Reef-dwelling Holothuroidea (Echinodermata) of the Spermonde Archipelago (South-West Sulawesi, Indonesia)

C. Massin

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Claude Massin, IRScNB, Malacology Section, 29 rue Vautier, 1000 Bruxelles, Belgium.

Key words: Echinodermata; Holothuroidea; Spermonde Archipelago; Sulawesi; Indonesia; new species; taxonomy; distribution range.
During a survey at the Spermonde Archipelago (22.viii-5.x.1994) 56 holothurian species were collected; ten are new to the fauna of Indonesia and one is new to science: *Stichopus quadrifasciatus* spec. nov. Most of the species are described, figured and discussed. As far as possible, all literature records from 1970 onwards are listed and a distribution map is given for each species.

Introduction

Holothurians of Sulawesi (formerly Celebes), Indonesia, have not yet been the subject of a separate report. Only a few species have been recorded from the island but in papers dealing with the Indo-Pacific fauna in general (Semper, 1868; Lampert, 1885, Panning, 1941), in lists of museum collections (Ludwig, 1882; Sluiter, 1885; Rowe, 1983) and expedition reports such as those of the "Challenger" (Théel, 1886), the "Siboga" (Sluiter, 1901) and "Dr Th. Mortensen's Pacific Expedition" (Heding, 1928). Importantly, however, Sulawesi (as Celebes) is the type locality of some very common species: *Actinopyga lecanora* Jaeger, 1833, *A. echinites* Jaeger, 1833, *Bohadschia argus* Jaeger, 1833, *B. marmorata* Jaeger, 1833, *Holothuria (Halodeima) atra* Jaeger, 1833, *H. (Metriatyla) scabra* Jaeger, 1833 and *H. (Stauropora) fuscocinerea* Jaeger, 1833.

Sulawesi (see fig. 1) is an island extending for more than 900 km between Ujung Pandang (south-west) and Manado (north-east) with more than 4,000 km of coast, surrounded by hundreds of islands, islets, and reefs. The range of biotopes around the island includes a highly diverse fauna which differ considerably between the wide shallow-water reefs of the Spermonde Archipelago off Ujung Pandang (see fig. 2) and the narrow reefs with steep drop-offs near Butung and the Tukang Besi Islands off the SE of the island. The holothurian fauna of some reefs of the Spermonde Archipelago is thus certainly not representative of Sulawesi as a whole. This paper forms the first survey of holothurian species living on shallow-water reefs.

Material and methods

Specimens were collected by Scuba diving down to 37 m depth, and by hand collecting from reef flats at low tide, from 22.viii to 5.x.1994. The following sites have been sampled (see fig. 2): Gusung (3 dives), Samalona (12 dives and 1x collecting on reef flat), Kudingareng Keke (14 dives and 1x collecting on reef flat), Badi (2 dives), Barang Lompo (3 dives), Bone Tambung (2 dives), Panikiang (1 dive and 1x collecting on reef flat), Garong Kong (1x collecting on beach), Kapoposang (4 dives). Additional material was collected by Dr B.W. Hoeksema from Gusung (31.v.1994), Barang

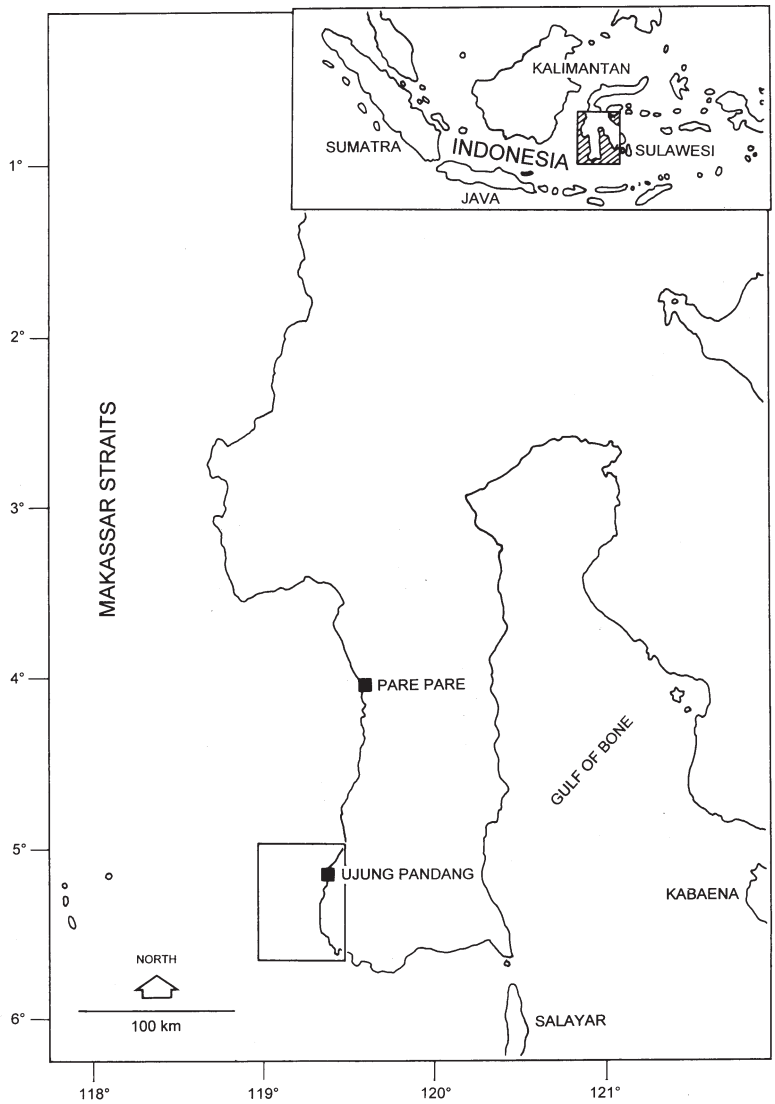


Fig.1. Location of the study area along the south west coast of Sulawesi.

Lompo (24.xi.1995) and Bone Baku (14.v.1997). Muddy or sandy bottoms and mangrove areas at the mainland coastline were not prospected. Table 1 presents the list of collected species for each locality.

Specimens were anaesthetized in 4-7% magnesium chloride during 0.5 to 3h according to their size and fixed in 10 % buffered formalin (pH 8.2-8.4). Additionally, large specimens (more than 10 cm long) were injected with 100 % formalin in the coelomic cavity. Later on, specimens were transferred to 70 % buffered alcohol for permanent storage. Ossicles were prepared for light microscopy by dissolving small

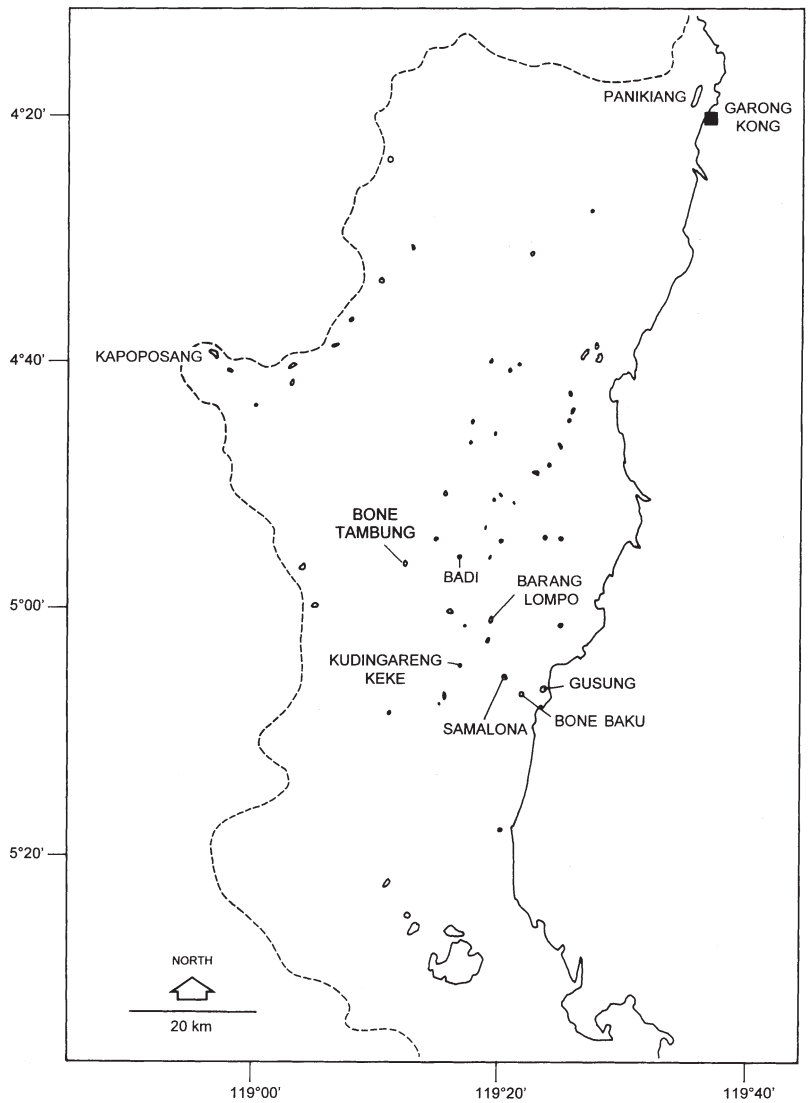


Fig. 2. The Spermonde Archipelago.

pieces of body wall, tube feet, papillae and tentacles in bleach, and by rinsing them carefully (6-8 times) with distilled water before to let them dry. Ossicles were mounted with Euparal under a cover slip.

The specimens were deposited in the collections of the Royal Belgian Institute of Natural Sciences (IRSNB), Brussels, Belgium (IG.28251), the Marine laboratory of Universitas Hasanuddin (Ujung Pandang) and at the National Museum of Natural History at Leiden (RMNH). Material for comparative study was obtained from the Musée National d'Histoire Naturelle Paris, France (MNHN), the Zoological Museum,

Table 1: List of species collected in the Spermonde Archipelago during the present survey. «*» : new record for Indonesia ; «**» : new species.

	Gusung	Samalona	Kudingareng Keke	Badi	Barang Lompo	Kapoposang	Panikiang	Garong Kong	Bone Baku
Actinopyga lecanora		X				X			
Actinopyga miliaris			X				X		
Bohadschia argus		X					X		
Bohadschia vitiensis		X							
Bohadschia spec.		X							
Holothuria (*Acanthotrapeza*) *coluber*			X	X		X			
Holothuria (*Halodeima*) *atra*		X	X			X			
Holothuria (*Halodeima*) *edulis*		X	X						
Holothuria (*Lessonothuria*) *hawaiensis* *			X	X					
Holothuria (*Lessonothuria*) *pardalis*					X				
Holothuria (*Mertensiothuria*) *leucospilota*			X				X		
Holothuria (*Metriatyla*) *scabra*							X		
Holothuria (*Microthele*) *nobilis*			X			X			
Holothuria (*Platyperona*) *difficilis*			X						
Holothuria (*Platyperona*) *excellens* *				X					
Holothuria (*Semperothuria*) *flavomaculata*				X					
Holothuria (*Semperothuria*) *imitans* *				X					
Holothuria (*Stauropora*) *discrepans* *				X					
Holothuria (*Stauropora*) *fuscocinerea*			X	X					
Holothuria (*Stauropora*) *olivacea*				X					
Holothuria (*Theelothuria*) *turriscelsa* *						X			
Holothuria (*Thymiosycia*) *hilla*			X	X	X				
Holothuria (*Thymiosycia*) *impatiens*		X	X	X		X	X		
Labidodemas rugosum			X						
Labidodemas semperianum			X			X			
Pearsonothuria graeffei		X							
Stichopus herrmanni			X		X				
Stichopus noctivagus *			X						
Stichopus quadrifasciatus **		X	X				X		
Stichopus vastus		X					X		

Table 1 continued. List of species collected in the Spermonde Archipelago during the present survey. «*» : new record for Indonesia ; «**» : new species.

	Gusung	Samalona	Kudingareng Keke	Badi	Barang Lompo	Kapoposang	Panikiang	Garong Kong	Bone Baku
Thelenota ananas		X							
Thelenota anax			X						
Colochirus robustus					X				
Plesiocolochirus australis	X	X							
Plesiocolochirus cf. *australis*			X						
Neothyonidium magnum			X		X				
Phyrella trapeza *			X						
Hemithyone semperi			X						
Lipotrapeza spec.									X
Afrocucumis africana		X							
Cladolabes schmeltzii		X	X						
Oshimella ehrenbergii *				X					
Euapta godeffroyi			X						
Opheodesoma grisea							X	X	
Polyplektana kallipeplos			X						
Polyplektana kefersteini	X	X							
Synapta maculata						X			
Synaptula cf. *denticulata*		X							
Synaptula cf. *lamperti*		X							
Synaptula media *						X			
Synaptula reticulata		X	X			X			
Synaptula cf. *reticulata*		X	X						
Synaptula psara		X		X					
Synaptula recta		X		X					
Synaptula spec.		X							
Chiridota sthulmanni				X					
Number of species	2	22	26	14	5	10	8	1	1
Number of dives	3	12	14	2	3	4	1	1	1

Kopenhagen, Denmark (ZMC), the Zoological Museum of Amsterdam, the Netherlands (ZMA) and the IRSNB, Brussels, Belgium.

The abbreviations used for the geographical range from different parts of Australia are as follows: GBR: Great Barrier Reef; NSW: New South Wales; NT: Northern Territory; QLD: Queensland; WA: Western Australia.

Literature records are as complete as possible for each species, excepting the most common species for which I mention only the recent records (from 1970 onwards). For the older records I refer to the comprehensive papers of Panning (1929, 1935a-d, 1949), Heding & Panning (1954), Cherbonnier (1955a, 1988) or Cherbonnier & Féral (1984a, b). Papers dealing with physiology or biochimestry are not included unless they give a record for a new locality.

Systematic account

Order Aspidochirotida Grube, 1840
Family Holothuriidae Ludwig, 1894
Genus *Actinopyga* Broon, 1860
Actinopyga lecanora (Jaeger, 1833)
(figs 3a-j, 4, 110a)

Mülleria lecanora Jaeger, 1833: 18, pl. 2 figs 2, 2b, pl. 3 fig. 8.

Holothuria (Actinopyga) lecanora; Panning, 1929 [1931]: 127, fig. 9a-c (synonymy and records before 1929).

Actinopyga lecanora; Endean, 1957: 254; Levin, 1979: 19; Sloan et al., 1979: 121; Mary Bai, 1980: 7, fig. 8B; Liao, 1980: 115; Price, 1982: 10; James, 1983: 93; Liao, 1984: 221; Price & Reid, 1985: 3; Reyes-Leonardo et al., 1985: 269, pl. 2 fig. 3a-f; Cannon & Silver, 1986: 20, textfig.; Féral & Cherbonnier, 1986: 72; Cherbonnier, 1988: 20, fig. 4A-I (synonymy and records before 1979); Jangoux et al., 1989: 163; Conand, 1989: 17; Levin & Dao Tan Ho, 1989: 55; Adams, 1992: 13; Marsh et al., 1993: 63; Allen & Steene, 1994: 242; Holland, 1994: 2; James, 1994: 28; James & Manikfan, 1994: 102, pl. 2B; Colin & Arneson, 1995: 260, fig. 1224; Rowe & Gates, 1995: 287; Liao & A.M. Clark, 1995: 425, fig 243a-b; Sant, 1995: 27; Gosliner et al., 1996: 277, fig. 1022; Massin, 1996b: 8, fig. 2A-B; Liao, 1997: 84, fig. 47a-b; Baine & Forbes, 1998: 4.

Material.— IRSNB IG.28251/126 (1 specimen), Samalona SW, 19.ix.94, 12 m depth; RMNH Ech. 6075 (1 specimen), Kapoposang, 30.ix.94, 10 m depth, night dive.

Description.— Specimens 195 × 75 and 160 × 70 mm, nearly uniformly chocolate brown with some lighter spots (fig. 110a); around the anus, the characteristic white zone with fine brown lines (fig. 110a); ventral sole of the smaller specimen beige; in alcohol beige-brown dorsally and white ventrally. Five strong yellow anal teeth (fig. 110a). Ventral sole flat, dorsal surface arched. Papillae few, scattered all over the bivium; tube feet restricted to the ambulacra; in each ambulacrum, tube feet long, narrow, on 5-10 rows in a zig-zag pattern (5-6 in the lateral ambulacra and 7-10 in the central ambulacrum). Skin very thick (10-11 mm). Both specimens contracted and consequently tentacles difficult to observe; specimen IRSNB IG 28251/126 with 19 tentacles visible.

Calcareous ring stout with large radial pieces (fig. 3a). On their central anterior

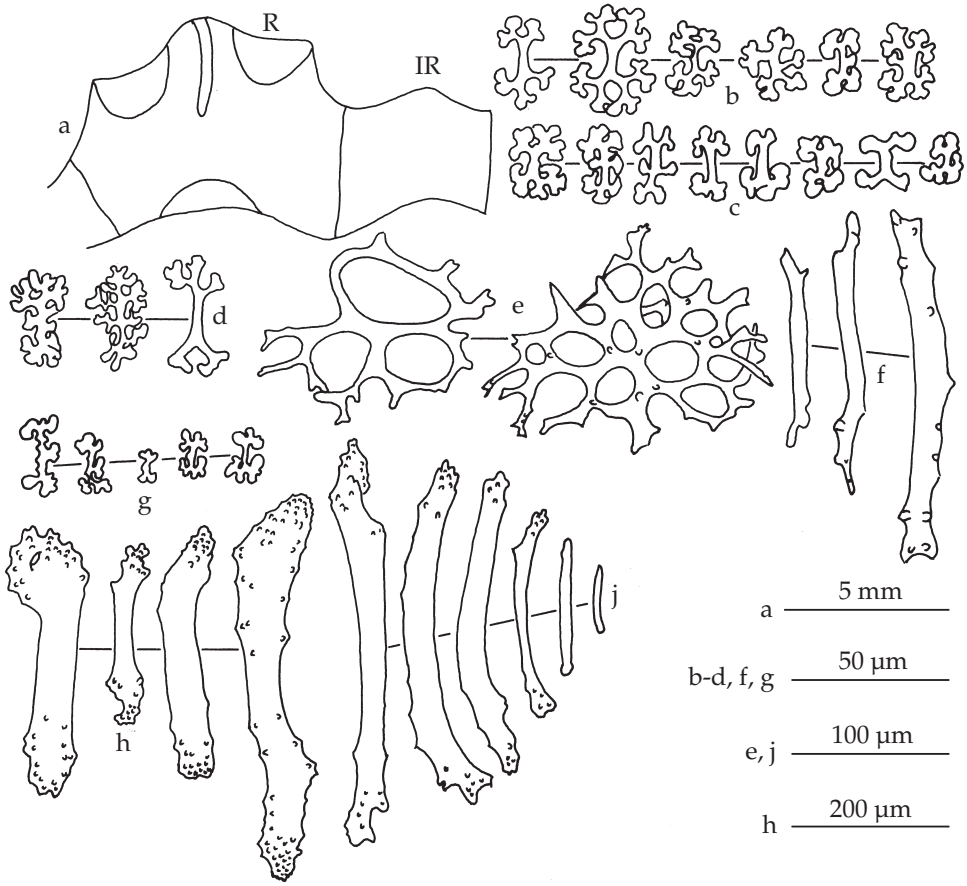


Fig. 3. *Actinopyga lecanora* (Jaeger, 1833). a: calcareous ring (IR: interradial piece; R: radial piece); b: rosettes from dorsal body wall; c: rosettes from ventral body wall; d: rosettes from dorsal papillae; e: plates from dorsal papillae; f: rods from dorsal papillae; g: tube foot rosettes ; h & j: tentacle rods.

tooth a slit for the insertion of the flat longitudinal muscles. One large Polian vesicle (50 mm long), swollen at the free extremity. One stone canal, very short with a large massive L-shaped madreporic plate.

Ossicles of the body wall small rosettes, 25-35 µm long dorsally (fig. 3b) and 20-25 µm long ventrally (fig. 3c). In the dorsal papillae, rosettes similar to those of the body wall; some more massive and longer (fig. 3d); together with the rosettes, spiny plates (fig. 3e) and rods (fig. 3f). In the tube feet, very small rosettes, 8-25 µm long (fig. 3g); terminal plate 250-300 µm across. In the tentacles, massive rods (figs 3h, j), 45-450 µm long, spiny at the extremities.

Geographic distribution (fig. 4).— Somalia, Kenya, Madagascar, Mauritius, Sri Lanka, Maldive Islands, India (Andaman Islands), Myanmar (Mergui Archipelago), Malaysia, Indonesia (Sumatra, Java, **Sulawesi** = type locality, Sumba, Salayer, Timor, Celebes Sea, Ambon, Kai Islands), Australia (WA, Timor Sea, NT, QLD), Philippines,

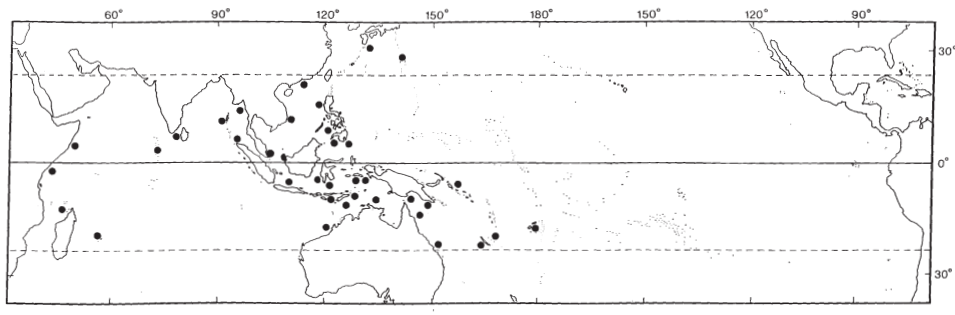


Fig. 4. Distribution of *Actinopyga lecanora* (Jaeger, 1833).

Vietnam, China, Japan (Bonin Islands, Ryukyu Islands), Papua New Guinea, Solomon Islands, Loyalty Islands, New Caledonia, Fiji.

Remarks.— Specimens of Sulawesi do not differ from those from other areas of the Indo-Pacific Ocean. The white anal cone is very characteristic and present throughout the area of distribution (fig. 4), except in some juveniles (Massin, 1996b). The colour pattern of the body wall is variable, ranging from uniformly chocolate brown to a complicated patchwork of brown, beige and white (Allen & Steene, 1994: 242).

Actinopyga miliaris (Quoy & Gaimard, 1833)
(figs 5a-d, 6, 110b)

Holothuria miliaris Quoy & Gaimard, 1833: 137.

Holothuria (Actinopyga) miliaris; Panning, 1929 [1931]: 127, fig. 10a-g (synonymy and records before 1929).

Actinopyga miliaris; Bell, 1887a: 523; Endean, 1956: 132; Endean, 1957: 254; James, 1969: 61; Tortonese, 1977: 275; Sloan et al., 1979: 121; Levin, 1979: 19; Mary Bai, 1980: 7, fig. 8D; Liao, 1980: 115; Humphreys, 1981: 33; Price, 1982: 10; James, 1983: 93, pl. 1C; Reyes-Leonardo, 1984a: 144, pl. 1 fig. 5a-e; Cherbonnier & Féral, 1984a: 667, fig. 4A-J (synonymy and records before 1984); Liao, 1984: 221; A.M. Clark, 1984: 99; Price & Reid, 1985: 3; Reyes-Leonardo et al., 1985: 269; Cannon & Silver, 1986: 20, fig. 5b, text-fig.; Féral & Cherbonnier, 1986: 74, fig. 40B; Conand, 1989: 19; James, 1989: 129; Chambers, 1989: 89; Adams, 1992: 13; Holland, 1994: 2; Kerr, 1994: 166, fig. 4a; James, 1994: 28; James & Manikfan, 1994: 102, pl. 1D; James & James, 1994: 4, fig. 1; Sant, 1995: 27; Colin & Arneson, 1995: 260, fig. 1222; Rowe & Gates, 1995: 287; Liao & A.M. Clark, 1995, fig. 245a-c; Massin, 1996b: 12, figs 6A-F, 7A-B; Belhadjali, 1997: 3; Tsuda, 1997: 16; Liao, 1997: 87, fig. 49a-c; Rowe & Richmond, 1997: 302; Baine & Forbes, 1998: 4.

Blackfish (= *Actinopyga miliaris*); Anon., 1996: 13.

Material.— IRSNB IG.28251/31 (1 specimen), Panikiang, 29.viii.94, reef flat at low tide, among seagrass-beds; RMNH Ech. 6076 (1 specimen), Kudingareng Keke S, 28.ix.94, reef flat at low tide.

Description.— Specimens 95 × 38 and 145 × 55 mm, uniformly deep brown dorsally and beige-brown ventrally; in alcohol uniformly beige-white. Dorsal surface with a thin mucous layer incorporating sand grains (fig. 110b). Ventral sole nearly flat, dorsum arched. Mouth and anus terminal; mouth with 20 tentacles surrounded by a collar of papillae; anus surrounded by 5 strong calcareous teeth. Body slightly tapering, both anteriorly and posteriorly. Papillae numerous, long, slender, scattered all over

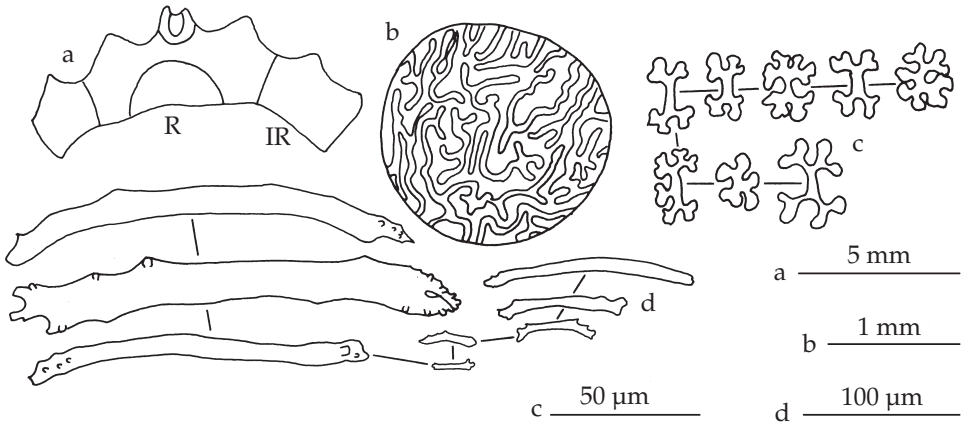


Fig. 5. *Actinopyga miliaris* (Quoy & Gaimard, 1833). a: calcareous ring (IR: interradial piece; R: radial piece); b: madreporic plate; c: rosettes from ventral body wall; d: tentacle rods.

the bivium; tube feet along the 3 ventral ambulacra, numerous, in 4-5 zig-zag rows in each lateral ambulacrum and 6-7 rows in the central ambulacrum. Skin 5 mm thick.

Very characteristic calcareous ring composed of radial pieces twice as broad as the interradial ones (fig. 5a). Radial pieces with 3 anterior teeth, the central one with a notch for the insertion of the longitudinal muscle. One Polian vesicle. One very short stone canal ending in a spherical yellow madreporic plate (fig. 5b), 1.8 mm across situated against the dorsal mesentery.

In the body wall a few rosettes, 20-30 µm long (fig. 5c), most of them located ventrally. In the tube feet no rosettes. Dorsally tube feet with a small terminal plate, 200-240 µm across, ventrally with a larger one, 400-500 µm across. In the tentacles rods, 30-300 µm long and slightly spinose at the extremities (fig. 5d).

Geographic distribution (fig. 6).— Red Sea, Kenya, Zanzibar, Mozambique, Madagascar, Mauritius, Seychelles (Mahé, Aldabra), Comores (Mayotte), Sri Lanka, Maldive Islands, India (Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Myanmar (Mergui Archipelago), Christmas Islands, Malaysia, Indonesia (Sumatra, Sumbawa, Sulawesi, Salayer, Tukang Besi Islands, Timor, Ambon, Sula Islands, Kai Islands, Irian Jaya), Australia (GBR, QLD, NE Coast), New Caledonia,

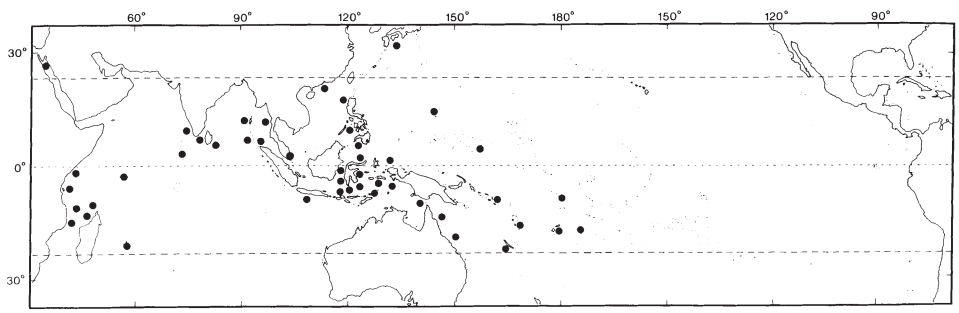


Fig. 6. Distribution of *Actinopyga miliaris* (Quoy & Gaimard, 1833).

China, Japan, Philippines, Mariana Islands (Saipan), Easter Caroline Islands (Kosrae), Solomon Islands (**Vanikoro** = type locality), Ellice Islands (Tuvalu), Vanuatu (= New Hebrides), Fiji, Tonga Islands.

Remarks.— The general aspect, calcareous ring and ossicles of the body wall, leave no doubt about the identity of the Sulawesi specimens as *Actinopyga miliaris* (see Cherbonnier & Féral, 1984a). However, both specimens have very few rosettes in the body wall and none in the tube feet which is uncommon for the species. *Actinopyga miliaris* seems to be a rather variable species, sometimes with very special rods in the dorsal tube feet (Massin, 1996b). A comparative study of specimens from different localities of its wide distributional area (fig. 6) would be useful to define its intraspecific variation.

Genus *Bohadschia* Jaeger, 1833
Bohadschia argus Jaeger, 1833
(figs 7, 110c)

Bohadschia argus Jaeger, 1833: 19, pl. 2 figs 1, 1b; A.M. Clark, 1962: 100 (colour plate); A.M. Clark & Taylor, 1971: 92; Levin, 1979: 19; Liao, 1980: 115; Tan Tiu, 1981: 68, pl. 10 figs 1-2; Grosenbaugh, 1981: 51; Rowe, 1983: 154; James, 1983: 93; Liao, 1984: 221; Brouns & Heijs, 1985: 175; Richard, 1985: 457; Reyes-Leonardo et al., 1985: 270; Marsh, 1986: 73; Cannon & Silver, 1986: 20, figs 3b, 5c; Massin & Doumen, 1986: 188; George & George, 1987: 246, pl. 11f; Cherbonnier, 1988: 34, fig. 10A-H (synonymy and records before 1979); Mukhopadhyay, 1988: 13; Conand, 1989: 21; James, 1989: 129; Chambers, 1989: 89; Zoutendijk, 1989: 2; Machida, 1989: 363;Levin & Dao Tan Ho, 1989: 55; Kalashnikov, 1989: 66; Chao & Chang, 1990: 66, figs 1, 3; Marsh et al., 1993: 63; Kerr, 1994: 163, 166; Marsh, 1994a: 10; Marsh, 1994b: 57; Holland, 1994: 2; Allen & Steene, 1994: 243; James, 1994: 28; James & James, 1994: 11, fig. 4; Rowe & Gates, 1995: 288; Liao & A. M. Clark, 1995: 428, fig. 246a-c; Sant, 1995: 27; Colin & Arneson, 1995: 260, fig. 1225; Gosliner et al., 1996: 278, fig. 1024; Belhadjali, 1997: 3; Tsuda, 1997: 16; Liao, 1997: 89, fig. 50a-c; Baine & Forbes, 1998: 4.

Holothuria (Bohadschia) argus; Panning, 1929 [1931]: 121, fig. 2a-i (synonymy and records before 1929)

Holothuria argus; Dawydoff, 1952: 117; Endean, 1953: 56; Endean, 1956: 130; Endean, 1957: 252; Endean, 1965: 253; James, 1969: 62; Townsley & Townsley, 1972: 176.

Tiger/Leopardfish (= *Bohadschia argus*); Anon., 1996: 13.

Material.— One specimen observed at Panikiang (15 m depth) and one at Samalona (20 m depth).

Geographic distribution (fig. 7).— Seychelles, Madagascar, Chagos Archipelago (Diego Garcia), Sri Lanka, India (Gulf of Mannar, Laccadive Islands, Andaman Islands, Nicobar Islands), Gulf of Bengal, Myanmar (Mergui Archipelago), Cocos Keeling Islands, Malaysia, Indonesia (Sumatra, Sumbawa, Flores, **Sulawesi** = type locality, Rotti, Timor, Ambon, Banda Islands, Irian Jaya), Malaysia (Sabah), Australia (WA, NT, QLD, GBR), Philippines, Vietnam, China, Taiwan, Japan, Mariana Islands (Guam, Saipan), Caroline Islands (Kosrae, Yap), Papua New Guinea (Madang Province), Solomon Islands, New Caledonia, Samoa, Ellice Islands (Funafuti, Tuvalu), Fiji, Vanuatu (= New Hebrides), Tonga, Line Islands (Fanning Island), Cook Islands, Society Islands (Tahiti).

Remarks.— No specimens of *Bohadschia argus* were collected because the species can be identified at sight without any doubt. This very characteristic species (fig. 110c) is normally abundant on reef flats and in shallow water. In the Spermonde

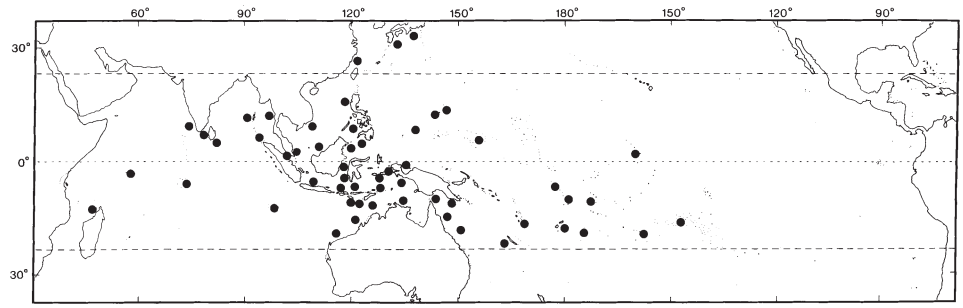


Fig. 7. Distribution of *Bohadschia argus* Jaeger, 1833.

Archipelago it is actually uncommon and lives deeper (15-25 m). It is certainly not a prized species as trepang (Anon., 1974; Conand, 1986) even in Indonesia (Sutaman, 1993) and the scarsity of the species cannot be explained by high human fishing pressure.

Bohadschia vitiensis (Semper, 1868)
(figs 8a-k, 9)

Holothuria vitiensis Semper, 1868: 80, pl. 30 fig. 2; Domantay, 1933: 76, pl.1 fig. 2; Domantay, 1953: 119.
Holothuria (Bohadschia) vitiensis; Panning, 1929 [1931]: 122, fig. 3a-k (synonymy and records before 1931); Domantay, 1935: 399.
Bohadschia marmorata vitiensis; Panning, 1944: 40, fig. 11a-y; Anon., 1979: 20; Belhadjali, 1997: 3.
Bohadschia vitiensis; Rowe, 1969: 130; A.M. Clark & Rowe, 1971: 176, pl. 27 fig. 5; Clastres et al., 1978: 973; Levin, 1979: 20; Mary Bai, 1980: 8, textfig. 8H; James, 1983, 93, pl. 1D; Féral & Cherbonnier, 1986: 78; Cherbonnier, 1988: 42, fig. 14A-I; Conand, 1989: 21, fig. 3; Chambers, 1989: 89; Rowe & Richmond, 1997: 302.
Bohadschia spec.; Colin & Arneson, 1995: 260, fig. 1229.

Material.— IRSNB IG.28251/12 (1 specimen), Samalona S, 24.viii.94, 21 m depth; RMNH Ech. 6077 (1 specimen), Samalona NW, 16.ix.94, 18 m depth.

Description.— Specimens 370 × 90 and 300 × 85 mm, brown dorsally with tube feet yellow at the base and brown at the tip; ventrally, yellowish with a median longitudinal line nearly white; tube feet circled with white at their base; in alcohol colour similar to that of living specimens but faded. Body cylindrical with mouth ventral and anus terminal; mouth with 20 short tentacles; anus surrounded by 5 radial groups of 4-5 papillae. Tube feet densely crowded dorsally and ventrally without alignment. Body wall 3-9 mm thick according to the state of contraction.

Calcareous ring stout; very large radial pieces with a deep anterior notch (fig. 8a); interradial pieces half the width of the radial ones (fig. 8a). One large Polian vesicle (1/10 of body length), ventrally located; one stone canal and very long tentacle ampullae (1/5 to 1/3 of body length). Cuvierian tubules numerous and quickly expelled when the animal is manipulated.

Ossicles of dorsal body wall rosettes (fig. 8b) 14-27 µm long. In the ventral body wall perforated and unperforated grains together with rosettes (fig. 8c), 13-27 µm long.

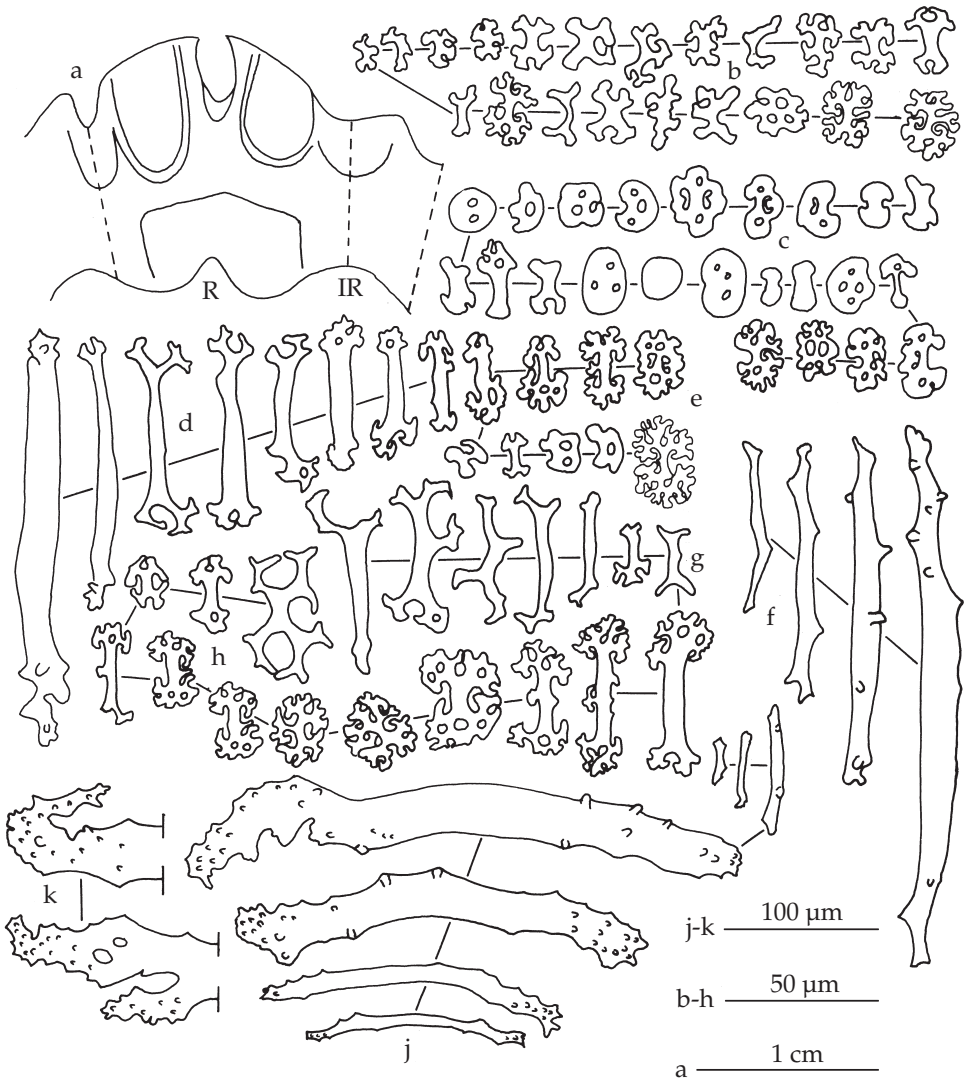


Fig. 8. *Bohadschia vitiensis* (Semper, 1868). a: calcareous ring (IR: interradial piece; R: radial piece); b: rosettes from dorsal body wall; c: grains and rosettes from ventral body wall; d: rods from ventral tube feet; e: rosettes from ventral tube feet; f: rods from ventral tube feet; g: branched rods from dorsal tube feet; h: rosettes from dorsal tube feet; j: spiny rods from tentacles; k: extremities from tentacle rods.

In the ventral tube feet rods (fig. 8d), 33-140 µm long and rosettes (fig. 8e) 13-35 µm long; end plate 450-680 µm across, made of several pieces. In the dorsal tube feet numerous rods (fig. 8f) 60-180 µm long, branched rods (fig. 8g) 20-65 µm long and rosettes (fig. 8h) 20-55 µm long; end plate 325-500 µm across, made of one piece. In the tube feet, rods, branched rods and rosettes without clear separation. In the tentacles spiny rods (fig. 8j), 30-470 µm long, with bifurcated or bended extremities (fig. 8k.

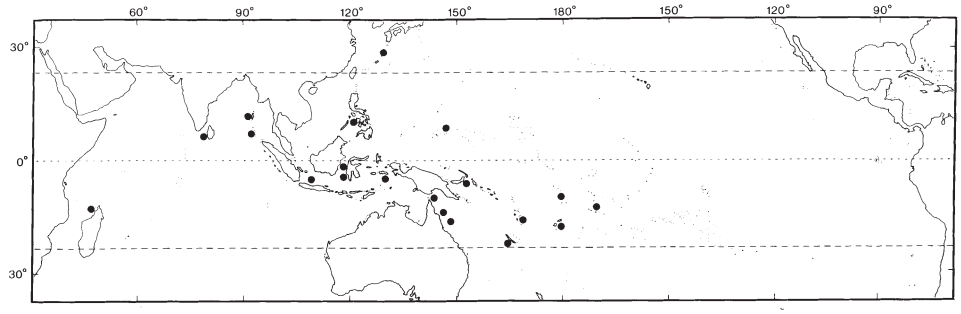


Fig. 9. Distribution of *Bohadschia vitiensis* (Semper, 1868).

Geographic distribution (fig. 9).— Madagascar, Sri Lanka, India (Nicobar Islands), Indonesia (Java, Sulawesi, Makassar Strait, Ceram), Philippines, Japan (Ryukyu Islands), Caroline Islands (Chuuk (= Truck) Atoll), Papua New Guinea (New Britain), Australia (GBR, Queensland), Vanuatu (= New Hebrides; Sfate Island), New Caledonia, Ellice Islands (Tuvalu), Fiji (**Viti Levu Island** = type locality), Samoa (Navigator Island).

Remarks.— The colour pattern of the specimens from Sulawesi is similar to the that of specimens depicted by Féral & Cherbonnier (1986: pl. on p. 79) and by Colin & Arneson (1995: fig. 1229). These specimens are without darker bands or spots as illustrated by Rowe & Doty (1977: fig. 6g, h) for *Bohadschia marmorata* Jaeger, 1833.

The ossicles of the dorsal and ventral body wall are similar to those illustrated by Panning (1944: fig. 11a-y) for *Bohadschia marmorata vitiensis*. However, I compared the material from Sulawesi with specimens of *B. vitiensis* from New Caledonia (held in the MNHN) and identified by Cherbonnier. These specimens have unperforated grains only in the ventral body wall, unlike those from Sulawesi. One therefore wonders whether we are dealing with two different species or with a single highly variable species?

Panning (1944), Rowe & Doty (1977), Tan Tiu (1981), Reyes-Leonardo (1984) and Rowe & Gates (1995) opted for a single species whose ossicle complexity increases with growth. Consequently, they consider *B. vitiensis*, together with other species, as subspecies or synonyms of *B. marmorata*. Provisionally, I maintain *B. vitiensis* as a separate species. In my view it is desirable to repeat the studies of growth series of *Bohadschia* to determine the degree of intraspecific variation and to relate ossicle changes with growth and colour pattern in order to determine the validity of conclusions of Panning (1944), Rowe & Doty (1977) and Rowe & Gates (1995). Because of these nomenclatorial problems some localities assigned to *B. marmorata* may belong to *B. vitiensis*, making its area of distribution wider than here presented (fig. 9).

Bohadschia spec.
(fig.10a-h)

Material.— IRSNB IG.28251/ 47 (1 specimen), Samalona W, 1.ix.94, 20 m depth, on sand.

Description.— Specimen 220 × 120 mm. Colour in alcohol yellow-white; the tube

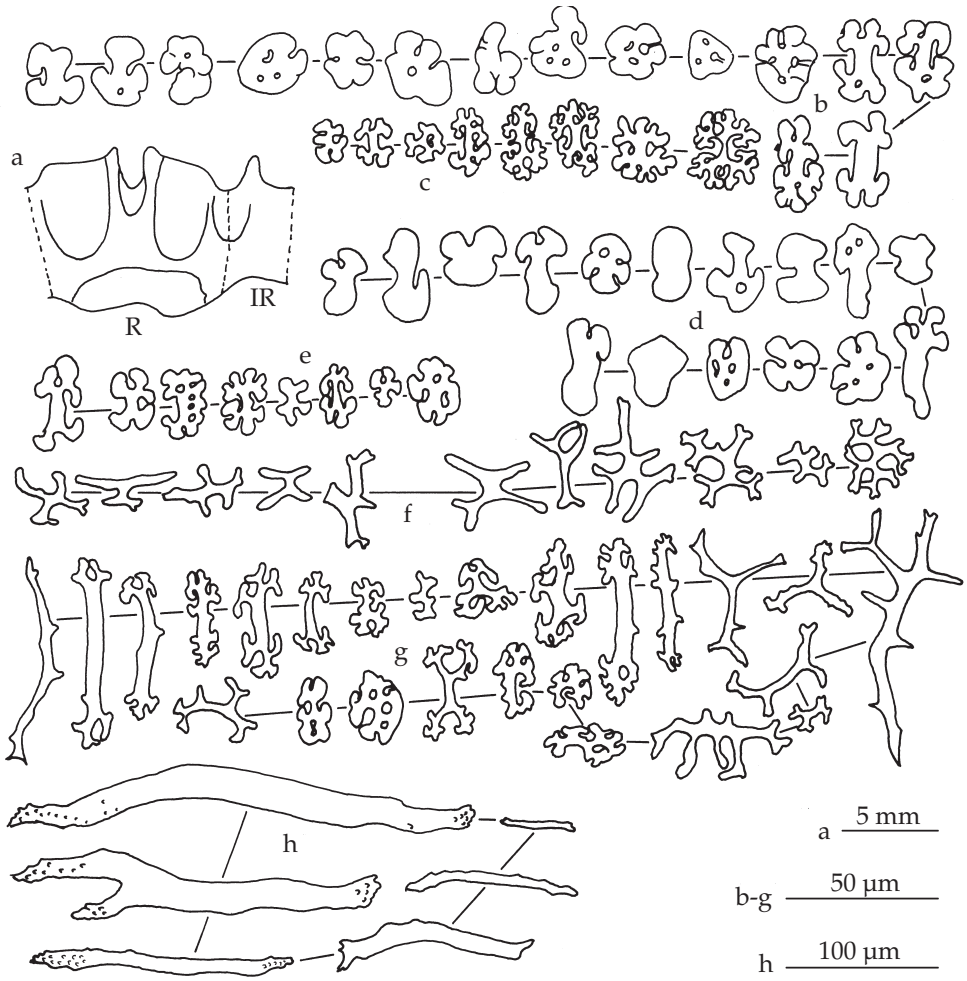


Fig. 10. *Bohadschia* spec. a: calcareous ring (IR: interradial piece; R: radial piece); b: grains and plump rosettes from ventral body wall; c: slender rosettes from ventral body wall; d: grains from dorsal body wall; e: rosettes from dorsal body wall; f: branched rods from ventral tube feet; g: rods and rosettes from dorsal tube feet ; h: tentacles rods.

feet whitish, the base circled with brown. Body cylindrical, mouth ventral, anus terminal; because of the state of contraction of the specimen, groups of radial papillae around the anus not seen; body wall 2-7 mm thick; tentacles 20, short, brown.

Calcareous ring stout (fig. 10a); large radial pieces with a deep anterior notch; interradial pieces half the width of the radial ones (fig. 10a). One Polian vesicle; one long (50 mm), straight stone canal ending in a madreporic plate narrower than canal diameter. Tentacle ampullae very long (1/3 to 1/4 of body length). Cuvierian tubules numerous.

Ossicles of ventral body wall perforated grains and plump rosettes (fig. 10b) 15-33 µm long, together with fine rosettes (fig. 10c) 14-27 µm long. In the dorsal body wall

perforated and unperforated grains (fig. 10d) 15-38 µm long and rosettes (fig. 10e) 14-31 µm long. In the ventral tube feet branched rods only (fig. 10f) 19-40 µm long; end plate 295-315 µm across. In the dorsal tube feet branched rods 15-85 µm long and rosettes 15-60 µm long with numerous intermediate stages (fig. 10g) between these two forms; end plate 400-550 µm across. In the tentacles rods with granulous extremities, 15-160 µm long (fig. 10h).

Remarks.— This *Bohadschia* specimen was collected in the same locality and depth as the two specimens of *B. vitiensis* described above. The size and the general aspect of the three specimens is similar. Only the colour of the base of the tube feet of the present specimen is different (brown versus yellow-white). However, the ossicles of its body wall and ventral tube feet are completely different. The specimen has ossicles presenting a mixture of characters from several other species such as *Bohadschia cousteaui* Cherbonnier, 1954 and *Bohadschia mitsoensis* Cherbonnier, 1988. The absence of unperforated grains ventrally is the only character which does not appear in other *Bohadschia* spp., although Massin (1996b) has described a specimen of *Bohadschia similis* (Semper, 1868) without unperforated grains ventrally.

The colour of the present specimen is the same as that of a specimen figured in Gosliner et al. (1996: fig. 1027) and in my view misidentified as *Bohadschia paradoxa* (Selenka, 1867) (cf. the descriptions and illustrations in Fisher, 1907, and Panning, 1929). The latter species lacks perforated and unperforated grains dorsally and the dorsal "rods" described by Fisher (1907), are quite different from those of the present specimen.

In conclusion, bearing in mind the high variability of some *Bohadschia* spp., it is not realistic to describe the present specimen as a new species.

Genus *Holothuria* Linnaeus, 1767
Subgenus *Acanthotrapeza* Rowe, 1969
Holothuria (Acanthotrapeza) coluber Semper, 1868
(figs 11a-k, 12)

Holothuria coluber Semper, 1868: 90, pl. 28, pl. 30 fig. 28, pl. 34 fig. 5; Panning, 1944: 62, fig. 30a-i; Dawydoff, 1952: 117; Endean, 1956: 131; Endean, 1957: 252; Endean, 1965: 233; Baine & Forbes, 1998: 4.

Holothuria (Holothuria) coluber; Panning, 1935a: 35, fig. 30a, b (synonymy and records before 1935).

Holothuria (Acanthotrapeza) coluber; Rowe, 1969: 138; Levin, 1979: 20; Cherbonnier, 1980: 636, fig. 11A-H (records before 1980); Tan Tiu, 1981: 74, pl. 16 figs. 1-3; Reyes-Leonardo, 1984a: 147, pl.2 fig. 2A-M; Price & Reid, 1985: 3; Reyes-Leonardo et al., 1985: 273; Cannon & Silver, 1986: 21, figs 3d, 6c; Féral & Cherbonnier, 1986: 80, fig. 40A, F; Conand, 1989: 16, 23; Chambers, 1989: 89; Marsh et al., 1993: 63; Kerr, 1994: 168, fig. 4b; Marsh, 1994a: 10; Marsh, 1994b: 57; Rowe & Gates, 1995: 290.

Material.— IRSNB IG.28251/106 (1 specimen), Kudingareng Keke NW, 15.ix.94, 5 m depth under a big coral slab; RMNH Ech. 6056 (1 specimen), Kudingareng Keke S, 29.ix.94, reef flat; IRSNB IG.28251/222 (1 specimen), Kapoposang, 30.ix.94, 1 m depth in the lagoon, night dive; RMNH Ech. 6078 (1 specimen), Badi, 3.x.94, 2 m depth.

Description.— One cylindrical juvenile specimen, 17 × 7 mm; three others, wider posteriorly than anteriorly, 150 × 18-23, 240 × 20-37 and 390 × 22-30 mm. Specimens black with white papillae dorsally and deep brown with white tube feet ventrally; in

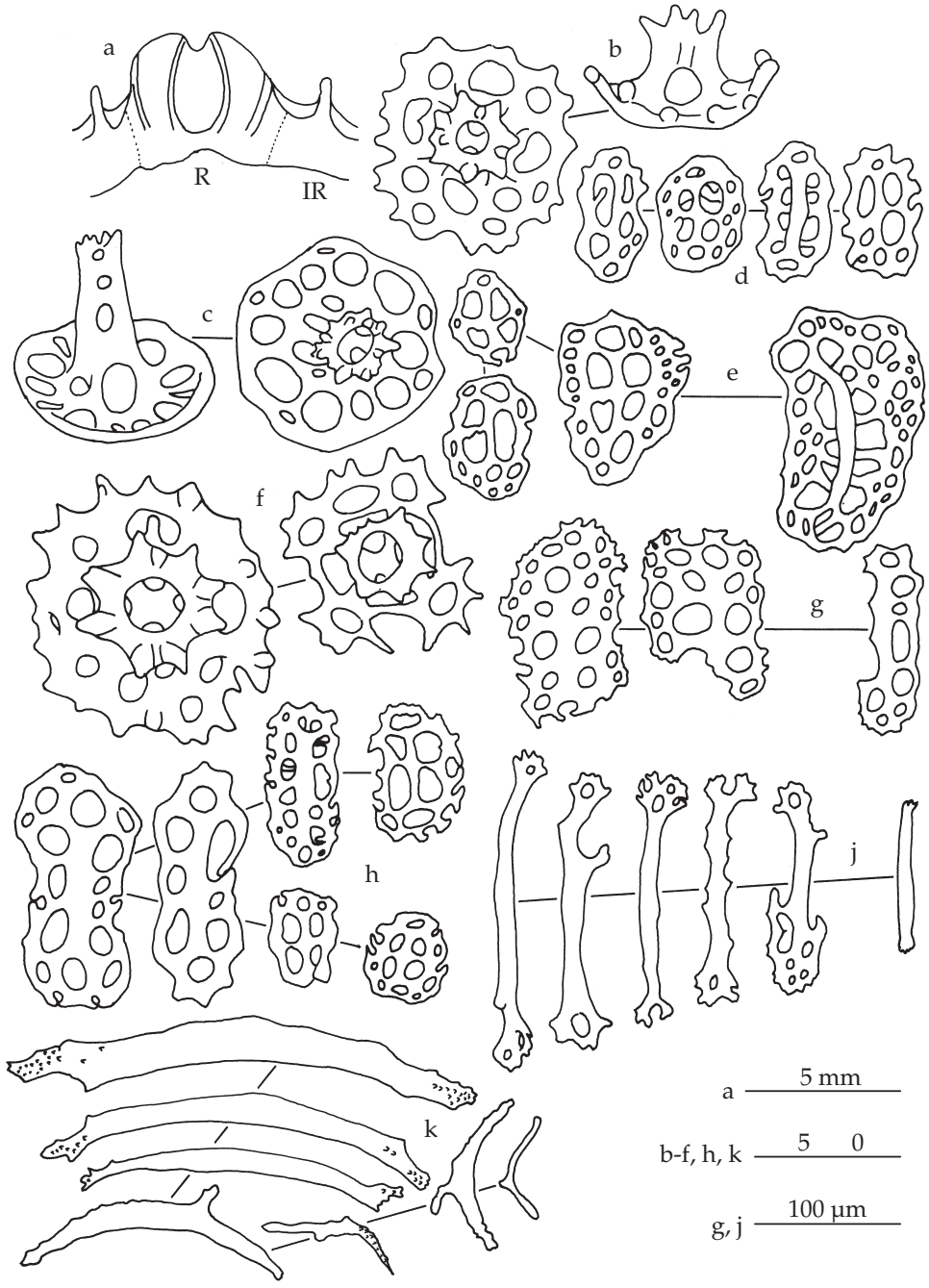


Fig. 11. *Holothuria (Acanthotrapeza) coluber* Semper, 1868. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables (L=390 mm; RMNH Ech. 6078); c: body wall tables (L=17 mm; IRSNB IG.28251/222); d: body wall buttons (L=390 mm; RMNH Ech. 6078); e: body wall buttons (L=17 mm; IRSNB IG.28251/222); f: tube foot tables; g & h: tube foot buttons; j: tube foot rods; k: tentacle rods.

alcohol light brown dorsally with white papillae, and white ventrally. For large specimens, papillae and tube feet very similar, numerous, and without regular arrangement. Juvenile with podia and papillae making a clear difference between trivium and bivium. Papillae 9-10 along the length of the body, without alignment, very large, white coloured due to dense accumulation of ossicles. Tube feet in ambulacral and interambulacral areas, cylindrical, short. Skin rough to the touch due to the orientation of tall-spired tables. Mouth ventral, anus terminal; tentacles 20.

One large Polian vesicle, 3 stone canals. Calcareous ring composed of radial pieces twice as large as the interradial pieces (fig. 11a); one anterior notch on the radial pieces and a sharp narrow anterior tooth on the interradial pieces. No Cuvierian tubules.

In the body wall, tables and buttons. Tables with disc diameter 60-80 µm (fig. 11b); edge of disc spinose, often turned up giving a 'cup and saucer appearance' to the table (fig. 11b); disc perforated by one large central hole and 12 small peripheral holes; 4 very short pillars forming a spire, united by one cross beam and ending in a crown of spines. A few buttons (fig. 11d) with 3-5 pairs of holes. In the tube feet, tables, perforated plates, rods and an end plate; tables similar to those of the body wall, some being larger (up to 100 µm across) (fig. 11f); perforated plates derived from the buttons, 35-140mm long (figs 11g, h); rods 50-110 µm long with enlarged perforated extremities (fig. 11j); end plate 530-560 µm across. In the tentacles rods 40-165 µm long, slightly curved with spinose extremities (fig. 11k).

In the body wall of the juvenile tables few, with a high spire (3 cross beams; fig. 11c); rim of the disc smooth; perforated plates (derived from buttons) numerous, 30-85 µm long (fig. 11e). In the tube feet tables, perforated plates, rods and a few small buttons similar to those of the large specimens; end plate 340-380 µm across.

Geographic distribution (fig. 12).— Cocos Keeling Islands, Malaysia, Indonesia (Sumatra, Makassar Strait, Sulawesi), **Philippines** = type locality, Vietnam, Australia (Ashmore Reef, Cartier Island, Timor Sea, GBR, QLD), Papua New Guinea, New Caledonia, Palau Islands, Caroline Islands (Kosrae, Pohnlei), Vanuatu (= New Hebrides).

Remarks.— Body wall colour and ossicles of *Holothuria (A.) coluber* show no variation throughout the area of distribution (fig. 12). Wherever the locality, it presents always the same behaviour: posterior swollen end of the body hidden under rocks whereas the narrower anterior part of the body is extended and exposed. In the field,

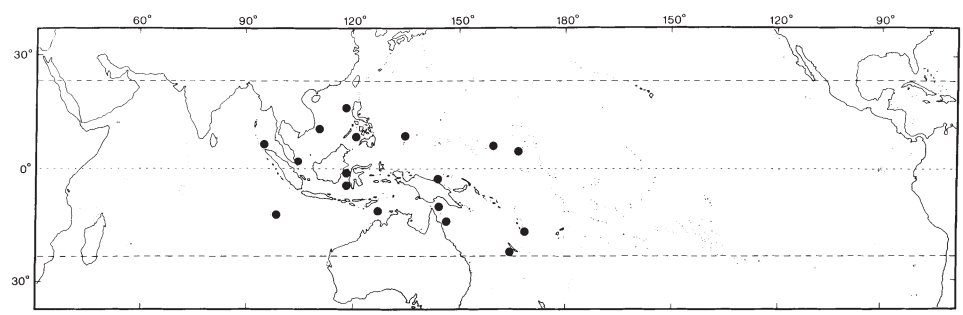


Fig. 12. Distribution of *Holothuria (Acanthotrapeza) coluber* Semper, 1868.

it is easy to distinguish it from *Holothuria leucospilota,* which has a similar colour pattern and behaviour, because of its very rough and hard skin. *Holothuria (A.) coluber* generally lives on the reef flats at less than a meter deep (Endean, 1965; Cherbonnier, 1980; Cannon & Silver, 1986; Conand, 1989; Chamber, 1989; Kerr, 1994; present study). There are only two records from somewhat deeper water (Semper, 1868: 6-8 Faden = 11-15 m; Féral & Cherbonnier, 1986: 25 m).

Subgenus *Halodeima* Pearson, 1914
Holothuria (Halodeima) atra Jaeger, 1833
(fig. 13)

Holothuria atra Jaeger, 1833: 22; Dawydoff, 1952: 117; Endean, 1953: 56; Endean, 1956: 131; Endean, 1957: 252; Bonham & Held, 1963: 305, fig. 3A; Loi & Sach, 1963: 241, pl. 2 figs B, C, pl. 4 fig. 7; Caso, 1965: 271, textfigs 17-19, pl. 5 figs 1-12, pl.7 figs 1-11; Townsley & Townsley, 1972: 176; McKnight, 1974: 45; Tortonese, 1977: 275; Tortonese, 1979: 316; Liao, 1980: 115; Lawrence, 1980: 202; Kropp, 1982: 446; James, 1983: 93; Brouns & Heijs, 1985: 175; Massin & Doumen, 1986: 188; Zoutendijk, 1989: 2; Dalzell et al., 1993: 37; Allen & Steene, 1994: 243; Colin & Arneson, 1995: 260, fig. 1230; Adjeroud, 1997: 14; Baine & Forbes, 1998: 4.

Holothuria (Holothuria) atra; Panning, 1935a: 30, fig. 22a-f (synonymy and records before 1935).

Holothuria (Halodeima) atra; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 210, fig. 10 (1-3); Rowe & Doty, 1977: 230, figs 3d, 7a; Ebert, 1978: 183; Levin, 1979: 20; Sloan et al., 1979: 122; Tortonese, 1980: 107; Cherbonnier, 1980: 631, fig. 8A-N (synonymy and records before 1974); Mary Bai, 1980: 12, textfig. 9D; Grosenbaugh, 1981: 51; Tan Tiu, 1981: 73, pl. 15 figs 1-3, pl. 29 figs 1-2e; Humphreys, 1981: 35; Price, 1982: 11; Rowe, 1983: 155; Price, 1983: 89, fig. 47a-d; Mukhopadhyay & Samanta: 1983: 302, fig. 3A-E; Reyes-Leonardo, 1984a: 145, pl. 2 fig. 1a-d; Liao, 1984: 222; A.M. Clark, 1984: 99; Price & Reid, 1985: 4; James, 1985 [1988]: 404; Richard, 1985: 457; Reyes-Leonardo et al., 1985: 271; Marsh, 1986: 73; Cannon & Silver, 1986: 22, figs 3f, 6d; Féral & Cherbonnier, 1986: 80, fig. 40E; George & George, 1987: 246; Mukhopadhyay, 1988: 5, fig. 3a-c; Cherbonnier, 1988: 73, fig. 28A-J; Jangoux et al., 1989: 163; Conand, 1989: 23, fig. 2; Chao & Chang, 1989: 117, figs 13, 29H; James, 1989: 124; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 55; Kalashnikov, 1989: 63; Marsh et al., 1993: 64; Kerr, 1994: 168; Marsh, 1994a: 10; Marsh, 1994b: 57; Holland, 1994: 2; James & Manikfan, 1994: 102; James & James, 1994: 16, fig. 10; Sant, 1995: 27; Rowe & Gates, 1995: 291; Liao & A.M. Clark, 1995: 435, fig. 251a-c; James, 1995a: 51, fig. 1E; Massin, 1996b: 18, fig. 10A-E; Gosliner et al., 1996: 279, fig. 1028; Britayev & Zamishliak, 1996: 177; Tsuda, 1997: 16; Liao, 1997: 99, fig. 55a-d; Rowe & Richmond, 1997: 304.

Lollyfish (= *Holothuria atra*); Anon., 1996: 13.

Material.— IRSNB IG.28251/66 (1 specimen), Samalona, 2.ix.94, reef flat at low tide; IRSNB IG.28251/201b (1 specimen) and RMNH Ech. 6057 (1 specimen), Kudingareng Keke, 28.ix.94, 1 m depth.

Description and remarks.— Specimens 100 × 25, 120 × 35, 140 × 40 mm, uniformly black; in alcohol brown dorsally and lighter ventrally. External features, calcareous ring and ossicles are similar to those observed for *Holothuria atra* from Ambon (Massin, 1996b).

Holothuria atra has been observed on Samalona, Kudingareng Keke and Kapoposang. It is still abundant on the reef flat of Kudingareng Keke. On the reef flat of Samalona, *H. atra*, together with *Holothuria edulis*, is a dominant species but with a low populatiopn density if compared with other Indo-Pacific areas (Bakus, 1973;

Lawrence, 1980). At Kapoposang, *H. atra* is present in the seagrass-beds of the lagoon. On the huge reef flat of Panikiang not a single *H. atra* was observed.

Geographic distribution (fig. 13).— Red Sea, Somalia, Oman (Muscat), Persian Gulf, Kenya, Zanzibar, Mozambique (Querimba Islands), Madagascar, Mauritius, Seychelles (Mahé, Amirantes, Aldabra), Maldive Islands, Chagos Archipelago (Diego Garcia), Sri Lanka, India (Laccadive Islands, Gulf of Mannar, southeast coast of India, Andaman Islands, Nicobar Islands), Myanmar (coast of Arakan), Malaysia (Peninsula, Sabah), Cocos Keeling Islands, Indonesia (Sumatra, Java, Sumbawa, **Sulawesi** = type locality, Makassar Strait, Lombok, Timor, Lucipara Islands, Ambon, Aru Islands, Banda Sea, Irian Jaya), Philippines, Vietnam, Taiwan, China, Japan, Papua New Guinea (Port Moresby, Madang Province), Solomon Islands, Australia (WA, NT, Timor Sea, QLD, GBR, NSW, Tasman Sea), Mariana Islands (Guam, Saipan), Marshall Island (Enewetak Atoll, Rongelap Atoll), Caroline Islands (Kosrae, Yap), New Caledonia, Niue, Vanuatu (= New Hebrides), Ellice Islands (Funafuti), Gilbert Islands (Boutaritari, Marakai), Fiji, Tonga Islands, Samoa (Navigator), Hawaiian Islands, Line Islands (Fanning Island), Cook Islands (Rarotonga, southern Cook Islands, Manihiki), Society Islands (Tahiti), Galapagos Islands, Cocos Islands, Panamic Region, Clipperton Island, Mexico (Zihuatanejo).

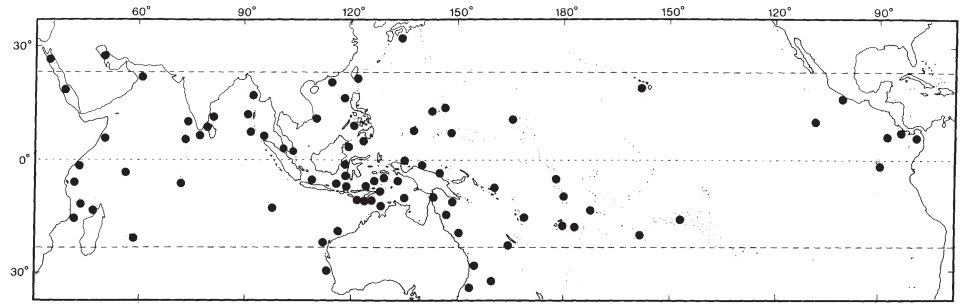


Fig. 13. Distribution of *Holothuria (Halodeima) atra* Jaeger, 1833.

Holothuria (Halodeima) edulis Lesson, 1830
(figs 14, 110d)

Holothuria edulis Lesson, 1830: 125, pl. 46 fig. 2; Dawydoff, 1952: 117; Endean, 1953: 56; Endean, 1956: 131; Endean, 1957: 252; Townsley & Townsley, 1972: 176; Tortonese, 1977: 275; Brouns & Heijs, 1985: 175; Allen & Steene, 1994: 244; Fiege et al., 1994: 86; Colin & Arneson, 1995: 260, fig. 1231; Baine & Forbes, 1998: 4.

Holothuria (Holothuria) edulis; Panning, 1935a, fig. 36a-d (synonymy and records before 1935).

Holothuria (Halodeima) edulis; Levin, 1979: 20; Cherbonnier, 1980: 632, fig. 9A-L (synonymy and records before 1977); Mary Bai, 1980: 12, textfig. 9E; Liao, 1980: 115; Grosenbaugh, 1981: 51; Price, 1982: 11; Rowe, 1983: 156; Liao, 1984: 222; Reyes-Leonardo, 1984a: 146, pl. 3 fig. 1A-I; Price & Reid, 1985: 4; Reyes-Leonardo et al., 1985: 272; James, 1985 [1988]: 404; Marsh, 1986: 73; Cannon & Silver, 1986: 22, fig. 6f, text fig.; George & George, 1987: 246; Féral & Cherbonnier, 1986: 82; Mukhopadhyay, 1988: 6, fig. 4a-b; Cherbonnier, 1988: 75, fig. 29A-I (records); Jangoux et al., 1989: 163; Conand, 1989: 23, fig. 2; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 55; Kalashnikof, 1989: 64, fig. 2; Marsh et al., 1993: 64; Marsh, 1994a: 10; Marsh, 1994b: 57; Holland, 1994: 2; Sant, 1995: 27; James, 1995a: 52, fig. 1F-G; Rowe & Gates, 1995: 291; Liao & A.M. Clark, 1995: 436, fig.

252a-c; Gosliner et al., 1996: 279, fig. 1029; Massin, 1996b: 19, fig. 11A-G; Tsuda, 1997: 16; Liao, 1997: 101, fig. 56a-d; Rowe & Richmond, 1997: 304.

Material.— RMNH Ech. 6079 (1 specimen), Samalona W, 24.viii.94, 2 m depth; IRSNB IG.28251/17 (1 specimen), Kudingareng Keke E, 26.viii.94, 7 m depth on steep sandy slope.

Description and remarks.— Specimens 190 × 50 and 91 × 17 mm, pink ventrally and brownish-black dorsally (fig. 110d); in alcohol grey-white ventrally and brown dorsally.

The external features, calcareous ring and ossicles are similar to those observed for *Holothuria edulis* from Ambon (Massin, 1996b). *Holothuria edulis* was observed at Samalona, Kudingareng Keke, Badi, Barang Lompo and Panikiang. It is definitely the most widespread and abundant species off Ujung Pandang, probably due to the fact that it is generally not used as trepang. However, Sutaman (1993) and Tsuda (1997) consider *H. edulis* as a potential species for trepang.

Geographic distribution (fig. 14).— Red Sea, Aden, Zanzibar, Mozambique, Madagascar, Oman (Muscat), Persian Gulf, Maldive Islands, Sri Lanka, India (Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Cocos Keeling Islands, Indonesia (Sumatra, Java, Makassar Strait, Sulawesi, Salayer, Komodo, Timor, Ceram, Ambon, **Mollucas** = type locality, Irian Jaya), Malaysia (Mainland, Shaba), Australia (WA, NT, QLD, NSW, Tasman Sea), Philippines, Vietnam, China, Japan, Mariana Islands (Guam, Saipan), Caroline Island (Chuuk (= Truck) Atoll, Tonoas Island, Yap), Papua New Guinea (Port Moresby, New Britain), Solomon Islands, New Caledonia, Loyalty Islands (Lifu), Vanuatu (= New Hebrides), Fiji, Line Islands (Fanning Island), Society Islands (Tahiti).

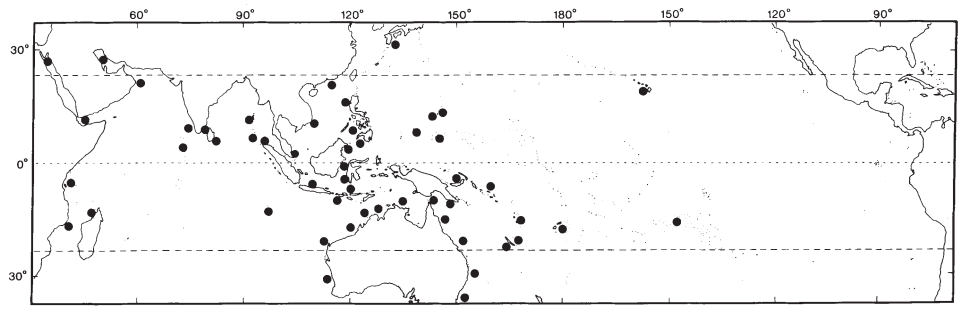


Fig. 14. Distribution of *Holothuria (Halodeima) edulis* Lesson, 1830.

Subgenus *Lessonothuria* Deichmann, 1958
Holothuria (Lessonothuria) hawaiiensis Fisher, 1907
(figs 15a-j, 16, 17, 110e)

Holothuria hawaiiensis Fisher, 1907: 668, pl. 68 figs 4, 4a-g; Dawydoff, 1952: 117.
Holothuria (Lessonothuria) hawaiiensis; Massin, 1996a (synonymy and records).

Material.— IRSNB IG.28251/175 (1 specimen), Kudingareng Keke S, 26.ix.94, 3 m depth; RMNH Ech. 6080 (1 specimen), Badi, 3.x.94, 2 m depth among dead coral branches.

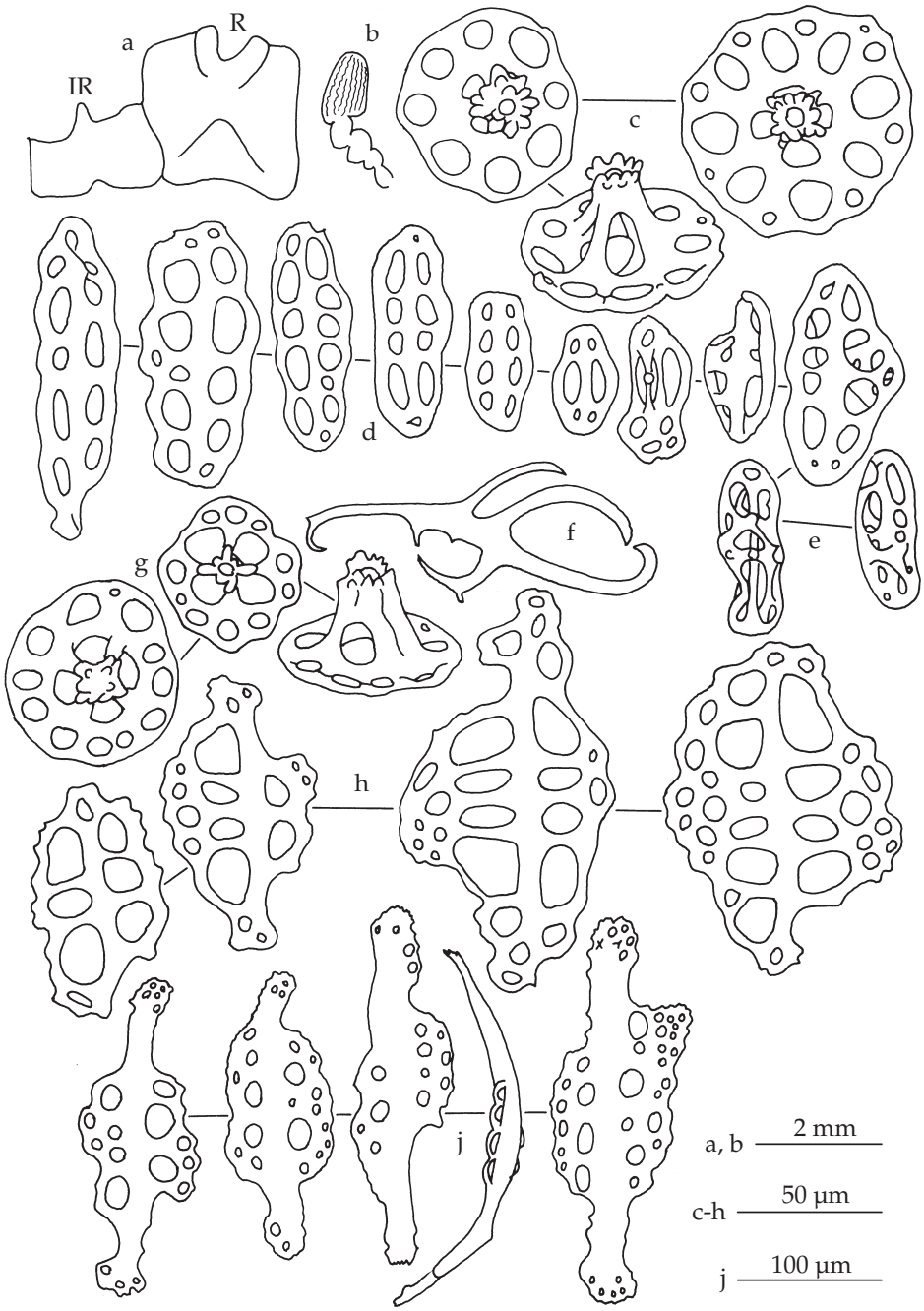


Fig. 15. *Holothuria (Lessonothuria) hawaiiensis* Fisher, 1907. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall tables; d: body wall buttons; e: irregular buttons from body wall; f: irregular curved rods from body wall; g: tube foot tables; h: perforated plates from tube feet; j: tube foot rods.

Description.— Specimens are 57 × 28 and 50 × 21 mm, greyish with tiny white spots corresponding to heaps of ossicles and a patchwork of rusty-brown dots (fig. 110e); tentacles pink; edge of the mouth red; in alcohol greyish with white dots. Body cylindrical, tapering anteriorly and posteriorly. Mouth and anus terminal; tentacles 30; tube feet only along the ambulacra. In each ambulacrum 4-6 rows of tube feet; papillae scattered on the whole bivium. Body soft, skin gelatinous, smooth and thin, damaged on preserved specimens.

Calcareous ring stout composed of radial pieces twice as high as interradial ones (fig. 15a). Anterior notch of the radial pieces very deep. One very long Polian vesicle (15-16 mm long) and one very short contorted stone canal ending in an ovoid madreporic plate (fig. 15b). Specimen from Badi with a well developed gonad made of a bundle of very long, undivided tubules. Cuvierian tubules numerous.

Ossicles of body wall tables and irregular buttons, also a few irregular curved rods (fig. 15f). Table discs 70-80 µm in diameter with 4 central holes, a crown of 8 large peripheral holes and a second crown of smaller holes, sometimes alternating with the large ones (fig. 15c); 4 pillars forming a spire united by one cross beam, exceptionally by 2, and ending in a dense crown of blunt spines (fig. 15c). Buttons 40-110 µm long, with 3-6 pairs of holes (fig. 15d), very often irregular (fig. 15e). Buttons gathered in heaps appearing as tiny white dots on the skin. In the tube feet tables, perforated plates, and rods. Tables similar to those of body wall but smaller, 50-65 µm across (fig. 15g); perforated plates 80-140 µm long, with 2 main central rows of large holes and small peripheral ones (fig. 15h); rods 195-270 µm long, perforated at the center and the extremities (fig. 15j); end plate 200-220 µm across. In the tentacles spiny rods, strait or curved, 110-460 µm long (fig. 16).

Geographic distribution (fig. 17).— Madagascar, Australia (GBR, Tasman Sea), Indonesia (Sulawesi), Vietnam (Bay of Nhatrang), Cook Islands, **Hawaiian Islands** = type locality, Easter Island.

Remarks.— The specimen from Sulawesi are very similar to those of Easter Island (Massin, 1996a) and lack the tables with 3 cross beams described by Fisher (1907). This

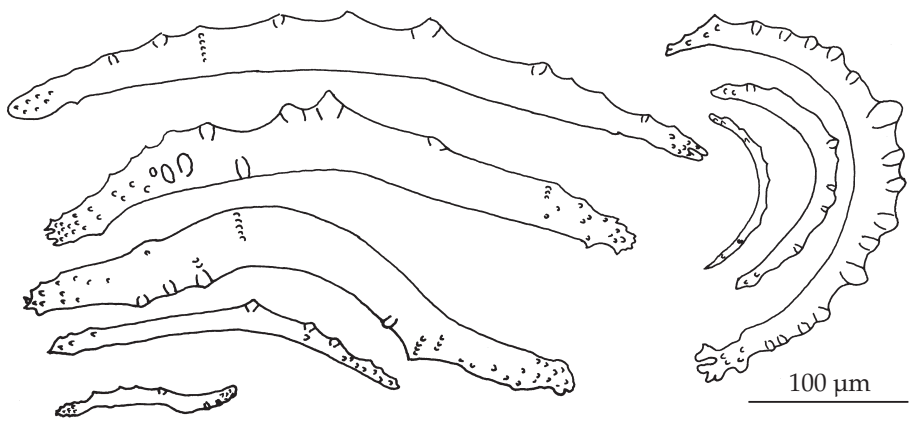


Fig. 16. *Holothuria (Lessonothuria) hawaiiensis* Fisher, 1907. Tentacle rods.

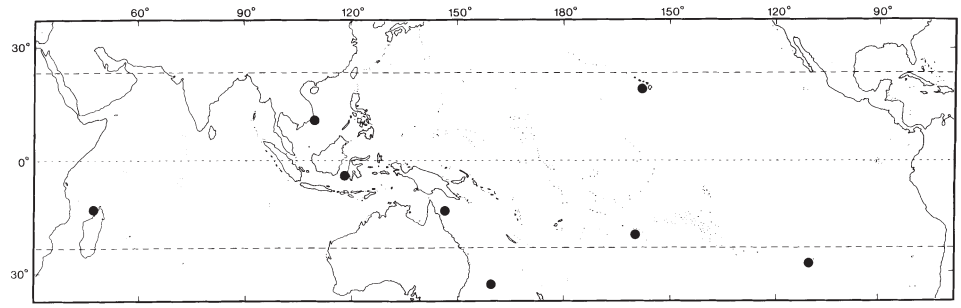


Fig. 17. Distribution of *Holothuria (Lessonothuria) hawaiiensis* Fisher, 1907.

difference can be ascribed to the relatively large size of the specimens. Data presented by Fisher (1907), Cherbonnier (1988), Massin (1996a) and the present study suggest that the number of cross beams diminishes with increasing body size (see table 2).

The species is new to the fauna of Indonesia.

Table 2. Variation in the number of cross beams of *Holothuria hawaiiensis*'s tables.

Author	Cherbonnier 88	Fisher 07	Present study	Massin 96a
Body size	40 mm	45 mm	50-57 mm	55-120 mm
nbr cross beams	3-5	3	1-2	1

Holothuria (Lessonothuria) pardalis Selenka, 1867
(figs 18a-j, 19)

Holothuria pardalis Selenka, 1867: 336, pl.19 fig. 85; Dawydoff, 1952: 117; Endean, 1956: 132; Endean, 1957: 254; Tortonese, 1977: 275; Tortonese, 1979: 316; James, 1983: 93.

Holothuria (Holothuria) pardalis; Panning, 1935d: 3, fig. 106a-x (synonymy and records before 1935).

Holothuria (Lessonothuria) pardalis; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 216, fig. 16 (1-2); Rowe & Doty, 1977: 233, fig. 4e; Levin, 1979: 21; Sloan et al., 1979: 122; Liao, 1980: 115; Tortonese, 1980: 109; Mary Bai, 1980: 14, textfig. 10C; Humphreys, 1981: 34; Price, 1982: 11; Rowe, 1983: 156; Mukhopadhyay & Samanta, 1983: 311; Reyes-Leonardo, 1984a: 148, pl. 4 fig 3a-f; Liao, 1984: 222; A.M. Clark, 1984: 99; Price & Reid, 1985: 4; Richard, 1985: 457; Reyes-Leonardo et al., 1985: 274; James, 1985 [1988]: 404; Marsh, 1986: 73; Cannon & Silver, 1986: 22, figs 3g, 6e; Rho & Shin, 1986: 248, pl. 2 figs 1-12; George & George, 1987: 246; Maluf, 1988: 97; Mukhopadhyay, 1988: fig. 1a-c; Cherbonnier, 1988: 117, fig. 47A-O (synonymy and records before 1975); Chao & Chang, 1989: 119, figs 20, 30G; James, 1989: 127; Levin & Dao Tan Ho, 1989: 55; Maluf, 1991: 359; Marsh, 1994a: 11; Marsh, 1994b: 57; Rowe & Gates, 1995: 292; Liao & A.M. Clark, 1995: 438, fig. 255a-c; James, 1995b: 191, fig. 3D-E; Tahera, 1996: 106; Massin, 1996b: 19, figs 12A-D, 13A-E; Liao, 1997: 105, fig. 59a-c.

Material.— IRSNB IG.28251/156A (1 specimen), Barang Lompo W, 23.ix.94, 5 m depth under coral rubble.

Description.— Specimen 22 × 10 mm. Colour in alcohol beige with brown spots

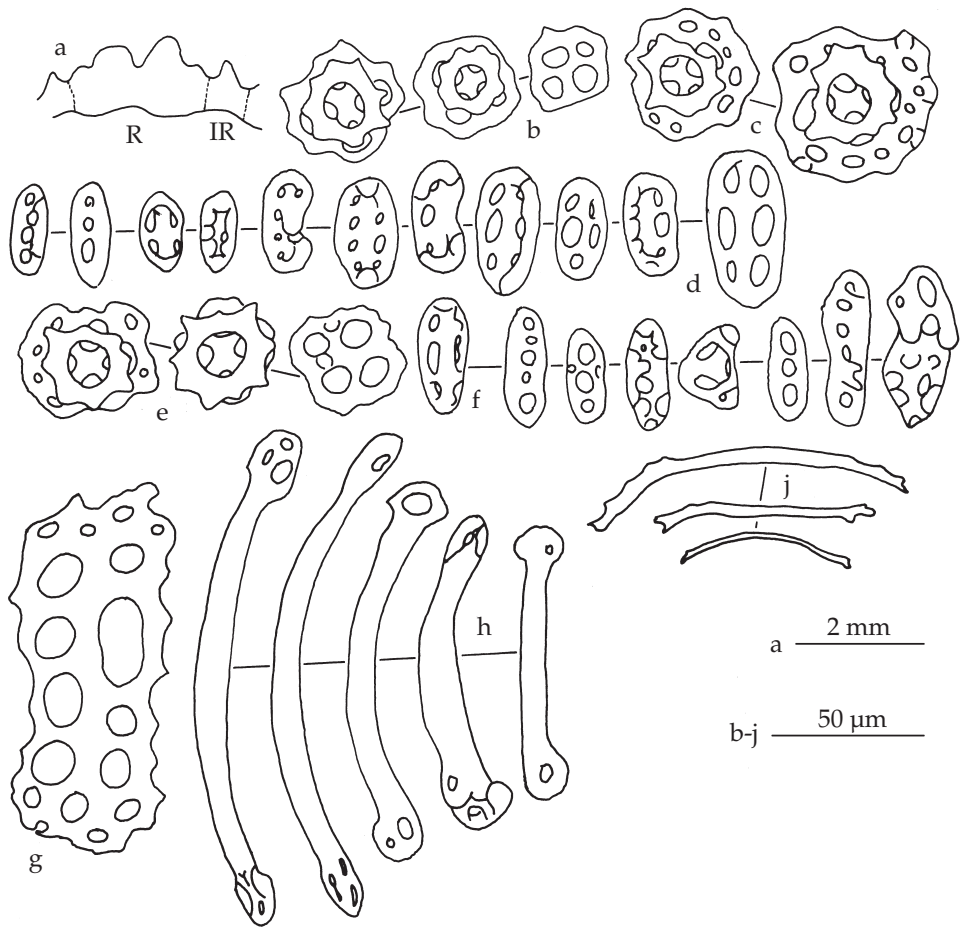


Fig. 18. *Holothuria (Lessonothuria) pardalis* Selenka, 1867. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: large tables from body wall; d: body wall buttons; e: tube foot tables; f: irregular buttons from tube feet; g: large perforated plate from tube feet; h: curved rods from tube feet; j: tentacle rods.

dorsally and white-beige ventrally. Body cylindrical, wider posteriorly than anteriorly. Mouth and anus terminal. Tube feet more numerous ventrally than dorsally, scattered over the whole body surface without alignment.

Calcareous ring composed of very large radial pieces (fig. 18a) and narrow interradial pieces; anterior notch of the radial pieces V-shaped and deep. One very short stone canal, ending in a madreporic plate slightly larger than the stone canal. One Polian vesicle 9 mm long; tentacle ampullae 3-3.5 mm long. No Cuvierian tubules.

Ossicles of body wall tables and buttons. Table discs (fig. 18b) 25-40 µm in diameter with the edge of the discs strongly undulated.; discs perforated by 4 large central holes; spire very flat ending in a crown of blunt spines (fig. 18b); ventral tables smaller and fewer than dorsal ones, sometimes reduced to the disc. In each preparation several larger tables 45-55 µm across (fig. 18c) with 7-9 peripheral holes. Buttons (fig.

18d) 25-55 µm long, nodulous, with 2-4 pairs of holes often reduced to one row of holes. In the tube feet tables (fig. 18e) similar to those of the body wall, very irregular buttons (fig. 18f), large perforated plates (fig. 18g) and curved rods (fig. 18h), 90-170 µm long, perforated at the extremities; end plate of tube feet 210-270 µm across. In the tentacles small spiny rods, 60-115 µm long (fig. 18j), located only in the shaft.

Geographic distribution (fig. 19).— Red Sea, Somalia, Republic of Yemen (Socotra), Kenya (Mombassa), Zanzibar (Tumbatu), Mozambique, Seychelles (Malé, Aldabra), Madagascar, Mauritius, Pakistan, Maldive Islands, Chagos Archipelago (Diego Garcia), Sri Lanka, India (Gulf of Kutch, Bombay, Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Myanmar (Mergui Archipelago), Malaysia, Cocos Keeling Islands, Indonesia (Sumatra, Java, Flores, Makassar Strait, Sulawesi, Salayer, Tukang Besi Islands, Rotti, Savu Island, Timor, Lucipara Islands, Ambon, Obi Islands, Halmaheira Islands, Celebes Sea), Philippines, Vietnam, Taiwan, China (Hong Kong, Xisha Islands), Japan, Korea, Mariana Islands (Guam), Papua New Guinea (Madang), Australia (WA, NT, Timor Sea, QLD, GBR), New Caledonia, Ellice Islands (Funafuti), Samoa (Navigator), **Hawaiian Islands** = type locality, Gulf of California, Mexico, islands off Panama, Columbia, Cocos Islands, Galapagos Islands.

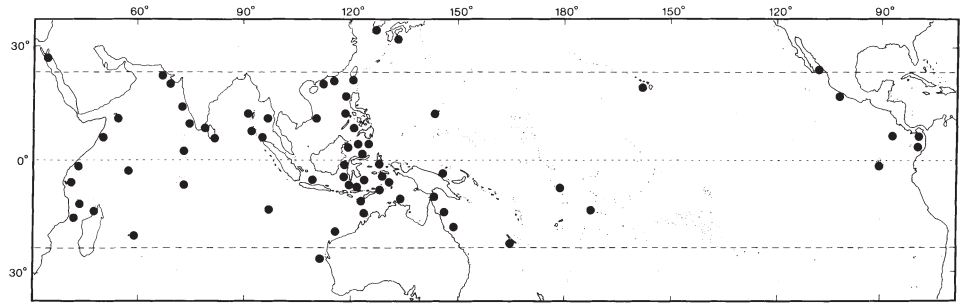


Fig. 19. Distribution of *Holothuria (Lessonothuria) pardalis* Selenka,1867.

Remarks.— The specimen is small but it already presents the colour and most of the ossicles of the adult. Tables are markedly small, 25-40 µm across. According to the literature they vary in diameter from 37 to 140 µm (Fisher, 1907; Domantay, 1933; Panning, 1935c; Liao, 1975; Cherbonnier, 1988; Chao & Chang, 1989; James, 1995b; Massin, 1996b) and there is no significant correlation between table diameter and body size. However, it must be noted that the present specimen is the smallest ever recorded. The rim of the disc is undulated and not really spinose as in adult specimens. Mitsubishi (1912) already noted "a disc with smooth crenate margin" in a small specimen 27 mm long. The fact that the ossicles become more spiny with advancing age is in accordance with many other observations on holothurians belonging to different orders (Massin, 1994).

Subgenus *Mertensiothuria* Deichmann, 1958
Holothuria (Mertensiothuria) leucospilota Brandt, 1835
(figs 20a-g, 21)

Holothuria leucospilota Brandt, 1835: 51; Endean, 1953: 57; Endean, 1956: 131; Endean, 1957: 253;

Endean, 1961: 295; Caso, 1962: 317, pl. 6 figs 1-6, pl. 7 figs 1-9; Bonham & Held, 1963: 305, fig. 3B; Caso, 1965: 266, figs 12-13; Townsley & Townsley, 1972: 176; Tortonese, 1977: 275; Lawrence, 1980: 222; Grosenbaugh, 1981: 51; James, 1983: 93; Massin & Doumen, 1986: 188; Zoutendijk, 1989: 2; Ong Che, 1992: 440; Allen & Steene, 1994: 244; Colin & Arneson, 1995: 262, fig. 1235; Baine & Forbes, 1998: 4.

Holothuria (Holothuria) vagabunda; Panning, 1935b: 67, fig. 45a-u (synonymy and records before 1935); Dawydoff, 1952: 117.

Holothuria vagabunda; Serene, 1937: 26; Loi & Sach, 1963: 240, pl. 1 fig. D, pl. 4 fig. 5.

Holothuria (Mertensiothuria) leucospilota; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 215; Rowe & Doty, 1977: 233, figs 4f, 7g; Levin, 1979: 21; Sloan et al., 1979: 122; Tortonese, 1980: 108; Liao, 1980: 115; Mary Bai, 1980: 14, textfig. 10B; Tan Tiu, 1981: 77, pl. 19 figs 1-2, pl. 29 figs 1, 2d; Humphreys, 1981: 34; Rowe, 1983: 156; Price, 1983: 91, fig. 49a-d; Mukhopadhyay & Samanta, 1983: 305, fig. 7A-G; Liao, 1984: 222; Cherbonnier & Féral, 1984a: 682, fig. 11A-M (synonymy and records before 1975); A.M. Clark, 1984: 99; Price & Reid, 1985: 4; James, 1985 [1988]: 404; Marsh, 1986: 73; Cannon & Silver, 1986: 23, figs 3h, 6g; Féral & Cherbonnier, 1986: 84; George & George, 1987: 246; Maluf, 1988: 96; Conand, 1989: 24; Chao & Chang, 1989: 119, figs 21, 30H; James, 1989: 126; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 56; Kalashnikov: 1989: 64, fig. 3; Maluf, 1991: 359; Marsh et al., 1993: 64; Kerr, 1994: 168; Cherbonnier, 1988: 112, fig. 45A-P; Marsh, 1994a: 11; Marsh, 1994b: 57; Rowe & Gates, 1995: 293; Liao & A.M. Clark, 1995: 442, fig 258a-c; James, 1995b: 190, fig. 3A-C, pl. 2A; Tahera, 1996: 106; Gosliner et al., 1996: 280, fig. 1034; Britayev & Zamishliak, 1996: 177; Liao, 1997: 109, fig. 62a-c; Rowe & Richmonds, 1997: 304.

Material.— IRSNB IG.28251/29 (1 specimen) and RMNH Ech. 6058 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide; IRSNB IG.28251/201A (1 specimen), Kudingareng Keke S, 28.ix.94, 1 m depth.

Description.— Specimens 100 × 25, 140 × 40 and 110 × 25 mm, completely black or black dorsally and deep brown ventrally; in alcohol beige-brown, somewhat lighter ventrally than dorsally. Body cylindrical, somewhat broader posteriorly than anteriorly. Skin thin and soft. Mouth ventral, anus terminal; tentacles 20. Tube feet more numerous ventrally than dorsally; densely crowded along the ambulacra ventrally and scattered over the whole surface dorsally. On one specimen, an eulimid gastropod attached dorsally.

Calcareous ring stout, quadrangular radial pieces (fig. 20a) with a deep narrow anterior notch and with an undulating edge posteriorly; interradial pieces low with a strong anterior tooth (fig. 20a) somewhat swollen at the extremity. One Polian vesicle, short tentacle ampullae and one short contorted stone canal ending in an ovoid madreporic plate (fig. 20b). Cuvierian tubules numerous, long, narrow.

Ossicles of body wall tables and buttons. Tables (fig. 20c) numerous, disc diameters 40-75 µm; disc perforated by 4 large central holes and 4-15 small peripheral holes; rim of the disc spinose; 4 short pillars forming a spire united by one cross beam and ending in a crown of sharp spines (fig. 20c), with a large central hole. Buttons few, 40-60 µm long with 3 pairs of holes (fig. 20d). Same ossicle types in dorsal and ventral tube feet. In dorsal tube feet small perforated plates, 65-75 µm long (fig. 20e) in addition to tables and buttons, and an end plate 490-500 µm across. In the ventral tube feet some buttons larger (fig. 20f), perforated plates larger than dorsally (fig. 20g) and end plate 580-600 µm across. No ossicles in the tentacles.

Geographic distribution (fig 21).— Red Sea, Aden, Somalia, Kenya, Zanzibar, Mozambique (Querimba Islands), Comore Islands, South Africa (Natal), Madagascar, Mauritius, Seychelles (Mahé, Amirantes, Aldabra), Maldive Islands, Chagos archipel-

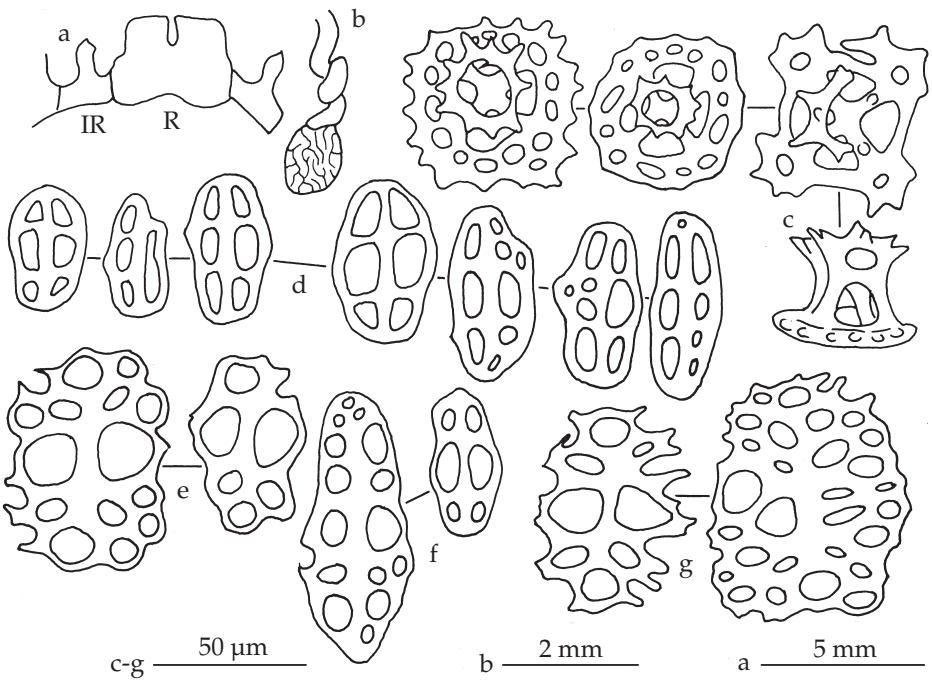


Fig. 20. *Holothuria (Mertensiothuria) leucospilota* Brandt, 1835. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall tables; d: body wall buttons; e: perforated plates of the dorsal tube feet; f: buttons of ventral tube feet; g: perforated plates of the ventral tube feet.

ago (Diego Garcia), Oman (Muscat), Persian Gulf, Pakistan, India (Goa, Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Sri Lanka, Myanmar (Mergui Archipelago), Cocos Keeling Islands, Indonesia (Sumatra, Java, Lombok, Flores, Timor, Rotti, Savu Island, Sulawesi, Ambon, Irian Jaya), Malaysia, Vietnam, Philippines, Taiwan, China (Xisha Islands, Hong Kong), Japan, Mariana Islands (Guam), Papua New Guinea (Madang Province), Australia (WA, NT, QLD, GBR, NSW), New Caledonia, Loyalty Islands, Caroline Islands (Kosrae, Yap), Marshall

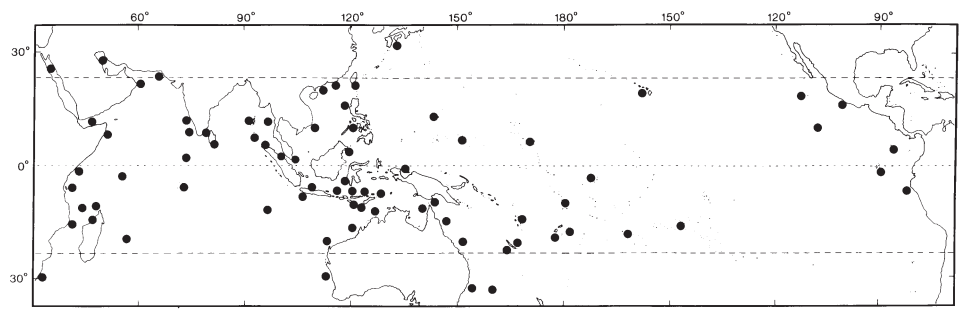


Fig. 21. Distribution of *Holothuria (Mertensiothuria) leucospilota* Brandt, 1835.

Islands (Enewetok, Rongelap, **Ualan =** type locality), Vanuatu (= New Hebrides), Ellice Islands (Funafuti), Phoenix Islands (McKean Island), Cook Islands, Samoa, Tonga Islands, Fiji, Hawaiian Islands, Line Islands (Fanning Island), Cook Islands, Society Islands (Tahiti), Mexico (Revillagigedos, Zihuatanejo), Clipperton Islands, Cocos Islands, Galapagos Islands, Peru.

Remarks.— *Holothuria leucospilota* is a little variable species, its ossicles showing no noticiable variation in specimens from areas as remote as Madagascar (Cherbonnier, 1988), the Galapagos Islands (Deichmann, 1958) or Hawaiian Islands (Théel, 1886). The species, which is usually very common on reef flats, has been observed and collected only at two sites (Panikiang and Kudingareg Keke) off Ujung Pandang. It is typically found with several specimens being together hidden under a coral slab with only the anterior part of the body protruding.

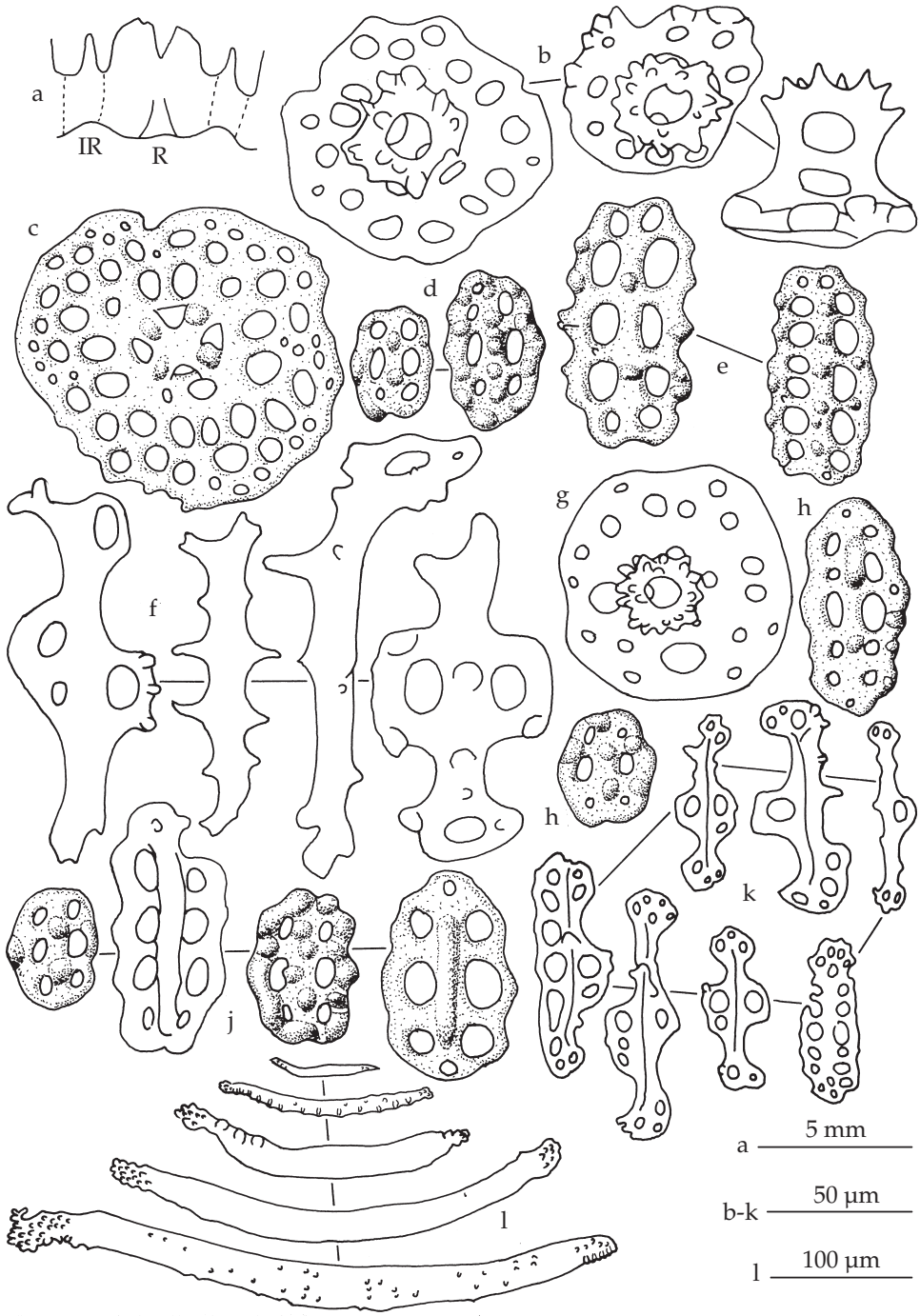
Subgenus *Metriatyla* Rowe, 1969
Holothuria (Metriatyla) scabra Jaeger, 1833
(figs 22a-l, 23, 110f)

Holothuria scabra Jaeger, 1833: 23; Serene, 1937: 26; Dawydoff, 1952: 117; Endean, 1953: 57; Endean, 1956: 132; Endean, 1957: 234; Loi & Sach, 1965: 241, pl. 2 figs A, D, pl. 4 fig. 6; Tortonese, 1979: 316; James, 1983: 93, pl. 1A; Brouns & Heijs, 1985: 175; Shelley, 1985: 298; Adams, 1992: 13.
Holothuria (Holothuria) scabra; Panning, 1935b: 80, fig. 66a-f (synonymy and records before 1935).
Holothuria (Metriatyla) scabra; Cherbonnier, 1980: 647, fig. 16 A-L (synonymy and records before 1980); Mary Bai, 1980: 15, textfig. 10G; Liao, 1980: 116; Tan Tiu, 1981: 83, pl. 25 figs 1-3; Humphreys, 1981: 34; Price, 1982: 12; A.M. Clark, 1982: 489; Liao, 1984: 237; Reyes-Leonardo, 1984a: 149, pl. 6 fig. 1a-g; A.M. Clark, 1984: 99; Reyes-Leonardo et al., 1985: 275; James, 1985 [1988]: 404; Cannon & Silver, 1986: 23, figs 4a, 6i; Féral & Cherbonnier, 1986: 86; Cherbonnier, 1988: 135, fig. 55A-O; Conand, 1989: 24, fig. 1; Zoutendijk, 1989: 3; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 56; VandenSpiegel et al., 1992: 168; Marsh et al., 1993: 64; Kerr, 1994: 168, fig. 4c; Marsh, 1994a: 11; Holland, 1994: 2; James, 1994: 27; James & James, 1994: 17, fig. 11; Rowe & Gates, 1995: 294; Liao & A.M. Clark, 1995: 446, fig. 262a-c; James, 1995b: 196, fig.4B-C, pl. 2C ; Sant, 1995: 27; Massin, 1996b: 25, figs 16A-F, 17A-D; Liao, 1997: 115, fig. 66a-c; Rowe & Richmond, 1997: 304.
Holothuria (Halodeima) scabra; Mortensen, 1934: 6.
Sandfish (= *Holothuria scabra*); Anon., 1996: 13.

Material.— RMNH Ech. 6081 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide; IRSNB IG.28251/36 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide.

Description.— Specimens 120 × 27 and 175 × 40 mm, grey dorsally with transversal greenish bands, grey-white ventrally (fig. 110f). In alcohol white-grey ventrally and grey-olive dorsally; ventral surface speckled with dark tiny dots corresponding to the tube feet; small specimen lighter coloured dorsally with dark, transverse bands. Body arched dorsally and more or less flat ventrally. Mouth ventral, surrounded by 20 short tentacles; anus terminal. Tube feet and papillae densely crowded without

Fig. 22. *Holothuria (Metriatyla) scabra* Jaeger, 1833. a: calcareous ring (IR: interradial piece; R: radial piece); b: tables from dorsal body wall; c: large table from from dorsal body wall; d: buttons from dorsal body wall; e: large buttons from dorsal body wall; f: rods from dorsal body wall; g: table from ventral body wall; h: buttons from ventral body wall; j: tube foot buttons; k: perforated rods from tube feet; l: tentacle rods.


a
IR
R
b
c
d
e
f
g
h
h
k
j
l
a 5 mm
b-k 50 µm
l 100 µm

alignment ventrally and dorsally. One median groove ventrally; skin rough, 2-3 mm thick.

Calcareous ring composed of quadrangular, large radial pieces with a deep V-shaped anterior notch (fig. 22a); interradial pieces narrow with a sharp anterior tooth (fig. 22a); posterior edge of the calcareous ring undulating. One very long stone canal (12-15 % of body length) with a very characteristic madreporic plate. One Polian vesicle; tentacle ampullae as long as the stone canal. No Cuvierian tubules.

In the dorsal body wall tables, buttons and rods. Table discs 60-95 µm in diameter; discs with undulating or spiny edge, perforated by one large central hole and numerous peripheral small holes (fig. 22b); in large tables central hole of the disc replaced by several small ones; 4 short pillars forming a spire united by one cross beam and ending in a dense crown of spines. A few very large tables 120 µm across, perforated by numerous holes and with the pillars reduced to knobs (fig. 22c). Buttons nodulous, 40-55 µm long with 3 pairs of holes (fig. 22d); a few larger with 5-7 pairs of holes (fig. 22e). Rods rare, 115-150 µm long, perforated or unperforated centrally and at the extremities (fig. 22f). Ventrally in the body wall tables (fig. 22g) and buttons (fig. 22h) very similar to dorsal ones. Tables somewhat smaller and no very large tables without pillars. Buttons more numerous, more massive, 40-75 µm long; small much more numerous than larger ones. In the tube feet nodulous buttons 40-90 µm long (fig. 22j), perforated rods 110-175 µm long (fig. 22k) and tables 50-100 µm across (identical to those of the body wall). In the dorsal papillae a few rods and numerous buttons similar to those of the tube feet; tables rare or absent. In the tentacles spiny rods, 80-440 µm long (fig. 22l).

Geographical distribution (fig. 23).— Red Sea, Somalia, Kenya, Zanzibar, Mozambique (Querimba Islands), South Africa (Natal), Madagascar, Seychelles (Mahé, Aldabra), Mauritius, Maldive Islands, Sri Lanka, India (Gulf of Kutch, Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Myanmar (Mergui Archipelago), Cocos Keeling Islands, Indonesia (Sunda Strait, Java, Bali Sea, **Sulawesi** = type locality, Makassar Strait, Salayer, Sula Islands, Ceram, Rotti, Timor, Ambon), Philippines, Vietnam, Japan, China (Hong Kong), Australia (WA, NT, Timor Sea, QLD, GBR, NSW), Papua New Guinea (Port Moresby, Madang Province), Solomon Islands, Palau Islands, Caroline Islands (Kosrae), New Caledonia, Vanuatu (= New Hebrides), Fiji, Tonga, Cook Islands.

Remarks.— *Holothuria scabra* is a common species whose ossicles show little varia-

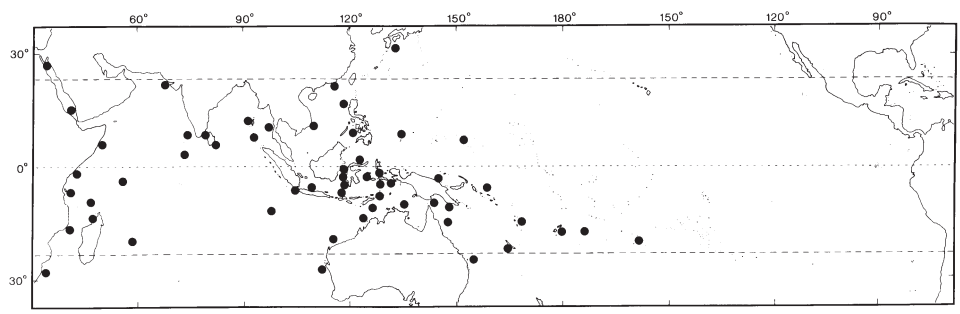


Fig. 23. Distribution of *Holothuria (Metriatyla) scabra* Jaeger, 1833.

tion throughout its distribution area (Cherbonnier, 1955a, 1988; VandenSpiegel et al., 1992; Massin, 1996b). The colour is highly variable as observed by Conand (1989) and VandenSpiegel et al. (1992). Conand (1989) proposed a new variety, *H. scabra* var. *versicolor* based not only on colour pattern but also on ecological and physiological differences. However, she recognised that ossicles, calcareous ring and anatomy are insufficiently different to describe a new species. It is the most prized species for trepang and as a consequence has been overfished. Off Ujung Pandang it is now a rare species.

Subgenus *Microthele* Brandt, 1835
Holothuria (Microthele) nobilis (Selenka, 1867)
(figs 24a-e, 25a-k, 26a-d, 27, 110g, h)

Mülleria nobilis Selenka, 1867: 313, pl. 17 figs. 13-15.

Holothuria nobilis; Serene, 1937: 26; Dawydoff, 1952: 117; Tortonese, 1977: 275; Tortonese, 1979: 316; Grosenbaugh, 1981: 51; Zoutendijk, 1989: 2; Dalzeel, 1990: 12; Allen & Steene, 1994: 244; Mc Elroy, 1990: 3; James & James, 1994: 15, fig. 9.

Microthele nobilis; Domantay, 1953: 122; Cherbonnier, 1967: 56; James, 1969: 61; A.M. Clark & Taylor, 1971: 92; Anon., 1979: 6; James, 1983: 93; Brouns & Heijs, 1985: 175; Massin & Doumen, 1986: 188; Dalzeel et al., 1993: 27.

Holothuria (Microthele) nobilis; Panning, 1929 [1931]; 131, fig. 15a-s (synonymy and records before 1929); Domantay, 1936: 398; Romimohtarto, 1975: 72; Levin, 1979: 21; Mary Bai, 1980: 15, textfig. 10H; Cherbonnier, 1980: 626, fig. 5A-N (synonymy and records before 1975); Liao, 1980: 116; Tan Tiu, 1981: 84, pl. 27 figs 1-4; Humphreys, 1981: 12, 35; James, 1982b: 128; Price, 1982: 11; Rowe, 1983: 157; Mukhopadhyay & Samanta, 1983: 311; Liao, 1984: 222; A.M. Clark, 1984: 99; Reyes-Leonardo, 1984a: 150, pl. 7 fig. 1a-g; Price & Reid, 1985: 4, fig. 2; Reyes-Leonardo et al., 1985: 275; Féral & Cherbonnier, 1986: 88, fig. 40L; Cannon & Silver, 1986: 24, figs 2i, 4b, 7a; Conand, 1986: 28, figs 7, 19, 20, 44D, 46 (4); Marsh, 1986: 73; Cherbonnier, 1988: 142, fig. 58A-L (records); Jangoux et al., 1989: 163; James, 1989: 127, fig. 26; Conand, 1989: 26, fig. 1; Chao & Chang, 1989: 117, figs 15, 30B, 33A; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 56; Kalashnikov, 1989: 66; Marsh et al., 1993: 64; Kerr, 1994: 169; Holland, 1994: 2; Marsh, 1994a: 5, 11; Marsh, 1994b: 57; James, 1994: 27, pl. 1C; James & Manikfan, 1994: 102, pl. 1B; James, 1995b: 199, pl. 2D fig 4D ; Rowe & Gates, 1995: 295; Liao & A.M. Clark, 1995: 449, fig. 264a-c; Massin, 1996a: 151, figs 1A-F, 2A-D, pl. 1B; Belhadjali, 1997: 3; Liao, 1997: 121, fig. 69a-c; Rowe & Richmond, 1997: 304.

Actinopyga nobilis; H.L. Clark, 1925: 106; Townsley & Townsley, 1972: 176.

Argiodia maculata; Domantay, 1933: 55, pl. 1 fig. 1a-f.

Holothuria (Microthele) fuscogilva Cherbonnier, 1980: 628, fig. 7A-L, pl. 1 fig. c; Conand, 1981: 523, figs 1c, c'; Cannon & Silver, 1986: 24; Féral & Cherbonnier, 1986: 88; Conand, 1989: 26, fig. 1; Liao & A.M. Clark, 1995: 448; Gosliner et al., 1996: 2789, fig. 1030; Liao, 1997: 119, fig. 68a-l.

Holothuria fuscogilva; Adams, 1992: 13; Allen & Steene, 1994: 244; Holland, 1994: 2; Sant, 1995: 27; Conand & Tuwo, 1996: 18.

White teatfish (= *Holothuria nobilis*); Anon., 1996: 13.

Material.— RMNH Ech. 6082 (1 specimen), Kudingareng Keke SE, 15.ix.94, 20 m depth; IRSNB IG.28251/185 (1 specimen), Kudingareng Keke S, 28.ix.94, 30 m depth; IRSNB IG.28251/211 (1 specimen), Kapoposang, 30.ix.94, 37 m depth; specimen not measured and released after taking small pieces of body wall, tube feet, papillae and tentacles; IRSNB IG.28251/255 (1 specimen), Kudingareng Keke S, 5.x.94, 25 m depth.

Description.— Specimens 230 × 130, 190 × 55 and 475 × 85 mm, white-cream to

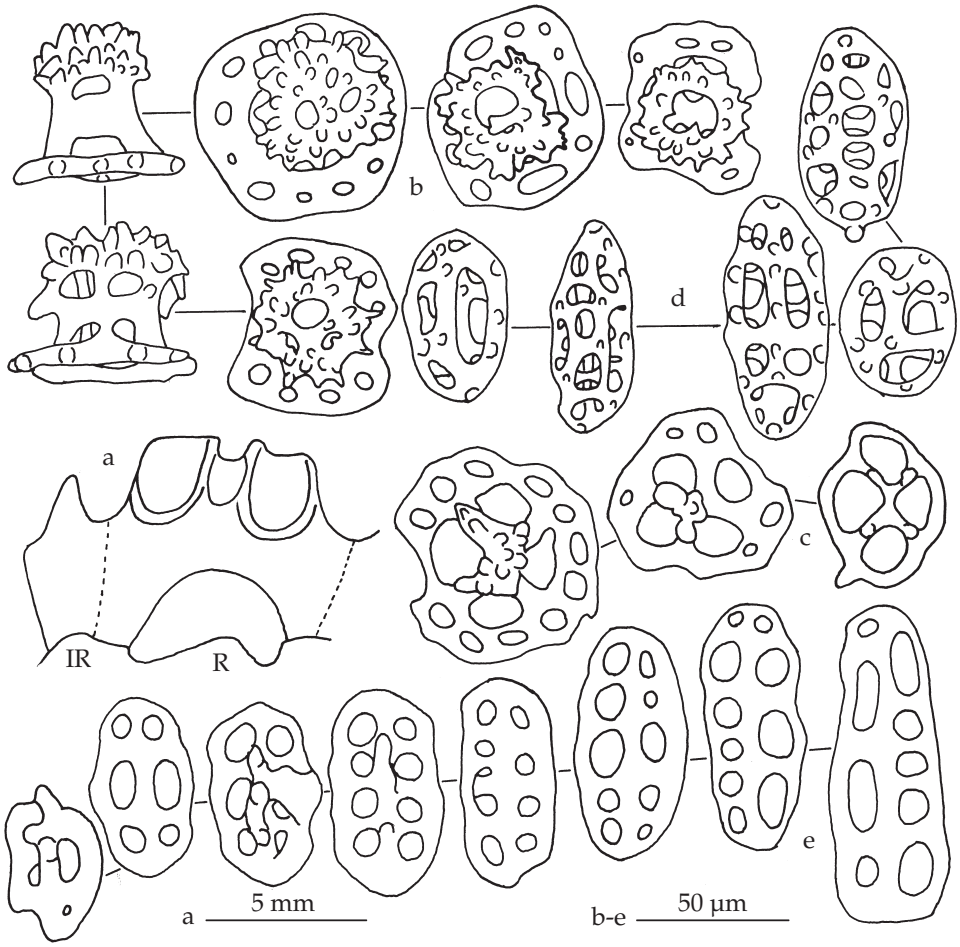


Fig. 24. *Holothuria (Microthele) nobilis* (Selenka, 1867). a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: reduced tables from body wall; d: body wall ellipsoids; e: body wall buttons.

light brown dorsally. Dorsally each papilla black with at its base a black area going from a small dot to a large spot (figs 110g, h). Several adjoining spots sometimes fused to form large black areas (figs 110g, h). In between the black areas body wall mottled with brown. Black surface very variable. Ventrally white-grey to light brown mottled with a few black spots; in alcohol same colour pattern but faded with light brown instead of black. Tube feet numerous, densely crowded over the whole ventral surface, without alignment. Papillae over the whole dorsale surface, from a simple point to large conical warts; laterally, on each side, a row of 5-6 prominent papillae. Body cylindrical or ovoid, mouth ventral, anus terminal; tentacles 20 surrounded by a collar of papillae; anus with five prominent, yellow anal teeth (fig. 110h) each followed by 3-5 papillae; body wall thick (10-14 mm).

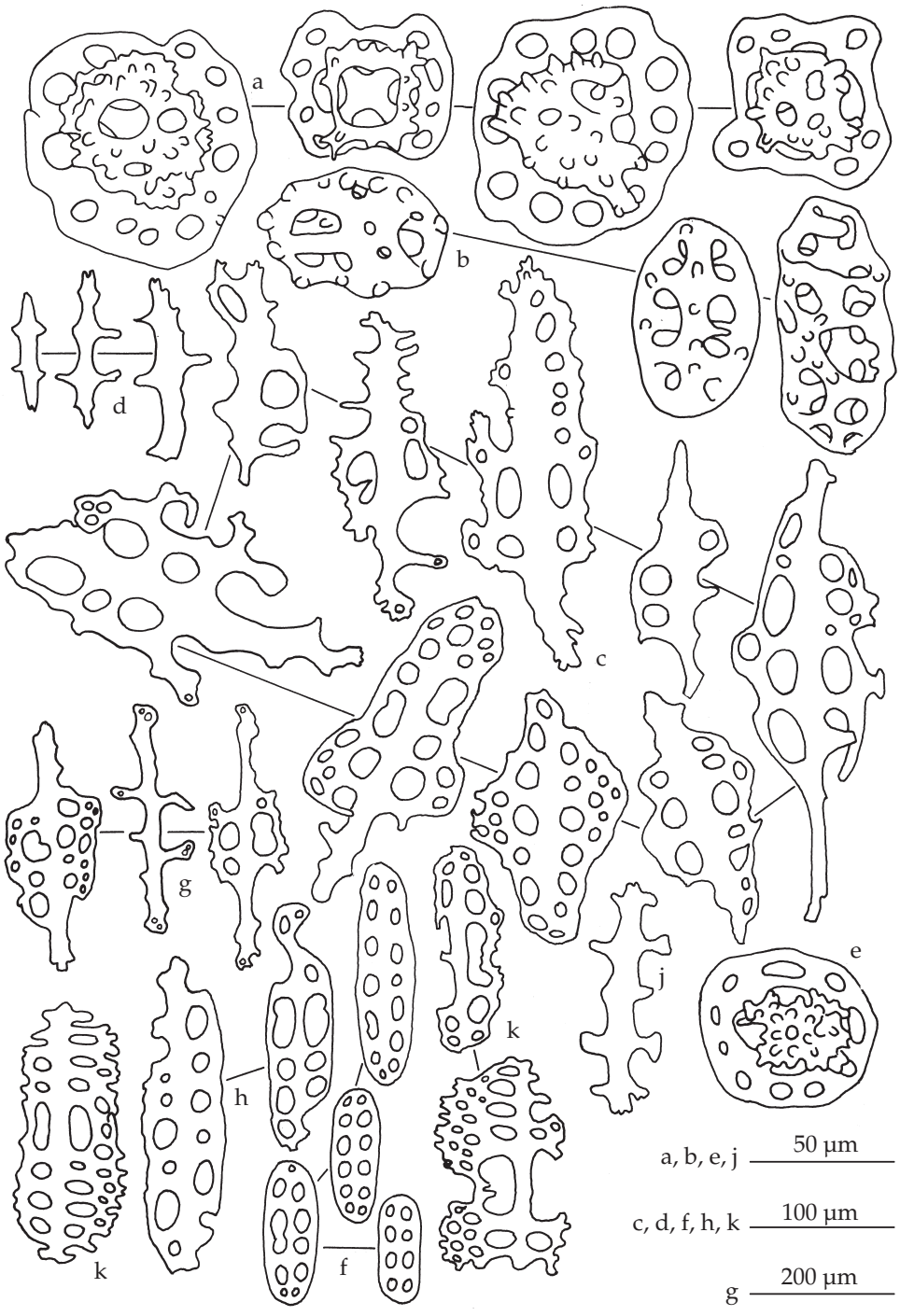
Calcareous ring composed of very large radial pieces having a well marked ante-

rior notch and two small blunt, posterior points (fig. 24a); interradial pieces narrow with one large anterior tooth (fig. 24a). One Polian vesicle and one very short stone canal (2-3 mm long) ending in a yellowish spherical madreporic plate. Tentacle ampullae very long (15-25 % of body length). Cuvierian tubules absent or few and short. Right respiratory tree very long, going up to the calcareous ring. Illustrated specimen IRSNB IG.28251/185 (fig. 110g) with Cuvierian tubules, specimen RMNH Ech. 6082 (fig. 110h) without.

Body wall ossicles tables, ellipsoids and buttons. Table discs 50-75 µm in diameter, edge smooth, undulating, sometimes with a few knobs; discs perforated by 4 large central holes and 4-12 peripheral holes (fig. 24b); some specimens with reduced tables both in the body wall (fig. 24c) and in the tube feet and papillae; 4 pillars forming a spire united by one cross beam and ending in a dense crown of spines (fig. 24b); central hole of the crown often concealed by spines (fig. 24b); body wall tables similar dorsally and ventrally. Ellipsoids 40-80 µm long, numerous, knobbed (fig. 24d); in one specimen ventral ellipsoids up to 100 µm long. Ventral ellipsoids not as complex as dorsal ones; in two specimens reduced to knobbed buttons with 3-5 pairs of holes (fig. 24e); the presence of ventral body wall buttons linked to the absence of Cuvierian tubules. In the dorsal papillae, tables, ellipsoids and perforated plates. Tables few, similar to those of the body wall, 60-90 µm across (fig. 25a), with 4-14 peripheral holes; ellipsoids 55-90 µm long, more irregular (fig. 25b) than in the body wall; perforated plates 150-330 µm long (fig. 25c), derived from rods 85-125 µm long (fig. 25d). Tube feet with numerous ossicles , viz. tables, buttons and three kinds of perforated plates; tables 55-65 µm across, similar to those of the body wall (figs 25e, 26a); buttons 60-105 µm long, smooth or knobbed (fig. 26b); regular elongated, perforated plates looking like large buttons, 100-200 µm long (fig. 25f); irregular narrow plates, 160-375 µm long, derived from spiny rods (figs 25g-j); irregular large plates, 150-230 µm long (fig. 25k), close to the end plate; end plate 600-750 µm across, made of several plates. In the tentacles spiny rods, 40-410 µm long, straight or slightly curved (fig. 26c), sometimes with curved, forked or perforated extremities (fig. 26d).

Geographic distribution (fig. 27).— Red Sea, Somalia, Kenya, **Zanzibar** = type locality, South Africa (Durban), Madagascar, Mauritius, Seychelles (Mahé, Aldabra), Maldive Islands (Malé), Chagos Archipelago (Diego Garcia), India (Laccadive Islands, Andaman Islands), Sri Lanka, Cocos Keeling Islands, Indonesia (Sumatra, Java, Sulawesi, Sumbawa, Timor, Flores, Rotti, Roma, Salayer, Tukang Besi Islands, Ceram, Banda Sea, Irian Jaya), Malaysia (Sabah), Philippines, Vietnam, China, Taiwan, Japan (RyuKyu Islands), Mariana Islands (Guam = Guahan), Caroline Islands (Yap), Papua New Guinea (Port Moresby, Madang Province), Australia (WA, Timor Sea, QLD, GBR, NSW, Tasman Sea), Solomon Islands, New Caledonia, Loyalty Islands (Lifu), Niue, Vanuatu (= New Hebrides), Fiji, Tonga Islands, Samoa, Ellice Islands (Tuvalu), Line Islands (Fanning Island), Cook Islands, Hawaiian Islands, Easter Island.

Remarks.— *Holothuria (Microthele) nobilis* is a highly variable species both as regards body colour and ossicles. Cherbonnier (1980) recognised a second species, *H.(M.) fuscogilva*, based on a mottled colour pattern, on the absence of Cuvierian tubules, on the presence of buttons in the ventral body wall and its supposed occurrence in a different habitat. The four observed specimens from the Spermonde Archipelago present the same mottled colour pattern and only two of the specimens have


a
b
d
c
g
h
k
f
k
j
e
a, b, e, j 50 µm
c, d, f, h, k 100 µm
g 200 µm

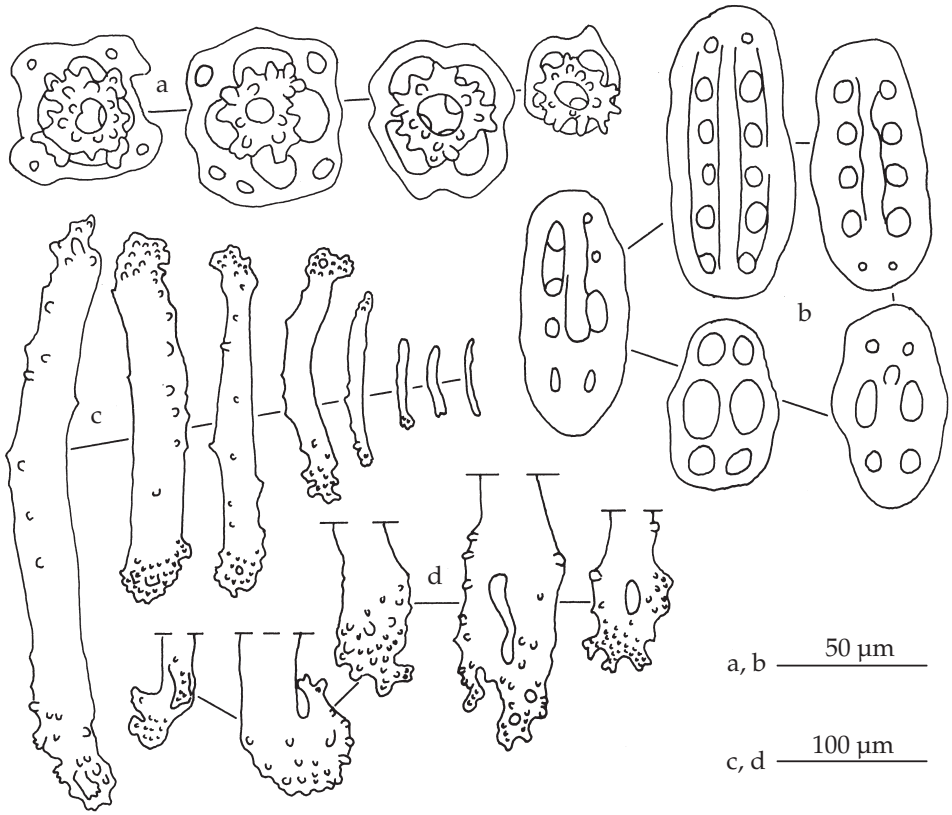


Fig. 26. *Holothuria (Microthele) nobilis* (Selenka, 1867). a: tube foot tables; b: tube foot buttons; c: tentacle rods; d: forked or perforated extremities from tentacle rods.

ventral body wall buttons and no Cuvierian tubules. The two others have ventral body wall ellipsoids and Cuvierian tubules, supposed to be typical of *H. (M.) nobilis*. Moreover, three of the studied specimens are from the same locality and from the same type of habitat. The two specimens without Cuvierian tubules present variation in their ossicles, mainly in the size of the tables and the buttons. All these observations reduce the differences between the two species to such an extend that I agree with Rowe & Gates (1995), considering *H. (M.) fuscogilva* as a synonym of *H. (M.) nobilis*.

The mottled colour pattern, corresponding to what Cherbonnier (1980) calls *H. (M.) fuscogilva*, has previously been observed in the Red Sea (Panning 1941, fig. 7b), India (James & James 1994, fig. 9), Sulawesi (Panning, 1941: fig. 7c; present study), New Caledonia (Cherbonnier, 1980; Féral & Cherbonnier, 1986; Conand, 1989), Papua

Fig. 25. *Holothuria (Microthele) nobilis* (Selenka, 1867). a: tables from dorsal papillae; b: ellipsoids from dorsal papillae; c: perforated plate from dorsal papillae; d: rods from dorsal papillae; e: tube foot tables; f: large buttons from tube feet; g & j: tube foot rods: h: narrow plates from tube feet; k: large plates from tube feet.

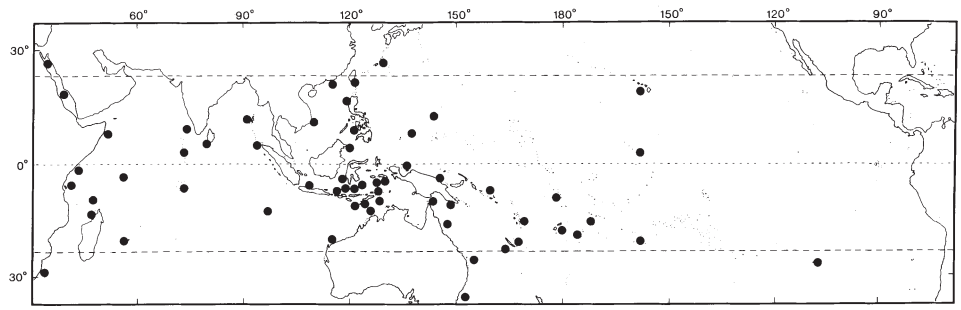


Fig. 27. Distribution of *Holothuria (Microthele) nobilis* (Selenka, 1867).

New Guinea (Gosliner et al., 1995; personal observations), Australia (Cannon & Silver, 1986), Solomon Islands (Holland, 1994) and Fiji (Adams, 1992). *Holothuria (Microthele) whitmaei* Bell, 1887, is to be considered as a separated species because it differs from *H. (M.) nobilis* not only by the colour (completely black) but also by a different reproductive cycle (Conand, 1981). In its original description Bell (1887b) mentioned that Cuvierian tubules are reduced or absent in *H. whitmaei* (observation based on two specimens). It would be interesting to know whether the presence/absence of Cuvierian tubules in *H. whitmaei* is linked with the presence of special types of ventral ossicles (buttons/ellipsoids) as in *H. (M.) nobilis*.

Subgenus *Platyperona* Rowe, 1969
Holothuria (Platyperona) difficilis Semper, 1868
(figs 28a-g, 29)

Holothuria difficilis Semper, 1868: 92, pl. 30 fig. 21; Endean, 1953: 253; Endean, 1957; 253; Caso, 1962: 305, pl. 1 figs 1-9, pl. 2 figs 5-9; Caso, 1965: 256, figs 7-8; Tortonese, 1977: 275; Tortonese, 1979: 316; Lawrence, 1980: 202; Solis-Marin et al., 1997: 256.

Holothuria (Microthele) difficilis; Panning, 1929 [1931]: 136, fig. 20a-l (synonymy and records before 1935).

Holothuria (Platyperona) difficilis; Levin, 1979: 21; Mary Bai, 1980: 12, textfig. 9G; Liao, 1980: 115; Price, 1982: 11; Mukhopadhyay & Samanta, 1983: 303, fig. 5A-C; A.M. Clark, 1984: 99; Marsh, 1986: 73; Maluf, 1988: 95; Conand, 1989: 27; James, 1989: 125; Maluf, 1991: 359; Marsh, 1994b: 57; Liao & A.M. Clark, 1995: 450, fig. 265a-c; James 1995a: 55, fig. 2C; Tahera & Kazumi, 1995: 71, fig. 1A-C; Rowe & Gates, 1995: 296; Tahera, 1996: 106; Massin, 1996a: 155, figs 3A-G, 4A-E (synonymy and records); Liao, 1997: 123, fig. 70a-c.

Material.— IRSNB IG.28251/189 (1 specimen), Kudingareng Keke S, 28.ix.94, reef flat, under coral rubble; RMNH Ech. 6059 (1 specimen), Kudingareng Keke S, 28.ix.94, reef flat; IRSNB IG.28251/204 (1 specimen), Kudingareng Keke S, 28.ix.94, reef flat.

Description.— Specimens 24 × 5, 22 × 7 and 21 × 7 mm. In alcohol uniformly beige-brown with brown tentacles; body cylindrical, slightly lighter coloured ventrally than dorsally. Mouth ventral with 20 tentacles surrounded by a collar of papillae; anus dorsal. Skin rugose, granulous because of the protrusion of the table spires. Tables visible under low magnification. Tube feet numerous, large, with a well

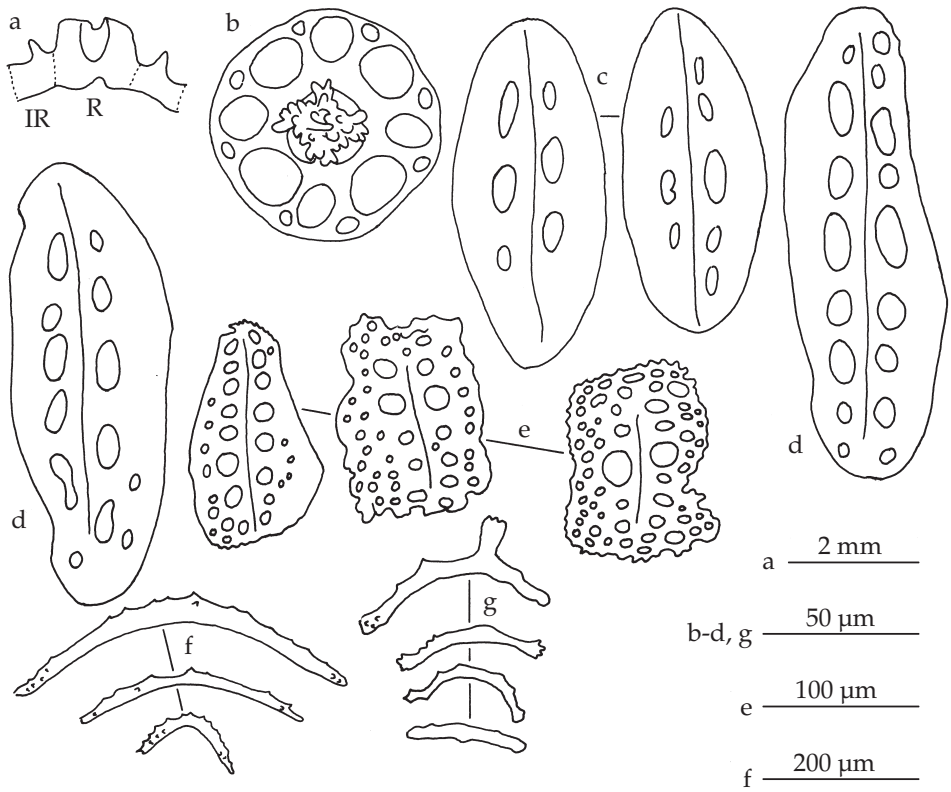


Fig. 28. *Holothuria (Platyperona) difficilis* Semper, 1868. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall table; c: body wall buttons; d: large buttons from tube feet; e: perforated plates from tube feet; f & g: tentacle rods.

marked brown end plate; tube feet more densely crowded posteriorly than anteriorly, arranged in 2 rows along the ventral lateral ambulacra and 4 rows along the ventral central ambulacrum. Papillae few, scattered over the whole dorsal surface, without alignment; most of them arising from a conical wart.

Calcareous ring stout, radial pieces quadrangular with an anterior and posterior notch (fig. 28a); interradial pieces with a well marked anterior tooth (fig. 28a). Tentacle ampullae short (1 mm long). One short, contorted stone canal ending in a cone shaped madreporic plate. One Polian vesicle 1/10 of body length. Cuvierian tubules large and brown.

Ossicles of body wall tables and buttons. Table discs 70-80 µm in diameter; disc rounded to quadrangular and perforated by 4 central holes, 8 large and 1-8 small peripheral holes (fig. 28b); edge of the disc smooth; 4 pillars forming a spire united by 1-2 cross beams and ending in a small crown of spines (fig. 28b). Buttons 105-145 µm long with 2-5 small pairs of holes and a median line (fig. 28c); more numerous dorsally than ventrally. In the tube feet tables similar to those of the body wall, large buttons 145-155 µm long (fig. 28d) and perforated plates 125-150 µm long (fig. 28e); end

plate 350-410 µm across. In the tentacles a few tables similar to those of the body wall and curved spiny rods, 40-620 µm long (figs 28f, g).

Geographic distribution (fig. 29).— Red Sea, Madagascar, Mauritius, Seychelles (Mahé, Aldabra), Pakistan, Maldive Islands, Sri Lanka, India (Laccadive Islands, Andaman Islands, Nicobar Islands), Indonesia (Java, Sulawesi, Timor, Banda Sea, Irian Jaya), Philippines, China, Taiwan, Japan, Australia (WA, NT, QLD, GBR, NSW, Norfolk Islands, Tasman Sea), Mariana Islands (Guam), Palau Islands, Caroline Islands (Kosrae), New Caledonia, Marshall Islands (Enewetok), Samoa (**Navigator Islands** = type locality), Ellice Islands, Fiji (Rotuma), Hawaiian Islands, Society Islands (Tahiti), Easter Island, Clipperton Island, Gulf of California, Mexico (Revillagigedos, Zihuatanejo) , Cocos Islands, Galapagos Islands.

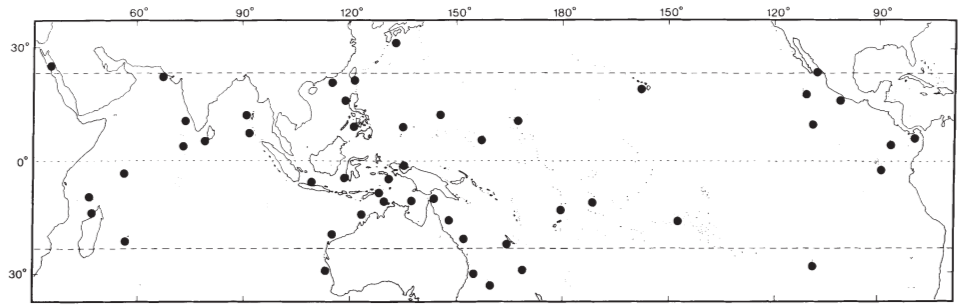


Fig. 29. Distribution of *Holothuria (Platyperona) difficilis* Semper, 1868.

Remarks.— There is little variation in the form of ossicles throughout the geographic range of *Holothuria difficilis*, from Madagascar (Cherbonnier, 1988) to Easter Island (Massin, 1996a) through Taiwan (Chao & Chang, 1989) and Sulawesi (present study).

Holothuria (Platyperona) excellens Ludwig, 1875
(figs 30a-j, 31)

Mülleria excellens Ludwig, 1875: 98, pl. 7 fig. 32; Lampert, 1885: 97; Théel, 1886: 199; Ludwig, 1889-92: 329;
Argiodia excellens; Pearson, 1914: 170.
Holothuria (Microthele) excellens; Panning, 1929 [1931]: 132, fig. 16.
Holothuria (Platyperona) excellens; Cherbonnier, 1988: 94, fig. 37A-N; Kerr et al., 1992: 209, figs 3g-h, 4a-c, 5a-e, pl. 1e-f.

Material.— IRSNB IG.28251/242 (1 specimen), Badi, 3.x.94, 1 m depth.

Description.— Small specimen, 24 × 9 mm, completely black; in alcohol beige-white. Body flat ventrally, arched dorsally; mouth ventral surrounded by 18 tentacles; anus terminal surrounded by 5 large calcareous teeth. In each ambulacrum tube feet wide, short, arranged in 2 rows with a zig-zag pattern. Papillae few, small, scattered on the whole bivium.

Radial and interradial pieces of the calcareous ring of nearly the same width, but

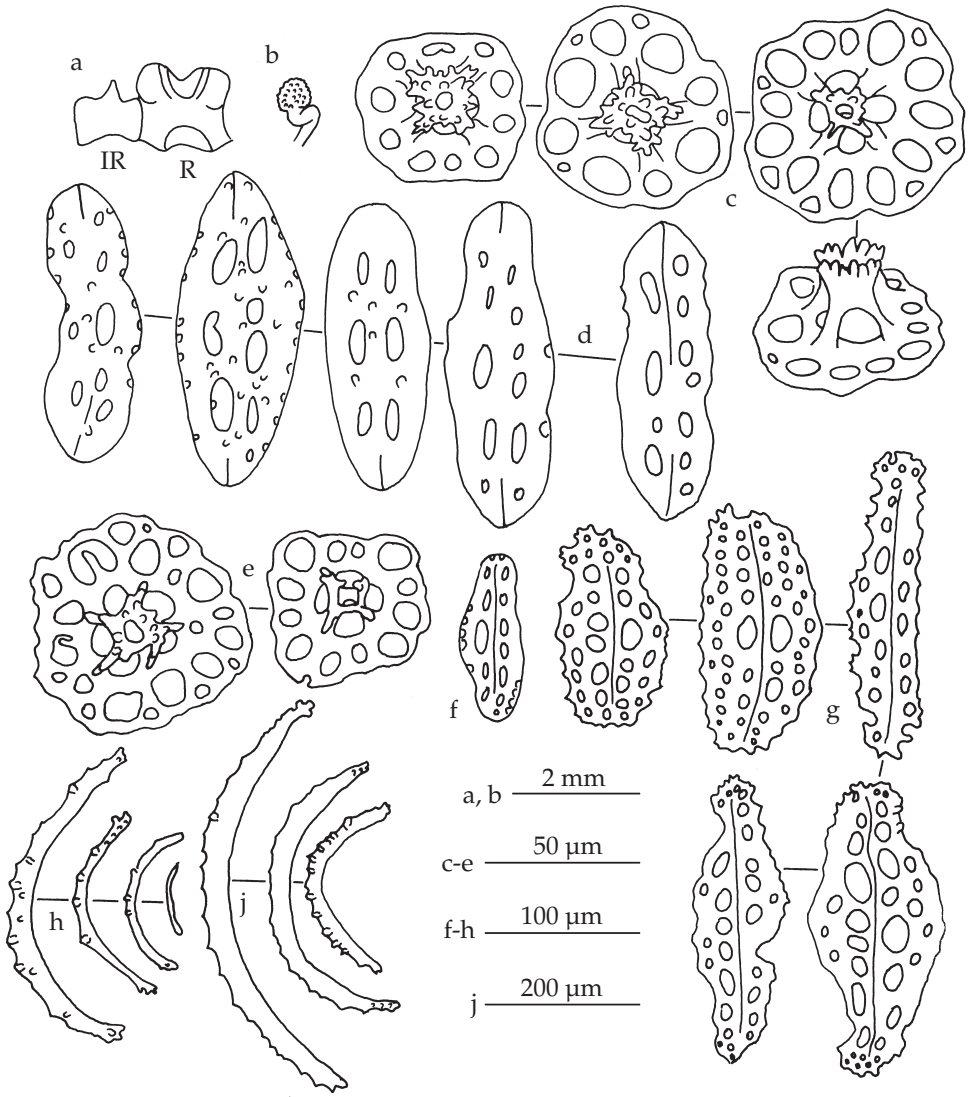


Fig. 30. *Holothuria (Platyperona) excellens* Ludwig, 1875. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall tables; d: body wall buttons; e: tube foot tables; f: tube foot buttons; g: perforated plates from tube feet; h & j: tentacle rods.

the radials twice the hight of the interradials (fig. 30a); radial pieces squarish with a large anterior notch; interradial pieces with anterior triangular tooth. One Polian vesicle; one short, contorted stone canal ending in a muriform madreporic plate (fig. 30b); tentacle ampullae short.

Ossicles of body wall tables and buttons. Table discs 50-80 µm in diameter and spire 25-30 µm high; disc perforated by one large central hole and 8-12 large peripheral holes; in the largest tables 1-6 additionnal small holes; rim of the disc smooth or

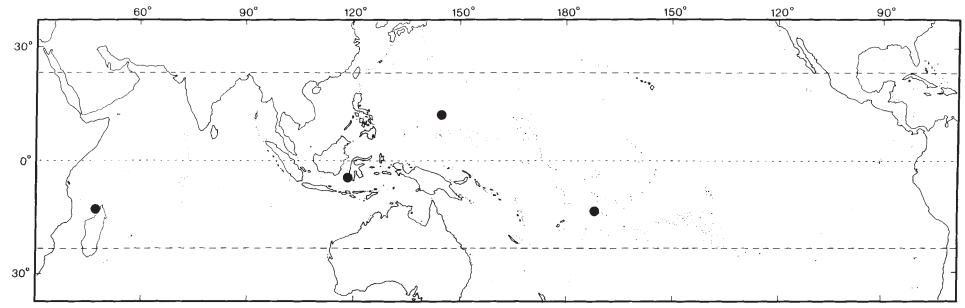


Fig. 31. Distribution of *Holothuria (Platyperona) excellens* Ludwig, 1875.

slightly undulating; 4 pillars forming the spire with one cross beam, ending in a dense crown of spines with a highly variable diameter (fig. 30c). Buttons 80-100 µm long, with 3-5 pairs of holes; button surface with a few small knobbs and often a row of knobbs along the edge (fig. 30d). In the tube feet tables 100-140 µm across (fig. 30e), a few buttons similar to those of the body wall (fig. 30f) and smooth perforated plates, 110-200 µm long, with a median longitudinal line (fig. 30g); end plate 350-380 µm across. In the tentacles curved spiny rods (figs 30h, j), 50-600 µm long.

Geographic distribution (fig. 31).— Madagascar, Indonesia (Sulawesi), Mariana Islands (Guam), **Samoa** = type locality.

Remarks.— I concur with Cherbonnier (1988) and Kerr et al. (1992) that *Holothuria excellens* and *H. difficilis* are closely related, though separate species. They differ mainly in the form of the buttons which are knobbed in *H. excellens* and smooth in *H. difficilis*. The distributional range of *H. excellens* is most probably much wider than shown in fig. 31 because many authors have considered *H. excellens* conspecific with *H. difficilis*. The species is new to the fauna of Indonsia.

Subgenus *Semperothuria* Deichmann, 1958
Holothuria (Semperothuria) flavomaculata Semper, 1868
(figs 32a-g, 33, 110j)

Holothuria flavomaculata Semper, 1868: 87, pl. 30 fig. 26; Grosenbaugh, 1981: 51.

Holothuria (Holothuria) flavomaculata; Panning, 1935a: 42, fig. 35a-e (synonymy and records before 1935).

Semperothuria flavomaculata; Deichmann, 1958: 303.

Holothuria (Semperothuria) flavomaculata; Rowe, 1969: 135; Liao, 1980: 115; Price, 1982: 11; Liao, 1984: 230, fig. 11 (1-6); Price & Reid, 1985: 6; Féral & Cherbonnier, 1986: 90, fig. 40D; Maluf, 1988: 95; Cherbonnier, 1988: 67, fig. 26A-K (synonymy and records before 1984); Conand, 1989: 16, 27; Kerr et al., 1992, 208, pl. 1 fig. 3e; Rowe & Gates, 1995: 298; Liao & A.M. Clark, 1995: 454, fig. 269a-f; Liao, 1997: 128, fig. 74a-f.

Material.— IRSNB IG.28251/251 (1 specimen), Badi, 3.x.94, 2 m depth.

Description.— Specimen 68 × 16 mm, brown-red with yellow-orange papillae and yellowish tentacles (fig. 110j); in alcohol brown-beige with white papillae and greyish

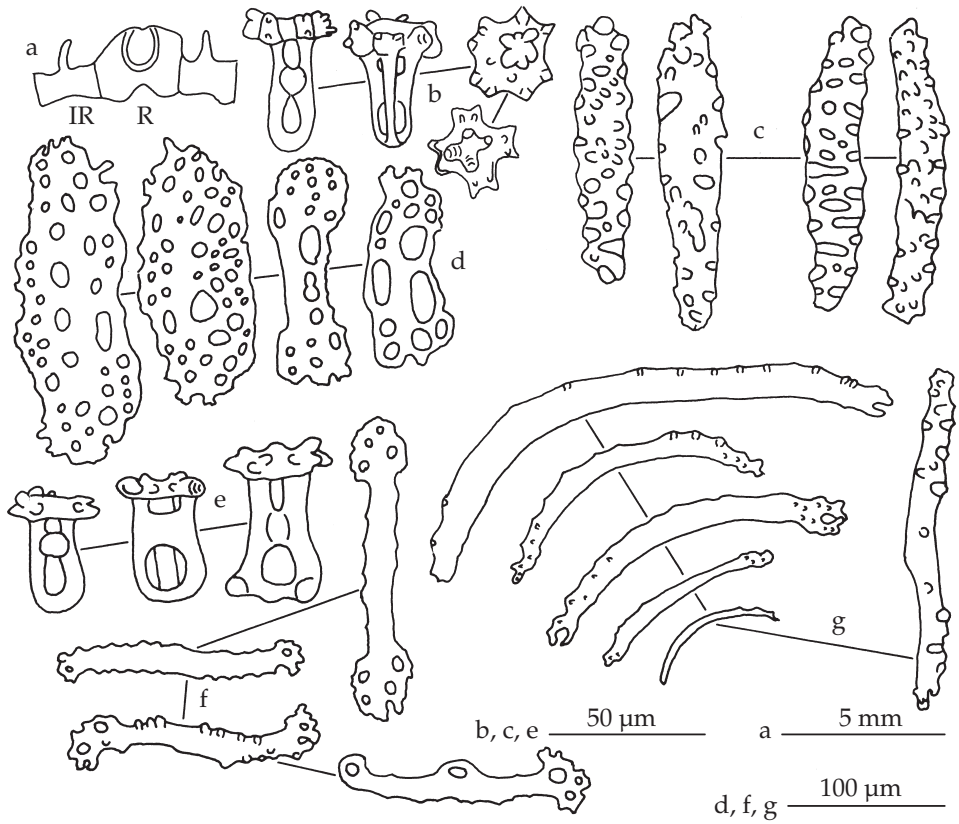


Fig. 32. *Holothuria (Semperothuria) flavomaculata* Semper, 1868. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: massive rods from body wall; d: perforated plated from tube feet; e: tube foot tables; f: perforated rods from tube feet; g: tentacle rods.

tentacles. Body club-shaped, wider posteriorly than anteriorly; mouth and anus terminal. Papillae scattered without alignment over the whole bivium. Tube feet along the ambulacra, more crowded posteriorly; in one row along the lateral ambulacra and 2 rows along the central one. Tentacles 22. Five groups of 3 papillae around the anus.

Calcareous ring composed of radial pieces larger than the interradial ones (fig. 32a); radial pieces with a long, narrow anterior tooth (fig. 32a); posterior edge of the calcareous ring undulating. Several Polian vesicles, one of which being particularly large. Five stone canals at the right hand side of the dorsal mesentery. No Cuvierian tubules.

Ossicles of body wall tables and rods. Tables without disc, but spire 40-47 µm in height, with the 4 pillars forming the spire united by one cross beam and ending in a bundle of spines forming a Maltese cross when seen from above (fig. 32b). Rods spiny, massive, 85-105 µm long (fig. 32c). In the tube feet tables (fig. 32e) similar to those of the body wall; rods with perforated extremities, 160-200 µm long (fig. 32f) and perforated plates 130-210 µm long (fig. 32d); end plate 475-500 µm across. In the tentacles rods curved or straight, spinose, 95-355 µm long (fig. 32g).

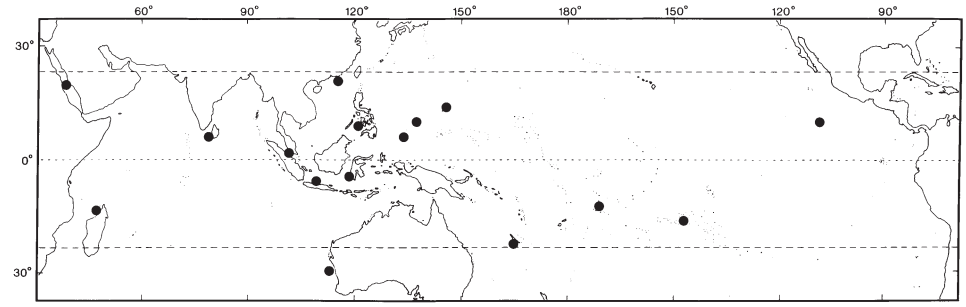


Fig. 33. Distribution of *Holothuria (Semperothuria) flavomaculata* Semper, 1868.

Geographic distribution (fig. 33).— Red Sea, Madagascar, Sri Lanka, Indonesia (Sumatra, Java, Sulawesi), China (Xisha Islands), Philippines, Australia (Abrohlos Islands), Mariana Islands (Guam), Palau Islands, Caroline Islands (Yap), New Caledonia, **Samoa** = type locality, Society Islands (Tahiti), Clipperton Island.

Remarks.— The ossicles of the specimen from Sulawesi are similar to those of specimens from Samoa (Semper, 1868), Tahiti (Cherbonnier, 1955b), Madagascar (Cherbonnier, 1988) and China (Liao, 1984). Colour seems to be more variable, from blue-black (Panning, 1935a; Cherbonnier, 1955b, 1988) to brown-red (present study) via brown-mauve (Féral & Cherbonnier, 1986). The number of tentacles also varies from 20 (Panning, 1935a) to 31 (Cherbonnier, 1955b). This is only the third record of *Holothuria flavomaculata* for Indonesia.

Holothuria (Semperothuria) imitans Ludwig, 1875
(figs 34a-k, 35, 111a)

Holothuria imitans Ludwig, 1875: 109, fig. 41; Caso, 1962: 299; Maluf, 1988: 96; Solis-Marin et al., 1997: 256.

Holothuria (Holothuria) imitans; Panning, 1935a: 39, fig. 33a-n (synonymy and records before 1935).

Holothuria (Halodeima) imitans; Panning, 1928: 223, figs 19-31.

Semperothuria imitans; Deichmann, 1958: 305, pl. 4 figs 8-12.

Holothuria (Semperothuria) imitans; Rowe, 1969: 135; A.M. Clark & Rowe, 1971: 178, pl. 27 fig. 16; Price & Reid, 1985: 6; James, 1995: 48.

Holothuria pseudo-imitans Cherbonnier, 1951: 18, pl. 4 figs 1-15.

Holothuria imitans var. *polymorpha* Caso, 1962: 310, pl. 4 figs 1-16, pl. 5 figs 1-17; Caso, 1965: 267, figs 14-15.

Material.— IRSNB IG.28251/237 (1 specimen), Badi, 3.x.94, 2 m depth in between branches of dead corals.

Description.— Specimen 34 × 7 mm, uniformly chocolate brown, somewhat lighter ventrally than dorsally; extremity of dorsal papillae, ventral tube feet and tentacles bright yellow (fig. 111a); in alcohol light brown dorsally, beige-white ventrally; extremity of dorsal papillae, ventral tube feet and tentacles grey-white. Body cylindrical with mouth ventral and anus terminal. Tentacles 19, surrounded by a crown of papillae. Dorsal papillae few, scattered without alignment except 2 lateral rows. Tube

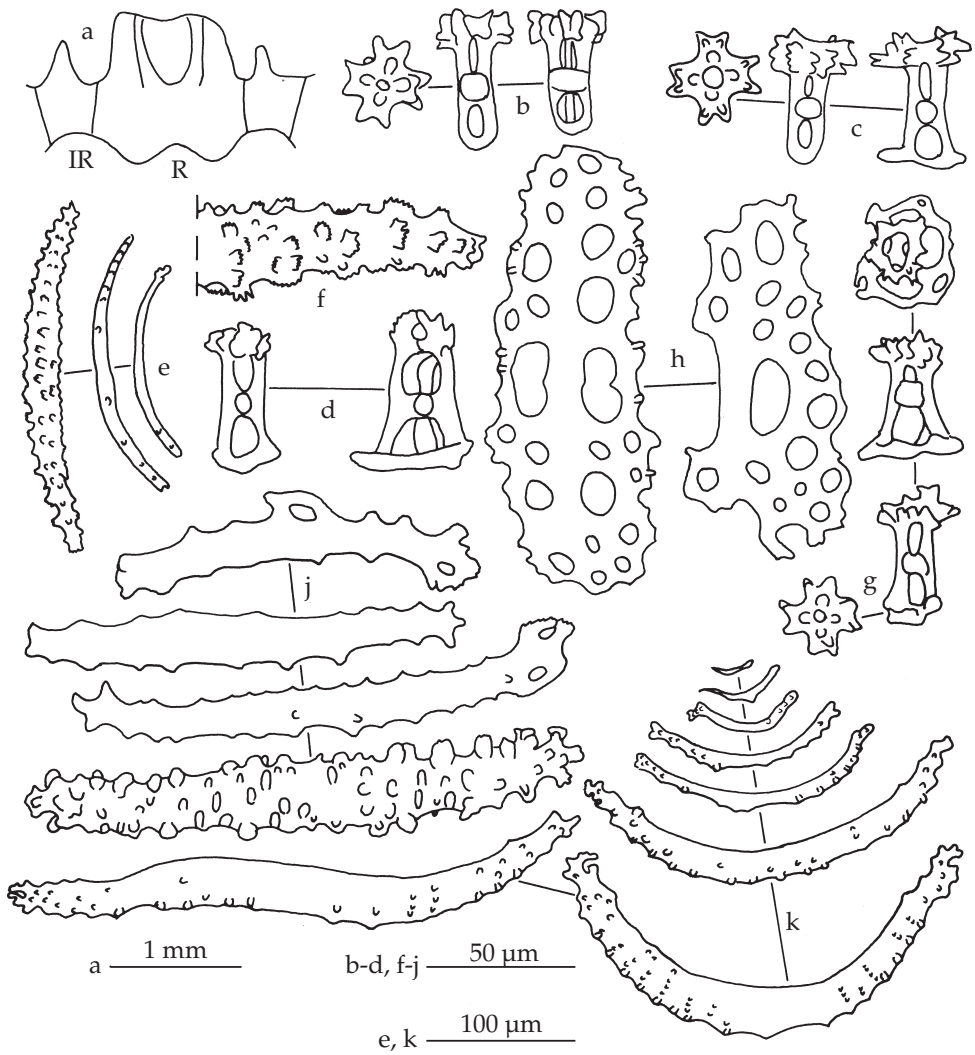


Fig. 34. *Holothuria (Semperothuria) imitans* Ludwig, 1875. a: calcareous ring (IR: interradial piece; R: radial piece); b: tables from dorsal body wall; c: tables from ventral body wall; d: tables from dorsal papillae; e: rods from dorsal papillae; f: extremity of a spiny rods from dorsal papillae; g: tube foot tables; h: perforated tables from tube feet; j: tube foot rods; k: tentacle rods.

feet few, on one row along the lateral ambulacra and 2 rows along the central ambulacrum, more crowded near the anus.

Calcareous ring composed of radial pieces twice as large as the interradial ones (fig. 34a); posterior edge of the calcareous ring undulating; interradial pieces with a sharp anterior tooth. Tentacle ampullae long (1/10 of body length). One very large (5 mm long) Polian vesicle. A bundle of 7 short contorted stone canals ending each in a spherical madreporic plate. Very fine white Cuvierian tubules.

Ossicles of the body wall tables only, with spire 40-50 µm high, and reduced disc

(fig. 34c) or no disc at all (fig. 34b); 4 pillars forming the spire united by one cross beam and ending in a crown of spines forming a Maltese cross when seen from above. In the dorsal papillae the tables are similar to those of the body wall but with a more prominent disc (fig. 34d); spinose rods 130-230 µm long (figs 34e, f). In the tube feet tables, with or without disc (fig. 34g), perforated plates 115-150 µm long (fig. 34h) and spiny rods 115-200 µm long (fig. 34j); end plate 250 µm across. In the tentacles spinose rods only, straight or curved, 30-435 µm long (fig. 34k).

Geographic distribution (fig. 35).— Sri Lanka, Indonesia (Sulawesi), Ellice Islands (Funafuti), **Samoa** = type locality, Galapagos Islands, Gulf of Panama, Mexico (Revillagigedos, Zihuatanejo), Gulf of California.

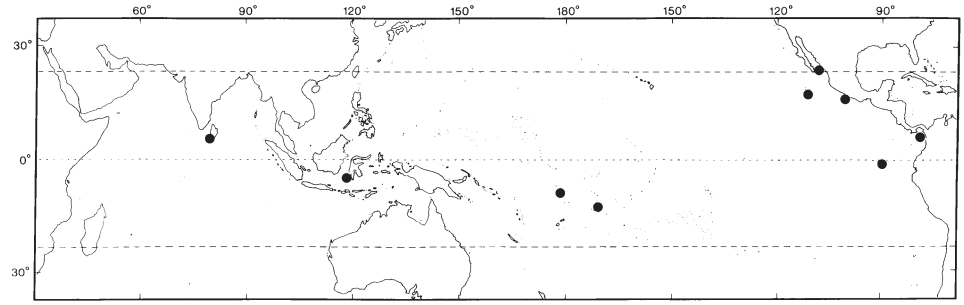


Fig. 35. Distribution of *Holothuria (Semperothuria) imitans* Ludwig, 1875.

Remarks.— The specimen from Sulawesi is very similar to those collected from other areas as remote as West-Africa (Panning, 1928) or Samoa (Ludwig, 1875). However, it differs by the absence in the dorsal papillae and ventral tube feet of rods with a central perforated process, and by the presence of Cuvierian tubules which are mentioned for the first time in this species.

Holothuria imitans is new to the fauna of Indonesia and must be considered a rare species in the Indian and West-Pacific Oceans.

Subgenus *Stauropora* Rowe, 1969
Holothuria (Stauropora) discrepans Semper, 1868
(figs 36a-k, 37, 111b)

Holothuria discrepans Semper, 1868: 251, 280, pl. 40 fig. 7; Lampert, 1885: 72; Théel, 1886: 226; Ludwig, 1889-92: 329; Pearson, 1913: 84, pl. 12 fig. 20; Panning, 1935d: 1, fig. 103.

Holothuria (Stauropora) discrepans; Rowe, 1969: 140, fig. 9; A.M. Clark & Rowe, 1971: 178, pl. 28 fig. 4; Liao, 1975: 211, fig. 11 (1-8); Levin, 1979: 21; Liao, 1980: 115; Liao, 1984: 222; Conand, 1989: 16, 28; Liao & A.M. Clark, 1995: 456, fig. 270a-g; Liao, 1997: 130, fig. 75a-g.

Material.— IRSNB IG.28151/235 (1 specimen) and RMNH Ech. 6083 (1 specimen), Badi, 3.x.94, 2 m depth among coral rubble.

Description.— Specimens 62 × 19 and 66 × 19 mm, uniformly brown with brown-bluish spots dorsally, mainly posteriorly (fig. 111b); top of dorsal papillae yellowish; in alcohol uniformly dark grey. Body cylindrical with mouth ventral and anus sub-

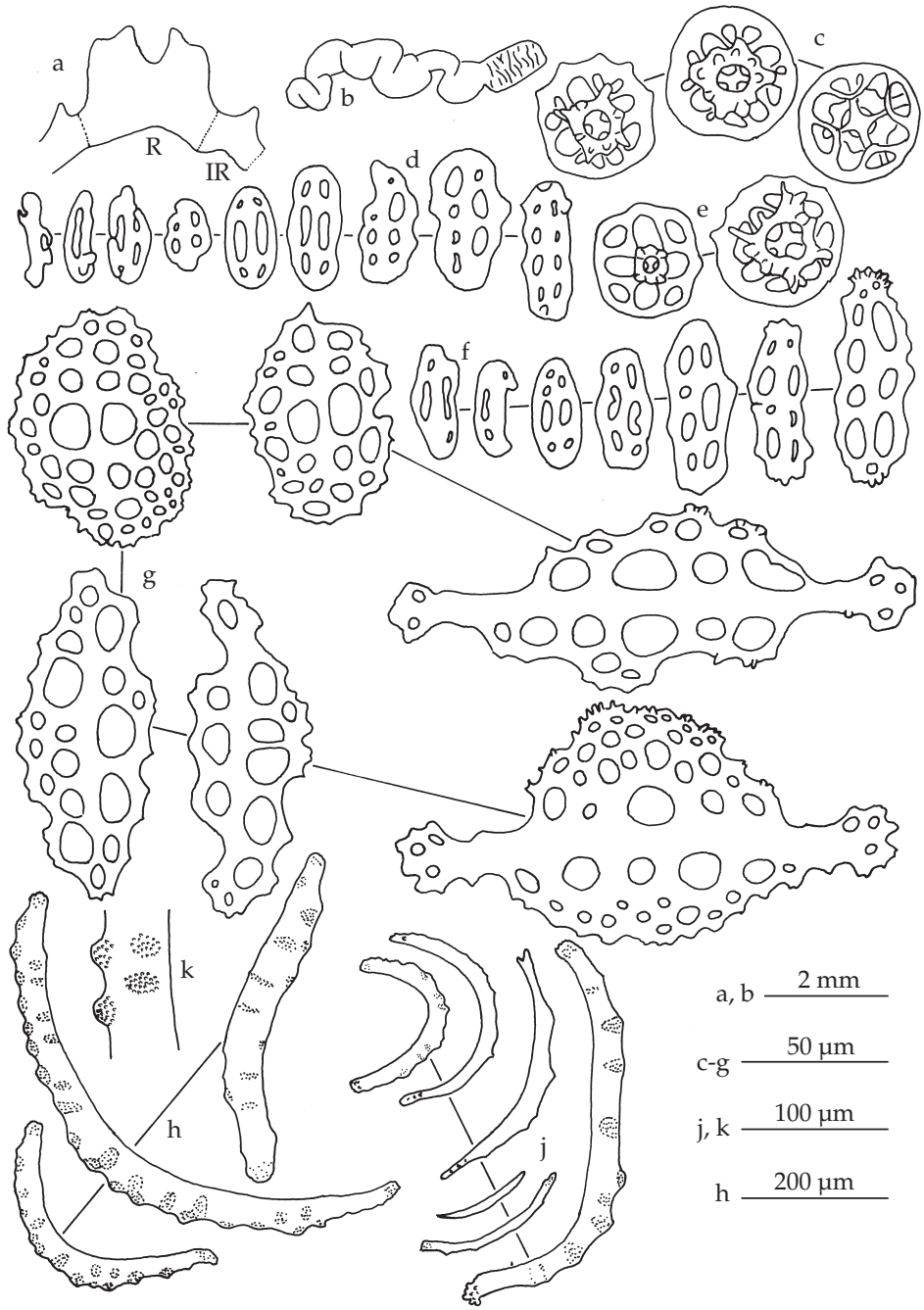


Fig. 36. *Holothuria (Stauropora) discrepans* Semper, 1868. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall tables; d: body wall buttons; e: tube foot tables; f: tube foot buttons; g: perforated plates from tube feet; h & j: tentacle rods; k: heaps of small spines on tentacle rods.

dorsal; 24-26 yellowish tentacles surrounded by a crown of papillae. Papillae few, without alignment and scattered over the whole bivium. Tube feet more or less aligned along the ambulacra and more numerous along the central ambulacrum than along the lateral ones. Skin soft, fragile, covered by a thick coating of mucus; under this coating, numerous tables form a continuous layer of ossicles, visible under low magnification; this layer easily torn away from preserved specimens.

Calcareous ring stout; large radial pieces with a deep V-shaped notch anteriorly (fig. 36a). One long contorted stone canal (fig. 36b) ending in an ovoid madreporic plate. One huge Polian vesicle, 1/5 of body length; tentacle ampullae 1/12 of body length; very fine, white Cuvierian tubules, readily expelled when animal disturbed.

Ossicles of body wall tables and buttons. Tables very abundant, discs 40-45 µm in diameter; disc with a central cross shaped perforation and 4-8 peripheral holes with 1-2 in each quadrant delineated by the cross hole; 4 pillars forming the spire ending in a crown of blunt spines (fig. 36c). Buttons 25-50 µm long with 2-4 pairs of holes (fig. 36d), some irregular and knobbed (fig. 36d). In the tube feet tables similar to those of the body wall (fig. 36e), buttons 30-60 µm long (fig. 36f) and perforated plates (fig. 36g) 80-180 µm long, especially numerous close to the end plate (300-320 µm across). In the tentacles rods (figs 36h, j) straight or curved, 70-720 µm long and covered by heaps of small spines (fig. 36k).

Geographic distribution (fig. 37).— Maldive Islands, Indonesia (Sulawesi), China, New Caledonia, **Samoa** = type locality.

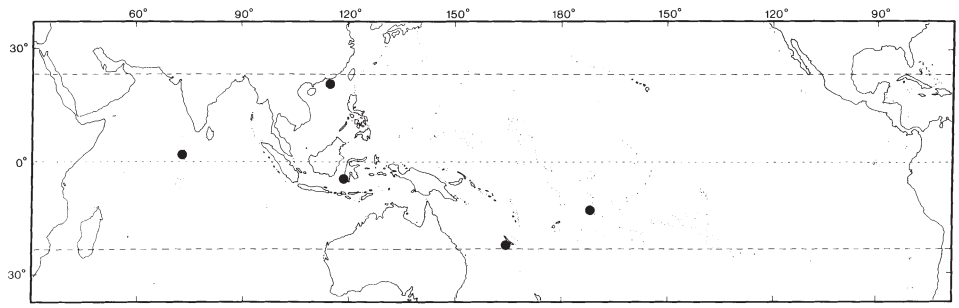


Fig. 37. Distribution of *Holothuria (Stauropora) discrepans* Semper, 1868.

Remarks.— Ossicles and calcareous ring of the Sulawesi specimens match those of specimens from the Maldive Islands (Pearson, 1913) and the Samoa (Semper, 1868). The number of tentacles seems to be variable: 30 according to Semper (1868), 24-30 according to Liao (1975, 1997) and 24-26 according to the present study. This number does not seem to be linked to body size because the specimens observed by Semper (1868) and in the present study are similar in length: 60-65 mm and 62-66 mm, respectively.

Holothuria discrepans is new to the fauna of Indonesia.

Holothuria (Stauropora) fuscocinerea Jaeger, 1833
(figs 38a-n, 39, 111c)

Holothuria fuscocinerea Jaeger, 1833: 22; Panning, 1935d: 4, fig. 107a-n (records before 1935); Endean, 1956: 131; Endean, 1957: 253; James, 1983: 92; Maluf, 1988: 95; Ong Che, 1992: 440; Salis-Marin et

al., 1997: 256.

Mertensiothuria fuscocinerea; Deichmann, 1958: 300, pl. 3 figs 13-23 (synonymy).

Holothuria (Mertensiothuria) fuscocinerea; Rowe, 1969; 148; Liao, 1975: 215; Mary Bai, 1980: 14, fig. 10A; Liao, 1980: 115; Tan Tiu, 1981: 78, pl. 20 figs 1, 2; Humphreys, 1981: 34; A.M. Clark, 1982: 489; Price, 1982: 11; Mukhopadhyay & Samanta, 1983: 304, fig. 6A-E; Liao, 1984: 222; Cherbonnier & Féral, 1984a: 680, fig. 10A-N (synonymy and records before 1984); Reyes-Leonardo et al., 1985: 274; Féral & Cherbonnier, 1986: 84; Cannon & Silver, 1986: 22; Cherbonnier, 1988: 108, fig. 44A-O (synonymy and records before 1975); Chao & Chang, 1989: 120, figs 23, 31B; Conand, 1989: 16, 24; Kerr et al., 1992: 208, fig. 3b; Marsh, 1994b: 57; Liao & A.M. Clark, 1995: 441, fig. 257a-d; James, 1995a: 61, fig. 2J; Liao, 1997: 108, fig. 61a-c.

Holothuria (Stauropora) fuscocinerea; Marsh et al., 1993: 64; Rowe & Gates, 1995: 299.

Material.— RMNH Ech. 6084 (1 specimen), Kudingareng Keke, 28.ix.94, reef flat; IRSNB IG.28251/254 (1 specimen), Badi, 3.x.94, 1 m depth.

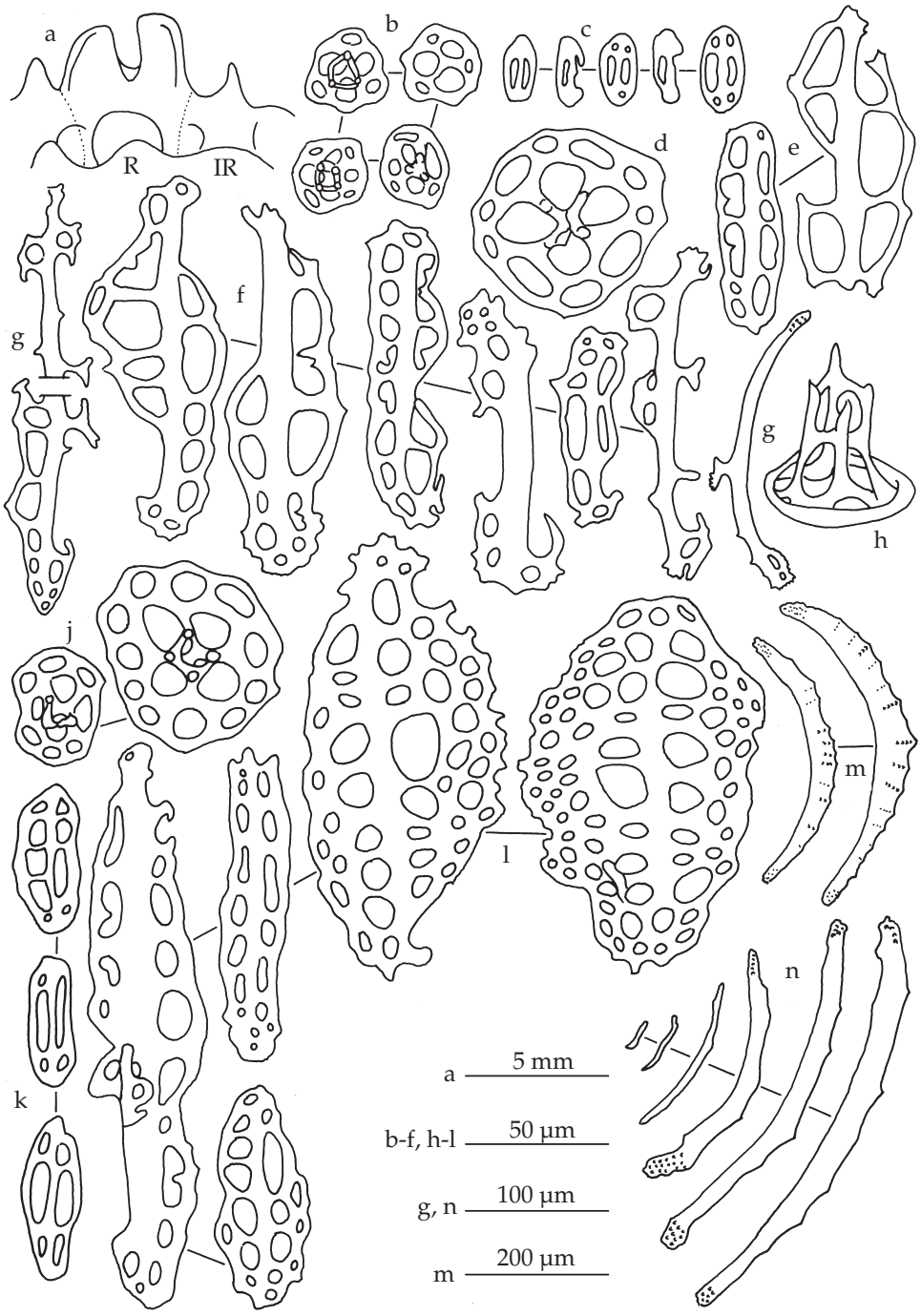
Description.— Specimens 120 × 25 and 140 × 26 mm uniformly brown dorsally and beige-brown ventrally with the base of the papillae deep brown circled with white-yellow (fig. 111c); in alcohol grey-green dorsally and grey-beige ventrally. Tube feet few, small, scattered on the whole trivium; tube feet at the edge between bivium and trivium larger and more numerous. Papillae with a large base and a narrow tip, scattered over the whole bivium. Mouth ventral with 20 tentacles surrounded by a crown of papillae.

Calcareous ring stout composed of massive radial pieces having a deep, narrow anterior notch (fig. 38a). One long Polian vesicle (1/7 of body length). One stone canal. Cuvierian tubules present and right respiratory tree extending up to the calcareous ring.

Ossicles of body wall tables and buttons. Tables very small with discs 23-30 µm in diameter; disc edge smooth, undulating; disc perforated by 3-4 large central holes and 2-4 small peripheral holes; 3-4 pillars forming the spire with or without a terminal crown of spines (fig. 38b). Buttons 25-40 µm long with 1-3 pairs of holes (fig. 38c). At the base of the dorsal papillae a few very large tables (fig. 38d), discs 65-70 µm in diameter with 4 large central holes and 10 peripheral holes, rods witht perforated extremities up to 230 µm long and irregular large buttons 80-100 µm long (fig. 38e). At the top of the dorsal papillae rods perforated at the extremities and sometimes laterally, giving rise to irregular perforated plates (figs 38f, g); exceptionally large tables with 4 pillars united by 2 cross beams (fig. 38h). In the tube feet tables 40-60 µm across (fig. 38j), buttons with 3-5 pairs of holes (fig. 38k), and perforated plates 80-200 µm long (fig. 38l); end plate 530-560 µm across. In the tentacles rods, slightly curved, 25-625 µm long; longest with transversal rows of spines all along, medium only spiny at the extremities, and smallest smooth (figs 38m, n).

Geographic distribution (fig. 39).— Red Sea, Kenya, Moçambique (Querimba Islands), Madagascar, Mauritius, India (Laccadive Islands), Myanmar (Mergui Archipelago), Indonesia (Java, **Sulawesi** = type locality, Sumba, Irian-Jaya), China (Hong Kong, Xisha Islands), Taiwan, Japan, Philippines, Mariana Islands (Guam), Australia (WA, NT, QLD, GBR, NSW, Lord How Island, Tasman Sea), New Caledonia, Society Islands (Tahiti), Gulf of California.

Remarks.— The ossicles of the specimens from Sulawesi (type locality) are similar to those of specimens reported from as wide afield as New Caledonia (Cherbonnier &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g, n 100 µm
m 200 µm

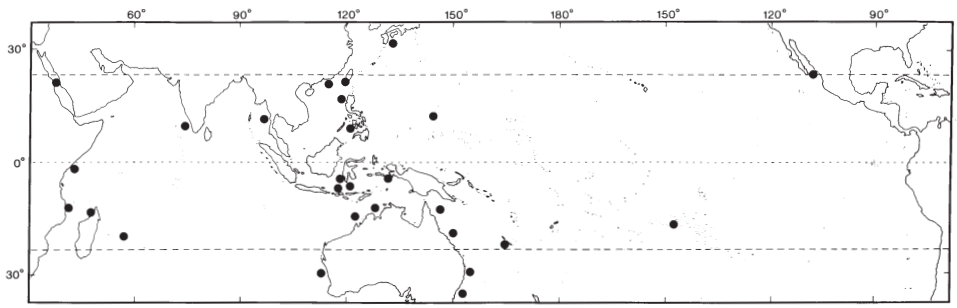


Fig. 39. Distribution of *Holothuria (Stauropora) fuscocinerea* Jaeger, 1833.

Féral, 1984a) and Taiwan (Chao & Chang, 1989). Specimens from Tahiti (Cherbonnier, 1955b) and Madagascar (Cherbonnier, 1988) have tables with higher spire (up to 3-4 cross beams). The colour of *Holothuria fuscocinerea* is highly variable as mentioned by Féral & Cherbonnier (1986).

Holothuria (Stauropora) olivacea Ludwig, 1888
(figs 40a-h, 41)

Holothuria olivacea Ludwig, 1888: 811, pl. 30 figs 8-17.
Holothuria (Holothuria) olivacea; Panning, 1935b: 76, fig. 58a-e (synonymy and records before 1935).
Holothuria (Stauropora) olivacea; Rowe, 1969: 141; Liao, 1975: 212, fig. 12 (1-7); Liao, 1980, 115; Cherbonnier, 1988: 78, fig. 3A-P (synonymy and records before 1975); Rowe & Gates, 1995: 299; Liao & A.M. Clark, 1995: 457, fig. 271a-g; Liao, 1997: 132, fig. 76a-g.
Holothuria (Stauropora) fuscoolivacea; Price, 1982: 11; Cannon & Silver, 1986: 25.
Holothuria fusco-olivacea; Endean, 1956: 137.

Material.— IRSNB IG.28251/239 (2 specimens) and RMNH Ech. 6060 (1 specimen), Badi, 3.x.94, 2 m depth; IRSNB IG.28251/252 (1 specimen), Badi, 3.x.94, 2 m depth.

Description.— Specimens 95 × 21 , 86 × 17, 83 × 16 and 48 × 13 mm. Colour in alcohol uniformly olive-gray; largest dorsal papillae emerging from a whitish wart; base of the dorsal papillae circled with a brown line. Body cylindrical tapering slightly anteriorly. Mouth ventral, anus dorsal surrounded by 5 groups of 3 long papillae; 19-20 yellowish tentacles surrounded by a collar of large papillae. Papillae numerous, small, scattered over the whole bivium. Tube feet large, numerous, in 6-7 rows with a zig-zag pattern along each ambulacrum. Skin solid, 2 mm thick, rough to the touch.

Calcareous ring stout; large radial pieces with an anterior and posterior notch (fig. 40a). Tentacle ampullae long: 1/14 of body length. One very long Polian vesicle, 1/4 of body length. One contorted stone canal ending in a large ovoid madreporic plate (fig. 40b). Cuvierian tubules long and fine.

Fig. 38. *Holothuria (Stauropora) fuscocinerea* Jaeger, 1833. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: body wall buttons; d: table from dorsal papillae (base); e: irregular large buttond from dorsal papillae (base); f & g: perforated rods from dorsal papillae (top); h: table from dorsal papillae (top); j: tube foot tables; k: tube foot buttons: l: perforated plates from tube feet; m & n: tentacle rods.

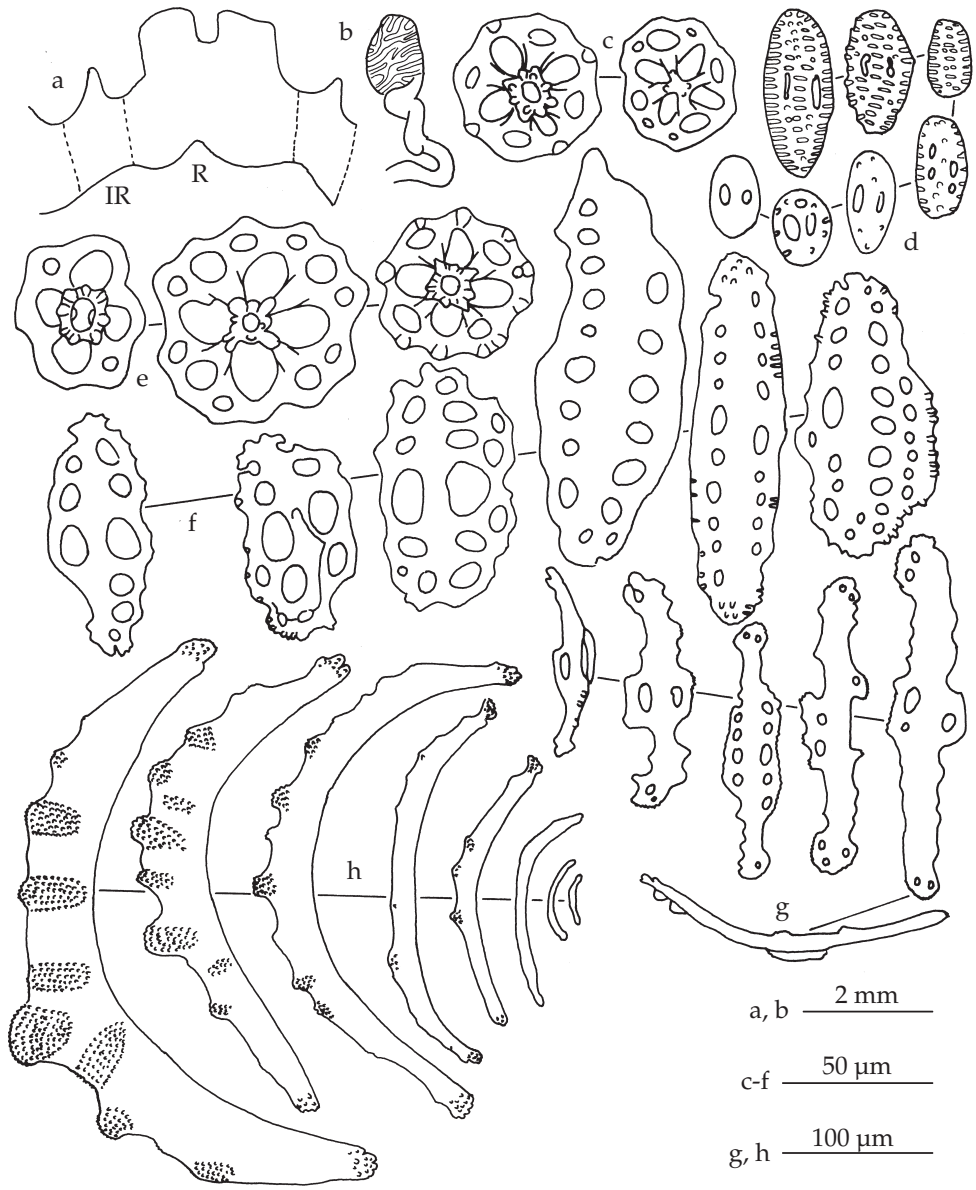


Fig. 40. *Holothuria (Stauropora) olivacea* Ludwig, 1888. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall tables; d: body wall buttons; e: tube foot tables; f: perforated plates from tube feet; g: tube foot rods; h: tentacle rods.

Ossicles of body wall tables and buttons. Disc of the tables (fig. 40c) with a central cross shaped hole, 4 large and several small peripheral holes; edge of the disc smooth undulated or spinose; 4 very short pillars form the spire and end in a small crown of spines (fig. 40c). Buttons 25-55 µm long, smooth or covered by small blunt spine; per-

forations reduced or obliterated (fig. 40d). In the tube feet tables similar to those of the body wall but sometimes larger (fig. 40e), perforated plates 80-140 µm long with smooth or spinose edge (fig. 40f), and rods 125-245 µm long, perforated centrally and at the extremities (fig. 40g); edge of the rods somewhat ragged; end plate 325-330 µm across. In the tentacles curved rods, 35-500 µm long, covered with heaps of small spines (fig. 40h).

Geographic distribution (fig. 41).— Red Sea, Madagascar, Indonesia (Sulawesi, Mollucas, **Ambon** = type locality, Savu Islands), China (Xisha Islands), Australia (WA, NT, QLD, GBR), Solomon Islands, Hawaiian Islands.

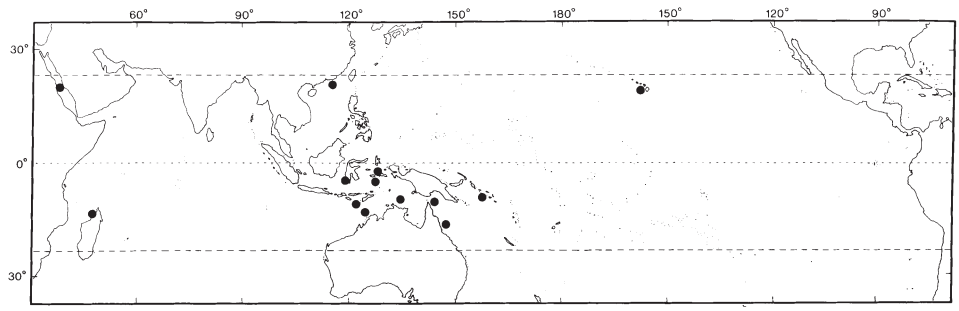


Fig. 41. Distribution of *Holothuria (Stauropora) olivacea* Ludwig, 1888.

Remarks.— Ossicles of *Holothuria olivacea* show little variation throughout the geographical range of the species (Ludwig, 1888; Liao, 1975; Cherbonnier, 1988). Only the edge of the perforated plates from the tube feet is more ragged in specimens from Madagascar (Cherbonnier, 1988). Three of the specimens from Badi are relatively large: 83, 86 and 95 mm long. Only Liao (1997) mentioned larger specimens (100 mm long) from China. The other known specimens are smaller: 58 mm long (Fisher, 1907; Tortonese, 1953), 70 mm long (Ludwig, 1888; Liao 1975); 80 mm long (Cherbonnier, 1988).

Subgenus *Theelothuria* Deichmann, 1958
Holothuria (Theelothuria) turriscelsa Cherbonnier, 1980
(figs 42a-l, 43)

Holothuria (? Theelothuria) turriscelsa Cherbonnier, 1980: 644, fig. 15A-L, pl. 1E.
Holothuria (Theelothuria) turriscelsa; Féral & Cherbonnier, 1986: 92, fig. 40M; Kerr et al., 1992: 209, fig. 3f, pl. 1d.

Material.— IRSNB IG.28251/219 (1 specimen) and RMNH Ech. 6085 (1 specimen), Kapoposang, 30.ix.94, 12 m depth, night dive; MNHNP slides of the holotype.

Description.— Specimens 165 × 32 and 200 × 40, grey-brown dorsally and beige ventrally; in alcohol grey-brown dorsally with beige papillae and beige ventrally. Papillae large, wart-like, scattered over the whole bivium. Tube feet numerous covering ambulacral and interambulacral areas. Mouth ventral, surrounded by a collar of papillae; 18 tentacles are visible; anus terminal. Skin 6.5 mm thick.

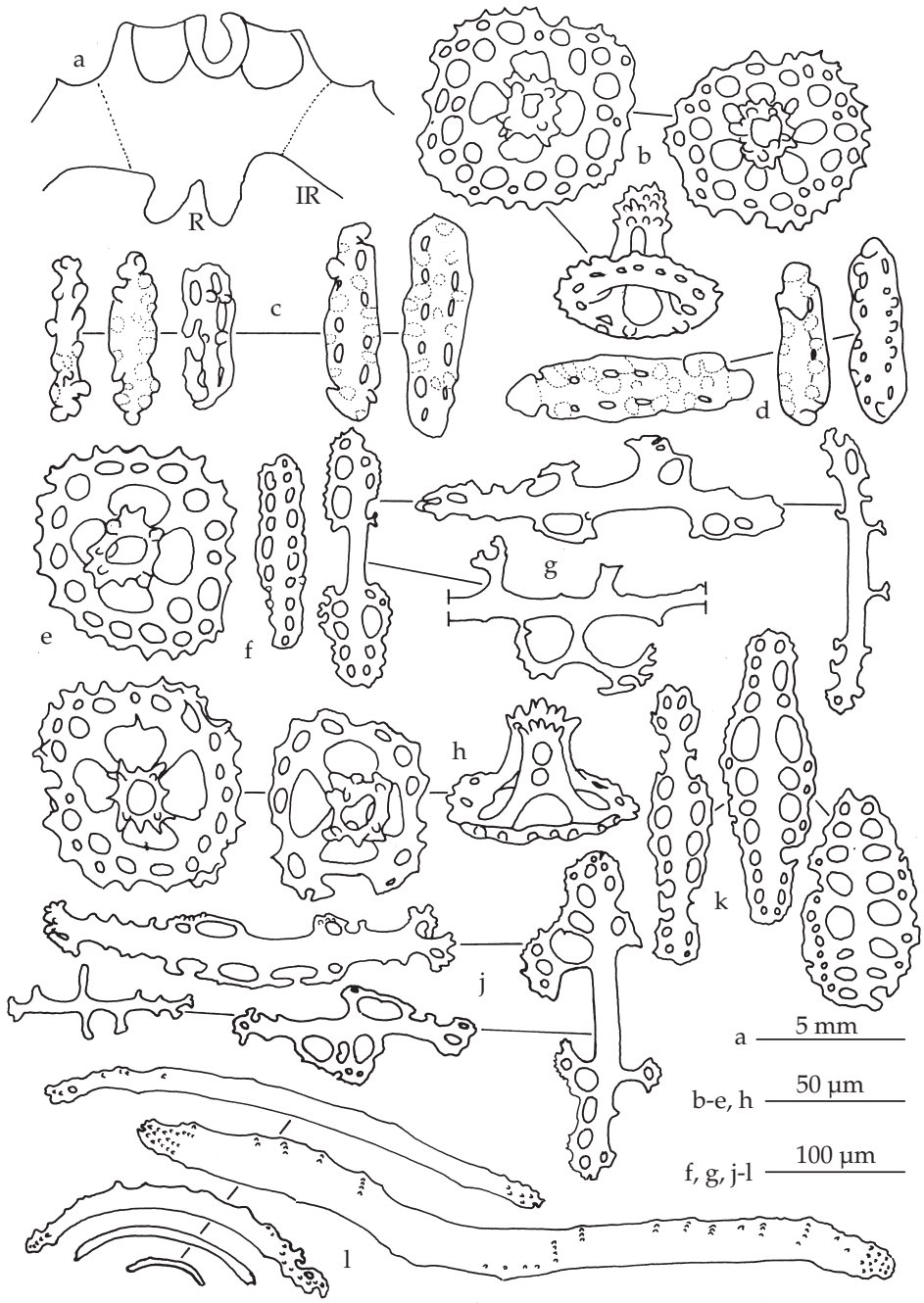


Fig. 42. *Holothuria (Theelothuria) turriscelsa* Cherbonnier, 1980. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: buttons from dorsal body wall; d: buttons from ventral body wall; e: table from dorsal papillae; f: buttons from dorsal papillae; g: rods from dorsal papillae; h: tube foot tables; j: tube foot rods; k: perforated plates from tube feet; l: tentacle rods.

Calcareous ring stout composed of massive radial pieces characterized by a deep rounded anterior notch and two large posterior points; interradial pieces with a small anterior median tooth (fig. 42a). Three large (15-25 mm long) and several small (1-3 mm long) Polian vesicles. The free extremity of the Polian vesicles is enlarged and full of brown bodies; Cuvierian tubules numerous, thick, readily expelled.

In the body wall numerous tables and few buttons. Tables (fig. 42b) with discs 60-80 µm in diameter; disc perforated by 4 large central holes and numerous small peripheral holes arranged in 1-2 concentric circles; rim of the disc spinose; spire short, made of 4 pillars united by 1-2 cross beams and ending in a small, very spiny crown. Buttons (figs 42c, d) very nodulous, often irregular, perforated by numerous holes; some buttons less nodulous ventrally than dorsally. In the dorsal papillae, few tables (fig. 42e), few buttons (fig. 42f) and numerous rods perforated laterally and/or at the extremities (fig. 42g). In the tube feet tables (fig. 42h) with central holes larger than the ones of the body wall tables, rods (fig. 42j), and perforated plates 130-290 µm long (fig. 42k). In the tentacles rods only (fig. 42l), 60-540 µm long; smallest smooth, medium spiny at the extremities and largest spiny on the whole length.

Geographic distribution (fig. 43).— Indonesia (Sulawesi), Mariana Islands (Guam), **New Caledonia** = type locality, Society Islands (Tahiti).

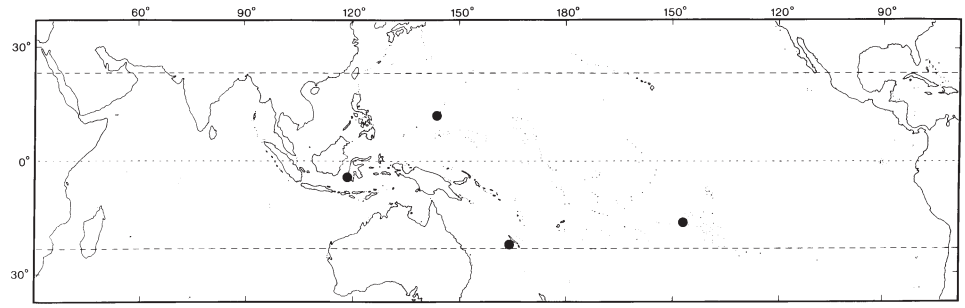


Fig. 43. Distribution of *Holothuria (Theelothuria) turriscelsa* Cherbonnier, 1980.

Remarks.— Minor variations occurs between the specimens from Sulawesi and the holotype. The specimens from Sulawesi do not have bridges on the body wall buttons, their rods of the dorsal papillae are less massive and their tentacle rods are smaller than the ones of the holotype. The body wall with the wart-like papillae is very characteristic and similar to specimens from New Caledonia (Cherbonnier, 1980; Cherbonnier & Féral, 1986), and Guam (Kerr et al., 1992). *Holothuria turriscelsa* is nocturnally activ and has only been collected at night. It is a new species for the fauna of Indonesia.

Subgenus *Thymiosycia* Pearson, 1914
Holothuria (Thymiosycia) hilla Lesson, 1830
(figs 44, 111d)

Holothuria hilla Lesson, 1830: 226, pl. 78; Lawrence, 1980: 202; Grosenbaugh, 1981: 51; Kropp, 1982: 446; James, 1983: 93; Zoutendijk, 1989: 2; Colin & Arneson, 1995: 262, fig. 1234; Baine & Forbes, 1998: 4.
Holothuria (Holothuria) monacaria; Panning, 1935b: 69, fig. 47a-u (synonymy and records before 1935).

Holothuria (Thymiosycia) hilla; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 214; Rowe & Doty, 1977: 232, figs 4b, 8b; Levin, 1979: 22; Sloan et al., 1979: 123; Tortonese, 1980: 107; Mary Bai, 1980: 13, textfig. 9I; Liao, 1980, 115; Tan Tiu, 1981: 75, pl. 17 figs 1-2, pl. 29 figs 1-2g; Humphreys, 1981: 35; Price, 1982: 11; Rowe, 1983: 158; Price, 1983: 93, fig. 51a-d'; Mukhopadhyay & Samanta, 1983: 307, fig. 8A-C; Reyes-Leonardo, 1984a: 147, pl. 4 fig. 2a-f; Liao, 1984: 222; A.M. Clark, 1984: 99; Richard, 1985: 457; James, 1985 [1988]: 404; Price & Reid, 1985: 6; Marsh, 1986: 73; Cannon & Silver, 1986: 25, fig. 7e, textfig.; Féral & Cherbonnier, 1986: 92; George & George, 1987: 247; Mukhopadhyay, 1988: 8, fig. 7a-b1; Cherbonnier, 1988: 85, fig. 34A-L (synonymy and records before 1975); Jangoux et al., 1989: 163; Conand, 1989: 28; Chao & Chang, 1989: 118, figs 17, 30D; James, 1989: 126; Levin & Dao Tan Ho, 1989: 57; Marsh et al., 1993: 64; Kerr, 1994: 169; Marsh, 1994a: 11; Marsh, 1994b: 57; Rowe & Gates, 1995: 302; Liao & A.M. Clark, 1995: 463, fig. 276a-d; James, 1995a: 59, fig. 2H; Massin, 1996b: 30, fig. 20A-G; Gosliner et al., 1996: 280, fig. 1032; Liao, 1997: 141, fig. 83a-d; Rowe & Richmond, 1997: 304.

Material.— IRSNB IG.28251/147 (1 specimen), Barang Lompo NNW, 23.ix.94, 3 m depth, under coral slab; RMNH Ech. 6061 (1 specimen), Kudingareng Keke S, 26.ix.94, 7 m depth under coral rubble; IRSNB IG.28251/187 (1 specimen), Kudingareng Keke S 28.ix.94, 5 m depth under coral slab; RMNH Ech. 6086 (1 specimen), Kudingareng Keke S, 29.ix.94, reef flat at low tide under coral slab; RMNH Ech. 6062 (1 specimen), Kudingareng Keke S, 28.ix.94, 1 m depth; IRSNB IG.28152/241 (1 specimen), Badi, 3.x.94, 2 m depth.

Geographic distribution (fig. 44).— Red Sea, Somalia, Kenya, Zanzibar, Mozambique (Querimba Islands), Madagascar, Mauritius, Seychelles (Mahé, Aldabra), Persian Gulf, Oman (Muscat), Maldive Islands, Chagos Archipelago (Diego Garcia), Sri Lanka, India (Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Myanmar (Mergui Archipelago), Cocos Keeling Islands, Malaysia (mainland, Sabah), Indonesia (Java, Lombok, Komodo, Salayer, Sulawesi, Makassar Strait, Sulu Islands, Obi Major, Ambon, Mollucas, Irian Jaya, Banda Sea, Timor, Savu Islands, Flores), Philippines, Vietnam, China, Taiwan, Japan, Mariana Islands (Guam), Caroline Islands (Kosrae, Yap), Papua New Guinea (New Ireland), Solomon Islands (Vanikoro), Australia (WA, NT, Timor Sea, QLD, GBR, NSW, Tasman Sea), New Caledonia, Loyalty Islands, Marshall Island (Enewetok), Fiji, Hawaiian Islands, Cook Islands, Society Islands (**Borabora** = type locality).

Description and remarks.— The size of the specimens ranges from 85 × 13 to 145 × 16 mm. The colour pattern is typical of *Holothuria hilla* with dorsal papillae and tentacles often white-green instead of cream-beige, especially on specimens with a very

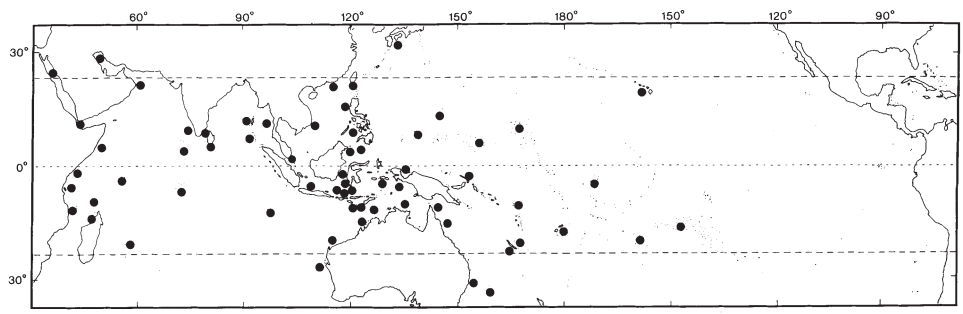


Fig. 44. Distribution of *Holothuria (Thymiosycia) hilla* Lesson, 1830.

pale brown body colour (fig. 111d). The ossicles are identical to material described from Ambon (Massin, 1996b). Most of the specimens come from Kudingareng Keke where the species is the most common one under coral slabs on the reef flat. *Holothuria hilla* often occupies the same habitat as *H. impatiens* and *H. leucospilota*.

Holothuria (Thymiosycia) impatiens (Forskål, 1775)
(figs 45, 111e)

Fistularia impatiens Forskål, 1775: 121, pl. 39 fig. B.

Holothuria (Holothuria) impatiens; Panning, 1935c: 86, fig. 72a-u (synonymy and records before 1935).

Holothuria impatiens; Serene, 1937: 26; Dawydoff, 1952: 117; Endean, 1953: 57; Endean, 1956: 131; Endean, 1957: 253; Caso, 1962: 315; Loi & Sach, 1963: 239, pl. 4 fig. 4; Caso, 1965: 257; Townsley & Townsley, 1972: 176; Mc. Knight, 1974: 45; Tortonese, 1977: 275; Tortonese, 1979: 316; James, 1993: 92; Solis-Marin et al., 1997: 275; Baine & Forbes, 1998: 4.

Holothuria (Thymiosycia) impatiens; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 214, fig. 14 (1-3); Rowe & Doty, 1977: 233, figs 4c, 7e; Levin, 1979: 22; Sloan et al., 1979: 123; Liao, 1980: 115; Tortonese, 1980: 107; Cherbonnier, 1980: 642, fig. 14A-H (synonymy and records before 1975); Mary Bai, 1980: 13, textfig. 9J; Tan Tiu, 1981: 75, pl. 18 figs 1-2; Humphreys, 1981: 35; Price, 1982: 11; Rowe, 1983: 159; Price, 1983: 95, fig. 52a-d'; Mukhopadhyay & Samanta, 1983: 307, fig. 9A-D; Reyes-Leonardo, 1984a: 147, pl. 4 fig. 1a-d; Liao, 1984: 222; A.M. Clark, 1984: 99; Reyes-Leonardo et al., 1985: 273; Marsh, 1986: 73; Cannon & Silver, 1986: 25, figs 4g, 7f; Féral & Cherbonnier, 1986: 94; Cherbonnier, 1988: 89, fig. 35A-K (synonymy and records); Maluf, 1988: 96; Conand, 1989: 28; Chao & Chang, 1989: 118, figs 18, 30E; James, 1989: 125; Levin & Dao Tan Ho, 1989: 57: Kalashnikov, 1989: 66; Maluf, 1991: 359; Marsh et al., 1993: 64; Marsh, 1994a: 11; Marsh, 1994b: 57; Rowe & Gates, 1995: 303; Liao & A.M. Clark, 1995: 464, fig. 277a-d; James, 1995a: 58, fig. 2E-F; Massin, 1996b: 30, fig 21A-E; Gosliner et al., 1996: 280, fig. 1033; Liao, 1997: 144, fig. 84a-c; Rowe & Richmond, 1997: 304.

Material.— IRSNB IG.28251/33 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide; IRSNB IG.28251/132 (1 specimen), Samalona NW, 21.ix.94, 12 m depth under a boulder of dead coral; IRSNB IG.28251/166 (1 specimen), Kudingareng Keke S, 28.ix.94, 3 m depth under a boulder of dead coral; IRSNB IG.28251/181 (1 specimen), Kudingareng Keke S, 28.ix.94, 5 m depth under a dead table of *Acropora* spec.; IRSNB IG.28251/194 (1 specimen) and RMNH Ech. 6063 (1 specimen), Kudingareng Keke S, 28.ix.94, reef flat at low tide under a coral slab; IRSNB IG.28251/198 (1 specimen), Kudingareng Keke S, 28.ix.94, 2 m depth; IRSNB IG.28251/200 (1 specimen and RMNH Ech. 6064 (1 specimen), Kudingareng Keke S, 28.ix.94, 1 m depth; IRSNB IG.28251/217 (1 specimen), Kapoposang, 30.ix.94, 10 m depth; IRSNB IG.28251/223 (1 specimen), Kapoposang, 30.ix.94, 1 m depth, lagoon; IRSNB IG.28251/233 (2 specimens) and RMNH Ech. 6065 (2 specimens), Badi, 3.x.94, 2 m depth; IRSNB IG.28251/253 (1 specimen), Badi, 3.x.94, 2 m depth; IRSNB IG.28251/258 (1 specimen), Kudingareng Keke S, 5.x.94, 1 m depth.

Geographic distribution (fig. 45).— **Red Sea** = type locality, Somalia, Kenya, Zanzibar (Tumbatu), Mozambique (Querimba Islands), South Africa (Natal), Madagascar, Mauritius, Seychelles (Mahé, Aldabra), Persian Gulf, Maldive Islands, Chagos Archipelago (Diego Garcia), Sri Lanka, India (Laccadive Islands, Gulf of Mannar, Andaman Islands, Nicobar Islands), Cocos Keeling Islands, Myanmar (Mergui Archipelago), Malaysia (mainland, Gudang), Indonesia (Sumatra, Java, Lombok, Sumbawa, Flores, Savu Islands, Timor, Salayer, Sulawesi, Makassar Strait, Kalimantan, Sulu Islands, Celebes Sea, Halmaheira, Obi Major, Ceram, Ambon, Lucipara Islands, Kai Islands, Tukang Besi Islands, Irian Jaya), Philippines, Vietnam, Taiwan, China,

Japan, Mariana Islands (Guam), Caroline Islands (Kosrae), Palau Islands, Australia (WA, NT, Timor Sea, QLD, GBR, NSW, Tasman Sea), New Caledonia, Loyalty Islands, Fiji (Rotuma), Samoa (Navigator), Tonga Islands, Cook Island (Manihiki), Phoenix Islands, Line Islands (Fanning Island), Hawaiian Islands, Marquesas Islands, Society Islands (Tahiti), Mexico (Revillagigedos, Zihuatanejo), Gulf of California, Cocos Islands, Panama, Ecuador, Galapagos Islands.

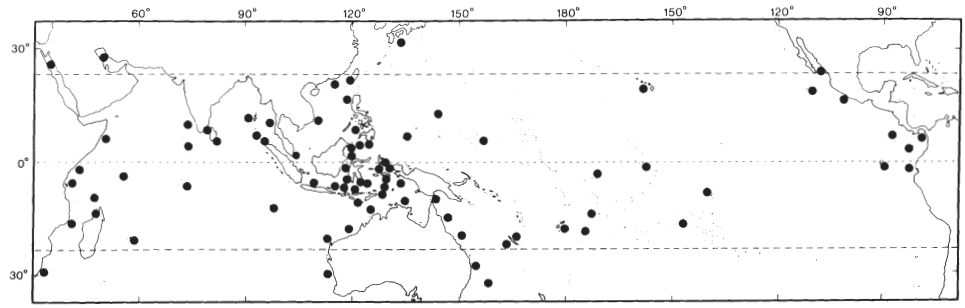


Fig. 45. Distribution of *Holothuria (Thymiosycia) impatiens* (Forskål, 1775).

Description and remarks.— The size of the collected specimens ranges from 18 × 6.5 to 360 × 35 mm. The colour and general aspect of living specimens (fig. 111e) are similar to specimens from other areas except for a few specimens which are nearly white. Internal anatomy and ossicles are in accordance with material described from Ambon (Massin, 1996b). Even the smallest specimen (18 × 6.5 mm) has ossicles of the same size as in adult ones.

Holothuria impatiens is abundant, especially under coral slabs on the reef flats. Most of the specimens have been collected between 0 and 2 m depth, the usual depth range of *H. impatiens* (Cherbonnier & Féral, 1986). Only twice they have been found deeper (10 & 12 m depth). The local distribution is patchy. Samalona and Kudingareng Keke have been similarly investigated but the species is obviously much more abundant on Kudingareng Keke.

Genus *Labidodemas* Selenka, 1867
Labidodemas rugosum (Ludwig, 1875)
(figs 46a-j, 47a-c, 48)

Holothuria rugosa Ludwig, 1875: 110, pl. 7 fig. 33d-e; H.L. Clark, 1946: 435; James, 1969: 61.

Holothuria (Holothuria) rugosa; Panning, 1935b: 75, fig. 7a-g (synonymy and records before 1935); Domantay, 1936: 399.

Labidodemas rugosum; Rowe, 1969: 133; A.M. Clark & Rowe, 1971: 176, fig. 88a, pl. 28 fig. 14; Sloan et al., 1979: 121; Tortonese, 1980: 104, fig. 3A-I; Mary Bai, 1980: 8, figs 4A, 8I; James, 1981: 83, figs 1, 2a-e; James, 1982b: 128; Bruce, 1983: 107; Mukhopadhyay & Samanta, 1983: 308, fig. 10A-E; James, 1983: 86, 92, pl. 1E; A.M. Clark, 1984: 99; Cannon & Silver, 1986: 21; Cherbonnier, 1988: 53, fig. 19A-T; James, 1989: 122; Rowe & Gates, 1995: 304.

Labidodemas rugosa; A.M. Clark & Taylor, 1971: 91; Jangoux et al., 1989: 163.

Material.— IRSNB IG.28251/256 (1 specimen), Kudingareng Keke, 5.x.94, 2 m depth.

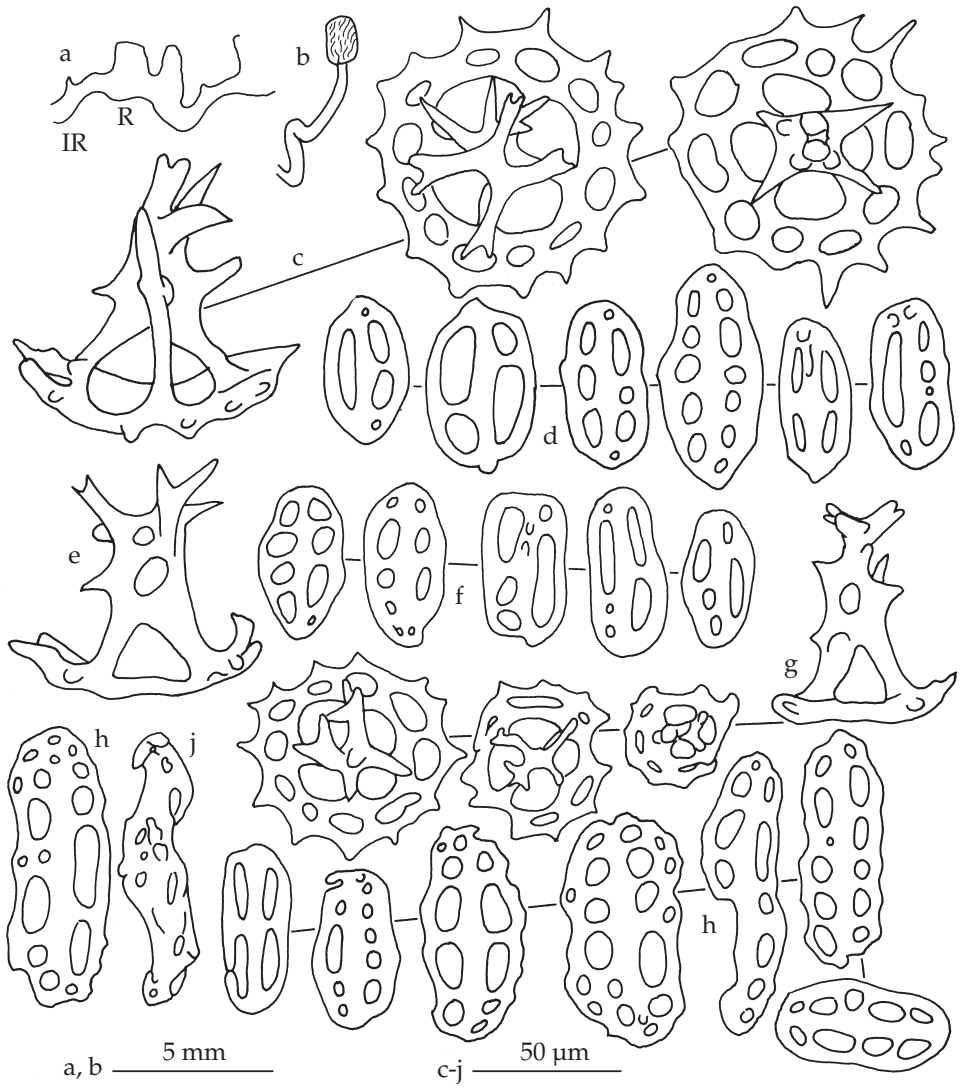


Fig. 46. *Labidodemas rugosum* (Ludwig, 1875). a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: tables from dorsal body wall; d: buttons from dorsal body wall; e: table from ventral body wall; f: buttons from ventral body wall; g: tables from dorsal papillae; h: buttons from dorsal papillae; j: irregular buttons from dorsal papillae.

Description.— Specimen 133 × 20 mm, white with yellow tube feet; in alcohol uniformly white. Body cylindrical, tapering posteriorly with mouth and anus terminal; tentacles 20. Tube feet very long, narrow, mainly along the ambulacra, a few in the interambulacra; latero-ventral ambulacra with 2 rows of tube feet, central ambulacrum with 4 rows of tube feet. Papillae large, less numerous than the tube feet, conical, forming more or less 12 rows on the bivium; lateral rows particularly prominent.

Calcareous ring fine composed of massive radial pieces and ribbon-like interradi-

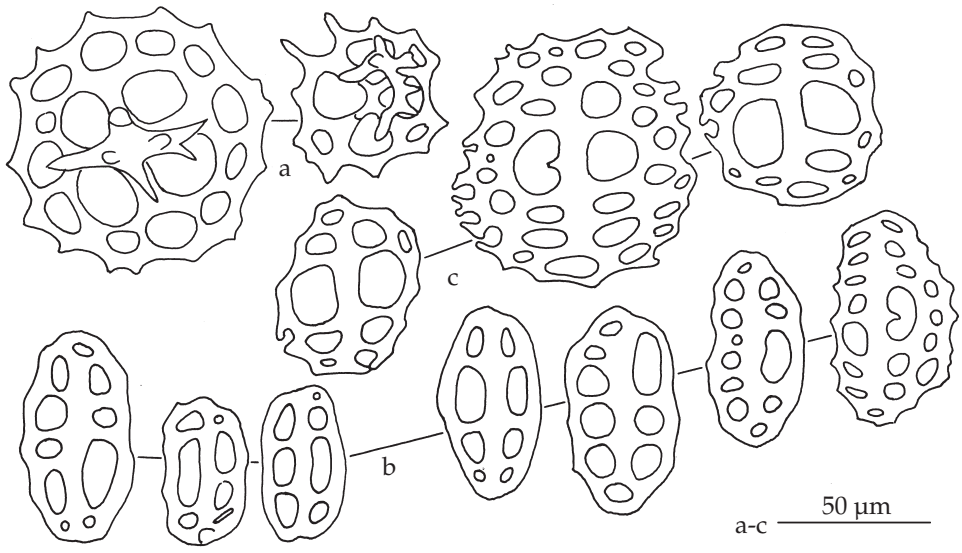


Fig. 47 *Labidodemas rugosum* (Ludwig, 1875). a: tube foot tables; b: tube foot buttons; c: perforated plates from tube feet.

al pieces (fig. 46a). One Polian vesicle, and one stone canal going upward and ending in a quadrangular madreporic plate (fig. 46b).

In the body wall, dorsal papillae and tube feet tables and buttons. Tables of the body wall with discs 80-95 µm in diameter; disc perforated by 4 large central holes and 10-12 peripheral holes (figs 46c, e); rim of the disc very spinose; height of the spire equal to disc diameter; 4 pillars, spiny near the top, united by 1-2 cross beams and ending in a bundle of very strong spines; most of the spines bifurcated at their extremities. Buttons smooth, regular, perforated by 2-6 pairs of holes, 45-75 µm long and more numerous dorsally than ventrally (fig. 46g). Tables of dorsal papillae (figs 46d, f) smaller (35-60 µm long) than those of body wall, whereas buttons (fig. 46h) are larger (55-95 µm long) and sometimes irregular (fig. 46j). Tables of tube feet 45-85 µm across (fig. 47a), buttons 50-70 µm long (fig. 47b) and end plate 640-660 µm across; close to the end plate, rounded perforated plates (fig. 47c) derived from buttons.

Geographic distribution (fig. 48).— Somalia, Seychelles (Mahé, Aldabra), Madagascar, Maldive Islands, Chagos Archipelago (Diego Garcia), India (Laccadive Islands, Andaman Islands), Indonesia (Sulawesi, Komodo, Lucipara Islands, Irian Jaya), Philippines, Palau Islands (Palau = Pelew), Australia (Torres Strait), Papua New Guinea (New Britain), Fiji (Rotuma), **Samoa** = type locality.

Remarks.— The tables of the body wall are characteristic of *Labidodemas rugosum* and little variable throughout the distribution range. The buttons show more variation. For example, they are more irregular in specimens from Madagascar (Cherbonnier, 1988). The ribbon-like aspect of the calcareous ring is also variable. It is said to be massive according to James (1981) and Cherbonnier (1988) and more ribbon-like according to Ludwig (1875), Pearson (1913), Mary Bai (1980) and the present study.

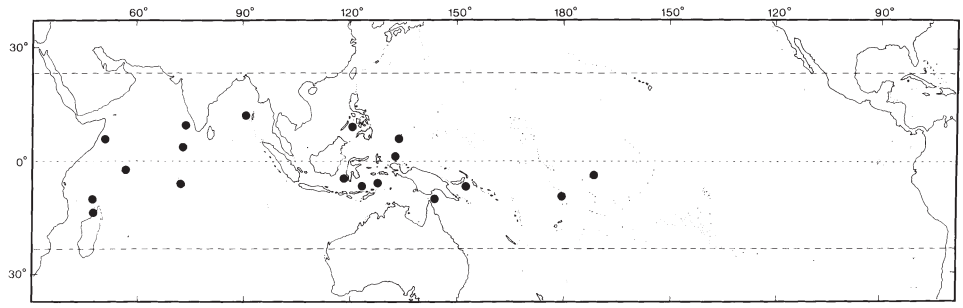


Fig. 48. Distribution of *Labidodemas rugosum* (Ludwig, 1875).

Labidodemas semperianum Selenka, 1867
(figs 49a-c, 50, 111f)

Labidodemas semperianum Selenka, 1867: 309, pl. 17 figs 1-3; H.L. Clark, 1921: 172; Endean, 1956: 130; Endean, 1957: 253; Cherbonnier, 1970: 566, figs A-P (synonymy and records before 1970); A.M. Clark & Rowe, 1971: 176, pl. 18 fig. 12; Liao, 1975: 209, fig. 9 (1-7); Rowe & Doty, 1977: 223, 230, figs 3b, 5g; Tortonese, 1977: 275; Mary Bai, 1980: 8, fig. 8J; Liao, 1980: 115; Humphreys, 1981: 33; Price, 1982: 10; Rowe, 1983: 155; Price, 1983: 88, fig. 45a-d; Liao, 1984: 221: Cannon & Silver, 1986: 21, figs 3c, 6a; George & George, 1987: 246; Conand, 1989: 16, 23; Marsh et al., 1993: 63; Kerr, 1994: 170; Allen & Steene, 1994: 245; Marsh, 1994a: 10; Rowe & Gates, 1995: 305.

Material.— IRSNB IG.28251/197 (1 specimen), Kudingareng Keke, 28.ix.94, 1.5 m depth, under a coral slab; RMNH Ech. 6087 (1 specimen), Kapoposang, 30.ix.94, 5 m depth, under a coral slab.

Description.— Specimens 120 × 10 and 155 × 20 mm, white-pink (111f) with yel-

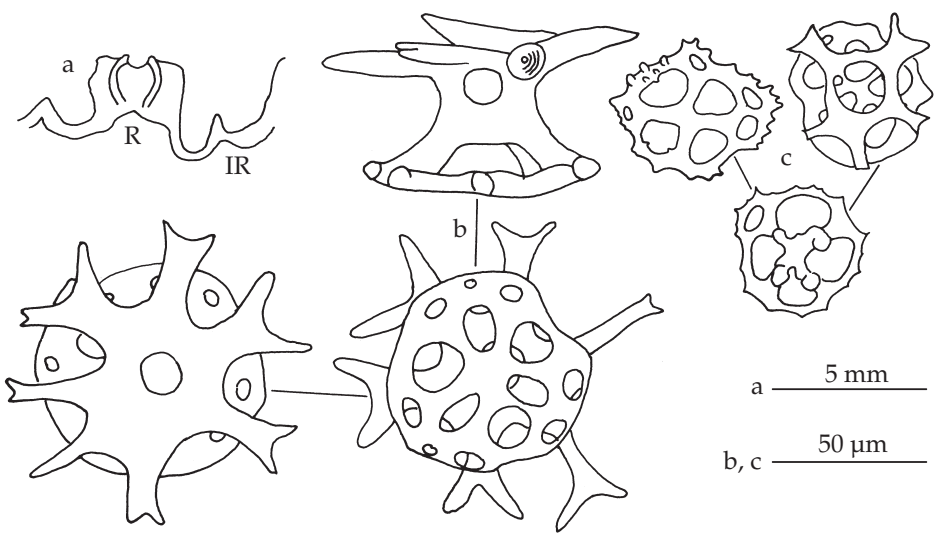


Fig. 49. *Labidodemas semperianum* Selanka, 1867. a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: tube foot tables.

low tube feet; largest specimen pink-brown around the mouth; in alcohol uniformly white. Body cylindrical with mouth and anus terminal; mouth surrounded by 20 tentacles; anus surrounded by 5 radial pairs of papillae. Few, long, slender, slightly conical papillae scattered over the whole bivium, presenting a vague alignment in 3 double rows close to the mouth and anus. Tube feet very long, restricted to the ambulacra; in each ambulacrum 2 rows of tube feet with a zig-zag pattern.

Calcareous ring composed of massive radial pieces and ribbon-like interradial pieces (fig. 49a). One Polian vesicle and one stone canal going upwards and ending in a muriform madreporic plate. Digestive tract filled with very rough calcareous sand.

In the body wall and tube feet tables only. Tables of body wall with discs 65-80 µm in diameter; disc perforated by 5-6 large central holes and 7-10 peripheral holes (fig. 49b); rim of disc smooth, undulating; spire low with 4 pillars united by one cross beam and ending in a crown of huge spines, bifurcated at the apex; the crown of spines larger than the disc. In the tube feet tables the same size as those of the body wall and in addition smaller ones (fig. 49c), often reduced to the disc; reduced tables with the rim of the disc spinose; end plate 370-400 µm across.

Geographic distribution (fig. 50).— Red Sea, Kenya, Persian Gulf, Maldive Islands, India (Andaman Islands), Cocos Keeling Islands, Indonesia (Sulawesi, Timor, Sumba, Aroe, Irian Jaya), Malaysia (Sabah), Australia (WA, NT, QLD, NSW), Philippines, China, Mariana Islands (Guam), Caroline Islands (Kosrae), New Caledonia, Fiji, **Hawaiian Islands** = type locality, Society Islands (Tahiti).

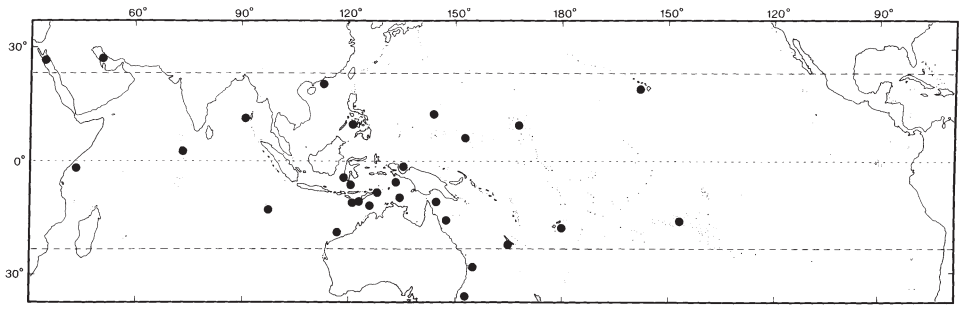


Fig. 50. Distribution of *Labidodemas semperianum* Selanka, 1867.

Remarks.— The specimens from Sulawesi differ slightly from those from the Marshall Islands (Cherbonnier, 1970) with the edge of the disc of the large tables being smooth instead of spiny and by the absence of buttons in the dorsal body wall. The aspect of the main tables is very characteristic and makes the identification of *Labidodemas semperianum* very easy.

Genus *Pearsonothuria* Levin, Kalinin & Stonik, 1984
Pearsonothuria graeffei (Semper, 1868)
(figs 51, 111g, h)

Holothuria graeffei Semper, 1868: 78, pl. 30 fig. 9.
Holothuria (Bohadschia) graeffei; Panning, 1929 [1931]: 124, fig. 6a-f (synonymy and records before 1929).
Bohadschia graeffei; Levin, 1979: 19; Tortonese, 1979: 316; Tan Tiu, 1981: 68, pl. 9 figs 1-2; Price, 1982: 10;

Reyes-Leonardo, 1984a: 144, pl. 1 fig. 1a-h; Cherbonnier & Féral, 1984a: 669, fig. 6A-J (synonymy and records); Price & Reid, 1985: 3; Brouns & Heijs, 1985: 175; Reyes-Leonardo et al., 1985: 270; Marsh, 1986: 73; George & George, 1987: 246, pl. 11 fig. G; Jangoux et al., 1989: 163; Marsh et al., 1993: 63; Allen & Steene, 1994: 243; Marsh, 1994a: 10; Holand, 1994: 2; Sant, 1995: 27; Colin & Arneson, 1995: 238, 261, figs 1226-1227; Gosliner et al., 1996: 278, fig. 1025; Britayev & Zamisliak, 1996: 177; Baine & Forbes, 1998: 4.

Bohadschia (Pearsonothuria) graeffei; Kalashnikov, 1989: 67, fig. 4.

Pearsonothuria graeffei; Cherbonnier, 1988: 492, fig. 17A-F (records); Levin & Dao Tan Ho, 1989: 55; Massin, 1996b: 33, fig. 22A-H (synonymy and records); Clouse, 1997: 191, fig. 5a-e; Liao, 1997: 147, fig. 85a-f; Rowe & Richmond, 1997: 302.

Material.— One specimen observed at Samalona.

Geographic distribution (fig. 51).— Red Sea, Comores, Madagascar, Maldive Islands, India (Laccadive Islands), Cocos Keeling Islands, Indonesia (Sumatra, Java, Sumba, Timor, Sulawesi, Halmaheira Sea, Ceram, Ambon, Banda Island, Kai Islands), Malaysia (Mainland, Sabah), Vietnam, China, Philippines, Taiwan, Mariana Islands (Guam), Caroline Islands (Kosrae), Papua New Guinea (Madang Province, Port Moresby), Solomon Islands, Australia (WA, Timor Sea, NT, QLD, GBR), New Caledonia, Fiji (**Viti Island** = type locality).

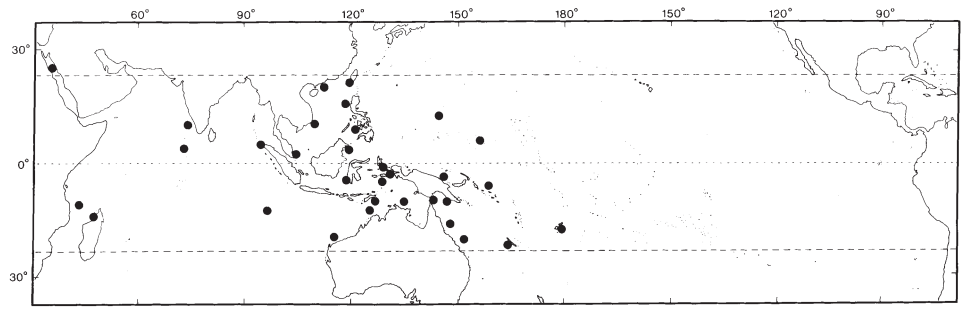


Fig. 51. Distribution map of *Pearsonothuria graeffei* (Semper, 1868).

Description and remarks.— *Pearsonothuria graeffei* has a very characteristic colour pattern for adult (fig. 111g) and subadult specimens (fig. 111h) and can be identified in the field without hesitation. It is surprising that only a single specimen was observed since it is normally a common coral reef species between 2-10 m depth. This scarcity is difficult to relate to human fishing pressure because *P. graeffei* is normally not used as trepang (Anon., 1979; Conand, 1986, 1989; Mc Elroy, 1990). In the Solomon Islands it is only fished for in recent times (Holland, 1994) but is considered a species of mediocre quality (Sant, 1995).

Family Stichopodidae Haeckel, 1886
Genus *Stichopus* Brandt, 1835
Stichopus herrmanni Semper, 1868
(fig. 52a-n)

Stichopus variegatus Herrmanni Semper, 1868: 73, pl. 17, pl. 30 fig. 2.

Stichopus variegatus var. *herrmanni*; H.L. Clark, 1922: 68; George & George, 1987: 246.
Stichopus hermanni; Marsh et al., 1993: 64; Rowe & Gates, 1995: 324; Rowe & Richmond, 1997: 306.
Stichopus herrmanni; James, 1983: 92; Massin, 1996b: 35, figs 24A-G, 25A-B.

Material.— IRSNB IG.28251/156b (1 specimen), Barang Lompo, 23.ix.94, 5 m depth under coral rubble; Kudingareng Keke, 28.ix.94, reef flat (1 large specimen observed).

Description.— Collected specimen 18 × 10 mm, nearly white; the large observed

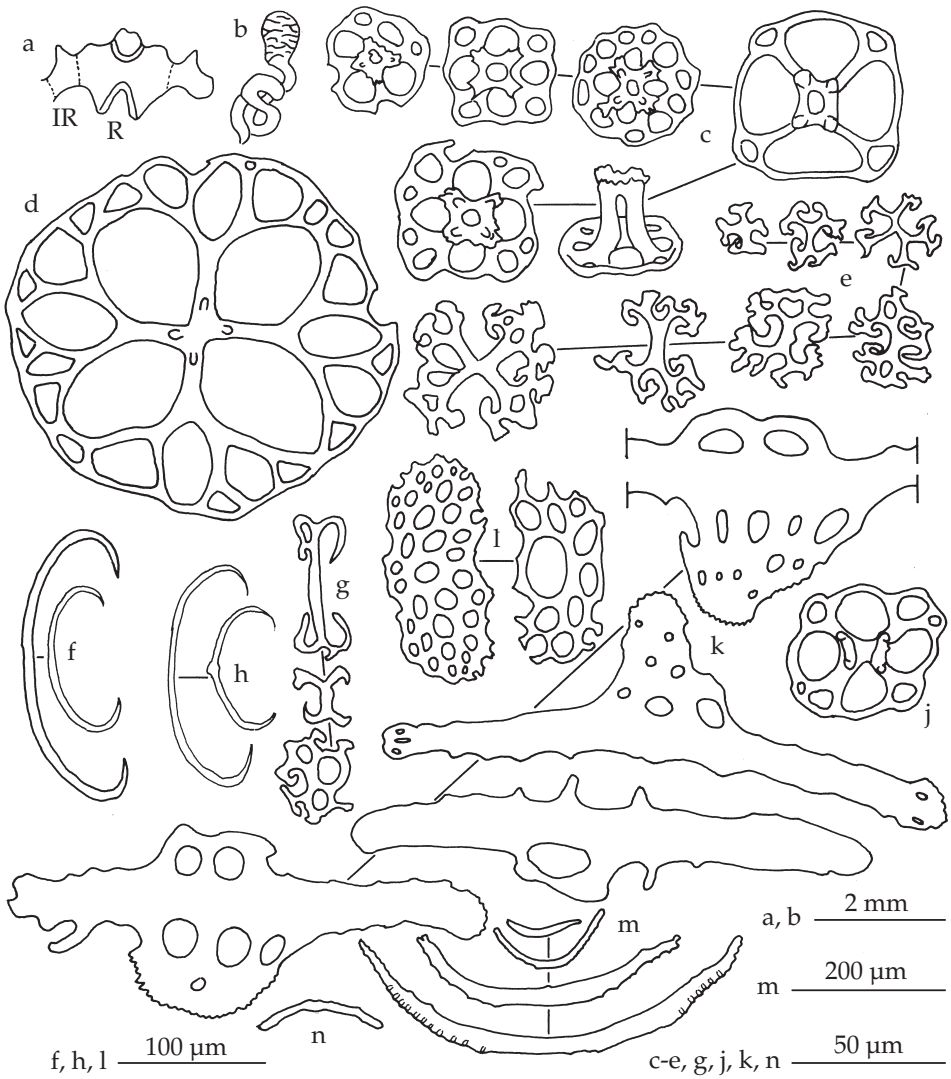


Fig. 52. *Stichopus herrmanni* Semper, 1868. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: tables from dorsal body wall; d: large tables from dorsal body wall; e: rosettes from dorsal body wall; f: C-shaped rods from dorsal body wall; g: rosettes from ventral body wall; h: C-shaped rods from ventral body wall; j: tube foot tables; k: tube foot rods; l: perforated plates from tube feet; m & n: tentacle rods.

specimen yellow-greenish with numerous brown spots dorsally; in alcohol uniformly white. Mouth ventral, anus terminal. Papillae scattered over the whole bivium without alignment. Ventrally 2-3 rows of tube feet along each ambulacrum.

Calcareous ring well developed; very large interradial pieces with 2 short posterior projections and narrow interradial pieces with one anterior tooth (fig. 52a). One contorted stone canal going upwards and ending in a rounded madreporic plate located against the calcareous ring (fig. 52b). One Polian vesicle. Tentacle ampullae short (same length as the radial pieces). No gonads.

Ossicles of dorsal body wall include tables, rosettes and C-shaped rods. Tables with discs 35-65 µm in diameter (fig. 52c); disc round or quadrangular with 4 large central holes and 4-11 small peripheral holes; 4 short pillars ending in a small crown of spines, sometimes forming a Maltese cross when see from above; a few large tables with disc diameter up to 135 µm but with spire reduced to spine or knobs (fig. 52d). Rosettes abundant, 15-55 µm across (fig. 52e), varying in shape from a simple cross with bifurcated extremities to much more complicated forms. C-shaped rods 95-180 µm long, very numerous (fig. 52f). Ventrally in the body wall tables, rosettes and C-shaped rods; tables similar to the dorsal ones but more numerous; rosettes (fig. 52g) nearly of the same size as dorsally, 15-50 µm long, but more simple; C-shaped rods (fig. 52h) smaller (80-150 µm long) and less numerous than dorsally. In the tube feet a few tables (fig. 52j) similar to those of the body wall, rods with enlarged and perforated central process (fig. 52k), 160-190 µm long and perforated plates 125-150 µm long (fig. 52l), located close to the end plate; end plate 250-290 µm across. In the tentacles curved spiny rods 45-600 µm long (figs 52m, n).

Remarks.— Judging from its size, the reduced number of tube feet in each ambulacrum and the absence of gonads the specimen is a juvenile. This is further confirmed by the 4 very large holes in the table discs, typical of juveniles of other *Stichopus* species (H.L. Clark, 1922; Cherbonnier, 1988). However, most of the ossicles of the specimen have already reached the condition found in adult.

Stichopus herrmanni has a wide Indo-West Pacific distribution (Rowe & Gates, 1995). However, its distribution map is problematical because in most of the literature before 1995 it is cited as *Stichopus variegatus* Semper, 1868, a name which is no longer valid (Rowe & Gates, 1995). The specimens formerly gathered under *S. variegatus* are now divided among two species: *S. herrmanni* and *S. monotuberculatus* (Quoy & Gaimard, 1833). Many of the references from the literature give only lists of holothurian names and it is not possible to ascertain the species we are dealing with.

Stichopus noctivagus Cherbonnier, 1980
(figs 53a-m, 54, 112a)

Stichopus noctivagus Cherbonnier, 1980: 654, fig. 19A-P, pl. 1A; Féral & Cherbonnier, 1986: 96; Kerr et al., 1992: 213, pl. 1C; Allen & Steene, 1994: 245; Colin & Arneson, 1995: 262, fig. 1239; ? Gosliner et al., 1996: 281, fig. 1033; Erhardt & Baensch, 1998: 1094.

Material.— IRSNB IG.28251/108 (1 specimen), Kudingareng Keke NW, 15.ix.94, 12 m depth, under rubble of coral; MNHN Paris, slides of the holotype.

Description.— Specimen 80 × 21 mm, rust brown to beige with a patchwork of

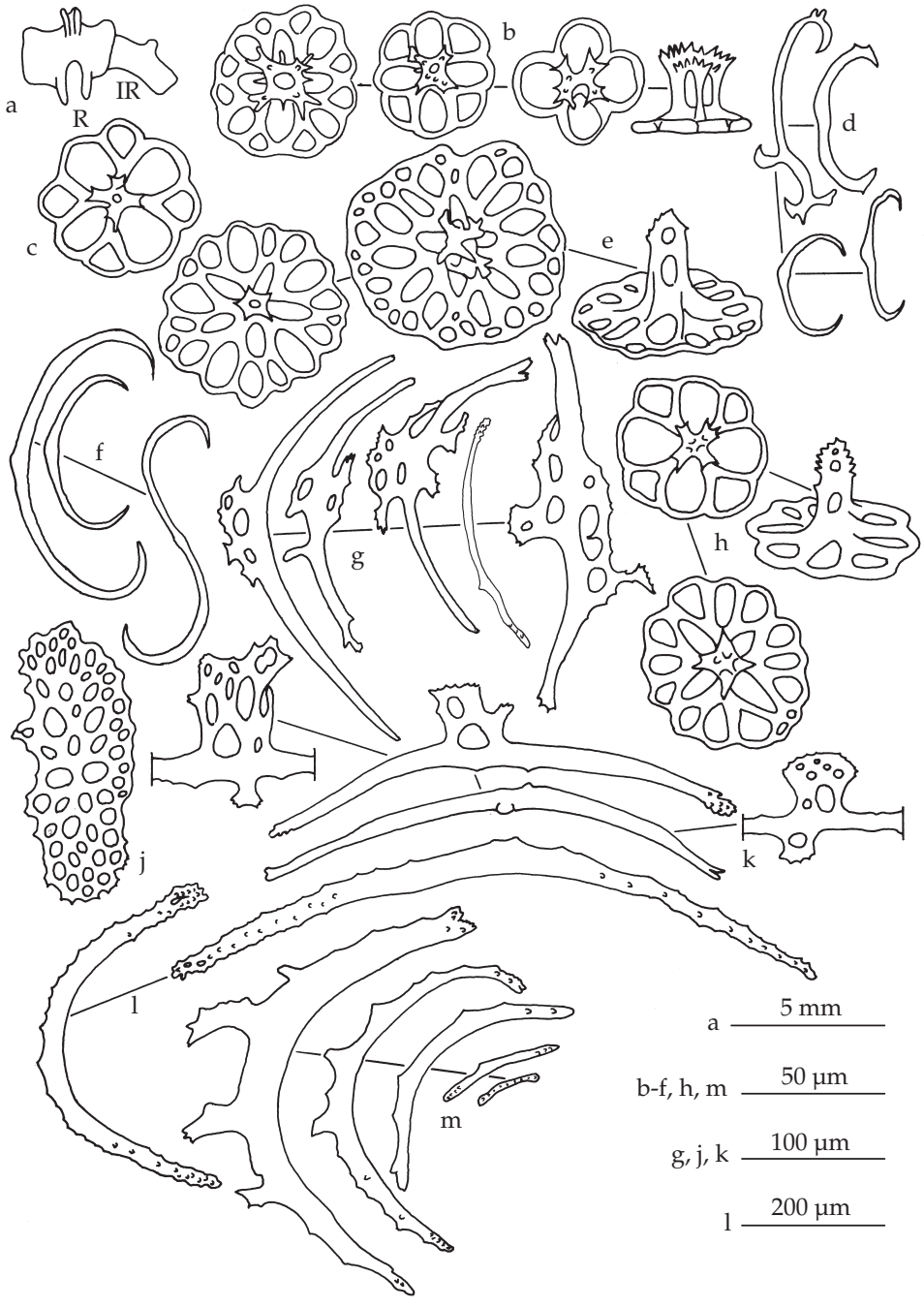


Fig. 53. *Stichopus noctivagus* Cherbonnier, 1980. a: calcareous ring (IR: interradial piece; R: radial piece); b: tables from dorsal body wall; c: tables from ventral body wall; d: C- and S-shaped rods from dorsal body wall; e: tables from dorsal papillae; f: C- and S-shaped rods from dorsal papillae; g: rods from dorsal papillae; h: tube foot tables; j: perforated plate from tube feet; k: tube foot rods; l & m: tentacle rods.

darker spots (fig. 112a); base of the papillae dark brown, tip white; anus deep brown; in alcohol colour disappear completely. Body flat ventrally, arched dorsally; mouth ventral, anus terminal. Dorsal papillae few, long, narrow at the tip, without alignment except on the flanks. Ventral tube feet only along the ambulacra; lateral ambulacra with 2 rows of tube feet, central one with 3-4 rows. Tentacles 20.

Calcareous ring composed of massive radial pieces having 2 short posterior projection and one anterior tooth split at the apex (fig. 53a); the interradial pieces twice as wide as high with a small central, blunt spine (fig. 53a). One Polian vesicle and one stone canal ending in a conical madreporic plate.

In the body wall tables, C- and S-shaped rods. Tables with discs 45-55 µm across; disc perforated by 4 large central holes and 0-12 peripheral holes; rim of the disc smooth and undulating (fig. 53b); ventrally maximally 4 peripheral holes; spire short made of 4 pillars ending in a crown of spines (fig. 53c). S- and C-shaped rods (fig. 53d) irregular, rare dorsally, absent ventrally. In the dorsal papillae, tables, C- and S-shaped rods and rods with enlarged, perforated central process. Tables discs 60-80 µm in diameter (fig. 53e) with the tip of the spire ending in one point giving the table a tack-like appearance. S- and C-shaped rods (fig. 53f) very abundant and regular. At the tip of the dorsal papillae long curved rods, 170-350 µm long (fig. 53g) with a central, perforated process; also a few spiny perforated plates located at the extreme tip of the papillae. In the tube feet tables (fig. 53h), perforated plates (fig. 53j), rods with enlarged perforated central part (fig. 53k) and an end plate 430-450 µm across; no C- or S-shaped rods. In the tentacles spiny curved rods (figs 53l, m), 20-1000 µm long, some with lateral processes.

Geographic distribution (fig. 54).— Indonesia (Sulawesi), Philippines, Mariana Islands (Guam), Palau Islands, Papua New Guinea, **New Caledonia** = type locality, (?) Hawaiian Islands.

Remarks.— The ossicles of the specimen from Sulawesi are similar to those of the holotype. Specimens from Palau (Colin & Arneson, 1995), New Caledonia (Féral & Cherbonnier, 1986) and Sulawesi (present work) have the same colour pattern. Specimens from Guam depicted by Kerr et al. (1992) and Erhardt & Baensch (1998) are more reddish, whereas the one pictured by Allen & Steene (1994) has the base of the papillae blue and the back ground more brown. The specimen from Hawaiian Islands (Gosliner et al. 1996) is so different from the general aspect of the species that I doubt the correctness of the identification.

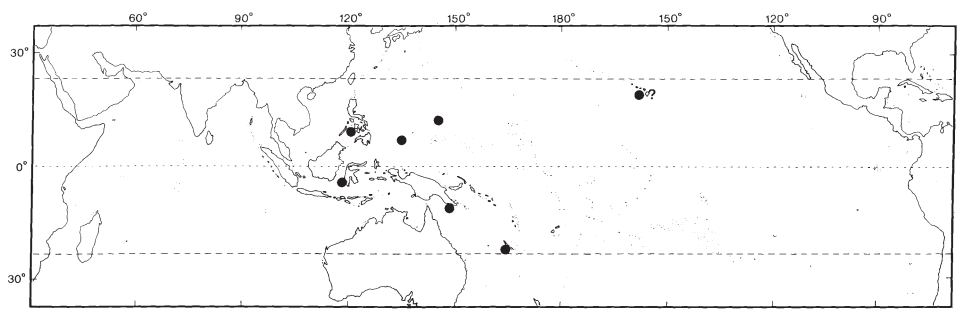


Fig. 54. Distribution of *Stichopus noctivagus* Cherbonnier, 1980.

Stichopus quadrifasciatus spec. nov.
(figs 55a-r, 56a-k, 112b, c)

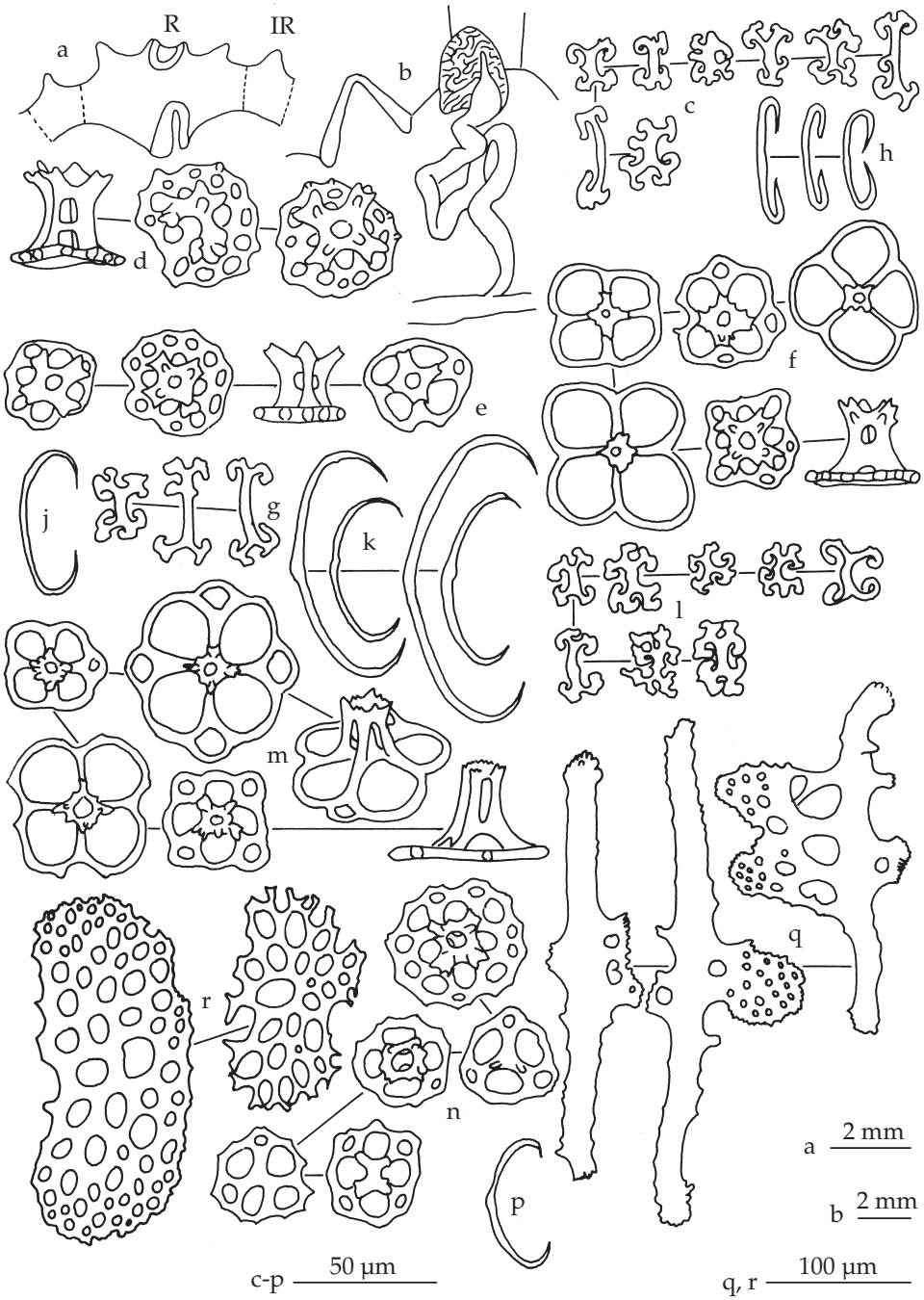
Material.— IRSNB IG.28251/32 (paratype), Panikiang S, 30.viii.94, reef flat; IRSNB IG.28251/131 (paratype), Samalona NW, 21.ix.-94, 12 m depth, under coral slabs; RMNH Ech. 6088 (paratype), Samalona NW, 21.ix.-94, 8 m depth, under coral slabs, a scale worm creeping on body wall, four eulimid gastropods attach to the mouth inside the tentacle crown and one 97 mm long *Carapus* spec. in the cloaca.; IRSNB IG.28251/193 (holotype), Kudingareng Keke S, 28.ix.94, reef flat.

Description.— Holotype 155 × 40 mm, paratypes 91 × 24, 125 × 40 and 45 × 23 mm. Colour yellow-grey with 4 large transversal, black-grey bands (fig. 112b). Tip of the dorsal papillae brown to red (fig. 112c), dorsal papillae white; in alcohol completely white. Dorsal papillae scattered, highly variable in size, without alignment except along the zone between bivium and trivium. Body flattened with mouth ventral an anus terminal to subdorsal. Mouth with 19-20 tentacles surrounded by a collar of papillae united by a web; collar of the holotype 7 mm height; tentacles small, yellowish with large, flat extremities. Tube feet along the ambulacra; lateral ones with 3-4 rows of tube feet, central one with 5-6 rows; only a few tube feet in the interambulacra; juvenile (45 mm long) with only one row of tube feet in the lateral ambulacra and 2 rows in the central one; each row in a zig-zag pattern. Skin firm, granulous, rough to the touch.

Calcareous ring composed of large radial and narrow interradial pieces (fig. 55a). Dorsal radial piece with a deep posterior slit, V-shaped in the holotype (fig. 55b) but more narrow in smaller specimens (fig. 55a); anteriorly, radial pieces with a central notch and two lateral teeth (fig. 55a). One Polian vesicle (10 % of body length) and one long, contorted stone canal, going upwards and ending in a large circular madreporic plate, 2-3 mm across (fig. 55b), located close to the median dorsal interradial piece. Tentacle ampullae medium size (10-13 % of body length). Gonads in 2 bundles, one on each side of the dorsal mesentery; no gonads in the juvenile.

Body wall ossicles rosettes, tables and C-shaped rods; rosettes 20-35 µm long (figs 27c, g, l) abundant to very abundant dorsally, very rare to absent ventrally. Table discs 35-50 µm in diameter; edge of the disc undulating, smooth or spinose; disc perforated by 4 large central holes and 0-16 small peripheral ones; 4 pillars forming the spire united by one cross beam and ending in a crown of spine making a Maltese cross when seen from above (figs 55d, e); tables rare to abundant dorsally, always

Fig. 55. *Stichopus quadrifasciatus* spec. nov. a: calcareous ring (IR: interradial piece; R: radial piece) (paratype L=125 mm; IRSNB IG.28251/131); b: stone canal and madreporic plate (holotype; IRSNB IG.28251/193); c: rosettes from dorsal body wall (holotype; IRSNB IG.28251/193); d: tables from dorsal body wall (holotype; IRSNB IG.28251/193); e: tables of ventral body wall (holotype; IRSNB IG.28251/193); f: tables from dorsal body wall (paratype L=45 mm; RMNH Ech. 6088); g: rosettes from ventral body wall (holotype; IRSNB IG.28251/193); h: C-shaped rods from dorsal body wall (holotype; IRSNB IG.28251/193); j: C-shaped rods from ventral body wall (holotype; IRSNB IG.28251/193); k: C-shaped rods from dorsal body wall (paratype L=45 mm; RMNH Ech. 6088); l: rosettes from dorsal body wall (L=45 mm; RMNH Ech. 6088); m: tables from ventral body wall (paratype L=45 mm; RMNH Ech. 6088); n: tube foot tables (holotype; IRSNB IG.28251/193); p: C-shaped rods from tube feet (paratype L=45 mm; RMNH Ech. 6088); q: tube foot rods (holotype; IRSNB IG.28251/193); r: perfotated plates from tube feet (holotype; IRSNB IG.28251/193).


R
IR
a
b
c
d
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k
l
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a 2 mm
b 2 mm
c-p 50 µm
q, r 100 µm

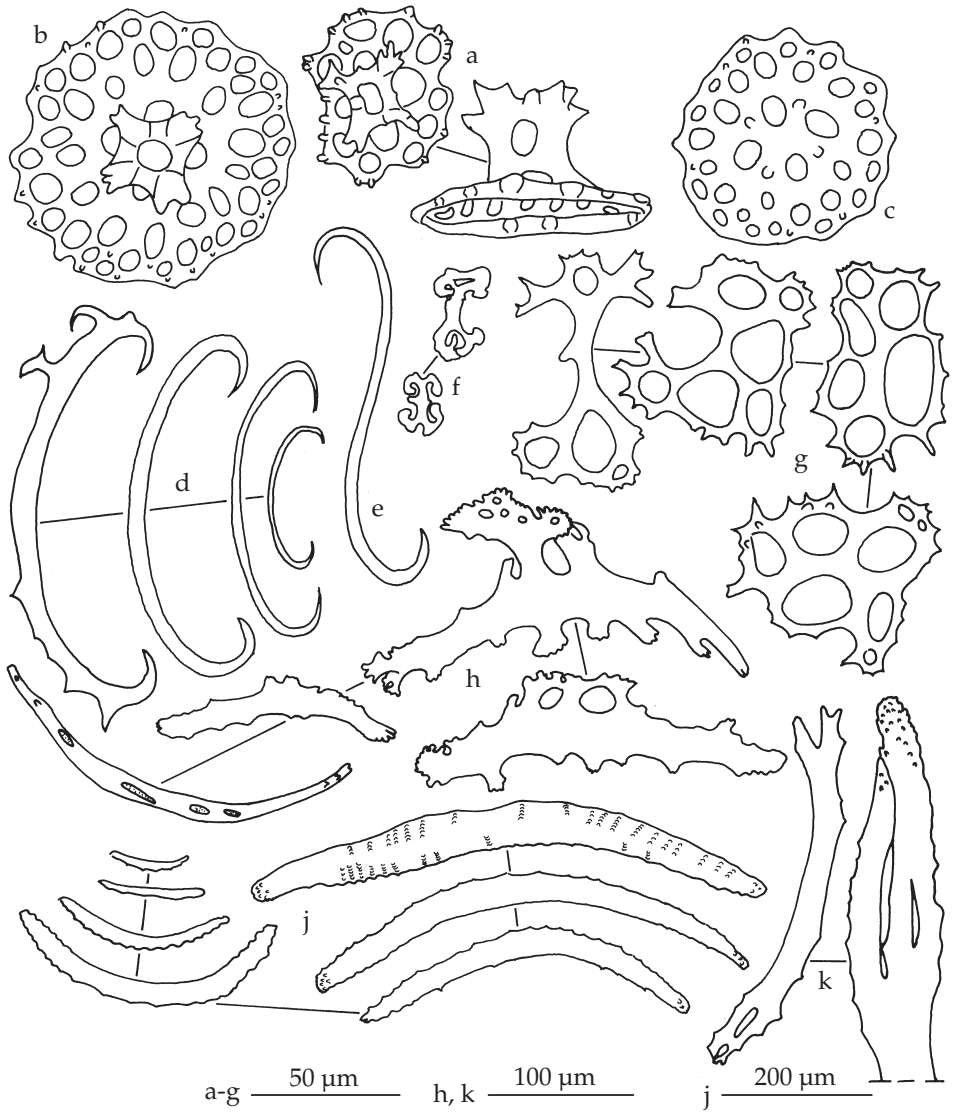


Fig. 56. *Stichopus quadrifasciatus* nov. spec. (a-h: holotype; IRSNB IG.28251/193; j-k: paratype L=91 mm; IRSNB IG.28251/32). a: tables from dorsal papillae; b: large table from dorsal papillae (holotype; IRSNB IG.28251/193); c: reduced table from dorsal papillae; d: C-shaped rods from dorsal papillae; e: S-shaped rods from dorsal papillae; f: rosettes from dorsal papillae; g: perforated plates from dorsal papilllae; h: rods from dorsal papillae; j & k: tentacle rods.

abundant ventrally. Central holes of the disc much larger in the juvenile (fig. 55f) than in the adults. C-shaped rods 35-50 µm long (figs 55h, j), rare dorsally and very rare ventrally or enterely absent; juvenile with large C-shaped rods, 50-100 µm long (fig. 55k) located dorsally. In the dorsal papillae tables, C- and S-shaped rods, rosettes, perforated plates and spiny rods. Tables similar to those of the body wall with the

edge of the disc more spinose (fig. 56a); a few large tables, diameter 80-100 µm (fig. 56b), with numerous peripheral holes; pillars and crown of spines similar to those of the small tables; some tables reduced to disc (fig. 56c); C-shaped rods 50-135 µm long (fig. 56d); S-shaped rods (fig. 56e) and rosettes (fig. 56f) rare; perforated plates with spiny edge (fig. 56g); spiny rods 150-280 µm long (fig. 56h), some with central perforated process. In the tube feet tables, C-shaped rods, spiny rods and perforated plates. Tables numerous, discs 25-50 µm in diameter with or without pillars (fig. 55n); C-shaped rods very rare, 45 µm long (fig. 55p); spiny rods 240-360 µm long (fig. 55q) with very large central perforated process; perforated plates 155-240 µm long (fig. 55r), located close to the end plate; end plate 750-900 µm across, composed of several pieces. In the tentacles spiny rods, 100-1000 µm long, slightly curved (fig. 56j); a few irregular with perforated or forked extremities (fig. 56k).

Etymology.— *quadrifasciatus* means circled with four bands refering to the very characteristic four black-grey transversal bands on the body wall.

Remarks.— *Stichopus quadrifasciatus* spec. nov. looks very much like *Stichopus horrens* Selenka, 1867. However, the absence of large tack-like tables in the dorsal papillae of the new species clearly separates both species. The ossicles and calcareous ring of *S. quadrifasciatus* are close to those of *S. herrmanni, but S. quadrifasciatus* does not have large tables in the ventral tube feet and in the dorsal body wall as *S. herrmanni*. Moreover, *S. quadrifasciatus* has spiny perforated plates in the dorsal papillae, plates which have never been mentioned for *S. herrmanni*. The ossicles of *Stichopus monotuberculatus* (Quoy & Gaimard, 1833) (see Massin, 1996b) present also many similarities with those of *S. quadrifasciatus*. Both species are separated by their colour pattern, by their calcareous ring (no posterior projections on the radial pieces of *S. monotubercualtus*; see Cherbonnier, 1952b; Massin, 1996b) and by the size of the large tables in the dorsal papillae (70 µm versus 100 µm across).

All the other *Stichopus* spp. of tropical Indo-Pacific waters are very different by their colour, the presence of tack-like tables, and the absence of rosettes, C-shaped rods or spiny perforated plates (see Lampert, 1885; Erwe, 1913; H.L. Clark, 1922, 1938; Cherbonnier, 1967, 1980; Liao, 1980).

Stichopus vastus Sluiter,1887
(figs 57a-l, 58a-m, 59a-g, 60a-d, 61, 112d, e)

Stichopus vastus Sluiter, 1887: 198, pl.2 figs 46-48; Sluiter, 1895: 79; Rowe & Gates, 1995: 326.
Stichopus spec.; Allen & Steene, 1994: 246; Colin & Arneson, 1995: 262, fig. 1242; Gosliner et al., 1996: 282, fig. 1039.
Stichopus "variegatus"; Colin & Arneson, 1995: 262, fig. 1240.

Material.— RMNH Ech. 6089, (1 specimen), Panikiang S, 30.viii.94, reef flat; IRSNB IG.28251/54, (1 specimen), Samalona W, 2.ix.94, 11 m depth.

Description.— Specimens 190 × 55 and 310 × 100 mm, yellow or green with numerous brown lines dorsally (figs 112d, e) and brown with yellow-orange interambulacra ventrally; most of the brown lines transversal, discountinuous, encircling the base of the large papillae; in alcohol nearly white, only a few faded brown lines still visible. Ventral sole flat with tube feet along the ambulacra; 4-5 rows of tube feet in

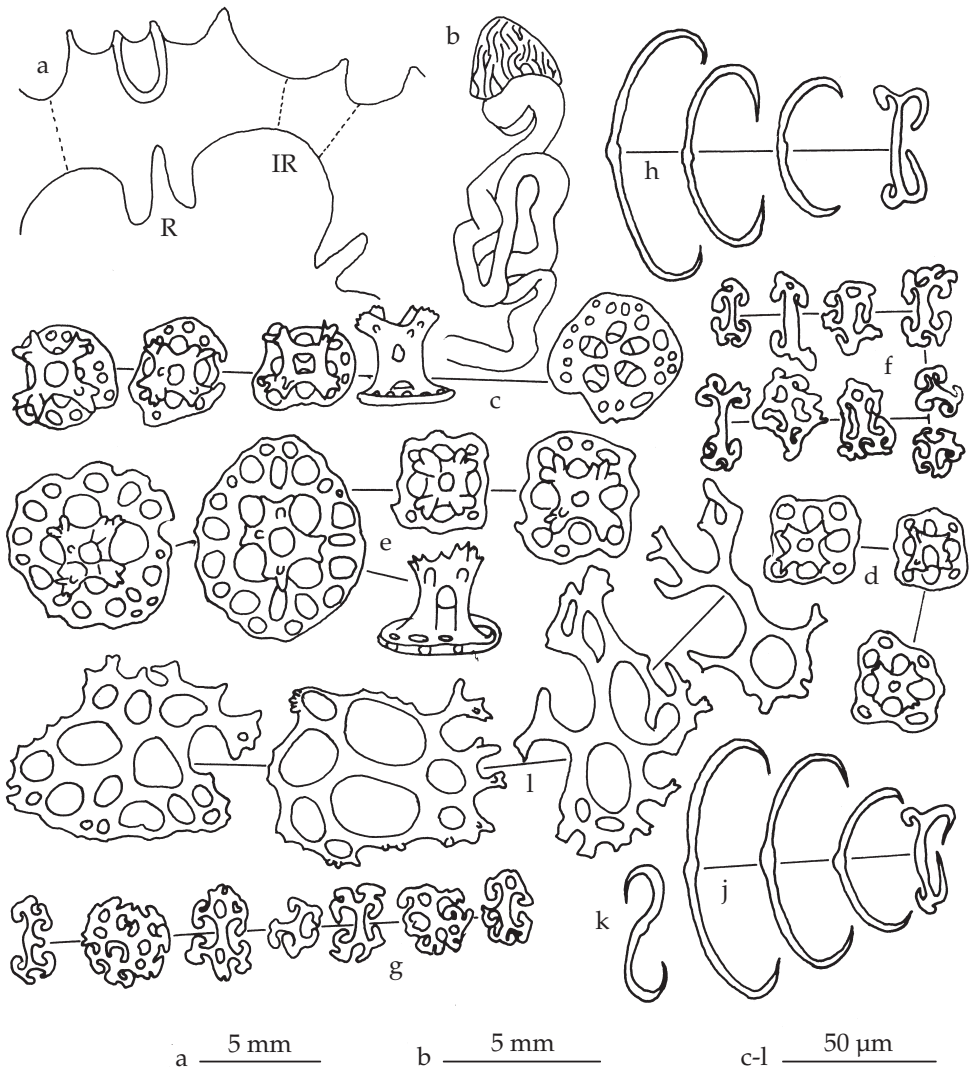


Fig. 57. *Stichopus vastus* Sluiter, 1887. a: calcareous ring (IR: interradial piece; R: radial piece) (L=190 mm; RMNH Ech. 6089); b: stone canal and madreporic plate (L=190 mm; RMNH Ech. 6089); c: tables from dorsal body wall (L=190 mm; RMNH Ech. 6089); d: tables from ventral body wall (L=190 mm; RMNH Ech. 6089); e: tables of dorsal body wall (L=310 mm; IRSNB IG.28251/54); f: rosettes from dorsal body wall (L=190 mm; RMNH Ech. 6089); g: rosettes from ventral body wall (L=190 mm; RMNH Ech. 6089); h: C-shaped rods from dorsal body wall (L=190 mm; RMNH Ech. 6089); j: C-shaped rods from ventral body wall (L=190 mm; RMNH Ech. 6089; k: S-shaped rods from ventral body wall (L=310 mm; IRSNB IG.28251/54); l: perforated plates from dorsal body wall (L=310 mm; IRSNB IG.28251/54).

the lateral ambulacra and 6-10 rows in the central one; the larger the specimen the higher the number of rows of tube feet; interambulacra narrow. Dorsal surface clearly separate from the ventral sole. Large dorsal papillae more or less aligned in 5-6 rows with 6-9 papillae in each row. Small papillae not aligned. Body cylindrical to quadrangular with mouth ventral and anus terminal. Tentacles partially withdrawn; 15 visible on the small specimen; however, according to their arrangement, most probably 20; preserved large specimen in poor condition, disintegrating when manipulated. Skin thick (10 mm), smooth, fragile, easily damaged when the specimen was collected.

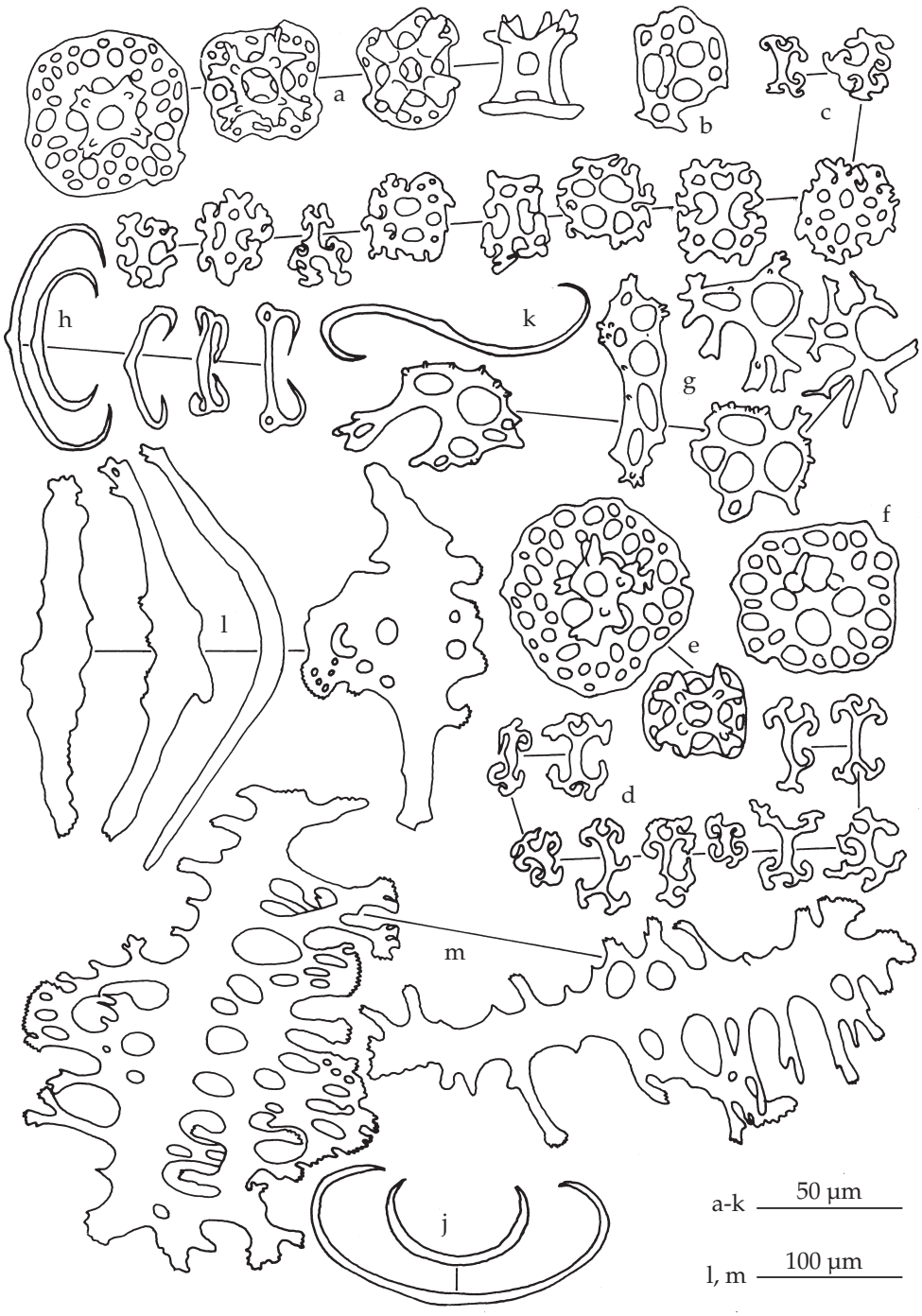
Calcareous ring composed of very large radial and narrow interradial pieces (fig. 57a); radial pieces with 2 posterior projections (more developed on the dorsal pieces) (fig. 57a) and anteriorly one central notch and 2 lateral sharp teeth (fig. 57a). One Polian vesicle (11 % of body length) and one very long, contorted stone canal (fig. 57b) going upwards, embedded in the dorsal mesentery and ending in a large madreporic plate (fig. 57b). Internal anatomy difficult to study without destroying the poorly preserved specimens.

Ossicles of body wall tables, rosettes and C-shaped rods. Tables very numerous, with discs 25-40 µm in diameter dorsally and ventrally in the small specimen (figs 57c, d); in the large specimen tables larger (25-65 µm across) dorsally (fig. 57e); edge of the disc regular to undulating; disc perforated by 4 large central holes and 4-22 peripheral holes; 4 pillars forming the spire united by one cross beam and ending in a crown of spines looking like a Maltese cross when seen from above (figs 57c-e). Rosettes 17-35 µm long (figs 57f, g); some transformed into perforated plates (figs 57f, g). C-shaped rods 40-85 µm long in the small specimen (fig. 57h) and 30-60 µm long in the large specimen (fig. 57j); a few irregular ones (figs 57h, j); exceptionally S-shaped rods (fig. 57k).

In the dorsal body wall of the large specimen a few spiny perforated plates (fig. 57l).

In the dorsal papillae tables, rosettes, rods with a central perforated process, C- and S-shaped rods. Tables very numerous, similar to those of the body wall but larger: 30-70 µm across (figs 58a, e); sometimes pillars of the tables with a spine half-way; a few tables reduced to the disc (figs 58b, f). Rosettes numerous, 19-38 µm long (figs 58c, d); in the small specimen some transformed into small perforated plates (fig. 58g); C-shaped rods 35-80 µm long (figs 58h, j); S-shaped rods (fig. 58k) very rare. Rods (with central perforated process) 250-360 µm long (fig. 58l) in the small specimen, 340-390 µm (fig. 58m) in the large specimen; rods located at the tip of the papillae, parallel to each other and perpendicular to main axis of papilla; rod morphology much more complex in the large specimen than in the small one. Tables, rosettes, C- and S-shaped rods in an outer layer of ossicles, rods with central perforated process in an inner layer of ossicles.

In the tube feet tables, perforated plates and spiny rods with an enlarged central process. Table discs 23-47 µm in diameter (figs 59a, b), many with pillars reduced to knobs (fig. 59a). Perforated plate 190-300 µm long (figs 59c, d); holes fewer and larger in the large specimen (fig. 59d); rods with enlarged central perforated process 280-325 µm long in the small specimen (fig. 59e) and 390-445 µm in the large specimen (fig. 59f); moreover, rods of the large specimen more ragged and complex than those of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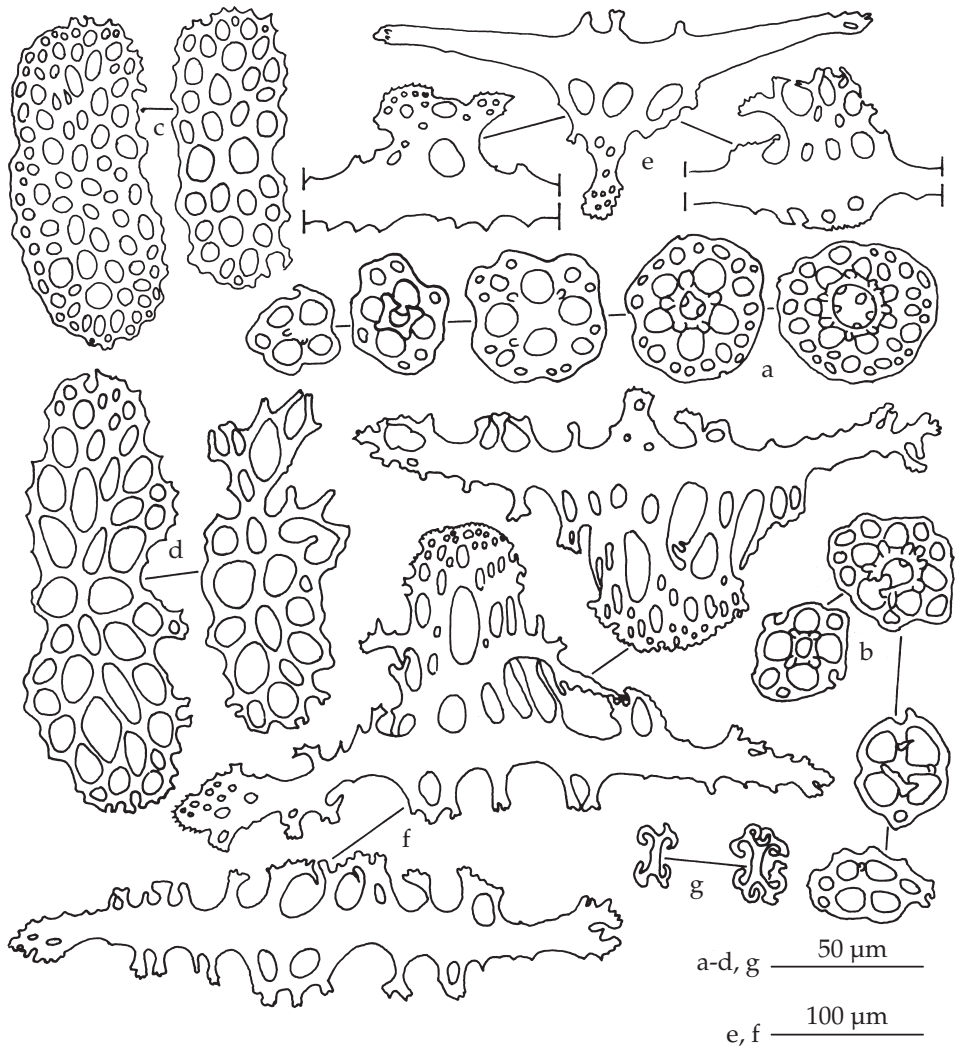


Fig. 59. *Stichopus vastus* Sluiter, 1887. a: tube foot tables (L=190 mm; RMNH Ech. 6089); b: tube foot tables (L=310 mm; IRSNB IG.28251/54); c: perforated plates from tube feet (L=190 mm; RMNH Ech. 6089); d: perforated plates from tube feet (L=310 mm; IRSNB IG.28251/54); e: tube foot rods (L=190 mm; RMNH Ech. 6089); f: tube foot rods (L=310 mm; IRSNB IG.28251/54); g: tube foot rosettes (L=310 mm; IRSNB IG.28251/54).

Fig. 58. *Stichopus vastus* Sluiter, 1887. a: tables from dorsal papillae (L=190 mm; RMNH Ech. 6089); b: reduced table from dorsal papillae; c: rosettes from dorsal papillae (L=390 mm; RMNH Ech. 6089); d: rosettes from dorsal papillae (L=310 mm; IRSNB IG.28251/54); e: tables from dorsal papillae (L=310 mm; IRSNB IG.28251/54); f: reduced table from dorsal papillae (L=310 mm; IRSNB IG.28251/54); g: perforated plates from dorsal papillae (L=190 mm); h: C-shaped rods from dorsal papillae (L=190 mm; RMNH Ech. 6089); j: C-shaped rods from dorsal papillae (L=310 mm; IRSNB IG.28251/54); k: S-shaped rod from dorsal papillae (L=190 mm; RMNH Ech. 6089); l: apical rods from dorsal papillae (L=190 mm; RMNH Ech. 6089); m: apical rods from dorsal papillae (L=310 mm; IRSNB IG.28251/54).

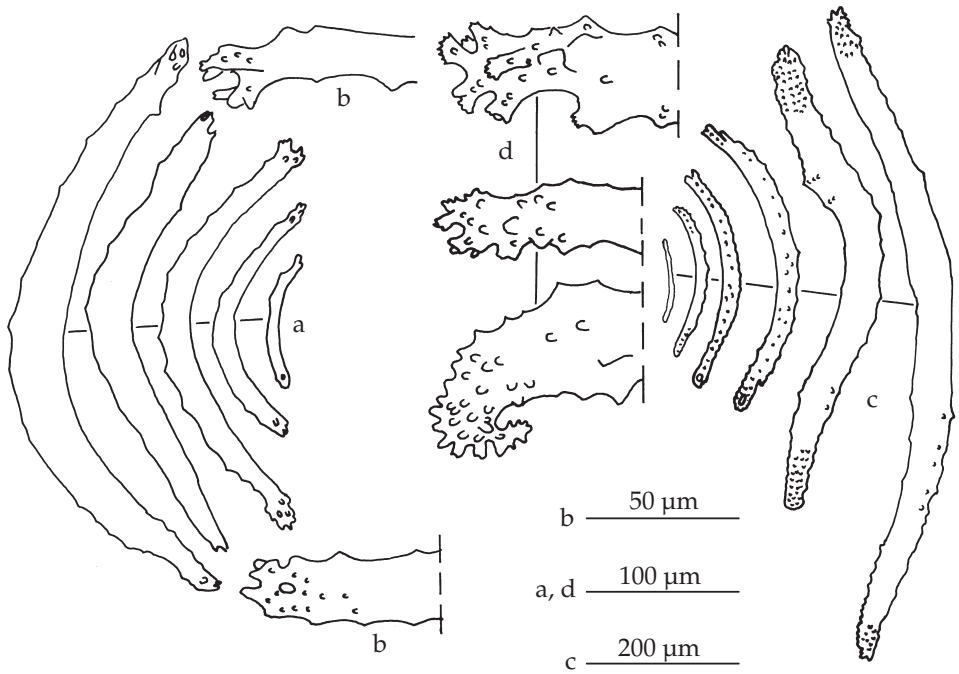


Fig. 60. *Stichopus vastus* Sluiter, 1887. a & b: tentacle rods (L=190 mm; RMNH Ech. 6089); c & d: tentacle rods (L=310 mm; IRSNB IG.28251/54).

the small specimen; exceptionally rosettes (fig. 59g) and C-shaped rods in the tube feet of the large specimen; end plates 330-380 µm across in the small specimen and 650 µm in the large specimen.

In the tentacles curved spiny rods, 90-425 µm long in the small specimen (figs 60a, b) and 100-1000 µm in the large specimen (fig. 60c); extremities of the rods particularly spiny (fig. 60d).

Geographic distribution (fig. 61).— Indonesia (**Java** = type locality, Sulawesi), Papua New Guinea, Palau Islands, Micronesia, Australia (GBR, NE coast, QLD)

Remarks.— *Stichopus vastus* has a unique colour pattern which has already been illustrated several times in field guides (Allen & Steene, 1994; Colin & Arneson, 1995;

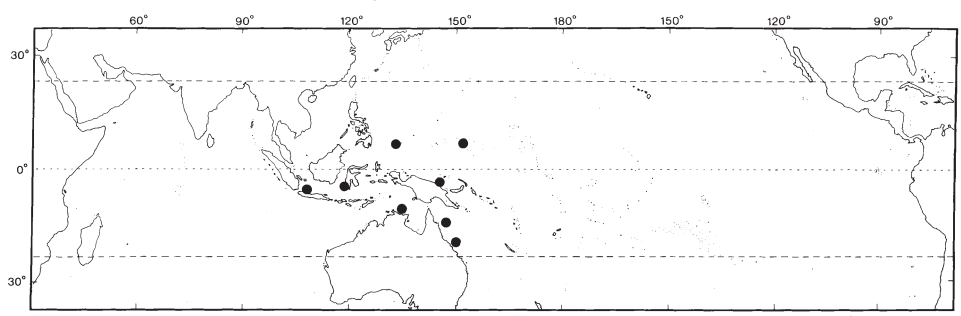


Fig. 61. Distribution of *Stichopus vastus* Sluiter, 1887.

Gosliner et al., 1996). It presents some variation in the background colour and the density of the brown lines. Moreover, the larger the specimen the larger some ossicle types: tables of the dorsal body wall, rods of the tube feet, end plate of the tube feet and tentacle rods. By its ossicles and calcareous ring, *S. vastus* is close to *S. herrmanni*.

Genus *Thelenota* H.L. Clark, 1921
Thelenota ananas (Jaeger, 1833)
(figs 62, 112f)

Trepang ananas Jaeger, 1833: 24, pl. 3 fig. 1.

Thelenota ananas ; H.L. Clark, 1921: 184, pl. 18 fig. 2; Dawydoff, 1952: 117; Endean, 1957: 252; James, 1969: 60; Meyer-Rochow, 1977: 582; Levin, 1979: 22; Liao, 1980: 116; Tan Tiu, 1981: 64, pl. 6 figs 1-2; Grosenbaugh, 1981: 51;Humphreys, 1981: 36; Conand, 1981: 523, figs 1a-a'; Mukhopadhyay & Samanta, 1983: 312; Liao, 1984: 222; A.M. Clark, 1984: 99; Cherbonnier & Féral, 1984b: 829, fig. 62A-S (synonymy and records before 1979); Brouns & Heijs, 1985: 175; Price & Reid, 1985: 6; Richard, 1985: 457; Reyes-Leonardo et al., 1985: 267, pl. 2 fig. 4a-c; Féral & Cherbonnier, 1986: 100; Cannon & Silver, 1986: 28, figs 2a, 7i; Marsh, 1986: 74; George & George, 1987: 246, pl. 12a; Conand, 1989: 31; Jangoux et al., 1989: 163; Chao & Chang, 1989: 116, figs 10, 29E; James, 1989: 130, fig. 28; Chambers, 1989: 89; Zoutendijk, 1989: 2; Levin & Dao Tan Ho, 1989: 57; Kalashnikov, 1989: 70, fig. 6; Marsh et al., 1993: 64; Dalzeel et al. 1993: 27; Kerr, 1994: 171; Allen & Steene, 1994: 246; Marsh, 1994a: 11; Holland, 1994: 2; Fransen, 1994: 123; James, 1994: 28; James & James, 1994: 14, fig. 8; James & Manikfan, 1994: 102, pl. 1A; Sant, 1995: 27; Colin & Arneson, 1995: 263, fig. 1244; Rowe & Gates, 1995: 326; Liao & A.M. Clark, 1995: 469, fig. 282a-b; Gosliner et al., 1996: 282, fig. 1040; Conand & Tuwo, 1996: 18; Belhadjali, 1997: 3; Liao, 1997: 157, fig. 91a-b; Rowe & Richmond, 1997: 306; Baine & Forbes, 1998: 4.

Thelenota anax; Ballard, 1981: 18, fig. 4.

Prickly redfish (= *Thelenota ananas*); Anon., 1996: 13

Material.— Samalona SE, 16.ix.94, a single specimen, about 50 cm long, observed at 20 m depth (fig. 112f).

Geographic distribution (fig. 62).— Kenya, Madagascar, South Africa (Natal), Seychelles (Aldabra), Mauritius, Maldive Islands, India (Laccadive Islands), Cocos Keeling Islands, Indonesia (Sumatra, Java, Sumba, **Sulawesi** = type locality, Banda Islands, Irian Jaya), Malaysia (Tioman, Sabah), Australia (WA, NT, QLD, NSW), Philippines, Vietnam, Taiwan, China, Japan, Mariana Islands (Guam), Palau Islands, Caroline Islands (Kosrae, Yap), Papua New Guinea (Madang Province, New Ireland),

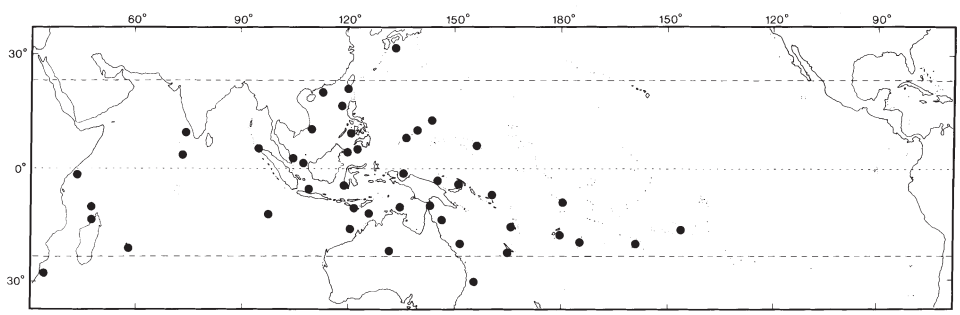


Fig. 62. Distribution of *Thelenota ananas* (Jaeger, 1833).

Solomon Islands, New Caledonia, Niue, Vanuatu (= New Hebrides), Fiji, Tonga, Ellice Islands (Tuvalu), Cook Islands, French Polynesia.

Remarks.— No specimen of this unmistakable and large species was collected in the Spermonde Archipelago. *Thelenota ananas* is normally very abundant from the surface to 30 m depth. The species, being highly prized as trepang, and overexploited by local fishermen, is now rare in the Spermonde Archipelago.

Thelenota anax H.L. Clark, 1921
(figs 63a-k, 64)

Thelenota anax Clark, 1921: 185, pl. 18 fig. 3; Liao, 1975: 205, fig. 6 (1-10); Lamberson, 1978: 115, figs 1-4; Levin, 1979: 22; Cherbonnier, 1979: 9, fig. 5A-N; Liao, 1980: 116; Liao, 1984: 222, 243; Brouns & Heijs, 1985: 175; Féral & Cherbonnier, 1986: 100, figs 39, 40O; Cannon & Silver, 1986: 28; Marsh, 1986: 74; Thandar, 1987: 262; Cherbonnier, 1988: 156, fig. 64A-L (synonymy and records before 1975); Conand, 1989: 31; Massin & Lane, 1991: 57; Lane, 1992: 176; Marsh et al., 1993: 64; Allen & Steene, 1994: 246; Holland, 1994: 2; James & Manikfan, 1994: 103; Sant, 1995: 27; Colin & Arneson, 1995: 263, fig. 1245; Rowe & Gates, 1995: 327; Liao & A.M. Clark, 1995: 470, fig. 283a-d; Gosliner et al., 1996: 282, fig. 1041; Conand & Tuwo, 1996: 18; Liao, 1997: 158, fig. 92a-d; Rowe & Richmond, 1997: 306.

Stichopus spec. George & George, 1987: 246, pl. 12b.

Stichopus variegatus; A.M. Clark, 1984: 88, fig. 2.

Material.— IRSNB IG.28251/183 (1 specimen), Kudingareng Keke S, 28.ix.94, 6 m depth.

Description.— Specimen 206 × 50 mm, greyish-cream with numerous reddish spots and on each side a more or less continuous reddish line located in a groove; in alcohol uniformly grey-white. Body quadrangular, mouth ventral, anus subdorsal. Ventral sole covered by numerous, densely crowded tube feet. Border of ventral sole clearly marked by a row of large papillae, some of which fused; papillae scattered over the whole dorsal surface. Skin very thick (15 mm).

Calcareous ring well developed but relatively small for such a large species; radial pieces large with 2 posterior points (fig. 63a), especially well marked on the dorsal ones; interradial pieces half the width of the radial ones and with a short anterior tooth. One very short and contorted stone canal ending in a large, cylindrical madreporic plate (fig. 63b). Three Polian vesicles; tentacle ampullae 20-25 mm long.

Ossicles of the body wall dichotomously branched rods (fig. 63c), pseudotables 50-60 µm high (fig. 63d) and countless small rounded miliary granules 1.5-4 µm across (fig. 63e). In the tube feet rods (fig. 63f) and dichotomously branched rods (fig. 63g) smaller than in the body wall and some perforated plates (fig. 63h); end plate 460-530 µm across. In the tentacles spiny perforated plates (fig. 63j) derived from dichotomously branched rods (fig. 63k), 50-100 µm long in the tips of the tentacles and up to 130 µm long in the shafts.

Geographic distribution (fig. 64).— Madagascar (Glorious Islands), Seychelles (Mahé), Maldive Islands, Malaysia (Shaba), Indonesia (Sulawesi), Australia (WA, NT, **Torres Strait** = type locality, QLD), China, Japan (Ryukyu Islands), Palau Islands, Mariana Islands (Guam), Marshall Islands (Enewetok), Papua New Guinea, Solomon Islands, New Caledonia, Fiji, Society Island (Moorea).

Remarks.— *Thelenota anax* has a characteristic, very consistent colour and body

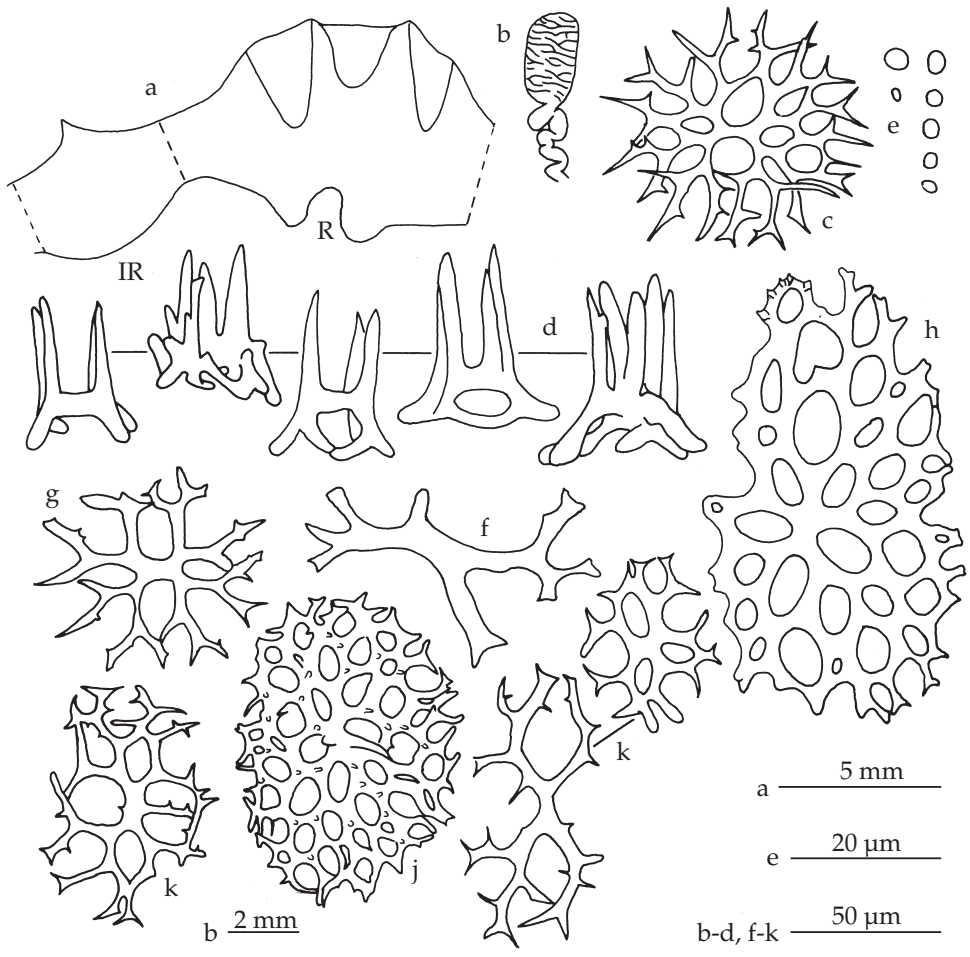


Fig. 63. *Thelenota anax* H.L. Clark, 1921. a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: branched rods from body wall; d: body wall pseudo-tables; e: miliary granules from body wall; f: tube foot rods; g: branched rods from tube feet; h: perforated plate from tube feet; j: perforated plate from tentacles; k: branched rods from tentacles.

form throughout its distribution range. Some characters of its internal anatomy and ossicles show more variation. The number of Polian vesicles varies from 30 (Cherbonnier, 1988) to 6 (Cherbonnier & Féral, 1984a) or even 3 (present study). Apparently pseudo-tables are not always present; they have been mentioned by Yulin (1975), Lamberson (1978) and in the present study, but not by Cherbonnier (1979, 1988) and Cherbonnier & Féral (1984b).

This is the first reliable record for Indonesia. Conand & Tuwo (1996) previously observed the species on the market of Ujung Pandang (Sulawesi). However, most of the holothurians sold as trepang in the Sulawesi are fished in remote areas, often close to or in Australian waters.

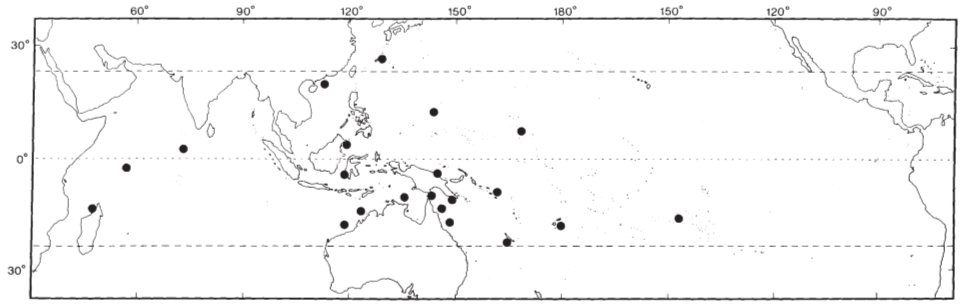


Fig. 64. Distribution of *Thelenota anax* H.L. Clark, 1921.

Order Dendrochirotida Grube, 1840
Family Cucumariidae Ludwig, 1894
Subfamily Colochirinae Panning, 1949
Genus *Colochirus* Troschel, 1846
Colochirus robustus Oestergren, 1898
(figs 65a-g, 66a-f, 67, 112g)

Colochirus robustus Oestergren, 1898b: 134; Ekman, 1918: 14, pl. 3 figs 8-9; Rowe & Gates, 1995: 273; Gosliner et al., 1996: 283, fig. 1043.

Pentacta robusta; H.L. Clark, 1946: 393; A.M. Clark & Rowe, 1971: 180; Panning, 1971: 39, fig. 4a-n; James, 1984: 112; Cannon & Silver, 1986: 30.

Colochirus luteus Sluiter, 1901: 100, pl. 2 fig. 6, pl. 7 fig. 2.

Colochirus squamatus Sluiter, 1901: 101, pl. 8 fig. 3.

Colochirus robustoides Ekman, 1918: 18, pl. 1 figs 5-6, pl. 3 figs 10-12.

Material.— IRSNB IG.28251/271 (10 specimens) and RMNH Ech. 6067 (11 specimens), Barang Lompo, 24.xi.95, 20-25 m depth, on algae and hydroids (collected by B.W. Hoeksema).

Description.— Specimens varying in size from 22 × 7 to 37 × 12 mm, uniformly bright yellow (fig. 112g); in alcohol uniformly beige. Body wall rough to the touch, rigid, leathery, quadrangular in section. Ventral sole with tube feet only along the ambulacra (fig. 65b); 2-4 rows of tube feet in the lateral ambulacra and 3-5 rows in the central one. Interambulacral areas narrow; contracted tube feet deep in a hollow, in extended state long and slender, ending in a large sucker. Dorsally 4 rows (2 lateral and 2 dorsal) of 5-18 prominent, rigid tapering papillae, 1-10 mm long (figs 65a, 113f); some of them in pairs, sometimes with a common base. Number of papillae increasing with increasing body length: 33 $\pm$ 6.9 (n = 6) for 22-25 mm long specimens, 46 $\pm$ 5.3 (n = 7) for 28-32 mm long specimens and 55 $\pm$ 7.5 (n = 8) for 33-37 mm long specimens. Mouth terminal closed by 5 triangular plates; anus dorsal surrounded by 5 large papillae and lined by rounded plates.

Tentacles 10 with the 2 ventral ones smaller. Calcareous ring narrow, without posterior projections (fig. 65c); radial and interradial pieces of the same width; radial ones with a large anterior tooth notched at the apex; posterior edge of the calcareous ring strongly undulating. One short dorsal stone canal going upwards, ending in a

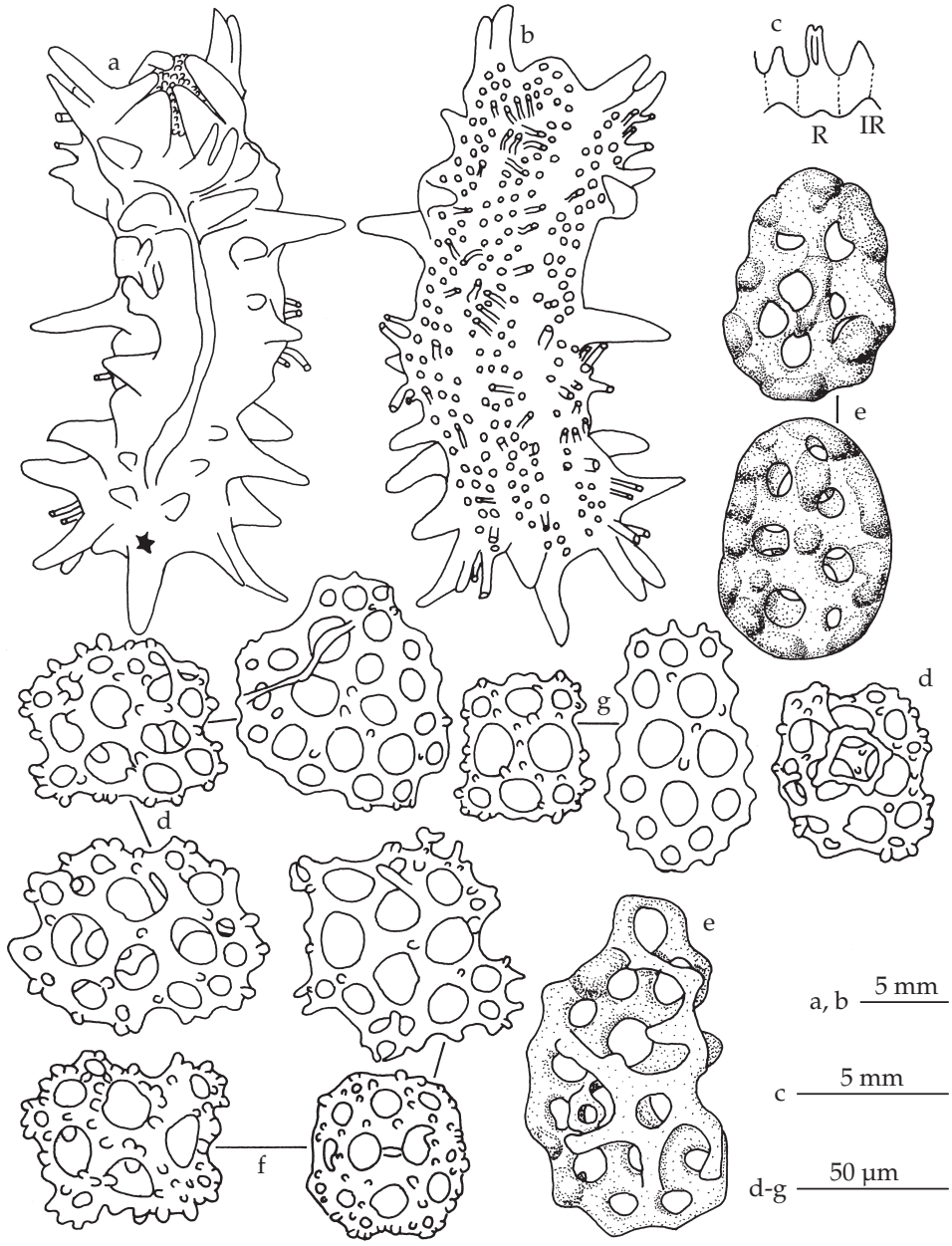


Fig. 65. *Colochirus robustus* Oestergren, 1898. a: general dorsal view; b: general ventral view; c: calcareous ring (IR: interradial piece; R: radial piece); d: incomplete sphere from body wall; e: knobbed perforated plates from body wall; f: flat cups from dorsal body wall; g: flat cups from ventral body wall.

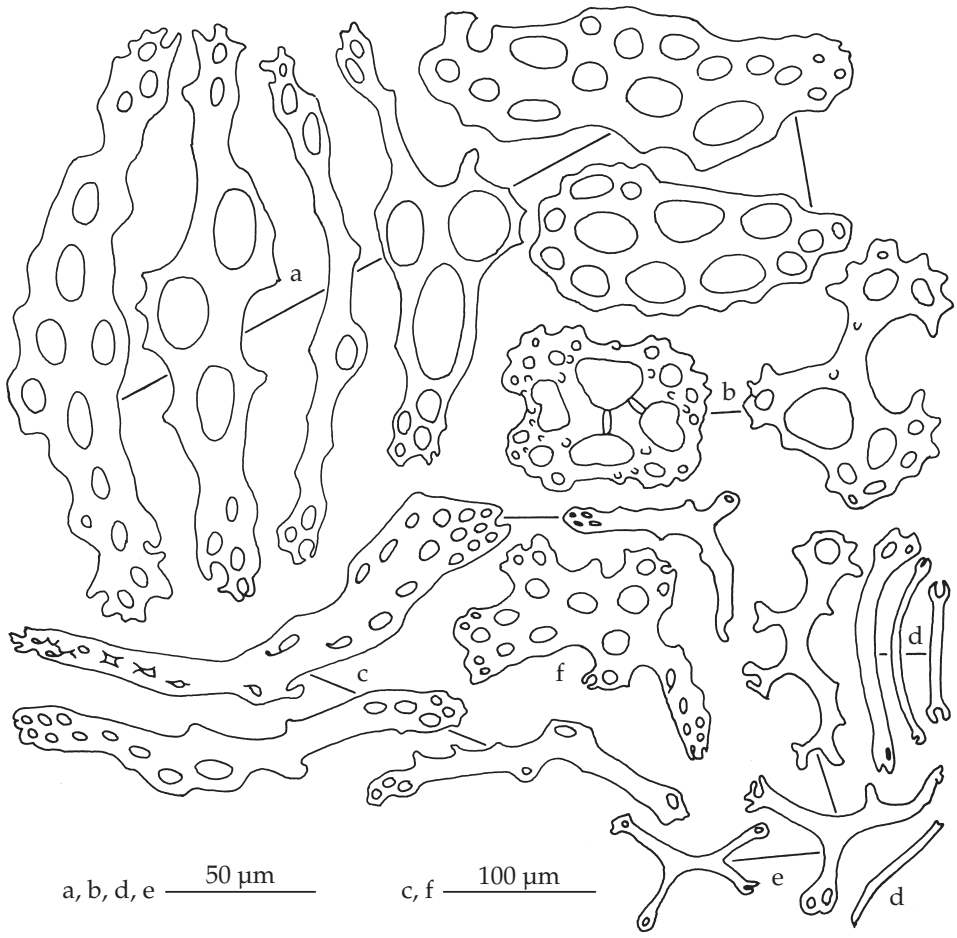


Fig. 66. *Colochirus robustus* Oestergren, 1898. a: perforated rods from tube feet; b: flat cups from tube feet; c: perforated rods from tentacles; d: small rods from tentacles; e: irregular rods from tentacles; f: perforated rod from tentacles.

narrow elongate madreporic plate; 2 ventral Polian vesicles: one large and one very short; retractor muscles of the pharynx attached at the anterior third of the body. Gonad well developed, forming a bundle of undivided tubules running parallel to each other.

Body wall ossicles thick reticulated bodies, incomplete spheres and flat, knobbed, squarish cups. Thick reticulated bodies ovoid or rounded, present dorsally and ventrally; ventrally up to 650 × 400 µm, dorsally up to 450 × 200 µm and 750 × 600 µm in the dorsal papillae. Incomplete spheres derived from perforated plates, flat cups (fig. 65d) or some kind of knobbed perforated plates (fig. 65e); incomplete spheres more abundant ventrally than dorsally, rare in the dorsal papillae. Flat knobbed cups 50-100 µm across, more nodulous dorsally (fig. 65f) than ventrally (fig. 65g); numerous in the dorsal papillae.

Tube feet with an end plate 300-350 µm across, perforated rods (fig. 66a) 100-200 µm long, and irregular flat knobbed cups (65-90 µm) (fig. 66b). In the tentacles, perforated rods (figs 66c, d) 45-400 µm long (smallest ones perforated only at the extremities, fig. 66d), small irregular rods (fig. 66e) and exceptionally enlarged rods looking like perforated plates (fig. 66f).

Geographic distribution (fig. 67).— **Korea Straits** = type locality, Philippines, Palau (=Belau) Islands, Indonesia (Sulawesi, Tukang Besi, Flores, Timor), Australia (NW oceanic, WA up to Cape Jaubert).

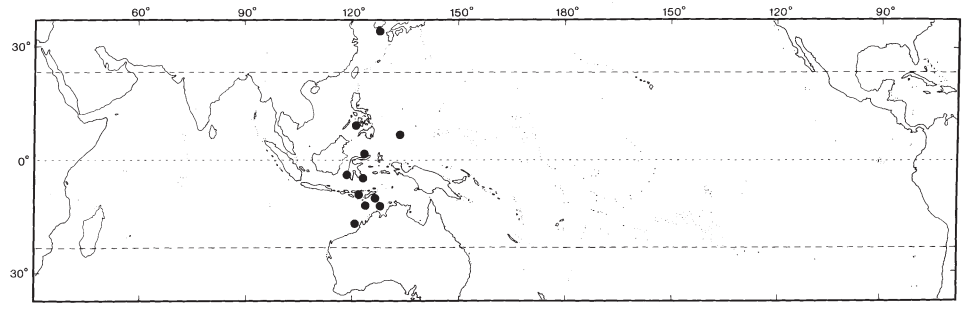


Fig. 67. Distribution of *Colochirus robustus* Oestergren, 1898.

Remarks.— *Colochirus robustus* Oestergren, 1898, *C. quadrangularis* Troschel, 1846 and *C. crassus* Ekman, 1918 are closely related species which have been often confused. According to Rowe (personal communication) *C. robustus* can be distinguished by its squarish, knobbed flat cups. The other two species have asymmetric flat cups, denticulated at one extremity, and with a smooth (*C. quadrangularis*) or slightly knobbed (*C. crassus*) surface. Moreover, *C. robustus* has fenestrated spheres more robust than in the two other species.

Colochirus robustus is obviously a variable species. Rowe & Gates (1995) consider that *Colochirus squamatus* Sluiter, 1901, *C. luteus* Sluiter, 1901 and *C. robustoides* Ekman, 1918 are conspecific with it. Even so, *C. robustus* has a restricted geographical range (fig. 67).

Colochirus robustus has been listed once in a paper dealing with echinoderms from Indian Seas (James, 1984). However, I have not succeeded tracing any primary source supporting this record.

Genus *Plesiocolochirus* Cherbonnier, 1946
Plesiocolochirus australis (Ludwig, 1875)
(figs 68a-k, 69a-j, 70, 112h)

Colochirus australis Ludwig, 1875: 88, pl. 6 fig. 15a-c; Bell, 1884a: 506; Bell, 1884b: 148; Lampert, 1885: 123; Théel, 1886: 83, 122, pl. 6 fig. 6, pl.14 figs 5-6; Sluiter, 1887: 205, pl. 8 figs 20-22; Lampert, 1889a: 304; Lampert, 1889b: 819; H.L. Clark, 1909: 561; Panning, 1949: 441, figs 39-40.

Pentacta australis; H.L. Clark, 1938: 445; H.L. Clark, 1946: 392; Endean, 1957: 251; Endean, 1965: 234; A.M. Clark & Rowe, 1971: 180; Cherbonnier & Féral, 1984b: 833, fig 20A-K; Féral & Cherbonnier, 1986: 100, figs 39, 40Q; Cannon & Silver, 1986: 30; Jangoux et al., 1989: 163.

Plesiocolochirus australis; Rowe & Gates, 1995: 278 (synonymy).

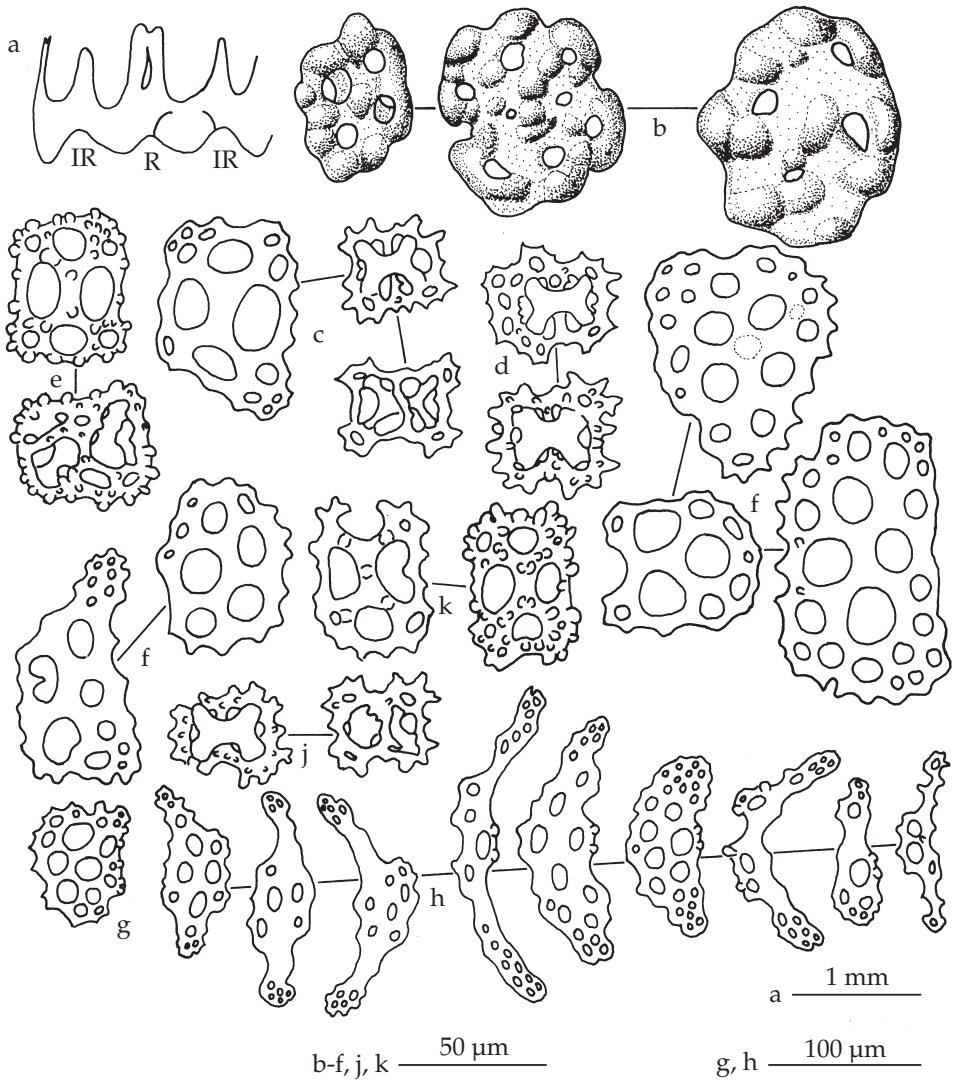


Fig. 68. *Plesiocolochirus australis* (Ludwig, 1875). a: calcareous ring (IR: interradial piece; R: radial piece); b: nodulous perforated plates from body wall; c: spinose baskets from body wall: d: spinose/nodulous baskets from body wall; e: nodulous baskets from body wall; f & g: perforated plates from tube feet; h: rod like perforated plates from tube feet; j: spiny baskets from tube feet; k: nodulous baskets from tube feet.

Pentacta minuta Ludwig, 1875: 89, pl. 6 fig. 16a-c.
Colochirus doliolum; Erwe, 1913: 351, pl. 5 fig. 1; Ekman, 1918: 29, pl. 2 figs 2-3, pl. 3 figs 20-22, pl. 4 figs 23-24.

Material.— IRSNB IG.28251/141 (92 specimens) and RMNH Ech. 6068 (30 specimens), Samalona NW, 21.ix.94, 5 m depth on a *Clavularia* spec. growing on a dead branch of *Acropora* spec. (collected by C.H.J.M. Fransen); IRSNB IG.28251/144B (9 specimens), Samalona NW, 21.ix.94, 5 m depth; IRSNB

IG.28251/272 (8 specimens) and RMNH Ech. 6069 (5 specimens), Gusung, 31.v.94, 3 m depth among *Halimeda* spec. (collected by B.W. Hoeksema).

Description.— Specimens ranging in size from 4 × 2.3 to 15 × 2.7 mm; widest specimen 3.7 mm across. Colour varying from dark brown to beige dorsally, lighter ventrally; tentacle shafts speckled with brown, tentacle tips speckled with yellow (fig. 112h); in alcohol light brown to beige dorsally, white ventrally, tentacles shafts speckled with brown, tentacle tips white. Body quadrangular, narrower posteriorly than anteriorly. Mouth terminal, closed by 5 large triangular flaps; anus terminal, surrounded by 5 triangular teeth. Tentacles 10, the 2 ventral ones smaller. Tube feet only along the ambulacra; in 2 rows, much more crowded ventrally than dorsally; the ventral rows shorter, starting behind the mouth at 1/5 of body length. Skin rigid.

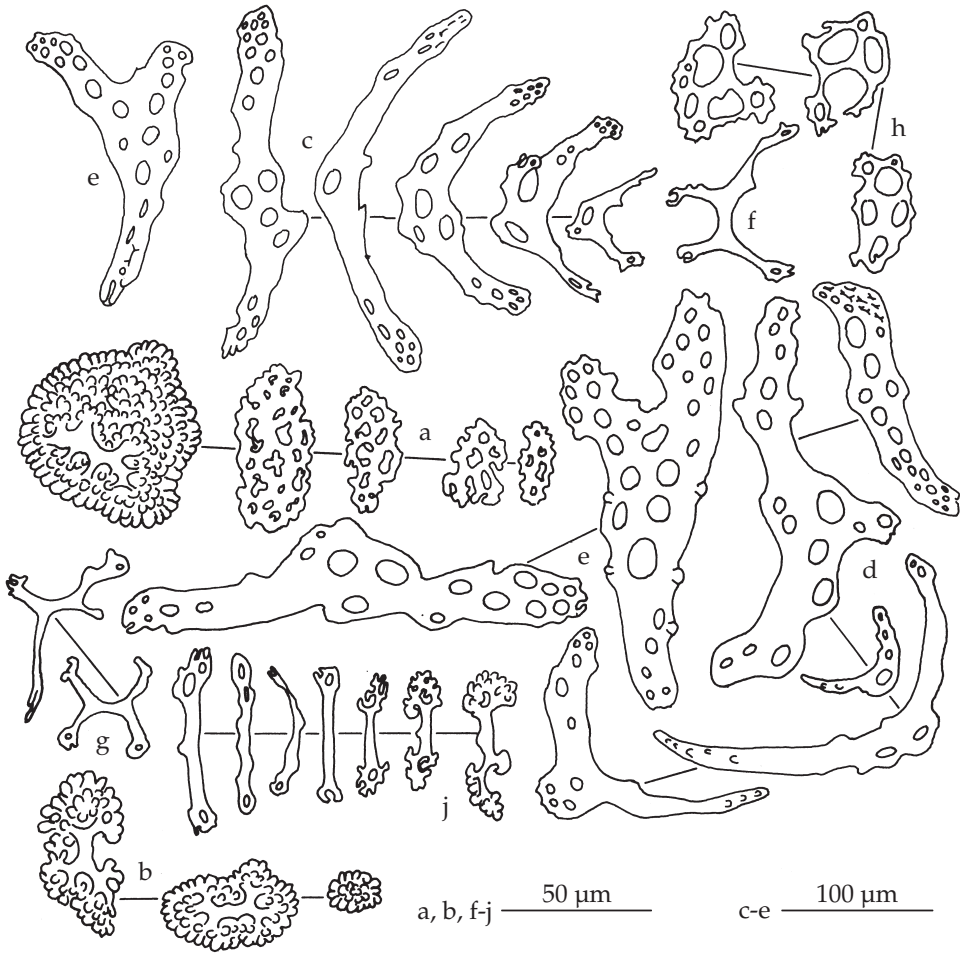


Fig. 69. *Plesiocolochirus australis* (Ludwig, 1875). Ossicles from tentacles. a & b: rosettes; c & d: large perforated rods; e: arrowhead perforated plates; f & g: X-shaped rods; h: small perforated plates; j: small perforated rods, some rosette-like.

Calcareous ring stout, without posterior projections but with an undulating posterior edge (fig. 68a); radial and interradial pieces of the same length with a strong anterior triangular tooth; radial pieces with a notch at the tip of the tooth (fig. 68a). Retractor muscles of the pharynx attached at half-way the body length. One large Polian vesicle and one contorted stone canal going upwards up to the calcareous ring and ending in an hemispherical mareporic plate.

Ossicles of body wall nodulous or spiny baskets, small nodulous perforated plates and large oval or conical, multilayered, knobbed plates. Multilayered plates 150-950 µm long, whatever body length. Small nodulous perforated plates 40-100 µm long (fig. 68b); the larger the specimen, the more numerous these nodulous perforated plates. Baskets highly variable, 30-55 µm long, spinose (fig. 68c), spinose/nodulous (fig. 68d) or nodulous (fig. 68e); central part with a cross only (fig. 68e) or with a bar perpendicular to the cross (fig. 68d); the different kinds of baskets not linked to body size. In the tube feet perforated plates, round or elongate (figs 68f, g), and some, nearly rod-like (fig. 68h), spiny (fig. 68j) or nodulous (fig. 68k) baskets; end plates 160-210 µm across. In the tentacles numerous rosettes 15-70 µm across (figs 69a, b), perforated rods 85-315 µm long (figs 69c, d, j), arrowhead perforated plates, 180-280 µm long (fig. 69e), X-shaped rods, 30-50 µm (figs 69f, g) and small perforated plates, 40-45 µm long (fig. 69h).

Geographic distribution (fig. 70).— Indonesia (Java Sea, Sulawesi, Sumba), Australia (WA, NT, QLD, **Bowen =** type locality, NSW), New Caledonia.

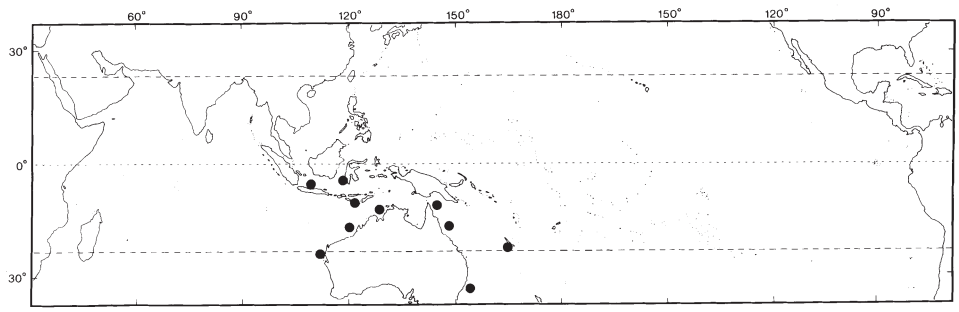


Fig. 70. Distribution of *Plesiocolochirus australis* (Ludwig, 1875).

Remarks.— The external aspect of all the specimens is similar. However, the baskets show considerable variation: they can be spinose with a bar perpendicular to the central X-shaped rods, or nodulous without this bar. These two types of basket correspond to the main difference previously used to separate *Plesiocolochirus australis* and *P. minutus* (Ludwig, 1875) (see Panning, 1949). Since these two types of basket are present in a single population (IRSNB IG.28251/141), I agree with Rowe & Gates (1995) that *P. minutus* is conspecific with *P. australis*.

Plesiocolochirus cf. *australis* (Ludwig, 1875)
(Fig. 71a-n)

Material.— IRSNB IG.28251/68 (1 specimen), Kudingareng Keke SW, 5.ix.94, 12 m depth.

Description.— Specimen 25 × 6 mm. Colour in alcohol brown dorsally and white-beige ventrally; base of the tentacles speckled with brown-black, tips with white. Body quadrangular with mouth and anus terminal. Five large triangular flaps around the mouth; 5 small calcareous teeth around the anus. Tentacles 10, with the 2 ventral ones smaller. Two rows of tube feet along each ambulacrum; tube feet more crowded

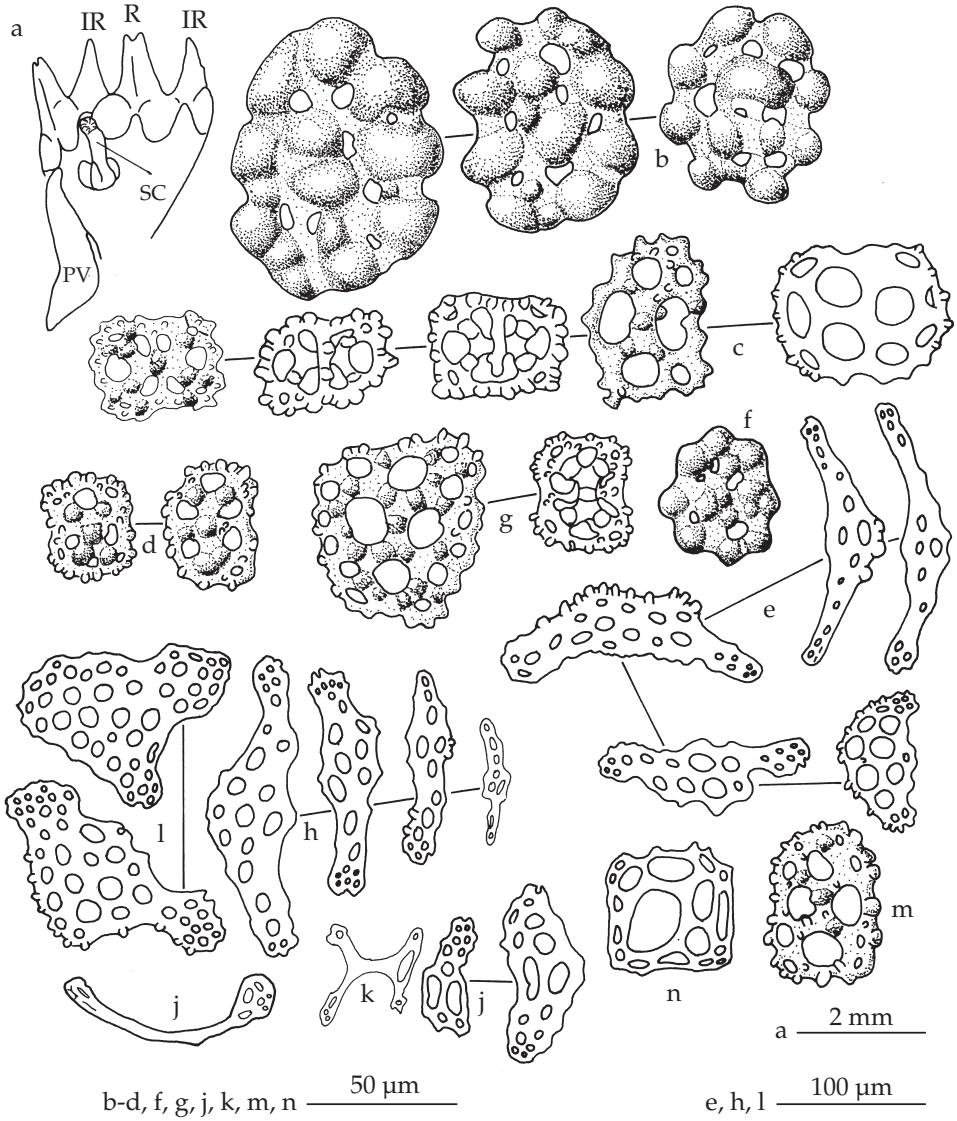


Fig. 71. *Plesiocolochirus* cf. *australis* (Ludwig, 1875). a: calcareous ring (IR: interradial piece; PV: Polian vesicle; R: radial piece; SC: stone canal); b: nodulous perforated plates from body wall; c: baskets from dorsal body wall; d: baskets from ventral body wall; e: perforated rods from tube feet; f: nodulous perforated plate from tube feet; g: tube foot baskets; h & j: perforated rods from tentacles; k: X-shaped rods from tentacles; l: triangular perforated plates from tentacles; m: nodulous basket from tentacles; n: smooth basket from tentacles.

ventrally than dorsally. Dorsally, 4-5 very small warts around each tube foot. Skin thick and rigid.

Calcareous ring without posterior projections (fig. 71a); radial and interradial pieces of the same length; radial ones with a notch anteriorly; posterior edge of the calcareous ring undulating. One large conical Polian vesicle 2.5 mm long (fig. 71a); one contorted stone canal ending in a madreporic plate adjoining the calcareous ring (fig. 71a). Retractor muscles of the pharynx flat, thin, attached at the anterior third of the body length.

Ossicles of body wall large pine cone plates, nodulous perforated plates and baskets. Pine cone ossicles 200-800 µm long, multilayered; nodulous perforated plates 65-95 µm long (fig. 71b), more numerous ventrally than dorsally; baskets nodulous, 45-60 µm long dorsally (fig. 71c) and 35-40 µm long ventrally (fig. 71d); most of them with a bar perpendicular to the central X-shaped rod. In the tube feet perforated rods (fig. 71e), nodulous perforated plates similar to those of the body wall (fig. 71f) but smaller (45-55 µm long) and baskets (fig. 71g); some baskets merging into nodulous plates up to 100 µm long (fig. 71g); end plate 200-220 µm across. In the tentacles perforated rods (figs 71h, j) 40-170 µm long, branched rods (fig. 71k), triangular perforated plates 45-210 µm long (fig. 71l) and a few nodulous (fig. 71m) or smooth (fig. 71n) baskets.

Remarks.— The specimen at hand looks very much like *Plesiocolochirus australis*. However, the tentacle ossicles are very different, mainly by the absence of rosettes. This difference can not be attributed to the size of the specimen (25 mm long versus 4-15 mm for the other *P. australis* observed in the present study) because Cherbonnier & Féral (1984b) working on specimens 18-30 mm long observed numerous rosettes in the tentacles. Obviously, species of the genera *Plesiocolochirus* and *Colochirus* show large ossicle variations and therefore, I am reluctant to describe the single specimen as a new species. It appears closely related and comparable to *P. australis*. More material and especially large specimens are necessary to solve this problem.

Family Phyllophoridae Oestergren, 1907
Subfamily Semperiellinae Heding & Panning, 1954
Genus *Neothyonidium* Deichmann, 1938
Neothyonidium magnum (Ludwig, 1882)
(figs 72a-k, 73, 113a)

Thyodinium magnum Ludwig, 1882: 132; Lampert, 1885: 170; Théel, 1886: 146.
Phyllophorus magnus; Ludwig, 1889-92: 347; Sluiter, 1901: 112, pl. 4 fig. 5, pl. 5 fig. 1; Domantay, 1933: 38, pl. 2 fig. 11a-g; Domantay, 1936: 399.
Neothyodinium magnum Heding & Panning, 1954: 197, fig. 98; A.M. Clark & Rowe, 1971: 182; Cherbonnier, 1980: 656, fig. 20A-Q; Féral & Cherbonnier, 1986: 102, fig. 40T; George & George, 1987: 246; Rowe & Gates, 1995: 312 (synonymy); Colin & Arneson, 1995: 262, fig. 1247; Gosliner et al., 1996: 283, fig. 1045.

Material.— RMNH Ech. 6090 (1 specimen), Barang Lompo, 23.ix.94, 3 m depth, in sand; IRSNB IG.28251/169 (1 specimen) Kudingareng Keke S, 26.ix.94, 14 m depth in coral rubble.

Description.— Only tentacle crown and introvert collected. Body deep in the sediment and animals autoeviscerating readily when manipulated. Tentacles 20, from yel-

Fig. 72. *Neothyonidium magnum* (Ludwig, 1882). a: calcareous ring (IR: interradial piece; R: radial piece); b: base of the calcareous ring (DT: digestive tract; MP: madreporic plate; PV: Polian vesicles; ST: stone canal); c: introvert tables; d: reduced table from introvert; e: perforated plates from tube feet; f: tube foot rosettes; g: tables from tentacle base; h: rosettes from tentacle base; j: rosettes from tentacle half length; k: rosettes from tentacle tips.

low to brown (fig. 113a), in two concentric circles of 10; outer circle with very large tentacles, inner with very small ones; shaft of large tentacles yellow with black annuli at the base. On the introvert tube feet densely crowded along the ambulacra.; due to the state of contraction of the introvert tube feet arranged on 5-6 rows in each ambulacrum, except the first ones which are on two rows (fig. 113a).

Calcareous ring very long (76 and 79 mm); radial and interradial pieces of the same length, non- fragmented (fig. 72a); radial pieces with deep anterior notch. Four Polian vesicles, 40-81 mm long, and one stone canal 15-16 mm long (fig. 72b).

In the introvert tables only, with discs 50-80 µm in diameter (fig. 72c); disc round or ovate, smooth with 4 large central holes and 1-20 peripheral holes in 1-2 irregular circles; 2 pillars forming a spire connected by 1-2 cross beams, each ending in a bundle of spines; pillars sometimes reduced to knobs (fig. 72d). Tube feet with elongated perforated plates 85-165 µm long (fig. 72e) and rosettes 15-55 µm long (fig. 72f). At the base of the tentacles tables similar to those of the introvert (fig. 72g) and rosettes (fig. 72h); in the shaft half-way tentacle length rosettes only (fig. 72j); in the smallest shafts very small rosettes (fig. 72k); no ossicles at the tip of the tentacles.

Geographic distribution (fig. 73).— Indonesia (Sulawesi, **Ambon** = type locality), Malaysia (Sabah), Philippines, Australia (WA, QLD, GBR), Papua New Guinea, New Caledonia.

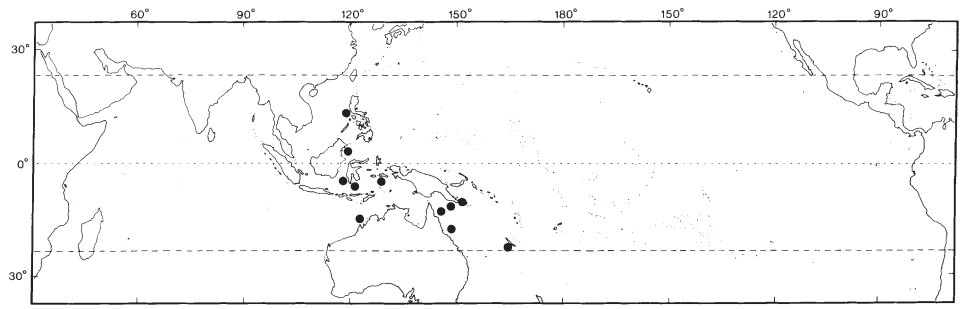


Fig. 73. Distribution of *Neothyonidium magnum* (Ludwig, 1882).

Remarks.— Complete specimens of *Neothyonidium magnum* are difficult to collect because they live deeply buried in sand or coral rubble and because there is a strong constriction at the base of the introvert, which easily detaches from the main body when a collector tries to extract a specimen from the substratum (Sluiter, 1901; Heding & Panning, 1954; Cherbonnier, 1980). However, even on the basis of incomplete specimens there is no doubt about their identification.

Genus *Phyrella* Heding & Panning, 1954
Phyrella trapeza (H.L. Clark, 1932)
(figs 74a-e, 75, 113b)

Phyllophorus trapezus H.L. Clark, 1932: 224, figs 4-9; H.L. Clark, 1946: 409; Endean, 1956: 137, 139; Endean, 1957: 252.

Phyrella trapeza; Heding & Panning, 1954: 182, figs a-e; A.M. Clark & Rowe, 1971: 184, fig. 95k, pl. 30 fig. 2; Rowe & Gates, 1995: 314.

Material.— IRSNB IG.28251/259 (1 specimen), Kudingareng Keke S, 5.x.94, reef flat at low tide.

Description.— Specimen 21 × 8 mm, uniformly chocolate brown with translucent tube feet, white at the tip (fig. 113b); in alcohol uniformly beige-white. Body cylindrical, curved, strongly tapering posteriorly. Tube feet densely crowded over the whole body surface (fig. 113b).

Calcareous ring small, brittle, radial pieces with an anterior notch and two posterior processes composed of 5 elements (fig. 74a); interradial pieces with only a long anterior tooth (fig. 74a). One short Polian vesicle (1/20 of body length). Gonad well developed, formes by a bundle of large undivided tubules.

Ossicles of body wall tables only (fig. 74b) with discs 70-95 µm in diameter, sometimes irregular or reduced to the disc (fig. 74c); disc perforated by one central hole and 8 peripheral holes; some additional smaller holes also present; edge of the disc

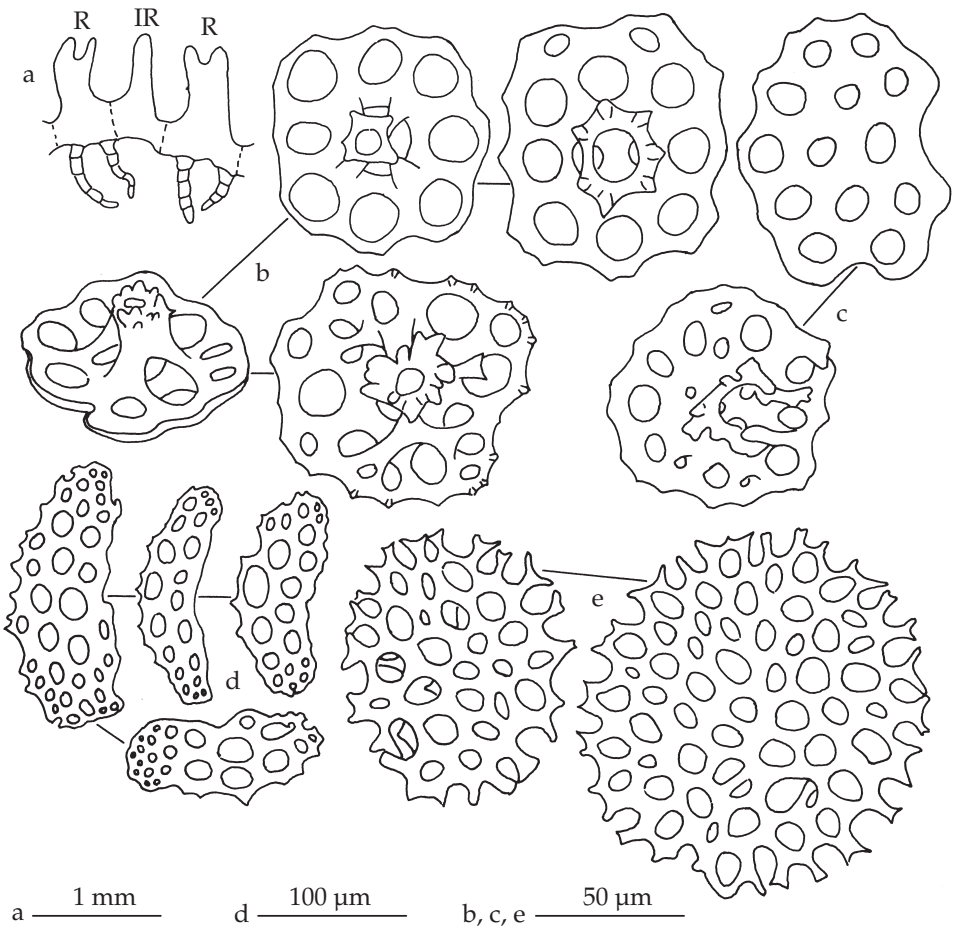


Fig. 74. *Phyrella trapeza* (H.L. Clark, 1932). a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall tables; c: reduced table from body wall; d: perforated plates from tube feet; e: end plates from tube feet.

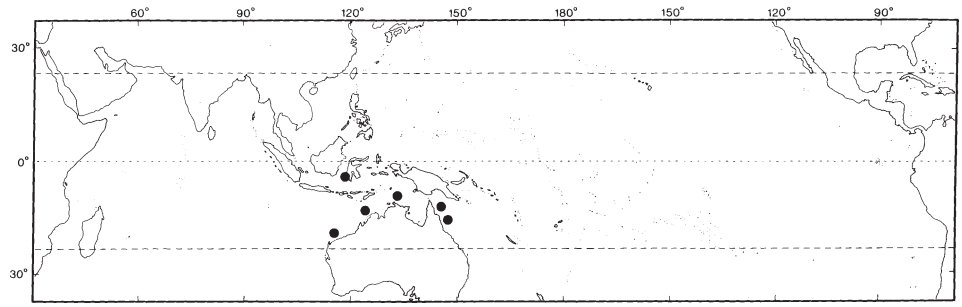


Fig. 75. Distribution of *Phyrella trapeza* (H.L. Clark, 1932).

undulated, smooth to spiny; 4 short pillars forming a spire ending in a crown of spines. Tube feet with perforated plates 130-170 µm long (fig. 74d) and located close to the end plate; end plate 200-270 µm across. Anterior tube feet with a very small end plate, 80-125 µm across (fig. 74e).

Geographic distribution (fig. 75).— Australia (WA, NT, QLD (**Low Isles** = type locality), GBR), Indonesia (Sulawesi)

Remarks.— The specimens from Sulawesi is small in comparison with the holotype and material studied by Heding & Panning (1954): 21 mm versus 57 and 60 mm, respectively. However, its well developed gonad and the similarity of its ossicles with those of the holotype indicate that we are dealing with an adult. Because of the small size of the specimen and of the tentacles being completely withdrawn, no preparation has been made of the ossicles of the introvert.

Phyrella trapeza is new to the fauna of Indonesia.

Subfamily Thyoninae Panning, 1949
Genus *Hemithyone* Pawson, 1967
Hemithyone semperi (Bell, 1884)
(figs 76a-h, 77)

Cucumaria semperi Bell, 1884b: 147, pl. 9 fig. A; Bell, 1889: 7; Pearson, 1910a: 169; Pearson, 1910b: 185, fig. 18; Vaney, 1912: 291; Dawydoff, 1952: 118; Endean, 1957: 251.

Cucumaria Semperi; Lampert, 1885: 138.

Hemithyone semperi; Pawson, 1967: 159, figs 1-10 (synonymy); James, 1969: 60; A.M. Clark & Rowe, 1971: 180, fig. 92J, J', pl. 29, fig. 15; Rowe, 1983: 159; James, 1984: 115, fig. 2b-c (synonymy); James, 1985 [1988]: 405; Cherbonnier, 1988: 208, fig. 90A-H (synonymy); Rowe & Gates, 1995: 311.

Material.— IRSNB IG.28251/114 (1 specimen), Kudingareng Keke NW, 16.ix.94, 12 m depth on the skeleton of *Halomitra pileus*.

Description.— Specimen 14 × 4.5 mm. Colour in alcohol uniformly white-beige. Body pentagonal in section, tapering posteriorly, curved upward at both ends. Mouth and anus terminal. Tube feet in a zig-zag pattern along each ambulacrum; a few tube feet also in the interradii. Anus surrounded by 5 minute triangular teeth, each nearly completely concealed by 1-2 long tube feet.

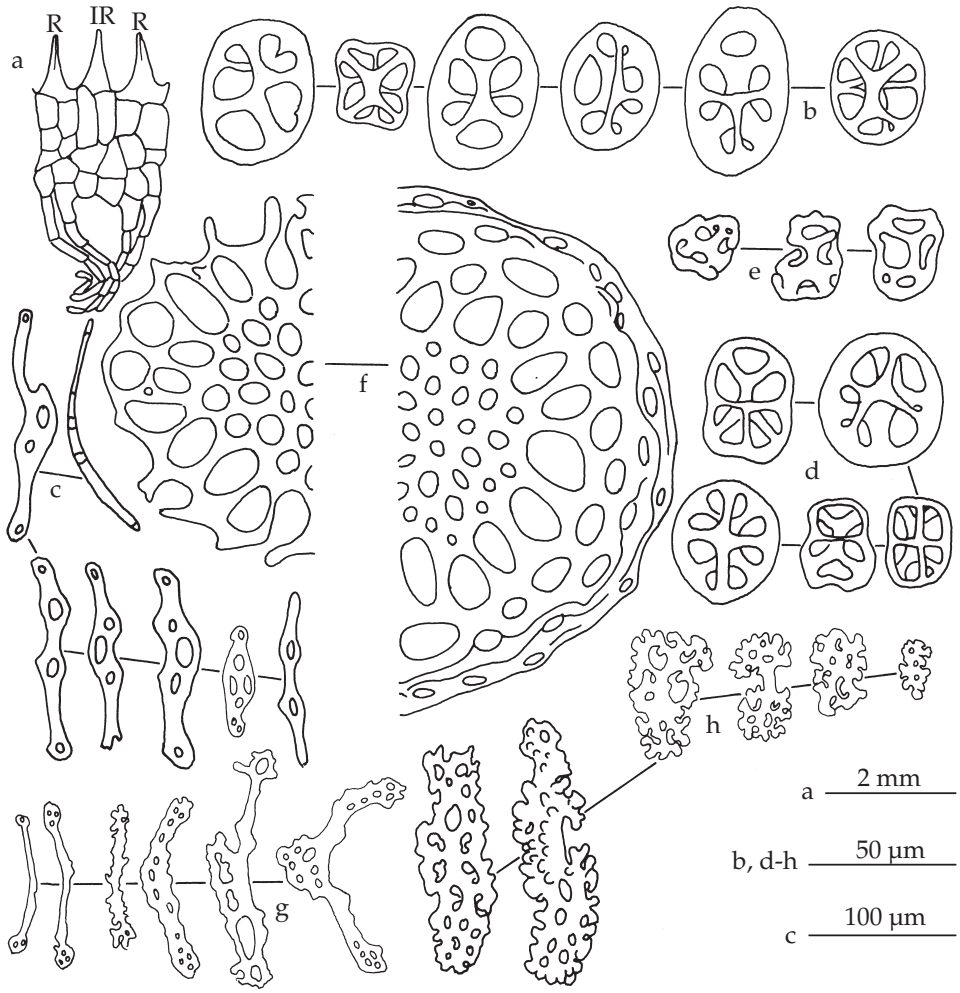


Fig. 76. *Hemithyone semperi* (Bell, 1884). a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall ellipsoids; c: tube foot rods; d: tube foot ellipsoids; e: irregular ellipsoids from tube feet; f: tube foot end plates; g: perforated rods from tentacles; h: tentacle rosettes.

Calcareous ring tubular, composed of a mosaic of plates (fig. 76a); radial pieces with 2 posterior projections composed of 5-6 pieces and with one anterior tooth; interradial pieces with an anterior tooth. One short Polian vesicle. Gonad well developed, formed of several long tubules.

Ossicles in the body wall ellipsoids only, 25-55 µm long, very often on one side with 2 bridges crossing at a right angle and on the other side a central bar with bifurcated extremities (fig. 76b). In the tube feet rods (fig. 76c), 70-155 µm long, perforated centrally and at the extremities, and ellipsoids 20-45 µm long (fig. 76d), some being irregular (fig. 76e); end plate 125-175 µm across (fig. 76f). In the tentacles small perforated rods (fig. 76g) and rosettes, 20-90 µm long (fig. 76h).

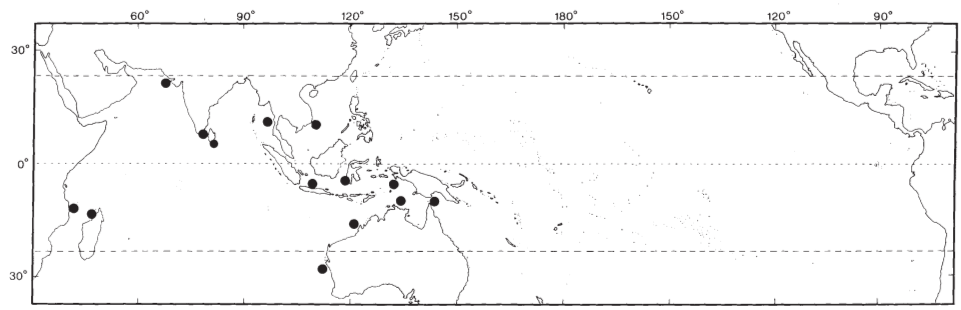


Fig. 77. Distribution of *Hemithyone semperi* (Bell, 1884).

Geographic distribution (fig. 77).— Mozambique (Querimba Islands), Madagascar, Pakistan (Karachi), Sri Lanka, India (Gulf of Mannar, Tuticorin), Myanmar (Mergui Archipelago), Indonesia (Java Sea, Sulawesi, Aru Islands), Vietnam, Australia (WA, NT, QLD, **Torres Straits** = type locality, GBR).

Remarks.— The specimen from Sulawesi is the smallest ever recorded. Previously recorded specimens range from 20 to 51 mm in length: Bell, 1884b: 25-36 mm; Lampert, 1885: 36 mm; Koehler & Vaney, 1908: 27, 40 mm; Pearson, 1910a: 45 mm; Pearson, 1910b: 20 mm; H.L. Clark, 1938: 25-30 mm; Pawson, 1967: 23-50 mm; James, 1984: 51 mm; Cherbonnier, 1988: 24-40 mm. Nevertheless the specimen is an adult (gonad well developed) with the ossicles typical of the species.

Subfamilly Phyllophorinae Oestergren, 1907
Genus Lipotrapeza H.L.Clark, 1938
Lipotrapeza spec.
(fig. 78a-e)

Material.— IRSNB IG.28251/269 (1 specimen), Barang Baku W, 14.v.97, 9 m depth (collected by B.W. Hoeksema).

Description.— Specimen 48 × 22 mm. Colour in alcohol uniformly brown. Body club-shaped with the largest diameter located anteriorly. Tube feet large, numerous, densely crowded over the whole body surface. Specimen auto-eviscerated, lacking tentacles, introvert, calcareous ring, gonad and digestive tract.

No ossicles in the body wall except close to the anus: tables, rods and miliary granules. Tables (fig. 78a) with very irregular disc, perforated by 4 large central holes and 4-20 peripheral holes; 2-4 pillars, each ending in a spine bent at an angle of 45°; some pillars united by a cross beam; rods (fig. 78b) 50-175 µm long, curved, simple, X- or Y-shaped with perforated extremities; some rods with perforations on the whole length (fig. 78c); miliary granules (fig. 78d) numerous, 30-100 µm across. In the tube feet perforated plates 170-200 µm long (fig. 78e), located close to the end plate; end plate 400-410 µm across.

Remarks.— The specimen is obviously a dendrochirote. However, in the absence of tentacles, introvert and calcareous ring, it is very difficult to allocate the specimen to a genus. The position of the tube feet, the absence of ossicles in the body wall

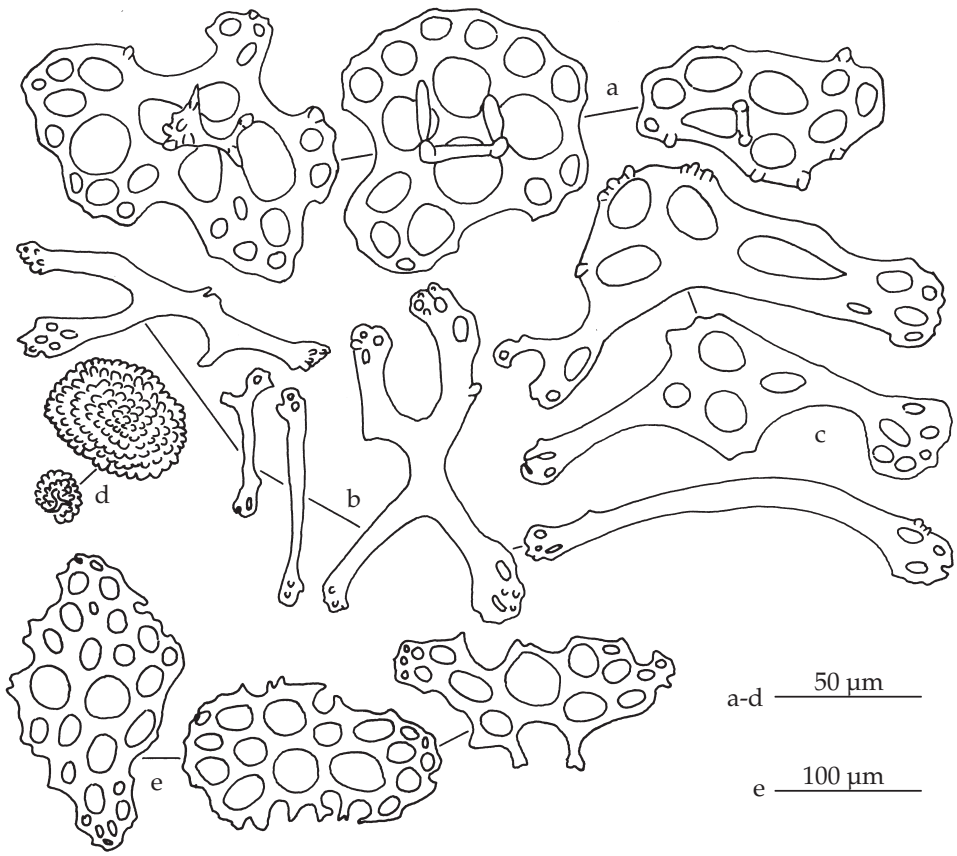


Fig. 78. *Lipotrapeza* spec. a: tables from anal region; b: rods from anal region; c: perforated rods from anal region; d: miliary granules from anal region; e: perforated plates from tube feet.

(except some rosettes, rods and tables close to the anus) and the ossicles of the tube feet being reduced to the end plate and a few perforated plates are congruent with some species belonging to the genus *Lipotrapeza* (H.L. Clark, 1938; Heding & Panning, 1954; Cherbonnier, 1988). It certainly shows affinities with *Lipotrapeza ambigua* Cherbonnier, 1988, from Madagascar. However, it differs from that species in having much larger ossicles (miliary granules 30-100 µm versus 25-40 for *L. ambigua*; tube feet end plate 400-410 µm across versus 200-220 µm for *L. ambigua)* and by the presence of rods close to the anus. The specimen is also close to *Lipotrapeza vestiens* (Joshua, 1914). According to H.L. Clark (1938) only small specimens (about 50 mm long) show numerous miliary granules, minute rods and a few tables around the anus. This fits the specimen from Sulawesi which is 48 mm long. However, unlike the Sulawesi specimen, *L. vestiens* does not have perforated plates in the tube feet (Joshua, 1914; H.L. Clark, 1938; Hickman, 1962). Moreover, that species is only known from Australian temperate waters: Victoria, south and western Australia and Tasmania (Rowe & Gates, 1995). In conclusion, it is impossible to positively identify the single incomplete specimen to species level.

Family Sclerodactylidae Panning, 1949
Subfamily Cladolabinae Heding & Panning, 1954
Genus *Afrocucumis* Deichmann, 1944
Afrocucumis africana (Semper, 1868)
(figs 79, 113c)

Cucumaria africana Semper, 1868: 53, 270, pl. 15 fig. 16.
Afrocucumis africana; James, 1969: 60; Lawrence, 1980: 222; Tortonese, 1980: 109; Humphreys, 1981: 36; A.M. Clark, 1982: 489; Mukhopadhyay & Samanta, 1983: 312; James, 1983: 92; James, 1984: 118, fig. 1e-g; A.M. Clark, 1984: 99; Rho & Shin, 1986: 250, pl. 3 figs 1-13; James, 1989: 131; Levin & Dao Tan Ho, 1989: 57; Marsh, 1994a: 11; Liao & A.M. Clark, 1995: 487, fig. 294a-b; Massin, 1996b: 39, fig. 27A-E (synonymy and records); Liao, 1997: 179, fig. 104a-b; Rowe & Richmond, 1997: 302.
Discucumaria africana; Endean, 1953: 56; Endean, 1956: 137; Endean, 1957: 252; Endean, 1961: 295.

Material.— IRSNB IG.28251/144a (1 specimen) and RMNH Ech. 6091 (1 specimen), Samalona NW, 21.ix.94, 5 m depth at the foot of a *Galaxea fascicularis*.

Geographic distribution (fig. 79).— Somalia, Kenya, Zanzibar, Mozambique (**Querimba Islands** = type locality), South Africa (Natal), Madagascar, Seychelles (Mahé, Aldabra), Mauritius, India (Laccadive and Andaman Islands), Myanmar (Mergui Archipelago), Cocos Keeling Islands, Indonesia (Sumatra, Kalimantan, Makassar Strait, Celebes Sea, Sulawesi, Salayer, Komodo, Sumba, Flores, Rotti, Ambon, Banda Island, Aru Islands), Australia (WA, NT, QLD, GBR), Vietnam, Taiwan, China, Korea, Japan, Mariana Islands (Guam), Caroline Islands (Kosrae), New Caledonia, Marshall Islands (Enewetok), Ellice Islands (Funafuti), Fiji (Rotuma).

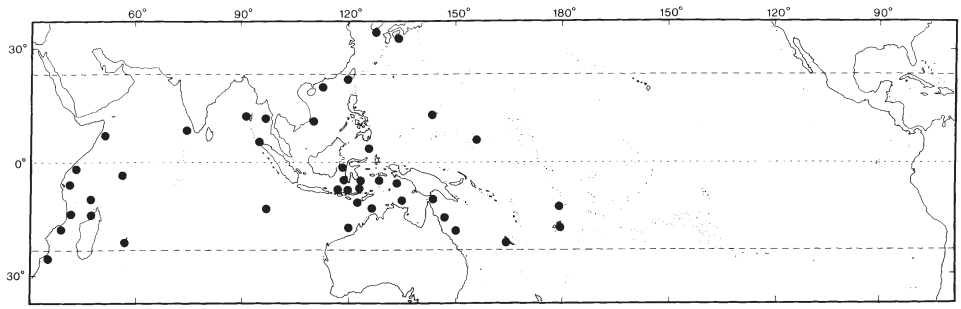


Fig. 79. Distribution of *Afrocucumis africana* (Semper, 1868).

Description and remarks.— Specimens 20 × 4.5 and 20 × 5 mm (fig. 113c), uniformly black. The external and internal anatomy, together with the ossicles are in accordance with specimens from Ambon (Massin, 1996b).

Genus *Cladolabes* Brandt, 1835
Cladolabes schmeltzii (Ludwig, 1875)
(figs 80a-e, 81, 113d)

Thyonidium Schmeltzii Ludwig, 1875: 94, fig. 20a, b; Lampert, 1885: 173.
Thyonidium schmeltzii; Bell, 1884b: 150; Théel, 1886: 148; H.L. Clark, 1921: 168, 196.

Phyllophorus schmeltzii; Ludwig, 1889-92: 347, pl. 3 fig. 8; Sluiter, 1901: 110.
Urodemas schmeltzii; H.L. Clark, 1938: 501; H.L. Clark, 1946: 410; Endean, 1956: 130; Endean, 1957: 252.
Cladolabes schmeltzii; Heding & Panning, 1954: 126, fig. 54; A.M. Clark & Rowe, 1971: 182, fig. 95d, pl. 30 fig. 7; Rowe & Gates, 1995: 322.
Cladolabes schmeltzi; Reyes-Leonardo, 1984b: 8; Reyes-Leonardo et al., 1985: 266, pl. 1 fig. 2a-d; Cannon & Silver, 1986: 37, fig. 10A; Liao & A.M. Clark, 1995: 490, fig. 296a-b; Liao, 1997: 183, fig. 107a-b.
Phyllophorus hamatus; Ekman, 1918: 54, pl. 5 figs. 52-55 (not *Phyllophorus hamatus* Sluiter, 1914).

Material.— RMNH Ech. 6070 (1 specimen), Samalona NW, 21.ix.94, 8 m depth under a coral slab; IRSNB IG.28251/139 (1 specimen), Samalona NW, 21.ix.84, 8 m depth under a mushroom coral (*Fungia scutaria*); IRSNB IG.28251/162 (1 specimen), Kudingareng Keke S, 26.ix.94, 3 m depth.

Description.— Specimens 17 × 4, 12.5 × 3.5 and 77 × 7 mm. Largest specimen yellow-orange (fig. 113d), the two others yellow-brown; tip of the tube feet reddish in all the specimens; in alcohol body wall and tube feet of the largest specimen beige-brown; in the two others, body wall beige with white tube feet. Body pentagonal in section, tapering posteriorly. Small specimens with large tube feet on a double row along each ambulacrum, twice as numerous ventrally as dorsally; largest specimen with tube feet over the whole body surface, more densely crowded along the ambulacra (fig. 113d). Mouth and anus terminal. Small specimens with 5 minute anal teeth.

Calcareous ring tubular, large (1/5 of body length) (fig. 80a); radial pieces twice as wide as the interradial ones and with 2 narrow posterior processes (fig. 80a). Seven long Polian vesicles and numerous small ones; numerous very short stone canals. Retractor muscles of the pharynx attached at half –way the body length.

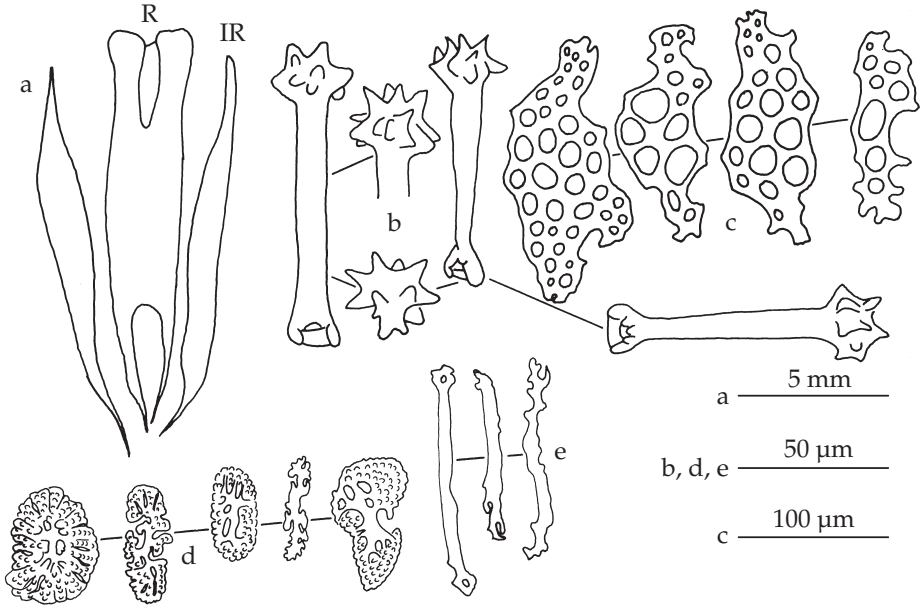


Fig. 80. *Cladolabes schmeltzii* (Ludwig, 1875). a: calcareous ring (IR: interradial piece; R: radial piece); b: club-shaped rods from body wall; c: perforated plates from tube feet; d: tentacle rosettes; e: tentacle rods.

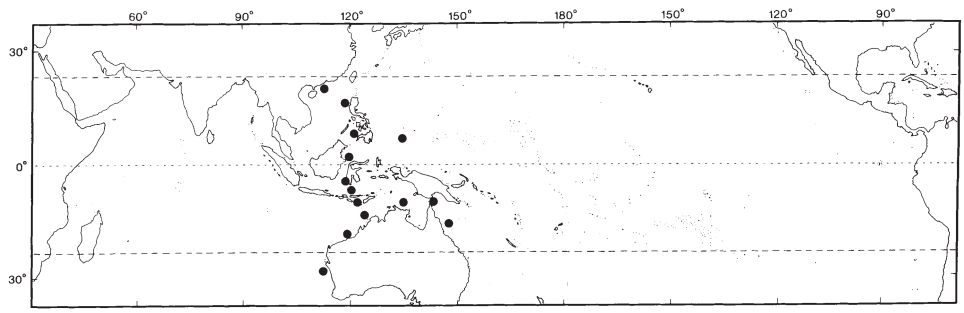


Fig. 81. Distribution of *Cladolabes schmeltzii* (Ludwig, 1875).

In the body wall club-shaped rods (modified tables), perforated at one extremity and spiked at the other (fig. 80b); rods 80-100 µm long in the two small specimens and 110-150 µm long in the large one. Tube feet with perforated plates (fig. 80c); end plate 250-300 µm across in the two small specimens and 500-525 µm across in the large one. In the tentacles numerous, oval or rounded, rosettes (fig. 80d), 35-55 µm across and sometimes small irregular rods (fig. 80e).

Geographic distribution (fig. 81).— Australia (QLD, GBR, **Bowen =** type locality), Philippines, Palau (= Pelew) Islands, Indonesia (North of Sumbawa, East of Flores, East Kalimantan, Sulawesi), China.

Remarks.— *Cladolabes schmeltzii* has very characteristic ossicles in the body wall that can not be confused with any other species. Within its restricted geographic range (fig. 81) it shows no variations of ossicles or calcareous ring. Théel (1886) noted that a very small specimen (12 mm long) had the same ossicles as larger ones. The ossicles of the specimen from Sulawesi have also a constant form but increase in size with increasing body length.

Genus *Ohshimella* Heding & Panning, 1954
Ohshimella ehrenbergii (Selenka, 1868)
(figs 82a-h, 83, 113e)

Urodemas Ehrenbergii Selenka, 1868: 114, figs 6-8.
Phyllophorus ehrenbergii; Semper, 1868: 245; Cherbonnier, 1955a: 169, pl. 44 figs i-n (synonymy).
Phyllophorus ehrenbergi; Ludwig, 1889-92: 347.
Ohshimella ehrenbergii; Heding & Panning, 1954: 133, figs 57-59 (synonymy and records before, 1954).
Ohshimella ehrenbergi; James, 1969: 60; A.M. Clark & Taylor, 1971: 91; Liao, 1975: 201, fig. 2 (1-4); Price, 1982: 12; Price, 1983: 97, fig. 54a-e; Cherbonnier, 1988: 216, fig. 94A-J (records before 1975); Liao & A.M. Clark, 1995: 492, fig. 298a-d; Liao, 1997: 186, fig. 90a-d.

Material.— IRSNB IG.28251/234 (1 specimen), badi, 3.x.94, 1 m depth.

Description.— Specimen 30 × 5 mm, reddish (fig. 113e) with white tube feet ringed by grey-black bands; in alcohol beige with white tube feet. Body cylindrical, slightly tapering at both ends (fig. 113e); mouth and anus terminal; anus surrounded by 5 small anal teeth. Tube feet only along the ambulacra, in 2 rows dorsally and 3 rows ventrally.

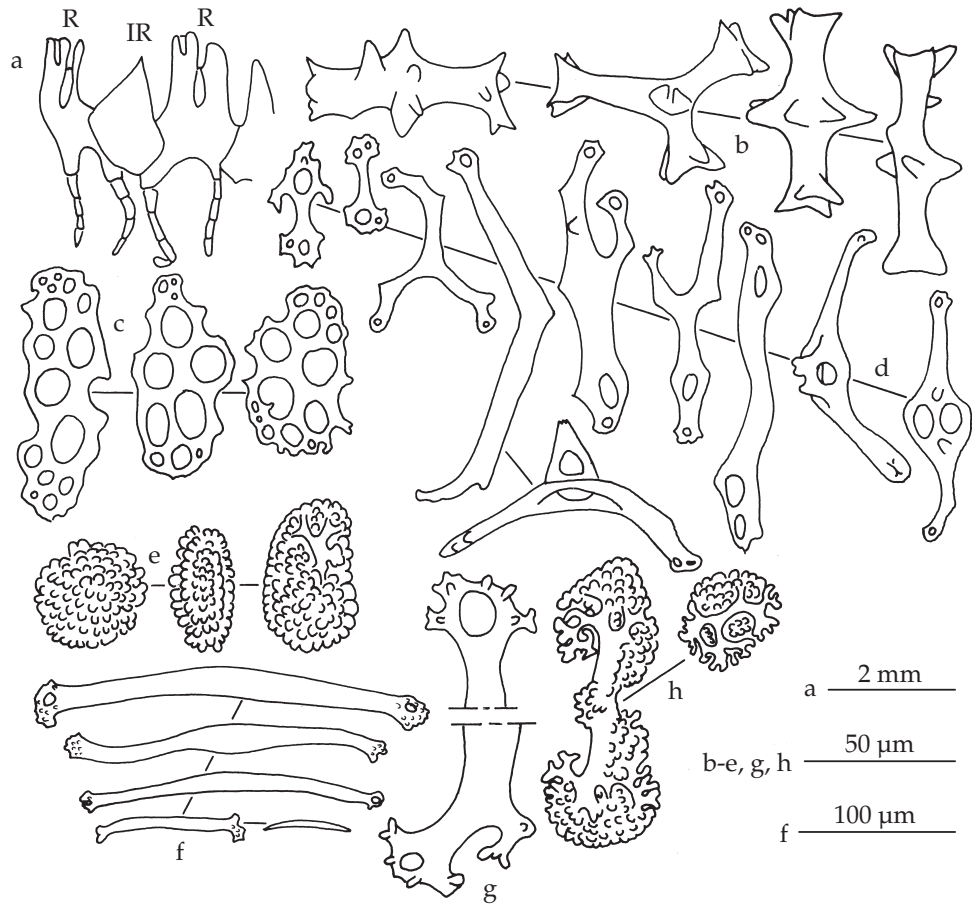


Fig. 82. *Ohshimella ehrenbergii* (Selenka, 1867). a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall rods; c: perforated plates from tube feet; d: perforated rods from tube feet; e: tube foot rosettes; f & g: tentacle rods; h: elongated rosettes from tentacles.

Calcareous ring stout, radial pieces with 2 posterior processes each composed of 4 units and with a deep central anterior notch (fig. 82a); at the left side of the notch a groove for the insertion of the longitudinal muscle; interradial pieces more or less triangular, somewhat shorter than the radial pieces; retractor muscles of the pharynx single in their anterior half and double in their posterior half; attached about half-way the body length. One Polian vesicle.

Ossicles of the body wall rods, often cruciform, (fig. 82b), 65-75 µm long, with well-developed spines, usually around the middle and at each end of the rod. In the tube feet small perforated plates (fig. 82c), rods with perforated extremities (fig. 82d) and mulberry like rosettes (fig. 82e); end plate 275-300 µm across. In the tentacles rods, 60-260 µm long, with perforated, spiny extremities (figs 82f, g) and elongated rosettes (fig. 82h), 35-95 µm long, less granular than those of the tube feet.

Geographic distribution (fig. 83).— **Red Sea** = type locality, Somalia, South Africa

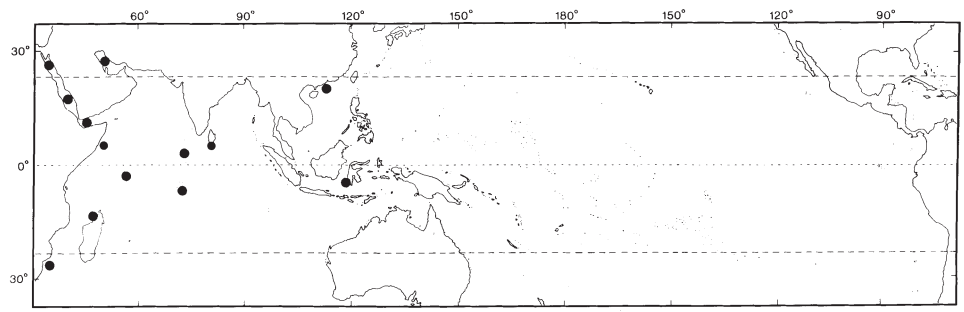


Fig. 83. Distribution of *Ohshimella ehrenbergii* (Selenka, 1867).

(Natal), Madagascar, Seychelles (Mahé), Maldive Islands, Chagos Archipelago (Diego Garcia), Persian Gulf, Sri Lanka, Indonesia (Sulawesi), China (Xisha Islands).

Remarks.— *Ohshimella ehrenbergii* has very characteristic body wall ossicles whose form is similar throughout its distribution area. The only variation is the presence or absence of the mulberry-like rosettes in the body wall, the tube feet and the tentacles. According to Cherbonnier (1955a, 1988) those are abundant in the body wall, whereas absent according to Heding & Panning (1954) and the present study. In the tentacles they may also be present (Cherbonnier, 1955a; Heding & Panning, 1954; present study) or absent (Cherbonnier, 1988). Furthemore the alignment of the tube feet along the ambulacra varies considerably from one specimen to another as previously noted by Selenka (1868). Presence or absence of the mulberry-like rosettes and the alignment of the tube feet can not be related to body size nor to geographic origin.

The species is new to the fauna of Indonesia.

Order Apodida Brandt, 1835
Family Synaptidae Burmeister, 1837
Subfamily Synaptinae Burmeister, 1837
Genus *Euapta* Oestergren, 1898
Euapta godeffroyi (Semper, 1868)
(figs 84a-k, 85, 113f)

Synapta Godeffroyi Semper, 1868; 231, pl. 39 fig. 13.

Euapta godeffroyi; Endean, 1957: 254; James, 1969: 62; James, 1982a: 98, fig. 1i; Price, 1982: 12; Mukhopadhyay & Samanta, 1983: 312; A.M. Clark, 1984: 99; Maluf, 1988: 103; James, 1989: 132; Levin & Dao Tan Ho, 1989: 59; Kalashnikov, 1989: 71; Marsh, 1994a: 11; Allen & Steene, 1994: 247; Colin & Arneson, 1995: 264, fig. 1252; Liao & A.M. Clark, 1995: 526, fig. 322a-f; Gosliner et al., 1996: 283, fig. 1046; Massin, 1996a: 164, fig. 11A-F (synonymy and records before 1994); Solis-Marin et al., 1997: 256; Liao, 1997: 255, fig. 151a-c.

Material.— IRSNB IG.28251/184 (1 specimen), Kudingareng Keke S, 28.ix.94, 5 m depth under a coral slab.

Description.— Specimen 400 × 22 mm. Body cylindrical, skin sticky to the touch. Colour white-grey with transversal black-brown stripes (fig. 113f); five brown radial lines on the whole body length, tentacles grey; in alcohol white-grey with transversal

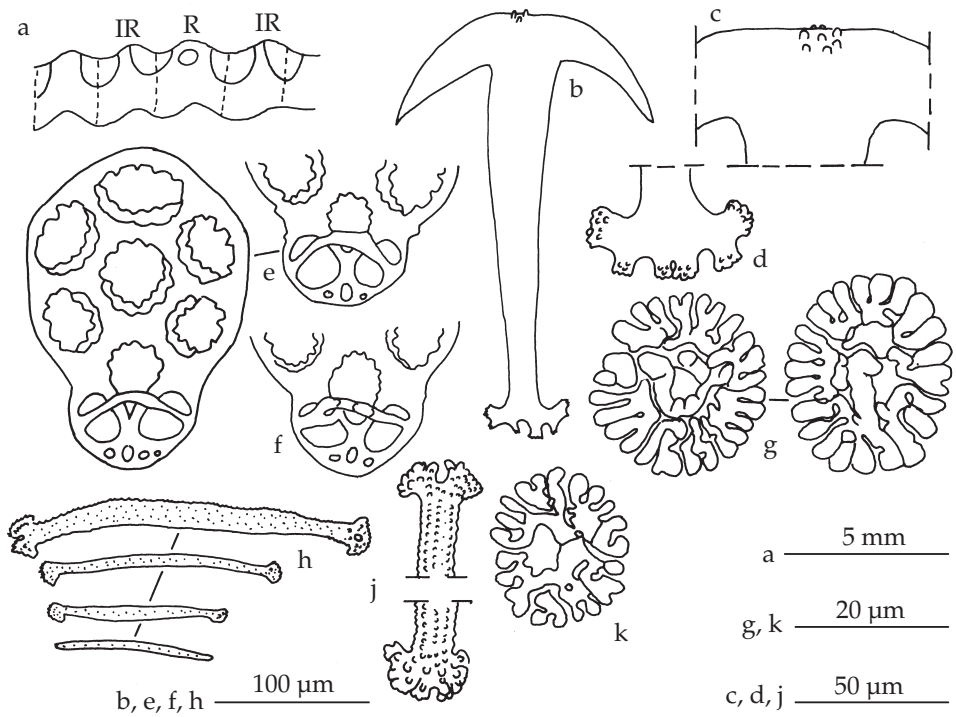


Fig. 84. *Euapta godeffroyi* (Semper, 1868). a: calcareous ring (IR: interradial piece; R: radial piece); b: body wall anchor; c: anchor vertex; d: anchor stock; e & f: body wall anchor-plates; g: miliary granules from body wall; h & j: tentacle rods; k: miliary granule from tentacles.

stripes strongly faded. Tentacles 15, feather- like, each with 24-27 pairs of digits united by a web up to half-way of their length.

Calcareous ring greenish; two interradial pieces alternating with one radial piece (fig. 84a); radial pieces perforated for the nerve. No cartilaginous ring. Numerous Polian vesicles. One narrow contorted stone canal going upwards and ending in a white hemispherical madreporic plate.

In the body wall anchors, anchor-plates and miliary granules. Anchors few, 270-280 × 170 µm (fig. 84b); arms smooth, vertex with 4-9 granules or blunt spines (fig. 84c); stock branched and granulous (fig. 84d).

Anchor-plates few, 180-220 × 130-145 µm, oval with a narrow posterior part; 7 large serrated holes, 2 smooth articular holes and 3-4 small posterior holes (fig. 84e); bridge well developed, smooth or with 1-2 knobs sometimes irregular (fig. 84f); miliary granules numerous, round or oval, 20-30 µm across (fig. 84g). In the tentacles spiny rods with knobbed extremities, 110-230 µm long (figs 84h, j) and miliary granules 20 µm across (fig. 84k), less numerous than in the body wall.

Geographic distribution (fig. 85).— Red Sea, Zanzibar, Seychelles (Aldabra), Madagascar, Mauritius, South Africa (Natal), Maldive Islands, India (Laccadive Islands), Cocos Keeling Islands, Indonesia (Sulawesi, Celebes Sea), Philippines, Vietnam, China, Mariana Islands (Guam), Palau Islands, Caroline Islands (Kosrae), Papua

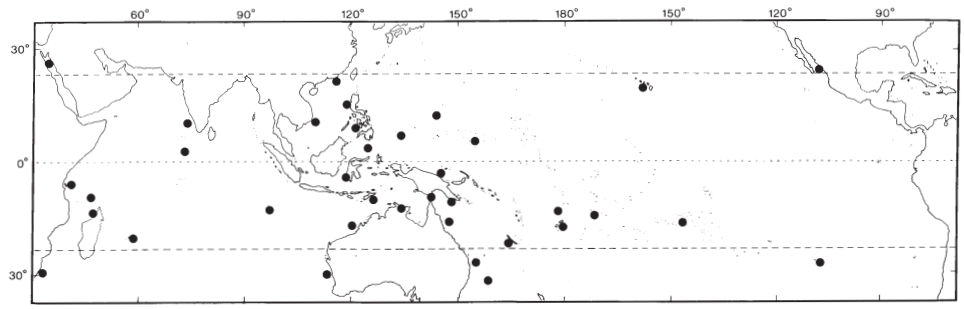


Fig. 85. Distribution of *Euapta godeffroyi* (Semper, 1868).

New Guinea (Madang Province), Australia (WA, NT, Timor Sea, QLD, GBR, NSW, Tasman Sea), New Caledonia, Fiji (Rotuma, Viti Island), Samoa (**Navigator** = type locality), Hawaiian Islands, Society Island, Easter Island, Gulf of California.

Remarks.— The specimen from Sulawesi is similar to specimens from Madagascar (Cherbonnier, 1988), New Caledonia (Cherbonnier & Féral, 1984b) and Hawaiian Islands (Heding, 1928). Only a specimen collected at Easter Island presents some variation (Massin, 1996a). *Euapta godeffroyi* is generally assumed to be common. However, the present record is only the second for Indonesia and obviously the species is uncommon off Ujung Pandang.

Genus *Opheodesoma* Fisher, 1907
Opheodesoma grisea (Semper, 1868)
(figs 86a-j, 87)

Synapta grisea Semper, 1868: 11, pl. 4 figs 6-7; Ludwig, 1882: 128; Bell, 1884b: 146; Lampert, 1885: 219; Ludwig, 1889-92: 357; Sluiter, 1894: 105; Sluiter, 1895: 82.

Opheodesoma grisea; Endean, 1957: 254; Cherbonnier, 1955a: 171, pl. 49 figs k-t (records); Endean, 1957: 254; Mary Bai, 1980: 4, 28, textfig. 13B; Tan Tiu, 1981: 62, pl. 4 figs 1-3, pl. 29 figs 1, 2a; Price, 1982: 12, Reyes-Leonardo, 1984a: 153, pl.11 fig. 3a-b; Reyes-Leonardo et al., 1985: 277; Cherbonnier, 1988: 244, fig. 109A-F (records); Chao & Chang, 1989: 120, figs 24, 31C; Marsh et al., 1993: 64; Kerr, 1994: 171, fig. 4e-f; Marsh, 1994a: 11; Rowe & Gates, 1995: 334; Liao & A.M. Clark, 1995: 530, fig. 325a-c; Massin, 1996b: 45, fig. 32; Liao, 1997: 261, fig. 155a-c.

Opheodesoma griseum; Tortonese, 1977: 275; Tortonese, 1979: 316.

Ophiodesma grisea; James, 1969: 62; James, 1982a: 97, fig. 1h; James, 1982b: 5; James, 1983: 93; James, 1989: 132.

Material.— IRSNB IG.28251/28 (1 specimen), Garong Kong, 30.viii.94, muddy beach at low tide; RMNH Ech. 6092 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide; IRSNB IG.28251/37 (1 specimen), Panikiang, 30.viii.94, reef flat at low tide.

Description.— Specimen 370 × 14, 160 × 14 and 275 × 13 mm. Specimen RMNH Ech. 6092 is narrower posteriorly (9 mm across). Colour of specimens from Panikiang (reef flat) dark grey-brown, lighter ventrally than dorsally); specimen from Garon Kong (muddy beach of the main land) brown dorsally and orange ventrally; in alcohol specimens from Panikiang uniformly grey-brown, specimen from Garong Kong

dark grey dorsally, light grey ventrally. Tentacles 15, feather-like, with 18-30 pairs of digits not united by a web.

Calcareous ring stout, white, with 2 interradial pieces alternating with one radial piece; posterior margin undulating (fig. 86a); radial pieces with a very large quadrangular hole for the nerve; anterior tooth of the interradial pieces very long. Cartilaginous ring present, as high as the calcareous ring with opening in it below the calcareous ring (fig. 86a). Numerous Polian vesicles, very long (1/10 of body length); numerous very short (<1 mm) stone canals ending in a hemispherical madreporic plate (fig. 86b).

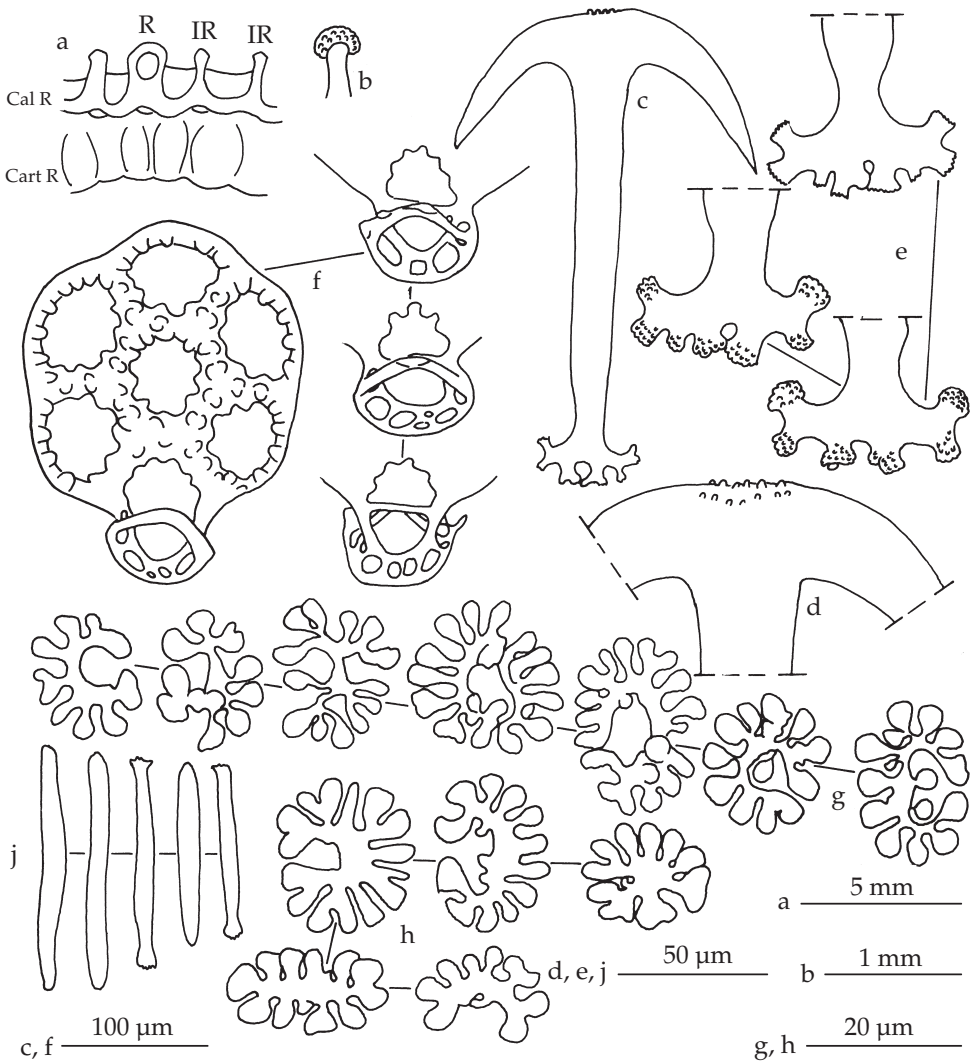


Fig. 86. *Opheodesoma grisea* (Semper, 1868). a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; R: radial piece); b: madreporic plate; c: body wall anchor; d: anchor vertex; e: anchor stocks; f: body wall anchor-plates; g: miliary granules from body wall; h: miliary granules from oral disc; j: oral disc rods.

Ossicles of the body wall anchors, anchor-plates and miliary granules. Anchors (fig. 86c) slightly larger anteriorly (310-320 × 180-200 µm) than posteriorly (255-285 × 160-175 µm); arms smooth, vertex with 4-12 small knobs (fig. 86d), stock branched and granulous (fig. 86e). Anchor-plates (fig. 86f) quadrangular, 210-240 × 160-175 µm, of the same size anteriorly and posteriorly; 7 serrated holes with a double row of teeth on one side of each hole; posterior part very narrow with 4-7 small smooth holes; bridge knobbed, centrally attached to a bar horizontally dividing the large posterior serrated hole. Miliary granules gathered in heaps, 17-22 µm across (fig. 86g); abundance varying a great deal from one specimen to the other. In the oral disc miliary granules (fig. 86h) similar to those of the body wall, and rods (fig. 86j) 60-80 µm long with rounded or slightly spinose extremities. In the tentacles miliary granules only, 17-20 µm across, similar to those of the body wall.

Geographic distribution (fig. 87).— Red Sea, Zanzibar, Madagascar, India (Andaman & Nicobar Islands), Myanmar (Mergui Archipelago), Cocos Keeling Islands, Indonesia (Java, Sumbawa, Paternoster Islands, Sulawesi, Timor, Celebes Sea, Ceram, Ambon), Philippines (**Bohol** = type locality), China, Taiwan, Mariana Islands (Guam), Australia (WA, NT, Timor Sea, QLD, GBR), Caroline Islands (Kosrae), Samoa, Hawaiian Islands.

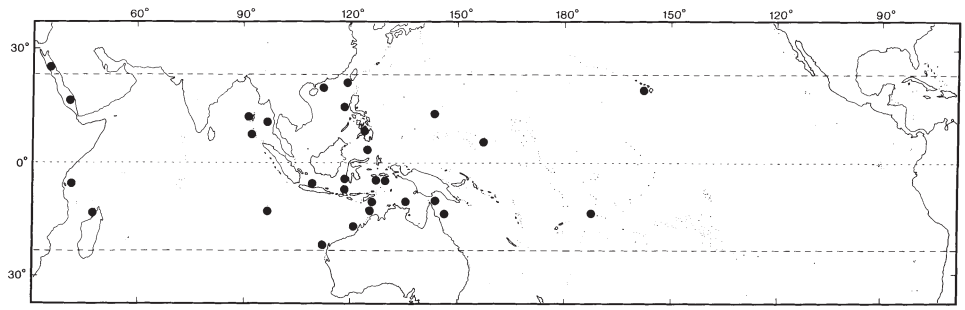


Fig. 87. Distribution of *Opheodesoma grisea* (Semper, 1868).

Remarks.— The very characteristic calcareous ring, the absence of a web linking the tentacle digits, and the presence of rods in the oral disc but not in the tentacles are typical of *Opheodesoma grisea*. The difference in colour pattern between the specimens from Panikiang (grey-brown) and Garong Kong (brown-orange) could be explained by the nature of the sediment type in which they live. In this content I refer to Cherbonnier & Féral (1984b) who noted previously that the colour of *Opheodesoma spectabilis* Fisher, 1907, is variable and that the red-orange specimens were found in a bay with sediment rich in laterite.

Genus *Polyplektana* H.L. Clark, 1907
Polyplektana kallipeplos (Sluiter, 1887)
(figs 88a-h, 89, 113g)

Synapta kallipeplos Sluiter, 1887: 217, pl. 2 figs 41-43; Ludwig, 1889-92: 357; Domantay, 1933: 88.
Chondrocloea kallipeplos; Oestergren, 1898a: 114.
Polyplektana kallipeplos; Heding, 1928; 142.

? *Polyplektana kefersteini*; Chao & Chang, 1989: 121, figs 25, 31E, 35C (A).

Material.— IRSNB IG.28251/188 (1 specimen), Kudingareng Keke S, 28.ix.94, 4 m depth under a coral slab; ZMA H2498 (1 specimen), holotype, Jakarta Bay.

Description.— Specimen 128 × 10 mm, uniformly brown with numerous white dots corresponding to heap of branched miliary granules (fig. 113g). Tentacles somewhat darker than body wall with white dots corresponding to heaps of branched miliary granules on the inner side at the tip; in alcohol uniformly white-beige. Skin sticky to the touch. Tentacles 24, feather-like with 18-24 pairs of digits united by a web at their base.

Calcareous ring white, posterior margin undulating (fig. 88a); two interradial

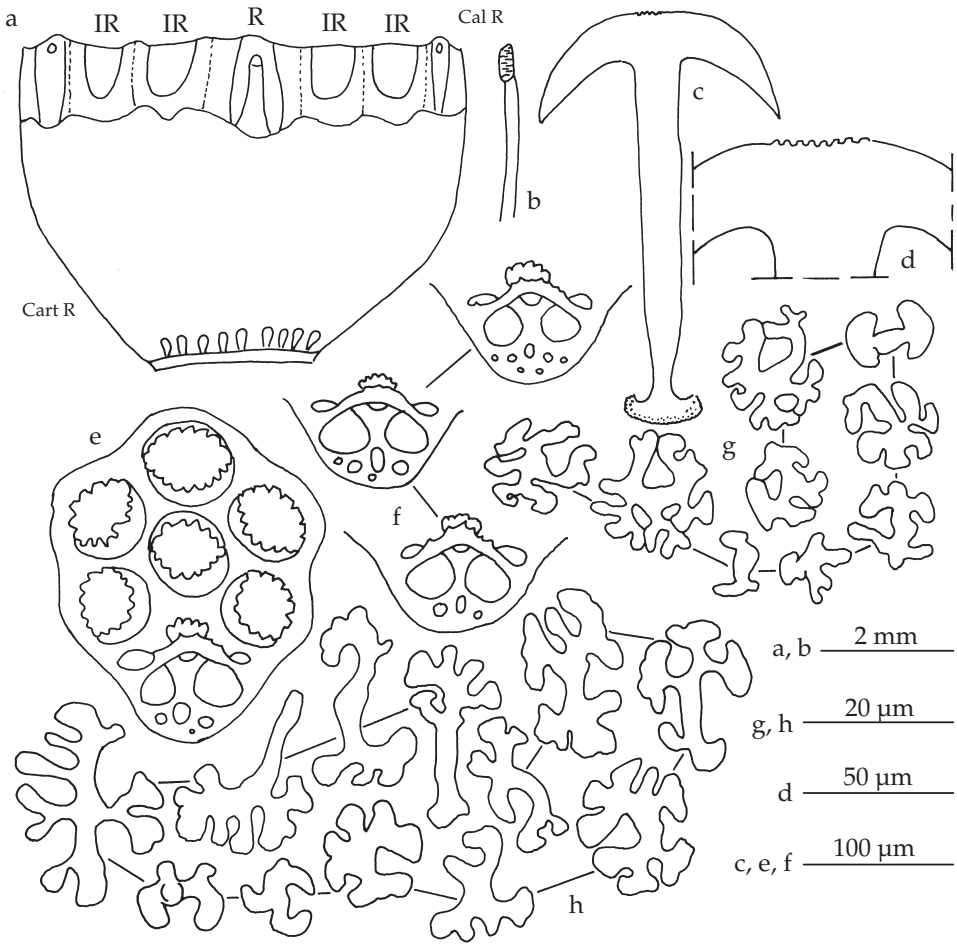


Fig. 88. *Polyplektana kallipeplos* (Sluiter, 1887). a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall anchor; d: anchor vertex; e & f: body wall anchor-plates; g: branched ossicles from body wall; h: branched ossicles from tentacles.

pieces alternating with one radial piece; latter perforated for the nerve. Cartilaginous ring huge (fig. 88a) embedding the calcareous ring. Close to the ring canal of the water vascular system, cartilaginous ring with small perforations. One stone canal in the dorsal mesentery, narrow, ending in a small, flat madreporic plate (fig. 88b). Numerous Polian vesicles.

Ossicles of body wall anchors, anchor-plates and branched ossicles. Anchors 250-290 × 150-175 µm (fig. 88c); arms smooth, vertex with 5-8 quadrangular teeth (fig. 88d), stock finely dented. Anchor- plates quadrangular (fig. 88e), 170-230 × 170-190 µm; 7 serrated holes, 2 smooth articular holes and 3-7 small posterior holes (fig. 88f); bridge spiny with 2-9 spines, many of them acute, mainly the central one. Numerous branched miliary granules, 11-21 µm long (fig. 88g). In the tentacles branched miliary granules 15-35 µm long (fig. 88h), also gathered in heaps.

Geographic distribution (fig. 89).— Indonesia (Java (**Jakarta Bay** = type locality), Sulawesi), ? Taiwan.

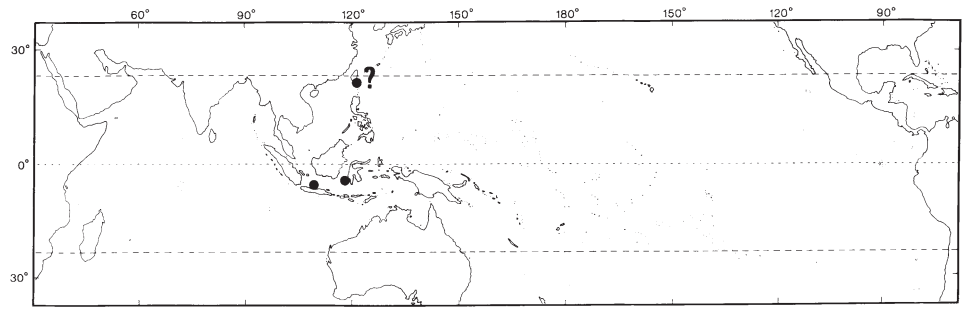


Fig. 89. Distribution of *Polyplektana kallipeplos* (Sluiter, 1887).

Remarks.— The specimen from Sulawesi is similar to the holotype, the only other specimen known so far. H.L. Clark (1907), Domantay (1953) and Cherbonnier & Féral (1984b) consider *Polyplektana kallipeplos* conspecific with *P. kefersteini*. However, the branched miliary granules of the tentacles of the former are typical and have never been described for the latter. Moreover, the quadrangular anchor-plates (fig. 88e) and the branched miliary granules of the body wall clearly separate *P. kallipeplos* from *P. kefersteini*. *Polyplektana kallipeplos* is also close to *P. nigra* but the latter lacks ossicles in the tentacles. Because the absence of miliary granules in the tentacles is a constant character of *P. kefersteini*, the specimens described by Chao & Chang (1989) from Taiwan could be *P. kallipeplos*.

Polyplektana kefersteini (Selenka, 1867)
(figs 90a-f, 91; 113h)

Synapta Kefersteini Selenka, 1867: 360, pl. 20 figs 120-121.

Polyplektana kefersteini; Townsley & Townsley, 1972: 176; Tortonese, 1977: 275; Tan Tiu, 1981: 61, pl. 3 figs 1-2; Price, 1982: 12; Cherbonnier & Féral, 1984b: 840, fig. 24A-N (synonymy and records); A.M. Clark, 1984: 99; Marsh et al., 1993: 65; Liao & A.M. Clark, 1995: 533, fig. 327a-d; Rowe & Gates, 1995: 334; Massin, 1996a: 167, fig. 12A-E (records); Liao, 1997: 268, fig. 159a-d.

Polyplektana kefersteinii; Endean, 1956: 132; Endean, 1957: 254.

Material.— IRSNB IG.28251/2 (1 specimen), Gusung Reef, 22.viii.94, 4 m depth, under coral slab; RMNH Ech. 6093 (1 specimen), Samalona NW, 21.ix.94, 8 m depth, under coral rubble.

Description.— Specimens 150 × 9 and 130 × 10 mm, uniformly brown or reddish with beige tentacles (fig. 113h); in alcohol uniformly beige-white. Tentacles 15-19 with 18-32 pairs of digits not united by a web. Skin sticky to the touch.

Calcareous ring composed of 2 interradial pieces alternating with one radial piece (fig. 90a); radial pieces perforated for the nerve. Huge cartilaginous ring (fig. 90a) masking partly the calcareous ring. Numerous long, thin Polian vesicles; one single, straight, stone canal ending in a narrow madreporic plate.

Ossicles of body wall anchors, anchor-plates and small branched ossicles, similar anteriorly and posteriorly. Anchors 240-300 × 120-180 µm (fig. 90b), slightly larger anteriorly than posteriorly; vertex with 4-9 quadrangular teeth; stock finely dented (fig.

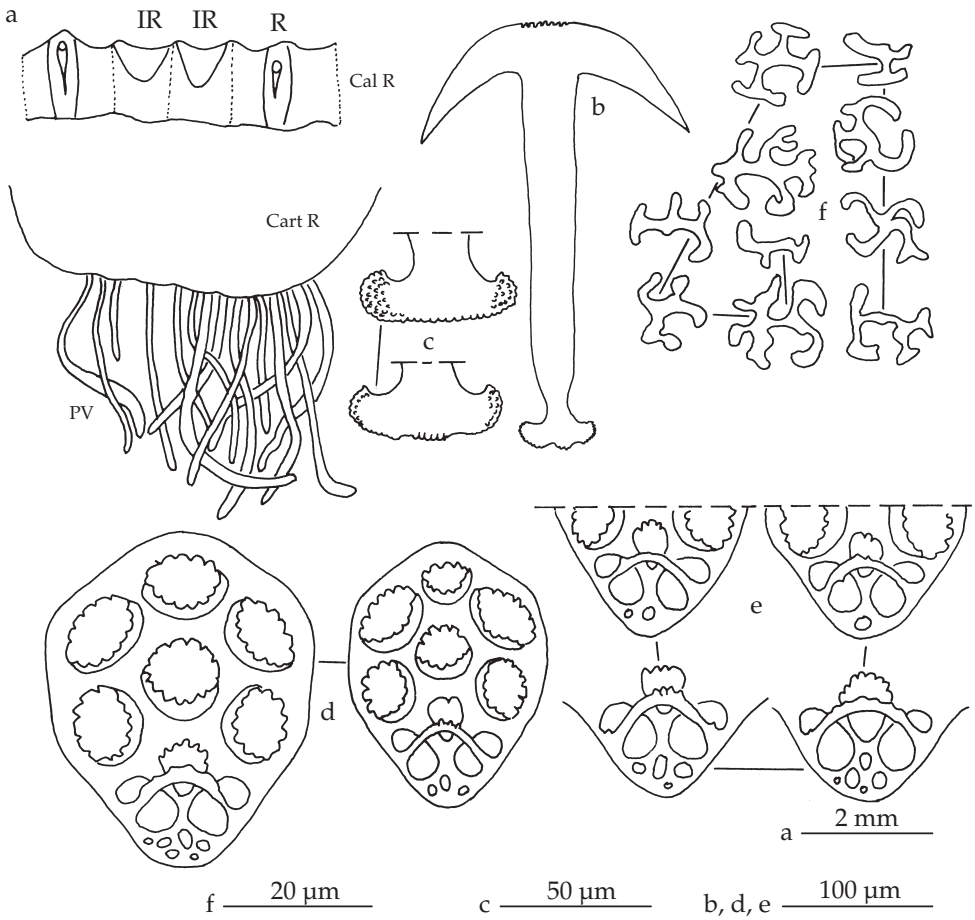


Fig. 90. *Polyplektana kefersteini* (Selenka, 1867). a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; PV: Polian vesicles; R: radial piece); b: body wall anchor; c: anchor stock; d & e: body wall anchor-plates; f: body wall branched rods.

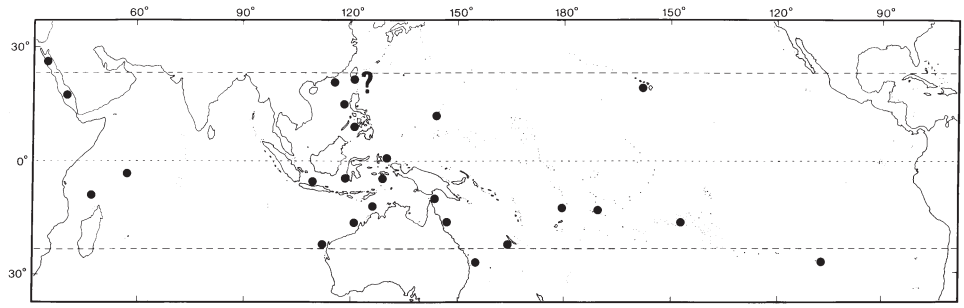


Fig. 91. Distribution of *Polyplektana kefersteini* (Selenka, 1867).

90c). Anchor-plates ovate, 170-225 × 135-185 µm (fig. 90d) with 7 serrated holes, two smooth articular holes and 1-6 small posterior holes (fig. 90e); bridge with 1-5 small, blunt spines. Branched ossicles 9-17 µm long (fig. 90f). No ossicles in the tentacles.

Geographic distribution (fig. 91).— Red Sea, Seychelles (Mahé, Aldabra), Indonesia (Java, Sulawesi, Ambon, Halmaheira), Philippines, Taiwan, China, Mariana Islands (Guam), Australia (WA, NT, Timor Sea, QLD, NSW, Tasman Sea), New Caledonia, Fiji (Rotuma), Samoa (Navigator), Line Islands (Fanning Island), **Hawaiian Islands** = type locality, Society Islands (Tahiti), Easter Island.

Remarks.— The number of tentacles and the number of digits per tentacle vary greatly in *Polyplektana kefersteini* (Heding, 1928; Cherbonnier & Féral, 1984b) even in specimens from a single locality. However, calcareous ring, anchors, anchor-plates and branched ossicles are constant throughout the range of distribution. Only specimens from Easter Island lack branched miliary granules in the body wall (Massin, 1996a). *Poyplektana kefersteini* is characterized by the absence of miliary granules in the tentacles (Selenka, 1867; H.L. Clark, 1907; Heding, 1928; Cherbonnier & Féral, 1984b; Féral & Cherbonnier, 1986; Massin, 1996a). Only H.L. Clark (1924) described minute oblong granules (6-10 µm long) from the very tip of the tentacles of specimens from Hawaiian Islands. The specimens described by Chao & Chang (1989) from Taiwan have small rods, up to 45 µm long, in the tentacles and quadrangular anchor-plates with a spiny bridge. These characters are totally atypical for *P. kefersteini* and therefore we are possibly dealing with *P. kallipeplos*.

Genus *Synapta* Eschscholtz, 1829
Synapta maculata (Chamisso & Eysenhardt,1821)
(fig. 92)

Holothuria maculata Chamisso & Eysenhardt, 1821: 325, pl. 25.

Synapta maculata; H.L. Clark, 1907: 78, pl. 1, pl. 4 figs 17-19, 26 (synonymy); Serene, 1937: 26; Dawydoff, 1952: 117; Endean, 1956: 132, 138; Endean, 1957: 255; Endean, 1961: 295; A.M. Clark & Spenser-Davies, 1966: 600; James, 1969: 62; Liao, 1975: 220, fig. 22 (1-3); Tortonese, 1977: 276; Sloan et al., 1979: 124; Tortonese, 1979: 316; Mary Bai, 1980: 28, textfig. 13C; Humphreys, 1981: 36; Tan Tiu, 1981: 60, pl. 2 figs 1-2, pl. 29 figs 1, 2b; Price, 1982: 12; James, 1982a: 99, fig. 1l-m; James, 1982b: 5; Mukhopadhyay & Samanta, 1983: 310, textfig. 11A-B; Rowe, 1983: 161; James, 1983: 93; Reyes-Leonardo, 1984a; 153, pl. 11 fig. 1a-b; A.M. Clark, 1984: 99; Price & Reid, 1985: 7; Brouns & Heijs, 1985: 176; Reyes-Leonardo et al., 1985: 276; Marsh, 1986: 74; Massin & Doumen, 1986: 188;

Féral & Cherbonnier, 1986: 106, fig. 40X; Mukhopadhyay, 1988: 10, fig. 10a-b; Cherbonnier, 1988: 251, fig. 112A-F (synonymy and records); Jangoux et al., 1989: 163; Chao & Chang, 1989: 120, figs 26, 31D; James, 1989: 132; Zoutendijk, 1989: 2; Chambers, 1989: 89; Levin & Dao Tan Ho, 1989: 59; Marsh et al., 1993: 65; Kerr, 1994: 171; Marsh, 1994a: 11; Fiege et al., 1994: 86; Allen & Steene, 1994: 247; Rowe & Gates, 1995: 336; Liao & A.M. Clark, 1995: 539, fig. 333a-c; Gosliner et al., 1996: 284, fig. 1047; Massin, 1996b: 46, fig. 33A-B; Liao, 1997: 278, fig. 166a-c; Rowe & Richmond, 1997: 306.

Material.— Panikiang, 30.viii.94, several specimens observed on reef flat; Kapoposang, 1.x.-94, numerous specimens observed in seagrass-bed.

Geographic distribution (fig. 92).— Red Sea, SE Arabia, Kenya, Zanzibar, Seychelles (Mahé, Aldabra), Madagascar, Mauritius, Maldive Islands, India (Laccadive Islands, Andaman Islands, Nicobar Islands), Sri Lanka, Cocos Keeling Islands, Indonesia (Sumatra, Java, Lombok, Sumbawa, Sumba, Savu, Rotti, Timor, Salayer, Sulawesi, Makassar Strait, Celebes Sea, Halmaheira, Ceram, Ambon, Lucipara Islands, Irian Jaya), Philippines, Vietnam, Taiwan, China, Japan, Mariana Islands (Guam), Papua New Guinea (Port Moresby, Samarai, Madang Province), Australia (WA, NT, Timor Sea, GBR, QLD), New Caledonia, New Hebrides, Caroline Islands (Kosrae), Gilbert Islands, **Marshall Islands** = type locality, Vanuatu (= New Hebrides), Fiji, Samoa, Cook Island, Society Islands (Tahiti).

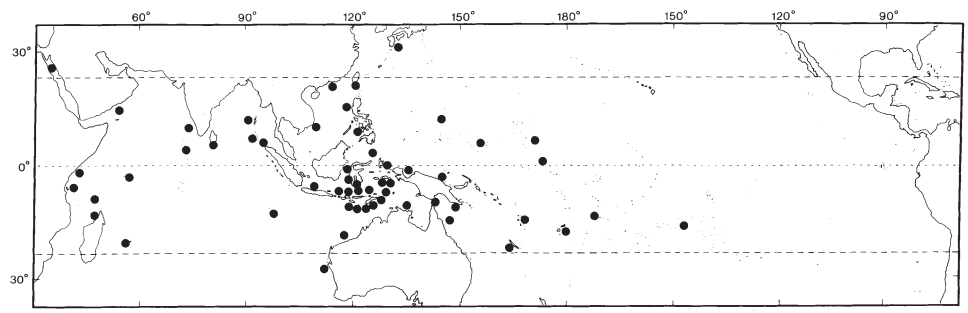


Fig. 92. Distribution of *Synapta maculata* (Chamisso & Eysenhardt, 1821).

Description and remarks.— *Synapta maculata* was observed at Panikiang and Kapoposang. At both sites the species is abundant in shallow seagrass-beds of the reef flat and lagoon. No specimens were collected because the species can be readily identified without doubt in the field. *Synapta maculata* has been reported from many localities in Indonesia (see Sluiter, 1901).

Genus *Synaptula* Oersted, 1849
Synaptula cf *denticulata* Heding, 1928
(figs 93a-l, 94, 113j)

Synaptula denticulata Heding, 1928: 177, fig. 22 (1-4); A.M. Clark & Rowe, 1971: 186.

Material.— RMNH Ech. 6094 (1 specimen), Samalona NW, 2.ix.94, 10 m depth; IRSNB IG.28251/137 (1 specimen), Samalona NW, 21.ix.94, 5 m depth in between living corals.

Description.— Specimens 136 × 9 and 176 × 8 mm, light brown with white dots and orange muscular bands (fig. 113j); in alcohol yellowish. Tentacles 13 with 18-30 pairs of digits united by a web. Skin thin, translucent, very sticky to the touch.

Calcareous ring white, completely embedded in a huge cartilaginous ring; radial pieces perforated for the nerve and with scars at the insertion points of the longitudinal muscles (fig. 93a); laterally, 2 interradial pieces alternating with a radial one. Cartilaginous ring with small perforations through the posterior margin (fig. 93a). At least 10 Polian vesicles 2.5 mm long; one stone canal, straight, going upwards and

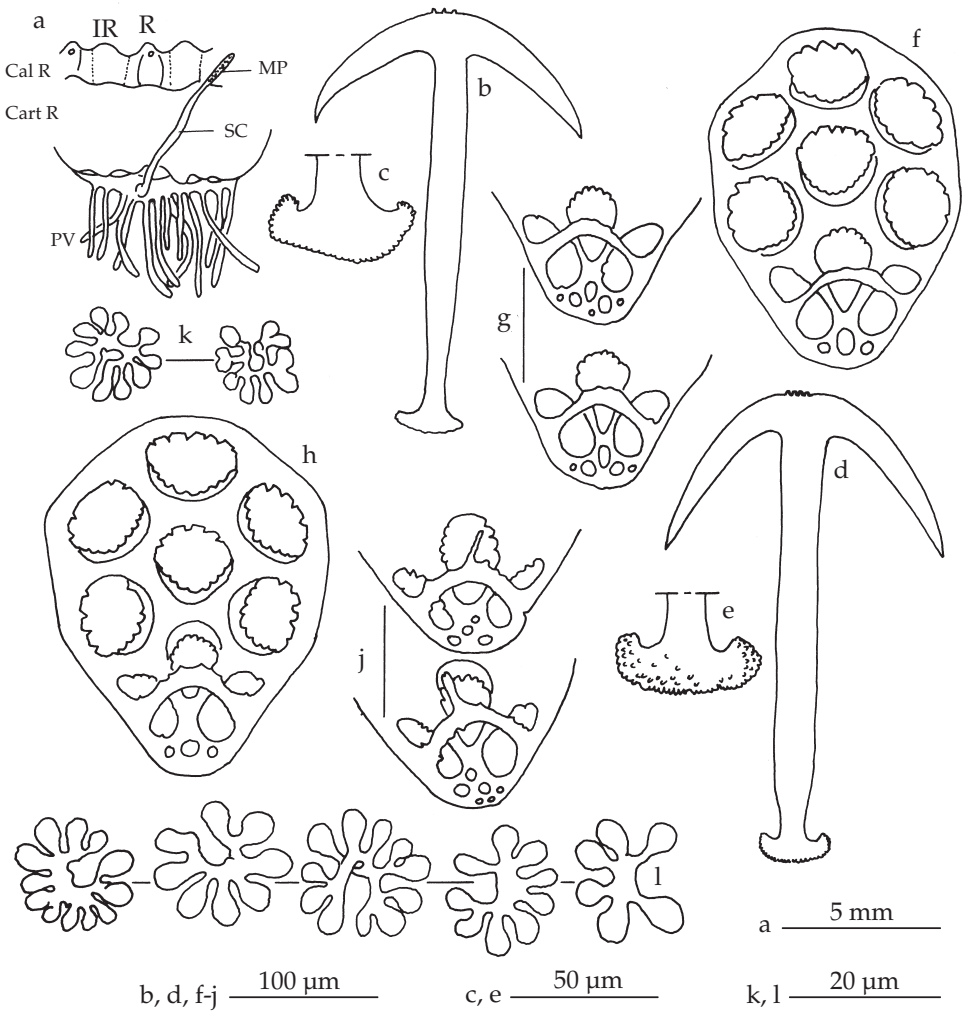


Fig. 93. *Synaptula* cf *denticulata* Heding, 1928. a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; MP: madreporic plate; PV: Polian vesicles; R: radial piece; SC: stone canal); b: anchor from anterior body wall; c: stock of anterior body wall anchor; d: anchor from posterior body wall; e: stock of posterior body wall anchor; f & g: anchor-plates from anterior body wall; h & j: anchor-plates from posterior body wall; k: miliary granules from body wall; l: miliary granules from tentacles.

ending in a elongated madreporic plate (fig. 93a). Gonad well developed, formed from branched tubules.

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors with the same size anteriorly (fig. 93b) and posteriorly (fig. 93d): 282.0±13.3 (n = 15) µm long in the 136 mm long specimen, 299.3±20.4 (n = 20) µm long in the 176 mm long specimen; arms smooth, a few knobs on the vertex, stock finely dented (figs 93e). Anchor-plates ovates (figs 93f, h) with 6 serrated holes, 3 articular holes [central one nearly always serrated (figs 93 f, j), lateral ones smooth or serrated (figs 93g, j)], and a bridge with 3-4 blunt spines (figs 93f, h). Large specimen posteriorly with sharp teeth on the bridge, central tooth being sometimes prominent (fig. 93j). The number of posterior small holes is 4.1±1.1 (n = 32) in anteriorly located anchor-plates and 3.8±1.0 (n = 36) in posteriorly located ones. Most of the miliary granules as dissociated grains; when intact, 13 µm across (fig. 93k). In the tentacles miliary granules only, 14-29 µm across (fig. 93l).

Geographic distribution (fig. 94).— Indonesia (Sulawesi, **Kai Islands** = type locality).

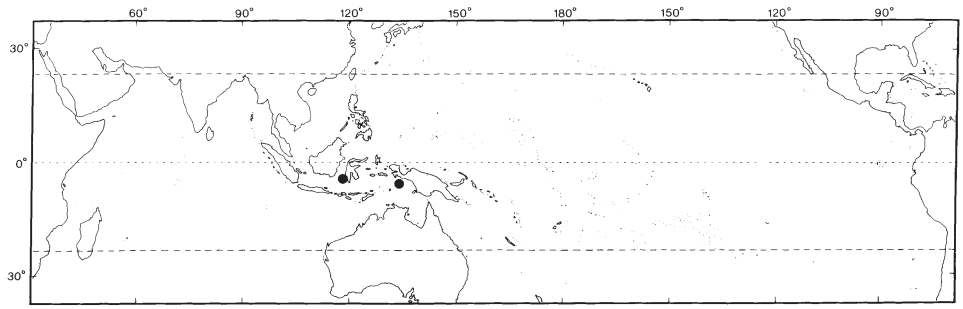


Fig. 94. Distribution of *Synaptula denticulata* Heding, 1928.

Remarks.— According to the key given by Heding (1928) the specimens from Sulawesi must be *Synaptula denticulata*. However, because of the colour of the body wall (light brown with white dots instead of colourless mottled with green and white) and the calcareous ring colour (white instead of green), and added to this the average number of posterior holes through the anchor-plates (4 instead of 7) doubt remains. The bulk of the type material of Heding (1928) consists of small specimens of 6-8 cm long. This disparity in size with the present material could explain some differences with the type material.

Synaptula cf. *lamperti* Heding, 1928
(figs 95a-h, 96, 114a)

Synaptula lamperti Heding, 1928: 193, fig. 25 (6-8); Cheng & Lewin, 1984: 95; Hammond & Wilkinson, 1985: 3, fig. 1; Rowe & Gates, 1995: 337.

Material.— IRSNB IG.28251/125 (1 specimen), Samalona NW, 16.ix.94, 7 m depth.

Description.— Specimen 46 × 4.2 mm, white with 5 radial purple stripes over the

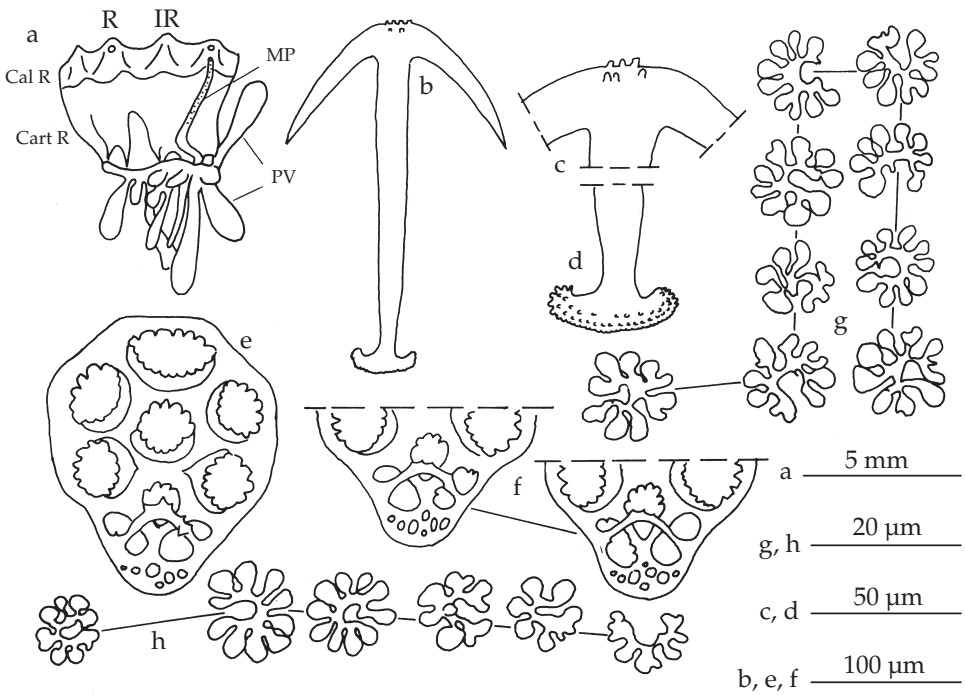


Fig. 95. *Synaptula* cf. *lamperti* Heding, 1928. a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; MP: madreporic plate; PV: Polian vesicles; R: radial piece); b: body wall anchor; c: anchor vertex; d: anchor stock; e & f: body wall anchor-plates; g: miliary granules from body wall; h: miliary granules from tentacles.

whole body length (fig. 114a); anterior quart of the stripes bifurcate; some very fine longitudinal purples lines are present in the interrambulacral areas; in alcohol pure white. Tentacles 10, each with about 20 pairs of digits. Presence or absence of a web between the digits could not be verified due to the strong contraction of the tentacles.

Calcareous ring faint, white; radial pieces perforated for the nerve (fig. 95a). Cartilaginous ring well developed, translucent, with holes of various size close to the ring canal of the water vascular system (fig. 95a). Polian vesicles 11 and one stone canal going upwards with a long cylindrical madreporic plate (fig. 95a). Prominent intestinal loop.

Ossicles of body wall anchors, ancho-plates and miliary granules. Anchors (fig. 95b) 215-245 × 140-160 µm; arms smooth, vertex with 4-7 quadrangular teeth (fig. 95c), stock finely dented (fig. 95d). Anchor-plates (fig. 95e) 175-190 × 145-160 µm, quadrangular with 7 serrated holes, 2 smooth or serrated articular holes and 5-8 small posterior holes (fig. 95f); bridge spiny with central tooth sometimes longer than the others. Miliary granules very abundant (fig. 95g), 11-14 µm across. In the tentacles miliary granules only, 9-14 µm across (fig. 95h).

Geographic distribution (fig. 96).— Indonesia (Sulawesi, **Banda** = type locality); Palau Islands; Australia (NE coast, N coast, QLD, NT).

Remarks.— By body size and colour, size and form of the ossicles (anchors,

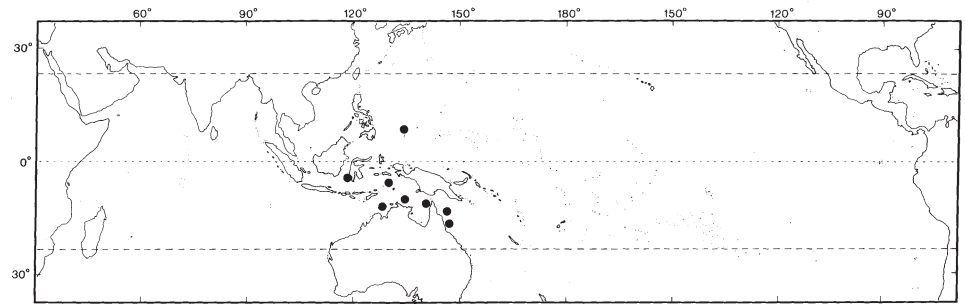


Fig. 96. Distribution of *Synaptula lamperti* Heding, 1928.

anchor-plates and miliary granules), number of tentacles and digits per tentacle, calcareous and cartilaginous rings, number of Polian vesicles, the Sulawesi specimen is very similar to *Synaptula lamperti* Heding, 1928. However, Heding (1928) mentioned the absence of an intestinal loop (present in the Sulawesi specimen) and the constant presence of 9 holes in the posterior end of the anchor-plates (versus 5-8 in the Sulawesi specimen). Because of these differences I am not convinced that we are dealing with *S. lamperti* and I prefer to refer to the specimen as *Synaptula* cf. *lamperti*.

Synaptula media Cherbonnier & Féral, 1984
(figs 97a-f, 98)

Synaptula media Cherbonnier & Féral, 1984b: 843, fig. 25A-F, pl. 4A-B; Féral & Cherbonnier, 1986: 106, fig. 40Y; Colin & Arneson, 1995: 264, fig. 1237.

Material.— IRSNB IG.28251/215 (1 specimen), Kapoposang NE, 30.ix.94, 31 m depth, observed on 3 different species of sponges.

Description.— Specimen 115 × 6 mm, grey-white with numerous longitudinal, purple lines; in alcohol completely white. Tentacles 10, each with 14-16 digits united by a web; skin thin, sticky to the touch.

Calcareous ring very fine, white; radial pieces perforated for the nerve; posterior edge of the calcareous ring undulating (fig. 97a). Cartilaginous ring moderately developed (fig. 97a), translucent; 10 Polian vesicles; one short stone canal; gonad composed of several large branched tubules. Longitudinal muscle bands narrow.

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors located posteriorly (fig. 97b) slightly smaller (216±5.5 × 140±6.8, n = 8) than those located anteriorly (fig. 97c) (230±10.3 × 150.5±6.0, n = 9); arms smooth, vertex with 3-6 blunt spines, stock finely dented. Size of anchor-plates similar anteriorly and posteriorly (fig. 97d) (176±3.0 × 140±4.0, n = 10); quadrangular with 6 serrated holes and one smooth hole (fig. 97d); articular holes smooth, 3-7 posterior holes in the anterior anchor-plates and 3-4 in the posterior ones; bridge spinose. Countless small miliary granules, 10-14 µm across (fig. 97e), most of them as dissociated grains. In the tentacles miliary granules only, few, 11-15 µm across (fig. 97f).

Geographic distribution (fig. 98).— Indonesia (Sulawesi), Micronesia, Papua New

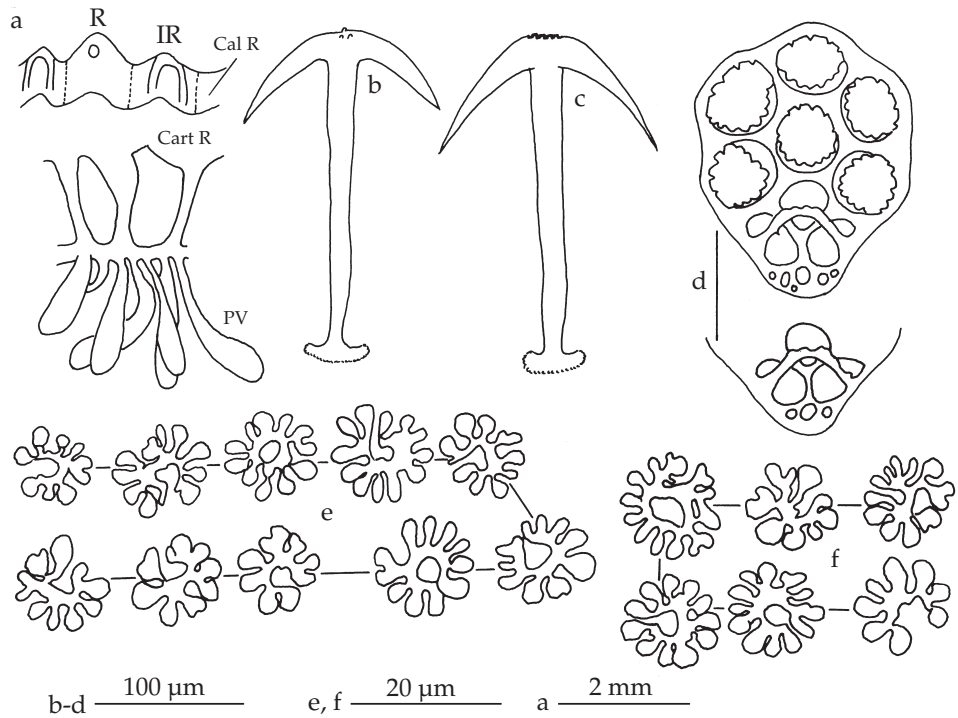


Fig. 97. *Synaptula media* Cherbonnier & Féral, 1984. a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; PV: Polian vesicles; R: radial piece); b: anchor from anterior body wall; c: anchor from posterior body wall; d: body wall anchor-plates; e: miliary granules from body wall; f: miliary granules from tentacles.

Guinea, **New Caledonia** = type locality.

Remarks.— The specimen from Sulawesi is much larger than those of the type series (115 mm versus 10-40 mm). However, the ossicles and calcareous ring are identical to the type series, both as regrads types and sizes (see Cherbonnier & Féral, 1984b). The species seems always related to sponges, living between 8 and 31 m depth. *Synaptula media* is new to the fauna of Indonesia.

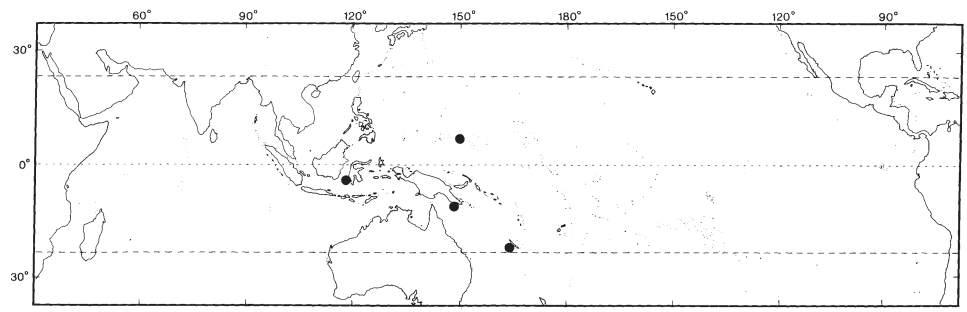


Fig. 98. Distribution of *Synaptula media* Cherbonnier & Féral, 1984.

Synaptula psara (Sluiter, 1887)
(figs 99a-f, 100)

Synapta psara Sluiter, 1887: 219, pl. 2 figs 36-39; Ludwig, 1889-92: 357; Sluiter, 1895: 82.
Chondrocloea psara; Oestergren, 1898: 114: Sluiter, 1901: 126.
Synaptula psara; H.L. Clark, 1907: 84; H.L. Clark, 1924: 475, pl. 3 figs 7-8, pl. 4 fig. 5; Heding, 1928: 176, fig. 24 (4-11): A.M. Clark & Rowe, 1971: 186.

Material.— IRSNB IG.28251/13 (2 specimens), Samalona N, 24.viii.94, 9 m depth; IRSNB IG.28251/249 (1 specimen) and RMNH Ech. 6095 (1 specimen), Badi, 3.x.94, 2 m depth among coral rubble.

Description.— Length ±175 × 14 mm, 22 × 3 mm (anterior part only), >200 × 10 and >200 × 9 mm, estimated because specimens fallen apart into fragments; body cylindrical tapering posteriorly; diameter given corresponds to the anterior part at the level of the calcareous ring. Colour varied from light to dark brown with white spots corresponding to heaps of miliary granules; in alcohol yellowish to pinkish with the white spots still visible. Tentacles 13, with 22-29 pairs of digits united by a web; the 2 ventral tentacles shorter, sometimes reduced to finger without digits; two specimens with 1-3 regenerating tentacles. Skin sticky to the touch, especially thick (1-2 mm) anteriorly.

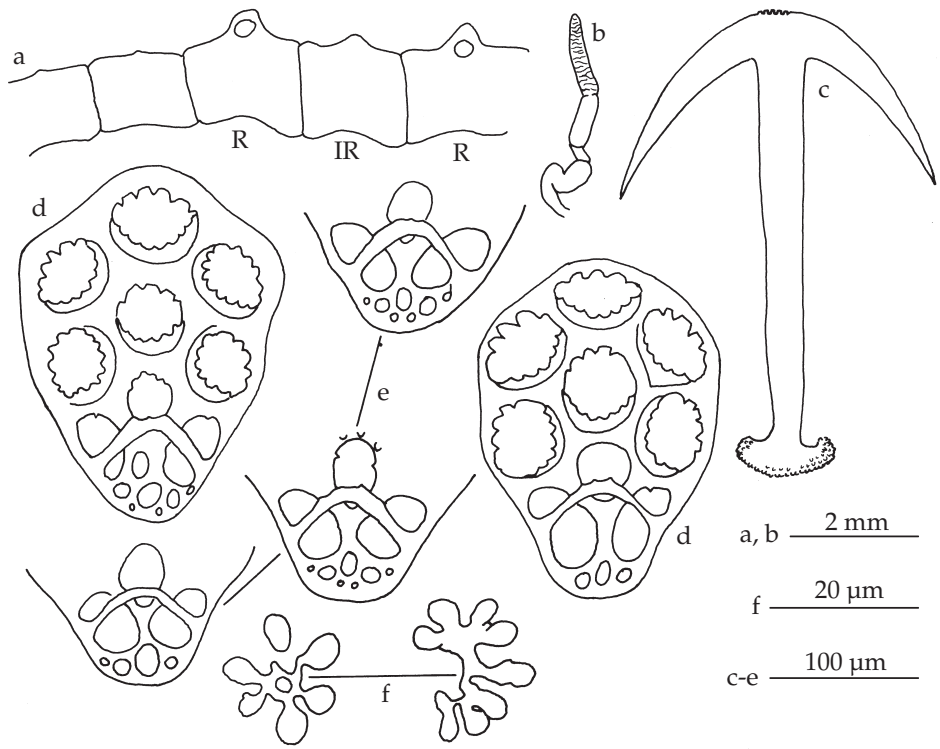


Fig. 99. *Synaptula psara* (Sluiter, 1887). a: calcareous ring (IR: interradial piece; R: radial piece); b: stone canal and madreporic plate; c: body wall anchor; d & e: body wall anchor-plates. f: miliary granules from tentacles.

Calcareous ring (fig. 99a) white, completely embedded in a large cartilaginous ring. Radial pieces perforated for the nerve; laterally, 2 interradial pieces alternating with one radial piece (fig. 99a), whereas dorsally and ventrally one radial alternating with one interradial piece. Cartilaginous ring with small perforations through its posterior margin. At least 10 Polian vesicles, 4-8 mm long. One stone canal going upwards ending in a long madreporic plate (fig. 99b). Gonad well developed, composed of branched tubules.

Ossicles of body wall anchors, anchor-plates and miliary granules. Statistically, anchors (fig. 99c) of the same size anteriorly (321.5±6.7 µm long) and posteriorly (326±21.4 µm long); arms smooth, vertex with 4-8 small blunt teeth, stock finely dented (fig. 99c). Anchor-plates (fig. 99d) slightly larger posteriorly (241±7.7 µm long) than anteriorly (220±6.2 µm long); plates ovate (fig. 99d) with 6 anterior, serrated holes; articular holes smooth or with a few spines (fig. 99e); bridge smooth or with 1-4 blunt spines; posterior holes more numerous (5.1±1.5; n = 22) on anterior anchor-plates than on posterior ones (4.3±1.1; n = 24). Miliary granules only as dissociated grains. In the tentacles miliary granules only, concentrated in heaps. Most of them as dissociated grains; the intact ones 17-20 µm across (fig. 99f).

Geographic distribution (fig. 100).— Indonesia (Java: **Jakarta Bay** = type locality), Sulawesi, Salayer, Kai Islands).

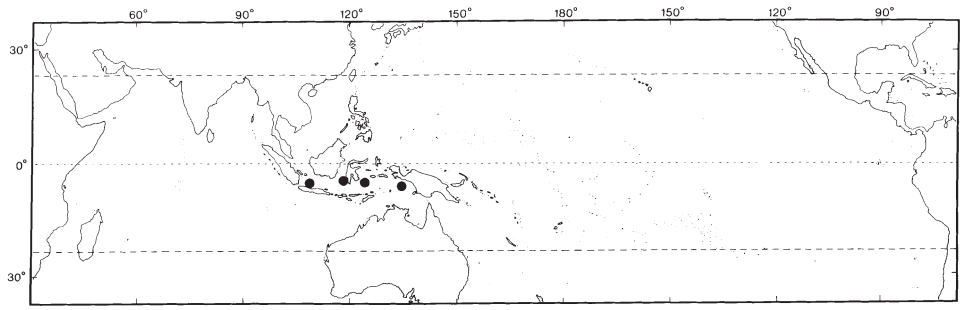


Fig. 100. Distribution of *Synaptula psara* (Sluiter, 1887).

Remarks.— *Synaptula psara* can readily be identified by its relatively thick anterior body wall, by the heaps of miliary granules and by its ovate, elongated anchor-plates. According to H.L. Clark (1924), Heding (1928) and the present work, the size of the anchors and anchor-plates increases with increasing body length.

Synaptula recta (Semper, 1868)
(figs 101a-k, 102, 114b, c)

Synapta recta Semper, 1868: 14, pl. 4 figs 2-3, pl. 5 fig. 18, pl.8 fig. 2; Lampert, 1885: 220; Bedford, 1899, 142; Koehler, 1895b: 385.

Chondrochloea recta; Oestergren, 1898a: 114; Sluiter, 1901: 125; Erwe, 1913: 390, pl.8 fig. 26a-b (synonymy and records); Ekman, 1918: 63; Endean, 1953: 57; Endean, 1956: 132; Endean, 1957: 255; Endean, 1961: 295.

Synaptula recta; H.L. Clark, 1907: 84 (synonymy); H.L. Clark, 1924: 475, pl. 1 fig. 13, pl. 3 fig. 9, pl. 4 fig. 3; Heding, 1928: 167, figs 16 (4-6), 17 (3-8); H.L. Clark 1932: 221; Tortonese, 1953: 46; A.M. Clark &

Spenser-Davies, 1966: 600; Tortonese, 1977: 276; Tortonese, 1979: 316; James, 1982a: 101, fig. 1n (synonymy and records); James, 1982b: 5; Price, 1982: 12; James, 1984 [1988]: 405; Mukhopadhyay, 1988: 15; Levin & Dao Tan Ho, 1989: 59; Marsh et al., 1993: 65; Marsh, 1994a: 11; Marsh, 1994b: 57; Rowe & Gates, 1995: 338; Tahera, 1996: 106; Tahera, 1997: 92; Baine & Forbes, 1998: 4.

Synapta striata Sluiter, 1887: 216, pl. 2 figs 39-40.

Material.— IRSNB IG28.251/136 (1 specimen), Samalona NW, 21.ix.94, 5 m depth, in between living corals; IRSNB IG.28252/138 (1 specimen), Samalona NW, 21.ix.94, 5 m depth; RMNH Ech. 6072 (1 specimen), Badi, 3.x.94, 2 m depth.

Description.— Specimens 190 × 9, 84 × 16 and 194 × 10 mm, colour varied from nearly black to brown, speckled with white spots corresponding to heaps of miliary granules (figs 114b, c); in alcohol grey-beige speckled with white spots. Skin sticky to the touch. Tentacles 13, with 19-20 pairs of digits not united by a web. Heaps of miliary granules sometimes forming white transversal bands in the tentacles.

Calcareous ring composed of radial and interradial pieces of the same size (fig. 101a); radial pieces perforated for the nerve. Huge cartilaginous ring partly masking the calcareous ring (fig. 101a); posterior part of the calcareous ring straight or slightly undulating. A few perforations at the base of the cartilaginous ring. Polian vesicles 15-20, very variable in size. One stone canal going upwards and ending in a madreporic plate 1/3 the length of the stone canal.

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors of the two largest specimens (fig. 101b) of similar size anteriorly and posteriorly (330.5±13.2 × 224.0±5.2 µm versus 326.5±18.3 × 210.5±15.5 µm; n = 10); a few tooth on the vertex, arms smooth and stock finely dented (fig. 101c). Anchors of the small specimen also of the same size anteriorly and posteriorly (274.5±10.7 × 172.5±8.3 µm and 273.0±15.7 × 161.5±8.5 µm; n = 10); arms smooth, vertex with a few knobs, stock finely dented, occasionally divided into several lobes (fig. 101c). Anchor-plates of the two large specimens (figs 101d, f) of the same size anteriorly and posteriorly (225.5±5.5 × 166.0±5.2 µm and 235.0±11.5 × 185.5±9.0 µm; n = 10), more ovoid anteriorly (fig. 101d); 6 serrated holes; articular holes smooth or serrated; bridge spiny with spines more prominent on posteriorly located anchor-plates; sometimes a strong median spine (figs 101e, g); 3-7 posterior holes with an average of 5.0±1.0 whatever the location of the anchor-plates (figs 101e, g). On one slide (IRSNB IG 28256/136) posterior holes of posteriorly located anchor-plates less numerous (2-7 with an average of 3.7±1.0). Anchor-plates of the small specimen of the same size anteriorly and posteriorly (203.5±6.3 × 154.5±4.4 µm and 191.0±10.7 × 157.0±5.9 µm; n = 10), ovate to quadrangular with 6 serrated holes; central articular hole serrated, lateral ones smooth; bridge knobbed to spiny, exceptionally with a strong median tooth; posterior holes 3-7 with an average of 5.7±1.1 (n = 15) in anteriorly located anchor-plates and 4.6±1.3 (n = 21) in posteriorly located ones. Miliary granules 12-16 µm across irrespective of the position along the body wall (figs 101h, j). In the tentacles miliary granules only (fig. 101k), somewhat larger (16-19 µm across) than in the body wall. In the small specimen, most of them as dissociated grains.

Geographic distribution (fig. 102).— Red Sea, French Somalia, Pakistan, Maldive Islands, Sri Lanka, India (Laccadive Islands, Gulf of Mannar, Madras, Andaman & Nicobar Islands), Myanmar (Mergui Archipelago), Cocos Keeling Islands, Malaysia,

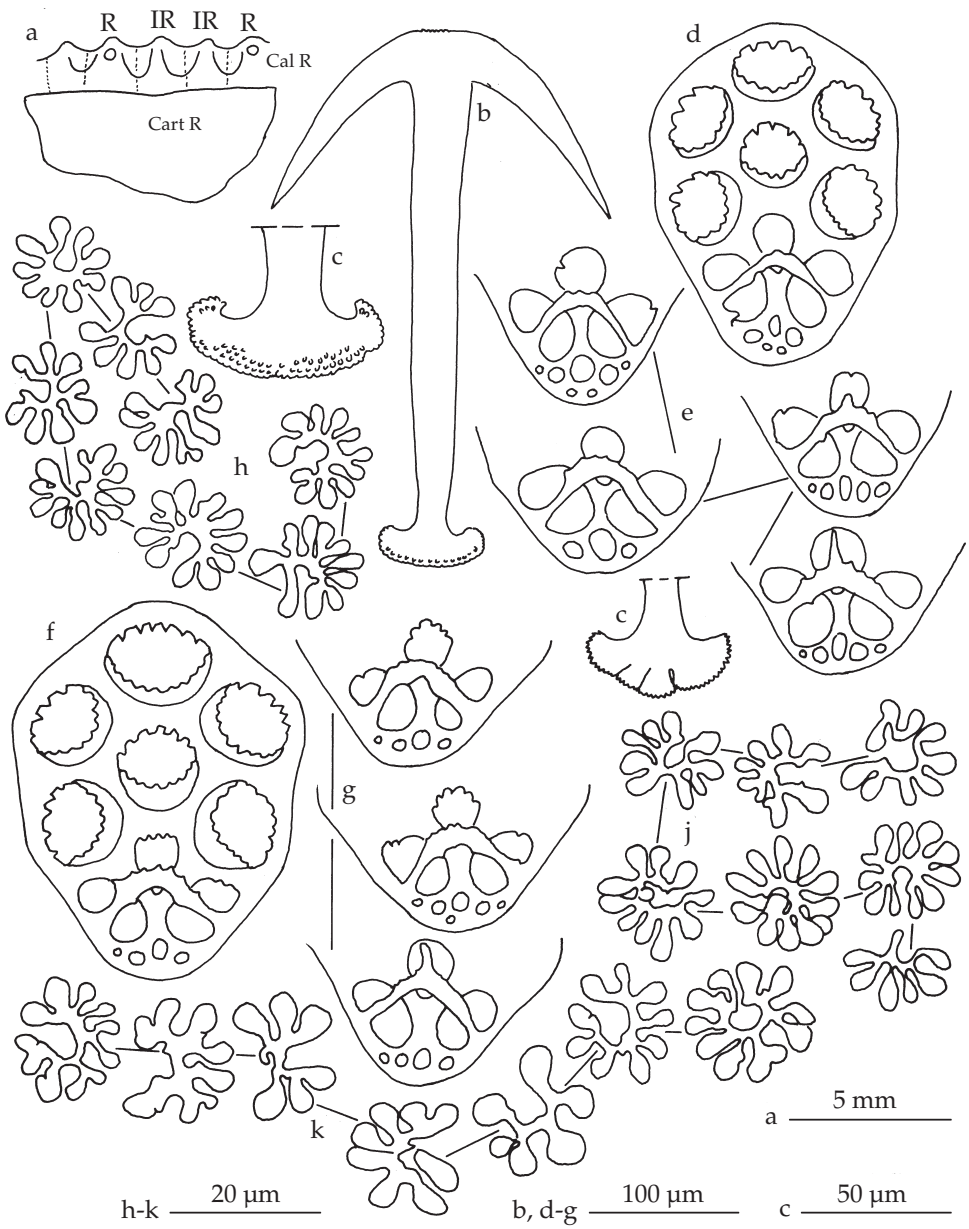


Fig. 101. *Synaptula recta* (Semper, 1868). a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; R: radial piece); b: body wall anchor; c: anchor stock; d-g: body wall anchor-plates; h: miliary granules from anterior body wall; j: miliary granules from posterior body wall; k: miliary granules from tentacles.

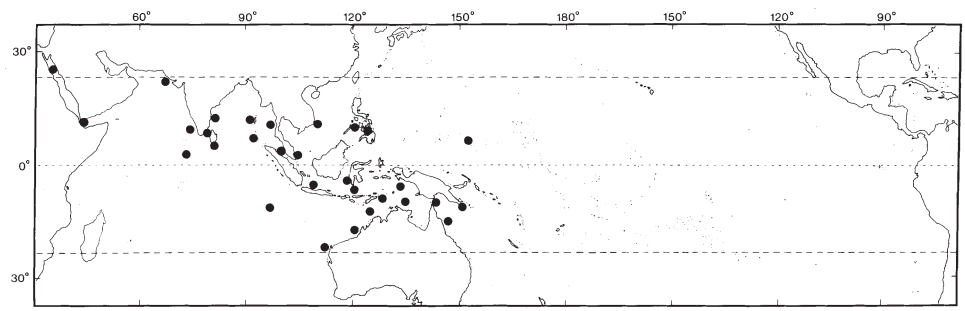


Fig. 102. Distribution of *Synaptula recta* (Semper, 1868).

Indonesia (Java, Salayer, Sulawesi, Timor, Kai Islands), Philippines (**Bohol** = type locality, Cebu, Samar), Vietnam, Australia (WA, NT, Timor Sea, QLD), Papua New Guinea (Samarai), Caroline Islands (Ponape).

Remarks.— The specimens from Sulawesi fit particularly well the description given by Heding (1928), except for the colour. However, the colour of *Synaptula recta* is highly variable ranging from bright reddish to deep brownish-purple. According to Pearson (1903) it can also be "striped lilac on a white ground" or according to Endean (1961) "olive". H.L. Clark (1907, 1946) noted that the species is "extraordinarily variable in colour". Notwithstanding these, the colour patterns described by Pearson (1903) and Endean (1961) are so different from the average found in *S. recta* that it throws some doubt on the identification of these two authors. The small specimen with a slightly undulating posterior margin of the calcareous ring and the very dark colour (fig. 116c) is close to S*ynaptula striata* (Sluiter, 1887). However, I agree with as H.L. Clark (1907) and Erwe (1913) that *S. striata* could be a synonym of *S. recta* because the main character to separate both species is based on the body wall colour (Heding, 1928) which, as said, is highly variable in *S. recta*.

Synaptula reticulata (Semper, 1868)
(figs 103a-e, 104)

Synapta reticulata Semper, 1868: 13, pl.4 figs 4-5, pl. 5 figs 12, 23, pl. 6 fig.9; Lampert, 1885: 226; Théel, 1886: 27; Sluiter, 1887: 214; Lampert, 1889b: 845; Koehler, 1895b: 385; Sluiter, 1895: 82.
Synapta reticulata var. nigro-punctata Bedford, 1899: 338.
Chondrochloea reticulata ; Oestergren, 1898: 114; Sluiter, 1901: 127.
Synaptula reticulata ; H.L. Clark, 1907: 86; H.L. Clark, 1924: 477; Heding, 1928: 191, fig 25 (1-4); A.M. Clark & Rowe, 1971: 188; Rowe & Doty, 1995: 338; Liao & A.M. Clark, 1995: 541, fig. 334a-c; Liao, 1997: 279, fig 167a-c.
Synaptula oestergreni Heding, 1928: 199, fig.27 (7-10).

Material.— IRSNB IG.28251/228 (1 specimen) and RMNH Ech. 6096 (1 specimen), Kapoposang, 1.x.94, 20 m depth, on sponges and on sand around the sponges; ZMC: 3 paratypes (14.3 × 2.3, 11.2 × 1.8 and 8.8 × 1.9 mm) of *Synaptula oestergreni* Heding, 1928.

Description.— Specimens 11.8 × 1.8 and 13.0 × 3.0 mm, white because of the huge amount of miliary granules in the body wall; in alcohol uniformly white. Ossicles

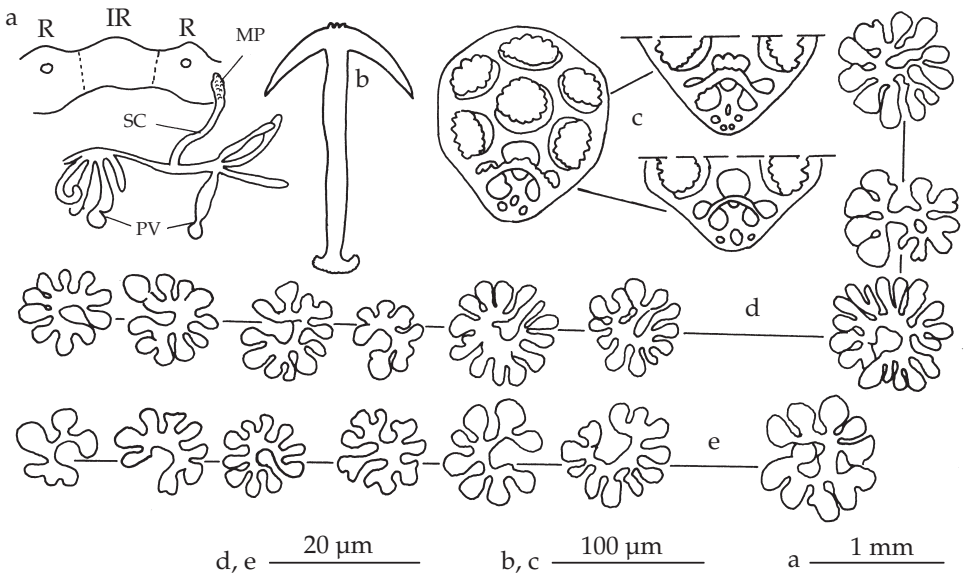


Fig. 103. *Synaptula reticulata* (Semper, 1868). a: calcareous ring (IR: interradial piece; MP: madreporic plate; PV: Polian vesicles; R: radial piece; SC: stone canal); b: body wall anchor; c: body wall anchor-plates; d: miliary granules from body wall; e: miliary granules from tentacles.

give a shiny aspect to the specimens. Tentacles 10 with 6-7 pairs of digits. Because of the state of contraction of the tentacles, the presence or absence of a membrane in between the digits is difficult to ascertain. Tentacles of the 11.2 mm long paratype of *S. oestergreni* with 6-8 pairs of digits.

Calcareous ring white, with radial and interradial pieces of the same size (fig. 103a); radials perforated for the nerve; posterior margin of the calcareous ring undulating. Cartilaginous ring translucent, weakly developed. Polian vesicles 8 in 2 clusters of 4 (fig. 103a); one stone canal going upwards, ending in a narrow madreporic plate. No gonad.

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors few, 158.8±11.8 × 100.0±0.0 µm (n = 4), arms smooth, a few knobs on the vertex and stock finely dented (fig. 103b). Anchor-plates 127.7±10.1 × 109.1±8.6 µm (n = 11), nearly rounded (fig. 103c), perforated by 6 serrated holes; lateral articular holes smooth, central one smooth or with 1-2 teeth (fig. 103c); bridge smooth or spiny; 1-5 posterior holes (fig. 103c) with an average of 3.1±1.0 (n = 22). Miliary granules 10-17 µm across (fig. 103d), not dissociated. In the tentacles miliary granules (fig. 103e) similar to those of the body wall.

Geographic distribution (fig. 104).— China, Philippine (**Bohol** = type locality), Indonesia (Java, Sulawesi, Biaru Islands, Salayer, Sumbawa, Flores, Salawatti, Banda Islands, Kai Islands, Aru Islands), Australia (NE coast, NW coast, GBR, QLD, WA), New Caledonia.

Remarks.— The small size of the specimens and the absence of gonad indicate that we are dealing with juveniles. As many characters (size of ossicles, number of

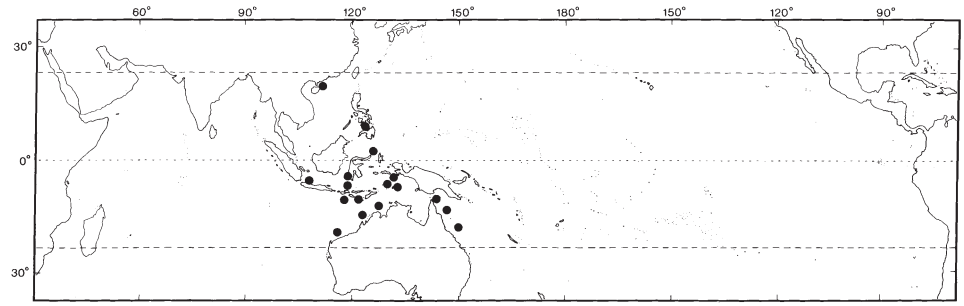


Fig. 104. Distribution of *Synaptula reticulata* (Semper, 1868).

tentacles, number of digits per tentacle, etc.) evolve with increasing body size, juveniles are very difficult to identify. The two specimens from Kapoposang look very much like the paratypes of *S. oestergreni*. All agree in the number of tentacles, number of Polian vesicles, size, general form and the number of posterior holes of the anchorplates, and the size of the anchors. Heding (1928) mentioned 16-20 pairs of digits for specimens 10-40 mm long. However, the 16-20 pairs of digits correspond only to the largest specimen. Smaller ones have the same number of digits as the specimens from Sulawesi (6-8 versus 6-7). It may be emphasized once more that in Synaptidae, the number of digits increases with body length, and that it is important to compare specimens of the same size, when using this character to separate species.

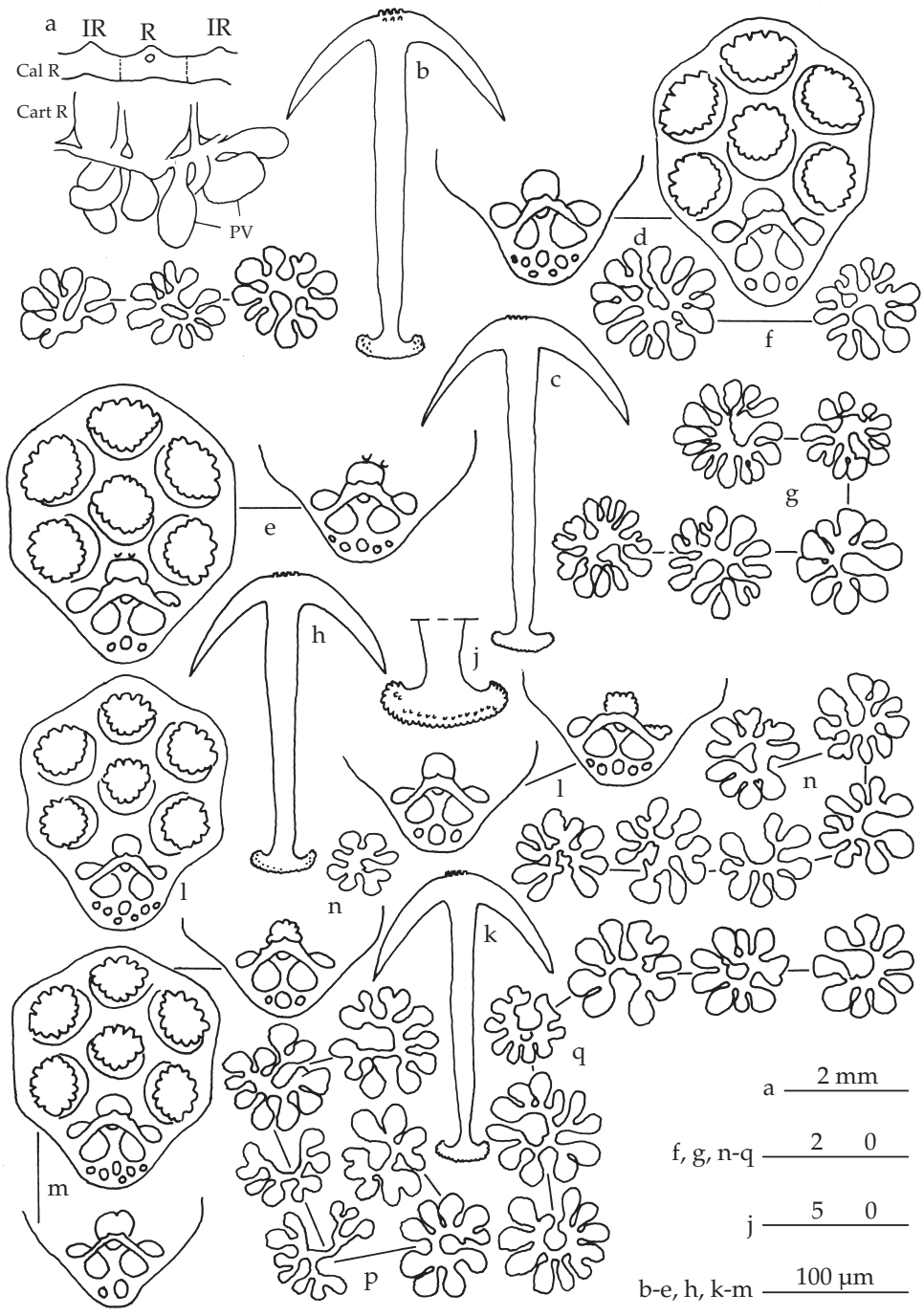
The only difference with the type material of *S. oestergreni* is the amount of miliary granules which is much higher in the specimens from Indonesia than in those from China. Heding (1928) recognised that the type material of *S. oestergreni* corresponds also to juveniles and he was not sure to be dealing with a new species. Since *S. oestergreni* is only known from southern China and since Liao & A.M. Clark (1995) and Liao (1997) recognise only one *Synaptula, S. reticulata,* in southern China, I provisionally consider *S. oestergreni* as a juvenile form of *Synaptula reticulata.* A study of growth series of *S. reticulata* is necessary to solve this problem

Synaptula cf. *reticulata* (Semper, 1868)
(figs 105a-q, 106a-j, 114d-f)

Synaptula lamperti; Gosliner et al., 1996: 284, fig. 1049.

Material.— IRSNB IG 28251/5 (1 specimen), Samalona S, 24.viii.94, 22 m depth; IRSNB IG.28251/9 (31 specimens) and RMNH Ech. 6073 (35 specimens), Samalona S, 24.viii.94, 7 m on sponges; IRSNB IG.28251/10 (2 specimens) and RMNH Ech. 6097 (1 specimen), Samalona S, 24.viii.94, 29 m depth; IRSNB IG.28251/48 (1 specimen) and RMNH Ech. 6098 (1 specimen), Samalona W, 1.ix.94, 8 m depth, on coral rubble; IRSNB IG.28251/55 (7 specimens), Samalona W, 2.ix.94, 12 m depth, on sponges; IRSNB IG.28251/57 (1 specimen), Samalona W, 2.ix.94, 12 m depth, on a sponge and on sand near the sponge; IRSNB IG.28251/165 (one specimen) and RMNH Ech. 6074 (1 specimen), Kudingareng Keke S, 26.ix.94, 15 m depth, on sponges, *Millepora* spec. and *Culcita* spec.

Description.— Eighty-two specimens from 17 × 2.3 to 95 × 5.5 mm. Colour highly variable, from nearly white with a few brown dots (fig. 114f) to white with rusty-red


a
IR
R
IR
Cal R
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n
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a 2 mm
f, g, n-q 2 0
j 5 0
b-e, h, k-m 100 µm

longitudinal lines and speckled with brown dots (fig. 114e). All these colour patterns observed in a single large sample collected on a single sponge (fig. 114d). Generally on sponges [mainly *Xetospongia* spp. (fig. 114d) and *Amphimedon* spp. (fig. 114e)] but also on *Millepora* spec. (Hydrozoa), or *Culcita* spec. (Asteroidea) and on sand or coral rubble. Colour not linked to the colour of the sponge. In small specimens (17-40 mm long) miliary granules very abundant forming broad longitudinal white bands; in alcohol uniformly light grey to white, longitudinal white bands sometimes still visible. Tentacles 10 irrespective of body length; number of digits increasing with increasing body size: from 7-8 pairs of digits (17 mm long specimens) to 15-18 pairs (60-95 mm long specimens); digits united by a web.

Calcareous ring white composed of radial and interradial pieces of the same size; radials perforated for the nerve (fig. 105a); posterior margin of the calcareous ring undulating. Cartilaginous ring translucent, with large posterior perforations (fig. 105a). Seven-15 Polian vesicles and one stone canal going upwards, ending in an elongate madreporic plate.

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors with smooth arms; vertex with a few knobs and stock finely dented (figs 105b, c, h, k). Posterior anchors nearly always somewhat larger than anterior ones; anchors 200-240 × 120-150 µm. No increase of anchor size with increasing body length. Anchor-plates 150-180 × 125-150 µm, quadrangular with 6 serrated holes (figs 105e, d, l, m); central articular hole smooth or with 1-3 small spines; lateral articular holes smooth; posterior holes 1-7 (figs 105e, d, l, m), always more numerous on anterior anchor-plates than on posterior ones. Average number of posterior holes in the anterior anchor-plates, 3-4 in small animals (17-30 µm long) and 4-5 in large ones (40-95 µm long). For the posterior anchor-plates average number of posterior holes 3-4 irrespective of body length. Bridge knobbed or spiny (figs 105e, d, l, m) sometimes with a large central spine (fig. 106f). One specimen with some anomalous anchor-plates (figs 106c, g) among normal anchors (figs 106a, e) and anchor-plates (figs 106b, f). Miliary granules (figs 105f-g, n, p, 106d, h) very abundant in small specimens and with a patchy distribution. In large specimens not so abundant and more regularly distributed. Miliary granules 8-18 µm across with size not related to body size. Most of the miliary granules as dissociated grains.

In the tentacles, miliary granules only; same size as the ones in the body wall (figs 105q, 106j) and absent in the largest specimens.

Remarks.— *Synaptula* cf. *reticulata* is very abundant in shallow-water (7-22 m depth) off Ujung Pandang, but only at Samalona (80 of the 82 collected specimens).

This species has previously been depicted by Gosliner et al. (1996), as *Synaptula lamperti* Heding, 1928, a misidentification because of the presence of a large intestinal

Fig. 105. *Synaptula* cf. *reticulata* (Semper, 1868). (a-g: L=95 mm; IRSNB IG.28251/9; h-q: L=27 mm; IRSNB IG.28251/9). a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; PV: Polian vesicles; R: radial piece); b: anchor from anterior body wall; c: anchor from posterior body wall; d: anchor-plates from anterior body wall; e: anchor-plates from posterior body wall; f: miliary granules from anterior body wall g: miliary granules from posterior body wall; h: anchor from anterior body wall; j: anchor stock; k: anchor from posterior body wall; l: anchor-plates from anterior body wall; m: anchor-plates from posterior body wall; n: miliary granules from anterior body wall; p: miliary granules from posterior body wall; q: miliary granules from tentacles.

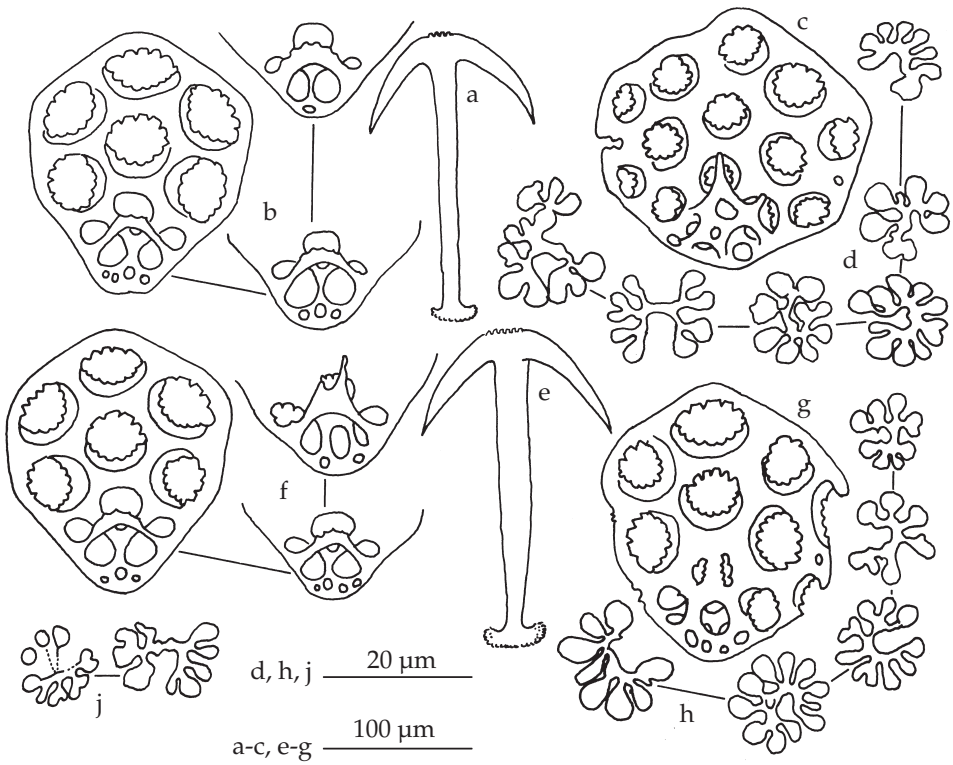

Fig. 106. *Synaptula* cf. *reticulata* (Semper, 1868). (a-j: L=32 mm; IRSNB IG.28251/55). a: anchor from anterior body wall; b: anchor-plates from anterior body wall; c: abnormal anchor-plate from anterior body wall; d: miliary granules from anterior body wall; e: anchor from posterior body wall; f: anchor-plates from posterior body wall; g: abnormal anchor-plate from posterior body wall; h: miliary granules from posterior body wall; j: miliary granules from tentacles.

lope (absent in *S. lamperti*) and because of the number of posterior holes in the anchor-plates (9 in *S. lamperti* according to Heding (1928); 3-5 (average) in *Synaptula* cf. *reticulata*).

The single anomalous specimen has modified anchor-plates which are very similar to those of *Synaptula virgata* (Sluiter, 1901) (see Heding 1928). However, *S. virgata* differs from this specimen mainly by the higher number of tentacles (13 versus 10), by the cartilaginous ring reduced to tentacle canals and by the higher number of holes in the posterior part of the anchor-plates.

According to the Heding's key to the species of *Synaptula* (Heding 1928), the present species is close to the group formed by *Synaptula maculata* (Sluiter, 1888), *Synaptula reticulata* (Semper, 1868) and *Synaptula purpurea* Heding, 1928. *Synaptula* cf. *reticulata* from Sulawesi presents a mixture of characters present in the three above mentioned species. It agrees with *S. reticulata* in the number of pair of tentacle digits, with *S. purpurea* more or less in colour, and with *S. maculata* in the calcareous ring and ossicle size. It differs from *S. purpurea* by the number of posterior holes in the anchor-plates and by the presence of rosettes, and from *S. maculata* by the number of tentacle

digits and by the number of holes in the posterior part of the anchor-plates. It shows the highest affinity with *Synaptula reticulata*, but the colour of the Sulawesi specimens is so different from typical *S. reticulata* that I prefer to refer to it as *Synaptula* cf. *reticulata*.

Synaptula spec.
(figs 107a-j, 114g)

Synaptula media; Gosliner et al., 1996: 284, fig 1048 (not Synaptula media Cherbonnier & Féral, 1984).

Material.— IRSNB IG.28251/130 (1 specimen), Samalona NW, 21.ix.94, 9 m depth on corals.

Description.— Specimen 220 × 6-8 mm, deep black to brown with large white spots anteriorly (fig. 114g) and small white spots or longitudinal bands posteriorly (fig. 116f). Five ambulacra corresponding to 5 white bands; in alcohol uniformly white. Tentacles 13, each with 22-24 pairs of digits united by a web.

Calcareous ring white, composed of radials and interradials pieces of the same size. Radial pieces perforated for the nerve; posterior edge of the calcareous ring undulating (fig. 107a). Huge cartilaginous ring masking partly the calcareous ring (fig. 107a); cartilaginous ring with posterior perforations. At least 13 Polian vesicles and one stone canal going upwards and ending in a short madreporic plate fixed at the level of the calcareous ring (fig. 107a).

Ossicles of body wall anchors, anchor-plates and miliary granules. Anchors slightly longer posteriorly (325.5±8.0 × 200.5±9.8 µm; n = 10) (fig. 107c) than anteriorly (301.1±14.3 × 210.0±17.3 µm; n = 5) (fig. 107b); arms smooth, a few knobs on vertex and stock finely dented (figs 107b, c). Anchor-plates slightly larger and more quadrangular posteriorly (219.5±11.9 × 170.5±11.2 µm; n = 10) (fig. 107e) than anteriorly (208.3±5.0 × 153.3±3.5 µm; n = 10) (fig. 107d); articular holes smooth or serrated (figs 107d-g); bridge spiny or knobbed (figs 107d-g); posterior holes 3-7, average of 4.8±1.6 (n = 9), on the anterior anchor-plates (figs 107d, f) and 1-4, average of 2.8±0.6 (n = 24) on the posterior ones (figs 107e, g). Miliary granules (fig. 107h) 10-16 µm across, most in the form of separated grains. In the tentacles miliary granules only, 17-25 µm across (fig. 107j), mostly as dissociated grains.

Geographic distribution- Indonesia (Sulawesi), Philippines.

Remarks.— If we look at the external anatomy (number of tentacles, number of digits per tentacle, presence or absence of a web between the digits), internal anatomy (shape of calcareous and cartilaginous rings, number of Polian vesicles, shape of the madreporic plate) and ossicles (size and shape of the anchors, anchor-plates, miliary granules), the present specimen is very close to *Synaptula denticulata* Heding, 1928, and *Synaptula psara* (Sluiter, 1887). Apart from the colour it differs from both species only by the number of posterior holes in the posterior anchor-plates (2.8±0.6 in the present specimen versus 3.8±1.0 and 4.3±1.1 in *S. denticulata* and *S. psara*, respectively). This difference is possibly not significant because based on a single specimen. Only the colour is very characteristic and it exactly match a specimen from the Philippines, misidentified as *Synaptula media* by Gosliner et al (1996, fig. 1048). However, colour vanishes in preserved specimens and is not sufficient to recognize a new

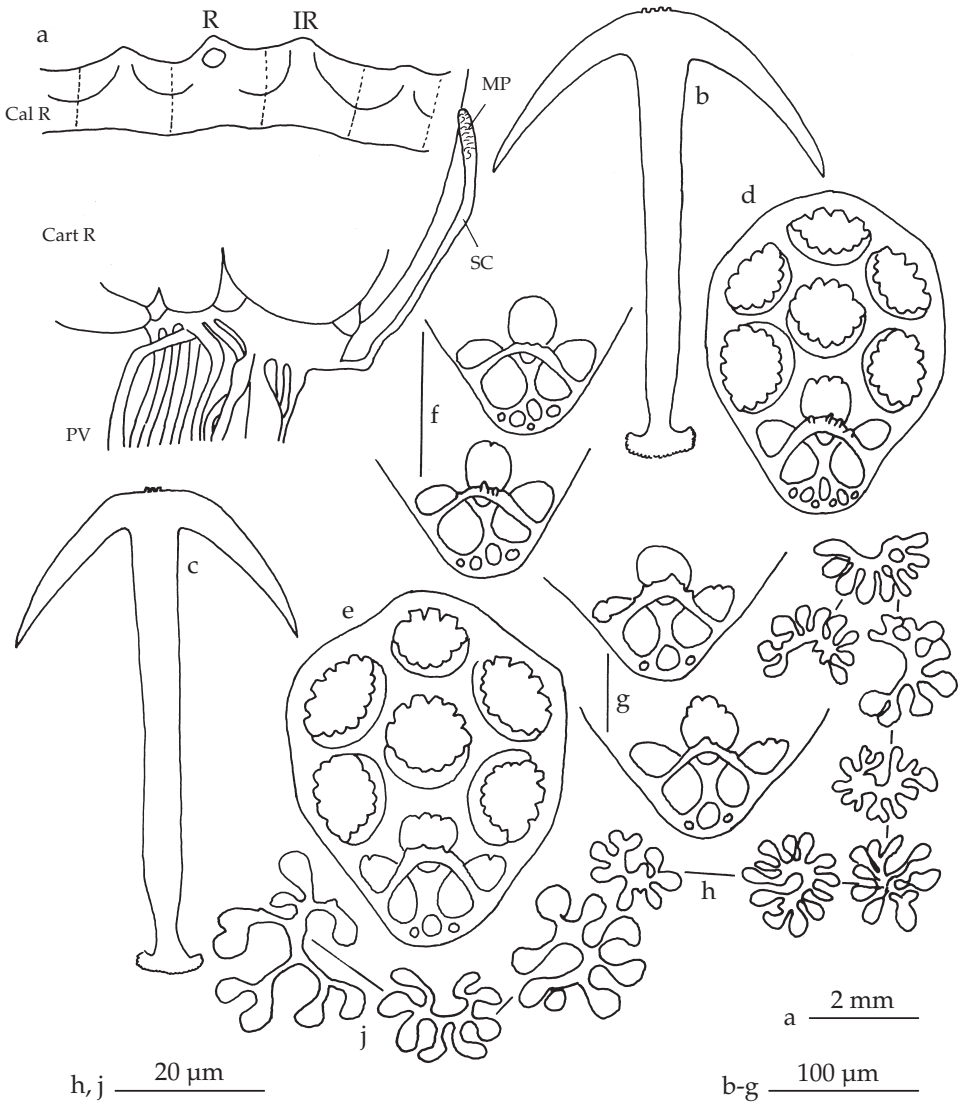

Fig. 107. *Synaptula* spec. a: calcareous ring (Cal R: calcareous ring; Cart R: cartilaginous ring; IR: interradial piece; MP: madreporic plate; PV: Polian vesicles; R: radial piece; SC: stone canal); b: anchor from anterior body wall; c: anchor from posterior body wall; d & f: anchor- plates from anterior body wall; e & g: anchor-plates from posterior body wall; h: miliary granules from body wall; j: miliary granules from tentacles.

species. More material is required to determine if we are dealing with a special colour form of *S. denticulata* or *S. psara*, or with a new species. It will be left unindentified within the genus.

Family Chiridotidae Oestergren, 1898
Genus *Chiridota* Eschscholtz, 1829
Chiridota stuhlmanni Lampert, 1896
(figs 108a-g, 109)

Chiridota stuhlmanni Lampert, 1896: 67; Oestergren, 1898a: 118; Ludwig, 1899: 563; H.L. Clark, 1907: 115; Heding, 1928: 302, fig. 64 (1-6); Heding, 1931: 676, fig. 12 (1-6); Dawydoff, 1952: 117; Cherbonnier, 1967: 67, fig. 6l-p; A.M. Clark & Rowe, 1971: 188; Liao, 1975: 224, fig. 27 (1-8); Tortonese, 1977: 276; Sloan et al., 1979: 125; Price, 1982: 12; A.M. Clark, 1984: 99; Price & Reid, 1985: 32; Cherbonnier, 1988: 270, fig 122A-G; Marsh et al., 1993: 65; Rowe & Gates, 1995: 267; Liao & A.M. Clark, 1995: 543, fig. 336a-e; Liao, 1997: 282, fig. 169a-h.

Material.— IRSNB IG.28251/244 (1 specimen), Badi, 3.x.94, 2 m depth.

Description.— Specimen 68 × 4 mm, pink when fully extended and brown-red when contracted; in alcohol uniformly beige-white. Body cylindrical with mouth and anus terminal. Tentacles 12, each with 8-9 pairs of digits. Wheel papillae scattered

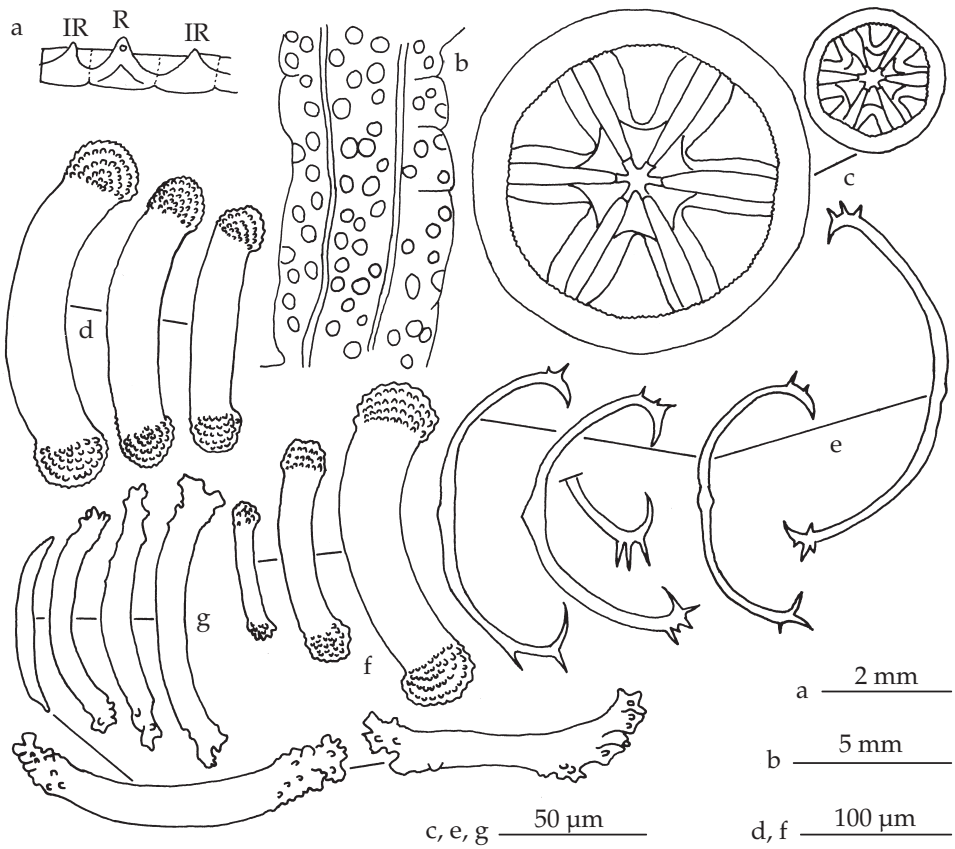

Fig. 108. *Chiridota stuhlmanni* Lampert, 1896. a: calcareous ring (IR: interradial piece; R: radial piece); b: position of the wheel papillae along the body wall; c: body wall wheels; d: ambulacral C-shaped rods; e: inter-ambulacral C-shaped rods; f: rods from tentacle base; g: rods from tentacle digits.

between the ambulacra over the whole length of the body (fig. 108b).

Calcareous ring stout and thick (fig. 108a), with radial and interradial pieces of the same width and both with an anterior tooth; radial pieces perforated for the nerve; posterior edge of the calcareous ring straight.

Ossicles of body wall wheels gathered in the wheel papillae; wheels 40-115 µm across anteriorly and 55-125 µm posteriorly (fig. 108c). Along the ambulacra, stout C-shaped rods (fig. 108d) with rounded, spiny extremities (fig. 108d). In the interambulacral areas fine C-shaped rods (fig. 108e), rare anteriorly and numerous posteriorly. At the base of the tentacles stout C-shaped rods similar to those of the body wall (fig. 108f); in the digits of the tentacles C-shaped rods with irregular spines at the extremities (fig. 108g).

Geographic distribution (fig. 109).— Red Sea (Eilat), Zanzibar (**Tumbatu** = type locality), Madagascar, Seychelles (Aldabra), Indonesia (Sumatra, Sulawesi), Australia (WA, Timor Sea, QLD, GBR), Vietnam (Gulf of Siam), China (Xisha Islands), Fiji.

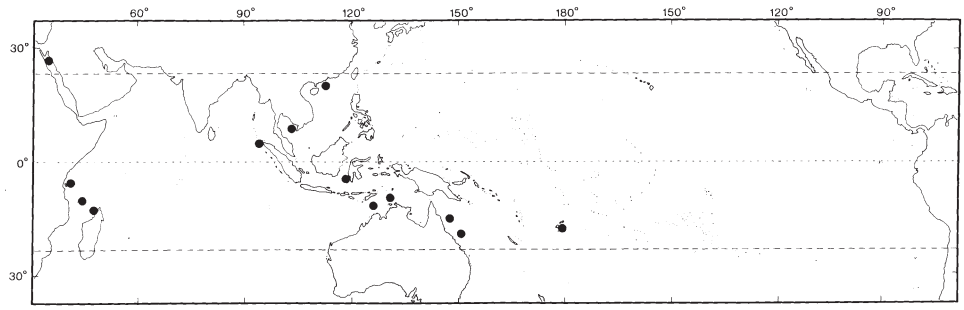

Fig. 109. Distribution of *Chiridota stuhlmanni* Lampert, 1896.

Remarks.— *Chiridota stuhlmanni* shows no variation in its ossicles throughout its range of distribution (Heding, 1928; Cherbonnier, 1967, 1988; Liao, 1975). As previously observed by H.L. Clark (1907) and Massin (1996a) for other *Chiridota* spp., the number of tentacle digits of *C. stuhlmanni* increases with increasing body length: tentacles of a 25 mm long specimen had 4 pairs of digits (Cherbonnier, 1967), of a 50 mm long specimen 7 pairs (Heding, 1928) and of a 68 mm long specimen 8-9 pairs (present study). However, the number of tentacles (12) is constant irrespective of body length.

It is only the second record for Indonesia, the first one being from Sumatra (Price & Reid, 1985).

General discussion on distribution

Table 1 gives the list of the species for each locality sampled in the Spermonde Archipelago. According to this list some islands seem very specific regarding the composition of their holothurian fauna (qualitatively as well as quantitatively). Gusung, Barang Lompo and Bone Tambung have a very low diversity whereas Badi seems particularly rich. Samalona and Kudingareng Keke which have been sampled with a comparable frequency (12 and 14 dives, respectively), yielded almost similar

numbers of species: 22 versus 26; and extrapolation would suggest these islands to be equally rich. However, the species composition found, with only six species in common, differs strikingly between these two islands. Samalona is particularly rich in Synaptidae (8 species versus only 3 for Kudingareng Keke) but relatively poor in species of the genera *Holothuria* and *Labidodemas* (3 species versus 12 for Kudingareng Keke). In comparison, the number of species of regular echinoids proved to be higher on Kudingareng Keke than on Samalona: 12 versus 8 species, respectively (de Beer, 1990). Moreover, both islands show a high similarity in the regular echinoid fauna (7 species in common).

No specimens were collected at Bone Tambung but remarkably, observation on this reef seemed to indicate absence of aspidochirote holothurians. Only a few synaptids were observed during the two dives at this locality.

Badi and Kudingareng Keke are equally rich in *Holothuria* spp. (10 species for each island). However, only half of the species collected are common to both islands. These differences cannot be ascribed to the different zones (1 to 4) defined by Moll (1983), Hoeksema (1990) and de Beer (1990) working on scleractinian corals and sea urchins because both islands belong to the same zone (the third one); moreover, they are similar in size and orientation with a similar reef flat (Moll, 1983: fig. 1B). Both islands are also close to each other (18 km) and human fishery pressure must be the same. With the data at hand it is not possible to ascribe the low similarity in holothurian fauna to known biotic and/or abiotic factors.

According to the number of dives performed around each island, Badi seem to have the highest holothurian diversity. This could be linked to the coral species composition which is more diverse on Badi (Moll, 1983). The general increase in species diversity observed from zone one to three (Moll, 1983; Hoeksema, 1990; de Beer, 1990) fits for holothurians with islands as Gusung (zone one), Samalona (zone two) and Badi (zone three). However, this is not always true, and Gusung (zone one), Barang Lompo (zone two) and Bone Tambung (zone three) seem to have a similar low holothurian diversity.

The majority (70%) of the holothurian species described in the present paper (new and undetermined species excluded) have an Indo-Pacific (43%) or a more restricted Indo-West Pacific (27%) distribution. Sixteen percent have an East Indian to West Pacific distribution and only 6% are restricted to the Pacific Ocean. The remaining 8% are "endemic species", restricted to Indonesia and adjacent waters (northern Australia, southern Philippines and Malaysia). Among the alleged endemic species, most are Synaptidae.

The present list of 56 species (table 1) is far from being complete because some biotopes (mangrove areas, muddy bottoms) have not been investigated and only a few islands of the Spermonde Archipelago have been visited. Moreover, only one night dive was carried out, although sampling in the dark usually yields species that never appear during day time. On the well investigated island of Samalona (12 dives) *Patinapta ooplax* (Marenzeller, 1881) has not been observed during the present survey, nor *Protankyra pseudodigitata* (Semper, 1868). Both species were recorded by Heding (1928) from Samalona, *P. ooplax* being common (82 specimens collected on its sandy shore).

Another factor to be taken into account in the study of holothurian diversity is

human pressure by trepang fishery. Through this activity some reefs off Ujung Pandang have nearly been stripped from the largest and commercially important species such as *Holothuria nobilis*, *H. scabra*, *Stichopus* spp., *Thelenota* spp., and *Bohadschia* spp.

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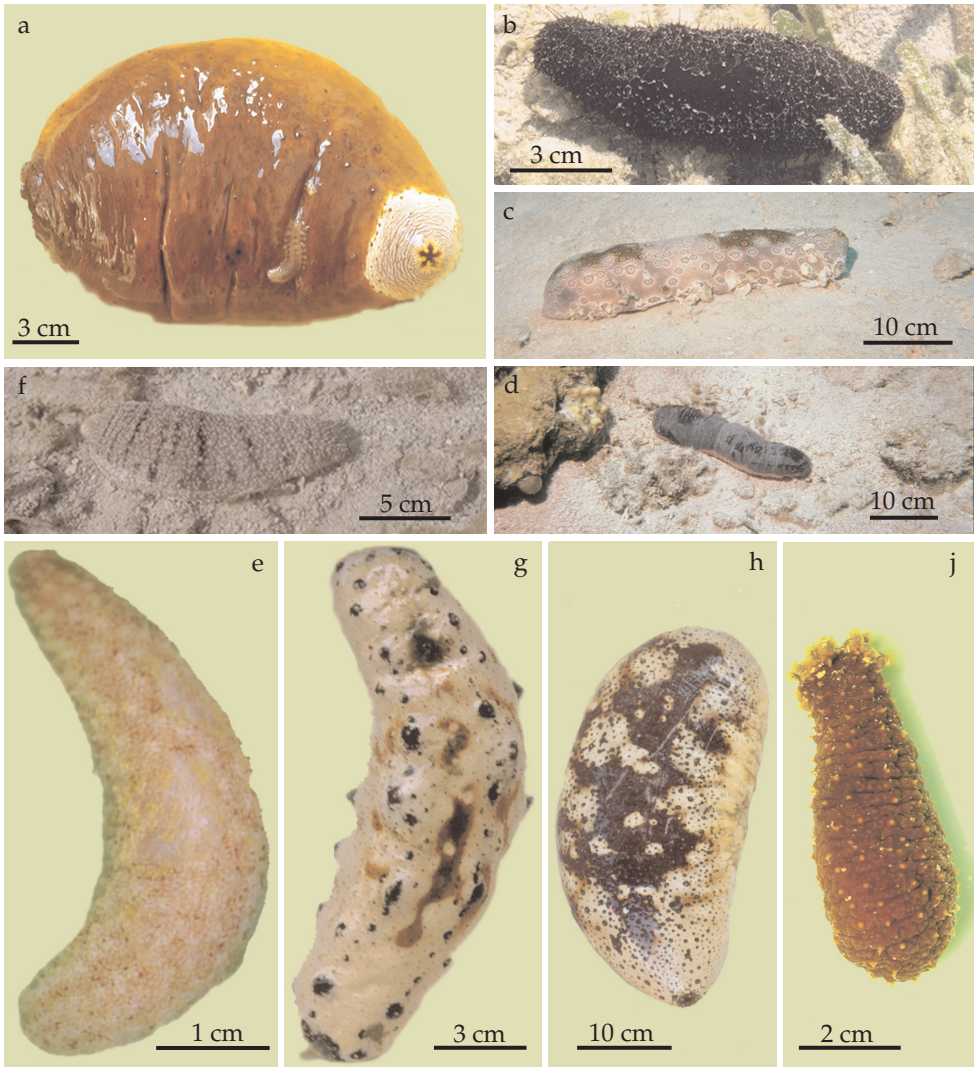

Fig. 110. a: *Actinopyga lecanora* (Jaeger, 1833) (IRSNB, IG 28252/126).
b: *Actinopyga miliaris* (Quoy & Gaimard, 1833) (IRSNB, IG 28252/31).
c: *Bohadschia argus* Jaeger, 1833.
d: *Holothuria (Halodeima) edulis* Lesson, 1830.
e: *Holothuria (Lessonothuria) hawaiiensis* Fisher, 1907 (RMNH Ech. Ech 6080).
f: *Holothuria (Metriatyla) scabra* Jaeger, 1833. Photo B.W. Hoeksema.
g: *Holothuria (Microthele) nobilis* (Selenka, 1867) (IRSNB, IG 28252/185).
h: *Holothuria (Microthele) nobilis* (Selenka, 1867) (IRSNB, IG 28252/211).
j: *Holothuria (Semperothuria) flavomaculata* Semper, 1868 (IRSNB, IG 28251/251).

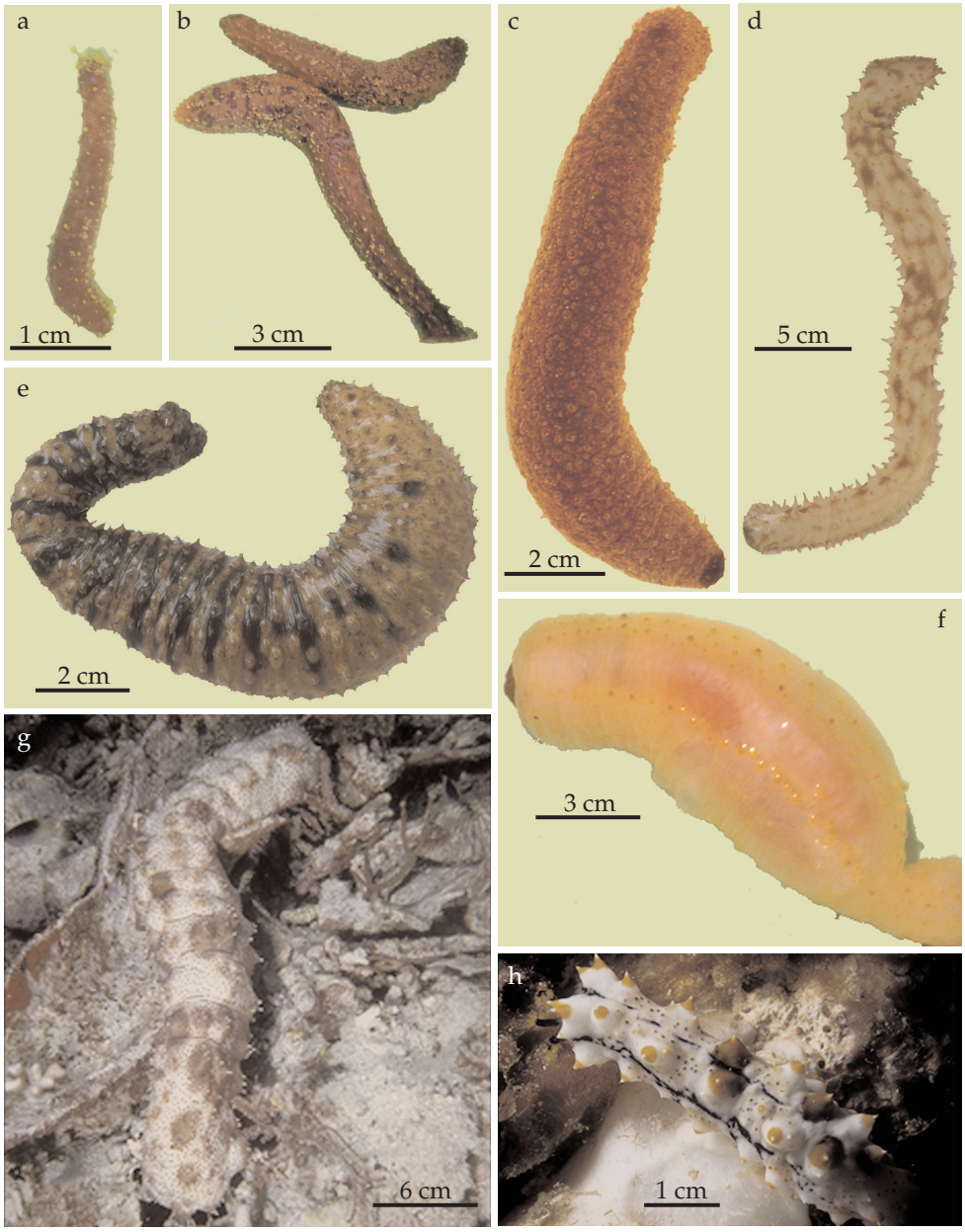

Fig. 111. a: *Holothuria (Semperothuria) imitans* Ludwig, 1875 (IRSNB, IG 28251/237).
b: *Holothuria (Stauropora) discrepans* Semper, 1868 (RMNH Ech. 6083).
c: *Holothuria (Stauropora) fuscocinerea* Jaeger, 1833 (IRSNB, IG 28251/254).
d: *Holothuria (Thymiosycia) hilla* Lesson, 1830 (RMNH Ech. 6061).
e: *Holothuria (Thymiosycia) impatiens* (Forskål, 1775) (IRSNB, IG 28251/132.
f: *Labidodemas semperianum* Selanka, 1867 (RMNH Ech. 6087).
g: *Pearsonothuria graeffei* (Semper, 1868). Adult; photo B.W. Hoeksema.
h: *Pearsonothuria graeffei* (Semper, 1868). Sub-adult; photo B.W. Hoeksema.

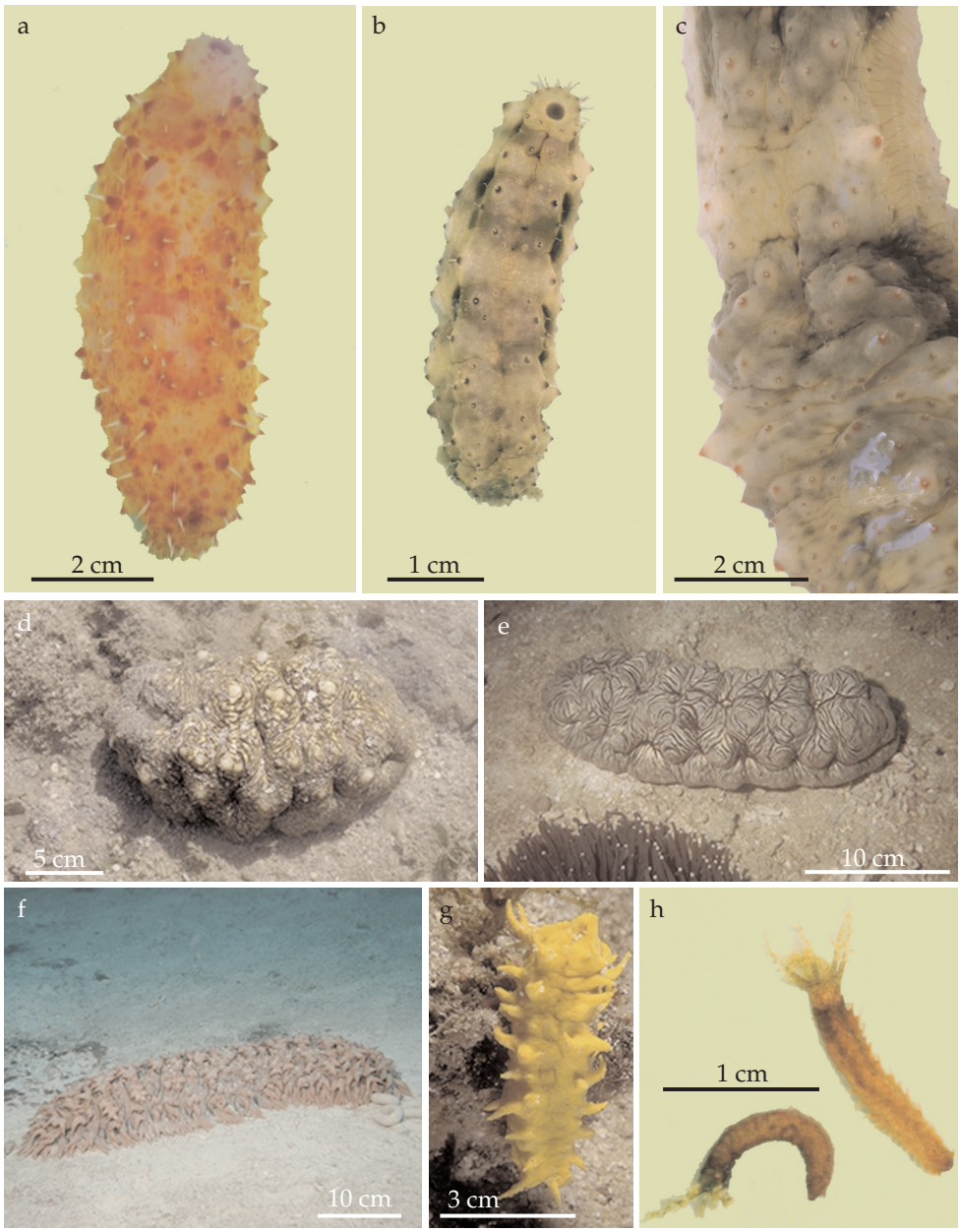

Fig. 112. a: *Stichopus noctivagus* Cherbonnier, 1980 (IRSNB, IG 28251/108).
b: *Stichopus quadrifasciatus* spec. nov. (RMNH Ech. 6088, paratype).
c: *Stichopus quadrifasciatus* spec. nov. (IRSNB, IG 28251/131, paratype).
d: *Stichopus vastus* Sluiter, 1887 (RMNH Ech. 6089).
e: *Stichopus vastus* Sluiter, 1887. Photo B.W. Hoeksema.
f: *Thelenota ananas* (Jaeger, 1833).
g: *Colochirus robustus* Oestergren, 1898. Photo B.W. Hoeksema.
h: *Plesiocolochirus australis* (Ludwig, 1875) (IRSNB, IG 28251/141).

Fig. 113. a: *Neothyodinium magnum* (Ludwig, 1882). Photo B.W. Hoeksema.
b: *Phyrella trapeza* (H.L. Clark, 1932) (IRSNB, IG 28251/259).
c: *Afrocucumis africana* (Semper, 1868) (IRSNB, IG 28251/144).
d: *Cladolabes schmeltzii* (Ludwig, 1875) (IRSNB, IG 28251/162).
e: *Ohshimella ehrenbergii* (Selenka, 1867) (IRSNB, IG 28251/234).
f: *Euapta godeffroyi* (Semper, 1868) (IRSNB, IG 28251/184).
g: *Polyplektana kallipeplos* (Sluiter, 1887) (IRSNB, IG 28251/188).
h: *Polyplektana kefersteini* (Selenka, 1867) (RMNH Ech. 6093).
j: *Synaptula* cf *denticulata* Heding, 1928 (IRSNB, IG 28251/137).

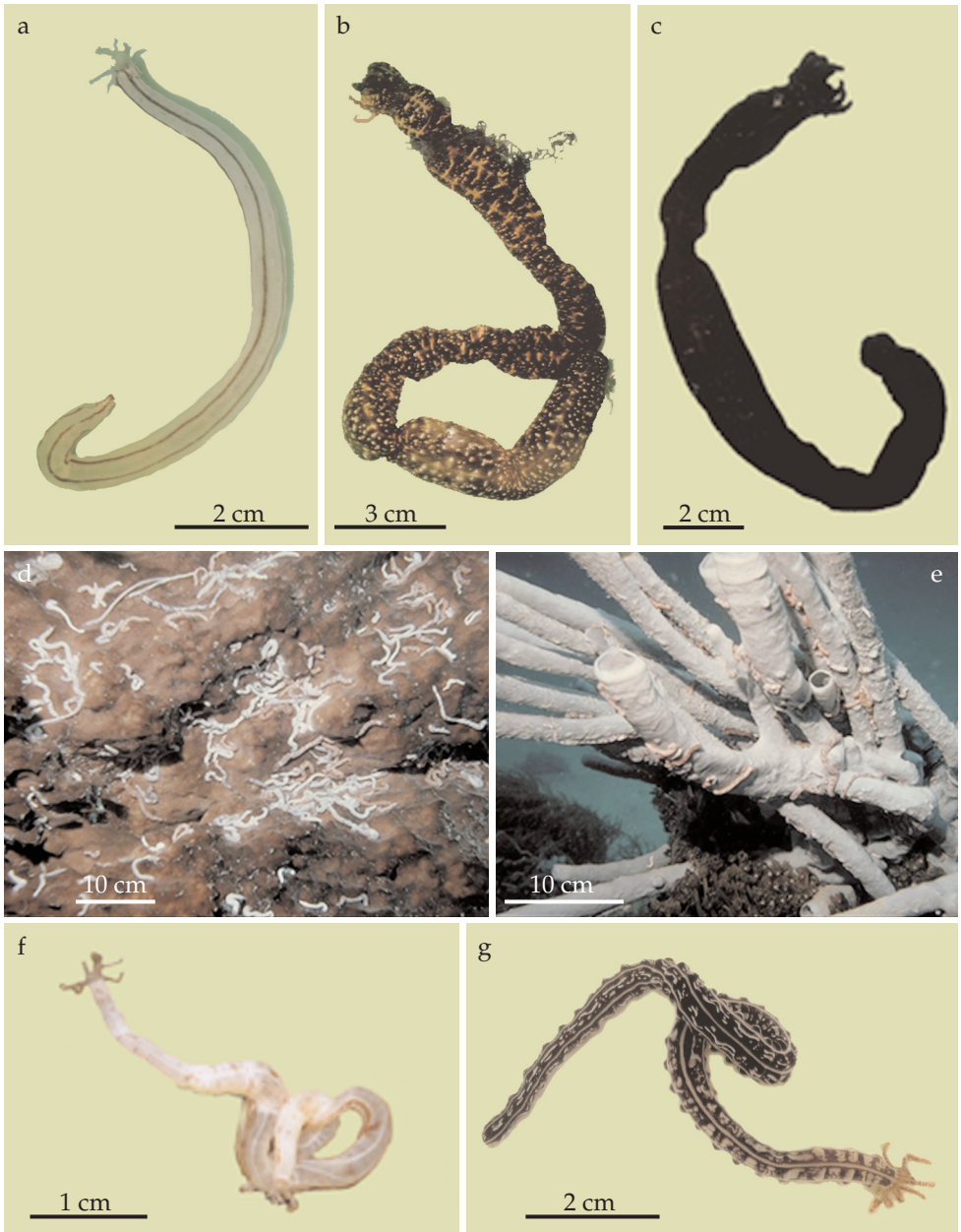

Fig. 114. a: *Synaptula* cf. *lamperti* Heding, 1928 (IRSNB, IG 28251/125).
b: *Synaptula recta* (Semper, 1868) (IRSNB, IG 28251/136).
c: *Synaptula recta* (Semper, 1868) (IRSNB, IG 28251/138).
d: *Synaptula* cf. *reticulata* (Semper, 1868) on *Xetospongia* spec.
e: *Synaptula* cf. *reticulata* (Semper, 1868) on *Amphimedon* spec.
f: *Synaptula* cf. *reticulata* (Semper, 1868) (IRSNB, IG 28251/48).
g: *Synaptula* spec. (IRSNB, IG 28251/130).