau abapical. Protoconque blanc brillant, ouverture blanche transparente. Périostracum non obervé.

Discussion.

Vexillum (Costellaria) alvinobalani diffère de *V. (C.) obeliscus* (Reeve, 1844) des Philippines (Fig. 14-16) par son ouverture étroite, allongée à l'extrémité abapicale et par son dernier tour orné de 25 ou 26 côtes axiales et de 19 ou 20 cordons spiraux, au lieu de 20 ou 21 côtes axiales et de 15 ou 16 cordons spiraux chez *V. (C.) obeliscus*. Elle diffère également par sa couleur et ses bandes subsuturales brunes-orangées, alors que *V. (C.) obeliscus* est brune avec une étroite ceinture crème subsuturale.

V. (C.) alvinobalani diffère de *V. (C.) macandrewi* (Figs 10-13) par sa plus grande taille (30-35 mm de haut, comparé à 16 mm pour le même nombre de tours de téléoconque chez *C. macandrewi*) et par la base de la coquille plus élancée et plus mince.

Aux Philippines, *V. (C.) alvinobalani* n.sp. vit en sympatrie avec *Mitra (Mitra) hilli* Cernohorsky, 1985, *Cancilla isabella* Swainson, 1831 et *Vexillum (Costellaria) martinorum* Cernohorsky, 1986.

Etymologie.

Ce nouveau Costellariidae est dédié à mon ami Alvino Balan, pêcheur de l'île de Balicasag, Bohol.

REMERCIEMENTS. Je suis particulièrement reconnaissant à H. Turner, Rovio, Suisse, pour ses remarques, ses conseils avisés, et pour les nombreuses photographies, à R. Houart, Landen, Belgique, pour la lecture et la correction du manuscrit, et à P. Bail, Paris, France, pour les clichés de types.

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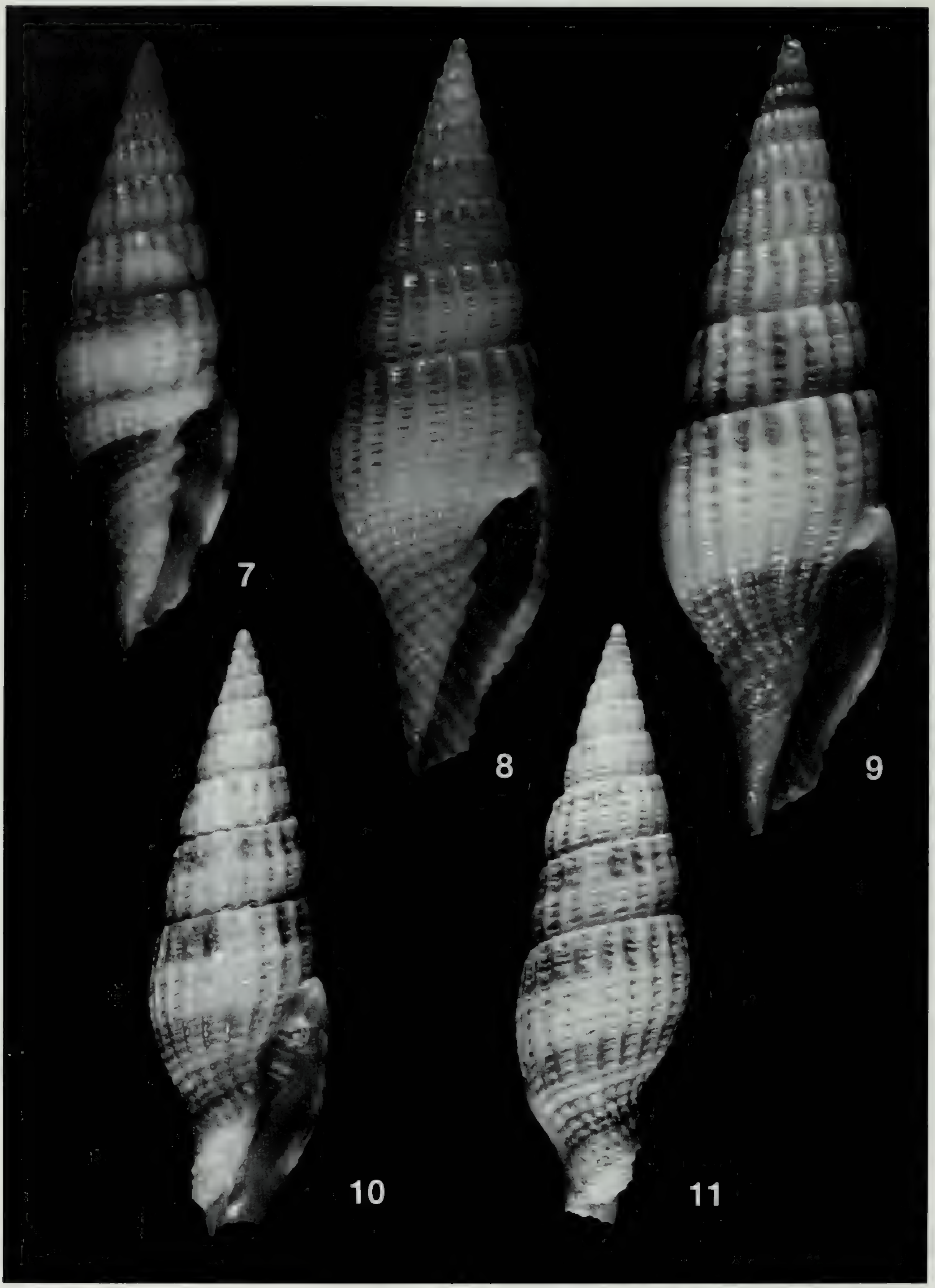
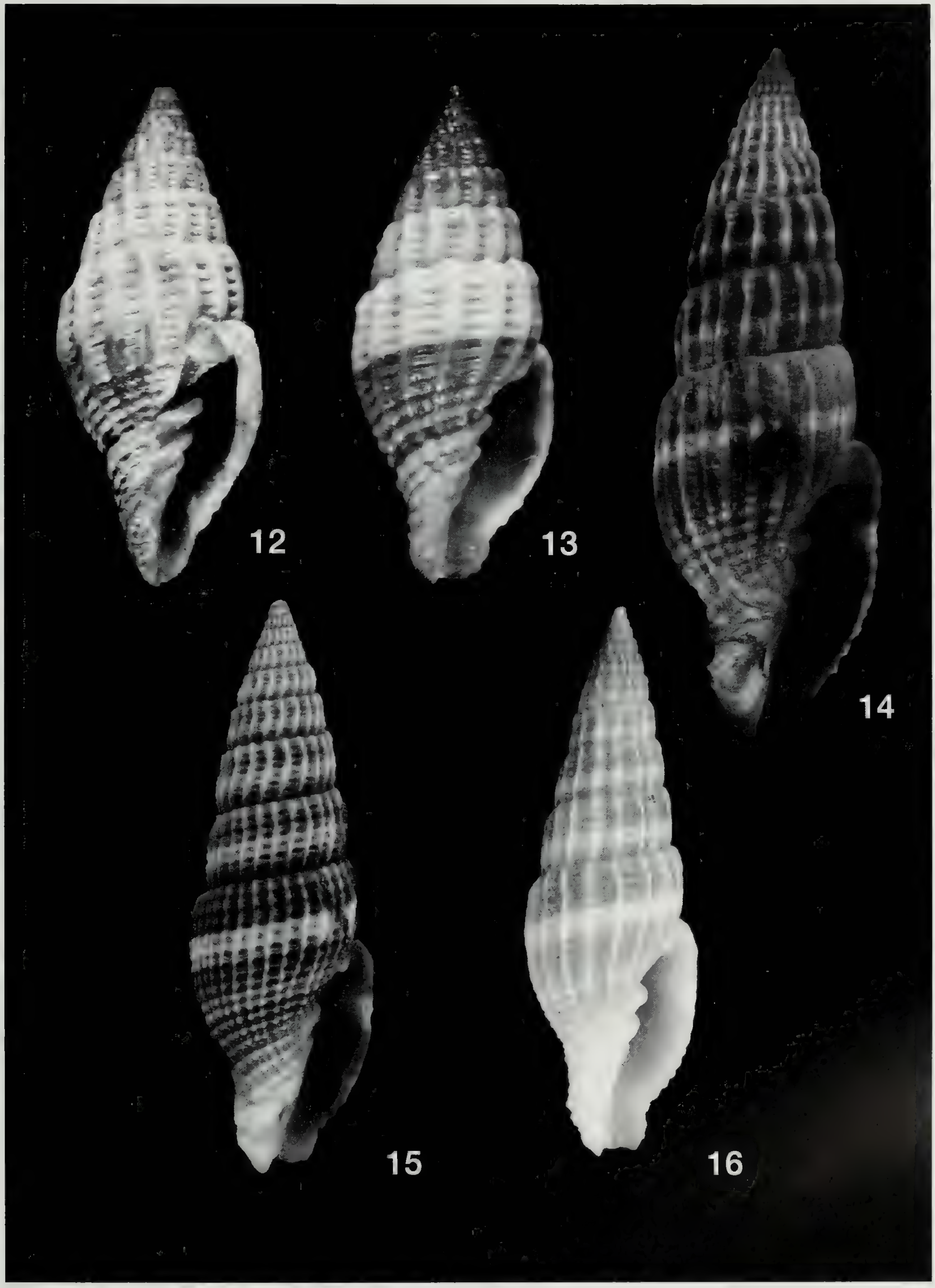
Figs. 1-6. *Vexillum (Costellaria) alvinobalani* n.sp., Philippines, sud-ouest de l'île de Balicasag, Bohol, 440-480 m. Figs. 1-2. Holotype MNHN, 31,7 X 18,2 mm. Figs. 3-4. Paratype 1, coll. E. Guillot de Suduiraut, 30,3 X 19 mm. Figs. 5-6. Paratype 2, coll. H. Turner, 30,7 X 18,7 mm.



Figs. 7-9. *Vexillum (Costellaria) alvinobalani* n.sp. Fig. 7. Paratype 3, Philippines, Bohol, Panglao, coll. J.-P. Vezzaro, 23 X 6,8 mm (photo H. Turner). Fig. 8. Paratype 5, Philippines, Cebu, ZMA 3.98.016, 20,6 X 6,2 mm (photo H. Turner). Fig. 9. Paratype 4, Philippines, Bohol, coll. T.W. Baer, 21,9 X 6,2 mm (photo H. Turner). **Figs. 10-11.** *Vexillum (Costellaria) macandrewi* (Sowerby II & III, 1874), Gulf of Aqaba, HUJ 37916, 15, 7 X 4,9 mm (photos H. Turner).



Figs. 12-13. *Vexillum (Costellaria) macandrewi* (Sowerby II & III, 1874), Gulf of Suez, leg R. Mac Andrew, Feb-Marc 1869, UMZC, 12,9 mm, juveniles (photos H. Turner).
Figs. 14-16. *Vexillum (Costellaria) obeliscus* (Reeve, 1844). Figs. 14-15. Philippines, Island of Negros, Bais, 7 fms (13 m). Deux des trois syntypes BMNH 1967825; Fig. 14: 29,3 X 9,3 mm.; Fig. 15: 23,9 X 7,5 mm (photos W.O. CERNOHORSKY; courtesy H. Turner). Fig. 16. Philippines, Cebu, Mactan Island, 120 m. Coll. E. Guillot de Suduiraut, 21 X 6,5 mm.

A new species of *Livonia* (Gastropoda: Volutidae) from Northwest Australia

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KEYWORDS. Gastropoda, Volutidae, N.W. Australia, *Livonia limpusi* nov. sp.

ABSTRACT. *Livonia limpusi* is described from deep water of Northwest Australia. It is compared with *Livonia roadnightae* (McCoy, 1881) and *Livonia mammilla* (Sowerby I, 1844).

INTRODUCTION

Early in the eighties, several experimental trawlings were made by shrimp boats along the West Australian shores. Many of these have led to the discovery of unknown populations of Volutidae, e.g. *Calliotectum dalli claydoni* (Poppe, 1986), *Calliotectum tibiaeforme* forma *dupreyae* (Emerson, 1985), *Amoria rinkensi* Poppe, 1986, and *Livonia joerinkensi* (Poppe, 1987).

Unfortunately, many hauls were very poor in shrimps and trawling was not continued in these regions; most of the prospected areas are now deserted.

Some hauls were very productive in shells and yielded several specimens of unknown species in apparently restricted areas, among them the new Volutidae here described.

SYSTEMATICS

Family **VOLUTIDAE** Rafinesque, 1815
Subfamily ***Zidoninae*** H. & A. Adams, 1853
Genus ***Livonia*** Gray, 1855

Livonia limpusi nov. sp.
Figs. 1-10, 15a

Type material.

Holotype. Length (L): 133.4 mm, width (W): 65.5 mm. WAM S.12011 (West Australian Museum, Perth, West Australia). (Figs. 1-2).
Paratype 1. L: 114.8 mm, W: 61.2 mm. Bail coll. (Figs. 3-4).
Paratype 2. L: 100.5 mm, W: 50.0 mm. Limpus[1] coll. (Figs. 5-6).
Paratype 3. L: 125.9 mm, W: 64.3 mm. Limpus coll. (Figs. 7-8).
Paratype 4. L: 116.0 mm, W: 63.0 mm. Douté[2] coll. (Fig. 9).
Paratype 5. L: 111.1 mm, W: 59.4 mm. Bail coll.

Two additional specimens examined in private collections.

Type locality.

The type locality still remains uncertain. It is reliably located in a square demarcated by Broome, Karratha, Rowley Shoals and Scott Reef. Waters off Karratha seem to be the most probable area. Some specimens are presumed to come from Scott Reef. This locality seems to be uncertain because no specimen of *Livonia limpusi* was ever recorded so far north, whereas trawlings were so productive for the above mentioned taxa. Anyway, the geographical distribution of *L. limpusi* is the most northern locality ever recorded for a *Livonia* species.

Habitat.

Unknown. Probably on muddy bottom at 150-300 m deep.

Description.

Shell very small for the genus, solid, heavy for its size, ovate shaped with glossy surface. Protoconch large, slighty oval (diameter of holotype protoconch: 15.3 mm) globose with one and a half rounded first whorl. Nuclear and part of first whorl situated laterally, deviated at 90° on its vertical axis. Spire low, consisting of two smooth slighty convex whorls. Body whorl large without shoulder, smooth, of a regular shape with shiny surface when fresh. Sculpture of

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spiral ridge stronger below suture and on anterior tip, almost obsolete on middle of body whorl. Aperture large, forming 80% of total shell lengh. Outer lip beveled, slighty everted, forming a rounded angle when merging backwards to body whorl. Columella arched with four thick inequal plaits. Siphonal notch wide, very shallow. Fasciole absent.

Base flesh to whitish with on some shells a pattern of large axial zigzag brown lines forming an open tent-like design (Fig. 10), close to *L. mammilla* (Sowerby I, 1844).

Uniformly coloured shells seem to be more common than the patterned ones (6 versus 2 of the examined shells).

Animal and radula unknown.

Discussion.

This species obviously belongs to the genus *Livonia*: particular shell characteristics, extremely large globose protoconch, shape and pattern.

It is closely related to *L. roadnightae* (McCoy, 1881) and *L. mammilla* (Sowerby I, 1844).

Livonia roadnightae has an extremely large geographical range, from Port-Stevens (New South Wales) to Alhobros Islands (West Australia) (see Fig. 20). This species shows no noticeable variation along its range. It differs from *L. limpusi* by its bigger size (average length: 180 mm), by its strongly shouldered shape with thick axial ribs, and by its colour pattern made of large, irregular, blackish fine zigzag lines, never forming true tent-like design as in *L. limpusi* (Figs. 11-12)

Comparison of a juvenile of *L. roadnightae* and a juvenile of *L. limpusi* shows the difference (Figs. 15a-15b).

According to its northernmost range, *L. roadnightae* seems to be sympatric with *L. limpusi* in a narrow area. However, this is not yet proved because of current insufficient exploration.

Livonia mammilla is an eastern species whose range extends from Bass Strait and East Tasmania to east of Swain Reefs (Queensland) (see Fig. 20). Although it has the same smooth shape and the same pattern of open tent-like lines (Figs. 13-14), it differs by its giant size and bulbous protoconch, its lighter structure and its smooth surface without spiral ridges. See also the comparison of a juvenile of *L. mamilla* and a juvenile of *L. limpusi* (Figs. 15a-15c).

According to our current knowledge of its distribution, a 5,000 km gap of allopatry excludes conspecificity with *L. limpusi*.

Remarks.

Several problematic shells were recently discovered at a depth of 130-160 m, in an area between Kalbarri and Shark Bay. These shells are F.A.V. 293m (Abbottsmith, 1969), a juvenile specimen from the West Australian Museum (Figs. 18-19), and an adult specimen in Limpus coll. (Figs. 16-17). They have a shape and a pattern very close to *L. limpusi* but slighty differ by their large size (up to 146 mm) and a more inflated outline. Only three specimens are available, which is not sufficient to allow a precise identification. They can be considered either as a southern range extension of *L. limpusi*, showing a variation in size and outline from south to north or, less likely, as a new taxon. Further material is needed to solve this problem. This population shows, more than typical *L. limpusi* does, a clear relationship with *L. mammilla* from the east coast of Australia. A common ancestor, whose previous large geographical range could have been currently reduced into western and eastern populations, separated by a gap of the whole width of southern Australia, is possible.

Although different by their much smaller protoconch, and especially by the absence of axial ribs, these shells may be also compared with *L. quisqualis* Iredale,1957 from Bass Strait, which has been interpreted up to now as a hybrid between *L. mammilla* and *L. roadnightae*, sympatric at this locality. This interpretation remains uncertain and could be reconsidered.

Etymology.

This species is named in honor of Allan Limpus of Bundaberg, a well-known volute collector, who generously gave one of his specimens to the West Australian Museum as holotype.

CONCLUSION

Until now, the genus *Livonia* included four species: *L. joerinkensi* (Poppe, 1987), *L. nodiplicata* (Cox, 1910), *L. mammilla* (Sowerby I, 1844), and *L. roadnightae* (McCoy, 1881). It now appears to include more species, either in a restricted, still unexplored area, or with a more extended range than expected. The coast of West Australia is probably the richest in future discovery, as the latter problematical *Livonia* leads one to suppose.

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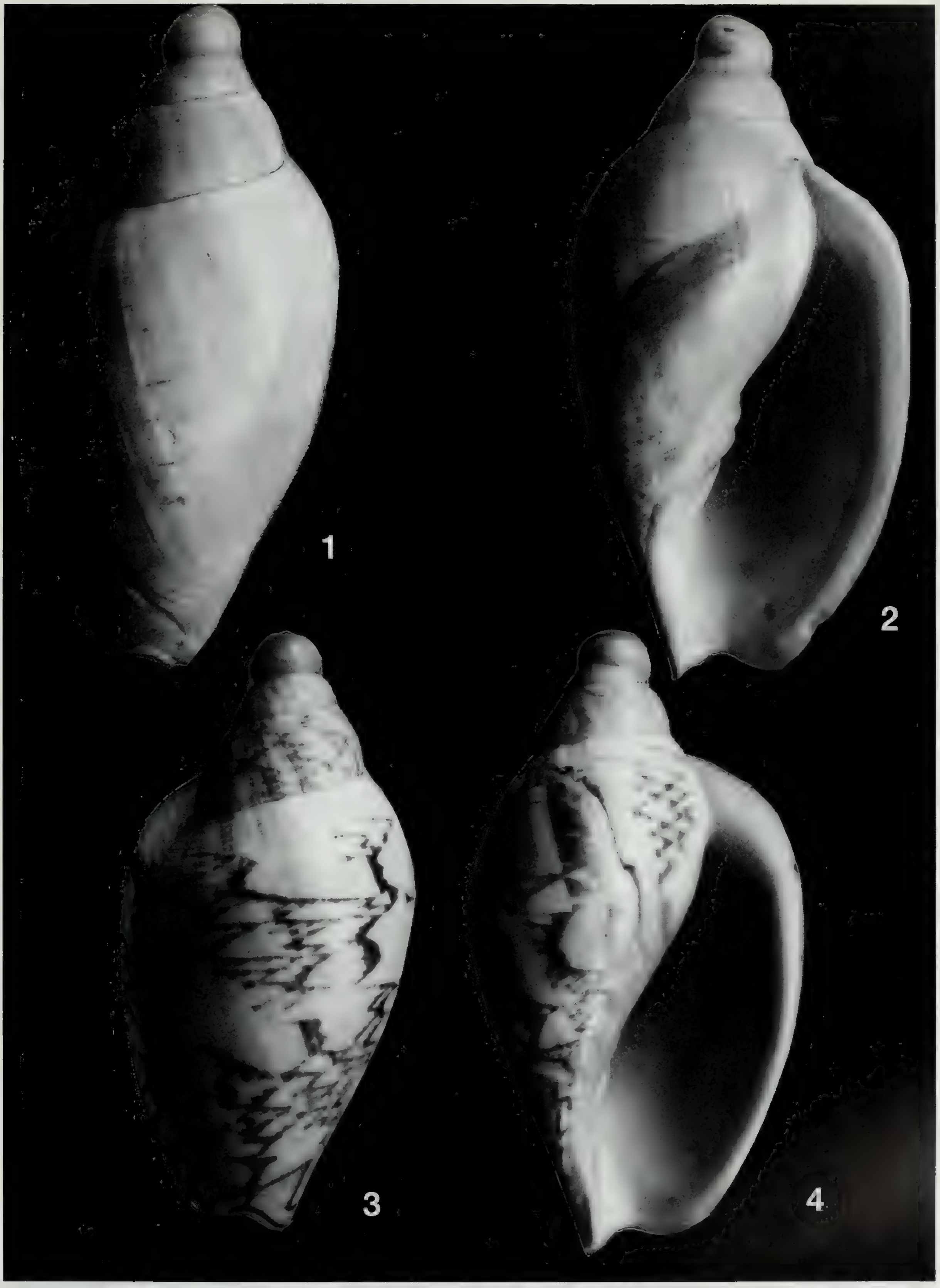
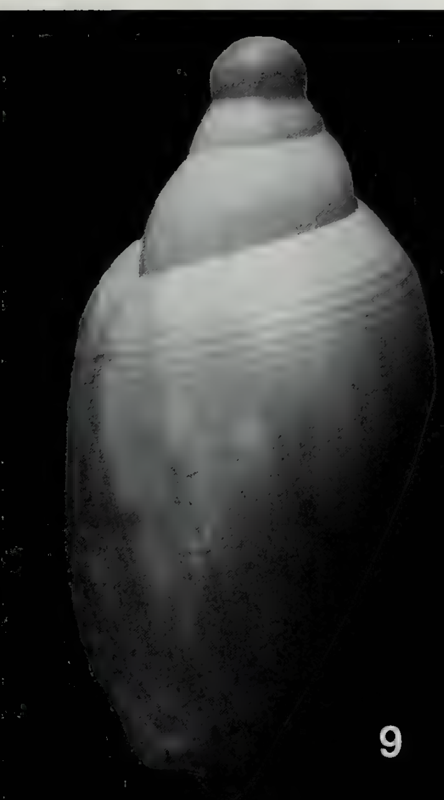


Figs. 1-4. *Livonia limpusi* nov. sp. Figs. 1-2. Holotype. L: 133.4 mm, W: 65.5 mm, WAM S.12011 (West Australian Museum,Perth, West Australia). Figs. 3-4. Paratype 1. L: 114.8 mm, W: 61.2 mm, Bail coll.

Figs. 5-8. *Livonia limpusi* nov. sp. Figs. 5-6. Paratype 2. L: 100.5 mm, W: 50.0 mm, Limpus coll. Figs. 7-8. Paratype 3. L: 125.9 mm, W: 64.3 mm, Limpus coll.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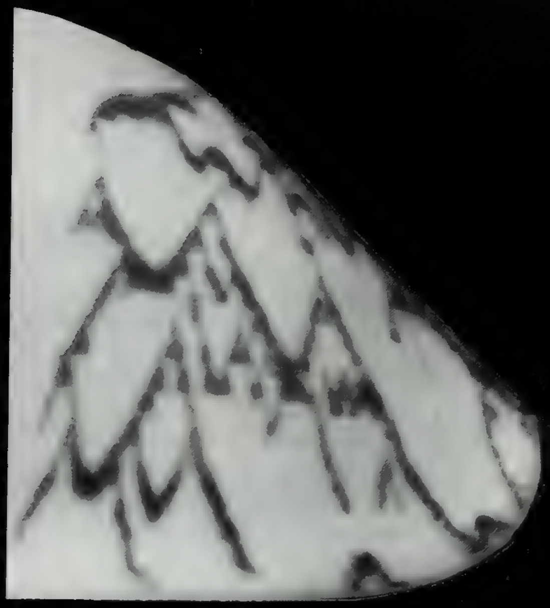
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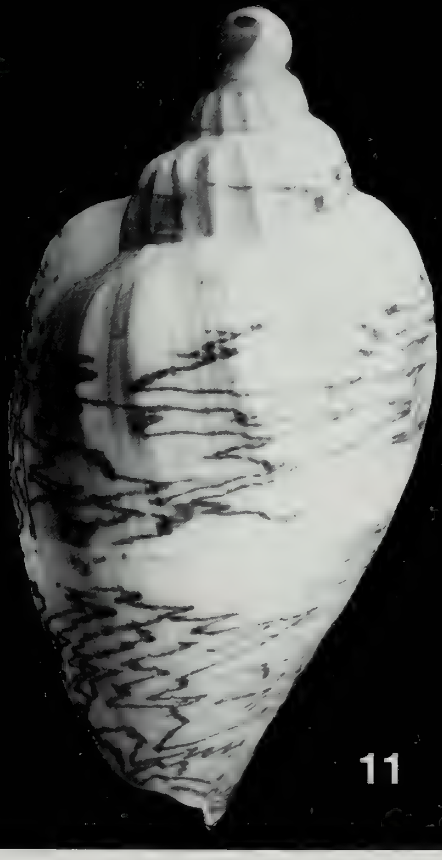
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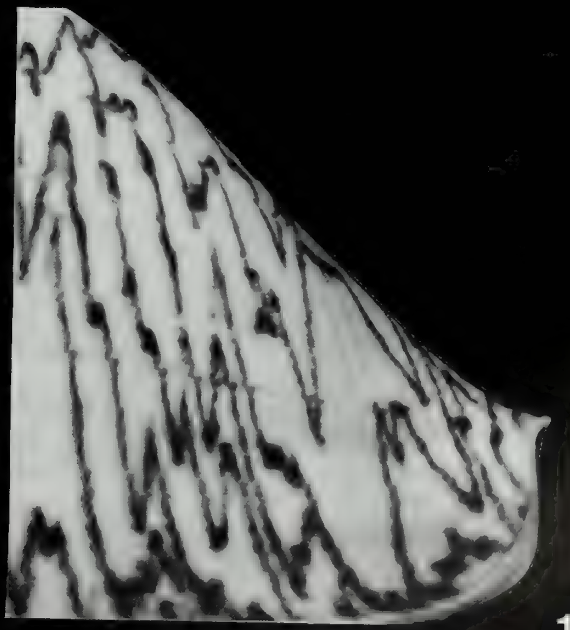
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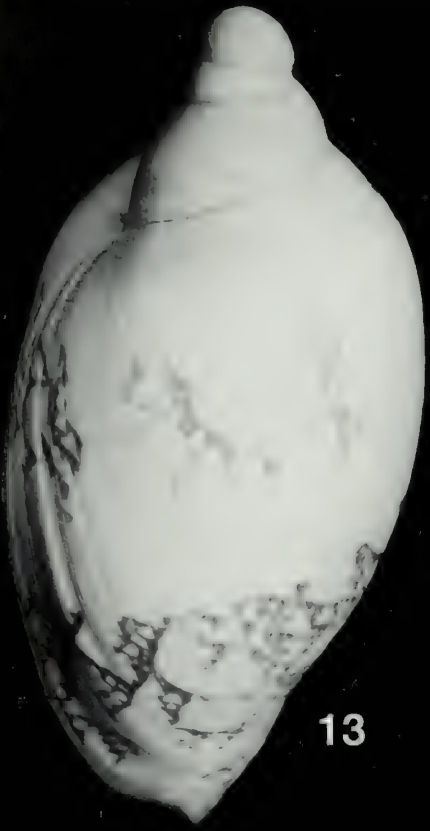
Figs. 9-10. *Livonia limpusi* nov. sp. Fig. 9. Paratype 4. L: 116.0 mm, W: 63.0 mm, Douté coll. Fig.10. Typical tent-like pattern. **Figs. 11-12.** *Livonia roadnightae* (McCoy,1881). Fig.11. L: 158 mm. Great Australian Bight, Bail coll. Fig.12. Typical zigzag pattern.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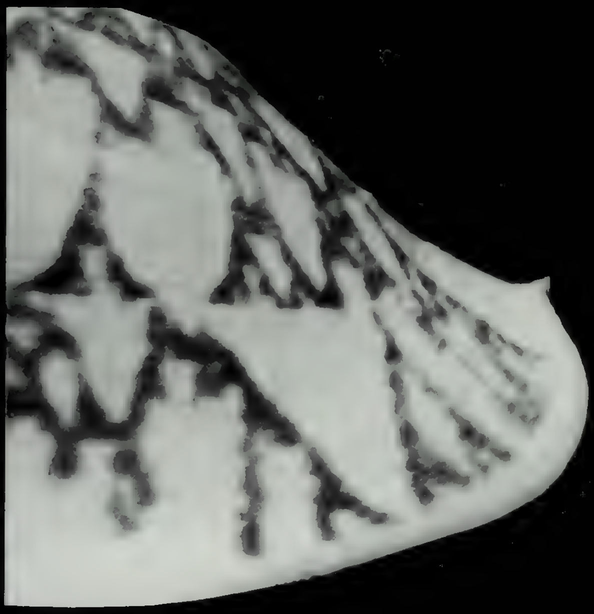
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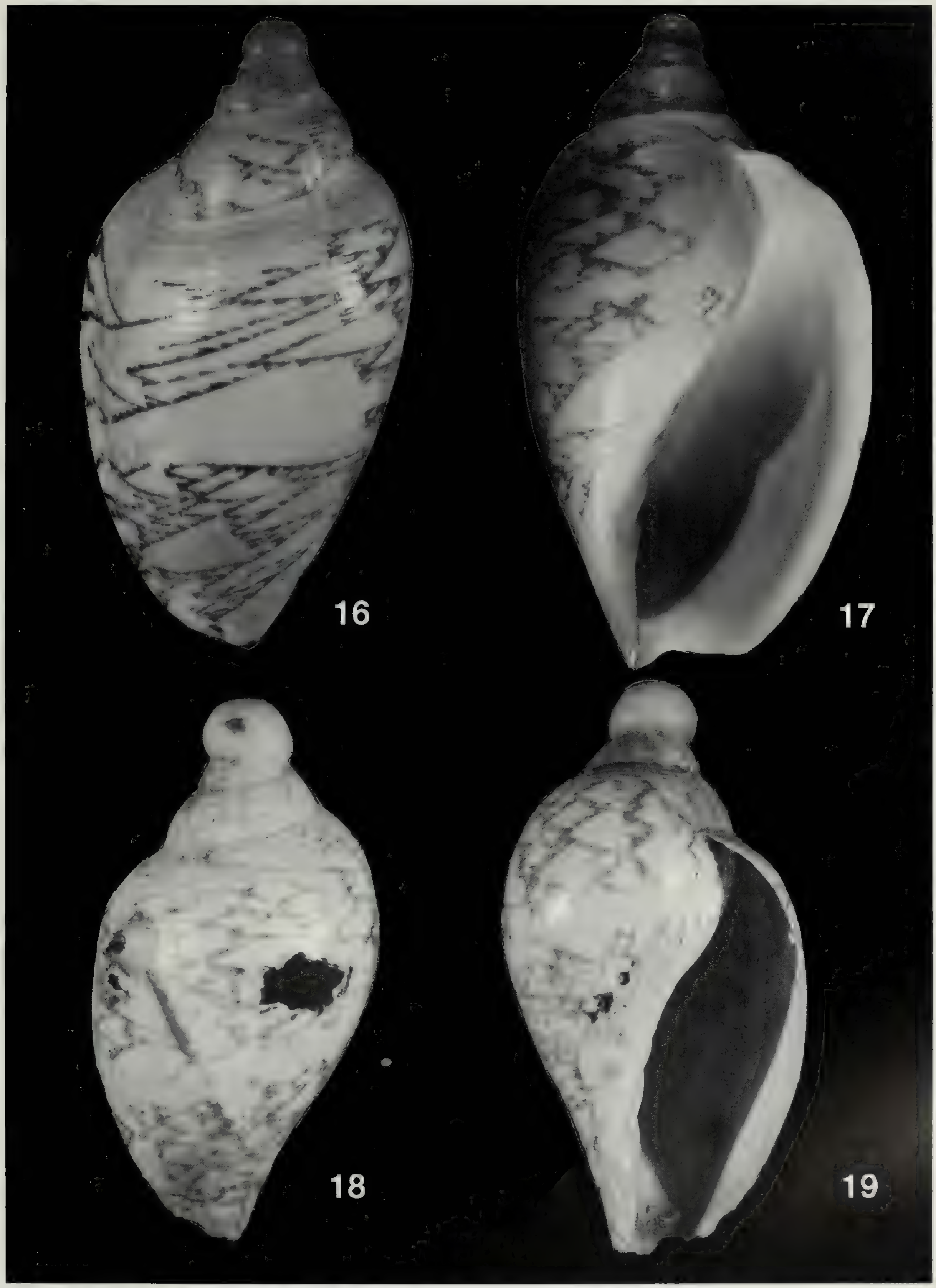
15 A

15 B

15 C

Figs. 13-14. *Livonia mammilla* (Sowerby I, 1844). Fig.13. L: 224 mm. Bass Strait Tasmania. Bail coll. Fig.14. Typical tent-like pattern. **Fig.15a.** Juvenile of *L. limpusi* nov. sp. L: 125.9 mm. **Fig 15b.** Juvenile of *L roadnightae* (McCoy, 1881) L: 129.7 mm. **Fig. 15c.** Juvenile of *L. mammilla* (Sowerby I, 1844) L: 133.7 mm.



Figs. 16-19. *Livonia* cf. *limpusi* nov. sp. Figs. 16-17. Off Kalbarri, W.A. 130 m deep, L: 146 mm, Limpus coll. Figs. 18-19. Juvenile from Dorre Island, 23°37 S / 113°04 E, 165 m deep, West Australian Museum.

Fig.20. Geographic distributions around Australia.

<——> *L. limpusi* nov. sp.
<·········> *L. roadnightae*
<·+++++·> *L. mammilla*

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Relevé de l'association de *Epilepton clarkiae* (W. Clark, 1852) et de *Mioerycina coarctata* (S. V. Wood, 1851) avec *Phascolion strombi* (Montagu, 1804) en Méditerranée.

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KEYWORDS. Bivalvia, Galeommatacea, *Mioerycina coarctata*, *Epilepton clarkiae*, Sipuncula, *Phascolion strombi*, Association, Mediterranean Sea, *Turritella*.

MOTS - CLEFS. Bivalves, Galeommatacea, *Mioerycina coarctata*, *Epilepton clarkiae*, Siponculiens, *Phascolion strombi*, Association, Méditerranée, *Turritella*.

ABSTRACT. This paper is an inventory of bivalves associated with the sipunculan *Phascolion strombi* (Montagu, 1804) in 60 empty shells of *Turritella communis* Risso, 1826 found in the Mediterranean sea (Benicarlo – Spain). 32 *Turritella* (53 %) were occupied by the sipunculan alone and 28 (47%) were occupied by the sipunculan and one or more bivalves, namely *Epilepton clarkiae* (W. Clark, 1852) or *Mioerycina coarctata* (S. V. Wood, 1851). The association between *Phascolion strombi* and *Epilepton clarkiae* is new for the Mediterranean sea.

RESUME. L'article présente un inventaire des bivalves associés avec le siponculien *Phascolion strombi* (Montagu, 1804) dans 60 coquilles vides de *Turritella communis* Risso, 1826 trouvées en Méditerranée (Benicarlo – Espagne). 32 *Turritella* (53%) étaient occupées par le siponculien seul et 28 (47%) contenaient le siponculien et un ou plusieurs bivalves des espèces *Epilepton clarkiae* (W. Clark, 1852) ou *Mioerycina coarctata* (S. V. Wood, 1851). L'association entre *Phascolion strombi* et *Epilepton clarkiae* est nouvelle pour la Méditerranée.

INTRODUCTION

La nomenclature des bivalves utilisée dans cet article est basée sur les travaux de VAN AARTSEN (1996a, b) et celle des siponculiens sur l'ouvrage de STEPHEN & EDMONDS (1972).

L'association entre des représentants de la superfamille des Galeommatacea (Bivalvia) et des membres de la famille des Golfingiidae (Sipuncula) est un fait établi depuis le début du siècle. PEREZ (1924) rapporte la présence du bivalve *Mioerycina coarctata* (S.V. Wood, 1851) (plus généralement connu sous la dénomination *Montacuta (Tellimya) phascolionis* Dautzenberg & Fisher, 1925) dans des coquilles vides de *Turritella communis* Risso, 1826 occupées par le siponculien *Phascolion strombi* (Montagu, 1804). PELSENEER (1925) décrit une association voisine entre *Epilepton clarkiae* (W. Clark, 1852) et *Golfingia vulgaris* (Blainville, 1827) dans des tubes vides de *Sabellaria alveolata* Linné (Polychète sédentaire). D'autres associations entre ce bivalve et *Golfingia pellucida* (Keferstein, 1865) ainsi que *Golfingia elongata* (Keferstein, 1862) sont rapportées par BOSS (1965).

TRONCOSO & URGORRI (1990, 1992) mentionnent, pour la première fois en Atlantique, la présence simultanée de *Phascolion strombi*, *Mioerycina coarctata* et *Epilepton clarkiae* dans une coquille vide de *Dentalium novemcostatum* Lamarck, 1818. DELONGUEVILLE & SCAILLET (1998) ont également observé l'association entre *Phascolion et Mioerycina* dans d'autres gastéropodes que les *Turritella* en Atlantique (*Aporrhais, Nassarius*) ou en Méditerranée (*Cancellaria, Fusinus*).

Pour rappel, selon PEREZ (1925), le siponculien occupe l'intérieur du gastéropode privé de parties molles et obture l'ouverture de la coquille par un bouchon de sable percé de deux canaux. Le canal le plus large débouche à l'extérieur dans la partie supérieure du bouchon et permet le passage de la trompe du siponculien. Le canal le plus étroit s'ouvre dans la partie inférieure du bouchon et assure l'évacuation de l'eau hors de la coquille hôte. Le bivalve cohabitant avec *Phascolion* se trouve généralement fixé sur la columelle, à l'intérieur de la coquille hôte, à un emplacement situé au voisinage de l'orifice interne du plus petit des deux canaux percés dans le bouchon de sable. Gage (1979) explique les mouvements de l'eau dans ces différents canaux.

Le présent travail fait l'inventaire des bivalves récoltés dans un échantillon de 60 *Turritella communis* de Méditerranée occupées par le siponculien *Phascolion strombi*.

MATERIEL ET METHODES

60 *Turritella communis* dont l'ouverture était obturée par un bouchon de sable percé de deux orifices (Fig. 1) ont été récoltées le 1er juin 1998 sur le pont d'un chalutier à Benicarlo (Costa del Azahar - Espagne - Méditerranée). Le lieu de récolte se situe à quelques kilomètres du port (pêche journalière), une provenance plus précise n'a pu être établie.

Chaque *Turritella* a été disséquée au moyen d'une pince coupante en commençant l'opération dans le tiers supérieur du gastéropode, puis en descendant progressivement vers son ouverture. Les bivalves présents aux côtés du siponculien ont été récoltés au fur et à mesure de leur mise en évidence.

RESULTATS ET DISCUSSION

Deux espèces de bivalves ont été identifiées dans l'échantillon: *Mioerycina coarctata* (Fig. 2) et *Epilepton clarkiae* (Figs. 3 et 4). L'inventaire est résumé dans le Tableau 1.

26 spécimens de *Mioerycina* étaient vivants, 1 était privé de parties molles et 8 spécimens brisés lors de la découpe n'ont pu être documentés. La taille des bivalves varie de 1,1 x 0,8 mm à 3,0 x 1,7 mm. Les deux spécimens vivants de *Epilepton clarkiae* sont de taille identique: 1,4 x 1,1 mm.

Tout comme mentionné par Perez (1925) dans sa description de l'association entre *Mioerycina coarctata* et *Phascolion strombi*, les spécimens de *Mioerycina coarctata* ainsi que les deux spécimens de *Epilepton clarkiae* se trouvaient eux aussi à l'intérieur de la *Turritella*, à un emplacement situé au voisinage de l'orifice interne du plus petit des deux canaux percés dans le bouchon de sable.

La présence simultanée de plusieurs bivalves (jusqu'à 4) dans une même coquille occupée par *Phascolion strombi* confirme les observations de Perez en 1925 (souvent 3) et celles de Troncoso & Urgorri en 1992 (jusqu'à 6).

Figure 1. *Turritella communis* Risso, 1826 - coquille hôte - 30,8 x 7,7 mm.

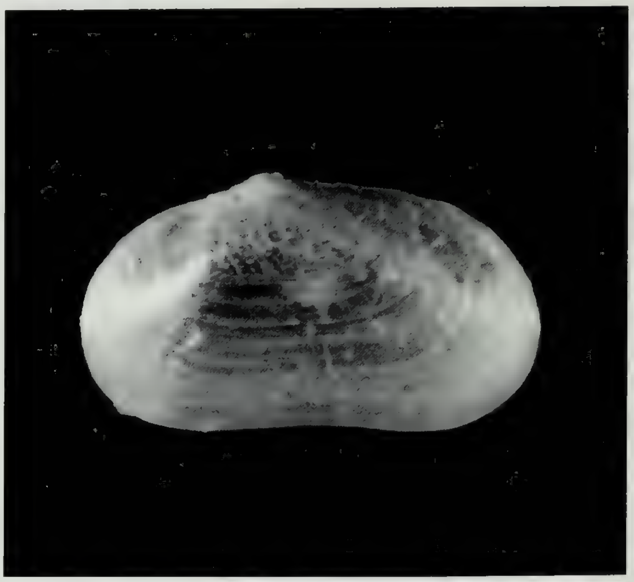

Figure 2. *Mioerycina coarctata* (S.V. Wood, 1851) – 2,4 x 1,2 mm.

Figure 3. *Epilepton clarkiae* (W. Clark, 1852) - face interne - 1,4 x 1,1 mm.

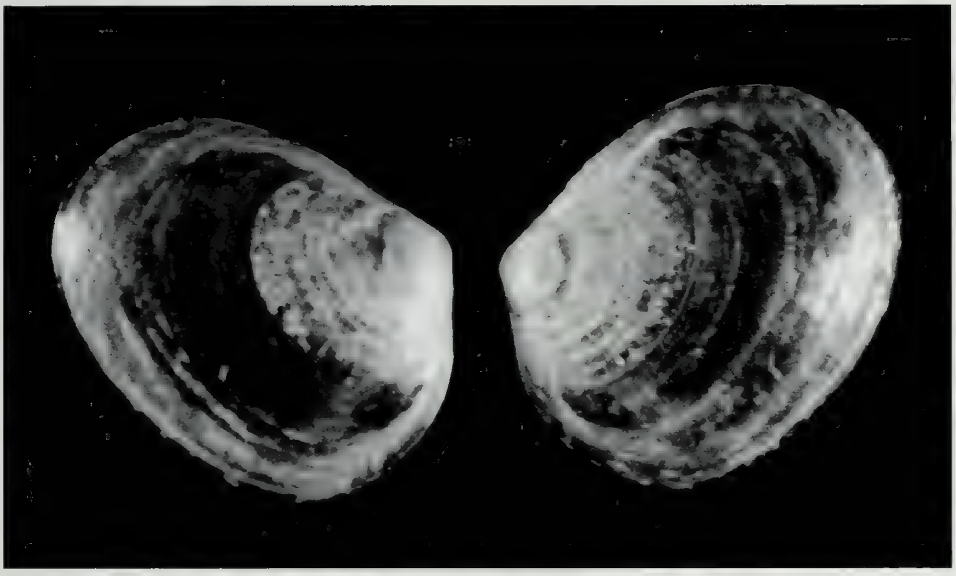

Figure 4. *Epilepton clarkiae* (W. Clark, 1852) - face externe - 1,4 x 1,1 mm.

	Nombre de *Turritella*	%
Siponculien seul	**32**	**53,3**
Association avec *M. coarctata*	**26**	**43,4**
1 individu	20	33,3
2 individus	4	6,7
3 individus	1	1,7
4 individus	1	1,7
Association avec *E. clarkiae*	**2**	**3,3**
1 individu	2	3,3

Tableau 1. contenu de 60 *Turritella communis* occupées par *Phascolion strombi.*

CONCLUSIONS

La présente observation confirme, en Méditerranée, l'association entre *Phascolion strombi* et *Mioerycina coarctata* dans des coquilles vides de gastéropodes (*Turritella communis*).

Elle établit également l'existence d'une seconde association, moins fréquente, avec un autre Montacutidae: *Epilepton clarkiae*.

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Counting shell whorls. Remarks.

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ABSTRACT. The suture is usually utilised for counting the number of whorls of coiled shells. This measurement can be influenced by several factors, such as the location of the centre of measurement, the orientation of the shell, the existence of several growth phases, the irregularities in the beginning of the protoconch suture, the difference in the orientation of the protoconch and the teleoconch, a gradual transition between the protoconch and the teleoconch. A simple and practical method is described.

INTRODUCTION

The number of whorls of coiled shells is a fundamental information for morphometric studies. Counting the number of whorls of a shell appears to be a straightforward operation. Yet, different authors may report a surprisingly different number of whorls for the same shell. GOULD (1989) and STONE (1995) have underlined the difficulties inherent to the process of counting the whorls of coiled shells.

Authors are unanimous on what is to be counted: a whorl is a complete volution or turn of the spire of a univalve shell (ARNOLD, 1965). Experimental errors certainly do occur, but most differences stem from another source: the number of whorls can vary considerably according to the method used for counting (see Fig. 1).

There is no consensus on what would be the best "standard method". The existing methods fall broadly into two categories, according to the point of origin of the measurements (see Fig.1).

One group of methods uses a "centre" of the nucleus (in most cases this "centre" is not precisely defined):

- method **A** (EHRMANN, 1956; JUNG, 1986; VALOVIRTA & VÄISÄNEN, 1986),
- method **B** (VERDUIN, 1977; WAREN, 1974; KERNEY & CAMERON, 1979; PFLEGER, 1989; VERMEULEN & WHITTEN, 1998),
- method **C** (a novel method described here under).

The other group of methods uses the starting point of the suture; the shell is oriented by reference to the tangent to the suture at the starting point (or to its perpendicular):

- method **D** (DIVER, 1931),
- method **E** (TURSCH & GERMAIN, 1985),
- method **F** (HOENSELAAR & GOUD, 1998).

Some of these methods also differ in what is considered to be the first whorl (see Fig.1). Method **C** systematically gives 0.25 whorl more than method **B**, which in turn gives 0.25 whorl more than method **A**. Method **E** gives 0.25 whorl more than method **D**. Methods **C** and **E** give similar results for every multiple of 0.5 whorl (in all other cases the difference depends on the distance between the start of the suture and the centre of measurement).

The reported precision of the measurement varies from author to author. For instance it is 0.05 whorl for DIVER (1931) and for TURSCH & GERMAIN (1985); 0.125 whorl for VERMEULEN & WHITTEN (1998); 0.25 whorl for BAMINGER (1997).

This paper aims at providing a general, comparative discussion of methodology and an evaluation of the factors influencing the accuracy and reproducibility of measurements. It also introduces a simple, practical method for counting whorls.

LIMITATIONS

To count whorls, one must be able to distinguish the different volutions. This is usually achieved by observing the suture in apical view.

There is a broad agreement on the definition of the suture. It is for instance "*the line of contact where two whorls meet*" (FRETTER & GRAHAM, 1962), or "*a continuous spiral line marking the junction of whorls in a gastropod shell*" (ARNOLD, 1965), or "*the junction of each whorl against the other*" (ABBOTT, 1974).

There are **limitations** to the use of the suture. For instance, in the genus *Epitonium* [also in *Blaesospira echinus* (Pfeiffer, 1864)], the last whorls are not attached and there is no suture left; one then uses the borders of the whorls, seen in apical view. In the genus *Oliva*, the suture is rather inconspicuous and the filament channel is used instead (see VAN OSSELAER &

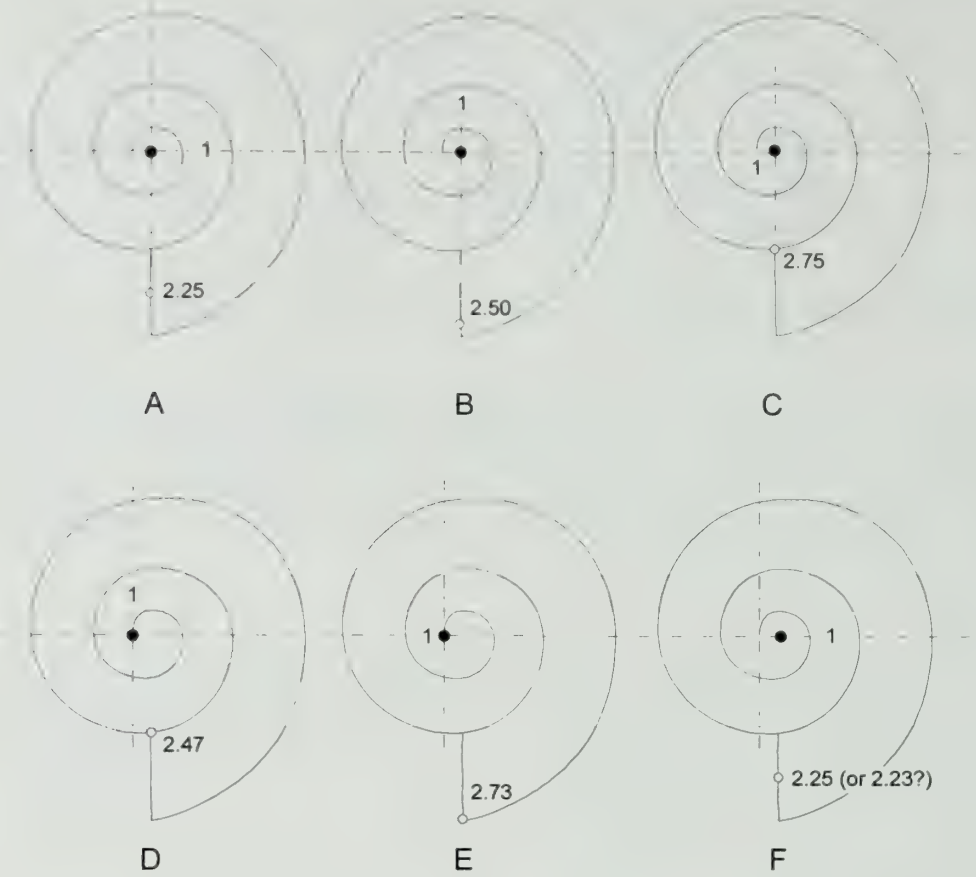

Figure 1. Number of whorls of the same fictive shell, measured by different methods. Black dot: point of origin of measurements. White circle: point being measured. **A**, **B**, **C**. methods using the "centre" of the spiral. **D**, **E**. methods using tangent to the suture at the starting point (or to its perpendicular). **A**. method of EHRMANN (1933), JUNG (1986), VALOVIRTA & VÄISÄNEN (1986). **B**. method of VERDUIN (1974), WAREN (1974), KERNEY & CAMERON (1979), PFLEGER (1989), VERMEULEN & WHITTEN (1998). **C**. method presented in this paper (see Figs. 10, 11). **D**. method of DIVER (1931). **E**. method of TURSCH & GERMAIN (1985). **F**. method of HOENSELAAR & GOUD (1998) (it is not clearly stated from where to count whorls).

TURSCH, 1994). In other cases, such as adult shells of the genus *Cypraea*, the suture is covered by a callus and cannot be observed.

DEFINITIONS

Counting whorls amounts to measuring an angle. This requires a centre of measurements and two lines (centre to starting point and centre to ending point).

For most Gastropod shells, the suture can be described (see VAN OSSELAER & GROSJEAN, in press) by a three-dimensional logarithmic helicospiral defined by the equations:

$$\begin{cases} r = r_0 \,.\, S_r^{\theta} \\ z = z_0 \,.\, S_z^{\theta} \end{cases}$$

where θ is the number of volutions of the suture. r is the distance from the coiling axis to the suture. z is the longitudinal coordinate from the origin of the logarithmic helicospiral. S_r is the radial expansion rate of the suture, S_z is its longitudinal expansion rate along the coiling axis. r_0 and z_0 are constants and correspond to the radial and the longitudinal distances of the suture from the pole of the spiral when θ equals zero (for details, see VAN OSSELAER & GROSJEAN, in press).

In the apical view of a logarithmic helicospiral, angles and co-ordinates are measured from its ***pole*** (often called the "centre" of the spiral). One should note that:

the pole is not the origin of the reference system ($x = 0, y = 0, z = 0$);

the pole is not the starting point of the suture (and cannot be on the actual helicospiral because $r = r_0 \neq 0$ for $\theta = 0$);

the pole is not the "centre" of a "circular approximation" of the nucleus (see Fig. 2) because the logarithmic helicospiral is not a circle.

The number of whorls of the shell (**NWh**) is **not** the number of volutions of the suture (θ). One has:

$$\mathrm{NWh} = \theta + 1.$$

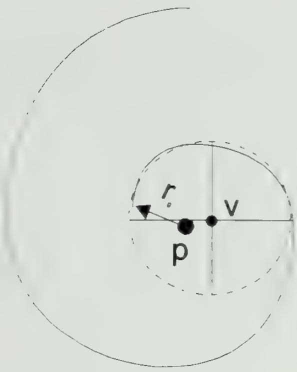

Figure 2. The pole (**p**) does not belong to the actual logarithmic helicospiral. It is located at a distance $\mathbf{r_0}$ from the beginning of the spiral. It is also different from the centre of a circular approximation of the nucleus (**v**).

SOURCES OF ERROR

Errors on the centre of measurement

Errors on the location of the centre of measurement can seriously affect the estimation of NWh, as shown in Figure 3. Such errors are particularly important when only a small number of whorls are counted.

Such errors could be avoided because the pole of a logarithmic spiral can easily be determined by a graphical method. An elementary property of a logarithmic spiral is that all the straight lines passing through the pole cross the curve at a constant, specific angle.

It follows that, if one draws a series of parallels tangent to opposite sides of the curve (Fig. 4), the pole is the point of intersection of lines joining the tangency points. This method is discussed in VAN OSSELAER & GROSJEAN (in press).

Errors in orientation of the shell

When the shell is oriented visually, its coiling axis rarely coincides *exactly* with the line of observation. The resulting error can be estimated with great accuracy by a computing method consisting in iterative recalculations of all co-ordinates in another projection plane (reprojection) and from another origin (relocation of the pole) (see VAN OSSELAER & GROSJEAN, in press). Table 1 shows that the error due to small angular errors in shell orientation is very small (about 0.01 whorl).

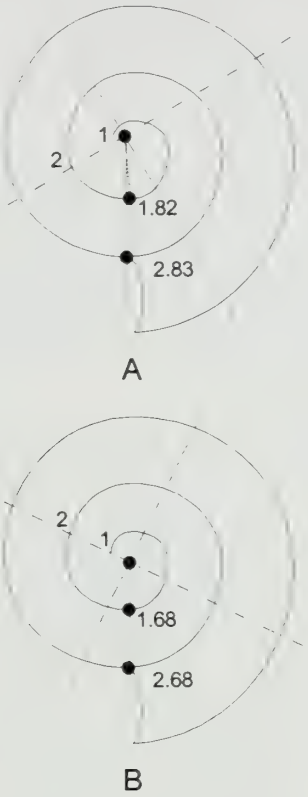

Figure 3. Determination of the angular position of two identical points measured on the same shell. Errors on the location of the centre of measurements could affect seriously the estimation of the number of whorls.

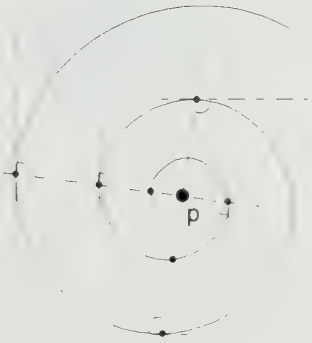

Figure 4. Graphical determination of the pole of the logarithmic spiral (**p**). The pole is at the intersection of lines crossing contact points of opposite parallels tangent to the spiral (from VAN OSSELAER & GROSJEAN, in press).

	Visual estimation	P+O Corrected	P corrected	O Corrected
Achatina achatina (L., 1758)	**3.667**	**3.673**	**3.680**	**3.674**
Anctus angiostoma (J.A. Wagner, 1827)	**4.208**	**4.227**	**4.219**	**4.215**
Helix pomatia L., 1758	**2.638**	**2.628**	**2.623**	**2.646**
Oliva porphyria (L., 1758)				
Phase 1	*1.944*	*1.943*	*1.956*	*1.944*
Phase 2	*1.639*	*1.656*	*1.658*	*1.656*
Sum of phases 1+2	**3.583**	**3.599**	**3.614**	**3.600**

Table 1. Number of whorls between two well defined points of the teleoconch. After iterative recalculations by a computing method, new angles are obtained. **P+O**: corrections for both the location of the pole and for the projection; **P**: correction for the location of the pole only, **O**: correction for the projection only. The correction angles for the projections are less than 5°. The correction for the location of the pole are less than 1 mm.

Errors due to combining protoconch and teleoconch

In some shells, the protoconch and the teleoconch have a different orientation of their coiling axes (COX, 1955; SAVAZZI, 1990; JOHNSTON *et al.*, 1991). This phenomenon is particularly obvious in heterostrophic protoconchs (see for example ROBERTSON, 1974; BOUCHET, 1987). Small, visually undetectable differences in the orientation of both parts of the shell have been evidenced by VAN OSSELAER & GROSJEAN (in press) and seem to be widespread.

This can lead to errors because, in any given position, the axis of at least one part of the shell is not correctly oriented. The poles of each part of the shell do not coincide and are sometimes far from each other (the pole of the teleoconch could, in some cases, not even be in the nucleus). Therefore, if the difference in coiling directions is large, the number of whorls of the two parts of the shell should better be counted independently.

Note: Methods D and E would be very inaccurate if applied to the beginning of the teleoconch, due to an important error on the centre of measurement (see Fig. 5).

Errors due to teleoconch growth phases

Multiphasic growth of the teleoconch, involving changes in the direction of coiling, may also cause errors in the estimation of NWh. The biphasic teleoconch of *Oliva porphyria* (see VAN OSSELAER & GROSJEAN, in press and Table 1) illustrates that an angle of a few degrees between the axis of each growth phase involves only weak corrections (about 0.02 whorl).

More important differences in orientation, such as found in the multiphasic, irregularly coiling *Vermicularia* (see GOULD, 1969; ACKERLY, 1989), require independent estimation for each growth phase.

Errors on starting point

Locating the starting point for counting whorls is not always easy, on the protoconch as well as on the teleoconch.

A. Protoconch.

GOULD (1989 : 519) underlined that : "*Few nonmalacologists realize that one cannot unambiguously define whorl numbers from the shell's apex; there is no clear zero point at the top of a shell where winding begins*".

The location of the initial point of the suture is not always obvious because the suture starts only **after** a part of the shell is already formed. Indeed, "*the initial shell is the only part of the shell formed by simultaneous deposition of calcium carbonate, the rest being due to the addition of rings to its mouth*" (FRETTER & GRAHAM, 1962 : 62). This explains why

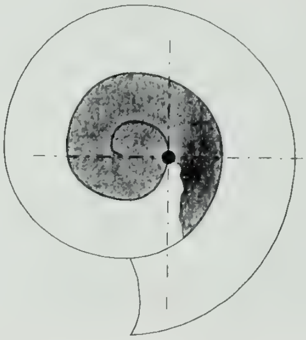

Figure 5. The methods using tangents or perpendicular to the suture (see Methods D, E) cannot be applied as such to the beginning of the teleoconch without introducing important errors on whorls estimation. The centre of measurements is far away from the pole of the spiral. In grey, the protoconch.

the early beginning of the "suture" line sometimes exhibits anomalies in curvature: a "hook" (see Fig. 6) or even an "S" shape (see MARSHALL, 1988 on Trochidae). Such a "hook" was observed by us in some specimens in the genera *Oliva* and *Helix*.

Counting methods D and E, based upon the tangent to the beginning of the protoconch suture (or its perpendicular) are then subject to important variations (*visually* fitting a tangent at an *estimated* beginning of the suture can be a problem). Taking or not this "hook" into account could involve up to 0.25 whorl discrepancy in the counting (see Fig. 6). Methods using a well defined centre of measurements are less sensitive to such effects (see Fig. 6).

Other problems also arise. Sometimes the protoconch suture is not visible (covered by a callus or hidden as in some heterostrophic protoconchs).

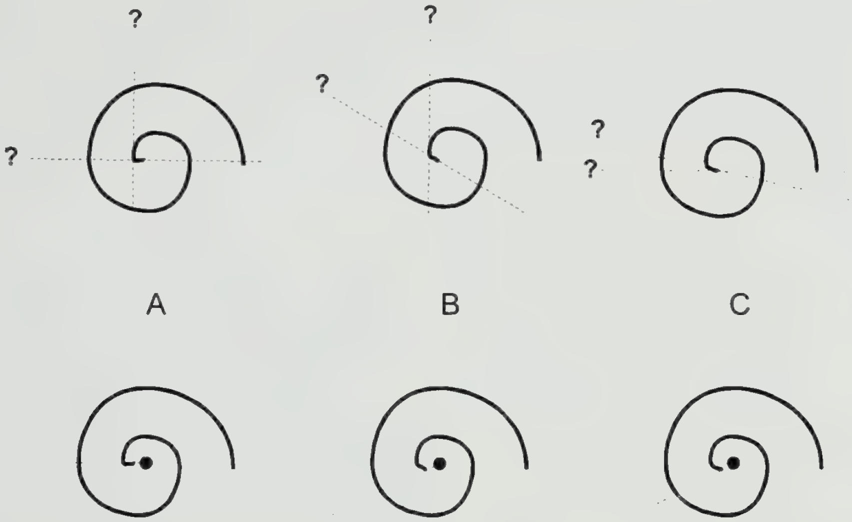

Figure 6. The beginning of the early suture line sometimes exhibits changes in curvature. These changes can be abrupt (A), more or less abrupt (B) or smooth (C). The methods based on tangent to the beginning of the suture (upper row) are more subject to important variations than the methods using a centre of measurements (lower row). Subjective interpretation of the suture starting point can lead to important variations in whorls estimations.

B. Teleoconch.

The transition from the protoconch to the teleoconch is sometimes gradual. In that case, there is a problem both for starting the count of the teleoconch whorls and for ending the count of the protoconch whorls (see Fig. 7).

The whorl count will depend on the extent of the gradual transition between the two parts of the shell and on the type of the approximation that is necessarily made. One could indeed consider that the transition point is:

- the last point belonging unambiguously to the protoconch,
- or the first point belonging unambiguously to the teleoconch,
- or the middle point between both of them (recommended).

In any case, one could report the extent of the transition (which is the range of uncertainty).

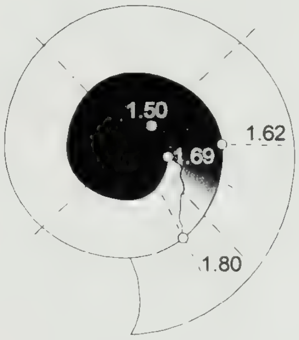

Figure 7. A gradual transition from the teleoconch to the teleoconch causes problems to estimate the number of whorls. One should take a convention on what is considered to be the transition. It could be the last point unambiguously belonging to the protoconch (1.50 or 1.62) or the first point unambiguously belonging to the teleoconch (1.69 or 1.80) or the middle point between both of them (1.60 or 1.71; not illustrated).

Errors on end point

For the protoconch, the "end point" is the transition to the teleoconch (the problem of gradual transitions has already been addressed). For the teleoconch, the end point is "somewhere in the aperture".

This raises another problem because the contour of the aperture (or the transition) is rarely in one plane (as it is in the fictive examples of Fig. 1). Even if the aperture should happen to be planar, the centre of measurements is not necessarily in the same plane (Fig. 1 D, E).

Some authors (EHRMANN, 1956; JUNG, 1986; VALOVIRTA & VÄISÄNEN, 1986) consider the "end point" as being the middle of the whorl, seen in apical view (point M in Fig. 8). Other authors (DIVER, 1931) consider the last point of the suture (point S in Fig. 8). Others yet (TURSCH & GERMAIN, 1985; BIELER, 1993) consider the most external point (point E in Fig. 8). Sometimes, such information is not clearly stated, as in HOENSELAAR & GOUD (1998). In some cases, the choice of one or another of these conventions can produce large differences in whorl counting (Figs. 7, 8).

Other conventions could also be considered. The aperture (and/or the transition) is sometimes tilted (prosocline or opisthocline apertures, see Fig. 9). One could select the most adapical, the most abapical or the mid-point as being the "end point". The difference resulting from that choice could be particularly important in the case of *sinugera* protoconchs (*sensu* BOUCHET, 1987: 19).

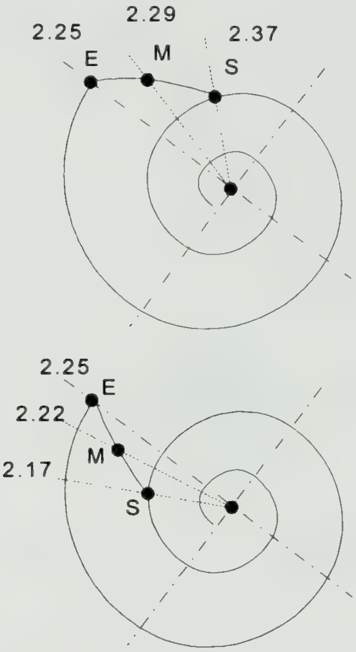

Figure 8. To count whorls, authors consider the "end point" as being the middle of the whorl (point M), or the last point of the suture (point S), or the most external point (point E). These points being rarely aligned along one radius from the centre, a convention must be specified. (see also Fig. 7 for the protoconch).

We advocate the following, simple convention (similar to that of TAYLOR [1975] in JABLONSKI & LUTZ [1980]) : the last point of the suture is considered to belong to the last whorl and to be its end point (NWh = $\theta + 1$, see *Definitions*). The previously mentioned problems then cease to exist.

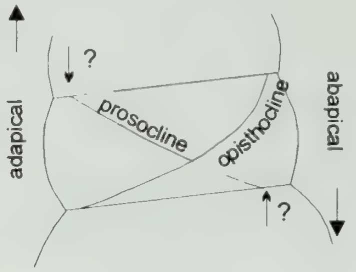

Figure 9. The aperture and/or the transition can sometimes be tilted (prosocline or opisthocline). Unless the final point of the suture is chosen as the "end-point" of counting, one must specify if the "end point" is the most adapical, the most abapical or the mid-point.

A RAPID, PRACTICAL METHOD

During morphometrical analyses in the genus *Helix*, difficulties were encountered because the early protoconch "hook" (see above) is often present and, in addition, the protoconch-teleoconch transition is often gradual. Counting the total number of whorls was therefore preferred and a simple method was developed. Two variants of a this method will be described.

A. From a drawing. The suture of the shell is drawn in apical view, using a binocular lens equipped with a *camera lucida*.

Starting from the last point of the suture (point S, Fig. 10 A), one draws the line L_0 which crosses the suture at its earliest point where a perpendicular, passing through point S, can be traced (see Fig. 10 D).

Then one draws a second line L_1, perpendicular to L_0 and perpendicular to the earliest possible point of the suture (see Fig. 10 B, E).

The intersection of L_0 and L_1 defines the centre of measurement (see Fig. 10 C, F). From the centre, a line L_2 is drawn to the starting point of the suture.

The total number of shell whorls (NWh) is estimated from the number of whorls (θ) of the suture (NWh = θ +1). Starting from the centre to the last point of the suture (S), the number of intersections between L_0 and the suture gives the integer part of the number of whorls. The angle between L_0 and L_2, expressed in decimal of a complete whorl (not in degrees) and measured ***against*** the direction of coiling, is the non-integer part of the number of whorls.

B. Quick variant. This does not require a drawing of the shell suture and the number of whorls can be visually estimated.

A star-grid with a grid of lines at 0.025 whorl (or less) angle (see Fig. 11) is seen trough the *camera lucida*, superimposed to the view of the shell. The line 0.00-0.50 and the line 0.25-0.75 are used as the lines L_0 and L_1 (sliding the grid brings it in the desired position, see Fig. 11 A, B). The counting procedure is then the same as described here above.

C. Precision. The precision of these very rapid methods is 0.05 whorl. This was estimated by ten repeats of measurement on one specimen of *Helix pomatia* (mean : 5.11 whorls; Minimum: 5.10 whorls; Maximum : 5.15 whorls ; Standard deviation: 0.02 whorls ; coefficient of variation : 0.34 %).

D. Discussion. The whorls of the whole shell can be determined in one operation only if the beginning of the first whorl of the protoconch can be clearly seen and the last whorl of the teleoconch suture located at the same time.

Separate determinations of NWh for the protoconch and the teleoconch could be done on the same drawing and are then straightforward.

Using a binocular lens, this method can be difficult for large and high spiralled shells, but remains valid for their protoconch.

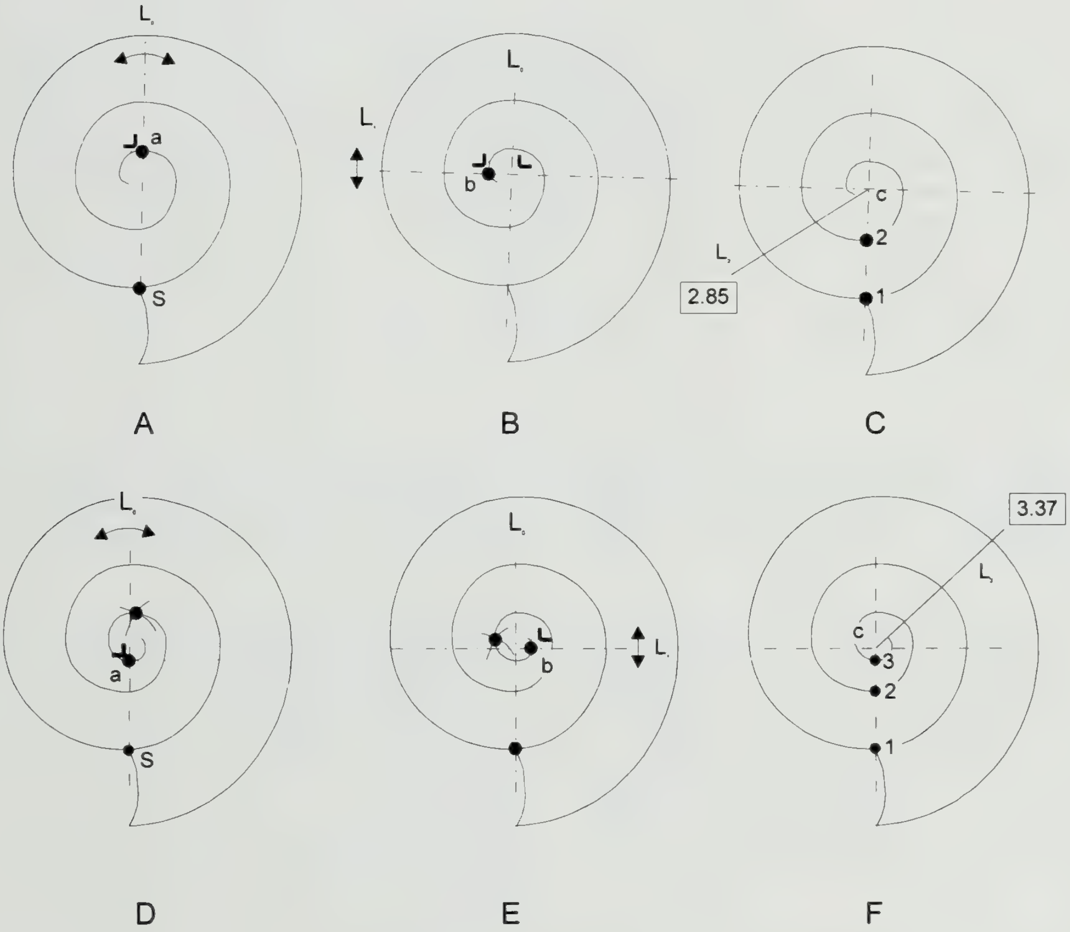

Figure 10. Description of a rapid, practical method to count whorls on two schematic examples. **A & D.** Starting from the last point of the suture (point S), a line L_0 is drawn perpendicular to the first whorl (the first perpendicular crossing is considered at point **a**). **B & E.** Then a line L_1, perpendicular to L_0, is also drawn perpendicular to the first whorl (the first perpendicular crossing is considered at point **b**). The intersection of L_0 and L_1 defines the centre of measurement (point **c**). **C & F.** From this centre, a line L_2 is drawn to the start of the suture. The angle between L_0 and L_2 allows the count of whorls.

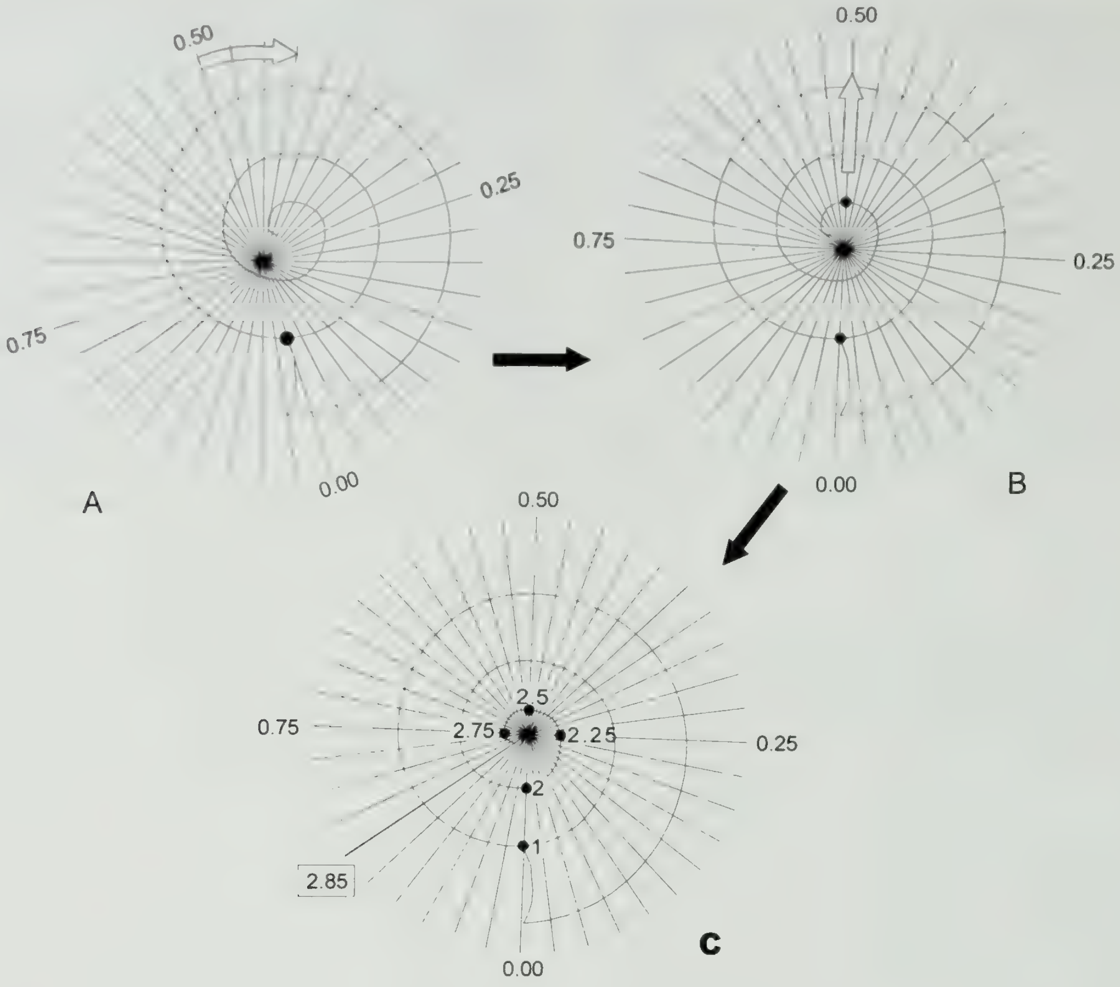

Figure 11. Quick variant of the previous method (see Fig. 10). The number of whorls can be visually estimated. A star-grid (lines at 0.025 whorl) is seen trough the *camera lucida*, superimposed to the view of the shell. The lines 0.00-0.50 and the line 0.25-0.75 are used as the lines L_0 and L_1 (see Fig. 10). Sliding the grid brings it in the desired position.

When the whorls of the whole shell cannot be determined in one operation, this method could be applied to the two parts of the shell independently. Different centres will be found for each part of the shell. Each of these centres will most often differ from the centre found if the whole shell is considered. In these cases, the present method to determine NWh still remains highly reproducible for the different parts of the shell but is not necessarily accurate for the teleoconch.

The distance separating (see Fig. 2) the centre (c) and the pole of the spiral (p) could become more important when applying the method only to the teleoconch. This distance is in direct proportion to the curvature of the spiral and to the size of the protoconch ("diameter" of the first whorl of the teleoconch). When the distance between the centre (c) and the pole of the spiral (p) is too important, this rapid method cannot be applied without introducing large bias (see Sect. *Errors on the centre of measurement*). It is therefore advised to use the pole of the spiral.

The method can be compared with that of VERDUIN, the only author having shown how to place the centre of measurement. For VERDUIN (1977), the centre of measurement is the centre of the nucleus, which is approximated by a circle (the diameter of the first half visible whorl is the diameter of the nucleus circle). There are two main differences between the new method and method A. The first difference is the location of the centre of measurement, which it is not placed at the middle of the first half whorl as in VERDUIN's method (Fig. 12 D). Let us notice that in the case of abnormal curvature of the early suture (see *Errors on starting point: A. Protoconch*), several different "circular approximations" of the nucleus could be made. The method of VERDUIN could then become quite subjective (see Fig. 12 A, B, C). Starting from point S, the proposed method avoid subjectivity in the appreciation of the beginning of the suture and is then particularly useful.

The centre determined by the new method does also not correspond to the pole of the logarithmic helicospiral (see Fig. 12 D) but it is often very close to it. However, the small error on the centre location has little effect on the whorl count (for similar error, see Table 1).

The second difference with method A is the starting point for counting whorls. The beginning of the suture is here considered to be the first whorl of the shell; this gives 0.50 whorl more than method A (see Fig. 1).

JABLONSKI & LUTZ (1980) used the method of TAYLOR (1975, in JABLONSKI & LUTZ [1980]) which concerns only the protoconch. This method appears close to ours, but the way to count the non-integer part of the number of whorls (from where?) is not indicated and can not be compared. In this method, the line starting from the sutural point of the aperture is defined perpendicular to and crossing the remaining apical sutures (JABLONSKI & LUTZ, 1980: 330). It must be noted that a line can not be perpendicular to several whorls of a logarithmic helicospiral. This can be the case for arithmetic spirals (r = a . θ), but a line starting from the sutural point of the aperture does not necessarily cross the centre of the spiral.

For some *Oliva* species, an arithmetic helicospiral appears to be more representative of the protoconch suture while the logarithmic helicospiral remains the best model for the teleoconch (unpublished results). The rapid method advocated here above can be applied to both arithmetic or logarithmic spirals.

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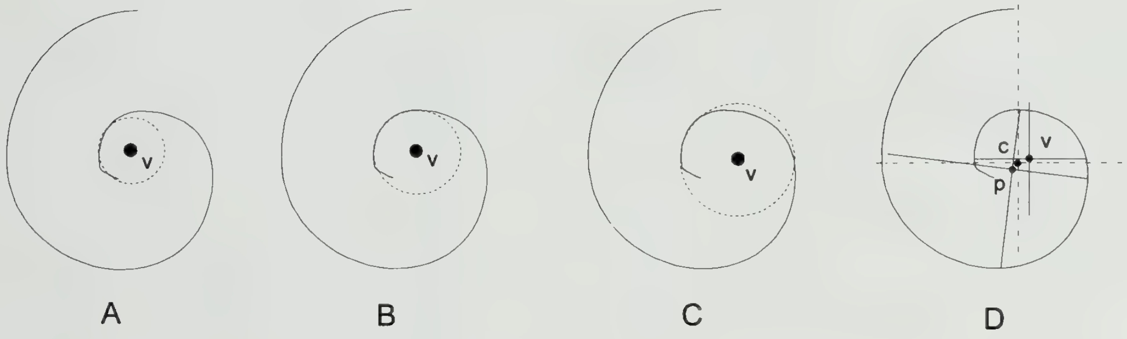

Figure 12. If the early protoconch presents a "hook", several "circular approximations" of the first half whorl (nucleus) can be made (**A, B, C**). Each of these leads to a different centre of measurements (**v**). The pole of the logarithmic helicospiral (**p**), the centre of measurements of the here described method (**c**) and the centre of the "circular approximations" (**v**) of the nucleus are rarely (if ever) coinciding (**D**).

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Description of a new species of *Marginella* (Volutacea: Marginellidae) from the Gulf of Guinea

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KEYWORDS. Taxonomy, Marginellidae, *Marginella*, *M. xicoi* n.sp., *M. tyermani*, West Africa, Gulf of Guinea.

ABSTRACT. The taxa belonging to the group *Marginella tyermani* Marrat, 1876 are reviewed. *M. keppeli* Sykes, 1905 and *M. eveleighi* Tomlin & Shackleford, 1913 are defined as synonyms of *M. tyermani*. *Marginella xicoi* n.sp. is described from the Ghanaean coast and is related with other species to a "complex *M. tyermani*".

RÉSUMÉ. Les taxa appartenant au groupe *Marginella tyermani* Marrat, 1876 sont revisées. *M. keppeli* Sykes, 1905 et *M. eveleighi* Tomlin & Shackleford, 1913 sont placés en synonymie de *M. tyermani*. *Marginella xicoi* n.sp. est décrite de la côte du Ghana et est reliée avec d'autres espèces à un "complexe *M. tyermani*".

INTRODUCTION

In February 1995, whilst dredging west of the mouth of the Volta River, Ghana (Fig. 1), the second author discovered several specimens of a small species belonging to the genus *Marginella* and considered by us as new to science.

Our new species presents evident similarities to taxa belonging to the group *Marginella tyermani*, so we propose their preliminary revision as a necessary step to the determination of our new species.

This century, very few works have dealt with Marginellids from the Gulf of Guinea. The principal ones are:

- KNUDSEN (1956), for scattered samplings in deep waters during the campaign of the vessel 'Atlantide'.
- TOMLIN & SHACKLEFORD (1913), GOFAS & FERNANDES (1988), and FERNANDES & ROLAN (1991) for shallow water samplings in Sao Tome and Principe.
- BERNARD (1984), for material mostly collected from shallow and moderate depths in Northern Gabon.

The paucity of scientific works on the subject clearly illustrates the very limited knowledge of the Marginellid fauna from the Gulf of Guinea. The southern part is perhaps best known, but even then only a few kilometers of coastline have been studied.

The results of some recent collecting trips along the northern coasts of the Gulf of Guinea (ROLAN & FERNANDES, 1977 ; P. Ryall, personal material and records) suggest that the claimed "poor diversity" of the marine molluscan fauna in this area could be a superficial and inaccurate point of view. The traditional view of Atlantic equatorial coasts, with their warm, muddy water, long sandy beaches and heavily rolling waves is of a generally inhospitable environment unable to support more than a few hardy species and occasional very specialised ones. The reality seems to be very different, as the benthic equatorial environment of the continental shelf in the Atlantic generally presents a high level of organic content as well as important heterogeneity of habitats and communities along hard and soft bottoms. Therefore it is probably necessary to re-evaluate the real diversity of the molluscan fauna in the Gulf of Guinea, with the help of future field studies, collecting, and an accurate examination of available material. The study of our newly discovered species is conceived as a contribution to this knowledge.

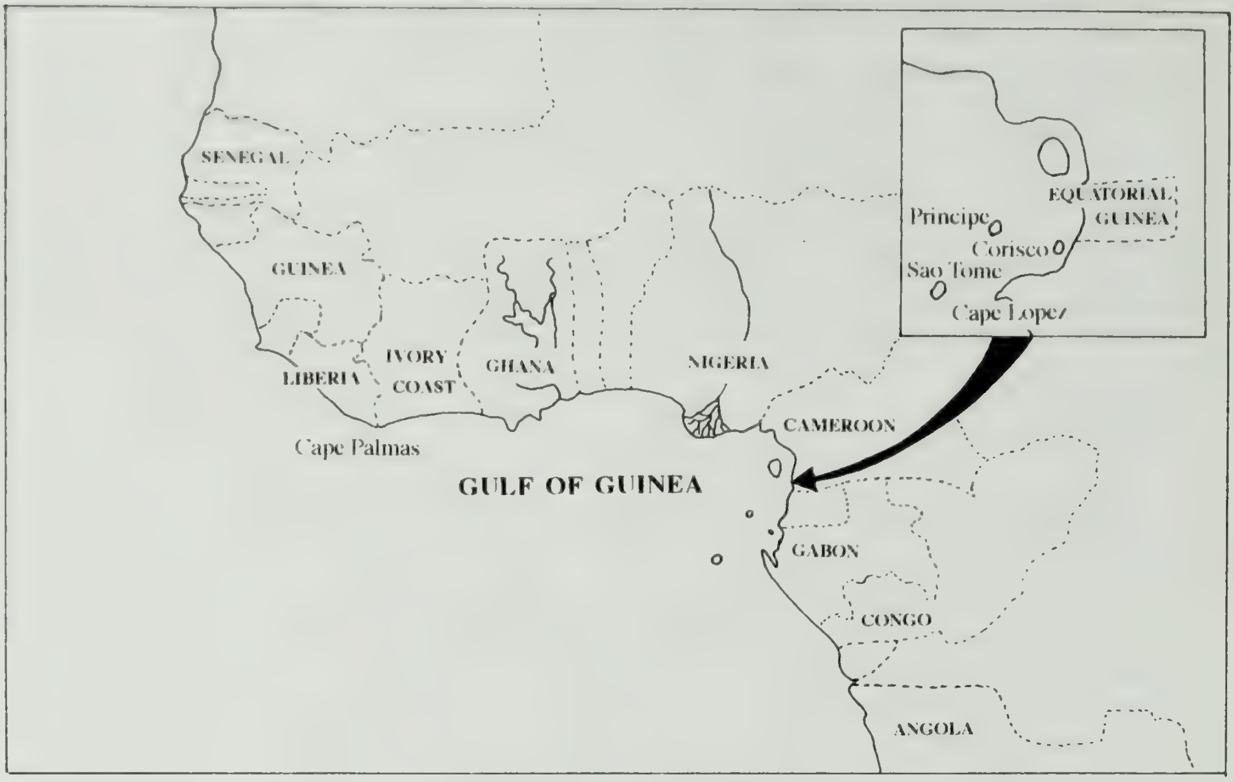

Fig. 1. Map of Central West Africa.

SYSTEMATIC ACCOUNT

Genus *Marginella* Lamarck, 1799

Type species: ***Voluta glabella*** Linne, 1758, by monotypy.

Marginella tyermani Marrat, 1876

Figs. 2-7

Original designation.

MARRAT, 1876. p. 136.

Original description.

"Marg. Testa subfusiformi – ovata, cinereo – alba, lineis nigris, spira brevi, antifractibus superne obtuse angulatis, ad angulum plicato – nodulatus, columella quadriplicata, labro late incrassato, intus denticulato".

"Var. with the lip smooth inside. The Corisco specimen. Found in company with *M. belli*, Sow., and is about the size of *M. festiva,* Kiener. Hab. 1. Corisco Bay, 1. Near Cape Palmas, West Africa. Coll. Keen, Liverpool".

Type material.

The description of the species referred to two non-figured specimens, from Coll. Keen, Liverpool, both present now in the collection of F.P. Marrat, Liverpool Museum, England: a larger, rather worn specimen, 11.20 x 5.90 mm (Figs. 2 & 3), and a smaller more glossy specimen, 8.55 x 5.00 mm (Figs. 4 & 5).

MARRAT (1876) designated the one "with the lip smooth inside" as being a variety ("Var."), and noted the locality as Corisco Bay, which presently is situated in Equatorial Guinea, on the border with Gabon. We therefore have to infer that the other specimen said to come from Cape Palmas, presently on the border between Liberia and Ivory Coast, represents the typical form and has to be considered as the holotype.

In reality the distinction between the typical and the varietal form is not apparrent, as neither of the shells has a smooth inner lip. The Latin text of the description is also contradictory; the shell is said to be light grey, to have a short spire and a widely thickened labrum, whereas in fact the larger specimen is light tan coloured with a tall spire and strongly thickened labrum with deep internal denticulations. The smaller specimen is light greenish grey, with a short spire and a moderately thickened labrum. So, it seems that the text of the description mixes up characteristic features of both shells, and does not really present the individual features of a single "typical specimen". Furthermore,

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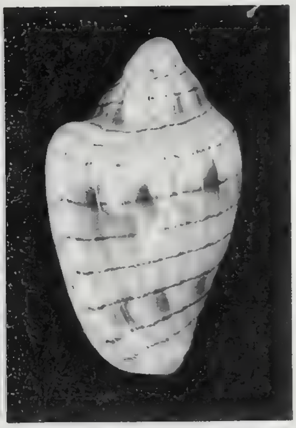

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Figs. 2-3. *M. tyermani* Marrat, holotype, Cape Palmas. Liverpool Museum Type Collection, 11.20 x 5.90 mm. **Figs. 4-5.** *M. tyermani* Marrat, varietal specimen of author, Corisco. Liverpool Museum Type Collection, 8.55 x 5.00 mm. **Fig. 6.** *M. tyermani* Marrat, Ivory Coast. Coll. F. Boyer, 7.40 x 4.50 mm. **Fig. 7.** *M. tyermani* Marrat, Banie I., Gabon. Coll. F. Boyer, left to right: 12.20 x 6.30 mm, 9.00 x 5.60 mm, 7.30 x 4.15 mm.

the labels attached to these specimens do not allow us to be absolutely certain of the geographical origin given by MARRAT for each shell, and the mention of the word "type" attached to the larger specimen seems to have been attributed later, probably by TOMLIN who examined this material first in early 1913 and again in June 1936.

TOMLIN left a label certifying the authenticity of the type specimens of *M. tyermani*, and the type localities, and he also added: "......but it is not stated from which loc. the type came." In 1913, TOMLIN considered as evident that the type specimen was the larger one. He commented that it was "rather worn" and with "an unusually thickened outer lip, which emphasises the internal denticulation." It seems apparent that TOMLIN, as the first revisor, did not designate a lectotype from undiscriminated original material, but recognised an evident holotype as such.

Despite the ambiguity of the original description, we follow Tomlin in recognising the largest shell as the holotype, as the strongly denticulated outer lip can be considered a distinctive feature, as opposed to the moderately denticulated outer lip of the smaller specimen, which can more easily be attributed as having a "smooth lip".

In conclusion, the larger specimen belonging to the Marrat Collection has to be considered as the holotype of the species, whereas the smaller specimen, being representative of a "variety" of the species, cannot be included amongst the type material.

Type locality.

Cape Palmas (Liberia).

Other material examined.

- One live collected specimen, dredged 25-30m off Cape Palmas, Liberia, 1996. Coll. P. Ryall (ex. Coll. Nora, Porto). The shell is pure milky white except for the first whorls which are greyish-brown, the surface of the body whorl is perfectly smooth, without tendency to any axial ribbing. The shoulder is rounded and does not present any angle or crenation. The inner labrum is moderately denticulate. 10.60 x 6.04 mm. Morphologically this specimen matches with the typical form of *M. tyermani*. Its origin is, however to be confirmed.

- One live collected specimen, off Ivory Coast, Coll. F. Boyer, 7.05 x 4.35 mm, live collected, (Fig. 6). This specimen matches the specimen illustrated in KNUDSEN (1956: pl II, Fig. 17) as *M. musica*, and does have a perfectly smooth labrum which could of course represent an immature phase of shell development. The blunt spire of this specimen bears a very low and wide protoconch. The background colour is greenish with black marks and axial flammules.

- Three large specimens from Punta Eviondo, Rio Muni, (currently Equatorial Guinea). Coll. F. Boyer: 11.15 x 6.00 mm, 10.05 x 5.45 mm, 10 x 5.50 mm. Shell colour varying from greenish-yellow to greenish-grey with dark spiral lines and blurred axial marks, sometimes more dense and arrow shaped under the shoulder.

- From the Komo Estuary and Banie Island, Gabon, Coll. F. Boyer: one large (12.20 x 6.35 mm), and sixteen smaller shells (7.15 to 9.00 mm in length). All adult shells, from shallow water. The shells from Banie Island exhibit the greatest diversity of colour from near all black to near all white. All have a denticulated labrum, except for the larger specimen from Banie Island, which is a young adult with a thin lip and no denticulations. The labial denticles appear to be a sign of maturation, and may disappear again when the animal reaches the gerontic stage, the lip becoming even more thickened.

- Off Banie Island, Gabon, Coll. P. Ryall. Many small to large specimens collected at 2-4 metres on fine sand.

The 18 specimens attributed to *M. tyermani* figured in the book 'Shells of Gabon' (BERNARD, 1984) present the range of colour variation for the species in Northern Gabon, from dark black through yellow, grey, tan and white forms, with or without a black central band on the body whorl. BERNARD (1984) does not, however, comment on the morphologic variation of the species (outline, proportions of the spire and labrum, strength and number of denticles), just giving 10 mm as being the maximum size reached by the shell. Observed populations are said to be found on sand at 0-5 metres, in Banie Island, Komo Estuary, and Port Gentil, Gabon.

Remarks.

As far as shell characters are concerned, the range of variability presented by *M. tyermani* in Equatorial Guinea and Northern Gabon includes both the typical form of the species (the large specimen with a slender spire said to come from Liberia) and the varietal form of Marrat (the squatter specimen with a short spire said to come from Corisco Bay). Intergrades between these two forms are fully represented, both for morphological features and colouration of the shell.

The specimen figured in KNUDSEN (1956: p.91, pl. II, fig. 17) and assigned to *M. musica* Hinds, was collected by the Atlantide Expedition (1945-1946), at station 98, 5 56' N, 4 26' E, 100 metres deep. This station is located off the coast of Nigeria. The shell figured measures 7.30 x 4.40 mm and has a very low conical spire, five black spiral lines on the body whorl, a relatively wide aperture, and a thin labrum with a faintly denticulated inner part. Knudsen describes the shell as being "greyish white with a white band at the suture". This shell clearly belongs to the species *M. tyermani*, even if it bears unusual spire morphology (it is comparable with one end of the natural range of variation of the populations observed from Northern Gabon). It also seems to be a dead shell, possibly transported to deeper levels by strong ocean currents, and its lack of axial decoration on the body whorl coupled with the presence of spiral lines, probably led to its incorrect identification as *M. musica*.

Marginella keppeli Sykes, 1905

Fig. 8

Original designation.

SYKES, 1905, pp. 315-316, pl. XVII, fig. 3.

Type material.

One syntype in BM(NH), London, coll. Sykes, not examined, described as measuring 9.5 x 5 mm.

Type locality.

West Africa.

Remarks.

The original figure and description of *M. keppeli* Sykes both perfectly fit into the range of natural variation of *M. tyermani* Marrat, concerning morphology of the shell, size and decoration. TOMLIN (1913, 1917) synonymized *M. keppeli* Sykes with *M. tyermani* Marrat, and we follow him in this conclusion.

Fig. 8. *M. keppeli* Sykes. Original figure.

Marginella eveleighi

Tomlin & Shackleford, 1913.

Fig. 9

Original designation.

TOMLIN and SHACKLEFORD, 1913, p. 11, Type figure in TOMLIN, 1913, pl. I, figs. 5-6.

Type material.

One syntype in the Tomlin-Melvill Collection (National Museum of Wales, Cardiff). Not examined. Described as measuring 7.25 x 4.00 mm. Type specimen drawn as holotype in GOFAS & FERNANDES (1988), length 6.20 mm.

Type locality.

"S. Thome Island, Gulf of Guinea. Scarce, in coral gravel."

Other material examined.

- One adult specimen from Sao Tome, Coll. F. Boyer, 7.50 x 4.00 mm. Black and white background.
- Three adult specimens and a fragment, Esprainha and Sao Tome City, Sao Tome Island, Coll. P. Ryall, collected in 1-3 metres under rocks.

Other material quoted and illustrated.

- Several shells and specimens referred to as *M. eveleighi* in KNUDSEN (1956, p. 84, pl. III, fig. 2), through 7 stations of the Atlantide Expedition:

One station off Monrovia (Liberia) in 10 metres (Stat. 52).

Five stations off the Niger delta (Nigeria), in 19 to 50 metres (Stat. 100, 104, 111, 112, 113). The shell figured in plate III is the one taken in 32 metres at station 113. The type of substrate was not recorded for these stations, with the exception of station 112 which is described as "clayish mud". In a previous work on the Atlantide material, KNUDSEN (1950, pp. 112-114, fig. 20 C-D) recorded the discovery of "15 oval and rather domed" egg capsules adhering to the surface of a decaying leaf, from 50 metres at station 104, and labelled as " *M. eveleighi*". However, although these egg capsules were found at the same station as a live specimen of "*M. eveleighi*", it does not necessarily mean that the egg capsules belong to this taxon. The comparison made between the embryo and the apex of *M. eveleighi* is similarly unconvincing. The white larval shell has no decorative features, and its very long and oblique anterior columellar plait (well separated from the other three smaller and more closely grouped ones) better suggests that it belongs to another species.

Fig. 9. *M. eveleighi* Tomlin and Shackleford. Original figure.

On the other hand, KNUDSEN (1950, pp. 115-116, fig. 22 E-D) records the discovery of 8 egg capsules "of the plano-convex type" in 40 m at stat. 103, labelled as "*Marginella sp.*". The larval shell is decorated on the last half whorl by "three dark transverse bands crossed by a single longitudinal one". These egg capsules and larval shells are quite likely referrable to the phena "*M. eveleighi*", even if the spiral black line is generally situated just under the suture of the first whorls, rather than in a more anterior position as seems to be the case in the figure 20 E-D.

One station off Luanda (North Angola) in 42 m (stat. 136, St. Paul de Loanda, mud). The occurence of *M. eveleighi* in this place is not confirmed by GOFAS & FERNANDES (1994), who intensively dredged at this depth over many years. So this shell collected by the Atlantide Expedition could possibly be a juvenile shell of *M. lucani* Jousseaume, 1884 (which is known to live from Southern Gabon to Northern Angola in shallow water, Fig. 10) or perhaps more probably, it is a juvenile specimen of *M. fumigata* Gofas and Fernandes, 1994, which lives in the same area but at deeper levels (type loc. : 40-50 m off Luanda).

[N.B. One single datum is quoted by KNUDSEN (1950) for measurements of the shells: height 10.70 mm. This length probably concerns the shell taken at St. 113 and figured in plate III].

- Five shells referred to as *M. eveleighi* in BERNARD (1984, pp. 88-89, pl. 39, no. 157), but looking very similar to the specimens presented as *M. tyermani* (no. 159) except for their larger size. These large specimens are said to live on sand in 2-5 m, only off Banie Island. BERNARD notes that the specimens of *M. eveleighi* bear few axial ribs, and that the specimens of *M. tyermani* are smooth. However, the figures of both species clearly show moderate to strong axial ribbing along their shoulders.

In fact, the specimens designated as *M. eveleighi* in BERNARD (1984), represent the taller variant of *M. tyermani*. Large specimens over 10 mm are not found in the Komo Estuary and Port Gentil. They are moderately rare in Banie Island, and seem to be more common in Equatorial Guinea. This kind of geographic or bathymetric cline in size range is commonly seen in many species of marine gastropods. The relative rarity of these larger specimens of *M. tyermani* in the field explains why they are poorly represented in collections, and also explains why they exhibit the most common pattern of decoration of the species (fine spiral black lines on a greyish -green background and a central black band on the body whorl). Within individual stations all size intergrades exist, so there is no need to subdivide the species on a morphological or taxonomic basis. In fact the holotype of *M. tyermani* is 11.20 mm long and itself links (if it is necessary to prove this) the smaller shells to the larger ones referred to in BERNARD.

- Several specimens and shells recorded in GOFAS & FERNANDES (1988, pp. 11-13, figs. 12-13) as *M. eveleighi* : 22 specimens from Sao Tome in Coll. F. Fernandes, Angola ; 1 specimen from Calypso cruise "Gulf of Guinea", in the Paris Museum (MNHN) ; 10 specimens from Gabon, ex-Coll. P. Bernard, in the Paris Museum (MNHN). All these shells from both Sao Tome and Gabon are 6 to 9 mm in length, and present a homogenous morphology and colour pattern "...with a rather high conical spire and axial folds on the shoulder. Outer lip stongly thickened, with 11-12 denticles. Colour pattern of black spiral lines, which can be interrupted, and irregular longitudinal flames, on a greyish or whitish background." The live animal of *M. eveleighi* is also described and illustrated in GOFAS and FERNANDES (1988, colour plate 1. fig. b.) of specimens from Sao Tome : "Foot translucent, with small yellow spots grading towards the inner areas to larger, paler cream-yellow blotches. Head and tentacles with a series of yellow spots. Siphon densely covered with yellow blotches, with slightly more intense hue than head and foot".

Fig. 10. *M. lucani* Jousseaume. Banana, Congo. Coll. F. Boyer, 15.70 x 8.90 mm.

GOFAS & FERNANDES (1988) noted that there were no appreciable differences between *M. eveleighi* and *M. tyermani* on the grounds of shell morphology and colour pattern. They do, however, show concern about the large specimens referred to in BERNARD (1984) as *M. eveleighi* which is unknown in Sao Tome, and prefer to reserve the name '*eveleighi*' for insular specimens "until identity is established by observing living animals from the mainland." They also note the original habitat of *M. eveleighi* in Sao Tome as " usually located near the mouth of small streams, in fine silty sand, loaded with plant debris of terrestrial origin, hand dredged in 1-2 m depth".

- Numerous specimens recorded from Principe Island in FERNANDES & ROLAN (1991, p. 86, fig. 1) as *M. eveleighi*. These specimens were collected in mud at 8-10 m, and are said to present no visible difference with the specimens from Sao Tome.

Egg capsules of *M. eveleighi* are noted to be frequently found on the turrid *Clavatula coerulea* Weinkauff, which lives in the same muddy habitat. One egg capsule is illustrated, containing a single developing embryo presenting the characteristic black axial marks on the first whorl of the shell.

Remarks.

Curiously, when commenting on the type specimens of *M. tyermani* in the Marrat collection, TOMLIN (1913) does not compare this species with *M. eveleighi*, which was published by himself only several months previously. The date of publication for the description of *M. eveleighi* was 1 January 1913, and his notes on the Marrat Collection were read before the Society on 12 March 1913.

TAXONOMY

The taxa *M. keppeli* Sykes and *M. eveleighi* Tomlin and Shackleford are both to be considered as junior synonyms of *M. tyermani*, Marrat. *M. tyermani* appears as a monospecific group, with no evident geographic or bathymetric polytypism. On the other hand, *M. tyermani* presents all the features of a polymorphic species, the most variable patterns being known from North Gabon. However, this zone is also the best sampled, so we could assume that the same kind of intrapopulational variability can also occur in other places. For example, the scarce shells from the northern side of the Gulf of Guinea (Liberia to Nigeria) show a noticeable diversity of sizes, proportions and colour backgrounds.

We do not find any reason to suspect the existence of several sibling species belonging to a group *M. tyermani*. All the morphologic and chromatic intergrades are known for the shells, and there is no indication of an ecologic specialisation for any population, as all the specimens confirmed to have been collected alive were found on soft bottoms, in silty sand or mud, often with the presence of organic debris. On the other hand, the occurence of sibling species remains a possibility, and it is difficult to be sure until their precise habitat and behaviour, their biochemical characters (from chromosomic studies and protein electrophoresis), and the chromatism of the soft parts for each population, have been examined.

For now there is no reason to have any doubt about the specific unity of the populations expressing the phena *M. tyermani*, and we propose to fully consider the taxon *M. tyermani* as representative of a natural species and to use it as such.

OTHER BIOLOGICAL ASPECTS

Animal.

The animal is illustrated by GOFAS & FERNANDES (1988) from the population of Sao Tome Island, as *M. eveleighi*. It has small yellow blotches on the foot, head, tentacles and siphon, and yellow spots along the edge of the foot. The chromatism of the soft parts is apparently similar in the population of Principe Island (FERNANDES & ROLAN, 1991). The soft parts were not observed in the other populations of *M. tyermani*.

We note that larger yellow blotches are a feature of *M. fumigata* Gofas and Fernandes, paler ones on *M. lucani* Jousseaume, and very much smaller ones on the Angolan *M. gemmula* Bavay, 1913, *M. luculenta* Gofas & Fernandes, 1994, and *M. undulans* Gofas & Fernandes, 1994 (all illustrated in GOFAS & FERNANDES, 1994).

The radula is unknown.

Development.

Paucispiral protoconch. The development is direct, as confirmed by the egg capsules pictured in KNUDSEN (1950) and FERNANDES & ROLAN (1991), showing larval shells at an advanced stage of maturation and near to hatching, with the first whorl fully developed. In both cases the egg capsule was rather rounded and arched.

Habitat.

M. tyermani seems to be strictly dependant on soft, silty to muddy bottoms incorporating a high organic content. This kind of environment is mainly found around river estuaries in shallow depths, and M. *tyermani* is generally found here from Liberia to Sao Tome. It appears therefore that it can tolerate water of reduced salinity. It can occasionally be found in deeper water, but always still around the mouth of larger rivers (like the Niger Delta) where large quantities of organic silty sediment is carried out to sea. It is however not proven that the species lives below 50 m.

The occurrence of *M. tyermani* in "coral gravel" (TOMLIN & SHACKLEFORD, 1913) is doubtful, and could constitute dead shells being found in beach drift.

The occurrence of *M. tyermani* in "sand" (BERNARD, 1984) has to be corrected to " silty sand to muddy sand" (BERNARD, personal communication).

Distribution.

Due to its special habitat associated with estuarine areas, the geographical distribution of *M. tyermani* is probably fragmented. For now, the occurrence of *M. tyermani* is recorded from Liberia to Sao Tome Island. The species seems to be absent in Senegal, but has to be looked for in Sierra Leone and Guinea. The species seems also to be absent in Southern Gabon, Congo (P.H. Hattenberger, personal communication) and Angola. In this area, it seems to be replaced in the same habitat and at the same depth by *M. lucani* Jousseaume, which exhibits similar shell decoration to *M. tyermani*. According to GOFAS & FERNANDES (1994), *M. lucani* is found "....on muddy bottoms of shallow bays with turbid waters, usually not far from the mouth of small coastal streams, at 5-10 m."

Phyletic relationship.

For chromatism of the soft parts and decoration of the shells, *M. tyermani* seems to be related to several species which occur from Southern Gabon to Northern Angola, on either side of the mouths of the Congo River, namely *M. lucani* Jousseaume, 1884, *M. fumigata* Gofas and Fernandes, 1994, and *M. marimba* Gofas and Fernandes, 1994. (*M. fumigata* and *M. marimba* could however have a deeper bathymetric distribution). This relationship needs to be verified more accurately, and the important disparity between shell morphologies of these four species needs to be explained.

The group *M. musica* Hinds (under study by the first author) is apparently represented by four different species in Northwest and South Africa, presents the same kind of shell decoration, and could be joined to a "complex *M. tyermani*", even if *M. cf. musica* (non-*M. diadochus* A. Adams & Reeve) from South Africa presents a somewhat distinct chromatism of the soft parts, with alternating red and yellow radiating stripes. *M. tyermani* could also be related to the group *M. festiva* Kiener, represented in Angola by three species which all bear a pattern of small, densely grouped yellow spots on the soft parts, not so far from the pattern presented by *M. tyermani*. Further investigations on this group and its phyletic organization are required.

NEW SPECIES

Marginella xicoi n.sp.

Fig. 11

Type material.

Holotype (Fig.11) deposited in Paris Museum (MNHN), adult shell, 7.70 x 4.95 mm; Paratype 1: Coll. F. Boyer, 7.50 x 4.50 mm; Paratype 2: Coll. A. Wakefield, 7.15 x 4.70 mm; Paratypes 3 to 8: Coll. P. Ryall 8.78 x 5.18 mm, 9.01 x 5.54 mm, 8.46 x 5.23 mm, 8.64 x 5.26 mm, 7.84 x 4.57 mm, 7.05 x 3.75 mm (juvenile). Paratype 9: Coll. M. Pin, 6.75 x 3.80 mm (juvenile).

Type locality.

West of estuary of Volta River, Ghana. Discovered in a single dredging by Peter Ryall at 15-20 m. in sand and broken shells, February 1995. Has not been found subsequently in dredgings from the same area.

Other material examined.

- several crabbed specimens collected in beach drift, in Lome, Togo, by P. Escudie (Dec. 1982). Stored in Coll. P. Geniez.
- 2 crabbed specimens from the same origin (ex. Coll. P. Geniez), now in Coll. F. Boyer. 6.90 x 4.70 mm and 6.00 x 3.90 mm (the latter with its protoconch absent).

Description.

Small, stocky and solid shell of 2.4 whorls. Moderately elevated, blunt spire. Sub-ovate body whorl. Wide, low protoconch and two whorls visible from ventral view. Axial ribs on first and last whorls, just disappearing before the base. Very thick lip bearing fifteen or so labial denticles. White labrum with a heavy margin. Four strong columellar plaits, the first two being slightly 'S' shaped, running parallel and very close. Black and white flammules on a pale greenish-yellow background, forming arrowhead patterns just under the shoulder and at the first anterior quarter of the body whorl. Protoconch light pinkish-orange.

Animal and radula unknown.

Development presumed direct. Paucispiral protoconch.

Distribution.

Only known from East and West neighbouring areas of the mouth of the Volta River. However, dredgings of micromolluscs in this region remain scarce, so the range of this species could be made tentatively wider.

Discussion.

Marginella xicoi n.sp. presents close similarities with *M. tyermani*, particularly in the pattern of columellar plaits and siphonal canal (Fig. 12: compare with the first two long sigmoidal columellar plaits and truncated base in *M. reeveana* Petit, 1851), and the same pattern of axial black and white flammules. The principal differences are that *M. tyermani* presents a more tapering slender outline, less developed labrum and axial ribbing, 3.25 whorls (from the ventral view: protoconch and 3 whorls), a more produced protoconch, and the presence of black spiral lines.

The geographic variability of *M. xicoi* is at present unknown, the species having been studied so far from only two samplings. It is a fact, however, that all the shells present a very homogenous morphology and decoration. A further point to make is that reported

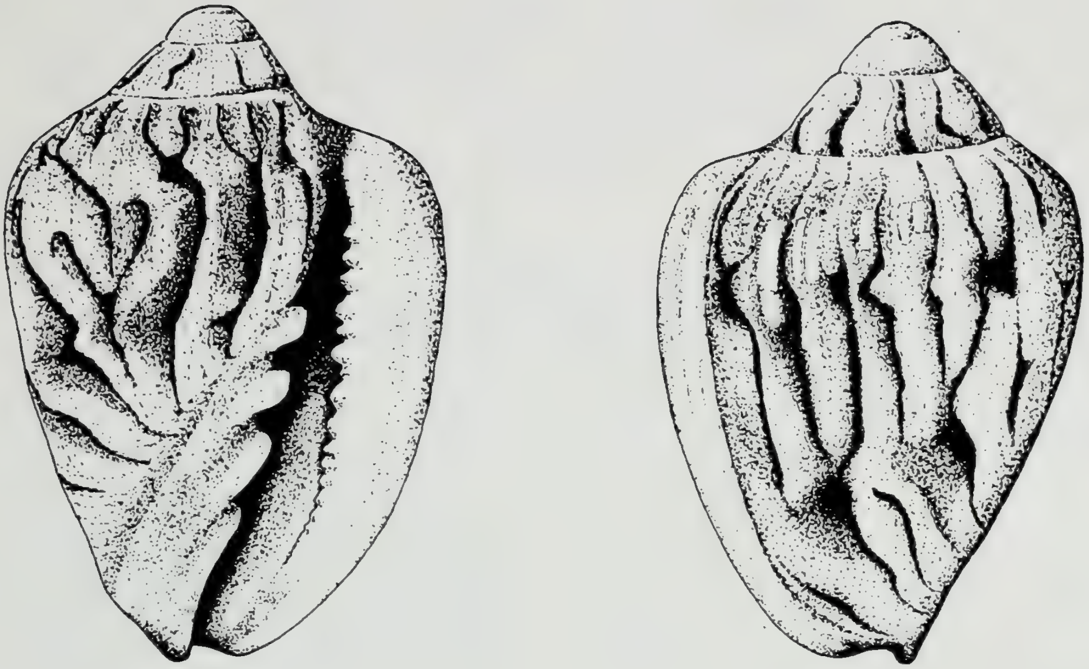

Fig. 11. *M. xicoi* n. sp. Holotype. 7.70 x 4.95 mm.

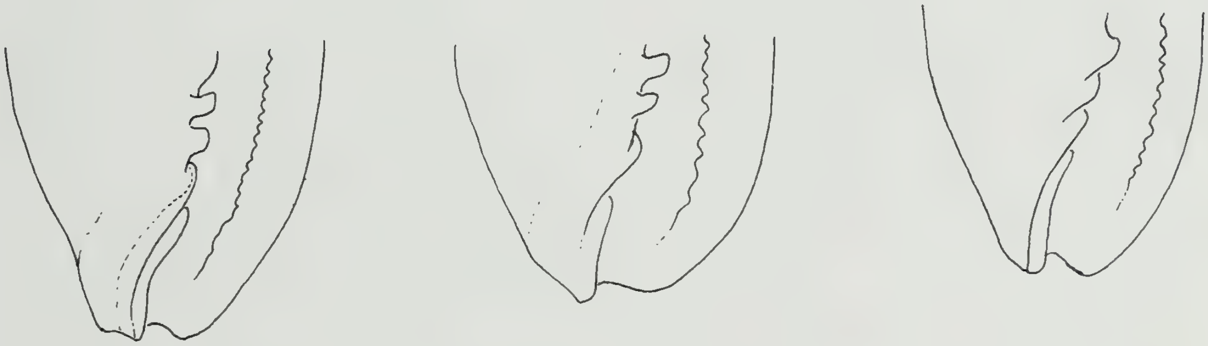

Fig. 12. Detail of columellar plaits and siphonal canals of *M. reeveana*, *M. xicoi*, and *M. tyermani*.

populations of *M. xicoi* are both located centrally in the zone of distribution of the polymorphic *M. tyermani*, and that the distinctive features of *M. xicoi* (principally the reduced number of whorls and the absence of spiral lines on the pattern of axial flammules) are not found in the range of shell variability of *M. tyermani*. *M. xicoi* has therefore to be considered a distinct species, with a close phyletic relationship to *M. tyermani*. We propose to place *M. xicoi* in a "complex *Marginella tyermani*" which could possibly expand with the discovery of new related species in the Gulf of Guinea.

Etymology.

Named in memory of Francisco Xico Fernandes, from Luanda, Angola. A keen collector and scholar who contributed greatly to the malacological discovery of Angola and West Africa in recent years. Died 19 January 1996.

ACKNOWLEDGEMENTS. We would like to thank Nora F. McMillan of the Liverpool Museum, and Kathie Way of British Museum of Natural History, London, for helpful advice and support, and for enabling detailed study of important type specimens. We are also indebted to our two referees for their valuable contributions.

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Taxonomic implications of syntopy:

the status of *Oliva truncata* Marrat, 1867 (Gastropoda, Olividae)(°)

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KEYWORDS. *Oliva*, *truncata*, *polpasta*, taxonomy, nomenclature.

ABSTRACT. *O. truncata* Marrat, 1867 has been previously considered to be a junior synonym of *O. polpasta* Duclos, 1833. Syntopic populations of these two taxa, easily separable by morphometry, have been found at Cebaco I., Panama. This establishes that these taxa are distinct species. Problems of data interpretation and character validity are discussed.

RÉSUMÉ. *O. truncata* Marrat, 1867 a été considérée comme étant un synonyme junior de *O. polpasta* Duclos, 1833. Des populations syntopiques de ces deux taxa, aisément séparables par morphométrie, ont été trouvées à l'île de Cebaco, Panama. Ceci établit que ces taxa sont des espèces distinctes. Les problèmes d'interprétation des données et de validité des caractères sont discutés.

1. INTRODUCTION

The taxonomic status of the tropical Eastern Pacific taxon *O. truncata* Marrat, 1867 (holotype illustrated Plate 1, A) has been quite controversial. It was the Western Pacific *O. elegans* Lamarck, 1811 for BURCH & BURCH (1960), ZEIGLER & PORRECA (1969) and WAGNER & ABBOTT (1978). The taxon is not cited in the very thorough *Seashells of tropical West America* by KEEN (1971). PETUCH & SARGENT (1986) correctly recognised that *O. truncata* belongs to the Panamic Fauna and considered it to be a distinct species, differing from *O. polpasta*.

The very similar *O. polpasta* Duclos, 1833 (Figured syntype illustrated Plate 1, A) is a variable species, as attested by the several names given to its forms: *O. callosa* Li, 1930, *O. davisae* Durham, 1950, *O. kerstitchi* da Motta, 1985, *O. olssoni* Petuch & Sargent, 1986 (the latter could still pose some problem). TURSCH, GREIFENEDER & HUART (1998) failed in their attempts at total morphometrical separation of allopatric samples of the "*O. polpasta* complex" into smaller, objective subgroups. They were therefore compelled to conclude that "*in the absence of valid arguments to the contrary*" *O. truncata* is a junior synonym of *O. polpasta*.

This paper reports that such arguments to the contrary have now been found.

2. NEW DATA ON SYNTOPY

The Belgian sailing yacht *La Boudeuse* was moored at the South-Western tip of Cebaco Island (West Panama) in May 1997, in a wide bay, open to the SW swell. The locality (N 07°29,5' / W 83°13,4' by GPS) is called Caleta Caïman in sailing chartbooks but this name is not confirmed by locals.

Using the dinghy, a short dredge haul was made in 25 m depth, dark muddy sand, yielding several live shells matching the holotype of *O. truncata* and numerous others matching the holotype of *O. polpasta*. Specimens of *O. polpasta* forma *kerstitchi* da Motta, 1985 were also present, together with intergrading specimens linking the form *kerstitchi* to the typical habitus (on this point, see KOCH 1992). The haul also contained *O. kaleontina* Duclos, 1835 and numerous live specimens of *O. spicata* (Röding, 1798). The same mixture of *O. polpasta* and *O. truncata* was also obtained nearby, in another short dredge haul in 6-8 m, dark muddy sand.

3. MATERIAL AND METHODS

3.1. Measurements.

Linear teleoconch measurements were effected with we an electronic calliper (brand ROCHE) with numerical display, giving measurements reproducible to 1/100 mm. The measurements H, L, LW, D, X, R, MPRO and NW have been defined in TURSCH & GERMAIN (1985). As a quick reminder, their meaning is sketched in the graphs where these measurements are used.

3.2. Specimens measured

O. truncata Marrat, 1867. 11 specimens ranging from H 16.62 to 38.07 mm. Seven of the specimens had an intact apex (affording our first opportunity to measure the protoconch characters of *O. truncata*).

O. polpasta Duclos, 1833. 12 specimens (selected at random amongst 20) ranging from H 26.11 to 35.04 mm, all with intact protoconch.

3.3. Remarks.

In each of the two samples, the shells are very homogeneous in aspect and closely match the type material (see Plate 1, A), except that the *O. polpasta* from Cebaco I. are slightly more angular in outline. Note: When freshly collected, the shell of *O. polpasta* has a distinct greenish tinge which fades with time.

The data reported here apply to one single locality. The ranges of variation are expected to be larger over the whole distribution ranges. The specimen numbers "V- " refer to the Vassart collection.

4. RESULTS AND INTERPRETATION

The shells referable to *O. truncata* and to *O. polpasta* were easily (and totally) separated in many morphometric analyses. Only a few need to be reported here. Dealing with controversial taxa, the observed separations have to be interpreted with special caution.

4.1. Teleoconch features.

A total separation on teleoconch characters is given in Figure 1 (scatter diagram of the shape factors X/LW vs. D/L).

4.2. Precautions in interpretation.

How do we know that the clustering of points in Figure 1 is objective and reflects biological reality? Any distribution of points on a graph could indeed be grouped in many different arbitrary clusters. In this case, the observed gap is quite large but this could be due to problems in sampling (intermediate specimens missing).

An easy visual character for distinguishing the two species was found by Nicolas Vassart (then aged 12): all the non-juvenile specimens of *O. truncata* display a conspicuous dark-brown blotch inside the anterior notch (see Plate 1, B). The dark blotch is not so visible on small (<10mm) specimens. This blotch is always present on all the specimens of *O. truncata* and absent on all the specimens of *O. polpasta*, in the hundreds of specimens seen by one of us (A.V.) in many other localities, from Ecuador to Costa Rica (when the two species coexist, *O. truncata* was found to be the more common, except in Cebaco I.).

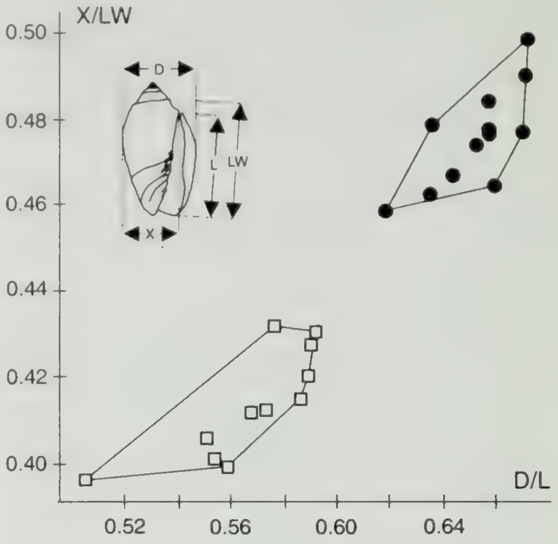


Figure 1. Teleoconch characters. Scatter diagram of X/LW *vs.* D/L. Minimum convex polygons. Black circles: *O. polpasta* Duclos, 1833. Open squares: *O. truncata* Marrat, 1867. Additional independent evidence: see text, § 4.1.

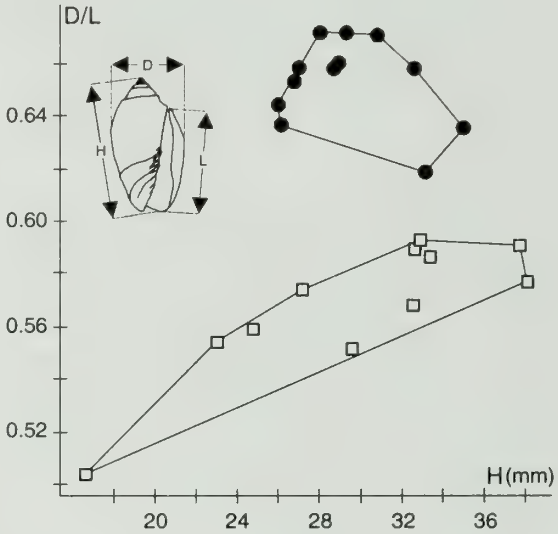


Figure 2. Teleoconch discriminants are unrelated to size. Scatter diagram of D/L *vs.* H. Minimum convex polygons. Black circles: *O. polpasta* Duclos, 1833. Open squares: *O. truncata* Marrat, 1867. Additional independent evidence: see text, § 4.1.

This feature (amongst others) provided the "*independent additional evidence*" necessary to give credibility (see TURSCH 1998) to the separation in Figure 1. All the specimens of one cluster possess the dark blotch, those from the other cluster do not. The same goes for Figures 2, 3 and 4. Further additional evidence is brought by the observation of large differences in protoconch characters (see § 4.3 and Figure 3).

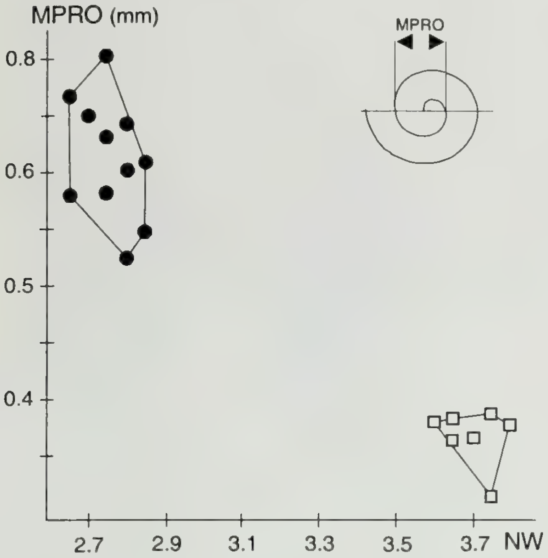


Figure 3. Protoconch characters. Scatter diagram of MPRO *vs.* NW (number of nuclear whorls). Minimum convex polygons. Black circles: *O. polpasta* Duclos, 1833. Open squares: *O. truncata* Marrat, 1867. Additional independent evidence: see text, § 4.1.

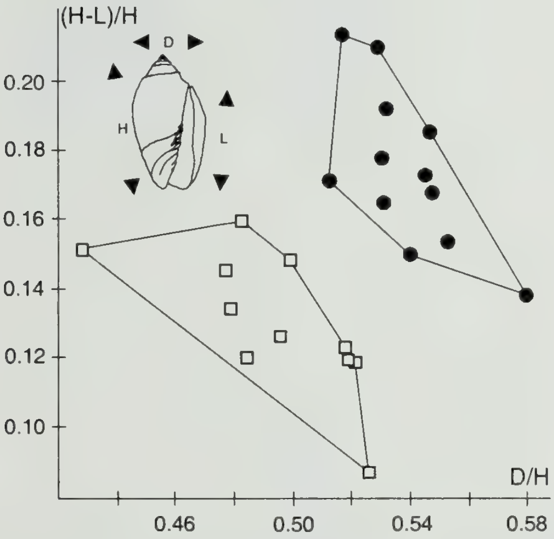


Figure 4. Teleoconch characters. Scatter diagram of (H-L)/H *vs.* D/H. Minimum convex polygons. Black circles: *O. polpasta* Duclos, 1833. Open squares: *O. truncata* Marrat, 1867. Additional independent evidence: see text, § 4.1.

More precautions must be taken before interpreting the data. First, one has to show that the observed morphometric gap is not due to a size effect. Many *Oliva* shells have a non-isometric growth (their shape is modified as they grow). Intermediates between the "juvenile" and the "adult" forms can be very rare and easily overlooked (see TURSCH 1997). So the possibility always exists that one is really separating two growth stages of the same species. Figure 2 shows that the difference in the shape factor D/L is not due to size.

One should also check that the separation is not due to sexual dimorphism or to a bias in sampling. This is the case: sexual dimorphism seems to be negligible in *Oliva* shells (see TURSCH 1997) and the blind process of dredging ensures against collecting bias.

4.3. Protoconch features.

These are easier to interpret, being independent from the shell size. Although the protoconchs do at first glance look quite similar (see Plate 1, C), the two samples differ very much in the size of the first volution of the protoconch (much larger in *O. polpasta*) and in the number of nuclear whorls (much larger in *O. truncata*). This is shown in Figure 3.

4.4. Conclusion.

All the necessary precautions being taken, the demonstration of a total gap in the distribution of characters of ***syntopic*** samples establishes the existence of two distinct morphospecies. "Syntopic" is here taken in the restricted sense: "*observable in close proximity, in the same biotope*" (see LINCOLN & *al.* 1982, TURSCH 1995). The scale of sympatry in *Oliva* species can be much smaller than generally imagined (see TURSCH 1994), so only syntopy ensures that the samples are really sympatric.

O. truncata Marrat, 1867 has therefore to be considered as a separate species and removed from the synonymy of *O. polpasta* Duclos, 1833. As far as we know, the name *O. truncata* has no junior synonyms.

5. DISCUSSION

5.1. Problems with traditional taxonomic characters.

MARRAT (1870-71: 7), in the description of *O. truncata*, wrote: "*The rounded form, numerous plaits,* ***short spire*** *and different markings, all serve to distinguish this from* O. polpasta" (bold ours).

PETUCH & SARGENT (1986) reported that *O. truncata* differs from O. polpasta by "*being a more slender, cylindrical shell with a reddish-brown zig-zag color pattern, by having smaller, less prominent subsutural flammules, and by having a* ***higher spire*** *with a larger, protracted, needle-like protoconch*" (bold ours).

The following analysis illustrates both the necessity of a more accurate descriptive vocabulary and the hazards of isolated traditional taxonomic "characters".

To distinguish two taxa, characters with overlapping ranges of variation are not operational in a *monothetic* classification (this is the usual system, in which a unique set of features is both necessary and

PLATE 1 (opposite page)

A. The figured syntype of *O. polpasta* Duclos, 1833 (Muséum National d'Histoire Naturelle, Paris) and the holotype of *O. truncata* Marrat, 1867 (Merseyside County Museum, Liverpool), compared to material from Cebaco I. Scale bars: 10 mm.

B. Features of *O. polpasta* Duclos, 1833 and *O. truncata* Marrat, 1867 (illustrated for specimens V- 2634 and V-2610, both from Cebaco I.). The much smaller first nuclear whorl and the presence of a dark blotch inside the anterior notch are diagnostical for *O. truncata*. In apical view, the two species are quite similar.

C. Comparison of the protoconchs of *O. polpasta* Duclos, 1833 and *O. truncata* Marrat, 1867. All at same scale. Scale bars: 1 mm.

sufficient for membership in a group -by opposition to "*polythetic*", see SNEATH & SOKAL, 1973: 20). Let us now analyse the discriminant characters given by PETUCH & SARGENT (1986), when applied to the samples from Cebaco I.

- *MORE SLENDER SHELL*. This can be measured by the ratio D/H. One finds for *O. truncata*: mean 0.49, σ (standard deviation) 0.03, min. 0.43, max. 0.53. For *O. polpasta*: mean 0.54, σ 0.02, min. 0.51, max. 0.58. The mean values are indeed different, but the ranges overlap (as can also be seen in Figure 4). It is the *body whorl* (not the whole shell) that is demonstrably more slender (this can be measured by the ratio D/L, see Figure 1 showing that the ranges do not overlap).

- *MORE CYLINDRICAL SHELL*. This can be measured by the ratio D/R (R is the diameter of the spire at right angle from the apertural plane, not illustrated here). One finds for *O. truncata*: mean 2.35, σ 0.08, min. 2.23, max. 2.48. For *O. polpasta*: mean 2.12, σ 0.14, min. 1.89, max. 2.32. The mean values are indeed different, but the ranges overlap.

- *HIGHER SPIRE*. This can be measured by the ratio (H-L)/H. One finds for *O. truncata*: mean 0.13, σ 0.02, min. 0.09, max. 0.16. For *O. polpasta*: mean 0.17, σ 0.02, min. 0.14, max. 0.21. The mean values are indeed different, but the ranges overlap (as can also be seen in Figure 4). One will notice that it is *O. polpasta* (not *O. truncata*) that has the higher spire (the name *truncata* of Marrat probably refers to a "shortened" spire).

- *REDDISH-BROWN ZIG-ZAG COLOR PATTERN*. The chevrons of *O. truncata* tend indeed to be reddish, whereas in *O. polpasta* they are nearly black.

- *SMALLER, LESS PROMINENT SUBSUTURAL FLAMMULES*. This is not evident to us (see Plate 1, B). Both species have nearly the same "cogwheel pattern" (see TURSCH, GREIFENEDER & HUART 1998)

- *LARGER, PROTRACTED, NEEDLE-LIKE PROTOCONCH*. This is also not evident (at first glance, one would even tend to consider the protoconch of *O. polpasta* as being larger, see Plate 1, C). What can be demonstrated is that *O. truncata* has nearly one more protoconch whorl and a much smaller first nuclear whorl (see Figure 3 and Plate 1, B). The size of the first nuclear whorl can be appreciated only under strong magnification.

5.2. Comment on species detection.

It is remarkable that PETUCH & SARGENT (1986), using a series of non-operational characters, nevertheless reached the correct conclusion that *O. polpasta* and *O. truncata* are distinct species.

This is not at all an isolated case: the traditional description of any *Oliva* species boils down to a list of discriminant characters that, when tested, often (mostly?) turn out to be non-operational. One could thus logically expect most of their species to be wrong, but this is clearly not the case. How then could one justify their amazing rate of success ? This certainly demonstrates the acuity of perception of highly experienced malacologists. But is it simply a case of being right for the wrong reasons?

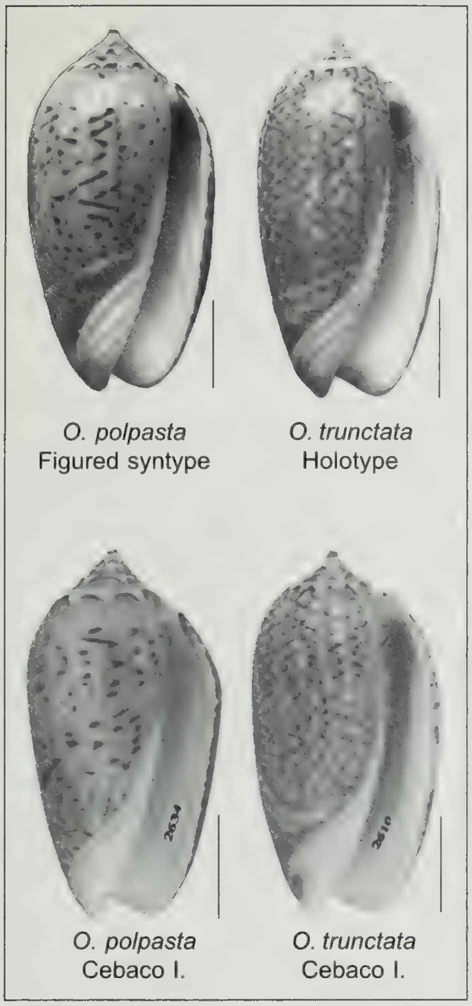
Let us consider the graph of Figure 4. A full separation is obtained by combining two characters that are non-operational if taken separately. Scatter diagrams (see TURSCH 1998) can indeed evidence the "*special sets of covariance*" that are of taxonomic importance (GOULD 1984).

It seems likely that experienced malacologists subconsciously integrate their data and somehow manage to detect the "special covariance sets" included in the total *Gestalt* of the shell. Only some kind of telepathy could communicate this essential phase of work to the reader. The systematic use of scatter diagrams is strongly advocated as a more operational and explicit alternative (see TURSCH, 1998): the existence of different sets of covariance is seen at first glance.

5.3. Size of morphological gaps.

The morphological gaps observed here (especially for protoconch characters, see Figure 3) are unusually large for closely related species. This might be a good illustration of the law of "*character displacement*": wherever two closely related species come into contact, their characters tend to diverge (see for instance BUTLIN, 1989).

Plate 1



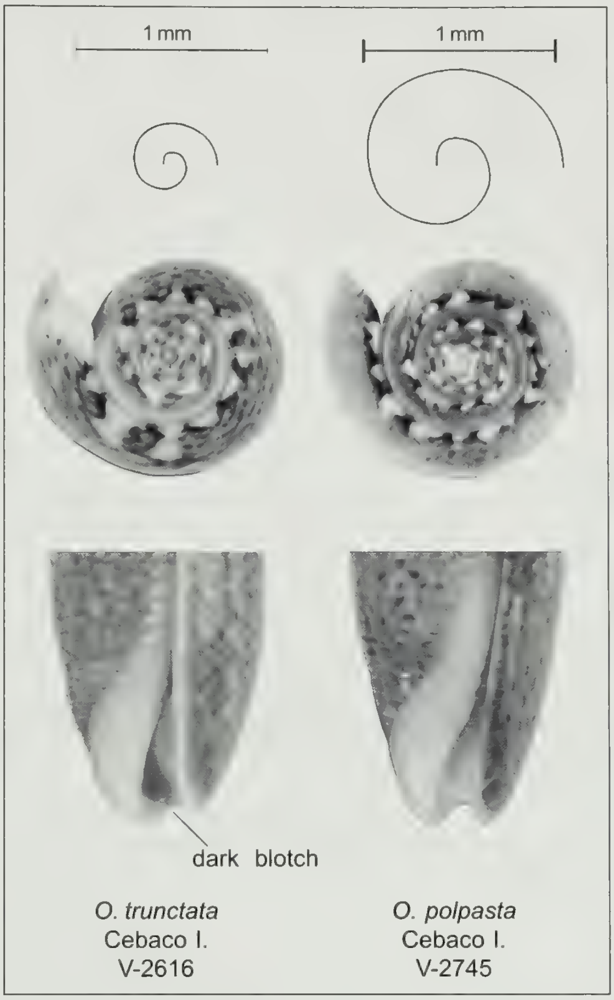
O. polpasta
Figured syntype

O. truncata
Holotype

O. polpasta
Cebaco I.

O. truncata
Cebaco I.

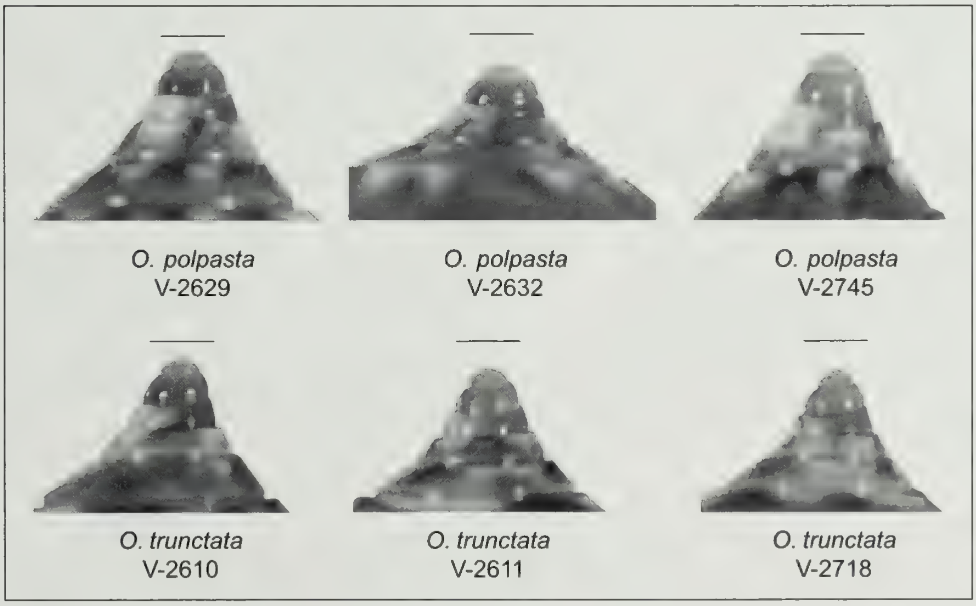
A



O. truncata
Cebaco I.
V-2616

O. polpasta
Cebaco I.
V-2745

B



O. polpasta
V-2629

O. polpasta
V-2632

O. polpasta
V-2745

O. truncata
V-2610

O. truncata
V-2611

O. truncata
V-2718

C

5.4. Data on syntopy.

This case invites a comment on the nature of the contribution that field collectors can make to malacology.

Nearly all marine mollusc species are based only upon differences in their external aspect (morphological gaps). A morphological gap between two samples of shells does not necessarily mean that one deals with two species. Differences -even *large* differences- can (and are fully expected to) occur between populations of the same species.

Interpreting differences in terms of morphospecies is straightforward only if one compares *sympatric* samples. But when can we say that two samples are sympatric? Should the localities be separated by less than 100 m? 10 km ? 1000 km ? The range of sympatry (the cruising range) of most molluscs being unknown, syntopic occurrence remains the best proof that two taxa are really sympatric.

This crucial problem can mostly be addressed only by reliable first-hand information. The localities reported on most labels, especially for commercial specimens, are not accurate enough (some are deliberately misleading). Most field collectors concentrate their efforts on the search for "rare" species or "new" species. They could obtain at least equally significant results by addressing the question: "*what are the taxa that share the same micro-habitat*?".

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Three New Gastropod (Mollusca) Species from the New World

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KEYWORDS. Gastropoda, Muricidae, Columbellidae, Terebridae, new species, New World.

ABSTRACT. Three new gastropod species from the New World assigned to the families Muricidae, Columbellidae and Terebridae, are described and compared with their closest relatives. *Chicoreus (Siratus) vokesorum*, n. sp., from the Bahama Islands is compared with *C (S.) cailleti* (Petit de la Saussaye, 1856) and two species of *Vokesimurex* Petuch: *V. tryoni* (Hidalgo in Tryon, 1880) and *V. sunderlandi* (Petuch, 1987). *Columbella marrae*, n. sp., from southwestern Panama, is compared with *C. sonsonatensis* (Mörch, 1860) and *C. fuscata* Sowerby, 1832; and *Terebra mugridgeae*, n. sp., from the northern Gulf of Mexico, is compared with *T. riosi* Bratcher and Cernohorsky, 1985, *T. petiveriana* Deshayes, 1857, *T. concava* (Say, 1826), *T. protexta* (Conrad, 1846), and *T. vinosa* Dall, 1889.

INTRODUCTION

Long years of interest in western hemisphere mollusks, the access to important molluscan collections, and the opportunity to collect in areas of the ocean difficult to reach, has led the author to the discovery of three unusual new species.

Sometime ago the author obtained a single, live collected specimen of an undescribed muricid species that can be assigned to the subgenus *Chicoreus (Siratus)*. It had been dredged in deep water in the Bahama Islands. When a second live collected specimen from the same general area was discovered on a reef wall by means of *scuba* diving, the author decided to describe the species.

JOUSSEAUME (1880) recognized a group of muricids, typified by *Murex senegalensis* Gmelin, 1791, as the genus *Siratus*. At that time he did not describe the genus but did so in 1882. Fourteen living species of *Siratus* are currently known from the western Atlantic. All fourteen have been treated by VOKES (1990), who referred them to the subgenus *Chicoreus (Siratus)*.

In November, 1996, the author spent several days on board of the R/V "Pelican", a research vessel operated by the Louisiana Universities Marine Consortium (LUMCON). While dredging off the Mississippi coast, several specimens of an undescribed species of *Terebra*, were collected in anaerobic sediment (black mud) in shallow water.

BRACHTER & CERNOHORSKY (1987) have monographed the family Terebridae, describing, figuring, and comparing nineteen living western Atlantic species. Since the publication of that monograph, six new western Atlantic species have been described: *Terebra biminensis* Petuch, 1987; *T. lindae* Petuch, 1987; *T. pacei* Petuch, 1987; *T. curacaoensis* De Jong and Coomans, 1988; *T. imitatrix* Auffenberg and Lee, 1988; and *T. reticulata* Lopes de Simone and Verissimo, 1995.

Finally, in January, 1998, a dredging opportunity was afforded the author by an invitation from James Ernest, the well-known Panamanian collector. Dredging in the isolated Islas Secas, Golfo de Chiriquí, southwestern Panama, yielded five specimens of an undescribed species of *Columbella*, which were found on a sandy bottom covered with live and dead *Pinctada mazatlanica* (Hanley, 1856) and *Hyotissa hyotis* (Linnaeus, 1758).

ABBREVIATIONS OF REPOSITORY INSTITUTIONS

- ANSP- The Academy of Natural Sciences, Philadelphia, PA.
- BMSM- The Bailey-Matthews Shell Museum, Sanibel, FL.
- LACM- The Natural History Museum of Los Angeles County, CA.
- UF- The University of Florida Natural History Museum, Gainsville, FL.

SYSTEMATICS

Superfamily **MURICOIDEA**

Family **Muricidae** Rafinesque, 1815

Genus ***Chicoreus*** Montfort, 1810

Subgenus ***Siratus*** Jousseaume, 1880

Chicoreus (Siratus) vokesorum, new species
(Figures 1-4)

Description. Shell club-shaped, delicate; last whorl small, globose; length of holotype 32 mm; siphonal canal long, 17 mm in length. Protoconch of 2.5 whorls, last whorl spirally ridged (Fig. 3); 4.5 teleoconch whorls. Spiral ornamentation on first two teleoconch whorls of four strong cords, forming knobs at intersection with sharp axial ribs; spiral cords increasing to about 12 on body whorl, diminishing in strength. Axial ribs strong on first two teleoconch whorls, about 10 in number on the second; with every third rib developing a shoulder spine. On third whorl spinose ribs becoming varices, ornamented with two adapically recurved spines; other axial sculpture becoming weak, barely appearing as slightly swollen nodes. Last whorl with three well developed varices each with three recurved, adapically projecting spines; shoulder spine longest, and one minor and two major intervarical ridges, producing spirally elongated nodes where crossed by spiral threads. Suture simple, crossed by axial growth lamellae. Aperture ovate. Inner lip adpressed posteriorly, slightly erect on almost entire length; columella smooth. Outer apertural lip weakly erect, crenulated. Siphonal canal long, about 54% of total shell length; open by a very narrow slit, strongly recurved dorsally; ornamented with a single recurved spine on each varix at base of body whorl. Shell white, with a narrow, diffused brownish-red band at shoulder, darker when crossing varices; a similar band at base of last whorl.

Radula: See Figure 4

Type material. Holotype (ANSP 400854) length 32.0 mm, width of last whorl 10.5 mm. Paratype (Craig L. Caddigan collection) length 24.0 mm, width of last whorl 9.0 mm.

Type locality. Off San Salvador I., central Bahama Islands, taken live at 273 m.

Distribution. Off San Salvador and Lee Stocking Islands, central Bahamas, taken live at 46 - 273 m.

Etymology. Named for Dr. Emily H. Vokes and Dr. Harold E. Vokes in recognition of their life-long devotion to the study of the Muricidae and Bivalvia respectively and their unselfish will to help amateur conchologists.

Discussion. Currently, there are two known specimens of this species. The holotype came from the collection of the late Eugenia Wright, the well-known muricid collector from Arizona. A second specimen was collected on September 13, 1996, by Mr. Craig L. Caddigan of Fort Pierce, Florida, while *scuba* diving on a reef wall in 46 m off Lee Stocking Island, central Bahamas. Both specimens were collected live.

The unique adapically directed spine formation and the ridged protoconch immediately separate this shell from all other western Atlantic species of *Chicoreus* (*Siratus*). In general shape it is closest to typical *C. (S.) cailleti* (Petit de la Saussaye, 1856), less so to the variation *kugleri* (Clench and Pérez Farfante, 1945). However, *C. (S.) cailleti* has a smooth protoconch of 1.5 whorls, has a denticulated columellar lip and more numerous whorls with different spine ornamentation. Because of its size and fragility the new species could be confused with *Vokesimurex tryoni* (Hidalgo *in* Tryon, 1880) and *Vokesimurex sunderlandi* (Petuch, 1987). However, these latter two species have the straight siphonal canal characteristic of *Vokesimurex* Petuch, 1994 (type species: *Murex messorius* Sowerby, 1841) and differ in coloration, sculpture and spine formation.

Family **Columbellidae**

*Genus **Columbella*** Lamarck, 1799

Columbella marrae, new species
(Figures 9-14)

Description. Shell thick, typically columbelloid; up to 9.6 mm in length. First whorl eroded on only protoconch available, two smooth, bulbous whorls remaining; tan in color. Protoconch of planctotrophic larval type, bearing a deep sinusigeral notch. Teleoconch of five whorls, the first slightly concave and axially ribbed, the next three nearly smooth. Posterior to suture, a thickened band delimited by poorly developed pustules, giving median whorls a concave appearance. Last whorl pear-shaped, smooth. Aperture S-shaped; outer lip thickened, arched, with about ten denticles; anal canal delineated by thickening of the parietal wall; parietal wall glazed over, glaze thick enough in some specimens to form shield. Columella twisted, bearing 5 to 9 denticles. Shell tan, with irregular nebulous areas either white or pale violet, with freckled tan markings. Outer aperture yellow; pale lavender inside.

Figs. 1-4. *Chicoreus (Siratus) vokesorum* n. sp. Holotype. Figs. 1-2. Ventral and dorsal views (Length: 32.0 mm, Width: 10.5 mm). Fig. 3. Detail of protoconch (Scale bar: 40µm). Fig. 4. Radula (Scale bar 30µm). **Figs. 5-8.** *Terebra mugridgeae* n. sp. Fig. 5. Holotype (Length: 9.7 mm; Width: 2.7 mm). Fig. 6. Protoconch of Holotype (Scale bar: 180µm). Fig. 7. Paratype F (Length: 16.1 mm; Width: 4.6 mm). Fig. 8. Paratype E (Length: 13.5 mm; Width: 4.2 mm).

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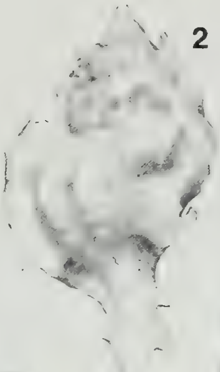

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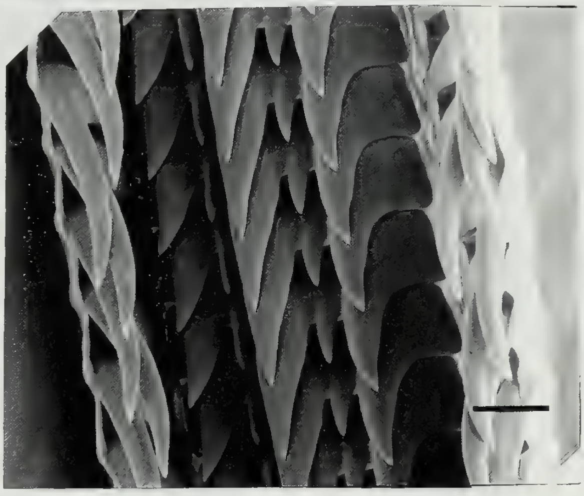

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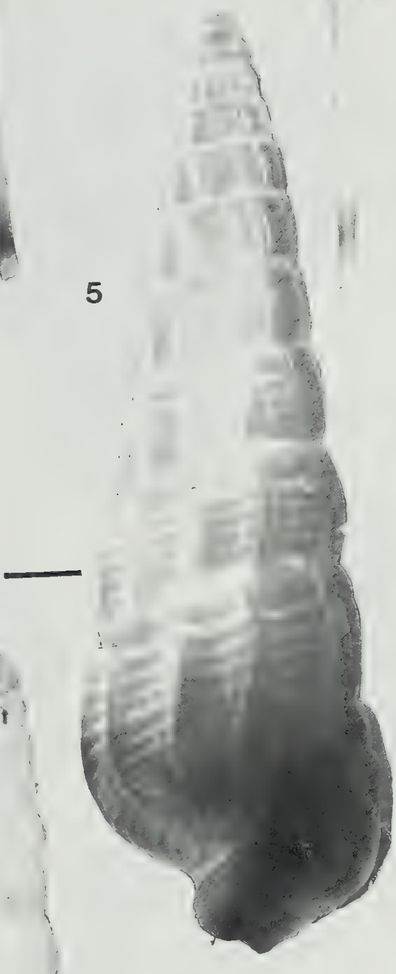

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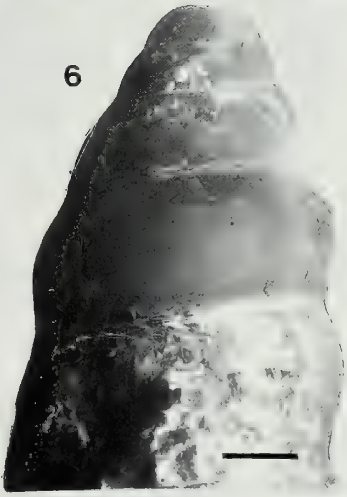

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Type material. Holotype (ANSP 400855) length 9.6 mm, width 5.7 mm (Figs. 9-12). Paratype A (ANSP 400856) length 8.6 mm, width 5.2 mm (Figs.13-14). Paratype B (BMSM 2242) length 9.0 mm, width 5.4 mm. Paratype C (LACM 2870) length 8.0 mm, width 5.2 mm. Paratype D (author's collection 17018) length 8.2 mm, width 5.3 mm.

Type locality. Islas Secas, Golfo de Chiriquí, southwestern Panama. Dredged in 24 to 37 m, on a sand bottom.

Distribution. Known only from the type locality.

Etymology. Named for Mrs. Lauretta Marr, of Midland, Texas, for her interest in Panamanian shells.

Discussion. The relatively small area where the new species was found is characterized by very strong currents, which is probably the cause for having such an abundance of *Pinctada mazatlanica* and *Hyotissa hyotis*. These two species seem to be essential to the development of the rich molluscan fauna of the area, for if the dredge did not bring up those two species, very few or no other species were dredged. The area yielded 73 species of gastropods representing 34 families. Of these, the muricids were by far the most numerous with 11 species. The bivalves were represented by 26 species in 15 families.

In spite of variations in the nebulous color markings of the species, all five type specimens show them below the suture to a greater or lesser degree. The markings may be present in other parts of the body whorl; however, the general appearance of the species is constant.

The small size separates this species from most Panamic species of *Columbella*. The closest congener is *Columbella sonsonatensis* (Mörch, 1860) (Figs. 15-19). However, that species has sharper columellar denticles; is narrower (see Table I); the shell is white, streaked with blackish-brown markings; has a white lip and aperture, with darker markings showing through; and it has four white, semi-translucent protoconch whorls comparatively larger than the new species. *Columbella sonsonatensis* prefers an intertidal, muddy environment, but *C. marrae* inhabits deeper water, on a coralline substrate.

C. marrae	**Locality**	**Length (mm)**	**Width (mm)**	**L / W**
Holotype	Islas Secas	9.6	5.7	1.68
Paratype A	Islas Secas	8.6	5.2	1.65
Paratype B	Islas Secas	9.0	5.4	1.67
Paratype C	Islas Secas	8.0	5.2	1.54
Paratype D	Islas Secas	8.2	5.3	1.55
Mean				1.62
C. sonsonatensis	**Locality**	**Length (mm)**	**Width (mm)**	**L / W**
	Río Mar, Panama Bay	8.0 mm	4.4 mm	1.82
	Hicacos Pt., Montijo Bay	8.2	4.5	1.82
	Arenas de Quebro	7.7	4.0	1.92
	Arenas de Quebro	7.2	3.5	2.05
	Arenas de Quebro	7.2	3.7	1.95
	Arenas de Quebro	7.3	3.5	2.09
	Arenas de Quebro	7.2	3.5	2.06
Mean				1.97

Table1. Chart showing length/width ratio of *C. marrae vs. C. sonsonatensis* from Panama.

Fig. 9-14. *Columbella marrae* n. sp. Fig. 9. Ventral view of holotype (Length: 9.6 mm; Width: 5.7 mm). Figs. 10-11. Ventral and dorsal view of holotype. Fig. 12. Protoconch and early teleoconch whorls of holotype (Scale bar 165 µm). Figs. 13-14. Ventral and dorsal view of paratype A (Length: 8.6 mm; Width: 5.2 mm). **Figs. 15-19.** *Columbella sonsonatensis* (Mörch, 1860). Fig. 15. Protoconch of a specimen of *C. sonsonatensis* from Río Mar, Panama (Scale bar 165 µm). Figs. 16-17. Ventral and dorsal views *C. sonsonatensis* from Río Mar, Panama (Length: 8.0 mm; Width: 4.4 mm) . Protoconch shown in Fig. 15. **Figs. 18-19.** Ventral and dorsal views of *C. sonsonatensis* from Hicaco Point, Veraguas Province, southwestern Panama (Length: 8.2 mm; Width: 4.5 mm). **Figs. 20-21.** Ventral and dorsal views of *Columbella fuscata* Sowerby, 1832, Gobernadora Island, Veraguas Province, southwestern Panama (Length: 20.6 mm; Width: 11.4 mm).


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Columbella fuscata Sowerby, 1832 (Figs. 20-21), an intertidal species that also prefers a muddy environment (CANTERA *et al.*, 1979; POORMAN & POORMAN, 1988), is closest in general appearance to *C. marrae*. However, it is much larger in size (average length 20 mm); is chestnut-brown, dotted and irregularly spotted with white throughout the last whorl, does not have a thickening of the parietal wall at anal canal; does not have a parietal glaze; and has more numerous (about 12) denticles in the outer lip. The aperture of *C. fuscata* is lavender-colored in fresh specimens, soon fading to white. The aperture of *C. marrae* is yellow.

Superfamily **CONOIDEA**

Family **Terebridae**

*Genus **Terebra*** Bruguière, 1789

Terebra mugridgeae, new species

(Figures 5-8)

Description. Shell to 16.1 mm in length (paratype F, Fig. 7), rather thin. Multispiral protoconch, with four whorls rapidly increasing in size; last whorl as wide as first teleoconch whorl. Teleoconch of 11 turreted, slightly convex whorls, each increasing in width more rapidly than most western Atlantic *Terebra* species. First teleoconch whorl with 12 axial ribs; ribs increasing in number to 15 on penultimate whorl of largest specimen. Axial ribs somewhat arcuate, wider than interspaces. Spiral sculpture beginning on second teleoconch whorl, confined to interspaces on first four whorls, crossing axial ribs on later whorls; sculpture of about five to six wide cords on teleoconch whorls, increasing in number on last whorl. Subsutural band inconspicuous, about 8% of last whorl, delimited abapically by a groove; smooth except for elongated nodes formed by axial ribs. Columella recurved, developing two folds in largest specimen. Aperture quadrate. Shell pale tan, with a darker peripheral band and a second, narrower band at base of last whorl. Columella colored purplish in fresh specimens.

Type material. Holotype (ANSP 400857) length 9.7 mm, width 2.7 mm (Figs. 5-6). Paratype A (LACM 2871) length 9.5 mm, width 2.6 mm. Paratype B (BMSM 2240) length 7.8 mm, width 2.2 mm. Paratype C (BMSM 2241) length 7.8 mm, width 2.5 mm. Paratype D (author's collection 16952) length 11.7 mm, width 3.5 mm. Paratype E (ANSP 400858) length 13.6 mm, width 4.2 mm (Fig. 8). Paratype F (UF 268094) length 16.1 mm, width 4.6 mm (Fig. 7). Paratype G (UF 268095) length 8.3 mm, width 2 mm. Paratype H (in author's collection 17918) length 5.9 mm, width 2 mm.

Type locality. Gulf of Mexico, off Mississippi, at 29°53.25'N, 88°40.46'W, in 18 m, dredged in anaerobic sediment (black mud).

Distribution. The species is known from the type locality, where the holotype and paratypes A through F were found. Two specimens, paratypes G and H, were dredged at 29°27.32'N, 88°17.32' W, in 56 m, also in anaerobic sediment.

Etymology. Named for Ms. Edith Mugridge, a well known resident of Sanibel Island, Florida, and the author's shelling mentor over 30 years ago. Ms. Mugridge is one of the great benefactors of the Bailey-Matthews Shell Museum, Sanibel Island.

Discussion. *Terebra mugridgeae* n. sp. is a common species at the type locality. Presumably it has been overlooked because of its small size and inconspicuous coloring. *Terebra mugridgeae* is different from other *Terebra* species in the western Atlantic because of its multispiral protoconch of four whorls. Of the western Atlantic species only *T. petiveriana* Deshayes, 1857, and *T. riosi* Bratcher and Cernohorsky, 1985, have a planktotrophic type protoconch. However, *T. riosi* has 3.5 protoconch whorls, is yellowish cream, almost translucent, has a purplish-brown subsutural line, is much narrower, and reaches 10 mm in length. Currently, it is known only from Brazil. *Terebra petiveriana* has from 3 to 3.5 slender protoconch whorls, has a thick, convex subsutural band, is proportionately narrower, and is a much larger species, reaching 46 mm in length. Currently, this species is known from the northern coast of South America, the West Indies, and the Panamic Province.

The multispiral protoconch of the new species, denoting planktotrophic larval development, may indicate a long veliger stage and, therefore, a wide distribution; however, dredgings done west of the delta of the Mississipi River as far as Galveston, Texas, have failed to produce this species in spite of the fact that the same anaerobic sediment of the type locality exists off the Louisiana coast.

Of the western Atlantic species, *Terebra mugridgeae* is closest in general shape to *Terebra concava* (Say, 1826), which has a quadrate aperture and the general proportions of the new species. However, *T. concava* has two protoconch whorls, concave teleoconch whorls, swollen, nodulated spiral cords above and below the suture, and lacks axial sculpture. *Terebra vinosa* (Dall, 1889) has 1.5 protoconch whorls, is grayish-white, has a swollen subsutural band with 3 to 6 spiral cords, is narrower in shape (the 11th whorl of widest specimen available measures 4.3 mm in width vs. 4.6 for the new species), and has an elongated aperture. *Terebra protexta* (Conrad, 1846) has 1.5 protoconch whorls; is brown or tan (dull white when faded), has narrower and more numerous axial ribs (17-

24 on penultimate whorl), is narrower in shape (the 11th whorl of widest specimen available has a width of 3.9 mm), and has a more elongated aperture.

The new species was collected with *Tellidora cristata* (Récluz, 1844) , *Linga amiantus* (Dall, 1901), *Corbula contracta* Say, 1822, and *Cosmioconcha calliglypta* (Dall and Simpson, 1901). The last two species were common.

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Description of *Austromitra hayesi* n. sp. (Neogastropoda: Muricoidea: Costellariidae) from South Africa

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KEYWORDS. Costellariidae, *Austromitra*, new species, South Africa

ABSTRACT. *Austromitra hayesi* is described from a 70 to 120 m deep rocky sea bottom habitat off Algoa Bay and off Bird Island, South Africa. This new species is distinguished from the similar species *Austromitra distincta* (Thiele, 1925) by flat and stepped whorls with flat ledges on the sutures; from *Austromitra maculosa* Turner & Simone, 1998 by smaller size and more numerous axial ribs which are articulated by distinct spiral threads and grooves, and from an undescribed smooth *Austromitra* sp. by an overall rough sculpture.

INTRODUCTION

The coastal and moderately deep oceanic reaches of South Africa are inhabited by eight known species of Costellariidae: *Vexillum (Pusia) patulum* (Reeve, 1845) (ranging from the N. W. Cape to the Natal south coast), *Austromitra capensis* (Reeve, 1845) (from Table Bay to the Natal south coast), *A. canaliculata* (G. B. Sowerby III, 1900) (Jeffreys Bay to western Transkei), *A. bathyraphe* (G. B. Sowerby III, 1900) (Jeffreys Bay to East London), *A. kowieensis* (G. B. Sowerby III, 1901) (Port Alfred and surroundings), *A. distincta* (Thiele, 1925) (in 70 to 300 m depth off Mossel Bay, Algoa Bay and Transkei), *A. rhodarion* (Kilburn, 1972) (East London to the Natal south coast) and *A. maculosa* Turner & Simone, 1998 (Hout Bay and False Bay). More detailed information on these species is given by THIELE (1925), TURTON (1932), BARNARD (1959), KILBURN (1972), KILBURN & RIPPEY (1982), MARAIS & GRAEVE (1989), TURNER (1993, 1994) and TURNER & SIMONE (1998).

From 1995 until March 1999, Mr. Brian HAYES (Port Elizabeth, S. A.) has provided several lots of small gastropod shells for study. These shells were found dead off Algoa Bay (including Bird Island) in cray traps. Each trap had been let down to the rocky sea bottom at depths 70 to 120 m by a single long rope attached to a surface buoy. The traps were used for catching the rock-lobster *Panulirus homarus* (Linnaeus, 1758) and were usually left at the bottom for 2–5 days at a time. The small gastropod shells, incidentally caught with the cray traps, turned out to belong to the family Costellariidae. Comparison with an extensive Costellarid material (including documentation of types) has proved that 15 specimens out of all lots represent a species new to science which is described in the following pages.

ABBREVIATIONS

BMNH: Natural History Museum, London
NMSA: Natal Museum, Pietermaritzburg
SMF: Senckenberg-Museum, Frankfurt/M
ZMB: Zoologisches Museum der Humboldt-Universität, Berlin

SYSTEMATICS

Superfamily **MURICOIDEA** Rafinesque, 1815
Family **Costellariidae** Macdonald, 1860
Genus ***Austromitra*** Finlay, 1927

Type species by original designation: *Columbella rubiginosa* Hutton, 1873, Recent, New Zealand.

Austromitra hayesi n. sp.
Figs. 1–7

Type material. Holotype (Figs. 1–2) 8.3 x 3.3 mm, aperture length 4.2 mm, collected by cray trap off Algoa Bay, about 100 m (70 m to 120 m) depth, 1997; ex collection B. HAYES, Port Elizabeth, South Africa; deposited in NMSA (V7304/T1717). Paratype #1 (Figs. 3–4) 8.4 x 3.3 mm, aperture 4.2 mm, from the type locality, 14 November 1995; deposited in BMNH (#19990443). Paratype #2 (Fig. 5) 8.0 x 3.3 mm, aperture 3.9 mm, from the type locality, March 1995; in coll. H. TURNER. Paratype #3 (7.9 x 3.3 mm, aperture 3.8 mm) from the type locality, March 1995; in coll. B. HAYES (P.O. Box 804, Port Elizabeth, 6000 South Africa). Paratype #4 (5.6 x 2.4 mm, aperture 2.8 mm, juvenile specimen) from off Bird Island, 100 m depth, in cray trap, dead, 23 Nov. 1995; in coll. H.

TURNER. Paratype #5 (Fig. 6) 8.0 x 3.6 mm, aperture 4.0 mm, from the type locality, 1996; deposited in SMF (#319985). Paratype #6 (7.8 x 3.1 mm, aperture 3.8 mm) from the type locality, 1996; donated to Mr. R. SALISBURY. Paratype #7 (7.7 x 3.5 mm, aperture 3.8 mm, lip broken) from the type locality, 1996; in coll. H. TURNER. Paratype #8 (8.0 x 3.5 mm, aperture 3.8 mm), from the type locality, 1997; in coll. B. HAYES. Paratype #9 (7.4 x 3.0 mm, aperture 3.6 mm, lip broken), from the type locality, 1997; in coll. B. HAYES. Paratype #10 (7.6 x 3.2 mm, aperture 3.7 mm) from the type locality, 1998; in coll. B. HAYES. Paratype #11 (7.0 x 3.2 mm, aperture 3.7 mm, lip broken), from the type locality, 1997; in coll. B. HAYES. Paratype #12 (fig. 7) 6.2 x 2.8 mm, aperture 3.2 mm, juvenile, from the type locality, 1997; in coll. B. HAYES.

Other material studied. Two specimens (7.0 x 3.1 mm, juvenile, apex and lip broken; 6.2 x 2.7 mm, juvenile, bad crack in body whorl, lip broken), from the type locality, 1997; in coll. B. HAYES.

Type locality. Off Algoa Bay, South Africa, depth 70 m to 120 m (in crayfish traps).

Distribution and habitat. Known only from Algoa Bay (including Bird Island), South Africa. The species inhabits a flat, rocky sea bottom in about 100 m depth and lives probably amongst rocks, sponges and soft corals. It shares its habitat with the rock-lobster *Panulirus homarus* (Linnaeus, 1758).

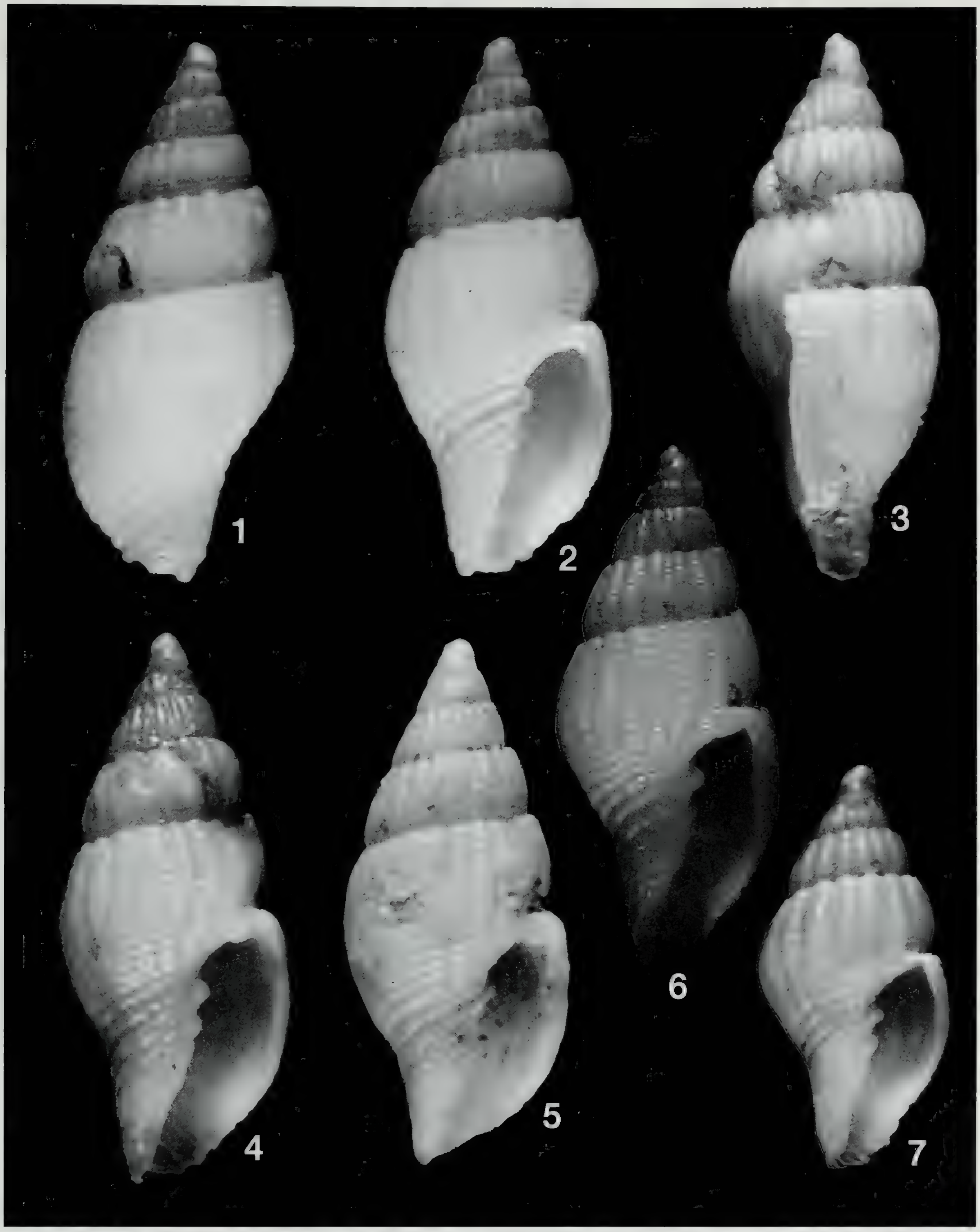
Etymology. Named in honour of Mr. Brian HAYES (Port Elizabeth, South Africa), a well known conchologist and particularly an expert in South African reef molluscs, in appreciation of his merits for malacology.

Description. Shell of medium size for the genus, up to 8–9 mm in length and 3.3–3.6 mm in width, shape fusiform, solid. Protoconch acuminate-involute-paucispiral with 1 1/2 smooth glassy whorls (counted from the origin). Teleoconch with 5 moderately rounded whorls, spire outline likewise moderately convex; sutures form a well developed flat ledge, giving the spire a stepped appearance. Spire whorls are sculptured with rounded, evenly spaced axial ribs which number 16 to 17 on the first whorl and 18 to 19 on the following whorls; on the body whorl less numerous (10 to 14) axials which become indistinct on the anterior half and obsolete towards the aperture. The axial ribs are separated by concave interspaces of about the same width. Spiral sculpture changes noticeably during individual growth; on the first 2 or 3 spire whorls spiral grooves number 8 to 9 and are restricted to the interspaces of the axial ribs while the ribs are smooth; on later spire whorls and on the body whorl spiral sculpture becomes more distinct as the spiral grooves are intersecting the axial ribs, with the result that distinct and regular spiral cords and grooves are evenly developed on the axial ribs as well as in their interspaces. Spiral cords number 10 to 11 on the 4th spire whorl and 23 to 25 on the body whorl where the spirals become somewhat stronger anteriorly and extend almost unchanged onto the siphonal fasciole and the anterior end of the shell. Rostrum slightly recurved to the dorsum, siphonal notch indistinct. Columella with 4 slender folds decreasing in size anteriorly. Aperture moderately wide (width = 31–34 % of length), attenuated at base, not lirate within, posterior aperture angle blunt because of a flat ledge at the suture and a callus pad; inner lip of glazed enamel not elevated from the columella; outer lip thin and crenelated by spiral cords and grooves. Shell overall white to beige. — A peculiar feature of this new species is that about one third of the individuals show healed shell fractures and cracks in various stages of individual growth, even on the very early whorls (e. g. paratype #1).

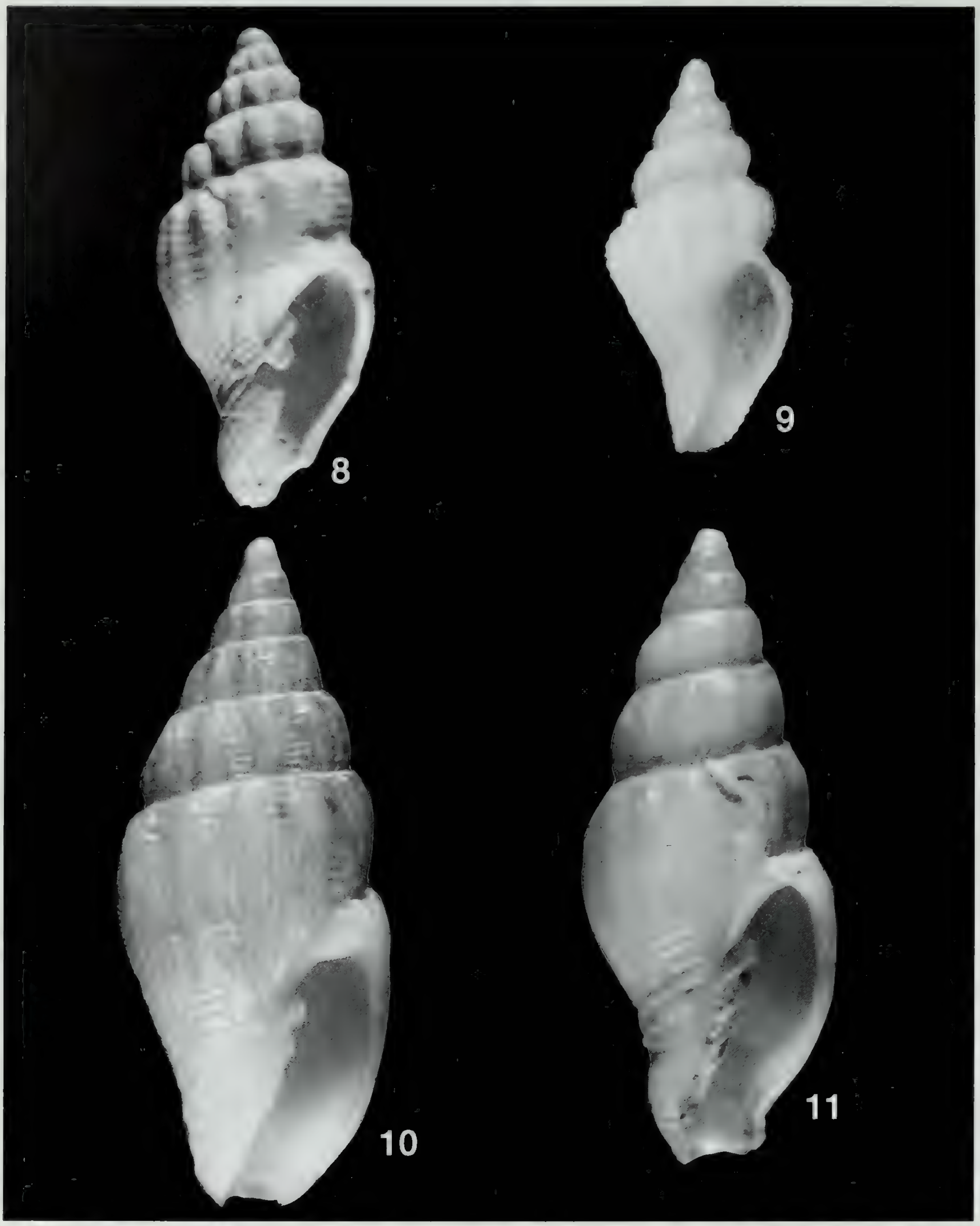
Discussion. This new species is similar to *Austromitra distincta* (Thiele, 1925) (Figs. 8–9). Both species have white shells of roughly the same size and show a similar spiral sculpture with numerous and distinct spiral threads and grooves on teleoconch whorls including the whole body whorl until its anterior end. Both species inhabit the same habitat in the Algoa Bay; beyond this sympatric occurrence, *A. distincta* is known, however, from a much larger range (Cape Agulhas to Transkei, in depths from 70 m to about 300 m). In shell morphology, *A. distincta* differs distinctly by its strongly rounded and shouldered whorls as well as in having fewer and much broader axial ribs. Moreover, *A. distincta* shows distinct spiral threads and grooves over-riding the axial ribs also on the early spire whorls. The well developed flat ledge at the sutures, giving the spire of *A. hayesi* n. sp. a stepped appearance, is missing in *A. distincta*.

A. hayesi n. sp. is superficially similar to a recently described South African species, *A. maculosa* Turner & Simone, 1998 (Fig. 10) (loc. typ.: Hout Bay; new records also from False Bay). Both species may be easily distinguished as *A. maculosa* grows to a larger size (14 x 5.5 mm) and shows a sculpture with fewer axial ribs which are not articulated by distinct spiral threads and grooves. Moreover, *A. maculosa* differs by its peculiar colour pattern of brown blotches below the suture.

A. hayesi n. sp. is superficially similar to a recently described South African species, *A. maculosa* Turner & Simone, 1998 (Fig. 10) (loc. typ.: Hout Bay; new records also from False Bay). Both species may be easily distinguished as *A. maculosa* grows to a larger size (14 x 5.5 mm) and shows a sculpture with fewer axial ribs which are not articulated by distinct spiral threads and grooves. Moreover, *A. maculosa* differs by its peculiar colour pattern of brown blotches below the suture.



Figs. 1–7. *Austromitra hayesi* n. sp. Figs. 1–2. Holotype, NMSA V7304/T1717 (8.3 x 3.3 mm), off Algoa Bay, South Africa, about 100 m depth, dead in crayfish trap, 1997. Figs. 3–4. Paratype #1, BMNH 19990443 (8.4 x 3.3 mm), from the type locality, 14 Nov. 1995. Fig. 5. Paratype #2, H. TURNER coll. (8.0 x 3.3 mm), from the type locality, March 1995. Fig. 6. Paratype #5, SMF #319985 (8.0 x 3.6 mm), from the type locality, 1996. Fig. 7. Paratype #12, B. HAYES coll. (6.2 x 2.8 mm, juvenile), from the type locality, 1997.



Figs. 8–9. *Austromitra distincta* (Thiele, 1925). Fig. 8. Lectotype, ZMB (7.3 x 3.2 mm), from Agulhas Bank, 155 m depth ("Valdivia" Stat. 104). Fig. 9. Juvenile specimen, M. MARROW coll. #10699 (6.2 x 2.6 mm), from off Nthlonyane River, Transkei, dredged at 300 m depth. **Fig. 10**. *Austromitra maculosa* Turner & Simone, 1998. Holotype, NMSA V4687/T1452 (13.4 x 5.4 mm), from Houtbaai near Kommetjie at 36 m depth, west coast of Cape Peninsula, South Africa. **Fig. 11**. *Austromitra* sp. H. TURNER coll. (9.9 x 3.7 mm), from Algoa Bay, South Africa, ex pisce, 25 Oct. 1995.

A. hayesi n. sp. was also compared with an obviously undescribed species from the Algoa Bay, *Austromitra* sp. (Fig. 11), which was brought to my knowledge recently and is still under study. Both species are similar in size and shape, but differ distinctly as *A. hayesi* shows a rough sculpture of axial ribs and spiral cords on all teleoconch whorls whereas the undescribed *Austromitra* sp. has an almost smooth shell with obsolete flat and wide, almost obsolete axial ribs on the spire whorls and with several rounded spiral threads only at the base of the body whorl.

ACKNOWLEDGEMENTS. I am greatly indepted to Mr. Brian Hayes (Port Elizabeth, South Africa) who generously gave all specimens of the new species at my disposal and who informed me in detail of the habitat data.

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Three new costellarid species from Japan, Papua New Guinea and other Indo-Pacific locations (Neogastropoda: Muricoidea: Costellariidae)

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KEYWORDS. Costellariidae, *Vexillum*, Japan, Philippine Islands, Solomon Islands, Papua New Guinea, Hawaii, South Africa

ABSTRACT. *Vexillum (Costellaria) nodai* n. sp. (Figs 1–4) is described from Japan, the Philippines, Hawaii and South Africa; it is compared to *Vexillum (Costellaria) kurodai* (Sakurai & Habe, 1964). *Vexillum (Costellaria) leforti* n. sp. (Figs 8–11) is described from Japan and the Philippines; it is compared to *Vexillum (Costellaria) alvinobalani* Suduiraut, 1999 and *V. (C.) filistriatum* (G. B. Sowerby II & III, 1874). *Vexillum (Costellaria) beverlyae* n. sp. (Figs 15–20) is described from Papua New Guinea, the Philippine and Solomon Islands; it is compared to *Vexillum (Pusia) festum* (Reeve, 1845), *V. (C.) leforti* n. sp. and *V. (C.) alvinobalani* Suduiraut, 1999.

INTRODUCTION

Two new costellarid species have been collected in lobster nets from Wakayama Prefecture, Japan. These same species have also been collected in widely distributed locations across the Indo-Pacific. A third new costellarid species has been collected off Rabaul and Nordup, East New Britain, Papua New Guinea. It has been known to the authors for more than 10 years. Only recently have additional specimens come to our knowledge, partially from Indo-Pacific locations widely apart from the original place of discovery.

ABBREVIATIONS

ANSP: Academy of Natural Sciences, Philadelphia, PA
BMNH: Natural History Museum, London
MNHN: Muséum national d'Histoire naturelle, Paris
NSMT: National Science Museum, Tokyo
ZMA: Zoological Museum, Amsterdam

SYSTEMATICS

Family COSTELLARIIDAE MacDonald, 1860

Genus *Vexillum* Röding, 1798

Subgenus *Costellaria* Swainson, 1840

Type species by monotypy: *Mitra rigida* SWAINSON, 1821 = *Mitra semifasciata* Lamarck, 1811 = *Vexillum (Costellaria) semifasciatum* (Lamarck). Recent. Indo-Pacific.

Vexillum (Costellaria) nodai n. sp.

Figs 1–4

Mitropifex kurodai (young specimen): Kuroda, Habe & Oyama, 1971: 192, pl. 53, fig. 6 (non *Mitropifex kurodai* Sakurai & Habe, 1964)

Type material. Holotype (Figs 1–2) 30.25 x 9.70 mm (aperture length 12.95 mm) at the type locality taken alive, ex coll. Mr. K. NODA; deposited in ANSP (# 402017). Paratype # 1 (30.61 x 10.88 mm, aperture 14.56 mm) from the type locality; in coll. K. NODA. Paratype # 2 (24.4 x 9.7 mm, aperture 11.5 mm) from Cebu, Philippines; in coll. Mr. J. C. MARTIN (# 2659). Paratype # 3 (23.9 x 9.0 mm, aperture 11.3 mm) from off Balicasag Island, Bohol, Philippines; in coll. Mr. E. G. de SUDUIRAUT (# 1006). Paratype # 4 (Figs 3–4) (30.64 x 9.86 mm, aperture 13.04 mm) from off Park Rynie, southern kwaZulu-Natal, South Africa, dredged fresh dead at approximately 150 m depth by G. SMITH, May 1994; in coll. Mr. M. LUSSI. Paratype #5 (24.15 x 9.64 mm, aperture 11.16 mm) from off Balicasag Island, Bohol, Philippines, tangle nets 140 m, May 1998; in coll. Mr. Al DEYNZER. Paratype #6 (11.61 x 4.88 mm, aperture 5.10 mm) from off Pokai Bay, Oahu, Hawaii, dredged by A. Adams, May 19, 1976; in coll. R. Salisbury.

Other material studied. A badly broken and dark stained specimen 34.40+ (portion of spire missing) x 11.55 mm, aperture 15.23 mm; in coll. Mr. K. NODA.

Type locality. Off Cape Kirime, Kii peninsula, Wakayama Prefecture, Central Honshu, Japan, in 80-90 m (alive in lobster nets).

Distribution and habitat. Japan, Philippine Islands, Hawaii and South Africa. In the Philippines the species was collected dead on sand and broken coral in 80–180 m. In Hawaii, the species was collected dead in mud and sand in 110-130 m. In South Africa the species was collected fresh dead on a rubble and sponge substrate in ca. 150 m.

Etymology. Named after Mr. Kazutaka Noda, Gobo Town, Wakayama Prefecture, Japan. — A new common Japanese name is here designated: Atsumi-fude-gai (Atsumi's Mitre); this name refers to Mr. Noda's daughter Atsumi.

Description. Shell large, to approximately 35 mm in length. Elongate-fusiform. Protoconch unknown. Whorls number 8–10; spire outline nearly straight; sutures well defined; early spire whorls sculptured with 12–17 large, rounded, longitudinal ribs, first few spire whorls bear 6 or 7 equally spaced, strong spiral grooves confined to bottom of interspaces; on later whorls, spiral grooves become strong enough to weakly bisect the longitudinal ribs; body whorl with 20–27 large, round longitudinal ribs; ribs on body whorl found in single, paired and even triple sets; 17–19 spiral grooves, weakly bisecting the ribs, body whorl ribs extend to rostrum where they are interrupted by 4 or 5 rows of strong nodulose cords; first of these cords white, very large, occasionally split into two cords, separated from subsequent cords by wide, deep, open trench; remaining 3 or 4 cords brown, large, widely spaced. Columella with 4 very strong folds or teeth. Aperture narrow, length less than half total shell length; interior white, strongly lirate; siphonal notch moderately wide, slightly recurved; outer lip thin, simple and rounded, a few weak crenulations near siphonal notch. Shell dark-brown, with varying number of yellowish-white bands; on each whorl largest yellowish-white band divided by thin dark-brown spiral thread lying in posterior 1/3 of band; body whorl with white pustulose cord emerging just above largest columellar fold.

Discussion. This new species is larger than most members of the subgenus *Costellaria*. It was erroneously illustrated as a young or immature specimen of the Japanese species *Mitropifex kurodai* Sakurai & Habe, 1964. The two species are roughly the same size and have about as many longitudinal ribs (Figs. 5–7). However, the spiral grooves of *M. kurodai* are much deeper, wider, and do not bisect the ribs. Adult specimens of *M. kurodai* have a small but prominent parietal callus near the anal sulcus which is not seen in this new species. The overall colour pattern of *M. kurodai* is orange-yellow with three narrow white bands on the body whorl. There is no hint of a spiral thread in any of the white bands. This colour pattern contrasts sharply with the dark-brown and yellowish-white bands of *V. nodai* n. sp.

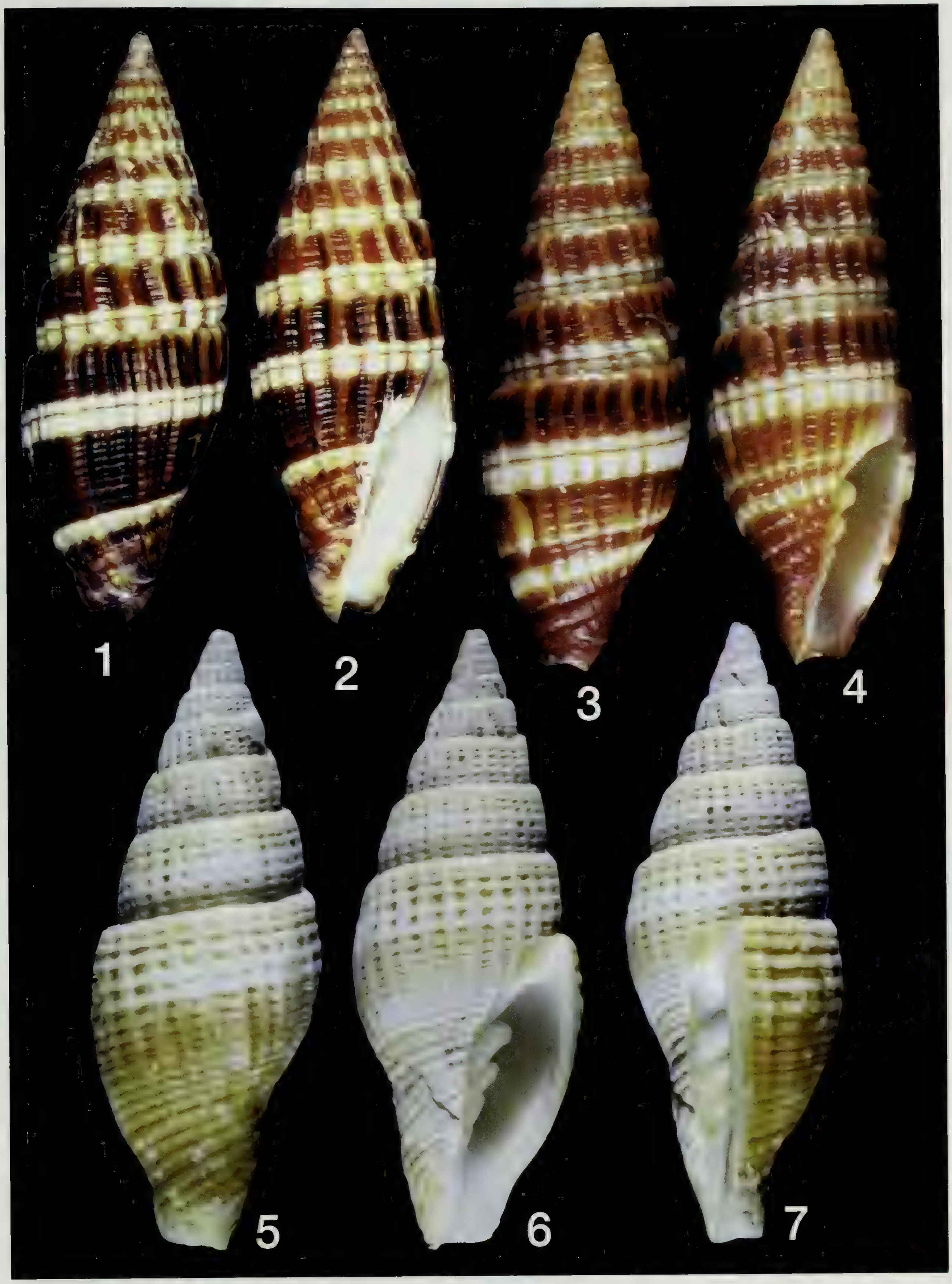
Like many other Japanese species it is also found in the Philippines in deep water. Remarkably, a live specimen of *V. nodai* (paratype # 4, Figs 3–4) was collected off Natal, South Africa, extending the species' range across the Indian Ocean. The South African specimen is slightly more slender than those found in Japan and the Philippines.

Vexillum (Costellaria) leforti n. sp.
Figs 8–11

Type material. Holotype (Figs 8–9) 19.94 x 6.18 mm (aperture length 8.58 mm) at the type locality collected alive, ex coll. Mr. K. Noda; deposited in ANSP (# 402018). Paratype # 1 (19.90 x 6.05 mm, aperture 8.58 mm) from the type locality; in coll. Mr. K. Noda. Paratype # 2 (Figs 10–11) 19.9 x 6.1 mm (aperture 8.5 mm) from off Panglao Island, 140–150 m depth, Bohol, Philippines, collected by native fisherman in tangle net; ex coll. Mr. J. P. Lefort (#1376); deposited in BMNH (# 19990434). Paratype # 3 (18.7 x 6.2 mm, aperture 8.0 mm) from the Cebu area, Philippines, ex coll. S. Martin, 1990; now in ZMA (Moll. 3.99.043). Paratype # 4 (16.6 x 5.7 mm, aperture 7.8 mm) from the Cebu area, Philippines, ex coll. S. Martin, 1990; now in ZMA (Moll. 3.99.044). Paratype #5 (17.21 x 5.67 mm, aperture 7.61 mm) from off Balicasag Island, Bohol, Philippines; in coll. Mr. E. G. de Suduiraut. Paratype # 6 (16.4 x 5.5 mm, aperture 7.1 mm) from off Balicasag Island, Bohol, Philippines, tangle nets in depth 160 to 180 m, August 1998; in coll. senior author (H. T.). Paratype # 7 (15.8 x 4.9 mm, aperture 6.8 mm) from Bohol, Philippines, deep water, 1986, ex H. Fischöder; in coll. Dr. T. W. Baer. Paratype # 8 (14.0 x 4.5 mm, aperture 6.5 mm) from Bohol Straits, Philippines, deep water; in coll. Mr. M. P. Marrow.

Type locality. Off Cape Kirime, Kii peninsula, Wakayama Prefecture, Central Honshu, Japan, in 80 m (in lobster nets).

Figs. 1–4. *Vexillum (Costellaria) nodai* n. sp. Figs. 1–2. Holotype, ANSP #402017 (30.25 x 9.70 mm) ex coll. K. Noda; Japan, Honshu, Wakayama Pref., Kii peninsula, off Cape Kirime, in 80–90 m collected alive. Figs. 3–4. Paratype # 4 (30.64 x 9.86 mm) coll. M. Lussi; South Africa, Southern kwaZulu-Natal, off Park Rynie, in 150 m dredged fresh dead. **Figs. 5–7.** *Mitropifex kurodai* Sakurai & Habe, 1964, figured paratype NSMT-Mo 39797 (32.0 x 11.7 mm); Japan, Shikoku, Kochi Pref., off Ashizuri-Misaki, about 200 m depth.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Distribution and habitat. Japan (at the type locality found alive) and Central Philippines (Cebu and Bohol area, deep water; paratype # 6 collected dead on sand among volcanic stones, in 160–180 m).

Etymology. Named after Mr. Jean Paul LEFORT, Maeva, Huahine Island, French Polynesia, who was very generous in providing extensive material of uncommon and new mitriform species to H. T. for studies. — A new common Japanese name is here designated: Nanase-fude-gai (Nanase's Mitre); this name refers to Mr. NODA's daughter Nanase.

Description. Shell of medium size to 20 mm in length. Fusiform-elongate; spire sharply acuminate. Conoidal protoconch of 3 glassy white whorls, basal diameter 0.6 mm. Teleoconch whorls number 8 or 9, spire whorls slightly convex in outline, sutures form a narrow flat ledge, early whorls with 12–21 longitudinal ribs; ribs weakly bisected by indistinct subsutural groove, interspaces with 3–8 deep spiral grooves; later spire whorls bisected by wide, shallow grooves, forming nodulose regions along tops of ribs; ribs appear almost vertebrate in shape; body whorl with 25–29 longitudinal ribs, subsutural groove obsolete, bisected by 15–18 deep spiral grooves giving the shell a pustulose appearance. Aperture narrow, strongly lirate within, white with brown band, length less than half total shell length; outer lip thin, finely crenulated along margin, margin outline curves gently, margin straight at anterior section near siphonal notch; columella with 4 folds; largest folds may have groove along top of tooth. Shell white, early whorls light-brown, the 3rd and 4th whorls decorated with dark-brown spots and dashes, later whorls occasionally spotted dark-brown; body whorl white with large brown band at centre; occasionally small light-brown spot at intersection of spiral grooves and ribs; on some specimens these spots fill several spiral intersections forming a spotted line at the periphery of the shell, or the light-brown spots may be scattered randomly over the upper body whorl.

Discussion. This new species could be confused with *Vexillum (Costellaria) alvinobalani* Suduiraut, 1999 (Figs 12–13). Both species are found in deep water off the Philippines and have white shells with brown bands. However, both species may be easily distinguished since *V. leforti* is much smaller (adult shells 20 mm in length, whereas *V. alvinobalani* grows to a comparatively large size of 35 mm). Furthermore the shell base of *V. leforti* is truncated (not distinctly elongated as in *V. alvinobalani*). The colour pattern is also quite different: *V. leforti* does not show a subsutural brown band nor a brown shell base as in *V. alvinobalani*; in addition, light-brown coloured early whorls, some with dark-brown spots and dashes (a very distinctive character of *V. leforti*) are not found in *V. alvinobalani*.

V. leforti n. sp. resembles superficially *V. filistriatum* (G. B. Sowerby II & III 1874) (Fig. 14) with which is has been confused by collectors. *V. filistriatum* is indeed similar in size (holotype is 16.7 mm in length) and shows likewise a white shell with a brown subperipheral zone on the body whorl. *V. filistriatum* differs, however, by a more coarse and clathrate sculpture and by a very distinctive colour pattern with quadrangular brown blotches mainly on the periphery of the whorls. This brown colour pattern, scarcely noticed on the worn and faded holotype (not illustrated), is fairly well developed on fresh specimens (Fig. 14; CERNOHORSKY 1978: pl. 36, fig. 7; PECHAR & al. 1980: pl. 31, figs 13–14).

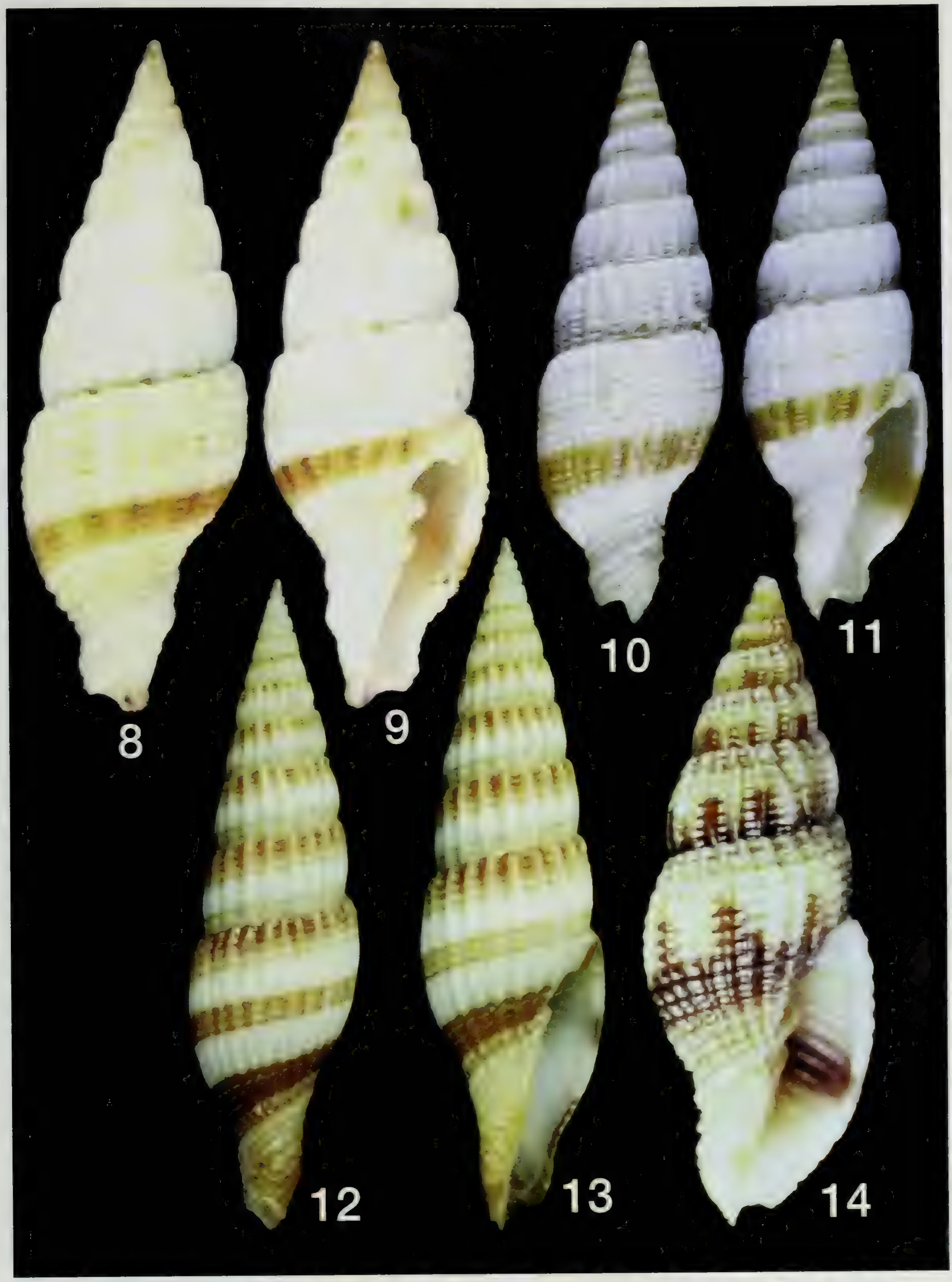
Vexillum (Costellaria) beverlyae n. sp.

Figs 15–20

Vexillum (Costellaria) festum (Reeve): PECHAR, PRIOR & PARKINSON (1980): pl. 33, figs 13 & 16 (non *Mitra festa* Reeve, 1845)

Type material. Holotype (Figs 15–16) 31.57 x 9.24 mm (aperture length 14.25 mm), taken alive by B. PARKINSON, night dive, May 1976, 21.00 hours; ex coll. Mr. Al & Mrs. B. DEYNZER, Sanibel FL, USA; deposited in ANSP (# 402019). Paratype # 1 (26.85 x 7.98 mm, aperture 11.43 mm) from Rabaul P.N.G., crabbed, in sand, depth 17 m, Febr. 1984, ex coll. Mrs. A. RICHARDS; now in coll. junior author (R. S.). Paratype # 2 (23.83 x 7.33 mm, aperture 11.25 mm) collection data as paratype # 1; deposited in BMNH (# 19990435). Paratype # 3 (21.83 x 7.27 mm, aperture 9.92 mm) collection data as paratype # 1. Paratype # 4 (25.1 x 8.2 mm, aperture 10.8 mm) from off Nordup P.N.G., ex coll. Mrs. A. RICHARDS, Nov. 1982; now in coll. Mr. J. P. LEFORT. Paratype # 5 (Figs 17–18) 24.0 x 7.5 mm (aperture 10.81 mm) from the Solomon

Figs. 8–11. *Vexillum (Costellaria) leforti* n. sp. Figs. 8–9. Holotype, ANSP #402018 (19.94 x 6.18 mm) ex coll. K. NODA; Japan, Honshu, Wakayama Pref., Kii peninsula, off Cape Kirime, in 80 m collected alive. Figs. 10–11. Paratype # 2, BMNH #19990434 (19.9 x 6.1 mm) ex coll. J. P. LEFORT; Philippines, Bohol, off Panglao Island. **Figs. 12–13.** *Vexillum (Costellaria) alvinobalani* Suduiraut, 1999, holotype, MNHN (31.7 x 18.2 mm); Philippines, Bohol, off S.W. coast of Balicasag Island, in 440–480 m. **Fig. 14.** *Vexillum (Costellaria) filistriatum* (G. B. Sowerby, II & III 1874), specimen 14.6 x 5.2 mm, coll. H. TURNER; Hawaiian Islands, Oahu Bay, Pokay Bay, dredged on sand in 75 m.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Islands, Honiara – Guadalcanal, night dive, depth 43 m, collected alive by S. YEE, Aug. 1980, in coll. Mr. G. & Mrs. B. COOK. Paratype # 6 (Figs. 19–20, light coloured specimen) 29.02 x 8.41 mm (aperture 11.94 mm) from Punta Engano, Cebu, Philippines, net fisherman; in coll. DEYNZER. Paratype # 7 (24.54 x 8.58 mm, aperture 10.78 mm) from Talvat, Rabaul P.N.G., depth 33 m, in black sand by the wall of a small drop-off; in coll. DEYNZER. Paratype # 8 (28.0 x 9.1 mm, aperture 12.8 mm) from off Nordup P.N.G., ex coll. Mrs. A. RICHARDS, Nov. 1982; now in coll. Mr. S. GORI.

Type locality. Off Nordup near Rabaul, East New Britain, Papua New Guinea, in 36 m, in dark volcanic sand on slope at bottom of a coral cliff.

Distribution and habitat. Papua New Guinea, Solomon Islands and the Philippine Islands. Live and dead specimens found at scuba depths (17 to 36 m) in dark volcanic sand in Papua New Guinea, alive in muddy sand at 43 m in the Solomons.

Etymology. Named after Mrs. Beverly DEYNZER, Sanibel FL, USA.

Description. Shell of medium size, to 31 mm in length, elongate-fusiform, acuminate. Protoconch hemi-ellipsoidal in shape, basal diameter 0.55 mm, 2 1/2 glassy white whorls. Teleoconch of adult shell with 10–12 whorls, sutures well defined, slightly stepped. Early whorls ornamented with 12–16 strong, round, evenly spaced, slightly curved axial ribs. Interstices between ribs with 4–7 deep spiral grooves, on early whorls grooves do not bisect ribs, on later whorls few spiral grooves may weakly cross crown of rib. Penultimate whorl ornamented with 18 or 19 strong, moderately curved axial ribs with narrow, smooth crowns; body whorl ornamented with 19–23 strong, moderately curved axial ribs with narrow, smooth crowns. Interstices with 7 or 8 deep, evenly spaced spiral grooves on penultimate whorl, with 18–23 spiral grooves on body whorl; anterior portion of body whorl ornamented with progressively more distinct pustulate spiral cords. Columella acuminate, with 4 slender folds decreasing in size anteriorly. Columellar fasciole with 4–7 oblique, rounded cords, some cords appearing to be a continuation of columellar folds. Aperture with a callosity on parietal side of posterior angle. Outer lip thin, simple and smooth, with noticeably undulate slight constriction at anterior portion. 7 or 8 unbroken slender lirations in interior of aperture, not extended into siphonal canal; latter narrow and relatively straight-sided, slightly recurved towards dorsum. Shell white, spire in all specimens examined totally white; body whorl white with thin, golden line at shell periphery; golden line faded and extremely hard to see in beach-worn shells; with a broad yellow-cream, golden or reddish-brown band on lower body whorl, just posterior to white (or light yellow) columellar fasciole; columella white.

Discussion. This new costellarid has been confused with *Vexillum (Pusia) festum* (Reeve, 1845) (Figs. 21–22, lectotype). It differs from that species in being much larger (adult shells 31 mm in length versus 15 mm), more slender and acuminate in shape, whorls less shouldered at the sutures, with uniform spiral grooves between close-set, evenly spaced and more slender axial ribs. Moreover, *V. beverlyae* n. sp. differs from *V. festum* by the more basal position of the brown band on the body whorl. The band of this new species occasionally being light golden-red (Figs. 19–20), rather than brown.

V. beverlyae n. sp. could also be confused with *Vexillum leforti* n. sp. (described above, Figs 8–11), but may be distinguished because the whorls of *V. beverlyae* are less rounded and are separated by only shallow sutures, the apex and early whorls are not brown but white, the brown band on the body whorl is not so narrow and sharply delimited to a zone at the posterior aperture angle, but extending much farther towards the shell base.

V. beverlyae n. sp. resembles to some degree also the recently described *Vexillum alvinobalani* Suduiraut, 1999 (Figs 12–13). It differs from that species mainly by a less coarse sculpture, spiral cords not over-riding the axial ribs, and by the colour pattern lacking broad brown sub-sutural and peripheral bands.

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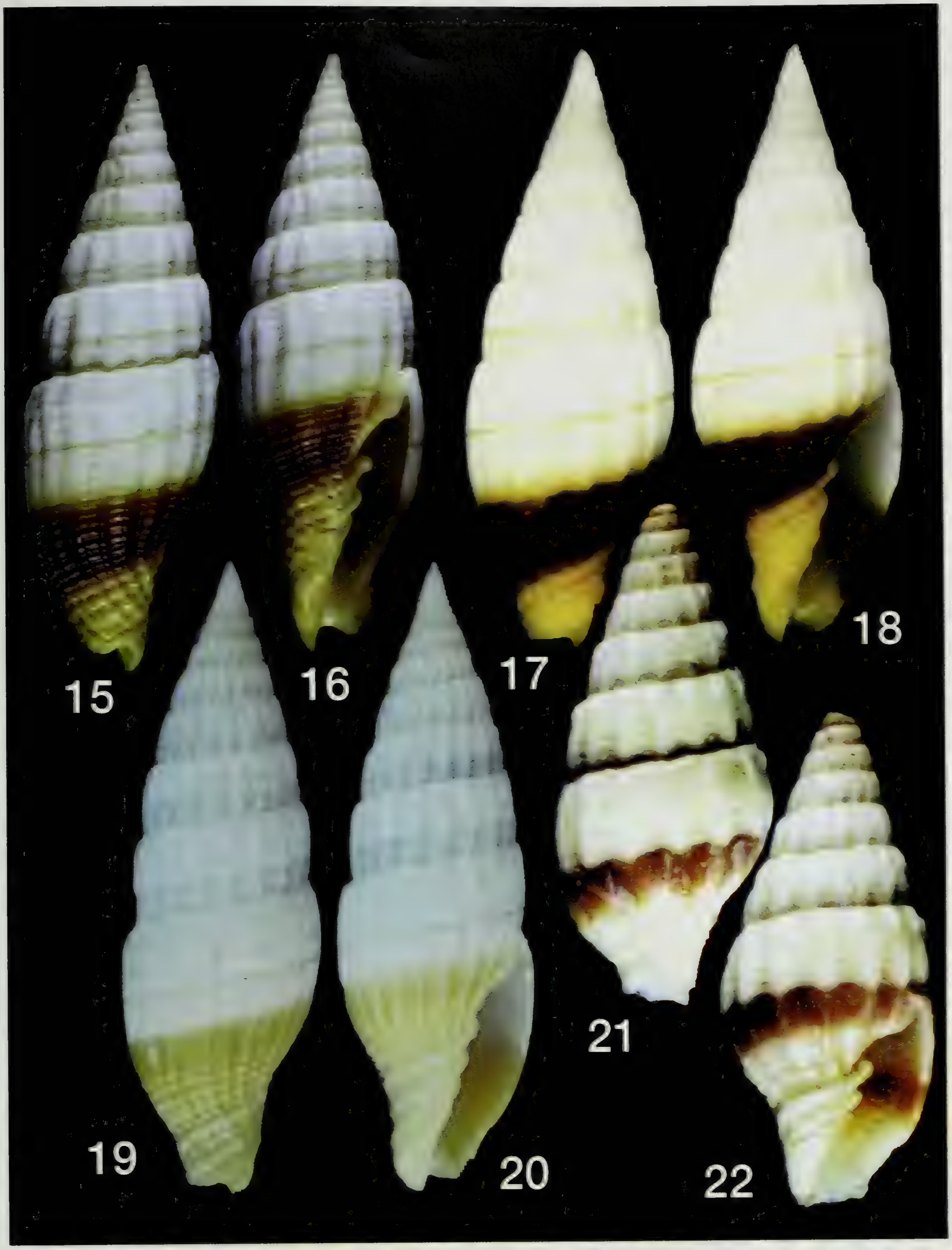
Figs. 15–20. *Vexillum (Costellaria) beverlyae* n. sp. Figs. 15–16. Holotype, ANSP #402019 (31.57 x 9.24 mm); Papua New Guinea, East New Britain, off Nordup, 36 m depth, collected alive by B. PARKINSON, night dive, May 1976, 21.00 hours. Figs. 17–18. Paratype #5 (24.0 x 7.5 mm) coll. G. & B. COOK; Solomon Islands, Honiara – Guadalcanal, depth 43 m, collected alive by S. YEE, night dive, Aug. 1980. Figs. 19–20. Paratype # 6 (29.02 x 8.41 mm, light coloured specimen) coll. DEYNZER; Philippines, Cebu, Punta Engano, net fisherman. **Figs. 21–22.** *Vexillum (Pusia) festum* (Reeve, 1845). Lectotype of *Mitra festa* Reeve, BMNH #1967756 (11.0 x 4.6 mm); Philippines, Island of Mindoro, Puerto Galero.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CALLOMON (Osaka, Japan), Mrs. Bunnie COOK & Mr. George COOK (Honolulu HI), Mrs. Beverly DEYNZER & Mr. Al DEYNZER (Sanibel FL), Mr. Sandro GORI(Livorno, Italy), Mr. Jean Paul LEFORT (Huahine, French Polynesia), Mr. Markus LUSSI (Durban, South Africa), Mr. Maxwell P. MARROW (Hampton, Victoria, Australia), Mr. Jean Claude MARTIN (Saint Denis, Réunion), Mr. Kazutaka NODA (Gobo Town, Japan) and Mr. Emmanuel Guillot de SUDUIRAUT (Lapu Lapu City, Cebu, Philippines). Our special thanks are due to Dr. Gary ROSENBERG (Academy of Natural Sciences, Philadelphia, PA) who was instrumental in obtaining material of new species from Japan and helped on early versions of the *V. nodai* description.

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Review of the Indo-West Pacific species of *Haustellum* Schumacher, 1817 and comments on *Vokesimurex* Petuch, 1994 (Gastropoda: Muricidae) with the description of *H. bondarevi* n.sp.

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KEYWORDS. Gastropoda, Muricidae, *Haustellum*, *Vokesimurex*, Indo-West Pacific.

ABSTRACT. Eight Recent species and two subspecies are included in *Haustellum*. The species are described and discussed. A new species, *Haustellum bondarevi* n. sp. is described from Saya de Malha Bank, Western Indian Ocean. Fourteen species and three subspecies from the Indo-West Pacific are included in *Vokesimurex* Petuch, 1994.

RESUME. Huit espèces et deux sous-espèces récentes sont incluses dans le genre *Haustellum* Schumacher, 1817. Les espèces sont décrites, commentées et comparées. *Haustellum bondarevi* n. sp. est décrit du Banc Saya de Malha, Océan Indien Occidental. Quatorze espèces et trois sous-espèces actuelles de l'Indo-Ouest Pacifique sont incluses dans *Vokesimurex* Petuch, 1994.

INTRODUCTION

Since the revision of *Murex* s.s. and *Haustellum* (PONDER & VOKES, 1988), I examined many Recent specimens belonging to *Haustellum*, and analyzed recent literature (VOKES, 1990, PETUCH, 1994, PARTH, 1995). In a previous paper (HOUART, 1990), the genus *Haustellum* (*sensu* PONDER & VOKES, 1988) was considered to be divided into two groups: the group of *Haustellum haustellum* (Linnaeus, 1758), characterized by a globose, and spineless last teleoconch whorl, rounded varices, large, roundly-ovate aperture, without labral tooth, with a raised peristome and projecting inner lip, and a long, slender, often spineless, or almost spineless, siphonal canal ; and another group including species without labral tooth but more similar in appearance to species of *Murex* s.s. or *Siratus* Jousseaume, 1880.

Haustellum, and particularly *H. haustellum* has been studied and discussed by several authors (VOKES, 1971, 1990, FAIR, 1976, RADWIN & D'ATTILIO, 1976, KOSUGE, 1980, PONDER & VOKES, 1988, HOUART, 1990, HOUART, 1993, PARTH, 1995). PARTH (1995) considered "all the various populations scattered throughout the Indo-Pacific parts of just one species" (i.e. *Haustellum haustellum*). He mentioned the work of PONDER & VOKES (1988), who considered the various populations to be a form of a single species, and HOUART (1990, 1993) who splits *H. haustellum* into no less than seven species (*H. haustellum*, *H. longicaudum*, *H. fallax*, *H. kurodai*, *H. vicdani*, *H. barbieri*, and *H. langleitae*).

The problem will perhaps not be definitively resolved, but at least I hope to show that more than one species is involved in this group of gastropods.

MATERIAL

Hundreds of specimens have been examined throughout many years from BMNH, IRSNB, MNHN, private collections, and the author's collection. No extensive list of material is given.

RESULTS

Genus : *Haustellum* Schumacher, 1817

I. There is no known case of poecilogony (different larval development in a same species) in Prosobranchia, so that a single species will not have shells with a multispiral (planktotrophic) protoconch together with specimens with a paucispiral (non-planktotrophic) protoconch (BOUCHET, 1989; HOAGLAND & ROBERTSON, 1988). A planktotrophic protoconch is characterized by the presence of a protoconch I, with a small diameter, followed by a protoconch II, ending with a sinusigeral notch (terminal varix of sinusigera type). A non-planktotrophic protoconch is characterized by the absence of protoconch I/protoconch II discontinuity, and by the larger diameter of the first protoconch whorl, than in planktotrophic species.

As a first conclusion, *Haustellum haustellum* (Figs 23-26) may be separated from any other species of *Haustellum*.

II. The microsculpture of the protoconch whorls is another valuable tool for species separation [many personal observations; P. Middelfart (in litt.); SABELLI & TOMMASINI, 1982], so that, once more, *H. haustellum* may be separated from any other species of *Haustellum* (Fig. 26). The protoconch of *H. longicaudum* is also different from the other species by its particular microsculpture, consisting of numerous, small pustules (Fig. 43), which are smaller than in *H. haustellum*, and by its broad, irregularly shaped, protoconch.

One of the examined juvenile specimens of *H. langleitae* has very few, sporadic, small pustules on the last whorl, close to the terminal varix; all other examined specimens of *H. langleitae* have smooth protoconchs.

To my knowledge, the microsculpture of the protoconch of *Haustellum* has never been observed in any other species of *Haustellum*. However, microsculpture has been observed in *Vokesimurex* (BANDEL, 1975).

III. Three species have a protoconch with the characteristic morphology of intracapsular metamorphosis (few whorls, broad, irregular shape): *H. longicaudum*, *H. fallax*, and *H. wilsoni*. However, the protoconch of *H. longicaudum* has a keeled last whorl, ornamented with microsculpture, while those of *H. fallax* and *H. wilsoni* are smooth.

Species with intracapsular larval development have a restricted geographical distribution. *H. longicaudum* is indeed restricted to the southern part of the Red Sea and adjacent localities, *H. fallax* seems to live only from Durban, South Africa, to southern Mozambique, and *H. wilsoni* is known from a small area off West Australia.

After having separated *H. haustellum*, *H. longicaudum*, *H. fallax*, and *H. wilsoni*, we still have a group consisting of *H. barbieri*, *H. franchii*, *H. langleitae*, *H. kurodai*, and *H. vicdani*.

H. franchii and *H. barbieri* can be clearly separated from the other species by their teleoconch characters (see description and Table 1). *H. langleitae*, *H. kurodai*, and *H. vicdani* are somewhat similar, although having different teleoconch characters. The protoconch morphology of *H. vicdani* is not known, but both *H. langleitae* and *H. kurodai* have a rounded protoconch of 2-2.5 whorls. These three taxa appear to have a different geographical distribution (Fig. 14).

At first sight the three taxa differ in teleoconch morphology but it would be useful to observe specimens (if any) from adjacent and intermediate localities to fill the gaps between the different geographical distributions.

- If these forms are sympatric, then they may be considered at a specific level.

- If each form is isolated, then two solutions are conceivable:

  * There are three different species, clearly separated by natural barriers and teleoconch characters.

  * There is one species with two morphologically divergent local populations (subspecies).

Currently, having these forms geographically separated as three distinct populations (Fig. 14), I will use trinominal nomenclature.

List of (sub)species: *H. barbieri* Houart, 1993
H. bondarevi n. sp.
H. fallax (Smith, 1901)
H. franchii Bozzetti, 1993
H. haustellum (Linnaeus, 1758)
H. kurodai kurodai (Shikama, 1964)
  H. k. vicdani Kosuge, 1980
  H. k. langleitae Houart, 1993
H. longicaudum (Baker, 1891)
H. wilsoni D'Attilio & Old, 1971

Genus : ***Vokesimurex*** Petuch, 1994

PETUCH (1994) introduced *Vokesimurex*, for the American long-canalled "*Murex*" species without labral tooth like *Murex messorius* Sowerby, 1841, included in *Haustellum* by PONDER & VOKES (1988). He observed that *Vokesimurex* lived together with true *Haustellum* species in the Pliocene. *Haustellum* s.s. became extinct in the Americas by the beginning of the Pleistocene, but survives in the Indo-West Pacific. *Vokesimurex* appears to be a younger group than *Haustellum* s.s., and is known in the western Atlantic and the Eastern Pacific.

These considerations, personal observations, and clear similarities in shell and radula morphology (Figs 1-2, 3-8) between the West Atlantic and East Pacific *Vokesimurex* and Indo-West Pacific *Murex*-like species without labral tooth, have led me to consider the following Indo-West Pacific species as belonging to *Vokesimurex* :

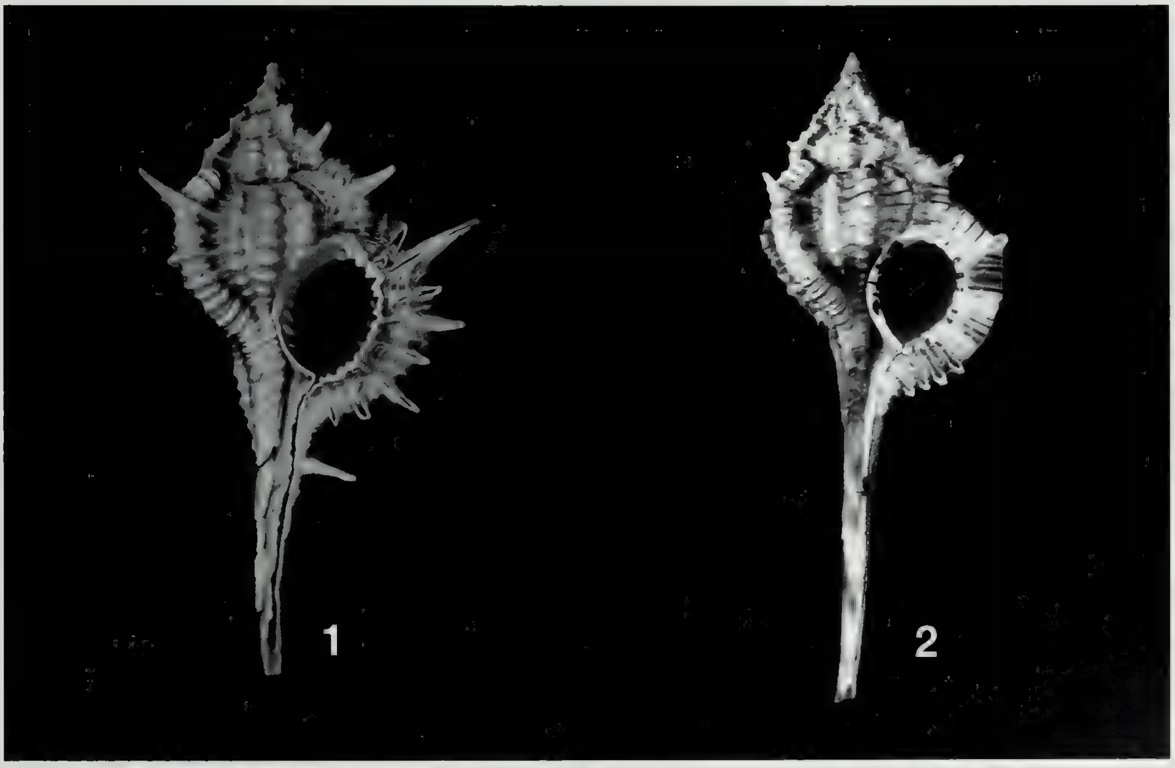
V. bobyini (Kosuge, 1983)
V. dentifer dentifer (Watson, 1883)
  V. dentifer coriolis (Houart, 1990)
V. danilai (Houart, 1992)
V. dolichourus (Ponder & Vokes, 1988)
V. gallinago gallinago (Sowerby, 1903)
  V. gallinago fernandesi (Houart, 1990)

V. hirasei (Dautzenberg in Hirase, 1915)
V. kiiensis (Kira, 1959)
V. malabaricus (E. A. Smith, 1894)
V. mindanaoensis (Sowerby, 1841)
V. multiplicatus multiplicatus (Sowerby, 1895)
  V. multiplicatus bantamensis (Martin, 1895)
V. purdyae (Radwin & D'Attilio, 1976)
V. rectirostris (Sowerby, 1841b)
V. sobrinus (A. Adams, 1863)
V. tweedianus (Macpherson, 1962)

As stated in PONDER & VOKES (1998: 13), this group of species also have similarities with *Siratus* Jousseaume, 1880. They suggest that the group must have evolved from *Siratus* well before the appearance of *V. messorius* because *V. messorius* has a paucispiral protoconch whereas some Recent Indo-Pacific species have a multispiral protoconch. However, some Indo-Pacific species, i.e *V. dentifer*, *V.rectirostris*, *V. sobrinus*, *V. tweedianus*, and others, also have a paucispiral protoconch of 1.5 – 1.75 whorls as in the West Atlantic species.

Radula.

The radula of both *Haustellum* and *Vokesimurex* are typical muricine, consisting of a sickle shaped, unicuspid lateral tooth on each side, and of a rachidian tooth with a long central cusp, small lateral denticles, and long lateral cusps. No intermediate denticles were ever observed in any radula studied.



Figs. 1-2. (Rem: All specimens in the figures are in the coll. R. Houart, unless stated). Fig. 1. *Vokesimurex olssoni* (Vokes, 1967). Oregon, stn 4896, holotype USNM 67704, 52 mm. Shell whitened. Photo courtesy E.H. Vokes. Fig. 2. *V. dolichourus* (Ponder & Vokes, 1988). South Africa, Zululand, NM E4416, 67.1 mm.

Character	***H. haustellum***	***H. longicaudum***	***H. fallax***
Protoconch (see Figs 23-26, 42-48, 54)	Conical, keeled, with 2.25-2.75 whorls. Last whorl with micro sculpture. Terminal varix of sinusigera type. Very regular in shape. Planktotrophic larval development.	Irregular, broad, 2-2.5 whorls. Last whorl keeled, with micro sculpture. Strong, high carina. The form and breadth of the protoconch is typical for intracapsular development	Rounded, with 1.5-2.25 broad, smooth whorls. No micro sculpture. Twice the size of the protoconch of *H. haustellum*. Most probably intracapsular larval development, relative to the size, and the form of the protoconch. Terminal varix high, broad.
Number of spiral threads on first teleoconch whorl	4	4	5-6
Last teleoconch whorls	Broad, rounded, with 3 or 4 axial nodules. Spiral sculpture of numerous, regular threads. Aperture pink.	Broad, rounded, 3 or 4 low axial nodules. Spiral sculpture of numerous, shallow threads. Aperture white.	Broad, angulate, with 2 or 3 high, broad axial nodules. Spiral sculpture of numerous, shallow, low threads (fewer than in *H. haustellum, H. langleitae* and *H. longicaudum*). Aperture white.
Siphonal canal	Usually without spines, rarely with small, short spinelets at the base.	Smooth.	With short, weakly adapically curved spines on the base.

Character	***H. kurodai kurodai***	***H. kurodai langleitae***	***H. kurodai vicdani***
Protoconch (see Figs 23-26, 42-48, 54)	Rounded, with 2-2.25 smooth whorls. Terminal varix high. Similar to *H. fallax* but relatively smaller.	Cylindrical or rounded, with 2-2.5 smooth whorls.	Examined protoconch partly broken. Whorls rounded, smooth. Apparently no micro sculpture.
Number of spiral threads on first teleoconch whorl	3-4	3	4
Last teleoconch whorls	Broad, angulate, with 3 or 4 narrow axial nodules. Spiral sculpture of numerous, shallow, low threads, fewer than in *H. haustellum*, *langleitae* and *longicaudum*. Aperture white or light pink.	Broad, rounded or angulate, with 2-4, occasionally broad, high axial nodules. Spiral sculpture of numerous, shallow, low, irregular threads. Aperture yellow or pink.	Broad, angulate or rounded, with 3 or 4 axial nodules. Spiral sculpture of numerous, shallow threads, more apparent than in *kurodai* or *fallax*. Aperture light orange or yellowish.
Siphonal canal	Adapically curved small spines on the base.	Smooth.	Smooth.

Table 1. Comparison of four species of *Haustellum*.

SYSTEMATICS

Family **MURICIDAE** Rafinesque, 1815
Subfamily **Muricinae** Rafinesque, 1815
Genus ***Haustellum*** Schumacher, 1817

Type species (by tautonomy) *Murex haustellum* Linnaeus, 1758, Recent, Indo-West Pacific.

Brontes Montfort, 1810 (not Fabricius, 1801)

Brontesia Reidenbach, 1828 (new name for *Brontes* Montfort, 1810)

Haustellaria Swainson, 1833

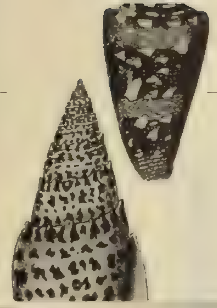
Distribution.

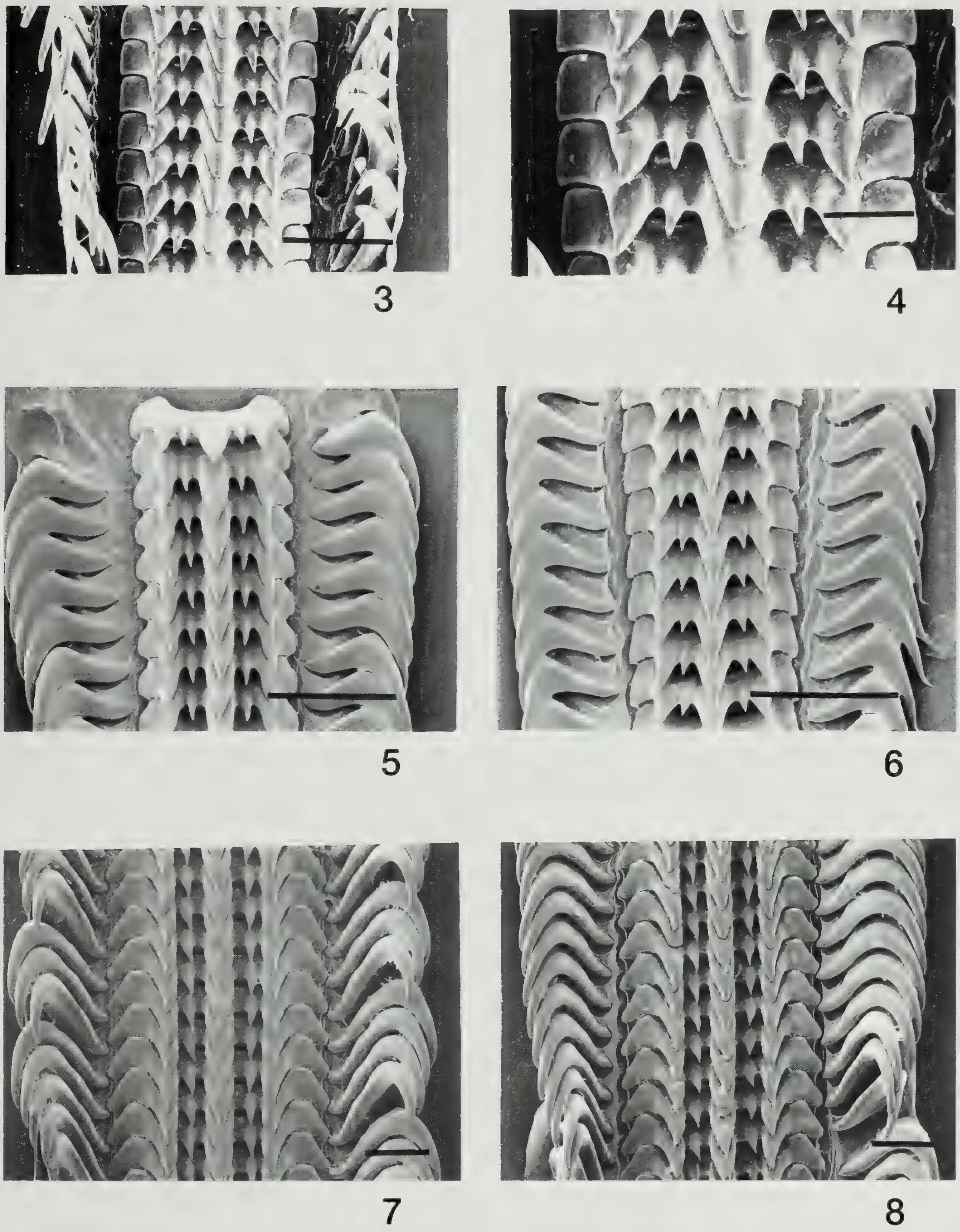
Throughout the tropical and subtropical Indo-West Pacific.

Description.

Shell medium-sized to relatively large, up to 165 mm in length. Last teleoconch whorl globose, rounded. Axial sculpture of last teleoconch whorl consisting of 3, usually high, rounded, spineless varices.

Aperture rounded, large. Outer lip crenulate, erect, without labral tooth. Columellar lip strongly projecting, flaring, weakly adherent adapically, otherwise erect.





Figs. 3-8. Radulae of *Haustellum*, and *Vokesimurex* species (scale bars: 100 µm). Figs. 3-4. *Vokesimurex dentifer coriolis* (Houart, 1990) (New Caledonia) (Fig. 4: scale bar 50 µm). Fig. 5. *V. dolichourus* (Ponder & Vokes, 1988) (Madagascar). Fig. 6. *V. olssoni* (Vokes, 1967) (Colombia). Figs. 7-8. *Haustellum haustellum* (Linnaeus, 1758) (New Caledonia).

Siphonal canal long to very long (52-73 % of total shell length), straight, narrowly open, smooth or occasionally with 1 or 2 small spines adaperturally.

Haustellum barbieri Houart, 1993
Figs 9, 40-41, 55

Haustellum barbieri Houart, 1993: 147, figs 6-9.

Protoconchs examined: Off Madagascar (3 specimens) (private collections).

Distribution.

The species is known in the vicinity of the type locality: Sainte-Marie (Nosy-Boraha), Madagascar, 30-35 m.

Description.

Shell up to 90 mm in length with 7 teleoconch whorls; protoconch smooth, consisting of 1 ½ whorls. Axial sculpture of last teleoconch whorl with 3 low, rounded, nodose, spineless varices. Other axial sculpture of 4 nodose ribs and numerous narrow, nodose, irregular threads. Spiral sculpture of 8 low, tuberculate cords and numerous threads. Aperture broad, rounded. Outer lip weakly crenulate, erect, smooth within. Columellar lip smooth, strongly raised, adherent adapically.

Siphonal canal long, spineless, straight, open.

Pinkish-brown with darker blotches on spiral cords and lighter coloured axial threads. Aperture glossy white.

Remarks.

Haustellum barbieri differs markedly from the other species of the genus by its colour and sculpture. All specimens known to date come from Madagascar.

Haustellum bondarevi n.sp.
Figs 10, 49-51

Material Examined.

Western Indian Ocean, Saya de Malha Bank, approximately 10°30' S, 60°00' E, holotype MNHN (79 mm) and paratype coll. R. Houart (60 mm); NE part of lagoon, 40-45 m, paratype coll. I. Bondarev [1] (101.2 mm).

Protoconchs examined: Paratype I. Bondarev (partially broken); paratype R. Houart.

Distribution.

Indian Ocean, Saya de Malha Bank, 40-45 m.

Description.

Shell medium sized for the genus, up to 101.2 mm in length at maturity, heavy, nodose. Spire high with 2.25 protoconch whorls and 7 broad, rounded, nodose teleoconch whorls. Suture impressed. Protoconch small, whorls rounded (weakly eroded in examined specimen); terminal varix high, weakly convex.

Axial sculpture of teleoconch whorls consisting of rounded, nodose, broad ribs on first to third whorl: 11 ribs on first whorl, 12 on second, 13 on third; fourth and fifth whorl with 3 strongly abaperturally excavated varices and 3 intervarical ribs; sixth and seventh whorl with three varices and 4 or 5 intervarical ribs. Varices more prominent at the intersection of spiral cords and threads, giving a strongly nodose sculpture. Spiral sculpture of low, narrow, nodose cords, and threads: 3 cords and one shoulder thread from first to third whorl, 3 cords and 2 shoulder threads on fourth whorl, 3 cords with 1 thread between each pair, and 2 shoulder threads on fifth and sixth whorl, last whorl with 5 cords, 2-3 threads between each pair, and 2 shoulder threads.

Aperture large, roundly-ovate; columellar lip narrow, strongly flaring, smooth with small parietal tooth at adapical end; lip strongly erect, adherent at adapical small portion; anal notch narrow, constricted, deep; outer lip erect, crenulate, with 12 or 13 weak lirae within. Siphonal canal long, narrow, straight, narrowly open, with 7 or 8 strong spiral cords adapically, almost smooth abapically.

Protoconch and first whorls creamy-white or light brown, other whorls white. Last whorl with three light orange or light brown bands, more apparent on varices. Single orange band on previous whorls. Light orange or light brown tinge on spiral cords of siphonal canal, and on columellar and outer apertural edges.

Operculum and radula unknown.

Remarks.

H. bondarevi differs from *H. barbieri* in having a more rounded last teleoconch whorl, a smaller aperture, narrower varices and axial ridges, a narrower siphonal canal, in lacking the wrinkled micro-sculpture, and in having a narrow, constricted anal notch relatively to the broad notch in *H. barbieri*. From *H. longicaudum*, *H. bondarevi* differs in its more nodose sculpture, narrower siphonal canal, more numerous axial intervarical ridges (4 or 5 vs 3 or 4) and deep narrow, constricted anal notch, relatively to the more shallow, broad, bell-shaped notch in *H. longicaudum*. From *H. franchii* it differs in having a higher spire, more numerous spiral cords on spire whorls, a more nodose shell, a constricted anal notch, and a different colour,

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[1] Fadeev Str., 21-B, fl. 17, Sevastopol 335038, Crimea, Ukraine

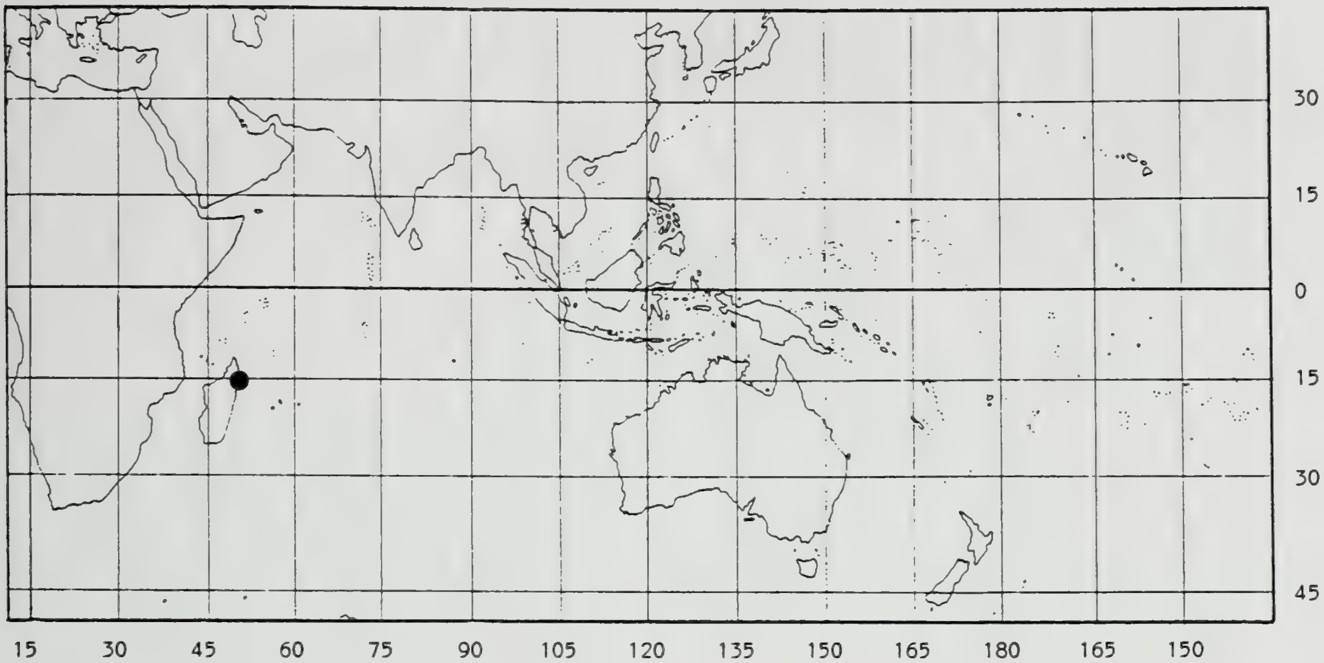

Fig. 9. Distribution of *Haustellum barbieri*.

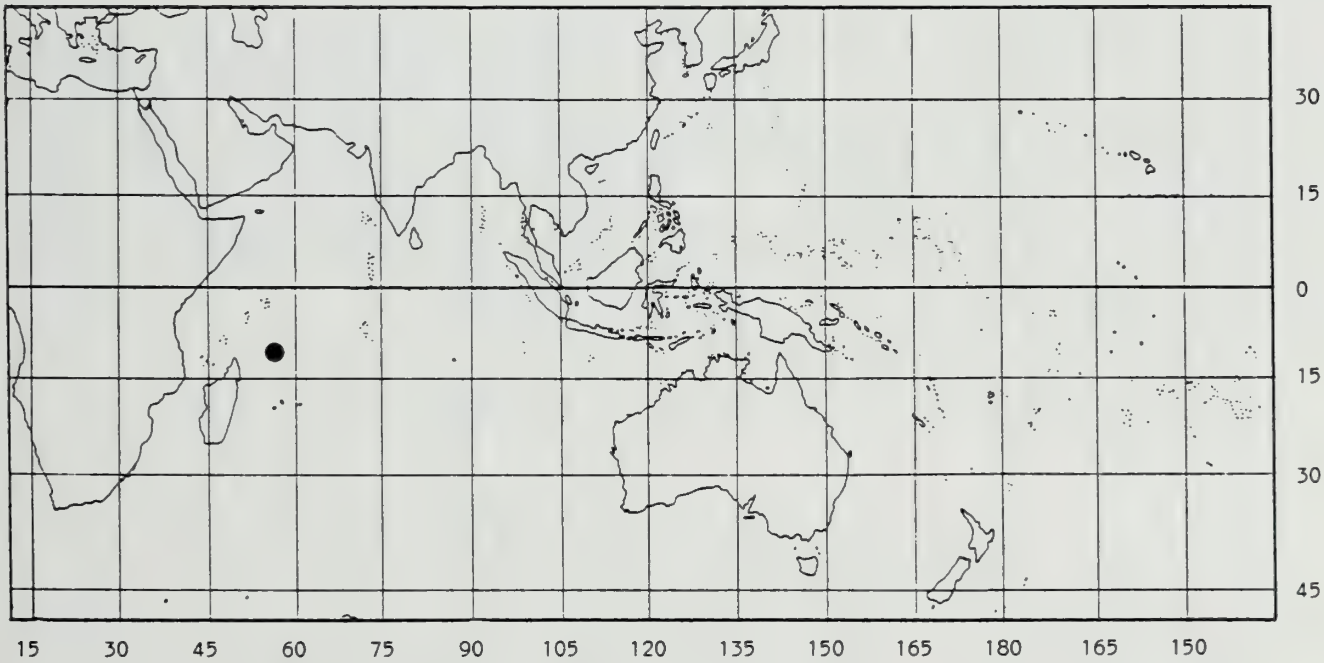

Fig. 10. Distribution of *Haustellum bondarevi*

H. franchii having particular reddish-brown spiral threads, and a pure white aperture.

Other Mollusca with non-planktotrophic larval development are apparently endemic to Saya de Malha Bank (BOUCHET & BAIL, 1991, OKUTANI, 1991, HOUART, 1992)

Etymology.

Named after Igor Bondarev, Sevastopol, Ukraine, who discovered, and donated the type material.

Haustellum fallax (Smith, 1901)
Figs 11, 20-22, 54

Murex fallax Smith, 1901: 113, pl. 1, fig. 9.

Protoconchs examined: S. Africa, off Natal (1 sp.); Mozambique, off Quissico (1 sp.); Mozambique, Zavora Pt (1 sp.) (Coll. R. Houart), Mozambique (2 sp.) (private coll.).

Distribution.

Durban, South Africa (type locality) to Zavora Point, Mozambique, 40-175 m.

Description.

Shell up to 95 mm in length with 1.5-2.25 protoconch whorls and 6 teleoconch whorls. Protoconch globose, smooth. Whorls rounded.

Axial sculpture of last teleoconch whorl consisting of 3 moderately high, rounded, spineless varices. Other axial sculpture of 3 high, strong ribs. Spiral sculpture of numerous, weak, smooth, shallow threads.

Aperture broad, rounded; outer lip weakly crenulate, smooth within. Columellar lip smooth, strongly raised, adherent adapically.

Siphonal canal long, with a single, acute, short spine adaperturally.

Light tan to light brown with some darker coloured blotches. Aperture glossy white.

Remarks.

Haustellum fallax was considered a subspecies of *H. haustellum* by PONDER & VOKES (1988). It is rarely seen in collections but it is much appreciated due to its scarcity and beauty. *H. fallax* is one of the three *Haustellum* species with probable intracapsular metamorphosis, but the teleoconch characters are almost invariable, and obviously different from the two other species, *H. longicaudum* and *H. wilsoni* (see also Table 1).

Haustellum franchii Bozzetti, 1993
Figs 12, 52-53

Haustellum franchii Bozzetti, 1993: 107, figs 1, 2.

Protoconchs examined: paratype (coll. R. Houart), and original description.

Distribution.

Ras Hafun, Somalia, 200-250 m.

Description.

Shell up to 67 mm in length, with 1.5-2 protoconch whorls and 6 teleoconch whorls. Protoconch globose, smooth, whorls rounded.

Axial sculpture of last teleoconch whorl consisting of 3 high, rounded, spineless varices. Other axial sculpture of 4 or 5 high, narrow, rounded ribs. Spiral sculpture of numerous, weak, smooth threads.

Aperture broad, rounded. Outer lip weakly crenulate, with 13-15 elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically.

Siphonal canal long, open, spineless.

Creamy-white with dark brown or reddish-brown spiral threads. Aperture white.

Remarks.

Haustellum franchii differs markedly from *H. haustellum* in having a white aperture, in the colour of the shell and different protoconch (rounded and smooth, with 1.5-2 whorls in *H. franchii* while conical, minutely punctate, with 2.25-2.75 whorls in *H. haustellum*) . It differs from *H. longicaudum* and *H. fallax*, both known from the western Indian Ocean, in its more rounded shell contour, weaker axial cords, and apertural lirations.

Haustellum haustellum (Linnaeus, 1758)
Figs 7-8, 13, 17-19, 23-26

Murex haustellum Linnaeus, 1758: : 746.

Murex scolopaceus Röding, 1798: 144 (ref. to Favanne, 1784).

Aranea denudata Perry, 1811: pl. 45, fig. 1.

Haustellum laevae Schumacher, 1817: 213 (ref. to Martini, 1777).

?*Murex erythrostoma* Swainson, 1840: 296 (non *Murex erythrostomus* Swainson, 1831).

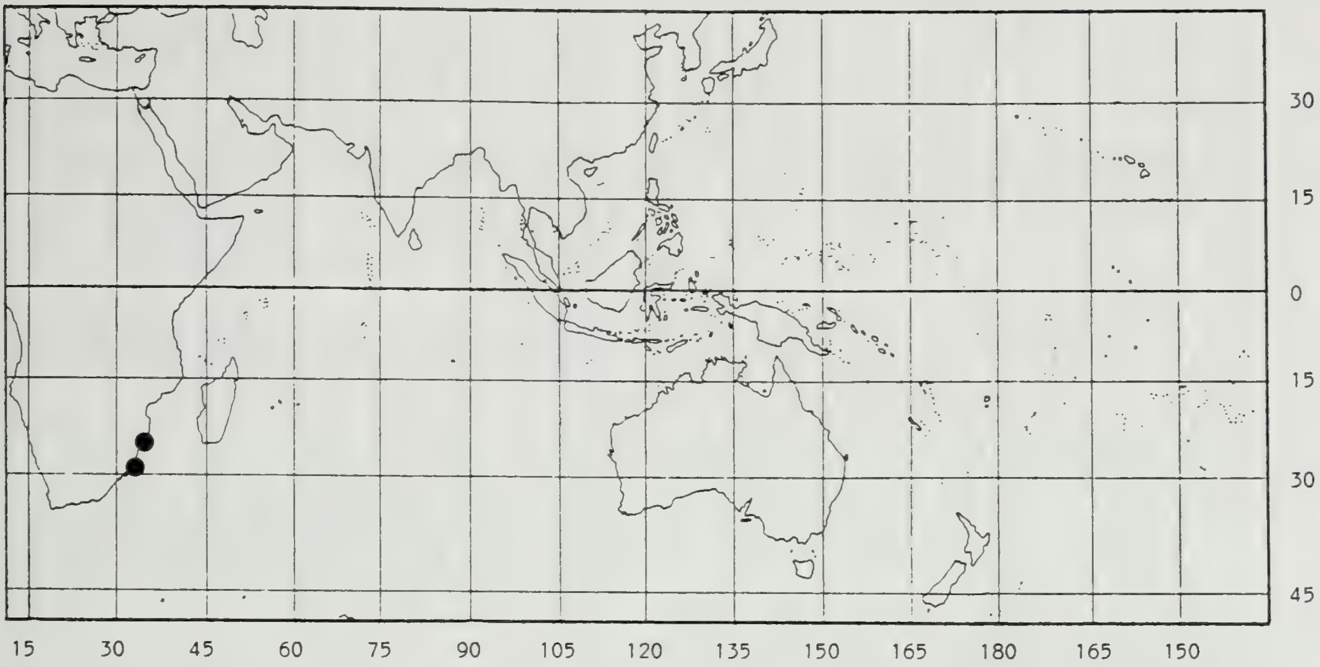

Fig. 11. Distribution of *Haustellum fallax*.

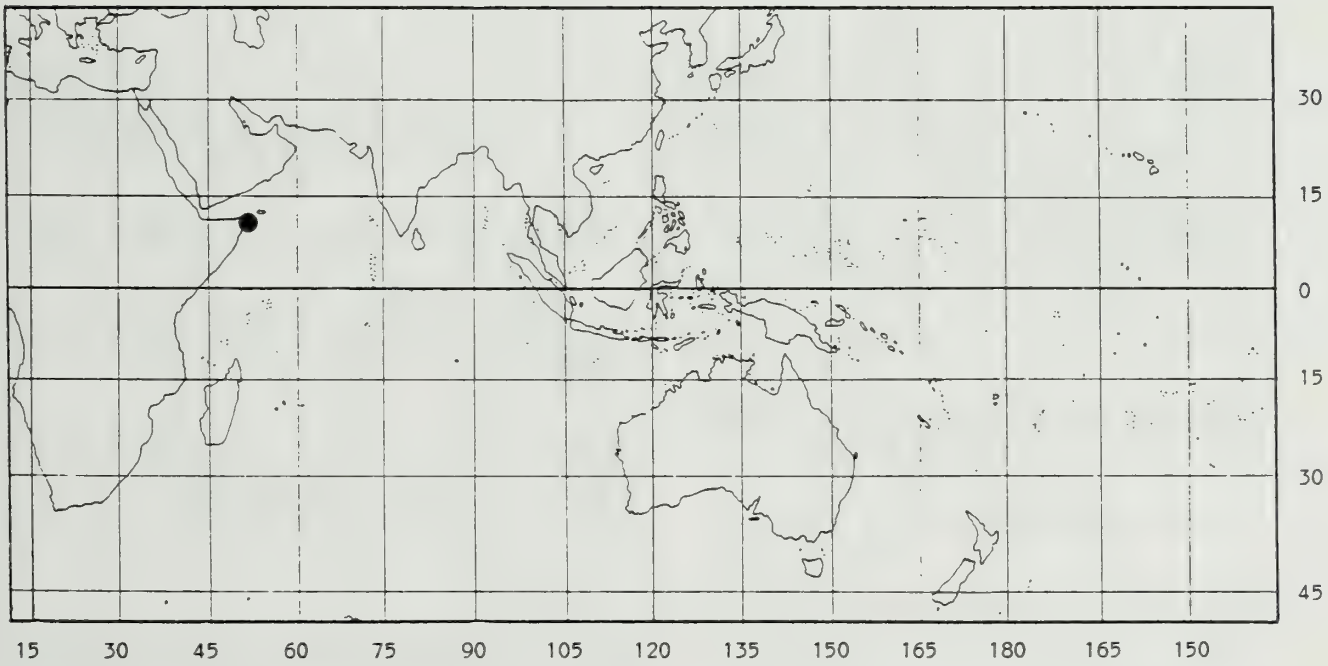

Fig. 12. Distribution of *Haustellum franchii*.

Protoconchs examined: Papua New Guinea, and Philippines (many specimens) (Coll. R. Houart, and private coll.)

Distribution.

Singapore, throughout the Philippines, Taiwan, Ryukyus, Papua New Guinea, Solomon Islands, North Queensland, New Caledonia, and Fiji.

Description.

Shell up to 165 mm in length with 2.25-2.75 protoconch whorls and 8 teleoconch whorls.

Protoconch weakly conical, last whorl minutely punctate, with spiral keel abapically.

Axial sculpture of last teleoconch whorl consisting of 3 moderately high, rounded, spineless varices. Other axial sculpture of 3 or 4 low, weakly rounded, nodose ribs, crossed by low, weak, smooth primary and secondary spiral threads.

Aperture broad, rounded. Outer lip weakly crenulate, erect, with weak elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically.

Siphonal canal long, straight, open, smooth or occasionally with small spinelets adaperturally.

Creamy-white to light brown with dark brown or reddish-brown spiral threads, and 3 dark brown to bluish-brown blotches on varices. Aperture apricot or pale pink.

Remarks.

Haustellum haustellum is a common species with globose body whorl and long, usually spineless siphonal canal. *H. longicaudum*, *H. kurodai kurodai*, and *H. k. vicdani* Kosuge, 1980 have been tentatively synonymised by PONDER & VOKES (1988: 86) and *H. fallax* was synonymised in RADWIN & D'ATTILIO (1976: 49). *H. haustellum* is separated here on basis of morphological differences in shell structure and type of larval development. *H. haustellum* is the most common species of the genus.

Haustellum kurodai kurodai (Shikama, 1964)

Figs 14, 35-37, 47-48

Murex kurodai Shikama, 1964: 33, pl. 3, figs 1, 2.

Protoconchs examined: Philippines, Siasi Id (2 sp.) (Coll. R. Houart), and a few specimens in private coll.

Distribution.

The Arafura Sea and the Philippine Islands (Sulu Sea and Zamboanga).

Description.

Shell up to 93 mm in length with 2-2.25 protoconch whorls and 7 teleoconch whorls. Protoconch globose, smooth, glossy, whorls rounded.

Axial sculpture of last teleoconch whorl consisting of 3 narrow, high, nodose, almost spineless varices, each with occasionally 1 acute, short spine on shoulder. Other axial sculpture of 3 or 4 nodose ribs. Spiral sculpture of 4 or 5 weak, tuberculate cords, more apparent on axial ribs, and numerous, low, smooth lirae between cords.

Aperture broad, rounded. Outer lip crenulate, with numerous, weak elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically.

Siphonal canal long, straight, open, with a single, acute, short spine adaperturally.

Creamy-white with light to dark brown blotches on varices, axial ribs and siphonal canal. Occasionally occurs with darker coloured shoulder and/or siphonal canal or darker coloured teleoconch whorls. Aperture white, light peach or light pink.

Remarks.

Haustellum k. kurodai is here separated from *H. haustellum* in having a different protoconch (rounded and smooth in *H. k. kurodai* while conical, minutely punctate, with 2.25-2.75 whorls in *H. haustellum*) (Figs 47-48), a more fragile and lighter shell with lower spire, more shouldered teleoconch whorls, narrower varices, small spines on the siphonal canal. It is also usually smaller. For other remarks see Table 1.

Haustellum kurodai langleitae Houart, 1993

Figs 14, 27-32, 45-46

Haustellum langleitae Houart, 1993: 145, figs 5, 10-12.

Protoconchs examined: Mozambique, Nacala (3 sp.); Madagascar (1 sp.) (Coll. R. Houart), and a few specimens in private coll.

Distribution.

Tulear, Madagascar, Mozambique, Tanzania, Pakistan, India, Sri Lanka, SW Java, West Sumatra.

Description.

Shell up to 94 mm in length with 2-2.5 protoconch whorls and 8 teleoconch whorls. Protoconch smooth, high, weakly shouldered.

Axial sculpture of last teleoconch whorl consisting of 3 rounded, strong, spineless varices. Other axial sculpture of 2 or 3 strong ribs. Spiral sculpture of

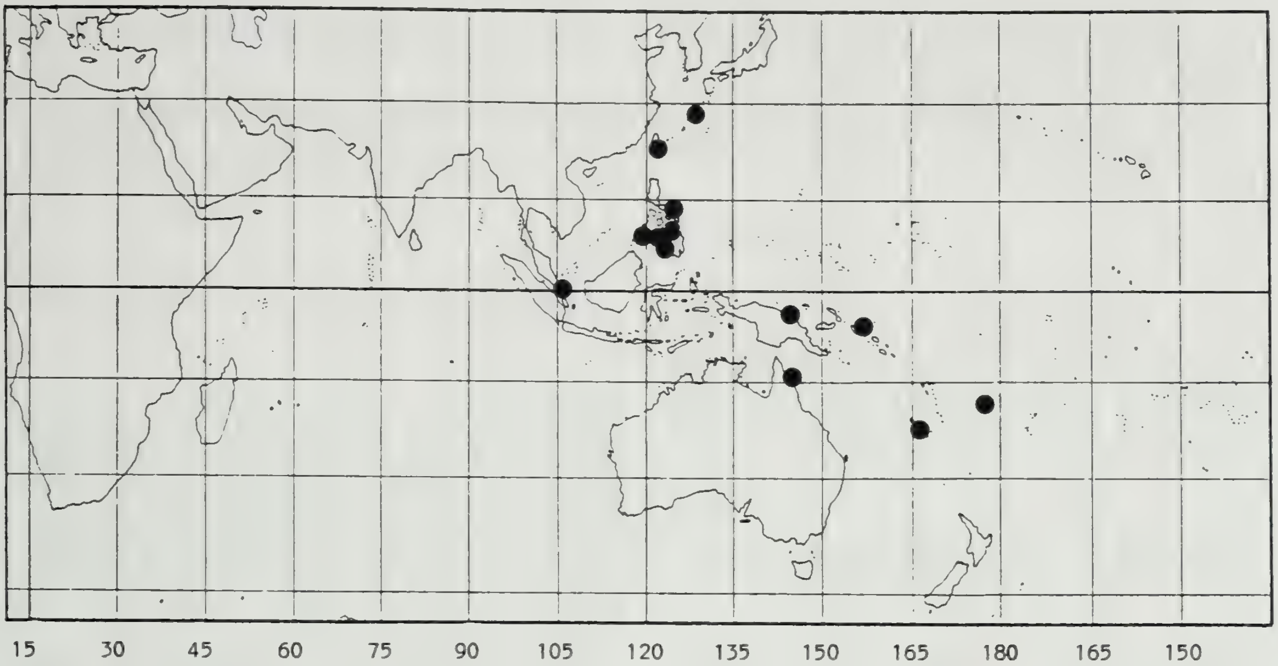

Fig. 13. Distribution of *Haustellum haustellum.*

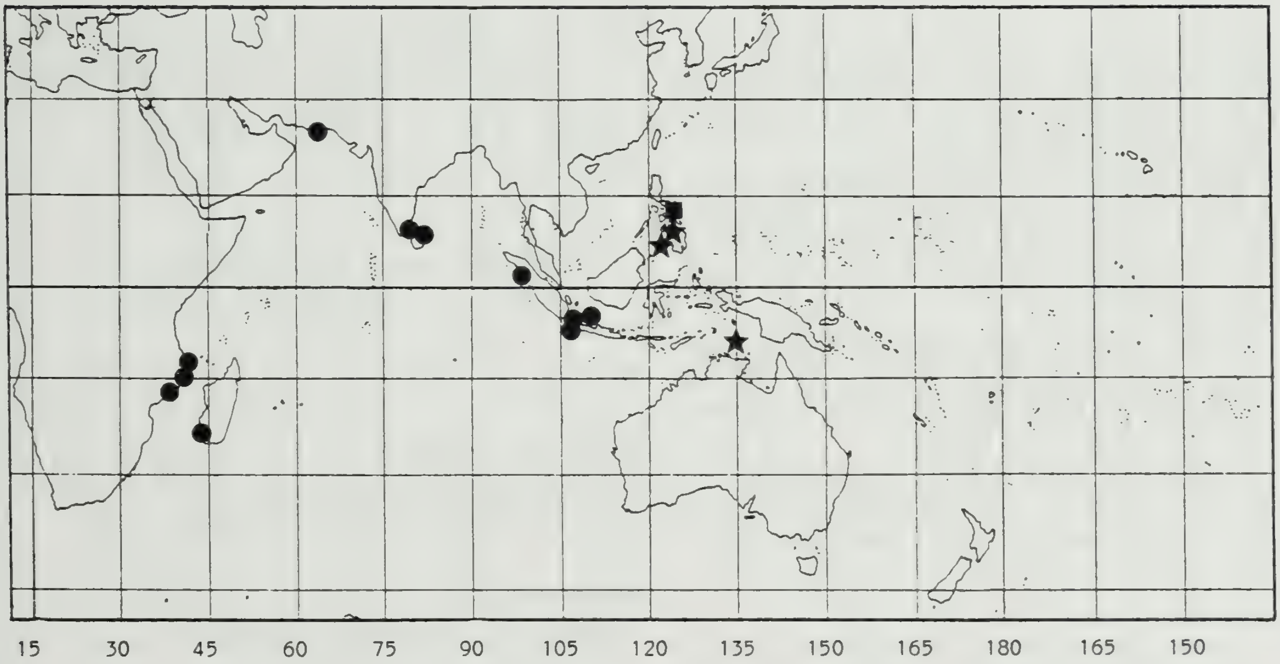

Fig. 14. Distribution of *Haustellum kurodai kurodai (*stars), *H. k. vicdani* (square), and *H. k. langleitae* (circles).

numerous, low, indistinct, smooth threads, more developed on axial ribs.

Aperture broad, rounded. Outer lip crenulate, erect with numerous, weak, elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically. Siphonal canal long, straight, open, spineless.

Greyish-brown with bluish-black or brown blotches on spire and on siphonal canal. Aperture light yellow or pink.

Remarks.

H. k. langleitae differs from *H. haustellum* in having a different larval development, coarser, irregular, spiral sculpture, consisting of similar sized cords. Other shell characters, such as thickness, height of the intervarical ribs, breadth of the varices, are quite variable. For differences with *H. k. kurodai* see Table 1.

Haustellum kurodai vicdani Kosuge, 1980
Figs 14, 33-34

Haustellum vicdani Kosuge, 1980: 57, pl. 17, figs 2, 4.

Protoconchs examined: Philippines, Sorsogon (1 sp., partially broken) (Coll. R. Houart).

Distribution.

Currently known from a small area in the Philippine Islands: Sorsogon and Bulan, Luzon Island.

Description.

Shell up to 117 mm in length with 7 teleoconch whorls. Protoconch partially broken in examined specimens, globose, smooth, whorls rounded.

Axial sculpture of last teleoconch whorl consisting of 3 high, rounded, spineless varices. Other axial sculpture of 3 or 4 low or moderately high, strong, nodose ribs. Spiral sculpture of numerous, low, weak, smooth threads.

Aperture broad, rounded. Outer lip crenulate with very weak elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically. Siphonal canal long, straight, open, spineless.

Lavender with scattered light or dark brown blotches on varices, shoulder, axial ribs and siphonal canal. Aperture light orange or orange-yellow.

Remarks.

The absolutely spineless siphonal canal and lavender colour separate that species from *H. k. kurodai* and *H. haustellum*, two other species occuring in the Philippines. The shell is smoother, and spineless. For other differences see Table 1.

Haustellum longicaudum (Baker, 1891)
Figs 15, 38-39, 42-43, 57-58

Murex haustellum var. *longicaudum* Baker, 1891: 56.

Protoconchs examined: Ethiopia, Malajus (1 sp.); Gulf of Aden (1 sp.) (coll. R. Houart); Gulf of Aden (2 sp.) (coll. Wilhelm-Pieck-Universität, Rostock).

Distribution.

Southern Red Sea, the Gulf of Aden, the Gulf of Oman and the Persian (Arabian) Gulf.

Description.

Shell up to 87 mm in length with 2-2.5 protoconch whorls and 8 teleoconch whorls. Protoconch large, globose, irregularly shaped, smooth.

Axial sculpture of last teleoconch whorl consisting of 3 narrow, high, spineless varices. Other axial sculpture of 3 or 4 low, nodose ribs. Spiral sculpture of numerous, low, smooth threads.

Aperture broad, rounded. Outer lip crenulate, erect with very weak, elongate lirae within. Columellar lip smooth, strongly raised, adherent adapically. Siphonal canal long, straight, open, spineless.

Light tan with dark brown blotches on varices and scattered blotches on teleoconch whorls. Aperture white.

Remarks.

Haustellum longicaudum is also occasionally synonymised with *H. haustellum*. For differences in shell morphology with the other species see discussion under *Haustellum* and Table 1. The species is illustrated in D. & E. Bosch (1989: 57) as *H. haustellum*.

Haustellum wilsoni D'Attilio & Old, 1971
Fig. 56

Haustellum wilsoni D'Attilio & Old, 1971: 316, figs 1,2.

Protoconchs examined: West Australia, Jurien Bay (1 sp.); West Australia, Augusta (1 sp.) (coll. R. Houart); original description and subsequent literature.

Distribution.

Geographe Bay to Jurian Bay, West Australia.

Description.

Shell up to 80 mm in length with 1.75-2 protoconch whorls and 6 or 7 teleoconch whorls. Protoconch broad, globose, smooth, glossy. Whorls rounded.

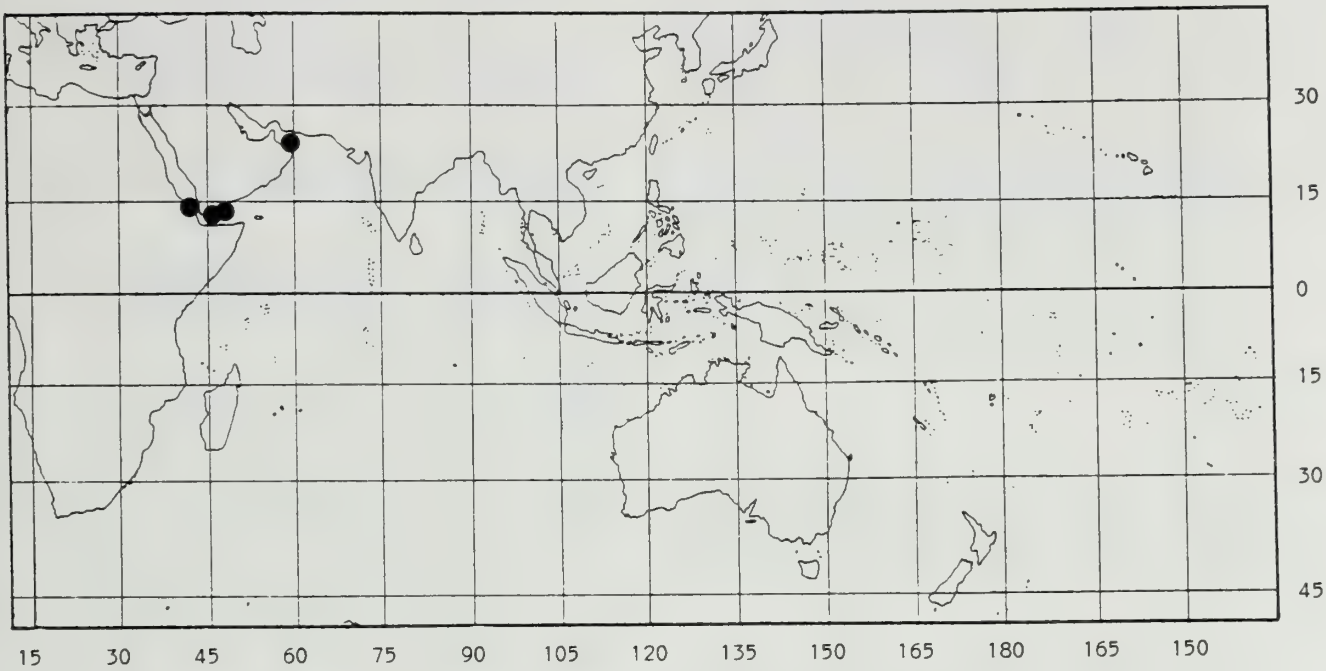

Fig. 15. Distribution of *Haustellum longicaudum*.

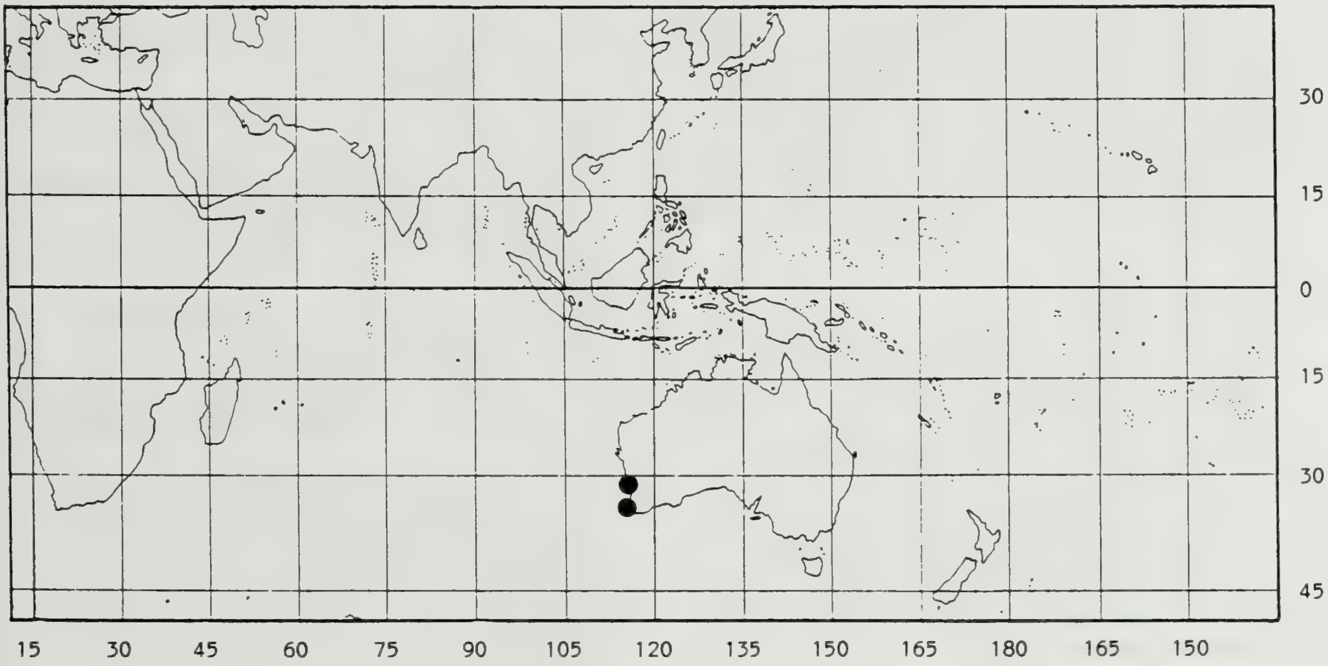

Fig. 16. Distribution of *Haustellum wilsoni*.

Axial sculpture of last teleoconch whorl consisting of 3 rounded, spineless varices. Last varix more prominent, others low or almost flat and undistinguishable in some specimens. Other axial sculpture of several, low, nodose ribs. Spiral sculpture of 10 or 11 low, rounded, tuberculate cords with numerous smooth threads on and between the cords.

Aperture broad, roundly-ovate or rounded. Outer lip crenulate with several weak elongate lirae within. Columellar lip smooth, raised, adherent adapically. Siphonal canal moderately long, straight, open, spineless with some knobs (or nodules) adaperturally.

Ivory-white or creamy-white with some darker coloured (brown) blotches on and between varices and on siphonal canal. Aperture white.

Remarks.

A rare and remarkable species. It cannot be confused with any other species of the genus thanks to its broad, rounded protoconch, rounded and nodose whorls with deeply channeled suture, broadly developed apertural varix, and nodose base of the siphonal canal.

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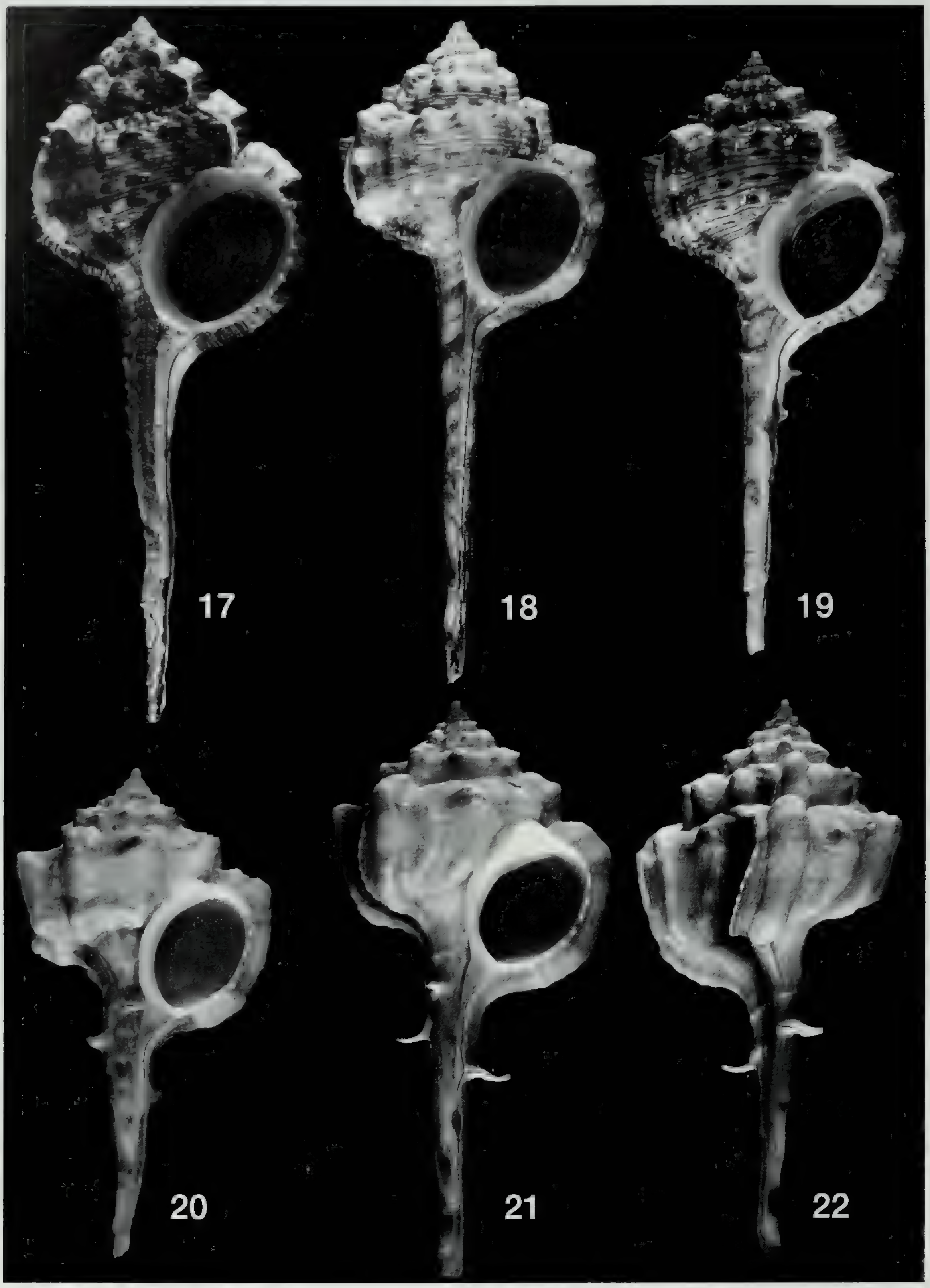
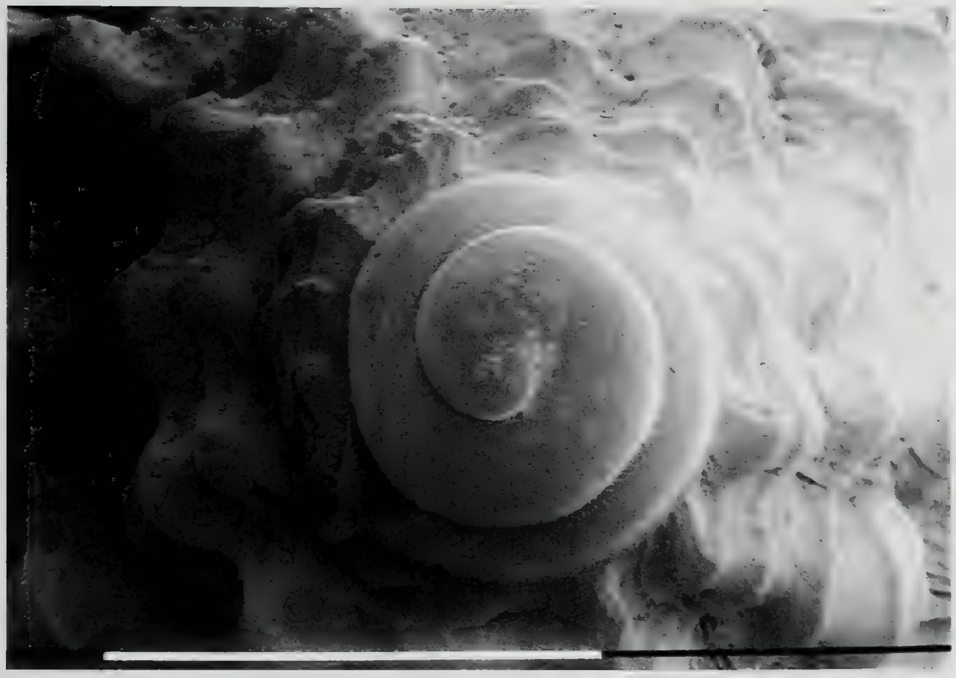


Figs. 17-19. *Haustellum haustellum* (Linnaeus, 1758). Fig. 17. Philippines, Cebu, 144.8 mm. Fig. 18. West Sumatra, near Sibolga, 95 mm. Fig. 19. New Caledonia, 86.6 mm. **Figs. 20-22.** *Haustellum fallax* (Smith, 1901). Fig. 20. South Africa, off Natal, 63.1 mm. Fig. 21-22. Mozambique, between Cabo das Correntes and Zavora Point, 78.7 mm



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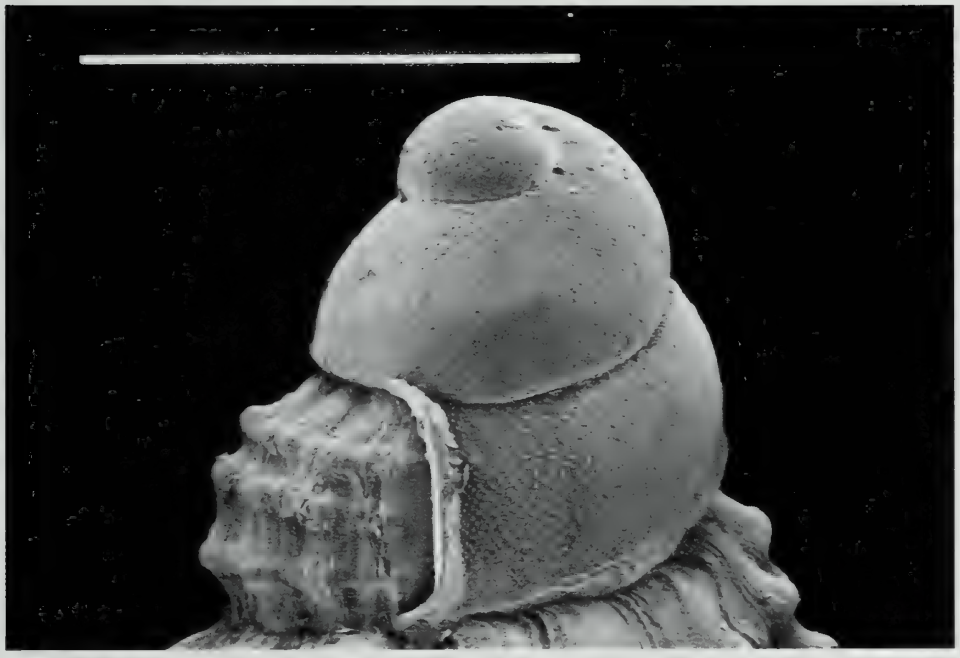

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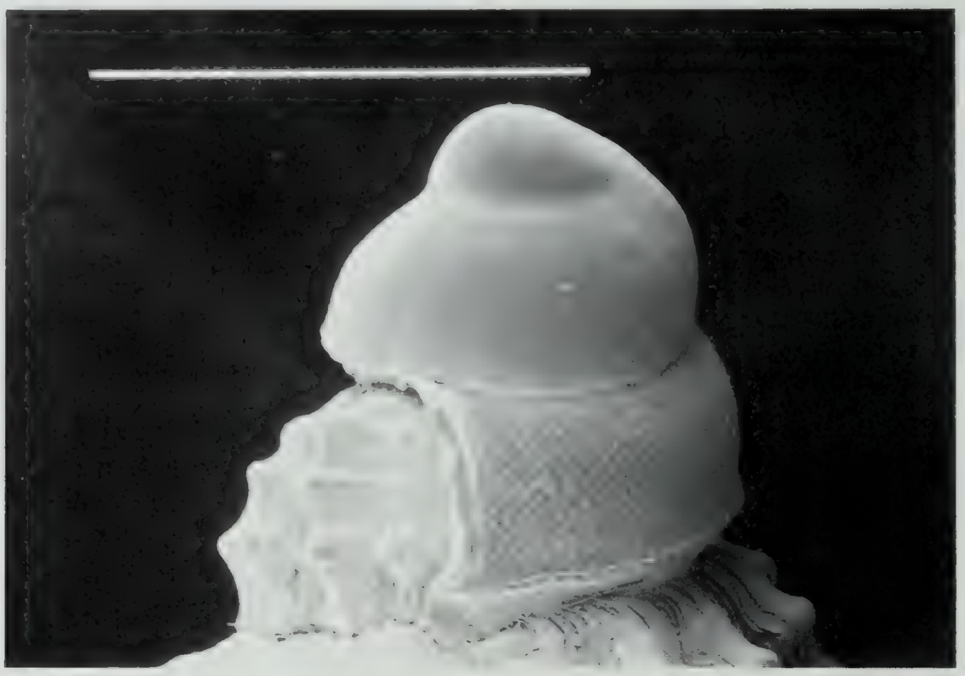
Figs. 23-24. Protoconchs of *Haustellum haustellum* (Linnaeus, 1758), Papua New Guinea. (scale bars: 1 mm)



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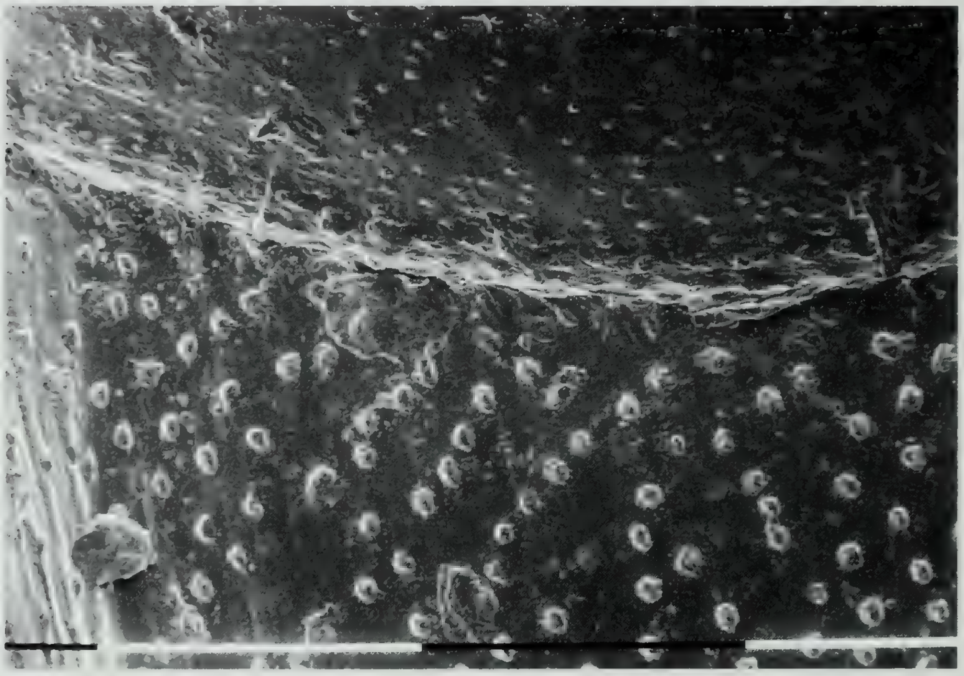

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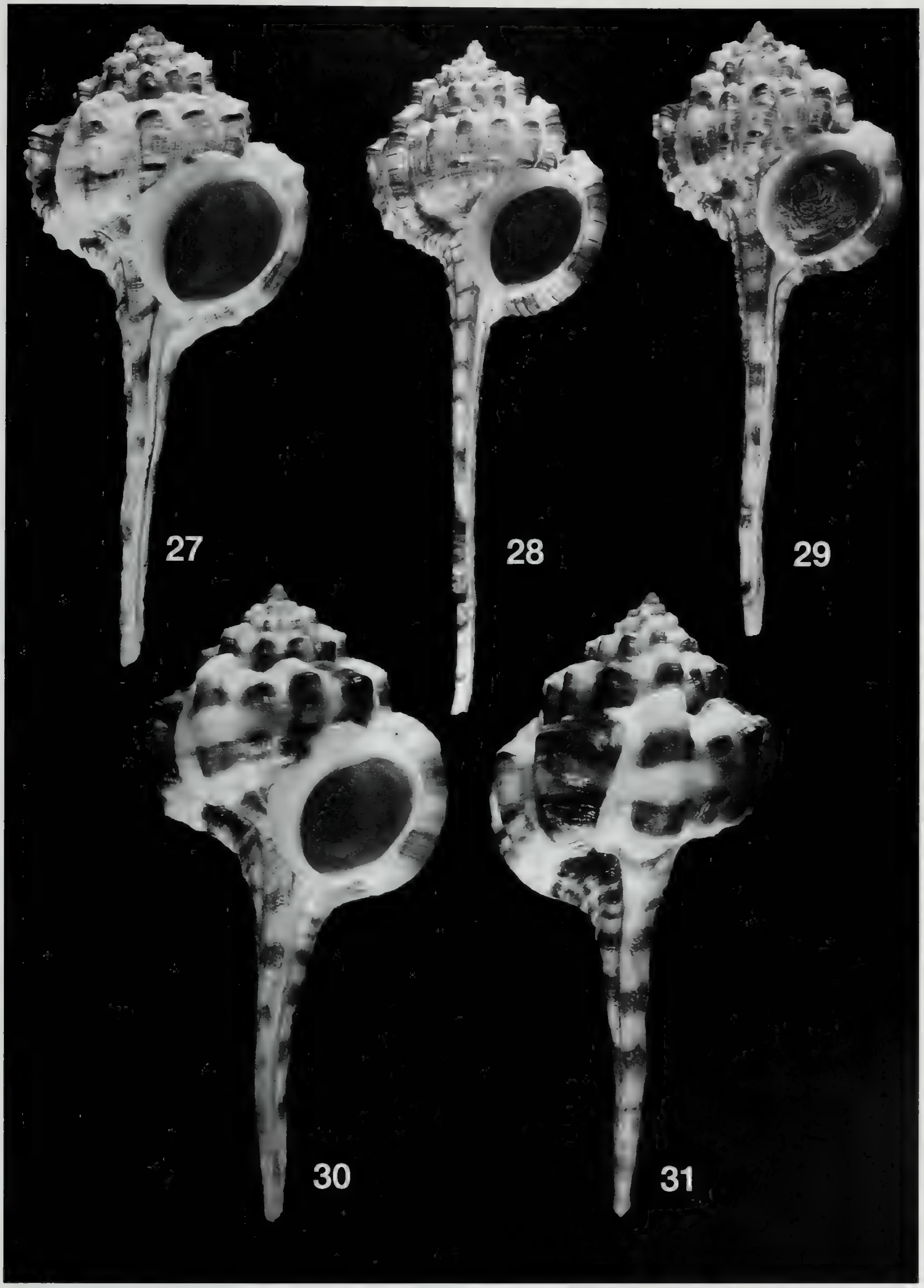
Figs. 25-26. Protoconchs of *Haustellum haustellum* (Linnaeus, 1758), Papua New Guinea. (scale bars: 25: 1 mm; 26: 100 µm).



Figs. 27-31. *Haustellum kurodai langleitae* Houart, 1993. Fig. 27. Mozambique, Bazaruta Island region, 104 mm. Fig. 28. Southwestern Java, 124 mm. Fig. 29. India, Rameswaram, 90.2 mm. Fig. 30-31. Tanzania, Dar-es-Salaam, paratype, 94.1 mm.

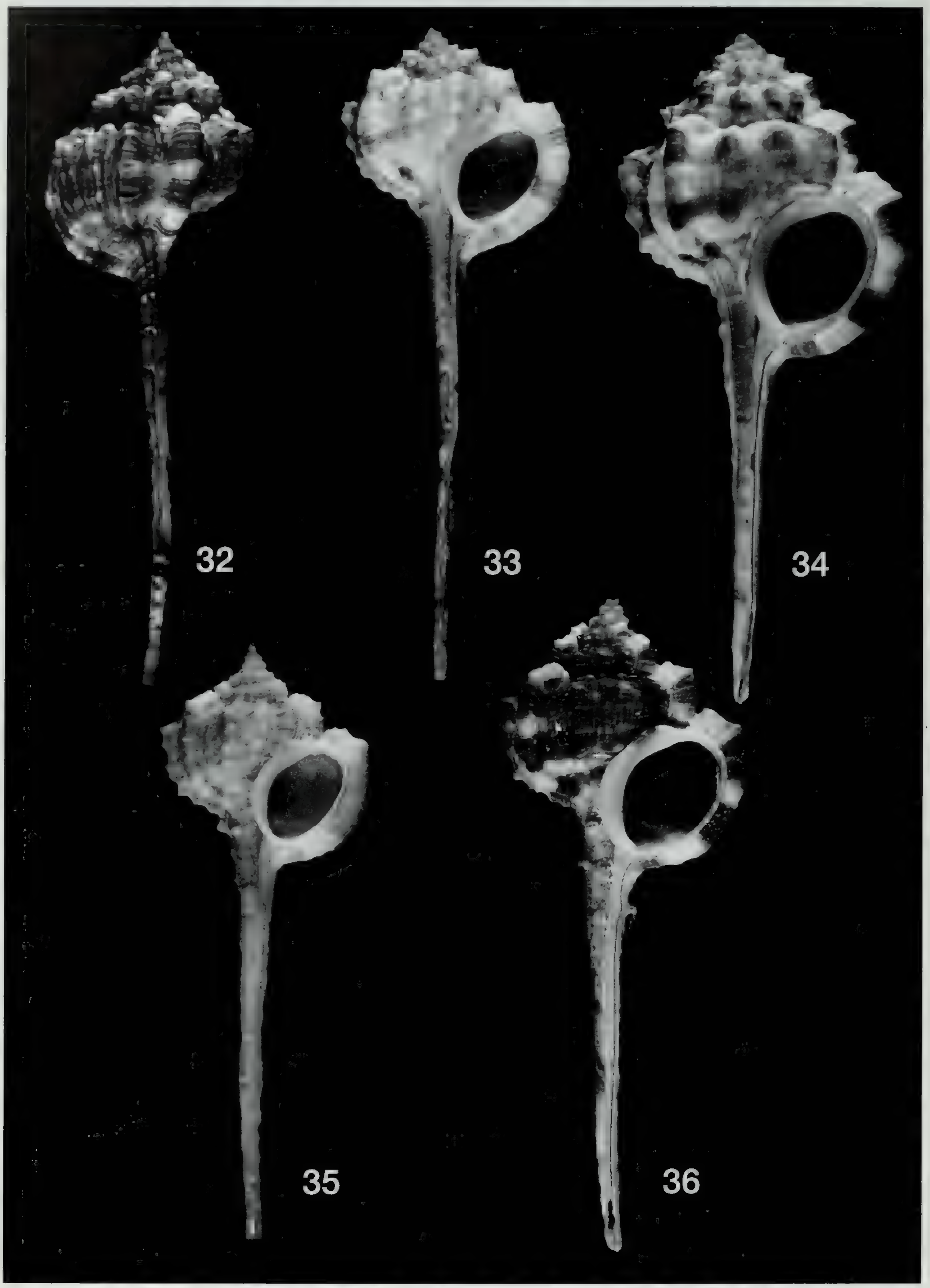


Fig. 32. *Haustellum kurodai langleitae* Houart, 1993, Java, Djakarta, 100 mm. **Figs. 33-34.** *H. kurodai vicdani* Kosuge, 1980, Philippines, Luzon Island, Sorsogon. Fig. 33. 93.5 mm. Fig. 34. 117 mm. **Figs. 35-36.** *H. kurodai kurodai* (Shikama, 1964), Philippines, Sulu, Siasi Island. Fig. 35. 62.3 mm. Fig. 36. 85.4 mm.

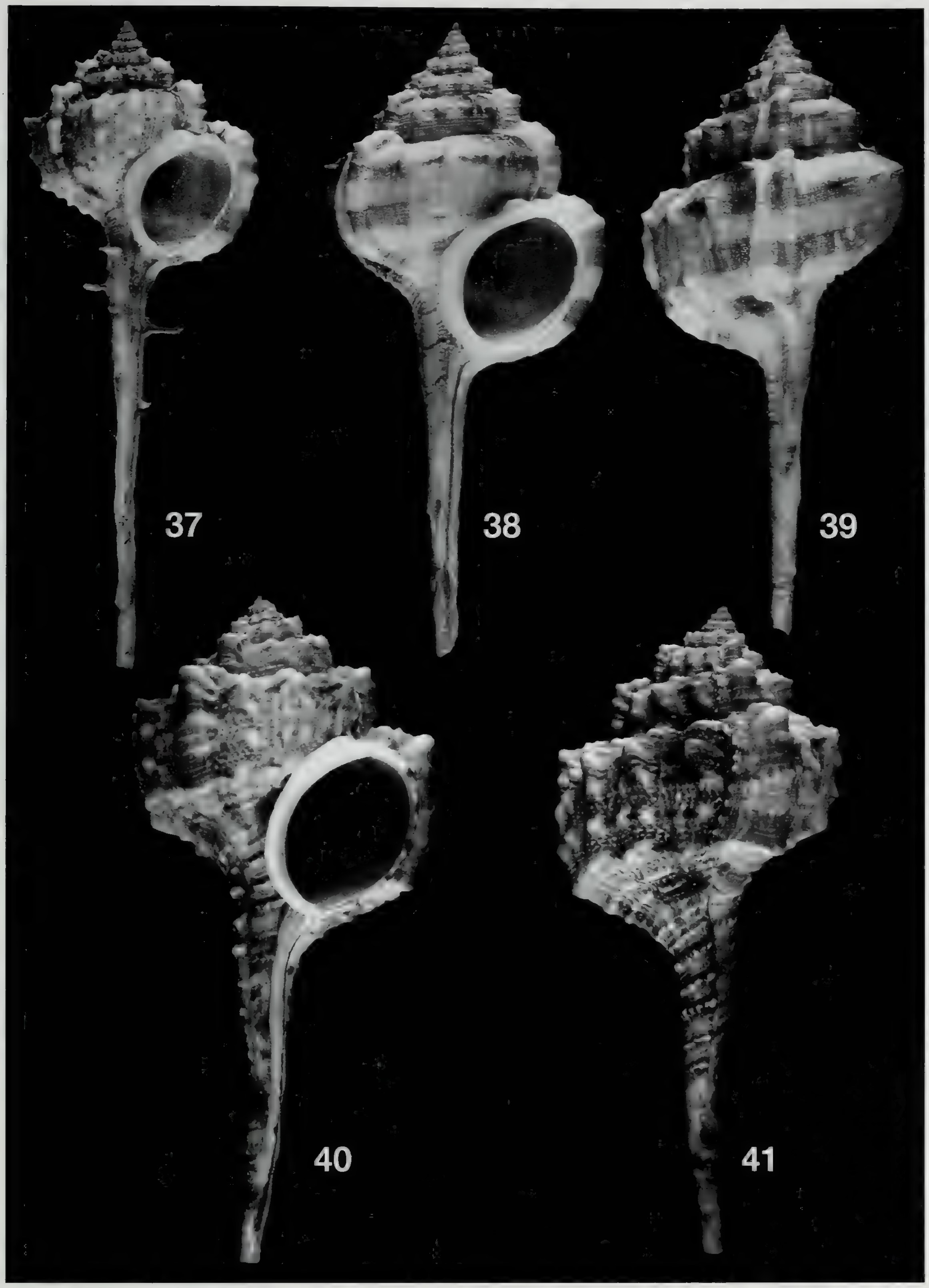
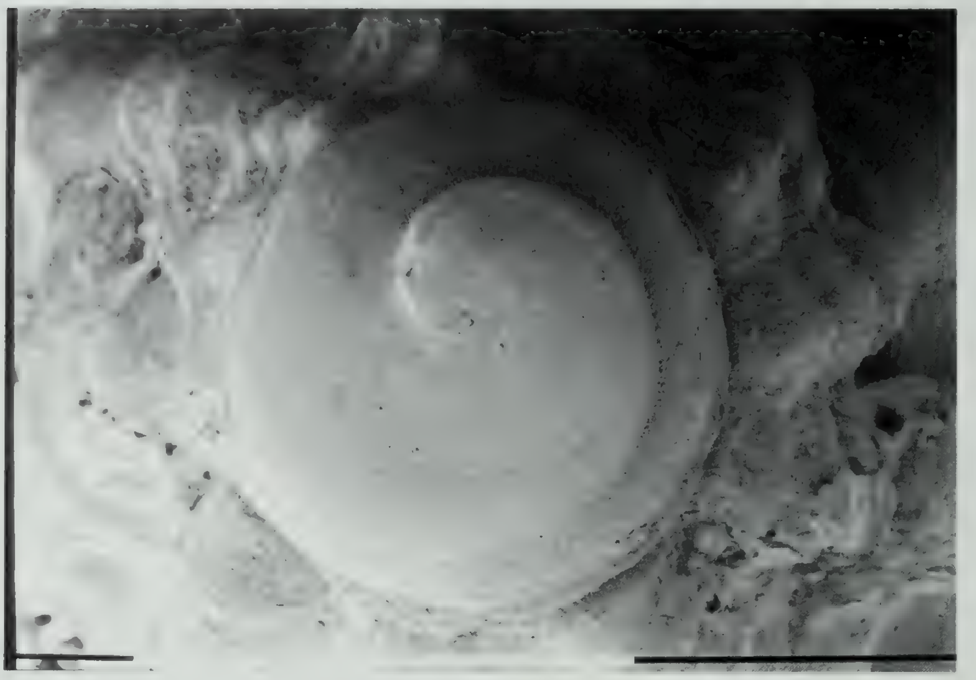


Fig. 37. *Haustellum kurodai kurodai* (Shikama, 1964), Philippines, 86.5 mm. **Figs. 38-39.** *H. longicaudum* (Baker, 1891), Ethiopia, Malajus, 86.7 mm. **Figs. 40-41.** *H. barbieri* Houart, 1993, Madagascar, Sainte-Marie (Nosy-Boraha), paratype, 90.4 mm.



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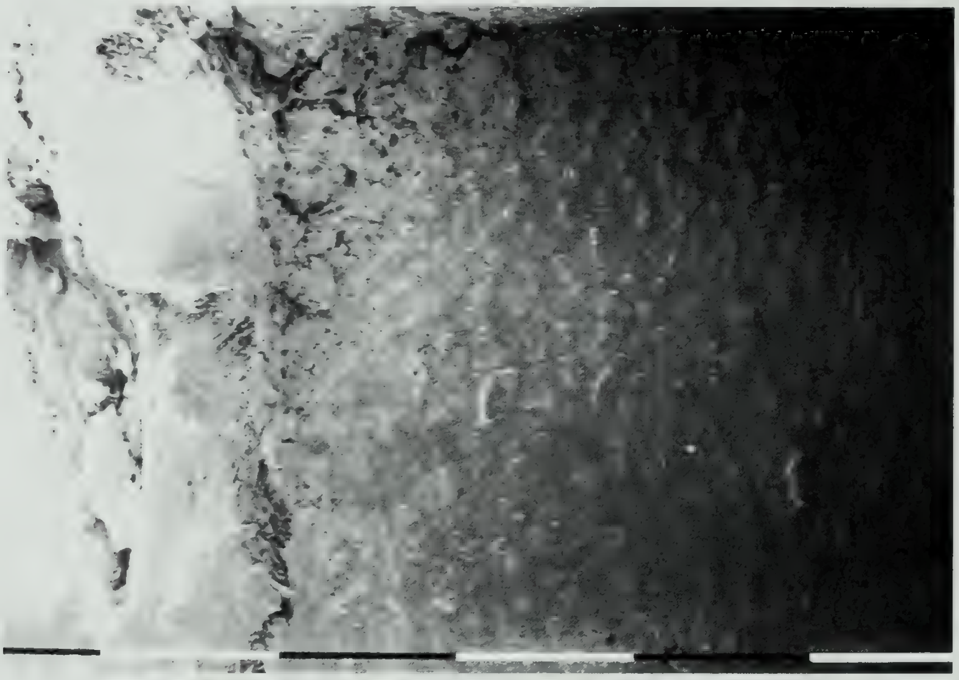

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Figs. 42-43. Protoconchs of *Haustellum longicaudum* (Baker, 1891), Gulf of Aden. (scale bars: 42: 1 mm; 43: 100 µm).

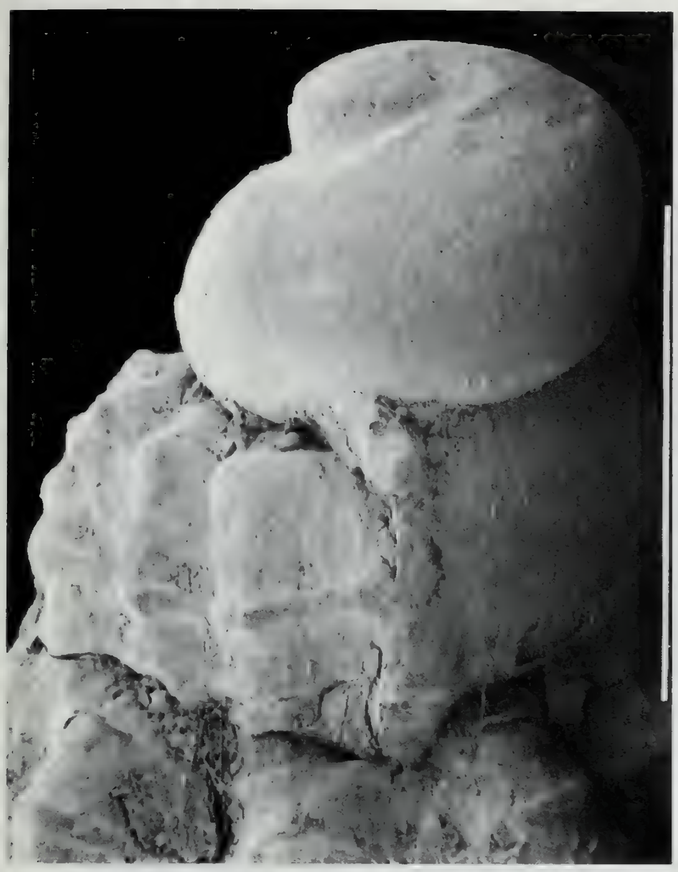

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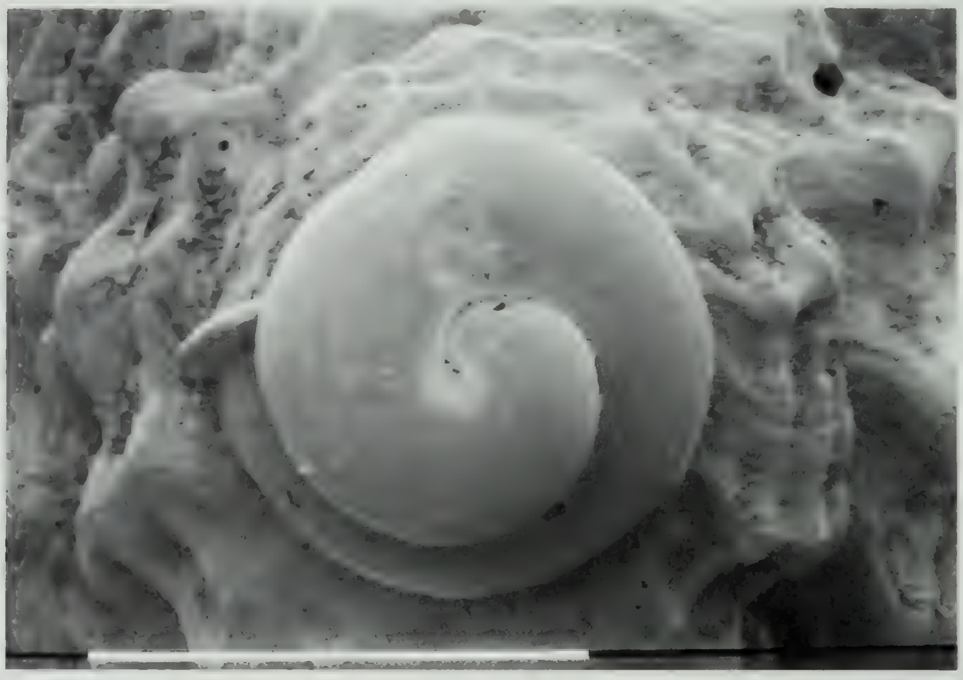
Fig. 44. Protoconch of *Haustellum longicaudum* (Baker, 1891), Gulf of Aden. (scale bars: 1 mm). **Figs. 45-46.** Protoconchs of *H. kurodai langleitae* Houart, 1993, Madagascar. (scale bars: 1 mm).



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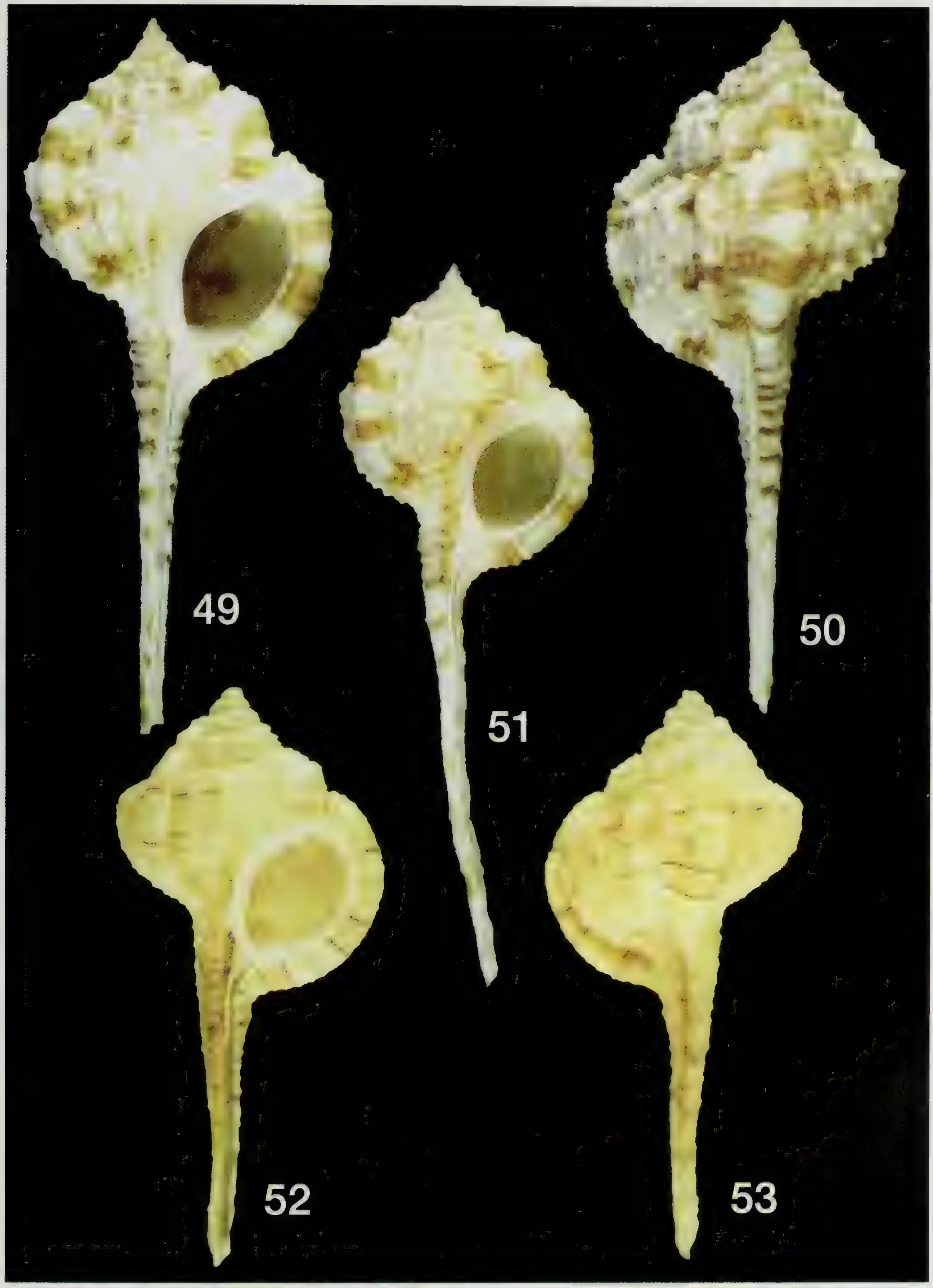
Figs. 47-48. Protoconchs of *H. kurodai kurodai* (Shikama, 1964). (scale bars: 1 mm).



Figs. 49-51. *Haustellum bondarevi* n.sp., Saya de Malha Bank. Fig. 49-50. Holotype MNHN, 79 mm. Fig. 51. Paratype coll. Bondarev, 101.2 mm. **Figs. 52-53.** *H. franchii* Bozzetti, 1993, Northeastern Somalia, off Ras Hafun, 59.8 mm, holotype IRSNB 27962/459.

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Fig. 54. *Haustellum fallax* (E. A. Smith, 1901), Mozambique (protoconch) (scale bar: 1 mm). **Fig. 55.** *Haustellum barbieri* Houart, 1993, holotype, detail of shell sculpture (scale bar: 1 mm).

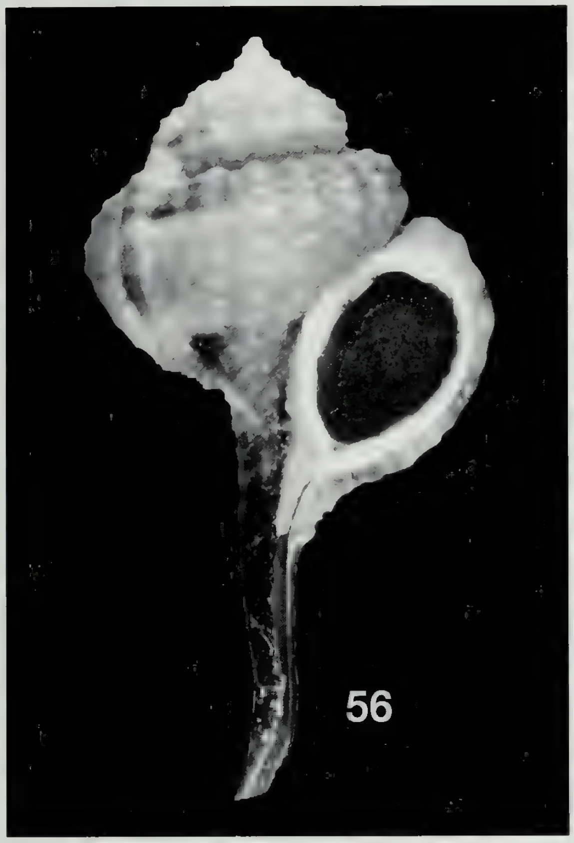

Fig. 56. *Haustellum wilsoni* D'Attilio & Old, 1971, West Australia, Augusta, 64.1 mm. **Figs. 57-58.** *Haustellum longicaudum* (Baker, 1891), Red Sea, holotype ANSP 60965, 49.7 mm.

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