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NEW GENERA AND SPECIES OF THE HOLAXONIAN FAMILY CHRYSOGORGIIDAE (OCTOCORALLIA: GORGONACEA)

by

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With 10 text-figures and 7 plates

ABSTRACT

Two new genera and four new species of the gorgonacean family Chrysogorgiidae are described and illustrated, and keys to the genera and species are presented. The genus *Stephanogorgia* is established for a new shallow-water species, *Stephanogorgia wainwrighti*, from the Fiji Islands. A second new species from the Sulu Archipelago, collected by the U.S. Fish Commission steamer "Albatross", is described as *S. diomedea*. A species from the Palau Islands, recently described by Bayer as *Trichogorgia faulkneri*, is shown to be generically distinct from *Trichogorgia* and is here transferred to *Stephanogorgia*.

A new species of the genus *Trichogorgia* Hickson, obtained by diving and shallow-water trawling in the Caribbean Sea, is described as *Trichogorgia lyra*, and the synonymy of the genus *Malacogorgia* Hickson with *Trichogorgia* Hickson, as proposed by Kükenthal, is supported.

A new genus, *Xenogorgia*, is established for an unusual chrysogorgiid from South Africa having a colonial form different from all chrysogorgiids heretofore known; the type and only species is *Xenogorgia sciurus*, spec. nov.

INTRODUCTION

A new species of *Trichogorgia* recently was described from the Palau Islands (Bayer, 1974: 263), which raises some important questions regarding this genus, its place in the family Chrysogorgiidae, and the relationship of the family to the other holaxonian families having strongly calcified axial skeletons. Some additional material from widely diverse localities serves to place these questions in better perspective.

The first of these is a species of chrysogorgiid collected in the Fiji Islands

by the second author in 1972. It bears a close resemblance to *Trichogorgia faulkneri* Bayer but differs from it in several particulars. Both of these obviously congeneric species differ from *Trichogorgia flexilis* Hickson to such a degree in their manner of branching, a character of major importance in the family Chrysogorgiidae, that they cannot be retained in the genus *Trichogorgia*.

The second is a species from the Sulu Sea, taken by the U.S. Fish Commission steamer "Albatross" in 1908, which agrees in manner of branching with the Fijian and Palauan species, but differs from both in several details. For these three species, we here establish a new genus in the family Chrysogorgiidae.

The third is a shallow-water species of chrysogorgiid from the Caribbean Sea, which bears a striking resemblance to a species from South Africa described by Hickson (1904: 226). It is unusual, but not unique, in having no calcareous sclerites in the coenenchyme or in the polyps. Hickson's species, *Malacogorgia capensis*, is similarly without sclerites but lacks calcareous deposits in the axis as well. Otherwise, *Malacogorgia capensis* Hickson is practically identical with the chrysogorgiid *Trichogorgia flexilis* Hickson, 1904, also from South Africa and described at the same time (Hickson, 1904: 222). Although Hickson established a new family, Malacogorgiidae, for this uncalcified form, Kükenthal (1919: 498) was of the opinion that the absence of sclerites and axial calcium was unimportant and synonymized *Malacogorgia* with *Trichogorgia*, retaining the type-species as *Trichogorgia capensis* (Hickson). The new Caribbean species is so similar in colonial form that it only can be placed in *Trichogorgia*, and it provides additional evidence that *Trichogorgia faulkneri* Bayer was erroneously placed generically.

The fourth is a new species from moderate depths off South Africa having a growth form quite different from any chrysogorgiid heretofore known. For this species we erect a new genus, and provide a revised key to all the genera of the family Chrysogorgiidae that we now consider valid.

ACKNOWLEDGMENTS

We are grateful to Dr. Charles Birkeland, Dr. Nigel Christie, Mr. Douglas Faulkner, and Dr. David Meyer for specimens reported here. Dr. David Pawson of the Smithsonian Institution very kindly made material collected by the U.S. Fish Commission steamer "Albatross" available to us for study. The expedition during which *Stephanogorgia wainwrighti* was collected was supported by, and the second author's participation made possible by, the generosity of Dr. Stephen A. Wainwright, and our debt to him cannot be acknowledged adequately in these few words.

Operations of R/V "Gerda" in 1967 and 1968, and of R/V "Pillsbury" in 1966, 1967, 1968 and 1971, during which some of the specimens herein described were collected, were supported by the U. S. National Science Foundation under grants GB-3808, GB-5776, GB-7082, GA-4569, and GD-27252.

That portion of the research dealing with Caribbean material was supported by grant GB 030741 from the National Science Foundation, Frederick M. Bayer, principal investigator. We are glad to express here our appreciation of this support.

The ophiuroid commensals were kindly identified by Dr. Lowell P. Thomas. To all those other friends and colleagues who helped, perhaps unknowingly, in many small but important ways, we extend our sincere gratitude.

Family Chrysogorgiidae Verrill

Chrysogorgiidae Verrill, 1883: 21.

Chrysogorgiidae Versluys, 1902: 2. — Kükenthal, 1919: 486; 1924: 383. — Bayer, 1956: *F216*; 1974: 262.

Dasygorgiidae Wright & Studer, 1889: xxxix.

Dasygorgiidae Hickson, 1904: 221.

Malacogorgiidae Hickson, 1904: 226.

Diagnosis. — Gorgonaceans having an unjointed scleroproteinous axis with a central core that is not hollow and cross-chambered, made up of concentric layers that are not undulated, with a smooth surface unmarked by longitudinal grooves (except on lower part of trunk in some cases). Axis branched or unbranched, arising from a rootlike or discoidal base that is usually strongly calcified. Sclerites usually present in coenenchyme, in the form of flat, oval or elongate scales with or without a median constriction and sometimes terminally lobate, and/or fusiform rods with prickly sculpture; scales showing irregular concentric bands of interference colors in polarized light. Axis more or less heavily calcified, commonly showing metallic or iridescent reflections.

Discussion. — Although this family has been considered to be generally one of deep waters, a few species from relatively shallow water have been known for a long time: *Chrysogorgia cupressa* (Wright & Studer), 90 m (Versluys, 1902); *Trichogorgia flexilis* Hickson, 102 m (Hickson, 1904); *Trichogorgia capensis* (Hickson), 46 m (Hickson, 1904); and *Trichogorgia viola* Deichmann, 79 m (Deichmann, 1936).

In 1972, the second author obtained a delicate, flabellate gorgonian by diving in the Fiji Islands, which proves to belong to a species of chrysogorgiid strikingly similar to one recently described from the Palau Islands (Bayer,

1974). Comparison of the two shows that they are distinct but related species that cannot be assigned to *Trichogorgia* because of differences in colonial form and branching. Therefore, we now propose a new genus, *Stephanogorgia*, for the species from Fiji, and transfer *Trichogorgia faulkneri* Bayer into it.

In addition, another gorgonian recently found among the octocorals collected by the U.S. Fish Commission steamer "Albatross" during its Philippine Cruise of 1907-1910 has proved to be a third species referable to the genus *Stephanogorgia*.

Coincidentally, Dr. Charles Birkeland of the Smithsonian Tropical Research Institute has sent us some specimens from the Atlantic coast of Panamá that are referable to the original genus *Trichogorgia*, first described from South Africa (Hickson, 1904). These specimens are very similar to some dredged along the Caribbean coast of Central and South America by research vessels of the University of Miami. Comparison shows that all are the same, and that they represent a new western Atlantic species of *Trichogorgia*. It is entirely appropriate to record this new Atlantic *Trichogorgia* at the same time that we remove the first presumed Pacific representative from the genus. Therefore, the genus *Trichogorgia* remains unrepresented in the Pacific, as *Chrysogorgia constricta* Hiles, 1899, which was assigned by Hickson (1904: 221) to his new genus *Trichogorgia*, is probably not even a chrysogorgioid (Versluys, 1902). Although the type-specimen was re-examined by Hickson, the original figures of it are not convincing (Hiles, 1899: 195, pl. 22 figs. 8-10).

One of the major taxonomic characters used in classifying the Chrysogorgiidae is the branching and resultant growth form of the colony. We have received from South Africa specimens having distinctively chrysogorgioid sclerites and polyps, but differing in branching, which fit satisfactorily into no established chrysogorgioid genus. Rather than widening the generic definition of *Chrysogorgia* to accommodate these unusual specimens, we are here establishing a new genus for them.

The characteristics distinguishing the two new genera herein proposed are shown in the following key to the genera of Chrysogorgiidae.

Key to the genera of the family Chrysogorgiidae

1. Colonies unbranched: 2
1. Colonies branched: 3
2. Polyps with an operculum of 8 triangular plates: *Chalcogorgia* Bayer
2. Polyps without an operculum, but with the bases of the tentacles armed with several small sclerites: *Radicipes* Stearns

3. Colonies branched in one plane: 7
3. Colonies not branched in one plane: 4
4. Primary branches unbranched: *Iridogorgia* Verrill
4. Primary branches give rise to secondary branches: 5
5. Secondary branches repeatedly subdivided in apparently dichotomous manner: 6
5. Secondary branches bearing a few short lateral branchlets arise all around the main stem in "bottle brush" manner: *Xenogorgia* gen. nov.
6. Colonies with dichotomously divided branches arising from the upper end of a stout main trunk, monopodial: *Metallogorgia* Versluys
6. Colonies with dichotomously divided branches arising along the main stem in a regular or irregular spiral sequence, sympodial; one or more of the uppermost branches may divide in one plane and even dominate the colony so as to produce a flabellate or biflabellate form, but traces of the spirally arranged older branches usually can be observed on the lower parts of the main stem: *Chrysogorgia* Duchassaing & Michelotti
7. Branching unilateral, forming flat, lyrate colonies with few, long terminal branchlets reaching or surpassing half the height of the fully developed colony: 8
7. Branching pinnate, forming broad, flat fans with many relatively short branchlets much less than half the height of the fully developed colony: *Stephanogorgia* gen. nov.
8. Sclerites abundant, including many plates with thick projecting processes developed on the outer surface, as well as thin scales with serrated edges: *Pleurogorgia* Versluys
8. Sclerites few or absent; when present, consisting of small scales with slight median constriction ("double paddles") or without waist: *Trichogorgia* Hickson

***Stephanogorgia* gen. nov.**

Diagnosis. — Flabellate chrysogorgiids alternately and pinnately branched in one plane, with numerous terminal branchlets much shorter than half the height of fully developed colonies; basal attachment calcified, sometimes with lobate ridges.

Description. — The colonies form flat fans with extremely fine, alternate pinnate branching; the terminal branchlets are short relative to the height of the colony. The axis is calcified, longitudinally grooved in the proximal parts but becoming smooth distad, with more or less conspicuous metallic reflections. The polyps are placed uniserially or biserially on the terminal

branchlets, biserially in the plane of branching on the larger branches and main stem. They have a thin layer, sometimes very sparse, of scale-like sclerites which converge toward the bases of the tentacles and may extend out onto the backs of the tentacles, becoming smaller distad. The coenenchyme is smooth and very thin, with a few sclerites only in the vicinity of the polyps, or none at all.

Type-species. — *Stephanogorgia wainwrighti* spec. nov., here designated.

Etymology. — From Greek *στέφανος*, a crown, in allusion to the gold of which crowns may be made as well as to the proper name Stephen.

Comparisons. — The gross aspect of branching of all known species of *Stephanogorgia* is denser than that of *Trichogorgia*, resulting in richly branched, fan-shaped colonies. The terminal branchlets are more numerous and much shorter relative to the total height of the colonies.

Key to the species of the genus *Stephanogorgia*

1. Terminal branchlets short, up to 18 mm but mostly 8-12 mm; 20-25 polyps per centimeter of branchlet; sclerites up to 0.15 mm long: *S. wainwrighti*, spec. nov.
1. Terminal branchlets longer; fewer than 20 or more than 25 polyps per centimeter of branchlet; sclerites small, up to 0.12 mm long: 2
2. Terminal branchlets up to 35 mm long, mostly 15-20 mm; 12-14 polyps per centimeter of branchlet; main trunk slender, 2.5 mm in diameter; sclerites to 0.12 mm long, with tapered or rounded ends: *Stephanogorgia faulkneri* (Bayer)
2. Terminal branchlets up to 55 mm long, mostly 45-50 mm; 27-40 polyps per centimeter of branchlet; main trunk stout, 5 mm in diameter; sclerites to 0.08 mm long, many with truncated ends: *Stephanogorgia diomedea*, spec. nov.

Stephanogorgia wainwrighti spec. nov. (figs. 1, 2A-B, 3B; pls. 1, 7D)

Material examined. — "Bu Reef," Nananu-I-Ra Island, 17°15'S 178°12'E, 3 km NNW of Viti Levu, Fiji Islands, 10 m; coll. Katherine Muzik and Stephen Wainwright, August 4, 1972; 3 colonies.

Diagnosis. — *Stephanogorgia* with undivided terminal branchlets up to 18 mm long, mostly 8-12 mm, main axis distinctly bent at each branch origin; polyps 20-25 per centimeter of branchlet length; sclerites up to 0.015 mm long, 0.07 mm wide, forming a complete layer in polyp body; backs of tentacles with a longitudinal tract of minute rods.

Description. — The colonies are flabellate and branched in one plane,

alternately pinnate and without anastomoses. The holotype (pl. 1) is a colony 150 mm in height, 160 mm in width, with the main stem 2 mm in diameter at the base. The basal attachment is whitish, calcified, with lobed longitudinal ridges giving it a grooved appearance; its greater diameter is 3 mm.

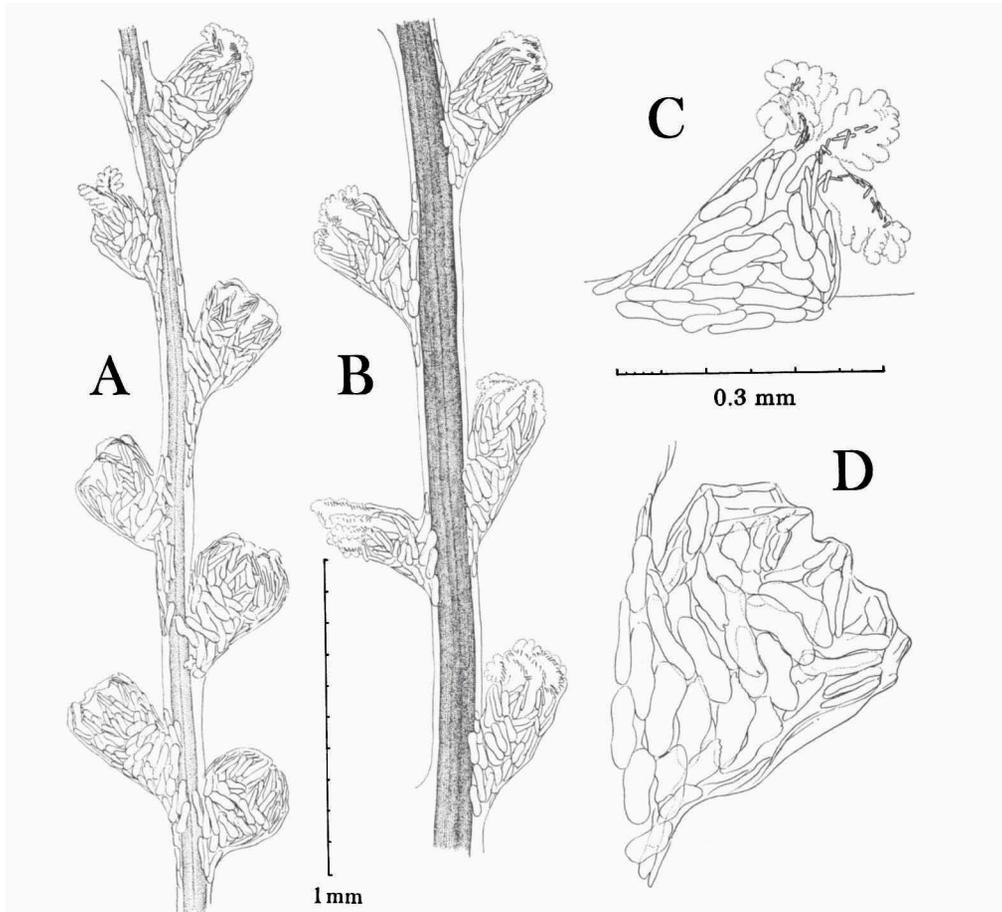


Fig. 1. *Stephanogorgia wainwrighti* spec. nov. A, distal part of terminal branchlet; B, proximal part of terminal branchlet; C, polyp with tentacles extended; D, polyp with tentacles folded in.

The axis is strongly calcified, longitudinally grooved only near the base of the main stem. The entire axis is golden and glossy from base to ultimate branches in preserved specimens. Alive and under water, the color of the colony appears yellow, as the axis shows through the nearly transparent coenenchyme.

Branching is monopodial, with undivided branchlets arising in a regularly

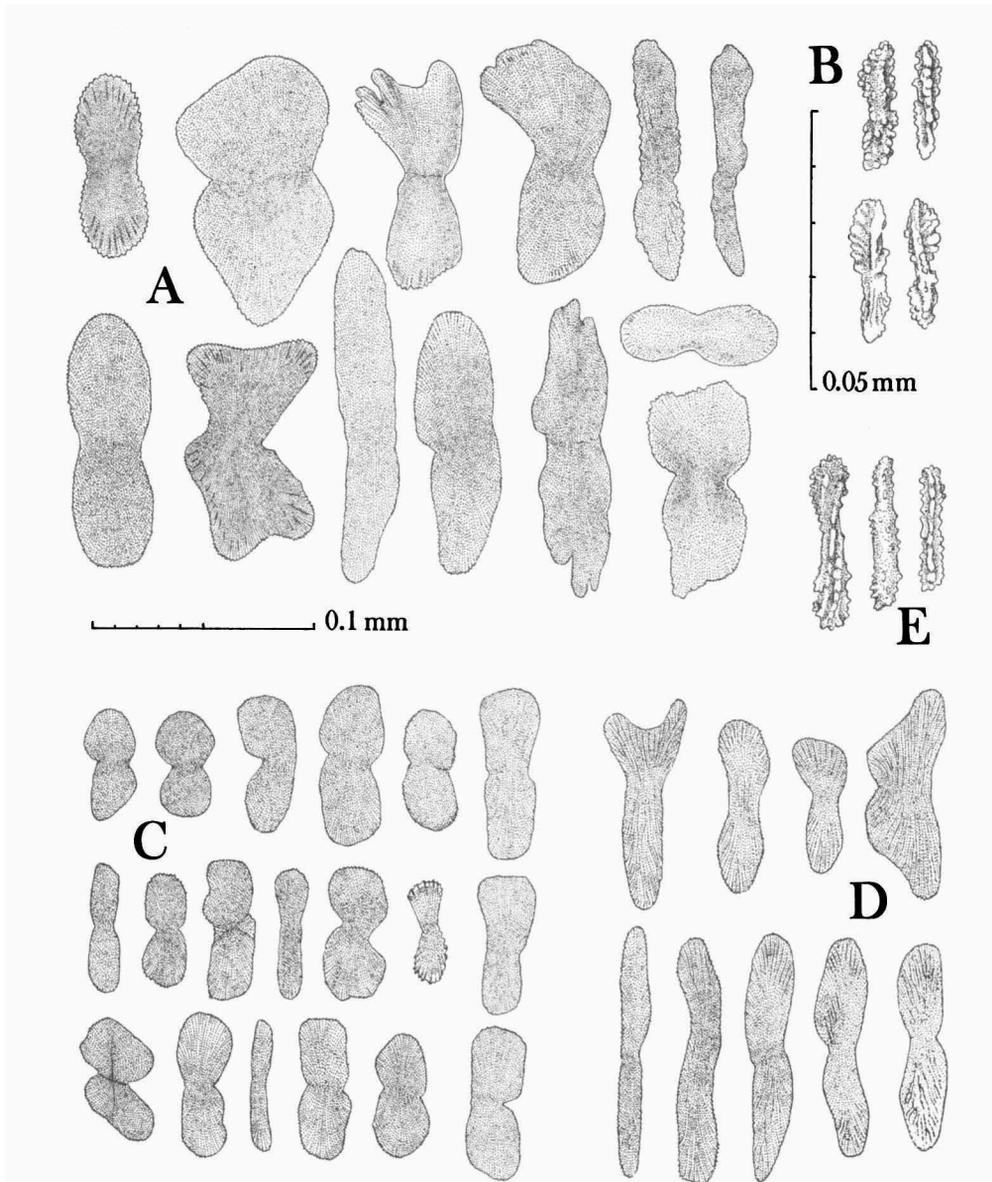


Fig. 2, A, sclerites from body of polyp of *Stephanogorgia wainwrighti* spec. nov.; B, sclerites from tentacles of *S. wainwrighti*; C, sclerites from polyp of *Stephanogorgia diomedea* spec. nov.; D, sclerites from body of polyps of *Stephanogorgia faulkneri* (Bayer); E, sclerites from tentacles of *S. faulkneri*. (0.1 mm scale applies to A, C, and D; 0.05 mm scale applies to B and E.)

alternate, pinnate manner, from 2.5 to 5 mm apart measured between successive branchlets, the average interval being 3-4 mm. Branching proceeds to the fourth order, which is the rank of most undivided terminal branchlets. These are at most 18 mm in length but commonly are shorter, from 8 to 12 mm. As each lateral branch is produced, the main axis bends slightly away from it and consequently follows a zigzag course (fig. 3B).

The polyps are placed biserially, the rows lying in the plane of branching of the colony (fig. 1A, B). They are small, less than 0.3 mm in height in semi-contracted condition (fig. 1C, D). They are directed distad, at an approximately 45° angle with the branch, and are 0.4 to 0.6 mm apart; 20-25 polyps occur in 1 cm. This arrangement is most consistent on the terminal branchlets but is generally typical of the colony as a whole.

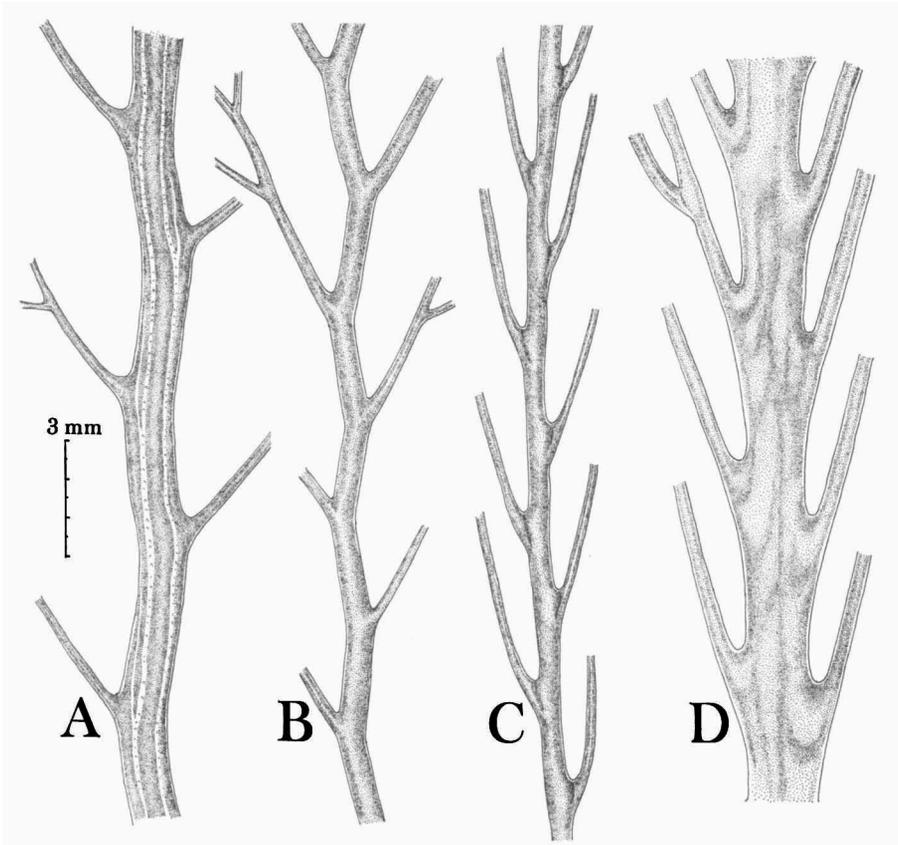


Fig. 3. A, main axis of *Stephanogorgia faulkneri* (Bayer) about 7.5 cm from base; B, axis of major branch of *Stephanogorgia wainwrighti* spec. nov.; C, axis of penultimate branch of *Stephanogorgia diomedea* spec. nov.; D, axis of major branch of *S. diomedea*. All figures drawn to same scale.

Sclerites in the form of thin, flat scales are present in the polyps but only rarely in the coenenchyme between polyps. In the body of the polyps they are placed obliquely or transversely; distad, the scales become narrower and are set in a roughly en chevron arrangement below the tentacles (fig. 1). In the proximal part of the tentacles, the sclerites assume a longitudinal orientation, but toward the tip they are oblique or transverse. The semi-contracted state of the polyps makes the exact arrangement in the tentacles difficult to ascertain.

Sclerites of the polyp body are smooth ovals, with minutely serrated edges (fig. 2A). Some are elongate, with a median constriction ("double paddles"); often, one or both ends are broadened and occasionally divided into lobes. Others are very narrow, with little or no median constriction. The longest sclerite is 0.15 mm in length, the broadest is 0.07 mm in width. The sclerites of the tentacles are small, irregular rods with serrated edges (fig. 2B). They decrease in size distad, the larger ones measuring 0.034 mm, the smaller ones 0.02 mm or less.

The coenenchyme is extremely thin, so the gold colored axis is easily visible through it, giving the colony in situ its characteristic yellow color. Samples from the type-specimen were sectioned and found to contain spermaries. Small (2μ) eosinophilic nematocysts were visible in sections stained by Gomori's trichrome method. No zooxanthellae were visible.

Two additional specimens complete the type series. One measures 47 mm in height by 75 mm in width (pl. 6D), the other 73 mm in height by 50 mm in width. These small colonies represent the more typical size encountered on the Fijian reefs.

All specimens were preserved in 10% formalin upon collection and then transferred to 70% ethanol.

Holotype. — USNM ¹⁾ 54056.

Paratype. — RMNH ²⁾ Coel. Coll. 11057.

Etymology. — Named in honor of Dr. Stephen A. Wainwright, leader of the Duke Expedition to the Fiji Islands, 1972.

Comparisons. — Polyps of *Stephanogorgia wainwrighti* are more closely spaced than in *S. faulkneri* and more distantly spaced than in *S. diomedea*. Terminal branchlets are shorter than in either *S. faulkneri* or *S. diomedea*. Sclerites are larger and much more abundant in the polyps, and have a coarser surface texture, than those of the other two species in this genus.

¹⁾ USNM = National Museum of Natural History, Smithsonian Institution, Washington, D. C.

²⁾ RMNH = Rijksmuseum van Natuurlijke Historie, Leiden.

Remarks. — The base of the holotype is partly covered by a mat of fine algal filaments in which an ophiuroid (*Ophiothela* spec.) is entwined. A smaller *Ophiothela* was clinging to the upper branches.

Stephanogorgia diomedea spec. nov. (figs. 2C, 3C-D, 4; pl. 3)

Material examined. — Jolo Light, E. 2.6 miles (4.2 km), 6°03'45"N 120°57'E, 20 fathoms (37 m), "Albatross" sta. D5174, March 5, 1908; 1 colony broken into several pieces.

Diagnosis. — *Stephanogorgia* with undivided terminal branchlets up to 55 mm long, mostly 45-50 mm; main axis remaining straight at branch origins; polyps 27-40 per centimeter of branchlet length; sclerites up to 0.085 mm long, 0.03 mm wide, sparsely scattered in distal part of polyp body, apparently absent in some polyps; tentacles lacking sclerites.

Description. — The colony is flabellate, branched in one plane, with branchlets arising usually alternately from the strong main branches up to 5 mm in diameter. The holotype is a broken colony, the largest fragment only 170 mm long, but the size of the complete colony is estimated from the fragments to have been at least 250 mm in height and probably 300-400 mm. The basal attachment is missing.

The trunk and larger branches are longitudinally grooved, conspicuously so in the proximal parts. The axis is calcified and shows conspicuous golden reflections, especially in the ultimate branchlets.

Branching is monopodial, with alternating branchlets arising 2.5 to 9.0 mm apart, measured between successive branchlets. The axis is thickened near the origin of each branch, and the axis of the branchlets is noticeably thickened proximally (fig. 3C, D). The main axis does not change its direction at the origin of branches and branchlets, hence is straight, not zig-zag. Branching proceeds to at least the fourth order, with terminal undivided branchlets reaching 55 mm in length, commonly 45-50 mm. Polyps occur biserially, the rows lying in the plane of branching (fig. 4). The height of contracted polyps is about 0.5 mm, but condition of the specimen does not permit reliable measurement. Fully extended polyps probably were at least 1 mm tall, possibly more. The number of polyps in 1 cm of branchlet length ranges from 25 to 40, spaced up to 0.6 mm apart.

Sclerites in the form of thin, flat scales are present only in the polyps, and there, apparently, only in the distal part of the polyp body below the origin of the tentacles. In no case were sclerites seen in the tentacle backs. Some polyps are entirely without sclerites, and no sclerites were present in the coenenchyme. Sclerites are smooth, with extremely fine surface granulation and very finely serrated edges (fig. 2C). Most are elongate, with a median con-

striction and often with bluntly truncated ends. The longest scale measures 0.085 mm long and 0.031 mm wide; the broadest one is 0.056 mm long and 0.034 mm wide.

The coenenchyme is extremely thin, with the gold colored axis visible through it. Gonads, probably eggs, were found in the gastric cavities of the polyps (fig. 4).

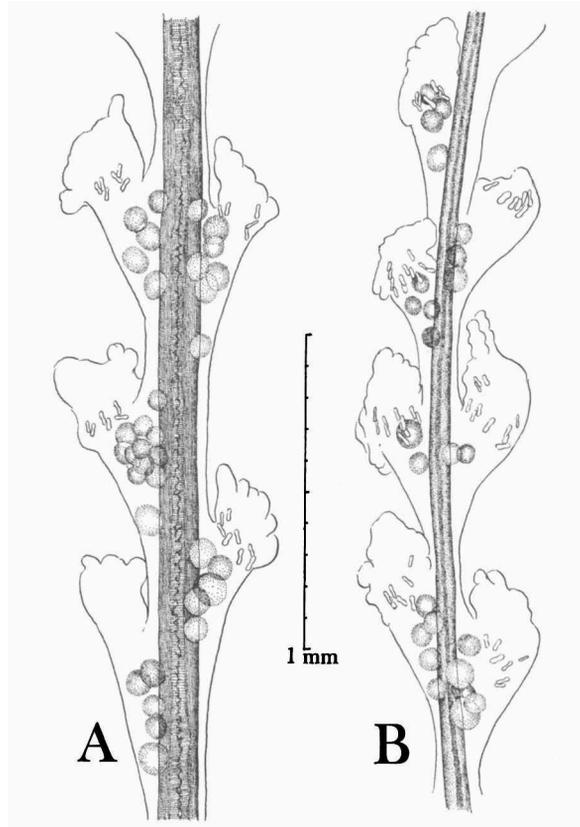


Fig. 4. *Stephanogorgia diomedea* spec. nov. A, proximal part of terminal branchlet; B, distal part of terminal branchlet.

Holotype. — USNM 54031.

Etymology. — From *Diomedea*, the generic name of the albatross, alluding to the name of the collecting vessel as well as to the large size of the bird.

Comparisons. — The unbranched terminal branchlets are much longer in *S. diomedea* than in either *S. faulkneri* or *S. wainwrighti*. The main branches are much larger in diameter than in the two other species, and do not show the zig-zag course so obvious in them. The polyps are much more crowded

and more sparsely set with sclerites than in either *S. faulkneri* or *S. wainwrighti*, and the sclerites are smaller and more commonly truncated.

Stephanogorgia faulkneri (Bayer) comb. nov. (figs. 2D-E, 3A, 5; pl. 2)

Trichogorgia faulkneri Bayer, 1974: 263, figs. 2, 3A-C; pl. 3.

Diagnosis. — *Stephanogorgia* with undivided terminal branchlets up to 35 mm long, mostly 15-20 mm; main axis distinctly bent at each branch origin; polyps 12-14 per centimeter of branchlet length; sclerites up to 0.12 mm long, 0.02 mm wide, scattered in incomplete layer in polyp body; backs of tentacles with a tract of obliquely placed minute rods.

Discussion. — In the original description of this species, the distance be-

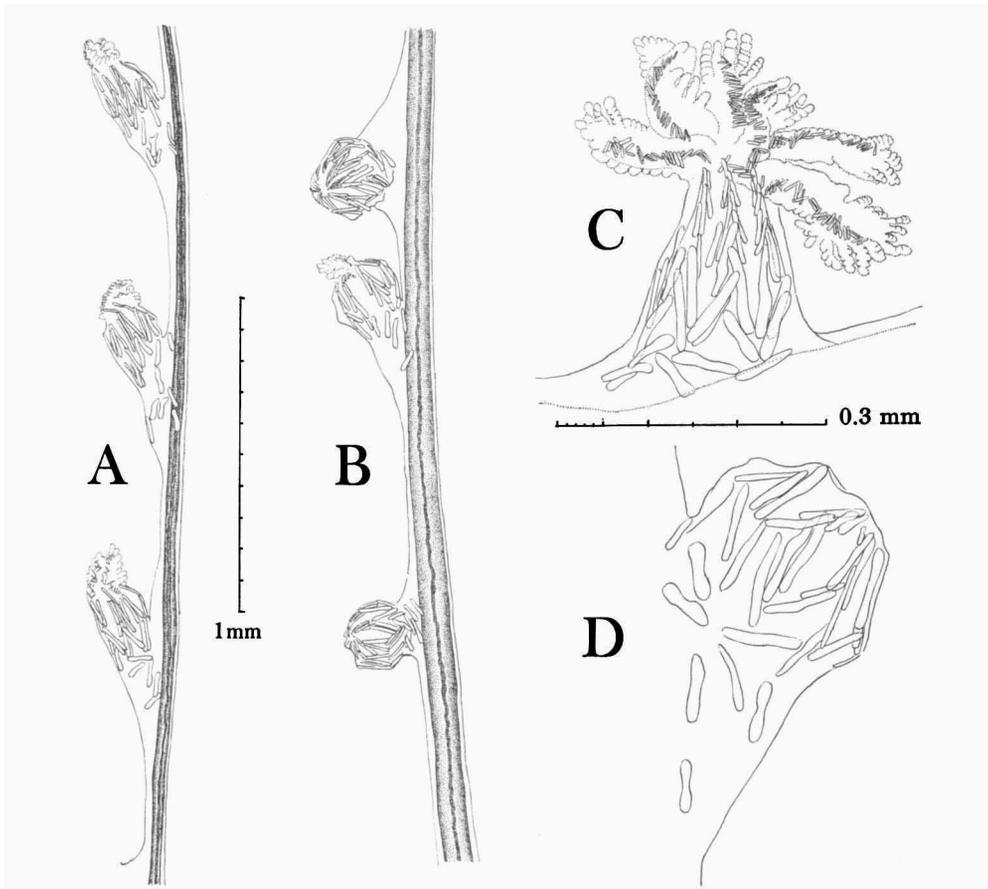


Fig. 5. *Stephanogorgia faulkneri* (Bayer). A, distal part of terminal branchlet; B, proximal part of terminal branchlet; C, polyp with tentacles extended; D, polyp with tentacles folded in.

tween branches was expressed as the distance between branches along one side of a main branch (Bayer, 1974: 266). If the distance between successive branchlets is measured instead, it represents internodal length. In 68 measurements, this ranges from 1.7 to 5.3 mm, with an average of 3.4 mm; 66% of the measurements are from 2 mm to 4 mm, and 35% from 2 mm to 3 mm.

Many underwater photographs, as well as actual specimens, indicate that *Stephanogorgia faulkneri* reaches a larger size than does *S. wainwrighti*. There also is some indication that colonies of *S. faulkneri* tend to be tall and narrow in outline, whereas *S. wainwrighti* is shorter and broader, but this character would certainly be subject to local circumstances and may have no significance at all.

Commensals. — Preserved specimens of *S. faulkneri* may have specimens of a small brittlestar attached, and photographs of living colonies show that some are heavily infested. Dr. Lowell P. Thomas has kindly identified these as a species of *Ophiothela* (family Ophiotrichidae).

Trichogorgia Hickson, 1904

Trichogorgia Hickson, 1904: 222 (type-species, *Trichogorgia flexilis* Hickson, 1904; by monotypy and original designation under Art. 68(a) (i), Internat. Code Zool. Nomencl.). — Kükenthal, 1919: 497; 1924: 383. — Deichmann, 1936: 223.
Malacogorgia Hickson, 1904: 226 (type-species, *Malacogorgia capensis* Hickson, 1904; by monotypy).

This genus was established by Hickson (1904: 222) for *Trichogorgia flexilis*, a South African chrysogorgiid having a characteristic flabellate growth form quite unlike any other known member of the family. Another species, completely devoid of calcareous sclerites and axial calcium carbonate but otherwise identical with *T. flexilis*, was described in the same paper by Hickson (1904: 226) as *Malacogorgia capensis* and assigned to a new family Malacogorgiidae. Kükenthal (1919: 498) considered the absence of calcification to be unimportant and transferred *M. capensis* to *Trichogorgia*, with which he synonymized *Malacogorgia*. Deichmann (1936: 223) concurred with this view on the grounds that the sclerites of *Malacogorgia capensis* might have been dissolved, even though Hickson (1904: 226) took that possibility into consideration and justifiably ruled it out. Deichmann further described a new species of *Trichogorgia* from the western Atlantic, *T. viola*, with branching like that of *T. flexilis* as nearly as could be determined from three small, damaged colonies. Its sclerites are not unlike those of *T. flexilis*.

During trawling operations along the western shore of the Caribbean Sea from 1966 to 1971, the research vessels "John Elliot Pillsbury" and "Gerda" obtained numerous specimens of a gorgonacean with growth form very simi-

lar to that of *Trichogorgia flexilis* and *T. capensis*. Although the Caribbean specimens differ in certain particulars, they seem referable to *Trichogorgia* and in some respects bridge the gap between it and *Malacogorgia*, thus supporting Kükenthal's opinion (1919: 498). They are devoid of calcareous sclerites as is *M. capensis* but, unlike it, they have calcareous deposits in the older parts of the axis. The polyps of the Caribbean specimens are widely set biserially, whereas those of the South African species are placed all around the branches and are crowded, especially toward the branch tips. Specimens of this remarkable Caribbean form also have been collected by Drs. Charles Birkeland and David Meyer of the Smithsonian Tropical Research Institute during diving operations off Portobelo, Panamá. These are in perfect condition and provide much better information about the systematic characters of the species than do the trawled specimens.

Hickson (1904: 223) originally diagnosed the genus *Trichogorgia* as follows: "Colony branching in one plane. Axis becoming very thin in the terminal branches. Calices numerous and situated on all sides of the terminal and subterminal branches. Spicules very thin double discs or double paddles, numerous, overlapping, in one layer on calices and coenenchym." Because of the incorporation of *Malacogorgia* into the genus, and because of the characters of the new Caribbean species here described, we amend the generic diagnosis as follows.

Diagnosis. — Chrysogorgiids branched in one plane, colonies flabellate, lyrate, with long terminal branches. Axis with or without calcareous deposits, becoming very thin and flexible in the terminal branches. Calices biserial or on all sides of the terminal and subterminal branches, widely spaced or more crowded terminally. Sclerites present or absent; if present, in the form of very thin double discs or double paddles, with finely serrated edges.

***Trichogorgia lyra* spec. nov.** (figs. 6, 7; pls. 4, 5, 6, 7C)

Material examined. — Yucatan: Arrowsmith Bank, 21°12'N 86°20'W, 73-64 m, September 9, 1967, Gerda sta. 882; 1 colony. — Arrowsmith Bank, 20°50'N 86°30'W, 183-46 m, January 29, 1968, Gerda sta. 956; 1 damaged colony with terminal branches broken off.

Honduras: N. of Cayo Gorda, off eastern Honduras, 16°16'N 82°26.5'W, 37 m, May 20, 1967, Pillsbury sta. 574; 1 colony and broken branches. — N. of Payabela, 16°04'N 84°44'W, 51 m, February 2, 1971, Pillsbury sta. 1366; 2 colonies. — N. of Punta Patuca, 16°00.5'N 84°19.5'W, 38 m, February 1, 1971, Pillsbury sta. 1365; 1 regenerated colony. — Gulf of Honduras, 15°58.1'N 88°20.3'W, 33-46 m, March 19, 1968, Pillsbury sta. 613; 3 colonies represented by main stems and broken branches.

Nicaragua: N. E. of Cabo Gracias a Dios, 15°30.5'N 82°39.5'W, 33-37 m, February 1, 1971, Pillsbury sta. 1361; 9 colonies and fragments. — E. of Cayos King, 12°42'N 82°47'W, 38-46 m, January 29, 1971, Pillsbury sta. 1336; 3 colonies, more or less broken.

— E. of Cayos King, $12^{\circ}28.9'N$ $83^{\circ}04.8'W$, 27 m, January 28, 1971, Pillsbury sta. 1335; 1 colony.

Panamá: Salmedina Reef, off Portobelo, 24 m, Charles Birkeland coll., by diving, April 1, 1974, holotype and 9 other colonies; 30 m, Charles Birkeland and David Meyer coll., by diving, September 4, 1974, 7 colonies; 23 m, Charles Birkeland and David Meyer coll., by diving, March 16, 1975, 11 colonies. — Golfo de los Mosquitos, $9^{\circ}08.5'N$ $80^{\circ}29.5'W$, 37-48 m, July 20, 1966, Pillsbury sta. 435; 5 colonies and 1 denuded axis. — Off Golfo de San Blas, $9^{\circ}37.5'N$ $78^{\circ}54'W$, 128-64 m, July 8, 1966, Pillsbury sta. 330; 1 small colony.

Colombia: Islas de San Bernardo, 4 miles S. S. E. of Isla Ceycen, $9^{\circ}37.9'N$ $75^{\circ}50.4'W$, 37 m, July 13, 1966, Pillsbury sta. 370; 1 damaged colony. — Off Punta Caribana, $8^{\circ}51.9'N$ $77^{\circ}00.7'W$, 79-73 m, July 17, 1966, Pillsbury sta. 401; 1 nearly complete colony. — Entrance of the Gulf of Uraba, $8^{\circ}48.7'N$ $77^{\circ}12.7'W$, 99-97 m, July 17, 1966, Pillsbury sta. 403; 2 colonies, one of them nearly complete.

Diagnosis. — *Trichogorgia* with widely spaced, biserial polyps not crowded terminally on the branches; no calcareous sclerites; axis containing calcareous deposits especially in the proximal parts; holdfast root-like.

Description. — Colonies branched in one plane from a stout main trunk, anchored in the substrate by means of root-like processes attached to any accessible small solid objects; ramification normally proceeding in a regular, pseudodichotomous manner, producing extremely slender, long, nearly straight and subparallel ascending terminal branches in a lyrate fashion (fig. 6) up to the 9th order but commonly to the 6th or 7th, the resulting fan either flat or gently convex (pls. 4, 5, 7C). Polyps placed biserially along the terminal branches (pl. 6) as well as on the more proximal internodes, but usually absent from the main stem except in small colonies; depending upon the state of contraction, they are either goblet-shaped (fig. 7A), trumpet-shaped (fig. 7B), or subcylindrical (pl. 6); the tentacles can be completely retracted within the distal part of the polyps, but in many cases are extended in preservation even when the polyps are strongly contracted.

The coenenchyme consists of a delicate, translucent cortex formed by four thin-walled longitudinal canals. As nearly as can be seen from the preserved material, all of the polyps arise from the canals lying in the plane of branching, whereas the canals on the two faces of the colony produce no polyps. On the main trunk the cortex is thicker, fleshy, greyish white, smooth, but marked by shallow grooves that indicate the course of the stem canals.

Both polyps and coenenchyme are totally devoid of sclerites of any description. The tissues of the polyps are translucent, clearly showing the pharynx, septa and filaments through the body wall. The axis is creamy white or pale straw colored, showing the metallic reflections and pearly iridescence typical of the Chrysogorgiidae. It is smooth in the branches, but in the main trunk the axis has obscure longitudinal grooves following the course of the stem canals.

Holotype. — USNM 54032. National Museum of Natural History, Smithsonian Institution, Washington, D. C.: Salmedina Reef, off Portobelo, Panamá, 24 m, Charles Birkeland coll., by diving, April 1, 1974.

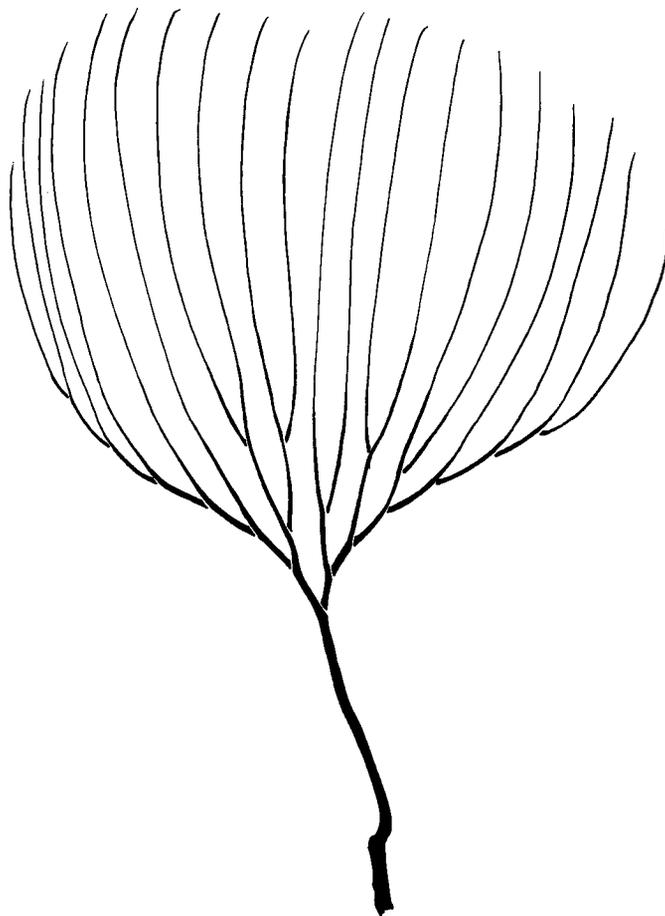


Fig. 6. Branching pattern of *Trichogorgia lyra* spec. nov.

Paratypes. — USNM 54033: 8 colonies collected with the holotype. — RMNH Coel. Coll. 11054: 1 colony collected with the holotype. — USNM 54044: Salmedina Reef, off Portobelo, Panamá, 30 m, Charles Birkeland and David Meyer coll., by diving, September 4, 1974: 6 colonies. Additional paratypes in the Smithsonian Institution, Rijksmuseum van Natuurlijke Historie (Leiden) and British Museum (Natural History) (London).

Etymology. — From Latin *lyra*, a stringed musical instrument, in allusion to its shape.

Remarks. — Some colonies, because of either injury or their immediate surroundings, develop unilaterally, so that only one half of the lyre-shaped fan is produced (pl. 4). All the larger colonies show evidence that injuries and breakage occur frequently in nature, and that the colonies have a strong capacity for regeneration. One colony with a total of six bifurcations and seven terminal branches arises from the top of a main trunk 85 mm tall,

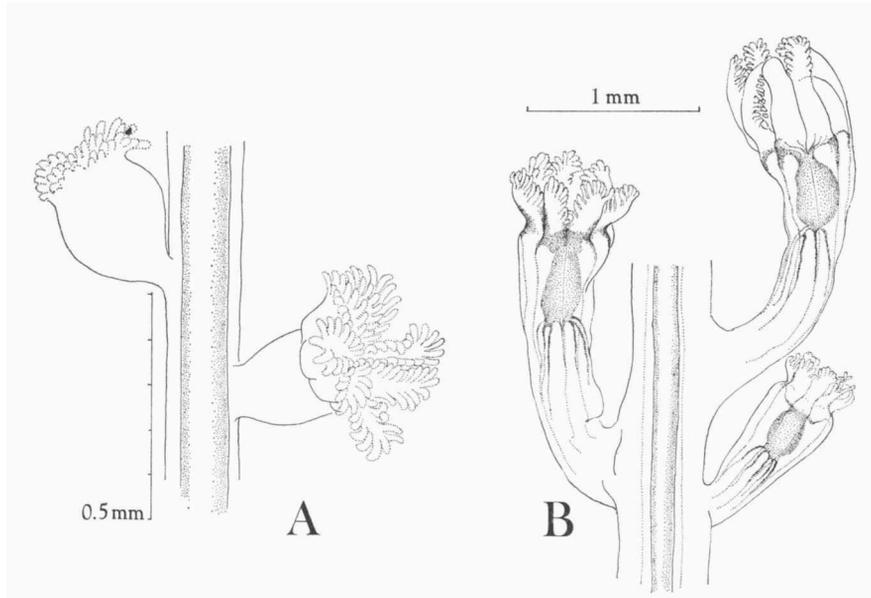


Fig. 7. *Trichogorgia lyra* spec. nov. A, contracted polyps; B, extended polyps.

which has the healed stumps of at least seven former major branches; the regenerated portion is 58 mm tall.

Because calcareous sclerites, the most useful taxonomic characters of gorgonians, are not present in these colonies, detailed measurements were made of the length of the internodes — i.e., the distance between branches — and counts were made of the number of polyps present in a given length of branch, in order to determine the constancy of these characters and to provide a basis for comparison should related species lacking sclerites be discovered. The height of polyps was not measured, as this character is so greatly influenced by the state of contraction and method of preservation.

Internodal lengths were measured to the nearest 0.5 mm in all of the complete or nearly complete colonies in the collection. A total of 37 colonies

from 12 stations yielded 506 measurements. Arithmetic means were calculated for each specimen individually and for each station. Modal lengths were calculated to the nearest 1 mm for each specimen and for each station, and then combined into 3-mm units.

The length of internodes ranges from 1 mm to 44 mm, but the average internodal length ranges from 4.5 mm to 18.5 mm owing to the relative scarcity of internodes longer than about 15 mm. In the collection as a whole, 82.6% of the internodes are from 4 mm to 15 mm in length.

When the data are grouped according to collection station, some differences in the modal length of internodes were observed among them. In the two collections from Salmedina Reef, Panamá, internodes are most commonly (40.6%) from 7 to 9 mm long, whereas in the specimens from Pillsbury stations 330, 370, 435 and 613, the internodes are most commonly (53.6%) from 4 to 6 mm long. The specimens from six other stations (Pillsbury 401, 574, 1336, 1361 and 1366; Gerda 882) agree with those from Salmedina Reef in having most internodes (24.8%) from 7 to 9 mm long, but in these specimens a larger percentage (41.1%) of internodes are 13 mm or longer than in those from Salmedina Reef (17.4%).

The geographical distribution of the collections reveals no pattern. The lots with predominantly shorter internodes are distributed throughout the range and are interspersed among those with longer internodes. We therefore conclude that this character is of no value in subdividing the material now available for study.

The number of polyps occurring in a 5-mm length of branch was counted in the hand-collected specimens from Salmedina Reef, but could not be counted accurately in the trawled specimens owing to damage incurred during collection.

In the ten colonies collected on April 1, 1974, the number of polyps present in 5 mm ranges from 7 to 16; in single colonies, the lowest range is 7 to 9, the highest 12 to 16; the average number of polyps is 11.7 based on 88 counts, and the modal number is 12 (28%).

In the seven colonies collected on September 4, 1974, the number of polyps in 5 mm ranges from 8 to 15; in single colonies, the lowest range is 8 to 9, the highest 14 to 15. The average of 45 counts is 10.6 polyps in 5 mm, and the modal number is 9 (20%).

Combining these data results in a total of 133 counts, which yield an average of 11.4 polyps in 5 mm, a range from 7 to 16, and a modal number of 12 (21.8%). The data show that the number of polyps present in 5 mm of branch is variable. Within any one colony, the spacing of the polyps is reasonably constant, varying by only 3 or 4 polyps in 5 mm, so that the polyps

are widely spaced in some colonies (as few as 7 in 5 mm), whereas in others they are more crowded (up to 16 in 5 mm). As the collections from two different but nearby localities at Portobelo give different mean and modal numbers of polyps in 5 mm, it appears that the spacing of polyps is more consistent in a limited region than throughout the population as a whole.

All colonies obtained by trawling are more or less damaged and are in strongly contracted condition, as might be expected. Because the coenenchyme is without sclerites and extremely thin, the polyps remain fully exsert; they have a narrow base and widen toward the oral end, where the tentacles commonly are extended in the preserved state.

The specimens hand-collected by SCUBA divers are in perfect condition and show the extent of expansion and distension of which the colonies are capable. The longitudinal stem canals, four in number, may be widely dilated and transparent, separated by partitions visible on the surface of the coenenchyme. In any colony, or in part of a colony, one or more of the canals may be preserved in a distended condition; when two opposite canals are widely distended and the other two less so, their boundaries are very distinct, but if all are equally distended the longitudinal partitions can be seen only with difficulty, if at all.

The polyps of preserved specimens vary greatly in size, according to maturity, degree of contraction and method of preservation. The tallest polyps are 1.75 mm in height, 0.3 mm in diameter, nearly cylindrical except at the distal end where the infolded tentacles produce a more or less distinct swelling. Only a few of these fully extended polyps are preserved with the tentacles also extended. In some of the colonies studied, the polyps are contracted into a distinctly chalice-like shape. They are about 0.5 mm tall and flare from a narrow base to the oral end where the tentacles are extended in many individuals. Polyps with the tentacles infolded are shorter and roughly pyriform. Young polyps of all sizes may be found at any level on the branches, intercalated between fully grown individuals.

A single specimen (USNM 52875) from Pillsbury station 857 southeast of Carriacou ($12^{\circ}23.5'N$ $61^{\circ}21.6'W$) in 358-9 meters differs from the material described above in such a way that we exclude it from the paratype series. The colony lacking its holdfast is 195 mm tall, of symmetrically lyrate form with an upright, straight main stem 33 mm tall. The terminal branches, although very thin, are stiffer than those of the type series, and they stand rigidly upright. A field note made by Dennis M. Opresko at the time of collection records the color of the living animal as bright red, whereas all specimens in the type series were translucent white when alive. The colony contains 13 internodes with an average length of 5.7 mm and a modal length of

5 mm. From 14 to 20 polyps occur in 5 mm, and those still remaining on the colony do not differ from those of other specimens.

Although the red color in life and the unusual stiffness of the branches strongly suggest that this specimen represents a species distinct from *T. lyra*, the morphological features fall within the ranges observed for that species. As we have only a single specimen, we believe it is premature to establish a separate species for it. Pending further exploration in the area, we here merely call attention to it in the hope that additional specimens will be collected, perhaps by divers.

This is the only record of *Trichogorgia* from the Antillean arc. It was collected on a very steep slope so the exact depth of occurrence is unknown.

Xenogorgia gen. nov.

Diagnosis. — Chrysogorgiids forming colonies in bottle-brush form, the secondary branches arising from the main axis in an irregular manner; branchlets arising from the secondary branches in an irregular lateral manner. Polyps cylindrical, on all sides of branches and branchlets. Axis smooth, translucent, weakly calcified; basal holdfast formed by a small expansion of the trunk.

Description. — The main stem, undivided or with one or two strong primary branches, gives rise on all sides to numerous short branches bearing smaller lateral branchlets, resulting in a bottle-brush growth form. Polyps cylindrical, scattered, on all sides of the branches and branchlets. Sclerites in the form of thin, oval scales, often with a slight median constriction, with extremely fine surface texture scarcely visible with the light microscope. Axis smooth, translucent, amber colored in the thicker parts, faintly yellowish in the fine branchlets, only weakly calcified; basal attachment a small expansion of the trunk, marginally calcified, fastened to solid objects.

Type-species. — *Xenogorgia sciurus* spec. nov., here designated.

Etymology. — From Greek ξένος, strange, foreign + gorgia.

Xenogorgia sciurus spec. nov. (figs. 8-10; pl. 7A-B)

Material examined. — Off Lamberts Bay, South Africa, 32°03.3'S 16°02' E, 680-800 m, September 25, 1971; foraminiferal sandy ooze; 5 nearly complete colonies and 3 fragments.

Description. — Unbranched or weakly branched main stem arises from a small expansion of the trunk, marginally calcified, attached to solid objects (pl. 7A, B). Numerous short branches arise on all sides of the main stem, singly or rarely in opposite pairs, often in groups close together but not in whorls, separated by as much as 5 mm of main axis. The branches produce

short lateral branchlets which may bear still smaller branchlets, arising at approximately right angles from any side, without any apparent regularity (fig. 8).

The polyps are scattered on all sides of the branches and branchlets, not in whorls, sometimes close together, more often separated by 1 mm or more; they are tall, cylindrical, curved toward the tips of the branches, about 1.75-

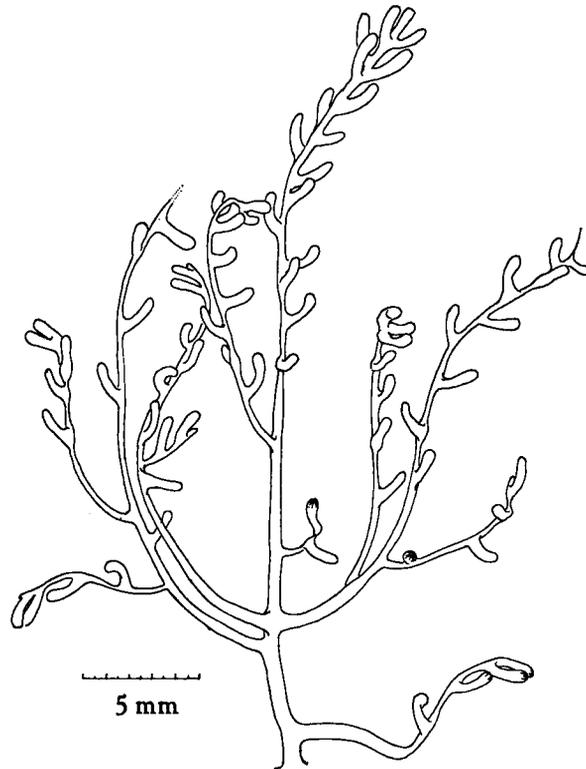


Fig. 8. Complete secondary branch of *Xenogorgia sciurus* spec. nov., showing arrangement of branching.

2.00 mm tall and 0.75 mm in diameter (fig. 9). They are covered with a layer of thin, oval scales up to about 0.26 mm long and 0.08 mm broad, usually with a slight median constriction (fig. 10). Their edges are finely dentate, and the surface has a very fine granular texture that is scarcely visible even at high magnification with the light microscope; near the margins there are a few weak, radially disposed striations, especially near the ends of the scales. Twinned forms occur in small numbers as usual.

On the body of the polyps, the scales are arranged mostly longitudinally,

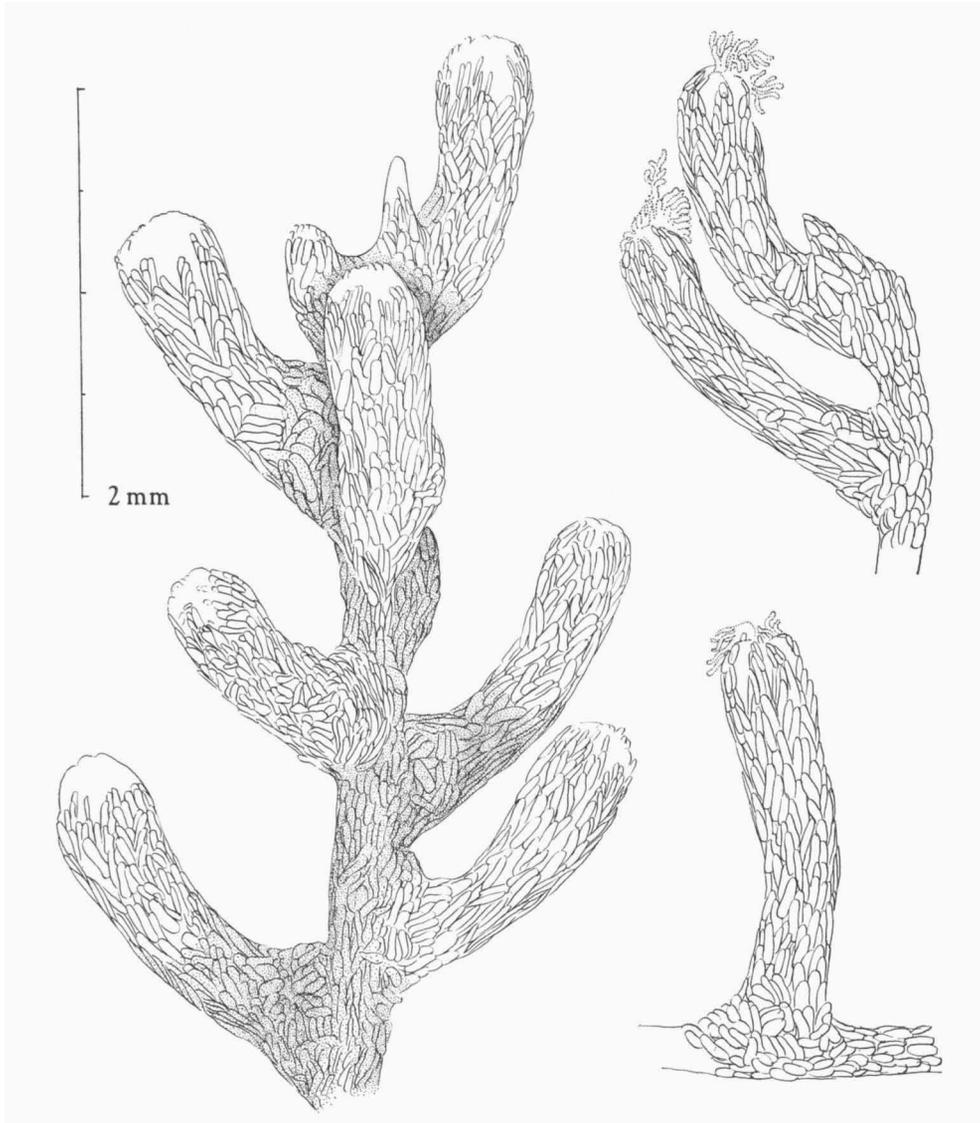


Fig. 9. Polyps of *Xenogorgia sciurus* spec. nov.

and extend into the bases of the tentacles. No sclerites are present in the distal part of the tentacles nor in the pinnules. Toward the base of the polyps, the scales assume an irregularly oblique orientation and merge into those of the coenenchyme. The scales of the coenenchyme are like those of the polyps in size and shape, and for the most part are longitudinally disposed. On the main stem and branches, the coenenchyme is densely filled with scales, but

toward the tips of the final branchlets they may be sparse, not sufficiently close together to form a complete layer.

The axis is smooth, translucent, amber colored in the main stem, becoming paler distally, where it is only faintly yellowish in the terminal parts. The axial material is weakly calcified, but there is no detectable metallic sheen or iridescence. Even after decalcification in hydrochloric acid, the axial substance is brightly birefringent when viewed with crossed Nicols or crossed

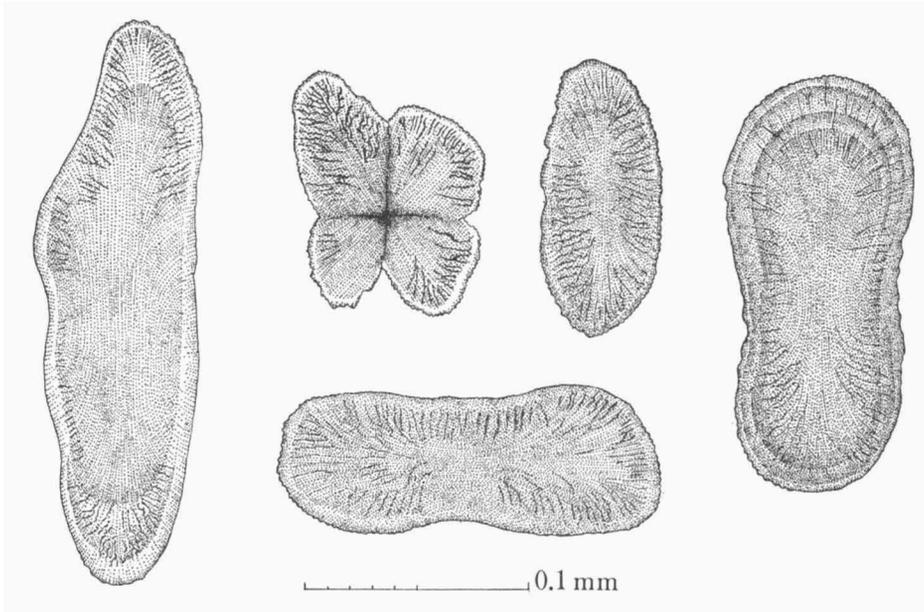


Fig. 10. Sclerites of *Xenogorgia sciurus* spec. nov.

polarizing filters. A narrow structural core is visible in the terminal parts of the axis, but it is neither hollow nor cross-chambered.

Holotype. — USNM 54424.

Paratypes. — RMNH Coel. Coll. 11056; British Museum (Nat. Hist.), London; University of Cape Town, Rondebosch, South Africa.

Etymology. — From Greek, σκίουρος, squirrel, in allusion to the brush-like colonial form.

Comparisons. — Although the colonies of *Xenogorgia sciurus* are tall, cylindrical and branched all around, they bear a closer superficial resemblance to some primnoids such as *Thouarella* than to *Chrysogorgia* because the branches arise from the main stems in an irregular manner rather than in a regular spiral sequence. The subdivision of the secondary branches is similarly irregular, not stiffly dichotomous as in *Chrysogorgia*. The polyps are

not regularly distributed on the internodes of the branches but are irregularly scattered on all sides, sometimes closely placed, sometimes more distant.

The species of *Chrysogorgia* having the closest gross similarity to *X. sciurus* is *C. agassizii* (Verrill) from deep water off Georges Bank in the western North Atlantic. However, in that species the colonies are more delicate, the branches arise in a regular 2/5 spiral to the right and are subdivided in a dichotomous manner, and the polyps contain spindles as well as flat scales.

SUMMARY

A new chrysogorgiid genus, *Stephanogorgia*, characterized by delicate pinnate branching in one plane, is established for a new species, *S. wainwrighti*, collected in shallow water in the Fiji Islands. A second new species, *S. diomedea*, taken by oyster dredge by the steamer Albatross in the Sulu Sea, is also assigned to the new genus. It is shown that the branching of *Trichogorgia faulkneri* Bayer, recently described from the Palau Islands, is not like that of *Trichogorgia* but is very similar to that of *Stephanogorgia*, so the species is transferred to that genus with the new combination *Stephanogorgia faulkneri* (Bayer).

S. wainwrighti differs from *S. faulkneri* in having shorter terminal branchlets and larger and more numerous scales in the polyps. Both species were found to be infested with ophiuroids of the genus *Ophiothela*.

S. diomedea is distinct from both *S. wainwrighti* and *S. faulkneri* in having a larger main axis, longer terminal branchlets, and polyps with fewer and smaller sclerites.

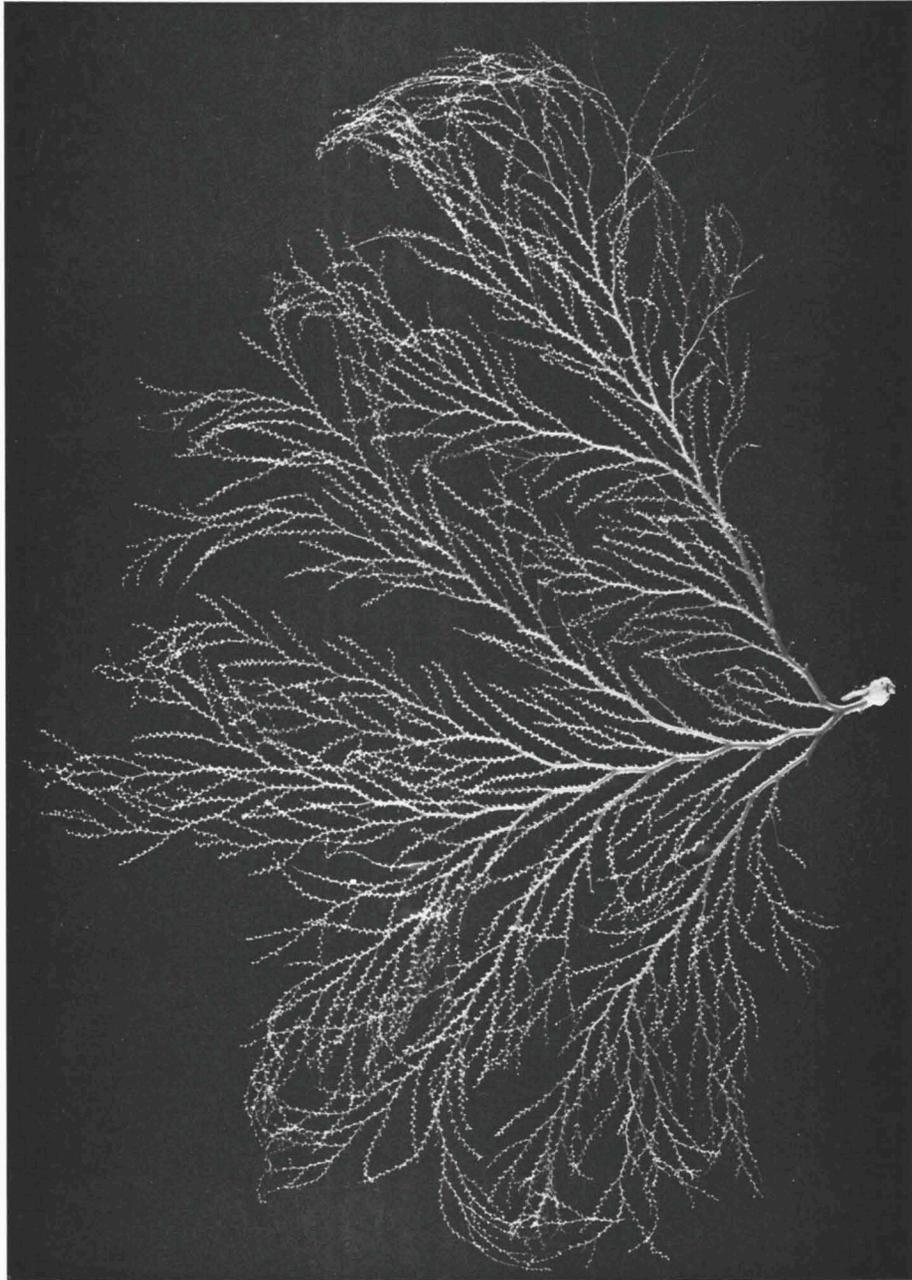
Specimens trawled by R/V Pillsbury and collected by diving by Drs. Charles Birkeland and David Meyer in the southwestern part of the Caribbean Sea have the branching characteristic of *Trichogorgia* Hickson and *Malacogorgia* Hickson, originally reported from South Africa, and show clearly that the Pacific specimens assigned to *Trichogorgia* cannot belong to that genus, as mentioned above. They lack calcareous sclerites in the coenenchyme and polyps, but have calcareous deposits in the axis, hence are intermediate between *Trichogorgia flexilis* Hickson and *Malacogorgia capensis* Hickson. They support the argument of Kükenthal (1919) that *Malacogorgia* should be treated as a synonym of *Trichogorgia*. The Caribbean specimens are described as a new species, *Trichogorgia lyra*, characterized by widely spaced, biserial polyps not crowded all around the tips of the terminal branches.

Some strange, bottle-brush shaped colonies from South Africa with aspect similar to that of certain species of the primnoid genus *Thouarella*, prove to have typical chrysogorgiid sclerites. The main branching occurs all around

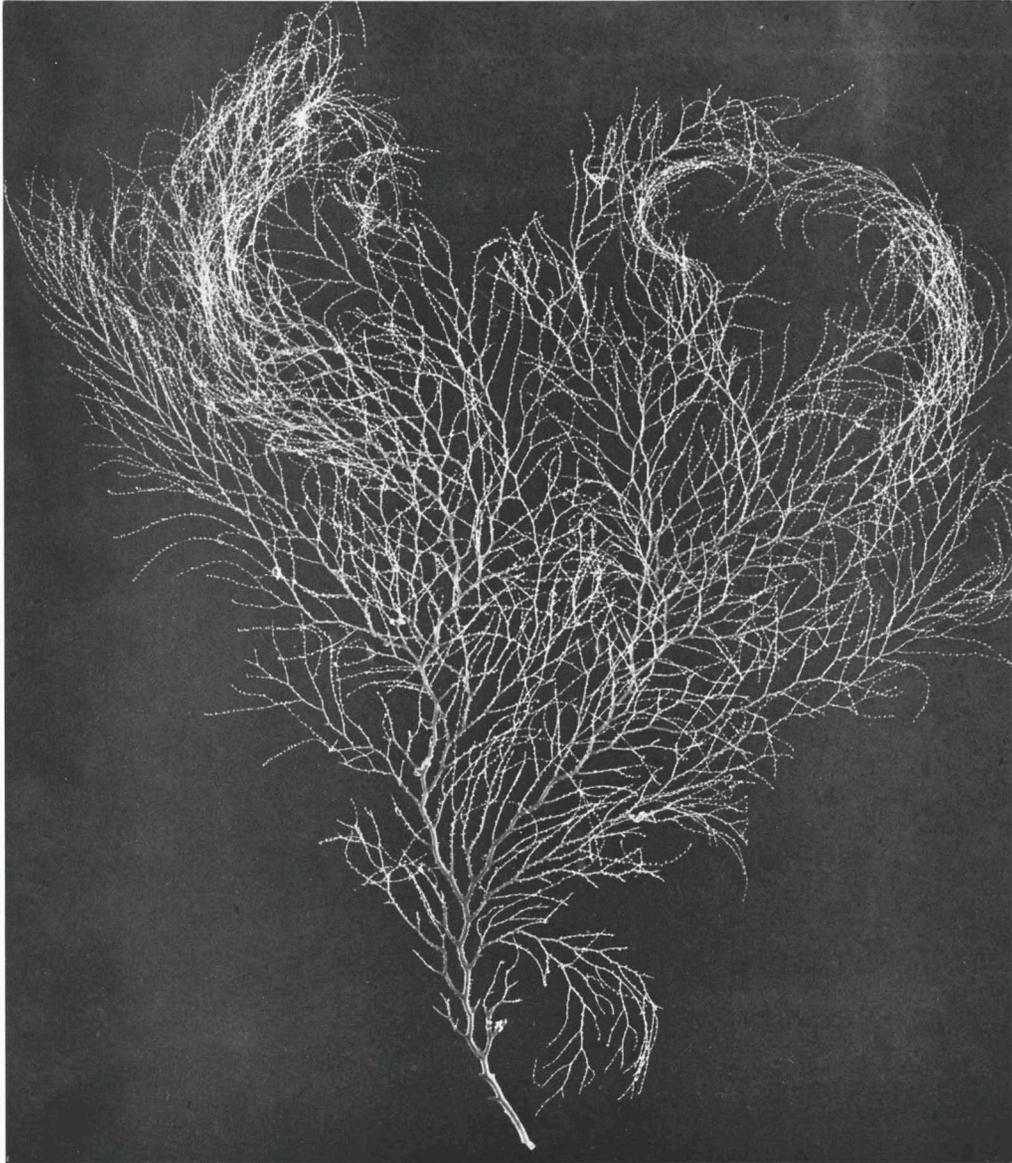
the primary axis and does not arise in an orderly spiral sequence as in *Chrysogorgia*. The secondary branching occurs laterally from the branches and does not follow the usual dichotomous pattern found in *Chrysogorgia*. The polyps are tall and much more closely placed than in *Chrysogorgia*. The axis is smooth, translucent yellowish in the distal parts, becoming progressively darker and opaque in the proximal parts, without metallic reflections or iridescence. The axis is calcified in the larger parts but in the terminal branchlets is weakly calcified if at all. The basal holdfast is small, like the axis in substance, spread on solid objects and marginally calcified. The specimens are assigned to a new genus, *Xenogorgia*, and the type-species is called *X. sciurus*.

REFERENCES

- BAYER, Frederick M., 1956. Octocorallia. In MOORE, R. C. (Ed.), Treatise on invertebrate paleontology, F. Coelenterata: 166-231, figs. 134-162. (Geol. Soc. America and Univ. Kansas Press).
- , 1974. A new species of *Trichogorgia* and records of two other octocorals new to the Palau Islands. — *Micronesica*, 10 (2): 257-271, figs. 1-3, pls. 1-3.
- DEICHMANN, Elisabeth, 1936. The Alcyonaria of the western part of the Atlantic Ocean. — *Mem. Mus. Comp. Zool. Harvard*, 53: 1-317, pls. 1-37.
- HICKSON, Sydney J., 1904. The Alcyonaria of the Cape of Good Hope. Part II. — *Marine Invest. S. Africa*, 3: 211-239, pls. 7-9.
- HILES, Isa L., 1899. The Gorgonacea collected by Dr Willey. Zoological Results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere, collected during the years 1895, 1896 and 1897, by Arthur Willey, part II: 195-206, pls. 22-23. (Cambridge University Press).
- KÜKENHAL, Willy, 1919. Gorgonaria. — *Wiss. Ergebn. deutschen Tiefsee Exped.*, 13 (2): 1-946, text figs. 1-319, pls. 30-89.
- , 1924. Gorgonaria. — *Das Tierreich*, 47: i-xxviii, 1-478, text figs. 1-209.
- VERRILL, Addison E., 1883. Report on the Anthozoa, and on some additional species dredged by the "Blake" in 1877-1879, and by the U. S. Fish Commission Steamer "Fish Hawk" in 1880-1882. — *Bull. Mus. Comp. Zool. Harvard*, 11 (1): 1-72, pls. 1-8.
- VERSLUYS, J., 1902. Die Gorgoniden der Siboga Expedition. I. Die Chrysogorgiidae. — *Siboga-Exped. Monogr.*, 13: 1-120, text figs. 1-168.
- WRIGHT, E. P. & TH. STUDER, 1889. Report on the Alcyonaria collected by H. M. S. Challenger during the years 1873-1876. — *Challenger Exped., Zool.*, 31 (64): i-lxxii, 1-314, pls. 1-43.



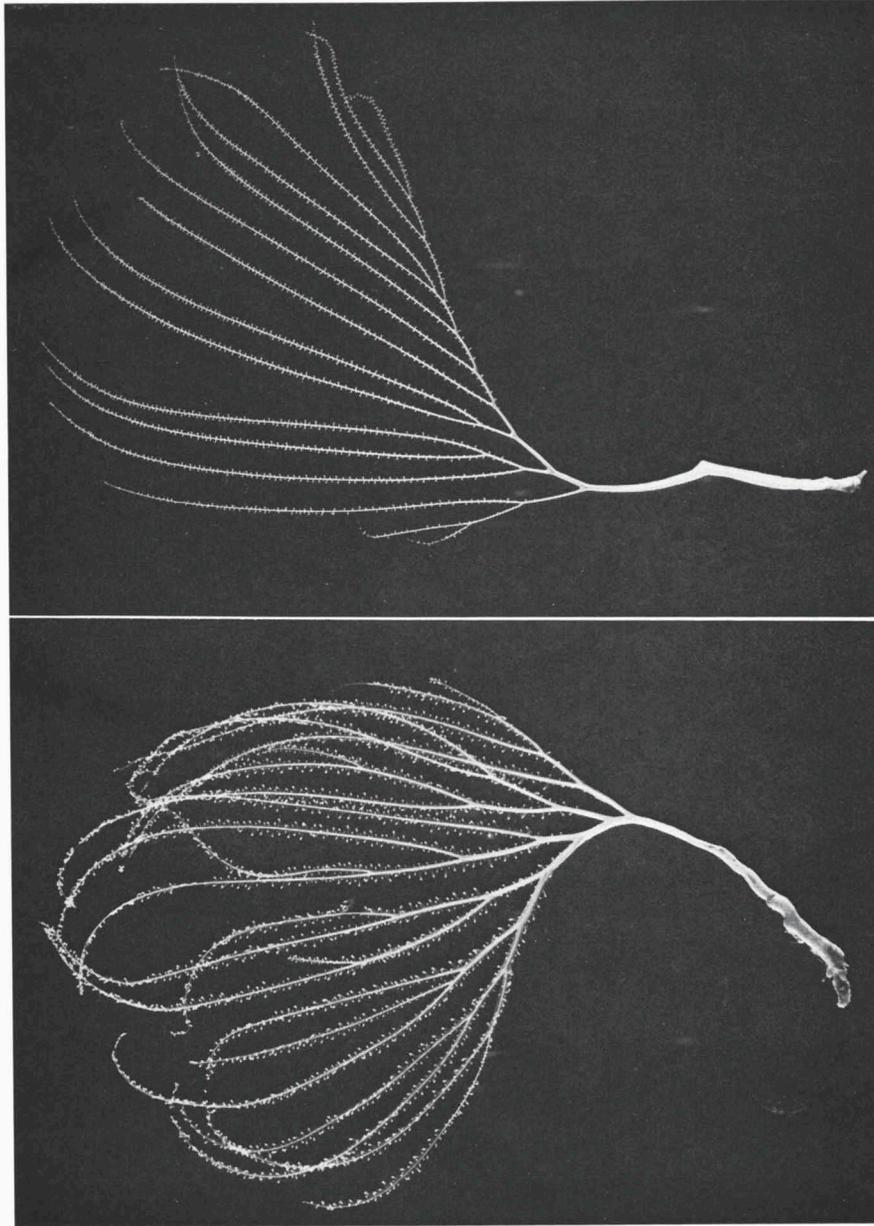
Stephanogorgia wainwrighti spec. nov. holotype, X 3/4.



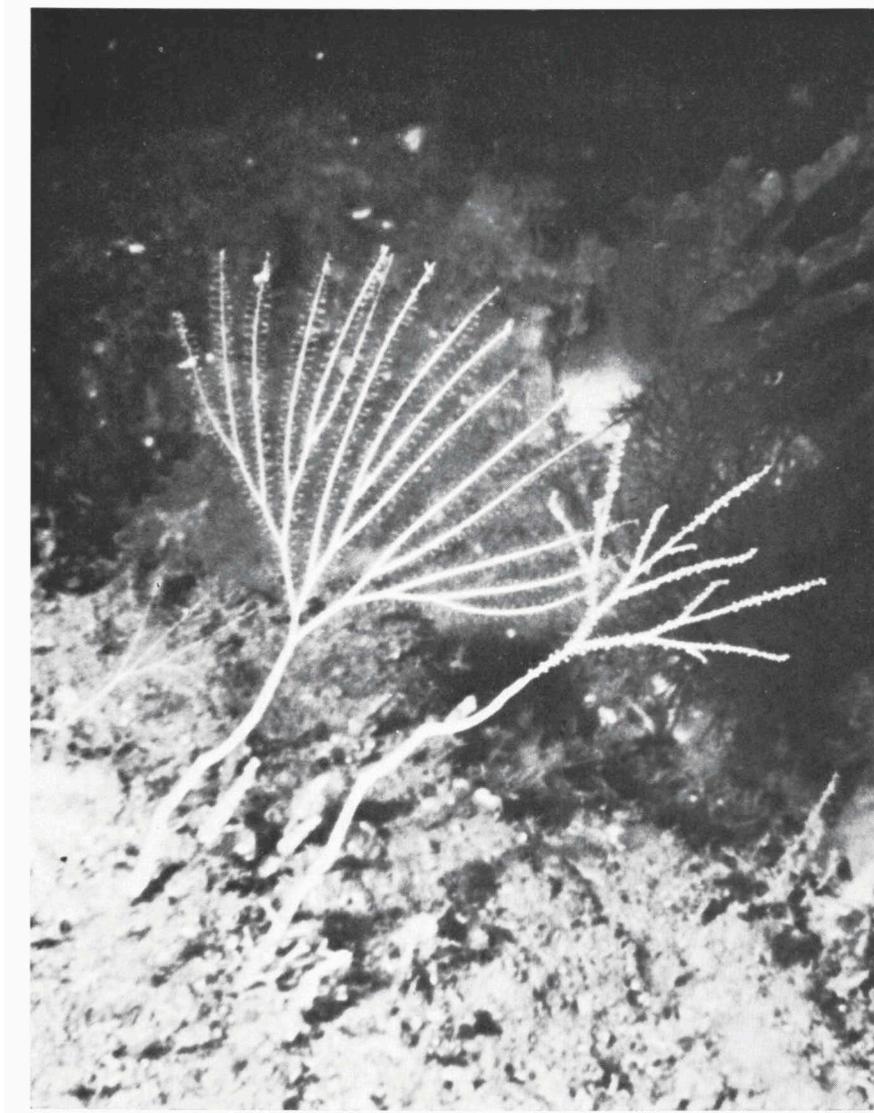
Stephanogorgia faulkneri (Bayer), paratype, $\times 3/4$.



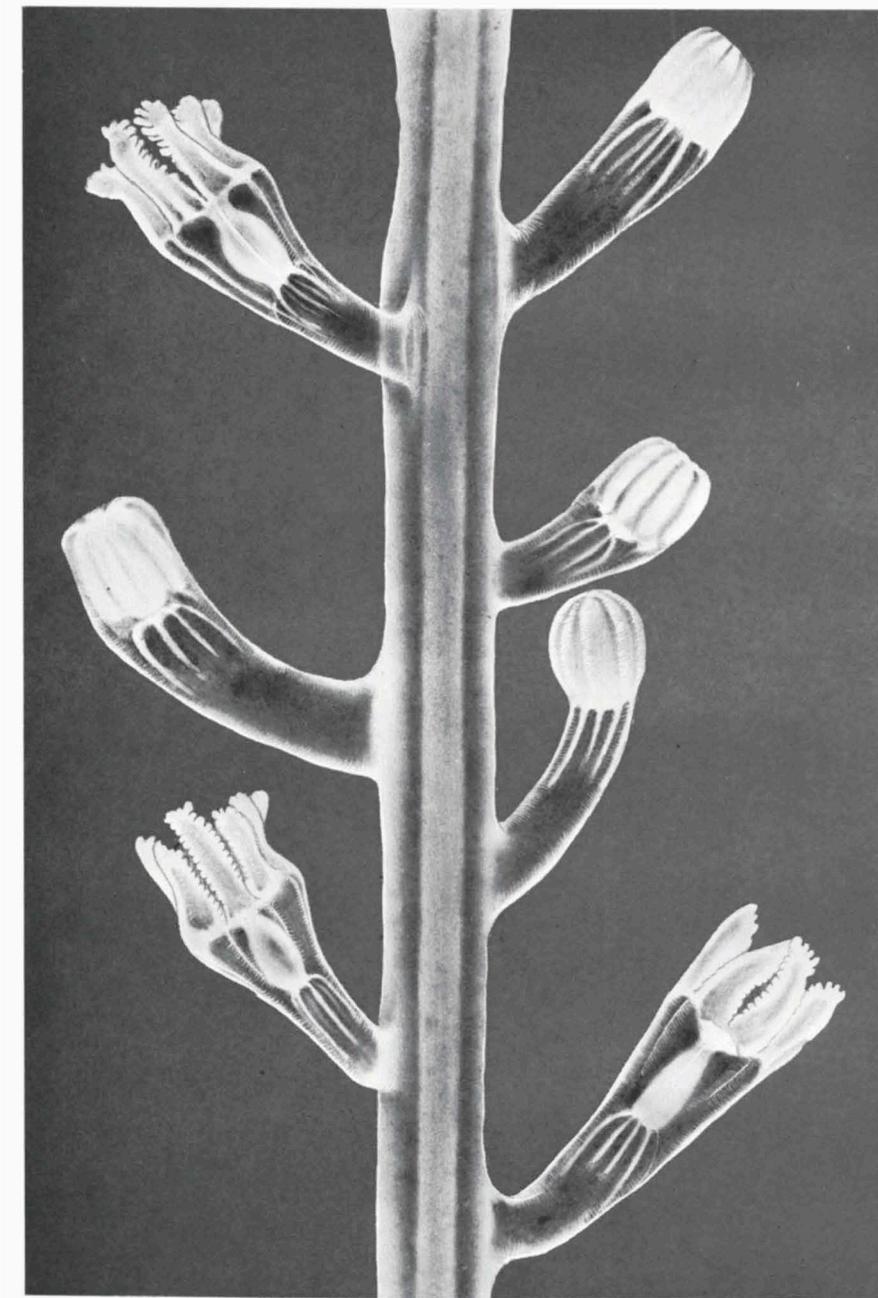
Stephanogorgia diomedea spec. nov., branches of holotype, X c.8.



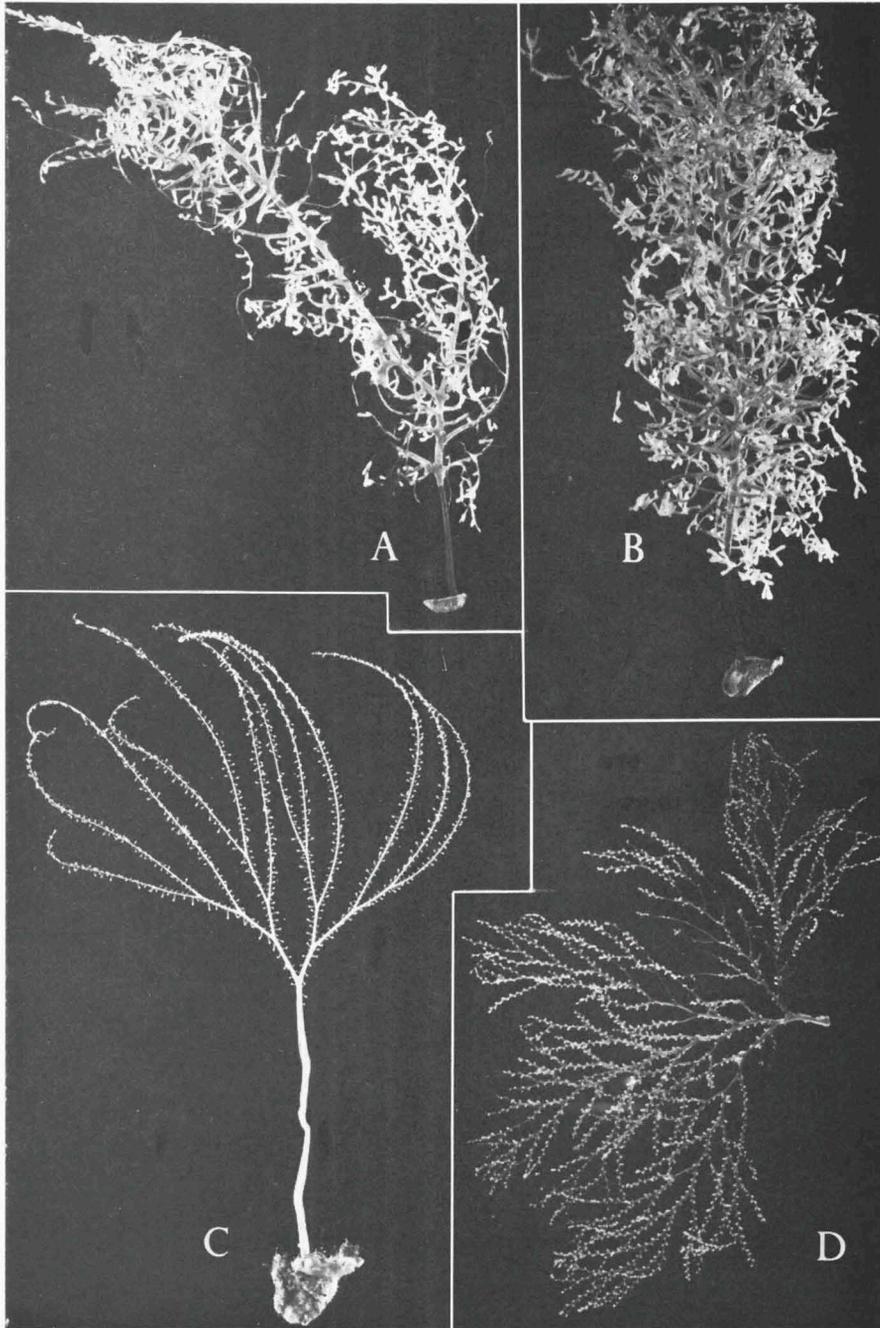
Trichogorgia lyra spec. nov. holotype (left) and paratype (right), $\times 3/4$.



Trichogorgia lyra spec. nov., paratype colonies photographed in situ at Salmedina Reef, off Portobelo, Panamá, by Charles Birkeland.



Trichogorgia lyra spec. nov., polyps of preserved specimen, $\times 35$.



Xenogorgia sciurus spec. nov., A, paratype, $\times 1-1/8$; B, holotype, $\times 1-1/8$.
Trichogorgia lyra spec. nov., C, paratype, $\times 3/4$.
Stephanogorgia wainwrighti spec. nov., D, paratype, $\times 1-1/8$.