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Two New Species of the Gorgonacean Genus *Paragorgia* (Coelenterata: Octocorallia) (Figures 1-3)

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Abstract

A new species of *Paragorgia* from the Ceram Sea is described as *P. coralloides* and illustrated in comparison with *Paragorgia splendens* Thomson & Henderson, 1906, as originally described, and as subsequently reported from the *Siboga* Expedition by Nutting (1911) and Stiasny (1937). Sclerites of *P. splendens* are illustrated from original material for the first time. The *Siboga* specimen formerly identified as *P. splendens* is shown to be a new species, here called *P. sibogae*, related to but distinct from *P. coralloides* n. sp.

During the years 1907 through 1909, the U. S. Fish Commission steamer *Albatross* undertook the lengthiest expedition of its illustrious career in marine exploration, cruising widely through the Philippine Archipelago, the China Sea, Sulu Islands, and Indonesia (then the Dutch East Indies). The large collection of octocorals obtained during more than 500 dredging, trawling and shore stations was never studied as a faunistic unit. Subsequently, only a few of the more obvious new species have been described. Thus, although extensively sampled more than eight decades ago, the fauna remains relatively unknown. Some soft corals were described by Light (1913, 1914, 1915a, b, c) and the shallow-water Gorgonacea have been reported by Mai-Bao-Thu & Domantay (1970, 1971), but the species from deeper water are essentially unknown.

This paper records another of the conspicuous novelties taken by the Philippine Expedition of the *Albatross*, obtained in Indonesian waters shortly before the conclusion of the expedition, and demonstrates that the species reported by Nutting (1911) as *Paragorgia splendens* Thomson & Henderson was misidentified and is, in fact, a new species distinct from *P. splendens*.

Subclass Octocorallia
Order Gorgonacea
Suborder Scleraxonia
Family Paragorgiidae Kükenthal, 1916

Diagnosis: (see Kukenthal, 1916: 173; Aurivillius, 1931: 10; Verseveldt, 1940: 137; Stiasny, 1937: 73) Dimorphic Scleraxonia forming arborescent colonies having a central medulla penetrated throughout by longitudinal coelenteric canals and surrounded by cortex containing the gastric cavities of autozooids and siphonozooids. Medulla and cortex not

separated by boundary canals. Cortical sclerites 6-, 7- and 8-rayed capstans, in some species with rays asymmetrically developed; medullar sclerites long, rodlike forms with prominent, commonly branched processes.

Remarks: The genus *Sibogagorgia* Stiasny was originally assigned to this family (Stiasny, 1937: 73). However, after a detailed anatomical investigation which revealed significant differences in the canal system, Verseveldt (1942: 185) made it the type genus of a separate family Sibogagorgiidae. As this difference is taken into account in my key to genera (Bayer, 1981: 911), it is obvious that its continued assignment to the Paragorgiidae in the classification (Bayer 1981: 945) was an oversight.

Genus *Paragorgia* Milne Edwards & Haime, 1857

Paragorgia Milne Edwards & Haime, 1857: 190.–Kükenthal, 1919: 77 (synonymy); 1924: 28 (synonymy).

Diagnosis: As for the family.

Type species : *Paragorgia arborea* (Linnaeus, 1758), by monotypy.

Paragorgia coralloides n. sp.

(Figure 1)

Material Examined: Ceram sea, off Gomoemoe Island [= Pulau Gomumu] south of Obi Major: 01° 54′ 00″ S, 127° 36′ 00″ E, 602 m (329 fath.), USFC Str. *Albatross* sta. D-5634, 3 December 1909. Part of a larger branch originally preserved but subsequently lost, USNM 50891 (holotype).

Diagnosis: Slender *Paragorgia* with terminal branches only 1 mm in diameter excluding calices; cortex with 8-rayed capstans only, up to 0.06 mm in length, many of the smaller individuals asymmetrically developed as "Opera-glass" forms by hypertrophy of the tubercles of one side; tentacles with irregularly spinose fusiform rods 0.1 mm in length. Color, red.

Description: The specimen is a branch 9 cm in height, originally part of a large colony, branched in one plane in a lateral manner. The polyps are grouped in clusters along, and at the ends of, short, slender branchlets (Fig. 1 a). The diameter of the terminal branchlets, exclusive of the polyps, is about 1 mm. The diameter of the main branch at its stoutest point is 3.5 mm. The calices of the autozooids are short cylinders, sometimes slightly tapered, sometimes hemispherical, about 1 mm in diameter and the same height; their margins are 8-lobed and the closed apertures form stellate figures. The siphonozooids are visible as small, hemispherical verrucae with simple aperture, less than 0.5 mm in diameter, encircling the base of the autozooids. The surface of the coenenchyme is minutely granular owing to the outermost layer of small sclerites. The color of the colony in alcohol is bright red. All but the terminal branchlets are overgrown with a dark brown zoanthid whose walls are filled with accumulated sand grains and other debris, mostly foraminiferans and the sclerites of its host. The original label bears the following field note: "Main stem and large polyps [i.e., the zoanthid] pale dull ochre; hard tips coral red. Beautiful!! F. M. C[hamberlain]."

Canal system : The specimen is not in satisfactory condition for histological study, showing evidence of having been partially dried at one time, but free-hand sections permit the following observations.

The general plan is in agreement with that of *Paragorgia arborea* as described by Verseveldt (1940). The gastric cavity of the terminal polyps extends, greatly narrowed, as

a gastrodermal canal at the center of the medulla (Fig. 1 b), but the mesenteries terminate within the gastric cavity proper and cannot be traced into the canal. There is no appreciable zone of mesogloea devoid of sclerites surrounding the longitudinal canals and medullar solenia. The calicular walls are divided into an inner and an outer layer by a solenial network. The outer layer extends throughout the colony as a thin outer cortex separated by the solenial network from the deeper layer of cortical coenenchyme; the inner layer, immediately surrounding the gastric cavities, also surrounds the coelenteric canals arising from the terminal polyps and follows them down the center of the branches as a reddish medulla. Near the tips of the branchlets, this is the only medullar tissue but, in the lower parts of the branchlets, coenenchyme containing colorless sclerites appears just inside the solenial network and quickly increases in thickness basad until a conspicuous colorless layer intervenes between the red cortex and the red zone surrounding the coelenteric canals. The central zone is the primary medulla, since it is the only medulla present in the branch tips. Although the colorless intermediate layer makes up the greater part of the medulla in the larger branches (Fig. 1 c), it arises secondarily in an interstitial manner and is here called secondary, or interstitial, medulla. In spite of the fact that the inner layer of the calicular walls is continuous with the primary medulla and is identically spiculated, it is cortical in position and must be so termed. The lateral autozooids are in communication with the superficial solenial system but do not elongate into coelenteric canals. the siphonozooids occur only around the bases of the autozooid calices, and their gastric cavities lie mostly below the solenial network, with which they connect, and therefore within the tissue that surrounds the inner parts of the autozooids and the coelenteric canals.

Sclerites: The sclerites of the anthocodiae are arranged in eight interseptal tracts which continue as narrow bands along the backs of the tentacles but do not extend into the pinnules. These sclerites are chiefly small rods at most 0.1 mm in length, irregularly sculptured with obtusely conical processes which are occasionally subdivided and show two or three terminal projections (Fig. 1 d). In the interseptal tracts, a number of radiates like those of the cortex, and spindles like those of the inner layer of the calicular walls, may occur along with the rods.

The thin surface layer of cortex lying outside the solenial network is characterized by the presence of 8-rayed capstans 0.04-0.06 mm in length (Fig. 1 e); a very large proportion of these are modified into "opera-glass" sclerites by the enlargement of three lateral and the two terminal radii, just as in some species of *Corallium*.

Immediately surrounding the central coelenteric canals is a zone of red sclerites containing blunt rods with obtuse, conical projections (Fig. 1 f); this inner medullar zone follows the coelenteric canals upward to the gastric cavities of the autozooids, which it surrounds, thus forming the inner layer of the calicular walls, separated from the outer layer by the solenial network. The spindles of the inner calicular layer are similar to those of the central medulla, commonly measuring 0.15 mm in length (Fig. 1 f). The pale secondary medulla is filled with colorless rods having prominent processes often branched (Fig. 1 g).

Distribution: Known from the type locality only.

Associates: An encrusting zoanthid covers the main branches.

Comparisons: The terminal branches of *Paragorgia coralloides* are unusually slender for the genus. In gross appearance, it bears an overall resemblance to *Paragorgia splendens*

Thomson & Henderson, which also is of remarkably slender build, although no measurement of the terminal branches was given (Thomson & Henderson, 1906: 20). Sclerites of *P. splendens* were not illustrated originally, but a fragment of the type specimen kindly provided by the late Dr. W. J. Rees of the British Museum (Nat. Hist.)(now the Natural History Museum), London, makes it possible to present drawings for direct comparison.

Specimens identified as *Paragorgia splendens* Thomson & Henderson were obtained from the Sulu Islands by the *Siboga* Expedition and reported by Nutting (1911: 16, pl. 3, figs. 4, 4a) without detailed description. Stiasny (1937: 78, text fig. AA; pl. 5, fig. 37) agreed with Nutting's identification and provided additional descriptive information together with drawings of the sclerites. As Stiasny's style of illustration does not give an adequate impression of the sclerites, new drawings have been made directly from his slide preparation, permitting comparison with both *P. splendens* and *P. coralloides*, n. sp. This reveals that the *Siboga* specimen is not *P. splendens* after all, but a distinct species similar to but distinct from *P. coralloides.*

Remarks: Not only do the 8-rayed capstans of *Paragorgia coralloides* resemble those of *Corallium*, but the modified forms have also been transformed into the "opera-glass" type of sclerite just as in that genus. So closely do they resemble the sclerites of some species of *Corallium* that a slide preparation of sclerites unassociated with the entire specimen could justifiable be assigned to that genus.

Paragorgia splendens Thomson & Henderson, 1906

Figure 2

Paragorgia splendens Thomson & Henderson, 1906: 20, pl. 1, fig. 5; pl. 5, figs. 9, 14.

Not *Paragorgia splendens.*–Stiasny, 1937: 78, fig. AA; pl. 5, fig. 37.

Material Examined: Part of the holotype, BM(NH) 1933.3.13.38, and another specimen taken at *Investigator* station 333 but not reported by Thomson & Henderson.

Diagnosis: *Paragorgia* with slender terminal branches; cortex with predominantly 8-rayed capstans up to 0.085 mm long, 7-rayed forms rare, and belted spindles to 0.145 mm in length; tentacular rods to 0.1 mm long. Color, red.

Description: See Thomson & Henderson, 1906: 20.

The general aspect of the colony was well illustrated in color as well as monochrome in the original description. The autozooids form hemispherical verrucae (Fig. 2 e) and tend to occur in clusters. Siphonozooids were reported as "occurring over the whole cortex" but in the drawing of part of a branch (pl. 5, fig. 14) they appear to be concentrated around the clusters of autozooids, as they are on the fragment of the type and the additional sample provided by Dr. W. J. Rees, They appear as small papillae and may be so inconspicuous that they are visible around the autozooids only as minute spots without sclerites.

Canal System: A detailed investigation of the canal system has not been possible, but a free-hand cross section of a small branchlet shows that the center of the medulla is perforated by several large stem canals, presumably continuations from the coelenteric cavities of the polyps (Fig. 2 f).

Sclerites: The anthocodiae contain blunt, stubby rods of the same general type found in all species of *Paragorgia* (Fig. 2 a), but somewhat stouter and more strongly sculptured than those of *P. coralloides*, n. sp. and *P. sibogae* n. sp.

The outermost cortex is filled with 8-rayed capstans (Fig. 2 b) larger than those of

P. coralloides and some developed as belted spindles, but none of them asymmetrically developed as "opera-glass" sclerites; 7-rayed forms are rare and no 6-rayed forms were found.

The pink sclerites of the medulla (Fig. 2 c) are rods and slightly tapered spindles with more prominent sculpture than in *P. coralloides*. The colorless sclerites (Fig. 2 d) are narrow rods irregularly sculptured with conical projections some of which develop apical processes that may subdivide further.

Paragorgia sibogae n. sp.

Figure 3

Paragorgia splendens.–Nutting, 1911: 16, pl. 3, figs. 4, 4a.–Stiasny, 1937: 78, fig. AA; pl. 5, fig. 37.

Not *Paragorgia splendens* Thomson & Henderson, 1906: 20, pl. 1, fig. 5; pl. 5, figs. 9, 14.

Material Examined: Stiasny's slide preparation of sclerites of the specimen from the Pearl Banks, Sulu Islands: 5° 43.5′ N, 119° 49.6′ E, 522 m, *Siboga* station 95, 26 June 1899 (Zoologisch Museum, Amsterdam).

Diagnosis: Slender *Paragorgia* with terminal branches 1.3 mm in diameter exclusive of autozooid calices; cortex with small 6-, 7-, and 8-rayed capstans, many of the smaller individuals asymmetrically modified as "opera-glass" forms, the largest unmodified 8-rayed forms reaching 0.075 mm in length; tentacular rods to 0.085 mm. Color, "bright coral red".

Description: See Nutting, 1911; Stiasny, 1937.

Sclerites: Stiasny's drawings (1937: 79, fig. AA) give such a distorted impression of the sclerites that new drawings from his slide are presented here, The anthocodial sclerites (Fig. 3 a), not mentioned by Stiasny, are of the usual type present in *Paragorgia*. The cortical sclerites are 6-, 7-, and 8-rayed capstans mostly developed asymmetrically in the form of "opera-glass" sclerites (Fig. 3 b) similar to those of some species of *Corallium*. This feature is not conveyed by Stiasny's fig. AA, c-g. The larger 8-rayed capstans (Fig. 3 c) do not appear to be so modified. The longer belted rods and spindles (Fig. 3 d) likely occur in the calices but this point needs confirmation, as Stiasny illustrates (Fig. AA, h-k) tuberculate rods as occurring in the calices. It is more likely that this type (Fig. 3, e) originated in the medulla, possibly extending into the deeper layer of the calicular walls. The colorless medullar sclerites (Fig. 3, f) correspond well with Stiasny's fig. (AA, l-q).

Comparisons: The growth form of this species (Nutting, 1911: pl. 3, figs. 4, 4a; Stiasny, 1937: pl. 5, fig. 37) appears to be more robust than that of either *P. splendens* or *P. coralloides*. *P. sibogae* resembles *P. coralloides* in the abundance of asymmetrically developed "opera-glass" sclerites but includes numerous 6-rayed forms, which do not occur in *P. coralloides*.

Acknowledgments

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and made possible the untangling of numerous old taxonomic snarls involving the magnificent collection of gorgonians obtained by the *Siboga* Expedition. I am grateful for his kind hospitality. As always, the thoughtful comments of Dr. Manfred Grasshoff, Frankfurt, have contributed significantly to this paper. It is a pleasure to express my thanks to these colleagues, and to the many others who have contributed to this and other research projects published and unpublished.

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Captions

Fig. 1. *Paragorgia coralloides*, n. sp. a, part of branch with two terminal branchlets. b, Diagram of canal system at end of branchlet. c, Diagrammatic cross section of larger branch. d, Sclerites of anthocodiae. e, Pink sclerites of outer cortex. f, Pink sclerites of inner calicular wall. g, Colorless sclerites of secondary medulla. 0.1 mm scale applies to *d* and *e*; 0.2 mm scale applies to *g* and *f* ; 1 mm scale applies to *b* and *c*.

Fig. 2. *Paragorgia splendens* Thomson & Henderson. a, Sclerites of anthocodiae. b, Pink sclerites of outermost cortex. c, Pink sclerites of medulla. d, Colorless sclerites of secondary medulla. e, Part of branchlet with autozooid calices, f, Diagrammatic corss-section of branchlet. Schizoholotype, BM(NH). Scale at *a* applies also to *b*; scale at *c* applies to *c* only; scale at *d* applies to *d* only; 2 mm scale applies to *e* and *f*.

Fig. 3. *Paragorgia sibogae*, n. sp. a, Sclerites of anthocodiae. b, Pink sclerites of outermost cortex. c, Pink 8-rayed capstans of outermost cortex. d, Belted spindles probably from inner calicular walls. e, Tuberculate rods probably from primary medulla. f, Thorny and tuberculate rods probably from secondary medulla. Drawn from Stiasny's slide preparation of sclerites of *Paragorgia splendens* det. C. C. Nutting. Scale at *a* applies to *a*, *b*, *c* and *d*; scale at *e* applies to *e* only; scale at *f* applies to *f* only.

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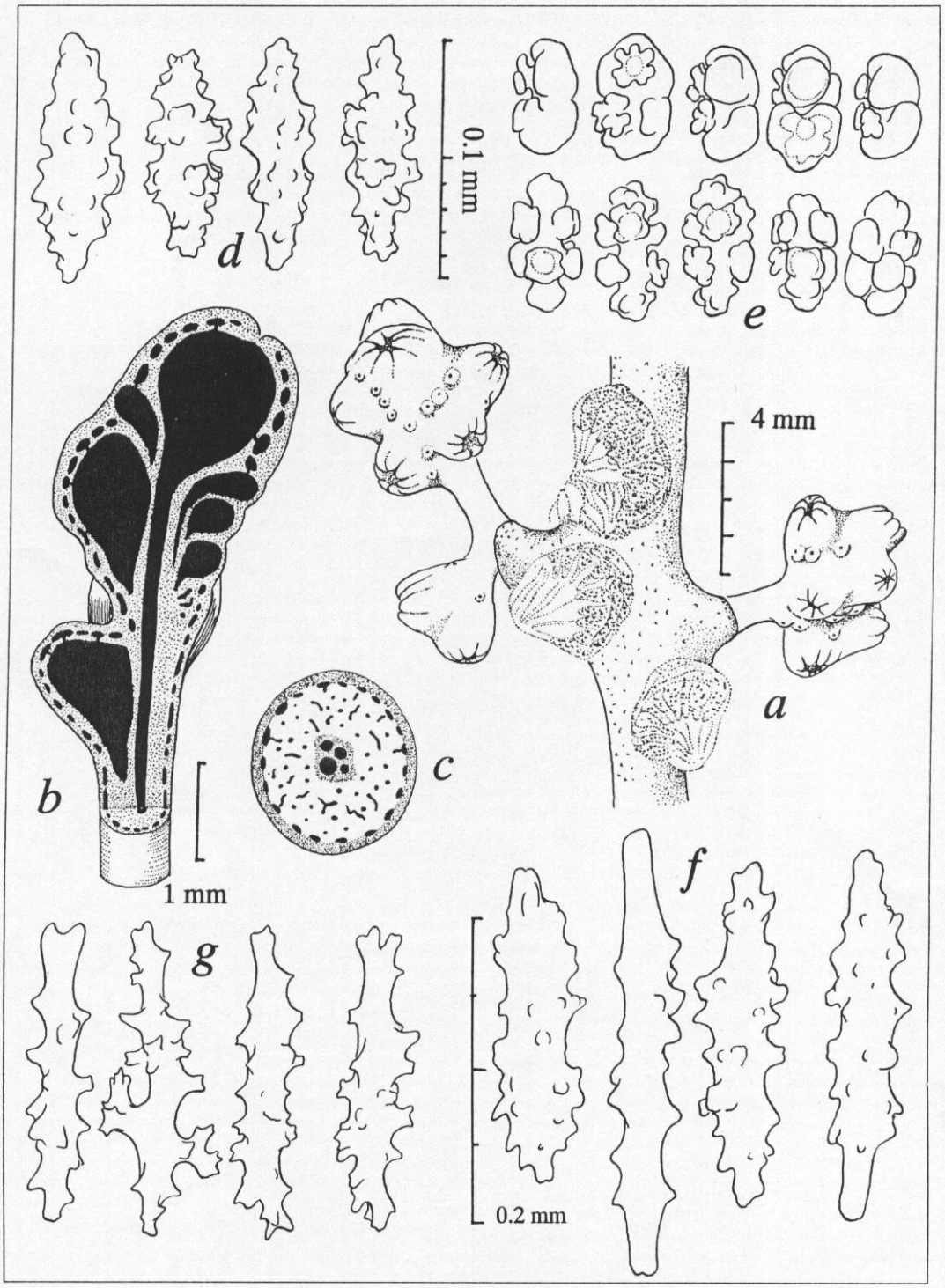
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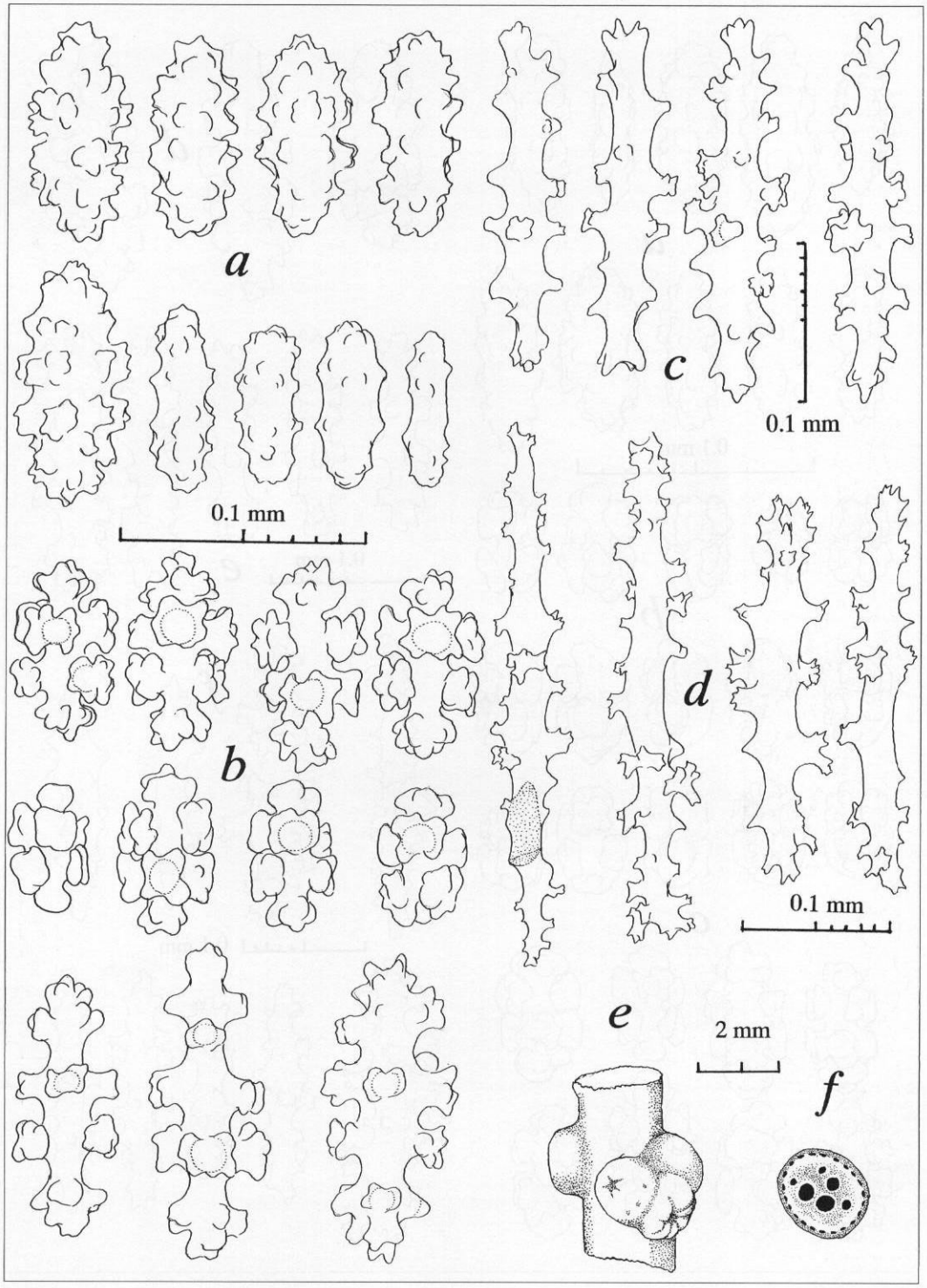
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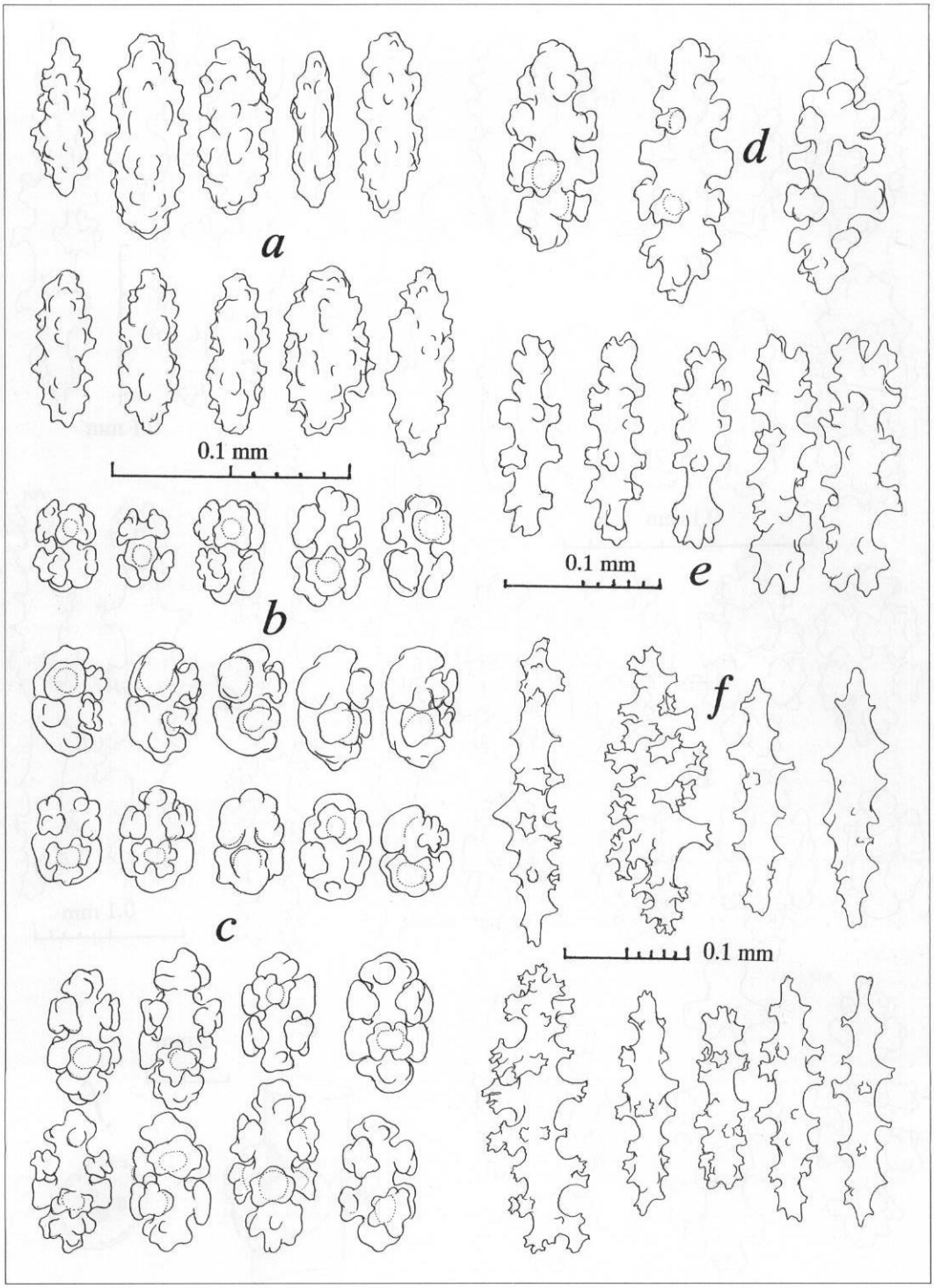
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