

Table 5. — Comparison of the three Recent species of *Trochocyathus* (*Aplocyathus*).

|   | <i>T. (A.) hastatus</i> Bourne, 1903   | <i>T. (A.) brevispina</i> Cairns & Zibrowius, 1997   | <i>T. (A.) longispina</i> Cairns & Zibrowius, 1997                                    |
|---|--|--|---|
| Nature of Base  | Rounded (protuberant); small, circular scar; porcellaneous   | Usually flat; hexagonally shaped epitheca surrounds epicentre, substrate usually incorporated in base; porcellaneous   | Usually flat; circular scar; granular   |
| Costae near Calicular Margin                                | Finely granular  | Coarsely granular  | Coarsely granular   |
| Maximum Calicular Diameter (mm)                             | 18.0   | 26.1   | 17.0  |
| Colour of Corallum  | Upper theca and septa brown-black  | Upper theca and septa usually reddish-brown  | White   |
| Number (Size) and Shape of Costal Spines                    | 5 elongate (up to 15 mm) spines, circular in cross section   | 6 compressed spines (up to 8 mm), often ridged basally and extending to epicentre; often crooked or curved             | 6 elongate (up to 10 mm) spines, circular in cross section                            |
| Septal Formula (Number of Septa); S <sub>1</sub> Dimorphism | S <sub>1</sub> >S <sub>2</sub> >S <sub>4</sub> ><S <sub>3</sub> (48); 2 principal S <sub>1</sub> smaller than others | S <sub>1</sub> >S <sub>2</sub> >S <sub>4</sub> ≥S <sub>3</sub> >S <sub>5</sub> (48-72); all S <sub>1</sub> equal-sized | S <sub>1.2</sub> >S <sub>3</sub> >S <sub>4</sub> (48); all S <sub>1</sub> equal-sized |
| Relative Palar Width (Number of Palar Crowns)               | P <sub>1</sub> <P <sub>2</sub> <<P <sub>3</sub> (3 crowns)   | P <sub>1.4</sub> equal-sized (3 or 4 crowns)   | P <sub>1.2</sub> <<P <sub>3</sub> (2 crowns)  |
| Distribution; Depth   | Funafuti, Wallis, Vanuatu, Kermadec Islands; 366-710 m   | Banda Sea, Vanuatu region; 240-560 m   | Philippines, Celebes Sea; 326-760 m   |

*Trochocyathus (A.) brevispina* Cairns & Zibrowius, 1997

Figs 9 f-i

*Trochocyathus (A.) brevispina* Cairns & Zibrowius, \*1997: 113, figs 12 d-f.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 959, 2 (MNHN). — Stn 963, 65: 56, including one cemented to a *Xenophora* shell (MNHN), 9 (USNM 98649). — Stn 964, 14 (MNHN). — Stn 999, 1 (USNM 98647). — Stn 1003, 4 (MNHN). — Stn 1004, 12: 8 (MNHN), 4 (USNM 98648). — Stn 1020, 1 (MNHN). — Stn 1058, 2 (MNHN). — Stn 1065, 1 (MNHN).

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

REMARKS. — *Trochocyathus brevispina* is compared to the other two Recent species in the subgenus in Table 5, and was described and illustrated by CAIRNS & ZIBROWIUS (1997). It is easily distinguished from other species by its relative septal and palmar sizes and by its frequent incorporation of substrate into its base. The most commonly incorporated substrates are gastropod and bivalve fragments (Figs 9 f, i), but also include: pteropod shells, sand conglomerate, pebbles, serpulid tubes, and other dead solitary corals.

The specimens reported above allow the observation that the costal spines are often curved or crooked, and can reach a length of up to 8 mm. Although not as long as the 10 mm costal spines of *T. longispina*, the distinction of costal spine length between these two species is not as much as previously thought and hardly warrants the etymological distinction; however, several other characters do distinguish these two species (Table 5).

Specimens from three stations (MUSORSTOM 8 stn 1004, 1058, and 1103) bear elaborate, irregularly-shaped, nodular proliferations at the base of their costal spines and sometimes around the entire calicular edge (Figs 9 g-h). It is unknown what stimulates or irritates the coral to produce these growths.

One aberrant specimen from MUSORSTOM 8 stn 963 of 16.5 mm GCD is septameral in septal and costal symmetry, having 7 septal systems (54 septa, 1 half-system lacking S<sub>4</sub>) and 7 costal spines.

DISTRIBUTION. — Vanuatu region: Anatom, Erromango, Efaté, and Malakula; 110-436 m. Elsewhere: Banda Sea; 240-560 m (CAIRNS & ZIBROWIUS, 1997).

Genus *TETHOCYATHUS* Kühn, 1933

*Tethocyathus virgatus* (Alcock, 1902)

*Trochocyathus* (*Tethocyathus*) *virgatus* Alcock, v\*1902a: 98-99; v.1902c: 16-17, pl. 2, fig. 13.

*Tethocyathus virgatus* - CAIRNS, 1995: 65-66, pl. 16, figs c-f, map 11 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 114-115.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 522, 1 (USNM 98652).

Vanuatu. MUSORSTOM 8: stn 973, 7 (USNM 98650). — Stn 977, 5 (MNHN). — Stn 978, 2 (MNHN). — Stn 982, 2 (MNHN). — Stn 1015, 1 (MNHN). — Stn 1026, 1 (MNHN). — Stn 1095, 1 (MNHN). — Stn 1108, 3 (MNHN).

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

REMARKS. — *Tethocyathus virgatus* is more fully described and illustrated by CAIRNS (1995). One of the differences between this species and the species of the similar genus *Trochocyathus* is that the edge zone of *T. virgatus* periodically secretes additional nontrabecular calcium carbonate on the outside of the corallum, which, in time, produces a very thick theca, transforming a conical corallum into a subcylindrical or cylindrical shape. The layering of the added calcium carbonate is particularly noticeable in a basal fracture, and additional evidence of the periodic layering is evidenced by the covering and incorporation into the theca of small epizoid organisms that become covered and subsequently buried in the increasingly thick theca. According to STOLARSKI (1995), the proper name for this deposit is *textura*, not *epitheca*, the latter term being reserved for nontrabecular calcium carbonate that is secreted only at the calicular edge of a corallum (lappet cavity) and that does not periodically form layers. One of the adaptive values of *textura* (in the basal region) is to strengthen attachment to a substrate; however, it is suggested that another possible adaptive value of *textura* (in the wall region) is to guard against the boring of acrothoracican cirripeds, to which this genus is particularly susceptible (see ZIBROWIUS, 1976; CAIRNS, 1995; CAIRNS & ZIBROWIUS, 1997). Coralla from two stations (MUSORSTOM 8 stns 972 and 982) contain coralla having the characteristic lenticular-shaped outline of acrothoracican cirripede borings in the corallum of living specimens.

DISTRIBUTION. — Wallis and Futuna; 450-650 m. Vanuatu region: Tanna, Efaté, and Espiritu Santo; 320-460 m. Elsewhere: Philippines; Indonesia; ridges north of New Zealand; 137-530 m.

Genus *POLYCYATHUS* Duncan, 1876

*Polycyathus octuplus* sp. nov.

Figs 10 a-c

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 494, 1 holotype (MNHN). — Stn 496, 2 paratypes (MNHN). — Stn 499, 1 paratype (USNM 98654). — Stn 504, 7 paratypes (MNHN), 3 paratypes (USNM 98653). — Stn 509, 3 paratypes (MNHN). — Stn 513, 1 paratype (MNHN). — Stn 516, 1 paratype (MNHN).

Solomon Islands (*Pelau*): short drop off, 90 m, 3 paratypes (USNM 98954).

TYPE LOCALITY. — MUSORSTOM 7 stn 494: 14°18.9'S, 178°03.0'W (Futuna), 100-110 m.

ETYMOLOGY. — The species name *octuplus* (Latin *octuplus*, eight fold) refers to the octameral septal symmetry.

DESCRIPTION. — Corallum solitary, straight, and subcylindrical, firmly attached to substrate through a thick pedicel (PD:GCD = 0.56-0.79). Holotype 6.7 x 6.4 mm in CD, 4.4 mm in PD, and 7.5 mm in height. Calice circular to slightly elliptical: GCD:LCD = 1.02-1.20. Costae well developed and finely granular; however, at an early stage thin bands of epitheca are secreted around the corallum base, and as the coral increases in size the epithecal bands thicken, eventually extending from the base to the calicular edge. Underlying costae and outer edges of septa chocolate brown in colour, but overlying epitheca, basal encrustation, pali and columella are white.

Septa octamerally arranged in 2 or 3 size classes. Small coralla below a GCD of 4.6 mm usually have 8 primary septa and 24 equally-sized secondary and tertiary septa (8:8:16, 32 septa). Larger coralla have up to 5 pairs of quaternary septa (e.g., the holotype, 8:8:16:10, 42 septa) as 3 size classes of septa: primaries, secondaries, and tertiaries + quaternaries, the latter two of equal size. One aberrant specimen (MUSORSTOM 7 stn 504) has heptameral symmetry (7:7:14:6, 34 septa, Fig. 10 c). Primary septa about 1.2 mm exsert, having moderately sinuous distal and axial edges. In small specimens, secondaries and tertiaries of equal exsertness (about 0.9 mm) and width (about 3/4 that of the primaries), also having sinuous distal and axial edges. In larger specimens containing sectors in which quaternaries are present, the secondaries are slightly wider than the remaining tertiaries and quaternaries. Quaternaries equal in size to tertiaries. Small pali (0.3-0.4 mm wide) occur on axial edges of the primary septa, whereas the pali flanking the secondary septa are twice as wide and rise slightly higher in the fossa. Occasionally there is an accessory paliform lobe internal to the P<sub>2</sub>. When quaternary septa occur in a sector, the flanked tertiary septum bears a palus of equal size to the P<sub>2</sub>, but slightly recessed from the columella and also rising slightly higher than the P<sub>2</sub>. All pali are obliquely carinate and highly sinuous, their peripheral edges (edge adjacent to their corresponding septum) being quite contorted. Fossa shallow, containing a discrete columella composed of a field of 10-16 slender, finely granular papillae.

REMARKS. — It is with some hesitation that this species is placed in *Polycyathus*, since it does not display the defining character for the genus, i.e., budding from a common encrusting coenosteum. It may be that all the specimens examined are founder corallites or that they were broken from the substrate above their common attachment. In all other characteristics, this species is characteristic of the genus *Polycyathus*. Five species of this genus are known from the western Pacific: *P. fulvus* Wijsman-Best, 1970; *P. hodgsoni*, *P. marigondoni*, and *P. furanaensis*, all described by VERHEIJ and BEST, 1987; and *P. norfolkensis* Cairns, 1995. *P. octuplus* differs from these and all other known species (BEST *et al.*, in press) in having primarily octameral septal symmetry.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 110-441 m. Elsewhere: Solomon Islands, Pelau; 90 m.

Genus *BOURNEOTROCHUS* Wells, 1984

*Bourneotrochus stellulatus* (Cairns, 1984)

Figs 8 c, 10 d-g

*Trochocyathus hastatus* Bourne, v\*1903: 32-37 (in part: pl. 6, figs 9-11).

*Deltocyathus stellulatus* Cairns, \*1984: 15-16, pl. 3, figs C-D.

*Bourneotrochus veroni* Wells, v\*1984: 213-214, pl. 3, figs 7-18.

*Bourneotrochus stellulatus* - CAIRNS, 1995: 71-72, pl. 18, figs f, i, pl. 19, figs a-c, map 18. — CAIRNS & ZIBROWIUS, 1997: 115.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 509, 4 (MNHN) and SEM stub 879 (USNM 98708). — Stn 510, 3 including 1 anthocaulus (MNHN). — Stn 511, 14 including 3 anthocauli and SEM stubs 880-881 (USNM 98704). — Stn 512, 65 including 1 anthocaulus (MNHN). — Stn 513, 25 including 1 anthocaulus

(USNM 98707). — Stn 514, 13 (USNM 98706). — Stn 516, 5 (USNM 98705). — Stn 556, 2 (MNHN). — Stn 569, 3 (MNHN). — Stn 585, 5 including 3 anthocauli (USNM 98710). — Stn 586, 2 (MNHN). — Stn 591, 1 (MNHN). — Stn 594, 2 (MNHN). — Stn 595, 1 (MNHN). — Stn 604, 13 including 3 anthocauli and SEM stub 878 (USNM 98711). — Stn 605, 8 (USNM 98711). — Stn 608, 5 (USNM 98709). — Stn 610, 14 including 1 anthocaulus (MNHN). — Stn 618, 3 anthocauli (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 963, 2 cemented to *Xenophora* shell (MNHN). — Stn 969, 1 (MNHN). — Stn 1018, 1 cemented to *Xenophora* shell (MNHN). — Stn 1023, 1 cemented to *Xenophora* shell (MNHN). — Stn 1061, 1 (MNHN). — Stn 1087, 2 cemented to *Xenophora* shells (MNHN). — Stn 1097, 11 cemented to *Xenophora* shells (MNHN). — Stn 1106, 10 cemented to *Xenophora* shells (MNHN).

**TYPE LOCALITY.** — HON stn 9-3: 19°48'N, 154°58'W (off Hawaiian Islands), 337 m.

**REMARKS.** — The anthocyathus of *B. stellulatus* was recently redescribed and illustrated by CAIRNS (1995); however, the anthocaulus stage remained unknown. Of the 215 specimens reported above, 15 are the anthocaulus stage, in some cases still attached to an incipient anthocyathus (Fig. 10 e). The anthocaulus is cylindrical to barrel shaped, 1.5-2.9 mm in height and 2.6-3.3 mm in maximum diameter, usually having 36 septa, as in most of anthocyathi. The base is slightly expanded over the substrate and firmly attached to it. It has a white, porcellaneous theca and lacks spines. The small, still-attached anthocyathus also lack costal spines at this stage.

Most anthocyathi examined contained 36 septa, one pair of S<sub>4</sub> in each system. Because the costal spines are associated with the C<sub>1</sub>, they are symmetrically distributed around the perimeter of the corallum (Fig. 10 d). However, about 20% of the examined coralla lack one to three pairs of S<sub>4</sub>, resulting in a total of 30-34 septa and a closer arrangement of the costal spines that border these systems. Some anthocyathi (e.g., MUSORSTOM 7 stn 513, 594, 604) appear to have the ability to asexually bud another anthocyathus from its calice. These "secondary" anthocyathi are small (2.7-3.0 mm in diameter), cylindrical coralla that have a well-developed basal scar, lack spines, often have less than 36 septa, and appear to have a primitive epithelial wall.

Although no anthocyathus was found to have a CD larger than that previously reported (i.e., 6 mm by CAIRNS, 1995), some specimens (e.g., MUSORSTOM 7-510) have elongate costal spines up to 4 mm long, twice the previously reported length.

Among the 21 coral species found cemented to *Xenophora* shells, *B. stellulatus* was most commonly found, 27 coralla recorded from six MUSORSTOM stations (see Material Examined). In all cases the calicular face was directed upward and in some cases the corallum appeared to have been alive when collected.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis, Futuna, and Alofi; Tuscarora, Waterwitch, and Field Banks; 240-566 m. Vanuatu region: Anatom, Efaté, Malakula, and Espiritu Santo; 280-458 m [Pleistocene of Espiritu Santo (Wells, 1984)]. Elsewhere: Queensland; ridges north of New Zealand; Indonesia; Chesterfield Islands; Funafuti and Tuvalu; Cook Islands; Hawaiian Islands; 263-476 m (CAIRNS & ZIBROWIUS, 1997).

### Genus *STEPHANOCYATHUS* Seguenza, 1864

#### Subgenus *STEPHANOCYATHUS* (*STEPHANOCYATHUS*) Seguenza, 1864

#### *Stephanocyathus* (*S.*) *regius* Cairns & Zibrowius, 1997

Figs 10 h, 11 a-c

*Stephanocyathus* (*S.*) *regius* Cairns & Zibrowius, \*1997: 117-118, figs 14a-c.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 564, 68 (MNHN). — Stn 565, 8 (USNM 98659). — Stn 567, 14 (MNHN). — Stn 621, 5 (MNHN). — Stn 623, 2 (MNHN). — Stn 635, 24 (MNHN). — Stn 636, 14 (MNHN). — Stn 637, 14 (USNM 98660).

**Vanuatu.** MUSORSTOM 8: stn 990, 1 (MNHN). — Stn 992, 5 (USNM 98655). — Stn 996, 2 (MNHN). — Stn 1007, 2 (MNHN). — Stn 1036, 11 (MNHN). — Stn 1109, 5 (USNM 98656). — Stn 1110, 1 (MNHN). — Stn 1125, 1 (USNM 98658). — Stn 1127, 1 (MNHN). — Stn 1129, 8, including SEM stub 882 (USNM 98657).

TYPE LOCALITY. — "*Hokuho-Maru*" stn KH72-1-26: 9°27'S, 127°58.6'E (Timor Sea, south of Leti Islands), 610-690 m.

REMARKS. — Little can be added to the original description; however, the microstructure of an actively growing costal edge was examined, which revealed its irregularly-shaped tufts of calcareous fibres. The tufts measured 11-15 µm in diameter, and consisted of elongate fibres about 0.9 µm in diameter (Figs 11 b-c).

DISTRIBUTION. — Wallis and Futuna region: Tuscarora, Combe, and Rotumah Banks; 700-1280 m. Vanuatu region: Erromango, Efaté, and Espiritu Santo; Guyot Bougainville; 775-1550 m. Elsewhere: South China Sea; Philippines; Indonesia; Kermadec Islands; 563-2160 m (CAIRNS & ZIBROWIUS, 1997).

### Subgenus *STEPHANOCYATHUS* (*ODONTOCYATHUS*) Moseley, 1881

#### *Stephanocyathus* (*O.*) *coronatus* (Pourtalès, 1867)

Figs 11 d-f

*Platycyathus coronatus* Pourtalès, v\*1867: 114.

*Odontocyathus coronatus* - MOSELEY, v.1881: 148-151, pl. 2, figs 4a-b, 5a-b.

*Sabinotrochus flatiliseptis* Alcock, v\*1902a: 103; v.1902c: 26, pl. 4, figs 24, 24a (new synonym).

*Stephanocyathus* (*O.*) *coronatus* - CAIRNS, 1979: 109-111, pl. 20, figs 5-6, 8-9 (synonymy); 1995: 69, pl. 17, figs j-l, pl. 18, figs a-b.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 621, 3 (MNHN). — Stn 622, 4 (MNHN). — Stn 623, 7 (USNM 98661).

Vanuatu. MUSORSTOM 8: stn 956, 2 (MNHN). — Stn 1125, 1 (MNHN).

TYPE LOCALITY. — 30°41'N, 77°03'W (Blake Plateau off Florida), 841 m.

REMARKS. — This species was recently redescribed and illustrated based on specimens collected from submarine ridges north of New Zealand (CAIRNS, 1995). The material reported herein contains several ontogenetic suites including coralla as small as 9 mm CD, which allows the synonymy of the juvenile specimen ALCOCK (1902a) reported as *Sabinotrochus flatiliseptis*. The holotype of ALCOCK's species (CD = 11.6 mm) was figured by CAIRNS & ZIBROWIUS (1997: fig. 14i) and a similarly-sized corallum (CD = 9.1 mm) is figured herein (Fig. 11 f).

DISTRIBUTION. — Wallis and Futuna region: Combe Bank; 1280-1300 m. Vanuatu region: Anatom; Guyot Bougainville; 1175-1210 m. Elsewhere: Selayar, Flores Sea (ALCOCK, 1902a); Lord Howe Rise; Three Kings Ridge; Kermadec Ridge; western Atlantic; 543-1276 m (CAIRNS, 1995).

#### *Stephanocyathus* (*O.*) *weberianus* (Alcock, 1902)

*Stephanotrochus weberianus* Alcock, v\*1902a: 101-102; v.1902c: 25, pl. 3, figs 22, 22a.

*Stephanotrochus sibogae* Alcock, v\*1902a: 101-102; v.1902c: 25-26, pl. 3, figs 23, 23a.

*Stephanocyathus* (*O.*) *ixine* Squires, v\*1958: 54 (in part: "*Albatross*" stn 5545, pl. 8, figs 3-4).

*Stephanocyathus* (*O.*) *weberianus* - CAIRNS, 1994: 57-58, pl. 25, figs d-f (synonymy); 1995: 68-69, pl. 17, figs g-i (synonymy). — CAIRNS & ZIBROWIUS, 1997: 119-120, figs 14g-h.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1074, 7 (USNM 98662). — Stn 1080, 3 (MNHN).

TYPE LOCALITY. — "*Siboga*" stn 284: 8°43.1'S, 127°16.7'E (Timor Sea), 828 m.

REMARKS. — The species was redescribed and illustrated by CAIRNS (1994) and compared to *S. (O.) coronatus* by CAIRNS (1994, 1995). It is a relatively common deep-water species found throughout the western Pacific at depths of 700-1500 m.

DISTRIBUTION. — Vanuatu region: Espiritu Santo and Malakula; 798-799 m. Elsewhere: western Pacific from Japan to Lord Howe Seamount Chain; 206-1756 m, although most records are deeper than 700 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *STEPHANOCYATHUS* (*ACINOCYATHUS*) Wells, 1984

*Stephanocyathus* (*A.*) *spiniger* (Marenzeller, 1888)

*Stephanotrochus spiniger* Marenzeller, \*1888b: 20-21.

*Odontocyathus spiniger* - YABE & EGUCHI, 1942: 124-125, pl. 10, figs 26-28 (synonymy).

*Stephanocyathus* (*O.*) *spiniger* - WELLS, v.1984: 209, pl. 2, figs 10-13. — CAIRNS & PARKER, 1992: 26-27, pl. 7, figs g-i (synonymy). — CAIRNS, 1994: 57, pl. 25, figs a-c (synonymy); 1995: 67-68, pl. 17, figs d-f, pl. 18, fig. c (synonymy); 1998: 381. — CAIRNS & ZIBROWIUS, 1997: 118-119, figs 13f, 14d.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 585, 1 (MNHN). — Stn 604, 1 (MNHN). — Stn 606, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 963, 8 (MNHN). — Stn 1003, 1 (MNHN). — Stn 1004, 2 (USNM 98664). — Stn 1058, 1 (MNHN). — Stn 1087, 1 (USNM 98665). — Stn 1092, 1 (USNM 98663).

TYPE LOCALITY. — Sagami Bay, Honshu, Japan (depth not given).

REMARKS. — This commonly collected, distinctive species, characterised by having six elongate costal spines (C<sub>1</sub>) and highly exsert S<sub>1</sub>, has been described and figured several times in the recent past (see synonymy). It is compared to *S. explanans*, the only other Recent species in this subgenus, by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Wallis; 420 m. Vanuatu region: Anatom, Erromango, Malakula, and Espiritu Santo; 319-400 m. Pleistocene of Vanuatu (WELLS, 1984). Elsewhere: widespread throughout Indo-West Pacific from southwestern Indian Ocean to Japan and South Australia; 120-695 m (CAIRNS & ZIBROWIUS, 1997). Neogene of Japan (YABE & EGUCHI, 1932b); Oligocene of Victoria, Australia (DENNANT, 1899; see YABE & EGUCHI, 1942).

Genus *VAUGHANELLA* Gravier, 1915

*Vaughanella concinna* Gravier, 1915

Figs 11 g-h

*Vaughanella concinna* Gravier, v\*1915: 10. — ZIBROWIUS, v.1980: 104-105, pl. 52, figs A-K, pl. 53, figs A-L (synonymy).

*Vaughanella oreophila* - CAIRNS, 1995: 70, pl. 18, figs d-e (Not *V. oreophila* Keller, \*1981).

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 572, 1 (MNHN).

TYPE LOCALITY. — 38°35'30"N, 28°05'45"W (Azores), 1250 m.

REMARKS. — One specimen is reported, measuring 30.4 x 27.9 mm in CD, 30.3 mm in height, 12.3 mm in pedicel diameter, and having 62 septa (7 pairs of S<sub>5</sub>). It is indistinguishable from coralla reported from the eastern Atlantic (e.g., *Jean Charcot* 134, USNM 48765) by ZIBROWIUS (1980). A re-evaluation of the specimens I (CAIRNS, 1995) previously reported from north of New Zealand as *V. oreophila* Keller, 1981 also appear to be typical *V. concinna*. KELLER's (1981) type material of *V. oreophila* is not included as *V. concinna* because she stated that her specimens did not have P<sub>3</sub>, which are prominent in all coralla of *V. concinna*.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 500-560 m. Elsewhere: Norfolk and Colville Ridges; 646-757 m (CAIRNS, 1995); eastern Atlantic between Celtic Sea, the Azores, and Madeira; 1022-3018 m (ZIBROWIUS, 1980).

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

*Deltocyathus magnificus* Moseley, 1876

Fig. 11 i

*Deltocyathus magnificus* Moseley, v\*1876: 552-553; v.1881: 147-148, pl. 4, figs 1-2. — CAIRNS & PARKER, 1992: 27-28, pl. 7, figs j-l, pl. 8, fig. a. — CAIRNS, 1994: 56, pl. 24, figs d-e, g-h (synonymy); 1998: 381-382, fig. 4a. — GUERRIERO *et al.*, 1996: 986. — CAIRNS & ZIBROWIUS, 1997: 126-127.

MATERIAL EXAMINED. — **Vanuatu.** MUSORSTOM 8: stn 963, 12: 8 (MNHN), 4 (USNM 98666). — Stn 964, 1 (MNHN). — Stn 980, 1 (MNHN).

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

REMARKS. — *Deltocyathus magnificus* is one of four species in the genus to have 5 cycles of septa in its adult state, the others being *D. rotulus* (Alcock, 1898), *D. suluensis* Alcock, 1902, and *D. sarsi* (Gardiner & Waugh, 1939), the last thought to reproduce primarily by fragmentation. *D. magnificus* is the largest of the four species and was redescribed and illustrated by CAIRNS (1995) and CAIRNS & PARKER (1992), and is distinguished from other western Pacific species in a key published by CAIRNS & ZIBROWIUS (1997). The Vanuatu specimens differ from others previously reported in having only 72 septa, pairs of S<sub>5</sub> lacking from each half-system adjacent to an S<sub>2</sub>. Perhaps because of this deficiency, some of these specimens have a hexamerous outline (Fig. 11 i). Normally a corallum of 8 mm CD would have a full complement of 96 septa, but Vanuatu coralla as large as 25 mm CD have only 72 septa. All other characters being similar, the septal number and shape differences are considered to be only population differences.

DISTRIBUTION. — Vanuatu region: Anatom and Tanna; 408-433 m. Elsewhere: western Pacific from Japan to southeastern Australia; Western Australia; 88-1500 m (CAIRNS & ZIBROWIUS, 1997).

*Deltocyathus rotulus* (Alcock, 1898)

*Trochocyathus rotulus* Alcock, \*1898: 16, pl. 2, figs 1, 1a.

*Deltocyathus fragilis* Alcock, v\*1902a: 99-100; v.1902c: 21, pl. 2, figs 15, 15a.

*Deltocyathus rotulus* - CAIRNS, 1994: 55-56, pl. 24, figs j-k. — CAIRNS & ZIBROWIUS, 1997: 125-126, figs 16 a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 621, 3 (MNHN). — Stn 622, 3 (MNHN). — Stn 623, 2 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 1125, 5 (USNM 98667). — Stn 1127, 1 (MNHN). — Stn 1129, 11 (USNM 98668).

TYPE LOCALITY. — "Investigator" stn 216: North Maldivé Atoll, 1408-1756 m.

REMARKS. — Medium- to large-sized specimens of *Deltocyathus rotulus* are easily distinguished as having 5 cycles of septa; a serrate (lancetted) calicular margin, each S<sub>4</sub> and adjacent pair of S<sub>5</sub> projecting beyond the S<sub>1-3</sub>; a large, undercut papillose columella; and a prominent crown of large P<sub>4</sub>. Smaller specimens (i.e., CD < 12 mm) may be confused with juveniles of *D. suluensis*, both species having between 48-72 septa at this size. Juvenile *D. rotulus* differ from *D. suluensis* by having S<sub>4</sub> solidly attached to the S<sub>3</sub>, not just attached by trabecular processes, as in *D. suluensis*; and in having a lancetted calicular margin. It also appears to be adapted to a deeper

(i.e., cooler) environment, most commonly found between 1000- 2000 m. *D. rotulus* is more fully described and illustrated by CAIRNS (1994), and included in a key to congeners by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Field Bank; 1280-1300 m. Vanuatu region: Guyot Bougainville; 1050-1160 m. Elsewhere: Indo-West Pacific from Durban, South Africa to Japan; 210-1986 m (CAIRNS & ZIBROWIUS, 1997).

*Deltocyathus suluensis* Alcock, 1902

*Deltocyathus magnificus* var. *suluensis* Alcock, v\*1902c: 20-21.

*Deltocyathus formosus* Cairns, \*1995: 73-74, pl. 19, figs f-g.

*Deltocyathus suluensis* - CAIRNS & ZIBROWIUS, 1997: 125, fig. 16d. — CAIRNS, 1998: 382.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 522, 1 (MNHN). — Stn 529, 2 (USNM 98672). — Stn 530, 4 (MNHN). — Stn 532, 3 (MNHN). — Stn 534, 17 (USNM 98674). — Stn 535, 14 (USNM 98671). — Stn 540, 74 (MNHN). — Stn 541, 3 (MNHN). — Stn 546, 1 (MNHN). — Stn 557, 1 (MNHN). — Stn 575, 1 (MNHN). — Stn 578, 1 (MNHN). — Stn 590, 6 (MNHN). — Stn 594, 2 (MNHN). — Stn 595, 3 (USNM 98673). — Stn 631, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 975, 7 (USNM 98669). — Stn 1028, 3 (USNM 98670).

TYPE LOCALITY. — "Siboga" stns 95 and 100: Sulu Archipelago, 450-522 m.

REMARKS. — *Deltocyathus suluensis* is characterised by having a relatively thin, flat, costate, coarsely granular base; a finely serrate (not lancetted) calicular edge, the lower cycle septa (e.g., S<sub>1-3</sub>) projecting beyond the higher cycle septa (e.g., S<sub>4-5</sub>); 5 cycles of septa (96) above a CD of 18 mm; and rudimentary S<sub>5</sub>, joined to adjacent S<sub>4</sub> close to the columella by several slender processes. The largest known specimen (MUSORSTOM 7 stn 540) is 22.3 mm in CD. The species is described in greater detail by CAIRNS (1995) as *D. formosus*, and included in a key to western Pacific *Deltocyathus* species by CAIRNS & ZIBROWIUS (1997), who also figured one of the syntypes. It is one of four species in the genus that has 5 cycles of septa in the adult stage, three of which are reported herein.

DISTRIBUTION. — Wallis and Futuna region: Wallis, Waterwitch, Combe, Tuscarora, Field, and Bayonnaise Banks; 400-650 m. Vanuatu region: Tanna and Efate; 566-624 m. Elsewhere: western Australia; Philippines to ridges north of New Zealand; 142-565 m (CAIRNS & ZIBROWIUS, 1997).

*Deltocyathus taiwanicus* Hu, 1987

Figs 12 a-b

*Deltocyathus taiwanicus* Hu, \*1987: 39, pl. 1, figs 1, 4-5, 10.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 522, 11 (MNHN). — Stn 523, 1 (MNHN). — Stn 525, 1 (MNHN). — Stn 529, 12 (USNM 98680). — Stn 535, 1 (MNHN). — Stn 537, 1 (MNHN). — Stn 540, 5 (MNHN). — Stn 541, 2 (MNHN). — Stn 542, 6 (USNM 98679). — Stn 546, 4 (MNHN). — Stn 555, 5 (MNHN). — Stn 556, 10 (MNHN). — Stn 557, 1 (MNHN). — Stn 560, 1 (MNHN). — Stn 585, 1 (MNHN). — Stn 589, 4 (USNM 98678). — Stn 590, 9 (USNM 98675). — Stn 591, 22 (MNHN). — Stn 594, 19 (USNM 98677). — Stn 597, 9 (USNM 98676).

TYPE LOCALITY. — Maanshan Mudstone (Plio-Pleistocene), Tantz Village, Nanwan Bay, Hengchun Peninsula, southern Taiwan.

DESCRIPTION OF RECENT SPECIMENS. — Corallum shaped as a shallow bowl, sometimes with a flat base, but always with upturned outer edges. Centre of base sometimes bears a concave scar or, just as often, is slightly protuberant. Calice circular, but often slightly irregularly formed; margin not lancetted or serrate. Largest specimen reported above (MUSORSTOM 7 stn 541) 15.6 mm in CD; however the fossil holotype is 19.1 mm in CD. Costae equal in width and rounded, each bearing coarse (0.2 mm in diameter), unilinearly arranged granulations near



the centre of base, which rather abruptly grade into very fine (0.05 mm in diameter) granulations arranged 4-7 across a costa nearer the calicular edge. Intercostal furrows deeply incised only near calicular edge. Well-preserved coralla have a light reddish-brown base.

Septa hexamerally arranged in 4 complete cycles and a portion of the fifth:  $S_{1-2} > S_3 > S_4 > S_5$ . Between a CD of about 6.5-7.0 mm, pairs of  $S_5$  begin to appear, up to an observed maximum of 13 pairs, or a total of 74 septa, e.g., in a specimen 12.4 mm in CD (MUSORSTOM 7 stn 546) as well as the holotype. A specimen of CD 13.2 mm (MUSORSTOM 7 stn 556) has 5 pairs of  $S_5$  (58 septa) and the largest specimen (CD = 15.6 mm) 11 pairs (70 septa), thus the correlation between CD and number of septa is not always direct. There also appears to be no order in which the  $S_5$  pairs are inserted, some half-systems in the same corallum having 2 pairs, 1 pair, or no  $S_5$ .  $S_{1-2}$  about 1.2 mm exsert, extending about half distance to columella, where each is separated from its broad palus (up to 1.7 mm wide) by a deep notch; however, the 2  $P_1$  associated with the principal septa are noticeably smaller, only about 0.9 mm wide.  $S_3$  about 0.7 mm exsert and half the width of the  $S_{1-2}$ , each bordered by a  $P_3$  about 1.4 mm wide that is slightly recessed from the columella, its axial edge strongly fused to its adjacent  $P_2$ .  $S_4$  dimorphic in size. If unflanked by  $S_5$ ,  $S_4$  are rudimentary, well developed only at the calicular edge and represented by discontinuous spines within the theca, joining to their adjacent  $S_3$  by 4 or 5 thin (0.15 mm in diameter) processes well below the  $S_3$ - $P_3$  notch (Fig. 12 b). However, if  $S_4$  are flanked by a pair of  $S_5$ , they are  $2/3$  the width of an  $S_3$  and bear pali ( $P_4$ ) of equal size to the  $P_3$ , the axial edges of which are strongly fused to the  $P_3$  and recessed slightly more from the columella than the  $P_3$ . In this case the  $S_5$  resemble the unflanked  $S_4$  as described above. All septal and palar faces are covered with spinose granulations. Fossa shallow, containing a papillose columella consisting of 10-22 granular elements, each about 0.3 mm in diameter. Columellar elements arranged in an elongate ellipse, the greater axis aligned with the 2 principal septa (by definition), which confers a bilateral symmetry to the corallum.

REMARKS. — *Deltocyathus taiwanicus* is very similar to *D. suluensis*, equal-sized coralla of both species having a similar septal insertion pattern and number of septa, and both species being found at many of the same stations. *D. taiwanicus*, however, seems to have a smaller corallum, a specimen of *D. taiwanicus* having a thick, upturned calicular edge at the same CD that a *D. suluensis* would have a thin, flat, serrate edge, characteristic of a juvenile corallum. *D. suluensis* ultimately achieves a full fifth cycle (96 septa) and a CD of 22.3 mm, whereas the largest *D. taiwanicus* is 19.1 mm (holotype) and yet no specimen is known to have over 74 septa. Furthermore, the costae of *D. taiwanicus* are finely granular at the calicular edge, whereas they are coarsely granular on *D. suluensis*. Also, the columellar elements of *D. taiwanicus* appear to be coarser and more independent than those in *D. suluensis*.

Although the three specimen type series was not examined (deposited at the Taiwan Normal University, Taipei), HU's description and figures were considered adequate to identify the species.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, Tuscarora, and Field Banks; 320-697 m. Elsewhere: Plio-Pleistocene of southern Taiwan (HU, 1987).

#### *Deltocyathus vaughani* Yabe & Eguchi, 1932

*Deltocyathus vaughani* Yabe & Eguchi, \*1932a: 388-389. — CAIRNS, 1994: 54-55, pl. 23, figs i-j, pl. 24, figs a-c, f (synonymy). — CAIRNS & ZIBROWIUS, 1997: 122.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1006, 1 (MNHN). — Stn 1011, 1 (MNHN).

TYPE LOCALITY. — Bosyu (= Awa), Japan (depth not given).

REMARKS. — The species is distinguished from others in the region by having four cycles of septa, pali or paliform lobes before all septa, coarsely dentate costae, and equally exsert septa. The species can attain a CD of 27 mm and often has a patellate corallum, the basal angle ranging from 130° to 170°. It is fully described and illustrated by CAIRNS (1994), and included in a key to western Pacific *Deltocyathus* in CAIRNS & ZIBROWIUS

(1997). Although coarsely dentate costae are diagnostic for the species, it is interesting to note that the specimen from MUSORSTOM 8 stn 1006 (CD = 20.4 mm) has finely granular costae.

DISTRIBUTION. — Vanuatu region: Erromango and Efata; 585-919 m. Elsewhere: western Pacific from Japan through Indonesia; 88-1097 m (CAIRNS & ZIBROWIUS, 1997).

*Deltocyathus crassiseptum* sp. nov.

Figs 12 c-f

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 511, 2 paratypes (MNHN). — Stn 523, 6 paratypes (MNHN). — Stn 529, 13 paratypes (USNM 98683). — Stn 537, 38 paratypes (MNHN). — Stn 570, 3 paratypes (MNHN). — Stn 585, 8 paratypes (USNM 98684). — Stn 586, 1 paratype (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 604, 5 paratypes (MNHN). — Stn 608, 2 paratypes (MNHN). — Stn 618, 1 paratype (MNHN).

Vanuatu. MUSORSTOM 8: stn 958, 9 paratypes (USNM 98682). — Stn 959, 14 paratypes (MNHN). — Stn 977, 2 paratypes (USNM 98681). — Stn 978, 3 paratypes (MNHN). — Stn 980, holotype (MNHN). — Stn 983, 5 paratypes (USNM 98686). — Stn 1061, 2 paratypes (MNHN). — Stn 1068, 2 paratypes (USNM 98685).

TYPE LOCALITY. — MUSORSTOM 8 stn 980: 19°21'S, 169°25'E (Tanna), 433-450 m.

ETYMOLOGY. — The species name *crassiseptum* (Latin *crassus*, thick + *septum*, partition) refers to the thick S<sub>1-2</sub>. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum shaped as a small, shallow bowl, with a flat to slightly convex base and upturned calicular edge. Largest specimen (holotype) 14.1 mm in CD and 5.8 mm in height. Calice circular; theca relatively thick. Costae rounded and finely granular, the granules changing to slender spines near calicular edge. Costae separated by deep intercostal grooves at calicular edge, near point of upward thecal inflection. In most coralla, each intercostal groove is bisected by a low, narrow (0.1 mm wide) row of granules (Fig. 12 f). Most coralla bear evidence of a former scar of detachment located at or near the centre of base. This scar may be pear-shaped in outline, circular, or an irregularly-shaped depression. Circular-shaped scars may also occur in various diameters, those of 0.8 mm diameter usually showing the traces of 6 larger and 6 smaller septa; larger scars of 1.3 mm diameter or more showing 24 septa. In some cases there are 2 concentric scars, with different numbers of septa. Most coralla are uniformly white, but some well-preserved coralla (e.g., the holotype) have a light reddish-brown colour to the calicular edge.

Septa hexamerally arranged in 4 complete cycles (S<sub>1</sub>>S<sub>2</sub>>S<sub>3</sub>>S<sub>4</sub>), for a total of 48 septa; however, the holotype is missing one half-system, resulting in 11 major septa and a total of only 44 septa. S<sub>1</sub> about 2 mm exsert, extend about half way to the columella, having straight, vertical to slightly concave axial edges. S<sub>1</sub> can be remarkably thick, up to 1.0 mm at the calicular edge. S<sub>2</sub> only slightly smaller than S<sub>1</sub> and equally thick. S<sub>3</sub> about half as exsert and wide as S<sub>1-2</sub>, and of normal thickness (i.e., 0.4 mm). S<sub>4</sub> rudimentary in small coralla, but up to 3/4 exsertness and width of an S<sub>3</sub> in larger coralla. Lower axial edges fuse to adjacent S<sub>4</sub> low in fossa adjacent to columella through 3 or 4 slender processes. P<sub>1-3</sub> all about 1 mm wide, the 6 P<sub>1</sub> being the only independent pali, forming a crown low in the fossa encircling the columella. The 6 P<sub>2</sub> rise slightly higher in the fossa, and the 12 P<sub>3</sub> higher still and are recessed from the columella, the axial edges of each pair of P<sub>3</sub> fusing to its adjacent P<sub>2</sub> in the typical deltoyathid chevron arrangement. Fossa moderately deep, containing a papillose columella composed of many fine interconnected elements.

REMARKS. — Among the approximately 24 Recent *Deltocyathus* species, *D. crassiseptum* can most easily be distinguished by its unusually thick S<sub>1-2</sub>. Other consistent characters include its relatively small size, basal scar, deep peripheral intercostal grooves, and the small rows of granules that bisect each intercostal groove. It also appears to be restricted to a rather narrow bathymetric (i.e., temperature) range.

One corallum from MUSORSTOM 7 stn 585 showed evidence of a petrarcid ascothoracidan gall beneath its columella, a symbiosis previously reported in this genus by ZIBROWIUS & GRYGIER (1985), GRYGIER (1991), and GRYGIER & NOJIMA (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch and Field Banks; 420-510 m. Vanuatu region: Anatom, Tanna, and Malakula; 413-536 m.

*Deltocyathus cameratus* sp. nov.

Figs 12 g-i, 13 a

MATERIAL EXAMINED/TYPES. — Wallis and Futuna region. MUSORSTOM 7: stn 520, 2 paratypes (MNHN). — Stn 530, 1 paratype (MNHN). — Stn 537, 1 paratype (MNHN). — Stn 541, 1 paratype (MNHN). — Stn 542, 4 paratypes (USNM 98688). — Stn 546, 1 paratype (MNHN). — Stn 552, 1 paratype (USNM 98690). — Stn 555, 1 paratype (MNHN). — Stn 557, 3 paratypes (USNM 98691). — Stn 560, 1 paratype (USNM 98687). — Stn 567, 1 paratype (MNHN). — Stn 569, 1 paratype (USNM 98689). — Stn 578, 2 paratypes (MNHN). — Stn 589, 2 paratypes (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 635, 18 paratypes (MNHN). — Stn 636, 3 paratypes (MNHN).

Vanuatu. MUSORSTOM 8: stn 956, 4 paratypes (USNM 98693). — Stn 992, 1 paratype (USNM 98692). — Stn 1007, holotype (MNHN). — Stn 1036, 4 paratypes (MNHN). — Stn 1061, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1007: 18°52'S, 168°52'E (Erromango), 720-830 m.

ETYMOLOGY. — The species name *cameratus* (Latin *camerata*, chambered) refers to the 24 elliptical chambers formed by the robust S<sub>4</sub>-P<sub>3</sub> and P<sub>2</sub>-P<sub>3</sub> fusions.

DESCRIPTION. — Corallum shaped as a shallow bowl, with a flat or slightly convex base. Holotype 13.7 mm in CD and 5.2 mm in height; largest specimen (MUSORSTOM 7 stn 557) 15.2 mm in CD. Calice circular but with a jagged margin, the 12 CS<sub>3</sub> and adjacent pairs of CS<sub>4</sub> projecting outward as short (about 0.9 mm) triangular to rectangular lancets. Costae inconspicuous except at calicular edge, where they are separated by intercostal grooves. Costae on base covered with a low granulation, changing to slender spines at calicular edge; no attachment scar. Most coralla uniformly white, but some (e.g., the holotype) are a light reddish-brown in the paler region.

Septa hexamerally arranged in 4 complete cycles (S<sub>1</sub>>S<sub>2</sub>>S<sub>4</sub>>S<sub>3</sub>). In a large well-preserved corallum, S<sub>1</sub> are about 1.6 mm exsert, extending about half distance to columella; S<sub>2</sub> similar in shape and exsertness but only slightly less wide. S<sub>3</sub> about 1.3 mm exsert and half the width of an S<sub>1</sub>. S<sub>4</sub>, although less exsert than the S<sub>3</sub> (about 1.0 mm), are slightly wider than the S<sub>3</sub>, the axial edges of each S<sub>4</sub> pair solidly fused as a thick lamella to the outer edge of the adjacent P<sub>3</sub>. This fusion reaches as high as the S<sub>3</sub>-P<sub>3</sub> notch and is thick and solid except near the columella, where it is perforated with several small pores. All septa uniformly thin and have straight axial edges. Pali (P<sub>1-3</sub>) uniform in width (about 1.2 mm) and separated from their corresponding septa by wide notches (about 0.8 mm). Axial edges of P<sub>1</sub> and P<sub>2</sub> solidly fused to the columella, although P<sub>2</sub> rise slightly higher in the fossa. Axial edges of each pair of P<sub>3</sub> solidly fused to their adjacent P<sub>2</sub>, this fusion being imperforate and reaching as high as the S<sub>3</sub>-P<sub>3</sub> notch. The fossa is shallow to nonextant, containing a well-developed papillose columella consisting of 10-15 robust (0.3-0.6 mm in diameter), granular rods, in some coralla ornately sculptured (Fig. 13 a).

REMARKS. — The well-developed lamellar fusions of the S<sub>4</sub> to P<sub>3</sub> and P<sub>3</sub> to P<sub>2</sub> serve to differentiate this species from all others, as well as subdivide the corallum into 24 elliptical compartments, or chambers. In each system there are 2 small chambers formed by each pair of S<sub>4</sub>, bisected by the S<sub>3</sub>; 1 slightly larger compartment formed between each S<sub>3</sub>, bisected by the S<sub>2</sub>; and an elongate compartment between each system, bisected by an S<sub>1</sub>. This compartmentalization is better seen in a worn specimen in which the bisecting septa are reduced or missing (Fig. 12 i). At least two other species, *D. pourtalesi* Cairns, 1979 and *D. italicus* (Michelotti, 1838), both Atlantic species, have similarly high S<sub>4</sub>-P<sub>3</sub>/P<sub>3</sub>-P<sub>2</sub> fusions, joining at or above the notch that separates septum from palus, but in neither case are these fusions as robust, and in both cases there are many other differences among the 3 species.

On corallum from MUSORSTOM 7 stn 557 showed evidence of a petraroid ascothoracidan gall beneath its columella.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, Tuscarora, Field, and Rotumah Banks; 305-1010 m. Vanuatu region: Erromango and Malakula; 512-1175 m.

*Deltocyathus stella* Cairns & Zibrowius, 1997

Figs 13 b-c

*Deltocyathus stella* Cairns & Zibrowius, \*1997: 123-124, figs 15 f-h.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 509, 6 (USNM 98695). — Stn 510, 1 (MNHN). — Stn 511, 1 (MNHN). — Stn 512, 41 (MNHN). — Stn 513, 22 (MNHN). — Stn 514, 4 (MNHN). — Stn 516, 5 (MNHN). — Stn 523, 11 (USNM 98694). — Stn 537, 1 (MNHN). — Stn 541, 1 (MNHN). — Stn 556, 4 (MNHN). — Stn 569, 6 (USNM 98696). — Stn 585, 1 (USNM 98697). — Stn 594, 1 (MNHN). — Stn 605, 16 (USNM 98698). — Stn 610, 6 (MNHN). — Stn 626, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 967, 3 (USNM 98700). — Stn 969, 4 (MNHN). — Stn 1097, 1 cemented to *Xenophora* shell (MNHN). — Stn 1106, 1 (MNHN).

**TYPE LOCALITY.** — KARUBAR stn 35: 5°46'45"S, 132°11'10"E (Kai Islands, Banda Sea), 156-305 m.

Table 6. — Comparison of the spined species of *Deltocyathus*.

|  | <i>D. stella</i> Cairns & Zibrowius, 1997  | <i>D. heteroclitus</i> Wells, 1984  | <i>D. ornatus</i> Gardiner, 1899  | <i>D. corrugatus</i> sp. nov.  | <i>D. calcar</i> Pourtalès, 1874   |
|--|--|---|---|--|--|
| Calicular Margin   | Lancetted  | Polygonal, asymmetric hexagonal   | Circular  | Prominently lancetted  | Serrate  |
| Maximum Calicular Diameter, Exclusive of Spines (mm)         | 12.3   | 5.4   | 10.4  | 12.0   | 14.8   |
| Costal Spines: Number; Length; Shape                         | 12 C <sub>3</sub> ; short (1.2 mm); stubby, thick  | 6-8 C <sub>3</sub> ; short (1.5 mm); wide-based, circular in cross section, attenuate | 12 C <sub>3</sub> ; short (1.6 mm); slender, circular in cross section, flattened | 12 C <sub>3</sub> ; long (3.5 mm); slender, circular in cross section            | 6 C <sub>1</sub> ; long (4.0 mm); slender, attenuate, circular in cross section      |
| Corallum Shape   | Shallow bowl   | Shallow bowl  | Discoidal (flat base)   | Discoidal (flat base)  | Patellate  |
| Costae: Relative Width; Granules/Costal Width                | C <sub>3</sub> >C <sub>1-2</sub> , 4; 2 granules/costa                                       | All costae equal; 1 granule/costa   | C <sub>3</sub> >C <sub>1-2</sub> , 4; several granules/costa                      | C <sub>3</sub> >C <sub>1-2</sub> , 4 (C <sub>3</sub> prominent); 1 granule/costa | C <sub>3</sub> >C <sub>1-2</sub> , 4 (C <sub>3</sub> prominent); 2-3 granules/costa; |
| Number of Septa  | 48   | 40  | 48  | 48   | 48   |
| Height and Nature of S <sub>4</sub> -P <sub>3</sub> Junction | Just below S <sub>3</sub> -P <sub>3</sub> notch, 4-5 slender processes                       | At S <sub>3</sub> -P <sub>3</sub> notch, slender processes                            | Slightly below S <sub>3</sub> -P <sub>3</sub> notch, thick processes              | At S <sub>3</sub> -P <sub>3</sub> notch, slender processes                       | Just below S <sub>3</sub> -P <sub>3</sub> notch, 5-6 slender processes               |
| Pali: Relative Width; P <sub>1</sub> Size Dimorphism         | P <sub>3</sub> >P <sub>1-2</sub> (axial edges sinuous and dentate); P <sub>1</sub> dimorphic | P <sub>3</sub> >P <sub>1-2</sub> ; not dimorphic                                      | All palar cycles equal sized, but P <sub>1</sub> dimorphic                        | All palar cycles equal sized, but P <sub>1</sub> dimorphic                       | P <sub>3</sub> >P <sub>1-2</sub> ; not dimorphic                                     |
| Distribution; Depth  | Philippines, Indonesia, Wallis and Futuna, Vanuatu; 206-597 m                                | Futuna, Vanuatu; 208-335 m  | Wallis and Futuna, Vanuatu, Loyalty Islands; 73-360 m                             | Norfolk Ridge, Lord Howe Rise; 280-390 m   | W. Atlantic; 81-675 m  |

REMARKS. — Little can be added to the original description of this recently described species except to note that in well-preserved coralla the distal and axial edges of the P<sub>3</sub>, and occasionally the P<sub>1</sub> and P<sub>2</sub>, are dentate. *Deltocyathus stella* is most easily distinguished from other spined *Deltocyathus* (Table 6), by having short, thick, stubby costal spines, and large, sinuous, dentate P<sub>3</sub>.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe, Tuscarora, Waterwitch, Bayonnaise, and Field Banks; 240-597 m. Vanuatu region: Anatom and Espiritu Santo; 280-305 m. Elsewhere: Philippines and Indonesia; 206-280 m (CAIRNS & ZIBROWIUS, 1997).

*Deltocyathus heteroclitus* Wells, 1984

Figs 13 d-g, Fig. A

*Deltocyathus heteroclitus* Wells, v\*1984: 210, figs 3, 1-6. — CAIRNS & ZIBROWIUS, 1997: 124 (mentioned).

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 514, 16: 12 (MNHN), 4 (USNM 98701).

Vanuatu. MUSORSTOM 8: stn 1106, 2 cemented to *Xenophora* shells (MNHN).

TYPE LOCALITY. — USGS stn 24918: Navaka River, Espiritu Santo, Vanuatu (Late Pleistocene).

DESCRIPTION. — Corallum shaped as a shallow bowl, the largest known specimen (MUSORSTOM 7 stn 514) 5.4 mm in CD (exclusive of costal spines). Costae coarsely granular and not well defined. Six to eight robust costal spines (C<sub>3</sub>) project up to 1.5 mm from the calicular edge, spines forming only in half-systems in which the CS<sub>3</sub> is flanked by a pair of CS<sub>4</sub> (see Remarks). Costal spines thick at base, circular in cross section, attenuate at the tip, and coarsely granular. Corallum primarily white, but with a circular band of light red-brown pigmentation in palar region.

Septa hexamerally arranged in 4 cycles, but usually only 1 pair of S<sub>4</sub> occurs in each system, resulting in 36 septa (Fig. A, but see Remarks). S<sub>1</sub> only independent septa, each bordered axially by a slender (0.4 mm wide) palus. S<sub>2</sub> about 2/3 width of the S<sub>1</sub>, each bearing a similarly sized palus, but rising higher in the fossa. S<sub>3</sub> dimorphic in size: S<sub>3</sub> unflanked by S<sub>4</sub> about 3/4 width of the S<sub>2</sub>, their axial edges fused to the adjacent P<sub>2</sub>, and often bear a small paliform lobe. S<sub>3</sub> flanked by S<sub>4</sub> are the smallest of septa, seeming to rest on the centre of the costal spine, each having a dentate upper edge and bordered by a prominent palus. P<sub>3</sub> wide (0.6 mm), sinuous, highly granular, and are the tallest and most recessed pali from the fossa. S<sub>4</sub> slightly wider than flanked S<sub>3</sub>, have a dentate distal margin, a peripheral margin that borders the costal spine, and an axial margin that fuses to the adjacent P<sub>3</sub> at the level of the S<sub>3</sub>-P<sub>3</sub> notch. Fossa shallow, containing a papillose columella composed of 5-9 well-formed (0.25 mm in diameter), finely granular elements.

REMARKS. — I (CAIRNS, 1995: 72) questionably considered *D. heteroclitus* to be a junior synonym of *D. ornatus* Gardiner, 1899; however, this decision was based on a misconception of the latter species and the knowledge of only the small type series of the former. The additional MUSORSTOM specimens and subsequent examination of the type of *D. ornatus* show the two species to be distinct, as compared in Table 6. This is considered to be the first report of *D. heteroclitus* subsequent to its original description and the first record from the Recent, the types having been collected from the Late Pleistocene.

The pattern of costal spine insertion (as well as S<sub>4</sub> pair insertion) in *D. heteroclitus* is identical to that of *Anthemiphyllia spinifera* (Fig. A), the first 6 spines occurring in the "anterior" half-system of each system (i.e., half-systems I, III, V, VIII, X, and XII), which produces the "roughly hexagonal" calicular perimeter noted by WELLS (1984). The majority of specimens (the holotype, 4 paratypes, and 12 of the MUSORSTOM specimens) have this complement, i.e., 6 costal spines and 36 septa. One paratype and 4 MUSORSTOM specimens have 7 costal spines and 38 septa, the additional costal spine occurring in half-system VI in two specimens, half-system VII in one specimen, and half-system IX in two specimens. Two MUSORSTOM specimens have 8 costal spines and 40 septa, one corallum being poorly preserved, the other with the additional costal spines in half-systems VI and VII (Fig. 13 g).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 349-355 m. Vanuatu region: Espiritu Santo; 208-210 m and Late Pleistocene of Espiritu Santo (WELLS, 1984).

*Deltocyathus ornatus* Gardiner, 1899

Figs 13 h-i

*Deltocyathus ornatus* Gardiner, v\*1899a: 163-164, pl. 20, figs 25a-b.

Not *Deltocyathus ornatus* - Cairns, 1995: 72-73, pl. 19, figs d-e (= *D. corrugatus* n. sp., described below in Remarks).

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 569, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 964, 2 (USNM 98703). — Stn 967, 1 (MNHN). — Stn 1017, 1 (MNHN). — Stn 1018, 1 (USNM 98702). — Stn 1094, 2 (MNHN).

TYPE LOCALITY. — Sandal Bay, Lifu, Loyalty Islands, 73 m.

REMARKS. — *Deltocyathus ornatus* is compared to the other spined *Deltocyathus* in Table 6. It can be characterised as having a circular calice, 12 relatively short costal spines (C<sub>3</sub>), dimorphic P<sub>1</sub>, and an S<sub>4</sub>-P<sub>3</sub> junction slightly below the S<sub>3</sub>-P<sub>3</sub> notch. Before I examined the holotype of *D. ornatus* (deposited at the University Museum of Zoology, Cambridge), I (CAIRNS, 1995) incorrectly identified several specimens from New Zealand as this species, based on the resemblance in size and costal spines. It is now clear that the New Zealand specimens differ in having a strongly lancetted calicular margin; C<sub>3</sub> so prominent that they give the base of the corallum a corrugated aspect; much longer costal spines; a higher S<sub>4</sub>-P<sub>3</sub> fusion; and a flatter corallum (Table 6). To this, as yet unnamed, species I propose the name *Deltocyathus corrugatus*, new species, described and figured by CAIRNS (1995) as *Deltocyathus ornatus*, and diagnosed and compared in Table 6, herein. The holotype is the specimen figured by CAIRNS (1995: pl. 19, figs d-e, ex USNM 94169, now NZOI H 689) from NZOI stn P27 (28°54'36"S, 167°44'12"E, Norfolk Island, 390 m, = type locality), and the other 15 specimens from four NZOI stations reported by CAIRNS (1995) as *D. ornatus* are considered as paratypes. The name *corrugatus* (Latin *corrugatus*, ridged) refers to the corrugated base.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 300-305 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 295-360 m. Elsewhere: Loyalty Islands; 73 m (holotype).

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

*Heterocyathus* sp. cf. *H. sulcatus* (Verrill, 1866)

Figs 14 a-d

*Stephanoseris sulcatus* Verrill, v\*1866: 48.

*Heterocyathus sulcatus* - HOEKSEMA & BEST, 1991: 231-233, figs 19-23 (synonymy).

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 494, 4 (USNM 98717). — Stn 495, 16 (USNM 98716). — Stn 496, 1 + (3) (USNM 98715). — Stn 509, 5 (USNM 98713). — Stn 510, 1 (MNHN). — Stn 512, 19 + (6) (MNHN). — Stn 513, 70 + (3); 60 + (3) (MNHN), 10 and SEM stubs 886-888 (USNM 98712). — Stn 514, 2 (MNHN). — Stn 516, 2 + (2) (MNHN). — Stn 556, 1 (MNHN). — Stn 570, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 969, 1 (MNHN). — Stn 976, 17 + (2) (USNM 98714). — Stn 1069, 10 (USNM 98718). — Stn 1094, 1 (MNHN). — Stn 1097, 2 (MNHN).

TYPE LOCALITY. — Ceylon (= Sri Lanka), depth not reported.

DESCRIPTION. — All specimens reported above are unattached, the base usually forming a low, flattened cylinder that completely encapsulates a small gastropod that was colonized by a sipunculid worm. If the gastropod was small or circular in diameter, the concentric internal sipunculid tube forms a regular cylinder, whereas if the

gastropod was elongate, an irregularly-shaped base results. A cylindrical corallum of smaller diameter sits upon the base, which contains the coral polyp. The corallum base is up to 6.0 mm in diameter and about 2.5 mm in height, whereas the upper corallum rarely exceeds 4.0 mm in diameter and is also up to 2.5 mm tall. The sipunculid canal is about 1.2 mm in diameter, opening to the surface of the coral through a pore of equal diameter on the lower lateral surface of the base. Smaller efferent pores associated with the sipunculid are rare, occasionally one 0.2 mm in diameter opening on the lower surface of the base or on the upper edge of the base. Costae well-developed, rounded and very finely granular; however, in older coralla tectural deposits completely cover the costae resulting in a smooth porcellaneous surface. Costae occur only on lateral faces of the corallum, including both upper and lower sections, but the flat base of the corallum is smooth. The costal width must gradually increase in the region of the base that covers the sipunculid worm tube, in order to cover the larger circumference formed by the housing of the worm. Intercostal furrows quite thin (about 30  $\mu\text{m}$ ) and deep, such that the underlying theca cannot be seen. C<sub>1-3</sub> light brown to chocolate-brown in colour, alternating with the white C<sub>4</sub>; however, only the S<sub>1-2</sub> are similarly coloured, the pigment of the C<sub>3</sub> stopping at the calicular edge. Palar and columellar elements usually also pigmented, but in some cases are white.

Septa hexamerally arranged in 4 cycles, but a complete fourth cycle is rare, most coralla missing 1 or more pairs of S<sub>4</sub> resulting in 36 to 46 septa: S<sub>1</sub>>S<sub>2</sub>>S<sub>4</sub>>S<sub>3</sub>. S<sub>1</sub> about 1.1 mm exsert, extend about half way to columella, and bordered by 1 or 2 narrow paliform lobes. S<sub>2</sub> 0.7 mm exsert, about 3/4 width of the S<sub>1</sub>, and also bear 1 or 2 paliform lobes. S<sub>3</sub> that are flanked by a pair of S<sub>4</sub> are the smallest septa, only 0.5 mm exsert and half the size of the S<sub>2</sub>, but if not flanked by S<sub>4</sub>, an S<sub>3</sub> is as wide as an S<sub>2</sub> and often considerably thicker. S<sub>4</sub> also dimorphic in size, those adjacent to S<sub>1</sub> as wide as an S<sub>2</sub> and fused to its adjacent S<sub>1</sub> in a lancet. S<sub>4</sub> adjacent to S<sub>2</sub> are smaller, only slightly wider than an S<sub>3</sub>. Both S<sub>3</sub> and S<sub>4</sub> bear 2 or 3 slender paliform lobes. Septa crowded in arrangement and bear prominent granulations on their faces. All paliform lobes slender, not lamellar, about 0.25 mm in diameter, and bear obliquely oriented menianes. Fossa shallow, containing a papillose columella consisting of 10-15 cylindrical elements that are similarly transversely ridged as the paliform lobes. In fact there is little difference between palar and columellar elements except that the former rise higher in the fossa and are aligned with particular septa.

REMARKS. — HOEKSEMA & BEST (1991) consolidated the 23 described species and subspecies of *Heterocyathus* into three species and provided a key for their differentiation. According to their diagnoses, coralla having a dark brown centre, alternating costal pigmentation, and a compact, cylindrical upper corallum, should be identified as *H. sulcata*. However, I have noted that several specimens in larger lots that were certainly conspecific did not have a dark brown centre, and I have also noted other specimens of *Heterocyathus* with dark brown centres that were otherwise very different from the species described herein. The type of *H. sulcata* (YPM 764) from Sri Lanka is now so damaged that it is of little use in defining the species; only about one-third of the original corallum is present. Because of the large number of nominal species and the variation inherent in this genus these specimens are only provisionally identified as *H. sulcatus*.

Specimens from six of the lots listed above, indicated with parentheses around the specimen number, differ in having a larger corallum (CD up to 6.0 mm, basal diameter up to 8.5 mm) and in having 2-6 sipunculid efferent pores located circumferentially at the junction of the base and upper corallum. These are assumed to be larger individuals of the same species, the larger size mediated by the increased development of the sipunculid.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Tuscarora and Waterwitch Banks; live specimens from 110-260 (dead specimens found to 550 m). Vanuatu region: Anaton, Tanna, and Espiritu Santo; 182-312 m (live specimens). Elsewhere: See HOEKSEMA & BEST (1991).

### *Heterocyathus alternatus* Verrill, 1865

Figs 14 e-f

*Heterocyathus alternatus* Verrill, v\*1865: 149. — HOEKSEMA & BEST, 1991: 230-231, figs 12-18 (synonymy). — CAIRNS, 1998: 384, figs 3d-e.

**MATERIAL EXAMINED.** — **Vanuatu.** MUSORSTOM 8: stn 1004, 1 (MNHN). — Stn 1018, 4 (USNM 98719).

**TYPE LOCALITY.** — "Gaspar Straits" = Selat Gelasa, between the islands of Bangka and Belitung, Sumatra, Indonesia.

**DIAGNOSIS** (specimen from MUSORSTOM 8 stn 1004). — Corallum cylindrical and free: 10.2 x 9.4 mm in CD and 8.1 mm in height. Costae well defined, rounded, and finely granular (not porcellaneous); intercostal grooves narrow and relatively deep. Base flat and not costate, but covered with fine granulations; the sipunculid tube opening and one efferent pore also occur on the flat base. Septa hexamerally arranged in 4 complete cycles ( $S_1 > S_2 > S_4 > S_3$ ), although HOEKSEMA and BEST (1991: fig. 17) show that this species may sometimes attain a full fifth cycle.  $S_1$  highly exsert (3.7 mm), forming tall lancets with their adjacent  $S_4$ , and axially bordered with 2 or 3 slender paliform lobes.  $S_2$  about 2.5 mm exsert, also forming lancets with their adjacent  $S_4$ .  $S_3$  bear only 1 or 2 paliform lobes, whereas the larger  $S_4$  bear 4 or 5 lobes that merge indistinguishably into the columella. All paliform lobes are slender (cylindrical) and not ridged. Fossa quite deep, containing a papillose columella composed of numerous fine elements.

**REMARKS.** — These specimens appear to be conspecific with the diagnosis and illustrations of HOEKSEMA and BEST (1991). The holotype (YPM 6828), although well preserved, appears to be a juvenile specimen.

*Heterocyathus alternatus* differs markedly from the species described above as *H. cf. sulcatus* by having a larger corallum with more septa, granular costae (not porcellaneous) and base, more highly exsert  $S_1$  and  $S_2$ , nonridged paliform lobes, a deeper fossa, and finer columellar elements.

**DISTRIBUTION.** — Vanuatu region: Erromango and Efaté; 301-319 m. Elsewhere: Indonesia; Philippines; northern Indian Ocean; Western Australia; South China Sea (HOEKSEMA & BEST, 1991).

Genus *CONOTROCHUS* Seguenza, 1864

*Conotrochus funiculumna* (Alcock, 1902)

*Ceratotrochus (Conotrochus) funiculumna* Alcock, v\*1902a: 93; v.1902c: 11-12, pl. 1, figs 6, 6a.

*Conotrochus funiculumna* - CAIRNS, 1994: 58-59, pl. 24, fig. i, pl. 25, figs g-l (synonymy). — CAIRNS & ZIBROWIUS, 1997: 127. — CAIRNS, 1998: 385.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 511, 6 (MNHN). — Stn 522, 1 (MNHN). — Stn 523, 5 (MNHN). — Stn 525, 2 (MNHN). — Stn 532, 1 (MNHN). — Stn 535, 1 (MNHN). — Stn 537, 1 (MNHN). — Stn 540, 4 (MNHN). — Stn 541, 1 (MNHN). — Stn 542, 1 (MNHN). — Stn 555, 1 (USNM 98721). — Stn 556, 3 (MNHN). — Stn 557, 4 (USNM 98720). — Stn 560, 1 (MNHN). — Stn 570, 12 (MNHN). — Stn 571, 2 (MNHN). — Stn 585, 3 (USNM 98724). — Stn 604, 3 (MNHN). — Stn 618, 40 (USNM 98722). — Stn 619, 14 (USNM 98723).

**Vanuatu.** MUSORSTOM 8: stn 1059, 1 (USNM 98728). — Stn 1060, 1 (MNHN). — Stn 1065, 8 (USNM 98726). — Stn 1072, 3 (MNHN). — Stn 1087, 8 (USNM 98729). — Stn 1088, 1 (USNM 98725). — Stn 1091, 1 (MNHN). — Stn 1107, 1 (USNM 98727). — Stn 1113, 1 (MNHN).

**TYPE LOCALITY.** — "Siboga" stns 95 and 100: Sulu Archipelago, 450-522 m.

**DIAGNOSIS.** — Corallum ceratoid (edge angle up to 35°), straight, and attached by a narrow pedicel that is usually reinforced by an extensive secondary attachment along the lower edge of the corallum contiguous with the pedicel. Calice circular to slightly elliptical, the largest specimen reported herein 12.5 mm in GCD. The theca of a well-preserved corallum often bears slender, hollow, hispid granulations; worn coralla often show longitudinal costae. Theca of well-preserved coralla sometimes longitudinally streaked with brown pigmentation that occurs without symmetry, the streaks ranging from 1 to 8 septa in width, alternating with white theca. Theca thick, projecting 0.5-0.7 mm above the peripheral distal septal edges as a continuous rim;



stereome present internally. Septa hexamerally arranged in 4 cycles ( $S_1 > S_2 > S_3 > S_4$ ), a full fourth cycle complete in some coralla at a CD of 4.6 mm, but larger specimens sometimes lacking several pairs of  $S_4$ . Columella a well-formed, discrete concentration of lamellar elements, often swirled in a circular manner, and occasionally fused into a more solid structure. Lamellar elements often fused to one another in a labyrinthiform arrangement.

REMARKS. — *Conotrochus funiculumna* is similar to *C. brunneus*, both species secondarily attached basally and having a similar thecal structure. *C. funiculumna* differs in having: a larger corallum (up to 12.5 mm CD vs <8.0 mm for *C. brunneus*); more septa at the same CD, most *C. funiculumna* have 48 septa, whereas most *C. brunneus* have only 36-40 septa; a more open corallum (slightly higher edge angle); less internal stereome; and occasionally a streaked theca, whereas that of *C. brunneus* is white or uniformly brown. The species is more fully described and figured by CAIRNS (1994).

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch, Combe, and Tuscarora Banks; 370-697 m. Vanuatu region: Malakula and Espiritu Santo; 350-700 m. Elsewhere: Philippines; Indonesia; Japan; Australia; Hawaiian Islands; 88-616 m (CAIRNS & ZIBROWIUS, 1997).

### *Conotrochus brunneus* (Moseley, 1881)

*Pleurocyathus brunneus* Moseley, v\*1881: 159-160, pl. 2, figs 1a-c.

*Conotrochus brunneus* - CAIRNS, 1995: 74-75, pl. 20, figs a-b (synonymy). — CAIRNS & ZIBROWIUS, 1997: 127-128, fig. 16e.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 511, 1 (USNM 98734). — Stn 513, 1 (MNHN). — Stn 525, 1 (MNHN). — Stn 530, 1 (USNM 98731). — Stn 546, 1 (MNHN). — Stn 586, 1 (MNHN). — Stn 590, 1 (MNHN). — Stn 591, 1 (MNHN). — Stn 597, 1 (MNHN). — Stn 625, 1 (USNM 98730).

**Vanuatu.** MUSORSTOM 8: stn 959, 2 (USNM 98732). — Stn 977, 1 (MNHN). — Stn 1006, 1 (MNHN). — Stn 1089, 1 (MNHN). — Stn 1090, 1 (USNM 98733). — Stn 1092, 1 cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — "Challenger" stn 194: 4°34'S, 129°57'30"E (Banda Island, Banda Sea), 366 m.

REMARKS. — *Conotrochus brunneus* was redescribed and figured by CAIRNS (1995), and compared to *C. funiculumna* in the previous account.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, Field, and Bayonnaise Banks; 300-580 m. Vanuatu region: Anatom, Tanna, Erromango, and Espiritu Santo; 321-574 m. Elsewhere: Indo-West Pacific from Madagascar to South China Sea; 97-1051 m (CAIRNS & ZIBROWIUS, 1997).

### *Conotrochus asymmetros* sp. nov.

Figs 14 g, 15 a-e

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region.** MUSORSTOM 7: stn 495, 3 paratypes and SEM stub 890 (USNM 98735). — Stn 496, 1 holotype (MNHN). — Stn 504, 6 paratypes (MNHN). — Stn 509, 10 paratypes (USNM 98736). — Stn 512, 3 paratypes (MNHN). — Stn 513, 6 paratypes (MNHN). — Stn 516, 3 paratypes (MNHN). — Stn 586, 1 paratype (MNHN). — Stn 610, 1 paratype (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 1016, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 1017, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 1097, 1 nontype cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — MUSORSTOM 7 stn 496: 14°19.6'S, 178°04.3'W (Futuna), 250-330 m.

ETYMOLOGY. — The species name *asymmetros* (Greek *asymmetros*, without symmetry) refers to the asymmetrical arrangement of septa within the calice.

DESCRIPTION. — Corallum varies from conical (edge angle = 30°) to flabellate (e.g., the holotype: edge angle up to 65°, face angle = 15°), depending on the corallum and its stage of thecal edge spine development. Holotype 8.9 x 4.6 mm in CD, 7.3 mm in height, and 1.3 mm in pedicel diameter. Calice elliptical (GCD:LCD = 1.2) to highly compressed (GCD:LCD = 2.0), the higher ratio characteristic of coralla in process of edge spine formation, which temporarily elongates the corallum. Elliptical calices are sometimes asymmetrical in shape, one face being almost straight, the other convex. Several more septa often originate from the convex thecal face than the straight face. Calicular edge finely serrate, separated from the peripheral septal edges by a shallow trough. Basal disc 0.8-1.3 mm in diameter, in many cases augmented by a contiguous secondary thecal attachment up to 2.0 mm in diameter. Thecal edges bear 1-3 pairs of spines (up to 2.0 mm long); short, triangular crests; or low eversions. Transverse division not noted. Theca porcellaneous, covered with low, rounded granules characteristic of the genus. Theca usually white, but occasionally longitudinally streaked with brown pigment.

Septa hexamerally arranged in 3 size classes, usually resulting in 32 or 30 septa accordingly: 6:10:16 or 6:9:15. The 6 primary septa are up to 0.7 mm exsert, having straight axial edges that reach the columella. Primary septa are not aligned with the greater calicular axis, as in all other known corals having an elliptical calice. Rather, they occur on either side of the calicular axis and on the lateral faces, resulting in a secondary or tertiary septum being aligned with the greater axis, usually one of each size class on either end of the corallum. Secondary septa 0.4 mm exsert, about 4/5 width and less thick than a primary septum. In coralla having 32 septa, all 6 systems contain at least one secondary septum and 4 systems contain a pair of equal-sized secondary septa; in coralla having 30 septa, only 3 systems contain a pair of secondaries. There seems to be no consistent arrangement in which systems contain pairs of secondaries, only that they are usually in contiguous systems and often occur in a system aligned with the greater axis. Tertiary septa nonexsert and rudimentary, only about 1/4 the width of a secondary, and quite thin. Fossa of moderate depth, containing a papillose columella composed of 6-11 granular, interconnected papillae that are also attached to the lower, axial edges of primary and secondary septa.

REMARKS. — The unusual septal symmetry and thecal edge spines distinguish this species from all others in the genus. In fact, I know of no other scleractinian species that possesses a pair of equal-sized secondary septa within one system or a septal arrangement that aligns a secondary and/or tertiary septum on the greater calicular axis.

DISTRIBUTION. — Wallis and Futuna; 210-510 m. Vanuatu region: Efaté and Espiritu Santo; 288-294 m.

### Genus *LOCHMAEOTROCHUS* Alcock, 1902

#### *Lochmaeotrochus gardineri* sp. nov.

Figs 15 f-g

MATERIAL EXAMINED/TYPES. — MUSORSTOM 7: stn 539, 17 paratypes (MNHN). — Stn 548, 1 paratype (MNHN). — Stn 557, 1 paratype (MNHN). — Stn 560, 1 paratype (USNM 98739).

Vanuatu. MUSORSTOM 8: stn 956, 9 paratypes (MNHN). — Stn 992, 3 paratypes (USNM 98738). — Stn 1034, 1 paratype (MNHN). — Stn 1036, holotype (MNHN) and 13 paratypes (USNM 98737).

TYPE LOCALITY. — MUSORSTOM 8, stn 1036: 18°01'S, 168°48'E (Efaté), 920-950 m.

ETYMOLOGY. — This species is named for J. Stanley GARDINER, in recognition of his pioneering work on azooxanthellate corals from the central and South Pacific (GARDINER, 1899a, b).

DESCRIPTION. — Corallum conical (ceratoid, having an edge angle of 18°-23°), straight, and free, having a basal disc about 1.1 mm in diameter that is occasionally reinforced with a small contiguous secondary attachment of equal diameter. Largest specimen (holotype) 10.8 mm in CD and 17.4 mm in height; calice circular. Theca covered with slender, hispid granulations, characteristic of the genus *Conotrochus*. Theca lipped with successive

circumferential growth ridges or lips, each projecting up to 0.3 mm in height, the uppermost thecal rim projecting upward about 0.7 mm and separated from the distal, peripheral septal edges by a shallow trough. Theca relatively thick, containing layers of internal stereome. Corallum uniformly white.

Septa hexamerally arranged in 4 cycles, the fourth cycle never complete:  $S_1 > S_2 > S_3 > S_4$ . Most coralla have 1 pair of  $S_4$  in each system, resulting in 36 septa; however, the holotype has 40 septa, and a smaller specimen (CD 9.4 mm) has 42 septa.  $S_1$  nonexsert, extend about 3/4 distance to the columella, having straight, vertical axial edges. Rarely (e.g., the holotype) the  $S_1$  bear a small (0.6 mm wide), lamellar  $P_1$ , separated from its septum by a deep, narrow notch.  $S_2$  about 3/4 width of the  $S_1$ .  $S_3$  dimorphic in size:  $S_3$  unflanked by  $S_4$  about half the size of the  $S_2$ , but those flanked by  $S_4$  are only slightly less wide than the  $S_2$  and usually bear a broad (1.2 mm wide), lamellar palus. The position of the  $P_3$  is variable. Although it is usually aligned with the  $S_3$ , it is sometimes aligned between the  $S_3$  and adjacent  $S_2$ , or may be absent. Even when aligned with the  $S_3$ , lower in the fossa the  $P_3$  is usually connected to the adjacent  $S_2$ . Also, in some systems having a full complement of 2 pairs of  $S_4$ , only one palus is present before the  $S_2$ , but this palus having connections to the 2 adjacent  $S_3$  lower in the fossa.  $S_4$  about half width of a flanked  $S_3$ . Axial edges of  $S_{2-4}$  very slightly sinuous. Fossa moderately deep, containing a papillose columella composed of 0-10 interconnected cylindrical elements 0.2-0.3 mm in diameter.

REMARKS. — *Lochmaetrochus gardineri* is similar to but differs from the only other species described in this genus, *L. oculus* Alcock, 1902, in having: a solitary, free habit with a small basal disc (vs a quasicolonial habit with a broad secondary attachment); circumferential thecal ridges; fewer septa at a corresponding size and a lower maximum number of septa (most *L. oculus* have 48 septa); wider and better developed pali; and a deeper fossa. It is also known from greater depths than *L. oculus*.

*Lochmaetrochus gardineri* is also similar to *Conotrochus funiculumna*, particularly in corallum size and thecal granulation; these species also co-occur at one station. *L. gardineri* is distinguished by having at least 6 lamellar pali ( $P_3$ ), which are different in shape from its cylindrical columellar elements, *C. funiculumna* only having swirled, interconnected (labyrinthiform) lamellar columellar elements and no pali. *L. gardineri* also has a narrower basal attachment, a deeper fossa, fewer septa at a corresponding CD, and a greater disparity between the width of its  $S_1$  and  $S_2$ . *L. gardineri* also seems to be found, in general, at greater depths than *C. funiculumna*.

DISTRIBUTION. — Wallis and Futuna region: Combe and Tuscarora Banks; 608-700 m. Vanuatu region: Anatom, Erromango, and Efaté; 750-1175 m.

#### Genus *AULOCYATHUS* Marenzeller, 1904

##### *Aulocyathus recidivus* (Dennant, 1906)

*Ceratotrochus recidivus* Dennant, \*1906: 159-160, pl. 6, figs 1-2.

*Aulocyathus recidivus* - CAIRNS, 1982: 25-26, pl. 7, figs 7-9, pl. 8, fig. 1 (synonymy); 1994: 59-60, pl. 26, fig. a-b. — CAIRNS & PARKER, 1992: 22-24, pl. 6, figs d-e, g-h (synonymy). — CAIRNS & ZIBROWIUS, 1997: 129-130.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 564, 4 (USNM 98741). — Stn 567, 1 (MNHN). — Stn 620, 1 (MNHN). — Stn 622, 1 (MNHN). — Stn 623, 2 (MNHN).

TYPE LOCALITY. — Off Cape Jaffa and Neptune Island, South Australia, 165-190 m.

REMARKS. — *Aulocyathus recidivus* was more fully redescribed and figured by CAIRNS (1982, 1994) and CAIRNS & PARKER (1992). The four known species of *Aulocyathus* are compared in Table 7, and the three Pacific species illustrated by CAIRNS (1994: pl. 26). *A. recidivus* is unique in having a notch between the theca and peripheral septal edges, and is further distinguished by having a relatively large, fragile corallum with well-spaced septa and a well-developed columella.

TABLE 7. — Comparison of the four known species of *Aulocyathus*.

|                         | <i>A. recidivus</i><br>Dennat, 1906 | <i>A. atlanticus</i><br>Zibrowius, 1980 | <i>A. matricidus</i><br>(Kent, 1871) | <i>A. juvenescens</i><br>(Kent, 1871) |
|-------------------------|-------------------------------------|---|--------------------------------------|---------------------------------------|
| Calicular Diameter (mm) | 15.0                                | 9.5                                     | 8.5                                  | 4.5                                   |
| H:GCD                   | 2.7                                 | 1.1-6.6                                 | 3.6                                  | 2.9-3.5                               |
| Costae                  | Hispid granules                     | Granular to hispid                      | Hispid, twice as many as septa       | Porcellaneous                         |
| Number of Septa         | 32-66                               | <48                                     | 36-48                                | 30-32                                 |
| Calicular Edge          | Serrate                             | Serrate                                 | Smooth                               | Serrate                               |
| Upper Peripheral Septa  | Notched                             | Not notched                             | Not notched                          | Not notched                           |
| Columella               | Well developed, papillose           | Well developed, papillose               | Rudimentary                          | Rudimentary                           |
| Distribution; Depth     | Indo-West Pacific; 128-1137 m       | Eastern Atlantic; 450-1716 m            | Japan; 84-207 m                      | Indo-West Pacific; 182-463 m          |

DISTRIBUTION. — Wallis and Futuna region: Tuscarora and Combe Banks; 1020-1280 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 128-1137 m (CAIRNS & ZIBROWIUS, 1997).

#### *Aulocyathus juvenescens* Marenzeller, 1904

Fig. 15 h

*Aulocyathus juvenescens* Marenzeller, v\*1904: 301-302, pl. 18, fig. 17. — ZIBROWIUS, 1980: 107. — CAIRNS & KELLER, 1993: 247. — CAIRNS, 1994: pl. 26, figs h-i. — CAIRNS & ZIBROWIUS, 1997: 130 (mentioned).

MATERIAL EXAMINED. — **Philippines.** MUSORSTOM 3: stn 87, 1 juvenile (USNM 97653).  
**Vanuatu.** MUSORSTOM 8: stn 976, 2 (MNHN). — Stn 1070, 1 (USNM 98740).

TYPE LOCALITY. — Pemba and Zanzibar Islands, Tanzania, 400-463 m.

REMARKS. — Two adult, intact coralla are reported herein: one (MUSORSTOM 8 stn 1070) 4.4 mm in CD and 14.6 mm in height, the other (MUSORSTOM 8 stn 976) 3.7 mm in CD and 11.0 mm in height. Both specimens have a smooth, porcellaneous theca with no indication of granulation or intercostal striae. The theca of the larger specimen has streaks of brown pigment, the other is pure white. Both coralla have a finely serrate, circular calicular margin and both have 32 septa arranged  $S_1 > S_2 > S_3 > S_4$ ; however, the size difference between the  $S_2$  and the flanking  $S_3$  is slight. The lower axial edges of  $S_1$  bear robust tubercles; the columella is rudimentary. These specimens resemble the syntypes of *A. juvenescens* in all respects except for thecal texture, the syntypes having faint, longitudinal intercostal striae and low, glisteny granulations.

*Aulocyathus juvenescens* is compared to the other Recent congeners in Table 7. It is distinguished by having the smallest calicular diameter, least number of septa, and a porcellaneous theca.

DISTRIBUTION. — Vanuatu region: Tanna and Espiritu Santo; 182-184 m. Elsewhere: Philippines; Tanzania; 196-463 m (CAIRNS & ZIBROWIUS, 1997).

#### Genus *DESMOPHYLLUM* Ehrenberg, 1834

##### *Desmophyllum dianthus* (Esper, 1794)

*Madrepora dianthus* Esper, \*1794: pl. 69, figs 1-3.

*Desmophyllum cristagalli* H. Milne Edwards & Haime, v\*1848a: 253.

Not *Desmophyllum* sp. cf. *D. cristagalli* - WELLS, 1954: 470 (= *Javania exserta*).

*Desmophyllum dianthus* - CAIRNS, 1994: 26-27, pl. 9, figs a-d (synonymy and neotype designation); 1995: 77, pl. 21, figs d-f, map 4 (synonymy); 1998: 385-386. — CAIRNS & ZIBROWIUS, 1997: 131, figs 17g-h.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 637, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 1088, 8 (MNHN). — Stn 1089, 1 (MNHN). — Stn 1128, 1 (USNM 98742).

**TYPE LOCALITY.** — Sagami Bay, Japan (depth not known).

**REMARKS.** — This ubiquitous coral has been redescribed and figured many times, often under the junior synonym name of *D. cristagalli* (see ZIBROWIUS, 1980; CAIRNS, 1979, 1982, 1994, 1995). But, despite its widespread distribution and abundance in certain regions, it is rarely collected in the tropical South Pacific (CAIRNS & ZIBROWIUS, 1997).

**DISTRIBUTION.** — Wallis and Futuna region: Rotumah Bank; 820-830 m. Vanuatu region: Espiritu Santo; Guyot Bougainville; 455-778 m. Elsewhere: cosmopolitan except off continental Antarctica and northern boreal Pacific; 35-2460 m (CAIRNS, 1994).

#### Genus *THALAMOPHYLLIA* Duchassaing, 1870

##### *Thalamophyllia tenuescens* (Gardiner, 1899)

*Desmophyllum tenuescens* Gardiner, v\*1899a: 161-162, pl. 19, figs 1a-b.

*Desmophyllum delicatum* - WELLS, v.1954: 470 (Not *Desmophyllum delicatum* Yabe & Eguchi, 1942).

*Thalamophyllia tenuescens* - CAIRNS, 1995: 78, pl. 21, figs g-i, map 19; 1998: 386. — CAIRNS & ZIBROWIUS, 1997: 133, figs 17d-e.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 496, 1 (MNHN). — Stn 499, 1 (MNHN). — Stn 504, 2 (MNHN). — Stn 509, 2 (MNHN). — Stn 512, 3 (USNM 98744). — Stn 513, 1 (MNHN). — Stn 514, 1 (USNM 98743).

**Lord Howe Island.** NZOI: stn P115, 2 colonies (USNM 94363).

**TYPE LOCALITY.** — Sandal Bay, Lifu, Loyalty Islands, 73 m.

**REMARKS.** — This species was recently redescribed and illustrated by CAIRNS (1995). The largest known corallite, reported herein from Lord Howe Seamount Chain (NZOI P115), measures 24 x 15 mm in CD, 27 mm in height, and contains three pairs of S<sub>5</sub> (54 septa).

**DISTRIBUTION.** — Futuna; 240-349 m. Elsewhere: Philippines; Indonesia; Bikini Island, Marshall Islands (WELLS, 1954); Loyalty Islands (GARDINER, 1899a); Kermadec Islands; Lord Howe Seamount Chain (reported herein); off Queensland; 8-315 m (CAIRNS & ZIBROWIUS, 1997).

#### Genus *LOPHELIA* H. Milne Edwards & Haime, 1849

##### *Lophelia pertusa* (Linnaeus, 1758)

*Madrepora pertusa* Linnaeus, \*1758: 797.

*Madrepora prolifera* Pallas, \*1766: 307.

*Lophelia prolifera* - CAIRNS, 1979: 125-127, pl. 24, figs 1-5 (synonymy); 1991a: 17-18, pl. 6, fig. j.

*Lophelia pertusa* - ZIBROWIUS, v.1980: 126-130, pl. 66, figs A-L (synonymy). — CAIRNS, 1995: 27-28, pl. 9, figs e-i (synonymy).

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 530, 19 fragments: 15 (MNHN), 4 (USNM 98745). — Stn 572, 1 (MNHN).

**TYPE LOCALITY.** — Not stated, but probably the fjords of Norway (ZIBROWIUS, 1980).

**REMARKS.** — This species, which is common in the Atlantic, is rarely collected in the Indo-Pacific, represented in this collection only by several dead fragments.

**DISTRIBUTION.** — Wallis and Futuna region: Waterwitch Bank; 560-580 m. Elsewhere: cosmopolitan, except off continental Antarctica (rare in western Pacific); 60-2170 m (CAIRNS, 1995).

### Genus *DACTYLOTROCHUS* Wells, 1954

#### *Dactylotrachus cervicornis* (Moseley, 1881)

Figs B, 16 a-f

*Tridacophyllia cervicornis* Moseley, \*1881: 183-184, pl. 10, figs 2a-d, 3a. — BASSETT-SMITH, 1890: 368.

*Tridacophyllia primordialis* Gardiner, v\*1899a: 168, pl. 19, figs 7a-e.

*Dactylotrachus cervicornis* - WELLS, v.1954: 470-471, pl. 178, figs 1-3. — CAIRNS & ZIBROWIUS, 1997: 131.

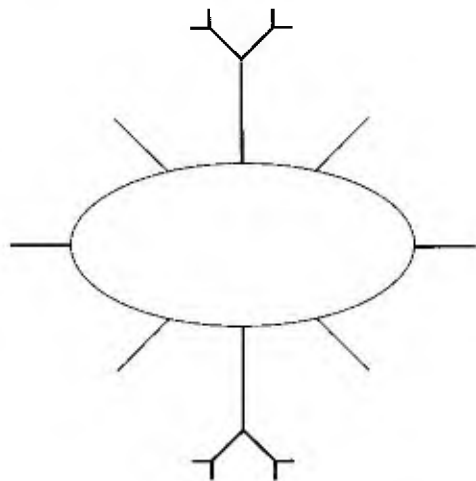


FIG. B. — Diagrammatic representation of the calice of *Dactylotrachus cervicornis*, showing the placement, length, and orientation of the calicular extensions. Thick lines represent a vertical extension; thin lines represent a horizontal to oblique extension. Length of extensions drawn in proportion to calicular diameter.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 504, 1 (MNHN). — Stn 512, 2 (MNHN). — Stn 513, 1 (MNHN). — Stn 514, 4 (MNHN) and SEM stub 889 (USNM 98746). — Stn 515, 1 (USNM 98747). — Stn 584, 1 (MNHN). — Stn 589, 1 (MNHN). — Stn 605, 3 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 988, 3 (USNM 98749). — Stn 1095, 1 (USNM 98748).

**Guam.** East Agana Bay, 7.08.1986, 128-137 m, 1 (USNM 96503).

**TYPE LOCALITY.** — Unknown.

**DESCRIPTION.** — Corallum attached through a robust (3-6 mm in diameter) cylindrical to subcylindrical pedicel and a thin, slightly expansive base, the base and lower pedicel usually covered with several faint, annular epithelial ridges. One damaged specimen (MUSORSTOM 8 stn 1095) and two syntypes display a polycyclic base, achieved by thecal bridging of raised costal ridges in the vicinity of the base. Above the pedicel, at a height of 3-10 mm, the theca and corresponding internal septa are divided into several (up to 8) elongate, tapered and sometimes bifurcating thecal extensions (Fig. B). The largest thecal extensions originate from the two thecal faces, the basal part of each extension 6-8 mm in length and 4-6 mm wide, beyond which it bifurcates into two

smaller extensions 2-3 mm in width, which, in larger specimens, bifurcate once more. These laterally-placed, bifurcating extensions are vertical in orientation, producing a constricted fossa. In a well-developed corallum, between each laterally-placed extension and the greater axis may be 4 smaller, nonbifurcating extensions, each about 5 mm long, 3 mm in width, oriented outward from the calicular edge. Finally, 2 more nonbifurcating, upward-projecting extensions originate from the greater axis of the corallum, each about 4 mm long and 3 mm wide. Not all coralla have all 8 digitiform projections, but the two lateral and two axial extensions are usually

present even in the smallest coralla. Largest specimen (MUSORSTOM 8 stn 988) 23.1 x 12.9 mm in CD and 30 mm in height. Theca white, covered with granules that are sometimes arranged in longitudinal rows, but costae and intercostal striae absent.

Septal symmetry is difficult to determine. Large coralla have about 240 septa arranged in 7 size classes, each progressive size class being narrower and originating closer to the calicular margin. Septa closely spaced, have smooth faces, and bear 2-5 elongate ridges (menianes) oriented parallel to the septal edge. The menianes are 60-70  $\mu\text{m}$  in height and about 30  $\mu\text{m}$  wide, alternating in position with those from the adjacent septal faces (Figs 16 d-e), thus blocking a view of the lower interseptal spaces. Fossa deep and elongate; no columella.

REMARKS. — *Dactylotrachus cervicornis* is assumed to be a solitary coral since no stolons were detected and only one elongate fossa (one mouth) is present. All previous authors described the septate digitiform thecal extensions of this species as branches, but it seems incongruous to refer to a solitary coral as having branches, thus the term "thecal extension" is used.

The five syntypes of *T. primordialis* Gardiner, 1899 are deposited at the University Museum of Zoology, Cambridge, the largest specimen a juvenile 10 mm in height and 2.4 mm in pedicel diameter, having only 66 septa and only three septal extensions.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna: Field Bank; 245-400 m. Vanuatu region: Tanna and Espiritu Santo, 320-372 m. Elsewhere: Philippines; South China Sea; Guam (reported herein); Bikini, Marshall Islands; New Caledonia and Loyalty Islands; 73-400 m (CAIRNS & ZIBROWIUS, 1997).

#### Genus *RHIZOSMILIA* Cairns, 1978

##### *Rhizosmilia robusta* Cairns, 1993

*Rhizosmilia robusta* Cairns in CAIRNS & KELLER, \*1993: 250-253, pl. 6, figs F-1. — CAIRNS & ZIBROWIUS, 1997: 133-134.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 509, 2 (MNHN). — Stn 524, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 961, 2 (MNHN). — Stn 964, 1 (MNHN). — Stn 971, 1 (MNHN). — Stn 1021, 1 (USNM 98752). — Stn 1071, 1 (USNM 98750). — Stn 1077, 3 (USNM 98751). — Stn 1078, 1 (MNHN). — Stn 1084, 1 (MNHN).

TYPE LOCALITY. — "*Anton Bruun*" stn 373B: 26°00'S, 33°05'E (off southwestern Mozambique), 135 m.

REMARKS. — Because of its size, shape, and paler configuration, this species can be taken for a *Caryophyllia* at first view, but differs from that genus in having a polycyclic base, endothecal dissepiments, and a columella composed of irregularly shaped papillae, not twisted lamellae.

DISTRIBUTION. — Wallis and Futuna; 240-300 m. Vanuatu region: Anatom, Efaté, Espiritu Santo, and Malakula; 110-360 m. Elsewhere: southwestern Indian Ocean; Philippines; 66-202 m (CAIRNS & ZIBROWIUS, 1997).

#### Genus *ASTEROSMILIA* Duncan, 1867

##### *Asterosmilia gigas* (van der Horst, 1931), n. comb.

Figs 16 g-i, 17 a-b

*Caryophyllia gigas* van der Horst, v\*1931: 4-5, pl. 2, figs 1, 4. — ZIBROWIUS, 1980: 70.  
*Rhizosmilia gigas* - CAIRNS & KELLER, 1993: 251-252.

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 510, 1 (MNHN). — Stn 515, 16: 10 (MNHN), 6 (USNM 98754). — Stn 523, 4 (MNHN). — Stn 535, 2 (USNM 98753). — Stn 537, 2 (MNHN). — Stn 586, 1 (MNHN).

**TYPE LOCALITY.** — Mauritius, 183-366 m.

**DESCRIPTION.** — Corallum robust and ceratoid, either regularly curved or irregularly bent in a scoleoid fashion. Corallum free, always with an open, broken base 1.5-2.5 mm in diameter revealing 12 septa. Base monocyclic, not reinforced with rootlets-like. Largest specimen reported herein (MUSORSTOM 7 stn 515) 28.2 x 26.0 mm in CD and 65 mm in height; however, the holotype (BM 1939.7.20.851) measures 39.4 x 31.6 mm in CD and 79 mm in height. C<sub>1-3</sub> expressed as low, rounded ridges; in some coralla C<sub>4-5</sub> also present as faint ridges. No intercostal striae or granules. Theca white, often covered with encrusting organisms (e.g., foraminifera) and small buds, presumably of the same species. Buds are found on most coralla and cluster near the calicular margin, each measuring 1.5-3.0 mm in diameter and up to 2 mm in height and having 12 septa.

Septa hexamerally arranged in 5 cycles (S<sub>1</sub>>S<sub>2</sub>>S<sub>3</sub>>S<sub>4</sub>>S<sub>5</sub>); however, it is not unusual for even large coralla to lack several pairs of S<sub>5</sub> resulting in less than 96 septa, or for some coralla to have additional pairs of S<sub>6</sub>. The holotype, for example, has 5 pairs of S<sub>6</sub> for a total of 100 septa. S<sub>1</sub> up to 3.5 mm exsert, having straight vertical axial edges. S<sub>2-4</sub> progressively and gradually narrower; however, S<sub>5</sub> only half width of S<sub>4</sub>. Triangular lancets corresponding to S<sub>1</sub> and S<sub>2</sub> form at calicular margin. Wide (2.5-3.0 mm), thin paliform lobes (P<sub>4</sub>) usually border every S<sub>4</sub> that is flanked by a pair of S<sub>5</sub>, the P<sub>4</sub> appearing as pairs in those half-systems containing both pairs of S<sub>5</sub>; however, occasionally a paliform lobe occurs before an S<sub>3</sub>, even though pairs of S<sub>5</sub> are present. Stereome sometimes present in base of corallum, giving it a dense aspect. Lower portion of corallum also filled with abundant vesicular endothecal dissepiments. Fossa of moderate depth, containing a well-developed, papillose columella composed of irregularly-shaped, crispate elements.

**REMARKS.** — This appears to be the first report of this species subsequent to its original description, which was based on one specimen, and the first record from the Pacific Ocean. Both VAN DER HORST (1931) and CAIRNS & KELLER (1993) noted that the broken cross section of the base of the holotype was surrounded by what appeared to be contiguous rootlets, which is characteristic of the genus *Rhizosmilia*. However, all specimens reported above propagated by asexual budding, the open base of every corallum corresponding in shape, size, and number of septa to the buds that occur on its theca. A budding mode of reproduction is inconsistent with the polycyclic reinforcement of a *Rhizosmilia*, and thus the root-like structures of the holotype are not interpreted as such, but as an artifact. Discounting the rootlet structures, this species belongs in the genus *Asterosmilia*, which often reproduces by asexual budding. In fact, *A. gigas* is remarkably similar to *A. profunda* (Duncan, 1864) (see CAIRNS & WELLS, 1987), known only from the Eocene to Pliocene of the Caribbean.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 252-510 m. Elsewhere: Mauritius; 183-366 m.

#### Family TURBINOLIIDAE H. Milne Edwards & Haime, 1848

#### Genus *ALATOTROCHUS* Cairns, 1994

#### *Alatotrochus rubescens* (Moseley, 1876)

*Platytrochus rubescens* Moseley, v\*1876: 553.

*Sphenotrochus rubescens* - MOSELEY, v.1881: 157-159, pl. 6, figs 8, 8a.

*Alatotrochus rubescens* - CAIRNS, 1994: 68-69, pl. 29, figs g-l; 1995: 84, pl. 24, figs a-b, map 14; 1997: 14, pl. 1, fig. a, pl. 4, fig. a; 1998: 390. — CAIRNS & ZIBROWIUS, 1997: 141, fig. 18h.

**MATERIAL EXAMINED.** — Vanuatu. MUSORSTOM 8: stn 1068, 2: 1 (MNHN), 1 (USNM 98755).



TYPE LOCALITY. — "*Challenger*" stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 236 m (not 136 m, as reported by CAIRNS (1994, 1995) and CAIRNS & ZIBROWIUS (1997)). However, the "*Challenger*" station list presented as Appendix II of the "Narrative" (TIZZARD *et al.*, 1885) lists 140 fathoms (= 256 m) as the depth for station 192.

REMARKS. — This species was recently redescribed and the types illustrated by CAIRNS (1994).

DISTRIBUTION. — Vanuatu region: Malakula; 536-619 m. Elsewhere: Japan; Philippines; Banda Sea; northwestern Australia; southern Norfolk Ridge; 180-751 m (CAIRNS & ZIBROWIUS, 1997).

Genus *PLEOTROCHUS* Cairns, 1997

*Pleotrochus venustus* (Alcock, 1902)

Figs 17 d-e

*Ceratotrochus venustus* Alcock, v\*1902a: 92; v.1902c: 10, pl. 1, figs 5, 5a.

*Cryptotrochus venustus* - CAIRNS, 1995: 88 (in part: only pl. 27, figs a-b; remaining figures and description pertain to *P. zibrowii* Cairns, \*1997).

"*Cryptotrochus*" *venustus* - CAIRNS & ZIBROWIUS, 1997: 142-143.

*Pleotrochus venustus* - CAIRNS, 1997: 14, pl. 1, fig. b, pl. 4, fig. b.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1114, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stn 256: 5°26.6'S, 132°32.5'E (Kai Islands, Banda Sea), 397 m.

REMARKS. — Although worn and obviously long dead when collected, the single specimen reported above is undoubtedly conspecific with *P. venustus*. It represents the first record outside the Banda Sea and the largest known corallum: 13.5 x 11.4 mm in CD and 11.7 mm in height. The species is more fully described by CAIRNS & ZIBROWIUS (1997), and the species and genus are figured and discussed by CAIRNS (1997).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 647 m. Elsewhere: Banda Sea, Indonesia: 200-397 m (CAIRNS & ZIBROWIUS, 1997).

*Pleotrochus zibrowii* Cairns, 1997

Figs 17 g-h

*Cryptotrochus venustus* - CAIRNS, 1995: 88-89 (in part: pl. 26g-i; not pl. 27a-b, which is *Ceratotrochus venustus* Alcock, 1902).

*Pleotrochus zibrowii* Cairns, \*1997: 14-15, pl. 1, fig. c, pl. 4, fig. c.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 637, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 1113, 1 (USNM 98756).

TYPE LOCALITY. — NZOI stn U584: 31°26.3'S, 172°35.6'E (Three Kings Ridge, New Zealand), 1137-1150 m.

REMARKS. — Although worn and obviously dead when collected, the two specimens reported above are virtually identical to specimens in the type series, the larger specimen (MUSORSTOM 7 stn 637) measuring 13.4 x 12.6 mm in CD and 11.5 mm in height. These records represent the second collection of this recently described species.

DISTRIBUTION. — Wallis and Futuna region: Rotumah Bank; 820-830 m. Vanuatu region: Espiritu Santo; 700-736 m. Elsewhere: Three Kings Ridge, New Zealand; 1137-1150 m.

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

*Tropidocyathus lessonii* (Michelin, 1842)

Fig. 17 c

*Flabellum Lessonii* Michelin, \*1842: 119.

*Tropidocyathus lessonii* - CAIRNS, 1989a: 33-34, pl. 16, figs d-I (synonymy); 1994: 67, pl. 29, figs a-b (synonymy).

*Tropidocyathus lessonii* - CAIRNS & ZIBROWIUS, 1997: 146-147. — CAIRNS, 1997: 16, pl. 1, fig. e, pl. 4, fig. e, pl. 7, fig. d; 1998: 390-392.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1016, 1 (MNHN).

TYPE LOCALITY. — Unknown.

REMARKS. — The single specimen reported above, worn and dead when collected, measures 12.8 x 10.7 mm in CD and 10.8 mm in height. This species is distinctive in having a rhomboidal calice (the lateral thecal faces bulging outward) and highly developed edge crests up to 3.4 mm in height. This relatively common deep-water species was redescribed, illustrated, and discussed by CAIRNS (1989, 1994, 1997).

DISTRIBUTION. — Vanuatu region: Efaté; 291-300 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 50-421 m (CAIRNS & ZIBROWIUS, 1997).

*Tropidocyathus labidus* Cairns & Zibrowius, 1997

Fig. 2 d

"*Tropidocyathus*" *labidus* Cairns & Zibrowius, 1997: 148, figs 20 a-g. — CAIRNS, 1998: 392.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 8: stn 963, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1026, 1 (MNHN). — Stn 1065, 1 (MNHN). — Stn 1068, 2 (USNM 98758).

TYPE LOCALITY. — KARUBAR stn 2: 5°47'00"S, 132°11'35"E (Kai Islands, Banda Sea), 209-240 m.

REMARKS. — This small, distinctive species was recently described and illustrated. All specimens reported above were alive when collected and well preserved.

DISTRIBUTION. — Vanuatu region: Anatom, Efaté, and Malakula; 419-536 m. Elsewhere: Indonesia; Ryukyu Islands; tropical Western Australia; 206-425 m (CAIRNS, 1998).

Genus *CYATHOTROCHUS* Bourne, 1905

*Cyathotrochus pileus* (Alcock, 1902)

*Trochocyathus pileus* Alcock, v\*1902a: 96-97; v.1902c: 15-16, pl. 2, figs 11, 11a.

?*Cyathotrochus herdmani* Bourne, \*1905: 193, pl. 1, figs 2, 2a.

*Tropidocyathus pileus* - CAIRNS, 1989a: 34-35, pl. 17, figs a-h (synonymy); 1994: 68, pl. 29, figs d-e; 1995: 91, pl. 28, figs a-c, map 11. — CAIRNS & ZIBROWIUS, 1997: 147-148, figs 19 h-i.

*Cyathotrochus pileus* - CAIRNS, 1997: 16, pl. 1, figs f-g, pl. 4, fig. f; 1998: 392.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 958, 2 (USNM 98760). — Stn 959, 1 (MNHN). — Stn 980, 1 (MNHN). — Stn 1016, 1 (MNHN).

TYPE LOCALITY. — "*Siboga*" stn 95: 5°43'N, 119°40'E (Sulu Archipelago, Philippines), 522 m.

REMARKS. — Descriptions and illustrations of this commonly collected deep-water coral can be found in CAIRNS (1989a, 1994, 1997). Most of the specimens reported above were alive when collected and possess four cycles of septa.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, and Efaté; 300-497 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 123-522 m (CAIRNS & ZIBROWIUS, 1997).

Genus *DELTOCYATHOIDES* Yabe & Eguchi, 1932

*Deltocyathoides orientalis* (Duncan, 1876)

*Deltocyathus orientalis* Duncan, \*1876: 431.

*Peponocyathus orientalis* - WELLS, v.1984: 214.

*Peponocyathus australiensis* - CAIRNS, 1989a: 29, 30-32, pl. 14, figs d-j, pl. 15, figs a-d (synonymy); 1994: 65-66, pl. 28, figs c-f, pl. 41, fig. 1 (synonymy). [Not *Deltocyathus italicus* var. *australiensis* Duncan, v\*1870].

*Deltocyathoides orientalis* - CAIRNS & ZIBROWIUS, 1997: 144. — CAIRNS, 1997: 17, pl. 1, fig. h, pl. 7, fig. f; 1998: 392.

MATERIAL EXAMINED. — MUSORSTOM 7: stn 512, 1 (MNHN). — Stn 523, 1 (MNHN).

TYPE LOCALITY. — 34°12'N, 136°20'E (southeastern Honshu, Japan), 95 m.

REMARKS. — This small, commonly collected and locally abundant coral was redescribed and illustrated by CAIRNS (1989, 1994) as *Peponocyathus australiensis*.

DISTRIBUTION. — Wallis and Futuna; 245-455 m. Late Pleistocene of Espiritu Santo, Vanuatu (WELLS, 1984). Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 44-635 m.

Genus *NOTOCYATHUS* Tenison Woods, 1880

*Notocyathus conicus* (Alcock, 1902)

*Citharocyathus conicus* Alcock, v\*1902b: 118-119; v.1902c: 22, pl. 3, figs 18, 18a.

*Notocyathus conicus* - CAIRNS, 1989a: 28, pl. 13, figs a-i (synonymy); 1994: 64-65, pl. 28, figs a-b; 1995: 91-92, figs c, g, map 10; 1997: 17, pl. 4, fig. j. — CAIRNS & ZIBROWIUS, 1997: 143-144.

Not *Citharocyathus conicus* - WELLS, v.1984: 214, figs 4, 2-5 [= ?*Notocyathus venustus* (Alcock, 1902)].

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1018, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1067, 2 (MNHN).

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

REMARKS. — Three well-preserved specimens of *N. conicus* are reported herein, the largest 6.2 mm in CD and 7.8 mm in height. This species was redescribed and figured by CAIRNS (1989, 1994), as well as compared to the other Recent sibling species, *N. venustus* (Alcock, 1902). WELLS (1984) reported the "*venustus*" form of *N. conicus* from the Pleistocene of Vanuatu, but the small size and poor condition of his specimens do not allow a definite attribution between these two very similar species.

DISTRIBUTION. — Vanuatu region: Efaté and Malakula; 344-366 m. Elsewhere: Japan; Philippines; Indonesia; Norfolk and Kermadec Ridges; 34-923 m (CAIRNS & ZIBROWIUS, 1997).

Genus *CRYPTOTROCHUS* Cairns, 1988*Cryptotrochus brevipalus* sp. nov.

Figs 17 f, i

MATERIAL EXAMINED/TYPES. — Vanuatu. MUSORSTOM 8: stn 988, 2 paratypes (MNHN). — Stn 1014, 1 paratype (MNHN). — Stn 1028, 1 paratype (USNM 98762). — Stn 1034, holotype (MNHN) and 1 paratype (MNHN). — Stn 1067, 1 paratype (MNHN). — Stn 1113, 1 paratype (USNM 98763).

TYPE LOCALITY. — MUSORSTOM 8: stn 1034: 17°54'S, 168°42'E (Efaté), 690-750 m.

ETYMOLOGY. — The species name *brevipalus* (Latin *brevis*, short + *palus*, stick) is a reference to the relatively short pali (P<sub>2</sub>) of this species. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum a regular inverted cone, the blunt basal angle ranging from 68° to 72° (turbinate). Largest specimen (holotype) 10.3 mm in CD and 10.0 mm in height. Calice circular; theca thick, about 0.7 mm. Costae 0.4-0.5 mm wide at calicular edge, separated by deep intercostal furrows 40-50% the costal width. C<sub>1-2</sub> independent in origin, but C<sub>4</sub> originate by trifurcation of C<sub>3</sub> 2.3-2.5 mm above base. Costae serrate, the outer edge of each costa covered with a single row of small teeth about 0.15 mm in diameter and height; smaller spines about 0.1 mm in height and 0.04 mm diameter project laterally from each costa into the intercostal spaces, although they are so small and well spaced that they do not obscure the view of the underlying theca between the costae. Corallum uniformly white.

Septa hexamerally arranged in 4 complete cycles in all specimens examined (CD = 6.0-10.3 mm): S<sub>1</sub>>S<sub>2</sub>>S<sub>3</sub>>S<sub>4</sub>, 48 septa. S<sub>1</sub> about 1.8 mm exsert, extend about 3/4 distance to columella, having straight, vertical axial edges that fuse to the columella lower in fossa. S<sub>2</sub> about 1.2 mm exsert and 2/3 width of the S<sub>1</sub>, each bearing a prominent palus (P<sub>2</sub>). S<sub>3</sub> about 0.9 mm exsert and 3/4 width of the S<sub>2</sub>, their lower axial edges strongly fused to the peripheral edge of the P<sub>2</sub> lower in fossa, but easily visible in calicular view. In fact, in some specimens it would appear that each S<sub>3</sub> bears a palus, a pair of which unite before their common S<sub>2</sub> to form a V-shaped P<sub>2</sub> (as in the case of *Notocyathus*); however, each P<sub>2</sub> in this species rises higher in the fossa (usually just above the level of the columella) as a single slender structure. S<sub>4</sub> about 0.7 mm exsert, 2/3 width of the S<sub>3</sub>, and have free axial edges. Septal faces covered with very small spines, the same size and shape as those occurring on the lateral faces of the costae. Fossa of moderate depth, containing a papillose columella of 4-7 strongly fused elements.

REMARKS. — Of the two other species known in the genus, *C. brevipalus* is most similar to *C. javanus* Cairns, 1988 (Java Sea, 585 m) in size and shape, and in having independent S<sub>4</sub>; however, differs in having serrate costae (not granular), S<sub>3</sub> fused to the peripheral edge of P<sub>2</sub>, and in having less prominent P<sub>2</sub>. *C. brevipalus* resembles *C. carolinensis* Cairns, 1988 (western Atlantic, 320-338 m) in having serrate costae and S<sub>3</sub> that fuse with the P<sub>2</sub>, but differs in having a larger and more open corallum (higher basal angle), independent S<sub>4</sub>, and pointed P<sub>2</sub> that rise slightly higher in the fossa. Although not in the same genus, *C. brevipalus* resembles *Pleotrochus zibrowii* Cairns, 1997, in size, shape, and in having S<sub>3</sub> that fuse to the peripheral edge of the P<sub>2</sub>. The two species have also been found at the same station; however, *C. brevipalus* differs in having a costae:septa ratio of 1 (vs 2), costal trifurcation (vs independent origin), a blunt base (vs pointed), and less prominent P<sub>2</sub>.

DISTRIBUTION. — Vanuatu region: Tanna, Efaté, Malakula, and Espiritu Santo; 466-700 m.

Genus *IDIOTROCHUS* Wells, 1935*Idiotrochus kikutii* (Yabe & Eguchi, 1941)

*Placotrochides kikutii* Yabe & Eguchi, \*1941: 104; 1942: 149, pl. 9, fig. 16a-c.

*Idiotrochus kikutii* - CAIRNS, 1989a: 36-37, pl. 18, figs a-b, d-h (synonymy); 1994: 69, pl. 30, figs a-d; 1997: 21, pl. 5, fig. g, pl. 7, fig. l; 1998: 390. — CAIRNS & ZIBROWIUS, 1997: 148-149.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 509, 6 (MNHN). — Stn 512, 1 (USNM 98764). — Stn 513, 1 (MNHN).

TYPE LOCALITY. — Toyama Bay, Honshu, Japan (depth not given).

REMARKS. — This distinctive, wedge-shaped species is well described and illustrated by CAIRNS (1989a) and CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 240-260 m. Elsewhere: western Pacific from Japan through Indonesia; Western Australia; 97-645 m (CAIRNS & ZIBROWIUS, 1997).

### Genus *PEPONOCYATHUS* Gravier, 1915

#### *Peponocyathus folliculus* (Pourtalès, 1868)

Figs 18 a-b

*Stephanophyllia folliculus* Pourtalès, v\*1868: 139.

*Peponocyathus variabilis* Gravier, v\*1915: 5; v.1920: 39, pl. 4, figs 60-73, pl. 13, fig. 202, pl. 14, figs 203-204.

*Peponocyathus folliculus* - CAIRNS, 1979: 113-115, pl. 22, figs 1-4; 1989a: 32-33 (in part: pl. 16, figs a-c); 1994: 66-67, pl. 28, figs g-k (synonymy and description); 1997: 30, pl. 3, fig. k, pl. 6, figs h-j. — ZIBROWIUS, v.1980: 113-115, pl. 58, figs A-L, pl. 59, figs A-K (synonymy). — CAIRNS & ZIBROWIUS, 1997: 146.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1088, 1 attached to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — "Bibb" stn 51: 24°12'40"N, 81°19'25"W (Straits of Florida, western Atlantic), 433 m.

REMARKS. — The single specimen reported herein is "gourd"- or "onion-shaped", measuring 4.9 mm in greatest diameter, but only 3.3 mm in CD, having 30 septa. The species is known to be variable in shape, the onion-shaped form being well illustrated and discussed by GRAVIER (1920) and ZIBROWIUS (1980). The specimen was dead when collected, and basally incorporated into a *Xenophora* gastropod shell. *Xenophora* gastropods, also called "carrier shells", appear to be efficient collectors of small, otherwise rarely collected deep-water Scleractinia, this particular shell (Fig. 18 a) having cemented eight solitary corals to its outer whorls, including: one *P. folliculus*, two *Caryophyllia abrupta*, three *Trochocyathus discus*, and two as yet unidentified species (i.e., Gardineriidae gen. nov. sp. nov. sensu STOLARSKI, 1996).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 425-455 m. Elsewhere: Atlantic; western Pacific from Japan through Indonesia; 50-582 m (CAIRNS & ZIBROWIUS, 1997).

### Superfamily FLABELLOIDEA Bourne, 1905

#### Family GUYNIIDAE Hickson, 1910

#### Genus *GUYNIA* Duncan, 1872

#### *Guynia annulata* Duncan, 1872

*Guynia annulata* Duncan, v\*1872: 32, pl. 1, figs 1-8. — ZIBROWIUS, v.1980: 161-162, pl. 83, figs A-Q (synonymy). — CAIRNS, 1989a: 42-43, pl. 21, fig. f, pl. 22, figs a-e; 1998: 392. — CAIRNS & PARKER, 1992: 42-43, pl. 14, figs g-h. — CAIRNS & ZIBROWIUS, 1997: 150 (synonymy).

**MATERIAL EXAMINED.** — Wallis and Futuna region. MUSORSTOM 7: stn 504, 4 attached to theca of ?dead corallum of *Conotrochus asymmetros* (MNHN). — Stn 513, 1 attached to theca of dead corallum of *Heterocyathus* cf. *sulcatus* (MNHN). — Stn 569, 1 attached to theca of dead corallum of *Flabellum arcuatile*, n. sp. (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 1016, 1 attached to base of dead discoidal coral, perhaps a *Deltocyathus* (USNM 98765). — Stn 1097, 1 cemented to a *Xenophora* shell (MNHN).

**TYPE LOCALITY.** — Adventure Bank, Mediterranean, 168 m.

**REMARKS.** — This extremely small, serpulid-like corallum is often found attached to living and dead coralla of other scleractinian species (see Material Examined). Although difficult to detect in collections because of its small size (CD about 1 mm) and its sometimes cryptic habit, its widespread distribution is becoming increasingly well known as large collections are closely examined. The species is more fully described and illustrated by ZIBROWIUS (1980), CAIRNS (1989a), and CAIRNS & PARKER (1992).

**DISTRIBUTION.** — Wallis and Futuna region: Futuna; Waterwitch Bank; 260-300 m. Vanuatu region: Efaté and Espiritu Santo; 288-300 m. Elsewhere: cosmopolitan in tropical and warm temperate regions; 28-653 m (CAIRNS & ZIBROWIUS, 1997).

Genus *TRUNCATOGUYNIA* Cairns, 1989

*Truncatoguynia irregularis* Cairns, 1989

Fig. 18 c

*Truncatoguynia irregularis* Cairns, \*1989a: 43, pl. 22, figs f-g, pl. 23, figs a-c, f; 1994: 70, pl. 30, figs e-f; 1995: 93-94, pl. 29, figs g-h, pl. 30, figs a-b, map 12.  
*Truncatoguynia* sp. Cairns, 1989a: 43, pl. 23, figs d-e.

**MATERIAL EXAMINED.** — Vanuatu. MUSORSTOM 8: stn 967, 4 (one in 5 pieces) (USNM 98766).

**TYPE LOCALITY.** — "Albatross" stn 5311: 21°33'N, 116°15'E (north of Pratas Island, South China Sea), 161 m.

**REMARKS.** — This species was described and illustrated several times recently as indicated in the synonymy. The specimens reported above pertain to the diminutive form of the species, similar to those reported from NZOI stn C531 by CAIRNS (1989a, 1995). These specimen are characterised by an elongate, curved corallum up to 21 mm in length, but having a small calice of only 2.4-2.8 mm GCD, resulting in a length:GCD ratio of 7.3-7.6. The basal scar is correspondingly small (1.1-1.8 x 0.9-1.4 mm), coralla containing only 24 hexamerally arranged septa: S<sub>1-2</sub>>>S<sub>3</sub>.

**DISTRIBUTION.** — Vanuatu region: Anatom; 295-334 m. Elsewhere: Ryukyu Islands; South China Sea; Norfolk and Kermadec Ridges; 80-248 m (CAIRNS, 1995).

Genus *TEMNOTROCHUS* Cairns, 1995

*Temnotrochus kermadecensis* Cairns, 1995

Figs 18 d-e

*Temnotrochus kermadecensis* Cairns, \*1995: 96, pl. 31, figs a-d.

**MATERIAL EXAMINED.** — Vanuatu. MUSORSTOM 8: stn 963, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1023, 2 cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — 3.7 km off Nugent Island, Raoul Island, Kermadec Ridge, 366-402 m.

REMARKS. — Little can be added to the original description based on these three specimens. *Temnotrochus kermadecensis* is characterised as having an elongate compressed-cylindrical anthocyathus that originates by transverse division, a papillose columella, and paliform lobes before the  $S_{1-2}$ . The characteristic thecal spots are often difficult to see, and are evident only on the specimen from MUSORSTOM 8 stn 963. The specimens reported above constitute the second report of this species and include specimens larger than in the type series, one from MUSORSTOM 8 stn 963 being 2.1 mm in GCD and 6.0 mm in length. All three specimens were obtained as objects cemented to the "carrier" gastropod shell *Xenophora*, an efficient collector of azooxanthellate corals of this size range.

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; 321-400 m. Elsewhere: Kermadec Ridge; 366-402 m.

Family FLABELLIDAE Bourne, 1905

Genus *FLABELLUM* Lesson, 1831

Subgenus *FLABELLUM (FLABELLUM)* Lesson, 1831

*Flabellum (F.) pavoninum* Lesson, 1831

Figs 18 g-i

*Flabellum pavoninum* Lesson, v\*1831: 2. — CAIRNS, 1989a: 46-50, pl. 23, figs g-l, pl. 24, figs a-d, g-h (synonymy); 1994: 70-71, pl. 30, figs g-i, pl. 31, figs a-c. — CAIRNS & ZIBROWIUS, 1997: 150-151, fig. 20h.  
*Flabellum coalitum* Marenzeller, v\*1888a: 48-49. — CAIRNS, 1989a: 46, 47, 50, pl. 24, figs e-f, i-l.  
*Flabellum* sp. - CAIRNS, 1989a: 24, pl. 24, figs e-f.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 504, 1 (MNHN). — Stn 513, 2 (MNHN). — Stn 516, 2 (MNHN). — Stn 523, 4 (MNHN). — Stn 538, 3 (USNM 98767). — Stn 569, 3 (MNHN). — Stn 605, 4 (MNHN). — Stn 610, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 963, 12 (USNM 98871). — Stn 964, 3 (USNM 98874). — Stn 971, 1 (USNM 98873). — Stn 976, 7 (MNHN). — Stn 988, 2 (MNHN). — Stn 1004, 1 (MNHN). — Stn 1005, 1 (MNHN). — Stn 1016, 2 (USNM 98770). — Stn 1017, 1 (MNHN). — Stn 1018, 4 (USNM 98768). — Stn 1065, 5 (USNM 98769). — Stn 1070, 1 (MNHN). — Stn 1071, 2 (MNHN). — Stn 1084, 4 (MNHN). — Stn 1085, 125 (MNHN). — Stn 1086, 6 (MNHN). — Stn 1087, 1 (USNM 98872). — Stn 1091, 3, including 1 cemented to a *Xenophora* shell (MNHN). — Stn 1102, 1 (MNHN). — Stn 1103, 15: 12 (MNHN), 3 (USNM 98875). — Stn 1132, 3 (MNHN). — Stn 1134, 3 (MNHN). — Stn 1135, 2 (MNHN).

TYPE LOCALITY. — "Sandwich Islands" (= Hawaiian Islands), no depth given.

DESCRIPTION (*coalitum* form). — Corallum flabellate: angle of thecal faces, 27°-47°; angle of thecal edges bimodal, the lower 5 mm of the corallum (the pedicel) having an edge angle of 40°-50°, above which the corallum widens to an edge angle of 62°-143°. Thecal faces virtually planar, meeting in acute thecal edges that bear a prominent, discontinuous edge crest composed of 1-4 (depending on size of corallum) thecal eversions, each eversion an irregularly shaped discrete structure up to 2.5 mm in height. Largest specimen examined (MUSORSTOM 8 stn 1102) 29.1 x 16.3 mm in CD and 22.5 mm in height. Basal disc quite small (0.9-1.0 mm in diameter), containing 6 protosepta, only the smallest coralla maintaining its original attachment to substrate. Theca dull in lustre, covered with fine transversely oriented ridges, and often covered with encrusting organisms, in four cases (MUSORSTOM 7 stn 538, MUSORSTOM 8 stns 976, 1104 and 1132) bored by acrothoracican Crustacea (Fig. 18 h). Lower 5 mm of corallum (basal disc and lower pedicel) white; remaining theca a light reddish brown, with more intense radial stripes corresponding to  $S_{1-3}$ .

Septa hexamerally arranged in 5 cycles and often part of a sixth cycle ( $S_{1-3}$ > $S_4$ > $S_5$ > $S_6$ ) in larger coralla, pairs of  $S_6$  particularly common in the quarter systems adjacent to the principal septa, but also occurring in random

order in lateral face quarter systems; largest corallum contains 140 septa. Distal peripheral edges of S<sub>1-3</sub> nonexsert, separated from thecal edge by a low notch or slight concavity, then projecting into fossa as a prominent lobe; midaxial edges of S<sub>1-3</sub> often slightly concave, and lower axial edges thickened and very sinuous. The two principal S<sub>1</sub> aligned with the GCD are smaller than the other 4 S<sub>1</sub>. Distal edges of S<sub>4</sub> not lobate and thus much narrower than S<sub>1-3</sub>, but lower in fossa almost 3/4 width of the S<sub>1-3</sub>; axial edges straight. S<sub>5</sub> about 1/3 width of an S<sub>4</sub>. When pairs of S<sub>6</sub> are present, the S<sub>5</sub> they flank widen to 2/3 the width of an S<sub>4</sub> and the S<sub>6</sub> are the size of a typical S<sub>5</sub>. Fossa deep and elongate; lower axial edges of S<sub>1-3</sub> fuse to form a rudimentary columella.

REMARKS. — Although recently redescribed and figured (CAIRNS, 1989a, 1994; CAIRNS & ZIBROWIUS, 1997), *F. pavoninum* is redescribed above based on the abundance of well-preserved specimens of this otherwise poorly represented species. All specimens reported above pertain to the "coalitum" form of the species, as discussed by CAIRNS (1994) and CAIRNS & ZIBROWIUS (1997), which is distinguished from the typical form by having a smaller corallum, a lower edge angle, and fewer septa.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 286-455 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; 161-400 m. Elsewhere: Indo-Pacific from southwest Indian Ocean to Hawaiian Islands, forma *coalitum* being most common off Japan; 73-665 m (CAIRNS & ZIBROWIUS, 1997).

*Flabellum (F.) arcuatile* sp. nov.

Figs 19 a-d

*Flabellum (F.) angiosomum* - CAIRNS, 1995: 99, pl. 32, figs d-f, map 13 [Not *Flabellum angiosomum* Folkeson, v\*1919].

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region.** MUSORSTOM 7: stn 524, 2 paratypes (MNHN). — Stn 530, 3 paratypes (MNHN). — Stn 534, 1 paratype (MNHN). — Stn 535, 2 paratypes (MNHN). — Stn 542, 1 paratype (USNM 98876). — Stn 546, 2 paratypes (USNM 98877). — Stn 578, 1 paratype (USNM 98878). — Stn 589, 1 paratype (MNHN).

**New Zealand region.** NZOI: stn 192, 9 paratypes (USNM 94322). — Stn 197, 35: 20 paratypes (NZOI), holotype (NZOI H688), 14 paratypes (USNM 94323). — Stn U599, 1 paratype (NZOI).

TYPE LOCALITY. — NZOI stn 197: 32°22.9'S, 167°28.2'E (southern Norfolk Ridge), 540-544 m.

ETYMOLOGY. — The species name *arcuatile* (Latin *arcuatilis*, shaped like a bow) refers to the regular crescent-shaped arc formed by the calicular margin.

DIAGNOSIS. — Corallum flabellate, highly compressed (GCD:LCD = 2.1-3.1), never constricted, and robust. Corallum wider than tall: GCD: H = 1.25-1.45. Thecal edges always rounded, the lower 7-9 mm of the corallum having an edge angle of 60°-80°, changing to a more open 125°-180° with height. Face angle = 26°-39°. Holotype 38.4 x 15.4 mm in CD and 28.3 mm in height, chosen because it represents a corallum with a full sixth cycle of septa; largest corallum (paratype from NZOI 197, NZOI) 49.8 x 20.5 mm in CD and 33.8 mm in height. Pedicel small: 1.1-1.3 mm in diameter. Thecal of well-preserved specimens uniformly reddish brown. Septa hexamerally arranged in 6 or more cycles, the sixth cycle attained at a GCD of 20-25 mm, and larger coralla having some pairs of S<sub>7</sub>: S<sub>1-4</sub>>S<sub>5</sub>>S<sub>6</sub>>S<sub>7</sub>. Axial edges of S<sub>1-4</sub> extremely sinuous.

REMARKS. — Among the 23 Recent species in the subgenus, *F. arcuatile* is one of three species to have a flabellate corallum with rounded thecal edges, the other two species being *F. knoxi* Ralph & Squires, 1962 (New Zealand region south of 38°S), and *F. impensum* Squires, 1962 (Antarctic, 46-2200 m). *F. arcuatile* is most similar to *F. knoxi*, but differs in having a more robust corallum, a smaller pedicel with fewer protosepta (6 vs 12), a lesser developed columella, and a more compressed corallum.

A fuller description of *Flabellum arcuatile* can be found in CAIRNS (1995), as *Flabellum angiosomum*. I (CAIRNS, 1998) subsequently examined the type of *Flabellum angiosomum*, transferred it to the genus *Truncatoflabellum*, and eliminated the New Zealand records from its range, but did not at that time indicate the



identity of the New Zealand specimens previously identified as *F. anglostomum*, which now form part of the type series of *F. arcuatile*.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Field Banks; 300-640 m. Elsewhere: southern Norfolk Ridge; Three Kings Ridge; 544-590 m (CAIRNS, 1995).

Subgenus *FLABELLUM (ULOCYATHUS)* Sars, 1851

*Flabellum (U.) deludens* Marenzeller, 1904

Fig. 18 f

*Flabellum deludens* Marenzeller, \*1904: 269-272, pl. 17, figs 10, 10a. — CAIRNS, 1989a: 55-56, pl. 29, figs a-f (synonymy); 1994: 73, pl. 32, figs d-e; 1998: 395. — CAIRNS & ZIBROWIUS, 1997: 154-156.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 532, 1 (MNHN).

TYPE LOCALITY. — "Valdivia" stns 185 and 203: west of Sumatra, 614-660 m.

REMARKS. — Only one worn specimen is reported herein, measuring 27.8 x 16.1 mm in CD, 20.6 mm in height, and 1.8 x 1.5 mm in PD, containing 72 septa - a pair of rudimentary S<sub>5</sub> flanking each S<sub>3</sub>. This specimen is unusual in that its C<sub>1-2</sub> are produced as prominent, rounded ridges (Fig. 18 f). The species is redescribed and illustrated by CAIRNS (1989a, 1994) and a table comparing similar species is given by CAIRNS & ZIBROWIUS (1997: Table 2).

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 516-530 m. Elsewhere: Indo-West Pacific from northern Indian Ocean through Indonesia to Japan; 106-1035 m (CAIRNS & ZIBROWIUS, 1997).

*Flabellum (U.) aotearooa* Squires, 1964

Fig. 19 e

*Flabellum aotearooa* Squires, v\*1964: 7-9, pl. 2, figs 15-18. — CAIRNS, 1995: 102-103, pl. 33, figs d-f, i, Map 16 (synonymy).

*Flabellum* sp. cf. *F. deludens* - WELLS, v.1984: 215, pl. 4, figs 8-10 [Not *Flabellum deludens* Marenzeller, \*1904].

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn \*959, 3 (MNHN). — Stn 963, 25, including 1 cemented to a *Xenophora* shell (USNM 98882). — Stn \*964, 4 (MNHN). — Stn \*977, 1 (MNHN). — Stn \*1004, 1 (MNHN). — Stn 1005, 2 (MNHN). — Stn \*1016, 30 (MNHN). — Stn \*1017, 6 (USNM 98880). — Stn \*1018, 148 (MNHN). — Stn \*1023, 2 (MNHN). — Stn 1060, 1 (MNHN). — Stn 1065, 1 (USNM 98881). — Stn 1091, 4 (USNM 98879). — Stn \*1134, 1 (MNHN).

TYPE LOCALITY. — "Ikatare" stn B-26: 35°04'S, 174°23.2'E (Bay of Islands, near Cape Brett, New Zealand), 184 m (see CAIRNS, 1995).

REMARKS. — Although previously known from the Late Pleistocene of Vanuatu (WELLS, 1984), this is the first record of living specimens from this archipelago. The species was recently redescribed and illustrated by CAIRNS (1995). It is characterised by having a scalloped calicular edge; a granular, but lustrous theca; and S<sub>1-4</sub> with highly sinuous axial edges. Several stations reported above (indicated with an asterisk) include populations that are diminutive in size, the coralla never exceeding 15 mm in GCD. These specimens nonetheless have a full fifth cycle and often have highly developed edge crests (Fig. 19 e), resulting in an edge angle (crests included) of 180°.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, Erromango, Efaté, Malakula, and Espiritu Santo (including Late Pleistocene, see WELLS, 1984); 287-436 m. Elsewhere: northern New Zealand and ridges north of New Zealand; Chesterfield Islands; 130-1300 m (CAIRNS, 1995).

*Flabellum (U.) marcus* Keller, 1974

Fig. 19 f

*Flabellum deludens* - VAUGHAN, v\*1907: 63-65, pl. 3, fig. 5 [Not *Flabellum deludens* Marenzeller, \*1904].  
*Flabellum marcus* Keller, \*1974: 208-209, pl. 1, fig. 5, pl. 3, figs 5-6, pl. 5, fig. 8, text-fig. 1; 1981a: 31-32, pl. 1, figs 7a-b, pl. 2, figs 5a-b. — CAIRNS, 1984: 21.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 956, 7 (USNM 98883). — Stn 1037, 8 (MNHN). — Stn 1129, 1 (MNHN).

TYPE LOCALITY. — "Vityaz" stn 6363: 21°10'N, 163°16'E (Marcus-Necker Ridge), 1350 m.

REMARKS. — The best description of this species is that of specimens from Hawaii by VAUGHAN (1907), as *Flabellum deludens*. The specimens reported above differ from the Hawaiian populations in having a lesser edge angle (125°-142° vs 180°), and a taller pedicel (up to 4 mm vs 1.5-1.8 mm in diameter). They are otherwise quite similar and found at a comparable depth range.

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; Guyot Bougainville; 1050-1175 m. Elsewhere: central Pacific, including Marcus-Necker Ridge and Hawaiian Islands; 1261-1602 m (CAIRNS, 1984).

*Flabellum (U.) hoffmeisteri* Cairns & Parker, 1992

*Flabellum (U.) hoffmeisteri* Cairns & Parker, \*1992: 47-48, pl. 16, figs d-f (synonymy). — CAIRNS, 1995: 103-104, pl. 33, figs g-h, map 22; 1998: 394-395. — CAIRNS & ZIBROWIUS, 1997: 157-158.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1014, 1 (MNHN).

TYPE LOCALITY. — "Soela" stn 27: 37°59'S, 150°05'E (off Victoria, Australia), 452 m.

REMARKS. — Only one poorly-preserved corallum is reported herein measuring 33.1 x 20.6 mm in CD and 22.5 mm in height. Descriptions and illustrations can be found in CAIRNS & PARKER (1992) and CAIRNS (1995), and a table comparing similar species in CAIRNS & ZIBROWIUS (1997: Table 2).

DISTRIBUTION. — Vanuatu region: Efaté; 495-498 m. Elsewhere: Indonesia; Western Australia; Victoria; Tasmania; Kermadec and Colville Ridges; 110-646 m (CAIRNS, 1998).

*Flabellum (U.) apertum apertum* Moseley, 1876

*Flabellum apertum* Moseley, v\*1876: 556 (in part: "Challenger" stn 145); v.1881: 167-168 (in part: pl. 6, figs 7a-c). — CAIRNS, 1982: 44-46, pl. 13, figs 8-11, pl. 14, figs 1-4 (synonymy).  
*Flabellum patagonicum* Moseley, v\*1881: 166-167, pl. 15, figs 1-7.  
*Flabellum raukawaensis* Squires & Keyes, v\*1967: 27, pl. 4, figs 8-9.  
*Flabellum apertum apertum* - CAIRNS, 1995: 104-105, pl. 35, figs a-c, map 4 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 551, 49 (MNHN). — Stn 552, 53 (USNM 98884). — Stn 564, 30 (MNHN). — Stn 565, 53 (USNM 98885). — Stn 567, 6 (MNHN). — Stn 620, 1 (MNHN). — Stn 621, 1 (MNHN). — Stn 623, 1 (MNHN).

TYPE LOCALITY. — "Challenger" stn 145: 46°40'S, 37°50'E (off Prince Edward Island), 567 m.

REMARKS. — Little can be added to the redescriptions and figures of CAIRNS (1982, 1995). Once thought to be a species with an antiboreal distribution, it is now known from the warm temperate region off New Zealand (CAIRNS, 1995), and now from beneath tropical waters.

DISTRIBUTION. — Wallis and Futuna region: Combe and Tuscarora Banks; 795-1280 m. Elsewhere: circum-Subantarctic; New Zealand region to Three Kings Islands; 220-1575 m (CAIRNS, 1995).

Genus *TRUNCATOFLABELLUM* Cairns, 1989

*Truncatoflabellum stabile* (Marenzeller, 1904)

Figs 19 i-j

*Flabellum stabile* Marenzeller, \*1904: 273-274, pl. 17, figs 12a-b. — ZIBROWIUS, 1980: 150.

*Truncatoflabellum stabile* - CAIRNS, 1989a: 61. — ZIBROWIUS & GILI, 1990: 39.

*Truncatoflabellum* sp. cf. *T. stabile* - CAIRNS & KELLER, 1993: 264-265, fig. 10C, F.

*Truncatoflabellum* sp. A - CAIRNS, 1994: 79, pl. 34, figs c-e.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 996, 1 (MNHN). — Stn 1036, 1 (MNHN). — Stn 1037, 1 (USNM 98887). — Stn 1125, 2 (including an anthocaulus) (MNHN). — Stn 1127, 1 (MNHN).

Madeira Islands. CANCAP III: stn 3.053, 4 (USNM 98886).

TYPE LOCALITY. — "Valdivia" stn 37: 16°14'01"N, 22°38'03"W (Cape Verde Islands), 1694 m.

DESCRIPTION. — Anthocyathus: Angle of straight thecal edges 59°-73°; inclination of slightly convex thecal faces, 29°-40°. Thecal faces meet in an acute angle at the edges and are very slightly ridged within 1-4 mm of the basal scar, but edges do not bear crests or spines. Largest specimen reported herein (MUSORSTOM 8 stn 996) 28.2 x 16.9 mm in CD and 28.4 mm in height. Calicular margin slightly arched and finely serrate: GCD:LCD = 1.36-1.67; GCD:H = 1.00-1.15. Basal scar small and elliptical: 3.6-6.4 x 2.6-4.1 mm. Theca overlying C<sub>1-2</sub> produced as low, rounded longitudinal ridges, perpendicular to which are fine growth lines. Theca uniformly white. Anthocaulus 5.3 mm in height and 2.0 mm in pedicel diameter, having 3 cycles of septa.

Septa hexamerally arranged in 5 complete cycles: S<sub>1-2</sub>>S<sub>3</sub>>S<sub>4</sub>>S<sub>5</sub>, the base of an anthocyathus having only 3 cycles plus several pairs of S<sub>4</sub> (24-32 septa), and a full fourth cycle present by a GCD of 11 mm. S<sub>1-2</sub> only slightly wider than S<sub>3</sub>, whereas S<sub>3</sub> are twice the width of the S<sub>4</sub>, and S<sub>5</sub> are only about 1/3 the width of the S<sub>4</sub>. Axial edges of all septa straight and vertical, those of the S<sub>1-3</sub> thickened deep in fossa near their fusion to the columella. Fossa deep, containing a well-developed, elongate columella 1.8-2.0 mm wide.

REMARKS. — Although smaller than previously reported specimens from the Atlantic, Mozambique, and Japan, which reach 48 mm in GCD, the specimens reported herein are believed to be conspecific. MARENZELLER (1904) described his larger syntype as having a GCD of 60 mm, but his figure implies a corallum with a GCD of 41 mm. The syntypes of *Flabellum stabile* appear to be lost (ZIBROWIUS, 1980). Among the 29 Recent species of *Truncatoflabellum*, only four lack edge spines and edge crests: *T. inconstans* (Marenzeller, 1904); *T. trapezoideum* (Keller, 1981); *T. paripavoninum* (Alcock, 1898); and *T. stabile* (Marenzeller, 1904), the last three being found at great depths. Although I previously hesitated in identifying Pacific specimens as *T. stabile*, I now believe them to be the same based on the examination of specimens from the Madeira Islands (see Material Examined). Discussions and comparisons of the nonspinose *Truncatoflabellum* species are found in ZIBROWIUS & GILI (1990) and CAIRNS (1994). Although they are similar in corallum morphology, *T. stabile* differs from: *T. trapezoideum* in having a smaller basal scar; from *T. paripavoninum* in having a smaller basal scar, a small edge angle, less septa, and a more robust corallum; and from *T. inconstans* in having less septa, a more circular calice, and a much deep depth range.

DISTRIBUTION. — Vanuatu region: Erromango and Efaté; Guyot Bougainville; 786-1160 m. Elsewhere: Cape Verde, Selvagens, and Madeira Islands; Mozambique; Ryukyu Islands; 964-3010 m (ZIBROWIUS & GILI, 1990).

*Truncatoflabellum dens* (Alcock, 1902)

Figs 19 g-h

*Flabellum dens* Alcock, v\*1902a: 106-107; v.1902c: 32, pl. 4, figs 30, 30a. — CAIRNS, 1989a: 54, pl. 28, figs g-k.  
*Truncatoflabellum dens* - CAIRNS, 1995: 114-115 (in part: pl. 37, fig. g). — CAIRNS & ZIBROWIUS, 1997: 170.

**MATERIAL EXAMINED.** — **Wallis and Futuna region.** MUSORSTOM 7: stn 546, 1 (MNHN). — Stn 569, 8 (USNM 98889). — Stn 585, 2 (MNHN). — Stn 597, 1 (MNHN). — Stn 605, 4 (USNM 98890). — Stn 610, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 965, 3 (MNHN). — Stn 977, 1 (MNHN). — Stn 988, 3 (USNM 98888). — Stn 1015, 1 (MNHN). — Stn 1060, 1 (MNHN).

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

**DIAGNOSIS.** — Corallum small and compressed (GCD:LCD = 1.7-2.3), the largest specimen reported herein (MUSORSTOM 8 stn 1060) 8.6 mm in CD. Thecal edges rounded, at a height of about 6 mm above basal scar changing from an angle of 60°-80° to a more slender 20°-35°. At point of angular change there is usually a pair of short edge spines or low crests, often broken or worn away, as in the case of the syntypes. Basal scar quite small and almost circular, ranging from 1.4-1.7 x 1.1-1.3 mm in diameter, containing only 6 protosepta. Well-preserved coralla often show a reddish-brown longitudinal striping. Septa hexamerally arranged in 4 cycles (S1-2>S3>>S4); however, pairs of S4 often lacking in lateral half-systems, resulting in 40-44 total septa. Large coralla may have additional pairs of S5 in the end half-systems, but may also be lacking pairs of S4 in the lateral half-systems. Axial edges of S1-2 highly sinuous.

**REMARKS.** — This species is more fully described by CAIRNS (1989a, 1995). It is distinctive in having a relatively small corallum with a bimodal edge angle, and a very small, almost circular basal scar.

**DISTRIBUTION.** — Wallis and Futuna region: Wallis; Combe, Waterwitch, and Field Banks; 286-500 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 314-410 m. Elsewhere: Philippines; Indonesia; Kermadec and Norfolk Ridges; New Caledonia; 300-555 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum pusillum* Cairns, 1989

Fig. 20 a

*Truncatoflabellum pusillum* Cairns, \*1989a: 71-72, pl. 37, figs a-e. — CAIRNS & KELLER, 1993: 265, pl. 11, fig. E. — CAIRNS & ZIBROWIUS, 1997: 170.

**MATERIAL EXAMINED.** — **Vanuatu.** MUSORSTOM 8: stn 973, 2 (USNM 98891). — Stn 988, 1 (MNHN). — Stn 1016, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1094, 1 (MNHN). — Stn 1097, 10, including 1 cemented to a *Xenophora* shell (MNHN). — Stn 1098, 1 (USNM 98892). — Stn 1106, 3 attached to a *Xenophora* shells (MNHN).

**TYPE LOCALITY.** — "Albatross" stn 5178: 12°43'N, 122°06'15"E (Sibuyan Sea, Philippines), 143 m.

**REMARKS.** — The original description suffices for this species. It is characterised as having a small corallum (usually less than 7 mm GCD) with straight, rounded thecal edges (edge angle = 14°-18°), each edge bearing 2-4 downward projecting thecal spines. The basal scar is elliptical, up to 3.3 mm in greater diameter, bearing 12-24 septa. Septa are arranged in 3 cycles (S1-2>S3), larger specimen having pairs of S4 in their end half-systems (i.e., usually 24-32 septa). It differs from *T. dens* by having a larger basal scar with more septa, a constant edge angle, and additional pairs of edge spines.

**DISTRIBUTION.** — Vanuatu region: Tanna and Espiritu Santo; 285-460 m. Elsewhere: Philippines; Indonesia; Mozambique; 85-300 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum angustum* Cairns & Zibrowius, 1997

Fig. 20 b

*Truncatoflabellum dens* - CAIRNS, 1995: 114 (in part, pl. 37, figs f, h; NZOI K858)[Not *Flabellum dens* Alcock, v\*1902].  
*Truncatoflabellum angustum* Cairns & Zibrowius, \*1997: 172-173, figs 23c-f.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 501, 1 (MNHN). — Stn 502, 2 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 1016, 5 (USNM 98894). — Stn 1017, 1 (MNHN). — Stn 1018, 11 (MNHN). — Stn 1065, 3 (MNHN). — Stn 1087, 1 (MNHN). — Stn 1091, 1 (USNM 98893). — Stn 1135, 3 (USNM 98895).

TYPE LOCALITY. — MUSORSTOM 3 stn 143: 11°28.3'N, 124°11.6'E (Visayan Sea, Philippines), 205-214 m.

REMARKS. — *Truncatoflabellum angustum* was recently described and figured. In that account, specimens from MoNZ stn BS441, previously illustrated as *T. dens* by CAIRNS (1995: pl. 37, fig. g), were incorrectly listed as nontype specimens of *T. angustum*. Instead, those specimens should be considered as valid *T. dens*. *T. angustum* is most similar to *T. pusillum*, but differs by having a larger corallum, a higher edge angle, and more septa (i.e., usually 56).

Most of the specimens reported herein and most of the paratypes differ from the holotype in having 20 highly sinuous primary septa, not 24 S<sub>1-3</sub>.

DISTRIBUTION. — Futuna; 516-530 m. Vanuatu region: Efaté, Malakula, and Espiritu Santo; 295-394 m. Elsewhere: Philippines; Indonesia; Kermadec Islands; 195-465 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum phoenix* Cairns, 1995

*Truncatoflabellum* sp. B. - CAIRNS, 1994: 79, pl. 33, figs i, l.

*Truncatoflabellum phoenix* Cairns, \*1995: 115-116, pl. 37, fig. i, pl. 38, figs a-f. — CAIRNS & ZIBROWIUS, 1997: 171.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 495, 1 (USNM 98896). — Stn 509, 7 (MNHN). — Stn 512, 11 (USNM 98897). — Stn 513, 4 (MNHN). — Stn 514, 1 (MNHN). — Stn 516, 1 (MNHN). — Stn 538, 1 (MNHN).

TYPE LOCALITY. — NZOI stn C531: 29°14'40"S, 178°02'W (Raoul Island, Kermadec Islands), 179 m.

REMARKS. — This species is best characterised in its original description, and is distinguished from other species by having a small corallum with parallel thecal edges, and often elongate coralla caused by incomplete separation of successive anthocyathi. The specimens listed above differ from previously reported specimens in having an edge angle of 0°-10°, which results in a calicular diameter slightly greater than that of the basal scar, and a basal scar that reveals only 12 protosepta, instead of 24 protosepta as in typical *T. phoenix*. All other characters are similar.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Waterwitch Bank; 240-441 m. Elsewhere: Philippines; Indonesia; Ryukyu Islands; Kermadec Islands; 18-421 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum vigintifarium* sp. nov.

Figs 20 c-f

MATERIAL EXAMINED/TYPES. — **Vanuatu.** MUSORSTOM 8: stn 1004, 1 paratype (MNHN). — Stn 1018, 3 paratypes (USNM 98900). — Stn 1060, 1 paratype (MNHN). — Stn 1065, 3 paratypes (USNM 98899). — Stn 1094,

2 paratypes (MNHN). — Stn 1097, 5 paratypes (MNHN). — Stn 1098, holotype (MNHN) and 4 paratypes (USNM 98898). — Stn 1106, 9 paratypes (MNHN). — Stn 1113, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1098: 15°04'S, 167°10'E (northeast of Espiritu Santo), 277-285 m.

ETYMOLOGY. — The species name *vigintifarium* (Latin *viginti*, twenty + *farius*, a suffix meaning a multiplication in number of parts) refers to the 20-fold septal symmetry of the anthocyathus.

DESCRIPTION OF ANTHOCYATHUS. — Corallum flabellate: angle of straight, rounded thecal edges, 67°-84°; face angle, 25°-30°. Holotype 21.1 x 9.7 mm in CD, 17.3 mm in height, and 2.9 x 2.0 mm in basal scar diameter; largest specimen (MUSORSTOM 8 stn 1018) 26.4 x 13.4 mm in CD. Calice elliptical: GCD:LCD = 1.95-2.40. Thecal edges bear 2 or 3 (usually 3) pairs of elongate (up to 5 mm), attenuate spines, the first pair occurring 3-4 mm above the basal scar and additional pairs regularly spaced at 2.5-3.0 mm intervals. Basal scar small (2.9-3.6 x 2.0-2.7 mm) and elliptical in shape (ratio of greater to lesser scar diameters 1.24-1.37-1.60), clearly showing 12 septa (Fig. 20 c). Theca thin and transversely wrinkled in a chevron pattern. Theca longitudinally striped with reddish-brown pigment. Anthocaulus stage unknown.

Despite the hexamerall arrangement of septa in the basal scar, the septa of mature (GCD over 20 mm) specimens as expressed at the calicular margin are arranged 20-fold: 20:20:40, resulting in 80 septa. The distal, axial edges of the 20 primary septa are not exsert, but project well into the fossa, having straight distal axial edges and sinuous lower axial edges. Secondary septa much narrower, reaching their greatest width near the columella where they are about half the width of the primaries. Tertiary septa often rudimentary, usually only half the width and length of a secondary. Fossa deep and narrow, the columella a fusion of the lower axial edges of the 20 primary septa.

REMARKS. — Among the 30 known Recent species of *Truncatoflabellum*, only one other has decamerally arranged septa in the adult anthocyathus stage: *T. formosum* Cairns, 1989. *T. vigintifarium* differs from that species primarily in shape, having a more flabellate corallum characterised by a higher edge angle (67°-84° vs 37°-59°) and a higher GCD:LCD (1.95-2.4 vs 1.4-1.8). It has a smaller basal scar and usually one more pair of edge spines.

DISTRIBUTION. — Vanuatu region: Erromango, Efaté, Malakula, and Espiritu Santo; 288-700 m; however, most records between 300 to 400 m.

### *Truncatoflabellum mortenseni* Cairns & Zibrowius, 1997

*Truncatoflabellum mortenseni* Cairns & Zibrowius, \*1997: 171-172, figs 22g-h.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 523, 5 anthocauli (MNHN). — Stn 585, 1 anthocaulus (MNHN). — Stn 601, 4 anthocauli (MNHN).

Vanuatu. MUSORSTOM 8: stn 963, 1 anthocaulus (MNHN). — Stn 964, 1 anthocaulus (MNHN). — Stn 967, 5 anthocauli and 2 anthocyathi (MNHN). — Stn 969, 5 anthocauli (MNHN). — Stn 970, 1 anthocaulus (USNM 98901). — Stn 971, 3 anthocauli (USNM 98902). — Stn 1065, 2 anthocauli (MNHN). — Stn 1070, 1 anthocyathus (MNHN). — Stn 1071, 1 anthocaulus and 1 anthocyathus (MNHN). — Stn 1077, 1 anthocaulus (MNHN). — Stn 1102, 2 anthocauli and 1 anthocyathus (USNM 98903). — Stn 1103, 3 anthocauli and 30 anthocyathi (USNM 98904). — Stn 1134, 1 anthocaulus and 1 anthocyathus (MNHN).

TYPE LOCALITY. — MORTENSEN'S JAVA-SOUTH AFRICA EXPEDITION stn 5: 11°36'N, 121°43'E (Sulu Sea), 120-122 m.

REMARKS. — This species is characterised by having an anthocaulus that, even after forming a single pair of edge spines, usually resists the tendency to transversely divide. This results in a relatively large, triangular anthocaulus with a small pedicel (0.9-1.1 mm in diameter), 1 pair of edge spines, and 56, 64, or 80 septa, depending on the development of the fifth septal cycle. Most of the specimens reported above represent this distinctive anthocaulus stage; however, some coralla represent the anthocyathus stage, which has a greater basal scar diameter of 6-8 mm, several pairs of edge spines, and usually a full five cycles of septa (96). Anthocauli and anthocyathi are often found at the same station.

DISTRIBUTION. — Wallis; 350-455 m. Vanuatu region: Anatom, Malakula, and Espiritu Santo; 165-400 m. Elsewhere: Philippines; Indonesia; 50-156 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum vanuatu* (Wells, 1984)

*Flabellum vanuatu* Wells, v\*1984: 215, figs 4 (11-12), 5 (1).  
*Truncatoflabellum vanuatu* - CAIRNS, 1989a: 63, 69, pl. 36, fig. c.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 505, 1 (MNHN). — Stn 509, 6 (MNHN). — Stn 524, 4 (MNHN). — Stn 605, 1 (USNM 98906).

TYPE LOCALITY. — Kere River (Late Pleistocene), Espiritu Santo, Vanuatu.

REMARKS. — This species is characterised as having a small basal scar (4.1-4.9 mm in greater diameter) with 12 protosepta, low edge and face angles (20°-27°, 12°-17°, respectively), and a relatively tall corallum that bears up to five pairs of edge spines. In small to medium-sized coralla there are 16 primary septa (16:16:24-32, = 56-64 septa), but in larger coralla there may be up to 20 primary septa (20:20:32-40, = 72-80 septa). Theca reported herein are all smaller than those in the type series, most having 16 primary septa and 56 septa. They are the first report of this species subsequent to its original description and first report from the Recent.

DISTRIBUTION. — Wallis and Futuna; 240-335 m. Vanuatu region: Late Pleistocene of Espiritu Santo (WELLS, 1984).

*Truncatoflabellum aculeatum* (H. Milne Edwards & Haime, 1848)

*Flabellum aculeatum* H. Milne Edwards & Haime, v\*1848a: 272, pl. 8, figs 3, 3a.  
*Truncatoflabellum aculeatum* - CAIRNS, 1989a: 61, 64, table 6, pl. 31, figs h-l, pl. 32, figs a-c (synonymy); 1998: 399-400, table 4. — CAIRNS & ZIBROWIUS, 1997: 166-167.

MATERIAL EXAMINED. — Vanuatu. South Santo Island, coll. J.N. CARNEY, stn SDC-5, 30-50 m, II 1975, 2 (USNM 98905).

TYPE LOCALITY. — Philippines (depth not given).

REMARKS. — Although not reported from the MUSORSTOM cruises in this region, probably because of its shallow depth range, two typical specimens are reported from an independent collection made by J. N. CARNEY in 1975. The appearance of the specimens suggests a fossil age, perhaps Late Pleistocene, similar to the fauna reported by WELLS (1984). *T. aculeatum* was redescribed and illustrated by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 30-50 m. Elsewhere: Philippines; Indonesia (also Pleistocene of Tafaud); Western Australia; Northern Territory; 11-115 m (CAIRNS, 1998).

*Truncatoflabellum candeanum* (H. Milne Edwards & Haime, 1848)

*Flabellum candeanum* H. Milne Edwards & Haime, \*1848a: 278, pl. 8, fig. 13.  
*Truncatoflabellum candeanum* - CAIRNS, 1989a: 70-71, table 6, pl. 36, figs d-h (synonymy, neotype designation); 1994: 76-77, pl. 33, figs e-f. — CAIRNS & ZIBROWIUS, 1997: 167.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1086, 4: 3 (MNHN), 1 (USNM 98907).

TYPE LOCALITY. — "Albatross" stn 5369: 13°48'N, 121°43'E (Luzon, Philippines), 194 m.

REMARKS. — Only one lot of this species is reported herein, probably because of its relatively shallow depth range. It is distinguished from other species by its slightly scalloped calicular margin and its three pairs of flattened edge spines. It is more fully described and illustrated by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Malakula; 182-215 m. Elsewhere: western Pacific from Kyushu through Indonesia; 70-290 m (CAIRNS & ZIBROWIUS, 1997).

*Truncatoflabellum martensii* (Studer, 1878)

Figs 21 a-f

*Flabellum Martensii* Studer, v\*1878: 630-631, pl. 1, figs 4a-b; 1889: 268.

*Flabellum paripavoninum* - WELLS, v.1984: 214-215 (in part: USGS 25715, fig. 4 (6-7)) [Not *F. paripavoninum* Alcock, 1894].

*Truncatoflabellum martensii* - CAIRNS, 1989a: 61.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1085, 13: 10 (MNHN), 3 (USNM 98908). — Stn 1086, 4 (MNHN).

TYPE LOCALITY. — "Gazelle" stn 40: 26°51.1'S, 153°29.6'E (off Brisbane, Queensland), 139 m.

DESCRIPTION. — Corallum flabellate: edge angle, 40°-63°; face angle, 17°-19°. Thecal faces almost planar, meeting in straight, sharply defined (but not carinate) edges that usually bear 3 pairs of spines. Holotype (ZMB 1798) 21.7 x 10.9 mm in CD, 7.7 mm in greater basal scar diameter, and 18.6 mm in height; largest known specimen (Pleistocene specimen figured by WELLS, 1984; USNM 71858) 28.6 x 12.0 mm in CD, 8.3 mm in greater basal scar diameter, and 22.9 mm in height. Range of greater basal scar diameter 7.2-9.3 mm, well-preserved scars showing 4 complete cycles of septa. Theca dark reddish-brown overall, with more intense longitudinal striping associated with the S<sub>1-3</sub>. Basal scar, edge spines, and septa white. Anthocaulus unknown.

Septa hexamerally arranged in 5 cycles, small coralla having less than 96 septa, larger coralla having additional pairs of S<sub>6</sub> in half-systems adjacent to the principal septa (See Remarks). Septa formula: S<sub>1-3</sub>>S<sub>4</sub>>S<sub>5</sub>>S<sub>6</sub>. Axial edges of S<sub>1-3</sub> highly sinuous, their lower axial edges fusing into a columellar structure low in centre of fossa. S<sub>4-6</sub> progressively narrower and less sinuous, their axial edges not attaining the columella.

REMARKS. — The number of septa per corallum is roughly a function of the GCD, the largest specimen (WELLS' Pleistocene corallum from Vanuatu) of 28.6 mm GCD having 15 pairs of S<sub>6</sub>, or 126 septa, whereas a small anthocyathus of 16 mm GCD (e.g., MUSORSTOM 8 stn 1085) has only 64 septa. The transition to a full fifth cycle of 96 septa occurs at a GCD of 20-22 mm, the holotype of GCD 21.7 mm still having only 88 septa, but other specimens of similar GCD having 96 or even 104 septa. The first S<sub>6</sub> occur in the four half-systems adjacent to the two principal septa, resulting in 104 septa, and are progressively inserted in half-systems away from the edge.

This is believed to be the first report of this species subsequent to its original description from off Brisbane. It is distinguished from other congeners by its sharply angled thecal edges, almost planar thecal faces, and its overall reddish-brown theca.

DISTRIBUTION. — Vanuatu region: Malakula; 161-182 m. Vanuatu region: Late Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: off Brisbane, Queensland, 139 m (STUDER, 1878).

Genus *JAVANIA* Duncan, 1876

*Javania lamprotichum* (Moseley, 1880)

*Desmophyllum lamprotichum* Moseley, v\*1880: 41-42, figs 1-2.



*Javania lamprotichum* - CAIRNS, 1984: 21, pl. 4, figs D-E; 1995: 112, pl. 37, figs b-c, map 20; 1998: 403, figs 8j, m. — CAIRNS & ZIBROWIUS, 1997: 164 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 520 or 521 (confusion on label), 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 974, 1 (USNM 98909). — Stn 975, 1 (MNHN). — Stn 988, 1 (MNHN). — Stn 1014, 1 (USNM 98910).

TYPE LOCALITY. — Unknown.

REMARKS. — Of the ten Recent species in this genus, *J. lamprotichum* is one of five that has five cycles of septa. It is further distinguished by having a relatively large corallum, a flared calice, and usually having a reddish-brown theca, although the thick tectural deposits reinforcing the pedicel are usually white. Reported herein is the largest known specimen of this species (MUSORSTOM 8 stn 975), measuring 46.8 x 36.2 mm in CD and 47.9 mm in height, the base being broken above its attachment. One corallum, from MUSORSTOM 8 stn 974, contains several acrothoracican cirripede borings, a commensalism previously reported for this species by CAIRNS & ZIBROWIUS (1997) and CAIRNS (1998). The species was most recently redescribed and illustrated by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis; 890-920 m. Vanuatu region: Tanna and Efaté; 466-536 m. Elsewhere: central and western Pacific (Hawaiian Islands, Johnston Atoll, Philippines, Kermadec Ridge); Western Australia; 191-842 m (CAIRNS, 1998).

*Javania fusca* (Vaughan, 1907) comb. nov.

Figs 20 g-i

*Placotrochus fuscus* Vaughan, v\*1907: 66-67, pl. 4, figs 2-3.

"*Placotrochus*" *fuscus* - CAIRNS, 1989a: 45, 75.

*Javania pachythea* CAIRNS, \*1995: 112-113, pl. 36, figs j-l, pl. 37, fig. a, map 17. — CAIRNS & ZIBROWIUS, 1997: 165, figs 21i, 22a.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 525, 1 (USNM 98913). — Stn 530, 2 (MNHN). — Stn 540, 1 (MNHN). — Stn 578, 3 (MNHN). — Stn 592, 1 (USNM 98912).

**Vanuatu.** MUSORSTOM 8: stn 959, 1 (MNHN). — Stn 965, 3 (USNM 98911). — Stn 982, 1 (MNHN). — Stn 988, 3 (MNHN). — Stn 1097, 2 (MNHN). — Stn 1106, 1 (MNHN). — Stn 1114, 2 (USNM 98914). — Stn 1128, 20 (MNHN).

TYPE LOCALITY. — "*Albatross*" stns 3886 and 3999: Kauai and Molokai Islands, Hawaiian Islands, 271 m.

DIAGNOSIS. — Corallum small (GCD usually less than 9 mm), straight, and ceratoid to subcylindrical, with a thickened pedicel. Calice only slightly elliptical: GCD:LCD = 1.1-1.2; calicular edge serrate, triangular apices corresponding to the 24 S<sub>1-3</sub>, these projections best preserved and seen in small specimens. Theca thick, covered with numerous, very small, porcellaneous granules. Base colour of corallum white, but often pigmented with brownish-black rings encircling the theca, and irregular pigmentation of the same colour on the distal peripheral faces of the S<sub>1-2</sub>. Septa hexamerally arranged in 4 complete cycles: S<sub>1-2</sub>>S<sub>3</sub>>>S<sub>4</sub> (48 septa). S<sub>1-2</sub> 1.2-1.5 mm exsert, having slightly sinuous axial edges. S<sub>3</sub> up to 0.5 mm exsert and only 1/2-2/3 width of the S<sub>1-2</sub>, having moderately sinuous axial edges. S<sub>4</sub> nonexsert, in fact, their distal edges often several mm below the calicular edge. S<sub>4</sub> only 1/5-1/4 width of the S<sub>3</sub>, also having moderately sinuous axial edges. Fossa deep and lacking a columella, as is consistent with the generic definition.

REMARKS. — This species was originally placed in the genus *Placotrochus* by VAUGHAN because of the presence of a well-formed lamellar columella in one of the three syntypes (corallum number "1" of VAUGHAN, 1907, USNM 20734), notwithstanding the fact that a columella could not be found in the other two syntypes. After careful cleaning and examination, it was discovered that the columella in specimen 1 was simply a fragment from a distal septal margin, probably from the same specimen, that had accidentally become lodged in an axial

columellar position. This fragment has now been removed from the fossa. Lacking a columella, this species naturally falls into the genus *Javania*; in fact, it is the senior synonym of a species I recently described as *J. pachythea* Cairns, 1995.

VAUGHAN (1907) originally designated three syntypes of *Placotrochus fuscus*, two from "Albatross" stn 3999 and one from stn 3886, listing two USNM catalog numbers for the specimens: 20731 and 20732. Whereas USNM 20732 applies to the single syntype (specimen #2: VAUGHAN's pl. 4, fig. 2) from "Albatross" stn 3886, USNM 20731 was previously assigned to the holotype of *Gardinieria hawaiiensis*, a species described by VAUGHAN on the page previous to *Placotrochus fuscus*. The true catalog numbers (see CAIRNS, 1991b) for the remaining two syntypes from "Albatross" stn 3999 are: 20733 (specimen #3, VAUGHAN's pl. 4, fig. 3) and 20734 (specimen #1, unfigured by VAUGHAN).

Two of the specimens examined have acrothoracican cirripede borings: one from MUSORSTOM 8 stn 988 (Fig. 20 i), the other being one of the three syntypes (USNM 20733).

**DISTRIBUTION.** — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, and Field Banks; 600-730 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; Guyot Bougainville; 314-778 m. Elsewhere: Indonesia; Malaysia; northern New Zealand; Kermadec Ridge; Lord Howe Seamount Chain; Aitutaki Atoll, Cook Islands [not Chesterfield Islands, as incorrectly reported by CAIRNS (1995) and CAIRNS & ZIBROWIUS (1997) for *J. pachythea*]; Hawaiian Islands; 271-1045 m.

*Javania exserta* sp. nov.

Figs 21 g-i

*Desmophyllum* sp. cf. *D. crista-galli* - WELLS, 1954: 470 [Not *Desmophyllum cristagalli* H. Milne Edwards and Haime, 1848].

*Javania* sp. - CAIRNS & ZIBROWIUS, 1997: 165, figs 22b-c.

**MATERIAL EXAMINED/TYPES.** — **Indonesia.** KARUBAR: stn 30, 2 paratypes (USNM 98919). — Stn 44, holotype (MNHN). — Stn 49, 2 paratype fragments (USNM 97498). — Stn 86, 1 paratype (MNHN).

**Philippines.** MUSORSTOM 1: stn 65, 1 paratype (MNHN).

**Wallis and Futuna region.** MUSORSTOM 7: stn 499, 1 paratype (USNM 98916). — Stn 513, 2 paratypes (MNHN). — Stn 514, 1 paratype (MNHN). — Stn 523, 2 paratypes (MNHN). — Stn 537, 1 paratype (USNM 98915). — Stn 538, 1 paratype (MNHN). — Stn 569, 1 paratype (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 962, 1 paratype (MNHN). — Stn 964, 1 paratype (MNHN). — Stn 978, 1 paratype (USNM 98918). — Stn 1021, 5 paratypes (USNM 98917). — Stn 1030, 8 paratypes (MNHN). — Stn 1042, 2 paratypes (MNHN). — Stn 1060, 3 paratypes (MNHN). — Stn 1085, 1 paratype (MNHN).

**Caroline Islands (Pelau).** "Short drop off", 91 m, 1 fragment of a corallum, paratype (USNM 98956).

**TYPE LOCALITY.** — KARUBAR stn 44: 7°52'27"S, 132°48'24"E (south of Tanimbar Island), 291-295 m.

**ETYMOLOGY.** — The species name *exserta* (Latin *exsertus*, project or exsert) refers to the highly exsert  $S_{1-2}$  of this species.

**DESCRIPTION.** — Corallum ceratoid and straight, having a slightly flared calicular edge. Calice slightly elliptical: GCD:LCD = 1.05-1.20. Holotype 15.6 x 13.7 mm in CD, 33.8 mm in height, and 7.2 mm in PD. Calicular edge highly serrate, a tall, acute triangular apex corresponding to each  $S_{1-2}$ . Calicular edge between  $S_{1-2}$  of small specimens straight, but with increasing size becoming slightly convex or rounded, and in the largest specimens expressed as a low, obtuse, triangular apex corresponding to the  $S_3$ . Theca porcellaneous and usually white; however, specimens from KARUBAR stations pigmented a light purple-grey. Ridged  $C_{1-2}$  sometimes expressed within 0-3 mm of calicular edge.

Septa hexamerally arranged in 4 complete cycles (48 septa):  $S_1 > S_2 >> S_3 > S_4$ .  $S_1$  extremely exsert, in the holotype as much as 6.5 mm, but even in coralla of moderate size, 3-4 mm. Axial edges of  $S_1$  straight and vertical, the 4 lateral  $S_1$  almost meeting in centre of fossa.  $S_2$  also quite exsert but only 1/2-2/3 that of the  $S_1$ , about 3/4 width of the  $S_1$ , and also less thick than the  $S_1$ .  $S_3$  not exsert: rudimentary or absent near calicular edge,

increasing to about 3/4 width of S<sub>2</sub> lower in fossa. S<sub>4</sub> also nonexsert, 1/3-1/2 width of the S<sub>3</sub>. Axial edges of S<sub>1-2</sub> slightly sinuous. Fossa deep and narrow.

REMARKS. — *Javania exserta* is distinguished from the other three Recent species in the genus that have four cycles of septa [*J. cailleti* (Duchassaing & Michelotti, 1864); *J. pseudoalabastra* Zibrowius, 1974; and *J. fusca* (Vaughan, 1907)] by its relative septal exsertness: its S<sub>1</sub> being larger than its S<sub>2</sub>, and its S<sub>3-4</sub> being nonexsert.

Specimens from MUSORSTOM 8 stn 1085 and KARUBAR stn 86 contain acrothoracican cirripede borings.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 295-455 m. Vanuatu region: Anatom, Tanna, Efaté, Epi, and Malakula; 130-408 m. Elsewhere: Philippines; Arafura Sea south of Tanimbar Island; Pelau; Bikini, Marshall Islands; 91-291 m.

### Genus *RHIZOTROCHUS* H. Milne Edwards & Haime, 1848

#### *Rhizotrochus typus* H. Milne Edwards & Haime, 1848

Fig. 22 a

*Rhizotrochus typus* H. Milne Edwards & Haime, \*1848a: 282, pl. 8, fig. 16. — CAIRNS, 1989a: 79-81, pl. 41, figs f-j (synonymy); 1994: 81, pl. 35, figs a-c, pl. 40, figs h-i (synonymy). — CAIRNS & ZIBROWIUS, 1997: 161, figs 22d-e.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1021, 1 (USNM 98920). — Stn 1078, 1 (MNHN). — Stn 1131, 1 (MNHN).

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

REMARKS. — Three specimens of this common, relatively shallow-water azooxanthellate are reported herein. The genus is distinguished from other genera in the region by having several cycles of discrete (free standing, not contiguous with corallum), hollow rootlets. *R. levidensis* Gardiner, 1899, known from nearby Loyalty Islands at 84 m, differs in having a much smaller corallum (GCD < 6 mm) and fewer septa (≤ 34). *R. typus* was recently redescribed and figured by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Efaté, Malakula, and Espiritu Santo; 130-194 m. Elsewhere: Indo-West Pacific from Red Sea to Japan; 20-1048 m (CAIRNS & ZIBROWIUS, 1997).

#### *Rhizotrochus flabelliformis* Cairns, 1989

*Flabellum latum* - Alcock, v.1902c: 31 [Not *F. latum* Studer, 1878].

*Rhizotrochus flabelliformis* Cairns, v\*1989a: 81, pl. 41, figs k-l, pl. 42, figs b, d; 1995: 109-110, pl. 35, figs g-i, pl. 36, figs a-b, map 17.

"*Rhizotrochus*" *flabelliformis* - CAIRNS & ZIBROWIUS, 1997: 161-162.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 511, 1 (MNHN).

TYPE LOCALITY. — "Siboga" stn 105: 6°08'N, 121°19'E (Sulu Archipelago, Philippines), 275 m.

REMARKS. — One relatively small (GCD=24 mm), worn specimen is reported herein, still in the process of forming its edge rootlets. It is distinguished from all other corals in this region by having two massive rootlets, one on each corallum edge. It is best described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Futuna; 400-450 m. Elsewhere: Philippines; Indonesia; New Zealand; 228-419 m (CAIRNS & ZIBROWIUS, 1997).

Genus *POLYMYCES* Cairns, 1979*Polymyces wellsii* Cairns, 1991

*Polymyces wellsii* Cairns, \*1991a: 22, pl. 8, figs f, i, pl. 9, figs a-b; 1995: 108-109, pl. 35, figs d-f, map 10. — CAIRNS & ZIBROWIUS, 1997: 160-161. — CAIRNS, 1998: 403-404.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 975, 1 (MNHN).

TYPE LOCALITY. — "Johnson-Sea-Link" stn 1916: 1°18.7'S, 89°48.8'W (Española, Galápagos), 545-562 m.

REMARKS. — One live specimen, with tissue preserved, is reported. This species is distinctive in having four asymmetrically arranged, contiguous rootlets, all four rootlets occurring on one side of the corallum. It is best described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Tanna; 536-566 m. Elsewhere: Philippines; Indonesia; northwestern Australia; northeastern New Zealand; Kermadec Islands; Galápagos; 355-1165 m (CAIRNS & ZIBROWIUS, 1997).

## Superfamily VOLZEIOIDEA Melnikova, 1974

## Family GARDINERIIDAE Stolarski, 1996

Genus *GARDINERIA* Vaughan, 1907*Gardineria hawaiiensis* Vaughan, 1907

*Gardineria hawaiiensis* Vaughan, v\*1907: 65-66, pl. 4, fig. 1. — CAIRNS, 1984: 23; 1995: 110-111, map 13, pl. 36, figs c-f, i; 1998: 404. — STOLARSKI, v.1996: 348-350, figs 2F-G, 4A-I, 8A-C.

*Gardineria musorstomica* Cairns, v\*1989a: 82-83, pl. 42, figs c, e-g.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1006, 1 (USNM 98921). — Stn 1011, 1 (MNHN). — Stn 1014, 1 (MNHN). — Stn 1067, 1 (MNHN).

TYPE LOCALITY. — "Albatross" stn 3991: 22°15'24"N, 159°23'15"W (Kauai, Hawaiian Islands), 497-541 m.

REMARKS. — This species is characterised by having a thick epithelial wall, and hexamerally arranged septa in four cycles and three size classes, the last cycle incomplete (24-44 septa). Larger specimens possess 6 P<sub>2</sub> and a rudimentary columella. *G. hawaiiensis* is best described and figured by STOLARSKI (1996).

DISTRIBUTION. — Vanuatu region: Erromango, Efaté, and Malakula; 366-574 m. Elsewhere: Philippines; New Caledonia (STOLARSKI, 1996); Norfolk Ridge; Kermadec Islands; Bay of Plenty, New Zealand; Western Australia; Hawaiian Islands; 142-602 m (CAIRNS, 1995).

*Gardineria paradoxa* (Pourtalès, 1868)

Fig. 22 b

*Haplophyllia paradoxa* Pourtalès, v\*1868: 140-141.

*Gardineria paradoxa* - CAIRNS, 1979: 160-161, map 46, pl. 31, figs 4-6, 10 (synonymy). — STOLARSKI, v.1996: 348-350, figs 2C-E, 5A-G. — CAIRNS & ZIBROWIUS, 1997: 163, figs 21g-h.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: 1014, 1 (MNHN).

TYPE LOCALITY. — "Bibb" stn 22: 24°14'20"N, 80°59'40"W (Straits of Florida), 692 m.

REMARKS. — The single specimen reported herein measures 9.3 mm in CD and 36.6 mm in length, having a lateral thecal attachment for the basal 17 mm. It has 40 septa (20:20:40) and is very similar to the specimen reported by CAIRNS & ZIBROWIUS (1997) from the Banda Sea. *G. paradoxa* is distinguished from other congeners by having decamerally arranged septa, a strong lateral thecal attachment, and a heavily encrusted and worn looking corallum, even when the coral is collected alive.

DISTRIBUTION. — Vanuatu region: Efaté; 495-498 m. Elsewhere: Banda Sea; western Atlantic (Antilles); 91-700 m.

### Suborder DENDROPHYLLIINA

#### Family DENDROPHYLLIIDAE Gray, 1847

#### Genus *BALANOPHYLLIA* Searles Wood, 1844

REMARKS. — There are approximately 58 valid Recent species of *Balanophyllia* worldwide, and the genus is badly in need of revision (CAIRNS, 1995: 118). There are several reasons for the confused state of taxonomy in this genus. First, the range of corallum variation is poorly known for most species, several species known only from their type specimens. In an extreme case [i.e., *B. corniculans* (Alcock, 1902a)], the species was based on one specimen that is now lost, and no figure of the holotype or indication of the type locality was included in the original description. Secondly, basally-broken corallites of other genera, such as *Rhizopsammia*, *Eguchipsammia*, *Cladopsammia*, and even *Dendrophyllia*, could be mistaken for a *Balanophyllia*, and the juvenile stage of all of these genera pass through a solitary *Balanophyllia*-like stage. Third, most species of *Balanophyllia* are provincial in distribution, endemic to one side of an ocean basin, and thus a large number of species have been described, making it difficult to do a comprehensive comparison of unidentified material. Although the Atlantic species have been revised (CAIRNS, 1977; ZIBROWIUS, 1980), there has been no comprehensive worldwide revision of the genus. A subgeneric division or a good dichotomous key would alleviate some of these difficulties. At this point, however, it is useful to compare specimens collected from a geographic region to others known from that region. For instance, there are 10 species known from the western Atlantic, 4 from the eastern Atlantic, 5 from the southwestern Indian Ocean, 4 from the northern Indian Ocean, 5 from eastern Australia, 3 from New Zealand, 5 from the Hawaiian Islands, 21 from the tropical western Pacific (including northwestern Western Australia), 3 from the eastern Pacific, and one from the Subantarctic. There appears to be little cross over of species between regions. For instance, there are no species in common between the eastern and western Atlantic, and the eastern Pacific fauna is also discrete; however, there are several species that have wider distributions in the tropical western Pacific and the Hawaiian Islands and/or Japan and/or New Zealand. Therefore, in identifying the specimens collected by MUSORSTOM 7 and 8, all species known from the western and central Pacific were considered, but, even so, I was only able to confidently identify about one-third of the specimens available as one of six of the more common species.

#### *Balanophyllia desmophyllioides* Vaughan, 1907

Fig. 22 c

*Balanophyllia desmophyllioides* Vaughan, v\*1907: 149-150, pl. 45, fig. 1. — CAIRNS & ZIBROWIUS, 1997: 177-178, figs 23g-h.

*Balanophyllia desmophyllioides* - CAIRNS, 1984: 26.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 496, 2 (MNHN). — Stn 500, 4 (MNHN). — Stn 502, 1 (MNHN). — Stn 509, 17 (USNM 98924). — Stn 512, 5 (MNHN). — Stn 524, 2 (MNHN). — Stn 538, 1 (MNHN). — Stn 589, 1 (MNHN). — Stn 601, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 964, 2 (MNHN). — Stn 969, 3 (USNM 98926). — Stn 988, 1 (USNM 98922). — Stn 1030, 1 (MNHN). — Stn 1065, 1 (USNM 98925). — Stn 1098, 4: 3 (MNHN), 1 (USNM 98923).  
**Lord Howe seamount chain.** NZOI: stn 1741, 9 (USNM 94366).

TYPE LOCALITY. — "Albatross" stn 4061: Hawaii, 44-152 m.

DIAGNOSIS. — Corallum straight, firmly attached, and flared distally. Calice elongate; calicular edge arched and constricted in centre, in some cases (Fig. 22 c) producing a division of the fossa. Costae well defined; thin epitheca often present basally. Septa hexamerally arranged in 5 cycles, coralla of GCD 11-12 having a complete fifth cycle; additional half-systems of septa may occur in elongate specimens (e.g., the holotype).  $S_{1-3}$  equal in size, pairs of  $S_5$  fusing high in fossa before their flanking  $S_4$ . Lower axial edges of  $S_{1-3}$ , 5 coarsely dentate. Fossa deep; papillose columella small, elongate, and low.

REMARKS. — The species was recently redescribed and illustrated by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch and Field Banks; 240-516 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 190-372 m. Elsewhere: Hawaiian Islands; Philippines; Indonesia; Chesterfield Islands (reported herein); 95-658 m (CAIRNS & ZIBROWIUS, 1997).

*Balanophyllia laysanensis* Vaughan, 1907

Figs 22 d-e

*Balanophyllia laysanensis* Vaughan, v\*1907: 150-151, pl. 45, figs 2a-b.

MATERIAL EXAMINED. — **Vanuatu.** MUSORSTOM 8: stn 962, 2 (MNHN). — Stn 963, 1 (MNHN). — Stn 965, 1 (USNM 98927).

TYPE LOCALITY. — "Albatross" stn 3937: 25°52'05"N, 171°46'47"W (Laysan Island, Hawaiian Islands), 238-271 m.

REMARKS. — Little can be added to the VAUGHAN's original description. The species can be characterised as having a straight, ceratoid corallum with a highly serrate calicular margin. The theca is highly porous and coarsely granular; costae are poorly defined, but the  $C_{1-2}$  are prominent. Septa are arranged in 4 complete cycles, pairs of  $S_4$  bending toward but not quite fusing before their enclosed  $S_3$  relatively low in fossa.

This is the first report of *B. laysanensis* subsequent to its original description.

DISTRIBUTION. — Vanuatu region: Anatom; 377-400 m. Elsewhere: Laysan, Hawaiian Islands; 238-271 m (= type locality).

*Balanophyllia rediviva* Moseley, 1881

*Balanophyllia rediviva* Moseley, v\*1881: 193-194, pl. 15, figs 10-12. — CAIRNS & ZIBROWIUS, 1997: 181-182, figs 25d-f (synonymy).

MATERIAL EXAMINED. — **Vanuatu.** MUSORSTOM 8: stn 970, 1 (MNHN). — Stn 1077, 2 (USNM 98928). — Stn 1134, 2 (MNHN).

TYPE LOCALITY. — "Challenger" stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 256 m.

REMARKS. — *Balanophyllia rediviva* was recently redescribed and figured by CAIRNS & ZIBROWIUS (1997). It is distinguished by having an elongate, subcylindrical corallum that often shows signs of rejuvenescence, the rejuvenated corallum often smaller in calicular diameter than the parent. Its costae ( $C_{1-3}$ ) are also characteristically slightly ridged.

DISTRIBUTION. — Vanuatu region: Anatom, Malakula, and Espiritu Santo; 210-252 m. Elsewhere: Philippines; Indonesia; 90-256 m (CAIRNS & ZIBROWIUS, 1997).

*Balanophyllia gemma* (Moseley, 1881)

*Thecopsammia gemma* Moseley, v\*1881: 195, pl. 15, figs 8a-b.

*Balanophyllia gemma* - CAIRNS & ZIBROWIUS, 1997: 179, figs 24g-i (synonymy).

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1009, 2 (MNHN). — Stn 1015, 7: 5 (MNHN), 2 (USNM 98930). — Stn 1019, 2 (USNM 98929).

TYPE Locality. — "Challenger" stn 201: 7°03'N, 121°48'E (Sulu Sea), 187 m.

REMARKS. — *Balanophyllia gemma* was recently redescribed and the holotype illustrated by CAIRNS & ZIBROWIUS (1997). It is characterised by having a well-developed epitheca that covers most of the theca; low, equal costae; and a shallow fossa containing a discrete, swirled columella.

DISTRIBUTION. — Vanuatu region: Efaté; 397-430 m. Elsewhere: Philippines; Indonesia; 137-522 m (CAIRNS & ZIBROWIUS, 1997).

*Balanophyllia gigas* Moseley, 1881

*Balanophyllia gigas* Moseley, v\*1881: 193. — WELLS, v.1984: 217, figs 5 (2-3). — CAIRNS, 1994: 83, pl. 35, figs j-l (synonymy); 1995: 119-120, pl. 40, figs f-h, map 7 (synonymy); 1998: 404. — CAIRNS & ZIBROWIUS, 1997: 182.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 977, 1 (MNHN).

TYPE LOCALITY. — Japan (depth unknown).

REMARKS. — *Balanophyllia gigas* is well described and figured by CAIRNS (1994, 1995), including an illustration of the holotype. The single specimen reported herein measures 24.5 x 21.5 mm in CD and 54.5 mm in height. WELLS' (1984) Pleistocene specimens from Vanuatu (USNM 71862) were re-examined and considered conspecific. *B. gigas* attains the largest size of all *Balanophyllia*, and usually has five cycles of septa, if not some  $S_6$  in various half-systems.

DISTRIBUTION. — Vanuatu region: Tanna; 410-505 m; Late Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: widely distributed in western Pacific from Hawaiian Islands to New Zealand and West Australia; 90-640 m (CAIRNS & ZIBROWIUS, 1997).

*Balanophyllia crassithec*a Cairns, 1995

*Balanophyllia crassithec*a Cairns, \*1995: 120-121, map 18, pl. 40, fig. i, pl. 41, figs a-b.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 978, 1 (MNHN).

TYPE LOCALITY. — 37°17.0'S, 176°51.0'E (Rangatira Knoll, northwest of White Island, Bay of Plenty, New Zealand), 251-308 m.

REMARKS. — The single record reported herein does little more than extend the known distribution slightly to the north. The species is distinguished by having a very thick theca and crowded septa.

DISTRIBUTION. — Vanuatu region: Tanna; 408-413 m. Elsewhere: northeastern New Zealand; Lord Howe and Norfolk Islands; Kermadec Ridge; 190-508 m (CAIRNS, 1995).

Genus *ENDOPACHYS* H. Milne Edwards & Haime, 1848*Endopachys grayi* H. Milne Edwards & Haime, 1848

Fig. 22 f

*Endopachys grayi* H. Milne Edwards & Haime, \*1848b: 82-83, pl. 1, figs 2, 2a. — ZIBROWIUS & GRYGIER, 1985: 137 (New Caledonia). — CAIRNS, 1994: 84-85, pl. 36, figs e, h, pl. 37, fig. i (synonymy); 1995: 121-122, pl. 41, figs c-h, map 13 (synonymy); 1998: 405. — CAIRNS & ZIBROWIUS, 1997: 185-186.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 504, 1 (MNHN). — Stn 507, 1 (MNHN). — Stn 516, 1 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 967, 2 (USNM 98932). — Stn 969, 1 (MNHN). — Stn 976, 17 (MNHN). — Stn 1005, 1 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1018, 6 (MNHN). — Stn 1071, 3 (MNHN). — Stn 1085, 1 (USNM 98933). — Stn 1086, 6 (USNM 98934). — Stn 1134, 2 (USNM 98931).

TYPE LOCALITY. — Unknown.

REMARKS. — Most specimens of this commonly collected species are easily distinguished by having unattached, cuneiform-shaped coralla with prominent edge crests; asexual budding; and five cycles of septa. Its wide distribution may be due to its reproductive success, which employs two modes of asexual reproduction: transverse division and anthoblast production (= bud shedding)(see CAIRNS, 1989b). In the first case, once an attached division and anthoblast production (= bud shedding) reaches a height of about 7 mm and a GCD of 3.5-4.0 mm, it forms a crested anthocyathus that subsequently transversely divides from the anthocaulus (Fig. 22 f). The detached, free-living anthocyathus maintains the characteristic basal scar (greater diameter 3.5-4.0 mm) for a time but eventually heals its base, which becomes rounded. Each anthocyathus has the potential to form numerous buds (anthoblasts), which form at the calicular edge, usually adjacent to the edge crests. Only one other coral species is known to employ both asexual reproduction strategies, *Blastotrochus nutrix* H. Milne Edwards & Haime, 1848, a member of a different suborder.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 390-441 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; 181-360 m. Elsewhere: widespread throughout tropical and warm temperate Indo-Pacific, from the southwestern Indian Ocean to the Gulf of California; 37-386 m (CAIRNS & ZIBROWIUS, 1997).

Genus *HETEROPSAMMIA* H. Milne Edwards & Haime, 1848*Heteropsammia cochlea* (Spengler, 1781)

*Madrepora cochlea* Spengler, \*1781: 240-248, figs A-D.

*Heteropsammia cochlea* - VERON & PICHON, 1980: 416-420, in part: figs 727, 729 (synonymy and description). — HOEKSEMA & BEST, 1991: 234-237, figs 24-28 (synonymy!). — CAIRNS, 1998: 406-408.

MATERIAL EXAMINED. — **Wallis and Futuna region.** MUSORSTOM 7: stn 494, 83 (MNHN). — Stn 495, 9 (USNM 98937). — Stn 496, 30 (USNM 98935). — Stn 504, 10 (MNHN). — Stn 509, 11 (USNM 98936). — Stn 512, 3 (MNHN). — Stn 516, 9 (MNHN).

**Vanuatu.** MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 967, 1 (MNHN). — Stn 969, 1 (MNHN). — Stn 976, 1 (MNHN). — Stn 1072, 1 (MNHN).

TYPE LOCALITY. — Tranquebar, off southeastern India.

REMARKS. — The species is easily distinguished by its obligate symbiotic association with a sipunculid worm, which is housed in the base of the corallum and communicates with the environment through one large efferent pore in the base of the corallum and several smaller pores on the lower theca. It is similar in shape to



species of *Heterocyathus*, which also lives with an obligate sipunculid, but differs in having a porous upper theca, and septa that are arranged in a Pourtalès plan. *H. cochlea* is best described and figured by VERON & PICHON (1980) and HOEKSEMA & BEST (1991). Shallow-water representatives of this species are assumed to be zooxanthellate, whereas the deeper specimens must be azooxanthellate.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 110-441 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 110-622 m. Elsewhere: widespread throughout tropical Indo-West Pacific; 9-137 m, although depths have rarely been reported (HOEKSEMA & BEST, 1991).

### Genus *DENDROPHYLLIA* Blainville, 1830

#### *Dendrophyllia ijimai* Yabe & Eguchi, 1934

*Dendrophyllia ijimai* Yabe & Eguchi, \*1934b: 2026. — EGUCHI, 1965: 294, 2 figs; 1968: C65 (in part: pl. C16, figs 1-2, pl. C22, fig. 1)(synonymy). — CAIRNS & KELLER, 1993: 280, fig. 13G. — CAIRNS, 1995: 89, pl. 38, figs c, f (synonymy).

?*Dendrophyllia subcornigera cylindrica* Eguchi, \*1968: C64-65, pl. C32, figs 1-2 [Not *D. subcornigera subcornigera* Eguchi, 1968].

*Dendrophyllia subcornigera* - WELLS, v.1984: 215-216, fig. 5 (4-5) [Not *D. subcornigera subcornigera* Eguchi, 1968].

*Dendrophyllia* sp. cf. *D. ijimai* - CAIRNS & ZIBROWIUS, 1997: 191-192, fig. 29e.

MATERIAL EXAMINED. — USGS stn 25715 (*Dendrophyllia subcornigera* of WELLS, 1984): figured specimen (USNM 71863), 12 branches (USNM 73976).

TYPE LOCALITY. — Unknown, but presumed to be from off Japan.

REMARKS. — *Dendrophyllia ijimai* belongs to the "first group" of *Dendrophyllia* species sensu CAIRNS (1995), this group characterised by having a robust axial corallite from which additional corallites bud at right angle. WELLS (1984) correctly identified the Vanuatu Pleistocene specimens as *D. subcornigera*, listing *D. ijimai* as a junior synonym, not realizing that *D. ijimai* was described earlier. The nominal subspecies of *D. subcornigera* is probably a junior synonym of *D. arbuscula* van der Horst, 1922 (see CAIRNS, 1995). *D. ijimai* was recently redescribed and figured by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: southwestern Indian Ocean to Japan; 10-366 m (CAIRNS, 1995).

#### *Dendrophyllia arbuscula* van der Horst, 1922

*Dendrophyllia arbuscula* van der Horst, v\*1922: 53 (in part: "Siboga" stn 277, pl. 8, fig. 6). — CAIRNS, 1994: 90-91, pl. 38, figs i-l (synonymy); 1995: 125-126, pl. 43, figs e-f, map 15; 1998: 408-409. — CAIRNS & ZIBROWIUS, 1997: 192-193, figs 29a-c (lectotype designated).

*Dendrophyllia horsti* Gardiner & Waugh, v\*1939: 237-238, pl. 2, figs 5-6.

MATERIAL EXAMINED. — Vanuatu. MUSORSTOM 8: stn 1018, 4 colonies (USNM 98938). — Stn 1021, 1 colony (MNHN). — Stn 1030, 2 colonies and 2 branches (MNHN). — Stn 1058, 2 colonies and 1 branch (MNHN).

TYPE LOCALITY. — "Siboga" stns 260 and 277: Banda Sea, 45-90 m.

REMARKS. — *Dendrophyllia arbuscula* is the only species reported herein that belongs to *Dendrophyllia* "group 2" sensu CAIRNS (1995), i.e., species having relatively small, bushy colonies with irregular branching from a short, but robust axial corallite. It is distinctive in having a relatively shallow fossa with a well-developed columella that is often constricted into three lobes. It was recently redescribed and figured by CAIRNS (1994, 1995).

DISTRIBUTION. — Vanuatu region: Efaté and Malakula; 130-319 m. Elsewhere: Indo-West Pacific from southwestern Indian Ocean to Japan; 2-353 m (CAIRNS, 1998).

*Dendrophyllia alcocki* (Wells, 1954)

*Sclerhelia alcocki* Wells, v\*1954: 465-466, pl. 177, figs 1-2.

*Dendrophyllia alcocki* - ZIBROWIUS, v.1974b: 570-573, figs 10-14. — CAIRNS, 1995: 126-127, pl. 43, figs g-i, pl. 44, figs a-b, map 3 (synonymy); 1998: 408, fig. 9g. — CAIRNS & ZIBROWIUS, 1997: 193.

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 506, 1 colony (MNHN). — Stn 514, 3 branches (USNM 98943).

Vanuatu. MUSORSTOM 8: stn 971, 4 colonies (MNHN). — Stn 977, 1 colony (MNHN). — Stn 978, 1 branch (MNHN). — Stn 980, 1 branch (MNHN). — Stn 982, 4 branches (MNHN). — Stn 983, 1 colony and 2 branches (USNM 98940). — Stn 988, 4 branches (USNM 98942). — Stn 1015, 2 branches (USNM 98939). — Stn 1019, 1 branch (USNM 98941). — Stn 1023, 2 branches (MNHN). — Stn 1095, 1 branch (MNHN). — Stn 1108, 1 branch (MNHN).

TYPE LOCALITY. — Bikini Atoll, Marshall Islands, 177-243 m.

REMARKS. — *Dendrophyllia alcocki* belongs to the "third group" of *Dendrophyllia* species sensu CAIRNS (1995), i.e., those species having dendroid coralla produced by sympodial branching. *D. alcocki* is further distinguished as having dense, spinose coenosteum (porous only near distal branch tips); three cycles of septa; and prominent P<sub>2</sub>. It was recently redescribed and illustrated by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 355-400 m. Vanuatu region: Anatom, Tanna, Efaté, and Espiritu Santo; 315-475 m. Elsewhere: Indo-West Pacific from Maldives Islands to New Zealand, including the Marshall Islands and South China Sea; 118-616 m (CAIRNS, 1998).

Genus *ENALLOPSAMMIA* Michelotti, 1871

*Enallopsammia rostrata* (Pourtalès, 1878)

*Amphihelia rostrata* Pourtalès, v\*1878: 204, pl. 1, figs 4-5.

*Dendrophyllia amphelioides* Alcock, v\*1902a: 112-113.

*Enallopsammia rostrata* - ZIBROWIUS, 1973: 44-45, pl. 2, figs 14-15. — CAIRNS, 1982: 57, pl. 18, figs 1-4 (synonymy); 1994: 92-93, pl. 39, figs d-f (synonymy); 1995: 127-128, pl. 44, figs c-f, map 5. — CAIRNS & ZIBROWIUS, 1997: 195.

*Enallopsammia amphelioides* - ZIBROWIUS, 1973: 45-46 (Tuamotu Archipelago).

MATERIAL EXAMINED. — Wallis and Futuna region. MUSORSTOM 7: stn 501, 5 nonrostrate branches (MNHN). — Stn 520, 2 rostrate branches (MNHN). — Stn 522, 3 rostrate branches (USNM 98947). — Stn 530, 1 nonrostrate branch (MNHN). — Stn 574, 2 rostrate colonies (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 4 nonrostrate branches (USNM 98945). — Stn 974, 3 nonrostrate branches (MNHN). — Stn 977, 3 nonrostrate colonies and 3 branches (MNHN). — Stn 1006, 2 nonrostrate branches (USNM 98946). — Stn 1015, 4 nonrostrate branches (MNHN). — Stn 1024, 1 nonrostrate colony and 2 branches (USNM 98944).

TYPE LOCALITY. — "Blake" stn 2: 23°14'N, 82°25'W (Straits of Florida), 1472 m.

REMARKS. — This widespread species varies in calicular diameter and the expression of the costoseptal rostrum (see CAIRNS, 1982, 1995). All Vanuatu specimens lack the costoseptal rostrum and have calices of intermediate size (2.6-3.5 mm GCD), whereas those from the Wallis and Futuna region represent rostrate and nonrostrate forms (see Material Examined). There seems to be no correlation between having a rostrum and GCD, the rostrate forms ranging from 2.3 (MUSORSTOM 7 stn 574) to 4.1 (MUSORSTOM 7 stn 530) mm in GCD. *E. rostrata* was recently redescribed and figured by CAIRNS (1994, 1995). It is easily distinguished from other colonial deep-water corals

from this region by having a flabellate colony with uniaxially arranged corallites, the corallites often having a prominent costoseptal rostrum; and three cycles of normally inserted septa.

The corallum of one specimen from MUSORSTOM 7 stn 501 contained several acrothoracican crustacean borings.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 400-920 m. Vanuatu region: Anatom, Tanna, Erromango, and Efaté; 370-574 m. Elsewhere: cosmopolitan, except for eastern Pacific and off continental Antarctica; 110-2165 m (CAIRNS & ZIBROWIUS, 1997).

### ACKNOWLEDGEMENTS

I would like to thank Bertrand RICHER DE FORGES (ORSTOM, Nouméa), Philippe BOUCHET (BIMM, Muséum national d'Histoire naturelle, Paris) and Alain CROSNIER, who collected the specimens used in this study. Alain CROSNIER provided too the support and encouragement to complete the study.

I also thank the following people, who generously loaned specimens used in the study and/or facilitated visits to their collection: Richard PREECE (University Museum of Zoology, Cambridge), Eric LAZO-WASEM (Yale Peabody Museum), Kei MORI [Institute of Geology and Paleontology, Tohoku (Imperial) University, Sendai], Maya BEST (Nationaal Natuurhistorisch Museum, Leiden), Sheila HALSEY (The Natural History Museum, London), and Peter BARTSCH (Zoologisches Museum, Berlin).

The scanning electron photomicrographs were taken in the SEM Laboratory, NMNH.

I am also grateful to Helmut ZIBROWIUS, who carefully reviewed an early draft of this manuscript.

### REFERENCES

- ALCOCK, A., 1893. — On some newly-recorded corals from the Indian seas. *Journal of the Asiatic Society of Bengal*, 62(2): 138-149, pl. 5.
- ALCOCK, A., 1898. — An account of the deep-sea Madreporaria collected by the Royal Indian marine survey ship Investigator. Calcutta: Trustees Indian Museum, 29 pp., 3 pls.
- ALCOCK, A., 1902a. — Diagnoses and descriptions of new species of corals from the Siboga expedition. *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, (2)7: 89-115.
- ALCOCK, A., 1902b. — Further diagnoses and descriptions of new species of corals from the Siboga expedition. *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, (2)7: 116-123.
- ALCOCK, A., 1902c. — Report on the deep-sea Madreporaria of the Siboga-Expedition. *Siboga-Expeditie Monographies*, (16a), 55 pp., 5 pls.
- BASSETT-SMITH, P.W., 1890. — Report on the corals from the Tizard and Macclesfield Banks, China Sea. *Annals and Magazine of Natural History*, (6)6: 353-374, 443-458, pl. 12-14.
- BEST, M.R.B., CAIRNS, S.D., & HOEKSEMA, B.W., in press. — UNESCO-IOC register of marine organisms: Coelenterata or Cnidaria: Class Hexacorallia: Order Scleractinia (Stony Corals). *Sixth International Conference on Coelenterate Biology (ICCB VI)*, Leiden. 21 pp.
- BOSCHMA, H., 1923. — The Madreporaria of the Siboga expedition. Part 4. *Fungia patella*. *Siboga-Expeditie Monographies*, (16d): 1-20, pl. 9-10.
- BOURNE, G. C., 1903. Some new and rare corals from Funafuti. *Journal of the Linnean Society of London (Zoology)*, 29: 26-37, 2 pls.
- BOURNE, G. C., 1905. Report on the solitary corals collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries., Supplementary Report*, (29): 187-242, 4 pls.
- BRIGGS, J.C., 1974. — *Marine zoogeography*. New York: McGraw Hill. x + 475 pp.

- CAIRNS, S.D., 1979. — The deep-water Scleractinia of the Caribbean Sea and adjacent waters. *Studies on the Fauna of Curaçao*, **67**(108), 341 pp., 40 pls.
- CAIRNS, S.D., 1982. — Antarctic and subantarctic Scleractinia. *Antarctic Research Series*, **34**(1): 74 pp., 18 pls.
- CAIRNS, S.D., 1984. — New records of ahermatypic corals (Scleractinia) from the Hawaiian and Line Islands. *Occasional Papers, Bernice P. Bishop Museum*, **25**(10), 30 pp., 5 pls.
- CAIRNS, S.D., 1988. — *Cryptotrochus*, new genus and two new species of deep-water corals (Scleractinia: Turbinoliinae). *Proceedings of the Biological Society of Washington*, **101**(4): 709-716.
- CAIRNS, S.D., 1989a. — A revision of the ahermatypic Scleractinia of the Philippine islands and adjacent waters. Part 1. Fungiacyathidae, Micrabaciidae, Turbinoliinae, Guyniidae, and Flabellidae. *Smithsonian Contributions to Zoology*, (486), 136 pp., 42 pls.
- CAIRNS, S.D., 1989b. — Asexual reproduction in solitary Scleractinia. *Proceedings of the Sixth International Coral Reef Symposium*, **2**: 641-646.
- CAIRNS, S.D., 1991a. — A revision of the ahermatypic Scleractinia of the Galápagos and Cocos Islands. *Smithsonian Contributions to Zoology*, (504), 44 pp., 12 pls.
- CAIRNS, S. D., 1991b. — Catalog of the type specimens of stony corals (Milleporidae, Stylasteridae, Scleractinia) in the National Museum of Natural History, Smithsonian Institution. *Smithsonian Contributions to Zoology*, (514), 59 pp.
- CAIRNS, S.D., 1994. — Scleractinia of the temperate North Pacific. *Smithsonian Contributions to Zoology*, (557), 150 pp., 42 pls.
- CAIRNS, S.D., 1995. — The marine fauna of New Zealand: Scleractinia (Cnidaria: Anthozoa). *New Zealand Oceanographic Institute Memoirs*, **103**, 210 pp., 44 pls.
- CAIRNS, S.D., 1997. — A generic revision and phylogenetic analysis of the Turbinoliidae (Cnidaria: Scleractinia). *Smithsonian Contributions to Zoology*, (591), 55 pp., 10 pls.
- CAIRNS, S.D., 1998. — Azooxanthellate Scleractinia (Cnidaria: Anthozoa) of Western Australia. *Records of the Western Australian Museum*, **18**: 361-417, 9 pls.
- CAIRNS, S.D. & KELLER, N.B., 1993. — New taxa and distributional records of azooxanthellate Scleractinia (Cnidaria, Anthozoa) from the tropical southwest Indian Ocean, with comments on their zoogeography and ecology. *Annals of the South African Museum*, **103**(5): 213-292.
- CAIRNS, S.D. & PARKER, S.A., 1992. — Review of the recent Scleractinia (stony corals) of South Australia, Victoria and Tasmania. *Records of the South Australian Museum*, Monograph Series, (3): 82 pp., 18 pls.
- CAIRNS, S.D. & WELLS, J.W., 1987. — Neogene paleontology in the northern Dominican Republic. 5. The suborders Caryophylliina and Dendrophylliina (Anthozoa: Scleractinia). *Bulletins of American Paleontology*, **93**(328): 23-43 (bibl.: 52-55), pl. 8-11.
- CAIRNS, S.D. & ZIBROWIUS, H., 1997. — Cnidaria Anthozoa: Azooxanthellate Scleractinia from the Philippine and Indonesian regions. In: A. CROSNIER & P. BOUCHET (eds), *Résultats des Campagnes MUSORSTOM*, Volume 16. *Mémoires du Muséum national d'Histoire Naturelle*, **172**: 27-243, including 29 pls.
- CHEVALIER, J.-P., 1971. — Les Scléactiniaires de la Mélanésie Française, 1re partie. In: *Expédition Française sur les Récifs Coralliens de la Nouvelle-Calédonie*, **5**, 307 pp. 38 pls. Paris: Éditions de la Fondation Singer-Polignac.
- CHEVALIER, J.-P., 1978. — Les coraux des Iles Marquises. *Cahiers du Pacifique*, **21**: 243-283, 4 pls.
- CHEVALIER, J.-P., 1980. — La fauna corallienne de l'île Tubuāi (Archipel des Australes). *Cahiers de l'Indo-Pacifique*, **2**(3): 55-68.
- DANA, J.D., 1846-1849. — Zoophytes. *United States exploring expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N.*, **7**, vii + 740 pp., 61 pls.
- DENNANT, J., 1899. — Descriptions of two new species of corals from the Australian Tertiaries. 1. *Transactions and Proceedings and Report of the Royal Society of South Australia*, **23**: 112-122, pl. 2-3.
- DENNANT, J., 1906. — Madreporaria from the Australian and New Zealand coasts. *Transactions of the Royal Society of South Australia*, **30**: 151-165, pl. 5-6.
- DUNCAN, P.M., 1872. — On the structure and affinities of *Guynia annulata* Dunc., with remarks upon the persistence of Palaeozoic types of Madreporaria. *Philosophical Transactions of the Royal Society of London*, **162**(1): 29-40, pl. 1.

- DUNCAN, P.M., 1873. — A description of the Madreporaria dredged up during the expeditions of H.M.S. "Porcupine" in 1869 and 1870. Part 1. *Transactions of the Zoological Society of London*, **8**(5): 303-344, pl. 39-49.
- DUNCAN, P.M., 1876. — Notices of some deep-sea and littoral corals from the Atlantic Ocean, Caribbean, Indian, New-Zealand, Persian Gulf, and Japanese &c. seas. *Proceedings of the Zoological Society of London*, 1876: 428-442, pl. 38-41.
- EGUCHI, M., 1965. — [Scleractinia]. In: T. UCHIDA *et al.* (eds), *New illustrated encyclopedia of the fauna of Japan*, Volume 1 [In Japanese] Tokyo: Hokuryu-kan: 270-296, fig. 353-452.
- EGUCHI, M., 1968. — *The hydrocorals and scleractinian corals of Sagami Bay collected by His Majesty the emperor of Japan*. Tokyo: Maruzen. xv + 221 pp, 70 pls.
- ESPER, E.J.C., 1794. — Fortsetzungen der Pflanzenthiere, Vol. 1, parts 1-2, Nürnberg. 64 pp.
- FAUSTINO, L.A., 1927. — Recent Madreporaria of the Philippine Islands. *Philippine Bureau of Science, Monograph*, (22): 310 pp., 100 pls.
- GARDINER, J.S., 1899a. — On the solitary corals. In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895-1896 and 1897*. Cambridge Univ. Press. **2** (11): 161-170, pl. 19-20.
- GARDINER, J.S., 1899b. — On the turbinolid and oculinoid corals collected by the author in the South Pacific. *Proceedings of the Zoological Society of London*, 1899: 994-1000, pl. 62.
- GARDINER, J. S., 1900. — On the anatomy of a supposed new species of *Coenopsammia* from Lifu. In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895-1896 and 1897*. Cambridge Univ. Press. **4**: 359-380, pl. 34.
- GARDINER, J.S., 1905. — Madreporaria. Parts 3. [Fungida] and 4. [Turbinolidae]. In: J.S. GARDINER (ed.), *The fauna and geography of the Maldive and Laccadive archipelagos, being an account of the work carried out and the collection made by an expedition during the years 1899 and 1900*. **2** (Supplement 1): 933-953, 953-957, pl. 89-93.
- GARDINER, J.S. & WAUGH, P., 1939. — Madreporaria excluding Flabellidae and Turbinolidae. *The John Murray Expedition 1933-34, Scientific Reports*, **6**(5): 225-242, 2 pls.
- GRAVIER, C., 1915. — Note préliminaire sur les Madréporaires recueillis au cours des croisières de la Princesse-Alice et de l'Hirondelle. *Bulletin de l'Institut Océanographique*, Monaco, **12**(304), 22 pp., 11 figs.
- GRAVIER, C., 1920. — Madréporaires provenant des campagnes des yachts Princesse-Alice et Hirondelle II (1893-1913). *Résultats des Campagnes scientifique accomplies sur son yacht par Albert Ier, Prince Souverain de Monaco*, **55**, 123 pp., 16 pls.
- GRYGIER, M.J., 1991. — Addition to the ascothoracidan fauna of Australia and South-east Asia (Crustacea, Maxillopoda): Synagogidae (part), Lauridae and Petrarciidae. *Records of the Australian Museum*, **43**: 1-46.
- GRYGIER, M.J. & NEWMAN, W.A., 1985. — Motility and calcareous parts in extant and fossil Acrothoracica (Crustacea: Cirripedia), based primarily upon new species burrowing in the deep-sea scleractinian coral *Enallopsammia*. *Transactions of the San Diego Society of Natural History*, **21**: 1-22.
- GRYGIER, M.J. & NOJIMA, S., 1995. — Petrarcid galls and Petrarciidae (Crustacea: Ascothoracida) in some scleractinian corals from Japan. *Galaxea*, **12**: 83-101, 20 figs.
- GUERRIERO, A., D'AMBROSIO, M., ZIBROWIUS, H., & PIETRA, F., 1996. — Novel cholic-acid-type sterones of *Deltocyathus magnificus*, a deep-water scleractinian coral from the Loyalty Islands, SW Pacific. *Helvetica Chimica Acta*, **79**: 982-988.
- HICKSON, S.J., 1903. — The horny membrane of *Neohelia porcellana*. *Nature*, **67**(1737): 344.
- HOEKSEMA, B.W. & BEST, M.B., 1991. — New observations on scleractinian corals from Indonesia: 2. Sipunculan-associated species belonging to the genera *Heterocyathus* and *Heteropsammia*. *Zoologische Mededelingen*, **65**(16): 221-245, 31 figs.
- HORST, J.C. van, 1922. — The Madreporaria of the Siboga expedition. Part 3. Eupsammidae. *Siboga-Expeditie Monographies*, (16c): 46-75, pl. 1-8.
- HORST, J.C. van, 1931. — Some solitary corals from the Indian Museum. *Records of the Indian Museum*, **33**(1): 3-12, pl. 1-2.

- HU, C.-H., 1987. — Unusual fossil corals from Hengchun Peninsula, southern Taiwan. *Memoirs of the Geological Society of China*, 8: 31-48, 3 pls.
- INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE (ICZN), 1985. — W.D. RIDE (Chairman of editorial committee). *International Code of Zoological Nomenclature*, Third Edition, adopted by the XX General Assembly of the International Union of Biological Sciences. London: International Trust for Zoological Nomenclature. xx + 338 pp.
- KELLER, N.B., 1974. — New data about some species of madreporarian corals of the genus *Flabellum*. [Russian, with English summary]. *Trudy Instituta Okeanologii*, 98: 199-212, 7 pls.
- KELLER, N.B., 1976. — The deep-sea madreporarian corals of the genus *Fungiacyathus* from the Kuril-Kamchatka, Aleutian trenches and other regions of the World Ocean. [Russian, with English summary]. *Trudy Instituta Okeanologii*, 99: 30-44, pl. 1-3.
- KELLER, N.B., 1981a. — The solitary madreporarian corals. In: A.P. KUZNETSOV & A.N. MIRONOV (eds), *Benthos of the submarine mountains Marcus-Necker and adjacent Pacific regions*. [In Russian]. Moscow: P.P. Shirshov Institute of Oceanology : 28-39, 2 pls.
- KELLER, N.B., 1981b. — Interspecies variability of *Caryophyllia* (Madreporaria) in connection with their environment. [In Russian]. *Trudy Instituta Okeanologii*, 115: 14-25, 2 pls.
- KELLER, N.B., 1982. — Some new data on madreporarian corals of the genus *Deltocyathus*. [Russian, with English summary]. *Trudy Instituta Okeanologii*, 117: 47-58, pl. 1-2.
- LESSON, R.P., 1831. — *Illustrations de zoologie ou recueil de figures d'animaux peintes d'après nature*. Paris: A. Bertrand. 60 pls + text.
- LINNAEUS, C., 1758. — *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species*. Tomus I: Regnum animale. 10 ed. Stockholm. 824 pp.
- MANNING, R.B., 1991. — Crustacea Decapoda: *Cecidocarcinus zibrowii*, a new deep-water gall crab (Cryptochiridae) from New Caledonia. In: A. CROSNIER (ed.). Résultats des Campagnes MUSORSTOM, Volume 9. *Mémoires du Muséum national d'Histoire Naturelle*, (A), 152: 515-520, 3 figs.
- MARENZELLER, E. von, 1888a. — Ueber das Wachstum der Gattung *Flabellum* Lesson. *Zoologische Jahrbücher*, (Abtheilung für Systematik, Geographie und Biologie der Thiere), 3(1): 25-50.
- MARENZELLER, E. von, 1888b. — Ueber japanische Turbinoliden. *Annalen des K.-K. Naturhistorisches Hofmuséum Wien*, 3: 15-22.
- MARENZELLER, E. von, 1904. Steinkorallen. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899*, 7(3): 261-318, pl. 14-18.
- MARENZELLER, E. von, 1907. — Expeditionen S.M. Schiff Pola in das Rote Meer, nördliche und südliche Hälfte 1895/96 - 1897/98. Zoologische Ergebnisse 25. Tiefseekorallen. *Denkschriften der Mathematisch-Naturwissenschaftliche Klasse der Kaiserlichen Akademie der Wissenschaften*, 80: 13-25.
- MATTHEWS, S.C., 1973. — Notes on open nomenclature and on synonymy lists. *Paleontology*, 16(4): 713-719.
- MICHELIN, H., 1842. — Description d'une nouvelle espèce de zoophyte du genre Flabelline (*Flabellum*, Less.). *Revue de Zoologie*, 1842: 119.
- MILNE EDWARDS, H. & HAIME, J., 1848a. — Recherches sur les polypiers. Deuxième mémoire. Monographie des Turbinolides. *Annales des Sciences Naturelles*, Zoologie, (3)9: 211-344, pl. 7-10.
- MILNE EDWARDS, H. & HAIME, J., 1848b. — Recherches sur les polypiers. Troisième mémoire. Monographie des Eupsammides. *Annales des Sciences Naturelles*, Zoologie, (3)10: 65-114, pl. 1.
- MILNE EDWARDS, H., HAIME, J., 1850. — Recherches sur les polypiers. Cinquième mémoire: Monographie des Oculinides. *Annales des Sciences Naturelles*, Zoologie, (3)13: 63-110, pl. 3-4.
- MOSELEY, H.N., 1876. — Preliminary report to professor Wyville Thomson, F.R.S., director of the civilian staff, on the true corals dredged by H.M.S. Challenger in deep water between the dates Dec. 30th, 1870, and August 31st, 1875. *Proceedings of the Royal Society of London*, 24(170): 544-569.
- MOSELEY, H.N., 1880. — Description of a new species of simple coral (*Desmophyllum lamprotichum*). *Proceedings of the Zoological Society of London*, 1880: 41-42, 2 figs.
- MOSELEY, H.N., 1881. — Report on certain hydroid, alcyonarian, and madreporarian corals procured during the voyage of H.M.S. Challenger, in the years 1873-1876. *Challenger Reports*, Zoology, 2: 248 pp., 32 pls.

- OWENS, J.M., 1994. — *Letepsammia franki*, a new species of deep-sea coral (Coelenterata: Scleractinia: Microbaciidae). *Proceedings of the Biological Society of Washington*, **104**(4): 586-590.
- PALLAS, P.S., 1766. — *Elenchus Zoophytorum*. Hagae Comitum: P. van Clef. xvi + 28 + 451 pp.
- PONDER, W.F., 1983. — A revision of the Recent Xenophoridae of the world and the Australian fossil species (Mollusca: Gastropoda). *Memoirs of the Australian Museum*, Sydney, 17: 126 p., 42 figs.
- POURTALÈS, L.F. de, 1867. — Contributions to the fauna of the Gulf Stream at great depths. *Bulletin of the Museum of Comparative Zoology*, **1**(6): 102-120.
- POURTALÈS, L.F. de, 1868. — Contributions to the fauna of the Gulf Stream at great depths (2d series). *Bulletin of the Museum of Comparative Zoology*, **1**(7): 121-142.
- POURTALÈS, L.F. de, 1878. — Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico... Corals. *Bulletin of the Museum of Comparative Zoology*, **5**(9): 197-212, pl. 1.
- PRATT, E.M., 1900. — Anatomy of *Neohelia porcellana* (Moseley). In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895, 1896 and 1897*. Cambridge Univ. Press. 5: 591-602, pl. 62-63.
- RANDALL, R.H. & MYERS, R.F. 1983. — *Guide to the coastal resources of Guam*. Volume 2. The corals. Guam: University of Guam Press. 128 pp., 488 figs.
- REHBERG, H., 1892. — Neue und wenig bekannte Korallen. *Abhandlungen aus dem Gebiete der Naturwissenschaften, Hamburg*, **12**(1): 50 pp., 4 pls.
- RICHER DE FORGES, B. & MENOUE, J.-L., 1993. — La campagne MUSORSTOM 7 dans la zone économique de Wallis et Futuna. Compte rendu et liste des stations. In: A. CROSNIER (ed.), *Résultats des Campagnes MUSORSTOM*, Volume 10. *Mémoires du Muséum national d'Histoire Naturelle*, **156**: 9-25, 17 figs.
- RICHER DE FORGES, B., FALIEUX, E., & MENOUE, J.-L., 1996. — La campagne MUSORSTOM 8 dans l'archipel de Vanuatu. Compte rendu et liste des stations. In: A. CROSNIER (ed.), *Résultats des campagnes MUSORSTOM*. Volume 15. *Mémoires du Muséum national d'Histoire Naturelle*, **168**: 9-32, 16 figs.
- SEMPER, C., 1872. — Ueber Generationswechsel bei Steinkorallen und über das M.-Edwards'sche Wachstumsgesetz der Polypen (zugleich ein Beitrag zur Fauna der Philippinen). *Zeitschrift für Wissenschaftliche Zoologie*, **22**(2): 235-280, pl. 16-21.
- SIEG, J. & ZIBROWIUS, H., 1989. — Association of a tube inhabiting tanaidacean, *Bifidia scleractinicola* gen.n., sp.n., with bathyal scleractinians of New Caledonia (Crustacea Tanaidacea - Cnidaria Scleractinia). *Mésogée*, **48**: 189-199.
- SPENGLER, L., 1781. — Beskrivelse over et ganske besynderligt Corall-produkt, hvilket man, indtil dets Sloegt noermere bestemmes, kunde kalde en Snekke-Madrepore (*Madrepora cochlea*). *Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter*, **1**: 240-248 [not seen].
- SQUIRES, D.F., 1958. — The Cretaceous and Tertiary corals of New Zealand. *New Zealand Geological Survey, Paleontological Bulletin*, **29**: 107 pp. 16 pls.
- SQUIRES, D.F., 1964. — New stony corals (Scleractinia) from northeastern New Zealand. *Records of the Auckland Institute and Museum*, **6**(1): 1-9, 2 pls.
- SQUIRES, D.F. & KEYES, I.W., 1967. — The marine fauna of New Zealand: Scleractinian corals. *Bulletin of the New Zealand Department of Scientific and Industrial Research*, **185** [= New Zealand Oceanographic Institute Memoirs, 43]: 46 pp., 6 pls.
- STOLARSKI, J., 1996. — *Gardineria* - a scleractinian living fossil. *Acta Palaeontologica Polonica*, **41**(4): 339-367, 11 figs.
- STUDER, T., 1878. — Übersicht der Steinkorallen aus der Familie de Madreporaria aporosa, *Eupsammia* und *Turbinaria*, welche auf der Reise S.M.S. Gazelle um die Erde gesammelt wurden. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaften zu Berlin*, 1877: 625-655, pl. 1-4.
- TIZZARD, R. N., MOSELEY, H. N., BUCHANAN, J. Y., & MURRAY, J., 1885. — Narrative. *Report on the Scientific Results of the Voyage of the H. M. S. Challenger during the Years 1873-76*, **1**(2): 510-1100, pls F-O.
- UMBROVE, J.H.F., 1950. — Corals from the Putjangan beds (Lower Pleistocene) of Java. *Journal of Paleontology*, **24**(6): 637-651, pl. 81-84.
- VAUGHAN, T.W., 1907. — Recent Madreporaria of the Hawaiian Islands and Laysan. *Bulletin of the U. S. National Museum*, **59**, iv + 427 p., 96 pls.

- VERON, J.E.N., & PICHON, M., 1980. — Scleractinia of Eastern Australia. Part 3. *Australian Institute of Marine Science, Monograph Series*, 4: 1-422.
- VERRILL, A.E., 1865. — Classification of polyps (extract condensed from a synopsis of the polypi of the North Pacific Exploring Expedition...). *Proceedings of the Essex Institute*, 4: 145-152.
- VERRILL, A.E., 1866. — Synopsis of the polyps and corals of the North Pacific Exploring Expedition, under Commander C. Ringgold and Captain John Rodgers, U.S.N., from 1853 to 1856. Collected by Dr. Wm. Stimpson, naturalist of the expedition. With description of some additional species from the west coast of North America. Part 3. Madreporaria. *Proceedings of the Essex Institute*, 5: 17-50, pl. 1-2.
- WELLS, J.W., 1954. — Recent corals of the Marshall Islands. *United States Geological Survey, Professional Paper*, (260-1): iv + 385-486, pl. 94-187.
- WELLS, J. W., 1958. — Scleractinian corals. *B.A.N.Z. Antarctic Research Expedition, 1929-1931, Report* (Zoology and Botany), 6(11): 257-275, 2 pls.
- WELLS, J.W., 1977. — Eocene corals from Eua, Tonga. *United States Geol. Survey, Professional Paper*, (640-G): 1-9, pl. 1-3.
- WELLS, J.W., 1984. — Notes on Indo-Pacific scleractinian corals. Part 10. Late Pleistocene ahermatypic corals from Vanuatu. *Pacific Science*, 38(3): 205-219, 5 pls.
- WHITELEGGE, T., 1898. — The Madreporaria of Funafuti. *Memoirs of the Australian Museum*, Sydney, 3(6): 349-368.
- YABE, H. & EGUCHI, M., 1932a. — A study of the recent deep-water coral fauna of Japan. *Proceedings of the Imperial Academy of Japan*, 8(8): 387-390.
- YABE, H. & EGUCHI, M., 1932b. — Notes on a fossil turbinolian coral, *Odontocyathus japonicus* nov. sp., from Segoe, near Tokaoka-machi, province of Hyuga. *Proceedings of the Imperial Academy of Japan*, 9(3-4): 149-152, 1 pl.
- YABE, H. & EGUCHI, M., 1934a. — Probable generic identity of *Stephanophyllia* Michelin and *Micrabacia* M. Edwards and J. Haime. *Proceedings of the Imperial Academy of Japan*, 10(5): 278-281.
- YABE, H. & EGUCHI, M., 1934b. — On some specific names of corals. *Animal and Plant*, 111(11): 2026. [not seen, quoted from EGUCHI, 1965, 1968].
- YABE, H. & EGUCHI, M., 1941. — Corals of Toyama Bay. *Bulletin of the Biogeographical Society of Japan*, 11(12): 101-104.
- YABE, H. & EGUCHI, M., 1942. — Fossil and recent simple corals from Japan. *Science Reports of the Tôhoku Imperial University*, (Ser. 2, Geology), 22(2): 105-178, pl. 9-12.
- YABE, H. & SUGIYAMA, T., 1936. — Some deep-water corals from the Palao Islands. *Proceedings of the Imperial Academy of Japan*, 12: 346-349.
- ZIBROWIUS, H., 1973. — Révision des espèces actuelles du genre *Enallopsammia* Michelotti, 1871, et description de *E. marenzelleri*, nouvelle espèce bathyale à large distribution: Océan Indien et Atlantique Central (Madreporaria, Dendrophylliidae). *Beaufortia*, 21(276): 37-54, 3 pls.
- ZIBROWIUS, H., 1974a. — Scléactiniaux des Îles Saint-Paul et Amsterdam (Sud de l'Océan Indien). *Téthys*, 5(4), 1973: 747-778, 3 pls.
- ZIBROWIUS, H., 1974b. — Redescription of *Sclerhelia hirtella* from Saint Helena, South Atlantic, and remarks on Indo-Pacific species erroneously referred to the same genus (Scleractinia). *Journal of Natural History*, 8(5): 563-575, 14 figs.
- ZIBROWIUS, H., 1976. — *Les Scléactiniaux de la Méditerranée et de l'Atlantique nord-oriental*. Thèse Université Aix-Marseille, CNRS Archives originales 11.515, 302 pp., 106 pls, supplement of 29 maps.
- ZIBROWIUS, H., 1980. — Les scléactiniaux de la Méditerranée et de l'Atlantique nord-oriental. *Mémoires de l'Institut Océanographique*, Monaco, 11: 284 pp., 107 pls.
- ZIBROWIUS, H., 1985. — Asexual reproduction by bud-shedding in shallow-water *Balanophyllia* of the tropical Indo-Pacific (Cnidaria: Scleractinia: Dendrophylliidae). *Proceedings of the Fifth International Coral Reef Congress*, 5: 233-238, 1 pl.
- ZIBROWIUS, H. & GILI, J.M., 1990. — Deep-water Scleractinia (Cnidaria: Anthozoa) from Namibia, South Africa, and Walvis Ridge, southeastern Atlantic. *Scientia Marina*, 54(1): 19-46, 7 pls.