

OCTOCORALLIA FROM NORTH-WESTERN MADAGASCAR (PART I)

by

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With 7 plates and 17 text-figures

INTRODUCTION

During the years 1960, 1963, 1964 and 1967 Dr. Arthur G. Humes, Boston University, Massachusetts, U.S.A., collected a number of octocorals in the waters north-west of Madagascar, near the islands Nosy Bé, Nosy Komba, Ambariobe (a small island nearly between Nosy Komba and Nosy Bé), Tany Kely (a small island to the south of Nosy Bé), Nosy Faly, Isles Mitsio, etc. The purpose of his collecting was the study of the copepods associated with these corals. In order to know the identity of the coral hosts of his copepods, Dr. Humes entrusted his extensive collection to me for identification. I wish to express my best thanks to Dr. Humes for giving me the opportunity of working on his interesting material.

The present paper forms the first of a series devoted to these octocorals, which now form part of the collection of the Rijksmuseum van Natuurlijke Historie, Leiden; the registered numbers are indicated with the abbreviation RMNH. Through the kindness of Dr. J. H. Stock of the Zoölogisch Museum at Amsterdam I could also examine material held by that Museum and collected by Dr. Stock in 1963 and 1964 at the same localities as Dr. Humes's specimens. Dr. Stock's material is indicated with registered numbers preceded by the abbreviation ZMA.

For comparative purposes also material of the Siboga Expedition from the collection of the Amsterdam Museum was examined. I also examined fragments of the schizo-syntype of *Sympodium fuscum* Thomson & Henderson, which are kept in the British Museum (Natural History), London; the fragments have been placed at my disposal through the kindness of Dr. R. W. Sims, curator of the Annelida Section, who was then temporarily charged with the Coelenterate Section.

The canal system of the membranous form *Parerythropodium rubiginosum* could be examined in a series of microtome sections, made by Mrs. E. Jansen-

Havers, analyst, and Mr. W. de Priester, assistant, both of the Zoological Laboratory of Leiden University. I am greatly indebted to them for their help.

I am most thankful to Mr. W. ter Spill, who again revised my manuscript, and to Mr. G. J. Vrijmoeth for the excellent photographs.

List of the species and the subspecies

Family Alcyoniidae Lamouroux, 1812

1. *Parerythropodium fulvum fulvum* (Forskål, 1775)
2. *Parerythropodium fulvum fuscum* (Thomson & Henderson, 1906)
3. *Parerythropodium rubiginosum* Verseveldt, 1968

Family Nephtheidae Gray, 1862 (emend. Utinomi, 1954)

4. *Lemnalía flava* (May, 1898)
5. *Lemnalía africana* (May, 1898)
6. *Lemnalía tixierae* nov. spec.
7. *Lemnalía digitata* (May, 1898)
8. *Lemnalía longiramus* nov. spec.
9. *Lemnalía humesi* nov. spec.
10. *Lemnalía tenuis* nov. spec.
11. *Lemnalía cervicornis* (May, 1898)
12. *Lemnalía madagascarensis* nov. spec.
13. *Lemnalía crassicaulis* nov. spec.
14. *Lemnalía acutispiculata* nov. spec.
15. *Paralemnalia thyrsoides* (Ehrenberg, 1834)
16. *Paralemnalia clavata* nov. spec.

ALCYONIIDAE Lamouroux, 1812

Parerythropodium Kükenthal, 1916

Parerythropodium fulvum (Forskål, 1775) (text-fig. 1)

Litophyton fulvum Forskål, 1775: 139.

Sympodium fulvum, Ehrenberg, 1834: 439; Klunzinger, 1877: 43, pl. 3 fig. 6; May, 1899: 52-53; Thomson & Dean, 1931: 21, pl. 24 fig. 7.

Alcyonium fulvum, Kükenthal, 1904: 41-43, pl. 4 fig. 4, pl. 5 figs. 15-17; Verseveldt, 1965: 29-30.

Sympodium fuscum Thomson & Henderson, 1906: 408-409, pl. 30 fig. 5.

Alcyonium (Erythropodium) fulvum var. *sclera* Cohn, 1908: 237-238, figs. 5, 6.

Parerythropodium fulvum, Kükenthal, 1916: 463; Tixier-Durivault, 1966: 101-103, figs. 94, 95.

The species is clearly characterized by the honeycomb-like structure of the upper surface of the membranous plates, which is caused by large spicules, sometimes up to 1.60 mm long, but in many other colonies they are up to 2 mm or 2.35 mm long.

Thomson & Henderson (1906) described the new species *Sympodium fuscum*. According to the authors the differences from *Parerythropodium fulvum* (Forsk.) are, firstly, that in *S. fuscum* the spicules composing the anthocodial transverse ring (the crown) are not "markedly different in size from the longitudinally disposed spicules", and, secondly, the presence of spicules in the tentacles. Also "in other features" there were supposed to be differences.

Cohn (1908) described *Alcyonium (Erythropodium) fulvum* var. *sclera* n. var. This variety as well is characterized by the occurrence of spicules in the tentacles.

Now, to verify Thomson & Henderson's findings, I carried out an examination of the spiculation of the tentacles in the material placed at my disposal (see below). For that purpose I cleared some zooids with phenol-xylol, I then observed the preparations with a polarizing microscope¹⁾. With great clarity I could see the tiny, transparent spicules, which are quite invisible through an ordinary microscope. I found that in most of the specimens tentacular spicules are present, but in a greatly varying quantity. At the base they are sometimes longer. It was impossible to draw a sharp line between zooids with and without tentacle spicules.

As to the shape, the size, and the disposition of the anthocodial spicules I could discern the following two forms.

Form (a) (fig. 1a). There is a crown of about five to seven rows of large, thick, bent spindles, measuring up to 0.80 to 0.90 mm in length and 0.06 to 0.10 mm in width. This crown is superposed by eight double rows of chevroned, pointed spindles, five to nine in a row, and measuring up to 0.35 mm in length, sometimes up to 0.45 mm. Probably also *A. fulvum* var. *sclera* Cohn belongs to this form, for Cohn speaks of eight double rows of spindles (I am surprised that Cohn states that the eight double rows of spindles are placed in the tentacles instead of in the wall of the anthocodia, as is usually the case).

¹⁾ With permission of Prof. Frederick M. Bayer, University of Miami, Florida, U.S.A., I cite from one of his letters the following passage: "With the prisms (or filters) crossed to give a dark field, the spicules display birefringence and are sharply set off from the cleared tissues. A polarizing filter made for use in cameras (polariscreen) can be obtained in a size that will just fit the ocular of a standard microscope, and a larger one for the filter clip under the condenser. Rotating the eyepiece, now an analyzer, gives a background of any desired darkness".

Form (b) (fig. 1b). The crown is more weakly developed. Sometimes it consists of three, four or five rows of spindles, 0.40 to 0.60 mm in length, in other cases the spindles are only 0.25 to 0.40 mm long. The other anthocodial spicules are not fusiform, but blunt-ended rods, 0.06 to 0.18 mm in length. They are not arranged en chevron. Sometimes they radiate fan-shaped from eight points distally from the crown, in other cases they are very small and totally irregularly distributed.

Now, which of these two forms, it may well be asked, agrees with Forskål's holotype of *P. fulvum*?

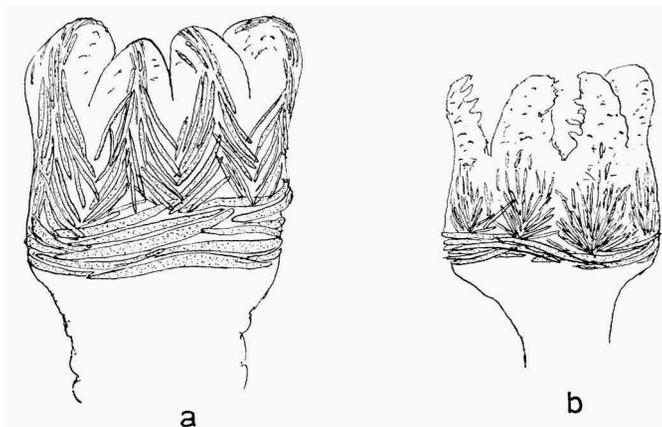


Fig. 1. a. *Parerythropodium fulvum fulvum* (Forskål). Anthocodia. b. *Parerythropodium fulvum fuscum* (Thomson & Henderson). Anthocodia. $\times 35$.

Forskål (1775: 139) diagnosed *Litophyton fulvum* as: "Crustaceum, carneum, fulvum, punctatum; poris majoribus elatis". This short description tells us nothing about the anthocodial spiculation. In Forskål's "Icones rerum naturalium" (1776), pl. 39 figs. C and c, a small colony of *Litophyton fulvum* is represented, in fig. c "ut interna structura appareat". These figures are by no means like the well-known colonies of *P. fulvum*. Perhaps that is why in the explanation of the plates it says: "Litophyton fulvum?", so with a question-mark. At all events the figures, too, are of no use in solving the problem, which engages us.

Forskål's type material seems to be lost. Dr. Kay W. Petersen of the Universitetets Zoologiske Museum of Copenhagen informed me (in litt., 27 January 1969) as follows:

"After having gone over our Forskål types most carefully I regret to inform you that we do not have the type of *Litophyton fulvum* Forsskål, 1775, in our collection, and as far as I can check it does not occur in any of our old inventories.

Thinking that the specimen might have been deposited in the Botanical Museum on the assumption that it was an alga, I have made inquiries there but was told that it was not in their collections either. I am, therefore, afraid that the material is lost".

Klunzinger (1877) and Kükenthal (1904) examined specimens from the Red Sea, and it is to be expected that the form described by these authors will agree with Forskål's holotype, which has also been collected in the Red Sea.

Now, Klunzinger (1877, pl. 3 fig. 6b) represented a polyp that shows the anthocodial spicules clearly arranged en chevron. This corresponds with Klunzinger's text (p. 43: "Winkelreihen, wie bei manchen Spongodes"). I think that Klunzinger investigated colonies with anthocodial form (a).

Kükenthal (1904) also examined specimens of the form (a) (cf. his pl. 5 fig. 16; as for the enlargement of Kükenthal's figures see below).

I therefore suppose that form (a) agrees with Forskål's holotype. This form (a) I propose to name *Parerythropodium fulvum fulvum* (Forskål).

Form (b) with the small crown spicules represents a second subspecies, which should bear the name *Parerythropodium fulvum fuscum* (Thomson & Henderson).

***Parerythropodium fulvum fulvum* (Forskål, 1775) (text-fig. 1a)**

Material. — Ambarionaombi, Nosy Komba, depth 1 m; 12 January 1964. J. H. Stock no. MD 81 and MD 82, ZMA Coel. nos. 5299 and 5303. Several specimens.

Pointe Mahatsinjo, Nosy Bé, depth 5 feet; 18 October 1960. A. G. Humes no. 599, RMNH Coel. no. 5006. Several specimens. Field-note: "Coelenterate, thin encrusting, polyps isolated with long stalks, separated by areas of large spicules, yellow grey".

Sailus Besar, Paternoster Islands, Indonesia. Several specimens collected by the Siboga Expedition, Sta. 315, examined for comparison.

The subspecies is characterized by its anthocodial spiculation consisting of large crown spicules and chevroned, sharp-ended point spicules, see above (fig. 1a).

There is something wrong with the enlargement of Kükenthal's figures (1904). According to the degree of the enlargement stated by Kükenthal (71 : 1) the length of the crown spicule in pl. 5 fig. 15a is about 1.4 mm, that of the same spicules in fig. 16 is more than 1 mm. The enlargement of fig. 16 is 13 : 1. If this were correct, the length of the anthocodia represented in fig. 16 would be 5 mm, tentacles included, and about 4 mm, measured up to the base of the tentacles. However, the dimensions of the spicules and the anthocodia mentioned in the text are quite different.

Parerythropodium fulvum fuscum (Thomson & Henderson, 1906)

(text-fig. 1b)

Material. — Pointe Mahatsinjo, Nosy Bé, depth 6 inches, low tide; 11 August 1960. A. G. Humes no. 519, RMNH Coel. no. 5004. Several colonies. Field-note: "Yellow coelenterate growing on stalk of *Cymodocea ciliata*".

Antsamantsara, north of Madirokely, Nosy Bé, depth 2 feet, low tide; 31 October 1960. A. G. Humes no. R 519, RMNH Coel. no. 5005. Several specimens. Field-note: "Yellow coelenterate growing on stalk of *Cymodocea ciliata*".

Ambariobe, Nosy Bé, reef, depth 2 m; 17 December 1963. J. H. Stock no. MD 5, ZMA Coel. no. 5301. Several specimens.

Ambariobe, Nosy Bé, depth 1 m; 15 January 1964. A. G. Humes no. 830, RMNH Coel. no. 5007; J. H. Stock no. MD 88, ZMA Coel. no. 5302. Several colonies.

Two fragments, each about 1½ cm² large, of the schizo-syntype of *Sympodium fuscum* Thomson & Henderson (1906), kept in the British Museum (Natural History), London, no. 1933.3.13.180, Prof. J. A. Thomson coll.

This subspecies is characterized by the weakly developed crown, the blunt-ended, small anthocodial spicules, which are not arranged en chevron (fig. 1b).

I found that the type-material of *S. fuscum* does not differ in any respect from the other specimens belonging to this subspecies. The crown spicules are up to 0.35 mm in length, the other anthocodial spicules are small rods, 0.06 to 0.13 mm in length, and, besides, they are irregularly arranged. At the base of the tentacles the longitudinally arranged rods are 0.06 mm in length, in the distal ends of the tentacles there are numerous, very tiny rods, 0.01 to 0.03 mm long.

Parerythropodium rubiginosum Verseveldt, 1968

(text-figs. 2-4; pl. I fig. 1)

Parerythropodium rubiginosum Verseveldt, 1968: 52-53.

Material. — East of Ambariobe, near Nosy Bé, depth 2 m; 4 October 1964. A. G. Humes no. 959, RMNH Coel. no. 3903, one fragment, the holotype; RMNH Coel. no. 5009, eight fragments, paratypes. Field-note: "colour yellow".

Pointe Mahatsinjo, Nosy Bé, depth 1 m; 7 June 1967. A. G. Humes no. 1055, RMNH Coel. no. 5008. Seven fragments. Field-note: "Flat thin hard sheets growing on dead coral, colour when undisturbed light brown, when disturbed colour changes to bluish white".

Banc des Frères, Isles Mitsio, N.E. of Nosy Bé, 12° 58' S 48° 28' E, depth 24 m; 17 August 1967. A. G. Humes no. A 15, RMNH Coel. no. 4997. Six fragments.

Description. — Each fragment (pl. I fig. 1, the holotype) consists of a broad plate (membrane), the largest of them measuring 200 × 90 mm, but according to verbal information by the collector, Dr. Humes, the plates may have a breadth of more than half a metre. These plates can easily be torn in pieces. The thickness of the membranes is 2 to 3 mm. It is flat or somewhat bumpy, here and there round openings occur. All around such openings the membrane is thinner, and devoid of zooids. At the underside a thin film occurs, which can sometimes easily be peeled off.

The plates are densely covered with zooids, in the holotype they are not retracted. Usually they almost touch each other. The distance between the centres of the zooids is 1.0 to 1.5 mm. Sometimes the plates are very thin, being less than 1 mm thick. In such a case the zooids are 2 to 3 mm apart, and they are more retracted within the membrane.

Each zooid consists of a proximal part, the anthostele (calyx), and a distal part, the anthocodia; between both there is a neck-zone. In the expanded zooids (fig. 2a) the anthostele is indistinct, it passes gradually into the neck-

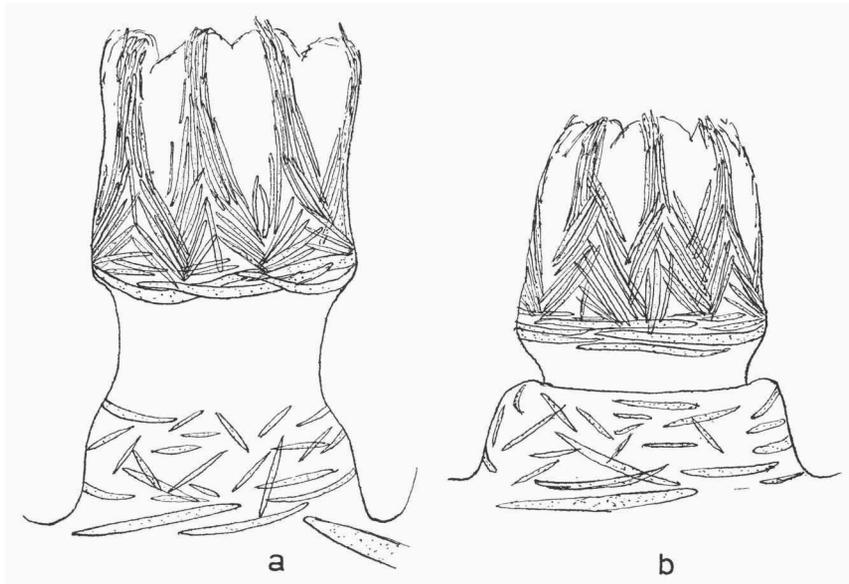


Fig. 2. *Parerythropodium rubiginosum* Verseveldt. Zooids. $\times 35$.

zone. But in the more or less retracted zooids (fig. 2b) the anthostele looks like an annular wall (calyx) up to about 0.4 mm in height. This calyx contains a number of fusiform spicules, up to 0.50 mm in length. The neck-zone is devoid of spicules.

The anthocodiae are armoured with crown and points. The crown, which protrudes slightly around the anthocodia, consists of three to five rows of spindles. In two or three rows the spindles are larger, being up to 0.85 mm long (fig. 3h); in the other rows, which are placed more distally, the spindles are smaller, but such smaller spindles are often absent. Above the crown there are eight double rows of spindles en chevron, each separate row has six to eight spindles, 0.25 to 0.40 mm long. In the axis of a double row a few spindles may be present. Distally the spicules are longitudinally arranged, they pass into small spindles in the basal part of the tentacle-back. In the

tentacles and the pinnules we find numerous tiny spicules, up to 0.06 mm in length. They are flattened, granulated rods with one or two constrictions (fig. 3i), and clearly visible in polarized light (see p. 5 and foot-note p. 5). On both sides the tentacles bear one row of seven or eight short, rounded pinnules.

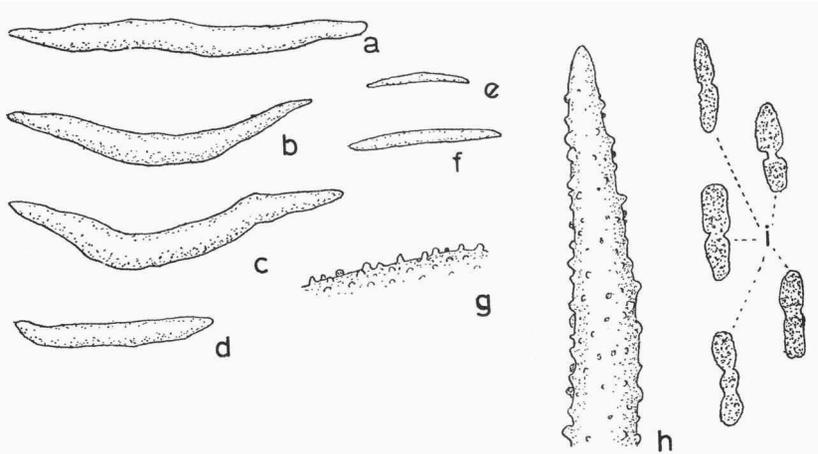


Fig. 3. *Parerythropodium rubiginosum* Verseveldt. a-f, coenenchymal spicules; g, part of the surface of a coenenchymal spicule; h, part of a crown spicule; i, spicules from the tentacles. a-f, $\times 22$; g-i, $\times 240$.

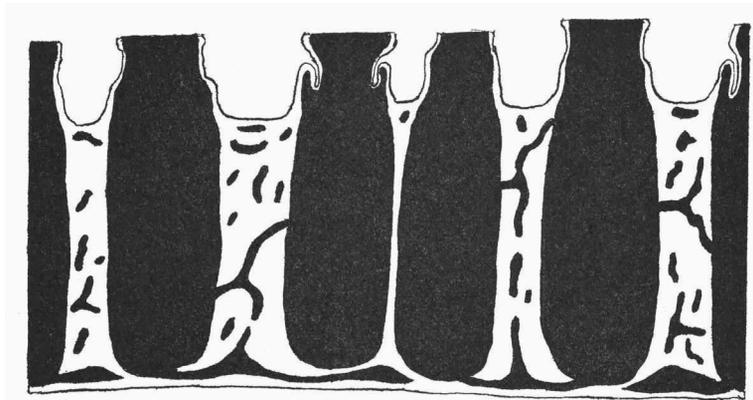


Fig. 4. *Parerythropodium rubiginosum* Verseveldt. Diagram of the canal system. $\times 15$.

As appears from the examination of a series of microtome sections (see the introduction of this paper) the gastral cavities extend nearly to the base of the plates (fig. 4). They are about 1 mm wide. In the partition-walls we find numerous large, usually irregularly curved spindles, covered with small spines (fig. 3a-g). They measure up to 2.10 mm in length and 0.21 mm in width. Some of these large spindles lie parallel to the gastral cavities, almost

reaching from the uppermost to the lowermost side of the plate. The coelenterons are connected by a network of solenia, on an average 0.06 mm wide. Those at the base of the membrane are widest. There is no horny substance.

Colour. — The field-note added to the holotype describes the colour as yellow, but in alcohol the colonies are brown or greyish-brown. The alcohol in which the colonies are kept, is rubiginous.

Variability. — The material from Banc des Frères, Isles Mitsio, consists of six slices; one of them measures 150 × 100 mm, another one is narrower but measures 270 mm in length. The zooids are entirely retracted into the membranes. All around each zooid there is an annular elevation, the calyx, within which the eight tentacles of the zooids are visible. The distance between the centres of the zooids is 1 to 2 mm.

Remark. — The shape and dimensions of the coenenchymal spicules wholly agree with those of *P. fulvum* (Forskål). But, unlike *P. fulvum*, the colonies do not show a honeycomb-like structure of the upper surface. Other differences are the dimensions of the membranous plates, the presence of anthosteles provided with spicules, the number of rows of spicules composing the anthocodial crown, and the colour.

NEPHTHEIDAE Gray, 1862 (emend. Utinomi, 1954)

Lemnalia Gray, 1868

An investigator who undertakes for the first time the task of identifying a *Lemnalia* species is confronted with a far from clear terminology. For the different parts of the colony have not always been indicated with the same names by the various authors dealing with them. In comparing, e.g., the terminology used by May (1899), Bourne (1900), Kükenthal (1903), Thomson & Dean (1931), Roxas (1933) and Macfadyen (1936) one finds that it is not always clear what is meant by "sterile trunk", "main branches", "branches", "primary, secondary and tertiary branches", "branchlets" and "twigs". That is why I propose to use one fixed term for each part. From the diagram in fig. 5 one can see what is meant by a given term. I must point out that stem and branches (primary, secondary and even tertiary) are all sterile. Only branchlets and twigs are beset with zooids. Between branchlets and twigs there is no clear distinction; the branchlets are stronger and longer than the twigs, usually a branchlet bears some twigs.

English	German	French	
common base	gemeinsame Basis	base commune	} sterile
stem	Stamm	tronc	
branch	Ast	branche	
branchlet	Ästchen	rameau	} fertile
twig	Zweig	brin	

In the left-hand part of the polyparium in fig. 5 the branchlets and twigs are stronger and wider, showing the type of, e.g., *L. digitata*. In the middle and to the right the branchlets and twigs are thin and slender. This type occurs in many other species.

When examining the cortical spicules in *Lemnalia* material I found that there is a great difference in the spiculation of the branchlets and twigs, the

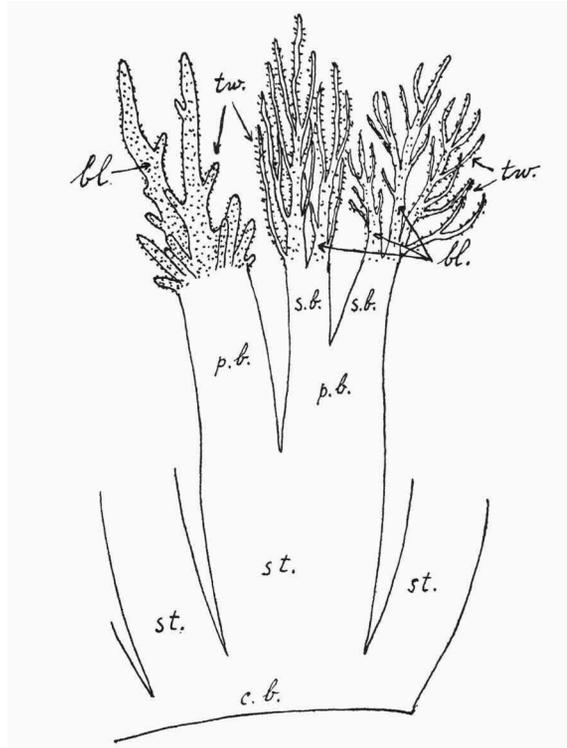


Fig. 5. Diagram of the genus *Lemnalia* Gray. c.b., common base; st., stem; p.b., primary branch; s.b., secondary branch; bl., branchlet; tw., twig.

distal and middle part of the stem, and the basal part of it. So far too little attention has been paid to this matter (Kükenthal, 1913: 15; Tixier-Durivault, 1966: 257). In most species the spicules in the basal part are small double-stars, or four-rayed forms with two long rays, and (or) crescents (see below). More distally, however, these types decrease in number, making place for more spindle- or needle-shaped forms. In the twigs there are usually needles and (or) spindles only. In describing *Lemnalia* specimens it is therefore necessary to record from which part of the colony the spicules have been taken.

In order to investigate these cortical spicules one has to remove a thin scale from the outer layer of the stem or the branch. But in doing so the coelenterons are torn open. The scale that is removed from the basal part of the stem appears to consist of two layers with different spicules: only the outer layer contains the small types of sclerites mentioned above: double-stars, four-rayed forms, and crescents, the inner layer having the same spindles and needles that occur in the walls separating the coelenterons (the "canal-walls"). The first-mentioned, small types are the real cortical spicules. In making a microscope slide with "cortical spicules" one must realize that both real cortical spicules and coenenchymal spicules will be present.

As has been said above two types of sclerites often occur in *Lemnalina*, viz.:

a. Curved spindles, more or less regularly covered with prominences, of which those at the convex side are usually higher. This type I would suggest to call crescents (fig. 7c-e; fig. 13 o, p; fig. 14f, g).

b. Curved spicules with two long rays and two median warts. They have been described by Bourne as "modified double four-rayed stars" (1900: 527) and as "modified double stars with two elongate rays" (1900: 530). Macfadyen described them as follows: "...bow-shaped form, with 2 basal warts" (1936: 51), and "bow-forms with the large median basal warts so that a somewhat 4-rayed form is produced" (1936: 52). Thomson & Dean (1931: 74) spoke of "brackets" and "bracket-like and bow-like forms with prominent warts projecting outwards from the middle of the convexity". In order to avoid such long descriptions I propose to call this type simply bracket (fig. 6e, l; fig. 8e, f).

Key to the species of *Lemnalina* described in this paper

- 1. Polyps sessile 2
- Polyps pedicellate 7
- 2. In the cortex double stars are present 3
- Double stars are absent 5
- 3. Twigs very long (up to 70 mm) and thin *L. longiramus*
- Twigs shorter (up to 20 mm) 4
- 4. Twigs stiff, erect; few cortical capstans *L. flava*
- Twigs flabby, slender; numerous cortical capstans *L. humesi*
- 5. Branchlets and twigs short, wide, stiff *L. digitata*
- Branchlets and twigs thin, slender 6
- 6. In cortex no brackets and four-radiates *L. africana*
- In cortex brackets and four-radiates present *L. tenuis*
- 7. In cortex no double stars or small rods *L. madagascarensis*
- In cortex small rods with two girdles of prominences *L. cervicornis*
- In cortex double stars occur 8
- 8. Anthocodial spicules very small (0.03-0.05 mm) *L. tixierae*
- Anthocodial spicules larger (0.15 mm and more) 9
- 9. Stems wide, colonies clumsy *L. crassicaulis*
- Stems slender, cortical double stars very spiny *L. acutispiculata*

Lemnalìa flava (May, 1898) (text-fig. 6; pl. I fig. 2)

Ammonothea flava May, 1898: 32; 1899: 137, pl. 2 fig. 17.

Lithophytum flavum, Kükenthal, 1903: 112; Thomson & Henderson, 1906: 427.

Lemnalìa flava, Kükenthal, 1913: 15; Tixier-Durivault, 1966: 235-236, figs. 222-224.

Material. — Pointe Ambarionaomby, Nosy Komba, near Nosy Bé, depth 1 m; 14 December 1963. A. G. Humes no. 774, RMNH Coel. no. 4980. Fourteen colonies and fragments.

The same locality and depth; 8 June 1967. A. G. Humes no. 1057, RMNH Coel. no. 4982. Ten small colonies and a fragment. Field-note: "Short whitish hard stems, terminal branches short and covered with fine knobs, no mucus".

The same locality and depth; 8 June 1967. A. G. Humes no. 1058, RMNH Coel. no. 4983. Five colonies. Field-note: "Short pale stems, terminal branches short with fine knobs".

East of Ambariotelo, a small island nearly between Nosy Komba and Nosy Bé, depth 2 m; 20 July 1967. A. G. Humes no. 1175, RMNH Coel. no. 4981. Nine small colonies. Field-note: "Short stalks, clusters of short brown branches at tips".

Ambariobe, a small island nearly between Nosy Komba and Nosy Bé, depth 1.5 m; 22 August 1967. A. G. Humes no. 1308, RMNH Coel. no. 4979. Six colonies, up to 100 mm high, which means that they are 20 to 40 mm higher than most of the colonies from the other localities. Field-note: "Rather slender tan-grey stalks, with clusters of short brown granular branches".

Description. — The largest of the specimens from lot RMNH Coel. no. 4980 is described here. It has a total height of 70 mm, a maximum width of 80 mm and a thickness of 40 mm, it is laterally flattened. From a common base a number of stems arise, 10 to 15 mm wide. A few of these ramify a little above the base, others are undivided as far as the polyp-bearing area. Stems and branches are smooth and stiff. From the stems and branches, at a height of 30 to 40 mm, rise a few branchlets, 30 to 35 mm long. These bear stiff, finger-like twigs, usually 2 to 15 mm long and 1.5 to 2.5 mm wide. Branchlets and twigs are densely but irregularly covered with zooids. The latter are sessile, 0.6 mm in diameter and mostly 0.20 to 0.30 mm in height. A few are up to 0.50 mm high, and look like low hillocks. The anthocodial spicules are curved needles with spines; their length is up to 0.28 mm, their width 0.014 to 0.018 mm. In the tentacles tiny flat, rod-like spicules occur, 0.05 to 0.08 mm in length, often bifurcated at one end, and provided with a few spines or small warts. Their surface is not granulated (fig. 6m-o).

In the distal part of the stem the cortex contains:

a. Spindles and needles, up to about 0.40 mm in length, while on the central part higher spines are found (fig. 6k). Most of them are slightly sickle-shaped.

b. Crescents and brackets, 0.16 to 0.26 mm long (fig. 6l).

In the basal part of the stem the cortical spicules are:

a. Spiny needles and spindles, curved or irregularly bent, varying in length from 0.30 to 0.50 mm and in width from 0.022 to 0.025 mm (fig. 6a-d).

b. Small double-stars and brackets, or irregularly shaped, sometimes capstan-like modifications of these (0.06 to 0.09 mm in length), of which a few are club-shaped (fig. 6e-i); small crescents also occur (fig. 6j).

The interior of the basal part of the stem has irregularly curved spindles, 0.25 to 0.45 mm long, 0.02 to 0.03 mm wide, and covered with numerous spines. More distally these spindles are narrower, 0.015 to 0.020 mm, and they have fewer spines.

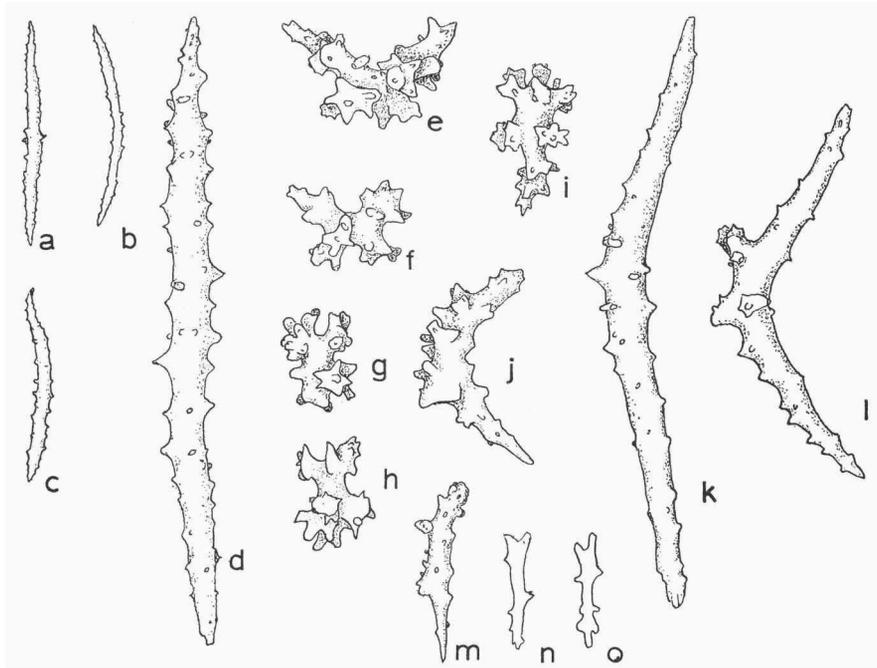


Fig. 6. *Lemnalia flava* (May). a-j, spicules from the cortex of the basal part of the stem; k, l, spicules from the cortex of the distal part of the stem; m-o, spicules from the tentacles. a-c, $\times 65$; d-o, $\times 240$.

Colour. — The colour is yellowish to light brown.

Geographical distribution. — The species has previously been recorded from Tumbatu (near Zanzibar), Zanzibar, Aldabra, and Madagascar.

Remarks. — According to May (1899: 137) and Kükenthal (1903: 112) the zooids measure 0.76 mm in height. In the material placed at my disposal the height of the zooids varies somewhat. Sometimes the body wall is only 0.20 mm high, while the tentacles are 0.40 mm long, the total height being 0.60 mm. In other cases the body wall is cylindrical in shape, 0.40 to 0.50 mm long, the total height of the anthocodia being up to 0.80 mm. Some of the twigs are longer than 8 mm. The cortical spindles are twice as long as those

recorded by the above-mentioned authors. As regards the colour, the colonies from lot RMNH Coel. no. 4983 are white, in all the other colonies the colour varies from whitish grey to brown.

Kükenthal (1903) stated that *L. flava* seems close to *L. africana*, and in his opinion the first mentioned species may be a variety of *L. africana* (cf. also Thomson & Henderson, 1906: 427). As appears from my descriptions of both species, there are several clear points of difference (cf. p. 18). Therefore I consider *L. flava* a true species. It is characterized by the smallness of the colonies and by the relatively thick, stiff branchlets and twigs, their width being intermediate between the wide branchlets and twigs occurring in *L. digitata* and the thin ones in, e.g., *L. africana*.

The specimen of *L. flava* represented by Tixier-Durivault, 1966, fig. 222, differs rather strongly from the colony figured by May, 1899, pl. 2 fig. 17, and from the photograph of one of our specimens, pl. 1 fig. 2.

Lemnalia africana (May, 1898) (text-fig. 7; pl. 2 fig. 1)

Ammonothea africana May, 1898: 33; May, 1899: 138, pl. 2 fig. 20.

Lithophytum africanum, Kükenthal, 1903: 110-111; Thomson & Henderson, 1906: 427.

Lemnalia africana, Kükenthal, 1913: 15.

Lemnalia laevis Thomson & Dean, 1931: 77, pl. 14 figs. 7, 8.

Not *Lemnalia laevis*, Tixier-Durivault, 1966: 258-261, figs. 245, 246.

Material. — Pointe Ambarionaomby, Nosy Komba, near Nosy Bé, depth 2 m; 27 September 1964. A. G. Humes no. 943, RMNH Coel. no. 4969. One colony.

West of harbour, Hellville, Nosy Bé, depth 12 m; 4 August 1967. A. G. Humes no. 1213, RMNH Coel. no. 4971. One colony. Field-note: "Light tan erect stalk, branches brown speckled with white polyps".

Banc des Frères, Isles Mitsio, 12° 58' S 48° 28' E, N.E. of Nosy Bé, depth 24 m; 18 August 1967. A. G. Humes no. A 3, RMNH Coel. no. 4968. One very large colony.

North of Ankazoberavina, 13° 27.6' S 47° 58.2' E, near Nosy Bé, depth 25 m; 24 August 1967. A. G. Humes no. A 8, RMNH Coel. no. 4970. One colony.

Kaniungan Ketjil, east coast of Borneo, Indonesia, reef, depth unrecorded. One colony collected by the Siboga Expedition, Sta. 89, type material of *L. laevis* Thomson & Dean (1931).

Description. — The following description is based on the specimen RMNH Coel. no. 4969 (pl. 2 fig. 1). This vigorous colony has a total height of 150 mm and a spread of about 170 mm. It consists of two or three stems, 20 to 40 mm wide. In their proximal part they are fused, forming a common base. The latter is attached to a piece of coral. At varying levels the stems give off upright, rather rigid primary and secondary branches, somewhat leathery to the touch just as the stems. At a height of 100 mm the uppermost branches rather abruptly divide into a large number of flabby branchlets and twigs. The longest of the branchlets are 40 to 50 mm, sometimes 60 mm long, but most of them are shorter. At their base the width is 5 to 7 mm. At

different levels they give off a number of twigs, up to 10 mm long and 1.5 to 2 mm wide.

The zooids are irregularly distributed on the branchlets and twigs. They measure 0.60 to 1.00 mm, but usually 0.80 mm, in height, and 0.60 to 0.85 mm in width. They are sessile and cylindrical; at the tip flat or slightly hollow. The spicules in the zooid-walls are thin needles, smooth, or provided with tiny spines at the tips, and a few somewhat larger spines in the middle; they measure 0.13 to 0.24 mm in length. In the tentacles we find small, granulated, lobated scales, 0.037 to 0.060 mm long (fig. 7g), and narrow rods, which are slightly longer.

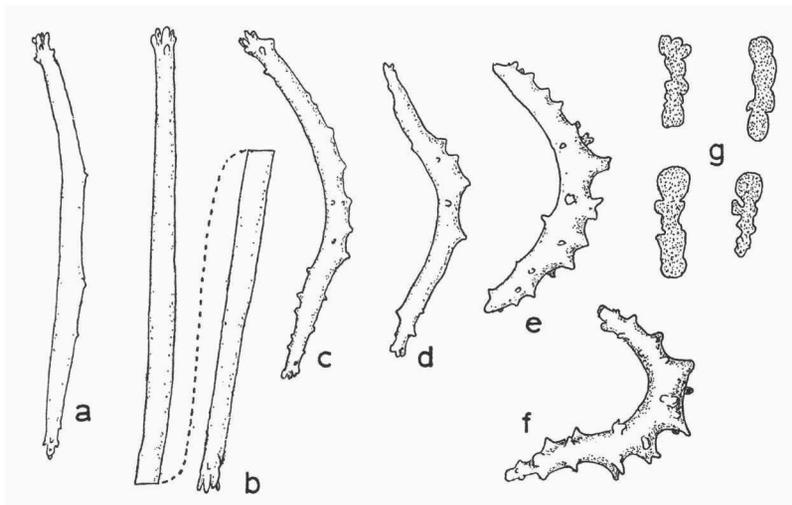


Fig. 7. *Lemnalia africana* (May). a-d, spicules from the cortex of the middle part of the stem; e, f, spicules from the cortex of the basal part of the stem; g, spicules from the tentacles. $\times 240$.

In the central part of one of the stems the cortex has very thin needles, quite smooth, except at the tips. They are 0.50 mm long and 0.011 to 0.016 mm wide (fig. 7a, b). Besides these, there are more or less crescent-shaped spindles (fig. 7c, d). In the cortex of the basal part of the stem the crescents are heavier, with stronger prominences; they are 0.12 to 0.18 mm long (fig. 7e, f). Real brackets are absent.

In the canal-walls we find numerous needles, smooth but with tiny prominences at the tips; the length is up to 0.60 mm.

Colour. — In alcohol one side of the colony is light brown, with zooids that are somewhat lighter brown; the other side is dark grey.

Geographical distribution. — The species has previously been recorded from Tumbatu (near Zanzibar), Zanzibar, and the Malay Archipelago.

Variability. — Specimen RMNH Coel. no. 4968 is the largest, being 180 mm high; the colour is grey.

The height of the white colony RMNH Coel. no. 4970 is 130 mm, the creamy-white colony RMNH Coel. no. 4971 is the smallest; it is 100 mm high, the branchlets and twigs are thinner and more slender.

Remarks. — May (1899, pl. 2 fig. 20) gave an illustration of a small colony. As far as I know colonies as large as those described and represented in this paper have never been reported upon before. Figures of the spicules are given for the first time.

At the end of the description of *L. flava* (p. 16) I noticed that *L. flava* is not identical with *L. africana*. I found the following differences:

<i>L. flava</i>	<i>L. africana</i>
1. Colonies small (70-100 mm high).	1. Colonies may be very large (150-200 mm high).
2. Branchlets and twigs stiff.	2. Branchlets and twigs flabby.
3. Tentacle spicules: rod-like, not granulated.	3. In the tentacles granulated scales.
4. In cortex brackets and double-stars.	4. Brackets and double-stars are absent.
5. Canal-wall spicules spiny.	5. Canal-wall spicules smooth.

I may add some remarks concerning *Lemnalia laevis* Thomson & Dean. According to these authors (1931: 77) the polyps of this species have short stalks, but in their figure of a twig (pl. 14 fig. 7) there is no sign of any such stalks. I therefore thought a new examination of the type material necessary, also in view of the description of the species by Tixier-Durivault (1966: 258-261, figs. 245, 246).

I found that, in fact, the polyps are sessile, as shown by Thomson & Dean's illustration. At the distal end of each polyp the tentacles form a protruding ring; these rings are clearly represented in Thomson & Dean's figure. However, the proper body-wall of the polyp is usually very low, most of the anthocodiae measuring 0.40 to 0.80 mm in total height, that is, the tentacles included. A few polyps are larger, up to 1.20 mm in total height (cf. Thomson & Dean's figure, the left lower polyp). The body-wall is always cylindrical, there is no trace of a short stalk.

The anthocodial spicules are nearly smooth, curved needles, usually 0.15 to 0.25 mm long, a few measure 0.30 mm in length. In the tentacles we find numerous granulated scales, and lobate rodlets, 0.05 to 0.08 mm long.

In the cortex of the twigs there are needles and rodlets, smooth except for a few tiny spines; 0.25 to 0.30 mm long, occasionally 0.35 mm long. Proximally the cortex of the stem has the same smooth needles, and, besides,

creasents. In the canal-walls we find smooth needles with small prominences at the tips; length: up to 0.50 mm.

From this description of the Siboga specimen it appears, firstly, that *L. laevis* is identical with *L. africana*. I could not detect any clear difference between them. Therefore the name *L. laevis* falls as a junior synonym of *L. africana*. Secondly, it appears that the specimens referred to *L. laevis* by Tixier-Durivault (1966) do not belong to this species. They differ in the following respects:

<i>L. africana</i>	<i>L. laevis</i> sensu Tixier-Durivault
1. Polyps sessile, more or less cylindrical.	1. Polyps pedicellate, polyp stalks 1 mm long.
2. Anthocodial spicules 0.15-0.25 mm long.	2. Anthocodial spicules 0.03-0.05 mm long (according to fig. 246 J, K, L and the given enlargement about 0.06-0.09 mm long).
3. Cortical spicules in the stem: thin, smooth needles, often with frayed ends, 0.50 mm long, and crescents, 0.12-0.18 mm long.	3. Cortical spicules in the stem: double-stars and crescents, 0.05-0.125 mm long. No record of smooth needles.
4. Cortical spicules in the twigs: smooth or nearly smooth needles, 0.25-0.35 mm long.	4. Cortical spicules in the twigs: needles and spindles with few spines, according to the given enlargement about 0.08-0.20 mm long.

In my opinion Tixier-Durivault's specimens belong to an undescribed species, which I propose to call *Lemnalia tixierae* nov. spec.

***Lemnalia tixierae* nov. spec.**

Lemnalia laevis, Tixier-Durivault, 1966: 258-261, figs. 245, 246 (not *Lemnalia laevis* Thomson & Dean, 1931).

A diagnosis and description of this species have been provided by Tixier-Durivault (1966). As the holotype I designate the specimen represented by Tixier-Durivault in her fig. 245.

Three colonies reported upon by Tixier-Durivault were collected near Tuléar (Madagascar) by Pichon in the year 1960, and four specimens near Aldabra Island (N.W. of Madagascar) by Cherbonnier in the year 1954. The material is kept in the Paris Museum.

This new species seems closest related to *L. crassicaulis* nov. spec., but differs from it in the general appearance of the colony and in the anthocodial spicules.

Lemnalía digitata (May, 1898) (text-fig. 8; pl. 2 fig. 2)

Ammothea digitata May, 1898: 31; 1899: 136-137, pl. 2 fig. 16.

Material. — Ambariobe, near Nosy Bé, depth 2 m; 22 August 1967. A. G. Humes no. 1309, RMNH Coel. no. 4976. Six colonies. Field-note: "Slender tough tan stalks, tips white with small brown polyps".

Boloboxo, Nosy Faly, near Nosy Bé, depth 15 m; 13 May 1964. A. G. Humes no. 866, RMNH Coel. no. 4977. Four colonies.

Near black buoy in pass north of Pointe Ambarionaomby, Nosy Komba, depth 17 m; 5 August 1967. A. G. Humes no. 1220, RMNH Coel. no. 4978. Two colonies. Field-note: "Fairly long whitish stalks, brown distally where branched in short branches covered with brown polyps".

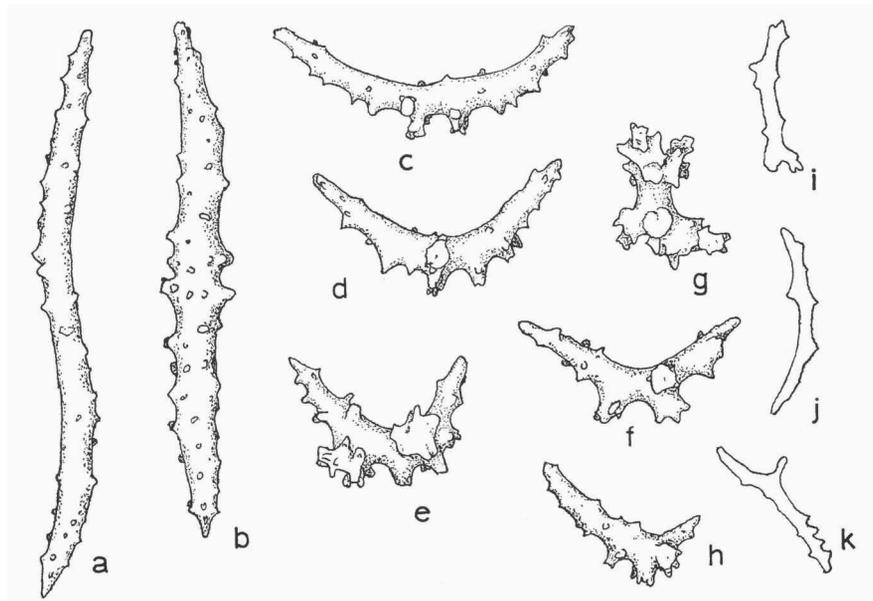


Fig. 8. *Lemnalía digitata* (May). a-h, spicules from the cortex of the basal part of the stem; i-k, spicules from the tentacles. $\times 240$.

Description. — The following description is based on the largest of the specimens from lot RMNH Coel. no. 4976 (pl. 2 fig. 2). It measures 80 mm in total height and 90 mm in maximum breadth, and it is laterally flattened.

From the common base, about 40 mm in width, a number of rigid stems arise, most of these 10 to 15 mm wide. At middle height of the colony the polyp-bearing region begins. At this height the stems pass into thick, stiff branchlets, which give off rigid side-branchlets and twigs. The branchlets are about 25 to 40 mm long, at base they measure 7 to 10 mm in width, distally they gradually become narrower. The side-branchlets and the twigs are short, thick, finger-shaped, sometimes spherical, 3 to 4 mm wide at the tips.

At the tips of branchlets and twigs the zooids are densely packed; proximally they are more distant and irregularly distributed. The anthocodiae are sessile, cylindrical, often with a cone-shaped base. The total height is 0.40 to 0.80 mm, the diameter is 0.60 to 0.70 mm. They are provided with densely crowded, strong spindles, weakly spined or smooth, measuring up to 0.40 mm in length and 0.03 mm in width. At the base of the tentacles the spindles are more longitudinally arranged, and shorter: 0.15 to 0.25 mm long. In the tentacles small, flat rods occur, provided with distant lobes; length: 0.05 to 0.08 mm (fig. 8i-k); granulated scales are absent.

The cortex of the twigs contains weakly spined needles, 0.30 to 0.50 mm long. In the cortex of the stem we find:

(a) needles, smooth, or provided with tiny spines at the tips; up to 0.50 mm long;

(b) shorter needles, often curved, bearing spines all over their surface; and

(c) more crescent-shaped, spiny spicules, about 0.15 to 0.22 mm long.

Towards the base of the colony the number of needles and spindles (fig. 8a, b) decreases, the crescents and brackets predominate; the crescents are 0.15 mm long, the warty brackets are slightly smaller (fig. 8c-f). Furthermore we find some small double-stars and irregular spicules derived from double-stars (fig. 8g, h).

In the canal-walls the needles are up to 0.55 mm long and 0.02 to 0.03 mm wide; they are either smooth or have inconspicuous spines and warts.

Colour. — The colour is creamy.

Variability. — The colonies RMNH Coel. no. 4978 are higher than the one just described, the largest one measures 120 mm in height. They are white in colour.

The specimens RMNH Coel. no. 4977 differ somewhat. Slightly above the middle of the colony the branches give off a number of closely set rigid branchlets and twigs as if they arise from a capitulum. Branchlets and twigs are narrower than those in the specimens mentioned above. The anthocodiae are higher, being up to 1.10 mm high, the anthocodial spicules are narrower and shorter; dimensions: 0.20 to 0.30 mm long, 0.018 mm wide. In the base of the stem the small, more or less capstan-like spicules are more numerous. The colonies are creamy in colour.

Remark. — May (1899: 136) supposed his *L. digitata* to be identical with *Alcyonum flabellum* Quoy & Gaimard. Kükenthal (1903: 111) pointed out that the type of *A. flabellum* represented by Quoy & Gaimard (1833, pl. 23 fig. 18) differs from May's specimen in one important respect, namely that also in the undermost, common part of the colony polyps are present. I must

add, however, that both the shape of the long, pointed lobes and the complete absence of branchlets and twigs show that *A. flabellum* is not identical with *L. digitata*. In my opinion *Alcyonium flabellum* is not a *Lemnalia* species at all, but rather an *Alcyonium*.

***Lemnalia longiramus* nov. spec.** (text-figs. 9, 10; pl. 3 fig. 1)

Material. — West of harbour, Hellville, Nosy Bé, depth 12 m; 4 August 1967. A. G. Humes no. 1209, RMNH Coel. no. 4987. One colony, the holotype. From the same locality etc., RMNH Coel. no. 5010, one complete colony and two fragments, the paratypes. Field-note: "Light tan stalks, tipped with long slender brown branches".

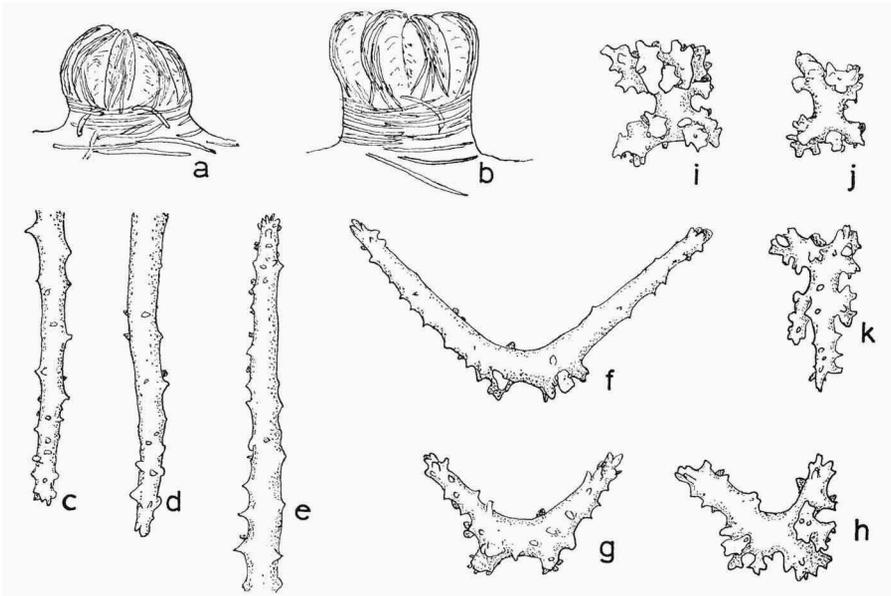


Fig. 9. *Lemnalia longiramus* nov. spec. a, b, zooids; c, d, parts of spicules from the cortex of a twig; e, part of a spicule from the cortex of the distal part of the stem; f-k, spicules from the cortex of the basal part of the stem. a, b, $\times 35$; c-k, $\times 240$.

Description. — The holotype (pl. 3 fig. 1) is 170 mm high. From a short common base, about 20 to 30 mm in diameter, some thick, flattened stems arise, which divide into a few primary branches. At a height of about 70 mm the polyp-bearing area begins, which is larger than the sterile portion of the colony. At this height the branches pass into the branchlets, which ramify into numerous side-branchlets and twigs. Branchlets and twigs are flaccid, and surprisingly long and slender. The branchlets are up to 100 mm long, at their base they are 3 to 6 mm wide, distally they taper slightly. The twigs may be up to 70 mm long, at the base and at the tips they are of nearly the same width, viz., 1.5 to 2 mm.

The anthocodiae are prominent, but sessile, nearly cylindrical in shape.

They are 0.20 to 0.60 mm high (tentacles included), and 0.50 to 0.65 mm wide (fig. 9a, b). They are regularly but not densely distributed over branchlets and twigs, 0.7 to 1.5 mm apart. The anthocodial spicules are transversely arranged, hardly spined spindles, proximally 0.35 mm long, and, more distally, 0.25 mm long. On the aboral surface of the tentacles we find longitudinally arranged spindles, about 0.15 mm long, and, more towards the tip, small curved rods, finely spined, and 0.07 to 0.12 mm long (fig. 10b). In the pinnules are flat, granulated scales, about 0.045 mm long (fig. 10a).

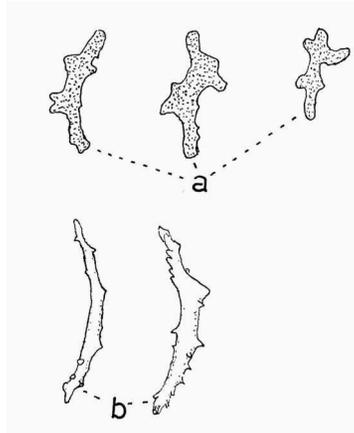


Fig. 10. *Lemnalia longiramus* nov. spec. a, spicules from the pinnules; b, spicules from the tentacles. $\times 240$.

In the cortex of the twigs needles occur, up to 0.45 mm long and 0.15 to 0.021 mm wide; they have few, tiny spines (fig. 9c, d). In the cortex of the stem there are needles, up to 0.50 mm long (fig. 9e), and crescents and brackets, 0.13 to 0.23 mm long. In the basal part of the stem we find:

(a) spindles with higher spines in the middle, which form two girdles; length: 0.25 to 0.35 mm;

(b) numerous small brackets, with warty rays; length: 0.08 to 0.13 mm (fig. 9g, h); intermediate forms between the spindles and these small brackets are also present (fig. 9f);

(c) small double-stars (capstans) with a median waist and two heads of spines and warts, 0.06 to 0.08 mm long, and clubs, 0.08 to 0.13 mm long; these types may be considered "miscarried brackets" (fig. 9i-k).

Colour. — The colour is creamy white.

Remark. — This species is characterized by the very tall and slender branchlets and twigs.

Lemnalia humesi nov. spec. (text-fig. 11; pl. 3 fig. 2)

Material. — Ambariobe, near Nosy Bé, depth 2 m; 25 May 1967. A. G. Humes no. 1024, RMNH Coel. no. 4984, the holotype, and RMNH Coel. no. 5011, five large colonies and two fragments, the paratypes. Field-note: "Long slender fleshy tan stalks with distally short whitish branches bearing small brownish knobs".

Pointe Lokobe, Nosy Bé, depth 10 m; 18 July 1967. A. G. Humes no. 1171, RMNH Coel. no. 4985. Twelve slender colonies. Field-note: "Firm slightly greyish tan stems, short brownish polyps on distal branches".

West of harbour, Hellville, Nosy Bé, depth 12 m; 4 August 1967. A. G. Humes no. 1203, RMNH Coel. no. 4986. Three colonies. Field-note: "Stalks brownish white, tipped with truncated very short brown branches".

Description. — The total height of the holotype (pl. 3 fig. 2) is 160 mm. It consists of a common base which gives rise to a number of stems dividing at different levels into primary branches. At a height of 90 to 110 mm they ramify into secondary branches, which pass into a number of branchlets bearing numerous twigs. The latter are slender, lax, about 3 to 20 mm long

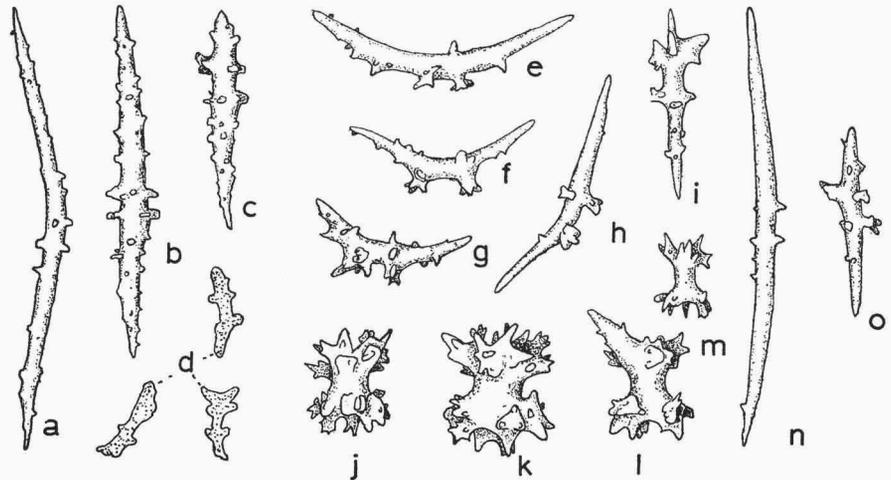


Fig. 11. *Lemnalia humesi* nov. spec. a-c, anthocodial spicules; d, spicules from the pinnules; e-o, spicules from the cortex of the middle part of the stem. $\times 240$.

and 1 to 2 mm wide. Many secondary branches, branchlets and twigs are flattened laterally. At the tips of the branchlets, and all around the twigs, the zooids are closely arranged; proximally they are less densely packed. The anthocodiae are sessile, about 0.20 to 0.40 mm high and 0.40 to 0.60 mm wide. They are thickly filled with spindles and needles, 0.12 to 0.25 mm long, and provided with higher spines in the middle; besides there are pseudo-clubs (fig. 11a-c). On the tentacle-backs smaller spindles occur, longitudinally arranged. The scales in the pinnules are granulated, and are 0.03 to 0.05 mm long (fig. 11d).

In the middle part of the stem the cortex contains the following types of spicules:

(a) spindles and needles with the highest spines in the middle, their length is up to 0.40 mm (fig. 11n);

(b) crescents, brackets and pseudo-clubs, about 0.10 to 0.15 mm long (fig. 11e-i, o);

(c) double-stars (capstans) with warty or spiny heads (fig. 11j, k, m), 0.08 mm long; sometimes one or two prominences have developed into longer rays (fig. 11l).

In the basal part of the stem the coarse capstans as represented in fig. 11k predominate strongly.

In the canal-walls we find spiny spindles and needles, up to 0.45 mm long and 0.025 mm wide. Most of these have the highest spines in the middle.

Colour. — The whole colony is white.

Variability. — The paratypes and all the other colonies agree to a large extent with the holotype. However, the specimens from lot RMNH Coel. no. 4986 show a very small polyp-bearing area, branchlets and twigs being relatively short.

Remarks. — This new species is characterized among other things by its high, sterile portion and the short branchlets and twigs, and by the typical coarse, tuberculated capstans occurring in the cortex. The species seems to be allied to *L. exilis* Tixier-Durivault, but it differs from the latter in the anthocodial spicules, which are much larger than those in *L. exilis*, and in the shape of the cortical capstans.

Lemnalina tenuis nov. spec. (text-fig. 12; pl. 4 fig. 1)

Material. — Banc de Cinq Mètres, near Nosy Bé, depth 50 m; 3 September 1967. A. G. Humes no. 1380, RMNH Coel. no. 4991, the holotype; no. 4992, paratype; no. 4990, several colonies and fragments, also paratypes. Field-note: "Slender, rather hard and brittle, greyish white stalks, branches fine and brown".

Description. — The colonies are all characterized by their slender, often irregularly bent, stiff and brittle stems and branches. The total height of the colonies is about 80 to 100 mm. In a few cases the colony consists of two stems fused together at base, but most colonies have only one stem. The latter is narrowest at the base, being there 6 to 9 mm thick, and widens upward. At different levels it may give off branches, in the holotype (pl. 4 fig. 1a) the stem bears a good many branches rising at varying heights from the stem, but in many specimens the stem is undivided up to a height just below the polyp-bearing area. This area is very small: in a colony with a

total height of 80 mm the stem is unbranched up to a height of 50 mm. The two branches arising here are 10 mm long, and thus at a height of 60 mm the polyps begin.

The branches are short, and bear a few short, thin twigs, 5 to 10 mm long and about 1 to 1.5 mm wide.

The zooids are regularly but not densely placed. They are sessile, cylindrical in shape, slightly widening at the height of the oral disc (fig. 12n). They are 0.60 to 1.00 mm high and 0.80 mm wide.

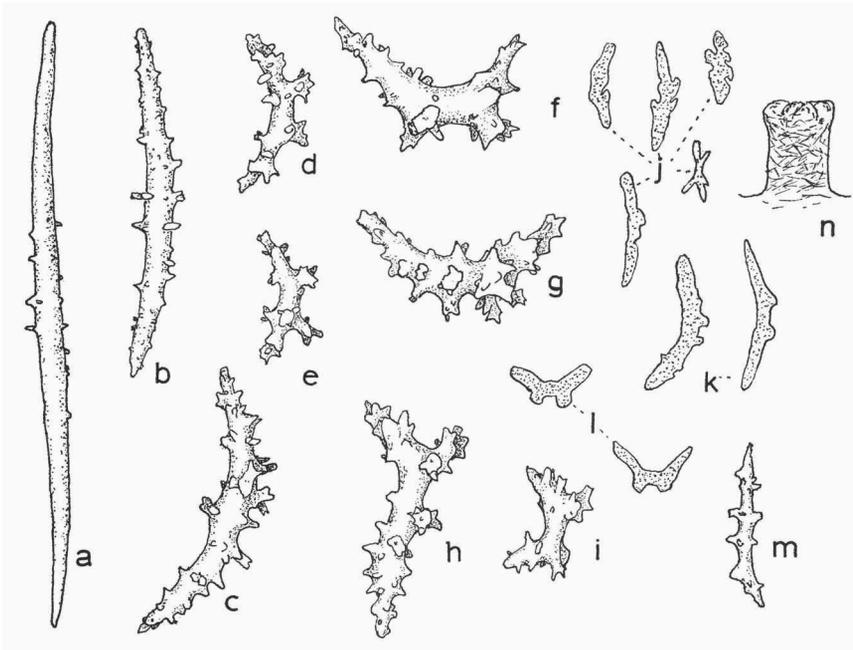


Fig. 12. *Lemnalia tenuis* nov. spec. a-e, spicules from the cortex of the stem; f-i, spicules from the cortex of the basal part of the stem; j-m, spicules from the tentacles and the pinnules; n, zooid. a-m, $\times 240$; n, $\times 14$.

The anthocodial spicules are irregularly, rather closely distributed thin needles, provided with tiny spines; they are 0.08 to 0.28 mm long. In the tentacles granulated scales occur, 0.035 to 0.065 mm long (fig. 12j), but also granulated rods, 0.09 mm long, often with two rounded lateral knobs (fig. 12k), and very small brackets, 0.045 mm long (fig. 12l). At the aboral side of the tentacles small, spiny spindles occur (fig. 12m).

The cortex of the stem has needles and spindles, up to 0.40 mm long, provided with a few spines in the middle part forming two or more girdles (fig. 12a); shorter spiny spindles, 0.16 to 0.25 mm long (fig. 12b); spiny and warty crescents, 0.10 to 0.17 mm long (fig. 12c), and some small brackets

(fig. 12d, e). In the basal part of the stem the number of needles and spindles diminishes, that of crescents (0.13 to 0.17 mm long, fig. 12g), brackets (0.08 to 0.12 mm long, fig. 12f), pseudo-clubs (about 0.08 mm long, fig. 12h), and small four-rayed bodies (0.06 to 0.10 mm long, fig. 12i) predominates. They are all provided with spines and coarse warts.

In the canal-walls we find needles covered with spines all over their surface. They are up to 0.46 mm long and 0.015 to 0.021 mm wide.

Colour. -- The colour is white.

Remark. — This species is characterized by the irregularly curved, relatively thin, hard stems, and the smallness of the polyp-bearing area.

Lemnalina cervicornis (May, 1898) (text-fig. 3; pl. 5)

Ammonothea cervicornis May, 1898: 52; May, 1899: 137-138, pl. 2 fig. 18.
Lemnalina cervicornis, Kükenthal, 1903: 138-139; Thomson & Dean, 1931: 75, pl. 14 fig. 9; Roxas, 1933: 403 (remark added to *L. faustoni*); Tixier-Durivault, 1966: 252-255, figs. 239-241.

Material. — Banc de Cinq Mètres, near Nosy Bé, depth 20 m; 6 August 1967. A. G. Humes no. 1228, RMNH Coel. no. 4973. Eleven colonies. Field-note: "Rather slender tough stems, branches covered with seedlike whitish polyps when contracted, in life extended and slightly grey".

Banc de Dzamandzar, Nosy Bé, depth 20 m; 30 August 1967. A. G. Humes no. 1364, RMNH Coel. no. 4972. Two colonies. Field-note: "Grey, with white stalk".

Description. — Plate 5 shows two colonies from lot RMNH Coel. no. 4973. In the left-hand specimen the common base gives rise to a number of straight stems, which at different levels divide into primary branches. Half-way up the colony the polyp-bearing area begins. Branchlets, side-branchlets and twigs are delicate, the twigs are thin and up to 20 to 25 mm long. The total height of the colony is 110 mm, the maximum width is 90 mm.

Most of the colonies, however, show a general shape like that represented in pl. 5, the right-hand specimen. The stem is curved, the branches are irregularly bent, branchlets and twigs diverge in different directions, sometimes they are antler-like.

The zooids are scattered, pedicellate. The anthocodiae are 0.60 to 1.00 mm high and 0.60 to 0.90 mm wide (fig. 13a). The anthocodial spicules are irregularly distributed, but distally they are longitudinally arranged, forming eight bundles that pass into the tentacles. Proximally the spicules are spiny spindles, up to about 0.23 mm long (fig. 13c), but distally and at the aboral side of the tentacles they are slightly club-shaped, with an inconspicuously spined shaft, the heads being directed distally. These clubs measure 0.15 mm in length (fig. 13d). In the tentacles we find scales, 0.05 to 0.09 mm long, and rods, 0.07 to 0.10 mm long, both being granulated (fig. 13e, f).

In the distal part of the stem and in the branches and the branchlets the cortex has thin needles, 0.16 to 0.28 mm long, provided with a few spines in the middle (fig. 13g). Some of these are curved in a crescent-like manner, with two smooth, curved ends and a spiny middle part (fig. 13i). There are also a few short spindles, covered with spines all over their surface; their length is 0.10 to 0.12 mm (fig. 13h), some are crescent- or club-shaped (fig. 13j, k).

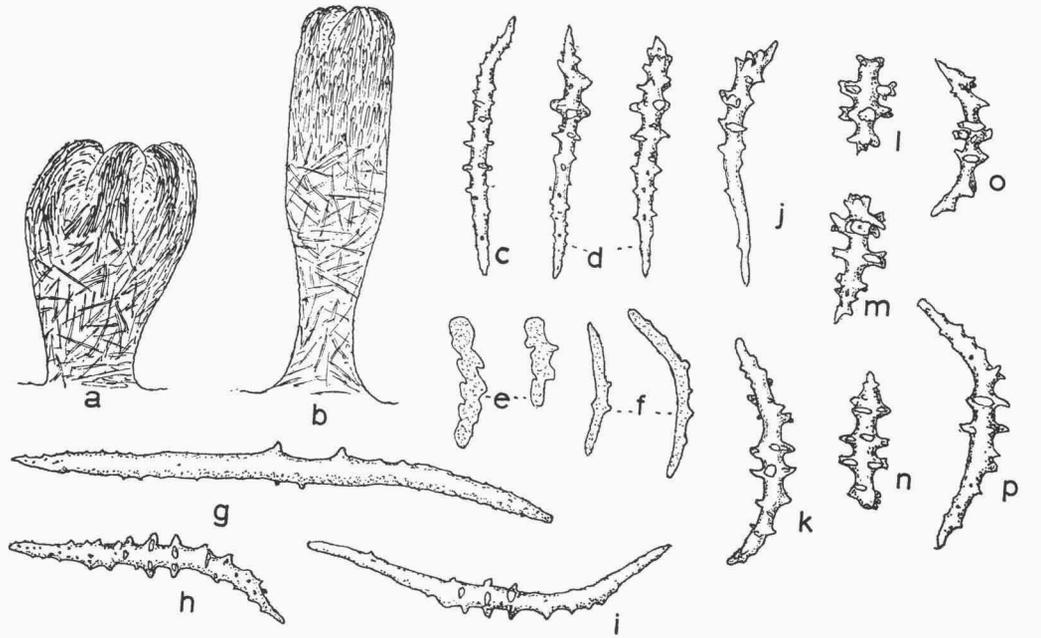


Fig. 13. *Lemnalia cervicoruis* (May). a, b, zooids; c, d, anthocodial spicules; e, f, spicules from the tentacles; g-k, spicules from the cortex of the distal part of the stem; l-p, spicules from the cortex of the basal part of the stem. a, b, $\times 35$; c-p, $\times 240$.

In the cortex of the basal part of the stem we find:

- (a) numerous small rods, 0.06 to 0.08 mm long, with two girdles of blunt-ended, laterally flattened spines or simple warts (fig. 13l-n),
- (b) crescents, 0.13 to 0.18 mm long (fig. 13 o), and
- (c) crescent-like spindles as described above, 0.15 to 0.23 mm long (fig. 13p).

Real brackets are absent, double-stars are very scarce.

In the middle part of the stem the canal-walls contain needles with inconspicuous spines; dimensions: up to 0.50 mm long, 0.015 to 0.021 mm wide. In the basal part of the stem there are also shorter and wider spindles, more closely beset with spines; dimensions: 0.25 to 0.35 mm long and 0.024 mm wide.

Colour. — The colour is white.

Variability. — The white colonies RMNH Coel. no. 4972 differ from the specimens described in the following respects:

(a) the anthocodiae are much higher, most of them are 0.85 to 1.40 mm long (fig. 13b), but sometimes they are 1.80 mm, and even 2.10 mm long; the width is 0.50 to 0.65 mm; and

(b) the scales in the tentacles are transparent.

The colonies are of a bizarre shape. One of them consists of two colonies, connected by an anastomosis.

Geographical distribution. — The species has been recorded from Mozambique, Zanzibar, Bueni Riff (east coast of Africa), Malay Archipelago, Aldabra Island (N.W. of Madagascar) and Madagascar.

Remark. — I doubt whether the specimens described and figured by Thomson & Dean (1931: 75, pl. 14 fig. 9) are identical with *L. cervicornis*. The branchlets and twigs in their material are too strong, not in the least antler-like, and the anthocodiae are sessile.

Lemnalina madagascarensis nov. spec. (text-fig. 14; pl. 4 fig. 2)

Material. — Banc des Frères, Isles Mitsio, N.E. of Nosy Bé, depth 24 m; 17 August 1967. A. G. Humes no. 1283, RMNH Coel. no. 4988, the holotype, and RMNH Coel. no. 5012, four paratypes. Field-note: "Stems pale brown, fine short branches tan and granular".

Near Nosy Bé, 13° 14' 15" S 48° 02' 05" E, depth 45 m; 30 August 1967. A. G. Humes no. A36, RMNH Coel. no. 4989. One fragment.

Description. — The holotype (pl. 4 fig. 2) is 120 mm high and 100 mm wide. The low common base gives rise to a number of stems, 40 to 50 mm long. At about halfway the height of the colony the stems divide into short primary branches, which almost immediately pass into the strongly subdivided branchlets and twigs. The numerous terminal twigs are about 1.2 mm wide and 10 mm long.

The anthocodiae are pedicellate; in a few cases they are more or less cylindrical (fig. 14a-d). They are 0.60 to 1.60 mm high, tentacles included. At base the anthocodiae are 0.40 to 0.65 mm wide, distally they widen, up to 0.60 to 1.00 mm. The anthocodial spicules are nearly smooth needles. They are irregularly distributed, and are up to 0.30 mm long. Distally they are slightly shorter, about 0.20 mm long, and they are more and more longitudinally arranged forming eight protruding ridges, between which there are still some irregularly placed spicules. The longitudinal rows of spicules continue at the aboral side of the tentacles, where the spindles are short,

about 0.08 to 0.15 mm, and more spiny. In the tentacles there are also numerous granulated scales, 0.03 to 0.06 mm long.

The cortex of the twigs contains smooth, thin needles, up to 0.35 mm in length. In the cortex of the stem the needles are a little longer and wider, more curved, sometimes slightly crescent-shaped, with stronger spines at the convex side. In the cortex of the common base the needles reach a length of 0.50 mm (fig. 14e). Further, we find here crescents, 0.13 to 0.22 mm long (fig. 14f, g). From this description it appears that the cortical spicules are rather uniform; double-stars (capstans) and brackets are totally absent.

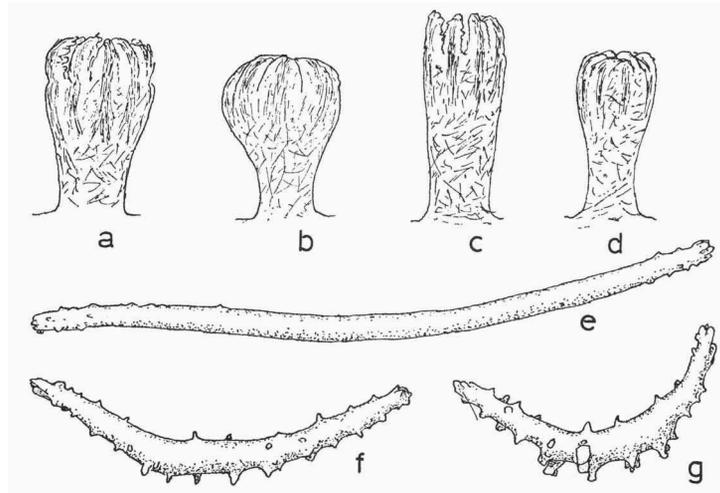


Fig. 14. *Lemmalia madagascarensis* nov. spec. a-d, zooids; e-g, spicules from the cortex of the common base. a-d, $\times 16$; e-g, $\times 240$.

In the canal-walls we find smooth needles with frayed ends; dimensions: up to 0.50 mm long and 0.02 mm wide.

Colour. — The whole colony is creamy white.

Variability. — The paratypes from the same locality are similar to the holotype. The fragment RMNH Coel. no. 4989 consists of only one stem, a few branchlets, and some twigs. The height of the anthocodiae is up to 2 mm, of which 0.40 mm goes to the expanded tentacles. The zooids are more clearly pedicellate, the polyp stalks being narrower. The colour is white.

Remark. — In many respects this new species agrees with *L. laevis* Thomson & Dean, especially in respect of the spicules in the cortex and in the interior. But in *L. madagascarensis* the ramification of the stems into the polyparium begins at half the height of the colony, the polyps are distinctly pedicellate, and much higher.

Lemnalina crassicaulis nov. spec. (text-fig. 15; pl. 6 fig. 1)

Material. — Banc de Cinq Mètres, near Nosy Bé, depth 20 m; 6 August 1967. A. G. Humes no. 1229, RMNH Coel. no. 4974. One large colony, the holotype. Field-note: "Stout soft fleshy white stalk, tips of branches brown and covered with whitish yellow seedlike polyps when contracted".

The same locality, depth 40 m; 3 September 1967. A. G. Humes no. A 29, RMNH Coel. no. 4975. One colony, the paratype.

Description. — The total height of the holotype (pl. 6 fig. 1) is 200 mm. The sterile part consists of one wide stem, which at the base is 35 mm in diameter. It remains undivided up to a height of 100 mm. At this level the

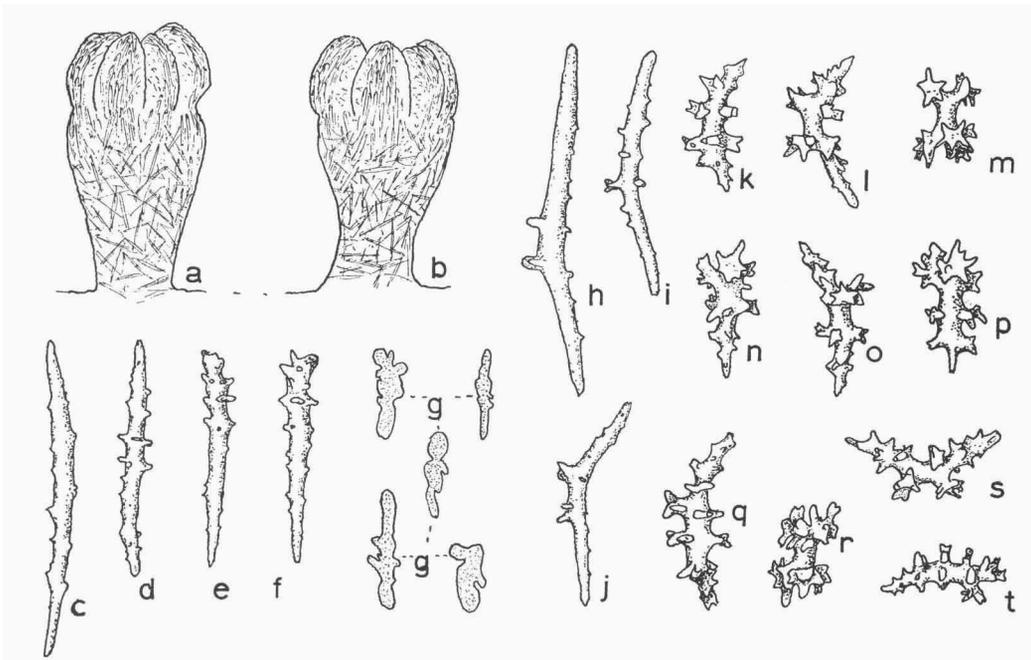


Fig. 15. *Lemnalina crassicaulis* nov. spec. a, b, anthocodiae; c-f, anthocodial spicules; g, tentacular spicules; h-t, spicules from the cortex of the stem. a, b, $\times 35$; c-t, $\times 240$.

stem, square in a transverse section, measure 50 mm in width, and here it divides into six dumpy primary branches, which give off a few secondary branches. At a height of 140 mm the polyparium begins. The branches pass into the branchlets, 2.5 to 3.5 mm in diameter at their base. The twigs are thin, being 0.8 to 1.6 mm wide, and up to 20 mm long.

The zooids (fig. 15a, b) are regularly and rather thickly distributed over the branchlets and twigs. They are pedicellate, their height is 0.80 to 1.00 mm, a few are up to 1.15 mm, pedicel and tentacles included, and their maximum diameter is 0.50 to 0.65 mm. The anthocodial spicules are irregularly arran-

ged, not densely crowded. In the basal part of the anthocodia (and also in the twigs) there are tiny, weakly spined needles, 0.16 mm long (fig. 15c, d). Distally and at the aboral side of the tentacles we find slightly clavate spicules with a barely spined handle and a head with higher, laterally flattened spines; the length of the clubs is 0.08 to 0.13 mm (fig. 15e, f). On the back-side of the tentacles these clubs are arranged in such a way that the heads are directed distally. The tentacular spicules are granulated scales and rods, length 0.035 to 0.065 mm (fig. 15g).

The cortex of the stem and the branches has:

(a) numerous fusiform spicules with higher spines at the middle part; they are 0.12 to 0.20 mm long (fig. 15h, i); a few are slightly bracket-shaped (fig. 15j);

(b) double-stars (warty capstans), about 0.06 mm in length; their waist measures 0.012 mm in width (fig. 15m, r);

(c) numerous warty, short rods and spindles, sometimes crescent-like or club-shaped, or irregularly formed, a few are real brackets; they vary in length from 0.06 to 0.10 mm (fig. 15k, l, n, o, p, q, s, t).

In the basal part of the stem the fusiform spicules mentioned sub (a) are small in number. For the rest the cortex contains the same spicules.

In the canal-walls are smooth needles, up to 0.50 mm long; the width is 0.012 to 0.021 mm.

Colour. — The colony is creamy white.

Variability. — The colony RMNH Coel. no. 4975 shows a still more clumsy general shape. At the base the stem has a diameter of 30 to 40 mm. Higher up it strongly widens, so that at a height of 70 mm the sterile part of the colony has a width of 100 mm. Then the stem divides into some thick primary branches, 30 to 40 mm wide. The polyp-bearing area is relatively small, the branchlets and twigs are flabby.

Lemnalina acutispiculata nov. spec. (text-fig. 16; pl. 6 fig. 2)

Material. — Banc de Cinq Mètres, near Nosy Bé, depth 15 m; 9 July 1967. A. G. Humes no. 1141, RMNH Coel. no. 4967, the holotype, and no. 4966, three colonies or fragments of colonies, the paratypes. Field-note: "Rather slender light tan stalks with short darker tan branches".

Description. — The total height of the holotype (pl. 6 fig. 2) is 110 mm. From a low common base a few stems arise, 10 to 20 mm wide, one of which is broken off. At a height of 30 to 40 mm one of the widest stems divides into two primary branches. The others remain undivided up to a height of 70 to 80 mm. At this level stems and branches give rise to a number of narrower branchlets and twigs. Branchlets and twigs are flabby. At the

proximal part of the branchlets the zooids are far apart, but distally, and also on the twigs, they are closely set.

The anthocodiae are shortly pedicelled, or sessile. On the twigs they are so densely packed that it is not easy to see whether they are sessile or pedicellate. In the places where they stand more apart we see that most of them are pedicellate. They are 0.60 to 1.00 mm high and on the average 0.70 mm wide, the pedicel being 0.50 to 0.60 mm wide.

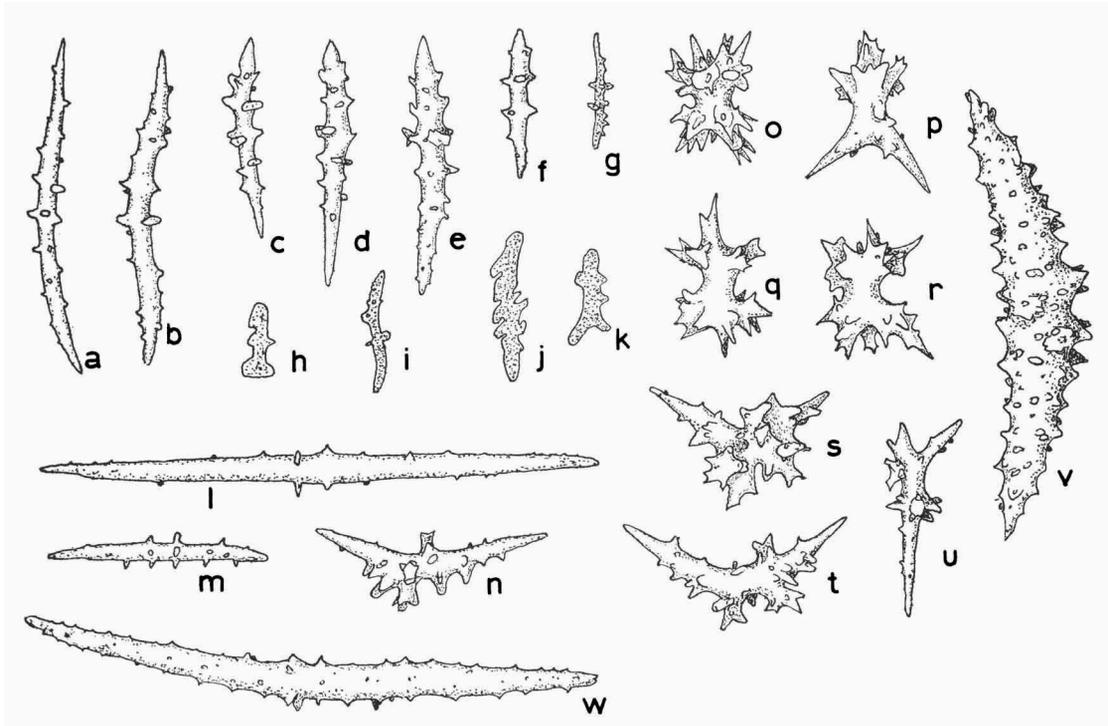


Fig. 16. *Lemnalia acutispiculata* nov. spec. a-e, anthocodial spicules; f-k, spicules from the tentacles and the pinnules; l-u, spicules from the cortex of the distal part of the stem; v, w, coenenchymal spicules. $\times 240$.

The anthocodial spicules are spiny spindles and pseudo-clubs. The spindles (fig. 16a, b) are 0.15 to 0.22 mm long, and they are densely and irregularly arranged. Distally they are replaced by club-shaped types, which on an average are 0.12 mm long, and provided with a curious, smooth, cone-shaped point at the head-end (fig. 16c-e). In the tentacles we find tiny spindles and rods, 0.07 to 0.11 mm long (fig. 16f, g, i), and granulated scales, 0.040 to 0.085 mm long (fig. 16h, j, k).

In the distal part of the stem the cortex has:

(a) straight or curved thin needles, 0.15 to 0.35 mm in length; the longer ones have higher spines in the middle part, the shorter ones have more spines (fig. 16l, m);

(b) very spiny double-stars, 0.06 to 0.08 mm long, the waist 0.018 to 0.023 mm wide (fig. 16 o, q, r);

(c) brackets with spines and spiny warts; dimensions: 0.07 to 0.12 mm (fig. 16s, t);

(d) transitional types between spindles and brackets (fig. 16n) and other irregular forms such as represented in fig. 16p, u.

All these types occur frequently.

In the basal part of the stem the double-stars are especially numerous. For the rest the same forms occur.

In the canal-walls of a branch only needles are present, up to 0.46 mm long, and about 0.015 to 0.024 mm wide. They bear numerous very tiny spines. Basally the coenenchymal spicules are:

(a) the same spindles as just mentioned (fig. 16w), and

(b) wider shorter spindles densely covered with spines and small warts, especially in the middle part; the length is up to 0.33 mm, the width is 0.030 to 0.045 mm (fig. 16v).

Colour. — The colour of the colonies is white.

Remark. — The specimens do not agree with any of the species with pedicellate anthocodiae described so far. The very thorny spicules in the cortex, the remarkable shape of the anthocodial clubs, and the broad, rough spindles in the interior of the stem compelled me to establish a new species.

Paralemnalia Kükenthal, 1913

Paralemnalia thyrsoides (Ehrenberg, 1834) (pl. 7 fig. 1)

Ammonothea thyrsoides Ehrenberg, 1834: 283; Klunzinger, 1877: 31, pl. 2 fig. 3; May, 1898: 30-31; May, 1899: 134-135.

Verrilliana thyrsoides, Gray, 1869: 131.

Lithophytum thyrsoides, Kükenthal, 1903: 109; Thomson & Henderson, 1906: 427 (with var. *durum*); Reinhardt, 1907: 348; Thomson & McQueen, 1907: 56.

Lemnalia thyrsoides, Thomson & Dean, 1931: 76-77, pl. 9 figs. 2, 6.

Paralemnalia thyrsoides, Kükenthal, 1913: 16-17; Roxas, 1933: 394-395, pl. 2 fig. 1, pl. 4 fig. 9; Macfadyen, 1936: 55; Utinomi, 1956: 232-233, fig. 6.

Material. — Pointe Antsamantsara, Nosy Bé, depth 3 m; 20 September 1964. A. G. Humes no. 930, RMNH Coel. no. 5002. Six colonies.

Banc du Touareg, Bay of Ampasindava, near Nosy Bé, depth 18 m; 11 July 1967. A. G. Humes no. 1149, RMNH Coel. no. 4995. Four colonies. Field-note: "Slender stalks, long slender tips with short greyish brown branches".

West of harbour, Hellville, Nosy Bé, depth 12 m; 4 August 1967. A. G. Humes no. 1204, RMNH Coel. no. 4996. Two colonies. Field-note: "Small, 3", brownish stalk, very slender terminal branches, darker brown".

West of Andilana, Nosy Bé, 13° 18' S 48° 07' E, depth 20 m; 24 August 1967. A. G. Humes no. 1334, RMNH Coel. no. 4994. Two colonies. Field-note: "Grey".

Description. — The following description is based on the colonies from lot RMNH Coel. no. 5002. The total height of the flabby colonies is up to 80 mm. From a common base some thick, sterile stems arise. At a height of 25 to 30 mm these stems divide into a number of upright, finger-shaped branches, standing close together and measuring 30 to 45 mm in length and 4 to 6 mm in width. The lowermost part of a branch is still sterile, the distal part, 20 to 35 mm long, bears the zooids. The latter are regularly placed, at mutual distances of 3 to 5 mm. At the tips they are more crowded.

The zooids are not retracted. The anthocodiae are 2 to 4.5 mm long, they are curved upwards and widen distally; at the base they are 0.85 mm wide, at the top 1.10 to 1.25 mm. They are provided with numerous spiny needles, irregularly distributed, and measure up to 0.32 mm in length. In the tentacles there are numerous, usually curved rods, sometimes antler-like at one end. Most of them are 0.07 to 0.09 mm long, a few measure up to 0.16 mm in length.

The cortex of the sterile stem contains:

- (a) thin needles, quite smooth except at the tips, which are beset with a few tiny spines; they are up to 0.45 mm long and 0.019 to 0.022 mm wide, and
- (b) shorter spindles with two median zones of spines; length: 0.07 to 0.18 mm.

In the interior of stem and branches the same needles occur, but they are slightly wider: 0.025 to 0.028 mm; the spiny spindles are absent.

Colour. — The colonies are brown.

Variability. — The colonies RMNH Coel. no. 4995 are very flabby and very high, the largest is 150 mm high. The specimens RMNH Coel. no. 4994 are dirty-green in colour.

Geographical distribution. — The species is known to occur in several localities in the Red Sea, the Indian Ocean, the Malay Archipelago, and the Pacific Ocean.

Remark. — Our colonies look quite different from those represented by Klunzinger (1877, pl. 2 fig. 3), Thomson & Dean (1931, pl. 9 figs. 2, 6), Roxas (1933, pl. 2 fig. 1), and Utinomi (1956, fig. 6). For this reason I provide here a photograph of one of the colonies from lot RMNH Coel. no. 5002 (pl. 7 fig. 1).

***Paralemmalia clavata* nov. spec. (text-fig. 17; pl. 7 figs. 2, 3)**

Material. — Ambariobe, near Nosy Bé, depth 2 m; 5 May 1967. A. G. Humes no. 1023, RMNH Coel. no. 4993. One colony, the holotype. Field-note: "Sausage-like branches arising from common flat white base, colour of branches light tan, polyps greenish".

The vigorous colony (pl. 7 figs. 2, 3) measures 105×130 mm in diameter; it is about 60 to 70 mm high. It consists of a common base, 10 to 20 mm thick, fastened to a piece of stone. From this common base a number of thickly set, somewhat flabby stems arise, mostly 30 to 50 mm high and 10 to 15 mm wide. Some of these divide dichotomously into two branches. In the basal part the stems are sterile, but distally the number of anthocodiae increases, the extreme distal part being entirely covered with densely packed zooids. Owing to this the stems look like clubs (hence the name of this

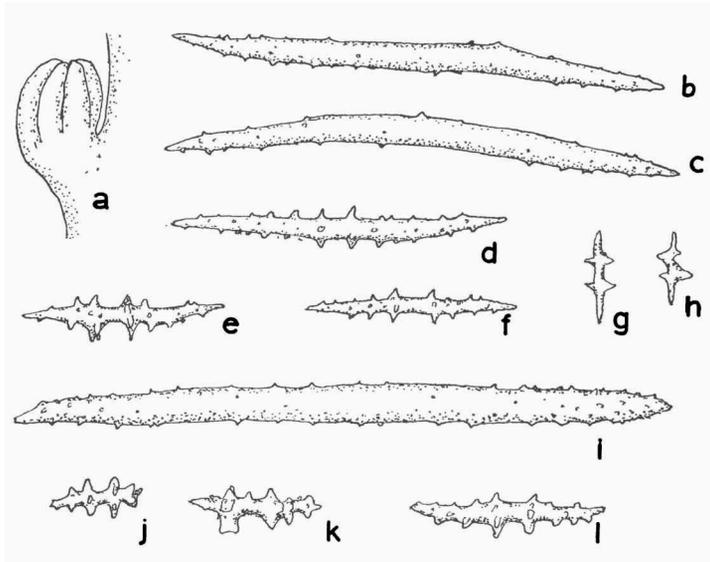


Fig. 17. *Paralemmalia clavata* nov. spec. a, anthocodia; b-f, anthocodial spicules; g, h, spicules from the tentacles; i-l, coenenchymal spicules. a, $\times 7$; b-l, $\times 240$.

species), but in reality they are of nearly the same width all along their lengths. In many places the zooids seem to be arranged on transverse rows, forming something like cross-placed crests.

The anthocodiae (fig. 17a) are curved upwards. They are globular or oval-shaped with a flattened or dented top; the width is 1.60 mm, the length measured at the side turned to the stem is 1.40 mm, on the outside about 2 mm. The uppermost part of an anthocodia is grooved, the ridges between the grooves pass into the incurved tentacles.

There are two kinds of anthocodial spicules: nearly smooth needles, 0.25 to 0.33 mm long (fig. 17b, c), and thin, pointed needles, 0.10 to 0.20 mm long, and provided with many spines (fig. 17d-f).

In the tentacles there are a few very small rods with high spines, 0.03 to 0.06 mm long (fig. 17g, h).

The cortex of the middle part of the stems, viz., that between the zooids, has the same nearly smooth needles, 0.30 to 0.40 mm long, and the same spiny spindles, averaging 0.10 to 0.16 mm in length. In the cortex of the common base the needles predominate; the spindles are smaller, 0.06 to 0.10 mm long.

In the interior of a stem we again find the same nearly smooth needles, up to 0.43 mm long and 0.015 to 0.025 mm wide (fig. 17i), and, besides, numerous small rods and spindles with girdles of spines; length: 0.05 to 0.11 mm (fig. 17j-1).

Colour. — In alcohol the colour is greyish.

Remark. — In respect of the spiculation there is considerable agreement with that of *P. thyrsoides*, but in the interior of the stems of *P. thyrsoides* the small spiny spindles are absent. The different general shape of the colony with its short, wide stems, the shape and the dimensions of the grooved anthocodiae justify the establishment of a new species. I do not believe that this specimen is identical with *Lithophytum thyrsoides* (Ehrenberg) var. *durum* Thomson & Henderson (1906: 427) because of the absence of "a large number of almost hemispherical lobes".

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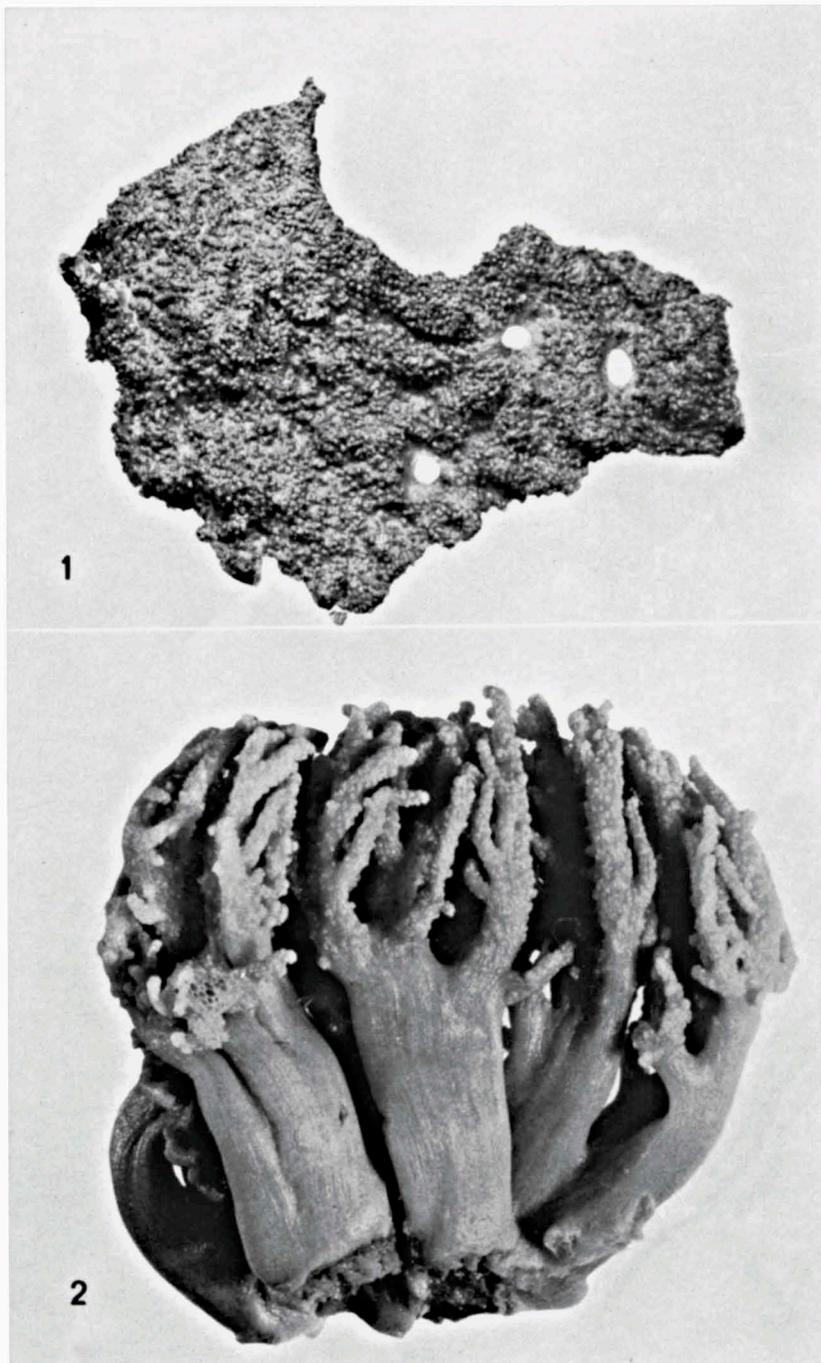


Fig. 1. *Parerythropodium rubiginosum* Verseveldt, holotype, RMNH Coel. no. 3903.
× c.8.

Fig. 2. *Lemnalia flava* (May), RMNH Coel. no. 4980. × 1.2.

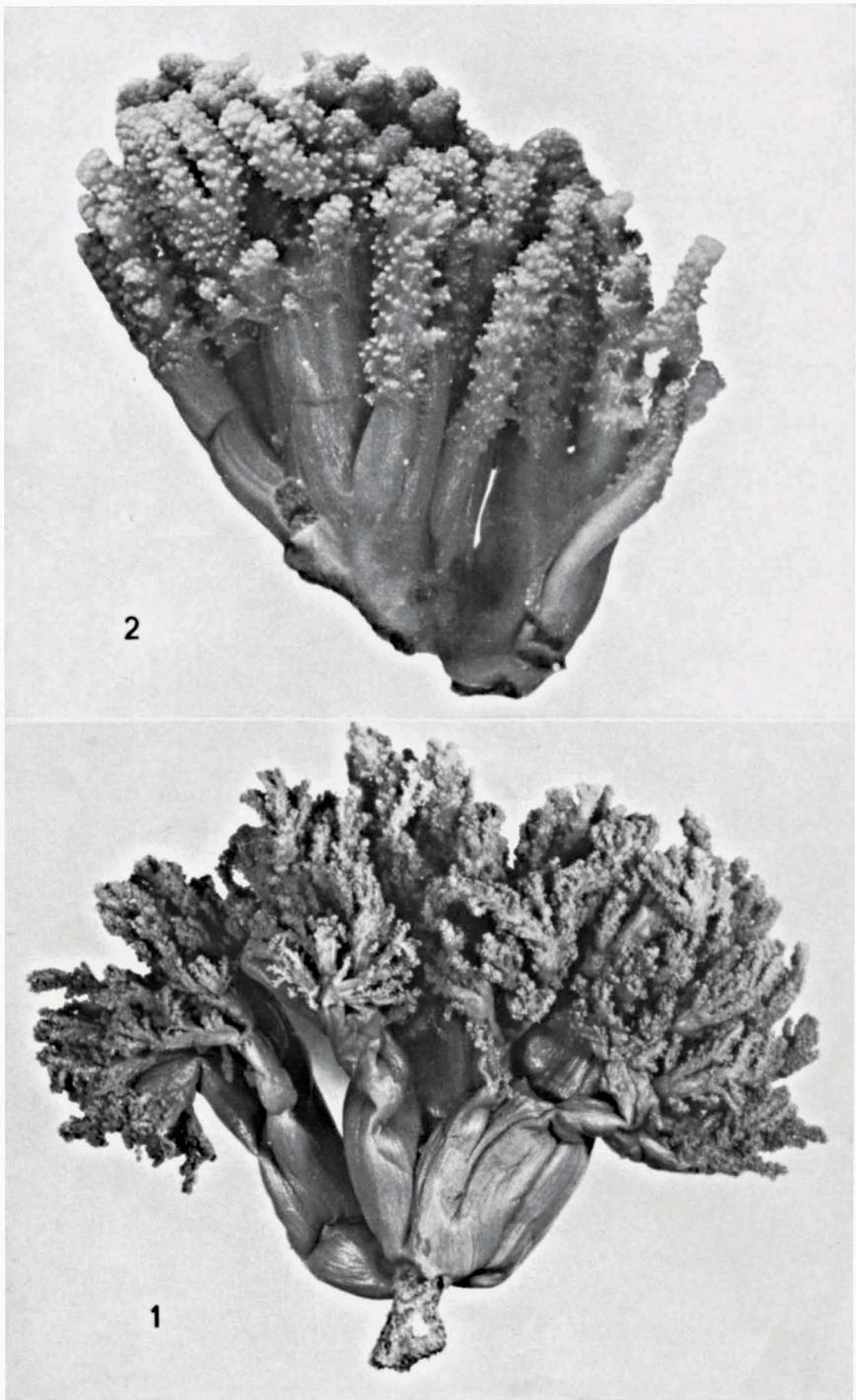


Fig. 1. *Lemnalia africana* (May), RMNH Coel. no. 4969. $\times 0.5$.
Fig. 2. *Lemnalia digitata* (May), RMNH Coel. no. 4976. $\times 1$.

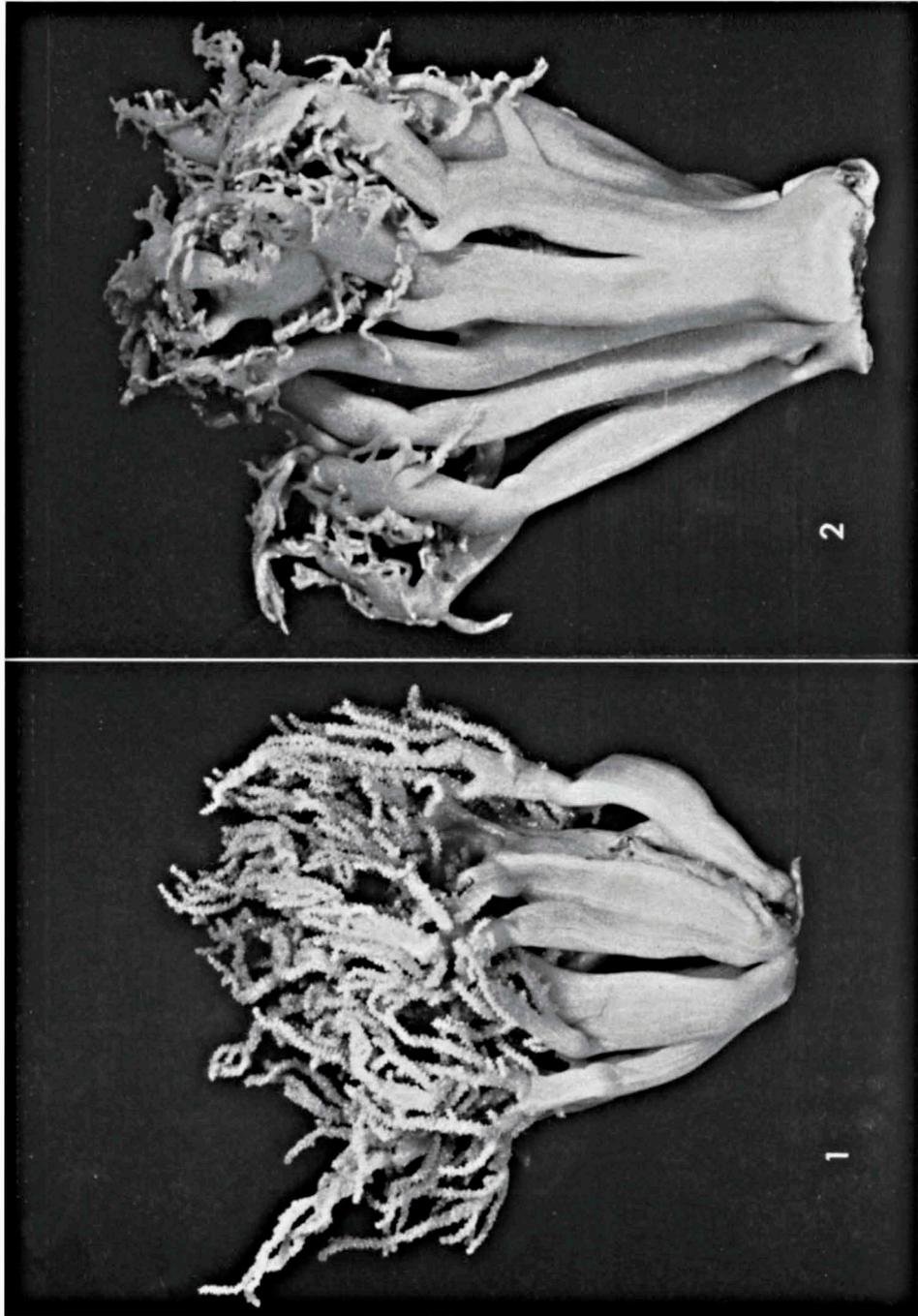


Fig. 1. *Lemmalia longiramus* nov. spec., holotype, RMNH Coel. no. 4987. $\times 0.56$.

Fig. 2. *Lemmalia humesi* nov. spec., holotype, RMNH Coel. no. 4984. $\times 0.7$.

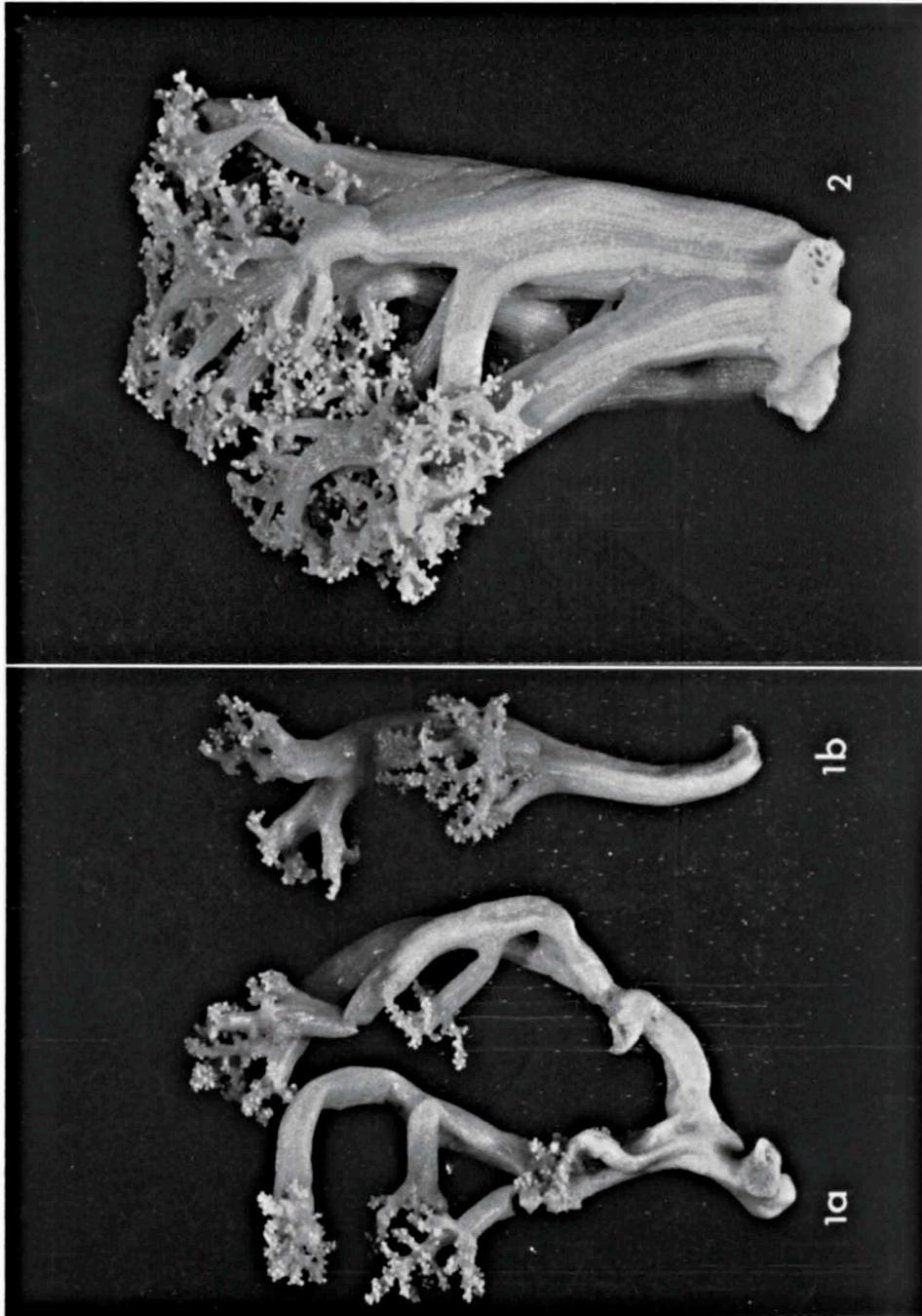


Fig. 1. *Lemnalia tenuis* nov. spec. a, holotype, RMNH Coel. no. 4991; b, paratype, RMNH Coel. no. 4992. $\times 0.8$.

Fig. 2. *Lemnalia madagascarensis* nov. spec., holotype, RMNH Coel. no. 4988. $\times 0.8$.



Fig. 1. *Lemnalia cervicornis* (May), RMNH Coel. no. 4973. Two colonies. X 1.

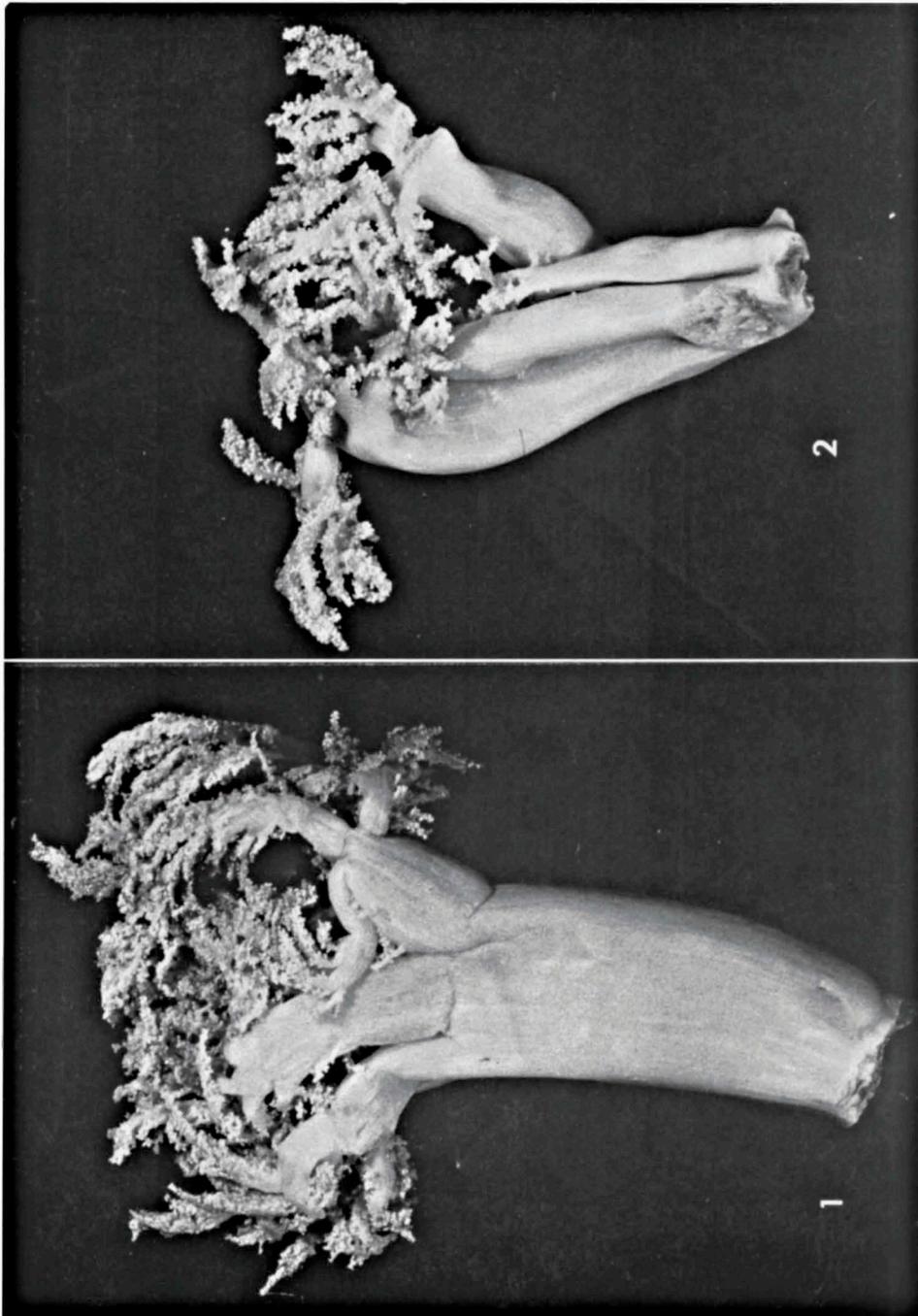


Fig. 1. *Lemnalia crassicaulus* nov. spec., holotype, RMNH Coel. no. 4974. X 0.5.
Fig. 2. *Lemnalia acutispiculata* nov. spec., holotype, RMNH Coel. no. 4967. X 0.75.

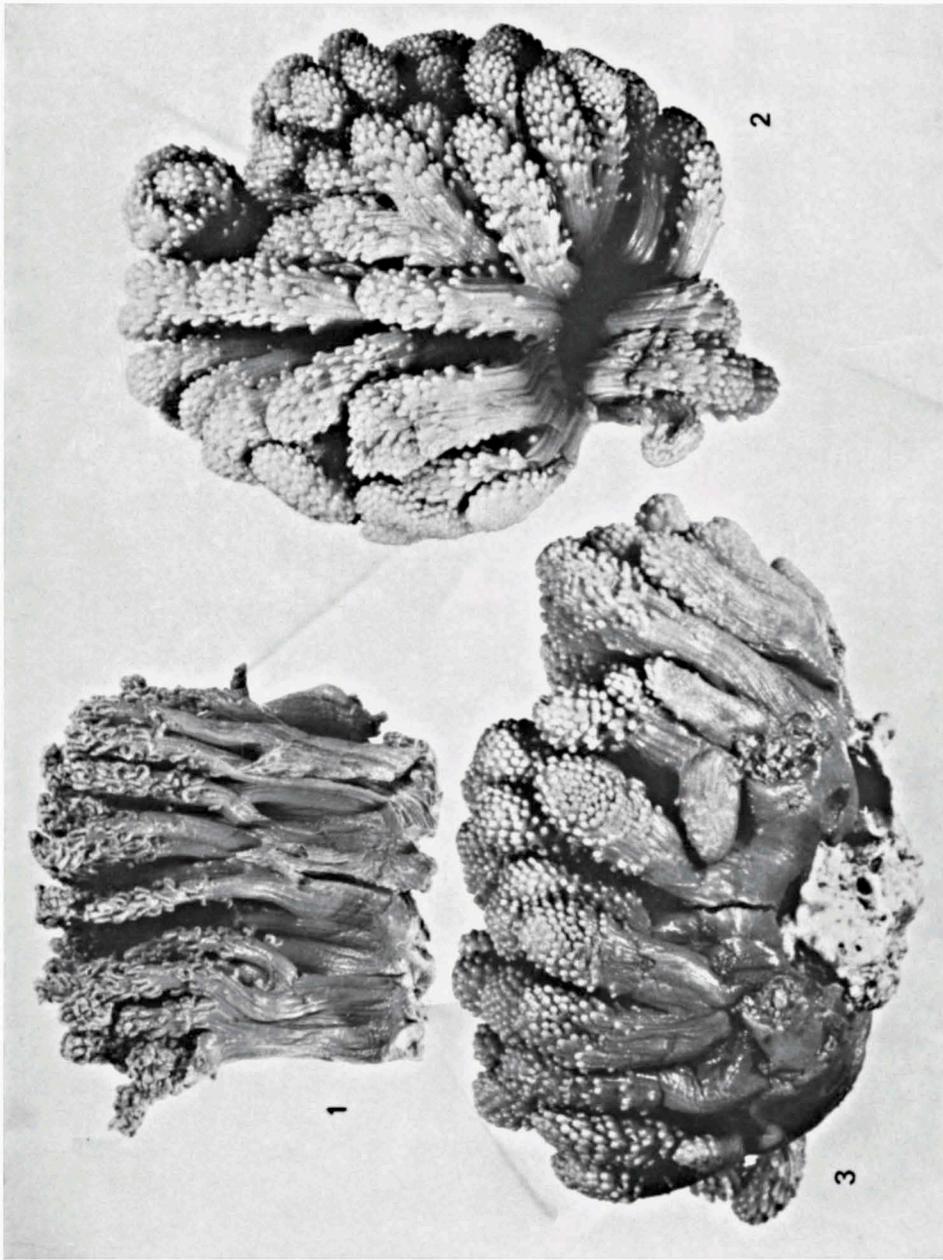


Fig. 1. *Paralemmalia thyrsoidea* (Ehrenberg), RMNH Coel. no. 5002. X 0.67.
Figs. 2, 3. *Paralemmalia clavata* nov. spec., holotype, RMNH Coel. no. 4993. X 0.67.