1

Bathyal Pectinoidea (Bivalvia: Propeamussiidae, Entoliidae, Pectinidae) from New Caledonia and adjacent areas

Henk H. DIJKSTRA

Institute of Systematics and Population Biology
(Zoological Museum)
University of Amsterdam
P.O. Box 94766, 1090 GT Amsterdam
The Netherlands

ABSTRACT

The biological exploration of deep-sea benthos off New Caledonia during the years 1978-1989 has yielded a rich mollusc fauna, including 30 species of Pectinoidea. The highest diversity, with 14 species, is observed in the 600-800 m depth interval, and only three species have been collected below 1500 m. The fauna belongs to Propeamussiidae (21 species, all taken alive), Entoliidae (1 species, alive), and Pectinidae (8 species, 6 taken alive). Nine species are new to science: *Parvamussium multiliratum, P. retiaculum, P. retiolum, P. squalidulum, P. undisonum, P. vesiculatum, Cyclopecten horridus, C. pellucidulus* (Propeamussiidae), and *Hyalopecten mireilleae* (Pectinidae). Most of the other species are new records for the region. Ten lectotypes are designated, one new synonym and one new combination recognized. This pectinoid fauna shows a strong similarity to that of the wider Indo-Pacific, and marginally to that of northern New Zealand and southeastern Australia.

RÉSUMÉ

Les Pectinoidea bathyaux (Bivalvia: Propeamussiidae, Entoliidae et Pectinidae) de Nouvelle-Calédonie et des régions voisines.

Les campagnes océanographiques réalisées de 1979 à 1989 autour de la Nouvelle-Calédonie ont récolté une riche faune de mollusques bathyaux et abyssaux, dont 30 espèces de bivalves Pectinoidea. Le maximum de diversité est observé entre 600 et 800 m de profondeur, avec 14 espèces, alors que trois espèces seulement ont été récoltées à plus de 1500 m. Cette faunule se répartit en Propeamussiidae (21 espèces, toutes récoltées vivantes), Entoliidae (1 espèce, vivante), et Pectinidae (8 espèces, dont 6 récoltées vivantes). Neuf espèces nouvelles sont décrites : *Parvamussium multiliratum, P. retiaculum, P. retiolum, P.*

DIJKSTRA, H.H., 1995. — Bathyal Pectinoidea (Bivalvia: Propeamusiidae, Entoliidae, Pectinidae) from New Caledonia and adjacent areas. *In*: P. BOUCHET (ed.), Résultats des Campagnes MUSORSTOM, Volume 14. *Mém. Mus. natn. Hist. nat.*, **167**: 9-73. Paris ISBN 2-85653-217-9.

Published 29th December 1995.

squalidulum, P. undisonum, P. vesiculatum, Cyclopecten horridus, C. pellucidulus (Propeamussiidae), et *Hyalopecten mireilleae* (Pectinidae). La plupart des autres espèces sont signalées pour la première fois de ce secteur géographique. Des lectotypes sont désignés pour dix taxons, et une nouvelle synonymie et une nouvelle combinaison sont établies. Cette faune de Pectinoidea fait incontestablement partie de l'Indo-Pacifique avec, marginalement, quelques affinités avec le Nord de la Nouvelle-Zélande et le Sud-Est de l'Australie.

INTRODUCTION

Deep-sea pectinoid bivalves from the tropical South-West Pacific are poorly known, and only a few species were described by previous authors (E.A. SMITH, 1885; HEDLEY, 1902). During the years 1978-1989 several French expeditions have collected rich samples of marine biota from bathyal depths around New Caledonia, including many pectinoidean bivalves. The species treated here are those occurring at depths below 100 m, *i.e.* all the littoral and reef associated species are not considered. With these limitations, the collection comprises 21 species of Propeamussiidae (all taken alive), one species of Entoliidae (alive), and 8 species of Pectinidae (6 taken alive), a total of 30 pectinoids. To make the survey of New Caledonia Propeamussiidae more complete, *Parvamussium pauciliratum*, a shallow-water species, is also treated and illustrated.

The present paper completes the revision of the pectinoids of New Caledonia. In a series of papers, DIJKSTRA (1983 to 1994) and DIJKSTRA *et al.* (1989, 1990) recorded the occurence of 33 species of Pectinidae from the reefs and coral reef lagoons.

As for other papers in this volume, the material studied was collected during the cruises reported on by RICHER DE FORGES (1990, 1993). For descriptions of deep-sea bottom topography and faunal zonation around New Caledonia, I refer to ROUX (1991) and ROUX *et al.* (1991). In species descriptions, morphological terminology follows WALLER (1978, 1984, 1991, 1993) and WALLER & MARINCOVICH (1992).

Comparative material from the Indo-Pacific and type material was studied from various museum collections, viz. AMS, BMNH, KBIN, MNHN, NMNZ, NMP, NMW, RMNH, ZMA, ZMC, ZSI. The present material is stored in MNHN; paratypes have been distributed to other museums, including the reference collection of the author.

ABBREVIATIONS AND TEXT CONVENTIONS

Repositories

AIM : Auckland Institute and Museum, Auckland
AMS : Australian Museum, Sydney
BMNH : The Natural History Museum, London
HD : H.H. Dijkstra collection
IOAS : Institute of Oceanology, Academia Sinica, Qingdao
KBIN : Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels
MCZ : Museum of Comparative Zoology, Cambridge (U.S.A.)
MNHN : Muséum national d'Histoire naturelle, Paris
NMNZ : Museum of New Zealand *Te Papa Tongarewa*, Wellington
NMP : Natal Museum, Pietermaritzburg
NMV : National Museum of Victoria, Melbourne
NMW : National Museum of Wales, Cardiff
NSMT : National Science Museum, Tokyo
RMNH : Nationaal Natuurhistorisch Museum, Leiden
USNM : National Museum of Natural History, Washington, DC
ZMA : Zoölogisch Museum, Amsterdam
ZMC : Zoologisk Museum, Copenhagen
ZSI : Zoological Survey of India, New Alipur, Calcutta

Station data

CC : Chalut à crevettes (Shrimp Trawl)
CP : Chalut à perche (Beam Trawl)
DC : Drague Charcot (Charcot Dredge)
DE : Drague épibenthique (Epibenthic Sledge)
DS : Drague épibenthique Sanders (Sanders epibenthic Sledge)
DW : Drague Warén (Warén Dredge)
KG : Carottier Usnel grande surface (Usnel Box-Corer)

Other abbreviations

db : doublet (paired valves, dead collected)
lv : left valve(s)
rv : right valve(s)
spm(s) : live-taken specimen(s)
v : valve(s)
OD : Original designation
SD : Subsequent designation.

SYSTEMATIC ACCOUNT

Class BIVALVIA Linnaeus, 1758

Subclass PTERIOMORPHIA Beurlen, 1944 [emend., Boss 1982]

Superorder EUPTERIOMORPHIA Boss, 1982

Order OSTREOIDA Waller, 1978

Suborder PECTININA Waller, 1978

Superfamily PECTINOIDEA Wilkes, 1810 [emend., Waller 1978]

Family PROPEAMUSSIIDAE Abbott, 1954

Propeamussiidae Abbott, 1954: 361, 369.

DIAGNOSTIC CHARACTERS. — Free or byssate Pectinoidea with outer foliated calcitic layer on left valve and prismatic calcitic layer on right valve present on the main part of the disc; inner layer crossed-lamellar aragonite beyond pallial line, sometimes nearly to distal margins; byssal notch without ctenolium.

REMARKS. — HERTLEIN (1969: N350) placed *Propeamussium* (with *Parvamussium*), as a subgenus together with *Amusium* Röding, 1798 and *Korobkovia* Glibert & van de Poel, 1965 in the *Amusium*-group, with the note that these genera may have been derived from different groups in Pectinidae. ABBOTT (1954), however, had introduced a new family Propeamussiidae [emended by WALLER (1978: 353)], for *Propeamussium*. WALLER (1984) also included several other related genera in Propeamussiidae, viz. *Parvamussium*, *Cyclopecten* Verrill, 1897, *Similipecten* Winckworth, 1932, and *Catillopecten* Iredale, 1939. HAYAMI (1988a) mentioned also *Polynemamussium* Habe, 1951 as a Recent genus of Propeamussiidae, and treated *Parvamussium* as a synonym of *Propeamussium*. Subsequently, HAYAMI & KASE (1993: 54) raised *Parvamussium* in rank to genus.

As HAYAMI (1988b) and WALLER (1991, 1993) mentioned, the suprageneric classification of the Pectinoidea is still in disorder and under appraisal.

Genus *Propeamussium* de Gregorio, 1884

Propeamussium de Gregorio, 1884: 119. [Proposed as a subgenus of *Pecten*]. Type species (OD): *Pecten (Propeamussium) ceciliae* de Gregorio, 1884; Miocene, Sicily, Italy.

Synonyms:

Paramusium Verrill, 1897: 72. Type species (OD): *Amussium dalli* E.A.Smith, 1885; Recent, off Bermuda, W Atlantic, 796 m.
Occultamussium Korobkov, 1937: 56. [Proposed as a subgenus of *Amusium*]. Type species (OD): *Pecten semiradiatus* Mayer, 1861; Upper Eocene, Austria.
Pseudopalliorum Oyama, 1944: 244. [Proposed as a subgenus of *Propeamussium*]. Type species (OD): *Pecten interradiatus* Gabb, 1869; Eocene, California, USA.
Bathymussium Oyama, 1951: 79. [Proposed as a subgenus of *Ctenamusium*]. Type species (OD): *Amussium jeffreysii* E.A.Smith, 1885; Recent, N Sulu Sea, Philippines, 686 m.
Micramussium Oyama, 1951: 80. [Proposed as a subgenus of *Ctenamusium*]. Type species (OD): *Ctenamusium (Micramussium) siratama* Oyama, 1951; Recent, Japan, 234-291 m.
Flavamussium Oyama, 1951: 81. [Proposed as a subgenus of *Parvamussium*]. Type species (OD): *Amussium caducum* E.A.Smith, 1885; Recent, Philippines, 1280 m.
Luteamussium Oyama, 1951: 82. Type species (OD): *Amussium sibogai* Dautzenberg & Bavay, 1904; Recent, Indonesia, 289 m.

DIAGNOSIS. — *Shell* equivalve, fragile, usually rather small, mostly transparent, laterally compressed, gaping along lateral margins; *left valve* smooth or sculptured with fine radial and/or concentric riblets or striae, *right valve* with concentric lines or lirae; auricles nearly equal to equal; byssal notch moderately slight; no ctenolium; internal riblets extend to submarginal region.

DISTRIBUTION. — Jurassic-Recent. Worldwide; 275-2740 m (WALLER, 1971).

REMARKS. — GRAU (1959) repeated the original diagnosis of *Propeamussium*, and of the type species *P. ceciliae*, with a translation in English. The red colour of the fossil shell described by DE GREGORIO, is probably the colour of iron oxyde, as commented by GALE (*in* GRANT & GALE, 1931: 232). The type specimen has been subsequently figured by DE GREGORIO (1898: pl. 4, figs 10-12). Figures 13 and 14, also referred to by GRAU (1959: 9) do not belong to the type species. HERTLEIN (1969: N350) has reproduced DE GREGORIO's illustration of the right (*sic*) valve of the holotype. NORTH (1951b: 123) mentioned that he could not trace the holotype.

GRAU (1959: 9) placed *Paramussium*, *Pseudopalliorum*, *Flavamussium* and *Luteamussium* in the synonymy of *Propeamussium*, and HERTLEIN (1969: N350) subsequently added also *Occultamussium*, and *Actinopecten* with a question mark. HAYAMI (1988a) enumerated also *Parvamussium*, *Ctenamussium* (*sic*), *Glyptamusium* "Oyama, 1944" (*sic*) [= *Glyptamusium* Iredale, 1939], *Bathyamussium* and *Micramussium* as synonyms of *Propeamussium*. However, the type species of *Ctenamusium* and *Glyptamusium* are morphologically similar to *Parvamussium*, whereas the type species of *Bathymussium* and *Micramussium* are more similar to *Propeamussium*.

Differences in shell characters of *Propeamussium* and *Parvamussium* are summarized in Table 1.

TABLE 1. — Characters of *Propeamussium* and *Parvamussium*.

	Propeamussium	*Parvamussium*
dimension	10 - 85 mm	5 - 20 mm
shape	orbicular to oval	orbicular to oblique
lateral gape	present	absent
byssal notch	absent	well developed
auricles	equal or nearly equal	unequal
internal ribs	starting in early ontogeny and developed to central or sub-marginal area	starting later and developed to marginal area

Propeamussium alcocki (E.A. Smith, 1894)

Figs 1-4, 133-137

Amussium alcocki E.A. Smith, 1894: 172, pl. 5, figs 15-16.

Other references:

Amussium alcocki – ALCOCK & ANDERSON, 1897: pl. 2, figs 3-3a. — ALCOCK, 1902: 282, fig. 79. — E.A. SMITH, 1906: 255. — THIELE & JAECKEL, 1931: 8. — WINCKWORTH, 1940: 26.
Propeamussium alcocki – ABBOTT & DANCE, 1982: 303.

TYPE MATERIAL. — Lectotype (Figs 133-7, H 40.4, L 39.8, D 7.9 mm) here designated ZSI 6154/9, live taken. Three paralectotypes: BMNH 1894.9.11.1, NMW 1955.158.785, ZMC. The types are somewhat damaged near the margins, and the right valves of three of them (ZSI, BMNH, NMW) are restored.

TYPE LOCALITY. — *"Investigator"*, stn 105, 15°02′ N, 72°34′ E, Laccadive Sea, 1353 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. CORAIL 2: stn DW 171, 18°24′ S, 155°22′ E, 650 m, 2 lv, 1 rv.
New Caledonia. BIOCAL: stn CP 75, 22°18′ S, 167°23′ E, 825-860 m, 23 spms.
BIOGEOCAL: stn CP 232, 21°33′ S, 166°27′ E, 760-790 m, 3 spms.
Loyalty Islands. MUSORSTOM 6: stn CP 427, 20°23′ S, 166°20′ E, 800 m, 6 spms. — Stn CP 438, 20°23′ S, 166°20′ E, 780 m, 5 spms.

DISTRIBUTION. — Laccadive Sea and Bay of Bengal (SMITH, 1894; ALCOCK, 1902), Gulf of Aden (THIELE & JAECKEL, 1931) and New Caledonia, Chesterfield Islands and Loyalty Islands. Present material living at 760-860 m.

DESCRIPTION. — *Shell* inequivalve, circular, up to ca. 50 mm high, inequilateral, fragile, creamy, translucent.

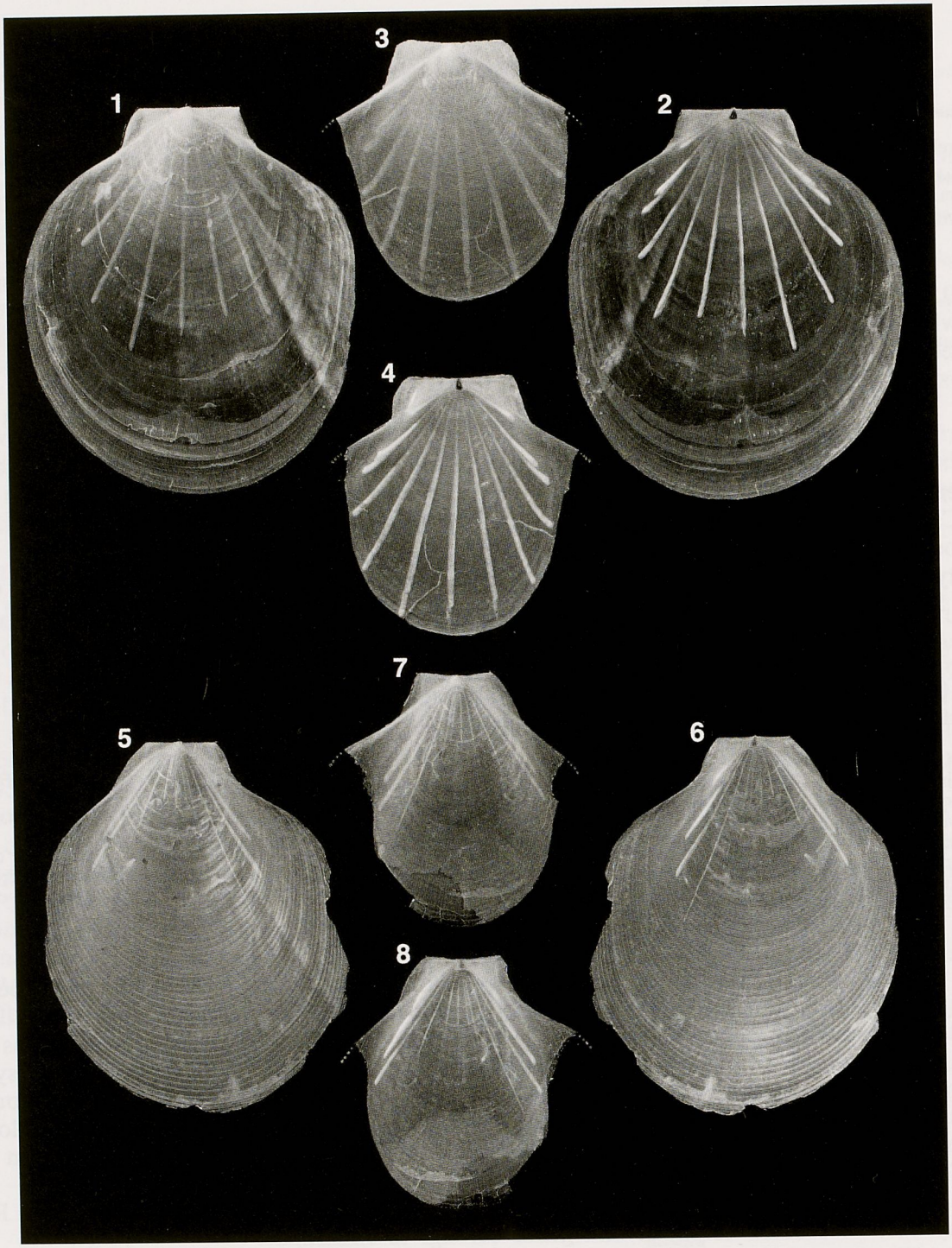
Prodissoconch ca. 240 µm in height.

Left valve somewhat more convex than right, with some concentric growth lines, and 1-3 fine radial lirae near posterior margin. Anterior margin more convex than posterior. Auricles equal, smooth, anterior margin somewhat raised. Eight to 10 internal riblets entering from near resilifer to two-thirds length of adult disc, somewhat finer than on right valve; one auricular lira on each side.

Right valve covered with wide-set concentric costae, commencing at ca. 3 mm shell length, with granulate interstitial microsculpture. Auricles with small concentric striations, prominent scales on posterior and anterior dorsal margins. Resilifer triangular. No byssal notch, or ctenolium.

REMARKS. — The present material of *Propeamussium alcocki* is similar to the type specimens, although the coloration is somewhat different (creamy instead of transparent white). All of the present specimens lack concentric lamellae near the ventral margin and minute radiations on the central part of the disc of the left valve. KNUDSEN (1967: 281) considered *P. alcocki* a junior synonym of *P. watsoni*, and interpreted as variation the differences in shape (circular to nearly oval), concentric sculpture of right valve (varies in setting), and radiating sculpture of left valve (varies in development) of his material from the Indian Ocean. I did not observe these variations in the material from around New Caledonia and the two species are well defined conchologically (see descriptions).

P. alcocki has been refered to *Amussium* Hermannsen, 1846 [emendation of *Amusium* Röding, 1798] by a number of authors, but that genus belongs to Pectinidae.



FIGS 1-8. — **1-4**, *Propeamussium alcocki*, BIOCAL: stn CP 75, 46.1 x 39.8 mm (db). — **1**, left valve, exterior. — **2**, left valve, interior. — **3**, right valve, exterior. — **4**, right valve, interior. — **5-8**, *P. andamanicum*, BIOCAL: stn CP 74, 44.9 x 36.8 mm (db). — **5**, left valve, exterior. — **6**, left valve, interior. — **7**, right valve, exterior. — **8**, right valve, interior.

Propeamussium andamanicum (E.A. Smith, 1894)

Figs 5-8, 138-142

Amussium andamanicum E.A. Smith, 1894: 172-173, pl. 5, figs 13-14.

Other references:

Amussium andamanicum – E.A. SMITH, 1895b: 265. — ALCOCK & ANDERSON, 1897: pl. 2, figs 1-1a. — E.A. SMITH, 1904: 14. — WINCKWORTH, 1940: 26. — KNUDSEN, 1967: 273, pl. 1, fig. 22, textfig. 15.

TYPE MATERIAL. — Lectotype (Figs 138-142, H 30.2, L 22.4, D 6.4 mm) here designated ZSI 7418/9, live taken. The type specimen is somewhat damaged on the posterior margin of the left valve and ventral margin of the right valve. Therefore its current dimensions differ from those in the original description. SMITH (1895b, 1904) indicated material from different stations of *"Investigator"*, however he mentioned only one station in the original description. Material from *"Investigator"*, stn 122 and 192 do not belong to the type series.

TYPE LOCALITY. — *"Investigator"*, stn 113, 12°59′ N, 93°23′10″ E, Andaman Sea, 1249 m. SMITH (1894) mentioned a depth of 688-922 fathoms [= 1258-1686 m], which should be 683 fathoms [= 1249 m] (stn 113) and 922 fathoms [= 1686 m] (stn 114). On a printed label of the Indian Museum is written in ink station number "113" and a depth of "683" fathoms (see Fig. 138).

MATERIAL EXAMINED. — The type material.
New Caledonia. BIOCAL: stn CP 74, 22°14′ S, 167°29′ E, 1300-1475 m, 1 spm.
BIOGEOCAL: stn CP 238, 21°27′ S, 166°23′ E, 1260-1300 m, 1 spm.

DISTRIBUTION. — Andaman Sea, Laccadive Sea and Arabian Sea (SMITH, 1895b, 1904), Zanzibar area and the Gulf of Aden (KNUDSEN, 1967), and now New Caledonia. Present material living at 1260-1475 m.

DESCRIPTION. — *Shell* fragile, hyaline, up to ca. 45 mm high, elongate, umbonal angle ca. 90°, left valve transparent-white, right valve creamy.

Prodissoconch ca. 250 µm in height (KNUDSEN, 1967).

Left valve somewhat more convex than right, ornamented with widespread concentric lirae that commence near the central part of disc and extend to ventral margin. Auricles equal and rather small, with delicate concentric striations. Anterior and posterior margin of auricles somewhat raised. Small scales on dorsal edge of auricles. Interior lirae commencing directly below resilifer, 9-11, with one small auricular lira on each side, all gradually enlarging.

Right valve covered with concentric lirae and interstitial granulated microsculpture (prismatic calcite layer). Auricles with delicate concentric striae. Dorsal margin with prominent scales. No byssal notch, no ctenolium. Resilifer rather triangular elongate.

REMARKS. — The present specimens resemble the type material, although the concentric lirae of the left valve are more delicate and start somewhat earlier. The internal riblets are variable in length and number. *P. andamanicum* is closest to *P. alcocki*, and is a typical *Propeamussium*.

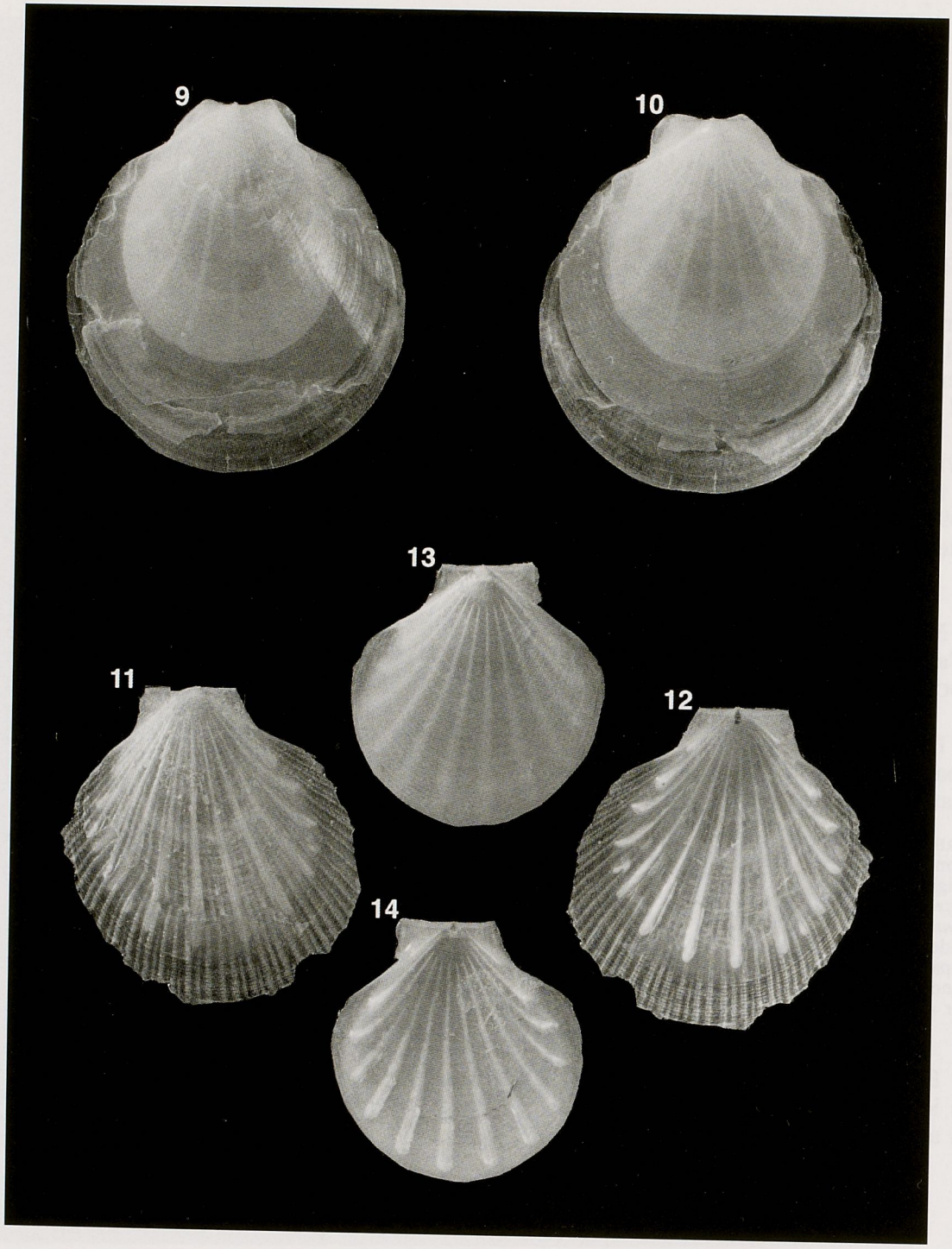
Propeamussium caducum (E.A. Smith, 1885)

Figs 9-10, 129-132

Amussium caducum E.A. Smith, 1885: 309, pl. 23, figs 1-1c.

Synonyms:

Amussium weberi Dautzenberg & Bavay, 1912: 32, pl. 28, figs 9-13.
Propeamussium nakazawai Kuroda, 1932: 87, figs 101-102 (*nomen nudum*). Synonymy established by OYAMA (1951), and subsequently followed by HABE (1958, 1977) and KNUDSEN (1967).



FIGS 9-14. — **9-10**, *Propeamussium caducum*, *"Vauban"* 1978-79: stn 31, 27.9 x 25.9 mm (db). — **9**, left valve, exterior. — **10**, right valve, exterior. — **11-14**, *P. maorium*, MUSORSTOM 4: stn CP 169, 19.2 x 18.3 mm (db). — **11**, left valve, exterior. — **12**, left valve, interior. — **13**, right valve, exterior. — **14**, right valve, interior.

Other references:

Amussium caducum – E.A. SMITH, 1894: 173; 1895a: 18; 1904: 13; 1906: 255. — MELVILL & STANDEN, 1907: 807. — THIELE & JAECKEL, 1931: 7. — WINCKWORTH, 1940: 26.
Parvamussium (Flavamussium) caducum – OYAMA, 1951: 81, pl. 13, figs 11-12. — KIRA, 1967: 138, pl. 49, fig. 15.
Flavamussium caducum – HABE, 1958: 267, pl. 11, fig. 26.
Propeamussium caducum – HAYAMI, 1988a: 476. — OKUTANI, TAGAWA & HORIKAWA, 1989: 58, figs. — DIJKSTRA, 1991: 6, figs 1-2.
Propeamussium (Propeamussium) caducum – WANG, 1984: 599, pl. 1, figs 3-4, textfig. 2. — DIJKSTRA, 1990: 9-10.

TYPE MATERIAL. — *A. caducum*: lectotype (Figs 129-132, H 20.9, L 18.8, D 4.5 mm), here designated BMNH 1887.2.9.3310, 4 paralectotypes BMNH 1887.2.9.3311/1-4. The anterior and posterior margins of the left valve and the marginal apron of the right valve of the holotype are broken off; in consequence the measurements differ slightly from the original ones. — *A. weberi*: lectotype, here designated ZMA 3.12.013, paralectotypes ZMA, RMNH, KBIN, MCZ. — *P. nakazawai*: holotype not seen.

TYPE LOCALITY. — *A. caducum*: *"Challenger"*, stn 207, 12°21′ N, 122°15′ E, W of Luzon, Philippines, alive, 1280 m. — *A. weberi*: *"Siboga"*, stn 316, 7°19.4′ S, 116°49.5′ E, Bali Sea, alive, 538 m. — *P. nakazawai*: Suruga Bay, Japan, alive, 549-732 m.

MATERIAL EXAMINED. — **New Caledonia**. *"Vauban"* 1978-79: stn 31, 22°31′ S, 166° 25′ E, 450-550 m, 2 spms. — Stn 32, 22°32′ S, 166°25′ E, 430-500 m, 2 rv. — Stn 33, 22°33′ S, 166°25′ E, 290-350 m, 1 lv. — Stn 34, 22°32′ S, 166°26′ E, 350-420 m, 2 lv.

DISTRIBUTION. — Japan (OYAMA, 1951; KIRA, 1967), Philippines (SMITH 1885; OYAMA, 1951; KNUDSEN, 1967), Indonesian Archipelago (DAUTZENBERG & BAVAY, 1912; THIELE & JAECKEL, 1931; DIJKSTRA, 1991), Arabian Sea and Bay of Bengal (SMITH, 1894, 1895a, 1904, 1906), Gulf of Aden and Zanzibar area (KNUDSEN, 1967). Now also New Caledonia. Present material living at 450-550 m.

DESCRIPTION. — *Shell* slightly inequivalve, fragile, nearly equilateral, up to ca. 25 mm high, somewhat higher than wide, rather opaque, glossy, creamy, umbonal angle about 90°, left valve somewhat more convex than the right.

Prodissoconch ca. 215 µm in height (KNUDSEN, 1967).

Left valve smooth, ornamented with concentric growth lines, no radial striations. Auricles rather small, without sculpture, somewhat raised near margins.

Right valve sculptured with wide-set concentric lirae, commencing at 3 mm shell height and extending to submarginal area, microscopic radial scratches between them. Auricles with very fine concentric striae, strong scales produced on the marginal areas of hinge. Hinge line straight near umbo, then rising near anterior and posterior dorsal margins. Internal lirae generally 10 in number, sometimes 9 or 11, slightly nodulose at distal ends. Lirae of right valve somewhat more strongly developed. No byssal notch or ctenolium, lateral gape present.

REMARKS. — Other specimens seen from the western Pacific differ slightly from the present material, mainly in coloration (somewhat paler) and in having usually 1 or 2 more internal lirae. The specimens are similar to the type material, although the concentric growth lines are weaker and there are no radial striae on the left valve. *Amussium weberi* is similar in all features, and is interpreted as junior synonym of *Propeamussium caducum*. *P. nakazawai* treated by OYAMA (1951), HABE (1958, 1977) and KNUDSEN (1967) as a synonym of *P. caducum* is a *nomen nudum* (no description and not compared with any other species).

Descriptions of the soft parts, food and reproduction are given by KNUDSEN (1967: 275). HAYAMI (1988a) described shell crystallography.

P. caducum is the type species of *Parvamussium (Flavamussium)*. KURODA & HABE (1981:62) treated *Flavamussium* as a subgenus of, and HERTLEIN (1969: N350) as a synonym of *Propeamussium*. *P. caducum* is a typical *Propeamussium*.

Propeamussium maorium (Dell, 1956)

Figs 11-14

Parvamussium maorium Dell, 1956: 20, figs 30-31.

Other references:

Parvamussium maorium – Powell, 1979: 381, figs 93.1-2. — Rombouts, 1991: 69.
Parvamussium maorum (*sic*) – Dell, 1962: 75; 1963: 206.

Type material. — Holotype dead-taken, NMNZ M9171, 5 paratypes NMNZ M9169.

Type locality. — Portobello *"Alert"*, stn 54-17, Canyon A, ENE of Taiaroa Head, New Zealand, 476-640 m.

Material examined. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn CP 387, 20°53′ S, 160°52′ E, 650-660 m, 1 spm.
CORAIL 2: stn DE 15, 20°51′ S, 160°56′ E, 580-590 m, 1 lv, 1 rv. — Stn DE 15b, 20°51′ S, 160°55′ E, 580-590 m, 3 lv, 1 rv.
New Caledonia. MUSORSTOM 4: stn CP 169, 18°54′ S, 163°11′ E, 590 m, 1 db.
Loyalty Islands. BIOGEOCAL: stn CP 232, 21°33′ S, 166°27′ E, 760-790 m, 1 lv, 2 rv.
MUSORSTOM 6: stn DW 469, 21°03′ S, 167°34′ E, 630 m, 1 spm. — Stn DW 483, 21°19′ S, 167°47′ E, 600 m, 1 spm.

Distribution. — North and South Islands of New Zealand, Chatham Islands (NMNZ), Kermadec Islands and Norfolk Island (Dijkstra, unpubl. data); now also the Chesterfield Islands and Loyalty Basin. Present material living at 600-660 m.

Description. — *Shell* somewhat inequivalve, fragile, suborbicular, up to ca. 20 mm high, semi-translucent, left valve brighter brownish or creamy than right, umbonal angle about 90°.

Prodissoconch ca. 210 µm in height.

Left valve somewhat more convex than right, covered with prominent, irregularly arranged radial costae, that extend to marginal area; the costae covered with fine lamellae, that become more closely spaced near ventral margin. Auricles small, equal in size, smooth.

Right valve with widely spaced concentric lirae. Auricles unequal, sculptured with fine concentric striae. Small scales produced on hinge line near dorsal margin. Internal lirae generally 10-12, sometimes a few secondary riblets developed between primary riblets near anterior and posterior margins. Resilifer triangular, elongate. Byssal notch small. Lateral gape present, no ctenolium.

Remarks. — The present specimens agree very well with the type material. The closest species is *Propeamussium investigatoris* (E.A. Smith, 1906) from the SE Arabian Sea. The irregularly spaced radial costae and concentric striae commence earlier on the disc of the latter species, whereas *P. maorium* is smooth and glossy at the same stage of growth. Another allied species is *P. jeffreysii* (E.A. Smith, 1885) from the Philippines, which has finer sculpture (somewhat cancellate) on the left valve that extend to the central part of the disc, and prominent concentric lamellae near the ventral margin at maturity.

Although Dell (1956) placed *P. maorium* in *Parvamussium*, it is a typical *Propeamussium*.

Propeamussium meridionale (E.A. Smith, 1885)

Figs 15-18, 143-146

Amussium meridionale E.A. Smith, 1885: 316, pl. 24, figs 1-1a.

Other references:

Amussium meridionale – KNUDSEN, 1967: 277, pl. 1, fig. 16, textfig. 17.
Propeamussium meridionale – GRAU, 1959: 12, pl. 1. — KNUDSEN, 1970: 94, pl. 12, figs 5-9, textfig. 58. — DELL, 1990: 37.
Propeamussium (Propeamussium) meridionale – DIJKSTRA, 1990: 2, 9, pl. 1, figs 1-2.
Varlamussium (*sic*) *meridionale* – POWELL, 1960: 175.
Verlamussium (*sic*) *meridionale* – CLARKE, 1962: 60.

TYPE MATERIAL. — Lectotype (Figs 143-6, H 13.8, L 13.4, D 4.0 mm) here designated, live taken, BMNH 1887.2.9.3337 (corresponding to the original description and measurements), 2 paralectotypes BMNH 1887.2.9.3335/1-2, undamaged left valve (corresponding to the figured shell from *"Challenger"*, stn 146). Posterior margin of left valve and marginal apron of right valve of the lectotype is somewhat damaged. — *A. meridionale* var. BMNH 1887.2.9.3336/1-4, 3 lv and 1 rv (stn 302) does not belong to the type series according to ICZN art. 72b(i).

TYPE LOCALITY. — *"Challenger"*, stn 158, 50°01′ S, 123° E, southern Indian Ocean, 3292 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. CORAIL 2: stn DW 172, 18°26′ S, 155°12′ E, 1100 m, 1 spm.
New Caledonia. BIOCAL: stn DS 04, 21°15′ S, 166°39′ E, 2340 m, 5 spms, 1 lv. — Stn DW 53, 23°09′ S, 167°42′ E, 975-1005 m, 3 lv. — Stn DW 56, 23°34′ S, 167°11′ E, 695-705 m, 1 rv. — Stn CP 61, 24°11′ S, 167° 31′ E, 1070 m, 3 lv, 4 rv. — Stn CP 63, 24°28′ S, 168°07′ E, 2160 m, 1 spm. — Stn DW 66, 24°55′ S, 168°21′ E, 505-515 m, 1 rv. — Stn DW 70, 23°24′ S, 167°53′ E, 965 m, 4 lv, 1 rv. — Stn DW 80, 20°31′ S, 166°48′ E, 900-980 m, 4 rv. — Stn DS 98, 21°24′ S, 166°29′ E, 2365-2470 m, 3 spms.
MUSORSTOM 4: stn DW 160, 18°42′ S, 163°13′ E, 675 m, 4 lv, 2 rv. — Stn CP 169, 18°54′ S, 163°11′ E, 600 m, 6 lv, 2 rv. — Stn CP 178, 18°56′ S, 163°12′ E, 520 m, 1 lv.
Loyalty Islands. BIOGEOCAL: stn CP 250, 21°24′ S, 166°28′ E, 2350 m, 1 spm. — Stn CP 290, 20°36′ S, 167°03′ E, 920-760 m, 2 spms, 3 lv, 2 rv. — Stn DW 296, 20°38′ S, 167°10′ E, 1230-1270 m, 3 lv, 2 rv. — Stn CP 297, 20°38′ S, 167° 10′ E, 1230-1240 m, 1 spm, 1 lv.
MUSORSTOM 6: stn DW 396, 20°48′ S, 167°00′ E, 1400 m, 3 lv, 1 rv. — Stn DW 397, 20°47′ S, 167°05′ E, 380 m, 1 lv. — Stn DW 488, 20°49′ S, 167°06′ E, 800 m, 4 spms, 37 lv, 29 rv.

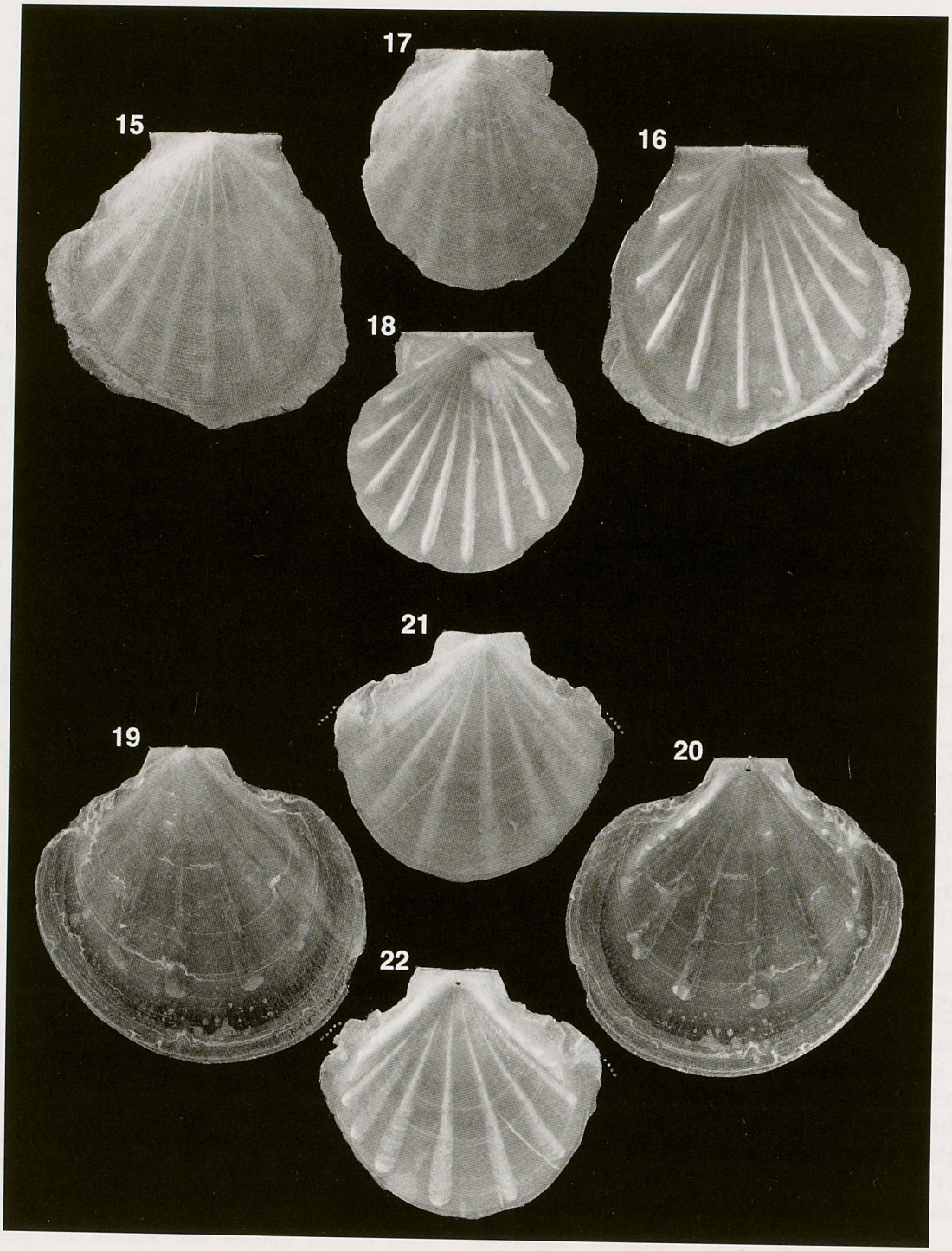
DISTRIBUTION. — SMITH (1885) recorded this species from three widely scattered localities: South of Western Australia, East of Marion Island (southern Indian Ocean), and West of Patagonia (southeastern Pacific). KNUDSEN (1967) added several new records from the northern Arabian Sea, Zanzibar area, Maldive Islands, the Gulf of Aden, and the Kermadec area (NE of New Zealand). DIJKSTRA (1990) mentioned a new record from the Flores Sea (Indonesia). Now also the Chesterfield Islands, New Caledonia and the Loyalty Islands. Present material living at 760-2470 m.

DESCRIPTION. — *Shell* fragile, somewhat inequivalve, nearly circular, up to ca. 15 mm high, left valve slightly more convex than right, auricles equal, pellucid white, umbonal angle about 120°.

Prodissoconch ca. 200 μm in height (KNUDSEN, 1967).

Left valve sculptured with delicate radial lirae, commencing at 3 mm shell length, extending almost to ventral margin. Prominent concentric lamellae extend to ventral margin, intersected by radial lirae to produce a somewhat cancellate sculpture. Auricles equal, sculptured with radial striae. Some delicate lamellae near anterior and posterior margins.

Right valve covered by regular concentric lirae, which are more close-set near margins. Auricles differently sculptured: Anterior auricle with stronger radial lirae than posterior, concentric lamellae near dorsal margin. Interior somewhat iridescent, hyaline near margins. Internal riblets variable in number, generally 12, without distinct terminal nodules. Hinge line straight with delicate scales on dorsal margin. Resilifer triangular. No byssal notch, or ctenolium.



FIGS 15-22. — **15-18**, *Propeamussium meridionale*, MUSORSTOM 6: stn DW 488, 18.0 x 18.5 mm (lv), 14.5 x 14.2 mm (rv). — **15**, left valve, exterior. — **16**, left valve, interior. — **17**, right valve, exterior. — **18**, right valve, interior. **19-22**, *P. sibogai*, MUSORSTOM 6: stn CP 467, 52.1 x 55.1 mm (db). — **19**, left valve, exterior. — **20**, left valve, interior. — **21**, right valve, exterior. — **22**, right valve, interior.

REMARKS. — The present specimens correspond very well with the type material, although the sculpture on the left valves is somewhat more pronounced, while a few (1-3) internal riblets are more strongly developed.

POWELL (1960: 175) placed *P. meridionale* in *Varlamussium*, but all its conchological characters indicate that it is *Propeamussium*.

HICKS & MARSHALL (1985: 227) describe the food of this species.

Propeamussium rubrotinctum (Oyama, 1951)

Figs 23-26

Parvamussium (Parvamussium) rubrotinctum Oyama, 1951: 81, pl. 13, figs 8-10.

Synonym:

Propeamussium (Propeamussium) stella Wang, 1984: 600, 602, pl. 1, figs 11-14. **(Syn. nov.)**

Other reference:

Propeamussium rubrotinctum – HAYAMI, 1988b: 80.

TYPE MATERIAL. — *P. rubrotinctum*: probably in the private collection of Dr K. OYAMA at Toba (not seen). — *P. stella*: holotype IOAS M25778, paratype IOAS M25779.

TYPE LOCALITY. — *P. rubrotinctum*: Shikoku, Gulf of Tosa, Japan, depth not mentioned, alive?. — *P. stella*: South China Sea, 19° N, 112.5° E, 290 m.

MATERIAL EXAMINED. — **New Caledonia**. *"Vauban"* 1978-79: stn 2, 22°17′ S, 167°14′ E, 425-430 m, 4 lv. — Stn 3, 22°17′ S, 167°12′ E, 390 m, 2 lv. — Stn 33, 22°33′ S, 166°25′ E, 290-350 m, 1 lv.
BIOCAL: stn DW 104, 21°30′ S, 166°21′ E, 375-450 m, 1 lv.
MUSORSTOM 4: stn DC 235, 22°13′ S, 167°12′ E, 405-415 m, 5 lv, 2 rv. — Stn DW 244, 22°02′ S, 167°08′ E, 435-445 m, 2 lv. — Stn CC 246, 22°08′ S, 167°11′ E, 410-420 m, 4 lv, 4 rv.
Loyalty Islands. BIOGEOCAL: stn DW 253, 21°31′ S, 166°28′ E, 310-315 m, 1 lv.
MUSORSTOM 6: stn DW 391, 20°47′ S, 167°05′ E, 390m, 1 lv, 4 rv. — Stn DW 406, 20°40′ S, 167°06′ E, 373 m, 3 lv, 5 rv. — Stn DW 407, 20°40′ S, 167°06′ E, 360 m, 1 lv. — Stn CP 408, 20°41′ S, 167°07′ E, 380 m, 2 spms. — Stn DW 410, 20°38′ S, 167°06′ E, 490 m, 1 spm, 1 lv, 1 rv. — Stn DW 411, 20°40′ S, 167°03′ E, 424 m, 11 spms, 22 lv, 13 rv. — Stn DW 412, 20°40′ S, 167° 03′ E, 437 m, > 50 spms. — Stn DW 413, 20°40′ S, 167° 03′ E, 463 m, 1 spm, 2 rv. — Stn CP 415, 20°40′ S, 167°03′ E, 461 m, 4 spms. — Stn DW 416, 20°42′ S, 166°59′ E, 343 m, 3 rv. — Stn DW 426, 20°24′ S, 166° 22′ E, 610 m, 1 lv, 1 rv. — Stn DW 428, 20°23′ S, 166°12′ E, 420 m, 1 spm, 1 rv. — Stn DW 447, 20° 54′ S, 167°19′ E, 460 m, 1 lv. — Stn DW 458, 21°00′ S, 167°29′ E, 400 m, 1 rv. — Stn DW 459, 21°01′ S, 167° 31′ E, 425 m, 1 lv. — Stn CP 464, 21°02′ S, 167°31′ E, 430 m, 3 lv, 1 rv.

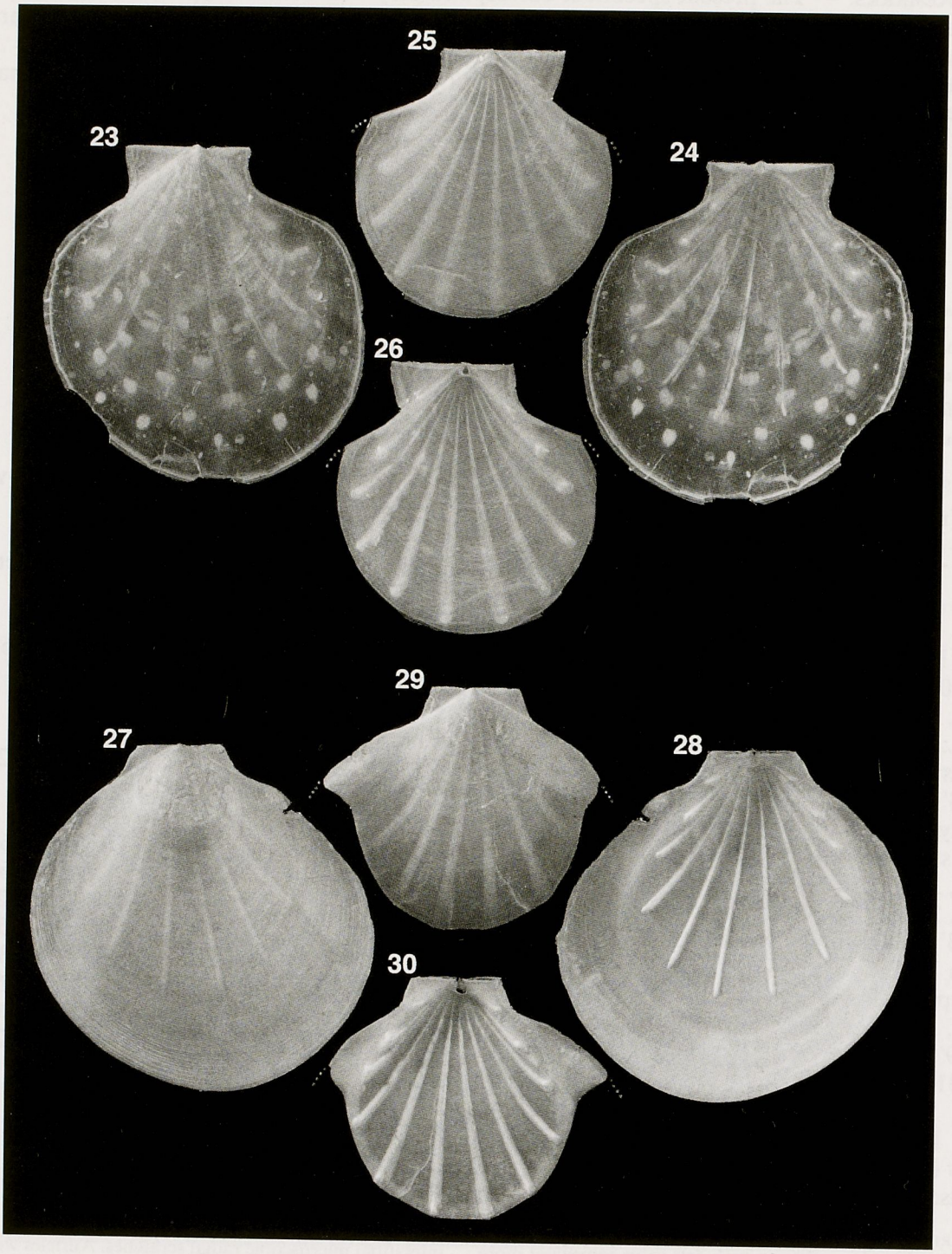
DISTRIBUTION. — OYAMA (1951) recorded this species from Shikoku and Kyushu, Japan. WANG (1984) added a new record from South China Sea. Now also New Caledonia and the Loyalty Islands. Present material living at 380-490 m.

DESCRIPTION. — *Shell* fragile, suborbicular, inequivalve, inequilateral, up to ca. 20 mm high, left valve somewhat more convex than right. Valves gaping at lateral margins. Auricles relatively small, unequal. Umbonal angle about 90°.

Prodissoconch ca. 200 μm in height.

Left valve covered with minute concentric lamellae in late ontogeny near periphery, otherwise smooth and glossy with a few concentric plications, one or two delicate radial plicae near posterior margin. Shell transparent, with light orange patches and small white dots. Auricles smooth. Hinge line straight.

Right valve covered with regular concentric lirae and interstitial microscopic radial scratches. Auricles with concentric striae and somewhat serrated on dorsal margin. Shell whitish, nearly opaque. Internal lirae generally 10, an auricular lira on each side, commencing directly below the resilifer, extending to submarginal area, slightly nodulous at distal ends. Internal lirae of right valve somewhat broader. Resilifer triangular, elongate. Outer ligament rather broad. Adductor scar large, nearly circular, with whitish spots. Small byssal notch, no ctenolium.



FIGS 23-30. — **23-26**, *Propeamussium rubrotinctum*, MUSORSTOM 6: stn DW 412, 21.8 x 20.5 mm (db). — **23**, left valve, exterior. — **24**, left valve, interior. — **25**, right valve, exterior. — **26**, right valve, interior. — **27-30**, *P. watsoni*, MUSORSTOM 5: stn CC 367, 47.1 x 47.0 mm (db). — **27**, left valve, exterior. — **28**, left valve, interior. — **29**, right valve, exterior. — **30**, right valve, interior.

REMARKS. — WANG (1984: 603) compared *Propeamussium stella* with *P. caducum*, and observed that these species differ in shape, the number of internal lirae, and in having a glossy surface and a colour pattern, but he overlooked *P. steindachneri* (Sturany, 1901) from the Red Sea and Gulf of Oman, and *P. rubrotinctum* (Oyama, 1951) from Japan. Both of the latter are similar to *P. stella*, although *P. steindachneri* is smaller (ca. 14 mm) and has fewer internal lirae (8), but other shell features are very similar, including the coloration.

OYAMA (1951) placed *P. rubrotinctum* in *Parvamussium s. str.*, but HAYAMI (1988b) indicated that it should be refered to *Propeamussium*, despite its unequal auricles and weakly developed byssal notch.

Propeamussium sibogai (Dautzenberg & Bavay, 1904)

Figs 19-22

Amussium sibogai Dautzenberg & Bavay, 1904: 207, figs 1-4.

Other references:

Amussium sibogai – DAUTZENBERG & BAVAY, 1912: 31, pl. 28, figs 1-4.
Amussium cf. *sibogai* – BARNARD, 1969: 655, pl. 1, figs a-d.
Luteamussium sibogai – OYAMA, 1951: 82, fig. 1. — KIRA, 1967: 138, pl. 49, fig. 14.
Luteamusium (*sic*) *sibogae* (*sic*) – KOSUGE, 1985: 58, pl. 23, fig. 12.
Propeamussium sibogai – KNUDSEN, 1967: 272, pl. 1, figs 23-24. — ABBOTT & DANCE, 1982: 303, fig. — LAMPRELL & WHITEHEAD, 1992: pl. 6, no. 34, fig. 34.
Propeamussium (Propeamussium) sibogai – WANG, 1984: 599, pl. 1, figs 1-2, textfig. 1.

TYPE MATERIAL. — Holotype, live taken, ZMA 3.04.001.

TYPE LOCALITY. — *"Siboga"*, stn 12, 7°15′ S, 115°15′ E, Bali Sea, Indonesia, 289 m.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DC 381, 19°37′ S, 158°46′ E, 620 m, 1 rv.
CORAIL 2: stn DE 16, 20°48′ S, 160°56′ E, 500 m, 1 lv, 1 rv. — Stn DC 169, 18°21′ S, 155°20′ E, 575 m, 2 rv.
New Caledonia. MUSORSTOM 4: stn CP 169, 18°54′ S, 163°11′ E, 600 m, 6 spms, 1 rv. — Stn CP 170, 18°57′ S, 163°12′ E, 485 m, 1 spm.
Loyalty Islands. BIOGEOCAL: stn DW 292, 20°28′ S, 166°48′ E, 465-470 m, 1 rv. — Stn DW 308, 20°40′ S, 166°58′ E, 510-590 m, 1 rv.
MUSORSTOM 6: stn DW 410, 20°38′ S, 167°06′ E, 490 m, 4 spms, 2 lv, 5 rv. — Stn DW 413, 20°40′ S, 167°03′ E, 463 m, 1 spm. — Stn DW 415, 20°40′ S, 167°03′ E, 461 m, 2 spms. — Stn CP 464, 21°02′ S, 167°31′ E, 430 m, 1 spm. — Stn CP 465, 21°03′ S, 167°32′ E, 480 m, 6 spms, 3 lv, 4 rv. — Stn CP 467, 21°05′ S, 167°32′ E, 575 m, 2 spms, 4 lv, 4 rv. — Stn DW 487, 21°23′ S, 167°46′ E, 500 m, 2 lv.
VOLSMAR: stn DW 37, 22°23′ S, 168°43′ E, 500-550 m, 3 rv.

DISTRIBUTION. — DAUTZENBERG & BAVAY (1912) recorded this species from the Bali Sea (Indonesia). OYAMA (1951), KIRA (1967) and OKUTANI *et al.* (1989) mentioned it from the southern Japanese waters to Indonesia. KNUDSEN (1967) enumerated several records from Indonesia, the Philippines, the Arafura Sea, and off Durban (S. Africa). KOSUGE (1985) added a new record from the Timor Sea (Northwestern Australia). Now this species is also known from New Caledonia and the Loyalty Islands. Present material living at 430-575m. KNUDSEN (1967) indicated a broader vertical range (183-710 m).

DESCRIPTION. — *Shell* fragile, nearly orbicular, inequivalve, somewhat inequilateral, oblique, up to ca. 55 mm high, left valve slightly more convex than right, gaping rather strongly, transparent, auricles rather small and equal in size, umbonal angle about 125°; left valve creamy brown, the right cream coloured.

Prodissoconch ca. 210 μm in height (KNUDSEN, 1967).

Left valve covered with a few delicate concentric growth

lines, a few minute concentric lamellae sometimes present near ventral margin. Delicate radial lirae developed near posterior margin. Auricles smooth and somewhat raised on lateral margins. Hinge line straight. Internal lirae generally 8, deep brown on left valve, whiter and broader on right. Marginal lirae with 4 or 5 small nodules that are visible through lateral gape.

Right valve covered with widely spaced concentric lirae that are much weaker at periphery, and microscopic interstitial granules. Marginal apron of right valve often missing due to the very thin layer of prismatic calcite (HAYAMI, 1988a: fig. 4). Auricles smooth. Resilifer triangular, elongate. No byssal notch, or ctenolium.

REMARKS. — The present material is very similar to the holotype from the Bali Sea, although they have 1 or 2 additional internal riblets.

DAUTZENBERG & BAVAY (1904) incorrectly indicated the type locality as "Celebes Sea", which they subsequently corrected (1912: 31).

P. sibogai is the type species of *Luteamussium*, which was treated by HERTLEIN (1969: N350) as a synonym of *Propeamussium*. Indeed, *P. sibogai* is a typical *Propeamussium*.

Descriptions of the soft parts, reproduction and food are given by KNUDSEN (1967: 272).

Propeamussium watsoni (E.A. Smith, 1885)

Figs 27-30, 123-124

Amussium watsoni E.A. Smith, 1885: 309, pl. 22, figs 8-8c.

Synonym:

Propeamussium watsoni bayonnaisense Okutani, 1962: 15-16, pl. 2, figs 1-2; 1966: 8.

Other references:

Amussium alcocki – THIELE & JAECKEL, 1931: 8.
Amussium watsoni – CLARKE, 1962: 61. — KNUDSEN, 1967: 280, pl. 1, fig. 18.
Propeamussium watsoni – KISELEVA, 1971: 221. — ABBOTT & DANCE, 1982: 303, fig. — HAYAMI, 1988a: 476, figs 2-6.

TYPE MATERIAL. — *A. watsoni*: lectotype (Figs 123-4, H 51.8, L 50.0, D 9.5 mm), here designated, BMNH 1887.2.9.3307, 2 paralectotypes BMNH 1887.2.9.3308/1-2. — *P. watsoni bayonnaisense*: holotype, alive, NSMT Mo.62759 and 5 paratypes NSMT Mo.62760.

TYPE LOCALITY. — *A. watsoni*: *"Challenger"*, stn 218, 2°23′ S, 144°04′ E, NE of New Guinea, alive, 1957 m. — *P. watsoni bayonnaisense*: 24 miles off Bayonnaise Rocks, 32°00.0′ N, 140°21.4′ E, Japan, 2140-2160 m.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DC 321, 21°20′ S, 158°02′ E, 1000 m, 1 lv, 2 rv. — Stn CP 323, 21°18′ S, 157°57′ E, 970 m, ca. 90 spms. — Stn CP 324, 21°15′ S, 157°51′ E, 970 m, 32 spms. — Stn CC 365, 19°42′ S, 158°48′ E, 710 m, 3 spms. — Stn CC 366, 19°45′ S, 158°45′ E, 650 m, 1 spm. — Stn CC 367, 19°36′ S, 158°53′ E, 830-855 m, 25 spms. — Stn CC 383, 19°40′ S, 158°46′ E, 600-615 m, 1 rv.
New Caledonia. BIOCAL: stn CP 30, 23°08′ S, 166°40′ E, 1140 m, 1 spm. — Stn CP 31, 23°07′ S, 166°50′ E, 850 m, 15 spms. — Stn CP 75, 22°18′ S, 167°23′ E, 825-860 m, 4 spms.
Loyalty Islands. MUSORSTOM 6: stn CP 427, 20°23′ S, 166°20′ E, 800m, 13 spms. — Stn CP 438, 20°23′ S, 166°20′ E, 780 m, 42 spms, 2 rv.
Philippines. MUSORSTOM 2: stn 69, 14°06′ N, 120°03′ E, 1800-1950 m, 2 spms.

DISTRIBUTION. — SMITH (1885) described this species from NE of New Guinea, and subsequently recorded it from the Bay of Bengal and Laccadive Sea. THIELE & JAECKEL (1931) recorded it from the Gulf of Aden, and OKUTANI (1962) from SE Japan. KNUDSEN (1967) enumerated records from the Arabian Sea, Zanzibar area and the Strait of Malacca. KISELEVA (1971) added a new

record from the Red Sea. This species is also found in the Chesterfield Islands, New Caledonia and the Loyalty Islands. Present material living at 650-1140 m.

DESCRIPTION. — *Shell* inequivalve, nearly circular, ca. 60 mm high, slightly higher than wide, somewhat inequilateral, umbonal angle ca. 125°, opaque, left valve milky-white, right valve creamy.

Prodissoconch ca. 240 µm in height.

Left valve more convex than right, with concentric lamellae near the ventral margin and delicate radial lirae that commence at ca. 3 mm shell length and extend to central part of disc, lamellae and lirae variable. Auricles equal, concentric lamellae prominent on anterior, finer and more closely-set on posterior. Generally 10 interior lirae and a small auricular lira on each side, commencing just below resilifer and extending to pallial line.

Right valve with fine regularly concentric lirae and granulate interstitial microsculpture (prismatic calcite layer). Auricles with concentric lirae, anterior auricle with a few radial lines near suture, absent on posterior auricle. Prominent scales on anterior and posterior dorsal margins of auricles. Resilifer triangular, erect. No byssal notch, or ctenolium.

REMARKS. — The present specimens are similar to the type material in shape, sculpture and coloration, although the concentric lirae of the left valve commence closer to the ventral margin, and the radial lirae are somewhat more delicate. Both of the latter two characters are variable.

I follow KNUDSEN (1967: 281) in interpreting *P. watsoni bayonnaisense* as a form of *P. watsoni*.

Genus *PARVAMUSSIUM* Sacco, 1897

Parvamussium Sacco, 1897a: 102. Proposed as a subgenus of *Amussium* Herrmannsen, 1846 (unjustified emendation of *Amusium* Röding, 1798); no diagnosis given, but type species designated; SACCO, 1897b: 48 (diagnosis). Type species (OD): *Pecten (Pleuronectes) duodecimlamellatus* Bronn, 1832; Upper Miocene, northern Italy.

Synonyms:

Variamussium Sacco, 1897a: 102. Proposed as a subgenus of *Amussium*; no diagnosis given, but type species designated. SACCO, 1897b: 49 (diagnosis). Type species (OD): *Amussium cancellatum* E.A.Smith, 1885; Recent, off Bermuda, W Atlantic, 796 m.

Ctenamusium Iredale, 1929: 164. Type species: *Amusium thetidis* Hedley, 1902; Recent, off New South Wales, Australia, 115-137 m.

Glyptamusium Iredale, 1939: 370. Type species (OD): *Amussium torresi* E.A.Smith, 1885; Recent, E of Cape York, Queensland, Australia, 283 m.

Squamamussium Oyama, 1944: 245. Proposed as a subgenus of *Propeamussium*. Type species (OD): *Amussium squamigerum* E.A.Smith, 1885; Recent, off E Puerto Rico, West Indies, 713 m.

Polynemamussium Habe, 1951: 72. Proposed as a subgenus of *Parvamussium*. Type species (OD): *Pecten intuscostatus* Yokoyama, 1920; Pleistocene, Miura City, Kanagawa Prefecture, Japan.

DIAGNOSIS. — *Shell* inaequivalve, orbicular to oblique, usually small to ca. 20 mm, laterally compressed, lateral gape absent; *left valve* usually strongly sculptured with radial and/or concentric riblets or striae, *right valve* with concentric lamellae; auricles unequal; byssal notch well-developed; no ctenolium; internal lirae extend to submarginal or marginal region.

DISTRIBUTION. — Cretaceous to Recent. Worldwide, living in 18-2110 m.

REMARKS. — The characters separating *Parvamussium* from *Propeamussium* are summarized in Table 1.

GRAU (1959: 15) and subsequently HERTLEIN (1969: N350) treated *Parvamussium* as a subgenus of *Propeamussium* and enumerated *Variamussium, Ctenamusium, Glyptamusium, Xenamussium, Squamamussium, Polynemamussium, Bathymussium* and *Micramussium* as synonyms of *Parvamussium*. HERTLEIN (1969: N350) also mentioned in the synonymy "*Graptamussium* Oyama, 1944", which is an error for *Glyptamusium*. *Bathymussium* and *Micramussium* are here considered synonyms of *Propeamussium*, and *Xenamussium* a synonym of *Cyclopecten*.

Parvamussium multiliratum sp. nov.

Figs 31-34, 91-92

TYPE MATERIAL. — Holotype MNHN. Paratypes: 11 MNHN, 1 AMS C201711, 1 HD, 1 USNM.

TYPE LOCALITY. — Southern New Caledonia, BIOCAL, stn CP 72, 22°10′ S, 167°33′ E, 2100-2110 m.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 72, 22°10′ S, 167°33′ E, 2100-2110 m, 2 spm, 1 lv (holotype and paratypes).
Loyalty Islands. BIOGEOCAL: stn KG 240, 21°29′ S, 166°27′ E, 1520 m, 1 rv (paratype). — Stn CP 243, 21°28′ S, 166°26′ E, 1820 m, 1 lv (paratype). — Stn CP 260, 21°00′ S, 167°58′ E, 1820-1980 m, 2 spms (paratypes). — Stn CP 272, 21°00′ S, 166°57′ E, 1615-1710 m, 1 spm (paratype). — Stn CP 273, 21°02′ S, 166°57′ E, 1920-2040 m, 5 spms (paratypes: 1 HD, 1 AMS, 2 MNHN, 1 USNM). — Stn CP 317, 20°48′ S, 166°53′ E, 1620-1630 m, 1 lv, 1 rv (paratypes).

DISTRIBUTION. — New Caledonia, 1520-2110 m, living in 1615-2110 m.

DESCRIPTION. — *Shell* rather small, fragile, orbicular, inequivalve, semi-transparent white, up to ca. 9 mm high, left valve slightly more convex than right, auricles subequal, umbonal angle about 110°.

Prodissoconch ca. 220 µm in height.

Left valve sculptured with widely spaced concentric lamellae that commence at 3 mm shell height, and extend to ventral margin. Irregularly spaced, delicate radial riblets arising near submarginal region, a few commencing earlier. Umbonal region glossy with some white spots, otherwise transparent and dull due to microscopic granules. Auricles with concentrically lamellate riblets that are closer near lateral margins.

Right valve with regularly spaced concentric lirae, somewhat interrupted near submarginal region by a disturbance of growth. Auricles with concentric lamellae that are somewhat stronger on anterior, and more closely spaced on posterior. Hinge line straight, with some scales near margins,that are more prominent on anterior. Byssal fasciole small. Each valve with 14 internal lirae plus 2 rudimentary interstitial lirae; one auricular lira on both auricles. External sculpture clearly visible from the interior. Resilifer triangular. Byssal notch present, no ctenolium.

Dimensions of the holotype: H 7.9, L 8.9, D 2.4 mm.

REMARKS. — The most closely related species is *Parvamussium permirum* (Dautzenberg, 1925) recorded from the Bay of Biscay (E Atlantic) and adjacent abyssal depths. *P. permirum* has more regularly spaced radial riblets on the left valve, and fewer concentric lamellae. Internal lirae generally 12 with 2-4 additional rudimentary interstitial lirae and the hinge line has fewer scales. *P. retiaculum* is somewhat similar to *P. multiliratum* in sculpture, although the latter has fewer radial riblets, and a more strongly orbicular shape, with more numerous internal lirae. DAUTZENBERG (1925: 11) placed *P. permirum* in *Amussium (Variamussium)*, but all the conchological characters are similar to *Parvamussium*.

ETYMOLOGY. — So named because the internal lirae are more numerous than usual for a propeamussiid (Lat. *liratus*, adj. = with lira(e)).

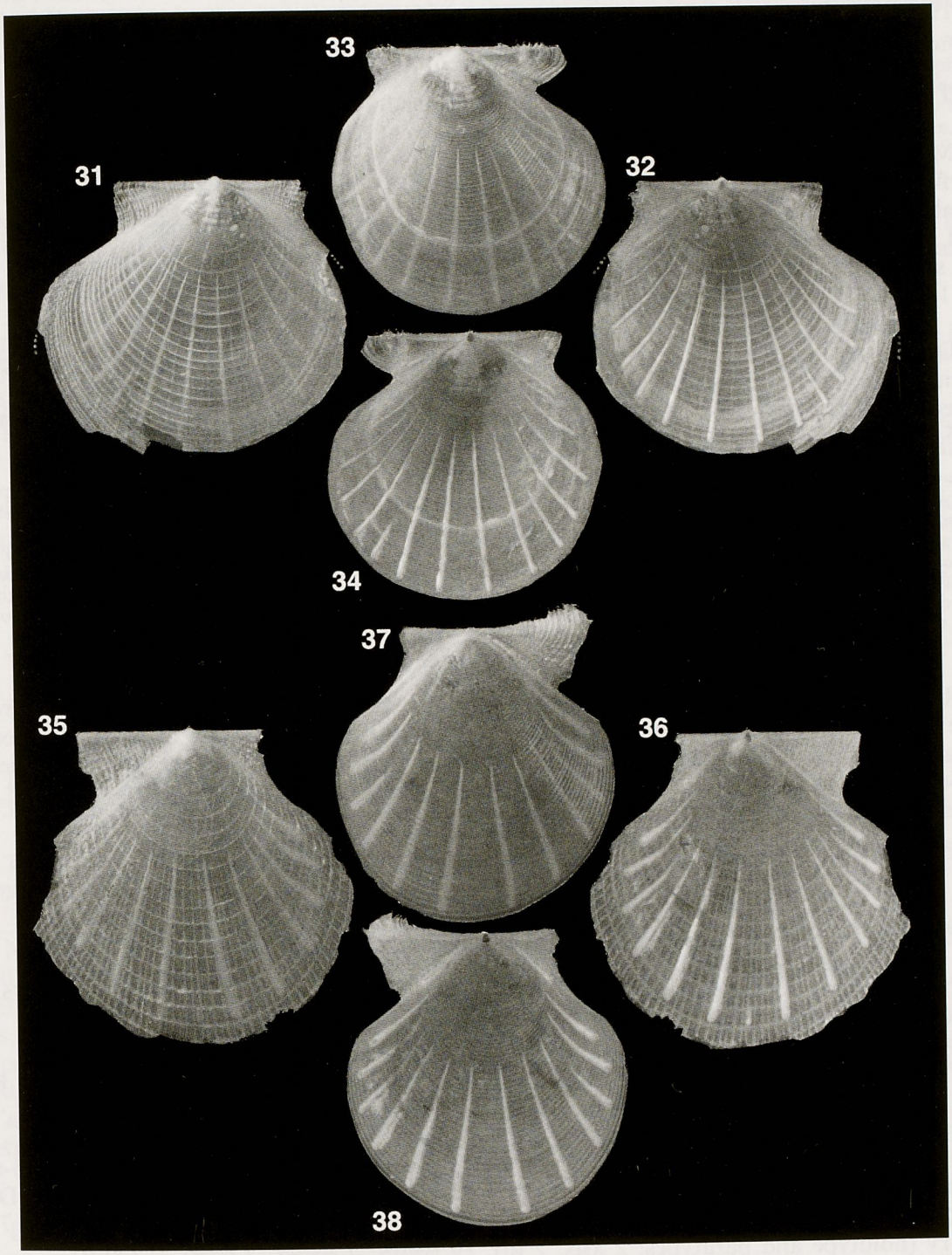
Parvamussium pauciliratum (E.A. Smith, 1903)

Figs 107-110, 151-152

Amussium paucilirata E.A. Smith, 1903: 622, pl. 36, figs 23-24.

Other reference:

Parvamussium pauciliratum – DIJKSTRA, 1991: 14, figs 23-24.



FIGS 31-38. — **31-34**, *Parvamussium multiliratum*, holotype, 7.9 x 8.9 mm (db). — **31**, left valve, exterior. — **32**, left valve, interior. — **33**, right valve, exterior. — **34**, right valve, interior. — **35-38**, *P. retiaculum*, holotype, 7.3 x 7.2 mm (db). — **35**, left valve, exterior. — **36**, left valve, interior. — **37**, right valve, exterior. — **38**, right valve, interior.

TYPE MATERIAL. — Lectotype (Figs 151-2, H 7.5, L 7.4, D 2.0 mm), here designated, live taken, BMNH 1903.9.17.17; 2 paralectotypes BMNH 1903.9.17.18/1-2. Although the original registration number indicated 4 specimens, only three syntypes are now present.

TYPE LOCALITY. — S Nilandu Atoll, Maldive Islands, 2-66 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn DW 263, 25°21′ S, 159°46′ E, 150-225 m, 1 lv, 1 rv.
New Caledonia. LAGON: stn 348, 22°42′ S, 166°55′ E, 45 m, 1 lv. — Stn 622, 22°02′ S, 166°53′ E, 67 m, 1 rv. — Stn 698, 21°29′ S, 166°09′ E, 40-43 m, 1 spm. — Stn 729, 21°19′ S, 165°54′ E, 42-45 m, 1 spm. — Stn 853, 20°41′ S, 165°07′ E, 27 m, 1 rv. — Stn 873, 20°39′ S, 164°46′ E, 27 m, 1 spm. — Stn 1191, 19°35′ S, 163°38′ E, 45 m, 1 spm.

DISTRIBUTION. — This is a shallow-water species, which is included here for a comprehensive treatment of the Propeamussiidae of New Caledonia. Beside the type locality, the Maldive Islands, it has been recorded from Indonesia by DIJKSTRA (1991). Present material from New Caledonia alive in 27-45 m. Also shells in the Chesterfield Islands in 150-250 m.

DESCRIPTION. — *Shell* rather small, semi-transparent, whitish, sub-orbicular, inequivalve, up to ca. 8 mm high, auricles nearly equal in size, right valve more convex than left, umbonal angle about 105°.

Prodissoconch ca. 200 µm in height.

Left valve glossy, with a few minute growth lines and covered with microscopic granules. Auricles smooth, sometimes [see Remarks] with delicate concentric lirae near anterior margin.

Right valve glossy, smooth, apart from microscopic granules. Anterior auricle with minute concentric lirae. Hinge line straight.

Internal lirae rudimentary, 1 or 2, usually a small auricular lira on each side. Outer ligament well developed. Left valve creamy-white, stained with white dots, right valve transparent-white. Resilifer triangular. Byssal notch very small, no ctenolium.

REMARKS. — The present specimens are similar in all aspects to the type material from the Maldive Islands, although microsculpture is sometimes variable. The New Caledonian specimens, which are from shallower depths, sometimes have microscopic divergent scratches near the postero-dorsal margin on the left valve. Microscopic granules are generally present on both valves. Juveniles often lack the internal rudimentary liration.

Parvamussium retiaculum sp. nov.

Figs 35-38

TYPE MATERIAL. — Holotype MNHN. Paratypes: 25 MNHN, 2 AMS C201712, 2 HD, 2 NMNZ M268536, 2 NSMT, 2 USNM.

TYPE LOCALITY. — Southern New Caledonia, BIOCAL, stn DW 51, 23°05′ S, 167°45′ E, 680-700 m.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL: stn DW 33, 23°10′ S, 167°10′ E, 675-680 m, 2 lv (paratypes). — Stn DW 36, 23°09′ S, 167°11′ E, 650-680 m, 2 lv (paratypes). — Stn DW 48, 23°00′ S, 167°29′ E, 775 m, 2 lv (paratypes). — Stn DW 51, 23°05′ S, 167°45′ E, 680-700 m, 7 spms, 8 lv, 15 rv (holotype and paratypes: 2 AMS, 2 HD, 19 MNHN, 2 NMNZ, 2 NSMT, 2 USNM).

DISTRIBUTION. — Southern New Caledonia 650-775 m, living 680-700 m.

DESCRIPTION. — *Shell* small, fragile, suborbicular, inequivalve, up to ca. 7 mm high, left valve slightly more convex than right, semi-transparent white, auricles of unequal size, umbonal angle about 100°.

Prodissoconch ca. 210 µm in height.

Left valve sculptured with 14 prominent, widely spaced, concentric lamellae, starting weakly at ca. 2 mm shell height, extending to ventral margin. Delicate, regularly spaced radial riblets, commence at about 3 mm shell height, and extend to

ventral margin. Exterior of disc with semi-reticulated sculpture produced by concentric lamellae and intersecting radial riblets. Anterior auricle stronger than posterior sculptured with close-set, irregularly spaced concentric lamellae; posterior auricle with identical though weaker sculpture. Hinge line straight.

Right valve with regularly spaced concentric lirae, close-set near umbonal area and becoming more widely spaced toward ventral margin. Anterior auricle more strongly sculptured near lateral margin with concentric lamellae. Hinge line somewhat elevated due to strong concentric lamellae. Byssal fasciole present.

Each valve with 12 internal lirae and 1 auricular lira that commence rather late and extend to near the periphery; one rudimentary interstitial lira on left valve near the ventral margin. Outer ligament well developed and rather broad on posterior auricle. Small byssal notch, no ctenolium.

Dimensions of the holotype: H 7.3, L 7.2, D 1.9 mm.

REMARKS. — *P. retiaculum* is somewhat similar to *P. multiliratum*, although the latter is slightly larger and more orbicular, while the auricles are more equal and smaller, fewer radial riblets are developed on the left valve, there are more internal lirae, and the hinge line of the right valve is straight. *P. multiliratum* lives at much great depths (lower bathyal to upper abyssal).

The right valve of *P. torresi* is somewhat similar to that in *P. retiaculum*, although the internal lirae commence earlier, and are fewer in number (generally 10). Moreover, the left valve of *P. torresi* is glossy and nearly smooth, whereas *P. retiaculum* is prominently sculptured and dull.

The left valve of *P. thetidis* is covered with prominent irregularly spaced, radial costae and delicate close-set concentric lamellae, whereas *P. retiaculum* has prominent concentric lamellae, and delicate radial riblets.

ETYMOLOGY. — From the cancellate sculpture of the left valve (Lat. *retiaculum*, n. = net, lattice-work, wattle-work).

Parvamussium retiolum sp. nov.

Figs 39-42, 97

TYPE MATERIAL. — Holotype MNHN. Paratypes: 36 MNHN, 2 AMS C201713, 2 HD, 2 NMNZ M268537, 2 NSMT, 2 USNM.

TYPE LOCALITY. — Chesterfield Islands, MUSORSTOM 5, stn CP 363, 19°47′ S, 158°44′ E, 685-700 m.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 340, 19°48′ S, 158°40′ E, 675-680 m, 1 spm, 1 lv, 3 rv. — Stn DW 341, 19°45′ S, 158°43′ E, 620-630 m, 5 spms, 3 lv, 3 rv. — Stn DC 357, 19°37′ S, 158°45′ E, 630 m, 2 lv, 2 rv. — Stn DC 358, 19°38′ S, 158°47′ E, 680-700 m, 4 spms, 1 lv, 5 rv. — Stn CP 363, 19°47′ S, 158°44′ E, 685-700 m, 41 spms, 6 lv (holotype and paratypes). — Stn CP 364, 19°45′ S, 158°46′ E, 675 m, 1 spm. — Stn DC 380, 19°37′ S, 158°43′ E, 555-570 m, 1 lv.
New Caledonia. BIOCAL: stn DW 56, 23°34′ S, 167°11′ E, 695-705 m, 1 lv, 7 rv.
MUSORSTOM 4: stn CP 158, 18°49′ S, 163°15′ E, 620 m, 1 lv. — Stn DC 168, 18°48′ S, 163°10′ E, 720 m, 1 spm.

DISTRIBUTION. — New Caledonia and Chesterfield Islands, 555-720 m, living 620-720 m.

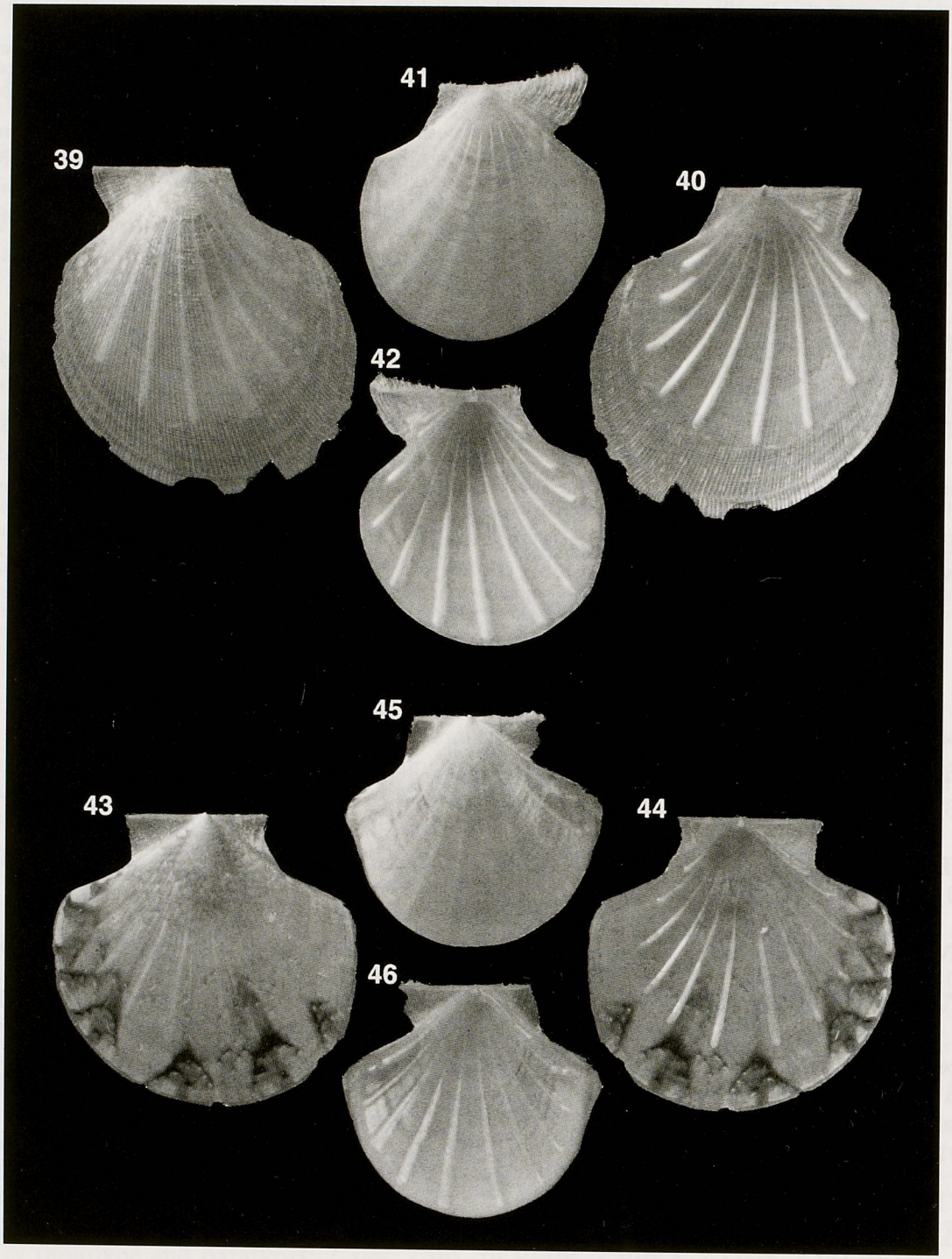
DESCRIPTION. — *Shell* rather small, inequivalve, inequilateral, up to ca. 16 mm high, left valve somewhat more convex than right, translucent white, auricles unequal, umbonal angle about 95°.

Prodissoconch ca. 220 µm in height.

Left valve covered with delicate concentric lamellae crossing closely spaced radial riblets, somewhat coarser near umbonal area, finer near ventral margin. Anterior auricle well developed, with many fine radial riblets that are crossed near margin by fine concentric lamellae; posterior auricle similary sculptured. Hinge line straight.

Right valve with regular concentric lirae, closely spaced near umbonal area, becoming more widely spaced towards the ventral margin. Microscopic interstitial radial scratches near margins. Auricles strongly developed, with concentric lamellae that are more prominent anteriorly. Strongly developed scales on antero-dorsal margin.

Internal lirae 10, plus 1 posterior auricular lira and 4 rudi-



FIGS 39-46. — **39-42**, *Parvamussium retiolum*, holotype, 16.0 x 14.8 mm (db). — **39**, left valve, exterior. — **40**, left valve, interior. — **41**, right valve, exterior. — **42**, right valve, interior. — **43-46**, *P. scitulum*, MUSORSTOM 6: stn DW 462, 10.9 x 11.4 mm (db). — **43**, left valve, exterior. — **44**, left valve, interior. — **45**, right valve, exterior. — **46**, right valve, interior.

mentary auricular lirae on left valve and 3 on right, ends nodose. Resilifer triangular, elongate. Strongly developed outer ligament near resilifer. Byssal notch small, no ctenolium. Dimensions of the holotype: H 16, L 14.8, D 3.5 mm.

REMARKS. — *Parvamussium retiolum* is somewhat similar to *P. thetidis*, which also occurs in the study area (see below). *P. retiolum* is larger, with a fine cancellate sculpture on left valve; the latter species has irregularly spaced, strong radial costae crossed by delicate concentric lamellae. Auricles and right valve of *P. retiolum* more sculptured with closely spaced, concentric lamellae. Internal lirae variable, somewhat similar to *P. thetidis*.

Parvamussium retiolum differs from *P. retiaculum* in its more delicate cancellate sculpture on left valve, and in having more closely spaced, concentric lamellae on right valve. Internal lirae of *P. retiolum* start earlier.

In all aspects *P. retiolum* is representative of *Parvamussium*.

ETYMOLOGY. — From the cancellate sculpture of the left valve (Latin *retiolum*, n. = small net).

Parvamussium scitulum (E.A. Smith, 1885)

Figs 43-46, 153-154

Amussium scitulum E.A. Smith, 1885: 312, pl. 23, figs 4-4b.

Synonym:

Amusium (Propeamusium) (*sic*) *scitulum* var.? *cmadoritinctum* Kuroda, 1931: 77, figs 81-82.

Other references:

Ctenamusium (Ctenamusium) cmadoritinctum – OYAMA, 1951: 80, pl. 13, figs 3-4.
Ctenammssium (*sic*) *cmadoritinctum* – HABE, 1964: 173, pl. 53, fig. 4.
Ctenamussium (*sic*) *scitulum* – KURODA & HABE, 1981: 63.
Propeamussium cmadoritinctum – HAYAMI, 1988a: 479, figs 2-1,2.
Propeamussium (Parvamussium) scitulum – DIJKSTRA, 1990: 3.
Parvamussium scitulum – DIJKSTRA, 1991: 16, figs 35-43.

TYPE MATERIAL. — *A. scitulum*: lectotype (Figs 153-4, left valve: H 4.4, L 4.5 mm), here designated BMNH 1887.2.9.3319/1; 6 paralectotypes BMNH 1887.2.9.3319/2-7. — *A. scitulum* var. *cmadoritinctum*: Kikuchi Shell Museum, Kuroda coll. (not seen).

TYPE LOCALITY. — *A. scitulum*: *"Challenger"*, stn 188, 9°59′ S, 139°42′ E, S of New Guinea, dead, 51m. — *A. scitulum* var. *cmadoritinctum*: Yakushima Island, Kagoshima Prefecture, Kyushu, Japan.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 258, 25°32′ S, 159°46′ E, 300 m, 1 spm. — Stn DW 270, 24°48′ S, 159° 34′ E, 223 m, 3 lv, 3 rv. — Stn DW 285, 24°09′ S, 159°34′ E, 245-255 m, 1 lv. — Stn DW 296, 23°12′ S, 159°36′ E, 278 m, 1 lv.
New Caledonia. *"Vauban"*1978-79: stn 40, 22°30′ S, 166°24′ E, 250-350 m, 17 lv, 21 rv.
BIOCAL: stn DW 64, 24°48′ S, 168°09′ E, 250 m, 3 spms, 3 lv.
SMIB 5: stn DW 96, 23°00′ S, 168°19′ E, 245 m, 1 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 462, 21°05′ S, 167°26′ E, 200 m, 3 spms, 4 lv, 1 rv.

DISTRIBUTION. — SMITH (1885) described this species from the southern area of New Guinea. KURODA (1931) mentioned it from Japanese waters, whereas KURODA & HABE (1981) recorded a larger distribution from Honshu (Japan) to Indonesia. DIJKSTRA (1990, 1991) summarized several records from the Indonesian Archipelago. Now it is also known from the New Caledonian region. Present material living at 200-300 m.

DESCRIPTION. — *Shell* rather small, sub-orbicular, compressed, inequivalve, inequilateral, right valve more convex than left, up to ca. 10 mm high, right valve semi-transparent white, left valve stained and opaque, auricles rather small and subequal, umbonal angle about 120°.

Prodissoconch ca. 210 µm in height.

Left valve flat, weakly sculptured with delicate, variable radial striations, somewhat stronger near posterior margin. Microscopic close-set concentric striae sometimes developed on disc, somewhat more widely spaced near umbonal area. Anterior auricle with prominent concentric lamellae close to flank of disc, decreasing in prominence or absent near antero-dorsal margin; posterior auricle covered with fine radial and concentric striations, sometimes nearly absent.

Right valve either weakly sculptured with a few growth lines or completely smooth. Internal lirae extending to submarginal area, and generally 9 or 10, sometimes with 1 or 2 rudimentary interstitial lirae. Resilifer triangular. Hinge line straight. Byssal notch present, no ctenolium.

REMARKS. — The present specimens are similar to the type material, although larger in size. SMITH (1885: 312) suggested that the syntypes of *P. scitulum* could be juveniles, which would seem to be the case. Sculpture and coloration are rather variable. *P. cmadoritinctum* has slightly stronger sculpture, but is otherwise similar to the present specimens. *Parvamussium sinense* Wang, 1980 (: 259), from the East China Sea, is somewhat broader, with stronger, scaly radial costae.

OYAMA (1951: 80) used the genus *Ctenamusium* for this species, but the shell characters are typical of *Parvamussium*, as indicated by HERTLEIN (1969).

Parvamussium squalidulum sp. nov.

Figs 47-50

TYPE MATERIAL. — Holotype MNHN. Paratypes: 2 AMS C201714, 3 HD, 6 MNHN, 2 USNM.

TYPE LOCALITY. — Lord Howe Rise, Kelso Bank, MUSORSTOM 5, stn DW 277, 24°11′ S, 159°35′ E, 270 m.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 255, 25°15′ S, 159°55′ E, 280-295 m, 1 lv, 2 rv. — Stn DW 258, 25° 33′ S, 159°46′ E, 300 m, 7 lv, 3 rv. — Stn DW 260, 25°29′ S, 159°44′ E, 285 m, 1 lv. — Stn DW 261, 25°27′ S, 159°46′ E, 300 m, 2 rv. — Stn CP 268, 24°45′ S, 159°39′ E, 280 m, 4 lv. — Stn CP 269, 24°47′ S, 159°37′ E, 250-270 m, 1 lv. — Stn DW 272, 24°41′ S, 159°43′ E, 500-540 m, 1 lv, 3 rv. — Stn DW 274, 24°45′ S, 159°41′ E, 285 m, 1 lv. — Stn DW 277, 24°11′ S, 159°35′ E, 270 m, 4 spms, 2 lv, 8 rv (holotype and paratypes: 2 AMS, 3 HD, 6 MNHN, 2 USNM). — Stn CP 279, 24°09′ S, 159°38′ E, 260-270 m, 6 lv, 1 rv. — Stn DW 299, 24°48′ S, 159° 24′ E, 360-390 m, 2 lv, 3 rv. — Stn DW 301, 22°07′ S, 159°25′ E, 487-610 m, 1 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 480, 21°08′ S, 167°56′ E, 380 m, 1 lv, 1 rv.
New Hebrides Arc [1]. VOLSMAR: stn DW 7, 22°26′ S, 171°44′ E, 325-400 m, 1 spm, 1 lv. — Stn DW 17, 22°23′ S, 171°41′ E, 260-300 m, 1 lv.

DISTRIBUTION. — Chesterfield Islands, New Caledonia to the New Hebrides Arc; shells in 260-610 m, alive in 260-400 m.

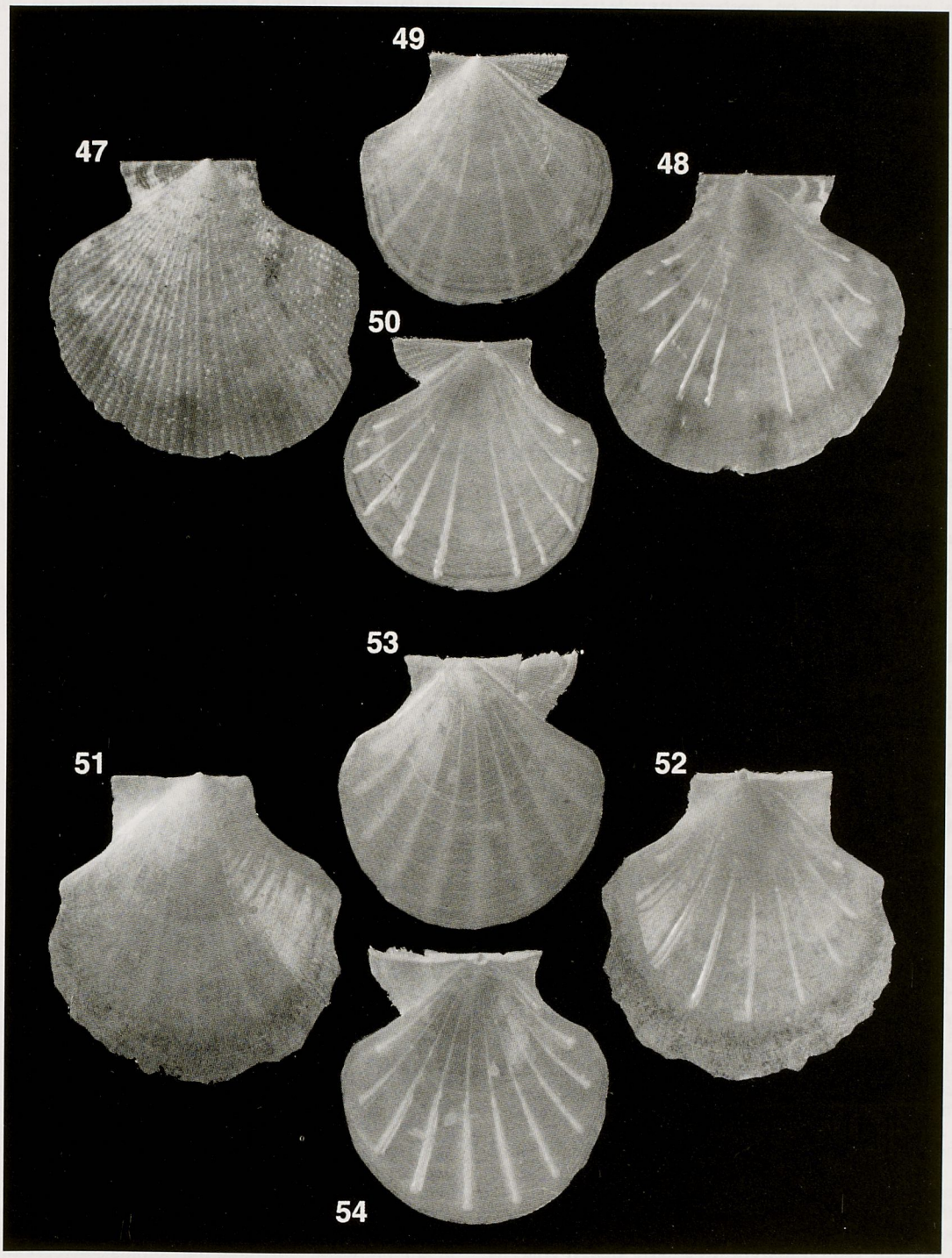
DESCRIPTION. — *Shell* rather small, suborbicular, inequivalve, inequilateral, semi-transparent, up to ca. 11 mm high, left valve slightly more convex than right; auricles rather small, unequal; umbonal angle about 125°.

Prodissoconch ca. 210 µm in height.

Left valve with numerous irregularly spaced, scaly radial costae, a few commencing weakly at about 1 mm shell height, increasing in number towards the ventral margin; small delicate concentric lamellae developing between them, more closely spaced near ventral margin. Anterior auricle well developed, posterior rather small. Three very weak radial lirae on anterior auricle, absent on posterior. Both auricles covered with concentric lamellae. Hinge line straight.

Right valve with minute concentric lirae near the lateral margin, absent from central region of disc. Marginal apron (outer prismatic calcite layer) mostly broken off, covered with fine concentric lirae (marginal region below the internal lirae). Anterior auricle well developed, provided with 5 radial riblets that are covered with con-centric lamellae, stronger on dorsal margin. Posterior auricle with delicate lamellae.

[1] Although the condominium of the New Hebrides has become independant under the name of Vanuatu, the term New Hebrides is retained here to designate the Hunter and Matthew area of the New Hebrides Arc. Hunter and Matthew are a dependency of New Caledonia. Similarly, geographers and geophysicists have retained the expression New Hebrides Trench.



FIGS 47-54. — **47-50**, *Parvamussium squalidulum*, holotype, 11.1 x 11.4 mm (db). — **47**, left valve, exterior. — **48**, left valve, interior. — **49**, right valve, exterior. — **50**, right valve, interior. — **51-54**, *P. torresi*, MUSORSTOM 5: stn DW 329, 9.0 x 8.9 mm (lv), 7.9 x 7.7 mm (rv). — **51**, left valve, exterior. — **52**, left valve, interior. — **53**, right valve, exterior. — **54**, right valve, interior.

Ten irregularly spaced internal lirae, plus 2 rudimentary lirae. One auricular lira on posterior auricle, absent on anterior. External sculpture and coloration slightly visible internally. Resilifer triangular. Byssal notch present, no ctenolium. Left valve creamy, with white and orange-brown maculations, right valve semi-transparent white and glossy.

Dimensions of the holotype: H 11.1, L 11.4, D 2 mm.

REMARKS. — The closest species is *Parvamussium sinense*, the left valve of which is more strongly sculptured with closely spaced scaly radial costae than in *P. squalidulum*. The latter is slightly more orbicular, and the right valve is covered with delicate concentric lirae, which are absent in *P. sinense*. The internal lirae of *P. sinense* are more regularly spaced with more stronger developed terminal nodules at the distal ends. Another related species is *P. scitulum*, the left valve of which is more delicately sculptured with close-set radial striae (sometimes absent), while concentric lirae are also absent on the right valve. *P. squalidulum* is slightly more convex than *P. scitulum*.

ETYMOLOGY. — From numerous scaly radial costae of the exterior of the left valve (Latin *squalidulus*, adj. = with small scales).

Parvamussium texturatum (Dautzenberg & Bavay, 1912)

Figs 103-106

Amussium texturatum Dautzenberg & Bavay, 1912: 37, pl. 27, figs 19-22.

Other reference:

Parvamussium cf. *texturatum* – DIJKSTRA, 1991: 17, figs 44-52.

TYPE MATERIAL. — Holotype, live taken, ZMA 3.12.022.

TYPE LOCALITY. — Sulu Archipelago, *"Siboga"*, stn 105, 6°08′ N, 121°19′ E, 275 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn DW 300, 22°48′ S, 159°24′ E, 450 m, 2 spms.
New Caledonia. BIOGEOCAL: stn DW 308, 20°40′ S, 166°58′ E, 510-590 m, 4 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 417, 20°42′ S, 167°04′ E, 283 m, 1 lv. — Stn DW 456, 21°01′ S, 167°26′ E, 240 m, 1 lv, 2 rv. — Stn DW 461, 21°06′ S, 167°26′ E, 240 m, 1 spm.

DISTRIBUTION. — Beside the type locality in the Sulu archipelago (Philippines), somewhat similar specimens were recorded by DIJKSTRA (1991) from Indonesia. Now it is also known from the Chesterfield Islands, New Caledonia and the Loyalty Islands. Present material live collected in 240-450 m.

DESCRIPTION. — *Shell* small, suborbicular, inequivalve, inequilateral, nearly opaque, up to ca. 5 mm high, left valve slightly more convex than right, auricles unequal in size, umbonal angle about 95°. Left valve creamy white, sometimes stained with few white and brown spots, right valve whitish.

Prodissoconch ca. 200 µm in height.

Left valve sculptured with strongly developed, irregularly-spaced radial costae, starting at 1-2 mm shell height and enlarging towards ventral margin. Regularly spaced concentric lamellae cross radial costae, which are ornamented with strongly developed spines or scales. Auricles sculptured with concentric lamellae, more strongly developed on anterior. Hinge line straight.

Right valve covered with regularly spaced, close-set concentric lirae that enlarge near ventral margin to form lamellae. Anterior auricles with 4-7 weak radial riblets covered with concentric lamellae. Posterior auricle with delicate concentric lamellae, very strongly developed on dorsal margin.

Internal lirae 10-15, sometimes one or more rudimentary interstitial lirae, plus 1 or 2 auricular lirae. Lirae commencing in late ontogeny, enlarging into submarginal region. Resilifer triangular. Byssal notch small, no ctenolium.

REMARKS. — The present specimens are similar to the type material from the Sulu Sea, although most have fewer internal lirae. The internal lirae, however, are variable in number, and it is possible that the number in the type specimen (16) is exceptional.

The closest species is *Parvamussium vesiculatum* sp. nov., see below.

Parvamussium thetidis (Hedley, 1902)

Figs 99-102

Amusium thetidis Hedley, 1902: 304, fig. 49.

Synonym:

Ctenamusium salacon Iredale, 1929: 164.

Other references:

Amusium thetidis – Hedley & Petterd, 1906: 223, pl. 38, figs 18-19.
Amussium thetidis – Pritchard & Gatliff, 1904: 266.
Ctenamusium thetidis – Iredale, 1929: 164, 188. — Cotton & Godfrey, 1938: 98, fig. 84. — Cotton, 1961: 102, fig. 88.
Parvamussium thetidis – Dijkstra, 1991: 14. — Lamprell & Whitehead, 1992: no. 35, pl. 6, fig. 35.

Type material. — *A. thetidis*: holotype, rv, AMS C13210, 5 paratypes, v, AMS C171634. — *C. salacon*: holotype, lv, AMS C24345.

Type locality. — *A. thetidis*: 5-8 miles off Port Kembla, New South Wales, Australia, *"Thetis"*, stn 49, 34°28′ S, 151°06-03′ E, 137-115 m. — *C. salacon*: 27 miles E of Sydney Heads, New South Wales, Australia, 549 m.

Material examined. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn DW 272, 24°40′ S, 159°43′ E, 500-540 m, 1 spm. — Stn DW 305, 22°09′ S, 159°24′ E, 430-440 m, 1 lv, 1 rv.
Norfolk Ridge. CHALCAL 2: stn DW 73, 24°40′ S, 168°38′ E, 573 m, 2 spms, 5 lv, 4 rv. — Stn DW 74, 24°40′ S, 168°38′ E, 650 m, 2 spms, 4 lv, 5 rv. — Stn DW 75, 24°39′ S, 168°39′ E, 600 m, 2 spms, 2 rv.
Loyalty Islands. MUSORSTOM 6: stn DW 479, 21°09′ S, 167°55′ E, 310 m, 1 lv. — Stn DW 485, 21°23′ S, 167°59′ E, 350 m, 1 lv.
New Hebrides Arc. VOLSMAR: stn DW 30, 22°17′ S, 171°18′ E, 450-550 m, 5 lv, 10 rv.
GEMINI: stn DW 51, 20°59′ S, 170°03′ E, 450 m, 4 lv, 6 rv.

Distribution. — Eastern Australia, Chesterfield Islands as far east as New Hebrides Arc. Present material living at 500-650 m.

Description. — *Shell* rather small, fragile, inequivalve, inequilateral, up to ca. 10 mm high, left valve slightly more convex than right, auricles unequal in size, umbonal angle about 95°. Left valve creamy, sometimes with white spots, opaque; right valve uniform whitish, semi-transparent.

Prodissoconch ca. 210 µm in height.

Left valve sculptured with irregularly spaced radial costae, commencing at ca. 2 mm shell height, enlarging to ventral margin. Concentric lamellae delicate, close-set transversing radial costae. Auricles with delicate, closely-spaced concentric lamellae. Hinge line straight.

Right valve with regularly spaced concentric lirae. Anterior auricle with closely-spaced, concentric lamellae and 1-3 weakly developed radial riblets.

Internal lirae generally 10, with some rudimentary interstitial lirae, plus 1 or sometimes 2 auricular lirae. Lirae fine at first, becoming stronger distally near submarginal region. Hinge line slightly raised at margins, with small scales on dorsal margin. Resilifer triangular. Byssal notch small, no ctenolium.

Remarks. — Closely related species are *Parvamussium cristatellum* (Dautzenberg & Bavay, 1912) from Indonesia and the Bay of Bengal, and *P. siebenrocki* (Sturany, 1901) from the northwestern Indian Ocean. It is possible that both are synonyms, as I have already suggested (Dijkstra, 1991: 14).

P. thetidis is the type species of *Ctenamussium* which Hertlein (1969: N350) synonymized with *Parvamussium*. Indeed, it is a typical *Parvamussium*.

Parvamussium torresi (E.A. Smith, 1885)

Figs 51-54, 125-128

Amussium torresi E.A. Smith, 1885: 311, pl. 23, figs 3-3b.

Other references:

Glyptamusium torresi – IREDALE, 1939: 370.
Propeamussium (Parvamussium) torresi – DIJKSTRA, 1990: 3.

TYPE MATERIAL. — Lectotype (Figs 125-8, H 7.8, L 7.9, D 2 mm) here designated, live taken, BMNH 1887.2.9.3316, 5 paralectotypes BMNH 1887.2.9.3317/1-5. Size of the lectotype is somewhat different from SMITH's measurements, due to some damages near ventral margin of left valve, and marginal apron of right valve broken off.

TYPE LOCALITY. — E of Cape York, Queensland, Australia, *"Challenger"*, stn 185B, 11°38′15″ S, 143°59′38″ E, 285 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. CHALCAL 1: stn D 13, 19°33′ S, 158° 38′ E, 390 m, 3 lv.
MUSORSTOM 5: stn DC 291, 23°08′ S, 159°28′ E, 300 m, 1 rv. — Stn DW 328, 20°23′ S, 158°44′ E, 340-355 m, 1 spm, 8 lv, 25 rv. — Stn DW 329, 20°23′ S, 158°47′ E, 320 m, 23 lv, 34 rv. — Stn DW 334, 20°06′ S, 158°48′ E, 315-320 m, 1 spm, 7 lv, 3 rv. — Stn DW 335, 20°03′ S, 158°45′ E, 315 m, 1 spm, 3 lv. — Stn DC 376, 19°51′ S, 158°30′ E, 280 m, 7 lv, 1 rv.
CORAIL 2: stn DC 169, 18°21′ S, 155°20′ E, 575 m, 1 lv, 2 rv.
New Caledonia. MUSORSTOM 4: stn CC 174, 19°00′ S, 163°18′ E, 365 m, 2 lv.
Norfolk Ridge. CHALCAL 2: stn DW 71, 24°42′ S, 168°09′ E, 230 m, 1 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 459, 21°01′ S, 167°31′ E, 425 m, 22 lv, 58 rv. — Stn DW 468, 21°06′ S, 167°33′ E, 600 m, 1 lv, 1 rv.
New Hebrides Arc. VOLSMAR: stn DW 17, 22°23′ S, 171°41′ E, 260-300 m, 1 spm, 1 lv, 1 rv.

DISTRIBUTION. — Torres Strait and Sulu archipelago (SMITH, 1885; DIJKSTRA, 1990). Now also recorded from the Chesterfield Islands, New Caledonia and Loyalty Islands. Present specimens living at 260-355 m.

DESCRIPTION. — *Shell* rather small, fragile, suborbicular, inequivalve, semi-transparent white, up to ca. 9 mm high, left valve somewhat more convex than right, auricles unequal in size, umbonal angle ca. 100°.

Prodissoconch ca. 200 µm in height.

Left valve glossy, very weakly sculptured with irregularly spaced concentric growth lines. Sometimes with minute, close-set concentric lamellae near ventral margin. Auricles smooth; anterior auricle considerable larger than posterior. Hinge line straight.

Right valve covered with regularly spaced concentric lirae, close-set near the umbonal area, becoming more widely spaced towards ventral margin. Anterior auricle sculptured with 1-5 weakly de-veloped radial riblets, absent on posterior. Prominent concentric lamellae near anterior margin, more weakly developed near posterior margin. Hinge line somewhat elevated due to strong lamellation on antero-and postero-dorsal margins.

Internal lirae generally 10, plus 1 small auricular lira on each side. Sometimes with the addition of 1 or 2 rudimentary interstitial lirae. Left valve transparent white, sometimes with white spots, right valve semi-transparent white. Resilifer triangular. Outer ligament well developed. Small byssal notch, no ctenolium.

REMARKS. — The present specimens are very similar to the type material. Small specimens of *P. torresi* and *P. scitulum* are easily confused, because of their variable sculpture. The left valve of *P. torresi* is rather convex, that of *P. scitulum* strongly compressed to nearly flat, and more brightly coloured. The right valve of *P. torresi* is covered with regularly concentric lirae, which are generally lacking on *P. scitulum*.

A closely related species is *Parvamussium formosum* (Melvill & Standen, 1907) from the Gulf of Oman, which is sculptured with weak radial striae near the posterior and anterior margins of the left valve, while the auricles are more strongly sculptured than in *P. torresi*.

P. torresi is the type species of *Glyptamusium*, which was synonymized with *Parvamussium* by HERTLEIN (1969: N350). OYAMA (1944: 242, 244) misspelled the name "*Graptamussium*".

Parvamussium undisonum sp. nov.

Figs 55-58

TYPE MATERIAL. — Holotype MNHN. Paratypes: 5 MNHN, 1 USNM, 2 HD.

TYPE LOCALITY. — Loyalty Islands, MUSORSTOM 6, stn DW 489, 20°48′ S, 167°05′ E, 700 m.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn KG 06, 20°34′ S, 166°52′ E, 735 m, 2 rv (paratypes: MNHN, USNM).
Loyalty Islands. MUSORSTOM 6: stn DW 488, 20°49′ S, 167°06′ E, 800 m, 4 lv (paratypes: 3 MNHN, 1 HD). — Stn DW 489, 20°48′ S, 167°05′ E, 700 m, 1 spm (holotype).
New Hebrides Arc. GEMINI: stn DW 55, 20°59′ S, 170°01′ E, 710 m, 1 spm, 1 rv (paratypes: MNHN, HD).

DISTRIBUTION. — New Caledonia and New Hebrides Arc, 700-800 m, living 700-710 m.

DESCRIPTION. — *Shell* rather small, inequivalve, inequilateral, up to ca. 14 mm high, somewhat higher than wide, left valve slightly more convex than right, translucent white; auricles nearly equal in size, relatively small, umbonal angle ca. 90°.

Prodissoconch ca. 210 µm in height.

Left valve covered with undulating concentric lamellae that cross irregularly spaced radial costae, enlarging towards ventral margin. Auricles with close-set concentric lamellae, which is somewhat more prominent on the anterior auricle. Hinge line straight.

Right valve ornamented with regularly spaced concentric lirae, very weak near submarginal and marginal areas, which are covered by a layer of delicate undulating concentric lamellae (often worn off in dead specimens). Anterior auricle well developed, sculptured with 5 radial riblets, covered with concentric lamellae, which is strongly developed on antero-dorsal margin. Posterior auricle covered with concentric lamellae, which are more prominent on postero-dorsal margin. Marginal apron broken off in all specimens seen.

Internal lirae 10, 4 of them rudimentary, plus 1 small posterior auricular lira on the left valve; 9 lirae plus 2 rudimentary, and 1 posterior auricular lira on right valve. Lirae commencing near adductor insertion scar and enlarging towards to submarginal area. Exterior sculpture of left valve slightly visible from the interior. Outer ligament small. Resilifer triangular. Byssal notch small. Fasciolar pseudo-ctenolium present, with one active tooth.

Dimensions of the holotype: H 14.2, L 13.9, D 3.1 mm.

REMARKS. — The most closely related species is *P. sayanum* (Dall, 1886) from the Gulf of Mexico and West Indies, which has almost identical sculpture. It differs, however, in having more prominent, radial and more widely spaced concentric lamellae, which are more delicate on the auricles.

WALLER (1984: 213) discussed the pseudo-ctenolium in *P. sayanum*, which is an unusual feature in Propeamussiidae. *P. undisonum* is another propeamussiid with an active tooth, only visible in adult specimens. One immature right valve (9 mm high) from BIOCAL stn KG 06 lacks this tooth.

No other propeamussiid species known from the Indo-Pacific region approaches *P. undisonum*.

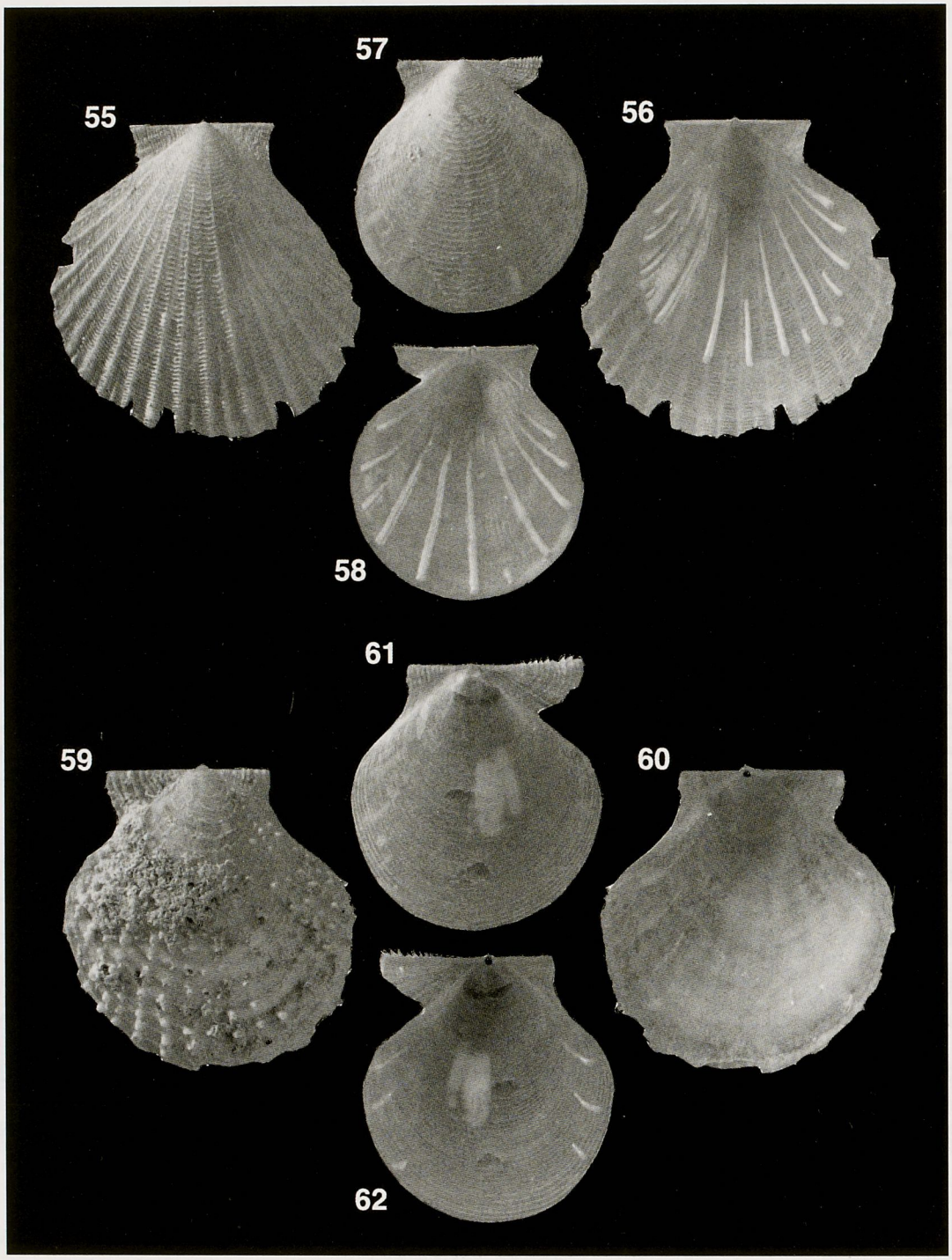
ETYMOLOGY. — From the undulating sculpture (Latin *undisonus*, adj. = surrounded by wave).

Parvamussium vesiculatum sp. nov.

Figs 59-62, 93-96

TYPE MATERIAL. — Holotype MNHN. Paratypes: 2 AMS C201715, 12 HD, 43 MNHN, 2 NMNZ M268538, 2 NSMT, 2 USNM.

TYPE LOCALITY. — South-east New Caledonia, BIOCAL, stn DW 44, 22°47′ S, 167°14′ E, 440-450 m.



FIGS 55-62. — **55-58**, *Parvamussium undisonum*, holotype, 14.2 x 13.9 mm (db). — **55**, left valve, exterior. — **56**, left valve, interior. — **57**, right valve, exterior. — **58**, right valve, interior. — **59-62**, *P. vesiculatum*, holotype, 6.0 x 5.8 mm (db). — **59**, left valve, exterior. — **60**, left valve, interior. — **61**, right valve, exterior. — **62**, right valve, interior.

MATERIAL EXAMINED. — **New Caledonia**. *"Vauban"* 1978-79: stn 15, 22°49′ S, 167°12′ E, 390-395 m, 1 lv.
BIOCAL: stn DW 08, 20°34′ S, 166°54′ E, 435 m, 1 rv. — Stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 37 spms, 13 lv, 14 rv (holotype and paratypes). — Stn CP 45, 22°47′ S, 167°15′ E, 430-465 m, 1 lv. — Stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 1 rv. — Stn DW 49, 23°03′ S, 167°32′ E, 825-830 m, 1 rv. — Stn DW 51, 23°05′ S, 167°45′ E, 680-700 m, 2 lv. — Stn DW 106, 21°36′ S, 166°29′ E, 625-650 m, 2 spms.
MUSORSTOM 4: stn DW 184, 19°04′ S, 163°27′ E, 260 m, 1 spm. — Stn DW 210, 22°44′ S, 167°09′ E, 340-345 m, 1 spm, 2 lv, 1 rv. — Stn DW 222, 22°58′ S, 167°33′ E, 410-440 m, 2 lv. — Stn DW 234, 22°15′ S, 167°08′ E, 350-365 m, 1 spm.
Norfolk Ridge. CHALCAL 2: stn DW 76, 23°41′ S, 167°45′ E, 470 m, 2 spms.
SMIB 3: stn DW 22, 23°03′ S, 167°19′ E, 503 m, 7 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 479, 21°09′ S, 167°55′ E, 310 m, 1 lv.

DISTRIBUTION. — New Caledonia and Loyalty Islands, shells in 260-830 m, living in 260-650 m.

DESCRIPTION. — *Shell* small, suborbicular, inequivalve, inequilateral, semi-transparent, up to 6 mm high, left valve slightly more convex than right, auricles unequal in size, umbonal angle ca. 95°.

Prodissoconch ca. 200 μm in height.

Left valve widely spaced concentric lirae with strongly developed nodules or hollow scales, broken off in all specimens seen below umbonal region, commencing almost immediately, close-set at first, becoming stronger and more widely spaced towards ventral margin. Irregular radial riblets between concentric lirae. Auricles covered with concentric lamellae, stronger on anterior auricle, slightly closer on posterior auricle. Hinge line straight.

Right valve with regularly spaced concentric lirae, very weakly developed near umbonal region. Prodissoconch and dissoconch pellucid. Anterior auricle with 4 delicate radial riblets, which are covered by concentric lamellae that develope into scales on the dorsal margin. Posterior auricle with concentric lamellae, strongly developed on dorsal margin. Byssal fasciole well developed.

Internal lirae rudimentary, 5 near anterior and 4 near posterior margin, 1 delicate auricular lira on anterior and a stronger one on posterior of left valve; right valve with 3 rudimentary lirae on anterior, posterior margin with 1 auricular lira on posterior auricle. External sculpture visible from interior of both valves. Resilifer triangular. Byssal notch small, no ctenolium.

Both valves semi-transparent white; right valve with a large white spot at centre of disc.

Dimensions of the holotype: H 6, L 5.8, D 1.8 mm.

REMARKS — A few paratypes lack external sculpture on the left valve (Figs 95-96) after the shell attains 2 mm high, and are very fragile, smooth, glossy and transparent.

Parvamussium vesiculatum most closely resembles *P. texturatum* which is sympatric and is slightly more orbicular with somewhat larger auricles. The radial costae on the left valve are more prominent in the latter species, whereas concentric lirae are more strongly developed and more widely spaced in *P. vesiculatum*. *P. vesiculatum* is ornamented with nodules on the concentric lirae, whereas *P. texturatum* bears more scales. There are also differences in the internal lirae, which are rudimentary and fewer in number in *P. vesiculatum*, and well developed in *P. texturatum*.

ETYMOLOGY. — From the nodular sculpture of the left valve (Latin *vesiculatus*, adj. = with nodules).

Genus *CYCLOCHLAMYS* Finlay, 1926

Cyclochlamys Finlay, 1926: 452. Type species (OD): *Pecten transenna* (*sic*) Suter, 1913. Recent, near the Snares, New Zealand, 91 m.

Synonym:

Chlamydella Iredale, 1929: 164, 188. Type species (OD): *Cyclopecten favus* Hedley, 1902. Recent, off New South Wales, Australia, 75-91 m.

DIAGNOSIS. — *Shell* inequivalve, minute, orbicular to strongly oblique; *left valve* sculptured with radial and/or concentric riblets or striae, *right valve* with commarginally elongate hexagonal

(honeycomb-like) microstructure (simple calcitic prismatic outer layer); auricles unequal; byssal notch well-developed; no ctenolium; no internal lirae.

DISTRIBUTION. — Recent. Subantarctic, South Australia and West Pacific from New Zealand to Japan (HAYAMI & KASE, 1993).

REMARKS. — *Cyclochlamys* was erroneously mentioned as a "*nom. null.*" by HERTLEIN (1969: N353). It differs from *Cyclopecten* by a pteriform shell, a triangular prodissoconch and the commarginally elongate hexagonal (honey-comb like) microstructure of the right valve.

Cyclochlamys favus (Hedley, 1902) comb. nov.

Figs 87-90

Cyclopecten favus Hedley, 1902: 305, fig. 50 (as *C. flavus, sic*).

Synonyms:

Cyclopecten obliquus Hedley, 1902: 306, fig. 51.
Cyclopecten nepeanensis Pritchard & Gatliff, 1904: 338, pl. 20, fig. 5.

Other references:

Chlamydella favus – COTTON & GODFREY, 1938: 98, fig. 85 (after HEDLEY). — COTTON, 1961: 103, fig. 89.

TYPE MATERIAL. — *C. favus*: holotype (H 3.0, L 3.4, D 0.5 mm) live taken, AMS C13231, 20+ paratypes v, AMS C171633. — *C. obliquus*: holotype lv, AMS C13234, 70+ paratypes v, AMS C13232, C13233. — *C. nepeanensis*: holotype lv, NMV F558.

TYPE LOCALITY. — *C. favus*: 5.5-7.5 miles NE of Cape Three Points, New South Wales, Australia, *"Thetis"*, stn 13, 33°28′ S, 151°33′ E, 75-91 m. — *C. obliquus*: 5-8 miles off Port Kembla, New South Wales, *"Thetis"*, stn 49, 34°28′ S, 151°06-03′ E, 115-137 m. — *C. nepeanensis*: Back Beach, Point Nepean, Victoria, Australia.

MATERIAL EXAMINED. — The type material.
Australia. Off Moreton Bay, Queensland, 27°31′ S, 153°40′ E, 75-80 m,1 rv (AMS). — E of Sydney, New South Wales, *"Gascoyne"*, stn G2-56-62, 150 m, several valves (AMS). — NE of Woolongong, New South Wales, *"Kapala"*, stn K75-05-06, 34°18-24′ S, 151°26-21′ E, 466-494 m, 13 v (AMS). — 2.5 miles NE Beaching Bay, Maria Island, SE Tasmania, *"Penghana"*, 42°27.5′ S, 148°12′ E, 82.5 m, several spms (AMS). — Between Eucla and Esperance, Western Australia, *"Gascoyne"*, stn G2-96-62, 79-147 m, several v (AMS).
New Caledonia. BIOCAL: stn DW 44, 22°47′ S, 167°14′ E, 440-450 m, 1 spm (typical). — Stn DW 46, 22°53′ S, 167°17′ E, 570-610 m, 6 spms (typical), 2 spms (var. *obliqua*).

DISTRIBUTION. — Southern Australia and New Caledonia. Present material living at 440-610 m.

DESCRIPTION. — *Shell* small, up to ca. 3 mm high, translucent. Valves dissimilar in shape, size and sculpture.

Prodissoconch ca. 240 µm in height (Figs 87-88).

Left valve somewhat larger, more convex, transparent, smooth except for a few minute concentric growth lines (typical) or with a few more prominent concentric lirae (var. *obliqua*); auricles nearly equal, with some concentric lines. Outer ligament insertion with small holes near resilifer (Fig. 89).

Right valve somewhat smaller, transparent, smooth, with hexagonal microsculpture (Fig. 90). Anterior auricle with close-set concentric lamellae. Byssal notch well developed; no ctenolium.

REMARKS. — The present material is similar in all respects to the type specimen from off New South Wales. *Cyclochlamys favus* is rather variable in sculpture on the left valves with weak or

pronounced concentric growth lines, and sometimes secondary radial striae. Completely smooth specimens are also known.

Genus *Cyclopecten* Verrill, 1897

Cyclopecten Verrill, 1897: 70. Type species (SD, Sykes, Smith & Crick, 1898): *Pecten pustulosus* Verrill, 1873: 14; Recent, off Newfoundland, Canada, 274 m.

Synonym:

Xenamussium Oyama, 1944: 244. [Proposed as a subgenus of *Propeamussium*]. Type species (OD): *Pecten hoskynsi* Forbes, 1844; Recent, "Asia minor" [= off Turkey].

Diagnosis. — *Shell* equivalve, small, usually orbicular, laterally compressed, prodissoconch flat curved; *left valve* usually sculptured with radial and/or concentric costae or striae, *right valve* with concentric lamellae; auricles unequal; byssal notch well-developed; no ctenolium; no internal lirae.

Distribution. — Miocene to Recent. Worlwide, subtidal to hadal (Hayami & Kase, 1993: 59). In the Indo-Pacific *Cyclopecten*, however, only lives in deep-water (Dijkstra, unpubl. data).

Remarks. — In the original diagnosis of *Cyclopecten*, the characters "few pectinidial teeth [= ctenolium], byssus small and a few threads", refer to *"Cyclopecten" orbicularis* (Sowerby) [= *Lissochlamis exotica* (Dillwyn, 1817)], a pectinid species. These characters are not present in *Cyclopecten*, as defined by the type species. There are many described species of *Cyclopecten* but they are currently placed in different genera, for example *Delectopecten* (a pectinid) (Hertlein, 1969; Knudsen, 1970; Habe, 1977; Bernard, 1978; Rombouts, 1991) or *Palliolum* Monterosato, 1884 (also a pectinid) (Abbott, 1974, *pro parte*). Also, several *"Cyclopecten"* species described from the subantarctic region, belong to *Cyclochlamys* (Dijkstra, unpubl. data). *Cyclopecten* is morphologically closest to *Parvamussium*. As Hayami & Kase (1993: 59) suggested, *Cyclopecten* may have been derived from *Parvamussium* through paedomorphic evolution. Shell characters of *Xenamussium* are sufficiently similar to *Cyclopecten* to suggest synonymy.

Cyclopecten horridus sp. nov.

Figs 63-64, 98

Type material. — Holotype MNHN. Paratypes: 5 MNHN, 2 HD.

Type locality. — Loyalty Islands, MUSORSTOM 6, stn DW 420, 20°29′ S, 166°43′ E, 600 m.

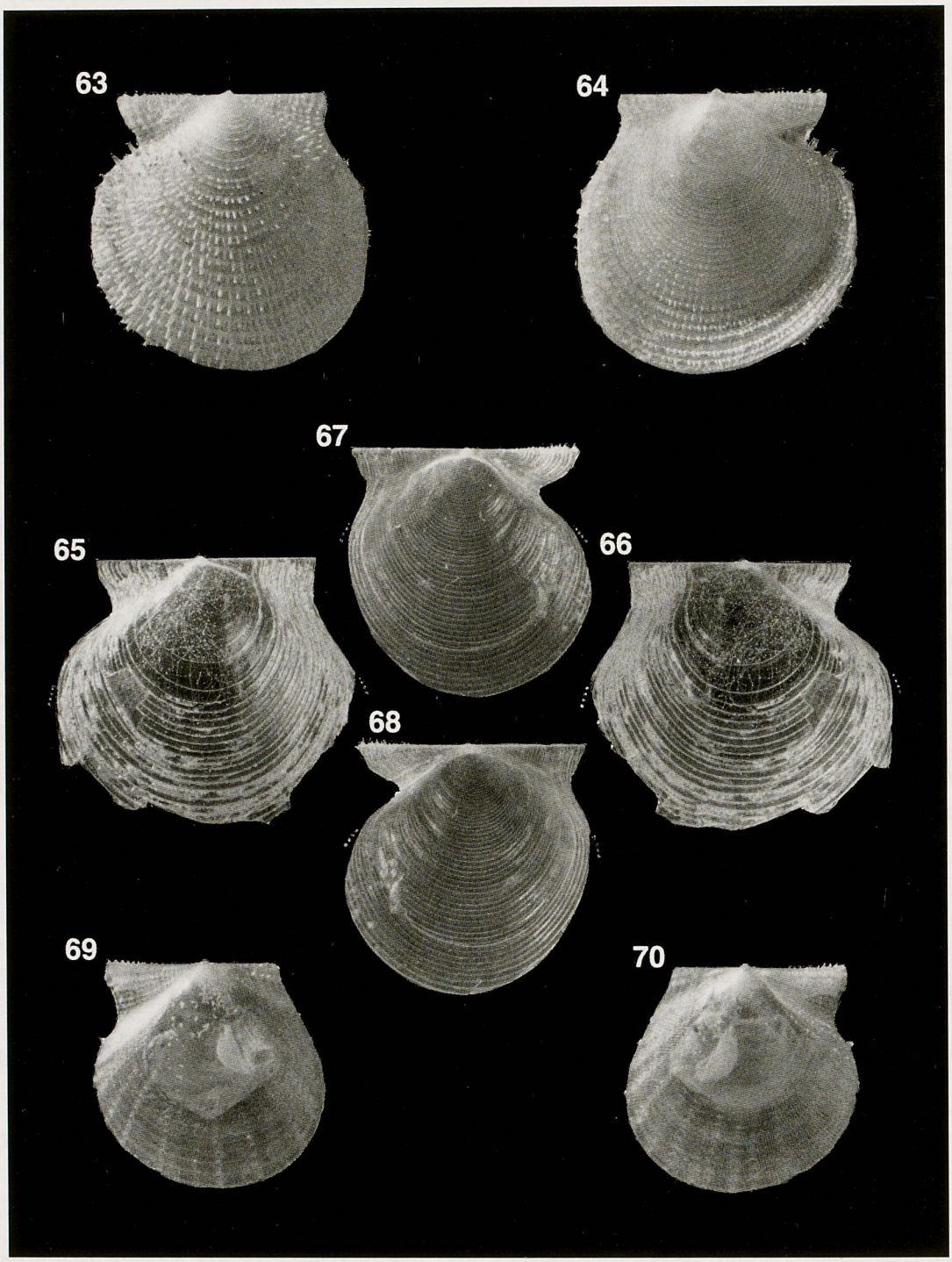
Material examined. — **New Caledonia**. BIOCAL: stn KG 06, 20°34′ S, 166°52′ E, 735 m, 1 lv (paratype). — Stn DW 08, 20°34′ S, 166° 53′ E, 435 m, 3 lv, 2 rv (paratypes: 3 MNHN, 2 HD). BIOGEOCAL: stn DW 307, 20°35′ S, 166°55′ E, 470-480 m, 1 lv (paratype).
Loyalty Islands. MUSORSTOM 6: stn DW 420, 20°29′ S, 166°43′ E, 600 m, 1 spm (holotype).

Distribution. — New Caledonia and Loyalty Islands, shells in 435-735 m, living in 600 m.

Description. — *Shell* small, suborbicular, inequivalve, up to ca. 6 mm high, left valve more convex than right, marginal apron of right valve pressed against margin of interior of left valve, auricles of nearly equal size, umbonal angle ca. 125°, whitish opaque.

Prodissoconch ca. 220 μm in height.

Left valve covered with regular concentric lamellae, closely-set in early ontogeny, enlarging towards periphery. Erect hollow spines developing on lamellae (Fig. 98), which are stronger near the ventral margin (broken off near umbonal area in all specimens seen). Crowded microscopic granules between concentric lamellae, radial scratches added in late ontogeny. Auricles covered with sculpture identical to that on exterior of disc.



FIGS 63-70. — **63-64**, *Cyclopecten horridus*, holotype, 5.9 x 6.0 mm (db). — **63**, left valve, exterior. — **64**, right valve, exterior. — **65-68**, *C. pellucidulus*, holotype, 6.1 x 6.8 mm (db). — **65**, left valve, exterior. — **66**, left valve, interior. — **67**, right valve, exterior. — **68**, right valve, interior. — **69-70**, *Delectopecten musorstomi*, BIOCAL: stn DW 64, 4.3 x 4.3 mm (db). — **69**, left valve, exterior. — **70**, right valve, exterior.

Right valve with regular concentric lirae, close-set to 2 mm shell height, then transformed into more widely spaced, undulating concentric lamellae with delicate spines near ventral margin. Granulate microsculpture between the concentric lirae and lamellae. Anterior auricle sculptured with 3 radial riblets covered with concentric lamellae. Posterior auricle poorly differentiated from disc, covered with concentric lirae. Hinge line straight. Antero-dorsal margin with scales, squamae weakly developed on postero-dorsal margin. Byssal notch strongly developed. No ctenolium.

Dimensions of the holotype: H 5.9, L 6, D 1.6 mm.

REMARKS. — A somewhat similar species is *Parvamussium araneum* Dijkstra, 1991 from the Indonesian Archipelago. This species has a few internal rudimentary lirae, and micro-sculpture on the right valve has radial scratches. Another related species is *P. vidalense* (Barnard, 1964) from off Zululand, South Africa. The radial sculpture of *P. vidalense* is somewhat weaker than in *P. araneum*, with overriding concentric lamellae, while the erect spines are weaker. Moreover, a few more internal rudimentary lirae are present in *P. vidalense* than in *P. araneum*, but they are absent in *C. horridus*.

Some shell features of *C. horridus* resemble those characteristic of *Delectopecten*, such as arrangement of erect spines on concentric lamellae, and strongly developed byssal notch. A ctenolium however, is absent, and the sculpture of the right valve is more similar to that in *Cyclopecten*.

ETYMOLOGY. — From the spiny sculpture (Latin *horridus*, adj. = bristly).

Cyclopecten pellucidulus sp. nov.

Figs 65-68

TYPE MATERIAL. — Holotype MNHN. Paratypes: 1 HD, 2 MNHN.

TYPE LOCALITY. — South of New Caledonia, BIOCAL, stn DW 51, 23°05′ S, 167°44′ E, 680-700 m.

MATERIAL EXAMINED. — Only known from the type material.

DISTRIBUTION. — Only known from the type locality, northern Norfolk Ridge, alive in 680-700 m.

DESCRIPTION. — *Shell* small, fragile, pellucid, suborbicular, inequivalve, up to ca. 6 mm high, left valve slightly more convex than right, auricles equal in size, umbonal angle ca. 125°.

Prodissoconch ca. 230 µm in height.

Left valve covered with curved concentric lamellae, commencing at 2 mm shell height, enlarging towards ventral margin. Umbonal area smooth and glossy. Auricles with close-set concentric lamellae.

Right valve covered with delicate regularly spaced concentric lirae that gradually enlarge, interspaces with microscopic radial scratches. Anterior auricle with concentric lamellae, stronger than on posterior auricle, strongly developed scales on antero-dorsal margin. Exterior sculpture visible from interior of both valves. Interior with one weak liration on the inner side of each auricle. Resilifer triangularly elongate. Byssal notch present, no ctenolium. Outer ligament small.

Dimensions of the holotype: H 6.1, H 6.8, D 1.2 mm.

REMARKS. — A somewhat similar species is *Cyclopecten aupouria* Powell, 1937 from northern New Zealand, which attains larger size, is more convex, and is opaque white with more delicate concentric lirae and finer radial lirae. Another related species is *C. bavayi* Dijkstra, 1990 from the Ceram Sea (Indonesia), which is also slightly larger, opaque, and covered with numerous concentric lamellae on the early disc, and small radial riblets, which are absent in *C. pellucidulus*.

ETYMOLOGY. — From the translucence of the shell (Latin *pellucidulus*, adj. = translucent).

Family ENTOLIIDAE Teppner, 1922

Entoliidae Teppner, 1922: 89, 274.

Synonym:

Syncyclonemidae Waller, 1978: 353.

DIAGNOSIS. — Byssate or free Pectinoidea, lacking prismatic calcite; foliated calcite thin or absent; crossed-lamellar aragonite dominant extending to margins; byssal notch without ctenolium.

REMARKS. — WALLER (1978) described a new family Syncyclonemidae in Pectinoidea, and treated *Pectinella* as a junior synonym of *Syncyclonema* Meek, 1864. Later, he reduced Syncyclonemidae in rank within the family Entoliidae, and reinstated *Pectinella* as a Recent genus (WALLER, 1984: 219).

Genus *PECTINELLA* Verrill, 1897

Pectinella Verrill, 1897: 68. Type species (OD): *Pecten (Pseudamusium) sigsbeei* Dall, 1886; Recent, Cuba, 289 m.

DIAGNOSIS. — *Shell* equivalve, small, transparent, nearly smooth, with convex and nearly equal valves; auricles very unequal, oblique; byssal notch well-developed; no ctenolium.

DISTRIBUTION. — Recent, Gulf of Mexico, Caribbean Sea, central and western Pacific; 240-300 m.

Pectinella aequoris Dijkstra, 1991

Figs 71-74

Pectinella aequoris Dijkstra, 1991: 23, figs 78-86.

TYPE MATERIAL. — Holotype lv, RMNH 56567, 4 paratypes rv, RMNH 56568-56569.

TYPE LOCALITY. — Indonesia, Bay of Sanggar, N of Sumbawa, *"Snellius-II"*, stn 4.111, 8°19.3′ S, 118°15.6′ E, 175-185 m.

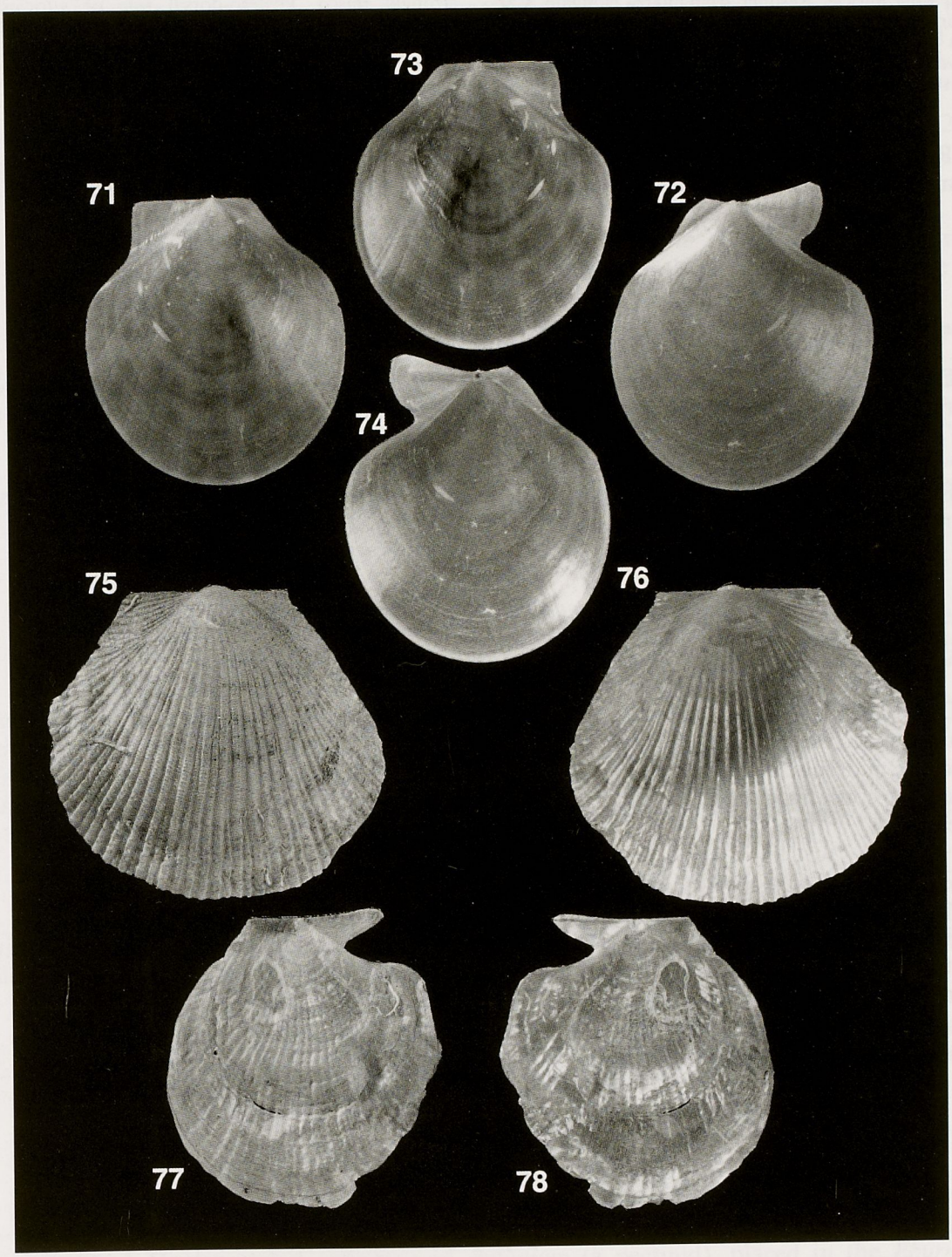
MATERIAL EXAMINED. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn DW 272, 24°41′ S, 159°43′ E, 500-540 m, 1 lv.
Loyalty Islands. BIOGEOCAL: stn DW 296, 20°38′ S, 167°10′ E, 1230-1270 m, 1 lv.
MUSORSTOM 6: stn DW 397, 20°47′ S, 167°05′ E, 380 m, 1 lv. — Stn DW 474, 21°09′ S, 167°55′ E, 260 m, 1 spm.
VOLSMAR: stn DW 38, 22°22′ S, 168°44′ E, 380-420 m, 1 lv.

DISTRIBUTION. — Indonesia, Hawaiian Islands and Fiji Islands (DIJKSTRA, 1991). Now also found in the Chesterfield Islands and the Loyalty Islands. Present material living at 260 m.

DESCRIPTION. — *Shell* rather small, convex, elongate, slightly equivalve, semi-transparent, up to ca. 20 mm high, right valve somewhat more convex than left, auricles unequal in size, umbonal angle ca. 90°.

Prodissoconch ca. 220 µm in height.

Left valve smooth, glossy, with microscopic radially diverging scratches. Delicate close-set concentric striae enlarging towards ventral margin. A few concentric lirae near umbonal region. Some specimens with a few delicate, irregularly spaced radial grooves that commence near centre of disc and enlarge ventral margin (visible from interior as very weak lirae).Anterior auricle with concentric lirae, weaker on posterior. Delicate concentric striae near lateral margin. Hinge line straight. Internal surface glossy, and microscopically



FIGS 71-78. — **71-74**, *Pectinella aequoris*, MUSORSTOM 6: stn DW 474, 18.2 x 16.6 mm (db). — **71**, left valve, exterior. — **72**, left valve, interior. — **73**, right valve, exterior. — **74**, right valve, interior. — **75-78**, *Pseudohinnites levii*, BIOGEOCAL: stn CP 273, paratypes, 41.8 x 45.1 mm (lv), 28.9 x 37.2 mm (rv). — **75**, left valve, exterior. — **76**, left valve, interior. — **77**, right valve, exterior. — **78**, right valve, interior.

granulated. One liral tooth (auricular crura) formed near border of each auricle. Resilifer triangularly elongate. Cardinal crura rather broad near resilial pit on antero-dorsal region. A prominent tooth near pit on postero-dorsal region.

Right valve with similar microsculpture to that of left valve. Auricles strongly produced on dorsal margin. Antero-dorsal region of auricles with narrow straight groove, hinge line strongly raised. Postero-dorsal side of auricles a small depression. Byssal notch well developed, no ctenolium.

Creamy transparent with orange-brown and white maculations on left valve, right valve transparent and uniformly cream.

REMARKS. — The present specimens are similar to the type material, although larger in size. For comparison with *Pectinella sigsbeei* and other species, see DIJKSTRA (1991: 25).

Family PECTINIDAE Wilkes, 1810

Pectinidae [as Pectinoidae] Wilkes, 1810: 32 [emend. Waller, 1978]

DIAGNOSIS. — Byssate, cemented, or free living Pectinoidea with outer, prismatic calcited layer on right valve; crossed-lamellar aragonite inside of pallial line or absent; byssal notch with ctenolium, at least at early growth stages.

REMARKS. — The family Pectinidae is usually attributed to RAFINESQUE (1815). WILKES, however, has priority. For synonymy see HERTLEIN (1969: N348).

Genus *PSEUDOHINNITES* Dijkstra, 1989

Pseudohinnites Dijkstra, 1989: 29. Type species (OD): *Pseudohinnites levii* Dijkstra, 1989.

DIAGNOSIS. — *Shell* inequivalve, medium-sized, fragile, very irregular, with a *Hinnites*-like appearance; auricles unequal; *left valve* convex, right valve flat; exterior of left valve with irregular radial costae and concentric lamellae overlying the radial costae and interstices; *right valve* smooth, with irregular concentric waves or irregular depressions, giving a deformed appearance; byssal notch with ctenolium.

DISTRIBUTION. — Recent. Western to southwestern Pacific; 700-2000 m.

REMARKS. — *Pseudohinnites* somewhat resembles *Hyalopecten*, although the former has different shape ("*Hinnites*-like"), whereas the latter is regular undulated. *Pseudohinnites* is still under study and will be discussed elsewhere (KNUDSEN & DIJKSTRA, in prep.).

Pseudohinnites levii Dijkstra, 1989

Figs 75-78

Pseudohinnites levii Dijkstra, 1989: 29, figs 1-3; 1990: 7, figs 14-15.

TYPE MATERIAL. — Holotype and paratypes MNHN.

TYPE LOCALITY. — SE of New Caledonia, BIOCAL, stn DW 70, 23°25′ S, 167°53′ E, 965 m.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 26, 22°40′ S, 166°27′ E, 1618-1740 m, 2 fragm. lv, 3 fragm. rv (paratypes). — Stn CP 30, 23°09′ S, 166°41′ E, 1140 m, 4 fragm. lv, 1 fragm. rv (paratypes). — Stn DW 70, 23°25′ S, 167°53′ E, 965 m, 1 lv (holotype). — Stn DW 80, 20°32′ S, 166°48′ E, 900-980 m, 1 rv (paratype).

BIOGEOCAL: stn CP 232, 21°34′ S, 166°27′ E, 760-790 m, 1 lv. — Stn CP 243, 21°27′ S, 166°26′ E, 1820 m, 3 lv. — Stn CP 260, 21°00′ S, 166°58′ E, 1820-1980 m, 3 lv, 2 rv (paratypes). — Stn CP 265, 21°04′ S, 167°00′ E, 1760-1870 m, 1 fragm. lv. — Stn CP 273, 21°02′ S, 166°57′ E, 1920-2040 m, 4 lv, 3 rv (paratypes).
CALSUB: dive 13, 21°26′ S, 166°23′ E, 1567-1807 m, 1 spm (juv.).
Loyalty Islands. MUSORSTOM 6: stn CP 438, 20°23′ S, 166°20′ E, 780 m, 2 rv. — Stn DW 488, 20°49′ S, 167°06′ E, 800 m, 2 lv, 2 rv. — Stn DW 489, 20°48′ S, 167°06′ E, 700 m, 2 fragm. rv.
New Hebrides Arc. SUBPSO: dive 7, sample 706, 15°50′ S, 166°42′ E, 2000 m, 2 spms.

DISTRIBUTION. — DIJKSTRA (1989) described this species from New Caledonia, and recorded material from the Philippines and Indonesia (DIJKSTRA 1989, 1990). Now also found from the Loyalty Islands and the New Hebrides Arc. Present specimens living at 1567-2000 m.

DESCRIPTION. — *Shell* medium-sized, fragile, semi-transparent white, interior nacreous, suborbicular, inequivalve, variable in shape, left valve strongly convex, right valve flat to slightly concave, up to ca. 35 mm high, auricles unequal, umbonal angle ca. 110°.

Prodissoconch ca. 300 µm in height.

Left valve covered with rather regular, closely spaced, radial costae, which multiply and enlarge towards ventral margin. Irregular close-set concentric lamellae between and across radial costae, commencing at ca. 10 mm shell height and enlarging to form slightly scaly lamellae near periphery. Auricles continuous with disc margins, sculpture similar to that on disc. Hinge line straight.

Right valve irregularly indented, ornamented with delicate, rather regularly spaced, undulating radial lirae. Anterior auricle separated from disc by a distinct suture, posterior continuous with disc margin, auricular sculpture similar to that on disc. Byssal notch present. Inactive and active ctenolium (4-7 teeth). Hinge line somewhat elevated. Two indistinct resilial teeth are present; no dorsal teeth (crura). Resilifer triangular, outer ligament very small.

REMARKS. — The present specimens of *P. levii* will make it possible to supplement the original description with information on the anatomy (KNUDSEN & DIJKSTRA, in prep.). For comparison with *Pseudohinnites adamsi* (Dall, 1886) from the West Indies, see DIJKSTRA (1989: 32).

Genus *HYALOPECTEN* Verrill, 1897

Hyalopecten Verrill, 1897: 63, 71, pl. 18, fig. 5. Type species (OD): *Pecten undatus* Verrill & S. Smith *in* Verrill, 1885; Recent, off Chesapeake Bay, Maryland, USA, 2603 m.

REMARKS. — *P. undatus* Verrill & S. Smith is a homonym of *Pecten undatus* Defrance, 1825 and a senior synonym of *Hyalopecten dilectus* Verrill & Bush *in* Verrill, 1897 [Recent, off Martha's Vineyard, Massachusetts, USA, 3316 m], which then becomes the valid name of the type species (see NORTH, 1951a: 234).

DIAGNOSIS. — *Shell* inequivalve, compressed, hyaline; valves with concentric undulations or corrugations and sculptured with fine radial lirae on one or both valves; auricles unequal; byssal notch well-developed, ctenolium present.

DISTRIBUTION. — Miocene to Recent, worldwide, 800-7000 m (KNUDSEN, 1970).

REMARKS. — GRAU (1959: 55) treated *Hyalopecten* as a subgenus of *Cyclopecten* (a propeamussiid), and was followed by KNUDSEN (1970: 97) and ROMBOUTS (1991: 79). HERTLEIN (1969: N354) considered *Hyalopecten* a subgenus of *Palliolum* (a pectinid), placed in the *Eburneopecten* group, and VAUGHT (1989: 119) placed *Hyalopecten* in the tribe Eburneopectinini. *Hyalopecten* is considered a valid Recent genus of Pectinidae by other authors (BERNARD, 1983; SCHEIN, 1988, 1989; DELL, 1990; DIJKSTRA, 1991). WALLER & MARINCOVICH (1992: 219) consider *Hyalopecten* as related to a radially sculptured ancestor, *Praechlamys* Allasinaz, 1972 from the Triassic, without placing it in a higher taxon.

Hyalopecten mireilleae sp. nov.

Figs 79-82

TYPE MATERIAL. — Holotype MNHN. Paratypes: 2 MNHN, 2 HD.

TYPE LOCALITY. — S New Hebrides Arc, VOLSMAR, stn DW 55, 20°59′ S, 170°02′ E, 710 m.

MATERIAL EXAMINED. — **New Caledonia**. BIOCAL: stn CP 72, 22°09′ S, 167°33′ E, 2100-2110 m, 1 juv. rv (paratype). — Stn KG 85, 20°59′ S, 167°00′ E, 1639 m, 1 lv (paratype).
Loyalty Islands. MUSORSTOM 6: stn CP 438, 20°23′ S, 166°20′ E, 780 m, 1 lv (paratype HD). — Stn DW 489, 20°48′ S, 167°06′ E, 700 m, 1 rv (paratype HD).
New Hebrides Arc. GEMINI: stn DW 55, 20°59′ S, 170°02′ E, 710 m, 1 spm (holotype).

DISTRIBUTION. — Eastern New Caledonia to the New Hebrides Arc, 700-2110 m, living in 710 m.

DESCRIPTION. — *Shell* small, up to ca. 14 mm high, fragile, oblique, elongate, inequivalve, inequilateral, semi-transparent white, right valve more convex than left, auricles unequal, umbonal angle ca. 90°.

Prodissoconch ca. 200 µm in height.

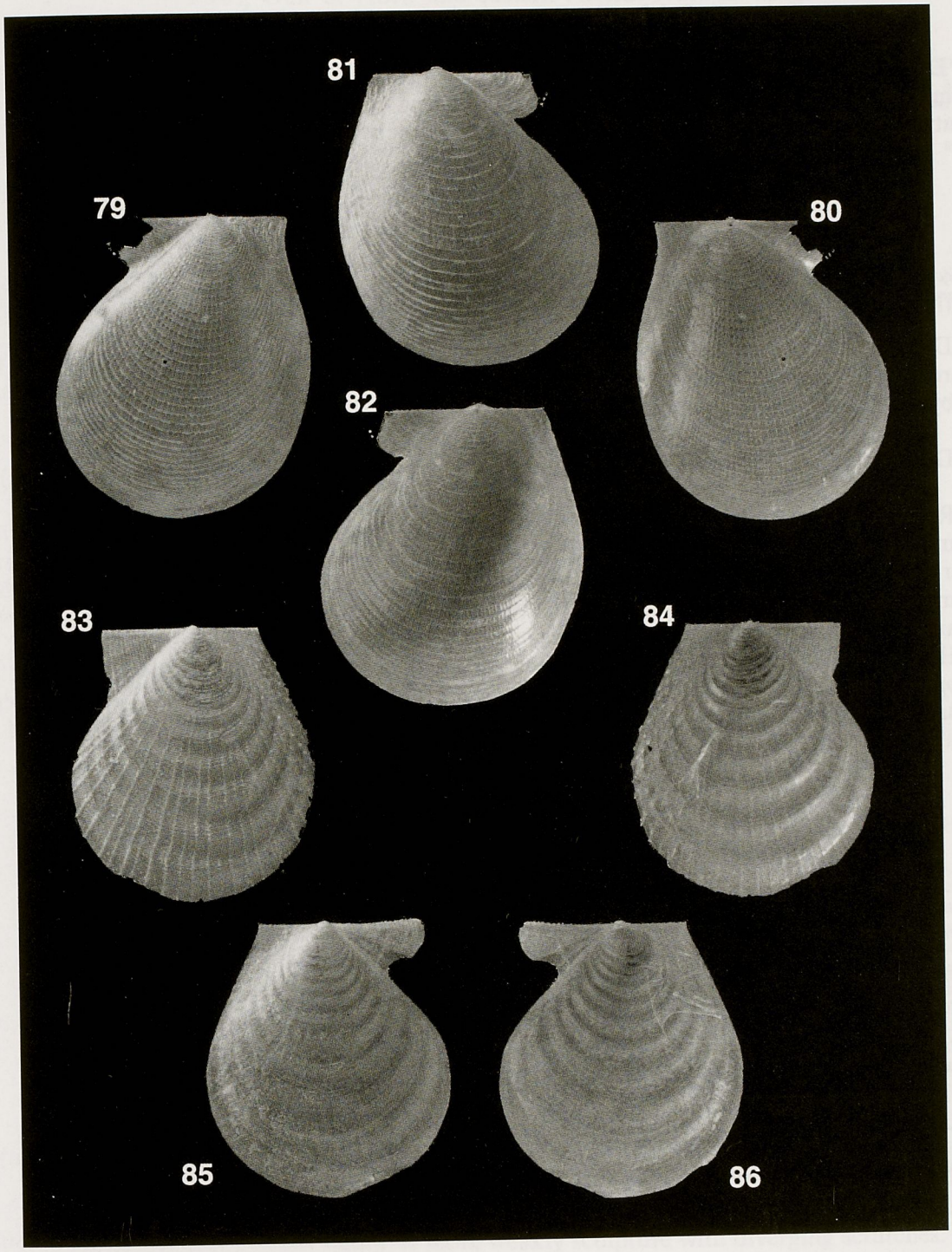
Left valve externally sculptured over entire surface with regular spaced concentric lamellae that enlarge towards ventral margin. Lamellae near periphery more strongly curved and more irregularly and closely spaced. Delicate radial lirae between concentric lamellae, more prominent directly beneath each concentric lira. Anterior and posterior auricles with curved, closely spaced concentric lirae, somewhat more prominent and widely arranged on anterior. Anterior auricle larger than posterior auricle, sculpture similar to that of disc margins. External sculpture visible from interior. Interior surface nacreous.

Right valve with regular concentric lamellae and many delicate interstitial radial lirae similar to those on left valve. Anterior auricle separated from disc by distinct suture, sculptured with irregularly spaced, concentric lamellae, developed into spinous scales on dorsal margin. Posterior auricle with close-set concentric lamellae and continuous with the disc margin. Resilifer triangular. No cardinal crura exposed. Only an inactive ctenolium is developed (two teeth of active ctenolium are developed in paratype from BIOCAL: stn CP 72). Byssal notch present.

Dimensions of the holotype: H 13.4, L 11, D 5.6 mm.

REMARKS. — A somewhat similar species is *Hyalopecten tydemani* Dijkstra, 1990 from the Ceram Sea (Indonesia), which is smaller, less oblique, and ornamented with very closely spaced concentric lamellae. Moreover, the delicate interstitial radial lirae are absent. The western Atlantic species *H. strigillatus* (Dall, 1889) is more like *H. tydemani,* but is somewhat more strongly sculptured with closely spaced concentric lamellae. The anterior auricle of the right valve in both species is relative smaller in *H. mireilleae*. *Hyalopecten pudicus* (E.A. Smith, 1885) from the southern Indian Ocean is more depressed, slighly more orbicular, with an undulating surface. *H. pudicus* is more similar to *H. dilectus* from the Atlantic Ocean. *Hyalopecten neoceanicus* (Dall, 1908) from the Galapagos Islands is more orbicular and depressed with a slightly undulating surface, and reticulate sculpture. *Hyalopecten profundicola* (Okutani, 1962) from abyssal depths of Japan is more depressed, more oblique and orbicular, and the right valve has more closely spaced lamellae. *Hyalopecten hadalis* (Knudsen, 1970) from the Kermadec Trench is somewhat larger (up to 20 mm in height), oblong, strongly undulated, and sculptured with fine, close-set radial striae, anterior auricle of the right valve very small and byssal notch well developed. *Hyalopecten* sp. (KNUDSEN, 1970: 102) from the Tasman Sea is much larger (up to ca. 35 mm), also oblong and strongly undulated, and sculptured with radial riblets.

ETYMOLOGY. — Named after Mrs Mireille Moreau, technician at MNHN, who has skilfully been processing the bivalves from the various expeditions around New Caledonia.



FIGS 79-86. — **79-80**, *Hyalopecten mireilleae*, holotype, 13.4 x 11.0 mm (lv). — **79**, left valve, exterior. — **80**, left valve, interior. — **81-82**, MUSORSTOM 6: stn CP 438, paratype, 12.1 x 10.4 mm (rv). — **81**, right valve, exterior. — **82**, right valve, interior. — **83-86**, *Delectopecten fluctuatus*, CALSUB: dive 15, 4.5 x 5.1 mm (db). — **83**, left valve, exterior. — **84**, left valve, interior. — **85**, right valve, exterior. — **86**, right valve, interior.

Subfamily CAMPTONECTINAE Habe, 1977

DIAGNOSIS. — Pectinidae with antimarginal microsculpture, weak radial costae or striae sometimes present; shell microstructure of outer lathic or foliated calcite, inner crossed-lamellar aragonitic layer to margins; auricles unequal; byssal notch with ctenolium.

Genus *DELECTOPECTEN* Stewart, 1930

Delectopecten Stewart, 1930: 118. [Proposed as a subgenus of *Palliolum*]. Type species (OD): *Pecten (Pseudamusium* [*sic*]*) vancouverensis* Whiteaves, 1893; Recent, British Columbia, Canada, 18-37 m.

DIAGNOSIS. — *Shell* inequivalve, small, fragile, nearly orbicular, valves nearly equal convex, sculptured with concentric rows of scales or vesicles, spinose radial ridges and/or fine diverged radial striae; byssal notch well-developed; ctenolium present.

DISTRIBUTION. — Early Cretaceous to Recent, worldwide, 27-4256 m (CLARKE, 1962).

REMARKS. — GRAU (1959: N38) considered *Delectopecten* a subgenus of *Cyclopecten* and synonymized *Arctinula* Thiele, 1934 and *Catillopecten* Iredale, 1939. Characters of *Arctinula*, however, are similar to those of *Similipecten* Winckworth, 1932 (SCHEIN, 1989: 96), now placed in Propeamussiidae. *Catillopecten* is also considered a Recent genus of Propeamussiidae (SCHEIN, 1988, 1989), and most closely related to *Bathypecten* Schein-Fatton, 1985.

HERTLEIN (1969: N354) treated *Delectopecten* as a subgenus of *Palliolum*, placed in the *Eburneopecten* group. Currently, however, *Delectopecten* is interpreted as a Recent genus of Pectinidae (MOORE, 1984: B13; WALLER, 1991: 13; WALLER & MARINCOVICH, 1992: 219) and placed in the subfamily Camptonectinae.

Delectopecten alcocki (E.A. Smith, 1904)

Figs 111-114, 147-150

Pecten alcocki E.A. Smith, 1904: 13.

Other references:

Pecten alcocki – ALCOCK, ANNANDALE & MCGILCHRIST, 1907: pl. 18, figs 4, 4a-b. — KNUDSEN, 1967: 282, pl. 2, figs 3-4, textfig. 19.
Pecten (Pseudamussium) alcocki – THIELE & JAECKEL, 1931: 6.
Propeamussium (Hyalopecten) alcocki – WINCKWORTH, 1940: 26.
Delectopecten alcocki – POUTIERS, 1981: 331, pl. 1, fig. 1. — DIJKSTRA, 1991: 26, fig. 87.

TYPE MATERIAL. — Lectotype live taken, (Figs 147-150; H 19.0, L 18.0, D 7.0 mm), here designated, ZSI M669/1, and 29 paralectotypes ZSI M667-668, M670-698/1.

TYPE LOCALITY. — Off southern India, *"Investigator"*, stn 232, 7°17′ N, 76°54′ E, 786 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn CP 387, 20°53′ S, 160°52′ E, 650-660 m, 1 lv, 1 rv.
CORAIL 2: stn DE 14, 21°01′ S, 160°57′ E, 650-660 m, 1 spm.

DISTRIBUTION. — SMITH (1904) described this species from off southern India. THIELE & JAECKEL (1931), KNUDSEN (1967) and DIJKSTRA (1991) added records from the Philippines, the Banda

Sea and Sumatra (Indonesia), Gulf of Aden and eastern Africa. Now its range is extented to the Chesterfield Islands. Present material living at 650-660 m.

DESCRIPTION. — *Shell* up to ca. 15 mm high, orbicular, semi-transparent white, auricles nearly equal in size, umbonal angle ca. 125°.

Prodissoconch ca. 280 µm (KNUDSEN, 1967).

Left valve with delicate diverging radial striae over entire disc. Crenulated concentric growth lines with radially aligned scales. Auricles identically sculptured and continuous with the disc. Hinge line straight.

Right valve sculptured as on left valve, although somewhat weaker. Anterior auricle separated from disc by a suture, with 2-4 radiating ridges and radial lamellae. Byssal fasciole and notch strongly developed. Inactive and active ctenolium (3-5 teeth) present. Resilifer triangular. External sculpture barely visible from interior.

Anatomy described by KNUDSEN (1967: 282).

REMARKS. — The present material corresponds in all aspects with the type material. Further notes on soft parts and ecology are given by KNUDSEN (1967: 283) and DIJKSTRA (1991: 26).

Delectopecten fluctuatus (Bavay, 1905)

Figs 83-86

Pecten (Chlamys) fluctuatus Bavay, 1905: 188, pl. 17, figs 3a-b.

TYPE MATERIAL. — Holotype, ?live taken, ZSI M 3359/1.

TYPE LOCALITY. — Off Andaman Islands, depth unknown.

MATERIAL EXAMINED. — The type material.
Loyalty Islands. CALSUB: dive 15, 20°37′ S, 166°58′ E, 538 m, 1 spm (juv.).

DISTRIBUTION. — Andaman Islands and the Loyalty Islands. The present specimen living at 538 m.

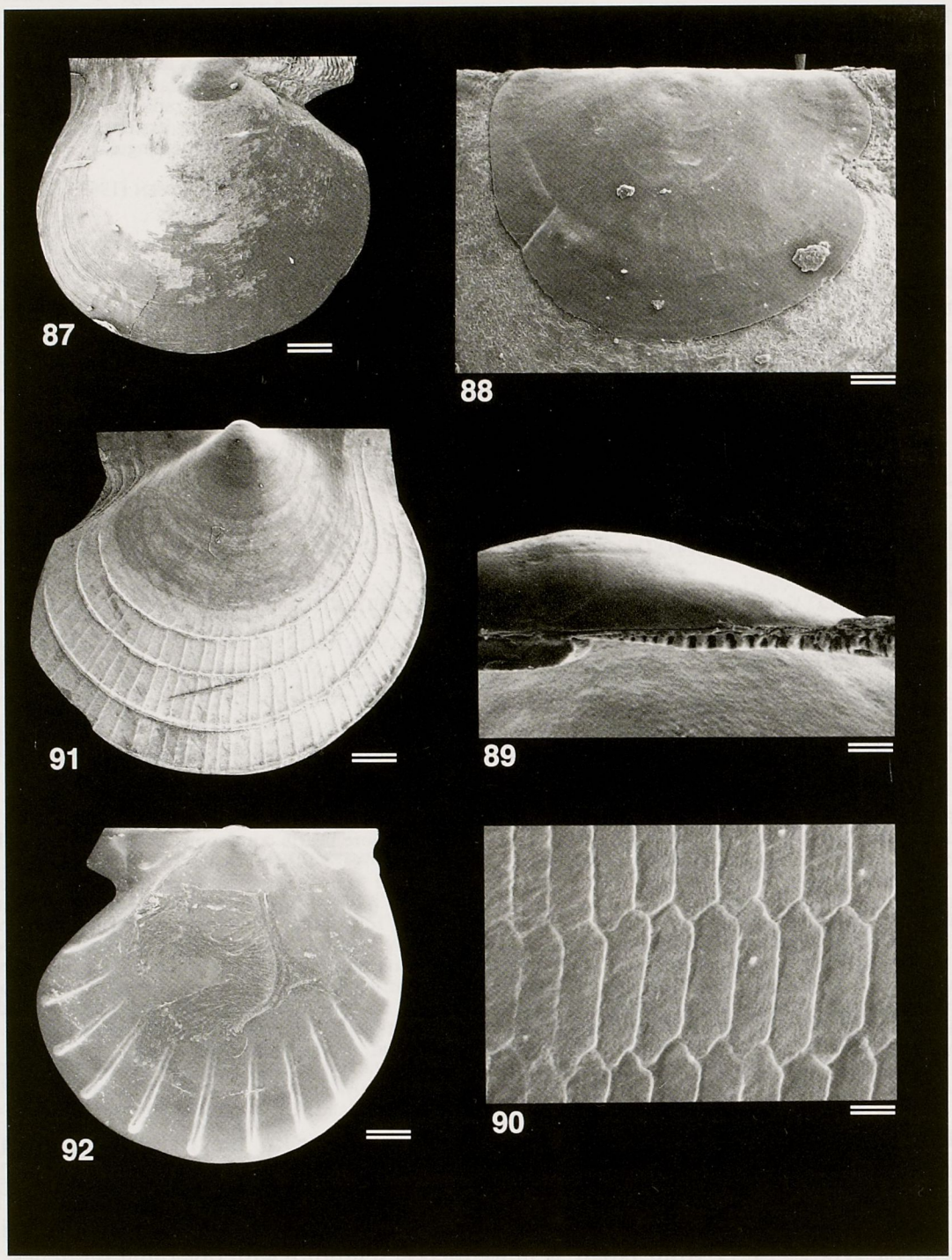
DESCRIPTION. — *Shell* up to ca. 10 mm high, fragile, suborbicular, undulating, slightly inequilateral, semi-transparent white to opaque cream, auricles unequal, umbonal angle 90°-105°.

Prodissoconch ca. 200 µm in height.

Left valve undulating and complexly sculptured with fine, regularly spaced, scaly radial riblets, commencing at ca. 2 mm shell height and progressively enlarging and multiplying by intercalation to ca. 30. Delicate, closely spaced lamellae between radial riblets commencing early on disc, enlarging towards ventral margin. Entire surface of disc covered with microscopic diverging striae. Anterior auricle larger than posterior, both auricles sculptured with delicate, close-set, concentric lamellae, and very fine radial striae; posterior auricle more nearly continuous with disc margin. Hinge line straight. A few small scales on dorsal margin. External sculpture sometimes visible from interior of valves.

Right valve undulating, sculptured as in left valve but with smaller scaly radial riblets. Anterior auricle separated from disc by distinct suture, posterior continuous with disc. Anterior auricle with 4 very weak radial riblets, covered with concentric lamellae. Strongly developed scales on antero-dorsal margin. Byssal fasciole and notch well developed. Inactive and active ctenolium (3 teeth) present. Resilifer triangular. No cardinal crura.

REMARKS. — The present immature specimen is similar to the type specimen, although semi-transparent white instead of opaque cream as in the holotype. Moreover, the scaly sculpture is somewhat more prominent in the holotype. *Delectopecten alcocki* is closely related but is more orbicular and larger, with an almost smooth exterior surface, and without any undulations. *D. macrocheiricola* (Habe, 1951), from Japan, is more weakly sculpture with diverging scratches, and the surface of its disc is more weakly undulating, especially on the early disc. Habe's species is also much larger (up to 25 mm high). *D. musorstomi* is orbicular with a stronger sculpture, diverging radial scratches and weaker concentric lirae. DIJKSTRA (1989: 32) suggested that *D. fluctuatus* could possibly be a *Pseudohinnites*, but after examining the badly damaged holotype (ZSI), I have come to the conclusion that it is a *Delectopecten*.



FIGS 87-92. — **87-90**, *Cyclochlamys favus*, BIOCAL: stn DW 46. — **87**, right valve, exterior, scale bar 200 µm. — **88**, right valve, dissoconch stage, scale bar 50 µm. — **89**, right valve, hollow sections internal ligament, scale bar 25 µm. — **90**, right valve, hexagonal prismatic microstructure, scale bar 10 µm. — **91-92**, *Parvamussium multiliratum*, BIOCAL: stn CP 75, paratypes. — **91**, left valve, exterior, scale bar 350 µm. — **92**, right valve, interior, scale bar 350 µm.

Delectopecten musorstomi Poutiers, 1981

Figs 69-70

Delectopecten musorstomi Poutiers, 1981: 331, pl. 1, figs 2-3.

Other reference:

Delectopecten musorstomi – DIJKSTRA, 1991: 26.

TYPE MATERIAL. — Holotype live taken, MNHN.

TYPE LOCALITY. — N of Lubang, Philippines, MUSORSTOM 1, stn 18, 13°57′ N, 120°17' E, 150-159 m.

MATERIAL EXAMINED. — The type material.
New Caledonia. BIOCAL: stn DW 64, 24°48′ S, 168°09′ E, 250 m, 1 spm.

DISTRIBUTION. — Philippines (POUTIERS, 1981), Indonesian Archipelago (DIJKSTRA, 1991), now extended to New Caledonia. Present material living at 250 m.

DESCRIPTION. — *Shell* small, up to ca. 5 mm high, orbicular, transparent, equivalve, equilateral, anterior auricle somewhat larger than posterior, umbonal angle ca. 120°.

Prodissoconch ca. 200 µm in height.

Left valve covered with microscopic diverging radial striae and 14-20 fine, irregularly spaced, scaly radial lirae, that commence at ca. 1 mm shell height and progressively enlarge. Fine regularly spaced, somewhat crenulated, concentric growth lines. Scales often broken. Auricles continuous with the disc and similarly sculptured. Hinge line straight.

Right valve sculptured similar to that of left valve, with slightly stronger microscopic concentric lirae in early disc, that commence at about 1.5 mm shell height. Anterior auricle separated from the disc by distinct suture, with 4-5 radial ridges and concentric lamellae, the latter strongly developed at dorsal margin. Byssal fasciole and notch well developed. Inactive and active ctenolium with 2-3 teeth. Resilifer triangular. Valves sometimes with a few white spots. External sculpture visible from the interior.

REMARKS. — The present specimen is very similar to the holotype of *D. musorstomi* from the Philippines.

POUTIERS (1981: 332) compared *Delectopecten musorstomi* with *D. polyleptus* (Dall, 1908), from the Galapagos Islands and Chile. Another related species is *D. fluctuatus* which has similar sculpture, though it is larger (up to 10 mm high) and the disc is undulating, and there are more numerous scaly radial lirae.

Subfamily CHLAMYDINAE Teppner, 1922

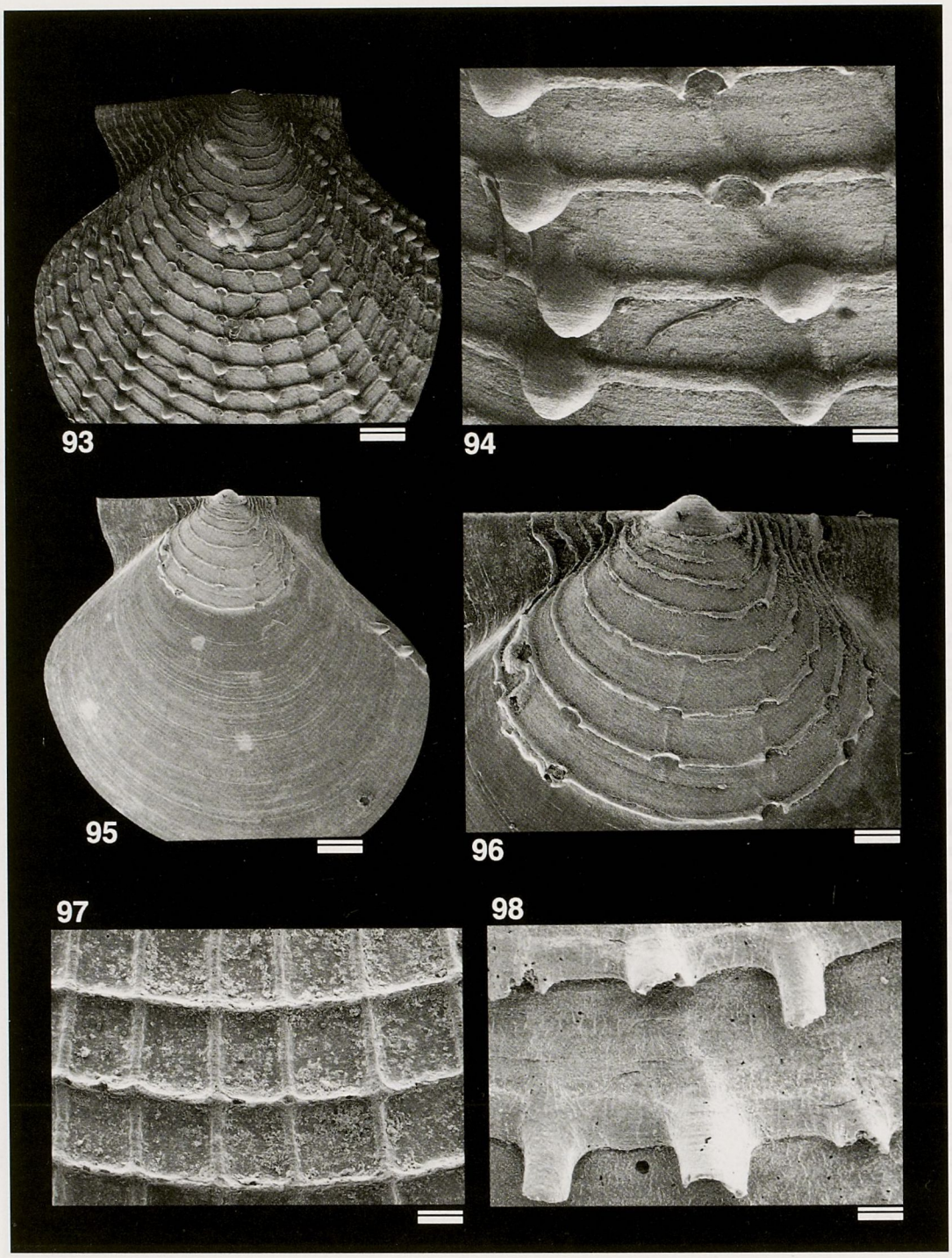
Tribe CHLAMYDINI Teppner, 1922

DIAGNOSIS. — Chlamydinae with microsculpture of diverged striae (antimarginal); shagreen (reticulated) microsculpture present at least in early growth stages.

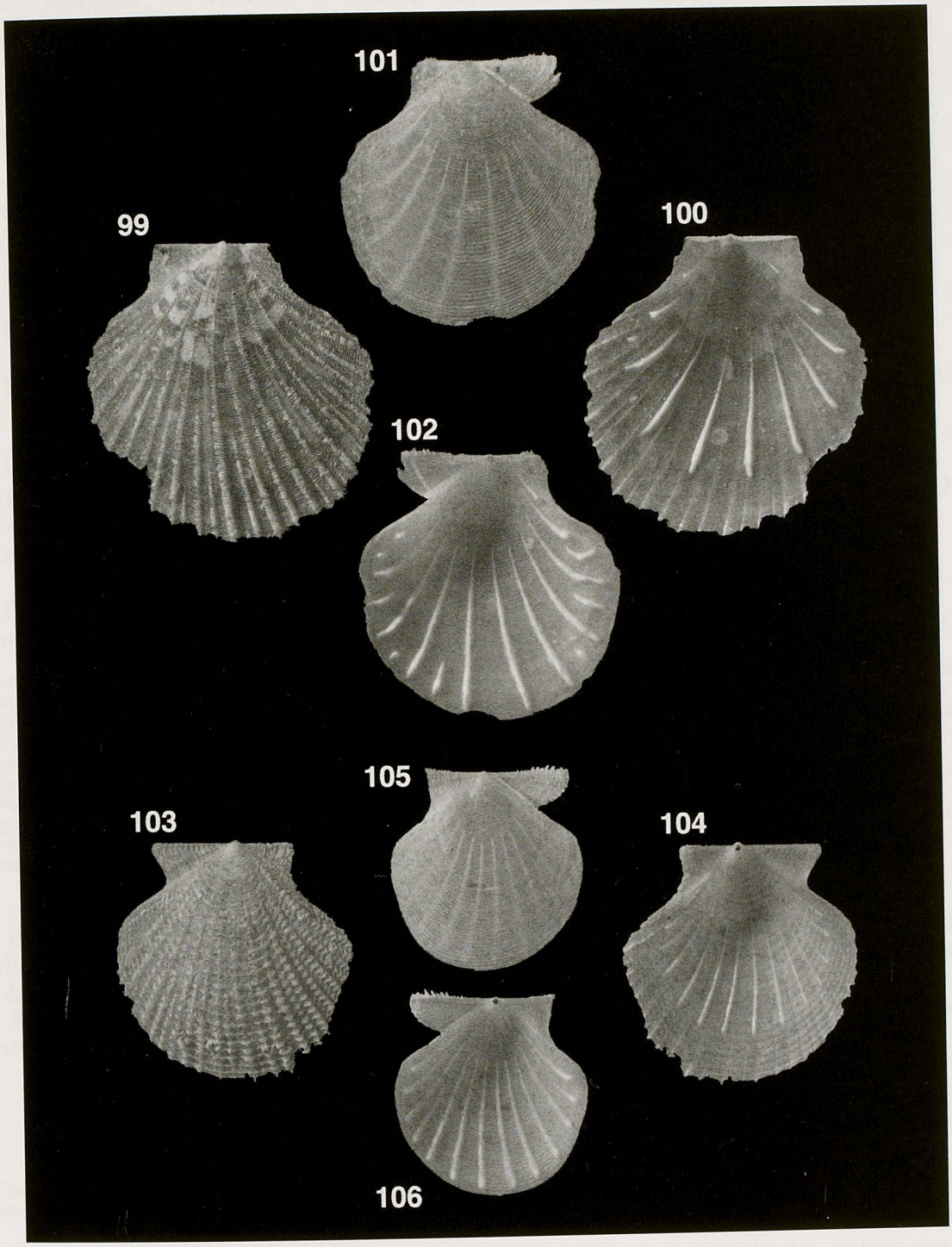
Genus *LAEVICHLAMYS* Waller, 1993

Laevichlamys Waller, 1993: 204. Type species (OD): *Pecten multisquamatus* Dunker, 1864; Recent, Cuba.

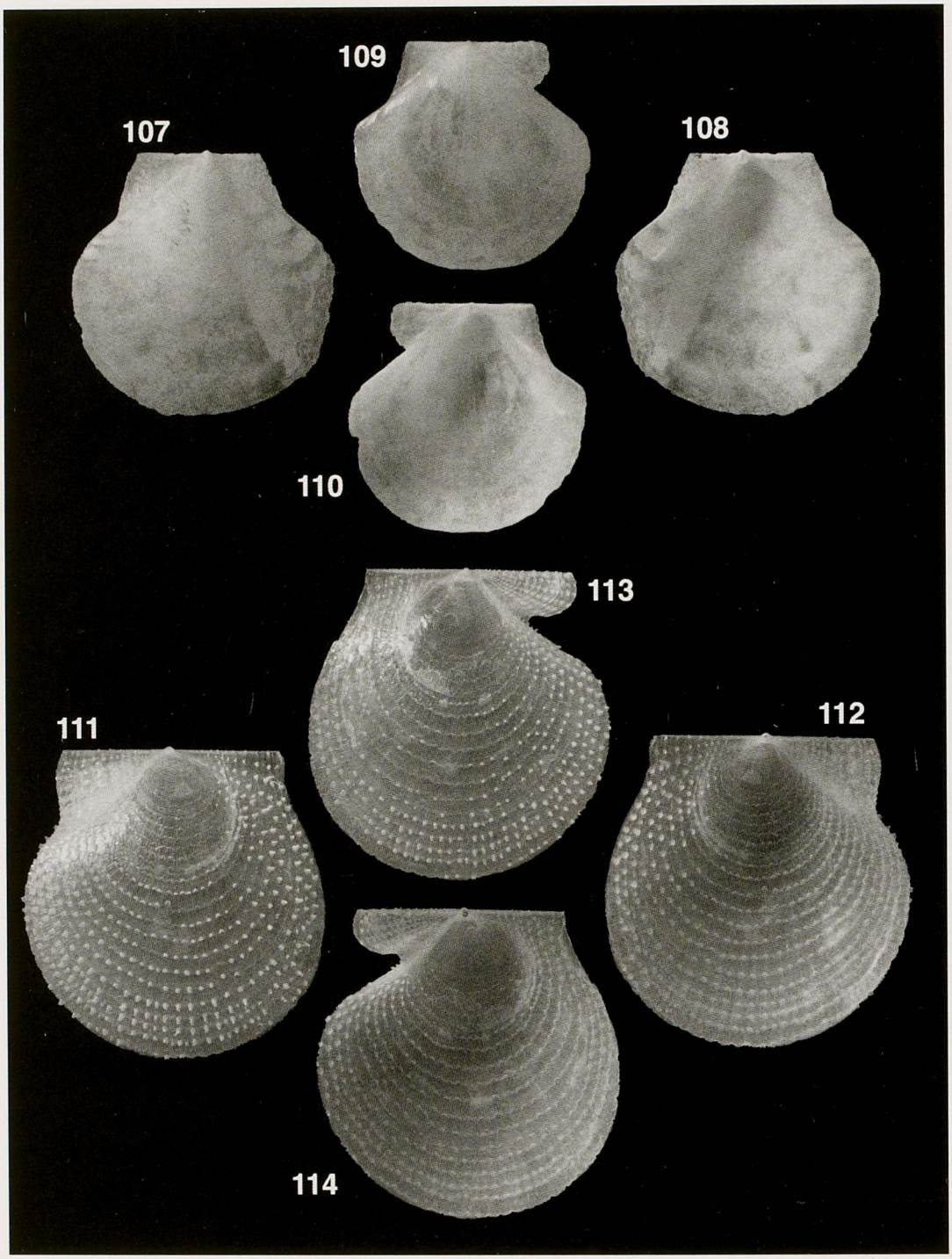
DIAGNOSIS. — Byssate, non-cemented, free living Chlamydini; shagreen (reticulated) microsculpture absent; sculptured with closely spaced, weak radial costae on both valves; regular commarginal lirae absent; byssal notch with ctenolium.



FIGS 93-98. — **93-96**, *Parvamussium vesiculatum*, BIOCAL: stn DW 44, paratypes. — **93**, left valve, exterior, scale bar 600 µm. — **94**, left valve, exterior, antero-marginal detail, scale bar 100 µm. — **95**, left valve, exterior, scale bar 600 µm. — **96**, left valve, exterior, dorsal region detail, scale bar 200 µm. — **97**, *P. retiolum*, MUSORSTOM 5: stn CP 363, paratype, left valve, exterior, central detail, scale bar 100 µm. — **98**, *Cyclopecten horridus*, BIOCAL: stn DW 08, left valve, exterior, postero-marginal detail, scale bar 50 µm.



FIGS 99-106. — **99-102**, *Parvamussium thetidis*, CHALCAL 2: stn DW 73, 10.0 x 9.8 mm (lv), 8.9 x 8.9 mm (rv). — **99**, left valve, exterior. — **100**, left valve, interior. — **101**, right valve, exterior. — **102**, right valve, interior. — **103-106**, *Parvamussium texturatum*, MUSORSTOM 5: stn DW 300, 6.5 x 6.6 mm (db). — **103**, left valve, exterior. — **104**, left valve, interior. — **105**, right valve, exterior. — **106**, right valve, interior.



FIGS 107-114. — **107-110**, *Parvamussium pauciliratum*, MUSORSTOM 5: stn DW 263, 8.2 x 8.1 mm (lv), 7.2 x 7.2 mm (rv). — **107**, left valve, exterior. — **108**, left valve, interior. — **109**, right valve, exterior. — **110**, right valve, interior. — **111-114**, *Delectopecten alcocki*, CORAIL 2: stn DE 14, 10.4 x 10.1 mm (db). — **111**, left valve, exterior. — **112**, left valve, interior. — **113**, right valve, exterior. — **114**, right valve, interior.

DISTRIBUTION. — Miocene to Recent. Indo-West Pacific and western Atlantic; littoral to sublittoral.

Laevichlamys kauaiensis Dall, Bartsch & Rehder, 1938

Figs 121-122

Chlamys kauaiensis Dall, Bartsch & Rehder, 1938: 92, pl. 22, figs 9-10.

Other references:

Chlamys kauaiensis – KAY, 1979: 525, figs 168 F-G. — EARLE, 1985: 1, 4, fig.

TYPE MATERIAL. — Holotype, rv, USNM 335674.

TYPE LOCALITY. — Off Hanamaulu warehouse, Kauai, Hawaii Islands, *"Albatross"*, stn 4132, 470-571 m.

MATERIAL EXAMINED. — The type material.
Chesterfield Islands. MUSORSTOM 5: stn DW 329, 20°23′ S, 158°47′ E, 320 m, 1 rv. — Stn DC 388, 20°45′ S, 160°54′ E, 500-510 m, 1 rv.
New Caledonia. *"Vauban"* 1978-79: stn 40, 22°30′ S, 166°24′ E, 250-350 m, 1 rv.

DISTRIBUTION. — Hawaiian Islands (DALL, BARTSCH & REHDER, 1938; KAY, 1979; EARLE, 1985), now also Chesterfield Islands and New Caledonia. Present material taken dead at 250-510 m.

DESCRIPTION. — *Shell* small, up to ca. 6 mm high, fragile, suborbicular, equivalve, right valve slightly more convex than left, anterior and posterior auricles very unequal in size, umbonal angle 90-95°.

Prodissoconch ca. 240 µm in height.

Left valve sculptured with 24-28 fine regularly spaced radial riblets, with delicate scales (often eroded). Microscopic diverging scratches between radial riblets. Auricles sculptured with 3 or 4 scaly axial riblets that are somewhat more prominent on anterior. Hinge line straight.

Right valve sculptured like the left. Anterior auricle with 5 or 6 scaly radial scaly. Antero-dorsal margin strongly denticulate. Posterior auricle narrow, with 3 or 4 spinous riblets. Byssal fasciole and notch well developed. Inactive and active ctenolium with 4-6 teeth. Resilifer triangular. Anterior resilial tooth more prominent than posterior. Internal plicae extending from central sector to ventral margin.

Left and right valves usually cream, white or bright yellow or orange-red, sometimes with small white spots.

REMARKS. — The present specimens are very similar to the holotype of *L. kauaiensis*, although somewhat more brightly coloured, with slightly stronger sculpture on the posterior auricle of the right valve. *L. kauaiensis* is rather variable in radiation and coloration.

Also similar to *L. kauaiensis* is *L. allorenti* (Dijkstra, 1988) from Réunion and adjacent areas (see DIJKSTRA, 1988: 21).

Genus *VEPRICHLAMYS* Iredale, 1929

Veprichlamys Iredale, 1929: 164, 188 [Proposed as a subgenus of *Mimachlamys*]. Type species (OD): *Chlamys perillustris* Iredale, 1925; Recent, off Victoria, Australia, 274-457 m.

DIAGNOSIS. — Non-cemented thin Chlamydini, obliquely oval; slender radial costae with prickly lamellae, interstices broad with or without secondary radial riblets; microsculpture longitudinal or diverged scratches; auricles very unequal; inner ribs undulated, lacking carinae; byssal notch well-developed with ctenolium.

DISTRIBUTION. — ?Miocene to Recent, Pacific Ocean, including New Zealand and the Galapagos Islands; 120-1280 m (DIJKSTRA, unpubl. data).

Veprichlamys kiwaensis Powell, 1933

Figs 119-120

Chlamys kiwaensis Powell, 1933: 371, pl. 40, figs 1-5.

Other reference:

Chlamys kiwaensis – Powell, 1979: 378, pl. 72, fig. 14.

Type material. — Holotype live taken, AIM AK70167.

Type locality. — 400 miles W of New Plymouth, New Zealand, 39°00′ S, 168°50′ E, 1097-1280 m.

Material examined. — **New Zealand**. Off Taiaroa Heads, 475-640 m, 2 v (NMNZ M9138). — 41°35′ S, 174°53′ E, Palliser Bay, 366-549 m, 5 spms (NMNZ M9850). — 44°45.6′ S, 171°05′ E, off Taiaroa Heads, 549 m, 2 v (NMNZ M12827). — 41°30.7′ S, 174°58.4′ E, Turakirae Trench, Cook Strait, 448-512 m, 7 spms (NMNZ M29148). — 41°30.5′ S, 174°54′ E, Turakirae Trench, Cook Strait, 640-658 m, 3 spms (NMNZ M29129). — 43°14′ S, 173°39′ E, Pegasus Canyon, off Banks Peninsula, 512-1006 m, 18 spms + many valves (NMNZ M52769). — 42°35′ S, 173°41′ E, off Kaikoura, 640 m, 5 spms (NMNZ M53676). — 41°55.9′ S, 174°43.2′ E, off Cape Campbell, 424-454 m, 14 spms (NMNZ M59679). — 41°55.8′ S, 174°40.7′ E, SE of Cape Campbell, 434-446 m, 10 spms + many valves (NMNZ M60407). — 37°22.0′ S, 176°28.5′ E, off Mayor I., 388-448 m, 2 spms (NMNZ M60094). — Conway Rise, Kaikoura, 400 m, 10 spms (NMNZ M76106).
New Caledonia. MUSORSTOM 4: stn DW 225, 22°52′ S, 167°23′ E, 590-600 m, 1 rv.

Distribution. — New Zealand, living in 366-1006 m; New Caledonia, taken dead at 590-600 m.

Description. — *Shell* equivalve, up to ca. 35 mm in height, suborbicular to oblique, compressed, fragile, auricles strongly unequal.

Valves sculptured with 20-24 scabrous radial costae, interspaces with *Camptonectes*-like radial striae, sometimes absent in late growth stages. Anterior auricle of left valve sculptured with 8 radial riblets, 5 on right valve; posterior auricles nearly smooth.

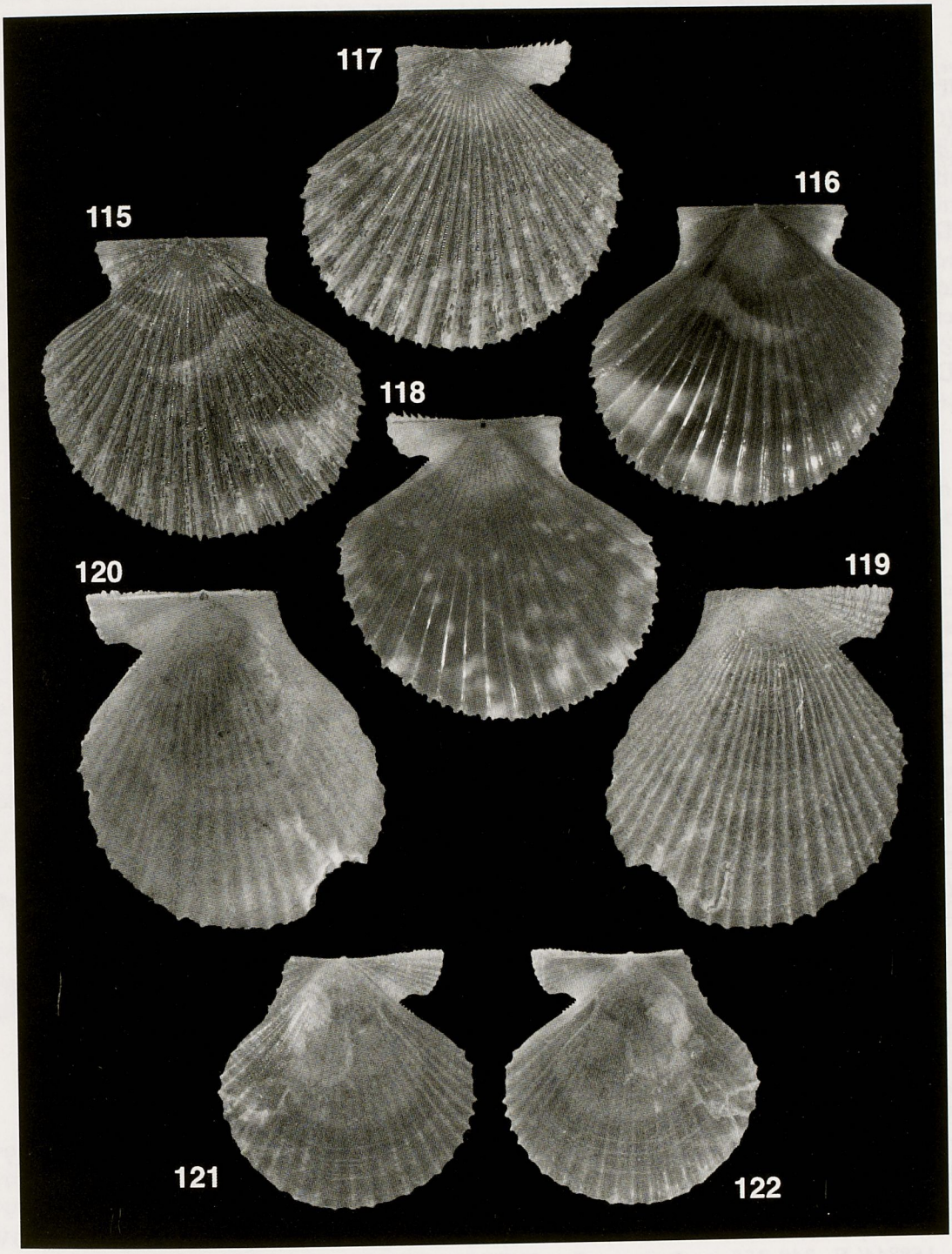
Byssal notch well-developed, with ctenolium. Colour outside dull-white or creamy, sometimes with the radials brownish-pink; inside nacreous.

Remarks. — The present material from off New Caledonia is very similar to the type specimens of *C. kiwaensis* from New Zealand, although smaller (height 12 mm). The microscopic diverging striae between the radial costae ("*Camptonectes*" – like divarications of Powell's description) are strongest near the antero-lateral margin in the present material, and absent near the ventral margin.

Related species are *Veprichlamys jousseaumei* Bavay, 1904 from southern Japan to Indonesia, *V. perillustris* from SE and S Australia, and *V. incantata* (Hertlein, 1972) from the Galapagos Islands. Waller (1993: 236) mentioned also *V. onzola* (Olsson, 1964), a Neogene species from northwestern Ecuador. *V. jousseaumei* is slightly orbicular in shape, and has numerous radial costae (30-38). *V. perillustris* is more oblique, and has fewer radial costae (20-26), which are more strongly imbricated. *V. incantata* is larger (height up to ca. 55 mm), less obliquely oval, and sculptured with ca. 20 radial costae and interstitial radial riblets.

Tribe Aequipectinini Nordsieck, 1969

Diagnosis. — Chlamydinae with complex sculpture of radiating costae, regularly lamellose with series of hollow chambers or secondary interstitial concentric lamellae, equilateral and auricles more equal in late growth stages.



FIGS 115-122. — **115-118**, *Cryptopecten bullatus*, MUSORSTOM 6: stn CP 464, 15.9 x 17.0 mm (db). — **115**, left valve, exterior. — **116**, left valve, interior. — **117**, right valve, exterior. — **118**, right valve, interior. — **119-120**, *Veprichlamys kiwaensis*, MUSORSTOM 4: stn DW 225, 12.2 x 10.8 mm (rv). — **119**, right valve, exterior. — **120**, right valve, interior. — **121-122**, *Laevichlamys kauaiensis*, *"Vauban"* 1978-79: stn 40, 6.9 x 6.9 mm (rv). — **121**, right valve, exterior. — **122**, right valve, interior.

Genus *Cryptopecten* Dall, Bartsch & Rehder, 1938

Cryptopecten Dall, Bartsch & Rehder, 1938: 93. Type species (OD): *Cryptopecten alli* Dall, Bartsch & Rehder, 1938; Recent, off Hawaii, 95-435 m.

Synonym:

Corymbichlamys Iredale, 1939: 367.Type species (OD): *Chlamys corymbiatus* Hedley, 1909; Recent, off Queensland, Australia, 9-18 m.

Diagnosis. — *Shell* small, orbicular, convexity variable, laterally compressed, auricles nearly equal; *valves* sculptured with 12-25 radial costae, regularly lamellose, interspaces with fine imbricated scales; auricles sculptured with a few radial riblets; byssal notch well-developed and moderately deep, with ctenolium.

Distribution. — Lower Miocene-Recent. Indo-Pacific, western Atlantic; upper shelf to upper bathyal (Hayami 1984: 116).

Cryptopecten bullatus (Dautzenberg & Bavay, 1912)

Figs 115-118

Pecten (Chlamys) bullatus Dautzenberg & Bavay, 1912: 17, pl. 27, figs 1-2.

Synonyms:

Cryptopecten alli Dall, Bartsch & Rehder, 1938: 93, pl. 23, figs 1-4, 7.
Cryptopecten complanus Wang, 1983: 402, 405, figs 1.1-7.

Other references:

Chlamys (Aequipecten) tissotii – Kuroda, 1932: app. 95.
Chlamys alli – Kay, 1979: 524, fig. 168A.
Cryptopecten bullatus – Hayami, 1984: 96, pl. 1, figs 1-6, pl. 2, figs 1-3, pl. 9, fig. 1, pl. 10, fig. 3, pl. 11, fig. 3; Wagner, 1989: 60, figs 14-16. — Dijkstra, 1991: 35; 1992: 26, figs 1-4.

Type material. — *C. bullatus*: holotype, live taken, zma 3.12.006, 2 paratypes zma 3.12.007. — *C. alli*: holotype, live taken, usnm 173194. — *C. complanus*: holotype, live taken, ioas M11072, paratype ioas M11073.

Type locality. — *C. bullatus*: Sulu Archipelago, Philippines, *"Siboga"*, stn 105, 6°08′ N, 121°19′ E, 275 m. — *C. alli*: South coast of Oahu, Hawaii Islands, *"Albatross"*, stn 3811, 436-461 m. — *C. complanus*: East China Sea, 31°05′ N, 128°00′ E, 147 m.

Material examined. — The type material.
Chesterfield Islands. chalcal 1: stn D 35, 19°45′ S, 158°26′ E, 210 m, 1 lv.
musorstom 5: stn DW 255, 25°15′ S, 159°55′ E, 280-295 m, 3 lv. — Stn DW 258, 25°33′ S, 159°46′ E, 300 m, 1 spm. — Stn DW 277, 24°11′ S, 159°35′ E, 270 m, 1 rv. — Stn CP 279, 24°09′ S, 159°38′ E, 260-270 m, 1 lv. — Stn CP 289, 24°02′ S, 159°38′ E, 273 m, 2 lv. — Stn DW 299, 22°48′ S, 159°24′ E, 360-390 m, 1 lv, 1 rv. — Stn DW 306, 22°08′ S, 159°21′ E, 375-415 m, 2 lv, 1 rv. — Stn DW 328, 20°23′ S, 158°44′ E, 340-355 m, 1 rv. — Stn DC 388, 20°45′ S, 160°54′ E, 500-510 m, 1 lv.
corail 2: stn DW 114, 19°25′ S, 158°38′ E, 217 m, 1 lv, 1 rv. — Stn DW 129, 19°28′ S, 158°34′ E, 215 m, 1 rv. — Stn CP 131, 19°25′ S, 158°38′ E, 215-217 m, 1 lv.
New Caledonia. *"Vauban"* 1978-79: stn 33, 22°33′ S, 166°25′ E, 290-350 m, 1 lv. — Stn 37, 22°32′ S, 166°26′ E, 175-250 m, 1 rv. — Stn 40, 22°30′ S, 166°24′ E, 250-350 m, 1 lv.
biocal: stn CP 105, 21°31′ S, 166°22′ E, 330-335 m, 1 lv.
musorstom 4: stn DW 219, 23°03′ S, 167°33′ E, 760 m, 1 rv.

SMIB 2: stn DW 14, 22°53′ S, 167°13′ E, 405-444 m, 1 spm.
SMIB 5: stn DW 77, 23°41′ S, 168°01′ E, 270 m, 1 spm. — Stn DW 91, 22°18′ S, 168°41′ E, 340 m, 1 rv. — Stn DW 92, 22°20′ S, 168°41′ E, 280 m, 1 rv. — Stn DW 98, 23°02′ S, 168°16′ E, 335 m, 1 lv. — Stn DW 105, 23°14′ S, 168°05′ E, 310 m, 1 lv.
Loyalty Islands. MUSORSTOM 6: stn DW 391, 20°47′ S, 167°06′ E, 390 m, 1 spm, 2 rv. — Stn DW 392, 20°47′ S, 167°05′ E, 340 m, 1 rv. — Stn DW 398, 20°47′ S, 167°06′ E, 370 m, 1 lv. — Stn DW 406, 20°41′ S, 167°07′ E, 373 m, 1 spm, 1 lv. — Stn DW 416, 20°42′ S, 166°60′ E, 343 m, 3 rv. — Stn DW 421, 20°26′ S, 166°40′ E, 245 m, 1 rv. — Stn DW 428, 20°24′ S, 166°13′ E, 420 m, 1 rv. — Stn DW 457, 21°00′ S, 167°29′ E, 353 m, 2 lv, 2 rv. — Stn DW 459, 21°01′ S, 167°31′ E, 425 m, 1 spm, 1 lv, 1 rv. — Stn DW 464, 21°02′ S, 167°32′ E, 430 m, 3 spms, 4 lv. — Stn DW 479, 21° 09′ S, 167°55′ E, 310 m, 1 lv, 2 rv. — Stn DW 480, 21°09′ S, 167°56′ E, 380 m, 1 rv. — Stn DW 481, 21°22′ S, 167° 50′ E, 300 m, 1 lv. — Stn DW 485, 21°23′ S, 167°59′ E, 350 m, 1 rv. — Stn DW 487, 21°23′ S, 167°46′ E, 500 m, 1 spm.
New Hebrides Arc. VOLSMAR: stn DW 7, 22°26′ S, 171°44′ E, 325-400 m, 2 spms, 2 lv, 2 rv. — Stn DW 8, 22°25′ S, 171°43′ E, 630 m, 1 fragm. lv. — Stn DW 9, 22°23′ S, 171°42′ E, 275-300 m, 1 lv. — Stn DW 16, 22°25′ S, 171°41′ E, 420-500 m, 1 lv, 1 rv. — Stn DW 17, 22°23′ S, 171°42′ E, 260-300 m, 1 spm. — Stn DW 38, 22°22′ S, 168°43′ E, 380-420 m, 1 lv.

DISTRIBUTION. — Throughout the western, southwestern and central Pacific, western Indian Ocean, Chesterfield Islands, New Caledonia, Loyalty Islands and New Hebrides Arc. Present material living at 260-500 m.

DESCRIPTION. — *Shell* up to ca. 25 mm high, usually 20 mm, moderately thin, depressed, somewhat oblique towards posterior half, equivalve, inequilateral, right valve slightly more convex than left, auricles unequal in size, umbonal angle ca. 110°.

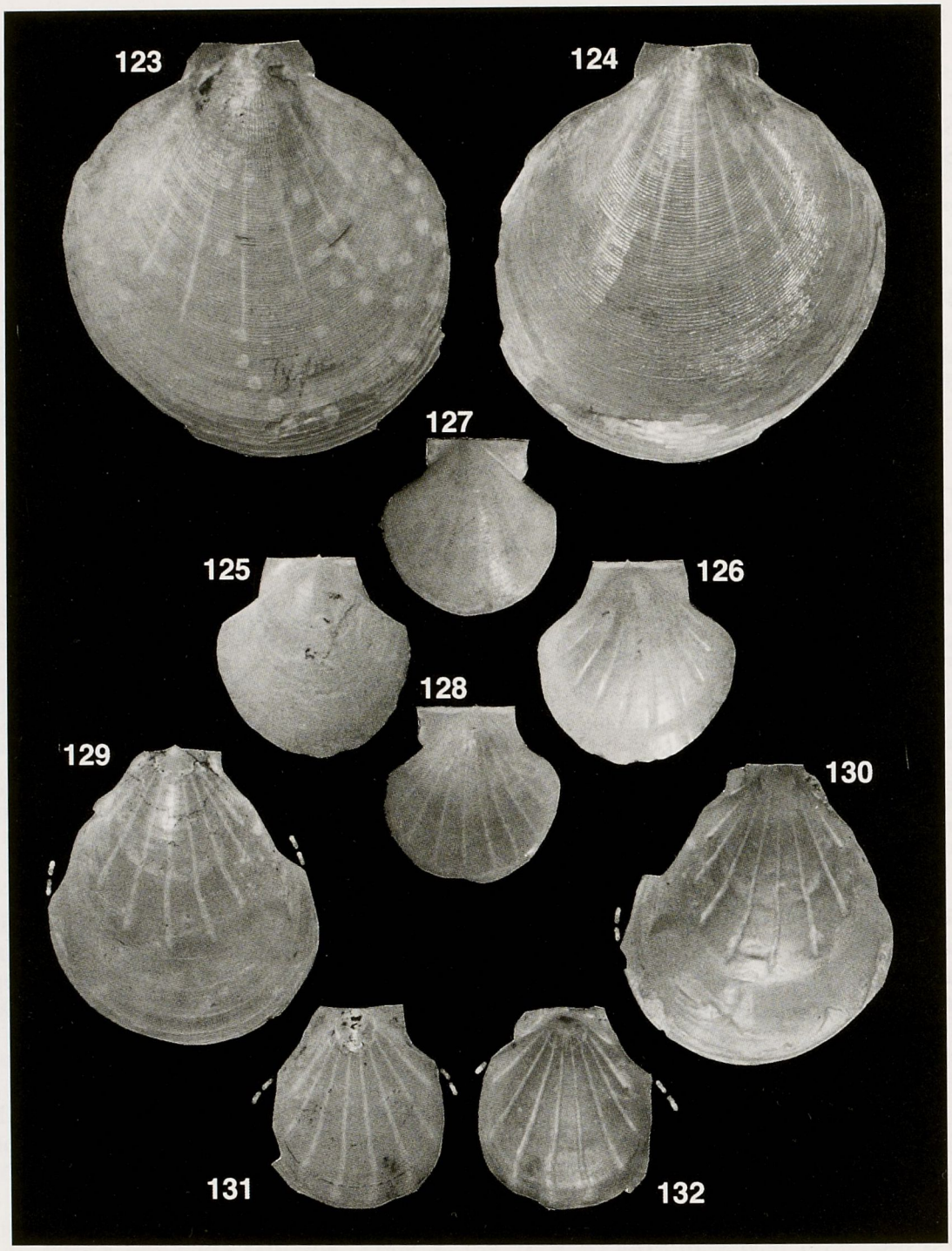
Prodissoconch ca. 230 μm in height.

Left valve with 17-20 radial costae (commonly 18-19), commencing at 2 mm shell height and gradually enlarging, strong on central ridge, with numerous cavities on their sides. Interspaces commonly narrower than costae, finely lamellate. Anterior auricle slightly larger than posterior, sculptured with 2 prominent radial riblets and 2-4 interstitial radial riblets. Posterior auricle with 1 strong radial riblet and 3-5 smaller ones between disc margin. A few denticulated scales on antero — and postero-dorsal margins. Hinge line straight.

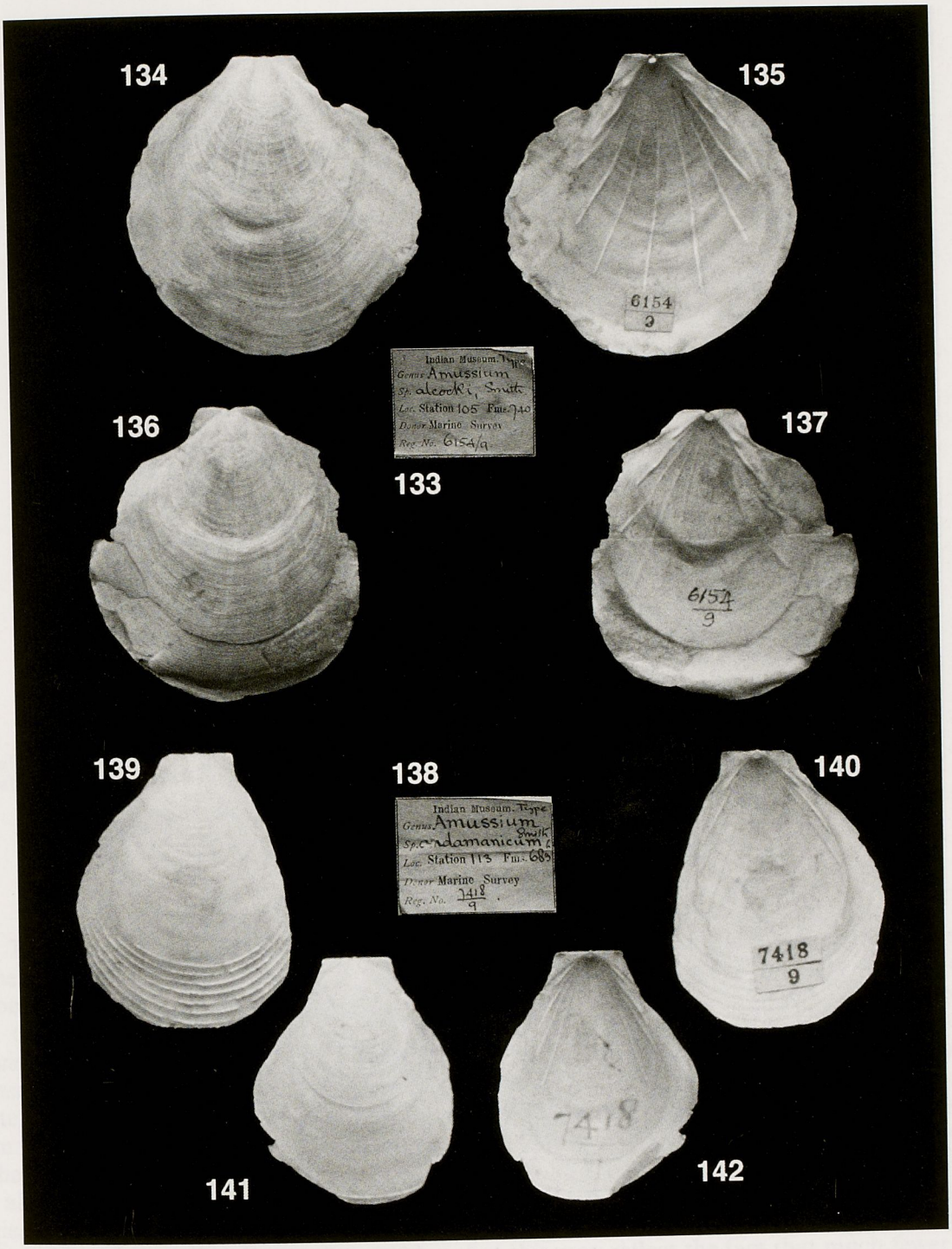
Right valve similar to that of left valve, with finer interstitial lamellae, and stronger denticulate scales on dorsal margin. Hinge line somewhat raised. Byssal fasciole relative small, byssal notch rather deep. Inactive and active ctenolium with 4 or 5 teeth. Antero — and postero-lateral margins of disc scarcely gaping. Resilifer elongate triangular. Inner surface of both valves strongly plicate.

Coloration very variable, commonly reddish brown with pale oblique or zigzag markings, sometimes uniform yellow or purple.

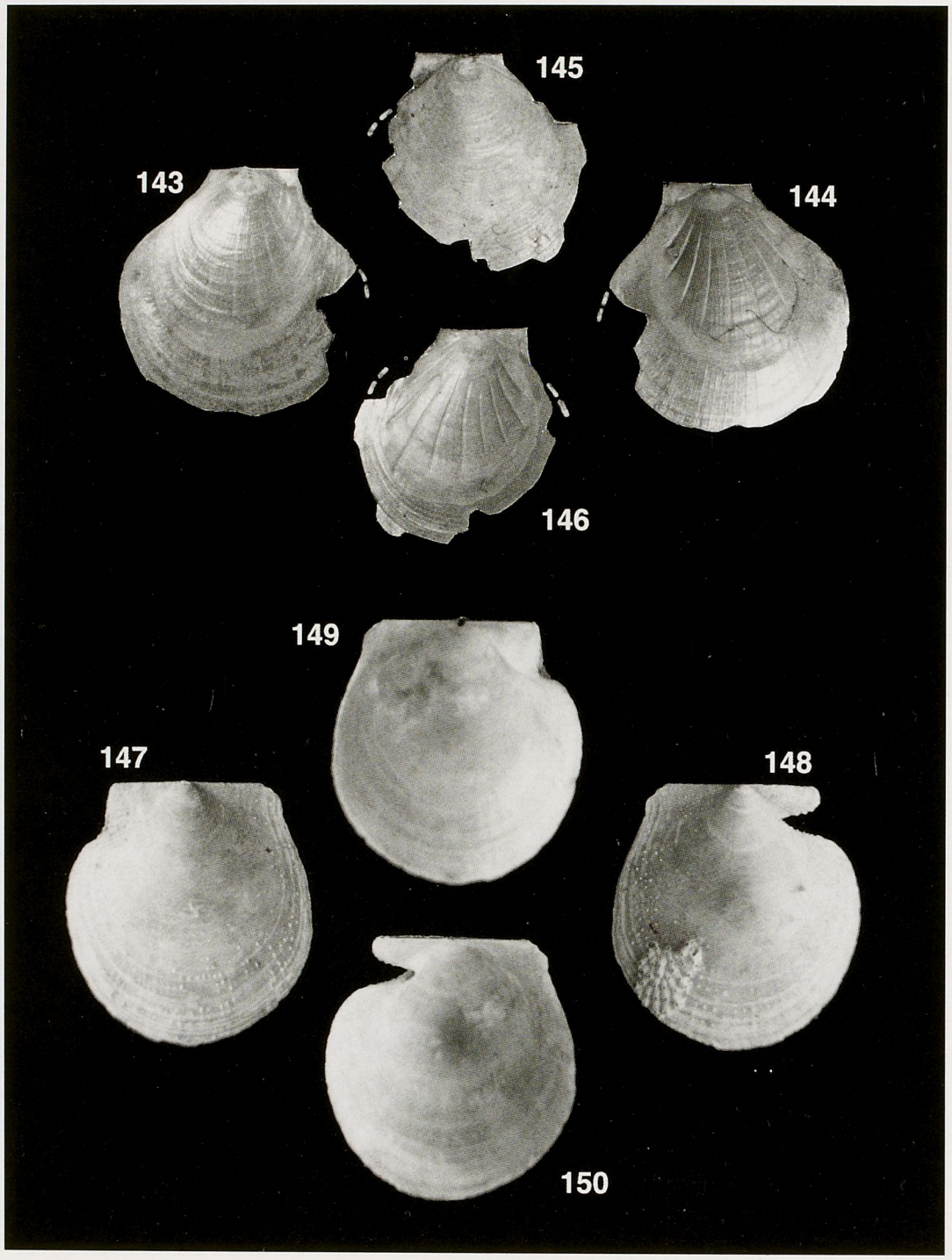
REMARKS. — The present material is very similar to the type specimens of *C. bullatus* from the Sulu Archipelago, but the latter have more radial costae (22). The auricles also have a lower number of radial riblets. The convexity and sculpture vary with the bathymetric range and geographic distribution. For further discussion see HAYAMI (1984: 98), WAGNER (1989: 61), and DIJKSTRA (1991: 36).



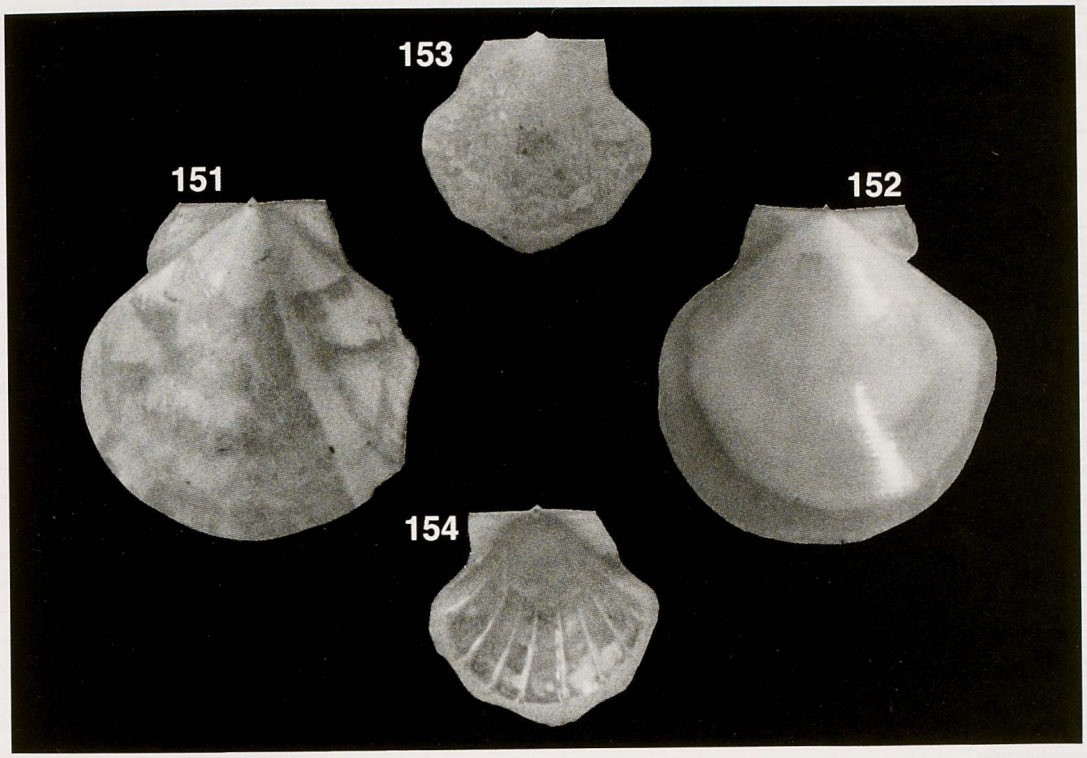
FIGS 123-132. — **123-124**, *Propeamussium watsoni*, lectotype, 51.8 x 50.0 mm (db). — **123**, left valve, exterior. — **124**, right valve, exterior. — **125-128**, *Parvamussium torresi*, lectotype, 7.8 x 7.9 mm (db). — **125**, left valve, exterior. — **126**, left valve, interior. — **127**, right valve, exterior. — **128**, right valve, interior. — **129-132**, *Propeamussium caducum*, lectotype, 20.9 x 18.8 mm (db). — **129**, left valve, exterior. — **130**, left valve, interior. — **131**, right valve, exterior. — **132**, right valve, interior.



FIGS 133-142. — **133-137**, *Propeamussium alcocki*, lectotype, 40.4 x 39.8 mm (db). — **133**, original label. — **134**, left valve, exterior. — **135**, left valve, interior. — **136**, right valve, exterior. — **137**, right valve, interior. — **138-142**, *Propeamussium andamanicum*, lectotype, 30.2 x 22.4 mm (db). — **138**, original label. — **139**, left valve, exterior. — **140**, left valve, interior. — **141**, right valve, exterior. — **142**, right valve, interior.



FIGS 143-150. — **143-146**, *Propeamussium meridionale*, lectotype, 13.8 x 13.4 mm (db). — **143**, left valve, exterior. — **144**, left valve, interior. — **145**, right valve, exterior. — **146**, right valve, interior. — **147-150**, *Delectopecten alcocki*, lectotype, 19.0 x 18.0 mm (db). — **147**, left valve, exterior. — **148**, right valve, exterior. — **149**, left valve, interior. — **150**, right valve, interior.



FIGS 151-154. — **151-152**, *Parvamussium pauciliratum*, lectotype, 7.5 x 7.4 mm (db). — **151**, left valve, exterior. — **152**, right valve, exterior. — **153-154**, *Parvamussium scitulum*, lectotype, 4.4 x 4.5 mm (lv). — **153**, left valve, exterior. — **154**, left valve, interior.

DISCUSSION

Thirty species of Pectinoidea are now known from the Chesterfield Islands, New Caledonia and the Loyalty Islands, at depths below 100 m. Including *Pseudohinnites levii*, which had been described earlier in a seperate paper, 10 species, precisely a third of the fauna, were undescribed before this survey. The collection studied here comprised 236 lots, *i.e.* 8.7 lots per species. Only 4 species (*Cyclopecten pellucidulus, Delectopecten fluctuatus, D. musorstomi* and *Veprichlamys kiwaensis*), or 13.3% of the total fauna, are known from a single sample. All these observations indicate that the fauna is probably now rather adequately sampled, at least at depths shallower than 1500 m. The bathymetric distribution of the species is summarized in Table 2. The highest diversity is in the 600-800 m depth interval, with 14 live-taken species; respectively 9 and 8 species have been taken alive in the 200-400 m and 400-600 m depths intervals. Below 800 m, the diversity drops to 4 species. Only 3 species (*Propeamussium meridionale, Parvamussium multiliratum* and *Pseudohinnites levii*) have been taken alive deeper than 1500 m, but this may reflect the fact that much fewer samples have been taken in very deep water.

Up to 4 species have been collected from a single station: MUSORSTOM 6: stn CP 438, 780 m (*Propeamussium alcocki* and *P. watsoni*, alive; *Hyalopecten mireilleae* and *Pseudohinnites levii*, dead). A maximum of 2 species have been collected alive in a single station. However, ca. 70% of the stations with pectinoids contain a single species.

TABLE 2. — Bathymetric range of deep-water Pectinoidea from the New Caledonia region and Indonesia. Thick bar: confirmed living depth range; thin line: depth range indicated by empty shells only. Solid black: data for New Caledonia; stippled: data for Indonesia.

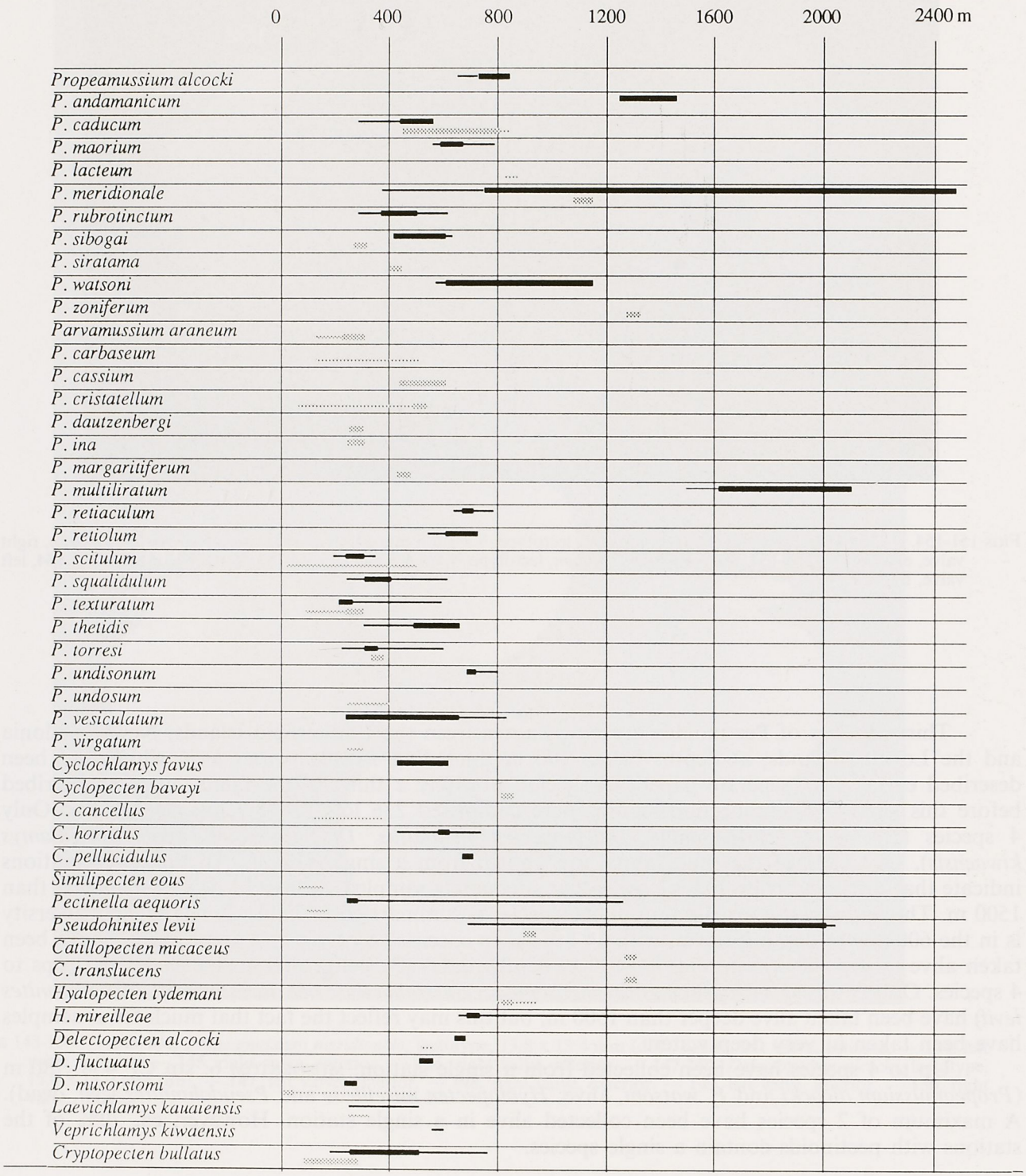


TABLE 3. — Occurence and abundance of Pectinoidea in deep-water off Indonesia and New Caledonia.
Stn: number of stations where the species has been recovered.
Live/dead: number of specimens taken alive and dead respectively.

Species	Indonesia			NC region		
	Stn	live	dead	Stn	live	dead
Propeamussium alcocki	-	-	-	5	37	3
P. andamanicum	-	-	-	2	2	-
P. caducum	11	20	11	4	2	5
P. maorium	-	-	-	6	3	9
P. lacteum	1	-	2	-	-	-
P. meridionale	1	-	1	20	18	46
P. rubrotinctum	-	-	-	24	70	52
P. sibogai	1	1	-	15	23	12
P. siratama	1	-	1	-	-	-
P. watsoni	-	-	-	12	226	4
P. zoniferum	1	1	5	-	-	-
Parvamussium araneum	3	2	1	-	-	-
P. carbaseum	14	-	73	-	-	-
P. cassium	1	1	-	-	-	-
P. cristatellum	6	1	43	-	-	-
P. dautzenbergi	2	-	3	-	-	-
P. ina	1	-	3	-	-	-
P. margaritiferum	1	1	-	-	-	-
P. multiliratum	-	-	-	7	10	5
P. retiaculum	-	-	-	4	7	6
P. retiolum	-	-	-	10	53	14
P. scitulum	14	-	>100	8	7	47
P. squalidulum	-	-	-	15	5	42
P. texturatum	3	2	1	5	3	8
P. thetidis	-	-	-	9	7	29
P. torresi	1	1	-	13	4	156
P. undisonum	-	-	-	4	2	6
P. undosum	5	-	6	-	-	-
P. vesiculatum	-	-	-	15	44	17
P. virgatum	3	-	5	-	-	-
Cyclochlamys favus	-	-	-	2	9	-
Cyclopecten bavayi	1	1	-	-	-	-
C. cancellus	6	-	15	-	-	-
C. horridus	-	-	-	4	1	7
C. pellucidulus	-	-	-	1	4	-
Similipecten eous	3	-	7	-	-	-
Pectinella aequoris	2	-	5	5	1	4
Pseudohinnites levii	1	1	-	14	3	36
Catillopecten micaceus	1	1	-	-	-	-
C. translucens	1	1	-	-	-	-
Hyalopecten tydemani	2	-	2	-	-	-
H. mireilleae	-	-	-	5	1	4
Delectopecten alcocki	1	-	1	2	1	2
D. fluctuatus	-	-	-	1	1	-
D. musorstomi	10	1	19	1	1	-
Laevichlamys kauaiensis	-	-	-	3	-	3
Veprichlamys kiwaensis	-	-	-	1	-	1
Cryptopecten bullatus	4	1	6	45	13	50

Cryptopecten bullatus is the species represented by the highest number of samples (45), followed by *Propeamussium rubrotinctum* (24) and *Propeamussium meridionale* (20). The species new to science are not particularly the rare ones: they are represented, as a mean, by 8.1 samples per species, with a minimum of 1, and a maximum of 15 samples.

Between 200 and 1000 m, propeamussiids are not only a diverse group, they may also be locally abundant as individuals, as the examples below indicate:

— *Propeamussium rubrotinctum*: Loyalty Islands, MUSORSTOM 6: stn DW 412, 437 m (> 50 spms).
— *Propeamussium watsoni*: Chesterfield Islands, MUSORSTOM 5: stn CP 323, 970 m (ca. 90 spms).
— *Parvamussium retiolum*: Chesterfield Islands, MUSORSTOM 5: stn CP 363, 685-700 m (40 spms).
— *Parvamussium vesiculatum*: New Caledonia, BIOCAL: stn DW 44, 440-450 m (37 spms).

The faunal assemblage from the Chesterfield Islands, New Caledonia and the Loyalty Islands may be compared to that of the Indonesian Archipelago (Tables 2 and 3). The sampling efforts are not directly comparable. In Indonesia, there are fewer than 150 deep-water stations (*"Siboga"*: 91 stations, *"Snellius-II"*: 54 stations), as compared to ca. 700 stations for the New Caledonia region. Conversely, the Indonesian Archipelago covers a larger geographical area, with more complex topography, than the New Caledonia region. However, several papers (DAUTZENBERG & BAVAY 1912; DIJKSTRA, 1990, 1991) cover the deep-water pectinoid fauna of Indonesia, and a comparison between the two faunal assemblages is not meaningless.

It is remarkable that, despite the difference in sampling intensity, Indonesia and New Caledonia have exactly the same number of deep-water pectinoids, 30 species. It is not less remarkable that only 12 species are shared: 60% of the pectinoids of New Caledonia are not recorded from Indonesia and *vice versa*. Considering the lower number of stations in Indonesia, it is not surprising that these 30 species are represented by fewer samples (Table 3): there is a total of 102 deep-water pectinoid samples, or 3.5 samples per species. As many as 14 species (46.7% of the fauna) have been recorded from Indonesia based on a single sample. This indicates a more highly diversified fauna, and it is very likely that additional species will be recorded when the sampling intensity increases.

TABLE 4. — Summary of faunal affinities on the deep-water Pectinoid fauna from the New Caledonian region.

Species shared with New Zealand	2	6.7%
Species shared with temperate Australia	2	6.7%
Species shared with tropical Indo-Pacific (of which: Species shared with Indonesia: 12)	17	56.6%
New species (actual distribution unknown, some may be endemic)	9	30.0%

Notwithstanding the relatively low proportion of species shared with Indonesia, the New Caledonia fauna consists mostly of species with larger Indo-West Pacific distribution (Table 4). Four species have a more restricted South-West Pacific distribution:*Parvamussium thetidis* and *Cyclochlamys favus* are shared with southern and eastern Australia, and *Propeamussium maorium* and *Veprichlamys kiwaensis* are shared with New Zealand.

AKNOWLEDGEMENTS

I am much indebted to P. Bouchet and B. Richer de Forges for allowing me to study the Pectinoidea from the New Caledonian region. I am also grateful to P. Bouchet and the two referees for their valuable advise and critical comments on this paper. Also many thanks are due to B. Métivier and the technical staff, notably M. Moreau, P. Maestrati and P. Lozouet, for their kind assistance during my visits to the MNHN. Furthermore, I wish to express my gratitude to the following persons, who provided access to collections, assisted me, and lent or donated study material: W. Ponder and I. Loch (AMS), B.A. Marshall (NMNZ), A.B. Stephenson and B.W. Hayward (AIM), F.E. Wells and S.M. Slack-Smith (Western Australian Museum, Perth), Subba Rao and Surya Rao (ZSI), T. Okutani (Tokyo University of Fisheries), I. Hayami (Geological Institute, University of Tokyo), T. Habe (NSMT), A. Matsukuma (Department of Earth and Planetary Sciences, Kyushu University, Fukuoka), Z. Wang (IOAS), R.N. Kilburn (NMP), H.K.Mienis (Hebrew University, Jerusalem), E. Gittenberger and J. Goud (RMNH), H.E. Coomans and R.G. Moolenbeek (ZMA), J. Van Goethem and A. Lievrouw (KBIN), C. Vaucher and Y. Finet (Muséum d'Histoire Naturelle, Geneva), J. Knudsen and T. Schiötte (ZMC), S. Morris (formerly of the BMNH), and P.G. Oliver and A. Trew (National Museum of Wales, Cardiff). For technical assistance I thank R.G. Moolenbeek (Figs 87-98) and L. Van Der Laan (ZMA) (Figs 1-86, 99-122) for taking scanning electron micrographs and light photographs.

REFERENCES

ABBOTT, R. T., 1954. — *American Seashells*. New York. xiv + 541 pp.

ABBOTT, R. T., 1974. — *American Seashells*, 2nd ed. New York. 663 pp.

ABBOTT, R. T. & DANCE, S. P., 1982. — *Compendium of Seashells*. New York. ix + 411 pp.

ALCOCK, A., 1902. — *A naturalist in Indian Seas*. London. xiv + 328 pp.

ALCOCK, A. & ANDERSON, A. R. S. (eds), 1897. — Mollusca. Part I. *In*: Illustrations of the Zoology of the Royal Indian Marine Surveying Steamer *"Investigator"*. 6 pls. Calcutta.

ALCOCK, A., ANNANDALE, N. & MCGILCHRIST, A. C. (eds), 1907. — Mollusca. Part IV. *In*: Illustrations of the Zoology of the Royal Indian marine surveying steamer *"Investigator"*. 5 pls. Calcutta.

BARNARD, K. H., 1964. — Contributions to the knowledge of South African marine Mollusca. Part 5. Lamellibranchiata. *Annals of the South African Museum*, **47** (3): 361-593.

BARNARD, K. H., 1969. — Contributions to the knowledge of South African marine Mollusca. Supplement. *Annals of the South African Museum*, **47** (4): 595-661.

BAVAY, A., 1905. — Espèces nouvelles du genre *Pecten* provenant de l' "Indian Museum de Calcutta". *Mémoires de la Société Zoologique de France*, **17**: 186-190.

BERNARD, F. R., 1978. — New bivalve molluscs, subclass Pteriomorphia, from the northeastern Pacific. *Venus*, **37**: 61-75.

BERNARD, F. R., 1983. — Catalogue of the living Bivalvia of the Eastern Pacific Ocean: Bering Strait to Cape Horn. *Canadian Special Publication of Fisheries and Aquatic Sciences*, **61**: i-vii, 1-102.

CLARKE, A. H., 1962. — Annotated list and bibliography of the abyssal marine molluscs of the world. *National Museum of Canada, Bulletin* **181** *(Biological Series* **67**): i-vi, 1-114.

COTTON, B. C., 1961. — *South Australian Mollusca. Pelecypoda*. Adelaide. 363 pp.

COTTON, B. C. & GODFREY, F. K., 1938. — *The molluscs of South Australia. Part I. The Pelecypoda*. Adelaide. 314 pp.

DALL, W. H., 1886. — Report on the results of dredging (...) in the Gulf of Mexico by the U.S. coast guard survey steamer *"Blake"* (...) Report on the Mollusca. Part 1. Brachiopodes and Pelecypodes. *Bulletin of the Museum of Comparative Zoology, Harvard*, **12** (6): 171-318.

DALL, W. H., 1889. — Report on the results of dredging (...) in the Gulf of Mexico by the U.S. coast guard survey steamer *"Blake"* (...) Report on the Mollusca. Part 2. *Bulletin of the Museum of Comparative Zoology, Harvard*, **18**: 1-492.

DALL, W. H., 1908. — Reports on the dredging operations off the coast of Central America to the Galapagos, to the West coast of Mexico, and in the Gulf of California, (...) by the (...)*"Albatross"* (...). *Bulletin of the Museum of Comparative Zoology, Harvard,* **43**: 205-487.

DALL, W. H., BARTSCH, P., & REHDER, H.A., 1938. — A manual of the Recent and fossil marine pelecypod mollusks of the Hawaiian Islands. *Bernice P. Bishop Museum Bulletin,* **153**: i-iv, 1-233.

DAUTZENBERG, P., 1925. — Mollusques nouveaux provenant des croisières du Prince Albert Ier de Monaco. *Bulletin de l'Institut Océanographique de Monaco,* **457**: 1-12.

DAUTZENBERG, P. & BAVAY, A., 1904. — Description d'un *Amussium* dragué par le *"Siboga"* dans la mer de Célèbes. *Journal de Conchyliologie,* **52** (3): 207-211.

DAUTZENBERG, P. & BAVAY, A., 1912. — Les lamellibranches de l'expédition du *"Siboga"*. Systématique. I. Pectinidés. *Siboga-Expeditie,* **53b**: 1-41.

DELL, R. K., 1956. — The archibenthal Mollusca of New Zealand. *Dominion Museum Bulletin,* **18**: 1-235.

DELL, R. K., 1962. — Additional archibenthal Mollusca from New Zealand. *Records of the Dominion Museum,* **4** (6): 67-76.

DELL, R. K., 1963. — Archibenthal Mollusca from Northern New Zealand. *Transactions of the Royal Society of New Zealand,* **3** (20): 205-216.

DELL, R. K., 1990. — Antarctic Mollusca. *Bulletin of the Royal Society of New Zealand,* **27**: 1-311.

DIJKSTRA, H. H., 1983-94. — The Pectinidae of New Caledonia. *Rossiniana,* **21-60** [33 parts].

DIJKSTRA, H. H.,1988. — *Chlamys allorenti* sp. nov. from Réunion (Bivalvia: Pectinidae). *La Conchiglia,* **19** (228-9): 19-21.

DIJKSTRA, H. H., 1989. — *Pseudohinnites levii* gen. et spec. nov. (Mollusca, Bivalvia: Pectinidae) from New Caledonia. *Basteria,* **53** (1-3): 29-33.

DIJKSTRA, H. H., 1990. — Three new pectinacean species from the Indonesian Archipelago collected during the *"Siboga"* expedition (1899-1900) with additional information and corrections on the previous report (Mollusca: Propeamussiidae, Pectinidae). *Beaufortia,* **40** (1): 1-14.

DIJKSTRA, H. H., 1991. — A contribution to the knowledge of the pectinacean Mollusca (Bivalvia: Propeamussiidae, Entoliidae, Pectinidae) from the Indonesian Archipelago. *Zoologische Verhandelingen, Leiden,* **271**: 1-57.

DIJKSTRA, H. H., RICHER DE FORGES, B., CLAVIER, J. & LEFORT, Y., 1989-90. — Pectinidae found on the soft bottoms of the New Caledonian and Chesterfield lagoons. *Rossiniana,* **45** (1989): 21-24; **46** (1990): 3-10; **47** (1990): 3-9.

EARLE, J., 1985. — Nine colorful Pectens from Hawaii. *Hawaiian Shell News,* **307**: 1, 4-5.

FINLAY, H. J., 1926. — A further commentary on New Zealand molluscan systematics. *Transactions and Proceedings of the New Zealand Institute,* **57**: 320-485.

GRANT, U. S. & GALE, H. R., 1931. — Catalogue of the marine Pliocene and Pleistocene Mollusca of California and adjacent regions. *San Diego Society of Natural History Memoirs,* **1**: 1-1036.

GRAU, G., 1959. — Pectinidae of the eastern Pacific. *Allan Hancock Pacific Expedition,* **23**: i-viii, 1-308.

GREGORIO, A. DE, 1884. — Nota intorno ad alcune nuove Conchiglie mioceniche di Sicilia. *Naturalista Siciliano,* **3**: 119-120.

GREGORIO, A. DE, 1898. — Études sur le genre *Amussium* avec un catalogue bibliographique et synonymique (...). *Annales de Géologie et Paléontologie,* **23** : 1-70.

HABE, T., 1951. — *Genera of Japanese shells.* Tokyo. 326 pp.

HABE, T., 1958. — Report on the Mollusca chiefly collected by the S.S. *"Soyo-Maru"* of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan during the years 1922-1930. Part 3 and 4. *Publications of the Seto marine Biological Laboratory,* **6**: 241-280; **7**: 19-52.

HABE, T., 1964. — *Shells of the Western Pacific in color,* vol. 2. Osaka. 223 pp.

HABE, T., 1977. — *Systematics of Mollusca in Japan. Bivalvia and Scaphopoda.* Tokyo. 372 pp. [In Japanese]

HAYAMI, I., 1984. — Natural history and evolution of *Cryptopecten* (a Cenozoic-Recent pectinid genus). *The University Museum, The University of Tokyo, Bulletin,* **24**: 1-149.

HAYAMI, I., 1988a. — Functional and taxonomic implications of the internal ribs of *Propeamussium. Transactions and Proceedings of the Palaeontological Society of Japan,* N.S., **150**: 476-490.

HAYAMI, I., 1988b. — Taxonomic characters of propeamussiids from Japan. *Venus,* **47** (2): 71-82.

HAYAMI, I. & KASE, T., 1993. — Submarine cave Bivalvia from the Ryukyu Islands: systematics and evolutionary significance. *The University Museum, University of Tokyo, Bulletin,* **35**: i-vi, 1-133.

HEDLEY, C., 1902. — Scientific results of the trawling expedition of H.M.C.S. *"Thetis"* off the coast of New South Wales in Febr./March 1898. Part I. Brachiopoda and Pelecypods. *Memoirs of the Australian Museum,* **4**: 287-324.

HEDLEY, C. & PETTERD, W. F., 1906. — Mollusca from three hundred fathoms off Sydney. *Records of the Australian Museum,* **6**: 211-225.

HERTLEIN, L. G., 1969. — Family Pectinidae Rafinesque, 1815. Pp. 348-373. *In*: R.C. MOORE (ed.), *Treatise on Invertebrate Paleontology.* Part N, vol. 1. Mollusca 6, Bivalvia. University of Kansas. 489 pp.

HERTLEIN, L. G., 1972. — Description of a new species of *Chlamys* from the Galapagos Islands. *Proceedings of the California Academy of Sciences*, **39** (1): 1-6.

HICKS, G. R. F. & MARSHALL, B.A., 1985. — Sex selective predation of deep-sea, meiobenthic copepods by pectinacean bivalves and its influence on copepod sex ratios. *New Zealand Journal of marine and freshwater Research*, **19**: 227-231.

IREDALE, T., 1925. — Mollusca from the continental shelf of eastern Australia. *Records of the Australian Museum*, **14** (4): 243-270.

IREDALE, T., 1929. — Mollusca from the continental shelf of eastern Australia. N° 2. *Records of the Australian Museum*, **17** (4): 157-189.

IREDALE, T., 1939. — Mollusca. Part I. *In*: British Museum (Natural History) Great Barrier Reef Expedition 1928-29. *Scientific Reports*, **5**: 209-425.

KAY, E. A., 1979. — Hawaiian marine shells. Reef and shore fauna of Hawaii. Section 4: Mollusca. *Bernice P. Bishop Museum Special Publication*, **64** (4): i-xviii, 1-653.

KIRA, T., 1967. — *Shells of the western Pacific in color*, 3rd edition. Osaka. 224 pp.

KISELEVA, G. A., 1971. — On the species composition and ecology of Bivalvia in the Red Sea. *In*: V.A. VODIANITZKII (ed.), *Benthos of the Red Sea*. Kiev. 295 pp. [In Russian]

KNUDSEN, J., 1967. — The deep-sea Bivalvia. *The John Murray Expedition 1933-34. Scientific Report*, **11** (3): 237-343.

KNUDSEN, J., 1970. — The systematics and biology of abyssal and hadal Bivalvia. *Galathea Report*, **11**: 1-241.

KNUDSEN, J. & DIJKSTRA, H. H. (in prep.). — The morphology and assignment of *Pseudohinnites levii* Dijkstra, 1989 (Mollusca, Bivalvia, Pectinoidea).

KOSUGE, S., 1985. — Noteworthy Mollusca from North-western Australia (1) (Preliminary report). *Bulletin of the Institute of Malacology, Tokyo*, **2** (3): 58-59.

KURODA, T., 1929-35. — An illustrated catalogue of the Japanese shells. Parts 1-16. *Venus*, separately paginated appendices to vols. 1-5. 154 pp.

KURODA, T. & HABE, T., 1981. — A catalogue of molluscs of Wakayama Prefecture, the province of Kii. *Publications of the Seto Marine Biological Laboratory, Special Publications Series*, **7**: i-xx, 1-301.

LAMPRELL, K. & WHITEHEAD, T., 1992. — *Bivalves of Australia*, vol. 1. Bathurst. xiii + 182 pp.

MELVILL, J. C. & STANDEN, R., 1907. — The Mollusca of the Persian Gulf, Gulf of Oman and Arabian Sea as evidenced mainly through the collections of Mr F.W. Townsend, 1893-1906, with descriptions of new species. Part 2. Pelecypoda. *Proceedings of the Zoological Society of London*, (1906): 783-848.

MOORE, E. J., 1984. — Tertiary marine pelecypods of California and Baja California: Propeamussiidae and Pectinidae. *US Geological Survey Professional Papers*, 1228-B: i-iv, B1-B112.

NORTH, F. K., 1951a. — On the type of *Pseudamussium* and other notes on pectinid nomenclature. *Journal of Paleontology*, **25** (2): 231-236.

NORTH, F. K., 1951b. — *The fossil and Recent Pectinidae. Their origin, development, distribution, and classification*. Brasenose College, unpublished thesis. 238 pp.

OKUTANI, T., 1962. — Report on the archibenthal and abyssal lamellibranchiate Mollusca mainly collected from Sagami Bay and adjacent waters by the R.V. *"Soyo-Maru"* during the years 1955-1960. *Bulletin of Tokai Regional Fisheries Laboratory*, **32**: 1-40.

OKUTANI, T., TAGAWA, M. & HORIKAWA, H., ["1988"] 1989. — *Bivalves from continental shelf and slope around Japan*. Japan Fisheries Resource Conservation Association, Tokyo. 190 pp.

OLSSON, A. A., 1964. — *Neogene mollusks from northwestern Ecuador*. Paleontological Research Institution, Ithaca. 256 pp.

OYAMA, K., 1944. — Classification of the genus *Propeamussium*. *Venus*, **13** (5-8): 240-254.

OYAMA, K., 1951. — Amusiinae in Japan. *Illustrated Catalogue of Japanese Shells*, **13**: 79-89.

POUTIERS, J. M., 1981. — Mollusques : Bivalves. *In*: Résultats des Campagnes MUSORSTOM. I-Philippines (18-28 mars 1976). *Mémoires ORSTOM, Paris*, **91** : 325-356.

POWELL, A. W. B., 1933. — Two new molluscs of the Pectinidae from 600 to 700 fathoms, four hundred miles West of New Plymouth. *Transactions and Proceedings of the New Zealand Institute*, **63** (3): 370-372.

POWELL, A .W. B., 1937. — *The shellfish of New Zealand. An illustrated handbook*. Auckland. 100 pp.

POWELL, A. W. B., 1960. — Antarctic and Subantarctic Mollusca. *Records of the Auckland Institute and Museum*, **5** (3-4): 117-193.

POWELL, A. W. B., 1979. — *New Zealand Mollusca. Marine, land and freshwater shells*. Auckland. xiv + 500 pp.

PRITCHARD, G. B. & GATLIFF, J. H., 1904. — Catalogue of the marine shells of Victoria. Part VIII. *Proceedings of the Royal Society of Victoria*, N.S., **17** (1): 220-266.

RAFINESQUE, C. S., 1815. — *Analyse de la nature*. Palermo. 225 pp.

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, vol. 6. *Mémoires du Muséum national d'Histoire naturelle, Paris*, (A), **145** : 9-54.

RICHER DE FORGES, B., 1993. — Campagnes d'exploration de la faune bathyale faites depuis mai 1989 dans la zone économique de la Nouvelle-Calédonie. Listes des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, vol. 10. *Mémoires du Muséum national d'Histoire naturelle, Paris*, **156**: 27-32.

ROMBOUTS, A., 1991. — *Guidebook to Pecten shells. Recent Pectinidae and Propeamussiidae of the world.* Oegstgeest. 157 pp.

ROUX, M., 1991. — La Nouvelle-Calédonie et ses alentours. Cadre géologique et océanographique du programme ENVIMARGES et de la campagne CALSUB. *Documents et Travaux de l'IGAL*, **15** : 22-36.

ROUX, M. *et al.*, 1991. — L'étagement du benthos bathyal observé à l'aide de la soucoupe *"Cyana". Documents et Travaux de l'IGAL*, **15**: 151-165.

SACCO, F., 1897a. — I molluschi dei terreni terziarii del Piemonte e della Liguria. Part 24. *Bollettino dei Musei di Zoologia ed Anatomia comparata della Reale Universita di Torino*, **12** (298): 101-102.

SACCO, F., 1897b. — *I molluschi dei terreni terziarii del Piemonte e della Liguria.* Part 24 (Pectinidae). Torino. 116 pp., 21 pls.

SCHEIN, E., 1988. — Un Pectinacea (Bivalvia) très primitif: *Bathypecten vulcani*, du site hydrothermal de 13° N (Pacifique oriental). *Oceanologica Acta*, **8** : 83-98.

SCHEIN, E., 1989. — Pectinidae (Mollusca, Bivalvia) bathyaux et abyssaux des campagnes BIOGAS (Golfe de Gascogne). Systématique et biogéographie. *Annales de l'Institut océanographique, Paris*, **65** (2): 59-125.

SMITH, E. A., 1885. — Report on the Lamellibranchiata collected by H.M.S. *"Challenger"* during the years 1873-1876. *Challenger Reports, Zoology*, **13** (35): 1-341.

SMITH, E. A., 1894. — Natural history notes from H.M. Indian Marine Survey Steamer *"Investigator"*. Ser. 2 (10). Report upon some Mollusca dredged in the Bay of Bengal and the Arabian Sea. *Annals and Magazine of Natural History*, ser. 6, **14**: 157-174.

SMITH, E. A., 1895a. — Natural history notes from H.M. Indian Marine Survey Steamer *"Investigator"*. Ser. 2 (19). Report upon the Mollusca dredged in the Bay of Bengal during the season 1893-94. *Annals and Magazine of Natural History*, ser. 6, **16**: 1-19.

SMITH, E. A., 1895b. — Natural history notes from H.M. Indian Marine Survey Steamer *"Investigator"*. Ser. 2 (20). Report upon some Mollusca dredged in the Arabian Sea during the season 1894-5. *Annals and Magazine of Natural History*, ser. 6, **16**: 262-265.

SMITH, E. A., 1903. — Marine Mollusca. *In*: J.S. GARDINER (ed.), The fauna and geography of the Maldive and Laccadive Archipelagoes, **2** (2): 589-630. Cambridge.

SMITH, E. A., 1904. — Natural history notes from H.M. Indian Marine Survey Steamer *"Investigator"*, Ser. 3 (1). On Mollusca from the Bay of Bengal and the Arabian Sea. *Annals and Magazine of Natural History*, ser. 7, **14**: 1-14.

SMITH, E. A., 1906. — Natural history notes from H.M. Indian Marine Survey Steamer *"Investigator"*, Ser. 3 (10). On Mollusca from the Bay of Bengal and the Arabian Sea. *Annals and Magazine of Natural History*, ser. 7, **18**: 157-175, 245-264.

STEWART, R. B., 1930. — Gabb's California Cretaceous and Tertiary type lamellibranchs. *Academy of Natural Sciences of Philadelphia, Special Publications*, **3**: 1-314.

STURANY, R., 1901. — Lamellibranchiaten des Rothen Meeres. *Denkschriften der Mathematisch-Naturwissenschaftliche Classe der Kaiserlichen Akademie der Wissenschaften*, **69**: 255-295.

TEPPNER, W. VON, 1922. — Lamellibranchiata Tertiaria, Anisomyaria, 2. *In*: *Fossilium Catalogus*, I, Animalia, Part 15: 67-296. Berlin.

THIELE, J. & JAECKEL, S., 1931. — Muscheln der Deutschen Tiefsee Expedition. *Deutsche Tiefsee-Expedition 1898-99*, **21** (1): 1-110.

VAUGHT, K. C., 1989. — *A classification of the living Mollusca.* Melbourne, USA. xii + 195 pp.

VERRILL, A. E., 1885. — Third catalogue of Mollusca recently added to the fauna of the New England coast. Consisting mostly of deep-sea species with notes on other species previously recorded. *Transactions of the Connecticut Academy of Arts and Science*, **6**: 395-452.

VERRILL, A. E., 1897. — A study of the family Pectinidae, with a revision of the genera and subgenera. *Transactions of the Connecticut Academy of Arts and Science*, **10**: 41-95.

WAGNER, H. P., 1989. — The genus *Cryptopecten* Dall, Bartsch & Rehder, 1938, in the Indo-Pacific (Mollusca; Bivalvia; Pectinidae). *Basteria*, **53** (1-3): 53-62.

WALLER, T. R., 1971. — The glass scallop *Propeamussium*, a living relict of the past. *American Malacological Union, Annual Report for 1970*: 5-7.

WALLER, T. R., 1978. — Morphology, morphoclines and a new classification of the Pteriomorphia (Mollusca: Bivalvia). *Philosophical Transactions of the Royal Society of London*, (B), **284**: 345-365.

WALLER, T. R., 1984. — The ctenolium of scallop shells: functional morphology and evolution of a key family-level character in the Pectinacea (Mollusca: Bivalvia). *Malacologia*, **25** (1): 203-219.

WALLER, T. R., 1991. — Evolutionary relationship among commercial scallops (Mollusca: Bivalvia: Pectinidae). Pp. 1-73. *In*: S.E. SHUMWAY (ed.), *Scallops: Biology, ecology and aquaculture*. Amsterdam. xx + 1095 pp.

WALLER, T. R., 1993. — The evolution of *"Chlamys"* (Mollusca: Bivalvia: Pectinidae) in the tropical western Atlantic and eastern Pacific. *American Malacological Bulletin*, **10** (2): 195-249.

WALLER, T. R. & MARINCOVICH, L., 1992. — New species of *Camptochlamys* and *Chlamys* (Mollusca: Bivalvia: Pectinidae) from near the Cretaceous/Tertiary boundary at Ocean Point, North Slope, Alaska. *Journal of Paleontology*, **66** (2): 215-227.

WANG, Z., 1980. — Study on Chinese species of the family Pectinidae (Mollusca, Bivalvia). I. A new species of the subfamily Propeamussiinae. *Oceanologia et Limnologia Sinica*, **11** (3): 259-262.

WANG, Z., 1983. — Studies on Chinese species of the family Pectinidae. III. Chlamydinae (Genus *Bractechlamys*). *Oceanologia et Limnologia Sinica*, **14** (6): 531-535.

WANG, Z., 1984. — Studies on Chinese species of the family Pectinidae. VI. Subfamily Propeamussiinae. *Oceanologia et Limnologia Sinica*, **15** (6): 598-604.

WILKES, J., 1810. — Conchology. *In*: *Encyclopaedia Londinensis; or, Universal Dictionary of Arts, Sciences, and Literature*: 14-41. London.

WINCKWORTH, R., 1940. — A systematic list of the *"Investigator"* Mollusca. *Proceedings of the Malacological Society of London*, **24**: 19-29.