

# Revision of the Antipatharia (Cnidaria: Anthozoa). Part II. Schizopathidae

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The family of antipatharian corals, Schizopathidae (Cnidaria: Anthozoa: Antipatharia), is revised. The family is characterized by polyps elongated in the direction of the axis and having a transverse diameter of 2 mm or more. Genera are recognized on the basis of morphological features of the corallum. *Schizopathes* Brook (type species: *S. crassa* Brook) has a simple, pinnate corallum with a hook-like hold-fast for support in soft sediments. *Bathypathes* Brook (type species: *B. patula* Brook) is characterized by a simple pinnate corallum and a flat discoidal basal plate for attaching to a solid substrate. *Parantipathes* Brook (type species: *Antipathes larix* Esper) has a largely monopodial corallum with simple pinnules in six or more rows. *Taxipathes* Brook (type species: *T. recta* Brook) has a branched corallum and simple pinnules in four to eight rows. *Lillipathes* gen. nov. (type species: *Antipathes lilliei* Totton) has simple pinnules in four rows. *Stauropathes* gen. nov. (type species: *S. staurocrada* spec. nov.) is branched with simple, bilateral, subopposite pinnules. *Abyssopathes* gen. nov. (type species: *Bathypathes lyra* Brook) is monopodial with two rows of simple, lateral pinnules and one (sometimes multiple) row of simple or branched anterior pinnules. *Dendrobathypathes* gen. nov. (type species: *D. grandis* spec. nov.) has a branched, planar corallum with two rows of subpinnulated primary pinnules. *Saropathes* gen. nov. (type species: *Bathypathes scoparia* Totton) is monopodial to sparsely branched, with four rows of subpinnulated primary pinnules.

## Introduction

This is the second in a series of papers in which the order Antipatharia (Cnidaria: Anthozoa) is being revised. In the first part of this series the new family Myriopathidae and four new genera were established for species related to *Antipathes myriophylla* Pallas (Opresko, 2001). In this paper the family Schizopathidae is reviewed and revised. Included in the family are four previously established genera, *Schizopathes*, *Bathypathes*, *Taxipathes*, and *Parantipathes*, and five new ones.

## Abbreviations

BMNH = British Museum of Natural History, London, United Kingdom

RMNH = National Museum of Natural History, Leiden, The Netherlands

SAM = South Australian Museum, Adelaide, South Australia

SMF = Senckenberg Museum, Frankfurt am Main, Germany

USNM = Museum of Natural History, Smithsonian Institution, Washington, DC, USA

**Taxonomic Section**  
**Schizopathidae Brook, 1889 emend.**

**Diagnosis.**— Polyps elongated transversely; 2 mm or more in transverse diameter, with six primary and four secondary mesenteries. Corallum monopodial or branched; stem and branches pinnulate. Pinnules simple or complexly subpinnulate. Spines triangular, laterally compressed, simple or rarely with multiple bifurcations at apex, subequal in size around circumference of axis or larger on one side.

**Remarks.**— This family is based on Brook's subfamily Schizopathinae. The subfamily originally included the genera *Schizopathes*, *Bathypathes*, *Taxipathes*, and *Cladopathes*. Although some later workers have maintained the subfamily ranking of this taxon, others have elevated the Schizopathinae to the family level (Roule, 1905; Hickson, 1907; Pax, 1918, 1987; Opresko, 1997).

Brook (1889) established the Schizopathinae for species whose polyps were said to be divided along the transverse axis into three sections each bearing one pair of tentacles, and which Brook regarded as dimorphic zooids (i.e., two gonozooids and one gastrozoid for each polyp). In *Schizopathes* these divisions of a polyp were reported to be associated with external "peristomal involutions" (constrictions of the coenenchyme between the sagittal and each lateral pair of tentacles) and with internal "mesogloal septa" hanging down from the upper surface of the coelenteron and placed parallel to the sagittal axis of the polyp. These modifications of the polyp are generally not considered a case of true dimorphism but rather one of polyp specialization, with the reproductive tissues being isolated in the lateral chambers of the coelenteron (Thompson, 1905; van Pesch, 1914).

All the genera originally placed in the subfamily Schizopathinae presumably have external "peristomal involutions" and internal "mesogloal septa" however, Brook (1889) did not clearly describe or illustrate these features for the polyps of *Bathypathes*, *Taxipathes*, or *Cladopathes*, and, in fact, the polyps of these three genera often do not exhibit external "peristomal involutions". Furthermore, the occurrence of internal "mesogloal septa" is difficult to assess without longitudinal histological sectioning of the polyps, and such sectioning is complicated by the presence of the hard underlying axial material. Without confirmation of the presence of internal "mesogloal septa", the family Schizopathidae is herein defined primarily on the basis of the transverse elongation of the polyps, as well as by the polyps having six primary and four secondary mesenteries.

The family Schizopathidae is here divided into two subfamilies, the Schizopathinae containing those genera in which the polyps reach a maximum size of 3 mm or more in transverse diameter, and the Parantipathinae in which the polyps are usually 2-3 mm in transverse diameter. Brook (1889) originally placed the genus *Parantipathes* in the subfamily Antipathinae. Even though the polyps of *Parantipathes* are transversely elongated, Brook (1889) did not consider them to be identical to the "dimorphic zooids" of *Schizopathes* and *Bathypathes*. In actuality, except for the difference in size, the polyps of *Parantipathes* are almost indistinguishable from the polyps of *Bathypathes*, and their transverse elongation suggests a closer association with the Schizopathidae than with the Antipathidae.

Previously, many described species in the Schizopathinae were placed in the

genus *Bathypathes* even though these species encompassed a very wide range of diversity in skeletal morphology. In this revision the genus *Bathypathes* is restricted to those species having an attached monopodial corallum with two rows of simple lateral pinnules. Other genera in the family are recognized on the basis of differences in the formation of the corallum and in the number and arrangement of the pinnules and subpinnules. A key to the genera based on these features is presented below:

### Key to genera of the family Schizopathidae

1. Primary pinnules in two rows ..... 2
  - Primary pinnules in more than two rows ..... 5
2. Pinnules simple ..... 3
  - Pinnules subpinnulate ..... *Dendrobathypathes* gen. nov.
3. Corallum monopodial ..... 4
  - Corallum branched ..... *Stauropathes* gen. nov.
4. Corallum attached ..... *Bathypathes*
  - Corallum not attached ..... *Schizopathes*
5. Primary pinnules in three or four rows ..... 6
  - Primary pinnules in six or more rows ..... 8
6. Primary pinnules in three rows: two lateral rows of simple pinnules and one anterior (sometimes multiple) row of simple or subpinnulate pinnules .....
  - ..... *Abyssopathes* gen. nov.
  - Primary pinnules in four rows ..... 7
7. Pinnules simple ..... *Lillipathes* gen. nov.
  - Pinnules subpinnulate ..... *Saropathes* gen. nov.
8. Corallum monopodial or sparsely branched ..... *Parantipathes*
  - Corallum branched to the third or fourth order ..... *Taxipathes*

### Schizopathinae Brook, 1889

Diagnosis.— Polyps 3 mm or more in transverse diameter.

Remarks.— As noted above, the subfamily originally included the genera *Schizopathes*, *Bathypathes*, *Taxipathes*, and *Cladopathes*. As defined here, it contains the first two genera as well as the new genera *Stauropathes*, *Dendrobathypathes*, *Abyssopathes* and *Saropathes*.

### *Schizopathes* Brook, 1889

(fig. 1)

*Schizopathes* Brook, 1889: 146; Hickson, 1907: 6; Cooper, 1909: 308; Silberfeld, 1909b: 12; Pax, 1918: 468; 1987: 204; Opresko, 1974: 51; 1997: 158.

*Bathypathes*; van Pesch, 1914: 27 (in part, as subgenus *Schizopathes*); Pasternak, 1958: 180; 1977: 157; Grasshoff, 1981: 961; Zhou & Zou, 1992: 46.

Diagnosis.— Corallum monopodial and pinnulate, unattached, with hook-like holdfast for support in soft sediments. Pinnules simple, bilateral and alternate. Spines simple, triangular, compressed. Polyps 3-6 mm in transverse diameter.

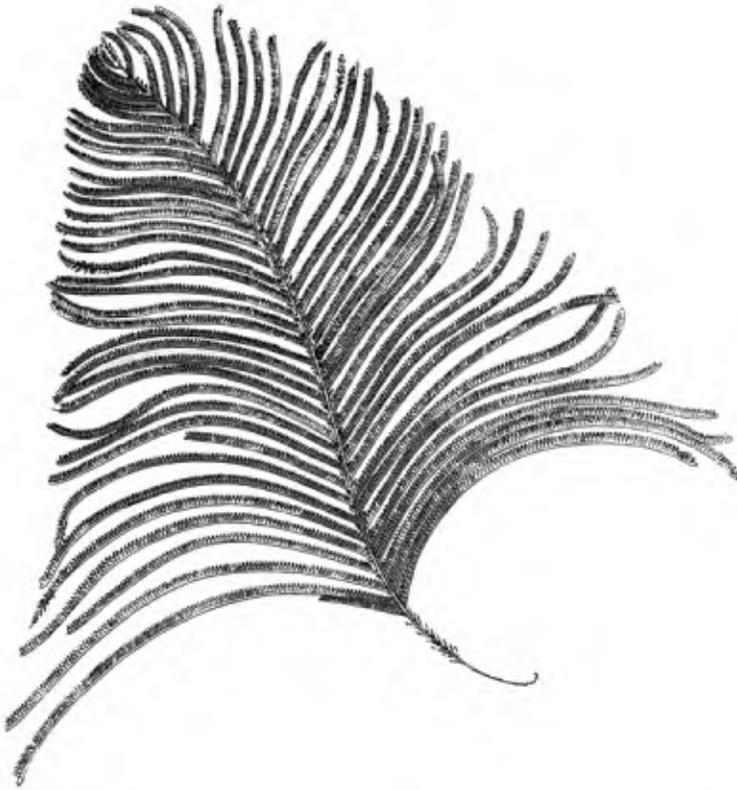


Fig. 1. *Schizopathes crassa* Brook, 1889, digital scan of the illustration of holotype, from Brook, 1889, pl. 8, fig. 1 (stem 57 cm long), 0.2 ×.

Type species.— *Schizopathes crassa* Brook, 1889: 147-148, pl. 8 (see discussion in Opresko, 1997).

Type material.— Holotype (BMNH 1890.4.9.10); southwestern Atlantic, off Montevideo, Uruguay, 35° 39'S, 50° 47'W, 28.ii.1876, 1900 fm, HMS "Challenger" sta. 323.

Description of the type species.— The holotype of *S. crassa* was described and illustrated by Brook (1889: 147). A brief summary of the description of the species, as given by Opresko (1997), is presented here.

The holotype (fig. 1; digital scan of the illustration of the type given by Brook, 1889, pl. 8) is 53 cm high and about 53 cm wide across the lowermost pinnules. The pinnules are simple, bilateral, alternating, and decrease in size from the base to the apex of corallum. On a colony 55 cm tall the lowermost and largest pinnules are about 30 cm long. The spines are small, triangular compressed, and generally not more than 0.08 mm tall. On the mid and distal sections of the pinnules the polyps are 4-6 mm in transverse diameter, but at the basal end of the pinnules and on the stem they are usually less than 4 mm.

Species assigned to *Schizopathes*.— Only three species are currently assigned to *Schizopathes*: *S. crassa* Brook, 1889, *S. affinis* Brook, 1889, and *S. amplispina* Opresko, 1997. Although *S. crassa* and *S. affinis* have been synonymized by a number of workers

(van Pesch, 1914; Pasternak, 1958, 1977), these species can be differentiated on the basis of morphology of the corallum (i.e., relative length of the pinnules on different parts of the stem) and on the size of the spines and polyps (see Opresko, 1997).

Remarks.— The genus *Schizopathes* was treated as a subgenus of *Bathypathes* by van Pesch (1914) who did not consider the difference in the holdfast to be a generic-level character. Pasternak (1958, 1977) later synonymized all species of *Schizopathes* with *Bathypathes patula* Brook after examining a large number of specimens and deciding that there was considerable overlap in almost all taxonomic characters. In Pasternak's opinion the shape of the holdfast is an intraspecific character determined by the type of substrate on which the planula settles. Although it is indeed true that there are many close similarities between the two genera, if *Schizopathes* spp. and *B. patula* are the same species, one would expect to find at least a few specimens in museum collections with partially modified holdfasts, as would be expected if a planula settled on a stone that was too small to support the colony as it grew larger. Furthermore, colonies of *B. patula* typically have subopposite pinnules, the longest of which are usually found along the middle portion of the stem, whereas no colonies of *Schizopathes* have been reported with subopposite pinnules, and in all species of *Schizopathes* the longest pinnules are those lowermost on the corallum. In the alternate arrangement of the pinnules, *Schizopathes* is more similar to *B. alternata* Brook than to *B. patula*. In some specimens that can be referred to *B. alternata*, the longest pinnules are also the lowermost ones on the corallum; however, in these cases, the unpinnulated portion of the stem is usually much longer than in colonies of *Schizopathes*.

Distribution.— Species of this genus have been reported from the Atlantic, Pacific, and Indian Oceans.

### ***Bathypathes* Brook, 1889**

(fig. 2)

*Bathypathes* Brook, 1889: 151; Schultze, 1896: 12; 1903: 97; Thomson, 1905: 76; Roule, 1905: 76; Cooper, 1909: 310; Silberfeld, 1909b: 12; van Pesch, 1914: 27 (in part); Pax, 1918: 468; 1987: 204; Gravier, 1918a: 343; 1921: 16; Pasternak, 1958: 180; 1964: 183; 1977: 157 (in part); Opresko, 1974: 51; Grasshoff, 1981: 961.

Diagnosis.— Corallum monopodial and pinnulate; attached to hard substrates by an adhesive basal plate. Pinnules simple, bilateral and either subopposite or alternating. Spines usually simple, triangular, compressed; rarely with knob-like bifurcations at the apex. Polyps 3-9 mm in transverse diameter.

Type species.— *Bathypathes patula* Brook, 1889: 151-152, pl. 5, figs. 1-4.

Type material.— Holotype (BMNH 1890.4.9.19), north central Pacific, 35°22'N, 169°53'W, 28.vi.1875, 2900 fm, HMS "Challenger" sta. 244. [Note: in the original description of the species Brook (1889:152) describes from "Challenger" sta. 195 "two or three younger specimens which probably belong to this species"; however, he specifically identifies the specimen from "Challenger" sta. 244 as the type specimen].

Description of the type species.— A description of the holotype of *B. patula* is given by Brook (1889: 151). A brief summary of Brook's description is provided here.

The corallum (fig. 2; digital scan of an illustration of the holotype given by Brook, 1889, pl. 5) is monopodial and 19 cm tall. The pinnules are bilateral and subopposite and about 9 mm apart. The longest ones, which occur near the middle of the corallum,

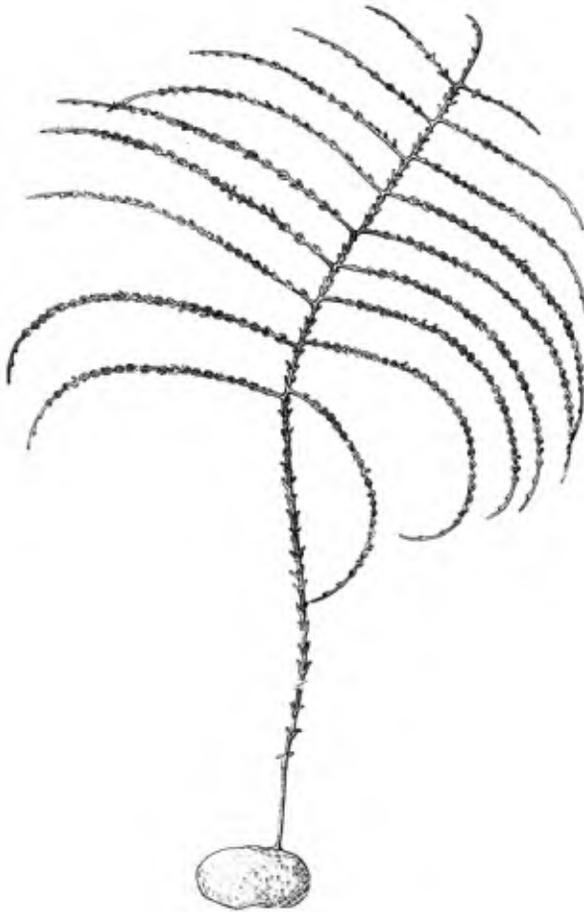


Fig. 2. *Bathypathes patula* Brook, 1889, digital scan of the illustration of holotype, from Brook, 1889, pl. 5, fig. 1 (stem 19 cm long), 0.64 ×.

measure 7.5 cm. The polypar spines, as estimated from the illustration given by Brook, are about 0.06 mm tall from the midpoint of base to apex. Brook (1889) reported that the “zooids” were “subequidistant” and about 3 mm apart; therefore, the transverse polyp diameter can be estimated to be about 6 mm.

Species assigned to *Bathypathes*.— In addition to the type species, other nominal species that may be assigned to *Bathypathes* include: *B. alternata* Brook, 1889, *B. bifida* Thomson, 1905, *B. platycaulus* Totton, 1923, *B. galathea* Pasternak, 1977, and *B. erotema* Schultze, 1903. *Bathypathes galathea*, *B. erotema* and *B. bifida* are similar to *B. patula* in having subopposite pinnules. *Bathypathes alternata* and *B. platycaulus* have alternately arranged pinnules. Several workers including van Pesch, 1914 and Pasternak, 1958, 1977 have considered *B. alternata* to be synonymous with *B. patula*; however, besides the differences in the arrangement of the pinnules, there appear to be consistent differences in the size of the polyps (rarely more than 4 mm in transverse diameter in *B.*

*alternata* and commonly more than 4 mm and up to 9 mm in transverse diameter in *B. patula*) and in the orientation of the stem (more sigmoidal in *B. patula*) to maintain these as separate species.

Remarks.— As noted above, several workers have considered the differences between *Bathypathes* and *Schizopathes* to be subgeneric and even intraspecific. Such interpretations most likely have been due to the considerable variability of many of the taxonomic characters in both genera. This has resulted in closely related species being synonymized (*B. alternata* with *B. patula* and *S. crassa* with *S. affinis*) by earlier workers, thereby causing generic boundaries to become less distinct.

Distribution.— Species of this genus are known from the Atlantic, Pacific and Indian Oceans.

***Stauropathes* gen. nov.**  
(figs 3-5)

[*Antipathes*] *sensu lato*; Brook, 1889: 160 (species *incertae sedis*).  
*Bathypathes*; Pax, 1932: 270 (in part).

Diagnosis.— Corallum sparsely to densely branched. Stem and branches pinnulate. Pinnules simple, bilateral in two rows, and subopposite. Spines triangular and compressed. Polyps usually 3-6 mm in transverse diameter.

Type species.— *Stauropathes stauocrada* spec. nov.

Type material.— See below.

Species assigned to *Stauropathes*.— In addition to the type species, other nominal species that can be assigned to the genus are *Antipathes arctica* Lütken (1872), and possibly *Tylopathes? punctata* Roule (1905).

Remarks.— *Stauropathes* is similar to some species of *Bathypathes*, particularly those that have subopposite pinnules. It differs from *Bathypathes* primarily in the extensive branching of the corallum, and in the relative shortness of the pinnules.

Etymology.— The genus name is derived from the Greek “*stauros*” (cross), in reference to the appearance of the subopposite pinnules, and the commonly used suffix “*pathes*”.

Distribution.— Species of this genus have been reported from the Arctic [*S. arctica* (Lütken)], eastern Atlantic [*S. punctata* (Roule)] and northcentral Pacific (*S. stauocrada* spec. nov.).

***Stauropathes stauocrada* spec. nov.**  
(figs 3-5)

Diagnosis.— Corallum branched and pinnulate. Stem and major branches largely in one plane. Pinnules simple, arranged in two anterolateral rows and also in subopposite pairs. Smallest, simple pinnules mostly 1-2 cm long and projecting out of one side of plane of corallum. Spines simple, triangular, compressed, smooth, and slightly larger on the polyp side of the axis; up to 0.06 mm tall. Polyps 2.4-4.0 mm in transverse diameter; uniserially arranged on one side of corallum, with two to three polyps per centimeter.



Fig. 3. *Stauropathes staurocrada* spec. nov., holotype (USNM 98846), entire corallum, height about 13 cm.

Material.— Holotype (USNM 98846); GenBank AY170478, submitted by M.R. Brugler and S.C. France, north central Pacific, Hawaii, Molokai Island, Penguin Bank, "Pisces V" dive P5-300, sta. PBS-110, spec. PBS-08, 20°59.377'N, 157°19.170'W, 19.ix.1996, 441 m, coll. S. C. France and E. A. Berntson; paratype (USNM 98847), north central Pacific, Hawaii, Molokai Island, Penguin Bank, "Pisces V" dive P5-300, sta. PBS-105, spec. PBS-04, 20°59.377'N, 157°19.170'W, 19.ix.1996, 414 m, coll. S. C. France and E. A. Berntson; paratype (USNM 77101; schizoparatype, RMNH Coel. 31005), north central Pacific, Hawaii, Kaiwi Channel, between Molokai and Oahu Islands, 21°12'10"N, 157°22'50"W, 19.iv.1902, 220-346 fm, R/V "Albatross" sta 3893; paratype (USNM 96965), north Pacific, south of Johnston Atoll, 14°27'23"N, 169°00' 10"W, 23.v.1985, 1700-1400 m, R/V Sonne.

Description of the holotype.— The holotype (fig. 3) is only the upper part of the colony (the remainder is being retained for molecular analysis by S.C. France of the College of Charleston, Charleston, SC). It is about 13 cm tall and 15 cm wide. The stem extends to the top of the corallum, and is about 1 mm in diameter at its basal end. The corallum is branched to the second and third order. The primary branches develop laterally, and several of the lowermost ones are almost as long as the stem. The smallest simple pinnules are arranged anterolaterally in two rows and also in subopposite pairs (fig. 4a). They are mostly 1-1.5 cm in length, 0.2-0.3 mm in diameter, and spaced 8-12

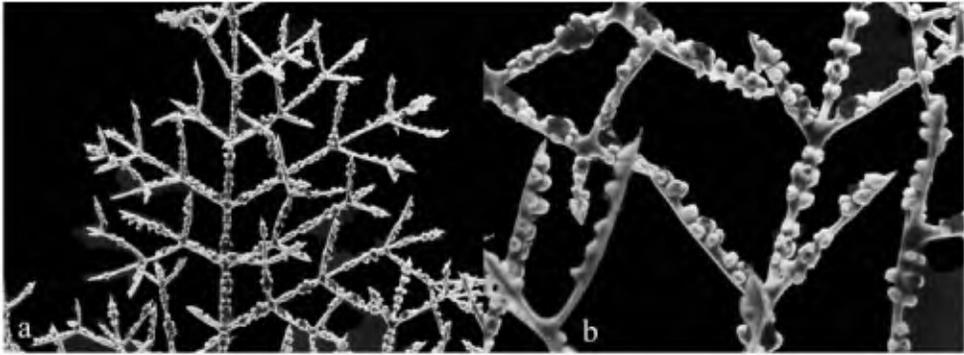


Fig. 4. *Stauropathes staurocrada* spec. nov., holotype (USNM 98846); a, section of branch (frontal view) showing arrangement of pinnules, 0.85  $\times$ ; b, close-up view of branchlet and pinnules showing polyps, approx. 2.5  $\times$ .

mm apart in each row (five to six occurring on each side along five centimeters of axis). The pinnules are inclined distally (distal angle formed with the stem about 60-70°) and they are also directed forward out of the general plane formed by the stem and branches (interior angle between subopposite pairs 90-150°). The longer pinnules (branchlets) are curved back somewhat towards the abpolypar side of corallum. Some of the pinnules overlap with one another and become fused.

The spines are triangular, laterally compressed, and have a rounded or acute apex (fig. 5a-d). They are nearly equal on all sides of the axis, or only slightly longer on the polyp side. The polypar spines are up to 0.04 mm tall. The spines on the pinnules are arranged in longitudinal rows, four to six of which can be seen in one view. They are spaced 0.12-0.24 mm apart, and there are on average about eight spines per millimeter in each row.

The polyps (fig. 4b) are arranged in a single row on one side of the pinnules (laterally relative to the direction of the branchlet) and on only one side of the branches and stem. The corallum, therefore, has a clearly defined polypar and abpolypar side. Polyps on subopposite pinnules tend to face towards each other. The polyps measure 2.4-2.8 mm in transverse diameter near the tips of the smallest pinnules, but are 2.8-4.0 mm (mostly 2.8-3.2 mm) on the larger pinnules and branches. There are two to three polyps per centimeter. The tentacles in the alcohol-preserved specimen are thick and blunt.

Remarks.— The other specimens assigned to this species (USNM 98847, 96965 and 77101) are similar to the holotype in having planar branching and a stem that extends from a basal plate to the top of the corallum. In USNM 98847, the corallum is 38 cm high, about 40 cm wide, and has a basal stem diameter of 4 mm. Only the lowermost 2 cm of the stem are not pinnulated. In USNM 96965 the stem is 30 cm in length and the lowermost 7 cm are not pinnulated. Starting about 5 cm above the basal plate and extending for about 4.5 cm the stem is modified into a series of grooves and ridges. In this specimen the lateral pinnules developing from the stem are only very weakly developed into pinnulated branches, and the entire corallum has a somewhat monopodial appearance. This specimen also differs from the holotype in having slightly longer pinnules (up to 2.5 cm) and taller spines (up to 0.06 mm).

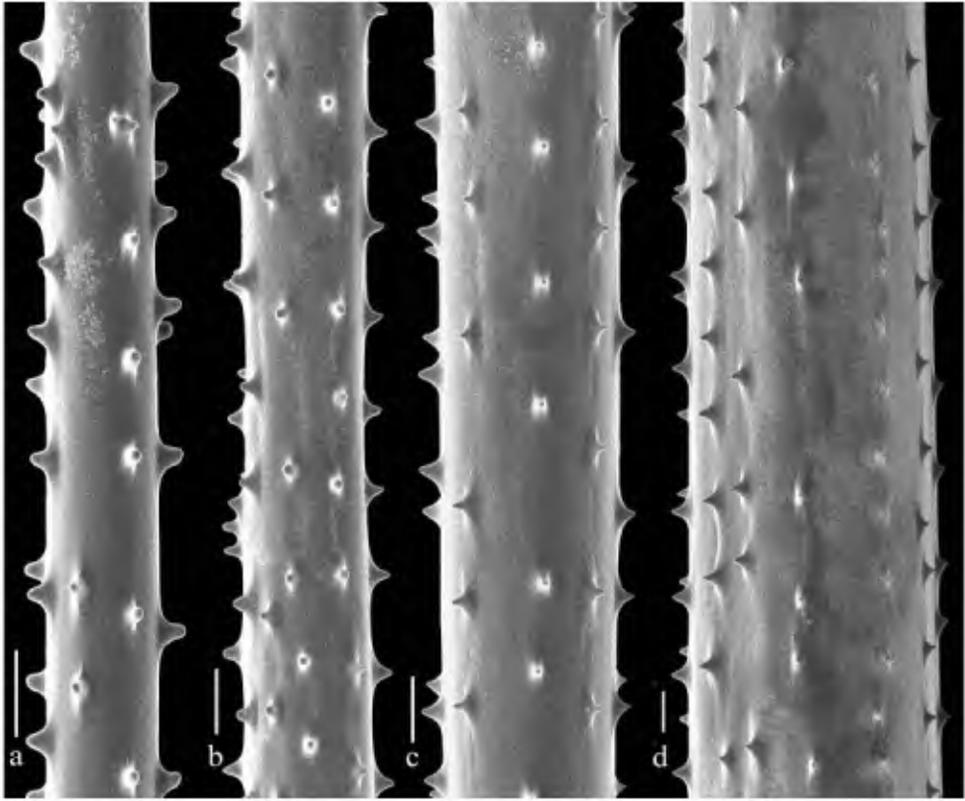


Fig. 5. *Stauropathes staurocrada* spec. nov., holotype (USNM 98846); a, spines on pinnule 0.13 mm in diameter; b, spines on pinnule 0.18 mm in diameter; c, spines on pinnule 0.28 mm in diameter; d, spines on branchlet 0.6 mm in diameter. Scale: 0.1 mm.

Comparisons.— This species is similar to *Stauropathes arctica* (Lütken, 1872) in pin-  
 nulation pattern, although in the latter species the pairs of pinnules of each higher order  
 stand off obliquely from those of the next lower order (see fig. 2 in Pax, 1932), whereas  
 in *S. staurocrada* the pinnules of each order tend to project more or less in the same direc-  
 tion - out of the front or polyp side of the corallum. The two species can also be differen-  
 tiated by the size of the polyps and spines. In *S. arctica* the polyps are as much as 6 mm  
 in transverse diameter, whereas in *S. staurocrada* they are about 3 mm and rarely more  
 than 4 mm in transverse diameter. The spines in *S. staurocrada* are, at most, 0.06 mm tall,  
 whereas those in *S. arctica* can be as much as 0.1 mm tall. The description of *Tylopathes?*  
*punctata* given by Roule (1905) is rather incomplete; neither the size of the spines nor the  
 size of the polyps is reported. Although the pinnules are similar in length to those in *S.*  
*staurocrada*, they are much more crowded (6-8 mm apart vs. 8-12 mm apart). (Note:  
 Roule was uncertain of the generic assignment for this species).

Etymology.— The specific name is derived from the Greek "stauros" (cross) and  
 "crada" (branch), in reference to the cross-like appearance of the pinnules.

Distribution.— Known only from the north central Pacific.

***Abyssopathes* gen. nov.**  
(figs 6-7)

*Bathypathes* Brook, 1889: 151 (in part); van Pesch, 1914: 85 (in part).

Diagnosis.— Corallum monopodial and attached; with two rows of lateral pinnules arranged alternately, and a single or multiple row of anterior pinnules. Lateral pinnules simple, elongate, decreasing in size towards the top of the corallum. Anterior pinnules usually very short, simple or subpinnulate, straight or curved distally. Spines triangular, compressed, smooth, acute. Spines on anterior pinnules similar in size or slightly larger than those on lateral pinnules. Polyyps 5-6 mm in transverse diameter.

Type species.— *Bathypathes lyra* Brook (1889: 154-155. pl. 6, figs. 4-6).

Type material.— Lectotype, herein designated (BMNM 1890.4.9.22), north central Pacific, 36°10'N, 178°0'E, 2.vii.1875, 2050 fm, HMS "Challenger" sta. 246; paralectotype (BMNM 1890.4.9.23), IndoPacific, Coral Sea, 13°50'S, 151°49'E, 25.viii.1874, 2440 fm, HMS "Challenger" sta. 181.

Description of the type species.— A description of the type specimens of *Bathypathes lyra* is given by Brook (1889: 154). A brief summary of Brook's description, supplemented by additional observations, is provided here.

The corallum of the lectotype (see pl VI, fig. 4, in Brook, 1889) is monopodial, about 11.5 cm tall, and has a small basal attachment plate. Just above the base the stem curves so that it is at right angles to the lower portion. Beginning about 1.3 cm from the base and continuing to near the apex of the corallum there are 18 bilaterally arranged pinnules; nine on each side. These lateral pinnules are simple, filiform, up to 11.5 cm long at the base of the corallum and decreasing in length toward the apex. They are spaced 6-14 mm apart on each side of the axis, and are curved upward and toward the top of the corallum, with many reaching a point level with the apex. They are arranged alternately, except the lowermost pair which are subopposite. In addition to the lateral pinnules there is a series of short, anterior pinnules extending out at right angles to the stem. These anterior pinnules average about 6 mm in length; they are spaced about 6 mm apart on the lower portion of the stem, but become more crowded towards the upper part of the corallum.

The spines are triangular, compressed, smooth, with an acute to rounded apex; subequal in length around circumference of axis, and, as estimated from the illustration provided by Brook (1889), are about 0.03 mm from the middle of the base to the apex.

The polyyps are approximately 5 mm in transverse diameter and are placed in a single series on one side of the pinnules. There are about two polyyps per centimeter of axis.

Species assigned to *Abyssopathes*.— Only one other species, *Abyssopathes lyriformis* spec. nov. (see below) can currently be assigned to this genus. The two species are separated primarily on the basis of the degree of subpinnulation of the anterior pinnules.

Remarks.— *Abyssopathes* is similar in general appearance to a species described by Kinoshita (1910) as *Hexapathes heterosticha*. The latter species was reported to have simple, elongate bilateral pinnules, as well as numerous, mostly short, anterior pinnules. Furthermore, the polyyps in *H. heterosticha* were reported to be 5-9 mm in transverse length, similar in size to those of *Abyssopathes*. The major difference between the two genera appears to be in the number of mesenteries in the polyyps.

Kinoshita (1910) reported that the polyps of *H. heterosticha* have only six mesenteries, whereas, *Bathypathes lyra* was originally placed by Brook (1889) in the Schizopathinae, implying that the polyps possess ten mesenteries. Because there is no evidence that Brook examined the internal anatomy of the polyps, there remains the possibility that this species possesses only six mesenteries. Polyps of neither *Abyssopathes lyra* (Brook) nor those of *A. lyriformis* spec. nov. (see below) were available for microscopic examination.

**Etymology.**— The genus name is derived from the Greek “abyssos”, in reference to the typical bathymetric distribution of species of this genus, and the commonly used suffix “pathes”.

**Distribution.**— Species of this genus are cosmopolitan and are found mainly at abyssal depths. Pasternak (1977) reported a depth range of 3500-6000 m for *A. lyra* (Brook).

*Abyssopathes lyriformis* spec. nov.  
(figs 6-7)

**Diagnosis.**— Corallum monopodial and pinnulate. Pinnules arranged in two lateral or anterolateral rows and one multiple anterior row containing two to three times the number of pinnules in either lateral row. Lateral pinnules simple; anterior pinnules usually with one, rarely two, secondary pinnules. Tertiary pinnules very rarely present on some secondary pinnules. Spines on the lateral pinnules triangular, compressed, 0.02-0.04 mm long; those on anterior pinnules and subpinnules up to 0.06 mm long, and often inclined distally. Three to four rows of spines seen in lateral view; with three to eleven spines per millimeter in each row. Polyps unknown.

**Material.**— Holotype (USNM 83567), central Pacific: Magellan Rise, 7°N, 177°W, 17-18.iii.1987, depth not reported, Scripps Institute of Oceanography, R/V “Atlantis” II; USNM 78818, off Antarctica, 66°01'S, 176°15'W, to 67°07'S, 176°18'W, 9.i.1967, 3459-3492 m, R/V “Eltanin”, cruise 27, sta. 1859.

**Description of the holotype.**— The holotype is a small colony, 6.5 cm tall and about 4 cm in width (fig. 6a). The stem diameter is 0.35 mm just above the basal plate. The lower unpinnulated portion of the stem is 8 mm long. Starting about 1 mm above the basal plate and extending for 5 mm is a region of distinct axial ridges and grooves which follow a very open spiral pattern around the stem. The stem is not straight but instead somewhat sigmoidal. It extends vertically a short distance, at which point it tilts backward at an angle of about 45°, and then gradually curves upward. The two lowermost lateral pinnules are inserted nearly opposite one another; all the others are inserted alternately. All are inclined distally and also curve away from the side of the stem carrying the anterior pinnules. The longest lateral pinnules eventually curve back so that the tips of those on one side are directed towards the tips of those from the opposite side (see fig. 6a). The distal angle formed by the lateral pinnules and the stem is 60-70° on the lower parts of the corallum; this angle decreases to about 30° near the top of the corallum. The interior angle formed by the two rows of lateral pinnules is 160-180°. The lowermost lateral pinnules are 7 cm long and about 0.02 mm in diameter near their base. The pinnules decrease regularly in length higher up on the corallum such that the uppermost pinnules are only about 1 cm in length. Within each lateral row the pinnules are spaced 4-5 mm apart, resulting in an average of about two pinnules per centimeter.

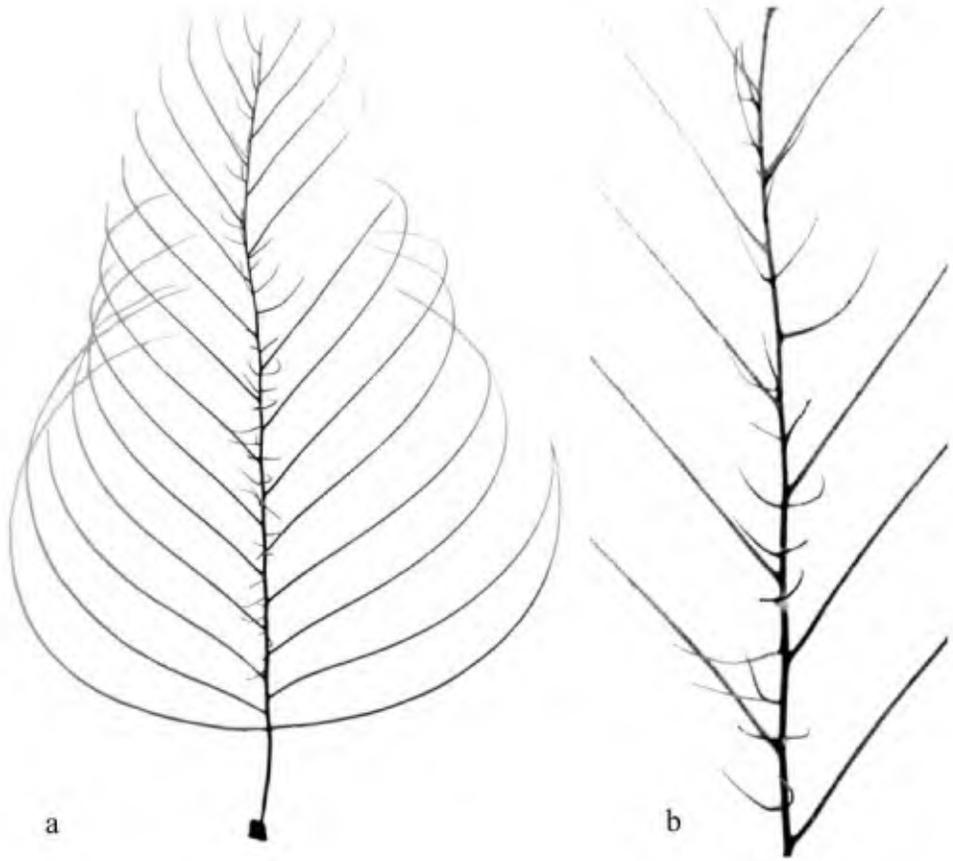


Fig. 6. *Abyssopathes lyriformis* spec. nov., holotype (USNM 83567); a, entire corallum, height about 6.5 cm, 1.7  $\times$ ; b, close-up view of center part of corallum showing anterior pinnules, approx. 4.6  $\times$ .

The anterior pinnules (fig. 6b) are arranged in an irregular double to triple row, meaning that the density of the pinnules is two to three times greater than that in either lateral row. They are spaced 1-2 mm apart, and as many as 13 occur along a 2-cm segment of the stem. The anterior pinnules are 4.5-5.5 mm long and stand out at right angles to the stem or are slightly inclined or curved distally. On most anterior pinnules, about 0.5 to 0.8 mm from the base, there is a single short subpinnule (secondary pinnule) usually extending out laterally (distal angle about 45°) and then curving to become almost parallel to the anterior pinnule from which it arises. These subpinnules are 3-4 mm long. On one anterior primary pinnule there are two secondary pinnules which arise at nearly the same point. In addition, one secondary pinnule has a small tertiary pinnule near its tip.

The spines (fig. 7a-d) on both the lateral and anterior pinnules are very small; those on the lateral pinnules are not more than 0.04 mm long (fig. 7b-d) and those on the anterior pinnules are not more than 0.06 mm long (fig. 7a). The spines on the lateral pinnules are equilateral or with the distal edge perpendicular to the axis; they are spaced 0.18-

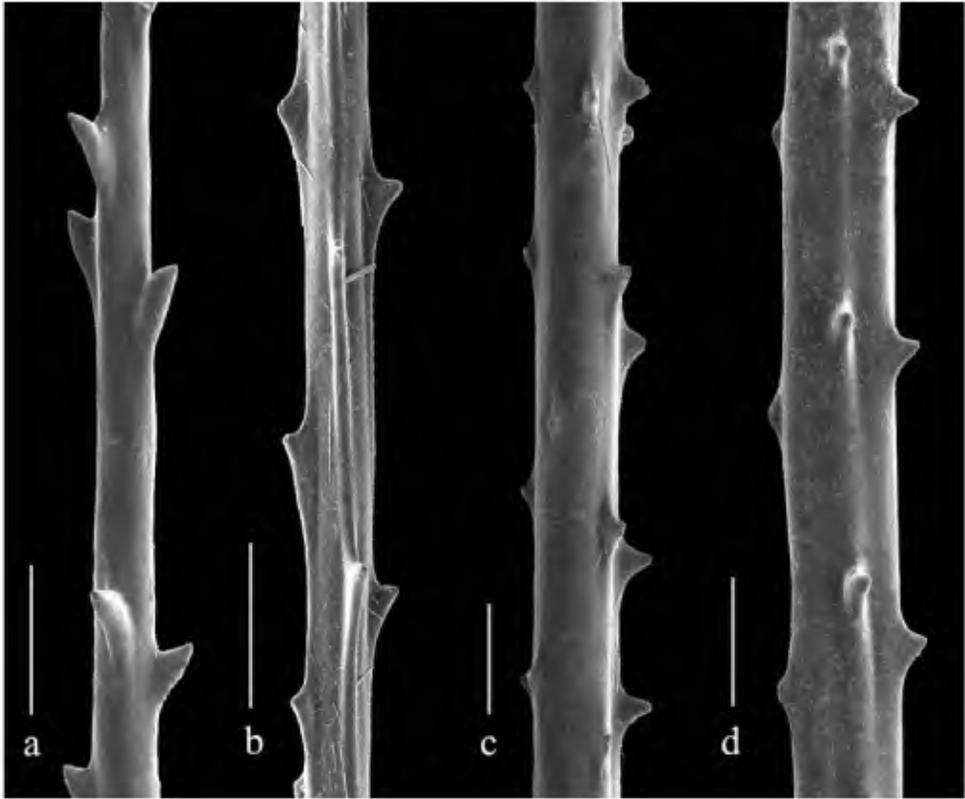


Fig. 7. *Abyssopathes lyriformis* spec. nov., holotype (USNM 83567); a, spines on anterior pinnule 0.09 mm in diameter; b, spines near tip of lateral pinnule 0.04 mm in diameter; c, spines on section of lateral pinnule 0.07 mm in diameter; d, spines on section of pinnule 0.09 mm in diameter. Scale: 0.1 mm.

0.22 mm apart with five to six spines per millimeter in each row. Three rows are visible in lateral view. Spines on the anterior pinnules tend to be inclined distally.

Polyps are not present on this specimen.

Remarks.— The “Eltanin” specimen tentatively referred to this species differs from the holotype in the relative development of the secondary pinnules on the anterior primaries. It generally has two secondary pinnules on each anterior and sometimes even three. It is possible that this difference represents more than just intraspecific variability.

Comparisons.— *Abyssopathes lyriformis* spec. nov. is closely related to *Abyssopathes lyra* (Brook), but differs in several characters. *A. lyriformis* has a single secondary pinnule on almost all of the anterior primary pinnules, whereas *A. lyra* has no secondary pinnules, even in colonies of similar size. The lateral pinnules in *A. lyriformis* are closer together (4–5 mm) than those in *A. lyra* (mostly 6–14 mm), and the density of the anterior pinnules is also greater (six to seven per centimeter vs. a maximum of about three per centimeter). Furthermore, in *A. lyriformis* some of the spines on the anterior pinnules are slightly larger (fig. 7a) than those on the lateral pinnules (fig. 7b–d), whereas in *A. lyra*, the spines are subequal on lateral and anterior pinnules.

Etymology.— From the Latin “lyre”, and “formis”, in the shape of, in reference to the general appearance of the corallum.

Distribution.— The type came from the Central Pacific; the “Eltanin” specimen from Antarctic waters.

*Saropathes* gen. nov.

(fig. 8)

*Bathypathes*; Totton, 1923: 98-100 (in part).

Diagnosis.— Corallum monopodial and pinnulate to the fourth order. Primary pinnules arranged in four rows and also in alternating groups of two each. Subpinnules arranged uniserially on anterior (polyp) side of lower order pinnules. Spines triangular compressed, smooth, acute. Polyyps 2.8-3.4 mm in transverse diameter.

Type Species.— *Bathypathes scoparia* Totton, 1923: 98-100, pl. 2, figs 3-4, text fig. 1, 2b.

Type material.— Holotype (BMNH 1923.10.19.1), New Zealand, 7 miles east of North Cape, 2.viii.1911, 70 fm, “Terra Nova” Expedition, sta. 96.

Description of the type species.— A detailed description of the holotype of *Bathypathes scoparia* is given by Totton (1923: 98). A brief summary of Totton’s description is presented here (the illustrations of the holotype are reproduced in fig. 8a-c).

The corallum consists of four broken pieces whose total length is 42 cm. The primary pinnules are arranged in four rows; with the two outer, more lateral rows set in planes which form an angle of 100°; the two inner (anterior) rows form an angle of 35° (fig 8b). The outer lateral primary pinnules are spaced 6-8 mm apart in each row and are arranged alternately along the stem. Each anterior primary pinnule is positioned about 2 mm below the adjacent lateral primary on the same side of the axis. The lateral primary pinnules are 11 to 18 cm long, the anterior ones are 6 to 15.5 cm long. Both lateral and anterior primaries are slightly inclined distally towards the top of the corallum (fig. 8a). The lateral primaries bear up to six uniserially arranged secondary pinnules, 11 to 17 cm in length; these form a narrow distal angle (15-20°) with the primary on which they are situated (fig. 8b). The secondary pinnules bear two or three uniserially arranged tertiary pinnules, and the tertiaries bear two or three quaternary pinnules (fig. 8b). All form narrow distal angles with the lower order pinnule from which they arise. The anterior primary pinnules bear two or three uniserially arranged secondary pinnules 5-14 cm in length: these secondary pinnules only rarely bear tertiary pinnules.

The spines are triangular, simple, 0.036 to 0.075 mm tall and 0.45 mm apart in the same row. The polyyps are 2.8 to 3.4 mm in length and placed in a single series on the side of the pinnules bearing subpinnules. The interpolypar distance is 0.6 mm, and the tentacles are about 2.2 mm long.

Species assigned to *Saropathes*.— Although no other nominal species are currently assigned to this genus, examination of the collections of the National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand, has revealed several specimens which appear to be distinct from *S. scoparia*.

Remarks.— Based on similarities in the morphology of the corallum, *Saropathes* appears to be related to *Dendrobathypathes* gen. nov. (see below for further discussion).

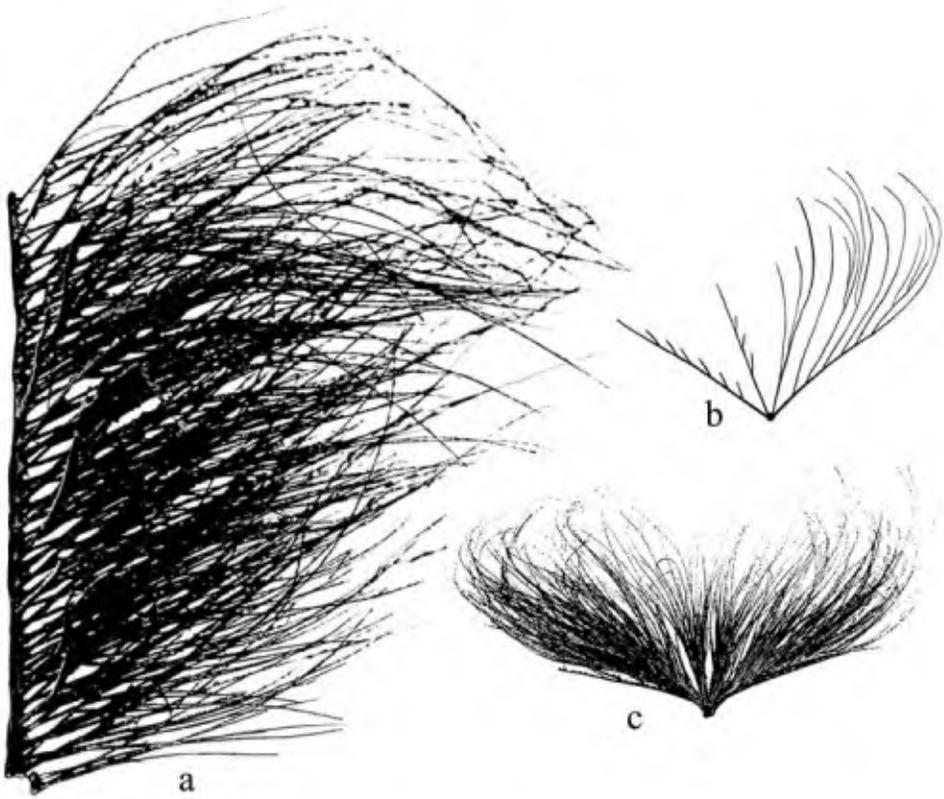


Fig. 8. *Saropathes scoparia* (Totton, 1923), digital scan of the illustration of holotype, from Totton, 1923; a, lateral view of section of corallum, approx. 0.5  $\times$ ; b, cross section of corallum showing one series of pinnules and subpinnules, approx. 0.25  $\times$ ; c, cross section of corallum showing multiple series of pinnules, approx. 0.3  $\times$ .

Etymology.— The genus name is derived from the Greek, “saron” (broom), and the commonly used suffix “pathes”.

Distribution.— The type of *Bathypathes scoparia* Totton was collected off the coast of New Zealand. The species has not been reported from any other locality.

***Dendrobathypathes* gen. nov.**

(figs 9-14)

Diagnosis.— Corallum monopodial to sparsely branched, and complexly pinnulate. Stem, branches, and primary pinnules generally in one plane. Primary pinnules arranged alternately in two bilateral rows. Secondary pinnules occurring on anterolateral sides of primaries; arranged uniseriably to biseriably. Tertiary and quaternary subpinnules arranged similarly on front side of lower order pinnules. Spines triangular, laterally compressed, smooth, acute, simple or rarely bifurcate at apex; up to 0.15 mm tall; polypar spines usually larger than abpolypar spines. Polyps 3-5 mm in transverse diameter.

Type species.— *Dendrobathypathes grandis* spec. nov.

Type material.— See below.

Species assigned to *Dendrobathypathes*.— In addition to the type species, one other species, *Dendrobathypathes isocrada* spec. nov., can be assigned to this genus (see below).

Remarks.— *Dendrobathypathes* gen. nov. is similar to *Saropathes* gen. nov. in the general arrangement of the pinnules and subpinnules, in the size of the spines, and in the size of the polyps. The major difference between the two genera is in the number of rows of primary pinnules and in the relative development of the subpinnules. *Dendrobathypathes* has two rows of primary pinnules and *Saropathes* has four rows. The subpinnules in the latter genus are uniserial, whereas those in *Dendrobathypathes* start out uniserial on the basal portion of the lower order pinnule, but become biserial in arrangement distally and eventually develop into a pinnulated branch.

Etymology.— The genus name is derived from the Greek “dendro” (tree), and the genus name “*Bathypathes*”, in reference to the branched pinnules which differentiate this genus from *Bathypathes*.

Distribution.— Both species of this genus have been collected in southern oceans, one species near the South Georgia Islands, and the other south of Australia and near New Zealand.

*Dendrobathypathes grandis* spec. nov.

(figs 9-11)

Diagnosis.— Corallum sparsely branched; densely pinnulate; stem, branches, and primary pinnules generally in one plane; secondary pinnules on each primary pinnule extending out laterally on one side of the plane containing the primary pinnules and stem. Primary pinnules arranged alternately along the stem and branches in two anterolateral rows. Secondary pinnules arranged mostly uniserially on front side of primary pinnules; biserial arrangement occurring distally on the largest primaries. Tertiary and quaternary pinnules, when present, arranged uniserially on front side of the lower order pinnules. Spines simple (rarely forked), conical, acute, slightly compressed; larger on one side of the axis (usually but not always corresponding to the polyp side). Polypar spines up to 0.15 mm tall; abpolypar spines 0.08 mm or less (sometimes absent). Polyps 3-5 mm in transverse diameter; arranged in one series with two to three polyps per centimeter.

Material.— Holotype (USNM 100114; schizoholotype, RMNH Coel. 31002), south Atlantic Ocean, Scotia Sea, off west tip of South Georgia Island, 54°29'S, 39°22'W to 34°31'S, 39°19'W, 8.ii.1966, 659-686 m, R/V “Eltanin”, sta. 1536; paratype (USNM 100131), south Atlantic Ocean, west of South Georgia Islands, 53°20'S, 42°42'W, 29.xi.1986, 417-514 m, R/V “Siedlecki”, Cruise 601, sta. 2.

Description of the holotype.— The holotype is 19 cm tall, about 9 cm wide and 2-4 cm thick (fig. 9). The tip of the stem and the basal plate are missing. Although there is a stump of a lateral pinnule about 4 mm from the basal end of the stem, there are no pinnules on the opposite side for 1.2 cm, suggesting that the colony may have been broken off near the basal plate. The stem at the basal end is 1.7 x 2.1 mm in diameter. The primary pinnules are situated along the stem in two anterolateral rows and they are arranged in an alternating pattern (fig. 10a). Within each row the pinnules are



Fig. 9. *Dendrobathypathes grandis* spec. nov., holotype (USNM 100114), entire corallum, height about 19 cm.

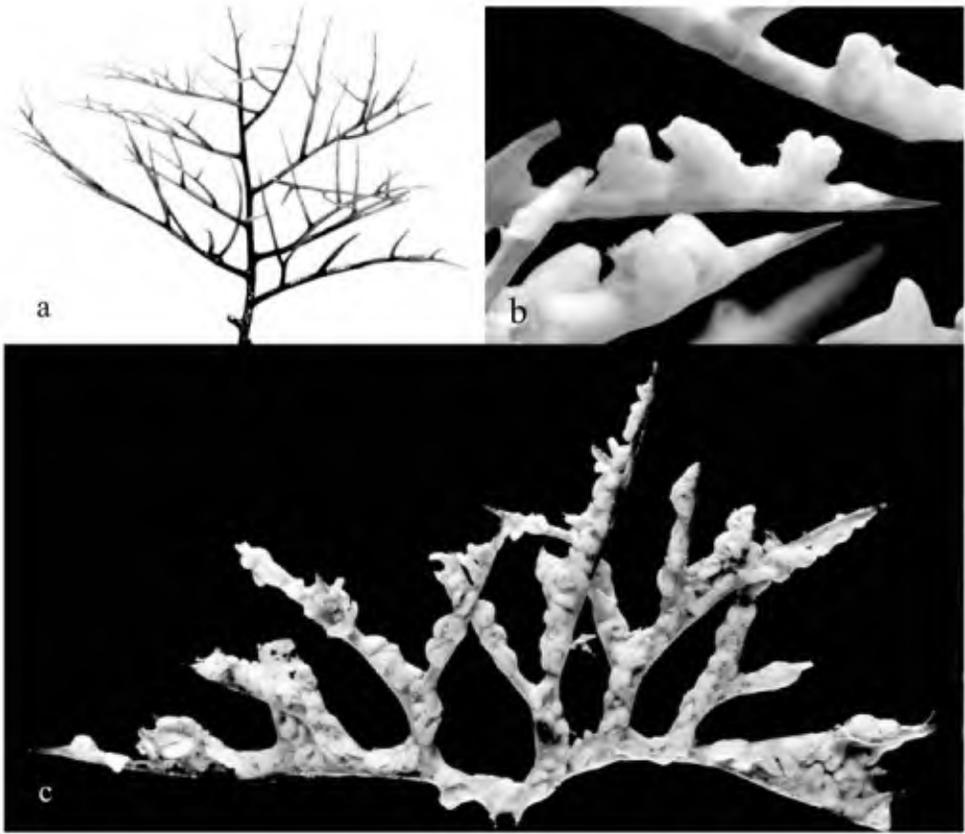


Fig. 10. *Dendrobathypathes grandis* spec. nov., holotype (USNM 100114); a, frontal view of apical end of branch showing arrangement of pinnules, 1.3  $\times$ ; b, close-up view of polyp, approx. 8  $\times$ ; c, cross section of branch showing arrangement of pinnules, 2.2  $\times$ .

spaced 5-10 mm apart (usually 6-7 mm); on average, there are two to three per centimeter. One of the lowermost primary pinnules is developed into a pinnulated branch, as is a secondary pinnule on the upper portion of the corallum. The interior angle formed by the two rows of lateral primary pinnules is 150-180° (fig. 10c). These pinnules are inclined slightly towards the upper end of the corallum (distal angle of 70-80°), and also curved back toward the posterior side of the corallum. Most are more than 3.5 cm long; the longest is 4.5 cm and has a basal diameter of about 1.0 mm (including spines). The primary pinnules possess secondary pinnules which, on most primaries, are arranged uniseriably on one side, and project out of the plane defined by the primary pinnules and the stem (fig. 10c). The secondary pinnules are inclined and curved towards the distal end of the primary pinnule from which they arise. On the larger primary pinnules, the most distal secondary pinnules are bilateral with a very narrow interior angle, suggesting that they might be incipient pinnulate branches. There are as many as eight secondary pinnules arranged uniseriably and two to four more distal ones arranged bilaterally. The secondary pinnules are mostly 1.5-2

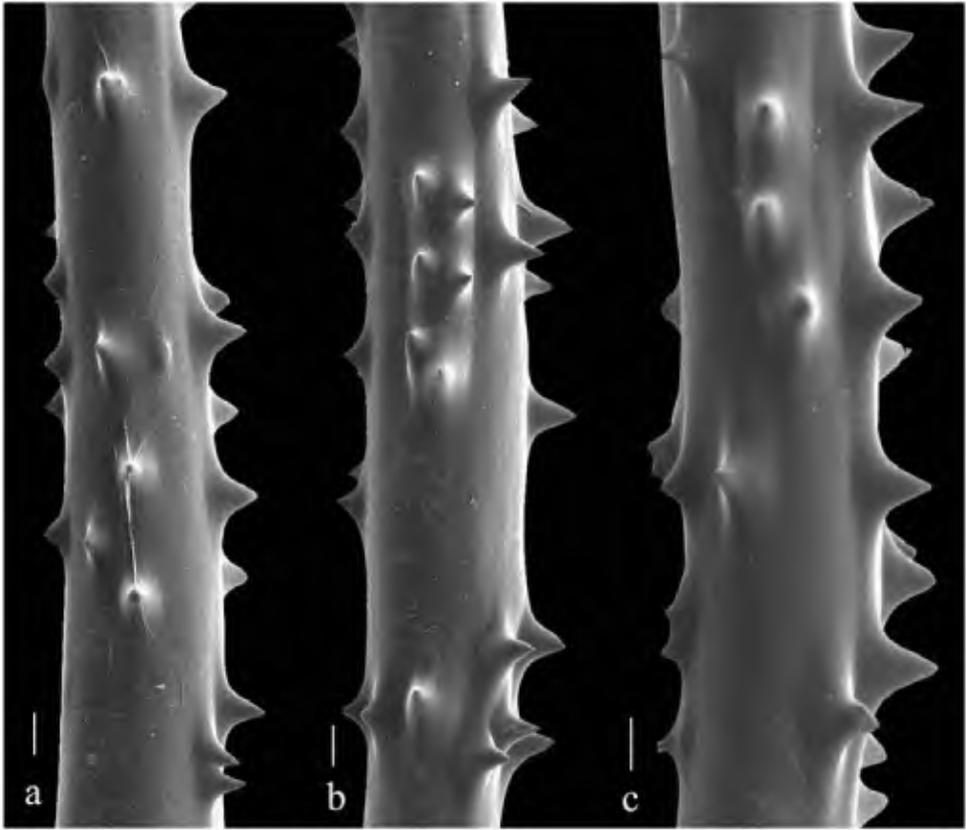


Fig. 11. *Dendrobathypathes grandis* spec. nov., holotype (USNM 100114); a, spines on pinnule 0.35 mm in diameter; b, spines on pinnule 0.4 mm in diameter; c, spines on pinnule 0.38 mm in diameter. Scale: 0.1 mm.

cm long, but can be up to 4 cm long, particularly near the base of the primaries. They are curved back towards the pinnule from which they arise and decrease in size towards the tip of the primary. Tertiary pinnules occur on many of the larger secondary pinnules (fig. 10c). They are also arranged uniserially, with up to five occurring on a secondary pinnule 4 cm in length. The largest ones, which occur near the base of the secondaries are up to 2 cm long and about 0.5 mm in diameter; the size of the more distal ones decreases towards the tip of the secondary pinnule. The tertiary pinnules lie in the same plane as the secondaries, or are angled downward toward the base of the corallum. The tips of the pinnules and subpinnules have very narrow walls and a relatively large central canal about 0.3 mm in diameter.

The pinnular spines (fig. 11a-c) are generally conical, acute, and slightly compressed laterally. They are arranged in very irregular axial rows, five to six of which are usually visible in lateral view. Within each row they are spaced at varying distances, from about 0.20 to 0.50 mm apart, and sometimes they occur in groups of two or three. The pinnular spines are usually larger on the side of the axis corresponding to the polyp side;

however, they can be offset to varying degrees from the polyp side and sometimes even appear to occur on the side opposite the polyps. The largest spines are mostly 0.08-0.10 mm tall, as measured from middle of the base to the apex, but they can be as large as 0.15 mm. The "abpolypar" spines are mostly 0.03 to 0.08 mm tall and are sometimes absent. In places some of the polypar spines appear to be directed basally. The tips of the pinnules lack spines, an apparent result of the sclerenchyme growing in spurts. The spines near the basal end of the stem are relatively small, about 0.06 mm.

Polyps occur only on the front or pinnulated side of the corallum (fig. 10c). They are arranged uniserially; usually on the lateral side of the pinnules and subpinnules, and thus facing out at right angles to the general vertical direction of the corallum. In some places, however, they are placed more towards the lower side of the pinnules. The polyps (fig. 10b) are mostly 3.5 mm to 4.0 mm (range 3-5 mm) in transverse diameter (from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles). The oral cone is about 1 mm high and the tentacles are up to 2 mm long in the alcohol-preserved material. The interpolypar space ranges from about 0.5 to 1.0 mm, and there are two to three polyps per centimeter.

Remarks.— The paratype was also collected in the south Atlantic, west of the South Georgia Islands. It is similar to the holotype in many respects. The corallum is 34 cm tall and has only one major branch, 27 cm long, arising from a lateral pinnule near the basal end of the stem. The primary pinnules are generally 2-3 cm long (maximum 4.5 cm) and about 7 mm apart in each lateral row. The largest primary pinnules have at least two and sometimes three orders of subpinnules. There are eight or nine secondary pinnules on the longest primaries and one or two tertiary pinnules (usually 1 cm or less in length) on the lowermost two or three secondaries. Fourth order subpinnules are occasionally found on the lowermost tertiary pinnules.

Comparisons.— This species can be differentiated from the related species *D. isocrada* spec. nov. by the thicker branches and pinnules, by the horizontally directed primary pinnules, and by the more extensive subpinnulation.

Etymology.— From the Latin "grandis" (large), in reference to its larger size and thicker branches in comparison to *D. isocrada* spec. nov.

*Dendrobathypathes isocrada* spec. nov.  
(figs 12-14)

Diagnosis.— Corallum branched and pinnulate. Stem, branches, and primary pinnules generally planar; secondary pinnules projecting out of one side of plane. Stem not distinct or only slightly thicker than thickest branches; stem and primary branches vertically directed and nearly parallel. Primary pinnules arranged alternately in two anterolateral rows with narrow interior angle at point of insertion; tending to curve posteriorly. Secondary pinnules projecting out of front side of corallum; arranged uniserially on basal portion of pinnule, becoming biserial on distal section. Tertiary pinnules occasionally present near base of secondaries. Branches and pinnules overlapping and adhering. Spines simple, conical, compressed; subequal to distinctly larger on one side of axis, although not always corresponding to the side bearing the polyps. Largest spines up to 0.10 mm tall (from apex to middle of base); spines on opposite side of axis 0.03-0.05 mm (sometimes absent). Polyps 2.5-4 mm in transverse



Fig. 12. *Dendrobathypathes isocrada* spec. nov., holotype (SAM H 905), entire corallum, height about 16 cm.

diameter; arranged in one row with two to three polyps per centimeter.

Material.— Holotype (SAM H 905; schizoholotype, USNM 99403; schizoholotype, RMNH Coel. 31004), Australia, ~125 nautical miles S of Eucla, S. Australia, 33°45'S, 129°17'E, 1.viii.1988, 999-1110 m, F/V "Adelaide Pearl", coll. K. Gowlett-Holmes, K. Olsson and M. Cameron; paratype (SAM H-747; schizoparatype, USNM 99408), Australia, Great Australian Bight, 33°39'S, 129°50'E, 12.xii.1989, 1015-984 m, F/V "Longa"



Fig. 13. *Dendrobathypathes isocrada* spec. nov., from schizoholotype (USNM 99403); a, frontal view of branch showing arrangement of pinnules, 2 ×; b, close-up view of polyps, approx. 9 ×.

III, coll. K. Gowlett-Holmes; paratype (SAM H-749), Australia, Great Australian Bight, ~75 nautical miles SSW of Pearson Id., 12.iv.1989, 35°08'S, 133°47'E, 920-1040 m, F/V "Comet", coll. K. Gowlett-Holmes; paratype (USNM 100112; schizoparatype, RMNH Coel. 31003), South Pacific Ocean, New Zealand, Macquarie Ridge, 52°17'S, 160°40'E, 9.ii.1965, 659-798 m, R/V "Eltanin", Cruise 16, sta. 1414.

Description of the holotype.— The holotype (SAM H-905) is about 16 cm high, 6-8 cm wide, and 2-3 cm thick (fig. 12). The basal plate is missing; the diameter of the largest branch at its basal end is about 0.6 mm. The corallum consists of several long, pinnulate branches (maximum length 12 cm) lying in nearly the same plane and extending vertically over most of their course. The branches and branchlets have two rows of anterolateral pinnules arranged in an alternating pattern (fig. 13a). Although the interior angle formed by the two rows is 30-45°, the pinnules are curved back so that they tend to lie in the same plane as the stem and branches. Several orders of small, subpinnules project out of one side of the corallum, with many overlapping and adhering. Consequently, the entire corallum forms a mass 2-3 cm thick.

The primary pinnules are spaced 3-4 mm apart within each row, resulting in three to four per centimeter. The distal angle that each primary pinnule forms with the stem is 60-80°; however, because they also curve distally (i.e., towards the distal end of the branch on which they originate), the apparent distal branch angle (the angle that they subtend over most of their upper course) is close to 45°.

The primary pinnules are up to 5 cm long and up to 0.4 mm in diameter near their base. The longest primary pinnules on the largest branches have eight to twelve secondary pinnules, all located on the same side of the axis and arranged in a single

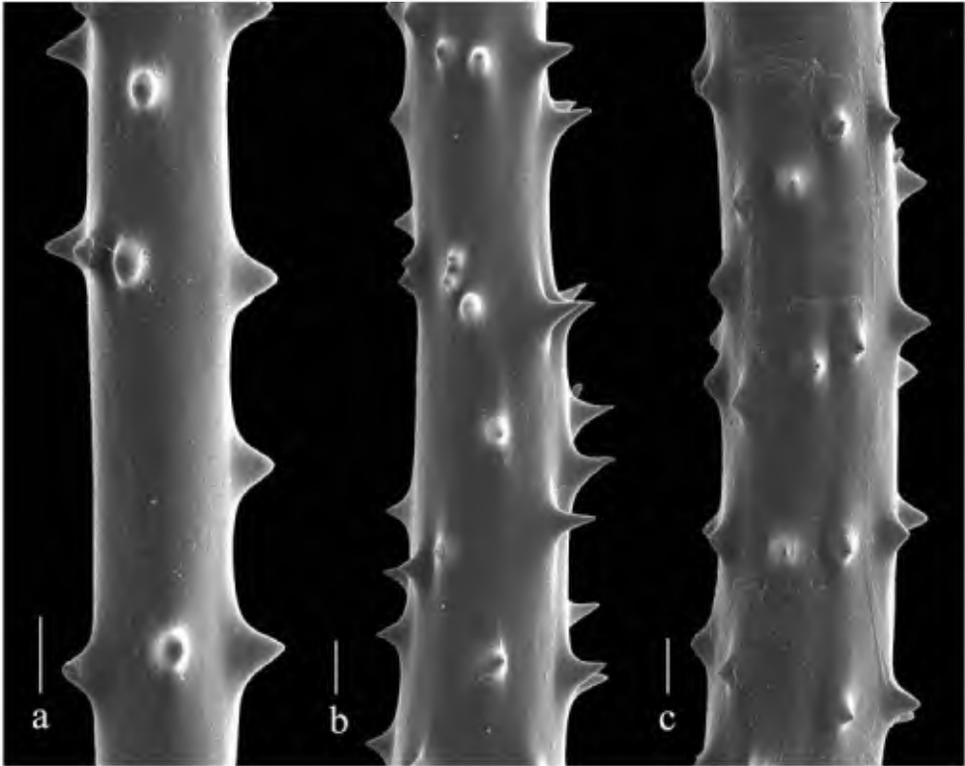


Fig. 14. *Dendrobathyopathes isocrada* spec. nov., from schizoholotype (USNM 99403); a, spines on pinnule 0.18 mm in diameter; b, spines on pinnule 0.29 mm in diameter; c, spines on pinnule 0.33 mm in diameter. Scale: 0.1 mm.

series or in a double series with a very narrow interior angle; the double series becoming more apparent on the distal sections of the primary pinnules. To varying degrees the secondary pinnules all project out of the same side of the corallum; those on adjacent primaries in opposite rows lying parallel to, or inclined towards each other. The secondary pinnules are as much as 2 cm long and 0.3 mm thick, and the larger ones have one or two tertiary pinnules near their base. The tertiary pinnules are usually not more than 1 cm long; they become secondary pinnules when the primary pinnule develops into a pinnulated branch. In some cases tertiary pinnules develop into pinnulated branches. The smallest simple pinnules on the corallum are typically 0.5-1.0 cm long and 0.2-0.3 mm in diameter.

The spines (fig. 14a-c) on the pinnules are generally conical, acute, and slightly compressed. They are arranged in axial rows of varying regularity, four to six of which can be seen in lateral view. Within each row they are spaced 0.2 to 0.5 mm apart, usually with three to four per centimeter. The spines on the pinnules are slightly larger on one side of the axis, but this does not always correspond to the polyp side of the axis. They are generally at right angles to the direction of the axis, but some have the appearance of being directed basally. Most spines are 0.04-0.06 mm tall as

measured from the midpoint of the base to the apex, but some reach a size of 0.08 mm. Some spines at the basal end of the largest branches are distorted in shape and appear swollen, while others are bifurcated.

All polyps (fig. 13a-b) occur on one side of the corallum, corresponding to the side that has projecting subpinnules. The polyps are arranged uniserially on the surface of the pinnules. Most are 3.0-3.5 mm in transverse diameter (range 2.5-4.0 mm) from the distal edge of the distal lateral tentacles to the proximal edge of the proximal lateral tentacles (fig. 13b). The interpolypar space is about 0.5 mm, and there are two to three polyps per centimeter.

Remarks.— The paratypes are similar to the holotype in having a planar corallum consisting of a series of parallel pinnulated branches with frequent fusions between adjacent pinnules and subpinnules. In one paratype (SAM H-747) the primary pinnules are more inclined distally than those in the holotype; with the interior angle formed by the two rows of lateral primary pinnules being about 30°. Although the distal angle at the point of insertion on the stem is near 90°, over the next 1-2 mm the pinnules are strongly curved distally so that they appear almost to parallel the course of the branch from which they arise. The smallest, simple pinnules are typically 0.5-1.0 cm long and 0.2-0.25 mm in diameter. The largest spines are 0.8-0.10 mm tall, and the polyps are 2.8-3.6 mm in transverse diameter.

Comparisons.— This species is differentiated from *D. grandis* spec. nov. by the lack of a clearly defined stem, by the parallel main branches, by the greater degree of branching, by the more distally directed primary pinnules, and by the fusion of adjacent pinnules and subpinnules.

Etymology.— From the Greek “iso” (like), and “crada” (branch), in reference to the development of several equally strong and parallel main branches on the corallum.

Distribution.— Known from the South Pacific Ocean, from waters south of Australia to just west of New Zealand.

### **Parantipathinae Roule, 1905**

Parantipathidae Roule, 1905: 38.

Diagnosis.— Polyps reaching a maximum size of 2-3 mm in transverse diameter; corallum monopodial or branched; pinnules simple.

Remarks.— Roule (1905) proposed placing *Parantipathes* in a family separate from both the Schizopathidae and the Antipathidae. This may eventually be shown to be a valid approach; however, it would be desirable to have additional characters besides the absolute size of the polyps to clearly differentiate such a family from the Schizopathidae.

As defined here, the subfamily contains, in addition to *Parantipathes*, the genus *Taxipathes* and the new genus *Lillipathes*.

### ***Parantipathes* Brook, 1889, emend.**

(fig. 15)

*Parantipathes* Brook, 1889: 141 (in part); Roule, 1905: 75; Silberfeld, 1909a: 761; 1909b: 10; van Pesch, 1914: 96 (in part); Pax, 1918: 469; 1987: 206; Gravier, 1918b: 236; 1921: 16; Opresko, 1972: 986; 1974: 50; 1997: 147 (in part); Grasshoff, 1981: 962.

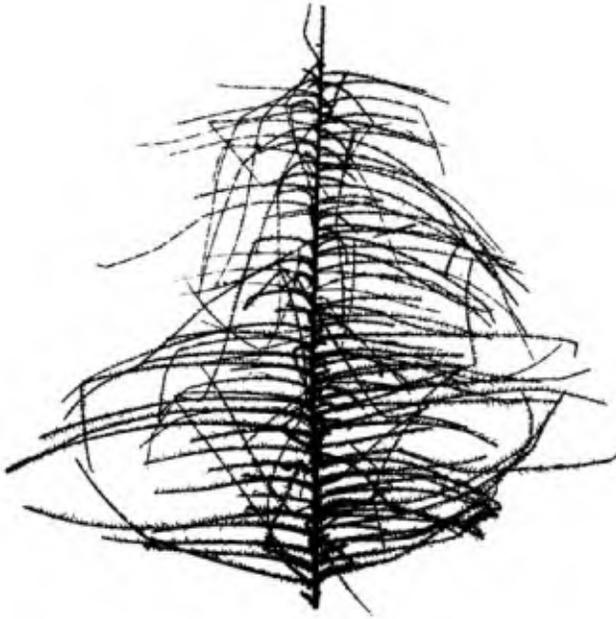


Fig. 15. *Parantipathes larix* (Esper, 1790), portion of a corallum of a specimen collected in the Bay of Naples (USNM 22512).

**Diagnosis.**— Corallum monopodial to very sparsely branched, stem and branches pinnulate. Pinnules simple, arranged in six or more rows, and in alternating groups of three or more on either side of the axis (fig. 15). Spines simple, triangular, compressed. Polyps 1.6-2.5 mm in transverse diameter (rarely larger).

**Type species.**— *Antipathes larix* Esper, 1790, pl. 4; 1792: 147.

**Type material.**— SMF 5892; Mediterranean Sea (this is the only specimen remaining from the material described by Esper; see discussion in Opresko and Baron-Szabo, 2001).

**Description of the type species.**— A detailed description of the type specimen of *Antipathes larix* Esper, is given by Opresko & Baron-Szabo (2001). A brief summary of that description is presented here.

The type specimen is about 60 cm tall and has one small branch. On the lower part of the corallum there are six rows of simple pinnules; higher up there are only four rows. The pinnules are arranged in alternating groups along the sides of the stem. The members of these groups arise from very near the same height on the stem or are slightly offset (distance apart about 0.3 mm). The groups of pinnules are 3-3.5 mm apart on each side of the stem. The pinnules are all broken off at their distal end; the maximum length of the longest incomplete pinnule is 6 cm. The pinnular spines are simple, smooth, acute, and triangular to horn-shaped in lateral view. The spines are up to 0.11 mm tall. On average, there are usually 4-4.5 spines per millimeter in each row. The polyps were estimated to be about 2.2 mm in transverse diameter.

Species assigned to *Parantipathes*.— In addition to the type species, other nominal species that may be assigned to *Parantipathes*, as it is defined here, include: *Antipathes tetrasticha* Pourtalès (1868), *Parantipathes helicosticha* Opresko (1999), *P. laricides* van Pesch (1914), and *P. wolffi* Pasternak (1977). The first two species are similar to *P. larix* in that they form a monopodial or very sparsely branched corallum with the pinnules arranged in six or more rows and also in bilaterally alternating, semi-spiral groupings. In both *P. laricides* and *P. wolffi* the pinnules in each bilateral group are not regularly arranged in semi-spiral patterns, but rather arise at about the same point on the axis, forming clusters or semi-whorls, and these clusters are arranged alternately along the axis. In *P. laricides* there are consistently three pinnules in each cluster. In *P. wolffi* there are usually two per cluster but sometimes three, with the extra pinnule occurring on either side of the axis, so there are a total of six rows, although the fifth and sixth rows are incomplete.

Remarks.— A number of other species previously assigned to *Parantipathes*, i.e., *P. columnaris* Duchassaing, 1870, *P. tenuispina* Silberfeld, 1909, and *P. triadocrada* Opresko, 1999, are here excluded from the genus based on the fact that their polyps, although appearing slightly elongated along the transverse axis, are rarely more than 1 mm in transverse length.

Distribution.— Species of this genus are known from the Mediterranean and eastern Atlantic (*P. larix*), western Atlantic (*P. tetrasticha*), and southwest Pacific (*P. helicosticha*, *P. laricides*, and *P. wolffi*).

### ***Taxipathes* Brook, 1889**

(fig. 16)

*Taxipathes* Brook, 1889: 155-156.

Diagnosis.— Corallum branched, stem and branches pinnulate. Pinnules simple, arranged bilaterally in four to eight rows (usually six), and also in alternating semi-spiral groupings. Spines simple, conical, hooked upwards. Polyps about 2.5 mm in transverse diameter.

Type Species.— *Taxipathes recta* Brook, 1889: 156-157, pl. 7, figs 1-5.

Type material.— Holotype (BMNH 1890.4.9.25), south Atlantic, off Ascension Island, 7°54' 20"S, 14°28' 20"W, 3.iv.1876, 420 fm, HMS "Challenger" sta. 344.

Description of the type species.— The holotype is approximately 26 cm tall, and is broken off at both the top and bottom (fig. 16; digital scan of the illustration of the type given by Brook, 1889, pl. 7). It is branched irregularly to the second order. The branches vary in length, the longest first order branch being more than 14 cm in length and the largest second order branch being about 9 cm. Brook (1889) reported that the stem and branches bear six rows of short, slender, rigid pinnules. Re-examination of the type specimen revealed that on parts of the corallum there are only four rows and on other parts seven and rarely eight rows. As Brook described, the pinnules are arranged bilaterally in alternating groups, with one pinnule from each row in each group. The members of each group are slightly offset from each other such that each group forms a semi-spiral pattern around part of the circumference of the axis. The semi-spirals cover a distance of 2-2.5 mm along the axis, and there are 11-12

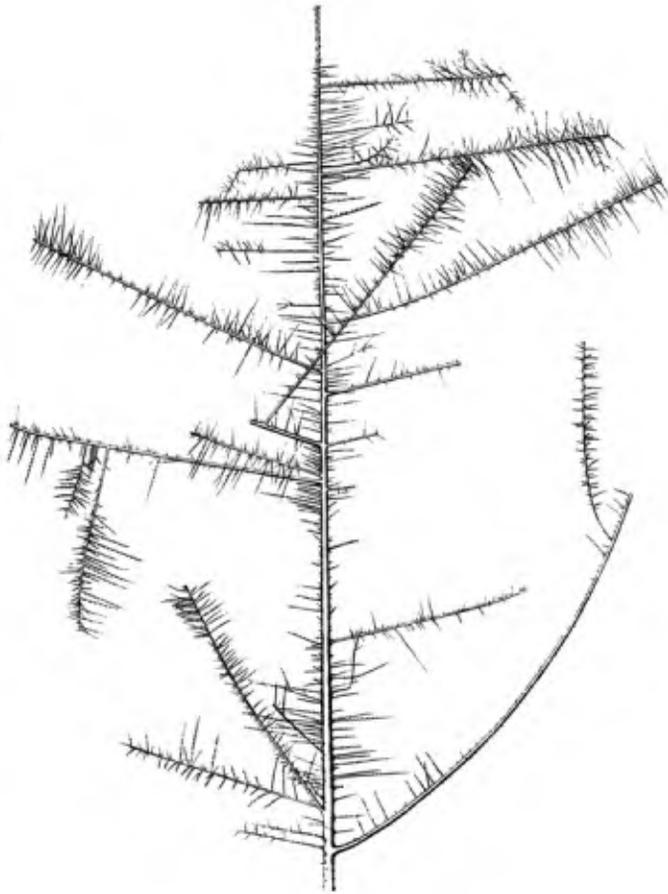


Fig. 16. *Taxipathes recta* Brook, 1889, digital scan of the illustration of holotype, from Brook, 1889, pl. 7, fig. 1; 0.47  $\times$ .

pinnules per centimeter on each side. The pinnules are up to 2.2 cm in length. The pinnular spines are simple, smooth, acute, and conical and hooked upward. The pinnular spines are about 0.14 mm tall, and the polyps are estimated to be about 2.5 mm in transverse diameter.

Species assigned to *Taxipathes*.— No other species have been assigned to this genus.

Remarks.— Brook (1889) originally placed the genus *Taxipathes* in the subfamily Schizopathinae on the basis of the polyps being “dimorphic”. The illustration that Brook gives of the polyps of *T. recta* (pl. VII, fig. 2) shows them to be elongated transversely, but not necessarily subdivided by peristomal folds. Furthermore, Brook (1889) did not specifically describe “meogloea septa” within the coelenteron of the polyps. In terms of the number and arrangement of the pinnules, the size and shape of the spines, and the size of the polyps, *Taxipathes* is very similar to *Parantipathes*. Based on these same characters, it also resembles *Sibopathes* (see Opresko, 1993). Species of

the latter genus, however, have only six mesenteries, whereas *Taxipathes* was placed by Brook (1889) in the Schizopathinae presumably because it has ten mesenteries. This needs further verification.

Distribution.— The type specimen of *Taxipathes recta* was collected in the south Atlantic off Ascension Island.

***Lillipathes* gen. nov.**

(fig. 17)

Diagnosis.— Corallum branched sparsely, mostly to the second and third order; stem and branches pinnulate. Pinnules simple, arranged bilaterally in four rows and also in alternating pairs. Spines simple, triangular, compressed. Polyyps up to 2.3 mm in transverse diameter.

Type Species.— *Antipathes lilliei* Totton, 1923: 101-103, pl. 1, figs 1-3.

Type material.— Holotype (BMNH 1923.10.19.3), New Zealand, 7 miles east of North Cape, 2.viii.1911, 70 fm, "Terra Nova" Expedition, sta. 96.

Description of the type species.— A detailed description of the holotype of *A. lilliei* is given by Totton (1923: 103). A brief summary of that description is presented here.

The branched corallum (fig. 17a; digital scan of the illustration of the type given by Totton, 1923, pl. 1, fig. 1) is 90 cm by 70 cm by 50 cm. The pinnules are 9-11 cm long and up to about 0.6 mm in diameter near their base. They are arranged bilaterally with two rows on either side of the axis (fig. 17b), as well as in groups of alternating pairs. The pinnules in the outer (lateral) rows are spaced about 3.2 mm apart. The pinnules in the inner (anterior) rows are placed 1-5 mm below the adjacent lateral pinnule on the same side of the axis. The spines are smooth, triangular, up to 0.065 mm tall on the polyp side of the axis and 0.05 mm on the abpolypar side. They are arranged in 10 longitudinal rows, and within each row they are spaced 0.15 mm to 0.26 mm apart. The polyyps are 1.86 to 2.33 mm in transverse diameter and they are spaced about 3.21 mm apart. The length of the tentacles ("macerated in water") is 0.6 mm.

Species assigned to *Lillipathes*.— Only one other nominal species, *Bathypathes quadribrachiata* van Pesch, 1914, is similar to *L. lilliei* in pinnulation, shape of the spines, and size of polyyps. The pinnules in *B. quadribrachiata* are arranged in four rows as in *L. lilliei*; however, the lateral pinnules are not more than 2.9 cm and the anterior pinnules are only 0.5-1.0 cm. Van Pesch based the species on a single specimen which was only 2.8 cm tall, therefore, there is some question as to whether the type exhibits all the characteristics of a mature colony. It is possible that larger colonies might have additional rows of pinnules, in which case the species could be more closely affiliated with *Parantipathes*. The species differs from both genera in having slightly smaller polyyps. Van Pesch (1914) reported that the distance between adjacent pairs of tentacles in *B. quadribrachiata* was 0.675 mm. This is equivalent to a transverse polyp diameter of 1.35 mm; however, re-examination of the type revealed that the size of the polyyps ranges from 1.5 mm to about 2.0 mm.

Remarks.— The size of the corallum indicates that the holotype of *L. lilliei* (Totton) is a mature colony, and, based on Totton's description, there is no evidence that the specimen has more than four rows of pinnules. Therefore, the fixed number of rows of pinnules is considered here the primary diagnostic character of the genus. Although

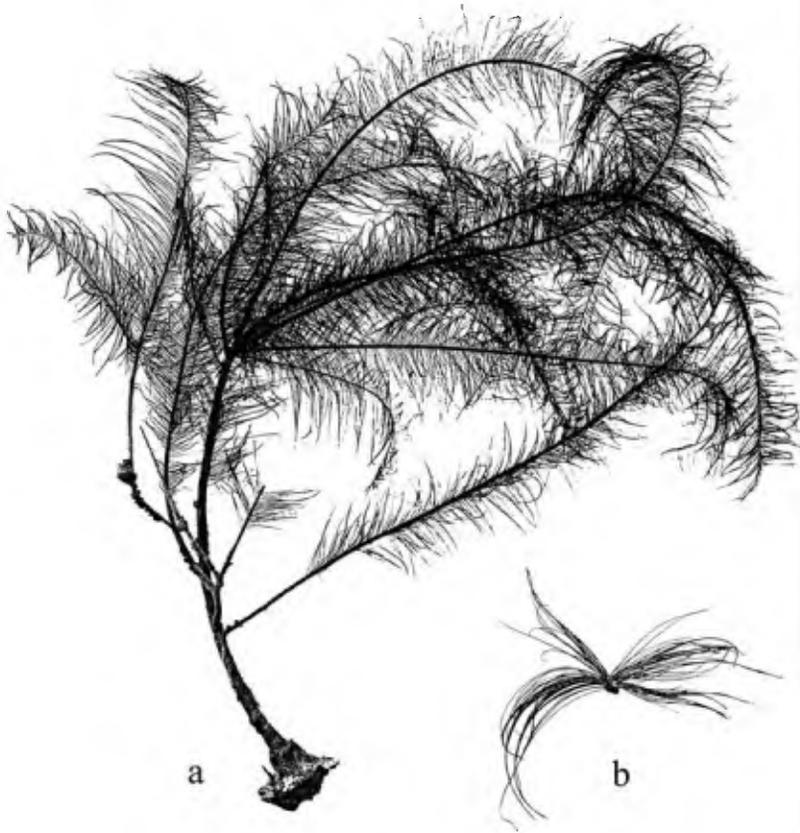


Fig. 17. *Lillipathes lilliei* (Totton, 1923), digital scan of the illustration of holotype, from Totton, 1923, pl.1; a, entire corallum, approx. 0.1  $\times$ ; b, cross section through branch showing arrangement of pinnules.

some species of *Parantipathes* have four rows of pinnules on parts of the corallum, additional rows are always present in varying degrees of regularity.

Etymology.— The genus name is derived from the specific name of the type species, “lilliei” and the commonly used suffix “pathes”.

Distribution.—The type species was collected off the coast of New Zealand; *B. quadribrachiata* came from the Banda Sea (1°58.5’N, 125°0.5’E).

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