MUSÉUM NATIONAL D'HISTOIRE NATURELLE

ORSTOM

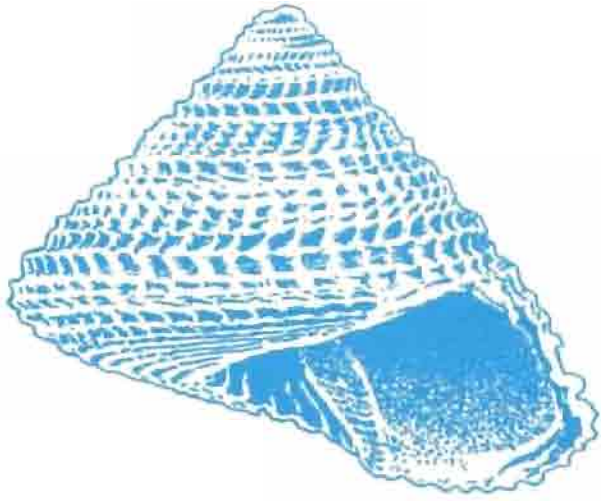
MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

ZOOLOGIE

TOME 150
1991

Résultats des Campagnes MUSORSTOM

Volume 7



Coordonné par

Alain CROSNIER

& Philippe BOUCHET

MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

Directeur de la publication : Philippe BOUCHET
Rédacteurs (Editors) : P. BOUCHET, A. DUBOIS, C. ERARD
Secrétariat : Bernadette CHARLES
Conception graphique : Alain DEFILIPPI
Rédaction : 57, rue Cuvier
75005 Paris

Les Mémoires du Muséum national d'Histoire naturelle publient des travaux originaux majeurs (100 pages et plus) dans les domaines suivants : Zoologie (série A), Botanique (série B), Sciences de la Terre (série C). Les auteurs sont invités, pour toutes les questions éditoriales, à prendre contact avec le directeur de la publication.

Mémoires du Muséum national d'Histoire naturelle publishes major original contributions (100 pages and over) in three different series : Zoology (série A), Botany (série B), Earth Sciences (série C). Prospective authors should contact the Editor. Manuscripts in French and English will be considered.

Vente en France
(uniquement)

Éditions du Muséum
Lionel GAUTHIER
38, rue Geoffroy St-Hilaire
75005 Paris
Tél. : (1) 40-79-37-00
Telex MUSNAHN 202641 F
Fax : 40-79-34-84

Sales Office
(France excluded)

Universal Book Services
Dr. W. BACKHUYS
Warmonderweg 80
2341 KZ Oegstgeest
The Netherlands
Tel. : (71) 17 02 08
Fax : (71) 17 18 56

Parution et prix irréguliers. Les ordres permanents d'achat et les commandes de volumes séparés sont reçus par le service de vente. Catalogue sur demande. Une liste des derniers titres parus figure en page 3 de couverture.

Volumes are published at irregular intervals, and at irregular prices. Standing orders and orders for single volumes should be directed to the Sales Offices. Free price list and catalogue on request. Recently published memoirs are listed on page 3 of the cover.

The Muséum national d'Histoire naturelle also publishes a Bulletin.

Printed on acid-free paper.
Imprimé sur papier non acide.

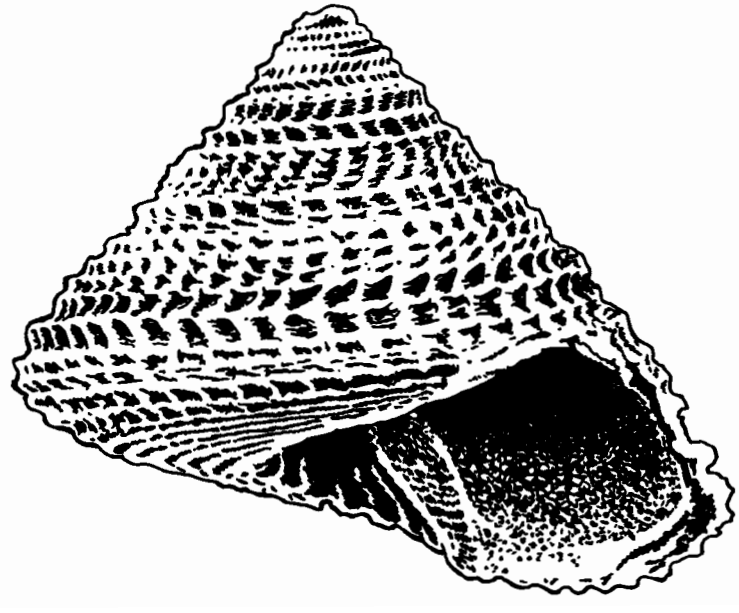
Résultats des Campagnes MUSORSTOM
Volumes déjà parus :

Volume 1 : Mém. ORSTOM, **91** : 1-558, 225 fig., 39 pl. (1981). ISBN : 2-7099-0578-7.
Volume 2 : Mém. Mus. natn. Hist. nat. Paris, (A), **133** : 1-525, 126 fig., 37 pl. (1986). ISBN : 2-85653-136-9.
Volume 3 : Mém. Mus. natn. Hist. nat. Paris, (A), **137** : 1-254, 82 fig., 9 pl. (1987). ISBN : 2-85653-141-5.
Volume 4 : Mém. Mus. natn. Hist. nat. Paris, (A), **143** : 1-260, 103 fig., 23 pl. (1989). ISBN : 2-85653-150-4.
Volume 5 : Mém. Mus. natn. Hist. nat. Paris, (A), **144** : 1-385, 128 fig., 35 pl. (1989). ISBN : 2-85653-164-4.
Volume 6 : Mém. Mus. natn. Hist. nat. Paris, (A), **145** : 1-388, 190 fig., 4 pl. couleur (1990). ISBN : 2-85653-171-7.
Volume 7 : Mém. Mus. natn. Hist. nat. Paris, (A), **150** : 1-264, 587 fig., (1991). ISBN : 2-85653-180-6.

résultats des campagnes

MUSORSTOM

Volume 7



ISBN : 2-85653-180-6
ISSN : 0078-9747

MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

SÉRIE A
ZOOLOGIE
TOME 150

Résultats des Campagnes MUSORSTOM

Volume 7

Coordonné par

Alain CROSNIER

Muséum national d'Histoire naturelle
Laboratoire de Zoologie, Arthropodes
61, rue Buffon
75005 Paris

&

Philippe BOUCHET

Muséum national d'Histoire naturelle
Laboratoire de Biologie des Invertébrés marins et Malacologie
55, rue Buffon
75005 Paris

Publié avec le concours de l'ORSTOM

ÉDITIONS
DU MUSÉUM
PARIS

1991

SOMMAIRE

CONTENTS

1

Mollusca Polyplacophora : Deep-water Chitons from New Caledonia

Pieter KAAS

Nationaal Natuurhistorisch Museum
P.O. Box 9517
2300 R A Leiden
The Netherlands

ABSTRACT

Five French deep-sea cruises made around New Caledonia during the years 1985-1987 brought altogether 92 specimens of chitons, representing 10 species in 5 families ; 8 species are new to science. The new genus *Vermichiton* is described for a small vermiform species ; this genus is compared with *Connexochiton* Kaas, 1979.

RÉSUMÉ

Mollusca Polyplacophora : Chitons bathyaux et abyssaux de Nouvelle-Calédonie.

Cinq campagnes françaises réalisées autour de la Nouvelle-Calédonie, de 1985 à 1987, ont permis la récolte de 92 spécimens de chitons, appartenant à cinq familles et comprenant dix espèces dont huit nouvelles. Le nouveau genre *Vermichiton* est décrit pour une petite espèce vermiforme ; ce genre est comparé avec *Connexochiton* Kaas, 1979.

KAAS, P., 1991. — Mollusca Polyplacophora : Deep-water Chitons from New Caledonia. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 9-27. Paris ISBN : 2-85653-180-6.
Publié le 20 mars 1991.

INTRODUCTION

During the years 1985-1987 several deep-sea cruises were made around New Caledonia. In 1985 the BIOCAL cruise, on the research vessel "*Jean Charcot*", procured 43 specimens of Polyplacophora from 8 stations S and SE of New Caledonia, in depths varying from 235 to 2 340 m. They belong to 6 species, 4 of them new to science. Later in 1985 the MUSORSTOM 4 cruise, on the research vessel "*Vauban*", hauled 36 specimens of chitons from 12 stations NW and SE of New Caledonia in depth from 75 to 720 m, representing 6 species, 4 new to science, one had also been procured by the BIOCAL cruise. In 1986 the CHALCAL 2 cruise added 11 more specimens, belonging to 3 species, two already found by the aforementioned cruises and one new. The same year the SMIB 2 and the SMIB 3 cruises, on the "*Vauban*", added two more specimens of species also found by the foregoing cruises. Altogether 92 specimens were captured, representing 10 species, 8 of which are new to science.

B. RICHER DE FORGES (1990) wrote a narrative of the cruises and provided a list of stations.

Thanks are due to Dr Philippe BOUCHET of the Muséum national d'Histoire naturelle, Paris, who participated in the BIOCAL, MUSORSTOM 4 and CHALCAL 2 cruises, for affording the author an opportunity to study and describe the material.

List of abbreviations :

AMS = Australian Museum, Sydney.
MNNH = Muséum national d'Histoire naturelle, Paris.
NMNZ = National Museum of New Zealand, Wellington.
RMNH = Rijksmuseum van Natuurlijke Historie, torie, Leiden. Now Nationaal Natuurhistorisch Museum.
VB = Private collection of R. A. VAN BELLE, Sint-Niklaas, Belgium.

SYSTEMATIC ACCOUNT

Order NEOLORICATA

Suborder LEPIDOPLEURINA

Family LEPTOCHITONIDAE

Genus ***LEPTOCHITON*** Gray, 1847

Subgenus ***LEPTOCHITON*** s.s.

Leptochiton (L.) belknapi Dall, 1878

Leptochiton belknapi Dall, 1878 : 1. — KAAS & VAN BELLE, 1987 : 23, fig. 10 (bibliography and synonymy). — KAAS, 1990 : 176.

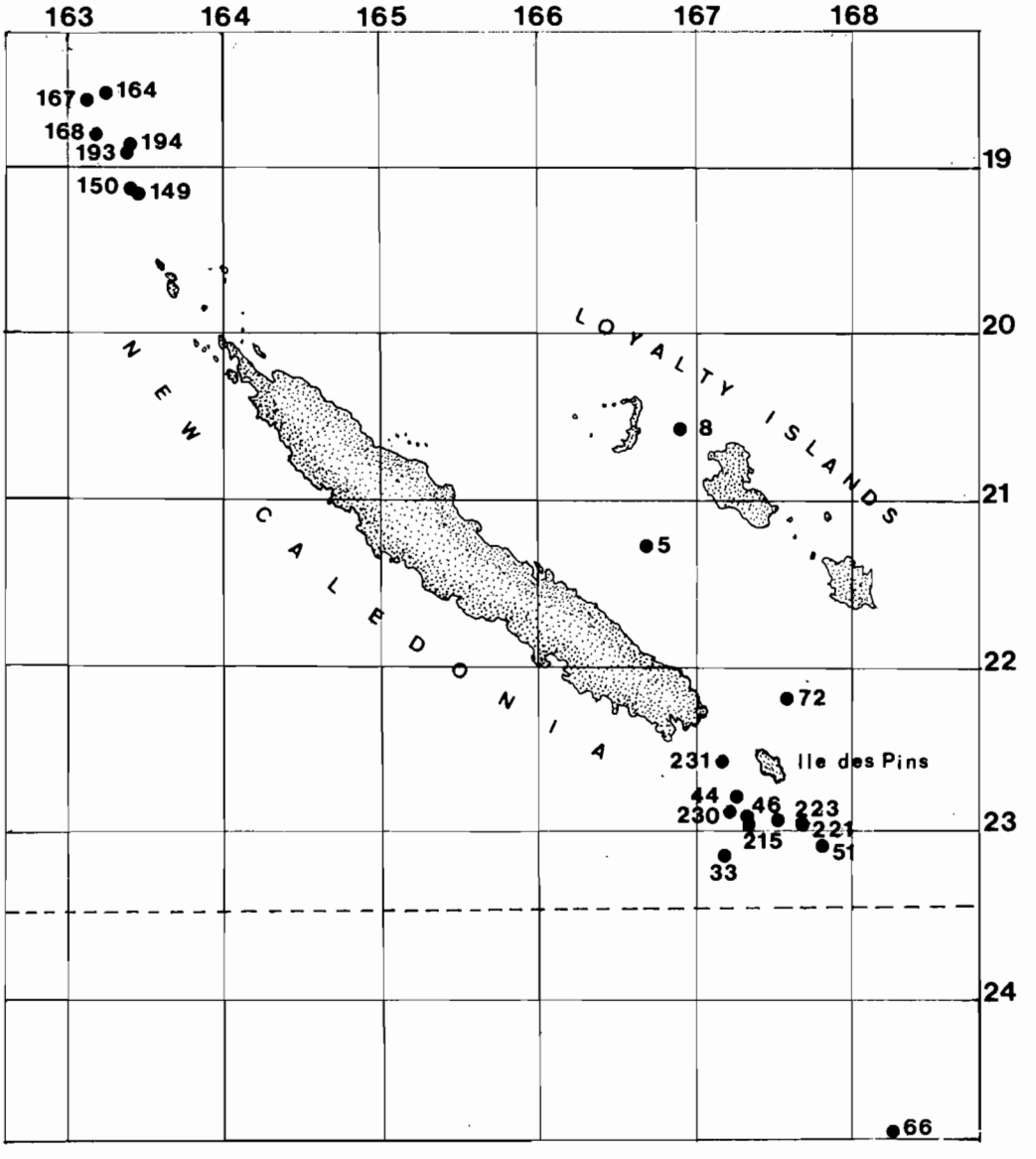
MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn CP 05, 21°16′ S, 166°44′ E, 2 340 m, 11.VIII.1985 : 1 spm. — Stn DW 33, 23°10′ S, 167°10′ E, 675-680 m, 29.VIII.1985 : 1 spm. — Stn CP 72, 22°10′ S, 167°33′ E, 2 100-2 110 m, 04.IX.1985 : 2 spms.

Leptochiton (L.) perscitus sp. nov.

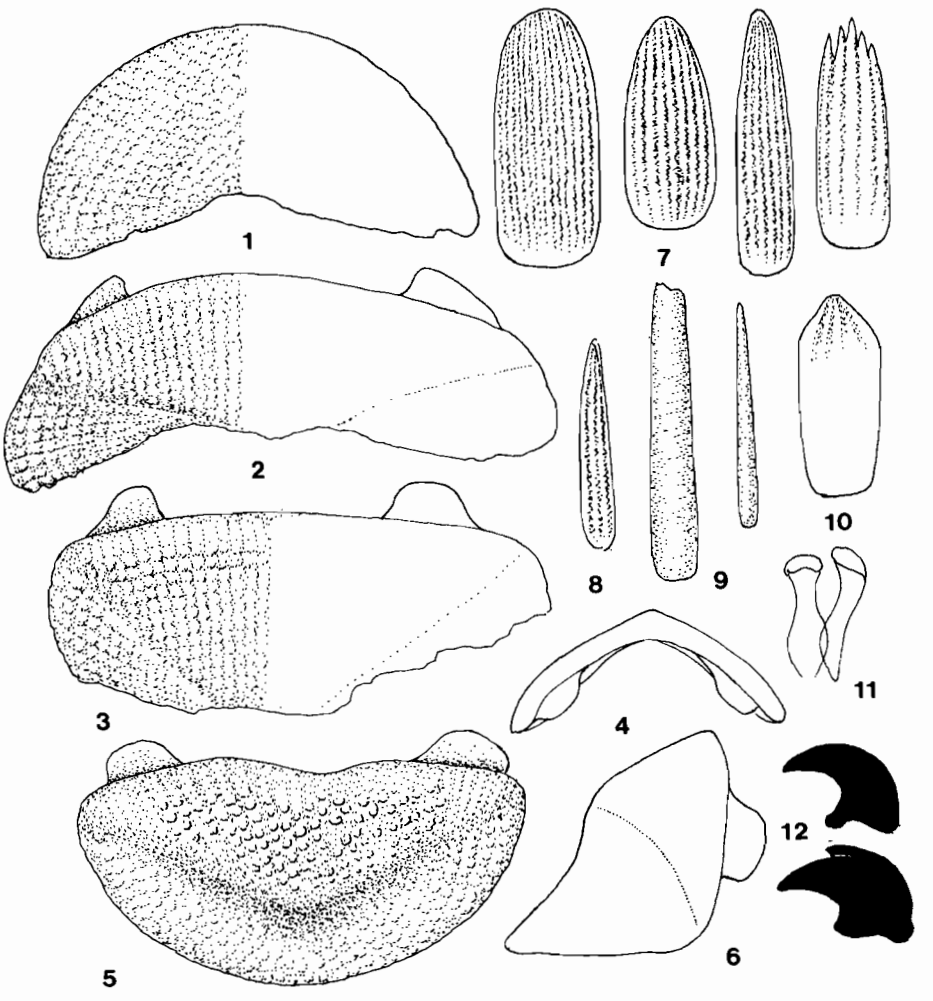
Figs 1-12

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 149, 19°08′ S, 163°23′ E, 155 m, 14.IX.1985 : 18 spms, paratypes (MNHN/12, RMNH 9264/2, VB 2983/2, NMNZ/1). — Stn DW 150, 19°07′ S, 163°22′ E, 110 m, 14.IX.1985 : 3 spms, holotype and disarticulated paratypes (MNHN).

DIAGNOSIS. — Animal c. 2 mm long, moderately elevated, subcarinated, valves not beaked,



Map showing stations of the cruises BIOCAL, 1985 (numbers < 100) and MUSORSTOM 4, 1985 (numbers > 100).



FIGS 1-12. — *Leptochiton (L.) perscitus* sp. nov. : **1**, valve I, dorsal view, × 46. —**2**, valve II, dorsal view, × 46. — **3**, valve VII, dorsal view, × 46. — **4**, *id.*, rostral view, × 23. — **5**, valve VIII, dorsal view, × 46. — **6**, *id.*, lateral view, × 46. — **7**, different types of dorsal girdle scales, × 460. — **8**, marginal spicule, × 460. — **9**, sutural spicules, × 460. — **10**, ventral scale, × 460. — **11**, central and first lateral radula teeth, × 460. — **12**, different views of head of major lateral tooth, × 460. — **1-12**, paratype from MUSORSTOM 4 cruise, stn DW 150.

lateral areas little raised, tail valve short, mucro post-median. End valves and lateral areas weakly quincuncially granulated, central and antemucronal areas with larger, roundish granules in longitudinal series. Girdle with finely striated scales, at the sutures occasionally small bunches of spicules. Dental cap of major lateral radula tooth bicuspid.

DESCRIPTION. — Animal very small, the largest 2.1 × 1.8 mm (curled), at most 2.5 mm long when stretched, oval, subcarinated, side slopes slightly convex, moderately elevated (dorsal elevation c. 0.40), valves not beaked.

Valve I somewhat less than semicircular, quincuncially sculptured with weakly pronounced, rounded granules. Intermediate valves rectangular, anterior margin convex in valve II, straight to a little concave in the others, posterior margin almost straight, often damaged as the valves are very thin and brittle. Lateral areas weakly raised, quincuncially granulated like head valve, central areas with longitudinal rows of well pronounced, round granules, more weakly developed on the

jugum. Apophyses small, short, triangular to trapezoid, widely spaced, jugal sinus almost flat. Tail valve short, length less than half its width, the mucro post-median, not swollen, posterior slope steep, concave. Antemucronal area sculptured like the central areas, postmucronal area like the head valve and lateral areas.

Girdle white, narrow, densely paved with finely longitudinally striated scales of various forms and sizes, but always at least twice as long as wide, with more or less rounded top, up to 75 μm long, 30 μm wide. Occasionally, small bunches of straight, slender, smooth spicules occur at the sutures, varying in length from 66-100 μm. Marginal spicules sharply pointed, longitudinally grooved, 60 × 10 μm. Ventral side of girdle paved with radiating rows of flat scales, c. 55 × 25 μm, distally narrowing to a blunt, grooved point.

Central tooth of radula narrow, slightly pinched in the distal half, with a rounded blade, first lateral weakly curved inwardly, with a small blade, dental cap of major laterals with a sharply bent, pointed main cusp and a short, small external cusp.

ETYMOLOGY. — The Latin *perscitus* = very fine, in relation to the delicacy of the shell.

DISCUSSION. — Until now species of *Leptochiton* have not been reported from New Caledonia. *L. perscitus* resembles *L. norfolcensis* (Hedley & Hull, 1912) from Lord Howe and Norfolk Islands and its supposed subspecies *subtropicalis* (Iredale, 1914) from the Kermadec Islands, which, however, grows much larger, to 6 mm long and has much shorter, sparsely but strongly ribbed dorsal girdle scales.

Leptochiton (L.) vaubani sp. nov.

Figs 13-23

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DC 168, 18°48′ S, 163°11′ E, 720 m, 16.IX.1985 : 1 spm, holotype (MNHN).

DIAGNOSIS. — Animal c. 2 × 1 cm, elongate oval, moderately elevated, carinated. Colour white. Valves not beaked, lateral areas not raised, mucro almost central. Apophyses ischnochitonoid, rather wide. End valves and lateral areas with small, elevated pustules arranged in curved series, continuing on central areas, where they are longitudinally arranged and less elevated. Girdle with elongate, striated spicules. Major lateral teeth of radula with bicuspid dental cap.

DESCRIPTION. — The holotype measures 19.8 × 9.9 mm (now disarticulated, slides of perinotum and radula). Dorsal elevation 0.44, which is moderate, the back carinated, side slopes straight. Colour of tegmentum and girdle white.

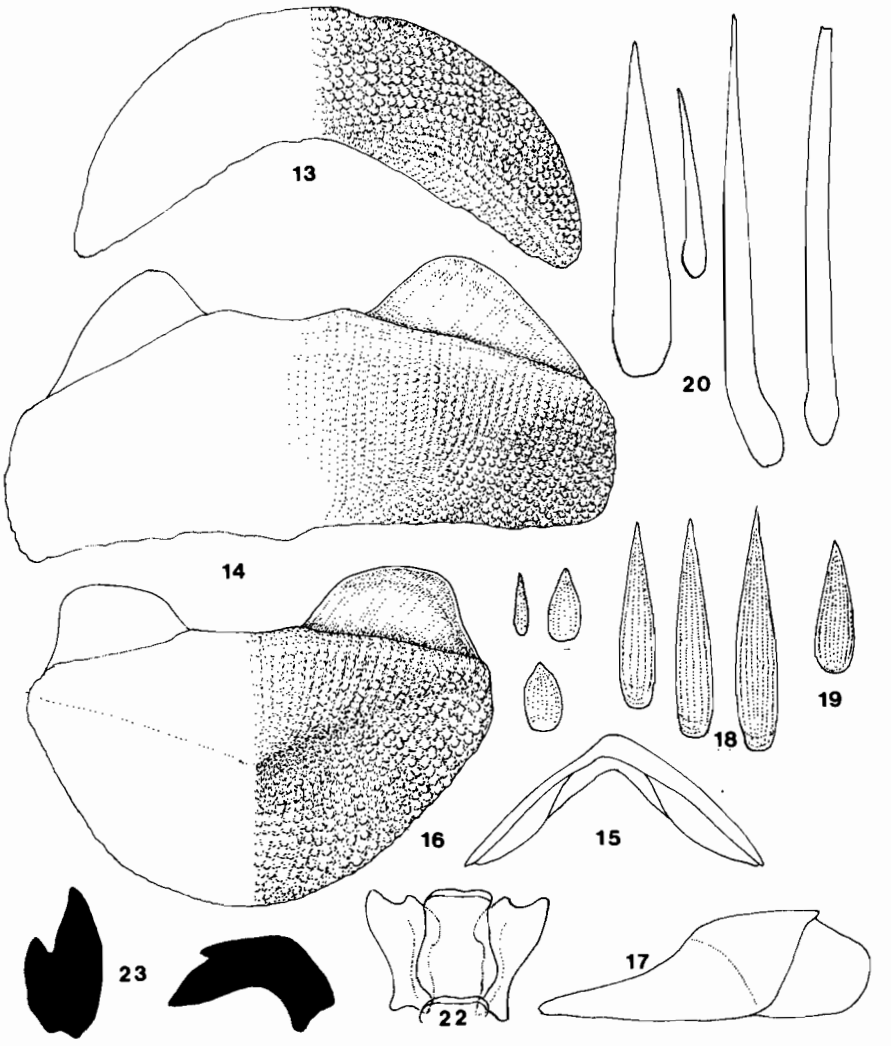
Head valve less than semicircular, anterior slope straight, posterior margin widely V-shaped. Intermediate valves broadly rectangular, side margins only little convex, anterior margin slightly convex, except for the jugal sinus which is decidedly concave ; posterior margin straight, the apex not or hardly projecting. Lateral areas not raised, marked only by the difference in orientation of the sculpture, consisting of chains of well raised, small, roundish pustules, arranged in curved series in two directions, forming a neatly quincuncial pattern. The series continue across the central area in parallel longitudinal lines, becoming less pronounced, almost obsolete on the jugum. Tail valve slightly narrower than head valve, the length about 3/5 of the breadth, the mucro about central, not swollen, posterior slope concave directly behind the mucro. Antemucronal area sculptured like the central areas, postmucronal area and head valve like the lateral areas.

Articulamentum thin, white, apophyses rather long, widely triangular in the intermediate valves, more or less trapezoid in the tail valve, ischnochitonoid, jugal sinus about one quarter of the valves's width.

Girdle narrow, covered with elongate, sharply pointed, longitudinally grooved spicules, 88 × 24 μm on mid-girdle, up to 160 × 30 μm at the inner margin. The cuticula of the girdle bridges bears long, glassy, slender and smooth needles, up to 300 × 20 μm. Ventral scales ovoid with pointed top, slightly striated, c. 28 × 24 μm.

Radula with a short and relatively wide central tooth, slightly bulbous proximally, with a narrow, straight blade ; first laterals widening distally, ending in a shallow sinus, without a blade ; major laterals with a strong, curved, bicuspid dental cap, the cusps pointed, the central one much larger than the outer one.

Gills merobranchial abanal ; c. 18 ctenidia per side.



FIGS 13-23. — *Leptochiton (L.) vaubani* sp. nov. : **13**, valve I, dorsal view, × 9.6. — **14**, valve IV, dorsal view, × 9.6. — **15**, *id.*, rostral view, × 4.8. — **16**, valve VIII, dorsal view, × 9.6. — **17**, *id.*, lateral view, × 9.6. — **18**, dorsal girdle spicules along valve margin, × 200. — **19**, *id.*, from mid-girdle, × 200. — **20**, needles from girdle bridges, × 200. — **21**, ventral spicules, × 200. — **22**, central and first lateral radula teeth, × 100. — **23**, head of major lateral tooth, × 100. — **13-23**, holotype.

ETYMOLOGY. — After the research vessel " *Vauban* ".

DISCUSSION. — *L. vaubani* does not resemble any known species of the genus. It is unique in the possession of strongly developed, ischnochitonoid apophyses, in the spiculose girdle and the needle-bearing girdle-bridges.

Leptochiton (L.) sp. indet.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn CP 05, 21°16′ S, 166°44′ E, 2 340 m, 11.VIII.1985 : 2 spms, too small to identify. — Stn DW 51, 23°05′ S, 167°45′ E, 680-700 m, 03.IX.1986 : 4 spms, smashed, unidentifiable.

Suborder ISCHNOCHITONINA
Family ISCHNOCHITONIDAE
Subfamily ISCHNOCHITONINAE

Genus *VERMICHITON* gen. nov.

DIAGNOSIS. — Animal small, narrowly elongate, more than four times longer than wide, highly elevated, carinated, apophyses connected by a jugal plate, articulamentum with many/1/many slits, girdle closely beset with bluntly pointed, juxtaposed spicules, directed towards the outer margin.

Type : *V. vermiculus* sp. nov.

Vermichiton vermiculus sp. nov.

Figs 24-36

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 30.VIII. 1985 : 1 spm, partly disarticulated, holotype (MNHN).

DIAGNOSIS. — Animal small, c. 5 mm long, 1 mm wide, valves highly elevated, carinated, hardly or not beaked. End valves and lateral areas pustulose, central areas finely longitudinally punctate-striate, apophyses connected by a jugal plate, slit formula of insertion plates many/1/many. Girdle with callochitonoid spicules.

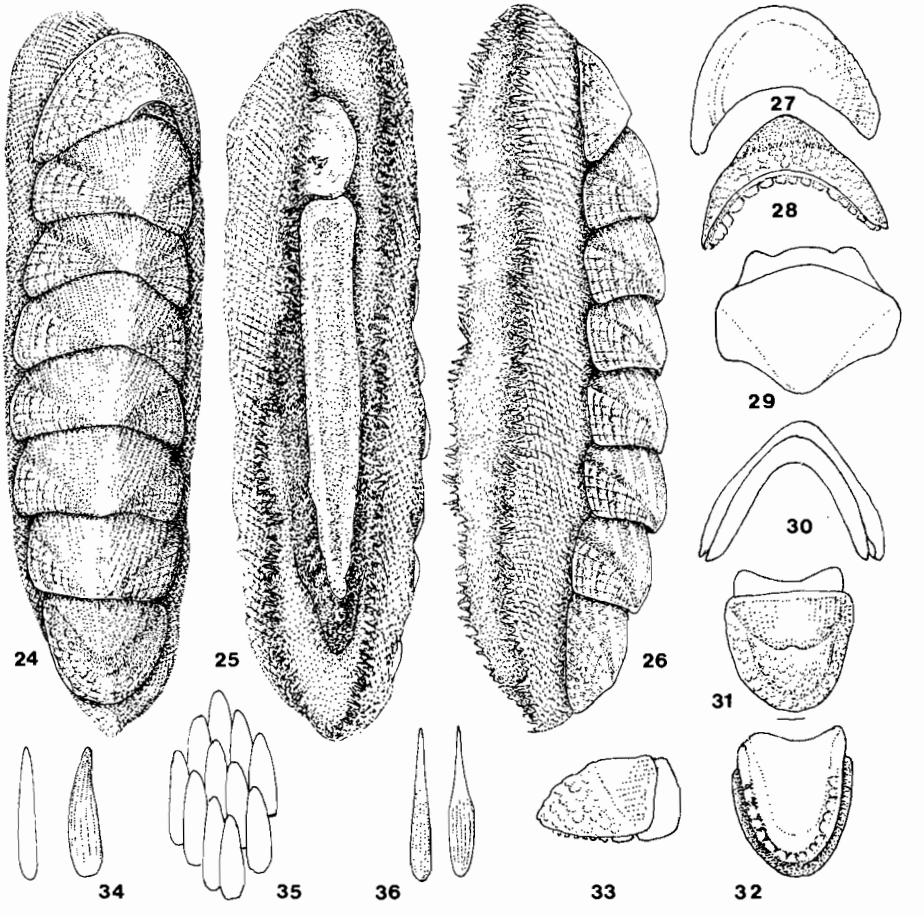
DESCRIPTION. — Animal small, narrowly elongate, 5.12 × 1.36 mm, highly elevated (dorsal elevation 0.63), sharply carinated, side slopes almost straight, valves not beaked, apices hardly indicated, lateral areas raised. Girdle relatively wide, covered with callochitonoid spicules. Colour of valves and girdle white.

Head valve little more than semicircular, anterior slope steep, straight, posterior margin baylike ; intermediate valves relatively long, not or slightly beaked, lateral areas clearly indicated, raised, anterior margin almost straight, convex in valve II, which is longer than the others, side margins straight, side slopes steep, almost straight. Posterior valve as long as wide, the mucro central, slightly directed forwardly, posterior slope convex. Sculpture consisting of relatively large, raised, round, quincuncially arranged pustules on head valve, lateral areas of intermediate valves and postmucronal area of tail valve ; central and antemucronal areas finely, longitudinally punctate-striate, obsolete on the jugum. End valves and lateral areas with a few concentric growth marks.

Articulamentum well developed, white, produced forwardly in valves II-VIII as to form a relatively long jugal plate, connecting the apophyses. As a result the jugal sinus is very shallow. Valve I with 14 slits, the insertion teeth smooth, eaves solid ; intermediate valves with 1-1 short slits, valve VIII with 16 slits, the teeth very short and blunt. There are no slit-rays.

Girdle relatively wide, directed downward, appearing narrow when viewed from above, dorsally covered with juxtaposed, bluntly pointed, elongate-ovoid, white spicules, neatly arranged in quincunx, c. 150 × 40 μm. There is a marginal fringe of two kinds of small, pointed spicules : white, smooth, slender ones, c. 120 × 15 μm, and stout, longitudinally grooved ones, 120 × 30 μm. Ventral spicules arranged in radiating rows, the basal half distinctly striated, distally abruptly narrowing to a needle-like point, 90 × 16 μm.

Animal white, with a rounded head about the



FIGS 24-36. — *Vermichiton* gen. nov. *vermiculus* sp. nov. : **24-26**, dorsal, ventral and lateral view respectively, × 18.75. — **27-28**, valve I, dorsal and anterior view respectively, × 18.75. — **29-30**, valve II, dorsal and rostral view respectively, × 18.75. — **31-33**, valve III, dorsal, ventral and lateral view respectively, × 18.75. — **34**, two types of marginal spicules, × 150. — **35**, dorsal girdle spicules *in situ*, × 75. — **36**, ventral scales, × 300. — **24-36**, holotype.

length of the foot, which is narrow, the width at most 1/7 of the length. Gills merobranchial, abanal, about 20 ctenidia per side.

Radula not examined.

ETYMOLOGY. — From the Latin *vermis* = worm, so worm-like chiton ; *vermiculus* = diminutive of *vermis*, meaning little worm, relating to the scantiness and worm-like appearance of the animal.

DISCUSSION. — This remarkable species shows some affinities to the genus *Callochiton* Gray, 1847, especially in the slitting of the insertion plates and the presence of a jugal plate in the valves II-VIII. The texture of the tegmentum, however, along with the elongate shape of the animal and the absence of extrapigmentary eyes in the shell plates, are of a more ischnochitonoid character. That is why the new genus *Vermichiton* has been created for this unique species, which should be classified with *Connexochiton* Kaas, 1979.

Genus *CONNEXOCHITON* Kaas, 1979

Connexochiton discernibilis sp. nov.

Figs 37-49

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 30.VIII. 1985 : 17 spms, MNHN/holotype + 10 paratypes ; RMNH 9265/2 paratypes ; VB 2984/2 paratypes ; AMS/ 1 paratype ; NMNZ/1 paratype.

DIAGNOSIS. — Animal small, elongate oval, up to 7.5 × 3.5 mm, white, highly elevated, side slopes straight, back carinated.

Lateral areas raised, with 5-7 radial sulci crossed by numerous fine, concentric lines. Central areas with a vague pattern of depressions, parallel to the diagonal ridges, crossed by concentric striae. Head valve and postmucronal area sculptured like lateral areas. Apophyses connected by a jugal plate, showing a small sinus in the median line of valves III-VII. Girdle narrow, covered with small, striated scales.

DESCRIPTION. — Animal elongate oval, twice as long as wide, small, the largest c. 7.5 × 3.5 mm, highly elevated (dorsal elevation c. 0.58), side slopes straight, the back sharply carinated. Valves slightly though sharply beaked. Colour of tegmentum and girdle white.

Head valve semicircular, posterior margin widely V-shaped, anterior slope steep, straight. Valve II longer than the others, forwardly produced in the jugal region, the anterior margin concave at both sides of the jugum. Valves III-VII transversely rectangular, anterior and posterior margins almost straight, but for the apex, forming a small but well marked beak. Side margins a little convex. Lateral areas slightly raised. Posterior valve crescent-shaped, more than twice as wide as long, anterior margin barely concave, mucro not prominent, central, posterior slope rather flat, only little excavated directly behind the mucro. Sculpture weakly pronounced, consisting of 6-8 fine radial grooves in the lateral areas, 25-30 in the head valve, less in the postmucronal area of the tail valve, separating weakly granulose riblets and crossed by numerous fine, concentric lines. Central areas vaguely sculptured with a series of wavy depressions parallel to the diagonal ridges, crossed by concentric striae, the jugum practically smooth.

Articulamentum well developed, forming a rather long jugal plate between the apophyses, dorsally with a few striations, in valves III-VII with a very small, narrow median sinus. Slit formula of insertion plates 9/1/8, teeth sharp, slit rays distinct, eaves solid.

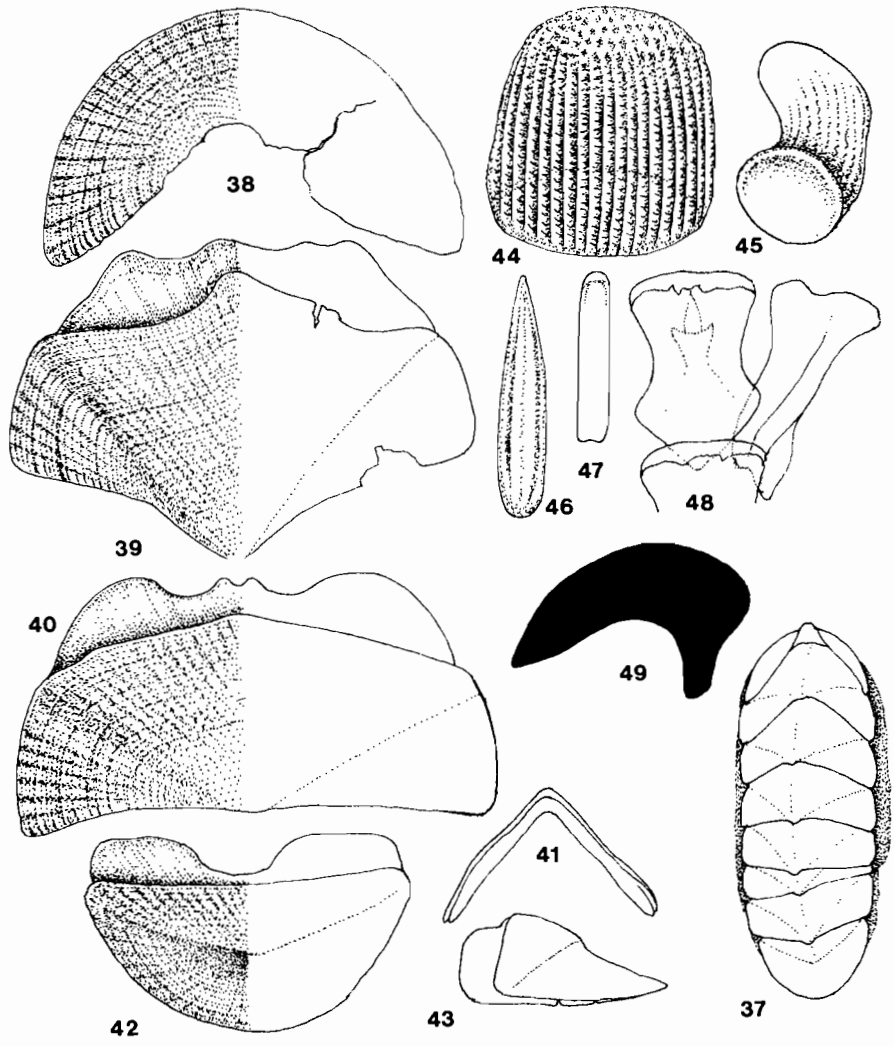
Girdle rather narrow, dorsally covered with small, rather elongate, curved, imbricating scales, the base elliptical, 72 μm wide, 80 μm high on mid-girdle, up to 130 μm along the valves' edges. They are sculptured with about 18 parallel, longitudinal riblets, as wide as the finely latticed interstices ; shortly before reaching the rounded top of the scale the riblets break into a reticulate pattern. Ventral scales elongate rectangular, distally rounded, 56 × 10 μm on mid-girdle. Marginal spicules spindle-shaped, pointed, 80 × 16 μm, with a few longitudinal riblets.

Central tooth of radula relatively wide, somewhat pinched in the middle, acutely widening in the basal part, with a narrow, straight blade ; minor laterals narrow, elongate, the distal edge wider, bilobed, without a blade ; major laterals with a single, strongly curved, sharply pointed cusp.

Gills merobranchial, adanal with interspace ; c. 13 ctenidia per side.

ETYMOLOGY. — The Latin adjective *discernibilis* means discernible, as the species is easy to distinguish.

DISCUSSION. — This is the first *Connexochiton* described from the Pacific Ocean, the three previously reported species are found in the deep water of the Atlantic, viz. *C. platynomenus* Kaas, 1979, the type of the genus, from the eastern side (Brittany to Morocco and in the Mediterranean Sea), *C. moreirai* (Righi, 1973) and *C. bromleyi* (Ferreira, 1985) from the tropical western side. *C. discernibilis* is easily recognizable by the absence of a pustulose tegmental sculpture and by its highly arched, sharply carinated shape.



FIGS 37-49. — *Connexochiton discernibilis* sp. nov. : **37**, complete specimen, dorsal view, × 6.6. — **38**, valve I, dorsal view, × 20.5. — **39**, valve II, dorsal view, × 20.5. — **40**, valve III, dorsal view, × 20.5. — **41**, *id.*, rostral view, × 10. — **42**, valve VIII, dorsal view, × 20.5. — **43**, *id.*, lateral view, × 20.5. — **44**, dorsal scale from mid-girdle, dorsal view, × 415. — **45**, *id.*, from inner margin, ventral view, × 205. — **46**, marginal spicule, × 415. — **47**, ventral scale, × 415. — **48**, central and first lateral radula teeth, × 415. — **49**, head of major lateral tooth, × 415. — **37-49**, paratypes (MNHN).

Genus *ISCHNOCHITON* Gray, 1847

Subgenus *STENOSEMUS* von Middendorff, 1847

Ischnochiton (Stenosemus) delicatus sp. nov.

Figs 50-56

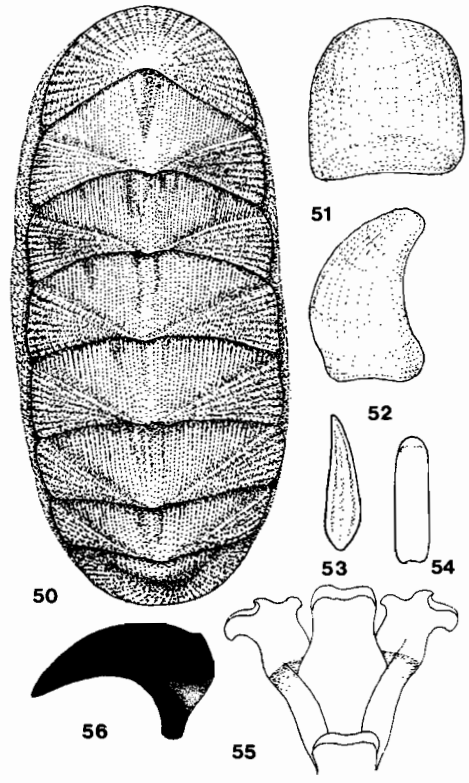
MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn CP 167, 18°36′ S, 163°06′ E, 575 m, 16.IX.1985 : 1 spm, holotype (MNHN). — Stn DW 221, 22°59′ S, 167°37′ E, 515-560 m, 29.IX.1985 : 1 spm, incomplete, paratype (MNHN).

DIAGNOSIS. — Animal of small to moderate size, elongate oval, more than twice as long as wide, rather elevated, valves slightly beaked, lateral areas little raised. Tegmentum white, finely granulated ; head valve, lateral and postmucronal areas with many weak radial grooves, crossed by fine, close-set concentric lines, central and antemucronal areas with many parallel longitudinal chains of very fine granules, obsolete on the jugum ; mucro of tail valve slightly antemedian. Girdle with short, globular, almost smooth scales. Dental cap of major lateral radula tooth with a single cusp.

DESCRIPTION. — Animal white, rather elongate oval, 17.5 × 7.0 mm, highly arched (dorsal elevation 0.47), carinated, side slopes weakly convex. Intermediate valves of about equal width, only slightly beaked, lateral areas little raised. Tegmentum granular, girdle narrow, scaly.

Head valve semicircular, posterior margin widely V-shaped, with a small notch at the apex, anterior slope straight, tegmentum granular, the granules transversely oval, arranged in radiating rows, separated by narrow, shallow grooves in the lower half. Intermediate valves rectangular, front marging nearly straight, except in valve II, which is forwardly produced, strongly convex between the apophyses, hind margin straight, with a small, hardly protruding apex. Side margins little convex. Lateral areas well marked, weakly raised, sculptured like head valve, with c. 10 shallow grooves ; central area with 30 or more longitudinal rows of roundish, separated, little elevated granules on the pleural sides, obsolete on the jugum. Tail valve with the mucro a little anterior, not swollen, the posterior slope straight, with only a slight excavation directly behind the mucro. Antemucronal area sculptured like central areas, postmucronal area like head valve.

Articulamentum well developed, white, apophyses moderately wide, broadly rectangular with rounded top, connected by a very short jugal plate, hardly projecting beyond the tegmentum. Insertion plates rather short, smooth-edged in valves I-VII, finely toothed in VIII. Slit-formula 7/1/7, slit rays distinct, eaves narrow, solid.



FIGS 50-56. — *Ischnochiton (Stenosemus) delicatus* sp. nov. : **50**, whole specimen, dorsal view, × 4.5. — **51**, dorsal girdle scale, × 187.5. — **52**, *id.*, lateral view, × 187.5. — **53**, marginal spicule, × 187.5. — **54**, ventral scale, × 187.5. — **55**, central and first lateral radula teeth, × 187.5. — **56**, head of major lateral tooth, × 187.5. — **50-56**, holotype.

Girdle rather narrow, partly folded under, regularly paved with dorsally globular, almost smooth to obsoletely striated, ventrally concave scales, up to 110 × 120 μm on mid-girdle, rapidly decreasing in size towards the outer margin, which bears a short fringe of conical, weakly ribbed spicules, up to 100 μm long, 24 μm thick at the base. Ventral side of girdle covered with radial rows of rectangular scales, slightly emarginate proximally, rounded distally, 90 × 25 μm on mid-girdle, shorter towards the outer margin.

Radula 7.3 mm long, which is c. 40 percent of the length of the body, with 28 rows of mature teeth. Central tooth bulged in the proximal half, with a weakly bilobed blade, first laterals of about equal length, distally with small projections in- and out-wardly, dental cap of major lateral tooth with a single, sharply pointed, strongly bent cusp.

Gills merobranchial, adanal with interspace; c. 22 ctenidia per side.

ETYMOLOGY. — The Latin adjective *delicatus* means fine of texture.

DISCUSSION. — Of the eight hitherto described species of the subgenus *Stenosemus* only *L. (S.) substriatus* Kaas & Van Belle, 1989 from the Cape Verde Archipelago, bears a slight resemblance to the new species, although it differs significantly in its much smaller size, in the absence of radial grooves in end valves and lateral areas, in the decidedly ribbed girdle scales and in the bicuspid dental cap of the major lateral radula tooth.

Ischnochiton (Stenosemus) robustus sp. nov.

Figs 57-67

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 30.VIII. 1985 : 5 spms, paratypes, totally disarticulated (MNHN/ 2, AMS/1, NMNZ/1, VB 2985/1).

MUSORSTOM 4 : stn CP 193, 18°56′ S, 163°23′ E, 415 m, 19.IX.1985 : 2 spms, smashed, paratypes (MNHN). — Stn CP 194, 18°53′ S, 163°22′ E, 545 m, 19.IX.1985 : 1 spm, paratype (MNHN). — Stn DW 221, 22°59′ S, 167°37′ E, 535-560 m, 29.IX.1985 : 2 spms, holotype (MNHN) and paratype (RMNH 9266). — Stn DW 230, 22°57′ S, 167°12′ E, 390-420 m, 30.IX.1985 : 1 spm, paratype (MNHN).

SMIB 2 : stn DW 10 : 22°55′ S, 167°16′ E, 490-495 m, 18.IX.1986 : 1 spm dry, paratype (MNHN).

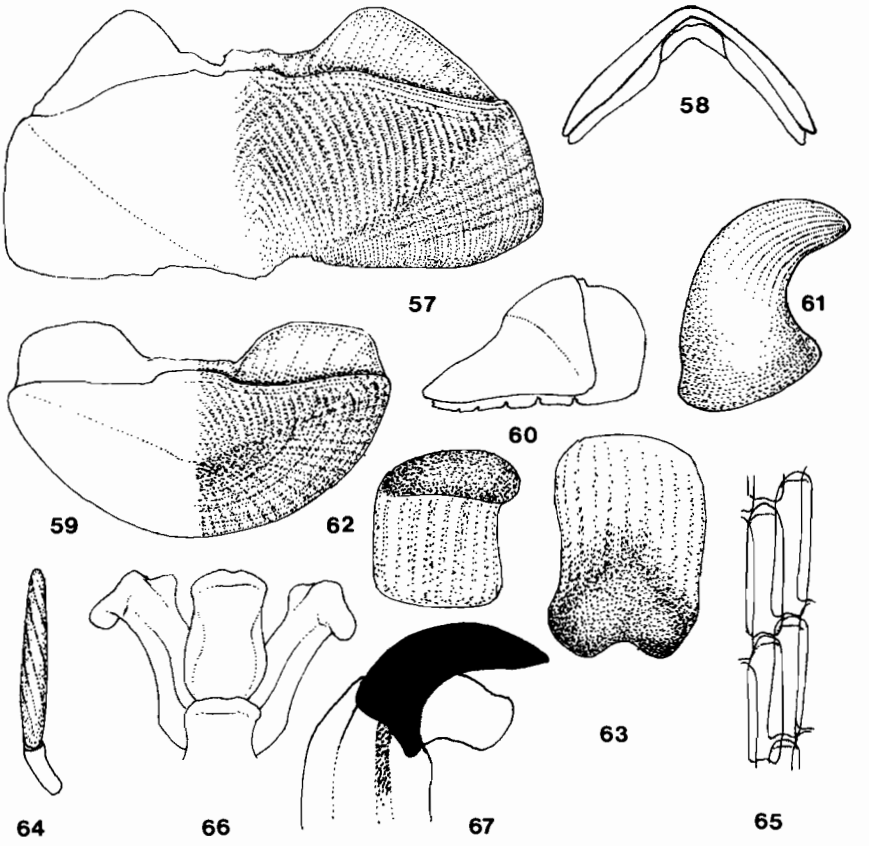
DIAGNOSIS. — Animal of moderate size, elongate oval, twice as long as wide, c. 30 × 15 mm, rather highly elevated, carinated, valves not beaked, lateral areas weakly raised, obsoletely radially ribbed, central areas with close-set, forwardly converging sulci. Head valve and postmucronal areas of tail valve sculptured like lateral areas. Colour white. Girdle with curved, bulbose, finely striated scales. Head of major lateral radula tooth unicuspid.

DESCRIPTION. — Animal elongate oval, holotype 29.8 × 14.8 mm, highly elevated (dorsal elevation 0.50), carinated, side slopes straight. Valves of equal width, the intermediate ones truncated at the outer margins, not beaked.

Head valve semicircular, posterior margin widely V-shaped with a rounded apical notch, anterior slope steep, straight, sculptured with c. 40 obsolete radial grooves. Intermediate valves rectangular, about twice as wide as long, front margin somewhat sinuate, with the jugal sinus slightly convex, the pleural parts concave, forming a sharp angle with the side margins; posterior margin straight, the apex not projecting, hardly discernible. Lateral areas well marked, only slightly raised, with 6-8 obsolete radial grooves, crossed by numerous fine growth lines, especially towards the outer margin. Central area with c. 30 forwardly converging, well marked sulci on either side, hardly narrower than the flat riblets in between. Tail valve short, outer margin 1/3 of a circle, front margin straight, but for a slight projection in the jugal sinus, mucro almost central, slightly swollen, postmucronal slope concave. Antemucronal area sculptured like the central areas, postmucronal area like the head valve and lateral areas.

Articulamentum well developed, white, apophyses rather long and wide, bluntly triangular in intermediate valves, trapezoid in tail valve, always connected by a narrow but distinct, dorsally striated jugal plate; sinus straight to somewhat convex. Insertion plates with 10/1/10-12 inequidistant slits, slit-rays distinct; eaves solid.

Girdle moderately wide, paved with curbed, dorsally bulbose, finely striated scales, c. 100 μm wide, up to 140 μm high on mid-girdle. There is a marginal fringe of fine, cylindrical, blunttopped, spirally grooved spicules, 112 × 16 μm. Ventral scales rectangular, distally rounded, 80 ×



FIGS 57-67. — *Ischnochiton (Stenosemus) robustus* sp. nov. : **57**, valve IV, dorsal view, × 5. — **58**, *id.*, rostral view, × 2.5. — **59**, tail valve, dorsal view, × 5. — **60**, *id.*, lateral view, × 5. — **61**, dorsal girdle scale from mid-girdle, lateral view, × 210. — **62**, *id.*, from side margin, ventral view, × 210. — **63**, *id.*, from mid-girdle, ventral view, × 210. — **64**, marginal spicule, × 210. — **65**, ventral scales, × 210. — **66**, central and first lateral radula teeth, × 210. — **67**, major lateral tooth, × 210. — **57-60**, paratype from MUSORSTOM 4, stn DW 223 (MNHN). — **61-67**, paratype from BIOCAL, stn DW 44 (MNHN).

24 μm on mid-girdle, shorter towards the outer margin, arranged in partly overlapping radial series.

Central tooth of radula rather short, widest in the proximal half, with a narrow, faintly bilobed blade ; first laterals relatively longer, with an excurved blade, projecting exteriorly ; major laterals with a unicuspid dental cap, the cusp curved, sharply pointed.

ETYMOLOGY. — The Latin adjective *robustus* means solid, relating to the texture of the shell plates.

OBSERVATIONS. — *I. (S.) robustus* differs significantly from all other species in this subgenus by the ornamentation of the central areas, which somewhat resembles that of certain delicately sculptured forms of *Chiton tuberculatus* Linnaeus, 1758.

Family SCHIZOCHITONIDAE

Genus *LORICELLA* Pilsbry, 1893

Loricella profundior (Dell, 1956)

Figs 68-73

Paricoplax profundior Dell, 1956 : 157, pl. 21, figs 213-219.
Componochiton raceki Milne, 1963 : 25, figs 1-5.
Loricella oviformis (pars) - KAAS, 1985 : 310, figs 41-45 ; 1990 : 178, figs. Non : *Squamophora oviformis* Nierstrasz, 1905.

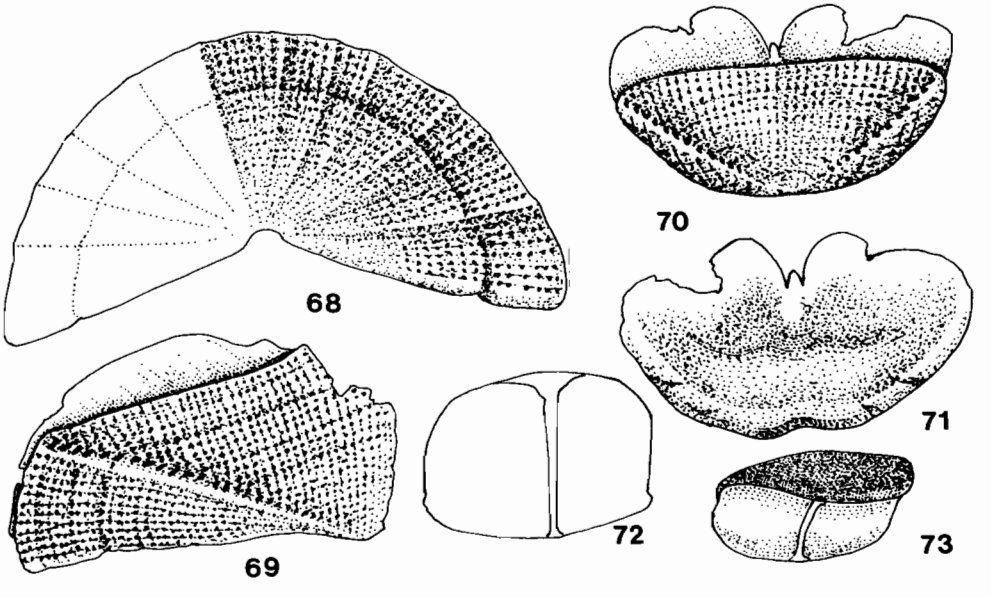
MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 08, 20°34′ S, 166°54′ E, 235 m, 12.VIII.1985 : 1 spm (MNHN).

MUSORSTOM 4 : stn DW 164, 18°33′ S, 163°13′ E, 255 m, 16.IX.1985 : 1 spm (MNHN). — Stn CP 215, 22°56′ S, 167°17′ E, 485-520 m, 28.IX.1985 : 2 spms (MNHN/1, RMNH/1).

CHALCAL 2, stn DW 72, 24°55′ S, 168°22′ E, 627 m, 28.X.1986 : 1 spm (MNHN). — Stn DW 76, 23°41′ S, 167°45′ E, 470 m, 30.X.1986 : 4 spms (MNHN/2, RMNH K2731/1, VB 2987/1). — Stn DW 80, 23°38′ S, 167°43′ E, 435 m, 30.X.1986 : 3 spms (MNHN).

SMIB 3 : stn DW 25, 22°56′ S, 167°16′ E, 437 m, 24.V.1987 : 1 spm (MNHN).

OBSERVATIONS. — In 1985 the author established the synonymy of the nominal species *Paricoplax profundior* Dell, 1956 and *Componochiton raceki* Milne, 1963 with *Squamophora oviformis* Nierstrasz, 1905, ranking them with the genus *Loricella* Pilsbry, 1893. Now that more specimens have turned up in New Caledonian waters it becomes obvious that they differ in several constant features from NIERSTRASZ's species, which measured 20 × 13 mm, whereas the Australasian specimens do not exceed 13 mm in length. The lateral areas of *oviformis* show only 7-9 radial ribs, the interstices solid, not perforated, while there are many more, much finer riblets, the interstices deeply pitted, in the Australasian and New Caledonian specimens, so that it appears justifiable to consider them as specifically different, resulting in the acknowledgement of *Loricella profundior* (Dell, 1956) as the valid name for the Australasian species.



FIGS 68-73. — *Loricella profundior* (Dell, 1965) : **68**, head valve, dorsal view, × 10. — **69**, left half of valve II, dorsal view, × 10. — **70**, valve VIII, dorsal view, × 10. — **71**, *id.*, ventral view, × 10. — **72, 73**, dorsal girdle scales, × 210. — **68-73**, spm from " *Vauban* " cruise, 1978/79, sta. 16 (from KAAS, 1985).

Family CHITONIDAE
Subfamily CHITONINAE

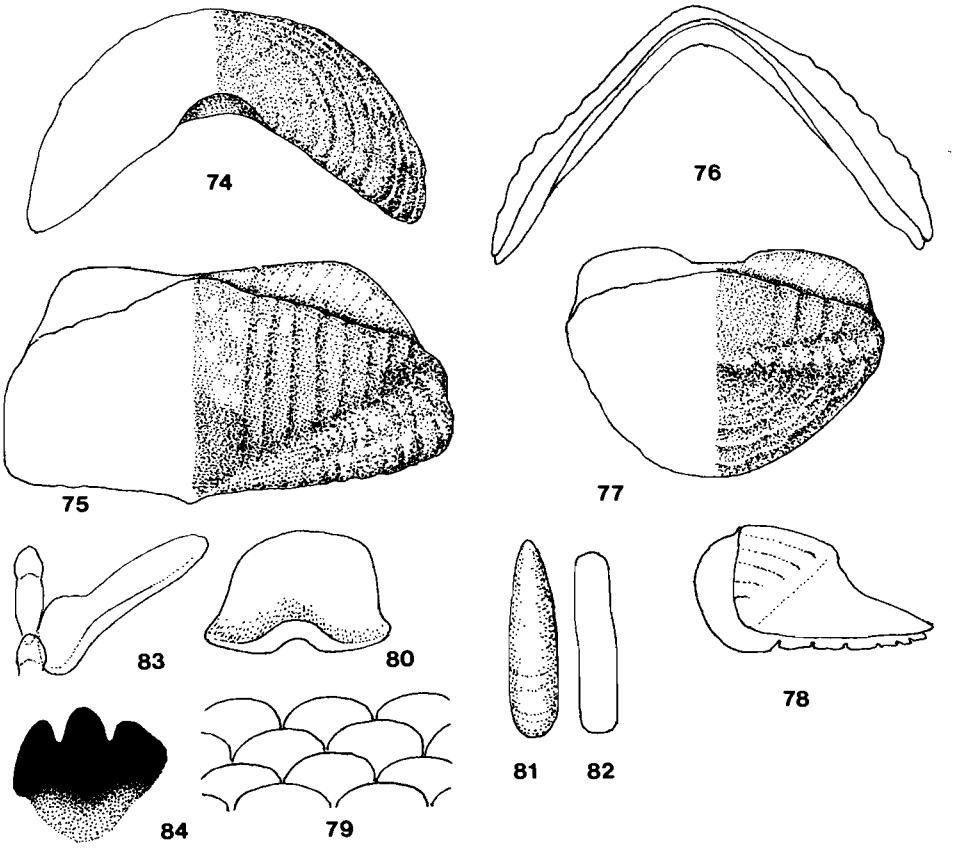
Genus *TEGULAPLAX* Iredale & Hull, 1926

Tegulaplax pulchra sp. nov.

Figs 74-84

MATERIAL EXAMINED. — **New Caledonia.** CHALCAL 2 : stn DW 80, 23°27′ S, 168°02′ E, 160 m, 30.X.1986 : 1 spm, holotype, now disarticulated (MNHN).

DIAGNOSIS. — Animal small, 7 × 3.5 mm, elongate oval, rather highly elevated, carinated. Valves little beaked, lateral areas well raised, with 6-8 white, concentric ridges, cut into two rows of transverse tubercles, one forming the diagonal ridge, the other accompanying the hind margin, by a slight radial depression. Central areas with a narrow, smooth jugal part, anteriorly produced, the pleurae with c. 8 deep longitudinal sulci on either side. End valves with c. 4-5 white, concentric, undulating ridges, cut into transverse tubercles by 8-10 vague radial depressions. Tegmentum light flesh-coloured, with roseate blotches and small white dots in the jugal region. Tail valve with mucro anterior, antemucronal and postmucronal areas separated by a tuberculose rib. Apophyses regularly rounded, connected across the shallow, convex sinus by a narrow jugal plate. Girdle roseate banded



FIGS 74-84. — *Tegulaplax pulchra* sp. nov. : **74**, valve I, dorsal view, × 21. — **75**, valve IV, dorsal view, × 21. — **76**, *id.*, rostral view, × 21. — **77**, valve VIII, dorsal view, × 21. — **78**, *id.*, lateral view, × 21. — **79**, dorsal girdle scales, dorsal view, × 105. — **80**, *id.*, ventral view, × 210. — **81**, marginal spicule, × 420. — **82**, ventral scale, × 420. — **83**, central and first lateral radula teeth, × 420. — **84**, head of major lateral tooth, × 420. — **74-84**, holotype.

with white, covered with imbricating, smooth scales. Dental cap major lateral radula tooth tricuspid. Gills merobranchial, adanal.

DESCRIPTION. — The unique type measures 6.8 × 3.6 mm, slightly curled before being disarticulated, elongate oval, carinated, dorsal elevation c. 0.57, side slopes convex. Head valve semicircular, anterior slope straight, the apex slightly notched, tegmentum ornamented with 4-5 white, concentric, wavy ridges, cut into transverse tubercles by c. 8 faint radial depressions, the marginal tubercles strongest developed. Intermediate valves less than twice as wide as long, the anterior margin convex, since the central area is decidedly produced anteriorly ; valve II relatively longer than the others. Posterior margin almost straight, the pointed apex barely protruding. Central area with 6-8 deep, longitudinal, parallel sulci, with only the innermost not reaching the front margin. Lateral areas well raised, with up to 8 white concentric ridges, divided by a slight radial depression into two rows of transverse, raised tubercles, the anterior one forming the diagonal rib, the other one accompanying the posterior margin. Posterior valve semi-elliptical, the mucro anterior at about 2/5 the length of the valve, posterior slope deeply concave, a strongly developed tuberculose rib separating the antemucronal area from the postmucronal one. Antemucronal area with 5 longitudinal sulci on either side of the smooth jugum, postmucronal area with 5-6 wavy, white, concentric ridges.

Articulamentum well developed, white to light roseate, insertion plates narrow. Slit formula 9/1/11, slits inequidistant, slit rays hardly conspicuous, teeth finely striated outside, eaves finely porous. Apophyses rather short, regularly rounded, close together, separated from a narrow jugal plate across the shallow, convex sinus, by distinct grooves.

Girdle moderately wide, dorsally clothed with small, imbricating, bluntly rounded, smooth scales, up to 120 × 80 μm (mean 108 × 52 μm), ventrally with a roundly emarginated base. Marginal spicules smooth, bluntly pointed, 60 × 16 μm, ventral scales elongate rectangular, truncated at both sides, 56 × 12 μm.

Radula short, c. 1.6 mm long, with c. 25 rows of mature teeth. Central tooth small, narrow, bearing an acorn-shaped blade, minor laterals twice as long, widely diverging, more or less wing-like, major laterals with a short, tricuspid head, the cusps bluntly rounded, the central one longest.

Gills merobranchial, occupying c. 3/4 of the length of the foot, adanal with interspace, c. 18 ctenidia per side.

ETYMOLOGY. — From the Latin adjective *pulcher* = beautiful.

OBSERVATIONS. — *T. pulchra* is the third known species of this genus. It is closely related to *T. boucheti* Kaas, 1989 from the Philippines, mainly differing from it in the smooth dorsal scales (ribbed in *boucheti*), in the tricuspid head of the major lateral radula tooth (non-cuspid in *boucheti*) and in the anterior position of the mucro (posterior in *boucheti*).

Suborder ACANTHOCHITONINA

Family ACANTHOCHITONIDAE

Subfamily ACANTHOCHITONINAE

Genus ***NOTOPLAX*** H. Adams, 1861

Subgenus ***SPONGIOCHITON*** Dall, 1882

Notoplax (Spongiochiton) producta (Carpenter *in* Pilsbry, 1892)

Spongiochiton productus Carpenter *in* Pilsbry, 1892 : 26.

Acanthochites (Notoplax) carpenteri Pilsbry, 1893 : 33, pl. 1, figs 14-22.

Acanthochites (Notoplax) involutus Carpenter *in* Pilsbry, 1893 : 35, pl. 1, figs 27-35.

Craspedochiton liberiensis Thiele, 1909 : 33, pl. 4, figs 29-35.

Notoplax foresti Leloup, 1965 : 155, figs 1-3, pls 1-2. — KAAS, 1979 : 873.
Notoplax (Spongiochiton) producta - KAAS, 1989 : 109.

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 231, 22°34′ S, 167°10′ E, 75 m, 01.X.1985 : 2 spms (MNHN).

Genus *CRASPEDOCHITON* Shuttleworth, 1853

Craspedochiton hystricosus sp. nov.

Figs 85-96

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 66, 24°55′ S, 168°22′ E, 505-515 m, 03.IX. 1985 : 9 spms (MNHN/holotype and 4 paratypes, RMNH 9267/1 paratype, VB 2986/1 paratype, AMS/1 paratype, NMNZ/1 paratype).

CHALCAL 2 : stn DW 72, 24°55′ S, 168°22′ E, 627 m, 28.X.1986 : 1 spm, paratype (MNHN). — Stn DW 76, 24°40′ S, 168°38′ E, 573 m, 29.X.1986 : 1 spm, paratype (MNHN).

DIAGNOSIS. — Animal small, up to 12 × 6 mm, elongate oval, highly elevated, carinated, valves, including I, sharply beaked, jugal tract narrow, almost smooth, not distinctly separated from the evenly granulated latero-pleural areas. Head valve and latero-pleural areas with only a vague indication of radial ribs corresponding with the slits in the insertion plates. Tail valve small, the insertion plate degenerate posteriorly, with only a fine irregular dentition. Colour white. Girdle moderately wide, somewhat encroaching at the sutures, narrow posteriorly, slightly widening anteriorly, finely spiculose. Sutural tufts small, indistinct. Major lateral radula tooth with tricuspid dental cap.

DESCRIPTION. — Head valve semicircular, anterior slope straight to slightly convex, posterior margin widely V-shaped, with a small, pointed, protruding apex, outer margin wavy, slightly curving inwardly between the articulamental slits, corresponding with them five hardly raised radials are to be observed. Tegmentum roughly granulose, the granules of irregular shape, increasing in size towards the outer margin, arranged in curved series radiating in two directions from the apex. Intermediate valves highly arched, dorsal elevation c. 0.55, strongly carinated, side slopes straight to a little concave at both sides of the narrow jugal tract. Front margin rounded at both sides of the narrow, concave jugal sinus, side margins very short, more or less truncated, posterior margin concave at both sides of the sharply pointed, decidedly projecting apex. Tail valve small, the length c. 2/3 of the width, mucro slightly posterior, not prominent, back slope almost straight, front margin regularly rounded, antemucronal area sculptured like latero-pleural areas, postmucronal area like head valve.

Articulamentum thin, white, transparent. Intermediate valves with moderately wide, regularly rounded apophyses, close together, sinus rather deep, concave, about 1/6 of the width of the valve, convex in the tail valve, the apophyses of which are short and trapezoid. Insertion plates of head valve well developed, with 5 short, equidistant slits, slit rays hardly perceptible; intermediate valves with 1-1 small slits, tail valve with a very narrow, irregularly and shallowly toothed posterior insertion plate.

Girdle rather narrow posteriorly, somewhat widening anteriorly, dorsally coated with fine, white, straight or slightly bent, bluntly pointed spicules, smooth to weakly striated distally, up to 80-100 × 20-25 μm. Sutural tufts very small, composed of c. 40 fine needles, up to 800 × 16 μm. Ventral side of girdle covered with slightly smaller, straight, weakly longitudinally ribbed, slender spicules, 80 × 15 μm.

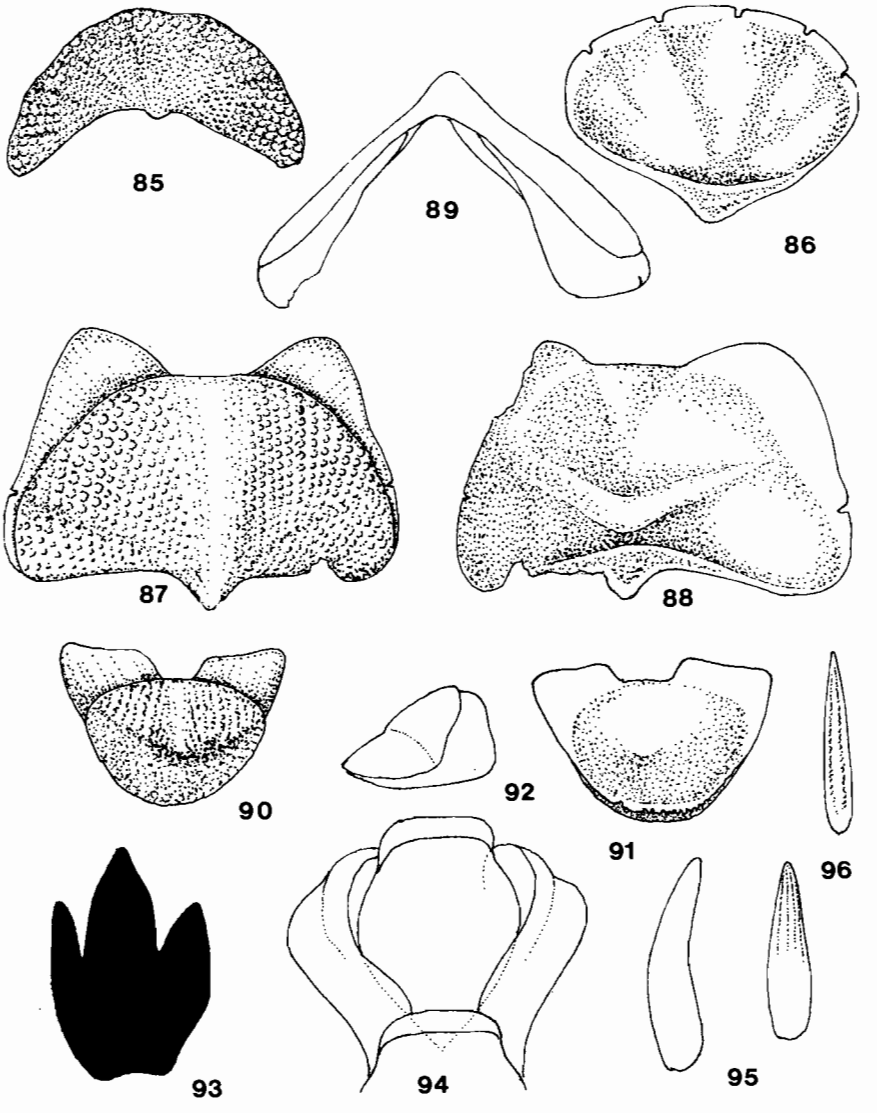
Radula with a bulging central tooth, bearing a narrow, straight blade, minor lateral teeth weakly S-shaped, parallel-sided, partly embracing the central teeth, major lateral with a tricuspid blade, the cusps pointed, the central one much longer than the others.

Gills merobranchial, adanal with interspace.

ETYMOLOGY. — The Latin adjective *hystricosus* is derived from *hystrix* (= porcupine), meaning spinous, relating to the nature of the girdle.

OBSERVATIONS. — *C. hystricosus* differs from all the known Australasian and West Pacific

species of *Craspedochiton* by the lack of well developed radiating ribs on the head valve and latero-pleural areas, by the small, hardly perceptible sutural tufts and especially by its sharply carinated, strongly beaked valves.



FIGS 85-96. — *Craspedochiton hystricosus* sp. nov. : **85**, valve I, dorsal view, × 11. — **86**, *id.*, ventral view, × 11. — **87**, intermediate valve, dorsal view, × 11. — **88**, *id.*, ventral view, × 11. — **89**, *id.*, rostral view, × 11. — **90**, valve VIII, dorsal view, × 11. — **91**, *id.*, ventral view, × 11. — **92**, *id.*, lateral view, × 11. — **93**, head of major lateral radula tooth, × 230. — **94**, central and first lateral radula teeth, × 230. — **95**, dorsal girdle spicules, × 230. — **95**, ventral spicule, × 230. — **85-96**, paratype from BIOCAL, stn DW 66 (MNHN).

REFERENCES

DALL, W. H., 1878. — Descriptions of new forms of mollusks from Alaska contained in the collections of the National Museum. *Proc. U.S. natn. Mus.*, **1** : 1-3.

DELL, R. K., 1956. — The archibenthal Mollusca of New Zealand. *Dom. Mus. Bull.*, **18** : 1-235, 265 figs, 2 pls.

FERREIRA, A. J., 1985. — Chiton (Mollusca : Polyplacophora) Fauna of Barbados, West-Indies, with description of a new species. *Bull. mar. Sci.*, **36** (1) : 189-219, 18 figs.

KAAS, P., 1979a. — On a collection of Polyplacophora (Mollusca : Amphineura) from the Bay of Biscay. *Bull. Mus. natn. Hist. nat. Paris*, (4) **1**, sect. A, (1) : 13-31, pls 1-5.

KAAS, P., 1979b. — The chitons (Mollusca : Polyplacophora) of Mozambique. *Ann. Natal Mus.*, **23** (3) : 855-879, pls 1-4.

KAAS, P., 1985. — Notes on Loricata (Mollusca) 11-14. 13, On some little known chitons from the tropical western Pacific. *Zool. Meded. Leiden*, **59** (25) : 309-314, figs 41-54.

KAAS, P., 1989. — Chitons (Mollusca : Polyplacophora) procured by the MUSORSTOM 3, Philippines expedition (1985). *In* : Résultats des Campagnes MUSORSTOM. Vol. 4 (3). *Mém. Mus. natn. Hist. nat. Paris*, (A), **143** : 105-111, figs 6-15.

KAAS, P., 1990. New species and further records of known species of Polyplacophora from the tropical Western Pacific. *Basteria*, **54** : 175-186.

KAAS, P., & VAN BELLE, R. A., 1987. — *Monograph of living chitons*, **3** : 1-302, 117 figs, 52 maps, E. J. Brill/Dr. W. Backhuys, Leiden.

LELOUP, E., 1965. — Description d'une espèce nouvelle de chiton recueillie par la *Calypso* dans le Golfe de Guinée, *Notoplax foresti* sp. nov. *Bull. Mus. natn. Hist. nat. Paris*, (2), **37** (1) : 155-161, figs 1-3, 2 pls.

MILNE, K. L., 1963. — A new deep water chiton (Polyplacophora : Chitonidae) from eastern Australia. *J. malac. Soc. Aust.*, **7** : 25-27, 5 figs.

NIERSTRASZ, H. F., 1905. — Die Chitonen der Siboga Expedition. *Siboga Exp.*, **48** : 1-112, 8 pls.

PILSBRY, H. A., 1892-1894. — *Polyplacophora (chitons)*. *In* : G. W. Tryon, *Manual of Conchology*, **14** : 1-128, pls 1-30 (1892) ; i-xxxiv, 129-350, pls 31-68 (1893). **15** : 1-64 (1893) ; 65-133, pls 1-17 (1894).

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. *In* : Résultats des Campagnes MUSORSTOM. Vol. 6, (1). *Mém. Mus. natn. Hist. nat. Paris*, (A), **145** : 9-54, figs 1-13.

RIGHI, G., 1973. — Adições aos Polyplacophora brasileiros (Mollusca). *Papéis avuls. Zool. S. Paulo*, **6** (22) : 259-273, 46 figs.

THIELE, J., 1909. — Revision des Systems der Chitonen. I. *Zoologica Stuttg.*, **22** : 1-70, figs A-E, pls 1-6.

2

Mollusca Bivalvia : Archibenthal Nuculidae off New Caledonia

Wim BERGMANS

Universiteit van Amsterdam
Instituut voor Taxonomische Zoölogie (Zoölogisch Museum)
Postbus 4766, 1009 AT Amsterdam
The Netherlands

ABSTRACT

Six species of Nuculidae have been identified from dredgings between 250 and 430 m off western New Caledonia : *Nucula nitidulaformis* Powell, 1971 ; *N. kanaka, N. oppressa*, and *N. libera*, spp. nov. ; *Nucula* sp. indet. ; and *Leionucula strangei* (A. Adams, 1856). *Ennucula* Iredale, 1931, is considered a synonym of *Leionucula* Quenstedt, 1930. This nuculid fauna shows rather strong similarities to that of New Zealand.

RÉSUMÉ

Mollusca Bivalvia : Nuculidae bathyales de Nouvelle-Calédonie.

Six espèces de Nuculidae ont été identifiées dans des récoltes faites entre 250 et 430 m de profondeur à l'ouest de la Nouvelle-Calédonie : *Nucula nitidulaformis* Powell, 1971 ; *N. kanaka, N. oppressa* et *N. libera*, spp. nov. ; *Nucula* sp. indét. ; et *Leionucula strangei* (A. Adams, 1856). *N. nitidulaformis* et *L. strangei* ont été décrites de la Nouvelle-Zélande. *N. kanaka* montre des similitudes avec *N. nitidula* A. Adams, 1856, de la Nouvelle-Zélande et des Îles Chatham, et avec *N. beachportensis* Verco, 1907, de l'Australie. *N. oppressa* ressemble à *Linucula recens* Dell, 1956, de la Nouvelle-Zélande et des Îles Chatham. Seule *N. libera* ne se rapproche pas d'une espèce de la Nouvelle-Zélande et, d'une manière générale, l'ensemble étudié a des rapports morphologiques assez étroits avec la faune de Nuculidae de la Nouvelle-Zélande. *Nucula strangei* a été classée dans le genre *Leionucula* Quenstedt, 1930, qui est caractérisé par l'absence d'une structure radiale intérieure des valves, qui par suite ont des bords lisses. *Ennucula* Iredale, 1931, est considérée comme un synonyme de *Leionucula*. Toutes les autres espèces rapportées possèdent cette structure et le bord ventral crénelé correspondant, et sont classées dans *Nucula* Lamarck, 1799. Dans *N. libera*, le bord ventral n'est crénelé qu'à partir d'une certaine taille.

BERGMANS, W., 1991. — Mollusca Bivalvia : Archibenthal Nuculidae off New Caledonia. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 29-40. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

On account of my earlier work on a number of Australian Nuculidae (BERGMANS, 1978) Dr Philippe BOUCHET of the Muséum national d'Histoire naturelle in Paris invited me to study a collection of Nuculidae from dredgings from off the west coast of New Caledonia by the vessel "*Vauban*" in 1978 and 1979. As this material offered an obvious opportunity to improve our knowledge and further shape ideas on the distribution patterns of archibenthal species or species aggregates in the Australian-Pacific region, and related taxonomic concepts, I accepted the offer with gratitude. This paper presents the results of this study.

MATERIAL AND METHODS

The material on which this report is based is listed under the species in the taxonomic section. Descriptions are in accordance with the terminology adopted in BERGMANS, 1978, and are explained in the Method paragraph of that paper. The present collection is housed in the Muséum national d'Histoire naturelle in Paris (MNHN); small samples have been deposited in the Zoölogisch Museum of the University of Amsterdam (ZMA). The photographs in this paper have been made with a scanning electron microscope.

SYSTEMATIC ACCOUNT

Nucula nitidulaformis Powell, 1971

Figs 1-2

MATERIAL EXAMINED. — 1 complete shell, 4 odd valves, collected by Ph. BOUCHET, 23 May 1978, at "*Vauban*" Stn 2, 22°17′ S, 167°14′ E, **New Caledonia**, depth 425-430 m (1 shell, 3 valves : MNHN ; 1 valve : ZMA).

DESCRIPTION. — Valves small, relatively solid, moderately convex, trapezoid ovate in outline. Lunule only slightly depressed. Dorsal margin weakly curved, without median angulation. Posterior margin truncated, straight ; posterodorsal angle not very distinct, posteroventral angle rather distinct. Anterior margin somewhat truncated, slightly curved ; dorsal margin gradually passing into anterior margin, anteroventral angulation broadly rounded but quite distinct. Ventral margin rounded anteriorly and slightly less so posteriorly. Exterior of embryonic shell with probably bifid umbo (shells too worn to be conclusive) and microscopically pitted surface. Interdissonconch smooth except growth lines. Remaining valve part with some pronounced growth lines and on the median part more or less affected by fine inner radial structure, which corresponds with crenulation of ventral margin. Hinge moderately strong, with up to 8 anterior and 5 posterior V-shaped secondary teeth (in the largest specimens of this sample). Tooth rows separated by a small chondrophore with a rounded or slightly angular ventral margin, only slightly projecting beyond hinge line, directed downward and very weakly forward. Dorsal margin somewhat thickened and flattened at both sides above chondrophore. No discernable trace of primary teeth. Adductor muscle scars distinct. Mantle line with shallow incurvation just anterior of the middle.

Shells white or tinged with pale brown. Traces of transparent light brown periostracum preserved in two specimens.

Measurements : Table 1.

DISCUSSION. — *Nucula nitidulaformis* was described from specimens dredged at 366-475 m,

TABLE 1. — Measurements in mm and number of secondary teeth in *Nucula nitidulaformis* Powell, 1971 from " *Vauban* " Station 2, New Caledonia.

Specimen	Length	Height	Section (one valve)	Length embryonic shell	Number of secondary teeth anterior	posterior
MNHN (right)	1.84	(1.64) +	0.60		8	4
ZMA (left)	1.84	1.60	0.56		8	5
MNHN (right) '	1.76	1.48			7	3
MNHN (doublet)	1.56	1.28	0.44	c. 0.34		
MNHN (right)	(1.48) "	1.28	0.44	0.28	6	4

+ Ventral margin incomplete ; ' figured specimen ; " posterior margin damaged.

east of Aldermen Islands, Bay of Plenty, New Zealand. The smallest specimen in the original lot, the holotype, measures 4.4 mm in length, the largest 7.8 mm. Larger specimens appear to be relatively high. Possible differences between New Zealand specimens and New Caledonian ones are the relatively low number of posterior secondary teeth in the latter and the rather perpendicular orientation of its chondrophore. POWELL (1971) counted 10 anterior and 8 posterior teeth (called posterior and anterior by him, respectively) in one of the Aldermen Islands specimens — without indicating valve length. He described the chondrophore as narrow, spoon-shaped, and anteriorly oblique. His photographs of the holotype specimen suggest that its chondrophore resembles that of the specimens from New Caledonia but unfortunately they are not distinct enough to be conclusive. In this connexion it may be of importance that POWELL did not assign *Nucula nitidulaformis* to the genus *Pronucula* Hedley, 1902 (considered a synonym of *Nucula* Lamarck, 1799, by the present author ; see BERGMANS, 1978). Although there is a definite anteriorly directed vector in its orientation, the chondrophore in the New Caledonian specimens possesses the configuration thought to warrant recognition of *Pronucula* by POWELL. The present sample appears to be the first to be reported after the description of the species.

Nucula kanaka sp. nov.

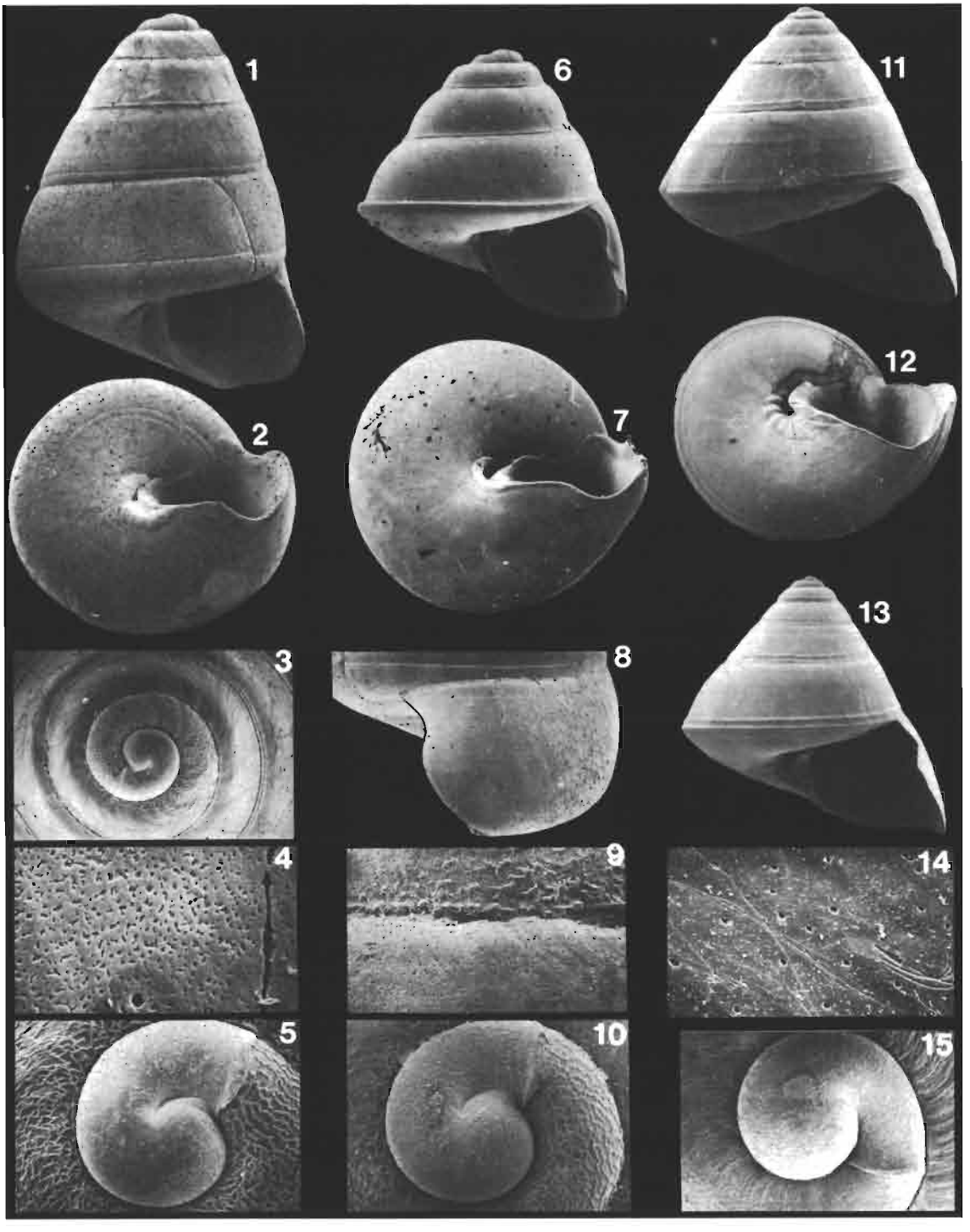
Figs 3-4

MATERIAL EXAMINED. — *Holotype* : 1 complete shell, collected by Ph. BOUCHET, 23 May 1978, at "*Vauban*" Stn 2, 22°17′ S, 167°14′ E, **New Caledonia**, depth 425-430 m (MNHN).

Paratypes : 2 left valves, data as for holotype specimen (MNHN ; ZMA 3.88.001) ; 1 left valve, collected by Ph. BOUCHET, 23 May 1978, at " *Vauban* " Stn 3, 22°17′ S, 167°12′ E, **New Caledonia**, depth 390 m (MNHN).

DIAGNOSIS. — Shell small, triangular, relatively high, smooth except irregular growth lines. Chondrophore small but essentially oblique. Anterior tooth row continuing above chondrophore. Ventral margin crenulated.

DESCRIPTION. — Valves rather small, moderately solid, thickened in the median area, not much inflated, rounded triangular in outline. Lunule not depressed. Dorsal margin weakly curved, short, gradually passing into long and nearly straight anterior margin and strongly descending straight posterior margin. Ventral margin evenly rounded. Anteroventral angulation rounded, posteroventral angulation rather distinct. Umbo pointed. Delimitations of embryonic shell and interdissoconch not discernable in the present material. Sculpture consisting of growth lines and, on the median area, occasional radial lines corresponding with a radial inner structure. Ventral margin crenulated by this structure. Hinge without a trace of primary teeth and with rather narrow, V-shaped secondary teeth. Nine anterior and five posterior teeth in largest specimen. Anterior tooth row narrowing towards chondrophore, and continuing with only one or two very small teeth above it. Chondrophore small, oriented forwards, parallelling anterior tooth row ; its ventral margin slightly inflated posteriorly and making a rounded angle with its anterior margin. Adductor muscle scars shallow but distinct. Mantle line simple. One



FIGS 1-15. — Genera *Anxietas, Asthelys* : **1-5, 8,** *Anxietas inspirata*, holotype, 1.85 × 1.40 mm, 3 × 50, 4 (4th TW) × 73, 5 × 135, 8 × 35. — **6, 7,** *Anxietas exigua*, holotype, 1.60 × 1.65 mm. — **9, 10,** *A. exigua*, paratype, BIOCAL stn DW 08, 9 (end 1st TW) × 175, 10 × 120. — **11, 12, 14,** *Asthelys nitidula*, holotype, 3.90 × 3.75 mm, 14 (last TW) × 510. — **13, 15,** *A. nitidula*, BIOCAL stn DW 79, 3.50 × 3.55 mm, 15 × 90.

TABLE 2. — Measurements in mm and number of secondary teeth in *Nucula kanaka*, sp. nov., from " *Vauban* " Station 2 and 3, New Caledonia.

Specimen	Length	Height	Section (one valve)	Number of secondary teeth anterior	posterior
Holotype (Stn 2)	2.84	2.48	0.68	right 9	4
				left 8	5
Paratype (Stn 2)	2.70	2.44	0.80	9	5
Paratype (Stn 2)	2.40	2.16	0.64	9	4
Paratype (Stn 2)	2.04	1.82	0.60	7	3
Paratype (Stn 3)	2.60	2.25	0.72	8	4

valve with a remnant of a dark brown periostracum.

Measurements : Table 2.

DISCUSSION. — Only the holotype has a well preserved hinge. In the paratypes it is difficult to see if the chondrophore is rounded and directed downwards or short and pointing forwards, and if the anterior teeth ascend above it. *Nucula kanaka* resembles the New Zealand species *Nucula nitidula* A. Adams, 1856 *sensu* POWELL (1979 : 356, Fig. 83-2), but differs in outline and details of the hinge. It is more produced dorsoposteriorly, its anterior tooth row is proportionally much narrower posteriorly, and its chondrophore is much shorter and directed more forwards. *Nucula beachportensis* Verco, 1907 (see BERGMANS, 1978, Fig. 15-19), from Australian waters, seems also morphologically related to *N. kanaka*. *N. kanaka* differs from it in being higher and more triangular, with a proportionally longer posterior margin, a smaller angle between its tooth rows, and a shorter chondrophore.

ETYMOLOGY. — The species name *kanaka* is derived from " Kanak ", the original name of the people of New Caledonia.

Nucula oppressa sp. nov.

Figs 5-8

MATERIAL EXAMINED. — *Holotype* : 1 left valve, collected by A. WARÉN, 7 June 1979, at " *Vauban* " Stn 40, 22°30′ S, 166°24′ E, **New Caledonia**, depth 250-350 m (MNHN).

Paratypes : 54 valves, data as for holotype specimen (44 valves : MNHN ; 10 valves : ZMA 3.88.002).

DIAGNOSIS. — A small, ovate shell with a truncated posterior side ; essentially smooth ; with visible inner radial structure in the median area and finer, more traverse line structure in anterior and posterior areas ; typically nuculid teeth ; a short but very oblique chondrophore ; and all margins except the median part of the dorsal margin crenulated by the inner structure.

DESCRIPTION. — Valves rather small, thin to moderately solid, median area thickened in a number of the specimens — mostly in larger valves —, moderately inflated, ovate in outline except for almost perpendicular posterior side. Radial zone corresponding with straight posterior margin slightly depressed. Larger valves relatively higher. Dorsal margin curved, in some specimens with a slight angle beneath the umbo. Anterodorsal angulation poorly defined or absent. Posterodorsal angulation rounded but distinct. Anterior margin weakly curved, partly straight in some specimens. Posterior margin short and straight. Anteroventral junction weakly marked, rounded, posteroventral junction more distinct. Umbo pointed. Embryonic shell bifid, surface finely pitted. Interdissoconch smooth. Embryonic shell and interdissoconch without visible radial structure. Remaining part of valve essentially smooth, with fine growth lines and in some larger valves a few growth zones near the margin, mutually separated by grooves. Central part of valve with inner radial structure appearing as fine lines ; anterior and posterior parts with still finer and widely divergent line structure. In a number of specimens, most of which are quite worn, this finer structure is hardly or not discernable, especially on the posterior part. Ventral margin crenulated by the radial structure of the central part ; anterior and

posterior margins and adjoining parts of dorsal margin crenulated by the finer, divaricating structure. This latter crenulation is difficult to trace in the majority of the specimens but most probably distinct in fresh ones. Hinge without a trace of primary teeth. Dorsal margin slightly thickened at both sides above chondrophore. Chondrophore oblique, directed forwards, relatively short. Up to about 12 anterior and five posterior short, triangular, secondary teeth. Anterior tooth row with two or three small teeth above chondrophore. Adductor muscle scars and simple mantle line visible in good specimens. Periostracum not preserved.

Measurements : Table 3.

DISCUSSION. — Of the known nuculids, *Linucula recens* Dell, 1956, seems to be the morphologically nearest relative of *Nucula oppressa*. *N. oppressa* differs in being less equilateral, in having a relatively larger number of anterior teeth (11 in *recens* specimens up to 4.04 mm in length ; DELL, 1956a), in the more oblique and more elongate form of the chondrophore, and in the form of the teeth near the chondrophore. In *oppressa*, these teeth do not deviate from the normal nuculid type. In *recens* " the two central teeth of each series are larger than their fellows and meet dorsally under the beaks to give the appearance of a bifid tooth, the two arms of which form the lateral limits of the chondrophore " (DELL, 1956a). (It has occurred to me that this configuration can only exist in one valve of each specimen, but its counterpart has not been described.) *Linucula* was described as a subgenus of *Nucula* by MARWICK (1931), to accommodate small shells from the Tertiary of New Zealand with weak radial sculpture and finer radials on anterior and posterior parts. MARWICK did not describe the hinge, partly because it had not been preserved well enough in his specimens but his descriptions were very short anyway. DELL (1956a) included *Nucula gallinacea* Finlay, 1930, in *Linucula*, on account of a quite different type of aberrant sculpture on its anterior side ; his figures of this species show a hinge typical of *Nucula*. DELL (1956a) reflected on the differences between that hinge and the hinge of *Linucula recens*, suggesting that *Linucula* — which he had raised to generic rank because of the divergent sculpture on its lunule, its well-defined geographical range, and its long Tertiary history — might consist of two groups. BERGMANS (1978) described *Nucula brongersmai* from New South Wales, Victoria and Tasmania in Australia, which also has a sculpture of radial lines and diverging lines on anterior and posterior parts, but smooth margins, and a round chondrophore separating the tooth rows. While agreeing that forms of aberrant structure and sculpture of anterior and posterior valve parts are worth considering in efforts to define natural groups within the Nuculidae, I do not think that *Linucula* is well defined, or that the species with such structure and sculpture are necessarily closely related. Further studies of such species should attempt to describe, and preferably illustrate, their hinge configurations in detail.

ETYMOLOGY. — The specific name *oppressa*, derived from the Latin *opprimere* (to oppress, to hide) refers to the inner line structures, oppressed

TABLE 3. — Measurements in mm and number of secondary teeth in *Nucula oppressa*, sp. nov., from " *Vauban* " Station 40, New Caledonia.

Specimen	Length	Height	Section (one valve)	Number of secondary teeth anterior ++	posterior
Right valve	3.17	2.79	0.92	10	4
Left valve +	2.92	2.68	0.87	11	5
Right valve	2.75	2.38	0.75	10	4
Right valve	2.58	2.12	0.71	8	4
Right valve	1.88	1.58	0.50	6	3
Right valve	1.54	1.34	0.42	5	2

+ Holotype specimen (All others : paratype specimens).
++ Innermost anterior teeth often worn away.

in the sense that they do not affect the outer shell surface (except the margins) and hidden, or difficult to discern, in many specimens.

Nucula libera sp. nov.

Figs 9-12

MATERIAL EXAMINED. — *Holotype* : 1 complete shell, collected by A. WARÉN, 7 June 1979, at " *Vauban* " Stn 40, 22°30′ S, 166°24′ E, **New Caledonia**, depth 250-350 m (MNHN).

Paratypes : 13 complete shells and 246 valves, data as for holotype specimen (10 shells and 231 valves : MNHN ; 3 shells and 15 valves : ZMA 3.88.003).

DIAGNOSIS. — A small, trapezoid ovate shell, with a relatively long posterior side, rather many posterior teeth, a partly concave posterior margin, a smooth outer surface, a weak ovate chondrophore separating the tooth rows, and in large specimens a crenulated ventral margin.

DESCRIPTION. — Valves small, moderately solid to solid, thickened in the central area in a number of larger specimens, only moderately inflated, trapezoid ovate in outline. Lunule slightly inflated, demarcated by a radial depression corresponding with a concavity in the posterior margin. Escutcheon not defined. Dorsal margin straight to slightly concave beneath the umbo and evenly, although not strongly, rounded at the sides ; junction with anterior margin gradual or with a distinct angulation just above the anteriormost tooth, junction with posterior margin gradual. Anterior margin weakly rounded, ventrally straight in some specimens ; anteroventral angulation rather distinct. Posterior margin more or less convex along the tooth row and in most specimens distinctly concave beneath it ; posteroventral junction distinct. Ventral margin rather broadly rounded, especially posteriorly. Umbo rather pointed. Embryonic shell extremely small, squarish ovate, with microscopically pitted surface. Interdissoconch smooth, polished, its margin distinct in part of the specimens. Remaining outer surface smooth, sometimes, in large specimens, with some slightly raised growth zones, especially near ventral margin. Radial structure weakly visible at a certain angle of light only. Hinge moderately strong, with up to six anterior and five posterior, moderately long, secondary teeth. Tooth rows separated by ovate chondrophore.

Chondrophore wider than high, not much projecting beyond hinge line, with a weakly rounded ventral edge. Resilifer roundish triangular. Dorsal margin thickened at both sides above chondrophore, in some specimens with traces of possible vertical striae on these thickened parts. In large specimens the inner ventral margin is weakly crenulated. Only in very few specimens a corresponding structure of radial lines is visible over a short distance near the crenulations. Adductor scars visible. Mantle line with shallow incurvation. Periostracum thin, transparent, tinged yellowish brown.

Measurements : Table 4.

REMARKS. — It is quite unusual that the crenulation of the ventral margin in an apparently radially structured *Nucula* shell is present only in large, probably adult specimens, and it is quite confusing when identifying smooth-margined specimens of this species. The variable outline, from rather squarish when the anterodorsal angle is distinct and the posterior margin

TABLE 4. — Measurements in mm and number of secondary teeth in *Nucula libera* sp. nov., from " *Vauban* " Station 40, New Caledonia.

Specimen	Length	Height	Section (one valve)	Length embryonic shell	Length interdissoconch	Number of secondary teeth anterior	posterior
Paratype, left valve	1.62	1.42	0.38	0.22		4	3
Paratype, right valve	1.84	1.62	0.54	0.22	0.70	7	4
Holotype, right valve	2.18	1.88	0.60	0.22		6	4
Holotype, left valve						6	5
Paratype, right valve	2.21	1.96	0.64	0.20	0.76	7	4

nearly straight, along the tooth row, to trapezoid ovate when that angulation is not well marked and the posterior margin distinctly curved, adds to the identification problem. A further difficulty is that fresh specimens are transparent and worn specimens opaque. Moreover, the valves are of rather variable thickness. It may be problematical to identify individual specimens, and it is fortunate that the type series is so large.

ETYMOLOGY. — This species is named *libera*, meaning free or unrestrained, in memory of Dr Dick HILLENIUS, zoologist and writer, for whom freedom of thought and opinion were synonymous with life itself. Dr HILLENIUS, a colleague at the Instituut voor Taxonomische Zoölogie of the Universiteit van Amsterdam, died unexpectedly on the 4th of May 1987, at the much too early age of 59.

Leionucula strangei (A. Adams, 1856)

Figs 13-14

Nucula strangei A. Adams, 1856 : 52.
Ennucula strangei - DELL, 1956a : 11, pl. 1, fig. 1.

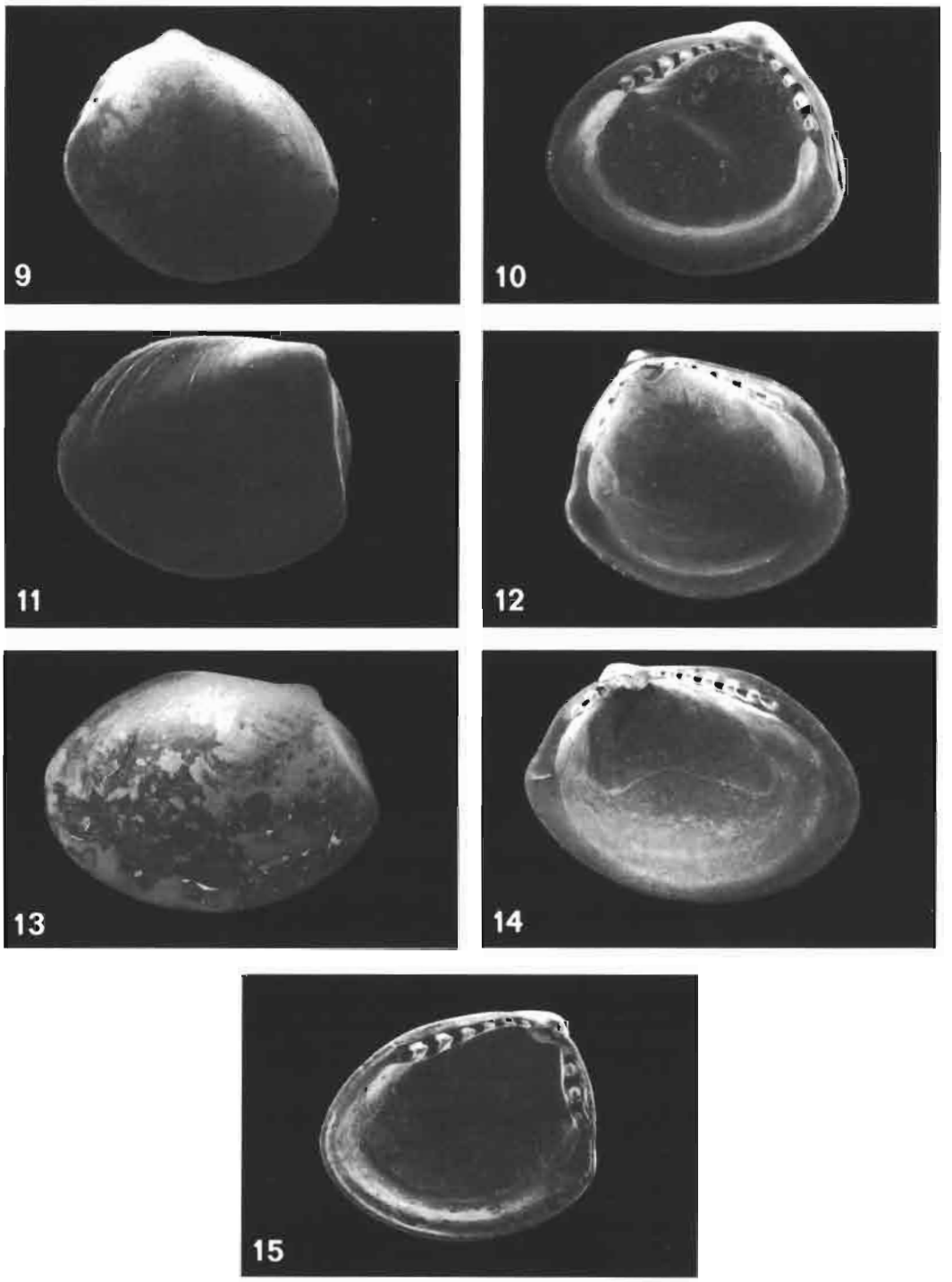
MATERIAL EXAMINED. — 31 valves, collected by A. WARÉN, 7 June 1979, at "*Vauban*" Stn 40, 22°30′ S, 166°24′ E, **New Caledonia**, depth 250-350 m (26 valves : MNHN ; 5 valves : ZMA) ; 1 valve, collected by A. WARÉN, 7 June 1979, at "*Vauban*" Stn 33, 22°33′ S, 166°25′ E, **New Caledonia**, depth 290-350 m (MNHN).

DESCRIPTION. — New Caledonian valves up to about 7 mm long, generally rather thin but thickened in the area enclosed by adductor muscle scars and mantle line, moderately inflated, broadly trapezoid in outline. Lunule and escutcheon slightly depressed, lunule bordered by a weak ridge. Older valves relatively more convex. Dorsal margin evenly curved, junctions with anterior and posterior margins gradual. Anterior margin very slightly convex in small specimens and straight or with a weak concavity above the junction with the ventral margin in large specimens. Posterior margin slightly concave below tooth row. Ventral margin broadly rounded, posteriorly somewhat flattened, gradually passing into anterior margin but with rather distinct posteroventral angle. Umbo rather pointed. Margins of embryonic shell and interdissoconch indistinct in these rather worn specimens. Embryonic shell microscopically pitted externally. Rest of valve with fine growth lines, which in large specimens may become quite pronounced near the valve margin, where a few growth zones may develop into concentric riblets. No trace of an inner radial structure or a corresponding sculpture.

Anterior hinge plate narrowing towards chondrophore and continuing above it. Posterior hinge plate rather wide, its inner margin undulated by the teeth. Chondrophore concave, rather long, projecting beyond hinge plate, oriented toward anteroventral junction of valve margin ; in young specimens (Fig. 14) the chondrophore hardly diverges from the anterior tooth row but after this stage its orientation changes and it becomes divergent. Up to 15 anterior and seven posterior secondary teeth, rather flat and broad, with weakly V-shaped basal sections. Adductor muscle scars distinct. Pallial line distinct, with a wide curve upward in the middle (Fig. 14). Shells white or tinged with very pale brown, polished inside. Periostracum not preserved. Inner ventral margin smooth.

Measurements : Table 5.

DISCUSSION. — DELL (1956b) figured an adult shallow-water specimen from Wellington Harbour, measuring 12.3 mm in length, and remarked that deep-water specimens do not attain a very large size. The present specimens are small, with a number of them about 7 mm in length, suggesting that this may be the adult size in the population concerned. Compared to DELL's figure, they are more trapezoid in outline, with a somewhat more truncated anterior margin and a slightly less produced posterior side, and only in large specimens a chondrophore resembling that in DELL's specimen. Of the Australian smooth-margined Nuculidae, *Nucula loringii* A. Adams & Angas, 1864 seems related. This species was synonymized with *Nucula cumingii* Hinds, 1843 by HEDLEY (1913), who figured the type specimen, but considered different from that species by IREDALE (1939), who figured a specimen from Low Isles, Queensland. To judge from those illustrations, *loringii* has a more produced posterior side, a larger angle between the tooth rows, much weaker teeth, and a narrower and longer chondrophore. Nevertheless, type material of *loringii* and *strangei* should be compared to



FIGS 9-15. — **9-10** : *Nucula libera*, sp. nov., right valve of paratype specimen, length 2.13 mm, from 250-350 m at " *Vauban* " Stn 40 (22°30′ S, 166°24′ E), New Caledonia (MNHN). — **11-12** : *Nucula libera*, sp. nov., left valve of paratype specimen, length 1.71 mm, data as for valve of figs 9-10. — **13-14** : *Leionucula strangei* (A. Adams), left valve, length 3.25 mm, from 250-350 m at " *Vauban* " Stn 40 (22°30′ S, 166°24′ E), New Caledonia (MNHN). — **15** : *Nucula* sp. indet., length 2.06 mm, from 425-430 m at " *Vauban* " Stn 2 (22°17′ S, 167°14′ E), New Caledonia (MNHN).

TABLE 5. — Measurements in mm and number of secondary teeth in *Leionucula strangei* (A. Adams, 1856) from " *Vauban* " Station 40, New Caledonia.

Specimen	Length	Height	Section (one valve)	Number of secondary teeth anterior	posterior
Right valve	7.17	5.50	1.83	14	7
Left valve	7.08	5.50	1.83	14	6
Left valve	6.10	4.71	1.25	12	5
Figured left valve	3.25	2.37	0.67	7	3

assess the possible relationship between the two forms. Unfortunately, HEDLEY (1913) offered no discussion on this point.

Nucula sp. indet.

Fig. 15

MATERIAL EXAMINED. — 1 right valve, collected by Ph. BOUCHET, 23 May 1978, at " *Vauban* " Stn 2, 22°17′ S, 167°14′ E, **New Caledonia**, depth 425-430 m (MNHN).

DESCRIPTION. — Valve small, very inequilateral, relatively solid, moderately convex, rounded triangular in outline. Median part of valve thickened. Lunule somewhat depressed, bordered by an indistinct radial ridge. Dorsal margin consisting of an anterior part which is curved at the ends and straight in the middle, and a very short, rather straight posterior part ; the two parts start beneath the umbo at slightly different levels (the posterior part more ventrally), causing a slight concavity in the dorsal margin. Anterodorsal junction obtuse, posterodorsal junction more distinct. Anterior margin weakly convex. Anteroventral junction a broad curve. Posterior margin weakly convex along tooth row and very weakly concave below it. Posteroventral angulation distinct. Ventral margin rounded. Surface of embryonic shell microscopically pitted. Outer surface of valve, including interdissoconch, smooth except very fine growth lines. Hinge rather strong, with seven anterior and four (fourth minute) posterior, short, secondary teeth. Anterior tooth row distinctly more narrow towards chondrophore and continuing above it. Chondrophore short, not extending far beyond ventral hinge line, distinctly forward directed, with its anterior margin bordering anterior tooth row but separated from posterior tooth row by small interspace. Dorsal margin peculiarly thickened along both tooth rows, with indistinct groove over the length of these, as if to receive two ridges dorsal to the tooth rows in the left valve. No trace of primary teeth. Adductor muscle scars visible. Mantle line with shallow incurvation in the middle. Valve white. Traces of a dark brown periostracum.

Measurements : Length 2.06, height 1.84, section 0.63 mm ; length of embryonic shell 0.23 and of interdissoconch 0.56 mm.

REMARKS. — As there is only one valve of this apparently undescribed species, and its condition is not perfect, I prefer to leave it without specific name.

Remarks on the genera *Leionucula* Quenstedt, 1930, and *Ennucula* Iredale, 1931

IREDALE's proposal to place smooth-margined *Nucula* species in a separate genus, *Ennucula* Iredale, 1931, has been followed by a number of authors for Australian and New Zealand species. In his diagnosis of *Ennucula*, IREDALE (1931) compared it with the type species of *Nucula* Lamarck, 1799, i. e. *Nucula nucleus* (Linnaeus, 1758), only. His diagnosis was very short : " a notably oblique chondrophore, above which the teeth become much smaller, and the angle of opposition of the two rows of teeth is scarcely marked ; further, the edge of the European shell

is strongly denticulate, whereas ours is practically smooth. "

As the obliqueness of the chondrophore is variable in both *Nucula* and in the species assigned to *Ennucula*, and the innermost anterior teeth, above the chondrophore, are smaller than their more anterior fellows in all Nuculidae with teeth above the chondrophore, the essential character of *Ennucula* seems to be its smooth margin. QUENSTEDT (1930) had proposed the genus *Leionucula* for smooth-margined Nuculidae. Although that author had not intended a systematic revision of the Family Nuculidae, his extensive study of morphological changes in its representatives through geological times resulted in conclusions about some natural sections, among which *Leionucula*. The diagnosis of this section, readily accepted as genus by THIELE (1934) and later authors, is " Bandgrubenzahn öfter, Verbindungsstück der Schlossplatte selten fehlend. Schalenrand glatt und daher die Grenzfläche von Schaloberschicht und Perlmutter eben. Gault bis jetzt. " (QUENSTEDT, 1930 : 112). (" Tooth-like projection on hinge plate part in between resilifer and posterior tooth row often, hinge plate part in question rarely lacking. Valve margin smooth and thus interface of outer and nacreous shell layers smooth. From Gault to Recent. ") Diagnostic for all species is the absence of radial inner shell structure and the corresponding smooth margin.

As IREDALE offered no additional characters which would separate *Ennucula* from *Leionucula* — apart from its supposedly different distribution in both time and space (IREDALE, 1939) — I consider *Ennucula* Iredale, 1931, a synonym of *Leionucula* Quenstedt, 1930. I have retained that genus for *Nucula strangei* A. Adams for the simple reason that there is no evidence that the shells of that species are radially structured, although it is not altogether impossible that they are (compare TAYLOR, KENNEDY & HALL, 1969). All other species described in this paper, except the as yet unnamed single valve, have crenulated ventral margins. *Nucula libera* is exceptional in that this crenulation develops only after a certain growth stage, but its inner radial structure is visible from the usual (prodissoconch) stage on.

Affinities of the New Caledonian archibenthal Nuculidae

The Nuculidae treated in this paper represent the first to be reported from New Caledonia. Two species, *Nucula nitidulaformis* and *Leionucula strangei*, have been described from New Zealand. The latter has been reported from Australia by SUTER (1913) but this has never been confirmed. In the present report it is suggested that *strangei* should be compared to the Australian *Nucula loringii* to assess if and how closely the two are related.

Nucula kanaka may be related to *N. nitidula* from New Zealand and Chatham Islands (POWELL, 1979) and to *N. beachportensis* from southeastern, southern and northwestern Australia (BERGMANS, 1978). *N. oppressa* seems to be related to *Linucula recens* from New Zealand and Chatham Islands (DELL, 1956b). *N. libera* is not obviously related to any of the known New Zealand species ; it may belong to the same lineage as the Australian *Nucula saltator* Iredale, 1939, from Queensland and possibly also from western Australia (BERGMANS, 1978) but that species is nevertheless quite distinct in a number of characters (compare Figs 27-29 in BERGMANS, 1978). The single valve listed provisionally as *Nucula* species cannot be associated with any of the known species.

It is possible that the New Caledonian archibenthal nuculid fauna, if examined further, will indeed be found to be more strongly related to that of New Zealand *sensu lato* than to others. At the same time the New Caledonian assemblage may partly consist of endemic species or species which do occur, or have their nearest relatives, off the Great Barrier Reef, eastern Papua or Rennell Island, for instance. From those areas no archibenthal Nuculidae seem to have been described yet.

ACKNOWLEDGEMENTS

I am much indebted to Dr Philippe BOUCHET for his confidence and his sustained patience during the preparation of this paper. Mr. Rob G. MOOLENBEEK of the Instituut voor Taxonomische Zoölogie of the Universiteit van Amsterdam made all the photographs, for which I am very grateful. He was assisted by the staff of the Vakgroep Elektronenmicroscopie of the same university.

REFERENCES

BERGMANS, W., 1978. — Taxonomic revision of recent Australian Nuculidae (Mollusca : Bivalvia) except *Ennucula* Iredale, 1931. *Rec. Aust. Mus.*, **31** (17) : 673-736.

DELL, R. K., 1956a. — Some new off-shore Mollusca from New Zealand. *Rec. Dom. Mus.*, **3** (I) : 27-59.

DELL, R. K., 1956b. — The archibenthal Mollusca of New Zealand. *Dom. Mus. Bull.*, **18** : 1-235.

HEDLEY, C., 1913. — Studies on Australian Mollusca. Part XI. *Proc. Linn. Soc. N. S. W.*, **38** : 258-339, pls XVI-XIX.

IREDALE, T., 1931. — Australian molluscan notes. No. 1. *Rec. Aust. Mus.*, **18** (4) : 201-235, pls XXII-XXV.

IREDALE, T., 1939. — Mollusca. Part I. *Scient. Rep. Gt. Barrier Reef Exp.*, **5** (6) : 209-245, pls I-VII.

MARWICK, J., 1931. — The Tertiary Mollusca of the Gisborn District. *Palaeont. Bull. Wellington*, **13** : 1-177, pls I-XVIII.

POWELL, A. W. B., 1971. — New Zealand molluscan systematics with descriptions of new species. Part 7. *Rec. Auckland Inst. Mus.*, **8** : 209-228.

POWELL, A. W. B., 1979. — New Zealand Mollusca. Marine, land and freshwater shells : i-xiii, 1-500. Collins, Auckland.

QUENSTEDT, W., 1930. — Die Anpassung an die grabende Lebensweise in der Geschichte der Solenomyiden und Nuculaceen. *Geol. Palaeont. Abh.*, (n. s.) **18** (1) : 1-120, pls I-III.

SUTER, H., 1913. — Manual of the New Zealand Mollusca : xxiii, 1-1210. Government Printer, Wellington.

TAYLOR, J. D., KENNEDY, W. J., & HALL, A., 1969. — The shell structure and mineralogy of the Bivalvia. Introduction. Nuculacea-Trigonacea. *Bull. Br. Mus. nat. Hist.*, Zool. Suppl., **3** : 1-125, pls I-XXIX.

THIELE, J., 1934. — Handbuch der systematischen Weichtierkunde, **3** : 779-1022. Fischer, Jena.

3

Mollusca Gastropoda : Seguenziidae from New Caledonia and the Loyalty Islands

Bruce A. MARSHALL

National Museum of New Zealand
P.O. Box 467, Wellington
New Zealand

ABSTRACT

Three subfamilies are recognised : Asthelysinae new subfamily, Seguenziinae Verrill, and Guttulinae Goryachev. Two tribes are recognised in Seguenziinae. Fifty five seguenziids are newly recorded from off New Caledonia and the Loyalty Islands, of which 50 are new to science. These species are referable to 13 genera, including 2 new genera and *Anxietas* Iredale, which is transferred from Trochidae. *Asthelys nitidula* sp. nov. is based on type material from Queensland. Jaw plates and lateromarginal radular plates are recorded for the first time in the family. Seguenziid species richness and western Pacific biogeography are briefly discussed.

RÉSUMÉ

Mollusca Gastropoda : Seguenziidae de Nouvelle-Calédonie et des îles Loyauté.

Une remarquable faune de Seguenziidae est décrite des étages bathyal et abyssal de la région néo-calédonienne (bassin des Loyauté et sud de la Nouvelle-Calédonie). La richesse spécifique de la famille et son apport à la biogéographie de l'Ouest Pacifique sont brièvement discutés. L'existence de mâchoires et d'une plaque latéromarginale sur la radula est signalée pour la première fois chez les Seguenziidae. Cinquante des 55 espèces présentes sont décrites comme nouvelles de cette région ; une espèce est décrite du Queensland. *Ancistrobasis monodon* (Schepman) est transféré des Calliostomatinae, et *Anxietas* Iredale des Trochidae, aux Seguenziidae. Deux nouveaux genres, *Eratasthelys* et *Halystina*, et une nouvelle sous-famille, Asthelysinae, sont créés ; la sous-famille nominale Seguenziinae est divisée en deux tribus.

MARSHALL, B. A., 1991. — Mollusca Gastropoda : Seguenziidae from New Caledonia and the Loyalty Islands. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 41-109. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

During the last ten years the deep-sea gastropods of the family Seguenziidae have received considerable attention from systematists, the number of genera increasing from 7 to 20, and the number of Recent species more than doubling to 139 with the present contribution. Through studies of shell structure (BANDEL, 1979 ; BARSKOV, GOLOVINOVA & GORYACHEV, 1980), radula (MARSHALL, 1983 ; QUINN, 1983b) and anatomy (QUINN, 1983b), this formerly enigmatic family is now firmly established as a member of the Archaeogastropoda. SALVINI-PLAWEN & HASZPRUNAR (1987) have recently referred the family to a new archaeogastropod suborder, Seguenziina.

Through the generosity of Philippe BOUCHET, I now have the privilege of recording by far the richest seguenziid fauna known, comprising 55 species in 13 genera. The fact that all are new records is testimony not only to the great diversity of the fauna occurring off New Caledonia and the Loyalty Islands, but also as to how little is actually known of the deep-sea molluscan fauna occurring off tropical and subtropical western Pacific islands in general.

Preserved specimens of several species recorded living were received too late for inclusion of descriptions and illustrations of their animals and radulae.

Abbreviations and text conventions :

AMS : Australian Museum, Sydney ;
BMNH : The Natural History Museum, London ;
D : Diameter ;
H : Height ;
MNHN : Muséum national d'Histoire naturelle, Paris ;
NMNZ : National Museum of New Zealand, Wellington ;
NMP : Natal Museum, Pietermaritzburg ;
NSMT : National Science Museum, Tokyo ;
TW : Teleoconch whorls (number) ;.
UD : Umbilicus/diameter as percentage of shell diameter ;
USNM : National Museum of Natural History, Washington DC ;
ZMA : Zoölogisch Museum, Amsterdam.

Height precedes diameter in all given dimensions. All shell measurements were taken on the longitudinal axis or at right angles to it. In descriptions of the posterior notch in the outer lip, " retraction depth " is the depth from the adapical insertion to the back of the notch, while " protraction depth " is the depth from the back of the notch to the tip of the forward-swinging abapical part of the lip. Unless otherwise stated these measurements were taken at the lip rim of mature specimens.

STATION DATA

Species taken alive are denoted by asterisks. Station number prefix CP = chalut à perche (beam trawl), DS = drague type Sanders (epibenthic sledge), DW = drague type Waren (rock dredge).

BIOCAL campaign stations : N. O. " *Jean-Charcot* ".

Station DS 04. — 21°16′ S, 166°40′ E, 2 340 m, 11.8.1985 : *Asthelys depressa, Halystina caledonica*, Seguenzia emmeles.*

Station DW 08. — 20°34′ S, 166°54′ E, 435 m, 12.8.1985 : *Anxietas exigua, Ancistrobasis monodon, A. tiara, Calliobasis spectrum, C. nepticula, C. merista, Fluxinella polita.*

Station CP 13. — 20°19′ S, 167°18′ E, 3 690-3 740 m, 13.8.1985 : *Basilissa superba*.*

Station DS 14. — 20°18′ S, 167°18′ E, 3 680-3 700 m, 13.8.1985 : *Seguenzia platamodes*, Fluxinella tenera.*

Station CP 17. — 20°35′ S, 167°25′ E, 3 680 m, 14.8.1985 : *Basilissa superba.*

Station CP 23. — 22°46′ S, 166°20′ E, 2 040 m,

28.8.1985 : *Quinnia laetifica*, Seguenzia richeri.*

Station CP 26. — 22°40′ S, 166°27′ E, 1 618-1 740 m, 28.8.1985 : *Carenzia serrata, C. acanthodes, Quinnia limatula, Seguenzia eidalima.*

Station DW 33. — 23°10′ S, 167°10′ E, 675-680 m, 29.8.1985 : *Ancistrobasis monodon, Fluxinella asceta*.*

Station DW 36. — 23°09′ S, 167°11′ E, 650-680 m, 29.8.1985 : *Fluxinella asceta.*

Station DW 38. — 23°00′ S, 167°15′ E, 360 m, 30.8.1985 : *Calliobasis phimosa, C. spectrum.*

Station DW 41. — 22°45′ S, 167°12′ E, 380-410 m, 30.8.1985 : *Calliobasis spectrum*.*

Station DW 44. — 22°47′ S, 167°14′ E, 440-450 m, 30.8.1985 : *Ancistrobasis tiara*, A. caledonica*, Calliobasis phimosa*, Fluxinella polita*.*

Station DW 46. — 22°53′ S, 167°17′ E, 570-610 m, 30.8.1985 : *Ancistrobasis tiara*, Fluxinella polita*, F. asceta*.*

Station DW 48. — 23°00′ S, 167°29′ E, 775 m, 31.8.1985 : *Eratasthelys corona, Ancistrobasis tiara, A. caledonica, A. adonis, Basilissopsis charcoti, Fluxinella asceta, F. runcinata.*

Station DW 49. — 23°03′ S, 167°32′ E, 825-830 m, 31.8.1985 : *Ancistrobasis adonis*, Fluxinella runcinata.*

Station DW 51. — 23°05′ S, 167°45′ E, 680-700 m, 31.8.1985 : *Ancistrobasis scitula*, Fluxinella asceta*, F. stirophora.*

Station DW 53. — 23°09′ S, 167°43′ E, 975-1 005 m, 1.7.1985 : *Fluxinella polita, F. asceta, F. runcinata.*

Station DW 56. — 23°35′ S, 167°12′ E, 695-705 m, 1.9.1985 : *Fluxinella stirophora.*

Station CP 57. — 23°44′ S, 166°58′ E, 1490-1 620 m, 1.9.1985 : *Asthelys nitidula*, Hadroconus grandiosus, Carenzia nitens, C. serrata.*

Station DS 59. — 23°56′ S, 166°41′ E, 2 650 m, 2.9.1985 : *Asthelys semiplicata, Fluxinella brychia, Basilissa superba, Carenzia ornata, Seguenzia chariessa, S. emmeles, S. levii.*

Station DW 64. — 24°48′ S, 168°09′ E, 250 m, 3.9.1985 : *Calliobasis festiva.*

Station DW 66. — 24°55′ S, 168°22′ E, 505-515 m, 3.9.1985 : *Ancistrobasis monodon.*

Station DW 70. — 23°25′ S, 167°53′ E, 965 m, 4.9.1985 : *Fluxinella polita, F. asceta, F. runcinata, Seguenzia eutyches.*

Station CP 72. — 22°10′ S, 167°33′ E, 2 100-2 110 m, 4.9.1985 : *Fluxinella brychia, Carenzia ornata, Quinnia patula, Seguenzia emmeles, S. levii.*

Station CP 75. — 22°19′ S, 167°23′ E, 825-860 m, 4.9.1985 : *Seguenzia chelina, S. chariessa*.*

Station DW 77. — 22°15′ S, 167°15′ E, 440 m, 5.9.1985 : *Ancistrobasis boucheti*, Fluxinella membranacea.*

Station DW 79. — 20°40′ S, 166°52′ E, 1 320-1 380 m, 5.9.1985 : *Asthelys nitidula, Fluxinella runcinata, F. euphanes, Carenzia nitens, C. acanthodes, Halystina carinata, Quinnia limatula, Seguenzia wareni, S. engonia, S. praeceps, S. chariessa.*

Station DW 80. — 20°32′ S, 166°48′ E, 900-980 m, 5.9.1985 : *Fluxinella asceta, F. runcinata, F. megalomphala, Seguenzia chelina, S. metivieri, S. matara, S. chariessa, S. stegastris.*

Station DW 83. — 20°35′ S, 166°54′ E, 460 m, 6.9.1985 : *Ancistrobasis tiara.*

Station DS 98. — 21°24′ S, 166°30′ E, 2 365-2 470 m, 7.9.1985 : *Carenzia ornata, Quinnia patula, Halystina caledonica, Seguenzia chariessa.*

Station DW 106. — 21°36′ S, 166°29′ E, 625-650 m, 8.9.1985 : *Fluxinella xysila.*

R. V. "*Vauban*" 1978-79.

Station 40. — 22°30′ S, 166°24′ E, 250-350 m, 7.6.1979 : *Anxietas inspirata, Fluxinella membranacea, Halystina vaubani, Seguenzia iota.*

SYSTEMATIC ACCOUNT

Subclass PROSOBRANCHIA Milne Edwards, 1848
Order ARCHAEOGASTROPODA Thiele, 1925
Suborder SEGUENZIINA Salvini-Plawen & Haszprunar, 1987
Superfamily SEGUENZIOIDEA Verrill, 1884
Family SEGUENZIIDAE Verrill, 1884

Seguenzidae Verrill, 1884 : 186 (emended).

The family Seguenziidae is divisible into four rather well defined groups characterised by distinctive combinations of shell, radula and external anatomy; three of these groups are here allocated subfamilial status, the nominal subfamily containing two tribes, and are defined as follows :

Subfamily ASTHELYSINAE nov.

TYPE GENUS. — *Asthelys* Quinn, 1987.

INCLUDED GENERA. — *Anxietas* Iredale, 1917 ; *Thelyssina* Marshall, 1983 ; *Asthelys* Quinn, 1987 ; *Eratasthelys* gen. nov.

DIAGNOSTIC CHARACTERS. — Teleoconch with anastomosing dendritic threads on first whorl and/or minute punctations on subsequent whorls. Axials seldom present. Posterior notch shallow, no tooth on inner lip. Snout tip blunt. Central and lateral teeth stout, rigid, outer marginals each with fine cusps that extend around tip of cutting area.

Subfamily SEGUENZIINAE Verrill, 1884

TYPE GENUS. — *Seguenzia* Jeffreys, 1876.

INCLUDED GENERA. — *Seguenzia* Jeffreys, 1876 ; *Basilissa* Watson, 1879 ; *Ancistobasis* Dall, 1889 ; *Basilissopsis* Dautzenberg & Fischer, 1897 ; *Thelyssa* Bayle, 1971 ; *Carenzia* Quinn, 1983 ; *Seguenziopsis* Marshall, 1983 ; *Calliobasis* Marshall, 1983 ; *Fluxinella* Marshall, 1983 ; *Hadroconus* Quinn, 1987 ; *Rotellenzia* Quinn, 1987 ; *Quinnia* Marshall, 1988 ; *Halystes* Marshall, 1988 ; *Halystina* gen. nov.

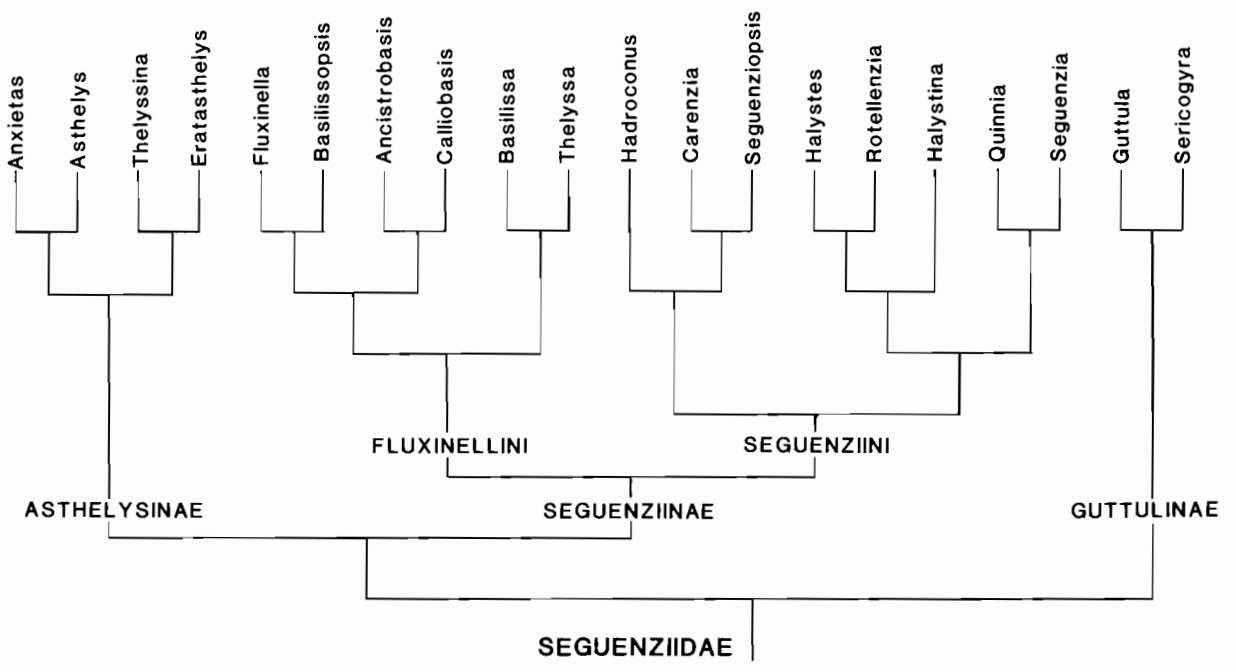
DIAGNOSTIC CHARACTERS. — Teleoconch microsculpture usually present, consisting of minute granulations. Axial sculpture present or absent. Posterior notch very shallow to very deep, inner lip with or without tooth. Snout tip blunt. Central and lateral teeth stoutly built and rigid, or thin and flexible, marginal teeth each with fine cusps that extend around cutting area, or with very long terminal cusp.

Tribe SEGUENZIINI Verrill, 1884

INCLUDED GENERA. — *Seguenzia, Carenzia, Seguenziopsis, Hadroconus, Rotellenzia, Quinnia, Halystes, Halystina.*

DIAGNOSTIC CHARACTERS. — Posterior notch of moderate to great depth. Central and lateral teeth thin and flexible, marginal teeth each with very long terminal cusp.

TABLE 1. — Suggested phylogenetic relationships between seguenziid subfamilies, tribes and genera (not cladistic).



Tribe FLUXINELLINI nov.

INCLUDED GENERA. — *Basilissa, Ancistrobasis, Basilissopsis, Thelyssa, Calliobasis, Fluxinella.*

DIAGNOSTIC CHARACTERS. — Posterior notch usually shallow, occasionally of moderate depth. Central and lateral teeth stoutly built and rigid, outer marginal teeth each with fine cusps that extend around cutting area.

Subfamily GUTTULINAE Goryachev, 1987

Guttulidae Goryachev, 1987 : 23.

TYPE GENUS. — *Guttula* Schepman, 1908.

INCLUDED GENERA. — *Guttula* Schepman, 1908 ; *Sericogyra* Marshall, 1988.

DIAGNOSTIC CHARACTERS. — Teleoconch entirely smooth throughout or with microsculpture of minute granulations. Anastomosing dendritic threads on first whorl resolving into riblets that are finer and closer than in Asthelysinae and Seguenziinae. Whorls strongly convex. Apertural rim simple, without notches or tooth. Snout bifid, tentacular. Central and lateral rather thin in section, somewhat flexible, marginal teeth each with long terminal cusp.

REMARKS

Asthelysinae stand well apart from other seguenziids in their distinctive microsculpture of wavy dendritic threads on the first teleoconch whorl and/or minute shallow punctations

that perforate the outer shell layer on subsequent whorls. Where present, microsculpture in other seguenziids consists only of minute granulations. The significance of these punctations and granulations is unknown, but they may facilitate adhesion of the periostracum, or perhaps they render the shell semipermeable to a secretion by the animal that maintains the condition of the periostracum. Most Asthelysinae are also distinctive in lacking primary axial sculpture. In the few known axially costate species the axials gradually resolve after the first teleoconch whorl, suggesting that axial ribbing may have appeared secondarily in the group, and thus perhaps independently in Segueziinae. The radula in Asthelysinae and in the seguenziine tribe Fluxinellini is distinctive in having stout, relatively rigid central and lateral teeth, and fine serrations that extend around the tips of the outer marginal teeth. By contrast, in the seguenziine tribe Seguenziini the central and lateral teeth are thinner in section and flexible, while the outer marginal teeth each have a long, slender terminal cusp. It seems reasonable to assume that the radula in Seguenziini has been derived from the plan exhibited in Asthelysinae and Fluxinellini through thinning of the central and lateral teeth, and modification of the marginal teeth. Although precise numbers of marginal teeth per transverse row are difficult to ascertain accurately from conventional views of the radula, the number is certainly greater in Asthelysinae and most Fluxinellini (up to about 20 pairs) than in Seguenziini (up to about 7 pairs), suggesting that there is a trend toward reduction in tooth number. If, as here interpreted, Seguenziini have been derived from Fluxinellini, there would seem to have been a trend toward deepening of the posterior notch and general elaboration of apertural features throughout the subfamily, which attains peak development in the genus *Seguenzia*. Although Seguenziinae are divisible into two groups on the basis of radula morphology and degree of elaboration of the apertural features, there is some degree of intergradation between the groups. For example, while the shell morphology in *Basilissa* and *Hadroconus* suggests close relationship to *Ancistrobasis* and *Fluxinella* (Fluxinellini), the rigidity of the central and lateral teeth in *Basilissa* and the shape of the marginal teeth in *Hadroconus* (BAYER, 1971, fig. 7) are intermediate between those in Fluxinellini and Seguenziini. Moreover, *Fluxinella stirophora* and species of *Carenzia, Hadroconus* and *Quinnia* are somewhat intermediate in gross shell facies between elaborately sculptured Fluxinellini and *Seguenzia*. Accordingly Fluxinellini and Seguenziini are interpreted as convenient informal tribal divisions of a single subfamily in which there is more or less continuous gradation in shell and radula morphology. Subfamily Guttulinae is strongly characterised by the simple shell shape, perfectly smooth or distinctively sculptured teleoconch, and a peculiar snout that is bifid and tentacular (MARSHALL, 1988) rather than blunt-tipped as in Asthelysinae and Seguenziinae. Guttulinae would seem to have the least derived shell morphology, with even simpler shells than Asthelysinae. This simplicity, together with the presence of dendritic threads in the first teleoconch whorl in *Sericogyra* (MARSHALL, 1988), suggests a direct relationship with Asthelysinae. The granulate shell microsculpture on later whorls (*Sericogyra*) and the radula, however, are similar to those in Seguenziini. On the sum of characters and character states it is concluded that Guttulinae and Seguenziinae have convergent radula morphologies, that Asthelysinae and Guttulinae diverged early in the history of the family, and that Seguenziinae originated from early Asthelysinae (Text Fig. 1). An equally parsimonious interpretation, however, is that Seguenziini and Fluxinellini arose independently from early Guttulinae and Asthelysinae respectively, which would suggest that Fluxinellini should perhaps be interpreted as a subfamily. Since early seguenziids probably resembled extant Asthelysinae and Guttulinae, it may be difficult or impossible to unequivocally recognise fossils among other groups of trochiform gastropods.

Subfamily ASTHELYSINAE

Genus *ANXIETAS* Iredale, 1917

Anxietas Iredale, 1917 : 334. Type species (by original designation) : *Anxietas perplexa* Iredale, 1917 ; Recent, Christmas Island, Indian Ocean.

REMARKS. — IREDALE (1917) proposed *Anxietas* for a minute barleeid-like gastropod from Christmas Island, Indian Ocean, the name bestowed expressing his opinion regarding its relationships. He placed it in Trochidae with considerable reservation. THIELE (1929) considered that *Anxietas* was little different from the rissoacean genus *Amphithalamus* Carpenter, 1865, WENZ (1939) considered them synonyms, while COAN (1964) placed it as a subgenus of *Scrobs* Watson, 1886 (Barleeidae, Anabathrinae). PONDER (1967) allowed *Anxietas* generic rank in Anabathrinae, but subsequently (1985) reported that *A. perplexa* has an internal nacreous layer and returned it to Trochidae. Although the nacreous layer was not mentioned by IREDALE, its presence may have influenced his decision to place the genus in Trochidae. *Anxietas perplexa* is clearly related to the type species of *Thelyssina* Marshall, 1983 (*T. sterrha* Marshall, 1983), which it resembles in gross shell morphology, including outer lip profile, the presence of anastomosing dendritic threads on the early teleoconch, and minute pits on subsequent whorls (MARSHALL, 1983, fig. 5 d, e, f-h ; PONDER, 1985, fig. 145 a, b). *Thelyssina* was referred to Seguenziidae because of similarity to seguenziids of the genera *Ancistrobasis* Dall, 1889 and *Fluxinella* Marshall, 1983 in outer lip profile. Although *Anxietas* and *Thelyssina* are unknown anatomically, placement in Seguenziidae is strongly supported by the characteristically seguenzoid animal and radula in *Asthelys* Quinn, 1987 (MARSHALL, 1988), most species of which they closely resemble in shell morphology, including the presence of pits on the teleoconch. Despite the fact that shell character differences between *Anxietas, Thelyssina* and *Asthelys* are matters of degree, I prefer to retain the latter two as distinct genera until animals and radulae can be compared. They are characterised thus : *Anxietas* — wavy threads on early teleoconch, no shoulder angulation, suprasutural groove ; *Asthelys* — no wavy threads or shoulder angulation on early teleoconch, close, similar peripheral and suprasutural spiral threads ; *Thelyssina* — wavy threads and shoulder angulation on early spire whorls, strong, rounded peripheral keel. Note that *Anxietas exigua* sp. nov. resembles *Anxietas* and *Asthelys* species in lacking a shoulder angulation, yet resembles *Thelyssina sterrha* in having a strong, rounded peripheral keel.

Anxietas inspirata sp. nov.

Figs 1-5, 8

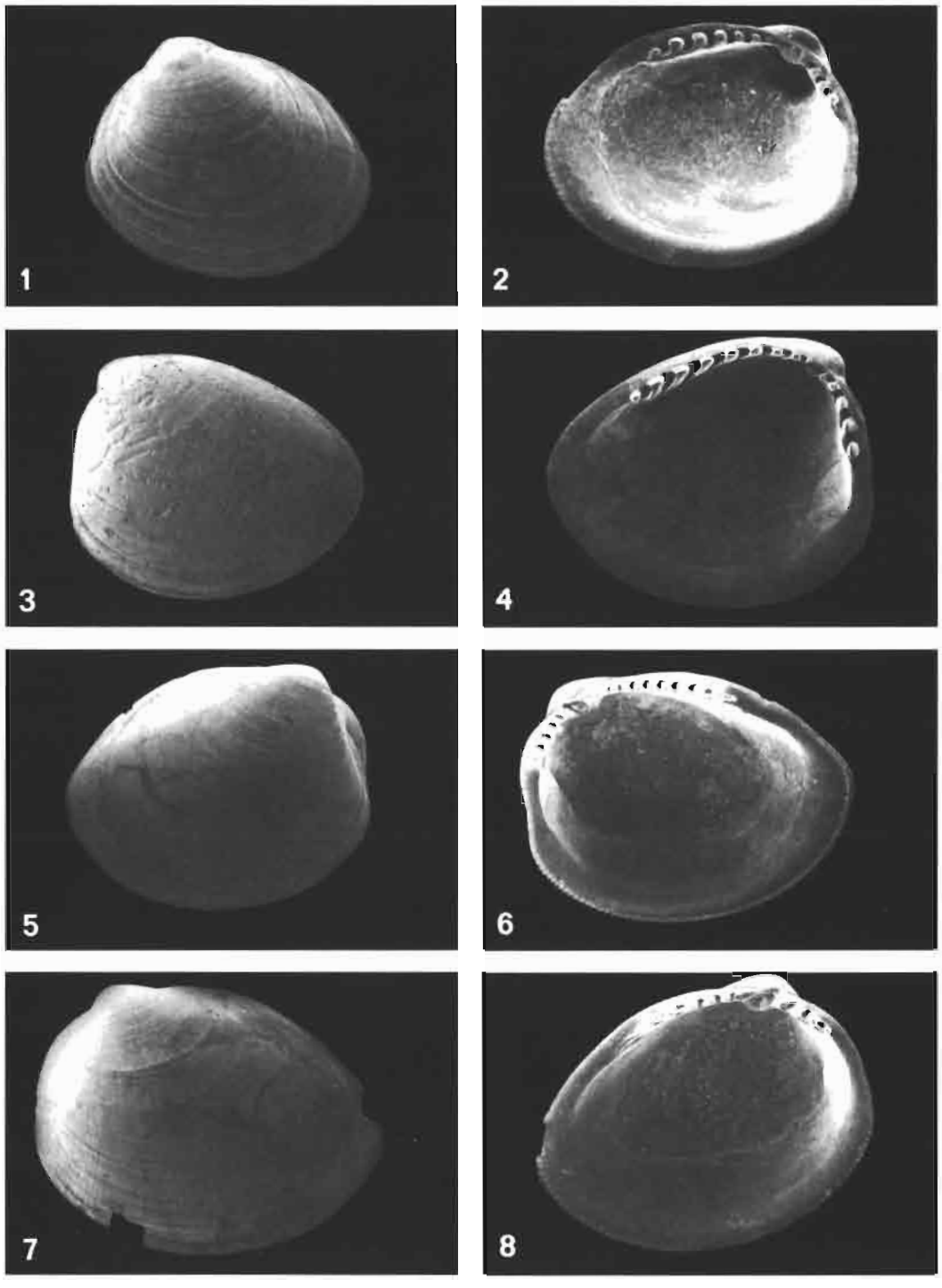
DESCRIPTION. — *Shell* (holotype) 1.85 mm high, markedly higher than broad, narrowly trochiform, stout, glossy, anomphalous ; spire weakly cyrtoconoid, 1.89 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 230 µm wide, minutely granulate.

Teleoconch of 4.8 whorls, 1st whorl convex, next whorl becoming flat, subsequent whorls very weakly convex, periphery tightly rounded, base very weakly convex. First whorl sculptured with fine, crisp, anastomosing, dendritic threads ; subsequent whorls with fine suprasutural groove and covered with minute, irregular pits. Base with 2 fine, close, shallow spiral grooves at about outer third, absent on last half whorl ; and strong, rounded, smooth inner spiral cord. Aperture subtrapezoidal. Outer lip thin at rim, rather strongly thickened within, posterior notch extremely shallow and broad, retraction depth 13 % of shell diameter, almost vertical below apex before retracting below periphery to shallow, broad, concave basal notch, no peripheral notch. Parietal glaze thin. Inner lip thick, spreading.

Animal unknown.

TYPE DATA. — Holotype MNHN (1.85 × 1.40 mm, 4.8 TW) : " *Vauban* ", stn 40.



FIGS 1-8. — **1-2** : *Nucula nitidulaformis* Powell, length 1.76 mm, from 425-430 m at " *Vauban* " Stn 2 (22°17′ S, 167°14′ E), New Caledonia (MNHN). — **3-4** : *Nucula kanaka*, sp. nov., right valve of holotype specimen, length 2.84 mm, from 425-430 m at " *Vauban* " Stn 2 (22°17′ S, 167°14′ E), New Caledonia (MNHN). — **5-6** : *Nucula oppressa*, sp. nov., left valve, holotype specimen, length 2.84 mm, from 250-350 m at " *Vauban* " Stn 40 (22°30′ S, 166°24′ E), New Caledonia (MNHN). — **7-8** : *Nucula oppressa*, sp. nov., right valve, paratype specimen, length 2.06 mm, data as for holotype specimen (MNHN).

DISTRIBUTION. — Off southern New Caledonia, 250-350 m (dead).

REMARKS. — *Anxietas inspirata* differs from (AMS) syntypes of *A. perplexa* in attaining maturity at larger size (1.85 × 1.40 mm, 4.8 TW, cf. 1.60 × 1.30, 4.25 TW) and in having a larger protoconch (diameter 230 μm, cf. 200 μm). The two species are otherwise very similar.

ETYMOLOGY. — Inspiring (Latin).

Anxietas exigua sp. nov.

Figs 6, 7, 9, 10 ; Table 1

DESCRIPTION. — *Shell* up to 2.10 mm high, glossy, trochiform, rather thin, stout, umbilicus an elliptical chink, spire 1.36-1.41 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 230-240 μm wide, minutely granulate.

TABLE 1. — *Anxietas exigua*. Shell measurements (mm) and countings.

H	D	H/D	TW	
2.10	1.70	1.23	4.70	Paratype
1.80	1.75	1.03	4.00	Paratype
1.70	1.70	1.00	4.00	Paratype
1.60	1.65	0.97	3.90	Holotype

Teleoconch of up to 4.7 weakly convex whorls, periphery angulate, base weakly convex. Most of 1st whorl with fine, crisp, anastomosing, dendritic threads, subsequent whorls minutely pitted. Peripheral keel rounded, adapical edge sharply shelved and exposed on spire, abapical margin not defined. Umbilicus bounded by smooth spiral cord, very narrow, rendered an elliptical chink by invading inner lip. Aperture subtrapezoidal. Outer lip thin at rim, modestly thickened within ; posterior notch very shallow and broad, retraction depth 6.9 % of shell diameter, almost vertical below retracting to broad, shallow, concave basal notch. No peripheral notch. Parietal glaze rather thick. Inner lip curved towards umbilicus, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN : BIOCAL, stn DW 08.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 435 m (dead).

REMARKS. — *Anxietas exigua* differs from *A. perplexa* and *A. inspirata* primarily in being more broadly conical and in having a pronounced peripheral keel. It differs from *Thelyssina sterrha* in being considerably smaller, in lacking a shoulder angulation on the early teleoconch whorls and in lacking spiral threads on the outer part of the base.

ETYMOLOGY. — Small (Latin).

Genus *ASTHELYS* Quinn, 1987

Asthelys Quinn, 1987 : 66. Type species (by original designation) : *Basilissa munda* Watson, 1879 ; Recent, eastern Atlantic.

Asthelys nitidula sp. nov.

Figs 11-15, 268-270 ; Table 2

DESCRIPTION. — *Shell* up to 3.90 mm high, trochiform, glossy, with narrow umbilical chink, rather thin, spire 1.19-1.29 × as high as aperture, white, nacreous through thin, translucent outer shell layer.

Protoconch 330 μm wide, minutely granulate.

Teleoconch of up to 5.20 whorls, 1st whorl strongly convex at first, becoming weakly convex, subsequent whorls more or less flat, periphery angulate, base weakly convex. Sculpture on spire consisting of 2 close, crisp, smooth, similar spiral threads, suprasutural spiral commencing on 2nd half of 1st whorl, peripheral spiral partly covered by succeeding whorls. Fine collabral growth lines

TABLE 2. — *Asthelys nitidula*. Shell measurements (mm) and countings.

H	D	H/D	TW	
3.90	3.75	1.04	5.20	Holotype
3.80	3.55	1.07	5.00	BIOCAL stn DW 79
3.50	3.55	0.99	5.00	BIOCAL stn DW 79
3.45	3.65	0.94	4.75	Paratype

and minute circular pits throughout, pits arranged in spiral lines on 1st few whorls. Base with 2 or 3 similar spiral threads beside periphery, a rounded radially pleated spiral cord beside umbilical chink, broad intermediate space with weak or very weak rounded spiral threads or obscure spiral lines. Umbilicus very narrow, rendered a narrow crescentic chink by invading inner lip. Aperture subtrapezoidal. Outer lip rim damaged, thin ; posterior notch very broad and shallow, retraction depth 5.3 % of shell diameter, slightly projected below before retracting to broad, shallow, concave basal notch ; no peripheral notch. Parietal glaze thin. Inner lip thick, concave, spreading into umbilicus, tapered to base, toothless.

Animal unknown (dried).

Radula (Figs 268-270) with the formula c. 12 + 1 + 1 + c. 12. Central tooth rigid, about as long as broad, cutting area jutting forward at right angle from shaft, angulate, with 9-11 sharp, conical cusps, laterobasal projections prominent. Lateral teeth rigid, broad, sharply serrate on inner and outer edges of large, narrowly angulate cutting area. Marginals slender, each with long series of fine cusps along outer edge of tip and few on inner edge, inner marginals with strong terminal cusp, outer marginals with fine cusps that extend around tip of cutting area. *Operculum* thin, multispiral.

TYPE DATA. — Holotype (AMS C. 156439) and 3 paratypes (2 AMS, 1 NMNZ) : 24°28.2′ S, 153°31.2′ E, NE of Sandy Cape, Queensland, Australia, alive, 1 330 m-1 380 m, 8 July 1984, HMAS " *Kimbla* ".

OTHER MATERIAL EXAMINED (4 specimens). — BIOCAL, stn DW 79 (1 MNHN, 1 NMNZ). — Stn CP 57 (2 MNHN).

DISTRIBUTION. — Off Queensland, Loyalty Islands, and New Caledonia, 1 320-1 620 m, living at 1 330-1 620 m.

REMARKS. — New Caledonian specimens differ from the type material in having broader umbilical chinks, but are otherwise indistinguishable on shell characters. *Asthelys nitidula* is extremely similar to *A. munda* (Watson, 1879) (eastern Atlantic, 2 058-2 311 m) and *A. simplex* (Watson, 1879) (off Argentina, 3 475 m) and differs primarily in having more closely spaced peripheral spiral cords (see QUINN, 1987, figs 9, 10-14 ; MARSHALL, 1988, figs 1 f-i). It differs further from *A. simplex* in having radial pleats beside the umbilical chink. Compared with *A. antarctica* Marshall, 1988 (off South Shetland Islands, 3 715-3 752 m) it differs in having finer peripheral spirals and an almost closed umbilicus with a radially pleated rim. *Asthelys simplex*, or a species very like it, was taken off Westport, New Zealand at 4 421-4 419 m (MARSHALL, 1988).

ETYMOLOGY. — Somewhat shining (Latin).

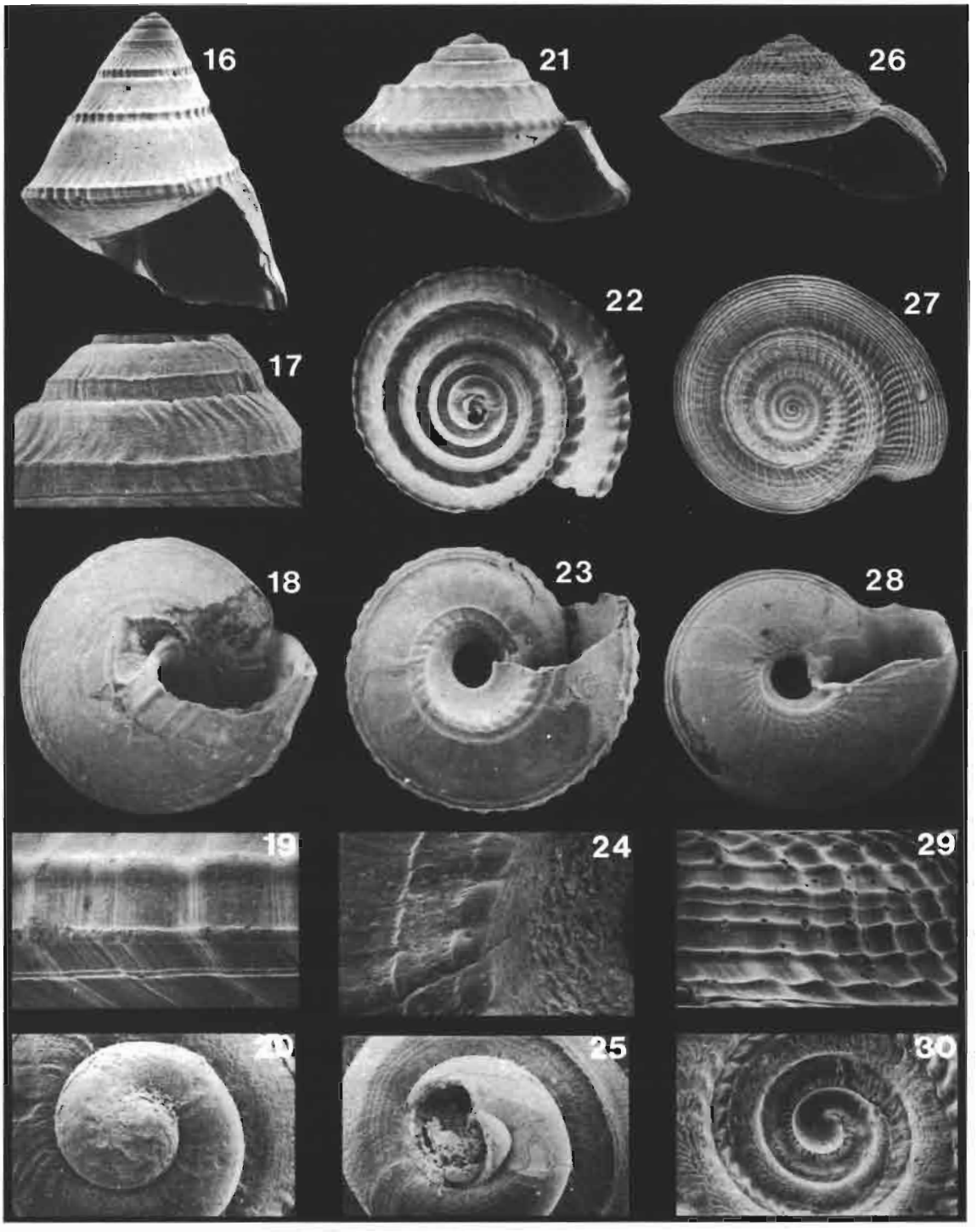
Asthelys semiplicata sp. nov.

Figs 16-20

DESCRIPTION. — *Shell* (holotype) 4.95 mm high, thin, narrowly trochiform, narrowly umbilicate, spire 1.26 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 330 μm wide, surface etched.

Teleoconch of 5.8 whorls ; 1st whorl strongly convex at first, becoming shallowly convex, next whorl becoming very weakly convex, subsequent whorls shallowly concave above flattened peripheral keel ; base suddenly contracted, weakly convex. Peripheral keel comprising 2 close, similar, rounded spiral threads, suprasutural spiral commencing on 2nd half of 1st whorl, peripheral spiral partly covered by succeeding whorls. Axial riblets commencing on 2nd whorl, rounded, collabral, opisthocline, becoming strongly defined on peripheral keel and rendering it undulant, weakly defined elsewhere, evanescent on outer part of base. Minute rounded pits throughout, arranged in spiral lines on 1st few whorls. Base with 3 similar spiral threads near periphery, and 3 smooth, rounded spiral cords on inner third, innermost bordering umbilicus. Umbilicus shallow, wall tapered. Aperture subtrapezoidal. Outer lip thin, rim damaged ; posterior notch very broad and shallow, retraction depth 7.3 % and protection



FIGS 16-30. — Genera *Asthelys, Eratasthelys* : **16-20,** *Asthelys semiplicata*, holotype, 4.95 × 4.55 mm, 17 (early TW) × 45, 19 (adult periphery) × 45, 20 × 75. — **21-25,** *A. depressa*, holotype, 1.40 × 2.22 mm, 24 (base) × 105, 25 × 75. — **26-30,** *Eratasthelys corona*, holotype, 3.65 × 6.70 mm, 29 (end 4th TW) × 35, 30 × 37.

depth 9.5 % of shell diameter (from collabral growth lines) ; basal notch broad, shallow, concave, no peripheral notch. Parietal glaze thin. Inner lip thin, gradually tapered to base, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (4.95 × 4.55 mm, 5.8 TW) : BIOCAL, stn DS 59.

DISTRIBUTION. — Off southern New Caledonia, 2 650 m (dead).

REMARKS. — *Asthelys semiplicata* is highly distinctive among its congeners in having axial riblets on the teleoconch that are strongly defined on the peripheral keel. *A. semiplicata* resembles *A. munda* in spacing of the spiral threads at the periphery, but differs from it, and from *A. simplex*, in lacking radial pleats at the umbilical rim. *A. semiplicata* further differs from *A. simplex* in having a broad, smooth median band on the base.

ETYMOLOGY. — Semiplicate (Latin).

Asthelys depressa sp. nov.
Figs 21-25

DESCRIPTION. — *Shell* (holotype) 2.22 mm wide, broader than high, of moderate thickness, stout, umbilicate, spire 0.71 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 330 μm wide, finely granulate.

Teleoconch of 3.5 whorls ; subsutural angulation strong, ramp narrow, more or less horizontal ; side broad, convex on 1st whorl, grading from flat to weakly concave on subsequent whorls ; peripheral keel bluntly angulate ; base weakly convex. Shoulder angulation commencing on 2nd half of 1st whorl, smooth on 1st 2 whorls, strong, rounded nodules on it and peripheral keel on subsequent whorls ; peripheral nodules partly covered by succeeding whorls, their adapical extremities bounded by crisp spiral thread on last whorl. Summit of peripheral keel and inner part of umbilical wall minutely granulate, whorls elsewhere pitted, pits arranged in spiral lines on 1st whorl. Base with 2 smooth, crisp, similar spiral threads beside periphery, and 2 spiral cords beside umbilicus, outer spiral smooth, innermost strong, with bluntly rounded nodules, bordering umbilicus. Umbilicus deep, wall angulate within, outer part shallowly tapered inwards, inner part steeply tapered outwards, diameter 26.0 % of shell diameter. Aperture subtrapezoidal. Outer lip rim damaged, from fine shallowly sigmoidal collabral growth lines posterior notch extremely broad and shallow, basal notch shallowly concave, no peripheral notch. Parietal glaze thin. Inner lip sharply flexed toward umbilical wall angulation, rim thin, rapidly thickened within, very thick against umbilical wall angulation, evenly tapered to base, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (1.40 × 2.22 mm, 3.5 TW) : BIOCAL, stn DS 04.

DISTRIBUTION. — Between New Caledonia and Lifou, Loyalty Islands, 2 340 m (dead).

REMARKS. — From the teleoconch pitting, *A. depressa* appears to be closely related to *Anxietas, Thelyssina*, and *Asthelys*, yet it differs markedly from members of these genera in the low spire, wide umbilicus, and nodular spiral cords. *A. depressa* is referred to *Asthelys* because of the lack of wavy threads on the early teleoconch, but this placement is obviously provisional.

ETYMOLOGY. — Low (Latin).

Genus ***ERATASTHELYS*** nov.

TYPE SPECIES. — *Eratasthelys corona* sp. nov., Recent, southern New Caledonia.

ETYMOLOGY. — From the Greek *eratos* (comely) and the seguenziid genus *Asthelys* Quinn, the latter an anagram of *Thelyssa* Bayer.

DIAGNOSIS. — Shell 6.7 mm wide, sublenticular, stout, umbilicate, white, nacreous within. Spire whorls reticulately sculptured with spiral threads and collabral axial riblets, with addition of fine, crisp, anastomosing, dendritic threads on 1st 2 teleoconch whorls. Posterior and basal notches very shallow and broad. Animal unknown.

REMARKS. — The type species of *Eratasthelys* is highly distinctive in combining the dendritic threads and very shallow labral sinuses characteristic of species of *Anxietas* and *Thelyssina* together with shell shape and reticulate sculpture similar to those in *Ancistrobasis* Dall and in some species of *Fluxinella* Marshall. On the basis of similarity in early teleoconch morphology, *Eratasthelys* is considered to be most closely related to *Thelyssina*. *Eratasthelys* is probably a minor offshoot of the Asthelysinae that has independently acquired some characteristics of *Ancistrobasis* species, rather than a descendant of the basal stock of *Ancistrobasis* and related genera.

Eratasthelys corona sp. nov.

Figs 26-30

DESCRIPTION. — *Shell* (holotype) 6.70 mm wide, markedly broader than high, stout, of moderate thickness, umbilicate ; white, nacreous through translucent outer shell layer.

Protoconch 330 μm wide, surface abraded.

Teleoconch of 5 whorls, almost flat above shallowly concave adapical side of sharply angulate periphery, last adult whorl becoming weakly and rather evenly convex, base weakly convex. Axial riblets weak and indistinct on 1st 1.5 whorls, strong, rounded and fold-like thereafter, confined to adapical half of 1st 2 whorls, extending to periphery on 3rd whorl. Spiral threads more crisply defined than axials, multiplying by intercalation ; 1 median spiral surmounting shoulder angulation on 1st 2 whorls, strong at first, gradually weakening until almost obsolete ; additional spirals commencing on 3rd whorl, gradually enlarging. Spirals numbering 8 at end of 2nd to last whorl, including peripheral spiral, summit of which is partly exposed on spire whorls. First 2 whorls with fine, crisp, anastomosing, vermiculate threads. Base with 2 similar, crisply defined spiral cords beside periphery ; fine inner spiral grooves that become more sharply defined towards umbilicus ; and low, rounded axial undulations that resolve between periphery and umbilicus and strengthen towards umbilicus. Umbilicus deep, wall obscurely spirally lirate, diameter 26 % of shell diameter. Aperture subtrapezoidal. Outer lip of moderate thickness, posterior notch very broad, extremely shallow, retraction depth 4.03 % and protraction depth 1.98 % of shell diameter ; basal notch broad and shallow, no peripheral notch. Parietal glaze thin. Inner lip thick, rim tightly folded towards umbilicus, concave below insertion, almost straight below, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.65 × 6.70 mm, 5 TW) : BIOCAL, stn DW 48.

DISTRIBUTION. — Off southern New Caledonia, 775 m (dead).

REMARKS. — An extremely distinctive species combining shell features of *Thelyssina* and *Ancistrobasis* species (see above).

ETYMOLOGY. — Crown (Latin).

Subfamily SEGUENZIINAE

Tribe FLUXINELLINI

Genus ***ANCISTROBASIS*** Dall, 1889

Ancistrobasis Dall, 1889 : 383. Type species (by subsequent designation of DALL, 1927) : *Basilissa costulata* Watson, 1879 ; Recent, south-eastern Florida and Gulf of Mexico.

Ancistrobasis monodon
(Schepman, 1908) comb. nov.

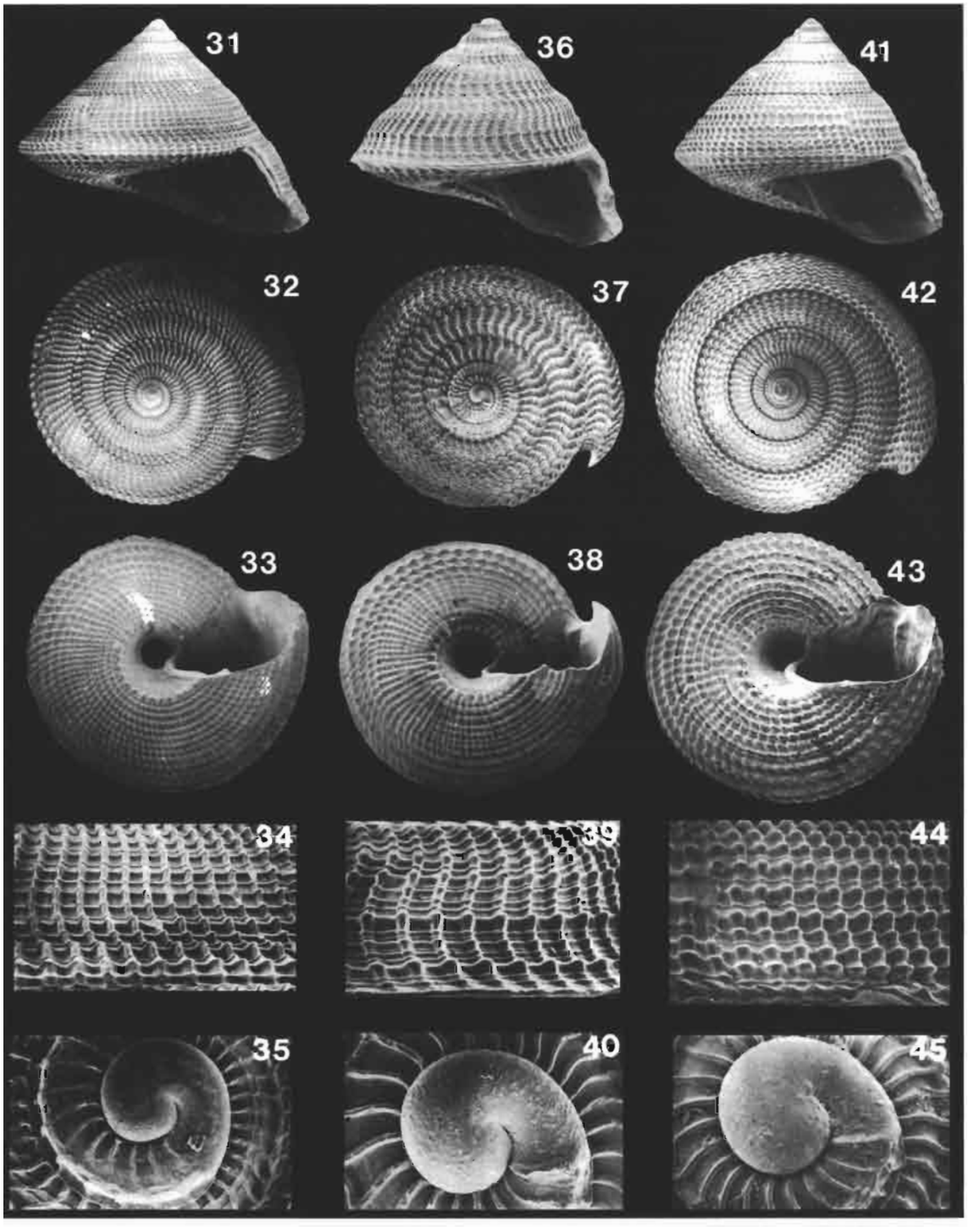
Figs 31-35

Calliostoma (Astele) monodon Schepman, 1908 : 68, pl. 6, fig. 2.

TYPE DATA. — Figured syntype ZMA 3.08.082 (4.70 × 5.75 mm, 5.25 TW) : " *Siboga* ", stn 95, 5°43.5′ N, 119°40′ E, off Sabah, Malaysia, 522 m.

OTHER MATERIAL EXAMINED (3 specimens MNHN). — BIOCAL, stn DW 08 (1). — Stn DW 33 (1). — Stn DW 66 (1).

DISTRIBUTION. — Off Sabah, Malaysia, and southern New Caledonia, 505-680 m (dead).



FIGS 31-45. — Genus *Ancistrobasis* : **31-35,** *Ancistrobasis monodon*, BIOCAL stn 66, 5.70 × 7.90 mm, 34 (last TW) × 20, 35 × 70. — **36-40,** *A. tiara*, holotype, 2.70 × 3.31 mm, 39 (last TW) × 35, 40 × 100. — **41-45,** *A. caledonica*, holotype, 4.05 × 5.05 mm, **44** (last TW) × 25, 45 × 80.

REMARKS. — New Caledonian specimens are indistinguishable from the holotype of *Calliostoma (Astele) monodon* — a typical *Ancistrobasis* species — in sculpture, shape, and shell size relative to the number of whorls. The present specimens differ, however, in having slightly larger protoconchs than the holotype (diameter 330 μm, cf. 310 μm), and in attaining maturity at larger shell size (5.70 mm × 7.90 mm, 5.9 TW), and may prove to represent a distinct, closely related species. See Discussion page 107.

Ancistrobasis tiara sp. nov.

Figs 36-40 ; Table 3

DESCRIPTION. — *Shell* up to 3.55 mm wide, broader than high, stout, of moderate thickness, umbilicate, spire 1.41-1.59 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 270-280 μm wide, rather coarsely granulate.

Teleoconch of up to 5.25 whorls. Shoulder angulation strong on 1st whorl, weakening and becoming obsolete on 2nd whorl, strongly supramedian at first, descending to submedian position ; subsequent whorls weakly convex ; base suddenly contracted below angulate, gently undulant periphery, weakly convex. Spire whorls sculptured with prominent, rounded, shallowly sigmoidal, collabral axial riblets, almost obsolete on peripheral spiral, interspaces about twice as wide as each axial, traversed by numerous finer spiral threads that multiply by intercalation. Submedian spiral and one submedially between it and periphery strong, others finer and similar, interspaces smooth apart from fine collabral growth lines. Base sculptured with low, rounded collabral riblets that extend to umbilical rim, and 9-11 spiral cords ; outer 2 or 3 spirals narrow, most prominent, distinctly nodular, outer 3 or 4 spirals with interspaces considerably wider than each spiral ; inner spirals closer, broadening towards umbilicus with narrowing interspaces, innermost spiral very broad, with rounded radial pleats. Umbilicus deep, diameter 22.6-28.5 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim of labial projection, elsewhere thick ; posterior notch broad, retraction depth 4.98-5.55 % and projection depth 6.95-9.25 % of shell diameter ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip thick, slightly tapered at abapical extremity, toothless.

Animal unknown (dried).

TABLE 3. — *Ancistrobasis tiara*. Shell measurements (mm) and countings. (BIOCAL, stn DW 44).

Character	*n*	Range	Mean	SD
H	10	2.65-2.91	2.75	0.08
D	10	3.13-3.55	3.35	0.12
H/D	10	0.80-0.86	0.82	0.02
TW	10	5.00-5.25	5.07	0.10
UD%	10	22.6-28.5	25.0	1.66

TYPE DATA. — Holotype (2.70 × 3.31 mm, 5 TW) MNHN, and 20 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 44.

OTHER MATERIAL EXAMINED (13 specimens MNHN). — BIOCAL, stn DW 08 (5). — Stn DW 46 (5). — Stn DW 48 (1). — Stn DW 83 (2).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, and southern New Caledonia, 435-775 m, living at 440-610 m.

REMARKS. — *Ancistrobasis tiara* closely resembles the Kermadec species *A. dilecta* Marshall, 1983, from which it differs primarily in having a considerably stronger shoulder angulation on the early teleoconch whorls, while the secondary spirals are considerably more numerous. It differs from *A. monodon* in being smaller, in having a shallow posterior notch, in having a shallowly instead of deeply undulant peripheral keel, and in lacking a denticle at the inner base of the outer lip. *A. tiara* and *A. monodon* occurred together at BIOCAL stn DW 08.

ETYMOLOGY. — Crown (Latin).

Ancistrobasis caledonica sp. nov.

Figs 41-45 ; Table 4

DESCRIPTION. — *Shell* up to 5.90 mm wide, broader than high, stout, of moderate thickness, umbilicate, spire 1.70-2.00 × as high as aperture ; white, nacreous through translucent outer shell layer.

Protoconch 330 μm wide, coarsely granulate.

Teleoconch of up to 5.8 whorls, 1st 2 whorls with distinct shoulder angulation, strong on 1st whorl, weakening and becoming obsolete on 2nd whorl, angulation descending from strongly supramedian to a submedian position, subsequent whorls weakly convex, periphery angulate, rendered strongly undulant by axial riblets, base weakly convex. Spire whorls sculptured with prominent, rounded, shallowly sigmoidal, collabral axial riblets that extend to periphery, interspaces slightly wider than each axial, traversed by finer spiral threads that multiply by intercalation, 9-11 major spirals at start of last adult whorl, small, rounded nodules at intersections, bases of interstitial pits finely granulate on later whorls. Base sculptured with low, rounded collabral riblets that extend to umbilical rim, and 10 or 11 similar, rounded spiral cords ; interspaces on outer part about twice as wide as each spiral, narrowing towards umbilicus, intersections with low, rounded nodules, innermost spiral more strongly beaded. Umbilicus deep, diameter 22.6-26.8 % of adult shell diameter. Aperture subquadrate. Outer lip rather thin at rim, thickened within, a spiral thickening near base of inner lip forming a prominent, rounded denticle at rim ; posterior notch very broad and shallow, retraction depth 6.78-7.98 % of shell diameter, descending more or less vertically before retracting to shallow, concave basal notch.

Animal unknown (dried).

TABLE 4. — *Ancistrobasis caledonica*. Shell measurements (mm) and countings. (BIOCAL, stn DW 44).

Character	*n*	Range	Mean	SD
H	10	3.90-4.45	4.23	0.20
D	10	5.05-5.90	5.46	0.27
H/D	10	0.73-0.82	0.77	0.03
TW	10	5.50-5.80	5.62	0.11
UD%	10	22.6-26.8	24.8	1.34

TYPE DATA. — Holotype (4.05 × 5.05 mm, 5.5 TW) MNHN, and 27 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 44.

OTHER MATERIAL EXAMINED (2 specimens MNHN). — BIOCAL, stn DW 48.

DISTRIBUTION. — Off southern New Caledonia, 440-775 m (alive).

REMARKS. — *Ancistrobasis caledonica* differs from the sympatric *A. tiara* sp. nov. and the Kermadec *A. dilecta* Marshall in having a larger protoconch, stronger spirals and closer axials on the teleoconch, and a more strongly undulant periphery, while the intersections are more distinctly nodular. It differs further from *A. tiara* in having a denticle at the inner base of the adult outer lip. From *A. monodon*, which it resembles in size, shape and in having a denticle at the inner base of the outer lip, *A. caledonica* differs in having broader, more closely spaced axial riblets, stronger nodules, and finer interstitial granules on the spire. *A. caledonica* and *A. monodon* have overlapping depth ranges off southern New Caledonia and the two species are probably locally sympatric.

ETYMOLOGY. — (New) Caledonian.

Ancistrobasis scitula sp. nov.

Figs 51-55, 271 ; Table 5

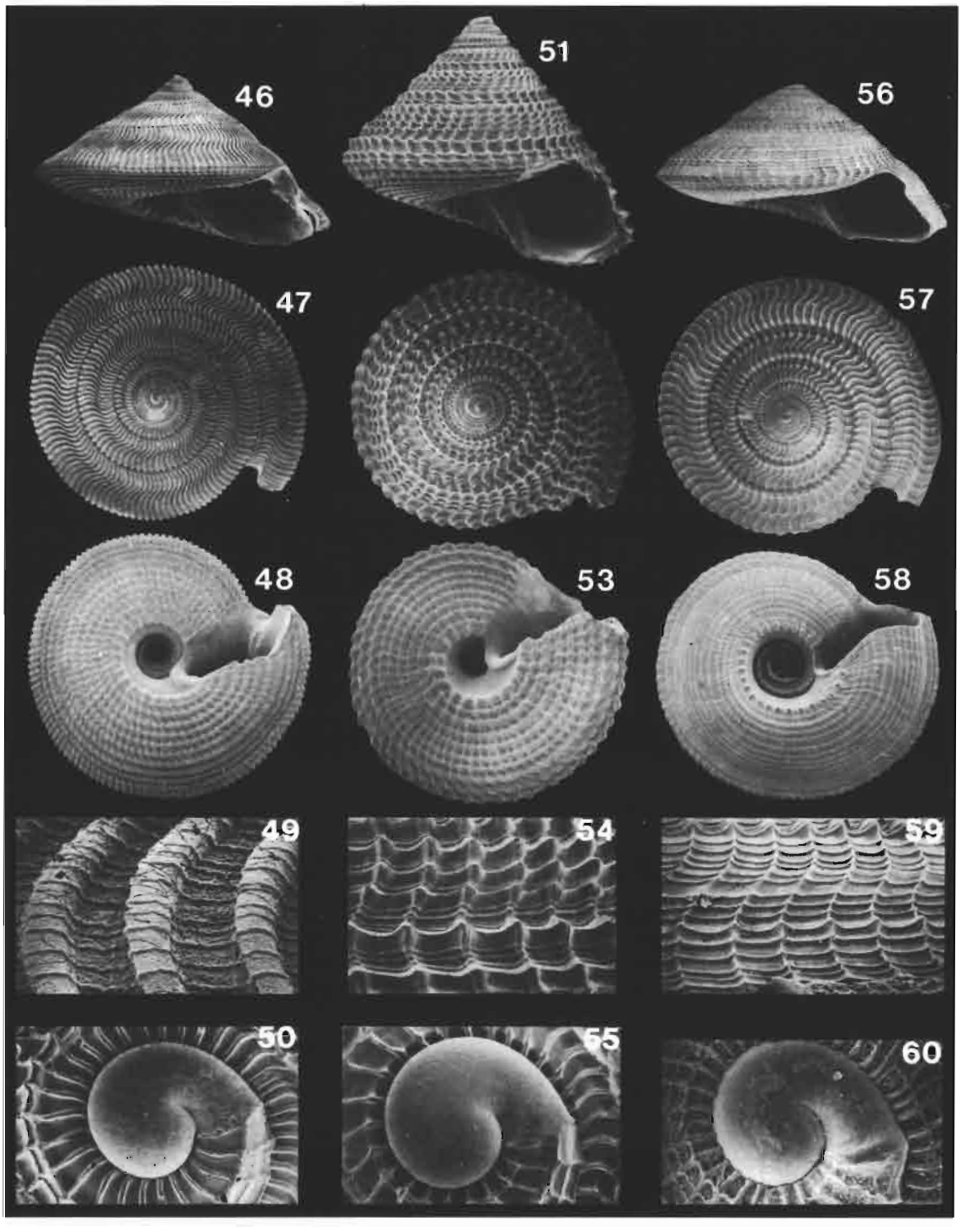
DESCRIPTION. — *Shell* up to 6.10 mm wide, broader than high, stout, of moderate thickness, umbilicate, spire 1.43-1.46 × as high as aperture ; white, nacreous through translucent outer shell layer.

Protoconch 350-370 μm wide, finely granulate.

Teleoconch of up to 5.80 whorls, 1st 3 whorls with supramedian shoulder angulation, subsequent whorls almost flat ; periphery narrowly rounded, rendered strongly undulant by axial riblets ; base weakly convex. Spire whorls sculptured with prominent, rounded, sigmoidal, collabral axial riblets, interspaces at least twice as wide as each axial, traversed by numerous spiral threads that multiply by intercalation, major spirals numbering about 7 at start of last adult whorl, a subsutural spiral vanishes at end of 1st whorl. Small, rounded, conical nodules at intersections, finely granulate at bases of interstitial depres-

TABLE 5. — *Ancistrobasis scitula*. Shell measurements (mm) and countings.

H	D	H/D	TW	UD%	
4.70	5.53	0.85	5.80	19.9	Paratype
4.50	5.50	0.82	5.75	25.4	Holotype
4.35	5.25	0.83	5.60	20.9	Paratype



FIGS 46-60. — Genus *Ancistrobasis* : **46-50,** *Ancistrobasis boucheti*, holotype, 3.10 × 5.71 mm, 49 (last TW) × 125, 50 × 70. — **51-55,** *A. scitula*, holotype, 4.50 × 5.50 mm, 54 (last TW) × 25, 55 × 70. — **56, 57, 59, 60,** *A. adonis*, holotype, 3.20 × 6.50 mm, 59 (last TW) × 30, 60 × 90. — **58,** *A. adonis*, paratype, BIOCAL stn DW 49, width 6.10 mm.

sions on later whorls. Shoulder spiral and spiral near abapical quarter strongest and similar on 1st 4 whorls, after which secondary spirals become as strong as shoulder spiral, that near abapical quarter remaining stronger. Base sculptured with narrow, rounded collabral riblets that are evanescent immediately within umbilical rim, and 9-11 stronger, rounded spiral cords, outer 3 with interspaces considerably wider than each spiral, interspaces narrowing towards umbilicus until about as wide as each spiral, small rounded nodules at intersections, innermost spiral strongly beaded at umbilical rim. Umbilicus deep, rim angulate, diameter, 19.9-25.4 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim, thickened within posterior notch, little thickened elsewhere ; posterior notch broad, shallow, retraction depth 8.2 % and protraction depth 5.2. % of shell diameter ; basal notch broadly concave, shallow, no peripheral notch. Parietal glaze thin. Inner lip thick, simple, gently tapered to abapical extremity.

Animal. Snout little over twice as long as broad, rounded lateral projections at tip, mouth a vertical slit beneath. Cephalic tentacles beside snout, inner bases at least twice as far apart as width of each tentacle base, narrowly tapered, dorsoventrally flattened, edges ciliate, left slightly longer than snout, right yet slightly longer, large black eyes at outer bases. Right suboptic tentacle slightly larger than right cephalic tentacle, longitudinally grooved beneath, the groove directly above tall, thin longitudinal ridge. Epipodial tentacles large, 6 on each side.

Radula (Fig. 271). Central tooth rigid, about as long as broad, cutting area jutting forward at right angle from shaft, angulate, with 7-9 stout, conical cusps, median cusp largest ; laterobasal projections prominent. Lateral teeth stout, broad, cutting area of each angulate, cusps sharp, terminal cusp largest, 5 or 6 smaller cusps on outer edge and 2 or 3 on inner edge. Marginal teeth slender ; innermost tooth broader than outer teeth, tip narrowly angulate, sharply serrate ; outer marginals each with finely and narrowly serrate, angulate tips, and long series of sharp slender cusps along outer edge.

Jaw plates thin, subrectangular, broader than long, elements short, anteriorly elongating.

TYPE DATA. — Holotype MNHN and 5 paratypes (4 MNHN, 1 NMNZ) : BIOCAL, stn DW 51.

DISTRIBUTION. — Off southern New Caledonia, 680-700 m (alive).

REMARKS. — *Ancistrobasis scitula* resembles *A. tiara* in lacking a tooth at the inner base of the outer lip at maturity, and differs in being more strongly sculptured with a more strongly rounded periphery. It differs from all other *Ancistrobasis* species in details of teleoconch sculpture, in its exceptionally large protoconch, and in having a subsutural spiral thread on the first teleoconch whorl. To my knowledge, jaw plates have not hitherto been recorded from this family. They are recorded herein from *Fluxinella, Calliobasis* and *Basilissa*. They are also present in at least one species of *Seguenzia* (*S. compta* Marshall, 1983).

ETYMOLOGY. — Beautiful (Latin).

Ancistrobasis boucheti sp. nov.

Figs 46-50, 272-277 ; Table 6

DESCRIPTION. — *Shell* up to 6.03 mm wide, considerably broader than high, very stout, rather thick, umbilicate, spire 1.00-1.13 × as high as aperture ; white, nacreous through translucent outer shell layer.

Protoconch 330-370 μm wide, surface granulate.

TABLE 6. — *Ancistrobasis boucheti*. Shell measurements (mm) and countings. (BIOCAL, stn DW 77).

Character	*n*	Range	Mean	SD
H	10	2.50-3.20	2.96	0.19
D	10	4.45-6.03	5.57	0.43
H/D	10	0.48-0.56	0.53	0.02
TW	10	4.40-5.10	4.84	0.21
UD%	10	24.7-29.3	27.3	1.55

Teleoconch of up to 5.10 whorls, 1st whorl with strong, strongly supramedian angulation, angulation weakening over next half whorl and vanishing while descending to median position, subsequent whorls weakly concave ; periphery sharply angulate, rendered sharply and closely serrate by axial riblets ; base weakly convex. Spire whorls sculptured with prominent, rounded, flexuous collabral axial riblets that extend

to periphery, summits broad, flattened, interspaces about 1.5 × as wide as each axial, traversed by numerous, considerably finer spiral threads, of which peripheral spiral is strongest, others similar ; intersections not nodular, entire surface covered with minute granules after 1st whorl. Base sculptured with rounded, flexuous collabral riblets that extend to umbilical rim, and 10 or 11 rounded spiral cords, interspaces wider than each spiral, outer 3 spirals similar, slightly narrower and closer than others, which are similar to each other, small, rounded nodules at intersections ; innermost spiral strongly beaded at umbilical rim. Umbilicus deep, rim angulate, diameter 24.7-29.3 % of adult shell diameter. Aperture subquadrate. Outer lip thick at rim, strongly thickened within, with prominent, angulate elliptical ridge against posterior notch, strong outer basal ridge, and prominent, rounded elliptical denticle near base of inner lip, interspaces concave, deeply so in front of labial projection. Posterior notch shallow, broad, retraction depth 3.50-4.60 % and protraction depth 4.72-5.84 % of shell diameter ; basal notch broad and shallow, no peripheral notch. Parietal glaze rather thick. Inner lip very thick, suddenly tapered at base to form bluntly rounded denticle.

Animal. Snout considerably longer than broad, sides subparallel, broad, rounded lateral extensions at tip, mouth a vertical slit below. Cephalic tentacles parallel to snout, lying above it, slightly longer than snout, right tentacle slightly longer than left, inner bases almost in contact, tapered, dorsoventrally flattened, edges and ventral surface ciliate, large black eyes at outer bases. Right suboptic tentacle larger than cephalic tentacles, dorsoventrally flattened, ventral surface longitudinally grooved directly above a narrow tentacle that emerges from its base. Epipodial tentacles large, tapered, 8 right and 7 left. Opercular lobe small, operculum thin, chitinous, spiral.

Radula (Figs 272-274) with the formula c. 13 + 1 + 1 + 1 + c. 13. Central tooth rigid, about as long as broad, cutting area jutting forward at right angle from shaft, angulate, with 9 large, sharp, narrowly conical cusps, median cusp largest. Lateral teeth stout, broad, cutting area of each angulate and sharply serrate. Innermost marginal long and narrow, stout, cutting area narrowly angulate, terminal cusp very large, subterminal cusps numbering about 7 on outer edge, fewer on inner edge. Outer marginals slender, each with numerous sharp slender cusps at tip and along outer distal edge.

Jaw plates (Figs 275-277) subrectangular, broader than long, thin, elements enlarging anteriorly, their tips minutely and sharply roughened.

TYPE DATA. — Holotype (3.10 × 5.71 mm, 5.10 TW) MNHN and 17 paratypes (AMS, BMNH, NMNZ, NMP, USNM) : BIOCAL, stn DW 77.

DISTRIBUTION. — Off southern New Caledonia, 440 m (living).

REMARKS. — *Ancistrobasis boucheti* is extremely distinctive in the combination of low spire, strongly thickened shell, shallowly concave spire whorls, and flattened axial riblets crossed by numerous much finer spiral threads.

ETYMOLOGY. — I take particular pleasure in naming this superb species after Philippe BOUCHET.

Ancistrobasis adonis sp. nov.

Figs 56-60 ; Table 7

DESCRIPTION. — *Shell* up to 6.65 mm wide, considerably broader than high, stout, of moderate thickness, umbilicate, spire about 1.25 × as high as aperture ; white, nacreous through translucent outer shell layer.

Protoconch 320-330 µm wide, surface slightly roughened, almost smooth.

TABLE 7. — *Ancistiobasis adonis*. Shell measurements (mm) and countings. (BIOCAL, stn DW 49).

Character	*n*	Range	Mean	SD
H	10	2.45-3.65	3.10	0.33
D	10	4.90-6.65	6.06	0.59
H/D	10	0.49-0.55	0.51	0.02
TW	10	4.70-5.60	5.20	0.23
UD%	10	26.8-33.8	30.2	2.16

Teleoconch of up to 5.60 whorls ; periphery angulate, rendered shallowly serrate by axial riblets ; base weakly convex. Shoulder angulation strong on 1st whorl, descending from strongly supramedian to submedian position, weak and at about abapical third on subsequent whorls.

becoming obsolete on last adult whorl. Spire whorls almost flat after 1st whorl, last adult whorl weakly convex, a low, immediately subsutural angulation develops late on 2nd whorl and becomes finely beaded, becoming obsolete on last adult whorl. Spire whorls sculptured with fine, crisp, sigmoidal, collabral axial riblets, these traversed by fine, crisp spiral threads that multiply by intercalation, numbering 16-18 at start of last adult whorl, thread surmounting shoulder angulation strongest, others finer and similar, interspaces finely granulate on all whorls. Basal axials flexuous, rounded, collabral, vanishing on outer part of umbilical wall, becoming almost obsolete on last adult whorl. Basal spirals numbering 14-18 in adults, interspaces finely granulate, outer 4 or 5 narrow and prominent, about as strong as axials, widely spaced, inner spirals lower than axials inwardly progressively widening then narrowing, interspaces narrower than each spiral ; innermost 2 spirals narrowest, widely spaced, connected by rounded radial pleats that extend onto outer part of umbilical wall. Umbilicus deep, rim angulate, diameter 26.8-33.8 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim, slightly thickened within ; posterior notch shallow, broad, retraction depth 3.03-3.07 % and protraction depth 4.54-4.61 % of shell diameter ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip thick, simple, gently tapered abapically, toothless.

Animal unknown (dried).

TYPE DATA. — Holotype (3.20 × 6.50 mm, 5.3 TW) MNHN and 51 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 49. Paratype (1 MNHN) : BIOCAL, stn DW 48.

DISTRIBUTION. — Off southern New Caledonia, 775-830 m, living at 825-830 m.

REMARKS. — *Ancistrobasis adonis* is rendered highly distinctive by its low spire, fine axial riblets, internally slightly thickened outer lip, persistent shoulder angulation, subsutural angulation, and by the immediate appearance of secondary spirals and minute granules on the teleoconch.

ETYMOLOGY. — After Adonis, a beautiful youth beloved by Venus.

Genus ***BASILISSOPSIS*** Dautzenberg & Fischer, 1897

Basilissopsis Dautzenberg & Fischer, 1897 : 163. Type species (by monotypy) : *Basilissopsis watsoni* Dautzenberg & Fischer, 1897 ; Recent, northeastern Atlantic.

REMARKS. — The new species described below and *Ancistrobasis regina* Marshall, 1983 closely resemble *B. watsoni* in general facies and thus appear to be closely related. Their shells are essentially similar to those of *Ancistrobasis* species, and differ primarily in having a strong shoulder angulation on all teleoconch whorls. *Ancistrobasis* species have a shoulder angulation on the earliest teleoconch whorls that soon becomes obsolete, so this difference is clearly a matter of degree. *Basilissopsis* may eventually prove to be better treated as a subgenus of *Ancistrobasis*, or perhaps a synonym, but I prefer to maintain it at generic level until animals and radulae can be compared. An undescribed species occurs in Otaian (Early Miocene) beds at Parengarenga Harbour, northern New Zealand.

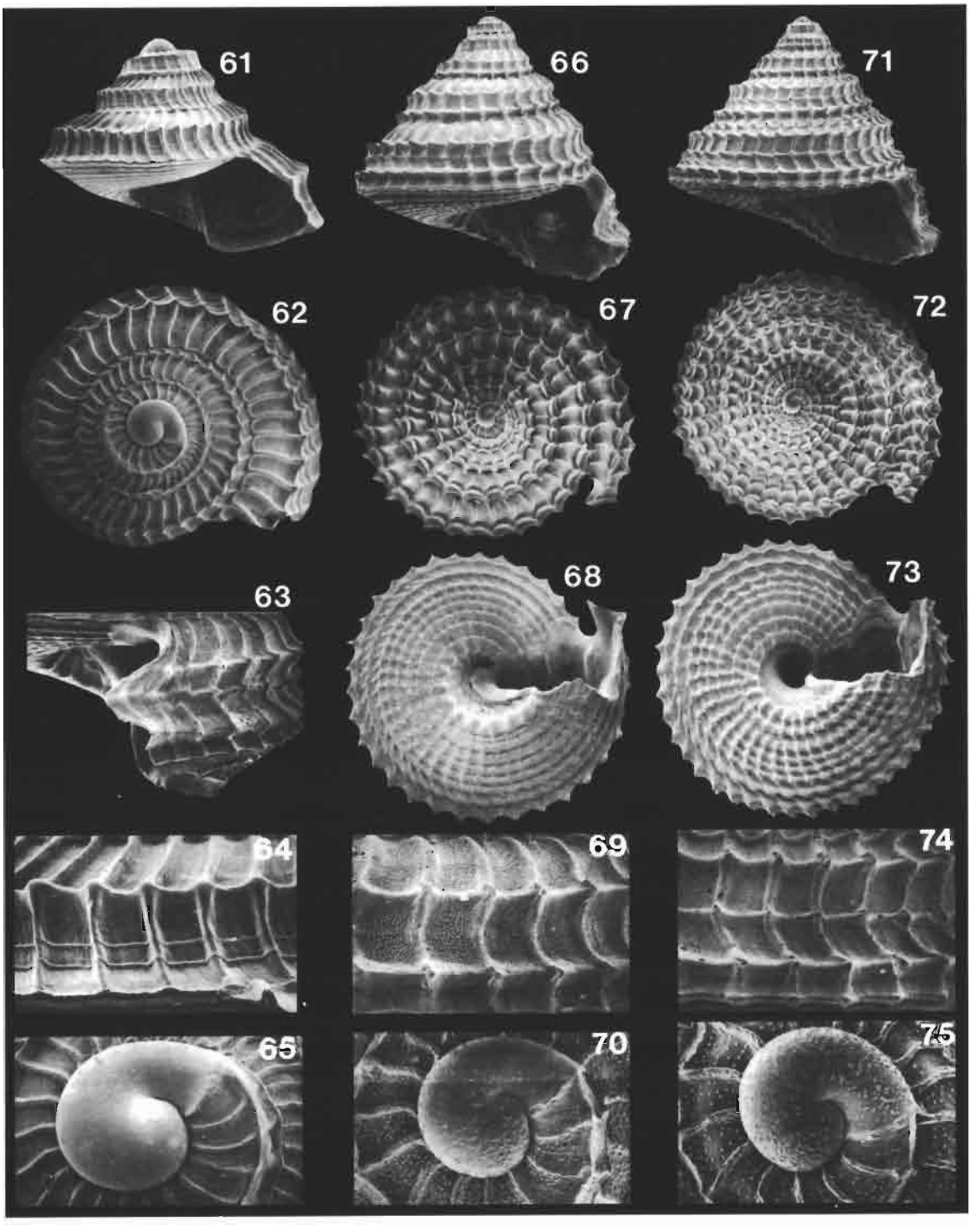
Basilissopsis charcoti sp. nov.

Figs 61, 62, 64-65

DESCRIPTION. — *Shell* (immature holotype) 1.60 mm wide, broader than high, thin, umbilicate, spire 1.18 × as high as aperture, white, nacreous through thin, translucent outer shell layer.

Protoconch 320 μm wide, smooth.

Teleoconch of 3 strongly shouldered whorls, shoulder angulation strongly supramedian at first, descending to an almost median position, ramp almost flat ; side steeply tapered, weakly concave ; periphery sharply angulate ; base weakly convex. Spire whorls axially and spirally ornamented. Axial riblets rounded, widely spaced, flexuous, collabral, interspaces with very fine granules and faint collabral growth lines, entirely traversing whorls, weak at periphery, prominent elsewhere. Shoulder and peripheral spirals strong, about as strong as axials, shoulder spiral with



FIGS 61-75. — Genera *Basilissopsis, Calliobasis* : **61, 62, 64, 65,** *Basilissopsis charcoti*, holotype, 1.12 × 1.60 mm, 64 (last TW) × 100, 65 × 90. — **63, 66-70,** *Calliobasis phimosa*, 2.50 × 5.25 mm, 63 × 25, 69 (last TW) × 50, 70 × 105. — **71-75,** *C. festiva*, holotype, 2.52 × 2.85 mm, 74 (last TW) × 45, 75 × 105.

small, rounded conical nodules where intersecting axials, peripheral spiral gently undulant, summit exposed on spire on 1st 2 whorls then covered by succeeding whorl ; interspace with 2 fine spiral threads that traverse axials. Base with 10 spiral cords, outer 3 narrow and widely spaced, inner spirals broader, closer and traversing weak, rounded, axial riblets. Umbilicus deep, rim rather sharply angulate, diameter 29 % of shell diameter. Aperture subquadrate. Outer lip thin, simple, posterior notch (from collabral sculpture) very broad and shallow, very slightly retracted from suture, weakly protractive below ; basal notch broad and concave. Parietal glaze very thin. Inner lip thin, straight, simple.

Animal unknown.

TYPE DATA. — Holotype MNHN (1.12 × 1.60 mm, 3 TW) : BIOCAL, stn DW 48.

DISTRIBUTION. — Off southern New Caledonia, 775 m (dead).

REMARKS. — Among nominate species, *Basilissopsis charcoti* most closely resembles *B. regina* (Marshall, 1983) from off the Three Kings Islands, northern New Zealand (622-805 m), differing primarily in lacking spiral threads on the ramp. The Atlantic *B. watsoni* has a much stronger peripheral keel. A species very similar to *B. charcoti*, perhaps the same, is represented by two fragmentary specimens from the northern Three Kings Rise (NZOI stn U602, 31°30.7′ S, 172°49.8′ E, 1 216-1 385 m). Judging from the simple apertural features, and particularly the size of the protoconch, the holotype of *B. charcoti* is immature, as are probably all of the specimens of *Basilissopsis* species known from northern New Zealand.

ETYMOLOGY. — After BIOCAL campaign ship N. O. " *Jean-Charcot* ".

Genus *CALLIOBASIS* Marshall, 1983

Calliobasis Marshall, 1983 : 254. Type species (by original designation) : *Basilissa bombax* Cotton & Godfrey, 1938 ; Recent, southern Australia.

REMARKS. — *Calliobasis* and *Ancistrobasis* species are similar in gross shell and external animal morphology. The radula of *C. spectrum* sp. nov. (see below) differs from that in *Ancistrobasis* and all other known seguenziids in having lateromarginal plates — probably reduced inner marginal teeth — and in having a shallowly rounded rather than angulate cutting area on the lateral teeth with relatively much larger cusps. *Calliobasis* species differ further from *Ancistrobasis* in attaining smaller shell size and in being smaller relative to the number of whorls (maximum diameter 2.25-3.01 mm, 4.80-5.50 teleoconch whorls, cf. 3.55-7.90 mm, 5.10-5.90 teleoconch whorls). Moreover, they have fewer intercalating spiral threads on the spire, and stronger peripheral and suprasutural spirals, while the shoulder angulation tends to be more persistent. Apart from *C. nepticula* sp. nov., the available specimens of which are possibly bleached, the species are outstanding among known seguenziids in having yellowish green or greenish yellow shell pigmentation, which suggests an unusual diet. Unlike typical *Ancistrobasis* species, interstitial granulation commences immediately after the protoconch. The gap in shell morphology between *Calliobasis* and *Ancistrobasis* species is bridged to some extent by *Ancistrobasis adonis* sp. nov., and *A. scitula* sp. nov., the former having interstitial granules on all teleoconch whorls, *A. scitula* having both a distinct suprasutural angulation and a persistent shoulder angulation. Although *Calliobasis* and *Ancistrobasis* are undoubtedly closely related, I prefer to maintain *Calliobasis* as a genus rather than a subgenus of *Ancistrobasis*, primarily because of the distinctive radular morphology and because both groups have been separate since at least the Eocene (*Calliobasis eos* Marshall, 1983 and *Ancistrobasis pacifica* Ladd, 1970).

Calliobasis phimosa sp. nov.

Figs 63, 66-70 ; Table 8

DESCRIPTION. — *Shell* up to 2.80 mm wide, about as broad as high ; spire broadly conical, 1.17-1.60 × as high aperture, stout, of moderate thickness, umbilicus invaded by inner lip.

Colour of protoconch and 1st 1.5-1.75 teleoconch whorls pale lime green. Subsequent whorls white, nacreous through thin, translucent outer shell layer, narrowly axially maculated at about each 4th or 5th axial costa with greenish yellow, maculations occasionally darkening to yellowish brown on last adult whorl, pigmentation deepest on spirals ; base white.

TABLE 8. — *Calliobasis phimosa*. Shell measurements (mm) and countings. (BIOCAL, stn DW 44).

Character	*n*	Range	Mean	SD
H	10	2.15-2.60	2.45	0.12
D	10	2.40-2.80	2.63	0.13
H/D	10	0.87-1.01	0.93	0.04
TW	10	5.00-5.50	5.24	0.19
UD%	10	20.3-24.0	22.4	1.19

Protoconch 270 μm wide, coarsely granulate.

Teleoconch of up to 5.5 convex whorls, subsutural ramp weakly convex, base suddenly contracted, very weakly convex. Spire whorls sculptured with strong, similar, reticulating spiral cords and collabral axial costae, interspaces concave, sharp conical nodules at intersections, minute granules throughout. Spiral cords numbering 3 or 4 on last adult whorl. Shoulder spiral commencing immediately, at about adapical third ; suprasutural spiral commencing early 2nd whorl, rapidly enlarging to resemble shoulder spiral ; intermediate spiral (present in about 1 specimen in 3, including holotype) commencing on last adult whorl, remaining weaker than others ; peripheral spiral covered by succeeding whorls, weaker than shoulder and intermediate spirals. Base sculptured with collabral axial riblets that extend into umbilicus, and 8 or 9 spiral cords, outer 2 spirals narrowest, outer 3 widely spaced, innermost spiral strongest, beaded at umbilical rim, low rounded nodules at intersections with axials. Umbilicus shallow, conical, infilled by inner lip, diameter 20.3-24.0 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim of labial projections elsewhere strongly thickened, especially behind peripheral and basal notches ; posterior notch gently flared, retraction depth 4.87-6.07 % and protraction depth 10.98-13.34 % of shell diameter. Forward-swinging limb depressed adaperturally, basal notch smaller than anterior, rim slightly flared ; peripheral notch very small, very shallowly retracted. Parietal glaze thin. Inner lip thick, spreading into umbilicus.

Animal unknown (dried).

TYPE DATA. — Holotype MNHN (2.50 × 5.25 mm, 5.25 TW) and 25 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 44. Paratypes (3 MNHN) : BIOCAL, stn DW 38.

DISTRIBUTION. — Off southern New Caledonia, 360-450 m, living at 440-450 m.

REMARKS. — *Calliobasis phimosa* differs from hitherto named species of *Calliobasis* in having an infilled umbilicus, and in sculptural details, particularly in the late appearance or absence of the intermediate teleoconch spiral.

ETYMOLOGY. — From the Greek *phimos* (stopping an orifice) and refering to the infilled umbilicus.

Calliobasis festiva sp. nov.

Figs. 71-75

DESCRIPTION. — *Shell* (holotype) 2.85 mm wide, slightly broader than high ; spire broadly conical, 1.5 × higher than aperture, deeply umbilicate, stout, of moderate thickness.

Protoconch translucent white. First 1.5 teleoconch whorls reddish brown through translucent outer shell layer, next whorl translucent white. Succeeding whorls translucent, regularly axially maculated with yellowish brown, each 3rd or 4th nodule on peripheral spiral deeply pigmented, coinciding nodule on shoulder spiral more lightly pigmented, very lightly pigmented in a spiral band between shoulder spiral and median spiral. Base translucent white. Aperture nacreous within.

Protoconch 260 μm wide, coarsely granulate.

Teleoconch of 5.25 whorls, rather strongly convex at first, becoming weakly convex, subsutural ramp weakly convex, base suddenly contracted, very weakly convex. Spire whorls sculptured with strong, similar, reticulating spiral cords and collabral axial costae, interspaces concave, sharp conical nodules at intersections, minute granules throughout. Spiral cords numbering 7 on last adult whorl. Shoulder spiral commencing immediately, at about adapical quar-

ter, suprasutural spiral commencing on 2nd half of 1st whorl, rapidly enlarging to resemble shoulder spiral ; intermediate spiral commencing late on 3rd whorl, remaining weaker than shoulder and suprasutural spirals ; ramp spiral commencing late on 4th whorl, becoming about as strong as intermediate spiral ; peripheral spiral slightly weaker than suprasutural spiral, covered by succeeding whorls ; 2 spirals intercalate near end of first half of last adult whorl, one between shoulder and intermediate spiral, the other between intermediate spiral and suprasutural spiral. Base sculptured with collabral axial riblets that extend into umbilicus, and 8 spiral cords, low rounded nodules at intersections, innermost spiral beaded at umbilical rim. Umbilicus conical, deep, diameter 25 % of adult shell diameter. Aperture subquadrate. Outer lip strongly thickened within ; retraction depth of posterior notch 7.02 % of shell diameter, protraction depth unknown (labial projection broken) ; basal notch concave, peripheral notch very small. Parietal glaze thin. Inner lip thick, gently curved, suddenly tapered near abapical extremity to form a small projection.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.52 × 2.85 mm, 5.25 TW) : BIOCAL, stn DW 64.

DISTRIBUTION. — Off southern New Caledonia, 250 m (dead).

REMARKS. — *Calliobasis festiva* seems closest to the Kermadec *C. miranda* Marshall, 1983, from which it differs in attaining larger size, in the presence of a spiral cord on the ramp, and in having a stronger shoulder spiral and closer suprasutural and peripheral spirals. It differs from *C. phimosa* sp. nov. in having an open umbilicus and in sculptural details, notably in the presence of a spiral cord on the ramp, and in the early appearance of the intermediate spiral.

ETYMOLOGY. — Delightful (Latin).

Calliobasis spectrum sp. nov.

Figs 76-80, 278, 279 ; Table 9

DESCRIPTION. — *Shell* up to 2.26 mm wide, slightly broader than high, stout, openly umbilicate, spire 1.26-1.56 × as high as aperture.

Protoconch and 1st 2.75 whorls white, subsequent spire whorls white, narrowly axially maculated with yellow at about each 4th or 5th axial costa, base white, aperture nacreous within.

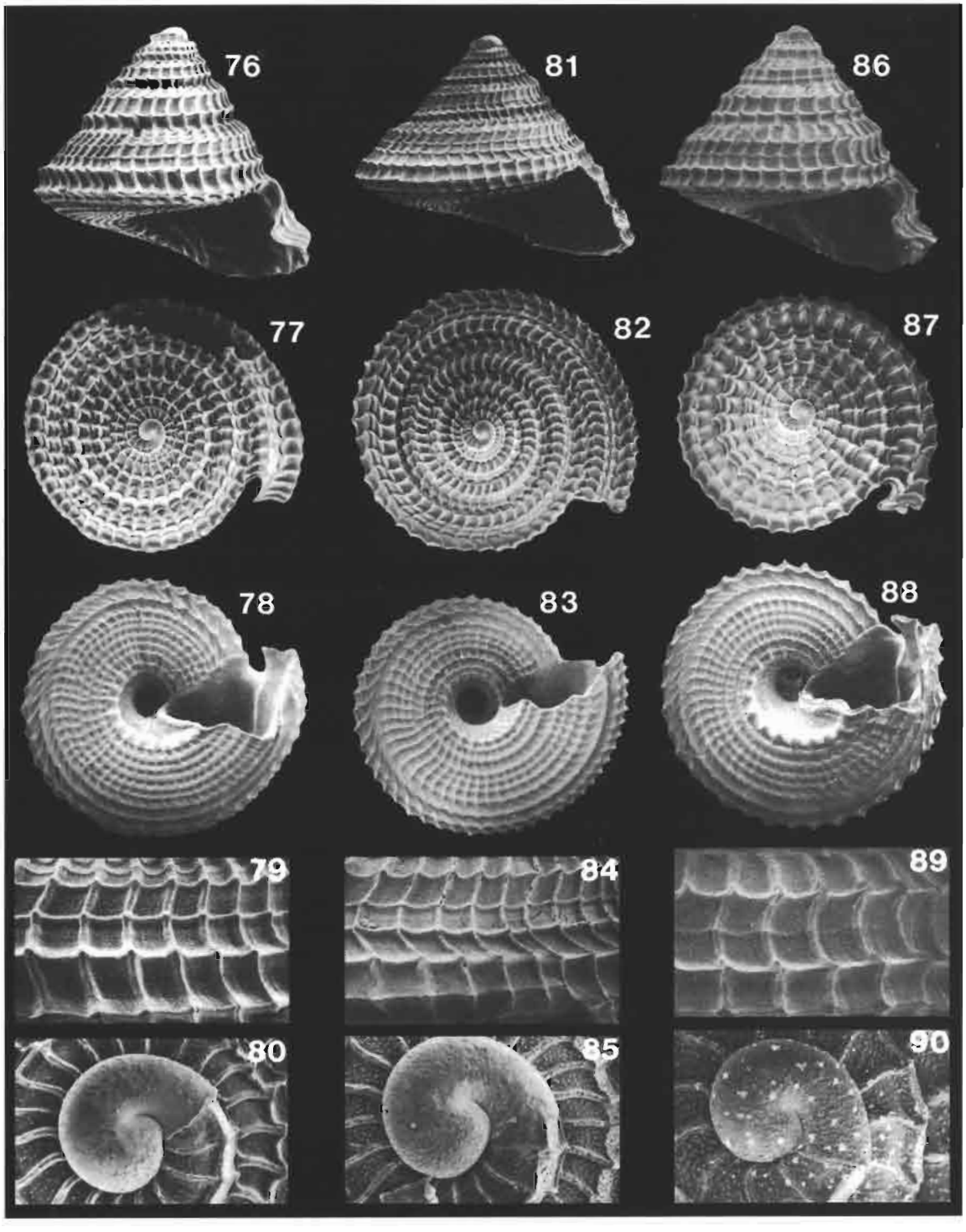
Protoconch 230-260 μm wide, coarsely granulate.

TABLE 9. — *Calliobasis spectrum*. Shell measurements (mm) and countings.

H	D	H/D	TW	UD%	
2.02	2.13	0.95	4.80	23.4	BIOCAL stn DW 41
2.00	2.26	0.88	5.00	28.0	BIOCAL stn DW 08
1.91	2.23	0.86	4.90	25.4	Holotype
1.90	2.20	0.86	4.75	30.3	BIOCAL stn DW 08

Teleoconch of up to 4.9 whorls, convex at first, becoming weakly convex, subsutural ramp more or less flat, base suddenly contracted, weakly convex. Spire whorls sculptured with strong, similar, reticulating spiral cords and collabral axial costae, interspaces concave, rounded conical nodules at intersections, minute granules throughout. Spiral cords numbering 6 on last adult whorl. Shoulder spiral commencing immediately, at about adapical quarter, relatively weak ; suprasutural spiral commencing on 1st half of 1st whorl, larger than shoulder spiral after 1st whorl ; intermediate spiral commencing late on 1st half of 4th whorl, enlarging to resemble shoulder spiral ; adapical ramp spiral commencing on 3rd whorl, abapical ramp spiral commencing of 2nd half of 4th whorl, both enlarging to resemble shoulder spiral ; peripheral spiral covered by succeeding whorls, intermediate in size between shoulder and intermediate spirals. Base sculptured with collabral axial riblets that extend into umbilicus, and 7-9 spiral cords, low rounded nodules at intersections, innermost spiral beaded at umbilical rim. Umbilicus conical, deep, diameter 23.4-30.3 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim of labial projection, elsewhere strongly thickened ; posterior notch shallow, retraction depth 6.24-8.96 % of shell diameter ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip thick, tapered at abapical extremity to form a small projection.

Animal white. Snout about twice as long as broad, tip deeply cleft between strong, rounded lateral projections, mouth a vertical slit below. Cephalic tentacles similar, dorsoventrally flat-



FIGS 76-90. — Genus *Calliobasis* : **76-80,** *Calliobasis spectrum*, holotype, 1.91 × 2.23 mm, 79 (last TW) × 60, 80 × 105. — **81-85,** *C. nepticula*, holotype, 2.30 × 3.10 mm, 84 (last TW) × 45, 85 × 95. — **86-90,** *C. merista*, holotype, 2.10 × 2.40 mm, 89 (last TW) × 45, 90 × 100.

tened, ciliate, gradually tapered, inner bases about 2 tentacle base-widths apart, large swollen black eyes at outer bases. Right suboptic tentacle as large as cephalic tentacles, posteroventral surface concave. Epipodial tentacles large, 6 on each side. *Operculum* thin, chitinous, spiral.

Radula (Fig. 278). Central tooth rigid, about as long as broad, tip flattened, cutting area jutting forward at right angle from shaft, angulate, with about 9 conical cusps, median cusp largest, laterobasal projections prominent. Lateral teeth stout, broad, each with broad, shallowly rounded cutting area with 9 or 10 relatively large, long, narrow cusps. Innermost marginal reduced to form convoluted articulatory lateromarginal plate. Outer marginals slender, small, sharp, slender cusps at tips and in long series on outer edges.

Jaw plates (Fig. 279) thin, ovate, broader than long, elements short, longer anteriorly.

TYPE DATA. — Holotype and 2 paratypes MNHN : BIOCAL, stn DW 41. Paratypes (3) : BIOCAL, stn DW 08 (1 MNHN, 1 NMNZ) ; BIOCAL, stn DW 38 (1 MNHN).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands and southern New Caledonia, 360-435 m, living at 380-410 m.

REMARKS. — *Calliobasis spectrum* superficially resembles the South Australian *C. bombax* (Cotton & Godfrey, 1938) (MARSHALL, 1983, fig. 7 g), from which it differs primarily in attaining maturity at considerably smaller size, and in the later appearance of spiral cords on the spire other than the shoulder and suprasutural spirals. From the New Caledonian *C. festiva* sp. nov., which also has a fully open umbilicus, it differs in having weaker spiral cords above the suprasutural spiral, which is set higher on late whorls, and in the later appearance of the intermediate spiral. It differs from the locally sympatric *C. phimosa* sp. nov. in having a fully open umbilicus and in sculptural details.

ETYMOLOGY. — Image (Latin).

Calliobasis nepticula sp. nov.

Figs 81-85

DESCRIPTION. — *Shell* up to 3.01 mm wide, broader than high, stout, openly umbilicate, spire rather broadly conical, 1.30-1.35 × as high as aperture. White (bleached ?), aperture nacreous within.

Protoconch 270 μm wide, coarsely granulate.

Teleoconch of up to 4.8 whorls, spire whorls convex at first, becoming very weakly convex ; sutural ramp flat throughout or becoming shallowly concave ; base suddenly contracted, weakly convex. Spire whorls sculptured with crisp, reticulating spiral cords and arcuate, collabral axial costae, interspaces concave, small conical nodules at intersections, minute granules throughout. Spiral cords numbering 6 on last adult whorl. Shoulder spiral commencing immediately, at about adapical quarter ; suprasutural spiral commencing almost immediately, becoming slightly larger than shoulder spiral ; intermediate spiral commencing on 2nd half of 3rd whorl, enlarging to resemble shoulder spiral ; subsutural spiral commencing at start of 2nd half of 3rd whorl, remaining weaker than shoulder spiral ; spiral between shoulder and intermediate spirals commencing on 2nd half of 4th whorl, enlarging to resemble adjacent spirals ; peripheral spiral covered by succeeding whorls, similar to suprasutural spiral. Base sculptured with arcuate collabral axial riblets that are evanescent on outer part of umbilical wall, and 7-9 similar, widely spaced spiral cords, low rounded nodules at intersections ; innermost spiral radially pleated at umbilical rim. Umbilicus conical, deep, diameter 25.4-31.0 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim of labial projection, elsewhere strongly thickened ; posterior notch broad, retraction depth 4.4 % and protraction depth 5.0 % of shell diameter ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip rather thin, a small rounded denticle near base.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.30 × 3.10 mm, 4.8 TW), and 2 paratypes MNHN, NMNZ (2.40 (est.) × 3.00 mm, TW ? ; 2.10 × 2.87 mm, 4.6 TW) : BIOCAL, stn DW 08.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 435 m (dead).

REMARKS. — *Calliobasis nepticula* closely resembles *C. bombax* in general facies, but differs in attaining maturity at smaller size, in

being more broadly conical, and in having more densely crowded granules on the spire whorls. It differs from *C. phimosa* sp. nov. in having a fully open umbilicus and in sculptural details, from *C. festiva* in having a weaker shoulder spiral and more widely spaced suprasutural and peripheral spirals, and from *C. spectrum* in being more finely sculptured, and in having one spiral cord on the subsutural ramp. The lack of shell pigmentation is possibly a distinctive character, but the available specimens are obviously long dead and so may well be bleached.

ETYMOLOGY. — Young granddaughter (Latin).

Calliobasis merista sp. nov.

Figs 86-90 ; Table 10

DESCRIPTION. — *Shell* up to 2.40 mm wide, about as broad as high ; spire 1.33-1.79 × as high as aperture, stout, openly umbilicate.

Colour of protoconch and 1st 2 teleoconch whorls pale greenish yellow. Subsequent whorls white, narrowly maculated at each 4th or 5th axial costa with greenish yellow, most deeply pigmented on suprasutural spiral, base white, aperture nacreous within.

TABLE 10. — *Calliobasis merista*. Shell measurements (mm) and countings. (BIOCAL, stn DW 08).

Character	*n*	Range	Mean	SD
H	6	2.05-2.25	2.15	0.07
D	6	2.25-2.40	2.34	0.05
H/D	6	0.87-0.96	0.92	0.04
TW	6	4.75-5.25	5.03	0.21
UD%	6	21.2-33.3	27.3	3.93

Protoconch 270 μm wide, coarsely granulate.

Teleoconch of up to 5.25 whorls, markedly convex at first, becoming weakly convex ; ramp narrow, weakly convex or flat ; base suddenly contracted, very weakly convex. Spire whorls sculptured with strong, similar, reticulating spiral cords and sigmoidal, collabral axial costae, interspaces concave, conical nodules at intersections, minute granules throughout. Spiral cords numbering 4 on last adult whorl. Shoulder spiral commencing immediately, at about adapical quarter ; suprasutural spiral commencing on 2nd half of 1st whorl, rapidly enlarging to resemble shoulder spiral ; intermediate spiral commencing on 2nd half of 4th whorl, remaining weaker than adjacent spirals ; peripheral spiral similar to suprasutural spiral, summit covered by succeeding whorls. Base sculptured with collabral axial riblets that extend into umbilicus, and 8 spiral cords, outermost close beside peripheral spiral, interspaces of outermost 4 spirals widest, other interspaces about as wide as each spiral, innermost spiral beaded at umbilical rim, other spirals with low rounded nodules at intersections with axials. Umbilicus conical, deep, diameter 22.2-33.3 % of adult shell diameter. Aperture subquadrate. Outer lip thin at rim of labial projection, elsewhere strongly thickened, posterior notch broad, retraction depth 5.50-5.80 %, and protraction depth 8.00-9.00 % of shell diameter, basal notch concave, no peripheral notch, distinctly notched against umbilical rim. Parietal glaze thin. Inner lip thick, tapered at abapical extremity, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.10 × 2.40 mm, 4.90 TW) and 7 paratypes (1 AMS, 5 MNHN, 1 NMNZ) : BIOCAL, stn DW 08.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 435 m (dead).

REMARKS. — *Calliobasis merista* is most similar to *C. phimosa* in shape and sculpture, differing primarily in being openly umbilicate, in having stronger and sharper nodules on the shoulder and suprasutural spirals, and in having the shoulder spiral set lower on the adult whorls. *C. merista* occurred with *C. spectrum* and *C. nepticula* at the type locality.

ETYMOLOGY. — Divided (Greek).

Genus *FLUXINELLA* Marshall, 1983

Fluxinella Okutani, 1968 : 42 (*nomen nudum*).
Fluxinella Marshall, 1983 : 250. Type species (by original designation) : *Fluxinella lepida* Marshall, 1983 ; Recent, New Zealand.

Fluxinella membranacea sp. nov.

Figs 91, 93, 94, 97 ; Table 11

DESCRIPTION. — *Shell* up to 4.00 mm wide, considerably broader than high, sublenticular, thin, fragile, glossy, umbilicate, spire 0.78-1.00 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 280-300 μm wide, side very finely granulate, summit essentially smooth.

TABLE 11. — *Fluxinella membranacea*. Shell measurements (mm) and countings. (" *Vauban* ", stn 40).

Character	*n*	Range	Mean	SD
H	10	1.22-1.75	1.49	0.16
D	10	3.20-4.00	3.58	0.23
H/D	10	0.38-0.47	0.41	0.03
TW	10	3.90-4.50	4.31	0.26
UD%	10	27.0-30.3	28.8	1.15

Teleoconch of up to 4.5 whorls. Shoulder angulation sharp on 1st whorl, progressively weakening until obsolete near end of 1st half of 3rd whorl, summit level with adapical extremity of protoconch on 1st half whorl, gradually descending over subsequent whorls to supramedian position. Second and later spire whorls weakly convex, shallowly concave above and below sharp, very shallowly undulant peripheral keel, base well rounded. Spire smooth apart from fine collabral growth lines. Base smooth apart from collabral growth lines and obscure spiral lines. Umbilicus deep, rim narrowly rounded, projecting inwards to overhang almost vertical wall, diameter 27.0-30.3 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin and fragile, damaged in all available specimens, posterior notch very shallow and broad, from growth lines weakly retracted from suture and weakly projected below ; basal notch concave ; peripheral notch contained in keel, not retracted. Parietal glaze very thin. Inner lip thin, simple, flexed at umbilicall rim, channelled below.

Animal unknown.

TYPE DATA. — Holotype MNHN (1.35 × 3.45 mm, 4.10 TW) and 62 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : " *Vauban* ", stn 40. Paratypes (4 MNHN) : BIOCAL, stn DW 77.

DISTRIBUTION. — Off southern New Caledonia, 250-440 m (dead).

REMARKS. — *Fluxinella membranacea* differs from all hitherto named species of *Fluxinella* in the combination of smooth spire, flattened summit, persistent shoulder angulation, and distinctly overhung umbilical wall.

Fluxinella xysila sp. nov.

Figs 98, 101, 103 ; Table 12

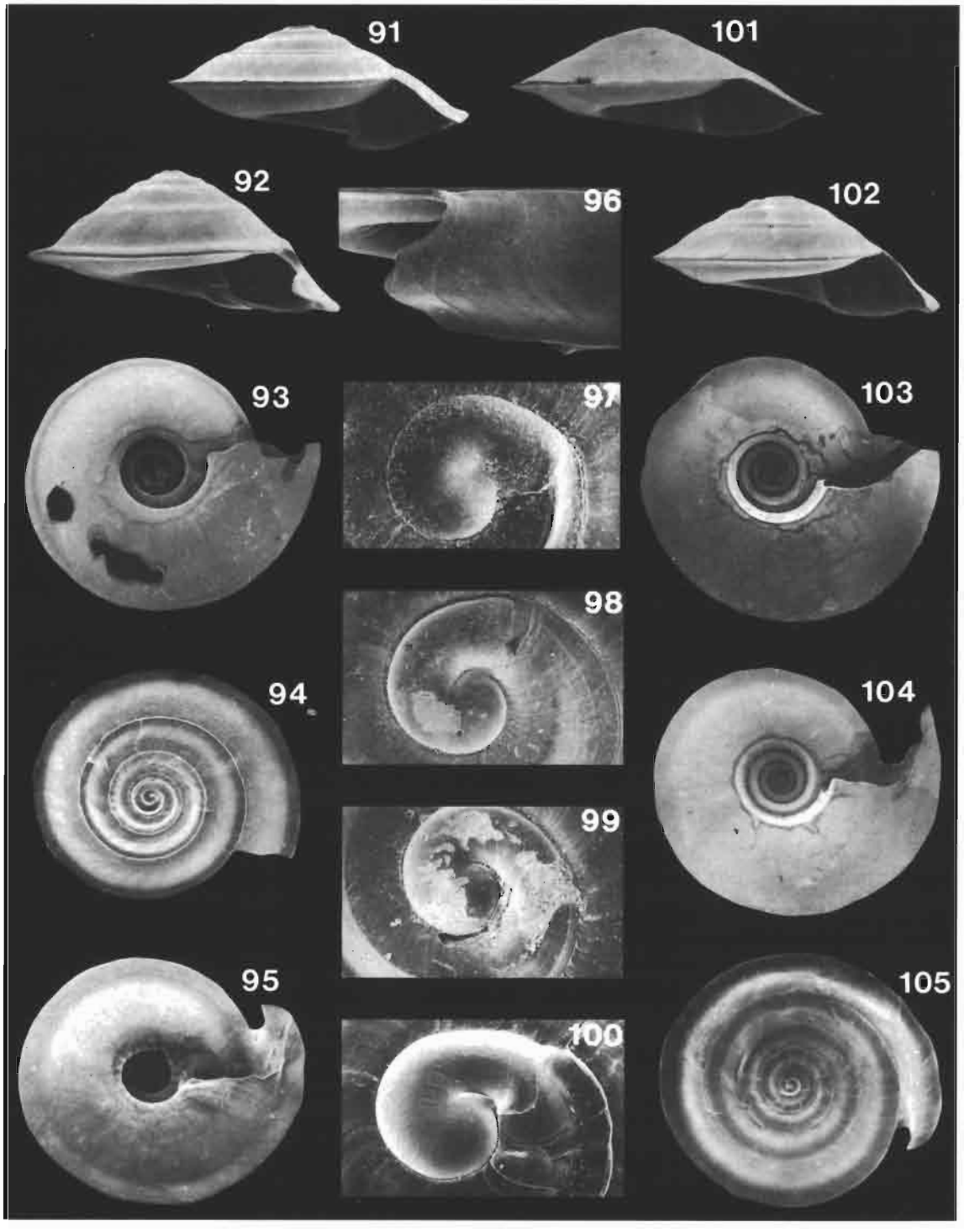
DESCRIPTION. — *Shell* up to 6.40 mm, markedly broader than high, sublenticular, thin, glossy, umbilicate, spire 0.91-1.17 × as high as aperture ; white, nacreous through thin, translucent shell layer.

Protoconch 350-370 μm wide, smooth.

TABLE 12. — *Fluxinella xysila*. Shell measurements (mm) and countings.

H	D	H/D	TW	UD%	
2.10	5.30	0.40	4.30	31.7	Holotype
2.45	6.40	0.38	4.40	31.3	Paratype
2.45	6.30	0.39	4.50	30.2	Paratype

Teleoconch of up to 4.50 whorls. First 2 whorls weakly convex, a weakly defined shoulder angulation on 1st half whorl, later whorls almost flat, peripheral keel prominent, sharp, flange-like, smooth ; base weakly convex. A crisp spiral thread bordering umbilicus, entire surface otherwise smooth apart from fine collabral growth lines. Umbilicus deep, wall steeply tapered, diameter 30.2-31.7 % of shell diameter. Aperture subrhomboidal. Outer lip rim damaged, thin,



FIGS 91-105. — Genus *Fluxinella* : **91, 93, 94,** *Fluxinella membranacea*, holotype, 1.35 × 3.45 mm. — **97,** *F. membranacea*, paratype, " *Vauban* " stn 40, × 105. — **92, 95, 96, 100, 105,** *F. polita*, holotype, 1.90 × 4.10 mm, 96 × 30, 100 × 95. — **98, 101, 103,** *F. xysila*, 2.10 × 5.20 mm, 98 × 73. — **99, 102, 104,** *F. brychia*, holotype, 2.10 × 5.20 mm, 99 × 70.

not, significantly thickened within, from growth lines posterior notch retraction and protraction depths 3.7 % of shell diameter ; basal notch shallow, concave, peripheral notch within keel. Parietal glaze thin. Inner lip thin, simple.

Animal unknown.

TYPE DATA. — Holotype (2.10 × 5.20 mm, 4.20 TW) and paratype (2.45 × 6.40 mm, 4.40 TW) MNHN, paratype NMNZ : BIOCAL, stn DW 106.

DISTRIBUTION. — Off southern New Caledonia, 625-650 m (dead).

REMARKS. — *Fluxinella xysila* appears to be most closely related to the New Zealand species *F. lenticulosa* (803-846 m), from which it differs in having a higher spire and a more weakly convex base. Other similar taxa are *F. discula* (Dall, 1889) (northwestern Atlantic, 1 597-1 796 m), *F. vitrea* (Okutani, 1968) (Japan, 2 100 m), *F. gellida* (Barnard, 1963) (South Africa, 2 268-2 377 m) and *F. lepida* Marshall, 1983 (New Zealand, 1 457-1 463 m). *F. xysila* differs from *F. gellida* in having a much more weakly convex base, and from the others in having a more weakly defined shoulder angulation on the first teleoconch whorl. It differs further from *F. discula* and *F. vitrea* in having a smaller protoconch (diameter 350-370 μm cf. 400 μm), from *F. vitrea* in having a flat rather than weakly convex umbilical wall, and from *F. lepida* in having a steeply tapered, rather than vertical umbilical wall.

ETYMOLOGY. — Smooth (Greek).

Fluxinella brychia sp. nov.

Figs 99, 102, 104

DESCRIPTION. — *Shell* up to 5.20 mm wide, considerably broader than high, sublenticular, thin, glossy, umbilicate, spire shallowly cyrtoconoid, 0.64-0.95 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 370 μm wide, smooth.

Teleoconch of up to 4.2 whorls. First whorl with supramedian shoulder angulation, sharp at first, progressively weakening, becoming obsolete early on 2nd half of 1st whorl. First 2 spire whorls weakly convex, subsequent spire whorls and base weakly convex, shallowly concave above and below very prominent, smooth, sharp peripheral keel. Smooth apart from flexuous collabral growth lines, and obscure spiral lines on base, a spiral thread at umbilical rim. Umbilicus very broad, deep, rim sharply angulate, wall steeply tapered, diameter 32.7-35.3 % of adult shell diameter. Aperture subquadrate. Outer lip thin, rim damaged, from growth lines posterior notch concave, retraction depth 2.6 % and protraction depth 7.7 % of shell diameter ; peripheral notch within keel, not retracted ; basal notch concave. Parietal glaze very thin. Inner lip thin, simple.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.10 × 5.20 mm, 4.2 TW) : BIOCAL, stn CP 72. Paratype (1 MNHN) : BIOCAL, stn DS 59.

DISTRIBUTION. — Off southern New Caledonia, 2 100-2 650 m (dead).

REMARKS. — *Fluxinella brychia* bears a strong general similarity to *F. xysila* sp. nov. and the following species with which it is compared. It differs from *F. discula* in having the whorls more weakly stepped within the umbilicus and in having a shallowly cyrtoconoid instead of rather evenly conical spire, from *F. discula* and *F. vitrea* in having a smaller protoconch (diameter 370 μm, cf. 400 μm), and from *F. vitrea* in having a flat rather than weakly convex umbilical wall. It differs from *F. lenticulosa* in having a higher spire, and a shoulder angulation on the first teleoconch whorl, and from *F. xysila* in having a weaker spiral thread at the umbilical rim, a more sharply defined shoulder angulation, and a deeper posterior notch. The base is more weakly convex than in *F. gellida.*

ETYMOLOGY. — From the deep (Greek).

Fluxinella polita sp. nov.

Figs 92, 95, 96, 100, 105 ; Table 13

DESCRIPTION. — *Shell* up to 4.40 mm wide, considerably broader than high, sublenticular, stout, glossy, umbilicate, spire 1.31-1.69 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

TABLE 13. — *Fluxinella polita*. Shell measurements (mm) and countings. (BIOCAL, stn DW 44).

Character	*n*	Range	Mean	SD
H	10	1.75-2.15	1.86	0.12
D	10	3.65-4.40	3.77	0.98
H/D	10	0.42-0.52	0.46	0.03
TW	10	4.25-4.75	4.51	0.17
UD%	10	18.2-21.7	20.0	1.29

Protoconch 300-330 μm wide, smooth apart from faint axial wrinkles at summit.

Teleoconch of up to 4.75 whorls. Spire whorls flat or very weakly convex above very prominent, sharp, thin, flange-like peripheral keel, which is shallowly concave above, and flat and almost horizontal below, drooping abapically at end of last adult whorl. Whorls smooth apart from fine collabral growth lines and obscure spiral lines, umbilical rim rendered shallowly undulant by weak, bordering radial pleats. Umbilicus deep, rim narrowly rounded, projecting inwards to overhang wall, diameter 18.2-21.7 % of adult shell diameter. Aperture trapezoidal. Outer lip thin at rim of labial projection and base, thick at inner basal extremity, thickened within, strongly so against posterior notch and peripheral keel ; posterior notch shallow, apical rim gently flared, retraction depth 2.38-2.50 % and protraction depth 5.82-7.55 % of shell diameter ; basal notch concave ; peripheral notch within keel, not retracted. Parietal glaze thin. Inner lip very thick, concave, flexed at base to form small, rounded tooth, below which is a narrow, shallow groove.

Animal unknown (dried).

TYPE DATA. — Holotype (1.90 × 4.10 mm, 4.7 TW) MNHN, and 755 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM): BIOCAL, stn DW 44.

OTHER MATERIAL EXAMINED (12 specimens MNHN). — BIOCAL, stn DW 08 (2). — Stn DW 46 (7). — Stn DW 53 (1). — Stn DW 70 (2).

DISTRIBUTION. — Off Ouvéa, Loyalty Is, and southern New Caledonia, 435-1 005 m, living at 440-610 m.

REMARKS. — *Fluxinella polita* differs from hitherto known species of *Fluxinella* in its stout glossy shell, smooth periphery, toothed inner lip, and radially pleated umbilical rim.

ETYMOLOGY. — Made smooth (Latin).

Fluxinella runcinata sp. nov.

Figs 106, 108, 110 ; Table 14

DESCRIPTION. — *Shell* up to 4.65 mm wide, considerably broader than high, stout, glossy, umbilicate ; spire weakly cyrtoconoid, 1.05-1.30 × as high as aperture ; white, nacreous through translucent outer shell layer.

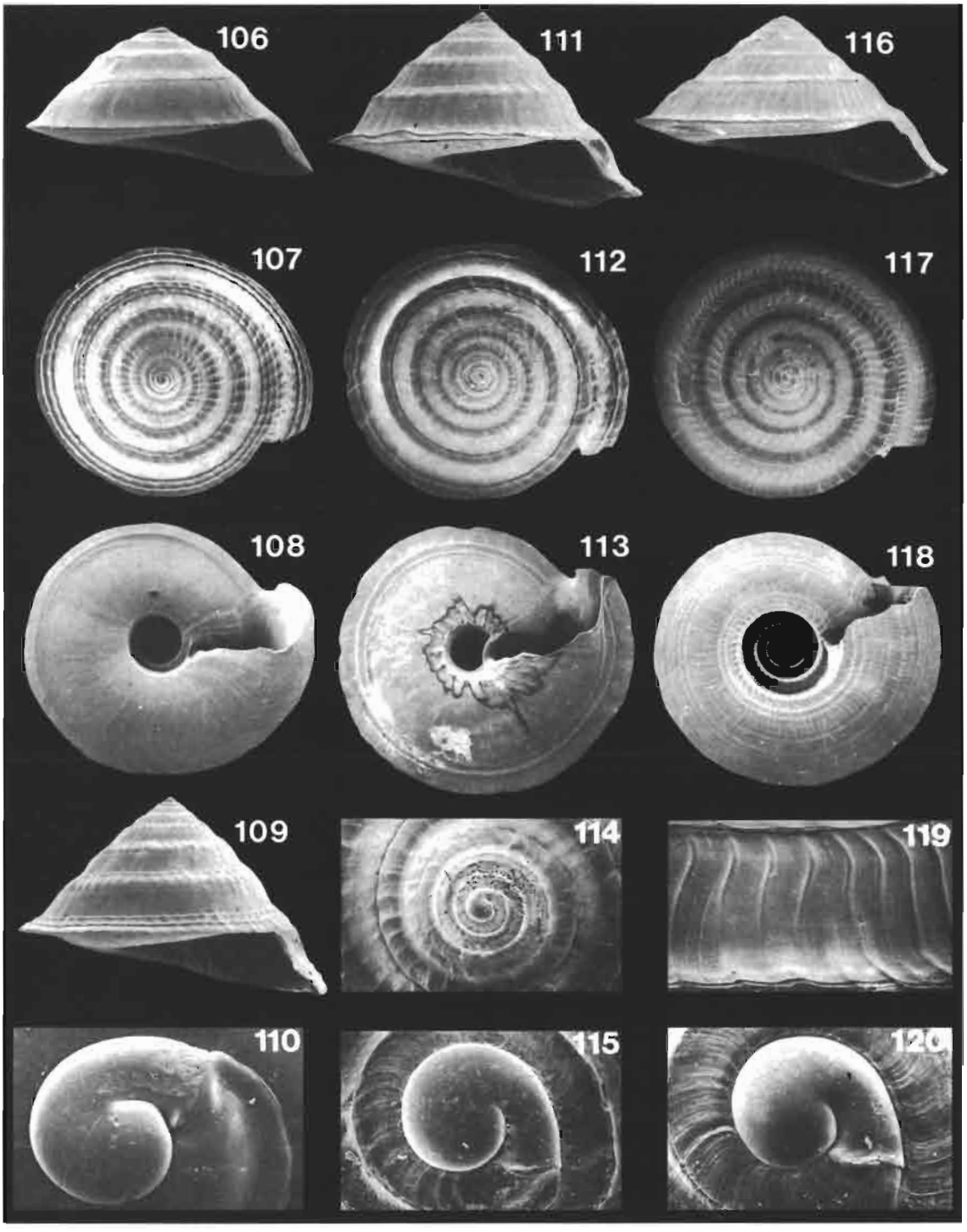
Protoconch 330-350 μm wide (usually 330 μm), smooth.

TABLE 14. — *Fluxinella runcinata*. Shell measurements (mm) and countings. (BIOCAL, stn DW 48, DW 53).

Character	*n*	Range	Mean	SD
H	10	2.00-2.68	2.33	0.24
D	10	3.75-4.65	4.16	0.31
H/D	10	0.53-0.59	0.55	0.02
TW	10	4.50-5.10	4.84	0.19
UD%	10	21.5-26.1	23.9	1.38

Teleoconch of up to 5.10 whorls. Spire whorls flat above shallowly concave adapical side of prominent, smooth, sharp peripheral keel, base very weakly and rather evenly convex from periphery to umbilical rim. Spire whorls smooth apart from fine collabral growth lines. Base with 2-4 fine, close, similar spiral threads near periphery, another crisply defined thread at umbilical rim, elsewhere smooth apart from collabral growth lines and obscure spiral lines. Umbilicus deep, rim smooth, narrowly rounded, weakly projecting inwards to slightly overhang wall, diameter 21.5-26.1 % of adult shell diameter. Aperture subtrapezoidal. Outer lip thin at rim of labial projection and base, moderately thickened within against posterior notch and peripheral keel ; posterior notch shallow, broad, retraction depth 2.59-3.54 % and protraction depth 1.30-4.45 % of shell diameter ; basal notch concave ; peripheral notch within keel, not retracted. Parietal glaze thin. Inner lip thick, concave, flexed at base to form small rounded tooth, below which is a narrow, shallow groove.

Animal unknown.



FIGS 106-120. — Genus *Fluxinella* : **106, 108, 110,** *Fluxinella runcinata*, holotype, 2.05 × 3.85 mm, 110 × 90. — **107, 109, 115,** *F. asceta*, paratype, BIOCAL stn DW 33, 3.80 × 6.50 mm, 115 × 80. — **111-114,** *F. asceta*, holotype, 4.00 × 6.90 mm, 114 × 20. — **116-119,** *F. megalomphala*, holotype, 4.05 × 7.80 mm, 119 (last TW) × 25. — **120,** *F. megalomphala*, paratype, BIOCAL stn DW 80, × 70.

TYPE DATA. — Holotype (2.05 × 3.85 mm, 4.6 TW) and 2 paratypes MNHN : BIOCAL, stn DW 48. Paratypes (31) : BIOCAL, stn DW 49 (2 MNHN). — Stn DW 53 (1 AMS, 1 BMNH, 6 MNHN, 2 NMNZ, 1 NMP, 1 USM). — Stn DW 70 (11 MNHN). — Stn DW 79 (2 MNHN). — Stn DW 80 (4 MNHN).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, and southern New Caledonia, 715-1 380 m (dead).

REMARKS. — Compared with *Fluxinella polita*, which it most resembles, *F. runcinata* differs primarily in its higher spire and narrower peripheral keel, and in lacking radial pleats at the umbilical rim. The two species have overlapping bathymetric ranges and they occurred together at BIOCAL stations DW 53 and DW 70.

ETYMOLOGY. — Planed off (Latin).

Fluxinella asceta sp. nov.

Figs 107, 109, 111-115, 280, 281 ; Table 15

DESCRIPTION. — *Shell* up to 7.20 mm wide, markedly broader than high, trochiform, stout, glossy, umbilicate, spire shallowly cyrtoconoid, 1.74-2.29 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

TABLE 15. — *Fluxinella asceta*. Shell measurements (mm) and countings. (BIOCAL, stn DW 33).

Character	*n*	Range	Mean	SD
H	10	3.00-4.55	3.77	0.49
D	10	5.33-7.20	6.49	0.65
H/D	10	0.53-0.63	0.58	0.03
TW	10	6.00-7.00	6.47	0.26
UD%	10	20.8-24.4	22.5	1.18

Protoconch 270-300 µm wide, smooth, tip excert.

Teleoconch of up to 7 whorls. Shoulder angulation strong on 1st whorl, progressively weakening, vanishing on next whorl. Subsequent whorls shallowly concave, adapical two-thirds flat, abapical third weakly convex at first, becoming flat and less steeply sloping than adapical two-thirds or grading to shallowly concave. Peripheral keel sharp-edged, narrowly angulate in section, strongly projecting, summit very weakly undulant, basal side more or less horizontal, keel often distinctly drooping at maturity, occasionally slightly upturned. Base weakly convex. Axial riblets on spire low, rounded, collabral, shallowly sigmoidal, resolving from weak undulations that commence on 2nd whorl, most strongly defined over abapical third, becoming strongly defined over adapical two-thirds on last part of last adult whorl. Spire whorls at first with single spiral thread at summit of shoulder angulation, becoming obsolete on about mid 3rd whorl, 2nd spiral commencing at end of 2nd whorl between shoulder spiral and periphery, tending to persist throughout at abapical third, a 3rd spiral often appears after 4th whorl between 2nd spiral and periphery. Spire whorls otherwise smooth apart from fine collabral growth lines and obscure spiral lines over adapical two-thirds. Base with 2-4 crisp spiral threads on outer part, and strong rounded axial pleats at umbilical rim, otherwise smooth apart from collabral growth lines and obscure spiral lines. Umbilicus deep, wall shallowly concave, steeply tapered, diameter 20.8-24.4 % of adult shell diameter. Aperture subtrapezoidal. Outer lip rather thin at rim, modestly and rather uniformly thickened within ; posterior notch broad, concave, retraction and protraction depths, 2.4 % of shell diameter ; basal notch broad, concave ; peripheral notch within keel, not retracted. Parietal glaze thin. Inner lip thick, deeply curved towards umbilicus, gently flexed at base.

Animal. Snout at least twice as long as broad, lateral projections at tip rounded, mouth a vertical slit beneath. Cephalic tentacles about twice as long as snout, dorsoventrally flattened, narrow, very gradually tapered, inner bases at least 2 tentacle base-widths apart, edges ciliate, large swollen black eyes at outer bases. Right suboptic tentacle large, shorter and stouter than cephalic tentacles, gradually tapered, tip rather blunt, ventrally grooved. Epipodial tentacles numbering 9 on right and 1 or 2 on left, right tentacles decreasing in size towards opercular lobe, left tentacles small and short. *Operculum* chitinous, spiral.

Radula (Figs 280, 281) with the formula c. 20 + 1 + 1 + 1 + c. 20. Central tooth rigid, slightly longer than broad, cutting area jutting forward at right angle from shaft, broadly angulate, with about 9 stout cusps, median cusp largest, laterobasal projections prominent. Lateral teeth broad, cutting area of each angulate,

terminal cusp largest, finer cusps on outer edge, fewer on inner edge. Innermost marginal broader than outer marginals, cutting area narrowly angulate, terminal cusp large, finer cusps on outer edge, a few fine cusps on inner edge. Outer marginals slender, each with small, slender cusps at tip and on outer edge.

Jaw plates subrectangular, thin, broader than long, elements short, longer anteriorly.

TYPE DATA. — Holotype MNHN (4.00 × 6.90 mm, 6.70 TW) and 193 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 33.

OTHER MATERIAL EXAMINED (125 specimens MNHN). — BIOCAL, stn DW 36 (4). — Stn DW 46 (8). — Stn DW 48 (19). — Stn DW 51 (81). — Stn DW 53 (7). — Stn DW 70 (2). — Stn DW 80 (4).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, and southern New Caledonia, 570-1 005 m, living at 570-700 m.

REMARKS. — *Fluxinella asceta* is highly distinctive in its large size, tall spire, low widely spaced axial riblets, and crisp peripheral spiral threads.

ETYMOLOGY. — Ornamented (Greek).

Fluxinella megalomphala sp. nov.

Figs 116-120

DESCRIPTION. — *Shell* up to 7.80 mm wide, considerably broader than high, depressed trochiform, stout, rather thin, spire 1.41-1.43 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 370 μm wide, essentially smooth.

Teleoconch of up to 6.30 whorls. Shoulder angulation sharp on 1st whorl, weakening and vanishing on 2nd whorl ; subsequent whorls grading from flat to weakly convex above prominent sharp, flange-like peripheral keel. Base suddenly contracted, weakly convex. Axial riblets commencing on 3rd whorl, widely spaced, low, rounded, weakly flexuous, rendering periphery weakly undulant. Base with 5 spiral threads on outer third, 3 or 4 spiral cords on inner quarter, and rounded, fold-like axial costae that resolve on inner half and enlarge towards umbilicus, extending onto outer part of umbilical wall. Additional spiral cords resolving on broad median basal zone on last half adult whorl. Umbilicus deep, wall steeply tapered, diameter 32.3-35.9 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin at rim, thicker within, posterior notch shallow and broad, retraction depth (from growth lines) 1.70-2.00 %, and protraction depth 2.10-2.60 % of shell diameter ; basal notch concave, peripheral notch within keel. Parietal glaze thin. Inner lip thick, curved towards umbilicus adapically, flexed below to form small, broadly rounded submedian projection.

Animal unknown.

TYPE DATA. — Holotype (4.05 × 7.80 mm, 6.30 TW) and paratype MNHN ; paratype NMNZ (3.40 × 6.50 mm, 6.00 TW) : BIOCAL, stn DW 80.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 900-980 m (dead).

REMARKS. — Compared with *Fluxinella asceta*, to which it is superficially similar, *F. megalomphala* differs principally in having a more broadly conical spire, finer spiral threads at the periphery, and a much wider umbilicus. The two species occurred together at the type locality.

ETYMOLOGY. — Big navel (Greek).

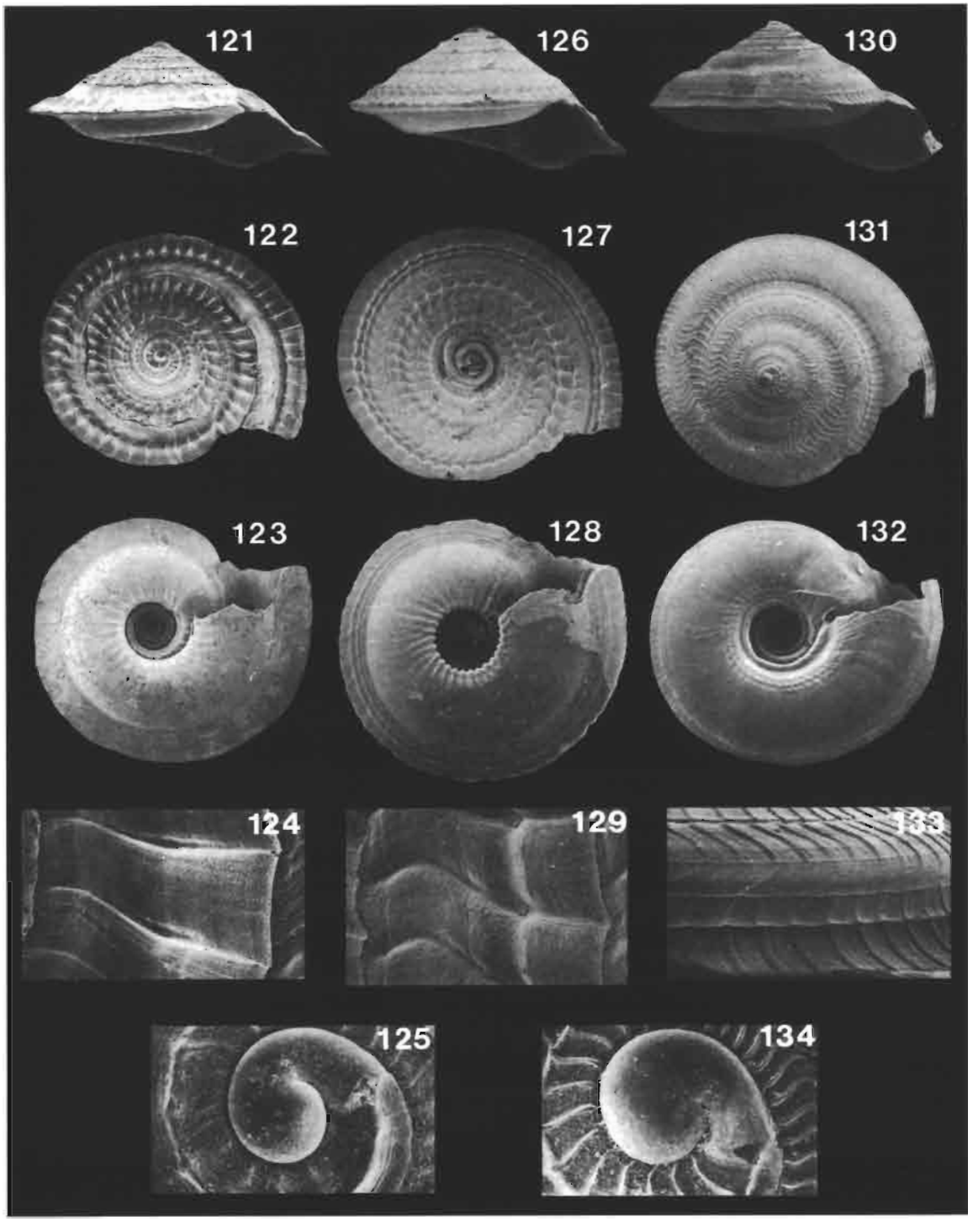
Fluxinella euphanes sp. nov.

Figs 121-125

DESCRIPTION. — *Shell* up to 4.65 mm wide, considerably broader than high, sublenticular, thin, spire 0.94-1.05 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 350-370 μm wide, minutely granulate.

Teleoconch of up to 4.90 whorls, periphery sharply angulate, flange-like ; base suddenly contracted, outer third below keel more or less horizontal, flat or shallowly concave, inner part convex. Shoulder angulation strong on 1st whorl, progressively weakening, vanishing early on 3rd whorl, commencing level with suture, descending to about adapical third, ascending late on 2nd whorl ; ramp and side



FIGS 121-134. — Genus *Fluxinella* : **121-125,** *Fluxinella euphanes*, holotype, 1.90 × 4.65 mm, 124 (late 3rd TW) × 60, 125 × 70. — **126-129,** *F. tenera*, holotype, 2.30 × 4.60 mm, 129 (last TW) × 60. — **130-134,** *F. stirophora*, holotype, 2.10 × 4.10 mm, 133 (last TW) × 50, 134 × 95.

concave. Third and later whorls with flattened sub and suprasutural zones, subsutural zone depressed, progressively grading from about third to half whorl height, becoming steeper than raised suprasutural zone. Spire whorls with prominent, widely spaced, shallowly flexuous axial riblets that render periphery gently undulant. Base with 3 or 4 fine, crisp spiral threads on outer third, and prominent, rounded axial pleats bordering umbilicus; elsewhere smooth apart from collabral growth lines and obscure spiral lines. Umbilicus deep, wall steep, weakly convex, diameter 25.0-25.4 % of adult shell diameter. Aperture subrhomboidal. Outer lip rim damaged, from growth lines posterior notch shallow and broad, retraction depth 2.20 % and protraction depth 5.7 % of shell diameter; basal notch concave, peripheral notch within keel. Parietal glaze thin. Inner lip hollow and comprising 2 thin parallel walls adapically, flexed submedially to form small, rounded tubular tooth; rim becoming covered over at maturity, thin and simple below tooth.

Animal unknown.

TYPE DATA. — Holotype (1.90 × 4.65 mm, 4.90 TW) and paratype (1.60 × 4.13 mm, 4.80 TW) MNHN : BIOCAL, stn DW 79.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 1 320-1 380 m (dead).

REMARKS. — Among previously described species of *Fluxinella, F. euphanes* is very distinctive in the stepped contour of the last adult and the strong, widely spaced axial riblets. The double or at least locally hollow inner lip wall in this and the following taxon is a most unusual character hitherto unknown from the family (see also *Quinnia limatula* sp. nov.).

ETYMOLOGY. — Very bright (Greek).

Fluxinella tenera sp. nov.

Figs 126-129

DESCRIPTION. — *Shell* (holotype) 4.60 mm wide, considerably broader than high, thin, spire 1.08 × as high as aperture; white, nacreous within.

Protoconch eroded, about 300 μm wide.

Teleoconch of 4.8 whorls, periphery sharply angulate, flange-like; base very suddenly contracted below periphery, convex. First 1.5 whorl eroded, next whorl shallowly concave below low subsutural bulge, subsequent whorls divided into 2 flattened zones, zone at abapical half slightly raised, shallowly concave on last adult whorl. Spire whorls entirely traversed by narrow, widely spaced, sigmoidal, collabral axial riblets. Abapical median spiral commencing on 2nd half of 3rd whorl, adapical median spiral commencing a whorl later, gradually enlarging to resemble abapical spiral; a weak secondary spiral commences at end of 4th whorl between abapical median spiral and periphery, vanishing within half a whorl. Spire whorls rendered dull by minute granules and obscure spiral lines. Outer base with 4 crisp spiral threads on peripheral flange, innermost 2 weaker. Inner base with 3 rounded spiral cords, innermost at umbilical rim; and rounded, fold-like axial riblets that resolve midway across base and enlarge towards umbilicus, extending around umbilical rim. Base with addition of minute granules, obscure spiral lines, and weak collabral growth lines, the latter most conspicuous on peripheral keel. Umbilicus deep, rim rounded to overhang minutely granulate, subvertical wall, diameter 22.8 % of shell diameter. Aperture subtrapezoidal, rim damaged. Outer lip simple within, posterior notch concave, from growth lines retraction depth 2.90 % and protraction depth 6.50 % of shell diameter; peripheral notch within keel, basal notch concave. Parietal lip thin. Inner lip thick, rim comprising inner and outer walls that are covered over at maturity, shallowly concave, produced and retracted at base to form low, rounded keel that borders narrow, concave basal channel.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.30 × 4.60 mm, 4.8 TW) : BIOCAL, stn DS 14.

DISTRIBUTION. — East of Ouvéa, Loyalty Islands, 3 680-3 700 m (dead).

REMARKS. — Compared with *Fluxinella euphanes*, which it most resembles, *F. tenera* differs primarily in having two median spiral cords on adult whorls, stronger basal spiral sculpture, an inwardly projecting umbilical rim, and a shallowly concave rather than convex umbilical wall.

ETYMOLOGY. — Delicate (Latin).

Fluxinella stirophora sp. nov.

Figs 130-134

DESCRIPTION. — *Shell* up to 4.20 mm wide, rather thin and fragile, umbilicate ; spire low, conical, 0.77-1.14 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 300 μm wide, surface obscurely and finely granulate.

Teleoconch of up to 5.25 whorls. First spire whorl weakly convex at first, grading to shallowly concave, 2nd and 3rd whorls shallowly concave, subsequently grading from concave to convex though remaining shallowly concave between suprasutural spiral and periphery ; periphery angulate, rendered shallowly serrate by axial riblets, base convex. Axial sculpture on spire consisting of fine, low, widely spaced, sigmoidal riblets. A suprasutural spiral thread commencing immediately, strong at first, progressively weakening, vanishing at end of 1st whorl. A second fine suprasutural spiral thread at about abapical third commencing at about mid 4th whorl, crisp throughout ; other fine threads commencing after 4th whorl and multiplying by intercalation, most crisply defined on abapical half of last adult whorl. Minute, crowded granules throughout. Base with a fine outer spiral thread, a very broad median zone that is smooth apart from fine collabral growth lines, and 3 or 4 inner spiral cords, the innermost strongest, smooth and separated by a conspicuous groove. Basal axial riblets confined to zone between periphery and outermost spiral thread, and between broad median zone and inner groove. Broad median zone and summits of inner basal spirals glossy, elsewhere roughened by minute granules. Umbilicus deep, rim angulate, diameter 23.6-23.8 % of adult shell diameter. Aperture ovate. Outer lip thin, not thickened within, mature rim damaged ; from growth lines posterior notch concave, retraction depth 4.9 % and protraction depth 8.1 % of shell diameter ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip short, very thick, a strong, blunt, rounded denticle at base.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.10 × 4.10 mm, 5.25 TW) and paratype NMNZ (2.00 × 4.20 mm, 4.80 TW) : BIOCAL, stn DW 56. Paratype (MNHN) : BIOCAL, stn DW 51.

DISTRIBUTION. — Off southern New Caledonia, 694-705 m (dead).

REMARKS. — *Fluxinella stirophora* is highly distinctive among *Fluxinella* species in the combination of low spire, convex adult spire whorls, fine reticulate teleoconch sculpture, grooved umbilical rim, and deeply retracted posterior notch. *F. stirophora* is referred to *Fluxinella* because of its general resemblance to *F. euphanes* sp. nov. and *F. tenera* sp. nov. This placement is provisional, however, for when animals are available for comparison it may prove to belong in tribe Seguenziini, perhaps *Quinnia*, species of which have similarly shaped posterior notches and somewhat similar sculpture.

ETYMOLOGY. — Keeled (Greek).

Genus *BASILISSA* Watson, 1879

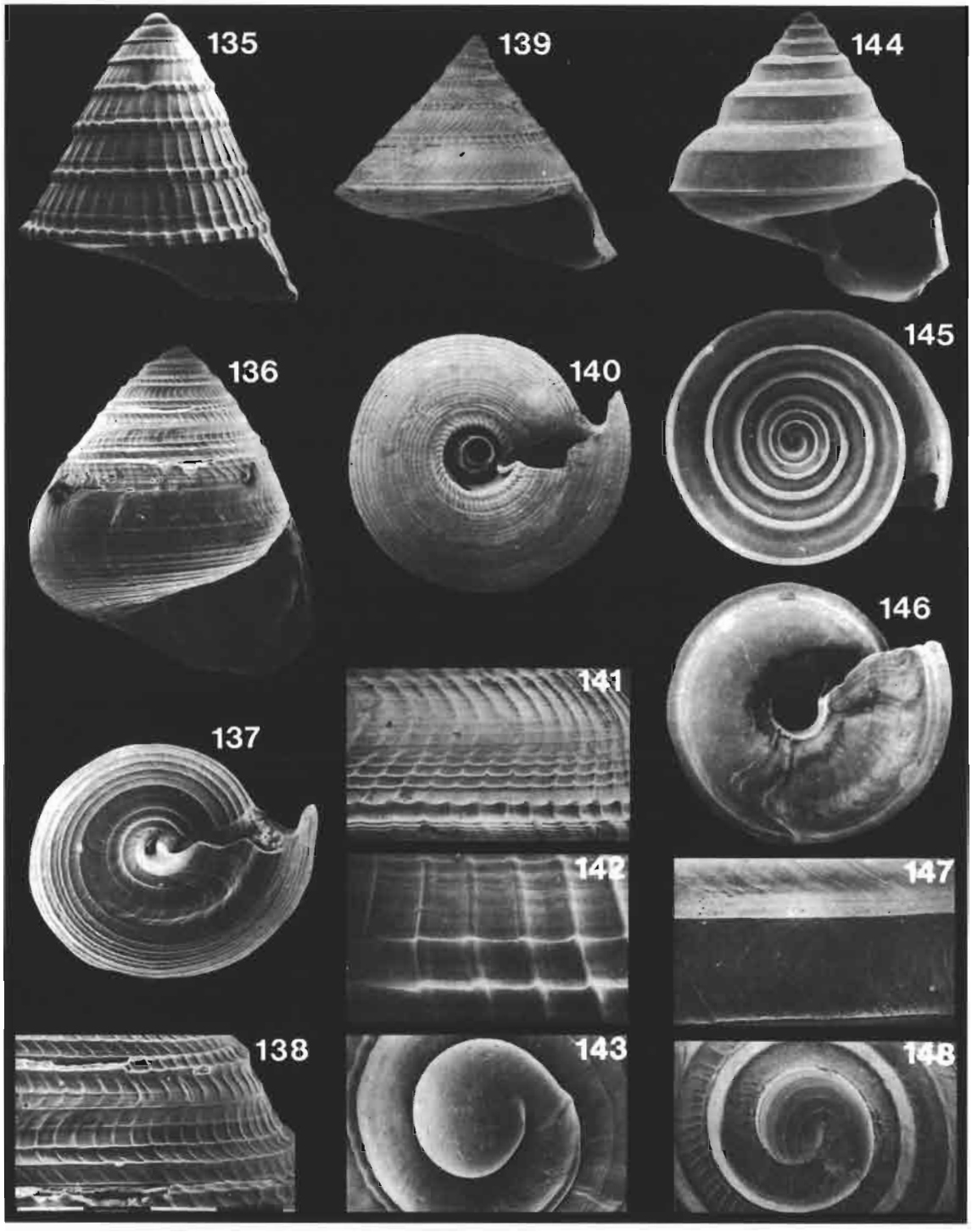
Basilissa Watson, 1879 : 593. Type species (by subsequent designation of COSSMANN, 1888) : *Basilissa superba* Watson, 1879 ; Recent, Coral Sea, east of Cape York.

REMARKS. — Although a number of species have been referred to *Basilissa* since its introduction, none are currently regarded as being congeneric with *B. superba* (QUINN, 1983b, 1987). It seems highly likely, however, that the Atlantic type species of *Thelyssa* Bayer, 1971 (*T. callisto* Bayer, 1971) belongs here.

Basilissa superba Watson, 1879

Figs 135, 142, 143, 284-287

Basilissa superba Watson, 1879 : 598 ; 1886 : 101, pl. 7, fig. 10. — CERNOHORSKY, 1978 : 33, pl. 8, fig. 4.



FIGS 135-148. — Genera *Basilissa, Halystina, Hadroconus, Carenzia* : **135, 142, 143,** *Basilissa superba* (juvenile), BIOCAL stn DS 59, 4.30 × 4.35 mm, 142 (last TW) × 30, 143 × 45. — **136, 138,** *Halystina siberutensis*, lectotype, 2.40 × 2.00 mm, 138 (late 3rd TW) × 55. — **137,** *H. siberutensis*, paralectotype, width 1.90 mm. — **139-141,** *Hadroconus grandiosus*, holotype, 9.00 × 11.0 mm, 141 (last TW) × 13. — **144-148,** *Carenzia nitens*, holotype, 2.50 × 2.60 mm, 147 (last TW) × 50, 148 × 70. (For various reasons Figs. 136-138 could not be included in systematic sequence).

DESCRIPTION (supplementary to the original). — Spire outline at first shallowly cyrtoconoid, becoming shallowly coeloconoid.

Protoconch globular, perfectly smooth, 530-600 μm wide, apertural rim flared.

Teleoconch : 1st whorl essentially smooth apart from peripheral keel, which is strong throughout. Axial riblets and traces of spiral threads gradually resolving late on 1st whorl, axials becoming clearly defined on 2nd whorl, spirals poorly defined on 1st 3 whorls, that beside peripheral keel enlarging more rapidly, becoming as strong as axials on 4th whorl, after which other spirals become as large.

Animal unknown (decayed).

Radula (Figs 284-287) whith the formula c. 12 + 1 + 1 + 1 + c. 12. Central tooth subrectangular, longer than broad, rigid, cutting area curving forward, angulate, median cusp strong, accessory cusps fine, 6-8 on each side, laterobasal projections weak. Lateral teeth broad, rigid, cutting area of each angulate, terminal cusp strong, accessory cups fine, about 18 on outer edge and 1 or 2 on inner edge. Innermost marginal broadest, thin in section, cutting area narrowly angulate, terminal cusp large, long series of fine accessory cusps on outer edge, fewer on inner edge. Outer marginals slender, cusps fine, narrowly conical, long series on outer edge, few on inner edge. Basal plate of each marginal flanged and grooved to interlock with laterals and with each other.

Jaw plates thin, subrectangular, considerably broader than long, elements short, longer anteriorly.

TYPE DATA. — Holotype BMNH 1887.2.9.354, Coral Sea, east of Cape York, Queensland, 2 560 m.

MATERIAL EXAMINED (5 specimens MNHN). — BIOCAL, stn CP 13 (1 adult). — Stn CP 17 (1 adult, 1 subadult). — Stn DS 59 (2 juveniles).

DISTRIBUTION. — Northern Coral Sea (2 560 m), off Lifou, Loyalty Islands (3 680-3 740 m) and off southern New Caledonia (2 560 m), living at 3 690-3 740 m.

REMARKS. — The present specimens agree well with the holotype. Judging from the description and illustrations (OKUTANI, 1982), specimens from the Philippine Sea (3 210-3 680 m) are also similar, but differ in having the umbilicus partly closed by a septum. The Coral Sea and Philippine Sea populations are separated by island arcs and deep trenches, and the status of the Philippine Sea form is uncertain. The jaw plates, which disintegrated during cleaning, are considerably broader relative to length than in *Ancistrobasis, Calliobasis* and *Fluxinella*. Convoluted interlocking marginal basal plates have not been hitherto recorded from the family, but since the bases of the marginal teeth of other seguenziids have not been studied, their significance is uncertain. This aptly named species is the largest seguenziid known, the largest of the present specimens (BIOCAL stn CP 17) having a diameter of 17.7 mm and an estimated height of 21 mm. See Discussion page 107.

Tribe SEGUENZIINI

Genus *HADROCONUS* Quinn, 1987

Hadroconus Quinn, 1987 : 61. Type species (by original designation) : *Basilissa alta* Watson, 1879 ; Recent, Atlantic central America.

Hadroconus grandiosus sp. nov.

Figs 139-141

DESCRIPTION. — *Shell* (holotype) 11.0 mm wide, broader than high, thin, umbilicate, spire 1.75 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 400 μm wide, surface eroded.

Teleoconch of 7.8 whorls ; 1st whorl convex, subsequent whorls flattened, suture flush, periphery angulate, base suddenly contracted, weakly convex. Axial riblets fine, crisp, opisthocline and noncollabral on spire ; sigmoidal, collabral and much weaker on base, though forming prominent, rounded, radial pleats at umbilical rim.

Spire spirals multiplying by intercalation, absent from broad median zone on 3rd-6th whorl, after which evenly distributed over adapical three quarters. Spiral at abapical quarter strongest, angulate in section, with small conical nodules at intersections with axials ; other spirals similar in size, thread-like. Basal spiral cords increasing in number to 18 ; outer 5 similar, angulate, interspaces broader than each spiral ; inner spirals flattened, interspaces narrower than each spiral. Umbilicus deep, diameter 25.4 % of shell diameter. Aperture trapezoidal. Outer lip thin, slightly thickened within ; posterior notch broad, rim damaged, retraction depth 3.6 % of shell diameter, protraction depth unknown (though certainly at least 11 % of shell diameter) ; basal notch shallow, concave ; peripheral notch within peripheral angulation, not retracted. Parietal glaze thin. Inner lip rather thick, rim tightly folded towards umbilicus, curved towards umbilicus at insertion, almost straight below, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (9.00 × 11.00 mm, 7.8 TW) : BIOCAL, stn CP 57.

DISTRIBUTION. — South of New Caledonia, 1 490-1 620 m (dead).

REMARKS. — Compared with the closely similar *H. altus* (Watson, 1879) (north-western Atlantic, c. 500-2 360 m), *H. grandiosus* differs primarily in having considerably closer, more numerous axial riblets that form weaker nodules at the periphery. It differs from *H. sibogae* (Schepman, 1908) (Indonesia, 1 158-1 301 m) in having more numerous spiral threads on the spire and weaker axials on the base, and from *H. diadematus* Marshall, 1988 (New Zealand, 1 463-1 457 m) in having fewer spiral threads on the spire before the last adult whorl, and in being smaller relative to the number of whorls.

ETYMOLOGY. — Enlarged (Latin).

Genus *CARENZIA* Quinn, 1983

Carenzia Quinn, 1983 : 355. Type species (by original designation) : *Seguenzia carinata* Jeffreys, 1877 ; Recent, North Atlantic.

Carenzia nitens sp. nov.

Figs 144-148

DESCRIPTION. — *Shell* up to 2.62 mm wide, about as broad as high, thin, umbilicate, spire 1.15-1.28 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

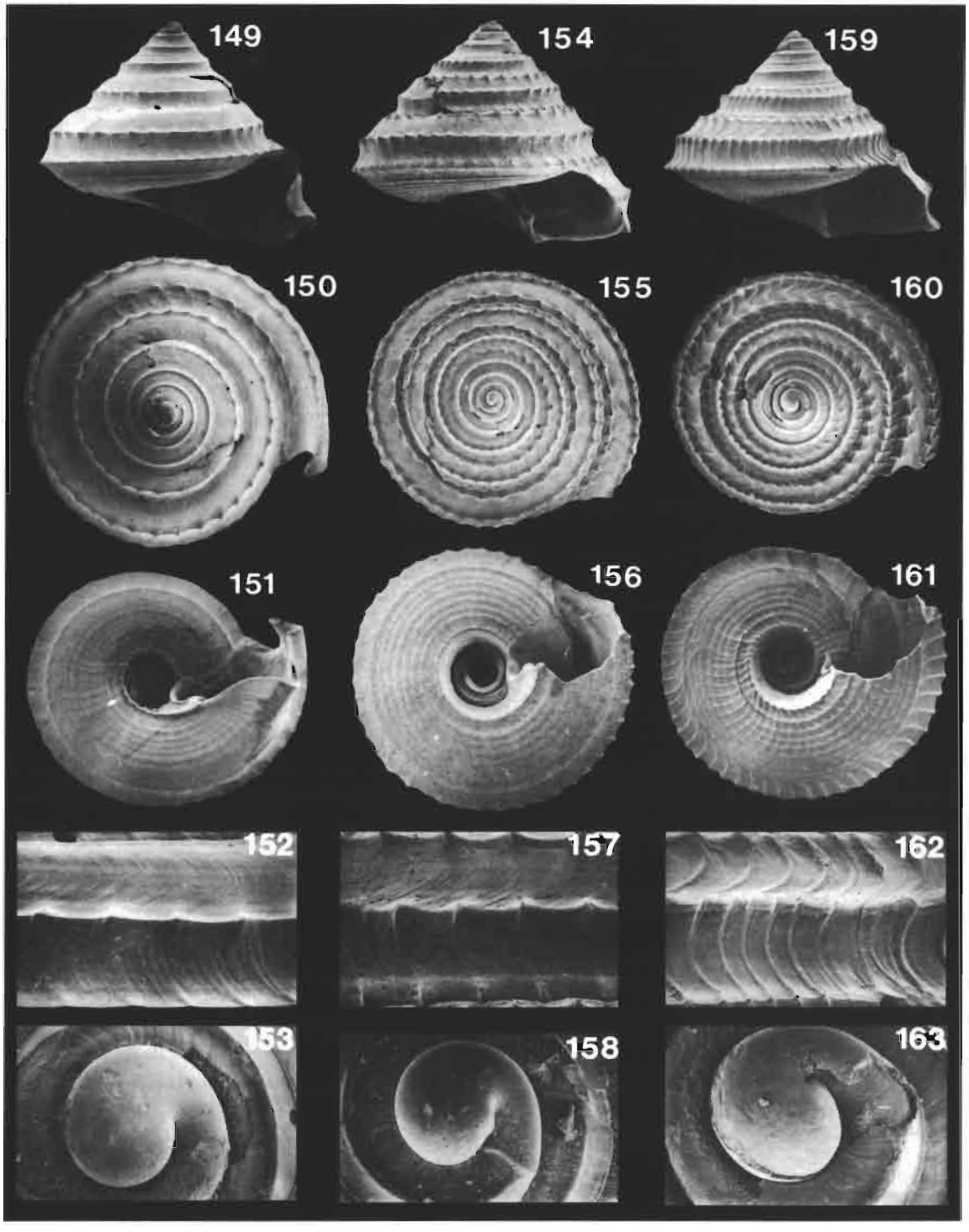
Protoconch 270-300 μm wide, with 6 fine spiral threads that vanish before apertural rim.

Teleoconch of up to 4.9 whorls, shoulder and peripheral angulations smooth ; ramp flat at first, becoming weakly convex ; side shallowly concave throughout or becoming flat ; base suddenly contracted, convex. Shoulder angulation supramedian, sharp, not projecting, becoming obsolete late on last adult whorl. Peripheral keel strong, sharply angulate. Base with weak spiral cord near periphery, obscure spiral lines, and rounded spiral cord at umbilical rim. First whorl finely and sparsely granulate. Fine collabral axial riblets commence late on 1st whorl, crisply defined on ramp, weaker on side, weakening and vanishing on 1st half of 3rd whorl. Subsequent whorls otherwise smooth apart from fine collabral growth lines. Umbilicus deep, diameter 16.7-28.6 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin, simple within ; posterior notch retraction depth 5.11 % and protraction depth at least 15 % of shell diameter (tip of labial projection broken) ; basal notch shallower, peripheral notch weak. Parietal glaze thin. Inner lip curved toward umbilicus, flexed near base to form small rounded tooth.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.50 × 2.60 mm, 4.5 TW) and 2 paratypes MNHN, NMNZ (2.40 × 2.40 mm, 4.6 TW ; 2.20 × 2.62 mm, 4.9 TW) : BIOCAL, stn DW 79. Paratypes (3 MNHN) : BIOCAL, stn CP 57.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, and southern New Caledonia, 1 320-1 620 m (dead).



FIGS 149-163. — Genus *Carenzia* : **149-153,** *Carenzia serrata*, holotype, 2.85 × 3.45 mm, 152 (last TW) × 40, 153 × 100. — **154-157,** *C. acanthodes*, holotype, 3.95 × 5.10 mm, 157 (last TW) × 30. — **158,** *C. acanthodes*, paratype, BIOCAL stn CP 26, × 70. — **159-163,** *C. ornata*, holotype, 2.70 × 3.60 mm, 162 (last TW) × 40, 163 × 80.

REMARKS. — *Carenzia nitens* resembles the New Zealand species *C. fastigiata* Marshall, 1983, and differs in attaining maturity at smaller size, and in having a weaker, unpleated peripheral keel.

ETYMOLOGY. — Shining (Latin).

Carenzia serrata sp. nov.

Figs 149-153

DESCRIPTION. — *Shell* up to 3.45 mm wide, broader than high, rather thin, umbilicate, spire 1.17 × as high as aperture, glossy ; white, nacreous through thin, translucent outer shell layer.

Protoconch 270 μm wide, very finely granulate at extreme tip of apical fold, elsewhere smooth.

Teleoconch of up to 5.75 whorls, shoulder and periphery angulated by sharp keels, ramp shallowly concave at first, becoming weakly convex ; side concave ; base suddenly contracted, weakly convex. Shoulder keel strongly supramedian at first, descending until almost median, peripheral keel more strongly projecting ; both smooth at first, with small, sharp, conical nodules after 3rd whorl. Nodules coinciding with weak axial riblets between shoulder keel and outermost basal spiral, axials strongest on shoulder and peripheral keels, and between peripheral keel and outermost basal spiral, almost obsolete between keels and beside outermost spiral. Spire whorls otherwise smooth apart from fine, sigmoidal, collabral growth lines. Base with 11 spiral cords, the 2 beside outermost spiral ill-defined, inner 9 spirals reticulating with fine collabral axial riblets. Umbilicus deep, diameter 26 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin at rim, modestly thickened within, posterior notch concave, rim flared, retraction depth 8.7 % and protraction depth 11.6 % of adult shell diameter ; basal notch narrower, rim flared ; periphery not retractively notched though adult rim concave and flared. Parietal glaze very thin. Inner lip curved toward umbilicus, flexed near base to form strongly projecting rounded tooth.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.85 × 3.45 mm, 5.75 TW) : BIOCAL, stn CP 26. Paratype (1 MNHN) : BIOCAL, stn CP 57.

DISTRIBUTION. — Off southern New Caledonia, 1 490-1 740 m (dead).

REMARKS. — Compared with *C. trispinosa* (Watson, 1879) (QUINN, 1983a, figs 8-12), which it most closely resembles, *C. serrata* differs in having the shoulder angulation set considerably lower on the whorls, and in having a smaller protoconch (diameter 270 μm, cf. 380 μm). It differs from the New Zealand species *C. fastigiata* Marshall, 1983 in having a lower peripheral keel and prominent nodules on the shoulder angulation.

ETYMOLOGY. — Saw-toothed (Latin).

Carenzia acanthodes sp. nov.

Figs 154-158

DESCRIPTION. — *Shell* up to 5.10 mm wide, markedly broader than high, of moderate thickness, stout, widely umbilicate, spire 1.76 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 330-370 μm wide, tip excert, sparsely and very finely granulate.

Teleoconch of up to 6.10 whorls, shoulder and periphery angulated by projecting, angulate keels, ramp more or less flat, side concave, base suddenly contracted, weakly convex. Spire with 3 spiral keels, shoulder keel strongly supramedian at first, descending until almost median, keels smooth at first, shoulder and peripheral keels with conical nodules on 3rd and subsequent whorls ; subsutural keel gradually resolving from low, rounded swelling, with conical nodules on 4th and subsequent whorls. Nodules coinciding with weak collabral axial riblets that gradually resolve on 2nd whorl, most crisply defined between shoulder keel and outermost basal spiral, almost obsolete on ramp. Spire otherwise smooth apart from obscure spiral lines and fine, sigmoidal, collabral growth lines. Adult base with 8 subequal spiral cords and weaker collabral axial riblets. Umbilicus deep, perspective to protoconch, diameter 32.5-34.0 % of adult shell diameter. Aperture subrhomboidal. Outer lip simple within, intact rim unknown, from growth lines retraction depth 5.88 % and protraction depth 6.52 % of shell diameter ; basal notch shallower, very slightly notched at periphery.

Parietal glaze very thin. Inner lip rather thick, curved toward umbilicus, flexed near base to form small rounded tooth.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.95 × 5.10 mm, 6.10 TW) : BIOCAL, stn CP 26. Paratypes (4 MNHN, 1 NMNZ) : BIOCAL, stn DW 79.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands and southern New Caledonia, 1 320-1 740 m (dead).

REMARKS. — *Carenzia acanthodes* closely resembles *C. melvilli* (Schepman, 1909) (Makassar Strait, Indonesia, 1 301 m) in general facies and the two species are undoubtedly closely related congeners. By direct comparison with the holotype (ZMA), *C. acanthodes* differs in having a lower, more broadly conical spire, and a substantially broader umbilicus (diameter 32.2-34.0 % cf. 27.2 % of shell diameter). Although the two forms are interpreted as distinct species, it must be admitted that there is currently insufficient material to assess the limits of variation in shell morphology. Compared with *C. serrata* sp. nov., with which it occurred at BIOCAL station CP 26, *C. acanthodes* differs in having a larger protoconch, in attaining larger size, and in having a more strongly nodular subsutural spiral.

ETYMOLOGY. — Prickly (Greek).

Carenzia ornata sp. nov.

Figs 159-163

DESCRIPTION. — *Shell* up to 3.60 mm wide (immature ?) markedly broader than high, rather thin, widely umbilicate, spire up to 1.40 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 370-380 μm wide, surface almost entirely etched away but intact surface beside suture apparently smooth.

Teleoconch of up to 5.1 whorls, shoulder and periphery angulated by sharply angulate keels, ramp and side concave ; base suddenly contracted, weakly convex. Shoulder keel strongly supramedian at first, descending until almost median, peripheral keel stronger and more narrowly angulate. Shoulder and peripheral keels smooth at first, small conical nodules on peripheral keel after late 1st whorl and on shoulder keel after 2nd whorl. An angulate subsutural keel with small conical nodules commences late on 3rd whorl. Summits of keels on last 2 adult whorls with fine spiral threads, 2 each on subsutural and peripheral keels, 3 on shoulder keel, additional threads between periphery and outermost basal spiral. Axial riblets fine, crisp, sigmoidal, collabral, commencing late on 1st whorl. Axials at first between shoulder and periphery, extending adapically onto ramp on 1st half of 3rd whorl and progressively extending to suture. From late 3rd whorl axials continuous over spire whorls and base, including outer part of umbilical wall. Base either with 9 spiral cords, the outer 3 weaker, or 8 similar spiral cords. Umbilicus deep, rim sharply angulate, diameter 27.8 % of shell diameter. Aperture subrhomboidal, intact rim unknown. From growth lines retraction depth 2.77 %, and protraction depth 10.19 % of shell diameter. Parietal glaze very thin. Inner lip (immature ?) thin, shallowly sigmoidal, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.70 × 3.60 mm, 5.1 TW) : BIOCAL, stn CP 72. Paratypes (2 MNHN) : BIOCAL, stn DS 59.— Stn DS 98.

DISTRIBUTION. — Off southern New Caledonia, 2 100-2 650 m (dead).

REMARKS. — *Carenzia ornata* most closely resembles *C. melvilli* (Schepman, 1909) and *C. acanthodes* sp. nov., differing from the former in having finer sculpture on the spire and a broader umbilicus, and from the latter in having a larger protoconch, a thinner shell, and closer and stronger axial sculpture. That the present specimens may be immature is suggested by the exceptionally large protoconch and the simple inner lip.

ETYMOLOGY. — Ornate (Latin).

Genus *QUINNIA* Marshall, 1988

Seguenziella Marshall, 1983 : 245. Type species (by original designation) : *Seguenziella patula* Marshall, 1983 ; Recent, New Zealand (not *Seguenziella* Neviani, 1901, not Sacco, 1904).
Quinnia Marshall, 1988 : 242. Replacement name for *Seguenziella* Marshall, 1983 (preoccupied).

Quinnia patula (Marshall, 1983)

Figs 164-168 ; Table 16

Seguenziella patula Marshall, 1983 : 245, figs 4 a-e, 8 j-l.
Quinnia patula - MARSHALL, 1988 : 242.

TYPE DATA. — Holotype. NZOI H. 377 : P 939, 41°20′ S, 166°54.8′ E, E slope of Tasman Basin, off Westport, New Zealand, 1 760-1 799 m, 22 April 1980, R. V. " *Tangaroa* ".

OTHER MATERIAL EXAMINED (3 specimens MNHN). — BIOCAL, stn CP 72 (1). — Stn DS 98 (2).

DISTRIBUTION. — Off southern New Caledonia (dead, 2 100-2 470 m) and off Westport, New Zealand (alive, 1 760-1 799 m).

REMARKS. — I am unable to detect any taxonomically significant differences between New Caledonian and New Zealand specimens. The species is extremely similar to *Q. cazioti* (Dautzenberg, 1925), based on a specimen taken at 2 286 m off Madeira.

TABLE 16. — *Quinnia patula*. Shell measurements (mm) and countings.

H	D	H/D	TW	UD%	
5.65	8.40	0.67	6.10	23.4	Holotype
4.60	7.30	0.63	5.75	31.5	BIOCAL, stn CP 72
3.90	6.10 (est.)	0.64	5.40	30.3	BIOCAL, stn DS 98
2.00	3.40	0.59	4.00	23.5	Paratype
1.30	2.45	0.53	3.20	28.5	BIOCAL, stn DS 98

Quinnia laetifica sp. nov.

Figs 169-173

DESCRIPTION. — *Shell* up to 4.20 mm wide, broader than high, thin, umbilicate, spire about as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 370 μm wide, minutely granulate.

Teleoconch of up to 4.70 weakly convex, shouldered whorls. Shoulder angulation sharp, supramedian at first, descending to submedian position, ramp and side shallowly concave. Peripheral angulation similar to shoulder angulation, base rather gently contracted, convex. Spire whorls with similar, fine, crisp, sigmoidal, collabral axial riblets, and spiral threads, very minutely granulate throughout. Axial riblets evenly developed over spire to outermost basal spiral, weaker on base, evanescent on umbilical wall. Spiral threads multiplying by intercalation, at start of last adult whorl numbering 3 or 7 on ramp and 3 or 4 on side, subsutural spiral surmounting low angulation that commences on 2nd half of 3rd whorl. Base with 2 or 3 fine outer spiral threads below periphery, and 9 stronger cords that enlarge towards umbilicus ; interspaces considerably wider than each spiral, locally with addition of 1 or 2 intercalating spiral threads. Umbilicus deep, rim sharp, diameter 25.6-28.5 % of adult diameter. Aperture subrhomboidal. Outer lip rim damaged, not thickened within ; from growth lines posterior notch well retracted from suture, apex roundly angulate, retraction depth 4.28 % and protraction depth 9.41 % of shell diameter ; basal notch rounded ; no peripheral notch. Inner lip thin, simple.

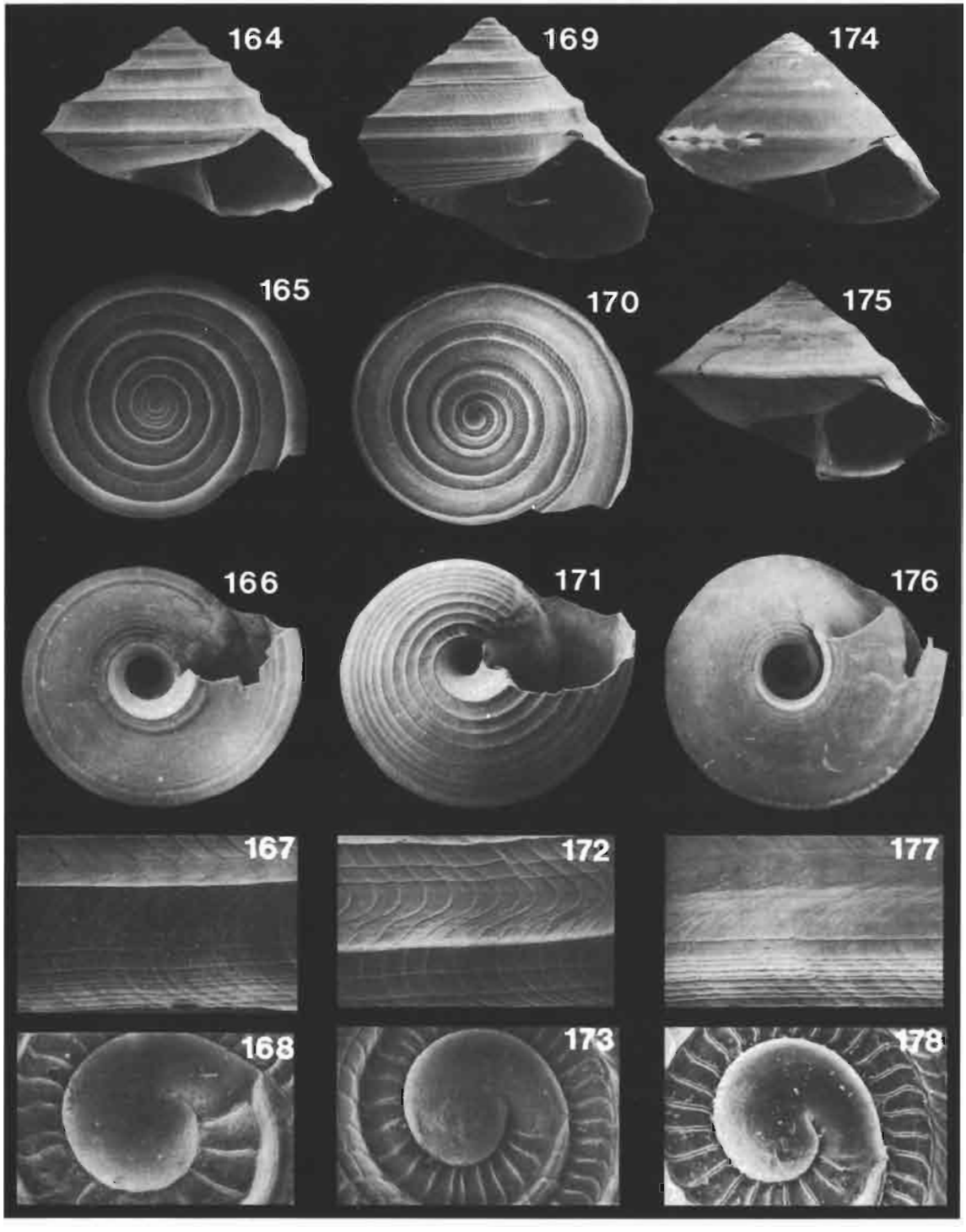
Animal unknown (dried).

TYPE DATA. — Holotype (3.02 × 3.90 mm, 4.40 TW) and paratype (3.58 × 4.20 mm, 4.70 TW) MNHN : BIOCAL, stn CP 23 (alive).

DISTRIBUTION. — Off southern New Caledonia, 2 040 m (alive).

REMARKS. — *Quinnia laetifica* differs from *Q. patula* and *Q. cazioti* in having a submedian instead of supramedian shoulder angulation, a taller spire, stronger spiral sculpture on the base, and a narrower umbilicus.

ETYMOLOGY. — Gladdening (Latin).



FIGS 164-178. — Genus *Quinnia* : **164-167,** *Quinnia patula*, BIOCAL stn CP 72, 4.60 × 7.30 mm, 167 (last TW) × 25. — **168,** *Q. patula*, BIOCAL stn DS 98, × 75. — **169-173,** *Q. laetifica*, 3.02 × 3.90 mm, 172 (last TW) × 40, 173 × 70. — **174,** *Q. limatula*, paratype, BIOCAL stn CP 26, 4.52 × 6.90 mm. — **175-178,** *Q. limatula*, holotype, 3.60 × 5.40 mm, 177 (last TW) × 40, 178 × 80.

Quinnia limatula sp. nov.

Figs 174-178

DESCRIPTION. — *Shell* up to 6.90 mm wide, broader than high, thin, umbilicate, spire 0.71-1.11 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 330 μm wide, tip minutely granulate, last half whorl smooth.

Teleoconch of up to 5.9 whorls ; 1st whorl with strong supramedian shoulder angulation, angulation weakening and vanishing over next half whorl, subsequent whorls very weakly concave or convex, periphery sharply angulate ; base suddenly contracted, convex, flattened below periphery. Axial riblets fine, sigmoidal, collabral, entirely traversing 1st 2 whorls, after which obsolete in supramedian band, crisp on 1st 3.5 whorls, thereafter obsolete. Spiral threads crisp, similar to axials on early whorls, multiplying by intercalation, becoming obsolete over abapical half or two thirds of each whorl on 3rd or 4th whorl, reappearing in subsutural zone on last adult whorl. Base finely lirate over outer third, umbilicus bounded by 3-5 smooth spiral cords, innermost 3 most widely spaced and with axial riblets in interspaces, median third with weakly defined grooves and obscure spiral lines. Umbilicus deep, wall vertical, diameter 27.5-29.6 % of shell diameter. Aperture subtrapezoidal. Outer lip rim damaged, with narrow median tubular cavity in peripheral and basal angulation, from collabral growth lines retraction depth 3.7 % and protraction depth 16.7 % of shell diameter ; basal notch concave ; peripheral notch within peripheral angulation, not retracted. Parietal glaze thin. Inner lip (adult paratype) rather thin, curved towards umbilicus, abapical end broken but probably flexed to form a small tooth.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.60 × 5.40 mm, 5.25 TW) : BIOCAL, stn DW 79. Paratype MNHN (4.52 × 6.90 mm, 5.9. TW) : BIOCAL, stn CP 26.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands and southern New Caledonia, 1 320-1 740 m (dead).

REMARKS. — *Quinnia limatula* differs from all known species of *Quinnia* in lacking a shoulder angulation on all but the earliest teleoconch whorls. Unlike *Q. patula, Q. cazioti* and *Q. laetifica*, this species probably has a tooth on the adult inner lip, a character shared with possible congeners *Seguenzia ionica* Watson, 1879 and *S. rushi* Dall, 1927. Apart from the lack of a shoulder angulation on later whorls, and the probable presence of a tooth on the inner lip, *Q. limatula* is essentially similar to typical *Quinnia* species. The tubular cavities in the outer lip rim at the peripheral and basal angulations are characters hitherto unknown from this family.

ETYMOLOGY. — Somewhat polished (Latin).

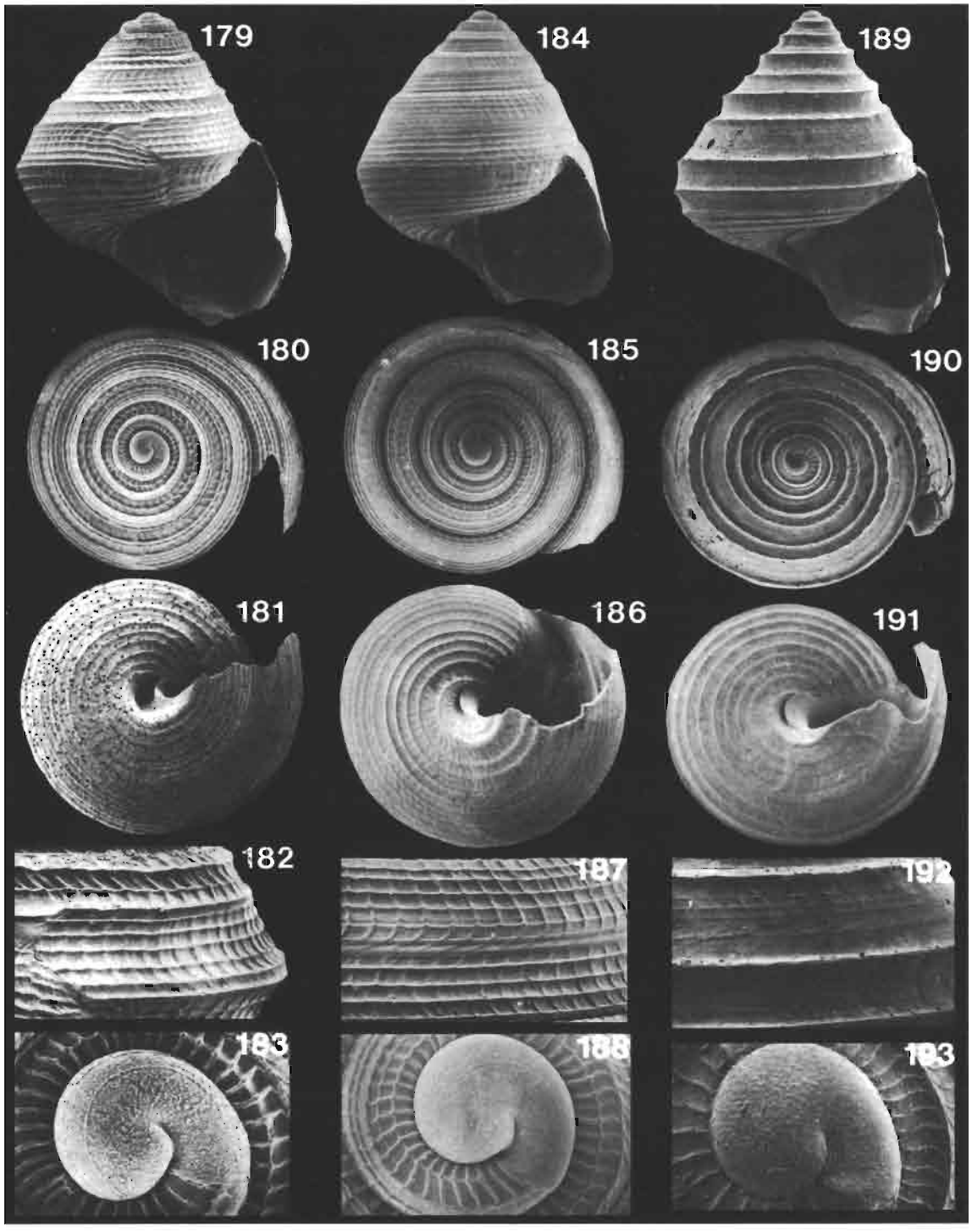
Genus *HALYSTINA* gen. nov.

TYPE SPECIES. — *Halystina caledonica* sp. nov.

ETYMOLOGY. — Diminutive of seguenziid genus *Halystes* Marshall, 1988, which is an anagram of the seguenziid genus *Thelyssa* Bayer.

DIAGNOSIS. — Shell 2.1-4.0 mm high, depressed or narrowly turbiniform, narrowly umbilicate. Protoconch finely granulate, with or without 2 fine spiral threads. Teleoconch whorls becoming almost flat-sided. Sculpture of collabral axial and spiral riblets, axials well-developed throughout or soon becoming obsolete, with or without stronger, angulating spirals on spire. Posterior apertural notch broad, protraction depth 9.7-25.2 % of shell diameter. Columella toothless. External anatomy unknown (animals dried). Radula similar to that in *Halystes* and *Seguenzia*.

REMARKS. — Apart from the three species described below, this genus contains *Seguenzia siberutensis* Thiele, 1925 (off Siberut Island,



FIGS 179-193. — Genus *Halystina* : **179, 180, 182, 183,** *Halystina vaubani*, holotype, 1.80 × 1.70 mm, 182 × 55, 183 × 110. — **181,** *H. vaubani*, paratype, " *Vauban* " stn 40, width 1.80 mm. — **184-188,** *H. caledonica*, holotype, 3.00 × 2.70 mm, 187 × 40, 188 × 85. — **189-193,** *H. carinata*, holotype, 3.40 × 3.18 mm, 192 × 33, 193 × 95.

western Sumatra, 750 m), and *S. simplex* (Barnard, 1963) (off Cape Point, South Africa, 1 280 m). It is thus equivalent to *Seguenzia* Group III of QUINN (1983). Members of the group are extremely similar to the abyssal type species of *Halystes* Marshall, 1988 (*H. chimaera* Marshall, 1988) in gross facies, but differ collectively in attaining smaller maximum size (height 2.1-4.0 mm, cf. 8.6 mm), and in having narrower and deeper posterior notches (maximum depth 9.7-25.2 %, cf. 2.3 % of shell diameter). Although *Halystina* is here interpreted as a discrete monophyletic radiation, *Halystes chimaera* may prove to be an aberrant member of the same group, in which case *Halystina* might be better placed as a subgenus. Until animals of *Halystina* species are available for comparison with that of *H. chimaera*, I prefer to treat *Halystes* and *Halystina* as distinct, closely related genera. The central radular tooth in *H. caledonica* is shorter than in *H. chimaera*. Both groups appear to be closely related to *Rotellenzia* Quinn, 1987 (type species *Basilissa lampra* Watson, 1879).

Halystina caledonica sp. nov.

Figs 184-188, 282, 283; Table 17

DESCRIPTION. — *Shell* up to 3.35 mm high, higher than broad, umbilicus mostly invaded by inner lip, thin; spire weakly cyrtoconoid, 0.77-0.82 × as high as aperture; white, nacreous through thin, translucent outer shell layer.

TABLE 17. — *Halystina caledonica*. Shell measurements (mm) and countings. (BIOCAL, stn DS 04, DS 98).

Character	*n*	Range	Mean	SD
H	6	2.85-3.35	3.07	0.16
D	6	2.40-2.95	2.78	0.20
H/D	6	1.05-1.19	1.11	0.05
TW	6	4.40-4.50	4.45	0.05

Protoconch 330 μm wide, minutely granulate.

Teleoconch of up to 4.5 whorls; 1st 2 whorls convex, subsequent whorls flat above rounded periphery, base convex. Very minutely granulate throughout. Axial riblets fine, crisp, sigmoidal, collabral, traversing spire and base, evanescent on outer part of umbilical wall. Spiral threads fine, crisp, similar on spire and base, multiplying by intercalation, numbering about 12 at start of last adult whorl and 12-16 on base, an additional thread on outer part of umbilical wall in most adults. Umbilicus reduced to a shallow crescentic depression by invading inner lip. Aperture subtrapezoidal. Outer lip thin; posterior notch broad, retraction depth 6.9-7.0 % and protraction depth 17.2-18.6 % of shell diameter; basal notch concave, apical rim slightly flared; peripheral notch shallow, concave. Parietal glaze thin. Inner lip almost straight, toothless.

Animal unknown (dried).

Radula (Figs 282, 283). Central tooth subovate, longer than broad, thin in section, flexible, cutting area curving forward from shaft, narrowly angulate, terminal cusp large, accessory cusps fine, about 8 on each side, shaft tapered to horizontal basal plate. Lateral teeth broad, thin in section, flexible, cutting area narrowly angulate, terminal cusp large, 4-6 fine, accessory cusps on each side. Marginal teeth slender, terminal cusp of each very long and slender, a few fine accessory cusps on outer edge.

Jaw not found, reduced or absent.

TYPE DATA. — Holotype (3.00 × 2.70 mm, 4.5 TW) and paratype MNHN : BIOCAL, stn DS 04. Paratypes (3 MNHN, 1 NMNZ) : BIOCAL, stn DS 98.

DISTRIBUTION. — Between New Caledonia and Lifou, Loyalty Islands, 2 340-2 470 m, living at 2 340 m.

REMARKS. — Compared with *Halystina siberutensis*, which it much resembles in general facies, *H. caledonica* differs in sculptural details, in attaining maturity at larger size (height 3.40-4.00 mm cf. 2.40 mm) and in having a larger protoconch (width 330 μm cf. 230 μm).

ETYMOLOGY. — (New) Caledonian.

Halystina carinata sp. nov.

Figs 189-193; Table 18

DESCRIPTION. — *Shell* up to 4.00 mm high, slightly higher than broad at maturity, thin, umbilicus invaded by inner lip, sometimes with a fine crescentic chink, spire 1.13-1.15 × as high as aperture; white, nacreous through thin, translucent outer shell layer.

Protoconch 300-310 μm wide, minutely granulate.

Teleoconch of up to 5.75 whorls ; shoulder angulated by sharp-edged keel, ramp and side more or less flat ; periphery rounded, with smooth angulate keel, base convex. Shoulder keel strongly supramedian on 1st whorl, descending to submedian position, smooth ; subsutural angulation commencing on about mid 3rd whorl, summit undulant throughout. Axial riblets collabral, fine, crisp on 1st 2 whorls, weakening on 3rd whorl, becoming obsolete on 4th whorl, sometimes reappearing on ramp on last part of last adult whorl. Spiral threads fine, crisp, multiplying by intercalation, commencing on 3rd whorl, covering last adult whorl from suture to periphery and between periphery and outmost basal spiral. Base with 8-10 smooth, subequal spiral cords, interspaces considerably wider than each spiral. Aperture subtrapezoidal. Outer lip thin, slightly thickened within ; posterior notch retraction depth 9.6-10.7 % and protraction depth 21.5-25.2 % of shell diameter ; basal notch concave, gently flared ; peripheral notch small, shallow. Parietal glaze thin. Inner lip rather thick, spreading into and almost or entirely infilling umbilicus, almost straight, toothless.

Animal unknown.

TABLE 18. — *Halystina carinata*. Shell measurements (mm) and countings. (BIOCAL, stn DW 79).

Character	*n*	Range	Mean	SD
H	8	3.35-4.00	3.54	0.20
D	8	3.03-3.38	3.22	0.12
H/D	8	1.05-1.18	1.09	0.04
TW	8	5.20-5.75	5.36	0.19

TYPE DATA. — Holotype MNHN (3.40 × 3.18 mm, 5.4 TW) and 11 paratypes (AMS, BMHN, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 79.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 1 320-1 380 m (dead).

REMARKS. — *Halystina carinata* differs markedly from its congeners in having angulate subsutural, shoulder and peripheral keels. The South African *H. simplex* (Barnard, 1963) resembles it in having a shoulder angulation, but in *H. carinata* the angulation is set lower on later whorls, the spire is more narrowly conical, there are more numerous basal spire cords, while the umbilicus is closed instead of fully open.

ETYMOLOGY. — Keeled (Latin).

Halystina vaubani sp. nov.

Figs 179-183 ; Table 19

DESCRIPTION. — *Shell* up to 2.10 mm high, about as high as broad, thin, narrowly umbilicate, spire 0.75-0.92 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

TABLE 19. — *Halystina vaubani*. Shell measurements (mm) and countings. (" *Vauban* ", stn 40).

Character	*n*	Range	Mean	SD
H	10	1.72-2.10	1.92	0.12
D	10	1.70-1.82	1.78	0.04
H/D	10	0.98-1.15	1.07	0.06
TW	10	3.80-4.40	4.15	0.17

Protoconch 330-400 μm wide, sculptured with minute granules and 2 fine spiral threads.

Teleoconch of up to 5.75 whorls ; 1st spire whorl convex, subsequent whorls almost flat, with low angulate keels at about adapical third and subsuturally ; periphery broadly angulate ; base convex, on last adult whorl becoming shallowly concave from midway between periphery and umbilicus to innermost 2 spiral threads. Last part of last adult whorl becoming steeper-sided. Axial riblets fine, sigmoidal, collabral, crisp on spire, weaker on base where typically absent from a median spiral band. Spiral threads fine, crisp, traversing axials, multiplying by intercalation, numbering 7-9 on spire at start of last whorl, and 10-12 on base. Very minutely granulate throughout. Umbilicus conical, diameter 18.3-23.1 % of adult shell diameter. Aperture subquadrate. Outer lip thin ; posterior notch broad, shallow, rim damaged, from collabral sculpture retraction depth 5.8 % and protraction depth 9.7 % of shell diameter ; basal notch concave, rim gently flared ; peripheral notch shallow, angulate. Parietal glaze thin. Inner lip thin, almost straight, toothless.

Animal unknown.

TYPE DATA. — Holotype MNHN (1.80 × 1.70 mm, 4.0 TW) and 32 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : " *Vauban* ", stn 40.

DISTRIBUTION. — Off southern New Caledonia, 250-350 m (dead).

REMARKS. — Compared with *H. siberutensis* (Figs 136-138) to which it is closely similar, *H. vaubani* differs in having considerably narrower, more crisply defined spiral threads on the last adult whorl, and in having a low angulation at the adapical third on the spire whorls, while the innermost two basal spiral threads are finer, and the inner base is more shallowly concave at the same stage of growth. Moreover, *H. vaubani* appears to attain maturity at smaller size (maximum height 2.10 mm, cf. 2.40 mm), and does not become as distinctly pupoidal in outline at maturity. Of the 14 syntypes of *H. siberutensis* (Zoological Museum, Berlin) the specimens here chosen as lectotype (Figs 136-138) closely matches the original illustration (THIELE, 1925, Pl. 1, figs 13-14) and agrees well with the original given dimensions (2.4 × 1.9 mm).

ETYMOLOGY. — Named after N. O. "*Vauban* ".

Genus *SEGUENZIA* Jeffreys, 1876

Seguenzia Jeffreys, 1876 : 200. Type species (by monotypy) : *Seguenzia formosa* Jeffreys, 1876 ; Recent, North Atlantic.

Seguenzia chelina Marshall, 1983

Figs 194-197 ; Table 20

Seguenzia chelina Marshall, 1983 : 240, figs 2 k-o.

TYPE DATA. — Holotype NZOI H. 371 : P 929, 40°42.8′ S, 167°50.0′ E, E slope of Tasman Basin, off Westport, New Zealand, 1 029 m, 18 April 1980, R. V. " *Tangaroa* ".

OTHER MATERIAL EXAMINED. — **New Caledonia** and Loyalty Islands (5 specimens) — BIOCAL stn CP 75 (1 MNHN). — Stn DW 80 (3 MNHN, 1 NMNZ). **New Zealand** (5 specimens) : BS 846 (O 592), 37°04.3′ S, 176°26.6′ E, SE of Aldermen Is, dead, 807-872 m, 23 January 1981, R. V. " *Tangaroa* " (3 NMNZ) ; P 942, 41°00.6′ S, 169°06.0′ E, E slope of Tasman Basin, off Westport, dead, 914 m, 24 April 1980, R. V. "*Tangaroa* " (2 NZOI).

TABLE 20. — *Seguenzia chelina*. Shell measurements (mm) and countings.

H	D	H/D	TW	
2.98	2.45	1.22	5.60	BIOCAL, stn DW 80
3.00	2.45	1.22	5.90	BIOCAL, stn DW 80
3.10	2.61	1.15	6.00	BIOCAL, stn DW 80
3.00	2.60	1.15	6.25	Holotype
3.05	2.50	1.22	6.00	BS 846
3.30	2.95	1.12	6.00	BS 846
3.30	2.80	1.18	6.00	P 942
3.35	2.65	1.26	5.80	BS 846

DISTRIBUTION. — New Caledonia and Loyalty Islands (825-980 m), and New Zealand (807-1 029 m).

REMARKS. — Specimens from off New Caledonia and the Loyalty Islands differ from the holotype and additional material from the Tasman Basin in having the umbilicus only partly invaded by the inner lip and thus more open, but are otherwise indistinguishable. Two of the three New Zealand specimens taken off the Aldermen Islands have the umbilicus intermediate in width between the extremes, so there would seem to be north-south clinal intergradation in umbilicus width. It transpires that the holotype is atypical in lacking spiral cords from a broad zone beside the umbilical chink. All other New Zealand specimens have spiral cords that extend to the umbilical rim (Fig. 197), numbering 7-9 in New Zealand material, and 8 or 9 in specimens from New Caledonia and the Loyalty Islands. See Discussion page 107.

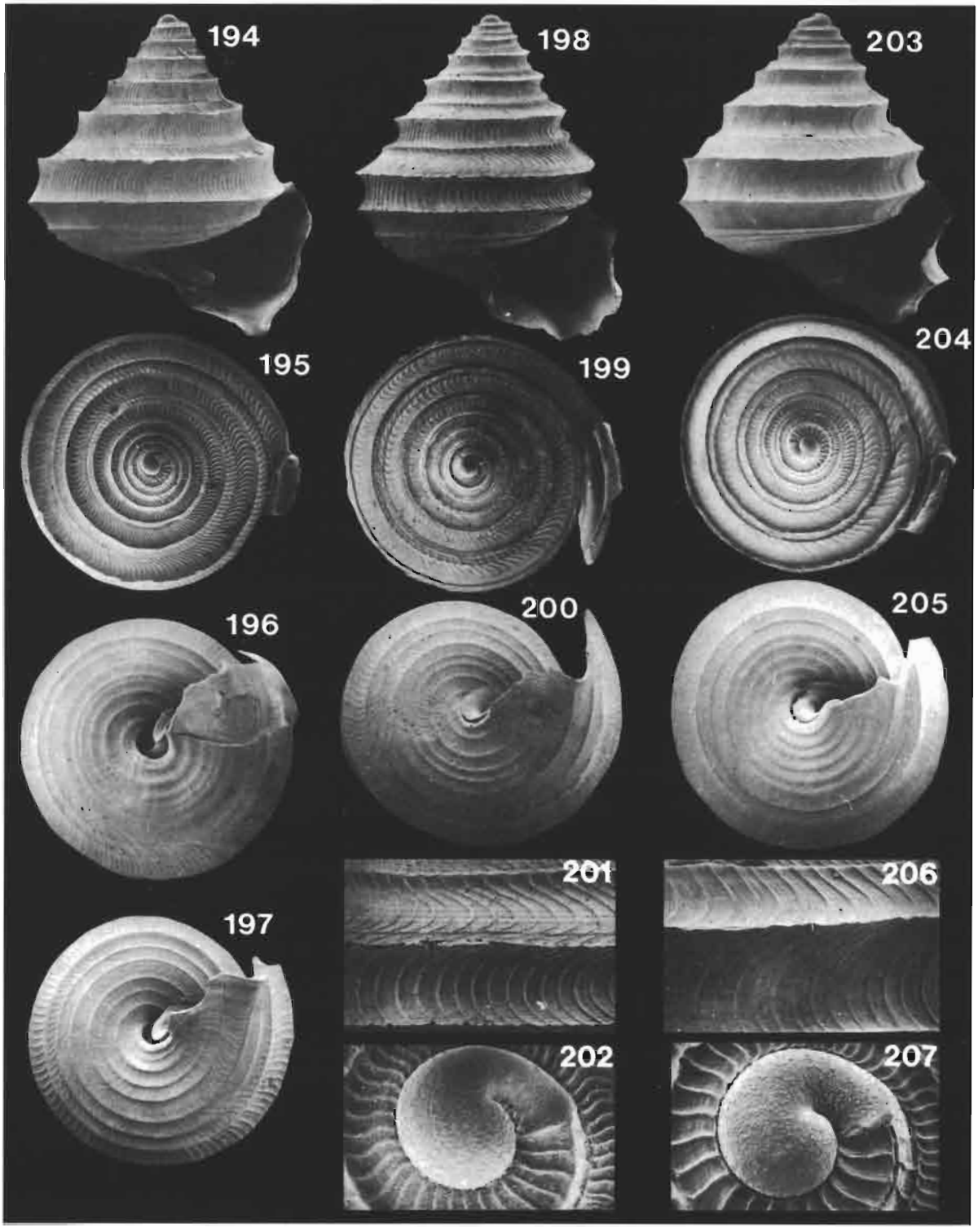
Seguenzia praeceps sp. nov.

Figs 198-202 ; Table 21

DESCRIPTION. — *Shell* up to 4.55 mm high, higher than broad, thin, anomphalous, spire 1.19-1.35 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 300-330 μm wide, minutely granulate.

Teleoconch of up to 6.6 whorls, shoulder and



FIGS 194-207. — Genus *Seguenzia* : **194-196,** *Seguenzia chelina*, BIOCAL stn DW 80, 3.15 × 2.65 mm. — **197,** *S. chelina*, off Aldermen Is, New Zealand, 807-872 m (NMNZ M. 95411), width 2.70 mm. — **198-202,** *S. praeceps*, holotype, 4.15 × 3.25 mm, 201 × 30, 202 × 85. — **203-207,** *S. metivieri*, holotype, 2.88 × 2.52 mm, 206 × 45, 207 × 90.

periphery angulated by sharp-edged keels, ramp shallowly concave, concave between periphery and outermost basal spiral, most deeply concave between shoulder and periphery; base gently contracted, convex. Very minutely granulate throughout. Shoulder keel at adapical third, its summit on last whorl with distinct bevel bounded by spiral threads; a finely serrate subsutural angulation commencing late on 4th whorl. Axial riblets fine, sigmoidal, crisp on spire and base to innermost basal spiral, numbering 13-18 per mm between spire keels at end of 5th whorl. spiral threads finer than axials, multiplying by intercalation, covering spire and periphery to outermost basal spiral. Base with 7-9 similar, prominent spiral cords, interspaces considerably broader than each spiral. Aperture subrhomboidal. Outer lip thin, posterior notch deep, retraction depth 14.0-18.4 % and protraction depth 53.2-58.4 % of shell diameter, apical rim flared; basal notch U-shaped, apical rim flared; peripheral notch angulate, well retracted. Parietal glaze thin. Inner lip concave, sharply flexed at base to form prominent tooth, broadly channelled below.

Animal unknown.

TABLE 21. — *Seguenzia praeceps*. Shell measurements (mm) and countings. (BIOCAL, stn DW 79).

Character	*n*	Range	Mean	SD
H	9	4.00-4.55	4.22	0.22
D	9	3.15-3.35	3.23	0.08
H/D	9	1.25-1.38	1.30	0.04
TW	9	6.10-6.60	6.41	0.18

TYPE DATA. — Holotype MNHN (4.15 × 3.25 mm, 6.10 TW) and 11 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USNM) : BIOCAL, stn DW 79.

OTHER MATERIAL EXAMINED (3 specimens MNHN). — BIOCAL, stn DS 59 (2). — Stn DS 98 (1).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands and southern New Caledonia, 1 320-2 650 m (dead).

REMARKS. — Among previously described species, *S. praeceps* seems closest to *S. fulgida* Marshall, 1983, based on two specimens taken at 1 760-1 799 m off Westland, New Zealand. The New Caledonian species differs primarily in having more crisply-defined axial riblets on later whorls, including the base, in having closer shoulder and peripheral keels, and in attaining maturity at smaller size, *S. fulgida* attaining 6.10 mm in height. It also closely resembles syntypes (USNM 181650) and NMNZ specimens of *S. formosa* Jeffreys, 1876 (off Portugal, 4 220-4 380 m) and the holotype (NSMT) of *S. mirabilis* Okutani, 1964 (off Japan, 3 150-3 550 m) in general facies, differing from *S. formosa* in having a smaller protoconch (diameter 300-330 μm, cf. 370 μm) and a sharper subsutural angulation, and from *S. mirabilis* in being smaller relative to the number of whorls and in having considerably weaker spiral threads on the spire. The undescribed Philippine species illustrated by QUINN (1983b, fig. 1) is superficially similar, but differs in having a much stronger tooth on the inner lip.

ETYMOLOGY. — Steep (Latin).

Seguenzia metivieri sp. nov.

Figs 203-207

DESCRIPTION. — *Shell* up to 2.88 mm high, slightly higher than broad, thin, anomphalous, or with narrow umbilical chink, spire 1.15 × as high as aperture; white, nacreous through thin, translucent outer shell layer.

Protoconch 280 μm wide, finely granulate.

Teleoconch of up to 5.80 whorls, shoulder and periphery angulated by sharp-edged keels, ramp almost flat, side concave, shallowly concave between periphery and outermost basal spiral, base rather gently contracted, convex. Very minutely granulate throughout. Shoulder angulation at about adapical third, a low angulation bordering suture on last adult whorl. Axial riblets fine, sigmoidal, crisp on spire and on base to outermost basal spiral, obsolete on adapical side of shoulder keel, obsolete elsewhere on base, numbering 17 per mm between keels at end of 5th whorl. No spiral threads. Base with 8 spiral cords, outermost cord angulate in section, most prominent, others considerably lower, interspaces similar, considerably broader than each spiral. Umbilicus narrow, either fully invaded by inner lip, or partially invaded to form an elliptical chink. Aperture subrhomboidal. Outer lip thin, posterior notch deep, retraction depth 10.2 % and protraction depth at least 24 % shell diameter (tip of labial projection broken), apex flared;

basal notch shallow, concave, apex slightly flared ; peripheral notch smallest, roundly angulate. Parietal glaze thin. Inner lip thick, deeply curved into umbilicus, sharply flexed at base to form strong tooth, channelled below.

Animal unknown.

TYPE DATA. — Holotype (2.88 × 2.52 mm, 5.50 TW) and paratype (2.75 × 2.45 mm, 5.80 TW) MNHN : BIOCAL, stn DW 80.

DISTRIBUTION. — Off Ouvea, Loyalty Islands, 900-980 m (dead).

REMARKS. — *Seguenzia metivieri* bears a close superficial resemblance to the New Zealand species *S. transenna* Marshall, 1973, from which it differs primarily in lacking spiral threads on the teleoconch, and in having the axial riblets weaker between the periphery and outermost basal spiral, and obsolete elsewhere on the base, while the tooth on the inner lip is much stronger. Moreover, the axial riblets on the shoulder are shorter, extending almost to the summit of the keel in *S. transenna*. *S. metivieri* occurred together with *S. chelina* at the type locality.

ETYMOLOGY. — Named after Bernard METIVIER (MNHN) who participated on the BIOCAL campaign.

Seguenzia richeri sp. nov.

Figs 208-212

DESCRIPTION. — *Shell* (holotype) 3.55 mm high, slightly higher than broad, thin, umbilicate, spire as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 370 μm wide, minutely granulate.

Teleoconch of 5.0 whorls ; shoulder and periphery angulated by sharp-edged keels, ramp and side concave, concave between periphery and outermost basal spiral ; base evenly contracted, convex. Very minutely granulate throughout. Shoulder keel at about adapical third, adapical edge distinctly bevelled on last 2 whorls, bevel bounded by crisp spiral thread ; a low, finely serrated subsutural angulation on last whorl. Axial riblets fine, crisp, sigmoidal, traversing spire and base onto outer part of umbilical wall, numbering 13 per mm on spire between keels at end of 5th whorl. Spiral threads crisp, similar to axials, multiplying by intercalation, covering spire and periphery to outermost basal spiral. Base with 6 similar prominent spiral cords ; interspaces similar, considerably broader than each spiral. Umbilicus deep, rim angulate, diameter 19.3 % of shell diameter. Aperture subrhomboidal. Outer lip thin ; posterior notch deep, retraction depth 6.45 % of shell diameter, protraction depth unknown (rim damaged) but at least 34 % of shell diameter ; basal notch well developed, flared ; peripheral notch in angulation, slightly retracted. Parietal glaze very thin. Inner lip rather thin, rolled outwards at rim, deeply curved into umbilicus, sharply flexed at base to form prominent tooth, narrowly channelled below.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.55 × 3.10 mm, 5 TW) : BIOCAL, stn CP 23.

DISTRIBUTION. — Off southern New Caledonia, 2 040 m (dead).

REMARKS. — *Seguenzia richeri* closely resembles *S. metivieri* sp. nov., and the New Zealand species *S. transenna* Marshall, 1973, in shape, differing from both in having a larger protoconch and a wider, open umbilicus. It differs further from *S. metivieri* in lacking the bevelled edge on the shoulder keel, in having strong axial sculpture on the base, and in having fewer (6 cf. 8), more widely spaced cords on the base, while *S. transenna* has finer basal sculpture with 11 or 12 spiral cords, and a much weaker tooth on the inner lip.

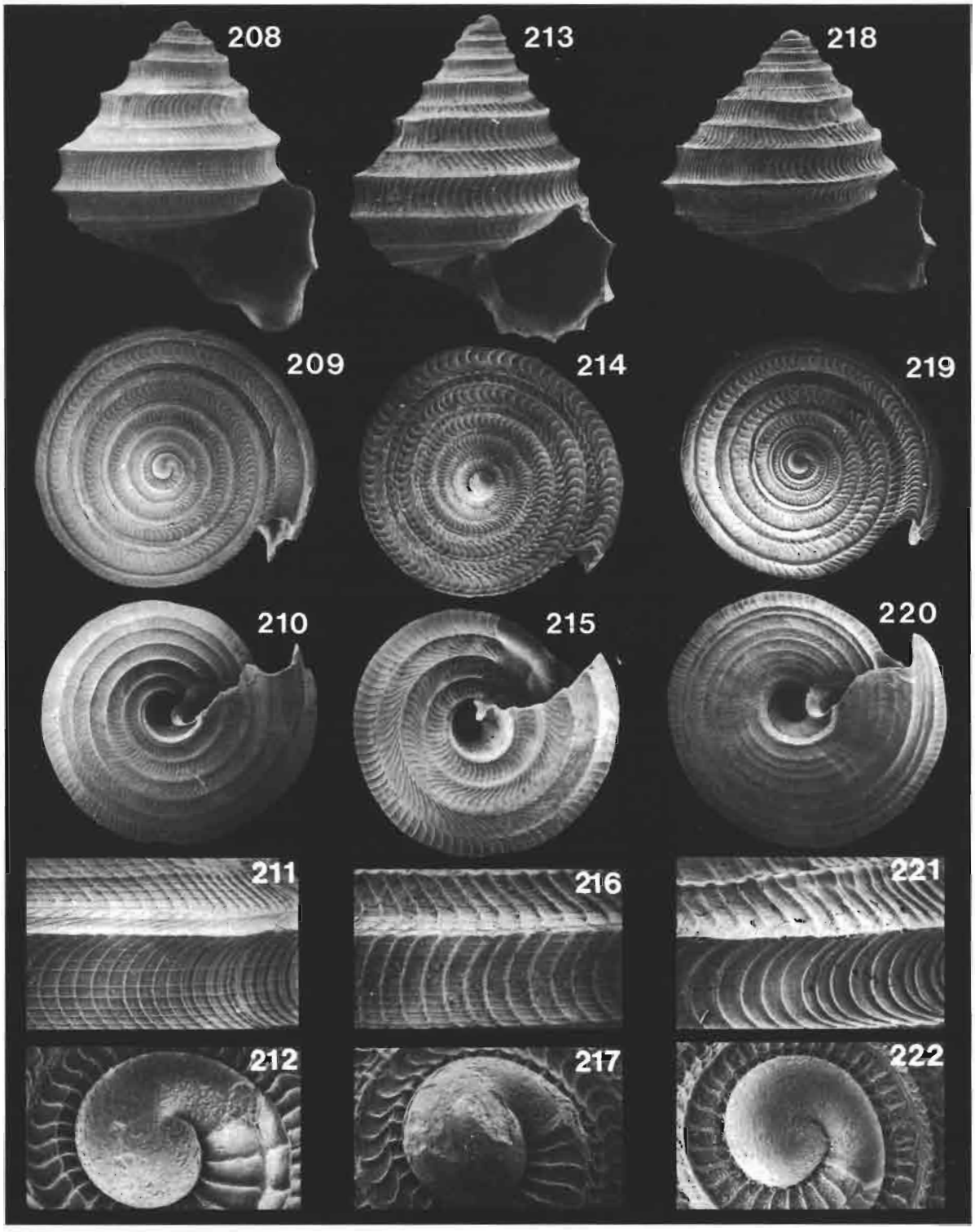
ETYMOLOGY. — Named after Bertrand RICHER DE FORGES, who participated on the BIOCAL campaign.

Seguenzia emmeles sp. nov.

Figs 213-217

DESCRIPTION. — *Shell* (subadult holotype) 3.55 mm high, higher than broad, thin, umbilicate, spire 1.25 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch (holotype and paratype) 330 μm wide, tip bulbous.



FIGS 208-222 — Genus *Seguenzia* : **208-212,** *Seguenzia richeri*, holotype, 3.55 × 3.10 mm, 211 × 35, 212 × 85. — **213-216,** *S. emmeles*, holotype, 3.55 × 2.90 mm, 216 × 30. — **217,** *S. emmeles*, paratype, BIOCAL stn 59, × 70. — **218-222,** *S. eutyches*, holotype, 2.90 × 3.00 mm, 221 × 40, 222 × 80.

Teleoconch (holotype) of 5.6 whorls ; shoulder and periphery angulated by similar, sharp edged keels, ramp and side concave, concave between periphery and outermost basal spiral ; base evenly contracted, convex. Shoulder keel at about adapical third, a low, finely serrate subsutural angulation commencing on 3rd whorl. Axials fine, crisp, sigmoidal, collabral, entirely traversing spire and base, evanescent deep within umbilicus, numbering 12 per mm on spire between keels at end of 5th whorl. Spiral threads crisp, numerous, similar, multiplying by intercalation, covering spire, periphery and base to outermost spiral, a few threads in each interspace of inner basal spirals. Base with 4 strong spiral cords, outermost angulate in section, most prominent, others lower and similar, interspaces much wider than each spiral. Umbilicus deep, diameter 25.3 % of shell diameter. Aperture subtrapezoidal. Outer lip thin, retraction depth of posterior notch 6.9 % of shell diameter, protraction depth unknown (rim damaged) ; basal notch concave ; peripheral notch small, angulate, slightly retracted. Parietal glaze very thin. Inner lip thin, shallowly curved towards umbilicus, weakly flexed at base, toothless.

Animal unknown.

TYPE DATA. — Holotype (3.55 × 2.90 mm, 5.6 TW) and immature paratype MNHN : BIOCAL, stn DS 59.

OTHER MATERIAL EXAMINED (3 immature specimens MNHN). — BIOCAL, stn DS 04 (2). — Stn CP 72 (1).

DISTRIBUTION. — Off southern New Caledonia, 2 100-2 650 m (dead).

REMARKS. — Compared with *S. richeri* to which it has a general resemblance, *S. emmeles* differs in having a more excert protoconch, a more narrowly conical spire, and in lacking the clearly defined bevel on the adapical side of the summit of the shoulder keel. *S. mirabilis* Okutani, 1964 (off Japan, 3 150-3 350 m ; holotype at Geological Institute, University of Tokyo, RM 8811) is even closer in general facies, but differs in sculptural details, in having a narrow umbilical chink, and in having 7 instead of 4 spiral cords on the base.

ETYMOLOGY. — Harmonious (Greek).

Seguenzia eutyches sp. nov.

Figs 218-222

DESCRIPTION. — *Shell* up to 3.40 mm high, slightly broader than high, thin, umbilicate, spire 0.78-1.03 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 300 μm wide, minutely granulate.

Teleoconch of up to 5.2 whorls ; shoulder and periphery angulated by sharp-edged keels, ramp and side concave, concave between periphery and outermost basal spiral ; base gently contracted, weakly convex. Very minutely granulate throughout. Shoulder keel at adapical third, similar to peripheral keel ; low, finely serrate subsutural angulation commencing on 2nd whorl. Axial riblets fine, crisp, sigmoidal, strong over spire to outermost basal spiral, finer on inner base, evanescent on outer part of umbilical wall, numbering 15 per mm at end of 5th whorl. Spiral threads almost obsolete, present on spire and between periphery and outermost basal spiral. Base with 8 crisp spiral cords, outermost angulate in section, most prominent, next spiral finest, inner spirals low and and similar, spiral interspaces considerably wider than each spiral. Umbilicus deep, diameter 21.6-27.7 % of shell diameter. Aperture subrhomboidal. Outer lip thin, rim damaged, basal notch concave, apical rim slightly flared. Parietal glaze thin. Inner lip thick, rim tightly folded towards umbilicus, gently curving towards umbilicus, gently flexed at base to form small rounded tooth, shallowly channelled below.

Animal unknown.

TYPE DATA. — Holotype (2.90 × 3.00 mm, 5.2 TW) and paratype (3.40 × 3.55 mm, 5.1 TW) MNHN : BIOCAL, stn DW 70.

DISTRIBUTION. — Off southern New Caledonia, 965 m (dead).

REMARKS. — *Seguenzia eutyches* most closely resembles *S. richeri* sp. nov. but differs in a number of characters, including the very much weaker spiral threads, the earlier appearance of the subsutural angulation, the more shallowly concave inner lip, and the considerably weaker tooth. It differs further in the lack of a thread-bounded bevel on the shoulder keel, and in the

straighter axial riblets on the ramp on the early teleoconch whorls.

ETYMOLOGY. — Good luck (Greek).

Seguenzia wareni sp. nov.

Figs 223-227 ; Table 22

DESCRIPTION. — *Shell* up to 2.90 mm high, slightly higher than broad, thin, narrowly umbilicate, spire 0.97-1.07 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 270-300 μm (mostly 270 μm) wide, finely granulate.

TABLE 22. — *Seguenzia wareni*. Shell measurements (mm) and countings. (BIOCAL, stn DW 79).

Character	*n*	Range	Mean	SD
H	10	2.55-2.90	2.69	0.11
D	10	2.30-2.55	2.45	0.07
H/D	10	1.04-1.15	1.09	0.04
TW	10	4.80-5.20	4.94	0.12
UD%	10	16.8-20.8	18.9	1.14

Teleoconch of up to 5.2 whorls ; shoulder and periphery angulated by sharp-edged keels, ramp and side concave, concave between periphery and outermost basal spiral ; base evenly contracted, convex. Very minutely granulate throughout. Shoulder keel strongly supramedian at first, descending to adapical third. Axial riblets, fine, crisp, sigmoidal, entirely traversing spire and base to umbilical rim, numbering about 33 per mm between spire keels at end of 5th whorl. Spiral threads similar, similar to axials, multiplying by intercalation, extending from suture to periphery, a few developing on last adult whorl between periphery and outermost basal spiral. Base with 7 similar, prominent spiral cords, interspaces considerably broader than each spiral. Frequently a weaker cord immediately within umbilicus. Umbilicus deep, rim angulate, diameter 16.8-20.8 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin ; posterior notch deep, retraction depth 12.9-17.3 % and protraction depth 54.8-55.4 % of shell diameter, apical rim flared ; peripheral and basal notches similar, U-shaped, flared. Parietal glaze thin. Inner lip strongly curved towards umbilicus, sharply flexed at base to form prominent tooth, channelled below.

Animal unknown.

TYPE DATA. — Holotype MNHN (2.80 × 2.45 mm, 5 TW) and 20 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USM) : BIOCAL, stn DW 79.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 1 320-1 380 m (dead).

REMARKS. — Compared with *S. richeri*, which it much resembles in shape and in having a narrow, open umbilicus, *S. wareni* differs in being smaller with a smaller protoconch, and in having finer and closer reticulate sculpture.

The unusually deep, U-shaped peripheral notch in the mature outer lip is an extremely distinctive character. *S. wareni* occurred together with *S. chariessa* at the type locality.

ETYMOLOGY. — This species is named after Anders WARÉN (Swedish Museum of Natural History, Stockholm), who provided critical comparative material and who designed the excellent rock dredge with which most of the present material was obtained.

Seguenzia matara Marshall, 1988

Figs 228-232

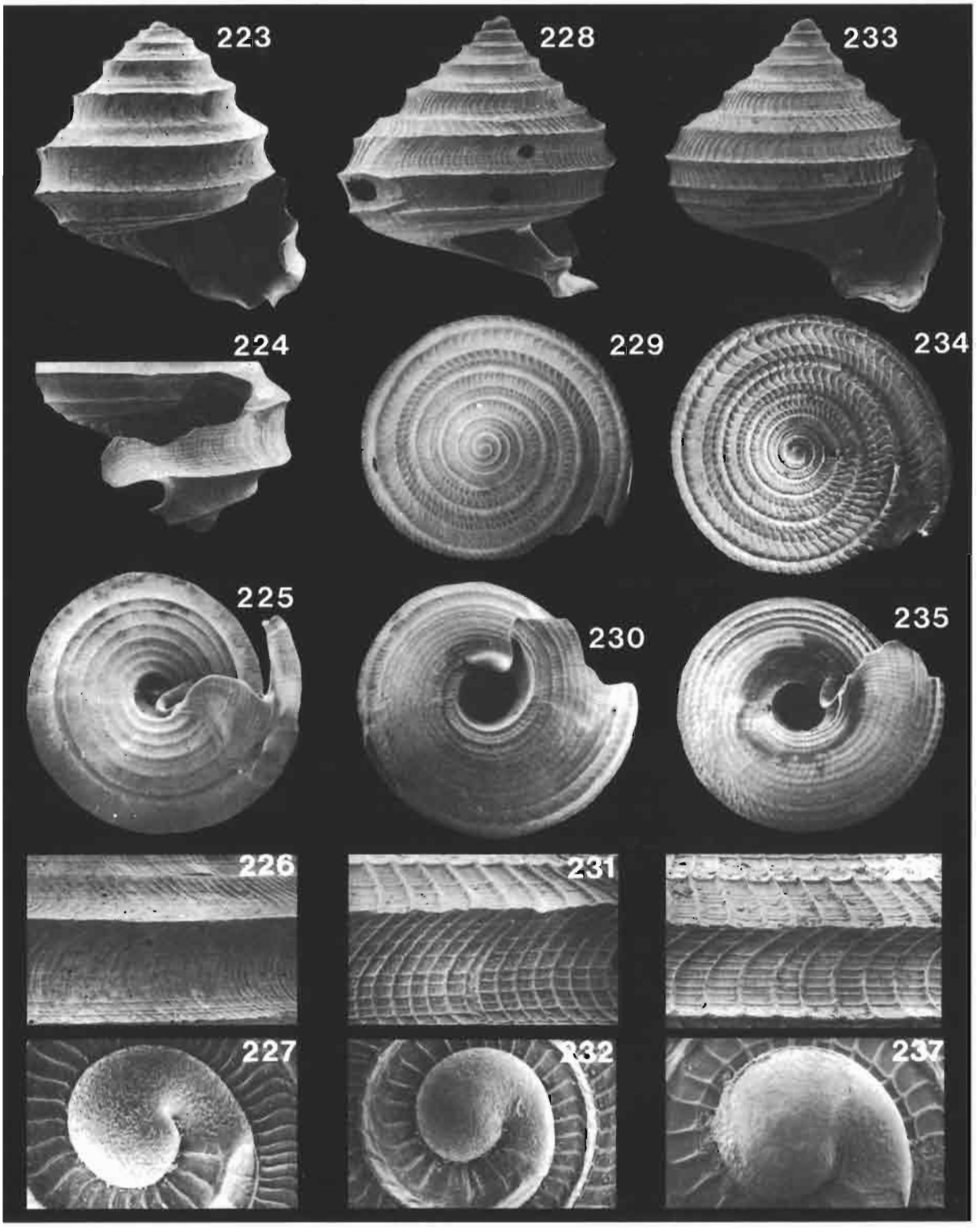
Seguenzia matara Marshall, 1988 : 242, figs 2 k-o, 4 g, 5 a.

TYPE DATA. — Holotype NZOI H. 453 : Q 696, 42°36.1′ S, 169°34.8′ E, off Westland, New Zealand, alive, 935-920 m, 21 February 1982, R. V. " *Tangaroa* ".

OTHER MATERIAL EXAMINED (2 specimens MNHN). — BIOCAL, stn DW 80.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands (dead, 900-980 m), and New Zealand (alive, 750-1 029 m).

REMARKS. — The two New Caledonian specimens fall within the range of variation in shell morphology exhibited by New Zealand type material of *S. matara*, and would thus seem to be



FIGS 223-237. — Genus *Seguenzia* : **223, 225-227,** *Seguenzia wareni*, holotype, 2.80 × 2.45 mm, 226 × 45, 227 × 95. — **224,** *S. wareni*, paratype, BIOCAL stn DW 79, × 20. — **228-232,** *S. matara*, BIOCAL stn DW 80, 3.20 × 3.40 mm, 231 × 45, 232 × 80. — **233-237,** *S. eidalima*, holotype, 3.27 × 3.10 mm, 236 × 45, 237 × 110.

conspecific. *S. matara* is similar to *S. elegans* Jeffreys, 1885 and *S. nipponica* Okutani, 1964 in general facies. It differs from both in that the outermost basal spiral and peripheral keel are set further apart. It differs further from *S. elegans* in attaining maturity of larger size and in having a wider umbilicus, while the last adult whorl is more strongly convex with more prominent shoulder and peripheral keels. When introducting *S. matara* I did not indicate its affinities with *S. nipponica* because New Zealand specimens seemed to differ widely from the original illustration of the holotype (OKUTANI, 1964, pl. 6, fig. 1, cf. MARSHALL, 1988, fig. 2 k). Comparisons of the type material, however, reveal that they are in fact closely related. Of the three species, *S. nipponica* and *S. elegans* are the most similar, *S. nipponica* differing from *S. elegans* in attaining larger size and in having fewer, more widely spaced axial riblets on the spire. A closely related species is described below. See Discussion page 107.

Seguenzia eidalima sp. nov.

Figs 233-237

DESCRIPTION. — *Shell* (holotype) 3.27 mm high, about as broad as high, thin, umbilicate, spire 0.80 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 270 μm wide, surface mostly etched away, remaining surface granulate.

Teleoconch of 5.5 whorls, shoulder and periphery angulated by sharp-edged keels, ramp and side shallowly concave, shallowly concave between peripheral and outermost basal spiral, base evenly contracted, weakly convex. Very minutely granulate throughout. Shoulder keel near adapical third, rather low, peripheral keel stronger ; low, finely serrate subsutural angulation commencing on 2nd whorl. Axial riblets fine, crisp on spire and on outer half of base, weaker on inner half of base, numbering 10 per mm between keels at end of 5th whorl. Spiral threads multiplying by intercalation, crisp, that surmounting subsutural angulation becoming as strong as axials, others finer and similar, covering spire and occupying spaces between periphery and outermost 2 basal spirals. Base with 13 crisp spiral cords, interspaces considerably wider than each spiral, outer 2 spirals angulate in section, most prominent, others considerably lower. Umbilicus deep, rim narrowly rounded and overhanging wall that is sigmoidal in section, diameter 26.7 % of shell diameter. Aperture subrhomboidal. Outer lip thin, posterior notch apex flared, retraction depth 10.7 % of shell diameter, protraction depth unknown (labial projection broken) ; basal notch concave, no peripheral notch. Parietal glaze thin. Inner lip rather thick, tightly rolled outwards at rim, deeply curved towards umbilicus, strongly flexed at base to form very prominent tooth, deeply channelled below.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.27 × 3.10 mm, 5.5 TW) : BIOCAL, stn CP 26.

DISTRIBUTION. — Off southern New Caledonia, 1 618-1 740 m (dead).

REMARKS. — *Seguenzia eidalima* closely resembles type material of the North Atlantic species *S. elegans* Jeffreys, 1885 (syntypes BMNH 885.11.5 2628-30, 2587-88) and the Japanese *S. nipponica* Okutani, 1964 (holotype Department of Geology, University of Tokyo RM 8812 ; paratype NSMT MO 64682). It differs from *S. nipponica* in being smaller relative to the number of whorls (*S. nipponica* paratype 4.20 × 4.05 mm, 4.5 TW), and from *S. elegans* in having a wider umbilicus (diameter 26.7 % of shell diameter, cf. 19.7 %). It differs further from both in that the outer part of the umbilical wall is concave and overhung by the umbilical rim.

ETYMOLOGY. — Shapely (Greek).

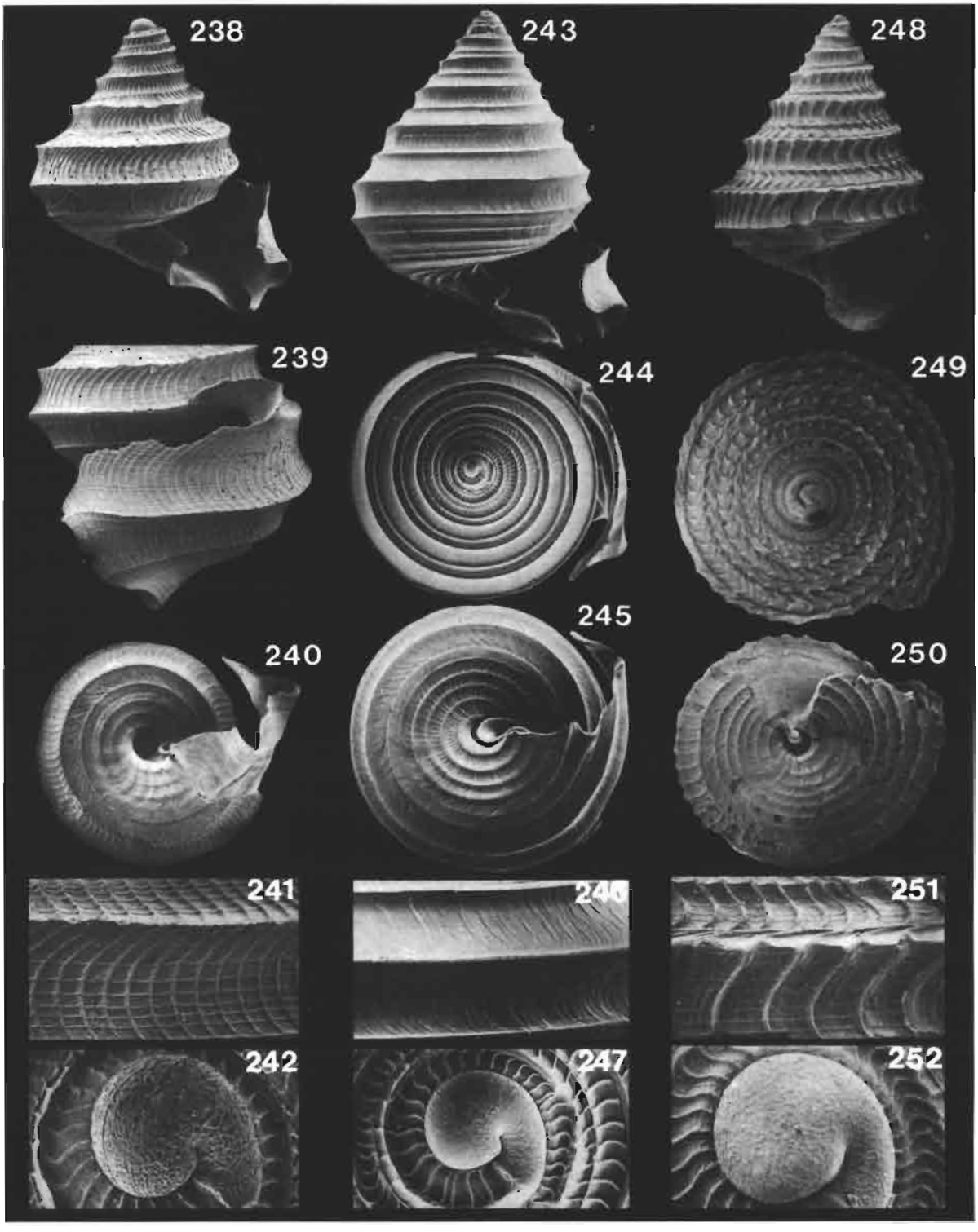
Seguenzia iota sp. nov.

Figs 238-242 ; Table 23

DESCRIPTION. — *Shell* up to 2.60 mm high, slightly higher than broad, thin, narrowly umbilicate, spire 0.95-1.09 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 230-270 μm wide, coarsely granulate throughout and with 2 spiral threads.

Teleoconch of up to 5.75 whorls ; shoulder and periphery strongly angulated by prominent, sharp-edged keels, ramp shallowly concave, shallowly concave between periphery and outermost basal spiral, more deeply concave between shoul-



FIGS 238-252. — Genus *Seguenzia* : **238, 239,** *Seguenzia iota*, paratypes, " *Vauban* " stn 40, 2.30 × 2.10 (238), 2.05 × 1.90 (239). — **240-242,** *S. iota*, holotype, 2.23 × 2.01 mm, 241 × 60, 242 × 110. — **243, 244, 246, 247,** *S. chariessa*, holotype, 5.30 × 4.30 mm, 246 × 25, 247 × 70. — **245,** *S. chariessa*, paratype, BIOCAL stn CP 75, width 3.95 mm. — **248-251,** *S. levii*, holotype, 5.00 × 3.55 mm, 251 × 25. — **252,** *S. levii*, paratype, BIOCAL stn CP 72, × 80.

der keel and periphery ; base gently contracted, convex. Very minutely granulate throughout. Shoulder keel at about adapical third, summit slightly upturned. Axial riblets fine, sigmoidal, crisp on spire and base to outermost basal spiral, developing between outermost 2 basal spirals on last adult whorl, obsolete elsewhere on base, numbering 16-22 per mm between keels at end of 5th whorl. Spiral threads crisp, numerous, multiplying by intercalation, covering spire, developing between periphery and outermost basal spiral on last adult whorl, and later, frequently between outermost 2 basal spirals. Base with 5 or 6 crisp, similar spiral cords, interspaces considerably wider than each spiral. Umbilicus deep, outer part of wall shallowly convex, concave behind inner lip, diameter 12.3-17.7 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin, posterior notch deep, apical rim strongly flared radially and adapically, retraction depth 21.6-27.0 % and protraction depth 65-73 % of shell diameter ; peripheral notch only slightly retracted though strongly radially flared at rim ; basal notch concave, prominently flared. Parietal glaze thin. Inner lip rather thick, rim tightly folded towards umbilicus, deeply curved towards umbilicus, sharply flexed at base to form strong tooth, channelled below.

Animal unknown.

TABLE 23. — *Seguenzia iota*. Shell measurements (mm) and countings. (" *Vauban* ", stn 40).

Character	*n*	Range	Mean	SD
H	11	2.00-2.60	2.31	0.18
D	11	1.88-2.12	1.97	0.07
H/D	11	1.06-1.30	1.17	0.07
TW	11	4.90-5.75	5.31	0.28
UD%	11	12.1-17.7	14.7	2.03

TYPE DATA. — Holotype (2.23 × 2.01 mm, 5 TW) MNHN and 679 paratypes (AMS, BMNH, MNHN, NMNZ, NMP, USM) : " *Vauban* ", stn 40.

DISTRIBUTION. — Off southern New Caledonia, 250-350 m (dead).

REMARKS. — Among previously described species of *Seguenzia, S. iota* is rendered highly distinctive by its small size and very strongly developed apertural features.

ETYMOLOGY. — Very small (Greek).

Seguenzia chariessa sp. nov.

Figs 243-247 ; Table 24

DESCRIPTION. — *Shell* up to 5.75 mm high, narrowly conical, considerably higher than broad, thin, anomphalous, spire 1.32-1.36 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 330-350 μm wide (mostly 330 μm), minutely granulate.

Teleoconch of up to 7.3 whorls ; shoulder and periphery strongly angulated by smooth, sharp-edged keels, ramp, side and basal spiral interspaces shallowly concave ; base evenly contracted, convex. Shoulder keel strongly supramedian at first, descending to almost median position, summit slightly upturned ; subsutural angulation strong, smooth, commencing on 2nd whorl. Axial riblets fine, sigmoidal, crisp on early whorls, less crisply defined on later whorls, extending over spire and base to umbilical rim, numbering 13 per mm between shoulder keel and periphery at end of 5th whorl. Spiral threads absent. Base with 6 or 7 strong, smooth spiral cords, interspaces considerably broader than each spiral. Aperture subrhomboidal. Outer lip thin ; posterior notch deep, retraction depth 12.1-14.6 % and protraction depth up to at least 61 % of shell diameter (tip of labial projection broken), apical rim flared ; basal notch U-shaped, rim flared ; peripheral notch shallow, concave, flared. Parietal glaze thin. Inner lip thick, deeply curved away from aperture, strongly flexed at base to form strong, narrowly angulate tooth, channelled below.

Animal unknown.

TABLE 24. — *Seguenzia chariessa*. Shell measurements (mm) and countings. (BIOCAL, stn CP 75, DW 80).

Character	*n*	Range	Mean	SD
H	7	4.70-5.75	5.30	0.33
D	7	3.65-4.25	3.92	0.20
H/D	7	1.21-1.41	1.35	0.05
TW	7	6.50-7.30	6.90	0.26

TYPE DATA. — Holotype (5.30 × 4.30 mm, 6.75 TW) MNHN, and 81 paratypes (AMS, BMNH, MNHN, NMP, NMNZ, USM) : BIOCAL, stn CP 75. Paratypes (12 MNHN) : BIOCAL , stn DW 79 (2). — Stn DW 80 (10).

DISTRIBUTION. — Off Ouvéa, Loyalty Islands and southern New Caledonia, 825-1 380 m, living at 825-860 m.

REMARKS. — *Seguenzia chariessa* is rendered very distinctive by the combination of large size, tall spire, lack of spiral threads, and rather weak axial riblets.

ETYMOLOGY. — Graceful (Greeck).

Seguenzia levii sp. nov.

Figs 248-252

DESCRIPTION. — *Shell* up to 5.00 mm high, narrowly conical, considerably higher than broad, thin, becoming rather thick, very narrowly umbilicate, spire 1.58 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 350 μm wide, finely granulate.

Teleoconch of up to 7.0 whorls, shoulder and periphery strongly angulated by prominent keels, ramp shallowly concave, shallowly concave between periphery and outermost basal spiral, more deeply concave between shoulder keel and periphery ; base gently contracted, convex. Shoulder keel summit narrowly rounded, strongly serrate, becoming slightly higher than weakly serrate peripheral keel at maturity, at about adapical third ; subsutural angulation commencing on 2nd whorl, gradually enlarging, becoming serrate. Very minutely granulate throughout. Axial riblets sigmoidal, narrow, strongly raised, relatively very strong on spire, weaker on base, weakening towards umbilicus, coalescing to form strong spiral thread on adapical side of shoulder keel, numbering 6 per mm between keels at end of 5th whorl. Spiral threads crisp, considerably finer than axials, multiplying by intercalation, covering spire and base to outermost basal spiral, commencing between outermost 2 basal spirals on last adult whorl. Base with 9 or 10 crisp spiral cords, outer 3 or 4 spirals angulate in section, inwardly decreasing in prominence, innermost spiral weakest, bordering umbilicus, interspaces considerably wider than each spiral. Umbilical diameter 11.3 % of adult shell diameter. Outer lip broken back, from growth lines posterior notch probably very deep ; basal notch concave ; peripheral notch shallow, concave, angulate. Parietal glaze thin. Inner lip rather thick, rim tightly folded towards umbilicus, weakly flexed at base to form small, blunt, solid tooth.

Animal unknown.

TYPE DATA. — *Holotype* (5.00 × 3.55 mm, 7.0 TW) MNHN, and immature paratype MNHN : BIOCAL, stn CP 72. Paratype (MNHN) : BIOCAL, stn DS 59.

DISTRIBUTION. — Off southern New Caledonia, 2 100-2 650 m (dead).

REMARKS. — *Seguenzia levii* is highly distinctive in its tall, narrowly conical spire, very prominent axial riblets and strong, serrate shoulder keel.

ETYMOLOGY. — It is named after Claude LEVI, who was cruise leader of the 1985 BIOCAL campaign.

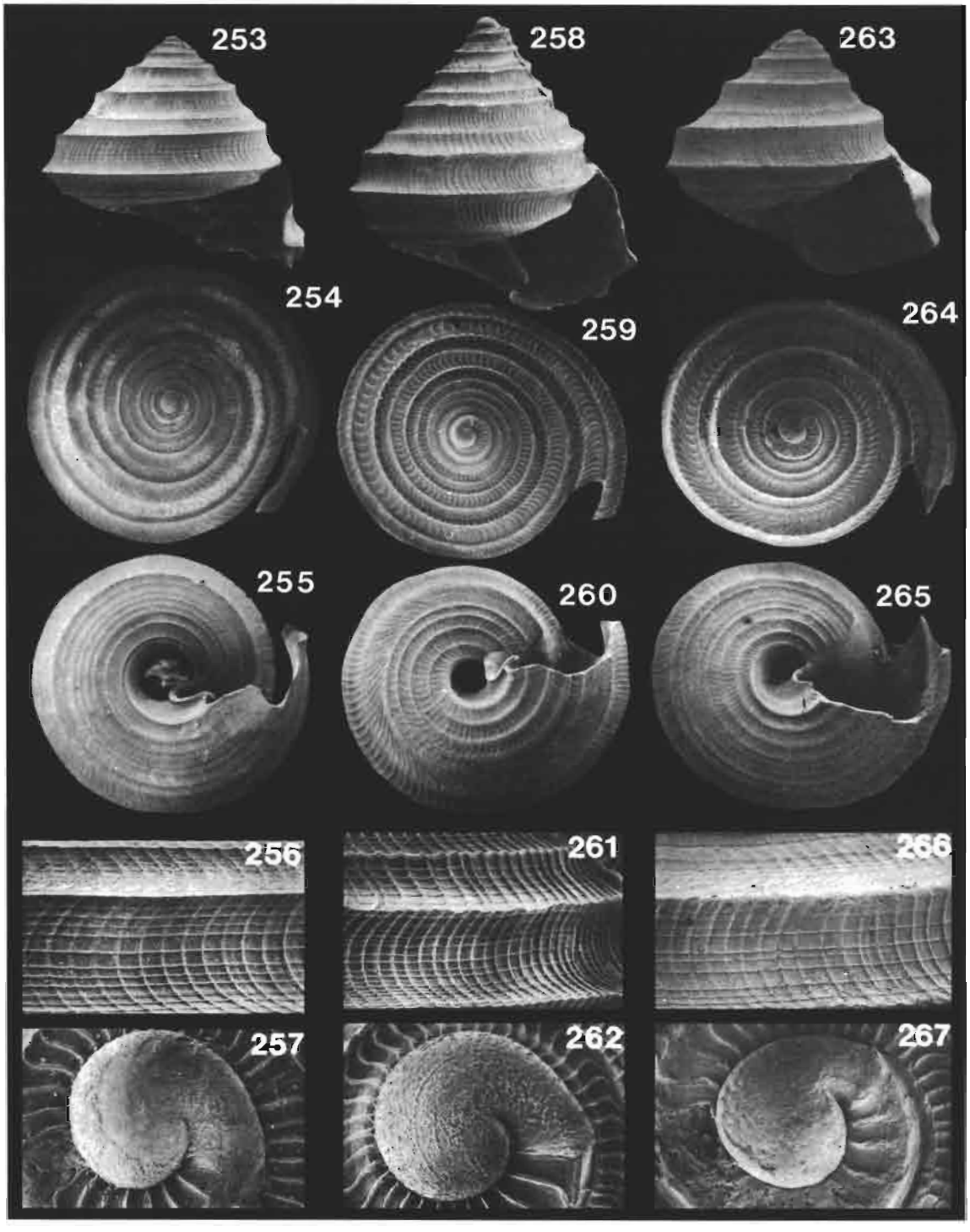
Seguenzia engonia sp. nov.

Figs 253-257

DESCRIPTION. — *Shell* up to 3.25 mm high, broader than high, thin, widely umbilicate, spire 0.76-1.06 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 300-320 μm wide, finely granulate.

Teleoconch of up to 5.10 whorls, shoulder keel at adapical third, peripheral keel very strong, ramp and side shallowly concave, shallowly concave between periphery and outermost basal spiral ; base sharply contracted, weakly convex. A long though distinct, weakly serrate, subsutural angulation commencing on 4th whorl. Axial riblets fine, crisp, sigmoidal, traversing spire, base and outer part of umbilical wall, numbering 12 or 13 per mm between keels at end of 5th whorl. Spiral threads crisp, similar to axials, multiplying by intercalation, covering spire and base to outermost spiral. Base with 7-9 crisply defined spiral cords, outermost angulate in section and most prominent, interspaces considerably wider than each spiral. Umbilicus deep, rim angulate, diameter 28.6-34.1 % of adult shell diameter. Aperture subrhomboidal. Outer lip thin ; posterior notch deep, retraction depth 6.6-7.4 % and protraction depth 34.1 % of shell diameter ; slightly flared at apex ; basal notch U-



FIGS 253-267. — Genus *Seguenzia* : **253-257,** *Seguenzia engonia*, holotype, 3.10 × 3.52 mm, 256 × 35, 257 × 105. — **258-262,** *S. stegastris*, holotype, 2.70 × 2.80 mm, 261 × 45, 262 × 105. — **263-267,** *S. platamodes*, holotype, 2.73 × 3.28 mm, 266 × 45, 267 × 70.

shaped at rim, scarcely retracted behind. Parietal glaze thin. Inner lip rather thick, rim tightly folded towards umbilicus, deeply curved towards umbilicus, strongly flexed at base to form strong, rounded tooth, channelled below.

Animal unknown.

TYPE DATA. — Holotype MNHN (3.10 × 3.52 mm, 5.1 TW) and 3 paratypes (2 MNHN, 1 NMNZ) (3.25 × 3.60 mm, 5.1 TW ; 2.95 × 3.50 mm, 4.75 TW) : BIOCAL, stn DW 79.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 1 320-1 380 m (dead).

REMARKS. — *Seguenzia engonia* is a very distinctive species characterised by low spire, sharply angulate periphery, broad umbilicus, and strong tooth on the inner lip.

ETYMOLOGY. — Angular (Greek).

Seguenzia platamodes sp. nov.

Figs 263-267

DESCRIPTION. — *Shell* (holotype) 2.73 mm high, slightly broader than high, thin, umbilicate, spire 1.10 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 400 μm wide, surface eroded.

Teleoconch of 4.1 whorls, shoulder and periphery angulated by blunt-edged keels, ramp and side shallowly concave, shallowly concave between periphery and outermost basal spiral ; base rather suddenly contracted, weakly convex. Shoulder keel at adapical third, a low serrated subsutural angulation commencing on 4th whorl. Very minutely granulate throughout. Axial riblets fine, crisp, sigmoidal, traversing spire and base, extending onto outer part of umbilical wall, numbering 11 per mm between keels at end of 4th whorl. Spiral threads crisp, finer than axials, multiplying by intercalation, covering spire and outer base to outermost spiral. Base with 8 crisp, similar spiral cords, interspaces considerably wider than each spiral. Umbilicus deep, rim angulate, diameter 24.4 % of shell diameter. Aperture subquadrate. Outer lip thin, retraction depth 4.1 % of shell diameter, protraction depth unknown (rim damaged) ; basal notch concave, peripheral notch very slightly retracted. Parietal glaze thin. Inner lip thick, shallowly curved towards umbilicus, not flexed at base, toothless.

Animal unknown (dried).

TYPE DATA. — Holotype MNHN (2.73 × 3.28 mm, 4.1 TW) : BIOCAL, stn DS 14.

DISTRIBUTION. — Off Lifou, Loyalty Islands, 3 680-3 700 m (alive).

REMARKS. — *Seguenzia platamodes* most closely resembles *S. engonia* sp. nov., from which it differs in being larger relative to the number of whorls, in having a much larger protoconch, in the later appearance of the subsutural angulation, and in having more bluntly angulate summits on the shoulder and peripheral keels. Judging from the simple apertural features and the large protoconch, the holotype may be immature. Accordingly, larger specimens may be expected to develop a tooth at the base of the inner lip.

ETYMOLOGY. — Flattened (Greek).

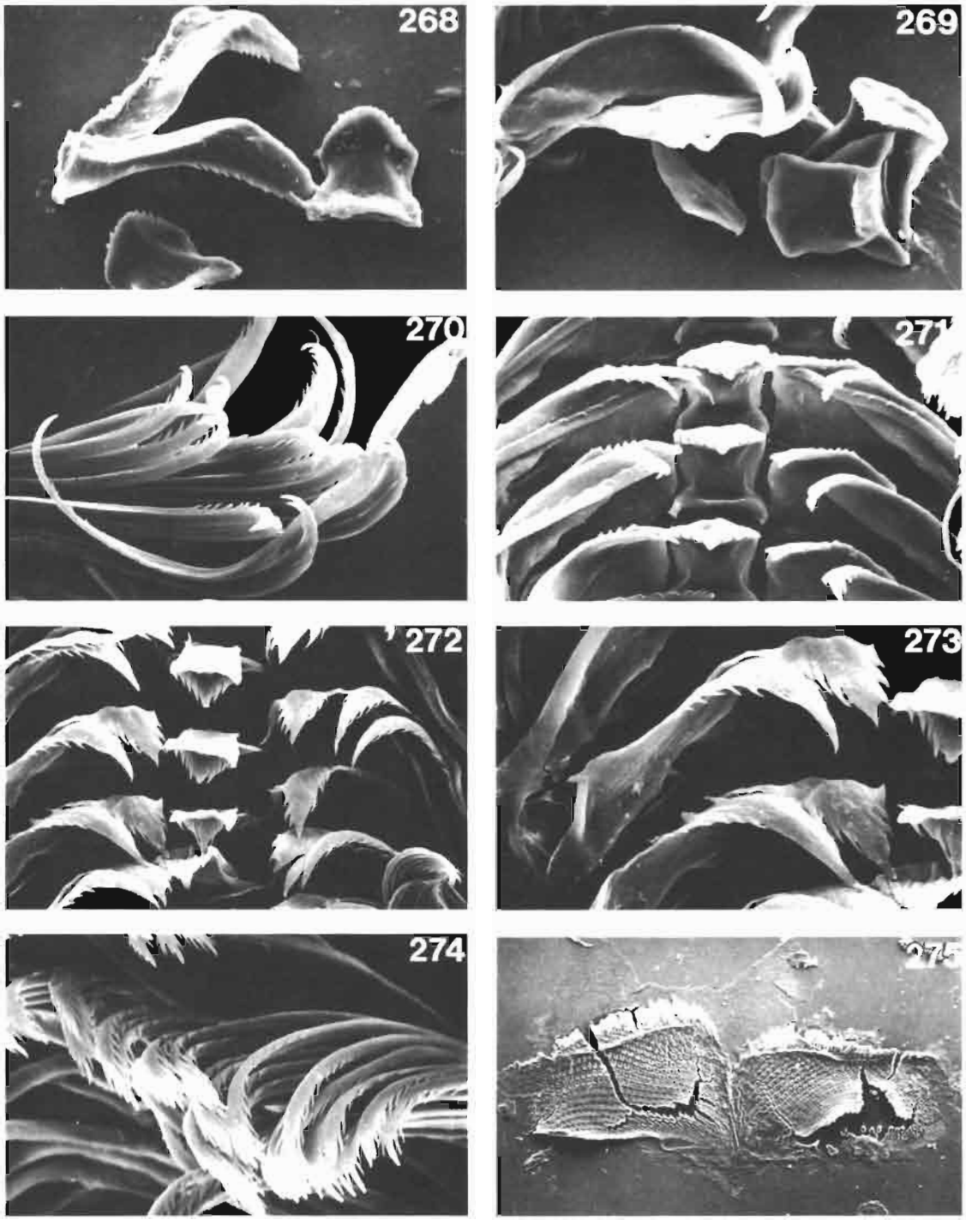
Seguenzia stegastris sp. nov.

Figs 258-262

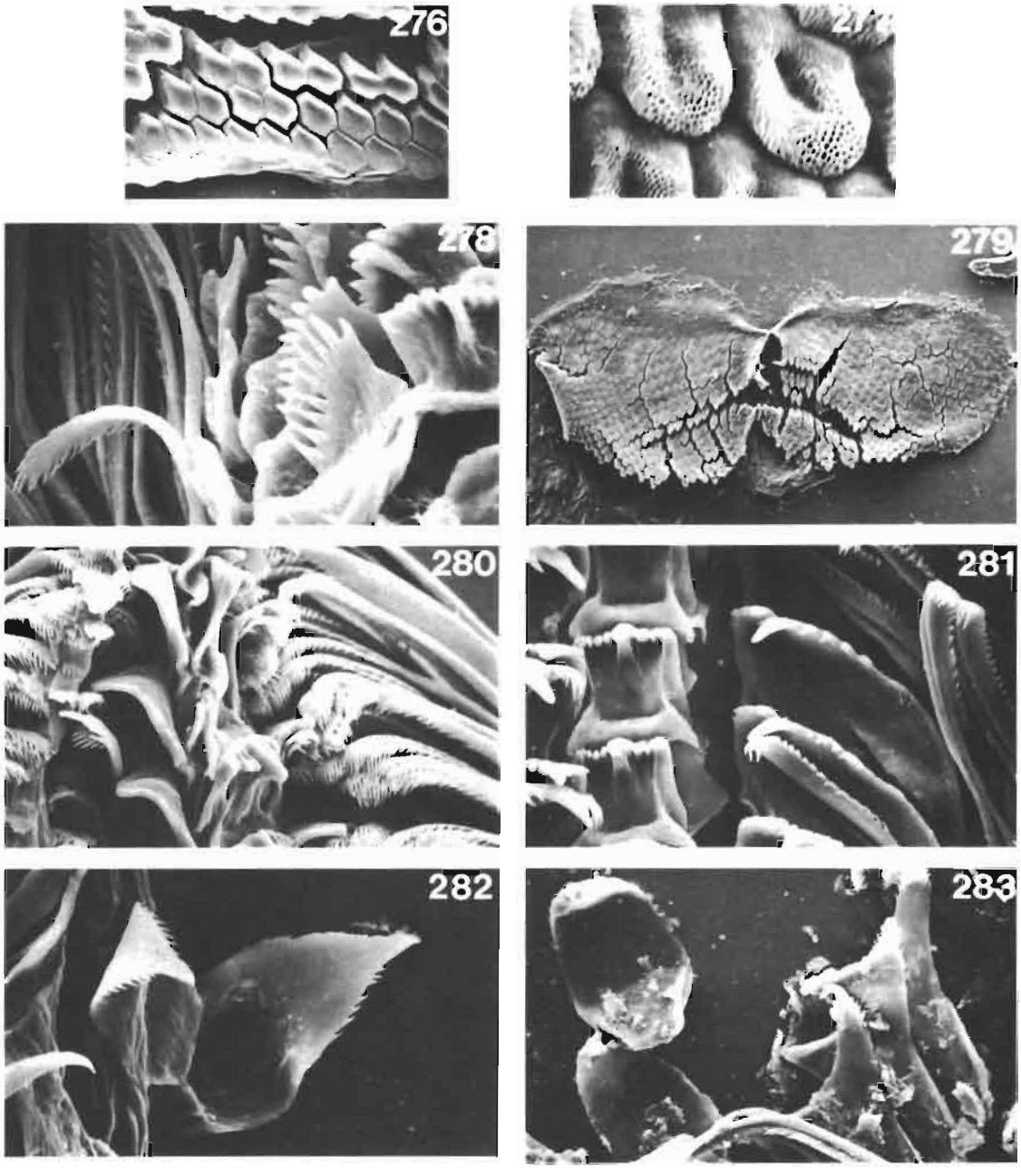
DESCRIPTION. — *Shell* (holotype) 2.70 mm high, about as high as broad, thin, umbilicate, spire 1.07 × as high as aperture ; white, nacreous through thin, translucent outer shell layer.

Protoconch 310 μm wide, minutely granulate, granules coalescing to form single spiral thread at summit.

Teleoconch of 5.25 whorls ; shoulder and periphery angulated by sharp-edged keels of similar size, ramp and side concave, concave between periphery and outermost basal spiral ; base gently contracted, convex. Shoulder keel at about adapical third, summit slightly upturned ; a prominent, finely serrate subsutural angulation commences on 3rd whorl. Axial riblets fine, crisp, sigmoidal, collabral, traversing spire and base to spiral thread within umbilicus, numbering 13 per mm between keels on spire at end of 5th whorl. Spiral threads crisp, similar, numerous, multiplying by intercalation, covering spire and base from periphery to outermost basal spiral, commencing between outer 2 basal spirals on last half of last adult whorl. Base with 6 crisp spiral cords, outermost angulate in section, most



FIGS 268-275. — Radulae and jaws (275) : **268-270,** *Asthelys nitidula*, NE of Sandy Cape, Queensland (AMS C. 154369), 268 × 830, 269 × 1 000, 270 × 1 250. — **271,** *Ancistrobasis scitula*, paratype, BIOCAL stn DW 51, × 1 060. — **272-275,** *Ancistrobasis boucheti*, paratype, BIOCAL stn DW 77, 272 × 950, 273 × 1 380, 274 × 1 210, 275 (jaws) × 150.



FIGS 276-283. — Jaws (276, 277, 279) and radulae : **276, 277,** *Ancistrobasis boucheti*, paratype, BIOCAL stn DW 77 (jaw details), 276 × 700, 277 × 2 830. — **278, 279,** *Calliobasis spectrum*, paratype, BIOCAL stn DW 41, 278 × 1 890, 279 (jaws) × 220. — **280, 281,** *Fluxinella asceta*, paratype, BIOCAL stn DW 33, 280 × 1 140, 281 × 1 140. — **282, 283,** *Halystina caledonica*, paratype, BIOCAL stn DS 04, 282 × 1 420, 283 × 1 960.

prominent, widely separated from next spiral; inner spirals similar, closer though interspaces considerably broader than each spiral, a fine spiral thread in each interspace of 2nd-4th spirals from umbilicus. Umbilicus deep, a spiral thread on wall behind tooth on inner lip, diameter 22.6 % of shell diameter. Aperture subrhomboidal. Outer lip thin ; retraction depth of posterior notch 12.5 % of shell diameter, protraction depth unknown (labial projection broken) ; basal notch concave ; peripheral notch small, angulate. Parietal glaze thin. Inner lip rather thick, rim tightly folded towards umbilicus, deeply curved towards umbilicus, sharply flexed at base to form strong angulate denticle, channeled below.

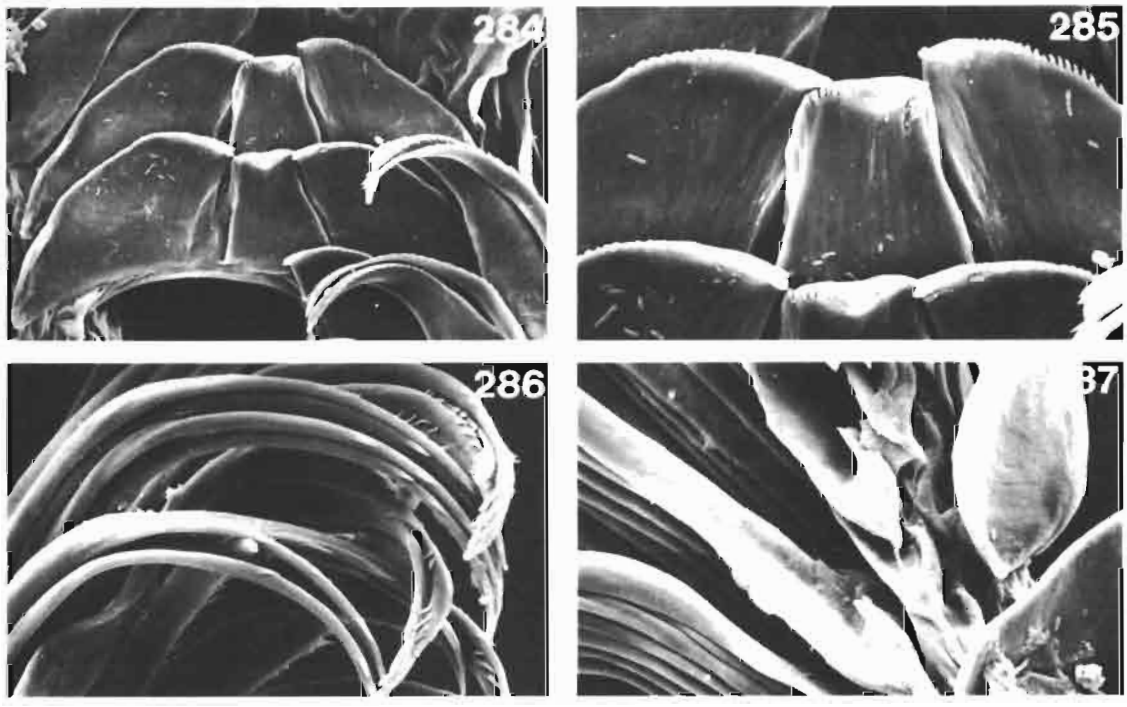
Animal unknown (dried).

TYPE DATA. — Holotype MNHN (2.70 × 2.80 mm, 5.25 TW) : BIOCAL, stn DW 80.

DISTRIBUTION. — Off Ouvéa, Loyalty Islands, 900-980 m (dead).

REMARKS. — *Seguenzia stegastris* most closely resembles *S. eutyches* sp. nov. in shape, and differs primarily in having much stronger spiral threads on the spire, and a considerably stronger tooth on the inner lip.

ETYMOLOGY. — A weaver (Greek).



FIGS 284-287. — Radula, *Basilissa superba*, BIOCAL stn CP 13, 284 × 508, 285 × 1 164, 286 × 1 164, 287 (showing interlocking marginal tooth bases) × 1 164.

DISCUSSION

The seguenziid fauna off New Caledonia and the Loyalty Islands is exceptionally diverse in comparison with the 89 Recent taxa hitherto known from the rest of the world (QUINN, 1983b, Table 1 ; Table 25 herein). Of the 55 species present, 50 (91 %) are unknown from elsewhere, 28 (51 %) are known from single stations, while 12 (22 %) are represented by single specimens, the two latter totals suggesting that additional species remain to be discovered. Judging from personal examination of rich unworked collections from off the Philippine Islands (MNHN, USNM), seguenziid species richness in this area will probably prove to be at least as high.

TABLE 25. — Geographic distributions of Recent Seguenziidae with numbers of nominate taxa. Numbers of species shared with other regions in parenthesis.

New Caledonia and Loyalty Islands — 55 (6)
New Zealand region — 22 (4)
Western Atlantic — 18 (2)
Indonesia, Malaysia, Coral Sea — 12 (2)
Eastern Atlantic — 10 (1)
Northeastern Pacific — 7
Japan — 6
Australia — 5 (2)
Southwestern Indian Ocean and South Africa — 5
Southern Ocean and Antarctica — 3 (1)
Northern Indian Ocean — 2
Central Atlantic — 1
Northern Pacific — 1

The relatively low seguenziid diversities reported from elsewhere in the world — Australia (5 species) and Japan (6) are particularly anomalous — may reflect insufficient sampling with appropriate gear (i.e. fine-meshed epibenthic sledges) at bathyal and abyssal depths. The family is very poorly represented both as taxa and individuals in extensive (AMS) collections of mollusca from depths shallower than 1 000 m off Australia, however, and species richness in this depth range may not in fact be as high. By comparison, 15 species from off New Caledonia and the Loyalty Islands have mean depth occurrences of less than 1 000 m (overall mean 709 m), and four of these taxa are locally abundant.

BIOCAL samples from deep water (> 200 m) off New Caledonia and the Loyalty Islands contain exceptionally rich (largely unworked) mollusc faunas in general, and to judge from the remarkable Pleistocene assemblage at Santo, Vanuatu (LADD, 1976 ; 1982), it seems likely that similarly diverse faunas will be found to occur throughout Melanesia. Since the Melanesian arc is situated at current or former boundaries of the Australian and Pacific lithospheric plates, species richness there is probably due at least partly to progressive accumulation of taxa transported on the plates.

Six taxa recorded from off New Caledonia and the Loyalty Islands occur elsewhere in the western Pacific : *Basilissa superba* (northern Coral Sea and Philippine Sea), *Asthelys nitidula* (Queensland), *Ancistrobasis monodon* (Malaysia), *Quinnia patula* (New Zealand), *Seguenzia chelina* (New Zealand), and *S. matara* (New Zealand). *Basilissa superba* (2 560-3 740 m) probably has a continuous distribution through the Coral Sea to New Caledonia, but is bathymetrically isolated from the Philippine Sea population by island arcs and associated trenches, which probably accounts for the difference in umbilical morphology between the two populations. Known populations of *Asthelys nitidula* (1 320-1 620 m), *Ancistrobasis monodon* (505-680 m), *Seguenzia chelina* (807-1 029 m), and *S. matara* (750-1 029 m) are currently separated by depths considerably greater than the deepest known occurrences of living specimens. *Asthelys nitidula* and *Ancistrobasis monodon* may have essentially continuous distributions via drifting eggs or larvae from populations off the intervening islands, reefs and submarine banks, either through the Melanesian Arc, or between Queensland and New Caledonia. That their distributions may be relicts of formely more continuous distributions, rather than the result of continuous larval dispersal events, is suggested by differences in shell and umbilicus size between the widely separated populations. Known populations of *Quinnia patula* (1 760-2 740 m), *Seguenzia chelina* and *S. matara* are separated by the 1 400 km long Norfolk Ridge, which is virtually continuous between New Caledonia and New Zealand on the 1 500 m contour, with a chain of rises on the 1 000 m contour (" GEBCO ", 1982). Although all

of these species could easily have continuous gene flow along the Norfolk Ridge, northern and southern populations of *S. chelina* and *S. matara* may now be isolated by bathymetry.

Available evidence indicates that New Caledonia and New Zealand had very similar geological histories throughout the Mesozoic and into the Paleocene and Eocene (GRANT-MACKIE, 1985 ; LILLIE & BROTHERS, 1970 ; STEVENS, 1980). Total or partial emergence of the Norfolk Ridge during the Mesozoic and perhaps into the Tertiary could account for some of the observed similarities in the present day terrestrial biotas of New Caledonia and New Zealand (DAWSON, 1963 ; STEVENS, 1980).

Evidence of major Eocene subsidence of the northern part of Norfolk Ridge has been discussed by DANIEL *et al.* (1976) and BITOUN & RECY (1982), who respectively deduced subsidences of about 400 m during the late Miocene or Pliocene and about 1 500 m during the Miocene. If the southern part of the Norfolk Ridge subsided during the same timeframe, this could account for the disjunct distributions of *S. chelina* and *S. matara*.

Potential biogeographical affinities of the New Caledonian Recent marine fauna should be sought in the subtropical mid tertiary faunas of northern New Zealand, such as in the richly fossiliferous lower Miocene beds at Pakaurangi Point, Kaipara Harpara Harbour, and especially Parengarenga Harbour. From a general biogeographical standpoint it is appropriate to indicate that the *differences* between the marine and terrestrial biotas of New Caledonia and New Zealand might reasonably be expected to be almost as great as they are today if there was currently continuous land between them, given the latitudinal range covered.

ACKNOWLEDGEMENTS

I am grateful to P. BOUCHET (MNHN) for the opportunity to study this remarkable fauna. For the loan of type material and reference specimens I thank I. HAYAMI (Geological Institute, University of Tokyo), R. S. HOUBRICK (USNM), A. MATSUKUMA (NSMT), R. G. MOOLENBEEK (ZMA), A. WARÉN (Swedish Museum of Natural History, Stockholm), and K. M. WAY (BMNH). For discussions on south-west Pacific geology I thank H. J. CAMPBELL, R. A. COOPER and G. R. STEVENS (New Zealand Geological Survey, Lower Hutt). Thanks to J. W. DAWSON (Victoria University, Wellington) for information on New Caledonian plant biogeography, K. DOWNIE and D. WAKELIN (NMNZ) respectively for photographic printing and word processing, and to B. BURT and W. St GEORGE (New Zealand Geological Survey, Lower Hutt) for assistance with scanning electron microscopy.

REFERENCES

BARNARD, K. H., 1963. — Contributions to the knowledge of South African marine Mollusca. Part 4. Gastropoda : Prosobranchiata : Rhipidoglossa, Docoglossa. Tectibranchiata. Polyplacophora. Solenogastres. Scaphopoda. *Ann. S. Afr. Mus.*, **47** : 201-360.

BARSKOV, I. S., GOLOVINOVA, M. A. & GORYACHEV, V. N., 1980. — Structure of the nacreous layer of deep-water molluscs of the genus *Seguenzia* (Mollusca, Gastropoda). *Dok. Akad. Nauk. SSSR*, **252** : 1015-1017.

BAYER, F. M., 1971. — New and unusual mollusks collected by R/V *John Elliot Pillsbury* and R/V *Gerda* in the tropical western Atlantic. *Bull. Mar. Sci.*, **21** : 111-236.

BITOUN, G. & RECY, J., 1982. — Origine et évolution du Bassin des Loyauté et de ses bordures après la mise en place de la série ophiolitique de Nouvelle-Calédonie. *Trav. Doc. O.R.S.T.O.M.*, **147** : 505-539.

CERNOHORSKY, W. O., 1978. — Tropical Pacific Marine Shells. Pacific Publications, Sydney. 352 pp.

COAN, E., 1964. — A proposed revision of the rissoacean families Rissoidae, Rissoinidae, and Cingulopsidae (Mollusca : Gastropoda). *Veliger*, **6** : 164-171.

DALL, W. H., 1889. — Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78) and in the Caribbean Sea (1879-80), by the U.S. Coast Survey Steamer "Blake" Lieut. - Commander C. D. Sigsbee, U.S.N., and Commander J. R. Bartlett, U.S.N., commanding. 29. Report on the Mollusca. Part 2, Gastropoda and Scaphopoda. *Bull. Mus. Comp. Zool.*, **18** : 1-492.

DANIEL, J., DUGAS, F., DUPONT, J., JOUANNIC, C., LAUNAY, J., MONZIER, M. & RECY, J., 1976. — La zone charnière Nouvelle Calédonie-Ride de Norfolk

(S. W. Pacifique) — Résultats de dragages et interprétation. *Cah. O.R.S.T.O.M., Geol.*, **8** : 95-105.

DAUTZENBERG, P. & FISCHER, H., 1897. — Campagnes scientifiques de S.A.S. le Prince Albert 1er de Monaco. Dragages effectués par *l'Hirondelle* et par la *Princesse-Alice. Mém. Soc. Zool. France*, **10** : 139-234.

DAWSON, J. W., 1963. — New Caledonia and New Zealand — A botanical comparison. *Tuatara*, **11** : 178-193.

" GEBCO ", 1982. — Chart 5.10 (General Bathymetric Chart of the Oceans). Canadian Hydrographic Service, Ottawa.

GORYACHEV, V. N., 1987. — The volume and the position of the family Seguenziidae (Mollusca, Gastropoda, Seguenziidae) in the gastropod class. *In* : Y. I. Starobogatov, A. N. Golilov, and I. M. Likharev (eds), Molluscs, results and perspectives of investigation. Eighth meeting on the investigation of molluscs, USSR Academy of Sciences Zoological Institute : 21-23.

GRANT-MACKIE, J. A., 1985. — New Zealand - New Caledonian Permian - Jurassic faunas, biogeography and terranes. *N.Z. Geol. Surv.*, **9** : 50-52.

IREDALE, T., 1917. — On some new species of marine Mollusca from Christmas Island, Indian Ocean. *Proc. Malac. Soc. Lond.*, **12** : 331-334.

JEFFREYS, J. G., 1876. — Preliminary report of the biological results of a cruise in H. M. S. *Valorous* to Davis Strait in 1875. *Proc. Roy. Soc.*, **25** : 177-230.

LADD, H. S., 1976. — New Pleistocene Neogastropoda from the New Hebrides. *Nautilus*, **90** : 127-138.

LADD, H. S., 1982. — Cenozoic fossil mollusks from Western Pacific islands ; gastropods (Eulimidae and Volutidae through Terebridae). *U. S. Geol. Surv. Prof. Pap.*, **1171** : 1-100.

LILLIE, A. R. & BROTHERS, R. N., 1970. — The geology of New Caledonia. *New Zealand J. Geol. Geophys.*, **13** : 145-183.

MARSHALL, B. A., 1979. — The Trochidae and Turbinidae of the Kermadec Ridge (Mollusca : Gastropoda). *New Zealand. J. Zool.*, **6** : 521-552.

MARSHALL, B. A., 1983. — Recent and Tertiary Seguenziidae (Mollusca : Gastropoda) from the New Zealand region. *New Zealand. J. Zool.*, **10** : 235-260.

MARSHALL, B. A., 1988. — New Seguenziidae (Mollusca : Gastropoda) from the Tasman, South Pacific and southern Antilles Basins. *New Zealand. J. Zool.*, **15** : 235-247.

OKUTANI, T., 1964. — Report on the archibenthal and abyssal gastropod Mollusca mainly collected from Sagami Bay and adjacent waters by the R. V. *Soyo-Maru* during the years 1955-1963. *J. Fac. Sci. Univ. Tokyo*, (2), **15** : 371-447.

OKUTANI, T., 1982. — Rediscoveries of an abyssal trochid, *Basilissa superba* Watson from the south of Japan. *Venus*, **40** : 237-239.

PONDER W. F., 1967. — The classification of the Rissoidae and Orbitestellidae with descriptions of some new taxa. *Trans. Roy. Soc. N. Z., Zool.*, **9** : 193-224.

PONDER W. F., 1985. — A review of the genera of the Rissoidae (Mollusca : Mesogastropoda : Rissoacea). *Rec. Aust. Mus.*, Suppl. 4, 221 pp.

QUINN, J. F., 1983a. — *Carenzia*, a new genus of Seguenziacea (Gastropoda : Prosobranchia) with the description of a new species. *Proc. Biol. Soc. Wash.*, **96** : 355-364.

QUINN, J. F., 1983b. — A revision of the Seguenziacea Verrill, 1884 (Gastropoda : Prosobranchia). 1. Summary and evaluation of the superfamily. *Proc. Biol. Soc. Wash.*, **96** : 725-757.

QUINN, J. F., 1987. — A revision of the Seguenziacea Verrill, 1884 (Gastropoda : Prosobranchia). 2. The new genera *Hadroconus, Rotellenzia*, and *Asthelys*. *Nautilus*, **101** : 59-68.

SALVINI-PLAWEN, L. & HASZPRUNAR, G., 1987. — The Vetigastropoda and the systematics of streptoneurous Gastropoda (Mollusca). *J. Zool. Lond.*, **211** : 747-770.

SCHEPMAN, M., 1908. — The Prosobranchia of the Siboga Expedition. Part 1 : Rhipidoglossa and Docoglossa. *Siboga-Expeditie*, 49a : 1-107.

SCHEPMAN, M., 1909. — The Prosobranchia of the Siboga Expedition. Part 2 : Taenioglossa and Ptenoglossa. *Siboga-Expeditie*, 49b : 109-231.

STEVENS, G. R., 1980. — New Zealand Adrift. Read, Wellington. 442 pp.

THIELE, J., 1925. — Gastropoda der Deutschen Tiefsee-Expedition 2. *Deutsche Tiefsee-Expedition, 1898-1899*, **17** (2) : 35-382.

THIELE, J., 1929-1935. — Handbuch der systematischen weichtierkunde. 2 vols. Fischer, Jena. 1134 pp.

VERRILL, A. E., 1884. — Second catalogue of Mollusca recently added to the fauna of the New England coast and the adjacent parts of the Atlantic, consisting mostly of deep-sea species, with notes on others previously recorded. *Trans. Connect. Acad. Sci.*, **6** : 139-294.

WATSON, R. B., 1879. — Mollusca of H.M.S. 'Challenger ' Expedition. 3. Trochidae, viz. the genera *Seguenzia, Basilissa, Gaza* and *Bembix*. *J. Linn. Soc. Lond. Zool.*, **14** : 586-605.

WATSON, R. B., 1886. — Report on the Scaphopoda and Gasteropoda collected by H.M.S. *Challenger* during the years 1873-76. *Repts Sci. Res. Challenger Exp., Zool.*, **42** : 1-756.

WENZ, W., 1938-44. — Gastropoda. Allgemeine Teil und Prosobranchia. *In* : O. Schindewolf (ed.), *Handbuch der Palaozoologie*, **6** (1). 2 vols. 1639 pp.

4

Mollusca Gastropoda : Systematic position and revision of *Haloceras* Dall, 1889 (Caenogastropoda, Haloceratidae fam. nov.)

Anders WARÉN

Naturhistoriska Riksmuseet
Box 50007
10405 Stockholm
Sweden

&

Philippe BOUCHET

Muséum national d'Histoire naturelle
Laboratoire de Biologie des Invertébrés marins et Malacologie
55, rue Buffon
75005 Paris
France

ABSTRACT

Haloceras, until now included in the Trichotropidae, is made the type of a new family, Haloceratidae, considered related to but more primitive than the Tonnoidea and the Echinospirida, on the basis of new anatomical information. The main difference from existing tonnoidean families is a more primitive nervous system and the absence of complex salivary glands. The new family shows similarities to the Trichotropidae, a family which should be included in the Echinospirida. *Micropiliscus* Dall, 1927, until now included in the Trochidae, is synonymized with *Haloceras*, and the new genus *Zygoceras* is introduced. Seventeen named species (ten new) and three left unnamed are here included in the family. All species live on the outer part of the continental shelf and the slope, down to about 3500 m depth. Species of Haloceratidae are known from the mid and low latitudes of the Atlantic, Indian, East and West Pacific oceans. All but one species have planktotrophic larval development and one species is known from both the Atlantic and the Indian Oceans.

RESUME

Position systématique et révision du genre *Haloceras* Dall, 1889 (Caenogastropoda, Haloceratidae fam. nov.).

Le genre *Haloceras* était jusqu'ici classé dans les Trichotropidae. Sur la base de nouveaux caractères anatomiques,une famille nouvelle Haloceratidae est créée. Elle est considérée proche de, mais plus primitive que les Tonnoidea et les Echinospirida. Les différences principales qui séparent les Haloceratidae de la lignée tonnoïde sont un système nerveux plus primitif et l'absence de glandes salivaires complexes. Cette nouvelle famille présente des ressemblances avec les Trichotropidae, qui doivent d'ailleurs être classés dans les Echinospirida. Le genre *Micropiliscus* Dall, 1927, jusqu'ici classé dans les Trochidae, est placé en synonymie d'*Haloceras*, et le nouveau genre *Zygoceras* est décrit. La famille comprend dix-sept espèces nommées (dont 10 nouvelles) et trois laissées sans nom; toutes vivent sur les parties profondes du plateau continental et sur la pente, jusqu'à 3500 m environ, aux latitudes basses et moyennes dans les océans Atlantique, Indien, Ouest et Est Pacifique. Toutes les espèces, sauf une, ont un développement larvaire planctotrophe et une espèce est connue à la fois de l'océan Atlantique et de l'océan Indien.

WARÉN, A. & BOUCHET, P., 1991. — Mollusca Gastropoda : Systematic position and revision of *Haloceras*, Dall 1889 (Caenogastropoda, Haloceratidae fam. nov.). *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 111-161. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

HISTORICAL BACKGROUND

Based on shell and opercular features, DALL (1889) introduced the name *Haloceras* for the NW Atlantic deep-sea gastropod *Cithna cingulata* Verrill, 1884. He considered *Haloceras* a subgenus of *Separatista* Gray, 1847 (then placed in the Adeorbidae, now, in our view correctly, placed in the Trichotropidae). THIELE (1929: 243) and WENZ (1940: 890) classified *Haloceras* as a subgenus of *Torellia* Jeffreys, 1867 in the family Trichotropidae (=Capulidae).

DALL (1927) described *Micropiliscus*, as a subgenus of the trochid genus *Solariella* Wood, 1842, differing from the typical species by having a brownish larval shell. *Micropiliscus* has since been retained in the Archaeogastropoda as a subgenus of *Solariella* by the few authors that have mentioned or listed it (THIELE, 1929: 48; WENZ, 1938: 275; QUINN, 1979: 43).

During the last 10 years we have been aware that there exist several species similar to *Haloceras*, and we have been accumulating material of them and searching museum collections we have visited. The present paper is based on all the 103 specimens and shells that, to our knowledge, have been taken by oceanographic expeditions worldwide in 120 years. The absence of fossil record should probably be interpreted as a reflection of the rarity of the family. It is remarkable to note that, whereas the first haloceratid specimen was collected in 1870 (although described in 1883), 64 % of the specimens now available have been taken in just the last 20 years. No haloceratid was taken during the "*Challenger*", "*Valdivia*" or "*Siboga*" expeditions, and half of the species had not been collected 10 years ago. Two regions, the South-West Pacific with 8 species and the North Atlantic with 6 species, now contain together 82% of the species of the family, but this simply represents a collecting effort artefact. We believe that future exploration of tropical deep waters will greatly increase the number of species in the family.

THE GENUS *CITHNA* A. ADAMS, 1863

The genus *Cithna* A. Adams, 1863 has frequently been used for strange, globular or discoid gastropods, among them *Haloceras*. Presently (THIELE, 1929: 64; WENZ, 1938: 336) *Cithna* is classified among the archaeogastropods. We figure (Figs 44-45) a syntype from USNM, to show the planktotrophic larval shell which directly excludes *Cithna* from the Archaeogastropoda. The soft parts are not known, but a position in the vicinity of *Scrupus* Finlay, 1924 (position in Rissooidea presently unknown, see PONDER, 1985), seems very likely, judging from shell morphology.

Abbreviations used in text:

sh(s) — (empty) shell(s);
spm(s) — (live taken) specimen(s);
AMS — The Australian Museum, Department of Invertebrate Zoology, Sydney;
BMNH — British Museum of Natural History, Mollusca Section, London;
LACM — Los Angeles County Museum of Natural History, Los Angeles;
MNHN — Muséum national d'Histoire naturelle, Paris;
MOM — Musée océanographique, Monaco;
NMNZ — National Museum of New Zealand, Wellington;
NSMT — National Science Museum, Tokyo;
RMNH — Rijksmuseum van Natuurlijke Historie, Leiden;
USFC — United States Fisheries Commission;
USNM — U.S. National Museum of Natural History, Division of Mollusks, Washington D.C.;
ZMC — Zoologisk Museum, Köbenhavn.

MATERIAL AND METHODS

Most species are known from empty shells, sometimes with partly decayed and dried soft parts. These were used for radular preparation after rehydration. The alcohol preserved specimens turned out to be a problem since the soft parts could not be extracted without damaging the shells, which was too great a drawback when often only one or two shells were known of the species. Therefore they were dried and the soft parts loosened from the columella by gently pushing them backwards, into the shell. After that they were rehydrated in buffered formalin and extracted. They could then be used for examination of external morphology and some rough dissections, including preparation of the radula.

The anatomical descriptions are thus mainly based on dried and rehydrated specimens of:

Haloceras carinata (RMNH)

Haloceras cingulata (USNM 52077)

Haloceras galerita (holotype). A partly damaged head-foot was serially sectioned in the same way as *Z. tropidophora*. It contained none of the organs behind the cephalopedal haemocoel.

Haloceras japonica (LACM 67-167.2)

Haloceras tricarinata (" *Discovery* " stn 10141)

Zygoceras tropidophora (paratype). The specimen was decalcified, serially sectioned at 5 µm and stained with Ehrlich's haematoxylin - eosin. One specimen was dried to allow safe removal of the body from the shell after rehydration and used for radular preparation.

ANATOMY

EXTERNAL MORPHOLOGY

Figs 1-2

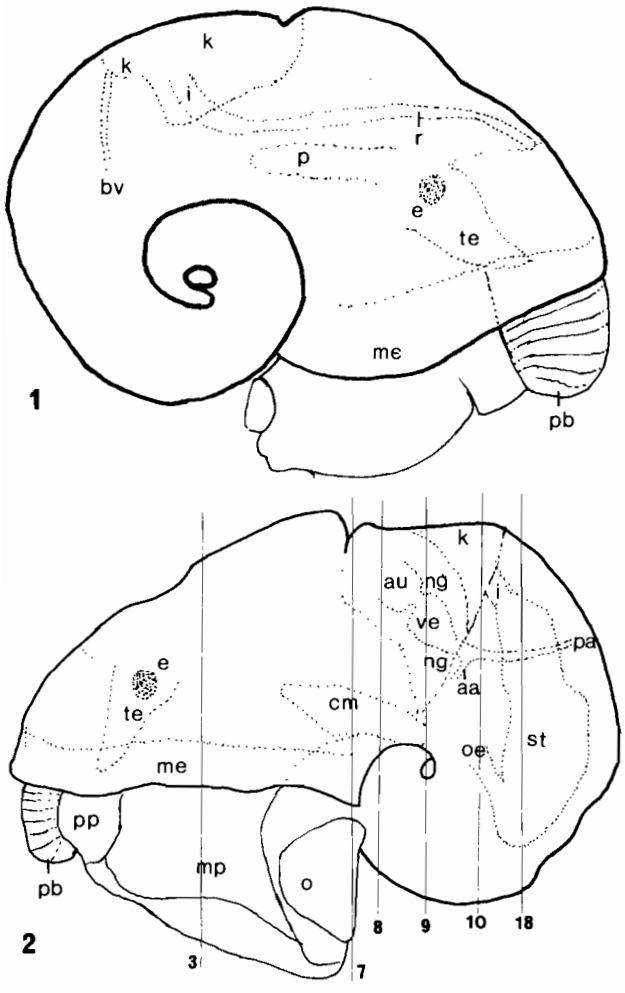
The general colour of the soft parts in alcohol is whitish-yellowish transparent, with a more opaque osphradium and occasionally (*Z. tropidophora*) a brownish-violet intestine and stomach.

The body consists of about 1.7 whorls in *Z. tropidophora*, of which the voluminous head-foot and pallial complex occupy 0.25-0.30 whorls. The rather shallow pallial cavity reaches back about 0.25 whorls and its most posterior part forms a blunt wedge-shaped space between the pericardium and cephalo-pedal haemocoel.

The columellar muscle (Fig. 2) is solid and broad but very short.

The head-foot is large, occupies about 0.25 whorls (slightly more in the tall-spired species) and the pallial skirt covers most of this when the soft parts are retracted. Many of the internal organs can be seen by transparency (Figs 1-2). In *H. tricarinata* the posterior part of the foot is quite suckershaped, in other species less so but to some extent it is divided in a more solid, rounded, posterior part and an anterior, thinner, strongly folded, and probably very motile part. The latter has been strongly contorted in all specimens but its anterior dorsal side carries a large and fleshy propodium, well aligned with the anterior edge of the foot. The lower part of the side of the foot is distinctly demarcated from the upper parts, by a more or less distinct horizontal furrow (Fig. 3) and by having a rougher surface. *H. tricarinata* and *Z. tropidophora* have a large posterior pedal gland opening in the posterior part of the foot. This could not be discerned in the other species, but neither could its absence be ascertained. On the rear, dorsal part of the foot, there is a thick but fragile, yellowish operculum. In species with a depressed or disc-shape shell the operculum (Figs 28, 31-34) is fan-shaped with the initial coils situated apically, but they are usually worn off in large specimens, so only the latest formed section of the fan remains. In more tall-spired species the operculum is more ovate and spirally coiled. If the nucleus is left, there is a distinctly set off part, which is thinner, smoother and multispiral, and which corresponds to the larval operculum.

The head is about as broad as the foot and equipped with tentacles which in one specimen of *Zygoceras tropidophora* are tapering, long and



FIGS. 1-2. — *Zygoceras tropidophora*, external view of soft parts. **1.** right side. — **2.** Left side. Fine vertical lines indicate position of cross sections with corresponding Fig. number.

aa — anterior aorta; *au* — auricle; *bv* — blood vessel; *cm* — columellar muscle; *e* — eye; *i* — intestine; *k* — renal organ; *me* — mantle edge; *mp* — mesopodium; *ng* — renal gland; *o* — operculum; *oe* — oesophagus; *p* — penis; *pa* — posterior aorta; *pb* — proboscis; *pp* — propodium; *r* — rectum; *st* — stomach; *te* — tentacle; *ve* — ventricle.

slender; in the other species, strongly wrinkled, short and conical, and evidently strongly contracted. All species have large eyes situated dorso-laterally on, and of a diameter corresponding to about 2/5 of, the tentacle base. The tentacles are connected by a thin skin-fold, covering the proboscis. The dorsal body-wall is quite thick and muscular.

Presumably no species have a snout. This could, however, not be verified in some specimens, because the proboscis has been more or less everted in all specimens examined and in some specimens which were badly preserved and dried it could not be seen if there was a tip of a proboscis or a snout.

The pleurembolic proboscis, often partly everted, is quite solid and muscular, in *Z. tropidophora* 5 mm long and 2.5 mm diameter, but can unquestionably be extended much more since the wall of the proboscis sheath is about 1 mm thick. The buccal mass is fairly small, 0.8 mm long and 0.6 mm diameter. There is a pair of solid, slender jaws (Figs 4, *j*; 29, 30).

All specimens examined had a simple, flattened, finger-shaped penis attached slightly behind and below the right tentacle (Fig. 1). In *H. japonica, H. galerita* and *H. cingulata,* the penis also had an anteriorly directed simple fold-like process. Such a flap was missing in *Z. tropidophora* and *H. carinata.* It was not possible to distinguish an external sperm groove, but it can be seen in sections of the two sectioned species.

Some species (*H. cingulata, Z. tropidophora*) have an external skinfold on the inner and distal part of the pallial oviduct, but its morphology could not be studied in detail.

One specimen of *Haloceras carinata* had a large egg-mass in the pallial cavity (Figs 64-65), measuring 0.9 x 0.9 x 1.6 mm and consisting of about 200 developing, shell-less embryos of a diameter of about 0.16 mm. Due to the dried state of the specimen it was not even possible to verify the presence of an oviduct, but a penis was present.

One specimen, *Haloceras japonica*, proved to be ovoviviparous and had 9 large embryos (Fig. 64) in the partly ruptured (from drying?) oviduct. These embryos were lying in the duct behind the pallial cavity, along almost one whorl of the visceral mass. This specimen also had a penis of normal appearance and position for the genus.

The pallial cavity is wide and spacious (Fig. 3). The anterior edge of the pallial skirt has a simple, thick and muscular, well defined zone with no papillae or appendices. At the left corner this zone is broader and thicker, and may function as a siphon.

The gill occupies a narrow zone, from the thickened edge of the pallial skirt backwards to the bottom of the cavity and consists of about 25 flattened, fingershaped leaflets, in *Z. tropido-*

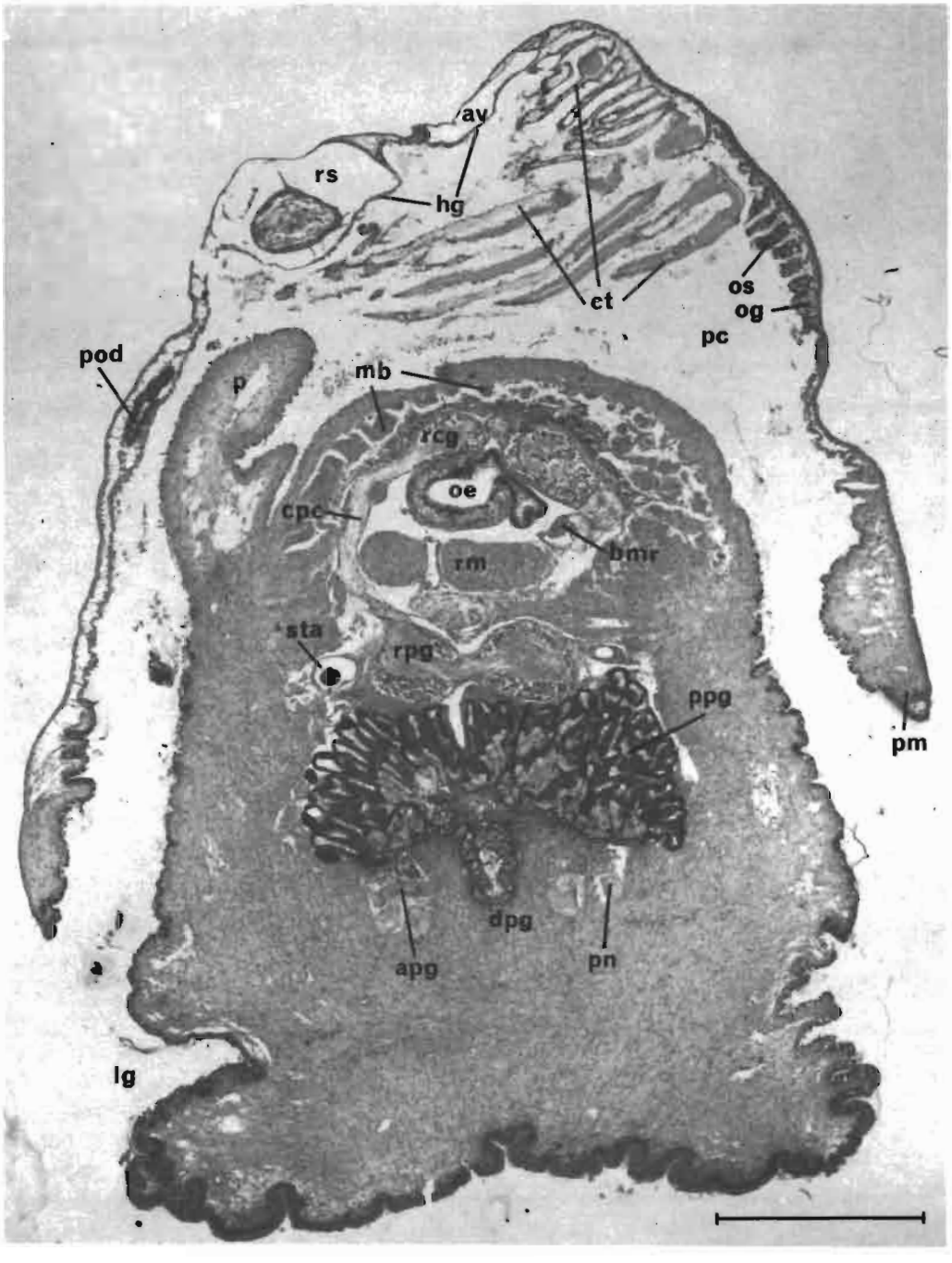


FIG. 3. — *Zygoceras tropidophora*, cross section of body behind tentacles.
apg — accessory pedal ganglion; *av* — afferent branchial vessel (from rectal sinus); *bmr* — buccal mass retractor; *cpc* — cerebro-pedal connective; *ct* — ctenidium; *dpg* — duct of posterior pedal gland; *hg* hypobranchial gland; *lg* — lateral groove; *mb* — muscle bundles from proboscis sheath; *oe* — oesophagus; *og* — osphradial ganglion; *os* — osphradium; *p* — penis; *pm* — pallial margin; *pn* — (outer) pedal nerve; *pod* — pallial oviduct; *ppg* — posterior pedal gland; *rcg* — right cerebral ganglion; *rm* — retractor muscle of proboscis; *rpg* — right pedal ganglion; *rs* — rectal sinus; *sta* — statocyst. Scale line 1 mm.

phora 1.1 mm long and of a diameter of about 0.1 mm. In *H. galerita* they were 45 in number, 0.5 mm long, 0.07 mm broad and 0.03 mm thick. In the posterior part of the cavity the gill is fairly central, anteriorly it bends slightly over to the left.

The osphradium is partly bipectinate and it is situated along the anterior 3/5 of the gill. It consists of 15-30 leaflets (in *Zygoceras tropidophora* 0.5 mm long and 0.12 mm broad) facing the gill and half that number of smaller leaflets along facing to the left. In *H. tricarinata* only the outer half was bipectinate, in *Z. topidophora* the inner half bipectinate and in *H. cingulata* it was probably monopectinate.

The rectum runs almost centrally in the pallial cavity and ends close to the edge of the pallial skirt. Its most distal part is free from the pallial roof.

The specimen of *H. carinata* had white faecal pellets in rectum and a foraminiferan in the stomach. A specimen of *Z. tropidophora* had a few small faecal pellets in rectum, consisting of unidentified organic material and free from mineral particles.

The hypobranchial gland is very thin and inconspicuous. It covers the inner side of the rectal sinus and a part of the pallial skirt in the central part of the pallial cavity, but can only be discerned in histological sections.

INTERNAL ANATOMY
Figs 3-27

Head-foot

The tentacles, the sides and the back of the head-foot are covered by a thin epithelium, on the sides of the foot with numerous large mucus producing cells mixed with the epithelial cells. Mucous cells are common also on the penis. The hypobranchial (Figs 3, 5, *hg*) gland consists of a single layer of secreting cells, which covers the left side of the rectal sinus and the pallial roof leftwards to the gill, from just in front of the rectum back to the kidney.

The sole of the foot has a dense layer, one cell thick, of mucous cells directly under the epithelium. The posterior pedal gland (Fig. 3, *ppg*) is large and voluminous, anteriorly bilobed and abutting the pedal ganglia. Less than half-way to its opening the two lobes unite and form a common duct (Fig. 3, *dpg*) which opens posteriorly and centrally via a wide pore. The anterior pedal gland (Fig. 6, *ang*) fills a large cavity between the pro- and mesopodium, invades them both, and extends back to the pedal ganglia where it abuts the posterior pedal gland. It has a wide opening between the pro- and mesopodium.

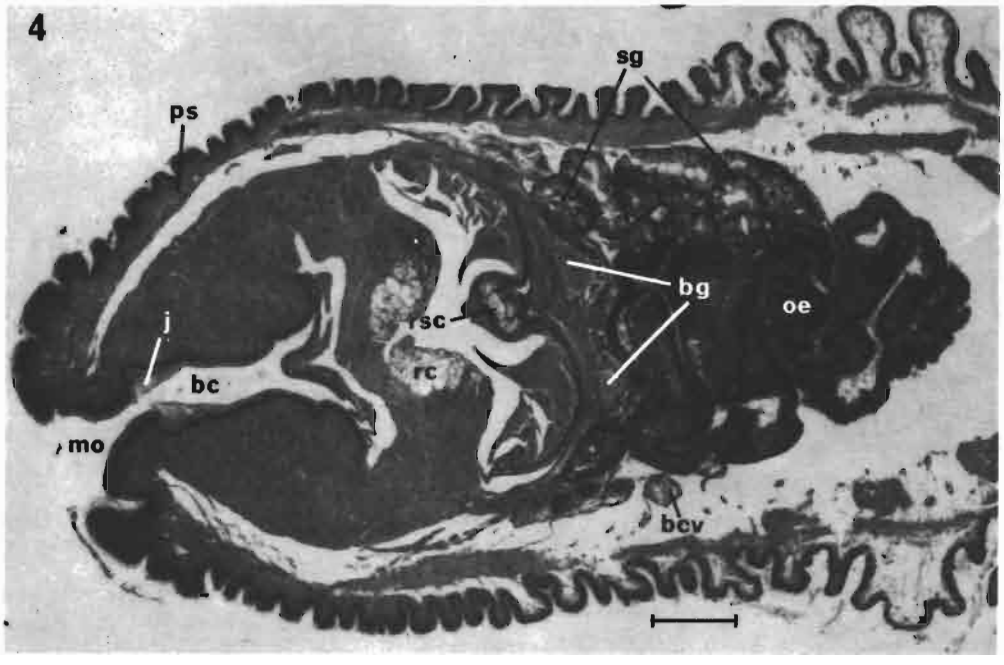
Alimentary canal
Figs 4, 11-22

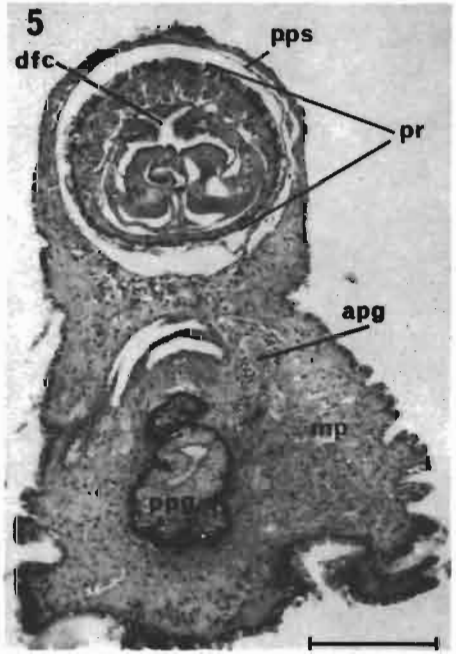
The alimentary system consists of a pleurembolic proboscis, a buccal mass with taenioglossate radula, an anterior oesophagus with lateral pouches, a long midoesophagus, a comparatively short posterior oesophagus, a simple stomach, a short intestine and a long rectum.

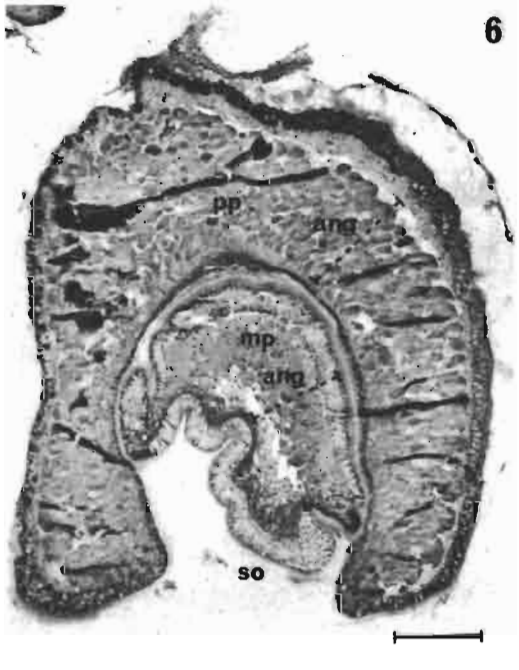
The anterior part of the proboscis sheath is solid and muscular and can be retracted so the true mouth is situated immediately behind the tentacles and the posterior end of the muscular section abuts the cerebral ganglia. It is manipulated by two major ventral muscle bundles (Fig. 3, *rm*) which connect it to the columellar muscle, and numerous smaller muscles (Fig. 3, *mb*), which in *Z. tropidophora* end in the walls of the cephalopedal haemocoel. In *H. galerita* they fuse with the two ventral muscle bundles. The rear part of the sheath is extremely thin-walled (Fig. 5, *pps*) and when the proboscis is retracted, it leads from the rearmost, thick-walled section forwards to the level of the tentacles.

The mouth is situated terminally at the tip of the proboscis (Fig. 4, *mo*). The sides of the oral cavity are equipped with a pair of prismatic, semicircular jaws (Figs 4, *j*; 29-30) and the buccal cavity is largely lined with cuticle. The salivary ducts open shortly behind the jaws dorsolaterally via a small pore. Their ducts meander backwards; in *H. galerita* all the way through the nerve-ring, in *Z. tropidophora* they stop halfway. The salivary glands each consist of a single thick-walled coiled tube (Fig. 4, *sg*).

In *Z. tropidophora* the radular sac exits poste-

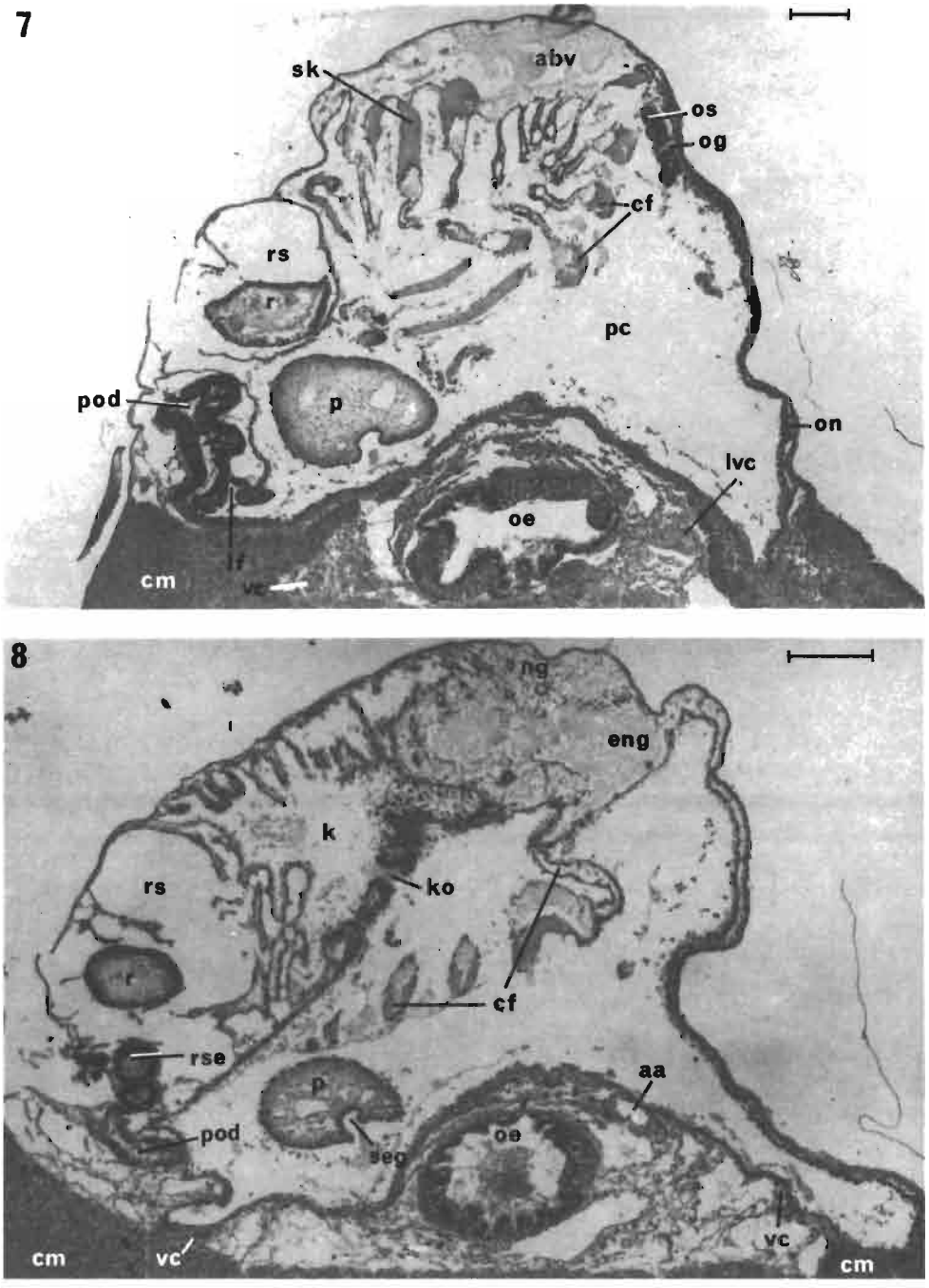






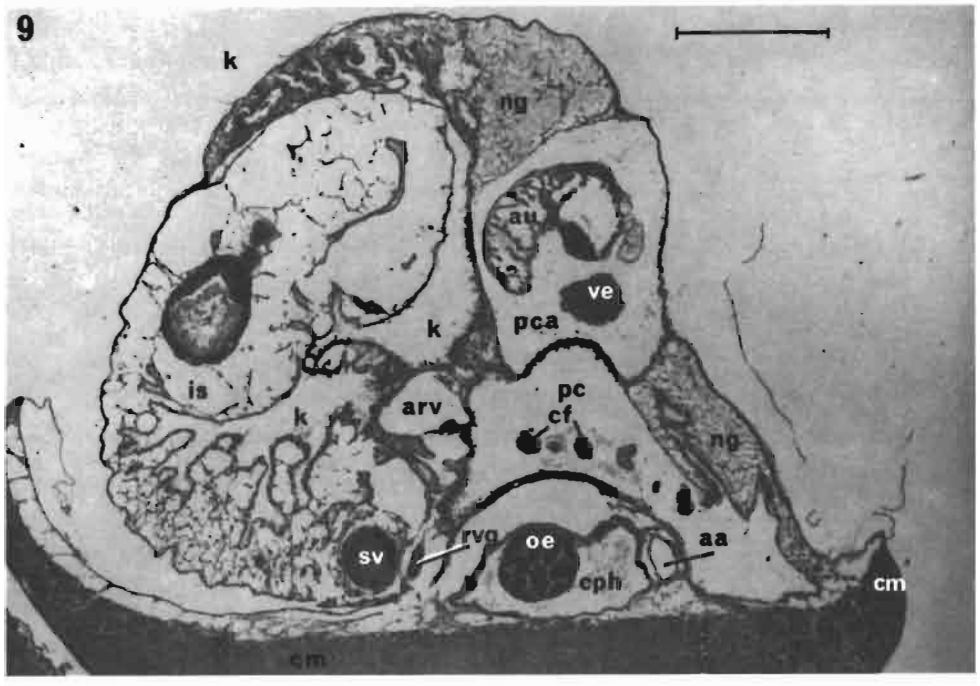
FIGS. 4-6. — **4.** *Zygoceras tropidophora*, horizontal section through anterior part of proboscis. — **5.** *H. galerita*, cross-section through head-foot between tentacles and penis. — **6.** *H. tropidophora*, horizontal section through pro- and mesopodium.

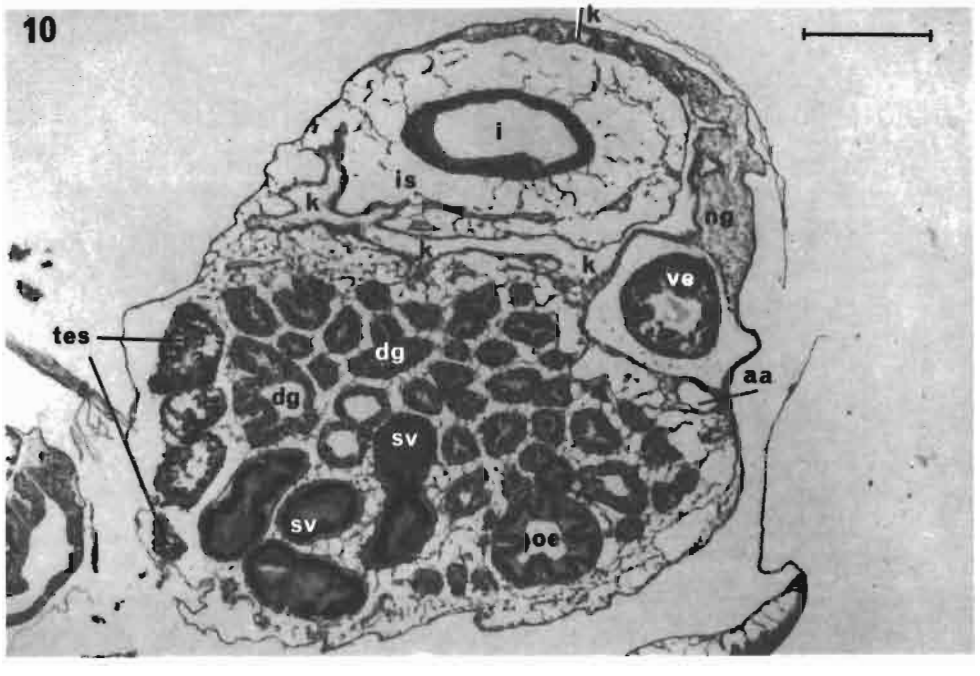
ang — anterior pedal gland; *apg* — acessory pedal ganglion; *bc* — buccal cavity; *bcv* — buccal connective; *bg* — buccal ganglia; *dfc* — dorsal food channel; *j* — jaw; *mo* — mouth; *mp* — mesopodium; *oe* — oesophagus; *pp* — propodium; *ppg* — posterior pedal gland; *pps* — posterior part of proboscis sheath; *pr* — proboscis; *ps* — proboscis sheath; *rc* — radular cartilage; *rsc* — radular sac; *sg* — salivary glands; *so* — sole of mesopodium. Scale line 0.25 mm.



FIGS. 7-10. — *Haloceras tropidophora*, cross section of pallial cavity and visceral mass. Position of sections indicated in Fig. 2. — **7.** Middle part of pallial cavity. — **8.** Anterior part of kidney. — **9.** Most posterior part of pallial cavity. — **10.** Visceral hump, anterior to stomach.

aa — anterior aorta; *abv* — afferent branchial vein; *arv* — afferent renal vein; *au* — auricle; *cf* — ctenidial filament; *cm* columellar muscle; *cph* — cephalo-pedal haemocoel; *dg* — digestive gland; *eng* — efferent cavity, collecting blood from renal gland and ctenidium; *i* — intestine; *is* — intestinal sinus; *k* — renal organ; *ko* — renal opening; *lvc*





— left visceral connective; *lf* — lateral groove on free lobe of pallial oviduct; *ng* — renal gland; *oe* — oesophagus; *og* — osphradial ganglion; *on* — osphradial nerve; *os* — osphradium; *pc* — pallial cavity; *pca* — pericardium; *p* — penis; *pod* — pallial oviduct; *r* — rectum; *rs* — rectal sinus; *rse* — receptaculum seminis; *rvg* — right visceral ganglion; *seg* — seminal groove; *sk* — skeletal rod; *sv* — seminal vesicle; *tes* — testicle; *vc* — visceral connective; *ve* — ventricle. Scale lines 7-8, 0.25 mm, 9-10, 0.5 mm.

riorly and makes a sharp turn ventrally, then dorsally, so it ends ventrally to the anterior oesophagus, immediately behind the buccal mass. In *H. galerita* it exits posteriorly and parallels the anterior oesophagus (Figs 16-17, *rsc*) for a short distance before it ends just in front of the buccal ganglia, which are situated unusually far back in this species. The radular cartilages are well developed.

The oesophagus starts with a dorsal food channel (Fig. 16, *dfc*), which as soon as the ventral floor has been formed, widens to form a pair of shallow and thin lateral pouches over the posterior part of the buccal mass. These disappear behind the buccal mass. In *H. galerita* the dorsal food channel continues dorsally, ciliated and glandular, while the ventral floor of the oesophagus is lined by a cuticle (Fig. 17). The dorsal folds become broader and are strongly ciliated and the oesophagus gets a roughly I-shaped cross section, all the way back to the nerve ring, where the oesophagus widens and the walls become more uniform all around. Here the oesophagus is also quite compressed and folded so it was not possible to discern the torsion. In *Z. tropidophora* the ventral part of the anterior oesophagus is not lined by a cuticle, but the whole circumference, except the dorsal food channel is lined by mucus producing epithelium (Fig. 11). This thick-walled, ventral part then splits in two parts connected by a thin wall. At the same time the dorsal food channel has rotated to become ventral (Fig. 13, *dfc*) giving rise to an I-shaped portion (Fig. 13).

The posterior oesophagus (Fig. 14) begins at the end of the cephalopedal haemocoel and has folded walls. It opens ventrally and slightly in front of the posterior end of the stomach, jointly with two openings from the digestive gland. It could not be ascertained if these openings correspond to an anterior and posterior lobe of the digestive gland.

The stomach (Fig. 2, *st*; 18) is situated close to the left side of the body, just behind the pericardium. It is simple and sausage-shaped, tapering towards the anterior end where it goes over into the intestine via the style-sac without any abrupt change. It is almost three times as long as broad. There seems to be no crystalline style.

To the right of and posteriorly to the oesophageal opening there is a prominent gastric shield and a large cuticularized area where food is accumulated. In the ventral, posterior part of the stomach run two low and broad typhlosoles which continue some distance into the style sac (Fig. 20, *t1, t2*).

The intestine leaves the anteriorly and dorsally situated posterior part of the stomach, turns to the right under the left-most and posterior extension of the kidney (Fig. 10, *i*), in a very spacious haemocoel (Fig. 10, *is*), then it enters the pallial skirt and turns to the left, so the anus is more centrally situated than the proximal parts of the rectum (Fig. 7). There was no great histological difference between the proximal and more distal parts (rectum) (Figs 21-22).

Vascular system

Figs 7-10

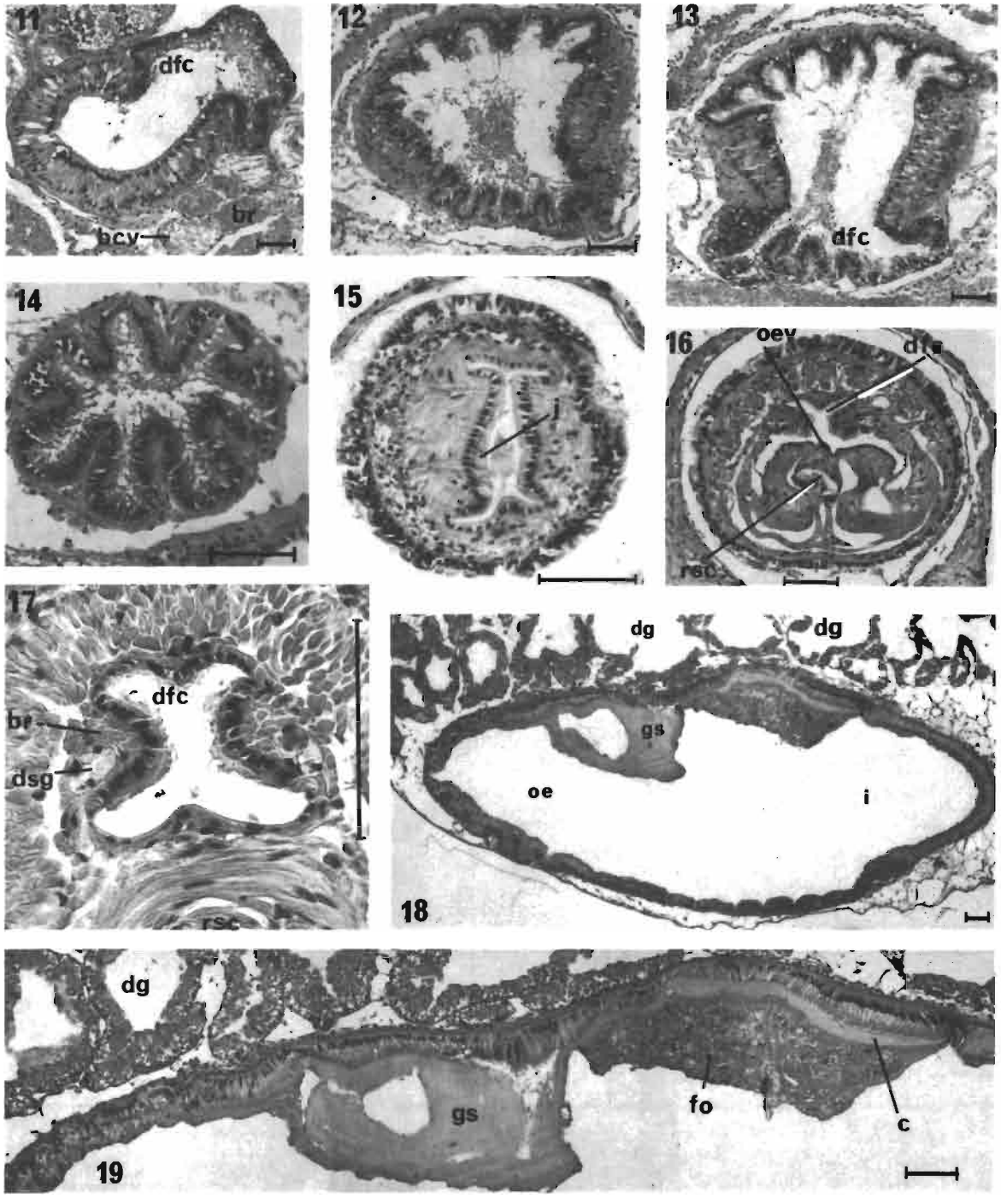
All organs are lying in a system of very spacious venous sinuses which are filled by a sponge-like system of interconnected cells, giving the tissues a very porous appearance.

The pericardium (Fig. 9, *pca*) is situated with its anterior end above the posterior part of the pallial cavity, with the auricle in front of and above the ventricle. In cross-section it is roughly triangular with one corner drawn out towards the center of the whorl. The renopericardial duct leaves this corner at the anterior part of the ventricle. There is no gonopericardial duct.

We assume that blood from the cephalopedal haemocoel collects in a system of large anastomosing venous cavities (Figs 9, 23, *arv*) which communicate with the visceral and intestinal haemocoels and the kidney. There is also a somewhat separate dorsal vein (Fig. 23, *kv*) which starts from spaces in the intestinal haemocoel and the venous cavities and connects with the kidney folds and the renal gland (Fig. 23, *ng*).

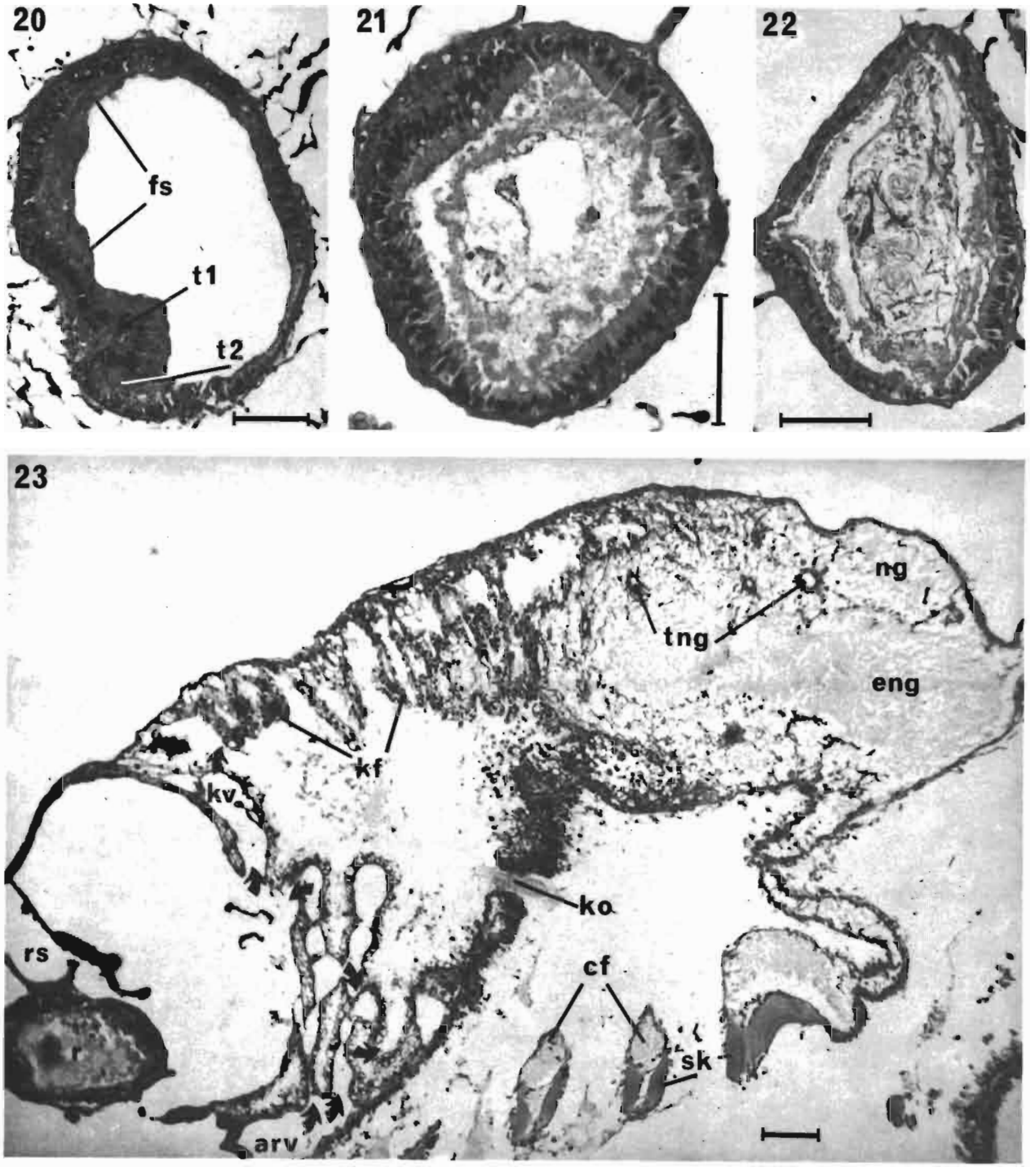
The efferent branchial vein and the efferent renal gland vein (Fig 23, *eng*) join anteriorly to the pericardium and carry the blood to the auricle.

The aorta leaves the ventricle posteriorly and splits directly into one anterior and one posterior branch. The posterior aorta is very thin-walled and continues superficially backwards, sending off smaller vessels which supply the visceral hump with blood. It was followed backwards past the stomach. The anterior branch of the aorta (Figs 8-10, *aa*) turns forwards, passes



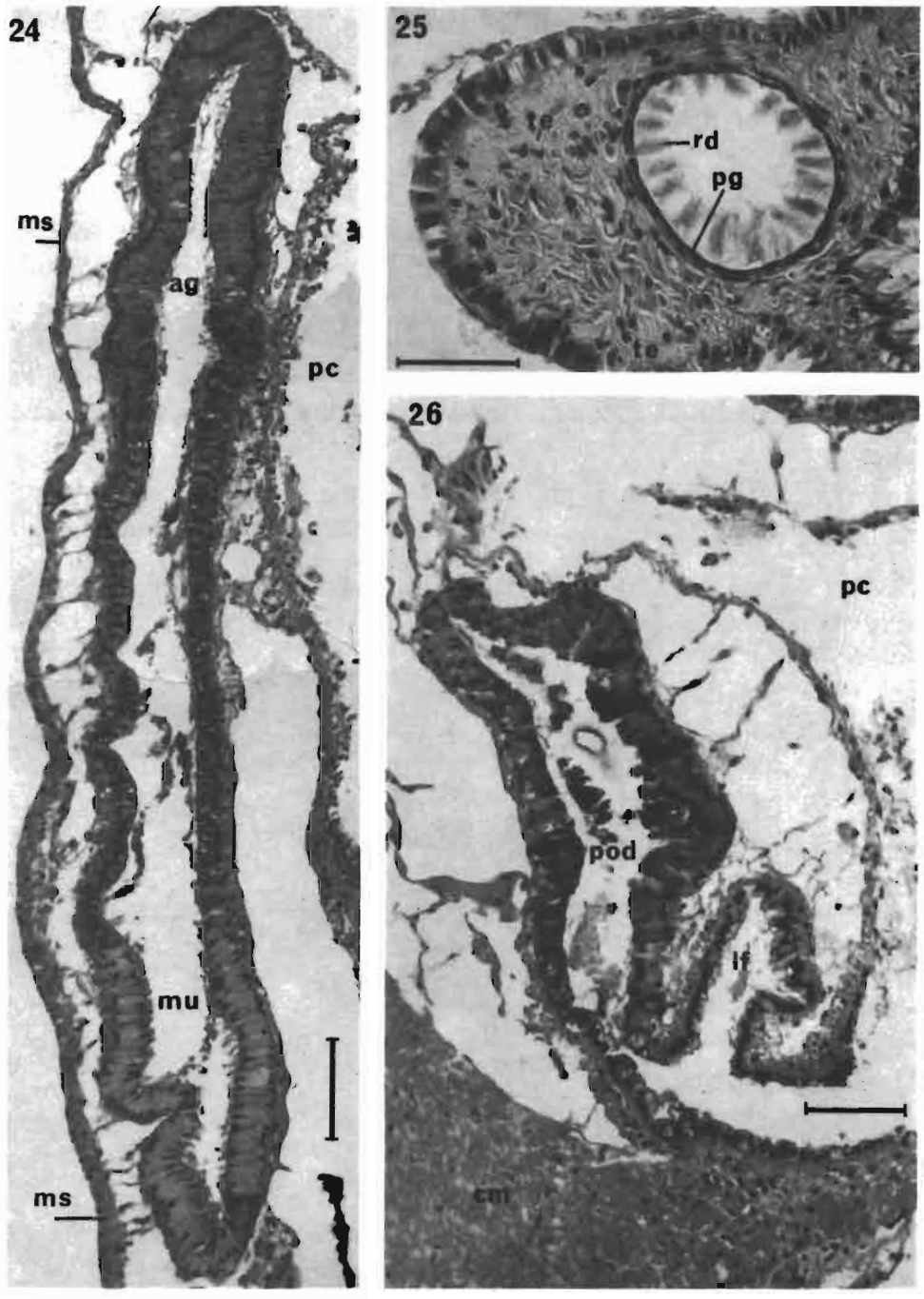
FIGS. 11-19. — Anterior alimentary canal and stomach of *Z. tropidophora* (11-14, 18, 19) and *H. galerita* (15-17). — **11.** Anterior oesophagus with dorsal food channel. — **12-13.** Midoesophagus, after the rotation of dorsal food channel. — **14.** Posterior oesophagus. — **15.** Proboscis tip with oral tube and left jaw. — **16.** Proboscis and buccal mass, retracted into head-foot. — **17.** Anterior oesophagus between buccal ganglia and buccal mass. — **18.** Stomach, longitudinal section at close to right angle to oesophagus and intestine. — **19.** Detail of gastric shield.

bcv — buccal connective; *br* — buccal mass retractor; *c* — cuticle lining; *dfc* — dorsal food channel; *dg* — digestive gland; *dsg* — duct of salivary gland; *fo* — food; *gs* — gastric shield; *i* — position of exit of intestine from style sac; *j* — jaw; *oe* — position of entrance of oesophagus; *oev* — oesophageal valve; *rsc* — radular sac. Scale lines 0.1 mm.



FIGS. 20-23. *Zygoceras tropidophora*, posterior alimentary canal and kidney. — **20.** Intestine shortly after stomach. — **21.** Intestine more distally. — **22.** Rectum. — **23.** Pallial skirt with anterior part of kidney.

cf — ctenidial filament; *eng* — efferent cavity, collecting blood from renal gland and gill, leading to auricle; *fs* — food string; *kf* — renal folds; *ko* — renal pore; *kv* — vessel connecting kidney folds and rectal sinus; *ng* — renal gland; *r* — rectum; *rs* — rectal sinus; *sk* — skeletal rods in gill filament; *t1, t2* — typhlosoles; *tng* — tubules of renal gland. Scale lines 0.1 mm.



FIGS. 24-26. — **24.** *Z. tropidophora*, Distal, closed part of pallial oviduct. — **25.** *Haloceras galerita*, cephalic tentacle with eye. — **26.** *Z. tropidophora*, open part of pallial ociduct and sperm grove.
ag — albumen gland; *cm* — columellar muscle; *lf* — lateral fold; *ms* — pallial skirt; *mu* -mucus producing epithelium; *pc* — pallial cavity; *pg* — pigment layer; *pod* — pallial oviduct; *rd* — rods of retina; *te* — cephalic tentacle. Scale lines 24, 26, 100 µm, 25, 50 µm.

through the anterior left corner of the renal gland and enters the cephalopedal haemocoel to the left of the oesophagus. It then follows the oesophagus forwards, turns to the right to a position dorsally to the oesophagus and splits in several smaller vessels shortly behind the supraoesophageal ganglion.

Excretory organs

Figs 2, 8-10, 23

The renal organ extends back to just past the ventricle; rightwards it extends dorsally and ventrally to the intestine; anteriorly it invades the pallial roof (Fig. 8, *k*). One lobe of the renal

gland protrudes in front of the pericardium, surrounds the efferent branchial and renal vessels, and the anterior aorta and extends down to the columellar muscle (Figs 8-10, *ng*).

The renal pore (Fig. 23, *ko*) is situated dorsally in the pallial roof just in front of the pericardium.

Dorsally the right half of the renal organ is occupied by renal folds; the left half consists of the renal gland, penetrated by several narrow, blindly ending ducts from the cavity of the kidney (Fig. 23, *tng*).

Nervous system

Fig. 27

The nervous system is partly concentrated with the pleural ganglia being fused with the cerebral ones and short and thick commissures and connectives in the nerve-ring. The oesophageal ganglia have rather long, but solid, connectives and the visceral and buccal connectives are long and very thin.

The pedal ganglia are about as long as high and somewhat wider. They are connected by a very short commissure. At their anterior and ventral ends two large nerves emerge close to each other, an anterior one leading to an anterior accessory pedal ganglion and a ventral one leading to a posterior accessory ganglion. Both these pairs of ganglia are partly embedded in the posterior pedal gland. Each pedal ganglion also sends out at two large nerves laterally. The anterior accessory pedal ganglia innervate the anterior parts of the foot. The posterior accessory ganglia each send out two nerve stems backwards in the foot, of which the more central

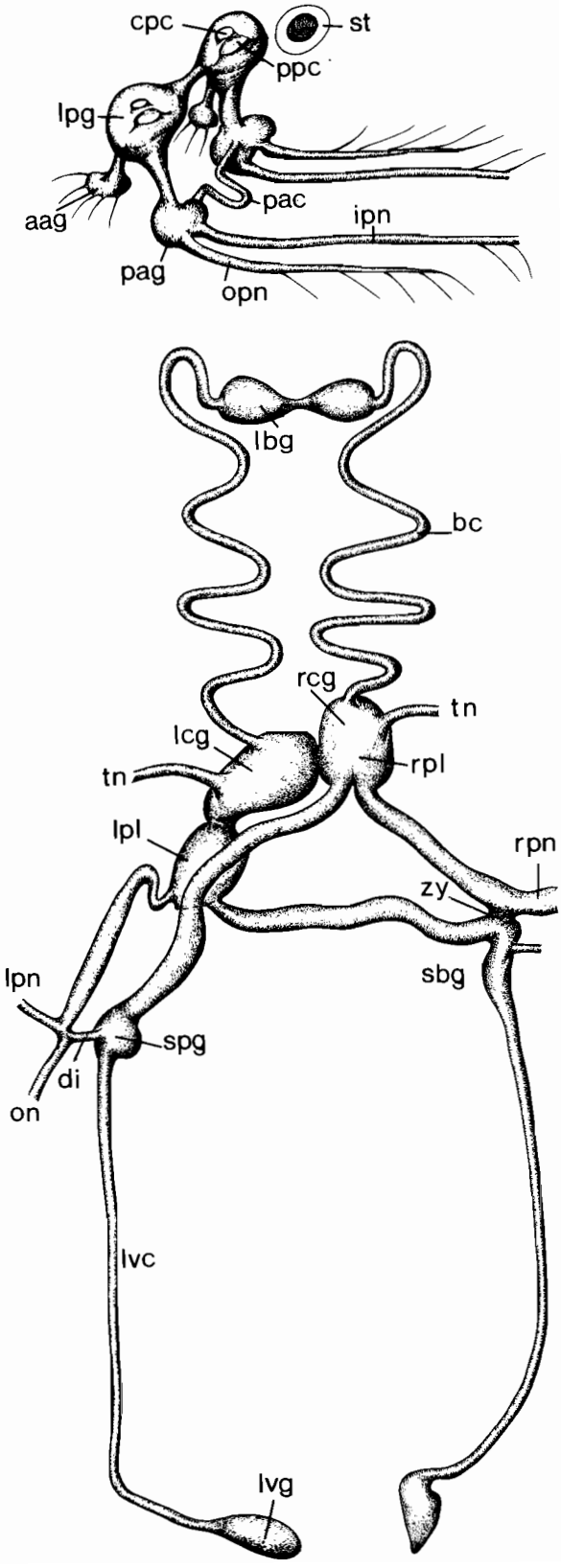


FIG. 27. — *Zygoceras tropidophora*, nervous system. Pedal ganglia separated from cerebral ones; only right statocyst drawn.

aag — anterior accessory pedal ganglion; *bcv* — buccal connective; *ca* — commissure between posterior accesory pedal ganglia; *di* — dialyneury; *ipn* — inner pedal nerve; *lbg* — left buccal ganglion; *lcg* — left cerebral ganglion; *lpg* — left pedal ganglion; *lpn* — lateral pedal nerve; *lpn* — left pallial nerve; *lvg* — left visceral ganglion; *opn* — outer pedal nerve; *pac* — commissure between posterior accessory pedal ganglia; *pag* — posterior accessory pedal ganglion; *plg* — pleural ganglion; *rpn* — right pallial nerve; *rvg* — right visceral ganglion; *sbg* — subeosophageal ganglion; *spg* — supraoesophageal ganglion; *stc* — statocyst; *tn* — tentacle nerve; *zy* — zygoneury.

nerve innervates the rear part of the foot, the more lateral one the middle part and sides of the foot. No connections between the stems were found. There is also a large nerve from each posterior accessory ganglion which follows the duct of the posterior pedal gland backwards for a short distance and then connect dorsally to the duct.

The cerebral ganglia are lying abutting each other, connected by a thin commissure. The right ganglion is completely fused with the right pleural ganglion. The tentacle nerve exits dorsolaterally at the anterior 1/4 and the nerve is simple. The buccal connective, together with several other nerves to the proboscis, leaves anteriorly. Posteriorly the right cerebro-pleural ganglion is drawn out into the pleural-supraoesophageal connective and a pallial nerve forming a zygoneury with the suboesophageal ganglion. The left cerebral ganglion is separated from the pleural ganglion by a shallow constriction. The left pleural ganglion sends out the pleural-suboesophageal connective and a pallial nerve which forms a dialyneury with the osphradial nerve. The cerebro- and pleuro-pedal connectives are of a length corresponding to 2/3 of the width of the combined cerebral ganglia and the pleural connective is about twice as thick as the cerebral one.

The suboesophageal ganglion is situated some distance behind the nerve ring in the right corner of the cephalopedal haemocoel, the supraoesophageal ganglion slightly further back and more dorsally. It sends out a large osphradial nerve, which after the dialyneury continues in the pallial skirt, anteriorly, till it joins the osphradial axis which is occupied by the large osphradial ganglion throughout its length.

The visceral connectives are long and slender and it was not possible to find the connection between the two visceral ganglia of which the left one lies in the cephalopedal vein, the right one in the space where the cephalopedal and visceral veins join.

In *Z. tropidophora* the buccal ganglia are situated on the posterior part of the buccal mass and joined by a commissure of about the same length as the diameter of the ganglia. In *H. galerita* the buccal ganglia are situated further back, behind the radular sac, closely appressed to each other and to the anterior oesophagus.

The innervation of the penis could not be worked out in detail, but it may be of both cerebral and pedal origin.

Sense organs

A pair of statocysts is present, lying posterolaterally to the pedal ganglia in *Z. tropidophora* (Fig. 3, *sta*), posteriorly in *H. galerita*. They have a single statolith.

The eyes (Fig. 25) are unusually large, equipped with a lens and a well developed retina. They are innervated by a branch of the tentacle nerve.

The osphradium (Figs 3, 7, *os*) is well developed, bipectinate with more leaflets along the inner side than on the outer side (see external morphology). The axis is filled by the large osphradial ganglion (Fig. 7, *og*). Due to poor preservation no detailed observations were made on the structure of the leaflets except that they are constricted basally and strongly ciliated above the constriction.

Reproductive organs

Figs 3, 7-10, 24, 26

In the sectioned specimen of *Z. tropidophora* the pallial oviduct is probably not fully formed, but it possesses also a complete set of male organs. These form the basis for the description.

The male organs consist of testis, a long and winding sperm duct opening in the posterior part of the oviduct; possibly a gutter along the free lobe of the oviduct; and a penis with a sperm gutter.

The testis (Fig. 10, *tes*) is situated along the right and more posteriorly also the dorsal side of the visceral mass. It consists of numerous tubules which anteriorly and ventrally unite to form a common sperm duct, which also functions as a seminal vesicle. Beside eu- and paraspermatozoa, there are also scattered eggs in early developmental stages in the gonad.

The sperm duct starts with a few coils (Figs 9-10, *sv*), then it passes straight forwards. Most of it contains a dense mass of euspermatozoa oriented with the heads towards the epithelium of the duct and a mass of slender paraspermatozoa in the center of the duct. The most distal tenth of the duct contains mainly paraspermatozoa (Fig. 9, *sv*). The sperm duct opens in the very

proximal part of the pallial oviduct, close to the openings of the receptaculum seminis. No obvious connection to the sperm gutter on the penis (Fig. 8, *seg*) was found, unless a ciliated furrow along the ventral part of the free lobe of the pallial oviduct has such a function.

The female system consists of an open, glandular pallial oviduct with six seminal receptacles (Fig. 8, *rse*) opening via separate ducts to the very proximal part of the oviduct (Fig. 8, *pod*). The latter is presumably not fully formed.

The pallial oviduct is open (Figs 7, 26), except its most distal and proximal parts (Fig. 3, 24, 8, *pod*) which form wedge-shaped caeca in the pallial skirt. The posterior caecum is continued by a short blindly ending duct, to which the seminal receptacles open, via individual ducts. Anteriorly to these opens vas deferens. Along the broad edge of the free lobe of the oviduct runs a strongly ciliated gutter (Figs 7, 26, *lf*) which starts at the very first part of the ventral slit and continues anteriorly to shortly after where the oviduct closes anteriorly. There the free lobe of the gutter continues and transforms into a short (tongue-like?) skinfold.

The proximal 1/3 of the oviduct is lined by a low epithelium of several types of gland cells. After this part a tall (40-50 µm) dark greyish violet staining epithelium appears in the dorsal part of the oviduct. This epithelium which is interpreted as an albumen gland (Fig. 24, *ag*) then spreads ventrally so it covers most of the inside, except a narrow zone at the level of the slit. The low epithelium spreads again, at the beginning of the anterior caecum (Fig. 24), where it covers the mid 1/3 of the height of the caecum. The lower 1/3 is covered by tall (40-50 µm) mucus producing epithelium (Fig. 24, *mu*), which is continuous with the much lower but otherwise identical epithelium of the corner of the pallial cavity around the anterior part of the slit of the oviduct.

Discussion

The capulids and trichotropids are presently (Boss, 1982; Ponder & Warén, 1988 [as Capulidae]) placed in the Calyptraeoidea, but there is evidence from sperm morphology (J. Healy, pers. comm.) that they actually are most closely related to the Tonnoidea, a view we share. This is also supported by further facts mentioned in « Relationships ».

Furthermore, in the forthcoming discussion we fully accept the view of Ponder & Warén (1988) that the Capulidae and Trichotropidae are synonyms and use the name Capulidae to include also the trichotropids.

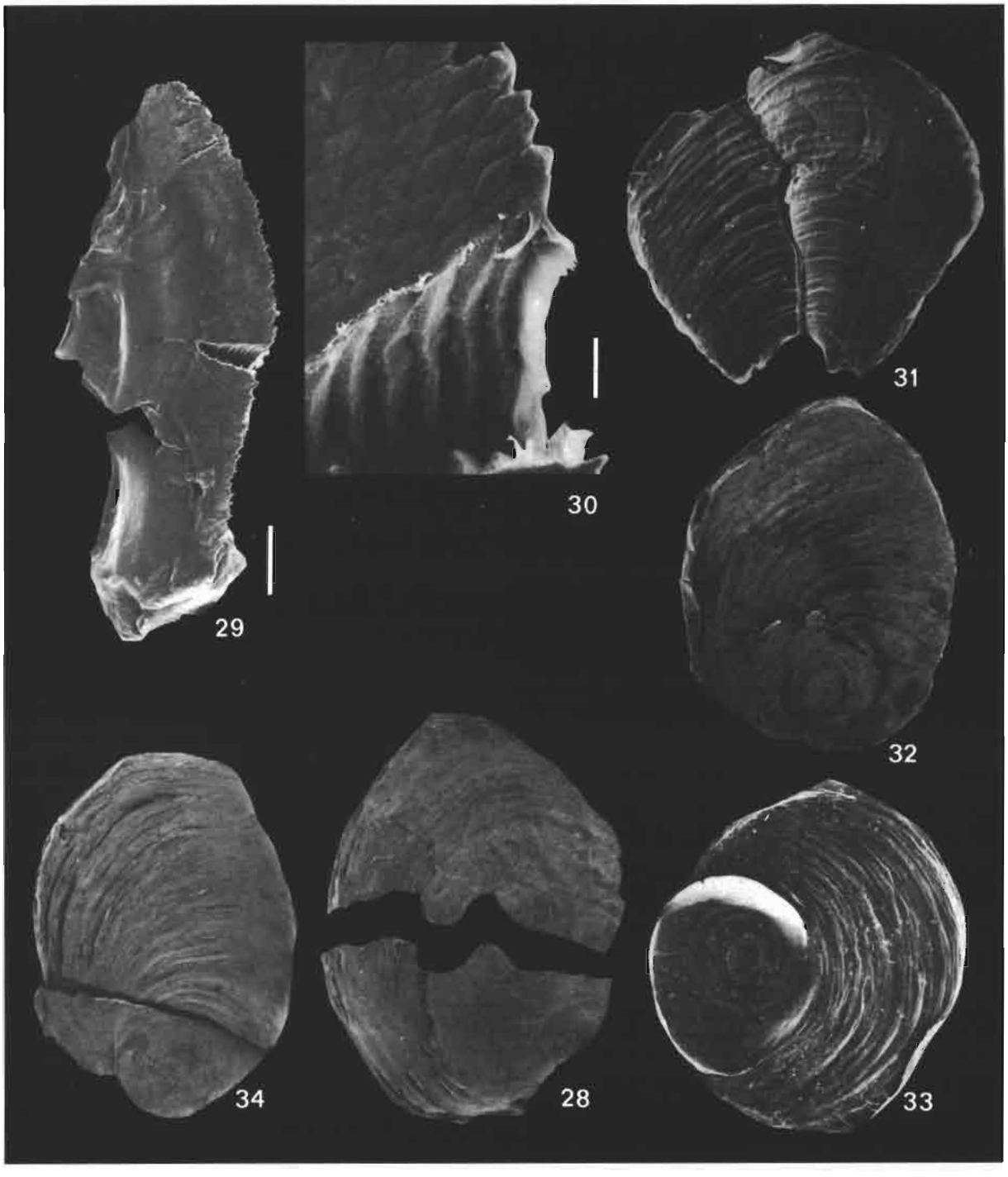
Scarcity of material and validity of results

The anatomical description is severely hampered by the fact that very little material has been available, and most of the information is derived from a single specimen of *Z. tropidophora*. Serial sections of the head-foot of *H. galerita* showed some differences in the structure of the oesophagus and minor differences in the shape of the ganglia of the central nervous system. The external morphology is, however, quite similar as far as could be observed from rehydrated bodies. There were differences in the shape of the penis and the foot, but not very great and the latter can to some extent be due to differences in fixation and a result of the drying and rehydration. There seem, however, to be present two types of penes; with or without an anterior lobe.

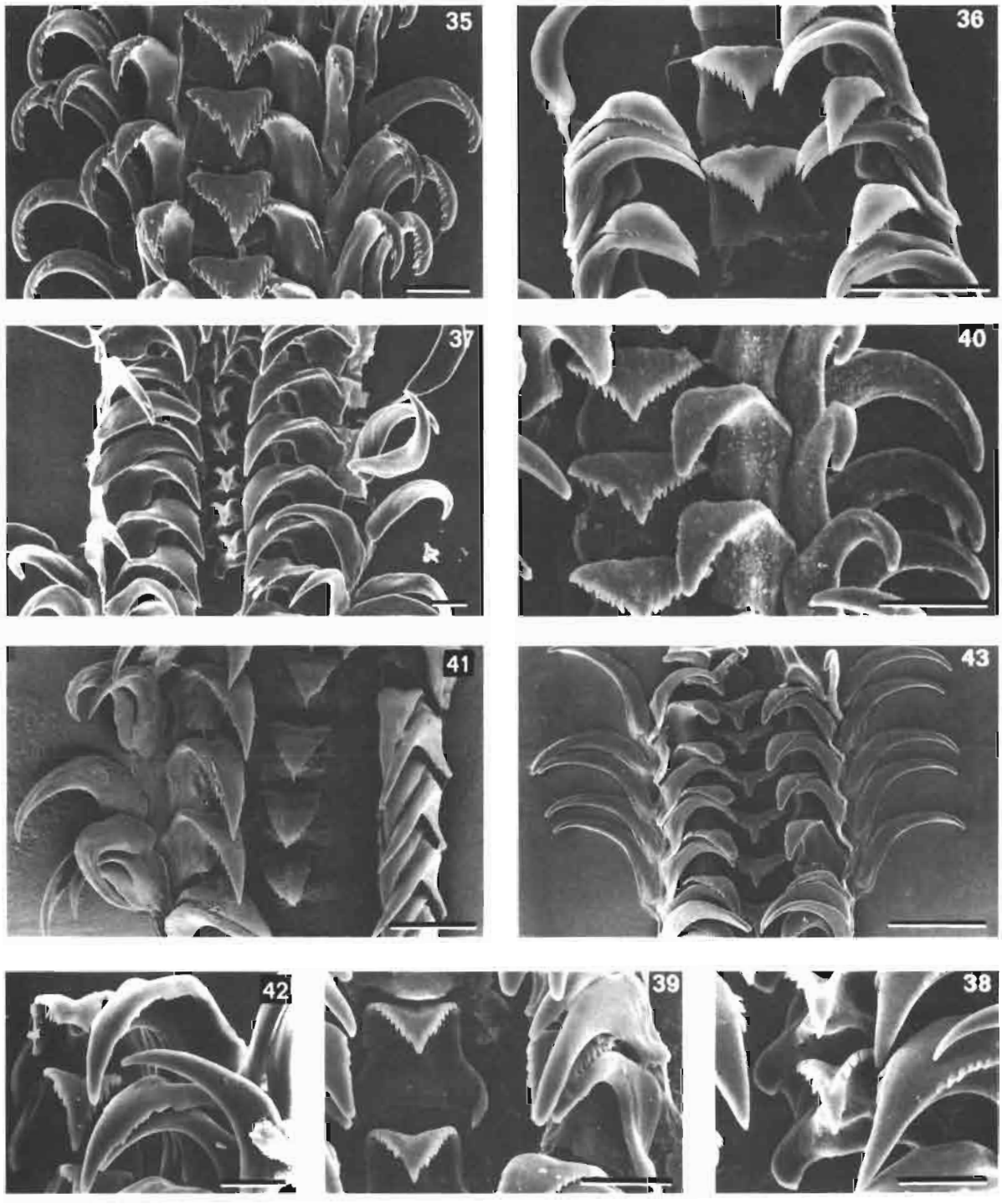
Larval shell

The morphology of the larval shell, with distinct protoconch I and II present in almost all species (not in *H. japonica*) indicates that they have planktotrophic development. This is further confirmed by the egg-capsule of *H. carinata* with embryos of a size of 0.16 mm, which corresponds well with the size of protoconch I in that species.

The larval shell is quite similar to some species of Capulidae, see Figs 48-49. A few capulids are known to have so-called echinospira larvae (*Capulus*: Fretter & Graham, 1962; *Trichosirius*: Pilkington, 1974, 1976). We have examined protoconchs of several species known to have echinospira larvae, from all families where this type of larval development is known and found that they conchologically are characterized by



FIGS. 28-34. — Jaws and opercula of Haloceratidae. — **28-30,** *Zygoceras tropidophora*. — 28, operculum, height 4.6 mm. — 29-30, jaw, scale lines 0.1 and 0.01 mm. — **31,** *Haloceras cingulata*, operculum, height 1.9 mm. — **32,** *H. phaeocephala*, operculum, height 1.13 mm. — **33,** *H. carinata*, operculum, height 0.8 mm. — **34,** *H. japonica*, operculum, height 1.84 mm.



FIGS. 35-43. — Radulae of Haloceratidae. — **35,** *Zygoceras tropidophora*, paratype. — **36,** *Haloceras carinata*, CANCAP stn 2.155. — **37-38,** *H. tricarinata*, BENTHEDI stn 87. — **39,** *H. tricarinata*, " *Discovery* " stn 10141. — **40,** *H. japonica*, off Oregon. — **41,** *H. cingulata*, USNM 52077. — **42,** *H. cingulata*, USNM 94898. — **43,** *H. phaeocephala*, paratype. Scale lines 25 µm (36, 39, 40, 42) and 50 µm (35, 37, 38, 41, 43).

the absence of a sharp distinction of protoconch I and II. Judging from the presence of such a distinct demarcation in the species of *Haloceras*, we believe that the similarity to some capulids cannot be used to infer that *Haloceras* has such echinospira larvae.

Teleoconch

The more or less planispiral teleoconch, with a large, irregularly shaped aperture and rapidly increasing diameter of the whorls hints towards a sedentary life probably on rocky bottoms or on some other solid substrate.

Anatomical details

The shape of the front part of the foot was always too distorted, to be used for comparisons between the species. It does, however, imply a sedentary mode of life. The division of the foot into a rear part that contracts to a solid lump and an anterior extensile part which contracts more folded can be seen in many trichotropids (GRAHAM, 1954; YONGE, 1962; WARÉN unpubl.) and is especially obvious in *Capulus*. YONGE (1962) described the behaviour of *Trichotropis cancellata*, which has a morphologically similar foot. Specimens of that species sit attached by the rear part of the foot, filtering sea-water with the gill. When crawling the anterior part of the foot can be extended far ahead. In *Haloceras* the anterior part of the foot is evidently not used as in *Capulus*, for holding and protecting the egg mass (THORSON 1965), since an egg mass with developing embryos was found in the pallial cavity of one specimen, which possessed this kind of foot.

The anterior pedal gland, the glandular layer on the propodium and on the front part of the mesopodium are unusually thick and certainly have some functional importance in connection with a sedentary life.

The very strongly contracted proboscis sheath, the folded oesophagus, the long, coiled and folded buccal and pedal connectives as well as the length of other nerves emerging from the cerebral ganglia, indicate that the proboscis can be extended considerably and that probably the cerebral ganglia move forwards during that process.

It is not certain how the pallial parts of the gonoduct function. It is obvious that (the own) sperm is transported to the initial part of the pallial oviduct by the vas deferens which also functions as a seminal vesicle. But after that there exist two possible ways: Either the sperm continue forwards in the pallial oviduct, or it leaves the pallial oviduct and uses the gutter along the edge of the free lobe of the oviduct. This gutter ends on a skin-fold on the outside of the lobe, at the same level as the penis. The skin-fold could then have a function to transfer the sperm to the penis since there seems to be no sperm gutter across the neck. This explanation, however, is not likely because the sperm gutter of the oviduct must be used for transport of sperm from another male at copulation, unless sperm can be transported both ways.

The absence of a bursa copulatrix can hardly be explained by the fact that the specimen is not a mature female, because, from a fertilization point of view, it actually is mature since the seminal receptacles were full of sperm.

Biology

Very little identifiable stomach and rectal contents were found. A foraminiferan was found in a single specimen of *Haloceras carinata*. Several other species had some unidentifiable organic material, but there were no remains of planktonic organisms or mineral particles. This excludes filter feeding or grazing the detritus cover of the bottom, since every such gastropod we have examined, invariably has the stomach and intestine filled with at least partly identifiable matter. Such a feeding is also unlikely in species with a well developed proboscis.

An active and predatory way of life is, however, unlikely because of the morphology of the foot, which suggests that this animal is adapted for a sedentary life.

The presence of unusually large eyes in a gastropod group almost exclusively living in the deep sea is somewhat surprising, but the eyes are not necessarily used during the benthic life. They may be a reminiscence from the planktonic life of the larva. BOUCHET & WARÉN (1986) found that almost no deep-sea eulimids with lecithotrophic development have eyes, while species with planktotrophic larvae usually have eyes. In some

species, however, the eyes are lost soon after settlement.

The presence of a penis in every specimen, also those with unquestionably female features (egg mass in pallial cavity, developing embryos in oviduct) indicates that the species are either simultaneous or protandric hermaphrodites. The latter is supported by the histology of the testis of *Z. tropidophora*, which was almost exclusively male, but with some immature eggs present. Hermaphroditism is mainly known from prosobranchs with a sedentary or not very active mode of life.

A consequence of the specimen of *Z. tropidophora* being in the process of sex change is that it may be far from full grown, since most protandrous hermaphroditic prosobranchs change sex around or below half maximum size (e.g. *Trichotropis*: YONGE, 1962; *Eulima*: WARÉN, 1984; *Capulus*: THORSON, 1965 and own observations).

Another remarkable feature in the biology of the species of Haloceratidae is their apparent rarity. We know a total of 20 species from 103 specimens and shells. Only seven species are known from more than five specimens, although several occur in comparatively well investigated areas. Despite this rarity it is obvious that when one species is present, there is an unexpectedly high probability to find at least one more species:

H. tricarinata, laxa, cingulata and *carinata* were all found at SEAMOUNT stn CP 30, SW of Portugal in 2000m;

Haloceras japonica and *millestriata* were described from the same dredge haul off S Japan, 1300 m;

H. laxa and *carinata* at " *Porcupine* " Expedition 1870 stn 16, off Portugal in 1900 m;

H. aff. *laxa* and *H. cingulata* at " *Thalassa* " stn Z435 in the northern part of the Bay of Biscay in 1000m;

H. spinosa, phaeocephala and *Haloceras* sp. 1 at " *Kapala* " stn 80-20-10, off New South Wales in 1100 m;

H. biocalae and a damaged undetermined species at BIOCAL stn DW 48, off southern New Caledonia in 800 m;

H. cingulata and *H.* aff. *laxa* at BIOGAS stn CP 37, Bay of Biscay in 2200 m.

Considering that this material comes from more than 2000 dredge hauls in the depth range 400-4000m, it is obvious that the catches were not randomly distributed, but we do not know any uniting factor, except that these stations are sometimes unusually rich also in other gastropods.

To summarize the biological features of the two genera, we get a group of not very active deep-sea gastropods usually with planktotrophic development, and some unknown, very special requirements on the biotope. The species are probaly predators.

Relationships

The anatomical and biological features outlined above and in the description clearly indicate that *Haloceras* and *Zygoceras* belong to the Caenogastropoda, more precisely the Neotaenioglossa:

— Taenioglossate radula; not taenioglossate in Neogastropoda.
— A simple oesophagus; with a valve of Leiblein or similar structures in Neogastropoda.
— Both zygo- and dialyneury; none of these in Archaeotaenioglossa.
— Protandrous hermaphoditism present; very rare in Neogastropoda.

There is, however, no neotaenioglossate family in which *Haloceras* and *Zygoceras* can be included.

Several features point in different directions:

The larval shell of the species with assumed planktotrophic development shows the greatest similarity to the genus *Benthonella* (Rissoidae, Figs 46-47: *B. tenella* (Jeffreys, 1867); see also PONDER, 1985; BOUCHET, 1976). The distinct coloration, size, and sculpture of protoconch I and II are quite similar. Also certain capulids, for example *Trichotropis crassicostata* Melvill, 1912, have a similar larval shell, but it is smaller and more planispiral (Figs 48-49).

The teleoconch does not resemble any other group in a way that makes it possible to include it there, although there is some resemblance to the Capulidae, in that the shell is slightly irregularly shaped, paucispiral with rapidly increasing diameter, often has an irregular, rough sculpture and has a well developed periostracum. These features may, however, be convergences caused by a sedentary life.

The foot resembles that of many Tonnoidea

TABLE 1. — Comparison of *Haloceras*, Capulidae and Tonnoidea.

CHARACTER	LAUBIERINIDAE *	CAPULIDAE	*Haloceras*
Foot with lateral furrow	yes	yes	yes
Posterior pedal gland	?	poorly developed	present
Hypobranchial gland	thin	thick	thin
Anterior alimentary canal	pleurembolic proboscis	very short pleurembolic proboscis [1]	pleurembolic proboscis
Lower lip	unmodified	pseudoproboscis	unmodified
Jaws	present	absent	present
Salivary ducts	long and slender	short	long and slender
Salivary ducts pass nerve ring	yes	no	yes and no
Accessory salivary glands	present	absent	absent
Oesophageal gland	present	absent	absent
Digestive gland openings	*distant from each other	distant fom each other	close together
Crystalline style	*absent	present	absent ?
Osphradium	monopectinate/bipectinate *	monopectinate	bipectinate
Suboesophageal ganglion	with dialyneury	with or without dialyneury	with dialyneury
Supraoesophageal ganglion	?, with zygoneury *	with zygoneury	with zygoneury
Pedal ganglia	no accessory ganglia, no cross connective	with accessory ganglia, no cross connective	with accessory ganglia, with cross connective
Larval type	normal veligers	echinospira	normal veligers
Protoconch I distinct from II	yes	no	yes
Sperm duct on head-foot	*open or closed	open	not present ?
Seminal receptacle	*posterior, one or many	posterior, one	posterior, many
Bursa copulatrix	*anterior	absent	absent
Pallial oviduct	closed	open	open
Sperm gutter on pallial oviduct	? no	no	yes
Gonopericardial duct	unknown	no	no
Mode of feeding	*predatory	filterfeeders	predatory ?

An asterisk (*) indicates that the character is not known in the Laubierinidae and is extrapolated from other tonnoidean families. Anatomical details from BOUVIER (1889), DELL & PONDER (1964), LACAZE-DUTHIERS (1872, 1901), WARÉN & BOUCHET (1990), YONGE (1962).

1. *Capulus ungaricus* as well as other capulids do have a very short pleurembolic proboscis, as can be seen from the skin fold between the tentacles. The pseudoproboscis actually is a drawn out part of the proboscis sheath (unpublished).

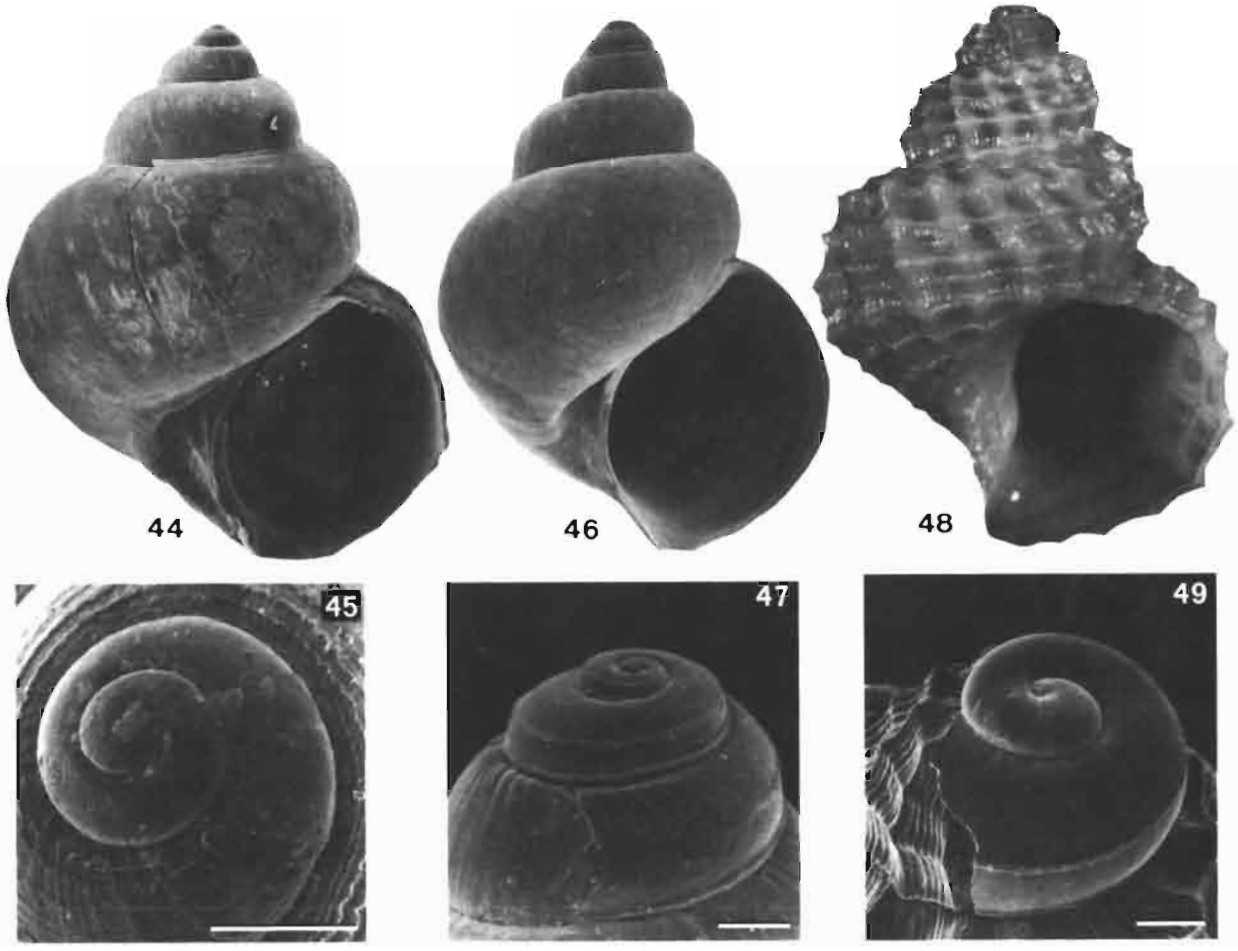
and the Capulidae in having a demarcated, rough zone along and above the edge of the sole. This is a rare character among gastropods and has rarely been noticed, but we have seen it in Aporrhaidae and WARÉN & PONDER (in press) reported it in the Loxonematoidea.

The foot also resembles many capulids (especially *Capulus*), all calyptraeids and some vanikorids in being divided into two functionally different parts. This is probably also functionally evolved since it also occurs in Amathinidae (Pyramidelloidea; PONDER, 1987), a totally unrelated group.

The operculum shows clear similarities to all capulids (WARÉN unpublished) and many tonnoids (WARÉN & BOUCHET, 1990) in having the larval operculum remaining and clearly set off from the postlarval part when young and then losing the old part by some kind of erosion.

The alimentary system is very similar to that of the Laubierinidae and some other of the less modified Tonnoidea (see WARÉN & BOUCHET, 1990), but differs in not having the complex and large salivary glands present in all tonnoids (except the Ficidae). Neither does it have a well developed oesophagal gland.

The radula is quite similar to that of many of the advanced mesogastropods, except some of



FIGS. 44-49. – *Cithna, Benthonella, Trichotropis.* — **44-45,** *Cithna globosa*, syntype USNM 186381, height 2.8 mm. — **46-47,** *Benthonella tenella*, BIOMEDE 2 stn 6, 39°40'N, 04°57'E, 2610 m, height 4.4 mm. — **48-49,** *Trichotropis crassicostata*, " *Marion-Dufresne* " cruise 32, stn DC10, 21°13'S, 55°52'E, 930-980 m, height 5.6 mm. Scale lines 200 µm.

the more modified groups (e.g. *Lamellaria*, *Cypraea*, *Pedicularia*, etc.), but it is especially similar to that of the two recently described tonnoidean groups Laubierinidae and Pisanianurinae (Ranellidae) (see WARÉN & BOUCHET, 1990).

The anatomy and ontogeny of the reproductive system is very similar to the Capulidae. Direct comparison with sectioned specimens of *Capulus hungaricus*, in the sexual phase when oocyte production just has started showed a similar construction of the oviduct, except that *Capulus* has only a single seminal receptacle, a less developed ciliated furrow and a shorter ventral slit of the oviduct.

On account of these characters we feel confident that a position in the vicinity of the Tonnoidea and the Capulidae is quite a realistic assumption, and we have tabulated a number of characters for the least modified tonnoidean family and the Capulidae in Table 1.

The larval development of the Capulidae, via an echinospira larva is a character shared with the Lamellariidae, Velutinidae, Triviidae and Eratoidae (we do not consider the status of these taxa, and the larva of Pseudosacculidae is not known). Whether it is a homologous character and its significance for these taxa being monophyletic was discussed by FRETTER & GRAHAM (1962:627). They concluded that this was the

case, based on GRAHAM'S (1954) comparative study of *Capulus*, *Trichotropis* and *Calyptraea*, but maintained that *Capulus* is more closely related to Calyptraeoidea than to Lamellarioidea. Since then PILKINGTON (1974, 1976) has shown that also species of the old family Trichotropidae have echinospira larvae, which supports FRETTER & GRAHAM'S ideas about Trichotropidae as an ancestral group of the species possessing echinospira larvae, the « Echinospiracea » (modified to « Echinospirida » by GOLIKOV & STAROBOGATOV, 1975). This finding also contributed to PONDER & WARÉN'S (1988) view that the Trichotropidae and Capulidae should be considered one family.

To our ideas about the Capulidae not being related to the Calyptraeoidea, but to the groups possessing an echinospira-larva should be added the fact that all taxa within the Calyptraeoidea have a normal snout, while the Capulidae as well as the Lamellarioidea have a proboscis (not to be confused with the so-called pseudo-proboscis of the Capulidae, which is an additional process from the proboscis sheath).

If the echinospira larvae of the groups are homologous (as we believe) this certainly substantiates the use of that type of larvae for classification and makes it practical to maintain them as a group, without mixing them with species without that kind of larval development (unless it is lecithotrophic).

We thus get a situation with a caenogastropod lineage which splits into the Tonnoidea and the Echinospirida (disregarding Hennigian principles about ranks). The Laubierinidae and the Capulidae respectively are the most primitive members of these two branches. The problem then is: Where do *Haloceras-Zygoceras* join the « Y »?

There are actually no characters of the Echinospirida and Tonnoidea which are more primitive than in *Haloceras-Zygoceras*, but there are characters in *Haloceras* and *Zygoceras* which are more primitive, e.g. the closely placed openings of the digestive glands and the accessory pedal ganglia with a cross connection. The normal veliger larva is more primitive than the echinospira larva (unless one assumes the normal veliger to be secondary). This should support a position either on the basal limb of the « Y » or on the branch leading to the Tonnoidea, or on the branch leading to the Echinospirida, before the development of the echinospira larva took place. The anatomical information available is, however, hardly detailed enough to allow a clear answer to where to place the two genera.

Whatever the relationships may be, *Haloceras* and *Zygoceras* do not fit in any of the families mentioned, why we suggest a new family for them. We consider it related to but more primitive than the superfamily Tonnoidea and the suborder Echinospirida.

Family HALOCERATIDAE fam. nov.

DIAGNOSIS. — Shell disc-shaped to fairly tall-spired, with 1.5-3 teleoconch whorls covered by a well developed, often fringed periostracum. Sculpture usually spiral ribs and sinuous growth-lines. Aperture rounded to depressed, without siphonal canal. Umbilicus usually broad and deep, occasionally closed. Protoconch I with numerous small short raised ridges, often encircling small round surfaces and usually aggregated to form 4-7 spiral ribs which are more well defined towards periphery. Sometimes micro-ridges are confined to spiral ribs and leave rest of shell smooth. Protoconch II with 1-3 whorls, 2-3 spiral keels close to periphery, sometimes also with pustules and other sculpture on last whorl.

Soft parts with bipectinate osphradium, pleurembolic proboscis, simple salivary glands with ducts which may or may not pass nerve-ring, fairly concentrated nervous system with dialyneury between supra- and cerebral, zygoneury between suboesophageal and cerebral ganglia. Two pairs of accessory pedal ganglia, posterior pair with commissure. Foot with anterior and posterior pedal glands and lateral furrow above edge of sole. Protandrous or simultaneous hermaphrodites.

SYSTEMATIC ACCOUNT

Genus *HALOCERAS* Dall, 1889

Separatista (Haloceras) Dall, 1889: 277. Type species: *Cithna cingulata* Verrill, 1884, by monotypy.
Solariella (Micropiliscus) Dall, 1927:130. (New synonym). Type species: *S.(M.) constricta* Dall, 1927, by original designation.

REVISED DIAGNOSIS. — Haloceratids with (in species with planktotrophic development) multispiral brown globular protoconch. Protoconch I with 4-8 spiral cords on a background of numerous anastomosing riblets and pustules. Protoconch II with 3 spiral keels, of which two remain uncovered above suture by successive whorl. Teleoconch trochiform to lenticular, umbilicus narrow to wide, whorls with 1 or 2 strong spiral keels. Soft parts with the characters of the family.

REMARKS. — The history of the name has been summarized in the introduction. For a comparison with *Zygoceras*, see that name.

Haloceras acrocomata sp. nov.

Figs 88, 93-94

TYPE MATERIAL. — Holotype in AMS C146278.

TYPE LOCALITY. — "*Kimbla*" 1977, stn 3, 23°33.7'S, 152°37'E, 348-339 m, E of Lady Musgrave Id, Queensland, Australia.

MATERIAL EXAMINED. — **Australia**. "*Kimbla*" 1977, stn 3, E of Lady Musgrave Island, Queensland, 23°33.7'S, 152°37'E, 348-339 m: holotype (AMS C146278). — Stn 22, off NW Island, Queensland, 23°15'S, 152°24'E, 284 m: 1 sh. (AMS C150187). — 1984, stn 15, E of Lady Musgrave Island, Queensland, 23°52'N, 152°42'E, 296 m: 1 sh., 1 juv. sh. (AMS C147272).

DESCRIPTION. — *Shell* small, thin, solid, consisting of 2 protoconch and 1.75 teleoconch whorls. Protoconch rather flat, almost planispirally coiled. Protoconch I, diameter 240 µm, sculptured by 6 strong spiral cords, continuous from nucleus to protoconch II, except for a small area near transition between protoconch I and II, which is occupied by granules. Protoconch II with 1.4 whorls, sculptured by two strong keels, a third keel hidden at suture, visible only in young postlarvae. Between keels, on later part of protoconch II small granules; rest of larval shell smooth or with occasional traces of periostracal spirals. Protoconch/teleoconch transition sharp. Teleoconch whorls turreted, broadly conical, with two strong keels giving whorls a very angular profile; no other spiral sculpture. Discrete axial sculpture made stronger by periostracal lamellae, best visible at periphery, where forming projecting scales between keels. Umbilicus broad, encircled by one strong thread. Aperture broadly quadrangular; lip sharp, thin, only very slightly reflected on columellar side. Colour of shell very light amber white, with 2 carinae and umbilical thread distinctly darker; protoconch light brown.

Dimensions: Height 2.07 mm, breadth 3.06 mm; aperture height 1.14 mm, breadth 1.26 mm.

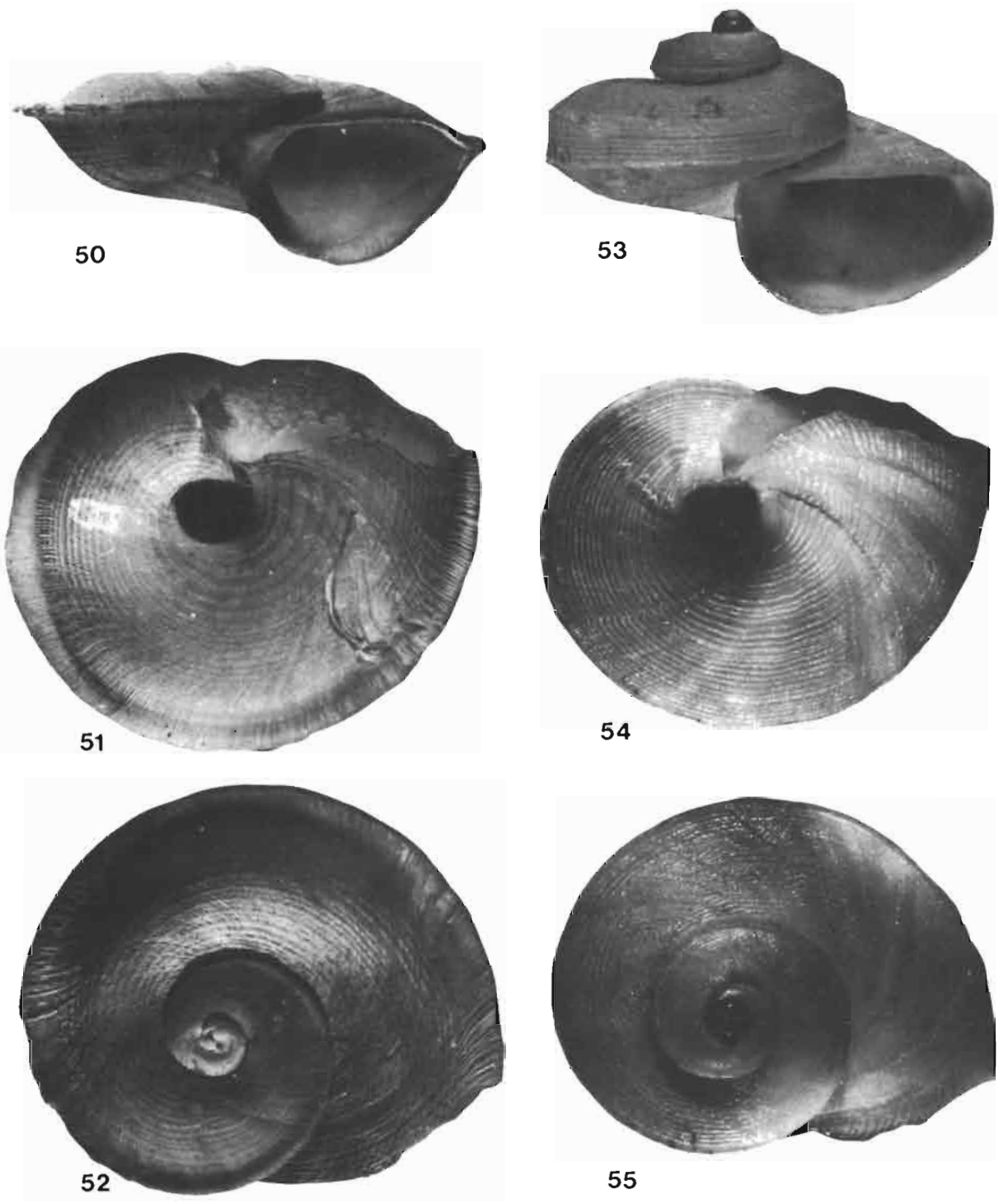
Larval shell measurements:

	diameter (µm)	no. whorls (prot. II)
holotype	940	1.4
AMS 147279	1000	1.6
AMS 142679	980	1.45
AMS 150187	960	1.5

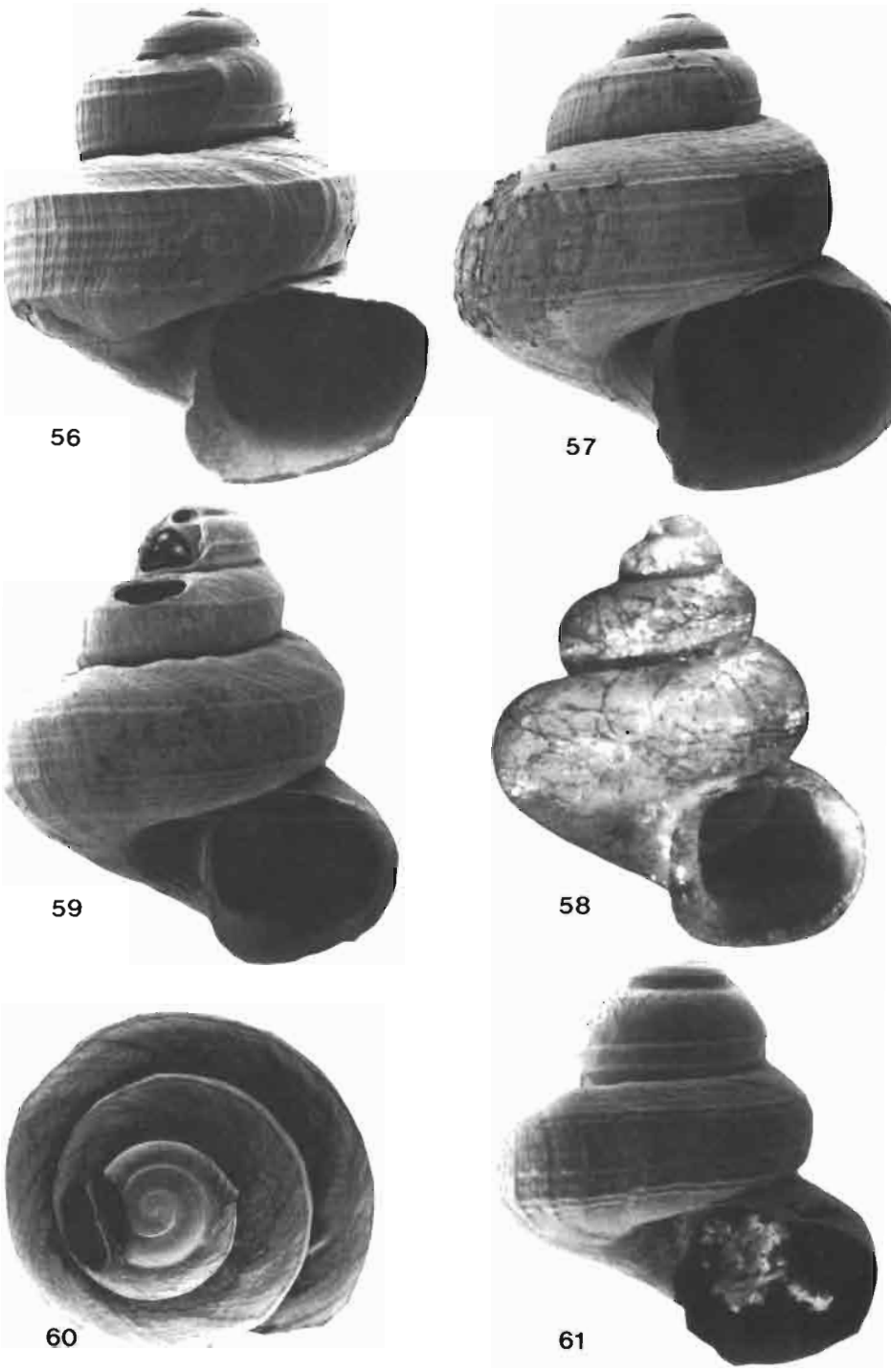
REMARKS. — One shell (AMS 150187) has a proportionally higher spire and narrower umbilicus (the two characters are linked), but otherwise identical protoconch and general morphology.

The two strong keels on the teleoconch of *H. acrocomata* make it resemble *H. exquisita* and *H. cingulata*. It differs from *H. exquisita* by its low-spired protoconch with fewer whorls, by teleoconch whorls which increase more rapidly in diameter, and its broader umbilicus. *H. cingulata* reaches a much larger size at the same number of postlarval whorls, and has a narrower umbilicus.

ETYMOLOGY. — From the Greek *akros*, at the top, and *comatas*, hairy; to remind of the hairy periostracum of the protoconch.



FIGS. 50-55. — Genus *Haloceras*. — **50-52,** *H. tricarinata*, BENTHEDI stn 87, diameter 14.0mm. — **53-55,** *H. cingulata*, BIOGAS stn CP37, diameter 13.8mm.



FIGS. 56-61. — Genus *Haloceras*. — **56,** *H. mediocostata*, MONACO stn 703, height 3.2mm. — **57,** *H. mediocostata*, lectotype, height 3.5mm. — **58,** *H. carinata*, holotype of *Solariella constricta*, height 3.3mm. — **59-60,** *H. carinata*, BALGIM stn CP92, height 2.65mm, diameter 2.35mm. — **61,** *H. carinata*, CANCAP stn 2.155, height 1.6mm.

Haloceras carinata (Jeffreys, 1883)

Figs 33, 36, 58-61, 105-108

Cithna carinata Jeffreys, 1883: 111, pl. 20, fig. 9.
Solariella (Micropiliscus) constricta Dall, 1927: 130. (New synonym).
Solariella (Micropiliscus) constricta- QUINN 1979:43, figs 67, 68.

TYPE MATERIAL. — *C. carinata*: Holotype BMNH 1885.11.5.1623; *S. constricta*: 11 syntypes, USNM 108414a,b.

TYPE LOCALITIES. — *C. carinata*: " *Porcupine* " 1870, stn 16, 39°55'N, 09°56'W, 1810m, off Portugal; *S. constricta*: " *Albatross* " stn 2415, 30°44'N, 79°26'W, 805m, off Florida.

MATERIAL EXAMINED. — **Eastern Atlantic**. " *Porcupine* ", stn 16, off Portugal, 39°55'N, 09°56'W, 1810 m: 1 sh., holotype.

SEAMOUNT, stn CP30, Gorringe Bank, 36°44'N, 11°23'W, 1940-2075m: 1 sh., 2 frgms (MNHN). — Stn DW116, Galicia Bank, 42°52'N, 11°51'W, 985-1000m: 3 shs (SMNH).

BALGIM, stn CP92, Ibero-Moroccan Gulf, 34°24.3'N, 07°30.3'W, 1182m: 1 sh. (MNHN).

INCAL, stn DS3, W of the British Isles, 57°27'N, 11°03'W, 609-619m: 1 larva (lost).

CANCAP, stn 2.067, Canary Islands, 27°58'N, 14°12'W, 1820m: 1 sh. (RMNH). — Stn 2.155, Canary Islands, 27°35'N, 17°59'W, 700m: 1 spm., 3 shs (RMNH).

Western Atlantic (Florida). " *Albatross* ", stn 2415, 30°44'N, 79°26'W, 805 m, 11 shs (syntypes of *S. constricta* Dall, 1927).

DESCRIPTION. — *Shell* small, solid, conical, with 2.5 protoconch and up to 2.75 teleoconch whorls. Protoconch globular, multispiral. Protoconch I diameter 200 µm, with sculpture of star-shaped little knobs forming a reticulation, and 5 spiral cords formed by coalescing such knobs. Protoconch II with two spiral keels well visible above suture, third keel hidden by subsequent whorl. Sculpture of granules appear in subsutural zone after first whorl of protoconch II, then gradually expends over most of protoconch surface. 3-6 prosocline axial lamellae, situated on last part of protoconch II, just behind peristome. Protoconch lip expanded. Protoconch/teleoconch discontinuity very abrupt. Teleoconch trochoid with regularly convex whorls and very deep suture. Sculpture consisting mainly of spiral cords, two of which are sometimes stronger, forming weak spiral keels. About 25 spiral cords on penultimate whorl of large specimens. Base and umbilicus sculptured by similar cords. Border of umbilicus not marked by cord. Spiral cords cross much weaker incremental lines. Above shoulder intersection of spiral cords and incremental lines produces a kind of malleated surface, more distinct after coating for SEM. Base convex, umbilicus open and broad. Aperture rounded, peristome almost continuous. Outer lip thin, sharp, slightly reflected over umbilicus. Colour of protoconch brown, teleoconch dirty white.

Dimensions of shells: USNM 108414, height 3.24 mm, breadth 3.0 mm; aperture height 1.20 mm, breadth 1.45 mm. BALGIM stn CP92, height 2.62 mm, breadth 2.28 mm; aperture height 1.0 mm, breadth 1.10 mm .

Larval shell measurements:

	diameter (µm)	no. whorls (prot. II)
holotype *carinata*	840	1.8
USNM 108414	710	1.9
USNM 108414	720	1.8
USNM 108414	700	1.7
USNM 108414	770	1.9
USNM 108414	740	1.8
CANCAP 2.067	980	1.75
CANCAP 2.155	840	1.9
CANCAP 2.155	730	1.7
CANCAP 2.155	840	1.75
CANCAP 2.155	890	1.8
BALGIM CP 92	840	1.9
SEAMOUNT CP 30	920	1.9
SEAMOUNT DW 116	840	1.8
SEAMOUNT DW 116	900	1.9
SEAMOUNT DW 116	900	1.75

REMARKS. — WARÉN (1980: 20), misled by the similarities in the protoconch, commented that the holotype of *C. carinata* is: « A monstrosity of *Benthonella tenella* (Jeffreys) ».

QUINN (1979) listed as *Solariella constricta* (= *carinata*) three other lots which here are described as *Haloceras trichotropoides*. Indeed, the two species have rather similar teleoconchs, although *H. trichotropoides* can be recognized by its coarser sculpture, with fewer and stronger spiral cords. They can also be separated by *H. trichotropoides* having a flatter larval shell with fewer whorls.

H. carinata also resembles *H. mediocostata*. That species has a larger protoconch (diameter 1220 µm vs. 700-920 µm in *carinata*), and a broader teleoconch sculptured by stronger spiral keels.

Haloceras cingulata (Verrill, 1884)

Figs 31, 41-42, 53-55, 113-115

Cithna cingulata Verrill, 1884: 184, pl. 32, fig. 7.

TYPE MATERIAL. — Holotype USNM 38101.

TYPE LOCALITY. — "*Albatross*" stn 2076, 41°13'N, 66°01'W, 1658m, Georges Bank, S of Nova Scotia.

MATERIAL EXAMINED. — **Western Atlantic.** "*Albatross*", stn 2043, S of Nova Scotia, 39°49'N, 68°29'W, 2685 m: 1 spm., paratype (USNM 38104). — Stn 2076, Georges Bank, S of Nova Scotia, 41°13'N, 66°01'W, 1658 m: 1 sh., holotype (USNM 38101). — Stn 2084, S of Nova Scotia, 40°17'N, 67°05'W, 2361m, 1 sh., paratype (USNM 38105). — Stn 2571, S of Nova Scotia, 40°09'N, 67°09'W, 2480m: 1 spm. (USNM 52077). — Stn 2733, off North Carolina, 37°26'N, 73°43'W, 1728m: 1 spm. (USNM 94898).

Eastern Atlantic. BIOGAS, stn CP 37, Bay of Biscay, 47°34'N, 08°40'W, 2175 m: 1 spm. (MNHN).

"*Thalassa*", Stn Z 435, Bay of Biscay, 48°40'N, 09°56'W, 1050 m: 1 sh. (MNHN).

SEAMOUNT, stn CP30, Gorringe Bank, 36°44'N, 11°23'W, 1940-2075m: 7 juv. and frgms (MNHN).

DISTRIBUTION. — The temperate North Atlantic, between 36° and 49°N, in 1050-2685m (bathyal); amphiatlantic.

DESCRIPTION. — *Shell* large, solid, depressed, consisting of 2.5 protoconch and up to 2.6 teleoconch whorls. Protoconch globular, multispiral. Protoconch I diameter 250 µm, sculpture not very well preserved on available specimens, but reticulation of anastomosing star-shaped knobs present beside a few (3-5 ?) spiral cords. Protoconch II with two spiral keels apparent above suture, third keel concealed by subsequent whorl. Last half protoconch II whorl with discrete sculpture of tubercles in subsutural zone. Protoconch/teleoconch transition very sharp. Teleoconch with strongly keeled whorls, almost rectangular in cross-section, adhering to preceding whorl just below abapical keel, and concealing suture in deep furrow. Sculpture consisting of spiral cords and incremental lines. 25 spiral cords between suture and first keel on adapical part of body whorl; 6 between keels; and about 30 on base, also in umbilicus. In addition to incremental lines, also a few coarse, strongly prosocline ribs on shoulder of terminal part of body-whorl. Umbilicus very broad. Aperture rectangular, peristome almost continuous; outer lip sharp, simple. Parietal wall convex, strongly reflected towards umbilicus. Colour of protoconch brown, teleoconch dirty white.

Dimensions of a fully grown shell: Height 8.1 mm, diameter 13.2 mm; aperture height 4.3 mm, breadth 7.7 mm.

Larval shell measurements:

	diameter (µm)	no. whorls (prot. II)
USNM 52077	1380	2.2
SEAMOUNT CP 30	1510	2.2
SEAMOUNT CP 30	1490	2.25
SEAMOUNT CP 30	1660	2.3
SEAMOUNT CP 30	1580	2.1
BIOGAS CP 37	1340	?
"*Thalassa*" Z435	1300	2.1

REMARKS. — There is no species easily confused with *H. cingulata*. The two strong spiral keels appear early on the teleoconch, making identification of very young specimens possible. At comparable size only *Zygoceras biocalae* bears some resemblance but lacks almost completely a spiral sculpture and has a much smaller umbilicus.

Haloceras exquisita sp. nov.

Figs 83, 89-90

TYPE MATERIAL. — Holotype in MNHN.

TYPE LOCALITY. — BIOCAL, stn DW66, 24°55'S, 168°22'E, 505-515m, S of New Caledonia.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL, stn DW 66, 24°55'S, 168°22'E, 505-515 m: holotype (MNHN).

DESCRIPTION. — *Shell* small, thin, fragile, consisting of 2.5 protoconch and 1.5 teleoconch whorls. Larval shell globular, multispiral. Protoconch I diameter 215 µm, sculptured with rather irregularly disposed knobs in nucleus, later arranged in spiral lines. Protoconch II with 2.1 whorls, diameter 870 µm; first whorl sculptured by one strong spiral keel and one row of subsutural granules; later a second spiral keel, previously hidden by suture, and a sculpture of

small knobs and granules appears, between keels. Surface of last half whorl of protoconch II completely covered by such granules and knobs. Teleoconch whorls turreted, with two very strong keels at periphery giving a very angular profile to whorls. No other spiral sculpture except for a discrete thread bordering umbilicus. Upper part of whorls with sculpture of prosocline axial ribs extending from suture to adapical keel, forming spiny intersections with keel. Axial ribs obsolete between keels. Base smooth. Umbilicus narrow. Aperture quadrangular, outer lip thin, sharp, a little reflected over umbilicus. Colour of protoconch brown, teleoconch white.

Dimensions: Height 1.80 mm, breadth 1.75 mm; aperture height 0.72 mm, breadth 0.77 mm.

REMARKS. — *Haloceras exquisita* has a very distinctive protoconch and teleoconch morphology which should facilitate identification. The protoconch is smaller, at a similar number of whorls, than in any other haloceratid. The general morphology and sculpture of the teleoconch whorls resemble *H. acrocomata*, but the whorls are not as depressed as in *H. acrocomata*.

ETYMOLOGY. — From the latin *exquisitus*, fine.

Haloceras galerita sp. nov.

Figs 66, 100-102

TYPE MATERIAL. — Holotype AMS C150227.

TYPE LOCALITY. — " *Kapala* ", stn K80.20.20, 33°35-37'S, 152°05'E, 1143-1106m, off Sydney, New South Wales.

MATERIAL EXAMINED. — **Australia.** " *Kapala* ", stn K 80.20.20., off Sydney, 33°35'S, 152°05'E, 1143-1106 m: holotype (AMS C150227).

DESCRIPTION. — *Shell* small, solid, trochoid, consisting of 2.5 protoconch and 1.9 teleoconch whorls. Protoconch I diameter 200 µm, sculpture not very distinct but seemingly consisting of coarse spiral cords. Protoconch II with 2 spiral keels visible above suture, and a subsutural row of granules. Also a few distinct incremental ribs just before larval peristome; rest of protoconch smooth. Teleoconch whorls convex with rather deep suture. Sculpture of spiral cords and strong incremental, almost lamellar, lines. Two spiral cords form keels; abapical one, sharp and clearly defining basal surface. About 8 spiral cords above shoulder of body whorl, 6 at periphery between keels, and about 18 on basal area, extending into umbilical region. Incremental lines strongly curved, with most retracted point on adapical keel. Umbilicus narrow. Aperture ovoid, broader than high. Outer lip thin, simple, a little reflected over umbilicus. Colour of protoconch brown, teleoconch white.

Dimensions: Height 2.6 mm, breadth 2.8 mm; aperture height 1.2 mm, breadth 1.5 mm.

Larval shell measurements:

diameter (µm)	no.whorls (prot.II)
1080	2.0

REMARKS. — *Haloceras galerita* resembles *H. mediocostata*, but it has a stronger, coarser spiral sculpture, with better defined spiral keels, the umbilicus is even more narrow and the diameter of the whorls increases less rapidly than in *mediocostata*.

ETYMOLOGY. — From the Latin *galerum*, a hat or helmet; to remind of the large and conspicuous protoconch.

Haloceras heliptyx sp. nov.

(Figs 63, 103)

TYPE MATERIAL. — Holotype in MNHN.

TYPE LOCALITY. — BIOGEOCAL, stn DW289, 20°36'S, 167°00'E, 830-840 m, Loyalty Basin, E of New Caledonia.

MATERIAL EXAMINED. — **Loyalty Basin (E of New Caledonia).** BIOGEOCAL, stn DW 289, 20°36'S, 167°00'E, 830-840 m: holotype (MNHN).

DESCRIPTION. — *Shell* small, solid, trochoid consisting of 2.75 teleoconch, and unknown number of protoconch whorls (apex broken). Protoconch probably globular; little more than last whorl remaining, diameter 770 µm. Protoconch II sculptured with two strong spiral keels, one at periphery, one just above suture; zone between two keels with numerous small

pustules. Flexuous axial riblets above peripheral keel on last part of protoconch II. Teleoconch whorls very convex, with slightly channelled suture. Spiral sculpture stronger than axial sculpture, consisting of three strong keels and much weaker spiral cords. Abapical spiral keel hidden at suture on spire, apparent only on body whorl. 6 much finer cords on shoulder of whorls, one between keels, and 10 on basal area. Axial sculpture consisting of strongly prosocline cords, not extending to basal area and forming little nodules at intersections with spiral keels. Also numerous second order incremental ridges, extending over base. Umbilicus open, smooth inside. Aperture ovate, outer lip rather regularly convex, columellar region slightly reflected over umbilicus. Colour of protoconch brown, teleoconch white.

Dimensions: Height 3.1 mm, breadth 2.9 mm; aperture height 1.0 mm, breadth 1.25 mm.

REMARKS. — *H. heliptyx* resembles *H. galerita*, but differs by having stronger axial sculpture and fewer and stronger spiral cords. The umbilicus of *H. galerita* is almost closed and its protoconch II has a bigger diameter, 1080 µm. There is also a general resemblance to *H. japonica*, which has a thinner shell with thick periostracum and rounded aperture, and differs in its brooding reproductive biology.

ETYMOLOGY. — From the Greek *helix*, spiral, and *ptyx*, a fold; to remind of the strong spiral keels of the shell.

Haloceras japonica Okutani, 1964

Figs 34, 40, 62, 64-65

Halocerus japonicus Okutani, 1964: 397, pl. 6, fig. 8.

TYPE MATERIAL. — Holotype and 1 paratype in Tokyo University Museum, RM 8824.

TYPE LOCALITY. — 34°10′N, 140°05.5′E, 1230-1350m, 26 miles off Miyake Island, Japan.

MATERIAL EXAMINED. — **Japan**. 26 miles off Miyake Island, 34°10′N, 140°05.5′E, 1230-1350 m: holotype, 1 paratype (Tokyo Univ. Mus. RM 8824).

Eastern Pacific (Oregon). " *Yaquina* ", stn OTB-188, 45°50′N, 125°14′W, 1580 m: 1 spm. (LACM 67-167.2).

DESCRIPTION. — Teleoconch high, trochoid, consisting of more than 2.5 whorls (corroded) with thick, strongly adhering periostracum. Whorls convex, suture moderately deep. Sculpture consisting of spiral cords, of which two form keels at periphery, no spiral cords above shoulder, 2 between keels and 5 on base. Axial sculpture of periostracal lamellae. Umbilicus broad, encircled by a broad but indistinct cord. Aperture rounded, forming a slight angle at base of columellar pillar. Outer lip thin, sharp. Colour of shell chalky white, periostracum dark greenish brown.

Dimensions of holotype: height 5.95 mm, breadth 5.05 mm; diameter of the aperture 2.25 mm.

REMARKS. — Neither of the two known shells have a well preserved protoconch. The dried body of the specimen from off Oregon was found to contain 9 brooded embryos (Fig. 64). The shells of some of these embryos were extracted (Fig. 65). They are white, 1030-1050 µm in diameter, with a sculpture of coarse granules extending half a whorl further than on protoconch I of other haloceratids. The assignment of the species to *Haloceras* rather than *Zygoceras* is based on the general resemblance in the shape of the teleoconch compared with other species of *Haloceras*, primarily *H. galerita* and *H. heliptyx*.

Haloceras laxa (Jeffreys, 1885)

Figs 74-75, 116-118

Seguenzia laxa Jeffreys, 1885: 44, pl.5, figs 4-4a.

TYPE MATERIAL. — Holotype BMNH 1885.11.5.2586.

TYPE LOCALITY. — " *Porcupine* " 1870, stn 16, 39°55′N, 09°56′W, 1810m, off Portugal.

MATERIAL EXAMINED. — **Eastern Atlantic.** " *Porcupine* ", 1870, stn 16, off Portugal, 39°55′N, 09°56′W, 1810 m: holotype (BMNH 1885. 11.5.2586).

MONACO, stn 624, Azores, 38°59′N, 28°18′W, 2102m, 1 sh. (MOM).

" *Sarsia* ", stn 7614, Bay of Biscay, 43°43′N, 03°38′W, 1100m: 1 sh. (BMNH).

SEAMOUNT, stn CP 30, Gorringe Bank, 36°44′N, 11°23′W, 1940-2075 m: 7 shs (MNHN).

Three additional shells are tentatively identified as *Haloceras* aff. *laxa*:

" *Thalassa* " stn Y 378, off NW Spain, 41°34′N, 09°16′W, 1000m: 1 sh. (MNHN). — Stn Z 435, Bay of

Biscay, 48°40'N, 09°56'W, 1050m: 1 sh. (MNHN).
BIOGAS, stn CP 37, 47°34'N, 08°39'W, 2175m: 1 sh (MNHN).

DESCRIPTION. — *Shell* small, solid, discoid, consisting of 2.3 protoconch whorls and up to 1.4 teleoconch whorls. Protoconch globular, multispiral. Protoconch I diameter 220 µm, sculptured by combination of anastomosing star-shaped knobs and spiral cords. Protoconch II smooth, except two strong spiral keels and one subsutural row of granules. Protoconch/teleoconch transition abrupt. Teleoconch whorls convex, first rather regularly rounded in young postlarva, then cross-section of whorl becomes more and more depressed, ending up in a horizontally ovoid cross-section of body-whorl, with very deep suture. Sculpture consisting of strong spiral cords and incremental lines. Cords strongest at periphery and weaker or obsolete on shoulder and base. Incremental lines very regular and closely set, giving shell a shining appearance, especially on shoulder. Umbilicus wide, not encircled by cord. Aperture horizontally ovoid, peristome continuous, only slightly adhering to penultimate whorl. Inner lip strongly reflected over umbilicus. Colour of protoconch I brown, protoconch II much paler except at protoconch-/teleoconch transition, teleoconch white.

Dimensions of largest shell: Height 2.1 mm, diameter 3.4 mm; aperture height 0.9 mm, breadth 1.9 mm.

Larval shell measurements:

	diameter (µm)	no.whorls (prot.II)
SEAMOUNT CP 30	1130	1.8
SEAMOUNT CP 30	1150	1.8
SEAMOUNT CP 30	1100	1.75
SEAMOUNT CP 30	1100	1.75
SEAMOUNT CP 30	1140	1.75
SEAMOUNT CP 30	1140	1.8
MONACO 624	1200	?
" *Sarsia* " 7614	980	1.7
aff. *laxa*		
" *Thalassa* " Y378	1030	1.75
" *Thalassa* " Z435	1060	1.85
BIOGAS CP 37	1100	1.8

REMARKS. — The holotype of *S. laxa* is 4.2mm high, it is badly broken and worn which makes identification of the name very difficult. Although the identification at family level is beyond doubt, there are no specimens collected in the NE Atlantic that match this fragment precisely. It could be a fragment of a very large *H. carinata* (but there is no specimen of *H. carinata* higher than 3.3 mm known), or it could be a fragment of the species we have used the name for (but it has less depressed whorls than our shells of that size). It is probable that when more NE Atlantic specimens become available, it will be possible to match this fragment more accurately, but it is incredible that Jeffreys based a new species on this worn fragment.

H. laxa can be identified from other species by the absence of well defined keels at the periphery of teleoconch whorls, its depressed whorls, and small adult size. *H. cingulata* is similarly depressed, but has strongly keeled whorls and a much larger adult size. *H. carinata* also lacks well defined spiral keels but it has a higher spire and considerably smaller protoconch. *H. rugosa*, from the SE Pacific, has an almost closed umbilicus and a distinctive sculpture on the adapical part of teleoconch whorls.

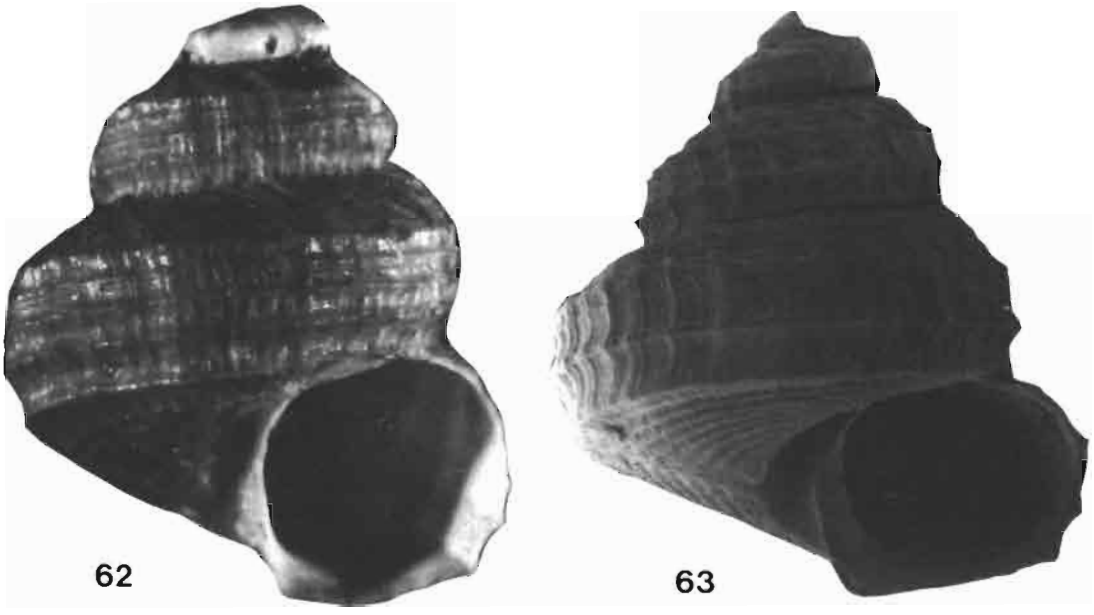
The shells referred to as *H.* aff. *laxa* differ in having a stronger spiral sculpture, and more regularly rounded, not depressed whorls. The protoconch sculpture and measurements are however indistinguishable from those in typical *laxa*. Two of these shells originate from the northern part of the Bay of Biscay, while the more depressed specimens are from further south. They may represent variation or belong to a distinct species.

Haloceras sp. 1

Figs 68-69, 70-71, 104

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL, stn DW 70, 23°25'S, 167°53'E, 965 m: 2 shs (MNHN).
Australia. " *Kapala* " stn 80-20-10, off Sydney, 33°36'S, 152°05'E, 1105-1143m: 3 shs (AMS C157269).

DESCRIPTION. — *Shell* trochoid, with a low spire. Protoconch I, diameter 230 µm, not perfectly preserved but with reticulation of anastomosing knobs and spiral cords. Protoconch II with 2 visible spiral keels, one well visible and one at or just above suture. Subsutural zone granulated. Teleoconch with up to 1.9 convex,



FIGS. 62-63. — Genus *Haloceras*. — **62,** *H. japonica*, holotype, height 5.97mm. — **63,** *H. heliptyx*, holotype, height 3.1mm.

regularly rounded whorls, sculptured with spiral cords and incremental lines. Two spiral cords form indistinct keels at periphery. Umbilicus is open.

Dimensions of largest shell: Height 2.7 mm, breadth 3.1 mm.

Larval shell measurements:

	diameter (μm)	no.whorls (prot.II)
BIOCAL DW 70	1020	1.9
BIOCAL DW 70	1080	1.9
AMS 157269	900	1.75
AMS 157269	920	1.95
AMS 157269	900	2.0

REMARKS. — These shells are somewhat intermediate between *H. carinata* and *laxa*. They have a higher spire and a stronger spiral sculpture than *H. laxa*, and a lower spire and bigger protoconch than *H. carinata*. There is no doubt however that *Haloceras laxa* and *H. carinata* are two distinct species in the North Atlantic.

In fact these shells strongly resemble the NE Atlantic shells we have called *Haloceras* aff. *laxa* above, and may be conspecific with them. We would probably have treated them as a single species if they had originated from the same ocean. Considering the vast distances (more than 20,000 km) separating the locations, we judge the material insufficient to conclude if one, somewhat variable, or several, closely related species are involved.

Haloceras mediocostata
(Dautzenberg & Fischer, 1896)

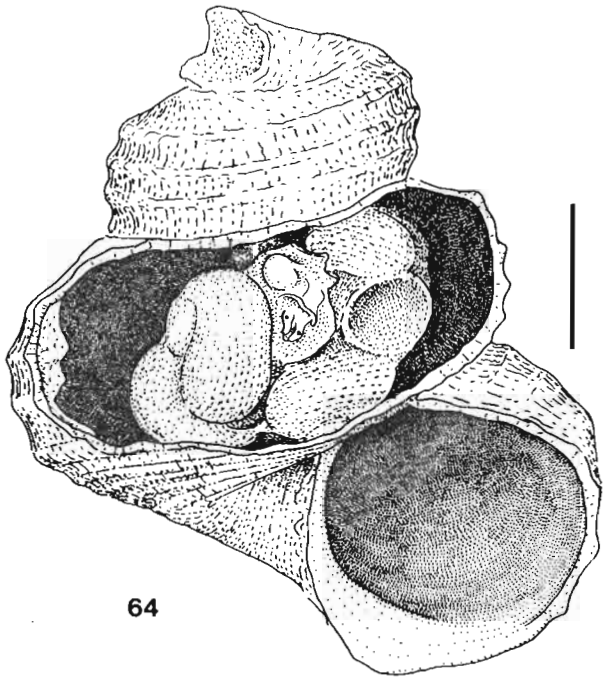
Figs 56-57, 97-99

Cithna carinata var. *mediocostata* Dautzenberg & Fischer, 1896: 449.
Cithna jeffreysi var. *mediocostata* Dautzenberg & Fischer, 1897: 159.
Cithna carinata var. *mediocostata* — DAUTZENBERG 1927: 118.

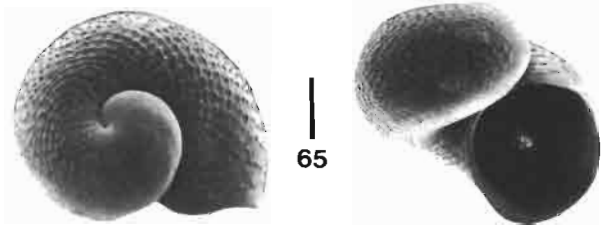
TYPE MATERIAL. — Lectotype, here designated, one shell marked by DAUTZENBERG « type » in MOM (Fig. 57); paralectotype from the same station in MNHN.

TYPE LOCALITY. — MONACO, stn 553, 37°43'N, 25°05'W, 1385m, Azores.

MATERIAL EXAMINED. — **Eastern Atlantic.** MONACO, stn 553, Azores, 37°43'N, 25°05'W, 1385 m: Lectotype (MOM); 1 paralectotype (MNHN). — Stn 578, 38°26'N, 26°31'W, 1165m: 1 sh. — Stn 703, 39°21'N, 31°06'W, 1360m: 2 shs.



64



65

FIGS. 64-65. — *Haloceras japonica*, off Oregon. — **64,** Specimen with partly broken body whorl showing the embryos brooded in the oviduct; scale line 1 mm. — **65,** Larval shell of the embryos; scale line 0.25 mm.

DAUTZENBERG (1927) also listed material from stn 203, 683, 698 and 719. We have examined this material in MOM: the shell from stn 683 belongs to an undescribed species of *Zygoceras* (see p. 159); others are unrecognizable fragments, or have been destroyed by acidic glass tubes.

DESCRIPTION. — *Shell* small, thin, fragile, trochoid, consisting of 2.5 protoconch and up to 2.3 teleoconch whorls. Protoconch globular, multispiral. Protoconch I, diameter 200 µm, with a sculpture of spiral cords. Protoconch II with two spiral keels (one at or just above suture) and a subsutural row of granules. In last part of protoconch II, just before larval peristome, a few strong incremental ribs; rest of protoconch smooth. Teleoconch whorls regularly convex, suture slightly channeled but otherwise only moderately deep. Sculpture of spiral cords and incremental lines. Two stronger cords form spiral keels at periphery; about 8 spiral cords on shoulder of body whorl, 3 at periphery between keels; 12 on base, extending to umbilical region. Umbilicus rather narrow, not encircled by cord. Aperture rounded; outer lip thin, simple, inner lip a little reflected over umbilicus. Colour of shell white, protoconch brown.

Dimensions of a complete shell: Height 2.5 mm, breadth 2.6 mm; aperture height 1.2 mm, breadth 1.3 mm.

Larval shell measurements:

	diameter (µm)	no.whorls (prot.II)
MONACO 553	1220	2.1
MONACO 553	1240	2.1
MONACO 578	1200	2.0
MONACO 703	1300	2.1
MONACO 703	1240	2.0

REMARKS. — The assignment of this species to *Cithna jeffreysi* [= *Benthonella tenella* (Jeffreys, 1869); Rissoidae] by DAUTZENBERG & FISCHER, 1897 was due to a printer's mistake (DAUTZENBERG, 1927).

H. mediocostata bears some resemblance to the keeled specimens of *H. carinata* (which lives in the same part of the North Atlantic), but can be separated by the size of the protoconch: diameter 700-920 µm (mean 817 µm) in *H. carinata*, vs. 1200-1300 µm (mean 1240 µm) in *H. mediocostata*; *H. carinata* also has a higher spire.

Haloceras millestriata (Okutani, 1964)

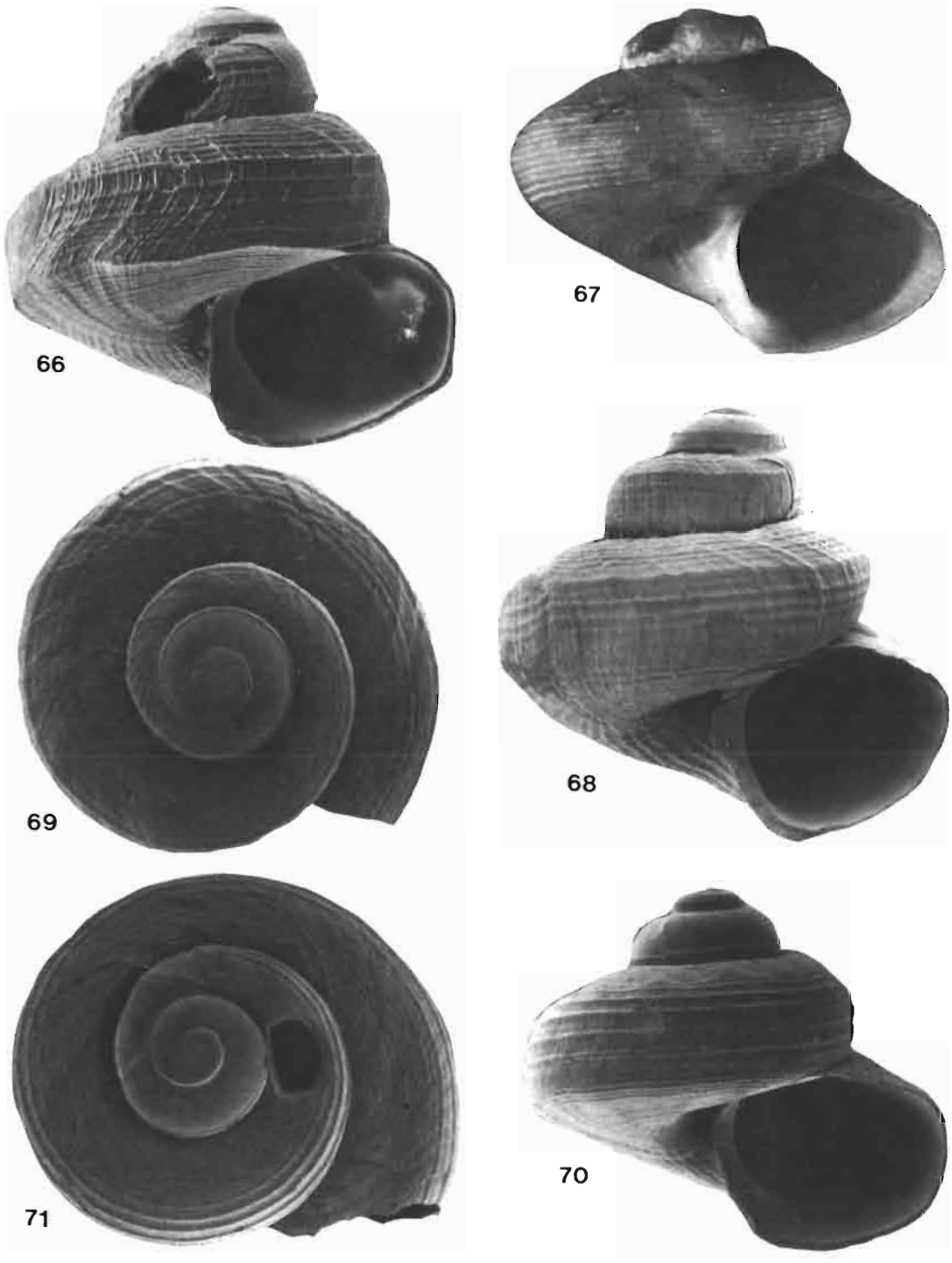
Fig. 67

Torellia millestriata Okutani, 1964: 397, pl. 6, fig. 4.

TYPE MATERIAL. — Holotype in Tokyo University Museum, RM 8822.

TYPE LOCALITY. — 34°10'N, 140°05.5'E, 1230-1350m, 26 miles off Miyake Island, Japan.

MATERIAL EXAMINED. — **Japan.** 26 miles off Miyake Island, 34°10'N, 140°05.5'E, 1230-1350 m: holotype (Tokyo Univ. Mus., RM 8822).



FIGS. 66-71. — Genus *Haloceras*. — **66,** *H. galerita*, holotype, height 2.6mm. — **67,** *H. millestriata*, holotype, height 3.3mm. — **68-69,** *Haloceras* sp.1, AMS C 157269, diameter 2.35mm, height 2.65mm. — **70-71,** *Haloceras* sp.1, BIOCAL stn DW70, diameter 2.9mm, height 2.5mm.

REMARKS. — The holotype and only known shell of *H. millestriata* has no larval shell. Our generic assignment is based on the general morphology of the teleoconch. The whorls are depressed and the spiral sculpture forms two indistinct keels at the periphery. *Haloceras millestriata* ressembles a little *H. laxa* and *H. rugosa*, which both have a low spire, and regularly rounded whorls. It is however easily recognizable by its even sculpture of strong spiral lines, and moderately open umbilicus.

Haloceras phaeocephala sp. nov.

Figs 32, 43, 81-82, 95-96

TYPE MATERIAL. — Holotype and 2 paratypes (1 live taken) AMS C146202.

TYPE LOCALITY. — "*Kapala*" 1980, 33°36'S, 152°05'E, 1143-1106m, off Sydney, New South Wales, Australia.

MATERIAL EXAMINED. — **Australia.** "*Kapala*" 1980, off Sydney, 33°36'S, 152°03'E, 1143-1106 m: holotype, 2 paratypes (AMS C146202). — Off Sydney, 33°38'S, 152°03'E, 924-896m: 1 sh. (AMS C150189). — Off Wollongong, New South Wales, 34°26'S, 151°27'E, 1200m: 2 shs (AMS C150188). — NE of Batemans Bay, New South Wales, 35°30'S, 150°52'E, 960-969m: 1 spm. (AMS C150190).

DESCRIPTION. — *Shell* small, solid, depressed rissoiform, consisting of 2.3 protoconch and 2 teleoconch whorls with thick adhering periostracum. Protoconch I, diameter 230 µm, nucleus with thin spiral threads which soon stop, leaving rest of protoconch I smooth, except for 4 spiral threads above suture. First whorl of protoconch II sculptured by continuation of spiral threads from protoconch I. Later sculpture of irregular, raised scratches and spirally elongated knobs develops and completely covers last protoconch whorl. Protoconch/teleoconch discontinuity very sharp. Teleoconch whorls convex, shouldered, with moderately deep suture. Sculpture consists of strong, broad axial ribs, thin incremental lamellae and spiral cords. 11 axial ribs on first teleoconch whorl, and 15 on body whorl of holotype. 5 strong spiral cords at periphery of which adapical one forming a slightly spiny shoulder at intersections with axial ribs. 2, later on body-whorl 3, fainter spiral cords on shoulder, 8 on base, of which one demarcates umbilicus. Umbilical chink narrow. Outer lip thin, simple, with most projecting point at lower third; inner lip slightly reflected and forming narrow callus over umbilicus, a little protracted at base. Colour of larval shell reddish brown, teleoconch with yellowish white periostracum.

Dimensions: Height 3.33 mm, breadth 3.06 mm; aperture height 1.74 mm, breadth 1.50 mm.

Larval shell measurements:

	diameter (µm)	no.whorls (prot.II)
AMS 146202 (holotype)	1060	2.0
AMS 146202	940	1.8
AMS 146202	1000	1.9
AMS 150188	1000	1.9
AMS 150189	910	1.8
AMS 150190	890	1.8

REMARKS. — There is variation in the strength of the sculpture. One of the shells (AMS 150189) is almost devoid of axial ribs, but transitional specimens are present, although sculptured specimens appear to be more frequent. The sculpture, size and number of whorls of the protoconch are the same in strongly and weakly sculptured shells and they are undoubtedly conspecific.

The protoconch of *H. phaeocephala* differs from that of congeners in having a protoconch I with spiral threads on a smooth background, a character of *Zygoceras*. Protoconch II however is characteristic for the genus.

Recognition of this distinctive little haloceratid should be easy since it is the only representative of the family with a strongly sculptured, rissoiform shell.

ETYMOLOGY. — From the Greek *phaios*, brown, and *kephale*, head; to remind of the brown coloured protoconch.

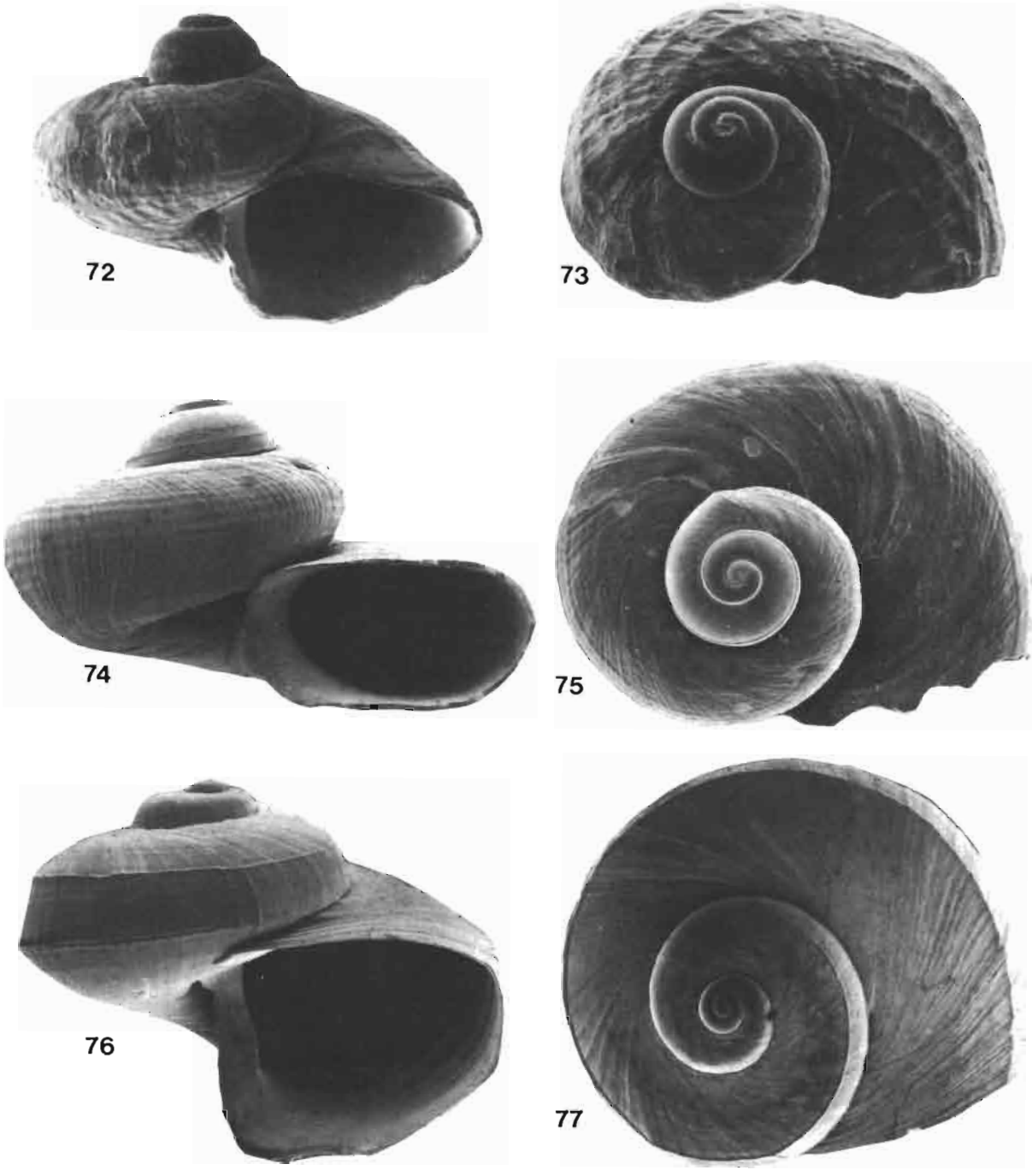
Haloceras rugosa sp. nov.

Figs 72-73, 91-92

TYPE MATERIAL. — Holotype LACM 2279.

TYPE LOCALITY. — Allan Hancock Foundation, stn 482, 01°09'S, 90°36'W, 455m, Galapagos Islands.

MATERIAL EXAMINED. — **Galapagos Islands.** ALLAN HANCOCK FOUNDATION, stn 482, 01°09'S, 90°36'W, 455 m: holotype (LACM 2279).



FIGS. 72-77. — Genera *Haloceras* and *Zygoceras*. — **72-73,** *Haloceras rugosa*, holotype, height 2.95mm, diameter 3.65mm. — **74-75,** *H. laxa*, SEAMOUNT stn CP30, height 2.1mm, diameter 3.4mm. — **76-77,** *Zygoceras biocalae*, holotype, height 7.0mm, diameter 9.6mm.

DESCRIPTION. — *Shell* solid, globular, consisting of 2.5 protoconch and 1.25 teleoconch whorls. Protoconch I, diameter 200 µm, with about 10 irregular spirals, interconnected by a net of anastomosing short trabecles. Protoconch II with two spiral keels; one well exposed, one partly hidden at suture; rest of protoconch smooth except for one row of subsutural granules. Teleoconch whorls regularly convex, with deep suture. Umbilicus open, narrow. Sculpture above periphery of diverging, strongly opisthocline radiating ribs which intersect rather coarse, prosocline incremental ribs and produce irregular hammered appearance. 5-6 regular spiral cords at and below periphery; another group of similar spiral cords, more crowded towards basal and umbilical region. Incremental sculpture weak and indistinct. Aperture simple, outer lip sharp, thin, inner lip slightly reflected over umbilicus. Protoconch brown, teleoconch white.

Dimensions of shell: Height 2.95 mm, diameter 3.65 mm; aperture height 1.80 mm, breadth 1.95 mm.

Larval shell measurements:

diameter (µm)	no.whorls (prot.II)
1100	2.1

REMARKS. — *H. rugosa* is characterized by the malleated appearence of the surface of the adapical part of its whorls, with the strongly opisthocline ribs that cross prosocline incremental ribs. This character, in combination with the small umbilicus and regularly rounded, unkeeled whorl facilitates the identification.

ETYMOLOGY. — From the Latin *rugosus*, schriveled, wrinkled; to remind of the teleoconch sculpture.

Haloceras spinosa sp. nov.
Figs 80, 109-110

TYPE MATERIAL. — Holotype AMS C157270.

TYPE LOCALITY. — " *Kapala* ", stn K80.20.10, 33°36'S, 152°03'E, 1106-1143m, off Sydney, New South Wales, Australia.

MATERIAL EXAMINED. — **Australia.** " *Kapala* ", stn K 79.20.14, off Broken Bay, New South Wales, 33°38'S, 152°06'E, 1033 m: 1 sh. (AMS C146529). — Stn K 80.20.10, off Sydney, 33°36'S, 152°03'E, 1106-1143 m: holotype (AMS C157270).

Loyalty Basin (E New Caledonia). BIOGEOCAL, stn CP 232, 21°34'S, 166°27'E, 760-790 m: 2 shs (MNHN).

DESCRIPTION. — *Shell* small, solid, broadly rissoiform, consisting of 1.7 protoconch and 2.7 teleoconch whorls, with thin, transparent, adhering periostracum. Protoconch I, diameter 290 µm, sculptured with about 10 rather fine spiral threads. Shell corroded at transition protoconch I/II. Protoconch II smooth and shiny except for narrow subsutural zone of granules, and two strong spiral keels at periphery. Protoconch / teleoconch transition abrupt, with peristome of protoconch slightly flaring. Teleoconch whorls convex with rather deep channelled suture. Sculpture consisting of strong spiral cords and weaker, lamellar axial ribs, forming small raised spines when they intersect. 4 spiral cords on first whorl, secondary spirals appear on body whorl between adapical cords; also one cord encircling slightly convex base, 4 other cords on base and 2 more indistinct ones in umbilicus. Channeled appearance of suture results from it being lined by two adjacent raised spiral cords. 19 prosocline axial ribs on first teleoconch whorl, 32 on body whorl. Between these, fine incremental lines. Umbilicus open, small. Aperture slightly depressed; outer lip sharp, simple; inner lip slightly reflected over umbilicus. Colour of larval shell brown, teleoconch white.

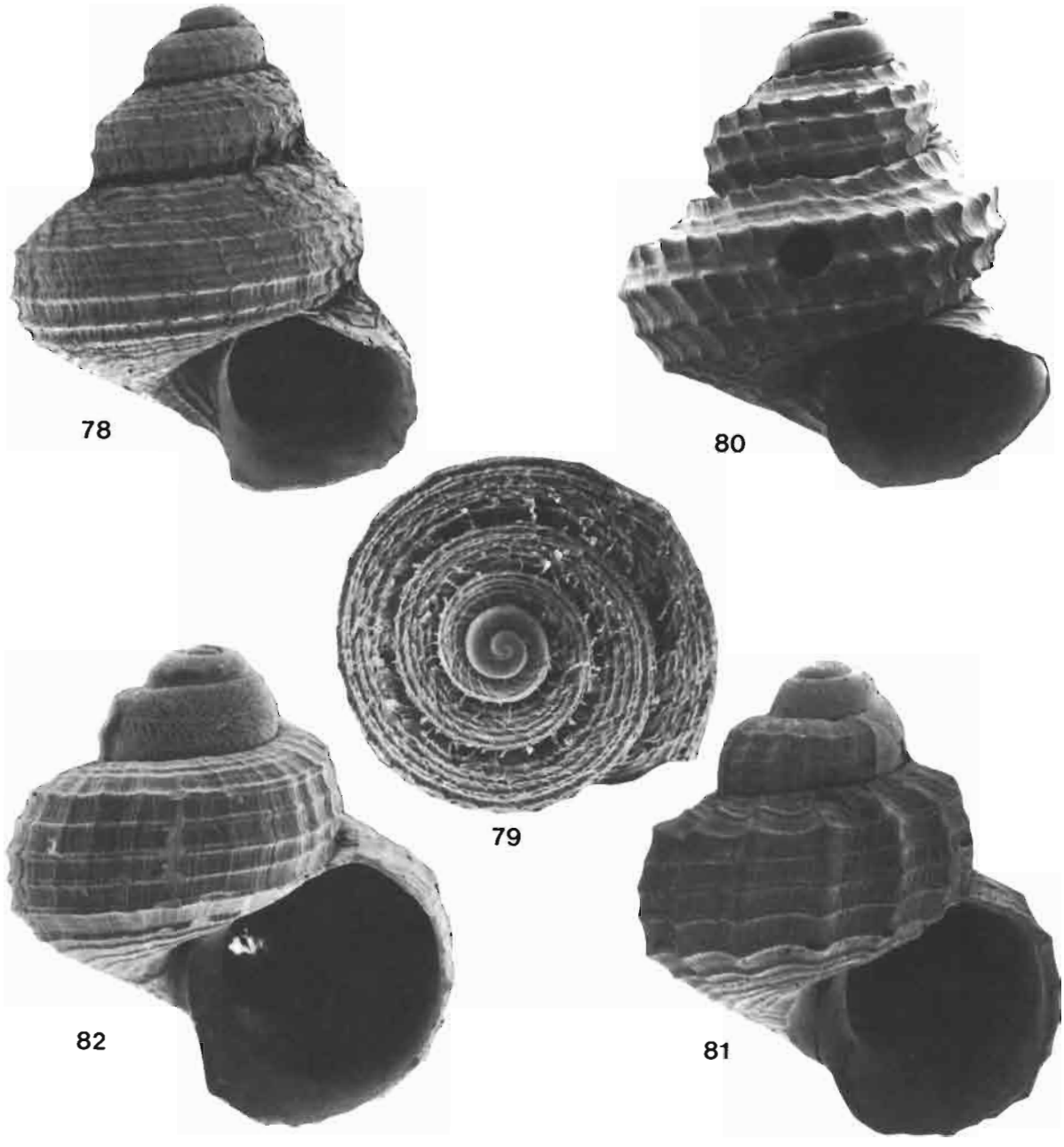
Dimensions: Height 3.28 mm, breadth 2.88 mm; aperture height 1.12 mm, breadth 1.32 mm.

Larval shell measurements:

	diameter (µm)	no.whorls (prot.II)
holotype	720	1.2
BIOGEOCAL CP 232	675	1.3
BIOGEOCAL CP 232	690	1.3

REMARKS. — *H. spinosa* is immediately separated from other haloceratids by the spiny general appearance.

ETYMOLOGY. — From the Latin *spinosus*, thorny; to remind of the teleoconch sculpture.



FIGS. 78-82. — Genus *Haloceras*. — **78-79,** *H. trichotropoides*, holotype, height 3.57 mm, diameter 3.06mm. — **80,** *H. spinosa*, holotype, height 3.28mm. — **81,** *H. phaeocephala*, holotype, height 3.33 mm. — **82,** *H. phaeocephala*, AMS C 150189, height 2.50mm.

Haloceras tricarinata (Jeffreys, 1885)
Figs 37-39, 50-52, 119-120

Seguenzia tricarinata Jeffreys, 1885: 43, pl.5, fig.2.
Seguenzia tricarinata- QUINN 1983: 744.

TYPE MATERIAL. — Holotype BMNH 1885.11.5.2589.

TYPE LOCALITY. — "*Porcupine*" 1870, stn 17a, 39°39'N, 09°39'W, 1347m, W of Portugal.

MATERIAL EXAMINED. — **Eastern Atlantic.** "Porcupine" 1870, stn 17a, W of Portugal, 39°39'N, 09°39'W, 1347 m: holotype (BMNH 1885.11.5.2589).
"*Discovery*", stn 10141, 24°34'N, 19°41'W, 3460-3470 m: 1 spm and 1 larva (BMNH).
SEAMOUNT, stn CP30, Gorringe Bank, 36°44'N, 11°23'W, 1940-2075m: 1 young sh (MNHN).
BIACORES, stn 126, Azores, 39°19'N, 33°47'W, 3360m: 1 larva (MNHN).
BIOGAS, stn DS 62, 47°33'N, 08°40'W, 2175m: 1 larva (MNHN).
Mozambique Channel. BENTHEDI, stn 87, SE Glorieuses Islands, 11°44'S, 47°35'E, 3716 m: 2 shs (MNHN).
South Africa. "*Galathea*", stn 192, off Durban, 32°00'S, 32°41'E, 3430 m: 1 sh (ZMC).

DISTRIBUTION. — Eastern Atlantic Ocean and SW Indian Ocean, between 40°N and 32°S, in 1940-3716m (abyssal).

DESCRIPTION (of a shell from Mozambique channel). — *Shell* large, solid, depressed, consisting of a globular larval shell with 3 whorls, and 1.75 planispirally coiled teleoconch whorls. Even on best preserved benthic specimen protoconch I and initial part of protoconch II corroded. Protoconch II with one strong, raised spiral thread well above suture, a second similar one, hidden by subsequent whorl, apparent only on terminal part of protoconch. In addition to raised spirals, also weaker periostracal spiral threads present on body-whorl of protoconch, 4 such spirals between adapical suture and raised keel, 4 between raised keel and abapical suture. Protoconch/teleoconch transition very sharp. Teleoconch with strongly keeled whorls, giving shell a lenticular appearance. Whorls convex above and below keel. Body-whorl adhering to penultimate whorl just below keel, thus concealing suture in a channel. Umbilicus broad and deep, continuous with larval umbilicus. Sculpture consists of spiral cords and thin, raised, periostracal incremental lamellae. About 15 spiral cords above periphery on early teleoconch, about 20 on later parts. Base of shell and umbilical region with about 25 such spiral cords. Outer lip thin, simple, angular at periphery; inner lip sharp, simple, slightly reflected over umbilicus. Shell chalky white with strong yellowish brown periostracum.

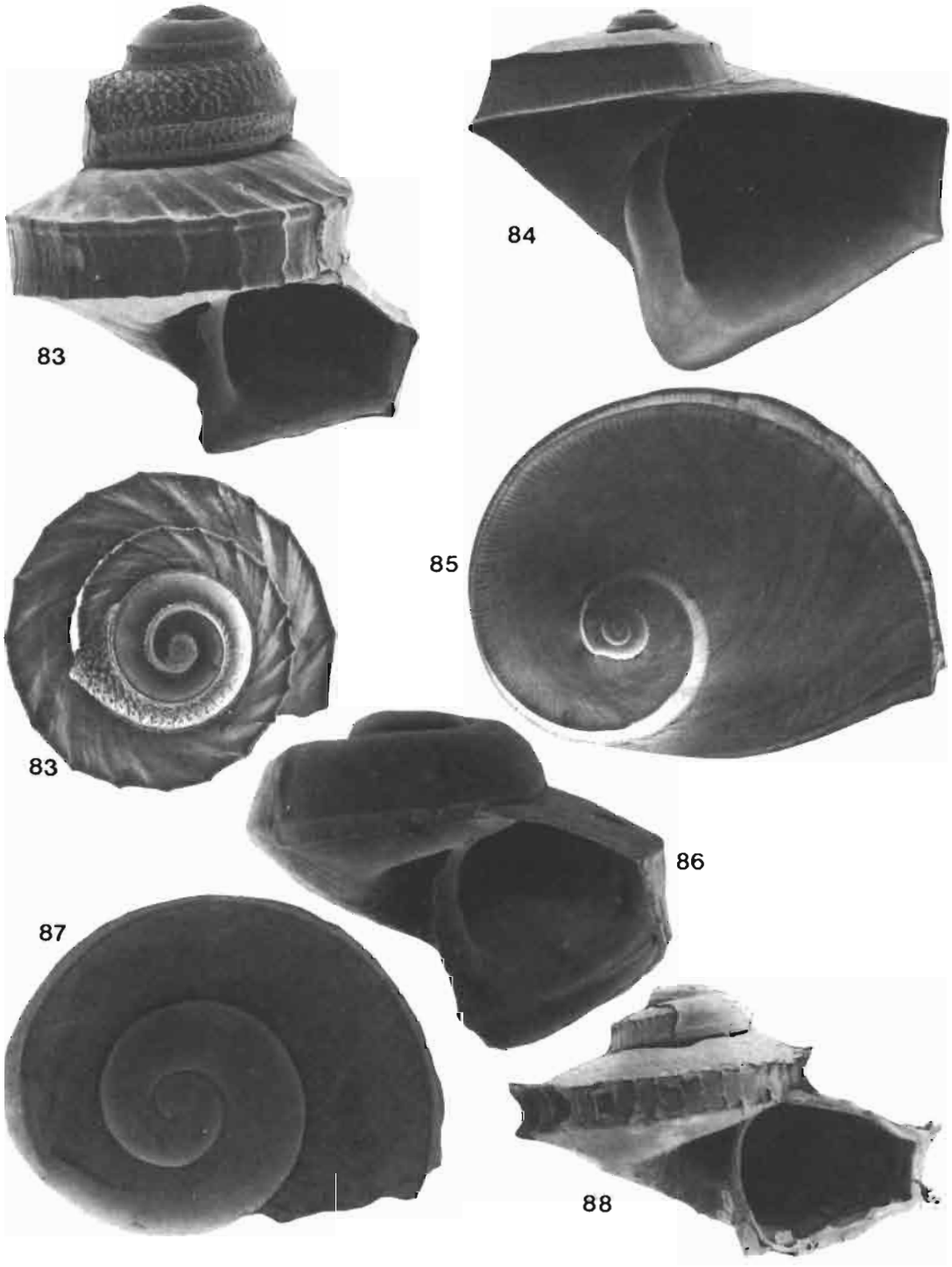
Dimensions of shell: Height 6.5 mm, max. diameter 14.1 mm; aperture height 4.8 mm, breadth 7.0 mm.

Larval shell measurements:

	diameter (μm)	no. whorls (prot.II)
BENTHEDI 87	1800	?
BENTHEDI 87	1920	?
"*Galathea*" 192	2300	2.3
"*Discovery*" 10141	1500	?
SEAMOUNT CP 30	2100	2.6
Unmetamorphosed larvae:		
holotype	2080	2.2
BIACORES 126	2110	2.4
BIOGAS DS 62	1810	2.5
"*Discovery*" 10141	1750	2.5

REMARKS. — QUINN (1983: 744) recognized that the holotype of *Seguenzia tricarinata* is a larval shell. Only a single species of Haloceratidae has a protoconch of this size (see measurements above and p. 159), which enables identification of *S. tricarinata*. This larval shell is superficially similar to certain nassarid larval shells and was erroneously regarded as such by QUINN (1983: 744). Nassarid larval shells have a broad and shallow sinusigera notch above the peripheral keel. The name *tricarinata* was based on the three strong keels present on the larval shell. Of these only the adapical keel remains well visible on the apex of the postlarva, the median keel is usually hidden just above or just below the suture, and the basal (abapical) keel is totally covered by the first teleoconch whorl.

Haloceras tricarinata can be identified, both as a larva and as a benthic snail, by its large protoconch. If this is destroyed, the lens-shaped, strongly keeled teleoconch, resembling certain land snails of the genus *Iberus* is characteristic. Among other species of Haloceratidae, it is only the larval shell of *H. cingulata* which approaches



FIGS. 83-88. — Genera *Haloceras* and *Zygoceras*. — **83,** *Haloceras exquisita*, holotype, height 1.8mm, diameter 1.75mm. — **84-85,** *Zygoceras tropidophora*, holotype, height 8.7mm, diameter 11.9mm. — **86-87,** *Zygoceras* sp., MONACO stn 683, height 1.25mm, diameter 1.7mm. — **88,** *H. acrocomata*, holotype, height 2.07mm.

the size of that of *H. tricarinata* (range 1300-1660 vs. 1500-2300 μm). The specific name is most unfortunate in view of the general appearance of the adult shell.

The specimen from off NW Africa ("*Discovery*", stn 10141) is still more lenticular (height 3.6 mm, diameter 10.1 mm; aperture height 3.0 mm, breadth 6.2 mm), with a weaker spiral sculpture, and the diameter of the larval shell is significantly smaller than in the 3 Indian Ocean snails; it may represent another species, although the large sized larvae from the SW Indian Ocean and the NE Atlantic appear to be conspecific.

Haloceras sp. 2

not figured

MATERIAL EXAMINED. — **Australia.** "*Kimbla*" 1984, stn 17, NE of Sandy Cape, Queensland, 1330-1380m, 1 sh (AMS C146279).

DESCRIPTION. — *Shell* small, solid, lenticular, consisting of about 3 protoconch and slightly more than one teleoconch whorl. Larval shell globular, multispiral. Apical part partly corroded, only sutures left, so size and sculpture of protoconch I cannot be determined. Protoconch II smooth, except for two spiral keels. Teleoconch whorl depressed, with one sharp keel at periphery; parts of whorl above and below keel regularly convex. Body whorl is adhering to penultimate whorl just below keel, giving suture very deep appearance. Sculpture consisting of strong spiral cords and much finer, rather indistinct incremental lines. About 20 spiral cords above keel, same number on base, extending into umbilicus. Umbilicus very broad, not encircled by a cord. Aperture ovoid, much broader than high, angular at periphery. Outer lip sharp, thin, inner lip slightly reflected over umbilicus.

Dimensions: Height 2.7 mm, breadth 5.05 mm; aperture height 1.8 mm, breadth 2.70 mm.

Larval shell measurements:

diameter (μm)	no.whorls (prot.II)
1580	ca. 2.3

REMARKS. — *Haloceras* sp. 2 is very similar to *H. tricarinata* in having a single sharp peripheral keel. In typical *H. tricarinata* however, the whorls are increasing more rapidly in diameter: at a little more than 1 teleoconch whorl, their diameter is already 7.2-8.5 mm, vs. only 5mm in *Haloceras* sp. 2. Also, in *H. tricarinata*, the peripheral keel is still sharper and more prominent. However, the larval shell characteristics fall within the range of variation observed for typical *tricarinata*. Only further material may solve the identity of this single shell.

Haloceras trichotropoides sp. nov.

Figs 78-79, 111-112

TYPE MATERIAL. — Holotype and one paratype, both live taken, USNM 450423 and 859418.

TYPE LOCALITY. — "*Aeolis*", stn 326, 136m, off Sand Key, Florida.

MATERIAL EXAMINED. **Western Atlantic (Florida).** "*Aeolis*", stn 326, off Sand Key, 136 m: holotype (USNM 450423); 1 paratype (USNM 859418). — Stn 338, off Sand Key, 156 m: 1 sh (USNM 450526). — Stn 344, off Key West, 183m, 1 sh (USNM 450536). — Stn 369, off Ajax Reef, 146-182m, 1 sh (USNM 450971). — Stn 370, off Ajax Reef, 128-165m, 2 shs (USNM 450572). — Stn unknown: 1 sh (USNM 878134).

DESCRIPTION. — *Shell* small, solid, conical, trochiform, consisting of 1.5 protoconch and 3 teleoconch whorls. Protoconch depressed, almost planispirally coiled. Protoconch I diameter 280 μm, with about 12 regular spiral cords. Protoconch II with two strong spiral keels, otherwise smooth: A third more basal keel, hidden by first teleoconch whorl, is visible on a juvenile with less than one postlarval whorl. Teleoconch with regularly convex whorls, a deep suture, and thick adherent periostracum. Sculpture consists of spiral cords and axial periostracal lamellae. 5 spiral cords at periphery slightly stronger than 5 above shoulder and 7 on base, of which one encircles umbilicus and two are situated in umbilicus. Periostracal lamellae strongest on adapical part of whorl, where forming scale-like projections adhering to preceding whorl. Umbilicus rather broad, open. Aperture rounded; outer lip sharp, thin; inner lip not reflected over umbilicus, with shallow siphonal depression. Colour of protoconch brown, teleoconch light amber brown.

Dimensions: Height 3.57 mm, breadth 3.06 mm; aperture height 1.40 mm, breadth 1.38 mm.

Larval shell measurements:

	diameter (μm)	no.whorls (prot.II)
USNM 450572	670	1.05
USNM 450572	670	1.05
USNM 450526	700	1.0
USNM 450536	660	1.05
USNM 450971	610	1.0
USNM 438412	650	1.05
USNM 450423	650	1.05
USNM 450423	650	1.05

REMARKS. — *H. trichotropoides* has the smallest protoconch of all known haloceratids, with only a single, almost planispiral whorl in protoconch II. It resembles a little *H. carinata*, which is partly sympatric with it in the West Atlantic, but that species has less coarse teleoconch sculpture, and a globular protoconch consisting of 1.7-1.9 whorls in protoconch II.

ETYMOLOGY. — From the genus name *Trichotropis* and the suffix *-oides*, having the form of; meaning that it ressembles that genus.

Genus *ZYGOCERAS* nov.

TYPE SPECIES. — *Zygoceras tropidophora* sp. nov.

DIAGNOSIS. — Haloceratidae with (in species with planktotrophic development) light yellowish multispiral protoconch. Protoconch I smooth except for 4-6 thin spiral cords placed near periphery. Protoconch II with two strong spiral keels of which one is hidden below suture by successive whorl. Teleoconch depressed with strongly angular whorls, narrow to closed umbilicus, and aperture with a swelling at base of columellar pillar. Soft parts with characters of the family.

REMARKS. — *Zygoceras* differs from *Haloceras* by the general shape and sculpture of the protoconch. The protoconch is low spired and light yellowish in *Zygoceras*, high spired and brown in *Haloceras*. Protoconch I has only 4-6 thin spiral cords on a smooth background in *Zygoceras*, vs. anastomosing riblets and pustules in *Haloceras*. In *Zygoceras* protoconch II has two spiral keels, of which one only is left apparent above suture by successive whorl; in *Haloceras* there are three spiral keels, with two left apparent above suture. The columellar swelling of the teleoconch appears to be absent in *Haloceras*, also in the two larger species of comparable size (*cingulata, tricarinata*).

Although we have emphasized here the characters of the protoconch of species with planktotrophic development, we fully expect that species with non-planktotrophic development, and therefore paucispiral protoconch, may occur in both genera.

ETYMOLOGY. — From the Greek, *zygos*, a pair, and the suffix *-ceras*, as in *Haloceras*; to mean that the new genus forms a pair with *Haloceras*, and also to remind the two strong spiral keels.

Zygoceras biocalae sp. nov.

Figs 76-77, 123-124

TYPE MATERIAL. — Holotype in MNHN.

TYPE LOCALITY. — BIOCAL, stn DW48, 23°00'S, 167°29'E, 775 m, off S New Caledonia.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL, stn DW 48, 23°00'S, 167°29'E, 775 m: holotype (MNHN).

DESCRIPTION. — *Shell* large, thin, solid, globular, with low spire of 1.75 protoconch and 2.3 teleoconch whorls. Larval shell depressed dome-shaped. Sculpture and limits of protoconch I not visible on only shell available. Protoconch II with approximately 1.25 whorls, diameter 1000 μm. One spiral keel just above suture, a second one hidden at suture. Except for these keels, protoconch smooth. Protoconch/teleoconch transition less distinct than in other haloceratids. Teleoconch whorls convex; after first, regularly convex whorl, two spiral keels, becoming stronger on body whorl. In addition to keels, subtle, ill-

defined, spiral threads and strong, prosocline and oblique, incremental ribs. Very narrow umbilical chink, almost closed by reflected inner lip. Aperture wide, rather rounded despite spiral keels. Outer lip thin, columellar pillar straight. Teleoconch white.

Dimensions: Height 7.0 mm, breadth 9.6 mm; aperture height 4.5 mm, breadth 5.1 mm.

REMARKS. — *Zygoceras biocalae* is a very distinctive species, that is best identified by its bicarinated teleoconch whorls of rapidly increasing diameter, and by its almost closed umbilicus. *Haloceras cingulata* has a broad open umbilicus, and a sculpture of strong spiral cords; *H. exquisita* and *H. acrocomata* have thin, strong axial lamellae in addition to two very sharp keels at the periphery. It resembles *Z. tropidophora* in having a depressed protoconch with the keel almost hidden by the next whorl, and in that protoconch I lacks the complex sculpture of anastomosing ridges and granules.

ETYMOLOGY. — From the cruise name BIOCAL, a contraction for BIOlogie and CALédonie, during which the material was collected in 1985.

Zygoceras tropidophora sp. nov.

Figs 28-30, 35, 84-85, 121-122

TYPE MATERIAL. — Holotype in MNHN; one paratype dissolved for anatomical investigation.

TYPE LOCALITY. — MUSORSTOM 6, stn 438, 20°23'S, 166°20'E, 780m, Loyalty ridge, E of New Caledonia.

MATERIAL EXAMINED. — **Loyalty Islands (E of New Caledonia).** MUSORSTOM 6, stn 438, 20°23'S, 166°20'E, 780 m: holotype, 1 paratype (MNHN).

Kermadec Islands. "*Akademik Nesmeyanov*", off Curtis Island, 30°28'S, 178°37'W, 1000 m: 1 sh (NMNZ MF49882).

DESCRIPTION. — *Shell* large, solid, depressed, consisting of 2 protoconch and 1.75 teleoconch whorls. Protoconch with very low spire. Protoconch I, diameter 300 µm, sculptured by a few spiral lines. Protoconch II, diameter 1400 µm, consisting of 1.6 whorls, smooth with sharp spiny keel at periphery, just above suture; projecting spines calcareous, not periostracal. Teleoconch whorls very angular, of rapidly increasing diameter. Body-whorl very large. 2 strong keels at periphery give the whorl a roughly square cross-section. Shoulder and base moderately convex. Beside 2 keels, sculpture consists of thin weak spiral cords and incremental ridges; ridges stronger at periphery and fading on shoulder and base. Between peripheral keels, spiral and axial sculpture of equal strength; intersections forming fine sharp decussation. No umbilicus. Aperture strongly angular, with basal part considerably drawn out, slightly flaring. Outer lip thin, sharp. Inner lip indistinct. Columellar pillar strong, excavated at mid aperture height, slightly twisted below. Colour of protoconch light yellowish brown, teleoconch white.

Dimensions: Height 8.7 mm, breadth 11.9 mm; aperture height 7.1 mm, breadth 6.8 mm.

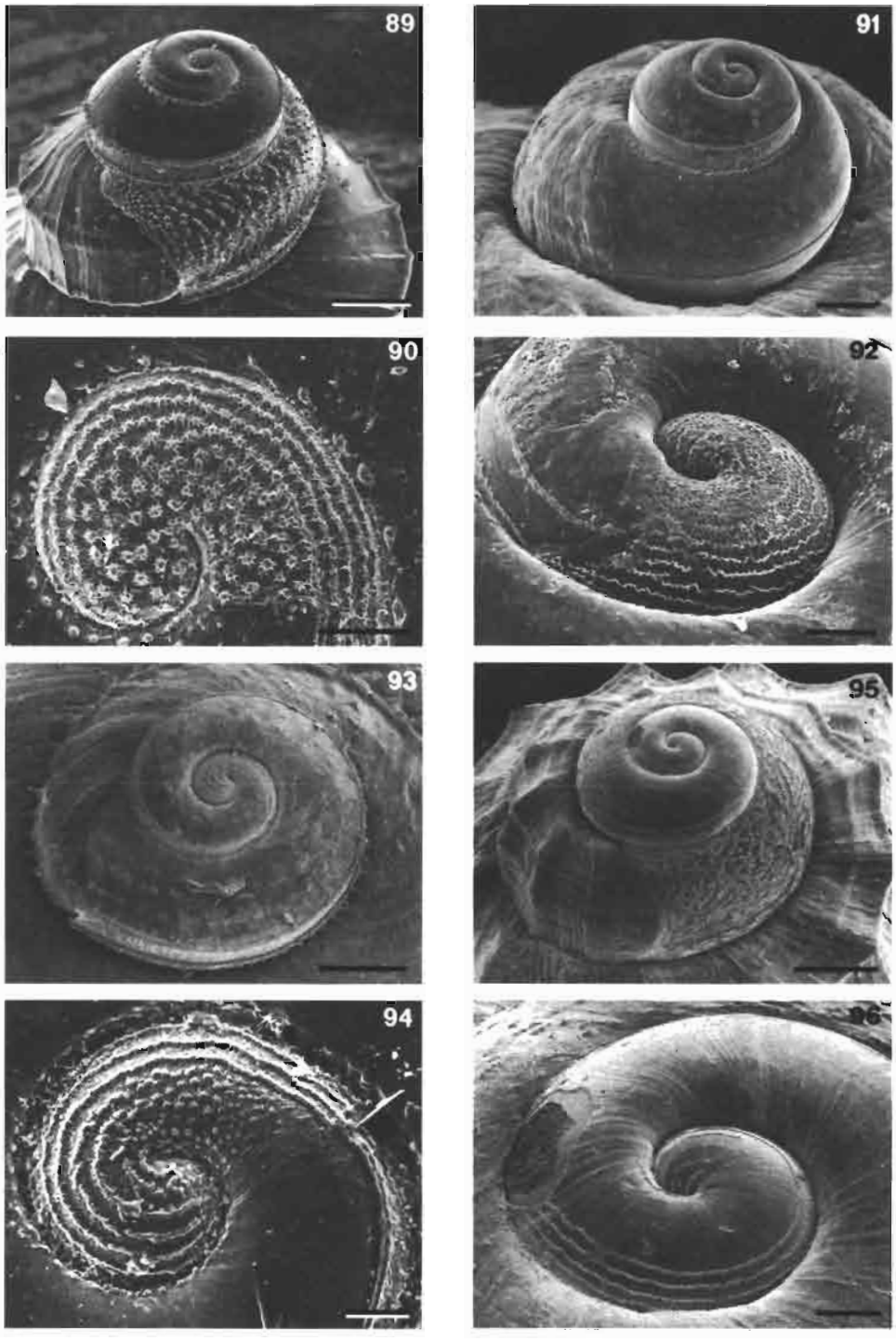
Larval shell measurements:

	diameter (µm)	no. whorls (prot.II)
holotype	1400	1.6
NMNZ 49882	1450	1.8

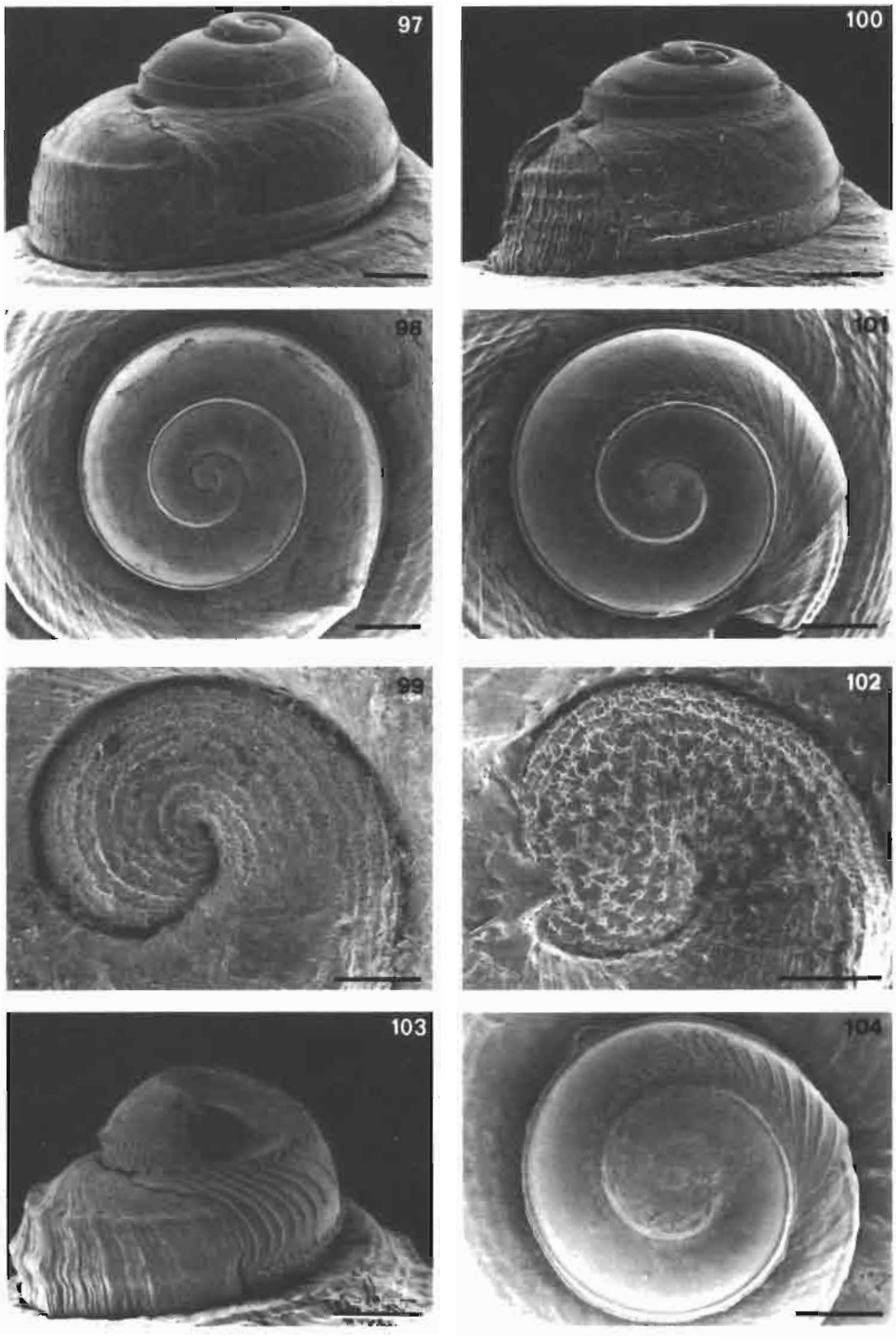
REMARKS. — *Zygoceras tropidophora* can hardly be confused with any other species of Haloceratidae. *Halocears cingulata* differs by having much more depressed whorls and aperture, weaker peripheral keels, and a broad open umbilicus. *Z. biocalae* has a similar low protoconch, but with fewer whorls and without projecting spines on the spiral keel. Furthermore it has a small but distinct umbilicus, weaker spiral sculpture and a more rounded aperture.

The protoconch of *Z. tropidophora* stands out among all gastropod larval shells we have examined in having a keel of solid calcified projecting spines (not periostracal bristles as is found in a number of Tonnoidea). In that respect it resembles a miniature *Cochliolepis gruveli* from West Africa (see ADAM & KNUDSEN 1969: fig.33).

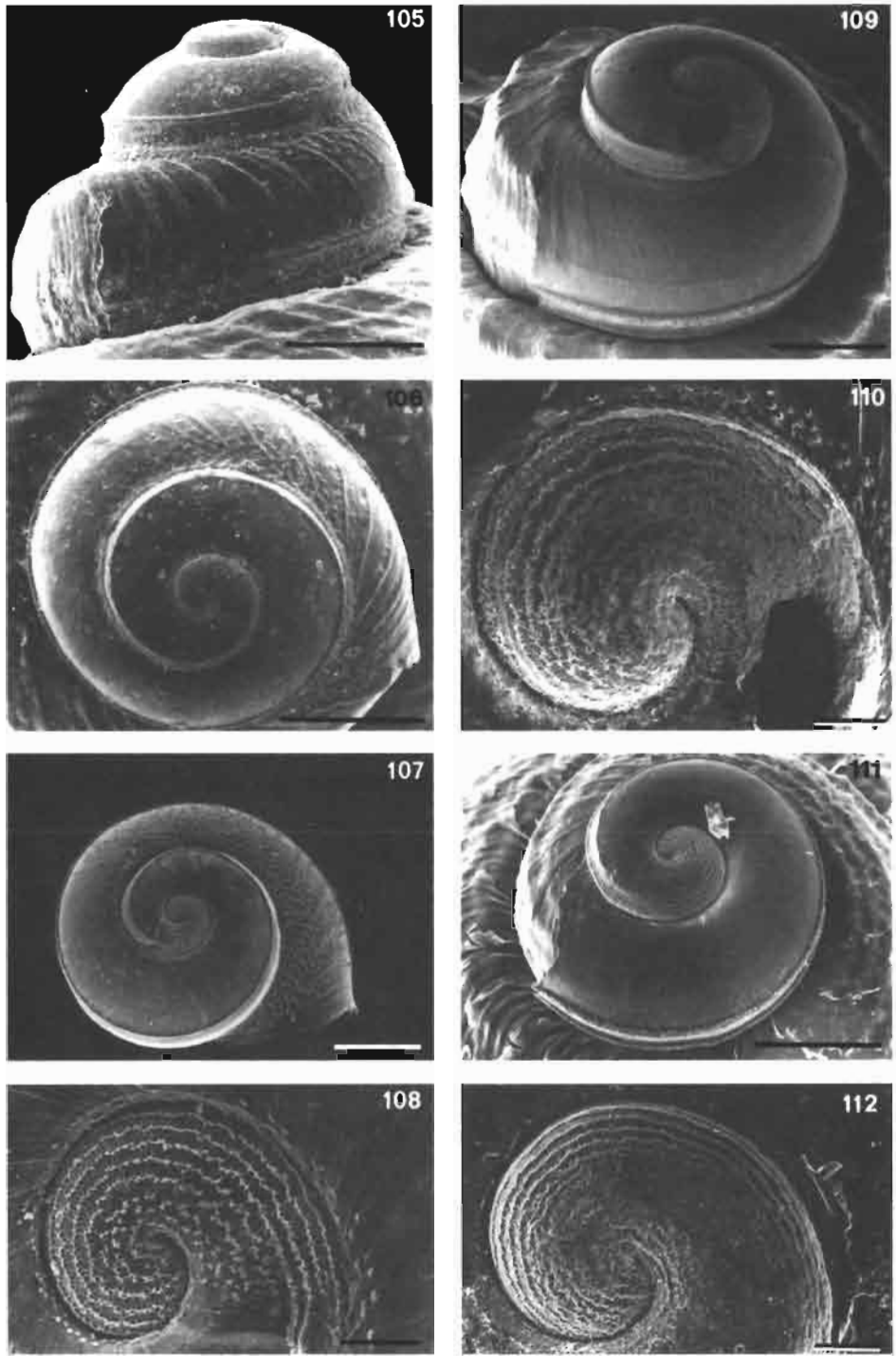
ETYMOLOGY. — From the Greek *tropis*, keel, and *phoreus*, carrier; to remind of the teleoconch sculpture. *Tropidophora* is also a genus of land snails from Madagascar, which has a superficial ressemblance with *Zygoceras*.



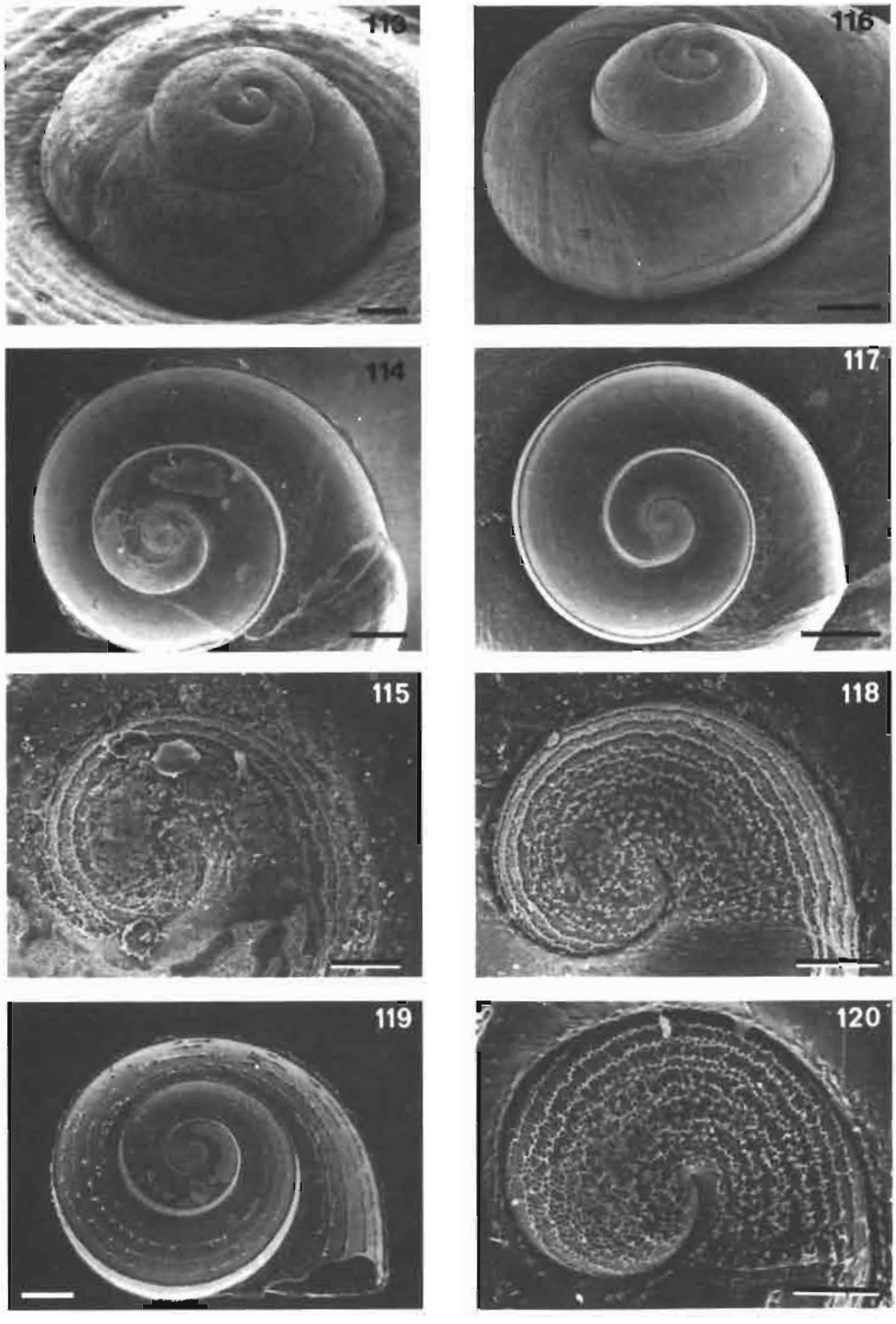
FIGS. 89-96. — Protoconchs of *Haloceras*. — **89-90,** *H. exquisita*, holotype. — **91-92,** *H. rugosa*, holotype. — **93,** *H. acrocomata*, holotype. — **94,** *H. acrocomata*, AMS C 147279. — **95-96,** *H. phaeocephala*, paratype. Scale lines 250 µm (89, 91, 93, 95) and 50 µm (90, 92, 94, 96).



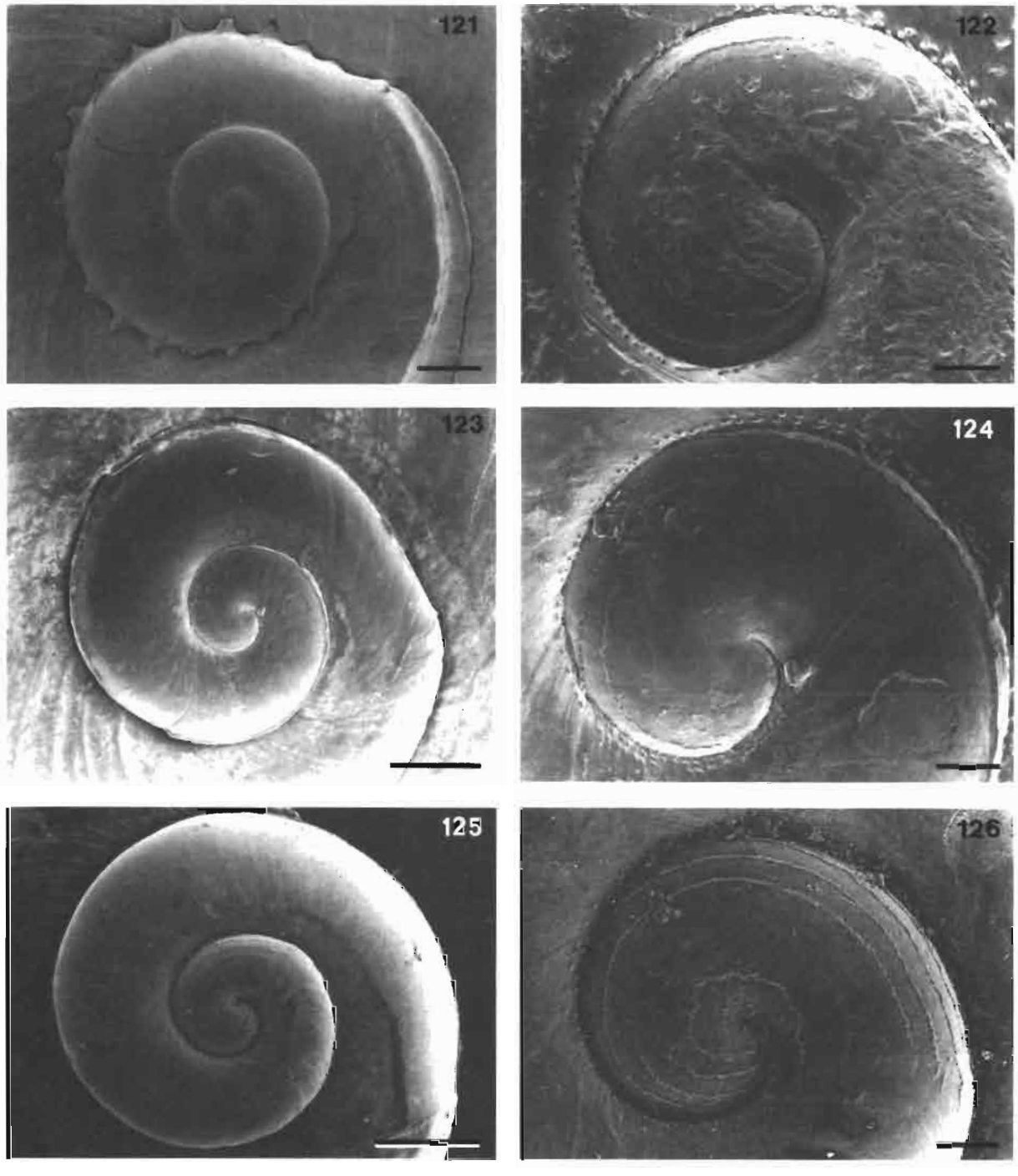
FIGS. 97-104. — Protoconchs of *Haloceras*. — **97-99,** *H. mediocostata*, lectotype. — **100-102,** *H. galerita*, holotype. — **103,** *H. heliptyx*, holotype. — **104,** *Haloceras* sp.1, AMS C 157269. Scale lines 250 µm (97-98, 100-101, 103-104) and 50 µm (99, 102).



FIGS. 105-112. — Protoconchs of *Haloceras*. — **105-106,** *H. carinata*, syntype of *Solariella constricta*. — **107-108,** *H. carinata*, unmetamorphosed larva, INCAL stn DS3. — **109-110,** *H. spinosa*, holotype. — **111-112,** *H. trichotropoides*, USNM 450526. Scale lines 250 µm (105-107, 109, 111) and 50 µm (108, 110, 112).



FIGS. 113-120. — Protoconchs of *Haloceras*. — **113,** *H. cingulata*, " *Thalassa* " stn Z435. — **114-115,** *H. cingulata*, SEAMOUNT stn CP30. — **116-118,** *H. laxa*, SEAMOUNT stn CP30. — **119-120,** *H. tricarinata*, " *Discovery* " stn 10141. Scale lines 250 µm (113-114, 116-117, 119) and 50 µm (115, 118, 120).



FIGS. 121-126. — Protoconchs of *Zygoceras*. — **121-122,** *Z. tropidophora*, holotype. — **123-124,** *Z. biocalae*, holotype. — **125-126,** *Zygoceras* sp., MONACO stn 683. Scale lines 250 µm (121, 123, 125) and 50 µm (122, 124, 126).

Zygoceras sp.

Figs 86-87, 125-126

MATERIAL EXAMINED. — **Eastern Atlantic.** MONACO, stn 683, Azores, 38°20'N, 28°05'W, 1550 m: 1 young sh (MOM).

REMARKS. — A very characteristic juvenile with 0.6 postlarval whorl, which cannot be identified with any of the described species. Protoconch I, diameter 350 µm, has a sculpture of spiral cords on the nucleus and the abapical, coiled part, leaving a smooth adapical zone. Protoconch II, diameter 980 µm, is low-spired and has 1.25 whorls with only 2 keels instead of 3 as in *Haloceras*. One keel is visible above the suture, a second one concealed by the suture. The teleoconch has two strong keels at periphery.

IDENTIFICATION: SUMMARY OF LARVAL SHELL CHARACTERISTICS

The multispiral protoconch of the Haloceratidae offers very good characters for identification of the species. To facilitate comparisons, we have compiled the characteristics of all species below, arranged from the smallest to the largest larval shell.

Table 2. — Larval shell characteristics of Haloceratidae

	diameter(µm)		no.whorls prot.II		n
	range	mean	range	mean	
trichotropoides	610-700	657	1.0-1.05	1.04	8
spinosa	675-720	695	1.2-1.3	1.27	3
heliptyx	770	770	?		1
carinata	700-920	817	1.7-1.9	1.82	16
exquisita	870	870	2.1	2.1	1
phaeocephala	890-1060	967	1.8-2.0	1.87	6
acrocomata	940-1000	970	1.4-1.6	1.49	4
biocalae	1000	1000	1.25	1.25	1
galerita	1080	1080	2.1	2.1	1
laxa	980-1200	1118	1.7-1.8	1.76	8
rugosa	1100	1100	2.1	2.1	1
mediocostata	1200-1300	1240	2.0-2.1	2.06	5
tropidophora	1400-1450	1425	1.6-1.8	1.7	2
cingulata	1300-1660	1466	2.1-2.3	2.19	7
tricarinata	1500-2300	1930	2.2-2.6	2.42	9

Not entered in table: *japonica, millestriata.*

ACKNOWLEDGEMENTS

We thank the curators of the institutions which have loaned us material of Haloceratidae over the last 10 years: W. PONDER and I. LOCH (AMS), B. MARSHALL (NMNZ), J. MCLEAN (LACM), R. HOUBRICK and the late J. ROSEWATER (USNM), E. GITTENBERGER (RMNH), T. OKUTANI (Tokyo) and K. WAY (BMNH). We also thank the leaders and participants to the various deep-sea expeditions in New Caledonia that collected haloceratids: C. LÉVI, C. MONNIOT, B. MÉTIVIER and P. LOZOUET (MNHN), and B. RICHER DE FORGES (ORSTOM, Nouméa). A. WARÉN also wants to thank AMS for a position as visiting research scientist during which much of this material was found.

V. HÉROS (MNHN) and M. SEGONZAC (CENTOB, Brest) sorted much of this material. S. GOFAS prepared figure 64.

We also want to thank A. GRAHAM, G. HASZPRUNAR and W.F. PONDER who read and commented this manuscript.

For technical assistance in the preparation of this work, we thank C. HAMMAR and A. HEDSTRÖM (SMNH) and D. GUILLAUMIN (Centre de Microscopie, CNRS, Paris).

REFERENCES

ADAM, W. & KNUDSEN, J., 1969. — Quelques genres de Mollusques Prosobranches marins inconnus ou peu connus de l'Afrique occidentale. *Bull. Inst. r. Sci. nat. Belg.*, **44**(27): 1-69.

BOSS, K.J., 1982. — Mollusca. *In*: S.P. PARKER (ed.), Synopsis and Classification of Living Organisms. McGraw Hill Book Co., New York. Vol. **1**: 945-1166, Vol. **2**: 1092-1096.

BOUCHET, P., 1976. — Mise en évidence d'une migration de larves véligères entre l'étage abyssal et la surface. *C. r. hebd. Séanc. Acad. Sci., Paris*, (D) **283**: 821-824.

BOUVIER, E.-L., 1887. — Système nerveux. Morphologie générale et classification des gastéropodes prosobranches. *Annls. Sci. nat. Zool.*, (7)**3**:1-510.

DALL, W.H., 1889. — Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78) and in the Caribbean Sea (1879-80), by the US coast survey steamer « *Blake* », Lieut.-Commander C.D. Sigsbee, U.S.N. and Commander J.R. Bartlett, U.S.N. commanding. XXIX. -Report on the Mollusca. Part II. Gastropoda and Scaphopoda. *Bull. Mus. comp. Zool.*, **18**: 1-491.

DALL, W.H., 1927. — Small shells from dredgings off the southeast coast of the United States by the United States Fisheries Steamer « *Albatross* », in 1885 and 1886. *Proc. U.S. natn. Mus.*, **70**(18): 1-134.

DAUTZENBERG, P. & FISCHER, H., 1896. — Dragages effectués par l' « *Hirondelle* » et par la « *Princesse-Alice* »: 1. Mollusques Gastéropodes. *Mém. Soc. zool. Fr.*, **9**: 395-498.

DAUTZENBERG, P. & FISCHER, H., 1897. — Dragages effectués par l' « *Hirondelle* » et par la « *Princesse-Alice* » 1888-1896. *Mém. Soc. zool. Fr.*, **10**: 139-234.

DAUTZENBERG, P., 1927. — Mollusques provenant des campagnes scientifiques du Prince Albert Ier de Monaco dans l'Océan Atlantique et dans le Golfe de Gascogne. *Result. Camp. scient. Prince Albert I*, **72**: 1-407.

DELL, R.K. & PONDER, W.F., 1964. — Some notes on the gastropod *Zelippistes benhami* (Suter). *Rec. Dom. Mus. Wellington*, **5**: 63-72.

GIESE, M., 1915. — Der Genitalapparat von *Calyptraea sinensis* Lin., *Crepidula unguiformis* Lam. und *Capulus hungaricus* Lam. *Z. wiss. Zool.*, **114**:169-231.

GRAHAM, A., 1954. — The anatomy of the prosobranch *Trichotropis borealis* Broderip & Sowerby, and the systematic position of the Capulidae. *J. mar. biol. Assoc. U.K.*, **33**: 129-144.

HALLER, B., 1893. — Die Morphologie der Prosobranchier. IV. *Morph. Jb.*, **19**:553-591.

HOUBRICK, J.R. & FRETTER, V., 1969. — Some aspects of the functional anatomy and biology of *Cymatium* and *Bursa*. *Proc. malac. Soc. London*, **38**:415-429.

JEFFREYS, J.G., 1883. — On the Mollusca procured during the « *Lightning* » and « *Porcupine* » expeditions 1868-70. Part VI. *Proc. zool. Soc. London*, **1882**: 88-149.

JEFFREYS, J.G., 1885. — On the Mollusca procured during the « *Lightning* » and « *Porcupine* » expeditions 1868-1870. Part IX. *Proc. zool. Soc. London*, **1885**: 27-63.

LACAZE-DUTHIERS, H. de, 1872. — Otocystes des mollusques suite, troisième type. *Archs Zool. exp. gén.*, (3)**9**:43-79.

LACAZE-DUTHIERS, H. de, 1901. — Le système nerveux du Cabochon *Capulus hungaricus*. *Archs Zool. exp. gén.*, (3)**9**:43-79.

MORTON, J.E., 1952. — The role of the crystalline style. *Proc. malac. Soc. London*, **29**: 85-92.

OKUTANI, T., 1964. — Report on the archibenthal and abyssal gastropod mollusca collected from Sagami Bay and adjacent waters by the R.V. SOYO-MARU during the years 1955-1963. *J. Fac. Sci. Tokyo Univ.*, , (2) **15**: 371-447.

PILKINGTON, M.C., 1974. — The eggs and hatching stages of some New Zealand prosobranch molluscs. *Jl R. Soc. N.Z.*, **4**:411-431.

PILKINGTON, M.C., 1976. — Descriptions of veliger larvae of monotocardian gastropods occurring in Otago plankton hauls. *J. molluscan Stud.*, **42**:337-360.

PONDER, W., 1985. — A review of the genera of Rissoidae (Mollusca: Mesogastropoda: Rissoacea). *Rec. Austr. Mus.*, suppl. **4**: 1-221.

PONDER, W. & WAREN, A., 1988. — Classification of the Caenogastropoda and Heterostropha- A list of the family-group names and higher taxa. *Malac. Review*, suppl. **4**: 288-326.

QUINN, J.F., 1979. — Biological results of the University of Miami deep-sea expeditions. 130. The systematics and zoogeography of the gastropod family Trochidae collected in the straits of Florida and its approaches. *Malacologia*, **19**: 1-62.

QUINN, J.F., 1983. — A revision of the Seguenziacea Verrill, 1884. I. Summary and evaluation of the superfamily. *Proc. Biol. Soc. Wash.*, **96**(4): 725-757.

THIELE, J., 1929-34. — Handbuch der systematischen Weichtierkunde. I. G. Fischer, Stuttgart. 1023 pp.

THORSON, G., 1965. — A neotenous dwarf-form of *Capulus ungaricus* (L.) (Gastropoda, Prosobranchia) commensalistic on *Turritella communis* (Risso). *Ophelia*, **2**:175-210.

VERRILL, A.E., 1884. — Second catalogue of Mollusca recently added to the fauna of the New England coast and the adjacent parts of the Atlantic, consisting mainly of deep-sea species with notes on others previously recorded. *Trans. Conn. Acad. Sci. Arts*, **6**: 139-294.

WARÉN, A., 1979. — Marine Mollusca described by John Gwyn Jeffreys, with the location of the type material. Conchological Society of Great Britain and Ireland, Special Publication 1: 1-60, 8 plates.

WARÉN, A., 1984. An anatomical comparison of *Eulima* and *Pyramidelloides* with a revision of the species of *Pyramidelloides* (Mollusca, Prosobranchia, Eulimidae). *Zoologica Scripta*, **12**:273-294.

WARÉN, A. & BOUCHET, P., 1989. — Laubierinidae and Pisanianurinae (Ranellidae), two new deep sea taxa of the Tonnoidea (Gastropoda: Prosobranchia). *Veliger*, **33**: 56-102.

WARÉN, A. & PONDER, W. F., (in press). — New species, anatomy and systematic position of the hydrothermal vent and hydrocarbon seep family Provannidae n.fam. (Caenogastropoda). *Zoologica Scripta*

WENZ, W., 1938-44. — Gastropoda. I. Allgemeiner teil und Prosobranchia. Handbuch der Paläozoologie, **6**:1-1639.

YONGE, C.M., 1962. — On the biology of the mesogastropod *Trichotropis cancellata* Hinds, a benthic indicator species. *Biol. Bull.*, **122**: 160-181.

5

Mollusca Gastropoda : Four new rissoinine species (Rissoininae) from deep water in the New Caledonian region

Willy J. SLEURS *

Koninklijk Belgisch Instituut voor Natuurwetenschappen
Recent Invertebrates Section
Vautierstraat, 29
B — 1040 Brussels
Belgium

ABSTRACT

Four new species, belonging to the subfamily Rissoininae (Neotaenioglossa : Truncatelloidea : Rissoidae), are described from deep water in the New Caledonian region : *Rissoina (Rissoina) boucheti* sp. nov., *R. (R.) longispira* sp. nov., *Zebina (Zebina) reclina* sp. nov. and *Z. (Z.) retusa* sp. nov. An anatomical description of *R. boucheti* is given.

RÉSUMÉ

Mollusca Gastropoda : Quatre espèces nouvelles de Rissoininae (Rissoidae) des eaux profondes néo-calédoniennes.

Quatre nouvelles espèces de la sous-famille Rissoininae (Neotaenioglossa : Truncatelloidea : Rissoidae) sont décrites : *Rissoina (Rissoina) boucheti* sp. nov., *R. (R.) longispira* sp. nov., *Zebina (Zebina) reclina* sp. nov. et *Z. (Z.) retusa* sp. nov.

Rissoina est présent jusqu'à 700 m de profondeur, ce qui représente les occurences les plus profondes actuellement connues.

* The author is granted by the " National Fund for Scientific Research (Belgium) ".

SLEURS, W. J., 1991. — Mollusca Gastropoda : Four new rissoinine species (Rissoininae) from deep water in the New Caledonian region. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 163-178. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

Most of the material reported here was collected during the BIOCAL Expedition, conducted in 1985 aboard the R. V. "*Jean-Charcot*", under the direction of Prof. C. LEVI. Specimens were sorted on board by P. BOUCHET, B. METIVIER and B. RICHER DE FORGES, and residues were saved for further sorting at CENTOB, Brest, under the supervision of M. SEGONZAC. For further information on the expedition, see RICHER DE FORGES (1990).

Additional material collected during the SMIB 3 Expedition (1986), south of Ile des Pins and on the guyots of the Norfolk ridge is included. Furthermore also a small collection, made aboard the "*Kimbla*" in 1971 and housed in the AMS, in included.

This paper represents the first study on the deep water Rissoininae from New Caledonia : all previous studies on New Caledonian rissoinines refer to shallow water species. This study forms part of a species review on the Rissoininae, currently in progress.

Abbreviations of institutions :

AMS : Australian Museum, Sydney.
BMNH : The Natural History Museum, London.
KBIN : Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels.
LACM : Los Angeles County Museum.
MNHN : Muséum national d'Histoire naturelle, Paris.
NMNZ : National Museum of New Zealand, Wellington.

SYSTEMATIC ACCOUNT

Superorder CAENOGASTROPODA Cox, 1959
Order NEOTAENIOGLOSSA Haller, 1882
Superfamily TRUNCATELLOIDEA Gray, 1840
Family RISSOIDAE Gray, 1847
Subfamily RISSOININAE Stimpson, 1865

The genera of the family Rissoidae are revised by PONDER (1985), and the classification proposed in that paper is followed here ; therefore we refer to that paper for generic diagnoses.

Genus *RISSOINA* d'Orbigny, 1840

Rissoina (Rissoina) boucheti sp. nov.
Figs 1-2, 3 a-c, 5-11

TYPE MATERIAL. — All from BIOCAL, stn DW 44, 30.VIII.1985. Holotype : empty shell in MNHN. Paratypes : 30 specimens (some of them with dried animal) in MNHN. One paratype in the following institutions or museums : AMS, KBIN, LACM and NMNZ.

TYPE LOCALITY. — New Caledonia, 22°47′ S, 167°14′ E, 440-450 m.

MATERIAL EXAMINED (Apart from type material). — **New Caledonia**. BIOCAL : stn DW 33, 23°10′ S, 167°10′ E,

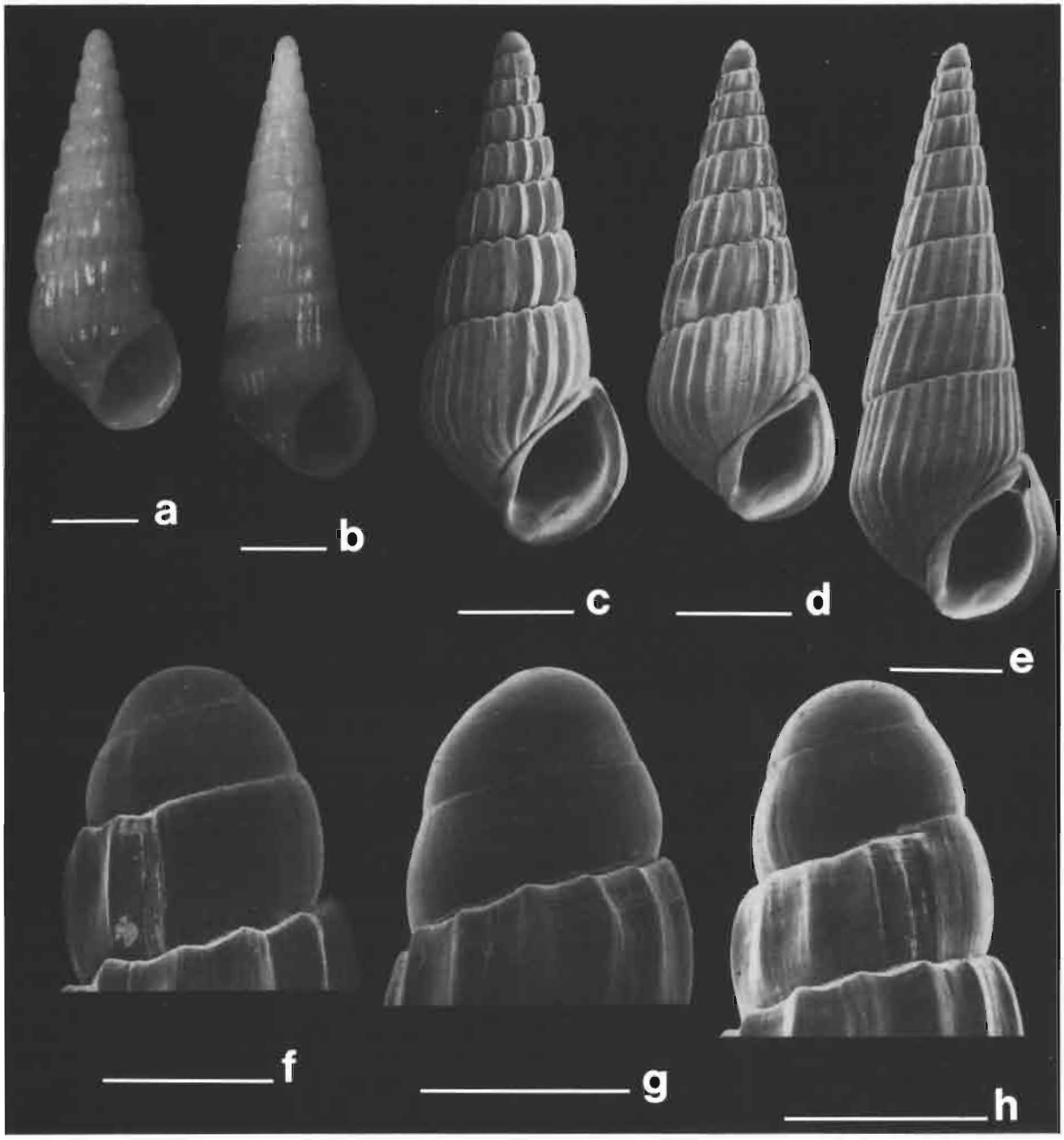


FIG. 1. — *Rissoina (s. s.) boucheti* sp. nov. : **a-e** : shells and **f-h** : protoconchs. **a** — holotype, New Caledonia, BIOCAL stn DW 44 (MNHN) ; **b** — south New Caledonia, SMIB 3 stn DW 22 (MNHN) ; **c** — paratype, New Caledonia, BIOCAL stn DW 44 (MNHN) ; **d** — New Caledonia, BIOCAL stn DW 77 (MNHN) ; **e** — south New Caledonia, SMIB 3 stn DW 22 (MNHN) ; **f** — paratype, New Caledonia, BIOCAL stn DW 44 (MNHN) ; **g** — paratype, New Caledonia, SMIB 3 stn DW 22 (same specimen of Fig. 1 e) ; **h** — New Caledonia, BIOCAL stn 77 (MNHN).
Scale : a-e = 2 mm ; f-h = 0.5 mm.

675-680 m, 29.VIII.1985 : 6 spec. (MNHN). — Stn DW 41, 22°45′ S, 167°12′ E, 380-410 m, 30.VIII.1985 : 1 spec. (MNHN). — Stn DW 43, 22°46′ S, 167°15′ E, 400 m, 30.VIII.1985 : 4 spec. (MNHN). — Stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 30.VIII.1985 : 90 spec. (with animals preserved in alcohol) (MNHN). — Stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 30.VIII.1985 : 2 spec. (MNHN). — Stn DW 56, 23°35′ S, 167°12′ E, 705-695 m, 01.IX.1985 : 3 spec. — Stn DW 77, 22°15′ S, 167°15′ E, 440 m, 05.IX. 1985 : 75 spec. (MNHN).

SMIB 3, R. V. "*Vauban*" : stn DW 10, 235 m, 21.V.1987 : 1. spec. — Stn DW 21, 22°59′ S, 167°19′ E, 525 m, 24.V.1987 : 1 spec. (MNHN). — Stn DW 22, 23°03′ S, 167°19′ E, 503 m, 24.V.1987 : 73 spec. (MNHN).

HMAS "*Kimbla*", stn K4-71-3, 22°50′ S, 167°34′ E (approx. 7 km S. of I. des Pins), 275 m, coral sand bottom, 08.V.1971, coll. P. H. COLMAN & J. PAXTON : 3 spec. (AMS, C153935) ; *Ibidem*, 274 m : 3 spec. (AMS, C153936).

DESCRIPTION. — *Shell* (Fig. 1 a-e) : moderately large (length 9.9 mm in holotype), solid, more or less elongate conical ; last whorl moderately angulate to subangulate at the periphery.

Protoconch (Fig. 1 f-h) : of non-planktotrophic larval type (and probably with intracapsular metamorphosis), moderately elongate conical to subcylindrical, glossy, of about 2 smooth whorls ; transition to teleoconch abruptly with a straight, non-thickened margin.

Teleconch : of about 7 to 8 whorls ; spire whorls almost flat, weakly to moderately angulate just below and/or above the deeply to moderately impressed, weakly undulating sutures.

Axial sculpture of slightly opisthocline axial ribs, the latter variable in strength, ranging from very prominent, sharp, distantly spaced, to weak, densely spaced and rounded ; axial sculpture usually somewhat more prominent on spire whorls than on last whorl, but sometimes equal in strength throughout ; axial ribs on last whorl somewhat weaker below periphery, but continuous to peristome.

Spiral sculpture very variable, ranging from microscopic, irregular and irregularly spaced scratches (Fig. 3 a-c), to moderately prominent, more or less regularly and densely spaced spiral threads or weak spiral ribs ; spiral sculpture, when present, mostly more prominent on penultimate and last whorl than on the early spire whorls.

Aperture : moderately large, D-shaped to lenticular or auriculiform ; columellar side moderately concave ; anterior channel narrow, short, shallow ; outer lip with a prominent interior swelling near the transition to the anterior channel ; posterior channel very short, triangular ; outer lip slightly opisthocline in profile with a moderately wide, rounded, prominent varix externally.

Colour : yellowish white with large orange spots on last and penultimate whorl or with a rather wide orange spiral band below the suture ; some specimens white throughout.

Operculum (Fig. 2 e-f) : thick, with weakly curved, hollow peg ; muscle-attachment area sausage-shaped.

Radula (Fig. 2 a-d) : central teeth of taeniglossate radula with the formula (PONDER, 1985 : 10) : $\frac{3\text{-}4 + 1 + 3\text{-}4}{1 \qquad 1}$; ventral margin with strongly-developed U-shaped extension ; lateral margins making an angle of ca. 30° with dorsoventral axis. Lateral teeth 7-9 + 1 + 3-4. Inner marginal teeth with 7-11 sharp cusps on distal half of outer edge and with some weak cusps just below. Outer marginals with weak cusps on outer and inner edge.

Head-foot characters : cephalic tentacles usually covered by a thin sheath (probably an artifact due to preservation), the latter with deeply indented margins ; right pallial tentacle narrow, rather long, simple ; left pallial tentacle deeply bifurcate, consisting of 2, rather wide, lobes ; metapodial tentacle not observed in preserved specimens.

Mantle cavity (Fig. 11) : mean ctenidium length : 2.45 mm (n = 5) ; mean number of gill filaments : 45 (n = 5) ; gill filaments rather short, longest gill filament measuring approx. 0.25 mm ; osphradium somewhat shorter than ctenidium, consisting of a rather thick, wide undulating (probably due to contraction) main ridge ; lateral ridges very narrow, hidden beneath the mean ridge ; hypobranchial gland inconspicuous.

Digestive system (Figs 5, 7, 11) : mouth opening between two fleshy lips into a rather long buccal tube ; one pair of jaws in anterior third of buccal tube ; salivary glands simple single tubes, not reaching the nerve ring and with distal part folded ; oesophagus rather uniform in structure from its departure from buccal cavity to the opening into the anterior chamber of the stomach ; oesophagus with about 10 folds internally. Stomach occupying about one whorl ;

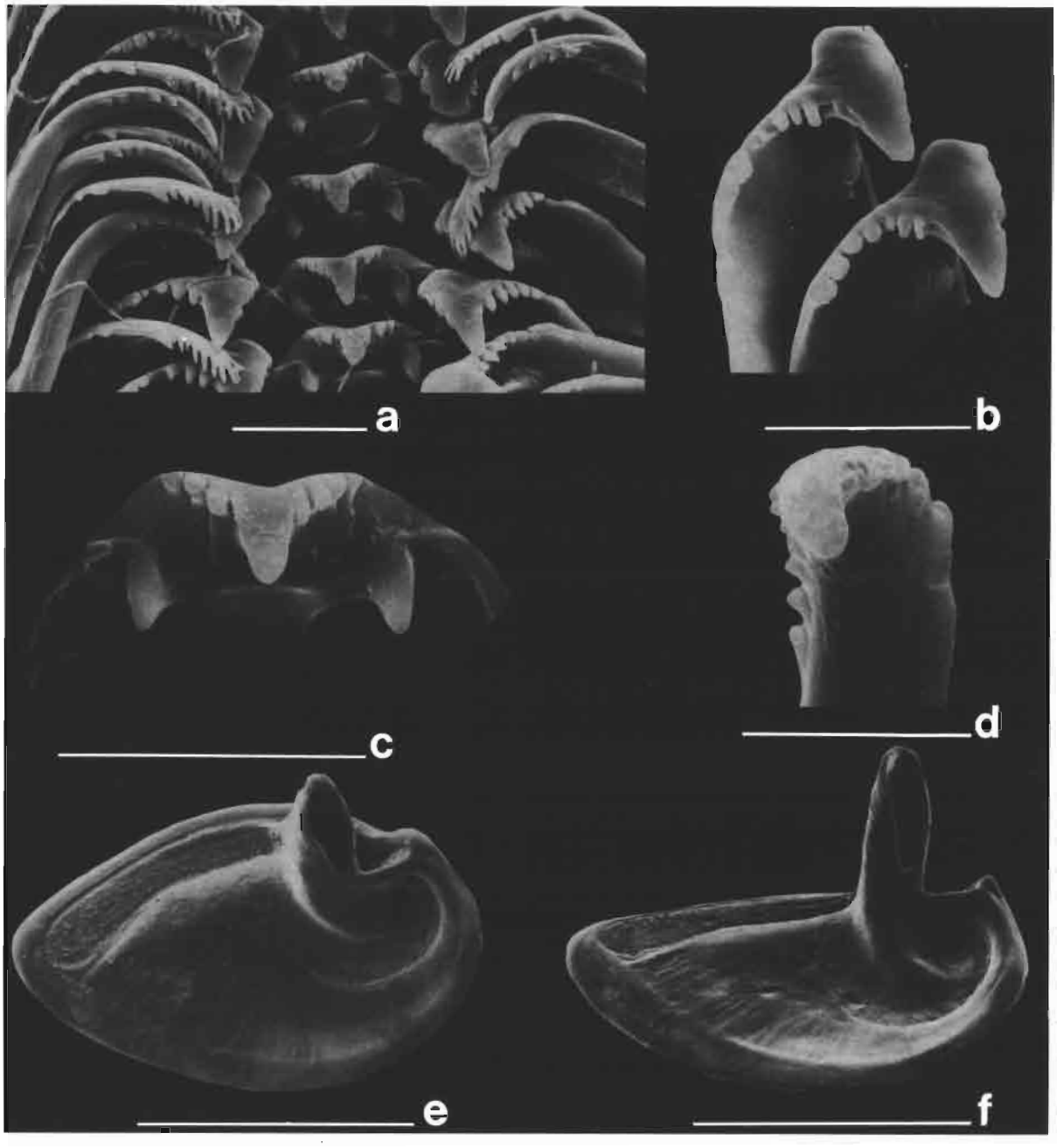


FIG. 2. — SEM micrographs of radula and operculum of *Rissoina (s. s.) boucheti* sp. nov., (KBIN stub 77 E-F), New Caledonia, BIOCAL stn DW 44. **a** — centrals, laterals and inner marginals ; **b** — laterals ; **c** — central ; **d** — distal part of outer marginal ; **e** — inner side of operculum ; **f** — lateral aspect of inner side of operculum.
Scale : a, b, c = 0.02 mm ; d = 0.01 mm ; e, f = 1 mm.

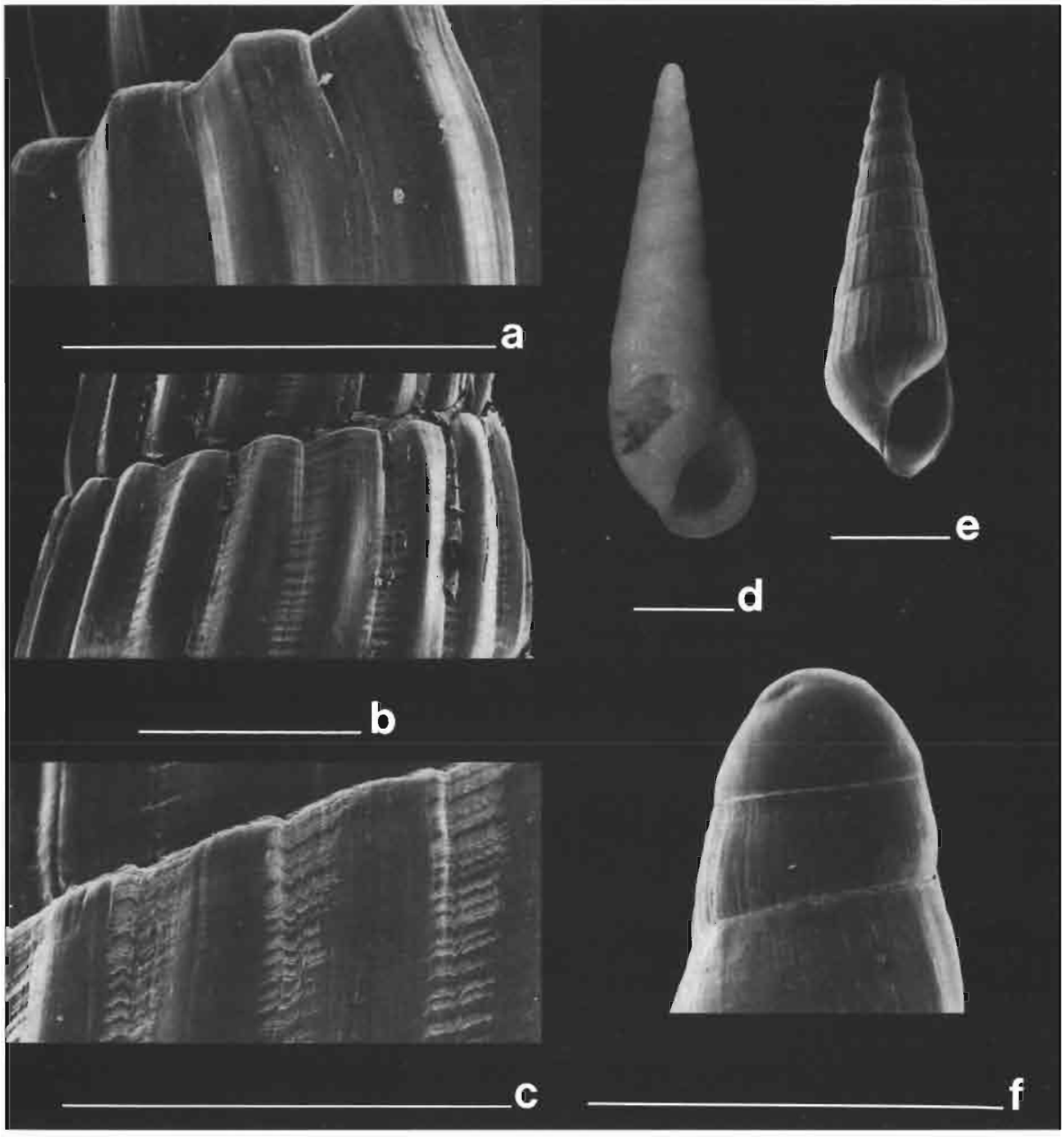


FIG. 3 a-c. — Variation in microsculpture of teleoconch (penultimate whorl) of *Rissoina (Rissoina) boucheti* sp. nov. : **a** — paratype, New Caledonia, BIOCAL stn DW 44 (MNHN) ; **b** — New Caledonia, BIOCAL stn DW 77 (MNHN) ; **c** — New Caledonia, BIOCAL stn DW 22 (MNHN).

FIG. 3 d-f. — *Rissoina (Rissoina) longispira* sp. nov. : **d** — holotype (MNHN) ; **e** — paratype (immature specimen), New Caledonia, BIOCAL stn DW 33 (MNHN) ; **f** — protoconch (same specimen as Fig. 3 e).
Scale : a, b, c = 0.1 mm ; d, e = 2 mm ; f = 1 mm.

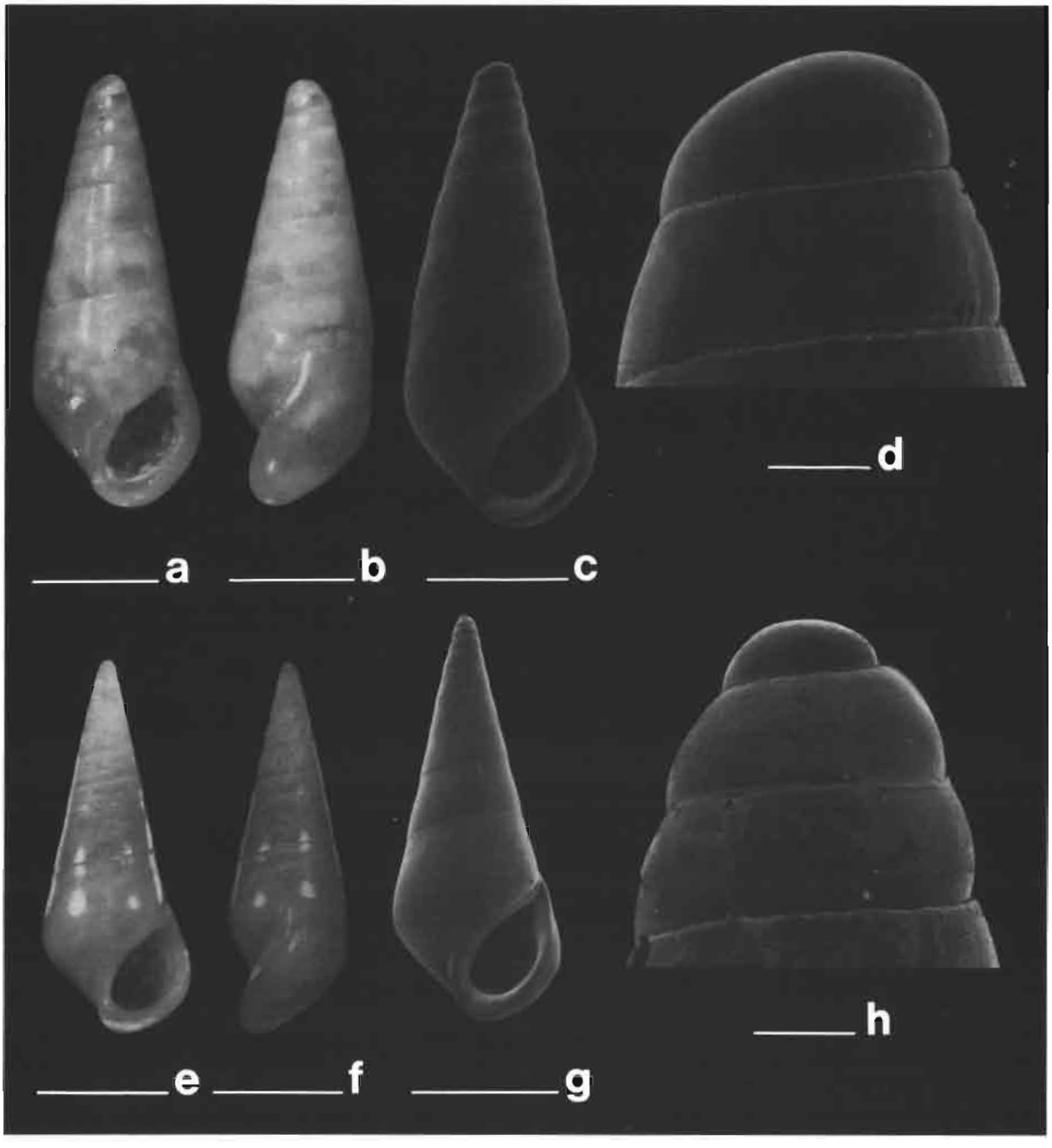


FIG. 4 a-d. — *Zebina (Zebina) retusa* sp. nov. : **a, b** — holotype (MNHN) ; **c, d** — shell and protoconch of paratype, New Caledonia, BIOCAL stn DW 38 (MNHN).
FIG. 4 e-h. — *Zebina (Zebina) reclina* sp. nov. : **e, f** — holotype (MNHN) ; **g, h** — shell and protoconch of paratype, New Caledonia, BIOCAL stn DW 44 (MNHN).
Scale a, b = 1 mm ; c, e, f, g = 2 mm ; d, h = 0.1 mm.

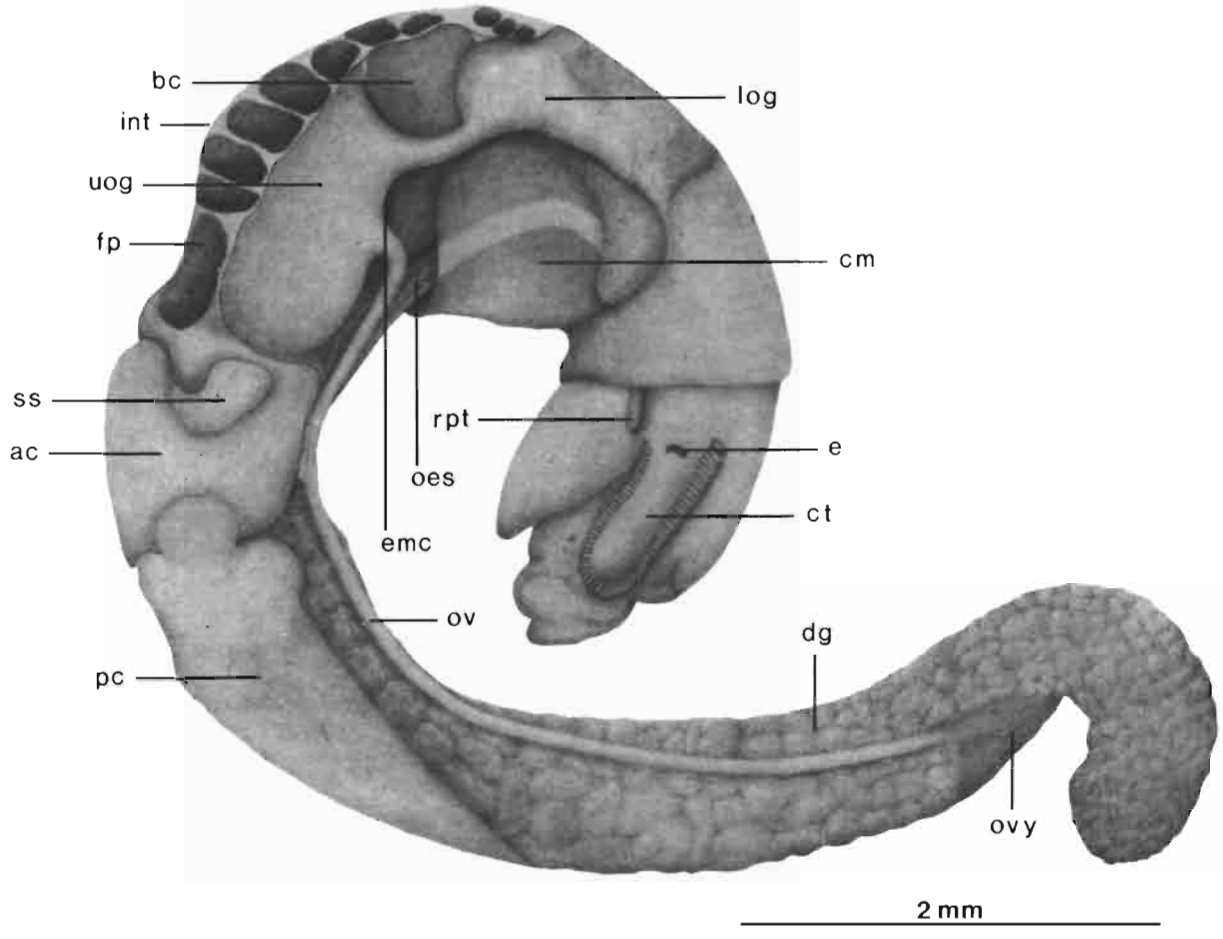


FIG. 5. — Anatomy of uncoiled female of *Rissoina (s. s.) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44.
(Abbreviations : ac — anterior chamber of stomach ; bc — bursa copulatrix ; cm — columellar muscle ; ct — cephalic tentacle ; dg — digestive gland ; e — eye ; emc — end of mantle cavity ; fp — faecal pellet ; int — intestine ; log — lower oviduct gland ; oes — oesophagus ; ov — oviduct ; ovy — ovary ; pc — posterior chamber of stomach ; rpt — right pallial tentacle ; ss — style sac ; uog — upper oviduct gland).

stomach morphology typical of genus : stomach/style sac ratio (as defined by PONDER, 1984 : 13) : 13 (n = 3) (due to the very elongate posterior chamber) ; length/width ratio (as defined by PONDER, 1985 : 13) : 3.7 ; stomach containing foraminiferan material and fragments of filamentous algae ; style sac short (crystalline style not observed) ; gastric shield broadly triangular ; digestive gland dark brown, occupying about 2 1/2 whorls, not anterior to anterior chamber of stomach ; intestine very thin-walled, very wide in mid-section, filled with numerous cylindrical fecal pellets with rounded anterior and posterior ends.

Female reproductive system (Figs 5-6) : ovary very short ; oviduct thin-walled ; upper oviduct gland large, more or less bilobed, subequal to length of lower oviduct gland, oval in section, with a slit-like lumen ; bursa copulatrix rather small, between lower and upper oviduct gland, partly overlying both glands at the right side ; seminal receptacle not observed (probably overlooked or inconspicuous when not filled with sperm) ; sperm duct strongly muscular, narrow, lying along left side of lower oviduct gland, only very weakly expanded near anterior end. One mature female was found with normal female reproductive organs and with a non-functional

penis, the latter very short as in immature male specimens.

Male reproductive system (Figs 7-8) : testis occupying about 1 whorl, overlying the digestive gland ; seminal vesicle highly coiled, strongly expanded, with posterior half folded over posterior half of posterior chamber of stomach ; anterior half covered by digestive gland ; visceral vas deferens, passing along stomach ; prostate gland open, elongate, thin. Penis occupying most of mantle cavity, large with a wide, spoon-shaped, distal lobe ; penial groove open, the latter terminating as a somewhat expanded gutter just above the spoon-shaped lobe ; one margin of the latter weakly denticulate ; ventral side of spoon-shaped lobe almost flat sided ; dorsal side of lobe with a median crest, the latter with a denticulate summit.

Central nervous system (Figs 9-10) : cerebral ganglia joined by a rather long commissure for genus ; RPG ratio (as defined by DAVIS *et al.*, 1976 : 263) : 0.6 ; pleural ganglia separated from cerebral ganglion by a rather deep constriction ; statocysts on the posterior edge of the pedal ganglia.

Shell dimensions and sculpture counts : See table 1.

VARIATION. — *Rissoina boucheti* sp. nov. shows considerable interpopulation variation with respect to shell sculpture, but is strikingly uniform within the same population. In the type series (Fig. 1 a, c), the axial ribs are very prominent, regularly spaced and sharp, while the spiral sculpture is almost absent except for some irregularly spaced scratches ; in specimens of other populations the axial sculpture ranges from moderately prominent (Fig. 1 d) to very weak, rounded, closely spaced ribs (Fig. 1 b, e) ; the spiral sculpture ranges from irregularly spaced microscopic scratches (Fig. 3 a) to more or less regularly spaced, moderately prominent spiral threads or fine spiral ribs (Figs 1 d ; 3 b, e).

In the type series the whorls are moderately angulate below the suture (Fig. 1a, c) ; in other

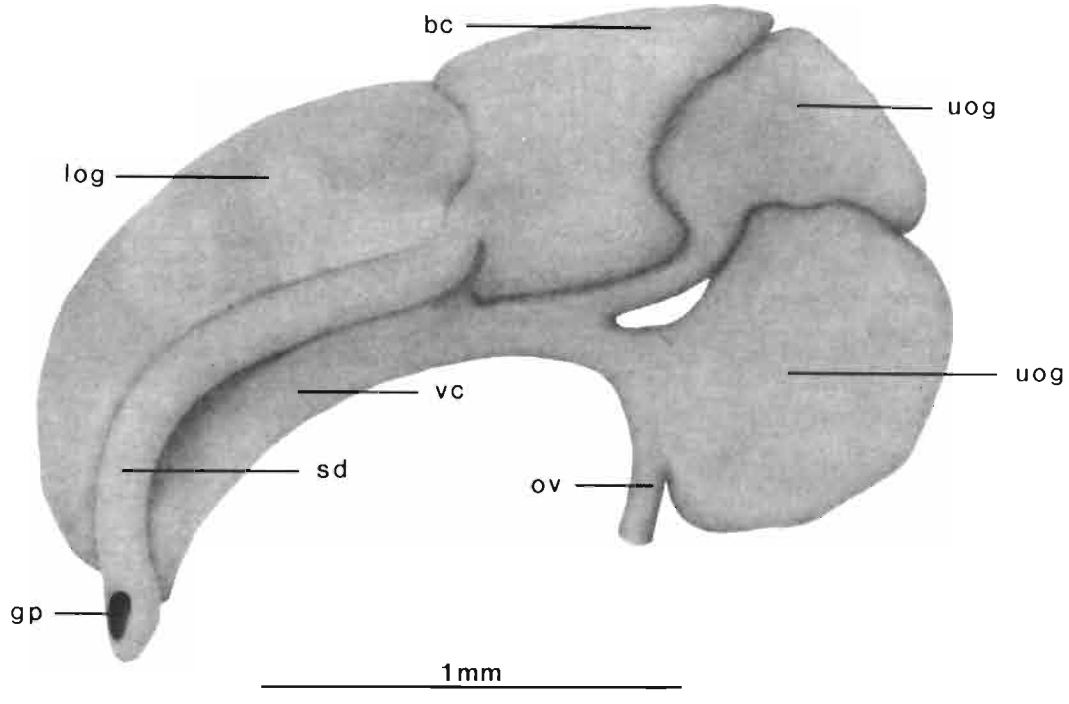


FIG. 6. — Female genitalia of *Rissoina (s. s.) boucheti* sp. nov. (visceral oviduct and ovary omitted), New Caledonia, BIOCAL stn DW 44.

(Abbreviations : bc — bursa copulatrix ; gp — genital porus ; log — lower oviduct gland ; ov — oviduct ; sd — sperm duct ; vc — ventral channel ; uog — upper oviduct gland).

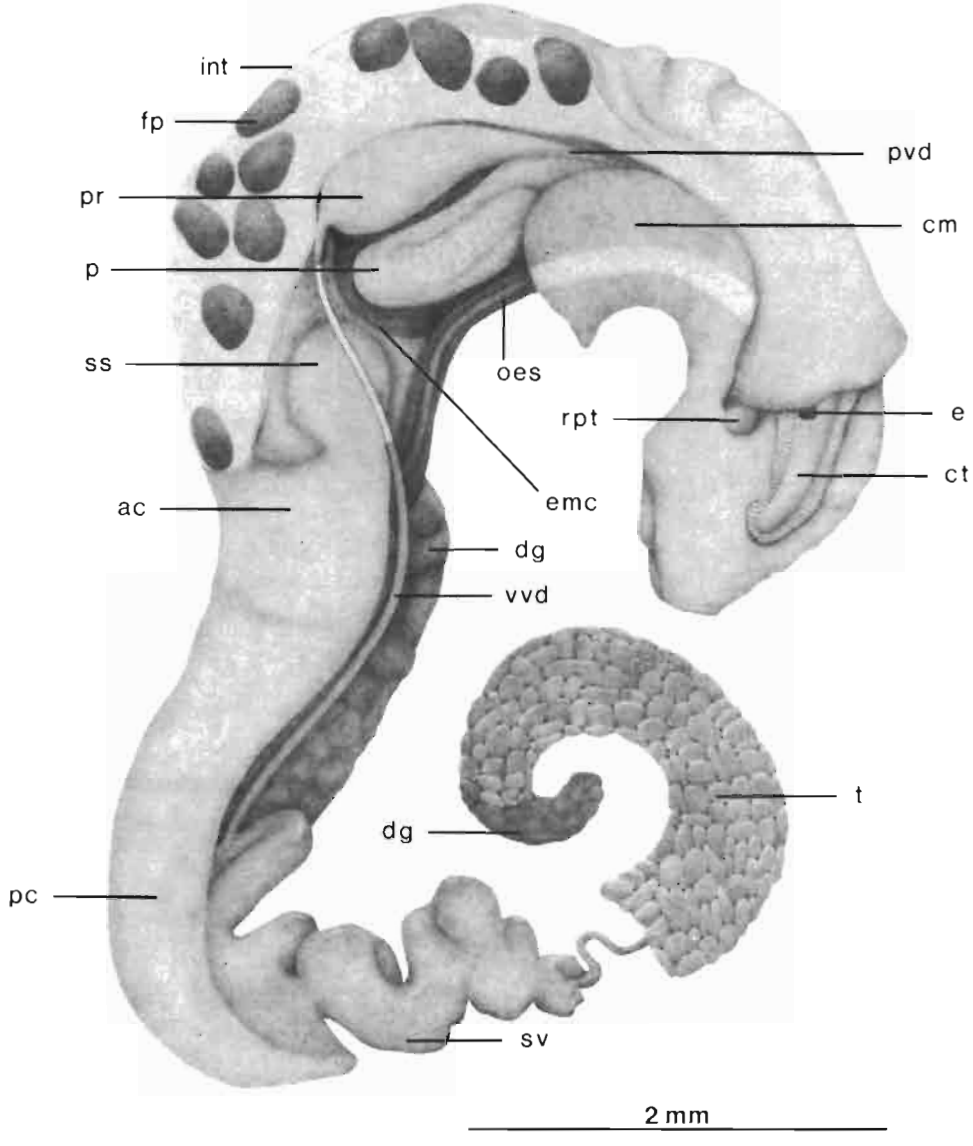


FIG. 7. — Anatomy of an uncoiled male of *Rissoina (s. s.) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44. (digestive gland partly removed to show the position of the seminal vesicle).

(Abbreviations : ac — anterior chamber of stomach ; cm — columellar muscle ; ct — cephalic tentacle ; dg — digestive gland ; e — eye ; emc — end of mantle cavity ; fp — faecal pellet ; int — intestine ; oes — oesophagus ; p — penis ; pc — posterior chamber of stomach ; pr — prostate gland ; pvd — pallial vas deferens ; rpt — right pallial tentacle ; ss — style sac ; sv — seminal vesicle ; t — testis ; vvd — visceral vas diferens ; part of visceral vas deferens indicated by dotted lines was never found, but it is here marked in its presumed position).

populations we found specimens with no or only very weakly angulate whorls (Fig. 1 b, d, e).

ETYMOLOGY. — This species is named after Dr Philippe BOUCHET of the MNHN, who made this New Caledonian collection of rissoinines available for examination, and who was one of the collectors of this new species.

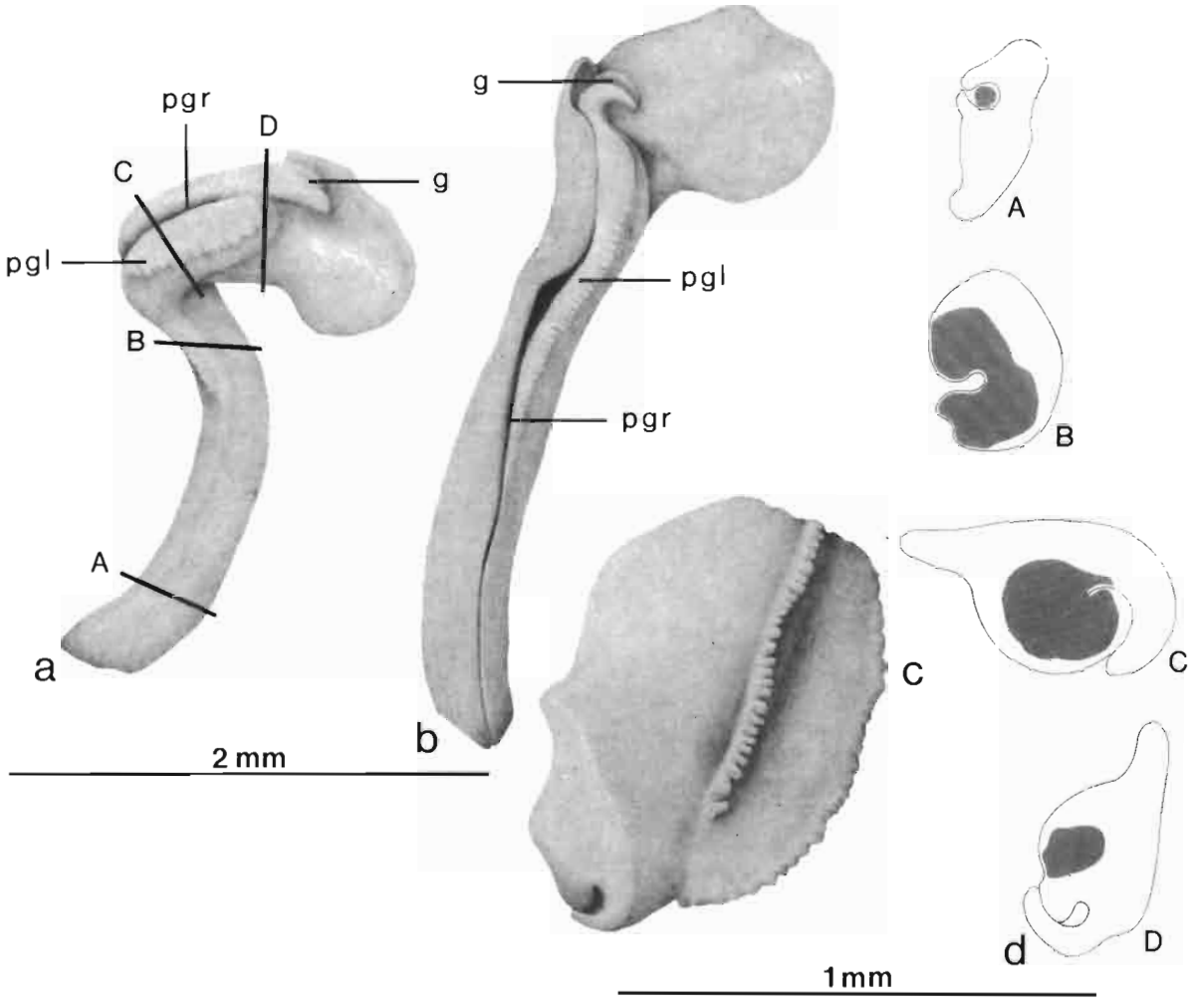


FIG. 8. — Penis of *Rissoina (s. s.) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44 (**a** — dorsal aspect, " in situ " ; **b** ventro-lateral aspect after stretching ; **c** — ventral aspect of spoon-shaped distal lobe ; **d** — transverse sections A, B, C and D, taken at positions indicated in Fig. 4 a ; penial gland dark).
(Abbreviations : g — gutter ; pgl — penial gland ; pgr — penial groove).

DISCUSSION. — *Rissoina (s.s.) boucheti* sp. nov. is very similar to *Rissoina aupouria* Powell, 1937, from Three Kings Islands (New Zealand), but differs in the protoconch being more conical, in having a more angulate last whorl and in having a prominent swelling near the base of the inner side of the outer lip ; furthermore the spiral sculpture is much weaker in *R. aupouria* and consists of numerous, very closely spaced, microscopic striations.

The new species is also very similar to three species, formerly included in the genus *Stiva* Hedley, 1904, from south-eastern Australia. PONDER (1985 : 82), however, considered the species of *Stiva* do not differ sufficiently from *Rissoina (s.s.)* to recognize *Stiva* even as a distinct subgenus of *Rissoina*.

R. (R.) boucheti differs primarily from *R. (R.) ferruginea* (Hedley, 1904), *R. (R.) royana* (Iredale, 1924) and *R. (R.) nielseni* (Laseron, 1950) in having a prominent ridge or swelling on the inner side of the outer lip, near the transition to

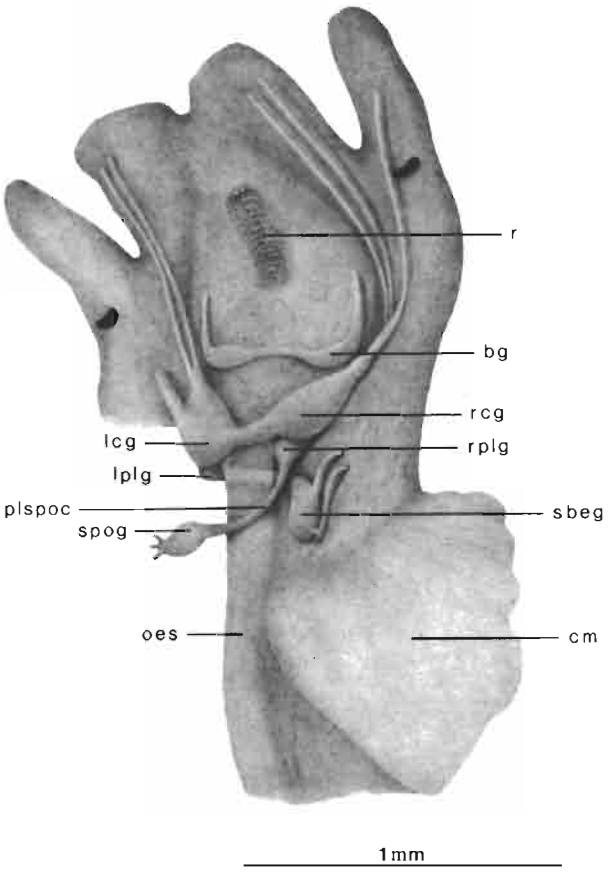


FIG. 9. — Nervous system (dorsal aspect) of *Rissoina (s. s.) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44.

(Abbreviations : bg — buccal ganglion ; cm — columellar muscle ; lcg — left cerebral ganglion ; lplg — left pleural ganglion ; oes — oesophagus ; plspo — pleural supraoesophageal connective ; r — radula ; rcg — right cerebral ganglion ; rplg — right pleural ganglion ; sbeg — suboesophageal ganglion ; spog — supraoesophageal ganglion).

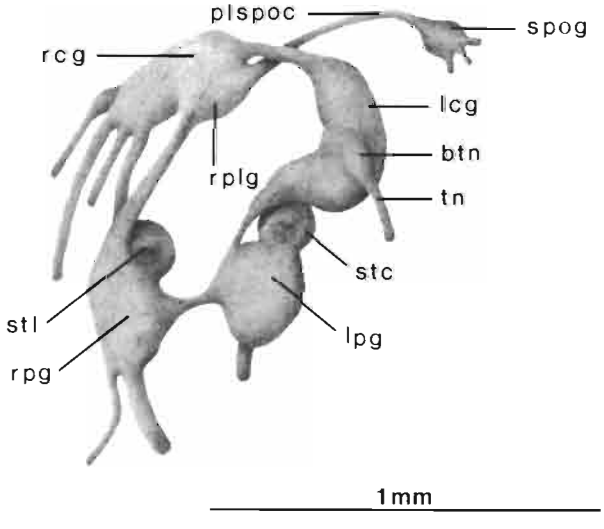


TABLE 1. — *Rissoina (Rissoina) boucheti* sp. nov. Shell dimensions and sculpture counts (L : shell length ; Ls : length of spire ; D : shell diameter ; Dp : diameter of last whorl of protoconch ; Nax : number of axial ribs on last whorl ; Naxp : number of axial ribs on penultimate whorl ; X : mean ; SD : standard deviation ; O.R. : observed range ; n : number of specimens).

	L (mm)	Ls (mm)	D (mm)	Nax	Naxp	Dp	No. whorls
Holotype (Fig. 1 a)	9.9	6.8	3.6	24	21	0.73	7
Paratypes (in MNHN except where explicitely stated)							
	10.4	7.3	3.8	22	16	0.75	7
NMNZ	10.0	6.7	3.9	21	21	?	7 1/4
	9.8	6.8	3.5	21	18	0.70	7
AMS	9.7	6.6	3.7	21	18	0.75	7
	9.6	6.8	3.5	27	26	0.73	7 1/4
Fig. 1 c	9.6	6.5	3.7	25	16	0.75	7
KBIN	9.4	6.5	3.5	24	20	0.75	7
LACM	9.4	6.3	3.7	22	20	0.75	6 3/4
	9.2	6.3	3.6	30	19	0.75	7
Stn DW 44 (n = 32)							
X	9.65	6.61	3.64	23.9	19		7.0
SD	0.33	0.28	0.17	3.0	2.3		0.2
O.R.	9.1-	6.2-	3.0-	19-	16-		6 1/2-
	10.4	7.3	3.9	31	26		7 1/2
Stn DW 22 (n = 22)							
X	11.2	8.0	3.8	32.2	26.8		8.1
SD	0.47	0.35	0.15	4.1	4.4		0.3
O.R.	10.8-	7.6-	3.5-	25-	19-		7 1/2-
	11.8	8.5	4.1-	41	40		8 3/4-
Stn DW 77 (n = 22)							
X	8.8	5.8	3.2	23	19		7.3
SD	0.36	0.9	0.1	1.9	1.5		0.3
O.R.	8.1-	5.5-	3.1-	20-	17-		6 1/2-
	9.2	6.6	3.4-	26	21		8

the anterior channel. *R. (R.) boucheti* differs anatomically from *R. (R.) ferruginea* in having an osphradium consisting of a thick undulating ridge, while the osphradium in the latter is of the bipectinate type ; futhermore *R. (R.) ferruginea* has a simple, very short left pallial tentacle, while the latter is bifurcate and well developed in *R. (R.) boucheti* sp. nov.

FIG. 10. — Nervous system (lateral aspect) of *Rissoina (s. s.) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44 (buccal ganglia omitted and left pleural ganglion covered by left cerebral ganglion).

(Abbreviations : btn — bulbus of tentacular nerve ; lcg — left cerebral ganglion ; lpg — left pedal ganglion ; plspoc — pleuro-supraoesophageal connective ; rcg — right cerebral ganglion ; rpg — right pedal ganglion ; rplg — right pleural ganglion ; spog — supraoesophageal ganglion) ; stc — statocyst ; stl — statholith ; tn — tentacular nerve).

DISTRIBUTION. — Thus far *Rissoina (Rissoina) boucheti* sp. nov. is only reported from southern New Caledonia.

Rissoina (Rissoina) longispira sp. nov.

Fig. 3 d-f

TYPE MATERIAL. — All from BIOCAL, stn DW 33, 29.VIII.1985. Holotype (Fig. 3 d) : empty shell in MNHN. Paratypes : 2 adult and one immature empty shell in MNHN. Immature paratype coated with gold for SEM-photography (Fig. 3 e-f).

TYPE LOCALITY. — New Caledonia, 23°10′ S, 167°10′ E, 675-680 m.

MATERIEL EXAMINED. — The type material is the only one available.

DESCRIPTION. — *Shell* : moderately large for genus, very strongly elongate, conical.

Protoconch (Fig. 3 f) : dome-shaped, of 1 1/2 smooth whorls, of non-planktotrophic larval type ; transition to teleoconch inconspicuous.

Teleoconch : of about 8 1/2, weakly convex to almost straight-sided whorls ; sutures linear, very weakly impressed.

Sculpture of very weak, irregular and rather distantly spaced, weakly opisthocline, narrow, axial ribs ; the latter becoming gradually less regularly spaced and less prominent on penultimate and last whorl ; axial ribs very weak to almost absent on abapical half of last whorl ; spiral sculpture of very weak, irregular and very irregularly spaced spiral threads, on the abapical half of spire whorls ; spiral threads slightly more prominent on last whorl.

Aperture : D-shaped ; inner lip thin with a very weak thickening near the transition to the anterior channel ; the latter narrow, moderately deep ; outer lip weakly thickened internally, with a weak, narrow varix externally ; outer lip weakly opisthocline to almost orthocline in profile.

Colour : glossy white throughout.

Operculum : unknown.

Radula and internal anatomy : unknown.

Shell dimensions : See table 2.

TABLE 2. — *Rissoina (Rissoina) longispira* sp. nov. Shell dimensions. (L : shell length ; LS length of spire ; D : shell diameter).

	L (mm)	Ls (mm)	D (mm)	No. whorls
Holotype (MNHN) (Fig. 3 d)	9.7	6.9	3.0	8 1/2
Paratypes (MNHN)	9.4	4.1	3.2	8
	8.8	6.3	2.8	7 3/4
Immature specimen (Fig. 3 e-f)	8.1	5.8	2.3	7 1/4

VARIATION. — There is barely any variation in shell size and sculpture in the small series of specimens examined.

ETYMOLOGY. — *Longus* (Latin) = long, *spira* (Latin) = spire : referring to the strongly elongate spire.

DISCUSSION. — *Rissoina (Rissoina) longispira* sp. nov. is superficially similar to *R. (R.) boucheti* sp. nov., but differs in having a less angulate last whorl and in lacking the thick swelling on the inner side of the outer lip, near the transition to the anterior channel.

R. (R.) longispira is most similar to *Rissoina jaffa* Cotton, 1952 from Cape Jaffa (South Australia) and collected from a depth of about 500 m ; the latter species, however differs from *R. longispira* in being much more acuminate, in having a rather angulate last whorl instead of a rather subglobose last whorl in *R. longispira* and in having more prominent and somewhat more opisthocline axial ribs. There are no other similar species described.

DISTRIBUTION. — *R. (R.) longispira* sp. nov. is thus far only known from the type locality.

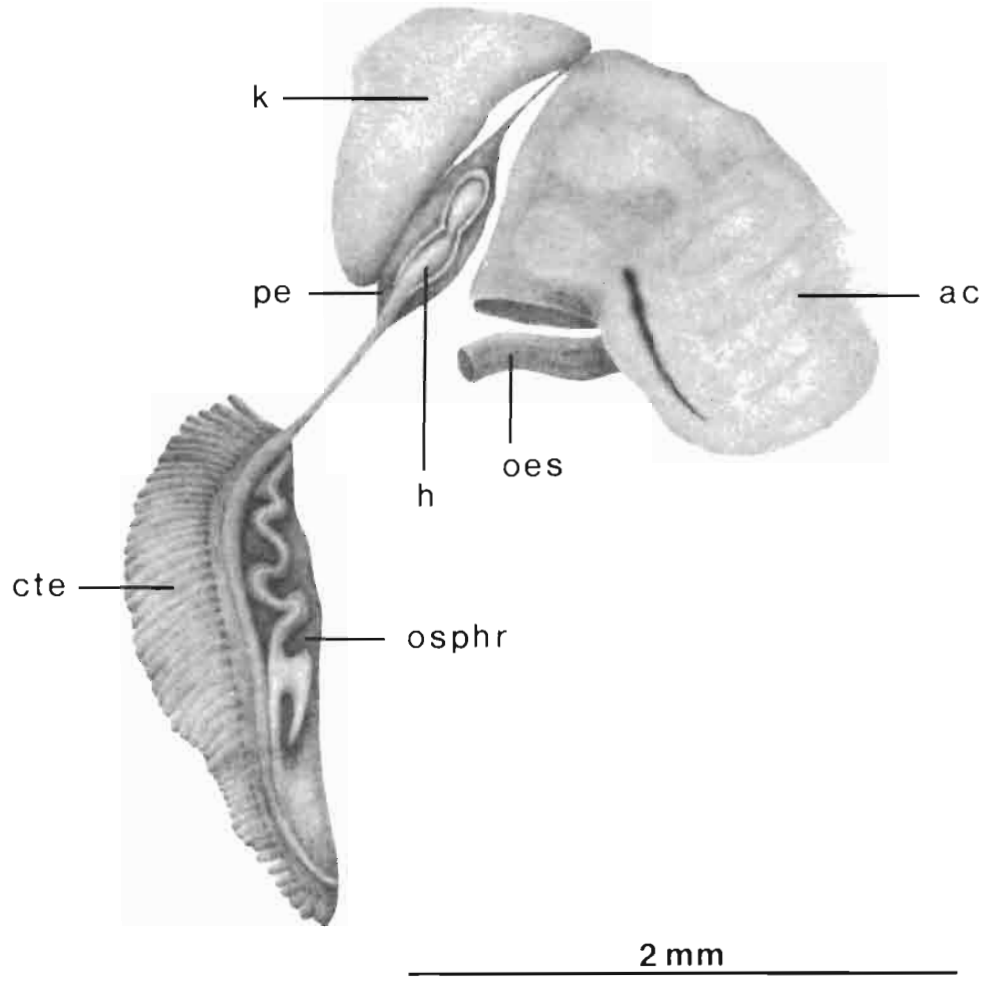


FIG. 11. — Mantle cavity structure and anterior part of stomach of *Rissoina (Rissoina) boucheti* sp. nov., New Caledonia, BIOCAL stn DW 44.

(Abbreviations : ac — anterior chamber of stomach ; cte — ctenidium ; k — kidney ; oes — oesophagus ; osphr — osphradium ; pe — pericardium).

Genus *ZEBINA* H. & A. Adams, 1854

Zebina (Zebina) reclina sp. nov.

Fig. 4 e-h

TYPE MATERIAL. — All from BIOCAL, stn DW 44, 30.VIII.1985. Holotype (Fig. 4 e-f) : empty shell in MHNH. Paratypes : 3 empty shells in MNHN.

TYPE LOCALITY. — New Caledonia, 22°47′ S, 167°14′ E, 440-450 m.

MATERIAL EXAMINED. — The type material is the only one available.

DESCRIPTION. — *Shell* : moderately large for genus, glossy, strongly elongate-conical.

Protoconch : of planctotrophic larval type, of 2 1/4, slightly convex, weakly ad-abapically compressed, smooth, whorls ; transition to teleo-

conch abruptly, with a rather deep sinusigeral notch.

Teleoconch : of about 7 to 7 3/4 whorls ; adapical spire whorls weakly convex ; abapical spire whorls becoming gradually less convex to almost flat-sided ; last whorl moderately angulate ; suture linear, not impressed. Whorls smooth, except for some very weak, densely spaced, growth lines.

Aperture : pyriform ; inner lip thin posteriorly, but becoming wider and thicker anteriorly near the shell base ; anterior channel absent ; posterior channel short, very narrow, triangular ; outer lip thin except for a weak thickening near the transition to the posterior channel and with basal part strongly protracted ; outer lip externally with a moderately thick, rounded, narrow varix.

Colour : glossy white throughout.
Operculum : unknown.
Radula and internal anatomy : unknown.
Shell dimensions : See table 3.

TABLE 3. — *Zebina (Zebina) reclina* sp. nov. Shell dimensions. (L : shell length ; Ls length of spire ; D : shell diameter).

	L (mm)	Ls (mm)	D (mm)	No. whorls
Holotype (MNHN)	5.9	3.8	2.3	7 3/4
Paratypes (MNHN)	6.0	4.0	2.3	7 3/4
	5.5	3.5	2.2	7 1/4
	5.3	3.4	2.1	7

VARIATION. — The four specimens examined (the type material) show only small differences in shell dimensions, but do not differ in size and shape.

ETYMOLOGY. — *Reclinus* (Latin) = leaning back, referring to the strongly opisthocline outer apertural lip.

DISCUSSION. — *Zebina reclina* sp. nov. is superficially similar to *Zebina acicula* Laseron, 1956 from Christmas I. in shell shape, but differs in having a more angulate last whorl and in the base of the outer lip being much more protracted.

Z. reclina is easily distinguished from all other known congeners by the strongly angulate last whorl.

DISTRIBUTION. — *Zebina reclina* sp. nov. is known only from the type locality.

Zebina (Zebina) retusa sp. nov.

Fig. 4 a-d

TYPE MATERIAL. — All from BIOCAL, stn DW 38, 30.VIII.1985. Holotype (Fig. 4 a-b) : empty shell in MNHN. Paratypes : 5 adult, empty shells and 1 immature, empty shell in MNHN.

TYPE LOCALITY. — New Caledonia, 23°00′ S, 167°15′ E, 360 m.

MATERIAL EXAMINED (Apart from type material). — **New Caledonia**. BIOCAL : stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 30.VIII.1985 : 1 spec. (MNHN).

DESCRIPTION. — *Shell* : small, glossy, conical, with bluntly rounded apex.

Protoconch : of non-planktotrophic larval type, of about 2, relatively wide, smooth whorls ; transition teleoconch abruptly.

Teleoconch : of 5 1/2 to 6 whorls ; adapical spire whorls slightly convex ; abapical spire whorls becoming gradually less convex to almost flat-sided ; last whorl subangulate near the periphery.

Spire whorls and last whorl smooth, apart from some weak growth lines.

Aperture : pyriform ; inner lip thin, becoming moderately expanded anteriorly, partly covering the shell base ; anterior channel absent ; outer lip thin, with about 3 weak parallel threads on the outer margin of the inner side ; outer lip with a moderately thick, rounded, narrow varix externally ; outer lip strongly opisthocline in profile.

Colour : spire whorls opaque white with some very irregular large semitransparent dots just above the suture ; last whorl with a rather wide opaque band below the suture and with abapical half semitransparent with irregular and irregularly distributed subcircular opaque white dots.

Operculum, radula and internal anatomy : unknown.

Shell dimensions : See table 4.

TABLE 4. — *Zebina (Zebina) retusa* sp. nov. Shell dimensions. (L : shell length ; Ls length of spire ; D : shell diameter).

	L (mm)	Ls (mm)	D (mm)	No. whorls
Holotype (MNHN) (Fig. 4 a, b)	3.4	2.3	1.4	5 3/4
Paratypes (MNHN)	3.5	2.2	1.4	6
	3.4	2.1	1.3	6
	3.4	2.2	1.3	5 3/4
	3.4	2.1	1.4	5 1/2
(Fig. 4 c, d)	3.3	2.2	1.3	6
New Caledonia (Stn DW 44) (MNHN)	3.6	2.3	1.5	5 1/2

VARIATION. — *Zebina retusa* sp. nov. appears to be very uniform in shell shape and shell size.

ETYMOLOGY. — *Retusus* (Latin) = blunt, referring to the blunt apex of the shell.

DISCUSSION. — *Zebina retusa* sp. nov. differs from *Z. reclina* sp. nov. in having a bluntly rounded apex instead of being strongly acuminate, in the last whorl being less angulate and in colour pattern.

Z. retusa differs from all its known congeners in colour pattern and in the blunt, almost rounded apex.

DISTRIBUTION. — *Z. retusa* sp. nov. is known only from the type locality.

ACKNOWLEDGEMENTS

I would particularly like to thank Dr P. BOUCHET, who provided me with the collection of New Caledonian rissoinids.

I am very grateful to Dr G. DAVIS and to Dr W. PONDER for their lessons on dissecting techniques.

I would like to thank in particular Dr J. VAN GOETHEM and Dr W. F. PONDER for providing constructive comments on the original manuscript and for constant encouragement of my research.

I wish to thank the following persons who kindly sent me type material on loan : Mrs K. WAY (BMNH), Mrs GOWLETT-HOLMES (South Australian Museum) and Mr P. COLMAN and Mr I. Loch (AMS).

The illustrations were rendered by Mr H. VAN PAESSCHEN (KBIN), who also mounted the plates. SEM photography was done by Mr J. CILLIS (KBIN).

REFERENCES

COTTON, B. C., 1952. — Australian Recent and Tertiary Mollusca (Terebridae, Rissoinidae, Rissoidae, Fasciolariidae, Volutidae). *Trans. R. Soc. S. Aust.*, **75** : 38-54, pl. 3-4.

DAVIS G., KITIKOON V. & TEMCHAROEN, P., 1976. — Monograph on " *Lithoglyphopsis* " *aperta*, the snail host of Mekong River schistosomiasis. *Malacologia*, **15** (2) : 241-287, 22 figs.

LASERON, C. F., 1956. — The families Rissoinidae and Rissoidae (Mollusca) from the Solanderian and Dampierian zoogeographical provinces. *Aust. J. mar. Freshwat. Res.*, **7** (3) : 384-478.

PONDER, W. F., 1985. — A Review of the Genera of the Rissoidae (Mollusca : Mesogastropoda : Rissoacea). *Rec. Aust. Mus.*, Suppl. **4** : 1-221.

POWELL, A. W. B., 1937. — New species of marine Mollusca from New Zealand. *Discovery Rep.*, **15** : 153-222, pl. 45-46.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. *In* : Résultats des campagnes MUSORSTOM. Volume 6 (1). *Mém. Mus. natn. Hist. nat. Paris*, (A) **145** : 9-54.

6

Mollusca Gastropoda : *Cypraeopsis superstes* sp. nov., Pediculariinae relique du bathyal de Nouvelle-Calédonie et de la Réunion

Luc DOLIN

2, place du Caquet
93200 Saint-Denis
France

RÉSUMÉ

Le genre *Cypraeopsis* n'était connu que par deux espèces du Miocène d'Europe et d'Asie du Sud-Est. Une espèce non dénommée est signalée ici de l'Oligocène supérieur de France et *C. superstes* sp. nov. est décrite de la faune bathyale actuelle de la Nouvelle-Calédonie et de la Réunion. *C. superstes* diffère des espèces fossiles par la sculpture finement côtelée du dernier tour et le bord externe ondoyant, annonçant les *Pedicularia*, par sa protoconque saillante, non ennoyée — un caractère peut-être progénétique —. *C. superstes* apparaît, paradoxalement, comme une relique évoluée.

ABSTRACT

***Cypraeopsis superstes* sp. nov., a new bathyal relict species of Pediculariinae (Gastropoda Ovulidae) from New Caledonia and Réunion.**

The genus *Cypraeopsis* was so far known from two species in the Miocene of Europe and South-East Asia. An unnamed species is here recorded from the upper Oligocene of France and *C. superstes* sp. nov. is described from the Recent bathyal fauna of New Caledonia and Réunion. *C. superstes* differs from the fossil species by the body whorl being spirally sculptured, by the outer lip undulating as in *Pedicularia*, and by the protruding, uncovered protoconch, a character tentatively interpreted as progenetic. *C. superstes* thus appears paradoxically as an evolved relict.

DOLIN, L., 1991. — Mollusca Gastropoda : *Cypraeopsis superstes* sp. nov., Pediculariinae relique du bathyal de Nouvelle-Calédonie et de la Réunion. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 179-186. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

Cette étude repose sur le matériel récolté dans le sud de la Nouvelle-Calédonie (voir RICHER DE FORGES, 1990) et à la Réunion, lors de campagnes des navires océanographiques " *Jean Charcot* ", " *Vauban* ", " *Coriolis* " et " *Marion Dufresne* ".

La faune bathyale de Nouvelle-Calédonie présente une richesse remarquable en Stylastérides (plusieurs dizaines d'espèces). *C. superstes* y est sympatrique avec *Pedicularia (s. s.)* cf. *elegantissima* Deshayes, 1863, qui a été récolté sur son hôte (Stylasteridae).

ÉTUDE SYSTÉMATIQUE

Superfamille CYPRAEOIDEA Rafinesque, 1815

Famille OVULIDAE Fleming, 1822

Sous-Famille PEDICULARIINAE Gray, 1853

Jusqu'à ce que GOSLINER et LILTVED (1985 : 105, 118-119, fig. 34) aient établi sur la base de critère anatomiques l'appartenance des Pediculariinae aux Ovulidae, cette entité phylétique a maintes fois changé et de rang, et de contenu. SCHILDER (*in* WENZ, 1941 : 1000-1003, 1007-1008) intégrait notamment au sein des Pediculariinae les genres monospécifiques éocènes *Semicypraea* Schilder, 1936 (= Cypraeidae, Bernayinae ; voir DOLIN & DOLIN, 1983 : 18-19, fig. 5 a-b), *Cypraeogemmula* Vredenburg, 1920 (= Ovulidae, Sulcocypraeinae) et *Eovolva* Schilder, 1932 ; mais alors que les *Cypraedia* Swainson, 1840 y étaient bien associées aux *Pedicularia* Swainson, 1840, les *Jenneria* Jousseaume, 1884 et *Cypraeopsis* Schilder, 1936 étaient relégués au sein des Sulcocypraeinae (= Eocypraeinae). Or *Cypraedia* (voir MARTIN, 1914 : fig. 121 b), *Cypraeopsis* (Fig. 2 a-b) et *Pedicularia* (SCHILDER 1931 : fig. 1 ; RICHTER & THORSON, 1975 : pl. 9, fig. 58 a-b) possèdent une protoconque en tous points semblables, sinusigériforme, multispirée à sculpture obliquement treillissée (décussée), et non verticalement quadrillée comme chez les Cypraeidae (voir THIRIOT-QUIEVREUX, 1967 : pl. 1-3 ; RICHTER & THORSON, 1975 : pl. 8, fig. 52-57 ; pl. 9, fig. 59-60 ; DOLIN & DOLIN, 1983 : fig. 3-4, 25, 26-b). De par ses spécificités originales, *C. superstes* permet par ailleurs de situer les *Cypraeopsis* à mi-chemin des *Jenneria* (prédateurs de Scléractinaires) et des *Pedicularia* (prédateurs d'Hydrozoaires).

Genre ***CYPRAEOPSIS*** Schilder, 1936

Cypraeopsis Schilder, 1936 : 87. Espèce-type, par désignation originale : *Cypraeopsis vandervlerki* Schilder, 1936.

« ... allied to *Transovula* in size, in general shape, and in the dentition of both lips, but differs by being less elongate, by the longitudinal dorsal sulcus, by a longitudinal callous carina, by the reduction for any thickening of the inner lip on its posterior extremity, and by the distinctly denticulate fossula ».

C. superstes diffère essentiellement de ses ancêtres par la structure finement côtelée de son

aire dorsale, par son canal anal peu marqué et par sa lèvre externe ondoyante. Je n'ai toutefois pas cru devoir sanctionner taxonomiquement cette évolution morphologique. Elle pourrait en effet être de nature adaptative : bien qu'aucun échantillon de *C. superstes* n'ait été récolté avec son hôte, le contour de la lèvre externe pourrait être induit par la forme d'une branche de Stylasteride, par exemple, comme c'est le cas chez les *Pedicularia* (ARNAUD & ZIBROWIUS, 1979 : 123-124 ; SCHMIEDER, 1982 : 272, fig. 1).

Cypraeopsis superstes sp. nov.

Fig. 1 a-c, 2 a-b, 3 a-b, 4.

MATÉRIEL TYPE. — Holotype MNHN (SMIB 3, st. DW 12 : Fig. 1 a-c, 4) et paratypes MNHN (BIOCAL, st. DW 51 : Fig. 2 a-b. — MUSORSTOM 4, st. DW 197 : Fig 3 a-b) ; paratypes NMNZ, AMS, NSMT, et NM (MUSORSTOM 4, st. DW 197).

LOCALITÉ TYPE . — SMIB 3, st. DW 12, 23°38′ S-167°42′ E, 470 m.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL, coll. BOUCHET, METIVIER et RICHER DE FORGES : St. DW 08, 20°34′ S, 166°54′ E, 435 m : 13 spms (population naine, adulte ne dépassant pas 6 mm). — St. DW 33, 23°10′ S, 167°10′ E, 675-680 m : 3 spms. — St. DW 48, 23°00′ S, 167°29′ E, 775 m : 20 spms. — St. DW 51, 23°05′ S, 167°45′ E, 680-700 m : 109 spms + récoltés vivant (nombreux stades juvéniles). — St. DW 53, 23°09′ S, 167°43′ E, 975-1 005 m : 1 spm. — St. DW 66, 24°55′ S, 168°22′ E, 515-606 m : 1 spm. — St. DW 70, 23°25′ S, 167°53′ E, 965 m : 3 spms. — St. DW 77, 22°15′ S, 167°15′ E, 440 m : 1 spm. — St. DW 83, 20°35′ S, 166°54′ E, 460 m : 2 spms.

MUSORSTOM 4, coll. BOUCHET et RICHER DE FORGES : St. DW 156, 18°54′ S, 163°19′ E, 530 m : 2 spms + vivant. — St. DW 159, 18°46′ S, 163°16′ E, 600 m : 3 spms. — St. DW 162, 18°35′ S, 163°10′ E, 535 m 1 spm. — St. CP 194, 18°53′ S, 163°22′ E, 550 m : 1 spm + 2 spms récoltés vivants. — St. DW 197, 18°51′ S, 163°21′ E, 560 m : 13 spms + 10 spms récoltés vivants. — St. DW 220, 22°58′ S, 167°38′ E, 505-550 m : 2 spms. — St. CP 216, 22°59′ S, 167°22′ E, 490-515 m : 2 spms récoltés vivants. — St. DW 221, 22°59′ S, 167°37′ E, 535-560 m : 2 spms. — St. DW 223, 22°57′ S, 167°30′ E, 545-560 m : 1 spm. — St. DW 225, 22°52′ S, 167°23′ E, 590-600 m : 1 spm.

CHALCAL 2, coll. BOUCHET, METIVIER et RICHER DE FORGES : St. DW 72, 24°55′ S, 168°22′ E, 527 m : 1 spm. — St. DW 76, 23°41′ S, 167°45′ E, 470 m : 8 spm.

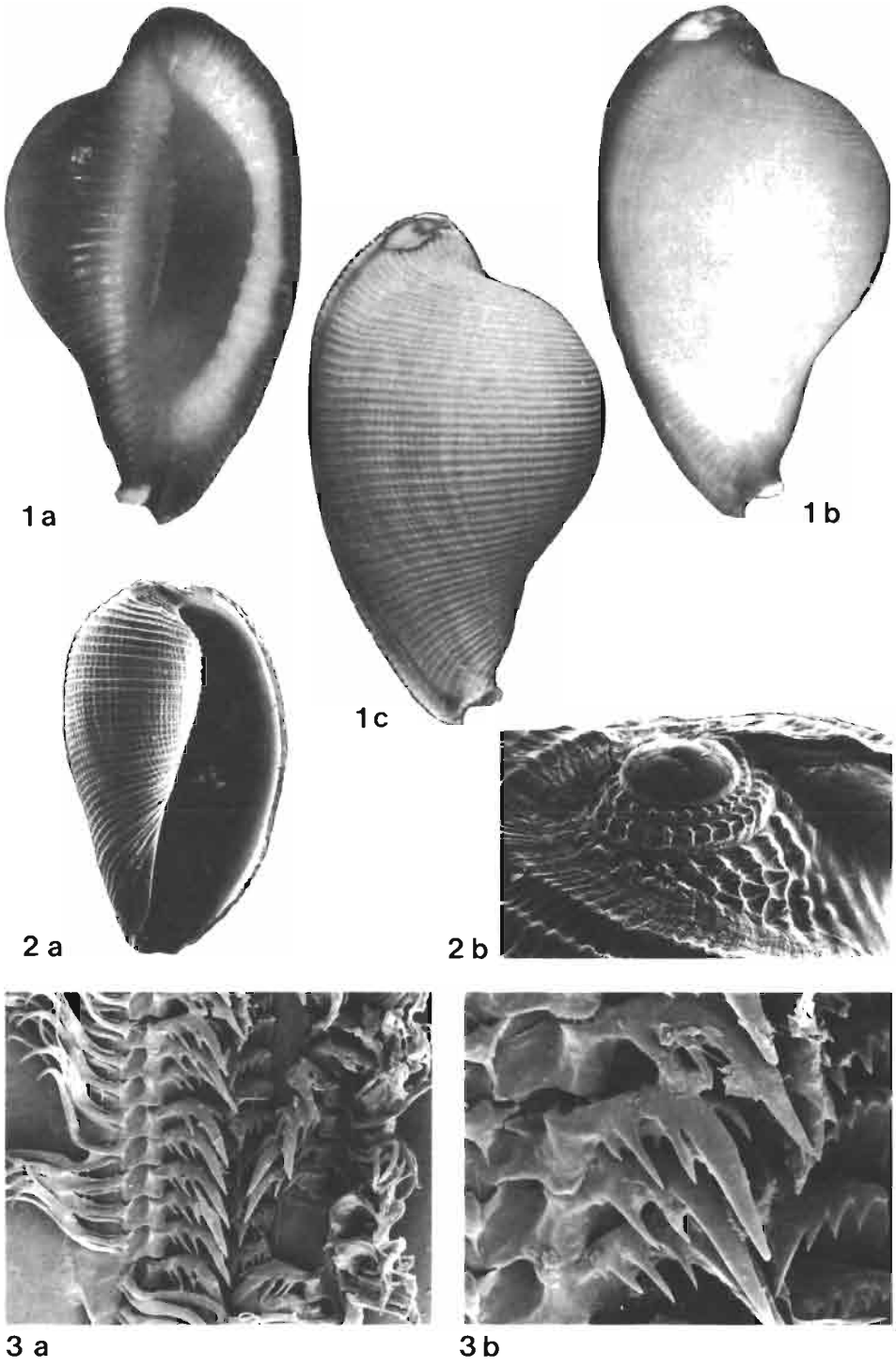
SMIB 3, coll. RICHER DE FORGES : St. DW 12, 23°38′ S, 167°42′ E, 470 m : 1 spm. — St. DW 24, 22°59′ S, 167°21′ E, 535 m : 4 spms.

Réunion : Campagne MD 32 : St. DC 10, 21°13′ S, 55°52′ E, 930-980 m : 1 spm + 6 spms juvéniles.

DESCRIPTION. — Coquille piriforme, à test mince et à lèvre ondoyante, contournant la zone apicale où elle se confond avec l'arête adapicale du bord interne. L'aire dorsale et la denticulation sont blanches. Une auréole beige pâle, passant graduellement au marron-rouge, souligne les marges latérales et les extrémités. L'unique spécimen adulte de la Réunion montre une protoconque brune, mais la téléoconque est d'un blanc immaculé.

Protoconque brun-rouge, en partie ennoyée dans le dernier tour de téléconque, faisant légèrement saillie au creux d'une dépression pseudombilicale. Sur les exemplaires juvéniles, on distingue une protoconque I lisse, avec seulement quelques granules suprasuturaux. Lui succède une protoconque II composée de 3 tours environ, à sculpture formée de croisillons obliques (Fig. 2 a-b). La transition protoconque/téléoconque (très distincte lorsqu'elle n'est pas recouverte par le tour suivant) montre la lèvre à 3 échancrures caractéristiques de la superfamille.

L'aire dorsale est parcourue d'une multitude de côtes spirales émoussées, équidistantes (6 à 7 au mm en moyenne), séparées par des sillons profondément incisés. De fines stries d'accroissement les recoupent plus ou moins régulièrement. Le canal siphonal est remarquablement allongé, assez profond bien délimité ; bien détaché, il forme un cou net. Le canal anal est beaucoup plus mal formé. Il n'est que faiblement limité abaxialement par les 3 dernières fortes dents de l'arête adapicale, et ne se creuse d'aucune gouttière. Le bord interne est fortement convexe, formant une crête longitudinale calleuse, fortement versante adaperturalement. Trente à quarante fortes rides parcourent l'aire basale divisée, ainsi, en deux versants ; se dédoublant parfois, elles sont affaiblies au niveau du versant adapertural, affaissé, concave en sa partie médiane. Le pli antérieur horizontal, remarquablement prolongé, et sa lame interne raccourcie à l'extrême, sont réduits à leur plus simple expression. La fossula est résiduelle, légèrement concave, et l'aire columellaire est étroite ; elles sont irrégulièrement denticulées. Lèvre externe ondoyante à marge lamelleuse, bordée, formant un méplat que parcourent une quinzaine de fortes dents



FIGS 1-3. — *Cypraeopsis superstes* sp. nov. : **1 a-b, c** (traité au chlorure d'ammonium), holotype MNHN, SMIB, 3 st. DW 12, 11,8 mm. — **2 a-b**, paratype MNHN juvénile, BIOCAL st. DW 51, 2 4.0 mm, 2 b × 92. — **3 a-b**, radula, BIOCAL st. DW 51, 3 a × 270, 3 b × 730.

faisant saillie sur l'ouverture ; de fines rides s'intercalent entre elles, limitées à l'extérieur du méplat et sans solution de continuité avec les côtes et sillons de l'aire dorsale. Le développement adapicale en pavillon de la lèvre externe accuse la largeur de l'ouverture.

La radula est taenioglosse (Fig. 3 a-b) : dent centrale avec une large plaque basale, un fort cuspide médian et 3-4 cuspides plus petits de chaque côté ; dent latérale avec un très long et fort cuspide et, respectivement, 1 et 2-3 cuspides vers l'intérieur et l'extérieur de la dent ; marginales longues, la dent interne étant emboîtée par sa base dans la dent externe.

DISTRIBUTION. — Bathyal du Sud de la Nouvelle-Calédonie et de la Réunion, les exemplaires vivants ayant été pris en Nouvelle-Calédonie entre 490 m et 700 m. Une plus vaste distribution Indo-Ouest Pacifique est envisageable.

ETYMOLOGIE . — Pour qualifier l'unique représentant actuel d'un genre Oligo-Miocène que l'on croyait éteint, *superstes* — le survivant — s'imposait.

DISCUSSION

Affinités : Le premier *Cypraeopsis* est connu avec certitude du Chattien (Oligocène supérieur, 26 millions d'années environ). L'unique spécimen (Fig. 4) a été récolté à « Estoti », Saint-Paul-lès-Dax (Landes, France) dans le faciès de base dont la thanatocoenose « indicates sedimentation on the lower beach environment » (LOZOUET *in* DOLIN *et al.*, 1985 : 10). Cette espèce, vraisemblablement nouvelle, annonce très précisément l'espèce suivante.

C. subursellus (d'Orbigny, 1852) du Burdigalien (Miocène inférieur) du bassin d'Aquitaine (France ; fig. 5) et des collines de Turin (Italie ; voir FERRERO MORTARA *et al.*, 1984 : pl. 26, fig. 6 a-b) en est toutefois spécifiquement distinct. En moyenne que son ancêtre, *C. subursellus* présente une denticulation du bord interne plus dense, tandis que celle du bord externe est dédoublé comme chez *C. superstes* ; par ailleurs, la fossula paraît bien avoir amorcé une réduction sensible, la denticulation s'accentuant au péristome de la fossula. Le *C.* sp. de l'Oligocène supérieur et *C. subursellus* se rencontrent dans des milieux sensiblement similaires, de récifs coralliens plus ou moins démantelés ; ils y sont systématiquement associés à des espèces du genres voisin *Jenneria*.

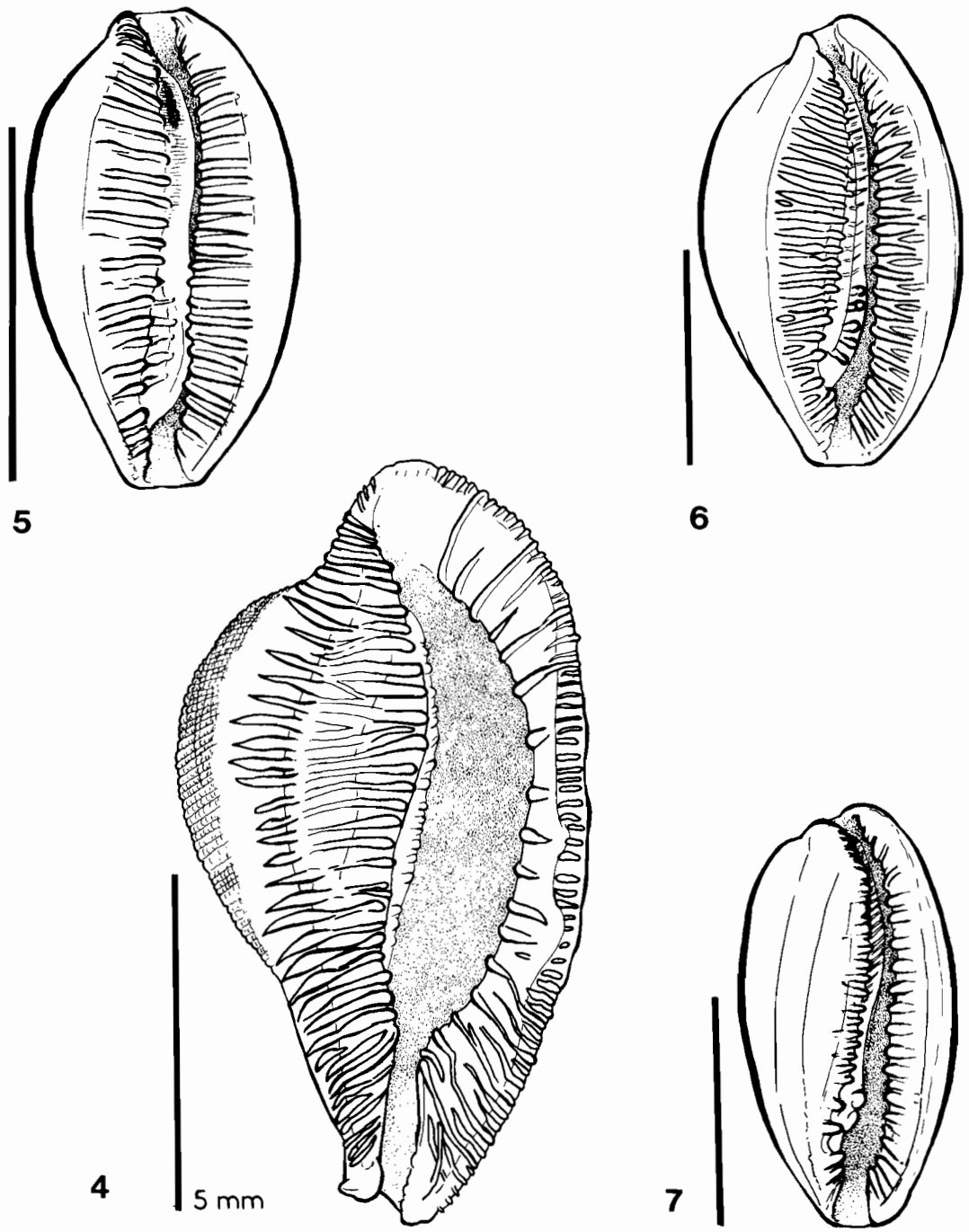
C. vandervlerki des « Taballar Kalk » (Miocène supérieur ?) de Bornéo (Indonésie), est fondé sur un unique exemplaire figuré dans WENZ (1941 : fig. 2894). Cylindracée, elle se distingue nettement des deux espèces européennes par sa denticulation réduite, y compris sur la fossula. Pour le reste, elle montre les caractères génériques — notamment — du pli antérieur court, des deux bords carénés, etc., jusqu'à et y compris la sculpture du juvénile qui persiste chez les trois espèces fossiles au niveau de l'aire columellaire (et que l'on pourrait prendre pour une denticulation interne).

En dépit d'un changement d'environnement radical (phénomène pour lequel je n'ai pas d'explication), et d'un écart stratigraphique avoisinant vraisemblablement une quinzaine de millions d'années, *C. superstes* présente nombre de caractères ancestraux, inchangés ou si peu. Elle offre même avec *C. subursellus* beaucoup d'affinités : le pli antérieur (davantage encore prolongé) ; la lame interne (quoique plus réduite) ; la denticulation forte du bord interne, à cheval sur la crête longitudinale affectant l'aire ventrale, légèrement affaissée ; le bord externe formant un méplat, bordé (devenant lamelleux), fortement denticulé, des rides s'intercalant entre les rides principales (limitées au péristome extérieur du labre).

Caractères taxonomiques : *C. superstes* ne diffère donc vraiment de ses ancêtres que par des détails, importants et rappelant certains genres, mais que je pense être d'ordre spécifique.

1. Alors que la protoconque est chez les espèces fossiles ennoyée par une épaisse callosité couronnant le canal anal, chez *C. superstes* son originalité est de se situer — même au stade adulte — au fond d'une dépression pseudombilicale, et de n'être jamais convolutée par le dernier tour — comme c'est le cas pour la quasi totalité des Ovulidae (voir RANSON, 1967 : 97-98, fig. 144-145, 148-145, 148-149). Ceci pourrait indiquer une progénèse.

2. Les *Cypraeopsis* fossiles, comme les *Jenneria*,



FIGS 4-7. — **4**, *Cypraeopsis superstes*, holotype MNHN, SMIB 3 st. DW 12 (Nouvelle-Calédonie), 11,8 mm. — **5**, *Cypraeopsis* sp. Estoti, Saint-Paul-lès-Dax (Landes, France), collection A. Cluzaud, Chattien (Oligocène supérieur), 13,6 mm. — **6**, *Cypraeopsis subursellus* (d'Orbigny), 1852), Moulin de Carreau, Corbieux (Landes, France), collection R. Favia, Burdigalien (Miocène inférieur sommital), 20,4 mm. — **7**, *Cypraeopsis vandervlerki* (d'après WENZ, 1941), Borneo (Indonésie), Taballar kalk (Miocène supérieur ?), 9,4 mm.

possèdent un sulcus dorsal, accentuation de la zone de jointoiement des deux lobes du manteau par l'hypertrophie des cals du canal siphonal, du canal anal et des marges. Chez *C. superstes*, l'aire dorsale — quoiqu'épaisse — est finement côtelée, ces costules spirales étant recoupées par les stries d'accroissement. Cette structure ne se retrouve telle quelle que chez les *Pedicularia*, et tout particulièrement chez *Pedicularia (Pediculariella) californica* (Newcomb, 1864).

3. Bien que les caractères du bord interne et de sa denticulation soient identiques chez *C. subursellus* et *C. superstes*, chez cette dernière la frange labrale ondule, se développant postérieurement en pavillon, sans former ni délimiter de canal exhalant. Ce critère préfigure également de manière évidente les *Pedicularia*, chez qui cette apomorphie correspond à une adaptation au commensalisme sur des Hydrocoralliaires Stylasterides (ARNAUD & ZIBROWIUS, 1979 : 123-124 ; SCHMIEDER, 1982 : 272, fig. 1).

Somme toute, si les *Cypraeopsis* fossiles se rattachent morphologiquement aux *Jenneria*, avec lesquels ils ont — au moins au début — partagé le même biotope, *C. superstes* fait le lien et annonce les *Pedicularia* ; aucune coupure intragénérique ne peut toutefois être sérieusement établie au sein des *Cypraeopsis*. Un rattachement aux *Pedicularia* ne serait pas plus fondé.

En effet, *Pedicularia (s.s) cf. elegantissima* Deshayes, 1863 avec laquelle *C. superstes* est sympatrique, montre (BIOCAL, st. DW 57 ; à publier) une radula identique à celle figurée par FISCHER (1887 : 665, fig. 423) reprise par THIELE (1929 : 269, fig. 284), figures en partie erronées car montrant une marginale en forme d'écaille, qui n'existe pas (BOUCHET, comm. pers.) ; or, celle de *C. superstes* en diffère notablement par sa dent centrale à cuspides moins nombreux mais longs et acérés, détachés les uns des autres. Sa radula lui confère donc une aussi grande originalité que les caractères morphologiques de son test, situant les *Cypraeopsis* à leur place, au sein des Pediculariinae, à mi-chemin des *Jenneria* et des *Pedicularia*.

CONCLUSION

Unique représentant vivant du genre *Cypraeopsis*, avec — qui plus est — une distribution bathyale, *C. superstes* présente un ensemble de caractéristiques qui conduisent à la qualifier paradoxalement de « relique évoluée ».

REMERCIEMENTS

Le matériel actuel étudié a été récolté lors de campagnes conjointes ORSTOM/MNHN ; je voudrais associer aux collecteurs cités, Virginie HEROS et Annie TILLIER (MNHN) pour leur travail patient et leur aide concrète.

Les échantillons fossiles proviennent de fouilles individuelles ; Raymond FAVIA et Alain CLUZAUD les ont amicalement mis à ma disposition.

Anders WARÉN du Naturhistorika Riksmuseet, Stockholm, a aimablement distrait de son temps pour extraire les radula de *Cypraeopsis superstes* et *Pedicularia cf. elegantissima*. Les photographies sont de Pierre LOZOUET et de Philippe BOUCHET (MEB), qui a, en outre, corrigé les manuscrits successifs.

Que tous trouvent ici l'expression sincère de ma reconnaissance.

RÉFÉRENCES BIBLIOGRAPHIQUES

ARNAUD, P. M. & ZIBROWIUS, H., 1979. — L'association *Pedicularia sicula* — *Errina aspera* en Méditerranée (Gastropoda Prosobranchia et Hydrocorallia Stylasterina). *Rapp. Comm. int. Mer Médit.*, **25/26** (4) : 125-126.

DOLIN, C. & DOLIN, L., 1983. — Révision des Triviacea et Cypraeacea (Mollusca, Prosobranchiata) éocènes récoltés dans les localités de Gan (Tuilerie et Acot) et Bosdarros (Pyrénées Atlantiques, France). *Meded. Werkgr. Tert. Kwart. Geol.*, (1) **20** : 5-48.

DOLIN, C., DOLIN, L. & LOZOUET, P., 1985. — Paleoecology of some classic Tertiary localities in the Aquitaine and Paris basins of France. *Mississipi Geology*, **5** (4) : 4-13.

FERRERO MORTARA, E., MONTEFAMEGLIO, L., NOVELLI, M., OPESSO, G., PAVIA, G., TAMPIERI, R., 1984. — Catalogo dei tipi e degli esemplari figurati della collezione Bellardi e Sacco. *Cataloghi Mus. reg. Sci. nat. Torino*, **7** (2) : 1-484.

FISCHER, P., 1887. — Manuel de Conchyliologie. F. Savy, Paris : 1-1369, pls 1-23.

GOSLINER, T. M. & LILTVED, W. R., 1985. — Aspects of the morphology of the endemic South African Cypraeidae with a discussion of the evolution of the Cypraeacea and Lamellariacea. *Ann. S. Afr. Mus.*, **96** (4) : 67-122.

MARTIN, K., 1914. — Die Fauna des Obereocäns von Nanggulan, auf Java. *Samml. Geol. Reichmus. Leiden*, (n.s.) **2** : 110-223, pls 1-8.

RANSON, G., 1967. — Les protoconques ou coquilles larvaires des Cyprées. *Mém. Mus. natn. hist. nat.*, (A) **47** (2) : 93-126, pl. 1-39.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. *In* A. CROSNIER (éd.), Résultats des campagnes MUSORSTOM, Volume 6. *Mém. Mus. natn. Hist. nat.*, (A), **145** : 9-54.

RICHTER, G. & THORSON, G., 1975. — Pelagische Prosobranchier-larven des Golfes von Neapel. *Ophelia*, **13** : 109-185.

SCHILDER, F. A., 1931. — Revision of the family Pediculariinae. *J. Conch.*, **19** : 165-169, pl. 6.

SCHILDER, F. A., 1936. — Anatomical characters of Cypraeacea which confirm the conchological classification. *Proc. Mal. Soc. Lond.*, **22** (2) : 75-112. pl. 11-12.

SCHMIEDER R. W., 1982. — Shape irregularity in *Pedicularia californica*. *Veliger*, **24** (3) : 272, fig. 1.

THIELE, J., 1929. — Handbuch der Systematischen Weichtierkunde, **1** (1). G. Fischer, Jena : 1-376.

THIRIOT-QUIEVREUX, C., 1967. — Observations sur le développement larvaire et postlarvaire de *Simnia spelta* Linné (Gastéropode Cypraeidae). *Vie & Milieu*, **18** (1-A) : 143-151.

WENZ, W., 1941. — Handbuch der Paläozoologie, **6**, (5). O. H. Schindewolf, Berlin : 949-1014 (Cypraeacea).

7

Mollusca Gastropoda : On a collection of Nassariidae from New Caledonian waters

Walter O. CERNOHORSKY

6 Rapallo Place
Farm Cove, Pakuranga
Auckland 6
New Zealand

ABSTRACT

The present report deals with a collection of 33 species of Nassariidae from New Caledonian waters. Approximately 30 % of the species recorded are new geographical range extensions. *Nassarius bifarius* (Baird *in* Brenchley, 1873), previously considered a synonym of *N. novaezelandiae* (Reeve, 1854), and *N. stigmarius* (A. Adams, 1852), previously considered a synonym of *N. splendidulus* (Dunker, 1846), are now acknowledged to be valid, separate species. *Nassarius olomea* Kay, 1979 is synonymized with *N. crebricostatus* (Schepman, 1911). *Nassarius (Zeuxis) arcus* sp. nov. is described and recorded from depths of 95-200 m.

RÉSUMÉ

Mollusca Gastropoda : Sur une collection de Nassariidae des eaux néo-calédoniennes.

Trente-trois espèces de Nassariidae sont signalées de la région néo-calédonienne, dont un tiers pour la première fois. Ce matériel permet de reconnaître la validité de *Nassarius bifarius* (Baird *in* Brenchley, 1873), jusqu'ici traité comme synonyme de *N. novaezelandiae* (Reeve, 1854), et *N. stigmarius* (A. Adams, 1852), jusqu'ici traité comme synonyme de *N. splendidulus* (Dunker, 1846). *Nassarius olomea* Kay, 1979 est placé en synonymie de *N. crebricostatus* (Schepman, 1911). *Nassarius (Zeuxis) arcus* sp. nov. est décrit d'après des spécimens pêchés entre 95 et 200 m de profondeur.

CERNOHORSKY, W. O., 1991. — Mollusca Gastropoda : On a collection of Nassariidae from New Caledonian waters. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 187-204. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

Through the courtesy of Dr P. BOUCHET, Department of Malacology, Muséum national d'Histoire naturelle, Paris, I have received for determination material of Nassariidae brought together by various expeditions and dredging programs in New Caledonian and adjacent waters. There are two main sources of material. One is a series of deep-sea expeditions in the Chesterfield islands and New Caledonia. For a narrative of these cruises, including complete station lists, see RICHER DE FORGES (1990). The other is the " programme LAGON " conducted for ORSTOM since 1984 by Dr B. RICHER DE FORGES aboard R. V. " *Vauban* " and R. V. "*Alis* " in the New Caledonian coral reef lagoon. This program comprises over 1000 dredging and trawling stations operated on a 2 nautical miles grid, mostly in depths between 10 and 60 m, with a few hauls in deeper water. In the present report, stations have been grouped according to the major geographical divisions of the New Caledonian lagoon. Full station data are to be found in RICHER DE FORGES & BARGIBANT (1985) and RICHER DE FORGES *et al.* (1987).

Species are arranged alphabetically within genera and subgenera, and the more significant species illustrated. The abbreviation spm refers to live-taken specimens as well as empty shells.

SYSTEMATIC ACCOUNT

Family NASSARIIDAE

Genus *NASSARIUS* Duméril, 1806

Nassarius (Alectrion) glans glans (Linnaeus, 1758)

Buccinum glans Linnaeus, 1758 : 737.
Nassarius (Alectrion) glans glans - CERNOHORSKY, 1984 : 61, pl. 2, figs 5-7 (synonymy).

MATERIAL EXAMINED. — **New Caledonia**. LAGON : *Surprise Atoll* : stn 465, 45 m : 1 spm. *Southwestern Lagoon* : stn 3, 15 m : 3 spm. — Stn 4, 9 m : 8 spm. — Stn 5, 10 m : 2 spm. — Stn 7, 14 m : 2 spm. — Stn 9, 10 m : 1 spm. — Stn 21, 10 m : 2 spm. — Stn 22, 11 m : 1 spm. — Stn 23, 10-18 m : 1 spm. — Stn 25, 28 m : 1 spm. — Stn 34, 10 m : 1 spm. — Stn 38, 20 m : 1 spm. — Stn 41, 28-46 m : 1 spm. — Stn 49, 10 m : 1 spm. — Stn 50, 12 m : 2 spm. — Stn 57, 10 m : 1 spm. — Stn 60, 11 m : 2 spm. — Stn 66, 15 m : 3 spm. — Stn 67, 21 m : 2 spm. — Stn 79, 16 m : 1 spm. — Stn 80, 33 m : 10 spm. — Stn 83, 22 m : 7 spm. — Stn 84, 17 m : 8 spm. — Stn 99, 17 m : 4 spm. — Stn 100, 15 m : 4 spm. — Stn 121, 12 m : 1 spm. — Stn 129, 44-55m : 1 spm. — Stn 156, 21 m : 1 spm. — Stn 161, 20 m : 3 spm. — Stn 166, 10 m : 1 spm. — Stn 169, 22 m : 1 spm. — Stn 170, 22 m : 1 spm. — Stn 185, 15 m : 5 spm. — Stn 192, 18 m : 2 spm. — Stn 201, 17 m : 4 spm. — Stn 206, 8 m : 2 spm. — Stn 210, 14 m : 1 spm. — Stn 212, 10 m : 1 spm. — Stn 229, 41 m : 1 spm. — Stn 233, 30 m : 1 spm. — Stn 247, 43 m : 1 spm. — Stn 249, 11 m : 2 spm. — Stn 250, 10 m : 1 spm. — Stn 252, 22 m : 2 spm. — Stn 253, 16 m : 2 spm. — Stn 259, 18 m : 3 spm. — Stn 269, 20 m : 1 spm. — Stn 272, 12 m : 1 spm. — Stn 275, 19 m : 1 spm. — Stn 282, 12 m : 1 spm. — Stn 284, 6 m : 2 spm. — Stn 293, 20 m : 2 spm. — Stn 295, 41 m : 1 spm. — Stn 298, 37 m : 1 spm. — Stn 305, 26 m : 1 spm. — Stn 306, 38 m : 1 spm. — Stn 312, 26 m : 1 spm. — Stn 339, 26 m : 1 spm. — Stn 340, 27 m : 1 spm. — Stn 349, 55 m : 1 spm. — Stn 547, 29 m : 1 spm. — Stn 548, 32 m : 1 spm. — Stn 550, 24 m : 3 spm. — Stn 555, 32 m : 2 spm. — Stn 591, 14 m : 5 spm. — *Eastern Lagoon* : stn 623, 32-40 m : 1 spm. — Stn 627, 45-47 m : 1 spm. — Stn 635, 51 m : 1 spm. — Stn 671, 36-39 m : 1 spm. — Stn 698, 40-43 m : 1 spm. — Stn 712, 47-49 m : 1 spm. — Stn 716, 30 m : 1 spm. — Stn 731, 37-42 m : 1 spm.

DISTRIBUTION. — From the Persian Gulf to Japan and the Marquesas Islands.

Nassarius (Plicarcularia) fraudulentus (Marrat, 1877)

Nassa fraudulenta Marrat, 1877 : 8, pl. 1, fig. 24.
Nassarius (Plicarcularia) fraudulentus - CERNOHORSKY, 1984 : 72, pl. 5, figs 11, 12 ; pl. 6, fig. 1 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands**. CHALCAL 1 : stn DC 21, 19°18′ S, 158°43′ E, 73 m, 17 July 1984 : 2 spm.
New Caledonia. LAGON :
Southwestern Lagoon : Stn 14, 22 m : 1 spm. — Stn 19, 29 m : 1 spm. — Stn 31, 29 m : 1 spm. — Stn 69, 13 m : 1 spm. — Stn 78, 35 m : 11 spm. — Stn 86, 29 m : 3 spm. — Stn 122, 28 m : 1 spm. — Stn 167, 11 m : 2 spm. — Stn 174, 45 m : 1 spm. — Stn 178, 20 m : 6 spm. — Stn 188, 8 m : 1 spm. — Stn 192, 18 m : 1 spm. — Stn 193, 20 m : 2 spm. — Stn 195, 12 m : 1 spm. — Stn 199, 50 m : 1 spm. — Stn 203, 13 m : 8 spm. — Stn 205, 13 m : 1 spm. — Stn 206, 8 m : 1 spm. — Stn 208, 9 m : 1 spm. — Stn 209, 14 m : 5 spm. — Stn 210, 14 m : 2 spm. — Stn 211, 12 m : 8 spm. — Stn 215, 14 m : 24 spm. — Stn 216, 14 m : 17 spm. — Stn 219, 32 m : 6 spm. — Stn 220, 12 m : 11 spm. — Stn 222, 24 m : 2 spm. — Stn 261, 19 m : 3 spm. — Stn 274, 12 m : 3 spm. — Stn 277, 12 m : 3 spm. — Stn 278, 17 m : 2 spm. — Stn 287, 29 m : 1 spm.
Eastern Lagoon : stn 691, 33-34 m : 1 spm.

DISTRIBUTION. — From Mauritius to India and the Society Islands.

Nassarius (Plicarcularia) globosus (Quoy & Gaimard, 1833)

Buccinum globosum Quoy & Gaimard, 1833 : 448, pl. 32, figs 25-27.
Nassarius (Plicarcularia) globosus - CERNOHORSKY, 1984 : 74, pl. 6, figs 7-10 (synonymy).

MATERIAL EXAMINED. — **New Caledonia**. LAGON :
Southwestern Lagoon : stn 221, 55-65 m : 5 spm.

DISTRIBUTION. — From the Red Sea to Japan and the Samoa Islands.

Nassarius (Plicarcularia) granifer (Kiener, 1834)

Buccinum graniferum Kiener, 1834 : 100, pl. 27, fig. 111.
Nassarius (Plicarcularia) granifer - CERNOHORSKY : 76, pl. 7, figs 1-2 (synonymy).

MATERIAL EXAMINED. — **New Caledonia**. LAGON :
Huon Atoll : stn 443, 40 m : 1 spm.
Surprise Atoll : stn 449, 21 m : 3 spm.
Northern Lagoon : stn 481, 33 m : 2 spm.
Southwestern Lagoon : stn 8, 15 m : 1 spm. — Stn 49, 10 m : 2 spm. — Stn 79, 16 m : 1 spm. — Stn 98, 15 m : 2 spm. — Stn 159, 17 m : 4 spm. — Stn 162, 10 m : 2 spm. — Stn 214, 12 m : 1 spm. — Stn 218, 15 m : 1 spm. — Stn 283, 13 m : 3 spm. — Stn 308, 18 m : 4 spm. — Stn 549, 26 m : 1 spm. — Stn 551, 9 m : 2 spm.

DISTRIBUTION. — From East Africa throughout the tropical Indo-Pacific to the Tuamotu Archipelago.

Nassarius (Plicarcularia) troendleorum Cernohorsky, 1980

Figs 1-2

Nassarius troendleorum Cernohorsky, 1980 : 118, figs 15-17 (shell), fig. 25 (protoconch).
Nassarius (Plicarcularia) troendleorum - CERNOHORSKY, 1984 : 77, figs 107, 108.

MATERIAL EXAMINED. — **New Caledonia**. LAGON :
Northern Lagoon : stn 489, 43 m : 1 spm.

DISTRIBUTION. — From New Caledonia to the Kingsmill Group, Gilbert Islands and the Tuamotu Archipelago.

Nassarius (Niotha) albescens albescens (Dunker, 1846)

Buccinum albescens Dunker, 1846 : 170.
Nassarius (Niotha) albescens albescens - CERNOHORSKY, 1984 : 81, pl. 7, figs 11, 12 ; pl. 8, fig. 1 (synonymy).

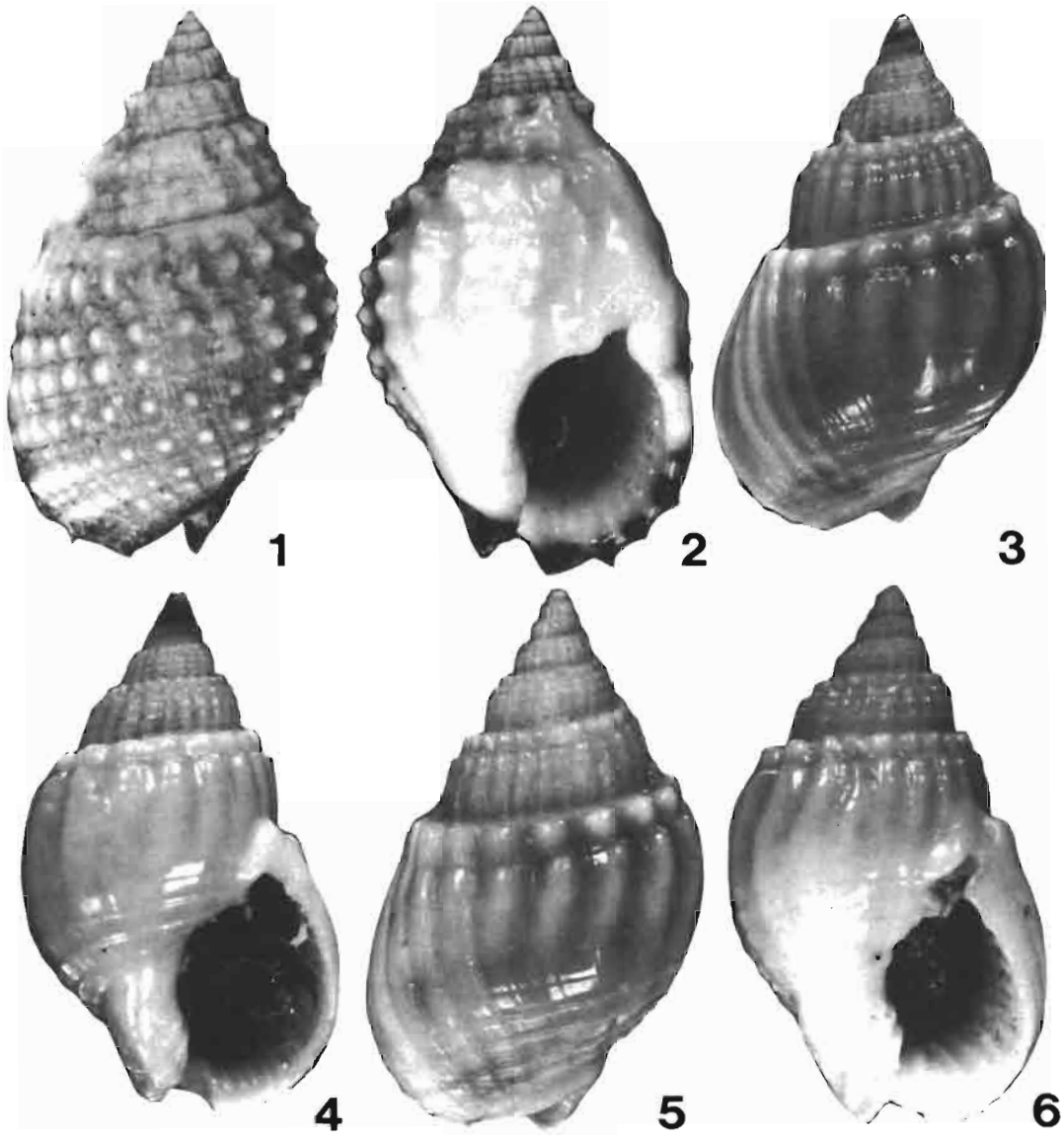
MATERIAL EXAMINED. — **New Caledonia.** LAGON :
Surprise Atoll : stn 449, 21 m : 3 spm.
Southwestern Lagoon : stn 21, 10 m : 2 spm. — Stn 49, 10 m : 2 spm. — Stn 98, 15 m : 2 spm. — Stn 162, 10 m : 2 spm. — Stn 214, 12 m : 1 spm. — Stn 296, 26 m : 1 spm. — Stn 341, 19 m : 2 spm. — Stn 554, 27 m : 4 spm.

DISTRIBUTION. — From the Nicobar Islands to Japan and the Cook Islands.

Nassarius (Niotha) bifarius (Baird *in* Brenchley, 1873)

Figs 3-6

Nassa bifaria Baird *in* Brenchley, 1873 : 436, pl. 38, figs 1, 2 (Type locality : New Caledonia).
Nassarius (Niotha) bifarius - CERNOHORSKY, 1972 : 143, fig. 40 (shell), fig. 58 (radula).



FIGS 1-6. — **1-2.** — *Nassarius troendleorum* Cernohorsky, 1980. LAGON, stn 489, 43 m ; 27.0 mm. **3-4.** — *Nassarius bifarius* (Baird *in* Brenchley, 1873). LAGON, stn 471, 42 m ; 17.0 mm. **5-6.** — *Nassarius bifarius* (Baird *in* Brenchley, 1873). LAGON, stn 63, 20 m ; 20.0 mm.

Nassarius (Niotha) novaezelandiae (Reeve) - CERNOHORSKY, 1978 : 81, pl. 25, fig. 1a only ; 1984 : 86, pl. 9, fig. 4 (lectotype of *N. bifarius*) and fig. 6 only [non *Nassa novaezelandiae* Reeve, 1854].

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 54, 21°26′ S, 159°00′ E, 36-42 m, 25 July 1984 : 1 spm. — Stn DC 55, 21°24′ S, 159°00′ E, 55 m, 25 July 1984 : 2 spm.

New Caledonia. LAGON :

Huon Atoll : stn 438, 37 m : 3 spm. — Stn 439, 39 m : 13 spm. — Stn 441, 37 m : 1 spm. — Stn 442 + bis, 39 m : 15 spm.

Surprise Atoll : stn 446, 36 m : 3 spm. — Stn 447, 36 m : 4 spm. — Stn 448, 30 m : 1 spm. — Stn 450, 29 m : 5 spm. — Stn 451, 30 m : 1 spm. — Stn 456, 37 m : 1 spm. — Stn 465, 45 m : 1 spm. — Stn 466, 42 m : 1 spm. — Stn 467, 41 m : 2 spm. — Stn 468, 40 m : 4 spm. — Stn 469, 39 m : 6 spm. — Stn 470, 41 m : 5 spm. — Stn 471, 42 m : 5 spm.

Northern Lagoon : stn 515, 54 m : 1 spm. — Stn 517, 42 m : 3 spm. — Stn 522, 42 m : 1 spm. — Stn 528, 47 m : 2 spm. — Stn 529, 50 m : 13 spm. — Stn 530, 48 m : 1 spm. — Stn 531, 56 m : 5 spm. — Stn 532, 56 m : 9 spm. — Stn 535, 46 m : 5 spm. — Stn 536, 61 m : 1 spm. — Stn 541, 45 m : 1 spm.

Southwestern Lagoon : stn 7, 14 m : 1 spm. — Stn 10, 15 m : 2 spm. — Stn 36, 20 m : 1 spm. — Stn 38, 20 m : 1 spm. — Stn 40, 21 m : 1 spm. — Stn 55, 23 m : 1 spm. — Stn 63, 20 m : 1 spm. — Stn 202, 13 m : 2 spm. — Stn 219, 32 m : 2 spm. — Stn 268, 24 m : 1 spm. — Stn 291, 31 m : 1 spm. — Stn 295, 41 m : 1 spm. — Stn 302, 17 m : 2 spm. — Stn 348, 45 m : 2 spm. — Stn 559, 52 m : 3 spm.

DISTRIBUTION. — From India to the Fiji Islands.

REMARKS. — CERNOHORSKY (1984) treated *Nassarius bifarius* as a smooth form of *N. novaezelandiae* (Reeve). Prolific material of *N. bifarius* from New Caledonia clearly shows that *N. bifarius* is a valid species, separate from *N. novaezelandiae*. *N. bifarius* lacks granules on the body whorl which is smooth and distinctly or obsoletely axially ribbed and the anterior half has a few spiral cords ; the sutural nodules are stronger and more distinct on the last 2 whorls, the aperture is wider and the colour is fawn to orange-brown with a whitish columellar callus, in contrast to the blackish-brown and white colour pattern of *N. novaezelandiae*.

Nassarius (Niotha) conoidalis
(Deshayes *in* Bélanger, 1832)

Buccinum conoidale Deshayes *in* Bélanger, 1832 : 433, pl. 3, figs 6, 7.

Nassarius (Niotha) conoidalis - CERNOHORSKY, 1984 : 78, pl. 7, figs 3-10 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 203, 22°36′ S, 167°05′ E, 105-110 m, 27 September 1985 : 1 spm. — Stn DW 204, 22°37′ S, 167°06′ E, 120 m, 27 September 1985 : 6 spm.

LAGON :

Huon Atoll : stn 439, 39 m : 1 spm. — Stn 440bis, 39 m : 1 spm. — Stn 442 + bis, 39 m : 2 spm.

Surprise Atoll : stn 447, 36 m : 4 spm. — Stn 469, 39 m : 6 spm.

Northern Lagoon : stn 478, 35 m : 1 spm. — Stn 485, 32 m : 1 spm. — Stn 503, 64 m : 8 spm. — Stn 503bis, 66 m : 8 spm. — Stn 504, 45 m : 3 spm. — Stn 516, 48 m : 1 spm. — Stn 517, 42 m : 14 spm. — Stn 522, 42 m : 6 spm. — Stn 529, 50 m : 1 spm. — Stn 534, 48 m : 2 spm. — Stn 535, 46 m : 45 spm. — Stn 536, 61 m : 87 spm. — Stn 537, 200 m : 8 spm. — Stn 538, 195 m : 1 spm. — Stn 541, 45 m : 6 spm.

Southwestern Lagoon : stn 69, 13 m : 3 spm. — Stn 80, 33 m : 1 spm. — Stn 120, 46 m : 1 spm. — Stn 149, 48 m : 10 spm. — Stn 152, 23 m : 1 spm. — Stn 187, 13 m : 2 spm. — Stn 192, 18 m : 1 spm. — Stn 202, 13 m : 1 spm. — Stn 219, 32 m : 1 spm. — Stn 221, 55-65 m : 7 spm. — Stn 230, 35 m : 3 spm. — Stn 234, 56 m : 31 spm. — Stn 234bis, 60 m : 12 spm. — Stn 235, 70 m : 3 spm. — Stn 236, 67 m : 1 spm. — Stn 240, 42 m : 8 spm. — Stn 244, 37 m : 5 spm. — Stn 245, 62 m : 2 spm. — Stn 268, 24 m : 1 spm. — Stn 281, 10 m : 1 spm. — Stn 297, 30 m : 1 spm. — Stn 301, 46 m : 2 spm. — Stn 305, 26 m : 1 spm. — Stn 306, 38 m : 1 spm. — Stn 308, 18 m : 1 spm. — Stn 315, 50 m : 5 spm. — Stn 316, 68 m : 11 spm. — Stn 317, 66 m : 5 spm. — Stn 318, 71 m : 3 spm. — Stn 319, 75 m : 10 spm. — Stn 326, 67 m : 2 spm. — Stn 329, 80 m : 2 spm. — Stn 332, 80 m : 15 spm. — Stn 333, 71 m : 26 spm. — Stn 334, 47 m : 2 spm. — Stn 336, 26 m : 1 spm. — Stn 346, 40 m : 2 spm. — Stn 347, 46 m : 6 spm. — Stn 348, 45 m : 13 spm. — Stn 350, 67 m : 19 spm. — Stn 352, 82 m : 26 spm. — Stn 354, 78 m : 7 spm. — Stn 356, 78 m : 1 spm. — Stn 357, 77 m : 6 spm. — Stn 359, 74 m : 1 spm. — Stn 368, 70 m : 1 spm. — Stn 370, 127 m : 1 spm. — Stn 376, 75-76 m : 32 spm. — Stn 384, 70 m : 1 spm. — Stn 397, 125 m : 1 spm. — Stn 400, 64 m : 4 spm. — Stn 401, 49 m : 2 spm. — Stn 403, 45 m : 4 spm. — Stn 405, 27 m : 9 spm. — Stn 406, 24 m : 2 spm. — Stn 407, 24 m : 3 spm. — Stn 408, 18 m : 1 spm. — Stn 410, 35 m : 18 spm. — Stn 411, 40 m : 1 spm. — Stn 414, 60 m : 18 spm. — Stn 559, 52 m : 6 spm. — Stn 560, 48 m : 4 spm. — Stn 562, 48 m : 1 spm. — Stn 564, 35 m : 3 spm. — Stn 569, 62 m : 1 spm. — Stn 571, 40 m : 2 spm. — Stn 574, 54 m : 1 spm. — Stn 575, 62 m : 1 spm. — Stn 577, 60 m : 1 spm. — Stn 580, 95-100 m : 1 spm. — Stn 581, 23 m : 5 spm. — Stn 582, 67 m : 1 spm. — Stn 591, 14 m : 4 spm. — Stn 596, 35 m : 6 spm.

Eastern Lagoon : stn 601, 47-48 m : 5 spm. — Stn 603, 78-80 m : 6 spm. — Stn 604, 80 m : 11 spm. — Stn 605, 65-70 m : 1 spm. — Stn 606, 46-48 m : 3 spm. — Stn 608, 50-56 m : 10 spm. — Stn 614, 48-50 m : 3 spm. — Stn 615, 56-60 m : 6 spm. — Stn 618,

53-58 m : 1 spm. — Stn 621, 55-56 m : 5 spm. — Stn 623, 32-40 m : 1 spm. — Stn 626, 47-48 m : 3 spm. — Stn 629, 47-48 m : 1 spm. — Stn 632, 44-45 m : 5 spm. — Stn 633, 50 m : 10 spm. — Stn 641, 50-52 m : 4 spm. — Stn 654, 32 m : 2 spm. — Stn 658, 49-51 m : 5 spm. — Stn 660, 48-52 m : 5 spm. — Stn 662, 50 m : 3 spm. — Stn 667, 33-37 m : 29 spm. — Stn 668, 40 m : 2 spm. — Stn 669, 30-40 m : 1 spm. — Stn 687, 37-40 m : 4 spm. — Stn 688, 36-40 m : 11 spm. — Stn 692, 44-48 m : 1 spm. — Stn 698, 40-43 m : 4 spm. — Stn 701, 36-39 m : 3 spm. — Stn 702, 37 m : 4 spm. — Stn 703, 38-40 m : 1 spm. — Stn 707, 34-38 m : 7 spm. — Stn 714, 37-38 m : 1 spm. — Stn 716, 30 m : 3 spm. — Stn 723, 45 m : 11 spm. — Stn 724, 36-38 m : 2 spm. — Stn 729, 42-45 m : 23 spm. — Stn 730, 40-43 m : 2 spm. — Stn 731, 37-42 m : 4 spm. — Stn 736, 44-45 m : 2 spm. — Stn 737, 49-50 m : 3 spm. — Stn 738, 59-61 m : 2 spm. — Stn 741, 77-80 m : 1 spm.

DISTRIBUTION. — From the Red Sea and the Persian Gulf to Fiji and the Line Islands.

REMARKS. — The species was previously known to occur subtidally to a depth of 120 m. This range is now extended to 200 m.

Nassarius (Niotha) delicatus (A. Adams, 1852)

Nassa delicata A. Adams, 1852 : 99.
Nassa nodicostata A. Adams, 1852 : 99.
Nassarius (Niotha) delicatus - CERNOHORSKY, 1984 : 100, pl. 14, figs 4-8.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Huon Atoll* : stn 438, 37 m : 38 spm. — Stn 439, 39 m : 1 spm. — Stn 440bis, 39 m : 17 spm. — Stn 441, 37 m : 12 spm. — Stn 442 + bis, 39 m : 24 spm. — Stn 443, 40 m : 5 spm.
Surprise Atoll : stn 446, 36 m : 36 spm. — Stn 447, 36 m : 1 spm. — Stn 448, 30 m : 19 spm. — Stn 449, 21 m : 6 spm. — Stn 450, 29 m : 2 spm. — Stn 452, 27 m : 20 spm. — Stn 453, 26 m : 19 spm. — Stn 454, 36 m : 7 spm. — Stn 455, 40 m : 7 spm. — Stn 456, 37 m : 2 spm. — Stn 463, 43 m : 3 spm. — Stn 465, 45 m : 11 spm. — Stn 466, 42 m : 3 spm. — Stn 467, 41 m : 1 spm. — Stn 469, 39 m : 18 spm. — Stn 470, 41 m : 8 spm. — Stn 472, 48 m : 1 spm. — Stn 473, 50 m : 11 spm. — Stn 474, 52 m : 1 spm.
Northern Lagoon : stn 478, 35 m : 32 spm. — Stn 481, 33 m : 49 spm. — Stn 482, 33 m : 24 spm. — Stn 517, 42 m : 2 spm. — Stn 519, 39 m : 10 spm. — Stn 535, 46 m : 1 spm. — Stn 536, 61 m : 2 spm. — Stn 541, 45 m : 2 spm. — Stn 542, 50 m : 3 spm.
Southwestern Lagoon : stn 7, 14 m : 32 spm. — Stn 8, 15 m : 11 spm. — Stn 9, 10 m : 1 spm. — Stn 39, 19 m : 1 spm. — Stn 40, 21 m : 14 spm. — Stn 41, 28-46 m : 2 spm. — Stn 46, 25 m : 2 spm. — Stn 47, 28 m : 1 spm. — Stn 50, 12 m : 9 spm. — Stn 51, 10 m : 15 spm. — Stn 64, 15 m : 16 spm. — Stn 65, 24 m : 39 spm. — Stn 66, 15 m : 13 spm. — Stn 77, 22 m : 2 spm. — Stn 78, 35 m : 2 spm. — Stn 80, 33 m : 32 spm. — Stn 83, 22 m : 24 spm. — Stn 84, 17 m : 5 spm. — Stn 85, 21 m : 1 spm. — Stn 95, 14 m : 8 spm. — Stn 98, 15 m : 7 spm. — Stn 150, 62-68 m : 2 spm. — Stn 160, 10 m : 1 spm. — Stn 161, 20 m : 14 spm. — Stn 162, 10 m : 12 spm. — Stn 163, 15 m : 28 spm. — Stn 170, 22 m : 19 spm. — Stn 186, 11 m : 17 spm. — Stn 187, 13 m : 2 spm. — Stn 192, 18 m : 8 spm. — Stn 199, 50 m : 1 spm. — Stn 200, 18 m : 5 spm. — Stn 202, 13 m : 1 spm. — Stn 206, 8 m : 1 spm. — Stn 212, 10 m : 29 spm. — Stn 214, 12 m : 34 spm. — Stn 217, 16 m : 9 spm. — Stn 218, 15 m : 2 spm. — Stn 219, 32 m : 2 spm. — Stn 226, 28 m : 31 spm. — Stn 233, 30 m : 5 spm. — Stn 239, 43 m : 3 spm. — Stn 265, 15 m : 3 spm. — Stn 266, 19 m : 1 spm. — Stn 268, 24 m : 10 spm. — Stn 269, 20 m : 1 spm. — Stn 277, 30 m : 1 spm. — Stn 281, 10 m : 5 spm. — Stn 284, 6 m : 2 spm. — Stn 290, 11 m : 6 spm. — Stn 291, 31 m : 1 spm. — Stn 293, 20 m : 20 spm. — Stn 294, 21 m : 1 spm. — Stn 296, 26 m : 1 spm. — Stn 305, 26 m : 4 spm. — Stn 306, 38 m : 1 spm. — Stn 308, 18 m : 2 spm. — Stn 311, 36 m : 3 spm. — Stn 316, 68 m : 1 spm. — Stn 336, 26 m : 2 spm. — Stn 339, 26 m : 2 spm. — Stn 340, 27 m : 1 spm. — Stn 341, 19 m : 8 spm. — Stn 345, 39 m : 2 spm. — Stn 348, 45 m : 2 spm. — Stn 544, 25 m : 12 spm. — Stn 546, 33 m : 1 spm. — Stn 547, 29 m : 14 spm. — Stn 548, 32 m : 3 spm. — Stn 549, 26 m : 5 spm. — Stn 550, 24 m : 1 spm. — Stn 554, 27 m : 1 spm. — Stn 556, 30 m : 2 spm. — Stn 559, 52 m : 1 spm. — Stn 560, 48 m : 1 spm. — Stn 564, 35 m : 1 spm. — Stn 571, 40 m : 2 spm. — Stn 581, 23 m : 8 spm. — Stn 582, 67 m : 1 spm. — Stn 585, 43 m : 1 spm. — Stn 589, 31 m : 3 spm. — Stn 590, 20 m : 14 spm. — Stn 591, 14 m : 6 spm. — Stn 593, 25 m : 1 spm.
Eastern Lagoon : stn 626, 47-48 m : 4 spm. — Stn 632, 44-45 m : 9 spm. — Stn 633, 50 m : 3 spm. — Stn 641, 50-52 m : 2 spm. — Stn 664, 28-30 m : 1 spm. — Stn 675, 43 m : 1 spm. — Stn 682, 36-37 m : 4 spm. — Stn 688, 36-40 m : 2 spm. — Stn 693, 35-38 m : 1 spm. — Stn 696, 41-57 m : 10 spm. — Stn 697, 35-36 m : 4 spm. — Stn 698, 40-43 m : 1 spm. — Stn 702, 37 m : 14 spm. — Stn 703, 38-40 m : 8 spm. — Stn 709, 39-40 m : 4 spm. — Stn 713, 34-35 m : 1 spm. — Stn 715, 34-35 m : 1 spm. — Stn 724, 36-38 m : 3 spm. — Stn 730, 40-43 m : 10 spm.

DISTRIBUTION. — From the Red Sea and the Persian Gulf to the Ryukyu and Fiji Islands.

REMARKS. — This species has been dredged in great numbers, and the majority of specimens were the nodulose form *nodicostata* A. Adams, although a few specimens were the typical *delicatus* form. In the nodulose form the axial ribs on the body whorl are distinctly nodulose and form 5-6 spiral rows of nodules.

Nassarius (Niotha) ecstilbus
(Melvill & Standen, 1896)

Nassa (Telasco) ecstilbus Melvill & Standen, 1896 : 274, pl. 9, fig. 4 (Type locality : Lifu, Loyalty Islands).
Nassarius (Niotha) ecstilbus - CERNOHORSKY, 1984 : 101, pl. 14, figs 9, 10 ; pl. 15, fig. 1.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Surprise Atoll* : stn 449, 21 m : 5 spm. — Stn 452, 27 m : 2 spm.
Northern Lagoon : stn 481, 33 m : 4 spm. — Stn 482, 33 m : 2 spm. — Stn 486, 33 m : 1 spm.
Southwestern Lagoon : stn 7, 14 m : 1 spm. — Stn 49, 10 m : 2 spm. — Stn 50, 12 m : 1 spm. — Stn 98, 15 m : 5 spm. — Stn 162, 10 m : 2 spm. — Stn 186, 11 m : 4 spm. — Stn 214, 12 m : 1 spm. — Stn 221, 55-65 m : 1 spm. — Stn 255, 11 m : 1 spm. — Stn 283, 13 m : 2 spm. — Stn 293, 20 m : 1 spm. — Stn 308, 18 m : 3 spm.

DISTRIBUTION. — From the Red Sea to the Philippines and the Fiji Islands.

REMARKS. — This species has been dredged in New Caledonian waters to a depth of 65 m.

Nassarius (Niotha) fretorum
(Melvill & Standen, 1899)

Nassa fretorum Melvill & Standen, 1899 : 159, pl. 10, fig. 3.
Nassarius (Niotha) fretorum - CERNOHORSKY, 1984 : 101, pl. 15, figs 2-5.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Southwestern Lagoon* : stn 324, 39 m : 1 spm. — Stn 358, 50 m : 1 spm.
Eastern Lagoon : stn 597 bis, 50-70 m : 1 spm.

DISTRIBUTION. — From India to the Philippines and NE Australia ; now New Caledonia.

REMARKS. — This is a new geographical record for the species.

Nassarius (Niotha) himeroessa
(Melvill & Standen, 1903)

Nassa (Alectryon) himeroessa Melvill & Standen, 1903 : 306, pl. 22, fig. 7.
Nassarius (Niotha) himeroessa - CERNOHORSKY, 1984 : 107, pl. 17, figs 5-7.

MATERIAL EXAMINED. — **Chesterfield Islands.** MUSORSTOM 5 : stn 300, 22°48′ S, 159°24′ E, 450 m, 11 October 1986 : 1 spm. — Stn 304, 22°10′ S, 159°26′ E, 385-420 m, 12 October 1986 : 1 spm. — Stn 306, 22°08′ S, 159°21′ E, 375-415 m, 12 October 1986 : 1 spm.
New Caledonia. BIOCAL : stn DW 08, 20°34′ S, 166°54′ E, 435 m, 12 August 1985 : 5 spm. — Stn DW 33, 23°10′ S, 167°10′ E, 29 August 1985 : 2 spm. — Stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 30 August 1985 : 1 spm. — Stn DW 48, 23°00′ S, 167°29′ E, 775 m, 31 August 1985 : 9 spm. — Stn DW 49, 23°03′ S, 167°32′ E, 824-830 m, 31 August 1985 : 1 spm. — Stn DW 51, 23°05′ S, 167°45′ E, 680-700 m, 31 August 1985 : 23 spm. — Stn DW 56, 23°35′ S, 167°12′ E, 695-705 m, 1 September 1985 : 1 spm. — Stn DW 66, 24° 55′ S, 168°22′ E, 505-515 m, 3 September 1985 : 8 spm. — Stn DW 77, 22°15′ S, 167°15′ E, 440 m, 5 September 1985 : 22 spm. — Stn DW 83, 20°35′ S, 166°54′ E, 460 m, 6 September 1985 : 1 spm. — Stn DW 106, 21° 36′ S, 166°29′ E, 625-650 m, 8 September 1985 : 1 spm.
MUSORSTOM 4 : stn DW 149, 19°08′ S, 163°23′ E, 155 m, 14 September 1985 : 1 spm. — Stn DW 156, 18°54′ S, 163°19′ E, 525 m, 15 September 1985 : 1 spm. — Stn DW 159, 18°46′ S, 163°16′ E, 585 m, 15 September 1985 : 1 spm. — Stn CC 247, 22°09′ S, 167°13′ E, 435-460 m, 4 October 1985 : 1 spm.

DISTRIBUTION. — From the Persian Gulf to the Philippines and the Kermadec Islands.

REMARKS. — This is a new record of the species for New Caledonia.

Nassarius (Niotha) quadrasi
(Hidalgo, 1904)

Nassa gruneri — REEVE, 1853 : pl. 12, fig. 75 (non *Buccinum gruneri* Dunker, 1846).
Nassa quadrasi Hidalgo, 1904 : 204 (nom. nov. pro *Nassa gruneri* of Reeve, 1853).
Nassarius (Niotha) quadrasi - CERNOHORSKY, 1984 : 108, pl. 17, figs 8-9 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Surprise Atoll* : stn 453, 26 m : 2 spm.
Southwestern Lagoon : stn 9, 10 m : 1 spm. — Stn 162, 10 m : 4 spm. — Stn 214, 12 m : 4 spm. — Stn 226, 28 m : 3 spm. — Stn 308, 18 m : 2 spm. — Stn 341, 19 m : 1 spm. — Stn 591, 14 m : 1 spm.

DISTRIBUTION. — From Malaysia to the Ryukyu and Samoa Islands.

Nassarius (Niotha) sinusigerus
(A. Adams, 1852)

Nassa sinusigera A. Adams, 1852 : 100.
Nassarius (Niotha) sinusigerus - CERNOHORSKY, 1984 : 103, pl. 16, figs 1-10 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Southwestern Lagoon* : stn 34, 10 m : 1 spm. — Stn 139, 45 m : 6 spm. — Stn 140, 47 m : 4 spm. — Stn 141, 44 m : 19 spm. — Stn 142, 34 m : 6 spm. — Stn 143, 32 m : 23 spm. — Stn 144, 25 m : 21 spm. — Stn 278, 17 m : 1 spm.
Eastern Lagoon : stn 721, 22-23 m : 1 spm.

DISTRIBUTION. — From the Red Sea and the Gulf of Oman to the Fiji Islands.

REMARKS. — This is a new record of the species for New Caledonia.

Nassarius (Niotha) splendidulus (Dunker, 1846)

Fig. 7

Buccinum splendidulum Dunker, 1846 : 170.
Nassarius (Niotha) splendidulus - CERNOHORSKY, 1984 : 85, pl. 8, figs 8-9 and 11-13 ; pl. 9, figs 1-2 (synonymy — with the exclusion of references to *Nassarius stigmarius* A. Adams, 1852).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Huon Atoll* : stn 438, 37 m : 2 spm. — Stn 440 bis, 39 m : 1 spm. — Stn 441, 37 m : 4 spm. — Stn 442 + bis, 39 m : 1 spm. — Stn 443, 40 m : 1 spm.
Surprise Atoll : stn 446, 36 m : 5 spm. — Stn 448, 30 m : 2 spm. — Stn 449, 21 m : 7 spm. — Stn 452, 27 m : 1 spm. — Stn 453, 26 m : 2 spm. — Stn 454, 36 m : 2 spm. — Stn 455, 40 m : 5 spm. — Stn 463, 43 m : 2 spm. — Stn 465, 45 m : 2 spm. — Stn 469, 20 m : 2 spm. — Stn 470, 41 m : 2 spm. — Stn 472, 48 m : 1 spm. — Stn 473, 50 m : 1 spm.
Northern Lagoon : stn 478, 35 m : 3 spm. — Stn 481, 33 m : 8 spm. — Stn 482, 33 m : 8 spm. — Stn 484, 35 m : 1 spm. — Stn 485, 32 m : 2 spm. — Stn 504, 45 m : 4 spm. — Stn 517, 42 m : 2 spm. — Stn 522, 42 m : 2 spm. — Stn 533, 50 m : 1 spm. — Stn 536, 61 m : 1 spm. — Stn 541, 45 m : 2 spm. — Stn 542, 50 m : 7 spm.
Southwestern Lagoon : stn 7, 14 m : 3 spm. — Stn 40, 21 m : 10 spm. — Stn 51, 10 m : 2 spm. — Stn 66, 15 m : 2 spm. — Stn 80, 33 m : 5 spm. — Stn 83, 22 m : 10 spm. — Stn 84, 17 m : 4 spm. — Stn 95, 14 m : 2 spm. — Stn 98, 15 m : 4 spm. — Stn 101, 18 m : 1 spm. — Stn 120, 46 m : 1 spm. — Stn 121, 12 m : 3 spm. — Stn 150, 62-68 m : 6 spm. — Stn 152, 23 m : 1 spm. — Stn 161, 20 m : 2 spm. — Stn 163, 15 m : 4 spm. — Stn 170, 22 m : 7 spm. — Stn 192, 18 m : 1 spm. — Stn 199, 50 m : 1 spm. — Stn 200, 18 m : 5 spm. — Stn 201, 17 m : 48 spm. — Stn 202, 13 m : 1 spm. — Stn 211, 12 m : 1 spm. — Stn 214, 12 m : 1 spm. — Stn 217, 16 m : 3 spm. — Stn 218, 15 m : 12 spm. — Stn 226, 28 m : 6 spm. — Stn 233, 30 m : 4 spm. — Stn 239, 43 m : 2 spm. — Stn 241, 35 m : 1 spm. — Stn 249, 11 m : 1 spm. — Stn 253, 16 m : 1 spm. — Stn 268, 24 m : 5 spm. — Stn 275, 19 m : 1 spm. — Stn 281, 10 m : 1 spm. — Stn 284, 6 m : 1 spm. — Stn 291, 31 m : 4 spm. — Stn 293, 20 m : 8 spm. — Stn 294, 21 m : 1 spm. — Stn 300, 21 m : 1 spm. — Stn 304, 27 m : 4 spm. — Stn 305, 26 m : 3 spm. — Stn 311, 36 m : 1 spm. — Stn 313, 30 m : 1 spm. — Stn 324, 39 m : 5 spm. — Stn 334, 47 m : 2 spm. — Stn 336, 26 m : 8 spm. — Stn 338, 32 m : 1 spm. — Stn 339, 26 m : 2 spm. — Stn 340, 27 m : 3 spm. — Stn 341, 19 m : 1 spm. — Stn 344, 37 m : 2 spm. — Stn 345, 39 m : 1 spm. — Stn 348, 45 m : 4 spm. — Stn 405, 27 m : 2 spm. — Stn 410, 35 m : 10 spm. — Stn 544, 25 m : 10 spm. — Stn 546, 33 m : 2 spm. — Stn 547, 29 m : 2 spm. — Stn 548, 32 m : 1 spm. — Stn 555, 32 m : 2 spm. — Stn 556, 30 m : 1 spm. — Stn 581, 23 m : 3 spm. — Stn 589, 31 m : 2 spm. — Stn 590, 20 m : 6 spm. — Stn 591, 14 m : 4 spm. — Stn 593, 25 m : 1 spm.
Eastern Lagoon : stn 620, 50-52 m : 1 spm. — Stn 625, 34-40 m : 1 spm. — Stn 631, 43 m : 3 spm. — Stn 632, 44-45 m : 5 spm. — Stn 633, 50 m : 2 spm. — Stn 641, 50-52 m : 3 spm. — Stn 681, 33 m : 3 spm. — Stn 682, 36-37 m : 5 spm. — Stn 685, 24-26 m : 1 spm. — Stn 697, 35-36 m : 4 spm. — Stn 701, 36-39 m : 1 spm. — Stn 702, 37 m : 12 spm. — Stn 703, 38-40 m : 3 spm. — Stn 709, 39-40 m : 2 spm. — Stn 713, 34-35 m : 1 spm. — Stn 715, 34-35 m : 1 spm. — Stn 716, 30 m : 2 spm. — Stn 724, 36-38 m : 1 spm. — Stn 729, 42-45 m : 4 spm. — Stn 730, 40-43 m : 2 spm.

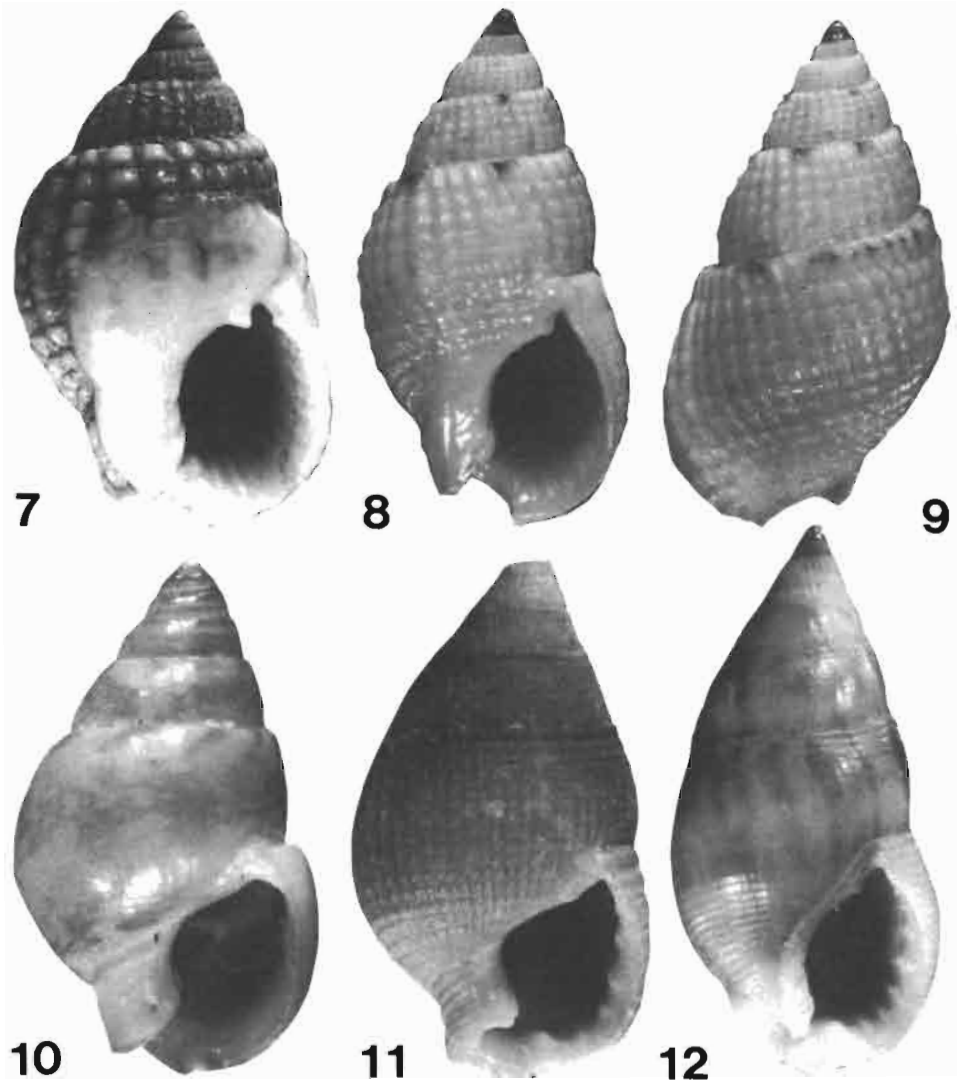
DISTRIBUTION. — From the Red Sea and the Persian Gulf to Hawaii and the Society Islands.

Nassarius (Niotha) stigmarius (A. Adams, 1852)

Figs 8-9

Nassa stigmaria A. Adams, 1852 : 96 (Type locality : Siquijor Id., Philippines).
Nassarius (Niotha) splendidulus - CERNOHORSKY [pars], 1984 : 85, pl. 8, fig. 10 only (illustrated holotype of *Nassa stigmaria* A. Adams) [non *Buccinum splendidulum* Dunker, 1846].

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 9, 20°44′ S, 161°02′ E, 75 m, 15 July 1984 : 2 spm. — Stn DC 10, 20°36′ S, 161°06′ E, 87 m, 15 July 1984 : 2 spm. — Stn DC 17, 19°12′ S, 158°56′ E, 44 m, July 1984 : 11 spm. — Stn DC 26, 19°11′ S, 158°35′ E, 48 m, 18 July 1984 : 1 spm. — Stn DC 39, 20°29′ S, 158°41′ E, 40 m, 23 July 1984 : 1 spm. — Stn DC 40, 20°32′ S, 158°51′ E, 65 m, 23 July 1984 : 2 spm. — Stn DC 41, 20°35′ S, 158°47′ E, 67 m, 23 July 1984 : 3 spm. — Stn DC 45, 20°49′ S, 158°30′ E, 50 m, 23 July 1984 : 2 spm. — Stn DC 46, 20°52′ S, 158°34′ E, 65 m, 23 July 1984 : 2 spm. — Stn DC 49, 20°58′ S, 158°35′ E, 48 m, 24 July 1984 : 1 spm. — Stn DC 52, 21°13′ S, 158°49′ E, 69 m, 24 July 1984 : 1 spm. — Stn DC 55, 21°24′ S, 159°00′ E, 55 m, 25 July 1984 : 4 spm. — Stn DC 56, 21°24′ S, 159°09′ E, 60 m, 25 July 1984 : 3 spm. — Stn DC 59, 21°40′ S, 159°21′ E,



FIGS 7-12. — **7**. — *Nassarius splendidulus* (Dunker, 1846). LAGON, stn 83, 22 m ; 14.0 mm. **8-9**. — *Nassarius stigmarius* (A. Adams, 1852). LAGON, stn 542, 50 m ; 15.0 mm. **10**. — *Nassarius vidalensis* (Barnard, 1959). BIOCAL, stn DW 64, 250 m ; 7.3 mm. **11**. — *Nassarius abyssicolus* (A. Adams, 1852). CHALCAL 1, stn DC 26, 48 m ; 11.0 mm. **12**. — *Nassarius haldemanni* (Dunker, 1847). LAGON, stn 620, 50-52 m ; 16.0 mm.

56 m, 25 July 1984 : 1 spm. — Stn CP 16, 21°42′ S, 159°22′ E, 53 m, 25 July 1984 : 1 spm. — Stn DC 61, 21°42′ S, 159°29′ E, 50 m, 26 July 1984 : 5 spm.

New Caledonia. LAGON :
Huon Atoll : stn 433, 40-67 m : 1 spm.
Surprise Atoll : stn 446, 36 m : 1 spm. — Stn 455, 40 m : 1 spm.
Northern Lagoon : stn 542, 50 m : 2 spm.
Southwestern Lagoon : stn 200, 18 m : 1 spm. — Stn 229, 41 m : 1 spm. — Stn 264, 56 m : 1 spm. — Stn 267, 70 m : 2 spm. — Stn 310, 46 m : 1 spm. — Stn 340, 27 m : 1 spm. — Stn 546, 33 m : 1 spm. — Stn 570, 53 m : 1 spm. — Stn 572, 65 m : 1 spm.
Eastern Lagoon : stn 598, 73-75 m : 2 spm. — Stn 644, 45-48 m : 1 spm. — Stn 736, 44-45 m : 1 spm.

DISTRIBUTION. — From the Philippines to Japan and New Caledonia, subtidal, from 18-87 m.

REMARKS. — CERNOHORSKY (1984) erroneously placed *N. (N.) stigmarius* (A. Adams), in synonymy of *N. (N.) splendidulus* (Dunker). The large number of specimens of both species taken in New Caledonian waters clearly shows that they are separate species. *N. (N.) stigmarius* is lighter in weight and considerably less solid than *N. (N.) splendidulus*, with a finer sculpture consisting of close-set nodules, thinner outer lip and a smaller parietal callus which is thinning posteriorly ; it is cream in colour with small undefined brown spots at sutures, 3 brown larval whorls and only 1 post-larval whorl purplish-brown. *N. (N.) splendidulus* always lacks the purplish-brown colouring of the apical whorls.

Nassarius (Telasco) multipunctatus (Schepman, 1911)

Nassa (Zeuxis) multipunctata Schepman, 1911 : 321, pl. 20, figs 4a, b.
Nassarius (Telasco) multipunctatus - CERNOHORSKY, 1984 : 122, pl. 22, figs 1-2 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 187, 19°08′ S, 163°29′ E, 65-120 m, 19 September 1985 : 1 spm. — Stn CP 190, 19°06′ S, 163°29′ E, 215 m, 19 September 1985 : 3 spm. — Stn DW 227, 22°46′ S, 167°20′ E, 300 m, 30 September 1985 : 1 spm.

LAGON :

Huon Atoll : stn 433, 40-67 m : 1 spm.
Northern Lagoon : stn 495, 80 m : 1 spm. — Stn 536, 61 m : 3 spm. — Stn 537, 200 m : 1 spm. — Stn 542, 50 m : 5 spm.
Southwestern Lagoon : stn 234, 56 m : 2 spm. — Stn 234 bis, 60 m : 2 spm. — Stn 239, 43 m : 2 spm. — Stn 240, 42 m : 6 spm. — Stn 244, 37 m : 1 spm. — Stn 319, 50 m : 6 spm. — Stn 320, 70 m : 3 spm. — Stn 322, 71 m : 2 spm. — Stn 324, 39 m : 8 spm. — Stn 331, 79 m : 11 spm. — Stn 333, 71 m : 1 spm. — Stn 334, 47 m : 1 spm. — Stn 344, 37 m : 1 spm. — Stn 348, 45 m : 3 spm. — Stn 350, 67 m : 1 spm. — Stn 353, 70 m : 1 spm. — Stn 357, 77 m : 4 spm. — Stn 358, 50 m : 1 spm. — Stn 360, 60 m : 1 spm. — Stn 361, 78 m : 6 spm. — Stn 363, 67 m : 2 spm. — Stn 368, 70 m : 3 spm. — Stn 374, 70-72 m : 2 spm. — Stn 375, 67-71 m : 2 spm. — Stn 376, 75-76 m : 1 spm. — Stn 377, 56 m : 2 spm. — Stn 383, 62 m : 1 spm. — Stn 384, 70 m : 2 spm. — Stn 385, 75 m : 3 spm. — Stn 391, 65 m : 1 spm. — Stn 392, 80 m : 1 spm. — Stn 398, 71 m : 4 spm. — Stn 400, 64 m : 3 spm. — Stn 403, 45 m : 12 spm. — Stn 405, 27 m : 1 spm. — Stn 413, 40-60 m : 3 spm. — Stn 414, 60 m : 7 spm. — Stn 428, 56 m : 3 spm. — Stn 429, 95 m : 1 spm. — Stn 561, 48 m : spm. — Stn 562, 48 m : 2 spm. — Stn 580, 95-100 m : 2 spm. — Stn 589, 31 m : 2 spm.
Eastern Lagoon : stn 598, 73-75 m : 20 spm. — Stn 599, 50 m : 1 spm. — Stn 601, 47-48 m : 1 spm. — Stn 602, 43-48 m : 5 spm. — Stn 604, 80 m : 1 spm. — Stn 607, 48-54 m : 7 spm. — Stn 615, 56-60 m : 1 spm. — Stn 620, 50-52 m : 1 spm. — Stn 621, 55-56 m : 2 spm. — Stn 626, 47-48 m : 1 spm. — Stn 633, 50 m : 1 spm. — Stn 640, 50-80 m : 4 spm. — Stn 662, 50 m : 1 spm. — Stn 668, 40 m : 1 spm. — Stn 729, 42-45 m : 2 spm. — Stn 736, 44-45 m : 1 spm. — Stn 737, 49-50 m : 1 spm.

DISTRIBUTION. — From East Africa to the Philippines and the Solomon Islands ; now New Caledonia.

REMARKS. — The record of *N. (T.) multipunctatus* from New Caledonia is a new eastward range extension. The bathymetric range is extended from 200 m to 300 m.

Nassarius (Telasco) shacklefordi (Melvill & Standen, 1896)

Nassa (Telasco) shacklefordi Melvill & Standen, 1896 : 274, pl. 9, fig. 3 (Type locality : Lifou, Loyalty Islands).
Nassarius (Telasco) shacklefordi - CERNOHORSKY, 1984 : 123, pl. 22, figs 6-8 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 6, 20°57′ S, 161°43′ E, 45 m, 14 July 1984 : 1 spm. — Stn DC 7, 20°51′ S, 161°37′ E, 62 m, 14 July 1984 : 1 spm. — Stn DC 9, 20°44′ S, 161°02′ E, 75 m, 15 July 1984 : 1 spm. — Stn DC 17, 19°12′ S, 158°56′ E, 44 m, 17 July 1984 : 3 spm. — Stn DC 24, 19°11′ S, 158°37′ E, 38 m, 18 July 1984 : 6 spm. — Stn DC 25, 19°09′ S, 158°32′ E, 56 m, 18 July 1984 : 1 spm. — Stn DC 45, 20°49′ S, 158°30′ E, 50 m, 23 July 1984 : 4 spm. — Stn DC 55, 21°24′ S, 159°00′ E, 55 m, 25 July 1984 : 1 spm. — Stn DC 60, 21°49′ S, 159°28′ E, 45 m, 25 July 1984 : 3 spm.

New Caledonia. LAGON :

Southwestern Lagoon : stn 7, 14 m : 1 spm. — Stn 9, 10 m : 1 spm. — Stn 64, 15 m : 1 spm. — Stn 79, 16 m : 6 spm. — Stn 80, 33 m : 1 spm. — Stn 82, 10 m : 1 spm. — Stn 83, 22 m : 3 spm. — Stn 84, 17 m : 1 spm. — Stn 95, 14 m : 1 spm. — Stn 99, 14 m : 3 spm. — Stn 192, 18 m : 1 spm. — Stn 217, 16 m : 2 spm. — Stn 226, 28 m : 1 spm. — Stn 264, 56 m : 2 spm. — Stn 267, 70 m : 3 spm. — Stn 293, 20 m : 5 spm. — Stn 294, 21 m : 4 spm. — Stn 296, 26 m : 3 spm. — Stn 324, 39 m : 2 spm. — Stn 342, 55 m : 1 spm. — Stn 343, 32 m : 1 spm. — Stn 545, 37 m : 7 spm. — Stn 550, 24 m : 1 spm. — Stn 552, 38 m : 1 spm. — Stn 561, 48 m : 1 spm.
Eastern Lagoon : stn 597 bis, 50-70 m : 1 spm. — Stn 677, 32 m : 1 spm

DISTRIBUTION. — From Lord Howe Island, Australia to New Caledonia and tentatively Japan.

REMARKS. — The known bathymetric range for the species is extended from 40 m to 75 m.

Nassarius (Telasco) vidalensis (Barnard, 1959)

Fig. 10

Nassa vidalensis Barnard, 1959 : 118, textfig. 24b.
Nassarius (Telasco) vidalensis - CERNOHORSKY, 1984 : 123, pl. 22, figs 3-5 ; 1988 : 84.

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 53, 21°19′ S, 158°55′ E, 60 m, 24 July 1984 : 1 spm.
MUSORSTOM 5 : stn 298, 22°44′ S, 159°22′ E, 320 m, 11 October 1986 : 1 spm. — Stn 299, 22°48′ S, 159°24′ E, 360-390 m, 11 October 1986 : 1 spm. — Stn 302, 22°10′ S, 159°23′ E, 345-360 m, 12 October 1986 : 1 spm. — Stn 304, 22°10′ S, 159°26′ E, 385-420 m, 12 October 1986 : 4 spm.
New Caledonia. BIOCAL : stn DW 64, 24°48′ S, 168°09′ E, 250 m, 3 September 1985 : 11 spm.
CHALCAL 2 : stn DW 71, 24°42′ S, 168°10′ E, 230 m, 27 October 1986 : 2 spm. — Stn DW 79, 23°41′ S, 168°00′ E, 243 m, 30 October 1986 : 1 spm. — Stn DW 84, 23°24′ S, 168°07′ E, 170 m, 31 October 1986 : 1 spm.

DISTRIBUTION. — From Reunion Island to South Africa, NW Australia and Japan ; now New Caledonia.

REMARKS. — The record of the species from New Caledonia represents a southeastward range extension. The known bathymetric range is extended from 225 m to 420 m. Fresh specimens are brightly ornamented with reddish-brown.

Nassarius (Zeuxis) abyssicolus (A. Adams, 1852)

Fig. 11

Nassa abyssicola A. Adams, 1852 : 100.
Nassarius (Zeuxis) abyssicolus - CERNOHORSKY, 1984 : 166, pl. 35, figs 1-3.

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 26, 19°11′ S, 158°35′ E, 48 m, 18 July 1984 : 1 spm.

DISTRIBUTION. — To date known only from the Philippines and the Hawaiian Islands ; now New Caledonia.

REMARKS. — This is a new record for New Caledonia and a southern range extension.

Nassarius (Zeuxis) arcus sp. nov.

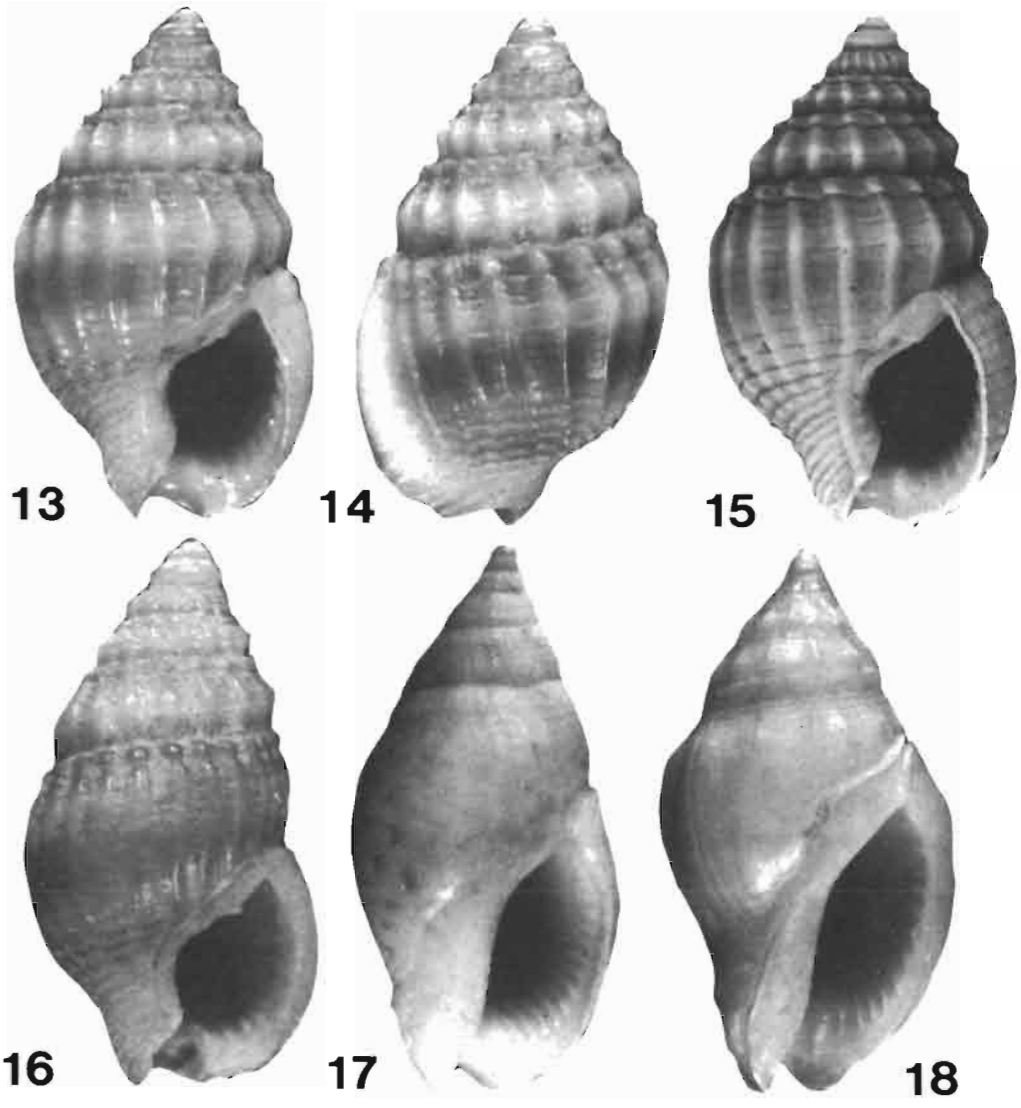
Figs 13-16

TYPE MATERIAL. — Holotype in MNHN ; paratypes in MNHN, AMS, AIM, NMNZ, NSMT, NM, USNM.

TYPE LOCALITY. — New Caledonia. LAGON : Southwestern Lagoon, Grand Récif Sud : stn 397, 22°39′ S, 167°11′ E, 125 m, 23 January 1985, B. RICHER-ORSTOM coll.

MATERIAL EXAMINED (all paratypes). — **New Caledonia.** MUSORSTOM 4 : stn DW 149, 19°08′ S, 163°23′ E, 155 m, 14 September 1985 : 150 spm, BOUCHET & RICHER coll. — Stn DW 150, 19°07′ S, 163°22′ E, 110 m, 14 September 1985 : 102 spm, BOUCHET & RICHER coll. — Stn DW 151, 19°07′ S, 163°22′ E, 200 m, 14 September 1985 : 38 spm.
LAGON : *Southwestern Lagoon* : stn 429, 22°40′ S, 167°15′ E, 95 m, 25 January 1985 : 7 spm, B. RICHER-ORSTOM coll.

DESCRIPTION. — Shell small, up to 9.0 mm in length, elongate-ovate, width 55-60 % of shell length, light in weight, teleoconch of 4-4 1/4 convex whorls, protoconch of 3 1/4-3 1/2 smooth, glassy-white larval whorls, ultimate turn finely carinate ; first 3 post-larval whorls angulate centrally, angulation usually only faintly indicated on the presutural ramp of the body whorl. Sculptured with distinct axial ribs which continue to the back of the outer lip and number from 13-20 on the penultimate and from 14-24 on the body whorl ; spiral sculpture distinct, consisting of fine spiral grooves which number from 4-7 on the penultimate and from 8-12 on the body whorl ; followed by 2-5 raised spiral threads anteriorly and from 5-7 oblique cords on the siphonal fasciole ; sutures with a uniformly nodulose girdle. Aperture about the same height as the spire, height 45-51 % of shell length, outer lip thickened and broadly variced, interior of outer lip with 8-11 fine, elongated denticles, columella concave and with 2-4 minute denticles, plus a weak or distinct parietal denticle, columellar callus narrow and confined to aperture, siphonal canal short, broad and prominent. White in colour, spire whorls with 2 brownish sutural bands, body whorl with a sutural, central



FIGS 13-18. — **13-15**. — *Nassarius arcus* sp. nov. Holotype. LAGON, stn 397, 125 m ; 7.9 mm (15, coated to show sculpture). **16**. — *Nassarius arcus* sp. nov. Paratype. LAGON, stn 429, 95 m ; 8.4 mm (slender individual). **17**. — *Cyllene concinna* A. Adams, 1851. LAGON, stn 218, 15 m ; 12.5 mm. **18**. — *Cyllene fuscata* A. Adams, 1851. MUSORSTOM 4, stn DW 150, 110 m ; 15.5 mm.

and sometimes basal brown band, aperture and varix white. Some specimens are white and have a single orange-brown band on body whorl. Preserved animal white, operculum translucent pale yellow with a short brown line in centre, rounded and simple at margins.

DISTRIBUTION. — To date known only from New Caledonia, in 95-200 m.

REMARKS. — *N. (Z.) arcus* is only superficially similar to *N. (Z.) agapetus* (Watson, 1882), but this species lacks the features of compressed and centrally angulate whorls and the prominent presutural groove and sutural nodules of *N. (Z.) arcus*. Some specimens of *N. (Z.) arcus*, especially those from MUSORSTOM 4, stn DW 149, are rather compressed so that all spire whorls are distinctly angulate on the presutural ramp and the body whorl is also subangulate.

Nassarius (Zeuxis) barsdelli Ladd, 1976

Nassarius (Alectrion) barsdelli Ladd, 1976 : 131, figs 12-15.
Nassarius (Zeuxis) barsdelli - CERNOHORSKY, 1984 : 140, pl. 27, figs 1-3.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Southwestern Lagoon* : stn 329, 80 m : 1 spm immature.

DISTRIBUTION. — Previously known only from Recent specimens in the Philippines and fossil specimens from the Pleistocene of Vanuatu ; now New Caledonia.

REMARKS. — Only one immature specimen of *N. (Z.) barsdelli* has been taken in New Caledonian waters. This is only the second locality after the Philippines from where Recent specimens have been recorded.

Nassarius (Zeuxis) castus (Gould, 1850)

Nassa casta Gould, 1850 : 154.
Nassarius (Zeuxis) castus - CERNOHORSKY, 1984 : 130, pl. 24, figs 7-17 ; pl. 25, figs 1-10 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Northern Lagoon* : stn 513, 55 m : 14 spm.
Southwestern Lagoon : stn 17, 24 m : 1 spm. — Stn 19, 29 m : 1 spm. — Stn 41, 28-46 m : 1 spm. — Stn 69, 13 m : 1 spm. — Stn 74, 31 m : 1 spm. — Stn 86, 29 m : 5 spm. — Stn 91, 30 m : 1 spm. — Stn 107, 33 m : 1 spm. — Stn 108, 17 m : 1 spm. — Stn 130, 32 m : 1 spm. — Stn 131, 38 m : 3 spm. — Stn 133, 59-62 m : 1 spm. — Stn 139, 45 m : 6 spm. — Stn 149, 48 m : 7 spm. — Stn 173, 20-50 m : 2 spm. — Stn 178, 20 m : 1 spm. — Stn 184, 13 m : 1 spm. — Stn 187, 13 m : 6 spm. — Stn 192, 18 m : 3 spm. — Stn 193, 20 m : 1 spm. — Stn 202, 13 m : 1 spm. — Stn 203, 13 m : 1 spm. — Stn 208, 9 m : 2 spm. — Stn 209, 14 m : 6 spm. — Stn 210, 14 m : 1 spm. — Stn 211, 12 m : 2 spm. — Stn 215, 14 m : 14 spm. — Stn 216, 14 m : 10 spm. — Stn 219, 32 m : 9 spm. — Stn 220, 12 m : 1 spm. — Stn 221, 55-65 m : 15 spm. — Stn 235, 70 m : 1 spm. — Stn 238, 50 m : 1 spm. — Stn 245, 62 m : 1 spm. — Stn 268, 24 m : 1 spm. — Stn 277, 30 m : 1 spm. — Stn 278, 17 m : 2 spm. — Stn 317, 66 m : 1 spm. — Stn 318, 71 m : 1 spm. — Stn 320, 70 m : 3 spm. — Stn 329, 80 m : 1 spm. — Stn 354, 78 m : 2 spm. — Stn 550, 24 m : 4 spm. — Stn 591, 14 m : 1 spm.
Eastern Lagoon : stn 606, 46-48 m : 2 spm. — Stn 608, 50-56 m : 9 spm. — Stn 611, 56-57 m : 3 spm. — Stn 614, 48-50 m : 2 spm. — Stn 619, 27-42 m : 1 spm. — Stn 624, 44-46 m : 1 spm. — Stn 628, 55-56 m : 15 spm. — Stn 635, 45-52 m : 1 spm. — Stn 636, 34-40 m : 82 spm. — Stn 638, 56-58 m : 1 spm. — Stn 643, 56-66 m : 8 spm. — Stn 646, 66-70 m : 1 spm. — Stn 647, 50-52 m : 1 spm. — Stn 649, 64-65 m : 3 spm. — Stn 652, 55-62 m : 2 spm. — Stn 654, 32 m : 3 spm. — Stn 655, 35-40 m : 2 spm. — Stn 656, 30-40 m : 14 spm. — Stn 660, 48-52 m : 5 spm. — Stn 667, 33-37 m : 3 spm. — Stn 670, 48 m : 1 spm. — Stn 672, 15-20 m : 2 spm. — Stn 674, 48 m : 5 spm. — Stn 683, 42-45 m : 1 spm. — Stn 692, 44-48 m : 6 spm. — Stn 694, 45-47 m : 7 spm. — Stn 695, 54-55 m : 16 spm. — Stn 705, 46-48 m : 1 spm. — Stn 712, 47-49 m : 7 spm. — Stn 723, 45 m : 4 spm. — Stn 727, 45-46 m : 2 spm. — Stn 728, 43-47 m : 13 spm. — Stn 729, 42-45 m : 3 spm. — Stn 732, 43-50 m : 3 spm. — Stn 733, 35-38 m : 1 spm. — Stn 737, 49-50 m : 3 spm. — Stn 738, 59-61 m : 14 spm.

DISTRIBUTION. — From the Red Sea and the Persian Gulf to Japan and the Samoa Islands.

REMARKS. — The majority of the New Caledonian *N. (Z.) castus* populations belong to the form *vitiensis* Rousseau, 1854.

Nassarius (Zeuxis) comptus (A. Adams, 1852)

Nassa compta A. Adams, 1852 : 107.
Nassarius (Zeuxis) comptus - CERNOHORSKY : 146, pl. 29, figs 1-7 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 44, 20°46′ S, 158°34′ E, 79 m, 23 July 1984 : 7 spm.

New Caledonia. MUSORSTOM 4 : stn CP 148, 19°23′ S, 163°32′ E, 58 m, 14 September 1985 : 2 spm.
LAGON :
Northern Lagoon : stn 506, 56 m : 1 spm. — Stn 529, 50 m : 5 spm. — Stn 532, 56 m : 2 spm. — Stn 535, 46 m : 2 spm. — Stn 539, 240 m : 2 spm.
Southwestern Lagoon : stn 1, 19 m : 3 spm. — Stn 2, 14 m : 2 spm. — Stn 11, 24 m : 16 spm. — Stn 16, 30 m : 3 spm. — Stn 17, 24 m : 3 spm. — Stn 19, 29 m : 4 spm. — Stn 24, 28 m : 4 spm. — Stn 25, 28 m : 13 spm. — Stn 26, 22 m : 1 spm. — Stn 27, 18 m : 3 spm. — Stn 28, 9 m : 1 spm. — Stn 29, 12 m : 6 spm. — Stn 31, 29 m : 2 spm. — Stn 32, 30 m : 5 spm. — Stn 33, 18 m : 4 spm. — Stn 34, 10 m : 5 spm. — Stn 41, 28-46 m : 2 spm. — Stn 42, 25 m : 3 spm. — Stn 45, 14 m : 2 spm. — Stn 46, 25 m : 3 spm. — Stn 47, 28 m : 2 spm. — Stn 54, 25 m : 5 spm. — Stn 55, 23 m : 1 spm. — Stn 57, 10 m : 2 spm. — Stn 58, 22 m : 1 spm. — Stn 69, 13 m : 1 spm. — Stn 70, 30 m : 1 spm. — Stn 71, 22 m : 5 spm. — Stn 72, 15 m : 6 spm. — Stn 73, 15 m : 2 spm. — Stn 74, 31 m : 3 spm. — Stn 78, 35 m : 5 spm. — Stn 85, 21 m : 1 spm. — Stn 86, 29 m : 9 spm. — Stn 87, 27 m : 8 spm. — Stn 88, 34 m : 1 spm. — Stn 89, 32 m : 4 spm. — Stn 91, 30 m : 2 spm. — Stn 92, 24 m : 4 spm. — Stn 104, 24 m : 9 spm. — Stn 105, 33 m : 5 spm. — Stn 107, 33 m : 7 spm. — Stn 109, 16 m : 3 spm. — Stn 111, 25 m :

4 spm. — Stn 115, 26 m : 1 spm. — Stn 119, 20 m : 3 spm. — Stn 122, 28 m : 1 spm. — Stn 131, 38 m : 7 spm. — Stn 139, 45 m : 2 spm. — Stn 143, 32 m : 1 spm. — Stn 147, 50-60 m : 2 spm. — Stn 149, 48 m : 1 spm. — Stn 154, 29 m : 2 spm. — Stn 155, 23 m : 3 spm. — Stn 165, 21 m : 4 spm. — Stn 167, 11 m : 1 spm. — Stn 168, 10 m : 1 spm. — Stn 169, 22 m : 4 spm. — Stn 175, 17 m : 1 spm. — Stn 178, 20 m : 2 spm. — Stn 179, 12 m : 5 spm. — Stn 180, 10 m : 4 spm. — Stn 187, 13 m : 3 spm. — Stn 188, 8 m : 1 spm. — Stn 192, 18 m : 2 spm. — Stn 199, 50 m : 3 spm. — Stn 201, 17 m : 1 spm. — Stn 202, 13 m : 1 spm. — Stn 203, 13 m : 2 spm. — Stn 230, 35 m : 1 spm. — Stn 231, 32 m : 1 spm. — Stn 249, 11 m : 1 spm. — Stn 252, 22 m : 1 spm. — Stn 260, 23 m : 5 spm. — Stn 262, 21 m : 3 spm. — Stn 263, 23 m : 9 spm. — Stn 264, 19 m : 1 spm. — Stn 266, 19 m : 1 spm. — Stn 268, 24 m : 1 spm. — Stn 269, 20 m : 5 spm. — Stn 270, 25 m : 14 spm. — Stn 271, 22 m : 9 spm. — Stn 272, 20 m : 5 spm. — Stn 274, 12 m : 1 spm. — Stn 275, 19 m : 4 spm. — Stn 276, 26 m : 5 spm. — Stn 277, 30 m : 4 spm. — Stn 278, 17 m : 8 spm. — Stn 279, 29 m : 5 spm. — Stn 285, 19 m : 1 spm. — Stn 286, 28 m : 2 spm. — Stn 287, 29 m : 2 spm. — Stn 289, 23 m : 4 spm. — Stn 290, 11 m : 4 spm. — Stn 314, 46 m : 1 spm. — Stn 320, 70 m : 7 spm. — Stn 322, 71 m : 4 spm. — Stn 328, 72 m : 1 spm. — Stn 331, 79 m : 3 spm. — Stn 376, 75-76 m : 1 spm. — Stn 429, 95 m : 1 spm.

DISTRIBUTION. — From the Red Sea and the Persian Gulf to Japan and the Society Islands.

Nassarius (Zeuxis) concinnus (Powys, 1835)

Nassa concinna Powys, 1835 : 95.
Nassarius (Zeuxis) concinnus - CERNOHORSKY, 1984 : 143, pl. 28, figs 2-9 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Southwestern Lagoon* : stn 143, 32 m : 2 spm. — Stn 206, 8 m : 1 spm. — Stn 549, 26 m : 1 spm. — Stn 550, 24 m : 1 spm.
Eastern Lagoon : stn 672, 15-20 m : 1 spm.

DISTRIBUTION. — From the Red Sea and the Persian Gulf to Japan and the Tuamotu Archipelago.

Nassarius (Zeuxis) crebricostatus (Schepman, 1911)

Nassa (Alectryon, Aciculina) crebricostata Schepman, 1911 : 318, pl. 20, figs 3a, b.
Nassarius olomea Kay, 1979 : 274, fig. 95E (new synonym).
Nassarius (Zeuxis) crebricostatus - CERNOHORSKY, 1984 : 160, pl. 33, figs 3-8 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands.** MUSORSTOM 5 : stn 304, 22°10′ S, 159°26′ E, 385-420 m, 12 October 1986 : 1 spm. — Stn 337, 19°54′ S, 158°38′ E, 412-430 m, 15 October 1986 : 1 spm. — Stn 378, 19°54′ S, 158°38′ E, 355 m, 20 October 1986 : 1 spm. — Stn 379, 19°53′ S, 158°40′ E, 370-400 m, 20 October 1986 : 3 spm. — Stn 381, 19°38′ S, 158°47′ E, 620 m, 21 October 1986 : 1 spm.
New Caledonia. BIOCAL : stn DW 104, 21°31′ S, 166°21′ E, 375-450 m, 8 September 1985 : 1 spm.
MUSORSTOM 4 : stn DW 181, 18°57′ S, 163°22′ E, 350 m, 18 September 1985 : 1 spm. — Stn DW 197, 18°51′ S, 163°21′ E, 550 m, 20 September 1985 : 1 spm. — Stn DW 222, 22°58′ S, 167°33′ E, 410-440 m, 30 September 1985 : 1 spm. — Stn DW 226, 22°47′ S, 167°22′ E, 390 m, 30 September 1985 : 4 spm. — Stn DW 227, 22°46′ S, 167°20′ E, 300 m, 30 September 1985 : 4 spm. — Stn CC 246, 22°08′ S, 167°11′ E, 410-420 m, 3 October 1985 : 6 spm. — Stn CC 247, 22°09′ S, 167°13′ E, 435-460 m, 4 October 1985 : 1 spm.

DISTRIBUTION. — From the Red Sea to the Tuamotu Archipelago and the Hawaiian Islands.

REMARKS. — This is a new record of the species for New Caledonia.

The known bathymetric range is extended from 472 m to 620 m.

Some of the specimens collected were uniformly white or fawn in colour, while others had the axial ribs partially or fully lined with reddish-brown. The more slender form of *N. (Z.) crebricostatus* with brown-lined axial ribs described by KAY (1979) as *N. olomea*, was found among populations of *N. (Z.) crebricostatus* in New Caledonian waters, and I have no hesitation in placing *Nassarius olomea* Kay, 1979, in synonymy of *N. (Z.) crebricostatus* (Schepman).

Nassarius (Zeuxis) crematus (Hinds, 1844)

Nassa cremata Hinds, 1844 : 35, pl. 9, figs 8-9.
Nassarius (Zeuxis) crematus - CERNOHORSKY : 129, pl. 24, figs 1-6 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Northern Lagoon* : stn 527, 59 m : 1 spm.
Southwestern Lagoon : stn 139, 45 m : 1 spm. — Stn 147, 50-60 m : 1 spm. — Stn 234, 56 m : 1 spm. — Stn 237, 62 m : 2 spm. — Stn 238, 50 m : 2 spm. — Stn 318, 71 m : 3 spm. — Stn 321, 70 m : 1 spm. — Stn 323, 80 m : 3 spm. — Stn 325, 75 m : 3 spm. — Stn 562, 48 m : 1 spm.
Eastern Lagoon : stn 605, 65-70 m : 2 spm. — Stn 609, 52-60 m : 1 spm. — Stn 610, 49 m : 1 spm. — Stn 611,

56-57 m : 1 spm. — Stn 622, 67 m : 1 spm. — Stn 628, 55-56 m : 2 spm. — Stn 630, 60-68 m : 4 spm. — Stn 636, 34-40 m : 7 spm. — Stn 637, 60-65 m : 2 spm. — Stn 638, 56-58 m : 2 spm. — Stn 643, 56-66 m : 3 spm. — Stn 646, 66-70 m : 1 spm. — Stn 647, 50-52 m : 7 spm. — Stn 649, 64-65 m : 2 spm. — Stn 652, 55-62 m : 4 spm. — Stn 655, 35-40 m : 4 spm. — Stn 656, 30-40 m : 1 spm. — Stn 660, 48-52 m : 1 spm. — Stn 665, 40-42 m : 4 spm. — Stn 666, 33-35 m : 3 spm. — Stn 667, 33-37 m : 1 spm. — Stn 674, 48 m : 1 spm. — Stn 679, 29-30 m : 1 spm. — Stn 683, 42-45 m : 2 spm. — Stn 689, 46-48 m : 1 spm. — Stn 691, 33-34 m : 1 spm. — Stn 692, 44-48 m : 4 spm. — Stn 694, 45-47 m : 1 spm. ; 54-55 m : 1 spm. — Stn 695, 54-55 m : 1 spm. — Stn 699, 50-52 m : 4 spm. — Stn 704, 46-58 m : 3 spm. — Stn 705, 46-48 m : 2 spm. — Stn 706, 52-56 m : 1 spm. — Stn 716, 30 m : 1 spm. — Stn 722, 42 m ; 1 spm. — Stn 723, 45 m : 1 spm. — Stn 726, 50-51 m : 2 spm. — Stn 727, 45-46 m : 3 spm. — Stn 728, 43-47 m : 2 spm. — Stn 733, 35-38 m : 2 spm.

DISTRIBUTION. — From East Africa to India, Japan and the Fiji Islands.

Nassarius (Zeuxis) haldemanni (Dunker, 1847)

Fig. 12

Buccinum haldemanni Dunker, 1847 : 62.
Nassarius (Zeuxis) haldemanni - CERNOHORSKY, 1984 : 145, pl. 28, figs 10-13 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Eastern Lagoon* : stn 620 : 50-52 m : 1 spm.

DISTRIBUTION. — From the Red Sea to the Philippines and the Marquesas Islands.

REMARKS. — Since the publication of the monograph of Nassariidae (CERNOHORSKY, 1984), specimens of *N. (Z.) haldemanni* have been examined from Faaone, Tahiti, and lots USNM 798419, 799215 and 790397 from the Marquesas Islands (National Museum of Natural History, Washington). The record of a single specimen of this rare species from New Caledonian waters is a new locality record, and the known bathymetric range is also extended from 40 m to 52 m.

Nassarius (Zeuxis) idyllius (Melvill & Standen, 1901)

Nassa (Alectryon) idyllia Melvill & Standen, 1901 : 410, pl. 23, fig. 12.
Nassarius (Zeuxis) idyllius - CERNOHORSKY, 1984 : 156, pl. 32, figs 8-12 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** LAGON : *Southwestern Lagoon* : stn 429, 95 m : 1 spm.

DISTRIBUTION. — From the Persian Gulf to the Philippines and the Fiji Islands.

REMARKS. — This is a new locality record for the species.

Nassarius (Zeuxis) macrocephalus (Schepman, 1911)

Nassa (Alectryon) macrocephala Schepman, 1911 : 317, pl. 20, figs 2a, b.
Nassarius (Zeuxis) macrocephalus - CERNOHORSKY, 1984 : 159, pl. 33, figs 1-2.

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn CC 175, 18°59′ S, 163°17′ E, 355 m, 17 September 1985 : 20 spm.

DISTRIBUTION. — From Indonesia to the China Sea and North Australia ; now New Caledonia.

REMARKS. — This record is a southeastward range extension for the species.

Nassarius (Zeuxis) siquijorensis (A. Adams, 1852)

Nassa siquijorensis A. Adams, 1852 : 97.
Nassarius (Zeuxis) siquijorensis - CERNOHORSKY, 1984 : 134, pl. 25, figs 12-14 ; pl. 26, figs 1-5 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 33, 19°45′ S, 158°26′ E, 205 m, 19 July 1984 : 4 spm. — Stn CP 10, 20°00′ S, 158°47′ E, 225 m, 22 July 1981 : 1 spm. — Stn DC 63, 22°11′ S, 159°15′ E, 305 m, 27 July 1984 : 7 spm. — Stn DC 64, 22°11′ S, 159°15′ E, 305 m, 27 July 1984 : 6 spm. — Stn DC 66, 22°26′ S, 159°20′ E, 320 m, 28 July 1984 : 3 spm. — Stn DC 67, 22°35′ S, 159°09′ E, 277 m, 28 July 1984 : 1 spm.

MUSORSTOM 5 : stn 255, 25°15′ S, 159°55′ E, 280-295 m, 7 October 1986 : 3 spm. — Stn 258, 25°33′ S, 159°46′ E, 300 m, 8 October 1986 : 3 spm. — Stn 263, 25°21′ S, 159°46′ E, 150-225 m, 8 October 1986 : 1 spm. — Stn 265, 25°21′ S, 159°45′ E, 190-260 m, 8 October 1986 : 7 spm. — Stn 266, 25°20′ S, 159°46′ E, 240 m, 8 October 1986 : 12 spm. — Stn 270, 24°49′ S, 159°34′ E, 223 m, 9 October 1986 : 5 spm. — Stn 276, 24°49′ S, 159°41′ E, 258-269 m, 9 October 1986 : 3 spm. — Stn 282, 24°12′ S, 159°32′ E, 226-230 m, 10 October 1986 : 6 spm. — Stn 284, 24°10′ S, 159°33′ E, 225-230 m, 10 October 1986 : 1 spm. — Stn 289, 24°02′ S, 159°38′ E, 273 m, 10 October 1986 : 2 spm. — Stn 291, 23°08′ S, 159°28′ E, 300 m,

11 October 1986 : 3 spm. — Stn 293, 23°09′ S, 159°31′ E, 280 m, 11 October 1986 : 1 spm. — Stn 294, 23°11′ S, 159°30′ E, 272 m, 11 October 1986 : 8 spm. — Stn 295, 23°13′ S, 159°32′ E, 279 m : 11 October 1986 : 6 spm. — Stn 296, 23°13′ S, 159°36′ E, 278 m, 11 October 1986 : 3 spm. — Stn 312, 22°17′ S, 159°25′ E, 315-320 m, 12 October 1986 : 3 spm. — Stn 315, 22°25′ S, 159°27′ E, 330-335 m, 13 October 1986 : 1 spm. — Stn 318, 22°27′ S, 159°21′ E, 330 m, 13 October 1986 : 2 spm. — Stn 320, 22°25′ S, 159°13′ E, 315 m, 13 October 1986 : 1 spm. — Stn 347, 19°39′ S, 158°28′ E, 260 m, 17 October 1986 : 1 spm.

New Caledonia. MUSORSTOM 4 : stn DW 151, 19°07′ S, 163°22′ E, 200 m, 14 September 1985 : 1 spm. — Stn CC 175, 18°59′ S, 163°17′ E, 355 m, 17 September 1985 : 1 spm. — Stn DW 186, 19°07′ S, 163°30′ E, 190 m, 19 September 1985 : 1 spm. — Stn DW 204, 22°37′ S, 167°06′ E, 120 m, 27 September 1985 : 1 spm.

LAGON :
Northern Lagoon : stn 502, 190 m : 1 spm.
Southwestern Lagoon : stn 367, 105 m : 1 spm.

DISTRIBUTION. — From the Red Sea to Japan and New Caledonia.

Nassarius (Profundinassa) babylonicus (Watson, 1882)

Nassa babylonica Watson, 1882 : 366.
Nassarius (Profundinassa) babylonicus - CERNOHORSKY, 1984 : 173, pl. 36, figs 1-4 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn CP 26, 22°40′ S, 166°27′ E, 1 680-1 740 m, 28 August 1985 : 1 spm. — Stn CP 75, 22°19′ S, 167°23′ E, 825-860 m, 4 September 1985 : 1 spm. — Stn DW 80, 20°32′ S, 166°48′ E, 900-980 m, 5 September 1985 : 1 spm.

DISTRIBUTION. — From the Gulf of Oman to Japan and East Australia ; now New Caledonia.

REMARKS. — The record of this species represents an eastward range extension from East Australia.

Nassarius (Hima) pauperus (Gould, 1850)

Nassa paupera Gould, 1850 : 155.
Nassarius (Hima) pauperus - CERNOHORSKY, 1984 : 176, pl. 37, figs 1-14 (synonymy).

MATERIAL EXAMINED. — **Chesterfield Islands.** CHALCAL 1 : stn DC 17, 19°12′ S, 158°56′ e, 44 m, 17 July 1984 : 1 spm. — Stn DC 18, 19°08′ S, 158°48′ E, 60 m, 17 July 1984 : 1 spm. — Stn DC 57, 21°29′ S, 159°16′ E, 62 m, 25 July 1984 : 1 spm.

New Caledonia. LAGON :
Huon Atoll : stn 441, 37 m : 1 spm.
Southwestern Lagoon : stn 10, 15 m : 1 spm. — Stn 64, 15 m : 2 spm. — Stn 68, 22-40 m : 1 spm. — Stn 77, 22 m : 1 spm. — Stn 78, 35 m : 1 spm. — Stn 95, 14 m : 1 spm. — Stn 146, 40-52 m : 1 spm. — Stn 161, 20 m : 1 spm. — Stn 234, 56 m : 1 spm. — Stn 240, 42 m : 1 spm. — Stn 287, 29 m : 1 spm. — Stn 290 ?, 11 m : 1 spm. — Stn 348, 45 m : 2 spm. — Stn 357, 77 m : 1 spm. — Stn 384 bis, 72 m : 1 spm.
Eastern Lagoon : stn 603, 78-80 m : 1 spm. — Stn 619, 27-42 m : 3 spm. — Stn 620, 50-52 m : 1 spm. — Stn 621, 55-56 m : 1 spm. — Stn 623, 32-40 m : 1 spm. — Stn 625, 34-40 m : 1 spm. — Stn 677, 32 m : 1 spm. — Stn 696, 41-57 m : 1 spm. — Stn 729, 42-45 m : 1 spm.

DISTRIBUTION. — From the Red Sea to South Africa, Japan, Cook and Hawaiian Islands.

Genus *CYLLENE* Gray *in* Griffith & Pidgeon, 1834

Cyllene concinna A. Adams, 1851

Fig. 17

Cyllene concinna A. Adams, 1851 : 205.
Cyllene concinna - CERNOHORSKY, 1984 : 225, pl. 51, figs 3-5 (synonymy) ; 1988 : 84.

MATERIAL EXAMINED. — **Chesterfield Islands.** MUSORSTOM 5 : stn 264, 25°20′ S, 159°44′ E, 56 m, 8 October 1986 : 4 spm.

New Caledonia. LAGON :
Southwestern Lagoon : stn 218, 15 m : 5 spm.

DISTRIBUTION. — From Réunion Island to Japan ; now New Caledonia.

REMARKS. — CERNOHORSKY (1988) recorded the species from various stations at Réunion Island at depths ranging from 40-340 m. The New Caledonian record is a considerable southeastern range extension. *C. concinna* is similar to *C. pulchella* Adams & Reeve, 1850, but differs in having a paucispiral protoconch of 1.5-2 whorls.

Cyllene fuscata A. Adams, 1851

Fig. 18

Cyllene fuscata A. Adams, 1851 : 205.
Cyllene fuscata - CERNOHORSKY, 1984 : 220, pl. 47, fig. 10 ; pl. 48, figs 1-5 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 150, 19°07′ S, 163°22′ E, 110 m, 14 September 1985 : 1 spm.

DISTRIBUTION. — From the Gulf of Oman to East Africa and Indo-Malaysia ; now New Caledonia.

REMARKS. — The single specimen recorded from New Caledonian waters belongs to the form *plumbea* Sowerby, 1859. This a considerable eastward range extension for the species.

Cyllene pulchella A. Adams & Reeve, 1850

Cyllene pulchella A. Adams & Reeve, 1850 : 33, pl. 10, fig. 11.
Cyllene pulchella - CERNOHORSKY, 1984 : 272, pl. 49, figs 1-8 (synonymy).

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 149, 19°08′ S, 163°23′ E, 155 m, 14 September 1985 : 1 spm.

DISTRIBUTION. — From the Red Sea to Japan and Vanuatu.

ACKNOWLEDGEMENTS

I am grateful to Dr P. BOUCHET, Muséum national d'Histoire naturelle, Paris, for the opportunity to examine and report upon the family Nassariidae from New Caledonian waters. I also would like to thank Mr P. LOZOUET and Ms V. HEROS from the same institution, for their assistance with photography and editing.

REFERENCES

ADAMS, A., 1851. — A monograph of Cyllene, a genus of gasteropodous Mollusca. *Proc. Zool. Soc. Lond.*, **18** : 204-206.

ADAMS, A., 1852-1853. — Catalogue of the species of Nassa, a genus of gasteropodous Mollusca belonging to the family Buccinidae, in the collection of Hugh Cuming Esq., with the description of some new species. *Proc. Zool. Soc. Lond.*, **19** : 94-114 (pp. 94-112 published 7 December 1852 ; pp. 113-114 published 29 April 1853).

ADAMS, A., & REEVE, L., 1850. — The Zoology of the voyage of H.M.S. " Samarang ". Mollusca. London, **2** : 25-44, pls 10-17.

BAIRD, W., *in* BRENCHLEY, J. L., 1873. — Cruise of H.M.S. " Curacao " among the South Sea Islands. Section " Shells ". London : 432-454, pls 36-42.

BARNARD, K. H., 1959. — Contributions to the knowledge of South African Marine Mollusca. Part 2. Gastropoda : Prosobranchiata : Rachiglossa. *Ann. S. Afr. Mus.*, **45** : 1-256.

CERNOHORSKY, W. O., 1978. — Tropical Pacific marine shells. Sydney : 352 pp., 68 pls.

CERNOHORSKY, W. O., 1980. — Taxonomic notes on Polynesian Mollusca with descriptions of new species of Nassariidae. *Rec. Auckl. Inst. Mus.*, **17** : 113-125.

CERNOHORSKY, W. O., 1984. — Systematics of the family Nassariidae (Mollusca : Gastropoda). *Bull. Auckl. Inst. Mus.*, **14** : 1-356.

CERNOHORSKY, W. O., 1988. — The Mitridae, Costellariidae and Nassariidae (Mollusca : Gastropoda) recently dredged at Reunion Island, Indian Ocean, with descriptions of new species. *Rec. Auckl. Inst. Mus.*, **25** : 75-85.

DESHAYES, G. P., *in* BELANGER, C., 1832. — Voyage aux Indes Orientales par le Nord de l'Europe... pendant les années 1825-1829... Zoologie. Mollusques. Paris : 403-440, pls 1-3.

DUNKER, G., 1846. — Diagnoses Buccinorum quorundam novorum. *Z. Malakozool.*, **3** : 170-172.

— 1847. — Diagnoses Buccinorum quorundam novorum. *Z. Malakozool.*, **4** : 59-64.

GOULD, A. A., 1850. — Shells collected by the United States Exploring Expedition. *Proc. Bost. Soc. Nat. Hist.*, **3** : 151-156 ; 169-172.

HIDALGO, J. G., 1904. — Catalogo de los moluscos testaceos de las islas Filipinas, Jolo y Marianas. *Rev. R. Acad. Cienc. Madrid*, **1** (3) : 153-210.

HINDS, R. B., 1844-1845. — The zoology of the voyage of H.M.S. " Sulphur " ; Mollusca. London, **1** : 1-24, pls 1-7 ; **2** : 25-48, pls 8-14 (1844) ; **3** : 49-72, pls 15-21 (1845).

KAY, E. A., 1979. — Hawaiian marine shells. Reef and shore fauna of Hawaii. Section 4. Mollusca. *Spec. Publ. Bernice P. Bishop Mus.*, **64** (4) : 1-653.

KIENER, L. C., 1834-41. Species general et iconographie des coquilles vivantes. Famille des Purpurifères. Genre Buccin. Paris, 9 : 1-108, pls 1-31 (p. 1-104 published in 1834 ; p. 105-112 in 1841).

LADD, H. S., 1976. — New pleistocene Neogastropoda from the New Hebrides. *Nautilus*, **90** (4) : 127-138.

LINNAEUS, C., 1758. — Systema naturae per regna tria naturae. Editio decima, reformata. Stockholm : 824 pp.

MARRAT, F. P., 1877. — On some proposed new forms of the genus Nassa. 15 pp., 1 pl.

MELVILL, J. C., & STANDEN, R., 1895-1896. — Notes on a collection of shells from Lifu and Uvea, Loyalty Islands, formed by the Rev. James and Mrs. Hadfield, with list of species. *J. Conch.*, **8** : 84-132, pls 2, 3 (1895) ; **8** : 273-315, pls 9-11 (1896).

MELVILL, J. C., & STANDEN, R., 1899. — Report on the marine Mollusca obtained during the first expedition of Prof. A. C. Haddon to the Torres Straits, in 1888-1889. *J. Linn. Soc. Lond., (Zool.)*, **27** : 150-206, pls 10, 11.

MELVILL, J. C., & STANDEN, R., 1901. — The Mollusca of the Persian Gulf, Gulf of Oman, and Arabian Sea, as evidenced mainly through the collections of Mr. F. W. Townsend, 1893-1900 ; with descriptions of new species. *Proc. Zool. Soc. Lond.*, **1901** (2) : 327-460, pls 21-24.

MELVILL, J. C., & STANDEN, R., 1903. — Descriptions of sixty-eight new Gastropoda from the Persian Gulf, Gulf of Oman, and North Arabian Sea, dredged by Mr. F. W. Townsend, of the Indo-European Telegraph service, 1901-1903. *Ann. Mag. Nat. Hist.*, (7) **12** : 289-324, pls 20-23.

POWYS, W. L., 1835. — Characters of new species of shells collected by Mr. Cuming. *Proc. Zool. Soc. Lond.*, **3** : 93-96.

QUOY, J. R. C., & GAIMARD, J. P., 1833. — Voyage de découvertes de l'Astrolabe exécuté par ordre du roi, pendant les années 1826-1829, sous le commandement de M. J. Dumont d'Urville. Zoologie, 2. Paris : 321-674, pls 24-45 bis.

REEVE, L., 1853-1854. — Conchologia Iconica, 8 ; monograph of the genus Nassa. London : pls 1-29, text.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. *In* : A. CROSNIER (ed.), Résultats des campagnes MUSORSTOM, Volume 6. *Mém. Mus. natn. Hist. nat.*, (A) **145** : 9-54.

RICHER DE FORGES, B., & BARGIBANT, G., 1985. — Le lagon Nord de la Nouvelle-Calédonie et les atolls de Huon et Surprise. ORSTOM, Centre de Nouméa. Rapports scientifiques et techniques, **37** : 1-23.

RICHER DE FORGES, B., *et al.*, 1987. — Le lagon sud-ouest de la Nouvelle-Calédonie. Observations préalables à la cartographie bionomique des fonds meubles. ORSTOM, Centre de Nouméa. Rapports scientifiques et techniques, Sciences de la Mer, **45** : 1-110.

SCHEPMAN, M. M., 1911. — The Prosobranchia of the Siboga Expedition. Part 4. Rachiglossa. Siboga-Expedition, **49d** : 247-363, pls 18-24.

WATSON, R. B., 1882. — Mollusca of H.M.S. "Challenger" Expedition. Part 13. *J. Linn. Soc. Lond.*, (Zool.) **16** : 358-372.

8

Mollusca Gastropoda : *Eumitra* récentes de la région néo-calédonienne et *Charitodoron* fossiles de l'Oligocène supérieur d'Aquitaine (Mitridae)

Pierre LOZOUET

Muséum national d'Histoire naturelle
Laboratoire de Biologie des Invertébrés marins et Malacologie
55, rue Buffon
75005 Paris
France

RÉSUMÉ

Des espèces récentes d'*Eumitra* sont décrites pour la première fois ; elles proviennent du bathyal de la région néo-calédonienne : *E. caledonica* sp. nov., *E. apheles* sp. nov., *E. imbricata* sp. nov. et *E. richeri* sp. nov. Les *Eumitra* n'étaient connues que du Miocène inférieur de Nouvelle-Zélande et du Miocène/Pliocène d'Australie. La dispersion peut expliquer la distribution du genre. Deux espèces fossiles provenant de paléocommunautés bathyales de l'Oligocène supérieur d'Aquitaine sont pour la première fois rapportées au genre *Charitodoron*. Les trois espèces actuelles de *Charitodoron* sont limitées au bathyal supérieur d'Afrique du Sud. *Charitodoron* et *Eumitra* morphologiquement proches n'apparaissent pas directement reliés.

ABSTRACT

Mollusca Gastropoda : Recent ***Eumitra*** **from New Caledonian region and fossil** ***Charitodoron*** **from upper Oligocene of Aquitaine (Mitridae).**

The first Recent species of *Eumitra* are described from deep-water in the New Caledonian region : *E. caledonica* sp. nov. (Southern New Caledonia), *E. apheles* sp. nov. (Northern New Caledonia), *E. imbricata* sp. nov. (Coral Sea, Lansdowne-Fairway) and *E. richeri* sp. nov. (Coral Sea, Mellish Reef). A SEM photograph of the radula is included. Fossil *Eumitra* are restricted to lower Miocene of New Zealand and Miocene/Pliocene of Australia. Dispersal is advocated to explain *Eumitra* distribution. For the first time fossil species from Upper Oligocene of Aquitaine Basin (Southwestern France) are referred to *Charitodoron*, an atypical member of the Mitridae : *C. tauzini* sp. nov. and *C. cancellatus* (Saubade, 1969). The three Recent *Charitodoron* are confined to the bathyal zone of South Africa, fossil Oligocene species have been collected from a bathyal palaeocommunity. In spite of columellar similarities, peculiar development of columellar folds (*Eumitra*) or edentulous columella (*Charitodoron*), these two genera are probably not closely related. In a paleobiogeographic discussion two key events are cited to explain the beginning of many marine disjunctions : Upper Eocene/Lower Oligocene crisis and closing of Tethys in Upper Oligocene/Lower Miocene.

LOZOUET, P., 1991. — Mollusca Gastropoda : *Eumitra* récentes de la région néo-calédonienne et *Charitodoron* fossiles de l'Oligocène supérieur d'Aquitaine (Mitridae). *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 205-222. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

L'une des caractéristiques des Mitridae est la présence de plis columellaires saillants. Deux exceptions sont cependant à signaler : le genre *Charitodoron* (limité aux côtes de l'Afrique du Sud) dont les espèces ne présentent aucune plication columellaire et le genre *Eumitra* (uniquement connu du Néogène australo-zélandais) chez lequel les plis sont faibles. Se basant sur ce caractère, CERNOHORSKY (1970) a proposé une filiation *Eumitra-Charitodoron*. Les *Charitodoron* se seraient séparés des *Eumitra* au cours du Pliocène. Or, deux espèces présumées de *Charitodoron* ont été récoltées dans l'Oligocène supérieur d'Aquitaine. D'autre part quatre espèces d'*Eumitra* ont été draguées lors des campagnes BIOCAL (Chef de Mission : C. LÉVI), MUSORSTOM 4 (Chef de Mission : B. RICHER DE FORGES) et CORAIL 2 (Chef de Mission : B. RICHER DE FORGES) dans le bathyal supérieur de Nouvelle-Calédonie et de la mer du Corail (banc Lansdowne-Fairway, Mellish Reef). Ces découvertes obligent à repenser le schéma de filiation de CERNOHORSKY et suscitent des interrogations biogéographiques.

Dans le cours du texte, différentes abréviations ont été utilisées :

IPM : Institut de Paléontologie du Muséum national d'Histoire naturelle, Paris
MNHN: Muséum national d'Histoire naturelle, Paris
NM : Natal Museum, Pietermaritzburg
SMF : Natur-Museum Senckenberg, Francfort
AMS : The Australian Museum, Sydney.

ÉTUDE SYSTÉMATIQUE

Famille des MITRIDAE

Genre ***CHARITODORON*** Tomlin, 1932

ESPÈCE-TYPE. — *Columbella barbara* Thiele, 1925.

Les premières espèces décrites furent classées dans les Buccinidae (*Columbella agulhasensis* Thiele, 1925 : 173, pl. 18 fig. 20 ; *Columbella barbara* Thiele, 1925 : 173, pl. 18 fig. 22). TOMLIN (1932) redécrit ces espèces (dans l'ignorance du travail de THIELE, 1925), en ajoute une troisième (*Charitodoron thalia*) et crée le genre *Charitodoron* qu'il classe dans les Buccinidae. TOMLIN (1943) décrit une quatrième espèce (*Charitodoron pasithea*) et BARNARD (1959) une cinquième qu'il place dans les Mitridae [*Mitra (Dibaphus) bathybius*] à la suite de l'examen de la radula. BARNARD (1960) examine la radula de *Charitodoron thalia* qui s'avère identique à celle de l'espèce *bathybius*. Il conclut au classement de *Charitodoron* dans les Mitridae et propose des rectifications de nomenclature. Enfin, CERNOHORSKY (1970, 1976) réexamine les différentes espèces de *Charitodoron*.

Le genre *Charitodoron* ne comprend finalement que trois espèces actuelles récoltées par dragages entre 150 m et 1 300 m, le long des côtes de l'Afrique du Sud (de Cape Point à East London) :

Charitodoron barbara (Thiele, 1925) (= *euphrosyne* Tomlin, 1932)
Charitodoron agulhasensis (Thiele, 1925) (= *aglaia* Tomlin, 1932)
Charitodoron thalia Tomlin, 1932 (= *pasithea* Tomlin, 1943 ; *bathybius* Barnard, 1959).

Outre sa columelle sans pli, *Charitodoron* se

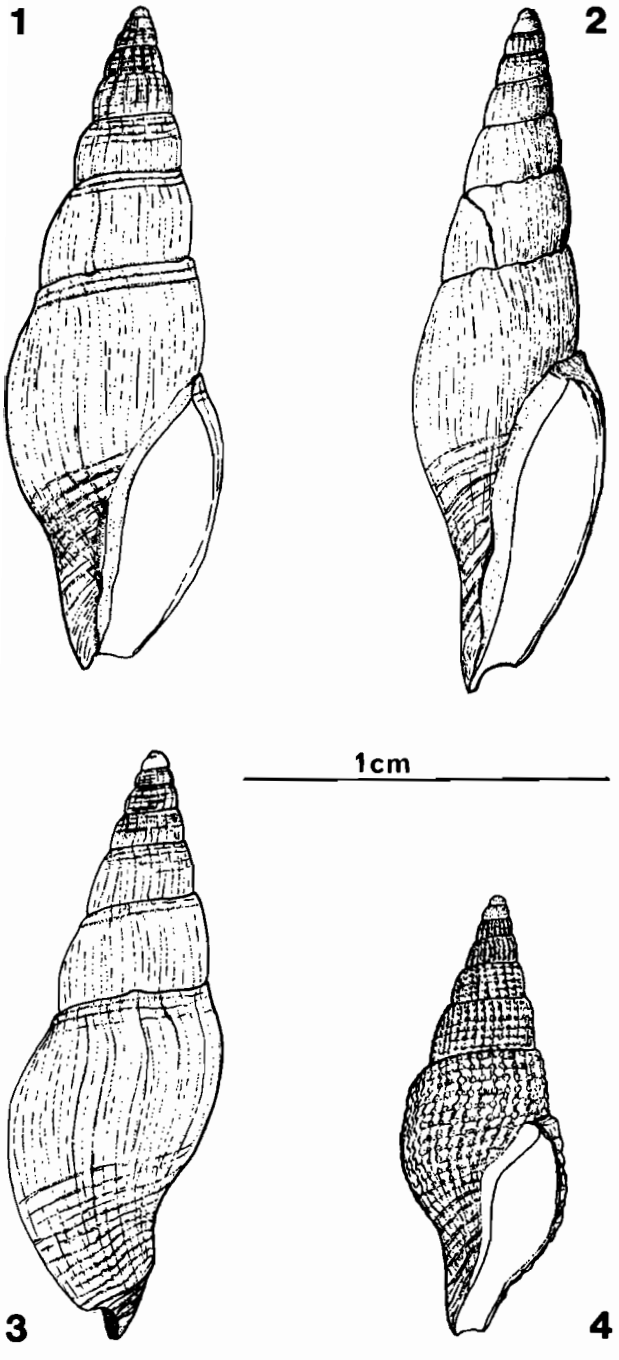


FIG. 1-4. — *Charitodoron* de l'Oligocène supérieur. **1-3**, *Charitodoron tauzini* (**1**, holotype, St-Étienne-d'Orthe, IPM R3074. — **2**, Peyrehorade, MNHN-Malacologie. — **3**, paratype, St-Étienne-d'Orthe, IPM R53075). — **4**, *Charitodoron cancellatus*, MNHN-Malacologie, St-Étienne-d'Orthe (Oligocène supérieur).

caractérise par une protoconque assez grosse et courte (indiquant un développement non-planctotrophe) et un labre fin non épaissi.

Charitodoron tauzini sp. nov.

Fig. 1-3, 7, 18, 33-34, 38

LOCALITÉ TYPE. — St-Étienne-d'Orthe, bassin d'Aquitaine (France).

ÉTAGE TYPE. — Oligocène supérieur, marnes à *Miogypsinoides*.

MATÉRIEL TYPE. — Holotype : IPM R53074 (coll. TOURNOUËR). Paratypes : St-Étienne-d'Orthe (IPM R53075 à 53082, 8 ex., coll. TOURNOUËR ; Muséum de Bordeaux, 2 ex., coll. DEGRANGE-TOUZIN) ; St-Étienne-d'Orthe : ruisseau de l'Église (10 ex.), Troun (4 ex.) (MNHN-Malacologie, coll. LOZOUET).

AUTRE MATÉRIEL. — Peyrehorade : Peyrère (2 ex., MNHN-Malacologie, coll. LOZOUET).

DESCRIPTION. — Coquille de petite taille, fusiforme, élancée, composée de six tours trois-quarts de téléoconque convexe à suture marquée. L'apex est mammillé peu saillant ; il se termine par de fines stries longitudinales auxquelles succèdent assez insensiblement les premières costules axiales. Entre ces dernières se développent rapidement des cordons spiraux. L'ornementation est ainsi constituée sur les trois premiers tours post-larvaires, de côtes axiales au nombre de 19-20 et de cordons spiraux (6-7), plus larges que leur intervalle, dont l'intersection forme de petits tubercules. Cette ornementation des premiers tours de téléoconque tend par la suite à devenir obsolète. Sur les derniers tours de la coquille ne subsistent que deux ou trois sillons spiraux bordant la suture et des fortes stries d'accroissement. Sur le dernier tour qui occupe un peu moins des 2/3 de la hauteur totale se développent en outre, sur sa base, de forts filets spiraux décussés par les stries d'accroissement. L'ouverture allongée est plus grande que la spire, le canal siphonal est légèrement recourbé et possède une fasciole basale ; la columelle est lisse avec un fin inductura. Le labre fin, lisse intérieurement, se termine par une échancrure siphonale

parfaitement distincte et son canal anal est bien marqué.

Protoconque : globuleuse, d'un tour et demi convexe, lisse. Le passage à la téléoconque n'est pas nettement matérialisé.

Dimensions (holotype) : hauteur 18,3 mm ; diamètre 5,8 mm.

DISCUSSION GÉNÉRIQUE ET SPÉCIFIQUE. — *Charitodoron tauzini* sp. nov. se distingue de *Parvisipho cancellatus* Saubade, 1969 (Fig. 4, 19, 31-32) des mêmes dépôts, par sa faible sculpture, obsolète sur les derniers tours, et sa protoconque moins acuminée.

L'examen des figures de *C. tauzini* (Fig. 1-3) montre deux formes de galbe différent. La forme de Peyrère est plus allongée et les derniers tours de la coquille ne présentent pas de sillons en bordure de la suture. Une variabilité comparable existe chez les *Charitodoron* actuels notamment avec les espèces *Charitodoron agulhasensis* et *C. aglaia* que CERNOHORSKY (1976) considère comme des synonymes.

L'espèce *tauzini* sp. nov. est morphologiquement très comparable à *Charitodoron barbara* et *C. agulhasensis* des côtes d'Afrique du Sud. L'espèce oligocène est toutefois de taille moindre et son canal anal est net. D'autre part, le canal siphonal est plus recourbé chez *tauzini*, peut-être plus proche de celui des espèces du genre *Metula* (Buccinidae) que des Mitridae (généralement court et subdroit). Il est à souligner que *Parvisipho cancellatus* qui semble indissociable génériquement de *C. tauzini*, présente une sculpture proche de celle des *Metula*. Toutefois, les espèces de *Metula* H. & A. Adams, 1853 (espèce-type : *Buccinum clathratum* Adams & Reeve, 1850) semblent avoir, toutes, un péristome épaissi pouvant former une varice et souvent le bord interne est finement denticulé. Je note aussi que, chez *Metula*, le canal siphonal (Fig. 10) ne présente pas de fasciole, or les espèces *tauzini* et *cancellatus* en possèdent une très nette. *Charitodoron barbara* et *agulhasensis* ont aussi un canal muni d'une fasciole (Fig. 9), celle-ci est cependant moins prononcée que chez *C. tauzini*.

Le genre *Parvisipho* Cossmann, 1889 (espèce-type : *Fusus terebralis* Lamarck, 1804 ; Éocène moyen, Lutétien du bassin de Paris), dans lequel SAUBADE (1969) a rangé l'espèce *cancellatus*, est aussi un Buccinidae (au sens de PONDER et WAREN, 1988). Chez l'espèce-type (Fig. 41-42), le labre est bordé extérieurement, finement denticulé intérieurement et le canal siphonal court est dépourvu de fasciole (le concept de *Parvisipho* de LE RENARD, 1989, n'est pas adopté car ce dernier en exclut l'espèce *terebralis*).

JANSSEN (1979) a rangé aussi dans le genre *Parvisipho* une espèce assez proche de *C. tauzini* et *cancellatus* (*Fusus scrobiculatus* Boll, 1851 ; Oligocène supérieur d'Allemagne). *Fusus scrobiculatus* possède une spire plus élevée, séparée par des tours canaliculés et une sculpture à base de forts cordons spiraux, très différente de celle de *C. tauzini*. Son canal siphonal, plus étroit, nettement individualisé du reste du dernier tour (d'après l'unique individu observé, SMF 250349/1), se distingue nettement de celui de *C. tauzini* (voir Fig. 6). Il ressemble un peu à celui du Turridae *Pusionella* (genre endémique à la province ouest-africaine). Ce dernier genre compte des espèces morphologiquement assez proches de *C. tauzini*, mais avec un canal siphonal plus étroit et allongé.

Dans cette discussion, trois familles de Neogastropoda ont été évoquées (Buccinidae, Mitridae et Turridae) avec respectivement les genres *Metula/Parvisipho, Charitodoron* et *Pusionella*. Le classement des espèces *tauzini* et *cancellatus* dans le genre *Charitodoron*, Mitridae atypique, paraît le mieux convenir. La principale divergence réside dans la forme du canal siphonal. Des différences toutefois aussi nettes ont été notées avec le canal de *Metula, Parvisipho* et *Pusionella*.

REMARQUES. — Dans les collections du Muséum de Bordeaux (coll. DEGRANGE-TOUZIN) mais aussi dans celle de la Faculté de Bordeaux-Talence (coll. REYT), *C. tauzini* est identifié sous le nom de *Linderia aturensis* Peyrot. À ma connaissance le genre *Linderia* et l'espèce *aturensis* sont des noms manuscrits.

ÉTYMOLOGIE. — Dédiée à l'Abbé TAUZIN, premier récolteur à St-Étienne-d'Orthe probablement autour de 1860-1870.

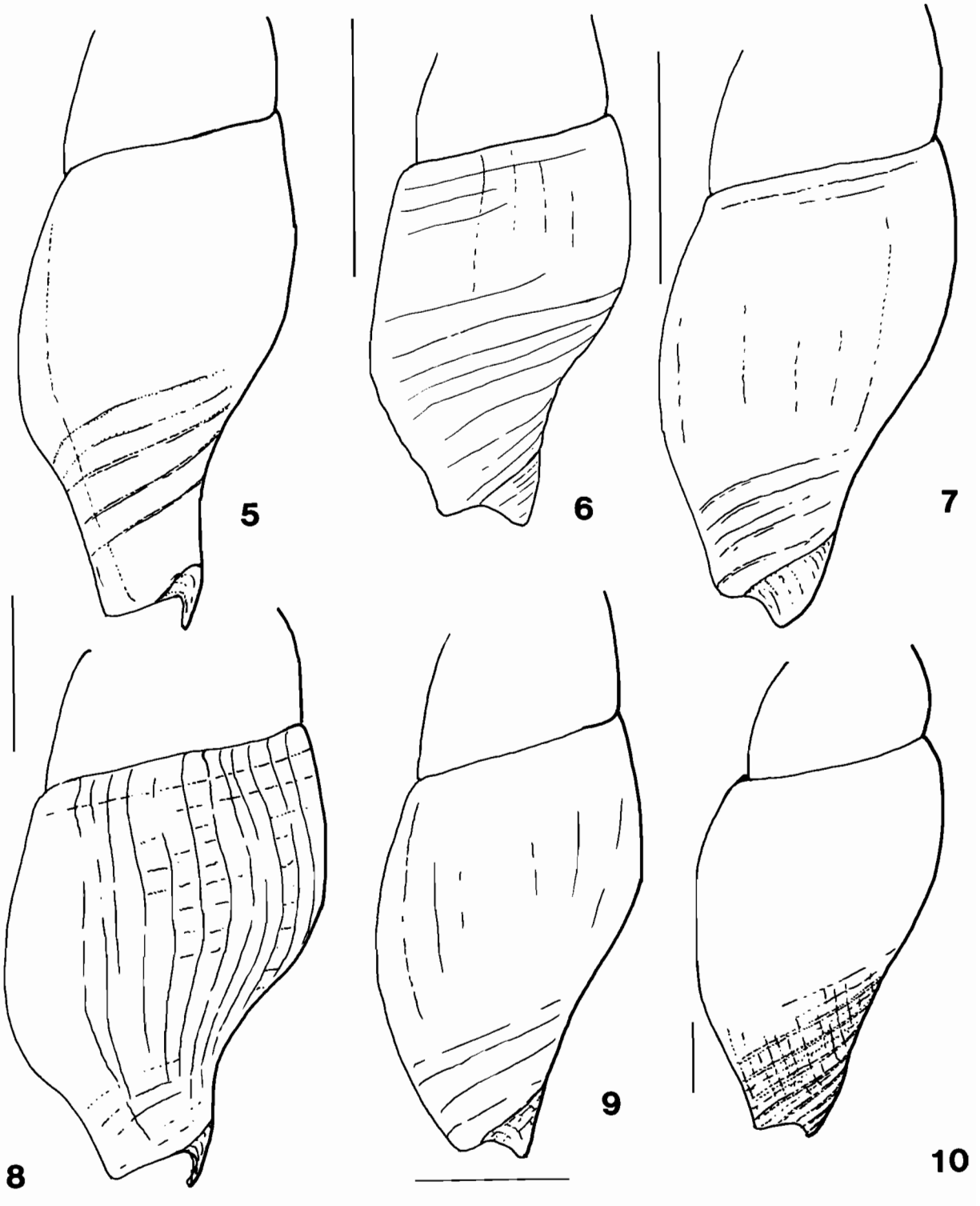


FIG. 5-10. — Canal siphonal : **5**, *Pusionella aculeiformis* (Lamarck, 1822), Côte d'Ivoire, Région d'Abidjan, dragages (MNHN, coll. Marche-Marchad). — **6**, *Fusus scrobiculatus*, Oligocène supérieur (SMF 250349/1, coll. Görges). — **7**, *Charitodoron tauzini*, holotype, Oligocène supérieur (IPM R53074, coll. Tournouër). — **8**, *Pusionella milleti* (Petit, 1851), Gambie, S. Cape Bald (MNHN). — **9**, *Charitodoron agulhasensis*, Afrique du Sud, Cape St Blaize, estomac de *Congiopodes* (NM A4054). — **10**, *Metula africana* Bouchet, 1988, Sénégal, St Louis, 300-600 m, (MNHN, leg. M. Pin). Échelle = 10 mm.

Genre *EUMITRA* Tate, 1889

ESPÈCE-TYPE. — *Mitra alokiza* Tenison-Woods, 1880. Miocène moyen du sud-est de l'Australie.

Eumitra se caractérise essentiellement (CERNOHORSKY, 1970) par la faiblesse de ses plis columellaires. Un seul pli est généralement bien développé. C'est sur la base de ce caractère que FINLAY (1926) a créé le genre *Diplomitra* pour des espèces du Miocène inférieur de Nouvelle-Zélande. Tel que le comprend CERNOHORSKY, le genre *Eumitra* englobe *Diplomitra*. Cependant, *Mitra alokiza* sensu TATE (1889) possède 5 plis columellaires décroissants. CERNOHORSKY (1970) précise que ceux qu'il a observé ont un pli proéminent et l'indice d'un second, mais il admet la présence d'individus pouvant en posséder davantage.

La coquille des *Eumitra* présente une faible sculpture spirale, toutefois les premiers tours peuvent présenter des côtes axiales notamment chez *Eumitra dictua* (Tenison-Woods, 1880) du Miocène australien.

Le genre *Eumitra* semblait limité au Néogène australo-zélandais (Miocène inférieur à Pliocène inférieur) où il ne compte qu'un petit nombre d'espèces. Toutefois, P. MAXWELL (comm. pers.) me signale la similitude entre *Eumitra alokiza* et le Mitridae du Miocène moyen de la Paratéthys rapporté à *Cancilla scrobiculata* (Brocchi, 1814) (espèce décrite du Pliocène d'Italie, ROSSI RONCHETTI, 1955, fig. 131). J'ai examiné du groupe de *Cancilla scrobiculata* : une quarantaine d'exemplaires du Miocène moyen du bassin de Vienne (Baden), cinq exemplaires du Miocène de Saubrigues (France, Landes) et différents lots du Pliocène d'Italie. Effectivement, quelques échantillons rappellent *E. alokiza*. Il existe une variabilité importante de la sculpture, de la force et du nombre des plis columellaires mais ceux-ci restent cependant compris entre 3 et 5 (Pour CERNOHORSKY, 1970, *Cancilla* présente de 3 à 6 plis columellaires). *Cancilla scrobiculata* sensu HÖRNES (1851 : Pl. 10, fig. 14-18) ne peut donc pas être rapportée au genre *Eumitra*. Cette espèce suscite cependant, en raison de sa ressemblance avec *Eumitra alokiza*, des interrogations quant à l'origine d'*Eumitra* et des relations éventuelles *Cancilla*/*Eumitra*. Notons que le groupe des *Cancilla* (s. s.) Swainson, 1840 (espèce-type : *isabella* Swainson, 1831 ; de l'Indo-Ouest-Pacifique), tel que le comprend CERNOHORSKY (1970), apparaît fondé uniquement sur les caractères de la coquille. Aucune radula du groupe ne semble avoir été examinée.

Eumitra caledonica sp. nov.

Fig. 11, 43-46

MATÉRIEL TYPE. — **Nouvelle-Calédonie** (sud de l'île des Pins). BIOCAL : Holotype (MNHN), stn 61, 24°11,67′ S-167°31,37′ E, 1 070 m, coquille vide. Paratypes, 3 exemplaires (MNHN) : 1 ex. de la même station que l'holotype (stn 61) ; stn 70, 23°24,70′ S-167°53,65′ E, 965 m, 1 ex. ; stn 62, 24°19′ S-167°49′ E, 1395-1410 m, 1 ex. Matériel récolté par P. BOUCHET, B. MÉTIVIER et B. RICHER DE FORGES à bord du N. O. " *Jean Charcot* ".

DESCRIPTION. — Coquille de taille moyenne, fusiforme, élancée. La téléoconque se compose de 5 tours 1/4 convexes séparés par une suture bien marquée. Apex peu distinct de la téléoconque. La sculpture se limite à de nombreuses mais faibles stries axiales, entrecoupées de stries spirales obsolètes. Toutefois, il existe, sur le premier tour et demi de la téléoconque, une sculpture de côtes axiales, légèrement renflées en bordure de la suture et formant un petit tubercule. Ouverture ovoïde ; avec un labre fin, lisse intérieurement, de direction légèrement opisthocline. Le bord pariétal et columellaire est recouvert par un mince inductura. La columelle présente en sa partie médiane deux faibles plis transverses de même force. Le canal siphonal est court, subdroit et assez largement ouvert.

Coloration uniformément blanchâtre.

Protoconque : d'environ 2 tours 1/2 convexes et nucléus assez petit. Le passage à la téléoconque est peu distinct.

Dimensions (holotype) : hauteur 35 mm ; diamètre 10,3 mm.

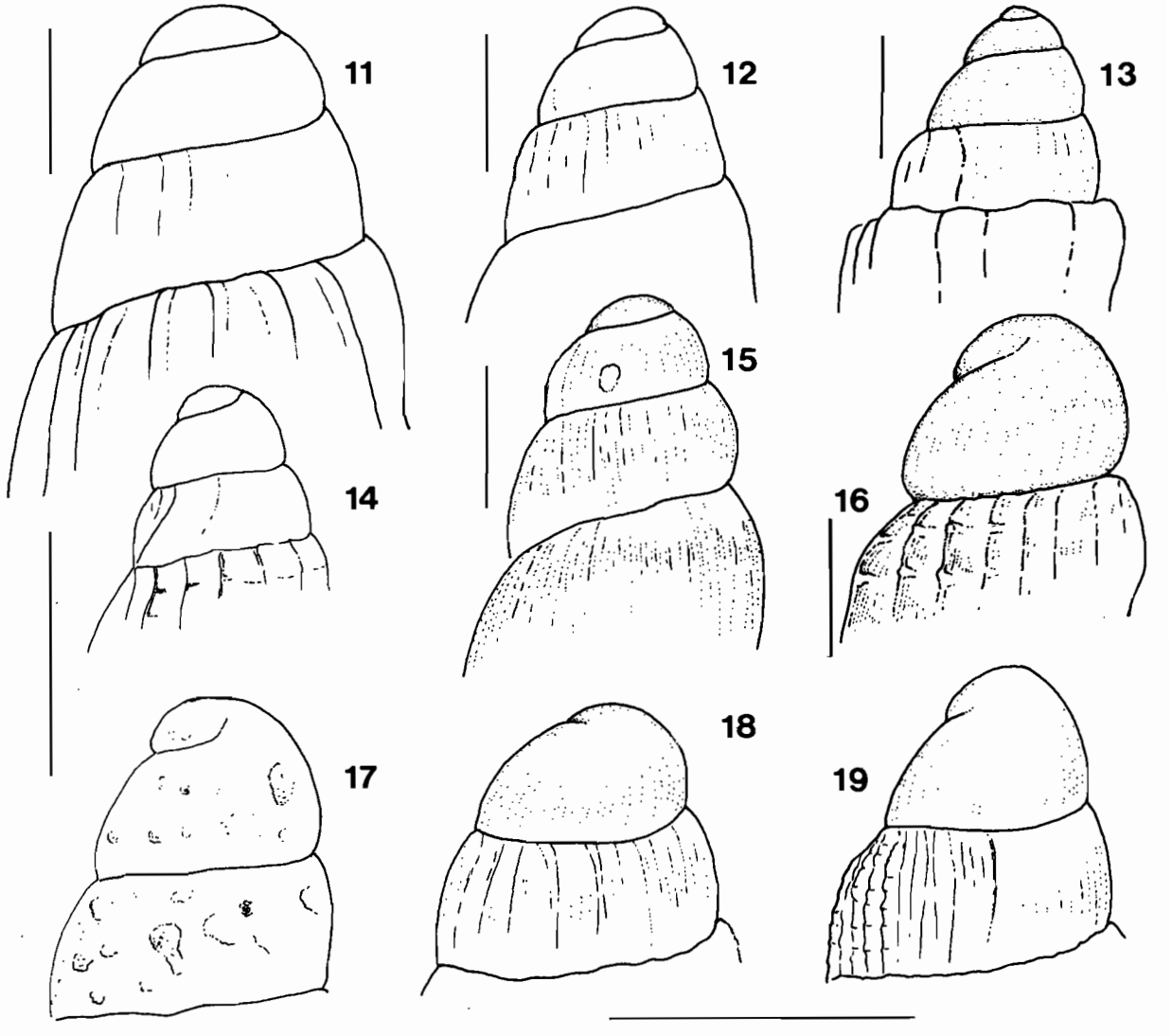


FIG. 11-19. — Protoconques : **11**, *Eumitra caledonica*, holotype, Nouvelle-Calédonie, BIOCAL, stn 61. — **12**, *Eumitra apheles* holotype, Nouvelle-Calédonie, MUSORSTOM 4, stn 159. — **13**, *Eumitra imbricata*, holotype, mer du Corail, Lansdowne-Fairway, CORAIL 2, stn 14. — **14**, *Pusionella aculeiformis*, Côte d'Ivoire, région d'Abidjan. — **15**, *Eumitra apheles*, paratype, Nouvelle-Calédonie, MUSORSTOM 4, stn 159. — **16**, *Charitodoron agulhasensis*, Afrique du Sud, Cape St Blaize (NM A4054). — **17**, *Fusus scrobiculatus*, Oligocène supérieur (SMF 250349/1). — **18**, *Charitodoron tauzini*, holotype, Oligocène supérieur (IPM R53074). — **19**, *Charitodoron cancellatus*, Oligocène supérieur, bassin d'Aquitaine, St-Etienne-d'Orthe. Échelle = 1 mm.

Eumitra apheles sp. nov.

Fig. 12, 15, 20, 47-50

MATÉRIEL TYPE. — Nord de la **Nouvelle-Calédonie** (Grand Passage), MUSORSTOM 4 : Holotype (MNHN), stn 159, 18°45,90′ S-163°15,60′ E, 600 m. Paratypes, 11 exemplaires (MNHN, NMNZ, AMS) : 2 ex. de la même station que l'holotype ; stn 161, 18°38,80′ S-163°10,60′ E, 565 m, 2 ex. ; stn 168, 18°48,20′ S-163°10,80′ E, 720 m, 7 ex. Matériel récolté par P. BOUCHET et B. RICHER DE FORGES à bord du N. O. " *Vauban* ".

DESCRIPTION. — Coquille de petite taille, fusiforme, élancée, composée de 4 tours 1/2 convexes

à suture bien marquée. La sculpture se compose de nombreuses mais faibles stries axiales extrêmement fines, recoupées par quelques stries spirales. Sur la base de la coquille, au niveau du canal siphonal, on distingue 4-5 cordons spiraux très obsolètes. Ouverture ovoïde ; labre de direction presque orthocline, très légèrement épaissi, lisse intérieurement. Columelle recouverte par un inductura excessivement fin ; elle porte, en sa partie médiane, deux faibles plis inégaux ; le premier (adapical) plus fort semble perpendiculaire à l'axe de la columelle, le second (abapical) obsolète apparaît plus parallèle. Le canal siphonal est court, presque droit, assez largement ouvert.

La coquille présente une coloration blanchâtre.

Protoconque : d'environ 2 tours convexes, à nucléus assez petit ; peu distincte de la téléoconque.

Dimensions : (holotype) : hauteur 15,6 mm ; diamètre 5,6 mm.

Radula : Rachiglosse de type Mitridae. Dent centrale petite, avec 5-6 cuspides réparties symétriquement de part et d'autre d'une cuspide centrale. Dents latérales grandes, allongées, munies de 9-10 cuspides beaucoup plus fortes que celles de la dent centrale.

DISCUSSION. — *Eumitra apheles* se sépare d'*E. caledonica* par sa protoconque et sa taille plus petite. *Eumitra apheles* est aussi totalement dépourvue de côte axiale alors qu'il existe chez *E. caledonica* une sculpture de côtes axiales faibles, mais nette sur le premier tour et demi.

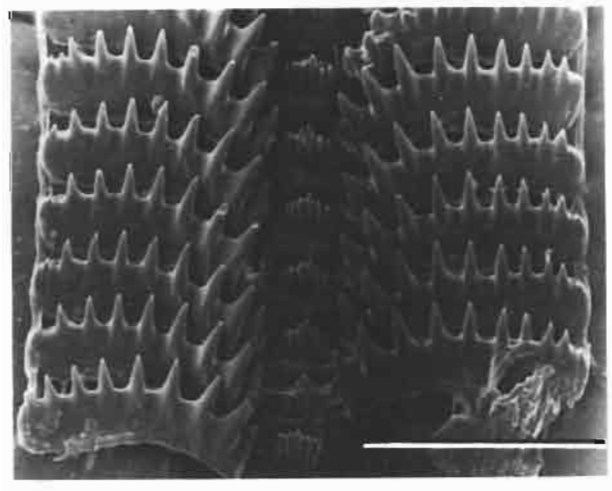


FIG. 20. — Radula d'*Eumitra apheles*, MUSORSTOM 4, stn 168, 720 m. Échelle = 100 µm.

Les *Eumitra* fossiles décrites soit par MARSHALL (1918), POWELL et BARTRUM (1929) pour la Nouvelle-Zélande, soit par TENISON-WOODS (1880), TATE (1889) pour l'Australie, apparaissent très distinctes. Les espèces les plus proches (*E. uniplica* Tate, 1889, du Miocène moyen d'Australie ; *Eumitra waitemataensis* Powell & Bartrum, 1929, du Miocène inférieur, Otaian) possèdent une suture beaucoup plus canaliculée et une téléoconque à tours moins convexes.

ÉTYMOLOGIE. — Lisse, non raboteuse (du grec : ἀφελής).

Eumitra imbricata sp. nov.

Fig. 13, 21, 56-58

MATÉRIEL TYPE. — **Mer du Corail,** Lansdowne-Fairway, CORAIL 2. Holotype unique (MNHN). — Stn 14, 21°00,69′ S-160°57,18′ E, 650-660 m.

DESCRIPTION. — Coquille de taille moyenne, fusiforme, élancée, composée de 4 tours 3/4. Les deux premiers tours de téléoconque, peu convexes, sont séparés par une suture fortement canaliculée, leur donnant un aspect imbriqué. Les tours suivants présentent un profil assez régulièrement convexe et la suture est moins marquée. Le singularisme des deux premiers tours est encore renforcé par une sculpture vigoureuse, composée de 14-15 côtes axiales assez fortes, moins larges que leur intervalle. Cette sculpture disparaît après le deuxième tour et on ne distingue que des stries d'accroissement, plus ou moins marquées, et des filets spiraux très obsolètes. Sur la base de la coquille, au niveau du canal siphonal, on observe une dizaine de faibles cordons spiraux. L'ouverture est ovoïde. Le labre, d'après les stries d'accroissement, devait être de direction orthocline. La columelle est recouverte par un faible inductura. Elle porte, en sa partie médiane, deux forts plis inégaux. Le premier (adapical) est plus marqué et semble plus nettement perpendiculaire à l'axe de la columelle. Le canal siphonal est court, presque droit, assez largement ouvert.

La coquille présente une coloration blanchâtre.

Protoconque : bien individualisée de la téléoconque, de 2 tours 1/2 à nucléus assez petit.

Dimensions : (holotype) : hauteur 15,6 mm ; diamètre 5,2 mm.

DISCUSSION. — *Eumitra imbricata* sp. nov. se distingue immédiatement d'*E. apheles* et *E. caledonica* par la vigueur de l'ornementation des premiers tours, sa suture fortement canaliculée, l'aspect imbriqué des tours et la force des deux plis columellaires.

La forme générale d'*E. imbricata* rappelle *Eumitra waitemataensis* (Powell & Bartrum, 1929) du Miocène inférieur de Nouvelle-Zélande dont elle se sépare par la sculpture de ses premiers tours.

ÉTYMOLOGIE. — Du latin *imbricata*, allusion à l'étagement des tours.

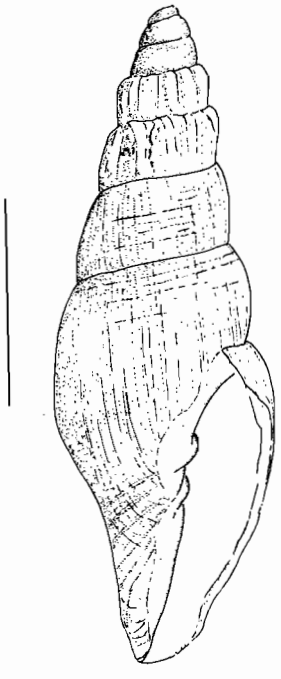


FIG. 21. — *Eumitra imbricata*, Holotype. Échelle = 5 mm.

Eumitra richeri sp. nov.

Fig. 51-55

MATÉRIEL TYPE. — **Mer du Corail,** SW de Mellish Reef, CORAIL 2. Holotype (AMS), stn 172, 18° 25,55′ S-155°12,82′ E, 1 100 m. Paratypes (MNHN) : 2 ex. de la même station que l'holotype.

DESCRIPTION. — Coquille de taille moyenne, fusiforme, élancée, composée d'un peu plus de 4 tours 3/4 de téléoconque séparés par une suture bien marquée. La sculpture se compose d'une dizaine de côtes axiales, restreintes aux deux premiers tours de téléoconque, et d'assez nombreux cordons spiraux limités au dernier tour. Il existe aussi de nombreuses stries d'accroissement. L'ouverture est ovoïde avec un labre presque orthocline. Le bord pariétal et columellaire est recouvert par un faible inductura. La columelle présente, en sa partie médiane, deux plis columellaires inégaux, le premier (adapical) est plus fort. Le canal siphonal est court, subdroit, assez largement ouvert.

Coquille blanchâtre.

Protoconque : de 2 tours 1/4, bien individualisée de la téléoconque.

Dimensions : (holotype) : hauteur 22,5 mm ; diamètre 7,7 mm.

REMARQUES. — Les deux paratypes ont des plis columellaires plus faibles, en particulier l'exemplaire de la figure 51.

DISCUSSION. — La présence de cordons spiraux bien marqués sépare cette espèce des autres *Eumitra* calédoniennes et en particulier d'*Eumitra apheles*. *Eumitra caledonica* qui présente une sculpture proche sur le premier tour est de taille supérieure et sa protoconque est plus grosse.

ÉTYMOLOGIE. — Dédiée à Bertrand RICHER DE FORGES.

Analyse biométrique des *Eumitra*

Afin de compléter les observations précédentes, 6 mesures et 3 rapports ont été effectués puis traités par une analyse factorielle des correspondances. Ces neuf variables sont (Fig. 22) :

1 — Hauteur de la coquille = HAU
2 — Diamètre maximum = DMA
3 — Hauteur de la spire = HSP
4 — Largeur de la spire = LGS

5 — Hauteur de l'ouverture = HTO
6 — Largeur de l'ouverture = LGO
7 — Rapport HAU/DMA = HDM
8 — Rapport HSP/LGS = HSL
9 — Rapport HTO/LGO = HOL

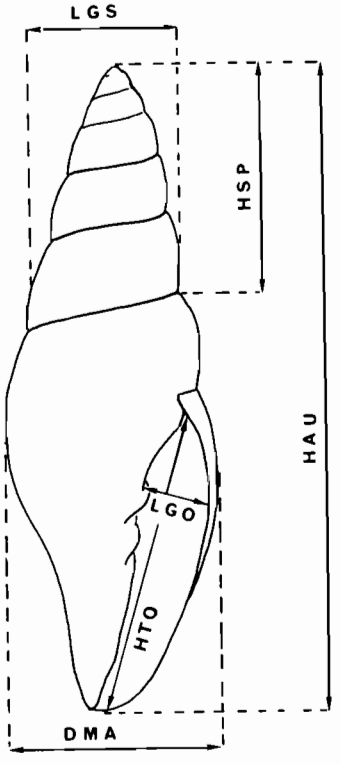


FIG. 22. — Mesures utilisées chez *Eumitra*.

Il convient de souligner l'hétérogénéité et la faiblesse de l'échantillonnage (20 spécimens dont 17 ont pu être mesurés). Ainsi, la population la moins médiocre (*Eumitra apheles*) comprend des individus très jeunes (HAU = 9,4 mm) à labre non formé et d'autres, comme l'exemplaire de la figure 50 (HAU = 16,9 mm), qui présentent différentes traces d'accidents de croissance.

L'axe 1 explique a lui seul 91 % de l'inertie totale contre 2,2 % pour l'axe 2 et est relativement monopolaire. L'inertie du nuage des variables est due aux fortes contributions des rapports (HOL, HDM). Il oppose ces dernières aux hauteurs de la coquille et de la spire (HAU, HSP). Ce qui se traduit par une opposition entre les grands individus d'*Eumitra caledonica* (C3, C1) et les jeunes individus d'*E. apheles* (A10, A9, A8, A3). Il apparaît sur le graphe factoriel (Fig. 23) que les quatre espèces ne se chevauchent pas. Cependant si la discrimination est nette entre *E. caledonica* et *E. apheles*, elle l'est beaucoup moins entre *E. apheles*/*E. imbricata* d'une part, et *E. caledonica*/*E. richeri* d'autre part.

Remarques sur les *Eumitra* néo-calédoniennes

Les caractéristiques sculpturales, bien que ténues, ont conduit à distinguer quatre espèces. L'absence (*Eumitra apheles*) ou la présence de côtes axiales sur les premiers tours (*E. caledonica, E. richeri, E. imbricata*) ont été considérées

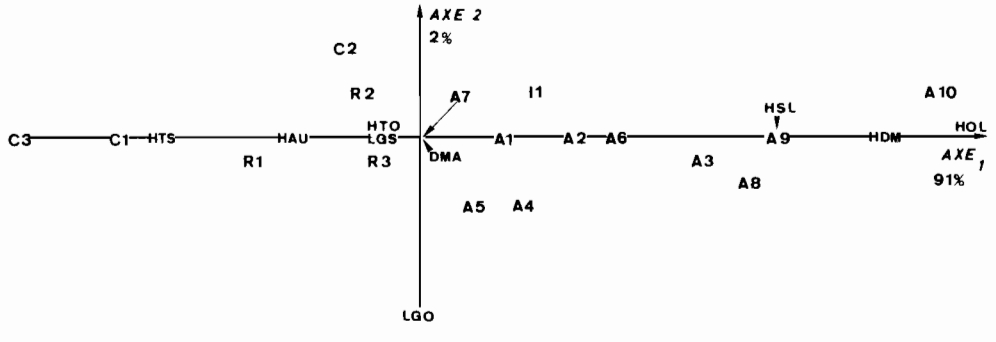


FIG. 23. — Analyse factorielle des correspondances des *Eumitra*. Projection des variables sur le plan factoriel 1-2. A = *E. apheles*, C = *E. caledonica*, I = *E. imbricata*, R = *E. richeri*.

comme significatives. Les côtes axiales sont fortes chez *Eumitra imbricata*, plus faibles chez *E. caledonica* et *E. richeri*. Chez cette dernière espèce, le dernier tour présente une sculpture spirale beaucoup mieux marquée. L'analyse biométrique n'infirme pas la séparation des *Eumitra* de la région calédonienne en quatre espèces. Elle conduit cependant à un rapprochement *E. caledonica/E. richeri* d'une part, *E. apheles/E. imbricata* d'autre part et montre une discrimination en fonction de la taille. La présence ou l'absence de sculpture sur les premiers tours indique clairement que cette discrimination ne peut être imputée à un phénomène de modification de forme en fonction de la croissance. On ne peut considérer, par exemple, qu'*Eumitra apheles* regroupe des jeunes *E. caledonica*.

Tout ceci suggère que nous nous trouvons en présence de quatre unités proches, mais génétiquement séparées. Il convient de rappeler que :
— les protoconques des quatre *Eumitra* indiquent un développement larvaire sans phase pélagique limitant donc les possibilités d'échanges entre les populations ;
— elles ont été draguées dans des fonds de 500 à 1 000 m en position d'isolement géographique (Fig. 24).

Bien qu'il existe une continuité bathymétrique entre *Eumitra apheles* (nord de la Nouvelle-Calédonie) et *Eumitra caledonica* (sud de l'île des Pins), ces deux espèces sont celles chez lesquelles les différences, non ornementales, apparaissent les plus tranchées. En revanche, les espèces géographiquement les plus éloignées l'une de l'autre (*E. caledonica* et *E. richeri*) sont proches sur le diagramme factoriel (Fig. 23).

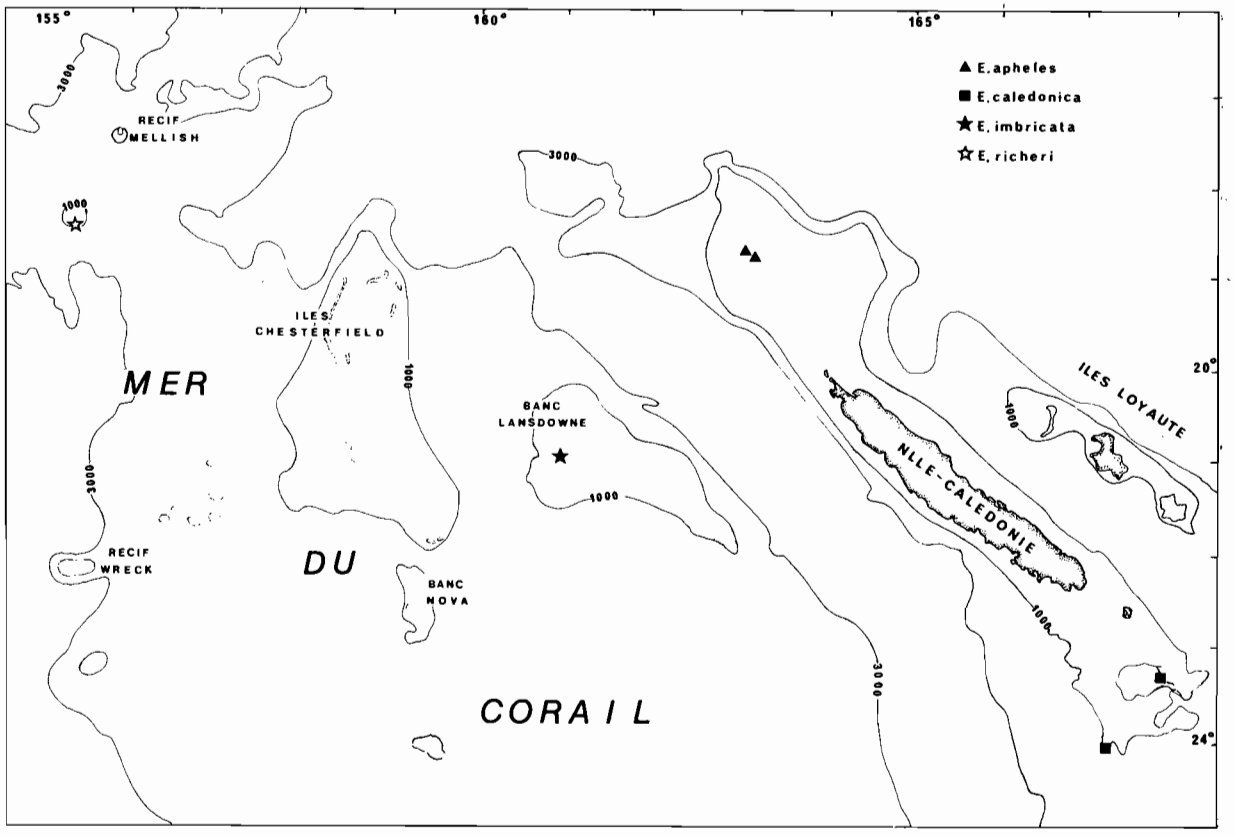


FIG. 24. — Carte de distribution des *Eumitra*.

CONCLUSION ET DISCUSSION PALÉOBIOGÉOGRAPHIQUE

L'hypothèse phylétique de CERNOHORSKY (1970) doit être réexaminée pour au moins deux raisons :

— *Eumitra* renferme au Miocène des espèces proches morphologiquement de *Mitra* (s. s.). En particulier, l'espèce-type *alokiza* présente parfois 5 plis columellaires. Les *Charitodoron* seraient, dès l'Oligocène supérieur, dépourvus de plis.

— la radula d'*Eumitra apheles* (Fig. 20) est bien de type Mitridae mais se distingue nettement de celle des autres Mitridae, y compris de celle de *Charitodoron thalia* (BARNARD, 1959, fig. 11 ; CERNOHORSKY, 1976 pl. 251), par sa dent centrale à petites cuspides.

Ces remarques suggèrent que la perte de la plication columellaire chez *Charitodoron* et sa faiblesse chez *Eumitra* ont été acquises indépendamment et ne sont pas dues à une ascendance directe.

Les *Eumitra* fossiles ont été décrites de faciès littoraux néogènes d'après les travaux de TATE (1889) pour l'Australie et POWELL et BARTRUM (1929) pour la Nouvelle-Zélande. La localisation au bathyal supérieur (500 à 1 000 m, Fig. 24) de Nouvelle-Calédonie et de la mer du Corail des quatre seules espèces actuellement connues est donc à souligner. Elle illustre une fois encore le conservatisme de cette tranche bathymétrique. La localisation bathymétrique des *Charitodoron* actuels (bathyal essentiellement ; moyenne des profondeurs relevées : 751 m) est conforme à celle des deux espèces fossiles oligocènes reconnues, ainsi que le montrent les reconstitutions paléoécologiques (LOZOUET, 1986).

La famille des Mitridae apparaît vers la fin du Crétacé et les genres *Charitodoron* et *Eumitra* ne s'individualisent vraisemblablement pas avant le Paléogène supérieur.

L'éclatement de la Tasmantis et la dérive de ses constituants sont donc trop anciens pour expliquer par un déplacement passif la répartition actuelle d'*Eumitra*. La dispersion rend mieux compte de ce phénomène. *Eumitra* a pu coloniser la région calédonienne à partir du plateau continental australien ou via la ride de Norfolk à l'exemple du modèle envisagé par BOUCHET et POPPE (1988) pour le gastéropode Volutidae *Alcithoe*. La dispersion étant favorisée au Néogène alors que l'ensemble Australie/Nouvelle-Zélande/Nouvelle-Calédonie était plus rapproché et les rides tectoniques plus prononcées. Notons qu'*Eumitra* n'est connue en Nouvelle-Zélande que dans le Miocène inférieur (Pakaurangi Point, Miocène inférieur) mais serait présent dans le sud de l'Australie jusqu'au Pliocène inférieur.

La répartition spatio-temporelle disjointe de *Charitodoron* est certainement, avant tout, un problème de lacune. Mais, on peut penser que sa distribution actuelle, restreinte, correspond à une dernière étape dans le processus expansion/réduction/disparition d'un taxon. Chez les Volutacea on connaît plusieurs exemples analogues, j'en exposerai deux :

— les Athletinae (Volutidae) ont au Paléogène une vaste répartition téthysienne et sont abondantes dans la zone infralittorale. Actuellement cette sous-famille a une distribution en « taches » et les 15 espèces vivent essentiellement dans le bathyal supérieur (moyenne des profondeurs relevées pour l'Afrique du Sud, 325 m ; l'Australie, 348 m). La principale « tache » se situe le long des côtes d'Afrique du Sud (11 espèces, LILTVED & MILLARD, 1986), une espèce vit en Tanzanie, une autre dans le sud de la Somalie (REHDER, 1981), et deux espèces sont connues du nord-est de l'Australie (DARRAGH, 1979) (voir carte Fig. 25) ;

— le genre *Loxotaphrus* (Cancellariidae ; BEU & MAXWELL, 1987) est connu de l'Oligocène au Miocène en Europe et en Inde, du Miocène sud-australien, et actuellement une seule espèce subsiste dans la province ouest-africaine : *Loxotaphrus deshayesi* (Duval, 1841). On constate d'autre part que *Loxotaphrus* possède jusqu'à l'Oligocène supérieur (observ. inédite) une protoconque de type planctotrophe facilitant donc la dispersion. La perte de la planctotrophie intervient au cours du Miocène, *L. variciferus* (Tate, 1888) d'Australie et *L. deshayesi* sont non-planctotrophes (BEU & MAXWELL, 1987).

Ces différents exemples de disjonctions d'aires de répartition évoqués chez les Volutacea ne permettent pas d'activer les grands problèmes de

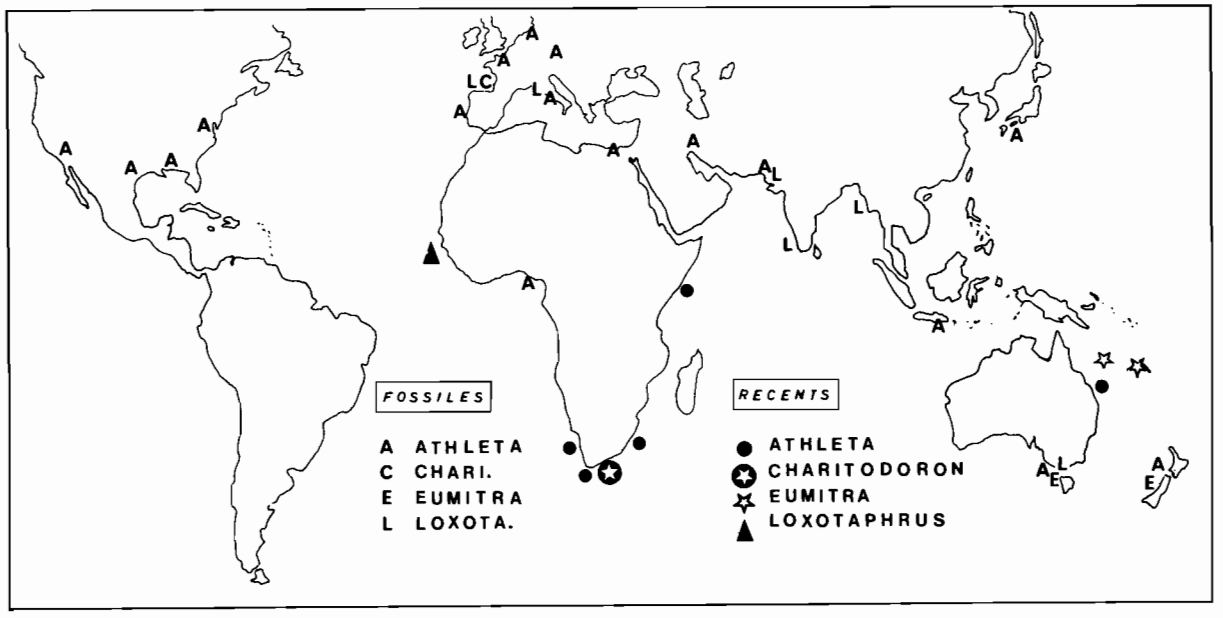


FIG. 25. — Carte montrant des disjonctions spatio-temporelles de répartition chez quelques Volutacea : Volutidae (Athletinae), distribution au Paléogène (A) et actuelle.
Mitridae (*Charitodoron*), espèces paléogènes (C) et distribution actuelle.
Mitridae (*Eumitra*), espèces fossiles miocènes (E) et distribution actuelle.
Cancellariidae (*Loxotaphrus*), distribution au Miocène (L) et actuelle.

la biogéographie mobiliste. En fait, la distribution actuelle de la majorité des organismes benthiques littoraux (voire bathyaux) et pélagiques des zones tropicales et subtropicales s'explique souvent au regard de deux événements majeurs, qui amorcent le dernier cycle de l'évolution de la biosphère marine (SPOEL, 1983 ; ROUX, 1982) :

— la crise climatique à la limite Éocène/Oligocène enregistrée par la plupart des organismes (CAVELIER, 1979), vraisemblablement liée au déplacement du continent Antarctique (? conjugé à une « catastrophe cosmique », RAUP & SEPKOSKI, 1984). La planète rentre alors dans un cycle glaciaire (CHAMLEY, 1984) ;

— l'interruption de la liaison tropicale mondiale, à la limite Oligocène/Miocène suite à la jonction des plaques arabique et africaine. Elle entraîne notamment l'individualisation de deux vastes provinces tropicales (Indo-Ouest-Pacifique et Euro-Ouest-Africaine, LOZOUET, 1986) et l'inversion du sens de la dispersion planctonique (SPOEL, 1983).

En dehors de ces événements (sans négliger l'importance d'épisodes plus récents tel l'émersion du seuil de Panama), l'interaction entre les propriétés biologiques propres à chaque espèce et les facteurs physico-chimiques, suffit à rendre compte de la distribution des organismes. C'est pourquoi la plupart des disjonctions spatio-temporelles, dans le domaine marin tropical et subtropical, ne nécessitent généralement pas une explication fondée sur une paléogéographie anté-Éocène, ainsi que le souligne BOUCHET (1987).

REMERCIEMENTS

Je remercie les différentes personnes qui m'ont communiqué le matériel sur lequel est fondé ce travail : P. BOUCHET (MNHN), R. JANSSEN (SMF), R. KILBURN (NM), C. LEVI (MNHN), J. PRUDHOMME (Muséum de Bordeaux), B. RICHER DE FORGES (ORSTOM, Nouméa). Les critiques et commentaires de P. BOUCHET, W. CERNOHORSKY (Auckland), A. CROSNIER (ORSTOM, Paris) et P. MAXWELL (Waimate, Nouvelle-Zélande) m'ont été particulièrement utiles. A. WAREN a préparé la radula d'*Eumitra*.

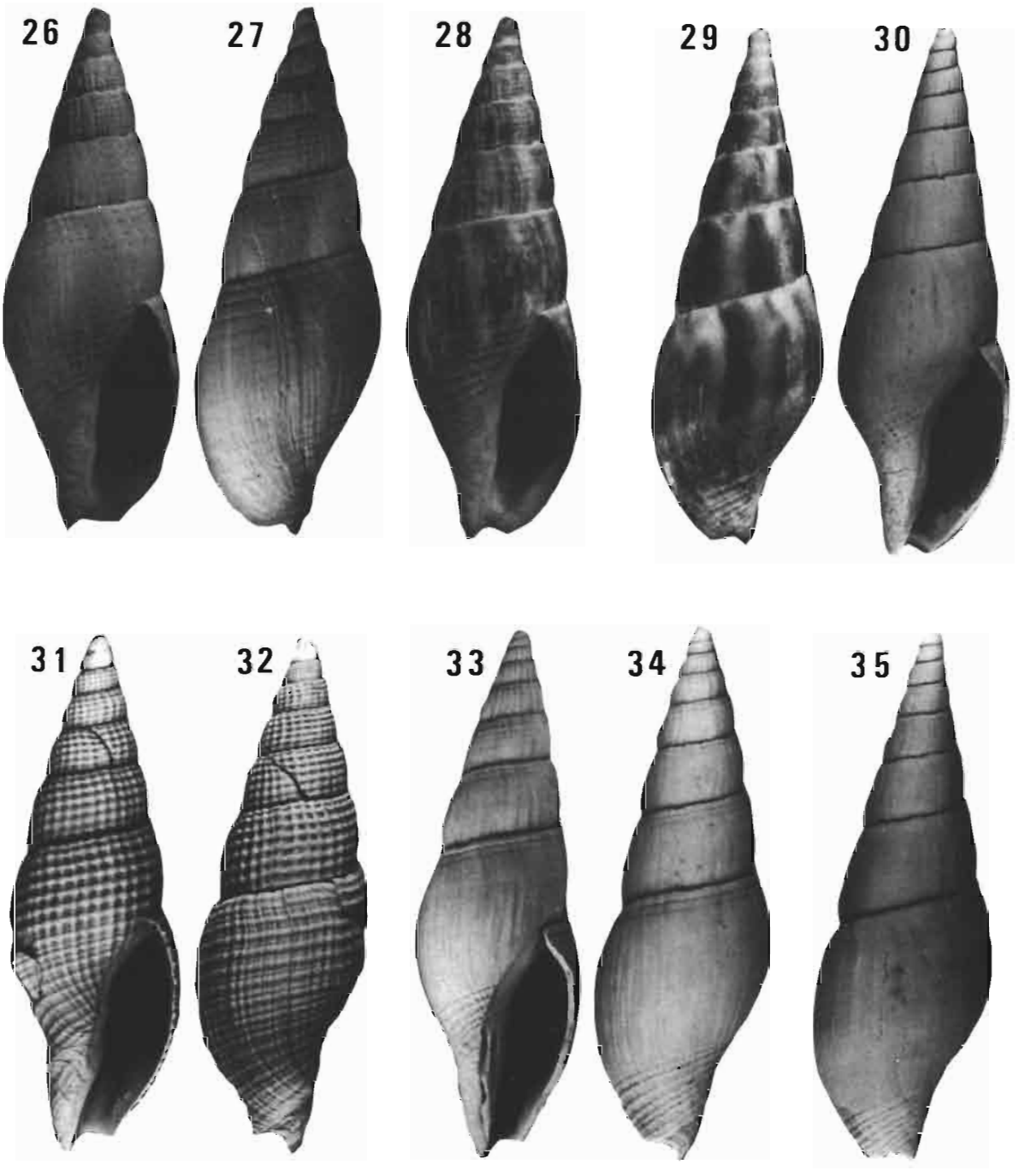


FIG. 26-35. — Genre *Charitodoron*. — **26-28**, *C. barbara*, Afrique du Sud, Agulhas Bank (NM B3109), H = 23 mm. — **29-30** et **35**, *C. agulhasensis*, Afrique du Sud, Agulhas Bank (NM A4054), H = 25 mm. — **31-32**, *C. cancellatus*, Oligocène supérieur, St-Etienne-d'Orthe (MNHN), H = 13,7 mm. — **33-34**, *C. tauzini*, Oligocène supérieur, St-Etienne-d'Orthe, holotype (IPM R53074), H = 18,3 mm. — Fig. 26-27 et 30-35 avec placage de chlorure d'ammonium.

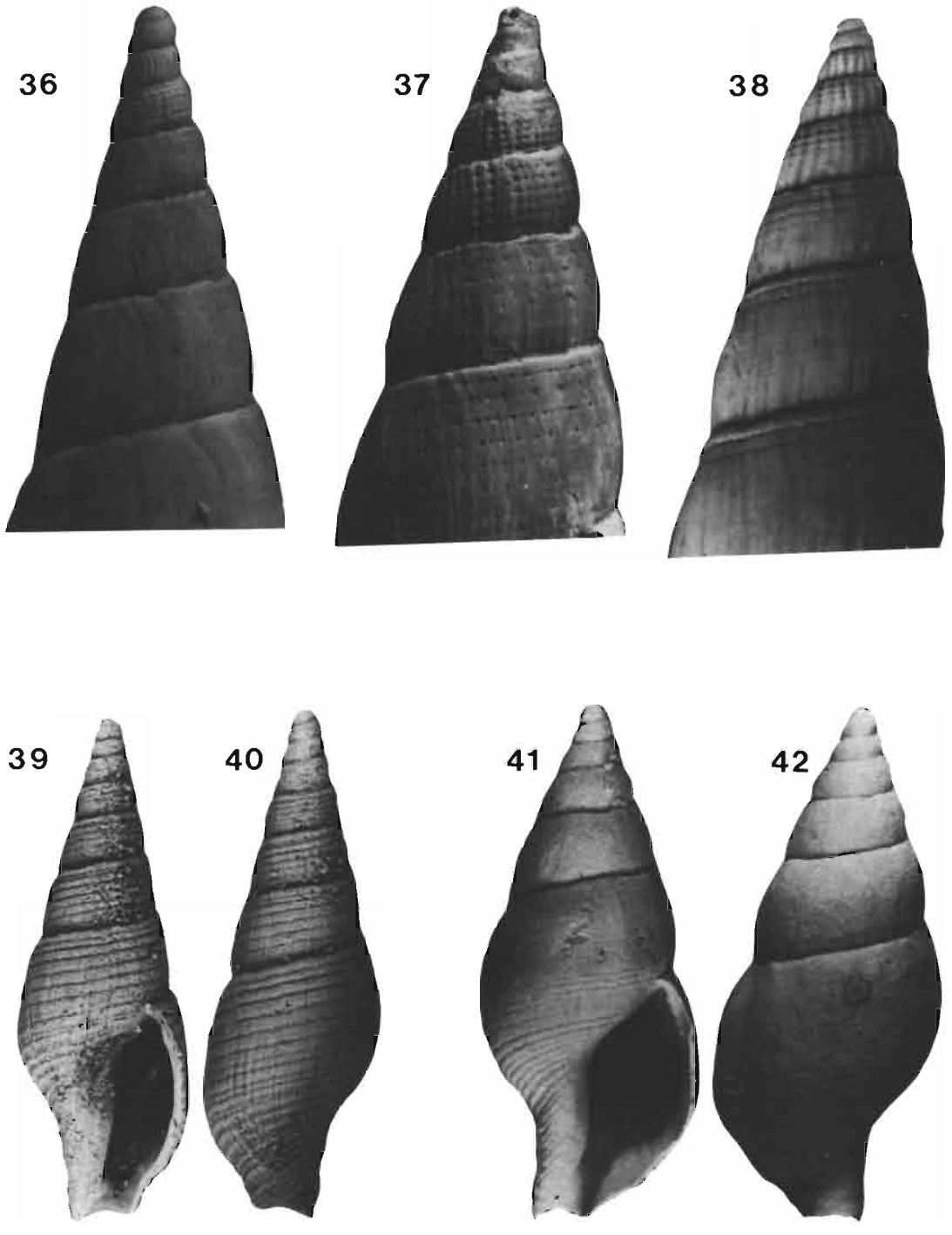


FIG. 36-42. — **36-38**, détail des premiers tours de spire de *Charitodoron* : **36**, *C. agulhasensis*, Afrique du Sud, Agulhas Bank (NM A4054). — **37**, *C. barbara*, Afrique du Sud, Agulhas Bank (NM B3109). — **38**, *C. tauzini* sp. nov., holotype. — **39-40**, *Fusus scrobiculatus*, Oligocène supérieur d'Allemagne (SMF 250349/1), H = 15 mm. — **41-42**, *Parvisipho terebralis* (espèce-type de *Parvisipho*), Eocène moyen du bassin de Paris, H = 9 mm. Toutes les figures avec placage de chlorure d'ammonium.

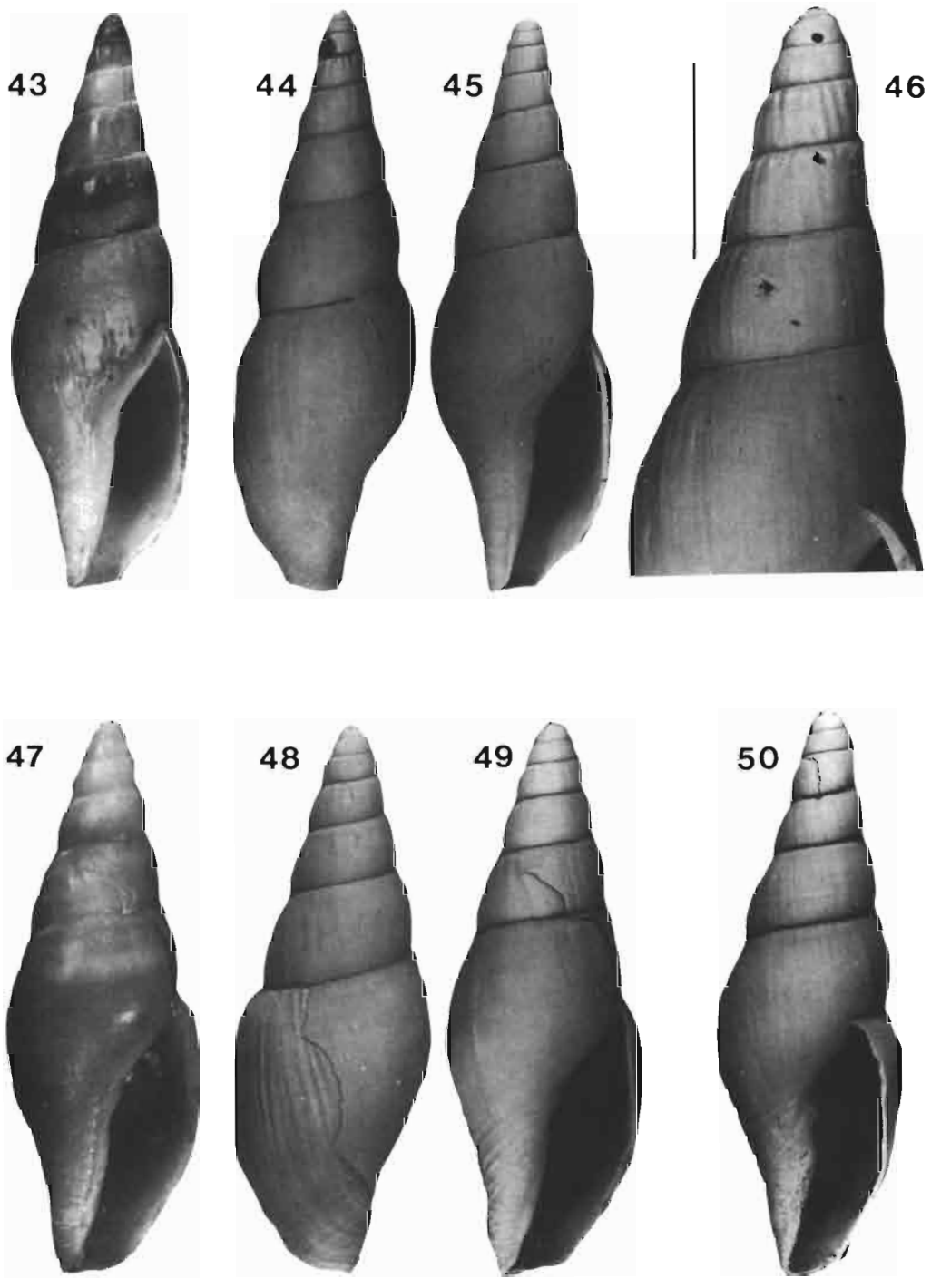


FIG. 43-50. — *Eumitra* de Nouvelle-Calédonie. — **43-46**, *Eumitra caledonica* : **43-45**, holotype, BIOCAL, stn 61, H = 35 mm. — **46**, paratype, détails premiers tours, BIOCAL, stn 70, Échelle = 5 mm. — **47-50**, *Eumitra apheles* : **47-49**, holotype, MUSORSTOM 4, stn 159, H = 17 mm ; **50**, paratype, MUSORSTOM 4, stn 159, H = 17 mm. — Fig. 44-46, 48-50 avec placage de chlorure d'ammonium.

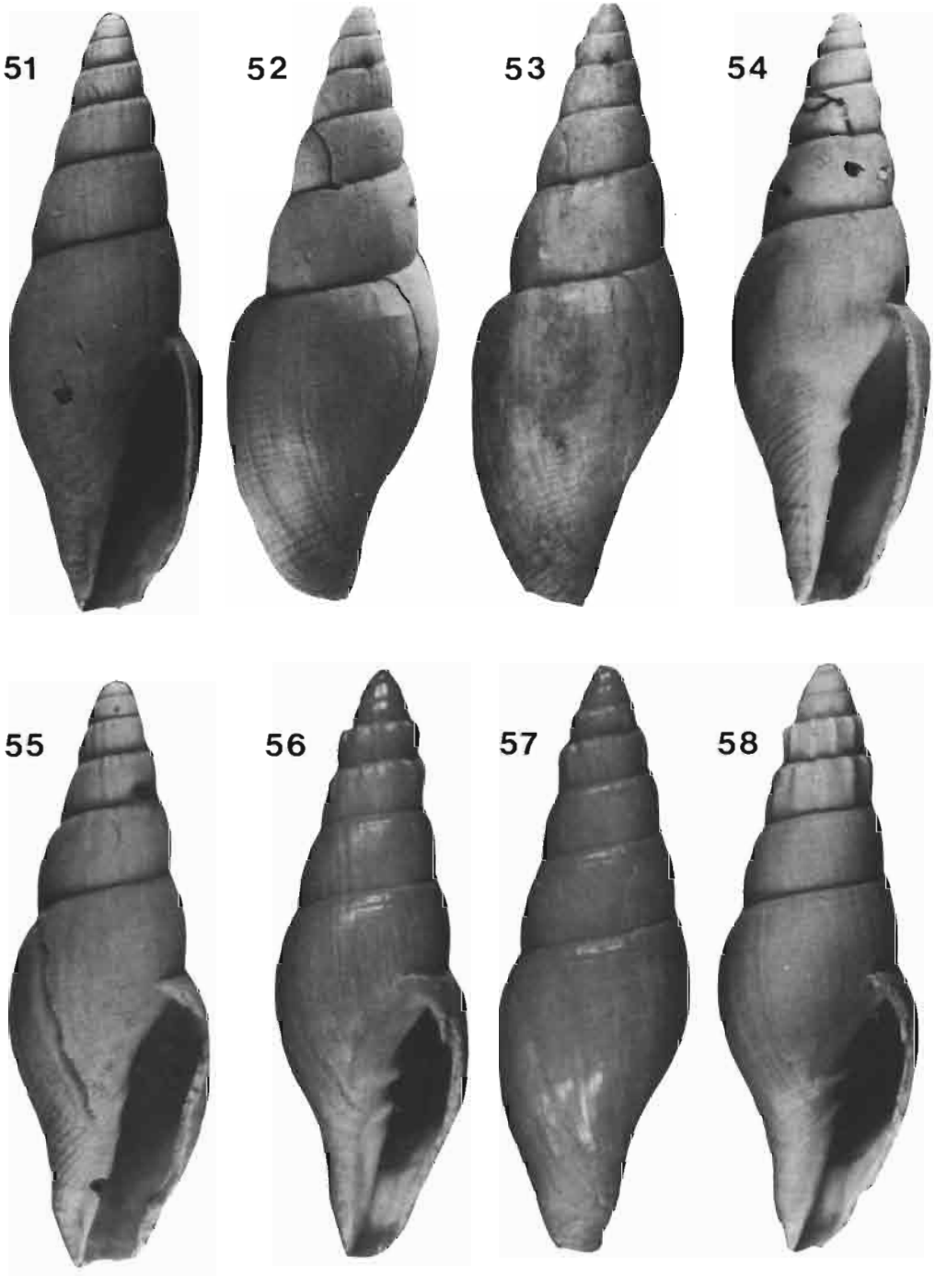


FIG. 51-58. — *Eumitra* de la région néo-calédonienne. — **51-55**, *Eumitra richeri*, mer du Corail, SW de Mellish Reef, CORAIL 2, stn 172 : **51**, paratype, H = 19,7 mm ; **52-54**, holotype, H = 22,5 mm ; **55**, paratype, H = 17,6 mm. — **56-58**, *Eumitra imbricata*, mer du Corail, Lansdowne-Fairway, CORAIL 2, stn 14, holotype, H = 15,6 mm. — Fig. 51-52, 54-55, 58 avec placage de chlorure d'ammonium.

RÉFÉRENCES BIBLIOGRAPHIQUES

BARNARD, K. H., 1959. — Contributions to the knowledge of South African marine mollusca. Part II. Gastropoda : Prosobranchia Rhachiglossa. *Ann. S. Afr. Mus.*, **45** : 1-237.

BARNARD, K. H., 1960. — The genus *Charitodoron* Tomlin, 1932. *J. Conch.*, **24** (11) : 402.

BEU, A. C., & MAXWELL, P. A., 1987. — A Revision of the Fossil and Living Gastropods Related to *Plesiotriton* Fischer, 1884 (Family Cancellariidae, Subfamily Plesiotritoninae n. subfam.). *N. Z. Geol. Surv. Pal. Bull.*, **54** : 1-140.

BOUCHET, P., 1987. — La protoconque des Gastéropodes. Aspects biologiques, taxonomiques et évolutifs. Thèse de Doctorat d'État (inédite), Paris, 181 p.

BOUCHET, P., & POPPE, G., 1988. — Deep Water Volutes from the New Caledonian Region, with a discussion on Biogeography. *Venus*, **47** (1) : 15-32.

CAVELIER, C., 1979. — La limite Éocène-Oligocène en Europe occidentale. *Mém. Sci. Géol.*, Strasbourg, **54** : 1-280.

CERNOHORSKY, W. O., 1970. — Systematics of the families Mitridae & Volutomitridae (Mollusca : Gastropoda). *Bull. Auckland Inst. Mus.*, **8** : 1-190.

CERNOHORSKY, W. O., 1976. — The Mitridae of the World. *Indo-Pacific Mollusca*, **3** (17), 273-528.

CHAMLEY, H., 1984. — Les Paléoenvironnements à la lumière des données océanologiques modernes. *Bull. Soc. géol. Fr.*, (7) **26** (3) : 407-416.

DARRAGH, T. A., 1979. — New species of *Athleta (Ternivoluta)* and *Nannamoria* (Mollusca : Volutidae) from the Capricorn Channel, Central Queensland, Australia. *J. Malac. Soc. Aust.*, **4** (3) : 129-134.

FINLAY, H. J., 1926. — A Further Commentary on New Zealand Molluscan Systematics. *Trans. Proc. N. Z. Inst.*, **57** : 320-485.

JANSSEN, R., 1979. — Die Mollusken der oberoligozän (Chattium) im Nordsee-Becken. 2. Neogastropoda, Euthyneura, Cephalopoda. *Arch. Moll.*, **109** (4/6) : 277-376.

HORNES, M., 1956. — Die fossilen Mollusken des Tertiärbeckens von Wien. Univalen. *Abhandl. Geol. R. Anst.*, **3** : 1-736.

LE RENARD, J., 1989. — Clefs de détermination des petites espèces de Gastéropodes de l'Éocène du Bassin de Paris. XXXVIII — Le genre *Parvisipho* Cossmann, 1889. *Cah. Naturalistes*, **45** (3) : 49-67.

LILTVED, B., & MILLAR, V., 1986. — Volutidae of South Africa. *The Strandloper*, **215** : 2-3.

LOZOUET, P., 1986. — Les Gastéropodes Prosobranches de l'Oligocène supérieur du bassin de l'Adour (Systématique, Paléoenvironnements, Paléoclimatologie, Paléobiogéographie). Mémoire E.P.H.E. (Paris) : 475 p.

MARSHALL, P., 1918. — The Tertiary Molluscan Fauna of Pakaurangi Point, Kaipara Harbour. *Trans. Proc. N. Z. Inst.*, **50** : 263-278.

PONDER, W., & WAREN, A., 1988. — Classification of the Caenogastropoda and Heterogastropoda, a list of the family-group names and higher taxa. *Malac. Rev.*, suppl. **4** : 286-324.

POWELL, A. W., & BARTRUM, J. A., 1929. — The Tertiary (Waitematan) Molluscan fauna of Oneroa, Waiheke Island. *Trans. Proc. N. Z. Inst.*, **60** (3) : 395-447.

RAUP, M., & SEPKOSKI, J. J., 1984. — Periodicity of extinctions in the geologic past. *Proc. Natn. Acad. Sci. USA*, **81** : 801-805.

REHDER, H. A., 1981. — A new species of *Volutocorbis* (Volutidae) from Somalia. *Nautilus*, **95** (4) : 169-170.

ROSSI RONCHETTI, C., 1955. — I Tipa della «Conchologia Fossile Subapennina» di G. Brocchi. II. Gastropodi, Scafopodi. *Riv. ital. Paleont. Stratigr.*, **5** (2) : 91-343.

ROUX, M., 1982. — De la biogéographie historique des océans aux reconstitutions paléobiogéographiques : tendances et problèmes illustrés par des exemples pris chez les Échinodermes bathyaux et abyssaux. *Bull. Soc. géol. Fr.*, (7) **25** (5-6) : 907-916.

SAUBADE, A. M., 1969. — Découverte d'une nouvelle espèce de gastropode dans les faluns de Saint-Étienne-d'Orthe (Landes). *Bull. Soc. Borda* (Dax) : 1-3.

SPOEL VAN DER, S., 1983. — Patterns in the Plankton Distribution and the Relation to Speciation : The Dawn of Pelagic Biogeography. *In* : R. W. Sims, J. H. Price & P. E. S. Whaley (eds), « Evolution, Time and Space : The Emergence of the Biosphere ». *Systematics Association*, **23** : 291-334, Academic Press, London.

TATE, R., 1889. — The Gastropods of the Older Tertiary of Australia. Part II. *Trans. R. Soc. Austr.*, **11** : 116-174.

TENISON-WOODS, 1880. — On some Tertiary Fossils. *Proc. Linn. Soc. N. S. W.*, **4** (1) : 1-20.

THIELE, J., 1925. — Gastropoda der Deutschen Tiefsee-Expedition, 2. *Wiss. Ergebn. dt. Tiefsee-Exped. "Valdivia"*, **17** : 35-282.

TOMLIN, J. R., 1932. — 9. Reports on the Marine Mollusca in the Collections of the South African Museum, VI-VIII. *Ann. S. Afr. Mus.*, **30** (2) : 157-169.

TOMLIN, J. R., 1943. — New species of *Charitodoron*. *J. Conch.*, **22** (3) : 50.

9

Mollusca Gastropoda : The Typhinae (Muricidae) from the New Caledonian region with description of five new species

Roland HOUART

St Jobsstraat, 8
B-3400 Landen
Ezemaal, Belgique

ABSTRACT

The New Caledonian species of Typhinae are revised. A total of 11 species are recorded ; 5, all from deep-sea, are new : *Siphonochelus (S.) angustus* ; *S. (S.) boucheti* ; *S. (S.) saltantis ; S. (S.) unicornis* and *S. (? Siphonochelus) undulatus*. All the species are described and illustrated together with comparative material. The radulae of 3 species are illustrated : *Typhis (Typhina) carolinae* Houart, 1987 ; *Siphonochelus (S.) boucheti* sp. nov. and *S. (S.) saltantis* sp. nov. Position and angle of anal tubes are considered to be a good criterion for the separation of species.

RÉSUMÉ

Mollusca Gastropoda : Les Typhinae (Muricidae) de la région néo-calédonienne. Description de cinq espèces nouvelles.

L'étude des Typhinae récoltés au cours des différentes campagnes entreprises depuis 1978 en Nouvelle-Calédonie a permis de recenser 11 espèces, dont 5 nouvelles, toutes d'eau profonde : *Siphonochelus (S.) angustus* ; *S. (S.) boucheti* ; *S. (S.) saltantis* ; *S. (S.) unicornis* et *S. (?Siphonochelus) undulatus*. Les 11 espèces sont décrites, comparées et illustrées. Les figures reprennent également quelques espèces comparées provenant d'autres régions du Pacifique, notamment du Japon et d'Australie. La radula de 3 espèces est illustrée : *Typhis (Typhina) carolinae* Houart, 1987 ; *Siphonochelus (S.) boucheti* sp. nov. et *S. (S.) saltantis* sp. nov. La position des tubes aperturaux (canal anal) et l'angle qu'ils forment sont considérés comme de bons critères pour la séparation des espèces. Par ailleurs d'autres points ont été retenus et ont servi à la comparaison et à la séparation d'espèces : forme et taille de la protoconque, sculpture et morphologie des varices, sculpture axiale intervaricale et sculpture spirale.

HOUART, R., 1991. — Mollusca Gastropoda : The Typhinae (Muricidae) from the New Caledonian region with description of five new species. *In* : A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 223-241. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

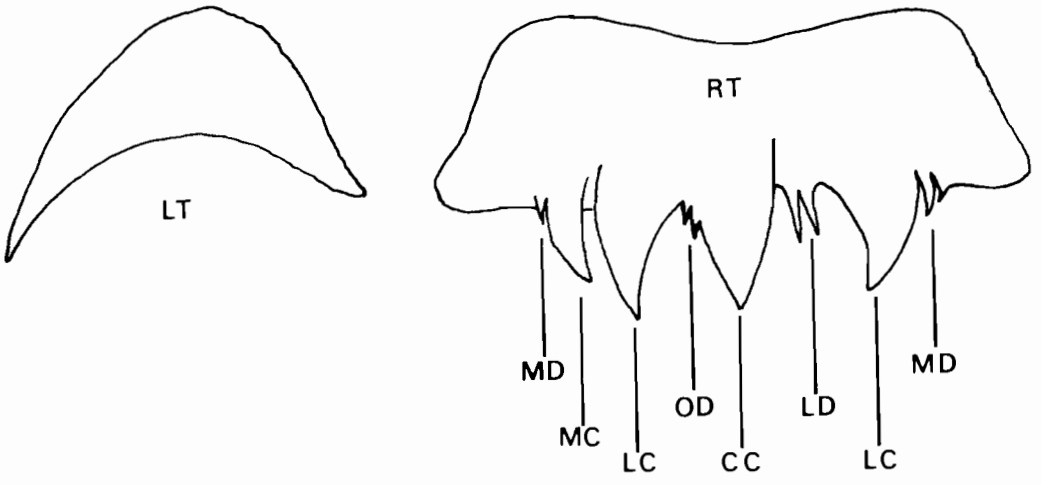
Several French expeditions have collected a considerable amount of marine material from deep water in the New Caledonian region, including many species of Muricidae. Among that material it has been possible to select an important collection of Typhinae, including many unknown species. Other Muricidae from the New Caledonian region are being studied by the author (in press) or have already been reported in other papers (HOUART, 1983, 1986, 1987a, 1987b, 1990).

The subfamily Typhinae is well studied and several authors (KEEN, 1944 ; VELLA, 1961 ; GERTMAN, 1969 ; D'ATTILIO, 1975, 1976, 1979 and D'ATTILIO & HERTZ, 1988) have done much for a better understanding of this group and its classification. The classification and methods used in the present paper are based mainly on the conclusions of these previous authors, but also on personal observations.

In their recent paper, D'ATTILIO & HERTZ (1988) reinstate the family Typhidae Cossmann, 1903, which they divide into two subfamilies : Typhinae and Tripterotyphinae. The purpose of this paper being not the discussion of the supraspecific classification of Typhinae, but only the review of the New Caledonian species, no other remarks will be given here on that study.

The Typhinae include a total of 45 Recent and 77 fossil species. No records were known from the New Caledonian waters before HOUART (1986), except one or two lots in European Museums (IRSNB I.G. 10591) but to my knowledge nothing has been published about them. Most Typhinae live in deep water, between 100 and 500 m, with an important radiation around 300-450 m, although some species occur in shallower waters (in New Caledonia *Typhis carolinae* Houart, 1987, and *Typhis neocaledonicus* Houart, 1987).

The species are characterized by their small size, whitish coloured shell and by the presence of hollow tubes, situated between each pair of varices, of which the function is not precisely known, although it is certain they are anal tubes. These anal tubes are gradually closed and broken during the growth of the shell, only the last tube is open and generally long to very long when intact. Other constant characteristics are the closed siphonal canal and the 4 (very rarely 5) varices per whorl. The group of species with three varices per whorl, formerly considered Typhinae, and consisting of the genera *Pterotyphis* Jousseaume, 1880, *Tripterotyphis* Pilsbry & Lowe, 1932, *Prototyphis* Ponder, 1972, and *Cinclidotyphis* du Shane, 1969, have been transfe-



FIGS 1. — Schematic drawing of a Typhinae radula. — RT : rachidian tooth ; LT : lateral tooth ; MD : marginal denticle ; MC : marginal cusp ; LC : lateral cusp ; OD : outer denticle ; CC : central cusp ; LD : lateral denticle. Terminology mainly based on FUJIOKA (1985) and KOOL (1987).

red to the subfamily Muricinae by D'ATTILIO (1982), and recently (D'ATTILIO & HERTZ, 1988) to the subfamily Tripterotyphinae, with the exception of *Cinclidotyphis*.

The protoconch of all known Recent species is smooth and paucispiral, formed by 1.25 to 2 whorls, indicating non-planktotrophic larval development, and thus a short to non existent free swimming larval stage. The operculum has an apical nucleus.

The radula consists of a rachidian tooth generally bearing 3 main cusps and 2 lateral denticles, and a pair of broad and curved lateral tooth. Lateral denticles of the central tooth are not always symmetrical, sometimes they are bifid or divided into 2 or more, smaller denticles. The presence and placement of the marginal denticles or cusps are erratic. Aberrant radular features in Typhinae can be observed in *Haustellotyphis cumingii* (Broderip, 1833) or *Typhisopsis coronatus* (Broderip, 1833) from the eastern Pacific region (RADWIN & D'ATTILIO, 1976 : 195, 213). Otherwise stated, the material is housed in the Muséum national d'Histoire Naturelle, Paris (MNHN).

MATERIAL AND METHODS

The material was collected during the following cruises (see RICHER DE FORGES, 1990, for additional data) :

(1) Aboard R. V. " *Vauban* ", off South New Caledonia, by P. BOUCHET and A. WAREN (1978-79).

(2) Programme LAGON, aboard R. V. "*Vauban* ", conducted by B. RICHER DE FORGES (1984-1989).

(3) BIOCAL cruise, aboard R. V. " *Jean Charcot* ", under the direction of C. LÉVI (1985).

(4) MUSORSTOM 4 cruise, aboard R. V. "*Vauban* ", under the direction of B. RICHER DE FORGES (1985).

(5) MUSORSTOM 5 cruise, aboard R. V. "*Coriolis* ", under the direction of B. RICHER DE FORGES (1986).

(6) CHALCAL 2 cruise, aboard R. V. " *Coriolis* ", under the direction of B. RICHER DE FORGES (1986).

Abbreviations :

a) preceding station numbers :

DW : Drague Waren (Waren Dredge)
CC : Chalut à crevettes (Shrimp Trawl)
CP : Chalut à perche (Beam Trawl)
DC : Drague Charcot (Charcot Dredge)

All stations of programme LAGON are dredgings using a Charcot dredge.

b) after data :

spm(s) : live-taken specimen(s) present in sample
sh(s) : only empty shells present in sample

The main features here retained for the separation of species are the form and size of the protoconch, the position, form and angle of the anal tubes, the sculpture and morphology of the varices, the intervarical axial sculpture (except growth lines) and the spiral sculpture.

The following measurements are used (Fig. 2) :

A. Length of the shell : taken from the apex to the tip of the siphonal canal.
B. Breadth of the shell : largest breadth, not including anal tubes.
C. Length and breadth of the aperture : largest measurements, taken from the inner side of the peristome.
D. Length of the siphonal canal.
E. Length of apertural anal tube.
F. Breadth of the apertural anal tube : largest breadth, taken near the base.
G. Tube angle : the shell is placed with the apex above, the aperture facing left ; the angle is measured between the axis of the shell and the axis of the anal tube, near its point of exit.

Museums where material is deposited are :

AMS : The Australian Museum, Sydney.
NMNZ : National Museum of New Zealand, Wellington.
NSMT : National Science Museum, Tokyo.
MNHN : Muséum national d'Histoire naturelle, Paris.
USNM : National Museum of Natural History, Washington, D.C.
IRSNB : Institut Royal des Sciences Naturelles de Belgique, Bruxelles.

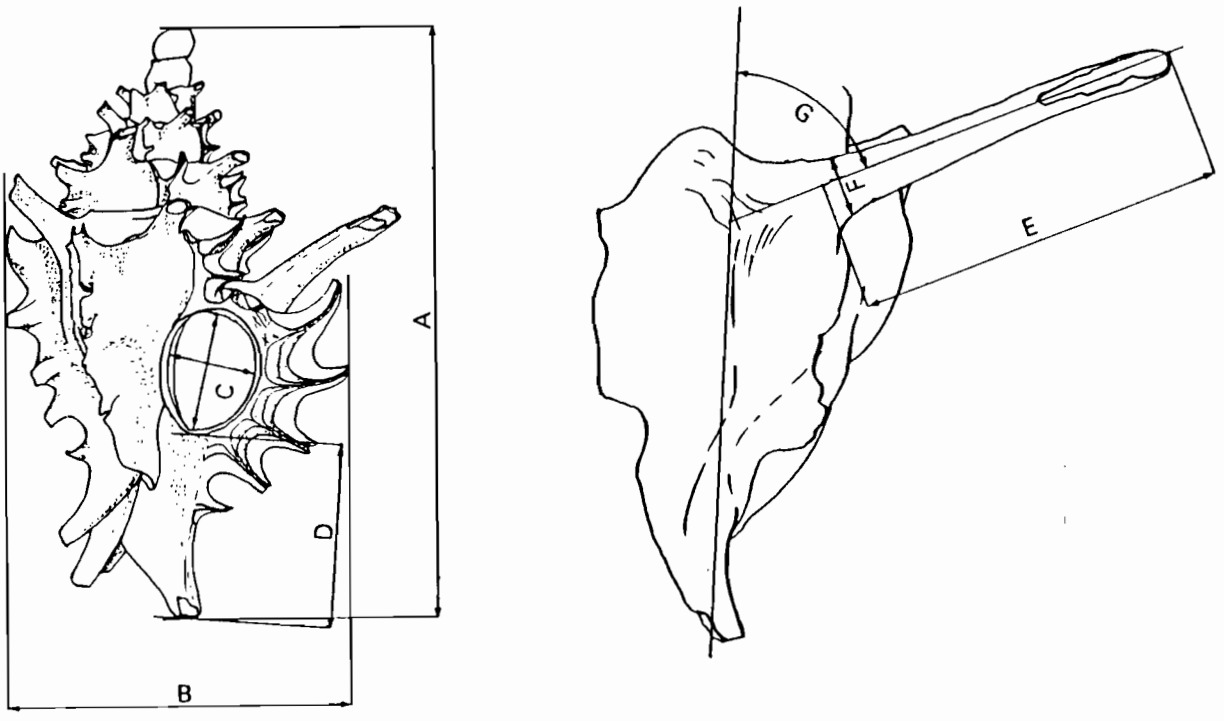


FIG. 2. — Illustration of measurements used.

SYSTEMATIC ACCOUNT

Family MURICIDAE Rafinesque, 1815

Subfamily TYPHINAE Cossman, 1903

Genus ***TYPHIS*** Montfort, 1810

Subgenus ***TYPHINA*** Jousseaume, 1880

Type-species by original designation : *Typhis belcheri* Broderip, 1833.

Typhis (Typhina) imperialis Keen & Campbell, 1964

Figs 10, 40, 60

Typhis (Typhina) imperialis Keen & Campbell, 1964 : 46, pl. 8, figs 1-4. — RADWIN & D'ATTILIO, 1976 : 207, pl. 32, fig. 8.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 64, 24°48′ S, 168°09′ E, 250 m, 3 September 1985 : 2 shs.

MUSORSTOM 4 : stn DW 222, 22°58′ S, 167°33′ E, 410-440 m, 30 September 1985 : 1 sh.

Chesterfield Islands. MUSORSTOM 5 : stn DW 274, 24°45′ S, 159°41′ E, 285 m, 9 October 1986 : 1 sh.

TYPE LOCALITY. — Trawled off Tosa, Japan, 33°20′ N, 138°40′ E, 200 m.

DESCRIPTION. — Shell moderately large and shouldered, up to 13.5 mm (MNHN, MUSORSTOM 4, stn DW 222). Spire high, consisting of 1.5 protoconch whorls and 5 shouldered teleoconch whorls. Suture of whorls deeply impressed. Protoconch elongate, somewhat keeled and smooth. Last whorl bearing 4 foliated varices, ventrally ornamented with crenulations with strong upward, curved, sealed spine on shoulder. No spiral sculpture. Axial sculpture consisting only of fine

growth striae. A rounded anal tube originates nearest to preceding varix, forming an angle of approximately 70° with the axis of the shell.

Aperture roundly ovate, edge erect and smooth, forming an entire peristome. Siphonal canal long and broad, sealed, ornamented with a broad fluted spine near its base. Colour creamy-white with brown-coloured last anal tube in juvenile specimens.

MEASUREMENTS (illustrated specimen). — A-B : 13.5 × 7.1 mm. — C : 2.5 × 1.9 mm. — D : 5.3 mm. — E : tube broken. — F : 1.1 mm. — G : 70°.

DISCUSSION. — This species is related to *Typhis montforti* A. Adams, 1863, and *T. teramachii* Keen & Campbell, 1964, but the shell differs from both by the presence of a broad, fluted spine on the siphonal canal and by the angle of the anal tube. The present material represents a wide geographical range extension for this apparently rare species, previously known only from the type locality.

Typhis (Typhina) virginiae Houart, 1986

Figs 12, 41, 62

Typhis (Typhina) virginiae Houart, 1986 : 440, pl. 2, fig. 7.

MATERIAL EXAMINED. — **New Caledonia.** "*Vauban*" 1978-79 : stn 2, 22°17′ S, 167°14′ E, 425-430 m, type locality.

BIOCAL : stn DW 77, 22°15′ S, 167°15′ E, 440 m, 5 September 1985 : 9 spms.

MUSORSTOM 4 : stn DW 226, 22°47′ S, 167°22′ E, 390 m, 30 September 1985 : 1 sh. — Stn CC 246, 22°08′ S, 167°11′ E, 410-420 m, 3 October 1985 : 5 shs. — Stn CC 247, 22°09′ S, 167°13′ E, 435-460 m, 4 October 1985 : 2 shs.

TYPE LOCALITY. — South of New Caledonia, 22°17′ S, 167°14′ E, 425-430 m.

DESCRIPTION. — Shell small, delicate, triangular, up to 7.8 mm (holotype). Spire moderately high, consisting of 1.25 protoconch whorls and 4 angulate teleoconch whorls. Suture of whorls slightly appressed. Protoconch smooth and rounded, glossy. Last whorl bearing 4 thin, sharp varices, ending in an acute and curved open spine. Apertural varix bearing a winglike flange, extending from the shoulder spine to approximately the 3/4 of the siphonal canal. Spiral sculpture obsolete. A moderately long anal tube originates between each pair of varices, situated slightly nearer to succeeding varix and forming an angle of approximately 25° with the axis of the shell. Other axial sculpture obsolete except fine growth striae.

Aperture small and ovate, edge forming an entire, erect peristome. Siphonal canal moderately long, sealed and smooth, tapering at the end, slightly bent to the right. Colour of the shell creamy white, siphonal canal and upper whorls pale brown ; a pale brown band also sometimes apparent at the base and the anterior part of the anal tubes.

MEASUREMENTS (holotype). — A-B : 7.8 × 4.1 mm. — C : 1.4 × 1.1 mm. — D : 2.8 mm. — E-F : 2.9 × 0.6 mm. — G : 25°.

DISCUSSION. — The species was originally compared with *Typhis (Typhina) pauperis* Mestayer, 1916, and *Typhis (Typhina) bivaricata* Verco, 1909. From *T. pauperis* the shell differs by its lower spire, its lower and more globose protoconch, the position of the anal tubes and the smooth and sharp varices. It differs from *T. bivaricata* by its larger size, its longer siphonal canal and its smooth and sharp varices. Both *T. pauperis* and *T. bivaricata* differ by having curving crenulations on the varices, mostly on the outer apertural lip.

Typhis (Typhina) carolinae Houart, 1987

Figs 3-4, 11, 42, 61

Typhis (Typhina) carolinae Houart, 1987 : 204, figs 2-4, 12, 13.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : stn 120, 22°28′ S, 166°44′ E, 46 m, 23 August 1984 : 1 spm. — Stn 296, 22°41′ S, 166°44′ E, 26 m, 26 November 1984 : 1 spm. — Stn 326, 22°26′ S, 167°02′ E, 67 m, 28 November 1984 : 1 spm (AMS C 153702). — Stn 354, 22°32′ S, 167°00′ E, 78 m, 29 November 1984 : 1 spm, holotype. — Stn 382, 22°33′ S, 167°14′ E, 57 m, 22 January 1985 : 1 spm. — Stn 383, 22°32′ S, 167°13′ E, 62 m, 22 January 1985 : 1 spm. — Stn 403, 22°35′ S, 167°18′ E, 45 m, 23 January 1985 : 1 spm. — Stn 405, 22°38′ S, 167°20′ E, 27 m, 23 January 1985 : 1 spm. (NMNZ MF 47730). — Stn 562, 22°44′ S, 166°59′ E, 48 m, 16 July 1985 : 1 spm. — Stn 572, 22°52′ S, 167°00′ E, 65 m, 17 July 1985 : 1 spm. (R. HOUART coll.). — Stn 598, 22°19′ S, 167°06′ E, 73-75 m, 5 August 1986 : 1 spm. — Stn 603, 22°16′ S.

167°05′ E, 78-80 m, 5 August 1986 : 1 spm. — Stn 632, 21°57′ S, 166°50′ E, 44-45 m, 6 August 1986 : 1 spm.

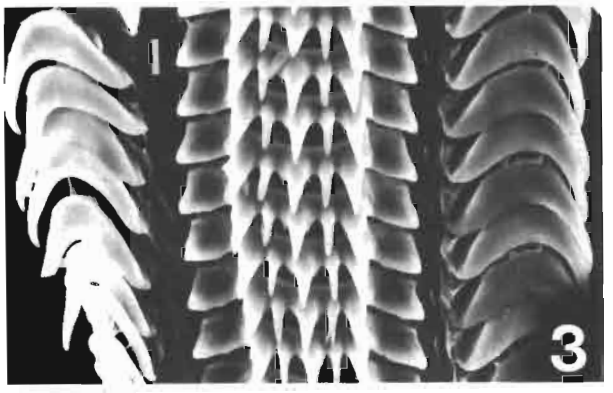
TYPE LOCALITY. — New Caledonia, Grand Récif Sud, Lagon, 22°32′ S, 167°02′ E, 78 m.

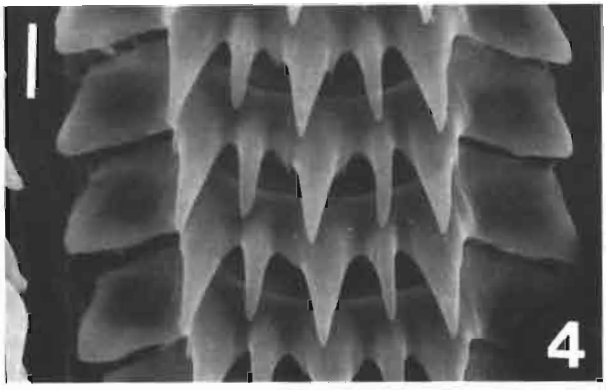
DESCRIPTION. — Shell large and spinose, up to 20.5 mm (holotype). Spire moderately high, consisting of 1.5 protoconch whorls and 5 shouldered, spinose, teleoconth whorls. Suture of whorls impressed. Protoconch rounded, smooth and glossy. Last whorl bearing 4 spinose and ventrally squamous varices, ornamented with small, backwardly curved, open spinelets. Shoulder spine long and strongly upwards curved. Spiral sculpture consisting of 3 to 4 very shallow, sometimes squamous, low cords on the posterior part of last whorl. Axial sculpture of fine growth striae. A rounded anal tube originates about midway between each pair of varices, slightly nearer preceding varix, forming an angle of 60 to 90° with the axis of the shell. Last tube long to very long and hollow, others gradually shorter and closed.

Aperture roundly-ovate to rounded, edge erect and smooth, forming an entire peristome. Siphonal canal sealed, long to very long, posteriorly flat and broad with spinelike projections posteriorly. Colour creamy-white to light brown, shoulder darker. Operculum with apical nucleus. Radula : rachidian bearing 3 cusps and 2 lateral denticles. Central and lateral cusps of approximately the same size ; lateral denticles slightly shorter and narrower ; 1 or 2 small outer denticles may erratically be present on the base of central cusp.

MEASUREMENTS (holotype). — A-B : 20.5 × 11.2 mm. — C : 4 × 3.5 mm. — D : 10.5 mm. — E-F : 13.3 × 1.5 mm. — G : 90°.

DISCUSSION. — This species was originally compared with *Typhis (Typhina) montforti* A. Adams, 1863, *T. (T.) yatesi* Crosse & Fischer, 1865, *T. (T.) imperialis* Keen & Campbell, 1964 and *T. (T.) teramachii* Keen & Campbell, 1964. The shell differs from these four species in having more spinose varices ; the varical ornamentation being dorsally bent, while the other species show ventrally bent crenulations. Other differences with related species are the position and angle of anal tubes ; ornamentation of the siphonal canal ; form of the protoconch and sculpture of the shell.





FIGS 3-4. Radula of *T. carolinae* Houart, 1987 (scale lines 10 µm).

Subgenus ***TALITYPHIS*** Jousseaume, 1882

Type-species by original designation : *Typhis expansus* Sowerby, 1874.

Typhis (Talityphis) neocaledonicus Houart, 1987

Figs 13, 44, 66

Typhis (Talityphis) neocaledonicus Houart, 1987 : 208, figs 8, 9, 16.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : stn 416, 22°38′ S, 167°14′ E, 40-50 m : 1 spm, holotype.

TYPE LOCALITY. — New Caledonia, Grand Récif Sud, Lagon, 22°38′ S, 167°14′ E, 40-50 m.

DESCRIPTION. — Shell relatively small for the subgenus and broadly fusiform, up to 18 mm. Spire moderately high, consisting of 1.5 protoconch whorls and 5 shouldered and angulate teleoconch whorls. Suture of whorls impressed. Protoconch rounded, somewhat flattened and smooth. Last whorl bearing 4 laminate and sharp varices. Last varix broad and expended, extending from the uppermost part of the shoulder spine to almost the tip of the siphonal canal. The partition is well developed. Varices ending in a sharp open shoulder spine. No apparent spiral sculpture but very shallow, low cords on posterior side of varices. A rounded anal tube originates at the shoulder margin, just in front of preceding varix, forming an angle of 70° with the axis of the shell. Last tube hollow and long, others short and closed.

Aperture rounded, edge erect and smooth, forming an entire peristome. Siphonal canal moderately long, broad and sealed, strongly bent backwards on its tip. Shell colour pale brownish with some brown spots on the edge of the aperture and on the siphonal canal.

MEASUREMENTS (holotype). — A-B : 18 × 13 mm. — C : 3.5 × 2.9 mm. — D : 6.5 mm. — E-F : 9.4 × 1.9. — G : 70°.

DISCUSSION. — *T. neocaledonicus* may be compared with *Typhis (Talityphis) bengalensis* (Radwin & d'Attilio, 1976) from the Bay of Bengal, but that species has a much smaller shell (7.6 to 9.5 mm), with no spiral sculpture, a larger aperture and a different arrangement of the anal tubes, situated approximately medially between each pair of varices. *T. (T.) campbelli* (Radwin & d'Attilio, 1976), has a more slender and higher protoconch ; the shoulder spines are not recurved and the position of the anal tubes is different, also situated medially between each pair of varices.

Genus *SIPHONOCHELUS* Jousseaume, 1880

Subgenus *SIPHONOCHELUS* Jousseaume, 1880

Type-species by original designation : *Typhis arcuatus* Hinds, 1843.

Siphonochelus (Siphonochelus) pavlova (Iredale, 1936)

Figs 14, 35, 45, 56, 63

Typhina pavlova Iredale, 1936 : 324, pl. 24, fig. 12. — RADWIN & D'ATTILIO, 1976 : 205, pl. 31, fig. 6. — KAICHER, 1978 : 1563. — HOUART, 1986 : 435, pl. 3, figs 8, 8A.

MATERIAL EXAMINED. — **New Caledonia.** " *Vauban* " 1978-79 : stn 40, 22°30′ S, 166°24′ E, 250-350 m, 7 June 1979 : 10 shs.

BIOCAL : stn DW 77, 22°15′ S, 167°15′ E, 440 m, 5 September 1985 : 1 spm.

MUSORSTOM 4 : stn CC 246, 22°08′ S, 167°11′ E, 410-420 m, 3 October 1985 : 1 sh. — Stn CC 247, 22°09′ S, 167°13′ E, 435-460 m, 4 October 1985 : 1 spm.

Chesterfield Islands. MUSORSTOM 5 : stn DW 301, 22°07′ S, 159°25′ E, 487-610 m : 1 spm.

Australia. Trawled off Cape Moreton, South Queensland : 2 spms (R. HOUART coll.).

TYPE LOCALITY. — Australia, east of Sydney, 200 m.

DESCRIPTION. — Shell small, biconic, up to 10 mm (MNHN, MUSORSTOM 4, stn CC 247), but larger (up to 16 mm) in Australian specimens. Spire high, consisting of 1.5 to 1.6 protoconch whorls and 5 somewhat shouldered teleoconch whorls. Suture of whorls impressed. Protoconch rounded, elongate and smooth. Last whorl bearing 4 rounded varices, joined to varix of preceding whorl by a buttress. No spiral sculpture. Axial sculpture consisting of a very shallow axial ridge and fine growth striae. A long, somewhat curved, tubular anal tube originates from the succeeding varix, forming an angle of approximately 40 to 45° with the axis of the shell. Tube of apertural varix long and hollow, others short (broken) and closed.

Aperture roundly-ovate, edge erect and smooth, forming an entire peristome. Siphonal canal long, sealed and smooth, slightly bent to the

right and tapering on its tip. Shell whitish to light brown with brown maculations on the base of the siphonal canal and on the buttresses on the suture.

MEASUREMENTS (illustrated specimen, MNHN). — A-B : 10 × 4.9 mm. — C : 1.7 × 1.4 mm. — D : 3.5 mm. — E-F : 2.9 × 9 mm. — G : 40 to 45°.

DISCUSSION. — For the differences with *Siphonochelus (S.) saltantis* sp. nov. see that species. There are no noticeable differences with the Australian shells, except these are somewhat more globose with slightly more rounded varices.

Known in Australia from the coast of New South Wales (IREDALE, 1936) and from Cape Moreton, South Queensland (RADWIN & D'ATTILIO, 1976 : Pl. 31, Fig. 6 and R. HOUART coll.).

Siphonochelus (Siphonochelus) angustus sp. nov.

Figs 15-16, 43, 65

MATERIAL EXAMINED. — **Chesterfield Islands.** MUSORSTOM 5, stn DW 304, 22°10′ S, 159°26′ E, 385-420 m : 2 shs.

TYPE MATERIAL. — Holotype MNHN, MUSORTOM 5, stn DW 304 (6.7 × 3.4 mm) ; 1 paratype MNHN, same station (6.3 × 3.3 mm).

TYPE LOCALITY. — Coral Sea, Nova Seamount, MUSORSTOM 5, 22°10′ S, 159°26′ E, 385-420 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 6.7 mm (holotype). Spire high, consisting of 1.5 protoconch whorls and 4 convex teleoconch whorls. Suture of whorls impressed when visible. Protoconch broad, rounded, slightly flattened and glossy. Last whorl bearing 4 rounded varices. No spiral sculpture. Axial sculpture consisting of one, sometimes shallow or obsolete, axial ridge, situated midway between each pair of varices. Shell slightly excavated between axial ridge and succeeding varix. A flattened and broad anal tube originates from succeeding varix, forming an angle of approximately 10 to 15° with the axis of the shell ; its broad and flattened base masks the suture of whorls. Other axial sculpture of fine growth striae.

Aperture ovate and smooth, partially broken. Siphonal canal short, broad at the base and narrower at its tip, smooth, tubular and sealed. Shell ivory white and glossy.

MEASUREMENTS (paratype). — A-B : 6.3 × 3.3 mm. — C : 1.4 × 1.0 mm. — D : 1.7 mm. — E : tube broken. — F : 1.2 mm. — G : 10 to 15°.

DISCUSSION. — The shell of *Siphonochelus japonicus* (A. Adams, 1863) is brown coloured, has more pronounced axial ribs and is deeply excavated between each varix and axial rib ; the suture is deeper and the anal tubes are more detached from the whorls ; the varices are weaker and the protoconch is higher and more rounded.

? *Siphonochelus syringianus* (Hedley, 1903) from shallower water has a brown coloured shell, it is barely half the size for the same number of teleoconch whorls ; its protoconch is slightly smaller and non acute ; its intervarical costae are more apparent ; the teleoconch whorls are more detached from each other and the shoulder is stronger and broader. The varices and anal tubes are more numerous for *S. syringianus* : 6 on first teleoconch whorl and 5 from second teleoconch whorl onwards, including the last whorl while *S. angustus* has 4 varices and 4 anal tubes on each whorl.

Siphonochelus boucheti sp. nov. has a comparatively larger shell, with a more rounded protoconch, smaller anal tubes and broader shell. It has more pronounced and erect axial ridges and varices.

ETYMOLOGY. — Named *angustus* due to its relatively narrow shell.

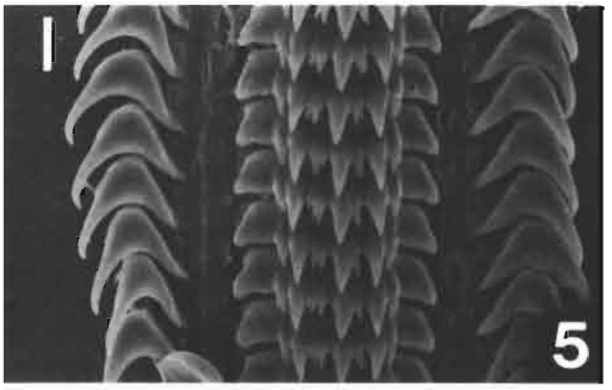
Siphonochelus (Siphonochelus) boucheti sp. nov.

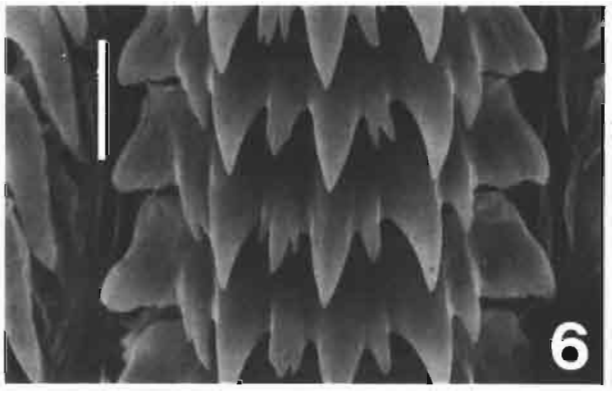
Figs 5-6, 17-18, 47, 68

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 30 August 1985 : 2 spms. — Stn DW 51, 23°05′ S, 167°45′ E, 680-700 m, 31 August 1985 : 6 spms. — Stn CP 57, 23°44′ S, 166°58′ E, 1 490-1 620 m, 1 September 1985 : 1 sh. — Stn DW 66, 24°55′ S, 168°22′ E, 505-515 m, 3 September 1985 : 20 spms. — Stn DW 70, 23°25′ S, 167°53′ E, 965 m, 4 September 1985 : 1 sh.

CHALCAL 2 : stn DW 72, 24°55′ S, 168°22′ E, 527 m, 28 October 1986 : 21 spms.

Chesterfield Islands. MUSORSTOM 5 : stn DC 358, 19°39′ S, 158°47′ E, 680-700 m, 18 October 1986 : 1 spm.





FIGS 5-6. — Radula of *S. boucheti* sp. nov. (scale lines 10 μm).

TYPE MATERIAL. — Holotype MNHN, CHALCAL 2, stn DW 72, 10.1 × 5 mm ; 20 paratypes, same station (MNHN, NMNZ, AMS, USNM, NSMT, Natal Mus., R. HOUART coll.).

TYPE LOCALITY. — South of New Caledonia, CHALCAL 2, stn DW 72, 24°55′ S, 168°22′ E, 527 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 10.5 mm (specimen from BIOCAL, stn DW 66). Spire high, consisting of 1.6 protoconch whorls and 5 shouldered teleoconch whorls. Suture of whorls impressed. Protoconch rounded, smooth and glossy. Last whorl bearing 4 rounded varices, angulate at the shoulder. No spiral sculpture. Intervarical axial sculpture consisting of a strong rounded ridge, situated about midway between each pair of varices, slightly nearer to succeeding varix. Shell excavated between axial ridge and succeeding varix. A flattened and arched anal tube originates from the succeeding varix ; broad at the base and gradually narrower at its tip, strongly upward bent, forming an angle of approximately 20 to 25° with the axis of the shell. Other axial sculpture of fine growth striae.

Aperture ovate, edge erect and smooth, forming an entire peristome. Siphonal canal short, broad at the base and narrower at its tip, smooth, tubular and sealed. Shell ivory white and glossy.

Radula : rachidian bearing 5 cusps and 2 lateral denticles. Laterals cusps rarely bearing outer denticles. Lateral denticles erratically divided into 2 or 3 smaller denticles.

MEASUREMENTS (holotype) : A-B : 10.1 × 5 mm. — C : 2.5 × 1.7 mm. — D : 2.6 mm. — E-F : 2.5 × 1.2 mm. — G : 20 to 25°.

DISCUSSION. — *S. boucheti* is related to *Siphonochelus nipponensis* Keen & Campbell, 1964 but the shell has more upward vertically bent anal tubes which are flatter on the base ; they originate immediately from the varix in *S. nipponensis* while they are somewhat separated in *S. boucheti*. The varices are more strongly shouldered than in *S. nipponensis* ; the protoconch of *S. boucheti* is approximately 50 % larger, and the aperture is narrower.

Siphonochelus japonicus (A. Adams, 1863), a smaller related species, has been compared with adult specimens of *S. boucheti* and also with an approximately equal-sized juvenile. *S. boucheti* has a translucent white shell while *S. japonicus* has a brownish to dark brown shell, but other differences are the more shouldered whorls in *S. boucheti*, which also has a more globose and almost twice larger protoconch ; the varices are strongly shouldered and the anal tubes are slightly joined to them while these of *S. japonicus* are rounded with the anal tubes distinctly joined ; these anal tubes being flatter in *S. japonicus*.

Siphonochelus generosus Iredale, 1936, a Southeastern Australian species is also similar to the new species but *S. boucheti* has a twice larger and more globose protoconch, more fusiform whorls, more erect apertural lip and slightly more upwardly bent anal tubes.

Siphonochelus solus Vella, 1961, is a more fusiform species with smaller protoconch and

weaker axial costae. The new species also has slightly more upwardly bent anal tubes and the axial costae are more separated from the anal tubes.

S. tillierae Houart, 1986, is a narrower and comparatively smaller shell. The anal tubes do not originate from the varices and are rounded and straight, while flattened and arched for the new species. The axial ridge is also stronger and more evident in *S. boucheti*.

ETYMOLOGY. — Named in honour of Dr P. BOUCHET (MNHN), who shared in most of the recent French expeditions in New Caledonia.

Siphonochelus (Siphonochelus) saltantis sp. nov.

Figs 7-8, 9, 19-20, 46, 70

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 64, 24°48′ S, 168°09′ E, 250 m, 3 September 1985 : 5 spms.

Chesterfield Islands. MUSORSTOM 5 : stn DW 263, 25°21′ S, 159°46′ E, 150-225 m, 8 October 1986 : 9 spms. — Stn DW 274, 24°45′ S, 159°41′ E, 285 m, 9 October 1986 : 1 spm. — Stn DW 303, 22°12′ S, 159°23′ E, 332 m, 12 October 1986 : 1 spm. — Stn DW 304, 22°10′ S, 159°26′ E, 385-420 m, 12 October 1986 : 1 sh.

TYPE MATERIAL. — Holotype MNHN, MUSORSTOM 5, stn 303, 9.2 × 4.1 ; 1 paratype MNHN, MUSORSTOM 5, stn 304.

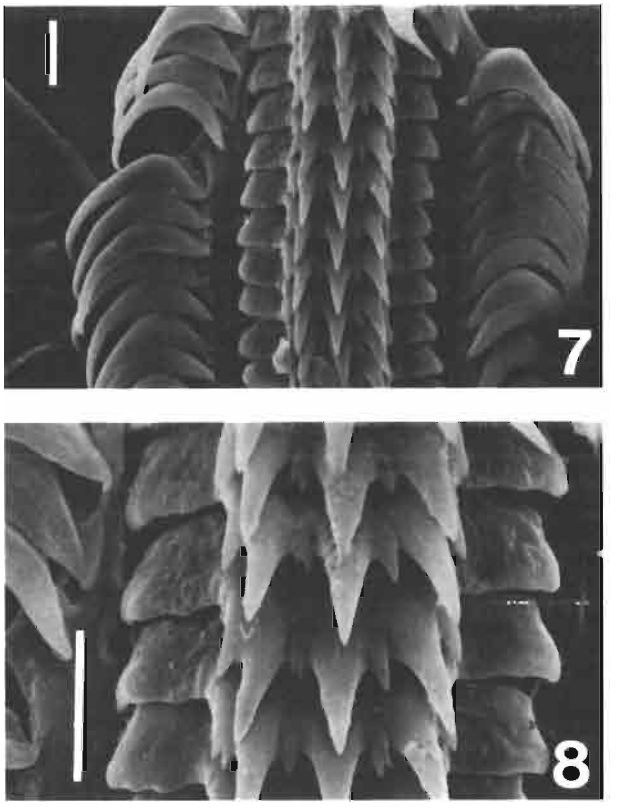
TYPE LOCALITY. — Coral Sea, Nova Seamount, MUSORSTOM 5, stn DW 303, 22°12′ S, 159°23′ E, 332 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 9.2 mm (holotype). Spire high, consisting of 1.5 to 1.75 protoconch whorls and 4 slightly angulate and shouldered teleoconch whorls. Suture of whorls impressed. Protoconch small, rounded and glossy. No spiral sculpture. Axial sculpture consisting of 4 sharp varices and fine growth striae. A long, fused, slightly angulate and slender anal tube originates from the varices, forming an angle of approximately 25 to 30° with the axis of the shell. Tube of apertural varix very long and hollow, others broken and closed.

Aperture rounded and very small, edge erect and smooth, forming an entire peristome. Siphonal canal long and fused, broad at the base, gradually narrower and tappering at its tip, bent to the right. Shell glossy white, often with more or less visible brown maculations at the base of the anal tubes, siphonal canal and remnants of previous siphonal canals.

Radula : rachidian bearing 3 cusps, 2 small lateral denticles and 2 small marginal denticles. Lateral denticles erratically divided into 2 smaller denticles.

MEASUREMENTS (holotype). — A-B : 9.2 × 4.1 mm. — C : 1.4 × 1.0 mm. — D : 3.6 mm. — E-F : 3.8 × 0.7 mm. — G : 25 to 30°.



FIGS 7-8. — Radula of *S. saltantis* sp. nov. (scale lines 10 μm).

DISCUSSION. — Compared with *S. pavlova* (Iredale, 1936), the shell is twice smaller for the same number of teleoconch whorls ; the aperture is also smaller. The protoconch is comparatively smaller, more rounded while that of *S. pavlova* is large and elongate. *S. pavlova* has a more globose shell with more rounded varices and more apparent buttresses where the varices join

the preceding whorl, and with a shallow axial ridge.

Typhis (Typhina) virginiae Houart, 1986, another recently named species from New Caledonia has a more angulate shell with a larger aperture ; the axial lamellae are separated from the anal tubes and are sharper while the anal tubes are less backwards bent and more horizontal. The suture is more impressed in *T. virginiae* and the buttresses formed where the varices or axial lamellae join the preceding whorl are shallow while they are large and very apparent in *S. saltantis*.

FIG. 9. — Operculum of *S. saltantis* sp. nov. (scale line 0.5 mm).

ETYMOLOGY. — *Saltantis* = dancer. Named for its similarity with *Siphonochelus pavlova* (Iredale, 1936).

Siphonochelus (Siphonochelus) unicornis sp. nov.

Figs 21-23, 48, 67

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 30 August 1985 : 1 spm. — Stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 30 August 1985 : 3 spms.
MUSORSTOM 4 : stn DW 226, 22°47′ S, 167°22′ E, 390 m, 30 September 1985 : 1 sh.

TYPE MATERIAL. — Holotype MNHN, MUSORSTOM 4, stn DW 226, 12 × 5.5 mm ; 1 paratype MNHN, BIOCAL, stn DW 44 ; 3 paratypes, BIOCAL, stn DW 46 (MNHN, NMNZ, R. HOUART coll.).

TYPE LOCALITY. — New Caledonia, MUSORSTOM 4, stn DW 226, 22°47′ S, 167°22′ E, 390 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 12 mm (holotype). Spire high, consisting of 1.5 to 1.75 protoconch whorls and 5 fusiform and slightly shouldered teleoconch whorls. Suture of whorls impressed. Protoconch large, rounded and glossy. No spiral sculpture. Axial sculpture consisting of 4 more or less sharp varices and a very shallow axial ridge, situated nearer to preceding varix. No other axial sculpture. A long, fragile and almost horizontal anal tube originates from the apertural varix, forming an angle of 70 to 75° with the axis of the shell (paratype MNHN, stn DW 46). Other tubes broken.

Edge of aperture slightly erect, ovate, forming an entire peristome. Siphonal canal moderate in length, broad at the base and narrow at its tip, smooth. Colour white, with a shallow pale brown band at the base of the siphonal canal.

MEASUREMENTS (paratype MNHN). — A-B : 9.7 × 4.7 mm. — C : 1.8 × 1.3 mm. — D : 3.3 mm. — E-F : 4.5 × 0.8 mm. — G : 75°.

DISCUSSION. — Compared with *Siphonochelus boucheti, S. unicornis* has a larger and more elongate protoconch and a larger aperture. The axial ribs are weaker and the anal tubes more backwards bent, being almost horizontal. *Siphonochelus (Siphonochelus) erythrostigma* Keen & Campbell, 1964, has a more rounded and smaller protoconch, rounded and spirally sculptured varices, globose and upwardly bent anal tubes.
No other related species is known.

ETYMOLOGY. — Named *unicornis* for its long apertural anal tube.

Siphonochelus (? Siphonochelus) undulatus sp. nov.

Figs 24-25, 49, 69

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4 : stn DW 203, 22°36′ S, 167°05′ E, 105-110 m, 27 September 1985 : 1 sh.

TYPE MATERIAL. — Only known from the holotype, MNHN.

TYPE LOCALITY. — New Caledonia, MUSORSTOM 4, stn DW 203, 22°36′ S, 167°05′ E, 105-110 m.

DESCRIPTION. — Shell very small, fusiform and biconic. Spire high, consisting of 1.75 protoconch whorls and 4 teleoconth whorls. Suture of whorls slightly appressed. Protoconch slightly elongate, convex and smooth. Last whorl bearing 4 rounded varices, extended on previous whorl by a small buttress. Other axial sculpture consisting of one elongate ridge, situated nearest to preceding varix ; shell excavated between axial ridge and succeeding varix. Spiral sculpture consisting of 5 cords, most evident on the varices and axial ridges. A short, rounded anal tube originates from succeeding varix, forming an angle of approximately 20 to 25° with the axis of the shell.

Aperture roundly-ovate, forming an entire peristome, smooth and slightly erect. Siphonal canal short, smooth and fused, sealed and tapering on its tip. Colour ivory-white with traces of pale brown on the anterior part of last whorl.

MEASUREMENTS (holotype). — A-B : 5.9 × 3.0 mm. — C : 1 × 0.8 mm. — D : 1.4 mm. — E : tube broken. — F : 0.6 mm. — G : 20 to 25°.

DISCUSSION. — *S. undulatus* is here tentatively included in *S. (Siphonochelus)*, its shell sculpture being somewhat unexpected in the nominal subgenus. *S. (Pilsbrytyphis)* Woodring, 1959, confined to the middle Miocene of Panama (GERTMAN, 1969) also has strange sculpture, consisting of a wrinkled shell surface. No other species of *Siphonochelus* is related, but the species may be compared with *Typhis (Typhina) bivaricata* Verco, 1909. In *T. bivaricata* the anal tubes are separated from the varices, which are foliated and sharp, while rounded and tuberculate for the new species ; it has also longer and more horizontal anal tubes.

Although probably subadult with its 4 teleoconch whorls, *S. undulatus* is definitely distinct from other Recent and fossil species.

ETYMOLOGY. — Named *undulatus* for its undulating spiral sculpture.

Subgenus ***LAEVITYPHIS*** Cossmann, 1903

Type-species by original designation : *Typhis muticus* J. Sowerby, 1834.

Siphonochelus (Laevityphis) tillierae
Houart, 1986

Figs 26, 27, 50, 64

Siphonochelus (Laevityphis) tillierae Houart, 1986 : 442, pl. 2, fig. 6.

MATERIAL EXAMINED. — **New Caledonia.** " *Vauban* " 1978-79 : stn 40, 22°30′ S, 166°24′ E, 250-350 m, 7 June 1979 : 2 shs. (type material).

BIOCAL : stn CP 75, 22°19′ S, 167°23′ E, 825-860 m, 4 September 1985 : 9 shs. — Stn DW 79, 20°40′ S, 166°52′ E, 1 320-1 380 m, 5 September 1985 : 1 sh. — Stn DW 80, 20°32′ S, 166°48′ E, 900-980 m, 5 September 1985 : 1 sh.

MUSORSTOM 4 : stn DW 161, 18°39′ S, 163°11′ E, 550 m, 15 September 1985 : 1 sh. — Stn DC 168, 18°48′ S, 163°11′ E, 720 m, 16 September 1985 : 1 sh.

TYPE LOCALITY. — New Caledonia, stn 40, 22°30′ S, 166°24′ E, 250-350 m (" *Vauban* " 1978-79).

MEASUREMENTS (holotype). — A-B : 5.9 × 2.8 mm. — C : 1.3 × 0.8 mm. — D : 1.3. — E-F : 1.1 × 0.5 mm. — G : 70 to 75°.

DESCRIPTION. — Shell small and fusiform, elongate, up to 9.9 mm (MUSORSTOM 4, stn DW 161). Spire high, consisting of 1.25 to 1.75 protoconch whorls and 4 to 5 rounded teleoconch whorls. Suture of whorls impressed. Protoconch rounded and smooth, glossy. Last whorl bearing 4 strong and somewhat rounded and shouldered varices. No spiral sculpture. Axial sculpture consisting of a shallow intervarical low ridge, slightly nearer to preceding varix. A rounded and short anal tube originates near preceding varix, forming an angle of approximately 70 to 75° with the axis of the shell. Other axial sculpture of fine growth striae.

Aperture ovate, columellar lip adherent posteriorly, otherwise erect. Outer apertural lip erect and smooth. Siphonal canal short, tubular and sealed, very slightly bent to the right. Shell entirely white.

DISCUSSION. — *S. tillierae* was originally compared with *Siphonochelus (S.) solus* Vella, 1961, *S. (S.) generosus* Iredale, 1936, *S. (Laevityphis) transcurrens* (von Martens, 1902) and *S. (Siphonochelus) tubuliger* (Thiele, 1925). The shell of *S. tillierae* differs from that of *S. solus,*

S. generosus and *S. transcurrens* by its smaller size, form of whorls and form and position of the anal tubes. From *S. tubuliger* it differs by its more elongate form, its shorter anal tubes and the angle of these. The aperture of *S. tubuliger* is rounded, but ovate in *S. tillierae*, and the varices are shorter and much finer.

ACKNOWLEDGEMENTS

I thank Dr P. BOUCHET (Mus. natn. Hist. nat., Paris) for giving me the opportunity to study that material and for SEM work, and Dr A. WARÉN (Nat. Hist. Mus., Stockholm) who mounted the radulae. Loan of comparative material was obtained thanks to most helpful collaboration of Dr K. GOWLETT-HOLMES (South Australian Museum); Mr B. MARSHALL (Natl Mus. New Zealand) and Dr A. MATSUKUMA (National Science Mus., Tokyo). I am also most indebted to Dr P. BOUCHET and Prof. E. H. VOKES (Tulane University) for reading the manuscript and for their remarks and suggestions.

REFERENCES

ATTILIO, A. D', 1975. — The typhine shell : theme, development and elaboration. *Festivus*, **6** (9) : 53-60.

ATTILIO, A. D',1976. — Recent and fossil Typhinae of the New World. *Festivus*, **7** (5) : 27-30.

ATTILIO, A. D', 1979. — Interpretation of typhine morphology with special reference to *Typhina clarki* (Keen & Campbell, 1964). *Festivus*, **11** (11) : 88-93.

ATTILIO, A. D', & HERTZ, C. M., 1988. — An illustrated catalogue of the family Typhidae Cossmann, 1903. *Festivus*, **20** (supplement) : 1-73, 109 figs.

FUJIOKA, Y., 1985. — Systematic Evaluation of Radular Characters in Thaidinae (Gastropoda : Muricidae). *J. Sci. Hiroshima Univ.*, **31** (2) : 235-287, 95 figs.

GERTMAN, R. L., 1969. — Cenozoic Typhinae (Mollusca : Gastropoda) of the western Atlantic region : *Tulane Stud. Geol. Paleont.*, **7** (4) : 143-191, 8 pls.

HOUART, R., 1983. — Three new tropical Muricacean species (Gastropoda : Muricidae). *Venus, Jap. J. Malac.*, **42** (1) : 26-33.

HOUART, R., 1986. — Mollusca Gastropoda : Noteworthy Muricidae from the Pacific Ocean with description of seven new species. *In* : Résultats des Campagnes MUSORSTOM I et II. Philippines (1976, 1980), volume **2** (13). *Mém. Mus. natn. Hist. nat. Paris*, (A), **133** : 427-455.

HOUART, R., 1987a. — Description of three new muricid gastropods from the South-Western Pacific Ocean with comments on new geographical data. *Bull. Mus. natn. Hist. nat. Paris*, (4) **8**, A, (4) : 757-767.

HOUART, R., 1987b. — Description of four new species of Muricidae (Mollusca : Gastropoda) from New Caledonia. *Venus, Jap. J. Malac.*, **46** (4) : 202-210.

HOUART, R., 1990. — New Taxa and new records of Indo-Pacific species of *Murex* and *Haustellum* (Gastropoda, Muricidae, Muricinae). *Bull. Mus. natn. Hist. nat. Paris*, (4) **12**, A, (2) : 329-347.

IREDALE, T., 1936. — Australian molluscan notes 2. *Rec. Aust. Mus.*, **19** : 267-340, pls 20-24.

KAICHER, S. D., 1978. — Card catalogue of worldwide shells, Muricidae III. Privately publ. St. Petersburg, Fla.

KEEN, A. M., 1944. — Catalogue and revision of the gastropod subfamily Typhinae. *J. Paleontology*, **18** (1) : 50-72, 20 figs.

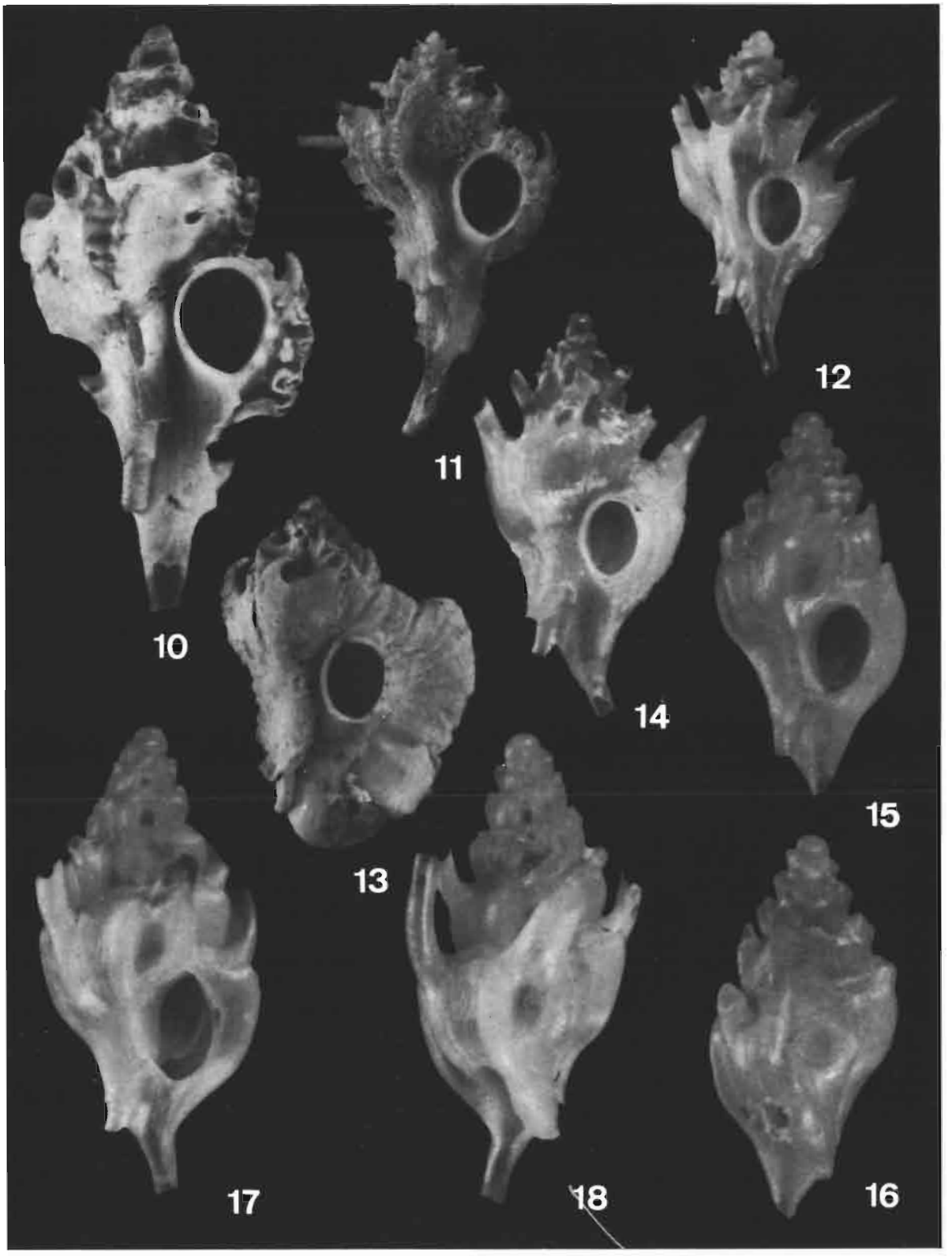
KEEN, A. M., & CAMPBELL, G. B., 1964. — Ten new species of Typhinae (Gastropoda : Muricidae). *Veliger*, **7** (1) : 46-57, pls 8-11.

KOOL, S. P., 1987. — Significance of radular characters in reconstruction of thaidid phylogeny (Neogastropoda : Muricacea). *Nautilus*, **101** (3) : 117-132.

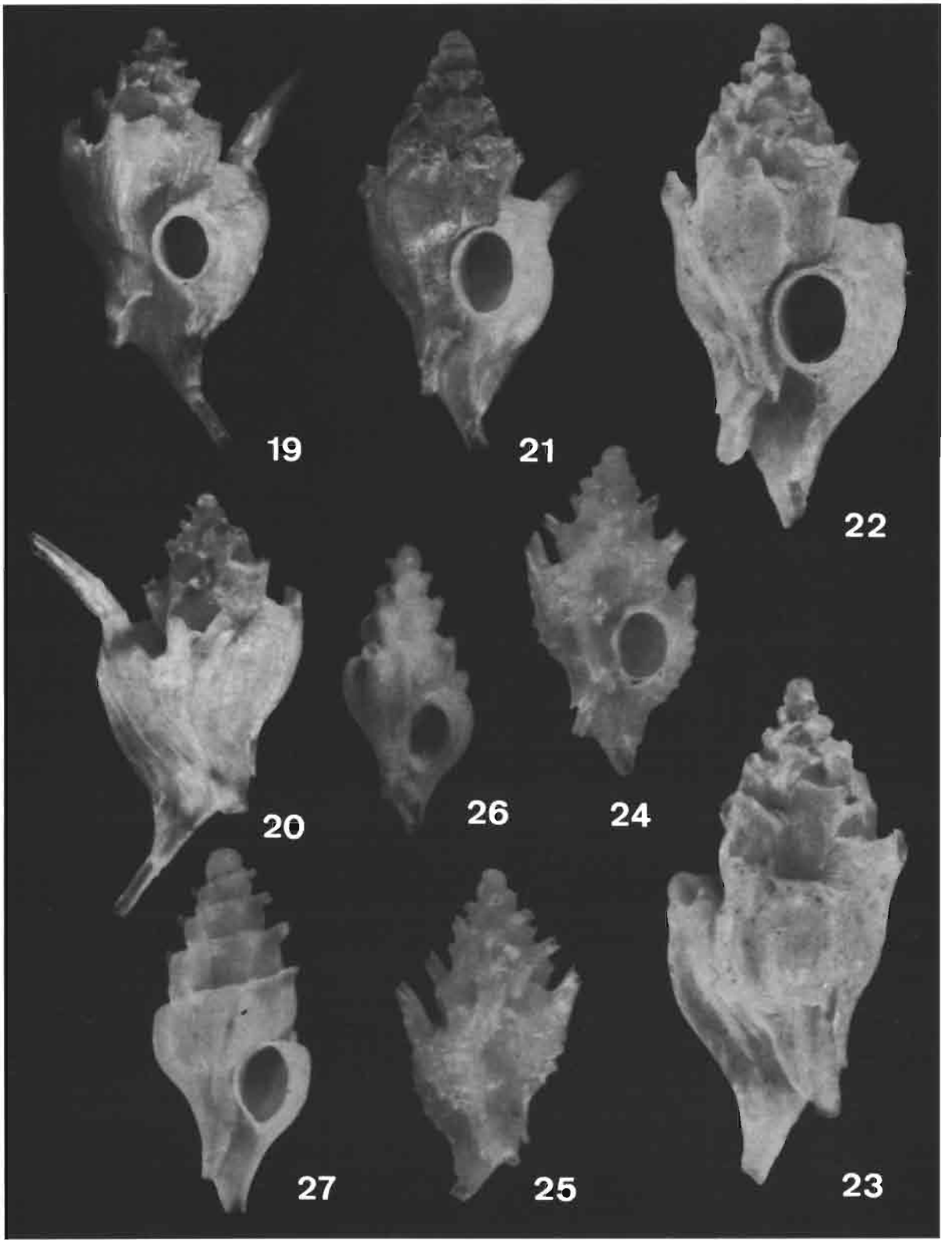
RADWIN, G., & D'ATTILIO, A., 1976. — *Murex* shells of the world, an illustrated guide to the Muricidae : 1-284, 32 pls, Stanford.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, volume **6** (1). *Mém. Mus. natn. Hist. nat., Paris*, (A) **145** : 9-54.

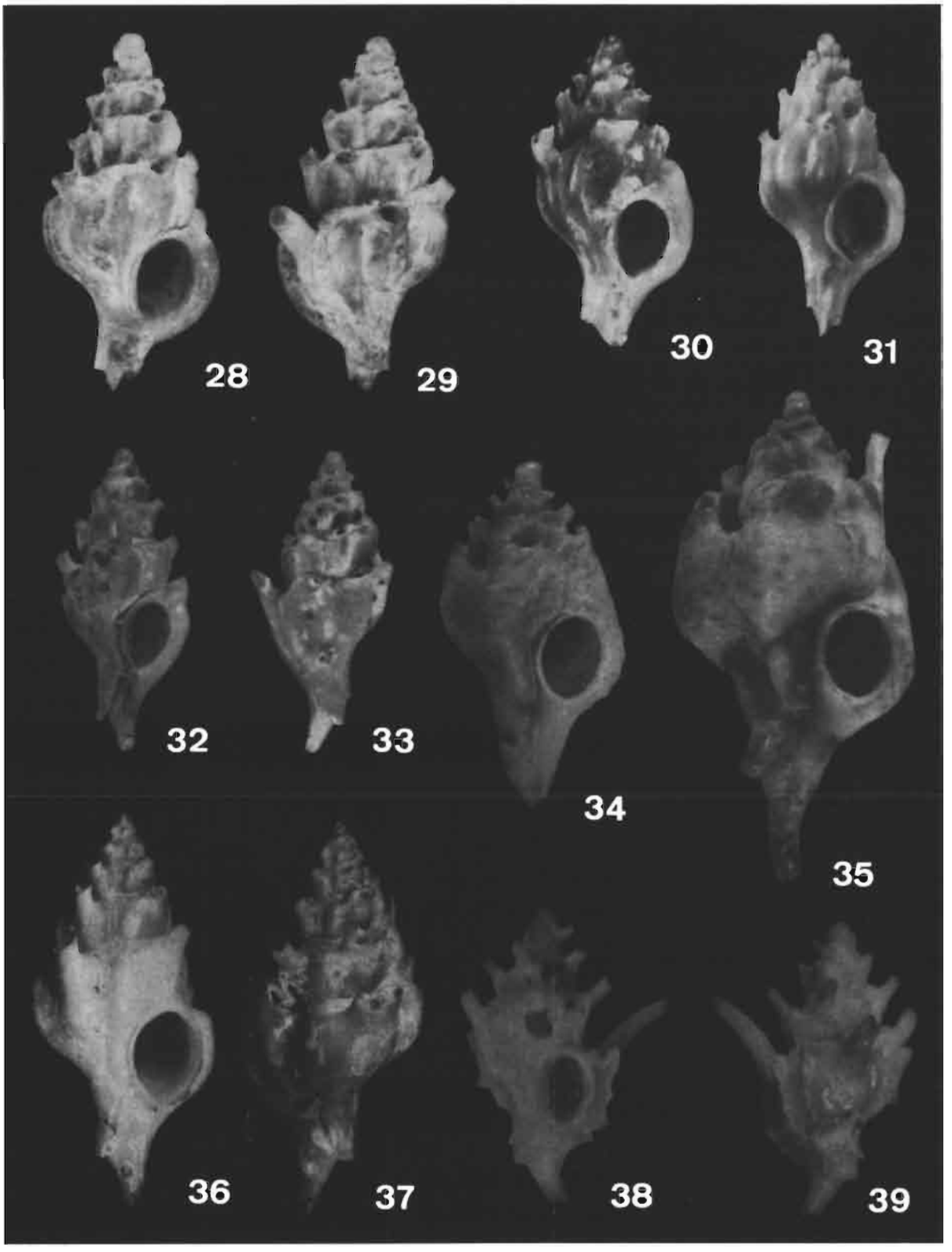
VELLA, P., 1961. — Australasian Typhinae (Gastropoda) with notes on the subfamily. *J. Palaeontology*, **4** (3) : 362-391, pls 46-47.



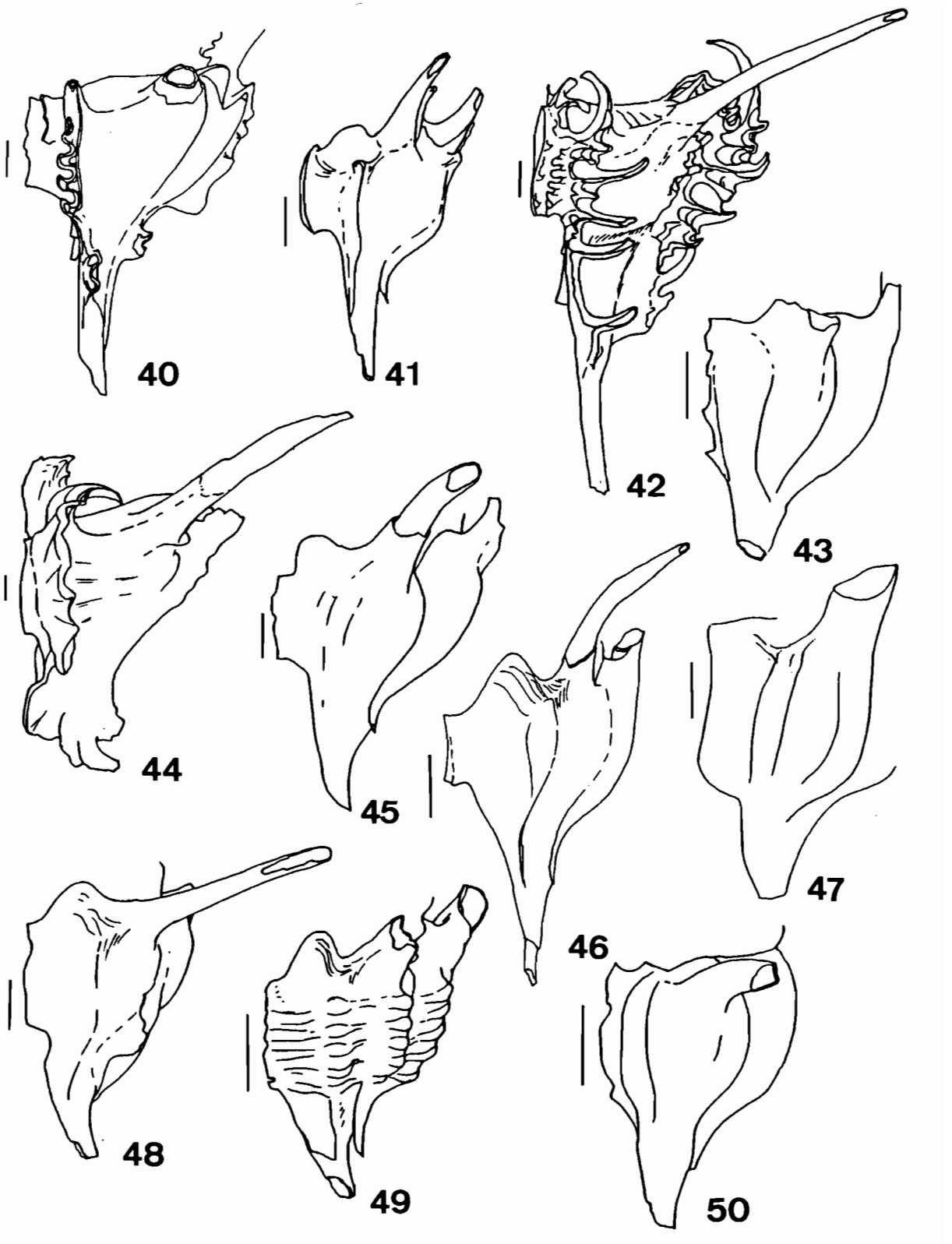
FIGS 10-18. — **10**. *Typhis (Typhina) imperialis* Keen & Campbell, 1964, New Caledonia, MUSORSTOM 4 : stn DW 222, MNHN, 13.5 mm. — **11**. *Typhis (Typhina) carolinae* Houart, 1987, New Caledonia, holotype MNHN, 20.5 mm. — **12**. *Typhis (Typhina) virginiae* Houart, 1986, New Caledonia, holotype MNHN, 7.8 mm. — **13**. *Typhis (Talityphis) neocaledonicus* Houart, 1987, New Caledonia, holotype MNHN, 18 mm. — **14**. *Siphonochelus (S.) pavlova* (Iredale, 1936), New Caledonia, MUSORSTOM 4 : stn CC 247, MNHN, 10 mm. — **15-16**. *Siphonochelus (S.) angustus* sp. nov., holotype MNHN, 6.7 mm. — **17-18**. *Siphonochelus (S.) boucheti* sp. nov., holotype MNHN, 10.1 mm.



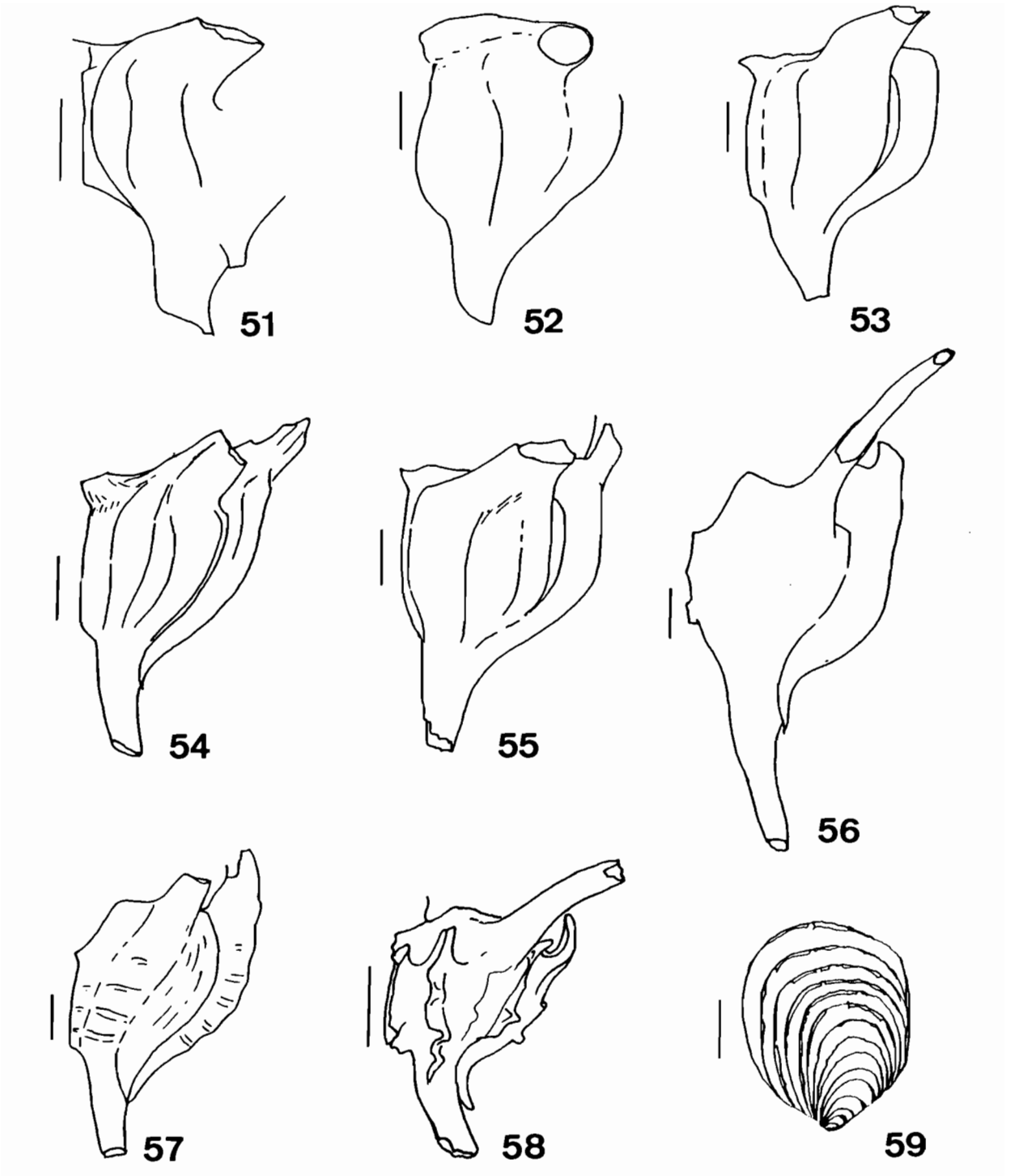
FIGS 19-27. — **19-20**. *Siphonochelus (S.) saltantis* sp. nov., holotype MNHN, 9.2 mm. — **21-23**. *Siphonochelus (S.) unicornis* sp. nov. : 21. New Caledonia, BIOCAL : stn DW 46, paratype MNHN, 9.1 mm. ; 22-23. Holotype MNHN, 12 mm. — **24-25**. *Siphonochelus (? Siphonochelus) undulatus* sp. nov., holotype MNHN, 5.9 mm. — **26-27**. *Siphonochelus (Laevityphis) tillierae* Houart, 1986. : 26. Holotype MNHN, 5.9 mm. ; 27. New Caledonia, BIOCAL : stn DW 80, MNHN, 8 mm.



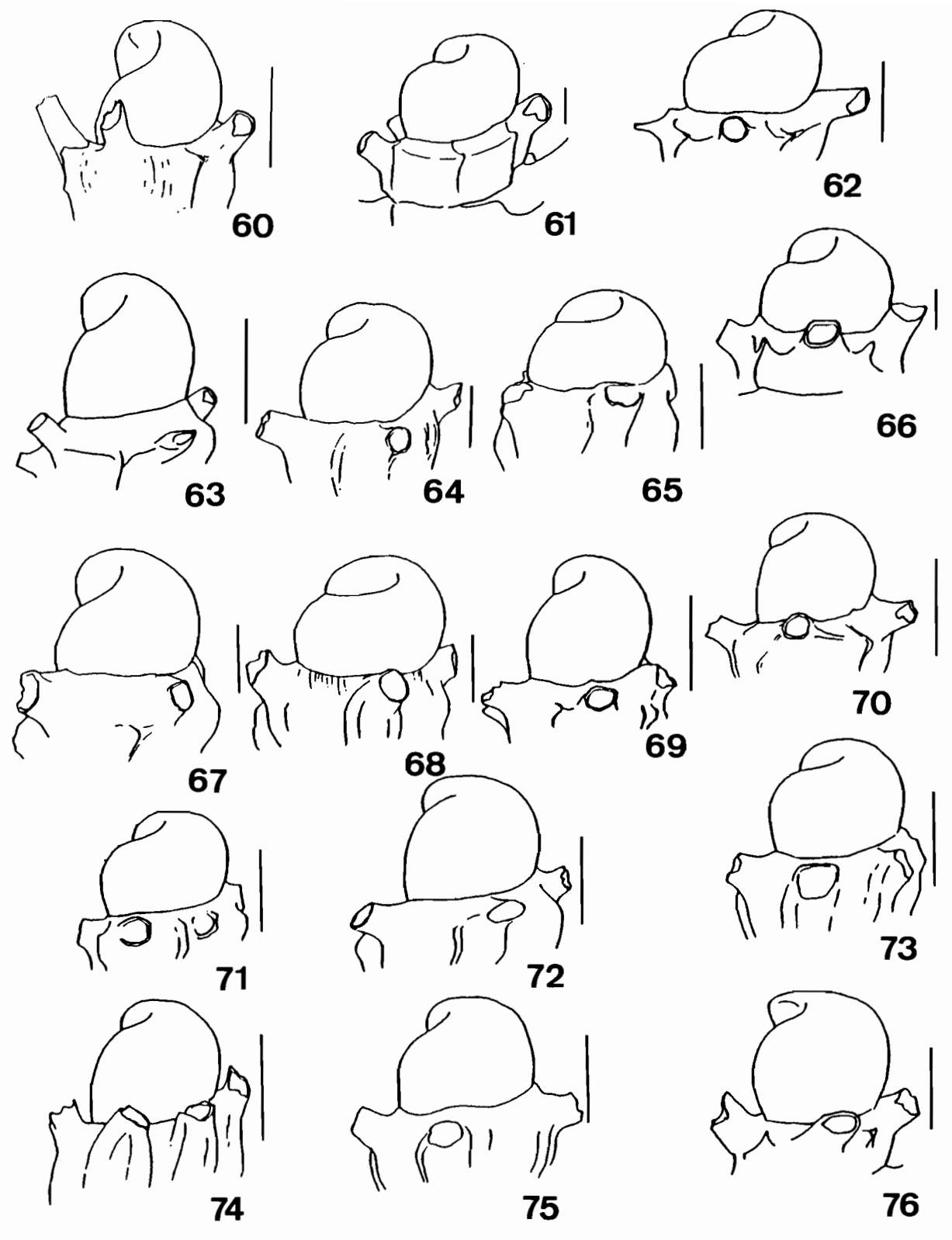
FIGS 28-39. — **28-29**. *Siphonochelus (S.) nipponensis* Keen & Campbell, 1964, Japan, NSMT 44065, 7.5 mm. — **30**. *Siphonochelus (S.) japonicus* (A. Adams, 1863), Japan, NSMT 44066, 6.6 mm. — **31**. *Siphonochelus (? Siphonochelus) syringianus* (Hedley, 1903), South Queensland, Australia, R. HOUART coll., 8.8 mm. — **32-33**. *Siphonochelus (S.) solus* Vella, 1961, New Zealand, NMNZ 66725, 9 mm. — **34**. *Siphonochelus (S.) erythrostigma* Keen & Campbell, 1964, South Queensland, Australia, R. HOUART coll., 10 mm. — **35**. *Siphonochelus (S.) pavlova* (Iredale, 1936), South Queensland, Australia, R. HOUART coll., 15.2 mm.— **36-37**. *Siphonochelus (S.) generosus* Iredale, 1936, syntype AMS C60688, 11.8 mm. — **38-39**. *Typhis (Typhina) bivaricata* Verco, 1909, holotype SAM D13481, 6 mm.



FIGS 40-50. — Profiles of aperture and last varix of Typhinae (scale lines : 1 mm). — **40**. *Typhis (Typhina) imperialis*, MUSORSTOM 4 : stn DW 222, MNHN. — **41**. *Typhis (Typhina) virginiae*, holotype MNHN. — **42**. *Typhis (Typhina) carolinae*, LAGON : stn 603, MNHN. — **43**. *Siphonochelus (S.) angustus*, holotype MNHN. — **44**. *Typhis (Talityphis) neocaledonicus*, holotype MNHN. — **45**. *Siphonochelus (S.) pavlova*, MUSORSTOM 4 : stn CC 247, MNHN. — **46**. *Siphonochelus (S.) saltantis*, holotype MNHN. — **47**. *Siphonochelus (S.) boucheti*, paratype MNHN. — **48**. *Siphonochelus (S.) unicornis*, BIOCAL : stn DW 46, paratype MNHN. — **49**. *Siphonochelus (? Siphonochelus) undulatus*, holotype MNHN. — **50**. *Siphonochelus (Laevityphis) tillierae*, holotype MNHN.



FIGS 51-59. — Profiles of aperture and last varix of Typhinae (scale lines : 1 mm). — **51**. *Siphonochelus (S.) japonicus*, NSMT 44066. — **52**. *Siphonochelus (S.) nipponensis*, NSMT 44067. — **53**. *Siphonochelus (S.) generosus*, syntype AMS C 60688. — **54**. *Siphonochelus (S.) solus*, NMNZ M 66725. — **55**. *Siphonochelus (? Siphonochelus) syringianus*, R. HOUART coll. — **56**. *Siphonochelus (S.) pavlova*, R. HOUART coll. — **57**. *Siphonochelus (S.) erythrostigma*, R. HOUART coll. — **58**. *Typhis (Typhina) bivaricata*, holotype SAM D 13481. — **59**. Operculum of *Typhis (Typhina) carolinae*, paratype MNHN.



FIGS 60-76. — Protoconchs (scale lines : 0.5 mm). — **60**. *Typhis (Typhina) imperialis*, BIOCAL : stn DW 64, MNHN. — **61**. *Typhis (Typhina) carolinae*, paratype MNHN. — **62**. *Typhis (Typhina) virginiae*, holotype MNHN. — **63**. *Siphonochelus (S.) pavlova, "Vauban"* : stn 40, MNHN. — **64**. *Siphonochelus (Laevityphis) tillierae*, holotype MNHN. — **65**. *Siphonochelus (S.) angustus*, holotype MNHN. — **66**. *Typhis (Talityphis) neocaledonicus*, holotype MNHN. — **67**. *Siphonochelus (Siphonochelus) unicornis*, MUSORSTOM 4 : stn CC 246, MNHN. — **68**. *Siphonochelus (S.) boucheti*, paratype MNHN. — **69**. *Siphonochelus (? Siphonochelus) undulatus*, holotype MNHN. — **70**. *Siphonochelus (S.) saltantis*, holotype MNHN. — **71**. *Siphonochelus (S.) nipponensis*, NSMT 44065. — **72**. *Siphonochelus (S.) generosus*, syntype AMS C 60688. — **73**. *Siphonochelus (S.) japonicus*, NSMT 44066. — **74**. *Siphonochelus (? Siphonochelus) syringianus*, R. HOUART coll. — **75**. *Siphonochelus (S.) solus*, NMNZ M 66725. — **76**. *Siphonochelus (S.) erythrostigma*, R. HOUART coll.

10

Mollusca Gastropoda : Columbariform Gastropods of New Caledonia

M. G. HARASEWYCH

Smithsonian Institution
National Museum of Natural History
Department of Invertebrate Zoology
Washington, DC 20560 U.S.A.

ABSTRACT

A survey of the deep-water malacofauna of New Caledonia has brought to light two species referable to the subfamily Columbariinae (Gastropoda: Turbinellidae). *Coluzea faceta* sp. nov. is described from off the Isle of Pines at depths of 385-500 m. Additional specimens of *Coluzea pinicola* Darragh, 1987, previously described from off the Isle of Pines, serve as the basis for the description of the new genus *Fustifusus*. *Serratifusus virginiae* sp. nov. and *Serratifusus lineatus* sp. nov., two Recent species of the columbariform genus *Serratifusus* Darragh, 1969, previously known only from deep-water fossil deposits of Miocene age, are also described. On the basis of anatomical and radular data, *Serratifusus* is transferred from the Columbariinae to the family Buccinidae.

RÉSUMÉ

Mollusca Gastropoda : Gastéropodes columbariformes de Nouvelle-Calédonie.

Au cours des campagnes d'exploration de la faune profonde de Nouvelle-Calédonie, deux espèces de la sous-famille Columbariinae (Gastropoda : Turbinellidae) ont été découvertes. *Coluzea faceta* sp. nov. est décrite du large de l'île des Pins entre 385 et 550 m. *Coluzea pinicola* Darragh, 1987, également décrite de l'île des Pins, a été récoltée vivante et devient l'espèce type du nouveau genre *Fustifusus*. Le genre *Serratifusus* Darragh, 1969 n'était jusqu'ici connu que de dépôts miocènes en faciès profond : deux espèces actuelles, *S. virginiae* sp. nov. et *S. lineatus* sp. nov., sont maintenant décrites de Nouvelle-Calédonie. Sur la base des caractères anatomiques et de la radula, le genre *Serratifusus* est transféré des Columbariinae à la famille des Buccinidae.

HARASEWYCH, M. G., 1991. — Mollusca Gastropoda : Columbariform Gastropods of New Caledonia. *In* : A. CROSNIER & P. BOUCHET (eds.), Résultats des Campagnes MUSORSTOM, Volume 7. *Mém. Mus. natn. Hist. nat.*, (A), **150** : 243-259. Paris ISBN : 2-85653-180-6.

Publié le 20 mars 1991.

INTRODUCTION

The Columbariinae is the most speciose of the subfamilies of Turbinellidae, with nearly 50 Recent species inhabiting bathyal depths along continental margins, predominantly in tropical and temperate latitudes (HARASEWYCH, 1986). These animals inhabit soft substrates and feed on tube-dwelling polychaete worms (HARASEWYCH, 1983). Earliest fossil representatives occur in the Late Cretaceous (Maestrichtian) deposits of Europe (DARRAGH, 1969). During the Paleogene, the Columbariinae were represented in shallow water (upper continental shelf) faunas ranging from western North America, throughout Europe, to New Zealand (DARRAGH, 1969). The few Neogene records are limited to deeper-water (outer continental shelf — upper continental slope) fossil deposits of southeastern Australia and New Zealand (DARRAGH, 1969; FINLAY, 1930), dating the shift in their habitat from subtidal to bathyal depths. Diverse columbariine faunas have long been known to occur in the western Atlantic (CLENCH, 1944, 1959; BAYER, 1971; HARASEWYCH, 1983), western Indian (MARTENS, 1901; TOMLIN, 1928; BARNARD, 1959), and western Pacific (HABE, 1979; DARRAGH, 1987; POWELL, 1979) Oceans. More recently, columbariines have been discovered along continental margins of the eastern Pacific (McLEAN & ANDRADE, 1982) and eastern Indian (HARASEWYCH, 1986) Oceans.

Dr Philippe BOUCHET, Curator of Marine Mollusca, Muséum national d'Histoire naturelle, Paris, has kindly made available specimens of columbariform gastropods dredged and trawled in the upper bathyal zone off New Caledonia as part of an ongoing faunal sampling program. The purpose of this paper is to report on this material, which contained: a new species of *Coluzea*; adult specimens and anatomical material of the recently described *Coluzea pinicola* Darragh, 1987, that serve as the basis for a description of a new genus; and two new Recent species referable to the genus *Serratifusus*, previously known only from Early to Middle Miocene horizons (DARRAGH, 1969, 1985).

MATERIALS AND METHODS

The present study is based primarily on specimens collected by the vessels R.V. "*Vauban*" and R.V. "*Jean-Charcot*" during BIOCAL, MUSORSTOM 4, LAGON, CHALCAL 2, and SMIB 4 cruises. For a narrative of the deep-sea cruises and list of stations, see RICHER de FORGES (1990).

Where sufficient specimens were available, material for anatomical studies was obtained by fracturing the shells in a vice, removing larger fragments with forceps, and dissolving remaining shell with 10% hydrochloric acid (HCl). Soft parts were rinsed in distilled water and transferred to 70% ethanol for dissection. Protoconchs and radulae were cleaned in dilute Sodium hypochlorite solution (1% NaOCl) prior to examination with SEM. All scanning electron micrographs were taken using a Hitachi S-570 SEM.

Repositories of examined specimens are indicated by the following abbreviations:

AMS — Australian Museum, Sydney
BM(NH)G — British Museum of Natural History, Geology Department, London
DMNH — Delaware Museum of Natural History, Wilmington
MNHN — Muséum national d'Histoire naturelle, Paris
NMNZ — National Museum of New Zealand, Wellington
USNM — National Museum of Natural History, Smithsonian Institution, Washington, DC

SYSTEMATIC ACCOUNT

Family TURBINELLIDAE Swainson, 1840
Subfamily COLUMBARIINAE Tomlin, 1928

Genus *COLUZEA* Allan, 1926

Coluzea Allan, 1926: 304, issued separately December 7, 1926.
Type species: *Fusus dentatus* Hutton, 1877, by monotypy.

Coluzea Finlay, 1926: 407, issued separately December 23, 1926.
Type species: *Fusus spiralis* A. Adams, 1856, by original designation.

The morphological similarities between the genera *Coluzea*, and *Fulgurofusus* Grabau, 1904, have been discussed previously (FINLAY, 1930: 267-268; HARASEWYCH, 1983: 5, 1986: 158). Full generic status is provisionally retained for *Coluzea* until a revision of the subfamily can be completed. *Coluzea* first appears in the Eocene deposits of the Paris and London Basins, and is known from the Late Oligocene of New Zealand (DARRAGH, 1969). As presently understood, the genus appears to be restricted in the Recent fauna to continental margins in the temperate and tropical regions of the Indian Ocean, to the eastern margin of the Australian tectonic plate, and to those adjacent regions of the Pacific tectonic plate west of the Andesite Line (see SPRINGER, 1982: fig. 2). A request for a ruling by the International Commission on Zoological Nomenclature on the authorship and type species of *Coluzea* (BEU *et al.*, 1969) is still pending.

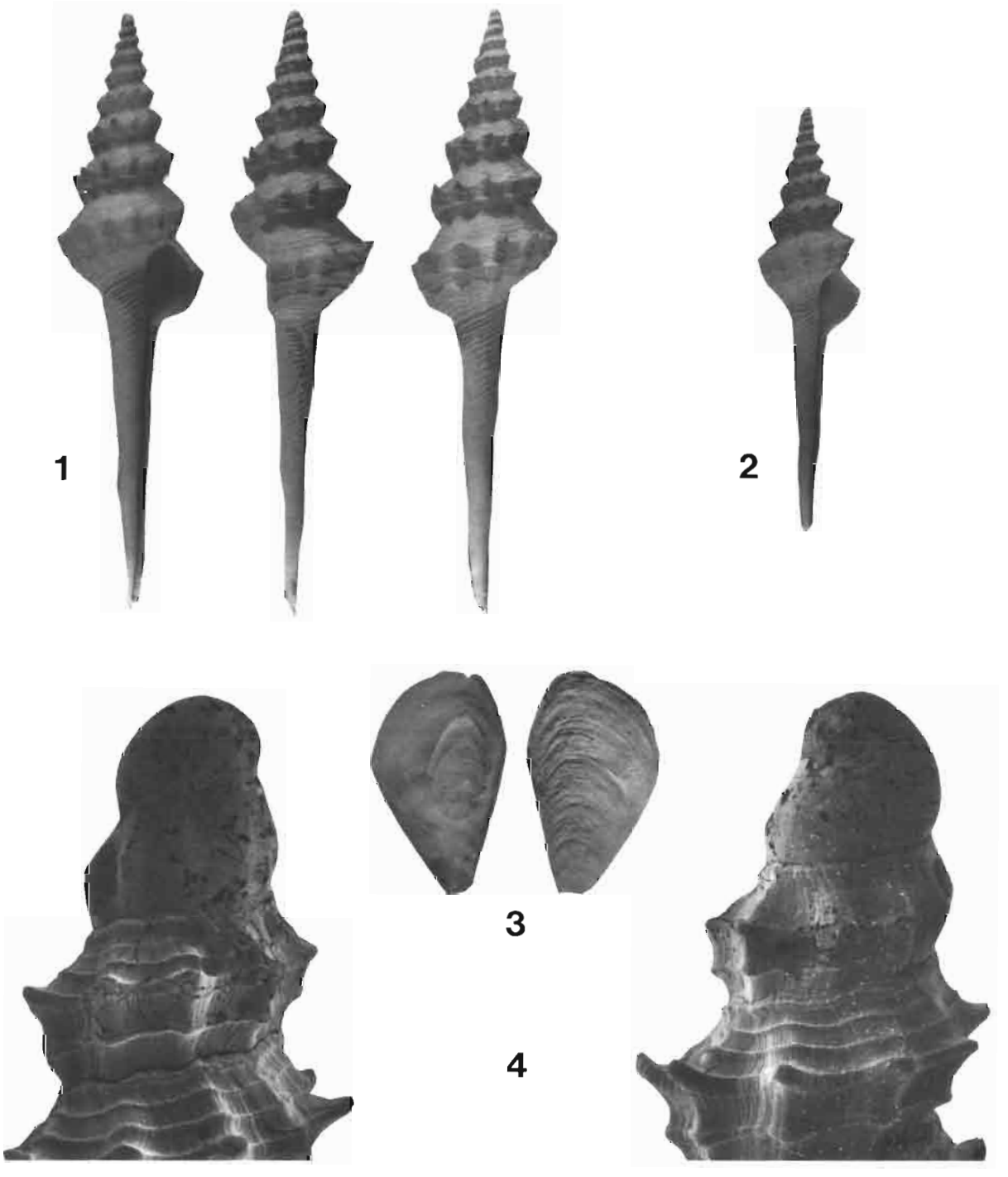
Coluzea faceta sp. nov.
Figs 1-4, 22; Table 1

MATERIAL EXAMINED. — **New Caledonia.** *"Vauban"*, 1978: stn 14, 22°16'S, 167°17'E, 465-495 m, 23-28.05.1978: paratype 10, 49.5 mm, MNHN.
MUSORSTOM 4: stn 239, 22°14.80'S, 167°15.70'E, 470-475 m, 2.10.85: paratype 9, 58.5 mm, MNHN. — Stn 242, 22°05.80'S, 167°10.30'E, 500-550 m, 3.10.1985: holotype 82.6 mm, MNHN. — Stn 247, 22°09.00'S, 167°13.30'E, 435-460 m, 4.10.1985: paratypes 1-2, 44.7 mm, 43.7 mm, USNM 860477; paratypes 3-5, 50.0 mm, 39.5 mm, 23.6 mm, MNHN; paratype 6, 38.1 mm, AMS. — Stn 248, 22°09.50'S, 167°10.00'E, 380-385 m, 4.10.1985: paratype 7, 57.4 mm, MNHN; paratype 8, 43.4 mm, NMNZ.

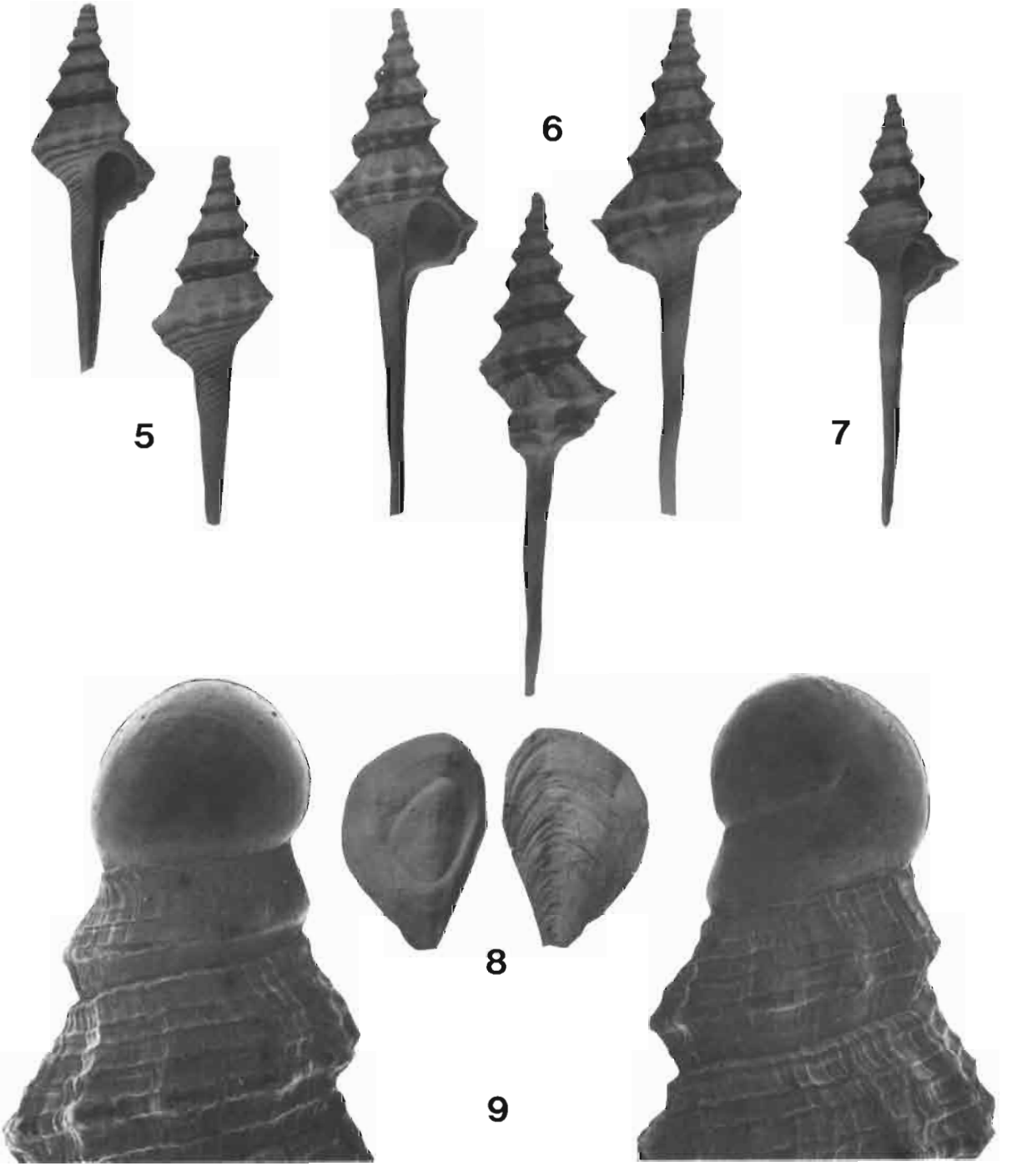
TYPE MATERIAL. — Holotype, MNHN; paratypes 1-2, USNM 860477; paratypes 3-5,7, 9, 10, MNHN; paratype 6, AMS; paratype 8, NMNZ.

TYPE LOCALITY. — Off southeastern New Caledonia, 22°05.80'S, 167°10.30'E, in 500-550 m. [MUSORSTOM 4, stn 242].

DESCRIPTION. — *Shell* (Figs 1-2) large (to 83 mm), heavy, fusiform; spire angle 28°-37°; protoconch (Fig. 4) of 1 1/4 whorls, with first whorl deflected from coiling axis by about 80°; transition to teleoconch marked by appearance of keeled axial ribs, followed within 1 whorl by spiral cords above and below shell periphery; teleoconch with up to 10 convex, weakly shouldered whorls; suture adpressed; axial sculpture of 9-10 hollow ribs on early postnuclear whorls, 10-11 thick, solid varices with short, open spines along periphery on sixth and subsequent whorls; spiral sculpture of 4-5 strong cords between suture and shoulder, 4-5 between shoulder and anterior carina, 4- 5 between anterior carina and base of siphonal canal, 32-38 cords on proximal 2/3 of siphonal canal; 1-4 fine threads between adjacent spiral cords; second, and occasionally first spiral cord anterior to periphery particularly



FIGS 1-4. — *Coluzea faceta* sp. nov. : **1**, Holotype, MNHN, MUSORSTOM 4, stn 242. Apertural, lateral and dorsal views. (0.775 x). — **2**, Paratype 7, MNHN, MUSORSTOM 4, stn 248. Apertural view. (0.775 x). — **3**, Operculum of paratype 7. (3.1 x). — **4**, Protoconch and first teleoconch whorl, paratype 5, MNHN, MUSORSTOM 4, stn 247. (24.8 x).



FIGS 5-9. — *Fustifusus pinicola* (Darragh, 1987) : **5**, Juvenile specimen of the same size as the holotype, MNHN, SMIB 4, stn 8. Apertural and dorsal views. (1.86x). — **6**, Adult specimen. MNHN, BIOCAL, stn 42. Apertural, lateral and dorsal views. (1.24 x). — **7**, Sub-adult specimen, MNHN, *"Vauban"*, 1978, stn 4. Apertural view. (1.24 x). — **8**, Operculum of specimen in figure 2. (4.34 x). — **9**, Protoconch and first teleoconch whorl, *"Vauban"*, 1978 stn 4. (24.8 x).

pronounced, giving posterior portions of axial ribs angular, banded appearance; aperture ovate; outer lip thick, furrowed beneath periphery, inner lip smooth; siphonal canal 1/2 shell length, axial, stout, slightly sinuate distally; shell color white; periostracum thin, yellowish, consisting of series of fine, axial, blade-like lamellae; operculum (Fig. 3) thin, amber-colored, strongly ovate, with sharply tapered terminal nucleus.

TABLE 1. — *Coluzea faceta* sp. nov. Measurements of shell characters. Linear measurements in mm. N = 10.

Character	$\bar{X}$	Range	SD
Shell length	47.9	23.6-82.6	14.7
Aperture length	7.4	3.6-12.6	2.2
Aperture length / Shell length	0.16	0.14-0.17	0.01
Siphonal canal length	23.7	15.6-40.4	7.3
Siphonal canal length / Shell length	0.49	0.41-0.55	0.05
No. whorls teleoconch	7.8	7.0-10.0	1.2
No. varices, body whorl	11.2	10-13	0.9
Spire angle	32.8°	28°-37°	2.5°

Animal: One male (paratype 9) and two female (holotype and paratype 7) specimens were dissected. Mantle cavity spanned about 3/4 whorl, kidney, 1/3 whorl, digestive gland not preserved; animal uniform tan in color; foot rectangular (L/W = 2.0); tentacles short; eyes absent or unpigmented; mantle edge thickened; osphradium short, broad (L/W = 3.0), with 65 leaflets above and 50 below axis; ctenidium 1.2 times as wide, 2.5 times as long as osphradium, with about 450 leaflets; hypobranchial gland transversely pleated; rectum long, narrow; rectal gland along anterior 1/3 of rectum; anus attached to roof of mantle cavity, with short ventral papilla; extended proboscis 1.1 times shell length; radula (Fig. 22) short (2 mm), narrow (110 μm), with 105-133 rows of teeth (n = 3); lateral teeth monocuspid, with broad basal plate; rachidian teeth tricuspid, with laterally expanded basal plates; valve of Leiblein large, completely containing region of oesophageal torsion; salivary glands asymmetrical, adhering to each other and to oesophagus; salivary ducts enter oesophagus anterior to valve of Leiblein, becoming embedded beneath dorsal folds; gland of Leiblein large, occupying posterior 1/2 of cephalic sinus, situated to left and below proboscis sheath; posterior oesophagus, broad, sacculate along gland of Leiblein, constricting at rear of cephalic sinus; stomach simple, U-shaped; rectum broad posteriorly, tapering anteriorly; female pallial gonoduct with long, tall capsule gland; bursa copulatrix ovate, anterior to capsule gland; male pallial gonoduct of simple narrow duct descending to floor of mantle cavity at mid-length to form deep, open, muscular groove lined with glandular tissue, running along inner edge of short, dorsoventrally-flattened penis; penis with glandular pad at distal end, without papilla; nervous system highly concentrated, with circumoesophageal ganglia fused.

ETYMOLOGY. — *L. facetus*, well made, elegant.

DISTRIBUTION. — This species is known from 5 stations, all off the southern tip of New Caledonia. The confirmed bathymetric range is 385-500 m, with a mean station depth of 461.5 m. Living specimens were taken at all stations except "*Vauban*" 1978, station 14.

ECOLOGY. — Little is known of the habitat of this species, other than the bathymetric range. Nearly all specimens have more than one repaired shell break, indicating frequent, unsuccessful predation by crabs and/or fish. All cases of shell breakage were limited to two varices or less (< 1/5 whorl), testifying to the effectiveness of the thickened costae as antipredatory adaptations. None of the specimens had been drilled.

COMPARATIVE REMARKS. — *Coluzea faceta* is conchologically most similar to *Coluzea distephanotis* (Melvill, 1891), but may be distinguished from this and the other Recent Western Australian and New Zealand species of *Coluzea* by its heavier shell, coarse spiral sculpture, and its pronounced and thickened axial costae. The lack of a canaliculate suture differentiates it from the Indonesian species *C. liriope* Harasewych, 1986 as well as from the geographically most proximal *C. bimurata* Darragh, 1987, which inhabits shallower depths off Queensland. *Coluzea faceta* also resembles *C. angularis* (Barnard, 1959) from off South Africa, but differs in having short, open spines along the peripheral keel, and by the rounder shape of its aperture. When compared to the New Zealand species of *Coluzea*, *C. faceta* more closely resembles *C. paucispinosa* Finlay, 1930 and *C. dentata* (Hutton, 1877), both from the Miocene, than any younger species.

Genus *FUSTIFUSUS* gen. nov.

TYPE SPECIES. — *Coluzea pinicola* Darragh, 1987: 133-134, figs 4 E,I.

DESCRIPTION. — Columbariinae with heavy, fusiform, high-spired shell of moderate size (to 46 mm); protoconch, glassy, inflated, deflected from coiling axis by about 60°, first whorl as large or larger than subsequent whorl; spiral sculpture predominating in early whorls, forming sutural canal by fourth or fifth post-nuclear whorl; axial sculpture increasing in prominence with increasing shell size, forming pronounced ribs or varices with open peripheral spines by seventh post-nuclear whorl; color light brown with bands of cream or white along periphery, at juncture of body whorl with siphonal canal, and along siphonal canal (Fig. 6); basal plate of rachidian tooth U-shaped (Fig. 24), but not laterally expanded.

ETYMOLOGY. — Latin *fustis*, a knobbed stick, *fusus*, a spindle.

COMPARATIVE REMARKS. — The globose, strongly deflected protoconch, pigmented shell, and weak but distinct raised columellar plate indicate that this genus is more closely related to *Columbarium* that to any of the genera or subgenera in the *Coluzea* — *Fulgurofusus* lineage. It differs from most Recent species of *Columbarium* in retaining the plesiomorphic high spire, in having broad, thickened varices, and a channeled suture, as well as in lacking numerous serrated spiral cords along the siphonal canal. The radula of the type species is unlike that of any known columbariine in having two usually well-defined but smaller cusps on either side of the three large cusps of the rachidian tooth. The recurved basal plate lacking laterally-expanded butresses is a character shared with species of *Columbarium* [e.g. *Columbarium spinicinctum* (von Martens, 1881) see HARASEWYCH, 1983: fig. 11].

Fustifusus pinicola (Darragh, 1987)

Figs 5-9, 23-24; Table 2

Synonymy: *Coluzea pinicola* Darragh, 1987: 133-134, figs 4 E,I.

MATERIAL EXAMINED. — **New Caledonia**: "*Vauban*", 1978: stn 4, 22°17'S, 167°13'E, 400 m, 23-28.05.1978: 3 specimens 37.0 mm, 26.6 mm, 14.5 mm, MNHN. — Stn 16, 22°46'S, 167°12'E, 390-400 m, 10-15.04.1978: 1 specimen 17.9 mm, MNHN.

LAGON: stn 395, 22°48.2'S, 167°07.6'E, 313 m, 23.01.1985: 1 specimen 31.9 mm, MNHN. — Stn 419, 22°42.3'S, 167°10.5'E, 330 m, 24.01.1985: 1 specimen 23.5 mm, MNHN.

BIOCAL: stn 38, 22°59.74'S, 167°15.31'E, 360 m, 30.08.1985: 1 specimen 35.44 mm, MNHN. — Stn 42, 22°45.14'S, 167°12.12'E, 380 m, 30.08.1985: 1 specimen 45.2 mm, MNHN. — Stn 44, 22°47.30'S, 167°14.30'E, 440-450 m, 30.08.1985: 7 specimens 20.8 mm, 19.4 mm, 19.3 mm, 19.2 mm, 19.0 mm, 17.8 mm, 16.6 mm, MNHN.

MUSORSTOM 4: stn 212, 22°47.40'S, 167°10.50'E, 375-380 m, 28.09.1985: 1 specimen 23.1 mm, MNHN. — Stn 226, 22°47.20'S, 167°21.60'E, 395 m, 30.09.1985: 3 specimens 41.2 mm, USNM 860478, 33.5 mm, 8.8 mm, MNHN. — Stn 227, 22°46.00'S, 167°20.00'E, 320 m, 30.09.1985: 1 specimen 20.3 mm, MNHN. — Stn 230, 22°52.50'S, 167°11.80'E, 390-420 m, 30.09.1985: 3 specimens 25.4 mm, 21.1 mm, 15.4 mm, MNHN. — Stn 234, 22°15.50'S, 167°08.30'E, 350-365 m, 2.10.1985: 1 specimen 36.6 mm, USNM 860479.

SMIB 4: stn 5, 22°56.3'S, 167°14.4'E, 398-410 m, 17.09.1986: 1 specimen 20.4 mm, MNHN. — Stn 8, 22°53.6'S, 167°12.5'E, 435-447 m, 18.09.1986: 1 specimen 21.1 mm, MNHN.

ca. 22°50'S, 167°15'E, 200-400 m: 3 specimens 40.4 mm, 35.2 mm, 24.13 mm, MNHN.

TYPE MATERIAL. — Holotype, AMS, C82163; paratype 1, AMS, C152010.

TYPE LOCALITY. — South of Isle of Pines, New Caledonia, 22°50'S, 167°35.5'E, in 370 m. ["*Kimbla*" stn K4-71-4].

DESCRIPTION. — *Shell* (Figs 5-7) of medium size (to 46 mm), moderately heavy, fusiform; spire angle 28°-33.5°; protoconch (Fig. 9) of 1

whorl, glassy, rotund; first 1/2 whorl deflected from shell axis by about 60°, larger than subsequent whorl; transition to teleoconch gradual, marked by formation of peripheral keel, rounded at first, becoming progressively more acute; nodules develop along keel by second postnuclear whorl, becoming short, open spines by fourth post-nuclear whorl; teleoconch with up to 7 convex whorls; suture adpressed; spiral sculpture of 3-4 cords between suture and periphery, 5-6 between periphery and siphonal canal, 20-28 on proximal 2/3 of siphonal canal; adsutural spiral cord increases in prominence, forming sutural canal by fourth post-nuclear whorl; axial sculpture of 8-16 low ribs per whorl, forming spines and nodes at intersections with peripheral keel and adjacent spiral cords, respectively; growth striae fine, sinuate; aperture strongly ovate to triangular; outer lip thick, glazed, furrowed beneath peripheral keel; inner lip smooth, with raised inductural edge extending length of siphonal canal in adult specimens; siphonal canal long, straight, stout; base color ginger to brown, with lighter bands along periphery and siphonal canal; aperture white, occasionally with brown band along outer lip; periostracum thin, ginger brown, with fine axial lamellae forming tufts along spiral cords and rim of sutural canal; operculum (Fig. 8) thin, amber-colored, rounded posteriorly, sharply tapered anteriorly, with terminal nucleus.

TABLE 2. — *Fustifusus pinicola* (Darragh, 1987). Measurements of shell characters. Linear measurements in mm. N = 10.

Character	$\bar{X}$	Range	SD
Shell length	35.3	23.1-45.5	6.4
Aperture length	5.6	4.5-6.7	0.8
Aperture length / Shell length	0.16	0.14-0.19	0.02
Siphonal canal length	16.9	9.4-23.4	4.5
Siphonal canal length / Shell length	0.50	0.45-0.53	0.02
No. whorls teleoconch	6.9	6.0-7.3	0.4
No. varices, body whorl	10.4	8-13	1.3
Spire angle	31.3°	28°-33.5°	1.5°

Animal: Two dried male specimens were rehydrated and dissected. Foot long, narrow, rectangular (L/W = 2.2); tentacles short, blunt, with large black eyes; mantle cavity narrow, of 1 1/4 whorl; osphradium large, broad, ctenidium equal in width to osphradium; hypobranchial gland whitish, globular, 1 1/2 times as wide as ctenidium; penis short, narrow, blunt, with open sperm groove; proboscis long, folded within proboscis sheath; buccal mass minute; radula (Figs 23, 24) short (980 µm), narrow (60 µm), consisting of 102-118 rows (n = 2); basal plate of rachidian tooth U-shaped, with 1-2 short cusps on either side of 3 long central cusps; lateral teeth with single, long, scythe- shaped cusps.

ETYMOLOGY. — Named after the type locality, the Isle of Pines.

DISTRIBUTION. — This species has been collected at 15 stations, all off the Isle of Pines. The confirmed bathymetric range for live-collected specimens is 330-440 m. Specimens inhabited by hermit crabs have been taken as shallow as 300 m. The mean station depth for all records is 373.2 m.

ECOLOGY. — This species inhabits soft substrates at depths of 330 to 440 meters, and co-occurs with *Serratifusus virginiae* sp. nov., described below, at 6 of the 15 stations. Polychaete setae were found in the rectum of one specimen of *Fustifusus pinicola*.

COMPARATIVE REMARKS. — This species was originally described in the genus *Coluzea*, based on the morphology of two immature specimens (DARRAGH, 1987). Although juvenile specimens of *Fustifusus pinicola* resemble New Zealand Miocene species of *Coluzea* in having high-spired shells with strong spiral sculpture and weak tubercles along the keel, these characters are probably symplesiomorphic within Columbariinae and therefore not indicative of close phylogenetic relationships. The globose protoconch, weakly raised columellar plate, and diffuse brown coloration present in this species are characters that occur in most western Pacific *Columbarium* species, but not in species *Coluzea* or *Fulgurofusus*. The thickened varices that generally do not appear until the seventh postnuclear whorl also occur in *Columbarium natalense* Tomlin, 1928, a species that inhabits shallower (90-200 m) depths off southeastern Africa.

Family BUCCINIDAE Rafinesque, 1815
Subfamily BUCCININAE Rafinesque, 1815

Genus *SERRATIFUSUS* Darragh, 1969

Serratifusus Darragh, 1969: 89

TYPE SPECIES. — *Fusus craspedotus* Tate, 1888, by original designation.

In his revision of the family Columbariidae, DARRAGH (1969: 90) proposed the genus *Serratifusus* for a group of closely related fossil species that: have prominent axial sculpture on the final whorl of the protoconch, have axial ribs on early teleoconch whorls, have a pronounced peripheral keel with open spines, and that lack a curved lamella on the columellar lip. He recognized that this genus differed from *Columbarium*, but retained it in the then family Columbariidae on the basis of the conchological resemblance to *Colu-zea*. *Serratifusus* was believed to be restricted to Early to Middle Miocene deposits of southeastern Australia and Tasmania (DARRAGH, 1969, 1985).

A newly discovered Recent species, described below, closely resembles *Serratifusus craspedotus* (Tate, 1888), the type species of *Serratifusus*, in features of shell and protoconch, and exhibits all the diagnostic characters of this genus. Thus, the stratigraphic range of *Serratifusus* is extended to the Recent. An examination of the anatomical organization of the Recent species reveals that *Serratifusus* is more properly assigned to the family Buccinidae. Tricuspid rachidian teeth with a rectangular basal plates, tricuspid lateral teeth, a narrow, sacculate gland of Leiblein, a closed vas deferens, a penis with a closed sperm duct, and the lack of a rectal gland are among the characters that support the transfer of the genus to the Buccinidae, and suggest that *Serratifusus* is closely related to *Penion* Fischer, 1884 (see PONDER, 1973).

In discussing the type species of *Serratifusus*, (as *Fusus craspedotus*) HARRIS (1897: 54, 135) commented on its resemblance to " certain forms of *Columbarium* ", but assigned it to the family Fasciolariidae on the basis of protoconch morphology. *Serratifusus youngi* (Chapman, 1922) was provisionally included in *Serratifusus*, but may prove to be referable to *Fusinus* (DARRAGH, 1969: 92). The eight remaining species originally included in *Serratifusus* (DARRAGH, 1969) most likely represent a monophyletic assemblage within the Buccinidae.

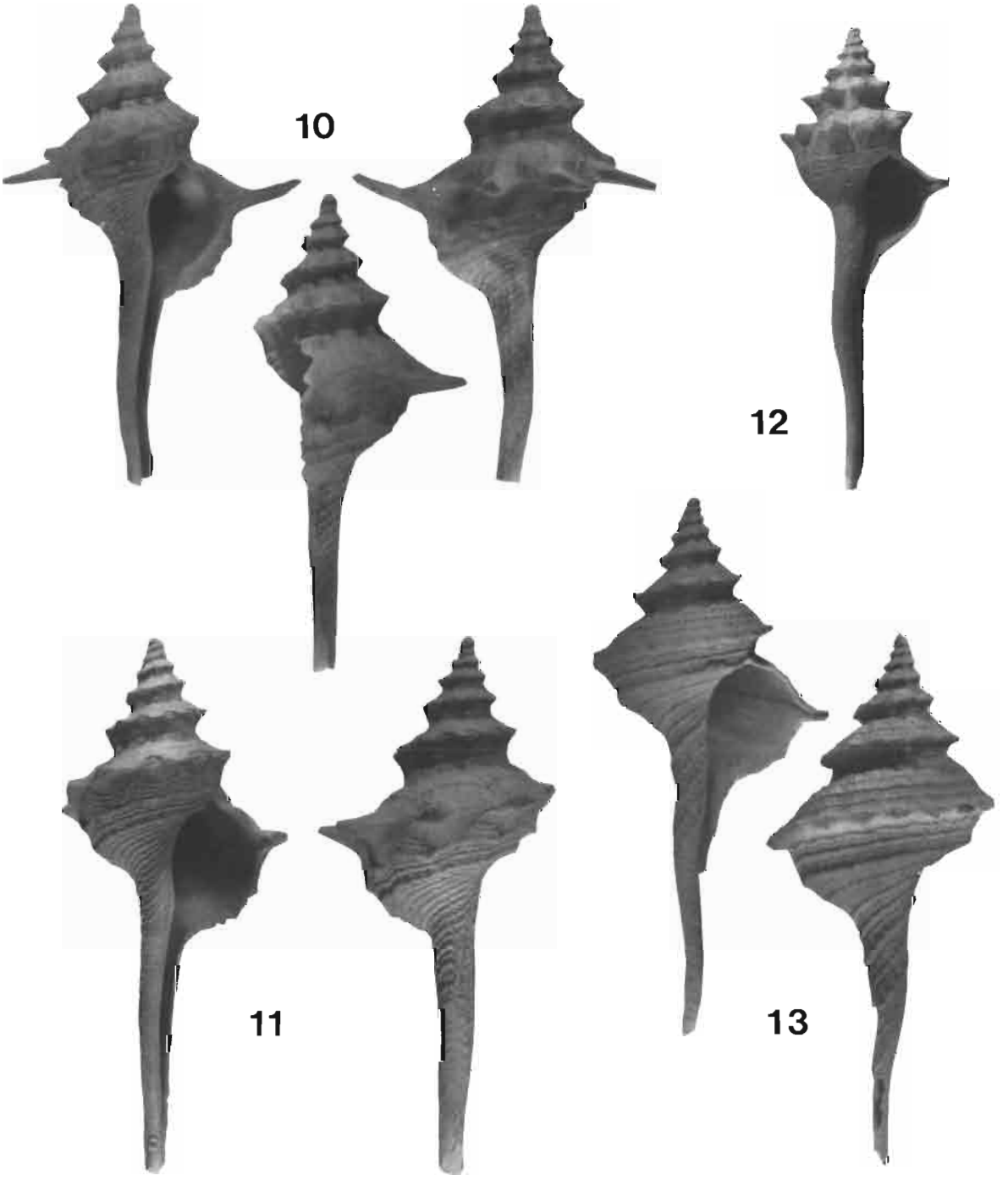
Serratifusus appears most closely related to *Penion* based on general conchological similarity as well as nearly identical anatomical organization and radular morphology (PONDER, 1973). *Serratifusus* may be distinguished from *Penion*, however, by its smaller, thinner shell, longer siphonal canal, and by its sharply angled periphery with prominent radial spines. *Serratifusus* and *Penion* are found together in Early to Middle Miocene beds (DARRAGH, 1989, personal communication). In the Recent fauna, *Serratifusus* is restricted to bathyal depths, while *Penion* occurs in shallower waters along the continental slope.

Serratifusus virginiae sp. nov.

Figs 10-12, 17, 19, 25; Table 3.

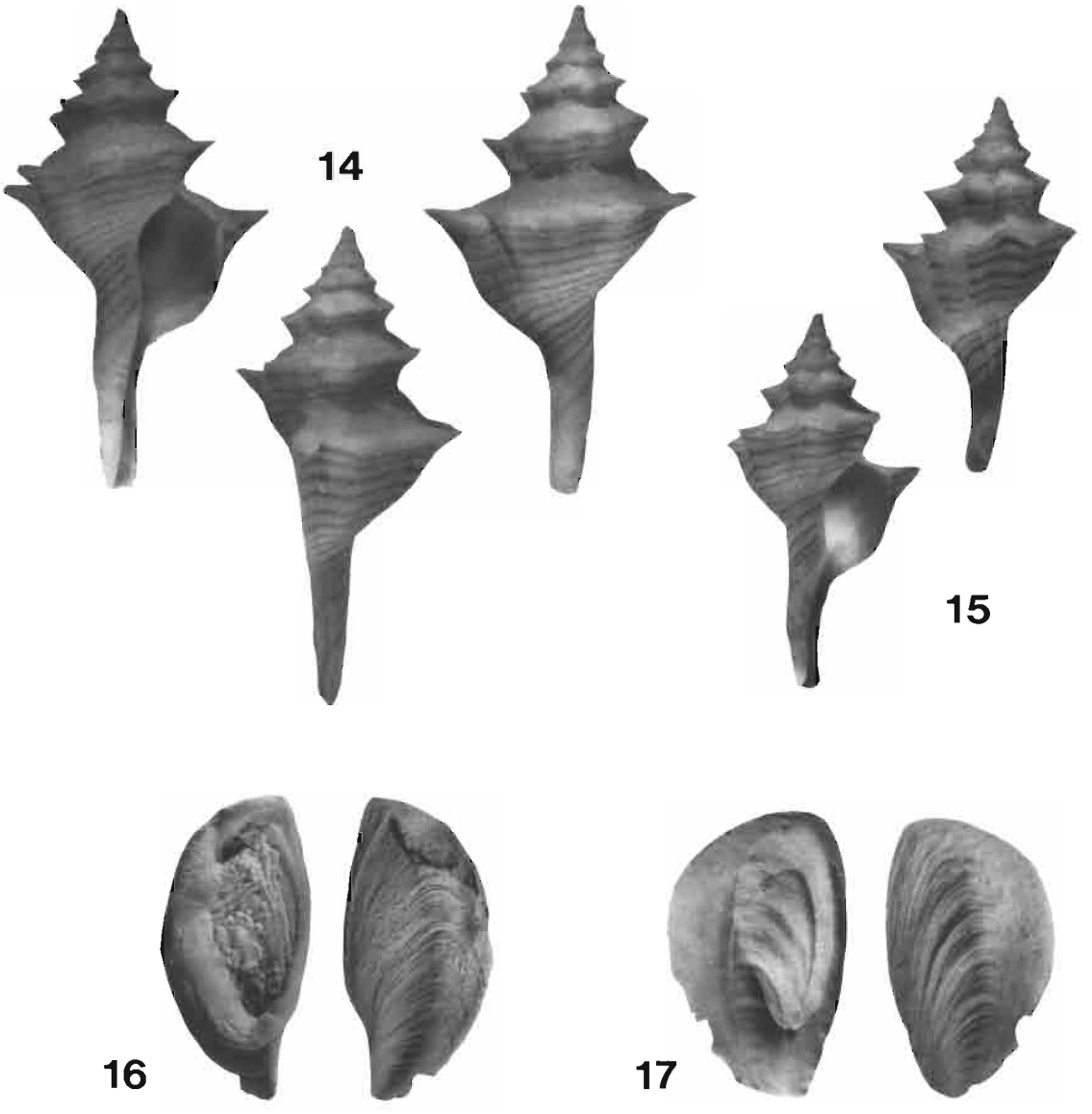
MATERIAL EXAMINED. — **New Caledonia.** *" Vauban"*, 1978: stn 16, 22°46'S, 167°12'E, 390-400 m, 10-15.04.1978: paratype 2, 40.5 mm, MNHN.

MUSORSTOM 4: stn 212, 22°47.40'S,167°10.50'E, 375-380 m, 28.09.1985: holotype, 40.7 mm, MNHN; paratype 1, 45.2 mm, USNM 860480. — Stn 226, 22°47.20'S, 167°21.60'E, 395 m, 30.09.1985: paratypes 3-4, 34.9 mm, 28.9 mm, MNHN. — Stn 227, 22°46.00'S, 167°20.00'E, 320 m, 30.09.1985: paratype 5, 35.6 mm, AMS; paratype 6, 32.8 mm, MNHN. — Stn 234, 22°15.50'S, 167°08.30'E, 350-365 m, 2.10.1985: paratypes 7-8, 39.0 mm, 30.7 mm, MNHN.



FIGS 10-12. — *Serratifusus virginiae* sp. nov. : **10**, Holotype, MNHN, MUSORSTOM 4, stn 212. Apertural, lateral and dorsal views. (1.24 x). — **11**, Paratype 1, USNM 860480 , MUSORSTOM 4, stn 212. Apertural and dorsal views. (1.24 x). — **12**, Paratype 7, MNHN, MUSORSTOM 4, stn 234. Apertural view. (1.24 x).

FIG. 13. — *Serratifusus craspedotus* (Tate, 1888). BM(NH) G.38761-5, Muddy Creek near Hamilton, Victoria, Australia. Balcombian (Middle Miocene). Apertural and dorsal views (1.24 x).



FIGS. 14-16. — *Serratifusus lineatus* sp. nov. : **14**, Holotype, MNHN, MUSORSTOM 4, stn 181. Apertural, lateral and dorsal views. (1.24 x). — **15**, Paratype 1, USNM 860843, MUSORSTOM 4, stn 181, apertural and dorsal views. (1.24 x). — **16**, Operculum of holotype of *Serratifusus lineatus* sp. nov. (3.1 x).

FIG. 17 — *Serratifusus virginiae* sp. nov. : Holotype, MNHN, MUSORSTOM 4, stn 212. Operculum.

CHALCAL 2: stn 81, 23°19.60'S, 168°03.40'E, 311 m, 31.10.1986: paratype 10, 38.2 mm, NMNZ; paratypes 11-12, 19.4 mm, 18.5 mm, USNM 860481. — Stn 82, 23°13.68'S, 168°04.27'E, 304 m, 31.10.1986: paratypes 13-14, 31.0 mm, 30.7 mm, MNHN.

From fishing boat, ca. 22°50'S, 167°15'E, 200-400 m: paratype 9, 31.7 mm, MNHN.

TYPE MATERIAL. — Holotype, MNHN; paratype 1, USNM 860480; paratypes 2-4, MNHN; paratype 5, AMS; paratypes 7-9, MNHN; paratype 10, NMNZ; paratypes 11-12, USNM 860481; paratype 13-14, MNHN.

TYPE LOCALITY. — West of the Isle of Pines, New Caledonia, 22°47.40'S, 167°10.50'E, in 375-380 m. [MUSORSTOM 4, stn 212].

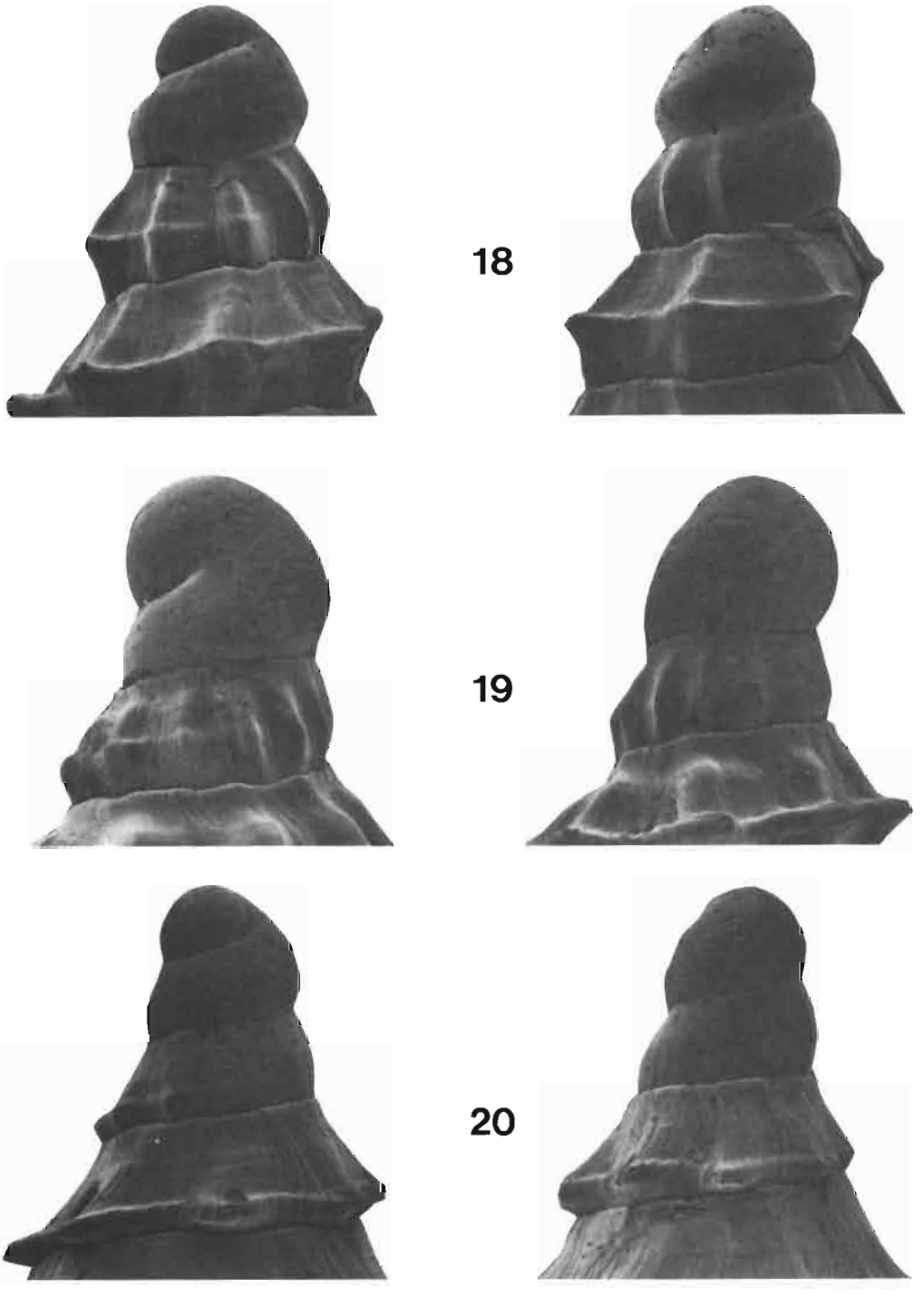
DESCRIPTION. — *Shell* (Figs 10-12) large (to 46 mm), thin, fusiform; spire angle 45-55°; protoconch (Fig. 19) of 1 1/2 inflated whorls, first whorl deviated from coiling axis by 45°; transition to teleoconch marked by smooth axial ribs with knobs along periphery becoming gradually more pronounced, forming short, broad, open spines by third postnuclear whorl; teleoconch with up to 6 inflated, sharply shouldered whorls; suture adpressed; spiral sculpture weak, area between suture and peripheral keel smooth, with weak threads along spines; body whorl below periphery with 19-21 cords; cords equally broad posteriorly, gradually differentiating into alternating broad and narrow cords anteriorly; 36-38 alternating broad and narrow spiral cords on proximal 2/3 of siphonal canal; axial sculpture of 6-8 ribs on early whorls, forming broad spines on later whorls; growth striae very fine, strongly sinuate; aperture subtriangular; outer lip furrowed beneath peripheral keel; inner lip smooth; siphonal canal long, slightly sinuate; shell color light tan to ginger, with white blotches on spines and reddish brown blotches most strongly pronounced between suture and periphery and along siphonal canal; aperture white to light tan; periostracum thin, amber-colored, axially lamellate; operculum (Fig. 17), broadly oval, with terminal nucleus and median ridge.

Animal: One male (paratype 5) and two female (holotype and paratype 1) specimens were dissected. Soft parts span 2 1/2 whorls, mantle cavity 1/2 whorl, kidney 1/4 whorl, digestive gland 1 1/2 whorls; animal yellowish tan, with fine black spots on head, foot; foot broad (L/W = 1.2); tentacles short, broad; eyes large, black; mantle edge thin, smooth; osphradium long, broad (L/W = 3.2), with 97 leaflets above and 78 leaflets below axis; ctenidium equally long, 1 3/4 times as wide as osphradium, with about 280 leaflets; hypobranchial gland narrower than ctenidium; rectum broad posteriorly, tapering anteriorly; rectal gland absent; anus pendant; extended proboscis about 0.4 times shell length; radula (Fig. 25) short (2 mm), narrow (80 µm), of 90-112 rows of teeth (n = 3); lateral teeth tricuspid, outermost cusp longest, emanating from near center of basal plate, central cusp shortest, thinnest; rachidian teeth tricuspid, central cusp longest, basal plate deep, rectangular; valve of Leiblein large, anterior to region of esophageal torsion; salivary ducts paired, surrounding valve of Leiblein and nerve ring; gland of Leiblein, thin, brown, situated along left side of retracted proboscis; stomach simple, tubular; female pallial gonoduct comprised of albumen gland, situated along right side of kidney, large ingesting gland, long, narrow capsule gland, and large, muscular, anteriorly situated bursa copulatrix; male pallial gonoduct consists of closed muscular duct of uniform diameter, glandular along posterior 3/4 of length, leading from rear of mantle cavity to base of penis; penis short (1/2 mantle cavity length), distally broad, dorsoventrally compressed, with short papilla along truncated distal outer edge; nervous system highly concentrated.

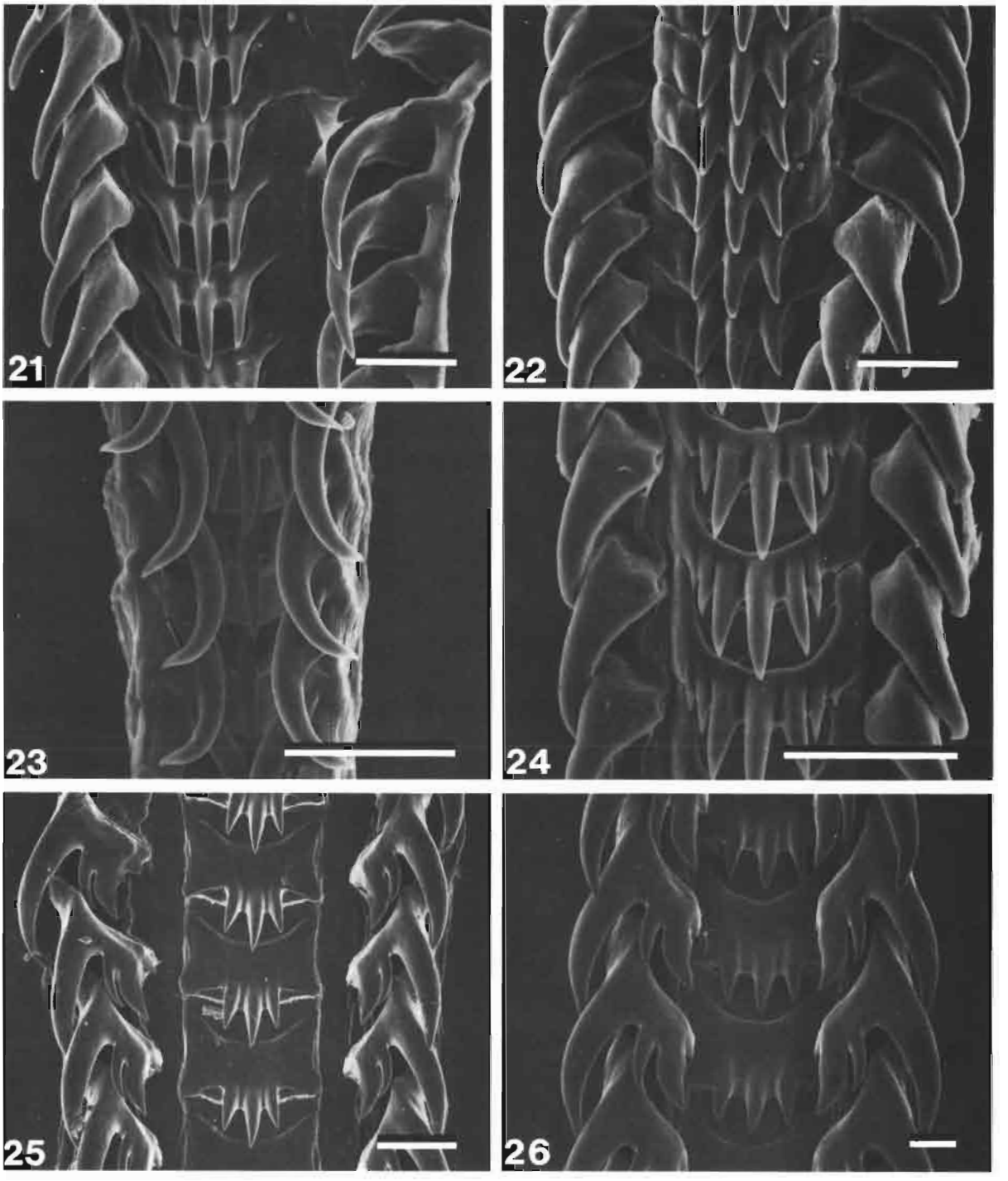
TABLE 3. — *Serratifusus virginiae* sp. nov. Measurements of shell characters. Linear measurements in mm. N = 9.

Character	$\bar{X}$	Range	SD
Shell length	34.8	17.3-45.2	7.8
Aperture length	8.8	6.1-11.8	2.7
Aperture length / Shell length	0.25	0.19-0.32	0.04
Siphonal canal length	15.4	8.6-21.3	4.2
Siphonal canal length / Shell length	0.44	0.36-0.53	0.07
No. whorls teleoconch	5.0	3.5-5.75	0.6
No. varices, body whorl	10.2	8-12	1.1
Spire angle	49.6°	45.5°-55.0°	3.2°

ETYMOLOGY. — This species honors Ms Virginie HEROS for her work in processing much of



FIGS. 18-20. — Protoconch and early teleoconch whorls of species of *Serratifusus*. All views 15.5 x : **18**, *Serratifusus craspedotus* (Tate, 1888), BM(NH) G.38761-5, muddy Creek near Hamilton, Victoria, Australia. Balcombian (Middle Miocene). — **19**, *Serratifusus virginiae* sp. nov., MUSORSTOM 4, stn 227. — **20**, *Serratifusus lineatus* sp. nov., MUSORSTOM 4, stn 181.



Radulae. Oriented with anterior end toward top of the page. All scale bars = 25 µm.
FIG. 21. — *Coluzea spiralis* (A. Adams, 1856) DMNH 48393. Off Kawau Id., North Island, New Zealand.
FIG. 22. — *Coluzea faceta* sp. nov. Holotype, MNHN, MUSORSTOM 4, stn 242.
FIG. 23-24. — *Fustifusus pinicola* (Darragh, 1987), USNM 860479, MUSORSTOM 4, stn 234 ;
23, Radula in retracted orientation, with lateral teeth folded over rachidian teeth.
24, Radula in extended, rasping orientation, with lateral teeth unfolded.
FIG. 25. — *Serratifusus virginiae* sp. nov. Holotype, MNHN, MUSORSTOM 4, stn 212.
FIG. 26. — *Serratifusus lineatus* sp. nov. Holotype, MNHN, MUSORSTOM 4, stn 181.

the deep-water expedition material collected off New Caledonia.

DISTRIBUTION. — This species has been collected at 8 stations, all off the Isle of Pines. The confirmed bathymetric range is 311-395 m for live-collected specimens. The mean station depth for all specimens is 343.4 m.

ECOLOGY. — This species inhabits soft substrates at depths of 300 to 390 meters, and co-occurs with *Fustifusus pinicola* (Darragh, 1987) at 6 of 8 stations. No identifiable gut contents were found in any of the three specimens examined.

COMPARATIVE REMARKS. — The inclusion of this new species in the genus *Serratifusus* is based on its distinctive protoconch as well as features of the sculpture, aperture and peripheral keel (DARRAGH, 1969: 69). Adult specimens of *Serratifusus virginiae* closely resemble *Serratifusus craspedotus* (Tate, 1888) (Fig. 13), but differ in being higher-spired and narrower, in having fewer, heavier and longer spines, and in lacking pronounced spiral cords between the suture and shell periphery. Sub-adult specimens (Fig. 12) of *S. virginiae* have proportionally longer siphonal canals, and thus may bear a closer resemblance to *S. stellatus* Darragh, 1969. The latter species differs from *S. virginiae* in having a higher spire, a thicker, stouter siphonal canal, and two or three scaly lirae along the siphonal canal.

Serratifusus lineatus sp. nov.

Figs. 14-16, 20, 26; Table 4.

MATERIAL EXAMINED. — **New Caledonia.** MUSORSTOM 4: stn 156, 18°54.00'S, 163°18.80'E, 525 m, 15.09.1985: 1 specimen (fragment) 37.7 mm, MNHN. — Stn 164, 18°33.20'S, 163°13.00'E, 255 m, 16.09.1985: 1 specimen 24.5 mm, MNHN. — Stn 181, 18°57.20'S, 163°22.40'E, 355 m, 18.09.1985: holotype, 35.6 mm, MNHN; paratypes 1-3, 31.0 mm, 30.4 mm, 27.7 mm, USNM 860843; paratypes 4-18, 40.9 — 14.3 mm, MNHN; paratype 19, 35.3 mm, AMS; paratype 20, 25.4 mm, NMNZ. — Stn 184, 19°04.00'S, 163°27.50'E, 260 m, 18.09.1985: paratypes 21-31, 43.0 — 10.4 mm, MNHN. — Stn 195, 18°54.80'S, 163°22.20'E, 470 m, 19.09.1985: paratypes 32-40, 32.2 — 19.1 mm, MNHN. — Stn 196, 18°55.00'S, 163°23.70'E, 460 m, 20.09.1985: paratypes 41-46,30.7 — 17.9 mm, MNHN.

TYPE MATERIAL. — Holotype, MNHN; paratypes 1-3, USNM 860843; paratypes 4-18, MNHN; paratype 19, AMS; paratype 20, NMNZ; paratypes 21-46, MNHN.

TYPE LOCALITY. — Western end of Grand Passage, off northwestern New Caledonia, 18°57.20'S, 163°22.40'E, in 350 m. [MUSORSTOM 4, stn 181].

DESCRIPTION. — *Shell* (Figs 14-15) large (to 42 mm), thick, fusiform; spire angle 48°-55°; protoconch (Fig. 20) conical, of 1 1/2 whorls, first whorl deviated from coiling axis by 50°; transition to teleoconch marked by axial ribs with pronounced knobs along periphery that form short, broad, solid spines by third postnuclear whorl; teleoconch with up to 7 inflated, strongly shouldered whorls; suture adpressed; spiral sculpture almost entirely lacking, limited to faint threads that correspond to spiral lines of dark brown pigment; axial sculpture of 6-8 broad flat solid spines along the shoulder; growth striae fine, sinuate; aperture ovate; outer lip smooth, or with 8-12 weak denticles in large specimens; inner lip smooth; siphonal canal slightly longer than aperture, sinuate; shell color white to light tan, with parallel, dark brown bands that may be solid or interrupted, 3 between suture and periphery, 1 along periphery, 8-9 on body whorl, and 7-8 on proximal 1/2 of siphonal canal; periostracum very thin, yellowish; operculum (Fig. 16), narrow, roughly semicircular, with terminal nucleus and curved median ridge on outer surface.

Animal: One male (holotype) and one female (paratype 1) specimen were dissected. Tissues span 2 3/4 whorls, mantle cavity 1/2 whorl, kidney 1/4 whorl, digestive gland 1 3/4 whorls; animal cream colored, with fine black spots on head, foot; foot broad (L/W = 1.4); tentacles short, broad; eyes large, black; mantle edge thin, smooth; osphradium (L/W = 2.2) as wide and 2/3 as long as ctenidium, with 110 leaflets above

TABLE 4. — *Serratifusus lineatus* sp. nov. Measurements of shell characters. Linear measurements in mm. N = 10.

Character	$\bar{X}$	Range	SD
Shell length	34.6	27.7-41.1	3.6
Aperture length	10.9	9.3-12.2	0.8
Aperture length / Shell length	0.32	0.30-0.34	0.02
Siphonal canal length	11.1	8.7-13.5	1.3
Siphonal canal length / Shell length	0.32	0.30-0.33	0.01
No. whorls teleoconch	6.0	5.5-6.5	0.2
No. varices, body whorl	7.4	7-8	0.5
Spire angle	51.8°	48.0°-55.0°	2.2°

and 92 leaflets below axis; ctenidium with about 350 leaflets; hypobranchial gland narrow, pendant, glandular; rectum broad posteriorly, tapering anteriorly, detaching from roof of mantle cavity just posterior to anus; rectal gland absent; extended proboscis about 0.5 shell length; radula (Fig. 26) short (3.5 mm), narrow (180 µm), of 98-124 rows of teeth (n = 3); lateral teeth tricuspid, outermost cusps longer than basal plates, emanating from near center of basal plates, central cusps narrowest; rachidian teeth tricuspid, cusps of equal length, basal plates deep, rectangular; valve of Leiblein large, anterior to region of esophageal torsion; salivary glands paired, surrounding valve of Leiblein and nerve ring; gland of Leiblein, thin, brown, running along left side of proboscis sheath; stomach simple, tubular, with two widely separated ducts to digestive gland; female pallial oviduct consisting of albumen gland along right wall of kidney, ingesting gland, elongate capsule gland, and large, pyriform bursa copulatrix situated anterior to capsule gland; male pallial gonoduct consists of closed muscular duct of constant diameter, leading from rear of mantle cavity to base of penis; penis long (2/3 mantle cavity length), dorsoventrally compressed, tapering distally, with short papilla along truncated outer edge.

ETYMOLOGY. — Latin *lineatus*, marked with lines.

DISTRIBUTION. — This species is known only from six stations, all off the western end of the Grand Passage. The confirmed bathymetric range for live-collected specimens is 260-470 m, although fragments and hermit-crab occupied specimens were taken from 255 m to 525 m. The mean station depth for all specimens is 387.5 m, for live-collected specimens 386.3 m.

ECOLOGY. — Little is known of the ecology of this species other than it inhabits rubble bottoms at depths of 260-470 m. No identifiable gut contents were found in any of the three specimens examined.

COMPARATIVE REMARKS. — The shorter siphonal canal, smaller but thicker spines along the shoulder, lack of spiral sculpture, and the characteristic coloration consisting of parallel brown spiral lines serve to distinguish this species from *Serratifusus virginiae*, its only presently known Recent congener.

ACKNOWLEDGEMENTS

I am grateful to Thomas A. DARRAGH, Museum of Victoria, and Bruce A. MARSHALL, National Museum of New Zealand, for their reviews of an earlier draft of this manuscript. Their comments and suggestions have substantially improved this paper.

REFERENCES

ALLEN, R. S., 1926. — The geology and paleontology of the Lower Waihao Basin, South Canterbury, New Zealand. *Trans. N. Z. Inst.*, **57**: 265-309.

BARNARD, K. H., 1959. — Contributions to the knowledge of South African marine mollusca. Part II. Gastropoda: Prosobranchia: Rachiglossa. *Ann. S. Afr. Mus.*, **45**(1): 1-237.

BAYER, F. M., 1971. — New and unusual mollusks collected by R/V John Elliot Pillsbury and R/V Gerda in the tropical western Atlantic. *Bull. mar. Sci.*, **21**(1): 111-236.

BEU, A. G., DELL, R. K., FLEMING, C. A., MARWICK, J., MAXWELL, P. A., PONDER, W. F., & POWELL, A. W. B., 1969. — Requests for rulings on works on New Zealand Mollusca by R. S. Allan and H. J. Finlay. Z.N. (S.) 1868. *Bull. zool. Nom.*, **26** (1): 42-50.

CHAPMANN, F., 1922. — New or little--known fossils in the National Museum. Part XXVI: Some Tertiary mollusca. *Proc. Roy. Soc. Vict.*, **35**(1): 1-18, pl. 1-3.

CLENCH, W. J., 1944. — The genus *Columbarium* in the western Atlantic. *Johnsonia*, **1**(15): 1-4.

CLENCH, W. J., 1959. — The genus *Columbarium* in the western Atlantic. *Johnsonia*, **3**(39): 330-331.

DARRAGH, T. A., 1969. — A revision of the family Columbariidae (Mollusca: Gastropoda). *Proc. R. Soc. Vict.*, **83** (1): 63-119, pls 2-6.

DARRAGH, T. A., 1985. — Molluscan biogeography and biostratigraphy of the Tertiary of southeastern Australia. *Alcheringa*, **9**: 83-116.

DARRAGH, T. A., 1987. — Columbariinae (Gastropoda; Turbinellidae) from Queensland, Australia. *Proc. R. Soc. Vict.*, **99** (4): 127-134.

FINLAY, H. J., 1926. — Further commentary on New Zealand Molluscan systematics. *Trans. N. Z. Inst.*, **57**: 320-485, pls 18-23.

FINLAY, H. J., 1930. — Revision of the New Zealand Shells referred to *Fusinus*. *Trans. N. Z. Inst.*, **61**: 259-270, pls 47-49.

GRABAU, A. W., 1904. — Phylogeny of *Fusus* and its allies. *Smithson. misc. Collns.*, **44**(1417): 1-192, pls 1-18.

HABE, T., 1979. — The western Pacific columbariid species. *Venus*, **38**(1): 1-4.

HARASEWYCH, M.G., 1983. — A review of the Columbariinae (Gastropoda: Turbinellidae) of the western Atlantic with notes on the anatomy and systematic relationship of the subfamily. *Nemouria*, **27**: 1-42.

HARASEWYCH, M.G., 1986. — The Columbariinae (Gastropoda: Turbinellidae) of the eastern Indian Ocean. *J. malac. Soc. Aust.*, **7** (3-4): 155-170.

HARRIS, G. F., 1897. — Catalogue of the Tertiary Mollusca. Part I. Australasia. British Museum (Nat. Hist.) London: xxvi + 407 p., 8 pls.

MARTENS, E. von, 1901. — Einige neue Meer-Conchylien von der deutschen Tiefsee-Expedition. *Sber. Ges. naturf. Freunde*, Berlin: 14-26.

MCLEAN, J. H. & ANDRADE, H., 1982. — Large archibenthal gastropods of central Chile: Collections from an expedition of the R/V Anton Bruun and the Chilean Shrimp Fishery. *Contr. Sci. nat. Hist. Mus. L.A. County*, **342**: 1-20.

PONDER, W.F., 1973. — A review of the Australian species of *Penion* Fischer (Neogastropoda: Buccinidae). *J. malac. Soc. Aust.*, **2** (4): 401-428.

POWELL, A. W. B., 1979. — New Zealand Mollusca, Marine, Land and Freshwater Shells. Collins, Auckland: xiv + 500 p., 82 pls, 119 figs.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. Explorations for bathyal fauna in the New Caledonian economic zone. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 6. *Mém. Mus. natn. Hist. nat.*, (A) **145** : 9-54.

SPRINGER, V. G., 1982. — Pacific plate biogeography, with special reference to shorefishes. *Smithson. Contrib. Zool.*, **367**: 1- 182.

SWAINSON, W., 1840. — A treatise on malacology; or the natural classification of shells and shellfish. A. Spottiswoode, London: viii + 419 p.

TATE, R., 1888. — The gastropods of the older Tertiary of Australia. Part I. *Trans. R. Soc. S. Aust.* **10**: 91-176, pl. 1-13.

TOMLIN, J. R., 1928. — Reports on the marine mollusca in the collections of the South African Museum. *Ann. S. Afr. Mus.*, **25**(2): 313-335.

ACHEVÉ D'IMPRIMER
EN MARS 1991
SUR LES PRESSES
DE
L'IMPRIMERIE F. PAILLART
À ABBEVILLE

DÉPÔT LÉGAL : 1er TRIMESTRE 1991
N° IMP. 7685. DISTRIBUÉ LE 20 MARS 1991

DERNIERS TITRES PARUS
RECENTLY PUBLISHED MEMOIRS

SÉRIE A (ZOOLOGIE) :

Tome 149 : Jean CHAZEAU & Simon TILLIER (eds), 1991 — Zoologia Neocaledonica. Volume 2. 358 pp. (ISBN 2-85653-179-2) 400 FF.

Tome 148 : Loïc MATILE, 1990 — Recherches sur la systématique et l'évolution des Keroplatidae (Diptera, Mycetophiloidea). 682 pp. (ISBN 2-85653-173-3) 650 FF.

Tome 147 : Nicole BERTI (ed.), 1990 — Miscellanées sur les Staphylins. 222 pp. (ISBN 2-85653-158-X) 300 FF.

Tome 146 : Christian ERARD, 1990 — Écologie et comportement des gobe-mouches (*Aves* : *Muscicapinae, Platysteirinae, Monarchinae*) du Nord-Est du Gabon. Volume 2 : Organisation sociale et écologie de la reproduction des Muscicapinae. 234 pp. (ISBN 2-85653-178-4) 320 FF.

Tome 145 : Alain CROSNIER (ed.), 1990 — Résultats des Campagnes MUSORSTOM. Volume 6. 388 pp. (ISBN 2-85653-171-7) 440 FF.

SÉRIE B (BOTANIQUE) :

Tome 32 : Claudine FRIEDBERG, 1990 — Le savoir botanique des Bunaq. Percevoir et classer dans le Haut Lamaknen (Timor, Indonésie). 304 pp. (ISBN 2-85653-177-6) 350 FF.

Tome 31 : Odile PONCY, 1985 — Le genre Inga (Légumineuses, Mimosoideae) en Guyane française. Systématique, Morphologie des formes juvéniles, Écologie. 124 pp. (ISBN 2-85653-135-0) 210 FF.

Tome 30 : Lucile ALLORGE, 1985 — Monographie des Apocynacées — Tabernaemontanoïdées américaines. 216 pp. (ISBN 2-85653-132-6) 280 FF.

Tome 29 : Monique KEDDAM-MALPLANCHE, 1985 — Le Pollen et les stomates des Gardéniées (Rubiacées) du Gabon. Morphologie et tendances évolutives. 109 pp. (ISBN 2-85653-131-C-8) 220 FF.

Tome 28 : Marie-France ROQUEBERT, 1981 — Analyse des phénomènes pariétaux au cours de la conidiogenèse chez quelques Champignons microscopiques. 79 pp. (ISBN 2-85653-116-4) 130 FF.

SÉRIE C (SCIENCES DE LA TERRE) :

Tome 56 : Jean-Paul SAINT MARTIN, 1990 — Les formations récifales coralliennes du Miocène supérieur d'Algérie et du Maroc. 373 pp. (ISBN 2-85653-170-9) 392 FF.

Tome 55 : Georges BUSSON (ed.), 1988 — Évaporites et hydrocarbures. 144 pp. (ISBN 2-85653-155-5) 180 FF.

Tome 54 : Monette VÉRAN, 1988 — Les éléments accessoires de l'arc hyoïdien des poissons téléostomes (Acanthodiens et Osteichthyens) fossiles et actuels. 114 pp. (ISBN 2-85653-154-7) 150 FF.

Tome 53 : Donald E. RUSSELL, Jean-Pierre SANTORO and Denise SIGOGNEAU-RUSSELL, 1988 — Teeth Revisited : Proceedings of the VIIth International Symposium on Dental Morphology. 462 pp. (ISBN 2-85653-148-2) 625 FF.

Tome 10 : Jacques ROGER, 1962 (Réimpression/Reprint 1988) — BUFFON. Les Époques de la nature. Édition critique. 344 pp. (ISBN 2-85653-160-1) 100 FF.

Prix hors taxe, valides jusqu'à décembre 1991. Frais de port en sus. Vente en France : TVA 2,10 %.

Prices in French Francs are valid until December 1991. Postage not included.

La zone économique maritime de la Nouvelle-Calédonie occupe 1,5 millions de kilomètres carrés dans le sud-ouest de l'Océan Pacifique. Depuis 1984, les navires de recherche français ont effectué une série de campagnes océanographiques pour l'exploration de la faune profonde de ce secteur. Plusieurs centaines de dragages et chalutages, jusqu'à 3700 m de profondeur, ont permis la découverte d'une faune d'une grande nouveauté, dont l'étude a été entreprise par les chercheurs de nombreux pays.

Le présent volume, le septième de la série des « Résultats des Campagnes MUSORSTOM », est consacré aux Mollusques bathyaux et abyssaux de Nouvelle-Calédonie. L'extrême originalité et la remarquable diversité de cette faune apparaissent nettement à travers les dix articles : ce ne sont en effet pas moins d'une famille et une sous-famille, 5 genres et 90 espèces nouvelles qui sont décrits dans ce volume. Trois genres de Gastéropodes, jusqu'ici connus uniquement à l'état fossile d'Australie et d'Asie du Sud-Est, sont signalés pour la première fois dans la faune actuelle.

Alain CROSNIER, qui est Directeur de Recherche à l'ORSTOM, coordonne l'étude de la faune profonde de Nouvelle-Calédonie et la publication des résultats scientifiques. Il a été secondé pour ce volume par Philippe BOUCHET, Sous-Directeur au Muséum national d'Histoire naturelle.

ÉDITIONS
DU MUSÉUM
38,
RUE GEOFFROY
SAINT-HILAIRE
75005 PARIS
ISBN 2-85653-180-6
ISSN 0078-9747

PRIX : 357 FF TTC (France)
350 FF (Étranger)