New species and new records of littoral and bathyal living Pectinoidea (Bivalvia: Propeamussiidae, Cyclochlamydidae, Pectinidae) from the western and southwestern Pacific

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New species and new records of littoral and bathyal living Pectinoidea (Bivalvia: Propeamussiidae, Cyclochlamydidae, Pectinidae) from the western and southwestern Pacific

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ABSTRACT
Twenty species of Pectinoidea (12 Propeamussiidae, three Cyclochlamydidae, five Pectinidae) are herein listed. Six new species of Pectinoidea (three Propeamussiidae, three Cyclochlamydidae) are from littoral and bathyal depths of the western and southwestern Pacific, sampled by various expeditions and cruises to Papua New Guinea and the South China Sea, viz. *Propeamussium regillum* n. sp. from the bathyal Bismarck and Solomon Seas, *Parvamussium minusculum* n. sp. from the lower bathyal South China Sea, *Cyclopecten inoculatus* n. sp. from the bathyal Bismarck Sea, *Cyclochlamys corrugata* n. sp., *Cyclochlamys barbatula* n. sp. and *Micropecten reticulatus* n. sp. from shallow coastal waters of Papua New Guinea. Fourteen species of Pectinoidea (nine Propeamussiidae, five Pectinidae) are new records for the Bismarck Sea (five), for the Solomon Sea (four), and for the South China Sea (seven).

KEY WORDS
Mollusca,
western and southwestern Pacific,
littoral,
bathyal,
new species,
new records.

RÉSUMÉ
Espèces et signalisations nouvelles de Pectinoidea actuels (Bivalvia: Propeamussiidae, Cyclochlamydidae, Pectinidae) des zones littorales et bathyales, originaires du Pacifique ouest et sud-ouest.
Vingt espèces de Pectinoidea (12 Propeamussiidae, trois Cyclochlamydidae et cinq Pectinidae) sont répertoriées dans ce travail. Six espèces nouvelles de Pectinoidea (trois Propeamussiidae et trois Cyclochlamydidae) sont décrites du littoral et des profondeurs du Pacifique ouest et sud-ouest, échantillonnées lors de plusieurs expéditions en Papouasie-Nouvelle-Guinée et dans la mer de Chine méridionale : *Propeamussium regillum* n. sp., du bathyal des mers de Bismarck et des Salomon, *Parvamussium minusculum* n. sp. du bathyal inférieur de la mer de Chine méridionale, *Cyclopecten inoculatus* n. sp. du bathyal de la mer de Bismarck, *Cyclochlamys corrugata* n. sp., *Cyclochlamys barbatula* n. sp. et *Micropecten reticulatus* n. sp. de la zone littorale de Papouasie Nouvelle-Guinée. Quatorze espèces de Pectinoidea (neuf Propeamussiidae, cinq Pectinidae) représentent de nouvelles signalisations pour la mer de Bismarck (cinq), la mer des Salomon (quatre) et la mer de Chine méridionale (sept).

KEY WORDS
Mollusca,
Pacifique ouest,
Pacifique sud-ouest,
littoral,
bathyal,
espèces nouvelles,
signalisations nouvelles.

INTRODUCTION

This paper deals with new littoral and bathyal pectinoid species and new records from the western and southwestern Pacific sampled by various expeditions and cruises, viz. BIOPAPUA (2010), PAPUA NIUGINI, MADANG LAGOON (2012), KAVIENG (2014) and MADEEP (2014) to Papua New Guinea, the Bismarck Sea and the Solomon Sea, and TAIWAN (2013), DONGSHA (2014), NANHAI (2014) and ZHONGSHA (2015) to the South China Sea. Further information on the expeditions can be found on http://expeditions.mnhn.fr/

The present paper adds new information to the Pectinoidea recorded in a previous publication (Dijkstra 1998) from Hansa Bay (Papua New Guinea), the Solomon Islands (Dijkstra & Maestrati 2008, 2013) and the South China Sea (Bernard *et al.* 1993; Xu & Zhang 2008; Dijkstra & Maestrati 2009).

MATERIAL AND METHODS

The gear used for collecting the deep-sea fauna on the different oceanographical vessels are a beam trawl on flat and soft bottoms and a Warén dredge for steep and hard bottoms (see abbreviations below). In the littoral zone, the sampling methods are more diversified. They extend from hand picking at low tide, to snorkelling, to the use of small tools such as a vacuum cleaner on various hard and soft bottoms, and brushes to take off invertebrates from stones and dead corals during scuba diving, to small dredges pulled by boat between 2-120 m.

The studied material is deposited in the MNHN, with some voucher specimens in the reference collection of the senior author (NBC).

ABBREVIATIONS AND TEXT CONVENTIONS

Repositories

MNHN	Muséum national d'Histoire naturelle, Paris;
NBC	Naturalis Biodiversity Center, Leiden;
NMNH	National Museum of Natural History, Smithsonian Institution, Washington (DC);
RMNH	Rijksmuseum van Natuurlijke Historie (now Naturalis Biodiversity Center, Leiden);
ZMA	Zoological Museum, University of Amsterdam, Amsterdam (now part of Naturalis Biodiversity Center, Leiden);
ZSI	Zoological Survey of India, New Alipur, Calcutta.

Station data

CP	chalut à perche (beam trawl);
DW	drague Warén (Warén dredge);
KB	K for Kavieng (2014), B for brushing basket;
KS	S for suction sampler (vacuum cleaner);
PB	P for PNG (Madang Lagoon 2012), B for brushing basket;
PD	D for small dredge;
PS	S for suction sampler (vacuum cleaner).

Other abbreviations

D	depth (inflation of paired valves);
H	height;
lv	left valve(s);
rv	right valve(s);
spm(s)	live-taken specimen(s);
stn	station;
W	width;
OD	original designation;
SD	subsequent designation.

SYSTEMATICS

Superfamily PECTINOIDEA Rafinesque, 1815
Family PROPEAMUSSIIDAE Abbott, 1954

Genus *Propeamussium* de Gregorio, 1884

Propeamussium de Gregorio, 1884: 119.

TYPE SPECIES (OD). — *Pecten* (*Propeamussium*) *ceciliae* de Gregorio, 1884 (Miocene, Sicily, Italy).

Propeamussium andamanicum (E. A. Smith, 1894)

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

Propeamussium andamanicum – Dijkstra 1995: 15, figs 5-8, 138-142.

MATERIAL EXAMINED. — **Andaman Sea**. 12°59'N, 93°23'10"E, 1249 m ("*Investigator*" stn 113), lectotype spm (ZSI 7418/9), designated by Dijkstra (1995: 15).
Bismarck Sea. KAVIENG 2014, stn CP4433, 02°16'S, 150°48'E, 1056-1200 m, 7 spms. — Stn CP4434, 02°19'S, 150°47'E, 1066-1200 m, 9 spms, 1 lv. — Stn CP4436, 02°16'S, 150°45'E, 1128-1135 m, 8 spms (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 79). Now also from the Bismarck Sea, live in 1056-1200 m.

Propeamussium regillum n. sp.
(Fig. 1A-G)

TYPE MATERIAL. — **Papua New Guinea**. KAVIENG 2014, stn CP4441, 02°17'S, 150°38'E, 684-791 m, alive, holotype spm (MNHN-IM-2013-58330). — Same data, paratype spm (MNHN-IM-2013-58329). — BIOPAPUA 2010, stn DW3680, 04°37'S, 149°27'E, 615-647 m, alive, paratype spm (MNHN-IM-2013-57983). — PAPUA NIUGINI 2012, stn CP3981, 05°11'S, 147°03'E, 688 m, alive, paratype spm (MNHN-IM-2000-33120). — Stn CP4014, 05°35'S, 148°13'E, 630-870 m, alive, 2 paratypes spms (MNHN-IM-2000-33119; RMNH.MOL.290821).

TYPE LOCALITY. — Papua New Guinea, New Ireland, 02°17'S, 150°38'E, 684-791 m (KAVIENG 2014, stn CP441).

DISTRIBUTION. — Bismarck Sea, live in 615-870 m (maximum depth range), 647-688 m (minimum depth range).

ETYMOLOGY. — Left valve with lamellose radials (Latin *regillus*, adjective meaning vertical rows of warp-threads).

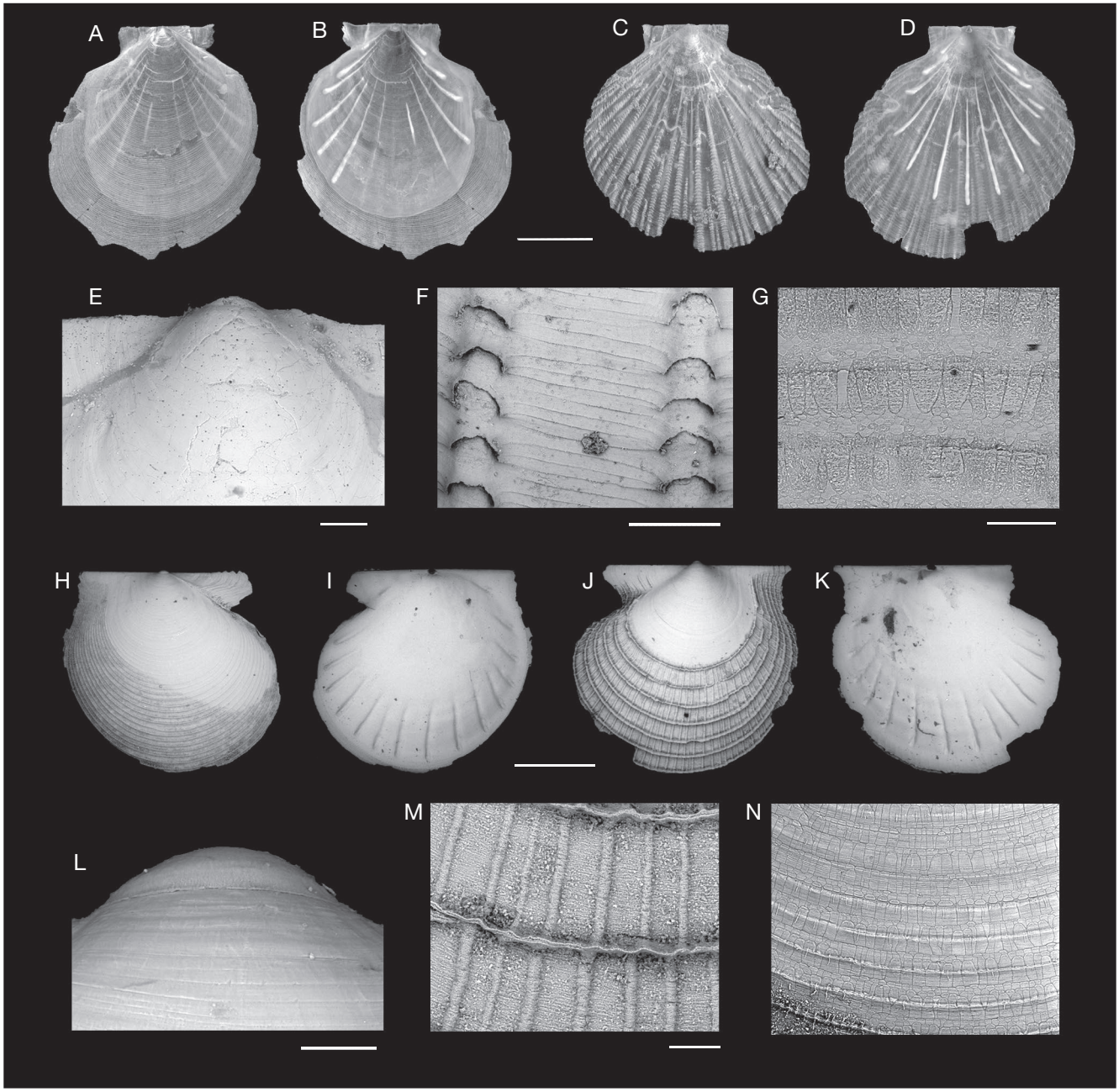

Fig. 1. — **A**-**D**, **F**, **G**, holotype of *Propeamussium regillum* n. sp. (MNHN-IM-2013-58330): **A**, exterior rv; **B**, interior rv; **C**, exterior lv; **D**, interior lv; **E**, paratype (MNHN-IM-2013-58329), prodissoconch and early ontogeny of lv shell disc; **F**, exterior detail lv; **G**, exterior detail rv; **H**-**N**, holotype of *Parvamussium minusculum* n. sp. (MNHN-IM-2013-59427); **H**, exterior rv; **I**, interior rv; **J**, exterior lv; **K**, interior lv; **L**, prodissoconch and early ontogeny of lv shell disc; **M**, exterior detail lv; **N**, exterior detail rv. Abbreviations: see Material and methods. Scale bars: A-D, 10 mm; E, G, 200 µm; F, H-K, 1 mm; L, 50 µm; M, N, 100 µm.

Description

Shell

Up to 31.1 mm high, fragile and transparent, almost circular, equilateral, inequivalve, slightly convex, left valve somewhat larger than right valve, auricles of left valve equal in shape and size, of right valve slightly unequal in shape, umbonal angle 100-110°.

Prodissoconch

240 µm long, larval shell inflated and smooth.

Left valve

Smooth in early ontogeny to *c.* 10 mm below umbonal top, irregularly spaced radial ribbing commencing after that (*c.* 10-15 ribs), increasing by intermediate ribs in later growth stage to the periphery (*c.* 50 ribs). Ribs with prominent lamellae; weak intercostal commarginal ridges on adults.

Auricles

With 3-4 delicate squamous radial riblets.

Right valve
Sculptured with fine, regularly spaced, close-set commarginal lamellae (5 per mm). Internal ribs 8 (2 central ribs weak or lacking), and 1-4 intercostal rudimentary riblets marginally. Marginal apron broad (*c.* 6-8 mm) and partly broken off. Hinge line straight. Resilifer triangular. No byssal fasciole or byssal notch, ctenolium lacking. Colour of left valve creamy, right valve whitish.

Dimension of holotype
H 31.1 mm, W 30 mm, D 4.9 mm.

REMARKS
The present species is morphologically closest to the superficially similar (shape, colour) congener *Propeamussium investigatoris* (E. A. Smith, 1906), known from the bathyal northern Indian Ocean and south-western Pacific (Dijkstra & Kastoro 1997: 248, figs 11-15; Dijkstra & Maestrati 2008: 82, 2012: 391; Dijkstra & Marshall 2008: 2).

Both species differ in size (*P. regillum* n. sp. up to 31 mm, *P. investigatoris* up to 26 mm but most specimens smaller, up to 20 mm in height).

The sculpture of the left valve of both species is also different, viz. the early growth stage of *P. regillum* n. sp. is smooth, *P. investigatoris* has a fine commarginal sculpture.

P. regillum n. sp. has finer and narrower radial ribs (*c.* 30 in adult growth stage) with prominent lamellae commencing 10 mm below umbonal top, and *P. investigatoris* has many more small radial ribs (*c.* 50 in adult growth stage) with fine lamellae (Dijkstra & Kastoro 1997: fig. 15) commencing 1-2 mm below the umbonal top.

The internal ribbing of *P. regillum* n. sp. are more delicate with a broad marginal apron of the right valve (*c.* 6-8 mm wide), that of *P. investigatoris* are more solid and the apron is narrower (*c.* 2-3 mm wide).

Propeamussium jeffreysii (E. A. Smith, 1885), known from the bathyal western Indian Ocean and western Pacific, is also similar in shape and colour, but differs from the present species by having an almost smooth shell disc of the left valve with delicate commarginal and radial sculpture in early ontogeny (smooth in *P. regillum* n. sp.) and commarginal lamellae in the later growth stage (*P. regillum* n. sp. with coarse, irregularly spaced radial ribs with prominent lamellae).

Genus *Parvamussium* Sacco, 1897

Parvamussium Sacco, 1897: 48.

TYPE SPECIES (OD). — *Pecten* (*Pleuronectes*) *duodecimlamellatus* Bronn, 1832 (Miocene, northern Italy).

Parvamussium ina (Dautzenberg & Bavay, 1912)

Amussium ina Dautzenberg & Bavay, 1912: 32, pl. 28, figs 18-21.

Parvamussium ina – Dijkstra & Maestrati 2013: 417.

MATERIAL EXAMINED. — **Indonesia**. Saleh Bay, N-coast of Sumbawa, 08°19'S, 117°41'E, 274 m ("*Siboga*" stn 312), lectotype spm (ZMA Moll. 3.12.011), designated by Dijkstra & Kastoro (1997: 248).
Solomon Sea. MADEEP 2014, stn CP4335, 09°05'S, 149°18'E, 240-250 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Kastoro (1997: 248). Now also from the Solomon Sea, live in 240-250 m.

Parvamussium lozoueti Dijkstra & Maestrati, 2008

Parvamussium lozoueti Dijkstra & Maestrati, 2008: 87, figs 11-17.

MATERIAL EXAMINED. — **Fiji**. Lau Ridge, 16°31'S, 179°00'E, 670-682 m, BORDAU I, stn CP1415, holotype spm (MNHN-IM-2000-20449).
Solomon Sea. MADEEP 2014, stn DW4290, 09°13'S, 153°54'E, 593 m, 1 spm (MNHN).
Taiwan. TAIWAN 2013, DW4095, 21°12'N, 121°33'E, 517-573 m, 4 spms (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 87). Now also Solomon Sea and South China Sea, live in 517-593 m.

Parvamussium multiliratum Dijkstra, 1995

Parvamussium multiliratum Dijkstra, 1995: 26, figs 31-34, 91-92.

MATERIAL EXAMINED. — **New Caledonia**. Entre Grande Terre et Ile des Pins, 22°10'S, 167°33'E, 2100-2110 m, BIOCAL, stn CP72, holotype spm (MNHN-IM-2000-21173).
South China Sea. DONGSHA 2014, stn CP4130, 20°16'N, 116°08'E, 795-822 m, 3 spms (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 91). Now also South China Sea, live in 795-822 m.

Parvamussium minusculum n. sp. (Fig. 1H-N)

TYPE MATERIAL. — **South China Sea**. ZHONGSHA 2015, stn CP4157, 19°48'N, 116°29'E, 1205-1389 m, alive, holotype spm (MNHN-IM-2013-59427).

TYPE LOCALITY. — South China Sea, SW of DongSha, 19°48'N, 116°29'E, 1205-1389 m (ZHONGSHA 2015, stn CP4157).

ETYMOLOGY. — Latin *minusculus*, adjective meaning very small.

DESCRIPTION
Shell
Up to 3.1 mm high, fragile, transparent in early growth stage, after that opaque, anteriorly oblique, inequilateral, inequivalve, slightly convex, auricles unequal in shape, equal in size, umbonal angle 120°.

Prodissoconch
160 µm long, larval shell inflated and smooth.

Left valve
Smooth in early ontogeny with a few commarginal growth lines to 1.8 mm below umbonal top, after that regularly spaced, strongly raised commarginal lamellae commence (3 per mm)

with weak interstitial antimarginal riblets (8-10 per mm). Auricles with 5-6 commarginal lamellae, slightly more widely spaced on anterior than on posterior.

Right valve
With closely and regularly spaced, faint commarginal ridges, 10 per mm. Auricles smooth, anterior separated and posterior continuous with shell disc. Hinge line straight with 4 weak spines anteriorly.

Byssal notch
Moderately deep. Internal riblets 14, short and commencing in late growth stage, extending almost to the periphery.

Dimension of holotype
H 3.1 mm, W 3.6 mm, D 1.2 mm.

REMARKS
The present species has a unique oblique shape, which is seldom seen in Propeamussiidae. *Parvamussium obliquum* (E. A. Smith, 1885), known from the lower bathyal tropical western Atlantic, is similar in size (3 mm), shape (anteriorly oblique) and internal ribbing (14 short riblets). However, *P. minusculum* n. sp. has a strongly sculptured left valve with commarginal lamellae and intercostal radial riblets in late ontogeny, whereas *P. obliquum* is smooth and translucent throughout.

A somewhat similar morphological congener (shape weakly anteriorly oblique, with short interior riblets) is *Parvamussium propinquum* (E. A. Smith, 1885), known from the lower bathyal and upper abyssal eastern Atlantic, which differs from the present species in size (*P. minusculum* n. sp. up to 3 mm in height, *P. propinquum* up to 7 mm), by having numerous delicate radial striae on the left valve and in internal ribbing (*P. minusculum* n. sp. 14 ribs, *P. propinquum* 12).

Another somewhat close congener is *Parvamussium permirum* (Dautzenberg, 1925), also known from the abyssal eastern Atlantic, which also differs from *P. minusculum* n. sp. in size (*P. minusculum* n. sp. up to 3 mm, *P. permirum* up to 7 mm), by having a circular shape, by its sculpture of weak, widely spaced commarginal lamellae and numerous closely spaced radial riblets of similar strength, and by its 13 longer interior riblets commencing earlier in ontogeny and developing to the periphery (*P. minusculum* n. sp. with 14 short riblets commencing in later growth stage and developing to the submarginal area).

Parvamussium retiaculum Dijkstra, 1995

Parvamussium retiaculum Dijkstra, 1995: 28, figs 35-38.

MATERIAL EXAMINED. — **New Caledonia**. Southern New Caledonia, 23°05'S, 167°45'E, 680-700 m, BIOCAL, stn DW51, holotype spm (MNHN-IM-2000-24266).
Solomon Sea. MADEEP 2014, stn DW4323, 08°38'S, 151°46'E, 720 m, 1 spm. — Stn DW4326, 08°19'S, 149°45'E, 640-660 m, 1 spm (MNHN).
Bismarck Sea. PAPUA NIUGINI 2012, stn CP4055, 03°03'S, 142°18'S, 370-374 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 93). Now also from the Solomon Sea and the Bismarck Sea, live in 370-660 m.

Parvamussium retiolum Dijkstra, 1995

Parvamussium retiolum Dijkstra, 1995: 29, figs 39-42, 97.

MATERIAL EXAMINED. — **Chesterfield Island**. 19°47'S, 158°44'E, 685-700 m, MUSORSTOM 5, stn CP363, holotype spm (MNHN-IM-2000-21171).
South China Sea. ZHONGSHA 2015, stn CP4155, 16°11'N, 115°00'E, 507-526 m, 1 spm. — Stn DW4139, 19°14'N, 113°57'E, 491-538 m, 1 lv. — Stn DW4161, 20°33'N, 116°39'E, 538-560 m, 12 spms. — Stn DW6164, 22°09'N, 118°43'E, 420-574 m, 3 lv, 1 rv. (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 93). Now also South China Sea, live in 507-560 m.

Parvamussium undosum Dijkstra, 1991

Parvamussium undosum Dijkstra, 1991: 18, figs 53-61.

MATERIAL EXAMINED. — **Indonesia**. Banda Sea, Tukang Besi Islands, NW of Binongko, 5°52.5'S, 123°58.5'E, 250-290 m, SNELLIUS-II, stn 4.033, holotype lv (RMNH 56550).
South China Sea. NANHAI 2014, stn DW4105, 13°57'N, 115°26'E, 297-565 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 96). Now also South China Sea, live in 297-565 m.

Parvamussium virgatum Dijkstra, 1991

Parvamussium virgatum Dijkstra, 1991: 20, figs 62-65.

MATERIAL EXAMINED. — **Indonesia**. Banda Sea, Tukang Besi Islands, NW of Binongko, 5°52.5'S, 123°58.5'E, 250-290 m (SNELLIUS-II, stn 4.033), holotype lv (RMNH 56556).
South China Sea. ZHONGSHA 2015, stn DW4144, 16°07'N, 114°23'E, 161 m, 1 lv. (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 97). Now also South China Sea, dead in 161 m.

Genus *Cyclopecten* Verrill, 1897

Cyclopecten Verrill, 1897: 70.

TYPE SPECIES (SD, by Sykes *et al.* 1898). — *Pecten pustulosus* Verrill, 1873 (Recent, off Newfoundland, Canada).

Cyclopecten inoculatus n. sp.
(Fig. 2A-G)

TYPE MATERIAL. — **Bismarck Sea**. MADEEP 2014, stn CP4251, 03°30'S, 148°02'E, 842-933 m, alive, holotype spm (MNHN-IM-2013-44910). — Stn CP4245, 04°06'S, 148°10'E, 790-808 m, alive, paratype spm (MNHN-IM-2013-44742). — Stn CP4246, 04°07'S, 148°09'E, 695-899 m, alive, paratype spm (MNHN-IM-2013-44801). — Stn CP4250, 03°31'S, 148°03'E, 780-855 m,

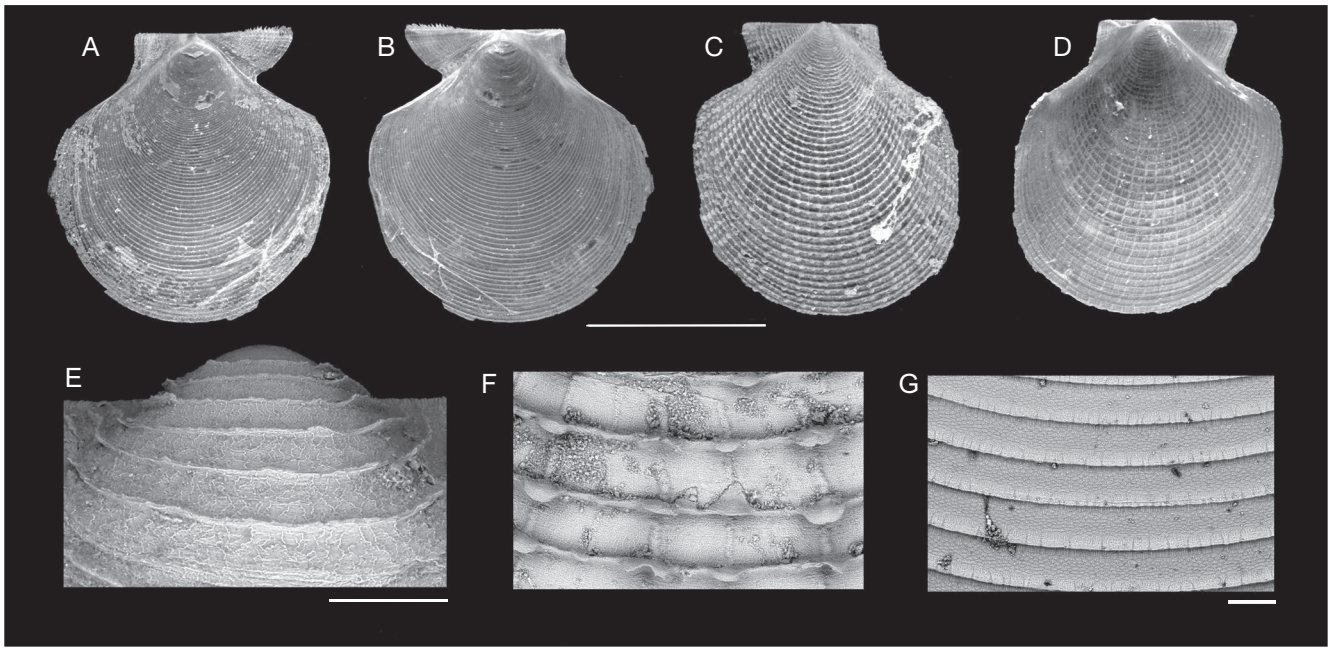

FIG. 2. — **A-G**, holotype of *Cyclopecten inoculatus* n. sp. (MNHN-IM-2013-44910): **A**, exterior rv; **B**, interior rv; **C**, exterior lv; **D**, interior lv; **E**, prodissoconch and early ontogeny of lv shell disc; **F**, exterior detail lv; **G**, exterior detail rv. Abbreviations: see Material and methods. Scale bars: A-D, 10 mm; E, F, G, 200 µm.

alive, paratype spm (MNHN-IM-2013-44844). — Stn CP4256, 02°51'S, 150°56'E, 1200-1274 m, alive, 2 paratypes spms (MNHN-IM-2013-45044, MNHN-IM-2013-45054).

TYPE LOCALITY. — Bismarck Sea, SE Sherburne reefs, SE Archipel Admirality Islands, 03°30'S, 148°02'E, 842-933 m (MADEEP 2014, stn CP4251).

ETYMOLOGY. — Ornamented with spoon-shaped lamellae on left valve (Latin *inoculatus*, adjective meaning ornamented).

DISTRIBUTION. — Bismarck Sea, live in 695-1274 m (maximum depth range), 808-1200 m (minimum depth range).

DESCRIPTION

Shell

Up to 13.1 mm high, fragile, compressed, slightly longer than wide, almost equilateral and equiconvex, auricles dissimilar in shape, anterior auricle larger than posterior, umbonal angle 80º, resilifer triangular, internal ribs lacking, opaque whitish.

Prodissoconch

145 µm long, larval shell weakly inflated and smooth.

Left valve

In early ontogeny sculptured with commarginal riblets (*c.* 6-8 per mm), more raised and prominent on central part of disc (4-5 per mm). Delicate intercostal radial riblets and spoon-shaped lamellae on intersections of radial and commarginal sculpture commence after *c.* 5 mm below umbonal top, increasing downwards in number and prominence. Auricles sculptured with closely spaced commarginal lamellae, more prominent on anterior than on posterior.

Right valve

With closely and regularly spaced commarginal ridges, *c.* 8 per mm on central part of disc. Anterior auricle with fine, closely spaced radial riblets and strongly overrunning commarginal lamellae, with spines developed on dorsal margin of anterior hinge; posterior auricle with closely set, prominent commarginal lamellae. Byssal fasciole broad, byssal notch moderately deep.

Dimension of holotype

H 13.1 mm, W 11.9 mm, D 2.8 mm.

REMARKS

The present species is morphologically closest to its congener *Cyclopecten kermadecensis* (E. A. Smith, 1885), known from the Kermadec Islands at lower bathyal depths, but differs in size (*C. inoculatus* n. sp. up to 13.1 mm, *C. kermadecensis* up to 7.5 mm), and in sculpture of the left valve (*C. inoculatus* n. sp. has regularly radially arranged spoon-shaped lamellae on the intersections, *C. kermadecences* has more irregularly, radially arranged curled lamellae of different prominence).

Another morphologically close congener is *Cyclopecten incongruus* (Dall, 1916) (Coan *et al.* 2000: 249, pl. 47), known from the lower bathyal eastern Pacific. This species differs from the present species in its somewhat larger size (*C. inoculatus* n. sp. up to 13.1 mm in height, *C. incongruus* up to 14 mm), in shape (*C. inoculatus* n. sp. is more elongate, *C. incongruus* more circular), in sculpture of the left valve (*C. inoculatus* n. sp. have strongly developed spoon-shaped lamellae on the intersections, *C. incongruus* more delicately pustulose). Moreover, *C. inoculatus* n. sp. has a broad byssal fasciole, *C. incongruus* a narrow one (Grau 1959: 203, pl. 13).

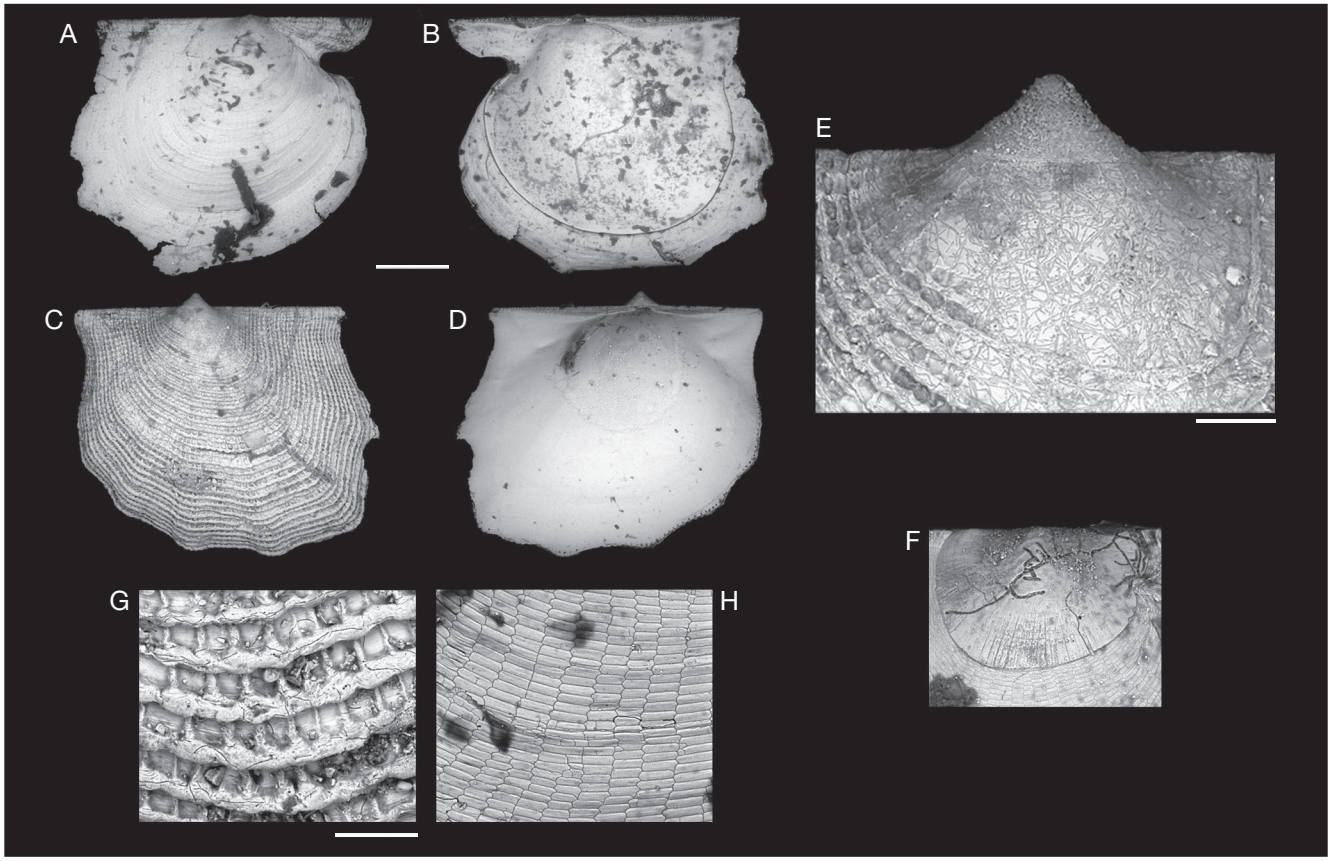

FIG. 3. — **A-H**, holotype of *Cyclochlamys corrugata* n. sp. (MNHN-IM-2013-55062); **A**, exterior rv; **B**, interior rv; **C**, exterior lv; **D**, interior lv; **E**, prodissoconch and early ontogeny of lv shell disc; **F**, prodissoconch and early ontogeny of rv shell disc; **G**, exterior detail lv; **H**, exterior detail rv. Abbreviations: see Material and methods. Scale bars: A-D, 500 µm; E, F, G, H, 100 µm.

Genus *Catillopecten* Iredale, 1939

Catillopecten Iredale, 1939: 347, 370.

TYPE SPECIES (OD). — *Pecten murrayi* E. A. Smith, 1885 (Recent, Coral Sea, East of Cape York).

Catillopecten translucens (Dautzenberg & Bavay, 1912)

Pecten (*Cyclopecten*) *translucens* Dautzenberg & Bavay, 1912: 30, pl. 27, figs 5-6.

Catillopecten translucens – Dijkstra & Maestrati 2008: 99, figs 34, 35.

MATERIAL EXAMINED. — **Indonesia**. Makassar Strait, 0°34.6'N, 119°8.5'E, 1301 m ("*Siboga*", stn 88), holotype spm (ZMA Moll. 3.12.008).
Solomon Sea. MADEEP 2014, stn CP4330, 06°08'S, 149°12'E, 315-625 m, 1 spm (MNHN).
Bismarck Sea. PAPUA NIUGINI 2012, stn CP3959, 05°04'S, 145°51'E, 582-587 m, 1 spm. — Stn CP3962, 04°59'S, 145°51'E, 598-614 m, 1 spm. — Stn CP3965, 05°06'S, 145°53'E, 980-985 m, 1 spm. KAVIENG 2014, stn CP4432, 02°19'S, 150°44'E, 767-936 m, 7 spms. — Stn CP4449, 02°10'S, 150°11'E, 623-908 m, 1 spm, 1 lv. — Stn CP4481, 02°47'S, 150°42'E, 579-1200 m, 1 spm. MADEEP 2014, stn CP4250, 03°31'S, 148°03'E, 780-855 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 100). Now also from the Solomon Sea and the Bismarck Sea, live in 315-1200 m (maximum depth range), 587-980 m (minimum depth range).

Family CYCLOCHLAMYDIDAE Dijkstra & Maestrati, 2012

Genus *Cyclochlamys* Finlay, 1926

Cyclochlamys Finlay, 1926: 452.

TYPE SPECIES (OD). — *Pecten* (*Pseudamusium*) *transenna* Suter, 1913 (Recent, New Zealand).

Cyclochlamys corrugata n. sp. (Fig. 3A-H)

TYPE MATERIAL. — **Papua New Guinea.** KAVIENG 2014, stn KB20, 02°45.2'S, 150°41.7'E, –8 m, alive, 5 paratype spms (MNHN-IM-2013-50881, 50883, 50885, 50887, 50889). — Stn KS35, 02°38.8'S, 150°40.7'E, 4-5 m, alive, 3 paratype spms (MNHN-IM-2013-53544, 53545, 53547). — Stn KB66, 02°35.2'S, 150°50.3'E, –17 m, alive, holotype spm (MNHN-IM-2013-55062). — Same stn, alive, 2 paratype spms (MNHN-IM-2013-55060, 55061).

OTHER MATERIAL. — **Papua New Guinea.** KAVIENG 2014, Stn KB08, 02°33.2'S, 150°48.2'E, –13 m, 1 lv. — Stn KB10,

02°33.5'S, 150°47.4'E, –13 m, alive, 2 spms (1 MNHN, 1 NBC). — Stn KB20, 02°45.2'S, 150°41.7'E, –8 m, alive, 1 spm, 4 lv. — Stn KB34, 02°43.7'S, 150°37.1'E, –43 m, 1 lv. — Stn KS35, 02°38.8'S, 150°40.7'E, 4-5 m, alive, 1 spm. — Stn KS61, 02°35.2'S, 150°43.1'E, 9-13 m, 3 lv. — Stn KS63, 02°45.2'S, 150°41.7'E, 10-12 m, alive, 2 spms, 4 lv. — Stn KB68, 02°45.2'S, 150°41.7'E, 22-27 m, 1 lv, 1 rv. — Stn KB74, 02°45.2'S, 150°44.5'E, –20 m, alive, 1 spm. — PAPUA NIUGINI 2012, stn PB16, 05°04.7'S, 145°48.8'E, –5 m, alive, 4 spms (3 MNHN, 1 NBC). — Stn PB40, 05°15.9'S, 145°47.1'E, 9-11 m, alive, 1 spm, 1 lv. — Stn PS41, 05°15.9'S, 145°47.1'E, –10 m, 3 lv. — PD51, 05°10.1'S, 145°50.3'E, 3-12 m, 1 lv. — Stn PD63, 05°09.9'S, 145°48.3'E, 0-15 m, 1 lv. (MNHN).

TYPE LOCALITY. — Papua New Guinea, New Ireland, mainland, N-coast, 02°35.2'S, 150°50.3'E, –17 m, alive in sand and rubble, 24.VI.2014 (KAVIENG 2014, stn KB66).

ETYMOLOGY. — Left valve commarginally wrinkled and ruffled (Latin *corrugata*, adjective meaning wrinkled or ruffled).

DISTRIBUTION. — Papua New Guinea, live in 4-20 m (maximum depth range), 5-20 m (minimum depth range).

DESCRIPTION

Shell

Up to 2.8 mm high, fragile, strongly posteriorly oblique, inequivalve, inequilateral, wider than high, lv opaque whitish, rv translucent. Shape irregular, variable, typically changing during ontogeny, commonly associated with change in spacing of commarginal lamellae (habitat constriction).

Prodissoconch

220 µm long, lv larval shell conical and granular, rv larval shell almost flat with irregularly spaced ridges and weak radial grooves.

Left valve

Disc with 3-6 weak radial plicae, lacking in some specimens, in early ontogeny smooth (*c.* 0.3-0.5 mm high), after that very closely spaced commarginal lamellae commence and develop to the periphery; on lamellae, very closely set small nodules present at intersections, resembling pearl strands; auricles similarly sculptured and continuous with disc, posterior auricle distinctly larger than anterior; interlamellar spaces narrow, with very closely spaced radial threads with convex crests, lacking in some specimens; ventral margin weakly angular to slightly convex.

Right valve

Disc and all but dorsal border of posterior auricle with outer layer of commarginal hexagonal prisms, more elongate in late ontogeny. Posterior auricle continuous with disc, smooth; anterior auricle distinctly demarcated from disc with 3-4 nodulous radial threads. Byssal notch of moderate depth, byssal fasciole rather broad.

Dimension of holotype

H 2.8 mm, W 3.4 mm, D 0.9 mm.

REMARKS

The present species resembles three congeneric species, viz. *Cyclochlamys nepeanensis* (Pritchard & Gatliff, 1904), known from southeastern and southern Australia, *Cyclochlamys incubata* (Hayami & Kase, 1993) from Japan, and *Cyclochlamys irregularis* Dijkstra & Marshall, 2008 from New Zealand. All of these species have nodules on the intersections of the commarginal lamellae and radial riblets of the left valve, although much more widely spaced than on the left valve of the present species (*C. corrugata* n. sp. combined together, *C. nepeanensis*, *C. incubata*, and *C. irregularis* with strongly variable interspaces, 6-10 per mm on central part of disc). Moreover, the shape of *C. corrugata* n. sp. is strongly posteriorly oblique and in most specimens with a more or less angular ventral margin, with angulations caused by the radial plicae (*C. nepeanensis* is circular, *C. incubata* weakly posteriorly oblique, and *C. irregularis* circular to slightly posteriorly oblique; all lack radial plicae).

Smooth specimens from stn KB50 (lv) and KS61 (2 lv) are close to or a smooth variant of *C. corrugata* n. sp., viz. the faint granular sculpture on the anterior auricle of the left valve of stn KB50 is very similar to that of *C. corrugata* n. sp.

Cyclochlamys barbatula n. sp.

(Fig. 4A-H)

TYPE MATERIAL. — **Papua New Guinea.** KAVIENG 2014, stn KB36, 02°38.8'S, 150°38.4'E, 3-8 m, alive, paratype spm (MNHN-IM-2000-33117). — Stn KB08, 02°33.2'S, 150°48.2'E, –13 m, paratype lv (MNHN-IM-2000-33114). — Stn KS09, 02°36.1'S, 150°45.9'E, 15-16 m, paratype lv (MNHN-IM-2000-33112). — Stn KS35, 02°38.8'S, 150°40.7'E, 4-5 m, paratype lv (MNHN-IM-2000-33113). — Stn KB60, 02°32.5'S, 150°35.3'E, –20 m, alive, holotype spm (MNHN-IM-2000-33116), 2 paratypes spms (MNHN-IM-2013-55047, 55049), 3 paratypes spm + 2 lv (4 MNHN-IM-2000-33115, RMNH.MOL.290719).

TYPE LOCALITY. — Papua New Guinea, Kavieng Lagoon, N-side of Wadei Island, 02°38.8'S, 150°38.4'E, 3-8 m, alive in sand and rubble slope, 13.06.2014 (KAVIENG 2014), stn KB36.

OTHER MATERIAL EXAMINED. — **Papua New Guinea.** MADANG LAGOON (PAPUA NIUGINI 2012), stn PB47, 05°11.3'S, 145°49.6'E, 5 m, alive, 1 spm, 1 rv (MNHN-IM-2013-6365).

ETYMOLOGY. — Left valve sculptured with strong commarginal lamellae like little fringes (Latin *barbatula*, adjective meaning with a fringe).

DISTRIBUTION. — Papua New Guinea, live in 3-20 m (maximum depth range), 8-20 m (minimum depth range).

DESCRIPTION

Shell

Up to 1.5 mm high, fragile, strongly posteriorly oblique, inequivalve, inequilateral, wider than high, posterior auricle larger than anterior auricle, translucent whitish. Shape somewhat irregular, variable, typically changing during ontogeny, commonly associated with change in spacing of commarginal lamellae (habitat constriction).

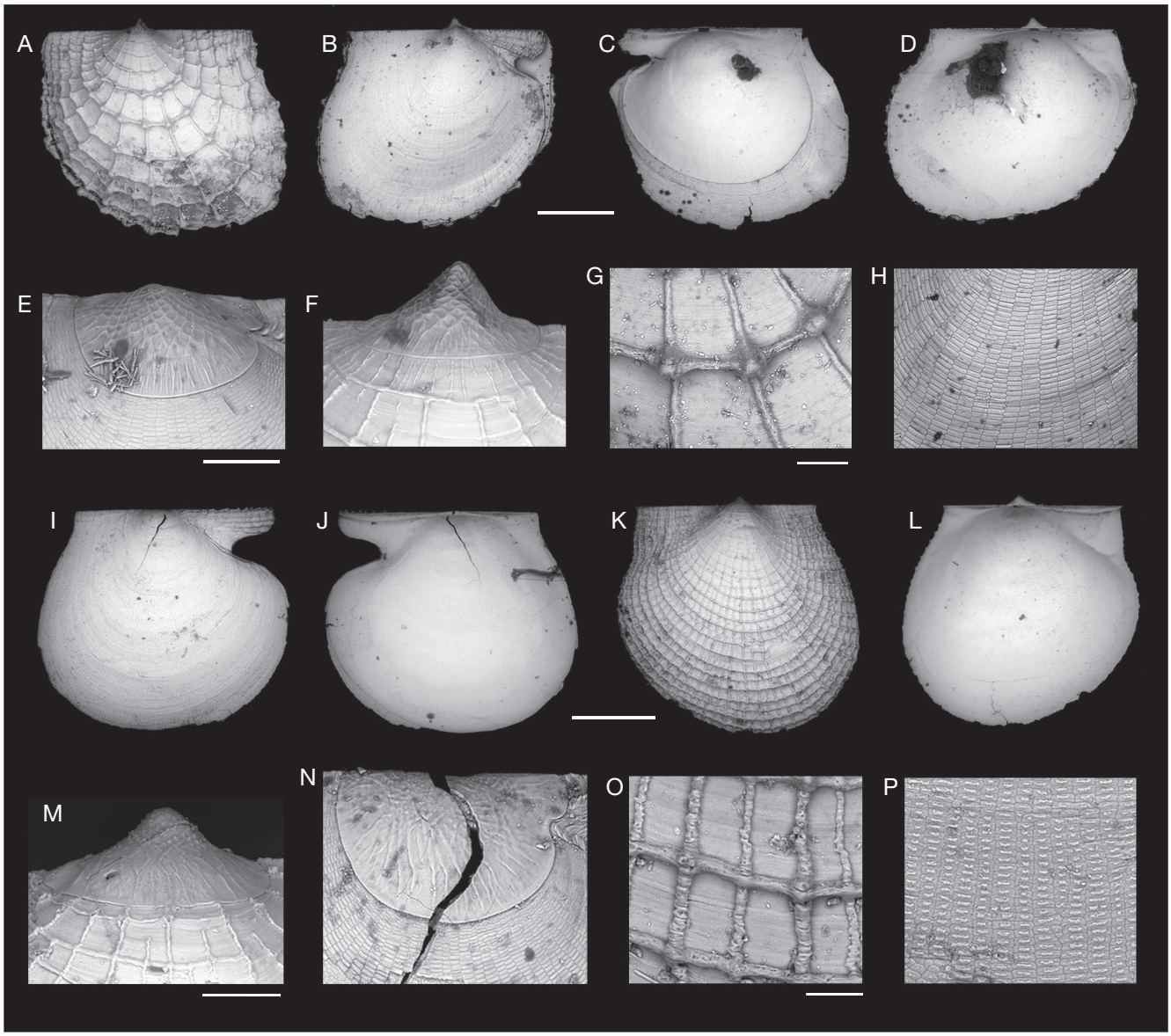

FIG. 4. — **A**, **B**, **E-H**, holotype of *Cyclochlamys barbatula* n. sp. (MNHN-IM-2000-33116): **A**, exterior lv; **B**, exterior rv; **C**, **D**, paratype (MNHN-IM-2013-55047); **C**, interior rv; **D**, interior lv; **E**, prodissoconch and early ontogeny of rv shell disc; **F**, prodissoconch and early ontogeny of lv shell disc; **G**, exterior detail lv; **H**, exterior detail rv ; **I-P**, Holotype of *Micropecten reticulatus* n. sp. (MNHN-IM-2013-50885): **I**, exterior rv; **J**, interior rv; **K**, exterior lv; **L**, interior lv; **M**, prodissoconch and early ontogeny of lv shell disc; **N**, prodissoconch and early ontogeny of rv shell disc; **O**, exterior detail lv; **P**, exterior detail rv. Abbreviations: see Material and methods. Scale bars: A-D, I-L, 500 µm; E-H, M, N, 100 µm; O, P, 50 µm.

Prodissoconch
235 µm long, lv larval shell conical, with reticulate sculpture, rv larval shell slightly raised, also with reticulate sculpture, in dissoconch stage radially sculptured with irregularly spaced ridges.

Left valve
With smooth disc in early ontogeny (*c.* up to 0.4-0.6 mm), after that there is a strong reticulate scupture commences, consisting of widely spaced commarginal lamellae and weaker radial riblets (*c.* 4-5 per mm on central part of disc), developing to the periphery; on lamellae prominent hollow nodules (*c.* 3-4 per mm) present on intersections of radial and commarginal sculpture. Auricles with similar, more closely spaced reticulate sculpture; continuous with disc.

Right valve
Disc and all but dorsal border of posterior auricle with outer layer of commarginal hexagonal prisms, more elongate in late ontogeny. Posterior auricle continuous with disc, smooth; anterior auricle distinctly separated from disc, with 4-5 delicate, nodulous radial threads. Byssal notch of moderate depth, byssal fasciole rather broad.

Dimension of holotype
H 1.5 mm, W 1.7 mm, D 0.6 mm.

Remarks

The present species resembles its congener *Cyclochlamys incubata* (Hayami & Kase, 1993: figs 202-212), known from littoral Japanese waters, in the shape of the shell disc and the reticulate sculpture on the left valve. However *C. barbatula* n. sp. differs from *C. incubata* by having a smooth disc in early ontogeny (*C. incubata* has radial threads immediately after the dissoconch stage), by having more prominent and more widely arranged commarginal and radial sculpture with more strongly developed hollow nodules or vesicles on the crests (*C. incubata* with weaker solid nodules).

A somewhat superficially similar congener is *Cyclochlamys irregularis* Dijkstra & Marshall, 2008, known from littoral to bathyal waters (shells only) of northern New Zealand. *Cyclochlamys barbatula* n. sp. differs from *C. irregularis* in size (*C. barbatula* n. sp. up to *c.* 1.5 mm high, *C. irregularis* up to *c.* 3 mm), in having a much more posteriorly oblique outline (*C. irregularis* circular to weakly posteriorly oblique), by having a more acutely conical prodissoconch (*C. irregularis* more roundly conical), by having a smooth dissoconch (*C. irregularis* sculptured with crisp delicate commarginal and radial sculpture), and by having more prominent and widely spaced reticulate sculpture on the left valve.

Genus *Micropecten* Dijkstra & Maestrati, 2012

Micropecten Dijkstra & Maestrati, 2012: 396.

Type species (OD). — *Cyclochlamys plectofilum* Oliver & Holmes, 2004 (Recent, Rodrigues Island, Indian Ocean).

Micropecten reticulatus n. sp.
(Fig. 4I-P)

Type material. — **Papua New Guinea**. KAVIENG 2014, stn KB20, 02°45.2'S, 150°41.7'E, 8 m, alive, holotype spm (MNHN-IM-2013-50885). — Same data, 4 paratype spms (MNHN-IM-2013-50879, 50884, 50886, 50888. — Stn KB60, 02°32.5'S, 150°35.3'E, 20 m, alive, paratype spm (MNHN-IM-2013-55048). — Stn KS61, 02°35.2'S, 150°43.1'E, 9-13 m, 3 lv paratypes (2 MNHN-IM-2000-33118, 1 RMNH.MOL.290914).

Type locality. — Papua New Guinea, Kavieng Lagoon, S-coast of Baudison Island, 02°45.2'S, 150°41.7'E, –8 m, live, wall with large ledges, 09.VI.2014 (KAVIENG 2014), stn KB20.

Etymology. — Left valve with reticulate shell disc (Latin *reticulatus*, adjective meaning made like a net; with a hair-net).

Distribution. — Papua New Guinea, live in 8-20 m.

Description

Shell

Up to *c.* 2.1 mm high, fragile, hyaline, circular to slightly posteriorly oblique, inequivalve, almost equilateral, left valve more inflated than right valve; translucent whitish.

Prodissoconch

280 µm long, lv larval shell conical and with granular sculpture, rv larval shell flat, also granular, in dissoconch stage more radially sculptured with irregularly spaced ridges.

Left valve

Left valve disc and auricles sculptured with numerous narrow antimarginal lirae, secondary riblets in interspaces increasing to periphery, and delicate closely spaced commarginal lirae of similar strength to antimarginal ones, commencing in early growth stage (*c.* 0.5-0.8 mm below umbonal top). Auricles subequal, anterior slightly larger than posterior.

Right valve

Right valve disc and ventral half of posterior auricle similarly sculptured with very narrow antimarginal threads. Delicate hexagonal microstructure of simple calcite prismatic outer layer. Posterior auricle continuous with disc, anterior auricle demarcated, sculptured with a 3-4 fine nodulous radial riblets, spinose on dorsal margin. Byssal notch relatively deep, byssal fasciole broad.

Dimension of holotype

H 1.8 mm, W 1.8 mm, D 0.6 mm.

Remarks

The most closely similar congener is *Micropecten excuratus* Dijkstra & Maestrati, 2012, known from shallow waters around the Vanuatu Archipelago and the Berau Islands (see Dijkstra & Moolenbeek 2008: 17-18, figs 5-6, as "*Cyclochlamys* sp."). *Micropecten reticulatus* n. sp. and *M. excuratus* are similar in size and shape, and their reticulate sculpture on the left valve is matching more or less. *Micropecten reticulatus* n. sp. has slightly more prominent sculpture with small, solid nodules on the crests, whereas *M. excuratus* has weaker sculpture with more irregularly spaced commarginal lirae. *Micropecten reticulatus* has very delicate antimarginal sculpture on the right valve, consisting of numerous fine threads, whereas *M. excuratus* has more prominent antimarginal sculpture of more strongly developed ridges.

Another similar congener is *Micropecten plectofilum* (Oliver & Holmes, 2004), known from shallow waters around Rodrigues (Indian Ocean). *Micropecten reticulatus* n. sp. differsfrom *M. plectofilum* by having regularly developed reticulate sculpture on the left valve, whereas *M. plectofilum* has irregularly spaced antimarginal sculpture with weaker commarginal threads. *Micropecten reticulatus* n. sp. also has very delicate, closely spaced antimarginal sculpture throughout on the right valve, whereas *M. plectofilum* has more prominent, widely spaced antimarginal riblets in late ontogeny.

Family Pectinidae Rafinesque, 1815

Genus *Ciclopecten* Seguenza, 1877

Ciclopecten Seguenza, 1877: 362.

Type species (OD). — *Ciclopecten peloritanus* Seguenza, 1877 (Pliocene, Italy).

Ciclopecten fluctuatus (Bavay, 1905)

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

Ciclopecten fluctuatus – Dijkstra & Maestrati 2008: 102.

MATERIAL EXAMINED. — **Andaman Sea**. Holotype spm (ZSI M3359/1).
Bismarck Sea. PAPUA NIUGINI 2012, stn CP3957, 05°05'S, 145°51'E, 452-504 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 102). Now also from the Bismarck Sea, live in 452-504 m.

Genus *Hyalopecten* Verrill, 1897

Hyalopecten Verrill, 1897: 63, 71.

TYPE SPECIES (OD). — *Pecten undatus* Verrill & S. Smith *in* Verrill, 1885 (Recent, off Chesapeake Bay, Maryland, USA).

Hyalopecten mireilleae Dijkstra, 1995

Hyalopecten mireilleae Dijkstra, 1995: 48, figs 79-82.

MATERIAL EXAMINED. — **New Hebrides Arc**. 20°59'S, 170°02'E, –710 m GEMINI, stn DW55, holotype spm (MNHN-IM-2000-24350).
South China Sea. ZHONGSHA 2015, stn CP4163, 21°35'N, 118°15'E, 1634-1683 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 103). Now also from the South China Sea, live in 1634-1683 m. The bathymetric range is remarkable, extended from 710-880 m (Dijkstra & Maestrati 2008: 103) to the present depth of 1634-1683 m.

Hyalopecten tydemani Dijkstra, 1990

Palliolum (*Hyalopecten*) *tydemani* Dijkstra, 1990: 7, pl. 2, fig. 13.

Hyalopecten tydemani – Dijkstra & Maestrati 2008:103, figs 42, 43.

MATERIAL EXAMINED. — **Indonesia**. Ceram Sea, 2°40'S, 128°37.5'E, 835 m ("*Siboga*", stn 178), holotype lv (ZMA Moll. 3.89.009).
South China Sea. DONGSHA 2014, stn CP4123, 21°36'N, 118°16'E, 1612-1665 m, 2 spms (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 103). Now also South China Sea, live in 1612-1665 m.

Genus *Pseudohinnites* Dijkstra, 1989

Pseudohinnites Dijkstra, 1989: 29.

TYPE SPECIES (OD). — *Pseudohinnites levii* Dijkstra, 1989 (Recent, New Caledonia).

Pseudohinnites levii Dijkstra, 1989

Pseudohinnites levii Dijkstra, 1989: 29, figs 1-3.

MATERIAL EXAMINED. — **New Caledonia**. SE of New Caledonia, 23°25'S, 167°53'E, 965 m, BIOCAL, stn DW70, holotype lv (MNHN-IM-2000-21417).

Bismarck Sea. PAPUA NIUGINI 2012, stn CP3959, 05°04'S, 145°51'E, 582-587 m, 1 spm. — Stn CP3964, 05°07'S, 145°50'E, 527-539 m, 3 spms. — KAVIENG 2014, stn CP4431, 02°16'S, 150°40'E, 830-894 m, 5 lv, 1 rv. — Stn CP4489, 02°24'S, 149°59'E, 175 m, 1 lv, 2 rv. — Stn DW4479, 02°47'S, 150°42'E, 560-1206 m, 1 rv. MADEEP 2014, stn CP4244, 04°06'S, 148°10'E, 830-840 m, 2 spms. — Stn CP4245, 04°06'S, 148°10'E, 790-808 m, 4 spms. — Stn CP4246, 04°07'S, 148°09'E, 695-899 m, 9 spms. — Stn CP4251, 03°30'S, 148°02'E, 842-933 m, 1 spm. — Stn CP4260, 02°54'S, 151°05'E, 350-647 m, 1 spm. — Stn CP4266, 04°35'S, 152°25'E, 575-616 m, 1 spm. — Stn CP4431, 02°16'S, 150°40'E, 830-894 m, 1 spm (MNHN).

DISTRIBUTION. — See Dijkstra & Maestrati (2008: 105). Now also from the Bismarck Sea, live in 582-933 m.

Genus *Veprichlamys* Iredale, 1929

Veprichlamys Iredale, 1929: 164, 188.

TYPE SPECIES (OD). — *Chlamys perillustris* Iredale, 1925 (Recent, off Victoria, Australia).

Veprichlamys versipellis Dijkstra & Kastoro, 1997

Veprichlamys versipellis Dijkstra & Kastoro, 1997: 270, figs 114-131.

MATERIAL EXAMINED. — **Indonesia**. Arafura Sea, E of Tanimbar Islands, 08°01'S, 132°51'E, 271-273 m, KARUBAR, stn CP46), holotype spm (MNHN-IM-2000-24384).
Solomon Islands. MADEEP 2014, stn DW4316, 09°49'S, 151°34'E, 150-180 m, 1 spm (MNHN).

DISTRIBUTION. — Dijkstra & Kastoro (1997: 270). Now also from the Solomon Sea, live in 150-180 m.

DISCUSSION

Two new Propeamussiidae species (*Propeamussium regillum* n. sp. and *Cyclopecten inoculatus* n. sp.) from bathyal depths of the Bismarck Sea are additions to the tropical southwestern Propeamussiidae (Dijkstra & Maestrati 2013). The new Propeamussiidae species (*Parvamussium minusculum* n. sp.) from the bathyal South China Sea differs strongly in shape (more anteriorly oblique) from other representative congeners of the tropical western Pacific and could only be compared with a similarly shaped congener, *Parvamussium obliquum*, from the tropical western Atlantic.

Three new Cyclochlamydidae species (*Cyclochlamys corrugata* n. sp., *Cyclochlamys barbatula* n. sp. and *Micropecten reticulatus* n. sp.), from the shallow coastal waters of Papua New Guinea, are also additions to the tropical southwestern Cyclochlamydidae (Dijkstra & Maestrati 2013). This group of algae dwelling micro-scallops occurs mainly in shallow water and recently more species have been discovered, even from remote islands in the tropical Indo-Pacific (Oliver & Holmes 2004: Rodrigues; Dijkstra & Raines 2013: Wake Atoll). This suggests that this group is widespread throughout the tropical Indo-Pacific and more taxa remain to be discovered.

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