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# The Marine Fauna of New Zealand: Porifera, Demospongiae, Part 3 (Haplosclerida and Nepheliospongida)

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P. R. BERGQUIST and K. P. WARNE

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**ABSTRACT**

New Zealand sponges belonging to the orders Haplosclerida and Nepheliospongida are described and discussed with respect to their systematic and ecological relationships. Forty-one species belonging to eight genera of Haplosclerida are described, of which twelve are new; of eight species belonging to four genera of Nepheliospongida, two are new. Particular attention is directed toward evaluating recent theories on the classification of the Haplosclerida, in particular the status of the genera *Haliclona* and *Reniera* and the importance of dermal morphology in the generic classification of the Callyspongiidae.

## INTRODUCTION

This, the third part of the Demospongiae of New Zealand, deals with two orders, the Haplosclerida and the Nepheliospongida. Without any doubt the sponges in these groups are the most difficult taxonomically of the entire class Demospongiae. They are also very well represented in the shallow waters and intertidal regions around New Zealand. There have been few publications recording Haplosclerida and Nepheliospongida from the New Zealand region (Lendenfeld 1887; Kirk 1911; Brφndsted 1923, 1924; Dendy 1924; Bergquist 1961a, b), and consequently, it is not surprising to find fourteen new species among the forty-nine dealt with in this monograph.

The major difficulty faced by successive authors who have attempted to find a workable and at the same time natural taxonomic scheme for these sponges, traditionally all classified within the Haplosclerida, has been the simplicity of most of the species in spicule content and in skeletal organisation. The megascleres are most frequently of a single diactinal type. Microscleres are not common and when present they are simple sigmas and/or toxas. In addition, there are few cases where markedly distinct regional spicule arrangements occur within the sponge. The clear ectosomal, endosomal and accessory skeletons so characteristic of the Poecilosclerida are not found in Haplosclerida and Nepheliospongida.

The only marked skeletal specialisation is seen in the development of a dermal skeleton in some genera. This is either spicular, fibrous, or both, and is a distinct,

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regular arrangement of skeletal elements in the plane of the dermal membrane. It is frequently referred to as a tangential dermal skeleton. Some authors (de Laubenfels 1936) have excluded forms with tangential dermal spicule skeletons from the Haplosclerida and placed them instead in the Poecilosclerida. Subsequent authors, Hechtel (1965), Levi (1973), and Bergquist (1978), have not adopted this view. Recently three authors have attempted a revision of the familial and generic classification of the Haplosclerida (Griessinger 1971; Wiedenmayer 1977a, b; van Soest in press). They have all concentrated on fine details of skeletal organization and composition and as a result it is now possible to detect some trends which permit a familial arrangement to be proposed with reasonable hope of stability. It is not possible to be more optimistic; genuine problems still exist at the generic level and substantive changes in classification may still be made on the basis of larval, chemical, and histological studies when sufficient comparative information is available. For example, the skeletal characteristics of the Nepheliospongiidae were clearly divergent from those of the Haliclonidae, Adociidae and Callyspongiidae. On the basis of these characters alone, however, it was not possible to separate the group from other Haplosclerida. When biochemical and reproductive characters and fossil history were considered in conjunction with skeletal features (Bergquist 1980) it was obvious that the two groups were separate at the ordinal level; the oviparous reproduction of the Nepheliospongida stands in strong contrast to the ovoviviparity of the Haplosclerida and represents the retention of a condition which is primitive within the class. With the Nepheliospongida removed, the Haplosclerida became a compact, homogeneous group.

In order to utilise the two order and five family classification which we have adopted in this monograph it is necessary to understand precisely which descriptive criteria have been used, how they have been applied, and also the relative importance which has been placed on each characteristic. Griessinger (1971) provided a detailed account of all the morphological features available for description of Haplosclerida; we list only those which have been used in this monograph.

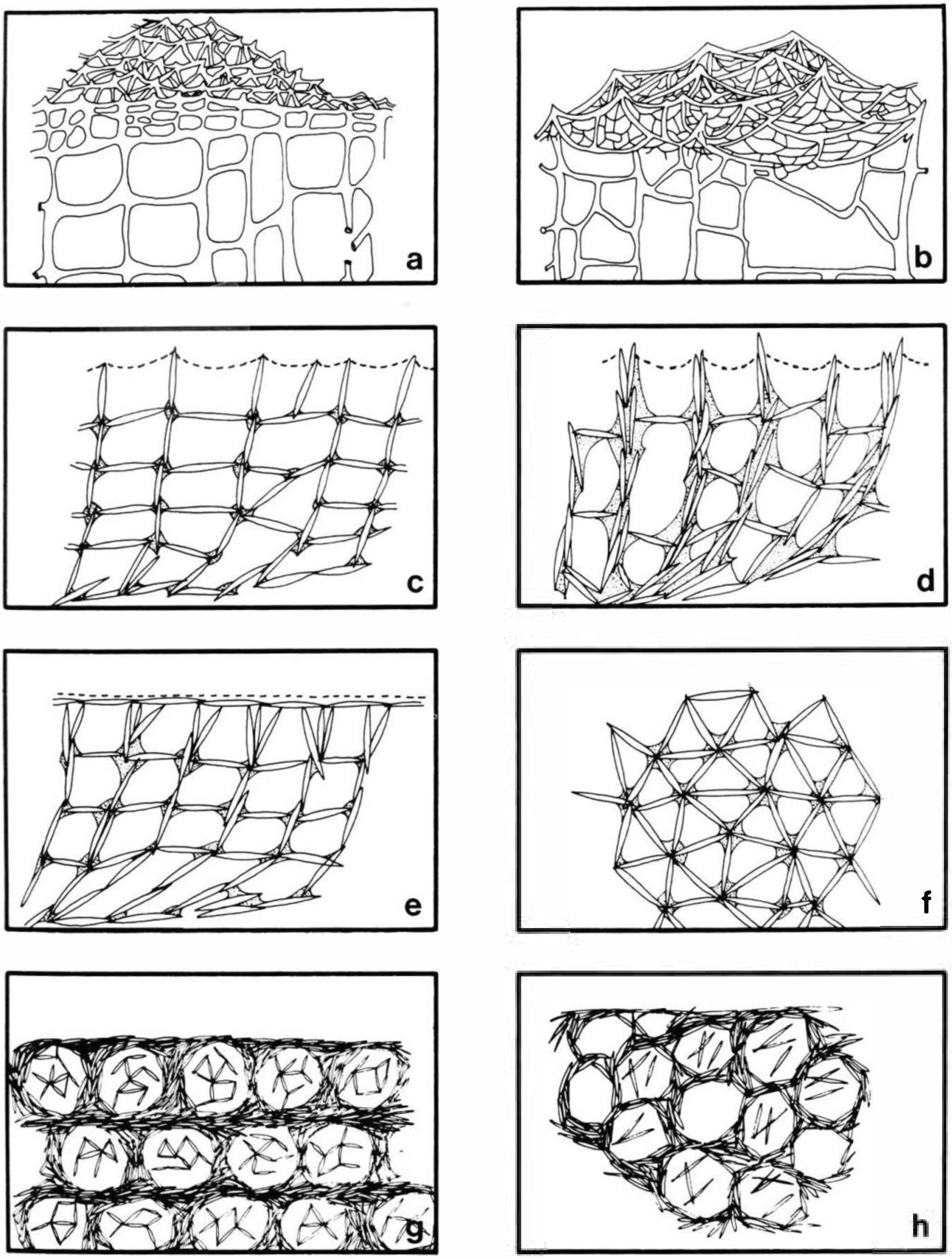
(i) Colour: The colour range within a species is often characteristic, and can be a useful guide to identification. In the Haplosclerida the range of colours is not great; various shades of fawn, yellow, brown, pink or mauve are dominant. Mauve pigmentation in particular seems often to be developed as a response to incident light. For instance, *Callyspongia diffusa* (Ridley) is found encrusting the undersides of boulders and growing out into the open sunlight. The parts which are in the shade are a pale yellow colour, but the branches exposed to light are mauve. This phenomenon is common in a number of haplosclerids: *Callyspongia fistulosa* (Kirk), *Adocia venustina* Bergquist, *Haliclona heterofibrosa* (Lundbeck). In Nepheliospongida common colours are yellow, brown, and red brown, and significantly there can be a marked differential pigmentation with the surface dark and the endosome pale. The latter condition never occurs in Haplosclerida.

(ii) Form: The form of a sponge may be a species-specific character, although in the past many wrong identifications have been made because the phenotypic flexibility of sponges with respect to form was not recognised. Details of the external appearance need to be recorded when the sponge is alive, since contraction of the tissues results in the loss of some features after preservation. For example, *Haliclona stelliderma* n.sp. is characterised by radiating subdermal canals which lead to the oscules, but this stellate pattern becomes inconspicuous when the sponge is preserved. The taxonomist must also be aware of the variability of the species he is dealing with. Unique habitats often result in unusual external appearances in the sponges living there. Differences in form are common when a sponge is found in situations of both high and low wave exposure as, for example, in *Haliclona heterofibrosa* (Lundbeck) and *Callyspongia bathami* n.sp.

(iii) Consistency: This character is in some cases a useful guide to the correct family allocation of a specimen: the Callyspongiidae are very elastic, the Adociidae have a crisp, friable texture, and Nepheliospongiidae a hard often stony texture. Certain species are characterised by the production of a sticky exudate. For example, *Dactylia palmata* Carter can be identified in the field by its pale khaki colour in combination with the copious amounts of mucus it releases.

(iv) Spicules: If distinct categories of spicules are present, generic distinctions can often be made on this basis alone as, for example, in *Petrosia, Sigmadocia,* and *Orina*. However, most Haplosclerida and Nepheliospongida have only a single category of spicules and intraspecific variability in the size and shape of the spicules is often so great as to render this character worthless. For example, the range of spicule

FIG. 1: Diagrammatic representation of the major types of skeletal architecture to be found within the Haplosclerida and Nepheliospongida. *a*: Aspiculous fibre skeleton of the *'Siphonochalina'* type. There is some peripheral condensation of the skeleton producing a fine mesh in the tangential plane at the surface. The primary and secondary components of this reticulation are not markedly different in diameter. Such skeletal types are considered here to fall within the definition of *Callyspongia* (redrawn from Weidenmayer 1977a); *b*: Aspiculous fibre skeleton of the *Callyspongia* (*Spinosella*) type with no peripheral condensation, elevation of surface into spines, and a hierarchy of fibre thicknesses in the tangential superficial plane (redrawn from Weidenmayer 1977a); *c*: A simple *Haliclona*-type skeleton with uni- to bi-spicular meshes, feeble spongin reinforcement, and no dermal spiculation in the tangential plane. Such skeletons would also typify simple members of the genus *Reniera* if this were recognised as distinct as in the work of Griessinger (1971); *d*: A complex *Haliclona*-type skeleton. Both spongin and spicule elements are amplified but no tangential dermal spiculation is developed; *e*: Characteristic skeleton of *Adocia* in vertical section. The spicule reticulation is relatively open, spongin is present at nodes of the reticulum, and a tangential dermal spicule reticulation is present; *f*: Surface view of the dermal reticulation of *Adocia; g*: Vertical section of the skeleton of *Petrosia* to show the characteristic heavy spicule emphasis, regular skeletal arrangement, and dermal spicule crust of the genus; *h*: Vertical section of the skeleton of *Xestospongia* to show the confused skeletal pattern based entirely on spicule tracts. Spongin is very sparse. A dermal spicule skeleton is present but does not form a thick crust.


a
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h

widths in the various specimens of *Callyspongia fistulosa* (Kirk) is considerable. Despite such instances some species are well characterised by the size or shape of their oxeas. For instance, *Callyspongia conica* (Brφndsted) is easily recognised by its stout, blunt-ended structural oxeas. It is always important to attempt to find the normal expression of each species with regard to the spicule complement.

(v) Skeleton: The greatest importance in this study is assigned to skeletal architecture. It is this character which provides the most basic easily observed distinctions between orders, families, genera and species. The Haliclonidae contains sponges with simple skeletal construction, usually with a high spicule:spongin ratio, and with no ectosomal specialisation of the skeleton (Fig.1 c,d). The Adociidae are characterised by the presence of a tangential ectosomal skeleton composed of spicules with only a little spongin (Fig.1 e,f), while the Callyspongiidae have a tangential fibroreticulation at the surface (Fig. 1 a,b). The Nepheliospongiidae have dense reticulate skeletal networks with a massive development of the siliceous skeleton as opposed to the fibrous component (Fig.1 g, h). The Oceanapiidae have a compacted dermal skeletal layer, some spicule fibre tracts in the endosome, but predominantly a disorganised mass of individual spicules.

The classification system that is adopted is based upon that of de Laubenfels (1936) modified as follows:

(i) The Adociidae is included in the Haplosclerida and is not retained in the Poecilosclerida. This follows the arrangement of Hechtel (1965).

(ii) The Desmacidonidae are not included in the Haplosclerida. Most desmacidonids as understood by de Laubenfels (1936) are Poecilosclerida, and the family as a whole was not well defined. A detailed discussion of this family can be found in Wiedenmayer (1977a).

(iii) The family Nepheliospongiidae is adopted for genera with extreme development of the siliceous skeleton.

(iv) A family Oceanapiidae has been included within the Nepheliospongida following Van Soest (1980). This includes genera which de Laubenfels placed in the Poecilosclerida.

The two family taxonomic scheme for the Haplosclerida proposed by Griessinger (1971) has not been adopted. Such a scheme is attractive from an evolutionary standpoint, since Levi (1973) and Griessinger (1971) have suggested that in the Haplosclerida (including the Nepheliospongida) there are two lines of evolutionary modification - one utilising reinforcement of the siliceous skeleton and one utilising reinforcement of the fibrous skeleton. The first line is developed in the family Renieridae and the second in the Haliclonidae. However, this is a difficult system to apply, particularly to sponges of simple construction. In simple forms, where the sponges lack skeletal reinforcement, there are no adequate criteria to separate them. Further, we consider that the possession of a special tangential dermal spicule or fibre skeleton is a criterion of sufficient importance and constancy to be recognised at the family level. Consequently we retain the families Callyspongiidae and Adociidae.

### ACKNOWLEDGMENTS

The senior author wishes to acknowledge the financial support of the University Research Grants Committee and the University of Auckland Research Committee.

## COLLECTIONS EXAMINED

The data for most of the stations from which material is described in this memoir were given in Parts 1 and 2 of this series.

The only further stations which need to be specified are as follows:

### CHATHAM ISLANDS EXPEDITION

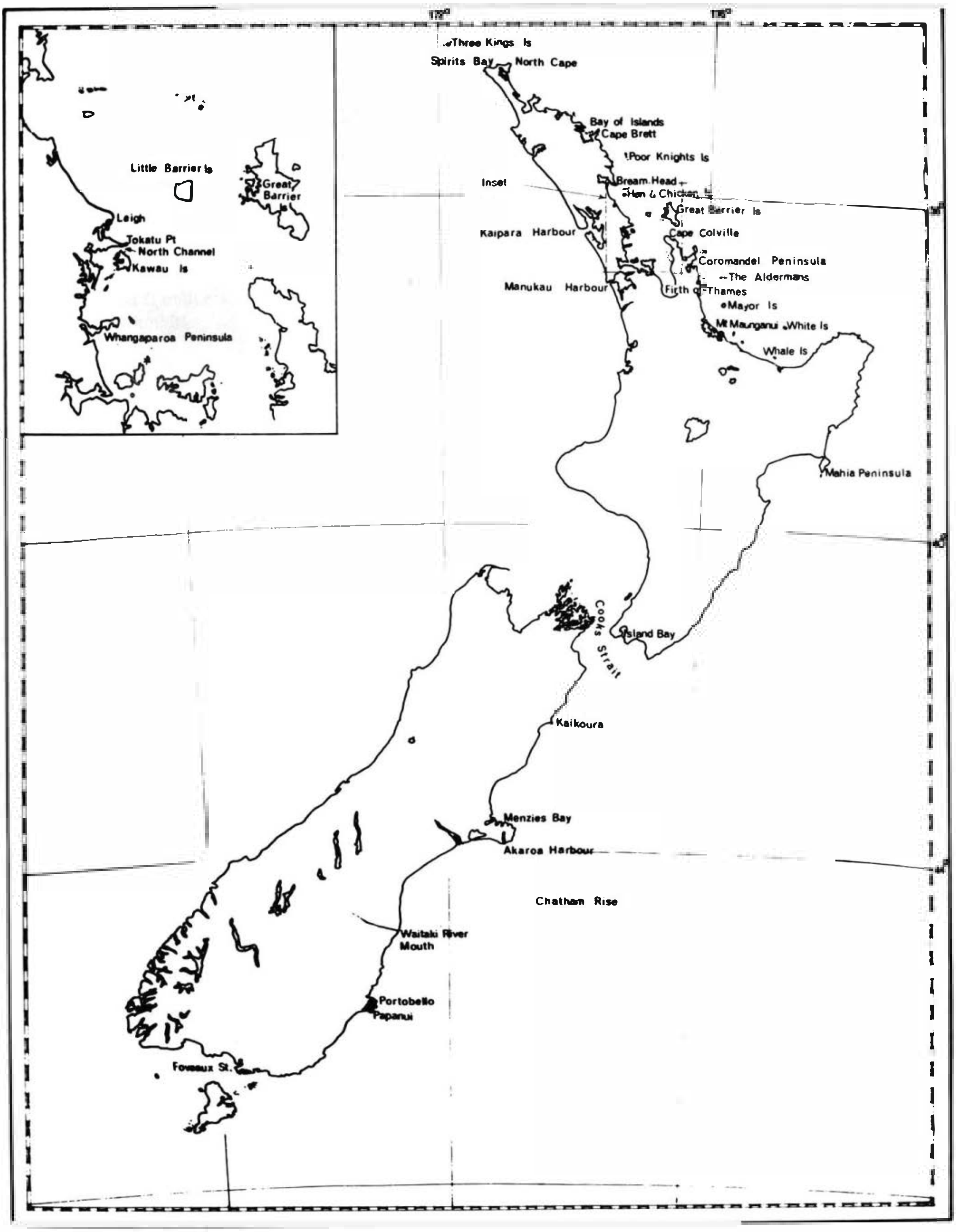
**Sta. 3** 23 Jan. 1954, 43°10.1'S 175°36.5'E, Mernoo Bank, 75m, DL.

### NEW ZEALAND OCEANOGRAPHIC INSTITUTE COLLECTION

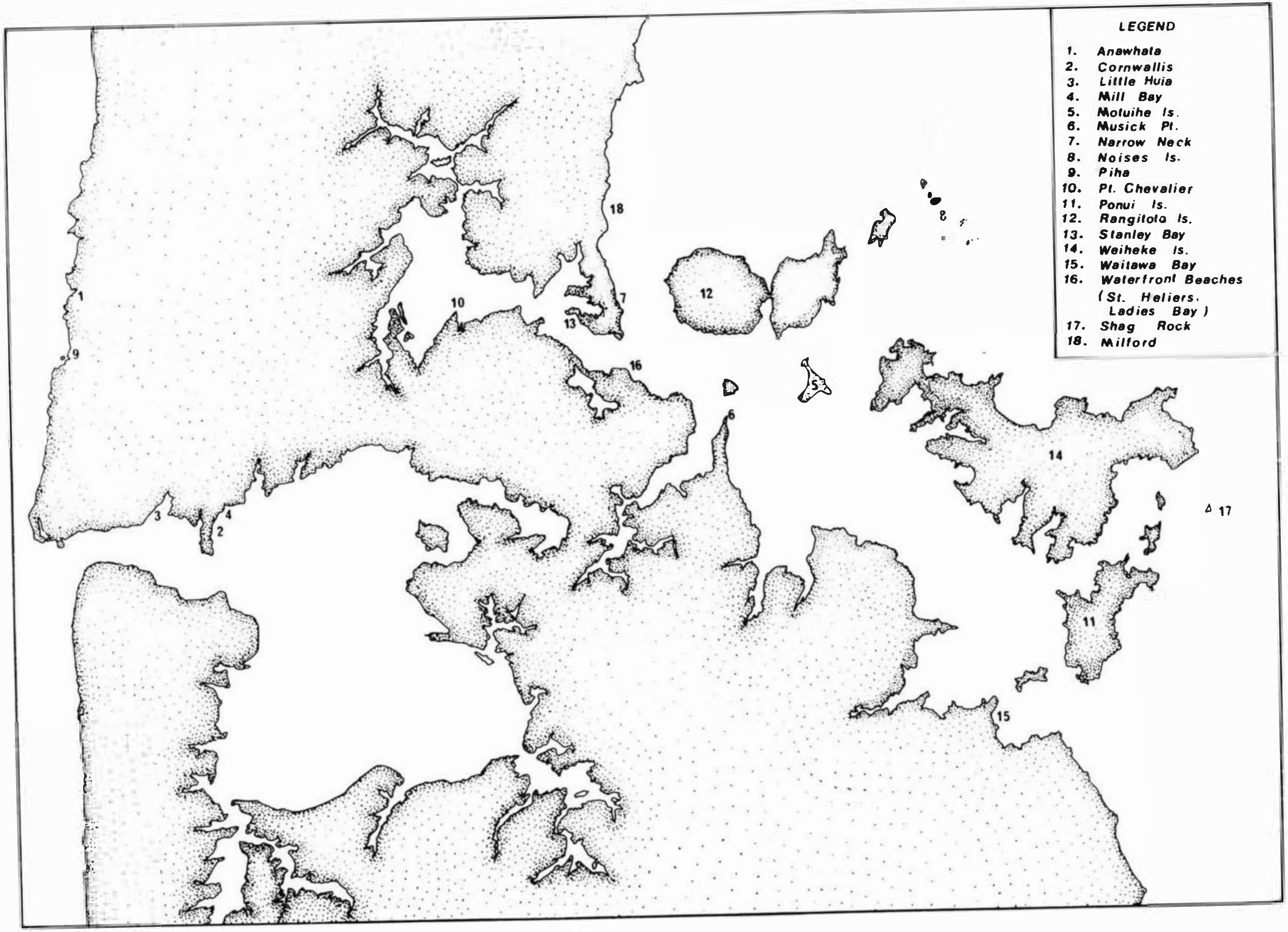
**Sta. E257** 6 Apr. 1965, 34°39.8'S 172°14.5'E, Three Kings, 163m, DCMB.

Personal collections have been made at numerous intertidal and shallow subtidal locations around the New Zealand coast (Figs. 2, 3).

FIG. 2: Locality map for sites from which material considered in this monograph was collected.


Three Kings Is
Spirits Bay
North Cape
Bay of Islands
Cape Brett
Poor Knights Is
Inset
Bream Head
Hen & Chicken Is
Great Barrier Is
Kaipara Harbour
Cape Colville
Coromandel Peninsula
The Aldermans
Manukau Harbour
Firth of Thames
Mayor Is
Mt Maunganui
White Is
Whale Is
Mahia Peninsula
Cooks Strait
Island Bay
Kaikoura
Menzies Bay
Akaroa Harbour
Chatham Rise
Waitaki River Mouth
Portobello
Papanui
Foveaux St.
Little Barrier Is
Great Barrier Is
Leigh
Tokatu Pt
North Channel
Kawau Is
Whangaparoa Peninsula

Inset 1


LEGEND
1. Anawhata
2. Cornwallis
3. Little Huia
4. Mill Bay
5. Motuihe Is.
6. Musick Pt.
7. Narrow Neck
8. Noises Is.
9. Piha
10. Pt. Chevalier
11. Ponui Is.
12. Rangitoto Is.
13. Stanley Bay
14. Weiheke Is.
15. Waitawa Bay
16. Waterfront Beaches (St. Heliers, Ladies Bay)
17. Shag Rock
18. Milford
1
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18

# LIST OF SPECIES DESCRIBED

*(*denotes species not collected during this investigation)*

Class **DEMOSPONGIAE** Sollas

Order **HAPLOSCLERIDA** Topsent

Family HALICLONIDAE de Laubenfels

Genus **Haliclona** Grant
**H. cinerea* (Grant)
*H. clathrata* (Dendy)
*H. brφndstedi* n.sp.
*H. fragilis* n.sp.
*H. heterofibrosa* (Lundbeck)
**H. implexa* (Schmidt)
*H. kaikoura* n.sp.
**H. laxa* (Lundbeck)
*H. maxima* n.sp.
*H. punctata* n.sp.
**H. reversa* (Kirk)
*H. sabulosa* n.sp.
*H. stelliderma* n.sp.
*H. tenacior* Bergquist

Family ADOCIIDAE de Laubenfels

Genus **Adocia** Gray
*A. caminata* n.sp.
*A. parietalioides* Bergquist
**A. pulcherrima* (Brφndsted)
**A. scyphanoides* (Lamarck)
*A. venustina* Bergquist

Genus **Orina** Gray
*O. petrocalyx* (Dendy)
*O. regius* (Brφndsted)

Genus **Sigmadocia** de Laubenfels
*S. flagellifer* (Ridley & Dendy)
*S. fragilis* n.sp.
*S. glacialis* (Ridley & Dendy)
*S. intermedia* (Brφndsted)
*S. irregularis* (Brφndsted)
*S. tubuloramosus* (Dendy)

Genus **Toxadocia** de Laubenfels
*T. toxophorus* (Hentschel).

Family CALLYSPONGIIDAE de Laubenfels

Genus **Callyspongia** Duchassaing & Michelotti
*C. bathami* n.sp.
*C. conica* (Brφndsted)
*C. diffusa* (Ridley)
*C. fistulosa* (Kirk)
*C. irregularis* n.sp.
**C. latituba* (Dendy)
**C. minor* (Dendy)
*C. oliveri* (Kirk)
*C. ramosa* (Gray)
*C. robusta* (Ridley)
*C. stellata* n.sp.

Genus **Chalinopsilla** Lendenfeld
*C. australis* Lendenfeld

Genus **Dactylia** Carter
*D. palmata* Carter

Order **NEPHELIOSPONGIDA** Bergquist

Family NEPHELIOSPONGIIDAE Clark

Genus **Petrosia** Vosmaer
*P. australis* n.sp.
*P. hebes* Lendenfeld

Genus **Xestospongia** de Laubenfels
*X. coralloides* (Dendy)
*X. novae zealandiae* n.sp.

Family OCEANAPIIDAE van Soest

Genus **Oceanapia** Norman
*O. aberrans* (Dendy)
*O. arcifera* Dendy
*O. fistulosum* (Bowerbank)

Genus **Vagocia** de Laubenfels
*V. imperialis* (Dendy)

# SYSTEMATICS

*(i) An asterisk (*) before a species name indicates species was not collected during this investigation.*
*(ii) Colour notations all refer to Munsell system* (Munsell 1942).
*(iii) Means of spicule measurements (given in parentheses following range of dimensions) are, unless otherwise indicated, based on 10 measurements for each spicule type.*

## Order HAPLOSCLERIDA Topsent

Demospongiae with a reticulate skeleton composed of spicule, spicule and fibre, or fibre, in which the pattern is isodictyal with rectangular or triangular meshes which can be unispicular or multispicular. Main skeletal elements can be recognised as primary (ascending or radial) and secondary (connective or tangential).

There is no regional size differentiation in the elements of the mineral skeleton, but a distinct dermal spicule or fibre skeleton is developed in some families.

Larvae are incubated parenchymellae which are completely or incompletely ciliated. In the latter case the posterior pole is bare, often pigmented. and frequently fringed by a ring of longer cilia.

### Family HALICLONIDAE de Laubenfels

Haplosclerida with skeletal organisation either a simple unispicular reticulation with spongin cementing the ends of the spicules, or a network of fibres in which spicules are incorporated; either spongin or spicule can predominate in the skeleton; special dermal skeleton absent; megascleres are simple, usually only oxeas, but styles and strongyles may also occur; microscleres, when present, are sigmas or toxas.

REMARKS: The sponges in this family are the most difficult to classify of all the Haplosclerida. The taxonomist is faced with great morphological variability within species and there are few macroscopic characters to work with. The megascleres are usually oxeas and their size can vary considerably within a species, although their shape may sometimes provide a stable taxonomic criterion. The dermal skeleton, which is relied on heavily in classifying the Adociidae and Callyspongiidae, is absent, and within a single species the skeleton may vary from a simple to a heavily reinforced network. Faced with great variability and few species-specific characters, the taxonomist must make extensive collections in an attempt to recognise the "normal" expression of each species in the field. Only then can a confident classification of haliclonid species be made.

The family diagnosis for the Haliclonidae has been widened from the concept of previous authors to include species possessing microscleres for two reasons. First, New Zealand haliclonid species have been found which consistently possess microscleres – *Haliclona brφndstedi* n.sp. which has toxas and *Haliclona sabulosa* n.sp. which has sigmas. Second, it is probable that not all of the species previously described as *Gellius* which have been relocated in adociid genera actually belong in that family. (*See also* the remarks concerning *Sigmadocia tubuloramosus* (Dendy)). In fact, with *Gellius* having been declared unrecognisable (de Laubenfels 1936, p.71) there remains no genus to accommodate non-fibrous Haplosclerida which possess microscleres but which lack a specialised dermal skeleton.

### **Haliclona** Grant, 1835

RESTRICTED SYNONYMY

*Reniera* Schmidt, 1862
*Chalina* Bowerbank, 1863
For further details of synonymy *see* Wiedenmayer (1977a).

Haliclonidae with a skeletal network which can be unispicular, spongin-reinforced or spicule-reinforced. Megascleres are small oxeas, with occasional styles and strongyles present; microscleres, when present, are sigmas or toxas.

TYPE SPECIES: *Spongia oculata* Linné, 1759, by monotypy.

REMARKS: In the literature today opinions still vary as to whether *Haliclona* and *Reniera* should be maintained as separate genera or whether they should be merged. The confusion has its origin in the differing historical usages of the generic names, and persists today because of the inadequate criteria for separating the skeletally simple representatives of each genus.

*Reniera* has been consistently used in sponge literature since its establishment, whereas the name *Haliclona* has only come into general usage since Burton revived it in 1932. (A detailed and accurate summary of the historical validity of the two names is given in Wiedenmayer 1977a). In earlier works the two families Chalininae and Renierinae, together with their nominate genera, were set up to separate sponges utilising spongin as the main reinforcing agent in the skeleton from those which emphasised increased spicule development (Fig. 4). The diagnoses of Dendy (1921) indicate the prevailing opinion at that time:

> Renierinae: "Haploscleridae with oxeote or strongylote megascleres and in which the microscleres have entirely disappeared and little or no spongin is developed."
>
> Chalininae: "Haploscleridae with oxeote or strongylote megascleres in which the microscleres have entirely disappeared. Skeleton a network of more or less strongly developed horny fibre cored by spicules and often with spicules scattered between the fibres."

For the two main genera Dendy says:

> *Reniera:* "Renierinae in which the skeleton is composed of a close reticulation of typically single megascleres, each forming one side of a rectangular, triangular or polygonal mesh."

(Dendy fails to note in this diagnosis that the skeleton may be composed of polyspicular primary tracts and unispicular (or occasionally polyspicular) secondaries, although he actually describes species possessing

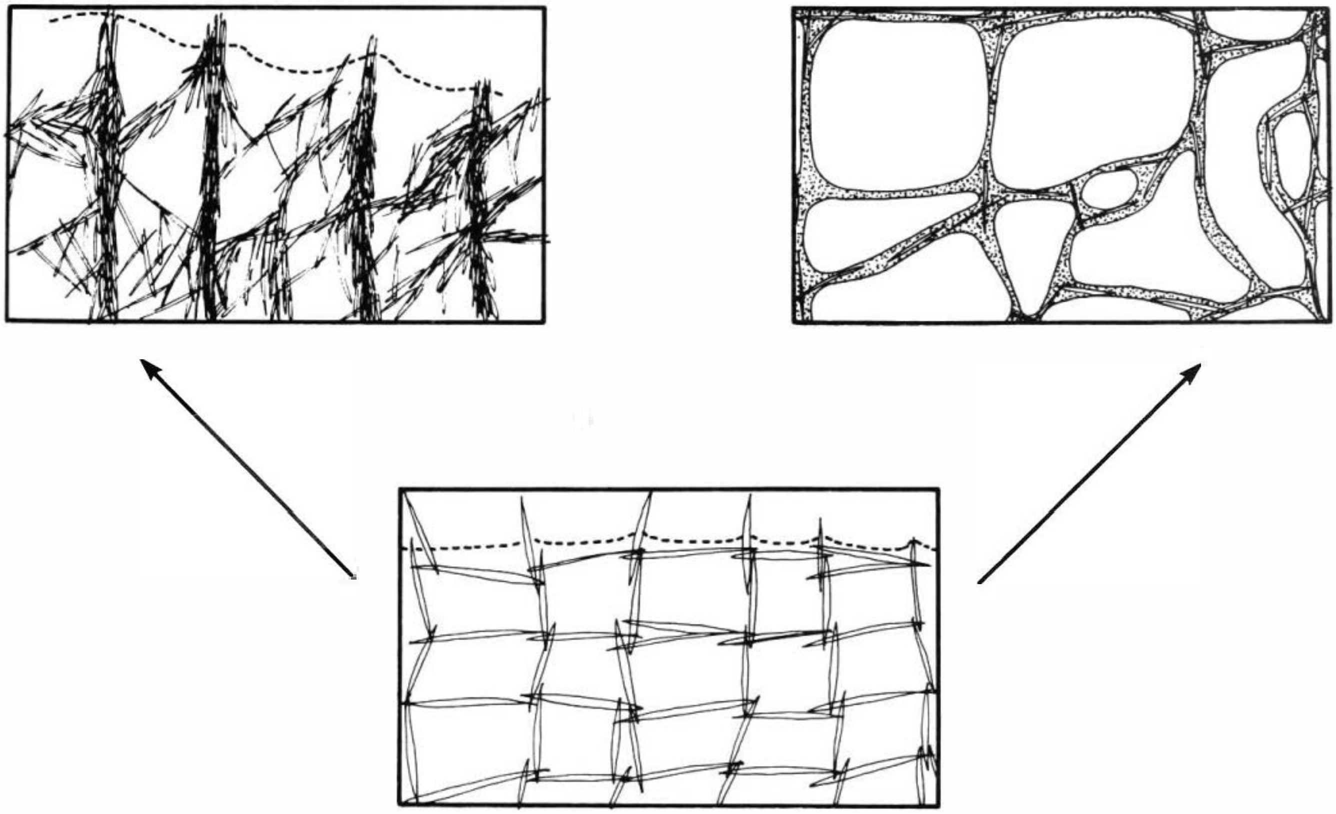

FIG 4. Evolutionary tendencies within the Haliclonidae. The simple regular spicule reticulum with very little spongin can be elaborated either by increasing spicule density (top left) or by amplifying the amount of spongin which encloses the spicules (top right). The former tendency has been held to characterise a family Renieridae and the latter to typify the Haliclonidae. The distinction is not upheld in this work because of the difficulty of discriminating between simple members of both groups which would have a skeleton of the type seen at lower centre.

skeletal networks of this type under the name *Reniera.)*

> *Chalina:* "Chalininae of various external form; not tubular. Skeleton reticulation typically rectangular; fibres usually slender with much spongin and few but usually well-developed spicules."

The differences between *Reniera* and *Chalina* was thus predominantly a skeletal difference, based on the spicule:spongin ratio. Ridley and Dendy (1887) described the relationship between the two genera as follows:

> "By development of more spongin uniting the spicules this genus *(Reniera)* appears to have given rise to those Chalinine sponges which possess a definite rectangular skeleton, the fibre of which is cored by few and small oxeas." (e.g., the genus *Chalina*).

When Burton (1934) revived Grant's genus *Haliclona* the situation became difficult, since his diagnosis encompassed many types previously known as *Reniera*. The relevant part of Burton's diagnosis is:

> "Haplosclerida with skeleton of short oxea arranged typically in an isodictyal network of ascending primary fibres and short connecting secondaries; fibres may be unispicular or multispicular with spongin at ends of spicules only or forming a thick investment on whole spicular skeleton . . .".

That this diagnosis included forms known previously under both the genera *Reniera* and *Chalina* was no problem to Burton because he abandoned *Reniera* entirely (Burton 1934, p. 535). However, since this time many authors have attempted to maintain both *Reniera* and *Haliclona,* and confusion has arisen.

In fact, there would be no difficulty in distinguishing the two genera in species where there is a degree of skeletal reinforcement - by increased spicule development in the case of *Reniera* or by increased spongin development in *Haliclona*. The problem lies in deciding what to do with species possessing simple non-reinforced skeletons. Such forms were described originally under the name *Reniera; Chalina* was reserved for species with spongin-reinforced skeletons. In recent years, however, many sponges with simple skeletal networks have been described as species of *Haliclona*. There appears to be an obvious solution: to place all simple or spicule-reinforced skeletons in *Reniera* and to reserve *Haliclona* for spongin-reinforced types. Unfortunately this solution is too simplistic and cannot be applied because within many species of *Haliclona* forms may be found whose skeletal architecture grades into the renierid part of the spectrum. Hartman's (1958) work on skeletal variation is important in this regard. He described specimens of

*Haliclona oculata* in which the skeleton varied from a subisodictyal, unispicular meshwork with spongin restricted to the ends of the spicules to an isodictyal skeleton with multispicular tracts enclosed by a spongin sheath. A situation in which there is such extensive overlap between two genera is clearly unworkable.

Faced with this difficulty, Griessinger (1971) attempted to distinguish between species of *Reniera* and *Haliclona* which possessed simple skeletal networks by utilising other criteria such as spicule size and the arrangement of the aquiferous system.

He concluded that species of *Haliclona* have smaller spicules, more regular skeletons, and a more elastic texture than do *Reniera* species. However, these differences are only expressed in relative terms and cannot be implemented for generic divisions. If Griessinger's hypothesis is valid small spicule size should coincide with a regular skeletal network, while large spicules should be characteristic of sponges with irregular or densely spiculose skeletons. Such a correspondence is not always observed. For example, *Haliclona fragilis* n.sp. has spicules that are 190 μ long, but it has a skeleton that is a loosely constructed, isodictyal unispicular network, and it has a soft, elastic texture. On the other hand, *Haliclona clathrata* (Dendy) possesses small oxeas (100 μ), but has a compact, spicule-reinforced skeleton and a firm texture. Griessinger also attempted to maintain a distinction at a histological level, according to the characteristics of the aquiferous system and the detachability of the exopinacoderm. The variability in these characters is regarded here as too great for them to be used as diagnostic criteria.

Wiedenmayer (1977b) stated:

> "The styles of skeletal architecture in *Reniera* and *Haliclona* are close, and the proportions of spongin to spicules and of spicules to choanosome probably intergrade. I am equally in doubt about the diagnostic value of size of spicules and their degree of uniformity in distinguishing *Haliclona* and *Reniera*."

He then concluded:

> "In my opinion, the renierid and chalinid structural types . . . intergrade, hence the genera possessing them should be merged in one family."

We would go further than this, and suggest that the only operable solution to the problem at present is to synonymise the two genera, and to use skeletal, spicular and other morphological characters at the specific level. If this is done, Grant's genus takes precedence over Schmidt's; therefore the New Zealand species have been classified under the name *Haliclona*.

## ***Haliclona cinerea** (Grant)

RESTRICTED SYNONYMY

*Spongia cinerea* Grant, 1827, p. 204.
*Reniera cinerea* Brφndsted, 1923, p. 120.
*Reniera cinerea* Brφndsted, 1924, p. 452.

REMARKS: Although Burton (1934) removed *R. cinerea* to *Adocia*, many of the sponges identified as *R. cinerea* do not belong in *Adocia* at all. Two of Brondsted's specimens from the Auckland Islands have been examined, and they definitely belong to the Haliclonidae rather than the Adociidae. However, they have a densely spiculose skeleton, making their placement in *R. cinerea* doubtful. They are left in this species only until the confusion surrounding the name *cinerea* can be adequately dispelled, and this requires the study of fresh material from the type locality.

DISTRIBUTION: Cosmopolitan. In New Zealand: Port Ross; Carnley Harbour, intertidal; Port Pegasus; Slipper Island, intertidal.

## **Haliclona clathrata** (Dendy) (Plate 1, a–d)

RESTRICTED SYNONYMY

*Reniera clathrata* Dendy, 1895, p. 237.
*Reniera* spec. 4. Hentschel, 1912, p. 410.
*Reniera clathrata* Brφndsted, 1923, p. 125.
*Reniera clathrata* Brφndsted, 1924, p. 453.
*Haliclona clathrata* Burton, 1934, p. 532.
*Haliclona clathrata* Bergquist, 1961(a), p. 35.
*Haliclona clathrata* Bergquist, 1961(b), p. 170.

HOLOTYPE: National Museum of Victoria, G2331.

MATERIAL EXAMINED: Waitangi Wharf (Chatham Island); Ladies Bay; Karaka Bay (St. Heliers); Menzies Bay; Island Bay; Laboratory Rocks (Kaikoura); Papanui Beach, Portobello.

DESCRIPTION: A massively encrusting sponge with broad-based conical elevated oscules (Plate 1, a).

DIMENSIONS: Length up to 6 cm; width up to 4 cm; thickness up to 2.8 cm. Oscular projections 1–4 mm high.

COLOUR: In life, yellow-brown (r-Y 8/6) to mauve (r-P 8/2); in spirit, fawn to grey (r-Y 8/4).

TEXTURE: Soft and friable, although thick specimens are more elastic.

SURFACE: Smooth and even, faintly hispid, with a punctate appearance. Oscules are 0.5–2.0 mm in diameter, fairly abundant, and are elevated on conical or monticular turrets. The dermal membrane is extremely porous, and is deposited like a veil on the topmost meshes of the skeleton (Plate 1, b).

SKELETON: The skeleton is a dense, more or less irregular unispicular reticulation. In places distinct ascending fibres are visible, and these are usually multispicular. At the surface there is no true ectosomal reticulation, but the skeleton is more distinct and regular. In sections at right angles to the surface a number of multispicular brushes can be seen (Plate 1, c).

SPICULES

*Megascleres:* Oxeas, straight or slightly curved, and gradually tapering to sharp points.

Spicule dimensions of *Haliclona clathrata*

| *Locality & author* | *Oxeas (μ)* |
|---|---|
| Chatham Is. | 120–141 × 5–6.2<br>(136 × 5.7) |
| Gt. Barrier Reef<br>Burton | 120 × 5 |
| S.E. Aust.<br>Dendy<br>(holotype) | 83 × 5 |
| Ladies Bay | 92–124 × 4–7<br>(108 × 5.2) |
| Campbell Is.<br>Brφndsted | 85–115 × 5 |

REMARKS: This species is well characterised by the monticular oscular projections, the polygonal surface reticulation, and the small size of the oscules. Another feature consistently observed in *H. clathrata* is the presence of a large number of aquiferous canals in the choanosome.

Burton (1934) in describing this species questions the taxonomic relevance of the isolated polyspicular bundles sometimes seen in the skeleton. In our experience such bundles are not a consistent feature in this species, and should be ignored.

Burton claims that the skeletal network is basically triangular. However, the holotype does not show a triangular network, but a rectangular to polygonal mesh. The spicules of the type were described by Dendy as being 83 × 5 μ, considerably shorter than in the New Zealand specimens. However, measurement of a fresh spicule preparation from the holotype gave a mean of 107 × 6 μ - considerably closer to the lengths of spicules from the New Zealand representatives (Plate 1, d).

DISTRIBUTION: Australia (south coast); Campbell Island; Malaya; Great Barrier Reef; Queen Charlotte Sound, 6-20 m.

### **Haliclona brϕndstedi** n.sp. (Plates 1, e,f; 2,a)

HOLOTYPE: National Museum, Wellington. Por. 72.

MATERIAL EXAMINED: Anawhata (holotype); Piha; Mt. Maunganui; Coromandel Peninsula (all intertidal).

DESCRIPTION: A thinly encrusting sponge with a large number of conical oscular turrets studding the surface.

DIMENSIONS: The area covered by the sponge may reach 100 $cm^2$; the thickness is 2-4 mm.

COLOUR: In life, fawn (r-Y 8/4); in spirit slightly paler. At one locality (Piha) the sponge had a deep blue colour (PB 3/4).

TEXTURE: Depending on the degree to which the skeleton is reinforced the texture is soft and compressible or firm and crumbly.

SURFACE: Even and minutely hispid. The oscules may reach a density of 25/$cm^2$. They may be flush with the surface, but are usually elevated on small turrets to a height of 0.5-1.5 mm. The openings are 0.2-0.8 mm in diameter. The dermal membrane, when intact, is transparent and penetrated by a few obvious pores.

SKELETON: The skeleton ranges from a unispicular rectangular mesh (Plate 1, f) to a reinforced network of multispicular primary fibres and unispicular (or occasionally multispicular) secondaries (Plate 2, a). The skeleton may be more or less regular depending on the degree of reinforcement. For example, some specimens with a unispicular skeleton do not have a regular quadratic network, and the spicules are strewn in a disoriented way throughout the entire skeleton. In specimens possessing a spicule-reinforced network the tips of the vertical fibres often form thick spicule bundles which project above the dermal membrane. Horizontal spicule bundles are also found occasionally.

SPICULES

*Megascleres:* Oxeas, straight or slightly curved, gradually tapering to sharp points. In some specimens they are stout and only slightly curved; in others they are thinner and more strongly bent. As in *Haliclona heterofibrosa* collected from Cornwallis (*see* p. 16), there is a correlation between skeletal reinforcement and spicule size - the more reinforced skeletons have thinner spicules.

*Microscleres:* Toxas are found in many specimens. They are always small (ranging from 5-15 μ) and are never abundant.

Spicule dimensions of *Haliclona brϕndstedi*

| *Locality* | *Skeletal type* | *Oxeas (μ)* | *Toxas* |
|---|---|---|---|
| Anawhata (holotype) | Reinforced | 88-106(96) × 4 | Present |
| Anawhata | Not Reinforced | 86-116(106) × 6 | Present |
| Piha | Reinforced | 88-99(95) × 4 | Absent |
| Mt. Maunganui | Not Reinforced | 63-88(71) × 5 | Present |

REMARKS: This species is remarkable in that it possesses toxas, yet it is clearly a *Haliclona*. In skeletal arrangement there are specimens approaching *Haliclona stelliderma* n.sp. and *Haliclona heterofibrosa* (Lundbeck); in spicule size *H. brϕndstedi* approaches *H. clathrata* (Dendy). *H. brϕndstedi* is one of the two New Zealand species of this genus which possess microscleres, the other is *H. sabulosa* n.sp., and it is because of the existence of these two species that the family diagnosis has been extended to include sponges possessing microscleres.

*Haliclona brϕndstedi* is also unusual in having a range of skeletal networks from non-reinforced to reinforced types. Specimens possessing different types of skeleton have been collected from the same locality, and are closely comparable in external appearance; there is little doubt that they are all representative of a single, morphologically variable species.

### **Haliclona fragilis** n.sp. (Plate 2, b,c)

HOLOTYPE: National Museum, Wellington. Por. 73.

MATERIAL EXAMINED: Wairepo Lagoon, Kaikoura (holotype); Harrington Point, Portobello; Kaipara Harbour.

DESCRIPTION: A thickly encrusting to massive sponge found in the lower intertidal or shallow subtidal zone. Oscules are broad and are elevated on short conical processes (Plate 2, b).

DIMENSIONS: The dimensions of the holotype are 6 cm × 5 cm × 1 cm. The thickness of the other specimens falls within the range 0.6-5.0 cm.

COLOUR: Cream (r-Y 8/4) to dull yellow (r-Y 7/6); similar in spirit.

TEXTURE: Soft and limp; easily torn; highly compressible and slightly slimy. The dried skeleton is extremely crisp and fragile.

SURFACE: Minutely granular and hispid, with a transparent dermal membrane through which the pores may be seen. Oscules are up to 3 mm in diameter.

SKELETON: The skeleton is a loosely constructed unispicular reticulation, in which spongin is visible at the nodes of the spicules (Plate 2, c). In places the network is recognisably rectangular or polygonal, but elsewhere it is irregular. There are a large number of interstitial spicules, and these sometimes form large aggregates which obscure the skeletal network entirely. Multispicular ascending fibres were only found in the Kaipara specimen.

SPICULES

*Megascleres:* Large stout oxeas, straight or slightly curved with sharply pointed or mucronate ends. There is a large range in the thickness of the oxeas (*see* table below). The thicker ones form the main meshes of the skeleton while the thinner ones are interstitial.

Spicule dimensions of *Haliclona fragilis*

| *Locality* | *Oxeas* (*μ*) |
|---|---|
| Wairepo Lagoon (holotype) | 131–197 × 2–13 (175 × 9) |
| Kaipara | 81–142 × 1–10 (113 × 6) |
| Harrington Pt. | 141–190 × 1–10 (166 × 7) |

REMARKS: In skeletal construction this species resembles some specimens of *Haliclona heterofibrosa* (Lundbeck) but the growth form is more massive in *H. fragilis* and the spicules are stouter.

### **Haliclona heterofibrosa** (Lundbeck) (Plate 2, d–f; 3, a,b).

RESTRICTED SYNONYMY

*Reniera heterofibrosa* Lundbeck, 1902, p. 47.
*Reniera heterofibrosa* Brøndsted, 1923, p. 121.
*Haliclona heterofibrosa* Bergquist, 1961a, p. 35.
*Haliclona glabra* Bergquist, 1961a, p. 35.
*Haliclona isodictyale* Bergquist, 1961a, p. 34.

HOLOTYPE: Zoology Museum, Copenhagen.

MATERIAL EXAMINED: Narrow Neck; Rangitoto; Musick Pt.; Mill Bay; Pt. Chevalier Reef; Cornwallis; Waiheke/Ponui Channel, 20 m; Motuihe Channel, 20 m.

DESCRIPTION: A thickly encrusting or ramifying sponge commonly found under stones or ledges in the mid-littoral, and occasionally found subtidally.

DIMENSIONS: The growth form of this sponge varies from a branching (Plate 2, e) to a fistulose encrusting habit (Plate 2, d). Correspondingly, the thickness ranges from 0.5 to 2.5 cm, the latter measurement being from a massive subtidal specimen.

COLOUR: In life, cream (r-Y 8/3) to mauve (P 6/2); in spirit, cream to grey.

TEXTURE: In some specimens, firm and elastic; in others, soft and limp.

SURFACE: Smooth and granular in some cases; shaggy and hispid in others. The oscules may be flush with the surface or, more commonly, raised on small rounded turrets or in extreme cases at the tips of barrel-shaped processes. The diameter of the oscules is 0.5–1.5 mm. The surface is usually punctate and the dermal membrane thin and porous.

SKELETON: A simple quadratic reticulation of oxeas is the typical skeletal arrangement, but this basic pattern may be reinforced by multispicular ascending fibres (Plate 2, f; 3, a, b). The multispicular tracts are 3–6 spicules across and are spaced one or two spicule lengths apart. The appearance of the surface reflects the skeletal organisation – a smooth surface corresponding to a unispicular skeleton and a shaggy, uneven surface to a multispicular skeleton. These two alternatives can be seen in vertical sections through the skeleton (Plate 3, a, b). The two types of skeletal organisations intergrade, and some specimens show a network of multispicular fibres at the base and a unispicular network at the surface. There seems to be a correlation between skeletal reinforcement and wave exposure. A number of specimens were collected from Cornwallis; some from boulders in the lower intertidal zone and some from mussels subtidally. The external form and colour of these specimens are closely comparable. However, the subtidal specimens are softer than the intertidal ones, and they have a simpler, less-reinforced skeleton. It is probable that spicule reinforcement of the skeleton is an ecophenotypic response to a situation of increased wave exposure.

SPICULES

*Megascleres:* Stout oxeas, gently curved, tapering abruptly to sharp points.

Spicule dimensions of *Haliclona heterofibrosa*

| *Locality & Author* | *Oxea size (μ)* |
|---|---|
| Pt. Chevalier Reef (branching) | 126–146 (135) × 8 |
| Pt. Chevalier Reef (encrusting) | 157–174 (164) × 8 |
| Musick Pt. | 124–139 (128) × 7 |
| Cornwallis (intertidal) | 101–134 (116) × 5.5 |
| Cornwallis (subtidal) | 111–129 (117) × 7.5 |
| Mill Bay | 101–129 (122) × 6 |
| Motuihe Channel | 149–164 (159) × 8.5 |
| Iceland (holotype) Lundbeck | 160–178 × 5–10 |
| Stanley Bay[1] | 130–172 (154) × 6.8 |
| Waitawa Bay[2] | 118–142 (136) × 6.7 |
| Campbell Is. Brøndsted | 130–170 × 8 |

1 Type locality of *H. glabra*.
2 Type locality of *H. isodictyale*.

REMARKS: *Haliclona heterofibrosa* is one of the most common haplosclerid species in New Zealand waters, although it has so far only been collected from the North Island and Campbell Island. There is considerable variation in external form, particularly in the shape of the oscular projections among the different specimens. For example, two ecophenotypes have consistently been collected from Pt. Chevalier – a branching smooth-surfaced type and an encrusting granular to shaggy type. It is not yet possible to assess the taxonomic status of these two varieties, but in this study they are regarded as representing two points in a spectrum of skeletal architectures.

The holotype of *Haliclona heterofibrosa* from the Copenhagen Museum has been examined, and the New Zealand specimens compare well with it. The only significant difference is that the skeletal organisation of the holotype is more irregular than in the New Zealand representatives and distinct primary fibres are only recognisable near the surface. Lundbeck (1902) himself observed that in different parts of the sponge the skeleton varied from unispicular fibres to polyspicular fibres and to an irregular network.

Burton 1930a relegated *H. heterofibrosa* to *Reniera aquaeductus* Schmidt, but he obviously reconsidered this decision since in 1959b he listed the species as *H. heterofibrosa*.

The type specimens of *Haliclona glabra* Bergquist and *Haliclona isodictyale* Bergquist have been examined and in all respects these species fall within the range of characters known for *Haliclona heterofibrosa*.

DISTRIBUTION: Arctic; Campbell Island; Stanley Bay; Waitawa Bay, Clevedon.

### ***Haliclona implexa** (Schmidt)

RESTRICTED SYNONYMY

*Reniera implexa* Schmidt, 1868, p. 27.
*Reniera implexa* Brφndsted, 1923, p. 122.
*Reniera implexa* Burton, 1930a, p. 515.
*Haliclona implexa* de Laubenfels, 1936, p. 40.
*Reniera implexa* de Laubenfels, 1954, p. 74.

DISTRIBUTION: Cosmopolitan. In New Zealand: Carnley Harbour, intertidal; Port Ross, 20 m.

### **Haliclona kaikoura** n.sp. (Plate 3, c–f)

HOLOTYPE: National Museum, Wellington. Por. 74.
MATERIAL EXAMINED: Wairepo Lagoon, Kaikoura.
DESCRIPTION: A palmodigitate to lobate sponge with numerous short pointed branches and large flattened areas. The most conspicuous feature is the punctate, reticulate appearance (Plate 3, c).
DIMENSIONS: Of the pieces that were collected, the largest has dimensions 6 cm × 3.5 cm × 1 cm.
COLOUR: Mauve in life (P 7/7); dull yellow in spirit (Y 8/4).
TEXTURE: Firm but compressible and slightly elastic.
SURFACE: Smooth and even; at the surface the skeleton is organised in "spicule ridges" which outline the pores, and it is these ridges which give the sponge its unique reticulate appearance. The oscules are compound, with up to 4 exhalant canals opening into a single atrium. They are 1–2 mm in diameter and are either flush with the surface or have slightly raised rims. The dermal membrane is very delicate.
SKELETON: This is a regular, compact rectangular network. Primary tracts are 1–4 spicules thick and are connected by single spicules at right angles to the tracts (Plate 3, f). At the surface the skeleton has a triangular to polygonal arrangement the regularity of which is especially noticable where the skeleton is underlying a pore (Plate 3, e).
SPICULES
*Megascleres:* Stout oxeas, straight or very slightly curved, tapering to sharp points from a distance of 1/5 a spicule length from each end (Plate 3, d). The dimensions are 124–149 (130) × 9 $\mu$.
REMARKS: The extremely lacunose body construction of this sponge is its most distinctive feature. It is because of this construction that the skeleton at the surface has the initial appearance of a special dermal network of the *Adocia* type. The growth form of *Haliclona kaikoura* is also characteristic and is not comparable to any of the other species of *Haliclona* described in this work. In the literature the only palmodigitate *Haliclona* to which this species may be compared is *Reniera* (= *Haliclona*) *longimanus* Dendy collected from Port Philip. The spicules of the latter species are, however, only 83 × 5 $\mu$.

### ***Haliclona laxa** (Lundbeck)

*Reniera laxa* Lundbeck, 1902, p. 46.
*Reniera laxa* Brφndsted, 1923, p. 124.
*Reniera laxa* Brφndsted, 1924, p. 453.
*Reniera laxa* Burton, 1930a, p. 517.

REMARKS: Burton 1959b mentioned the almost bipolar distribution of *Haliclona laxa* and *Haliclona heterofibrosa* and expressed the view that the two may eventually prove to be synonymous. From Lundbeck's published descriptions (Lundbeck 1902) there is certainly every reason to suspect that the two species are identical.
DISTRIBUTION: Cosmopolitan. In New Zealand: Colville Channel, 70 m; Campbell Island, 40 m; Auckland Island, 20 m.

### **Haliclona maxima** n.sp. (Plate 4, a–c)

HOLOTYPE: National Museum, Wellington. Por. 75.
MATERIAL EXAMINED: Pt. Chevalier Reef.
DESCRIPTION: An encrusting sponge which occupies the interstices of shell aggregates found strewn along a stretch of sand near low water mark (Plate 4, a).
DIMENSIONS: The area covered by the sponge varies according to the free space available within the cavernous interior of the shell aggregate. The thickness is usually 1–3 mm but may reach 10 mm.
COLOUR: Fawn to mustard (r-Y 8/4–8/6) in life; grey in spirit (Y 8/4).
TEXTURE: Soft and compressible.
SURFACE: Uneven and shaggy, hispid. The vertical spicule tufts are readily visible (Plate 4, b). Oscules are 0.5 to 3.0 mm in diameter and scattered at random over the surface. They are not abundant. Beneath the transparent dermal membrane wide subdermal canals can occasionally be seen leading to the oscules. The dermal membrane is tough, and there are no pores visible.
SKELETON: The skeleton is an irregular network of multispicular tracts and isolated spicules. The multispicular tracts, which are 3–10 spicules across, are organised as vertical fibres near the surface, and as spicule brushes projecting above the surface. In the basal region of the sponge the skeleton is a haphazard arrangement of individual spicules. The surface spicule brushes, which are 0.7–1.4 mm apart, are shown in Plate 4, b.
SPICULES
*Megascleres:* Oxeas, straight, slightly curved, or more often centrally bent. They taper abruptly to sharp points. Their large size is notable: 274–317 (293) × 15 $\mu$.
REMARKS: The irregular skeletal arrangement and large spicule size of *Haliclona maxima* are unusual within the genus *Haliclona,* and approach the structure of such forms as *Xestospongia disprosopia* de Laubenfels (type of the genus *Xestospongia*). *H. maxima* has the large spicules and irregular endosomal skeleton of a *Xestospongia,* but lacks dermal spicules and has the soft texture and detachable exopinacoderm of a *Haliclona.* The species has only been found at Pt. Chevalier.

### **Haliclona punctata** n.sp. (Plate 4, d–f)

HOLOTYPE: National Museum, Wellington. Por. 76.
MATERIAL EXAMINED: Three specimens of varying shape from Papanui Beach, Portobello.
DESCRIPTION: An encrusting sponge of variable thickness, flat or with conical oscular projections. It is found in the lower intertidal zone.

DIMENSIONS: Thickness varies among the specimens from 2–9 mm. The largest specimen had dimensions of 5 × 4 cm.
COLOUR: Cream to fawn in life (r-Y 8/3); cream to grey in spirit (g-Y 6/2).
TEXTURE: Where the sponge is thicker than a few millimetres the texture is soft and compressible. Where it is a thin encrustation it is firm and friable.
SURFACE: Smooth and faintly hispid, extremely punctate. The oscules are 0.5–1.0 mm in diameter, and occasionally have conspicuous subdermal canals radiating from them (Plate 4, d). The dermal membrane is very porous.
SKELETON: This is a dense network of multispicular ascending fibres (6–20 spicules across) with irregularly spaced or oriented secondary fibres and isolated spicules. In places a polygonally meshed secondary network is developed between the main fibres, and in some specimens the basal region is devoid of fibres, and is composed of an irregular network of single spicules. The distance between the main tracts is 100–200 μ. As in other *Haliclona* species, the variation in skeletal arrangement is considerable, from an irregular completely unispicular reticulum to a network of thick multispicular fibres and isolated spicule connectives (*compare* Plate 4, e and f).
SPICULES
*Megascleres:* Fine oxeas, straight or slightly bent about the centre. Dimensions are 81-109 (96) × 3 μ.
REMARKS: This species is distinguished from *H. stelliderma* by its smaller oxeas, fewer and less characteristic subdermal canals, softer texture, and papillate oscular projections. The appearance of the porous dermal membrane is also a distinguishing feature of *H. punctata*.

### ***Haliclona reversa** (Kirk)

*Reniera reversa* Kirk, 1911, p. 575.
*Reniera reversa* Fell, 1950, p. 11.
*Pseudotrachya reversa* de Laubenfels, 1954, p. 69.

HOLOTYPE: National Museum, Wellington. Por. 84.
REMARKS: Examination of the holotype of *H. reversa* revealed that the long erect dermal styles are foreign spicules of infrequent occurrence and adhering to the surface of the sponge. The presence of these styles was the reason for de Laubenfels' tentative placement of the species in the genus *Pseudotrachya*. Without them the sponge as described by Kirk (1911) is a typical *Haliclona*.
DISTRIBUTION: Meyer Island (Kermadecs).

### **Haliclona sabulosa** n.sp. (Plate 5, a–c)

HOLOTYPE: National Museum, Wellington. Por. 77.
MATERIAL EXAMINED: Spirits Bay, 8 m (holotype); Pandora Beach, North Cape, intertidal.
DESCRIPTION: An encrusting to massive sponge with short, rounded oscular papillae; almost totally invested with sand grains (Plate 5, a).
DIMENSIONS: Thickness varies from 1.5 cm to 3.0 cm.
COLOUR: Fawn to grey in life and spirit (r-Y 8/2–4).
TEXTURE: Firm and very crumbly.
SURFACE: Even, but owing to the sand particles, granular and rough to the touch. The oscules are 0.5–2.0 mm in diameter, flush with the surface or elevated on rounded processes, the latter never more than 0.4 cm high. There is no recognisable dermal membrane.
SKELETON: There are a few places near the surface where a spicular skeleton free from sand grains can be seen; the network is composed of multispicular ascending fibres with a few isolated spicules connecting them. This spicular skeleton only extends for 0.2–0.4 mm below the surface, the rest of the skeleton is composed of sand grains and isolated spicules with strands of spongin holding the entire aggregate together (Plate 5, b).
SPICULES
*Megascleres:* Straight oxeas with conical, gradually tapering points. Dimensions 68-95 (81) × 5 μ. A few strongyles and styles are also present.
*Microscleres:* Sigmas, C-shaped, of uniform size and shape; length, 18 μ (Plate 5, c).
REMARKS: The species is named in accordance with its distinguishing feature, almost complete replacement of the skeleton by sand. It is a matter of opinion whether this species should be included in the genus *Haliclona,* but since a spicular skeleton is occasionally seen, and since that skeleton is definitely haliclonid and is similar in construction to the network of *H. stelliderma* n.sp., *sabulosa* is retained in *Haliclona.*

### **Haliclona stelliderma** n.sp. (Plate 5, d, e)

*Haliclona petrosioides sensu* Bergquist, 1961a, p. 36.
**non** *Haliclona petrosioides sensu* Burton, 1932, p. 269.

HOLOTYPE: National Museum, Wellington. Por. 70.
NEOTYPE: National Museum, Wellington. Por. 78.
MATERIAL EXAMINED: Narrow Neck Reef (neotype); Coromandel; Rangitoto; Goat Island Bay, Leigh; Stanley Bay; Ladies Bay; Stanmore Bay; Milford; Mayor Island; Akaroa Peninsula.
DESCRIPTION: A thin encrusting sponge found under boulders or ledges in the mid-littoral zone. A most conspicuous feature of this sponge is the presence of subdermal channels radiating in a stellate pattern from the oscules.
DIMENSIONS: Length, up to 15 cm; width, up to 10 cm; thickness, up to 3 mm.
COLOUR: White to cream in life (N 9/5); grey-yellow in spirit (r-Y 7/4).
TEXTURE: Firm and friable.
SURFACE: Even and granular, minutely hispid, finely punctate, with prominent channels (1–4 mm long by 0.8 mm wide) radiating from each oscule. Due to the presence of these channels, the oscules have an irregular outline. The dermal membrane is transparent and remains intact when the sponge is dried. It is pierced by numerous small pores.
SKELETON: At the surface of the sponge, the skeleton consists of a large number of vertical spicule bundles, which can be readily seen in sections taken at right angles to the surface (Plate 5, e). These bundles vary in thickness (from 10–20 spicules) and in spacing (from 1–3 spicule lengths apart). At a distance of about 0.5 mm below the surface, these surface brushes grade

into a compact triangular or irregular unispicular network which forms the rest of the skeleton.

SPICULES

*Megascleres:* Oxeas, straight, but usually slightly bent about the centre, tapering gradually to sharp points.

Spicule dimensions of *Haliclona stelliderma*

| *Locality and author* | *Oxeas* ($\mu$) |
|---|---|
| Rangitoto I. Bergquist | 130-162 × 5.6-6.8<br>(147 × 7) |
| Mayor I | 101-152 × 4.6-8<br>(137 × 6) |
| Narrow Neck | 96-134 (118) × 7 |

REMARKS: Bergquist (1961a) initially identified this species as *Haliclona petrosioides* which Burton had described in 1932 from Tristan da Cunha. In his original description of *H. petrosioides* Burton made no mention of stellate subdermal canals, but described the surface simply as "uneven". However this feature is most conspicuous and characteristic of *H. stelliderma*. Furthermore, *H. petrosioides* has, according to Burton, well-developed multispicular primary and secondary tracts arranged in a regular rectangular network. This arrangement differs markedly from the skeletal network of *H. stelliderma,* which near the surface has spicule columns connected by single spicules, and in the basal region is unispicular. On these grounds *H. stelliderma* is judged to be distinct from *H. petrosioides*. *H. stelliderma* is closely related to *H. punctata* n.sp., but is distinguished by its smaller oscules, its more abundant subdermal channels, and its longer spicules.

Bergquist's original specimen of *H. stelliderma* (NZNM Por.70) was small and has been dried and damaged in such a way as to delete the essential surface morphology. This specimen none the less remains the holotype, but in this instance a neotype designation is given.

### **Haliclona tenacior** Bergquist (Plates 5, f; 6, a, b)

*Haliclona tenacior* Bergquist, 1961a, p. 34.

HOLOTYPE: National Museum, Wellington. Por. 6.

MATERIAL EXAMINED: North Piha; Cornwallis; Little Huia; Portobello; Mt. Maunganui (all intertidal).

DESCRIPTION: A thickly encrusting to massive and irregular sponge, usually infested with commensal tubeworms (Plate 5, f).

DIMENSIONS: Length up to 5.5 cm; width up to 3.8 cm; thickness up to 1.6 cm.

COLOUR: In life, dull yellow-brown (r-R 8/6); in spirit, orange yellow (YR-Y 8/8) to grey or white (YR-Y 8/2).

TEXTURE: Firm and friable, but may be hard if the infestation of polychaete tubes is heavy.

SURFACE: Uneven, minutely subpapillate (due to the openings of the worm tubes); in some cases shaggy. The oscules may be flush with the surface and inconspicuous, but they are usually elevated on monticular projections and have irregularly shaped openings ranging from 1-5 mm in diameter. The dermal membrane is relatively thick, but still transparent; it covers an extensive system of subdermal vestibules and is pierced by numerous large pores.

SKELETON: A compact isodictyal network of single spicules is the basic skeletal organisation, but in most cases there is an extensive reinforcement of the skeleton by the development of thick polyspicular fibres. These fibres are 26-60 $\mu$ thick and are separated by a distance of one to four spicule lengths. Where they reach the surface, these fibres become even thicker, forming large spicule bundles which support the dermal membrane (Plate 6, a,b).

SPICULES

*Megascleres:* Oxeas, slightly curved and sharply pointed. Dimensions are 119-147 (134) × 7.5 $\mu$.

REMARKS: The typical association of this sponge with commensal polychaetes and its massive habit and dense skeletal network compared to other New Zealand species of *Haliclona* are the reasons for the establishment of *H. tenacior*. In its skeletal network and spicule size *H. tenacior* approaches *H. stelliderma* n.sp., but the latter is well separated on the basis of external form - it is thinly encrusting and has stellate dermal canals.

DISTRIBUTION: Waitawa Bay (Clevedon); Rangitoto.

## Family ADOCIIDAE de Laubenfels

Haplosclerida in which the main skeleton is either a simple subisodictyal network or a reinforced network of multispicular ascending fibres and irregularly disposed connecting spicules. The special dermal skeleton is a tangential spicule network and the megascleres are oxeas or strongyles with occasional styles. Microscleres, when present, are sigmas and/or toxas.

REMARKS: The diagnostic feature of sponges which are placed in this family is the presence of a dermal spicule network which is clearly distinct from the underlying main skeleton. In this respect the Adociidae parallel the Callyspongiidae, since sponges in the latter family are also characterised by a distinct dermal network which is made up of spongin fibres. In the Adociidae the possession of microscleres is a criterion which can be used to divide the family into well-defined genera. Consequently, the genera *Sigmadocia, Toxadocia* and *Orina* are recognised, along with the nominate genus *Adocia*. It is acknowledged that this division on microsclere characteristics may prove artificial, but it is used here in the absence of better means of separating the many adociid species.

Another common feature of adociid sponges is their possession of extensive subdermal aquiferous spaces. The presence of these spaces contributes to the ease with which the dermal "skin" (the tangential dermal network plus the dermal membrane) can be removed from the main skeleton.

De Laubenfels (1936) placed the Adociidae in the Poecilosclerida. It is now generally recognised (*see* Hechtel 1965) that despite some poecilosclerid affinities, most notably the development of the distinct superficial skeleton, the Adociidae are true haplosclerids.

In the past there has been disagreement over whether the Adociidae should be maintained as a separate family or included in a revised Haliclonidae. Wiedenmayer (1977a) notes that "the distinction between haliclonid and adociid sponges is often vague because the style and the degree of superficial specialisation between the two taxa may intergrade". It is certainly true that merely by examining the surface of the sponge it is often difficult to distinguish between a *Haliclona* with a unispicular isodictyal skeleton where the topmost tangential spicules are prominent, and an *Adocia* with a distinct dermal network. However, if both vertical and tangential sections of the skeleton are taken, along with a thorough examination of the skeletal organisation of a dried piece of the sponge in question, it is usually possible to determine whether or not there is a distinct dermal skeleton, and it is on this basis that the Adociidae are maintained as a separate family.

## **Adocia** Gray, 1867

Adociidae in which microscleres are absent.
TYPE SPECIES: *Chalina simulans* Bowerbank, 1864.

### **Adocia caminata** n.sp. (Plate 6, e, f)

*Adocia semitubulosa* Bergquist, 1961b, p. 173.
non *Halichondria semitubulosa* Lieberkuhn, 1859, p. 363.
non *Pellina semitubulosa* Dickinson, 1940, p. 11.

HOLOTYPE: Canterbury Museum, Christchurch.
MATERIAL EXAMINED: Sta.3 Chatham Islands Expedition, Mernoo Bank, 75 m; Sta.37 Chatham Islands Expedition, between South East Island and Pitt Island, 60 m.
DESCRIPTION: A massive sponge with a cushion-like basal mat. Long hollow oscular fistules arise from the dorsal and lateral surfaces.
DIMENSIONS: Height 21 mm; length 60 mm; width 30 mm. Fistules 6–30 (20) mm high; 4–7 (5) mm wide, wall 0.8 mm thick.
COLOUR: In life, very pale yellow (r-Y 8/4); in spirit, pale yellowish white (g-Y 8/4).
TEXTURE: Crisp and fragile in the dermal region and the fistules, crumbly in the endosome.
SURFACE: The surface is smooth and porous. In some places up to 20 pores are grouped together and form conspicuous "pore areas". All pores lie flush with the surface of the basal mass, never extending onto the fistules. Under 15 × magnification the surface appears furry from the projecting ectosomal spicules. None of the oscules were open.
SKELETON: A dermal membrane 0.4 mm thick is present over the body, and is up to 0.8 mm thick in the fistules where subdermal tissues are almost lacking. In the body region the membrane overlies a well-developed system of small subdermal cavities.

Both main and dermal skeletons are in the form of a subisodictyal reticulation which is predominantly bispicular. Some organisation into spicule tracts is apparent in the endosome, but the greatest concentration of these is in the subdermal region. Here, to a depth of 1.2 mm, there is a series of ascending tracts, 10–20 spicules thick, with frequent unispicular connectives. These subdermal tracts expand as brushes immediately below the surface. The dermal brush spicules pierce the dermal membrane to a height of 20–30 μ. Tracts, which run vertically in the fistules, are thicker (15–30 spicules) than those of the subdermal region.
SPICULES:
*Megascleres:* Oxeas, usually slightly flexed, but sometimes straight, evenly tapered to a sharp point. Developmental forms, microxeas, are present. These are always dispersed, never forming part of fibre or reticulum. Dimensions are 100–180 × 4–7 μ (130 × 6 μ).
REMARKS: Bergquist (1961b) assigned this sponge to *Adocia semitubulosa* and synonomised *Pellina* with *Adocia*. Subsequent examination of European specimens assigned to *Pellina* has led us to the opinion that *Pellina,* of which *P. semitubulosa* is the type, should be maintained for forms with a fibrous endosomal skeleton augmented by a spicule reticulation and with very fine fistules which lack any endosomal component. The species described above does not conform to this description and is thus retained in *Adocia,* in which genus it is a new species.

### **Adocia parietalioides** Bergquist (Plate 6, c, d)

*Adocia parietalioides* Bergquist, 1961a, p. 37.

HOLOTYPE: National Museum, Wellington. Por. 9.
MATERIAL EXAMINED: Rangitoto Island; Milford, intertidal.
DESCRIPTION: An encrusting sponge, with an even porose surface.
DIMENSIONS: 3.7 cm long; 2.1 cm wide; 3–5 mm thick.
COLOUR: In life, faintly pink (p-R 8/2) to cream (r-Y 8/4). In spirit, pale brownish white (r-Y 8/2).
TEXTURE: Firm and friable, brittle when dry, extremely compact.
SURFACE: Smooth, with a prominent dermal skeleton slightly raised giving a reticulated effect. Oscules are 1–2 mm in diameter, scattered and lying flush with the surface.
SKELETON: Both main and dermal skeletons are arranged as unispicular isodictyal reticulations. The triangular meshes of the dermal skeleton are very prominent, slightly raised above the level of the dermal membrane and up to 120–130 μ wide.
SPICULES:
*Megascleres:* Oxeas, relatively stout, evenly tapered toward each end, occasionally centrotylote.

Spicule dimensions of *Adocia parietalioides*

| *Locality* | *Oxeas* (μ) |
|---|---|
| Rangitoto<br>(holotype) | 138–157 × 7–11<br>(148 × 10) |
| Milford Reef | 125–154 × 4–8<br>(142 × 6) |

REMARKS: *Adocia parietalioides* is not a common species. It occurs as an encrusting sponge under stones in the low tidal zone and in the Auckland area has only been found on basalt reefs. This species is most closely related to *A. parietalis* (Topsent) from the Mediterranean. It differs in three respects: it lacks subdermal canals radiating from the oscules; the oxeas are much stouter (7–11 μ) than in *A parietalis* (5 μ); and in *A. parietalis* the undersurface of the free edges are elevated and covered with a hispid spicule fur.

### ***Adocia pulcherrima** (Brϕndsted)

*Reniera pulcherrima* Brϕndsted, 1924, p. 451.

REMARKS: From Brϕndsted's description: "Dermal membrane thin supported by a beautiful dermal reticulation of spicules", this species may confidently be transferred to the genus *Adocia*. No further comment is possible in the absence of type material.
DISTRIBUTION: Colville Channel.

### ***Adocia scyphanoides** (Lamarck)

*Spongia scyphanoides* Lamarck, 1816, p. 368
*Reniera scyphanoides* Brϕndsted, 1924, p. 452.
*Siphonochalina scyphanoides* Topsent, 1932, p. 80.

REMARKS: The true generic position of this species is uncertain. Lamarck's original specimen was referred to *Siphonochalina* by Topsent (1932). Burton (1934) relegated *Siphonochalina* to *Adocia,* a move that has not been accepted by subsequent workers (Wiedenmayer 1977a). Brϕndsted (1924), in his description of *Reniera scyphanoides* from New Zealand, makes clear reference to a dermal skeleton and on this basis the species is placed in the genus *Adocia.* Almost certainly this specimen is not specifically identical with Lamarck's species, but in the absence of Brϕndsted's specimen the present allocation must stand.
DISTRIBUTION: Red Sea; South China Sea; Australia; New Plymouth.

### **Adocia venustina** Bergquist (Plate 7, a–c)

*Adocia venustina* Bergquist, 1961a, p. 37.

HOLOTYPE: National Museum, Wellington. Por. 82.
MATERIAL EXAMINED: North Piha; Matheson's Bay, Leigh; Cornwallis; Goat Island Bay, Leigh; Narrow Neck (all intertidal). Noises Islands; Motuihe Channel (subtidal).
DESCRIPTION: An encrusting to massive sponge, usually intertidal but also found subtidally to a depth of 20 m. In the latter habitat it is variable in external form, but frequently has tall oscular chimneys. In the intertidal zone it is more thinly encrusting with oscules elevated on short turrets (Plate 7, a).
DIMENSIONS: The encrusting form varies in thickness from 2–15 mm, and there is considerable variation in each specimen. In the massive form the thickness may reach 30 mm.
COLOUR: In life varies from pale yellow (Y 8/4) to pink (r-YR 7/4) to mauve (P-RP 7/2); in spirit, white to dull yellowish brown (YR-Y 7/4).
TEXTURE: Firm and friable; crisp.
SURFACE: Smooth, sometimes uneven, punctate; often subdermal canals or lacunae can be seen through the transparent dermal membrane. Oscules may be flush with the surface, elevated on broad papillae, or situated at the tips of tall, variously coalesced chimneys. The diameter of the oscules is 0.5–2.5 mm. When taken from the water the surface of the sponge has a shiny appearance due to the reflection of light from the tangential spicules of the dermal skeleton.
SKELETON: The main skeleton is a compact isodictyal network. Near the surface the network is usually unispicular with triangular or rectangular meshes, but in the deeper parts of the sponge the skeleton is more irregular with polyspicular ascending tracts often present. A recurrent feature of this, and other adociid species, is the presence of growth "rings" in the main skeleton. Growth in these sponges first requires growth at the surface, followed by deposition of a new tangential dermal spicule layer. Consequently, successive dermal layers remain visible in a vertical section through the sponge (Plate 7, b).

The dermal skeleton is a beautifully regular triangular unispicular network (Plate 7, c). It should be noted however, that the dermal skeleton does not always have this appearance. If the sponge is collected during a growth stage, and before the new dermal skeleton has been laid down, the surface has the appearance more of a *Haliclona* than an *Adocia,* with numerous vertical as well as tangential dermal spicules.
SPICULES
*Megascleres:* Oxeas, short, relatively stout, but variable in thickness among the various specimens examined; evenly curved and sharply pointed with fusiform, conical or rounded ends.

Spicule dimensions of *Adocia venustina*

| *Locality and form* | *Oxeas* (μ) |
|---|---|
| Motuihe Channel (massive) | 109–126 (119) × 8.5 |
| Narrow neck (encrusting) | 136–167 (158) × 9 |
| Matheson's Bay (encrusting) | 91–107 (100) × 4.5 |
| North Piha (encrusting) | 86–106 (99) × 6.5 |

REMARKS: *Adocia venustina* is a relatively common intertidal sponge in the North Island. It is variable in external form, colour and spicule size, but not in skeletal organisation. In the preceeding table it is noted that the specimen from Narrow Neck has oxeas which are much larger than those from any other locality. This specimen also differs in colour (pink) and in the shape of the oscules (broad and irregularly shaped papillae) from the other specimens. In its skeletal architecture, however, it is inseparable from the other specimens, so it is included here as a true representative of *A. venustina.*
DISTRIBUTION: Noises Island; Rangitoto.

## **Orina** Gray, 1867

Adociidae with sigmas and toxas as microscleres.

TYPE SPECIES: *Halichondria angulata* Bowerbank, 1866.
REMARKS: In his rearrangement of the genus *Gellius,* de Laubenfels (1936) reserved *Orina* for species containing both sigmas and toxas as microscleres. Two New Zealand species can be referred to *Orina* on this basis: *Gellius regius* Brϕndsted and *Gellius petrocalyx* Dendy.

### **Orina petrocalyx** (Dendy) (Plates 7, f; 8, a)

*Gellius petrocalyx* Dendy, 1924, p. 321.
*Orina petrocalyx* de Laubenfels, 1936, p. 69.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m.

DESCRIPTION: Several fragments of this sponge have been collected, all probably belonging to the one specimen. They differ strongly from the type in form. The habit was probably erect and sparsely branched.
DIMENSIONS: Diameter 7.0–17.0 mm (13.00 mm); vents 2.0–5.0 mm diameter.
COLOUR: In life, dull orange (YR 6/8); in spirit, yellow brown (Y-R-Y 5/6).
TEXTURE: Solid and incompressible.
SURFACE: Smooth, with a complete dermal membrane 0.2 mm thick.
SKELETON: A dense subisodictyal network of oxeas, sometimes unispicular but chiefly bi- or trispicular, in this respect differing from the type. Spicules are more or less tangential in the dermal membrane.
SPICULES
*Megascleres:* Oxeas are stout, slightly curved and evenly tapered.
*Microscleres:* Sigmas are abundant and slender with a distinct angulation in the centre. Toxas are small, slender, almost straight sided, coming to an angle of 100° and slightly reflexed at the tips. These are relatively rare.

Spicule dimensions of *Orina petrocalyx*

| *Locality and Author* | *Oxeas* (μ) | *Sigmas* (μ) | *Toxas* (μ) |
|---|---|---|---|
| E. of North Cape, 140 m<br>Dendy (holotype) | 184 × 12 | 30 | Not given |
| Three Kings Islands, 60–120 m | 242–311 × 11.5–17.4<br>(268 × 13) | 12–40<br>(25.5) | 17–34<br>(24) |

REMARKS: The spicule dimensions for this specimen are slightly larger than those quoted by Dendy (1924). This difference alone is not sufficient to consider the two distinct, but in conjunction with the different habit, could argue that these represent two species. Examination of the type specimen in the British Museum confirms that the two specimens are identical.
DISTRIBUTION: East of North Cape, 140 m; Three Kings Islands, 60–120 m.

### **Orina regius** Brϕndsted (Plate 7, d,e)

*Gellius regius* Brϕndsted, 1924, p. 447.
*Orina regius* de Laubenfels, 1936, p. 69.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m; off Mahia Peninsula, 120 m.
DESCRIPTION: A flat, biscuit-like sponge which has probably grown as an erect, curved lamella from a broad base. Both specimens are broken. The one from Three Kings Islands is a very small piece, that from Mahia is much larger and gives some idea of the form of the sponge.
DIMENSIONS: 6.5 cm high, 8 cm wide (base), 2.5 cm wide (apically), 8–11 mm thick.
COLOUR: In life, pale red-brown (Y-R 6/4); in spirit, grey with red tinge (y-Y-R 6/4).
TEXTURE: Hard, incompressible, brittle.
SURFACE: Irregular, rather shaggy with numerous spicules piercing the dermal membrane. The surfaces are distinct. The concave surface is porous and the convex surface bears the numerous oscules.
SKELETON: The main skeleton is composed of a dense mass of large oxeas with no organisation into fibres or layers. Some spicules do project above the surface, making this slightly hispid. The dermal skeleton is an irregular network of single spicules.
SPICULES
*Megascleres:* Oxeas are stout, long, evenly curved and of constant size.
*Microscleres:* Sigmas are small, thin, and regularly curved. These are very abundant. Toxas are relatively stout with reflexed points, also abundant.

Spicule dimensions of *Orina regius*

| *Locality and Author* | *Oxeas* (μ) | *Sigmas* (μ) | *Toxas* (μ) |
|---|---|---|---|
| Three Kings, 60–120 m<br>Brϕndsted (holotype) | 560 × 27 | 10–18 × 1 | 55 |
| Three Kings, 60–120 m | 532–570 × 19–24<br>(552 × 22) | 14–15.6 × 1<br>(14.7 × 1) | 52–64 × 2.4<br>(58 × 2.4) |
| Mahia Peninsula, 120 m | 493–605 × 23–29<br>(587 × 27) | 12–17 × 1<br>(15 × 1) | 53–65 × 3<br>(62 × 3) |

REMARKS: The spicule dimensions of the specimens at hand correspond very well to those of the holotype.
DISTRIBUTION: Three Kings Islands, 60–120 m; off Mahia Peninsula, 120 m.

## **Sigmadocia** de Laubenfels, 1936

Adociidae with sigmas as microscleres.
TYPE SPECIES: *Gellius texapatina* de Laubenfels, 1926.
REMARKS: Various species previously described under the name *Gellius* can be transferred to *Sigmadocia*.

### **Sigmadocia flagellifer** (Ridley & Dendy) (Plate 8, b)

RESTRICTED SYNONYMY
*Gellius flagellifer* Ridley & Dendy, 1886, p. 333.
*Gellius flagellifer* Ridley & Dendy, 1887, p. 42.
*Gellius flagellifer* Dendy, 1922, p. 26 (*see* this paper for earlier synonymy).
*Gellius flagellifer* Dendy, 1924, p. 320.
*Sigmadocia flagellifer* de Laubenfels, 1936, p. 69.
*Haliclona flagellifer* Burton, 1959a, p. 218.
MATERIAL EXAMINED: Three Kings Islands, 60–120 m.
DESCRIPTION: One tiny fragment (1.0 cm × 5.0 mm) was all that was obtained of this sponge. The characteristic sigmas leave no doubt as to the identity of the fragment since the sponge was recorded from the same region by Dendy (1924).
SPICULES
*Megascleres:* Oxeas relatively stout, slightly curved, tapering to sharp points.
*Microscleres:* Sigmas which are extremely abundant. They occur in a great variety of shapes and sizes. Normal sigmas predominate, but the flagelliform type are also very frequent.

Spicule dimensions of *Sigmadocia flagellifer*

| *Locality and Author* | *Oxeas* (μ) | *Sigmas* (μ) |
|---|---|---|
| Marion Is. 100–150 m<br>Ridley & Dendy (holotype) | 420 × 18 | 60 × 2 (flagelliform)<br>44 × 2.5 (normal) |
| Three Kings 60–120 m | 450–480 × 12–15<br>(460 × 14.8) | 28–57.9 × 2<br>(46 × 2) (flagelliform)<br>11–46 × 1–3<br>(20 × 2.4) (normal) |
| Three Kings 200 m<br>Dendy (1924) | 210 × 8 | 64 (flagelliform)<br>28 (normal) |

REMARKS: Dendy's (1924) specimen differs greatly from the holotype in megasclere dimensions; this specimen on the other hand compares very closely. It is certain that more than one species is represented among the sponges assigned to this species, but no subdivision can be made in the absence of new material.

DISTRIBUTION: Marion Island, 100–150 m; Davis Strait; Atlantic coast of Canada; Gulf of Gascoyne; Iceland; Saya de Malha (Indian Ocean); Three Kings Islands (New Zealand).

### **Sigmadocia fragilis** n.sp. (Plate 8, c, d)

HOLOTYPE: National Museum, Wellington. Por. 79.

MATERIAL EXAMINED: Takatu Channel, 15 m.

DESCRIPTION: A hemispherical sponge with fragile oscular fistules arising from the upper surface. It is investing a single valve of *Tawera spissa.*

DIMENSIONS: Body 3.0 cm long; 2.5 cm high; 2.5 cm wide. Oscular fistules 3.0–5.0 mm diameter; 0.5–1.0 cm high.

COLOUR: In life pale purple on the upper surface (P-RP 7/2), white elsewhere.

TEXTURE: Crisp and fragile.

SURFACE: Smooth with an obvious, regular dermal spicule reticulation.

SKELETON: The main skeleton is an irregular isodictyal reticulation with unispicular to trispicular sides. This reticulation is interrupted by spicule tracts running at right angles to the surface. Individiual tracts run for short distances only and are up to ten spicules wide.

The dermal skeleton is a regular tangential isodictyal reticulation with predominantly unispicular meshes.

SPICULES

*Megascleres:* Oxeas, stout, slightly curved with conical or mucronate ends. Dimensions are 305–341 (343) × 12 $\mu$.

*Microscleres:* Sigmas, angulate or C shaped, 11–14 $\mu$, extremely abundant.

REMARKS: This species is unlike any other *Sigmadocia* from the Australasian or Antarctic regions, being of small size, fistulose habit, and having an abundance of small sigmas, and short endosomal spicule tracts.

### **Sigmadocia glacialis** (Ridley & Dendy) (Plate 8, e, f)

RESTRICTED SYNONYMY

*Gellius glacialis* Ridley and Dendy, 1886, p. 333.
*Gellius glacialis* Ridley & Dendy, 1887, p. 41.
*Gellius glacialis* var. *nivea* Ridley and Dendy, 1887, p. 42.
*Adocia glacialis* Burton, 1932, p. 274.
*Sigmadocia glacialis* de Laubenfels, 1936, p. 69.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m.

DESCRIPTION: Very little can be added to the type description since all the specimens we collected were damaged. The range of form indicated by these specimens is similar to that described by Ridley and Dendy (1887), cylindrical to lobate.

COLOUR: In life, light yellow (Y 8/6); in spirit, greyish white.

TEXTURE: Fibrous and brittle.

SURFACE: This is smooth but uneven, with a distinct dermal membrane broken at intervals by oscules lying flush with the surface. When the specimens are wet the surface appears glazed as indicated by the "melting snow" simile in the type description. Pores are large, 0.1-0.15 mm diameter, with a tendency to occur in clusters.

SKELETON: The skeleton is made up of a loose reticulation of oxeas with no tendency to fibre production except in the immediate subdermal region. The dermal membrane with its tangential and markedly isodictyal skeleton is supported by ascending fibrous columns. These arise from the endosomal reticulum and run vertically, without branching, up to the surface where they expand into dermal brushes. The subdermal fibres may be up to 2.0 mm long. The dermal skeleton is extremely delicate and composed of similar spicules to those of the endosome. Spongin is extremely sparse.

SPICULES

*Megascleres:* Oxeas of extremely uniform shape, varying considerably in size. Many developmental stages are present.

*Microscleres:* Rare sigmas of simple form and considerable size range.

Spicule dimensions of *Sigmadocia glacialis*

| *Locality and Author* | *Oxeas* ($\mu$) | *Sigmas* ($\mu$) |
|---|---|---|
| Agulhas Bank, 300 m<br>Ridley & Dendy (holotype) | 650 × 36 | 70 × 6 |
| Three Kings, 60–120 m | 222–490 × 9–22<br>(387 × 18) | 28–86 × 1.3–4.0<br>(50 × 3) |

REMARKS: In external features and skeletal arrangement the New Zealand specimens closely approach the type. The details of spiculation, megasclere size, and relative abundance of microscleres differ greatly. Burton's (1934) Antarctic specimens are closer in megasclere size to the New Zealand representatives. We are not anxious to multiply the number of species in this already unwieldy genus and consequently have referred these specimens to *S. glacialis,* noting however, that they may eventually prove to be distinct.

DISTRIBUTION: Agulhas Bank, 300 m (South Africa); Prince Edward Island; Falkland Islands; South Georgia; Victoria Land; Shag Rock Island; Burwood Bank; Three Kings Islands (New Zealand).

### ***Sigmadocia intermedia** (Brϕndsted)

*Gellius intermedia* Brϕndsted, 1923, p. 127.
*Sigmadocia intermedia* de Laubenfels, 1936, p. 69.

REMARKS: De Laubenfels (1936) proposed an extensive revision of the huge and poorly defined genus *Gellius.* In this revision all species possessing only sigmas for microscleres fell into *Sigmadocia.* In this category are both the New Zealand subantarctic species described by Brϕndsted.

DISTRIBUTION: Carnley Harbour (Auckland Island), 90 m.

### ***Sigmadocia irregularis** (Brϕndsted)

*Gellius irregularis* Brϕndsted, 1923, p. 127.
*Sigmadocia irregularis* de Laubenfels, 1936, p. 69.

REMARKS: There is a possibility that *irregularis* is preoccupied in *Sigmadocia* as Kieschniek (1896, p. 531) described a species under the same name. De Laubenfels (unpublished index) was uncertain about the correct position of this earlier species, but favoured *Sigmadocia*. In view of this uncertainty we have not proposed a new name for Brøndsted's specimen, which is not available for examination.

DISTRIBUTION: Perseverance Harbour (Campbell Island), 20–40 m.

### ***Sigmadocia tubuloramosus** (Dendy) (Plate 9, a)

*Gellius tubuloramosus* Dendy, 1924, p. 323.
*Haliclona tubuloramosa* Burton, 1932, p. 266.
*Sigmadocia tubuloramosus* de Laubenfels, 1936, p. 69.

REMARKS: Burton (1932) referred this species to *Haliclona* rather than to *Adocia* because it was initially described as having no dermal skeleton (Dendy 1924, p. 323). Without examining the type material it is impossible to determine the true generic status of this and other species described under the name *Gellius*, so this species is provisionally placed in *Sigmadocia* as above.

DISTRIBUTION: East of North Cape, 140 m; Falkland Island, 145 m.

## **Toxadocia** de Laubenfels, 1936

Adociidae with toxas as microscleres.

TYPE SPECIES: *Gellius abbreviatus* Topsent, 1918.

REMARKS: Many species initially described under the name of *Gellius* can be transferred to *Toxadocia*.

### **Toxadocia toxophorus** (Hentschel)

*Gellius toxophorus* Hentschel, 1912, p. 392.
*Toxadocia toxophorus* de Laubenfels, 1936, p. 70.
*Toxadocia toxophorus* Bergquist, 1961a, p. 37.

MATERIAL EXAMINED: Rangitoto Island, at low tide mark.

DESCRIPTION: This sponge is found as cushion-shaped masses up to 1.0 cm thick under rocks at low water.

COLOUR: In life, greyish white to cream (Y 8/4–Y 8/2); in spirit, identical.

TEXTURE: Crisp, brittle.

SURFACE: Firm and uneven with scattered oscules 1.0–2.0 mm in diameter.

SKELETON: The skeleton is a loose, largely unispicular, subhalichondroid reticulation composed of oxeas.

SPICULES

*Megascleres:* Oxeas evenly curved and tapered, often with a tendency to be strongylote.

*Microscleres:* Toxas with slightly reflexed tips and very open curve.

Spicule dimensions of *Toxadocia toxophorus*

| *Locality and Author* | *Oxeas (μ)* | *Toxas (μ)* |
|---|---|---|
| Malaya, Hentschel (holotype) | 250 | 10–55 |
| Rangitoto Island | 230–290 × 10–14<br>(270 × 12) | 33–62<br>(45) |

DISTRIBUTION: Aru Island (Malay Archipelago), 8–12 m; Rangitoto Island (New Zealand), at low tide mark.

## Family CALLYSPONGIIDAE de Laubenfels

DIAGNOSIS: Haplosclerida with endosomal skeleton a reticulation of spiculo-spongin fibre; spongin always well developed in the skeleton; special dermal skeleton present, composed of a tangential reticulation of finer fibres making a denser secondary network; megascleres small oxeas or strongyles, which predominantly core or pack the fibres although they can occur strewn between the fibres. Spicules can also be rare or even absent. Microscleres, mainly toxas, may occur.

This diagnosis is an adaptation of de Laubenfels' description in which he specifies that the primary character distinguishing Callyspongiidae from Haliclonidae is the presence of a secondary fibroreticulation at the surface of the sponge. Detailed structure and organisation of this surface reticulation is of great importance in separating genera and species within the Callyspongiidae.

## **Callyspongia** Duchassaing & Michelotti, 1864

RESTRICTED SYNONYMY

*Siphonochalina* Schmidt, 1868
*Toxochalina* Ridley, 1884
*Spinosella* Vosmaer, 1885
*Ceraochalina* Lendenfeld, 1887
*Dactylochalina* Lendenfeld, 1887

DIAGNOSIS: Callyspongiidae with main skeleton a reticulation of spongin fibres which have a spicule axis; special dermal skeleton a tangential network of similar fibres subdivided by thinner secondary or even tertiary fibres; megascleres oxeas or strongyles, the oxeas with occasional stylote modifications; microscleres, when present, toxas.

TYPE SPECIES: *Callyspongia fallax* Duchassaing & Michelotti, 1864, subsequent designation by Burton (1934).

REMARKS: *Callyspongia* is by far the largest genus in the family, and receives sponges which had been described under a bewildering array of previous names. Fortunately, in recent years, there has been some clarification of the synonymy of the various genera. One of the most accurate and exhaustive treatments of the subject is that of Weidenmayer (1977a) who dealt with sponges from the Western Bahamas. Using the organisation of the ectosomal skeleton as the main criterion for distinguishing between the various "chalinine" sponges, he decided that two main groups could be recognised, namely the genera *Callyspongia* Duchassaing and Michelotti (= *Siphonochalina* Schmidt) and *Spinosella* Vosmaer. He distinguishes the two genera as follows:

> "The main difference between *Spinosella* and *Siphonochalina* lies in the superficial specialisation of the skeleton. In *Spinosella* there is a compound superficial reticulation which is strictly tangential, i.e., two-dimensional in any given area of the surface, with primary and secondary meshes lying in one plane. In *Siphono-*

> *chalina* there is a peripheral condensation of the main skeleton, so that the meshwork becomes finer at and just below the surface by intercalation of short "secondary" radial fibres between the ascending fibres of the main skeleton . . . and crowding of the connecting fibres."

While agreeing that this distinction in skeletal organisation is valid, and important, we think that it is an insufficient basis for a generic division, for the following reasons.

Accurate though Wiedenmayer's historical analyses of the various genera are, there still remain some inconsistencies in his treatment of this subject. The original diagnosis of the genus *Siphonochalina* by Schmidt in 1868 runs as follows:

> "Branched or unbranched tubes. The surface is dense with a finer denser fibre-reticulation spreading between the slightly protruding ends of the radial fibres" (Translated from the German).

Neither this brief diagnosis, nor Topsent's redescription of the holotype, *S. coriacea,* require one to infer that *Siphonochalina* was intended for species displaying a peripheral condensation of the main skeleton as opposed to a two-dimensional tangential network. Yet Wiedenmayer makes this inference. Furthermore, he claims that Dendy's descriptions of chalinine sponges of the genera *Spinosella* and *Siphonochalina* show a conscious or unconcious division on the basis of ectosomal organisation of the skeleton. However, the actual descriptions and figures do not show that Dendy had this distinction in mind. Dendy notes:

> "The genus *Spinosella* is very closely related to Schmidt's *Siphonochalina,* and it is an open question whether or not the two should be united." (1921, p. 359)

In fact, Dendy's primary criterion for distinguishing these two genera is the presence or absence of dermal spines. In his figures, the only drawing of a dermal reticulation is one given for *Spinosella sororia* var. *dilatata,* so, unfortunately, we cannot test the possibility that he regarded *Spinosella* and *Siponochalina* as separable according to ectosomal architecture of the skeleton. The only thing that is apparent from his descriptions is that in *Siphonochalina* the distinction between the primary and secondary fibres of the dermal skeleton is less pronounced than in *Spinosella.* It is interesting to note that Ridley and Dendy (1887) described the dermal skeleton of *Siphonochalina intermedia* in such a way as to convey the impression that it had a truly two-dimensional reticulation – the "*Spinosella*-type" according to Wiedenmayer's interpretation:

> "The true dermal skeleton is a very delicate, triangular or polygonally-meshed reticulation of spiculo-fibre, the fibre forming each side of a mesh being composed of a single spicule and a very large proportion of horny matter . . . The dermal skeleton is supported on the ends of the primary fibres which also form the nodes in a much coarser reticulation of stouter spiculo-fibre lying immediately below it."

It appears, therefore, that in Dendy's work differences in the organisation of the ectosomal skeleton are used to distinguish species, but not genera.

A further problem with the genus *Siphonochalina* is that it was erected primarily for sponges with a tubular form. Consequently, species having a tubular growth form have been interpreted as belonging to *Siphonochalina* regardless of their ectosomal skeletal structure. It is now realised that external form in chalinine sponges is an unreliable taxonomic character compared with skeletal organisation, although even this can vary a great deal. Consequently we are left with the problem of assessing the true status of the genus and reallocating the species that were described within it.

Burton (1934) attempted to remove *Siphonochalina* by making it a synonym of *Adocia.* This decision has not been accepted by other workers, and seems quite insupportable (for comment, *see* Weidenmayer 1977a, p. 91).

Some authors, Levi (1973), Griessinger (1971), have attempted to distinguish between *Callyspongia* and *Siphonochalina* on the basis of the presence or absence of a tubular habitus and the regularity of the dermal network. Griessinger states that in *Siphonochalina* spongin is much less developed and the mesh is more irregular than in *Callyspongia.* However, in view of the large range of skeletal types that have been described for these sponges and the variation which exists within a single species, we regard these criteria as insufficient for a generic distinction. Besides, it is not at all certain that species possessing tubular form also possess an irregular dermal network, and vice versa. In our experience there has been no consistent correlation between these two factors. Many workers have noted that the form of a sponge seems more often to be an individual ecophenotypic response to a particular environment rather than a species-specific genetic trait.

Described below are species with well defined skeletal and spicular characters, but which can vary from an encrusting or massive form to a tubular form, depending on their habitat. For example, *Callyspongia fistulosa* from low water mark was massively encrusting in form, while a subtidal representative of this species had a flattened infundibular shape. It has often been noted that in low wave-exposure situations, the growth form of a particular sponge is soft, luxuriant, and with a tubular-ramose form often favoured, while in a situation of greater wave action a more compact, firm texture is encountered, with the animals in general assuming an encrusting profile. The flexibility of growth form in these sponges must to some degree argue against the use of external shape as a primary taxonomic character.

It is appropriate to ask whether or not the distinction between peripheral condensation of the main skeleton and tangential double-compound surface reticulation, the character used by Wiedenmayer to distinguish *Callyspongia* (syn. *Siphonochalina*) from *Spinosella,* is valid taxonomically at the generic level.

The appearance of the skeletal network at the surface of the sponge will always vary and the variation reflects the relative contribution of the endosomal and ectosomal reticulations. In *Callyspongia irregularis* n.sp. and *Dactylia palmata* Carter the topmost secondary meshes of the main skeleton form the main polygonal reticulation of the surface. Between these main fibres a finer network of interlacing connectives is present to a greater or lesser extent, producing a web-like effect at the surface. Over the entire network the dermal membrane is deposited. To Wiedenmayer, this is the "*Spinosella* type" of dermal skeleton (*see* Fig. 1,b).

On the other hand, in sponges such as *Callyspongia diffusa* and *C. latituba* the distinction between primary and secondary fibres of the dermal skeleton is less pronounced, and the whole dermal network appears as a close-meshed reticulation of fibres of varying thickness with no well-marked primary and secondary meshes. In this situation it is not possible to equate "topmost secondary fibres of main skeleton" to "primary fibres of dermal skeleton" and there is a general crowding together and intergradation of ectosomal and endosomal fibres, so that the dermal reticulation is less strictly two-dimensional. Wiedenmayer terms this a "peripheral condensation of the main skeleton" and says that it is characteristic of the genus *Callyspongia* (= *Siphonochalina*) (Fig. 1,a).

In our opinion, the distinction between these two alternatives is not sufficiently marked or sufficiently consistent to discriminate between two genera. In fact, the appearance of the dermal skeleton often varies considerably within a species or even an individual, and seems to depend on the stage of growth or the prevailing environmental conditions. Evidence of this variability can be seen in the descriptions of *C. ramosa* and *C. fistulosa* below. We therefore argue that the best scheme for classifying the chalinine sponges which retain spicules is to place them in the single genus *Callyspongia* and to use differences in the main and dermal skeleton for classification at the species level.

Finally, it should be noted that in modern taxonomic procedure a genus is defined by the diagnosis of a designated type species. It is therefore essential that we establish the characters of *Callyspongia fallax,* since this species was designated as the type by Burton (1934). This species has, until recently, only been described poorly and there still seems to be some confusion as to the type of dermal skeleton it has. Weidenmayer (1977a) claims that it has a peripheral condensation of the main skeleton and on the basis of this observation drops *Siphonochalina* into synonymy with *Callyspongia.* However, when a specimen of *C. fallax* from the Caribbean was examined it was found that the dermal skeleton is really intermediate between the two types of construction – it is very nearly two-dimensional and yet does not have a strong distinction between primary and secondary fibres. Examination of a slide of the type specimen in the collection at the Peabody Museum, Yale University, confirms this observation.

### **Callyspongia bathami** n.sp. (Plates 11, f; 12, a–c)

HOLOTYPE: National Museum, Wellington. Por. 80.
MATERIAL EXAMINED: Headland Point, Portobello, intertidal (holotype); east of Portobello, 55 m.
DESCRIPTION: A digitate sponge made up of many interconnected sub-cylindrical branches. There are a few small inconspicuous oscules lying flush with the surface of the branches.
DIMENSIONS: Overall height of the holotype is 10 cm, with length of the longest isolated branch 4 cm. The branches range from 0.3 to 1.0 cm in diameter.
COLOUR: In life, mustard (r-Y 7/8) with occasional mauve patches. In spirit, uniform dull yellow (r-Y 8/6).
TEXTURE: Extremely limp and compressible, soft and "furry" to the touch.
SURFACE: The entire surface of the sponge is wrinkled, and highly punctiform. The oscules, which are flush with the surface, never exceed 2.5 mm in diameter. The ostia are comparatively large, up to 0.7 mm. In the holotype the dermal membrane, where intact, is extremely porous (Plate 12, b), whereas in the subtidal specimen it is more solid and only a few large orifices are apparent.
SKELETON: The main skeleton is, for the most part, an irregular reticulation of thin spiculo-spongin fibres which meander in a disorientated way throughout the sponge and are only differentiated vaguely into primaries and secondaries (Plate 12, a). In some places, the skeleton is more regular, approaching the typical *Callyspongia* rectangular network. The fibres range from unispicular to multispicular, with up to 5 spicules aligned coaxially. Large numbers of spicules occur between fibres throughout the cellular matrix of the sponge, and these may sometimes obscure the main radial lines of the endosomal skeleton. The spongin is pale in colour and is more or less obvious in accordance with the spicule denisty of the fibres. The meshes of the main reticulation are 300–600 $\mu$ wide, and the individual fibres 20–50 $\mu$ in diameter.

The dermal skeleton is slightly more regular than the main network. It is a denser reticulation of unispicular and multispicular fibres, with little distinction between primary and secondary elements. In the subtidal specimen the network is more strictly rectangular and the fibres are unispicular or bispicular.

SPICULES
*Megascleres:* Oxeas, straight or slightly bent about the centre, often with stylote or strongylote modifications. A number of juvenile forms are present. The degree of flexure of individual spicules is variable.

Spicule dimensions of *Callyspongia bathami*

| *Locality* | *Spicule type* | *Size* ($\mu$) |
|---|---|---|
| Headland Pt. (in cave) (holotype) | Oxeas | 111–154 (133) × 6.5 |
| Headland Pt. (under boulder) | Oxeas (and styles) | 100–126 (117) × 4 |
| Portobello (subtidal) | Strongyloxeas | 104–147 (124) × 3.5 |

REMARKS: This species is erected for soft, flaccid sponges, with an irregular skeletal network of thin fibres packed with large oxeas. Although the three specimens examined were all taken from near Portobello, the morphological variability among them is great. The holotype, found growing on the sides of a cave, is irregularly branching and anastomosing; the specimen collected from underneath a boulder is flat and encrusting; the subtidal specimen is ramose with cylindrical branches. The mesh size, regularity of dermal and main skeletons, and spicule size and shape also vary.

*C. bathami* is distinguished from *C. stellata* n.sp. (to which it is most closely related) by its larger oxeas, its thinner skeletal fibres, and its more compact ectosomal network.

The species is named after the late Dr E. J. Batham, who was Director of the Marine Laboratory at Portobello for many years.

### **Callyspongia conica** (Brφndsted) (Plate 12, d–f)

*Pachychalina conica* Brφndsted, 1924, p. 454.
*Cladochalina conica* Burton, 1927, p. 510.
*Haliclona conica* Burton, 1932, p. 266.

HOLOTYPE: Zoology Museum, Copenhagen.

MATERIAL EXAMINED: Wairepo Lagoon, Kaikoura, on the side of a rock face at 2 m.

DESCRIPTION: A soft, irregularly branching and anastomosing sponge with numerous prominent oscules. The branches are either cylindrical or form coalesced lobes.

DIMENSIONS: Branches are 1–2 cm thick. The longest free section of a branch is 5 cm.

COLOUR: Golden in life (r-Y 8/8); fawn in spirit (Y 8/4).

TEXTURE: Soft and easily torn, elastic.

SURFACE: Ostia are scattered in uneven clumps over the surface, giving the sponge an irregularly punctate appearance. Ostia may reach a diameter of 0.5 mm. The surface is smooth, and glistens when wet due to the light reflecting from isolated tangential spicules at the surface. The dermal membrane, where present, is fine and delicate. Oscules are large, 2–3 mm in diameter, and are either flush with the surface or raised on low conical projections.

SKELETON: The main skeleton is a regular rectangular network of fibres which are packed with spicules (Plate 12, e). Spongin is transparent and usually forms a complete envelope over the spicules. Interstitial spicules are also common throughout the matrix of the sponge. Near the surface the distance between the primary fibres is 250–350 μ, but in the deeper parts of the sponge this distance increases to 600 μ. There is an increasing density of secondary fibres near the surface where they form a closer network to support the dermal fibres.

The dermal skeleton is an irregularly polygonal reticulation of extremely fine spicule fibre. It is not strictly tangential and there are numerous projecting or echinating spicules present. It is impossible to distinguish primary and secondary dermal fibres, and the entire dermal network is best thought of as a combination of thin fibres and individual spicules.

SPICULES

*Megascleres:* Oxeas and strongyloxeas, with dimensions 73–116 × 3–10 μ (102 × 7 μ), straight or slightly curved with hastate, rounded or mucronate ends. The thickest (oldest) spicules have the most rounded ends (Plate 12, f), and these represent the main component of the skeletal fibres. The thinner (juvenile) forms are often interstitial or loosely associated with the skeletal fibres.

REMARKS: The specimen at hand corresponds very closely to Brφndsted's description of *Pachychalina conica*. The shape of the spicules of this species is a diagnostic feature, and the spicules of this specimen are closely comparable to those figured by Brφndsted (1924, p. 454, fig. 12). The dimensions of the spicules in his specimen are greater than in ours (130 × 12 μ as opposed to 102 × 7 μ), but the discrepancy is not great and the shape of both specimens is identical. Brφndsted quotes the mesh size of the main skeleton as 15–55 μ; a network with meshes of this size would be extremely dense, and it is likely that these figures refer to the width of the fibres, not to the meshes. Brφndsted states that no special dermal skeleton is to be seen. The dermal skeleton is paratangential rather than tangential, and is not typically callyspongiid. It is possible that this species should be placed in the genus *Amphimedon* as redefined by van Soest (1980), since its texture also is very soft for a *Callyspongia*. There are no comparable New Zealand species, and thus *conica* is being left at present in the genus *Callyspongia*.

DISTRIBUTION: Slipper Island (low tide); Falkland Island, 141–144 m.

### **Callyspongia diffusa** (Ridley) (Plate 13, a–d)

RESTRICTED SYNONYMY

*Cladochalina diffusa* Ridley, 1884, p. 672.
*Acervochalina finitima* (pars) Ridley, 1884, p. 399.
*Callyspongia diffusa* Burton, 1934, p. 541.

HOLOTYPE: British Museum (B.M. 82.10.17.57).

MATERIAL EXAMINED: Narrow Neck Reef, under boulders; Wairepo Lagoon; Headland Point, Portobello; Back Beach, Coromandel (all intertidal); Kaikoura, 2 m.

DESCRIPTION: A palmodigitate to subramose sponge in which the branches either coalesce to form ridges which bear apical oscules, or have bulbous swellings on which the oscules are flush with the surface or raised on small turrets. The growth form is very flexible, and seems to reflect the degree of wave exposure.

COLOUR: In life, gold (r-Y 8/8) to mauve (P 6/2). The mauve pigment is clearly produced as a response to incident light. In some parts of the sponge the colour is black-brown which, in spirit, becomes dark green; this colouration indicates the presence of algae. The rest of the sponge becomes fawn to dull yellow in spirit.

TEXTURE: Firm and elastic, or, in some specimens, especially those which are weather-beaten or are dying back, soft and spongy.

SURFACE: Where the dermal membrane is intact, the surface is smooth and slightly hispid with the dermal reticulation clearly visible to the naked eye. Near the tips of the branches the surface is more shaggy and hispid. Oscules are 1–4 mm in diameter, usually with serrated margins.

SKELETON: Near the surface, where it is fairly regular, the main skeleton is a rectangular reticulation of stout polyspicular fibres (Plate 13, c). The primary fibres may be 50–150 μ thick and contain a large number of spicules, up to 40, coaxially. The secondary fibres are more slender, but are also polyspicular. The width of the main meshes varies within and between specimens, but a typical average measurement is 0.5 mm. In the deeper parts of the endosome, the skeleton is more irregular, with the strong primary fibres curving upwards to the surface and an irregular scatter of secondaries connecting them. At the junctions of the primary and secondary fibres there is often a massive build-up of spicules, giving the meshes rounded corners. There are also numerous interstitial spicules scattered throughout the endosome.

The dermal skeleton is distinct from the underlying network, and is a dense triangular to polygonal reticulation of primary fibres, subdivided by numerous secondary and tertiary fibres (Plate 13, d). A triangular reticulation such as that figured by Burton (1934, text-fig. 6 (a), p. 542), in which there is a clear difference in the thickness of the primary and secondary fibres, is rarely encountered. The reticulation is usually less well defined, irregularly polygonal, and the differentiation in the thickness of the fibres not so pronounced. One of the distinguishing features of *Callyspongia diffusa* is the presence of spicule tufts echinating the fibres of the dermal skeleton (Plate 13, c).

SPICULES

*Megascleres:* Oxeas vary in size and shape but are usually smooth, fusiform, straight or slightly bent either about the mid-point or a point one third of the spicule length from one end. Burton gives the spicule dimensions of the type as being 135 × 6 μ. Our examination of the type showed that the spicules were in fact considerably shorter, 95 × 6 μ.

Spicule dimensions of *Callyspongia diffusa*

| *Locality* | *Oxeas* (μ) |
|---|---|
| Singapore Beach (holotype) | 83–104 (95) × 6 |
| Narrow Neck Reef | 83–109 (97) × 7 |
| Wairepo Lagoon | 61–91 (80) × 4.5 |

REMARKS: The distinctive features of this species are the great spicule density within the fibres, the spicule tufts echinating the dermal fibres, and the disposition of the dermal reticulation in general. Burton (1934) in his description of *C. diffusa* compiled an extensive synonymy to which the reader is referred. He also commented (p. 543):

> "The radical step of identifying this group of supposed species of markedly differing external form under one name needs good justification, for it is contrary to all ideas previously held on the classification of the Haploscleridae. But in the Barrier Reef collections we have a batch of specimens which show the following shapes: massive to massive with low tubular oscules; tubular and repent, the tubes anastomosing; erect and tubular; flabellate, with oscules arranged serially around the margin or scattered over one face; cylindrical and repent, with long slender branches".

Although we do not possess such a wide range of growth forms in the New Zealand specimens, the species clearly exhibits great morphological plasticity; indeed, comparable plasticity is a recurrent feature in many other species of *Callyspongia*.

One New Zealand specimen is placed with some hesitation in *C. diffusa*. It was collected in the mouth of a cave at Headland Point, Portobello. It is an erect, turbinate sponge, highly compressible, faintly hispid, but with an almost crisp texture. It is mauve in life, but fawn in spirit, and the surface fibroreticulation can be seen clearly through the dermal membrane. There are a number of thorny tubercles scattered over the surface, and there is only one large oscule 8 mm in diameter at one side of the sponge. The spicules are typical in size and shape, having dimensions 88–92–101 × 5 μ. The skeleton is also similar to other *C. diffusa* specimens, although it is a little more irregular. In the light of Burton's remarks on external form, we conclude that this specimen does indeed belong to *C. diffusa,* and that the unusual growth form is a response to the extreme shelter of the cave situation.

DISTRIBUTION: Australia (east and west coasts); Malay area; Indian Ocean; New Zealand.

### **Callyspongia fistulosa** (Kirk) (Plates 13, e, f; 14, a, b)

*Chalina fistulosa* Kirk, 1911, p. 576.

HOLOTYPE: National Museum, Wellington. Por. 71.

MATERIAL EXAMINED: Gt. Barrier Island; Mount Maunganui; North Piha; Anawhata; Wairepo Lagoon, Kaikoura (all these specimens were encrusting boulders or rock faces in the intertidal or shallow subtidal zone); Papanui Beach, Portobello (encrusting mussels at low water mark); Kermadec Islands (holotype).

DESCRIPTION: A thickly encrusting to massive sponge with numerous oscular chimneys or ridges formed by coalesced tubes. The sponge always covers substantial areas of the substratum.

DIMENSIONS: The encrusting base of the sponge is always around 0.5 mm thick and the oscular turrets are up to 1.5 cm high. The diameter of the oscules is 1–3 mm.

COLOUR: In life, mauve (P 6/1); in spirit, dull yellow to brown (Y 8/6—y-YR 5/6).

TEXTURE: Firm but compressible; highly elastic.

SURFACE: Smooth and granular. The oscules are circular and the tips of the oscular turrets are serrated. The sponge has a punctate appearance. In some specimens the dermal membrane is markedly porous.

SKELETON: The main skeleton is rectangular, with multispicular primary fibres and unispicular secondaries. Spongin is well developed and oxeas constitute a core to the fibres. The primary fibres are 30–40 μ thick, the secondaries 20–30 μ, and the mesh width is 200–400 μ. There is always a clear distinction between primary and secondary fibres on the basis of their orientation in the skeletal network and their spicule complement (Plate 14, a,b).

The dermal skeleton is a polygonal network of unispicular fibres. The main fibres of this reticulation outline meshes of variable size and shape, and thinner secondary fibres subdivide these meshes to produce a finer network (Plate 13, f). The dimensions of the primary and secondary fibres of the dermal skeleton are approximately the same as those of the main skeleton, except that some of the secondaries can be as thin as 15 μ. In some cases the distinction between primary and secondary fibres in the dermal network becomes obscure, and the reticulation has an irregular appearance. At the intersection points of the main meshes there are small dermal spines.

SPICULES

*Megascleres:* Oxeas, stout and hastate, uniform in length but not in breadth among the different specimens.

*Microscleres:* Toxas, 1 μ or less in thickness, variable in size and degree of flexure.

REMARKS: This species is a difficult one to characterise, since there is considerable variability among the specimens examined. Some aspects of this variability are summarised in Table 1.

TABLE 1
Characteristics of *Callyspongia fistulosa*

| *Locality* | *Oxeas* (μ) | *Toxas* (μ) | *Density of oxeas in primary fibres* | *Width of main meshes (mm)* | *Appearance* | *Texture* |
|---|---|---|---|---|---|---|
| Anawhata | 50-66(56) × 6 | 15-50 (22) | Sparse | 0.2-0.35 | Coalesced tubes, lobate | Firm and compressible |
| North Piha | 58-68(61) × 5 | 18-61 (29) | Medium | 0.3-0.45 | Coalesced tubes, with apical oscules | Soft and compressible |
| Wairepo Lagoon | 45-58(53) × 2.5 | 20-50 (35) | Sparse | 0.25-0.4 | Thickly encrusting with turret shaped or rounded oscules | Firm and compressible |
| Papanui Beach | 45-51(49) × 2 | 30-48(41) | Sparse | 0.3-0.6 | Massive coalesced tubes | Firm and compressible |
| Mount Maunganui | 56-73(66) × 5 | 22-40 (28) | Dense | 0.2-0.4 | Thickly encrusting with oscular turrets | Stiff and compressible |
| Great Barrier Island | 43-63(53) × 2.5 | 15-60 (32) | Sparse | 0.15-0.25 | Thickly encrusting with oscular turrets | Firm and compressible |
| Kermadec Islands (holotype) | 35-48(41) × 2 | Absent | Sparse | 0.2-0.35 | Thickly encrusting with short fistular oscular processes | Stiff and compressible |

The oxeas of the holotype and of the specimens from other southern localities are very fine. Those from the North Island are much stouter and approach the shape of the oxeas of *Callyspongia ramosa.* Microsclere complement also varies among the specimens – toxas are abundant in the Wairepo Lagoon specimens but are absent in the holotype.

Although the spicule density of the skeletal fibres is variable, most specimens have a regular rectangular network with evenly spaced primary and secondary fibres. The dermal skeleton shows a greater variability; in some cases it is strictly tangential and the primary and secondary fibres are clearly differentiated in thickness, while in others it is more irregular, not so strictly two dimensional, and shows little distinction between primary and secondary fibres.

We have been able to examine Kirk's holotype, and find that our specimens are closely comparable in the size of the spicules, the disposition of the main and dermal skeletons, and in external form. The holotype does not possess toxas, but the possession of these microscleres is characteristic of all the New Zealand specimens.

*Callyspongia fistulosa* and *Callyspongia ramosa* are very similar in skeletal arrangement. The two species may be distinguished as follows:

(1) The form of *C. ramosa* is typically solid and ramose or tubular-ramose, and the species is always subtidal. *C. fistulosa* is typically encrusting to massive, and typically intertidal. On the only occasion when it was recovered from a subtidal habitat it had a flattened infundibular form.

(2) *C. ramosa* from New Zealand waters rarely possesses toxas but this feature is characteristic of *C. fistulosa.*

DISTRIBUTION: Sunday Island (Kermadec Islands); New Zealand.

### **Callyspongia irregularis** n.sp. (Plate 14, c–e)

HOLOTYPE: National Museum, Wellington. Por. 81.
MATERIAL EXAMINED: North Channel, 12 m.
DESCRIPTION: An erect flabellodigitate to cylindrical and irregularly branched sponge, commonly growing attached to small stones.
DIMENSIONS: *see* table below.
COLOUR: In life, whitish purple (r-P 5/4); in spirit, golden brown (r-Y 6/4).
TEXTURE: Soft and compressible, very elastic.
SURFACE: The surface is entirely roughened by the raised dermal fibres which form prominent triangular meshes. At the points of intersection of the main dermal fibres with a stout ascending endosomal fibre from below, a single erect conical spine 0.15–0.2 mm high is produced. Oscules are numerous, round, situated along both edges of the central axis and the branches and flush with the surface.
SKELETON: The skeleton is an irregular reticulation of polyspicular fibres with no clear distinction between primary and secondary members. The fibres range from 19–160 μ (86 μ) in diameter, up to 193–250 μ at the nodes where as many as six large fibre tracts may intersect. The meshes between the fibres are irregular and 60–180 μ wide.

Dimensions of *Callyspongia irregularis*

| *Height* | *Width (apex)* | *Width (base)* | *Diameter of branches* | *Length of branches* | *Oscule diameter* |
|---|---|---|---|---|---|
| 10-15 cm | 5-8 cm | 1.8-2.5 cm (2.2 cm) | 0.3-1.5 cm (0.9 cm) | 0.7-5.6 cm (2.8 cm) | 2.0-4.2 mm (3.1 mm) |

The dermal membrane is extremely delicate, 0.04 mm thick, and supports the dermal skeleton. This is a series of primary fibres, 60–90 μ in diameter, which divide the surface into triangular sections; within each of these sections, which are from 1.0–2.2 mm long and 0.4–1.8 mm wide, is an extensive system of fine secondary fibres 10–25 μ in diameter. These are not arranged in any constant pattern. Many isolated spicules occur throughout the endosome. Spongin is present investing all fibres, but is often masked by the great numbers of spicules.

SPICULES

*Megascleres:* Slender, evenly curved oxeas tapering to sharp points. Dimensions 110–169 (136) × 4 μ.

REMARKS: This species is intermediate in some respects between *Callyspongia diffusa* (Ridley) and *Callyspongia ridleyi* Burton from the Great Barrier Reef.

In *C. ridleyi* there is no distinction between primary and secondary endosomal fibres. The endosomal skeleton is extremely irregular and the spongin is often masked by the great numbers of spicules in the fibres. *C. irregularis* differs from *C. ridleyi* in spicule dimensions, in having a regular dermal reticulation, in external form, and in the presence of dermal spines.

Points of resemblance to *C. diffusa* lie mainly in the roughly triangular nature of the dermal meshes and the presence of dermal spines (Plate 14,d). Spicule dimensions are also similar (135 × 6 μ in *C. diffusa* as against 136 × 4 μ in *C. irregularis*).

*C. irregularis* differs from *C. diffusa* in the irregular nature of the endosomal skeleton, with its numerous very fine fibres, and in the lack of dermal tufts of echinating oxeas.

### ***Callyspongia latituba** (Dendy)

*Siphonochalina latituba* Dendy, 1924, p. 329.

REMARKS: Dendy's original specimen has been examined (B.M. 23.10.1.71), and we have nothing to add to his description, except to note that the dermal skeleton of *Callyspongia latituba* is its most distinctive feature. It is highly spiculose with many echinating oxeas, either single or in tufts. The relegation of *Siphonochalina* Schmidt to *Callyspongia* Duchassaing and Michelotti has been discussed in the introduction to the genus *Callyspongia*.

DISTRIBUTION: East of North Cape, 140 m.

### ***Callyspongia minor** (Dendy)

*Siphonochalina minor* Dendy, 1916, p. 115.
*Siphonochalina minor* var. *regalis* Dendy, 1924, p. 328.
*Adocia minor* Burton, 1934, p. 537.

REMARKS: Burton's (1934) relegation of *Siphonochalina* to *Adocia* has not been accepted by subsequent workers, and *minor* is consequently placed in *Callyspongia*.

DISTRIBUTION: West coast of India; Low Isles; Three Kings Islands, 200 m.

### ***Callyspongia oliveri** (Kirk)

*Toxochalina oliveri* Kirk, 1911, p. 577, fig. 4.

HOLOTYPE: National Museum, Wellington. Por. 83.

REMARKS: Having examined the holotype, which is a dry specimen, we find that Kirk's remarks about the spiculation of this sponge need amplification. The large oxeas he mentions (240 × 8 μ) are certainly foreign. The microscleres Kirk mentions are not toxas, but merely very small oxeas. Their size is 38 × 1 μ, and they vary considerably in form. In a vertical section through the sponge, it is clear that these small oxeas are the structural spicules; they core the primary fibres in several rows and are present as a single row in the secondary fibres.

DISTRIBUTION: Sunday Island, Kermadec Islands.

### **Callyspongia ramosa** (Gray) (Plates 14, f; 15, a–f)

RESTRICTED SYNONYMY

*Spongia ramosa* Gray, 1843, p. 295.
*Toxochalina difficilis* Brøndsted, 1923, p. 132.
*Gelliodes filiformis* Brøndsted, 1923, p. 131.
*Gelliodes flagelliformis* Brøndsted, 1923, p. 129.
*Pachychalina affinis* Brøndsted, 1924, p. 455.
For detailed synonymy, *see* Burton, 1934, p. 603.

MATERIAL EXAMINED: Ponui Island, 15 m; Takatu Pt, 8 m; Noises Island, 4 m; Staffa Bay; Harrington Pt, 10 m; Three Kings Islands, 60–120 m; Cape Brett, 40 m; Spirits Bay, 4 m; Poor Knights Islands, 80 m; Hen Island, 40 m; Bream Head, 44 m; Little Barrier Island, 50 m; Kawau Island, 14 m; North Channel, 12 m; Onetangi, 12 m; Rangitoto Channel, 8 m; Motuihi Channel, 12 m; Shag Rock, 54 m; Cape Colville, 60 m; Alderman Island, 100 m; Whale Island, 60 m; off White Island, 40 m; Mayor Island, 6–12 m; Cook Strait 100 m; off Waitaki River, 100 m; Foveaux Strait, 50–80 m; Chatham Rise, 4–40 m; Mernoo Bank, 82 m; South East Island and Pitt Island, 4–60 m; Campbell Plateau, 92 m.

DESCRIPTION: Branching and erect with cylindrical or flattened branches which may be solid or tubular. Occasionally assumes an encrusting habit with tall digitate or vasiform oscular processes.

DIMENSIONS: The dimensions of the branches vary considerably depending on the habitat. Commonly the width of a branch is 6–8 mm, and the height of the entire specimen 20–40 cm.

COLOUR: In life, mauve (P 6/2) with white branch tips where the cellular material has been abraded away, or a uniform dull yellow (r-Y 8/6); in spirit, dull yellow to fawn.

TEXTURE: Firm and elastic, although some specimens with reduced reinforcement of the skeleton are soft and others, due to the inclusion of large amounts of foreign material or excessive spongin development, are almost incompressible.

SURFACE: Smooth and even, with oscules either flush with the surface or raised slightly with collar-like rims. They may be arranged in a linear series along the margins of the branches or scattered randomly over the surface.

SKELETON: The skeletal architecture of *C. ramosa* is variable, particularly in features of the dermal reticulation. Typically the main skeleton is a regular rectangular reticulation of multispicular primary fibres (3–6 spicules broad) and unispicular secondaries. The spiculation of the fibres is never heavy, spicules core but never pack the fibres. There is usually a condensation of the main skeleton near the surface, evident as a crowding together of the secondary fibres. The thickness of the fibres varies with the amount of spongin present (Plate 15, e,f). In some cases the skeleton is very horny with spicules much reduced in thickness and number.

The dermal skeleton is most frequently a regular, dense reticulation of primary rectangular meshes subdivided into secondary meshes. The fibres are unispicular, and in some cases may be echinated by spicule tufts or individual spicules. Dermal spines may also be present. In most cases the dermal skeleton is two-dimensional with a transparent dermal membrane stretched over the meshes. However, if the dermal membrane has been abraded away, the surface reticulation looks very different; there is little evidence then of a primary and secondary reticulation (Plate 15, c,d). We conclude that in *C. ramosa,* differences in mesh width, fibre thickness, and the degree to which the fibres lie in the same plane at the surface, are common. Even in a single specimen the type of dermal skeleton may vary at different points along a branch. For example, in a particular specimen from the Firth of Thames the meshes are two or three times as wide near the tips of the branches as they are further down. The indication is that the difference is a result of growth since it occurs at the same place on many branches.

Skeletal characteristics of *Callyspongia ramosa*

| *Locality* | *Oxea size* (μ) | *Spongin content of fibres* |
|---|---|---|
| Takatu Pt (a) | 63–76(70) × 5 | Medium |
| Takatu Pt (b) | 38–51(48) × 3 | High |
| Portobello | 48–61(53) × 2.5 | High |
| Ponui Island | 61–71(66) × 5 | Medium |
| Noises Island | 53–66(60) × 6 | Medium |
| Staffa Bay | 51–58(53) × 4 | High |

SPICULES

*Megascleres:* Oxeas, usually stout, straight and abruptly pointed, dimensions vary considerably, especially the thickness (Plate 15,b). It is apparent that as spongin increases in importance as the main structural element of the skeleton, there is a correspnding decrease in the importance of the spicules, and hence a smaller spicule size.

*Microscleres:* The importance of the presence of microscleres in this species has been questioned by Burton (1934). Only one specimen examined in this study possessed toxas in any number, the specimen from Portobello. The usual situation for *C. ramosa* from New Zealand waters is that microscleres are absent.

REMARKS: *Callyspongia ramosa* is our most common off-shore shallow-water sponge. It is found in a wide range of localities and displays great morphological variability. The branches may be tubular, having a single apical oscule, solid with a large number of oscules scattered over the surface, or a mixture of these two types may occur in the same specimen. In the face of such variability, it is essential that we try to understand the relative importance of environmental and genetic factors in determining the growth form. One factor which apparently influences the growth form is the strength of the water current. The specimens of *C. ramosa* from Harrington Pt., Portobello, are all luxuriant with thick branches, which may be up to 0.5 m high. In this locality near the head of Portobello Harbour, strong currents are known to sweep into and out of Harrington Bay.

Burton (1934, p. 603) has noted the similarity in external form between *C. ramosa* and *Haliclona oculata* Linné. These two species, of course, have a totally different skeleton organisation, and thus show a clear case of convergence in external form notwithstanding gross skeletal differences.

Burton also points out the similarity in skeletal arrangment of *C. ramosa* and *C. fallax*. The latter is distinguished by the slightly rounded meshes of its dermal skeleton, its finer fibres, and markedly softer texture.

The holotypes of the following species have been examined and they are regarded as being synonyms of *Callyspongia ramosa:*

*Pachychalina affinis* Brφndsted
*Gelliodes filiformis* Brφndsted
*Gelliodes flagelliformis* Brφndsted
*Toxochalina difficilis* Brφndsted.

It is probable that three more of Brφndsted's species (*Pachychalina lunae, P. densa* and *Gelliodes biformis*) are also conspecific with *C. ramosa*. No type material of these species was available.

Lendenfeld (1887) recorded thirty-two species of "Chalinine" sponges from New Zealand. With the exception of *Antherochalina renieropsis,* which may be a *Microciona, Cladochalina truncatella* var. *laxa,* which is a *Mycale, Cladochalina truncatella* var. *mollissima,* which is *Batzella inaequalis* (Hentschel), and *Cladochalina typica,* which may be a separate species of *Batzella,* all of those which are recognisable were judged by Burton (1934) to be synonyms of *Callyspongia ramosa.*

*Euchalinopsis* was judged unrecognisable by de Laubenfels (1936) and presumably, since Burton did not mention them otherwise, the two species recorded from New Zealand (*E. oculata* var. *elegans* and *E. minima*) are to be pronounced unrecognisable.

DISTRIBUTION: New Zealand; Australia; Mauritius; Bahia. Within New Zealand collections not previously mentioned are: Little Barrier, 60 m; Colville Channel, 70 m; Spirits Bay, 22–40 m; east of North Cape, 140 m; Carnley Harbour, 90 m; Perseverance Harbour, 20–40 m.

### **Callyspongia robusta** (Ridley) (Plate 16, a–c)

RESTRICTED SYNONYMY

*Toxochalina robusta* Ridley, 1884, p. 403.
*Toxochalina robusta* Dendy, 1905, p. 139.
*Toxochalina chalmeri* Brφndsted, 1927, p. 5.
*Callyspongia robusta* Bergquist, 1961b, p. 171.

MATERIAL EXAMINED: Portobello, 60 m.

DESCRIPTION: Erect, ramose sponge with thick subcylindrical to massively palmate branches which are variously anastomosed; oscules not abundant, flush with the surface.

DIMENSIONS: The specimen examined is 20 cm high; the flattened branches 1.5–3.0 cm wide, and palmate areas up to 6 cm wide.

COLOUR: Fawn to mustard in life and in spirit (r-Y 8/4–8).

TEXTURE: Hard and only slightly compressible. The dried skeleton is brittle and almost incompressible. The sponge is very difficult to tear because of the toughness of the fibres.

SURFACE: Even, tough skin, rough to the touch because of the inclusion of foreign material in the dermal membrane. The dark amber colour of the main fibres is visible as a polygonal reticulation immediately beneath the surface. Oscules vary in size and shape, from 1-4 mm diameter, usually simple in construction.

SKELETON: The main skeleton is an open network of thick spongin fibres. The primary fibres are more or less perpendicular to the surface and have a stronger spicule axis than the secondary fibres, but due to the great spongin development, the overall thickness of both types of fibres may be the same. The fibres are thickest just beneath the surface. Often the primary fibres have two or three distinct spicule axes enclosed by a single spongin envelope. As they approach the surface, these "composite" fibres divide into individual primary fibres with a single spicule axis (Plate 16, b). The primary fibres are normally 0.08–0.15 mm thick, and the width of the main meshes is 0.7–1.0 mm.

The dermal skeleton is a denser two-dimensional reticulation (Plate 16, c). The principal fibres of this network are 0.05–0.08 mm thick, and have a spicule axis of 1–4 spicules. The secondary and tertiary fibres, which form a close-meshed reticulation between the primary fibres, are 0.02 mm thick, but in some the spongin development is greatly reduced. There is a large amount of debris and broken spicules associated with the ectosome of this sponge.

SPICULES

*Megascleres:* Oxeas, straight or slightly curved, hastate, but with points frequently broken or eroded. Dimensions 68–81(75) × 5 μ.

*Microscleres:* Toxas are commonly embedded in spongin at the nodes of the main skeleton or where the primary fibres bifurcate. The size is variable, from 20–60 μ.

REMARKS: This specimen compares well in external form, colour and skeletal arrangement with Ridley's (1884) description of *Toxochalina robusta* from Port Jackson. The fibres of this sponge, however, appear to be thinner than those of the New Zealand representatives of *C. robusta.* A comparison of the dimensions of Ridley's sponge with New Zealand specimens in question is given by Bergquist 1961b, p. 172. Ridley states:

> "Sponge, in spirit, tough, but yielding and pliable (almost as much so as *Chalina oculata* Pallas). Internal fibres soft and elastic, forming a close network".

*C. robusta* from New Zealand waters cannot be described in these terms – the sponge is always firm and not pliable, and the fibres are tough and horny rather than soft and elastic.

The name *Toxochalina* is not maintained since the presence or absence of microscleres is not considered to be a sufficient criterion for a generic distinction in the Callyspongiidae. However, at the species level it would be unwise to ignore microscleres entirely. Throughout his work, Burton took the view that the microsclere complement was of no taxonomic value in the Haplosclerida even at the species level, and thus relegated *Toxochalina robusta* Ridley to *Callyspongia ramosa* (Gray).

We disagree with Burton for two reasons. Although some variation in microsclere complement admittedly occurs in this species, the normal situation does seem to be the possession of toxas. Such is not the case for *Callyspongia ramosa.* Throughout his publications Burton often takes pains to demonstrate intraspecific variability in the various taxonomic characters he is using, and uses such demonstrations as the grounds for extensive synonymy of previously described species. The desirability of this approach to the practical problems of sponge taxonomy is questionable. While admitting that there is substantial morphological variability in the entities he is studying, the taxonomist is forced eventually to decide between what constitutes variation within a species and what constitutes variation between species. Addressing himself to this problem, Weidenmayer (1977a) says:

> "Burton underestimated the significance of external shape. The habit is indeed variable in all species under consideration, more so than, e.g., Hechtel (1965) assumed; but each species has its characteristic, probably chiefly ecotypic, trends in this respect. Overlaps occur in some exreme cases, and could deceive workers familiar only with preserved material and poor descriptions. The species in question, however, can readily be distinguished in the field . . . "

In our opinion, the normal situation is that toxas are present in *Callyspongia robusta* and absent in *Callyspongia ramosa,* and that this difference supports the maintenance of the two species.

Secondly, the possession of toxas is only one criterion for separating *C. ramosa* and *C. robusta.* The main difference is the much greater thickness of the fibres and the width of the main meshes of the endosomal skeleton of the latter species compared with the former.

DISTRIBUTION: Port Jackson (Australia); Bahia; Port Chalmers.

### **Callyspongia stellata** n.sp. (Plate 16, d, e)

HOLOTYPE: National Museum, Wellington. Por. 85.

MATERIAL EXAMINED: Laboratory Rocks, Kaikoura (holotype); Wairepo Lagoon, Kaikoura; Aquarium Point, Portobello (found under boulders in the intertidal or otherwise encrusting rock stacks in the shallow subtidal).

DESCRIPTION: Encrusting to massive with a conulose surface, through which the prominent fibres of the dermal skeleton are visible giving the sponge surface a stellate appearance.

DIMENSIONS: *see* table below.

Dimensions of *Callyspongia stellata*

| *Locality* | *Dimensions (cm)* |
|---|---|
| Laboratory Rocks | 3 × 5 × 0.5–1.0 |
| Wairepo Lagoon | 3 × 7 × 2.0–2.5 |
| Aquarium Pt. | 4 × 6 × 2 |

COLOUR: Cream when found under boulders (Y 8/4); mauve in incident light (P 6/2). Fawn in spirit.

TEXTURE: Soft, compressible and elastic. The sponge is difficult to tear because of the strength of the endosomal fibres.
SURFACE: Smooth and conulose, with projecting vertical fibres giving a shaggy appearance. A few large, round oscules present, 3-4 mm in diameter, usually with slightly raised rims. The dermal membrane is transparent, and has distinct pore areas (Plate 16, e). The fibres of the dermal network are very prominent.
SKELETON: The main skeleton is rectangular, composed of thick fibres packed with spicules. Numerous interfibrillar spicules are scattered throughout the matrix of the sponge, sometimes obscuring the main lines of the skeleton. The primary fibres are packed solidly with spicules and are sometimes grouped together to give broad, composite spiculospongin columns, in which interstitial spicules join the various vertical tracts together. The primary fibres are 50–70 μ thick; the secondaries are slightly thinner and have fewer spicules in relation to fibre diameter. The prominent surface conules are formed wherever the main primary fibres reach the surface. However, these are not the only vertical fibres – there are some that never reach the surface and that only function in the reinforcement of the endosome. Thus, whereas the distance between the conules is 0.9–1.25 mm, the distance between the primary fibres at a deeper level may vary from 0.3–0.8 mm.

The dermal reticulation is an irregular polygonal network of fibres of varying thicknesses usually echinated by spicule tufts. Numerous interfibrillar spicules are also present. The main meshes are not highly subdivided by secondary or tertiary fibres; in fact, these categories do not really apply. At the intersection points of the dermal network which coincide with the primary lines of the main skeleton, the fibres raise the surface into a conule.

SPICULES

*Megascleres:* Oxeas, straight or slightly curved, fusiform and "cigar-shaped", 61–91 (88) × 4.5 μ. A few toxiform oxeas are also present.
REMARKS: This sponge bears some resemblance in skeletal arrangement to *C. bathami*. Both species have well developed spicule-fibres, and a broad-meshed, sometimes irregular endosomal skeleton, with fibres often curved and meandering through the sponge matrix rather than being straight and perpendicular to the surface. *C. stellata* is separated from *C. bathami* by having much thicker fibres, and hence tougher texture, a consistently conulose surface, and smaller oxeas.

*C. stellata* also resembles *C. diffusa* (Ridley). Both species have thick spiculo--fibres as the skeletal elements; both have echinating spicule tufts in the dermal skeleton, and the spicules of both species have similar dimensions. However, the organisation of the dermal skeleton differs markedly in the two species and *C. diffusa* never possesses a conulose surface. A further distinction is that the main fibres of *C. stellata* are thinner than those of *C. diffusa;* hence the former species has a much softer texture.

## Notes on the genus Callyspongia

Despite the morphological plasticity exhibited in species of *Callyspongia,* it has usually been possible to recognise a "normal" form, and then to describe a group of specimens whose characteristics fall on either side of this normal expression. In the absence of genetic and ecological data concerning the individual specimens, the decision as to what constitutes the normal expression of a species and how wide to make the species' limits is necesarily subjective. However, as was pointed out earlier, the taxonomist develops a total impression of the entities being considered, and can usually recognise a particular species in the field despite its deviations from the normal expression in one or more characteristics.

From this study it is clear that species of *Callyspongia* constitute a significant part of the intertidal sponge fauna, as well as being important subtidally. Six of the nine species described are found either entirely or commonly in the lower intertidal zone.

In this study we have not followed the procedure of Burton (1934), which was to minimise the value of architecture of the endosomal skeleton and microsclere component. We maintain that in the Callyspongiidae these criteria are valid at the species level, but still must be used with caution given the great flexibility in ecophenotypic response demonstrated by these sponges.

## **Chalinopsilla** Lendenfeld, 1888

*Chalinopsis* Lendenfeld, 1886

DIAGNOSIS: Callyspongiidae with main skeleton a reticulation of spongin fibres in which there are no inclusions; special dermal skeleton a network of similar fibres subdivided by thinner secondary or tertiary fibres, spicules absent.
TYPE SPECIES: *Chalinopsilla dichotoma* Lendenfeld, 1886, by monotypy.

### **Chalinopsilla australis** Lendenfeld (Plates 16, f; 17, a, b)

*Chalinopsilla australis* var. *repens* Lendenfeld, 1889, p. 136.
*Chalinopsilla australis* var. *reticulata* Lendenfeld, 1889, p. 137.

MATERIAL EXAMINED: Takatu Point, 6 m.
DESCRIPTION: Only a fragment of this sponge was obtained, a tubular piece 10 cm long, 3 cm diameter and 0.5 cm thick. It is abundantly studded with small oscules which are elevated on short conical processes.
COLOUR: Mauve in life (P 6/2), fawn to brown in spirit. The spongin is a dark brown colour, and renders the surface reticulation clearly visible.
TEXTURE: Compressible and resilient, smooth to the touch.
SURFACE: Between the oscular turrets the surface is even and punctate, the oscules are 1–2 mm in diameter and the dermal membrane is transparent.
SKELETON: The endosomal skeleton is an open rectangular reticulation of uncored fibres. The primary and secondary fibres, where they can be differentiated, have similar dimensions, 20–40 μ in diameter. The skeleton becomes more compact just beneath the surface in order to support the dermal network. At this level a number of vertical fibres may arise from a single secondary fibre parallel with the surface, and act as supporting pillars.

The dermal skeleton is an extremely fine tangential mesh in which the main fibres form a polygonal array between which numerous secondary and tertiary fibres ramify. The arrangement of the secondary fibres is not perfectly symmetrical, but when viewed as a whole, the network appears as a uniform lattice of very small square meshes, 50–60 $\mu$ across (Plate 16, b).

REMARKS: This species has the colouration both in the soft tissue and in the spongin that Lendenfeld (1889) records for *Chalinopsilla australis* var. *repens,* and the ectosomal reticulation recorded for *C. australis* var. *reticulata.* There is consequently no reason to sustain two varieties of *Chalinopsilla australis.*

### **Dactylia** Carter, 1885

DIAGNOSIS: Callyspongiidae with main skeleton a reticulation of spongin fibres, the primary fibres of which are cored by foreign material. The dermal skeleton is a network of similar fibres subdivided by thinner secondary or tertiary fibres; spicules absent.

TYPE SPECIES: *Dactylia chaliniformis* Carter, 1885, p. 309; subsequent designation by de Laubenfels 1936.

REMARKS: De Laubenfels (1936) placed *Chalinopsilla* Lendenfeld into synonymy with *Dactylia.* In the present study *Chalinopsilla* is retained as a separate genus for sponges which have no coring material at all in the skeleton.

### **Dactylia palmata** Carter (Plate 17, d–f)

*Dactylia palmata* Carter, 1885, p. 310.
*Chalinopsilla arborea* var. *macropora* Lendenfeld, 1889, p. 150.
*Chalinopsilla arborea* var. *massa* Lendenfeld, 1889, p. 153.
*Chalinopsilla palmata* Dendy, 1924, p. 331.

MATERIAL EXAMINED: Portobello, 55 m; North Cape, 100 m; North Channel; Cook Strait, 60 m; Little Barrier Island, 80 m; Ponui Island, 12 m; Little Huia, intertidal.

DESCRIPTION: This sponge is commonly dredged from shell-sand bottoms. The growth form may be encrusting with rounded oscular processes, or erect with cylindrical to massively palmate branches and the oscules flush with the surface.

DIMENSIONS: The Portobello specimen is typical in this respect, height 8–20 cm; diameter of cylindrical branches, 0.6–0.8 cm; breadth of largest lamella, 9.0 cm; thickness of this lamella, 0.6 cm.

COLOUR: In life, dull mustard (Y 7/4); in spirit, identical.

TEXTURE: Compressible and elastic, with tough fibres making the sponge difficult to tear; when compressed it releases a sticky exudate.

SURFACE: Uneven, shaggy, rough to the touch, often with a great deal of sand and foreign material associated with the dermal skeleton. Oscules 1–3 mm diameter, abundant, scattered over the entire surface or aligned along the edges of the flattened branches. The oscules are complex in structure, with 3–6 small orifices opening into each oscular recess. The dermal membrane is extremely porous (Plate 17, f).

SKELETON: The main skeleton is composed of a series of ascending fibres cored with sand grains, and thus of irregular diameter. These primary fibres are connected by uncored frequently branched secondaries, which are usually given off at right angles to the primaries (Plate 17, e). The skeleton is constructed asymmetrically; in some places it is a dense network, while in other places it is more open. The main fibres are frequently bifurcated, and in many places the skeleton is irregular, with primaries and secondaries distinguishable only on the basis of their thickness and inclusion of foreign material, and not their orientation. The distance between primary fibres in an erect specimen is about 1 mm, while it is only 0.5 mm in an encrusting specimen. The distance between the secondaries is highly variable within an individual.

In encrusting specimens the dermal skeleton is marginally, if at all, distinct from the main skeleton. The primary fibres simply reach the surface and are connected, as in the endosome, by thin uncored spongin fibres. In a tangential section the surface appears as a regular polygonal network with only a few secondary dermal fibres forming a denser network. In the deep-water specimens the ectosomal skeleton is more irregular and subdivided. As before, the tips of the primary fibres of the endosomal skeleton form the nodes of the dermal reticulation, and connecting fibres radiate out from these to other nodes. The meshes thus formed are subdivided into an irregular but compact network by secondary and tertiary fibres.

REMARKS: There is a significant difference between the dermal skeletons of the encrusting and erect specimens. However, the two types are retained within the same species since both are closely similar in external characteristics, colour, uneven surface, compound oscules and tough texture.

The encrusting specimens are usually found in an epizoic association with *Chlamys zelandiae.* The sponge grows first as a thin encrustation on both valves of the mollusc, and when all the available space has been used, forms digitate branches.

DISTRIBUTION: Port Phillip Heads; South Australia; Port Chalmers (New Zealand); Three Kings Islands.

## Order NEPHELIOSPONGIDA Bergquist

Demospongiae with a reticulate skeleton in which there is a clear dominance of mineral skeleton over spongin elements; the latter can be almost absent. As a consequence of the heavy spicule content many Nepheliospongida are firm, brittle, even stony in texture. The main skeleton is organized as a reticulation of spicule tracts which are not differentiated as ascending (primary) and secondary (connective) elements. Long, dense spicule tracts separate from this primary reticulation can be present and these meander through the endosome preserving no fixed orientation to the surface. The ectosomal skeleton is a tangential reticulation of single spicules or spicule tracts. Marked increase in the thickness of these tracts can produce a spicule crust. The regularity of both ectosomal and endosomal skeletons is often obscured by increase in thickness of all spicule tracts and by the presence of free, interstitial spicules. The latter often have an isodictyal arrangement.

Megascleres are diactinal, dominantly oxeas, occasionally strongyloxeas and strongyles, and rarely do stylote modifications occur. Microscleres when present are microoxeote, microstrongylote, sigmas and/or toxas.

Reproductive processes are little documented, but are known to be of oviparous type in *Xestospongia*. Larvae are unknown.

All genera of one family, the Nepheliospongiidae, contain novel sterols which have a cyclopropene ring in the side chain.

## Family NEPHELIOSPONGIIDAE Clark

Nepheliospongida in which there is a heavy dominance of mineral skeleton over the soft tissues and spongin elements; consequently the sponges all have a brittle, stony texture. The main skeleton is an isotropic reticulation of spicule tracts, the regularity of which is often obscured by increase in thickness of both elements and by emphasis of free interstitial spicules arranged either isodictyally or irregularly. The ectosomal skeleton is a tangential reticulation of single spicules or spicule tracts. Increase in spicule content in the ectosomal region can produce a marked spicule crust. Megascleres are dominantly oxeas, occasionally strongyloxeas and strongyles; microscleres when present are microoxeas or microstrongyles.

REMARKS: The above family diagnosis is amplified from that given by Wiedenmayer (1977b). We agree that those genera which show massive development of the siliceous skeleton compared with the cellular matrix or fibre skeleton should be separated from other Haplosclerida. We prefer to make the separation at the ordinal level and to take reproductive and biochemical characteristics into consideration. Genera included in the Nepheliospongida have, in general, a style of ectosomal specialisation not comparable to that encountered within the Haplosclerida. In this connection Wiedenmayer (1977a) says:

> "This family is further distinguished by a tendency to have a more or less developed ectosomal or peripheral crust. It usually grades into the main skeleton, and is rarely strictly tangential, or detachable, as is typical for the Adociidae. When least developed, as in most Xestospongiae, it may consist merely of a preferred tangential or erect orientation of the peripheral spicules."

## **Petrosia** Vosmaer, 1887

Nepheliospongiidae in which there are distinct categories of megascleres with respect to both size and type; large, thick strongyles, large thick oxeas, immature spicules of both types of the same length but thinner, and short, thick diacts. There is a specialised ectosomal skeleton of varying density, but which is usually present as a peripheral crust.

TYPE SPECIES: *Reniera dura* Schmidt, 1862, p. 77.

REMARKS: Bergquist (1965) noted that in the past two clearly separate groups of sponges had been placed in *Petrosia*. One group, included here as *Petrosia sensu stricto,* had the spiculation of the type species, a distinct dermal skeleton, and a rock-like texture. The other group had only oxeas as megascleres, lacked a clearly distinct dermal skeleton, but retained the stony texture. De Laubenfels erected the name *Xestospongia* for the latter group and this name is maintained here with a slightly altered diagnosis as suggested by Bergquist (1965) and amplified by Wiedenmayer (1977a).

### **Petrosia australis** n.sp. (Plate 9, b, c)

HOLOTYPE: Zoological Museum, Copenhagen.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m; east of North Cape, 110 m (holotype).

DESCRIPTION: This is a massive hemispherical sponge with long brittle oscular tubes arising either apically or at several points over the upper part of the surface.

DIMENSIONS: *see* table below.

COLOUR: In life, light reddish purple (p-R 6/2); in spirit, straw colour (Y 8/4).

TEXTURE: Solid and incompressible. The ectosome is stony, the endosome crumbly.

SURFACE: Smooth but uneven, in many parts encrusted by *Hymedesmia* and *Microciona*. Oscules are apical on long tubes. Since no unbroken tubes were obtained the oscule diameter is unknown. No pores were visible.

SKELETON: The skeleton is an extremely compact reticulation of tornote oxeas in which the arrangement into spicule tracts is still apparent despite the large numbers of individual spicules in each column. There are two sizes of oxeas present. The larger are the structural spicules. The smaller occur plentifully in both ectosome and endosome interspersed between tracts. The ectosomal region is 1 mm thick and clearly defined. The ectosomal skeleton is compacted into two or three concentric layers which have a tendency to scale apart rather like the components of a lamination. Spongin is greatly reduced, almost absent.

SPICULES

*Megascleres:* Oxeas of two sizes –

(a) Large, stout, evenly curved to straight spicules, tending toward a tornote condition.

(b) Small angulated tornote oxeas. These are not confined to the ectosome, but are more frequent in the ectosomal laminations which make up the walls of the oscular tubes.

Dimensions of *Petrosia australis*

| | | | | | *Oscular tubes* | |
|---|---|---|---|---|---|---|
| *Locality* | *Habit* | *Thickness* | *Length* | *Width* | *Height* | *Diameter* |
| Three Kings Islands | Massive | 5.0 cm | 8.5 cm | 6.0 cm | 4.0–6.0 cm | 5.0–8.0 mm |
| East of North Cape | Massive | Broken | 5.0 cm | 4.0 cm | 6.0–8.0 cm | 9.5–13.0 mm |

Spicule dimensions of *Petrosia australis*

| *Locality* | *Large oxeas* ( μ) | Small oxeas ( μ) |
|---|---|---|
| Three Kings Islands<br>60–120 m | 251–280 × 11–19<br>(272 × 16) | 82–145 × 5–8<br>(120 × 6) |
| East of North Cape<br>110 m | 240–276 × 10–18<br>(265 × 16) | 76–130 × 4.6–8<br>(115 × 5) |

### **Petrosia hebes** Lendenfeld (Plate 9, d–f)

*Petrosia hebes* Lendenfeld, 1888, p. 80.
*Petrosia hebes* Whitelegge, 1902, p. 282.
*Petrosia hebes* Hallmann, 1914, p. 335.

MATERIAL EXAMINED: Poor Knights Islands, 20 m; Mayor Island, 4 m; Cape Kari Kari, 80 m.

DESCRIPTION: A solid hemispherical sponge which in deeper subtidal locations has a thick-walled vase shape.

DIMENSIONS: Massive specimen, 4.9 cm long; 4.2 cm wide; 2.3 cm high. Vase-shaped specimens, 6.0–11.0 cm high; 5.0–13.0 cm wide; wall 1.2–2.5 cm thick.

COLOUR: In life, reddish mauve (r-RP 4/4) exterior, cream interior; in spirit, pale yellowish brown (r-Y 7/4 – r-Y 6/4).

TEXTURE: Stony, brittle, interior rather crumbly.

SURFACE: The surface is smooth, irregular, and under 15 × magnification appears uniformly porous. No oscules are visible.

SKELETON: The skeleton conforms closely with the descriptions given by Hallmann (1914) and Whitelegge (1902). Both ectosome and endosome are reticulate. In the endosome the fibres parallel to the surface are well defined. The ectosomal reticulum is very regular, composed of large oxeas in multispicular fibres 80–130 μ in diameter with roughly circular meshes up to 400 μ diameter. A small amount of spongin is present.

SPICULES

*Megascleres:* (a) Oxeas of three sizes –

(i) Large, stout, slightly curved and evenly tapered. These are the structural spicules of both ectosomal and endosomal fibres.

(ii) Slightly shorter than (i), very fine, occurring chiefly interstitially and in the dermis.

(iii) Very small, stout, strongly curved, very abundant in the endosomal fibres.

(b) Styles of identical form to the larger oxeas, but not frequent.

(c) Strongyles of three sizes. Except for the strongylote condition, these are identical in shape and distribution to the oxeas. The larger strongyles are relatively abundant, the smaller extremely abundant.

Spicule dimensions of *Petrosia hebes* from Poor Knights Islands, 20 m.

| *Spicule type* | *Size* ( μ) |
|---|---|
| Oxeas (large) | 251–331 × 16–19<br>(301 × 17) |
| Oxeas (fine) | 125–189 × 3<br>(172 × 3) |
| Oxeas (small) | 60–86 × 10–12<br>(78 × 11) |
| Strongyles (large) | 246–326 × 16–18<br>(308 × 17) |
| Strongyles (fine) | 110–164 × 3<br>(142 × 3) |
| Strongyles (small) | 35–69 × 9–11.5<br>(49 × 10) |
| Styles | 260–280 × 16<br>(268 × 16) |

REMARKS: Whitelegge (1902) drew attention to the deficiencies in Lendenfeld's original description of the spiculation of *Petrosia hebes* and Hallmann (1914) gave a relatively detailed re-description of the species. The New Zealand specimens are very close to those from Australia in all skeletal characters; the only difference is in overall form. The New Zealand specimens are often vase-shaped while the type specimen is massive with digitate extensions. Without more detailed knowledge of how form is affected by habitat it would be unwise to distinguish specifically between these sponges on this basis alone.

DISTRIBUTION: Australian east coast (Port Jackson); New Zealand (Poor Knights Islands, Mayor Island, Cape Kari Kari).

## **Xestospongia** de Laubenfels, 1932

*Schmidtia* Balsamo-Crivelli, 1863
*Neopetrosia* de Laubenfels, 1949

Nepheliospongiidae with no special dermal skeleton and only oxeas as spicules; these are chiefly of a single size class. The skeleton is a reticulation of spicule fibres, but in some cases this pattern may be obscured by the accumulation of isolated spicules in the interstices of the network.

TYPE SPECIES: *Haliclona diprosopia* de Laubenfels, 1930

REMARKS: Nothing needs to be added to Bergquist's (1965) review of the taxonomic position of *Xestospongia* and *Neopetrosia* in which she synonymised the two genera.

### **Xestospongia coralloides** (Dendy) (Plates 10, f; 11, a)

*Petrosia coralloides* Dendy, 1924, p. 324.
*Xestospongia coralloides* de Laubenfels, 1932, p. 116.

MATERIAL EXAMINED: North of Cape Kari Kari, 80 m; Three Kings Islands, 60–120 m.

DESCRIPTION: Two pieces of this sponge were collected – they are curved lamellae which show the characteristic feature of this species, a perforated oscular surface and a smooth nonoscular surface in which pores are visible.

DIMENSIONS: The larger piece is 10 × 7 cm, with a thickness of 0.5–1.0 cm.

COLOUR: In life, fawn (r—Y 8/6); in spirit, identical.

TEXTURE: Hard and brittle.

SURFACE: The nonoscular surface is smooth, glabrous, and covered by a transparent dermal membrane in which the pores are visible to the naked eye. The oscular surface has 1–3 mm diameter pores scattered over the entire surface at a distance of 2–3 mm apart. The oscules are flush with the surface, and most are simple in construction. They are fed by only one exhalant canal. The dermal membrane of this surface is clearly visible at the margins of the oscules where it operates as a sphincter.

SKELETON: This is a network of multispicular fibres and individual connecting spicules. The basic reticulation is rectangular, but in most places the skeleton has an irregular appearance due to the accumulation of isolated spicules. Numerous aquiferous canals traverse the sponge. At the surface the spicule density is reduced, and the dermal membrane is supported on spicules oriented in the vertical plane.

SPICULES

*Megascleres:* Oxeas, straight or slightly curved, abruptly pointed. Dimensions are 187-215 (199) × 8 μ.

REMARKS: The spicules of this specimen are considerably smaller than those of the type, quoted by Dendy (1924) as being 250 × 16 μ. However, in every other feature this specimen corresponds with Dendy's description.

DISTRIBUTION: North of Cape Kari Kari, 80 m; Three Kings Islands, 60–120 m.

### **Xestospongia novaezealandiae** n.sp. (Plate 10, a, b)

HOLOTYPE National Museum, Wellington. Por. 86.

MATERIAL EXAMINED: Menzies Bay, 20 m; Little Barrier Island, 40 m (holotype).

DESCRIPTION: The specimens have an erect massive but irregular form arising in the case of the holotype from a carrier shell (*Xenophora neozelanica).* The specimen from Menzies Bay is broken; it is more regular than the holotype, but could well represent the upper part of a specimen with similar base of attachment.

DIMENSIONS: *see* table below.

COLOUR: In life, light yellow (r-Y 8/6), to dull orange-brown (Y-R-Y 6/6); in spirit, yellowish brown (Y-R-Y 5/4).

TEXTURE: Stony.

SURFACE: Smooth, under low magnification showing plainly the triangular to rounded multispicular meshes of the dermal skeleton. The oscules are scattered irregularly over the surface, they are multiple structures, each one receiving at least three large exhalant canals immediately below the surface.

SKELETON: This is an irregular network of spicule tracts, with wide meshes between them. Interstitial, individual spicules are present, but not a common feature. Spongin is present in small amounts investing the tracts and the width of these varies considerably. The main ascending columns are 30–40 spicules thick (200–270 μ) and the more or less horizontal secondary tracts can be composed of as few as 2–3 spicules (48–90 μ). The dermal skeleton is tangential, composed of identical oxeas to those of the endosome and arranged as a reticulum.

SPICULES

*Megascleres:* Oxeas, usually slightly curved, but may be straight and sharply pointed. Dimensions: 240–314 × 10–18 μ (274 × 16 μ).

REMARKS: In habit and spicule dimensions *X. novaezealandiae* is quite distinct among species assigned to *Xestospongia.* Also the rarity of spicules which are not incorporated in fibres is distinctive.

## Family OCEANAPIIDAE van Soest

Nepheliospongida with a dense tangential ectosomal skeleton frequently in the form of a spicule crust. Main skeleton a dense irregular reticulation of single spicules augmented by spicule tracts often without fixed orientation to the surface. The dominance of the unaligned spicules produces an overall pulpy appearance in the endosome of the living sponge. Spongin can be prominent in the endosomal tracts. Megascleres oxeas or strongyles; microscleres sigmas and/or toxas.

### **Oceanapia** Norman, 1869

*Rhizochalina* Schmidt, 1870
*Phloeodictyon* Carter, 1882

DIAGNOSIS: Oceanapiidae in which the ectosomal bark-like skeleton is reinforced by spongin, this trend being particularly evident in the fistule walls. Megascleres oxeas; microscleres, when present, sigmas or toxas.

TYPE SPECIES: *Oceanapia jeffreysi* Bowerbank, 1866

REMARKS: Following Burton (1934) the genera *Oceanapia, Phloeodictyon* and *Rhizochalina* are considered synonymous. This implies acceptance of Burton's view that presence or absence of microscleres is an insufficient basis for generic distinction. The only reason for upholding this view in respect of the Oceanapiidae, and the reverse view in the Adociidae, is that there are many fewer species involved in the Oceanapiidae and they can be separated on skeletal characters. This is not true of the Adociidae. It must be stressed that the Oceanapiidae as here recognised are quite distinct from the Coelosphaeridae, a group which Burton did not recognise (*see* Dendy 1921; Bergquist 1965). The fact that some members of both groups are spherical, fistulose with bark-like ectosome masks the very obvious difference in skeletal organization and spiculation.

### ***Oceanapia aberrans** (Dendy) (Plate 11, e)

*Phloeodictyon aberrans* Dendy, 1924, p. 333.
*Rhizochalina aberrans* de Laubenfels, 1936, p. 72.

DISTRIBUTION: Three Kings Islands, 200 m.

### ***Oceanapia arcifera** (Dendy) (Plate 11, d)

*Oceanapia arcifera* Dendy, 1924, p. 332.

REMARKS: The single specimen was dubiously referred to this genus by Dendy. We have not recollected it nor found any later comments on its position.

DISTRIBUTION: Three Kings Islands, 200 m.

Dimensions of *Xestospongia novaezealandiae*

| *Locality* | *Height* | *Width* | *Thickness* | *Oscules* |
|---|---|---|---|---|
| Menzies Bay | 6.0 cm | 7.2 cm | 1.9–3.0 cm | 2.5–9.0 mm |
| Little Barrier Island (holotype) | 15.0 cm | 9.6 cm | 8.0 cm | 4.0–12.0 mm |

### **Oceanapia fistulosum** (Bowerbank) (Plate 11, b, c)

RESTRICTED SYNONYMY:

*Desmacidon fistulosa* Bowerbank, 1874, p. 19.
*Phloeodictyon fistulosum* Dendy, 1905, p. 165.
*Phloeodictyon fistulosum* Dendy, 1924, p. 332.
*Rhizochalina fistulosum* de Laubenfels, 1936, p. 72.
For fuller synonymy *see* Dendy 1905.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m; Bay of Islands, 40 m.

REMARKS: The specimens collected are extremely fragmentary and can add nothing to the descriptions of this sponge. Spicule dimensions are identical to those quoted by Dendy (1924).

DISTRIBUTION: Almost cosmopolitan (Dendy 1921).

## **Vagocia** de Laubenfels, 1936

Oceanapiidae in which the dermal skeleton is a multilayered or single-layered spicule reticulation and the endosomal skeleton has strong spicule fibres arranged into intertwined anastomosing tracts. Between spicule tracts there is an interstitial spicule reticulation without clear orientation. The sponges are all thin-walled fans or cylindrical structures. Megascleres oxeas, microscleres sigmas and/or toxas.

TYPE SPECIES: *Gellius arcuarius* Topsent, 1913, p. 638.

### **Vagocia imperialis** (Dendy) (Plate 10, c–e)

*Gellius imperialis* Dendy, 1924, p. 322, pl. IX, fig. 1.
*Calyx imperialis* Burton, 1932, p. 267.
*Vagocia imperialis* de Laubenfels, 1936, p. 133.

MATERIAL EXAMINED: Three Kings Islands, 60–120 m.

DESCRIPTION: Two specimens and fragments of another were obtained. Both specimens are identical in form. They are erect, stalked cup-shaped sponges, thin and papery when dry. The sponge differs from the description given by Dendy in that the stout ridges arising from the stalk and supporting the lamella are without oscules and pass into the outer, exhalant surface of the sponge. This surface is marked by concentric ribs which are interconnected by irregular radial ridges. The oscules are situated in small irregular elevations between the radial ridges and pores occur on the smooth regions between them. The inner surface of the lamella is inhalant and smooth. It is covered uniformly with small pores. Dendy's specimen was damaged and it appears from his illustration and description that he has reconstructed the sponge inside out.

DIMENSIONS: *see* table below.

COLOUR: In life, straw colour (Y 6/4); in spirit, identical.

TEXTURE: Fibrous and brittle when dry, tough when wet.

SKELETON: The endosomal skeleton is a loose irregular weft of anastomosing spicule fibres ranging from 0.1 to 1.0 mm in diameter and frequently twined around each other to form complex bundles. The dermal skeleton is different on the two surfaces. On the outer (exhalant) surface it is a thin irregular reticulation of oxeas, two to three spicules deep with one or two spicules to each arm of the reticulum. On the inner surface there is a uniformly unispicular reticulation with roughly triangular meshes. At intervals the thick intertwined endosomal spicule tracts are visible as ridges showing through the overlying dermal spicule reticulation. Spongin is present in extremely low amount in the endosomal region. Many interstitial oxeas occur in the region between the anastomosing endosomal fibres.

SPICULES

*Megascleres:* Oxeas, smooth, stout, straight or slightly curved spicules, evenly tapered at both ends.

*Microscleres:* Sigmas, small, slender, C-shaped spicules, rarely contort.

Spicule dimensions of *Vagocia imperialis*

| *Locality and Author* | *Oxeas* (μ) | *Sigmas* (μ) |
|---|---|---|
| Three Kings Islands, 200 m<br>Dendy (holotype) | 240 × 16 | 20 |
| Three Kings Islands, 60–120 m | 154–264 × 8.0–17.0<br>(217 × 12) | 17–32<br>(21) |

REMARKS: Burton (1932) transferred *G. imperialis* Dendy to *Calyx* Vosmaer. *G. arcuarius* Topsent was transferred also and was demonstrated to be a species in which toxas could be present or absent. On the grounds that microsclere content is notoriously variable, Burton held that the fact that *G. imperialis* had sigmas rather than toxas was of no account. De Laubenfels (1936) disagreed with Burton and erected *Vagocia* for three species, *G. kerguelensis* Hentschel, *G. imperialis* Dendy (both with sigmas), and *G. arcuarius* Topsent (with toxas), claiming that the microscleres in all three species were, in fact "raphides curiously altered so as to resemble toxas". This is clearly wrong, the microscleres in the three species under discussion are absolutely typical sigmas and toxas.

De Laubenfels was, however, correct in separating these three species from *Calyx,* which is a massive thick-walled cup-shaded sponge with a compressible texture, smooth surface and well developed isotropic spicule reticulation between the long winding spicule tracts. The genera *Calyx* and *Vagocia* are comparable in possessing spicule tracts rather than having a uniform endosomal spicule reticulation as does *Petrosia,* and in the overall cup-shape.

In fact *Vagocia* is difficult to place between the Nepheliospongiidae and the Oceanapiidae; the endosomal skeletal arrangement is typical of the latter, but the pulpy choanosome and compacted dermal skeleton are lacking.

Dimensions of *Vagocia imperialis*

| *Locality* | *Height* | *Width* | *Width of stalk* | *Thickness of lamella* | *Oscules* |
|---|---|---|---|---|---|
| Three Kings Islands, 60–120 m | 22.0–30.0 cm | 18.0–24.0 cm | 3.5–6.0 cm | 4.0–4.5 mm | 0.8–2.0 mm |

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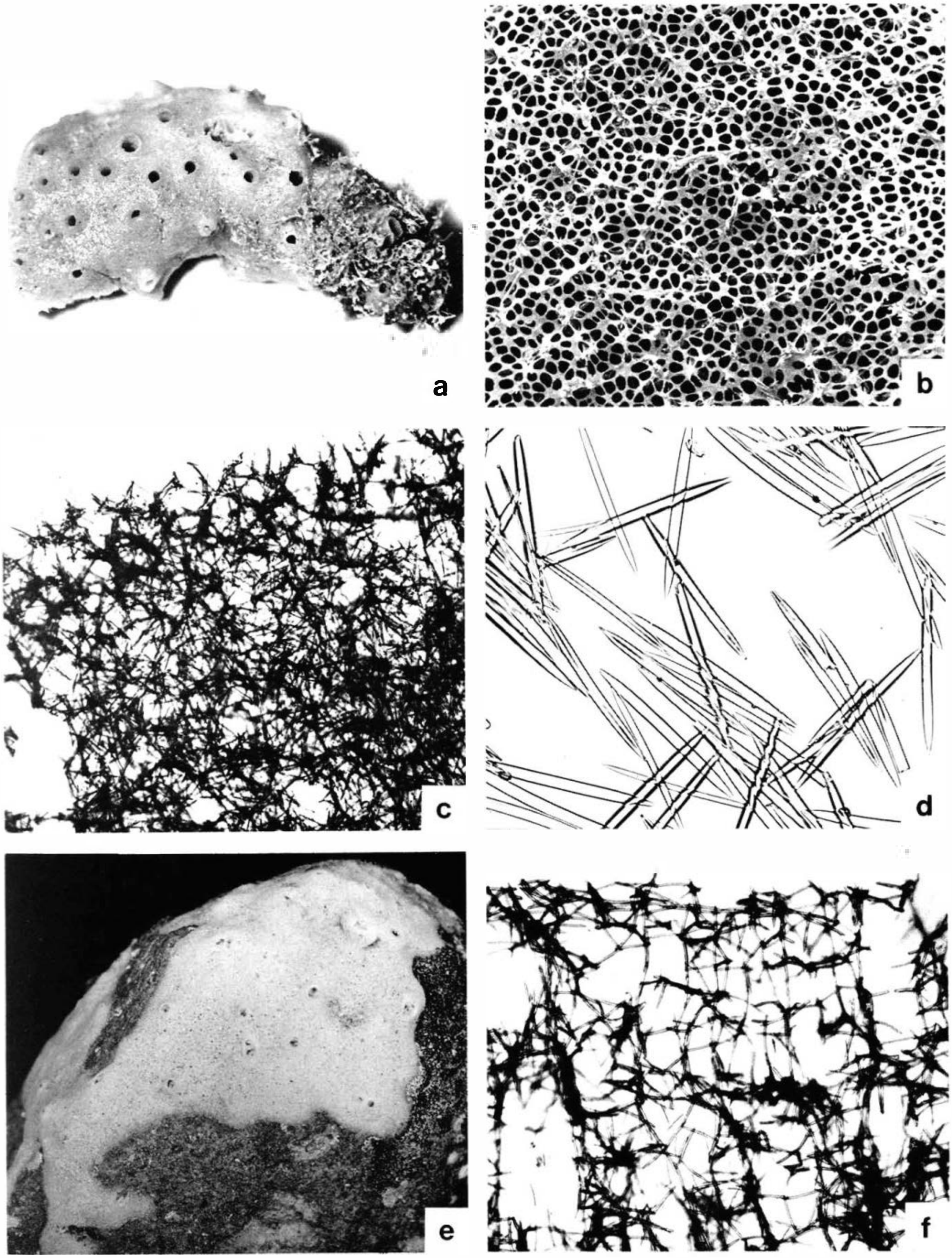
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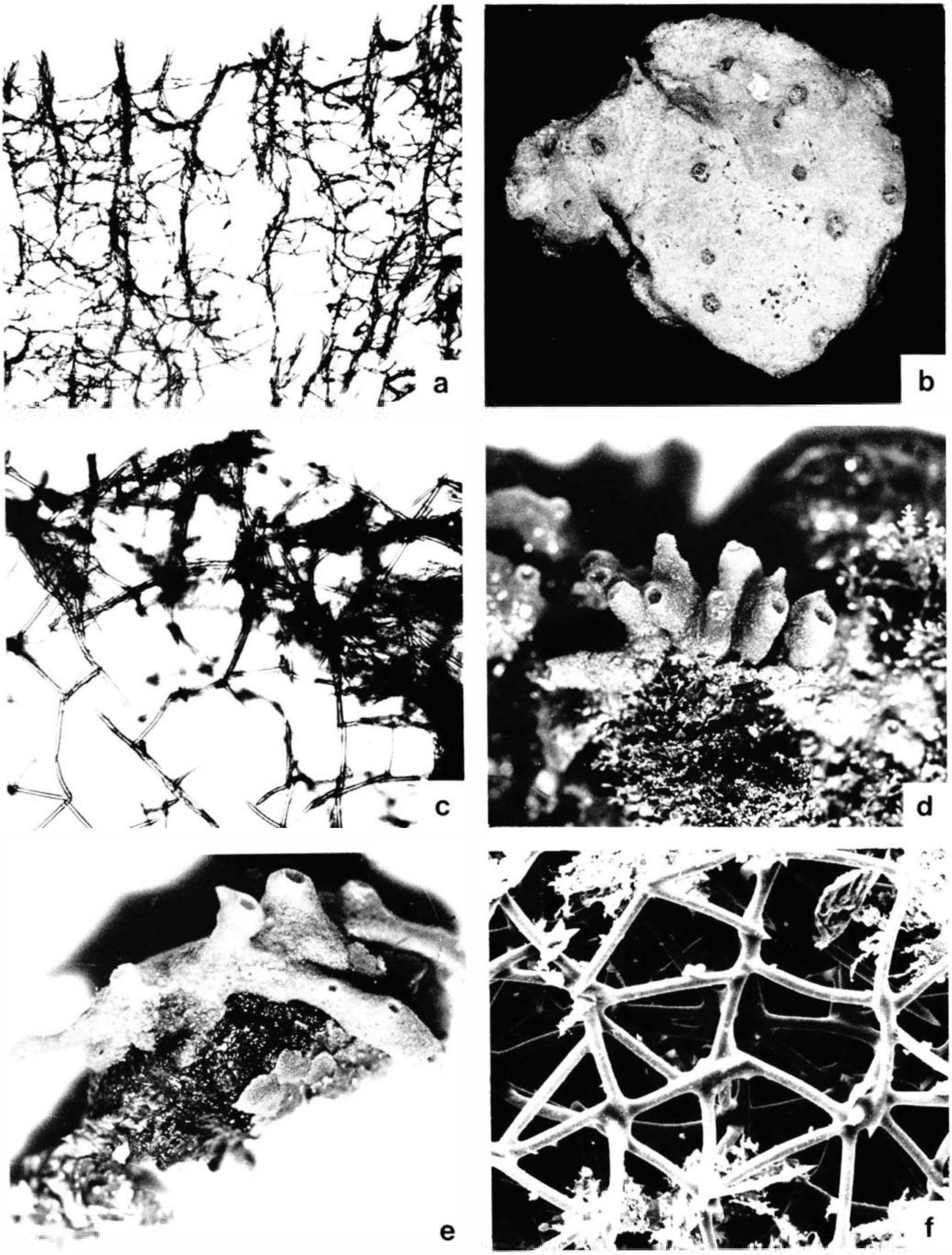
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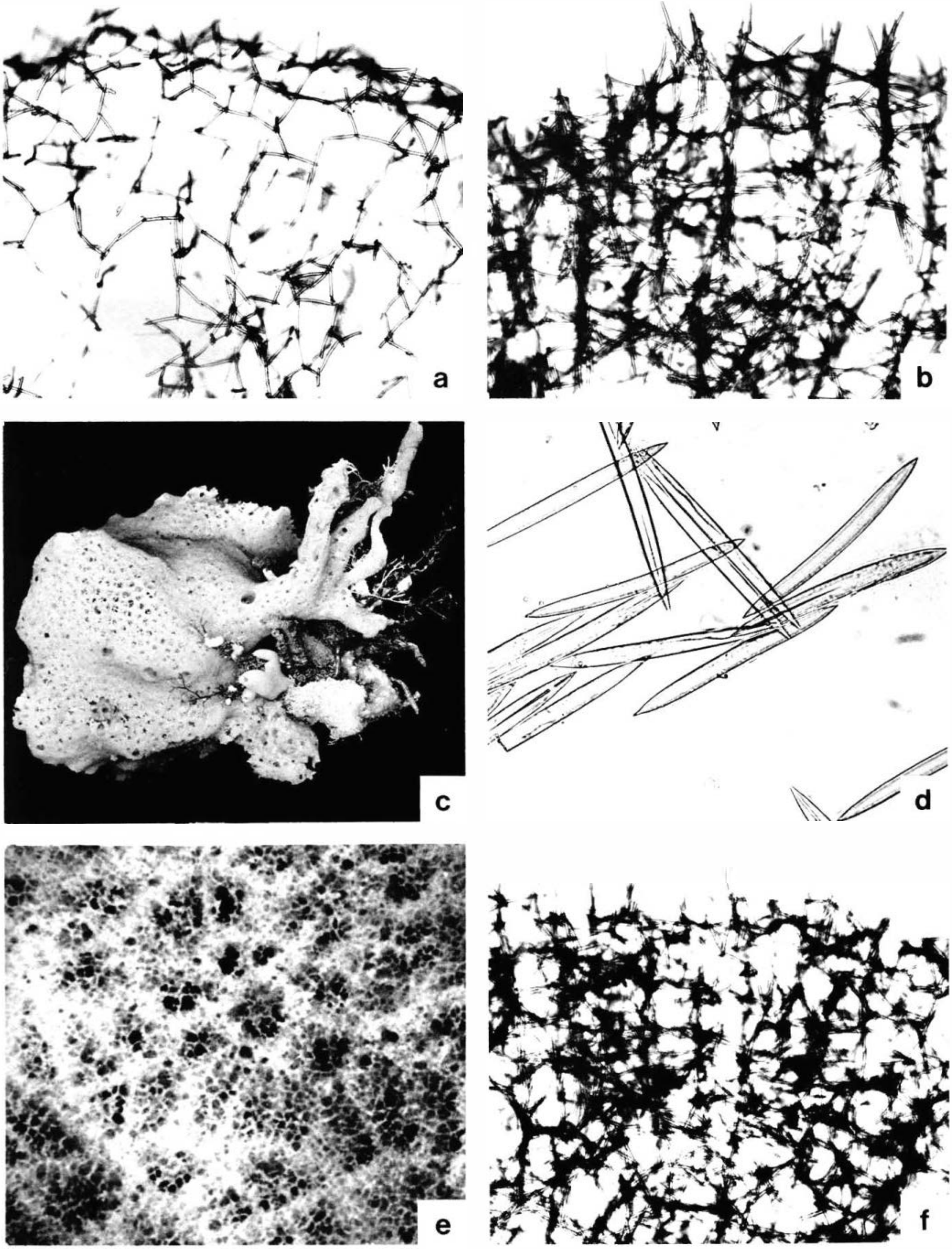
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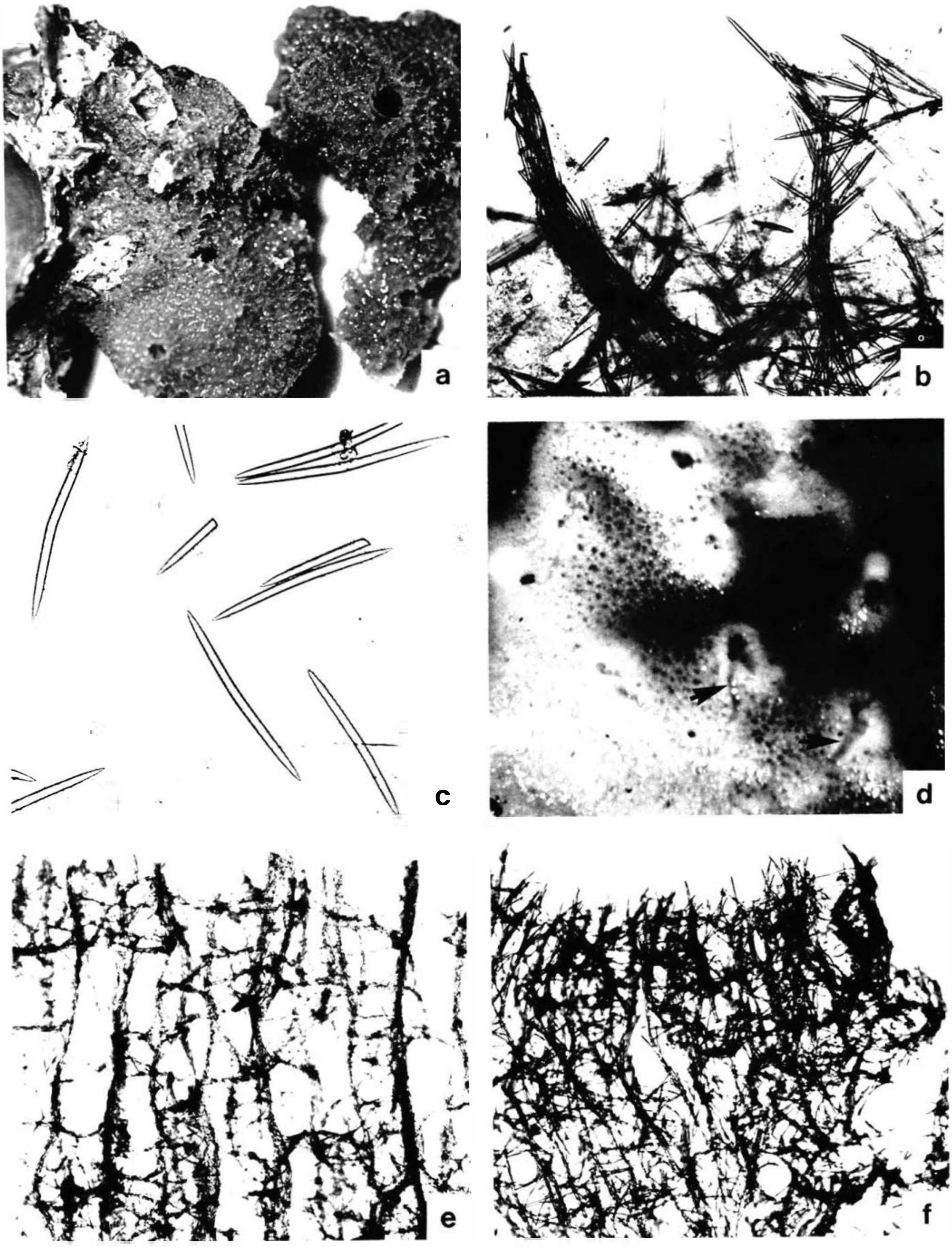
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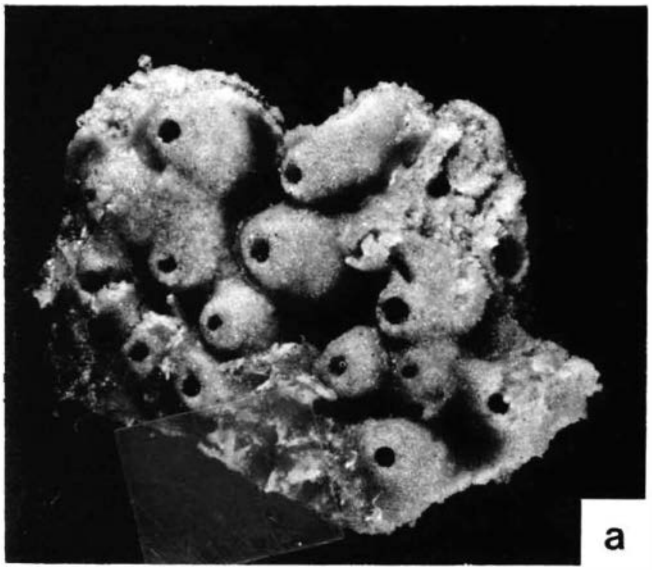
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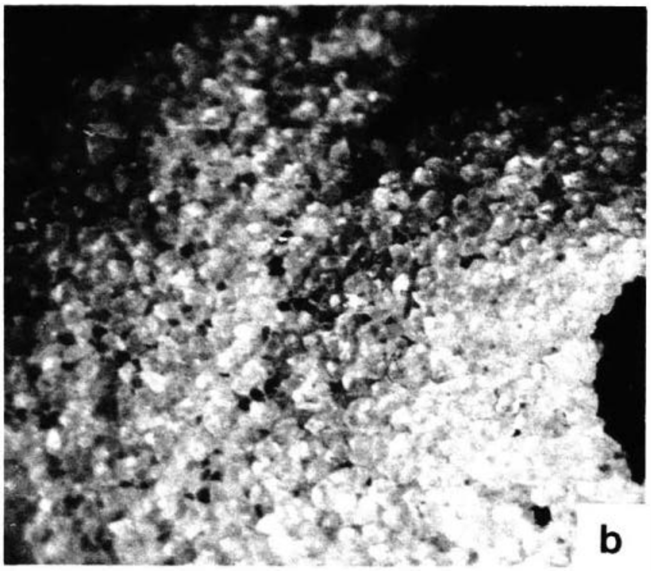
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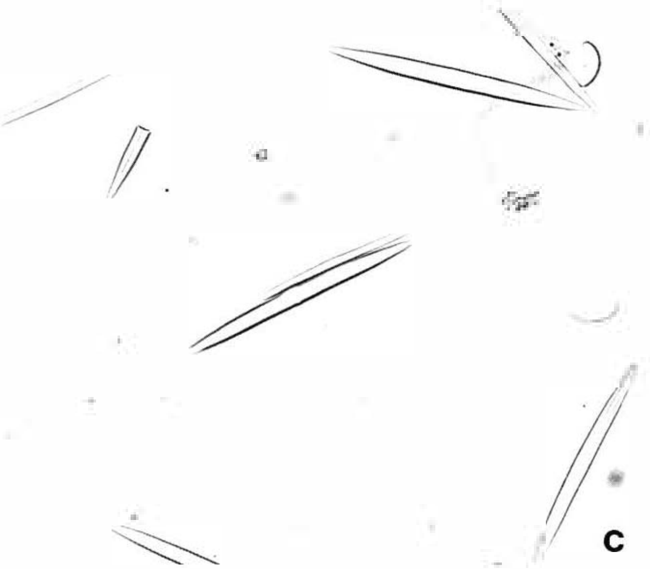
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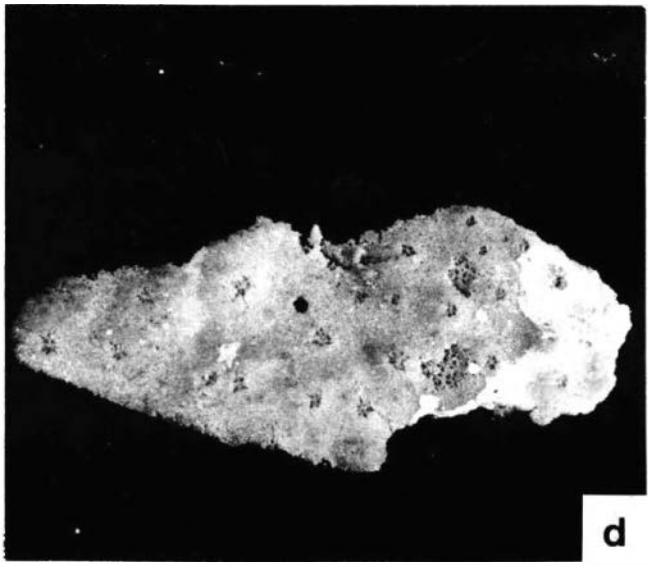
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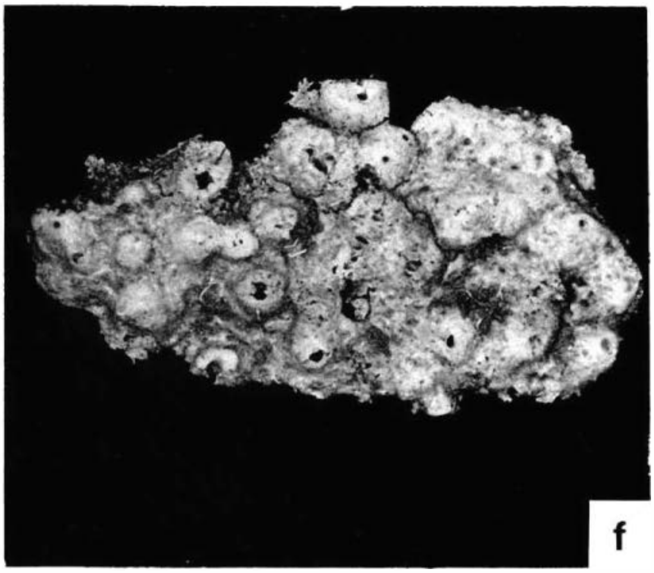
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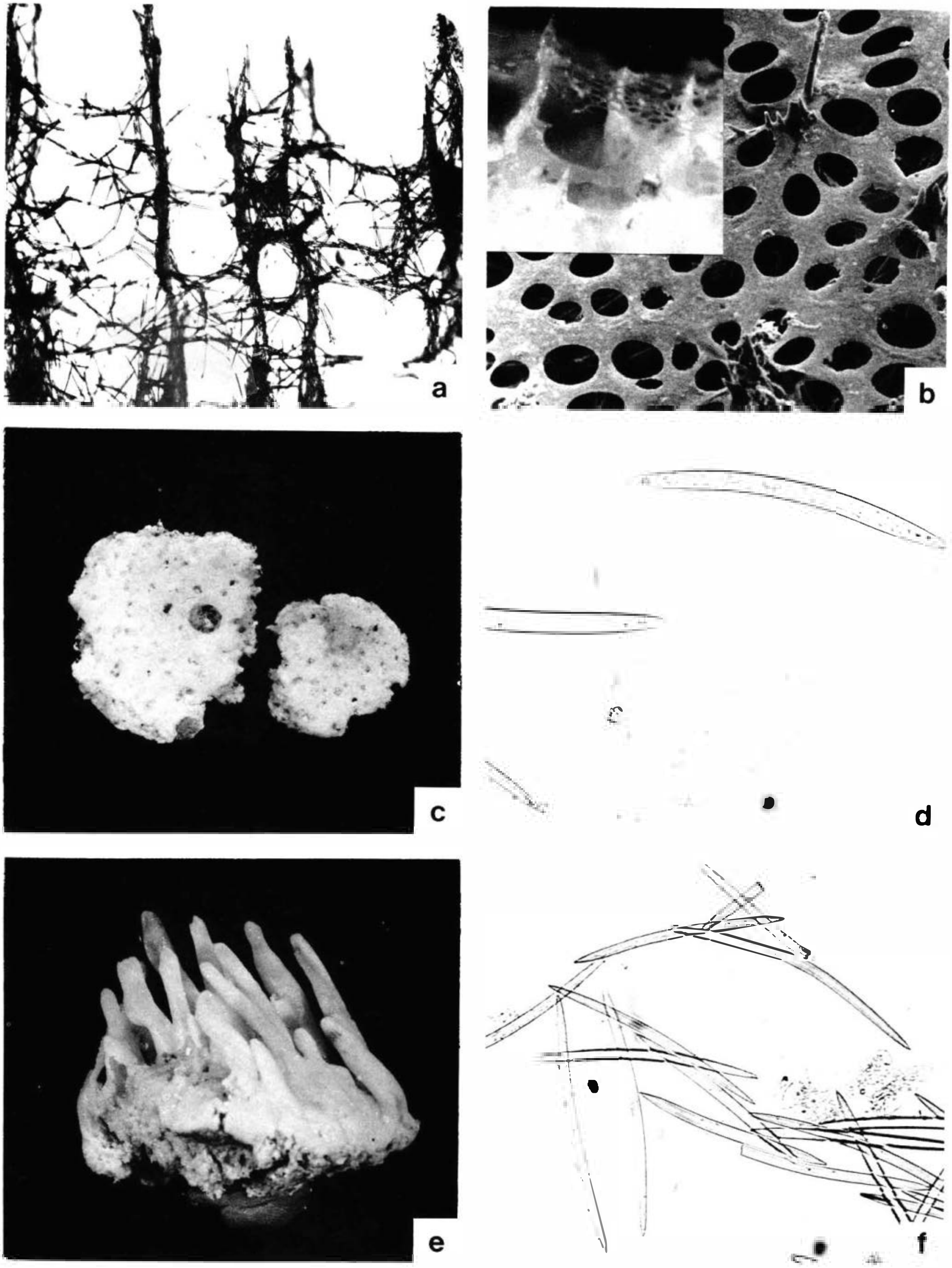
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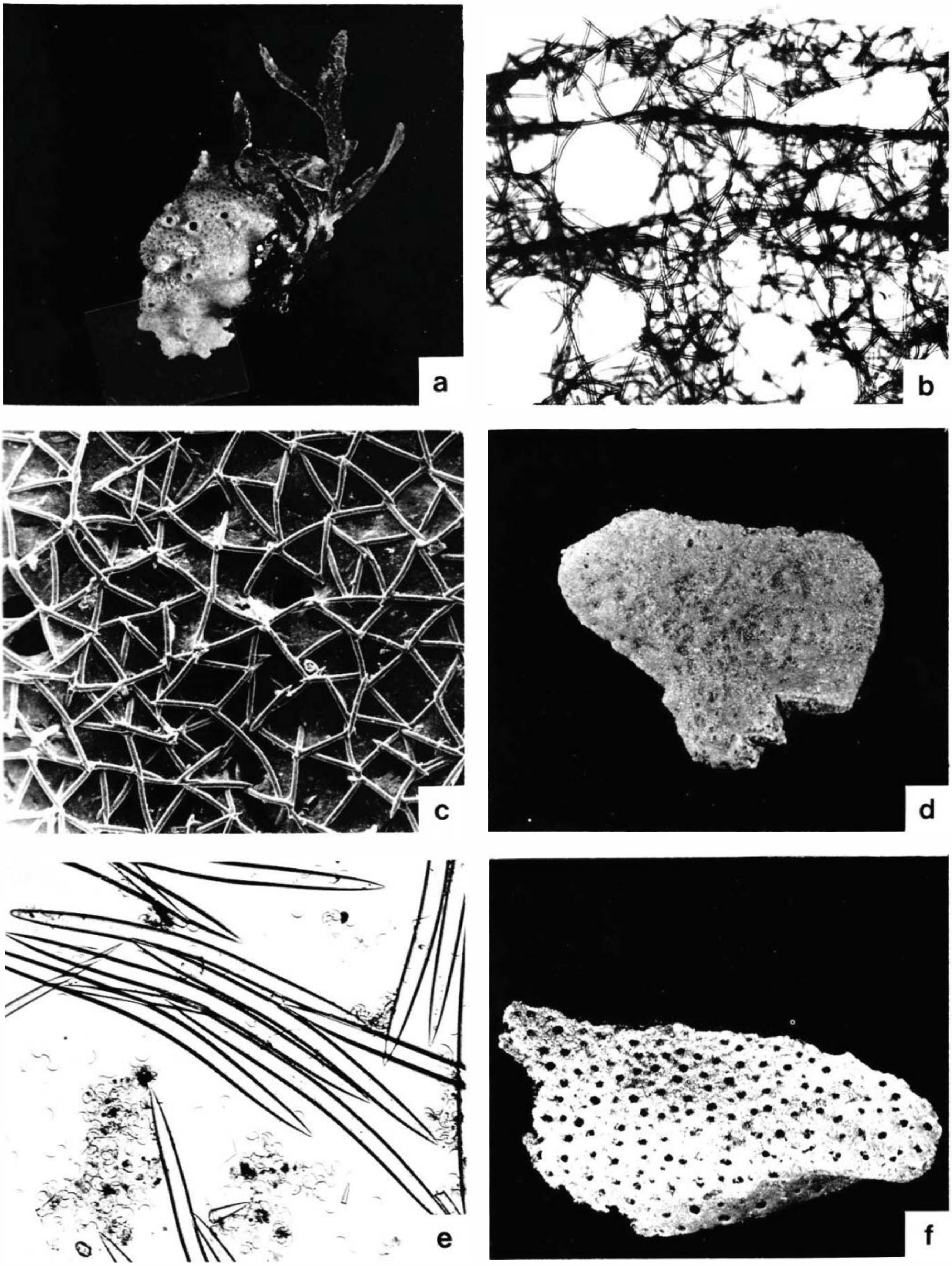
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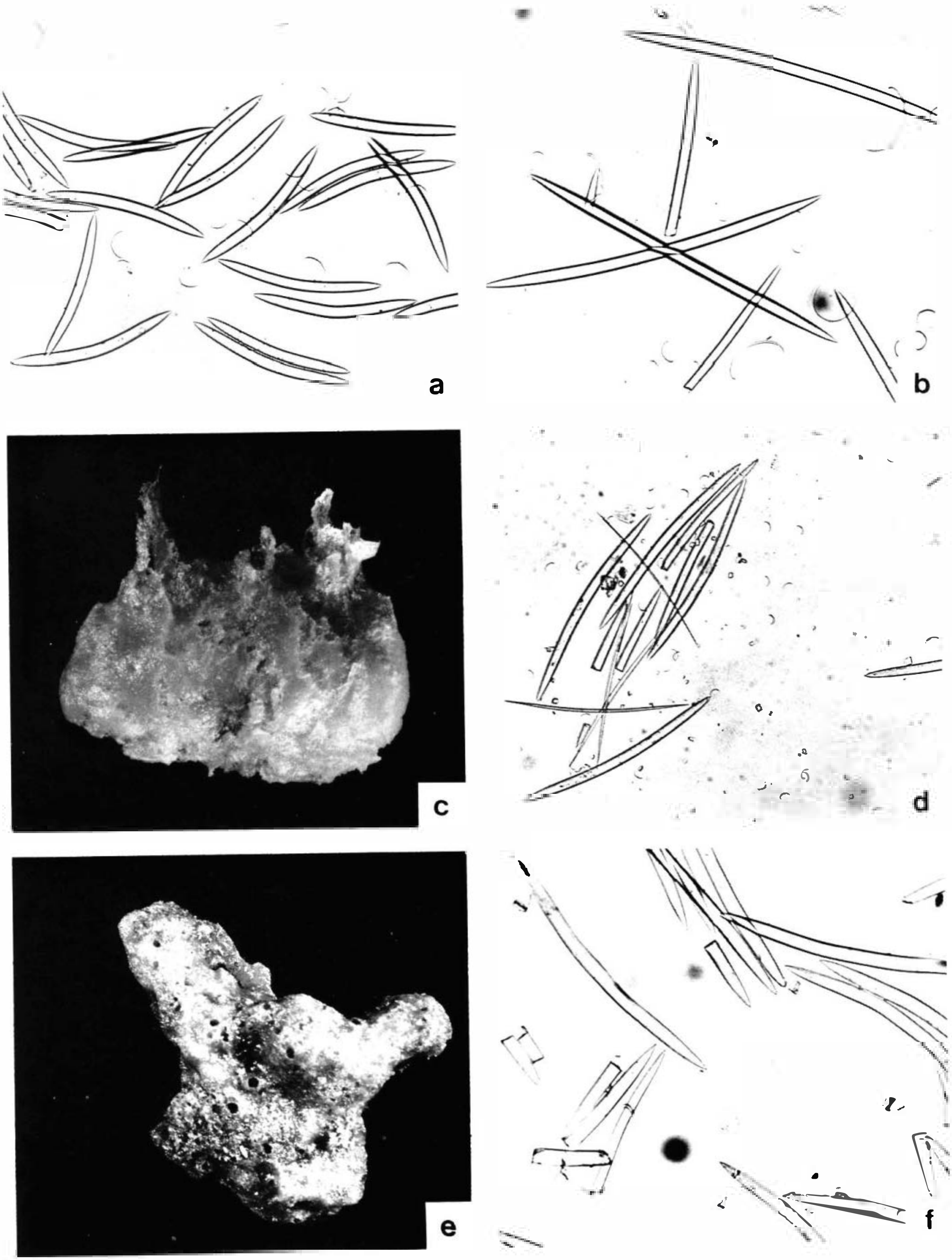
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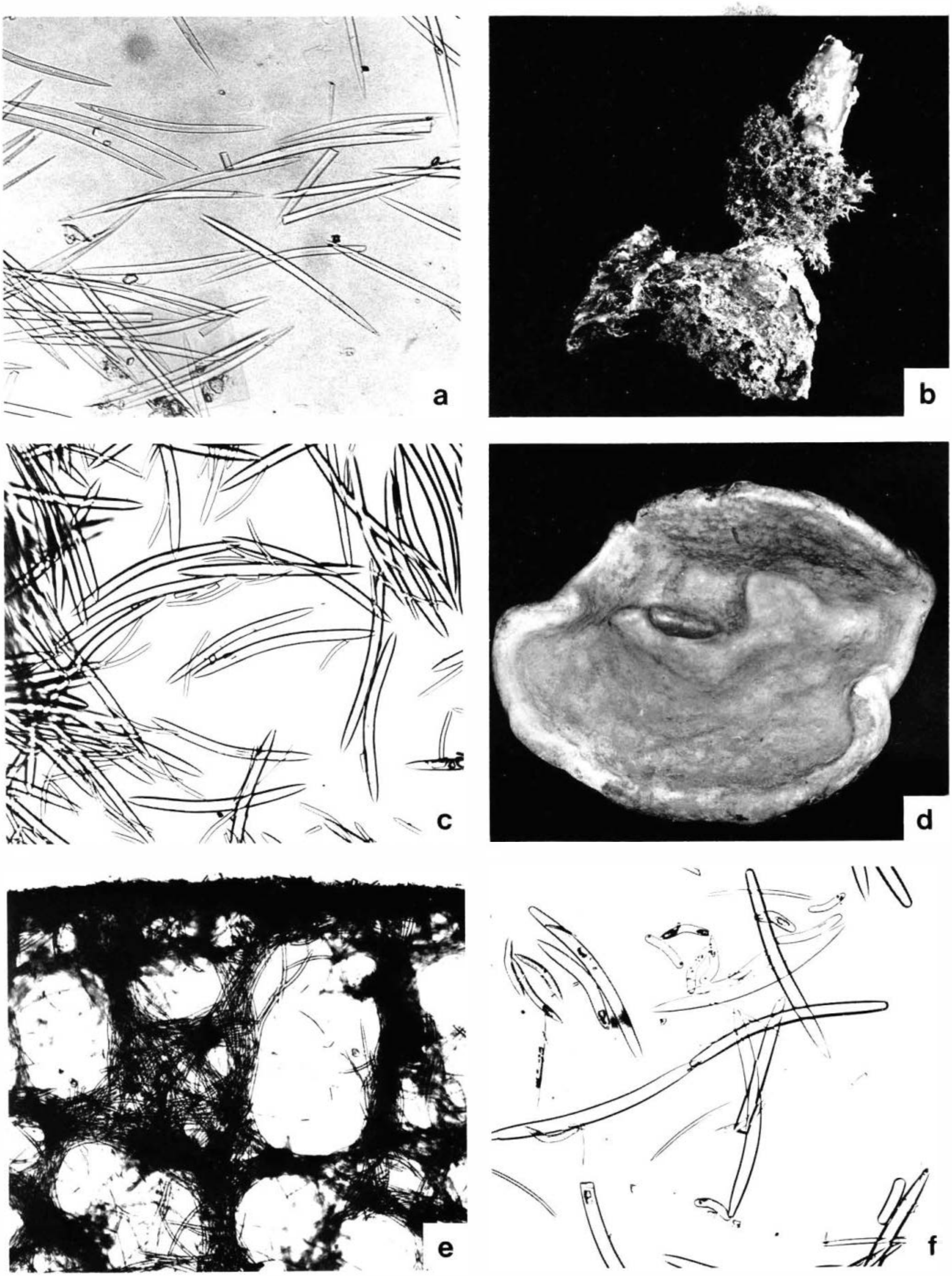
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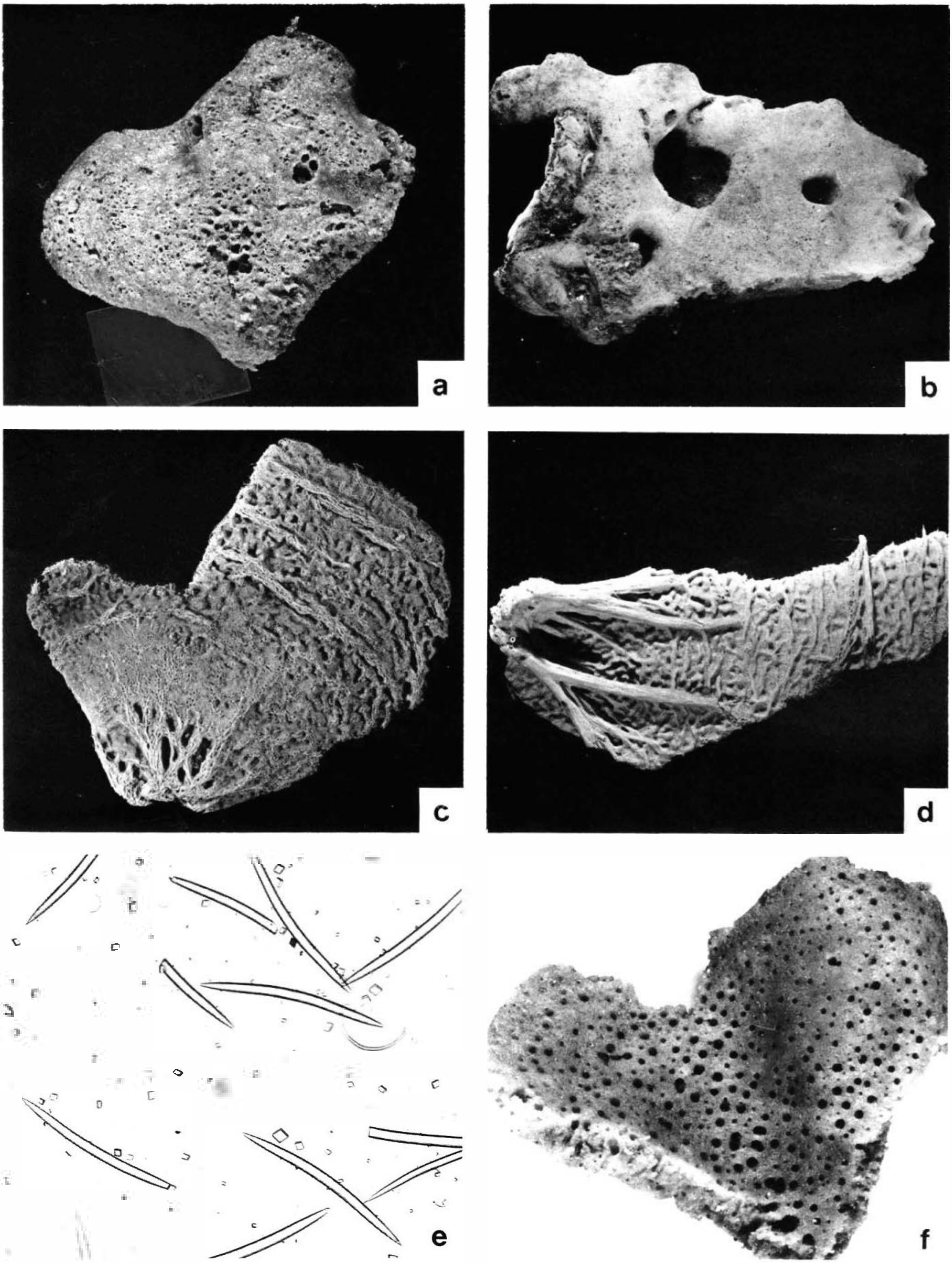
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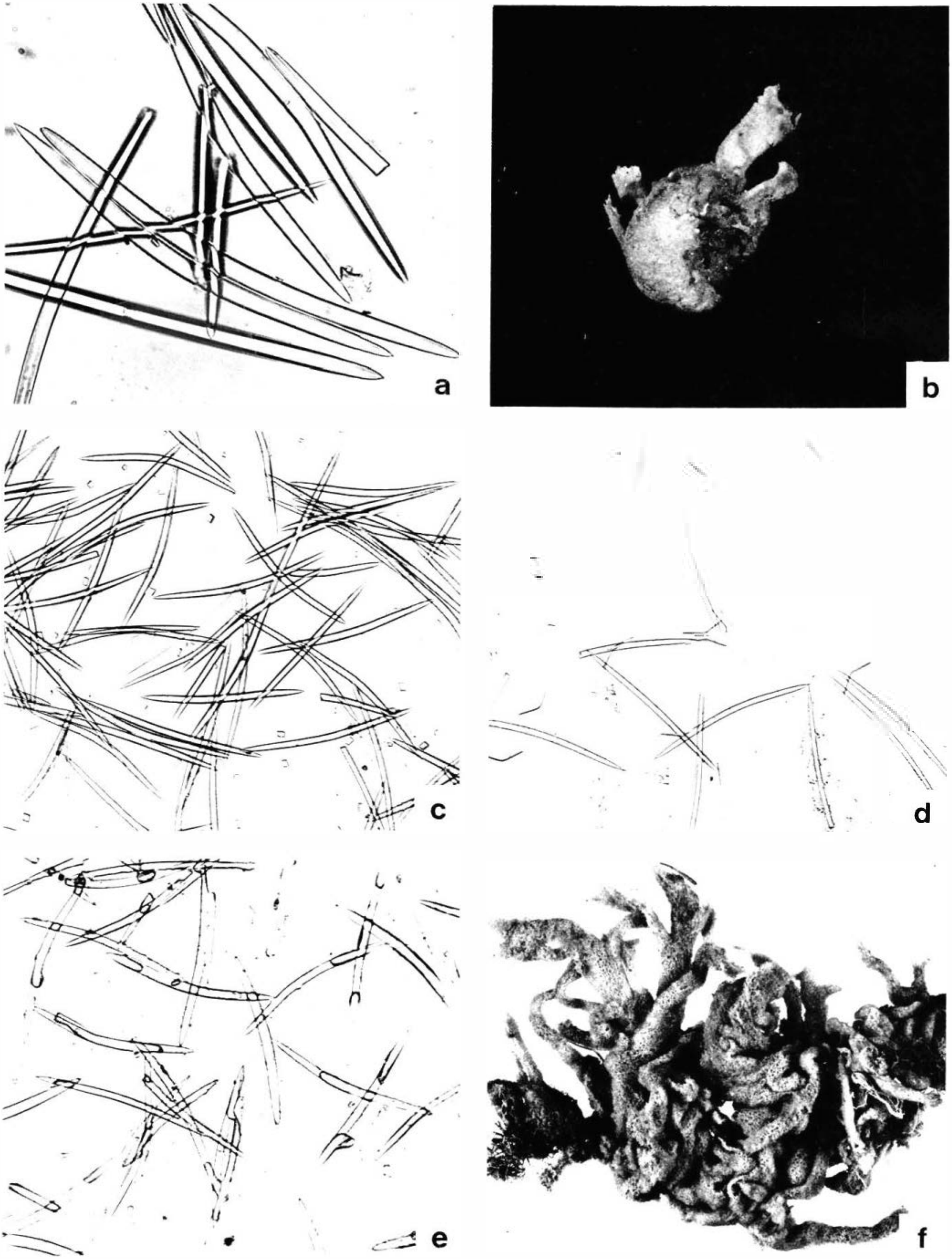
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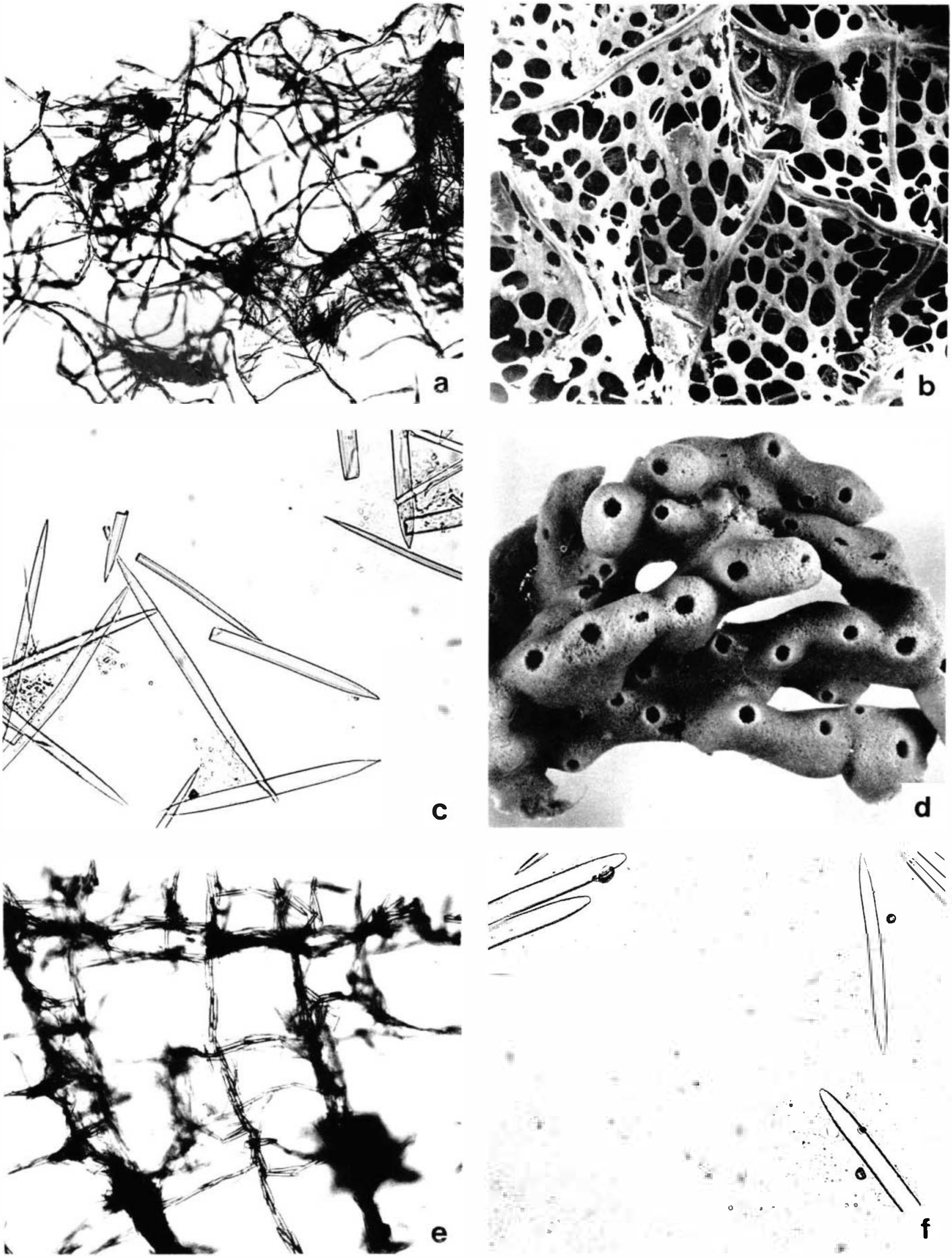
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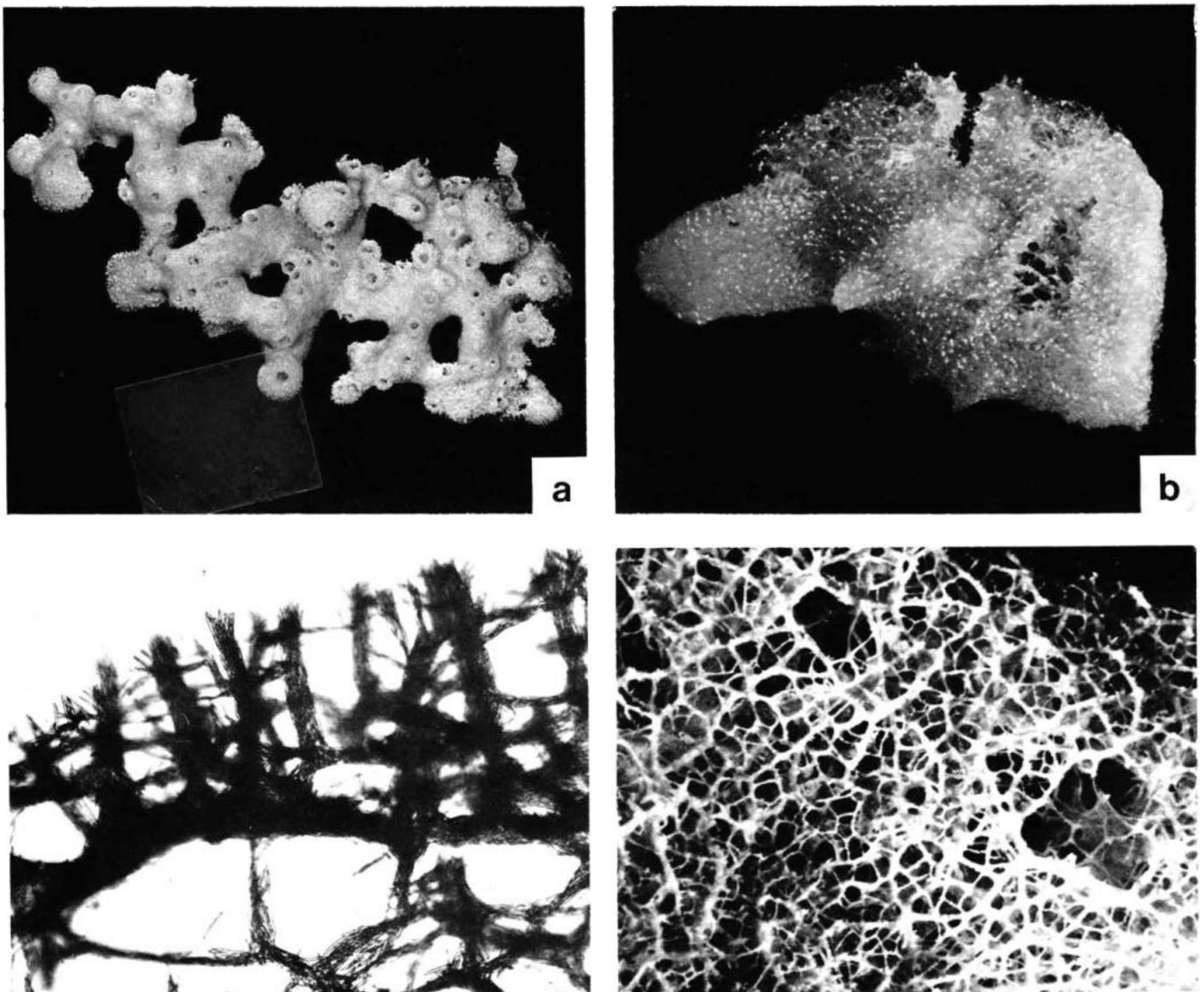
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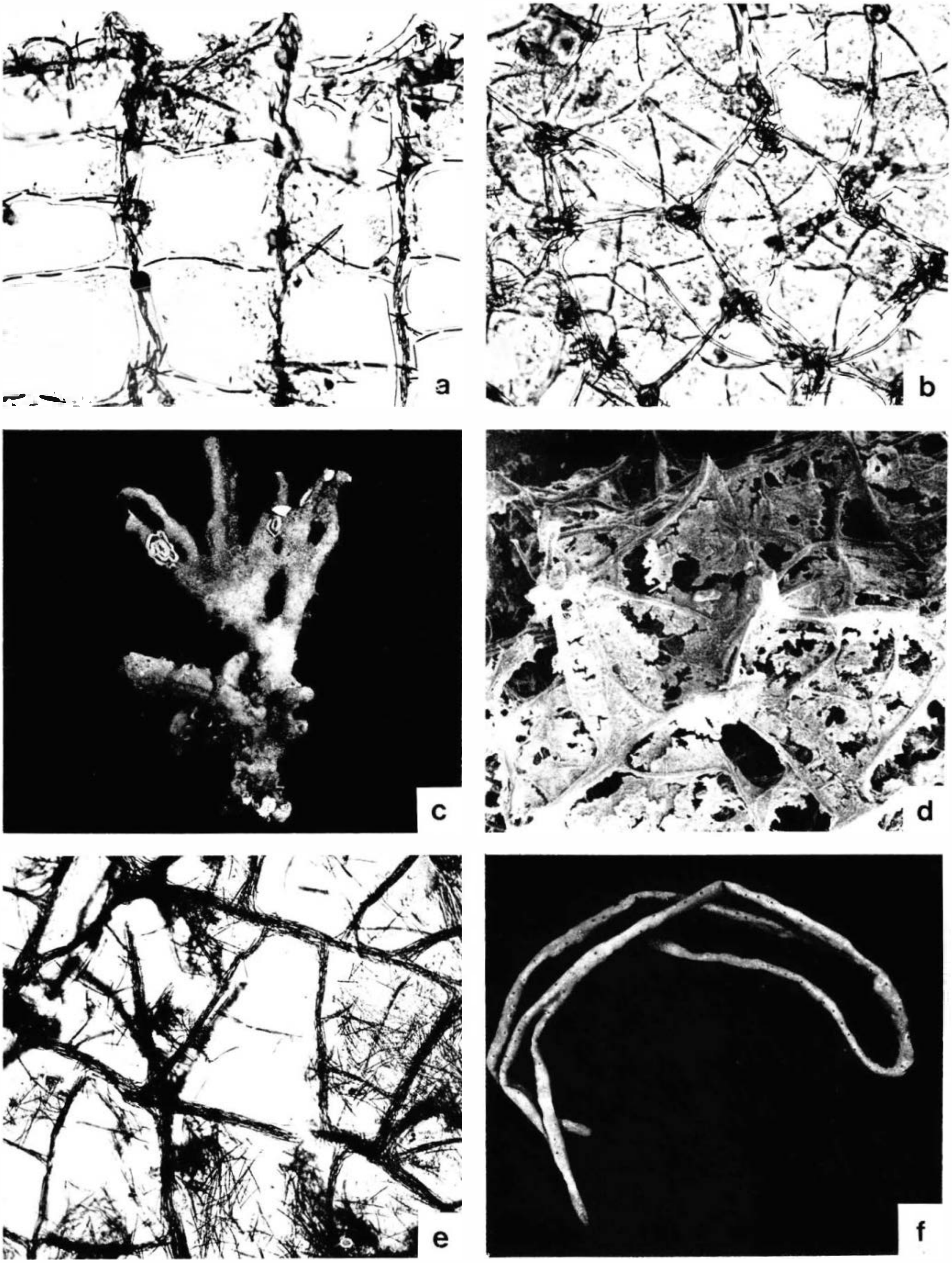
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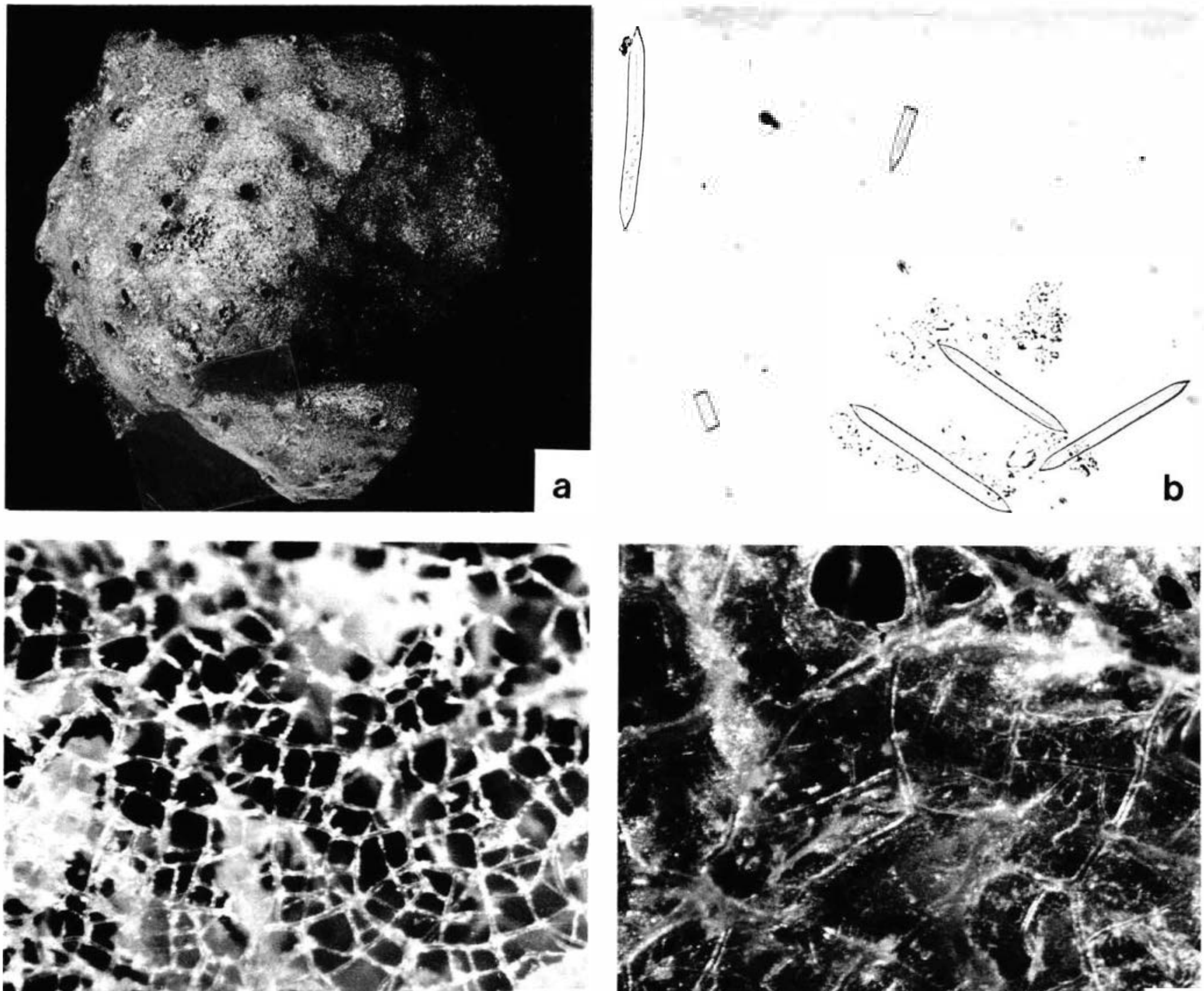
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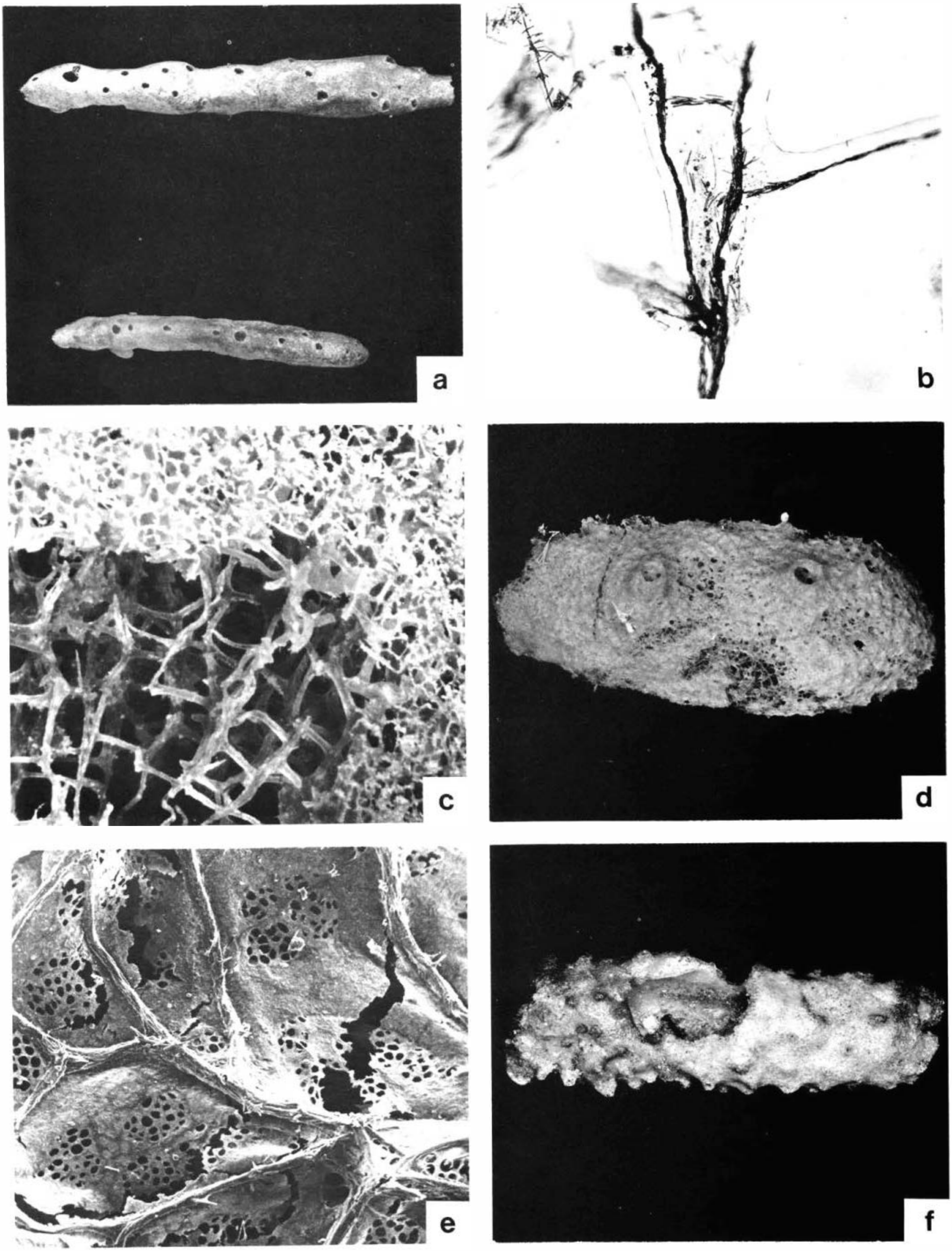
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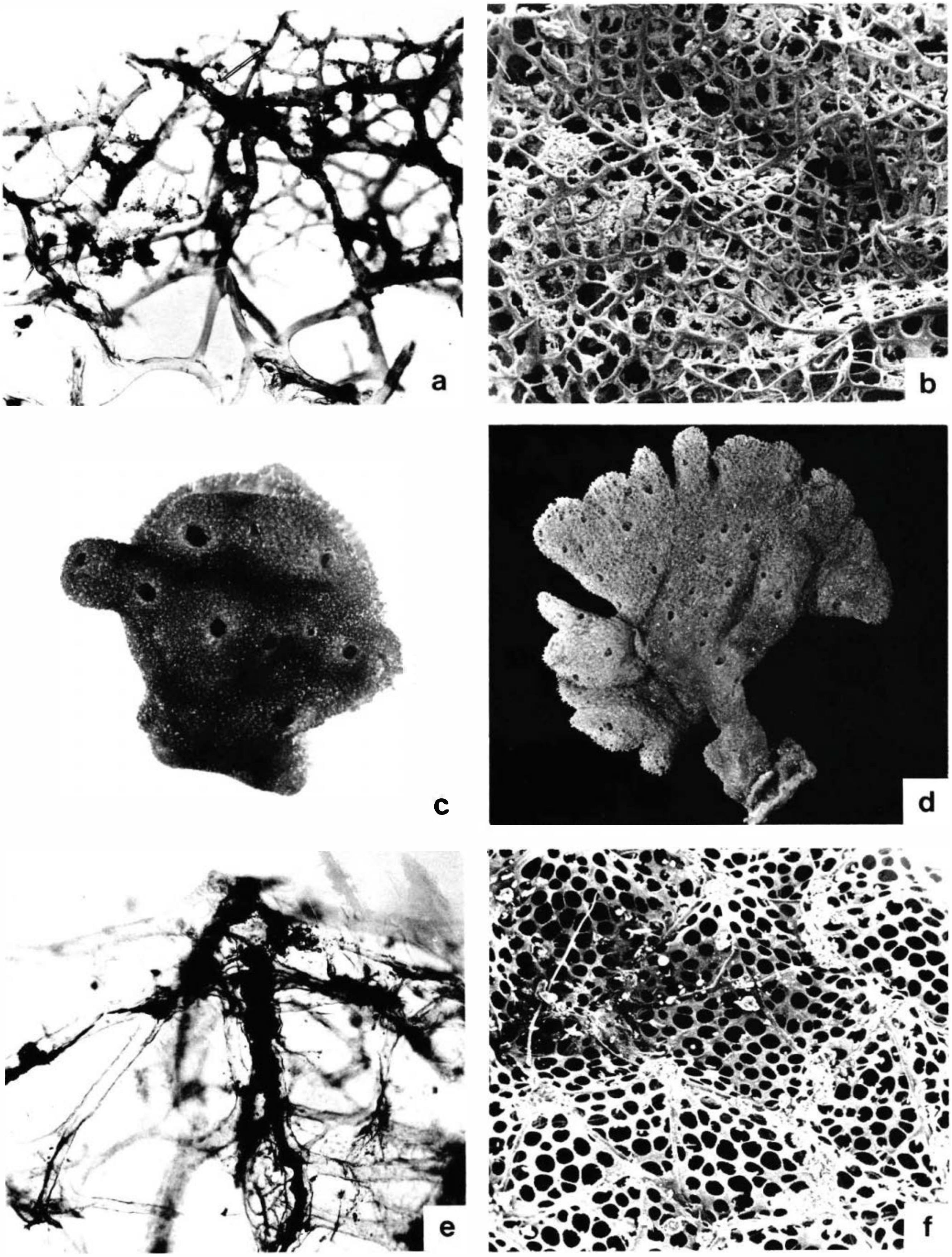

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