Revision of the Antipatharia (Cnidaria: Anthozoa). Part IV. Establishment of a new family, Aphanipathidae

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A new family of antipatharian corals, Aphanipathidae (Cnidaria: Anthozoa: Antipatharia), is established for *Aphanipathes sarothamnoides* Brook and related species. The family is characterized by tall, conical, acicular or cylindrical spines, which are usually covered to some degree with small tubercles (smooth spines occur in some species), and by polyps that are 0.5-1.3 mm in transverse diameter and have small, subequal tentacles. The family is divided into two subfamilies based on differences in the development of the polypar spines. In the Aphanipathinae the polypar spines are subequal. Genera are recognized on the basis of morphological features of the corallum. *Aphanipathes* Brook (type species *A. sarothamnoides* Brook) has a sparsely to densely branched corallum with straight, usually ascending, branchlets. *Phanopathes* gen. nov. (type species *Antipathes expansa* Opresko & Cairns) forms fan-shaped colonies with irregularly bilateral branchlets. *Pteridopathes* gen. nov. (type species *P. pinnata* spec. nov.) has mostly simple pinnules (sometimes with randomly occurring simple secondary pinnules) arranged in two rows. *Tetrapathes* gen. nov. (type species *Aphanipathes alata* Brook) has simple pinnules arranged in four rows, and *Asteriopathes* gen. nov. (type species *A. arachniformis* spec. nov.) has simple pinnules arranged in six or more rows. In the Acanthopathinae the polypar spines are anisomorphic, with the circumpolypar spines larger than the interpolypar spines and the hypostomal spines usually reduced or absent. As in the Aphanipathinae, genera are recognized on the basis of morphological features of the corallum. *Acanthopathes* gen. nov. (type species *Antipathes humilis* Pourtalès) forms candelabra and flabellate colonies and has reduced hypostomal spines. *Rhipidopathes* Milne Edwards & Haime (type species *Antipathes reticulata* Esper), forms flabellate colonies and has hypostomal spines that are not always reduced in size. *Distichopathes* gen. nov. (type species *D. disticha* spec. nov.) has simple, straight pinnules arranged primarily in two rows, and *Elatopathes* gen. nov. (type species *Antipathes abietina* Pourtalès) has simple pinnules arranged in four or more rows.

Introduction

This is the fourth in a series of publications in which the order Antipatharia is being revised. In the first part the family Myriopathidae was established for *Antipathes myriophylla* Pallas, 1766, and related species (Opresko, 2001). In the second part, the family Schizopathidae was revised and four new genera were established (Opresko, 2002). In the third part, the family Cladopathidae was revised and three new genera were recognized (Opresko, 2003). In this paper species related to *Aphanipathes sarothamnoides* Brook, 1889, are placed in a new family, the Aphanipathidae. The family is comprised of two subfamiles, one with five genera and the other with four genera.

This work is based on the examination of type material, as well as on the study of newly collected specimens from locations in both the Atlantic and Indo-Pacific. A major conclusion resulting from these studies is that many of the species previously assigned to *Aphanipathes* by Brook (1889) and others can be segregated by skeletal characteristics into a number of generic-level taxa. Consequently, these genera require differentiation from the Antipathidae by the establishment of a new family, the Aphanipathidae.

Holotypes of the new species are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM). Schizoholotypes of some of the species have also been deposited at the National Museum of Natural History, Leiden, The Netherlands.

Abbreviations

BMNH = British Museum of Natural History, London, United Kingdom
MCZ = Museum of Comparative Zoology, Cambridge, MA, USA
RMNH = National Museum of Natural History, Leiden, The Netherlands
SMF = Senckenberg Museum, Frankfurt, Germany
UMML = Rosentiel School of Marine and Atmospheric Science (RSMAS), University of Miami, Miami, FL, USA
USNM = National Museum of Natural History, Smithsonian Institution, Washington, DC, USA

Taxonomic treatment

Aphanipathidae fam. nov.

Diagnosis.— Polyps subequal or slightly elongated in either the transverse or sagittal axis; mostly 0.7-1.3 mm in transverse diameter. Tentacles of polyps short, blunt, subequal; maximum length generally less than the transverse diameter of the polyp. Spines conical to acicular to cylindrical; acute or blunt; usually with conical tubercles on surface, sometimes smooth; maximum height of polypar spines usually more than two times width at base; polypar spines distinctly larger than abpolypar spines; polypar spines either subequal, or with circumpolypar spines slightly to significantly taller than other polypar spines; hypostomal spines similar in size to circumpolypar spines, greatly reduced, or absent. Corallum irregularly bushy or flabellate. Stem and branches simple or pinnulate. Pinnules, when present, usually without subpinnules (rarely with randomly occurring simple secondary pinnules).

Remarks.— This family is based on the genus *Aphanipathes* which was established by Brook (1889) for species having small, inconspicuous polyps "often obscured by the elongate spines which project through the peristome of many species, in spirit specimens" (Brook, 1889: 121). It is the feature of the spines projecting through the soft tissue that was used as the diagnostic character of *Aphanipathes* in the past. In defining the new family Aphanipathidae, it is the morphology of the polyps and the relative size and shape of the spines that are considered the characteristic features of the family. Based on descriptions given in the literature and on observations made on preserved

and living material (see fig. 1c), the polyps in the Aphanipathidae appear to have tentacles that are shorter, blunter, and more uniform in size than those in the Antipathidae, *sensu stricto*. In this regard they resemble polyps of the Myriopathidae (see Opresko, 2001). Further observations on living material are needed to verify this supposition. In the Aphanipathidae, the spines are conical to cylindrical, usually covered with small conical tubercles to some degree (smooth in some species); however, they are not notched, bifurcated or multiply lobed at the apex as they are in many species in the Antipathidae.

Not included here in the family Aphanipathidae are several species of *Stichopathes* [e.g., *S. spiessi* Opresko & Genin, 1990, and *S. paucispina* (Brook, 1889)], and species of *Allopathes* Opresko & Cairns, 1994, which have tuberculate spines that are superficially similar to those found in the Aphanipathidae. There is some evidence, although based on preserved material, that the polyps of these species have unequal tentacles, with the sagittal tentacles longer than the lateral tentacles. This condition is more typical of the Antipathidae.

Also excluded from the Aphanipathidae are species of *Stichopathes* (e.g., *S. lutkeni Brook*, 1889) and *Antipathes* (e.g., *A. caribbeana* Opresko, 1996) which have very papillose spines. Although the papillae on these spines can somewhat resemble tubercles (see Opresko, 1996), they are generally more numerous and more irregular in shape than those in Aphanipathidae. Finely papillose spines are not uncommon in some species of *Antipathes*. In addition, based on the photographs of living colonies, the polyps of these species tend to have elongate sagittal tentacles and are therefore more similar to those of the Antipathidae than the Aphanipathidae.

As defined here, the family Aphanipathidae is divided into two subfamilies, the Aphanipathinae and the Acanthopathinae, based on the relative development of the polypar spines.

Aphanipathinae subfam. nov.

Diagnosis.— Polyps subequal or slightly elongated in either the transverse or sagittal axis; mostly 0.7-1.3 mm in transverse diameter. Tentacles of polyps short, blunt, subequal; maximum length generally less than the transverse diameter of the polyp. Spines conical to acicular, usually acute; usually with conical tubercles on surface; maximum height more than two times width at base; polypar spines distinctly larger than abpolypar spines; polypar spines subequal, or rarely with some slightly taller than others. Corallum irregularly bushy or flabellate. Stem and branches simple or pinnulate. Pinnules, when present, usually simple; rarely with randomly and sporadically occurring simple secondary pinnules.

Remarks.— This subfamily is based primarily on the features of the polypar spines being nearly equal in size and the hypostomal spines never reduced in size. The family consists of five genera defined by the mode of branching of the corallum.

Key to the Genera of Aphanipathinae

1. Corallum pinnulate, pinnules usually simple, arranged in two or more rows 2
- Corallum flabellate or bushy, not pinnulate 4

2. Corallum usually with two rows of simple pinnules; rarely with randomly occurring simple secondary pinnules ..... ***Pteridopathes*** gen. nov.
- Corallum with more than two rows of pinnules 3
3. Corallum with four rows of simple pinnules ..... ***Tetrapathes*** gen. nov.
- Corallum with six to ten rows of pinnules ..... ***Asteriopathes*** gen. nov.
4. Corallum sparsely or densely branched, with straight, ascending, often uniserial branches ..... ***Aphanipathes*** Brook
- Corallum flabellate, with straight or curved, irregularly bilateral branchlets ..... ***Phanopathes*** gen. nov.

Aphanipathes Brook, 1889
(figs 1a-c)

Aphanipathes Brook, 1889:121; Roule, 1905:38; Cooper, 1903:796; 1909: 311; Silberfeld, 1909: 9; Pax, 1918: 470 (all in part).
Antipathes; van Pesch, 1914: 85 (in part, as subgenus *Aphanipathes*).

Type species.— *Aphanipathes sarothamnoides* Brook, 1889. Although Brook did not specificially designate *A. sarothamnoides* as the type of his genus *Aphanipathes*, he indicated (1889: 75) that whenever possible he selected as type species those whose type specimens possessed polyps which he was able to examine histologically. *A. sarothamnoides* is the only species of *Aphanipathes* for which he gives a description of the internal anatomy and histology of the polyps; therefore, by default this species is considered the type species of the genus.

Diagnosis.— Corallum bushy, sometimes broom-like, sparsely to densely branched; with short to long, usually straight, ascending branches.

Type material.— Holotype: BMNH 1890.4.9.5. Locality: New Hebrides, off Api, 16º45'S, 168º7'E, 18.viii.1874, 63-130 fm, HMS "Challenger" Sta. 177.

Description of the holotype.— The type specimen of *A. sarothamnoides* was described in detail by Brook. A brief summary of that description is given here.

Corallum bushy, the mode of branching resembling that "of a spray of broom." Branchlets and branchlets largely uniserial and forming narrow distal branch angles (fig. 1a); branchlets 1.5-2.5 cm apart and 5-10 cm long.

The spines (fig. 1b) are "subcylindrical, with a blunt apex and a broad compressed base extending longitudinally ... Each spine bears a number of short blunt processes on its distal half ... The spines are bent upwards from the base". Brook (1889) does not describe the size of the spines; however, based on the illustration in the "Challenger" Report the spines were estimated to be about 0.20 mm tall, and this size was verified on a sample of the type (fig. 1b).

The polyps were reported by Brook to appear as small rounded or oral prominences on the sclerenchyme and confined to one aspect of the corallum. The diameter of individual polyps was not stated, but based on the illustration given, they occur in a single row, measure about 1.3 mm in transverse diameter and are crowded together with about six per centimeter.

Remarks.— As established by Brook (1889), the genus *Aphanipathes* contained a diverse assemblage of species which had only a single feature in common, very tall

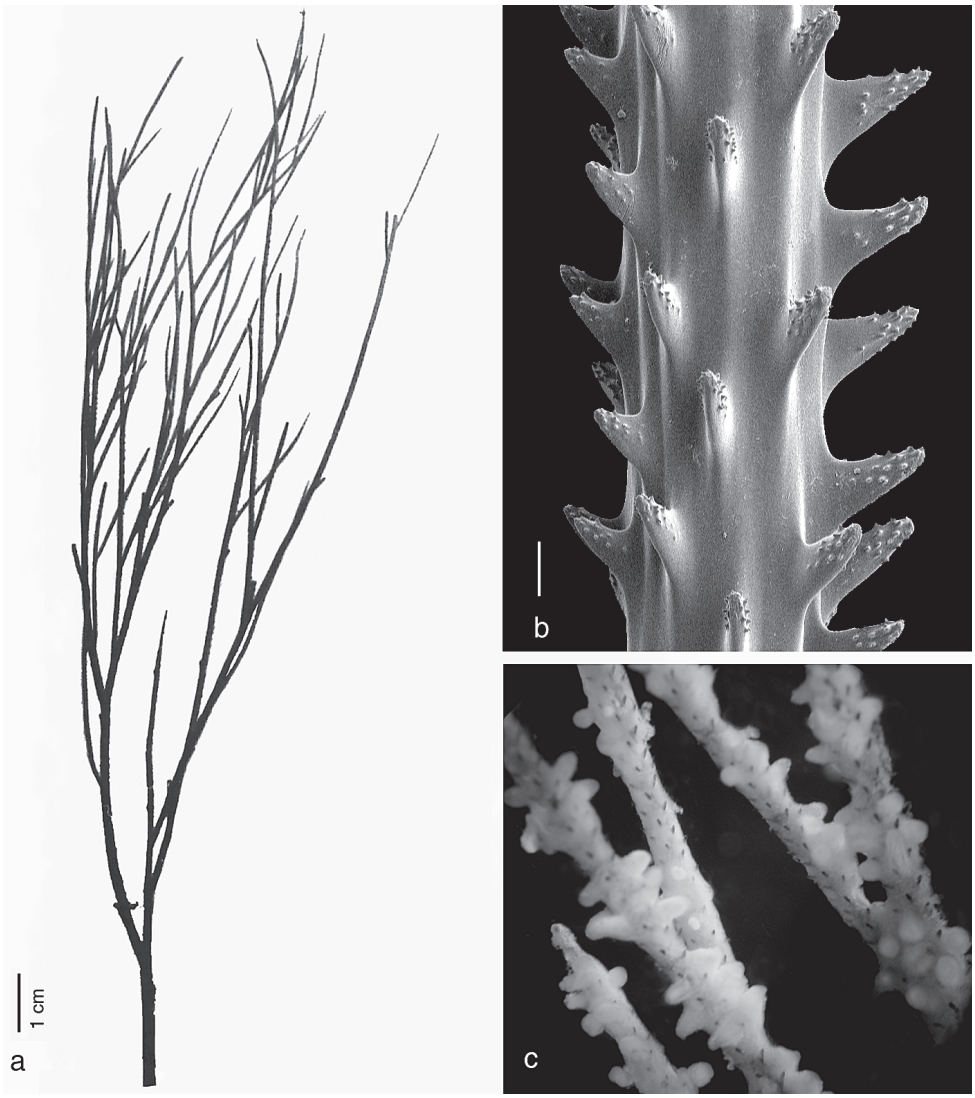

Fig. 1. *Aphanipathes* spp. a-b, *A. sarothamnoides* Brook; a, part of holotype (BMNH 1890.4.9.5); b, spines of holotype, scale 0.1 mm; c, *A. pedata* (Gray), polyps (photo courtesy of P. Entoyer and NOAA, Office of Ocean Exploration).

spines that appeared to penetrate through surface of the polyps, or, if polyps were not present on the specimen, were assumed to be capable of doing so. Originally included in the genus were several species with very tall polypar spines [*A. barbadensis* Brook, 1889, *A. pennacea* (Pallas, 1766) and *A. wollastoni* (Gray, 1857)], which, on the basis of other skeletal characters, have been placed in the family Myriopathidae (see Opresko, 2001).

Van Pesch (1914) relegated *Aphanipathes* to the status of a subgenus of *Antipathes*,

but continued to include in this subgenus species with very different morphological features. As emended here, *Aphanipathes* is restricted to those species originally included in the genus that have an irregularly branched, bushy corallum, with relatively straight and usually elongated branches.

Species assigned to *Aphanipathes*.— Nominal species that can be assigned to *Aphanipathes*, as it is defined above, include the type species as well as *Antipathes salix* Pourtalès, 1880; *Aphanipathes verticillata* Brook, 1889; and *Antipathes pedata* Gray, 1857. All four species have a similar growth form although there are slight differences in the arrangement and density of the branches. In *A. salix*, the branches and branchlets tend not to be as uniserially arranged as they are in the other three species. There are also slight differences among these species in the morphology and arrangement of the spines. The spines of *A. salix* have only a small number of large tubercles near the apex, whereas the spines of *A. verticillata* are typically arranged in distinct verticils.

Distribution.— Species of this genus have been reported from the Atlantic (*A. pedata* and *A. salix*), south Pacific (*A. sarothamnoides*) and Indian Ocean (*A. verticillata*).

***Phanopathes* gen. nov.**

(figs 2a-c)

Aphanipathes Brook, 1889:121 (in part).

Antipathes; Opresko, 1972: 959 (in part); Opresko & Cairns, 1992: 93; van Pesch, 1914: 85 (in part, as subgenus *Aphanipathes*).

Type species.— *Antipathes expansa* Opresko & Cairns, 1992: 93-97.

Diagnosis.— Corallum flabellate; highest order branchlets irregularly bilateral, not uniform in size or arrangement.

Type material.— Holotype: USNM 88340 (schizoholotype RMNH Coel. 32363). Locality: Gulf of Mexico, off southeastern Louisiana, 27º44.62'N, 91º07.9'W, 05.ix.1989, 129-144 m, Johnson Sea Link I DSR/V, sta 2585.

Description of the holotype.— A detailed description of this species is given by Opresko & Cairns (1992). A brief summary of the description of the holotype is provided here.

Corallum (fig. 2a) flabellate, about 9.5 cm high and 13 cm wide. Branchlets short, 5-9 mm long, straight or curved distally, arranged bilaterally, but not uniformly on the branches.

Spines conical, with acute apex and with distinct conical tubercles on distal half of surface (fig. 2b). Polypar spines up to 0.23 mm tall; in places very slightly unequal in size; abpolypar spines 0.09-0.13 mm tall. Pinnular spines 0.28 mm apart, resulting in four or five spines per millimeter.

Polyps (fig. 2c) uniserially arranged on one side of the corallum, about 0.8 mm in transverse diameter, interpolypar space about 0.3-0.4 mm; with eight or nine polyps per centimeter.

Remarks.— Species of *Phanopathes* are recognizable by their flabellate growth form and subequal polypar spines covered with small tubercles.

Etymology.— From the Greek "phanos", light, and the commonly used suffix "pathes".

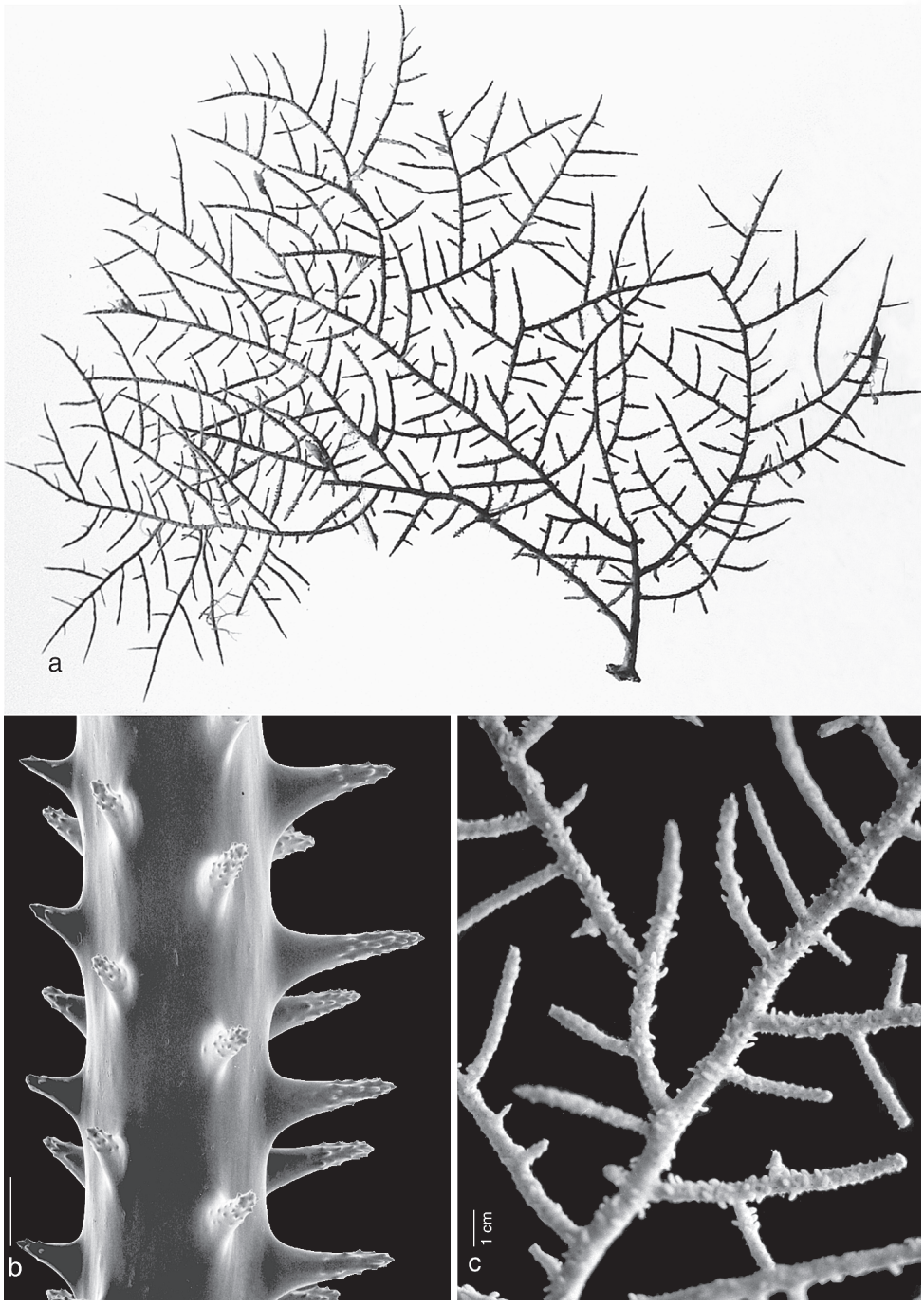

Fig. 2. *Phanopathes expansa* (Opresko & Cairns), holotype (USNM 88340); a, entire corallum, height ~9.5 cm; b, spines on branchlet, scale 0.1 mm; c, polyps.

Species assigned to *Phanopathes*.— In addition to the type species, two other species, *Aphanipathes cancellata* Brook, 1889, and *Antipathes rigida* Pourtalès, are assigned to the genus. Both species form flabellate colonies and in both the spines are distinctly tuberculate. In *P. cancellata* there is no clearly defined stem and the branchlets are extensively anastomosing, whereas in *P. expansa* and *P. rigida* there is a distinct stem and the branchlets are only occasionally fused. In addition, the polyps in *P. cancellata* are smaller (0.55-0.65 mm) than those in *P. expansa* (0.8 mm). In *P. rigida* the branchlets are more widely spaced and are longer than those in the other two species, and the polyps are up to 1.3 mm in transverse diameter (with six or seven polyps per centimeter).

Distribution.— *Phanopathes expansa* and *P. rigida* occur in the western Atlantic and *P. cancellata* is from the Indo-Pacific.

***Pteridopathes* gen. nov.**

(figs 3-5)

Type species.— *Pteridopathes pinnata* spec. nov.

Diagnosis.— Corallum sparsely branched; branches with usually simple pinnules (rarely with randomly occurring, simple secondary pinnules) arranged primarily in two lateral rows.

Type material.— Holotype: USNM 1007089. Locality: Palau.

Description of the holotype.— See below.

Remarks.— *Pteridopathes* is characterized by the pinnate arrangement of the pinnules and the subequal, tuberculate polypar spines.

Etymology.— From the Greek "pterido", a fern, in reference to the fern-like pinnate branching, and the commonly used suffix "pathes".

Species assigned to *Pteridopathes*.— In addition to the type species, one other species, *P. tanycrada* spec. nov., can be assigned to the genus. The two species are differentiated by the length of the pinnules, and by slight differences in the appearance of the spines (see below).

Distribution.— Species of this genus are known only from the Indo-Pacific.

Pteridopathes pinnata spec. nov.

(figs 3, 4a-c)

Material examined.— Holotype (USNM 1007089; schizoholotype RMNH Coel. 32364), Indo-Pacific, Palau, Koror, W. end of Uchelbeluu reef (south side), 07º17.39'N, 134º 31.23'E, 25.ii.2001, 120 m, coll. P. Colin, OCDN7086-M.

Diagnosis.— Colony sparsely branched, somewhat in one plane. Stem and branches pinnulate; pinnules simple, bilaterally and alternately arranged along the axis. Pinnules mostly 1-1.5 cm in length and 0.3-0.4 mm in diameter at base. Spines conical, with small conical tubercles on surface; up 0.13-0.17 mm tall on the polypar side of the axis. Polyps in a single row on one side of the branches; generally 0.7-0.8 mm in transverse diameter, with ten polyps per centimeter.

Description of the holotype.— The holotype consists of three pieces separated from a colony reported to be about 75 cm in height. The lowermost piece has a very

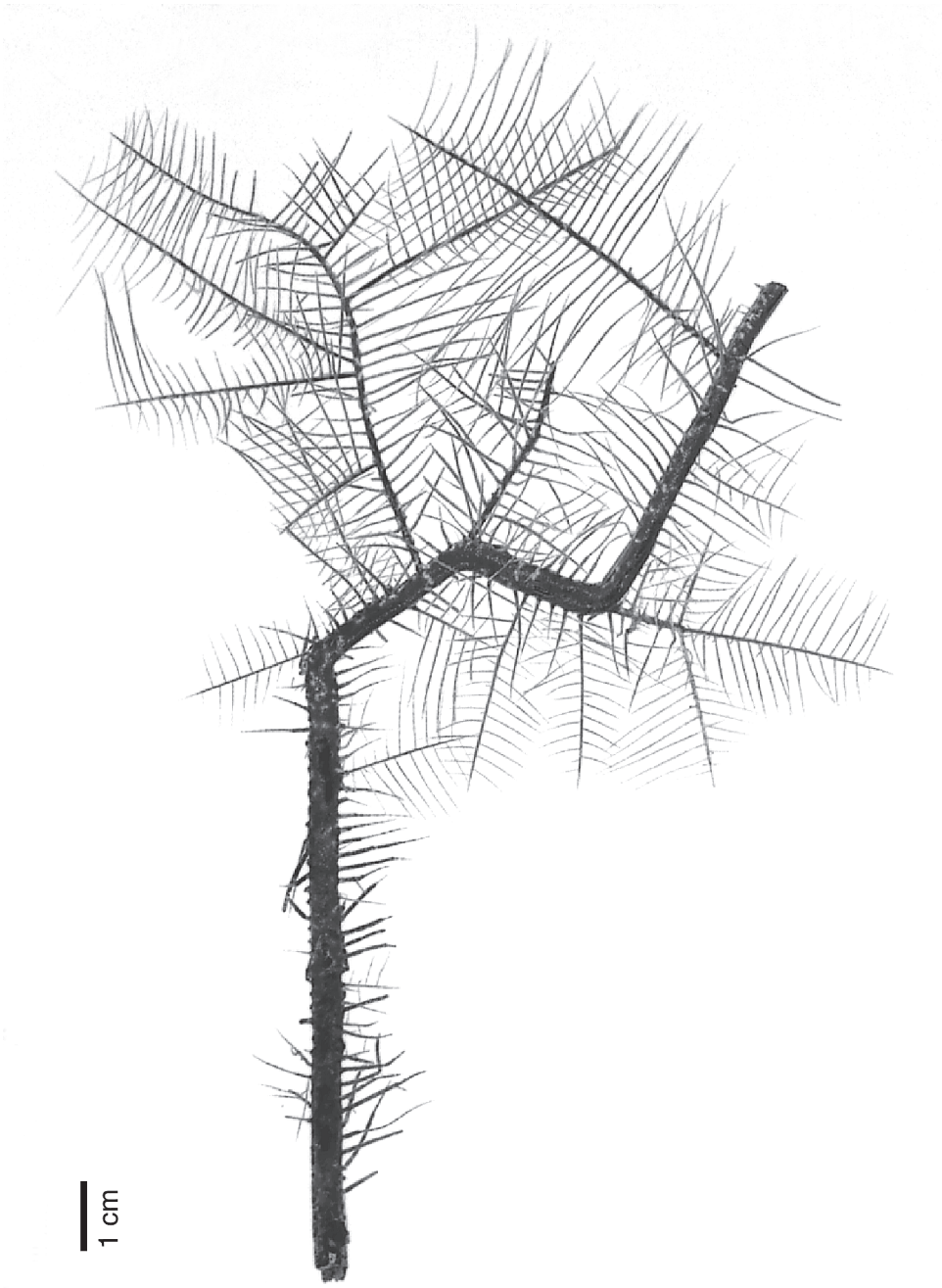

Fig. 3. *Pteridopathes pinnata* spec. nov., holotype (USNM 1007089), part of corallum.

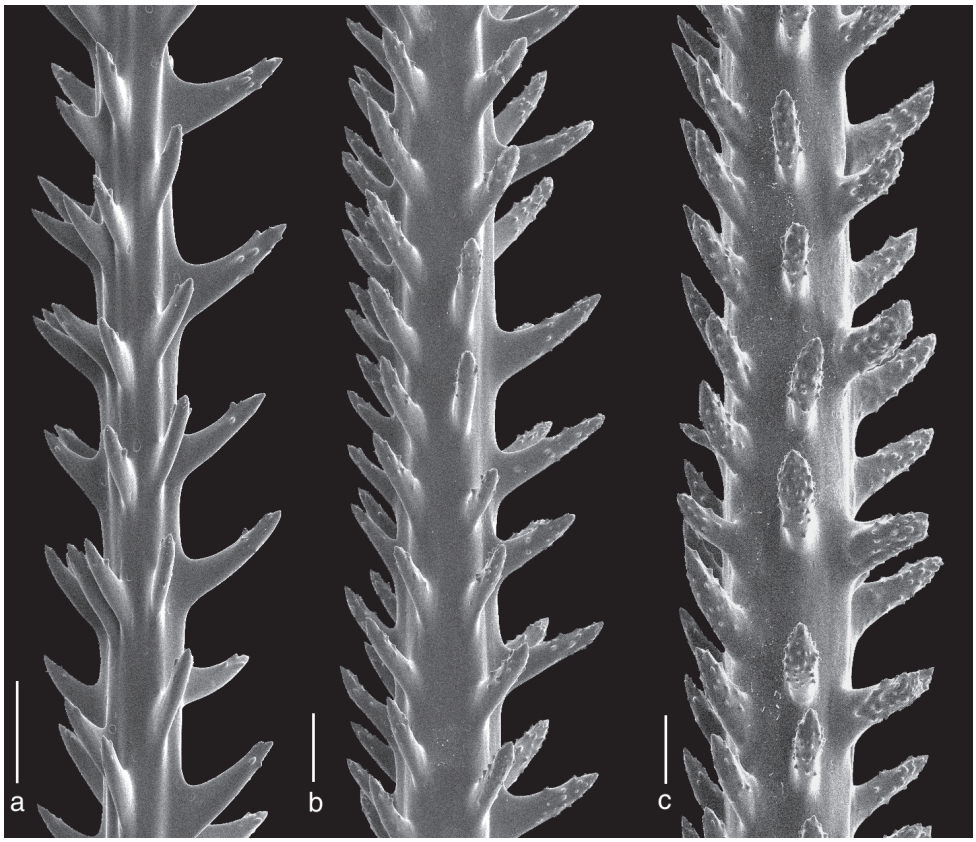

Fig. 4. *Pteridopathes pinnata* spec. nov., holotype (USNM 1007089); a-c, spines on pinnules, scale 0.1 mm.

large holdfast, with a stem diameter of 1 cm by 1.8 cm. The middle piece is shown in figure 3. The stem and larger branches are compressed laterally, with the pinnules originating not in the centre of the widest sides but offset to some degree. The pinnules are mostly 1 to 1.5 cm long, but some reach a maximum length of about 2.7 cm and a maximum diameter of about 0.5 mm (including spines). Adjacent pinnules in each lateral row are spaced about 2 mm apart, as measured from the centre of one pinnule to the centre of an adjacent one. There are five or six pinnules per centimeter on each side, and 11 pinnules per centimeter on both sides. In places a very short pinnule occurs randomly on one side of a branch (corresponding to the polyp-side of the corallum), in which case there may be up to 14 pinnules per centimeter. These "third row" pinnules are not more than about 0.5 cm in length. The distal angle that the pinnules form with the branchlets is mostly 80-90°.

The polypar spines appear somewhat acicular on the narrower parts of the pinnules (figs 4a-b); they are about 0.13 mm tall where the axis is about 0.08 mm in diameter, and have only a few small rounded tubercles. On the thicker parts of the pinnules (fig. 4c), they are more conical and blunt, up to 0.17 mm tall where the axis is 0.2

mm in diameter, and have larger and more numerous tubercles. In some cases the spines are somewhat hooked distally. The abpolypar spines are about 0.08 mm tall on the narrow sections of the pinnules, and up to 0.13 mm on the thicker sections. They are more distally inclined than the polypar spines. The spines are arranged in axial rows, four to five of which can be seen in one lateral view. The rows are closer together and the spines within each row are more crowded on the abpolypar side of the axis than on the polypar side; there are about five spines per millimeter on the polyp side, but up to nine per millimeter on the abpolypar sider. The spines on the stem are about 0.12 mm tall, and appear more acicular and more densely distributed than those on the pinnules.

The polyps are arranged in a single row on one side of the pinnules. The polyps are 0.7-0.8 mm in transverse diameter (from the distal side of distal lateral tentacles to the proximal side of proximal lateral tentacles) with an interpolypar space of 0.2 mm or less. There are about ten polyps per centimeter.

Comparisons.— In pinnulation pattern, *P. pinnata* is similar to *Pteridopathes tanycrada* spec. nov. (see below). Both species have two rows of lateral pinnules, however, in *P. pinnata* the pinnules are shorter (1-1.5 cm vs 4-6 cm) and the polyps are more crowded (ten per centimeter vs. seven to nine per centimeter).

Etymology.— From the Latin, "pinna", feather, in reference to the pinnate arrangement of the pinnules.

Distribution.— Known only from Palau.

Bathymetric range.— 120 m.

Pteridopathes tanycrada spec. nov.
(figs 5a-d)

Material examined.— Holotype (USNM 1007091; schizoholotype RMNH Coel. 32365), Palau, east side, Mutremdiu, 07º16.41'N, 134º31.43'E, 4.iii.2001, 105 m, coll. P. Colin, OCDN7838-F; paratype (USNM 1007095), Palau, Koror, W end of Uchelbeluu reef, 07º17.17'N, 134º31.56'E, 16.iii.2001, 99 m, coll. P. Colin, OCDN7871-P.

Diagnosis.— Colony monopodial or sparsely branched. Stem and branches pinnulate; pinnules usually simple, although rarely with randomly occurring simple secondary pinnules; primary pinnules alternately arranged in two rows. Pinnules mostly 4-6 cm in length and about 0.5 mm in diameter at base. Spines large, conical, with small conical tubercles on surface; usually 0.16-0.18 mm tall on the polyp side of axis. Polyps in a single row on one side of the corallum, generally 0.8-1.0 mm in transverse diameter, with seven to about nine polyps per centimeter.

Description of the holotype.— The holotype consists of one piece (fig. 5a) taken from a much larger colony. It is about 10 cm tall and 17 cm wide. The axis of the main branch has a diameter of about 4 by 6 mm. The entire colony was reported to be about 1 m tall with a basal stem diameter of 8 mm. On the type specimen the main branches are compressed laterally, with the two rows of pinnules originating not in the centre of the widest sides of the axis but closer to one end. The more developed pinnules are typically 4-6 cm long (maximum size about 7.5 cm) and they are about 0.5 mm in diameter near their base (including spines). They are inclined distally such that the distal angle that they form with the branch is about 75º. Adjacent pinnules in each

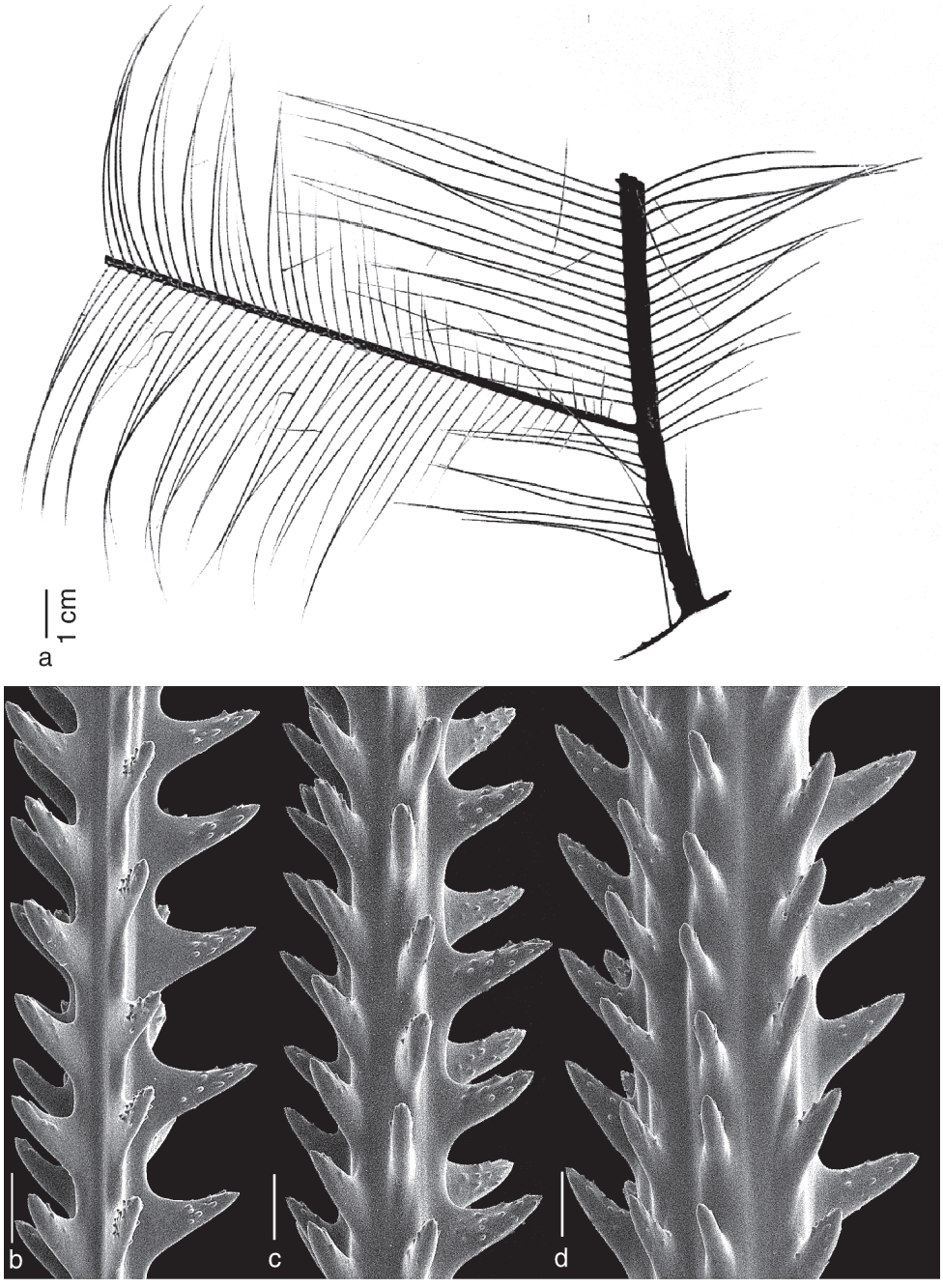

Fig. 5. *Pteridopathes tanycrada* spec. nov., holotype (USNM 1007091); a, corallum; b-d, spines on pinnules, scale 0.1 mm.

lateral row are spaced 2.5-3.0 mm apart. There are about four pinnules per centimeter on each side, and a total of seven or eight pinnules per centimeter for both sides. Occurring on several of the primary pinnules are isolated simple secondary pinnules. These are not uniform in size or location and almost appear to be incipient branches; however, they are not pinnulated themselves. Some occur near the base of the primary pinnules whereas others occur several centimeters distal from the base. The largest of these is about 2 cm in length.

The spines (figs 5b-d) on the pinnules are conical and have small tubercles on their surface. The polypar spines are mostly 0.16-0.20 mm from midpoint of base to apex, the abpolypar spines are 0.10-0.17 mm tall. The spines are arranged in axial rows, four or five of which are seen in one lateral view. The rows are closer together and the spines within each row are more crowded on the abpolypar side of the axis; on the polyp side there are five or six spines per millimeter, whereas on the abpoypar side there are six or seven spines per millimeter in each row. The spines on the main branch are about the same size as those on the pinnules, but are more acicular, more at right angles to the axis and more densely and irregularly distributed.

The polyps are arranged in a single row on one side of the pinnules. The polyps are 0.8-1.0 mm in transverse diameter (from distal side of distal lateral tentacles to proximal side of proximal lateral tentacles) with an interpolypar space of 0.2 to 0.3 mm. There are seven to almost nine polyps per centimeter. The diameter of the oral cone is 0.2-0.3 mm and the tentacles in the preserved material are not more than 0.3 mm in length.

Discussion.— The paratype (USNM 1007095) differs from the holotype in having slightly shorter (maximum length 6.5 cm) and more crowded pinnules (about 2 mm apart on one side), resulting in about nine per centimeter (total for both rows). This specimen was reported to be greater than 1 m in size and branched. Furthermore, the colour of the living polyps was reported to be milky orange to dark peach, whereas the colour of the holotype was reported to be gray.

Comparisons.— See discussion of *P. pinnata*, spec. nov.

Etymology.— From the Greek "tany", elongated, and "crada", twig, in reference to the elongated pinnules.

Distribution.— Known only from Palau.

Bathymetric range.— 99-105 m.

***Tetrapathes* gen. nov.**

(figs 6a-d)

Aphanipathes Brook, 1889: 121 (in part).

Type species.— *Aphanipathes*? *alata* Brook, 1889:126.

Diagnosis.— Corallum sparsely branched; branches with simple pinnules arranged, in varying degrees of regularity, in four rows, two lateral and two anterolateral.

Type material.— Schizoholotype: BMNH 1886.2.8.1 (a small fragment of the type specimen; the larger part of the specimen could not be located in the BMNH). Locality: Mauritius.

Description of the holotype.— The holotype was described by Brook (1889: 126) as

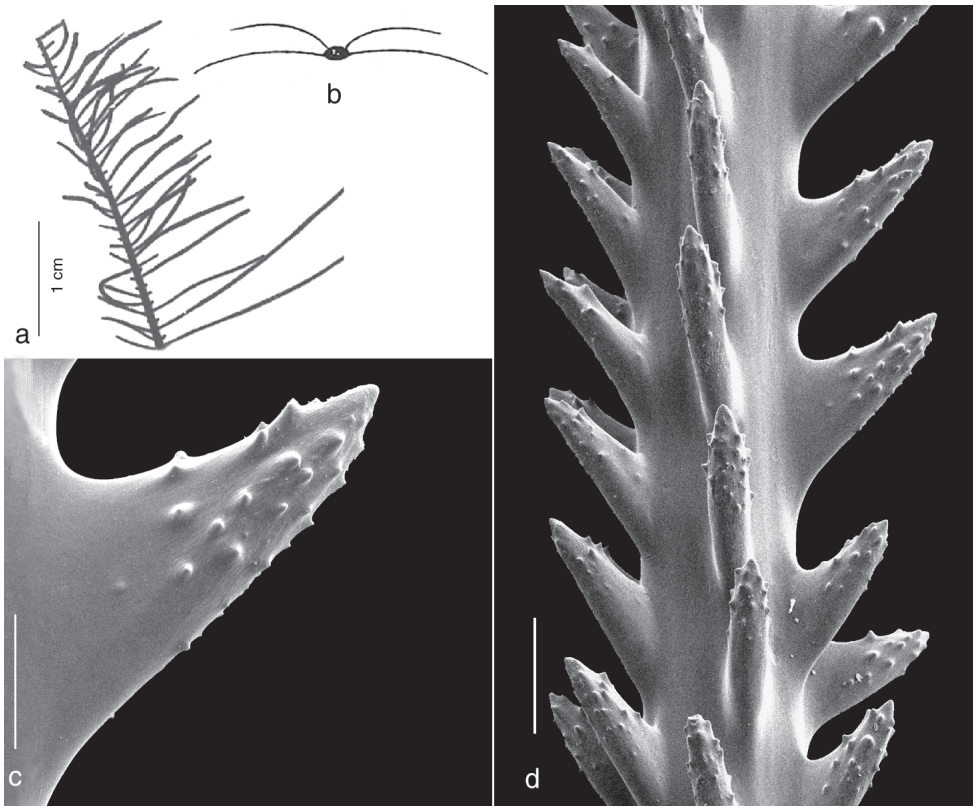

Fig. 6. *Tetrapathes alata* (Brook), holotype (BMNH 1886.2.8.1): a, fragment of the corallum; b, cross-sectional view of branchlet and pinnules, from Brook, 1889, text fig. 19; c, single pinnular spine, scale 0.05 mm; d, spines on pinnule, scale 0.1 mm.

being branched irregularly, with the main branches crowded and spreading, not in one plane. The corallum was reported to be 50 cm by 50 cm; with branches 14 to 23 cm long. The pinnules are simple, arranged in four rows, two lateral and two anterolateral (figs 6a-b). The lateral pinnules are about 3.5 cm long, the antero-lateral ones never over 2.5 cm, and usually shorter (and sometimes missing). There are about 12 pinnules per centimeter in each row.

The spines (figs 6c-d) are conical, acute, and covered with distinct conical tubercles on the distal part of their surface. The polypar spines are about 0.16 mm tall and the abpolypar spines about 0.13 mm; both are distally inclined. Three or four rows of spines are seen in lateral view, and there are five or six spines per millimeter in each row.

Polyps were not present on the holotype.

Remarks.— In terms of the number of rows of pinnules, *Tetrapathes* gen. nov. is intermediate between *Pteridopathes* gen. nov. which has two rows, and *Asteriopathes* gen. nov. (see below) which has six or more rows.

Species assigned to *Tetrapathes*.— No other nominal species can be assigned to this genus.

Ethymology.— Derived from the Greek "tetra", four, and the commonly used suffix "pathes", in reference to the four rows of pinnules.

Distribution.— Known only from the Indo-Pacific.

Asteriopathes gen. nov.
(figs 7-11)

Type species.— *Asteriopathes arachniformis* spec. nov.

Diagnosis.— Corallum sparsely branched; stem and branches with simple pinnules arranged in varying degrees of regularity in six or more rows, often arranged in a bilateral manner with an equal number on each side of the axis, and in alternating groups in which the members of each group arise at nearly the same level on the axis or are slightly offset such that they form semi-spiral groupings around part of the axis.

Type material.— Holotype: USNM 1007096. Locality: Palau.

Description of the holotype.— See below.

Remarks.— The genus *Asteriopathes* is related *Tetrapathes*, the only significant difference being the number of rows of pinnules.

Species assigned to *Asteriopathes*.— In addition to the type species, one other species, *A. colini* spec. nov., can be assigned to the genus.

Etymology.— From the Greek "asterio", star-like, and the commonly used suffix "pathes".

Distribution.— The two species assigned to this genus are known only from the Indo-Pacific.

Asteriopathes arachniformis spec. nov.
(figs 7, 8a-b, 9a-b)

Material examined.— Holotype (USNM 1007096; schizoholotype RMNH Coel. 32366), Indo-Pacific, Palau, Koror, E. of Malakal Harbor, W. of Augulepu reef, 7º17.242'N, 134º31.476'E, 26.ii.2001, 107 m, coll. P. Colin, CRCNI360; paratype (USNM 100121), New Caledonia, coll. Bruce; no other data, 1 specimen.

Diagnosis.— Colony sparsely branched and pinnulate; pinnules simple, arranged bilaterally and in alternating groups, each consisting of five or six pinnules. Pinnules generally 1-1.5 cm in length and 0.4-0.6 mm in diameter. Spines acute, acicular, with scattered tubercles on distal part of surface. Polypar spines on pinnules up to 0.22 mm tall. Polyps 0.7 to 1.1 mm in transverse diameter, with nine to 12 polyps per centimeter.

Description of the holotype.— The holotype (fig. 7) is a complete colony; the stem is 32 cm long and has a diameter of about 3 mm near the base. The corallum is sparsely branched with two long ascending branches arising from near the middle of the stem. The stem and branches are pinnulate with simple pinnules that are mostly about 1-1.5 cm long (maximum length about 1.7 cm) and about 0.4-0.6 mm in diameter at their point of insertion on the branch or stem. The pinnules (figs 8a-b) are arranged bilaterally and in alternating groups along the axis; usually with five or six pinnules in each group (range four to seven). Even at the tips of the branches there can be as many as five pinnules per group. The posterior-most pinnules in each group are usually the

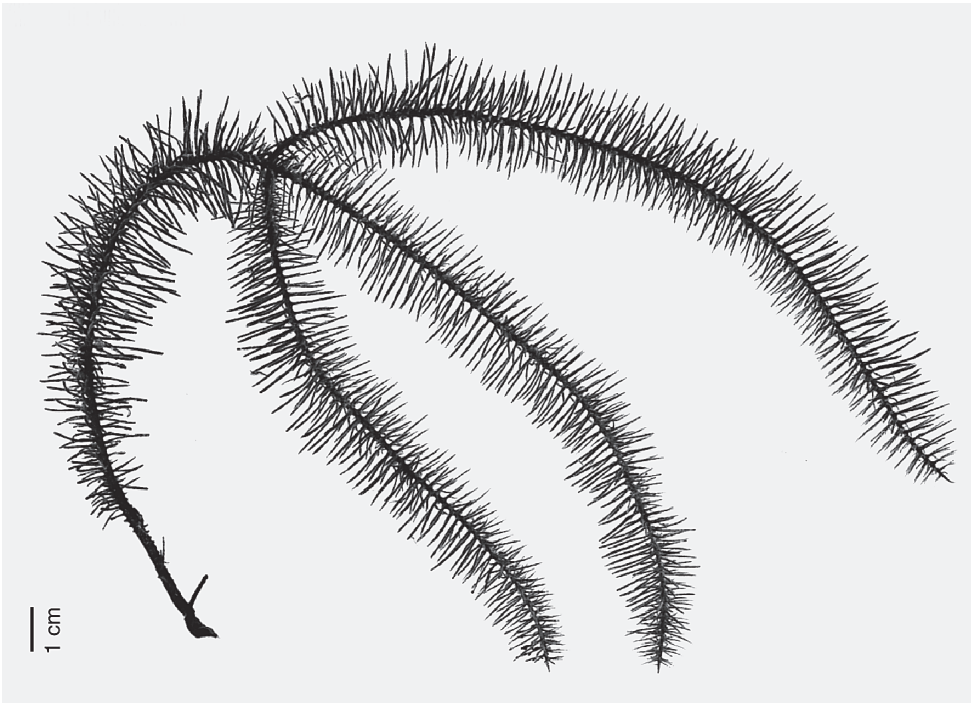

Fig. 7. *Asteriopathes arachniformis* spec. nov., holotype (USNM 1007096), entire corallum.

longest; those in the more anterior rows are usually progressively shorter, although in places an inner row pinnule can be longer than an adjacent outer row pinnule. The anterior pinnules can be so close together that the inner ones appear to be subpinnules of the outer ones. The pinnules in each group originate at about the same level on the axis and project out at almost right angles to the axis, or are inclined distally to a very slight degree. There are generally five or six groups of pinnules per centimeter on each side (25-35 pinnules per centimeter on each side). Pinnules in the anterior rows on each side are curved inward such that adjacent ones from opposite sides of the axis cross over each other, thus forming a semi-enclosed tube, which may function as a worm run.

The spines (figs 9a-b) on the pinnules are tall, acicular, acute; with tubercles on the upper half of the surface. They are unequal in size around the circumference of the axis; the polypar spines are 0.14-0.22 mm from midpoint of base to apex, and the abpolypar spines slightly smaller (0.10-0.18 mm). The polypar spines can sometimes be slightly unequal in size. The spines are arranged in axial rows, four to seven of which can be seen in one lateral view. The abpolypar spines are more distally inclined than the polypar spines and also more closely spaced; there are six or seven spines per millimeter on the polypar side of the axis and up to 10 per millimeter on the abpolypar side. On the larger branches and stem the spines are acicular, up to 0.28 mm tall, and very densely but irregularly arranged.

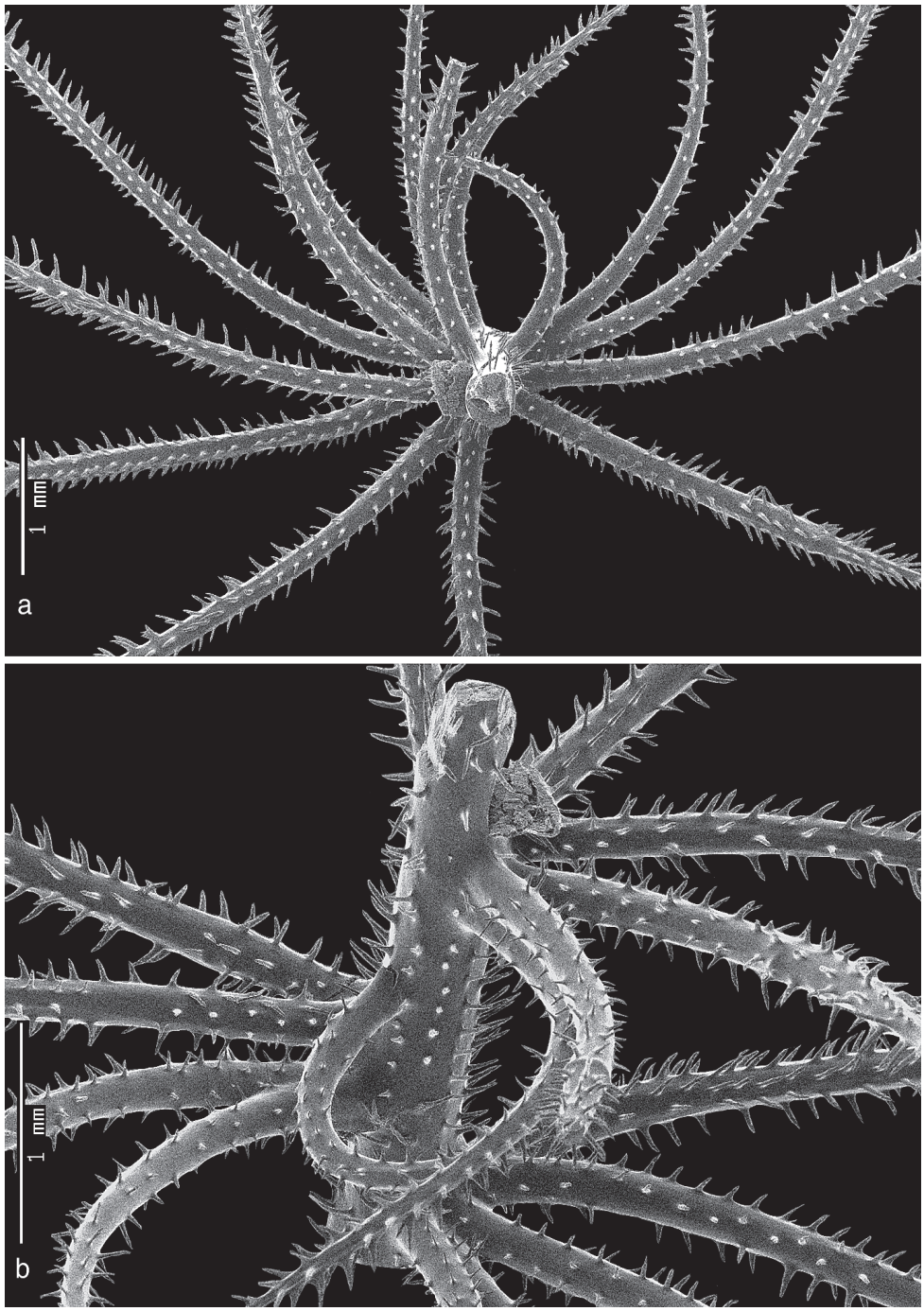

Fig. 8. *Asteriopathes arachniformis* spec. nov., holotype (USNM 1007096): a, cross-sectional view of branchlet showing arrangement of pinnules; b, oblique view of branchlet with pinnules.

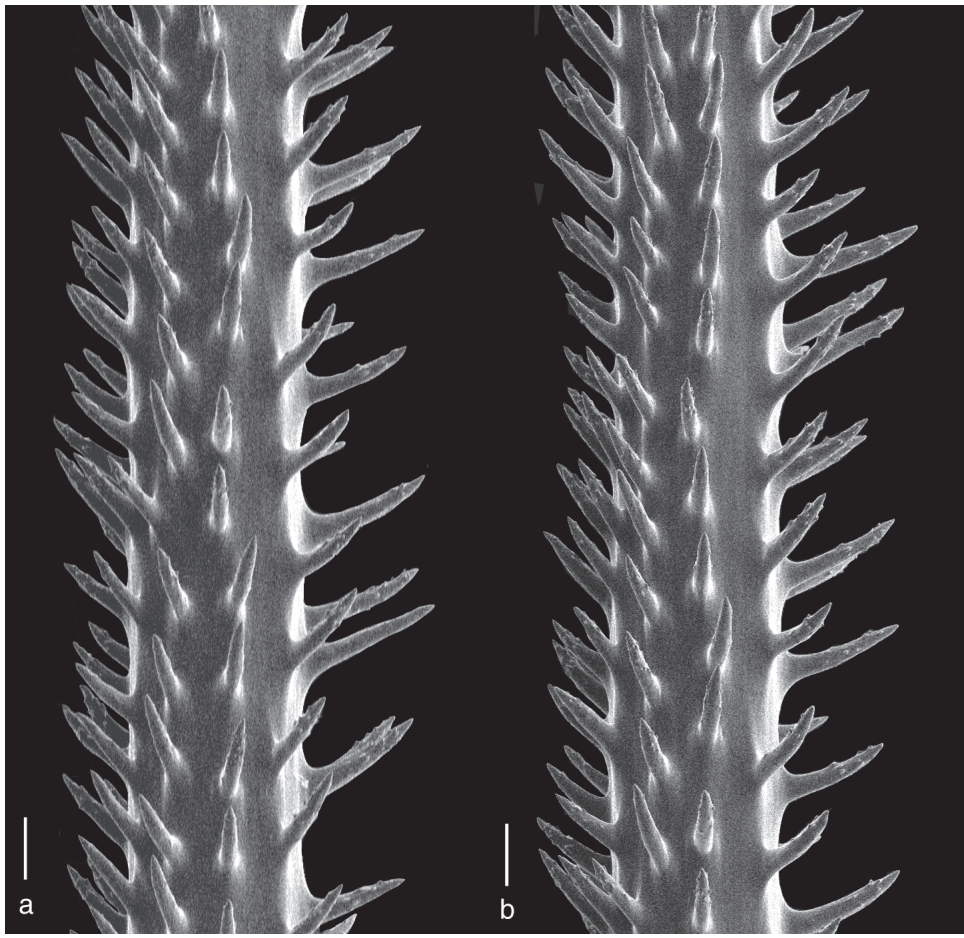

Fig. 9. *Asteriopathes arachniformis* spec. nov., holotype (USNM 1007096): a-b, spines on pinnules, scale 0.1 mm.

The polyps occur in a single series mostly on one, lateral side of the pinnules (sometimes they occur more towards the upper or distal side); those in the inner (anterior-most) rows on opposite sides of the axis therefore face towards each other. The polyps are 0.7 mm in transverse diameter (from distal side of distal lateral tentacles to proximal side of proximal lateral tentacles) and are separated by an interpolypar space of about 0.2 mm. There are nine to 12 polyps per centimeter on the pinnules. The colour of the living colony was reported to be brown.

Discussion.— The second specimen assigned to this species is only a small branch collected in New Caledonia. It differs from the holotype in having only six rows of pinnules, three on each side. The pinnules in each lateral group may be slightly offset so that they tend to form semispiral series, however, in most places the arrangement is less regular. This specimen is similar to the holotype in the length of the pinnules (mostly 1-1.5 cm) and in the density of the polyps (nine to ten per centimeter).

Comparisons.— In pinnulation pattern *A. arachniformes* spec. nov. closely resembles *A. colini* spec. nov. (see below). Differences exist primarily in the length of the pinnules and the density of the polyps.

Etymology.— From the Greek "arachno", spider, and the Latin suffix "formes" referring to the arachnid-like pattern formed by the groups of pinnules, as viewed in a cross-section of a branch.

Distribution.— Known only from Palau and New Caledonia.

Bathymetric range.— 107 m.

Asteriopathes colini spec. nov.
(figs 10, 11a-d)

Material examined.— Holotype (USNM 1007092; schizoholotype RMNH Coel. 32367), Indo-Pacific, Palau, east side, 7º16.41N, 134º31.43E, 5.iii.2001, 220 m, coll. P. Colin, OCDN7842-J.

Diagnosis.— Colony sparsely branched and pinnulate; pinnules simple, arranged bilaterally and in alternating groups of mostly four or five pinnules (maximum of six per group). Pinnules mostly 2-2.5 cm long and 0.5-0.6 mm in diameter (including spines) near base. Spines narrow, conical to acicular, sometimes slightly curved distally, with tubercles on upper half of surface; polypar spines up to 0.22 mm tall. Polyps about 1 mm in transverse diameter with six or seven polyps per centimeter.

Description of the holotype.— The type specimen consists of two pieces from the same colony, one about 12 cm tall (fig. 10) and the other 4 cm long. The lower piece has a basal holdfast, just above which the stem is about 3 x 4 mm in diameter. Based on the appearance of the upper piece, the entire corallum was probably sparsely branched. The stem and branches are pinnulate with simple pinnules mostly 2-2.5 cm long (maximum 3.5 cm) and 0.5-0.6 mm in diameter (including spines) near their point of insertion on the branch or stem. The pinnules (fig. 11a) are arranged bilaterally and in alternating groups, with five or six groups per centimeter on each side of the axis. On the branches arising from near the basal plate, there are two to four rows of pinnules, but on the upper branches there are as many as 12 rows, with six on each side. The pinnules in each lateral group tend to follow an ascending semispiral pattern, with the most posterior pinnules being the lowest on the axis; however, the two most anterior pinnules may be on the same level or even slightly lower than the adjacent ones in the group. The most posterior pinnules are also usually the longest, and the anterior-most ones the shortest (usually not more than about 5 mm). Furthermore, the anterior-most pinnules may be so close together that they appear to be subpinnules of the outer ones. Pinnules in the anterior rows on each side are curved inward such that adjacent ones cross over each other, thus forming a semi-enclosed tube which may function as a worm run. (fig. 11a)

The spines on the pinnules (figs 11b-d) are narrow, acicular, sometimes curved (or hooked) upward, and covered with conical tubercles on their upper surface. The tubercles are located mainly on the upper half of the spines. The polypar spines are up to 0.22 mm tall (from the midpoint of the base to the apex), the abpolypar spines are similar in size or smaller, and are more crowded and more inclined distally. The spines are arranged in axial rows, with five to seven rows visible in one lateral view.

There are about seven spines per millimeter in each row on the polyp side of the axis and up to ten per millimeter on the abpolypar side. On the thicker parts of the pinnules the spines tend to be less uniform in size and arrangement with some polypar spines appearing slightly larger than others. The spines on the stem are about 0.12 mm in height but appear more acicular than those on the pinnules.

The polyps are arranged in a single row primarily on the lateral surface of the pinnules. Those on the inner pinnules face toward those on the opposite side. The polyps are about 1.0 mm in transverse diameter (from the distal side of distal lateral tentacles to the proximal side of proximal lateral tentacles) and are separated by a space of 0.2-0.4 mm. There are usually six or seven polyps per centimeter (sometime slightly more). Tentacles in the preserved specimen are about 0.5 mm long and have a blunt apex.

Fig. 10. *Asteriopathes colini* spec. nov., holotype (USNM 1007092), entire corallum.

Comparisons.— This species is very similar to *Asteriopathes arachniformis* spec. nov. in pattern of pinnulation, but it has longer pinnules (up to 2.5 cm vs. 1-1.5 cm) and less crowded polyps (six to seven per centimeter vs. 10-12 per centimeter). Furthermore, in this species the spines are more crowded and show a greater tendency to be inclined or curved distally.

Etymology.— Named in recognition of P. Colin who collected many of the specimens described in this paper.

Distribution.— Known only from Palau.

Bathymetric range.— 220 m.

Acanthopathinae subfam. nov.

Diagnosis.— Polyps small, usually 0.5-1.0 mm in transverse diameter; subequal in transverse and sagittal axes or slightly longer along either axis; interpolypar space often relatively wide, as much as 0.4 mm in preserved material. Tentacles of polyps in preserved material short and blunt. Spines tall (0.4 mm or more), acicular to cylindrical, and anisomorphic; maximum height usually more than three times the width near the base; acute or blunt, smooth or slightly tuberculate on parts of surface, especially near the apex. Polypar spines considerably taller than abpolypar spines; circumpolypar

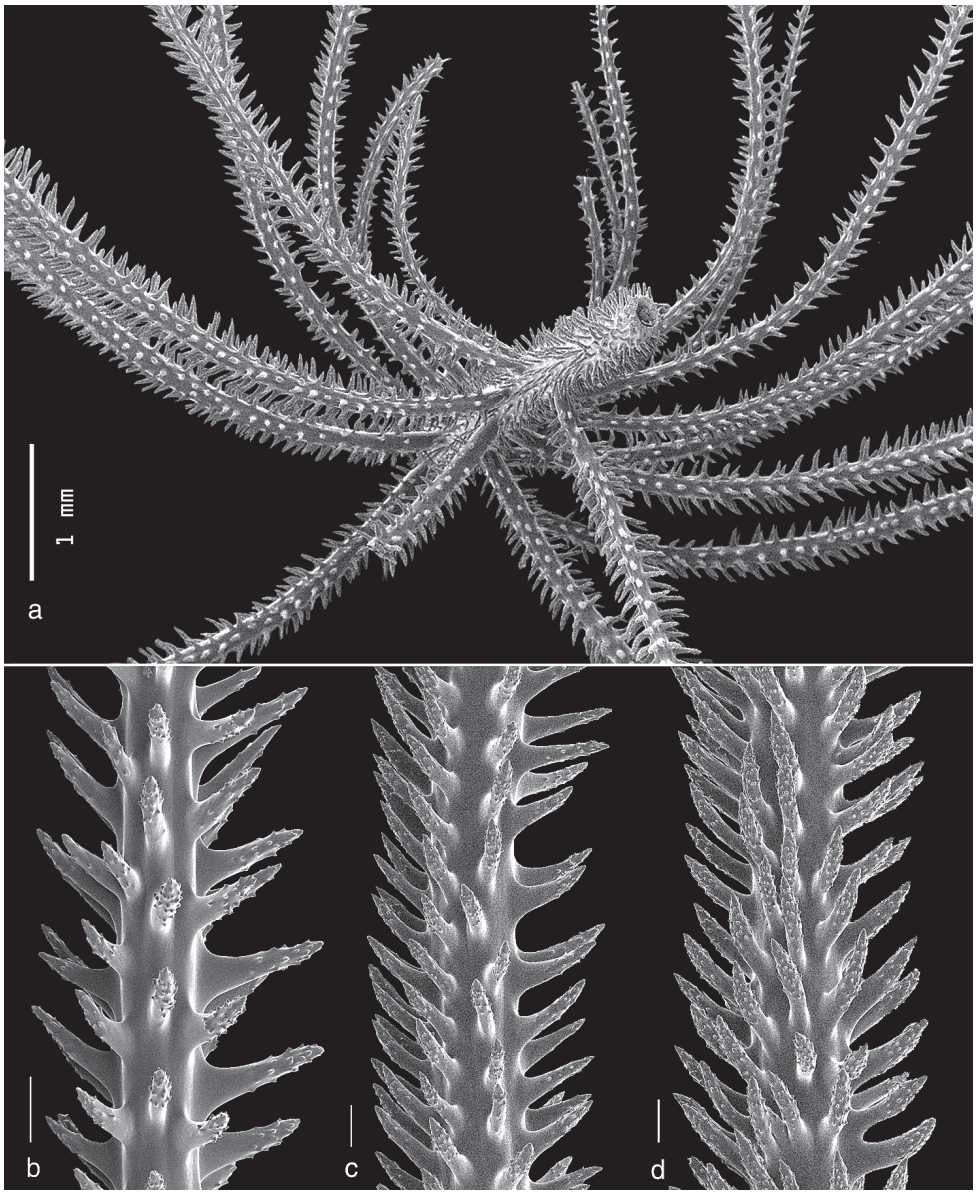

Fig. 11. *Asteriopathes colini* spec. nov., holotype (USNM 1007092): a, cross sectional view of branchlet showing arrangement of pinnules; b-d, spines on pinnules, scale 0.1 mm.

spines larger than interpolypar spines; hypostomal spines usually reduced or absent. Corallum flabellate or bushy. Stem and branches simple or pinnulate. When present, pinnules simple.

Remarks.— This subfamily is established on the basis of similarities in the morphology of the spines and polyps. It differs from the subfamily Aphanipathinae in

that the polypar spines are anisomorphic, with the circumpolypar spines being the tallest and the hypostomal spines usually reduced in size or absent (with the exception of the genus *Rhipidopathes*, see below). In the Aphanipathinae the polypar spines are subequal in size or with the interpolypar spines only slightly taller than the other polypar spines. Genera here assigned to the Acanthopathinae are flabellate or pinnulate with simple pinnules.

Key to the Genera of Acanthopathinae

1. Corallum not pinnulate; generally planar 2
- Corallum pinnulate; sparsely branched 3
2. Circumpolypar spines distinctly larger than interpolypar spines; hypostomal spines very reduced or absent ..... ***Acanthopathes*** gen. nov.
- Circumpolypar spines slightly larger than interpolypar spines; hypostomal spines of variable size, sometimes not reduced ..... ***Rhipidopathes*** Milne Edwards & Haime
3. Pinnules arranged in two regular rows ..... ***Distichopathes*** gen. nov.
- Pinnules arranged in three to six rows ..... ***Elatopathes*** gen. nov.

Acanthopathes gen. nov.

(figs 12a-d)

Antipathes; Pourtalès, 1867: 112; 1871: 54; 1874: 46; 1878: 210; 1880: 118 (in part).
Aphanipathes Brook, 1889: 131 (in part); Opresko, 1972: 993.

Type species.— *Antipathes humilis* Pourtalès, 1867: 112.

Diagnosis.— Corallum flabellate or tending to be planar; branchlets short, straight or curved distally; arranged uniserially or bilaterally; polypar spines acute, smooth or slightly tuberculate; circumpolypar spines distinctly larger than interpolypar spines; hypostomal spines very reduced or absent.

Type material.— Lectotype: MCZ No. 3 (original number for all syntypes); paralectotypes in alcohol, MCZ 3 (new number, MCZ 57348); paralectotype dry, MCZ 3 (new number, MCZ 57350). Locality: 1.6 miles off Chorrera, Cuba, 270 fm, 24-29.v.1867, "Corwin" sta. 2P-4P.

Description of lectotype.— The following description of the lectotype of *A. humilis* is excerpted from Opresko (1972: 994).

The corallum (fig. 12a) is about 9 cm high and about 8 cm wide and is branched to 12th order or more. The corallum is irregularly branched in two unequal, but somewhat parallel planes. Although some of the branchlets are irregularly bilateral in arrangement, most are unilateral with three or more occurring on the same side of a lower order branch. The branchlets are 1-3 cm in length, about 1 mm thick (including spines) and are spaced 3-6 mm apart. The branchlets generally form a distal angle of close to 90^{o} with the lower order branch. Some are straight or slightly curved; others are strongly curved distally to become parallel to the branch from which they arise, and a few may be curved in the opposite direction. In many cases the next higher order of branchlet arises on the convex side of the lower order branch, and this pattern can be repeated over several successive orders of branching; however, it is not followed regularly over the entire corallum.

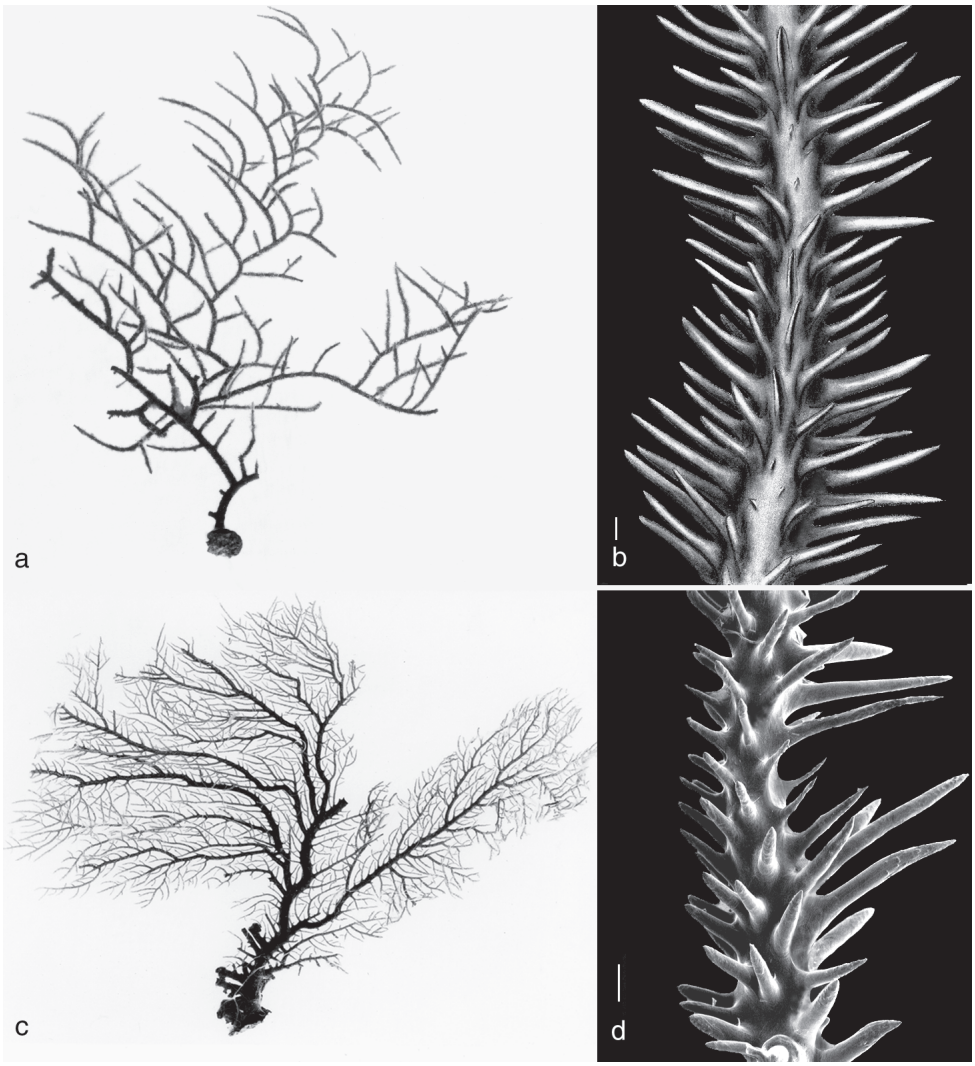

Fig. 12. *Acanthopathes* spp. a-b, *A. humilis* (Pourtalès), holotype (MCZ 3); a, entire corallum, height ~9 cm; b, spines on branchlet, scale 0.1 mm; c-d, *A. thyoides* (Pourtalès); c, entire corallum, height 22 cm; d, spines on branchlet, scale 0.1 mm.

The spines (fig. 12b) are tall, needle-like, acute, and smooth. The circumpolypar spines are up to 0.7 mm tall from the midpoint of base to apex; the interpolypar and abpolypar spines are 0.3-0.4 mm tall, and the hypostomal spines are only 0.05 mm. The spines on the branchlets are arranged in 15-20 rows (total around the circumference of the axis) with four to five spines per millimeter in each row.

The polyps are about 1 mm in transverse diameter (from the proximal side of proximal lateral tentacles to the distal side of distal lateral tentacles), and are arranged uniserially, with six to seven per centimeter.

Etymology.— The genus name is derived from the Greek "acantho", meaning "spiny" in reference to the very enlarged circumpolypar spines, and the commonly used suffix "pathes".

Remarks.— The genus is defined by the planar branching of the corallum and the distinctly anisomorphic spines.

Species assigned to *Acanthopathes*.— In addition to the type species, other nominal species that are assigned to *Acanthopathes* include: *Antipathes thyoides* Pourtalès, 1880; *Aphanipathes undulata* van Pesch, 1914; *Aphanipathes*? *hancocki* Cooper, 1909; and *Aphanipathes*? *somervillei* Cooper, 1909. The types of *A. somervillei*, and *A. hancocki* have not been located, and assignment of these species to *Acanthopathes* is based on the descriptions and illustrations given by Cooper. Although Cooper does not describe the polypar spines in either of these species as being unequal in size, the growth form of the corallum and the maximum size of the spines (1 mm in *A. somervillei*) suggest that *A. somervillei* is related to *A. humilis* and *A. hancocki* to *A. thyoides*. Similarly, van Pesch (1914) did not describe the hypostomal spines in *A. undulata* as being reduced, however, an examination of a fragment of the type revealed that they are indeed much reduced and even absent in places. Furthermore, in *A. undulata* there is also the tendency for the branchlets to develop on the convex side of the lower order branch as in *A. humilis*. In *A. thyoides* the branching pattern is more bilateral (fig. 12c), and the polypar spines (fig. 12d) are not as crowded, and fewer of them are enlarged, as they are in *A. humilis*.

Distribution.— Species of this genus are known from the Indian Ocean (*A. somervillei*, and *A. hancocki)*, the western Atlantic (*A. humilis* and *A. thyoides*), and from the Indo-Pacific and Hawaii (*A. undulata*).

Rhipidopathes Milne Edwards & Haime, 1857

(figs 13a-d)

Antipathes Pallas, 1766: 205; Esper, 1795, pl. 11; van Pesch, 1914: 90 (as subgenus, *Aphanipathes*); Pax & Müller, 1955: 108; Grasshoff, 1991: 362 (all in part).
Rhipidopathes Milne Edwards & Haime, 1857: 321.
Aphanipathes; Pax, 1918: 470 (in part); Opresko & Baron-Szabo, 2001: 10 (in part).
Antipathella Brook, 1889: 117 (in part).

Type species.— *Antipathes reticulata* Esper, 1795, pl. 11; 1797: 183.

Diagnosis.— Corallum flabellate; polypar spines acute or blunt, smooth or tuberculate; circumpolypar spines slightly larger than interpolypar spines; hypostomal spines often equal in size to the circumpolypar spines, but may be reduced in size or absent on some portions of the corallum.

Type material.— Holotype: SMF 5885 (see Opresko & Baron-Szabo, 2001). Locality: thought to be the "East Indian Ocean" (Esper, 1797).

Description of the type.— The specimen identified as Esper´s original type of *A. reticulata* was redescribed by Opresko & Baron-Szabo (2001: 10). A brief summary of that description is given here.

The corallum (fig. 13a) is flabellate and branched to 10th order or more, with extensive anastomosing among branches and branchlets. The major branches are dis-

Fig. 13. *Rhipidopathes* spp. a-b, *R. reticulata* (Esper), holotype (SMF 5885); a, entire corallum, height ~21 cm; b, spines on branchlet, scale 0.1 mm; c-d, *R. colombiana* (Opresko & Sanchez); c, entire corallum, height ~10 cm; d, spines on branchlet, scale 0.1 mm.

tinct, straight or somewhat sinuous. The highest order, unbranched branchlets are arranged bilaterally, irregularly alternate or subopposite; they are straight or slightly curved upward; typically 5-7 mm in length and spaced 1-1.5 mm apart, with seven to 10 branchlets per centimeter on both sides of axis.

The spines (fig. 13b) are tall, cylindrical, acute or blunt, sparingly tuberculate and anisomorphic. The polypar spines are up to 0.35 mm tall from the midpoint of base to apex; the abpolypar spines are 0.11-0.14 mm tall. The circumpolypar spines are slightly larger than the interpolypar spines; the hypostomal spines can be as large as the interpolypar spines, but in places they are reduced to only 0.03-0.04 mm. The polypar spines have low, oblong tubercles scattered on their surface; with some of the tubercles sometimes arranged in a ring just below the apex (see Opresko & Baron-Szabo, 2001, fig. 10). The spines on the branchlets are spaced 0.16-0.39 mm apart (four to five per millimeter) and are arranged in longitudinal rows, five or six of which are seen in lateral view.

Although the specimen is dry, polyp tissue is present and the polyps are estimated to be about 0.6 mm in transverse diameter (from the proximal side of the proximal lateral tentacles to the distal side of distal lateral tentacles). The interpolypar space is estimated to be 0.36-0.45 mm, resulting in about 10-11 polyps per centimeter.

Remarks.— Milne Edwards & Haime (1857) established the genus *Rhipidopathes* for species of antipatharians with a fan-shaped corallum. These authors included *Antipathes flabellum* Pallas, 1766, and *Antipathes reticulata* Esper, 1795, in the genus; however, they did not designate a type species. In 1889 *Antipathes flabellum* was provisionally assigned to the genus *Tylopathes* by Brook. Brook's decription and illustration indicate that the spines of *T. flabellum* are relatively small (about 0.1 mm), triangular in lateral view, and subequal in size around the circumference of the axis, with the polypar spines all of the same size; therefore, they are similar to the spines of species of *Antipathes*, *sensu stricto*. *Rhipidopathes*, as redefined here, includes species with tall circumpolypar spines.

The genus is similar to the newly established genus *Acanthopathes*. Both genera are characterized by a corallum which, to varying degrees, is planar. The major characters differentiating the two genera are the relative size and density of the spines. In *Acanthopathes* the polypar spines are more strongly developed and denser than in *Rhipidopathes*, and the hypostomal spines are more consistently reduced in size.

Species assigned to *Rhipidopathes*.— One other species, *Aphanipathes colombiana* Opresko & Sanchez (1997) is provisionally assigned to this genus. Although both this species and *R. reticulata* form fan-shaped colonies and have tall, subcylindrical, circumpolypar spines; they differ in the extent that the hypostomal spines are developed. In *A. colombiana* the hypostomal spines are only minimally reduced in size, and often not at all, especially near the distal end of the branchlets. The two species also differ in that the corallum in *A. colombiana* (fig. 13c) shows only a limited amount of anastomosing of the branchlets, and the spines are almost smooth with just a few tubercles (fig. 13d), whereas, in *R. reticulata* the corallum is strongly anastomosing and the spines are clearly tuberculate.

Distribution.— *Rhipidopathes reticulata* is known from the Indo-Pacific region and *R. colombiana* from the western Atlantic.

Distichopathes gen. nov.
(figs 14a-d)

Antipathes; Pourtalès, 1867:112, 1871: 54, 1880: 118 (all in part); van Pesch, 1914: 85 (as subgenus *Aphanipathes*).
Aphanipathes Brook, 1889: 121 (in part); Opresko, 1972: 993.

Type species.— *Distichopathes disticha* spec. nov. (see below).

Diagnosis.— Corallum monopodial, or sparsely branched, tending to be planar. Stem and branches pinnulate. Pinnules simple, not subpinnulate; arranged primarily in two lateral rows, but sometimes with a few additional pinnules occurring infrequently on the anterior (polyp) side of the axis. Pinnules in each lateral row alternating with those in opposite lateral row.

Type material.— Holotype: MCZ 38476. Locality: Lesser Antilles, off Martinique.

Remarks.— The major generic characteristics of *Distichopathes* are the simple, bilateral pinnules and the distinctly anisomorphic spines. In this regard the genus is closest to *Elatopathes* which also has simple pinnules, but in the latter case they are arranged in four to six rows. The genus is also superficially similar to the genus *Pteridopathes* in the subfamily Aphanipathinae; in the latter genus, however, the polypar spines are subequal in size.

Etymology.— from the Greek "distichos", of two rows, and the commonly used suffix "pathes".

Species assigned to *Distichopathes*.— One other species, *Antipathes filix* Pourtalès is assigned to this genus.

Distribution.— Both species of *Distichopathes* are known only from the western Atlantic.

Distichopathes disticha spec. nov.
(figs 14a-e)

Antipathes eupterida; Pourtalès, 1880: 117.
Aphanipathes filix; Opresko, 1972: 1003 (in part).

Diagnosis.— Corallum sparsely branched, branches tending to lie in one plane. Stem and branches pinnulate. Primary pinnules simple, mostly 3-7 cm long, but up to 12 cm; arranged in two very regular bilateral rows, with pinnules in each row alternating with those in opposite row. A few additional pinnules occurring infrequently on the anterior or polyp side of the axis.

Type material.— Holotype: MCZ 38476; Locality: Lesser Antilles, off Martinique, 14°28′50″N, 61°5′40″W, 10.ii.1879, 96 fm, "Blake" sta. 203; paratype (UMML 7.1138). Mexico, off Cozumel, 21°00′N, 86°23.5′W, 15.iii.1968, 95-190 m, R/V "Pillsbury" sta 592.

Description of the holotype.— Large, sparsely branched colony (fig. 14a); height about 18 cm, basal stem diameter 5.2 mm. Stem and branches with simple, filiform pinnules (fig. 14d), mostly 3-4 cm long (maximum about 7 cm) and 0.2-0.3 mm in diameter near base (excluding spines); arranged in two lateral rows with members of each row spaced 0.9 to 1.4 mm apart, resulting in 16-18 pinnules per centimeter (total for both rows). Scattered pinnules also occur infrequently (0-5 per centimeter) on the

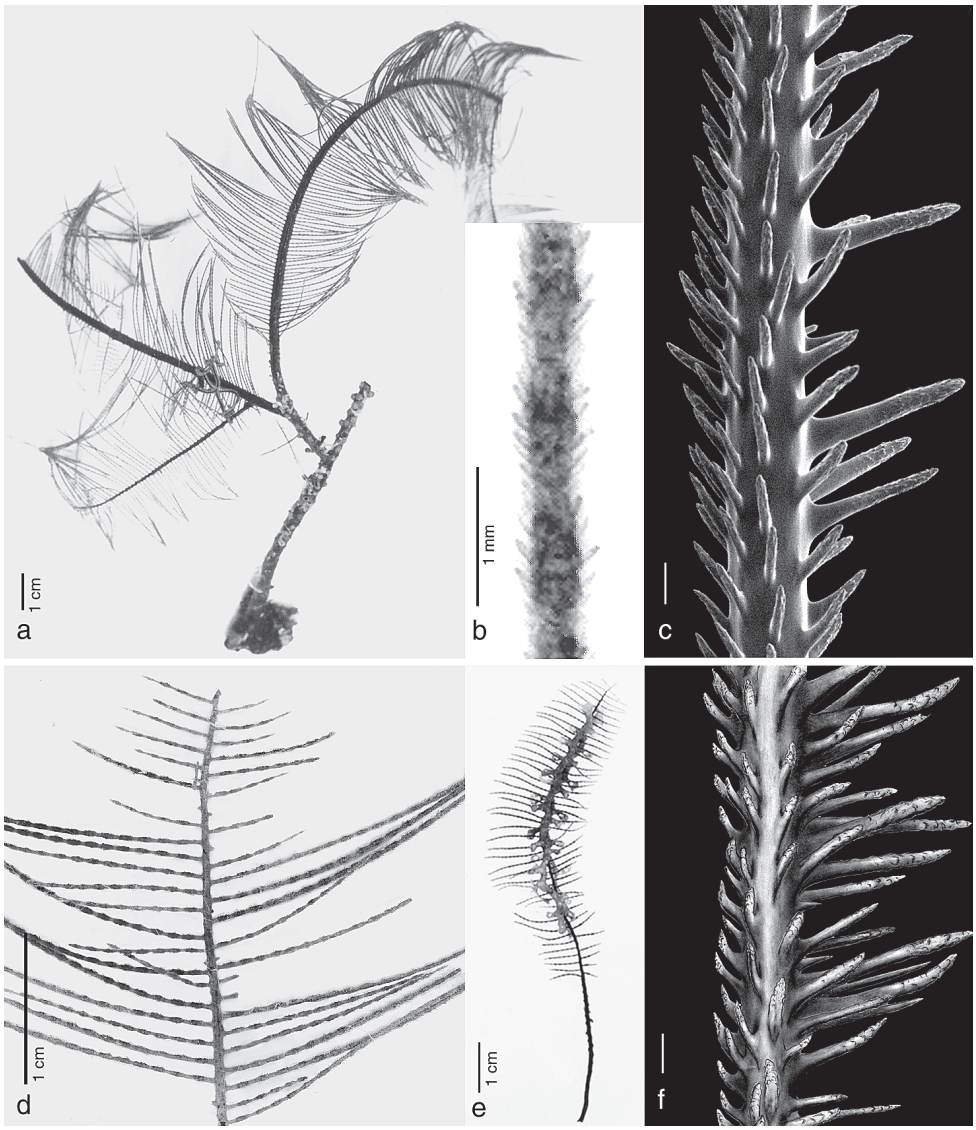

Fig. 14. *Distichopathes* spp. a-d, *D. disticha* spec. nov., holotype (MCZ 38476); a, entire corallum, height ~30 cm; b, polyps; c, spines on pinnule, scale 0.1 mm; d, branchlet and pinnules; e-f, *D. filix* (Pourtalès), (UMML 7.659); e, corallum; f, spines on pinnule, scale 0.1 mm.

anterior (polyp) side of the axis. Lateral pinnules extending out at nearly right angles to the axis of the stem or branch or slightly inclined distally. Interior angle formed by the two rows of pinnules 75-90º.

The pinnular spines (fig. 14c) are clearly anisomorphic. The circumpolypar spines are up to 0.4 mm tall, the interpolypar spines are about 0.2 mm, the hypostomal spines are 0.1 mm or less, and the abpolypar spines are about 0.1 mm. The pinnular

spines are arranged in rows, five or six of which can be seen in lateral view, with seven to eight spines per millimeter in each row. The polypar spines are slightly inclined distally and the abpolypar spines to a greater degree. The spines on the basal part of the stem are worn away.

The polyps (fig. 14b) are 0.7 mm in transverse diameter and are placed in a single series (eight or nine per centimeter) on one side of the pinnules.

Remarks.— The paratype is similar to the holotype in mode of branching, in the size, shape, and density of the pinnular spines, and in the size of the polyps (0.85 mm); however, it has longer pinnules. The pinnules in the paratype are mostly 5-7 cm, but some reach a maximum length of 12 cm).

Comparisons.— The only other nominal species having a similar pattern of pinnulation as well as anisomorphic spines is *Antipathes filix* Pourtalès, 1867. This species was originally described by Pourtalès as being only three inches high, with a straight, erect stem, and short pinnules set at right angles to the axis. In a later publication Pourtalès (1880: 116) decided that his original description was based on young colonies, and that older, larger colonies "branch in a subflabellate manner, spreading 30-40 cm, more in breadth than in height". Opresko (1972) summarized the variation in the skeletal and polyp morphology that occurs in specimens that have been assigned to this species. The length of the pinnules ranges from 0.6 to about 3 cm, the maximum size of the polypar spines ranges from 0.4 to 0.57 mm, and the transverse diameter of the polyps varies from 0.65 to about 1 mm. Small specimens conforming to Pourtalès original description (fig. 14e) characteristically have very short pinnules (0.6 to 1 cm) and long clavate polypar spines (fig. 14f). Larger specimens with slightly longer pinnules have thinner and more cylindrical polypar spines, suggesting that they might represent a separate species.

Etymology.— From the Greek, "distichos", of two rows, in reference to the arrangement of the pinnules.

Distribution.— Known only from the Caribbean.

Elatopathes gen. nov.

(figs 15a-b)

Antipathes; Pourtalès, 1874: 47; 1878: 209 (in part); Brook, 1889: 133 ("species incertae sedis").
Parantipathes; van Pesch, 1914: 20 (in part).
Aphanipathes; Opresko, 1972: 1009.

Type species.— *Antipathes abietina* Pourtalès, 1874: 47.

Diagnosis.— Corallum sparsely branched, sometimes from near the base. Stem and branches pinnulate. Pinnules simple; arranged in four to six rows and sometimes in alternating biserial, semispiral groups of varying regularity.

Type material.— Lectotype: MCZ 23 (original number for all syntypes); paralectotypes in alcohol, MCZ 23 (new number, MCZ 57351); paralectotype dry, MCZ 23 (new number, MCZ 57349). Locality: Barbados, Lesser Antilles.

Description of the lectotype.— A detailed description of this species is provided in Opresko (1972: 1009). A brief summary of the description of the lectotype is presented here.

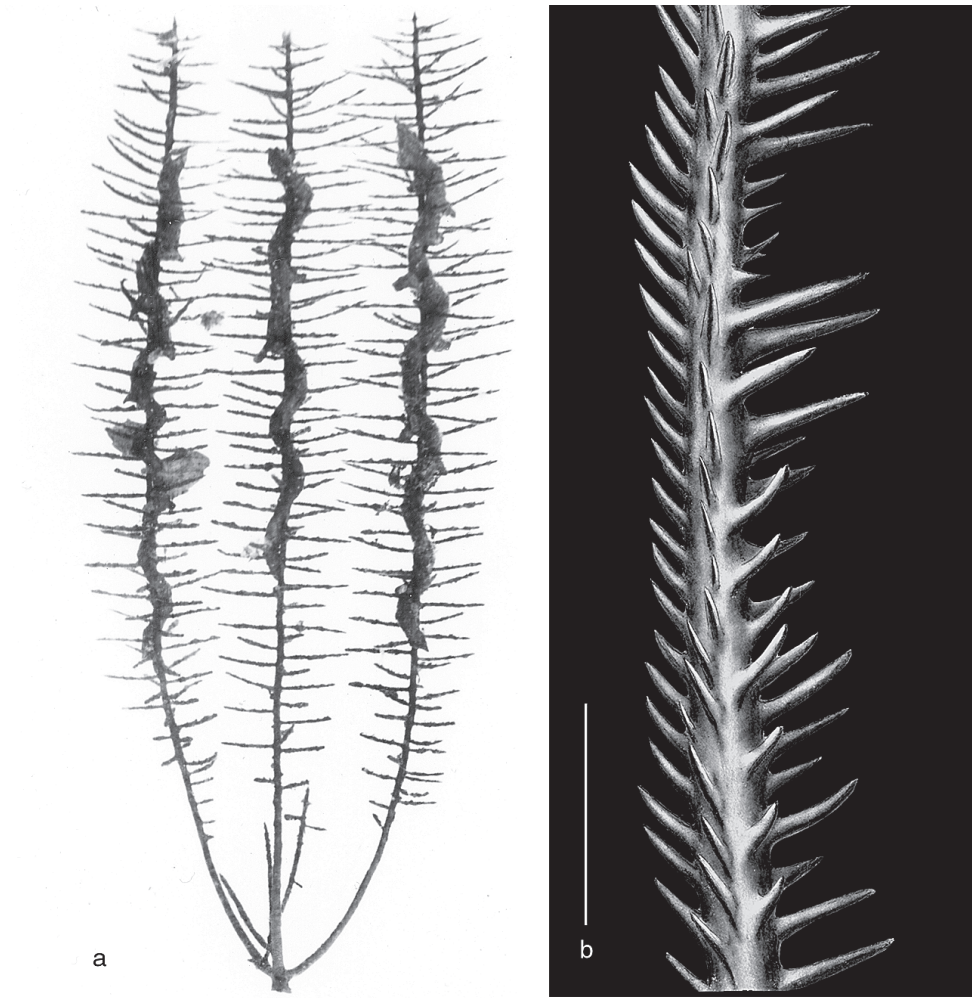

Fig. 15. *Elatopathes abietina* (Pourtalès), holotype (MCZ 23); a, entire corallum, height, 6 cm; b, spines on pinnule, scale 0.5 mm.

Colony sparsely branched from near the base (fig. 15a). Stem and branches pinnulate. Pinnules simple, 0.5-0.6 cm long and about 0.3 mm thick; arranged in six irregular rows. Adjacent pinnules in each row 1.5 mm to about 3 mm apart, with 23-26 pinnules per centimeter (total for all rows). Pinnules on some parts of the corallum arranged in alternating, bilateral, semispiral groups of three each.

The spines (fig. 15b) are long, acicular, acute, very slightly tuberculate, and anisomorphic. The circumpolypar spines are about 0.4 mm tall, and longest around the proximal lateral tentacles. They are straight or slightly curved upward. The interpolypar spines are about one-half as long as the circumpolypar ones. The hypostomal spines are 0.1 mm or less. The abpolypar spines are about 0.15 mm and strongly inclined distally. On the pinnules, eight or nine rows of spines are visible (in one lateral view),

each of which contains nine or ten spines per millimeter. The polyps measure 0.8 mm in the transverse diameter, and there are eight polyps per centimeter.

Remarks.— There is considerable variability in the size, number, and arrangement of the pinnules, and in the morphology of the spines of specimens that have been assigned to this species (see Opresko, 1972: 1009). In specimens that are most similar to the type, the pinnules are short, subequal in length and arranged around the circumference in subspiral patterns and the corallum is branched primarily from near the base. In other specimens the pinnules are unequal in size and tend to be arranged bilaterally, and the branching occur primarily on the upper parts of the corallum. The spines range from being almost smooth in the typical form to distinctly tuberculate. Further study may show that more than one species is represented within this range of variability.

Etymology.— Derived from the Greek "elate" meaning fir tree, and the commonly used suffix "pathes".

Distribution.— The type species occurs in the western Atlantic.

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