

# Two new species of protocardiine cockles (Mollusca, Bivalvia, Cardiidae) from the tropical Southwest Pacific

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## ABSTRACT

The two new species described in this paper are widely distributed in the tropical south-western Pacific; they have been found on the upper continental shelf of the area, around New Caledonia, westward to Chesterfield Islands and Lord Howe Ridge, southward to northern part of Norfolk Ridge, north- and eastward to Vanuatu, Fiji and Tonga islands. They belong to two often confused genera of subfamily Protocardiinae (*sensu* Keen 1980), *Frigidocardium* Habe, 1951 and *Microcardium* Thiele, 1934, that are briefly characterized herein. *Frigidocardium valdentatum* n. sp. is characterized by the peculiar sculpture of mid-posterior slope ending in strongly dentate margin. *Frigidocardium kirana* is a similar species with lower outer sculpture, more asymmetrical shape and rather strong umbronoventral fold; it is first recorded here from the tropical Southwest Pacific and Mascarene islands. Diagnostic features of *Microcardium trapezoidale* n. sp. include rather high trapezoidal shape and posterior sculptural area extending on 2/5 of shell length, with an anterior limit almost parallel to radial ribs in the adult and well-developed, non lamellous sculpture in the rib interstices. A comparative review of all Recent *Microcardium* species in the Indo-West Pacific is given, to place the new species in the context of the genus. Five *Microcardium* species are presently known in this area: *M. gilchristi* from southern Africa, *M. simillimum* n. comb. (for *Cardium (Fragum) simillimum*) from Sri Lanka and Mascarene Plateau, *M. sakurarii* from Japan and the Philippines (new record), *M. aequiliratum* from the Philippines, and *M. tenuilamellosum* from the Philippines and Solomon Islands (new record).

## KEY WORDS

Mollusca,  
Bivalvia,  
Cardiidae,  
*Frigidocardium*,  
*Microcardium*,  
Indo-Pacific,  
new species.

## RÉSUMÉ

Deux nouvelles espèces de Protocardiinae (Mollusca, Bivalvia, Cardiidae) du Pacifique sud-ouest tropical.

Les deux nouvelles espèces décrites dans cet article présentent une large distribution dans le Pacifique sud-ouest tropical ; elles ont été récoltées dans la partie supérieure des talus continentaux depuis les abords de la Nouvelle-Calédonie jusqu'aux îles Chesterfield et à la ride de Lord Howe vers l'ouest, à la zone nord de la ride de Norfolk vers le sud, aux îles Vanuatu, Fidji et Tonga vers le nord et vers l'est. Elles appartiennent à deux genres souvent confondus dans la sous-famille Protocardiinae (*sensu* Keen 1980), *Frigidocardium* Habe, 1951 et *Microcardium* Thiele, 1934, qui sont brièvement caractérisés. *Frigidocardium valdentatum* n. sp. est caractérisée par la sculpture de sa déclivité postéromédiane qui forme une forte dentelure marginale ; elle est aussi moins asymétrique que *F. kirana* (signalée ici des Mascareignes et du Pacifique sud-ouest tropical), à sculpture plus forte et pli umbonoventral moins marqué. *Microcardium trapezoidale* n. sp., de forme trapézoïdale assez haute, possède une sculpture postérieure sur les 2/5 du test, à limite antérieure subparallèle aux côtes radiales, avec des motifs intercostaux bien développés mais non lamelleux. Une revue comparée des différentes espèces actuelles permet de placer la nouvelle espèce dans le contexte du genre *Microcardium*, dans le domaine Indo-Pacifique. Cinq espèces sont connues à ce jour de cette région : *M. gilchristi* d'Afrique australe, *M. simillimum* n. comb. (pour *Cardium* (*Fragum*) *simillimum*) du Sri Lanka et du Plateau des Mascareignes, *M. sakuraii* du Japon et des Philippines (donnée nouvelle), *M. aequilratum* des Philippines, et *M. tenuilamellosum* des îles Philippines et Salomon (donnée nouvelle).

## MOTS CLÉS

Mollusca,  
Bivalvia,  
Cardiidae,  
*Frigidocardium*,  
*Microcardium*,  
Indo-Pacifique,  
espèces nouvelles.

## INTRODUCTION

Though some species of the cockle subfamily Protocardiinae (*sensu* Keen 1969, 1980) are known from the Indo-West Pacific realm since the 19th century (Sowerby 1834, 1838; Gray 1843; Reeve 1847; Adams & Reeve 1850; Smith 1885, 1896), recent investigations have shown that this mainly deep-sea group is imperfectly known in the Southwest Pacific (Poutiers 1992).

The two new species described here come from the extensive series of material collected since 1978 in New Caledonian and tropical southwestern Pacific waters, during offshore expeditions conducted conjointly by the MNHN and the Nouméa centre of the IRD (Institut de Recherche pour le Développement, formerly ORSTOM) (for more details see Richer de Forges 1990, 1991, 1993; Richer de Forges & Menou 1993; Richer de Forges & Chev-

lon 1996; Richer de Forges *et al.* 1996, 2000a, b; see also <http://www.tropicaldeepseabenthos.org>). Some of the material used in this paper comes from two recent major littoral sampling in New Caledonia, made to study and compare the species richness of coral reef areas with (expédition MONTROUZIER) and without (atelier LIFOU 2000) barrier reef and lagoon (for more details, see Bouchet 1994; Bouchet *et al.* 2001). These offshore expeditions and littoral workshops are here listed chronologically: VAUBAN 1978-1979; LAGON 1-6, 1984; LAGON 7-9, 1985; BIOCAL, 1985; MUSORSTOM 4, 1985; MUSORSTOM 5, 1986; SMIB 2, 1986; BIOGEOCAL, 1987; CORAIL 2, 1988; MUSORSTOM 6, 1989; BERYX 11, 1992; BATHUS 1-4, 1993; expédition MONTROUZIER, 1993; HALIPRO 1, 1994; MUSORSTOM 8, 1994; MUSORSTOM 10, 1998; BORDAU 1, 1999; BORDAU 2, 2000, atelier LIFOU, 2000, NORFOLK 1, 2001.

In species descriptions, morphological terminology mainly follows Cox (1969). In this paper, “horizontal” direction corresponds to the line joining the midpoint of the adductor muscle scars, and shell length is the maximum size measured in accordance with that direction. For features of the anterodorsal area of shell, I have used “lunular sector” instead of “lunule”, following Carter (1967). For the raised and more or less externally reflected part of the anterodorsal margin that appears just in front of the umbo in a number of cardiid species, I have avoided the use of the terms “lunule flap” (Schneider 1992, 1998), or “lunular heart” (Vidal 1994), as it is not known if they are strictly homologous on structural grounds.

Unless specified, all material is in MNHN.

#### ABBREVIATIONS AND TEXT CONVENTIONS

##### Repositories

- AMS Australian Museum, Sydney;  
 BMNH The Natural History Museum, London;  
 MNHN Muséum national d’Histoire naturelle, Paris;  
 NMNZ Museum of New Zealand Te Papa Tongarewa, Wellington;  
 NMSA Natal Museum, Pietermaritzburg, South Africa;  
 NMW National Museum of Wales, Cardiff;  
 NSMT National Science Museum, Tokyo;  
 USNM National Museum of Natural History, Washington D.C.

##### Stations data

- CC chalut à crevettes (shrimp trawl);  
 CH chalut à poissons (fish trawl);  
 CP chalut à perche (beam trawl);  
 DC drague Charcot (Charcot dredge);  
 DE drague épibenthique (epibenthic dredge);  
 DR drague à roche (rock dredge);  
 DW drague Warén (Warén dredge).

##### Other abbreviations

- lv left valve;  
 rv right valve;  
 sh shell (paired valves, dead collected);  
 spm live-taken specimen;  
 sv single valve.

#### SYSTEMATICS

Family CARDIIDAE Lamarck, 1809

Genus *Frigidocardium* Habe, 1951

TYPE SPECIES. — *Cardium eos* Kuroda, 1929, by original designation.

#### REMARKS

This genus has often been confused with *Microcardium* Thiele, 1934 (e.g., Wilson & Stevenson 1977), but it is quite distinct and can be easily characterised by its homogeneous outer sculpture with numerous radial ribs and spines developed on the whole surface (Poutiers 1992). The subgenus *Tobarum* Noda, 1988, based on *F. (T.) tobaruense* Noda, 1988 (a Pliocene species from Okinawa Island, SW Japan), actually belongs to *Microcardium* (Schneider 1995: 322).

*Frigidocardium* occurrence is restricted to the tropical Indo-West Pacific, where it is known from the Miocene onwards.

#### *Frigidocardium valdentatum* n. sp.

(Figs 1–4)

TYPE MATERIAL. — Holotype: New Caledonia, LAGON, stn 190, off Baie de Saint Vincent, 22°02.1’S, 165°57.3’E, 135–150 m, 1 sh (MNHN).

Paratypes: same locality, 1 sh with rv broken, 1 lv (all MNHN). — Stn 830, E Lagoon, off Poindimié, 20°48.9’S, 165°19.3’E, 105–110 m, 4 lv, 4 rv (3 MNHN, 1 BMNH, 1 NMNZ, 1 NSMT, 1 USNM, 1 AMS).

BATHUS 4, stn DW 882, off Passe de Saint Vincent, external slope, 22°02’S, 165°56’E, 250–350 m, 1 rv (MNHN).

TYPE LOCALITY. — Southern New Caledonia, off Baie de Saint Vincent, NW Récif Tétembia, 22°02.1’S, 165°57.3’E, 135–150 m, LAGON 3, stn 190.

ETYMOLOGY. — The name refers to the strongly serrate mid-posterior margin. It is derived from the Latin *valde* = strong, and *dentatum* = dentate.

OTHER MATERIAL EXAMINED. — **New Caledonia.** VAUBAN 1978–1979, stn DR 33, S Lagoon, off Passes de Boulari, external slope, 22°33’S, 166°25’E, 290–350 m, 1 lv. — Stn DR 40, S Lagoon, off Passes de Boulari, external slope, 22°30’S, 166°24’E, 250–350 m, 1 lv, 1 rv.

LAGON, stn 496, N Lagoon, northern external slope, 19°03.6’S, 163°10.3’E, 200–215 m, 1 lv, 1 rv. — Stn 858, E Lagoon, Grand Récif Mangalia, 20°37.3’S, 165°07.4’E, 220 m, 1 lv.

MUSORSTOM 6, stn DW 485, NE slope of Loyalty Islands, 21°23.48’S, 167°59.33’E, 350 m, 1 lv.

BATHUS 1, stn DW 678, off Passe de Touho, external slope, 20°49’S, 165°19’E, 94–100 m, 1 lv, 2 rv. — Stn DW 685, off Passe de Hienghu, 20°35’S, 165°07’E, 244 m, 1 lv. — Stn DW 691, off Passe de Hienghu,

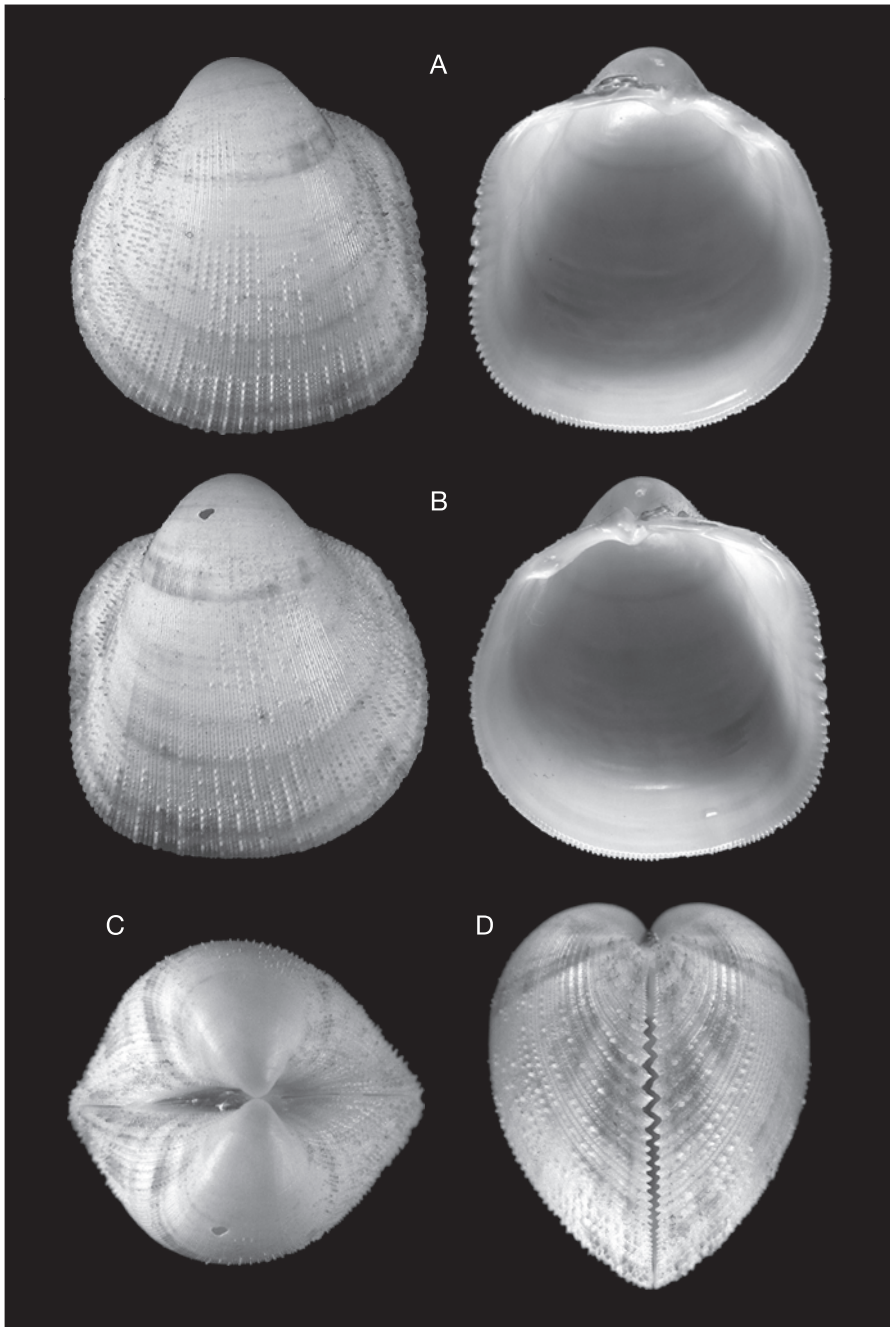


FIG. 1. — *Frigidocardium valdentatum* n. sp., holotype, length 23.6 mm, New Caledonia, LAGON, stn 190: **A**, exterior and interior of left valve; **B**, exterior and interior of right valve; **C**, dorsal view; **D**, posterior view.

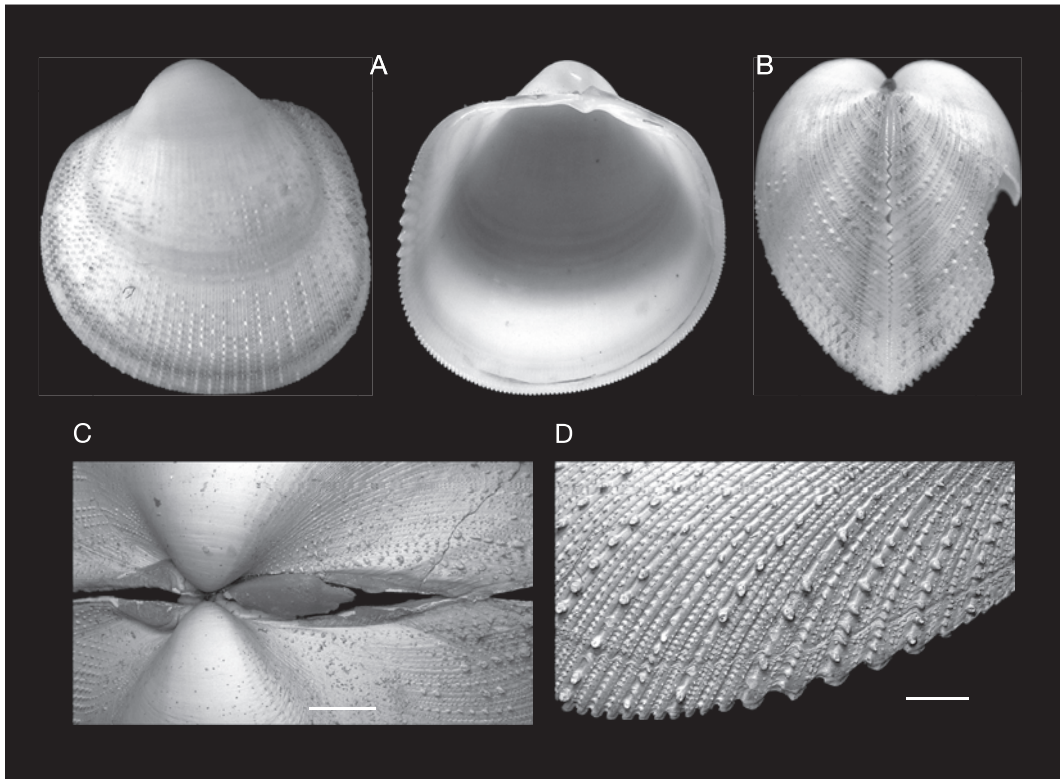


FIG. 2. — *Frigidocardium valdentatum* n. sp., paratype, length 14.5 mm, New Caledonia, LAGON, stn 190: **A**, exterior and interior of left valve; **B**, posterior view; **C**, detail of dorsal view (SEM); **D**, sculpture of posterior slope of left valve (SEM). Scale bars: 1 mm.

20°35'S, 164°59'E, 227-250 m, 1 lv, 6 rv. — Stn CP 701, off Passe de Baye, 20°58'S, 165°36'E, 302-335 m, 1 lv. — Stn CP 712, off Passe de Ngoé, 21°44'S, 166°35'E, 210 m, 2 rv.

BATHUS 4, stn DW 894, Grand Passage, 20°16'S, 163°52'E, 245-268 m, 1 sh, 1 lv. — Stn CP 897, Grand Passage, 20°16'S, 163°52'E, 305-350 m, 1 lv. — Stn DW 933, N Lagoon, northern external slope, 19°07'S, 163°29'E, 212-220 m, 1 rv.

Expédition MONTROUZIER, stn 1321, Koumac area, Passe Deverd, 20°44.7'S, 164°14.9'E, 90-115 m, muddy sand, 7 lv, 6 rv. — Stn 1323, Passe de Koumac, 20°40.9'S, 164°14.8'E, 82-120 m, shelly muddy sand, 3 lv.

Atelier LIFOU 2000, stn DW 1650, Baie du Santal, SW of Récif Shelter, 20°54.15'S, 167°01.7'E, 120-250 m, 2 lv.

NORFOLK 1, stn CP 716, Norfolk Ridge, northern slope of Artigonia Mount, 23°22'S, 168°03'E, 266-276 m, 1 lv (broken).

Vanuatu. MUSORSTOM 8, stn DW 1066, W Malekula

Island, 16°16'S, 167°21'E, 349-386 m, 1 lv. — Stn CP 1131, S Santo Island, 15°38'S, 167°04'E, 140-175 m, 1 rv. — Stn CP 1135, S Santo Island, 15°40'S, 167°02'E, 282-375 m, 1 lv.

Fiji. MUSORSTOM 10, stn DW 1333, Bligh Water, 16°50.4'S, 178°12.4'E, 200-215 m, 4 lv, 4 rv. — Stn DW 1334, Bligh Water, 16°51.4'S, 178°13.9'E, 251-257 m, 2 lv, 4 rv. — Stn CP 1363, S of Viti Levu, 18°12.4'S, 178°33.0'E, 144-150 m, 4 lv, 5 rv. — Stn CP 1366, S of Viti Levu, 18°12.4'S, 178°33.1'E, 149-168 m, 2 lv, 3 rv. — Stn CP 1370, S of Viti Levu, 18°12.3'S, 178°33.1'E, 113-123 m, 1 lv. — Stn CP 1371, S of Viti Levu, 18°12.4'S, 178°32.8'E, 135-151 m, 3 lv, 6 rv. — Stn CP 1387, near Beqa Channel, 18°18.5'S, 178°04.7'E, 229-370 m, 1 lv. — Stn CP 1389, near Beqa Channel, 18°18.6'S, 178°04.7'E, 241-417 m, 2 lv, 1 rv. — Stn CP 1390, near Beqa Channel, 18°18.6'S, 178°05.1'E, 234-361 m, 2 lv, 1 rv.

BORDAU 1, stn CP 1394, Somosomo Strait, 16°45'S, 179°59'E, 416 m, 4 lv, 8 rv. — Stn DW 1440, Vanua Balava, 17°11'S, 178°43'W, 190-308 m, 1 lv. — Stn CP



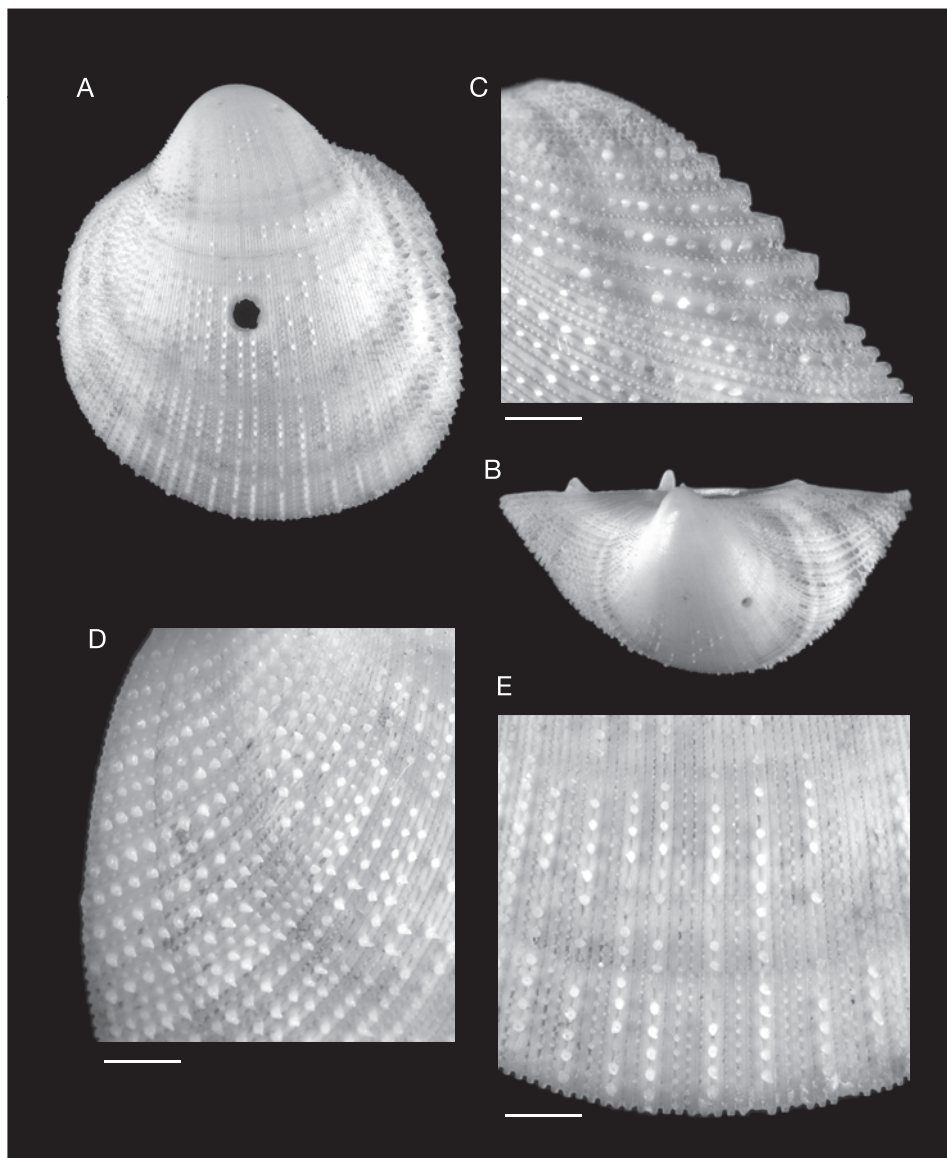


FIG. 3. — *Frigidocardium valdentatum* n. sp., paratype, length 21.3 mm, sculpture of left valve, New Caledonia, LAGON, stn 830: **A**, exterior; **B**, dorsal view; **C**, detail of posterior slope; **D**, detail of anterior slope; **E**, detail of ventral margin. Scale bars: 2 mm.

1448, Somosomo Strait, 16°45'S, 179°59'E, 410-500 m, 1 lv. — Stn DW 1451, Somosomo Strait, 16°45'S, 179°59'E, 400-460 m, 2 lv.

**Tonga.** BORDAU 2, stn DW 1510, NW of Tongatapu, 21°05'S, 175°23'W, 461-497 m, 1 rv. — Stn CP 1567, NW of Tongatapu, 21°02'S, 175°19'W, 351-356 m,

1 rv. — Stn CP 1568, NW of Tongatapu, 21°02.07'S, 175°18.62'W, 431 m, 1 lv.

**DISTRIBUTION.** — West Pacific, from off New Caledonia to Fiji and Tonga islands, north to Vanuatu and south to northern Norfolk Ridge, in 82-460 m.

TABLE 1. — Selected measurements (in mm) and length/height ratio of *Frigidocardium valdentatum* n. sp. Abbreviations: **lv**, left valve; **rv**, right valve; **sv**, single valve.

	Length	Height	Inflation (sv)	Length/height
MONTROUZIER, stn 1321 (lv)	6.7	6.8	2.3	0.98
MONTROUZIER, stn 1321 (lv)	11.6	12.3	4.4	0.94
LIFOU 2000, stn DW 1650 (lv)	15.3	16.7	6.2	0.92
MONTROUZIER, stn 1321 (lv)	17.0	17.5	6.7	0.97
BORDAU 1, stn CP 1394 (lv)	17.5	18.3	6.8	0.96
BATHUS 1, stn DW 678 (rv)	17.7	18.7	7.6	0.95
BORDAU 1, stn CP 1394 (rv)	17.8	19.2	7.6	0.93
BATHUS 1, stn DW 678 (lv)	18.0	18.4	7.1	0.98
LAGON, stn 496 (rv)	18.5	19.4	7.9	0.95
BATHUS 1, stn DW 678 (rv)	18.7	20.0	8.0	0.94
BORDAU 1, stn CP 1394 (rv)	19.9	20.8	8.0	0.96
MONTROUZIER, stn 1321 (lv)	20.7	21.9	8.5	0.94
BORDAU 1, stn CP 1394 (rv)	21.2	23.0	8.8	0.92
BORDAU 1, stn CP 1394 (rv)	21.8	22.5	9.0	0.97
BORDAU 1, stn CP 1394 (rv)	22.6	23.3	9.0	0.96
BATHUS 1, stn CP 712 (rv)	23.2	25.2	10.1	0.92
LAGON, stn 496 (lv)	23.5	24.4	9.4	0.95
VAUBAN, stn 33 (lv)	26.2	27.5	11.0	0.95

## DESCRIPTION

Shell equivalve, large-sized for the genus (up to 27.5 mm in height), inflated, slightly higher than long (length/height ratio 0.92 to 0.98), rounded-subquadrate and somewhat asymmetrical in outline, rather thin but solid. Umbones prosogyrate, prominent, situated in front of mid-length of valves. Anterodorsal margin widely convex, decidedly slanted forward. Anterior margin regularly rounded, joining without discontinuity the distinctly convex ventral margin, giving a semicircular outline to the anterior half of shell. Posterior margin truncate and straightish, higher than the anterior margin, forming a rounded angle with both posterodorsal and ventral margins. Posterodorsal margin elongate, feebly convex, becoming rounder posteriorly.

Surface of valves tumid, strongly oblique and somewhat flattened posterior to a radial zone extending from umbo to posteroventral angle of shell and forming the area of maximum convexity. Surface covered with numerous small radiating ribs and radial rows of spines of variable strength. Radial ribs about 150 to 180 or more per valve in adults, vanishing in dorsalmost anterior and posterior areas, and thus difficult to count exactly. Ribs low, rounded, flattened on top, about as wide as their interstices, becoming rounder and thinner on ante-

rior part of valves, flatter and squarer on posterior slope. Spines usually conical, pointed and more or less compressed laterally, becoming gradually thicker, shorter, blunt and somewhat spatulate on anterior slope. Larger spines generally entirely fill the rib interstices on median part of valves, smaller spines mainly confined to the limit between rib edges and interstices. Larger spines mostly encroaching upon the anterior side of ribs on the posterior 2/5 of shell length, and upon their posterior side on the anterior 3/5. Occurrence of larger spines variable, but generally on every four or five interstices in median part of shell, more frequent anteriorly (every two or three interstices). Intervening interstices with small granules, sometimes developed in medium-sized spines. Sculpture of the median part of posterior slope highly distinctive, comprising a series of five to seven widely set, large, asymmetrical radial ribs ending as prominent serrations on posterior margin; ribs ventrally steeper and bordered by a row of stout pointed spines, dorsally flattened to somewhat concave and bearing one or two radial rows of small granules along which tend to develop a secondary sculpture of tiny radial riblets that usually do not indent the posterior margin of valves. Lunular sector almost equally developed in both valves, somewhat flattened to concave in cross

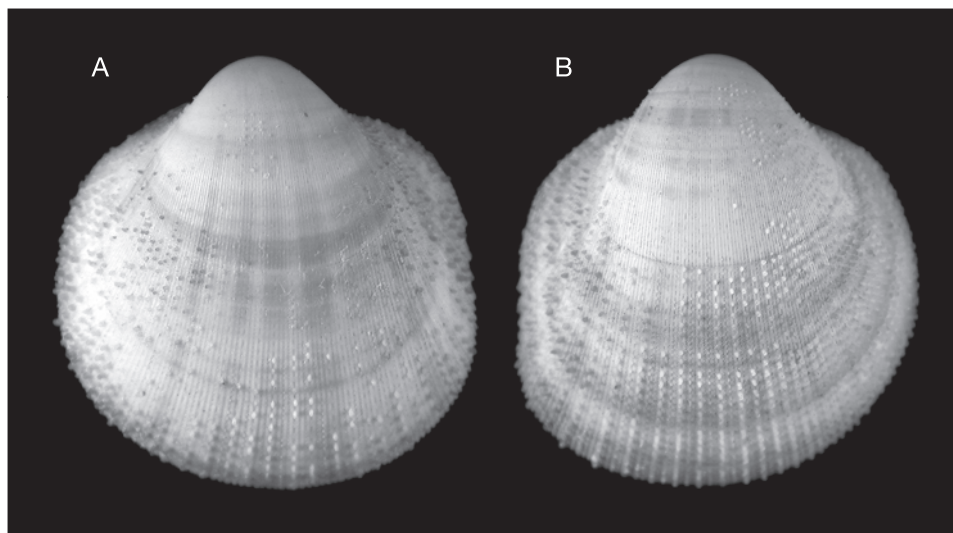


FIG. 4. — Shape and colour variation in *Frigidocardium valdentatum* n. sp.: **A**, length 17.0 mm, exterior of left valve, New Caledonia, MONTRouZIER, stn 1321; **B**, paratype, length 22.8 mm, exterior of right valve, New Caledonia, LAGON, stn 830.

section and, apart from the absence of crenulations on valve margin, barely distinct from the surrounding area. Sculpture of lunular sector devoid of radial ribs, but with radial rows of small granules which are concentrically aligned along growth lines or feeble ridges. Anterodorsal margin prominent and thickened just anterior to umbo, often more or less reflected over the corresponding part of the lunule to form a crescent-shaped, flat-topped and finely ridged process. Posterodorsal margin of right valve is slightly expanded posteriorly above the opposite valve margin.

Ligament a small arched corneous, brown band, extending half the length of posterodorsal margin.

Hinge slightly arched, umbonal angle between cardinal and lateral teeth about  $150^\circ$ . Two unequal cardinals in each valve, the ventralmost much larger and more prominent; cardinals connected by a shelly saddle in right valve, but well separated in left valve. Lateral teeth approximately equidistant from cardinals; right valve with paired anterior and single posterior submarginal laterals; left valve with single anterior submarginal lateral and single posterior marginal lateral.

Interior of valves smooth and porcelaneous, somewhat translucent with the outer radial sculpture

showing through. Adductor muscle scars subequal in size, posterior slightly larger and squarely ovate in shape, anterior roundly trigonal. Anterior pedal retractor scar reniform, generally not touching the adductor and stretching along ventral base of anterior lateral tooth. Posterior pedal retractor scar elongate, pointing toward the umbo, more or less connected with posterodorsal end of adductor scar. Dorso-umbonal pedal scar ovate, deeply impressed, situated on underside of hinge, just in front of ventralmost cardinal tooth. Pallial line entire, poorly impressed, very wide ventrally. Internal margins serrated matching the outer radial sculpture.

Shell colour white, often more or less suffused with yellowish tan on posterior slope and lunular sector, or with orange stains arranged radially and concentrically, and a thin border of bright orange along the ligament. Spines usually more deeply coloured than the shell. Interior whitish, often with a pale yellow hue in the umbonal cavity.

Measurements are provided in Table 1.

#### REMARKS

*Frigidocardium valdentatum* n. sp. is somewhat variable in shape and sculpture, both among individuals and during ontogeny. Spines may be more



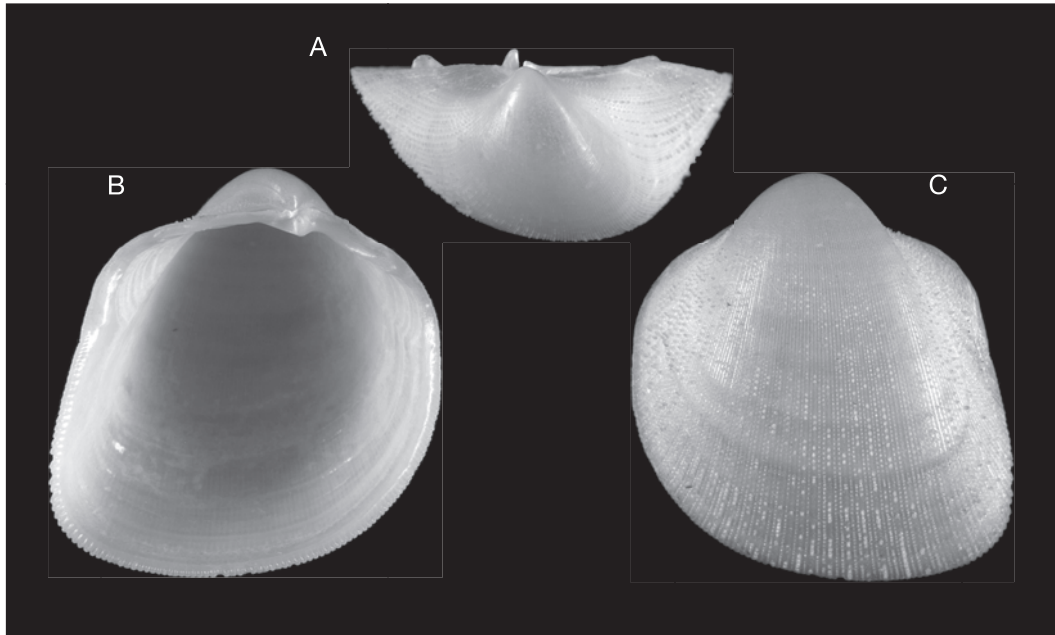


FIG. 5. — *Frigidocardium kirana* Sakurai & Habe, 1966, length 12.3 mm, left valve, Field Bank, Northern Fiji Basin, MUSORSTOM 7, stn DW 588: **A**, dorsal view; **B**, interior; **C**, exterior.

or less developed, dorsalmost anterior or posterior ribs variably differentiated, and secondary radial riblets of mid-posterior slope sometimes obscure, especially in later stages of growth of some larger shells, where concentric marks are stronger and more closely set. Juvenile specimens tend also to be less asymmetrical, with slighter sculpture and lower number of ribs.

This species can be easily differentiated from all other *Frigidocardium* species by the peculiar sculpture and margin of mid-posterior slope. It is similar to *Frigidocardium kirana* Sakurai & Habe, 1966 (Fig. 5), a species hitherto only known from East China Sea, in southern Japan (Habe 1977) and southern China (Bernard *et al.* 1983), but in fact widely distributed in the tropical Indo-West Pacific, in Coral Sea, New Caledonia, Wallis, Fiji, Tonga and Mascarene islands (Poutiers unpublished data). The latter species is smaller than *F. valdentatum* n. sp. (up to 14.1 mm in height), it has a lower external sculpture and more asymmetrical shape with oblique ventral margin, rather strong umboventral fold

and posterior lateral hinge teeth farther removed from cardinals than anterior laterals; furthermore, the umbonal part of the anterodorsal margin is only slightly protruding and neither thickened nor reflected over the lunular sector.

#### Genus *Microcardium* Thiele, 1934

TYPE SPECIES. — *Cardium (Fulvia) peramabilis* Dall, 1881, by subsequent designation (Keen 1937).

#### REMARKS

While creating *Microcardium*, Thiele (1934: 878) failed to designate a type species but recorded two species in his new genus, *Cardium (Fragum) torresi* E. A. Smith, 1885 and *Cardium (Fulvia) peramabilis*. Later, a type species was independently and almost simultaneously designated by Keen (1937: 15) and by Dall *et al.* (1938: 153). Unfortunately, the latter authors chose Smith species, on the wrong basis that *C. peramabilis* was already attributed

by Dall (1901) to *Protocardia* Beyrich, 1845, a Mesozoic genus of different origin. Although this action is invalidated by Keen's designation, it has undoubtedly contributed to misunderstand the true significance of *Microcardium*, and to its confusion with *Frigidocardium* (Habe 1951: 152) to which *C. torresi* must be attributed. Thiele's genus can be easily recognized from *Frigidocardium* by its heterogeneous sculpture (Poutiers 1992: 142), its outer surface being divided in two strongly distinct sculptural areas, with spines restricted to the posterior one. Then, *Tobarum* cannot stand in *Frigidocardium* as originally proposed by Noda (1988: 74), but falls within *Microcardium*. *Decussicardium* Fischer-Piette, 1977, invalidly introduced for the South African species *Cardium gilchristi* G. B. Sowerby III, 1904 (see Keen 1980; Voskuil & Onverwagt 1991), is another synonym of *Microcardium*.

In the Recent fauna, *Microcardium* is distributed on both sides of tropical America (for basic informations in this area, see Olsson 1961; Keen 1971; Abbott 1974), in addition to the Indo-West Pacific.

*Microcardium trapezoidale* n. sp.  
(Figs 6-9)

*Microcardium* sp. B – Poutiers 1992: 141, fig. 2L.

TYPE MATERIAL. — Holotype: MUSORSTOM 6, stn CP 464, E of Lifou, 21°02.30'S, 167°31.60'E, 430 m, 1 sh (MNHN).

Paratypes: same locality, 5 sh (3 MNHN, 1 NSMT, 1xUSNM); 1 lv, 1 rv (MNHN). — Stn DW 458, E of Lifou, 21°00.93'S, 167°29.96'E, 400 m, 1 spm (MNHN). — Stn DW 459, E of Lifou, 21°01.39'S, 167°31.47'E, 425 m, 1 sh (MNHN). — Stn CP 465, E of Lifou, 21°03.55'S, 167°32.25'E, 480 m, 1 spm (MNHN), 3 sh (1 AMS, 1 BMHN, 1 NMNZ).

TYPE LOCALITY. — Loyalty Ridge, E of Lifou, NE Cap des Pins, 21°02.30'S, 167°31.60'E, 430 m, MUSORSTOM 6, stn CP 464.

ETYMOLOGY. — The name alludes to the general outline of the shell.

OTHER MATERIAL EXAMINED. — New Caledonia. VAUBAN 1978-1979, stn 2, S Lagoon, off Presqu'île de Kuebeni, external slope, 22°17'S, 167°14'E, 425-430 m,

2 rv. — Stn 3, S Lagoon, off Presqu'île de Kuebeni, external slope, 22°17'S, 167°12'E, 390 m, 1 lv, 3 rv. — Stn DR 40, S Lagoon, off Passe de Boulari, external slope, 22°30'S, 164°24'E, 250-350 m, 1 lv.

MUSORSTOM 4, stn CP 171, N Lagoon, northern slope, 18°57.8'S, 163°14.0'E, 425 m, 1 spm (alcohol preserved). — Stn DC 235, S Lagoon, NNE Cap Coronation, 22°13.0'S, 167°12.0'E, 405-415 m, 1 lv. — Stn CP 239, S Lagoon, NNE Cap Coronation, 22°14.8'S, 167°15.7'E, 2 sh, 2 lv, 3 rv. — Stn CC 248, S Lagoon, NNE Cap Coronation, 22°09.5'S, 167°10.0'E, 380-385 m, 1 spm, 2 sh.

BIOCAL, stn DW 77, S Lagoon, off Presqu'île de Kuebeni, external slope, 22°15'S, 167°15'E, 440 m, 2 spm (alcohol preserved), 5 lv, 1 rv.

MUSORSTOM 5, stn DW 316, Banc Nova, S of Chesterfield Ridge, 22°25'S, 159°24'E, 330 m, 1 rv. — Stn DW 328, Chesterfield, 20°23'S, 158°44'E, 340-355 m, 1 lv. — Stn DW 350, Chesterfield, 19°34'S, 158°35'E, 280 m, 2 lv, 1 rv. — Stn DW 380, S of Chesterfield, 19°37.70'S, 158°33.90'E, 555-570 m, 19 lv, 8 rv. — Stn DW 381, S of Chesterfield, 19°38'S, 158°47'E, 620 m, 4 rv, 1 lv. — Stn DW 382, S of Chesterfield, 19°37'S, 158°43'E, 580 m, 1 lv. — Stn DW 388, Coral Sea, 20°45'S, 160°54'E, 500-510 m, 1 lv. — Stn DW 389, Coral Sea, 20°45'S, 160°54'E, 500 m, 1 lv.

SMIB 2, stn DW 21, S Île des Pins, 22°40.3'S, 167°41.3'E, 460-500 m, 1 spm.

BIOGEOCAL, stn DW 308, NW of Lifou, 20°40.00'S, 166°58.00'E, 510-590 m, 1 spm, 1 lv.

CORAIL 2, stn DE 16, S slope of Banc Lansdowne, Lord Howe-Fairway Ridge, 20°47.75'S, 160°55.87'E, 500 m, 2 rv.

MUSORSTOM 6, stn DW 391, Lifou, N Baie du Santal, 20°47.35'S, 167°05.70'E, 390 m, 1 sh, 3 lv. — Stn DW 393, E Baie du Santal, 20°48.29'S, 167°09.54'E, 420 m, 1 lv, 4 rv. — Stn DW 397, E Baie du Santal, 20°47.35'S, 167°05.17'E, 380 m, 1 rv. — Stn DW 398, same region, 20°47.19'S, 167°05.65'E, 370 m, 1 sh. — Stn DW 406, NW of Lifou, 20°40.65'S, 167°06.80'E, 373 m, 1 lv, 4 rv. — Stn DW 407, NW of Lifou, 20°40.70'S, 167°06.60'E, 360 m, 1 spm. — Stn DW 410, NW of Lifou, 20°38.05'S, 167°06.65'E, 490 m, 1 lv, 4 rv. — Stn DW 411, NW of Lifou, 20°40.65'S, 167°03.35'E, 424 m, 1 sh, 2 rv. — Stn DW 413, NW of Lifou, 20°40.10'S, 167°03.50'E, 463 m, 1 spm (broken), 2 rv. — Stn CP 428, NW of Ouvéa Atoll, 20°23.54'S, 166°12.57'E, 420 m, 1 sh. — Stn DW 446, Lifou, 20°54.33'S, 167°18.59'E, 360 m, 1 spm. — Stn DW 458, E of Lifou, 21°00.93'S, 167°29.96'E, 400 m, 2 lv, 1 rv. — Stn DW 459, E of Lifou, 21°01.39'S, 167°31.47'E, 425 m, 4 lv, 3 rv. — Stn CP 464, E of Lifou, 21°02.30'S, 167°31.60'E, 430 m, 2 spm (1 incomplete), 4 lv, 6 rv. — Stn CP 465, E of Lifou, 21°03.55'S, 167°32.25'E, 480 m, 4 lv, 2 rv. — Stn DW 481, NE slope of Maré, 21°21.85'S, 167°50.30'E, 300 m, 2 lv, 1 rv.

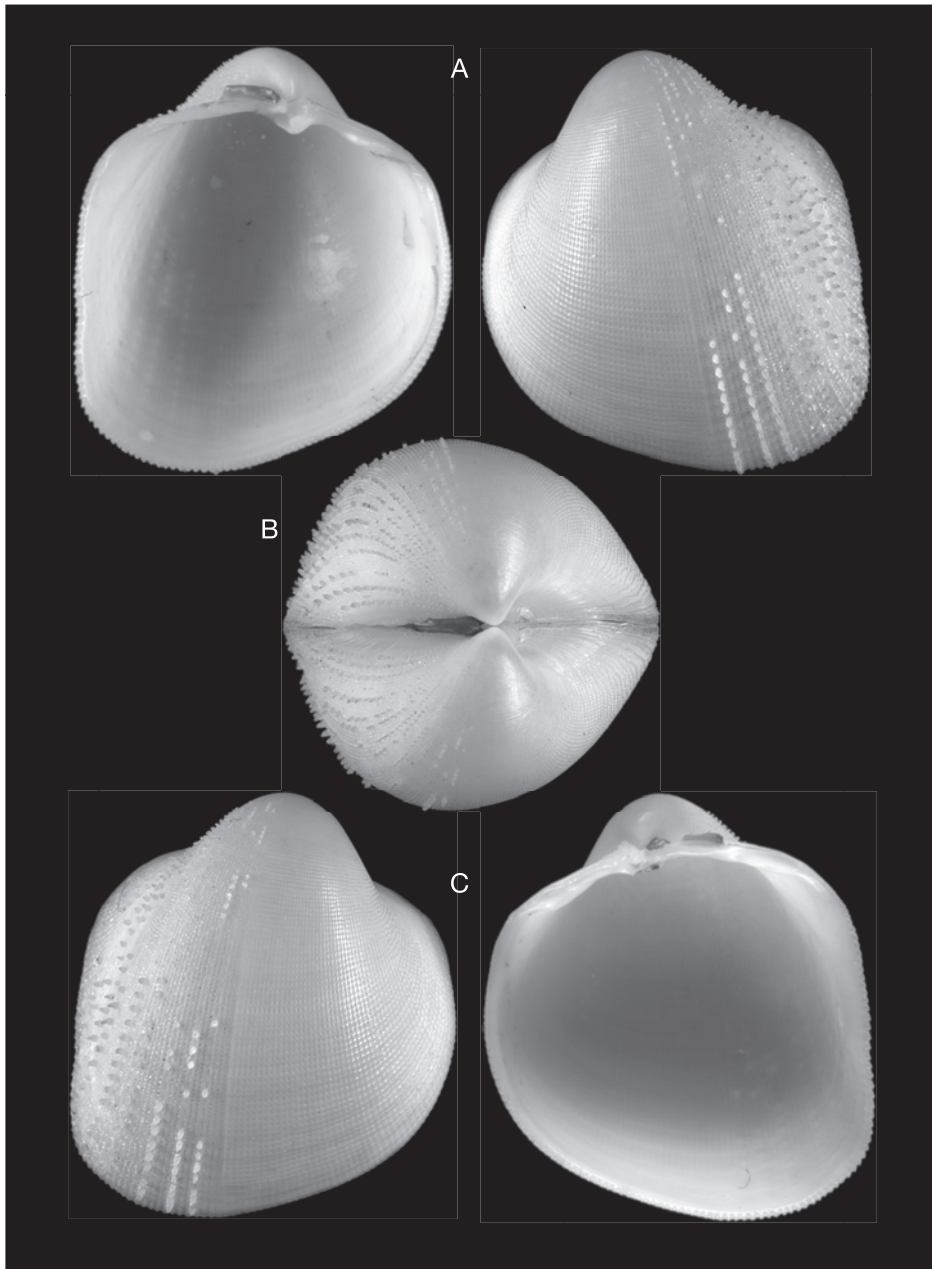


FIG. 6. — *Microcardium trapezoidale* n. sp., holotype, length 13.5 mm, Loyalty Islands, MUSORSTOM 6, stn CP 464: **A**, exterior and interior of left valve; **B**, dorsal view; **C**, exterior and interior of right valve.

BERYX 11, stn CP 21, Norfolk Ridge, 24°44'S, 168°07'E, 430-450 m, 1 sh, 1 rv.

BATHUS 1, stn DW 642, off Passe de Kouakoué,

external slope, 21°52'S, 166°50'E, 302-305 m, 1 lv, 1 rv. — Stn DW 643, off Passe de Kouakoué, external slope, 21°50'S, 166°48'E, 383 m, 2 lv. — Stn DW 670,

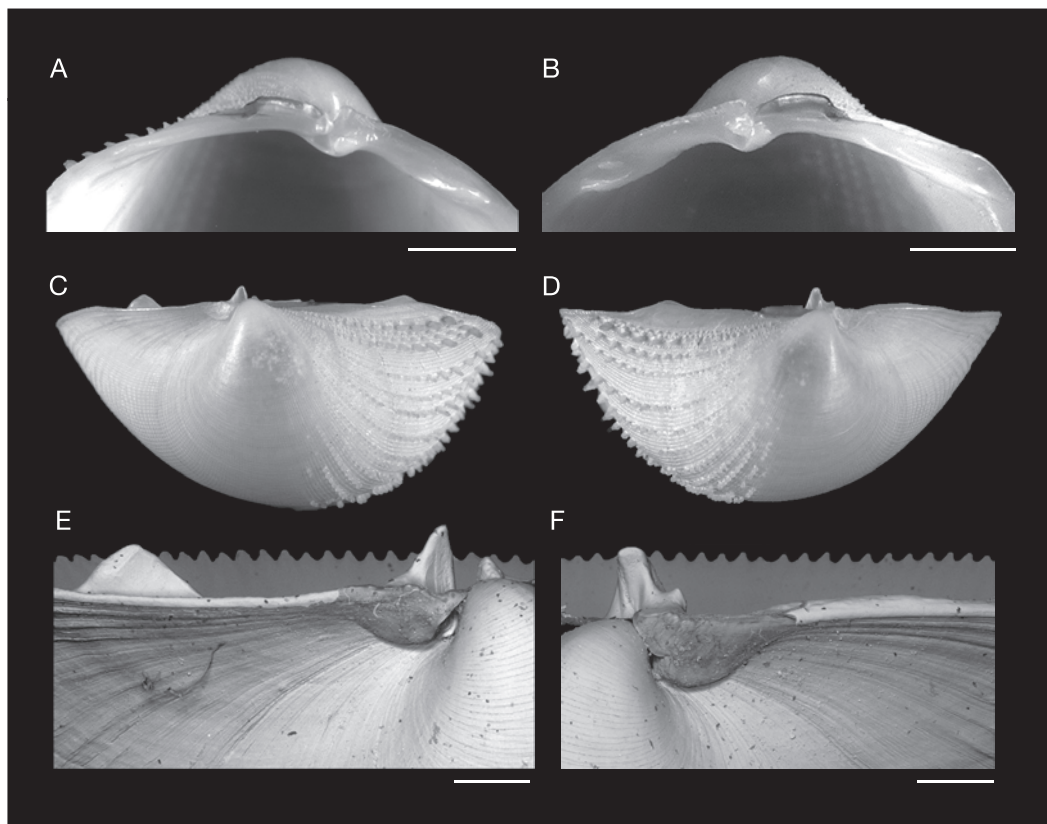


FIG. 7. — *Microcardium trapezoidale* n. sp., length 10.3 mm, S New Caledonia, BIOCAL, stn DW 77: **A**, hinge of left valve; **B**, hinge of right valve; **C**, dorsal view of left valve; **D**, dorsal view of right valve; **E**, anterodorsal area of left valve (SEM); **F**, anterodorsal area of right valve (SEM). Scale bars: A, B, 2 mm; E, F, 0.6 mm.

off Passe de Cap Baye, 20°54'S, 165°53'E, 394-397 m, 1 rv. — Stn CP 707, off Passe de Ngoé, 21°43'S, 166°36'E, 347-375 m, 1 sh.

BATHUS 2, stn DW 717, SW Île des Pins, external slope, 22°44'S, 167°17'E, 350-393 m, 3 lv, 2 rv. — Stn DW 724, SW Île des Pins, external slope, 22°48'S, 167°26'E, 344-358 m, 1 spm. — Stn DW 730, off Passe de Kouaré, 23°03'S, 166°58'E, 397-400 m, 1 spm, 1 rv. — Stn DW 731, off Passe de Kouaré, 22°49'S, 166°45'E, 300-370 m, 1 lv, 2 rv. — Stn CP 736, off Passe de Kouaré, 23°03'S, 166°59'E, 452-464 m, 1 sh, 2 lv, 5 rv.

BATHUS 3, stn CP 833, N Norfolk Ridge, 23°03'S, 166°58'E, 441-444 m, 1 sh, 1 lv, 1 rv.

HALIPRO 1, stn CP 951, off Passe Nord de Ngoé, 21°43'S, 166°37'E, 314-364 m, 1 rv (incomplete). — Stn CP 877, N Norfolk Ridge, 23°03'S, 166°59'E, 464-480 m, 2 lv.

BATHUS 4, stn DW 887, off Passe de Duroc, external slope, 21°07'S, 164°28'E, 320-344 m, 1 sh. — Stn

DW 889, off Passe de Duroc, external slope, 21°01'S, 164°27'E, 416-433 m, 2 lv. — Stn DW 902, Grand Passage, 19°01'S, 163°15'E, 341-351 m, 1 lv. — Stn DW 903, Grand Passage, 19°00'S, 163°14'E, 386-400 m, 1 spm, 2 lv, 2 rv. — Stn DW 907, Grand Passage, 19°01'S, 163°13'E, 370-394 m, 2 lv, 2 rv.

**Vanuatu.** MUSORSTOM 8, stn DW 960, S Anatom Island, 20°20'S, 169°50'E, 390-422 m, 1 spm, 2 lv, 2 rv. — Stn CP 963, S Anatom Island, 20°20'S, 169°49'E, 400-440 m, 1 spm, 2 lv, 3 rv. — Stn DW 977, NE Tanna Island, 19°25'S, 169°29'E, 410-505 m, 1 spm. — Stn DW 978, NE Tanna Island, 19°23'S, 169°27'E, 408-413 m, 1 spm, 4 lv, 4 rv. — Stn DW 1019, E Efate Island, 17°38'S, 168°34'E, 397-430 m, 1 lv. — Stn CP 1088, NE Espiritu Santo Island, 15°09'S, 167°15'E, 425-455 m, 1 spm, 1 rv. — Stn CP 1091, NE Espiritu Santo Island, 15°10'S, 167°13'E, 344-350 m, 1 lv. — Stn DW 1108, NE Espiritu Santo Island, 15°05'S, 167°15'E, 405-419 m, 3 spm, 3 lv, 2 rv.



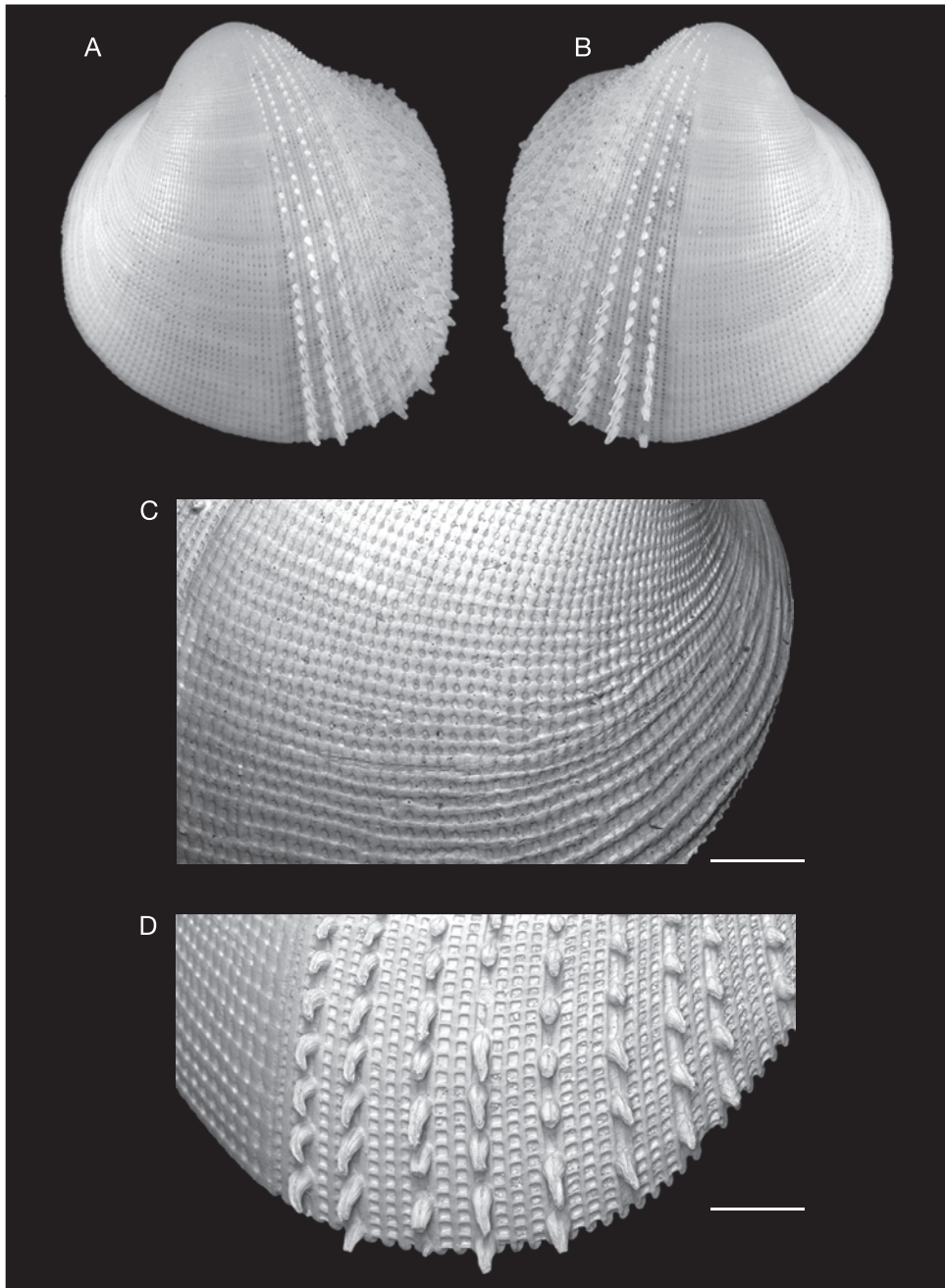


FIG. 8. — *Microcardium trapezoidale* n. sp., length 9.9 mm, outer sculpture, Vanuatu, MUSORSTOM 8, stn DW 1019: **A**, exterior of left valve; **B**, exterior of right valve; **C**, anterior sculptural area of right valve (SEM); **D**, posteroventral area of left valve (SEM). Scale bars: C, D, 1 mm.



**Fiji.** MUSORSTOM 10, stn DW 1319, Bligh Water, 17°15.6'S, 178°01.9'E, 341-347 m, 1 spm, 3 lv. — Stn CP 1325, Bligh Water, 17°16.4'S, 177°49.8'E, 282-322 m, 2 sh, 1 lv, 1 rv. — Stn CP 1327, Bligh Water, 17°13.3'S, 177°51.6'E, 370-389 m, 1 lv (incomplete). — Stn CP 1348, SE Viti Levu, 17°30.3'S, 178°39.6'E, 353-390 m, 1 spm. — Stn CP 1388, S Viti Levu, 18°18.8'S, 178°01.8'E, 313-446 m, 1 sh.

**BORDAU 1**, stn CP 1411, NE Vanua Levu, 16°05'S, 179°28'W, 390-403 m, 1 rv. — Stn DW 1450, Somosomo Strait, 16°44'S, 179°58'E, 327-420 m, 1 spm, 1 lv. — Stn CP 1467, NE Labeka, 18°12'S, 178°36'E, 417-427 m, 1 rv.

**Tonga.** BORDAU 2, stn DW 1509, NW Tongatapu, 21°05'S, 175°22'W, 456-510 m, 2 lv. — Stn CP 1510, NW Tongatapu, 21°05'S, 175°23'W, 461-497 m, 3 sh, 5 lv, 9 rv. — Stn DW 1520, Eua, 21°25'S, 175°03'W, 447-450 m, 1 spm, 1 sh, 8 lv, 11 rv. — Stn CP 1526, Eua, 21°16'S, 174°59'W, 463-464 m, 4 sh, 3 lv, 1 rv. — Stn CP 1527, Eua, 21°16'S, 174°59'W, 417-424 m, 2 spm, 1 sh, 5 lv, 5 rv. — Stn DW 1544, SW Tongatapu, 21°18'S, 175°18'W, 441-443 m, 1 spm, 1 rv. — Stn CP 1545, SW Tongatapu, 21°17'S, 175°17'W, 444-447 m, 6 spm (broken), 12 sh (some incomplete), 10 lv, 9 rv. — Stn CP 1546, SW Tongatapu, 21°18'S, 175°18'W, 430-441 m, 1 lv. — Stn CP 1547, SW Tongatapu, 21°24'S, 175°18'W, 488-491 m, 1 lv, 1 rv. — Stn DW 1549, S Nomuka Group, 20°38'S, 175°00'W, 500 m, 1 lv. — Stn DW 1555, N Nomuka Channel, 20°11'S, 174°45'W, 591 m, 1 lv. — Stn CP 1560, N Kotu Group, 19°52'S, 174°39'W, 365-372 m, 1 sh, 1 lv. — Stn CP 1562, N Kotu Group, 19°52'S, 174°42'W, 417-424 m, 2 sh, 4 lv, 9 rv. — Stn CH 1564, N Kotu Group, 19°52'S, 174°39'W, 371-387 m, 1 rv. — Stn DW 1571, N Ha'apai Group, 19°42'S, 174°32'W, 389-418 m, 2 lv, 3 rv. — Stn CP 1572, N Ha'apai Group, 19°42'S, 174°31'W, 391-402 m, 3 spm, 3 lv, 6 rv. — Stn CP 1593, N Ha'apai Group, 19°06'S, 174°18'W, 436-442 m, 2 lv, 1 rv. — Stn DW 1595, N Ha'apai Group, 19°03'S, 174°19'W, 523-806 m, 1 rv. — Stn DW 1614, "Seamount", 23°02'S, 175°51'W, 429-549 m, 2 lv. — Stn DW 1617, "Seamount", 23°03'S, 175°33'W, 483-531 m, 1 lv (fragmentary), 1 rv. — Stn DW 1628, "Seamount", 23°22'S, 176°18'W, 400-416 m, 1 lv, 1 rv. — Stn DW 1631, "Seamount", 23°23'S, 176°18'W, 407-443 m, 2 spm (incomplete), 1 sh, 5 lv, 6 rv. — Stn DW 1633, "Seamount", 22°59'S, 175°35'W, 442-453 m, 1 rv. — Stn CP 1638, NW Tongatapu, 21°05'S, 175°23'W, 469-520 m, 1 sh. — Stn CP 1640, NW Tongatapu, 21°09'S, 175°24'W, 564-569 m, 1 rv. — Stn CP 1641, NW Tongatapu, 21°09'S, 175°22'W, 564-569 m, 1 lv, 1 rv.

**DISTRIBUTION.** — West Pacific, from off New Caledonia and eastern Coral Sea to Fiji and Tonga islands, north to Vanuatu and south to northern Norfolk Ridge, in 270-806 m (living in 327-590 m). According to Marshall

(2005 *in litt.*), this species occurs also more in the South, on Norfolk Ridge (S of Norfolk Island) and Kermadec Ridge.

#### DESCRIPTION

Shell equivalve, medium-sized for the genus (attaining nearly 20 mm in height), well inflated and generally a little higher than long in the adult (length/height ratio 0.84 to 0.96), quite variable in shape with a more or less asymmetrical and roughly trapezoidal outline. Shell wall moderately thin to thin and brittle, depending on specimen examined. Umbones prosogyrate, rather prominent, situated slightly in front of mid-length of valves. Anterodorsal margin slightly convex and decidedly slanted, meeting the distinctly convex anterior margin in a slightly rounded, obtuse angulation. Posterior margin relatively high, straightish to somewhat sinuate in the middle, forming a rounded angle both with the evenly curved ventral margin and with the subhorizontal, slightly convex posterodorsal margin.

Surface of valves tumid, most strongly convex along a rounded radial zone extending from umbones to posteroventral angle. Posterior slope oblique, often somewhat depressed medially and becoming laterally compressed towards posterodorsal angle. Sculpture heterogeneous, dividing the outer surface into two markedly distinct areas. Anterior area porcelaneous, spreading over 3/5 of the surface, covered with a reticulate sculpture of about 60-65 shallow radial ribs with smooth rounded tops and becoming slightly nodulous where they cross the numerous, fine, approximately concentric transverse ridges. Concentric elements irregularly sinuous, branched or interrupted, tending to be more apparent anteriorly whereas the radial elements are fading out progressively. Posterior sculptural area on 2/5 of the surface, rough and dull, tending to retain sedimentary particles, composed of radial ribs, interstitial spines and transverse bars. Ribs rather prominent, square-shaped in cross section, as wide as the interstices, the latter becoming a little wider on posterior slope. Radial ribs about 50-55 in number, disappearing towards posterodorsal angle and thus difficult to count exactly. Bars of the rib interstices finer but as high as the ribs, sometimes a

TABLE 2. — Selected measurements (in mm) and length/height ratio of *Microcardium trapezoidale* n. sp. Abbreviations: **lv**, left valve; **sh**, shell (paired valves, dead collected); **spm**, live-taken specimen; **sv**, single valve.

	Length	Height	Inflation	Length/height
MUSORSTOM 4, stn CC 248 (sh)	6.4	6.3	4.9	1.02
BIOGEOCAL, stn DW 308 (spm)	7.8	8.0	6.5	0.97
BORDAU 2, stn 1520 (spm)	8.4	8.6	6.8	0.98
BORDAU 2, stn 1520 (sh)	8.6	8.7	6.7	0.99
MUSORSTOM 6, stn CP 465 (spm)	10.4	11.1	8.9	0.94
MUSORSTOM 4, stn CP 239 (sh)	10.5	11.2	9.4	0.94
MUSORSTOM 6, stn DW 391 (sh)	11.0	11.7	10.4	0.94
MUSORSTOM 4, stn CC 248 (spm)	11.6	12.5	9.8	0.93
BORDAU 1, stn DW 1450 (spm)	12.6	13.5	11.7	0.92
MUSORSTOM 6, stn CP 465 (sh)	12.7	14.1	11.7	0.90
SMIB 2, stn DW 21 (spm)	12.7	14.3	12.4	0.89
MUSORSTOM 6, stn CP 464 (sh)	13.2	14.7	11.8	0.90
MUSORSTOM 6, stn CP 464 (sh)	13.3	14.8	12.7	0.90
BATHUS 1, stn CP 707 (sh)	13.7	14.7	11.8	0.93
MUSORSTOM 6, stn CP 464 (sh)	13.9	15.2	12.5	0.91
BERYX 11, stn CP 21 (sh)	14.0	16.6	13.5	0.84
MUSORSTOM 10, stn DW 1319 (spm)	15.8	17.5	14.2	0.90
BORDAU 2, stn CP 1560 (lv)	17.2	19.9	8.8 (sv)	0.86

little shallower on posterior slope, not concentrically aligned, giving the shell a finely and irregularly latticed aspect. Sculpture of some interstices composed of a row of prominent spiny tubercles instead of the ordinary transverse sculpture. Distribution of the spine rows variable, generally arising on each two to four interstices on posteromedian area of valves, more variably distributed on posterior slope where some rows may be more widely set apart. Spines rather stout basally, narrowing distally and often a little bent ventralward and posteriorward on top, shallowly grooved on dorsal side. Sculpture reduced to a few radiating rows of tubercles near posterodorsal margin of shell. Demarcation line between anterior and posterior sculptural areas slightly oblique to radial ribs, gradually developing towards the anterior part of the surface during ontogeny but becoming almost parallel to radial sculpture in the adult. Lunular sector nearly smooth, flattened, often partially demarcated from the surrounding area by a faint radial change of convexity corresponding externally to the anterior limit of anterodorsal margin, and internally to the anterior lateral teeth. Anterodorsal margin prominent just anterior to umbo, thickened and more or less reflected over the corresponding part of the lunule to form a short, trigonal, distinctly raised, flat-topped

and finely ridged process. Posterodorsal margin of right valve rounded and smooth (apart from fine growth lines), expanding posteriorly over the left valve margin which has a correspondingly shallow radial groove. Periostracum inconspicuous, thin and closely applied, forming a transparent pale straw hue on shell surface and mostly visible towards margins in older specimens.

Ligament a small arched corneous band extending less than half-length of posterodorsal margin and further extended along each valve margin by a tenuous but prominent yellow band of fused periostracum (only visible on specimens in perfect condition).

Hinge somewhat arched, umbonal angle between cardinal and lateral teeth about 155°. Two unequal cardinals in each valve, the ventralmost much larger and prominent; dorsalmost cardinals forming a small but distinct conical tubercle in each valve, connected to ventral cardinal by a shelly saddle in right valve, but separated by a deep socket in left valve. Posterior lateral teeth slightly farther from cardinals than anterior laterals; right valve with paired anterior and single submarginal posterior laterals, with dorsalmost anterior lateral much reduced; left valve with single anterior submarginal lateral and single posterior marginal lateral.

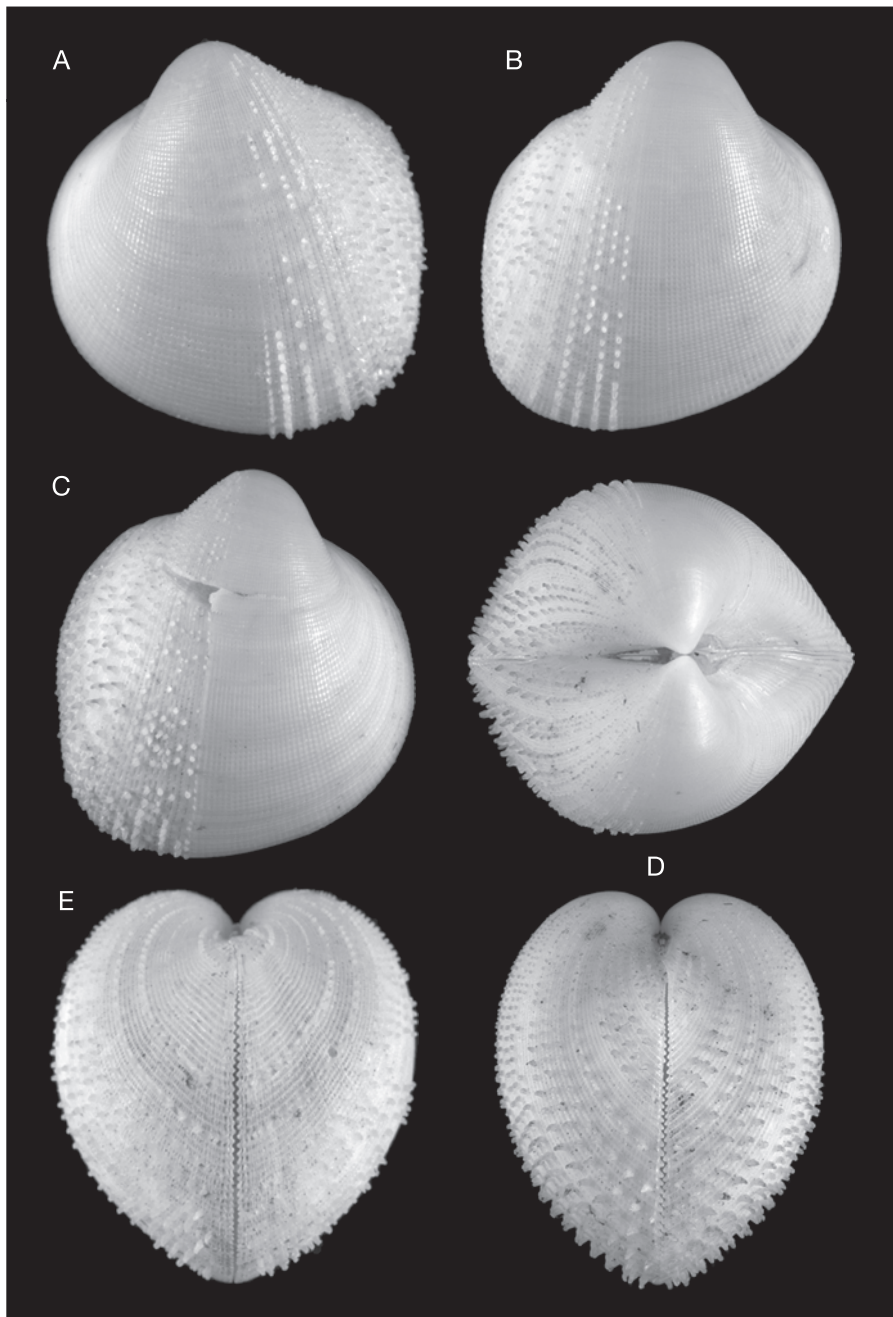


FIG. 9. — Shape and sculpture variation in *Microcardium trapezoidale* n. sp.: **A**, length 9.2 mm, exterior of left valve, Norfolk Ridge, BATHUS 3, stn CP 833; **B**, length 16.7 mm, exterior of right valve, Tonga, BORDAU 2, stn CP 1560; **C**, length 13.2 mm, exterior of right valve, Loyalty Islands, MUSORSTOM 6, stn CP 464; **D**, paratype, length 13.9 mm, dorsal and posterior views, Loyalty Islands, MUSORSTOM 6, stn CP 464; **E**, length 11.6 mm, posterior view, Vanuatu, MUSORSTOM 8, stn DW 1108.

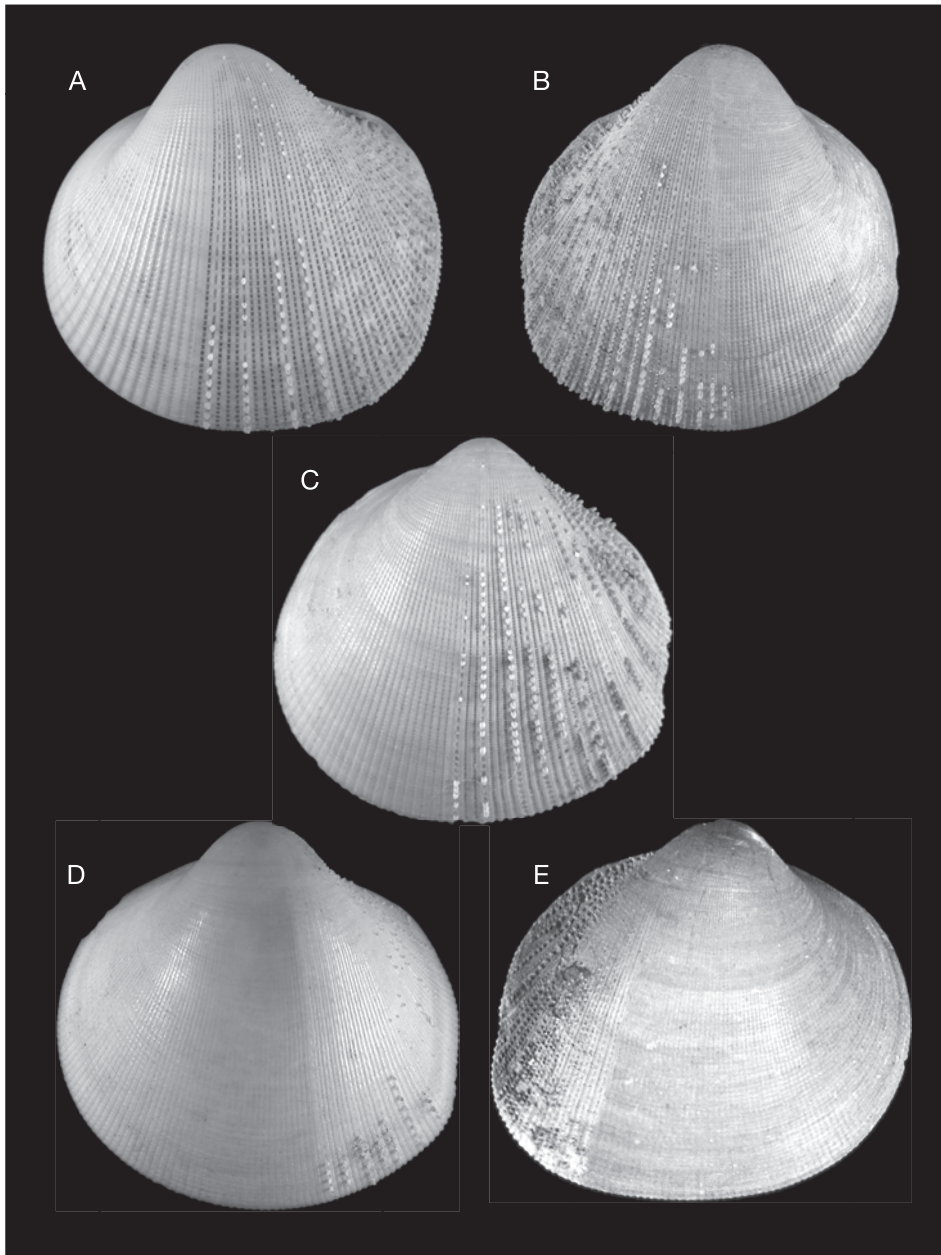


FIG. 10. — Indo-Pacific species of *Microcardium* Thiele, 1934: **A**, *M. aequiliratum* Poutiers, 1981, length 12.4 mm, exterior of left valve, North of Lubang, Philippines, MUSORSTOM 2, stn CP 21; **B**, *M. gilchristi* (G. B. Sowerby III, 1904), length 12.8 mm, exterior of right valve, off Mazi, Transkei, South Africa (NMSA C3274); **C**, *M. tenuilamellosum* Poutiers, 1981, length 8.4 mm, exterior of left valve, NW Leyte, Philippines, MUSORSTOM 3, stn CP 143; **D**, *M. simillimum* (E. A. Smith, 1896) n. comb., length 14.7 mm, exterior of left valve, Saya de Malha Banks (BMNH 1910.8.31.707); **E**, *M. sakurii* (Habe, 1961), length 17.8 mm, exterior of right valve, West of Luçon, Philippine (USNM 237559).



Interior of valves smooth and glossy, faintly affected by the outer radial ribbing and some concentric growth undulations. Muscle scars usually poorly distinct. Posterior adductor scar squarely ovate in outline and slightly larger, anterior adductor scar narrower and roughly crescent-shaped. Pallial line entire, poorly impressed. Internal margins serrated in accordance to the outer radial sculpture; protruding elements of this serration corresponding respectively with radial ribs of posterior sculptural area, and with rib interstices of anterior area.

Shell colour whitish, externally and internally.

Measurements are provided in Table 2.

#### REMARKS

As already mentioned in the above description, the shell of *Microcardium trapezoidale* n. sp. is rather variable. Some variation in shape and sculpture may be related to ontogeny. Juvenile shells smaller than 11 mm high tend to be as long as high (length/height ratio 0.95-1.02; mean value 0.99). Features of the posterior sculptural area change during growth, so that the rib number remains roughly constant: in young stages, the radial sculpture appears more developed posterodorsally, and the few dorsalmost spine rows are usually separated by two or three rows of tiny interstitial spines (rather than transverse bars) that vanish with growth; simultaneously, obliquity of the demarcation line with the anterior sculptural area reduces progressively during ontogeny. Sculptural pattern of the rib interstices can be obscured near posterior margin of some mature shells by closely set, raised concentric growth marks that are continuous over the radial ribs and their interstices.

Depending on individual examined, the trapezoidal outline vary from rather symmetrical, rounded subquadrate to strongly asymmetrical outlines, with very high posterior margin and strongly oblique ventral margin. On posterior slope, distribution of interstitial spines is mutable, but often shows a pattern including a few series of closely set spine rows (each two or three intervals) separated by quite large spineless areas (of seven to 11 intervals).

A number of individual variations in shell outline and sculpture are probably linked to the relative brittleness of shell wall, shell breaks causing distur-

tion in subsequent growth stages when associated with injuries to the pallial margins.

Like most other known Indo-Pacific species of *Microcardium*, the new species is devoid of fine transverse lamellae in rib interstices of the posterior slope; this lamellate sculpture is a diagnostic feature of *M. tenuilamellosum* Poutiers, 1981 (p. 338-340), a species previously only known from the Philippines (Fig. 10C), but recently found in Solomon Islands (Poutiers unpublished data). *Microcardium aequiliratum* Poutiers, 1981 (p. 339, 340), an endemic Philippine species (Fig. 10A), differs from *M. trapezoidale* n. sp. by its relatively wider posterior sculptural area (extending on at least 3/5 of shell length, instead of 2/5), and by its different shape (not trapezoidal, but rounded quadrate and longer than high, with a more rounded ventral margin). The Japanese *M. sakurarii* (Habe, 1961) (Fig. 10E), also occurs in the Philippines (Poutiers unpublished data), but has a relatively limited posterior area; it is generally as long as it is high or a little longer, and its posterior sculpture is less prominent, with shallower spines and smaller transverse bars in the rib interstices. This condition somewhat recalls *Cardium (Fragum) simillimum* E. A. Smith, 1896 (p. 372, 373) (Fig. 10D), a poorly known Indian Ocean species (only figured in Alcock & Anderson 1898) only found very occasionally off Sri Lanka, the Bay of Bengal (eastern India), and on the Mascarene Plateau (for a review of references, see Fischer-Piette 1977: 141; Hylleberg 2004: 768); it is here included in *Microcardium* (new combination). In the South African *M. gilchristi* (G. B. Sowerby III, 1904) (Fig. 10B), anterior and posterior sculptural areas are almost equally developed in adult stages (the posterior area may even be larger), and their demarcation line is markedly oblique to radial sculpture, contrary to that in *M. trapezoidale* n. sp.

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