Results of the Rumphius Biohistorical Expedition to Ambon (1990)

Part. 4. The Holothurioidea (Echinodermata) collected at Ambon during the Rumphius Biohistorical Expedition

C. Massin

Massin, C. Results of the Rumphius Biohistorical Expedition to Ambon (1990). Part. 4. The Holothurioidea (Echinodermata) collected at Ambon during the Rumphius Biohistorical Expedition.
Zool. Verh. Leiden 307, 23.xii.1996: 1-53, figs 1-35.—ISSN 0024-1652/ISBN 90-73239-48-6.
C. Massin, Royal Belgian Institute of Natural Science, Department of Invertebrates, 29 rue Vautier, 1000 Brussels, Belgium.

Key words: Holothurioidea; Ambon; taxonomy; new species.
During the Rumphius Biohistorical Expedition (4.xi-14.xii.1990) 52 specimens representing 27 holothurian species were collected. All the species are described, figured and discussed systematically. Six species are new to the fauna of Ambon; two of these are new to the fauna of Indonesia, and two are new species: *Afrocucumis stracki* and *Chiridota smirnovi*. The holothurian fauna of Ambon is now represented by 59 species.

Introduction

The first work on the holothurian fauna of Ambon was done by Rumphius (1705) who cited two species: *Phallus marinus* and *Phallus marinus verrucosus*. I agree with von Martens (1902) and Engel (1959) that the descriptions given by Rumphius (1705: 44, 45) are so vague that they may refer to several species of Holothurioidea.

In the second half of the nineteenth century and in the first half of the twentieth century several works dealt with the holothurian fauna of Ambon: Selenka (1867), Semper (1868), Ludwig (1882, 1888), Théel (1886), Sluiter (1890, 1894, 1895, 1901), Koehler (1895) and Heding (1928). More recently Rowe (1983) has studied a few specimens from Ambon, housed in the collections of the Leiden Museum. The list of the 53 species included in these works is given in table 1. As Ambon is in a zone where the marine fauna is the richest of the Indo-Pacific region, more species are to be expected.

Table 1. Holothurian fauna of Ambon according to the literature. 1) Selenka, 1867; 2) Semper, 1868; 3) Théel, 1886; 4) Ludwig, 1882; 5) Ludwig, 1888; 6) Sluiter, 1890; 7) Sluiter, 1894; 8) Sluiter, 1895; 9) Sluiter, 1901; 10) Koehler, 1895; 11) Heding, 1928; 12) Rowe, 1983.

Species present status	Cited as	1	2	3	4	5	6	7	8	9	10	11	12
ASPIDOCHIROTIDA													
Actinopyga echinites (Jaeger, 1833)	*Mülleria echinites* Jaeger, 1833							×					
Actinopyga lecanora (Jaeger, 1833)	*Mülleria lecanora* Jaeger, 1833							×	×				
Actinopyga mauritiana (Quoy & Gaimard, 1833)	*Mülleria mauritiana* Quoy & Gaimard, 1833				×								
Actinopyga miliaris (Quoy & Gaimard, 1833)	*Mülleria miliaris* Quoy & Gaimard, 1833				×	×		×					
Bohadschia argus (Jaeger, 1833)	*Holothuria argus* Jaeger, 1833										×		
Bohadschia marmorata Jaeger, 1833	*Holothuria marmorata* (Jaeger, 1833)				×	×		×	×				
Holothuria (*Acanthotrapeza*) *pyxis* Selenka, 1867	*Holothuria pyxis* Selenka, 1867							×					
Holothuria (*Cystipus*) *inhabilis* Selenka, 1867	*Holothuria fuscopunctata* Jaeger, 1833							×					
Holothuria (*Cystipus*) *rigida* (Selenka, 1867)	*Holothuria pleuripus* (Haacke, 1880)										×		
Holothuria (*Halodeima*) *atra* Jaeger, 1833	*Holothuria atra* Jaeger, 1833	×	×	×	×			×	×				
	Holothuria amboinensis Semper, 1868		×										
Holothuria (*Halodeima*) *edulis* Lesson, 1830	*Holothuria edulis* Lesson, 1830				×			×			×		
	Holothuria fuscocinera Jaeger, 1833	×				×							
Holothuria (*Halodeima*) *pulla* Lesson, 1830	*Holothuria pulla* Selenka, 1867	×											
Holothuria (*Lessonothuria*) *pardalis* Selenka, 1867	*Holothuria pardalis* Selenka, 1867						×			×	×		
Holothuria (*Lessonothuria*) *verrucosa* Selenka, 1867	*Holothuria immobilis* Semper, 1868					×							
Holothuria (*Mertensiothuria*) *leucospilota* Brandt, 1835	*Holothuria curiosa* Ludwig, 1874								×				
	Holothuria (*Mertensiothuria*) *leucospilota*												×
	Holothuria vagabunda Selenka, 1867					×		×	×		×		
Holothuria (*Mertensiothuria*) *pervicax* Selenka, 1867	*Holothuria pervicax* Selenka, 1867							×					
Holothuria (*Metriatyla*) *albiventer* Semper, 1868	*Holothuria albiventer* Semper, 1868		×										
Holothuria (*Metriatyla*) *mortensii* Semper, 1868	*Holothuria mortensii* Semper, 1868		×										
Holothuria (*Metriatyla*) *scabra* Jaeger, 1833	*Holothuria tigris* Selenka, 1867	×											
	Holothuria scabra Jaeger, 1833					×		×					
Holothuria (*Selenkothuria*) *erinaceus* Semper, 1868	*Holothuria erinaceus* Semper 1868								×				
	Holothuria marenzelleri Ludwig, 1883							×					
Holothuria (*Semperothuria*) *flavomaculata* Semper, 1868	*Holothuria flavomaculata* Semper, 1868					×							
Holothuria (*Stauropora*) *olivacea* Ludwig, 1888	*Holothuria olivacea* Ludwig, 1888					×	×	×					
Holothuria (*Stauropora*) *sluiteri* Ludwig, 1888	*Holothuria sluiteri* Ludwig, 1888					×							
Holothuria (*Theelothuria*) *klunzingeri* Lampert, 1885	*Holothuria Klunzingeri* Lampert, 1885							×					
Holothuria (*Theelothuria*) *notabilis* Ludwig, 1874	*Holothuria notabilis* Ludwig, 1874					×							
Holothuria (*Thymiosycia*) *arenicola* Semper, 1868	*Holothuria arenicola* Semper, 1868		×										
	Holothuria maculata Brandt, 1835					×							
Holothuria (*Thymiosycia*) *hilla* Lesson, 1830	*Holothuria monacaria* Lesson, 1830		×					×			×		

Table 1 (continued). Holothurian fauna of Ambon according to the literature. 1) Selenka, 1867; 2) Semper, 1868; 3) Théel, 1886; 4) Ludwig, 1882; 5) Ludwig, 1888; 6) Sluiter, 1890; 7) Sluiter, 1894; 8) Sluiter, 1895; 9) Sluiter, 1901; 10) Koehler, 1895; 11) Heding, 1928; 12) Rowe, 1983.

Species present status	Cited as	1	2	3	4	5	6	7	8	9	10	11	12
ASPIDOCHIROTIDA (continued)													
Holothuria (Thymiosycia) impatiens Forskål, 1775	*Holothuria impatiens* Forskål, 1775				×	×		×		×	×		
	Holothuria botellus Selenka, 1867		×										
Holothuria (Thymiosycia) truncata Lampert, 1885	*Holothuria truncata* Lampert, 1885								×				
Pearsonothuria graeffei (Semper, 1868)	*Holothuria graeffei* Semper, 1868										×		
Stichopus chloronotus Brandt, 1835	*Stichopus chloronotus* Brandt, 1835							×		×	×		
Stichopus horrens Selenka, 1867	*Stichopus godeffroyi* var b Semper, 1868					×							
Stichopus herrmanni Semper, 1868	*Stichopus variegatus* Semper, 1868					×		×	×	×			
DENDROCHIROTIDA													
Actinocucumis typica Ludwig, 1874	*Pseudocucumis quinquangularis* Sluiter, 1901									×			
	Actinocucumis typica Ludwig, 1874										×		
Afrocucumis africana (Semper, 1868)	*Pseudocucumis africana* (Semper, 1868)									×	×		
Cladolabes acicula (Semper, 1868)	*Pseudocucumis acicula* (Semper, 1868)					×		×					
Colochirus quadrangularis (Lesson, 1830)	*Colochirus quadrangularis* (Lesson, 1830)							×	×				
Neothyonidium magnum (Ludwig, 1882)	*Thyonidium magnum* Ludwig, 1882				×								
Pentacta doliolum (Pallas, 1776)	*Colochirus doliolum* (Pallas, 1766)					×		×					
Phyllophorus (Phyllophorus) bedoti Koehler, 1895	*Phyllophorus Bedoti* Koehler, 1895										×		
Phyllophorus (Urodemella) brocki Ludwig, 1888	*Phyllophorus brocki* Ludwig, 1888					×							
Thyonidium rigidum Sluiter, 1894	*Thyonidium rigidum* Sluiter, 1894							×					
MOLPADIDA													
Aphelodactyla molpadoides (Semper, 1868)	*Haplodactyla molpadoides* Semper, 1868								×				
APODIDA													
Chiridota rigida Semper, 1868	*Chiridota rigida* Semper, 1868					×							
	Chiridota amboinensis Ludwig, 1888					×							
Opheodesoma glabra (Semper, 1868)	*Synapta glabra* Semper, 1868							×				×	
Opheodesoma grisea (Semper, 1868)	*Synapta grisea* Semper, 1868							×					
Opheodesoma serpentina (J. Mueller, 1850)	*Synapta serpentina* J. Mueller, 1850					×		×				×	
Polyplektana kefersteini (Selenka, 1867)	*Synapta kefersteini* Selenka, 1867					×		×	×				
Protankyra petersi (Semper, 1868)	*Synapta petersi* Semper, 1868		×										
Synapta maculata (Chamisso & Eysenhardt, 1821)	*Synapta beselii* Jaeger, 1833			×		×		×			×		
	Synapta maculata (Chamisso & Eysenhardt, 1821)											×	
Synaptula indivisa (Semper, 1868)	*Synapta indivisa* Semper, 1868							×					
Synaptula reticulata (Semper, 1868)	*Synapta reticulata* Semper, 1868										×		
Synaptula virgata (Sluiter, 1901)	*Chondrocloea virgata* Sluiter, 1901											×	

Material and methods

Holothurians were collected from 7 November to 12 December, 1990 at Ambon (3°30'S-128°E) at 16 of the 44 localities sampled during the Rumphius Biohistorical Expedition. They were collected by hand-picking at low tide, by snorkeling, and by SCUBA diving up to seven m depth. Altogether 52 specimens representing 27 species were collected (see table 2). For descriptions of collecting localities I refer to Strack (1993).

In the text notations of size (e.g. 130 × 20 mm) refers to length and maximal width or diameter.

The material is deposited in the collection of the Nationaal Natuurhistorische Museum (RMNH), Leiden, The Netherlands. Comparison were made with material from the Musée National d'Histoire Naturelle (MNHN), Paris, France, the Zoological Museum (ZMC), Kopenhagen, Denmark, the California Academy of Sciences (CAS), San Fransisco, USA, and the Institut Royal des Sciences Naturelles de Belgique (IRSNB), Brussels, Belgium.

Taxonomy

Order Aspidochirodita Grube, 1840
Family Holothuriidae Ludwig, 1894
Genus *Actinopyga* Bronn, 1860
Actinopyga albonigra Cherbonnier & Féral, 1984
(fig. 1A-D)

Actinopyga albonigra Cherbonnier & Féral, 1984a: 661, fig. 2; Féral & Cherbonnier, 1986: 70.

Material.— RMNH Ech. 06030 (1 specimen).
Material studied for comparison.— MNHN EcHh 3112 (Holotype: type locality Ilot Maître, New Caledonia).

Description.— Specimen with strongly contracted and flattened body, 130 mm long; body wall smooth, 2-3 mm thick. Colour in alcohol gray-brown with large brown-black spots dorsally and numerous brown dots corresponding to dorsal tube feet; ventrally yellow-cream with most of tube feet restricted to ambulacra. In each ventral ambulacrum, 4-6 rows of small yellow tube feet. Mouth ventral; anus terminal, surrounded by five conspicuous anal teeth.

Very solid calcareous ring (fig. 1A); radial pieces with three anterior notches, central one corresponding to the longitudinal muscle insertion and lateral ones to tentacular ampullae. Twenty 25-30 mm long tentacular ampullae (count of tentacles not possible without damaging the single specimen at hand). One Polian vesicle, and one stone canal with a very large, ovoid madreporic plate. Specimen auto-eviscerated; only the right respiratory tree still present, very long and extending to the calcareous ring.

Body wall with rosettes only, quite similar dorsally (fig. 1C) and ventrally (fig. 1B). Tube feet with rosettes as in body wall, and a large terminal plate. Tentacles with large rods, 135-220 µm long, spiny at their extremities (fig. 1D).

Table 2. List of the holothurians collected at each station during the Rumphius Biohistorical Expedition, 1990. Species new to the fauna of Ambon are in bold; new species are indicated by an *.

Station number	Depth (m)	Species	Number of specimens	RMNH Ech. nr.
1	2	*Bohadschia tenuissima*	2	06011,06012
3	—	*Holothuria edulis*	1	06013
4	intertidal	*Bohadschia similis*	1	06014
	intertidal	***Protankyra* cf. *similis***	1	06015
	intertidal	*Synapta maculata*	1	06016
11	1-4	*Holothuria impatiens*	2	06017
	1-2	*Holothuria* cf. *verrucosa*	1	06018
	1-2	***Afrocucumis stracki** *	1	06019
	1-2	*Actinopyga mauritiana*	2	06020
14	intertidal	***Holothuria mactanensis***	1	06021
16	2-3	*Holothuria hilla*	1	06022
	2-3	***Synaptula bandae***	4	06023
	2-3	*Opheodesoma* cf. *grisea*	1	06024
17	0.5-1	*Holothuria atra*	1	06025
	1.5	*Holothuria hilla*	1	06026
	intertidal	*Afrocucumis africana*	1	06027
	1.0	*Stichopus* spec.	1	06028
18	2.0	*Holothuria edulis*	1	06029
	1-2	***Actinopyga albonigra***	1	06030
	2.0	*Actinopyga miliaris*	1	06031
	2.0	*Stichopus herrmanni*	1	06032
20	2-4	*Holothuria edulis*	2	06033
	1.0	*Holothuria atra*	2	06034, 06035
	0.5-2	*Holothuria hilla*	3	06036
	1.0	*Pearsonothuria graeffei*	1	06037
	intertidal	*Actinopyga echinites*	1	06038
	—	***Chiridota smirnovi** *	1	06039
21	intertidal	*Actinopyga lecanora*	2	06040
23	1.5-2	*Cladolabes acicula*	1	06041
30	1-2	*Holothuria hilla*	2	06042
	1-2	*Stichopus chloronotus*	1	06043
37	intertidal	*Holothuria pardalis*	4	06044
	intertidal	*Holothuria arenicola*	1	06045
39	1-3	*Holothuria impatiens*	1	06046
	1-3	***Afrocucumis stracki** *	1	06047
44	7.0	*Pearsonothuria graeffei*	1	06048
—	—	*Holothuria scabra*	1	06049

Remarks.— The specimen fits in well with the description of the holotype given by Cherbonnier & Féral (1984a). Some minor variations occur in the ossicles: dorsal and ventral rosettes are nearly similar in the Ambon specimen whereas in the holotype the dorsal rosettes have longer and finer branching than the ventral ones.

This is only the second record of the species and the first for Indonesia.

Distribution.— New Caledonia, Ambon.

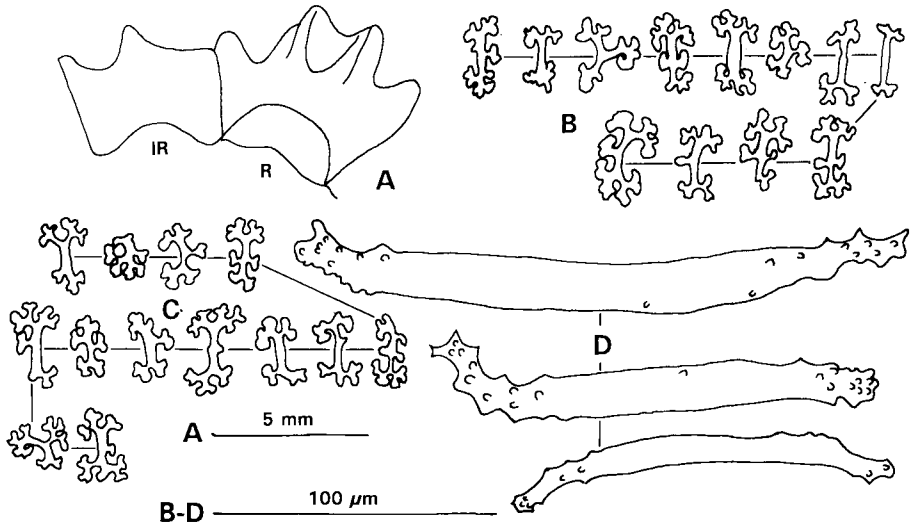

Fig. 1. *Actinopyga albonigra* Cherbonnier & Féral, 1984. A: calcareous ring (R: radial piece; IR: interradial piece); B: rosettes of the ventral body wall; C: rosettes of the dorsal body wall; D: rods of the tentacles.

Actinopyga echinites (Jaeger, 1833)
(figs 2A-B, 3A-B)

Synonymy.— See Cherbonnier, 1988: 31.

Material.— RMNH Ech. 06038 (1 specimen).

Description.— Specimen 73 × 20 mm. Colour in alcohol chocolate brown dorsally and ventrally. Mouth ventral, surrounded by 20 large brown tentacles; anus terminal, surrounded by five prominent anal teeth. Ventrally numerous large brown tube feet, mostly in ambulacral zones but some in interambulacral zones. Dorsally tube feet distributed over the whole surface. Body wall strongly contracted, with numerous folds; specimen auto-eviscerated.

Body wall with rods merging into rosettes (fig. 2A), dorsally 25-135 µm long (fig. 2A); ventrally only 25-80 µm, with fewer terminal dichotomous projections (fig. 2B). Tube feet with rods and rosettes similar to those of ventral body wall (fig. 3A). Tentacles with rods, spiny at their extremities, straight or curved, and 60-425 µm long (fig. 3B).

Remarks.— The specimen shows no variations with specimens from other parts of the Indo-Pacific area.

Distribution.— *Actinopyga echinites* is a very common species in the tropical Indo-West Pacific. It ranges from the Red Sea to Japan, Guam and New Caledonia.

Actinopyga lecanora (Jaeger, 1833)
(fig. 4A-G)

Synonymy.— See Cherbonnier, 1988: 20.

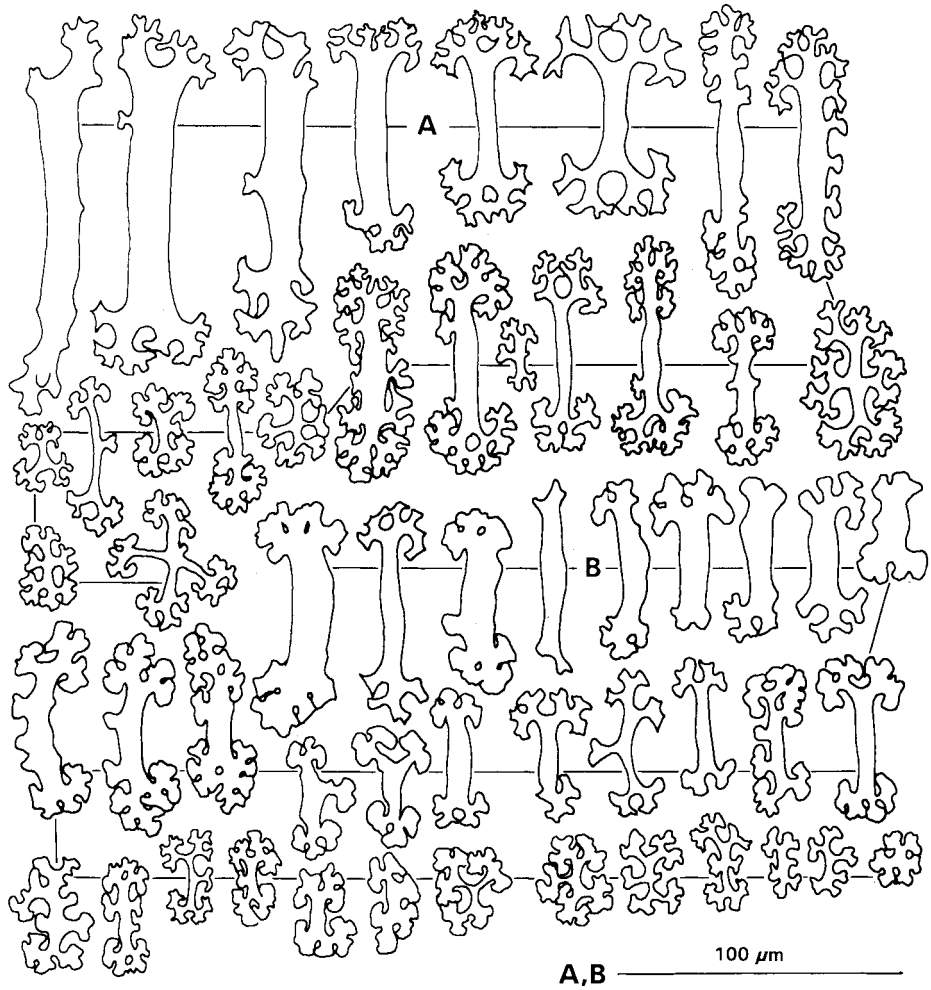

Fig. 2. *Actinopyga echinites* (Jaeger, 1833). A: rods and rosettes of the dorsal body wall; B: rods and rosettes of the ventral body wall.

Material.— RMNH Ech. 06040 (2 specimens).

Description.— Two small specimens 48 × 50 and 22 × 20 mm. Colour in alcohol white ventrally, beige or white-yellow mottled with brown dorsally; no lighter zone around the anus. Mouth ventral; anus dorsal, surrounded by five prominent anal teeth. Ventral tube feet restricted to ambulacra, with 2-6 rows of tube feet in each ambulacrum. Dorsally a few conical tube feet, scattered over the whole surface. The two specimens auto-eviscerated.

Body wall and tube feet with small rosettes (figs. 4A,B); no striking differences between ossicles of dorsal (fig. 4A) and ventral (fig. 4B) surfaces. Rosettes of tube feet (fig. 4C) similar to those of body wall. Ventral tube feet with a large terminal plate made up of several perforated plates. Dorsal tube feet with rosettes (fig. 4D), rods

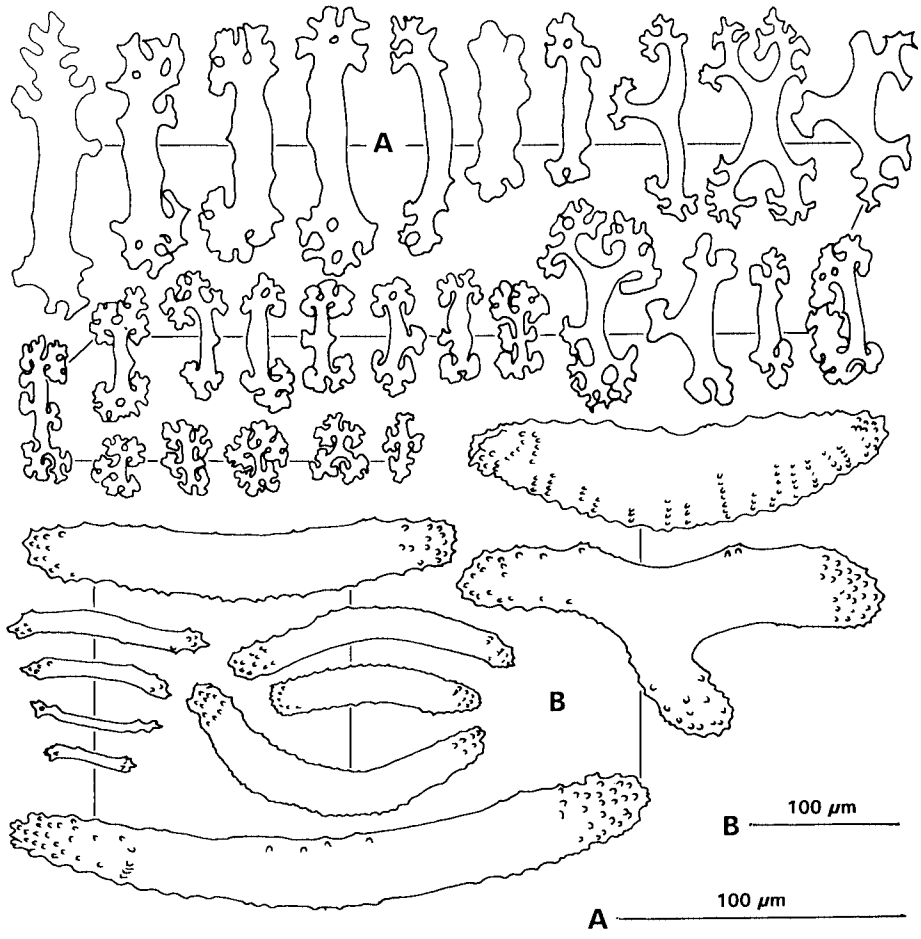

Fig. 3. *Actinopyga echinites* (Jaeger, 1833). A: rods and rosettes of the tube feet; B: rods of the tentacles.

(fig. 4E), and a small terminal plate, 100-150 µm across (fig. 4F). Rosettes and rods of dorsal tube feet in scattered concentrations which appear as white spots. Tentacles with rods, 60-220 µm long, straight or slightly arched, and spiny at their extremities (fig. 4G).

Remarks.— The ossicles of the two specimens agree fully with those of *Actinopyga lecanora*. However, the specimens do not exhibit the gray-white zone around the anus so characteristic of *A. lecanora* and usually visible on preserved specimens. The absence of this gray-white zone might be linked to the small size (50 mm long) of the specimens. Most of the descriptions in the literature (Pearson, 1914; Panning, 1931; Cherbonnier, 1988) bear upon much larger specimens (100-200 mm long).

Distribution.— *Actinopyga lecanora* is widely distributed in the tropical Indo-West Pacific ranging from Madagascar to New Caledonia, China and Japan.

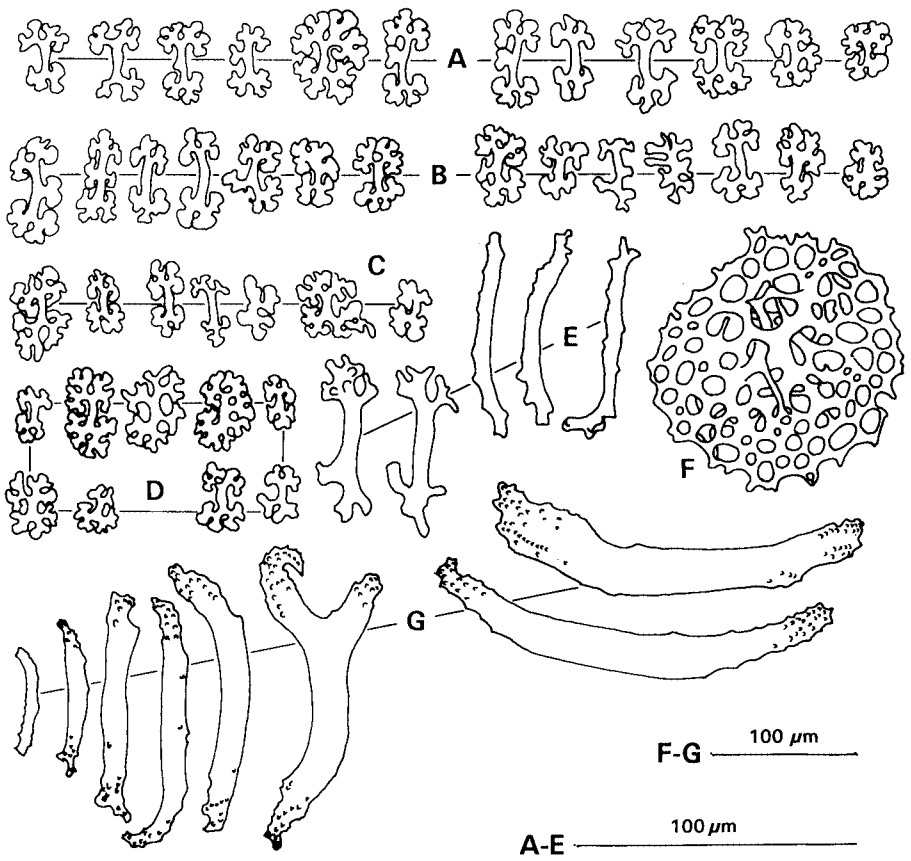

Fig. 4. *Actinopyga lecanora* (Jaeger, 1833). A: rosettes of the dorsal body wall; B: rosettes of the ventral body wall; C: rosettes of the ventral tube feet; D: rosettes of the dorsal tube feet; E: rods of the dorsal tube feet; F: terminal plate of a dorsal tube foot; G: rods of the tentacles.

Actinopyga mauritiana (Quoy & Gaimard, 1833) (fig. 5A-B)

Synonymy.— See Cherbonnier, 1988: 16.

Material.— RMNH Ech. 06020 (2 specimens).

Description.— Two specimens 140 × 65 and 170 × 80 mm. Colour in alcohol chocolate brown dorsally with white spots on one specimen; both with white spots around the anus. Ventrally light brown with numerous large tube feet. Mouth ventral; anus terminal, surrounded by five prominent yellow anal teeth. Distinction between dorsal and ventral surfaces clear. Both specimens very contracted and flattened with body wall smooth and thick.

Body wall with rosettes (fig. 5A) and spiny rods (fig. 5A). Ventrally rods shorter and more massive (fig. 5B) than dorsally, and rosettes replaced by round or oval

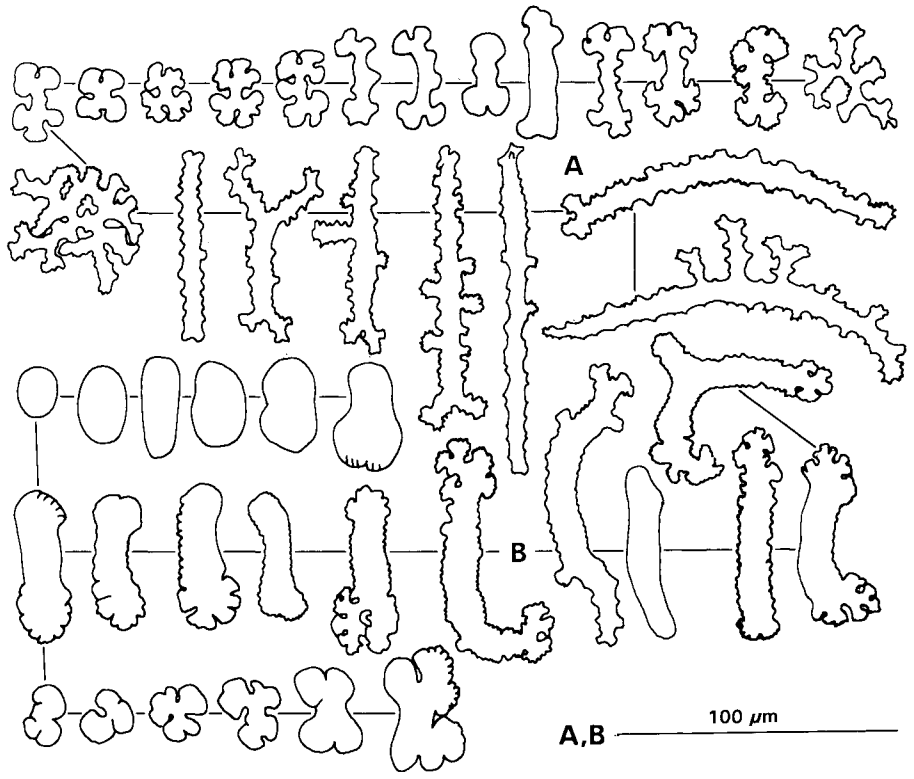

Fig. 5. *Actinopyga mauritiana* (Quoy & Gaimard, 1833). A: rods and rosettes of the dorsal body wall; B: rods and miliary granules of the ventral body wall.

smooth bodies (fig. 5B). No ossicles in tube feet, except for a large terminal plate (ca 500 µm across).

Remarks.— The specimens closely resemble those from other areas like Madagascar (Cherbonnier, 1988), East Africa (Panning, 1941), the Indian Ocean (Pearson, 1914), Japan (Mitsukuri, 1912), Guam (Rowe & Doty, 1977) and Hawaii (Fisher, 1907).

One and two eulimids (Mollusca, Gastropoda), respectively, are firmly attached to the body walls of the two specimens.

Distribution.— *Actinopyga mauritiana* is a common tropical Indo-West Pacific species.

Actinopyga miliaris (Quoy & Gaimard, 1833)
(figs 6A-F, 7A-B)

Synonymy.— See Cherbonnier & Féral, 1984a: 667.

Material.— RMNH Ech. 06031 (1 specimen).

Description.— Specimen 165 × 70 mm. Colour in alcohol uniform chocolate brown with ventral surface lighter. Mouth ventral; anus terminal, surrounded by five

prominent anal teeth. Ventral surface flat, dorsal arched. Specimen being very contracted, tube feet densely crowded on the whole ventral surface; narrow naked interambulacra no longer visible. Dorsal papillae less numerous than ventral tube feet, and distributed over the whole surface. Skin soft; body wall eight mm thick. No Cuvierian organs.

Body wall with rosettes only, similar dorsally (fig. 6A) and ventrally (fig. 6B). Tube feet with a few simple rosettes (fig. 6C), and a large terminal plate, up to 700 µm across, made up of several perforated plates. Dorsal papillae with rosettes and rods. Few rosettes, and of two sizes: 25-30 µm long (fig. 6D) and 45-80 µm long (fig. 6E). Rods also of two kinds: spiny, 55-230 µm long (fig. 7A), often with numerous lateral spiny processes, and smooth, 100-150 µm long (fig. 7B), sometimes rosette-like. Tentacles with rods, 45-250 µm long, spiny at their extremities (fig. 6F).

Discussion.— I refer this specimen with some doubt to *Actinopyga miliaris*. The

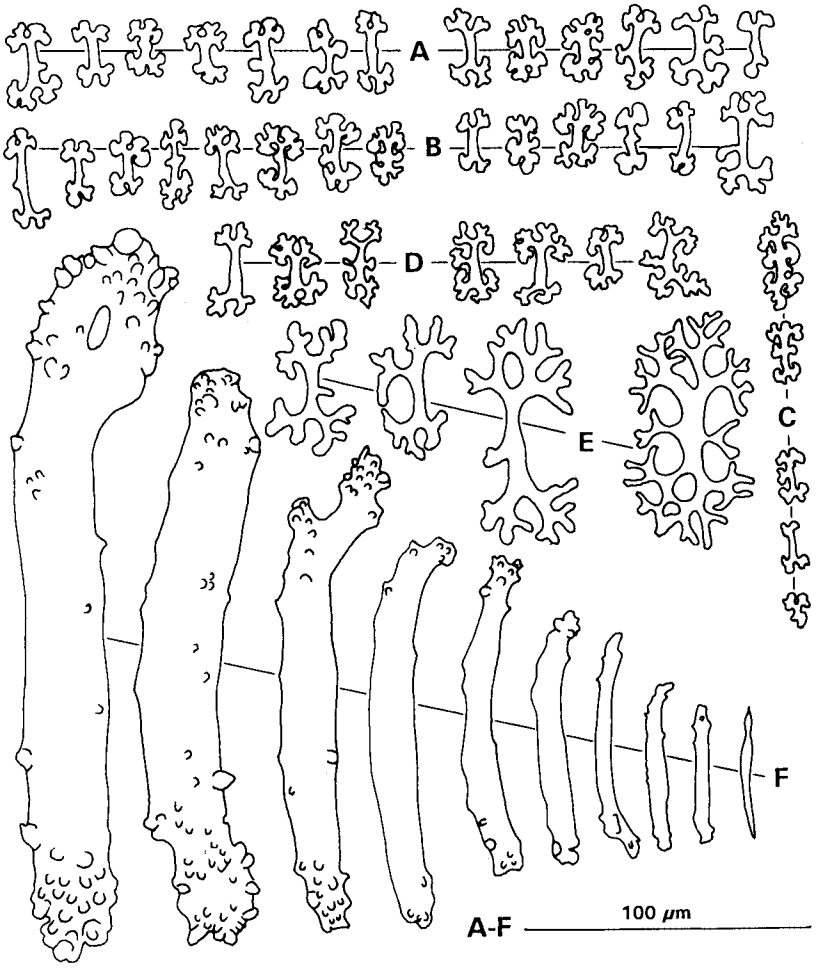

Fig. 6. *Actinopyga miliaris* (Quoy & Gaimard, 1833). A: rosettes of the dorsal body wall; B: rosettes of the ventral body wall; C: rosettes of the tube feet; D: small rosettes of the dorsal papillae; E: large rosettes of the dorsal papillae; F: rods of the tentacles.

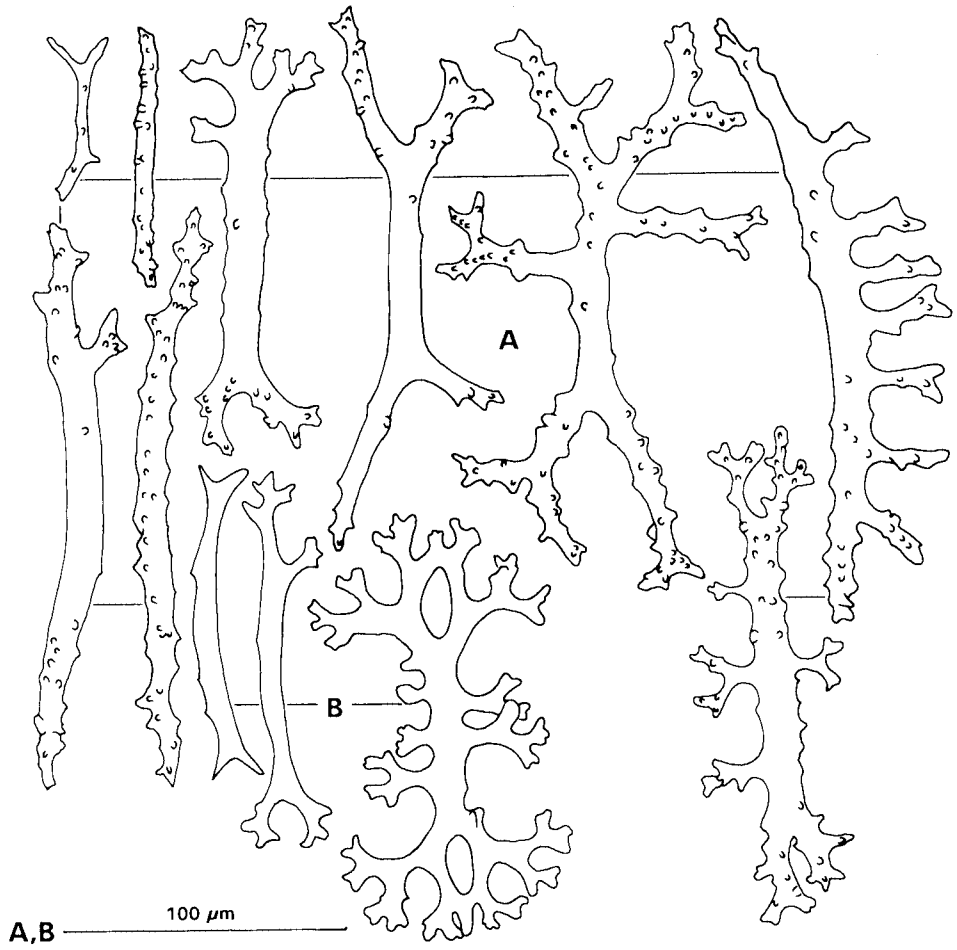

Fig. 7. *Actinopyga miliaris* (Quoy & Gaimard, 1833). Rods of the dorsal papillae. A: spiny; B: smooth.

colour, position of the tube feet, ossicles of the body wall, ventral tube feet and tentacles are in accordance with *A. miliaris*. However, the ossicles of the dorsal papillae appear to be distinctive. The long spiny rods have never been described from specimens from other areas. The ossicles of the dorsal papillae are not well known, and only figured for a few specimens (Cherbonnier & Féral, 1984a). Further study is needed to establish variation.

Distribution.— *Actinopyga miliaris* is widely distributed in the tropical Indo-West Pacific, from the Red Sea to Japan and Fiji.

Genus *Bohadschia* Jaeger, 1833
Bohadschia similis (Semper, 1868)
(fig. 8A-E)

Holothuria similis Semper, 1868: 85, 277, pl. XXV, pl. XXX, fig. 18; Lampert, 1885: 88; Théel, 1886: 204.

Holothuria (Bohadschia) similis; Panning, 1929 [1931]: 112, fig. 3d, e.
Bohadschia similis; Cherbonnier, 1954: 685, fig. 1a-g; Rowe, 1969: 130; Clark & Rowe, 1971: 176, 194; Cherbonnier, 1980: 616, fig. 1A-H; Féral & Cherbonnier, 1986: 78; Conand, 1989: 21.

Material.— RMNH Ech. 06014 (1 specimen).

Description.— Specimen 47 × 14 mm. Colour in alcohol gray-white ventrally, brown with darker elongated patches and numerous small brown spots corresponding to papillae dorsally. Mouth ventral, surrounded by 19 pale brown tentacles; anus terminal. Ventrally numerous tube feet in ambulacral and interambulacral zones. Dorsal papillae scattered over the whole dorsal surface. Calcareous ring thick; radial pieces twice as wide as interradial pieces and with an anterior notch (fig. 8A); interradial pieces with one central tooth (fig. 8A); long tentacular ampullae. Specimen partially auto-eviscerated; Cuvierian tubules present.

Ventral body wall with perforated grains and rosettes, 15-30 µm long (fig. 8C); dorsally small rods and very simple rosettes 10-30 µm long (fig. 8B). Ventral tube feet with rosettes and fine rods, 40-100 µm long with more or less numerous lateral and terminal projections (fig. 8D). Tentacles with rods, 50-210 µm long, smooth or spiny, with forked and/or perforated extremities (fig. 8E).

Discussion.— The specimen closely resembles the specimens described by Cherbonnier (1954) from Tahiti, except for the dorsal rosettes, which are much smaller. It also lacks imperforated grains in the body wall present in the 160 mm long specimen from New Caledonia studied by Cherbonnier (1980). These small differences could be linked to the small size of the Ambon specimen because it is well known that other aspidochirote holothurians such as *Actinopyga* species show variation of ossicles between juveniles and adults (Wiedemayer, 1994). Panning (1944) has already shown that the complexity of the branched rods increases with body size in adults of several species of *Bohadschia*. This was confirmed by Rowe & Doty (1977) who consider *Bohadschia similis* and *B. tenuissima* as synonyms of *B. marmorata* Jaeger, 1833. Panning (1931) had already considered *B. similis* and *B. tenuissima* as synonyms of *B. vitiensis* (Semper, 1868). More recently, Rowe & Gates (1995) considered that *B. vitiensis, B. tenuissima, B. similis, B. koellikeri* and *B. bivitata* as synonyms of *B. marmorata*. However, these authors recognize that their synonymies "may be too sweeping" and that "remaining type specimens and much more material are to be examined critically".

In contrast, Cherbonnier (1954, 1980, 1988), Clark & Rowe (1971), Féral & Cherbonnier (1986) and Conand (1989) consider *B. similis, B. tenuissima, B. vitiensis* and *B. marmorata* to be distinct species. Obviously, the different *Bohadschia* species show a great variation in their ossicles, and overlapping occurs between accepted species. For *Bohadschia* species we lack ontogenic information about the ossicles from the early juvenile to the adult. Provisionally, I am maintaining *B. similis* and *B. tenuissima* as different species.

Distribution.— *Bohadschia similis* has been reported previously from Mauritius, La Réunion, the Philippines, New Caledonia and Tahiti.

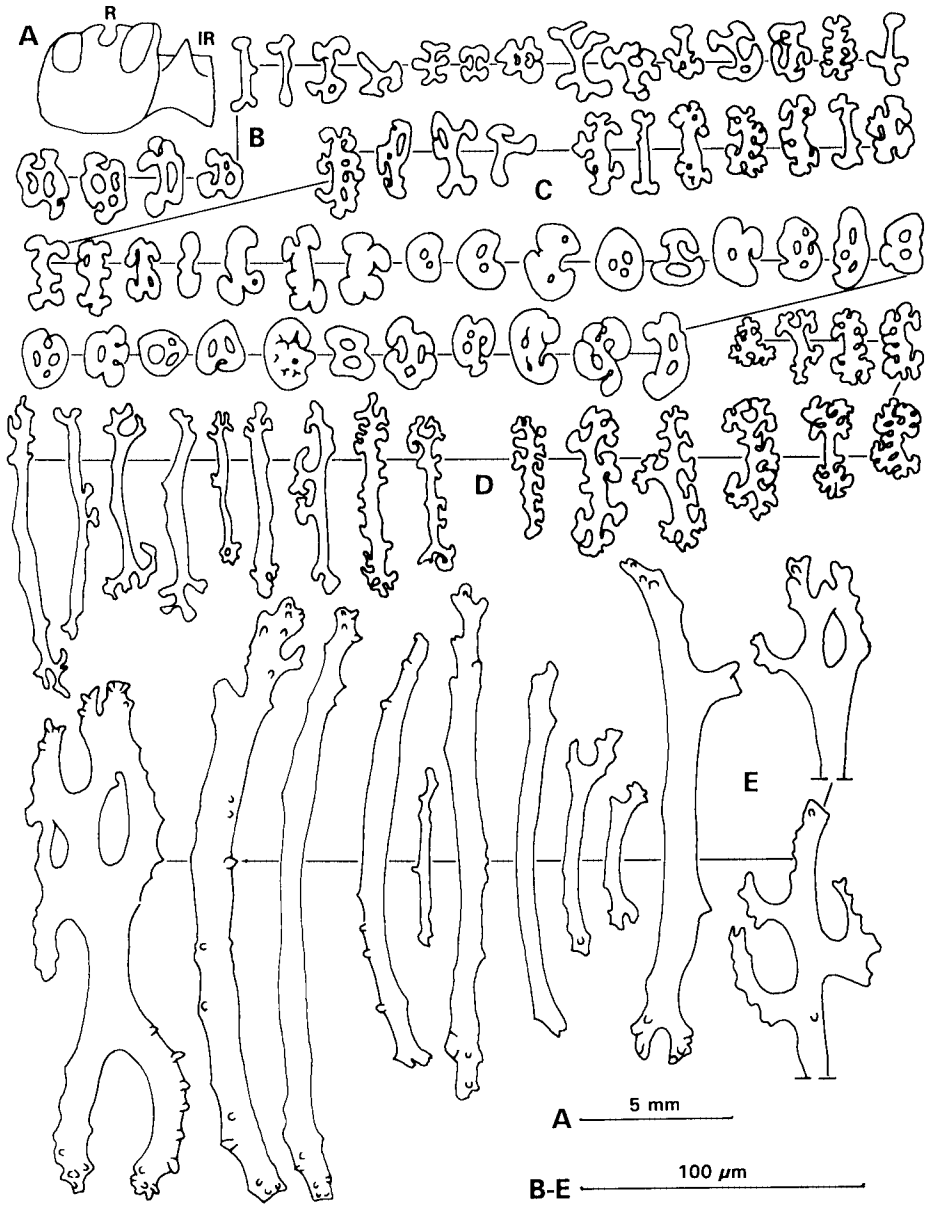

Fig. 8. *Bohadschia similis* (Semper, 1868). A: calcareous ring (R: radial piece; IR: interradial piece); B: rosettes of the dorsal body wall; C: rosettes of the ventral body wall; D: rods and rosettes of the tube feet; E: rods of the tentacles.

Bohadschia tenuissima (Semper, 1868)
(fig. 9A-E)

Holothuria tenuissima Semper, 1868: 85, 248, pl. XXX, fig. 20; Lampert, 1885: 88; Ludwig, 1882: 136;

Théel, 1886: 204; Sluiter, 1887: 185; Koehler, 1895: 383; Sluiter, 1901: 14; Pearson, 1903: 201; Koehler & Vaney, 1908: 16.

Bohadschia marmorata tenuissima; Panning, 1944: 42.

Bohadschia tenuissima; Cherbonnier, 1955: 135, pl. 22, figs. j-s; Cherbonnier, 1963: 5; Rowe, 1969: 130. Clark & Rowe, 1971: 176; Cherbonnier, 1980: 618, fig. 2A-J; Féral & Cherbonnier, 1986: 78; Cannon & Silver, 1986: 21; Cherbonnier, 1988: 46, fig. 16A-J; Conand, 1989: 21.

Material.— RMNH Ech. 06011 (1 specimen), 06012 (1 specimen)

Description.— Specimens equally large: 180 x 60 mm. Colour in alcohol beige to light brown with numerous brown spots corresponding to the papillae and tube feet. Papillae and tube feet not arranged in rows. Mouth ventral, anus terminal. Specimens partially auto-eviscerated. Very long Cuvierian tubules still visible.

Ventral body wall with perforated and unperforated grains, 20-30 µm long (fig. 9A), and massive rosettes (figs 9A,B); dorsally body wall with rosettes 15-20 µm long (fig. 9C). Tube feet with rods (fig. 9D), often cross-shaped, and a few rosettes. Sucker of tube foot with a large terminal perforated plate 400-450 µm across. Tentacles with spiny rods, 65-180 µm long, sometimes curved (fig. 7E).

Remarks.— Several eulimid gastropods and one *Lissocarcinus orbicularis* Dana, 1852 (Crustacea, Brachyura) were found on the body wall.

The colour of the two specimens is more reminiscent of *B. similis* than of *B. tenuissima*. However, the ossicles, particularly those of the tube feet, are typical of *B. tenuissima*.

Distribution.— *Bohadschia tenuissima* has been reported from the Red Sea, Madagascar, the Indian Ocean, Indonesia, the Philippines and the Samoan Islands.

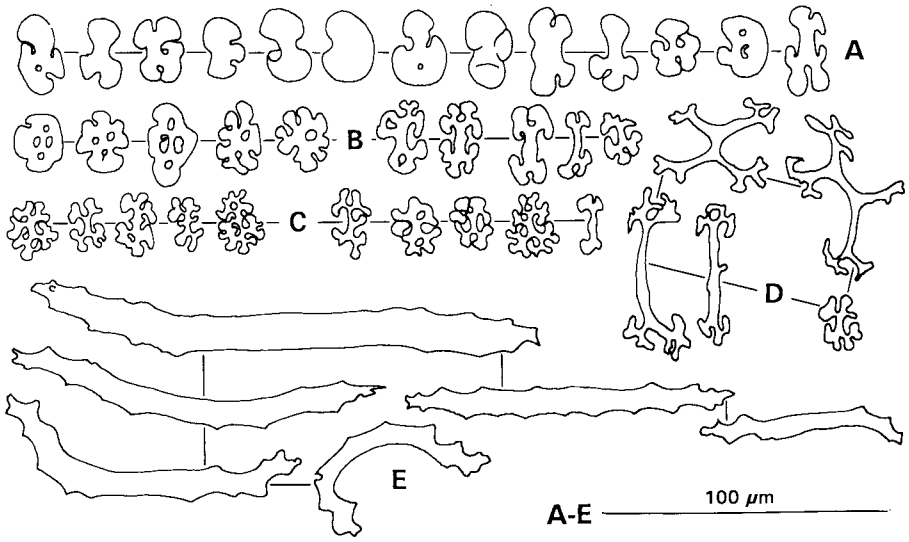

Fig. 9. *Bohadschia tenuissima* (Semper, 1868). A: grains of the ventral body wall; B: rosettes of the ventral body wall; C: rosettes of the dorsal body wall; D: rods of the tube feet; E: rods of the tentacles.

Genus *Holothuria* Linnaeus, 1767
Subgenus *Halodeima* Pearson, 1914
Holothuria (Halodeima) atra Jaeger, 1833
(fig. 10A-E)

Synonymy.— See Cherbonnier, 1988: 73.

Material.— RMNH Ech. 06025 (1 specimen); RMNH Ech. 06034 (1 specimen); RMNH Ech 06035 (1 specimen).

Description.— Size of specimens 125 × 25, 150 × 30 and 160 × 30 mm. Colour in alcohol completely black. Mouth ventral, surrounded by 20 black tentacles; anus terminal. Tube feet distributed over the whole surface, ventrally more numerous than dorsally; not arranged in rows. Body wall with tables (fig. 10A) and rosettes (fig. 10B). Tables with a small disc with four central and four peripheral perforations; edge of the disc sometimes with prominent spines; four pillars with one cross beam; pillars ending in a crown of spines forming a Maltese cross. Rosettes often incomplete, with two perforations, sometimes four (fig. 10B). Tube feet with tables reduced to the disc (fig. 10C), rosettes (fig. 10D), and pseudo-plates (fig. 10E).

Remarks.— On the smallest specimen, from station 17 (RMNH Ech. 06025), there are 24 eulimid gastropods representing at least two species.

In the tropical Indo-West Pacific *Holothuria atra* is probably the most common

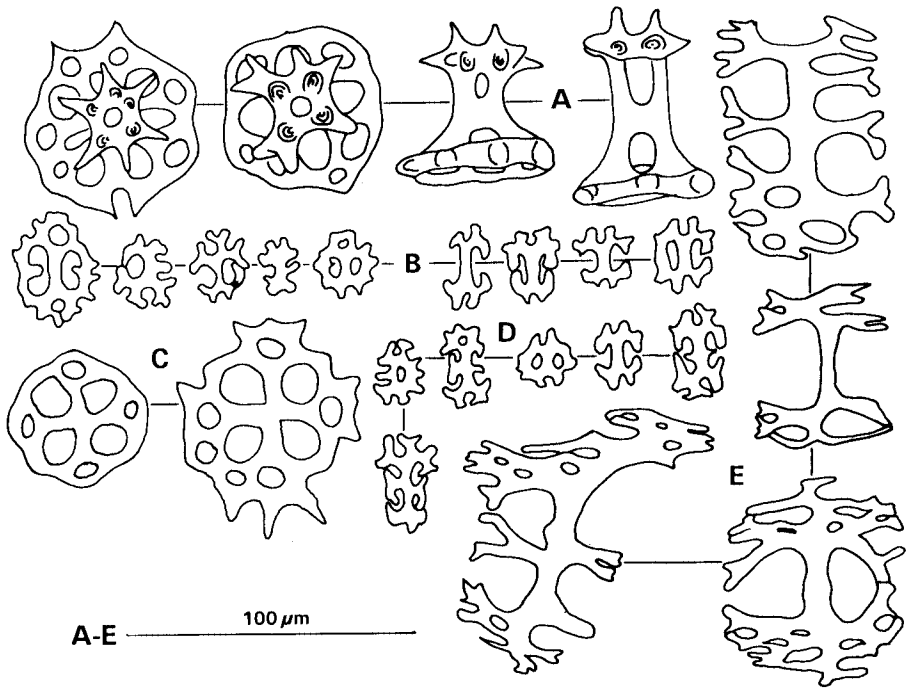

Fig. 10. *Holothuria (Halodeima) atra* Jaeger, 1833. A: tables of the body wall; B: rosettes of the body wall; C: tables of the tube feet; D: rosettes of the tube feet; E: pseudo-plates of the tube feet.

large shallow water holothurian, reaching densities on reef flats of up to 52/m^2 (Lawrence, 1980).

Distribution.— *Holothuria atra* is widely distributed in the tropical Indo-West Pacific, ranging from the Red Sea to Hawaii and Tahiti.

Holothuria (*Halodeima*) *edulis* Lesson, 1830
(fig. 11A-G)

Synonymy:.— See Cherbonnier, 1988: 75.

Material.— RMNH, Ech. 06013 (1 specimen); RMNH Ech. 06029 (1 specimen); RMNH Ech. 06033 (2 specimens).

Description.— Specimens 115-245 x 20-40 mm. Colour in alcohol brown dorsally, and gray-white, sometimes with orange lines, ventrally. Paler specimens light brown with almost no difference between dorsal and ventral surfaces. Mouth ventral, surrounded by 20 tentacles; anus terminal or subdorsal, and bordered by a black line. Ventral tube feet as black spots, all over the surface except near the anus where they are arranged in 3-5 rows in each ambulacrum. Dorsal papillae less numerous than tube feet, and distributed over the whole dorsal surface.

Body wall with tables and rosettes. Tables (fig. 11A) without disc and with apex of pillars ending in four points each forming a Maltese cross (fig. 11A); one cross beam. Tables identical ventrally and dorsally. Most of the rosettes with four perforations: two small and two large (fig. 11C); dorsally more perforations sometimes present (fig. 11B). Ventral rosettes less numerous and smaller than dorsal ones (fig. 11C). Tube feet with large perforated plates (fig. 11D), rods (fig. 11E) and a few large pseudo-buttons (fig. 11F). Tentacles with rods, 30-215 µm long, with spiny extremities (fig. 11G); smallest rods curved and sometimes bifurcated.

Remarks.— *Holothuria edulis* is one of the most common tropical Indo-West Pacific species. It is fairly consistent in colour and ossicles throughout its area of distribution.

Distribution.— *Holothuria edulis* is widely spread in the tropical Indo-Pacific, from the Red Sea to Hawaii and Tahiti.

Subgenus *Lessonothuria* Deichmann, 1958
Holothuria (*Lessonothuria*) *pardalis* Selenka, 1867
(figs 12A-D, 13A-E)

Synonymy.— See Cherbonnier, 1988: 117.

Material.— RMNH Ech. 06044 (4 specimens).

Description.— Small holothurians, 26-57 x 9-16 mm with body tapering anteriorly and posteriorly. Colour in alcohol brown with numerous yellow-cream to orange dots ventrally and dorsally; dots correspond to ventral tube feet or to dorsal warts on which the tube feet arise. Tube feet distributed over the whole body surface, ventrally more numerous than dorsally. In small specimens rows of tube feet visible posteriorly.

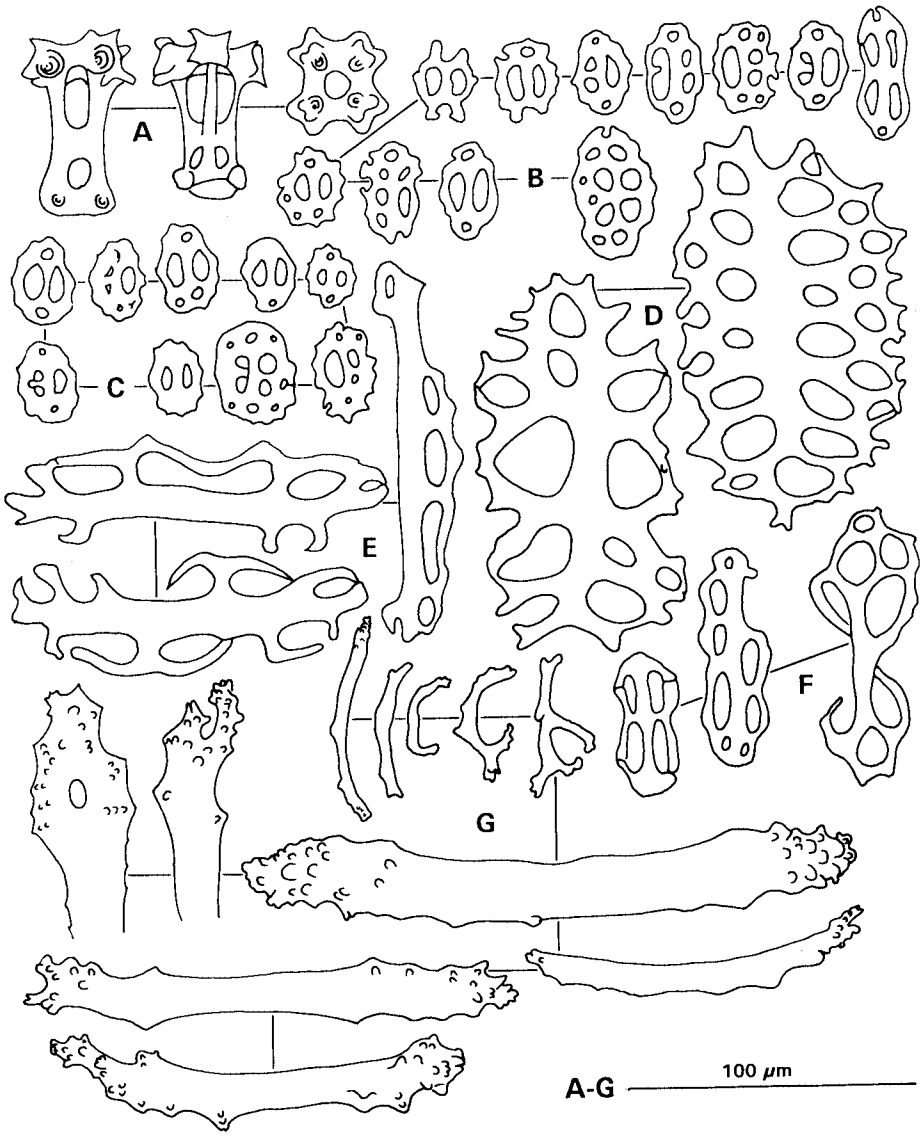

Fig. 11. *Holothuria* (*Halodeima*) *edulis* Lesson, 1830. A: tables of the body wall; B: rosettes of the dorsal body wall; C: rosette of the ventral body wall; D: plates of the tube feet; E: rods of the tube feet; F: pseudo-buttons of the tube feet; G: rods of the tentacles.

Mouth and anus terminal. Body wall thin and rough. Two Polian vesicles, and a short and contorted stone canal. Tentacular ampullae very short. Cuvierian tubules absent.

Body wall with buttons (fig. 12A) and tables (fig. 12B). Buttons 70-140 µm long and often irregular. Table disc with a toothed edge, and very low pillars ending in a ring of spines. Ventral tube feet with tables (fig. 12C), buttons, and large perforated plates (fig. 12D); terminal plate 300-320 µm across. Dorsal tube feet with tables (fig. 13A), buttons (fig. 13B), curved or V-shaped, smooth rods with perforated extrem-

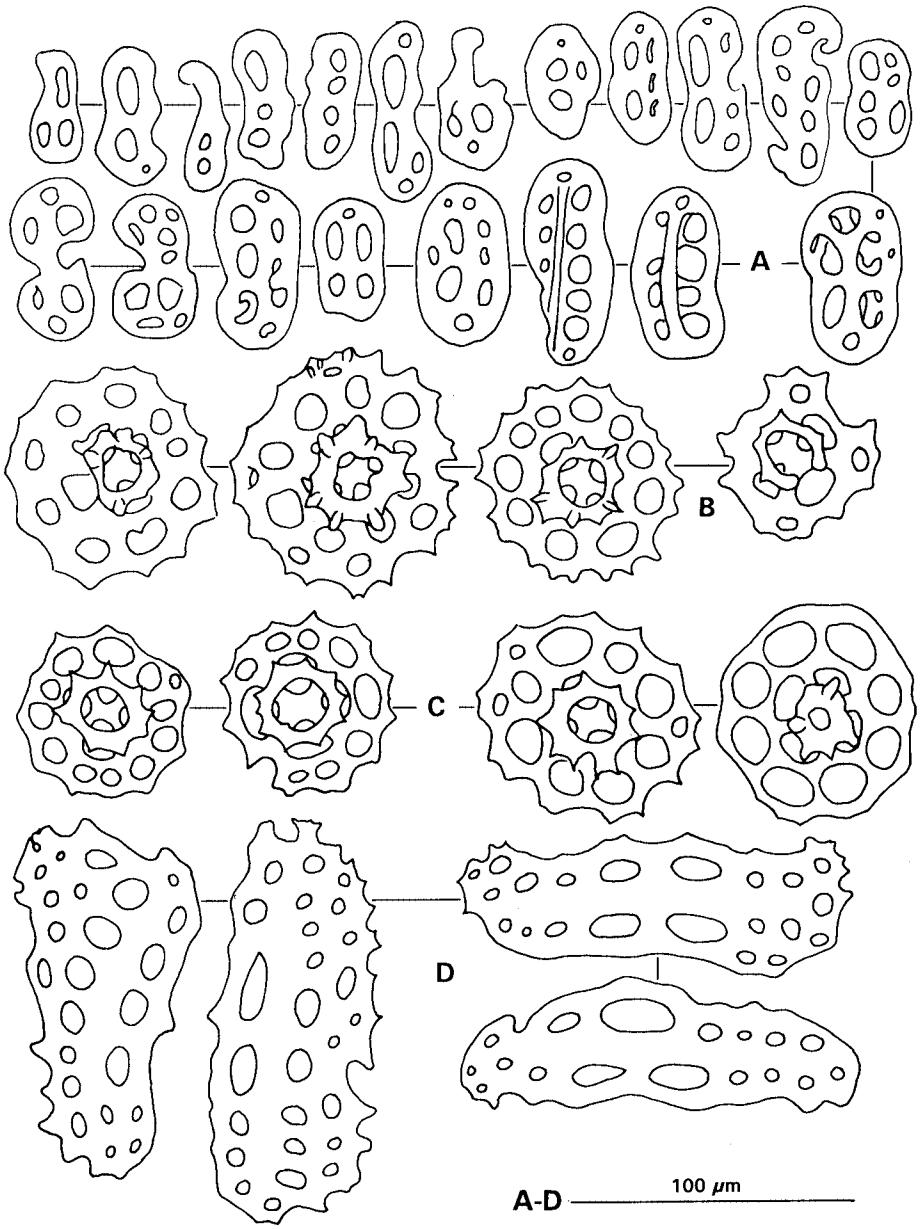

Fig. 12. *Holothuria* (*Lessonothuria*) *pardalis* Selenka, 1867. A: buttons of the body wall; B: tables of the body wall; C: tables of the ventral tube feet; D: plates of the ventral tube feet.

ities (fig. 13C), and a small terminal perforated plate, 180-200 µm across (fig. 13D). Tentacles with small, smooth rods (fig. 13E).

Discussion.— *Holothuria pardalis* is a variable species regarding the body wall colour pattern and form and size of the ossicles. For example, the size of the terminal plate of the tube feet are 380-420 µm in diameter in specimens from Madagascar

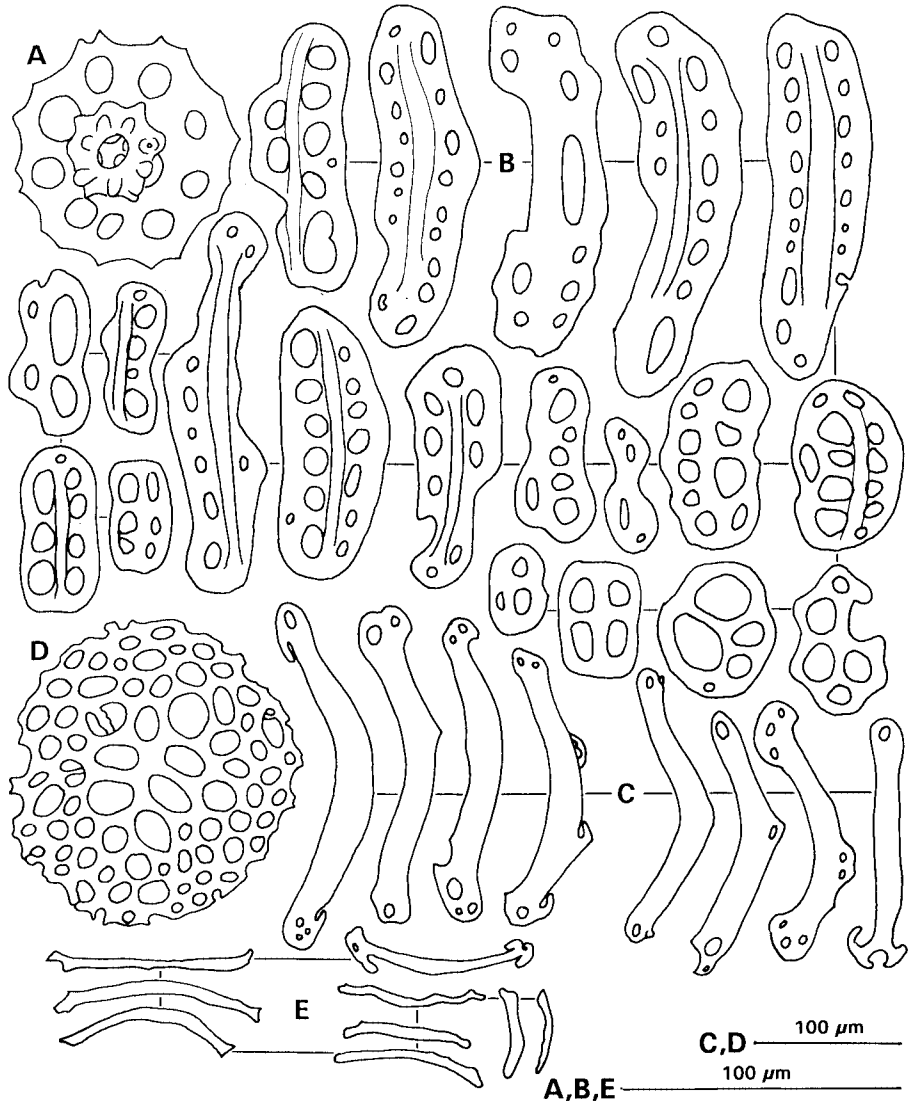

Fig. 13. *Holothuria* (*Lessonothuria*) *pardalis* Selenka, 1867. A: table of the dorsal tube feet; B: buttons of the dorsal tube feet; C: rods of the dorsal tube feet; D: terminal plate of a dorsal tube foot; E: rods of the tentacles.

(Cherbonnier, 1988), 240-260 µm in specimens from the Red Sea (Cherbonnier, 1955), and 300-320 µm in specimens from Ambon (present study). The presence of Cuvierian tubules is not constant. Cherbonnier mentioned them to be absent in 72 specimens from Madagascar (Cherbonnier, 1988), but he reported their presence in specimens from the Red Sea (Cherbonnier, 1955). Mitsukuri (1912) observed them in specimens from Japan, but they were always reduced to very short tubes at the bifurcation of the respiratory trees.

Distribution.— *Holothuria pardalis* is found throughout the tropical Indo-West Pacific, from the Red Sea to Japan and Hawaii.

Holothuria (*Lessonothuria*) cf. *verrucosa* Selenka, 1867
(figs 14A-D, 15A-G)

Synonymy.— See Cherbonnier, 1988: 121.

Material.— RMNH Ech. 06018 (1 specimen).

Description.— Specimen 15 × 4 mm. Mouth sub-ventral, anus terminal. Ventral tube feet arranged in two rows in each ambulacrum. Dorsal warts each bearing a dorsal papilla. Ventral surface flat, dorsum arched. Colour in alcohol gray-white, with a few small brown spots ventrally and with brown spots or brown transverse bands in between warts dorsally.

Body wall with tables, buttons and pseudo-buttons. Ventrally tables 60-70 µm across (fig. 14A) with the disc perforated by four central and 8-10 peripheral holes; four short pillars, without cross beam, and ending in a small crown of 7-9 spines;

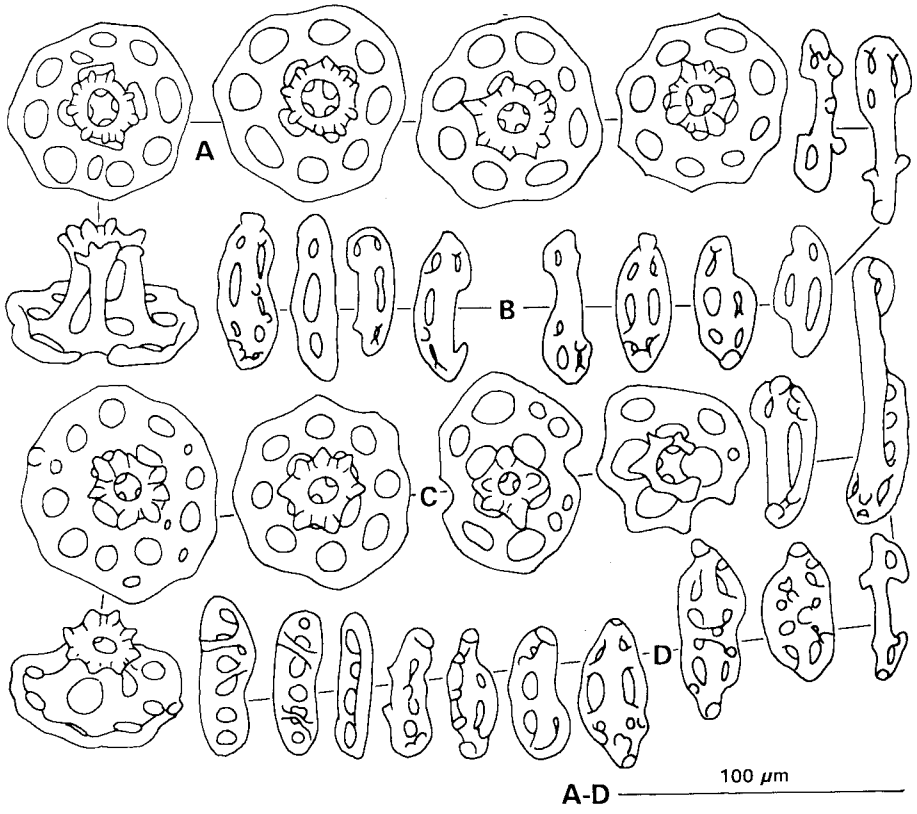

Fig. 14. *Holothuria* (*Lessonothuria*) cf. *verrucosa* Selenka, 1867. A: tables of the ventral body wall; B: pseudo-buttons of the ventral body wall; C: tables of the dorsal body wall; D: buttons and pseudo-buttons of the dorsal body wall.

edge of the disc smooth. Buttons (fig. 14B) and pseudo-buttons (fig. 14B) 40-65 µm long, very irregular and knobbed. Dorsally tables (fig. 14C) similar to ventral ones; some smaller and irregular (fig. 14C); buttons and pseudo-buttons 40-90 µm long (fig. 14D). Dorsal tube feet with smooth rods, 60-200 µm long, perforated at their extremities (fig. 15A), and a small terminal plate 125-150 µm across (fig. 15B). Ventral tube feet with mainly tables (fig. 15C), a few pseudo-buttons at the base (fig. 15D) and a large perforated plate 240-260 µm across at the apex (fig. 15E), surrounded by

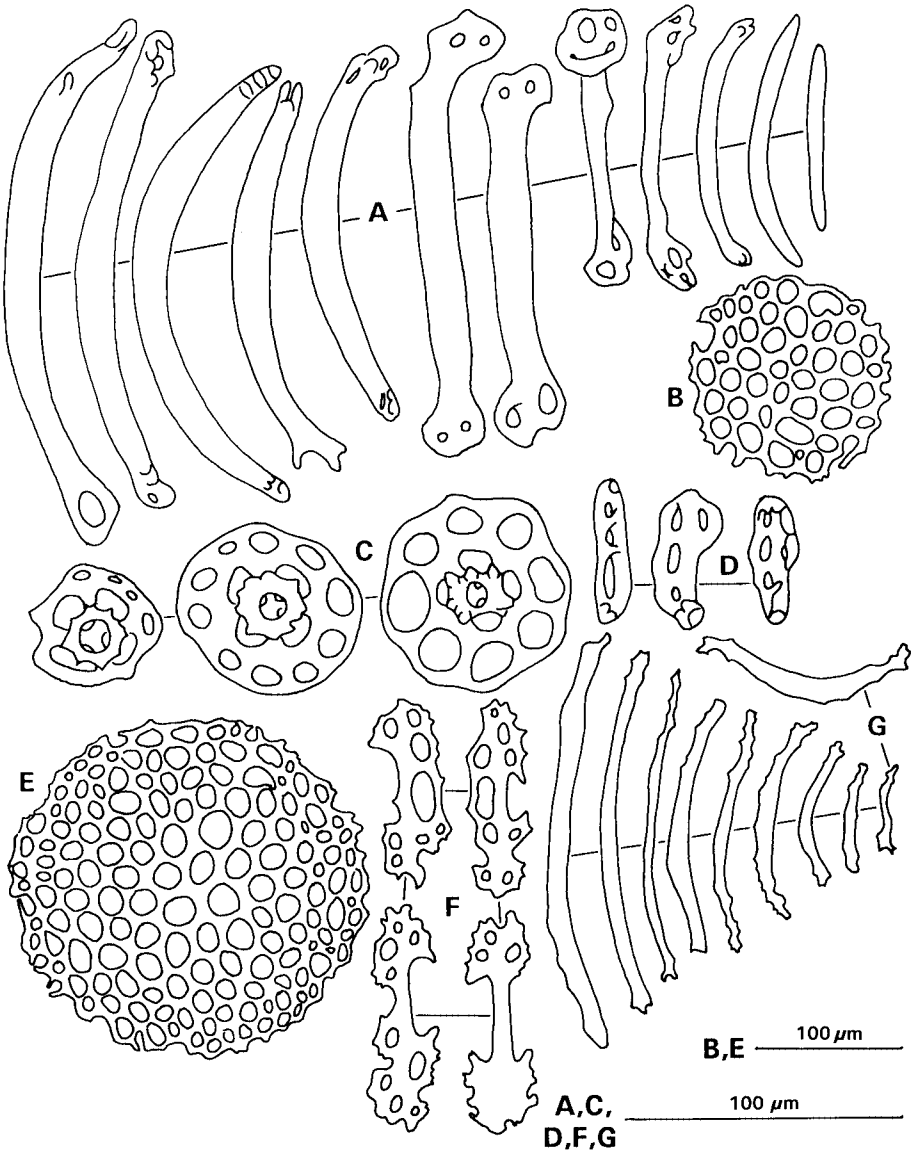

Fig. 15. *Holothuria* (*Lessonothuria*) cf. *verrucosa* Selenka, 1867. A: rods of the dorsal tube feet; B: terminal plate of a dorsal tube foot; C: tables of the ventral tube feet; D: pseudo-buttons of the ventral tube feet; E: terminal plate of a ventral tube foot; F: small plates of the ventral tube feet; G: rods of the tentacles.

smaller plates, 125-150 µm long (fig. 15F). Tentacles with straight to slightly curved spiny rods, 25-150 µm long (fig. 15G).

Discussion.— This specimen is obviously a juvenile, with its reduced number of ventral tube feet. However, the buttons and pseudo-buttons of the body wall, the rods of the dorsal tube feet, and the rods of the tentacles are so close to *H. (L.) verrucosa* Selenka, 1867, that we are most probably dealing with this species. It differs from specimen of *H. (L.) verrucosa* by the edge of the table disc being smooth instead of spiny. This is not necessarily a species difference because ossicles may be more spiny with increasing body size, as observed in some dendrochirote holothurians (Massin, 1994). The tables of the Ambon specimen also show similarity with some tables of *H. (L.) glandifera* Cherbonnier, 1955, from Tahiti.

Distribution.— *Holothuria verrucosa* is present throughout the tropical Indo-West Pacific, from Madagascar to Hawaii and from China to New Caledonia.

Subgenus *Metriatyla* Rowe, 1969
Holothuria (Metriatyla) scabra Jaeger, 1833
(figs 16A-F, 17A-D)

Synonymy.— See Cherbonnier, 1988: 135.

Material.— RMNH Ech. 06049 (1 specimen).

Description.— Specimen strongly contracted, 50 × 30 mm. Colour in alcohol white with numerous black spots ventrally and gray-black dorsally. Mouth ventral, surrounded by 20 tentacles; anus terminal. Tube feet numerous, scattered dorsally and ventrally, less numerous dorsally than ventrally. Body wall two mm thick, rough, dorsally with numerous transverse folds.

One long Polian vesicle and one very long (18 mm) stone canal. Tentacular ampullae well developed (9-10 mm long). Calcareous ring stout, with radial pieces twice as large as the interradial pieces. Radial pieces with a large, deep anterior notch; interradials with a long anterior tooth (fig. 16A).

Body wall with tables (figs 16B, D), buttons (figs 16C, E), and rods (fig. 16F). Tables 75-100 µm across with edge of the disc smooth; disc with four central holes and 8-10 peripheral holes; four short pillars with one cross beam, and ending in a crown of spines with a large central hole. Buttons nodular, the largest being the most nodular, 45-80 µm long, with 3-5 pairs of holes. Tables and buttons similar dorsally and ventrally. Ventrally a few rods, 140-190 µm long (fig. 16F). Tube feet with tables (fig. 17A), buttons (fig. 17B), and rods (fig. 17C); rods 125-200 µm long, with numerous perforations. Tentacles with rods, 60-290 µm long, spiny at their extremities (fig. 17D); smallest rods spiny over their whole surface.

Remarks.— Three eulimid gastropods are attached to the body wall.

The specimen here examined is a juvenile, but has already all the characteristics (colour and ossicles) of an adult.

Distribution.— *Holothuria scabra* is very common in the tropical Indo-West Pacific, from the Red Sea to China, Japan and New Caledonia.

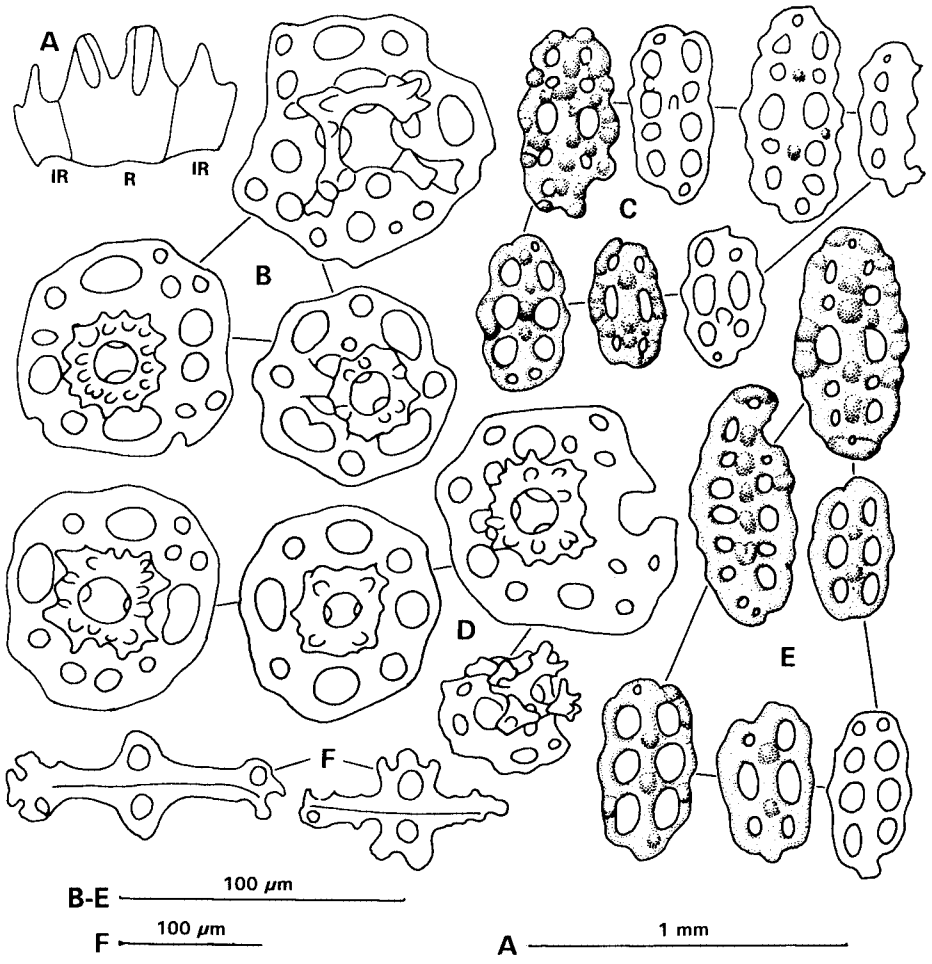

Fig. 16. *Holothuria* (*Metriatyla*) *scabra* Jaeger, 1833. A: calcareous ring (R: radial piece; IR: interradial piece); B: tables of the dorsal body wall; C: buttons of the dorsal body wall; D: tables of the ventral body wall; E: buttons of the ventral body wall; F: rods of the ventral body wall.

Subgenus *Selenkothuria* Deichmann, 1958
Holothuria (*Selenkothuria*) *mactanensis* Tan Tiu, 1981
(fig. 18A-E)

Holothuria (*Selenkothuria*) *mactanensis* Tan Tiu, 1981: 72, pl. 15 figs. 1-2.

Material.— RMNH Ech. 06021 (1 specimen).

Description.— Specimen 74 × 30 mm; body narrows strongly anteriorly and weakly posteriorly. Colour in alcohol chocolate brown with ventral surface paler. Dorsal tube feet distributed over the whole dorsal surface; ventrally tube feet somewhat more crowded along ambulacra, but also present in interambulacra. Skin soft,

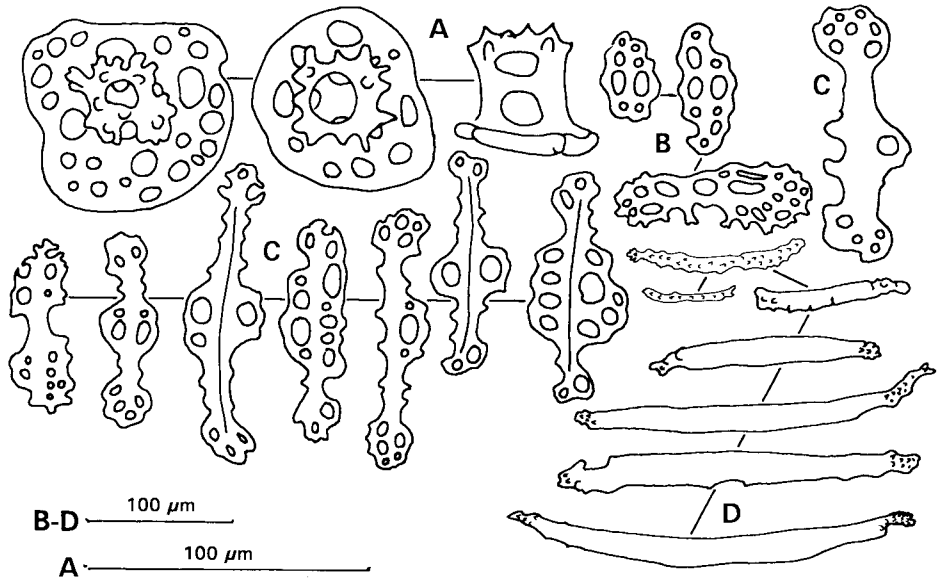

Fig. 17. *Holothuria (Metriatyla) scabra* Jaeger, 1833. A: tables of the tube feet; B: buttons of the tube feet; C: rods of the tube feet; D: rods of the tentacles.

smooth and thin (1 mm). One large Polian vesicle; tentacular ampullae long (8 mm) and narrow. Calcareous ring with radial pieces wider and higher than interradial pieces; radial pieces with a small anterior notch; interradial low, with a narrow long anterior tooth (fig. 18A). Cuvierian tubules numerous, short and white.

Body wall with rods only (figs. 18B,C); dorsally 50-120 µm long, granular, perforated or forked at their extremities (fig. 18B) with edges straight or sinuous; ventrally 50-90 µm long, wider than dorsally, and some completely smooth (fig. 18C). Ventral and dorsal tube feet with a few rods at the base (figs. 18D,E), similar to those of the body wall; dorsally rods less granular. Both ventral and dorsal tube feet with a terminal plate 550-600 µm and 250-290 µm across, respectively. No ossicles in the tentacles.

Remarks.— *Holothuria mactanensis* is very easy to distinguish from the 13 species described in the subgenus *Selenkothuria* because its rods have a smooth, sinuous edge, no lateral perforations and a smooth or granular surface. All the other species have perforations along the edge of the rods. *H. mactanensis* is closely related to *H. (S.) sinica* Liao, 1980, from China. *H. sinica* differs from *H. mactanensis* by the edge of the rods being ragged and/or perforated.

The present specimen from Ambon is the second known specimen and shows no differences from the holotype. The species is new to the fauna of Indonesia.

Distribution.— Mactan Island (Central Philippines), Ambon.

Subgenus *Thymiosycia* Pearson, 1914
Holothuria (Thymiosycia) arenicola Semper, 1868
(fig. 19A-E)

Synonymy.— See Cherbonnier, 1988: 82.

Material.— RMNH Ech. 06045 (1 specimen).

Description.— Specimen elongate, cylindrical, 120 × 15 mm. Colour in alcohol white-yellow ventrally, and yellow-beige with a double row of brown spots dorsally; anteriorly body wall more brown. Body wall soft, thin and rough. Mouth and anus

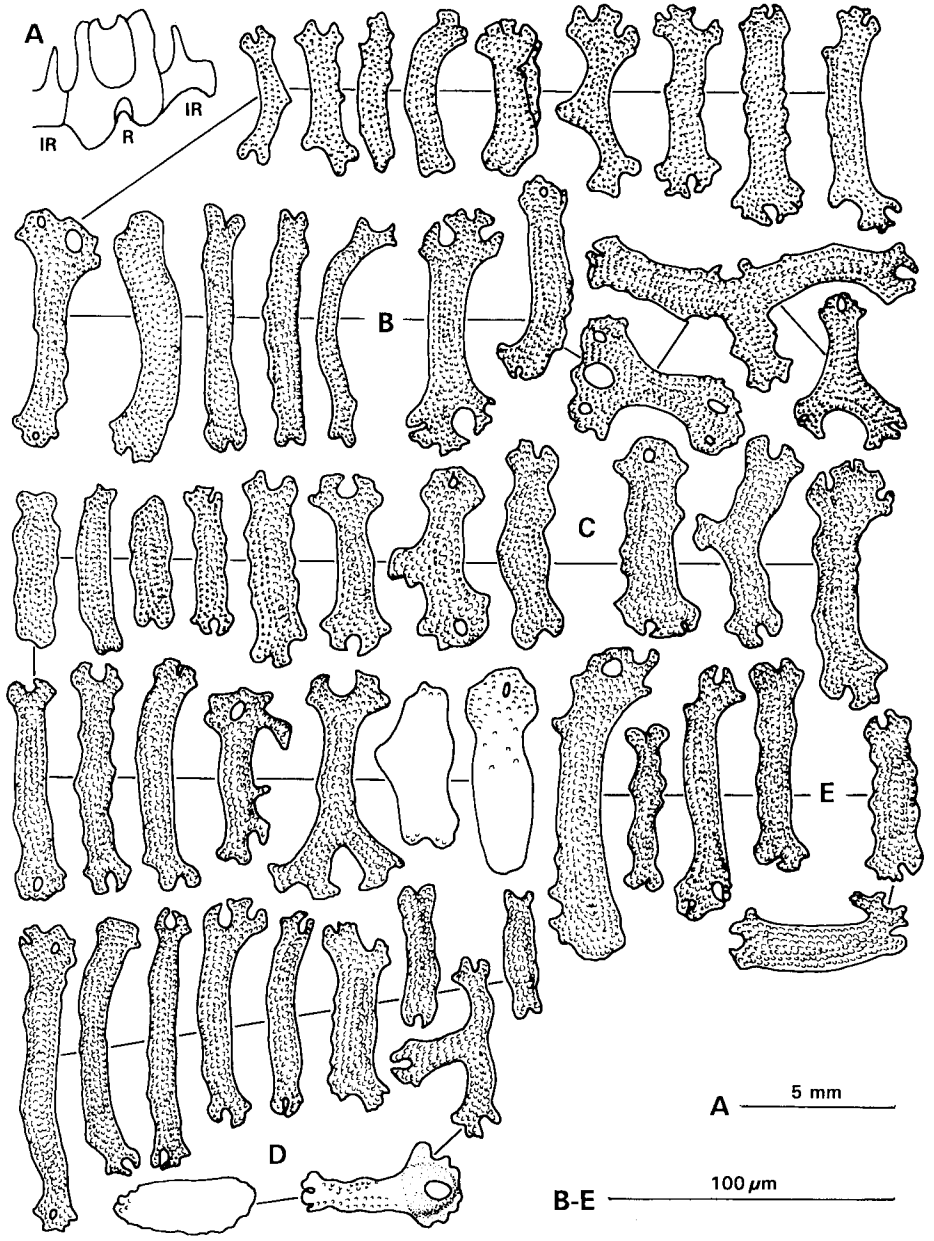

Fig. 18. *Holothuria* (*Selenkothuria*) *mactanensis* Tan Tiu, 1981. A: calcareous ring (R: radial piece; IR: interradial piece); B: rods of the dorsal body wall; C: rods of the ventral body wall; D: rods of the dorsal tube feet; E: rods of the ventral tube feet.

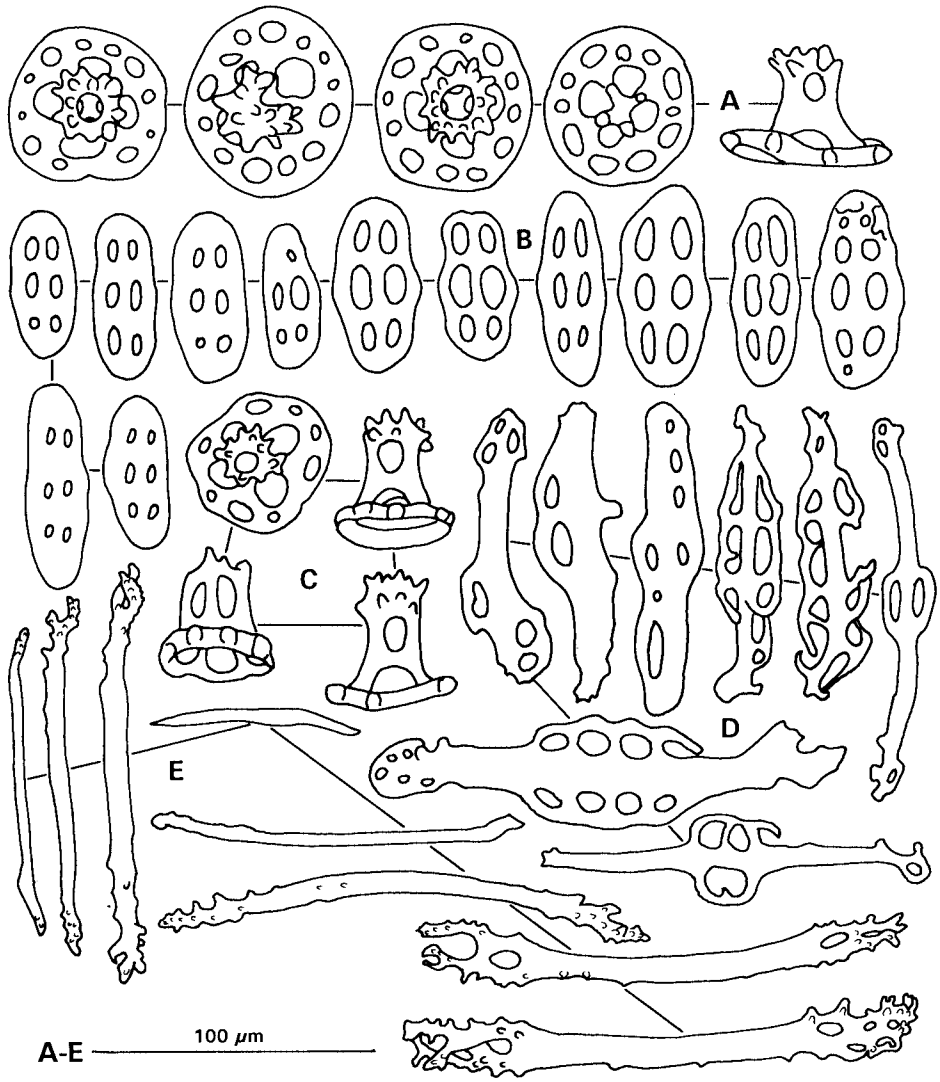

Fig. 19. *Holothuria* (*Thymiosycia*) *arenicola* Semper, 1868. A: tables of the body wall; B: buttons of the body wall; C: tables of the ventral tube feet; D: rods of the ventral tube feet; E: rods of the tentacles.

terminal; anus surrounded by five groups of three tube feet. Dorsally and ventrally tube feet distributed over the whole surface.

Body wall with tables (fig. 19A) and buttons (fig. 19B). Tables 45-65 µm across with a rounded disc perforated by four central and 10-13 peripheral holes; pillars short with one cross beam and ending in a crown of spines. Buttons smooth (except for a few large ones with nodules), 50-70 µm long with 3-5 pairs of holes (three being the most common) (fig. 19B). Tube feet with small tables, 40-50 µm across (fig. 19C), and perforated rods, 95-170 µm long (fig. 19D). Tentacles with rods, spiny at their extremities (fig. 19E); largest rods with perforated and/or forked extremities.

Remarks.— *Holothuria arenicola* shows no ossicle variation throughout its distributional range, and the description given by Cherbonnier (1988) for specimens from Madagascar is in accordance with the specimen from Ambon.

Distribution— *Holothuria arenicola* is well distributed in the tropical Indo-West Pacific, from the Red Sea to Japan and Hawaii

Holothuria (Thymiosycia) hilla Lesson, 1830
(fig. 20A-G)

Synonymy.— See Cherbonnier, 1988: 85.

Material.— RMNH Ech. 06022 (1 specimen): RMNH Ech. 06026 (1 specimen); RMNH Ech. 06036 (3 specimens); RMNH Ech. 06042 (2 specimens).

Description.— Specimens from 40 × 16 mm to 135 × 22 mm; body cylindrical. Mouth ventral, surrounded by 20 short tentacles; anus terminal. Colour in alcohol from a light brown, with numerous white-yellow spots corresponding to large tube feet to a uniform beige-brown ventrally; dorsally brown with white-yellow spots or transversal bands corresponding to dorsal papillae; top of papillae sometimes dark brown. Ventral tube feet in 3-4 rows on each ambulacrum; on some very contracted specimens rows no longer visible.

Body wall with tables and buttons. Tables of dorsal body wall 55-65 µm across, round or squarish, with four central and 11-13 peripheral holes; pillars short, ending in a crown of spines (fig. 20A). Tables of ventral body wall rare, and with a reduced spire (fig. 20B). Buttons similar dorsally (fig. 20C) and ventrally (fig. 20D), 50-80 µm long, smooth, with 3-5 pairs of holes. Tube feet with buttons, 55-90 µm long (fig. 20E), similar to those of body wall, and perforated plates 95-125 × 55-110 µm (fig. 20H). Terminal plate 500-520 µm across. Tentacles with rods, 70-155 µm long, spiny at their extremities, sometimes forked (fig. 20G).

Remarks.— The specimens from Ambon are identical with those collected in other parts of the distributional range, like Madagascar (Cherbonnier, 1988), New Caledonia (Féral & Cherbonnier, 1986), Guam (Rowe & Doty, 1977) or Taiwan (Chao & Chang, 1989).

Distribution.— *Holothuria hilla* is a very common species in the tropical Indo-West Pacific, ranging from the Red Sea to Japan, Hawaii and New Caledonia.

Holothuria (Thymiosycia) impatiens (Forskål, 1775)
(fig. 21A-E)

Synonymy.— See Cherbonnier, 1988: 89.

Material.— RMNH Ech. 06017 (2 specimens); RMNH Ech. 06046 (1 specimen).

Description.— Specimens from 14 × 4 to 36 × 13 mm, strongly contracted with body wall deeply folded, thin and rough. Mouth, surrounded by 20 short yellow tentacles, and anus terminal. Smallest specimen with only 15 tentacles. Colour in alcohol beige ventrally and pale brown dorsally. Tube feet sparse, distributed over whole

body wall surface, sometimes forming rows over short distances. Cuvierian tubules numerous, long and fine. Longitudinal muscles thick, each divided into two bands.

Body wall and tube feet with tables and rods. Tables 85-100 µm across; disc squarish, smooth at the edge, with eight peripheral holes; pillars short, with one cross beam, ending in a crown of spines (fig. 21A). Buttons 65-110 µm long with 2-5

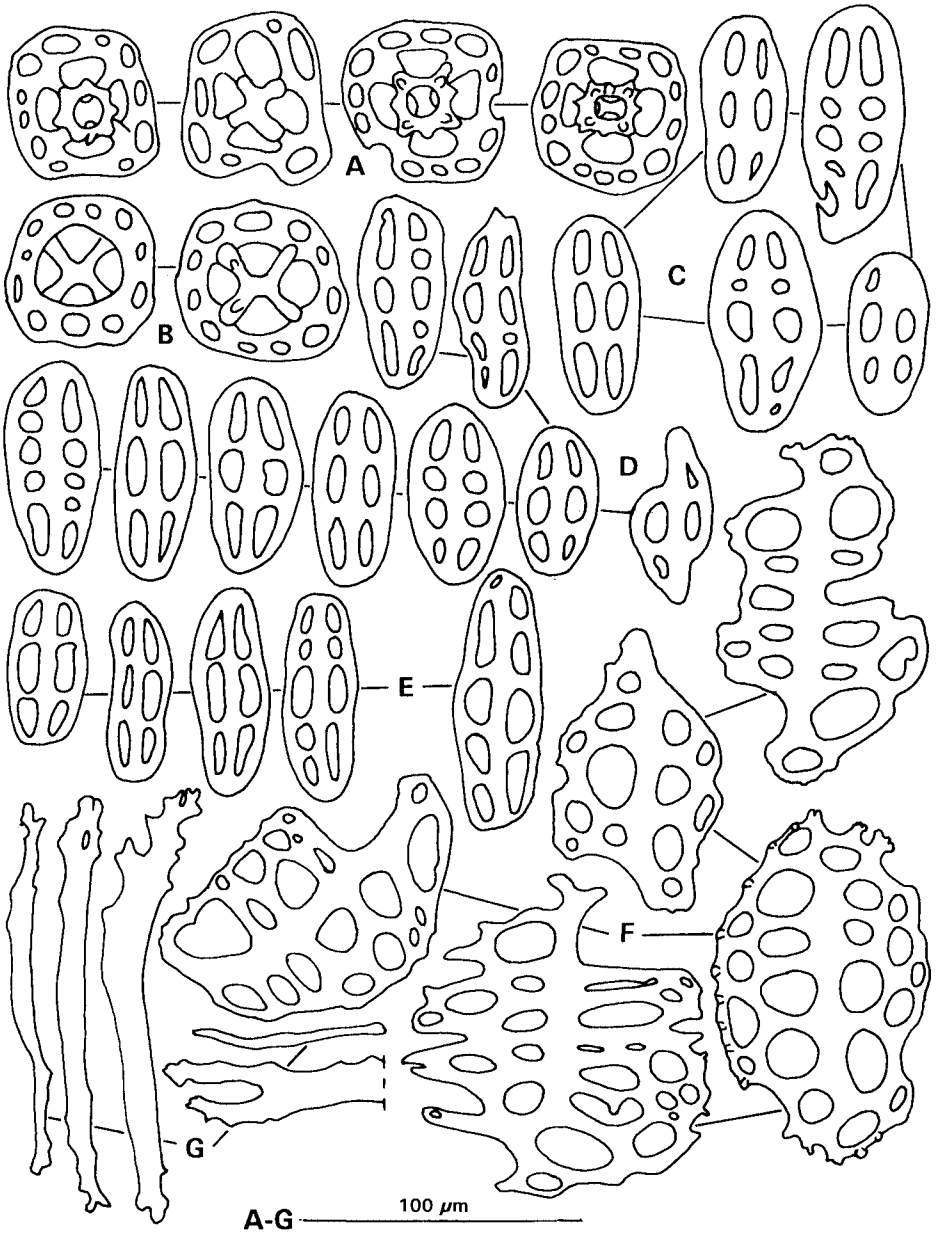

Fig. 20. *Holothuria (Thymiosycia) hilla* Lesson, 1830. A: tables of the dorsal body wall; B: tables of the ventral body wall; C: buttons of the dorsal body wall; D: buttons of the ventral body wall. E: buttons of the tube feet; F: perforated plates of the tube feet; G: rods of the tentacles.

pairs of holes (figs 21B, C). Tube feet with very large buttons 160-170 µm long (fig. 21C), and curved rods, 170-230 µm long (fig. 21D); terminal plate 280 µm across. Tentacles with curved rods, spiny at the extremities and 70-485 µm long (fig. 21E).

Remarks.— *Holothuria impatiens* is easy to identify and shows few variations throughout its area of distribution.

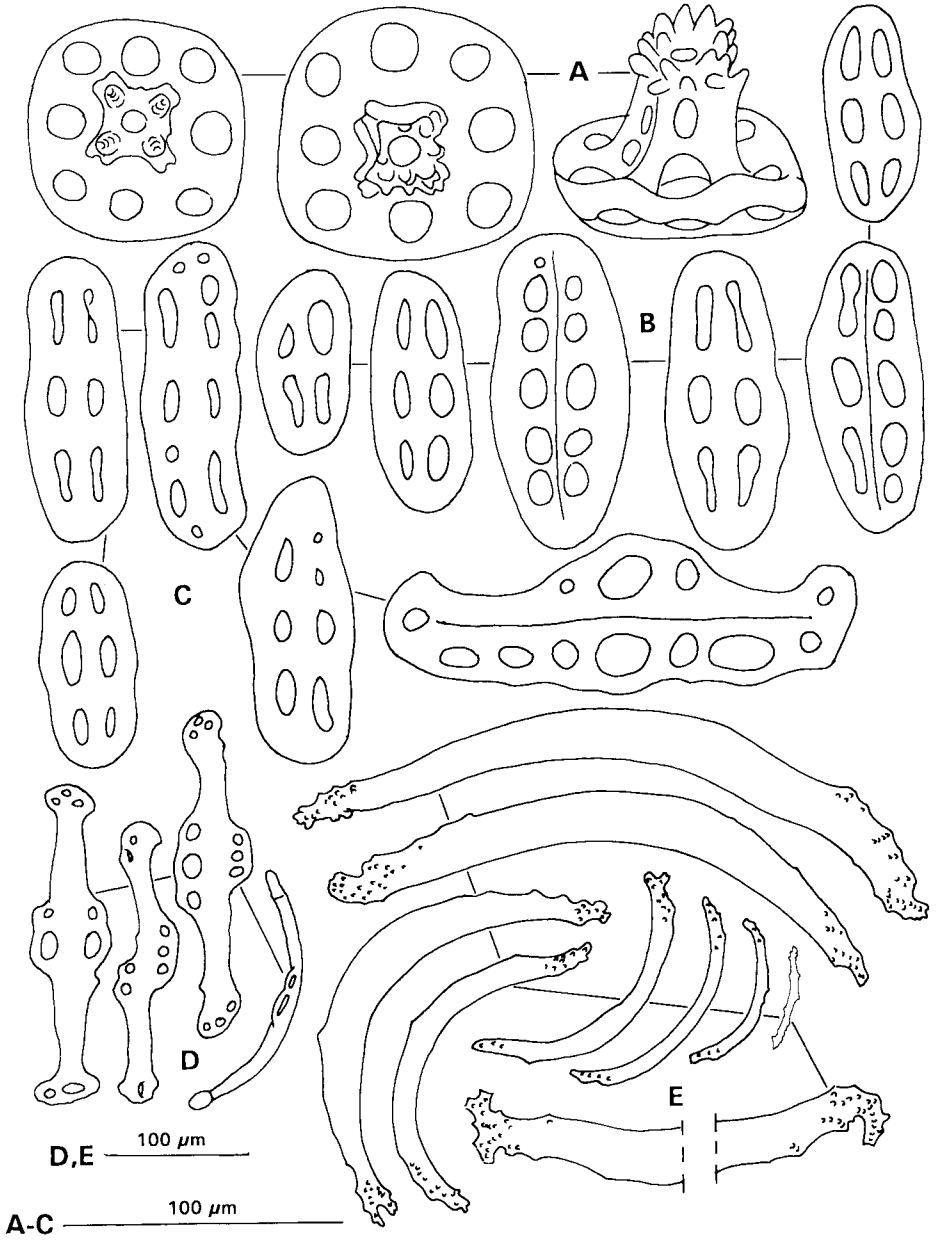

Fig. 21. *Holothuria* (*Thymiosycia*) *impatiens* (Forskål, 1775). A: tables of the body wall; B: buttons of the body wall; C: buttons of the tube feet; D: rods of the tube feet; E: rods of the tentacles.

Distribution.— *Holothuria impatiens* is a circum-tropical species, abundant in the Indo-Pacific area, from the Red Sea to Central America and the Galapagos Islands. It is also present in the Mediterranean Sea and in the western Atlantic.

Genus *Pearsonothuria* Levin, Kalinin & Stonik, 1984
Pearsonothuria graeffei (Semper, 1868)
(fig. 22A-H)

Holothuria graeffei Semper, 1868: 78, pl. 30, fig. 9.
Bohadschia graeffei; Panning, 1929 [1931]: 124, fig. 6; Jangoux et al., 1989: 163; Rowe & Gates, 1995: 288.
Pearsonothuria graeffei; Levin et al., 1984: 33-38, figs. 1, 2; Cherbonnier, 1988: 49, fig. 17A-F (Synonymy); Strack, 1990: pl. 4, fig. 1; Gosliner & Bahrens, 1990: 134, pl. 11, fig. B; Chao & Chang, 1990: 68, figs. 2, 4; Kerr, 1994: 170, tab. 1.

Material.— RMNH Ech. 06037 (1 adult specimen); RMNH Ech. 06048 (1 juvenile specimen).
Material studied for comparison.— Malaysia: CAS 099007 (1 juvenile specimen); CAS 099025 (1 juvenile specimen).— Philippines: CAS 099028 (1 juvenile specimen).

Description.— Juvenile from RMNH (Ech. 06048) 5.7 x 3.5 mm. Living specimen gray-white with longitudinal black lines and large yellow papillae dorsally; ventrally blue-gray with a few black spots or lines; black lines around tentacular crown. Dorsally no tube feet, but two rows of five large papillae. Laterally a row of papillae separates bivium from trivium. Ventrally three rows of long yellow-orange tube feet ending in a yellow sucker. Lateral rows of tube feet single (10 left; 13 right); central row of tube feet double (14 pairs). Mouth ventral, surrounded by yellow peltate tentacles (16 are visible); anus terminal. Skin thin and granular.

Calcareous ring translucent and weakly calcified (fig. 22A). Tube feet and tentacles without ossicles. Dorsally body wall with a continuous layer of very small branched ossicles (fig. 22B); laterally ossicles sparse and reduced to miliary granules (fig. 22C).

Adult specimen (Ech. 06037) 195 x 40 mm. Colour characteristic of the species: mottled beige with numerous small brown-black spots; tentacles black with a white edge. Body wall with small rosettes (fig. 22D) and knobbed pseudo-tables (fig. 22E). Tube feet with a terminal plate and same types of ossicles as in body wall but larger (figs 22F,G). Some rosettes from body wall look like perforated plates (fig. 22F). Tentacles with rosettes only (fig. 22H).

Discussion.— The juvenile and the adult are so different, that they could be mistaken for species belonging to different genera! However, Gosliner & Behrens (1990) have observed in Madang (Papua New Guinea) several intermediary colour stages between the juveniles and the adults of *Pearsonothuria graeffei*. Juveniles present an extraordinary Mullerian mimicry with three different species of poisonous Phillidiidae (Mollusca, Opistobranchia). There is a gradual change in colour pattern and form (large dorsal tubercles disappear) with increasing body size of *P. graeffei*. Unfortunately, Gosliner & Behrens (1990) did not describe ossicle changes.

A study of three juveniles from Malaysia and the Philippines, shows that the problem is more complex than foreseen. Two small individuals (one from Malaysia, 12 mm long, and one from the Philippines, 18.5 mm long) have ossicles similar to the

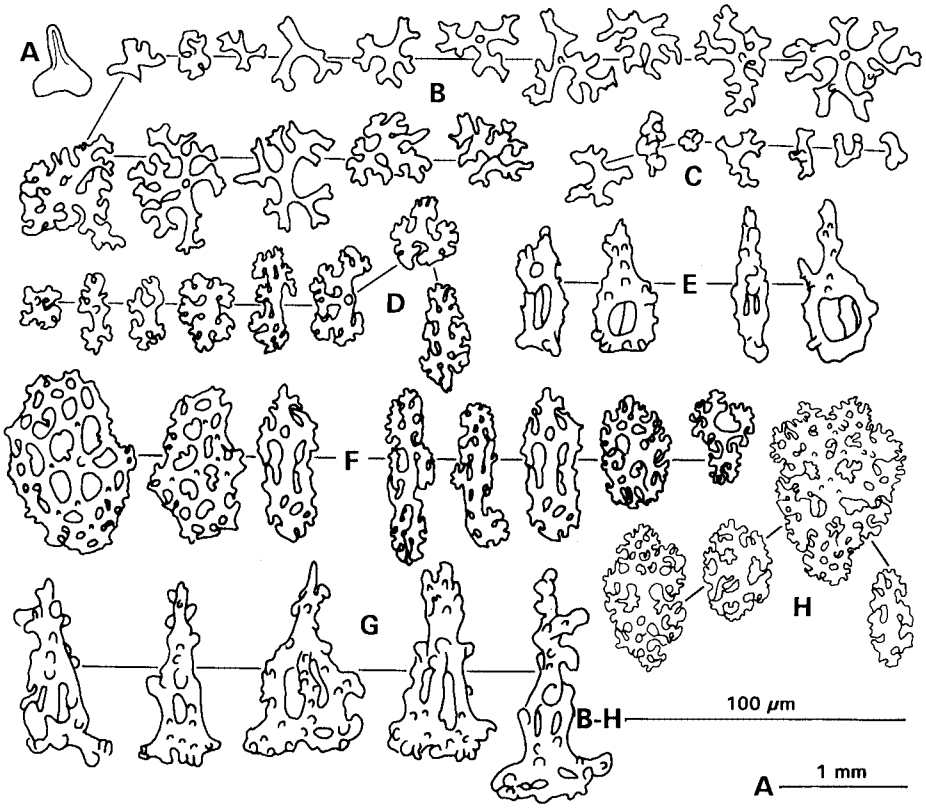

Fig. 22. *Pearsonothuria graeffei* (Semper, 1868). Ambon specimen, 5.7 mm long. A: interradial piece of the calcareous ring; B: branched ossicles of the dorsal body wall; C: ossicles of the lateral body wall. Ambon specimen, 195 mm long. D: rosettes of the body wall; E: pseudo-tables of the body wall; F: rosettes of the tube feet; G: pseudo-tables of the tube feet; H: rosettes of the tentacles.

juvenile from Ambon, whereas the third one (from Malaysia, 20.5 mm long) shows well-developed ossicles (tables and C-shaped rods) characteristic of Stichopodidae. This suggests that it concerns another species and that juveniles of other holothurians may also show Mullerian mimicry! Pending further study, to be dealt with in a separate paper, I consider the Ambon juvenile to belong to *P. graeffei*.

Distribution.— *Pearsonothuria graeffei* is an abundant species in the tropical Indo-West Pacific ranging from the Red Sea and Madagascar to Fiji.

Family *Stichopodidae* Haeckel, 1886
Genus *Stichopus* Brandt, 1835
Stichopus chloronotus Brandt, 1835
(fig. 23A-L)

Synonymy.— See Cherbonnier, 1988: 146.

Material.— RMNH Ech. 06043 (1 specimen).

Description.— Medium-sized specimen, 135 × 50 mm. Colour in alcohol yellow-brown dorsally and yellow-gray ventrally. Mouth ventral, surrounded by 16 tentacles (some have been torn away); anus terminal. Two dorsal double rows of large papillae and two lateral rows of papillae. Ventral surface flat with many rows of tube feet in each ambulacrum.

Body wall with numerous tables, 30-45 µm across (fig. 23A) and C-shaped bodies (fig. 23B), but no rosettes. Dorsal papillae with tables; table disc with four large central and numerous (10-20) small peripheral perforations; pillars ending in a crown of spines, sometimes irregular (fig. 23C); numerous C-shaped bodies (fig. 23D), some of which irregular (fig. 23E); a few rosettes also present (fig. 23F). Ventral tube feet with tables, 35-50 µm across (fig. 23G), irregular perforated plates, 160-270 µm long (fig. 23J), and spiny rods 300-450 µm long (fig. 23H), some with a large, perforated central part. Tentacles with curved spiny rods, 60-600 µm long, sometimes with forked extremities (fig. 23K), and perforated plates with four central holes, 1-14 peripheral holes, and a spiny edge (fig. 23L).

Remarks.— The specimen differs slightly from specimens from other areas; for example, the massive bodies mentioned by Cherbonnier (1988, fig. 60 K) to occur in the tentacles of Madagascan specimens have not been observed here.

Distribution.— *Stichopus chloronotus* is widely distributed in the tropical Indo-West Pacific, from the east coast of Africa to Hawaii.

Stichopus herrmanni Semper, 1868
(figs 24A-G, 25A-B)

Stichopus variegatus Herrmanni Semper, 1868: 73, pl. 17, pl. 30 fig. 2.
Stichopus variegatus var. *herrmanni*; Clark, 1922: 68.
Stichopus hermanni; Marsh et al., 1993: 64
Stichopus hermanni; Rowe & Gates, 1995: 324.

Material.— RMNH Ech. 06032 (1 specimen).

Description.— Medium-sized specimen, 135 × 35 mm. Colour in alcohol gray-yellow. Mouth ventral, surrounded by 20 brown tentacles; anus terminal. Ventrally 4-5 rows of tube feet along each ambulacrum. Position of dorsal papillae uncertain because of poor condition of specimen.

Body wall with a few rosettes (fig. 24A) and numerous tables (fig. 24B). Most of the tables small, 30-45 µm across, 40 µm in height, with a crown of spines as large as the disc; a few large tables, 70-80 µm across. Dorsal papillae with numerous rosettes (fig. 24C), tables similar to those of body wall (fig. 24D), and a few large C-shaped bodies (fig. 24E). Tube feet with tables, 25-65 µm across, sometimes with spinose disc (fig. 24F), regular rectangular perforated plates, 150-250 µm long (fig. 24G), and spinose rods, 140-400 µm long with a central perforated part (fig. 25A). Tentacles with curved spiny rods, 95-640 µm long (fig. 25B).

Discussion.— According to Rowe & Gates (1995), the type material of *Stichopus variegatus* Semper, 1868, corresponds to *Stichopus horrens* Selenka, 1867. The well-known beige to greenish yellow species with numerous small brown or black dots, up to now in many works on tropical holothurians referred to as *S. variegatus*, is to be

Fig. 23. *Stichopus chloronotus* Brandt, 1835. A: tables of the body wall; B: C-shaped rods of the body wall; C: tables of the dorsal papillae; D: C-shaped rods of the dorsal papillae; E: irregular C-shaped rods of the dorsal papillae; F: rosettes of the dorsal papillae; G: tables of the tube feet; H: rods of tube feet; J: perforated plate of the tube feet; K: rods of the tentacles; L: perforated plates of the tentacles.

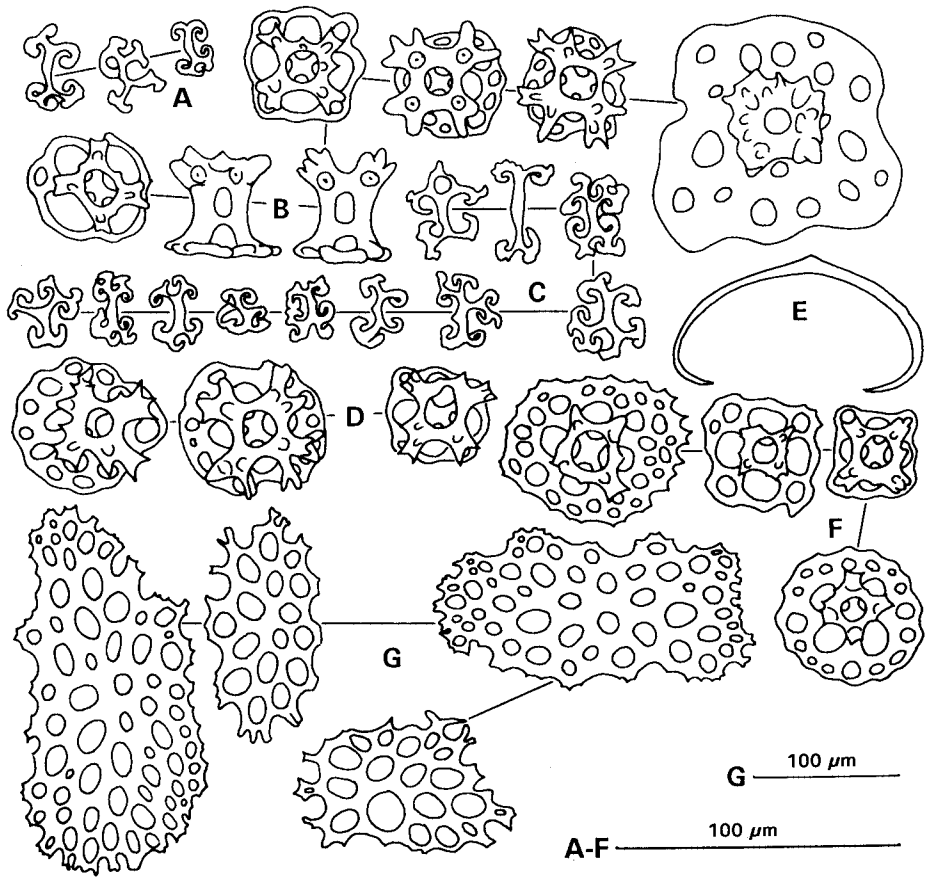

Fig. 24. *Stichopus herrmanni* Semper, 1868. A: rosettes of the body wall; B: tables of the body wall; C: rosettes of the dorsal papillae; D: tables of the dorsal papillae. E: C-shaped rod of the dorsal papillae; F: tables of the tube feet; G: perforated plates of the tube feet.

considered *Stichopus herrmanni* Semper, 1868. As indicated by its name, *S. variegatus* was considered as a highly variable species (Clark, 1922) and Clark's very broad concept of *S. variegatus* includes several other species such as *S. herrmanni* and *S. monotuberculatus* (Quoy & Gaimard, 1833) (Rowe & Gates, 1995). However, since Rowe & Gates (1995) don't give any drawing or diagnosis of *Stichopus horrens, S. herrmanni* and *S. monotuberculatus*, it is difficult to allocate most *S. variegatus* previously cited in the literature to one of the above mentionned *Stichopus* species. For this reason the synonymy and citation list here mentioned is restricted. Colour and ossicles of the specimen of Ambon fit in with *Stichopus herrmanni*, except for the reduced number of rosettes in the body wall.

Distribution.— *Stichopus herrmanni* occurs in the Red Sea, the Indian Ocean and the West Pacific (Rowe & Gates, 1995).

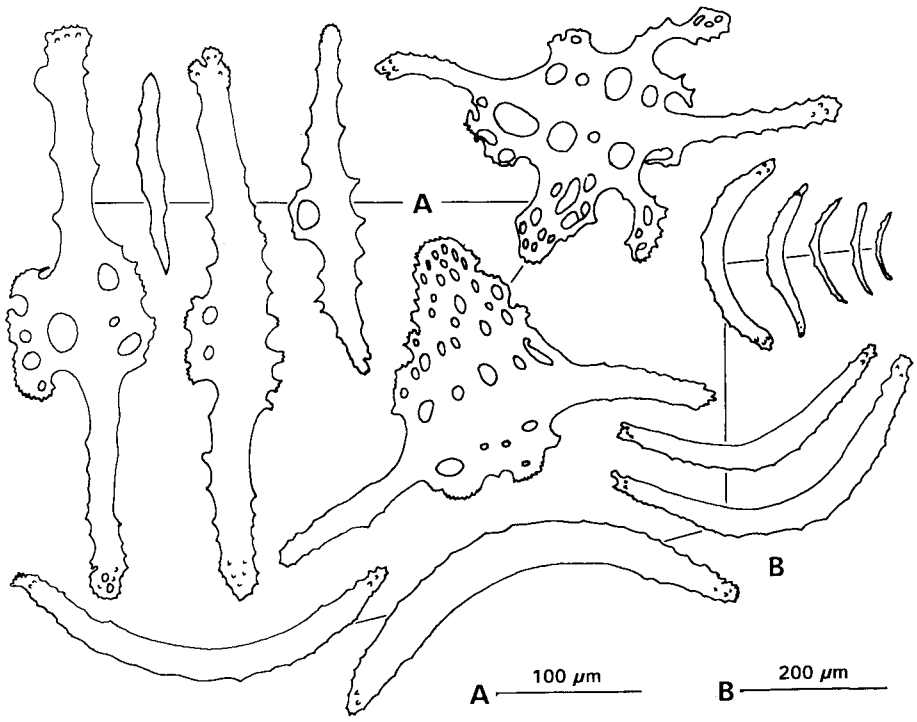

Fig. 25. *Stichopus herrmanni* Semper, 1868. A: rods of the tube feet; B: rods of the tentacles.

Stichopus spec.
(fig. 26A-B)

Material.— RMNH Ech. 06028 (1 specimen).

Description.— Specimen heavily damaged; length and width cannot be measured. 20 tentacles, each retracted in a sheath. Specimen auto-eviscerated. Calcareous ring (fig. 26A), a large Polian vesicle, and large tentacular ampullae still present. Surface of body wall torn away, and ossicles in poor condition with many broken tables and a few damaged rosettes. Some broken curved rods in the tentacles (fig. 26B).

Remarks.— The general aspect and the calcareous ring are typical of the Stichopodidae and probably of the genus *Stichopus*. However, the poor condition of the specimen and its ossicles does not allow identification to the species level.

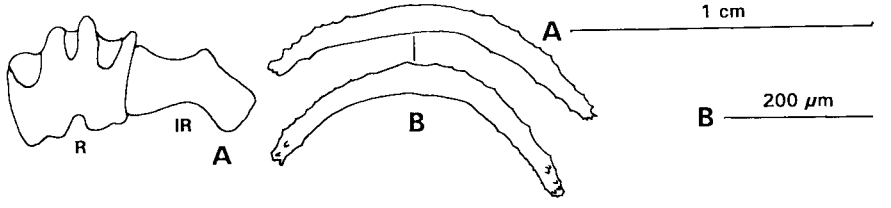

Fig. 26. *Stichopus sp.* A: calcareous ring (R: radial piece; IR: interradial piece); B: rods of the tentacles.

Order Dendrochirotida Grube, 1840
Family Sclerodactylidae Panning, 1949
Subfamily Cladolabinae Heding & Panning, 1954
Genus *Afrocucumis* Deichmann, 1944
Afrocucumis africana (Semper, 1868)
(fig. 27A-E)

Cucumaria africana Semper, 1868: 53, 270, pl. 15, fig. 16.

Afrocucumis africana; Deichmann, 1944: 736; Heding & Panning, 1954: 109, fig. 39 (synonymy); Clark & Rowe, 1971: 182, pl. 30, fig. 2; Liao, 1975: 202, figs. 3, 1-3; Rowe & Doty, 1977: 226, fig. 2a; Sloan et al., 1979: 124; Mary Bai, 1980: 24, text fig 12F; Rowe, 1983: 160; Cannon & Silver, 1986: 32, fig. 2k, fig. 8d; Cherbonnier, 1988: 218, fig. 95A-E; Jangoux et al., 1989: 163; Chao & Chang, 1989: 114, fig. 6A-E; Kerr, 1994: 171; Rowe & Gates, 1995: 321.

Material.— RMNH Ech. 06027 (1 specimen).

Description.— Specimen 29 × 5 mm. Colour in alcohol uniform gray-black. Body cylindrical, with mouth and anus terminal. Tentacles in two crowns: an outer one with 15 large tentacles and an inner one with four small tentacles. Tube feet large, restricted to ambulacra, and arranged in two rows.

Body wall with large lenticular perforated plates covered with prominent pyramidal teeth (fig. 27A); lenticular plates 175-300 µm across, and derived from small knobbed perforated plates (fig. 27B). Tube feet with straight rods perforated at their extremities (fig. 27C), small perforated plates, 155-175 µm long (fig. 27D), and a terminal plate ca. 400 µm across. Tentacles with straight rods, 150-285 µm long, perforated at their extremities (fig. 27E).

Remarks.— The specimen from Ambon is similar to those from other parts of the

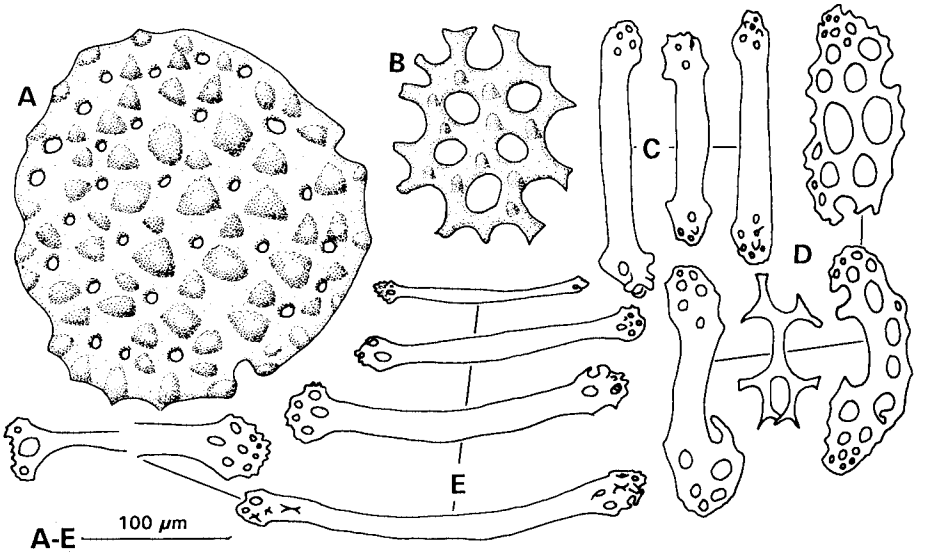

Fig. 27. *Afrocucumis africana* (Semper, 1868). A: lenticular plate of the body wall; B: plate from which the lenticular plates develop; C: rods of the tube feet; D: perforated plates of the tube feet; E: rods of the tentacles.

distributional range. Only the diameter of the large lenticular plates shows some variation: from 210 µm (Cherbonnier, 1988) up to 535 µm across (Liao, 1975).

Dsitribution.— *Afrocucumis africana* is one of the most common dendrochirote holothurians from tropical Indo-West Pacific, having been reported from Madagascar to China, Guam and the Caroline Islands.

Afrocucumis stracki spec. nov.
(fig. 28A-G)

Material.— RMNH Ech. 06019 (1 specimen; holotype); RMNH Ech. 06047 (1 specimen; paratype).

Description.— Holotype 70 × 17 mm. Body narrows anteriorly and posteriorly. At the level of mouth and anus the diameter is 9 and 11 mm, respectively. Paratype 14 mm long, bottle-shaped with an anterior diameter of 3.5 mm and a posterior diameter of seven mm. Colour in alcohol yellow-brown over the whole surface, tube feet appearing as brown spots for the holotype; brown dorsally and greyish ventrally for the paratype. Body wall thick and rough. Ventral tube feet of holotype large, numerous, and present in ambulacral as well as in interambulacral zones. Tube feet more numerous ventrally than dorsally and aligned longitudinally at some places. Paratype with ca. 20 brown tube feet in two rows on each ambulacrum. Mouth and anus terminal; anus surrounded by five small teeth. In both specimens introvert contracted and tentacles cannot be counted without causing damage. Radial pieces of calcareous ring of holotype with an anterior notch and two short unsegmented posterior projections (fig. 28A); interradial pieces with a prominent anterior triangular tooth (fig. 28A). Retractor muscles of the pharynx attached at 1/4 of body length. Holotype with one large Polian vesicle (14 mm long, 2 mm across) and one straight stone canal six mm long, ending in a muriform madreporic plate attached to the body wall dorsally.

Body wall with small rods (fig. 28C), and large lenticular perforated plates, 310-400 µm across, covered by prominent pyramidal teeth (fig. 28B). Tube feet with three kinds of ossicles: straight rods, 60-230 µm long (fig. 28D), perforated plates, 140-200 µm long (fig. 28E), and miliary granules, 15-45 µm long (fig. 28F). Tentacles with straight, smooth rods, 110-300 µm long, perforated at their extremities (fig. 28G); perforations numerous.

Discussion.— *Afrocucumis stracki* spec. nov. is closely related to *Afrocucumis africana*. It differs in its larger ossicles, in the presence of miliary granules in the tube feet, and in the multi-perforated extremities of the tentacle rods. In addition, the radial pieces of the calcareous ring of *A. stracki* are narrower anteriorly than in *A. africana*, and the posterior projections are unsegmented. The length of the body of *A. stracki* (70 mm) exceeds the largest size reported for *A. africana* (60 mm).

Distribution.— Ambon.

Ethymology.— The species is named after H.L. Strack, leader of the Rumphius Biohistorical Expedition, who invited me to study the holothurian material from Ambon.

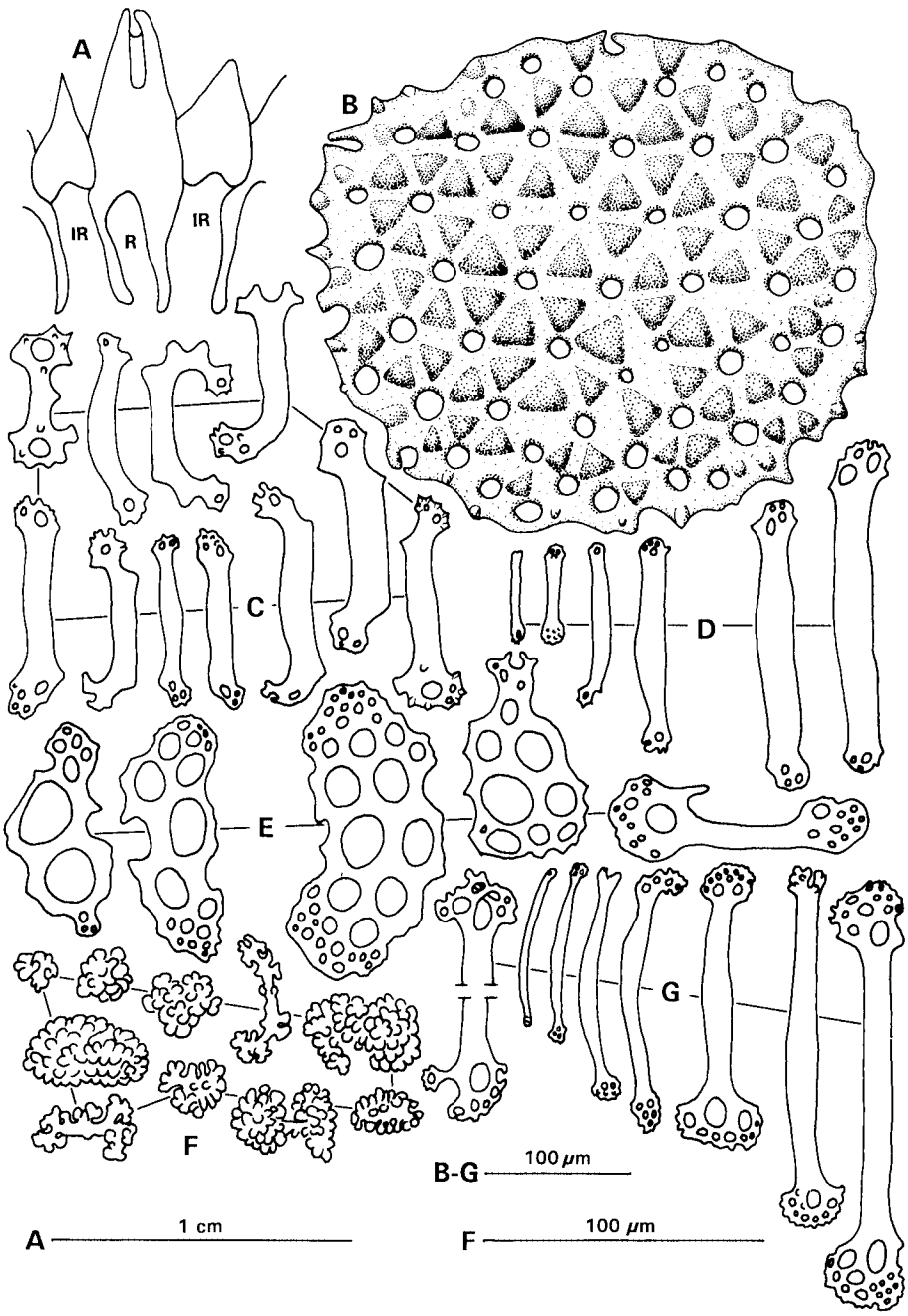

Fig. 28. *Afrocucumis stracki* spec. nov. A: calcareous ring (R: radial piece; IR: interradial piece); B: lenticular plate of the body wall; C: rods of the body wall; D: rods of the tube feet; E: perforated plates of the tube feet; F: miliary granules of the tube feet; G: rods of the tentacles.

Genus *Cladolabes* Brandt, 1835
Cladolabes acicula (Semper, 1868)
(figs 29A-D, 30A-C)

Cucumaria acicula Semper, 1868: 54, pl. 15, fig. 11.

Cladolabes aciculus; Heding & Panning, 1954: 130, fig. 56 (synonymy); Liao, 1975: 200, fig. 1, 1-4; Rowe & Gates, 1995: 322.

Cladolabes acicula; Clark & Rowe, 1971: 182, fig. 95c, pl. 30, fig. 6; Mary Bai, 1980: 22, text fig. 12D; Cherbonnier & Féral, 1984b: 835, fig. 21A-G; Cannon & Silver, 1986: 37; Féral & Cherbonnier, 1986: 102; Marsh, 1986: 69.

Material.— RMNH Ech. 06041 (1 specimen).

Description.— Specimen 176 × 20 mm. Colour in alcohol yellow-orange. Twenty brown tentacles in three crowns: 10 very large ones in an outer ring and 10 smaller ones in two inner rings. Mouth and anus terminal. Tube feet numerous, crowded in 4-6 rows on each ambulacrum, and more abundant ventrally than dorsally.

Body wall with pseudo-tables reduced to a central pillar, smooth, sometimes

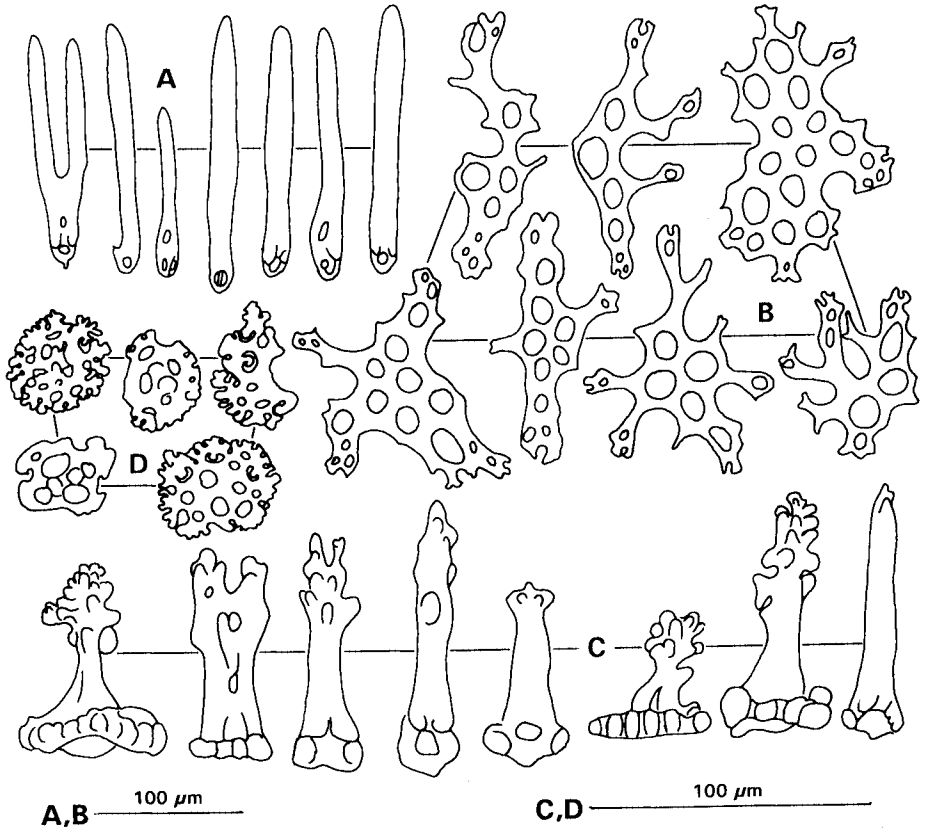

Fig. 29. *Cladolabes acicula* (Semper, 1868). A: pseudo-tables of the body wall; B: perforated plates of the tube feet; C: pseudo-tables of the introvert; D: rosettes of the introvert.

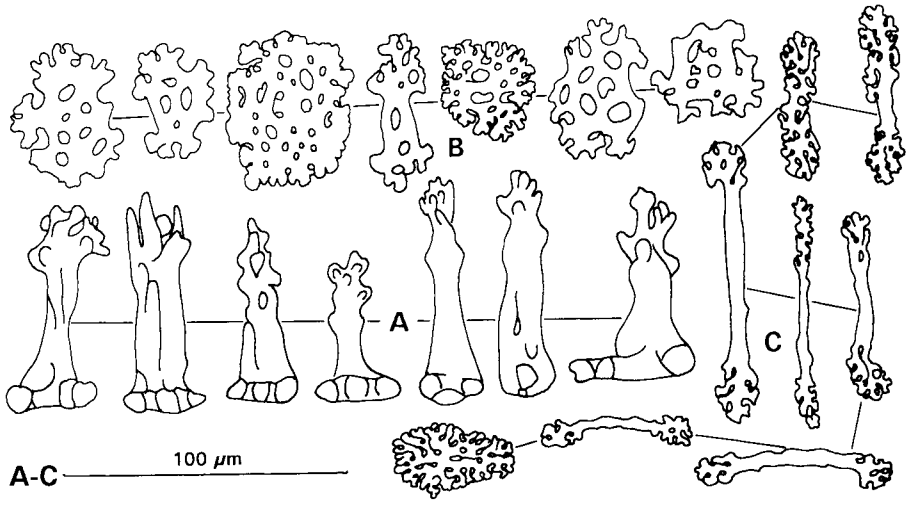

Fig. 30. *Cladolabes acicula* (Semper, 1868). A: pseudo-tables of the tentacles; B: rosettes of the tentacles; C: rods of the tentacles.

forked; pillar perforated at the base (fig. 29A). Tube feet with perforated plates (fig. 29B), and a large, terminal perforated plate 500-520 µm across. Introvert with pseudo-tables (fig. 29C) and rosettes (fig. 29D). Disc of table sometimes well-developed and nodular; pillar always spiny. At the base of tentacles, ossicles (figs. 30A,B) similar to those of introvert; rods at the apex of tentacles (fig. 30C).

Remarks.— *Cladolabes acicula* is a widespread species in the Indo-Pacific area, but not abundant. It is easy to identify because, whatever its origin, the external characters and the ossicles are constant.

Distribution.— In the Indian Ocean *Cladolabes acicula* is known only from Mauritius and the Andaman Islands. In the Pacific Ocean it is known from Indonesia, the Philippines, China, northern Australia, New Caledonia, Fiji, Tonga and Hawaii.

Order Apodida Brandt, 1835
Family Synaptidae Burmeister, 1837
Subfamily Rynkatorpinae Smirnov, 1989
Genus *Protankyra* Oestergren, 1898
Protankyra cf.*similis* (Semper, 1868)
(fig. 31A-F)

Synapta similis Semper, 1868: 10, pl. 3, fig. 2, Pl. 4, fig. 14, pl. 6, figs. 1-3, pl. 7, figs. 5-6, pl. 8, fig. 1; Sluiter, 1894: 105.

Protankyra similis; Oestergren, 1898: 117; Clark, 1907: 109, pl. 2, fig. 2; Clark, 1924: 498, pl. ç, fig. 11, pl. 12, figs 2-6; Heding, 1928: 251; Clark & Rowe, 1971: 186, pl. 31, figs. 7-8; ? Singh & Choudhury, 1992: 109, figs. 3, 4, 5A-D, 6A-C; Rowe & Gates, 1995: 335.

Material.— RMNH Ech. 06015 (1 specimen).

Description.— Body (broken into 2 pieces) ca 66 × 7 mm. Body wall granular

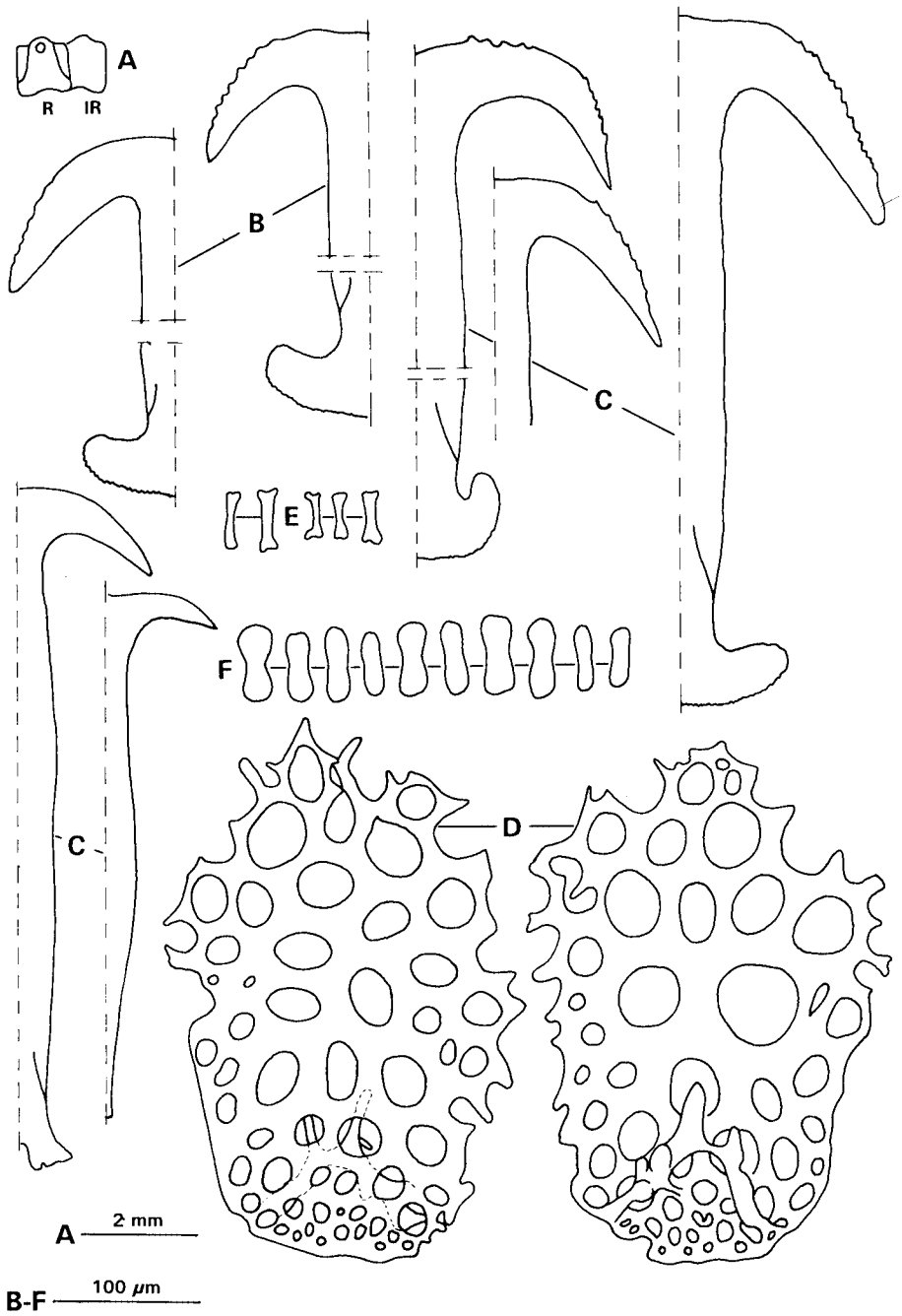

Fig. 31. *Protankyra* cf. *similis* (Semper, 1868). A: calcareous ring (R: radial piece; IR; interradial piece); B: anchors of the anterior body wall; C: anchors of the posterior body wall; D: anchor-plates of the body wall; E: rods of the body wall; F: grains of the tentacles.

when contracted. Colour in alcohol uniform gray-pink; no trace of longitudinal colour bands. 12 short tentacles, each with four digits (two lateral and two terminal). Radial and interradial pieces of the calcareous ring with the same width and height, and an anterior rounded tooth (fig. 31A); radial pieces perforated for the nerve. No trace of a cartilaginous ring. Three polian vesicles. Longitudinal muscles flat and especially broad.

Body wall with anchors (fig. 31B,C), anchor-plates (fig. 31D), and rods (fig. 31E). Anteriorly located anchors 390-460 × 220-240 µm; those located posteriorly 450-500 × 260-280 µm. Arms of anchors dentate (figs. 31B,C), vertex smooth; stock wide and finely dentate. Anchor-plates sub-rectangular, perforated by a few smooth holes (fig. 31D); central holes much larger than peripheral ones; presence of a pseudo spiny bridge; posterior holes of anchor-plates particularly small. Anteriorly located anchor-plates 290-340 × 200-225 µm, and posteriorly located 310-385 × 225-250 µm. Anteriorly, body wall with small rods, 25-40 µm long, bifurcated at their extremities (fig. 31E). Tentacles with oval, 40-55 µm long miliary granules (fig. 31F); most of them with a central constriction.

Discussion.— The general form, the colour, and the ossicles fit in well with the original description of *Protankyra similis* given by Semper (1868), and with the original ossicle preparations illustrated by Clark (1924) and Clark & Rowe (1971). However, Semper (1868) noted ten digitate tentacles whereas the specimen from Ambon has 12. According to Clark (1924) who examined the type material of Semper, the number ten "is probably a slip of the pen". This is confirmed by the fact that the 38 known species belonging to the genus *Protankyra* all have 12 tentacles.

The specimen from Ambon was found on a mud flat, near a river mouth; not a mangrove flat like the type locality but the biotope is similar. The specimens from India (Gangetic delta) described by Shing & Choudhury (1992) from a mangrove area may not be *P. similis* because the colour is very different (purple with white longitudinal stripes) and because the central holes of the anchor-plates are not very different from the peripheral ones (Singh & Choudhury 1992, figs 5D-F). Moreover, in the specimens illustrated by Singh & Choudhury (1992) the edge of the anchor-plates is smooth, and not ragged as illustrated by Clark (1924, pl. 12, fig. 2) and by Clark & Rowe (1971, pl. 31, fig. 7).

The species is new to the fauna of Indonesia.

Distribution.— The Philippines, Australia (Thursday Island in the Torres Strait), Ambon, ? India (Gangetic delta).

Subfamily Synaptinae Burmeister, 1837
Genus *Opheodesoma* Fisher, 1907
Opheodesoma cf. *grisea* (Semper, 1868)
(fig. 32)

Synonymy.— See Cherbonnier, 1988: 244.

Material.— RMNH Ech. 06024 (1 specimen).

Description.— Specimen damaged, 220 × 3-9 mm, but posterior part missing.

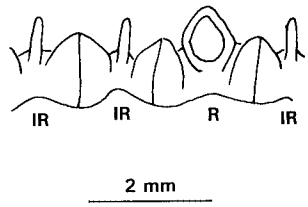

Fig. 32. *Opheodesoma* cf. *grisea* (Semper, 1868). Calcareous ring (R: radial piece; IR: interradial piece).

Colour in alcohol gray-white, mottled with dark gray spots. 15 long pinnate tentacles, each bearing 23-26 pairs of digits not united by a web; digits present only on distal half of tentacles. First and last pairs of digits very short. Calcareous ring narrow, white and well calcified; radial pieces perforated by a sub-pentagonal hole for the nerve (fig. 32); each interradial piece with a long anterior tooth (fig. 32). Several very long (10 mm) stone canals, and tens of Polian vesicles. No cartilaginous ring. Mesenteries covered by numerous, very small, ciliated funnels. Ossicles totally absent.

Discussion.— Some Synaptidae, belonging to the genera *Anapta* Semper, 1868 and *Rhabdomolgus* Keferstein, 1862, are known to be free of ossicles. However, these species have only 10-12 tentacles with very few digits (0-13) and a calcareous ring completely different from the observed specimen. The ossicles of the specimen at hand were probably dissolved in the preserving fluid. According to the number of tentacles, the number of digits not united by a web, the numerous Polian vesicles, and especially the form of the calcareous ring, the specimen belongs in *Opheodesoma* Fisher, 1907. In the absence of ossicles, it is very difficult to identify the species. However, the calcareous ring is so characteristic (see Semper, 1868; Heding, 1928; Cherbonnier, 1988) that it is probably a specimen of *Opheodesoma grisea* (Semper, 1868), a species already mentioned from Ambon by Sluiter (1894) (see table 1).

Distribution.— *Opheodesoma grisea* is distributed throughout the tropical Indo-West Pacific, from the Red Sea and Madagascar to Taiwan, Hawaii and northern Australia.

Genus Synapta Eschscholtz, 1829
Synapta maculata (Chamisso & Eysenhardt, 1821)
(fig. 33A-D)

Synonymy.— See Cherbonnier, 1988: 251.

Material.— RMNH Ech. 06010 (1 specimen).

Description.— Specimen broken and only anterior part present, 140 × 13 mm. Colour in alcohol pale beige-brown, with brown or gray-black spots and transverse bands. Body wall very sticky to the touch. 14 large pinnate tentacles, each with 20-23 pairs of digits not united by a web.

Body wall with anchors, anchor-plates and miliary granules. Anchors 790-1150 ×

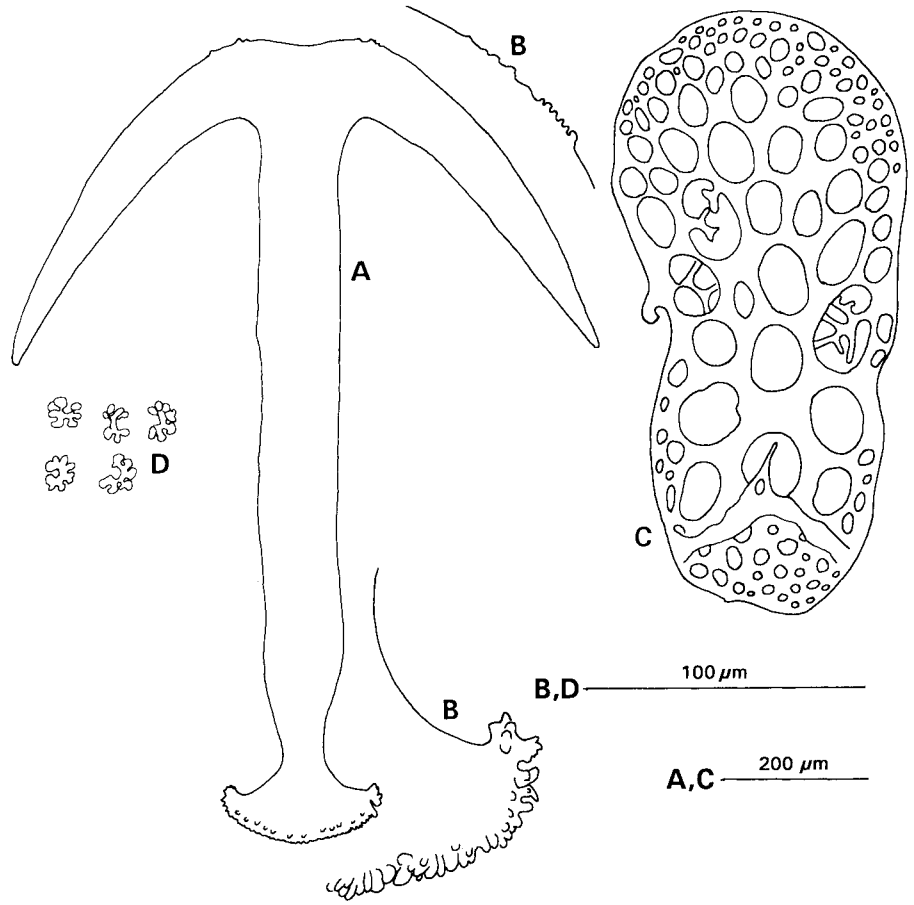

Fig. 33. *Synapta maculata* (Chamisso & Eisenhardt, 1821). A: anchor of body wall; B: details of the vertex and stock; C: anchor-plate of the body wall; D: miliary granules of the body wall.

525-850 µm (fig.33A); arms smooth, and vertex with a variable number of knobs or blunt spines (fig. 33B); edge of stock covered by numerous short spines (fig. 33B). Anchor-plates 780-820 × 350-400 µm (fig. 33C), perforated with numerous smooth holes, central ones being larger than those of the periphery. Anchor-plate with a thin bridge, sometimes with a central spine. Miliary granules, 12-15 µm across (fig. 33D), abundant in body wall.

Remarks.— *Synapta maculata* is the most common large apodid of the tropical Indo-Pacific. The species shows a wide variation in the size and form of its ossicles. The specimen from Ambon is reminescent of the form described as *Synapta maculata* var. *sundaensis* by Heding (1928), because of the size and proportion of the anchors and anchor-plates, and because of the spine on the bridge of the anchor-plates.

Distribution.— *Synapta maculata* is present in the tropical Indo-West Pacific, from the Red Sea and Madagascar to Japan, Hawaii and New Caledonia.

Genus *Synaptula* Oersted, 1849
Synaptula bandae Heding, 1928
(fig. 34A-H)

Synaptula bandae Heding, 1928: 195, fig. 26, 1-4; Clark & Rowe, 1971: 186.

Material.— RMNH Ech. 06023 (8 fragments representing at least 4 specimens).
Material studied for comparison.— ZMC 15-VI-1922 (Holotype: type locality off Waling, Banda, Indonesia); ZMC 4,5-VI-1922 (2 paratypes, Banda, Indonesia).

Description.— Eight fragments, four of which with a tentacular crown, representing at least four specimens. Estimated length 16, 21, 24 and 46 mm long and a diame-

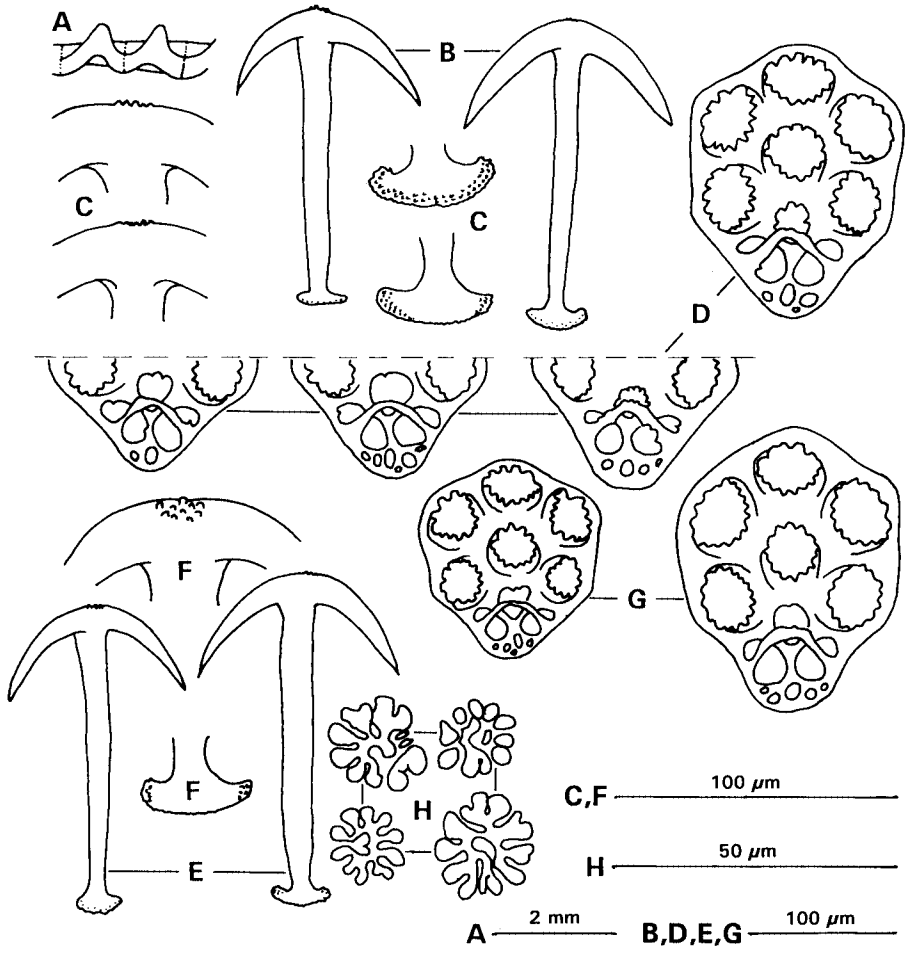

Fig. 34. *Synaptula bandae* Heding, 1928. A: calcareous ring; B: anchors of the body wall (ca.46 mm long specimen); C: details of the anchors (ca. 46 mm long specimen); D: anchor-plates of the body wall (ca. 46 mm long specimen); E: anchors of the body wall (ca.21 mm long specimen); F: details of the anchors (ca. 21 mm long specimen); G: anchor-plates of the body wall (ca. 21 mm long specimen); H: miliary granules of the body wall (ca. 21 mm long specimen).

ter varying between 2.5 and 4 mm. Colour in alcohol whitish gray with five purple lines, quite visible posteriorly but paler or absent anteriorly. Largest specimen nearly purely white. Ten, digitiform, arched, short tentacles (2.5 mm long; 1.3 mm wide) with an inner smooth side and an outer folded side with 15-18 folds. Anus closed by five prominent triangular flaps. Calcareous ring white, faint, with radial and interradial pieces of the same width, each with a prominent anterior tooth (fig. 34A). Cartilaginous ring present. 6-8 Polian vesicles.

Body wall with numerous anchors (figs 34B, E), anchor-plates (figs 34D, G), and miliary granules (fig. 34H). Anchors 200-225 × 125-145 µm, irrespective of body length; arms of anchors smooth and vertex with a few knobs; stock spiny on its edge (figs 34C, F). In largest specimen all the anchor-plates with approximately the same size: 175-185 × 150-155 µm. The six large perforations of anchor-plates dentate; the three perforations near the bridge smooth or dentate; bridge always knobbed; 2-6 small posterior holes (fig. 34D). In other specimens anchor-plates similar in form but with size varying from 140 to 195 µm long (fig. 34G). Miliary granules 10-20 µm across (fig. 34H), very abundant; most of them broken into small round grains.

Remarks.— The four specimens from Ambon fit the description of *Synaptula bandae* Heding, 1928, particularly in shape, and in the number and size of the ossicles. Moreover, the contracted tentacles of the type series are similar (digitiform, short, arched, folded on the external surface with digits not visible) to the contracted tentacles of the specimens from Ambon.

So far *Synaptula bandae* was known only from the type series from Banda. The species is new to the fauna of Ambon.

Distribution.— Banda Islands, Ambon.

Family Chiridotidae Oestergren, 1898
Genus *Chiridota* Eschscholtz, 1829
Chiridota smirnovi spec. nov.
(fig. 35A-F)

Material.— RMNH Ech. 06030 (1 specimen, holotype).

Description.— Body broken into three fragments: 16, 14 and 12 × 7 mm. Colour in alcohol white to pink-white. Body covered with numerous small warts. Posteriorly and dorsally large wheel papillae arranged in three longitudinal rows. Mouth and anus terminal. 12 tentacles, with the two ventral ones small; on each tentacle 6-8 pairs of digits not united by a web. Radial and interradial pieces of calcareous ring squarish and of about the same size (fig. 35A); radials with a large notch for the insertion of the longitudinal muscle.

Body wall with wheels and C-shaped rods. Wheels six-spoked, larger posteriorly than anteriorly (figs 35B, C), and restricted to wheel-papillae. C-shaped rods present throughout body wall, massive, with slightly enlarged smooth extremities (figs 35D, E); some of them forming O-shaped ossicle (figs 35D, E). Tentacles with irregular rods, 43-70 µm long, straight or slightly curved, rarely with forked extremities (fig. 35F).

Discussion.— More than 40 species have been described in the genus *Chiridota*.

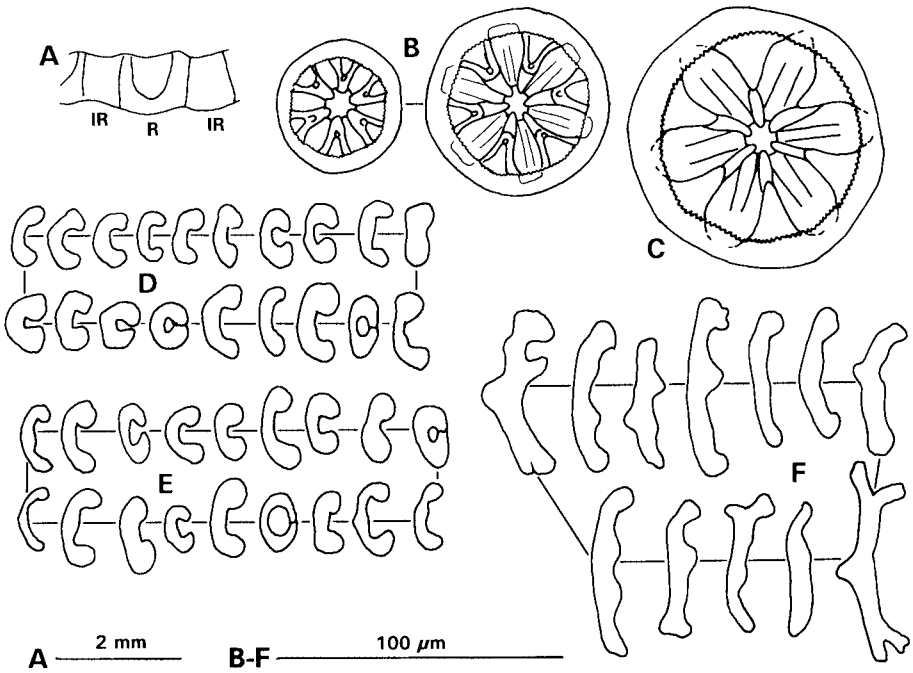

Fig. 35. *Chiridota smirnovi* spec. nov. A: calcareous ring (R: radial piece, IR: interradial piece); B: wheels of warts located anteriorly; C: wheel of a wart located posteriorly; D: C-shaped rods of the anterior body wall; E: C-shaped rods of the posterior body wall; F: rods of the tentacles.

Chiridota smirnovi spec. nov. is easy to distinguish from all the other *Chiridota* species because of the numerous C-shaped rods with smooth extremities. Most *Chiridota spp.* lack rods in the body wall or have rods with spinous or nodular extremities. Only four species, *Chiridota aponocrita* Clark, 1920, *C. exuga* Cherbonnier, 1986, *C. magna* Clark, 1938 and *C. intermedia* Bedford, 1899, have C-shaped rods with smooth extremities in the body wall. Moreover, in these four species the C-shaped rods are very thin and only slightly curved, whereas they are thick and strongly curved to O-shaped in *C. smirnovi*. *C. smirnovi* is closest to *C. intermedia* because the wheels and tentacle rods are similar.

Distribution.— Ambon.

Ethymology.— The species is named after Dr. A. Smirnov, a specialist in apodid holothurians.

General considerations

During the Rumphius Biohistorical Expedition 21 of the 53 species known from Ambon (see table 1) were again collected. Several common species, such as *Holothuria leucospilota, H. olivacea* or *Polyplektana kefersteini* are absent from the collection and the same holds true for very large holothurioids and stichopodids, for cryptic, nocturnal or deep living holothurian species.

Undoubtedly first of all due to the fact that no scientist of the expedition was in

charge of the holothurians, no special attention was paid to them and they must be considered as bycatch of the expedition.

In spite of this four new species have been added to the local fauna and 2 species are new to science. This suggests that the 59 species now recorded are far from exhaustive in the light of the ca 150 shallow-water species known from Indonesia (Clark & Rowe, 1971; Rowe, 1983; Massin, 1987; Jangoux et al., 1989). Hence no zoogeographical conclusions can be drawn from the present results, and many additional species are to be expected from this area.

Acknowledgements

It is a pleasure to thank H.L. Strack who invited me to study the holothurians collected during the Rumphius Biohistorical Expedition; Dr. Ph. Willenz, Dr. P.M. O'Loughlin, and J.C. den Hartog for critically reading the manuscript and improving the English; Dr. A. Smirnov for discussion and comments on the apodid holothurians; Dr. B. Hoeksema for drawing my attention on the Mullerian mimicry of *Pearsonothuria graeffei*; Dr. T.M. Gosliner (CAS) and Dr. M. Jensen (ZM, Copenhagen) for the loan of material and Dr. N. Cominardi for welcoming me in the Laboratoire des Invertébrés Marins et Malacologie at the MNHN of Paris.

References

Cannon, L.R.G. & H. Silver, 1986. Sea Cucumbers of Northern Australia: 1-60.— Queensland Museum, Brisbane.

Chao, S.M. & K.H. Chang, 1989. The Shallow-water Holothurians (Echinodermata: Holothurioidea) of Southern Taiwan.— Bull. Inst. Zool., Acad. Sinica 28 (2): 107-137.

Chao, S.M. & K.H. Chang, 1990. First record of two holothurians (Echinodermata: Holothurioidea) from Taiwan.— Bull. Inst. Zool., Acad. Sinica 29 (1): 65-69.

Cherbonnier, G., 1954. Holothuries récoltées en Océanie française par G. Ranson, en 1952.— Bull. Mus. natn. Hist. nat., Paris, 2ème sér. 26 (6): 685-690.

Cherbonnier, G., 1955. Holothuries récoltées en Océanie française par G. Ranson en 1952. (4ème note).— Bull. Mus. natn. Hist. nat., Paris, 2ème sér. 27 (4): 319-323.

Cherbonnier, G., 1963. Contribution to the knowledge of the Red Sea. N°27. Les holothuries de la Mer Rouge de l'Université hébraique de Jérusalem.— Bull. Sea Fish. Res. Stn. Israel 34: 5-10.

Cherbonnier, G., 1980. Holothuries de Nouvelle-Calédonie.— Bull. Mus. natn. Hist. nat., Paris, 4ème sér., 2, section A (3): 615-667.

Cherbonnier, G., 1988. Echinodermes: Holothurides.— Faune de Madagascar 70: 1-292.

Cherbonnier, G. & J.-P. Féral, 1984a. Les Holothuries de Nouvelle-Calédonie. Deuxième contribution (Première partie: Synallactidae et Holothuriidae).— Bull. Mus. natn. Hist. nat., Paris, 4ème sér, 6, section A (3): 659-700.

Cherbonnier, G. & J.-P. Féral, 1984b. Les Holothuries de Nouvelle-Calédonie. Deuxième contribution (Deuxième partie: Stichopodidae, Cucumariidae, Phyllophoridae et Synaptidae).— Bull. Mus. natn. Hist. nat., Paris, 4ème sér., 6, section A (4): 827-851.

Clark, A.M. & F.W.E. Rowe, 1971. Monograph of shallow-water Indo-West Pacific echinoderms.— Trust. Br. Mus. nat. Hist., London, 1-238, 31 pls.

Clark, H.L., 1907. The apodous holothurians. A monograph of the Synaptidae and Molpadiidae.— Smithson. Contr. Knowl. 35: 1-231, 13 pls.

Clark, H.L., 1922. The holothurians of the genus *Stichopus*.— Bull. Mus. Comp. Zool. Harvard 65 (3): 39-74.

Clark, H.L., 1924. The holothurians of the Museum of Comparative Zoology. The Synaptinae.— Bull. Mus. Comp. Zool. 65 (13): 459-501, 12 pls.

Conand, C., 1989. Les holothuries aspidochirotes du lagon de Nouvelle-Calédonie. Biologie, écologie et exploitation: 1-393.— Thèse de Doctorat, Paris.

Deichmann, E., 1944. *Urodemas bifurcatum* a new Holothurian from South Africa with a Revision of the Genus *Urodemas* Selenka.— Ann. Mag. nat. Hist. 11th ser. 11 (83) 731-737.

Engel, H., 1959. The Echinoderms of Rumphius. In: H.C.D. De Wit (ed.), Rumphius Memorial Volume: 209-223.— Hollandia, Baarn.

Féral, J.-P. & G. Cherbonnier, 1986. Les holothurides. In: A. Guille, P. Laboute & J.-L. Menou (eds.), Guide des étoiles de mer, oursins et autres échinodermes du lagon de Nouvelle-Calédonie: 55-107.— ORSTOM, Paris.

Fisher, W.K., 1907. The holothurians of the Hawaiian Islands.— Proc. U.S. natn. Mus. 32 (1555): 637-744, 17 pls.

Gosliner, T.M. & D.W. Behrens, 1990. Special Resemblance, Aposematic Coloration and Mimicry in Opistobranch Gastropods. In: M. Wicksten (ed.), Adaptative Coloration in Invertebrates: 127-138, 3 pls.— Texas A & M University, College Station.

Heding, S.G., 1928. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. 46. Synaptidae.— Vidensk. Meddr. dansk naturh. Foren. 85: 105-323, 2 pls.

Heding, S.G. & A. Panning, 1954. Phyllophoridae.— Spolia zool. Mus. Haun. 13: 1-209.

Jangoux, M., C. De Ridder, C. Massin & P. Darsono, 1989. The holothuroids, echinoids and asteroids (Echinodermata) collected by the Snellius-II Expedition.— Neth. J. Sea Res. 23 (2): 161-170.

Kerr, A.M., 1994. Shallow-water Holothuroids (Echinodermata) of Kosrae, Eastern Caroline Islands.— Pacif. Sci. 48 (2): 161-174.

Koehler, R., 1895. Echinodermes de la baie d'Amboine.— Revue suisse Zool. 3 (2): 275-293.

Koehler, R. & C. Vaney, 1908. An account of the littoral Holothurioidea collected by the royal Indian marine survey ship Investigator.— Trust. Indian Mus., Calcutta, 1-54, 3 pls.

Lampert, K., 1885. Die Seewalzen. Eine systematische Monographie.— in Semper, C. , Reisen im Archipel der Philippinen, Teil 2, Wiss. Res. 4, Wiesbaden.

Lawrence, J.M., 1980. Numbers and biomass of the common holothuroids on the windward reef flat at Enewetak atoll, Marshall Islands. In: M. Jangoux (ed.), Echinoderms: Present and Past, Proc. Eur. Coll. Echinoderms: 201-204.— Balkema, Rotterdam.

Levin, V.S., V.I. Kalinin & V.A. Stonik, 1984. Chemichal characters and taxonomic revision of holothurian *Bohadschia graeffei* (Semper) as refer to erection of a new genus.— Biologia moria, Vladivostok 3: 33-38.

Liao, Y., 1975. The echinoderms of Xisha Islands. I. Holothurioidea, Guandong Province, China.— Studia mar. Sinica 10: 199-230.

Ludwig, H., 1882. List of the holothurians in the collection of the Leyden Museum.— Notes Leyden Mus. IV (10): 127-137.

Ludwig, H., 1888. Die von Dr. J. Brock in Indischen Archipel gesammelten Holothurien.—Zool. Jb. Abt. Syst. 3 (6): 805-820, 1 pl.

Marsh, L.M., 1986. Echinoderms.— Rec. West. Aust. Mus. Suppl. 25: 63-74.

Marsh, L.M., L.L. Vail, A.K. Hoggett & F.W.E.Rowe. 1993. Echinoderms of Ashmore Reef and Cartier Island. In P.F. Berry (ed.), Marine faunal surveys of Ashmore Reef and Cartier Island, Northwestern Australia, Rec. W. Aust. Mus. Suppl. 44: 53-65.

Martens, E.,von, 1902. Die Mollusken (Conchylien) und die übrigens wirbellosen Thiere in Rumpf's Rariteitkamer. In: M. Greshoff (ed.), Rumphius Gedenkboek: 131-133.

Mary Bai, M., 1980. Monograph on *Holothuria (Metriatyla) scabra* Jaeger.— Mem. zool. Survey India 16 (2): 1-75, 1 pl.

Massin, C., 1987. Holothuries nouvelles et peu connues récoltées en Indonésie au cours de la Snellius-II Expedition.— Bull. Inst. r. Sci. nat. Belg., Biol. 57: 97-121.

Massin, C., 1994. Ossicle variation in Antarctic dendrochirote holothurians (Echinodermata).— Bull. Inst. r. Sci. nat. Belg., Biol. 64: 129-146.

Mitsukuri, K., 1912. Studies on Actinopodous Holothurioidea.— J. Coll. Sci. Imp. Univ. Tokyo 39 (2): 1-284, 8 pls.

Oestergren, H., 1898. Das System der Synaptiden.— Öfvers. K. VetenskAkad. Förh. 55: 111-120.

Panning, A., 1929 [1931]. Die Gattung *Holothuria*. (1. Teil).— Mitt. zool. StInst. Hamb. 44: 91-138.

Panning, A., 1941. Über einige ostafrikanische Seewalzen und ihre Eignung zur Trepanggewinnung.— Thalassia, Rovigno 4 (8): 1-18.

Panning, A., 1944. Die Trepangfischerei.— Mitt. hamb. zool. Mus. Inst. 49: 2-76.

Pearson, J., 1903. Report on the Holothurioidea collected by Prof. Herdman, at Ceylon, in 1902.— Rep. Ceylon Pearl Oyster Fish. Suppl. Rep. 5: 181-208, 3 pls.

Pearson, J., 1914. Notes on the Holothurioidea of the Indian Ocean. II.— The sub-genera *Argiodia* and *Actinopyga*.— Spolia zeylan. 9(35): 173-190, 3 pls.

Rowe, F.W.E., 1969. A review of the family Holothuridae (Holothurioidea: Aspidochirotida).— Bull. Br. Mus. nat. Hist. (Zool.) 18 (4): 119-170.

Rowe, F.W.E., 1983. A collection of holothurians in the Leiden Museum from the East Indies and New Guinea, with the description of a new species of *Protankyra* (Holothurioidea: Synaptidae) from Java.— Zool. Meded., Leiden 57 (17): 149-154.

Rowe, F.W.E. & J.E. Doty, 1977. The Shallow-Water Holothurians of Guam.— Micronesica 13 (2): 217-250.

Rowe, F.W.E. & J. Gates, 1995. Echinodermata. In: A. Wells (ed.), Zoological Catalogue of Australia: vol. 33, i-xiii, 510pp.— CSIRO Australia, Melbourne.

Rumphius, G.E., 1705. D'Amboinsche Rariteitkamer, etc. Amsterdam, 1-340, 60 pls, index (41pp).

Selenka, E., 1867. Beiträge zur Anatomie und Systematik der Holothurien.— Z. wiss. Zool. 17 (2): 291-374, 4 pls.

Semper, C., 1868. Reisen im Archipel der Philippinen. Holothurien.2. Wissenschaftliche Resultate. Leipzig: i-x, 1-288, 40 pls.

Singh, B.N. & A. Choudhury, 1992. A new record of *Protankyra similis* (Semper) (Holothurioidea, Apodida) from Indian brackish water environment.— Oebalia 18 N.S.: 109-119.

Sloan N.A., A.M. Clark & J.D. Taylor, 1979. The echinoderms of Aldabra and their habitats.— Bull. Br. Mus. nat. Hist. (Zool.) 37 (2): 81-128.

Sluiter, C. Ph., 1887. Die Evertebraten aus der Sammlung des königlichen naturwissenschaftlichen Vereins in Niederländisch Indien in Batavia.— Natuurk. Tijdschr. Ned.-Indië 47, 8ste ser. (8): 181-220, 2 pls.

Sluiter, C. Ph., 1890. Nachträgliches über die Echinodermen Fauna des Java-Meeres.— Natuurk. Tijdschr. Ned.-Indië 49, 8ste ser. (10): 105-110, 1 pl.

Sluiter, C. Ph., 1894. Holothurien.— Zool. Forsch. Aust. malay Archipel. V (1): 101-106.

Sluiter, C. Ph., 1895. Die Holothuren Sammlung des Museums zu Amsterdam.— Bijdr. Dierk. 17: 75-82.

Sluiter, C. Ph., 1901. Die Holothurien der Siboga Expedition.— Siboga Exped. 44: 1-142, 10 pls.

Strack, H.L., 1993. Result of the Rumphius Biohistorical Expedition to Ambon (1990). Part 1. General Account and List of Stations.— Zool. Verh., Leiden 289: 1-72.

Tan Tiu, A.S., 1981. The Intertidal Holothurian Fauna (Echinodermata: Holothuroidea) of Mactan and the Neighboring Islands, Central Philippines.— Philipp. Scient. 18: 45-119.

Théel, Hj., 1886. Holothurioidea. Part 2.— Rep. scient. Results Voy. Challenger (Zool.) 39: 1-290, 16 pls.

Wiedemeyer, W.L., 1994. Biology of small juveniles of the tropical holothurian *Actinopyga echinites*: growth, mortality and habitat preferences.— Mar. Biol., Berlin 120: 81-93.

Received: 16.viii.1995
Accepted: 5.viii.1996
Edited: J.C. den Hartog