

Suborder FAVIINA Vaughan & Wells, 1943

Superfamily FAVIICAE Gregory, 1900

Family OCULINIDAE Gray, 1847

Genus **Madrepora** Linnaeus, 1758

Diagnosis. – Colonial, extratentacular budding forming dendroid colonies. Coenosteum dense, no costae, corallites filled internally by stereome. No pali; columella spongy or absent. Type-species: *Madrepora oculata* Linnaeus, 1758, by subsequent designation (VERRILL, 1901).

7. **Madrepora oculata** Linnaeus, 1758

Plate III, figure 2; Plate IV, figure 5; Plate V, figures 1–3

Synonymy complete for western Atlantic only:

Madrepora oculata LINNAEUS, 1758: 798. – PALLAS, 1776: 308. – ESPER, 1789: 108, pl. 12, figs. 1–3. – MARENZELLER, 1904a: 79. – DURHAM & BARNARD, 1952: 11. – SQUIRES, 1959: 5–8 (in part: not station A 180–112). – EGUCHI, 1968: C-29, pl. C-8, figs. 1–9. – BEST, 1970: 298, fig. 2. – BOURCIER & ZIBROWIUS, 1973: 826, figs. 6–7. – ZIBROWIUS, 1974a: 762, pl. 2, figs. 2–5; 1976: 104–108, pl. 20, figs. A–P. – CAIRNS, 1978: 10.

Amphelia oculata: MILNE EDWARDS & HAIME, 1850a: 85.

Amphihelia oculata: MILNE EDWARDS & HAIME, 1857: 119. – POURTALÈS, 1871: 24. – DUNCAN, 1873: 326, pl. 45, figs. 1–3. – POURTALÈS, 1880: 96, 107. – JOURDAN, 1895: 26. – ALCOCK, 1902: 35. – MARENZELLER, 1904: 308, pl. 14, figs. 1, 1 a–b. – GRAVIER, 1920: 89, pl. 10, figs. 158–164. – CHEVALIER, 1966: 938 (in part: not specimen off Cape Naze), pl. 5, figs. 8–9.

Amphihelia ramea: DUNCAN, 1873: 326, pl. 44, figs. 1–3, pl. 45, figs. 4–6, pl. 46, figs. 1–19. – ?LINDSTRÖM, 1877: 14. – JOURDAN, 1895: 26.

Lophohelia carolina: MOSELEY, 1876: 547.

Amphihelia sculpta: POURTALÈS, 1878: 204.

Lophohelia candida: MOSELEY, 1881: 179–180, pl. 9, figs. 6–13.

Lophohelia prolifera: GRAVIER, 1920: 87 (in part).

Description. – *M. oculata* is extremely variable, forming large bushy or flabellate colonies by extratentacular budding. End branches are usually sympodial in growth form with calices occurring in opposite and alternating rows. New branches can occur at

the level of any calice. A large colony is anchored by a massive base measuring up to several centimeters in diameter. A base often encrusts the spicules of a deep-water sponge (*Hyalonema*). End branches measure as little as 2.3 mm in diameter, whereas basal branches often exceed 2 cm. Branches are usually round but may be very compressed, with greater to lesser branch diameters differing by ratios of over 2:1; the calices occur on the broad sides. Calices on the distal branches are well individualized and exsert, whereas calices occurring on thick, basal branches are often recessed in the coenosteum or completely covered by it. Rarely the basal calices are raised on small mounds. The coenosteum is white and extremely finely granulated, producing a smooth texture. Sometimes finely incised, longitudinal striae are present, most conspicuously on the sides of the branches that do not bear the calices. Calices vary in diameter from 2.5 to 3.8 mm.

Septa are arranged in six systems and three cycles. S_1 are usually larger than the S_2 but can be equal in size, especially in older coralites on basal branches. S_1 are slightly exsert and sometimes extend as a short costal ridge outside the calice. S_3 are much smaller and can be well developed or rudimentary, composed of a line of dissociated simple or bifid spines. The inner edges of all septa are straight and usually finely dentate. The septal faces bear granules, which are usually low in profile but sometimes very prominent (two times the thickness of the septum), giving a very hirsute appearance to the septa. The granules are often arranged in well-defined rows or even short carinae oriented parallel to the trabeculae.

The calicular fossae on terminal branches are usually very deep and slightly curved, with only rudimentary columellas. On older, thicker branches, calicular fossae are short and straight, sometimes sealed off by endothecal dissepiments and columellas are usually better developed, consisting of several crispate, spongy trabeculae, which are often connected to the S_1 . In general, the columella is quite variable and may not occur at all.

This species commonly occurs in another form (see DUNCAN, 1873: pl. 45, fig. 1) invariably associated with a commensal worm (*Eunice* sp.), around which the coral grows or encrusts. In this form the branching pattern is much closer, forming bushy colonies with

frequently anastomosing branches. The color of the coenosteum is yellowish-gray, and the fossae are filled in with stereome, almost obscuring the septa altogether. Often only low, crispate spines remain in the calice as evidence of the septa.

Discussion. — ZIBROWIUS (1974a: 762–766) should be consulted for a lengthy discussion of the synonymy of this variable species. He discusses 15 nominal species that might be considered as junior synonyms. Of these, I have examined the types of three: *M. galapagensis* Vaughan, 1906; *M. kauaiensis* Vaughan, 1907, and *L. candida* Moseley, 1881, and have concluded that the first two are valid species and the latter is a junior synonym of *M. oculata*. *M. galapagensis* has larger, flared corallites and exsert S_1 , more like *M. carolina* than *M. oculata*. *M. kauaiensis* has smaller corallites and very poorly developed S_3 , if they occur at all.

Remarks. — *M. oculata* and *L. prolifera* are the primary deep-bank builders in the eastern Atlantic. Although widespread in the western Atlantic, *M. oculata* is not a primary constituent of the coral banks in the Straits of Florida (see *E. profunda*).

Material. — P-364 (USNM 45891); P-388 (USNM 45895); P-607 (USNM 45897); P-636 (USNM 45890); P-673 (USNM 45898); P-675 (USNM 45893); P-689 (USNM 45888, UMML 8: 307); P-741 (USNM 45889, UMML 8: 305); P-747 (USNM 45892); P-755 (UMML 8: 233); P-954 (USNM 45899); P-1187 (USNM 45894); P-1262; colonies from 19 Gerda stations in the Straits of Florida (USNM 45871–45886); CI-148 (USNM 45900); GS-31; GS (G)-13 (USNM 45901); GS (G)-39 (USNM 45902); GS (G)-40 (USNM 45904); O-534; O-4569; O-4570; O-4807; O-4913; O-5930; O-11218; O-11718; BL-2 (MCZ); BL-15 (MCZ); BL-171 (MCZ); BL-240 (MCZ, USNM); BL-256 (MCZ); BL-260 (MCZ); BL-318; Alb-2117 (USNM 7056); Alb-2415 (USNM 10746); Alb-2416 (USNM 10528); Alb-2663 (USNM 15950); Alb-2669 (USNM 14496); Alb-2672 (USNM 36523); Gos-1615; Gos-1748; Gos-1750; Gos-1766; E-26004; E-26017; E-26023; E-26028 (USNM 45903); E-26052 (USNM 45896); WH-90/68 (SME); WH-104/68 (SME); Akaroa 5c (SME); TAMU 70A10–41 (TAMU); TAMU 71A8–29 (TAMU); TAMU 65A9–4 (TAMU). — Syntypes of *L. candida*; Marenzeller's (1904) specimens (USNM); Squires's (1959) specimens (AMNH); Lindström's (1877) specimens (NRM).

Types. — The Linnaean types of *M. oculata* from Sicily and the Tyrrhenian Sea are lost. Six syntype branches of *L. candida* are deposited at the BM (1880.11.25.95). They were collected at Chall-23, off Sombbrero Island, Lesser Antilles in 823 m.

Type-Locality. — Sicily and Tyrrhenian Sea, Mediterranean.

Distribution. – Western Atlantic: common throughout the tropical western Atlantic from Georgia to Rio de Janeiro, Brazil; Gulf of Mexico (Map 4). 144–1391 m. 4°–12°C, based on 12 records. – Elsewhere: eastern Atlantic, Indian, and Pacific Oceans. 80–1500 m.

8. *Madrepora carolina* (Pourtales, 1871)

Plate IV, figures 1–4

Not *Madrepora exigua* DANA, 1848: 469, pl. 38, figs. 2 a–b (= *Acropora exigua*). – RATHBUN, 1888: 15.

Lophohelia exigua POURTALES, 1871: 24, 26, pl. 1, figs. 6–7; 1878: 204; 1880: 96.

Lophohelia carolina POURTALES, 1871: 24, 26.

Not *Lophohelia carolina*: MOSELEY, 1876: 547 (= *Madrepora oculata*).

Not *Lophohelia exigua*: LINDSTRÖM, 1877: 14 (= *Thalamophyllia riisei*).

Lophohelia prolifera: MOSELEY, 1881: 179 (in part: Chall-109).

Madrepora carolina: CAIRNS, 1977b: 5; 1978: 10.

Description. – The corallum is attached by a thick base (up to 28 mm in diameter) expanding at the substrate into a thin encrusting layer, which supports randomly placed, upright corallites. Corallites generally occur in a sympodial growth form, in opposite, alternating fashion. However, in the largest colony examined (36 cm tall), all of the corallites are directed toward one side, the other side being covered by an encrusting zooanthid. Branching can occur at each calice and is usually in one plane, producing a flabellate colony. However, three-dimensional branching does occur, producing bushy colonies. The corallites are flared at their distal ends, even those on basal branches, and measure 3.5–5.5 mm in diameter. The coenosteum is white and finely granulated. Thin, ridged costae correspond to the first two cycles of septa but are only prominent near the calice. Very fine coenosteal striae are sometimes present, particularly at the base of the colony.

Septa are arranged in six systems and three cycles. Each higher cycle of septa is progressively smaller and less exsert. Four of the six S_1 on opposite sides of each calice are slightly larger than the other two; their lower, inner edges almost meet in the center of the fossa. Sometimes the S_3 are quite rudimentary, expressed only as thin ridges or rows of spines. The inner edges of all septa are entire

and slightly sinuous. Septal granules are small and inconspicuous, sometimes arranged in poorly-defined lines parallel to the trabeculae.

The fossa is deep and often curved on distal branches. There is never a columella.

Discussion. — POURTALÈS (1871) described two species of *Lophohelia*, *L. exigua* and *L. carolina*, on the same page. He based *L. exigua* on thin, bushy end branches and *L. carolina* on more massive basal branches with less exsert calices. It is now clear that both specimens belong to the same species. Since *L. exigua* is a secondary junior homonym of DANA's *Madrepora exigua*, *L. carolina* is chosen as the senior synonym.

M. carolina is easily differentiated from *M. oculata*, the only other *Madrepora* known from the Atlantic, by its larger, flared corallites, less prominent septal granulation, and dimorphic S_1 .

Material. — G-134 (USNM 45905, UMML 8: 232); G-135 (USNM 45911); G-251 (USNM 45906); G-503 (USNM 45907); G-636 (USNM 45912); G-691 (USNM 45908, UMML 8: 304); G-692 (USNM 45909); CI-6 (USNM 45913); GS (G)-44 (USNM 45914); O-1025; O-1890; O-3955; O-4833; O-4932; O-4938; O-4939; SB-206; SB-332; SB-2449; SB-3339; SB-3467; BL-45 (MCZ); Bibb-216 (MCZ); Alb-2153 (USNM 7189); Alb-2157 (USNM 10833); Alb-2324 (USNM 10215); Alb-2327 (USNM 36355); Alb-2345 (USNM 36348); Alb-2346 (USNM 10254); Alb-2353 (USNM 10252); Alb-2354; Alb-2661 (USNM 16156); Caroline-37; E-26538; E-26542; E-26549; E-30150; E-30176; BLM-22-VI-B (Alabama BLM); 27°54'53"N, 93°26'50"W, 100 m (Texas BLM); TAMU 65A9-20 (TAMU); Chall-109 (BM); Explorer-4. — Holotype of *L. carolina*; syntypes of *L. exigua*; Lindström's (1877) specimens (NRM); Moseley's (1881) specimens (BM).

Types. — The holotype of *L. carolina* (two labels are present: 2764 and 2754) is deposited at the MCZ. Two lots of syntypes of *L. exigua* are deposited at the MCZ: one lot (2778) contains three branches, the other (two labels are present: 2789 and 2781) contains four branches. Both are labelled "Florida Straits, 36-79 fathoms." The worn fragments from off Pacific Reef, Florida (Bibb-216) are not at the MCZ and are presumed lost.

Type-Locality. — Unknown, but probably from off Havana, Cuba.

Distribution. — Greater Antilles; western Caribbean; Gulf of Mexico; off eastern coast of U.S. from North Carolina to Florida; St. Peter and Paul Rocks (Map 5). 53-801 m, most common between 200-300 m.

Family **ANTHEMIPHYLLIIDAE** Vaughan, 1907Genus **Anthemiphyllia** Pourtales, 1878

Diagnosis. – Solitary, patellate, free. Septotheca thick and smooth (porcelaneous) or costate. Septa strongly dentate. No pali; columella trabecular, papillose on surface. Type-species: *Anthemiphyllia patera* Pourtales, 1878, by monotypy.

9. **Anthemiphyllia patera** Pourtales, 1878

Plate V, figures 5–7

Anthemiphyllia patera POURTALES, 1878: 205, pl. 1, figs. 14–15; 1880: 97, 112, pl. 2, figs. 5–6. – VAUGHAN, 1907: 80. – GARDINER & WAUGH, 1938: 172. – ZIBROWIUS, 1976: 108.

Description. – The corallum is bowl-shaped and free; the rounded base usually has a scar of attachment at its apex or shows regeneration from a parent fragment. The largest specimen examined measures 13.1 mm in calicular diameter and 7.3 mm in height. The calice is round. The wall is thick, porcelaneous, and smooth. Finely granulated, equal costae can be distinguished only at the calicular edge.

Septa are arranged in six systems and four cycles. S_1 reach the columella and bear seven-nine prominent spines. The one-three spines closest to the columella are slender and tall, compressed in the plane of the septum. The next several spines are larger and strongly compressed perpendicular to the plane of the septum. The outermost spines are much smaller, grading into a costal dentition near the base. S_2 and S_3 are equal in size and slightly smaller than the S_1 , but bear similar septal spination. S_4 are much smaller and bear seven-eight small spines. S_5 are sometimes present in the largest coralla. When this occurs, the S_4 that are flanked by the S_5 are enlarged to the same size as the S_2 and S_3 , and the S_5 are the same size as typical S_4 . S_{1-3} are equally exsert; S_4 are slightly less exsert. All septa bear low, rounded granules, often occurring in pairs.

Plate-like granules on the lower, inner edges of the S_{1-3} often

unite with those of adjacent septa, forming a solid platform surrounding the columella. The columella is massive, round, and flat, composed of numerous crispate, spongy trabeculae. The fossa is relatively shallow.

Discussion. – There are three nominal species of *Anthemiphyllia*: *A. patera* Pourtalès; *A. dentata* (Alcock, 1902) (Celebes Sea, Japan); and *A. pacifica* Vaughan, 1907 (Hawaii). YABE & EGUCHI (1942) implied that the two Pacific species were synonymous. *A. patera* is easily distinguished from *A. pacifica* by its shape, porcelaneous base, and distinctive columella.

Material. – P-861 (6) USNM 45916; G-688 (4) USNM 45915; BL-100 (15) MCZ, (2) USNM; Gos-1656 (1); Hudson-4B (10) NMC.

Types. – The holotype, collected at BL-16, is not at the MCZ, USNM, or BM; it is presumed lost.

Type-Locality. – 23°11'N, 82°23'W (off Havana, Cuba); 534 m.

Distribution. – Off Fernandina, Florida; Northwest Providence Channel, Bahamas; off Havana, Cuba; Grenadines, Lesser Antilles (Map 6). 500–700 m.

Suborder CARYOPHYLLIINA Vaughan & Wells, 1943

Superfamily CARYOPHYLLICAE Gray, 1847

Family CARYOPHYLLIIDAE Gray, 1847

Subfamily Caryophylliinae Gray, 1847

Genus *Caryophyllia* Lamarck, 1801

Diagnosis. – Solitary; ceratoid, turbinate, or subcylindrical; fixed or free. Septotheca usually strongly costate. Pali opposite S_3 in one crown (or before second group of septa when hexameral symmetry obscured). Columella fascicular, formed of twisted ribbons. Type-species: *Madrepora cyathus* Ellis & Solander, 1786, by subsequent designation (BRODERIP, 1828).

KEY TO THE ELEVEN WESTERN ATLANTIC SPECIES OF *Caryophyllia*

- 1 Corallum free. 2
- 1' Corallum attached. 4

- 2 Calicular diameter of adult over 30 mm; usually more than 48 septa *C. ambrosia caribbeana* n. subsp.
- 2' Calicular diameter of adult rarely exceeds 10 mm; 48 septa or less 3

- 3 Basal tip invariably broken off; pali irregular and poorly developed; 36 or less septa *C. cornuiformis* Pourtalès, 1868
- 3' Basal tip often pointed; pali well developed; usually 48 septa *C. horologium* Cairns, 1977

- 4 Septa arranged hexamerally 5
- 4' Septa not arranged hexamerally (pentamerally, heptamerally, octamerally, or decamerally) 10

- 5 Pali before antipenultimate cycle of septa (S_2)
. *C. paucipalata* Moseley, 1881
- 5' Pali before penultimate cycle of septa (usually S_3). 6

- 6 Last cycle of septa (S_4) extends as far or farther toward the columella as penultimate cycle (S_3)
. *C. polygona* Pourtalès, 1878
- 6' Last cycle of septa does not extend as far toward the columella as the penultimate cycle 7

- 7 Fine thecal striae occur perpendicular to the costae
. *C. corrugata*, n. sp.
- 7' No thecal striae. 8

- 8 Corallum small (average cd = 6 mm, 6–8 mm tall); short, oblique carinae on faces of S_4 *C. parvula*, n. sp.
- 8' Corallum large (over 10 mm in cd); no carinae on septal faces 9

- 9 Costae prominent, ridged; columellar elements usually fused to one another laterally; 55–91 m depth range. *C. horologium* Cairns, 1977
- 9' Costae usually flat; columellar elements distinct; 100–1033 m depth range *C. berteriana* Duchassaing, 1850
- 10 Septa always arranged octamerally; septal granules fused into short, oblique ridges near the inner septal margin *C. barbadensis*, n. sp.
- 10' Septa arranged heptamerally, octamerally, or decamerally; septa never ridged. 11
- 11 Septa arranged decamerally. 12
- 11' Septa arranged heptamerally or octamerally *C. berteriana* Duchassaing, 1850
- 12 Theca costate (not porcelaneous); fossa moderately deep; pali very narrow; upper corallum brownish . . . *C. zopyros*, n. sp.
- 12' Theca porcelaneous; fossa very shallow; pali narrow; corallum entirely white *C. antillarum* Pourtalès, 1874

10. **Caryophyllia berteriana** Duchassaing, 1850

Plate VI, figures 4–8; Plate VII, figure 1

Caryophyllia berteriana DUCHASSAING, 1850: 15. – MILNE EDWARDS & HAIME, 1857: 19, pl. D1, fig. 1. – DUCHASSAING & MICHELOTTI, 1860: 59; 1864: 64. – DUCHASSAING, 1870: 24. – POURTALÈS, 1871: 8. – DUNCAN, 1873: 317. – POURTALÈS, 1874: 33–34, pl. 1, figs. 1–2; 1880: 96, 99. – ?VAUGHAN, 1901: 292 (specimen lost). – LEWIS, 1965: 1063. – ZIBROWIUS, 1976: 117. – CAIRNS, 1977b: 5; 1978: 10.

Caryophyllia formosa POURTALÈS, 1867: 113; 1871: 7–8, pl. 1, fig. 16. – DUNCAN, 1873: 317. – POURTALÈS, 1878: 199.

Not *Caryophyllia berteriana*: LINDSTRÖM, 1877: 8 (= *C. antillarum* and *Trochocyathus rawsonii*). – MOSELEY, 1881: 134. – GARDINER, 1904: 112–113 (see Discussion). – WELLS, 1958: 261. – SQUIRES, 1961: 17.

Description. – The corallum is ceratoid and laterally compressed, producing a round to elliptical calice. The pedicel is usually reinforced by concentric layers of stereome but may be quite slender.

The corallum is firmly attached to the substrate by a thin, encrusting base. An average corallum measures 17.5×16.5 mm in calicular diameter and about 22 mm tall. The expression of costae is variable. Usually they are broad, flat, and subequal (C_4 broader than C_{1-3}), separated by narrow furrows, and prominent only near the calice. Sometimes, however, C_{1-3} form low ridges extending half-way to the base. Costal granules are small and arranged such that three-five low, rounded granules can be counted across the width of each costa near the calice.

Septa are arranged in four cycles and usually six systems, although seven and eight systems are common, resulting in 48, 56, or 64 septa. S_1 and S_2 are moderately exsert and equal in size, extending three-fourths of the distance to the columella. S_3 and S_4 are progressively smaller and less exsert. The inner margins of the S_1 , S_2 , and S_4 are slightly sinuous, whereas those of the S_3 are very sinuous with broad septal undulations. Septal granules are high and blunt, sometimes fusing into short, oblique carinae, which are arranged in widely spaced rows on slight undulations.

Depending on the number of systems present, there may be 12, 14, or 16 pali arranged in a ring before the S_3 . They are tall, thin, rounded on their upper edges, and have sinuous inner margins. The palar granules are larger than those of the septa. The columella is composed of 2-17 small, tightly twisted, pointed ribbons, which are rarely fused together. They are arranged linearly or randomly in an elliptical field.

Discussion. — POURTALÈS (1867) described *C. formosa* to apply to those forms with only twelve pali, a light, thin corallum (before secondary stereome thickening), and less exsert septa than *C. berteriana*. With more material at hand, POURTALÈS (1880) synonymized *C. formosa*. MOSELEY's *C. berteriana* is very similar to this species but has much thicker septa at the calicular edge and a narrower corallum. Additionally, this specimen is from the eastern Atlantic from 2779 m, well outside the known bathymetric and geographic ranges for *C. berteriana*.

GARDINER's (1904) specimens from South Africa are distinctly different from *C. berteriana* in that they possess file-sculptured

thecae and the S_4 are much longer than the S_3 . They probably represent an undescribed species. This erroneous African record formed the basis of WELLS's (1958) and SQUIRES's (1961) distributional records.

Material. – P-208 (1) USNM 45997; P-209 (1) USNM 45998; P-848 (1) USNM 46000, (1) UMML 8: 237; P-849 (2) USNM 46001; P-904 (1) USNM 46002; P-944 (2) USNM 46003; P-1140 (8) USNM 45999; G-23 (1) USNM 45986; G-261 (1); G-304 (2) USNM 45987; G-311 (1) USNM 45988; G-509 (2) UMML 8: 354; G-661 (1) USNM 45989; G-663 (2) USNM 45990; G-667 (1); G-707 (6) USNM 45991; G-708 (2) USNM 45992; G-711 (1) USNM 45993; G-725 (1) UMML 8: 352; G-889 (2) USNM 45994; G-1312 (1) USNM 45996; G-1329 (3) USNM 45995; CI-7 (1) USNM 46004; O-1993 (1); O-2356 (4); O-2655 (1); O-4297 (1); O-4398 (36); O-5015 (12); O-5432 (2); O-5645 (1); O-5648 (42); O-5934 (1); O-10833 (1); SB-3467 (1); SB-3472 (2); BL-20 (1) MCZ; BL-32 (1) MCZ; BL-45 (1) MCZ; BL-132 (2) MCZ; BL-154 (4) MCZ; BL-156 (1) MCZ; BL-157 (4) MCZ; BL-158 (1) MCZ; BL-189 (1) MCZ; BL-231 (1) MCZ; BL-240 (2) MCZ; BL-253 (1) MCZ; BL-254 (2) MCZ; BL-273 (6) MCZ; BL-293 (2) MCZ; BL-290 (39) MCZ; BL-292 (2) MCZ; BL-296 (9) MCZ; Hassler, off Barbados, 183 m (21) MCZ; Alb-2152 (2); Alb-2153 (3) USNM 7190; Alb-2342 (1) USNM 10232; Combat-238 (1) USNM 46005; Combat-447 (1); Combat-450 (1) USNM 45660; Combat-452 (1); Gos-112/78 (1); E-26017 (1); E-26549 (1); E-30179 (2); BLM 33-I-C (1) Alabama BLM; Atl-2980 B (1) MCZ; Atl-3341 (1) MCZ; Atl-3482 (2) MCZ; TAMU 65A9-15A (15) TAMU; east edge of DeSoto Canyon, west of Cape San Blas, Florida, 183–549 m (2) AMNH; Hummelinck-1443 (27). – Syntypes of *C. formosa*; Lindström's (1877) *C. berteriana*; Moseley's (1881) *C. berteriana*; Gardiner's (1904) *C. berteriana*.

Types. – The types of *C. berteriana* are probably lost; none are labelled as such at the MIZS or the MNHNP. Two syntypes of *C. formosa* are deposited at the MCZ (2756), collected at Corwin-2 or 4 off Havana in 494 m. Another syntype is at the YPM (4762).

Type-Locality. – Guadeloupe (Lesser Antilles); 100 m.

Distribution. – Common throughout Caribbean and eastern Gulf of Mexico, ranging from off Florida to off Surinam; however, present off northern coast of South America only off Leeward Group (Map 7). 100–1033 m. 7–23°C, based on six records.

11. *Caryophyllia cornuformis* Pourtalès, 1868

Plate VII, figures 2–5

Caryophyllia cornuformis POURTALÈS, 1868: 133; 1871: 9, pl. 1, figs. 14–15. – DUNCAN, 1873: 317. – POURTALÈS, 1878: 198–199; 1880: 96, 99–100. – LEWIS,

- 1965: 1063. — ZIBROWIUS, 1976: 137–139, pl. 73, figs. A–L. — CAIRNS, 1978: 10.
Caryophyllia pourtalesi DUNCAN, 1873: 317, pl. 42, figs. 3–10. — ?LINDSTRÖM, 1877: 8 (in part: northwest Atlantic specimen only), pl. 1, fig. 4. — DUNCAN, 1878: 238, pl. 43, figs. 1–7, 11–14; 1883: 362. — LINDSTRÖM, 1884: 102.
Caryophyllia communis: JOURDAN, 1895: 12 (in part: Sta. 161).
Caryophyllia clavus: GRAVIER, 1920: 16 (in part).
 Not *Caryophyllia cornuformis*: GARDINER & WAUGH, 1938: 179–180, text-fig. 2.

Description. — The corallum is small, free, and regularly curved, tapering only slightly toward the base. The base is always broken, revealing one or two cycles of septa. The largest corallum examined, containing 40 septa, measures 10.2 mm in calicular diameter and 25.0 mm tall, but an average-size specimen measures 5.5–6.5 mm in calicular diameter and contains 24–28 septa. The theca is usually porcelaneous and smooth, interrupted only by fine intercostal striae. The costae are broad, flat and extend to the base. C_3 are slightly broader than the other costae. Low, rounded granules are sometimes distinguishable on the costae, arranged such that four-five can be counted across the width of each costa near the calice. The calicular edge is regularly serrate, a low apex corresponding to every septum.

Septa are arranged in three cycles but in a variable number of systems, ranging from five to eleven. Typical septal arrangements are: 6/6/12, 7/7/14, and 8/8/16; the largest has 11/11/18. The total number of septa is roughly a function of calicular size, with new systems developing with growth. First an S_2 forms between two S_1 , then two S_3 develop, flanking the S_2 . Simultaneously, a palus forms before the S_2 . Often the incipient palus seems to be an adjacent columellar rod that enlarges, changing from a twisted ribbon to a lamellar plate. S_1 are slightly exsert and extend almost to the columella. S_2 and S_3 are progressively less exsert and smaller. The inner edges of all septa descend vertically into a moderately deep fossa; those of the S_1 and S_3 are sinuous, whereas those of the S_2 are very sinuous, corresponding to septal undulations directed parallel to the trabeculae. Pointed septal granules are arranged in lines on the crests of the septal undulations. The granules become less prominent toward the septal edge, which may be smooth or porcelaneous.

Palar development is very irregular. When present, the pali stand

before the S_2 ; however, they may be completely absent or correspond to any number of S_2 . They are typical in shape for the genus, with sinuous inner edges. Sometimes, however, they are large, spirally twisted rods, like the columella, especially when the system is newly formed. The paler granules are about twice the size of the septal granules and are often arranged in short carinae oriented horizontally or slightly obliquely. The columella is composed of one-nine tightly twisted ribbons, which lie in an elliptical paler fossa.

Discussion. – LINDSTRÖM's specimen of *C. pourtalesi* is atypical in that its pali are very poorly developed for its size. The distributional gap between Georgia and Newfoundland, as well as the difference in bathymetry is similar to the disjunct distribution of *C. ambrosia caribbeana*. More specimens from the northeast Atlantic may show a subspecific difference.

Material. – P-600 (1) USNM 46042; P-606 (2) USNM 46043; P-877 (2) USNM 46045; P-889 (2) USNM 46044; P-891 (2) UMML 8: 357; G-132 (1) USNM 46028; G-134 (1) USNM 46040; G-289 (38) USNM 46029, (4) UMML 8: 234; G-299 (10) USNM 46030; G-300 (18) USNM 46031; G-301 (1) USNM 46032; G-663 (29) USNM 46033, (9) UMML 8: 358; G-664 (200) USNM 46034; G-676 (1) USNM 46035; G-715 (3) USNM 46041; G-861 (2) USNM 46036; G-1015 (1) USNM 46039; G-1322 (5) USNM 46037; G-1323 (5) USNM 46038; O-2068 (5); O-2776 (6); O-4226 (100); SB-2425 (1); SB-2445 (3); BL-19 (10) MCZ; BL-100 (2) MCZ; BL-274 (2) MCZ; Alb-2659 (1) USNM 16114; Alb-2750 (33) USNM 36420; Alb-2756 (11) USNM 36363; Gos-1590 (3); Gos-1748 (1); E-43 (1); E-26019 (1); Akaroa-5c (1) SME. – Syntypes of *C. cornuformis* and *C. pourtalesi*; Lindström's (1877) specimens (NRM).

Types. – Two lots of syntypes are deposited at the MCZ: one lot, labelled "Fl. Straits, 237–250 fms" (5493a), contains two poor specimens; the other lot, labelled "Florida, 250 fms" (2771), contains three specimens, one of which is in good condition. DUNCAN's *C. pourtalesi* is based on two syntypes deposited at the BM (1883.12.10.143, 1880.12.10.22).

Type-Locality. – Off Sand Key and the Samboes, Florida; 433, 454 m.

Distribution. – Western Atlantic: Antillean distribution and off eastern Yucatan Peninsula to Belize (not off northern coast of South America); off Brazilian coast to Recife (Map 8). 37–931 m. – Elsewhere: northwest Atlantic from 46°–63°N. 1065–1970 m; eastern Atlantic in area bounded by the Celtic Sea, the Azores, and Morocco. 1300–2200 m.

12. ***Caryophyllia antillarum* Pourtalès, 1874**

Plate V, figures 8–10

Caryophyllia antillarum POURTALÈS, 1874: 34 (in part: see Types), pl. 6, figs. 3–4; 1880: 96, 100 (in part: BL-157, 166, 273, 288, 300).

Caryophyllia berteriana: LINDSTRÖM, 1877: 8 (in part: the larger of the two specimens).

Not *Caryophyllia antillarum*: POURTALÈS, 1878: 199 (indeterminate).

Not *Caryophyllia* sp. cf. *antillarum*: GOREAU & WELLS, 1967: 449. – WELLS, 1973: 58 (= *Caryophyllia* C. Cairns, 1976).

Description. – The corallum is ceratoid, narrowing to a pedicel measuring about one-half the calicular diameter, which expands basally to form an encrusting attachment. The calice is round to slightly elliptical. The lectotype measures 9.0×8.6 mm in calicular diameter. The theca is smooth and porcelainous, covered by very low, rounded granules. Costae are not usually distinguishable, but when present they are broad, flat, unequal (those corresponding to the tertiaries are twice as broad as all others), and separated by narrow, very shallow striae.

Septa are usually arranged decamerally in three cycles: 10/10/20. The 10 primaries are moderately exsert and extend about three-fourths of the distance to the columella. Secondaries and tertiaries are progressively less exsert and extend about halfway to the columella, the tertiaries being only slightly smaller than the secondaries. The inner edges of the primaries and tertiaries are only slightly sinuous, whereas those of the secondaries are extremely sinuous. The sinuosity reflects the septal undulations, running perpendicular to the trabeculae. The septal faces are smooth except for small pointed granules arranged in widely spaced rows on the crests of the septal undulations.

A very tall, narrow palus stands before each secondary septum, separated from it by a deep, narrow notch. Palar granulation is more prominent than that of the septa, consisting of numerous taller, blunt spines, which sometime form short horizontal carinae. The pali form an elliptical ring enclosing an elongate columella, which is composed of three–ten slender, twisted ribbons usually arranged in two parallel rows. The ribbons are basally interconnected as well as

connected to the inner edges of the pali. The fossa is very shallow; the tops of both the pali and columellar elements usually rise above the calicular edge.

Discussion. – *C. antillarum* is easily distinguished from all other western Atlantic *Caryophyllia* but easily could be confused with *C. abyssorum* Duncan, 1873, known only from the eastern Atlantic between 1000–1500 m. *C. abyssorum*, also decameral, differs in that it has a curved, slightly larger, more massive corallum, with thicker septa and a deeper fossa.

Material. – P-876 (2) USNM 45919; G-694 (1) USNM 45917; G-706 (1) UMML 8: 235; G-707 (1) USNM 45918; CI-93 (1) USNM 45920; BL-76 (1) MCZ; BL-157 (1) MCZ; BL-166 (1) MCZ; BL-273 (9) MCZ; BL-288 (2) MCZ; BL-300 (2) MCZ; Atl-3332 (1) MCZ; Pocock-IV (1) NMC; ?SME-1776 (1) SME. – Syntypes of *C. antillarum*; Lindström's (1877) specimen.

Types. – Three lots containing six syntypes of *C. antillarum* are deposited at the MCZ. The single specimen in lot 2786, the only one that is figured and described in the original description, is designated lectotype. Only one of the four specimens in lot 5432 is the same species (designated paralectotype); the other three are *Caryophyllia barbadensis*, n. sp. (1) and perhaps *Caryophyllia zopyros*, n. sp. (2). The third lot (5477) contains one specimen of *Caryophyllia barbadensis*. All six specimens were collected at an undetermined Hassler station off Barbados.

Type-Locality. – Barbados; 183 m.

Distribution. – Antillean distribution (Map 9). 150–1000 m.

13. *Caryophyllia polygona* Pourtalès, 1878

Plate VII, figures 6–9

Caryophyllia polygona POURTALÈS, 1878: 198–199; 1880: 96; CAIRNS, 1978: 10.
Caryophyllia antillarum: POURTALÈS, 1880: 100 (in part: BL-108).

Description. – The corallum is usually ceratoid and is firmly attached by a long, slender pedicel one-fourth to one-third the calicular diameter, which expands into a thin, encrusting sheet basally. Some specimens are more stout, with a shorter and thicker pedicel and thickened upper theca. The calice is round to slightly elliptical in shape. The largest specimen examined measures 18.2×15.2 mm in

calicular diameter and 32.1 mm tall, but normally individuals are much smaller. C_1 and C_2 are usually highly ridged, even cristiform, from the calice to the base. Sometimes, however, the ridges are prominent only near the calice, or for a short distance in the middle of the corallum, or, in rare cases, not ridged at all. C_3 and C_4 are usually not prominent. Specimens in good condition usually have smooth, porcelaneous thecae with no evidence of costal granulation. A small specimen of 24 septa measuring 5 mm in calicular diameter has a smooth, translucent, milky-white theca. Worn specimens, however, reveal a fine granulation of low, rounded tubercles. The calicular edge is serrate, forming a large apex corresponding to every septum of the first two cycles and a much smaller apex for every septum of the third and fourth cycles.

Septa are arranged in six systems and four cycles; the fourth cycle is usually complete at a calicular diameter of 10 mm. S_1 are slightly larger than S_2 . Both are highly exsert and extend about two-thirds of the distance to the columella. S_4 are smaller and less exsert than the S_2 but more exsert than the S_3 and also usually extend farther toward the columella than the S_3 . The inner edges of all septa are usually straight but may be slightly sinuous, especially the inner edges of the S_3 . Moderately tall, pointed, blunt granules occur randomly on the septal faces.

A tall, large palus stands before each S_3 and is separated from the septum by a moderately deep and narrow notch. The palar granulation is more prominent and the palar margins much more sinuous than those of the septa. The pali form an elliptical crown inside which the columella rests. The columella is composed of 4–15 slender, twisted ribbons, often linearly arranged in one–three parallel rows. The fossa is moderately deep.

Discussion. — In five of the 19 valid species of Atlantic *Caryophyllia* the last cycle of septa (usually S_4) extends farther toward the columella than the septa of the penultimate cycle (usually S_3): *C. ambrosia* Alcock, 1898; *C. polygona* Pourtalès, 1878; *C. barbadensis*, n. sp.; *C. atlantica* Duncan, 1873; and *C. calveri* Duncan, 1873. The last two are known only from the eastern Atlantic. *C. polygona* can be distinguished from all of these species by its prominently

ridged C_1 and C_2 . Other characters, such as porcelaneous theca, hexamerall symmetry, and lack of septal carinae additionally serve to differentiate it from these species.

Material. – P-586 (6) USNM 46049, (1) UMML 8: 238; P-634 (8) USNM 46050, (4) UMML 8: 356; P-1262 (1) UMML 8: 355; G-296 (1) USNM 46046; G-372 (1) USNM 46047; G-1111 (1) USNM 46048; O-11722 (1); BL-108 (1) MCZ; Gos-112/78 (1) Cornell; E-26017 (1); TAMU 69A13-16 (4) TAMU; Rosaura-34 (1) BM. – Syntypes of *C. polygona*.

Types. – The two syntypes, collected from BL-41, are deposited at the MCZ (5476).
Type-Locality. – 23°42'N, 83°13'W (western Straits of Florida); 1573 m.

Distribution. – Antillean distribution; off Campeche Bank, Mexico (Map 6). 700–1817 m. 5–8°C, based on four records.

14. ***Caryophyllia paucipalata* Moseley, 1881**

Plate VIII, figures 1–6

Caryophyllia paucipalata MOSELEY, 1881: 138, pl. 1, figs. 3, 3a.

Description. – The corallum is trochoid, narrowing to a base of attachment measuring about half the calicular diameter. The calice of the lectotype is round, measuring 10.5 mm in diameter; the corallum is 17.5 mm tall. The theca is very thick and bears broad, equal, flat costae barely distinguishable in the upper two-thirds of the corallum. On the basal third, faint intercostal striae are present. Low, rounded costal granules are visible only in the upper corallum; consequently the theca is rather smooth.

The septa of the lectotype are arranged pentamerally (5/5/10/20); however, the septal arrangement in three subsequently collected specimens is hexamerall, and the latter is believed to be the normal condition. S_1 are slightly exsert and extend almost halfway to the columella. S_1 are only slightly larger than the S_2 and S_3 , which are about the same size. The S_4 are about half the size of the S_3 . The inner edges of all septa are slightly sinuous, the paliferous septa (S_2) to the greatest degree. The septa bear moderately tall, pointed granules.

Typical *Caryophyllia*-like pali stand before the S_2 ; however,

only five pillar-like pali are present in the lectotype. The columella, which lies slightly below the pali, consists of one-five twisted laths. The fossa is moderately deep.

Discussion. – *C. paucipalata* is unique among the Atlantic *Caryophyllia* in that its pali stand before the antipenultimate group (second group) of septa instead of the penultimate group (usually the third) as in all others.

C. paucipalata should not be confused with *C. paucipaliata* Yabe & Eguchi, 1942, a Pliocene fossil from Japan.

Material. – BL-266 (1) MCZ; Rosaura-34 (2) BM 1938.3.1.83–91. – Types.

Types. – The two syntypes from Chall-24 are deposited at the BM (1880.11.25.34). The more complete specimen, which formed the basis of the original description and both figures, is herein designated as lectotype. The other specimen (paralectotype) is very worn but hexameral in septal arrangement.

Type-Locality. – Off Culebra, Virgin Islands; 714 m.

Distribution. – Known only from the Windward Group, Lesser Antilles (Map 9). 714–843 m.

15. *Caryophyllia ambrosia caribbeana*, new subspecies

Plate V, figure 4; Plate VI, figures 1–3, 9

Caryophyllia communis var. *costata*: POURTALÈS, 1880: 100, pl. 1, figs. 12–13.

Caryophyllia ambrosia: BOONE, 1928: 7–8, pls. 2–3. – KELLER, 1975: 180, pl. 2, figs. 5–8.

?*Caryophyllia clavus*: LEWIS, 1965: 1063.

Caryophyllia sp. cf. *C. ambrosia*: CAIRNS, 1978: 10.

Description. – The trochoid to turbinate corallum tapers to a very narrow, pointed, unattached base. The lower part of the corallum is usually curved about 90° (20°–180°) in the direction of the smaller calicular axis. The largest specimen measures 44.3 × 36.8 mm in calicular diameter and 69 mm tall. The expression of costae and costal granulation is quite variable. Usually the C₁ are prominent and ridged, highest near the calicular edge, and extend almost to the base. Broader, flat costae, equal in size and separated

from one another by narrow, shallow striae, correspond to the other septa. Sometimes none of the costae are ridged, but all are broad and flat or slightly convex; at other times, in addition to the primaries, the secondary costae are also slightly ridged. The costal granulation is usually very coarse, consisting of small, pointed spines, producing a very rough texture.

Septa of three different sizes are distinguishable: primaries, secondaries (bearing the pali), and tertiaries. Adult coralla usually possess 14, 16, or 18 primaries (56, 64, or 72 septa), rarely 12; all are highly exsert. This causes the calicular edge to be serrate, because the theca rises to an apex at each primary. The tertiaries flanking each primary are also quite exsert. The primaries extend three-fourths of the distance to the columella, the secondaries about half the distance. The secondaries are only slightly exsert and usually do not extend as far toward the columella as the tertiaries. The inner edges of the primaries and tertiaries are straight to slightly sinuous; those of the secondaries are the most sinuous, especially adjacent to the pali. The septa are thin and smooth except for low, blunt granules arranged in widely spaced rows on the crests of septal undulations, which run perpendicular to the trabeculae.

Each secondary septum bears a large palus, sometimes larger than the septum it borders, which extends to the columella. The pali are separated from the secondaries by deep, narrow notches and have very sinuous margins. Their granulation is much more prominent than that of the septa, usually composed of long (three-four times the palar thickness), blunt spines, which are often fused into short carinae.

The columella is elongate, enclosed by the elliptical palar crown. It is composed of numerous twisted, fascicular ribbons, which are usually fused to one another and to the pali. The ribbons often occur in one straight row but may also be arranged in two parallel rows or randomly in an elliptical field. The interiors of older coralla are solidly filled in with stereome.

Discussion. — Some authors (*e.g.*, POURTALES and MOSELEY) have attributed the common western Atlantic *Caryophyllia* to *Ceratocyathus communis* Seguenza, 1864, an Italian fossil species.

There is no doubt that *C. ambrosia* is similar, if not identical, to *Ceratocyathus communis*, as well as to *C. affinis*, *C. ponderosus*, *C. scillae*, *C. suborbiculata*, *C. ecostatus*, and *C. costatus*, all attributable to SEGUENZA. However, because none of SEGUENZA's types are preserved, his figures are inadequate, and the geological age of his fossils is not certain, some authors (e.g., ZIBROWIUS) have chosen not to accept his names for Recent species. Therefore, the first available name for the Recent species is *Caryophyllia ambrosia* Alcock, 1898.

The Caribbean and Gulf of Mexico specimens differ slightly but consistently from typical *Caryophyllia ambrosia* Alcock, 1898. The two most conspicuous differences, both of which are qualitative and somewhat subjective, concern the shape of the corallum and the nature of the costae. First, the corallum of *C. a. caribbeana* is more open, not as slender as in *C. a. ambrosia*. Second, the costae of *C. a. caribbeana* are more prominent, often ridged, and highly granulated, producing a rough texture. Furthermore, they are usually unequal, the C_1 and C_2 being larger. The costae of *C. a. ambrosia* are flat and equal, with a very fine, rounded granulation, producing a smooth texture. These morphological differences are augmented by both a geographic and bathymetric isolation of the two forms. *C. a. caribbeana* is widely distributed in the Gulf and Caribbean, off Brazil, and as far north as 26°28'N off east Florida, at depths of 183–1646 m. The typical subspecies is known from the Indian Ocean, eastern Atlantic, and in the western Atlantic off the northeast coast of North America no farther south than 38°34'N, from 1600–3000 m. It has been reported from off the northeast coast of the United States by MOSELEY (1881) and VERRILL (1885a, 1908a) as *C. communis*.

The first new name applied to the Caribbean subspecies was *C. communis* var. *costatus* Pourtalès, 1880; however, this combination is a junior homonym of SEGUENZA's (1864) *Ceratocyathus* (= *Caryophyllia*) *costatus*. The name *caribbeana* is proposed for the new subspecies. *C. seguenzae* Duncan, 1873 (eastern Atlantic) may also prove to be another subspecies of *C. ambrosia*.

Material. – P-340 (8) USNM 45974; P-364 (5) UMML 8: 351; P-394 (15) USNM 45973; P-445 (1) USNM 45975; P-448 (1) USNM 45976; P-478 (9) USNM 45980, (4)

UMML 8: 350; P-605 (1) USNM 45977; P-607 (11) USNM 45978; P-636 (2) USNM 45979; P-682 (7) USNM 45923, (2) UMML 8: 349; P-741 (12) USNM 45981, (1) UMML 8: 236; P-747 (2) USNM 45957; P-753 (100) USNM 45922; P-754 (6) USNM 45958; P-846 (2) USNM 45959; P-850 (3) USNM 45982; P-861 (4) USNM 45960; P-881 (13) USNM 45961; P-889 (4) USNM 45962; P-891 (2) USNM 45963; P-918 (6) USNM 45964; P-944 (1) USNM 45965; P-984 (2) USNM 45966; P-1171 (2) USNM 45971; P-1187 (3) USNM 45967; P-1255 (1) USNM 45968; P-1256 (1) USNM 45969; P-1262 (2) USNM 45970; P-1355 (1) 45983; 49 specimens from 19 Gerda stations in the Straits of Florida; GS-31 (55) USNM 45924; CI-12 (1) USNM 45985; CI-93 (1) USNM 45984; O-1884 (1); O-1911 (20); O-1981 (15) USNM 45658; O-1982 (3) USNM 45661; O-1985 (34) USNM 53370; O-1989 (30) USNM 45659; O-2202 (2); O-2637 (1); O-2772 (2); O-2774 (1); O-2775 (1); O-3252 (4); O-3550 (1); O-3553 (2); O-3554 (1); O-3562 (1); O-3573 (2); O-4226 (11) USNM 45925; O-4302 (9); O-4304 (7); O-4421 (1); O-4423 (9); O-4713 (3); O-4840 (1); O-4907 (10); O-4911 (1); O-4913 (2); O-5629 (1); O-5636 (7); O-5639 (1); O-5740 (3); O-5925 (1); O-5929 (4); O-6695 (2); O-6696 (1); O-6701 (1); O-6703 (2); O-6721 (6); O-6722 (5); O-10173 (2); O-10491 (3); O-10513 (1); O-10825 (3); O-10827 (2); O-10831 (1); O-10833 (1); O-10843 (1); O-10875 (5); O-10876 (1); O-10877 (1); O-10901 (2); SB-2474 (1); SB-2475 (13); SB-3514 (1); SB-3515 (6); SB-5142 (4); SB-5144 (1); SB-5168 (1); BL-2 (2) MCZ; BL-134 (2) MCZ; BL-143 (1) MCZ; BL-214 (1) MCZ; BL-227 (1) MCZ; BL-254 (1) MCZ; BL-258 (2) MCZ; BL-274 (1) MCZ; Alb-2117 (8) USNM 7057; Alb-2385 (2) USNM 10375; Alb-2392 (5) USNM 16106; Alb-2393 (1) USNM 10417; Combat-450 (23); Combat-449 (3); Caroline-23 (1); 47 specimens from 18 Atlantis stations from off the coasts of Cuba (MCZ); TAMU 65A9-14 (22) TAMU; TAMU 65A9-15 (1) TAMU; TAMU 66A5-4 (2) TAMU; TAMU 67A5-1A (1) TAMU; TAMU 67A5-7E (2) TAMU; TAMU 67A5-8B (2) TAMU; TAMU 67A5-13E (1) TAMU; TAMU 68A3-9A (2) TAMU; TAMU 68A7-7B (1) TAMU; TAMU 68A7-9A (5) TAMU; TAMU 68A7-12B (2) TAMU; TAMU 68A7-13B (1) TAMU; TAMU 68A7-13A (3) TAMU; TAMU 68A7-15D (2) TAMU; TAMU 68A7-15H (2) TAMU; TAMU 68A13-12A (1) TAMU; TAMU 68A13-23 (1) TAMU; TAMU 70A10-35 (1) TAMU; TAMU 70A10-41 (9) TAMU; TAMU 71A8-29 (2) TAMU; SME-1758 (2) SME; SME 1761 (4) SME; SME 1777 (1) SME; Chain-35 (1); Anton Bruun-831 (6) MCZ. — Type of *C. a. caribbeana*.

Types. — Syntypes of typical *C. ambrosia* are deposited at the Indian Museum, Calcutta, the ZMA (Coel. 1179), and the MNHNP. The holotype of *C. a. caribbeana*, collected at P-388, is at the USNM (45972).

Type-Locality. — 10°16'N, 76°03'W (off Isla de Rosario, Colombia); 814–1050 m (of new subspecies).

Distribution. — Widespread throughout Caribbean and Gulf of Mexico, ranging from off Florida to off Uruguay (Map 10). Between 26°30'N and 38°30'N off eastern coast of U.S. the species is poorly documented. Typical *C. ambrosia* occurs north of 38°30'N, in the eastern Atlantic, and Indian Ocean. *C. a. caribbeana*: 183–1646 m. 5–16°C, based on 12 records. — *C. a. ambrosia*: 1600–2670 m.

16. ***Caryophyllia barbadensis*, new species**

Plate VIII, figures 7-9; Plate IX, figure 1

Caryophyllia antillarum POURTALES, 1874: 34 (in part: see Types); 1880: 100 (in part: BL-294).

Description. – The corallum is slender, slightly curved, and sub-cylindrical, tapering only slightly toward the base of attachment. The calice is round to slightly elliptical. The holotype measures 6.0×5.5 mm in calicular diameter and 12.9 mm tall. The costae, which extend to the base, are equal, broad, slightly convex, and separated by shallow, narrow striae.

Septa are octamerally arranged: 8/8/16. The eight primaries are exsert and extend almost to the columella. Secondaries and tertiaries are equal in size, less exsert, and extend about halfway to the columella. The inner edges of all septa are sinuous, those of the secondaries being the most wavy. Septal granules are prominent, equal to the septal thickness in height, and usually fuse into short, horizontal carinae at the inner edges of all the septa.

Eight tall pali, separated from the secondary septa by deep and narrow notches, form a ring encircling the columella. The pali have very sinuous margins and bear short, horizontal carinae like the septa. The columella is composed of two-four twisted ribbons linearly arranged in the elongate fossa.

Discussion. – *C. barbadensis* is distinguished from all other Atlantic *Caryophyllia* by its octameral symmetry and very sinuous pali. Other distinctive characters are its shape, tertiary septa equal in size to the secondaries, and the horizontal carinae on the septal faces.

Material. – Types.

Types. – Of the six syntypes designated for *C. antillarum*, two are *C. barbadensis*: the single specimen from lot 5477 (designated here as paratype) and one of four specimens from lot 5432 (designated here as holotype). Both specimens were collected at the same Hassler station off Barbados and are deposited at the MCZ. Four more specimens (paratypes) from BL-294 are also at the MCZ.

Type-Locality. – Barbados; 183 m

Distribution. — Known only from Barbados, Lesser Antilles (Map 11). 183–249 m.

17. ***Caryophyllia corrugata***, new species

Plate IX, figures 2–5

Description. — The corallum is small, ceratoid to trochoid, and attached by a pedicel of about one-third the calicular diameter. The calice is strongly flared and elliptical; the calicular diameter of the holotype measures 9.0×7.8 mm. C_1 and C_2 are prominently ridged and extend about halfway to the base; C_3 are ridged only near the calice. Fine thecal lamellae, which often bifurcate and re-join one another, run perpendicular to the costae and form a very striking pattern. Those that encompass the narrow pedicel are continuous. These lamellae are similar to those found on two Pacific species, *C. rugosa* Moseley, 1881 and *C. lamellifera* Moseley, 1881.

Septa are arranged in six systems and four complete cycles. S_1 are slightly larger than the S_2 ; both are highly exsert and extend almost to the columella. S_3 and S_4 are progressively smaller and less exsert. The inner edges of the S_1 , S_2 , and S_4 are straight or only slightly sinuous, whereas the inner edges of the S_3 are very wavy, particularly near the adjacent pali. Moderately tall, blunt, pointed granules are arranged in widely spaced, well-defined, curved rows perpendicular to the trabeculae.

Tall, slender pali, separated from the septa of the third cycle by deep, narrow notches, extend to the columella. They have rounded upper edges and moderately sinuous inner and outer margins. The columella consists of several narrow, twisted ribbons linearly arranged in the elongate fossa.

Discussion. — *C. corrugata* is easily distinguished from all other Atlantic *Caryophyllia* by its distinctive thecal sculpture. Although similar to MOSELEY's two species in this regard (see Description), it is clearly different from them in size and shape.

Etymology. — The specific name *corrugata* (Latin, = wrinkled, ridged) refers to the distinctive thecal ornamentation.

Material. — Types.

Types. – Holotype: BL-69 (MCZ). – Paratypes: P-991 (1) USNM 46859; SB-3494 (2) USNM 46860.

Type-Locality. – Off Havana, Cuba; 183 m.

Distribution. – Antillean distribution from the Virgin Islands to Cuba (Map 11). 183–380 m.

18.

***Caryophyllia parvula*, new species**

Plate IX, figures 6–8; Plate X, figures 5–6

Description. – The corallum is small, subcylindrical to ceratoid, and firmly attached by a broad, smooth base, which is usually thickened by deposits of stereome. The upper half of the corallum is brownish in color, whereas the basal deposits are creamy white. The holotype measures 6.1×5.0 mm in calicular diameter and 5.8 mm tall but is not considered to have reached its adult size. The C_1 and C_2 of the holotype are highly ridged; C_3 are ridged only near the calice. No costal granulation is apparent. In contrast, a paratype (BL-139) has a smooth theca with no evidence of costae and very low, inconspicuous thecal granules.

The septa of the holotype are arranged in six systems and four cycles but S_4 are missing in two half-systems and are developed only incipiently in four other half-systems. It is not unusual for specimens of smaller calicular diameters to have 8–11 half-systems in various stages of development. S_1 are highly exsert and slightly larger than the S_2 , which, in turn, are much larger than the S_3 ; S_4 are equal in size to or slightly smaller than the S_3 . The inner edges of all septa are sinuous, especially those of the S_3 . The septal faces of the S_1 , S_2 , and S_3 are covered with randomly arranged, low, pointed granules. Septal granulation on the S_4 and sometimes the S_3 consists of low carinae, directed obliquely toward the columella, giving these septa a frilled appearance.

The fossa is moderately deep. A tall, narrow palus is separated from each septum of the third cycle by a deep, narrow notch. The inner and outer palar margins are slightly sinuous and their faces often bear short, horizontal carinae similar to those found on the S_4 . The columella is formed of four-six narrow, irregularly shaped rods, which terminate below the level of the pali.

Discussion. – This species can be distinguished from the other western Atlantic species of *Caryophyllia* by its small size, wide base of attachment, and the distinctive carinae of the S_4 .

Etymology. – The specific name *parvula* (Latin, = little) refers to the small size of the corallum in relation to the other western Atlantic *Caryophyllia*.

Material. – O-4459 (1); O-4938 (1, on base of *M. carolina*); BL, off Havana, 158 fms (= 289 m) (1) MCZ; BL-177 (1) MCZ; Steamer Norseman, 21°48'S, 40°03'W, 128 m (5); IOSP-1 (1) SME; Gos-39 (1); Atl-3332 (1) MCZ; Hummelinck-1443 (1). – Types.

Types. – Holotype: P-1140 (USNM 46865). – Paratypes: BL-139 (1) MCZ; G-984 (1) USNM 46868; SB-3494 (2) USNM 46866; SB-3496 (1) USNM 46867; Alb-2319 (1) USNM 36359; Alb-2320 (2) USNM 10094.

Type-Locality. – 20°50'N, 73°34'W (off northeast Cuba); 274–289 m.

Distribution. – Antillean distribution; Arrowsmith Bank, Yucatan; off Venezuela; off southeastern Brazil (Map 12). 97–399 m.

19. *Caryophyllia zopyros*, new species

Plate X, figures 1–4

Caryophyllia antillarum: POURTALÈS, 1880: 110 (in part: BL-239, BL-273, BL-294).

Description. – The shape of the corallum is very similar to that of *C. antillarum*: trochoid to ceratoid and firmly attached by a pedicel of about one-half the calicular diameter, which expands to form a thin encrusting base of attachment. The calice is usually round or slightly elliptical. A typical adult specimen measures 10 mm in calicular diameter and 15–17 mm tall. Broad, equal, flat to slightly convex costae are distinguishable only near the calice. They are separated at the calicular edge by shallow striae, which become indistinguishable toward the base. Low, rounded costal granules are present over the entire surface of each costa such that, on the average, three–four occur across each costa near the calicular edge. Often the upper half of the corallum is light brown, the lower half white. The theca is thick.

Septa are usually arranged decamerally in three systems; only

one specimen examined has eleven primaries (44 septa). Primaries are exsert and extend about halfway to the columella. Secondaries and tertiaries are progressively less exsert and extend a progressively shorter distance toward the columella. The inner edges of the primary and tertiary septa are moderately sinuous; those of the secondary septa are most wavy. The septal faces are covered by widely spaced, low, pointed granules in a random arrangement.

A high, narrow palus stands before each secondary, separated from it by a deep, narrow notch. Both the inner and outer palar margins are sinuous and their faces bear tall, blunt granules larger than those on the septal faces. The circumscribed columella stands lower in the fossa and is composed of several slender, twisted, interconnected ribbons, which are also in contact with the inner edges of the pali.

Discussion. — *Caryophyllia zopyros* resembles *C. antillarum* in many respects, but can be distinguished by a number of characters: its theca bears equal costae instead of being porcelaneous, its fossa is deeper, its pali are narrower, and its primaries are less exsert and less distinctive.

Etymology. — The specific name *zopyros* (Greek, = pyrotechnic) alludes to the resemblance of the calicular view of the corallum to an exploding fireworks display.

Material. — BL-157 (1) MCZ; Atl-3478 (2) MCZ; Pocock-IV (1) NMC. — Types.

Types. — Holotype: BL-273 (MCZ 5577). — Paratypes: BL-273 (10) MCZ 5577, (1) USNM 46870; BL-239 (2) MCZ; BL-294 (2) MCZ; P-890 (1) USNM 46869; Discovery Bay, Jamaica, 73 m (1) USNM 46056.

Type-Locality. — 13°03'05"N, 59°36'18"W (off Barbados); 188 m.

Distribution. — Antillean distribution (Map 13). 73–618 m.

Genus *Concentrotheca*, new genus

Diagnosis. — Solitary, subcylindrical, attached by polycyclic base. Costae inconspicuous; wall thick and smooth. Pali in one crown before S_3 or second group of septa. Columella papillose. Type-species: *Thecocyathus laevigatus* Pourtales, 1871, here designated.

Discussion. – The new genus *Concentrotheca* is erected for the single species *T. laevigatus*, which clearly does not belong to *Theco-cyathus* Milne Edwards & Haime, 1848 as originally placed by POURTALÈS. It differs from this European Jurassic genus in having pali only before one cycle, a polycyclic base, and no epitheca. The monotypic genus is most closely related to *Caryophyllia* in the Caryophylliinae but differs in having a polycyclic base and a papillose columella.

Etymology. – The generic name refers to the concentric thecal rings of polycyclic development. *Gender*: feminine.

20. ***Concentrotheca laevigata*** (Pourtalès, 1871), new comb.

Plate XVI, figures 7–12

Theco-cyathus laevigatus POURTALÈS, 1871: 14, pl. 5, figs. 3–4; 1878: 202 (in part: BL-5); 1880: 96. – GARDINER & WAUGH, 1938: 171. – ZIBROWIUS, 1974c: 25; 1976: 109–110, pl. 62, figs. A–N. – CAIRNS, 1977b: 5; 1978: 11.

Description. – The corallum is subcylindrical and firmly attached by a polycyclic base containing up to five concentric thecal rings. The calice is variable in shape: sometimes round, elliptical, or irregular. The largest specimen examined measures 8.4 mm in calicular diameter and 14.2 mm tall. The theca, particularly near the calicular edge, is thickened with stereome, which produces a heavy corallum. The theca is usually smooth and porcelaneous with no costal granulation. Equal, slightly convex costae, separated by narrow striae, are sometimes barely visible through the exterior, glossy deposits.

Septa are arranged in a regular hexameral pattern (six systems and three cycles) at calicular diameters of less than 5 mm. Above this calicular diameter there are 7–12 primary septa (half-systems), an equal number of secondaries, and usually twice as many tertiaries. However, it is common for one or more half-systems to be incomplete (lacking both tertiaries) or overdeveloped (with quaternary septa), with both conditions occurring in the same calice. The primaries are the largest septa, slightly exsert, and have vertical inner edges extending to the columella. The secondaries and terti-

aries are progressively smaller and barely exsert. All septal edges are vertical and straight except for the lower inner edges of the secondaries, which are slightly sinuous adjacent to their pali. Randomly arranged, low, rounded granules cover the septal faces.

A tall, narrow, pointed palus often occurs before each secondary. The presence of pali, however, is quite variable. In a corallum containing 10 secondaries, there may be 0–10 pali. The pali are usually larger than the columellar elements and project higher in the fossa. However, sometimes the pali and columellar pillars are similar, in which case the pali can be distinguished by their position directly before the secondaries. The pali are granulated like the septa. The papillose columella is composed of 1–13 slender, granulated pillars.

Material. – P-587 (1) USNM 46240; G-849 (1) USNM 46238, (1) UMML 8: 385; G-885 (1) USNM 46239; GS (G)-71-7 (1) USNM 46242; BL-5 (57) MCZ; Bibb-194 (1) MCZ; Alb-2601 (1); Alb-2672 (1); Combat-? off Jacksonville, Florida, 321 m (5); Gos-1584 (1); Gos-1737 (2); Gos-1766 (1); west of Anna Maria Key, Florida, 366–487 m (1). – Syntypes.

Types. – One hundred fourteen syntypes, divided into nine lots, bearing the numbers 2772 and 5609, are at the MCZ. Only three of the lots can be assigned a locality: Bibb-155 (50), 141 (1), and 169 (17). The other 46 specimens are labelled as "Florida Reefs, 100–315 m."

Type-Locality. – Straits of Florida; 183–576 m.

Distribution. – Western Atlantic: northern temperate distribution from off North Carolina to Florida Keys; Arrowsmith Bank, Yucatan (Map 13). 183–800 m, 10–12°C based on four records. – Eastern Atlantic: Azores. 600–772 m.

Genus **Cyathoceras** Moseley, 1881

Diagnosis. – Solitary, ceratoid to turbinate, fixed. Septotheca usually costate. No pali. Columella fascicular, composed of several twisted ribbons. Type-species: *Cyathoceras cornu* Moseley, 1881, by subsequent designation (FAUSTINO, 1927).

21. **Cyathoceras** sp. cf. **C. cornu**

Plate XII, figures 2, 4

Synonymy for *C. cornu*:*Cyathoceras cornu* MOSELEY, 1881: 156-157, pl. 4, figs. 7, 7a. — VAUGHAN, 1907: 78.

— WELLS, 1936: 106; 1958: 261. — SQUIRES, 1961: 17.

? *Cyathoceras woodsi* WELLS, 1964: 110-112, pl. 1, figs. 4-7.

Description. — The lectotype of *C. cornu* is ceratoid and straight, measuring 22.7 mm from the calice to the broken pedicel. The calice is irregularly round, with a diameter of about 11.2 mm. The theca is very smooth and porcelaneous; small costal ridges are distinguishable only near the calice and near the fracture. There are no costal granules or intercostal striae.

The septa are arranged hexamerally in four complete cycles plus six pairs of S_5 , for a total of 60 septa. S_1 and S_2 are equal in size, slightly exsert, and have wavy inner edges bordering the columella. S_3 are smaller, with straight inner edges. S_4 and S_5 are progressively smaller, the S_5 being quite rudimentary, and have straight, lacinate inner edges. The moderately deep fossa contains a fascicular columella composed of three very broad, twisted, and fused ribbons. The paralectotype from Chall-163 (Twofold Bay, New South Wales) is different in several respects and may be a different species. It is not considered in this comparison.

The three specimens from the Gerda and Pillsbury stations are very similar to *C. cornu*, but because of their small size and immaturity, they are not identified as such. These specimens are ceratoid to trochoid and firmly attached by a pedicel measuring about one-half the calicular diameter. The largest specimen measures 7.9×7.1 mm in calicular diameter and 12.3 mm tall. Costae are equal, flat or slightly ridged, and separated by very shallow, thin striae.

Septa are decamerally arranged; however, the broken base of one specimen reveals 12 septa. Ten large septa (primaries) are slightly exsert and have very sinuous, entire inner edges. The 10 secondaries are three-fourths that size and have slightly less sinuous margins. The 20 tertiaries are much smaller and have straight, slightly serrate

inner edges. All septa bear small, blunt granules arranged in close-set lines oriented parallel to the trabeculae.

The fascicular columella is composed of seven-eight broad, twisted, and fused ribbons.

Discussion. — Because *C. cornu* is known from only three adult specimens (lectotype — Pl. XII 1,3, paralectotype (?), and Calypso-171), its range of variation is very poorly known and identification of small specimens is therefore uncertain. The three specimens in question are very similar to *C. cornu*, differing primarily in their symmetry and the nature of their costae. Both of these differences may be due to the variation in their size. *Cyathoceras woodsi* Wells, 1964 from off Queensland, Australia is a similar decamerall species differing from *C. sp. cf. C. cornu* primarily in its smaller size. *C. woodsi* may prove to be a synonym of *C. cornu*.

Material. — P-596 (1); G-889 (1); G-893 (1); Calypso-171 (1) SME. — Types of *C. cornu*; types of *C. woodsi*.

Types. — The lectotype (1880.11.25.59), collected at Chall-320, and the paralectotype (1880.11.25.60), collected at Chall-163, are both at the BM. The holotype and paratypes of *C. woodsi* are deposited at the USNM.

Type-Locality. — 37°17'S, 53°52'W (off Rio de la Plata, Uruguay); 1097 m.

Distribution. — Off Rio de la Plata, Uruguay and Twofold Bay, New South Wales, Australia. The three compared specimens are known only from off Arrowsmith Bank, Yucatan Channel (Map 14). The bathymetric range of the types is 220–1097 m. The range of the compared specimens is 220–241 m.

22. **Cyathoceras squiresi**, new species

Plate XI, figures 5–9

Aulocyathus sp. SQUIRES, 1959: 23–24, figs. 11–12.

Description. — The attached corallum is ceratoid to trochoid, ranging in shape from straight to slightly curved, bent, or scolecoïd; the calice is usually round. The largest specimen examined (holo-

type) measures 10.7 mm in calicular diameter and 14.5 mm in height. The corallum tapers only slightly to a thick pedicel and monocyclic base, which is strengthened by deposits of stereome. The wall is likewise thickened, producing a heavy corallum. Very faint, shallow striae separate broad, flat, equal costae, which extend to the base. The costae are finely granulated with an average of three-four low, rounded granules occurring across the width of each costa near the calicular edge. In specimens in good condition, the costae and granulation are sometimes obscured by very smooth, glossy stereome.

The septa are rarely arranged in a hexameral pattern; instead, there are usually 10 primary septa (sometimes 9 or 11), all equal in size with very wavy inner edges. The secondary and tertiary septa are progressively smaller, with less wavy inner edges, and do not reach the columella as do the primaries. None of the septa, which often number 40, are exsert. The septal faces bear prominent granules arranged in rows oriented obliquely to the septal edges (perpendicular to the trabeculae). The granules often fuse to form carinae, particularly on the upper, inner edges of the primaries and secondaries.

The fossa is moderately deep and contains a compact columella composed of two-nine twisted, fascicular ribbons. The ribbons are interconnected basally and also fuse with the inner edges of the primary septa.

Discussion. — *C. squiresi* is easily distinguished from the other Recent species of *Cyathoceras* by its nonexsert septa and lack of hexameral symmetry. It is clearly identical to *Aulocyathus* sp. reported by SQUIRES (1959), who mistakenly cited the number of septa in his specimen as 28 instead of 38.

Remark. — *C. squiresi* is often found attached to *Enallopsammia profunda* and consequently is often found on deep-water coral banks, including the bank reported in the Straits of Florida (see *E. profunda*).

Etymology. — This species is named in honor of DONALD F. SQUIRES, author of numerous papers on the ahermatypic corals of New Zealand and Antarctic.

Material. — G-661 (2); SB-2484 (2); Gos-1643 (1). — Types: Squires's (1959) *Aulocyathus* sp. (AMNH 3347).

Types. – Holotype: CI-246 (USNM 46874). – Paratypes: CI-246 (4) USNM 46875; CI-140 (5) USNM 46876; G-44 (10) USNM 46877, (1) UMML 8: 282; E-26004 (2) USNM 46878; E-26017 (9) UMML 8: 296.

Type-Locality. – 26°22'N, 79°37'W (northern Straits of Florida); 743–761 m.

Distribution. – Northern temperate distribution from off Georgia to southern Florida (Map 14). 686–822 m.

Genus *Labyrinthocyathus*, new genus

Diagnosis. – Solitary, ceratoid to trochoid, fixed. Costae usually absent. No endotheca. No pali. Columella composed of interconnecting network of lamellar plates. Type-species: *Labyrinthocyathus langi*, n. sp., here designated.

Discussion. – *Labyrinthocyathus* is established for species similar to *Cyathoceras* and *Ceratotrochus*, but which have distinctive columellas composed of a network of plates instead of papillose, fascicular columellas of twisted ribbons. The genus *Crispatotrochus* is also similar to *Labyrinthocyathus*. The holotype of the type-species *C. inornatus* T. Woods, 1878 (deposited at the Macleay Museum, Sydney) has a fascicular columella of twisted ribbons (Pl. XII 5) similar to that of *Cyathoceras*. The following species are placed within this genus: *L. langi* n. sp. (type of genus) (Recent, western Atlantic), *Ceratotrochus limatulus* Squires, 1964 (Recent, New Zealand), *Cyathoceras cornu sensu* Gardiner, 1904 (Recent, Madagascar) (Pl. XI 10–11), *Cyathoceras kondoi* Wells, 1977 (Eocene, Tonga), and probably *Parasmilia mentaldoensis* Chevalier, 1961 (Miocene, Italy). The latter species was placed in *Parasmilia* instead of the superficially similar *Cyathoceras* because of the presence of an endotheca and of fine septal granules (not carinae) in *Parasmilia*. However, an endotheca was not reported for the holotype of *P. mentaldoensis*. These five species, the first four of which have been examined by the author, conform to the generic description, the diagnostic feature being the columella.

Etymology. – The generic name refers to the labyrinthine arrangement of the columellar elements. *Gender*: masculine.

23.

***Labyrinthocyathus langi*, new species**

Plate XIII, figures 1-4

Description. – The corallum is ceratoid to trochoid and usually bent or slightly curved. The holotype has a round calice measuring 12.0 mm in diameter narrowing to a slender pedicel 3.7 mm in diameter. It is attached by a slightly expanded base. The corallum wall is thick, particularly near the calicular edge. The theca is smooth, bearing no granulation; costae are only slightly expressed or absent. When present they are broad, flat, and separated by very faint, narrow striae.

Septa are arranged in six systems and four cycles. The holotype has two S_5 but also lacks two S_4 , resulting in 48 septa. S_1 and S_2 are equal in size, slightly exsert, and extend to the columella. S_3 and S_4 are progressively smaller; however, the S_3 also reach the columella. The inner edges of the first two cycles are sinuous, whereas those of the last two cycles are less so. Widely spaced rows of low, blunt granules oriented perpendicular to the trabeculae occur on the septal faces. Sometimes short carinae occur near the septal edges.

The fossa is moderately deep with a compact columella, which is round to elliptical in outline. The columella is a maze of short, interconnected lamellae, which are not conspicuously granulated. Usually a short section of a columellar lamella borders the inner edge of every S_3 . This often occurs by the bifurcation of a more centrally located lamella near the inner edge of an S_1 or S_2 ; the forked portions of the lamella are then directed toward each of the two S_3 that flank the S_1 or S_2 .

Discussion. – *L. langi* is most easily distinguished from *L. facetus*, n. sp. by its lack of granules or carinae on the columellar elements. It is also similar to *Parasmilia mentaldoensis* Chevalier, 1961, except that the latter is decameral.

Etymology. – This species is named in honor of JUDITH LANG, who provided me with the Eastward ahermatypes, which included the holotype of this species.

Material. – Gos-1645 (1); Caroline-94 (2); E-26023 (1) USNM 46809; E-30176 (1); E-30178 (2). – Types.

Types. – Holotype: E-26017 (USNM 46871). – Paratypes: G-694 (1) UMML 8: 297; E-14038 (2) USNM 46872; Atl-3341 (2) MCZ; Alb-2354 (5) USNM 46873.
Type-Locality. – 26°38.5'N, 79°32.5'W (northern Straits of Florida); 770–785 m.

Distribution. – Antillean distribution from Virgin Islands to Cuba; Arrowsmith Bank, Yucatan; off east coast of Florida (Map 15). 695–810 m.

24. **Labyrinthocyathus facetus**, new species

Plate XII, figures 6–9

Description. – The corallum is conical, ceratoid in the smaller paratype and subcylindrical in the larger holotype. The calice is slightly elliptical, with the longer axis defining the orientation of the slightly elongate columella. The holotype measures 10.2×10.0 mm in calicular diameter and 21.1 mm tall. It is solidly attached to the substrate by a thick pedicel 4.4 mm in diameter. The pedicel and theca are both extensively thickened by layers of stereome. There are no costae, even at the calicular edge. The theca is covered by small, low, rounded granules and is yellowish-brown toward the calice, white toward the base.

Septa are arranged in six systems and four cycles. The holotype lacks two pairs of S_4 (44 septa), whereas the paratype has only 11 half-systems and lacks one pair of S_4 (42 septa). S_1 and S_2 are equal in size, very thick near the theca, and moderately exsert in the paratype, but almost nonexsert in the holotype. These larger septa have vertical, entire inner edges, which are sinuous, especially near the columella. The S_3 are slightly smaller, much thinner, and also have sinuous inner edges. The S_4 are the smallest septa, yet are well developed, with a much finer sinuosity to their inner edges. All septal faces are smooth, covered by only a few randomly arranged, low, blunt granules.

The columella is very distinctive. It is composed of four-six highly granulated, irregularly shaped pillars, interconnected in the holotype but independent in the paratype. These pillars are not flattened, twisted ribbons as in *Caryophyllia* or *Cyathoceras*, but highly modified lamellae, which bear coarse granules and short carinae.

Discussion. — *L. facetus* is distinguished from the only other Recent Atlantic species of *Labyrinthocyathus*, *L. langi*, by its more compact and granulated columella and by the yellowish color of of its upper theca.

Etymology. — The specific name *facetus* (Latin, =elegant, well made) is given to this handsome coral.

Material. — Types.

Types. — Holotype: GS(G)-16 (USNM 46879). — Paratype: O-11722 (1) USNM 46880.

Type-Locality. — 24°15.7'N, 81°50.3'W (Pourtales Terrace, western Straits of Florida); 284–385 m.

Distribution. — Straits of Florida; off Savannah, Georgia (Map 15). 385–402 m.

Genus *Oxysmilia* Duchassaing, 1870

Diagnosis. — Solitary, ceratoid to trochoid, fixed. Corallum base increases in diameter by repeatedly covering raised costae with exothecal dissepiments, so as to produce partitioned concentric rings. Septotheca costate. No pali. Columella papillose or elongate, fused mass, not composed of twisted ribbons. Type-species: *Lophosmilia rotundifolia* Milne Edwards & Haime, 1849, by monotypy.

25. *Oxysmilia rotundifolia* (Milne Edwards & Haime, 1849)

Plate X, figures 7–9; Plate XI, figures 1–4

Lophosmilia rotundifolia MILNE EDWARDS & HAIME, 1849: 247, pl. 5, figs. 3, 3a; 1857: 180. — POURTALES, 1874: 40, pl. 7, figs. 2–3; 1880: 96, 108.

Desmophyllum incertum DUCHASSAING & MICHELOTTI, 1860: 60–61, pl. 9, fig. 4 (not 5). — DUCHASSAING, 1870: 25.

Oxysmilia rotundifolia: DUCHASSAING, 1870: 27. — VAUGHAN & WELLS, 1943: 204. — DURHAM, 1949: 153. — CAIRNS, 1978: 11.

?*Lophosmilia urena* DUCHASSAING, 1870: 26.

Parasmilia ? *punctata* LINDSTRÖM, 1877: 21, figs. 37–38.

?*Cyathoceras portoricensis* VAUGHAN, 1901: 293, pl. 2, figs. 1 a-c. — Lewis, 1965: 1062.

Cyathoceras incertum: ROSSI, 1958: 9-10, fig. 1.

Description. — The shape of the corallum is variable, ranging from ceratoid to trochoid to long and cylindrical. Most coralla have a thick pedicel, measuring one-third to two-thirds the calicular diameter, which expands into an encrusting base equal to or larger than the calice in diameter. The base is not polycyclic as defined by DURHAM (1949); instead, up to six concentric thecal rings can be present, as described in the generic diagnosis. The calice is elliptical; the largest specimen measures 35.0×27.0 mm in calicular diameter and 48 mm tall. Sometimes this species is found clumped in small quasicolonies probably produced by independent settlement of larvae.

Law, rounded costae of equal width, separated by wide, shallow grooves, correspond to every septum but are prominent only near the calicular edge and toward the base. Costal granulation is indistinguishable.

Septa are arranged in six systems and five complete cycles; larger coralla have some S_6 . S_1 are highly exsert, with vertical inner edges that reach the columella. The remaining cycles of septa are progressively smaller and less exsert. The inner edges of all septa are straight and entire, except for those of the S_5 , which are irregularly serrate. The lower, inner edges of the S_1 and S_2 are usually in contact with the columella; however, the S_3 are usually joined to the columella through small, slender paliform lobes (paliform trabeculae?), which are identical to the columellar elements in shape. Low, rounded, close-set septal granules are aligned parallel to the trabeculae near the septal edge, but are randomly arranged on the rest of the septal face.

The fossa is deep and bears an elongate, variable columella. Sometimes it is a massive, fused structure, which may be trilobed because of the partitioning of the inner edges of the lateral S_1 . Usually it is a spongy mass of thin trabeculae, which are united basally. It also can be carinate, composed of thick granulated pillars, or quite inconspicuous.

Discussion. — DUCHASSAING (1870) established *Oxysmilium* for the single species *L. rotundifolia* Milne Edwards & Haime, 1849, because he considered it to be a colonial form distinctive from the solitary *Lophosmilium*. POURTALES (1874, 1880) soon realized that it was not a colonial species and therefore returned it to *Lophosmilium*. VAUGHAN & WELLS (1943) have maintained the monotypic genus *Oxysmilium* in order to distinguish it from the distinctive genera *Cyathoceras* and *Lophosmilium*, which have differently shaped columellas.

There is no doubt that *D. incertum* is a junior synonym of *O. rotundifolia*. *P. punctata* Lindström, 1877, is also considered to be a young, worn specimen of this species. *C. portoricensis* is probably a small, elongate *O. rotundifolia*, but it is too small (cd = 5.5×7.0 mm) to accurately identify.

Material. — P-707 (1) USNM 46059; P-709 (1) USNM 46060; P-875 (2) UMML 8: 384; P-876 (4) USNM 46061; P-1303 (2) USNM 46062; P-1384 (2) USNM 46063; P-1386 (2) USNM 46064; P-1387 (2) USNM 46065; P-1393 (4) USNM 46066; G-725 (7) USNM 46057, (1) UMML 8: 240; G-984 (1) USNM 46058; O-1890 (4); O-4297 (21); O-4459 (1); O-4832 (4); O-4833 (1); O-4904 (1); O-5016 (5); O-5648 (1); O-5954 (1); O-5955 (2); O-6435 (2); SB-3476 (1); SB-3496 (2); BL-132 (1) MCZ; BL-133 (1) MCZ; BL-155 (28) MCZ; BL-156 (1) MCZ; BL-272 (6) MCZ; BL-292 (1) MCZ; Alb-2322 (3); E-9541 (1) USNM 46067; E-26547 (1); 27°54'53"N, 93°26'50"W, 100 m (2) BLM-Texas; Chain-35 (1); Chain-36 (1); Chain-43 (11); Hummelinck-1443 (7). — Holotypes of *L. rotundifolia*, *D. incertum*, *P. punctata*, and *C. portoricensis*.

Types. — A specimen that is probably the holotype of *L. rotundifolia* is deposited at the MNHNP; however, its label is unclear. The holotype of *D. incertum* is housed at the MIZS (Coel. 318). The holotype of *Parasmilium punctata* Lindström, 1877, is deposited at the NRM (type 114). The holotype of *C. portoricensis* is at the USNM (19633). The type of *L. urena* Duchassaing, 1870, is not at the MNHNP or the MIZS and is presumed lost.

Type-Locality. — "America"; no depth specified.

Distribution. — Common throughout Caribbean and Bahamas, ranging from off North Carolina to Surinam; one record from western Gulf of Mexico (Map 16). 46–640 m.

Genus **Trochocyathus** Milne Edwards & Haime, 1848

Diagnosis. — Solitary, turbinate to ceratoid, fixed or free. Septotheca costate, partially covered by a pellicular epitheca. Discrete pali arranged opposite all but last cycle of septa in two crowns. Columella essential, papillose, or spongy. Type-species: *Turbinolia mitrata* Goldfuss, 1827, by subsequent designation (MILNE EDWARDS & HAIME, 1850).

Discussion. — ALLOITEAU (1958) incorrectly changed the type of the genus to *T. plicata* Michelotti, 1838, apparently based on recommendation 69 B 11 or 12 of the International Code of Zoological Nomenclature; however, MILNE EDWARDS & HAIME (1850: xiv) clearly chose *T. mitrata* at a much earlier date.

The generic limits of *Trochocyathus*, *Paracyathus* Milne Edwards & Haime, 1848, *Tethocyathus* Kühn, 1933, and *Thecocyathus* Milne Edwards & Haime, 1848 have been interpreted differently by past authors primarily because of their choice of diagnostic characters and the interpretation of these characters. Consequently the numerous species assigned to these genera by SEMPER (1872), ALCOCK (1902), MARENZELLER (1907), VAUGHAN (1907), GARDINER & WAUGH (1938), YABE & EGUCHI (1942), and others should be reanalyzed in light of recent emendations of the generic diagnosis by WELLS (1956) and CHEVALIER (1961).

CHEVALIER (1961) defines *Paracyathus* as possessing paliform lobes, not true pali as found in *Trochocyathus*. ZIBROWIUS (1976) implies that *Paracyathus* is a rhizangiid. Without making a thin-section to check the trabecular structure of a paliform lobe vs. a true palus, one can usually distinguish *Paracyathus* by its multilobate paliform lobes, which are often indistinguishable from the columella.

Tethocyathus has been differentiated from *Trochocyathus* because of its extensive epitheca (VAUGHAN & WELLS, 1943). However, ALLOITEAU (1958) correctly pointed out that the type-species of *Trochocyathus*, *Turbinolia mitrata* Goldfuss, 1827 (= *T. plicata*), has a pellicular epitheca as do most other *Trochocyathus*. CHEVALIER

(1961) again uses the presence of true pali vs. paliform lobes to distinguish the two. According to him, *Tethocyathus* has paliform lobes and *Trochocyathus* has true pali. Without a longitudinal thin-section through a paliform process, *Tethocyathus* can usually be diagnosed by its thick, prominent epitheca (not pellicular). Also, if *Thecocyathus microphyllus* Reuss, 1871 (type-species of *Tethocyathus*) is found to be polycyclic, this may be an additional generic difference. However, even if the base is polycyclic, this is not universally accepted as a generic level character and the degree of expression of the epitheca is an unreliable character, especially since different specimens of the same species may or may not have an epitheca.

With this discussion in mind, the following three species are provisionally assigned to *Trochocyathus*: *T. rawsonii*, *T. fossulus*, n. sp., and *T. fasciatus*, n. sp.

26. *Trochocyathus rawsonii* Pourtalès, 1874

Plate XIII, figures 5-7; Plate XIV, figures 1-6

Trochocyathus rawsonii POURTALÈS, 1874: 35, pl. 6, figs. 7-10; 1878: 199 (in part: not BL-68); 1880: 96, 101 (in part: not BL-280). - ZIBROWIUS, 1974a: 767; 1976: 153. - CAIRNS, 1977b: 5; 1978: 11.

Montlivaultia poculum POURTALÈS, 1878: 205-206, pl. 1, figs. 21-22; 1880: 96.

Paracyathus laxus POURTALÈS, 1880: 96, 104-105, pl. 1, figs. 9-11.

Not *Trochocyathus rawsonii*: GARDINER, 1904: 100-103, 124, pl. 1, figs. 2 a-b, pl. 2, figs. A-K. - WELLS, 1956: F342; 1958: 261. - SQUIRES, 1961: 17.

Description. - The shape of the corallum is quite variable. It is commonly turbinate with a blunt monocyclic base, but also can be bowl-shaped or trochoid. The turbinate and bowl-shaped forms can occur either free or attached; the trochoid form is always attached. The free form usually bears a small scar of former attachment or a small object that has become incorporated into its base. The calice is often round but also may be elliptical or irregular. The largest calice examined measures 25.9×22.5 mm in diameter; the largest specimen measures 33.0 mm tall. Costae are usually masked by thin, wrinkled bands of epitheca, which extend to within 1-2 mm of the calice. The costae are usually distinguishable only near the

calicular edge, where they bear low, blunt granules and are separated by deep furrows.

Septa are arranged in six systems and five cycles, but the last cycle is never complete. At a calicular diameter of only 14 mm the septa are regularly arranged in four complete cycles, with pali before the first three cycles. With an increase in size, the higher septal cycles become difficult to distinguish because of the random and incomplete development of the fourth and fifth cycles. S_1 are the largest and the only independent septa. The higher cycle septa are progressively smaller and sometimes are interconnected with one another within each system through their pali. The lower, inner edges of the P_4 often unite with the P_3 , which, in turn, sometimes are fused to the P_2 near the columella. All septa are slightly exsert and have straight to slightly sinuous, entire edges except for those of the last cycle, which are coarsely dentate. The septal and palar faces bear low, rounded granules, randomly arranged except near the edges of the septa, where several granules are often arranged in lines parallel to the trabeculae.

Tall pali as thick as the septa are present before all but the last cycle of septa. P_1 are the smallest and extend to the columella. Two of the six P_1 , those opposite the principal septa, are slightly smaller than the other four. P_2 are twice as large and also extend to the columella. P_3 are equal in size to the P_2 but are slightly recessed from the columella. When S_5 are present in a half-system, P_4 also occur, which are then the smallest pali and the farthest away from the columella. The space between the inner edges of the P_3 (and P_4) and the columella is often occupied by progressively smaller secondary and tertiary paliform lobes.

The papillose columella is elliptical in outline and slightly lower in the fossa than the pali. It is composed of numerous, irregularly shaped, interconnected pillars and fused to the inner edges of the adjacent pali.

Discussion. — POURTALES (1874) originally described *T. rawsonii* from small specimens of 10–17 mm calicular diameter with few S_5 and no epitheca, characters typical for a small specimen. Later (1878), he described *M. poculum* from a larger, worn specimen of

22 mm calicular diameter with 10 S₅, poorly developed pali, and a very small columella. This specimen was an extreme variation of *T. rawsonii* in which the corallum underwent rejuvenescence, making it taller. Furthermore, the secondary paliform lobes of the higher cycle septa became long and slender, occupying the space normally taken up by the columella. Transitions from this form with long, slender paliform lobes and small columella to more typical *T. rawsonii* are known. Finally, in 1880, POURTALÈS described *P. laxus*, the typical adult *T. rawsonii*.

GARDINER's (1904) reference to *T. rawsonii* from South Africa was unfounded and led to WELLS's (1956, 1958) and SQUIRES's (1961) incorrect listings. GARDINER's specimen had a more elongate corallum, better delineated costae, and no S₅.

Material. — P-479 (1) USNM 46085; P-848 (9) USNM 46086; P-849 (1) USNM 46087; P-876 (6) USNM 46088; P-890 (9) USNM 46089; P-929 (1) USNM 46090; P-1303 (3) USNM 46091; P-1357 (3) USNM 46093; P-1395 (2) USNM 46092; G-480 (1) USNM 46081; G-694 (1) USNM 46082; G-1036 (6) USNM 46083; G-1312 (2) USNM 46084; GS (G)-5 (1) USNM 46098; GS (G)-15 (1) UMML 8: 382; GS (G)-23 (1) USNM 46099; GS (G)-48 (2) USNM 46100; O-2080 (6); O-4226 (34) USNM 46097, (3) UMML 8: 242; O-4398 (40); O-4931 (1); O-5645 (1); O-5648 (9); O-10513 (1); SB-1788 (1); SB-2424 (10); BL-2 (1) MCZ; BL-32 (14) MCZ; BL-50 (3) MCZ; BL-273 (1) MCZ; BL-300 (5) MCZ; Caroline-38 (1); Caroline-102 (1); MAFLA-2106 (1) FDNR; MAFLA-2746 (1) FDNR; TAMU 65A9-15A (7) TAMU; Explorer-4 (1); off Egmont Key, Florida, 366 m (1). — Syntypes of *T. rawsonii*, *P. laxus*; holotype of *M. poculum*; Gardiner's (1904) *T. rawsonii*.

Types. — Ten syntypes of *T. rawsonii*, divided into four lots, are deposited at the MCZ. One lot (5627) contains four specimens collected by SRIMPSON off the west coast of Florida (183 m); the other three lots (2762, 5479C, 5627) contain three, one, and two syntypes respectively, all collected from a Hassler station off Barbados. Fourteen syntypes of *P. laxus* collected from four stations are also at the MCZ: BL-149 (1), BL-214 (1), BL-253 (8), and BL-254 (4). They all bear the MCZ number 5482. The holotype of *M. poculum* (2759), collected by SRIMPSON, presumably off the west coast of Florida, is also at the MCZ.

Type-Locality. — West coast of Florida and Barbados; 183 m

Distribution. — Common throughout Caribbean, ranging from off Georgia to off the Amazon, Brazil; Campeche Bank, Mexico; Florida west coast (Map 17). 82–622 m. 8–23°C, based on four records.

27.

Trochocyathus fossulus, new species

Plate XV, figures 4-6, 11

Description. – The attached corallum is ceratoid, tapering to a massive, monocyclic base with a diameter of one-half to three-fourths the calicular diameter and secondarily thickened by stereome. The holotype is 10.2×9.7 mm in calicular diameter and 16.8 mm tall. The theca, which is largely obscured by encrusting organisms in both specimens, is smooth, with low, equal costae visible only at the calicular edge.

There are three different kinds of septa: primaries, secondaries, and tertiaries, arranged octamerally, resulting in 32 septa. The primaries are the largest and most exsert. The tertiaries, although slightly less exsert than the secondaries, extend slightly farther toward the columella than do the secondaries. The difference in exsertness of all three kinds of septa is slight. All septa have slightly sinuous inner edges. Their lateral faces are covered by large, blunt granules, which are randomly arranged except at the upper septal edge, where short carinae occur parallel to the trabeculae.

Tall pali are present before the primaries and secondaries. Those before the secondaries are two-three times larger and twice as wide as those before the primaries. The pali are single-lobed and distinct from the columella both in size and shape. The palar granulation is coarser and higher than that of the septa, sometimes forming horizontal carinae. The inner edges of all pali terminate at the columella, forming an elliptical ring, which encloses a field of numerous (7-14) irregular, tall columellar pillars, terminating just below the level of the pali. In the holotype, the pillars are narrow and evenly spaced; in the paratype, the pillars are massive and crowded. The upper edges of both pali and columella project above the calicular margin and are only slightly below the level of the exsert septa, resulting in a very shallow fossa.

Discussion. – There are several minor differences between the holotype and the paratype. The latter has a thicker base, more massive columellar elements, and more rounded septal granules.

These differences are probably a result of its greater deposits of stereome.

This species is easily distinguished from the other Recent species of *Trochocyathus* by its octameral symmetry and exsert calicular elements (shallow fossa). In corallum, septal, and columellar shape, it is similar to *T. virgatus* Alcock, 1902 and *T. rhombocolumna* Alcock, 1902.

Etymology. – The specific name *fossulus* (Latin, =small ditch) refers to the very shallow fossa of this species.

Material. – Types.

Types. – Holotype: P-991 (USNM 46881). – Paratype: CI-6 (1) USNM 46882.

Type-Locality. – 18°47'N, 64°47'W (Virgin Islands); 205–380 m.

Distribution. – Known only from the Bahamas and the Virgin Islands (Map 17). 205–380 m.

28. ***Trochocyathus fasciatus*, new species**

Plate XIV, figure 10; Plate XV, figures 1–3

Description. – The corallum is ceratoid, attached by a narrow pedicel measuring one-third to one-fourth the calicular diameter. The holotype, which is broken off near the base, measures 7.3×6.2 mm in calicular diameter and 16.1 mm from calice to break, where the pedicel diameter is 2.2 mm. A smaller corallum (paratype) of 4.5 mm in greater calicular diameter and 11.8 mm tall, is attached to the holotype but is not an extra- or intratentacular bud. The third paratype is 8.4×6.0 mm in calicular diameter and is also broken near the base. Costae are well-defined only near the calice, where the C_1 – C_3 are slightly ridged for several millimeters. In addition, the C_1 – C_2 and sometimes the C_3 are characteristically pigmented a light brown for about one-fourth of the distance to the base. The C_4 and the lower three-fourths of the theca are covered by low, rounded granules. There are no intercostal grooves.

Septa are arranged in six systems and four cycles. In the holotype

one half-system is incomplete (missing a pair of S_4), for a total of 46 septa; the small attached specimen lacks five pairs of S_4 for 38 septa; and the large paratype is irregular in that it has only 11 half-systems and lacks four pairs of S_4 , for only 36 septa. S_1 and S_2 are equal in size, exsert, and light brown on their upper, outer edges as a continuation of the costal stripes. Each of these septa has a straight, vertical inner edge separated from a small palus by a deep, narrow notch. The twelve P_{1-2} form a crown around the columella. S_3 are half as large as the S_{1-2} , less exsert, and bear large pali, which are four-five times larger than the P_{1-2} . The 12 P_3 project higher in the fossa than the P_{1-2} and also extend to the columella, forming a second distinct crown of pali. S_4 are smaller and less exsert than the S_3 and have slightly serrate inner edges. The septa and pali are covered by low rounded or low pointed granules, which are slightly larger on the pali. The septal granules are arranged in short lines parallel to the trabeculae.

The fossa is moderately deep and encloses a well-defined columella composed of a field of 10-15 discrete, irregularly shaped rods, which terminate at a level below the P_{1-2} .

Discussion. — *Trochocyathus fasciatus* is easily distinguished from all other Atlantic *Trochocyathus* by its variegated costae. Unfortunately, it is known from only three specimens from one locality, which does not allow an adequate description of its variability.

Etymology. — The specific name *fasciatus* (Latin, =striped) refers to the darkly pigmented striped costae.

Material. — Types.

Types. — Holotype: Alb-2354 (USNM 16116). — Paratypes: Alb-2354 (2, 1 attached to holotype) USNM 46913.

Type-Localities. — 20°59'30"N, 86°23'45"W (off Arrowsmith Bank, Yucatan Channel); 238 m.

Distribution. — Known only from type-locality (Map 18).