

Diagnosis.—Colonies flabellate or bushy; branches round in cross section, occasionally anastomosing, especially in flabellate colonies. Coenosteum linear-imbriate, composed of broad, flat platelets; no granules. Gastropores occur at branch tips, branching axils, and, in thicker branches, on lateral surfaces. Gastropore tube cigar shaped, with no style or tabulae; pore covered by a hinged operculum, which, when closed, is flush with the coenosteal surface. Dactylopores are randomly arranged, apically perforate mounds; no dactylostyles. Ampullae large and superficial, some with a lateral, tubular efferent canal.

Discussion.—The complete lack of coordination between the gastro- and dactylopores of *Adelopora*, and its long dactylopores clustered along branch axes, suggests an affinity with the more simple genera of the Erriniinae. It is most similar to *Pliobothrus*, both genera having apically perforate dactylopores spines, linear-imbriate coenosteal texture, and no gastrostyles. However, *Adelopora* differs significantly in having much better developed and organized coenosteal platelets, smaller coenosteal pores, better-formed gastropore tubes without tabulae, superficial ampullae with large efferent ducts, and gastropores located primarily at branch axils, each covered by a hinged operculum.

Occurrence.—Subantarctic seamounts from off South America and South Pacific. 298–915 m.

Type Species.—*A. pseudothyron* Cairns, 1982, by original designation.

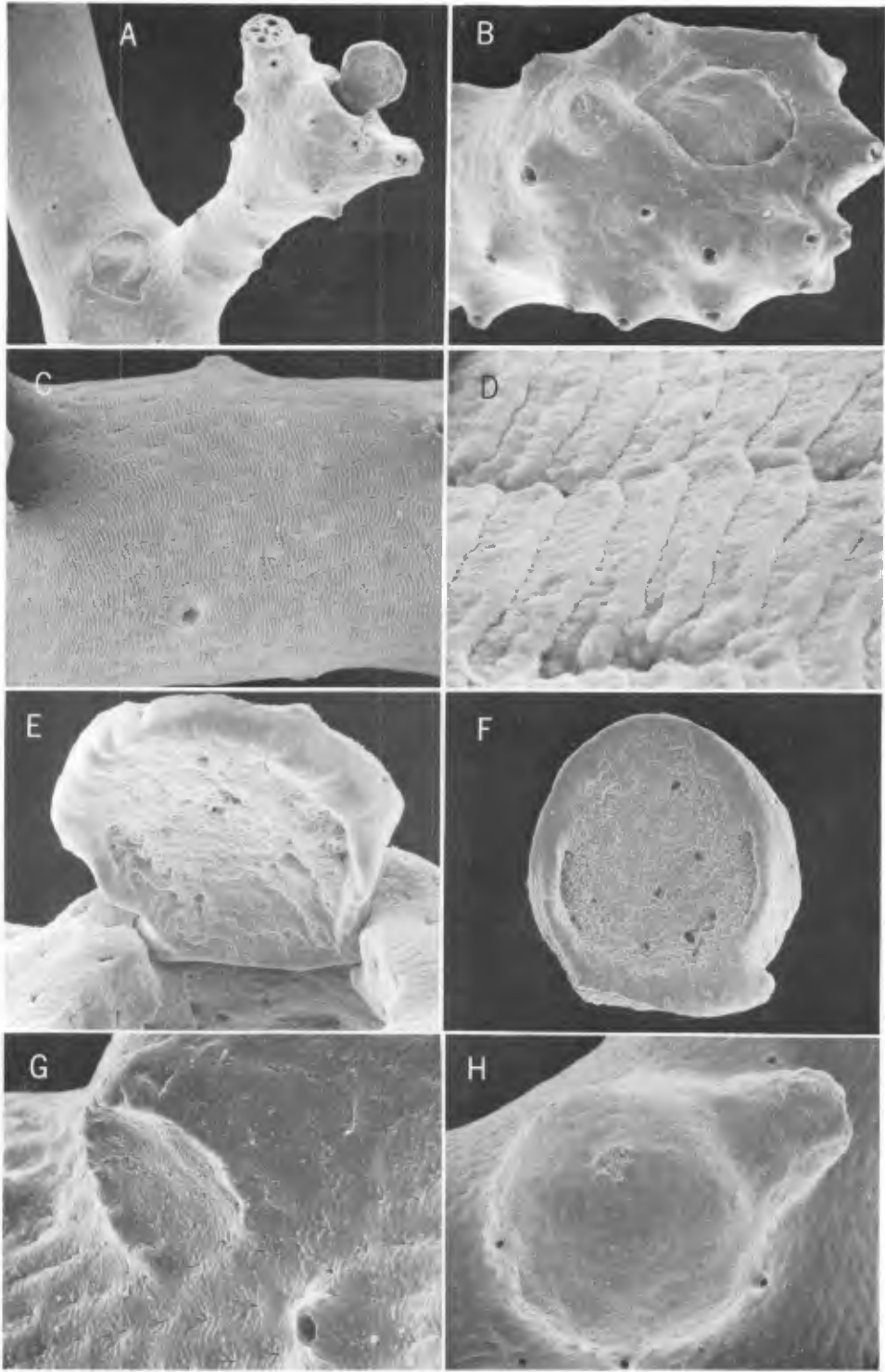
Adelopora pseudothyron Cairns, 1982
 Figures 14A–H, 24A–B, 27H–I, 28G

Adelopora pseudothyron Cairns, 1982a: 71–81, figs. 1–22; in press: figs. 31B, 35A–I.

Diagnosis.—Colonies up to 3.8 cm tall; distal branches about 0.9 mm in diameter, basal branches up to 1 cm in diameter. Branching axils often U-shaped. Coenosteal strips 53–70 μm wide, composed of broad platelets extending the entire width of one or two strips; 75–90 leading platelet edges occur per mm. Gastropore tubes at least 1 mm deep and 0.3 mm in diameter, ending in a gently rounded cul-de-sac. Opercula 0.39–0.58 mm long and 0.35–0.64 mm wide with length to width ratios of 0.71–1.34, but averaging about 1.1. Opercula 70 μm thick at their edges but considerably thinner toward the center because of the concavity of their lower sides. Dactylopores 25–35 μm in diameter, occurring only on small diameter distal branches. Dactylopores elevated on mounds up to 0.15 mm tall and 0.15 mm broad at their bases; the pores extend down the center of the branch axis in fascicles for a considerable distance. Ampullae 1.06–1.22 mm in diameter, the efferent canal up to 0.5 mm long and 0.23 mm in distal diameter.

Gastrozooids large, bottle shaped, with a crown of 7–9 relatively long tentacles below a tapered hypostome. Dactylozooids simple and long. Rod-shaped nematocysts measuring 11.8–12.5 \times 2.5–3.0 μm occur in the ectoderm, and oval nematocysts, 6.1–7.0 \times 3.0–3.5 μm , occur on gastrozooid tentacles. Two short

Figure 14. *Adelopora pseudothyron* (A, paratype from Eltanin 25–326: 46°04'S, 83°55'W, 298 m, 9 Oct. 1966; B–H, paratype from Eltanin-254: 59°49'S, 68°52'W, 512–622 m, 10 Oct. 1962): A, colony with one open and one closed operculum, $\times 23$; B, branch tip with closed operculum and numerous dactylopores, $\times 44$; C–D, imbricate coenosteal texture, $\times 67$, $\times 667$, respectively; E, operculum in open position, $\times 117$; F, underside of operculum removed from corallum, left nub broken off, $\times 95$; G, face of efferent tubule of figure H, $\times 100$; H, ampulla with efferent tubule, $\times 40$.



opercular retractor muscles attach to narrow slits, one on each side of the operculum adjacent to the lower, outer edge (Fig. 28G).

Discussion.—*A. pseudothyron* has been more thoroughly described and illustrated by Cairns (1982a); however, three corrections are made here: (1) the larger coenosteal canals 50–90 μm in diameter described by Cairns (1982a: fig. 22) are actually dactylopore tubes, (2) the gastropore tube is not 1 mm in diameter, but 1 mm long and about 0.3 mm in diameter, and (3) slightly different nematocyst measurements are given in the diagnosis.

Adelopora is a monotypic genus.

Distribution.—Subantarctic seamounts from Scotia Ridge, Drake Passage, Chile Rise, and Eltanin Fracture Zone (South Pacific). 298–915 m.

Types.—Holotype and most paratypes deposited at the USNM. Single paratypes also at BM, ROM, and RMNH.

Subfamily Distichoporinae Stechow, 1921

Diagnosis.—Gastropores linearly arranged, usually on the lateral branch edges, flanked on either side by a row of dactylopores.

Distichopora Lamarck, 1816

Millepora: Pallas, 1766: 288 (part).

Distichopora Lamarck, 1816: 198.—Moseley, 1881: 95.—Broch, 1942: 7–8.—Boschma, 1956: F100; 1959: 121–134.

Madrepora: Nardo, 1844: 68 (part).

Diagnosis.—Colonies usually flabellate, sometimes slightly bushy; branches closely spaced but rarely anastomotic. Branches usually elliptical to rectangular in cross section, the greater branch axis in the plane of the colony; branch tips usually blunt. Coenosteal texture tuberculate to reticulate, always covered by low granules; low, longitudinal supporting ridges sometimes present. Color of coenosteum highly variable. Gastro- and dactylopores extend for a long distance down the center of the branch. Gastropores aligned or slightly staggered in pore rows, which run along the lateral branch edges, sometimes meandering over the branch faces. Gastropores usually flanked on both sides by a row of dactylopores; however, sometimes only one side has pores or one side has a greater frequency and/or height of dactylopores. Gastropores round to polygonal, sometimes sunken along a recessed sulcus or flush with the coenosteum. Dactylopores oval to elliptical, their greater axis perpendicular to the pore row; dactylopores may be elevated (in which case a short dactylotome is present), conical, or flush with the surface. No dactylostyles. Gastrostyles needle shaped (H:W often over 10) and very prominently ridged, the ridges bearing tall, pointed spines. A diffuse ring palisade is often present and tabulae sometimes stabilize the style. Female ampullae superficial and often ridged in a stellate or longitudinal fashion; male ampullae smaller. Ampullae are often clustered.

Discussion.—*Distichopora* is most similar to the genus *Sporadopora*. Both have very long gastro- and dactylopores, and sacs which completely enclose the gastrozooids, characters shared only by the simple Errininae. Furthermore, both have extremely long, ridged gastrostyles supported by tabulae (a character shared only by these two genera), reticulate coenosteum on the older branches, flush gastro- and dactylopores (some *Distichopora*), blunt branch tips, and no dactylostyles. *Distichopora* differs primarily in its linear coordination of gastro- and dactylo-

pores, elliptical dactylopores, and superficial ampullae. One species, *D. providentiae* (Hickson and England, 1909), seems to be transitional between the two genera. It has distichoporine-shaped dactylopores and partially buried ampullae, but the coordination of its dactylo- and gastropores is not as intimate as in the other *Distichopora*, and in some places it is almost random (Fig. 16H). Both Hickson and England (1909) and Boschma (1959) considered *D. providentiae* to represent an intermediate between the two genera, the former placing it in *Sporadopora*, the latter transferring it to *Distichopora*. I agree with Boschma, that *D. providentiae* is more similar to the other species of *Distichopora* and that it may resemble a transitional stage between *Sporadopora* and *Distichopora*.

Occurrence.—Eocene: Paris; Miocene: New Zealand; Pliocene: Japan; Recent: Indo-West Pacific, North Pacific, off Galapagos (undescribed species from Albatross station 2818: 0°29'S, 89°54'30"W, 717 m, USNM), western Atlantic. 1–717 m.

Type Species.—*Millepora violacea* Pallas, 1766, by monotypy.

Distichopora (Distichopora) violacea (Pallas, 1766)

Figures 15A–H, 26C, 27D

Millepora violacea Pallas, 1766: 258.

Distichopora violacea: Lamarck, 1816: 198.—Hickson, 1892: 501–507, pl. 18, figs. 1–4, pl. 19, figs. 1–3; 1893: 129–153, pl. 9, figs. 1–18.—Hickson and England, 1909: 346–348.—England, 1926: 275–278, text-figs. 12–18.—Boschma, 1956: F100, fig. 83, 2a; 1957: 47–48; 1959: 134–144, pl. 1, figs. 2–17, pl. 2, figs. 3–8, pl. 3, figs. 1–3, pl. 4, figs. 1–3, 6–13, pl. 5, figs. 1–4, pl. 6, figs. 1–2, 4, pl. 14, figs. 3–4 (detailed synonymy and discussion).—Eguchi, 1965: 219; 1968: 38–40, pl. 25, figs. 3–5, pl. 26, figs. 3–5, 18, pl. 27, figs. 4–5.—Boschma, 1968d: 13–14, fig. 5.—Fenninger and Flajs, 1974: 71, 75, pl. 5, fig. 6.—Chevalier, 1978: 245, 273; 1979: 132.—?Rønneberg, Fox and Liaaen-Jensen, 1979: 408.

Distichopora cinabarina Nardo, 1844: 62.—Boschma, 1959: 139.

Madrepora violacea: Nardo, 1844: 68.

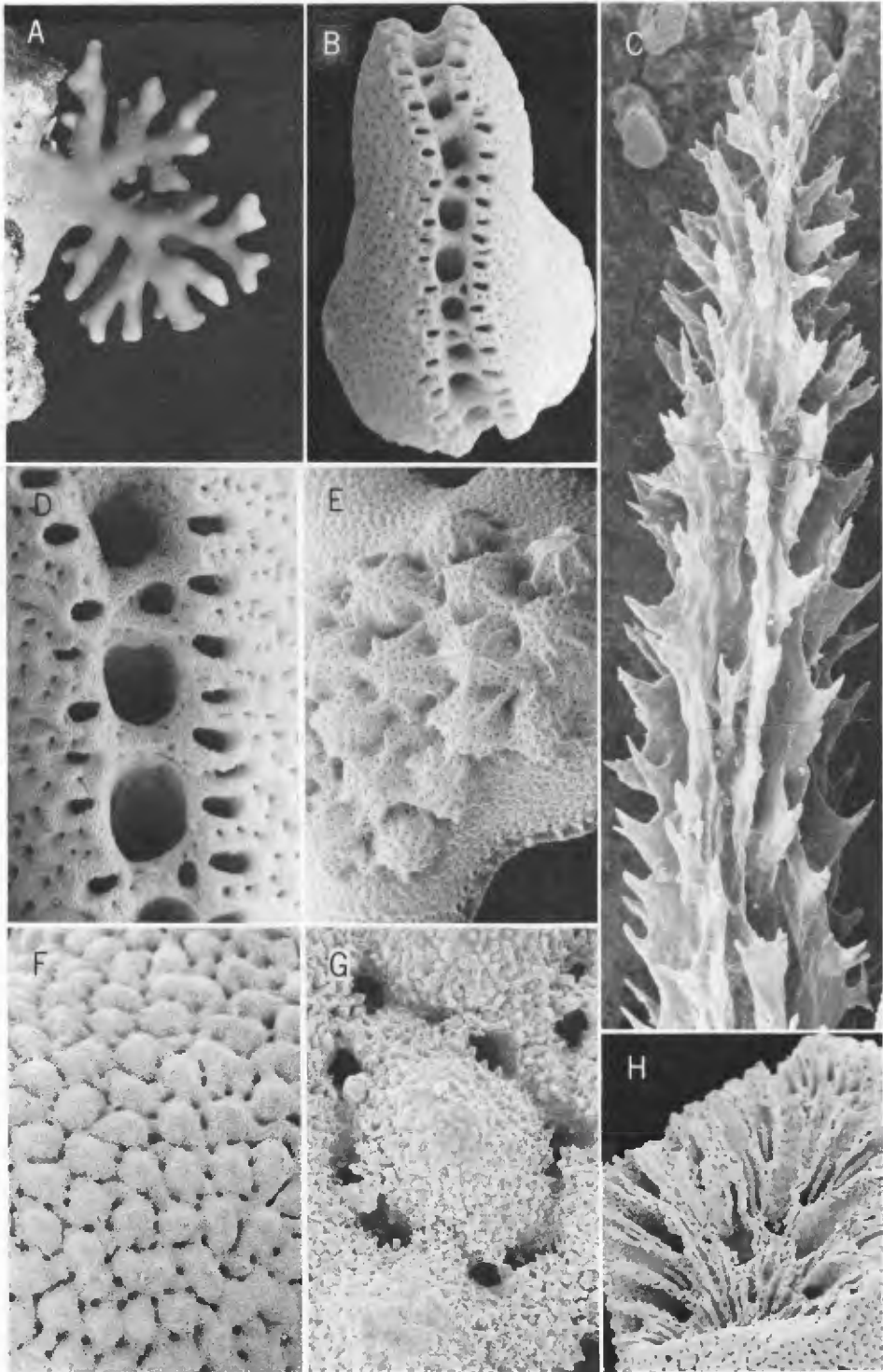
?*Distichopora fulvacea* Michelin, 1862: Annexe B.—Boschma, 1959: 152–153.

?*Distichopora rosea* Kent, 1871: 281.—Boschma, 1959: 139.

Distichopora fisheri Broch, 1942: 14–16, pl. 2, fig. 3, text-fig. 2, 30a.—Wells, 1954: 476, pl. 185, figs. 1–2.

Not *Distichopora violacea*: Broch, 1942: 9–14, pl. 1, figs. 1–2 (= *D. nitida* and *D. coccinea*).—Wells, 1954: 476, pl. 185, fig. 3 (= *D. nitida*).

Diagnosis.—Colonies flabellate, rarely exceeding 8–9 cm in height. Branches compressed in plane of fan, blunt tipped, and closely spaced. Colony form variable: forma *violacea* s.s. broadly flabellate with thick terminal branches (2.5 × 3.0–5.0 mm in diameter); forma *fisheri* flabellate but vertical branch growth predominates, terminal branches as in *violacea* s.s.; forma *tenella* broadly flabellate but terminal branches slender (1.5 × 2.5 mm in diameter). Intergrades and other variations of colony form and branch thickness also occur. Base of colony usually forms a broad encrustation. Coenosteum at branch tips tuberculate, composed of discrete convex tubercles measuring 0.15–0.20 mm in diameter, each surrounded by 5–8 round coenosteal pores 35–39 μm in diameter; tubercles covered by rounded granules 8–10 μm in diameter. Towards the colony base the tubercles fuse, creating a reticulate texture. Coenosteum usually violet or red but may be vermilion, pink, orange, brown, yellow, or white. Pore rows generally restricted to lateral branch edges but occasionally meandering over anterior or posterior faces; short rows running perpendicular to the lateral rows are common at branch tips; isolated rows of 1–4 gastropores also occur on the branch faces near the base of the colony, often resembling cyclo systems. Pore rows 0.8–1.0 mm in width, sulcus depth varies from shallow to deep. Gastropores round to polygonal, 0.3–0.5 mm in



diameter, usually arranged unilinearly. Dactylopores about 0.19 mm long and 0.06–0.08 mm wide, the pores narrowing to a lesser width near the gastropore. Dactylopores only slightly raised; dactyloptomes correspondingly short. Approximately 2.1–2.9 gastropores per mm and 4.0–4.5 dactylopores per mm, the dactylopores of equal frequency on either side of the pore row, thus 3–4 dactylopores per gastropore. Illustrated gastrostyle 0.55 mm tall, 0.064 mm wide (H:W = 8.5), bearing tall (up to 35 μm) sharp, upcurved, claw-like spines on its ridges. Diffuse ring palisade composed of clavate elements measuring up to 54 μm tall and 16–18 μm in diameter; no tabulae noted. Female ampullae 0.6–1.0 mm in diameter, usually bearing radiating ridges; male ampullae smaller and usually clustered into a large mass.

Gastrozooids with 4–6 tentacles; dactylozooids adnate. Ectodermal nematocysts oval, 6.5–8.0 \times 3.2–4.0 μm ; those of gastrozoid tentacles and dactylozooids rod shaped, 4.0 \times 1.5–2.0 μm . Sexes usually separate but hermaphrodites do occur. Male ampullae may have 4–5 gonophores apiece.

Discussion.—The history of the synonymy of *D. violacea* and a comparison to other species is given by Boschma (1959); remarks on its gonophores are made by Hickson (1893) and England (1926); and a description of the histology of the polyps and coenosteum is given by Hickson (1892).

Fifteen Recent species are assigned to *Distichopora* (Table 1): nine in the Indo-West Pacific region, one in the North Pacific, and five in the western Atlantic. In addition, three fossil species are known from the Eocene of Paris, Miocene of New Zealand, and Pliocene of Japan. I have examined representatives of all but three (*D. livida*, *D. sepens*, *D. profunda*) of the Recent species.

Distribution.—From the western Indian Ocean to the central Pacific, but not Hawaii (see Boschma, 1959: 144). Shallow water to 122 m.

Types.—Deposition unknown.

Subgenus *Distichopora* (*Haplomerismos*) Cairns, 1978

Distichopora (*Haplomerismos*) Cairns, 1978: 84.

Diagnosis.—Colonies small and flabellate, the flabellum sometimes slightly curved. After initial bifurcation of main stem no further branching occurs; instead, two vertically flattened lobes are produced which grow in opposite directions and parallel to the substrate. Coenosteum flat and granular (not reticulate), bearing low longitudinal ridges. Gastro- and dactylopores are both very long, extending for a great distance down the center of the lobes. Pore rows occur on lateral edges of lobes and main stem. Dactylopores occur in about equal number on both sides of pore rows. Gastrostyles have a very high H:W and are ridged, the ridges bearing tall, slender, often fused, spines; no ring palisade. Ampullae internal, opening to surface by irregularly shaped pores.

Discussion.—*Haplomerismos* differs from the nominate subgenus primarily in its unusual colony shape and its nonreticulate coenosteal texture. Other points of

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Figure 15. *Distichopora violacea* (A, Johnson Atoll; B–D, F–H, Pa'ea, Tahiti, USNM 43284; E, Gekei Atoll, Marshall Islands): A, colony, $\times 1.6$; B, D, pore row, $\times 16$, $\times 40$, respectively; C, gastrostyle tip, $\times 350$; E, clustered ampullae, $\times 15$; F–G, tuberculate coenosteal texture, $\times 37$, $\times 165$, respectively; H, longitudinal branch fracture revealing gastrostyles, $\times 15$.

difference include its gastrostyle spines, which are more slender and often fused, and its internal ampullae, both characters shared with the aberrant *D. providentiae*. The bilobate colonial form is unique among the Stylasterina. Several species of *Distichopora*, particularly *D. borealis*, have broad, flattened branch tips approximating a small lobe, but eventually bifurcation occurs producing an arborescent colony. Only one other species is known to have plate-like fronds: some specimens of *Errinopora nanneca* have large, vertical, solid flabella. *Stylantheca porphyra* also has a broad, flat coenosteal surface, but it is an encrusting species.

Occurrence.—Known only from off Laysan, Hawaiian Islands. 658–736 m.

Type Species.—*D. (Haplomerismos) anceps* Cairns, 1978, by original designation.

Distichopora (Haplomerismos) anceps Cairns, 1978
Figures 16A–G, 24C, 25F, 28E

Distichopora (Haplomerismos) anceps Cairns, 1978: 84–86, pl. 1, figs. 1–6.

Diagnosis.—Colonies up to 26.4 mm tall and 49.2 mm broad; main stem 4–5 mm in diameter and about 12 mm tall. Lobes 2.5–3.5 mm thick and usually slightly asymmetrical, one being larger than the other. Coenosteal granules rounded to conical, 15–30 μm in diameter and equally tall; coenosteal pores irregular in outline, 20–30 μm in diameter. Both granules and pores randomly scattered over the coenosteum, the pores much less numerous. Coenosteum white. Pore row about 1 mm wide, containing a recessed sulcus about 0.6 mm deep. Gastro-pores elliptical to rectangular, up to 0.75 mm long and 0.36 mm wide, the greater axis aligned with the sulcus. Gastropores regularly and unilinearly arranged, separated by thin septa; up to 15 pores per cm. Dactylopores elliptical in cross section, up to 0.35 mm long and 0.18 mm wide, oriented with their greater axes perpendicular to the pore row; no dactyloptome; up to 30 pores per cm. Sometimes the dactylopores on one side of the pore row are taller and fewer in number. Gastrostyles sometimes exceed 5.5 mm in length with an average diameter of 0.085 mm, producing H:W ratios in excess of 65. Styles bear elongate, slender spines up to 75 μm long and 6 μm in diameter, which project perpendicularly or slightly toward the tip of the style. Internal diameter of female ampullae 1.0–1.14 mm.

Gastrozooids short and squat in the contracted state, concentrated near the tip of the gastrostyle; gastrozooids orange in alcohol. Adnate dactylozooids long and slender, attached to an adhesive basal structure which is robust below the junction but long and ribbonlike above. Nematocysts of gastrozoid tentacles and dactylozooid tips small, measuring 5.0–6.0 \times 2.3–2.5 μm ; those of coenosteal canals only slightly larger: 7.3–8.0 \times 2.7–3.0 μm . Gonophores not examined.

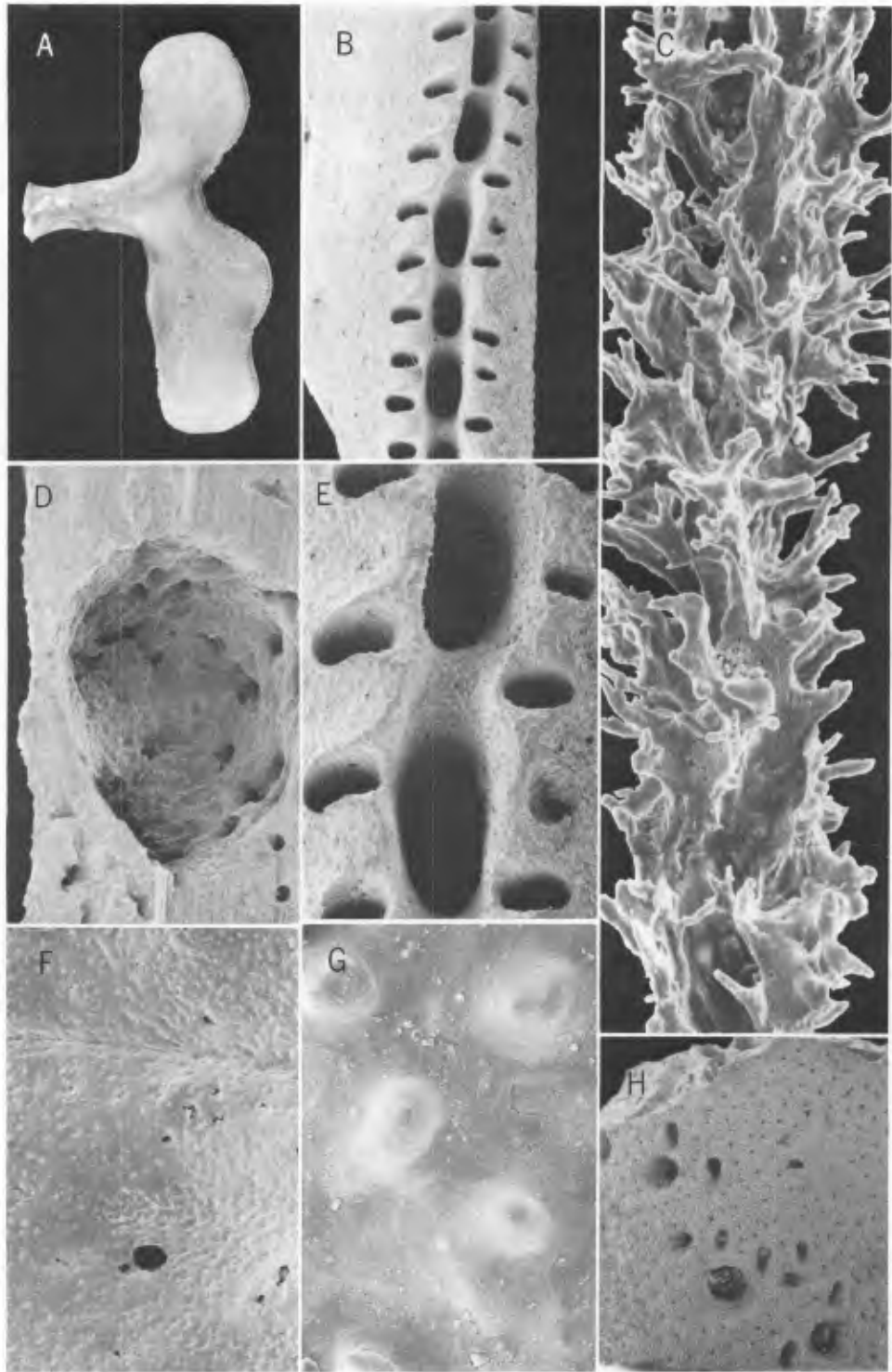
Discussion.—*Haplomerismos* is monotypic; the type-species has been more thoroughly described by Cairns (1978).

Distribution.—As for the genus.

Types.—The holotype and three paratypes are deposited at the USNM.

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Figure 16. *D. (Haplomerismos) anceps* (A–G, paratypes from off Laysan): A, colony, $\times 1.4$; B, E, pore row, $\times 15$, $\times 34$, respectively; C, midsection of a gastrostyle, $\times 270$; D, cross section of an internal ampulla, $\times 40$; F, coenosteal surface with ridge, $\times 30$; G, coenosteal granules, $\times 500$. *Distichopora providentiae*: H, syntype from Percy Sladen Trust Expd. station D-8; off Providence Island, 229 m, BM 1957.2.18.2, branch segment with irregular pore row, $\times 20$.



Subfamily Stylasterinae Gray, 1847

Diagnosis.—Gastro- and dactylopores arranged in distinct cyclo systems.

Stylaster Gray, 1831
Group A ("*Allopora*")

- Allopora* Ehrenberg, 1834: 303, 371.—Milne Edwards and Haime, 1857: 131.—Moseley, 1881: 91, 96–97.—Fisher, 1938: 503.—Boschma, 1956: F99–100.
Stylaster: Milne Edwards and Haime, 1857: 131 (part: third section).—Studer, 1878: 635 (part: third group).—Hickson and England, 1905: 7 (part: group C).
Dendracis: Römer, 1863: 243 (part).
Cryptaxis Reuss, 1865: 620.
Stylaster (Allopora): Broch, 1914: 7; 1936: 9.
Cryptaxiella Kühn, 1939: A-31.

Diagnosis.—Colonies flabellate to bushy, often massive. Branches cylindrical to slightly compressed and blunt; branch anastomosis occurs in some species. Coenosteum reticulate, covered by rounded or irregularly shaped granules; coenosteum white, orange, red, pink, purple, yellow, or blue. Coenosteal papillae (small mounds) and short, flattened coenosteal outgrowths present in some species. Cyclo systems uniformly spaced on all sides of branches. Gastrostyles quite variable in shape, ranging from almost hemispherical (H:W = 1), to bullet shaped (H:W = 2–5), to lanceolate (H:W up to 10). Gastrostyles longitudinally ridged and usually highly spinose; ring palisade often present; tabulae rarely present. Three to seventeen dactylopores per cyclo system; however, 7–9 are the most common numbers; diastemas rare. Additional isolated dactylopores often present, sometimes in great numbers. Dactylostyles well developed, composed of long cylindrical elements, but not present in isolated dactylopores. Ampullae low superficial bulges, sometimes ridged.

Group B (Annectant group)

- Stylaster* Gray, 1831: 37 (part).—Milne Edwards and Haime, 1857: 130 (part: second section).—Studer, 1878: 634 (part: second group).—Hickson and England, 1905: 7 (part: group B).
Stylaster (Eustylaster): Broch, 1914: 7 (part: group B).
Stylaster (Eu-Stylaster): Broch, 1936: 9 (part).

Diagnosis.—Like Group C, but in addition to the regularly sympodially arranged cyclo systems at the branch tips there are additional cyclo systems on the anterior and posterior branch faces, especially on the larger diameter branches. Colonies usually slightly more robust, sometimes bushy.

Group C ("*Stylaster*")

- Stylaster* Gray, 1831: 37 (part).—Milne Edwards and Haime, 1857: 128 (part: first section).—Studer, 1878: 634 (part: first group).—Moseley, 1881: 91, 97.—Hickson and England, 1905: 7 (part: group A).—Fisher, 1938: 498–499.—Boschma, 1956: F99.
Cyclopora Verrill, 1866: 38.
Deontopora Hall, 1893: 117.
Stylaster (Eustylaster): Broch, 1914: 7 (part: group A).
Stylaster (Eu-Stylaster): Broch, 1936: 9 (part).

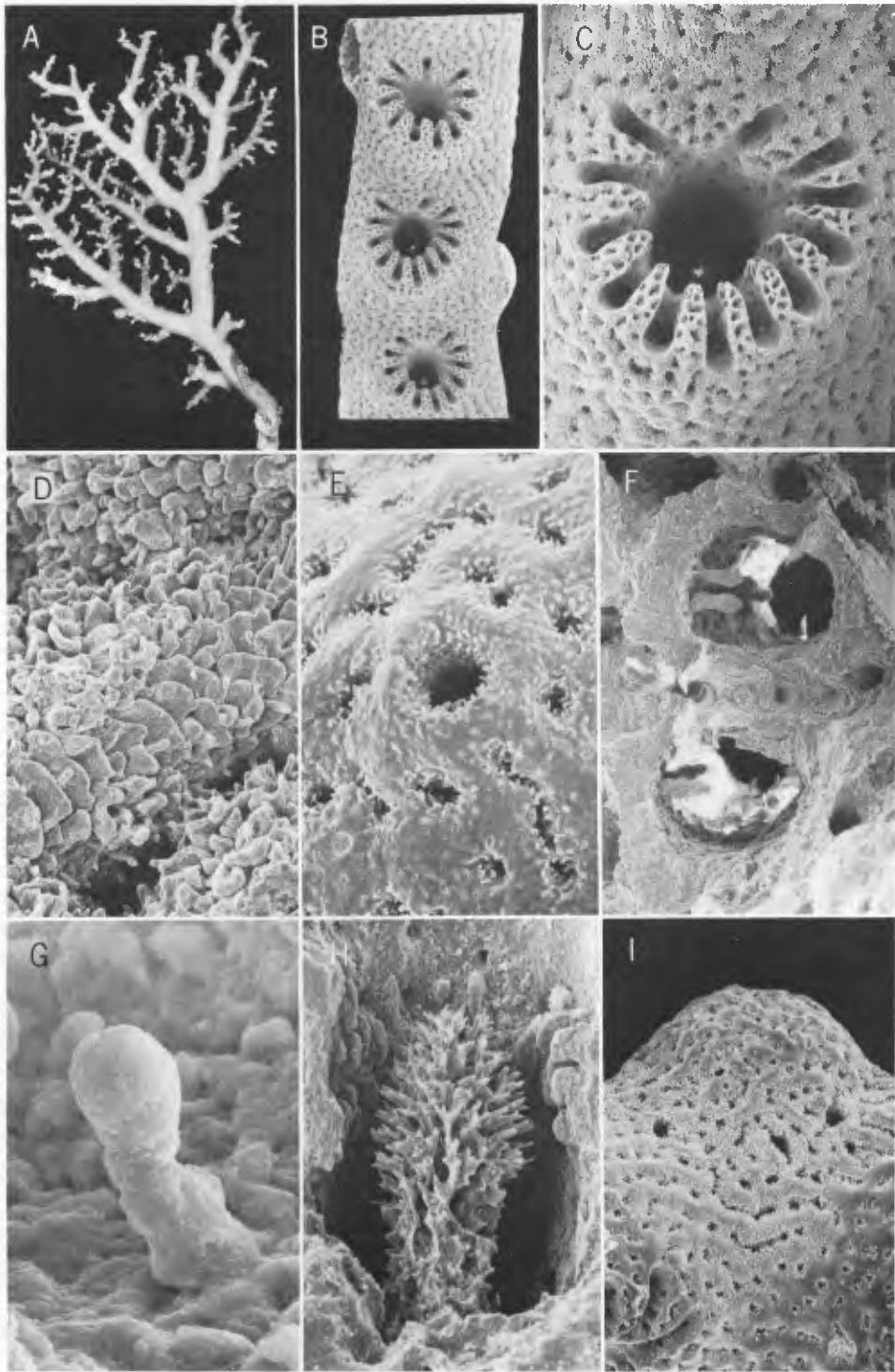
Diagnosis.—Colonies flabellate and delicate. Branches usually slender, terminating in a characteristic zigzag, sympodial shape. Branches elliptical in cross section and sometimes anastomose, even approaching the fenestrate growth form of *Er-rinopsis*. Coenosteum variable in texture, including reticulate-granular, linear-imbricate, and very irregular reticulate-imbricate. Papillae (nematopores ?) and

short ridges are sometimes present on the coenosteum. Coenosteum orange, beige, purple, or white. Cyclosystems occur in a regularly sympodial pattern resulting in two rows, one on each lateral branch edge. These rows may be displaced to the anterolateral edges of large diameter branches but cyclosystems do not occur on the anterior or posterior branch faces. Cyclosystems usually slightly raised above the coenosteum, especially the abcauline side, which gives them an anteriorly projecting aspect. Gastrostyles lanceolate and ridged, with a medium to high H:W ratio, and invariably with a well-developed ring palisade. Usually 10–15 dactylopores per cyclosystem; adcauline diastemas not uncommon; dactylostyles rudimentary. Ampullae large and superficial, sometimes ridged.

Discussion.—The problem of distinguishing *Stylaster* from *Allopora* has been discussed by many authors and has undoubtedly been the cause of great frustration. Typical representatives of the two genera are clearly quite different but species with intermediate characters are common. Milne Edwards and Haime (1857: 131) were the first to suggest dividing *Stylaster* into three groups: the first corresponding to my Group C, their second to my annectant Group B, and their third to my Group A. They also maintained the genus *Allopora*, distinguishing it by a more irregular branching and a smoother coenosteum. Studer (1878) accepted this scheme as did Hickson and England (1905: 6–7), who introduced a fourth group (D), which we now know as *Stenohelia*. Moseley (1881: 90–91, 97) acknowledged the problem but maintained two separate genera: *Stylaster* (my Groups B and C) and *Allopora* (my Group A). He differentiated them on the regularity of arrangement of cyclosystems and number of tentacles per gastrozoid. Broch (1914: 7; 1936: 8–11) admitted that there was no definite hiatus between *Allopora* and *Stylaster* but nonetheless established subgenera to name his groups: *S. (Eustylaster)*, my Groups C and B; *S. (Allopora)*, my Group A; and *S. (Stenohelia)*, *Stenohelia*. Fisher (1938: 498–499) pointed out that establishing subgenera does not solve the inherent problem of where to place an annectant species. His faunistic account employed only *Stylaster* (my Group C) and *Allopora* (my Groups A and B). Boschma (1956: F99–100) presented the two genera as distinct with no further explanation, and in 1965c he discussed the problem and gave a short history of the debate. All recent papers have used *Allopora* and *Stylaster* as distinct genera.

I have examined representatives of about two-thirds of the valid taxa that I have listed for this species complex and, like those before me, can find no discontinuity between the two genera. Intermediates exist which have cyclosystem arrangements typical of both genera on the same colony. I have therefore synonymized *Allopora* with *Stylaster* but, because this produces a large genus containing about one-third of the stylasterine species, I have divided the genus into three groups, a variation of the solution of Milne Edwards and Haime (1857). The groups have no taxonomic standing and are created for convenience only.

To reiterate, my Group A (“*Allopora*” of others) is characterized by having bushy to flabellate, robust colonies; thick cylindrical branches; reticulate-granular coenosteum; low or flush cyclosystems on all sides of the branches; well-developed dactylostyles; and low, superficial ampullae. Group C (“*Stylaster*” of others) is characterized by having delicate flabellate colonies; thin, flattened branches; variable coenosteal texture (including imbricate); raised cyclosystems arranged in two rows on the lateral branch edges; rudimentary dactylostyles; and large, superficial ampullae. The annectant Group B has characters intermediate between the two. The most significant character separating Groups A and C is the arrangement of the cyclosystems. No other character consistently distinguished the two; however, if more species are examined histologically and by scanning electron microscopy, a more valid division may be proposed in the future.



Stylaster (Group A) is very similar to *Errinopora*, as previously stated. Both Group A and certain species of *Errinopora* (i.e., *E. pourtalesii*, *E. styliifera*) have similar colony and branch shapes, coenosteal texture (including papillae), gastro- and dactylostyles, isolated dactylopores flush with the coenosteum, and superficial ampullae. The main difference between the two is the greater coordination of gastro- and dactylopores as distinct cyclo systems in Group A; however, as previously noted, isolated gastropores on basal branches of *Errinopora* are sometimes surrounded by dactylopores, resulting in rudimentary cyclo systems (pseudocyclo systems). Although cyclo systems are characteristic of all *Stylaster* and rudimentary ones are found in some *Errinopora*, it is not difficult to hypothesize that the ancestor of Group A evolved from an *Errinopora*-type stock by a selection for the pseudocyclo system arrangement of pores and a consistent lateral fusion of dactylo pore spines, as has occurred in *E. cestoporina* and *Gyropora*, resulting in true, highly coordinated cyclo systems.

Occurrence.—Group A is known from the Oligocene of Germany and Washington; the Atlantic, Pacific, and Antarctic Oceans; and off South Africa (not Indian Ocean). Group B is known from the Miocene of Czechoslovakia and from the Atlantic, Pacific, and Antarctic Oceans (not Indian Ocean). Group C is known from the ?Oligocene of Italy, Eocene of Madagascar and Tonga, Miocene of Australia and Japan, and from all ocean basins. (Undescribed species in the USNM collections are from Hawaii and the Galapagos.) 1–1,400 m.

Type Species.—*Madrepora rosea* Pallas, 1766, by subsequent designation (Milne Edwards and Haime, 1850); a member of Group B.

Stylaster roseus (Pallas, 1766)
Figures 17A–I, 25A, 26D, 28F, H

Madrepora rosea Pallas, 1766: 312.

Oculina rosea: Lamarck, 1816: 287.

Stylaster roseus: Gray, 1831: 37.—Milne Edwards and Haime, 1857: 130.—Pourtales, 1871: 83.—Boschma, 1955: 134–138; 1956: F99, fig. 80, 1; 1957: 14–15 (synonymy).—Goedbloed, 1962a: 442–445, text-figs. 11–17; 1962b: 529–531, text-figs. 22–26.—Boschma, 1965c: 227–247, pl. 1–3, text-figs. 1–4 (explicated synonymy).—Fox, 1972: 921–922.—Kruijff, 1977: 445–450, text-figs. 1–3, 5.—Cairns, 1982b: 274, fig. 119d–e.

Millepora rosacea: Nardo, 1845: 637.

Allopora rosea: Dana, 1848: 694.

Not *Stylaster roseus*: Perrier, 1881: 303.—Filhol, 1885: 268.—Krämer, 1897: 104.—Broch, 1914: 12–15 (= *S. erubescens*).—Boone, 1933: 31.

Not *Stylaster* (*Eu-Stylaster*) *roseus*: Broch, 1936: 15 (= *S. erubescens*).

Stylaster (*Eustylaster*) *duchassaingi*: Laborel, 1971: 224, pl. 8, fig. 4.

Diagnosis.—Colonies flabellate to bushy, up to 7 cm tall and 11 cm broad. Branches slightly elliptical in cross section and nonanastomotic; distal branches not much larger in diameter than diameter of a cyclo system (about 1 mm). Coenosteum linear-imbriate with a tendency toward reticulate structure near ampullae and cyclo systems. Strips usually 65–80 μ m wide, covered by a very irregular arrangement of platelets measuring 5–34 μ m in width. Slits separating strips narrow and

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Figure 17. *Stylaster roseus* (A–I, Carrie Bow Cay, Belize, 8–10 m, USNM 47807): A, colony, $\times 0.9$; B, cyclo system on lateral branch edge, $\times 19$; C, individual cyclo system, $\times 50$; D, imbricate coenosteal texture, $\times 380$; E, isolated dactylo pore, $\times 200$; F, two dactylo pores with dactylo styles, $\times 270$; G, dactylo style element, $\times 1,470$; H, gastro style and ring palisade, $\times 133$; I, ampulla, $\times 53$.

deep, bearing elongate granules. Coenosteum rose, red, light purple, or yellowish. Cyclostyles variable in their arrangements. Usually on distal branches they are arranged in a regularly sympodial manner which may continue throughout the colony or be augmented by additional cyclostyles on the anterior and posterior sides. Some colonies have entirely regularly sympodially arranged cyclostyles; on others they are mostly randomly arranged; and yet others have both arrangements on different branches of the same colony. It appears that bushy colonies have a greater tendency for the irregular arrangement. Cyclostyles round to slightly elliptical, 0.75–1.0 mm in diameter. Gastrostyles lanceolate and highly ridged, measuring 0.32–0.50 mm tall and 0.11–0.20 mm in diameter (H:W = 2.1–3.6). Gastrostyle spines fused along ridges; they are slender and pointed, up to 32 μm long. A distinct ring palisade is present, encircling the upper third of the style, composed of vertical ridges up to 52 μm long and 15 μm wide. Based on 1,003 cyclostyles, Boschma (1965c) found the range of dactylopores per cyclostyle to be 5–15, average = 9.7, and mode = 10. Both dactylopores and pseudosepta are about 60–70 μm wide; however, a small adcauline diastema is sometimes present, measuring 3–4 times the width of a pseudoseptum. Dactylostyles rudimentary, composed of widely spaced, linearly arranged, cylindrical to clavate elements 25–27 μm tall and 11 μm in greatest diameter. Ampullae very prominent, 0.5–0.7 mm in diameter, with a thin, porous surface which may be smooth or warty. Sometimes there is a small porous indentation about 0.17 mm in diameter near the base of the ampulla: the future efferent duct. Ampullae are often clustered on both the anterior and posterior sides.

Gastrozooids are short, blunt cylinders, each with several tentacles. Dactylozoid tentacles within cyclostyles are usually adnate (Goedbloed, 1962a); however, some are simple and greatly elongated (hair dactylozooids of Kruijf, 1977). Isolated simple dactylozooids also occur with varying frequency. Nematocysts of gastrozoid tentacles and dactylozooids about $6 \times 2 \mu\text{m}$; slightly larger swollen nematocysts measuring $7 \times 4 \mu\text{m}$ occur on the pseudosepta. Colonies may be hermaphroditic, but individual ampullae are exclusively male or female (Goedbloed, 1962b).

Discussion.—As I have divided the genus *Stylaster* (Table 1), Group A contains 24 species, 1 subspecies, and 1 forma; Group B has 16 species and 4 subspecies; Group C has 26 species, 5 formae, and 2 unnamed species; two more species are *nomina nuda*. *Stylaster* s.l. thus contains 68 species (plus 2 *nomina nuda*), 5 subspecies, and 6 formae, or a total of 79 taxa. *S. roseus* belongs in the annectant Group B, "a rather unfortunate choice" of the type-species, according to Boschma (1965c: 232), because of its intermediate position between *Stylaster* and *Allopora*.

Boschma (1955; 1965c) discussed the synonymy and morphology of *S. roseus* in great detail. Goedbloed (1962a; b) examined its dactylozooids and gonophores, and Kruijf (1977) reported on its polyp behavior and sweeping tentacles. Other important works dealing with the soft anatomy or natural history of other species of *Stylaster* s.l. include: Moseley (1881: 57–65), Hickson (1890), Broch (1914: 8–19; 1942: 73–77), England (1926), and Ostarello (1973; 1976).

Distribution.—Caribbean and off Brazil to Pernambuco (not Gulf of Mexico or Florida Keys). Most common between 0.5–4 m.

Types.—Pallas's types have not been traced.

Stylantheca Fisher, 1931

Stylantheca Fisher, 1931: 395.—Boschma, 1956: F100.

Allopora: Fisher, 1938: 528 (part).

Stylaster (Allopora): Broch, 1942: 101 (part).
Stylaster (Stylanthea): Boschma, 1951: 39.

Diagnosis.—Colonies encrusting, forming thin laminae on rocks and shells. Coenostemum reticulate-granular, purple to light pink, and bears numerous small, apically perforate papillae. Cyclo systems round to elliptical, each bearing 1–12 gastrozooids and gastrostyles. Gastrostyles globose to conical, squat (H:W usually less than 2), and vertically ridged; the ridges bearing long, slender spines. A prominent ring palisade originates from the common spongy horizontal gastropore floor, below which the gastrostyles are housed in individual gastrostyle chambers. Three to sixteen dactylo pores per cyclo system; isolated dactylo pores uncommon. Inner edge of dactylo tome deep, revealing a well-developed dactylo style. Ampullae internal, often massed together or encircling a cyclo system, alternating with the dactylo pores.

Discussion.—*Stylanthea* is very similar to *Stylaster* (Group A); several authors have synonymized the two or treated *Stylanthea* as a subgenus. It differs from *Stylaster* (Group A) primarily in its encrusting habit and its tendency to have more than one gastrozooid per cyclo system, both of which are characters unique in the Stylasterina. For these reasons *Stylanthea* is kept as a separate genus. *Stylaster verrillii* (Dall, 1884) also forms lumpy encrustations but also develops into upright lobes and normal arborescent colonies (Fisher, 1938: 521). In the case of *S. verrillii* the encrusting colonies are probably just a stage in the development of larger branched colonies. Two other characters that unite the species of *Stylanthea*, and serve to differentiate them from most *Stylaster*, are their well-developed coenosteal papillae and their very deep dactylo tome slits.

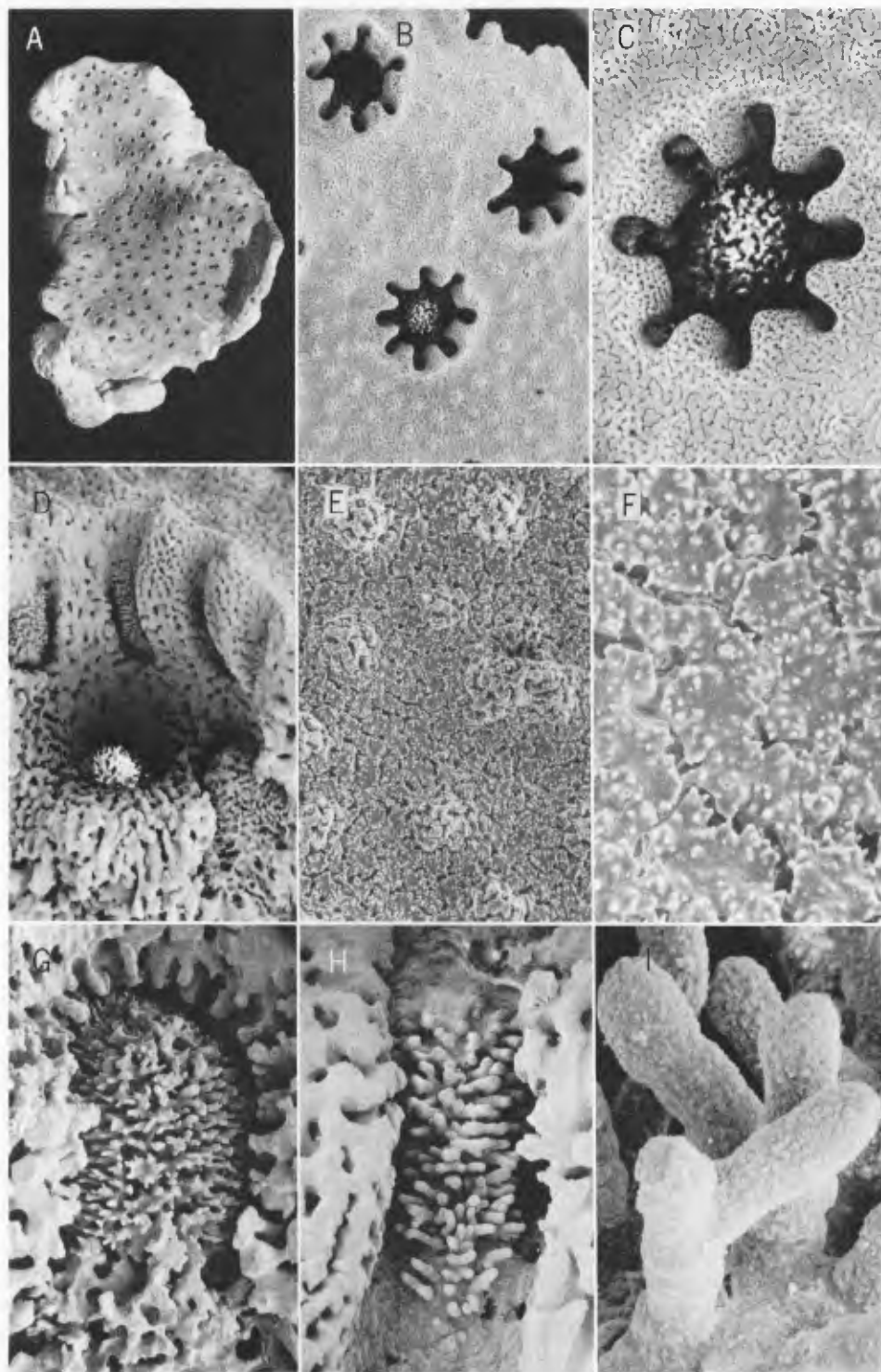
Occurrence.—Recent: Northeast Pacific from California to Alaska. 0–18 m.

Type Species.—*Stylanthea porphyra* Fisher, 1931, by monotypy.

Stylanthea porphyra Fisher, 1931
 Figures 18A–I, 24H, 27G, J

Stylanthea porphyra Fisher, 1931: 395–397, pl. 15, fig. 1, pl. 16, fig. 5, pl. 17, fig. 6.—Boschma, 1956: F100, text-fig. 81, 1; 1957: 33; 1960: 426–427, text-fig. 1e–f. 1961: 221.
Allopora porphyra: Fisher, 1938: 528–530, pl. 59, figs. 1–2, pl. 60, pl. 61, fig. 1, pl. 70, fig. 2.
Stylaster (Allopora) porphyrus: Broch, 1942: 101.
Stylaster (Stylanthea) porphyra: Boschma, 1951: 39, text fig. 5b.

Diagnosis.—Encrustations up to 30 × 25 cm, about 2.5 mm thick. Coenosteal strips flat, 25–55 μm wide, separated by deep slits about 7.5 μm wide; granules 3–7 μm in diameter, pointed. Coenosteal papillae uniformly spaced about 1 diameter from each other, fused into parallel rows, or absent altogether from portions of the colony. Papillae 0.07–0.19 mm in diameter and up to 0.24 mm tall, having an irregularly shaped apical pore measuring about 17 μm in diameter. Cyclo systems round to elongate; the most elongate appear to be multiple cyclo systems fused together. Round cyclo systems 1.0–1.1 mm in diameter, elongate ones up to 2.7 × 1.0 mm in size. Cyclo systems usually only slightly raised above coenostemum, more rarely elevated up to 2 mm with short coenosteal costae radiating from the dactylo tome edges. One to 12 gastrostyles per cyclo system (Fisher, 1938): in a sample of 31 cyclo systems examined from the type-specimens, a range of 1–8 was found, average = 3.3 (σ = 1.59), mode = 3. Gastrostyles globose and very irregular, 0.40–0.43 mm high, 0.26–0.33 mm broad, with H:W ranging from 1.2–1.6. Gastrostyle spines up to 80 μm long and 7 μm in diameter, pointed, and usually fused to adjacent spines near the underlying ridge. In a sample of 34 cyclo systems, the range of dactylo pores per cyclo system was 6–16, average 9.11



($\sigma = 2.08$), mode = 10. Dactylostyles up to 0.35 mm long and 0.09 mm wide, composed of long, blunt, cylindrical elements up to 50 μm long and 10 μm in diameter. Elements of ring palisade similar but shorter. Male ampullae about 0.3 mm in internal diameter, female 0.4 \times 0.6–0.8 mm in internal diameter.

Gastrozooids squat and clavate, with 5–8 short tentacles attached about midway down the polyp. Dactylozooids adnate with only a tiny free part. Nematocysts of gastrozooid tentacles and dactylozooids measure about 6 \times 2 μm ; there are larger nematocysts (9 \times 2.5 μm) in the epidermis, but unfortunately a surface papilla was not sectioned.

Discussion.—Three species are assigned to *Stylanthea*, all endemic to shallow water in the northeastern Pacific. *S. porphyra* is most similar to *S. petrograpta* (Fisher, 1938), the latter differentiated only by its lower number of gastrozooids per cyclo-system (range 1–3, average 1.35 for the type-specimens), fewer dactylozooids per cyclo-system (range 4–9, average 5.8), and smaller cyclo-systems (0.73–0.77 mm in diameter). The fewer gastrozooids and dactylopores per cyclo-system can probably be attributed to the smaller size of the cyclo-system, which, in turn, may be environmentally controlled. Therefore, it is possible that *S. petrograpta* may be synonymized or reduced to a subspecies or forma of *S. porphyra*. Fritchman (1974) has studied the planula and early settlement of *S. petrograpta*. The third species, *S. papillosa* (Dall, 1884), is known only from the tiny type-specimen which contains only 28 complete cyclo-systems. Each cyclo-system has but one gastrostyle; dactylopores per cyclo-system range from 3–5 (average = 4.0); and the asymmetrical cyclo-systems measure 0.82–0.85 mm in diameter. Because of its encrusting mode and only one gastrostyle per cyclo-system, it lies intermediate between typical *Stylaster* (Group A) and *Stylanthea*, but based on its coenosteal texture, gastrostyle, and general aspect, *S. papillosa* is tentatively assigned to *Stylanthea*. Obviously more specimens are needed to correctly resolve its position.

Distribution.—Known only from the Monterey Bay area, California, 0–1+ m.

Types.—The holotype and 13 paratype colonies are deposited at the USNM (43018, 43019, 43276, 43277). Presumably another paratype is at the BM. The types of all three species have been examined by the author.

Calyptopora Boschma, 1968

Stylaster: Pourtalès, 1867: 115.

Stenohelia: Kent, 1870: 123 (part: *S. complanata*).

Stylaster (*Stenohelia*): Broch, 1936: 10, 81 (part: *S. (S.) complanatus*).

Calyptopora Boschma, 1968a: 102.

Diagnosis.—Colonies flabellate. Branches round to elliptical in cross section, sometimes posteriorly carinate; branch anastomosis may occur. Coenosteum reticulate-granular and white, bearing numerous small papillae (nematopores), especially on larger diameter branches. Cyclo-systems unilinearly or sometimes slightly

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Figure 18. *Stylanthea porphyra* (A–I, syntypes from Carmel Bay, California): A, colony, $\times 1.1$; B, coenosteal surface with cyclo-systems and papillae, $\times 15$; C, cyclo-system, $\times 36$; D, longitudinal fracture of a cyclo-system revealing two gastrostyles and several dactylostyles, $\times 36$; E, coenosteum bearing papillae, $\times 67$; F, reticulate coenosteal texture, $\times 270$; G, gastrostyle, $\times 93$; H–I, dactylostyle and dactylostyle elements, $\times 144$, $\times 1,190$, respectively.

sympodially arranged, but in both cases the cyclo systems are all on the anterior side. Cyclo systems usually have one or more diastemas and one or more fixed lids of variable size. The lids are broad, tongue-shaped projections or simply the overdevelopment of several adjacent pseudosepta which overhang the gastropore. Lids are predominantly abcauline. Gastropores broad and deep with a small gastrostyle chamber containing a lanceolate, ridged gastrostyle of small-medium H:W. A ring palisade is present. Dactylostyles well developed. Ampullae superficial, sometimes with an efferent duct.

Discussion.—*Calyptopora* is very similar to *Stylaster* (Group C), differing primarily in its exclusively anterior facing and usually unilinearly arranged cyclo systems, and its cyclo system lids. These character states are approached by various species of *Stylaster*: e.g., some species of *Stylaster* have two rows of anterolaterally arranged cyclo systems indicating a distinct anterior side, and the pseudosepta of *S. alaskensis* are sometimes strongly exsert, approximating a lip. Nonetheless, the three species now placed in *Calyptopora* are considered as a distinct genus.

Occurrence.—Recent: New Zealand region and northern Caribbean. 183–2,010 m.

Type Species.—*C. reticulata* Boschma, 1968, by original designation.

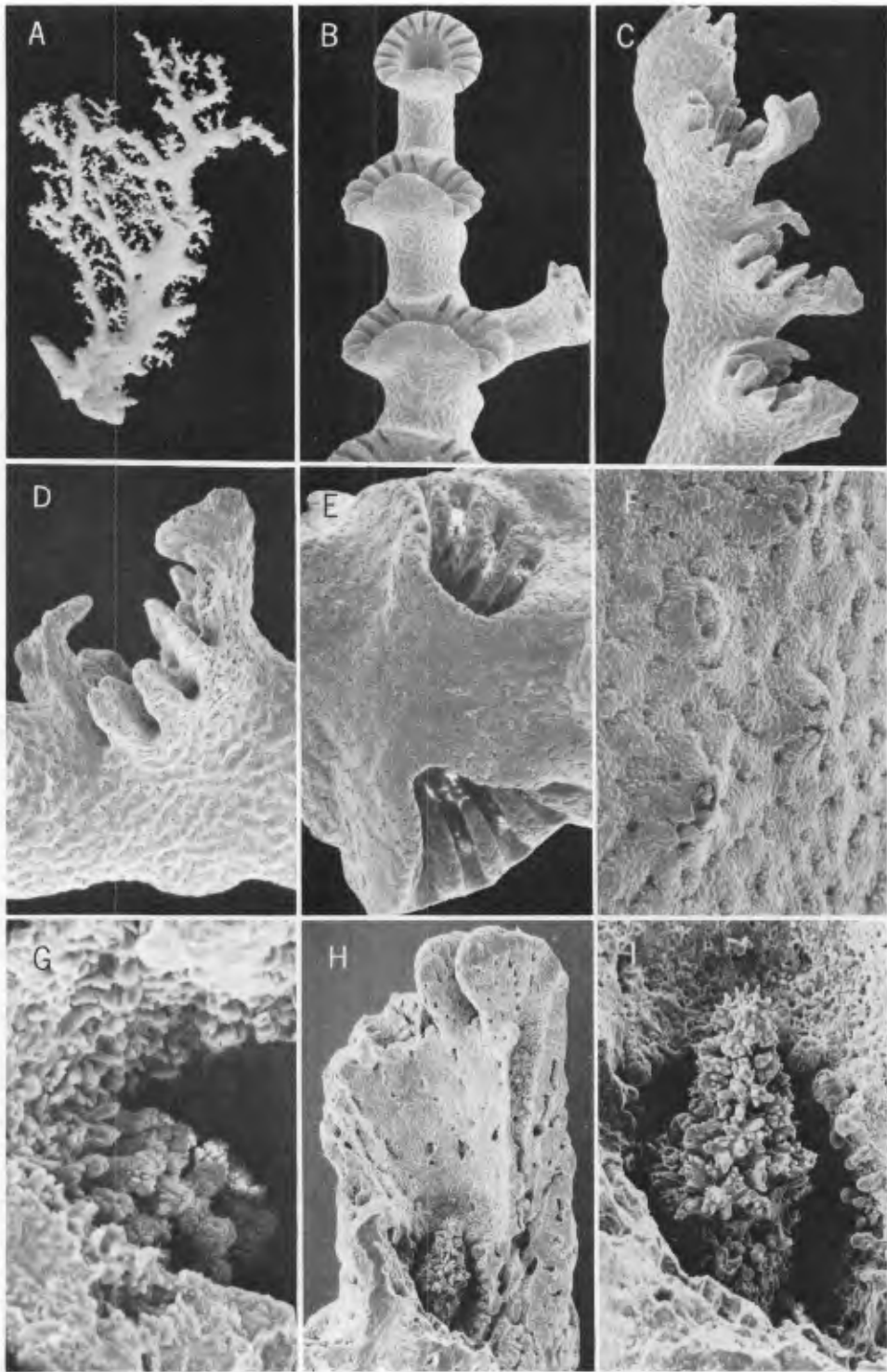
Calyptopora reticulata Boschma, 1968
Figure 19A–I

Calyptopora reticulata Boschma, 1968a: 102–108, pls. 1–3, text-figs. 1–2; 1968c: 315–320 (in text).—Cairns, in press: figs. 41E, 49A–H, 50A–E.

Diagnosis.—Colonies large, up to 17 cm tall and 20 cm broad; basal branches up to 2.3×1.9 cm in diameter. Distal branches often have a continuous ridge along their posterior sides; larger diameter branches round to slightly elliptical in cross section and frequently anastomotic, producing a well reinforced flabellum. A commensal polychaete, *Malmgreniella dicirra* Hartman (identified by M. H. Pettibone), induces flattened calcareous tubes to be formed on both the anterior and posterior colony faces. Coenosteal strips 50–90 μ m broad, covered by irregularly shaped, angular granules. Nematopore mounds 0.14–0.20 mm in diameter and about 0.05 mm tall, each apically perforated with irregular slits. Cyclo systems 0.9–1.6 mm in diameter; one or two short diastemas often present on the adcauline perimeter of the cyclo system, usually adjacent to an ascending branch. Pseudosepta often highly exsert, those on abcauline side often fused into a broad lid which overhangs the cyclo system. Expression of lid quite variable, ranging from slightly overdeveloped pseudosepta to two broad lids (one ab- and one adcauline), which fuse over the cyclo system, forming a canopy. Three to 17 dactylo pores per cyclo system; of 16 cyclo systems examined from the penultimate position on distal branches, the average was 11.3 ($\sigma = 2.27$), mode = 9.5. Gastrostyles up to 0.33 mm tall and 0.14 mm in diameter (H:W = 1.3–2.9). Dactylostyles consist of two to three adjacent rows of closely spaced pillars, measuring about 24 μ m tall by

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Figure 19. *Calyptopora reticulata* (A, E, Eltanin-1851: 49°40'S, 178°53'E, 476–540 m, 3 Jan. 1967; B, F, H–I, Eltanin-1991: 54°39'S, 170°22'E, 1,860–1,940 m, 2 Jan. 1968; C–D, G, Eltanin-2143: 49°51'S, 178°35'E, 2,010–2,100 m, 26 Feb. 1968): A, colony, $\times 0.43$; B–C, distal branch showing cyclo system lids, $\times 14$; D, cyclo system with lid, $\times 28$; E, cyclo system with lids completely fused over gastropore, $\times 38$; F, coenosteal papillae, $\times 73$; G, dactylostyle, $\times 390$; H–I, cross section of gastrostyle chamber containing a gastrostyle, $\times 43$, $\times 133$, respectively.



16 μm in diameter. Female ampullae 0.65–1.06 mm in diameter, sometimes with a short, tubular, lateral efferent duct. Male ampullae 0.49–0.61 mm in diameter, often clustered on the outside of the worm tube.

The soft parts were poorly preserved in the specimen sectioned; however, the tiny gastrozooids have several tentacles and the dactylozooids are adnate. Nematocysts measuring $7 \times 2.5 \mu\text{m}$ are common in gastrozoid tentacles and dactylozooids.

Discussion.—Two other species are placed in *Calyptopora*. *C. complanata* was previously assigned to *Stenohelia*, but with the establishment of *Calyptopora* for the unifacial stylasterines with gastrostyles and fixed lids (Boschma, 1968a), and the added fact that *Calyptopora* does have dactylostyles (Cairns, in press), it becomes clear that *C. complanata* belongs in this genus. Examination of the types of both *C. complanata* and *C. virginis* show them to be synonymous, as Broch (1936) suspected. *C. pachypoma* (Hickson and England, 1905) is quite different from the other two species in coenosteal texture, gastropore shape, and lack of dactylostyles and should probably form the basis of a new genus.

Distribution.—Macquarie Ridge; New Zealand Plateau; off Antipodes, Bounty, and Chatham Islands. 349–2,010 m.

Types.—The holotype and some paratypes are deposited at the New Zealand Oceanographic Institute; other paratypes are at the RMNH (Vervoort and Zibrowius, 1981: 30). Types not examined by the author.

Stenohelia Kent, 1870

Allopora: Johnson, 1862: 196 (part).

Stenohelia Kent, 1870: 121.—Moseley, 1881: 97.—Boschma, 1956: F100; 1964b: 64–72.

Stylaster (*Stenohelia*): Hickson and England, 1905: 8, 15.—Broch, 1936: 10 (part: not *S. (S.) complanatus*).

Stylaster: Hickson and England, 1905: 13–16 (part).

Diagnosis.—Colonies flabellate and delicate; distal branches round in cross section and usually very thin, sometimes half the diameter of a cyclosystem in thickness. Sometimes polychaete commensals induce perforated tubes to be produced, which usually leads to a more robust and slightly bushy corallum. Coenosteum white and usually longitudinally ridged, especially on distal branches; larger diameter branches are either ridged or reticulate in texture. Usually the coenosteum is covered by irregularly shaped granules but in one case (*S. robusta*) a linear-imbricate texture is present. Nematopores often occur on the outside of worm tubes but are otherwise rare; coenosteal spines sometimes present. All cyclosystems originate on the anterior side and project perpendicular to the branch. Cyclosystems are usually unilinearly arranged on a branch and measure 0.8–2.0 mm in diameter. Gastropores very long and invariably curved 90° along the branch axis, sometimes extending all the way to the wall of the more proximal cyclosystem. In the latter case, the gastrostyle is not visible from the outside; however, usually the gastropore is shorter and the tip of the style can be glimpsed projecting through a well-developed ring palisade. Gastrostyle of medium to high H:W, irregularly ridged, and bears fused spines. Seven to 20 dactylopores per cyclosystem; no diastemas or lids. Dactylostyles rudimentary. Ampullae superficial hemispheres, usually clustered around a cyclosystem, but may also be scattered irregularly over the anterior and posterior surfaces.

Discussion.—*Stenohelia* is most similar to *Stylaster* (Group C), differing from it by having: (1) all cyclosystems on the anterior side, (2) a curved gastropore, (3)

slightly concave upper edges of the pseudosepta, and (4) ampullae clustered around the base of the cyclosystems.

Occurrence.—Western Pacific, Antipodes, Galapagos, Madeira, Cape Verde Islands, Lesser Antilles. 91–1,901 m.

Type Species.—*Allopora maderensis* Johnson, 1862, by subsequent designation (Broch, 1936: 8).

Stenohelia maderensis (Johnson, 1862)

Figure 20A–B, D–G

Allopora maderensis Johnson, 1862: 196–197, text-figs. 1–3.—Boschma, 1956: F100.

Stenohelia maderensis: Kent, 1870: 121–122; 1871: 277, pl. 24, fig. 3.—Boschma, 1957: 31–32; 1967: 325–329 (part: pl. 1, figs. 2–4, pl. 2, figs. 3–4, not specimens from St. Vincent).—Zibrowius and Cairns, 1982: 211–212.

Allopora madeirensis: Studer, 1878: 633.

Stenohelia maderensis: Moseley, 1881: 88.—Greiff, 1886: 21.

Stylaster tiliatus: Hickson, 1912b: 461–462.

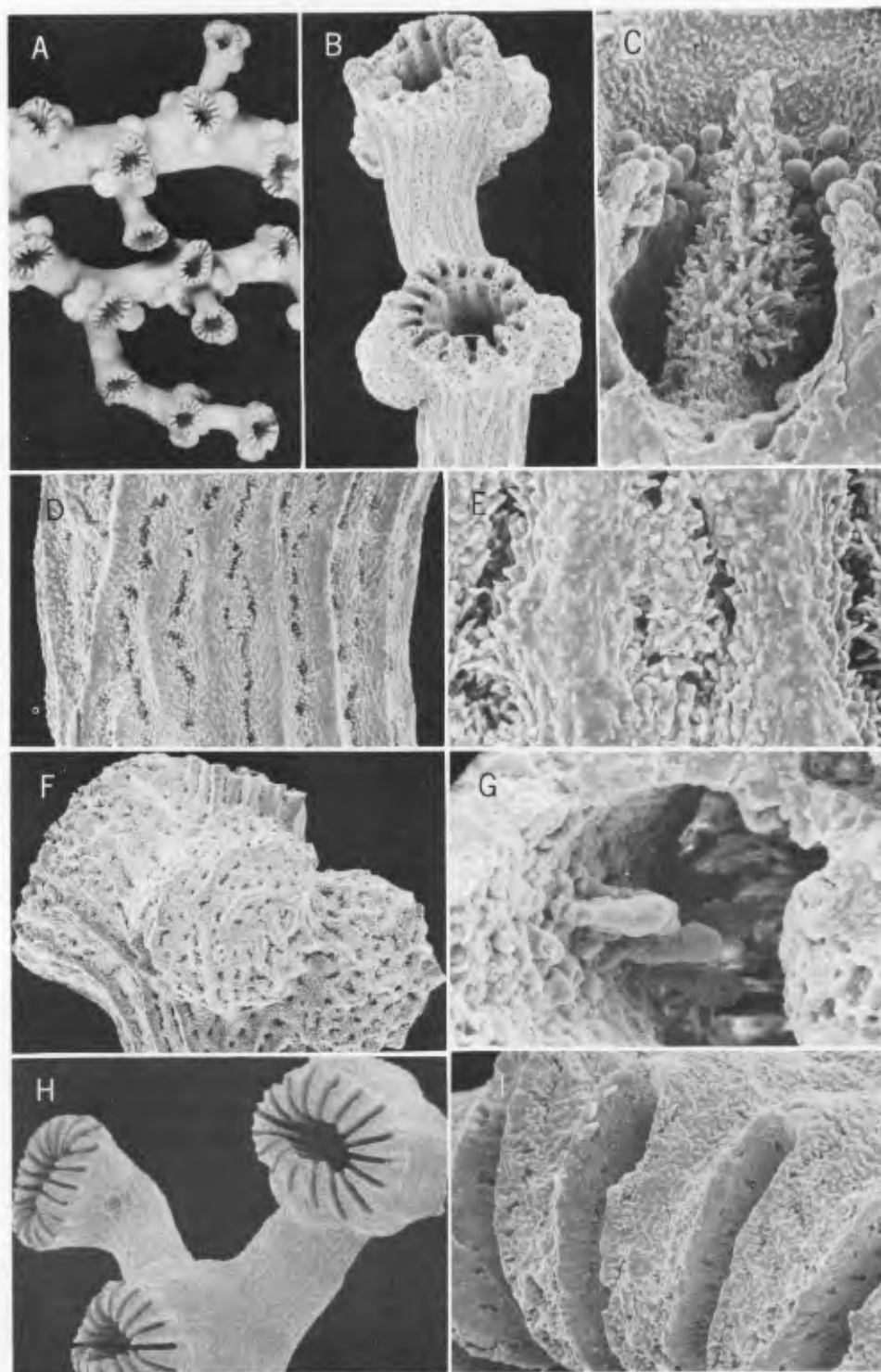
Not *Stenohelia maderensis* Boschma, 1964b: 64–69, pl. 1, figs. 13–14 (= *S. profunda*); 1964c: 80–84, pl. 2 (= *S. profunda*).

Diagnosis.—Colonies up to 9 cm tall and 5.7 cm broad, supported by a basal branch up to 5 mm in diameter. Branches anastomose infrequently and there is no polychaete commensal. Coenosteal strips 75–85 μm wide and usually slightly convex to ridged; sometimes ridged strips alternate with flatter ones. Coenosteal slits deep, about 10 μm wide. Strips covered by slender, rudimentary, imbricated scales. Cyclosystems elliptical in cross section, about 1.0 mm in greater diameter and 0.8 mm in lesser, the greater diameter transverse to the branch. Gastrostyles lanceolate, about 0.4 mm tall and 0.16 mm in diameter (H:W = 2.5), the tip easily visible from the outside. Ring palisade well developed. Of 100 cyclosystems examined, Boschma (1967) found a range of 9–19 dactylopores per cyclosystem, average = 13.5, and mode = 14. Dactylostyles composed of a unilinear row of slightly clavate elements about 42 μm tall and 12 μm in diameter. Ampullae quite prominent, expressed as globose hemispheres 0.75–0.85 mm in diameter surrounding the cyclosystems, and also sometimes found on the posterior side of the branch opposite a cyclosystem. Ampullae warty and often ridged. Female efferent ducts are indicated by a shallow circular depression about 0.17 mm in diameter on the sides of each ampulla.

Alcohol-preserved specimens of *S. maderensis* were not available for study, but examination of the soft parts of the closely related *S. profunda* from ALBATROSS-2753 (Figs. 20C, H–I, 24D, 26E, 27E–F) revealed a robust, cylindrical gastrozoid about 0.5 mm tall with a whorl of seven tentacles below an extended hypostome. Dactylozooids adnate. Nematocysts measuring 5.0–5.5 \times 2.0–2.5 μm common in gastrozoid tentacles and dactylozooids.

Discussion.—Ten species are assigned to *Stenohelia* (Table 1), only two of which occur in the Atlantic. *S. maderensis* is distinguished from the western Atlantic *S. profunda* Moseley, 1879, by its smaller, more regularly shaped cyclosystems; less dactylopores per cyclosystem; larger, more conspicuous ampullae; coarser coenosteal ridges; and shorter gastropore, which allows the gastrostyle tip to be seen from the outside. Boschma's (1964b; c; 1967) records of *S. maderensis* from the West Indies are *S. profunda*.

Stenohelia boschmai Wells, 1977 (Eocene, Tonga), is removed from *Stenohelia* and placed incertae sedis. Wells (1977) did not observe gastrostyles in his specimens and examination of his material suggests that gastrostyles were never pres-



ent. *S. boschmai* has the appearance of a *Crypthelia* without lids. No currently defined genus is appropriate to receive *S. boschmai*.

Distribution.—Known only from Madeira and Cape Verde Islands. 91–275 m.

Types.—The holotype was originally deposited at the BM but can no longer be found there; it is presumed to be lost.

Conopora Moseley, 1879

Stylaster: Studer, 1878: 635 (part).

Conopora Moseley, 1879: 503; 1881: 97.—Hickson and England, 1905: 25.—Broch, 1936: 84–87.—Boschma, 1956: F100.

Group A

Diagnosis.—Colonies flabellate unless modified by a commensal polychaete, which induces a somewhat bushy and more robust growth form. Distal branches delicate and slightly compressed in the plane of the colony, supporting sympodially arranged cyclosystems in alternating positions on the lateral branch edges; larger branches sometimes anastomose. Coenosteum irregularly linear-imbriate, covered by broad, flat platelets. Raised nematopores often present, sometimes in great density, especially on larger branches, the exterior of worm tubes, and the tops of pseudosepta. Coenosteum white. Distal cyclosystems slightly exsert and oriented toward the branch tip, as in *Stylaster* (Group C). Gastropore consists of two chambers, the upper, larger chamber separated from the lower, thinner one by a constricted aperture analogous (? homologous) to the ring palisade. Adcauline diastemas common in some species. Dactylotomes extend deeply into upper gastropore chamber. No gastro- or dactylostyles. Female ampullae usually superficial; male ampullae usually internal, communicating with the upper gastropore chamber via an efferent duct.

Group B

Diagnosis.—Colonies robust; branches large and round in cross section, supporting randomly arranged cyclosystems on all branch surfaces, as in *Stylaster* (Group A). Coenosteum reticulate-granular; nematopores common. No polychaete commensalism observed. Otherwise, similar to Group A.

Discussion.—*Conopora* is remarkably similar to *Stylaster*, differing primarily by its absence of gastro- and dactylostyles. Both genera even have a broad range of colony shapes and cyclosystem arrangement, which created the need for similar groups within the genera: *Stylaster* (Group A) and *Conopora* (Group B) are equivalent and *Stylaster* (Group C) and *Conopora* (Group A) are equivalent. *Stylaster* (Group B), the annectant group, has no counterpart in *Conopora*; however, it is interesting to note that two of the several hundred colonies of *C. verrucosa* examined had cyclosystems scattered irregularly on all sides of several distal branch-

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Figure 20. *Stenohelia maderensis* (A–B, D–G, specimens from Santiago de la Praya, Cape Verde Islands, BM 1950.1.11.81): A, part of colony, $\times 3.8$; B, F, branch fragment with ampullae, $\times 20$, $\times 40$, respectively; D–E, coenosteal texture, $\times 83$, $\times 270$, respectively; G, dactylostyle, $\times 400$. *Stenohelia profunda* (C, H–I, Albatross-2753: 13°34'N, 61°03'W, 514 m, 4 Dec. 1887): C, gastropore and ring palisade, $\times 100$; H, cyclosystem and ampullae around base of cyclosystem, $\times 13$; I, pseudosepta of a cyclosystem, $\times 100$.

es, possibly indicating a similar transition within *Conopora*. In *Stylaster*, the groups were historically given separate generic names, but not in *Conopora*, an inconsistency noted by Boschma (1968a: 101). However, the inconsistency is circumvented by considering *Stylaster* as a genus with three groups and *Conopora* as a genus with two groups.

Occurrence.—Group A: Recent: Indo-West Pacific, Antarctic and Subantarctic, New Zealand. 110–2,355 m.—Group B: ?Paleocene: Denmark; Recent: Providence, Indian Ocean. 228 m.

Type Species.—*C. tenuis* Moseley, 1879 (= *Conopora laevis* (Studer, 1878)), by monotypy.

Conopora laevis (Studer, 1878)

Figure 21A–D

Stylaster laevis Studer, 1878: 635, pl. 2, fig. 5a–b.—Not Moseley, 1881: 81 (= *C. verrucosa*).—Boschma, 1957: 12.

Stylaster obliquus Studer, 1878: 635–636, pl. 2, fig. 7a–d.

Conopora tenuis Moseley, 1879: 503; 1881: 82, pl. 12, figs. 5a–b, 6.—?Hickson and England, 1905: 25; 1909: 351.—?Broch, 1936: 88–91, pl. 13, fig. 37.—Boschma, 1956: F100, fig. 82, 2a; 1957: 39; 1966: 115–116.

Stenohelia obliqua: Boschma, 1957: 32.

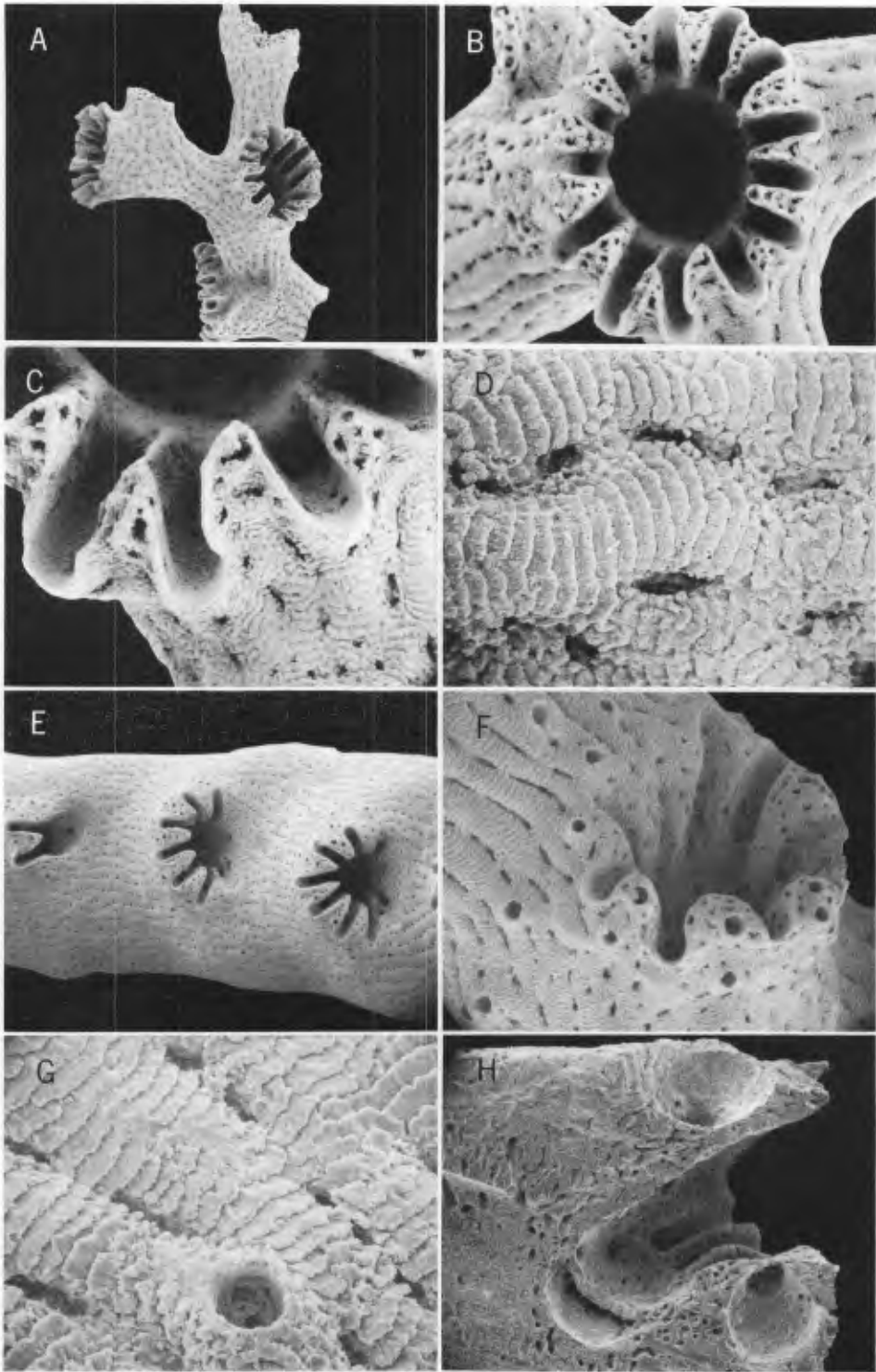
Conopora laevis: Zibrowius, 1981: 274–277, pl. 3, figs. 8–11, pl. 4, figs. 1–5.

Diagnosis.—Colonies up to 6.5 cm tall with a basal branch diameter up to 5.5 mm. Coenosteal strips 62–115 μm wide, covered by equally broad, imbricated platelets with a frequency of 55–60 leading edges per mm. The free edges of the platelets are usually directed toward the branch tip, but occasionally a series is directed proximally, and at some point on the coenosteal strip the series meet with little disruption. No nematopores. Cyclo systems round to elliptical, 1.02–1.22 mm in greater diameter; no diastemas. Based on 19 cyclo systems from the holotype of *C. laevis*, the range of dactylo pores per cyclo system is 8–12, average = 10.0 ($\sigma = 1.52$). Dactylo tomes are about 0.1 mm wide; pseudosepta are wedge shaped and sometimes concave. Male ampullae internal; female ampullae superficial, up to 0.6 mm in diameter. Soft parts unknown.

Discussion.—Only five species are assigned to *Conopora* (Table 1). I have examined the types of all but one of the nominal species (*C. major*) and herein synonymize *C. pauciseptata* Broch, 1951 with *C. verrucosa* (Studer, 1878) and strongly doubt the placement of *C. arborescens* Nielsen, 1919, in this genus. The poor preservation of a syntype and topotypic specimen of *C. arborescens* does not allow a decision on whether or not the cyclo systems have gastro styles; in this case, *Stylaster* (Group A) cannot be ruled out.

C. laevis is most similar to *C. verrucosa*, but can be distinguished by its complete lack of nematopores, lack of cyclo system diastemas and thus having slightly more

Figure 21. *Conopora laevis* (A–D, syntype of *C. tenuis* from Challenger-170: 29°55'S, 178°14'W, 951 m, 14 July 1874, BM 1880.11.25.184): A, distal branch, $\times 14$; B, cyclo system, $\times 41$; C, pseudosepta, $\times 80$; D, imbricate coenosteal texture, $\times 167$. *Conopora verrucosa* (E, Edisto 14-2: 71°50'S, 15°50'W, 1,006–1,189 m, 18 Jan. 1959; F–G, Vema 17-61: 54°44'S, 55°39'W, 1,814–1,919 m, 11 May 1961; H, Eltanin-1089: 60°47'S, 53°30'W, 641 m, 17 Apr. 1964): E, branch segment showing reduction in number of dactylo pores per cyclo system from distal to proximal end, $\times 14$; F, cyclo system and nematopores, $\times 47$; G, imbricate coenosteal texture and nematopores, $\times 200$; H, longitudinal section through a cyclo system flanked on either side by internal ampullae, $\times 27$.



dactylopores per cyclo-system, more exsert cyclo-systems, and more widely separated cyclo-systems. The nematopores of *C. verrucosa* are sometimes very dense (separated from one another by only 1–3 diameters), tall (up to 0.15 mm), and distributed over the entire colony. The type of *C. verrucosa* is a specimen such as this. However, the nematopores may also be much less common (occurring only on the pseudosepta and worm tube), and flush with the coenosteum. The type of *C. pauciseptata* and most of the specimens reported by Cairns (in press) as *C. pauciseptata* are intermediate between these extremes. *C. verrucosa* is also characterized by adcauline diastemas, not on distal cyclo-systems but on those cyclo-systems of larger diameter branches. The diastema reduces the average number of dactylopores per cyclo-system to about 7.1 (Boschma, 1966). Finally, the cyclo-systems on basal branches of *C. verrucosa* are flush or almost sunken into the coenosteum and the cyclo-systems on distal branches are more crowded.

Soft tissue of *C. laevis* was not available for study, but tissue of *C. verrucosa* from Edisto TD 2-14 (Figs. 21E–H, 26A, H) revealed a compressed hemispherical gastrozoid occupying the lower gastropore chamber which led via a narrow neck to a mound-like hypostome. Instead of tentacles, the hypostome contains large inflated cells. Dactylozooids adnate. Nematocysts of nematophores about $29 \times 4 \mu\text{m}$; smaller nematocysts measuring about $8 \times 1.2 \mu\text{m}$ are less common in the tissue.

Distribution.—Off New Zealand, Chatham Island, Kermadec Islands, ?Indonesia, ?Chagos Archipelago, ?western Indian Ocean, ?Japan. 110–951 m. (The distributional records of Hickson and England (1905, 1909) and Broch (1936) have not been verified.)

Types.—The types of *S. laevis* and *S. obliquus* are deposited at the Zoologisches Museum, Berlin (1776, 1778, respectively). The syntypes of *C. tenuis* are deposited at the BM (1880.11.25.184). All of these types were examined by the author.

Crypthelia Milne Edwards and Haime, 1849

Crypthelia Milne Edwards and Haime, 1849: 69.—Broch, 1936: 93–95.—Boschma, 1951: 455–456; 1956: F100.

Endhelia Milne Edwards and Haime, 1849: 69.

Cryptohelia Milne Edwards and Haime, 1857: 127.—Moseley, 1881: 98.—Hickson and England, 1905: 20.

Endohelia Milne Edwards and Haime, 1857: 128.

Diagnosis.—Colonies flabellate and usually small and delicate. About one-quarter of the species are associated with a commensal polychaete, which induces a more robust colony. Branches round in cross section and very thin; distal branches thinner in diameter than the cyclo-systems they support. Coenosteum linear-imbriate on distal branches, although this pattern is sometimes obscured on basal branches; coenosteum white. Nematopores common on coenosteum, particularly on the lid and pseudosepta. All cyclo-systems originate on the anterior side of the colony except in *C. trophostega*, which is bifacial; cyclo-systems project at right angles to the branch. Cyclo-systems round to elliptical in cross section, ranging from 0.7–5.0 mm in diameter. Gastropore composed of two chambers, the lower one very reduced. Every cyclo-system bears a fixed lid, usually attached at the abcauline position, which overhangs the gastropore to a variable degree. In the most extreme cases, the lid fuses to the coenosteum on the adcauline side, almost completely covering the cyclo-system and allowing the polyp to feed through only two lateral slits. Multiple lids are sometimes present. Seven to 25 dactylopores per cyclo-system; tops of pseudosepta often concave. No gastro- or dactylostyles.

Ampullae superficial and large, usually associated with the lid or encircling the cyclo-system. Efferent ducts from both male and female ampullae open into the cyclo-system.

Discussion.—Among the three genera of Stylasterinae that do not have gastro-styles, *Crypthelia* is easily distinguished by its prominent lids, which cover all or part of the cyclo-system. It is most similar to *Astya*, which has an homologous structure much lower in the gastropore chamber.

Occurrence.—Eocene: Tonga; Recent: Atlantic, Indo-West Pacific, North Pacific, Galapagos, off Panama (Pacific), Subantarctic. 183–2,789 m.

Type Species.—*Crypthelia pudica* Milne Edwards and Haime, 1849, by monotypy.

Crypthelia pudica Milne Edwards and Haime, 1849

Figure 22A–H

Crypthelia pudica Milne Edwards and Haime, 1849: 69; 1850: 93, pl. 3, fig. 1.—Broch, 1936: 95–99, pl. 13, fig. 39, text-fig. 31.—Boschma, 1956: F100; 1957: 36–38 (synonymy).—?Eguchi, 1965: 219, text-figs. 1–3.

Crypthelia pudica: Milne Edwards and Haime, 1857: 127.—?Moseley, 1881: 71–76, 82–83 (Not CHALLENGER sta. 3, 24, and 236, but perhaps sta. 171).—?Alcock, 1899: 11.—Hickson and England, 1905: 21.—Fisher, 1938: 535, pl. 64, fig. 1.—?Naumov, 1960: 588–590, text-figs. 434–435.

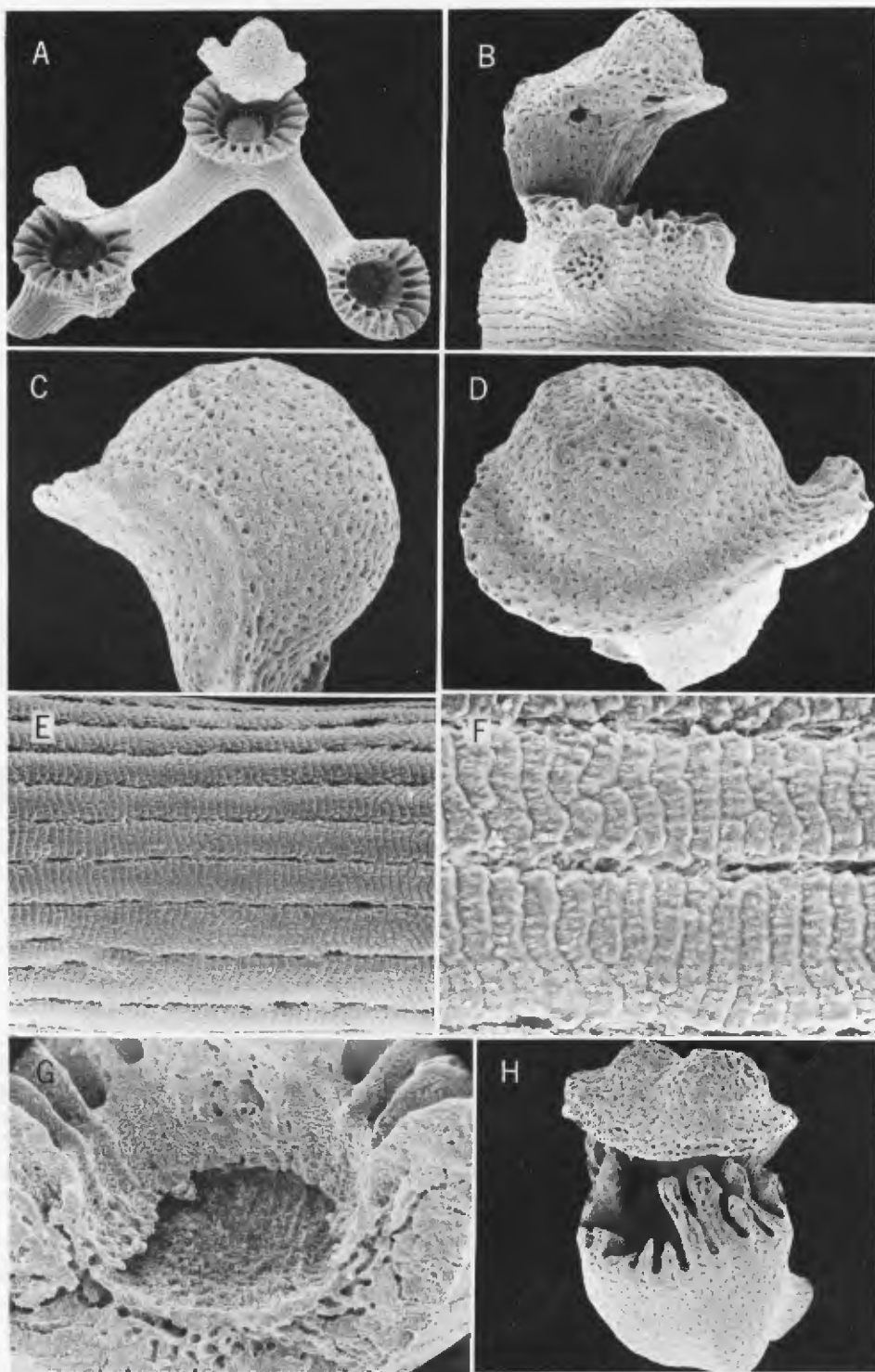
Not *Crypthelia pudica*: Studer, 1878: 633–634.—Marenzeller, 1904: 86.

Diagnosis.—Colonies very delicate, up to 7 cm tall; basal branches up to 2.2 mm in diameter. Coenosteal strips about 70 μm wide; platelets equally broad, about 75 per mm. Nematopores, about 40–45 μm in diameter, are restricted to the lids and pseudosepta. Cyclo-systems round to slightly elliptical in cross section, 1.2–1.5 mm in diameter; 15–19 dactylo-pores per cyclo-system. Thin, lower chamber of gastropore spiny, separated from upper chamber by a ring palisade instead of a solid, annular constriction. Lid large, covering the entire cyclo-system; lid raised high above the gastropore as a horizontal canopy; top of lid slightly concave. Female ampullae large, superficial hemispheres up to 1.3 mm in diameter and 1.1 mm tall, occurring on the top of each lid, usually one per lid. Male ampullae much smaller hemispheres, about 0.55 mm in diameter, occurring in clusters of 3–5 on the tops of lids. Immature cyclo-systems have no ampullae and their lids are very thin, as illustrated by Milne Edwards and Haime (1850). Both male and female ampullae have efferent ducts (pores) visible on the lower side of the lid, one pore corresponding to each ampulla.

Soft tissue of *C. pudica* was not available for study; however, examination of tissue from an undescribed species from the Galapagos (Figs. 26F, 28B) revealed a crescent-shaped gastrozoid without tentacles, adnate dactylozoids with a long free part, and nematocysts measuring $20 \times 2.5 \mu\text{m}$ in the nematophores and $7 \times 2.0\text{--}2.5 \mu\text{m}$ in the dactylozoids. Moseley (1881) and Broch (1947) also reported gastrozoids without tentacles for other species of *Crypthelia*, and the former described the soft parts of *C. affinis* in great detail.

Discussion.—The 15 species of *Crypthelia* (Table 1) are differentiated primarily on the basis of cyclo-system diameter, size and shape of the lid, and size and position of the ampullae. *C. pudica* is characterized by relatively small cyclo-systems with large lids and very conspicuous ampullae restricted to the top of the lid.

The type-specimen of *C. pudica* could not be obtained from the MNHNP and is presumed to be lost. My diagnosis and most figures for this species are based



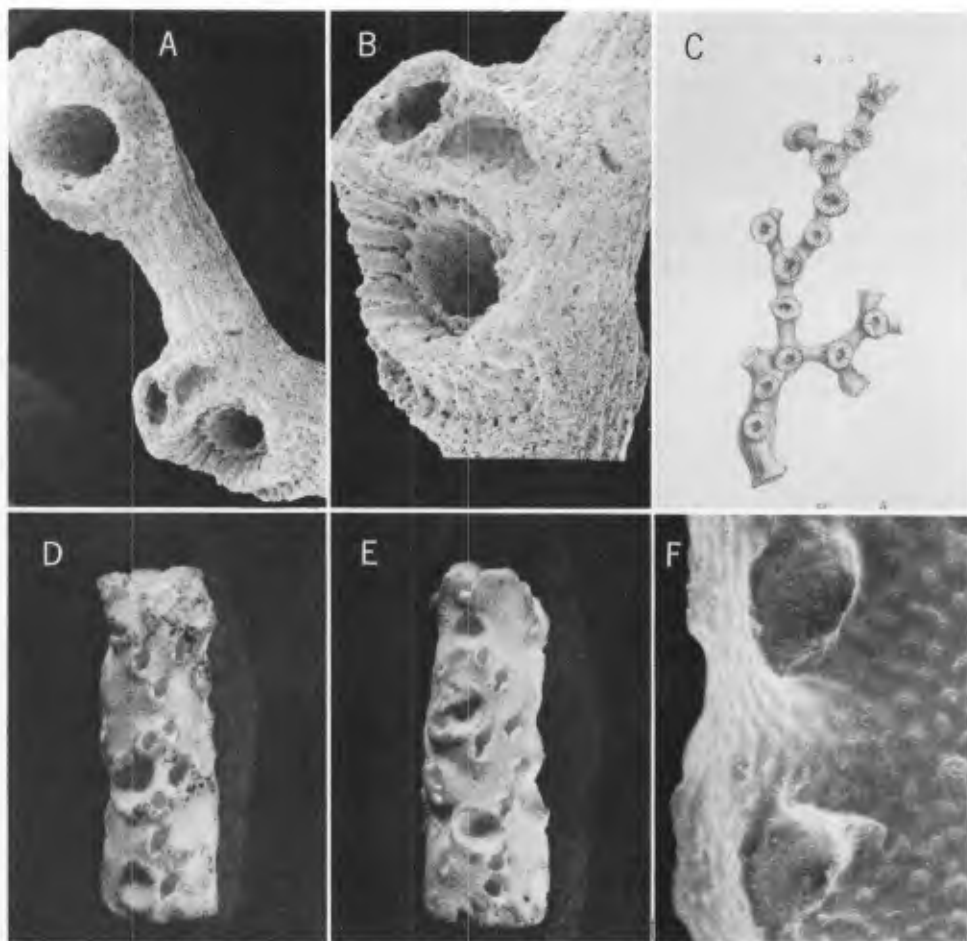


Figure 23. *Astya nielseni* (A–B, paratype): A, branch segment, $\times 14$; B, enlargement of a cyclosystem, $\times 27$. *Astya subviridis*: C, copy of Moseley's (1881) pl. 1, fig. 4, $\times 2.1$. *Congregopora nasiformis* (D–E, figured syntype, MMH 1750; F, topotypic specimen): D–E, branch segment, $\times 3.2$; F, ?gastropores, $\times 27$.

on topotypic (*sensu lato*) specimens from ALBATROSS-5423 ($9^{\circ}38'N$, $121^{\circ}11'E$, 929 m), described and figured by Fisher (1938). They differ from the figured type in having conspicuous ampullae in their lids; however, it is suggested that the figures of Milne Edwards and Haime (1850) are those of immature cyclosystems before ampullae had formed.

Several of the synonymy entries are prefaced with a question mark because I

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Figure 22. *Crypthelia pudica* (A–H, Albatross-5423: $9^{\circ}38'N$, $121^{\circ}11'E$, 929 m, 31 Mar. 1909): A, branch fragment showing increasing development of female ampullae away from the tip, $\times 13$; B, male cyclosystem, efferent pores in lid visible on underside of lid, $\times 30$; C–D, fully developed female ampulla, scattered nematopores, $\times 40$; E–F, imbricate coenosteal texture, $\times 83$, $\times 280$, respectively; G, longitudinal fracture through a cyclosystem showing flattened lower chamber, $\times 67$; H, aberrant male cyclosystem with highly developed pseudosepta, $\times 30$.

have not examined them; their distributional records are therefore also queried. Studer's (1878) specimen, however, was examined and found not to be *C. pudica* but an undescribed species similar to *C. fragilis*. Marenzeller's (1904) specimens (USNM 21285) also appear to be an undescribed species.

Distribution.—?Indian Ocean (368 m), Kermadec Island (1,097 m), Philippine Islands (549–1,633 m), ?Japan, ?Sea of Okhotsk (1,240 m).

Types.—Muséum National d'Histoire Naturelle, Paris (presumed lost). The types of 10 of the 15 species have been examined by the author.

Astya Stechow, 1921

Astylus Moseley, 1879: 457; 1881: 65, 97–98.

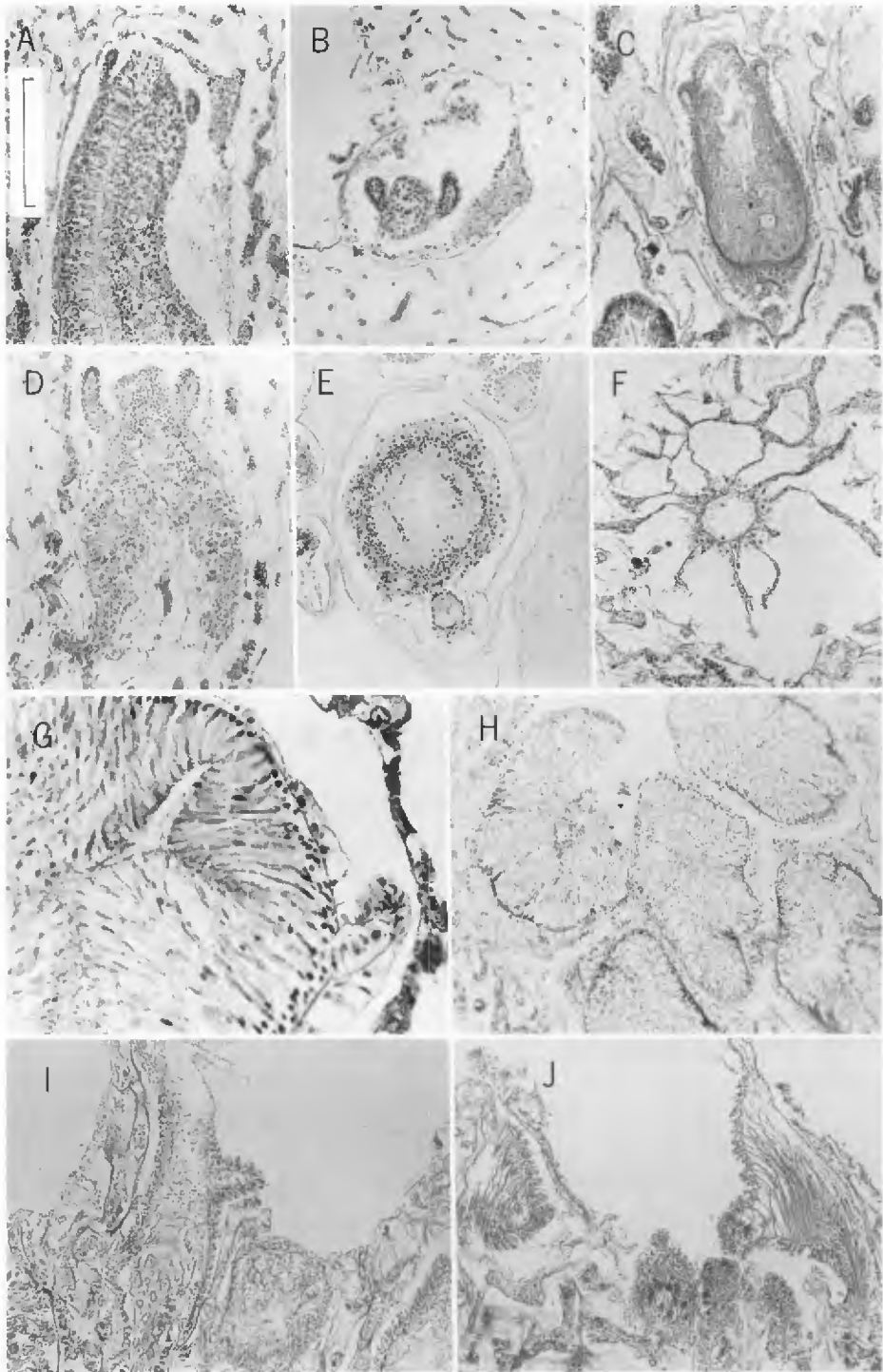
Astya Stechow, 1921: 253 (nom. nov.).—Boschma, 1956: F100.

Diagnosis.—Colonies small, delicate, and flabellate. Branches round in cross section and very thin; distal branches usually thinner in diameter than the cyclo-systems they support. Coenosteum linear-imbricate, white. All cyclo-systems originate on the anterior side of the colony and project at right angles to the branch. Cyclo-systems slightly exsert, round to elliptical in cross section, up to 1.9 mm in greater diameter. Gastropore composed of two chambers, as in *Conopora* and *Crypthelia*; however, in *Astya* a short, blunt pillar projects into the constricted aperture that separates the chambers. Seventeen to 19 dactylo-pores per cyclo-system. The upper, outer edge of each pseudoseptum bears a nematopore. No gastro- or dactylostyles. Ampullae restricted to a ring encircling the base of each cyclo-system, causing the cyclo-systems to appear globose.

The gastrozoid fills the crescent-shaped lower chamber and also projects upward as a cylindrical tube. Mouth cruciform, no tentacles. Dactylozoids are adnate with long free tentacles. Nematocysts of nematophores about $23 \times 6 \mu\text{m}$. Tissue bluish green.

Discussion.—Three genera (*Astya*, *Crypthelia*, and *Conopora*) are characterized by having a double-chambered gastropore, prominent nematophores, and lacking gastro- and dactylostyles. *Astya* is most similar to *Crypthelia* in that they are both unifacial, have superficial ampullae clustered around the cyclo-systems, and have a protective lid or small pillar covering the gastrozoid. They differ in that *Astya* has a small pillar overhanging only the gastrozoid, whereas *Crypthelia* has a lid

Figure 24. Histological sections of gastro- and dactylozoids: A, *Adelopora pseudothyron*, paratype from Eltanin 25–326: 46°04'S, 83°55'W, 298 m, 9 Oct. 1966, longitudinal section of gastrozoid including two tentacles; B, same specimen as figure A, oblique section through hypostome, two tentacles, and part of operculum; C, *D. (Haplomerismos) anceps*, paratype, longitudinal section through gastrozoid including two tentacles; D, *Stenohelia profunda*, Johnson-Smithsonian Deep-Sea Exp.-43: 18°04'N, 67°48'W, 439–549 m, 11 Feb. 1933, longitudinal section through gastrozoid including two tentacles; E, *Lepidotheca fascicularis*, paratype from Eltanin-1416: 53°45'S, 159°09'E, 787–842 m, 9 Feb. 1965, cross section of gastrozoid including four tentacles, larger canal at lower right is a coenosteal canal; F, *Sporadopora dichotoma*, Islas Orcadas 575-82: 55°29'S, 35°20'W, 413–462 m, 6 June 1975, cross section of radial canals and gastrozoid sac; G, *Phlobothrus symmetricus*, SABP, BLM-2H: 32°20'N, 78°10'W, 411 m, 15 Feb. 1977, cross section of gastrozoid including one tentacle; H, *Stylantheca porphyra*, topotypes from Carmel Bay, cross section through five gastrozoids in one cyclo-system; I, *Errinopora pourtalesii*, Albatross-3159: 37°47'N, 123°10'W, 49 m, 22 Mar. 1890, longitudinal section of gastrozoid flanked by adnate dactylozoid on left; J, *Gyropora africana*, BM specimen, gastrozoid flanked on either side by adnate dactylozoids. Scale bar for A–F, H–J = 0.2 mm (200 μm); G = 50 μm .



overhanging the cyclo-system. Moseley (1881) suggested that they were homologous structures but did not predict the polarity of the character states.

Occurrence.—Eocene: Tonga; Recent: off Meangis Islands, Philippines. 914 m.

Type Species.—*A. subviridis* Moseley, 1879, by monotypy.

Astya subviridis (Moseley, 1879)
Figures 23C, 28A

Astylus subviridis Moseley, 1879: 457–462, pl. 34, fig. 4, pl. 35, figs. 8, 15, pl. 41, fig. 1, pl. 43, figs. 10–11, pl. 44, fig. 2; 1881: 65–71, pl. 1, fig. 4, pl. 2, figs. 8, 15, pl. 8, fig. 1, pl. 10, figs. 10–11, pl. 11, fig. 2.

Astya subviridis: Stechow, 1921: 253.—Boschma, 1956: F100, fig. 82, 3; 1957: 40.

Diagnosis.—See that of genus.

Discussion.—There are two species in the genus *Astya*. Even though the preservation of the Eocene-aged *A. nielseni* Wells, 1977 (Fig. 23A–B), is not good enough to see the characteristic tongue-like projection between gastropore chambers, there is little doubt that it belongs to *Astya*. On the other hand, the placement of *Astya crassa* (Nielsen, 1919) is quite uncertain. It has sympodially arranged cyclo-systems and randomly placed ampullae; the preservation is not good enough to judge presence or absence of gastrostyles. It may be either a *Stylaster* (Group C) or a *Conopora*, but probably not *Astya*; it is therefore placed incertae sedis.

A. subviridis is apparently known from only one specimen, the figured type, deposited at the BM (1880.11.25.185), which, unfortunately, has almost completely disintegrated. Moseley's (1879) excellent description of both hard and soft parts forms the basis of our knowledge of this species. The only character I can add to Moseley's description is the imbricate nature of the coenosteum, barely visible on one fragment.

Distribution.—Off Meangis Islands, Philippines. 914 m.

Types.—Holotype at the BM (see Discussion). The types of all three nominal species have been examined by the author.

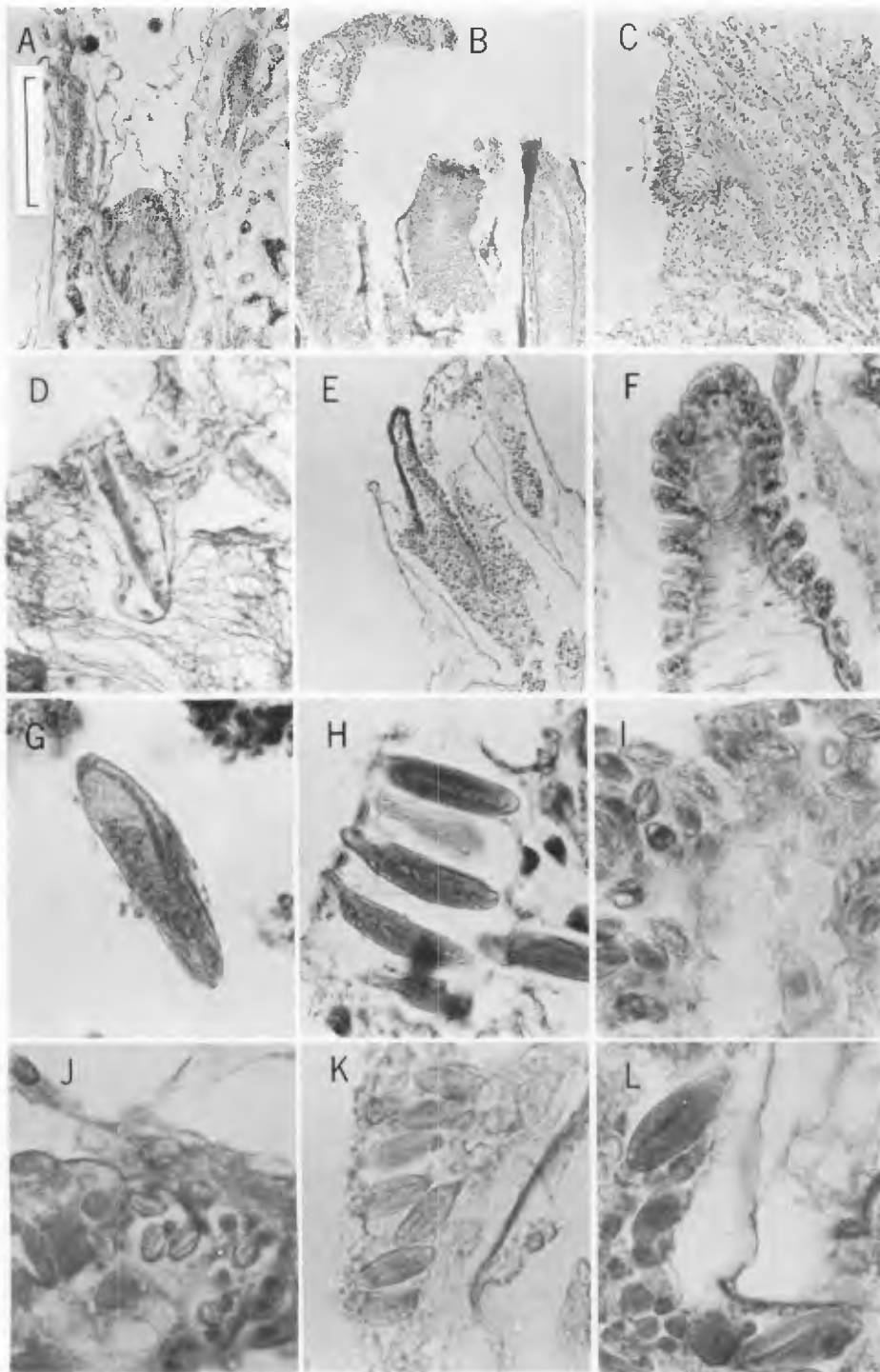
Incertae Sedis

Congregopora Nielsen, 1919

Congregopora Nielsen, 1919: 21.—Boschma, 1951: 39–42; 1956: F100.

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Figure 25. Histological sections of gastro- and dactylozooids, and nematocysts: A, *Stylaster roseus*, Carrie Bow Cay, longitudinal section through gastrozooid including one tentacle, and dactylozooids; B, *Inferiolabiata labiata*, Eltanin-1536: 54°29'S, 39°22'W, 659–686 m, 8 Feb. 1966, longitudinal section through gastrozooid flanked by one large, overhanging dactylozooid; C, *Errina antarctica*, Hero 715–874: 54°39'S, 63°50'W, 135–137 m, 26 Oct. 1971, adnate dactylozooid; D, *Phalangopora regularis*, type of *Pliobothrus seriatus*, simple dactylozooid; E, *Lepidotheca fascicularis*, paratype from Eltanin-1416: 53°45'S, 159°09'E, 787–842 m, 9 Feb. 1965, dactylozooid; F, *D. (Haplomerismos) anceps*, paratype, tip of dactylozooid; G, *Pliobothrus symmetricus*, SABP, BLM-2H: 32°20'N, 78°10'W, 411 m, 15 Feb. 1977, USNM 49130, nematocyst in a coenosteal canal; H, *Sporadopora dichotoma*, Islas Orcadas 575-82: 55°29'S, 35°20'W, 413–462 m, 6 June 1975, nematocyst of a nematophore; I, *Stelapora echinata*, Eltanin-1593: 54°43'S, 56°37'W, 339–357 m, 14 Mar. 1966, nematocyst of a dactylozooid; J, *Phalangopora regularis*, type of *P. seriatus*, nematocysts; K, *Errinopora pourtalesii*, Albatross-3159: 37°47'N, 123°10'W, 49 m, 22 Mar. 1890, cluster of nematocysts in coenosteum near gastropore; L, *Gyropora africana*, BM specimen, nematocysts. Scale bar for A–C, E = 200 μ m; D, F = 50 μ m; H = 41 μ m; G, I–L = 20 μ m.



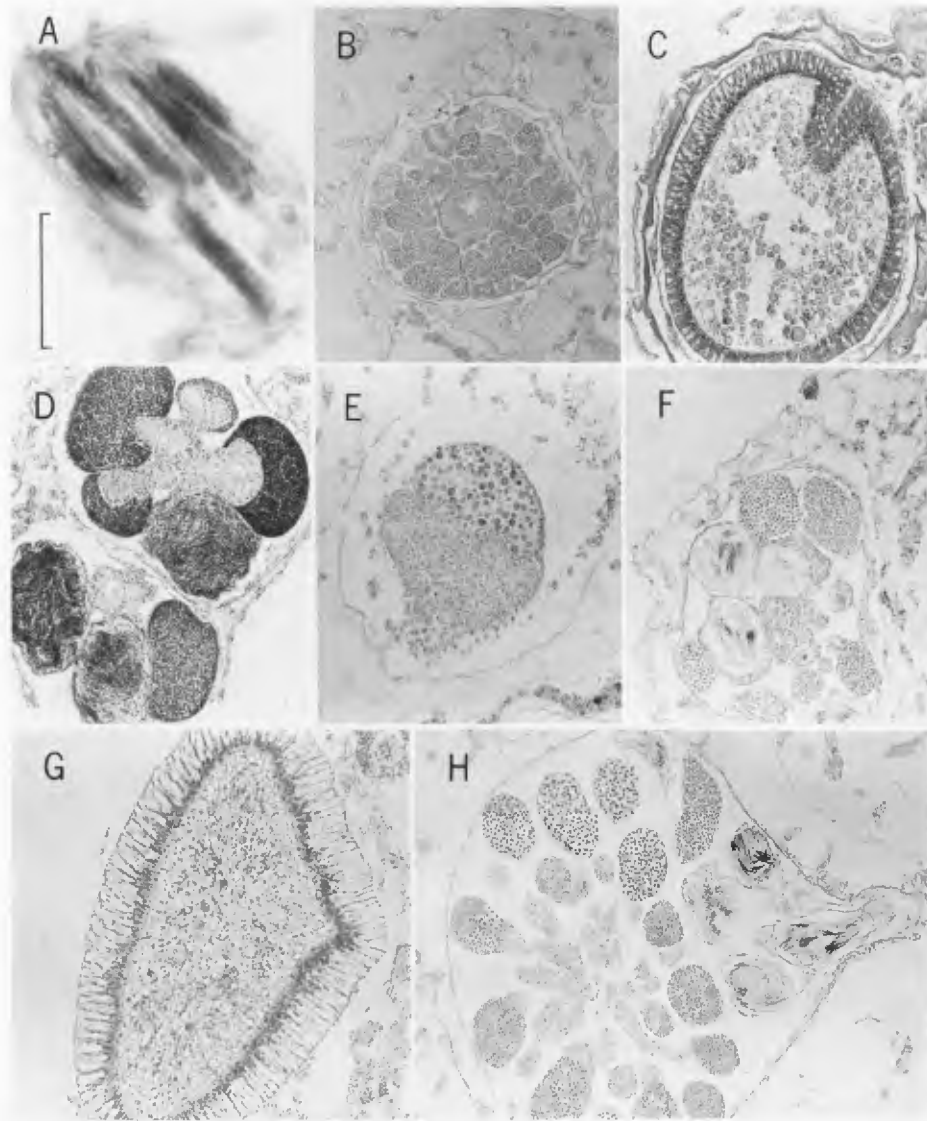


Figure 26. Histological sections of nematocysts and gonophores: A, *Conopora verrucosa*, Edisto 14-2: 71°50'S, 15°50'W, 1,006-1,189 m, 18 Jan. 1959, coenosteal nematophore; B, *Paraerrina decipiens*, syntype, cross section of male gonophore; C, *Distichopora violacea*, Rigili Island, Eniwetok Atoll, cross section of developing female planula; D, *Stylaster roseus*, Carrie Bow Cay, cross section of male gonophores; E, *Stenohelia profunda*, Johnson-Smithsonian Deep-Sea Expd. station 43: 18°04'N, 67°48'W, 439-549 m, 11 Feb. 1933, cross section of egg partially enveloped by spadix; F, *Crypthelia* sp., Albatross-2818: 0°29'S, 89°55'W, 717 m, 15 Apr. 1888, cross section of male gonophores in lid of cyclosystem, nematophore in upper right; G, *Errina antarctica*, Hero 715-874: 54°39'S, 63°50'W, 135-137 m, 26 Oct. 1971, cross section of planula; H, *Conopora verrucosa*, Edisto 14-2: 71°50'S, 15°50'W, 1,006-1,189 m, 18 Jan. 1959, cross section of male gonophores, efferent canal containing mature sperm on right. Scale bar for A = 20 μ m; B-H = 200 μ m.

Diagnosis.—Colonies flabellate, up to 6 cm tall and 8 cm broad. Branches round in cross section and blunt; basal branches up to 5 mm in diameter. Coenosteum covered by shallow pits that are equally spaced about 0.21 mm apart, perhaps the preservation of coenosteal pores of a reticulate texture. Cyclo systems triangular or elongate, the greater axis of the latter parallel to the branch. Elongate cyclo systems about 0.7 mm long and 0.3 mm wide. One of the syntypes has cyclo systems arranged in three longitudinal rows. Dactylo pores difficult to detect in the cyclo systems, but according to Nielsen (1919) they are few in number and irregularly scattered around the gastropore. No gastro- or dactylo styles. Craters of ruptured ampullae up to 1.34 mm in diameter.

Discussion.—Boschma (1968a: 100) defined *Congregopora* as "an *Allopora* without gastrostyles," and another time (Boschma, 1951) implied that its closest affinity was to *Conopora*, differing from this genus primarily by its lesser number of dactylo pores per cyclo system. This is a good guess, but the preservation of the very few Paleocene specimens is not adequate to intelligently discuss its phylogeny, or even to adequately define the genus.

Occurrence.—Paleocene: Denmark (Danian of Fakse).

Type Species.—*C. nasiformis* Nielsen, 1919, by monotypy.

Congregopora nasiformis Nielsen, 1919
Figure 23D–F

Congregopora nasiformis Nielsen, 1919: 21–22, pl. 2, figs. 24–27, text-figs. 3, 10.—Boschma, 1951: 40–42, text-fig. 6a–b; 1956: F100, text-figs. 82, 4a–c; 1957: 40.

Diagnosis.—See that of genus.

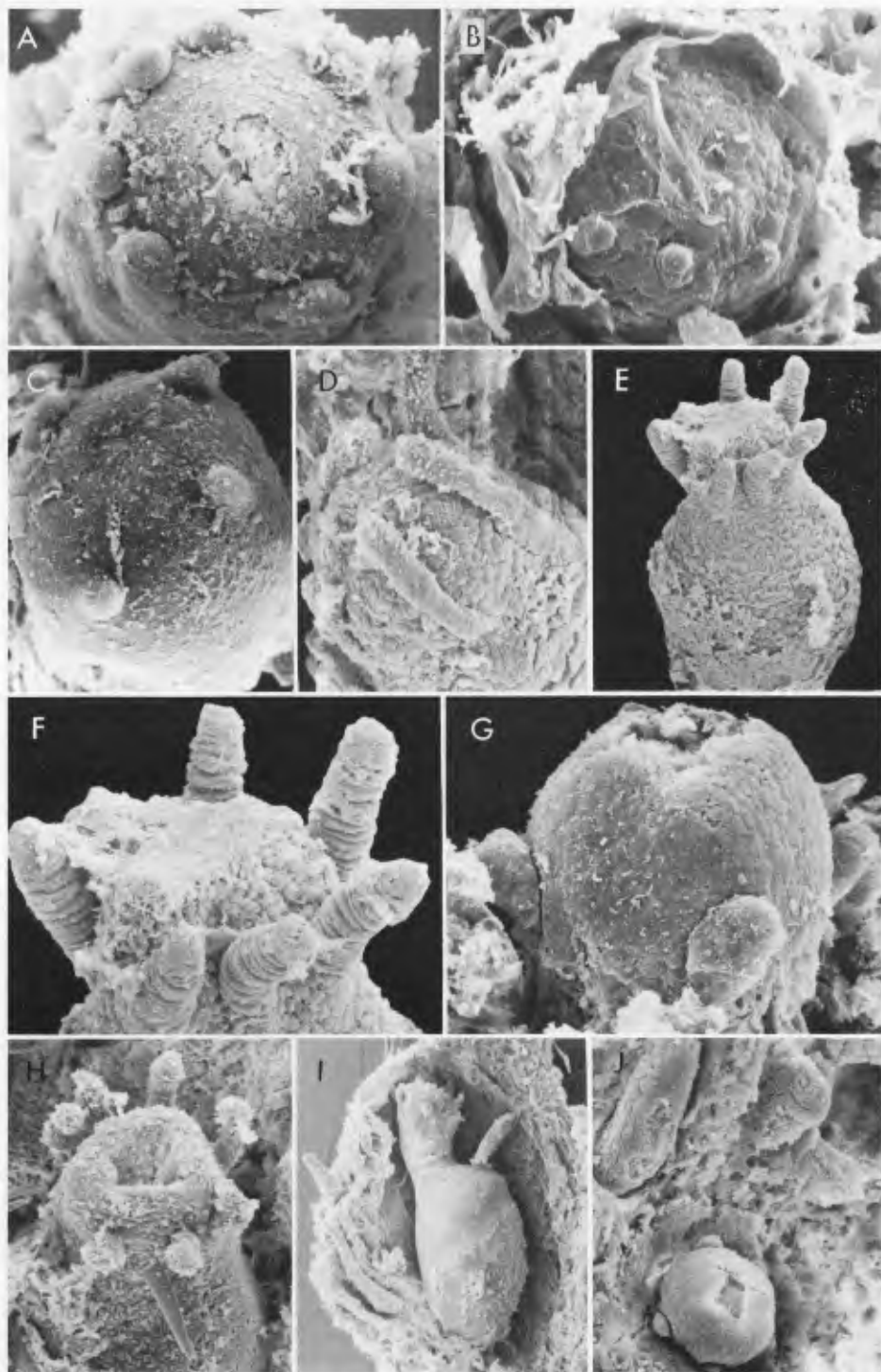
Discussion.—*Congregopora* is a monotypic genus; its single species has been reported only once.

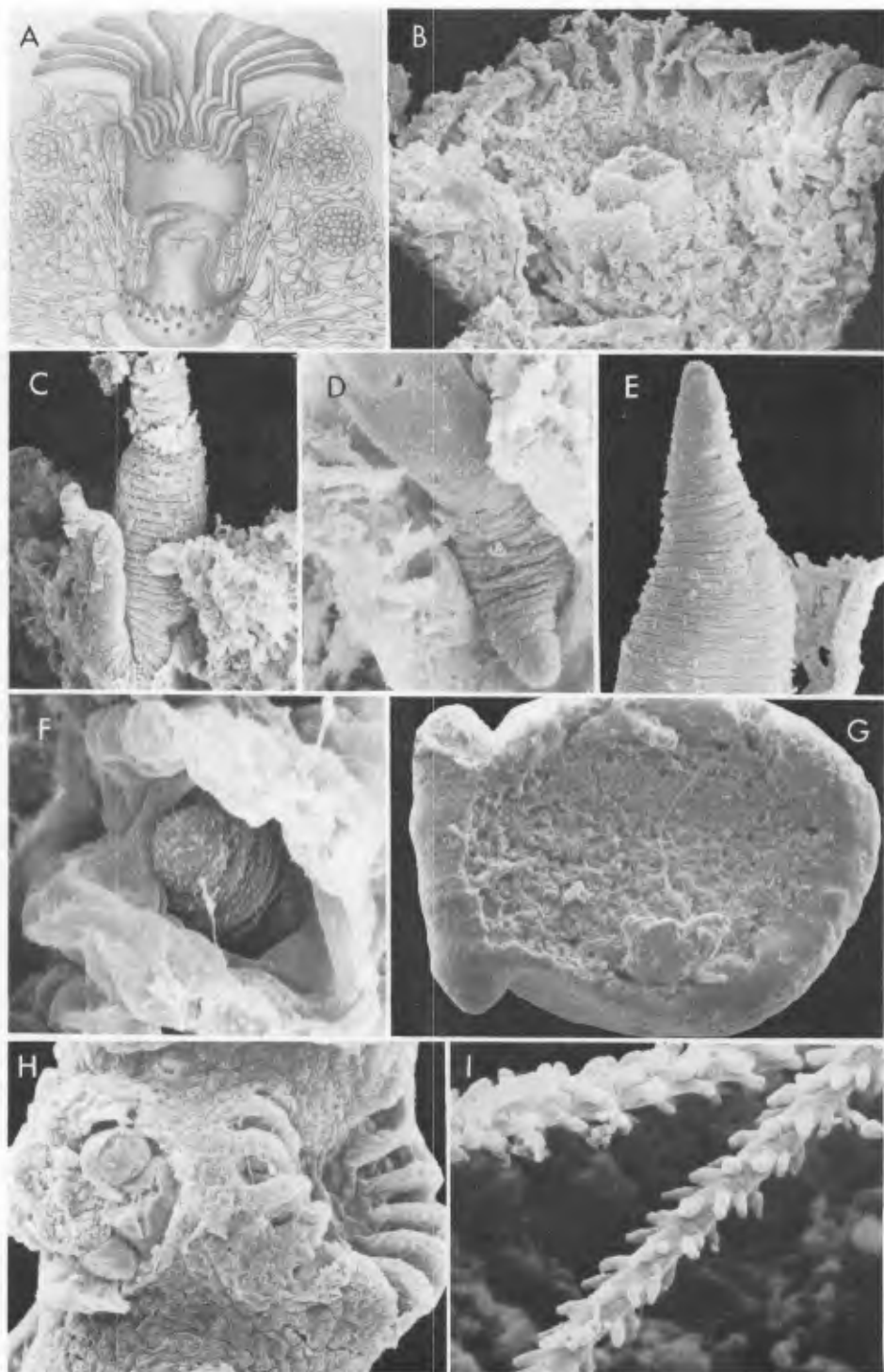
Distribution.—Known only from the Paleocene of Denmark.

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Figure 27. SEM of decalcified, critical-point-dried specimens: A, *Sporadopora dichotoma*, Islas Orcadas 575-82: 55°29'S, 35°20'W, 413–462 m, 6 June 1975, gastrozoid, ×143; B, *Pliobothrus symmetricus*, SABP, BLM-2H: 32°20'N, 78°10'W, 411 m, 15 Feb. 1977, gastrozoid, ×160; C, *Errinopsis reticulum*, Hero 715–879: 54°50'S, 63°50'W, 342–353 m, 28 Oct. 1971, gastrozoid, ×215; D, *Distichopora violacea*, off Rigili Island, Eniwetok, gastrozoid, ×270; E–F, *Stenohelia profunda*, Johnson-Smithsonian Deep-Sea Expedition sta. 43: 18°04'N, 67°48'W, 439–549 m, 11 Feb. 1933, gastrozoid, ×107, ×250, respectively; G, J, *Stylaster porphyra*, Carmel Bay, California, gastrozoid and gastrozoid with two dactylozoids, ×192, ×71, respectively; H–I, *Adelopora pseudothyron* (H, Eltanin 25–326: 46°04'S, 83°55'W, 298 m, 9 Oct. 1966; I, Eltanin-1521: 54°09'S, 52°08'W, 419–483 m, 30 Jan. 1966): H, gastrozoid, ×143; I, gastrozoid and dactylozoids, ×50.

Figure 28. SEM of decalcified, critical-point-dried specimens: A, Schematic longitudinal section through a cyclo system and ampullae of *Astya subviridis* from Moseley (1881: pl. 8, fig. 1), ×18; B, *Crypthelia* sp., Albatross-2818: 0°29'S, 89°55'W, 717 m, 15 Apr. 1888, longitudinal section through cyclo system, ×66; C, *Sporadopora dichotoma*, Islas Orcadas 575-82: 55°29'S, 35°20'W, 413–462 m, 6 June 1975, adnate dactylozoid, ×57; D, *Errinopora pourtalesii*, Albatross-3159: 37°47'N, 123°10'W, 49 m, 22 Mar. 1890, adnate dactylozoid, ×150; E, *D. (Haplomerismos) anceps*, paratype, tip of dactylozoid, ×180; F, *Stylaster roseus*, Carrie Bow Cay, Belize, tip of dactylozoid between two pseudosepta, ×420; G, *Adelopora pseudothyron*, Eltanin-1521: 54°09'S, 52°08'W, 419–483 m, 30 Jan. 1966, underside of undecalcified operculum showing retractor muscle, ×107; H, *Stylaster roseus*, Carrie Bow Cay, Belize, cyclo system and damaged male ampulla, ×54; I, *Inferiolabiata labiata*, Eltanin-1536: 54°29'S, 39°22'W, 659–686 m, 8 Feb. 1966, shafts of exploded nematocysts, ×8,450.





Types.—Deposited at the Geologisk Museum, Copenhagen. Examined by the author.

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