

Fungiacyathus (B.) granulosis Cairns, 1989

Bathyactis symmetrica - ALCOCK, 1902c: 37 (in part: "*Siboga*" stn 59). [Not *Fungia symmetrica* Pourtalès, 1871].
Fungiacyathus (B.) granulosis Cairns, 1989a: 11, pl. 4, figs d-i; 1994: 39, pl. 15, figs d-e.

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 1: stn 43, 5 (USNM 96705). — Stn 44, 13 (MNHN). — Stn 50, 1 (MNHN).

MUSORSTOM 2: stn 25, 20 (USNM 96707). — Stn 82, 14 (MNHN).

MUSORSTOM 3: stn 106, 6 (MNHN).

Indonesia. KARUBAR: stn 3, 1 (USNM 96708). — Stn 7, 7 + 8 juveniles (USNM 96702). — Stn 40, 3 (USNM 96704). — Stn 56, 1 (POLIPI). — Stn 58, 1 (MNHN). — Stn 59, 2 (MNHN).

TYPE LOCALITY. — "*Albatross*" stn 5590: 4°10'50"N, 118°39'35"E (off Sabah, Celebes Sea), 567 m.

DIAGNOSIS. — Corallum robust, up to 24.5 mm in calicular diameter (KARUBAR stn 40), with a flat to slightly concave base covered with rounded, granular costae. Septa hexamerally arranged in 4 cycles, each S₁ having 21-24 coarsely dentate trabecular ridges on each face and linked to its adjacent septa by 6-9 Y-shaped synapticulae. Septa planar. Septal canopies porous, but well developed. Paliform lobes absent, but well-developed trabecular spines present on all septa. Columella large and tuberculate.

REMARKS. — As noted by CAIRNS (1989a), *F. granulosis* differs from *F. sibogae* in having a granular base and beaded costae that are rounded to triangular in cross section, not covered with thin, serrate ridges as in *F. sibogae*. Also, *F. granulosis* attains a larger diameter (24 mm vs 15 mm) and has more robust inner trabecular spines, especially those of the S₂. *F. granulosis* is more fully described and figured by CAIRNS (1989a).

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Tablas Strait, Mindoro; 428-640 m.
Indonesia: Banda Sea (Kai Islands); Arafura Sea (southeast of Tanimbar Islands); Savu Sea (Timor); 287-567 m.
Elsewhere: Malaysia (Celebes Sea off Sabah); northern Ryukyu Islands; 402-410 m.

Fungiacyathus (B.) variegatus Cairns, 1989

Fungiacyathus fragilis - WELLS, 1984: 205-206 (in part: USGS 24918, pl. 1, figs 1-2). [Not *Fungiacyathus fragilis* G.O. Sars, 1872].

Fungiacyathus (B.) variegatus Cairns, 1989a: 11-12, pl. 5, figs a-h; 1994: 38-39, pl. 15, figs a-b.

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 1: stn 13, 2 (MNHN). — Stn 14, 3 (MNHN). — Stn 15, 4 (MNHN). — Stn 25, 1 (MNHN).

MUSORSTOM 2: stn 4, 1 (USNM 96710). — Stn 12, 1 (USNM 96711). — Stn 64, 2 (MNHN). — Stn 66, 1 (MNHN).

MUSORSTOM 3: stn 87, 3 (MNHN). — Stn 88, 1 (USNM 96713). — Stn 95, 1 (USNM 96714). — Stn 96, 1 (USNM 96715). — Stn 97, 2 (MNHN). — Stn 99, 7 (MNHN). — Stn 100, 7 (USNM 96718). — Stn 101, 21: 5 (MNHN), 16 (USNM). — Stn 108, 1 (USNM 96720). — Stn 111, 3: 2 (MNHN), 1 (USNM 96721). — Stn 112, 2 (MNHN). — Stn 121, 1 (MNHN). — Stn 140, 3 (USNM 96722).

Indonesia. DEKI: stn 24, 1 (NNM 22485). — Stn 48, 1 (NNM 22486). — Stn 50, 1 (ZMUC), 6 (NNM 22487). — Stn 63, 8 (NNM 22488).

"*Galathea*": stn 480, 9 (ZMUC).

SNELLIUS 2: stn 4.174, 1 (NNM 22490).

KARUBAR: stn 31, 1 (POLIPI). — Stn 76, 1 (MNHN).

TYPE LOCALITY. — "*Albatross*" stn 5113: 13°52'N, 120°51'E (Verde Island Passage, Luzon), 291 m.

DIAGNOSIS. — Corallum delicate, up to 10.3 mm in calicular diameter (KARUBAR stn 76), with a flat to slightly concave base. Centre of base granular, but edge of base covered with thin, serrate costal ridges. Septa hexamerally arranged in 4 cycles, each S₁ bearing 15-17 low dentate trabecular ridges per face and linked to their

adjacent septa by 3 or 4 solid synapticulae. Septa planar. Septal canopies well developed, solid, and inclined. Paliform lobes absent, but S₂ trabecular spines well developed. Columella rudimentary.

REMARKS. — *Fungiacyathus variegatus* is distinguished by its relatively small size and its broad, solid canopies that unite the inner edges of the S₃ to their common S₂, and the S₄ to their common S₃. In well-preserved coralla S₁₋₂ are pigmented a dark brown, but this pigmentation was present on only about 1/3 of the specimens listed above, the colour apparently fading after the death of the coral. Small coralla (< 4 mm GCD) are stellate in shape, their S₁₋₂ projecting beyond the otherwise circular calicular perimeter. This species is more fully described and illustrated by CAIRNS (1989a).

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan Sea; Visayan Sea; Sulu Sea (Semirara Islands); 84-333 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (south of Tanimbar Islands); Flores Sea (Selayar Island, Sulawesi); Bali Strait; 100-440 m. *Elsewhere*: South China Sea (Hong Kong); Japan (Kyushu and Ryukyu Islands); 422-715 m. Pleistocene of Vanuatu (WELLS, 1984).

Fungiacyathus (B.) turbinolioides Cairns, 1989

Fungiacyathus (B.) turbinolioides Cairns, 1989a: 12-13, pl. 6, figs a-g.

MATERIAL EXAMINED. — *Philippines*. "Albatross": stn 5424, 1 (USNM 96724).
"Galathea": stn 490, 1 (ZMUC).
"Hakuho Maru": stn KH72-1-20, 1 (USNM 96723).

TYPE LOCALITY. — "Albatross" stn 5586: 4°06'50"N, 118°47'20"E (off Sabah, Celebes Sea), 635 m.

DIAGNOSIS. — Corallum robust, relatively small (up to 10.3 mm calicular diameter), with a flat to slightly concave base covered with rounded granular costae. Costae separated by deep intercostal furrows. Septa hexamerally arranged in 4 cycles, each S₁ bearing 20-25 low, serrate trabecular ridges and joined to adjacent septa by 3 or 4 T-shaped synapticulae. Septal edges straight. Septal canopies absent. No paliform lobes, but trabecular spines robust. Columella well developed, tuberculate.

REMARKS. — *Fungiacyathus turbinolioides* is distinguished from all other species in the genus by having deep intercostal furrows, which suggests a resemblance to a turbinoliid. It is more fully described and illustrated by CAIRNS (1989a).

DISTRIBUTION. — *Philippines*: Sulu Sea (Cagayan Islands and Sulu Archipelago); 514-622 m. *Indonesia*: Java Sea; 570-635 m. *Elsewhere*: Malaysia (Celebes Sea off Sabah); South China Sea (northeast of Pratas Island); 622 m.

Fungiacyathus (B.) fissidiscus sp. nov.

Figs 2 a-d

MATERIAL EXAMINED/TYPES. — *Indonesia*. KARUBAR: stn 3, 8 paratypes (MNHN). — Stn 7, holotype and 140 paratypes (MNHN); 31 paratypes (POLIPI); 99 paratypes (USNM 96725).

TYPE LOCALITY. — KARUBAR stn 7: 5°47'35"S, 132°20'39"E (Kai Islands, Banda Sea), 282-287 m.

ETYMOLOGY. — The species name *fissidiscus* (Latin *findere*, to split + *discus*, a circular plate) refers to the tendency of this species to reproduce by fragmentation. The name is considered as a noun in apposition.

DESCRIPTION. — Corallum reproduces primarily by fragmentation (see Remarks), resulting in wedge-shaped pieces of 6-12 septa that ultimately regenerate into a roughly circular corallum containing 48 septa. Largest completely regenerated specimen (holotype) 4.9 mm in diameter and 1.7 mm in height. Base flat, often featureless at centre, but toward peripheral edge formed into well-defined, rounded, granular costae. Costae up to 0.27 mm wide, separated by deep intercostal furrows about 0.05 mm wide.

Septa hexamerally arranged in 4 cycles. S₁ extend to centre of fossa, each septum bearing 8-10 trabecular spines, the innermost spines short, flattened, and curved inward toward fossa; the outer spines are much more robust and cylindrical in cross section (0.20 mm in diameter). S₂ similar to S₁ in shape, but smaller, extending only 3/4 distance to centre of fossa, bearing only 7-9 trabecular spines that are less robust than those on the S₁. S₃ smallest septa, extending only 1/5 distance to centre of fossa and quite low, bearing only 2 or 3 small trabecular spines. S₄ dimorphic in size, those adjacent to S₁ being almost as large as S₁, bearing 7-9 trabecular spines, the inner edges of each pair within a system fusing near centre of fossa. S₄ adjacent to S₂ much smaller than those adjacent to S₁ and only marginally larger than the S₃, *i.e.*, extending 1/4 distance to centre of fossa, bearing 4 or 5 trabecular spines. All septa have straight upper edges and highly granular faces. Face granules up to 80µm in height and occasionally bifid, the granules aligned in low ridges only at upper septal edges along trabecular spines. Approximately 5 solid synapticular plates connect each S₁ to its adjacent S₄, the 4th plate from corallum centre being the tallest, rising almost to the upper edge of S₄. Only 2 synapticular plates connect S₂ to their adjacent S₄, and no synapticulae were noted on the S₃. Fossa shallow; no columella.

REMARKS. — The lack of synapticulae between S₃ and their adjacent S₄ creates radial lines of weakness throughout a corallum that are presumed to facilitate the fragmentation process.

Three other species of *Fungiacyathus* are characterised by having highly regenerative coralla: *F. crispus* (Pourtales, 1871): Atlantic, 183-1010 m; *F. fissilis* Cairns, 1984: Hawaiian Islands, 212-503 m; and *F. dennanti* Cairns & Parker, 1992: South Australia, 190-770 m. *F. fissidiscus* is distinguished from all 3 in having intercostal furrows, granular costae, and dimorphic S₄. *F. fissidiscus* is perhaps more similar to *F. turbinolioides* Cairns, 1989 (see above), both species having a similar costal structure and septal ornamentation; however, it differs in having dimorphic S₄, a smaller corallum, a regenerative corallum, and in lacking a columella.

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai Islands); 282-287 m.

Family MICRABACIIDAE Vaughan, 1905

Genus *LETOPENUS* Moseley, 1881

Leptopenus sp. A

Figs 2 e-f

Leptopenus sp. A - CAIRNS, 1989a: 14-15, pl. 7a-f.

MATERIAL EXAMINED. — *Indonesia*. KARUBAR: stn 7, 1 fragment (MNHN).

REMARKS. — One small specimen, a wedge-shaped fragment measuring 3.3 mm in calicular radius, is reported herein. It appears to be the same species described by CAIRNS (1989a) from the Celebes Sea. Based on this small fragment, nothing can be added to the previous description. Four other fragments, too small to identify, are also reported from KARUBAR stations 3 (USNM 96728) and 15 (USNM 96729). It is noteworthy that these specimens represent the shallowest record for *Leptopenus* (*i.e.*, 214-300 m), a genus customarily found at depths in excess of 2000 m.

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai Islands). *Malaysia*: Celebes Sea (off Sabah); 287-871 m.

Genus *LETEPSAMMIA* Yabe & Eguchi, 1932

Letepsammia formosissima (Moseley, 1876)

Stephanophyllia formosissima Moseley, 1876: 561-562; 1881: 201-204, pl. 4, fig. 11, pl. 13, figs 6-7, pl. 16, figs 8-9. — ALCOCK, 1902c: 39 (in part: "*Siboga*" stn 95). — BOSCHMA, 1923: 144-145, pl. 10, fig. 31. — FAUSTINO, 1927: 244-245, pl. 77, figs 7-8.

Letepsammia formosissima - OWENS, 1986b: 486-487. — CAIRNS, 1989a: 15-18, pl. 6, fig. j, pl. 7, figs g-i, pl. 8, figs a-d (synonymy); 1995: 36-37, pl. 3, figs f-g. — CAIRNS & PARKER, 1992: 8-9, pl. 1, figs f, h.
 Not *Stephanophyllia formosissima* var. - ALCOCK, 1902c: 39-40 [= *Rhombopsammia squiresi* Owens, 1986].
 Not *Letepsammia formosissima* - CAIRNS & KELLER, 1993: 230-231, pl. 3, fig. D [= *L. franki* Owens, 1994]. — CAIRNS, 1994: 40-41, pl. 15, figs c, f [= *L. superstes* (Ortmann, 1888)].

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 1: stn 2, 1 (USNM 96568). — Stn 3, 1 (USNM 96579). — Stn 4, 1 (USNM 96557). — Stn 9, 6 (MNHN). — Stn 10, 9 (MNHN). — Stn 12, 9 (MNHN). — Stn 14, 1 (USNM 96555). — Stn 20, 3 (USNM 96567). — Stn 24, 18 (MNHN). — Stn 25, 17 (MNHN). — Stn 35, 2 (MNHN). — Stn 61, 57: 1 (MNHN), 56 (USNM 96556). — Stn 62, 8 (USNM 96562). — Stn 64, 1 (MNHN).

MUSORSTOM 2: stn 1, 16 (MNHN). — Stn 2, 27 (MNHN). — Stn 4, 3 (USNM 96551). — Stn 6, 1 (USNM 96566). — Stn 10, 40: 29 (MNHN), 11 (USNM 96575). — Stn 11, 6 (USNM 96553). — Stn 12, 9 (MNHN). — Stn 13, 4 (USNM 96552). — Stn 15, 1 (MNHN). — Stn 18, 11: 6 (USNM 96576), 5 (BMNH 1992.8.11.12). — Stn 33, 6 (MNHN). — Stn 62, 4 (?). — Stn 63, 3: 1 (MNHN), 2 (USNM 96550). — Stn 64, 22 (USNM 96559). — Stn 66, 7 (USNM 96573). — Stn 68, 14 (MNHN).

MUSORSTOM 3: stn 86, 13 (MNHN). — Stn 87, 15 (USNM 96570). — Stn 88, 42 (MNHN). — Stn 90, 8 (MNHN). — Stn 91, 31 (MNHN). — Stn 92, 5 (MNHN). — Stn 96, 116: 63 (MNHN), 46 (USNM 81879), 7 (BMNH 1992.8.11.11). — Stn 97, 39: 23 (MNHN), 16 (USNM 96565). — Stn 98, 36: 6 (MNHN), 30 (USNM 96563). — Stn 99, 28: 17 (MNHN), 11 (USNM 96549). — Stn 100, 34: 19 (MNHN), 15 (USNM 96548). — Stn 101, 25 (MNHN). — Stn 102, 27 (MNHN). — Stn 103, 15: 8 (MNHN), 7 (USNM 96571). — Stn 107, 1 (MNHN). — Stn 108, 62: 17 (MNHN), 45 (USNM 81877). — Stn 109, 78: 54 (MNHN), 17 (USNM 81878), 7 (BMNH 1992.8.11.13). — Stn 110, 2 (MNHN). — Stn 111, 17 (MNHN). — Stn 112, 20 (USNM 96561). — Stn 124, 1 (MNHN). — Stn 126, 3 (MNHN). — Stn 131, 5 (MNHN). — Stn 139, 1 (MNHN). — Stn 143, 81 (USNM 81878).

Indonesia. DEKI: stn 2, 1 (NNM 22502). — Stn 3, 7 (NNM 22501). — Stn 4, 1 (NNM 22503). — Stn 41, 25 (NNM 22504). — Stn 42, 1 (NNM 22505). — Stn 44, 1 (NNM 22506). — Stn 46, 2 (NNM 22507). — Stn 49, 2 (NNM 22509). — Stn 58, 2 (NNM 22511). — Stn 63, 4 (NNM 22512).

"*Hakuho Maru*": stn KH72-1-28, 1 (USNM 96580).

SNELLIUS 2: stn 4.057, 1 (NNM 22513).

KARUBAR: stn 2, 9 (MNHN). — Stn 3, 8 (USNM 96577). — Stn 7, 5: 1 (MNHN), 4 (USNM 96578). — Stn 35, 1 (MNHN). — Stn 36, 11 (MNHN). — Stn 67, 2 (POLIPI). — Stn 85, 2 (POLIPI). — Stn 86, 8: 2 (MNHN), 6 (USNM 96569).

South China Sea. "*Hakuho Maru*": stn KH72-1-50, 2: 1 (USNM 96581), 1 (ORI).

TYPE LOCALITY. — Philippines and Indonesia, 174-236 m.

DIAGNOSIS. — Discoidal corallum up to 50.8 mm in GCD (KARUBAR stn 35); base flat to slightly convex; D:H up to 4.9 in large specimens. Thin (0.06-0.07 mm), ridged costae bear very small teeth or short spines, producing a finely serrate edge; intercostal region quite wide (3-6 times costal width) and porous, the synapticular bars connecting each costa to its 2 alternating, adjacent septa clearly visible in basal view through intercostal region. A low, marginal shelf, up to 4 mm wide, present on large, well-preserved specimens. Septa arranged in typical micrabaciid fashion (CAIRNS, 1989a, text-fig. 2), attaining the 120-septa stage at a GCD of 17-20 mm and often maintaining this number; however, a large syntype of GCD 38 mm has 144 septa, and the largest known specimen of GCD 51 mm has 228 septa. S₁ independent and unbranched, having a smooth upper, inner edge, but a spinose peripheral edge. S₁ of small specimens highly porous, but as corallum increases in size they develop a more solid, lamellar upper, inner edge — retaining their porosity only on their lower half near the base. S₂ also unbranched but not independent, a pair of S₃ fusing to each S₂ near the columella. Each S₃ bifurcates repeatedly, producing the majority of the septa. Columella elongate, spongy, and often densely fused.

REMARKS. — *Letepsammia formosissima* was the coral most commonly collected on the MUSORSTOM cruises, taken at 55 stations ranging from 115-390 m. A more complete description and illustrations of this species are given by CAIRNS (1989a) and CAIRNS & PARKER (1992), and a comparison to *Rhombopsammia niphada* is given in the account of that species.

Another species, *L. franki* Owens, 1994, occurs in the southwestern Indian Ocean where it had occasionally been ascribed to *L. formosissima* (see CAIRNS, 1989a; CAIRNS & KELLER, 1993; OWENS, 1994). *L. franki* differs from the latter by its papillose columella and coarse septal dentation that give the corallum a distinctly beaded appearance.

DISTRIBUTION. — *Philippines*: common from Lubang Island to the Bohol Sea; 115-390 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (south of Tanimbar Islands); Timor Sea (south of Leti Islands); Savu Sea (west of Timor); 154-390 m. *Elsewhere*: western Pacific to Hawaiian Islands, including South China Sea (Charlotte Bank); 97-457 m.

Letepsammia superstes (Ortmann, 1888)

Stephanophyllia superstes Ortmann, 1888: 160-161, pl. 6, fig. 5. — OWENS, 1986a: 487.
Stephanophyllia (Letepsammia) japonica Yabe & Eguchi, 1934a: 281, figs 1-3; 1942b: 156-157, pl. 12, figs 8a-c.
Letepsammia formosissima forma *superstes* - CAIRNS, 1994: 40, pl. 15, figs c, f.
Letepsammia superstes - CAIRNS, 1995: 34-35, pl. 2, figs f-i (synonymy).
 Not *Stephanophyllia (Letepsammia) japonica* - ZOU, 1988: 75, pl. 5, fig. 7 [= *Stephanophyllia neglecta* Boschma, 1923].

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 2: stn 32, 3 (USNM 96733).

Indonesia. KARUBAR: stn 1, 12 (MNHN). — Stn 7, 1 (USNM 96730). — Stn 18, 1 (USNM 96731). — Stn 50, 1 (USNM 96732).

TYPE LOCALITY. — Sagami Bay, Japan, 183-366 m.

REMARKS. — Although collected on the same type of bottom and often together mixed with the more common *L. formosissima*, *L. superstes* differs in having a smaller corallum with fewer septa. The largest known specimen (MUSORSTOM 2 stn 32) is only 22 mm in calicular diameter and has 96 septa, a size at which *L. formosissima* would have 120 septa. Although similar to *L. formosissima*, *L. superstes* differs in having a papillose columella, more robust trabecular spines, and a tendency to have a patellate (vs a flat based) corallum. The species is more fully described by CAIRNS (1994) as *L. formosissima* forma *superstes* and by CAIRNS (1995).

DISTRIBUTION. — *Philippines*: Verde Island Passage; 192-220 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (east of Tanimbar Islands); 185-282 m. *Elsewhere*: Japan (Honshu and northern Ryukyu Islands); Korea Strait; South China Sea (Hong Kong); Kermadec Ridge; 77-710 m. Pleistocene of Ryukyu Islands.

Genus *RHOMBOPSAMMIA* Owens, 1986

Rhombopsammia niphada Owens, 1986

Rhombopsammia niphada Owens, 1986a: 252-255, figs 2b, 3a-d. — CAIRNS 1989a: 19-20, pl. 9, figs d-i, pl. 10, figs a-b, text-fig. 2 (synonymy); 1994: 41, pl. 15, figs i-k, pl. 16, fig. e.

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 1: stn 47, 1 (USNM 96738).

MUSORSTOM 2: stn 25, 1 (MNHN).

MUSORSTOM 3: stn 116, 1 (MNHN).

Indonesia. DEKI: stn 3, 1 (NNM 22493).

KARUBAR: stn 20, 3 (POLIPI). — Stn 21, 15 (MNHN). — Stn 39, 14 (MNHN). — Stn 40, 15 (USNM 96735). — Stn 59, 17 (MNHN). — Stn 70, 7: 6 (MNHN), 1 (USNM 96737). — Stn 71, 3 (MNHN). — Stn 75, 4 (MNHN).

TYPE LOCALITY. — "Albatross" stn 4911: 31°38'30"N, 129°19'E (East China Sea, off Kyushu), 715 m.

DIAGNOSIS. — Discoidal corallum up to 46 mm in diameter (KARUBAR stn 59); base usually flat. Costae thin (0.06-0.07 mm) ridges. Intercostal regions much wider (about 0.45 mm) than costae, traversed by thin synapticulae, which produce a series of pores in each elongate space. Marginal shelf present but not wide and often damaged. Septa arranged in typical micrabaciid fashion (CAIRNS, 1989a, text-fig. 2), both septa and costae up to 144 in number, which alternate in position. Columella elongate and spongy.

REMARKS. — The similarities between *R. niphada* and *Letepsammia formosissima* have been noted previously (OWENS, 1986a; CAIRNS, 1989a). *R. niphada* differs in having solid S₁ that bear faint vertical ridges (vepreculae) on their faces, whereas the S₁ of *L. formosissima* are highly porous at a small calicular diameter and become more solid with age, but do not bear vepreculae, and always maintain some porosity adjacent to the base. *R. niphada* usually has 144 septa, whereas *L. formosissima* usually has 120 septa, but as many as 228. *R. niphada* has well-developed septal canopies and reduced trabecular spines, whereas *L. formosissima* has well-developed septal spines on the S₃ and S₃' and no canopies. Finally, *R. niphada* is characteristic of deeper water than *L. formosissima*, all records of the former between 405 and 804 m, of the latter species, 97-457 m. A more detailed description and illustrations of this species are found in OWENS (1986a) and CAIRNS (1989a).

DISTRIBUTION. — *Philippines*: Verde Island Passage; Mindoro Strait; Palawan Passage; 512-804 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (southeast of Tanimbar Islands); 405-768 m. *Elsewhere*: Japan (Honshu, Kyushu, and Ryukyu Islands); 660-783 m.

Rhombopsammia squiresi Owens, 1986

Stephanophyllia formosissima var. - ALCOCK, 1902c: 39-40. [See CAIRNS, 1989a].

Rhombopsammia squiresi Owens, 1986a: 250-252, figs 1a-d, 2a. — CAIRNS, 1989a: 18-19, pl. 8, figs e-j, pl. 9, figs a-c (synonymy).

MATERIAL EXAMINED. — *Indonesia*. CORINDON 2: stn 240, 3 (MNHN).
KARUBAR: stn 87, 1 (MNHN), 1 (POLIPI). — Stn 89, 2 (USNM 96741).

TYPE LOCALITY. — "Albatross" stn 5423: 9°38'30"N, 121°11'E (Cagayan Island, Philippines), 929 m.

REMARKS. — Previously known from only 5 specimens from 5 stations, 7 additional specimens of this rarely collected species are reported herein from the Indonesian region, the largest (KARUBAR stn 89) 41.2 mm in calicular diameter. *R. squiresi* is distinguished from *R. niphada* by its distinctive marginal shelf, wherein each septum projects as a broad, flat, spongy mass; and by having only 96 septa.

DISTRIBUTION. — *Philippines*: Sulu Sea (Cagayan Islands and Palawan); Iligan Bay, Bohol Sea. The Philippine depth range is 905-1401 m, not 622-1401 as previously reported (CAIRNS, 1989a). Also, the paratype mentioned by CAIRNS (1989a) from "Albatross" stn 5424, should read "Albatross" stn 5429. *Indonesia*: Makassar Strait; Timor Sea (southwest of Tanimbar Islands and southeast of Timor); 675-1048 m.

Genus *STEPHANOPHYLLIA* Michelin, 1841

Stephanophyllia fungulus Alcock, 1902

Stephanophyllia fungulus Alcock, 1902b: 122; 1902c: 40, pl. 5, figs 35a-b. — FAUSTINO, 1927: 245-246, pl. 77, figs 9-11. — ZOU *et al.*, 1988: 195. — CAIRNS, 1989a: 21-23, pl. 10, figs c-k, pl. 11, figs a-b, text-fig. 3 (synonymy). — CAIRNS & KELLER, 1993: 231. — CAIRNS, 1994: 41-42, pl. 16, figs a-d, f-g (synonymy).

Stephanophyllia complicata - ALCOCK, 1902c: 40 (in part: 1 of 3 specimens from "Siboga" stn 59). [Not *Stephanophyllia complicata* Moseley, 1876].

MATERIAL EXAMINED. — *Philippines*. "Hakuho Maru": stn KH72-1-20, 7 (USNM 96743).
Indonesia. DEKI: stn 6, 66, (NNM 22545). — Stn 49, 115 (NNM 22547). — Stn 52, 1 (NNM 22548).
SNELLIUS 2: stn 4019, 5 (NNM 22550).

TYPE LOCALITY. — "Siboga" stn 100: 6°11'N, 120°37.5'E (Sulu Archipelago), 450 m.

DIAGNOSIS. — Corallum discoidal, with a thick, flat base and slightly upturned edges; D:H = 1.9-2.6. Largest known specimen ("*Albatross*" stn 5586, Celebes Sea) 15.6 mm in diameter. Costae flat, ornamented with a medial row of coarse granules close to epicentre, but outward from basal centre each costa bears 2 rows of smaller granules, one row on each edge of the costa. No marginal shelf. Adjacent septal faces fused together by massive, elongate mural synapticalae (fulturae *sensu* GILL, 1979), producing a sturdy, robust corallum. 96 septa arranged in typical micrabaciid fashion (CAIRNS, 1989a, text-fig. 3). Septal edges straight; septal face granules wide-based, equilateral triangular-shaped spines. Columella massive, lenticular to rectangular in cross section, often surrounded by additional papillae.

REMARKS. — *Stephanophyllia fungulus* is distinguished from the other 2 Recent species in the genus by its massive columella and its thick, upturned base. A more complete description and comparisons to the other Recent species can be found in CAIRNS (1989a, table 2; 1994).

DISTRIBUTION. — *Philippines*: Sulu Sea (Sulu Archipelago); 450-514 m. *Indonesia*: Banda Sea (Kai and Tukangbesi Islands); Savu Sea (Timor); 210-635 m. *Elsewhere*: Malaysia (Celebes Sea off Sabah); widespread from southwestern Indian Ocean to Japan, including South China Sea (north of Pratas Island); 73-256 m.

Stephanophyllia neglecta Boschma, 1923

Fungia patella - VAN DER HORST, 1921: 57 (in part: "*Siboga*" stn 260). [Not *Madrepora patella* Ellis & Solander, 1786].
Stephanophyllia neglecta Boschma, 1923: 144-145, pl. 10, figs 28-30. — CAIRNS, 1989a: 23-24, pl. 11, figs c-j (synonymy).

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 2: stn 33, 1 (USNM 81866).

MUSORSTOM 3: stn 91, 1 (USNM 81865). — Stn 102, 46 (USNM 81859). — Stn 131, 1 (USNM 81864).

Indonesia. DEKI: stn 50, 1 (NNM).

MORTENSEN'S JAVA-S.A. EXPEDITION: stn 5, 54: 48 (ZMUC), 6 (USNM 96746). — Stn 6, 1 (ZMUC). — Stn 8, 2 (ZMUC).

SNELLIUS 2: stn 4.039, 2 (NNM 22758).

KARUBAR: stn 1, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stn 260: 5°36.5'S, 132°55.2'E (Kai Islands, Banda Sea), 90 m.

DIAGNOSIS. — Corallum discoidal, with a thin, flat to highly convex base; D:H = 2.8-3.2. Largest known specimen (MORTENSEN'S JAVA EXP. stn 5) 12.2 mm in calicular diameter and 5.1 mm in height. Costal ornamentation as in *S. fungulus*. No marginal shelf. Synapticalae variable in shape: circular, elliptical, or quite elongate. 96 septa arranged in typical micrabaciid fashion. Septal edges straight; septal face granules blunt to clavate cylindrical spines. Columella variable, usually papillose but in some coralla lamellar.

REMARKS. — *Stephanophyllia neglecta* is more fully described and illustrated by CAIRNS (1989a), who also compared it to the other Recent species.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan Sea; Samar Sea; Tablas Strait; Sulu Sea (Sulu Archipelago and Palawan); 49-555 m. *Indonesia*: Banda Sea (Kai and Tukangbesi Islands); Bali Strait; 50-525 m.

Stephanophyllia complicata Moseley, 1876

Stephanophyllia complicata Moseley, 1876: 558-561, text-fig.; 1881: 198-201, pl. 4, fig. 12, pl. 13, figs 3-5. — ALCOCK, 1902c: 40 (in part: "*Siboga*" stn 256). — CAIRNS, 1989a: 21, pl. 12, figs a-b; 1995: 37-38, pl. 3, fig. h, pl. 4, figs a-e (synonymy). — CAIRNS & KELLER, 1993: 231-232.
Stephanophyllia japonica - WELLS, 1984: 207, pl. 1, figs 5-6. Not *Stephanophyllia japonica* Yabe & Eguchi, 1934.

MATERIAL EXAMINED. — **Indonesia**. DEKI: stn 6, 1 (NNM 22542). — Stn 50, 7 (NNM). — Stn 52, 4 (NNM 22543).

KARUBAR: stn 2, 51 (MNHN). — Stn 3, 46 (POLIPI). — Stn 5, 1 (USNM 96748). — Stn 7, 66 (USNM 96749). — Stn 15, 1 (MNHN).

TYPE LOCALITY. — "*Challenger*" stn 192: 5°42'S, 132°25'E (Kai Islands, Banda Sea), 236 m.

DIAGNOSIS. — Corallum discoidal, with a thin, flat base; D:H = 2.5-2.7. Corallum up to 18 mm in calicular diameter. Costal ornamentation as in *S. fungulus* Alcock. At calicular edge of well-preserved specimens, costae are slightly upturned, and bifid, extending about 0.5 mm beyond calicular perimeter and producing a small marginal shelf. Synapticulae circular to elliptical in cross section. 96 septa arranged in typical micrabaciid fashion, the S₁₋₂ having straight edges, but the S₃ meandering toward the calicular edge. Septal faces covered with narrow-based isosceles triangular-shaped granules. Columella a prominent, but thin lamella, sometimes divided into papillae or sub-lamellar elements at its summit.

REMARKS. — All specimens reported above are essentially topotypic, being collected very close to the type locality in the Kai Islands. *S. complicata* is distinguished from the other species in the genus (see CAIRNS, 1989a, table 2) by having a thin, lamellar columella, and a narrow marginal shelf. It is described in greater detail by CAIRNS (1995) based on specimens from the New Zealand region.

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai Islands); 210-397 m. *Elsewhere*: western Indian Ocean; Norfolk and Three Kings Ridges; 229-1137 m.

Suborder FAVIINA

Superfamily FAVIOIDEA Gregory, 1900

Family RHIZANGIIDAE d'Orbigny, 1851

Genus *CULICIA* Dana, 1846

Culicia stellata Dana, 1846

Figs 3 a-b

Culicia stellata Dana, 1846: 377, pl. 28, figs 5a-d. — NEMENZO, 1976: 252, pl. 9, figs 2-3.

Culicia truncata Dana, 1846: 378, pl. 28, figs 7, 7a (**new synonym**).

Culicia japonica Yabe & Eguchi, 1936: 167-168, figs 1-3 (**new synonym**). — CAIRNS, 1994: 42, pl. 17, figs a-e (synonymy).

MATERIAL EXAMINED. — **Philippines**. "*Alpha Helix*": stn 79-M140, 1 large colony (USNM 80029).

Malaysia. Kota Kinabalu, Sabah, depth unknown, 2 colonies (USNM 78565).

TYPE LOCALITY. — Singapore, South China Sea (depth not given).

DESCRIPTION. — Philippine corallum consists of 50-60 corallites produced by extratentacular, reptoid budding. Stolons linking corallites thin and flat, 1.5-2.0 mm wide; corallites spaced 1-5 mm apart. Stolons often covered by encrusting epifauna. Corallites circular to slightly elliptical in cross section, up to 3.8 mm in GCD, and 4.3 mm in height. Corallites epithecate when well-preserved, with a very thin (50 µm), almost translucent, smooth upper rim that rises above upper outer septal edges (fig. 3b).

Septa hexamerally arranged in 4 cycles, the last cycle never complete, 34-42 being the most common septal complement. S₁ independent, each composed of a tall but narrow upper lobe, a vertical inner edge, and 1 or 2 lacinate teeth on its lower, inner margin. S₂₋₃ equal in size and shape, the inner edges of the 2 S₃ and 1 S₂ in

each system fusing near the columella. S₂₋₃ not lobate as the S₁, but bearing 3 or 4 lacinate teeth that grade into the columellar elements. S₄ rudimentary, consisting of a discontinuous row of spines, each spine 1/3 to 1/4 height of the adjacent lower cycle septum. Fossa of moderate depth. Columella papillose, consisting of 5-9 elements similar in size and shape to innermost septal teeth.

REMARKS. — DANA (1846: 377) described *C. stellata* as having corallites "3 lines high, and 1.5 broad" and 24 septa per corallite. Since a "line" is 1/12 inch (2.12 mm), the corallites are inferred to be about 6.4 mm in height and 3.2 mm in GCD. Examination of DANA's holotype (USNM 185) shows it to have shorter (4.3 mm max.) and broader (to 3.8 mm) corallites, most of which have septa of the 4th cycle, up to 42 septa/corallite. Likewise, his description of *C. truncata* implies corallites of 2.6 mm in height and GCD, and 24 septa; whereas the type (USNM 183) has corallites up to 3.5 mm in GCD and none over 2 mm in height, and most having some pairs of S₄. *C. truncata* would appear to be a specimen of *C. stellata* in which the corallites remained slightly lower than normal, possibly for an environmental reason. The description and figures of *C. japonica*, as well as the Japanese specimens reported by CAIRNS (1994), are also consistent with *C. stellata*.

DISTRIBUTION. — *Philippines*: Cebu and Bohol; 14-20 m. *Elsewhere*: South China Sea (Singapore; Kota Kinabalu, Sabah); Japan (Honshu, Kyushu, Ryukyu Islands, and Korea Strait); Fiji; 5-100 m.

Family OCULINIDAE Gray, 1847

Genus *MADREPORA* Linnaeus, 1758

Madrepora oculata Linnaeus, 1758

- Madrepora oculata* Linnaeus, 1758: 798. — ZIBROWIUS, 1974b: 762-766, pl. 2, figs 3-5 (synonymy). — CAIRNS, 1982: 15, pl. 3, figs 4-6 (synonymy); 1991: 9-10, pl. 2, fig. j, pl. 3, figs a-d (synonymy); 1994: 18-19, pl. 3, figs f-h (synonymy); 1995: 41, pl. 5, figs e-f, pl. 6, figs a-b. — CAIRNS & KELLER, 1993: 233.
- Lophohelia tenuis* Moseley, 1881: 180-181, pl. 8, figs 11-14.
- Amphihelia oculata* - ALCOCK, 1902c: 35. — MARENZELLER, 1904a: 308-310, pl. 14, fig. 1.
- Amphihelia ramea* - ALCOCK, 1902c: 35. [See ZIBROWIUS, 1980: 39 for a discussion of *Madrepora ramea*].
- Amphihelia arbuscula* - ALCOCK, 1902c: 35 (in part: "Siboga" 95, 156). [Not *Lophohelia arbuscula* Moseley, 1881].
- Amphihelia tenuis* - ALCOCK, 1902c: 36.
- Sclerohelia formosa* - ALCOCK, 1902c: 36. [See ZIBROWIUS, 1974a: 570 for a discussion of *Madrepora formosa*].
- Desmophyllum* sp. - ALCOCK, 1902c: 28.
- Madrepora alcocki* Faustino, 1927: 106 (*nom. nov.* for *M. ramea* Duncan, 1873; see ZIBROWIUS, 1980: 39).
- Madrepora tenuis* - FAUSTINO, 1927: 107-108, pl. 14, figs 2, 5. — ZIBROWIUS, 1974b: 765 (discussion).
- Lophelia tenui* (sic) - HU, 1987: 40-41, pl. 2, figs 8-10, 12.

MATERIAL EXAMINED. — *Philippines*. "Siboga": stn 95 (ZMA Coel. 6455).

"Albatross": stn 5123, 50 branches (USNM M235386). — Stn 5124, 2 branches (USNM 96608). — Stn 5201, 3 branches (USNM 96602). — Stn 5202, 1 (USNM 96612). — Stn 5327, 7 branches (USNM 96631). — Stn 5348, 1 (USNM 96625). — Stn 5349, 1 (USNM 96627). — Stn 5373, 5 branches (USNM 96607). — Stn 5378, 5 branches (USNM 96606). — Stn 5381, 6 branches (USNM 96630). — Stn 5403, 1 (USNM 96621). — Stn 5405, 10 fragments (USNM 96618). — Stn 5406, 4 branches (USNM 96609). — Stn 5407, 13 branches (USNM 96622). — Stn 5408, 2 branches (USNM 96616). — Stn 5411, 1 (USNM 96626). — Stn 5417, 1 (USNM 96619). — Stn 5418, 2 branches (USNM 96617). — Stn 5423, 2 (USNM 96620). — Stn 5424, 2 branches (USNM 96613). — Stn 5425, 1 branch (USNM 96602). — Stn 5428, 1 branch (USNM 96598). — Stn 5513, 5 branches (USNM 96604). — Stn 5516, 1 (USNM 96615). — Stn 5527, 4 branches (USNM 96594). — Stn 5529, 7 branches (USNM 96593). — Stn 5541, 2 branches (USNM 96614). — Stn 5543, 5 branches (USNM 96632). — Stn 5574, 3 branches (USNM 96633).

"Galathea": stn 436 (ZMUC). — Stn 443 (ZMUC).

"Hakuho Maru": stn KH72-1-20, 20 branches: 10 (ORI), 1 (USNM 96628).

MUSORSTOM 1: stn 49, 1 branch (USNM 96601).

MUSORSTOM 2: stn 36 (MNHN). — Stn 39 (MNHN). — Stn 49 (MNHN).

MUSORSTOM 3: stn 89 (MNHN). — Stn 105, 2 branches (USNM 96597). — Stn 106 (MNHN). — Stn 122, 3 branches (USNM 96599). — Stn 123 (MNHN). — Stn 128, 10 branches (USNM 96596). — Stn 139, 1 branch (USNM 96600).

Indonesia. "*Siboga*": stn 156 (ZMA). — Stn 259 (ZMA Coel. 5523).

"*Albatross*": stn 5586, 1 (USNM 96629). — Stn 5625, 8 branches (USNM 96623). — Stn 5645, 3 colonies (USNM 96592).

DEKI: stn 22, 2 branches (NNM 22723). — Stn 33 (NNM 22724). — Stn 45 (NNM 22726). — Stn 50 (NNM 22728). — Stn 52 (NNM 22729). — Stn 58 (NNM 22730 and ZMUC). — Stn 59 (NNM 22731).

"*Galathea*": stn 490 (ZMUC).

"*Hakuho Maru*": stn KH72-1-28, 10 branches (USNM 96603).

SNELLIUS 2: stn 4.144, 1 colony (NNM).

KARUBAR: stn 7, 2 (MNHN). — Stn 9, many branches (USNM 96582, 96635). — Stn 13, many branches (MNHN). — Stn 16, 3 branches: 2 (MNHN), 1 (POLIPI). — Stn 19, 7 branches (USNM 96584). — Stn 35, 3 branches (POLIPI). — Stn 39, 1 (USNM 96585). — Stn 42, 8 branches (POLIPI). — Stn 56, 3 branches (POLIPI). — Stn 59, many branches (POLIPI). — Stn 69, many branches (MNHN and USNM 96582). — Stn 77, 3 branches (MNHN and USNM 96634).

South China Sea. "*Albatross*": stn 5314, 2 branches (USNM 96610). — Stn 5317, 4 branches (USNM 96605).

"*Hakuho Maru*": stn KH72-1-52, 6 branches (USNM 96628). — Stn KH73-2-44-2, 20 branches (USNM 96586, 96587).

TYPE LOCALITY. — Tyrrhenian Sea and off Sicily (depth not given).

DIAGNOSIS AND REMARKS. — *Madrepora oculata* is a widespread, variable species. Many names have been used for it (ZIBROWIUS, 1974b) and more recently various forms have also been distinguished (CAIRNS, 1991). The most commonly collected form occurring in the Philippine/Indonesian region is characterized by having delicate, uniplanar colonies formed of regular, nonanastomosing, sympodially budded corallites (*M. tenuis* of MOSELEY, 1881 and form *beta* of CAIRNS, 1991). Its coenosteum is often light beige, finely granular, and longitudinally striate. It is often attached to long hexactinellid spicules. Corallites 2.3-3.0 mm in diameter, containing 3 full cycles of hexamerally arranged, narrow septa ($S_1 > S_2 > S_3$), the CS_{1-2} usually slightly exsert but extending only about 1 mm down from calice as thin, ridged costae. Inner edges of septa finely dentate to highly lacinate. Septal faces may also bear tall, slender spines. Fossa of distal corallites usually deep, containing a papillose columella.

Specimens from two lots (KARUBAR stn 56 and "*Albatross*" stn 5645) differ from the form described above in that they live in association with a symbiotic eunicid polychaete, which causes the coral to form a bushy corallum of highly anastomotic branches.

Specimens from seven lots (KARUBAR stns 9, 13, 19, 77; "*Albatross*" stn 5529; "*Hakuho Maru*" stn 73-2-44-2; and DEKI stn 50) bear some bell-shaped, hypertrophied corallites, as much as 23 mm in GCD and having up to 82 porous septa. Once reported as the first neoplasms in Scleractinia (SQUIRES, 1965), these abnormally large corallites are now known to be the manifestation of a parasitic petrarcid ascithoracidan crustacean (GRYGIER & CAIRNS, 1996).

A more complete description and illustrations of this species are found in ZIBROWIUS (1974b) and CAIRNS (1982, 1991).

DISTRIBUTION. — *Philippines*: common throughout Philippines from Lubang Island to Bohol Sea; Sulu Archipelago; 161-2021 m. *Indonesia*: Molucca Sea; Halmahera Sea; Banda Sea (Kai Islands and Sulawesi); Arafura Sea (southeast of Tanimbar Islands); Timor Sea (south of Leti and Timor Islands); Savu Sea; Flores Sea (Selayar Island, Sulawesi); Java Sea; 112-984 m. *Elsewhere*: Malaysia (Celebes Sea off Sabah); cosmopolitan, except for continental Antarctica; 15-1500 m.

Madrepora arbuscula (Moseley, 1881)

Figs 3 c-g

Not *Madrepora arbuscula* Dana, 1846: 474 [= *Acropora* sp.].

Lophohelia arbuscula Moseley, 1881: 180, pl. 8, figs 9-10.

Amphihelia arbuscula - ALCOCK, 1902c: 35 (in part: "*Siboga*" stn 12).

Madrepora arbuscula - FAUSTINO, 1927: 107 (in part). — ZIBROWIUS, 1974b: 765.

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 3: stn 126, 2 large colonies (USNM 96750) and 13 branch fragments (MNHN).

Indonesia. "Challenger": stn 194, holotype (BMNH 1880.11.25.96).

"Siboga": stn 12, 2 branches (ZMA).

"Albatross": stn 5584, 1 branch (USNM 96757).

KARUBAR: stn 18, 17 branch fragments (USNM 96752). — Stn 32, 4 branches: 1 (POLIPI), 3 (MNHN).

TYPE LOCALITY. — "Challenger" stn 194: 4°31'S, 129°57'E (Banda Island, Banda Sea), 366 or 658 m.

DESCRIPTION. — Corallum massive, the largest colony (MUSORSTOM 3 stn 126) 26 cm in height, having a stout, dense basal stem 5.0 cm in diameter. Lower 1/3 to 1/2 of colony consists only of basal stem and individual corallites that bud directly from the coenosteum, but upper corallum ramifies into anastomosing branches, each of which contains a central tubular cavity about 5 x 7 mm in diameter that is presumed to be inhabited by a eunicid polychaete. Calices 2.5-3.1 mm in diameter, circular to slightly elliptical, tending to concentrate on one face of the corallum (here defined as anterior). Whereas corallites do occur on the posterior face, they are fewer in number, often nonfunctional, filled in with stereome, and usually completely absent from the lower 10 cm of basal stem due to incorporation within basal coenosteal layering. Coenosteum on distal branches remarkably smooth and porcellaneous (not granular) even at a magnification of x 2500; however, larger-diameter branches and worn coenosteum sometimes reveal very shallow longitudinal striae that delimit perfectly flat costae. Septocostal ridges absent from calicular edges. Corallum white; however, coenosteum immediately adjacent to calice a dark brown.

Septa hexamerally arranged in 3 complete cycles: $S_1 > S_{2-3}$. S_1 only about 0.4 mm exsert, extremely narrow (0.10-0.15 mm), having entire (nondentate) inner edges and irregularly granular septal faces. S_{2-3} nonexsert, only about 0.06 mm (60 μ m) in width, and otherwise similar to the S_1 . Deep in fossa the lower, inner edges of the 6 S_1 and sometimes some of the S_2 widen and join one another in centre of fossa, forming a short styliform columella (Fig. 3f). Deep in fossa S_3 are very narrow, each pair within a system bending toward and fusing to its common S_2 . Fossa deep and spacious, due to the very narrow septa.

Each polyp possesses 1 long sweeper tentacle, up to 11 mm long in the preserved state, the other more typical tentacles being only 1-2 mm in length. This is the first case of sweeper tentacles being observed in a deep-water coral.

REMARKS. — *Madrepora arbuscula* differs from other species of *Madrepora* in several significant characters. It has: 1) a very massive basal stem, 2) no coenosteal granules, which produces a porcellaneous texture, 3) white coenosteum but brown-edged calices, 4) extremely narrow septa with no inner edge dentition, 5) a rudimentary styliform columella (that of *M. oculata* is papillose), and 6) sweeper tentacles. Although tentacle length of *Madrepora* generally had no special attention, the second author has occasionally observed that live *M. oculata* had short, uniform-length tentacles. It was therefore surprising to see that *M. arbuscula* from MUSORSTOM 3 stn 126 had one long sweeper tentacle per polyp in addition to normal-sized, shorter tentacles. This was seen on the freshly dredged live colonies kept in seawater, and can still be seen after preservation in formalin.

In addition to the ubiquitous spirocysts, both the normal and sweeper tentacles of *M. arbuscula* (MUSORSTOM stn 3-126) contain b-rhabdoids (type 1), p-rhabdoids D (type 1), and holotrichs (type I). According to DEN HARTOG (1977), the cnidae of sweeper tentacles are always different from that of normal tentacles, so *M. arbuscula* may present a unique condition among the approximately 14 scleractinian species now known to have sweeper tentacles (WILLIAMS, 1991). Nematocyst identifications and terminology follows the review by PIREZ and PITOMBO (1992) and is considered only preliminary — the quantification of sizes remains to be tabulated.

Madrepora arbuscula (Moseley, 1881) is a junior secondary homonym of *M. arbuscula* Dana, 1846, but because DANA's species is now considered to be in the genus *Acropora*, according to the ICZN (article 59c) MOSELEY's name does not have to be replaced.

DISTRIBUTION. — *Philippines*: Sulu Sea (Semirara Islands); 266 m. *Indonesia*: Banda Sea (Kai Islands and Banda Islands); Bali Sea; 212-658 m; *Malaysia* (Celebes Sea off Sabah).

Madrepora minutiseptum sp. nov.

Figs 4 a-d, 5 a-b

Amphihelia infundibulifera - SAVILLE KENT, 1871: 276-277, pl. 24, figs 4, 4a, 4b. — QUELCH, 1886: 26, 53. [Not *Oculina infundibulifera* Lamarck, 1816: 286; 1836: 457 (= stylasterid), see Remarks].

MATERIAL EXAMINED/TYPES. — **Indonesia**. Ternate, from local governor S.C.J. MUSSCHENBROEK to "Challenger" naturalists, October 1874, 1 paratype colony (BMNH 1886.12.9.57).

CORINDON 2: stn 235 (confused station data!), 1 branch fragment with 6 calices, paratype (USNM 96756). — Stn 248, 1 small branch with ca. 20 calices, paratype (POLIPI) and 1 small colony with remarkably different calices, but possibly the same species, see description (MNHN).

SNELLIUS 2: stn 4.196, 1 colony (holotype) (NNM 22734).

KARUBAR: stn 18, 3 tiny fragments altogether 4 calices (USNM 96755).

Taiwan (= Formosa). From R. SWINHOE, 3 paratype colonies (BMNH 1865.12.15.1), 6 paratype colonies (BMNH 1870.5.9.21-22-24-25-26-27). — 1 colony (AMS G 7014; probably transfer from BMNH). — coll. FRIES, 1 paratype colony (NMW 8227; old number 3180, registered in 1884).

Japan. From F. VAN HEUKELOM, 1 colony (ZMA Coel. 7400). — No details, 2 colonies (ZMA Coel. 138, 139). — No details, 1 colony (USNM 96754, ex ZMA Coel. 137, transfer Sept. 1994).

No origin indicated. Formerly GERRESHEIM collection, seen by EHRENBERG, 1 colony (ZMB 582).

TYPE LOCALITY. — SNELLIUS 2 stn 4.196: 6°23'S, 120°26.5'E (southwest of Salayer, Flores Sea), 150-200 m.

ETYMOLOGY. — The species name *minutiseptum* (Latin *minutus*, small + *septum*, a fence, bar), alludes to the very small septa of this species. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum arborescent, irregularly branching, often tending to form subflabellate colonies. Larger colonies (holotype; Ternate specimen) 20-25 cm in height. A strongly developed trunk and main branches are hollow, containing a central canal with lateral openings (by analogy with *Madrepora oculata* interpreted as tubular growth induced by an eunicid polychaete). Inner diameter of these tubes generally ca 3.5 mm. Anastomoses of branches frequent. Thin distal or peripheral branches distinctly zigzag-shaped, with corallites sympodially budded (1 or 2 on the parent corallite), on trunk and main branches corallites immersed into sclerenchyme. Corallum solid, with smooth surface; no costae. White, except for pigmented calicular edge or upper 1/2 of sympodial corallites. Pigmentation reddish brown to dark brown, extending throughout the skeleton thickness at the pigmented level, not only superficial; also extending inside calice on septa. Pigmentation of septa decreasing in depth of calice. Corallites on thin branches about equal in height and width, 1.5-2.5 mm in calicular diameter, with a narrow base, and up to 2.5 mm in height. Corallites distinctly infundibuliform, with wide "empty" fossa because of the low septa. Septa are essentially reduced to a row of flattened septal edge teeth coalescent laterally with granules of the reduced septal faces. Septa hexamerally arranged in 3 complete cycles, as ridges of low papillae rather than distinct lamellae. S₁ to S₃ slightly decreasing in width, with a correspondingly slight decrease in exsertness above the calicular edge. No columella, bottom of fossa covered by small papillae similar to those of the higher and more peripheral parts of the septa.

CORINDON 2 stn 248 provided 1 small branch (21 mm in length) with the eunicid-induced deformation and comprising ca. 20 calices, of the typical aspect. But from the same station there is another small colony about 15 mm in height with the same type of deformation, the calices of which are exceptionally small (1 mm or less in diameter), with only 12 septa. These septa are similar to those in typical *M. minutiseptum* with 24 septa (*i.e.*, as in the branch from CORINDON 2 stn 248) by being very low and denticulate. This unique specimen may be an initial colony of the same species, dwarfed for some reason. For this reason it is not given paratype status.

REMARKS. — Although differing considerably from the type of the genus, *Madrepora oculata*, the species in question is attributed herein, provisionally, to the genus *Madrepora* on the basis of a series of characters: the small sized corallites arranged in sympodial branches, septa in 3 cycles, the general shape of colonies, and the regular presence of a not yet observed symbiont which causes the tubular growth deformation and which is presumed to be an eunicid polychaete. *M. minutiseptum* differs from all congeners by its very low septa which are hardly more than a denticulate ridge. Like *M. arbuscula*, it is partly pigmented (near the calicular edge).

The species described here under *Madrepora minutiseptum* had recognizably been characterized and illustrated by SAVILLE KENT (1871) as a scleractinian under the name *Amphihelia infundibulifera*, on the basis of "specimens in the British Museum, collected at Formosa by Consul Swinhoe" (material which we have seen). SAVILLE KENT was mistaken in being convinced that his material was "evidently identical with the species described .. by Lamarck", i.e., *Oculina infundibulifera* Lamarck, 1816, presumed to come from the Indian Ocean. LAMARCK's (1816: 286) text in Latin and French (the same in the 2nd edition, 1836: 457, without additions) is brief and imprecise, as usual for most coral descriptions in the early 19th century. A critical analysis of this text strongly suggests that LAMARCK's *O. infundibulifera* is not a scleractinian but a stylasterid coral (at that time stylasterids were not yet recognized as a distinct group). *O. infundibulifera* was said to be close to the "following" species, *O. flabelliformis* Lamarck, 1816 (now *Stylaster flabelliformis*; for a detailed description, including of LAMARCK's type, see BOSCHMA, 1957b); to be almost flabellate; and to have very small zigzag-shaped branches aside the thicker main ones, both of which are coalescent. All this characterizes a stylasterid rather than a scleractinian.

LAMARCK's *O. infundibulifera* was mentioned by H. MILNE EDWARDS & HAIME (1857: 131) as a problematical stylasterid under the combination *Allopora (Stylaster) infundibulifera*. Having not seen LAMARCK's type, they referred to DANA (1848) for this interpretation. LAMARCK's type of *O. infundibulifera* appears lost. It is not with the LAMARCK collection at the Muséum national d'Histoire naturelle, Paris. It probably has never been there since LAMARCK's text does not indicate "Mus. no.", his usual way of referring to specimens present in the MNHN collection.

Many (not all) secondary quotations of LAMARCK's species are listed by BOSCHMA (1957a: 62-63, under *Amphelia infundibulifera*) who, following SAVILLE KENT (1871), considered it as a scleractinian. But, given the strong arguments for LAMARCK's *O. infundibulifera* being a stylasterid, this name cannot be used for SAVILLE KENT's species which is a *Madrepora* (= *Amphihelia*).

Should there be another old name available for SAVILLE KENT's scleractinian? EHRENBERG (1834: 302-303) distinguished 4 new varieties of *Oculina virginea* (this name dates back to *Madrepora virginea* Linnaeus, 1758, an unidentifiable taxon): *pachyclados*, *leptoclados*, *tubulifera*, *immersa*. As typical for EHRENBERG's taxa, the characterization of these 4 varieties is too brief to allow adequate identification based on his text alone, *O. virginea* being itself a confused taxon since the beginning.

The Berlin Museum possesses 5 colonies referable to 2 species of *Madrepora* (= *Amphihelia*) and considered as being part of the museum's initial collection studied by EHRENBERG (1834). All are without indication of origin, as common at that time of "natural history cabinets", and 4 of them are ascribed to GERRESHEIM, an early 19th century collector. The 2 species in question are: *Madrepora oculata* Linnaeus, 1758 (see CAIRNS, 1979; ZIBROWIUS, 1980) represented by 4 colonies, and *M. "infundibulifera"* sensu SAVILLE KENT, 1871, represented by one colony. Only one colony (of *M. oculata*) is accompanied by a label in EHRENBERG's handwriting, reading *Oculina virginea* Lam. (but no variety is indicated). The 4 other colonies (3 *M. oculata*; 1 *M. "infundibulifera"* sensu SAVILLE KENT) all have later 19th century, not original, labels reading *Oculina virginea* var. *leptoclados*. It cannot be elucidated whether the identification of colonies of 2 distinct species to var. *leptoclados* was by EHRENBERG himself or was due to some later confusion. EHRENBERG's characterization (*ramis tenuioribus*; Latin: with thinner branches) of var. *leptoclados* (Greek: thin branch), opposed to the characterization (*ramis crassioribus*; Latin: with thicker branches) of var. *pachyclados* (Greek: thick branch) is of no help, especially since no authentically labeled sample of var. *pachyclados* is present that could be the reference. Accordingly the only colony (ZMB 582, GERRESHEIM) of *M. "infundibulifera"* sensu SAVILLE KENT in the old Berlin collection should not be considered as the type of EHRENBERG's var. *leptoclados* and this name is rejected as unavailable for SAVILLE KENT's species. The latter is here named *Madrepora minutiseptum* because of its very reduced low septa.

DISTRIBUTION. — Remarkably, this species is represented by quite a number of colonies in several old museum collections (Berlin, Amsterdam, London, Sydney, Wien), received in the 19th century. A few more specimens were collected in the 1980's. Although there is no modern record from the area, Taiwan (= Formosa) as the origin of a series of colonies at the BMNH received from "consul Swinhoe" is surely correct since ROBERT SWINHOE (1836-1877) had indeed been on duty in China for many years, including in Taiwan (in 1858, 1861 and 1864-1866, especially at Tansui, in the north of the island; see MEARNS & MEARNS, 1988).

In Indonesia the species has been recorded from 4 distinct areas: from Salayer, type locality (SNELLIUS 2: 150-200 m); from Ternate ("*Challenger*" expedition: undetailed); from Makassar Strait (CORINDON 2 stn 235, although the depth of 1110 m is certainly confused); and from the Kai Islands (KARUBAR stn 18: 205-212 m).

Confirmed distribution. — Taiwan, Japan and Indonesia; 150-212 m.

Genus *CYATHELIA* H. Milne Edwards & Haime, 1849

Cyathelia axillaris (Ellis & Solander, 1786)

Madrepora axillaris Ellis & Solander, 1786: 153, pl. 13, fig. 5.

Cyathohelia axillaris - MOSELEY, 1876: 547; 1881: 175-176. — BASSETT-SMITH, 1890: 367. — BEDOT, 1907: 145, pl. 15, figs 1-3.

Cyathelia axillaris - NEMENZO, 1979: 11-12, pl. 3, fig. 3. — CAIRNS, 1994: 43-44, pl. 18, figs a-c (synonymy).

MATERIAL EXAMINED. — **Philippines.** "*Albatross*": stn 5134, 1 (USNM 96758). — Stn 5255, 1 (USNM 96759). — Stn 5268, 1 (USNM 96760). — Stn 5367, 5 (USNM 96761).

MUSORSTOM 3: stn 131, 2 (USNM 96763).

Indonesia. "*Siboga*": stn 260, 1 (ZMA Coel. 6438). — Stn 310, 1 colony (ZMA Coel. 6619); unknown station, 1 colony (ZMA Coel. 6439).

DEKI: stn 24, 2, (NNM 22449). — Stn 104, 1 (NNM 22448). — Stn 105, 1 (NNM 22443). — Unnumbered station, Ambon, 25-130 m, 1 (NNM 22445-47).

CORINDON 2: stn 248, 2 (MNHN).

SNELLIUS 2: stn 4.106, 1 (NNM 22444).

KARUBAR: stn 22, 1 (USNM 96762). — Stn 30, 1 (USNM 96763).

TYPE LOCALITY. — Eastern Indian Ocean (depth not given).

DIAGNOSIS. — Corallum sparsely branched, resulting in small, robust, bushy colonies, the largest known 7.5 cm in height, consisting of about 100 corallites (EGUCHI, 1968). Extratentacular branching essentially sympodial, 2 buds usually originating on opposite sides of a terminal corallite, the parent corallite eventually becoming immersed in thick coenosteum in resultant branch axil. Corallites relatively large, up to 11 mm GCD. Corallum light brown, the corallites usually a darker shade. Septa hexamerally arranged in 4 cycles: $S_{1-2} > S_3 > S_4$. A crown of 12 thick pali (P_{1-2}) encircle the columella and a second, slightly more recessed crown of 12 P_3 stand higher in the fossa, resembling the calice of a *Trochocyathus*. Columella papillose.

REMARKS. — Among the colonial azooxanthellate corals known from this region, *Cyathelia* is distinguished by its distinctive branching: two large corallites budding from opposite sides of a parent corallite, the parent corallite often becoming constricted. Also distinctive, the coenosteum of this species is white to beige, whereas the calice and near-calice coenosteum are a darker brown. A complete description is given by NEMENZO (1979) and CAIRNS (1994).

DISTRIBUTION. — **Philippines:** Verde Island Passage; Bohol Sea (Negros); Davao Gulf; Sulu Sea (Zamboanga Peninsula); 46-329 m. **Indonesia:** Makassar Strait; Molucca Sea; Ceram Sea (south of Obi Islands); Banda Sea (Kai and Ambon Islands); Flores Sea (Sumbawa); Java Sea (Sunda Strait); 13-170 m. **Elsewhere:** South China Sea (Tizard Bank); northern Indian Ocean; Japan (Honshu and northern Ryukyu Islands); Korea Strait; 15-366 m.

Genus *NEOHELIA* Moseley, 1881

Neohelia sp. cf. *N. porcellana* Moseley, 1881

Figs 5 c-e, g-h

MATERIAL EXAMINED. — **Indonesia.** "*Siboga*": stn 289, 1 colony (USNM 96766). — Stn 305, 1 colony (ZMA).

DEKI: unnumbered station in Bay of Ambon, 91 m, 1 broken colony (ZMUC). — Unnumbered station in Bay of Ambon, 46-55 m, 1 colony (NNM 22680).

CORINDON 2: stn 248, 1 colony (MNHN).

SNELLIUS 2: stn 4.104, several colonies (NNM 22681), 1 colony (USNM 96765). — Stn 4.105, 2 colonies (NNM 22733).

DESCRIPTION. — Corallum up to 5 cm in height, forming a very thin, easily fractured encrustation around the parchment-like tube of a eunicid polychaete or gorgonian axis. Only very short, slender branches consisting of 3-5 corallites project from the basal encrustation. If encrusting a polychaete tube, the terminal aperture created by the polychaete is approximately 2.8 mm in diameter; however, additional circular to elliptical pores of variable diameter (0.4-1.6 mm) penetrate the coenosteum providing feeding apertures for the worm. Calices circular but variable in diameter, ranging from 0.70-1.50 mm. Theca white, with very faint, longitudinal costal striations. Coenosteum of some coralla also densely covered with small, blunt papillae up to 70 μ m in diameter and 80 μ m in height, similar to the "granular echinulations" illustrated by PRATT (1900: pl. 62, fig. 2).

Septa hexamerally arranged in 3 generally full cycles: $S_1 > S_2 > S_3$; in some corallites from Ambon (ZMUC), 1 or 2 pairs of S_3 are sometimes missing, resulting in 20-22 septa. S_1 highly exsert (up to 0.25 mm) and quite narrow (about 0.11 mm). Vertical inner edges of S_1 slightly thickened and sinuous deep in fossa, where they extend to the centre of fossa. S_2 less exsert and narrower (about 0.6 mm) than the S_1 , not extending quite as far toward centre of fossa. S_3 least exsert and least wide (about 0.4 mm) septa, attenuating before they reach base of fossa. Fossa relatively shallow and quite wide, resulting from the small size of the septa; fossa with a horizontal floor. Columella rudimentary, consisting of several irregularly shaped papillae, the papillae often an extension of the inner S_1 septal edges.

REMARKS. — Both MOSELEY (1881) and PRATT (1900) reported their Vanuatu specimens of *N. porcellana* to have exclusively pentameral symmetry in 3 cycles (5:5:10), resulting in 20 septa, although PRATT (1900: 592) acknowledged that "there is a tendency for them to lose their symmetry of arrangement". Likewise, most of WELLS' (1984) Pleistocene Vanuatu specimens (USNM) have 20 septa, but several corallites were found to have 24 septa arranged in three cycles. Whereas most of the Ambon corallites have hexameral symmetry in 3 cycles (24 septa), the 3rd cycle is occasionally incomplete, resulting in 20, 22, or 24 septa. Because of the difference in septal symmetry (pentameral resulting in 20 septa for previously reported *Neohelia* vs. hexameral resulting in 24 septa) the Indonesian specimens are not definitively identified as *N. porcellana*.

Some early authors (PRATT, 1900; HICKSON, 1903) believed that *N. porcellana* was able to produce a horny membrane underlying its calcareous coenosteum. In fact, similar to *Madrepora*, *Neohelia* may overgrow the productions of other organisms and especially the membrane-like tubes of symbiotic eunicid polychaetes. However, more recently, polychaetes have been found within *Madrepora* axes (CAIRNS, 1991, 1995) and, indeed, a dried eunicid was found in the tube of the *Neohelia* from Ambon, suggesting that the polychaete, not the coral, secretes the horny membrane.

WELLS (1984) synonymised *Neohelia* with *Madrepora* without explanation. The rudimentary columella in *Neohelia* and its distinctive coenosteal papillae would seem to justify the retention of this genus. *Neohelia porcellana* is described in great detail by PRATT (1900), including characteristics of the soft parts.

DISTRIBUTION. — *Indonesia*: Makassar Strait; Banda Sea (Bay of Ambon: Solar Strait); Timor Sea (southeast of Timor); Lintah Strait, west of Flores; 55-170 m.

Typical pentameral *Neohelia porcellana* is known from Vanuatu (Api Island, type locality) (Fig. 5f) and Pleistocene of Kere and Navaka River (WELLS, 1984); Loyalty Islands (PRATT, 1900; HICKSON, 1903); and New Caledonia. WELLS (1984) listed *N. porcellana* from northwestern Australia (140-141 m), but we can find no documentation of this record. According to MOSELEY (1881) the types were collected at "Challenger" stn 177 at 63 fathoms (=115 m), but according to TIZZARD *et al.* (1885, cruise narrative) it is 130 fathoms (= 238 m). VAUGHAN & WELLS (1943) indicate a range of 91-115 m for the species, but again without documentation. The only reliable depth range for the species is that of the types: 115-238 m.

Family ANTHEMIPHYLLIIDAE Vaughan, 1907

Genus *ANTHEMIPHYLLIA* Pourtalès, 1878*Anthemiphyllia dentata* (Alcock, 1902)

- Discotrochus dentatus* Alcock, 1902a: 104; 1902c: 27, pl. 4, figs 26, 26a. — FAUSTINO, 1927: 63, pl. 7, figs 1-2.
Anthemiphyllia dentata - BEST & HOEKSEMA, 1987: 398-399, figs 9a-c. — ZOU *et al.*, 1988: 195. — CAIRNS & PARKER, 1992: 16-17, pl. 4, figs e-f (synonymy). — CAIRNS & KELLER, 1993: 233, pl. 3, fig. E. — CAIRNS, 1994: 44, pl. 18, figs d-f (synonymy); 1995: 41-42, pl. 6, figs c-g (synonymy).
Anthemiphyllia dentatus - YABE & EGUCHI, 1941b: 213, figs 1a-b.
Deltocyathus andamanicus - KELLER, 1982: 52 (in part: pl. 1 [= 4], figs 3-4, "Dimitri Mendeleev" stn 1411). [Not *Deltocyathus andamanicus* Alcock, 1898].
 Not *Discotrochus* sp. - ALCOCK, 1902c: 27-28 [= undescribed *Anthemiphyllia* having costal spines].
 Not *Anthemiphyllia dentata* - CAIRNS, 1984: 11, pl. 1, figs F-G [= undescribed *Anthemiphyllia*, see CAIRNS, 1994].

MATERIAL EXAMINED. — **Philippines.** "Albatross": stn 5162, 2 (USNM 96767). — Stn 5178, 1 (USNM 96768). "Hakuho Maru": stn KH72-1-20, 1 (USNM 96774).
 MUSORSTOM 2: stn 33, 7 (MNHN).
 MUSORSTOM 3: stn 108, 1 (USNM 96771). — Stn 126, 2 (USNM 96772). — Stn 130, 1 (MNHN). — Stn 131, 11 (MNHN).
Indonesia. "Albatross": stn 5584, 1 (USNM 96770).
 SNELLIUS 2: stn 4.033, 1 (NNM 22494). — Stn 4.034, 3 (NNM 18013, mentioned by BEST & HOEKSEMA, 1987).
 KARUBAR: stn 1, 10 (MNHN).

TYPE LOCALITY. — Sulu Sea, 350-522 m.

DIAGNOSIS. — Corallum discoidal, with a flat to slightly bowl-shaped base; largest Philippine specimen (MUSORSTOM 3 stn 126) 21.3 mm in calicular diameter. Corallum usually free, but with a circular scar or irregularity 2-6 mm in diameter at centre of base. Costae rounded and granular, separated by shallow intercostal furrows, that, in large coralla, are bisected by very thin ridges. Septa hexamerally arranged in 5 cycles, the 5th cycle complete only in large specimens. Septal formula: $S_{1-2} > S_3 > S_4 > S_5$. S_{1-2} quite thick, highly exsert, bearing 7-11 coarse septal lobes. Like the S_{1-2} , the S_3 also reach the columella but are less thick, having more numerous, finer teeth. S_4 much smaller than S_3 , having lacinate inner edges. S_5 rudimentary and highly lacinate. Fossa shallow; columella papillose.

REMARKS. — *Anthemiphyllia dentata* is distinguished from other solitary, discoidal, azooxanthellate species from this region by having very thick S_{1-2} with coarse septal dentition.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan Sea; Sulu Sea (Semirara Islands, Sulu Archipelago); 122-522 m. *Indonesia*: Banda Sea (Kai and Tukangbesi Islands); 280-534 m. *Elsewhere*: Malaysia (Celebes Sea off Sabah); South China Sea (west of Palawan; north of Pratas Islands); widespread from southwestern Indian Ocean to southern Japan, the Kermadecs, and Tasmania; 50-570 m.

Anthemiphyllia frustum Cairns, 1994

Figs 6 a-b

Anthemiphyllia frustum Cairns, 1994: 44-45, pl. 18, figs g-i, pl. 19, figs a-b.

MATERIAL EXAMINED. — **Indonesia.** SNELLIUS 2: stn 81.2, 3 (NNM 23073).
 KARUBAR: stn 2, 1 (MNHN). — Stn 15, 24: 6 (MNHN), 18 (USNM 96776).
South China Sea. "Albatross": stn 5313, 1 (USNM 96769).

TYPE LOCALITY. — 30°59'N, 130°32'E (Osumi Strait, southern Kyushu, Japan), 237-241 m.

DIAGNOSIS. — Anthocyathus: base flat, its calicular diameter being less than its basal diameter. Largest known specimen (SNELLIUS 2 stn 81.2) 10.2 mm in calicular diameter and 7.4 mm in height, consisting of 2 anthocyathi that have not completely separated (Fig. 6a). A faint, circular detachment scar 5-6 mm in diameter present in centre of base. Septa hexamerally arranged in 4 cycles ($S_1 > S_2 > S_3 > S_4$), being thick and closely spaced. Adjacent septa strongly fused by 3 or 4 vertical synapticular plates, similar to those illustrated for *Fungiacyathus turbinolioides* (CAIRNS, 1989a, pl. 6, fig. f), but only visible in a longitudinal fracture of a damaged corallum. All septa bear massive triangular teeth for their entire length. Columella papillose, composed of 10-15 massive, granular papillae. Anthocaulus unknown.

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai and Tanimbar Islands); 209-340 m. *Elsewhere*: South China Sea (Pratas Islands); Osumi Strait (south of Kyushu, Japan); 237-274 m.

Suborder CARYOPHYLLIINA

Superfamily CARYOPHYLLIOIDEA Dana, 1846

Family CARYOPHYLLIIDAE Dana, 1846

Genus *CARYOPHYLLIA* Lamarck, 1816

Subgenus *CARYOPHYLLIA* (*CARYOPHYLLIA*) Lamarck, 1816

**Key to the 13 species of *Caryophyllia* (*Caryophyllia*)
known from the Philippine/Indonesian region**

Note: Additional undescribed and/or unreported species of *Caryophyllia* probably also occur in this region. Thus this key should be considered as only a guide to the more common species included in this review.

- | | |
|--|-----------------------|
| 1. Corallum attached (ceratoid, trochoid, or subcylindrical) | 2 |
| — Corallum free (unattached), usually ceratoid | 12 |
| 2. Septa arranged hexamerally (6 or 12 primary septa) | 3 |
| — Septa arranged pentamerally, septamerally, octamerally, decamerally, or tetradecamerally
(5, 7, 8, 10, or 14 primary septa) | 7 |
| 3. Penultimate cycle of septa (S_3) equal to or wider than last cycle ($S_3 \geq S_4$) | 4 |
| — Penultimate cycle of septa (S_3) less wide than last (S_4) cycle ($S_3 < S_4$) | 6 |
| 4. Corallum firmly attached to substratum | 5 |
| — Corallum rises from a slender pedicel that bears a small detachment scar | <i>C. secta</i> |
| 5. Theca transversely ridged; septa often brown | <i>C. lamellifera</i> |
| — Theca longitudinally costate; corallum white | <i>C. diomedea</i> |
| 6. Fossa quite deep; columella rudimentary | <i>C. crosnieri</i> |
| — Fossa not deep; columella well developed | <i>C. panda</i> |
| 7. Septa arranged octamerally | 8 |
| — Septa arranged pentamerally, decamerally, or tetradecamerally | 9 |
| 8. Theca transversely ridged; $S_1 > S_2 > S_3$; S_{1-2} and pali quite sinuous | <i>C. rugosa</i> |
| — Theca costate or porcellaneous; $S_1 > S_3 > S_2$; septa and pali only moderately sinuous | <i>C. octonaria</i> |

9. Corallum with 5 large primaries (pentameral symmetry); theca and septa usually bear a mottled pigmentation *C. hawaiiensis*
 — Corallum with 10-14 large primary septa 10
10. Corallum with 10 primary septa (decameral symmetry) *C. quadragenaria*
 — Corallum with 14 (rarely 16) primary septa 11
11. Theca transversely ridged; septa usually darkly pigmented *C. lamellifera*
 — Theca longitudinally costate; septa not pigmented *C. transversalis*
12. Corallum with 96 or more septa 13
 — Corallum with less than 96 septa (usually 48-72) 14
13. S₄ wider than S₅; pedicel may be present; known depth range 251-567 m ... *C. grandis*
 — S₅ equal to or wider than S₄; pedicel absent; known depth range deeper, 468-1048 m
 *C. ambrosia*
14. Calicular margin lanceted; 48 septa usually present; depth range 353-1276 m
 *C. scobinosa*
 — Calicular margin serrate; usually 48-72 septa; known depth range deeper, 1525-2623 m ...
 *C. cornulum*

Caryophyllia (C.) diomedea Marenzeller, 1904

Caryophyllia ephyala - ALCOCK, 1902c: 9. [= ? *C. ephyala* Alcock in Wood-Mason & Alcock, 1891].

Caryophyllia diomedea Marenzeller, 1904b: 79-80, pl. 1, fig. 2. — CAIRNS, 1991: 11-12, pl. 4, figs c-e (synonymy); 1995: 49-50, pl. 9, figs a-d (synonymy).

MATERIAL EXAMINED. — **Philippines.** "*Siboga*": stn 95, 1 (ZMA).

"*Albatross*": stn 5317, 2 (USNM 96778).

MUSORSTOM 1: stn 49, 2 (USNM 96781).

MUSORSTOM 2: stn 15, 1 (MNHN).

MUSORSTOM 3: stn 95, 2 (MNHN).

Indonesia. "*Siboga*": stn 59, 1 (ZMA).

"*Albatross*": stn 5634, 1 (USNM 96789). — Stn 5656, 3 (USNM 96780).

KARUBAR: stn 3, 1 (MNHN).

TYPE LOCALITY. — "*Albatross*" stn 3358: 6°30'N, 81°44'W (off Coiba Island, Panama), 1043 m.

DIAGNOSIS. — Corallum conical, distally flared; largest known corallum 29.9 mm in GCD (CAIRNS, 1995), but largest from Indonesian region only 12 mm in GCD and 21 mm in height. PD:GCD = 0.26-0.40. Costae flat and poorly distinguished, covered with inconspicuous granules, sometimes porcellaneous. Septa hexamerally arranged in 4 full cycles: S₁₋₂>S₃>S₄. S₃ have highly sinuous inner edges, those of S_{1-2,4} less sinuous. Septa only moderately exsert. A tight crown of 12 P₃ encircle a fascicular columella of 3-12 slender lamellae. Fossa shallow.

REMARKS. — Among the 56 Recent species of *Caryophyllia* listed by CAIRNS (1991), the largest subset (19 species) are those species having attached coralla and hexamerally arranged septa in 4 cycles. *C. diomedea* belongs to this morphological subset, as do the first 3 species in the account of this genus, the 4th (*C. lamellifera*) having both hexameral and heptameral symmetry. *C. diomedea* can be distinguished from other species in this region using the key.

DISTRIBUTION. — **Philippines:** Lubang Island; Verde Island Passage; Sulu Sea (Sulu Archipelago); 330-865 m. **Indonesia:** Ceram Sea (south of Obi Islands); Banda Sea (Kai Islands); Teluk Bone (Sulawesi); Savu Sea (Timor); 300-885 m. **Elsewhere:** widespread, including throughout Pacific from Panama to Tasmania; 225-2200 m.

Caryophyllia (C.) crosnieri nom. nov.

Caryophyllia elongata Cairns in CAIRNS & KELLER, 1993: 236-237, pl. 4, figs A-B. — CAIRNS, 1995: 52, pl. 10, figs d-f. [Not *Caryophyllia clavus* var. *elongata* Duncan, 1873].

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 2: stn 15, 1 (MNHN).
Indonesia. DEKI: stn 3, 2 (NNM 22885). — Stn 12, 3 (NNM 22884).
 KARUBAR: stn 5, 1 (MNHN). — Stn 31, 7 (USNM 96785). — Stn 32, 1 (POLIPI).

TYPE LOCALITY. — "Vityaz" stn 2716: 33°17'S, 44°55'E (off Walter's Shoal, Madagascar Plateau), 630-680 m.

DIAGNOSIS. — Corallum ceratoid to subcylindrical; largest known specimen (KARUBAR stn 31) 8.8 x 10.8 mm in calicular diameter and 14.1 mm in height. PD:GCD = 0.50-0.81. Theca porcellaneous, covered with low, rounded granules. Corallum white, but often having a light brown calicular edge. Septa hexamerally arranged in 4 complete cycles: $S_1 > S_2 > S_4 \geq S_3$. S_1 highly exsert, forming triangular calicular lancets. Inner septal edges only slightly sinuous. A tight crown of 12 slender P_3 encircle a fascicular columella composed of 3-9 very slender twisted lamellae. P_3 appear to be paired within each system. Fossa extremely deep and narrow.

REMARKS. — *Caryophyllia crosnieri* is more fully described and illustrated by CAIRNS & KELLER (1993) and CAIRNS (1995) as *C. elongata*. The name *elongata* Cairns in CAIRNS & KELLER (1993) is a junior primary homonym of *Caryophyllia clavus* var. *elongata* Duncan, 1873, and thus is replaced herein. This species is renamed for Alain CROSNIER (MNHN), one of the driving forces behind the MUSORSTOM expeditions and the resultant publications. The species also occurs in Madagascar, Indonesia, Philippines, and New Caledonia, areas where he contributed to the collection of deep-water benthos.

Caryophyllia crosnieri is distinguished from its congeners by having an extremely deep fossa and small "paired" pali (see key).

DISTRIBUTION. — *Philippines*: Mindoro Strait; 326-330 m. *Indonesia*: Banda Sea (Kai Islands); 206-296 m. *Elsewhere*: Madagascar Plateau; Kermadec and Three Kings Ridges; New Caledonia region; 165-680 m.

Caryophyllia (C.) secta sp. nov.

Figs 6 c-e

MATERIAL EXAMINED/TYPES. — **Philippines.** "Albatross": stn 5116, 1 paratype (USNM 96786). — Stn 5265, holotype (USNM 96787) and 1 paratype (USNM 96788). — Stn 5567, 1 paratype (USNM 96789).

MORTENSEN'S PACIFIC EXPEDITION: Zamboanga Peninsula, 160-200 fv (= 301-373 m), 14 March 1914, 2 paratypes (NNM 22771).

MUSORSTOM 2: stn 32, 8 paratypes (MNHN).

MUSORSTOM 3: stn 126, 2 paratypes (USNM 96790).

Indonesia. MORTENSEN'S JAVA-S.A. EXPEDITION: stn 15, 1 paratype (ZMUC).

KARUBAR: stn 3, 1 paratype (MNHN).

TYPE LOCALITY. — "Albatross" stn 5265: 13°41'N, 120°00'E (Lubang Island, Philippines), 247 m.

ETYMOLOGY. — The species name *secta* (Latin *sectus*, cut) refers to the base of the anthocyathus stage, which appears to be cut from the anthocaulus.

DESCRIPTION. — Anthocaulus stage unknown, probably not collected because of its small size. Corallum (anthocyathus) elongate-conical (edge angle 24°-36°), straight, and always unattached, the pedicel narrowing to a small circular to elliptical detachment scar 2.0-2.5 x 2.2-3.4 mm in diameter. Holotype 15.7 x 12.9 mm in calicular diameter and 21 mm in height; largest calice (KARUBAR stn 3) 17.6 mm in GCD, and largest corallum (MUSORSTOM 3 stn 126) 30.0 mm in height. Calice elliptical: GCD:LCD = 1.19-1.24-1.39 (N=6). Costae flat to only slightly convex, each about 0.85 mm wide near calice and separated by very thin, shallow striae. Costae

covered with low, rounded granules — 4 or 5 occurring across width of a costa near calice. Thin porcellaneous epithecal bands present on well-preserved coralla. Corallum white to light reddish-brown.

Septa usually hexamerally arranged in 4 complete cycles of 48 septa according to formula: $S_{1-2} > S_3 > S_4$; only one corallum (KARUBAR stn 3) having 14 sectors, or 56 septa and 14 pali. Septa evenly and widely spaced, 0.6-0.7 mm from one another. S_{1-2} only slightly exsert (1.1-1.2 mm), extending about 3/4 distance to columella, having moderately sinuous inner edges. S_3 and S_4 equally exsert (about 0.8 mm), the S_3 about 3/4 width of S_{1-2} , having very sinuous inner edges. S_4 3/4 to 4/5 width of an S_3 , inner edges moderately sinuous. Septal faces covered with small, pointed granules arranged in closely-spaced, parallel rows in a fan system radiating from the thecal wall. An elliptical crown on 12 lamellar P_3 encircle the elongate columella, each palus having a slightly sinuous inner and outer edge and measuring 1.0-1.3 mm in width. Fossa shallow to moderate in depth. Columella consists of 4-9 slender, twisted lamellae.

REMARKS. — The nature of the base of *C. secta* is unique within *Caryophyllia*. If only one specimen were found to be truncate, with a small, basal scar, it might be interpreted as an accidental fracture from the substratum, but its presence in all specimens reported above suggests that it is a normal feature of the species. Basal scars are assumed to have resulted from transverse division from a small, attached anthocaulus stage; however, no such stage has yet been identified for this species.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sulu Sea (Semirara Islands and Zamboanga Peninsula); 220-366 m. *Indonesia*: Banda Sea (Kai Islands); Bali Sea; 240-278 m.

Caryophyllia (C.) lamellifera Moseley, 1881

Caryophyllia lamellifera Moseley, 1881: 140-141, pl. 1, figs 7a-b. — CAIRNS, 1995: 51-52, pl. 9, fig. i, pl. 10, figs a-c (synonymy).

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 3: stn 131, 2 (USNM 96791). — Stn 134, 5 (MNHN).

Indonesia. DEKI: stn 24, 1 (NNM 22747).

KARUBAR: stn 18, 2 (MNHN). — Stn 30, 1 (MNHN).

TYPE LOCALITY. — "Challenger" stn 170: 29°55'S, 178°14'W (north of Macauley Island, Kermadec Ridge), 1152 m.

DIAGNOSIS. — Corallum elongate-conical to trochoid; largest known specimen 15.5 mm in GCD (CAIRNS, 1995); largest reported herein (MUSORSTOM 3 stn 134) 11.5 mm in GCD and 17.2 mm in height. PD:GCD = 0.38-0.53. Theca glisteny, covered with closely spaced, transverse ridges. Most coralla have brown thecal striping and brown S_{1-2} . Septal symmetry variable, most specimens reported above having 4 cycles of heptamerally arranged septa (56 septa, 14 pali), but one small specimen (KARUBAR stn 18) having hexamerally arranged septa (48 septa, 12 pali). Septal formula: $S_1 > S_2 > S_3 > S_4$, the S_{1-2} highly exsert, forming triangular calicular lancets with their flanking S_4 . Inner edges of all septa slightly sinuous. 12 to 14 robust P_3 encircle a fascicular columella composed of 1-19 very slender twisted lamellae. Fossa of moderate depth.

REMARKS. — This species is more fully described and illustrated by CAIRNS (1995). It is distinguished by its relatively large, pigmented corallum and its transverse thecal ridging (see key).

DISTRIBUTION. — *Philippines*: northwestern Panay (Sulu Sea and Tablas Strait); 95-120 m. *Indonesia*: Banda Sea (Kai Islands); 100-212 m. *Elsewhere*: Kermadec Ridge; southern Norfolk Ridge; Lord Howe Island; Taupo Tablemount, Tasman Sea; 89-1152 m.

Caryophyllia (C.) transversalis Moseley, 1881

Figs 6 f-h

Caryophyllia clavus var. *transversalis* Moseley, 1881: 134-135, pl. 1, figs 2, 2a. — ALCOCK, 1902c: 9-10.

MATERIAL EXAMINED. — **Indonesia**. "Challenger": stn 192, syntype of *C. clavus transversalis* (BMNH 1880.11.25.23).

"Siboga": stn 12, 1 (ZMA). — Stn 256, 1 (ZMA).

DEKI: stn 3, 24 (NNM 22704). — Stn 6, 2 (NNM 22703). — Stn 32, 1 (NNM 22705). — Stn 41, 1 (NNM 22706). — Stn 42, 7 (NNM 22707). — Stn 44, 12 (NNM 22708). — Stn 46, 2 (NNM 22709). — Stn 48, 2 (NNM 22710). — Stn 50, 18 (NNM 22712). — Stn 62, 1 (NNM). — Stn 63, 1 (NNM 22713).

KARUBAR: stn 2, 8 (USNM 96793). — Stn 7, 6 (POLIPI). — Stn 67, 2 (MNHN). — Stn 68, 4: 2 (MNHN), 2 (USNM 96794). — Stn 79, 4 (POLIPI). — Stn 84, 4: 3 (MNHN), 1 (USNM 96796).

TYPE LOCALITY. — "Challenger" stn 192: 5°42'S, 132°25'E (Kai Islands, Banda Sea), 235 m.

DESCRIPTION. — Corallum trochoid (edge angle 53°-65°), straight, and always attached through a narrow pedicel 1.6-2.9 mm in diameter (PD:GCD = 0.11-0.19). Substratum often a small scaphopod, gastropod, or bivalve shell. Calice elliptical: GCD:LCD = 1.21-1.27-1.36 (N=6). Largest known specimen (KARUBAR stn 79) 21.6 x 15.9 mm in calicular diameter and 23.8 mm in height, with a pedicel diameter of 2.7 mm. Costae flat to slightly convex, each about 1.0 mm wide near the calice of a large specimen, and separated by thin, shallow striae. Costae covered with low, rounded, glisteny granules — 4 or 5 occurring across a costa. Corallum near calice of large specimens beige, becoming white or discoloured 4-5 mm below calicular edge.

Septa, even of coralla as small as 8.8 mm GCD, arranged accordingly: 14:14:28 (56 septa and 14 pali); however, 1 large corallum from KARUBAR stn 67 has 16 primary septa and 16 pali, and altogether in 60 septa. Primary septa highly exsert (up to 3.5 mm), with straight, vertical inner edges that attain the columella low in fossa. Secondary septa least exsert (about 1.3 mm), about 3/4 width of a primary, with highly sinuous inner edges. Tertiary septa about 2 mm exsert, each pair adjacent to a primary fusing to that primary in a low, triangular calicular lancet, producing a serrate calicular margin. Tertiary septa about 4/5 width of a secondary, with straight inner edges. An elliptical crown of 14-16 P₃ encircles an elongate columella, each palus about 1.7 mm wide, having highly sinuous edges. Fossa of moderate depth, containing a columella of 9-15 slender, closely-spaced twisted lamellae.

REMARKS. — *Caryophyllia transversalis* is similar to *C. secta* sp. nov., but can be distinguished by its attached, trochoid (vs unattached, ceratoid) corallum; lanceted calicular edge; and tendency to have 14 (vs 12) primary septa. Among the Recent *Caryophyllia*, attached species having decatetrameral symmetry (x 14) are not common, only three being listed by CAIRNS (1991, table 3), all of those species having a range of septal symmetry that includes decatetrameral.

DISTRIBUTION. — **Indonesia**: Banda Sea (Kai Islands); Arafura Sea (south of Tanimbar Islands); Bali Sea; 210-397 m.

Caryophyllia (*C.*) *rugosa* Moseley, 1881

Caryophyllia rugosa Moseley, 1881: 141-143, pl. 1, figs 8a-b. — FAUSTINO, 1927: 70-71, pl. 8, figs 12-14. — CAIRNS & KELLER, 1993: 236, pl. 3, fig. I. — CAIRNS, 1994: 47, pl. 20, fig. i, pl. 21, fig. a (synonymy); 1995: 43-44, pl. 6, fig. h, pl. 7, figs a-c.

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5172, 1 (USNM 96797). — Stn 5217, 1 (USNM 96798). MUSORSTOM 2: stn 33, 1 (MNHN).

Indonesia. DEKI: stn 3, 1 (NNM 22746).

KARUBAR: stn 18, 9: 5 (MNHN), 4 (USNM 96799).

TYPE LOCALITY. — "Challenger" stns 192 and 201: Banda and Sulu Seas, 187-230 m.

DIAGNOSIS. — Corallum elongate-conical to cylindrical, firmly attached through a thick pedicel (PD:GCD = 0.3-0.6); largest known corallum only 8.5 mm in GCD (CAIRNS, 1994). Theca covered with fine transverse ridges. Septa octamerally arranged in 3 cycles (S₁>S₂>S₃), resulting in 32 septa. Inner edges of S₁ and S₂ extremely sinuous. Septal faces bear blunt granules, some fused into short carinae. A crown on 8 very sinuous pali occurs

before the secondary septa, encircling a fascicular columella composed of 1-4-15 slender, twisted lamellae. Fossa shallow.

REMARKS. — *Caryophyllia rugosa* is a very common azooxanthellate coral found throughout the Indo-West Pacific, characterised by having a relatively small corallum, 3 cycles of very sinuous, octamerally arranged septa, and a transversely ridged theca. The 5 species of attached *Caryophyllia* having octamerally symmetrical septa are discussed in the following species account.

DISTRIBUTION. — *Philippines*: Verde Island Passage; Ragay Gulf; Sulu Sea (Sulu Archipelago); 137-581 m. *Indonesia*: Banda Sea (Kai Islands); 205-256 m. *Elsewhere*: widespread in Indo-West Pacific from South Africa to the Hawaiian Islands, including Japan and the Kermadec Islands; 71-508 m.

Caryophyllia (*C.*) *octonaria* sp. nov.

Figs 7 a-b

MATERIAL EXAMINED/TYPES. — **Philippines**. "Albatross": stn 5527, 1 paratype (USNM 97060).

MUSORSTOM 1: stn 64, holotype (MNHN).

MUSORSTOM 2: stn 2, 2 paratypes (MNHN).

MUSORSTOM 3: stn 88, 3 paratypes (USNM 96802). — Stn 90, 1 paratype (USNM 96803). — Stn 100, 3 paratypes (MNHN). — Stn 101, 1 paratype (MNHN). — Stn 102, 8 paratypes (USNM 96804).

TYPE LOCALITY. — MUSORSTOM 1 stn 64: 14°01'N, 120°16'E (Lubang Island, Philippines), 194-195 m.

ETYMOLOGY. — The species name *octonaria* (Latin *octonarius*, consisting of 8 units) refers to the octamerall symmetry of this species.

DESCRIPTION. — Corallum conical, straight to slightly bent, and always attached by a slender pedicel (PD:GCD = 0.26-0.31-0.40). Coralla always attached to gastropod or bivalve shells; one dead corallum (MUSORSTOM 2 stn 2) secondarily incorporated into a *Xenophora* shell. Calice slightly elliptical: GCD:LCD = 1.06-1.08-1.13. Largest known specimen (the holotype) 7.8 x 8.4 mm in calicular diameter, 13.9 mm in height, and 2.2 mm in pedicel diameter. Costae not well defined, the theca often smooth and porcellaneous near calice. Costae on lower corallum equal in width (0.5-0.6 mm) and flat, separated by very shallow, narrow intercostal striae and covered with low, rounded granules. Theca light grey-brown or reddish-brown; septa, pali, and columella usually white.

Septa octamerally arranged in 3 complete cycles (32 septa) in all specimens examined. Eight primary septa relatively highly exsert (1.7-2.2 mm), extend about 3/4 distance to columella, having moderately sinuous inner edges. Remaining septa equally exsert (1.0-1.2 mm), the 8 secondaries being about 5/6 width of a primary, also having moderately sinuous inner edges. Tertiary septa of small coralla equal to or slightly less wide than secondaries, but at a later stage its tertiaries become slightly wider than its secondaries ($S_1 > S_3 > S_2$). Inner edges of tertiaries only slightly sinuous. Septal faces covered with prominent, pointed granules. Fossa quite shallow, containing an elliptical crown of 8 sinuous pali before the secondaries, each palus 1.0-1.1 mm wide. The fascicular columella consists of a field of 6-9 twisted elements strongly fused together basally.

REMARKS. — There are 4 previously described octamerally symmetrical, attached *Caryophyllia*: *C. rugosa* Moseley, 1881; *C. barbadensis* Cairns, 1979; *C. octopali* Vaughan, 1907; and *C. marmorea* Cairns, 1984, all of which are characterised by having their tertiaries equal to or wider than their secondaries. *C. octonaria* is similar to *C. octopali*, but differs in having a narrower pedicel (PD:GCD = 0.26-0.40 vs >0.5 for *C. octopali*), a more flared corallum (that of *C. octopali* is elongate and subcylindrical), and in having relatively exsert septa. In the last character *C. octonaria* resembles *C. octopali* var. *incerta* Vaughan, 1907, but that form differs in having hexamerall or heptamerall symmetry, a very reduced columella, and a quasicolonial habit.

DISTRIBUTION. — *Philippines*: Lubang Island; Bohol Sea; 186-194 m.

Caryophyllia (C.) hawaiiensis Vaughan, 1907

Caryophyllia hawaiiensis Vaughan, 1907: 76, pl. 5, figs 4a-b. — CAIRNS, 1984: 11; 1995: 44-45, pl. 7, figs d-f.

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5310, 1 (USNM 96805).

MUSORSTOM 2: stn 33, 3 (MNHN).

MUSORSTOM 3: stn 117, 1 (MNHN).

Indonesia. DEKI: stn 25, 1 (NNM 22744). — Stn 53, 1 (NNM 22745).

CORINDON 2: stn 248, 2 (MNHN).

KARUBAR: stn 1, 1 (POLIPI). — Stn 22, 1 (USNM 96807).

TYPE LOCALITY. — "Albatross" stn 3838: 21°04'05"N, 157°10'35"W (off Molokai, Hawaiian Islands), 168-388 m.

DIAGNOSIS. — Corallum elongate-conical and attached; largest known specimen 11.6 mm in GCD (CAIRNS, 1995); largest specimen reported herein ("Albatross" stn 5310) 8.4 mm in GCD. PD:GCD = 0.34-0.49. Costae absent or poorly defined, the theca porcellaneous and covered with low, rounded granules. Theca and most septa speckled with dark brown pigmentation. Septa pentamerally arranged in 4 cycles (5:5:10:20, $S_1 > S_2 > S_4 > S_3$) resulting in 40 septa and 10 pali. The asymmetrical arrangement of the 5 S_1 results in a pentagonal disposition of major septa, with only one of the S_1 being aligned with the greater calicular axis. S_1 highly exsert, forming tall calicular lancets. A crown of 10 P3 encircles a fascicular columella consisting of 6-18 slender, twisted lamellae.

REMARKS. — *Caryophyllia hawaiiensis* is unique among the *Caryophyllia* in having pentamerally arranged septa. It is more fully described and illustrated by CAIRNS (1995).

DISTRIBUTION. — *Philippines*: Verde Island Passage; Midoro Strait; 97-130 m. *Indonesia*: Makassar Strait; Banda Sea (Kai Islands); 85-170 m. *Elsewhere*: South China Sea (Vereker Banks near Pratas Island); Hawaiian Islands; Kermadec Ridge; 126-279 m.

Caryophyllia (C.) quadragenaria Alcock, 1902

Caryophyllia quadragenaria Alcock, 1902a: 91-92; 1902c: 10, pl. 1, figs 4, 4a. — CAIRNS, 1994: 46-47, pl. 20, figs c-h, pl. 41, figs c-d (synonymy); 1995: 45-46, pl. 7, figs g-h (synonymy).

MATERIAL EXAMINED. — **Indonesia**. DEKI: stn 46, 2 (NNM 22741). — Stn 59, 1 (NNM 23080).

SNELLIUS 2: stn 81.2, 1 (NNM 23079).

KARUBAR: stn 2, 16 (MNHN). — Stn 3, 5 (USNM 96811).

South China Sea. "Albatross": stn 5313, 2 (USNM 96809). — Stn 5317, 6 (USNM 96810).

TYPE LOCALITY. — "Siboga" stns 90, 251, and 289: Makassar Strait, Banda, and Timor Seas, 54-281 m.

DIAGNOSIS. — Corallum elongate-conical and attached, straight, and relatively small; largest Indonesian specimen (KARUBAR stn 3) 8.9 x 12.0 mm in calicular diameter and 15.4 mm in height. PD:GCD = 0.11-0.39. Costae well defined only near calice. Septa decamerally arranged in 3 cycles (10:10:20, 40 septa; $S_1 > S_3 > S_2$). Ten broad, highly sinuous P₂ encircle a fascicular columella of 3-11 twisted lamellae.

REMARKS. — Comparisons of *C. quadragenaria* to the other 6 species of *Caryophyllia* that have decamerall symmetry are made by CAIRNS (1995), and the species is more fully described and illustrated by CAIRNS (1994, 1995).

DISTRIBUTION. — *Indonesia*: Makassar Strait; Banda Sea (Kai and Tanimbar Islands); Timor Sea (Timor); 112-385 m. *Elsewhere*: South China Sea (north of Pratas Island); Japan (Honshu, Shikoku, and northern Ryukyu Islands); New Zealand; 54-296 m.

Caryophyllia (C.) scobinosa Alcock, 1902

Caryophyllia cultrifera Alcock, 1902a: 89-90; 1902c: 7-8, pl. 1, figs 1, 1a. — FAUSTINO, 1927: 67-68, pl. 8, figs 8-9.

Caryophyllia scobinosa Alcock, 1902a: 90; 1902c: 8, pl. 1, figs 2, 2a. — FAUSTINO, 1927: 68-69, pl. 8, figs 10-11. — CAIRNS, 1994: 45-46 (in part: pl. 20, figs a-b); 1995: 52-53, pl. 10, figs g-i, pl. 11, figs a-c (synonymy).

MATERIAL EXAMINED. — **Philippines.** "Albatross": stn 5348, 1 (USNM 96812). — Stn 5444, 1 (USNM 96813). — Stn 5445, 12 (USNM 96814). — Stn 5447, 14 (USNM 96815). — Stn 5551, 4 (USNM 96816). — Stn 5564, 1 (USNM 96817). — Stn 5565, 2 (USNM 96818).

MUSORSTOM 1: stn 44, 1 (MNHN). — Stn 47, 10 (MNHN).

MUSORSTOM 2: stn 25, 1 (USNM 96821).

Indonesia. "Albatross": stn 5650, 2 (USNM).

CORINDON 2: stn 240, 1 (USNM 96822).

KARUBAR: stn 91, 2 (POLIPI).

TYPE LOCALITY. — "Siboga" stns 45 and 102: Flores and Sulu Seas, 535-794 m.

DIAGNOSIS. — Corallum ceratoid (usually curved between 45°-90°) and free; rarely more than 20 mm in GCD. C₁₋₂ ridged, C₃₋₄ flat and granular. Septa hexamerally arranged in 4 complete cycles: S₁₋₂>S₄≥S₃. S₁₋₂ highly exsert, forming calicular lancets with adjacent pairs of S₄. A crown of wide, lamellar P₃ encircles a fascicular columella of 4-14 relatively broad, twisted elements.

REMARKS. — *Caryophyllia scobinosa* is more fully described, illustrated, and discussed by CAIRNS (1994, 1995), and compared to *Caryophyllia cornulum* sp. nov. in the following account.

The second author believes that this taxon is a species complex, composed of several morphologically distinct species that are also bathymetrically distinct.

DISTRIBUTION. — *Philippines*: Lubang Island; South China Sea (Palawan); Lagonoy Gulf; Sulu Sea (Sulu Archipelago); 353-1270 m. *Indonesia*: Makassar Strait; Banda Sea (Gulf of Bone, Sulawesi); Timor Sea (south of Babar Islands); 675-988 m. *Elsewhere*: southwestern Indian Ocean; Queensland; Lord Howe Rise; Tonga and Samoa; 535-1276 m.

Caryophyllia (C.) cornulum sp. nov.

Figs 7 d-e

MATERIAL EXAMINED/TYPES. — **Indonesia.** "Albatross": stn 5606, 2 paratypes (USNM 96823). — Stn 5670, 16 paratypes (USNM 96824).

CORINDON 2: stn 220, holotype (MNHN), 12 paratypes (POLIPI). — Stn 241, 1 paratype (USNM 96826). — Stn 286, 1 paratype (MNHN).

Japan. "Tansei-Maru": stn KT86-16-F, 2 paratypes (USNM 96827). — Stn KT90-13-T6, 6 paratypes (USNM 96828).

TYPE LOCALITY. — CORINDON 2 stn 220: 0°13.8'S, 118°12.7'E (Makassar Strait), 2350 m.

ETYMOLOGY. — The species name (Latin *cornulum*, small horn) refers to the shape of the corallum. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum ceratoid, unattached, and rarely curved more than 45°, the base of all but 1 specimens being strongly eroded; the base of one specimen (CORINDON 2 stn 220) is 1.5 mm in diameter and shows 6 protosepta in the basal disc. Corallum of most specimens medium to small in size, the holotype only 15.3 x 17.9 mm in calicular diameter and 16.5 mm in height; however, the 8 Japanese specimens are larger, one up to 27 mm in GCD. Calice slightly elliptical: GCD:LCD = 1.06-1.18. Costae well preserved only near calice, where they are about 0.6 mm wide, separated by thin, shallow striae and covered with small granules. Below 2 mm

from the calicular edge the corallum is usually eroded, becoming grayish in color. Primary costae sometimes slightly ridged.

Septal arrangement variable, the most common complement being: 14:14:28, and 14 pali, shared by 11 of the 30 specimens analyzed. Nine specimens have 16 primary septa (up to 64 septa); the 8 Japanese specimens have only 12 primary septa (48 septa); 1 has 13 primary septa (52 septa); and 1 has 18 primary septa (72 septa). It is common, however, for 1 or more sectors to lack its tertiary pair of septa and corresponding palus, resulting in septal and palar complements that fall short of the expected for that number of primary septa (*e.g.*, a corallum having 16 primary and 16 secondary septa, may have only 28 or 30 (instead of 32) tertiary septa and only 14 pali). Primary septa little exsert (1.0-1.1 mm), extending only about 1/2 distance to columella, having straight to slightly sinuous inner edges. Secondary and tertiary septa equally exsert (0.7-0.8 mm), producing a low, serrate calicular margin. Secondaries about 1/2 width of a primary septum, having slightly sinuous inner edges; tertiaries equal to or slightly wider than a secondary, having slightly sinuous inner edges. A crown of 12-18 (usually 14-16) wide pali occurs before the secondary septa, the pali usually wider (2.2-2.8 mm) than septa they border. Palar edges slightly sinuous, their faces bearing a granulation coarser than that of septa. Columella fascicular, composed of 1-7 (usually 2 or 3) broad, twisted elements, often arranged in a line.

REMARKS. — *Caryophyllia cornulum* is similar to *C. scobinosa* but differs in having: much less exsert septa that do not form calicular lancets; a tendency to have 14-16 primary septa (vs 12 for the typical form); a less curved corallum with a strongly eroded base; and a deeper bathymetric range (1525-2576 m vs 353-1276 m for *C. scobinosa*). Although some large specimens of *C. scobinosa* occasionally have 14 or 16 primary septa (CAIRNS, 1995), even small specimens of *C. cornulum* have 14-16 primary septa, only the Japanese specimens having 12 primary septa.

DISTRIBUTION. — *Indonesia*: Makassar Strait; Gulf of Tomini, Sulawesi; 1525-2350 m. *Elsewhere*: Shikoku, Japan; 2576-2603 m.

Caryophyllia (C.) ambrosia Alcock, 1898

Caryophyllia ambrosia Alcock, 1898: 12, pl. 1, figs 1, 1a. — ZIBROWIUS, 1980: 63-65, pl. 25, figs A-K (synonymy). — CAIRNS & KELLER, 1993: 234, pl. 3, fig. 14 (synonymy). — CAIRNS, 1994: 48, pl. 21, figs d-h; 1995: 53-54, pl. 11, figs d-e.

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 1: stn 49, 4 (MNHN). — Stn 54, 1 (MNHN).

MUSORSTOM 3: stn 94, 1 (MNHN).

Indonesia. "Hakuho Maru": stn KH72-1-26, 3: 1 (USNM 96835), 2 (ORI).

CORINDON 2: stn 240, 4 (USNM 96834).

KARUBAR: stn 40, 1 (USNM 96829). — Stn 56, 3 (MNHN). — Stn 57, 1 (POLIPI). — Stn 72, 1 (POLIPI). — Stn 87, 10 (USNM 96832). — Stn 89, 3 (MNHN). — Stn 91, 2 (MNHN).

TYPE LOCALITY. — Laccadive Sea, Arabian Sea, 1829-1957 m.

DIAGNOSIS. — Corallum massive (GCD up to 60 mm) and curved, having a pointed and/or eroded base. C₁₋₃ usually slightly ridged. Coralla contain 18-30 (but usually 24) primary septa, an equal number of secondaries, and twice that number of tertiaries, resulting in calices with 72-120 (but usually 96) septa. Tertiary septa equal to or wider than secondaries, but always more exsert than secondaries, fusing with their flanking primary septum to form highly exsert lancets. A broad palus occurs before each secondary septum, each of the 18-24-30 pali usually wider than the septa they border. Fascicular columella composed of numerous, broad, twisted elements.

REMARKS. — CAIRNS (1994, 1995) redescribed what he believed to be the nominate subspecies of *C. ambrosia*. It appears to be a widespread Pacific and Atlantic species with regional variation regarding corallum size and number of septa (CAIRNS, 1995). The Philippine/Indonesian specimens are the largest thus far recorded, up to 60 mm in GCD and containing 130 septa, which makes them most similar to those reported from New Zealand

(CAIRNS, 1995). However, the second author believes that "*C. ambrosia*" may represent a species complex, the coralla of which are similar to virtually indistinguishable, and the species of this complex having more restricted geographic and bathymetric ranges. Characteristics of the soft parts or molecules may be necessary to resolve this taxonomic issue.

C. ambrosia is compared to *C. grandis* in the account of the latter species.

DISTRIBUTION. — *Philippines*: Lubang Island; 842-975 m. *Indonesia*: Makassar Strait; Arafura Sea (south of Tanimbar Islands); Timor Sea (south of Leti Islands); 468-1048 m. *Elsewhere*: ampho-Atlantic; Indo-West Pacific, including Japan and New Zealand; 311-2670 m.

Caryophyllia (C.) grandis Gardiner & Waugh, 1938

Figs 7 g-h

Caryophyllia grandis Gardiner & Waugh, 1938: 177, pl. 1, fig. 2. — CAIRNS & KELLER, 1993: 234 (synonymy).

MATERIAL EXAMINED. — *Indonesia*. "Albatross": stn 5589, 3 (USNM 96837). — Stn 5590, 15 (USNM 96836). — Stn 5592, 1 (USNM 86838).

KARUBAR: stn 39, 2 (USNM 96839). — Stn 40, 4 (POLIPI). — Stn 59, 8 (MNHN). — Stn 62, 1 (MNHN). — Stn 70, 3 (MNHN). — Stn 71, 4 (MNHN). — Stn 75, 2 (MNHN).

TYPE LOCALITY. — John Murray Expedition stn 145: 4°58'42"S, 73°16'24"E (Fadiffolu Atoll), 494 m.

DIAGNOSIS. — Corallum large (GCD up to 50 mm), sometimes free and curved, but more often straight to slightly bent, and attached by a narrow pedicel 1.8-6.5 mm in diameter. C₁₋₃ usually slightly ridged. Upper theca and septal faces light beige; lower theca white or discoloured. Septa usually hexamerally arranged in 5 cycles (S₁₋₃>S₄>S₅), but some large coralla have up to 28 primary septa and a total of 112 septa. S₅ narrower than S₄, but more exsert, fusing with their adjacent S₁₋₃ to form highly exsert lancets. 24 P₃, which are usually narrower than the S₃ they border, form a crown encircling a fascicular columella composed of broad, twisted lamellae.

REMARKS. — *Caryophyllia grandis* is distinguished from *C. ambrosia* by its: attached, reinforced pedicel; highest cycle septa (*i.e.*, S₅) that are narrower than their S₄; narrower pali; brownish theca; and usually straighter, less curved, corallum. In the Indonesian region *C. grandis* is also found at shallower depths than *C. ambrosia*: 251-567 m vs 468-1048 m, respectively.

DISTRIBUTION. — *Indonesia*: Arafura Sea (southeast of Tanimbar Islands); 251-567 m. *Elsewhere*: Malaysia (Celebes Sea off Sabah); Indian Ocean from South Africa to western Sumatra; 183-595 m.

Subgenus *CARYOPHYLLIA (ACANTHOCYATHUS)* H. Milne Edwards & Haime, 1848

Key to the six species of *Caryophyllia (Acanthocyathus)*
known from the Philippine/Indonesian region

1. Corallum bears thecal edge spines 2
- Corallum bears 1 or 2 thecal edge crests (but no spines) 4
2. Spines occur on both thecal edges, and sometimes even on thecal faces 3
- Spines occur only on convex thecal edge *C. (A.) dentata*
3. Corallum with 14 primary septa (≥56 septa) and 14 pali; C₁₋₂ rounded; 3 size classes of septa (14:14:28); thecal spines circular to elliptical in cross section *C. (A.) grayi*

- Corallum with 12 primary septa (48 septa) and 12 pali; C₁₋₂ ridged; 4 size classes of septa (6:6:12:24); thecal edge spines flattened in cross section *C. (A.) spinigera*
- 4. C₁₋₂ ridged; S₄ ≥ S₃ in width *C. (A.) spinicarens*
- C₁₋₂ rounded; S₄ ≤ S₃ in width 5
- 5. Corallum with 14 primary septa (56 septa) and 14 pali; both thecal edges crested; up to 25 mm in GCD *C. (A.) karubarica*
- Corallum with 12 primary septa (48 septa) and 12 pali; only convex thecal edge crested; smaller, only up to 16 mm GCD *C. (A.) unicristata*

Caryophyllia (A.) grayi (H. Milne Edwards & Haime, 1848)

Figs 7 c, f, i

Acanthocyathus grayi H. Milne Edwards & Haime, 1848a: 293, pl. 9, figs 2, 2a. — ALCOCK, 1898: 15. — VAN DER HORST, 1931: 6. — UMBGROVE, 1938: 264-265; 1950: 641-642, pl. 81, figs 27-32 (synonymy). — WELLS, 1984: 209, pl. 2, figs 5-9. — ZOU, 1988: 76, figs 8-9.
Caryophyllia (A.) grayi - CAIRNS, 1994: 49, pl. 21, figs i-k (synonymy).

MATERIAL EXAMINED. — **Philippines.** "Albatross": stn 5381, 1 (USNM 96843). — Stn 5593, 1 (USNM 96844). "Hakuho Maru": stn KH72-1-50, 1 (USNM 96855).

MUSORSTOM 1: stn 45, 2 (USNM 96851). — Stn 56, 10 (MNHN). — Stn 72, 5 (USNM 96847).

MUSORSTOM 2: stn 29, 1 (MNHN). — Stn 47, 4 (USNM 96848).

MUSORSTOM 3: stn 99, 1 (MNHN). — Stn 107, 1 (USNM 96850). — Stn 108, 1 (MNHN). — Stn 124, 3 (MNHN). — Stn 131, 22: 11 (MNHN), 11 (USNM 96846). — Stn 140, 8 (MNHN).

Indonesia. "Siboga": stn 204, 14 (ZMA Coel. 1159). — Stn 289, 6 (ZMA Coel. 1168).

DEKI: stn 4, 2 (NNM 22695). — Stn 6, 2 (NNM 22696). — Stn 25, 2 (NNM 22697). — Stn 44, 2 (NNM 22698). — Stn 49, 2 (NNM 22699). — Stn 53, 7 (NNM 22700).

MORTENSEN'S JAVA-S.A. EXPEDITION: stn 1, 1 (ZMUC). — Stn 5, 21 (ZMUC). — Stn 6, 11 (ZMUC). — Stn 8, 37 (ZMUC). — Stn 9, 18 (ZMUC).

CORINDON 2: stn 208, 2 (USNM 96852). — Stn 216, 4 (POLIPI). — Stn 251, 5 (MNHN). — Stn 261, 1 (MNHN).

SNELLIUS 1: unnumbered station, 8.04.1929, 7°33'S, 114°36'E, 200 m, 2 (NNM 22701).

Japan. Syntype (BMNH 1840.9.29.42).

TYPE LOCALITY. — Unknown.

DIAGNOSIS. — Corallum ceratoid, compressed (GCD:LCD = 1.3-1.5), and usually curved in plane of GCD. Largest Philippine specimen (MUSORSTOM 1 stn 56) 16.7 x 21.4 mm in calicular diameter and 24.9 mm in height. Corallum either attached to a small object through a slender pedicel 1.5-1.8 mm in diameter or secondarily unattached. Thecal edges rounded, the concave edge with 2 or 3 elongate spines, the convex edge bearing 3-5 elongate spines. Edge spines circular to elliptical in cross section. Costae rounded, not ridged. Septa usually arranged in 14 sectors: 14:14:28 (56 septa), with 14 pali; however, a large specimen from Japan (BMNH 1840.9.29.42) with a GCD of 22.3 mm has 16 pali and a septal complement of 64. Primary septa highly exsert, forming small (up to 3 mm) calicular lancets. Pairs of quaternary septa sometimes present in end half-systems. A distinct crown of 14 pali occurs before secondary septa, encircling an elongate fascicular columella composed of 7-10 highly fused (basally), twisted elements.

REMARKS. — *Caryophyllia (A.) grayi* is distinguished from *C. (A.) spinigera* by having: more septa and pali (usually 56 septa and 14 pali vs 48 septa and 12 pali for *C. spinigera*); low, rounded C₁₋₂ (not ridged as in *C. spinigera*); a gently curved corallum in the plane of the GCD and thus an asymmetrical arrangement of thecal edge spines; cylindrical, not spatulate, thecal edge spines; the absence of lateral face thecal spines; a brownish corallum (corallum of *C. spinigera* is more gray); and equally developed primary septa (the 6 S₁ of *C. spinigera* are much more exsert than their 6 S₂). *C. (A.) grayi* is more fully described and illustrated by CAIRNS (1994).

Caryophyllia (A.) guangdongensis Zou, 1984, known only from the northern South China Sea (167-179 m), is intermediate between *C. spinigera* and *C. grayi*. It resembles *C. spinigera* in having spatulate edge spines and only

48 septa with 12 pali, but differs from *C. spinigera* (and is thus similar to *C. grayi*) in having: convex, rounded C_{1-2} , equal-sized S_1 and S_2 , less exsert S_{1-2} , and no thecal face spines.

Five more species are recognised in this subgenus: 4 having edge crests, not spines: *C. (A.) spinicarens* (Moseley, 1881), *C. (A.) zanzibarensis* Zou, 1984, *C. (A.) karubarica* sp. nov. and *C. (A.) unicristata* sp. nov., and one having spines on only one thecal edge: *C. (A.) dentata* (Moseley, 1881). A 9th possible species, reported as *Caryophyllia laoagana* Smith, 1913, from the Pleistocene of the Philippines, may also belong to this subgenus, but the single type specimen is very poorly preserved. The second author suggests that only the 5 species having edge spines should be placed in the subgenus *Acanthocyathus*, the 4 species listed that have edge crests belonging more properly to the nominate subgenus.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan Sea; Sulu Sea (Semirara Islands and west of Panay); 50-268 m. *Indonesia*: Makassar Strait; Banda Sea (Kai Islands and southeastern Sulawesi); Timor Sea (south of Timor); Bali Sea and Bali Strait; 50-150 m. Pleistocene of Talaud, Timor, and Vanuatu (UMBROVE, 1938, 1950). *Elsewhere*: South Africa; Bay of Bengal; Andaman Islands; South China Sea (Charlotte Bank); Japan (Honshu and northern Ryukyu Islands); 37-490 m.

Caryophyllia (A.) dentata (Moseley, 1881)

Figs 8 a-d

Acanthocyathus sp. - MOSELEY, 1876: 550.

Acanthocyathus dentatus Moseley, 1881: 143, pl. 2, figs 7a-c.

MATERIAL EXAMINED. — *Indonesia*. "Challenger": stn 174, holotype (BMNH 1880.11.25.42).

DEKI: stn 2, 1 (NNM 23077). — Stn 3, 5 (USNM 96858). — Stn 6, 4 (NNM 22752). — Stn 48, 2 (NNM 22753). — Stn 63, 2 (NNM 22754). — Unnumbered station between Neira and Lontor, Banda Islands, 70-90 m, 1 (NNM 23076).

KARUBAR: stn 49, 1 (USNM 96856). — Stn 65, 5: 2 (MNHN), 3 (USNM 96857).

TYPE LOCALITY. — "Challenger" stn 174D: 19°05'50"S, 178°16'20"E (Fiji), 210 m.

DESCRIPTION. — Corallum compressed (GCD:LCD = 1.3-1.5) and usually slightly curved in plane of GCD, but rarely more than 90°. Holotype (BMNH 1880.11.25.42) 11 mm in GCD; largest known specimen (DEKI stn 3) 9.4 x 12.3 mm in calicular diameter. Pedicel quite small (1.2-1.5 mm in diameter) and circular in cross section. C_{1-2} of holotype highly ridged, but on all other specimens examined costae are low and rounded, covered with small granules. C_1 on convex thecal edge of holotype, as well as other specimens reported, ridged, bearing 4 or 5 prominent spines. Corallum white.

Septa of holotype and one specimen from the DEKI (between Neira and Lontor) hexamerally arranged in 4 cycles ($S_1 > S_2 > S_3 > S_4$, 48 septa); however, in remaining 10 specimens reported herein the symmetry is decamerall: 10:10:20, 40 septa. S_{1-2} (or 10 primary septa) highly exsert as much as 2.8 mm, forming rectangular lancets with their adjacent S_4 (or tertiaries). Inner edges of S_{1-2} moderately sinuous. S_3 (or secondaries) about 1/2 width of S_{1-2} , having very sinuous inner edges. S_4 (or tertiaries) 1/3 to 1/2 width of the S_3 , having moderately sinuous inner edges. 12 (10 in the case of the decamerall specimens) lamellar, highly sinuous pali occur in a crown before the S_3 (or secondaries). Fossa of moderate depth containing a fascicular columella composed of 3-7 twisted elements.

REMARKS. — As noted in the description, the holotype differs from all other specimens herein reported by having distinctly ridged C_{1-2} , but this is considered to be a variable character and thus within the range of variation for the species. More disconcerting is the difference between the hexamerall symmetry of the holotype and the decamerall symmetry of most of the other specimens reported. The decamerally symmetrical specimens may represent a different species, but more specimens of both forms (especially the hexamerall form) will have to be studied to resolve this problem.

Caryophyllia (A.) dentata is similar to *C. (A.) grayi*, but distinguished by having spines on only one thecal edge, having a smaller corallum, and having fewer septa (40-48 vs 56).

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai and Banda Islands); Arafura Sea (southeast of Tanimbar Islands); 90-263 m. *Elsewhere*: Kandavu Island, Fiji; 384 m.

Caryophyllia (A.) *spinigera* (Saville Kent, 1871)

Figs 7 e-f

Acanthocyathus spiniger Saville Kent, 1871: 275-276, pl. 23, figs 1 a-c.

Caryophyllia (A.) *spiniger* - CAIRNS, 1994: 49-50, pl. 21, fig. 1, pl. 22, figs a-d (synonymy).

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5117, 1 (USNM 96859). — Stn 5273, 3 (USNM 96860). — Stn 5278, 1 (USNM 96861). — Stn 5353, 1 (USNM 96862). — Stn 5369, 29 (USNM 92689). — Stn 5371, 66 (USNM 92690). — Stn 5372, 1 (USNM 96863). — Stn 5374, 3 (USNM 96864). — Stn 5376, 15 (USNM 96865). — Stn 5418, 1 (USNM 96866).

MUSORSTOM 1: stn 5, 1 (USNM 96869). — Stn 10, 1 (MNHN). — Stn 11, 1 (MNHN). — Stn 20, 3 (MNHN). — Stn 24, 5 (MNHN). — Stn 25, 9: 6 (MNHN), 3 (BMNH 1992.8.11.2). — Stn 40, 1 (USNM 96874). — Stn 61, 2 (MNHN). — Stn 71, 5 (MNHN). — Stn 72, 1 (MNHN).

MUSORSTOM 2: stn 1, 3 (MNHN). — Stn 4, 1 (USNM 96878). — Stn 10, 4 (MNHN). — Stn 11, 4 (MNHN). — Stn 12, 17 (MNHN). — Stn 13, 9 (USNM 96887). — Stn 18, 1 (MNHN). — Stn 20, 2 (USNM 96881). — Stn 21, 1 (USNM 96882). — Stn 62, 1 (?). — Stn 63, 26 (USNM 96883). — Stn 64, 9 (USNM 96884). — Stn 66, 95: 91 (USNM 96885), 4 (BMNH 1992.8.11.3). — Stn 68, 4 (MNHN).

MUSORSTOM 3: stn 86, 1 (MNHN). — Stn 87, 9 (MNHN). — Stn 88, 1 (MNHN). — Stn 90, 2: 1 (MNHN), 1 (USNM 96890). — Stn 91, 5 (MNHN). — Stn 92, 3 (MNHN). — Stn 96, 2 (MNHN). — Stn 97, 27 (USNM 96892). — Stn 98, 27 (USNM 96893). — Stn 99, 27: 17 (MNHN), 10 (USNM 96894). — Stn 100, 8: 6 (MNHN), 2 (USNM 96895). — Stn 101, 13 (USNM 96896). — Stn 102, 5 (MNHN). — Stn 103, 3 (USNM 96897). — Stn 108, 8 (USNM 96898). — Stn 109, 6 (MNHN). — Stn 111, 23 (MNHN). — Stn 112, 14: 3 (MNHN), 11 (USNM 96899). — Stn 120, 6 (USNM 96900). — Stn 139, 4 (MNHN).

Indonesia. DEKI: stn 42, 1 (NNM 22743).

MORTENSEN'S JAVA-S.A. EXPEDITION: stn 2, 4 (ZMUC).

KARUBAR: stn 62, 1 (USNM 96867). — Stn 79, 2 (POLIPI).

TYPE LOCALITY. — Japan, depth not given.

DIAGNOSIS/REMARKS. — This species was recently described and figured (CAIRNS, 1994) based on Philippine specimens; however, the following observations can be added. The largest known specimen (MUSORSTOM 1 stn 61) is 16.7 x 20.9 mm in calicular diameter, 24.6 mm in height, containing 50 septa; a slightly smaller specimen (MUSORSTOM 2 stn 1) of GCD 20.4 mm has 52 septa and 14 pali. All other specimens examined have 48 septa and 12 pali. Many specimens originally attached to a small, conically-shaped bryozoan colony. The corallum is straight, compressed (GCD:LCD = 1.3-1.4), and has ridged C₁₋₂. 2 to 4 pairs of elongate, spatulate thecal edge spines occur on each corallum, the 4th pair present only on the largest coralla. In 15-20% of the coralla examined, additional spines are also present on the lateral faces of the corallum, corresponding to each of the 4 lateral C₁. When present, the lateral thecal spines originate at a height intermediate between the 2nd and 3rd edge spines. In rare cases, a 2nd set of lateral thecal spines may occur above the 1st. Lateral thecal spines very irregular in development: sometimes present on one face and not the other; sometimes present on 1 lateral C₁ and not the other on the same face; and sometimes 2 occurring on one lateral C₁ and only one on the other C₁ on the same face. Presence of lateral thecal spines is not necessarily related to corallum size, since many of the largest coralla have none. Septal formula: S₁>S₂>S₃>S₄, the S₁ being highly exsert (up to 4.5 mm) and forming tall calicular lancets. A crown of 12 planar P₃ encircle a linear-fascicular columella composed of 3-12 broad, twisted elements.

Caryophyllia (A.) *spinigera* is easily distinguished from its congeners by its elongate, spatulate edge spines; it is compared to *C. grayi* in the account of that species.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan Sea; Bohol; Sulu Sea (Semirara Islands); South China Sea (Balabac Island); 127-347 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (southeast of Tanimbar Islands); Bali Sea; 200-245 m. *Elsewhere*: Japan (locality and depth unknown).

Caryophyllia (A.) *spinicarens* (Moseley, 1881)

Figs 8 g-i

Acanthocyathus spinicarens Moseley, 1881: 143-144, pl. 2, figs 6a-c.*Caryophyllia* (*Premocyathus*) *spinicarens* (sic) - CAIRNS & KELLER, 1993: 237 (listed only).MATERIAL EXAMINED. — **Philippines.** "*Challenger*": stn 210, holotype (BMNH 1880.11.25.43).

"*Albatross*": stn 5118, 1 (USNM 96901). — Stn 5198, 1 (USNM 96902). — Stn 5256, 8 (USNM 96903). — Stn 5260, 1 (USNM 36477). — Stn 5374, 11 (USNM 96908). — Stn 5403, 1 (USNM 96909). — Stn 5408, 1 (USNM 96910). — Stn 5411, 2 (USNM 96911). — Stn 5412, 1 (USNM 96912). — Stn 5417, 1 (USNM 96913). — Stn 5418, 2 (USNM 96914). — Stn 5505, 2 (USNM 96915). — Stn 5508, 3 (USNM 96916). — Stn 5527, 1 (USNM 96917). — Stn 5535, 1 (USNM 96918). — Stn 5536, 1 (USNM 96919). — Stn 5537, 1 (USNM 96920). — Stn 5538, 3 (USNM 97021). — Stn 5541, 1 (USNM 96922). — Stn 5565, 2 (USNM 96923).

"*Galathea*": stn 423, 5 (ZMUC). — Stn 436, 2 (ZMUC).

MUSORSTOM 1: stn 20, 2 (USNM 97024).

MUSORSTOM 2: stn 45, 2 (MNHN). — Stn 46, 16: 15 (MNHN), 1 (BMNH 1992.8.11.1). — Stn 63, 6 (USNM 97027). — Stn 83, 2 (USNM 97028).

MUSORSTOM 3: stn 92, 1 (MNHN). — Stn 119, 1 (MNHN). — Stn 125, 1 (MNHN). — Stn 138, 1 (USNM 97029). — Stn 139, 3 (USNM 97030). — Stn 145, 1 (MNHN).

Indonesia. "*Albatross*": stn 5622, 4 (USNM 97034). — Stn 5625, 2 (USNM 97032). — Stn 5626, 3 (USNM 97033).

DEKI: stn 62, 1 (NNM 22748).

South China Sea. "*Albatross*": stn 5301, 6 (USNM 96905). — Stn 5314, 1 (USNM 96907).

"*Hakuho Maru*": stn KH72-1-52, 2: 1 (ORI), 1 (USNM 97031).TYPE LOCALITY. — "*Challenger*" stn 210: 9°26'N, 123°34'E (off Negros, Philippines), 686 m.

DESCRIPTION. — Corallum compressed (GCD:LCD = 1.28-1.67) and often slightly curved up to 45° in plane of LCD. Angle of lateral edges 45°-76°; angle of thecal faces 22°-50°. Largest known specimen ("*Albatross*" stn 5256) 14.1 x 19.6 mm in calicular diameter and 25.5 mm in height. Pedicel small (1.8-2.5 mm in diameter), unattached as an adult, and circular to elongate in cross section. Convex thecal faces meet in sharp thecal edges, which are carinate from about 4 mm above base to calicular edge. Delicate edge crests, best preserved in small coralla, up to 1.9 mm in height, sometimes convoluted and frilled, and occasionally notched with thin discontinuities. This delicate structure usually reduced to a low, continuous ridge in larger coralla. Remaining C₁₋₂ on lateral faces highly ridged, up to 0.8 mm in height. Higher cycle costae (C₃₋₄) low and convex, covered with small, rounded granules. Corallum reddish-brown, the colour usually well preserved only near calice or on small specimens, the theca of larger coralla often discoloured or partly black.

Septa usually hexamerally arranged in 4 complete cycles (S₁₋₂>S₄≥S₃), with 12 pali, but large coralla may have 14 primary septa and 14 pali (56 septa), and coralla were also noted with 11 and 13 primary septa (44 and 52 septa, respectively). S₁₋₂ highly exsert, having straight to slightly sinuous inner edges that extend 4/5 distance to columella. S₃ least exsert (1.1-1.3 mm) and least wide septa (about 2/3 width of an S₁₋₂), with sinuous inner edges, each bordered by a slightly sinuous, lamellar P₃ 1.5-1.7 mm in width. S₄ about 2.2 mm exsert, fusing to their adjacent S₁ or S₂ in rectangular lancets. S₄ equal to or slightly wider than S₃, having slightly sinuous inner edges. S₄, especially of small coralla, spaced slightly closer to their adjacent S₁ or S₂ than to their adjacent S₃, appearing to be angled inward toward their adjacent S₃. Fossa relatively shallow, containing the palar crown (12 P₃) and a linear-fascicular columella composed of 7-20 closely-spaced twisted elements arranged in 1 or 2 rows.

REMARKS. — As MOSELEY (1881) suggested and as followed herein, even though *A. spinicarens* bears thecal edge crests instead of spines, it is similar to *Caryophyllia* (A.) *grayi* and was therefore placed in the same subgenus (but see alternate opinion in discussion of *C. (A.) grayi*). *C. (A.) spinicarens* also differs from *C. grayi* in having: S₄≥S₃; highly exsert calicular lancets; and ridged C₁₋₂. It is more similar to *C. zanzibarensis* Zou, 1984, known only from Tanzania at 238-302 m (CAIRNS & KELLER, 1993), differing only in having a less compressed corallum (GCD:LCD of *C. spinicarens*, 1.28-1.67; *C. zanzibarensis*, 1.77-2.10).

DISTRIBUTION. — *Philippines*: from Lubang Island to Sulu Archipelago; 222-717 m. *Indonesia*: Molucca Sea (Kayoa Island); Banda Sea (Kai Islands); Timor Sea (Timor); 290-750 m. *Elsewhere*: South China Sea (Pratas Island, Hong Kong, and Vanguard Bank); 223-380 m.

Caryophyllia (A.) *karubarica* sp. nov.

Figs 9 a-c

MATERIAL EXAMINED/TYPES. — *Indonesia*. KARUBAR: stn 10, 2 paratypes (MNHN). — Stn 12, 2 paratypes (POLIPI). — Stn 13, 1 paratype (MNHN). — Stn 39, 12 paratypes (USNM 97036). — Stn 58, holotype (MNHN). — Stn 71, 1 paratype (POLIPI).

TYPE LOCALITY. — KARUBAR stn 58: 8°22'S, 132°01'E (southeast of Tanimbar Islands), 457-461 m.

ETYMOLOGY. — This species is named for the KARUBAR expedition.

DESCRIPTION. — Corallum compressed (GCD:LCD = 1.26-1.36-1.50) and usually slightly curved in plane of LCD, but rarely more than 45°. Angle of lateral thecal edges 50°-61°; angle of thecal faces 38°-41°. One of the larger specimens (the holotype) is 18.8 x 25.3 mm in calicular diameter and 24.5 mm in height. Pedicel small (1.1-1.6 mm in diameter), circular, and always unattached as an adult; 6 protosepta usually can be seen on the basal disc. Thecal faces meet in sharply defined, carinate edges, but edge crests only 1.0-1.7 mm in height, usually discontinuous, and less developed on one side. Costae 0.8-1.0 mm wide, slightly convex in shape, and separated by narrow, shallow striae; every costa covered with low, rounded granules — 3 or 4 across the width of a costa. Primary costae slightly more prominent than others, but no costae are ridged. Theca of proximal 4/5 of corallum worn and white in colour, whereas uppermost theca adjacent to calice usually light reddish brown.

Septa of most specimens (GCD = 12-25 mm) 56 in number, arranged in 3 size classes and 14 sectors: *i.e.*, 14:14:28, and 24 pali; but, several of the larger specimens have 1 or 2 extra pairs of tertiary septa, resulting in 58 or 60 septa and 15 or 16 pali. Primary septa highly exsert (up to 5 mm), having sinuous inner edges that extend to the columella. Secondary septa only 2.1-2.2 mm exsert, 2/3 width of a primary, also having sinuous inner edges. Tertiary septa highly exsert (3.5-3.9 mm), each pair fused to its adjacent primary septum in a prominent calicular lancet that produce a highly serrate margin. Tertiary septa about 4/5 width of a secondary, having straight to only slightly sinuous inner edges. A ring of broad (up to 2.6 mm), sinuous pali occurs before the secondary septa. Fossa shallow, containing a fascicular columella consisting of 1 or 2 parallel rows of large, twisted elements.

REMARKS. — *Caryophyllia karubarica* is most similar to *C. spinicarens*, but differs in having: convex (rounded, not ridged) primary costae; less prominent edge crests; 14 primary septa, instead of a tendency toward 12 as in *C. spinicarens*; a "fuller" corallum (*i.e.*, a lower GCD:LCD), especially in lower half of corallum; and S₄ that are less wide than the S₃. *Caryophyllia karubarica* differs from *C. unicristata* sp. nov. in having a larger, less curved corallum; 14 primary septa, instead of exclusively 12; two carinate thecal edges, instead of a ridge only on the convex thecal edge; and more pronounced calicular lancets. These 2 species co-occur at 3 KARUBAR stations.

DISTRIBUTION. — *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (southeast of Tanimbar Islands); 389-477 m.

Caryophyllia (A.) *unicristata* sp. nov.

Figs 9 d-e

MATERIAL EXAMINED/TYPES. — *Indonesia*. KARUBAR: stn 39, 5 paratypes (POLIPI). — Stn 40, 1 paratype (USNM 97038). — Stn 58, 2 paratypes (POLIPI). — Stn 59, 81: 6 (MNHN), 75 paratypes (USNM 97040). — Stn 62, 17 paratypes (MNHN). — Stn 69, 1 paratype (POLIPI). — Stn 70, 1 paratype (MNHN). — Stn 71, 3 paratypes (USNM 97041). — Stn 76, holotype (MNHN) and 4 paratypes (MNHN).

TYPE LOCALITY. — KARUBAR stn 76: 8°49'S, 131°36'E (south of Tanimbar Islands), 400 m.

ETYMOLOGY. — The species name *unicristata* (Latin *unus*, one + *crista*, crest) refers to the single edge crest of this species.

DESCRIPTION. — Corallum relatively small, the largest specimen (KARUBAR stn 39) only 15.5 mm in GCD; the holotype is 10.9 x 13.4 mm in calicular diameter and 16.0 mm in height. Corallum ceratoid, regularly curved 45°-90° usually in plane of GCD. Pedicel small (0.8-0.9 mm in diameter), unattached, and not reinforced. Calice elliptical: GCD:LCD = 1.21-1.32. Base of pedicel often free, detached from substratum, its flat lower side revealing the 6 protosepta; sometimes worn to a rounded tip; or occasionally overgrown by a bryozoan colony. A low (0.9-1.1 mm), sinuous crest occurs on convex edge of each corallum, the concave edge being evenly rounded. Convex edge crest best developed in small coralla, often worn or lost in larger coralla. The other 11 C₁₋₂ are raised and slightly rounded (not ridged); C₃₋₄ flat. All costae covered with low, rounded granules, 3 or 4 across width of a costa. Upper 1-2 mm of theca and adjacent septa reddish-brown; remainder of corallum white.

Septa hexamerally arranged in 4 complete cycles: S₁₋₂>S₃≥S₄, and 12 pali. S₁₋₂ about 1.5 mm exsert, having vertical, slightly sinuous inner edges that almost attain the columella. S₃ about 0.4 mm exsert and 2/3 width of the S₁₋₂, having highly sinuous inner edges. S₄ intermediate in exsertness, each pair of S₄ fusing to its common S₁ or S₂ to form a low calicular lancet. S₄ equal to or slightly less wide than S₃, the widest S₄ occurring in coralla of greatest size. Inner edges of S₄ slightly sinuous. 12 prominent P₃ 1.2-1.4 mm wide, with sinuous edges. Columella consists of 4-12 well-formed, twisted elements, 4-6 arranged in a line or a larger number in 2 parallel rows.

REMARKS. — Within the subgenus *Acanthocyathus*, *A. unicristata* needs to be compared only to the 3 species that have ridged (nonspinose) thecal edges: *C. spinicarens*, *C. zanzibarensis*, and *C. karubarica*, from which it differs in having: only one carinate thecal edge (on its convex side); a more circular calice (a relatively low GCD:LCD of 1.21-1.32); a smaller pedicel diameter; consistently hexamerall symmetry; and low calicular lancets.

DISTRIBUTION. — *Indonesia*: Arafura Sea (southeast of Tanimbar Islands); 251-477 m.

Genus *PREMOCYATHUS* Yabe & Eguchi, 1942

Premocyathus dentiformis (Alcock, 1902) comb. nov.

Figs 9 f-j

Placotrochides dentiformis Alcock, 1902b: 121; 1902c: 33-34, pl. 4, figs 31, 31a.

Caryophyllia compressa Yabe & Eguchi, 1932a: 443 (*nom. nud.*).

Premocyathus compressus Yabe & Eguchi, 1942b: 121, 151-152, pl. 10, figs 13-14 (junior homonym).

Caryophyllia (P.) compressa - MORI, 1987: 21-30, 9 figs. — CAIRNS, 1994: 50-51, pl. 22, figs e-f (synonymy); 1995: 54-55, pl. 11, figs f-i.

? *Caryophyllia (P.) ceratoconus* Hu, 1987: 38-39, pl. 1, figs 16, 20.

Not *Caryophyllia compressa* Gardiner & Waugh, 1938: 180 [junior synonym = *Caryophyllia (A.) zanzibarensis* Zou, 1984, *nom. nov.*].

Not *Caryophyllia (P.) compressa* - WELLS, 1956: F422, fig. 323, 3 [= *Trochocyathus (T.) apertus* sp. nov. herein].

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5155, 1 (USNM 97042). — Stn 5217, 28 (USNM 62708).

Indonesia. "Siboga": stn 59, holotype (ZMA Coel. 1093).

"Galathea": stn 490, 4 (ZMUC).

KARUBAR: stn 15, 1 (MNHN). — Stn 18, 1 (USNM 97044).

TYPE LOCALITY. — "Siboga" stn 59: 10°22.7'S, 123°16.5'E (off Timor), 390 m.

DIAGNOSIS. — Corallum compressed (GCD:LCD = 1.2-1.4) and curved 30°-45° in plane of GCD, the concave thecal edge rounded, the convex thecal edge usually crested or even keeled. Base of corallum typically an open,

irregular scar 1.0-1.5 mm in diameter. Only one specimen (KARUBAR stn 15) was found bearing an opposite bud at this level, instead of having an open base. In fact, the usually open base is probably the result of breaking apart of parent or opposite bud. Septal symmetry quite variable. Of the 57 septal/palar permutations inferred by MORI (1987), the 4 well-preserved Philippine specimens displayed the following symmetries: 8/8/16, 8 (1 specimen), 10/10/20, 10 (1 specimen), and 10/10/18, 9 (2 specimens), which were the 13th, 4th, and 5th most common arrangements, respectively, among specimens MORI examined from the type locality. Primary and secondary septa and all pali have sinuous inner edges. Pali occur before secondary septa. Fascicular columella composed of 1-4 twisted elements.

REMARKS. — The holotype of *Placotrochides dentiformis* (ZMA Coel. 1093) is a poorly preserved specimen 4.2 x 6.9 mm in calicular diameter and 7.4 mm in height, having a septal complement of 8:8:10 (26 septa). This septal arrangement is shared with only 7 of the 1090 specimens analyzed by MORI (1987). Due to poor preservation, no pali are present, but a fascicular columella composed of twisted elements is recognizable. Although a poor specimen, there is little doubt that it is conspecific with the species later reported as *Premocyathus compressus*. Coralla of *Trochocyathus apertus* sp. nov. are similar in shape and size to *P. dentiformis* but differ in having a papillose columella, P₁₋₃ (not just P₃), and in having a less compressed corallum.

CAIRNS & KELLER (1993) and CAIRNS (1995) previously considered there to be 5 species in the subgenus *Caryophyllia* (*Premocyathus*), but we now place 2 of them, *Acanthocyathus spinicarens* (Moseley, 1881) and *C. zanzibarensis* Zou, 1984, in the subgenus *Caryophyllia* (*Acanthocyathus*); and the other 2, *C. (Premocyathus) burchae* Cairns, 1984, and *C. (P.) compressa* sensu Wells (1956) (= *Trochocyathus apertus* sp. nov.) are herein transferred to *Trochocyathus*. Only 1 species remains in *Premocyathus*, *P. dentiformis*. The genus *Premocyathus* is thus defined as having: a curved, laterally compressed corallum with a carinate convex edge and an open base that most likely is the result of separation from an opposite budded specimen; a variable septal symmetry; pali before the penultimate septal cycle; and a fascicular columella.

DISTRIBUTION. — *Philippines*: Ragay Gulf; Sulu Sea (Sulu Archipelago); 22-192 m. *Indonesia*: Banda Sea (Kai Islands); Savu Sea (Timor); Java Sea; 221-545 m. *Elsewhere*: Japan (from Honshu to northern Ryukyu Islands); Kermadec Islands; 115-757 m. Pleistocene of Japan. ? Plio-Pleistocene of Taiwan (as *C. (P.) ceratoconus* Hu, 1987).

Genus *CRISPATOTROCHUS* Tenison Woods, 1878

Crispatotrochus rubescens (Moseley, 1881)

Figs 10 a-c

Cyathoceras rubescens Moseley, 1881: 157, pl. 2, figs 8a-c. — CAIRNS, 1984: 15.

Cyathoceras tydemani Alcock, 1902a: 93-94; 1902c: 14, pl. 1, figs 7, 7a (new synonym). — FAUSTINO, 1927: 65, pl. 9, figs 5-6.

Cyathoceras diomedea Vaughan, 1907: 77-78, pl. 7, figs 1-2.

Crispatotrochus rubescens - CAIRNS, 1991: 15; 1994: 51, pl. 22, figs g-h (synonymy).

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5519, 1 (USNM 60586).

MUSORSTOM 2: stn 15, 4: 2 (MNHN), 2 (USNM 97049).

Indonesia. "Siboga": stn 105, syntype of *C. tydemani* (ZMA Coel. 579, Fig. 10c).

DEKI: stn 3, 1 (NNM 22418). — Stn 48, 1 (NNM 22415). — Stn 59, 4 (NNM 22416).

SNELLIUS 2: stn 4.066, 2 (NNM 22417).

KARUBAR: stn 16, 1 (USNM 97046). — Stn 67, 1 (USNM 97047). — Stn 86, 1 (MNHN).

South China Sea. "Hakuho Maru": stn KH73-2-44-2, 4: 2 (USNM 97050), 2 (ORI).

TYPE LOCALITY. — "Challenger" stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 236 m.

DIAGNOSIS. — Corallum elongate-conical to trochoid, with a straight, flared calice and a robust pedicel about 25% diameter of GCD. Largest known specimen ("Albatross" stn 5519) 34 x 28 mm in calicular diameter, 39 mm

in height, and 9.3 mm in pedicel diameter. Costae ridged near calice, but otherwise flat and granular. Septa hexamerally arranged in 5 cycles ($S_{1-2} > S_3 > S_4 > S_5$), the 4th cycle (48 septa stage) attained at a GCD of 7-9 mm. Inner edges of S_{1-2} moderately sinuous. Fossa deep; pali absent; fascicular columella composed of numerous (15-20), slender, twisted elements.

REMARKS. — *Crispatotrochus rubescens* is more fully described and illustrated by CAIRNS (1994). *Cyathoceras tydemani* is a juvenile specimen of *C. rubescens*, collected at a stage transitional between the 4th and 5th septal cycles, i.e., 60 septa at a GCD of 8 mm.

DISTRIBUTION. — *Philippines*: Lubang Island; Bohol Sea (south of Negros); Sulu Sea (Sulu Archipelago); 275-522 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (south of Tanimbar Islands); Savu Sea (Sumba); 226-315 m. *Elsewhere*: South China Sea (southern Formosa Strait); Japan (Honshu, Shikoku, and Kyushu); Hawaiian and Christmas Islands; 110-634 m.

Crispatotrochus rugosus Cairns, 1995

Crispatotrochus rugosus Cairns, 1995: 57, pl. 13, figs a-b.

MATERIAL EXAMINED. — *Indonesia*. "Albatross": stn 5586, 1 (USNM 97052).

TYPE LOCALITY. — NZOI stn Q70: 26°59.7'S, 159°18.9'E (Lord Howe Seamount Chain), 376 m.

REMARKS. — *Crispatotrochus rugosus* was recently described based on specimens from the New Zealand region; only a single, worn specimen of 8.7 mm GCD is reported herein. It is distinguished from *C. rubescens* by having fine, transverse thecal ridges, and S_1 that are wider than S_2 . Fragments of a much larger specimen (MUSORSTOM 2 stn 32, MNHN) — having an estimated GCD of 32 mm, 5 cycles of septa, and transverse thecal costal ridges — may represent a large specimen of this species. Unfortunately, that specimen is missing its pedicel and columellar region.

DISTRIBUTION. — ? *Philippines*: Verde Island Passage; 192-220 m. *Malaysia*: Celebes Sea (Sabah); 616 m. *Elsewhere*: Kermadec Islands; Lord Howe Seamount Chain; 142-508 m.

Genus *LABYRINTHOCYATHUS* Cairns, 1979

Labyrinthocyathus sp. A

Figs 10 f, i

MATERIAL EXAMINED. — *Indonesia*. KARUBAR: stn 36, 1 (MNHN).

DESCRIPTION. — Unique specimen 8.0 mm in calicular diameter, 15.5 mm in height, and 1.65 mm in pedicel diameter. Theca thick (about 0.9 mm) and heavily encrusted with serpulid tubes, otherwise C_{1-2} slightly ridged. Corallum white. Septa hexamerally arranged in 4 cycles: $S_1 > S_2 > S_3 >> S_4$. S_1 1.7 mm exsert, having moderately sinuous inner edges. S_2 only slightly narrower than S_1 ; S_3 about 1/2 width of S_2 . S_4 rudimentary: expressed only as a short costoseptal ridge at calicular margin, absent from upper fossa, and present in lower fossa only as a narrow lamella. Fossa of moderate depth; columella labyrinthiform.

REMARKS. — This specimen differs from the four Recent species of *Labyrinthocyathus* that have 4 cycles of septa [*L. delicatus* (Marenzeller, 1904); *L. limatulus* (Squires, 1964); *L. langae* Cairns, 1979; and *L. facetus* Cairns, 1979] by having rudimentary S_4 . It may represent an undescribed species.

DISTRIBUTION. — *Indonesia*: Banda Sea (between Tanimbar and Aru Islands); 210-268 m.

Genus *TROCHOCYATHUS* H. Milne Edwards & Haime, 1848

Key to the 12 species of *Trochocyathus* known from the Philippine/Indonesian region

1. Corallum with 6 basal spines (C₁), 1 corresponding to each C₁ 2
 - Corallum nonspinose, or, if spinose, the spines are limited to edge spines corresponding to only 2 C₁ 3
2. Basal spines short (less than 5 mm); some S₅ usually present *T. (A.) brevispina*
 - Basal spines longer (up to 10 mm); only 48 septa *T. (A.) longispina*
3. Corallum reproduces predominantly by transverse division, resulting in a characteristic basal scar on anthocyathus 4
 - Corallum does not reproduce by transverse division, the base either being firmly attached or having an open (broken) base 6
4. Corallum discoidal or bowl-shaped; thecal spines not present 5
 - Corallum elongate-conical; flattened edge spines present *T. (T.) cooperi*
5. Corallum discoidal: H:D about 0.5 *T. (T.) discus*
 - Corallum bowl-shaped: H:D 0.7-0.8 *T. (T.) gardineri*
6. Base of corallum attached to a substratum; corallum straight 7
 - Base of corallum open, as though broken; corallum curved 12
7. Corallum nonspinose 8
 - Corallum bears 1 or more pairs of thecal edge spines 11
8. Theca transversely ridged *T. (T.) rhombocolumna*
 - Theca longitudinally costate 9
9. Corallum (theca and septa) speckled with black pigment; pedicel robust (PD:GCD = 0.60-0.80), composed of chambered concentric rings *T. (T.) maculatus*
 - Corallum not speckled; pedicel small to medium-sized (PD:GCD = 0.10-0.45), not chambered 10
10. P₁₋₂ much smaller than P₃; corallum usually contains 48 septa; columella a field of 6-20 medium-sized elements *T. (T.) philippinensis* (nonspinose form)
 - P₁₋₃ equal in width; corallum usually contains more than 48 septa; columella a field of up to 40 slender elements *T. (T.) caryophylloides*
11. Septa decamerally arranged in 3 size classes (40 septa); pedicel small (1.7-1.9 mm diameter); ≥2 pairs of delicate thecal edge spines usually present *T. (T.) semperi*
 - Septa hexamerally arranged (S₁₋₂>S₃>S₄, 48 septa); pedicel larger (2.9-6.7 mm diameter); usually only 1 pair of robust edge spines present *T. (T.) philippinensis* (spinose form)
12. Crest on convex thecal edge continuous from base to calice; calice often brown-black near calice *T. (T.) burchae*
 - Crest on convex thecal edge restricted to lower corallum; corallum white *T. (T.) apertus*

Subgenus *TROCHOCYATHUS* (*TROCHOCYATHUS*) H. Milne Edwards & Haime, 1848

Trochocyathus (*T.*) *caryophylloides* Alcock, 1902

Trochocyathus caryophylloides Alcock, 1902a: 94; 1902c: 14-15, pl. 2, figs 10, 10a. — FAUSTINO, 1927: 80, pl. 7, figs 5-6. — YABE & EGUCHI, 1942b: 123-124, pl. 10, fig. 21. — ? ZOU *et al.*, 1988: 195. — CAIRNS, 1994: 52-53, pl. 23, figs a-c, h.

Not *Trochocyathus caryophylloides* ZOU, 1988: 76, pl. 5, fig. 5, 5a [= *Trophocyathus* (*T.*) ?*philippinensis* sp. nov. herein].

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 1: stn 63, 1 (USNM 97057).

MUSORSTOM 2: stn 2, 1 (MNHN). — Stn 32, 1 (MNHN).

MUSORSTOM 3: stn 88, 1 (MNHN).

Indonesia. DEKI: stn 7, 2 (NNM 22763).

KARUBAR: stn 32, 1 (MNHN). — Stn 49, 1 (MNHN). — Stn 50, 2 (MNHN). — Stn 61, 1 (MNHN). — Stn 86, 2 (USNM 97056).

TYPE LOCALITY. — "*Siboga*" stns 96, 251, and 253: Celebes and Banda Seas, Indonesia, 115-304 m.

DIAGNOSIS. — Corallum trochoid, firmly attached through a robust pedicel (PD:GCD = 0.11-0.41), up to 21 mm in GCD. Costae broad, flat to slightly convex, and covered with low, rounded granules. Corallum white to light brown. Septal symmetry appears to change with size. Coralla 8-12 mm in GCD have 4 cycles of 48 hexamerally arranged septa ($S_{1-2} > S_3 > S_4$). Larger coralla over 16 mm GCD often have 16 primary septa and 3 size classes of septa, resulting in 64 septa, or hexamerall symmetry but with an incomplete 4th cycle, also resulting in 64 septa (MUSORSTOM 1 stn 63). Discrete pali arranged in 2 or 3 crowns before all but last cycle of septa. Columella composed of an elliptical field on numerous (up to 45), slender rod-shaped papillae.

REMARKS. — One aberrant specimen (MUSORSTOM 2 stn 32) has undergone intratentacular budding, resulting in a small colony of 3 massive corallites, each the result of equal, intratentacular division. *T. caryophylloides* is more fully described and figured by CAIRNS (1994).

In our opinion, the species name was originally incorrectly formed, being derived from the root *Caryophyllia*, and thus should be *caryophyllioides*. However, according to the ICZN (Article 32dii) the original spelling cannot be changed.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; 186-192 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (southeast of Tanimbar Islands); 185-304 m. *Elsewhere*: Japan (Honshu and Fukue Jima); 115-344 m.

Trochocyathus (*T.*) *rhombocolumna* Alcock, 1902

Trochocyathus rhombocolumna Alcock, 1902a: 98; 1902c: 16, pl. 2, fig. 12. — CAIRNS, 1995: 60-61, pl. 13, fig. i, pl. 14, figs a-b (synonymy).

MATERIAL EXAMINED. — **Indonesia.** DEKI: stn 8, 1 (NNM 22755). — Stn 59, 1 (NNM 22756).

KARUBAR: stn 27, 1 (USNM 97061). — Stn 49, 2 (POLIPI). — Stn 86, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stn 95: 5°43.5'N, 119°40'E (Sulu Sea), 522 m.

DIAGNOSIS. — Corallum elongate-conical to trochoid, straight, firmly attached through a robust pedicel (PD:GCD = 0.34-0.56), and up to 14 mm in GCD (CAIRNS, 1995). Theca covered with thin transverse ridges. Corallum white. Septa hexamerally arranged in 4 full cycles: $S_1 > S_2 > S_4 > S_3$, the S_1 being highly exsert. Pali arranged in 3 crowns before all but last septal cycle, each P_2 and pair of P_3 within a system forming a distinctive

triangular pattern. Columellar elements few in number and irregular in shape, sometimes rhomboidal in cross section.

REMARKS. — *Trochocyathus rhombocolumna* is more fully described and illustrated by CAIRNS (1995) based on New Zealand specimens. One specimen from KARUBAR stn 27 has a characteristic lenticular-shaped aperture of an acrothoracican cirripede in the side of its corallum, but the symbiont no longer present.

DISTRIBUTION. — *Philippines*: Sulu Sea (Sulu Archipelago); 522 m. *Indonesia*: Banda Sea (Kai Islands); Arafura Sea (south and east of Tanimbar Islands); 209-385 m. *Elsewhere*: widespread in Indo-West Pacific from southwestern Indian Ocean to Hawaiian Islands, including ridges north of New Zealand; 110-530 m.

Trochocyathus (T.) maculatus Cairns, 1995

Trochocyathus (T.) maculatus Cairns, 1995: 61, pl. 14, figs c-d.

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 3: stn 134, 2 (MNHN).

TYPE LOCALITY. — NZOI stn P115: 31°25.9'S, 159°02.2'E (off Lord Howe Island), 183 m.

DIAGNOSIS. — Corallum elongate-conical, straight, flared distally, and attached by a broad pedicel 0.60-0.80 GCD. Pedicel increases in diameter by formation of thin exothecal dissepiments over raised basal costae, similar to the process in *Rhizosmilia*. Largest Philippine specimen 8.6 x 10.3 mm in calicular diameter and 9.7 mm in height; largest known specimen (CAIRNS, 1995) 13.8 mm in GCD. Costae granular, well-defined only in upper part of corallum. Corallum white, but theca and all septa (not pali) speckled with dark brown-black pigmentation. Septa hexamerally arranged in 5 cycles, the 5th never complete. The large Philippine specimen has only 1 pair of S₅ (50 septa) and a New Zealand specimen has as many as 64 septa. S₁ highly exsert, forming calicular lancets. S₂ smaller than S₁ but larger than S₃. S₄ variable in width, those adjacent to S₁ often wider than the S₃, those adjacent to S₂ usually less wide than S₃. Two crowns of pali present: 12 small P₁₋₂ occurring low in the fossa, and 12 larger P₃ rising much higher in fossa. P₄ present on septa flanked by a pair of S₅. Papillose columella a field of 20-30 fine pillars.

REMARKS. — *Trochocyathus maculatus* is more fully described and illustrated in the original account. It is distinguished from its congeners by its distinctively speckled corallum and exothecal dissepiments.

DISTRIBUTION. — *Philippines*: Sibuyan Sea (northeastern tip of Panay); 92-95 m. *Elsewhere*: Kermadec and Lord Howe Islands; Taupo Seamount and Dampier Ridge, southeastern Australia; 100-183 m.

Trochocyathus (T.) philippinensis Semper, 1872

Figs 10 d-e

Trochocyathus philippinensis Semper, 1872: 253, pl. 20, fig. 16. — FAUSTINO, 1927: 79-80, pl. 7, figs 3-4.
? *Trochocyathus caryophylloides* - ZOU, 1988: 76, pl. 5, figs 5, 5a. [Not *T. caryophylloides* Alcock, 1902a].

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5178, 8 (USNM 97065). — Stn 5213, 2 (USNM 97066). — Stn 5217, 1 (USNM 97067). — Stn 5381, 3 (USNM 97070).

MUSORSTOM 1: stn 13, 1 (USNM 97075). — Stn 14, 1 (MNHN). — Stn 35, 1 (USNM 97076). — Stn 64, 1 (MNHN). — Stn 72, 1 (MNHN).

MUSORSTOM 2: stn 6, 1 (MNHN). — Stn 10, 1 (USNM 97079). — Stn 17, 1 (MNHN). — Stn 33, 32 (USNM 97080).

MUSORSTOM 3: stn 88, 2 (USNM 97081). — Stn 96, 6 (USNM 97083). — Stn 98, 1 (USNM 97083). — Stn 102, 3 (MNHN). — Stn 108, 1 (MNHN). — Stn 124, 3. — Stn 131, 1 (USNM 97084).

Indonesia. DEKI: stn 6, 2 (NNM 22772). — Stn 24, 2 (NNM). — Stn 44, 8 (NNM 22773). — Stn 49, 7 (NNM 22774).

CORINDON 2: stn 248, 2 (MNHN).

KARUBAR: stn 2, 24 (POLIPI). — Stn 3, 8: 1 (MNHN), 7 (USNM 97071). — Stn 15, 1 (USNM 97072). — Stn 18, 1 (USNM 97073). — Stn 32, 1 (POLIPI).

South China Sea. "Albatross": stn 5311, 2 (USNM 97068). — Stn 5314, 1 (USNM 97069).

Ryukyu Islands. "Tansei Maru": stn KT93-09-AM6, 1 (USNM 93163). — Stn KT93-09-AM7, 1 (USNM 93160).

TYPE LOCALITY. — Pandanon, west coast of Bohol, Philippines, 27-54 m.

DESCRIPTION. — Corallum ceratoid to trochoid and relatively small, the largest corallum (MUSORSTOM 3 stn 88) 12.3 x 17.6 mm in calicular diameter and 26.4 mm in height, but most specimens less than half this size; one syntype measures 9.5 x 11.0 mm in calicular diameter and 19 mm in height (*vide* SEMPER, 1872). Calice elliptical: GCD:LCD = 1.15-1.64. Coralla often maintain their attachment to substratum through a robust pedicel 2.9-6.7 mm in diameter (PD:GCD = 0.20-0.44), the substratum often consisting of a small gastropod shell, an echinoid spine, a pebble, or a corallum of a dead Scleractinia such as *Flabellum* or *Balanophyllia*. Corallum usually straight, occasionally bent near base. About 1/3 of specimens examined bear slender thecal edge spines, the remaining coralla having evenly rounded thecal edges. Of those having edge spines, size and symmetry are quite variable. Some specimens have a pair of spines, but coralla bearing a single spine or just a nub or low crest on one thecal edge are not uncommon. Only one specimen (MUSORSTOM 3 stn 96) has 3 spines: 2 on one edge and 1 on the other. Lower 1/3 to 1/2 of theca white and porcellaneous; however, upper 1/2 to 2/3 dark brown, bearing well-formed, convex costae separated by deep intercostal furrows. Costae in upper corallum with minute granules.

Septa hexamerally arranged in 4 full cycles: $S_{1-2} > S_3 \geq S_4$; however, some large specimens have 1 or 2 pairs of S_5 resulting in 50-52 septa, and small coralla less than 9 mm GCD often lack several pairs of S_4 . S_{1-2} about 1.7 mm exsert, having vertical, slightly sinuous inner edges, each bordered by a small (0.3-0.5 mm) papillose to lamellar palus. S_3 about 1.3 mm exsert, with slightly more sinuous inner edges, and bordered by lamellar P_3 . P_3 each about 1.0 mm wide and forming a crown that rises higher in the fossa than the crown of P_{1-2} . S_4 equally exsert as S_3 ; in small to medium-sized coralla S_4 slightly less wide than the S_3 , but S_4 become proportionately wider with growth of the corallum, until they sometimes slightly exceed the S_3 in width. Fossa of moderate depth, containing a papillose columella consisting of 6-20 interconnected papillae.

REMARKS. — Among the 23 Recent species in the nominate subgenus of *Trochocyathus*, only 2 other have thecal edge spines: *T. semperi* sp. nov. and *T. cooperi* (Gardiner, 1905). *T. philippinensis* is distinguished from *T. semperi* by having: a larger corallum with a more robust pedicel (2.9-6.7 mm in diameter vs 1.7-1.9 mm for *T. semperi*); hexamerall septal symmetry resulting in 48 septa (not 40 septa); asymmetrical and erratic development of thecal edge spines (vs usually two pairs for *T. semperi*); and highest cycle septa (S_4) that are sometimes as large as the penultimate cycle (S_3), whereas the tertiary septa of *T. semperi* are 1/2 the width of their secondaries. Furthermore, *T. philippinensis* is more common in deeper water than *T. semperi*, i.e., 100-268 m whereas most records of *T. semperi* are from less than 100 m.

Although similar in calicular features, *T. cooperi* differs from *T. philippinensis* by dividing transversely (basal scar), and in having plate-like, lamellar thecal edge spines.

DISTRIBUTION. — *Philippines*: Lubang Island; Verde Island Passage; Sibuyan and Samar Seas; Burias Pass; Pandanon; Sulu Sea (Semirara Islands and west of Panay); 54-194 m. *Indonesia*: Makassar Strait; Banda Sea (Kai Islands); 100-268 m. *Elsewhere*: South China Sea (north of Pratas Island); Japan (northern Ryukyu Islands); 108-223 m.

Trochocyathus (T.) semperi sp. nov.

Figs 10 g-h, 11 f

MATERIAL EXAMINED/TYPES. — *Philippines*. "Albatross": stn 5133, 1 paratype (USNM 97085). — Stn 5142, 5 paratypes (USNM).

MUSORSTOM 3: stn 140, 9 paratypes (MNHN).

Indonesia. DEKI: stn 6, 3 paratypes (NNM 22784). — Stn 53, 2 paratypes (ZMUC), 2 paratypes (NNM 22785).

CORINDON 2: stn 251, 59: holotype (MNHN), 10 paratypes (POLIPI), 48 paratypes (USNM 97086).

TYPE LOCALITY. — CORINDON 2 stn 251: 0°53.7'S, 119°29.6'E (Makassar Strait), 65 m.

ETYMOLOGY. — This species named for Carl Gottfried SEMPER, in recognition of his work on shallow water azooxanthellate corals of the Philippine region (see SEMPER, 1872).

DESCRIPTION. — Corallum ceratoid and relatively small, most specimens examined only 5-7 mm in GCD and equally tall, the largest ("Albatross" stn 5142) being 7.7 x 9.7 mm in calicular diameter and 15 mm in height. Holotype 4.9 x 6.6 mm in calicular diameter and 8.4 mm in height. Calice elliptical: GCD:LCD = 1.25-1.37. Coralla often maintain their attachment to substratum through a robust pedicel 1.7-1.9 mm in diameter (PD:GCD = 0.18-0.30), the substratum often being a bivalve shell, large foraminiferan, or other corals, such as *Heteropsammia*. Pedicel next to basal disc often bent 30°-45°. Occasionally corallum detached from the substratum, revealing the basal disc and original 6-12 protosepta. Most coralla bear at least 2 pairs of delicate thecal edge spines, the 1st pair beginning its development almost immediately above the basal disc as an extension of the 2 principal CS₁; in 2 cases the lowermost spines were fused to the substratum. Edge spines spatulate proximally, cylindrical distally, and up to 3.6 mm in length, but, because of their delicate nature, only small coralla bear intact, elongate spines. All costae equally convex and granular. Upper 1/2 of theca blackish-brown; lower 1/2 of theca and calicular elements white.

In early development, septa are hexamerally arranged in 3 cycles, but by a GCD of about 4 mm a decamerall symmetry is adopted, adult coralla usually having 3 size classes of decamerally arranged septa (40 septa). Primary septa 0.8-1.0 mm exsert, having vertical, slightly sinuous inner edges, each bordered by a small, poorly-formed palus. Secondary septa 0.6 mm exsert and about 2/3 width of a primary, having sinuous inner edges, each bordered by a narrow (about 0.5 mm), lamellar palus. Tertiary septa equally exsert, but only 1/2 width of a secondary. Fossa of moderate depth, containing a papillose columella composed of 5-9 slender elements, sometimes indistinguishable in size and shape from the P₁.

REMARKS. — Only 3 of the approximately 23 Recent species of *Trochocyathus* (*Trochocyathus*) have thecal edge spines: *T. cooperi* (Gardiner, 1905); *T. semperi*; and *T. philippinensis*, the last 2 species being compared in the previous account. Within the Scleractinia, edge spines are often associated with coralla of species that transversely divide as a method of asexual propagation (e.g., *Trochocyathus cooperi*, most species of *Truncatoflabellum*); however, in both *T. philippinensis* and *T. semperi*, no specimens show evidence of transverse division, many displaying their original basal disc.

DISTRIBUTION. — *Philippines*: Sibuyan Sea; Sulu Sea (Zamboanga Peninsula and Sulu Archipelago); 38-93 m. *Indonesia*: Makassar Strait; Banda Sea (Kai Islands); 65-245 m.

Trochocyathus (*T.*) *apertus* sp. nov.

Figs 11 a-d

Caryophyllia (*Premocyathus*) *compressa* - WELLS, 1956: F422, fig. 323,3. [Not *Premocyathus compressus* Yabe & Eguchi, 1942].

Premocyathus compressus - CAIRNS, 1984: 14 (in part: "Albatross" specimens). [Not *Premocyathus compressus* Yabe & Eguchi, 1942].

Not *Caryophyllia* (*Premocyathus*) *compressa* - CAIRNS, 1995: 54-55. [See discussion of *Premocyathus dentiformis*].

MATERIAL EXAMINED/TYPES. — **Philippines**. "Albatross": stn 5156, 19 paratypes (USNM 62709). — Stn 5164, 526+: holotype (USNM 97087), 500+ paratypes (USNM 62710), 26 (MNHN).

Indonesia. DEKI: stn 10, 2 paratypes (NNM 22498).

MORTENSEN'S JAVA-S.A. EXPEDITION: stn 9, 1 paratype (ZMUC).

TYPE LOCALITY. — "Albatross" stn 5156: 5°01'40"N, 119°52'20"E (Sulu Archipelago), 33 m.

ETYMOLOGY. — The species name (Latin *apertus*, open) alludes to the open base of all specimens.

DESCRIPTION. — Corallum relatively small, usually curved about 90° in plane of GCD, and somewhat compressed (GCD:LCD = 1.19-1.37). Largest known specimen (ZMUC) 7.2 x 9.9 mm in calicular diameter and

14.3 mm in height; holotype 7.9 x 6.3 mm in calicular diameter and 11.8 mm in height. All coralla examined unattached (free), with an open base 1.2-1.8 mm in diameter that reveals the 12 septa: 6 thick and 6 thin. Each corallum bears a short thecal edge crest on its lower convex edge, up to 5 mm long, up to 3 mm in height, and about 0.5 mm thick. Crests best developed on small coralla, becoming worn or broken with age, not extending to calicular edge. Crests absent from concave thecal edge, but occasionally the principal C₁ of the concave edge is slightly prominent or thickened. Costae low, convex, granular ridges separated by broad, shallow intercostal furrows. Corallum white.

Septa hexamerally arranged in 4 cycles, but 4th cycle never complete. The most common septal complement is 40, arranged: 12:12:16, with 4 half-systems lacking pairs of S₄ (e.g., the holotype). If the 12 half-systems are numbered in a clockwise direction, starting with the half-system to the right of the principal septum aligned with the convex edge, the 4 half-systems that lack S₄ pairs are usually the 3rd, 5th, 8th, and 10th. Coralla having 44 septa, the largest number of septa observed, usually lack S₄ pairs in the 5th and 8th half-systems. S₁₋₂ up to 1.3 mm exsert, having vertical, slightly sinuous inner edges. S₃ about 1.0 mm exsert, with slightly sinuous inner edges, about 3/4 the width of an S₂. S₄ slightly less exsert and 3/4 width of an S₃. Most, but not all, S₁₋₂ bear a small (0.3-0.5 mm wide) papillose to lamellar palus, the papillae being indistinguishable from columellar elements, except that they rise higher in the fossa. P₃ always lamellar, about 1 mm wide, with straight edges, and rising even higher in the fossa. The fossa contains a papillose columella consisting of 7-10 interconnected pillars, each about 0.3 mm in diameter.

REMARKS. — CAIRNS (1984) previously considered this species to be *Premocyathus compressus* (= *Premocyathus dentiformis* herein) because of their similarity in corallum size and shape; because both species have open bases; and because many specimens of *T. apertus* lacked P₁₋₂ and thus resembled a *Caryophyllia* ground plan. In spite of these convergent characters, *T. apertus* differs significantly in having a papillose columella composed of slender rods (not a fascicular composed of twisted lamellae), and in having often distinct P₁₋₂. Furthermore, whereas the septal symmetry of *P. dentiformis* [= *C. (P.) compressa* sensu MORI, 1987] is quite variable, the hexamerall pattern that is most common in *T. apertus* (12:12:16) is quite rare (0.3%) in *P. dentiformis*. Overall hexamerall symmetry is the rule in *T. apertus*, but rare (only 3%) in *P. dentiformis*.

DISTRIBUTION. — *Philippines*: Sulu Sea (Sulu Archipelago); 33 m. *Indonesia*: Banda Sea (Kai Islands); Bali Strait; 50-70 m.

Trochocyathus (T.) burchae (Cairns, 1984) comb. nov.

Premocyathus burchae Cairns, 1984: 14, pl. 2, figs G-H.
Caryophyllia (P.) burchae - CAIRNS, 1995: 54 (listed).

MATERIAL EXAMINED. — **Philippines**. "Albatross": stn 5133, 6 (USNM 97064).

Indonesia. DEKI: stn 10, 18 (NNM 22764). — Stn 82, 1 (NNM 23202).

MORTENSEN'S JAVA-S.A. EXPEDITION: stn 5, 1 (ZMUC). — Stn 9, 4: 3 (ZMUC), 1 (USNM 97089).

TYPE LOCALITY. — 20°43.7'N, 156°54.6'W (Lanai, Hawaiian Islands), 64 m.

DIAGNOSIS/REMARKS. — Little can be added to the original description based on Hawaiian specimens. Although quite similar, *T. burchae* differs from *T. apertus* in having a smaller corallum with a smaller open base; a brown-black pigmented upper theca; and a more distinctly developed thecal edge crest. The crest of the convex side of *T. burchae* is up to 4.8 mm in height and usually continuous from base to calice, occasionally bilobate. Furthermore, some coralla have a low crest on the lower concave thecal edge. The largest known specimen (MORTENSEN stn 9) is 6.4 x 10.0 mm in calicular diameter.

Trochocyathus burchae is placed in this genus for the same reasons cited for *T. apertus*: its papillose columella and the occasional presence of P₁₋₂ as well as P₃.

DISTRIBUTION. — *Philippines*: Sulu Sea (Zamboanga Peninsula); 70 m. *Indonesia*: Banda Sea (Kai Islands); Bali Strait; Sunda Strait (Java Sea); 35-70 m. *Elsewhere*: Lanai, Hawaiian Islands; 64 m.

Trochocyathus (T.) cooperi (Gardiner, 1905)

Fig. 11 e

? *Trochocyathus weberi* Alcock, 1902a: 95-96.*Tropidocyathus cooperi* Gardiner, 1905: 955, pl. 93, fig. 30.*Trochocyathus* sp. - VAUGHAN & WELLS, 1943: 47, fig. 20b (inverted view of specimen from "Albatross" stn 5142).*Trochocyathus cooperi* - CAIRNS, 1994: 54, pl. 23, figs f-g.

MATERIAL EXAMINED. — **Philippines.** "Albatross": stn 5133, 1 (USNM 97090). — Stn 5136, 5 (USNM 97091). — Stn 5137, 2 (USNM 97092). — Stn 5142, 9 (USNM 97093). — Stn 5143, 3 (USNM 97094). — Stn 5144, 1 (USNM 97095). — Stn 5146, 5 (USNM 97096). — Stn 5147, 3 (USNM 97097). — Stn 5151, 9 (USNM 97098). — Stn 5202, 1 (USNM 97099). — Stn 5355, 1 (USNM 97100).

MUSORSTOM 1: stn 57, 1 (MNHN).

MUSORSTOM 2: stn 47, 1 (MNHN).

MUSORSTOM 3: stn 137, 2 (USNM 97102).

Indonesia. DEKI: stn 15, 1 (NNM). — Stn 17, 1 (NNM 22564). — Stn 24, 4 (NNM 22565). — Stn 53, 4 (NNM 22566). — Stn 90, 1 (NNM 22569). — Stn 95, 1 (NNM). — Stn 103, 72 (NNM 22570).

SNELLIUS 2: stn 4.234, 1 (NNM 22571).

South Pacific. "Pele": stn TH1, 16 (USNM 73764).

TYPE LOCALITY. — Kolumadulu and Suvadiva, Maldives Islands, 64-70 m.

DIAGNOSIS. — Corallum (anthocyathus) compressed (GCD:LCD = 1.4-2.3). Angle of thecal edges, not including crests, 19°-30°; angle of thecal faces, 20°-25°. One of the largest known specimens ("Albatross" stn 5202) 12.1 x 17.3 mm in calicular diameter and 17.7 mm in height, whereas another, rejuvenescent corallum (MUSORSTOM 1 stn 57) is 15.9 x 17.6 mm in calicular diameter and 26.9 mm in height. Basal scar elliptical, up to 4.0 mm in greater diameter. Base of each thecal edge bears a large (up to 4.5 mm), downward-projecting crest, sometimes recurved toward the basal scar. Corallum reddish-brown, often with a more intense costal striping and/or costal speckling near the calice. Septa hexamerally arranged in 4 full cycles (S₁₋₂>S₃>S₄). Large coralla may have some additional pairs of S₅ up to a total of 56-62 septa. Two crowns of pali occur, 12 small P₁₋₂ and 12 larger P₃. Papillose columella composed of 10-30 slender, cylindrical elements.

Anthocaulus stage rarely collected, attaining up to 6 mm in height, 7.7 mm in GCD, and having a robust pedicel diameter of 3.4 mm. It may have 4 complete cycles of septa (S₁₋₂>S₃>S₄) and prominent edge crests.

REMARKS. — *Trochocyathus cooperi* is one of 4 species in the subgenus that divides transversely. The other 3 species [*T. gardineri* (Vaughan, 1907); *T. cepulla* Cairns, 1995; and *T. discus* sp. nov.] are discoidal (bowl-shaped), nonspinose, and noncrested. *T. cooperi* is more fully described and illustrated by CAIRNS (1994).

The description of *Trochocyathus weberi* Alcock, 1902a fits that of *T. cooperi*, except for the colour of its corallum, which was stated to be "snow white". *T. weberi* was one of 8 species described by ALCOCK (1902a) in his preliminary "Siboga" report but not included in his final report (ALCOCK, 1902c). It was never illustrated, a station number was never cited, and it could not be found in the collections of the ZMA in 1994. Therefore, its equivalence with *T. cooperi* remains questioned.

DISTRIBUTION. — **Philippines:** Lubang Island; Sibuyan Sea; Sogod Bay, Leyte; Sulu Sea (Zamboanga Peninsula, Sulu Archipelago, and Balabac Island); 34-96 m, with one assumed incorrect record at 918 m ("Albatross" stn 5202). **Indonesia:** Banda Sea (Kai Islands); Flores Sea (Selayar Island, Sulawesi; Lintah Strait); Sunda Strait, Java Sea; 25-100 m. **Elsewhere:** Maldives Islands; northern Ryukyu Islands; Tahuata, Marquesas Islands (reported herein); 70-80 m.

Trochocyathus (T.) gardineri (Vaughan, 1907)*Paracyathus gardineri* Vaughan, 1907: 68-69, pl. 4, fig. 4.*Trochocyathus gardineri* - CAIRNS, 1984: 16.

Not *Paracyathus gardineri* - GARDINER & WAUGH, 1938: 183-184, pl. 3, fig. 5 [= *Trochocyathus (T.)* sp.].

MATERIAL EXAMINED. — **Philippines.** "Albatross": stn 5567, 1 worn anthocyathus (USNM 97103).

TYPE LOCALITY. — "Albatross" stn unknown: Hawaiian Islands (exact locality and depth unknown).

DIAGNOSIS/REMARKS. — Based on the single poorly-preserved specimen reported above, nothing can be added to the original description of VAUGHAN, except for the range extension. *T. gardineri* reproduces by transverse division, the anthocyathus having a flat base with a central circular detachment scar about 5 mm in diameter. At a calicular diameter of 10-12 mm, the thecal walls abruptly turn upward, forming a cylindrical corallum. Septa hexamerally arranged in 4 complete cycles: $S_{1-2} > S_4 \geq S_3$. Three crowns of well-formed pali are present: P₁, P₂, and P₃. Columella papillose.

DISTRIBUTION. — Philippines: Sulu Sea (Sulu Archipelago); 490 m. *Elsewhere*: Hawaiian Islands; 274-470 m.

Trochocyathus (T.) discus sp. nov.

Figs 11 g-h, 12 a-c

MATERIAL EXAMINED/TYPES. — **Indonesia.** KARUBAR: stn 2, 1 dead corallum, paratype (USNM 97104). — Stn 3, 20: holotype and 6 paratypes (MNHN), 3 paratypes (POLIPI), and 11 paratypes (USNM 97105).

TYPE LOCALITY: KARUBAR stn 3: 5°48'S, 132°12'E (Kai Islands, Banda Sea), 278-300 m.

ETYMOLOGY. — The species name (Latin *discus*, circular plate) refers to the shape of the anthocyathus.

DESCRIPTION. — Corallum (anthocyathus) discoidal and free, with a flat to slightly convex base. Central region of base a circular detachment scar, measuring 3.6-4.1 mm in diameter, with traces of 24 septa but no costae. Instead, small (about 40 µm in width), pointed granules cover the scar region and surrounding base, 4 or 5 occurring across the width of a costa. Holotype 9.2 x 9.7 mm in diameter and 5.2 mm in height: largest known specimen (KARUBAR stn 2) 12.2 mm in diameter. Toward calicular edge the costae are better defined by thin (70-90 µm wide), deep intercostal furrows that become progressively wider toward the periphery. Costae convex and about 0.4 mm wide, bearing a coarser granulation than the base, only 3 or 4 blunt granules occurring across the width of a costa (Fig. 12 a-b). Thecal edges and upper, outer regions of septa reddish-brown in well-preserved coralla, but base of colony and remaining septa, pali, and columella white. Anthocaulus unknown.

Septa hexamerally arranged in 4 cycles, a complete 4th cycle achieved at a GCD of about 8 mm. Specimens smaller than this always lack several pairs of S₄ (e.g., having 40-46 septa). S₁ highly exsert (about 1.8 mm), having vertical, slightly sinuous inner edges that extend 2/3 distance to columella. S₂ less exsert and about 2/3 width of an S₁, also with slightly sinuous inner edges. S₃ less exsert than S₂ and about 2/3 width of an S₂, having moderately sinuous inner edges. S₄ dimorphic in width and exsertness: those adjacent to S₁ being slightly more exsert and wider than an S₃; those adjacent to S₂ being slightly less exsert and less wide than an S₃. Septal faces covered with tall (0.11 mm height), pointed granules. P₁ lamellar, but only 0.3-0.5 mm in width; P₂ 0.5-0.6 mm wide, rising slightly higher in fossa; P₃ same size as P₂ but recessed from the columella, each pair within a system loosely fused to its common P₂ in a chevron pattern. Pali with granulation coarser than that of septa, also bearing short, oblique carinae. Fossa shallow, containing a columella of 10-15 irregularly-shaped (fig. 11g-h) papillae that are fused among themselves and to inner edges of P₁₋₂.

REMARKS. — Among the 4 species of *Trochocyathus (Trochocyathus)* that undergo transverse division, this species resembles *T. cepulla* Cairns, 1995, but is distinguished by its smaller, bowl-shaped corallum, which attains a full 4th cycle at a smaller size; its more regular septal arrangement; and its dimorphic S₄, those of *T. cepulla* being uniformly less wide than their S₃. It differs from *T. gardineri* in having a discoidal (vs bowl-shaped) corallum with lower H:D ratio (see key).

DISTRIBUTION. — **Indonesia**: Banda Sea (Kai Islands); 240-278 m.

Subgenus *TROCHOCYATHUS* (*APLOCYATHUS*) d'Orbigny, 1849*Trochocyathus* (A.) *brevispina* sp. nov.

Figs 12 d-f

Odontocyathus ? sp. Alcock, 1902c: 24.MATERIAL EXAMINED/TYPES. — **Indonesia**. "Siboga": stn 262, 1 paratype (ZMA Coel. 890).

DEKI: stn 12, 1 paratype (NNM 22499). — Stn 13, 1 paratype (NNM 22430). — Stn 41, 1 paratype (NNM 22500).

KARUBAR: stn 2, 1 paratype (POLIPI). — Stn 3, holotype (MNHN) and 8 paratypes (MNHN). — Stn 7, 19 paratypes (USNM 97106).

TYPE LOCALITY. — KARUBAR stn 3: 5°47'40"S, 132°12'11"E (Kai Islands, Banda Sea), 278-300 m.

ETYMOLOGY. — The species name *brevispina* (Latin *brevis*, short + *spina*, spine) refers to the 6 short C₁ spines.

DESCRIPTION. — Corallum bowl-shaped and free, the base flat to evenly rounded, often with a imprint of original substratum attachment or even an incorporated fragment of substratum at centre of base. Holotype 20.3 x 22.1 mm in calicular diameter and 9.3 mm in height, containing 66 septa; largest specimen (KARUBAR stn 3) 22.3 x 26.1 mm in calicular diameter and 12.8 mm in height, containing 72 septa. Calice elliptical: GCD:LCD = 1.07-1.17. Costae well defined only near calice, where they are slightly convex and granular; remainder of base usually worn and/or smooth, often with a hexagonal region of epitheca bounded by the 6 costal spines. All specimens examined bear 6 short (not more than 5 mm in length) costal spines associated with the C₁, the spines of some coralla being strongly compressed and ridged basally, these ridges extending to the centre of the base. Well-preserved coralla black-brown in colour.

Septa hexamerally arranged in 5 cycles, several pairs of S₅ present already in small coralla of 12 mm GCD, but even in large specimens 5th cycle never complete, the largest corallum having only 12 pairs of S₅, or a total of 72 septa. Septal formula: S₁₋₂>S₄≥S₃>S₅. S₁₋₂ are 3.5-4.0 mm exsert, robust, having thick, straight inner edges bordered by a well-defined palus. S₃ slightly less exsert (2.5 mm) and about 3/4 width of an S₁₋₂, each S₃ also bordered by a palus of equivalent size to a P₁₋₂ but recessed slightly from the columella. S₄ of equal exsertness to S₃, but slightly wider than S₃, unless flanked by a pair of S₅, in which case the S₄ are narrower than an S₃. S₄ flanked by S₅ bear a palus of similar size to the others, but recessed even more from the columella than the P₃. When present, S₅ are least exsert and least wide class of septa. All pali (P₁₋₄) thick, about 1.5 mm wide, having straight, vertical inner edges; pali separated from their bordering septa by narrow (about 0.8 mm), deep notches. Fossa shallow, containing a papillose columella composed of 9-20 small, irregularly-shaped pillars.

REMARKS. — Three Recent species are now attributed to the subgenus *Aplocyathus*. *Trochocyathus brevispina* differs from *T. hastatus* Bourne, 1903 (Figs 13 a-c), in always having 6 short costal spines, not 5 elongate ones. It also differs in: having a larger corallum with more septa, the maximum known size of *T. hastatus* is 18 mm GCD with 48 septa; having S₁=S₂, *T. hastatus* having S₁>S₂; and having equal-sized P₁₋₄, those of *T. hastatus* being unequal in size. *T. brevispina* is compared to *T. longispina* in the account of that species (see below).

DISTRIBUTION. — **Indonesia**: Banda Sea (Kai Islands); 240-282 m (a dead corallum from 560 m).*Trochocyathus* (A.) *longispina* sp. nov.

Figs 12 g-i

MATERIAL EXAMINED/TYPES. — **Philippines**. "Albatross": stn 5331, 1 paratype (USNM 97108). — Stn 5506, 1 paratype (USNM 97109). — Stn 5537, 1 paratype (USNM 97667).

MUSORSTOM 1: stn 50, holotype (MNHN).

MUSORSTOM 2: stn 44, 1 paratype (USNM 97111).

Indonesia. "Albatross": stn 5592, 1 paratype (USNM 97110).

TYPE LOCALITY. — MUSORSTOM 1 stn 50: 13°49'N, 120°01'E (Lubang Island, Luzon), 415-510 m.

ETYMOLOGY. — The species name *longispina* (Latin *longus*, long + *spina*, spine) refers to the 6 elongate C₁ spines.

DESCRIPTION. — Corallum bowl-shaped and free, the base flat to slightly convex, often maintaining the scar of original attachment. At a diameter of 9-11 mm the horizontal base is sharply inflected upward at 65-70°. Largest specimen (holotype) 17.0 mm in calicular diameter and 12.7 mm in height. Calice circular. Costae well defined only near calicular edge, otherwise lower theca and base uniformly granular. Six slender, elongate (up to 10 mm) costal spines (C₁) project horizontally from the outer edge of base; spines circular in cross section. Corallum white.

Septa hexamerally arranged in 4 complete cycles in all specimens reported (S₁₋₂>S₃>S₄). Each S₁₋₂ up to 3.0 mm exsert, with a slightly sinuous inner edge, bearing a small palus 0.5-1.0 mm in width that contributes to a crown of 12 P₁₋₂ located close to the columella. S₃ less exsert (about 1.7 mm) and about 2/3 width of S₁₋₂, having moderately sinuous inner edges. Each S₃ bordered by a large, lamellar P₃ about 2.0 mm wide, the 12 P₃ forming a crown that rises higher in the fossa and is slightly more recessed than the P₁₋₂ crown. S₄ about 0.8 mm exsert, 1/2 the width of S₃, without lobes. Fossa shallow, containing a prominent columella consisting of irregularly-shaped papillae.

REMARKS. — *Trochocyathus longispina* differs from *T. brevispina* sp. nov. in having a smaller corallum, less septa, a circular (not elliptical) calice, a white (not black-brown) corallum, and longer costal spines that are circular (not flattened) in cross section. *T. hastatus* Bourne, 1903 (Figs 13 a-c), the other Recent species in the subgenus, differs from *T. longispina* in having S₁>S₂, a porcellaneous base, a brown-black corallum, and only 5 costal spines. *T. longispina* also resembles *Stephanocyathus (Acinocyathus) explanans* (Marenzeller, 1904), both species having 6 long costal spines, a white corallum, and a similar palar arrangement, but differs in having a smaller corallum and correspondingly less septa and pali (48 vs 72 septa), and sinuous inner septal edges, especially of the S₃. The inner septal edges of *S. explanans* are straight, which is one of the few characters that differentiate the subgenera *Stephanocyathus (Acinocyathus)* and *Trochocyathus (Aplocyathus)*.

DISTRIBUTION. — *Philippines*: Zambalas, Luzon; Lubang Island; Sibuyan and Bohol Seas; 326-760 m. *Malaysia*: Celebes Sea (Sabah); 558 m.

Genus *TETHOCYATHUS* Kühn, 1933

Tethocyathus virgatus (Alcock, 1902)

Trochocyathus (Tethocyathus) virgatus Alcock, 1902a: 98-99; 1902c: 16-17, pl. 2, fig. 13. — FAUSTINO, 1927: 82-83, pl. 7, fig. 10.

Tethocyathus virgatus - CAIRNS, 1995: 65-66, pl. 16, figs c-f (synonymy).

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 1: stn 32, 2 (MNHN). — Stn 63, 2 (MNHN).

MUSORSTOM 2: stn 2, 1 (USNM 97113). — Stn 33, 2 (MNHN).

MUSORSTOM 3: stn 108, 4 (USNM 97114).

Indonesia. MORTENSEN'S JAVA-S.A. EXPEDITION: stn 15, 4: 1 (NNM 23201), 3 (ZMUC).

KARUBAR: stn 16, 1 (USNM 97115). — Stn 27, 1 (POLIPI). — Stn 44, 2 (MNHN).

TYPE LOCALITY. — "*Siboga*" stns 96 and 105: Sulu Archipelago, 275 m.

DIAGNOSIS. — Corallum elongate-conical to subcylindrical, firmly attached through a robust pedicel (PD:GCD = 0.54-0.84). Largest Philippine specimen (MUSORSTOM 1 stn 63) 13.8 mm in GCD and 14.9 mm in height, elsewhere coralla reported up to 16.3 mm in GCD (CAIRNS, 1995). Epitheca usually present, but variable in development. CS₁ darkly pigmented, highlighting hexamerall symmetry of corallum; however, in some specimens CS₂ are also pigmented, and in a few coralla upper edges of all septa are dark blackish-brown. Septa