Two new genera and five new species of the "*Cacospongia*" group (Porifera, Demospongiae, Dictyoceratida)

Steve de C. COOK
Marine Systematics Research Group, School of Biological Sciences,
University of Auckland, Private Bag 92019, Auckland (New Zealand)
s.cook@iname.com

Patricia R. BERGQUIST
Department of Anatomy, School of Medicine,
University of Auckland, Private Bag 92019, Auckland (New Zealand)
pr.bergquist@auckland.ac.nz

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ABSTRACT
This paper is the fourth in a series revising the taxonomy of New Zealand dictyoceratid sponges (phylum Porifera, class Demospongiae, order Dictyoceratida). In the course of this work the thorectid sponge genus *Cacospongia* Schmidt is redefined and amended to provide a less ambiguous taxon, and to more closely reflect the morphology of the type species *Cacospongia mollior* Schmidt, 1862. A new genus, *Scalarispongia* n. gen., is established for sponges previously assigned to *Cacospongia*, with *Cacospongia scalaris* Schmidt, 1862 designated as the type species. A third genus, *Semitaspongia* n. gen., is proposed to accommodate another group of sponges which are similar to *C. scalaris* Schmidt, but which display consistent morphological differences in their fibre skeleton, and in the deposition of collagen within the mesohyl. Five undescribed species from New Zealand, previously assumed to belong to *Cacospongia*, have been assigned to the genus *Semitaspongia*: *Semitaspongia incompta* n. sp., *S. glebosa* n. sp., *S. nigracorda* n. sp., *S. pulvinata* n. sp. and *S. bactriana* n. sp. The designated type species is *Semitaspongia incompta*. One species in this group of genera has previously been reported from New Zealand, and this is referred to *Cacospongia*.

KEY WORDS
Dictyoceratida,
Thorectidae,
Cacospongia,
Scalarispongia n. gen.,
Semitaspongia n. gen.,
new species,
new genera,
New Zealand,
Porifera,
revision.

RÉSUMÉ

Deux nouveaux genres et cinq nouvelles espèces dans le groupe « Cacospongia *» (Porifera, Demospongiae, Dictyoceratida).*

Cet article est le quatrième d'une série révisant la taxonomie des éponges dictyocératides (phylum Porifera, classe Demospongiae, ordre Dictyoceratida) de Nouvelle-Zélande. Dans ce travail, le genre d'éponges thorectides *Cacospongia* Schmidt est redéfini de façon à rendre ce taxon moins ambigu et à mieux tenir compte de la morphologie de l'espèce-type, *Cacospongia mollior* Schmidt, 1862. Le nouveau genre *Scalarispongia* n. gen. est établi pour des éponges préalablement classées dans *Cacospongia*, et *Cacospongia scalaris* Schmidt, 1862 est désigné comme l'espèce-type. Un troisième genre, *Semitaspongia* n. gen., est proposé pour recevoir un autre groupe d'éponges qui sont semblables à *C. scalaris* Schmidt, mais qui montrent des différences morphologiques constantes dans le squelette de fibres et dans le collagène du mésohyle. Cinq espèces non décrites de Nouvelle-Zélande, auparavant présumées appartenir à *Cacospongia*, ont été attribuées à *Semitaspongia* n. gen. : *Semitaspongia incompta* n. sp., *S. glebosa* n. sp., *S. nigracorda* n. sp., *S. pulvinata* n. sp., et *S. bactriana* n. sp. *Semitaspongia incompta* est désignée comme espèce-type. Une espèce de ce groupe de genres a déjà été signalée en Nouvelle-Zélande, et est transférée dans *Cacospongia*.

MOTS CLÉS
Dictyoceratida,
Thorectidae,
Cacospongia,
Scalarispongia n. gen.,
Semitaspongia n. gen.,
espèces nouvelles,
genres nouveaux,
Nouvelle Zélande,
Porifera,
révision.

INTRODUCTION

There are approximately 20 described species attributed to the genus *Cacospongia* worldwide. At least half of these are currently regarded as unrecognizable at the species level (Laubenfels de 1948; Bergquist 1980). This paper was not intended to revise the genus *Cacospongia*, but to address *Cacospongia* with respect to the New Zealand *Cacospongia*-like sponge species.

Cacospongia, as traditionally diagnosed, admits any thorectid sponge with cored primary fibres, uncored secondary fibres, and an unarmoured and finely conulose surface (Bergquist 1980; Desqueyroux-Faúndez & Van Soest 1997). We believe that this generic diagnosis is too loose, and have therefore amended it to more accurately describe the type species *C. mollior* Schmidt, 1862, particularly with respect to its skeletal organization.

The generic assignment of *Cacospongia scalaris* Schmidt, 1862, is also considered, and its affinity to *C. mollior* evaluated. A new genus is erected for this species, based primarily on its skeletal architecture.

A group of thorectid sponges from the temperate water of Australia and New Zealand have cored primary fibres, uncored secondary fibres, and an unarmoured, conulose surface. Though undescribed, these sponges were previously assumed to belong to *Cacospongia*. These species prove not to belong to *Cacospongia*, as defined by *C. mollior*, nor to the new genus erected for *Cacospongia scalaris*. A third genus has been proposed to accommodate them.

ABBREVIATIONS

BMNH Natural History Museum, London;
LMJG Landesmuseum Johanneum at Graz;
NMNZ Museum of New Zealand.

SYSTEMATICS

Class DEMOSPONGIAE Sollas, 1885
Order DICTYOCERATIDA Minchin, 1900

Family THORECTIDAE Bergquist, 1978

DIAGNOSIS

Thorectid sponges are Dictyoceratida with an anastomosing skeleton of concentrically laminat-

ed primary, secondary, and sometimes tertiary, fibres. Primary fibres have an axial, granular pith, which may extend into secondary fibres. The pith is not sharply disjunct from the investing spongin fibre but rather merges into it. Foreign material is often incorporated as a core within the fibres, obscuring the fibre pith when coring material is abundant. The anastomosing fibre skeleton is regular and often rectangular in arrangement. Fibres range in form, from simple fibres to strong, complex fascicles. Primary fibres may be reduced, and are absent in one genus. Zones of disjunction between successive fibrous layers remain tightly adherent, producing an overall homogeneous structure with visible contiguous laminae. Thorectids do not possess the fine filaments seen in sponges of the family Irciniidae. They have small, spherical and diplodal choanocyte chambers. The cortex may be armoured with foreign material; when not armoured, the surface is always coarsely to microconulose.

The Thorectidae comprises twenty-one genera, *Cacospongia* Schmidt, 1862, *Hyrtios* Duchassaing & Michelotti, 1864, *Phyllospongia* Ehlers, 1870, *Carteriospongia* Hyatt, 1877, *Taonura* Carter, 1882, *Aplysinopsis* Lendenfeld, 1888, *Thorecta* Lendenfeld, 1888, *Thorectandra* Lendenfeld, 1889, *Luffariella* Thiele, 1899, *Fasciospongia* Burton, 1934, *Dactylospongia* Bergquist, 1965, *Smenospongia* Wiedenmayer, 1977, *Fascaplysinopsis* Bergquist, 1980, *Fenestraspongia* Bergquist, 1980, *Lendenfeldia* Bergquist, 1980, *Strepsichordaia* Bergquist, Ayling & Wilkinson, 1988, *Collospongia* Bergquist, Cambie & Kernan, 1990, *Petrosaspongia* Bergquist, 1995, *Candidaspongia* Bergquist, Sorokin & Karuso (1999), *Scalarispongia* n. gen., *Semitaspongia* n. gen. These genera occur throughout the world, with the exception of polar seas. The family Thorectidae was erected by Bergquist (1978) to separate those taxa with laminated fibres and diplodal choanocyte chambers, from what are now recognized as spongiid taxa, characterized by homogenous (unlaminated) fibres. A group of three genera within the Thorectidae, *Ircinia* Nardo, 1833, *Psammocinia* Lendenfeld, 1889 and *Sarcotragus* Schmidt, 1862, were characterized by the presence of fine filaments in addition to the fibre skeleton. Bergquist & Wells (1983) suggested that on the basis of the fine filaments and terpene chemistry, a discrete family may need to be established for these three genera. Hooper & Wiedenmayer (1994) reassigned all thorectid taxa, including these three genera, to Irciniidae. This was rectified by Bergquist (1995) who separated this distinct group of filament-bearing genera from the Thorectidae and referred it to the family Irciniidae (Gray, 1867).

Genus *Cacospongia* Schmidt, 1862
(Figs 1A, B; 2A, B)

TYPE SPECIES. — *Cacospongia mollior* Schmidt, 1862 by subsequent designation (Laubenfels de 1936).

TYPE MATERIAL. — Lectotype Landesmuseum Johanneum at Graz, LMJG 15405 (dry).

DIAGNOSIS

Massive, low sponges, with an unarmoured surface. The sponge surface is finely and evenly conulose, and externally *Cacospongia* resembles *Spongia*. However, because of the harsh, brittle nature of the stratified fibres and the relative paucity of fibres as compared to *Spongia* species, *Cacospongia* is easily torn, and thus should never be confused in the field with *Spongia*, which is tough and elastic. The skeleton comprises relatively fine, concentrically laminated, primary and secondary fibres. Primary fibres are cored, and may form slight fascicles, usually near the sponge surface; secondary fibres are uncored. A granular pith is visible in primary fibres, where it is not obscured by the coring material, and sometimes extend into the secondary fibres. The secondary reticulum is well-developed, relative to primary fibres, branching and irregular (Fig. 1A). The consistency is soft to firm, compressible and is easily torn. There is low to moderate collagen deposition in the ectosome, and surrounding larger canals within the mesohyl (Fig. 1B).

No holotype has previously been designated for *C. mollior*, thus LMJG 15405 is here designated as lectotype. This is one of three specimens from Lesina (LMJG 15048 and LMJG 15411 paralectotypes), the locality mentioned by Schmidt (1862) in his original description. A specimen of

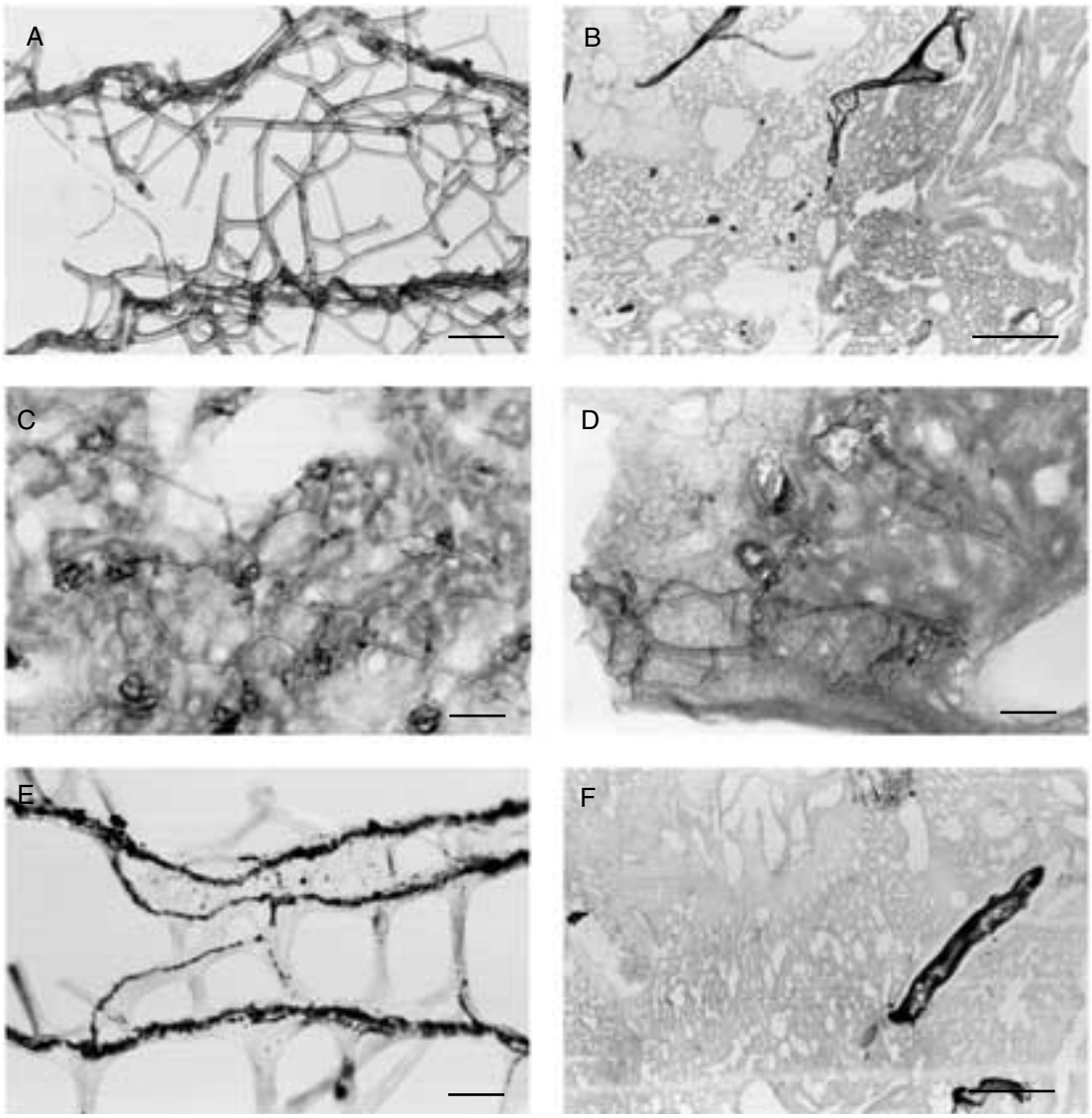

FIG. 1. — **A**, *Cacospongia mollior* (ex-Topsent collection, Strasbourg), fibre skeleton; **B**, *Cacospongia mollior*, showing histological detail; **C**, *Cacospongia serta,* holotype, BMNH 1886.8.27.166 (fragment = SDCC/NZ076), fibre skeleton; **D**, *Cacospongia serta* holotype, BMNH 1886.8.27.166 (fragment = SDCC/NZ076), detail of fibre skeleton; **E**, *Scalarispongia scalaris* (ex-Topsent collection, Strasbourg), fibre skeleton; **F**, *Scalarispongia scalaris*, showing histological detail. Scale bars: 500 µm.

C. mollior was among those presented by Schmidt to Bowerbank at the BMNH and a hand section of this "Adratic" specimen remains in the Bowerbank collection, BWK 1224 (Fig. 2A). This specimen gives a better indication of skeletal characters than can be found in the Desqueyroux-Faundez & Stone 1992 work on the Schmidt collection where only whole, dry specimens are figured. We have examined two other slides of *C. mollior*, BMNH 1910.1.1.2467 from the Norman collection (Fig. 2B), and another from a slide-series in the Topsent collection of the Strasbourg Museum (Fig. 1A). We have also examined and sectioned BMNH

FIG. 2. — **A**, *Cacospongia mollior* (Natural History Museum, London, Bowerbank collection 1224). Labels are probably in Bowerbank's handwriting; **B**, *Cacospongia mollior*, BMNH 1910.1.1.2467. Labels are probably in Bowerbank's handwriting; **C**, *Scalarispongia scalaris* (Natural History Museum, London, Bowerbank collection 1223). Labels are probably in Bowerbank's handwriting; **D**, *Scalarispongia scalaris* (Natural History Museum, London, uncatalogued slide). Labels are probably in Bowerbank's handwriting.

1877.5.21.315, a small, dry fragment from the Bowerbank collection, and BMNH 1883. 12.4.28, a specimen fragment in alcohol. The former is a species of *Cacospongia*, probably *mollior*, though is it difficult to be absolutely certain given the condition of the specimen. The latter specimen is *C. mollior*. A third specimen, BMNH 1867.7.26.2, was also examined and sectioned. This was not *Cacospongia*, but appeared to be what Schmidt (1862) originally understood as *Ditela*. The specimen had *Spongia*-like secondary fibres which dominated the fibre skeleton, plus a

very fine fibre reticulum, restricted to the surface regions of the sponge. In addition, we have examined a number of recently collected *mollior* specimens from the Mediterranean (Niolon, Portofino, Tunisia).

Cacospongia serta (Lendenfeld, 1888) n. comb. (Fig. 1C, D)

Stelospongia serta Lendenfeld, 1888: 163; 1889: 489, pl. 29, fig. 6, pl. 30, fig. 9.

HOLOTYPE. — Natural History Museum (London) BMNH 1886.8.27.166.

MATERIAL EXAMINED. — **Port Chalmers.** Otago, shallow water, 45°49.6'S, 170°37.4'E, 1886, SDCC/-NZ076 (BMNH 1886.8.27.166 (fragment of type)).

DISTRIBUTION. — Only known from the type locality.

DIAGNOSIS

Lendenfeld's (1888) diagnosis

"Lobose, massive, irregular sponges, which attain a maximum diameter of 160 mm. The continuous surface is covered with very small conuli 0.4 mm high and 1.2 mm apart. The oscula, which measure 1.4 mm in width, are scattered chiefly over the prominent parts. Light brown colour in spirit". A fragment of the type specimen examined by the authors is very pale grey externally.

Skeleton

A relatively fine network of concentrically laminated primary and secondary fibres. Primary fibres are cored with foreign inclusions and secondary fibres are clear. Secondary fibres are well-developed, branching and irregular, as is characteristic of the genus. The skeleton is punctuated by single or small groups of large sand grains. Primary fibres may form slight fascicles in the subsurface region. Primary fibres are 87 µm in diameter (49-155 µm, n = 9) and secondary fibres are 30 µm in diameter (19-49 µm, n = 29).

Histology

The diplodal choanocyte chambers are spherical to oval, and are 31 µm in diameter (42-63 µm, n = 20). There is a subdermal band of collagen, and minor deposits scattered through the mesohyl.

REMARKS

This is the only species of *Cacospongia* known from New Zealand, but it has not been recorded since its original description.

Genus *Scalarispongia* n. gen. (Figs 1E, F; 2C, D)

TYPE SPECIES. — *Cacospongia scalaris* Schmidt, 1862.

LECTOTYPE. — Landesmuseum Johanneum at Graz, LMJG 15405 (dry).

No holotype has previously been designated for *Cacospongia scalaris* and no collection location other than Adriatic was given by Schmidt (1862). This makes the choice of a lectotype from among Schmidt's specimens in the LMJG problematic. We have selected LMJG 15416 because it has the best locality data (Zara, Sebenicio). Two other specimens in the same collection, LMJG 15409 and LMJG 15410, also from Zara, are designated paralectotypes. Another specimen labelled *C. scalaris* LMJG 15406 is almost certainly not *C. scalaris*, and LMJG 15475 carries no locality data and is worthless.

Among Adriatic specimens given by Schmidt to Bowerbank was one labelled *Cacospongia scalaris* now represented by a slide in the Bowerbank collection BWK 1223 (Fig. 2C). This gives an excellent depiction of skeletal features.

We have also examined an uncatalogued slide of *Scalarispongia scalaris* from the Natural History Museum (London) (Fig. 2D), and another from a slide-series in the Topsent collection of the Strasbourg Museum (Fig. 1E). In addition, a number of freshly collected specimens from the Mediterranean (Niolon, Portofino, Elba) were made available for study.

ETYMOLOGY. — This new genus name *Scalarispongia* n. gen., based on the Latin word *scalaris*, simply means ladder sponge, for the regular, often rectangular fibre skeleton of these species. As an aside, the similar Latin word *scalarius* refers to the men who looked after the ladders in the Roman fire brigades.

DIAGNOSIS

Massive sponges, forming regular to irregular, pads or cushions. The surface is unarmoured, and covered with fine to coarse conules. The skeleton comprises a spongin fibre reticulum of concentrically laminated primary and secondary fibres, arranged in a regular, ladder-like pattern (Fig. 1E). The meshes of the skeletal reticulum are often, though not always, precisely rectangular, with secondary fibres forming almost perfect

right angles to primary fibres. Primary fibres are cored with foreign material and secondary fibres are clear. Primary fibres do not form fascicles but in one of the slides examined (ex-Topsent collection), some secondary fibres formed light webbing, rather than discrete secondary fibres, between the primary fibres. The mesohyl is moderately and evenly infiltrated with collagen (Fig. 1F). This new genus is typified by the well-known species described by Schmidt (1862) as *Cacospongia scalaris*.

Semitaspongia n. gen.
(Fig. 3)

TYPE SPECIES. — *Semitaspongia incompta* n. sp.

HOLOTYPE. — **Hauraki Gulf.** Maori Island, Leigh, 36°17.7'S, 174°49.0'E, 17 m, 2.I.1993, NMNZ POR459 (= SDCC/NZ031).

ETYMOLOGY. — The name *Semitaspongia* is based on *semita*, a Latin word for footpath. The same word was employed more loosely by poets, who used it to refer to tracks in the sky. Hence *Semitaspongia* literally means footpath or track sponge, referring to the footpath-like tracks of choanocyte chambers in the mesohyl.

DIAGNOSIS

Massive sponges, forming regular to irregular pads, blunt fingers or lobes, or cushions. The surface is conulose and unarmoured. The skeleton consists of an irregular to regular reticulum of concentrically laminated primary and secondary fibres. Primary fibres are cored and secondary fibres are clear. Primary fibres may be slightly fascicular, typically just beneath the cortex. A central pith is visible in primary fibres, though it may be obscured where fibres are cored, and can sometimes be seen extending into secondary fibres. The consistency is soft to firm, compressible and is easily torn. There is moderate to abundant collagen deposition in these species, typically in subdermal regions, around individual canals and canal beds, and in some cases it may constitute up to 40% of the mesohyl volume. In some species, the choanocyte chambers are arranged in tracks or in single file through collagenous deposits (Fig. 3F). This genus is closest to the new genus *Scalarispongia* diagnosed above, but is distinguished by its enhanced collagen deposition and the comparatively irregular skeletal reticulum.

Semitaspongia incompta n. sp.
(Fig. 3)

HOLOTYPE. — **Hauraki Gulf.** Maori Island, Leigh, 36°17.7'S, 174°49.0'E, 17 m, 2.I.1993, NMNZ POR459 (= SDCC/NZ031).

PARATYPE. — **Hauraki Gulf.** Maori Island, Leigh, 36°17.7'S, 174°49.0'E, 17 m, 2.I.1993, SDCC/NZ026. — Taranga (Hen Island), 35°58.1'S, 174°44.8'E, 12-15 m, 8.XII.1992, SDCC/NZ030.

ETYMOLOGY. — The species name reflects the untidy or scruffy appearance of this species, with its emergent fibres, and irregularly fleshed and unfleshed fibre skeleton.

DISTRIBUTION. — This species is only known from the type locality and Taranga (Hen Island).

DIAGNOSIS

A low, massive species, forming a highly irregular pad, comprising living tissue and exposed fibre network, which may be in the ratio of 1/1 in some specimens. The surface has numerous, fine to coarse conules, with long dendritic emergent terminal fibres. Thin ridges of pinacoderm are stretched between some adjacent conules on coarsely conulose specimens. The exposed fibre reticulum is an internal feature as well, where apparently solid areas of sponge have internal pockets of unfleshed fibre skeleton. The sponge is soft to moderately firm, and compressible. Colour is light to medium grey externally and light grey to brownish grey internally. Fibres are light to medium golden brown. All three specimens are *c.* 60-80 mm in diameter × 5-20 mm thick.

Skeleton

Comprised of concentrically laminated primary and secondary fibres. The skeleton is unusual, ranging from an occasional regular and rectangular reticulum, of low to moderate density, to the more typical tangled, relatively high density network. Primary fibres are axially to fully cored, and secondary fibres are uncored. Pith is visible in pri-

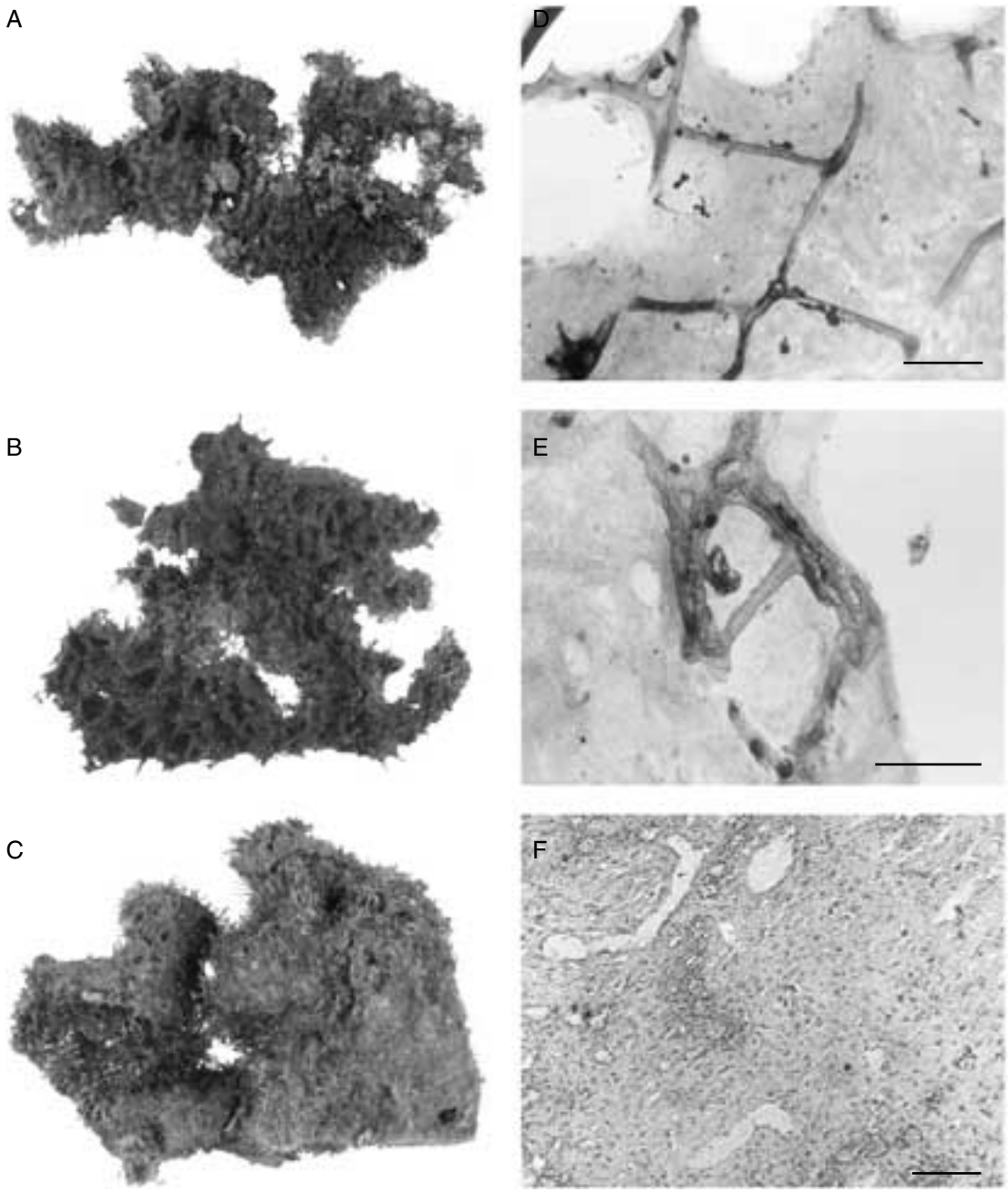

FIG. 3. — *Semitaspongia incompta* n. sp.; **A**, holotype, NMNZ POR459 (= SDCC/NZ031); **B**, paratype SDCC/NZ026; **C,** paratype SDCC/NZ030; **D**, holotype, NMNZ POR459 (= SDCC/NZ031), a more regular section of fibre skeleton; **E**, paratype SDCC/NZ030, detail of the typical irregular fibre skeleton. Note the appearance of the fibres themselves, in contrast to the relatively clear, finely laminated fibres of *Scalarispongia scalaris* in Fig. 1E; **F**, holotype, NMNZ POR459 (= SDCC/NZ031), histological detail, showing tracks of choanocyte chambers (upper centre and lower right of photo) through a collagenous deposit. Scale bars: D, E, 500 µm; F, 100 µm.

mary, and some secondary fibres. In places, fibres form complex, tangled fascicles, and vary greatly in diameter. Primary fibres are 194 µm in diameter (87-825 µm, n = 34) and secondary fibres are 78 µm in diameter (29-146 µm, n = 28).

Histology

The choanocyte chambers are diplodal, and spherical to oval in shape. They are loosely scattered throughout the mesohyl, and in some places arranged in tracks through beds of collagen. Choanocyte chambers are 29 µm in diameter (23-39 µm, n = 21). The mesohyl is heavily impregnated with collagen.

REMARKS

Typically irregular and unkempt, which may contribute to it being overlooked. An untidy looking species, which is readily distinguishable.

Semitaspongia glebosa n. sp.
(Fig. 4)

HOLOTYPE. — **Canyons.** Goat Island, Leigh, Northland, 36°16.3'S, 174°47.7'E, 10 m, 1.VIII.1992, C. N. Battershill, NMNZ POR457 (= SDCC/NZ081).

PARATYPES. — **Canyons.** Goat Island, Leigh, Northland, 36°16.3'S, 174°47.7'E, 12 m, 1.VIII.1992, C. N. Battershill, SDCC/NZ080. — Leigh Harbour, Northland, 36°17.7'S, 174°48.9'E, 10-15 m, 1.VIII.1992, C. N. Battershill, SDCC/NZ078.

ETYMOLOGY. — The name *glebosa* refers to this species resemblance to clods of earth, from the Latin *gleb*, clod of earth.

DISTRIBUTION. — Recorded only from the vicinity of Leigh, Northland, in 10-15 metres of water, encrusting vertical rock walls.

DIAGNOSIS

An encrusting species, forming a low, irregular pad, firmly attached to the substratum. The surface is conulose and slightly undulating. SDCC/NZ078 has two small turrets, 2-7 mm high, each with a small terminal oscule, ≤ 2 mm in diameter, otherwise, there are no visible oscules. This species is dark brownish grey externally and light brown greyish brown internally. Fibres are dark and are clearly visible within the pale matrix. The consistency is soft and compressible. The holotype is 65 mm × 55 mm × 5-12 mm thick. Paratypes are 75 mm × 45 mm × 5-10 mm thick (SDCC/NZ080) and 70 mm × 25-50 mm × 5-12 mm thick (SDCC/NZ078).

Skeleton

A moderately dense network of primary and secondary fibres. Fibres are concentrically laminated in cross-section and often a dark axial pith is visible, particularly in primary fibres, and sometimes extending into secondary fibres. Primary fibres can form loose, tangled groups of coalescing fibres, and are axially to fully cored with foreign sponge spicules and debris; they may also show light fascicles. A small amount of scattered interstitial detritus, mainly sponge spicules may be present. Secondary fibres may form ladders between primary fibres or branch before connecting with primary fibres, and rarely, may contain some axial coring. Primary fibres are 126 µm in diameter (68-262 µm, n = 61). Secondary fibres are 60 µm in diameter (29-184 µm, n = 51).

Histology

The diplodal choanocyte chambers are spherical to oval, and are 34 µm in diameter (23-44 µm, n = 56). A marked layer of collagen is evident dermally, and there is heavy deposition around larger canals, groups of canals and foreign material within the mesohyl. Choanocyte chambers can be observed embedded within the collagen, arranged in lines or in small blocks.

REMARKS

Another inconspicuous species, characterized by its simple, encrusting form and conulose surface. This species would be difficult to identify in the field, and could easily be confused with other dictyoceratid species, e.g. *Ircinia*, of similar form. However, this problem is easily solved once histological slides have been made and examined.

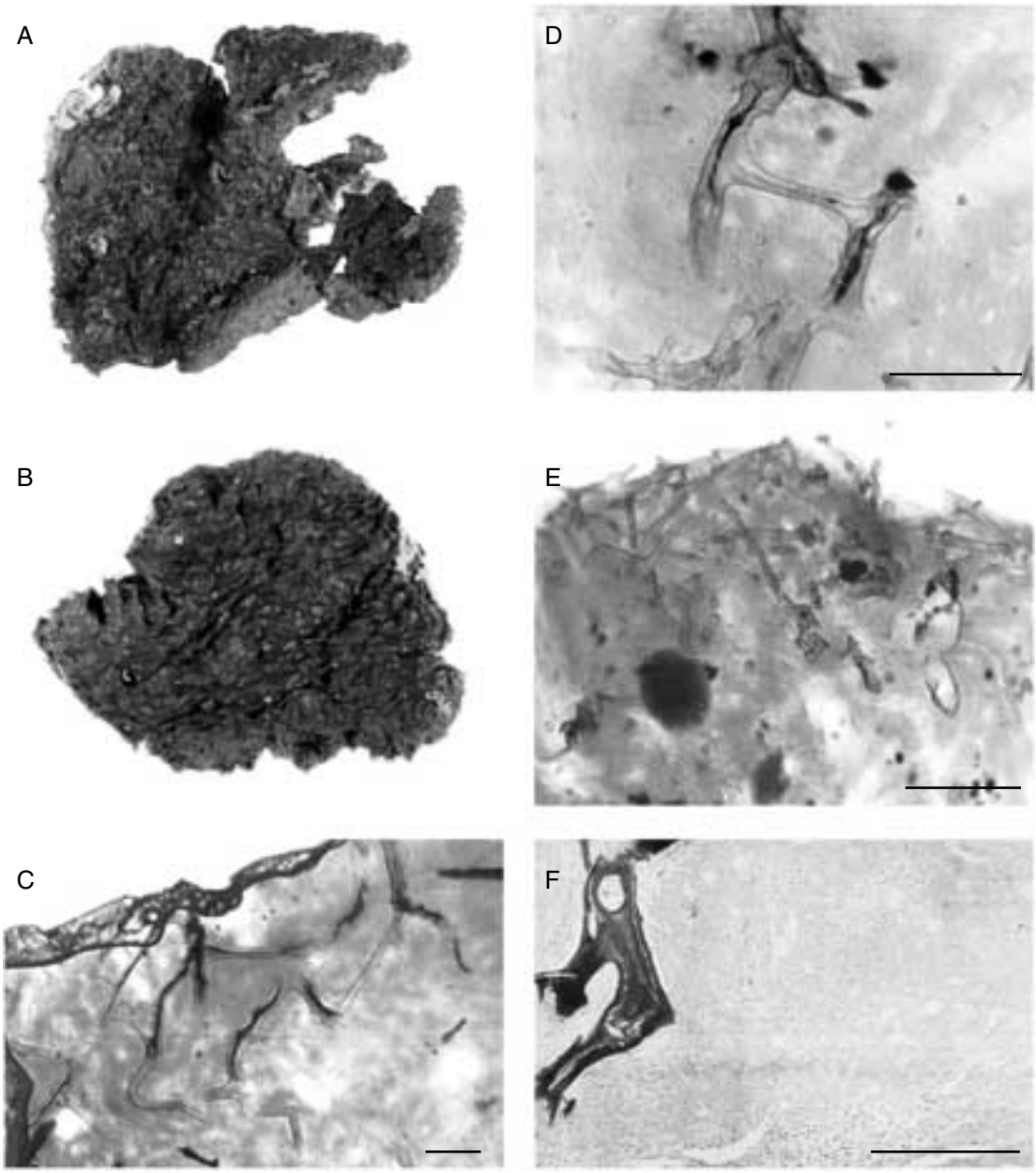

FIG. 4. — *Semitaspongia glebosa* n. sp.; **A**, holotype, NMNZ POR457 (= SDCC/NZ081); **B**, paratype, SDCC/NZ080; **C**, paratype, SDCC/NZ078, fibre skeleton; **D**, paratype, SDCC/NZ078, detail of fibre skeleton; **E**, holotype, NMNZ POR457 (= SDCC/NZ081), with some unidentified structures at the surface of the sponge, which superficially resemble fibres; **F**, holotype, NMNZ POR457 (= SDCC/NZ081), histological detail. Scale bars: C-E, 500 µm; F, 250 µm.

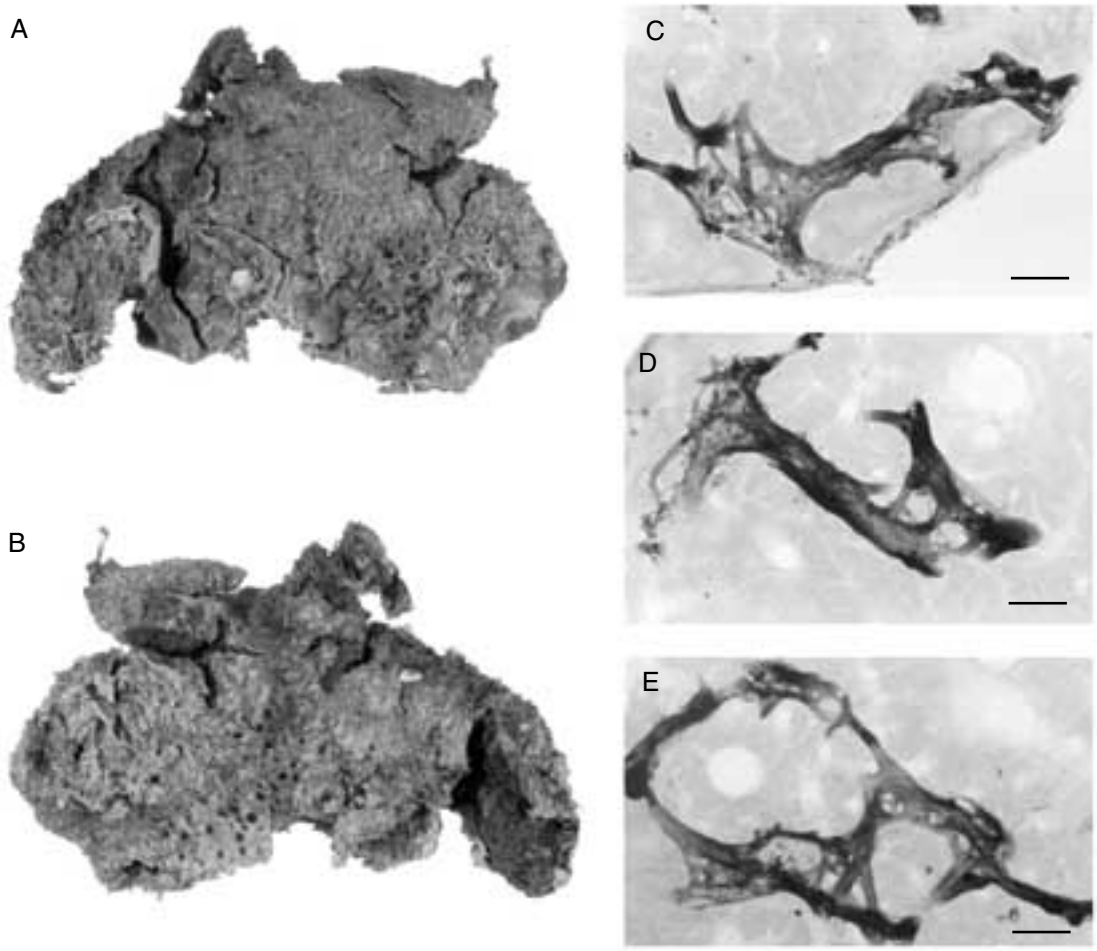

FIG. 5. — *Semitaspongia nigrachorda* n. sp.; **A**, top view; **B**, bottom view, showing dark fibres visible at or near surface; **C**, fibre skeleton (surface at lower right); **D**, fibre skeleton; **E**, fibre skeleton (surface at top left). Scale bars: 500 µm.

Semitaspongia nigrachorda n. sp.
(Fig. 5)

HOLOTYPE. — **Poor Knights.** 35°28.5'S, 174°44.5'E, 10-15 m, 25.V.1983, J. Fromont, NMNZ POR456 (= SDCC/NZ159).

ETYMOLOGY. — The species name highlights this species black-lined appearance where the skeletal reticulum is visible externally on the holotype.

DISTRIBUTION. — Only known from the type locality.

DESCRIPTION

A low, massive species, forming an irregular pad, most of which is raised off the substratum, remaining attached at several points. The surface is finely conulose, with single or multiple terminal emergent fibres. Pores are irregularly scattered on the undersurface of the holotype, and there is one small cluster of pores on one side of the upper surface. There are a number of other invertebrates growing on the sponge surface, including an encrusting bryozoan and two dendroceratid sponges. Colour is light brownish grey throughout. Fibres range in colour from light brownish grey to dark brown. They are visible at the surface in places, where they resemble fine, dark-coloured veins. Its consistency is moderately soft and compressible. The holotype is 130 mm × 35-75 mm and 15-50 mm high.

Skeleton
An irregular, moderate density skeleton of coarse primary and secondary fibres. Primary fibres are strongly laminated, with a marked pith; they may contain foreign debris, mainly sponge spicules, as an axial core, but most are clear of inclusions. Primary fibres may also form fascicles. Secondary fibres attach directly to primary fibres, or branch, sometimes becoming entangled, such that the distinction between primary and secondary fibres may not always be clear. Secondary fibres are uncored. Primary fibres are 631 µm in diameter (291-970 µm, n = 12) and secondary fibres are 184 µm in diameter (97-291 µm, n = 9).

Histology
The diplodal choanocyte chambers are spherical to oval, and 29 µm in diameter (26-31 µm, n = 20). There is a band of collagen ectodermally, around larger canals within the sponge matrix and often around skeletal fibres. Of the five new species described here, this sponge has the least amount of collagen in the mesohyl.

REMARKS
This species is characterised by its coarse, somewhat irregular fibre skeleton, along with the dark fibres on a pale background, and its irregular, upright form.

Semitaspongia pulvinata n. sp.
(Fig. 6)

HOLOTYPE. — **Hauraki Gulf.** Stn G11 ("Ikatere"), 3 km east of Little Barrier Island, 20 m, NMNZ POR454 (= SDCC/NZ156),

PARATYPE. — **Hauraki Gulf.** Stn G11 ("Ikatere"), 3 km east of Little Barrier Island, 20 m, SDCC/NZ251.

DISTRIBUTION. — Only known from the type locality, in the Hauraki Gulf.

ETYMOLOGY. — The species name for this sponge, *pulvinata* reflects its resemblance to a cushion or pillow.

DIAGNOSIS
A massive, compact species. The surface is irregular, varying from very finely to coarsely papillose, to conulose. In coarse areas, the pinacoderm is stretched between adjacent conules, forming a network of ridges, producing an irregular geometric pattern. The sponge has a number of low conical turrets scattered over the upper surface and sides; some turrets appear merely as slight extensions of the coarsely conulose surface. Each of the turrets bears a single terminal oscule. Pores (≤ 1 mm in diameter) are abundant and scattered over the sponge, particularly around the sides. On the surface there are patches of emergent fibres, either single or branched. The pinacoderm is translucent and the sponge is soft, compressible and fleshy. Colour both internally and externally is light greyish brown to pinkish grey. Fibres are light straw to light golden brown, and the oscular rim may be slightly darker coloured. These sponges were distinctly slimy when collected. The holotype is 135 mm long × 75 mm wide × 70 mm high; the paratype is 125 mm long × 65 mm wide × 60 mm high.

Skeleton
The fibre skeleton of concentrically laminated primary and secondary fibres, is regularly to irregularly disposed. Primary fibres are axially to fully cored, usually with sponge spicules, but also with fine sand and grit; the fibre coring obscures the fibre pith. Secondary fibres are generally uncored, though irregular, partial coring may be seen and these fibres may branch. The fibre pith is visible extending into some secondary fibres. Primary fibres are 146 µm in diameter (97-243 µm, n = 30) and secondary fibres are 87 µm in diameter (58-126, n = 16 µm). These two specimens were originally kept as a single sample. Histological sections were taken from both pieces. They were subsequently considered to be separate specimens, rather than two pieces of the same specimen. Unfortunately it is unknown which of the two specimens the histological sections figured represent.

Histology
Choanocyte chambers are spherical to oval, diplodal, and are 31 µm in diameter (21-39 µm, n = 21). The mesohyl of this species comprises at least 30-40% collagen, with distinct concentrations around canals, canal beds and surrounding foreign organisms living within the mesohyl.

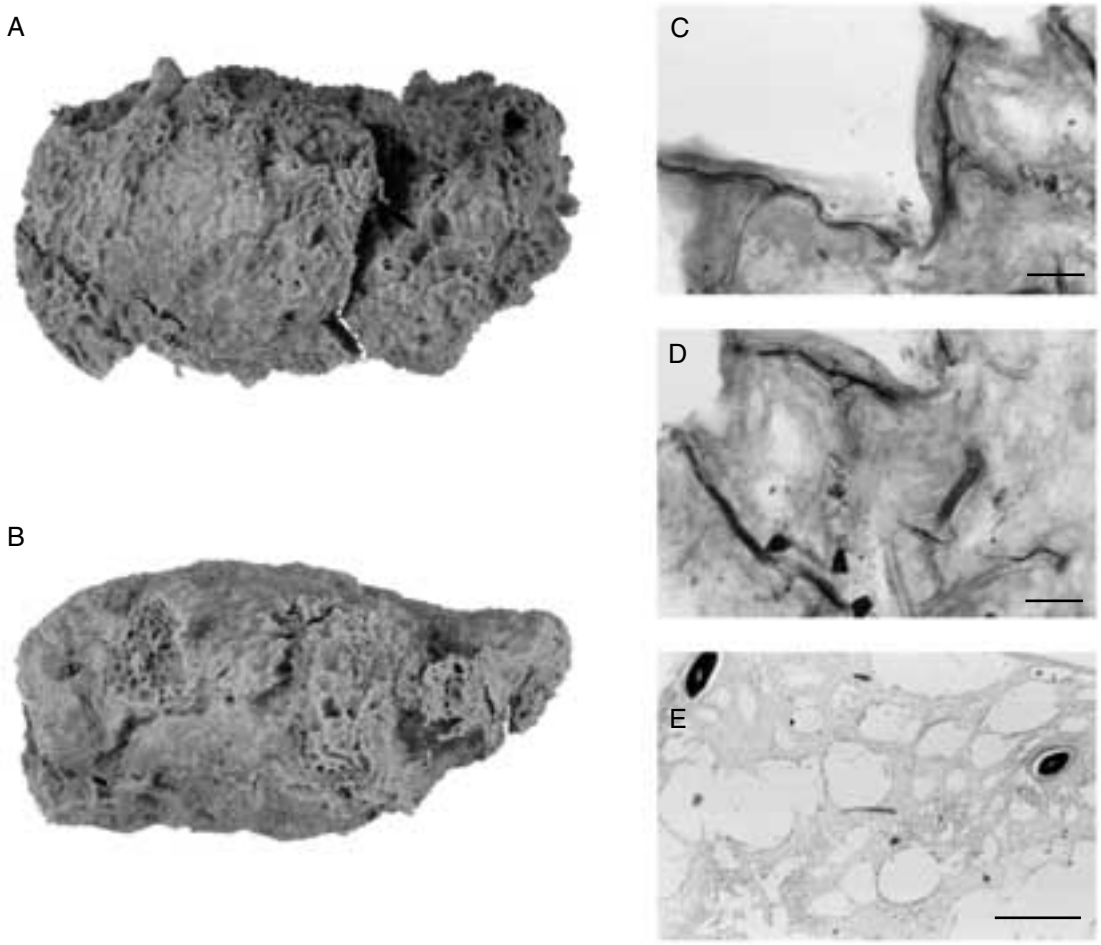

FIG. 6. — *Semitaspongia pulvinata* n. sp.; **A**, holotype, NMNZ POR454 (= SDCC/NZ156); **B**, paratype, SDCC/251; **C**, fibre skeleton; **D**, fibre skeleton; **E**, histological detail. Scale bars: 500 µm.

Collagen also dominates the surface regions, giving this species its fleshy appearance. The choanosome is arranged in blocks, and choanocyte chambers do not form tracks through collagen deposits as seen in other species.

REMARKS

This species is well characterized by its massive, cushion-like form, fleshy appearance and compressible texture, and in terms of its histology, by the high density of collagen deposition within the mesohyl.

Semitaspongia bactriana n. sp.
(Fig. 7)

HOLOTYPE. — **Poor Knights Islands.** 35°28.5'S, 174°44.5'E, VI.1981, NMNZ POR458 (= SDCC/NZ145).

ETYMOLOGY. — The specific name of this sponge reflects the humped form of the type specimen, which bears a strong resemblance to the two-humped Bactrian camels, indigenous to the Mongolian region. This central Asian area was once part of an area called Bactria.

DISTRIBUTION. — Only known from the type locality.

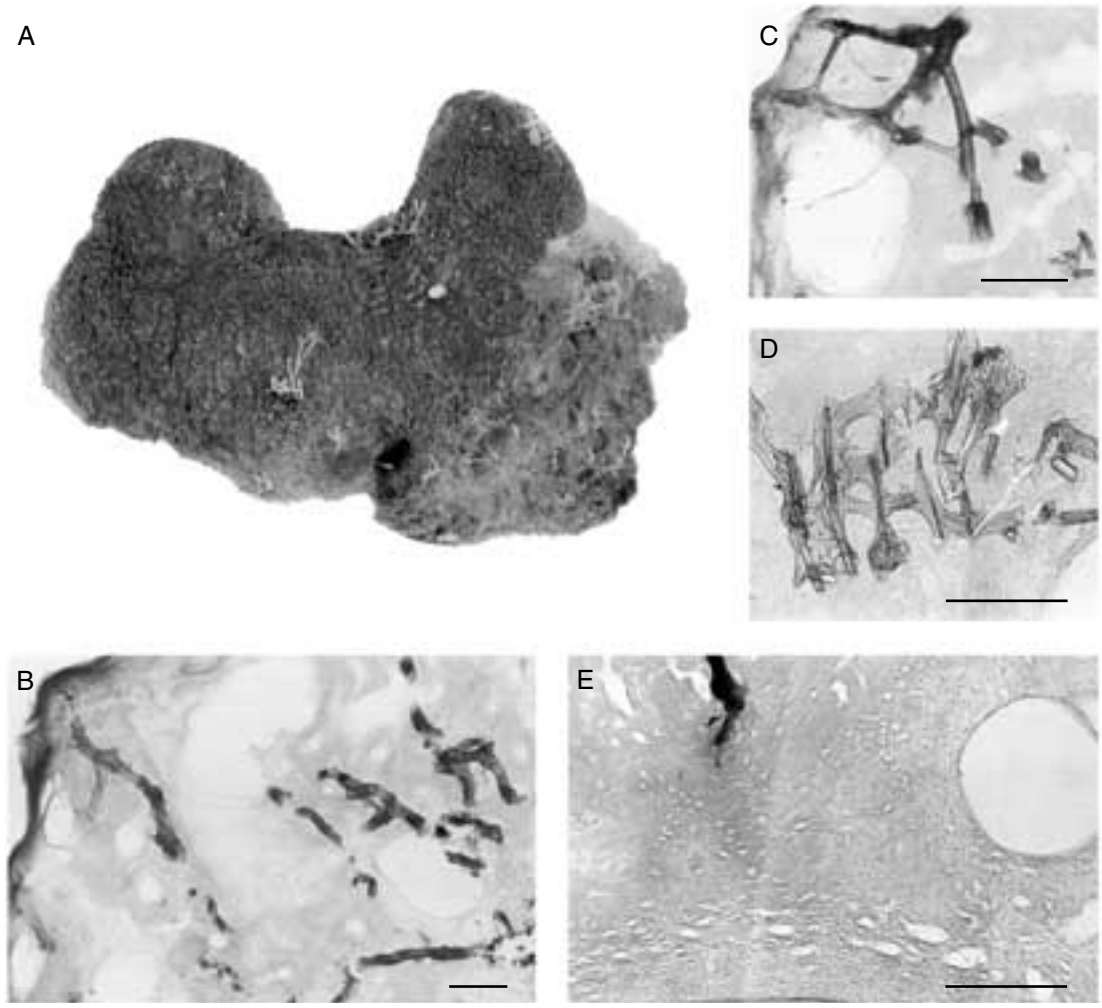

FIG. 7. — *Semitaspongia bactriana* n. sp.; **A**, side view; **B**, fibre skeleton; **C**, detail of fibre skeleton; **D**, detail of fibre skeleton; **E**, histological detail, showing clear tracks of choanocyte chambers through a bed of collagen. Scale bars: B, C, 500 µm; D, E, 250 µm.

DIAGNOSIS

This sponge is a massive low pad, with short, blunt fingers expanding out from the main body. The surface is densely covered with fine conules, some of which have emergent terminal fibres, that are simple or dendritically branched. Groups of very small pores are irregularly dispersed over the sponge surface. Approximately 70-80% of the base is attached to the substratum, with a central area raised up from the substratum. The consistency is moderately soft and compressible. Externally the sponge is brownish purple-grey, fading to cream basally. Internally the sponge is cream. This specimen has a number of bryozoan and hydrozoan epibionts. The holotype is 90 mm long × 35-65 mm wide × 25-35 mm high.

Skeleton

A moderate density, relatively regular skeleton of strongly laminated primary and secondary fibres. Primary fibres are irregularly and axially cored, sometimes heavily and sometimes only lightly, and may form tangled fascicles. Some fibres, seen in section, appear to have a distinct inner and outer region. Secondary fibres are partially cored. It may be difficult to distinguish between prima-

ry and secondary fibres, owing to the presence of fascicles. A central pith is visible in primary fibres, though obscured where fibres are cored, and can sometimes be seen extending into secondary fibres. There are patches of foreign sponge spicules embedded in the mesohyl, but these are not distributed regularly. Primary fibres are 146 µm in diameter (58-340 µm, n = 25); secondary fibres are 68 µm in diameter (29-116 µm, n = 14).

Histology

The choanocyte chambers are diplodal and mostly spherical in shape. They are 26 µm in diameter (21-34 µm, n = 30), and some are arranged in single-file rows. There is moderate to heavy collagen deposition, primarily at the surface, but also around the larger canals and canal beds. In all sections, collagen comprises 30-40% of the mesohyl.

REMARKS

The external features of this sponge are reminiscent of *Spongia* and *Cacospongia*, though when the internal structure is examined histologically, its affiliations to *Scalarispongia* n. gen. are clear. This is the only species of *Semitaspongia* n. gen. with a lobate form.

Five new species of *Semitaspongia* n. gen. are described above. A key has been devised to assist in identifying these species, though it should be used alongside the full species descriptions and plates.

1a. Small fistules or turrets 2

1b. Without fistules or turrets 3

2 *(1)* a. Forms large, soft, fleshy lumps ..... *pulvinata*

2b. Low, pad-like form ..... *glebosa*

3 *(1)* a. Regular, compact form, with numerous, very fine conules ..... *bactriana*

3b. Irregular form 4

4 *(3)* a. Very irregular, scruffy and somewhat hairy or bristly ..... *incompta*

4b. Irregular, but not bristly; dark fibres may be visible through pinacoderm .... *nigrachorda*

DISCUSSION

The genus *Cacospongia* was established by Schmidt (1862) for three species, *C. mollior*, *C. scalaris* and *C. cavernosa*. The latter was transferred to *Fasciospongia* (Burton 1934) and *C. mollior* was subsequently designated as the type species of *Cacospongia* by de Laubenfels (1936). Schmidt (1870) synonymized *Cacospongia* with *Euspongia*. Not all authors accepted this synonymy and the genus was misused for 20-30 years, during which time almost any species which had laminated fibres was called *Cacospongia*. For example, Poléjaeff (1884) used *Cacospongia* for a number of species, but went as far as including some sponges with the fine collagenous filaments unique to the group of sponges now recognized as the Irciniidae, though at that time Poléjaeff (1884), along with a number of other authors, believed the filaments were foreign organisms, or a direct result of the presence of foreign organisms in the mesohyl. Not surprisingly, Lendenfeld (1888, 1889) had no confidence in *Cacospongia*, and transferred Schmidt's original species, along with all other *Cacospongia* species to other genera. The genus *Cacospongia* was largely ignored until *C. mollior* and *C. scalaris* were reconsidered as congeneric, and the genus *Cacospongia* was re-established (Laubenfels de 1936, 1948; Vacelet 1959).

Bergquist (1980) recognized only two valid species, *C. mollior* and *C. scalaris*, both from the Mediterranean. *Cacospongia mollior* has a fine fibre skeleton, with a well-developed, branching and intermeshed secondary fibre reticulum (Fig. 1A). *Cacospongia scalaris* has a thicker, more

regular fibre skeleton, with secondary fibres characteristically forming a ladder-like arrangement between adjacent primary fibres (Fig. 1C). This species also appears more collagenous, macroscopically, than the former. The five new species described here from New Zealand exhibit two features which deviate from the Mediterranean sponges assigned to *Cacospongia*. There are pronounced tracts of collagen within the mesohyl of some species, and coarser, sometimes fascicular, skeletal fibres in others. Both attributes are more reminiscent of *C. scalaris* than of *C. mollior*.

Schmidt's original description of *Cacospongia* is vague, and the type species *C. mollior* was not illustrated, but this species is well-known, recognizable, and clearly characterizes the genus. We believe *Cacospongia* is a good genus, and that the oft-quoted diagnosis, which includes a "rectangular and regular fibre skeleton", is misleading. Schmidt's description of *C. mollior* refers to the resemblance of its fine fibres to the secondary fibres of *Spongia*. This is reflected in the revised generic diagnosis (above), which draws attention to the secondary fibre reticulum, which, in addition to the encrusting or pad-like form, simple cored primary fibres, uncored secondary fibres, and unarmoured surface, renders *Cacospongia* distinct from other thorectid genera. *Cacospongia serta* (Lendenfeld) from New Zealand, also recognized as a valid species, is currently known only from the type specimen. This species has the characteristic secondary fibre reticulum of *Cacospongia*, as diagnosed above.

We also believe that *Cacospongia scalaris* Schmidt is a good species, but it does not belong to *Cacospongia*. In 1874, Bowerbank came to a similar conclusion, though probably for a different reason. Schmidt visited Bowerbank at the British Museum, and presented him with "33 small portions of his Adriatic sponges for examination...", including specimens of *C. mollior* and *C. scalaris*. Though we do not agree with Bowerbank's suggested assignments ("a true spongia" and "an undoubted Verongia" respectively), he does clearly state that "The slightest microscopical examination of their structural peculiarities would have served at once to distinguish them as anatomically distinct genera". However, with regard to the supposed specimen of *C. mollior*, Bowerbank's comment that the specimen was "a true spongia", is likely to have been the result of an incorrectly labelled slide. As mentioned above, Bowerbank was in fact looking at a specimen of Schmidt's *Ditela nitens*, and not *C. mollior*.

The new genus *Scalarispongia* is established, creating the new combination *Scalarispongia scalaris* (Schmidt, 1862). *Scalarispongia* is characterised predominantly by its regular and, in some cases, perfectly rectangular fibre reticulum of simple primary and secondary fibres. *Scalarispongia scalaris* also has a moderate deposition of mesohyl collagen in contrast to the sparse collagen of *C. mollior*. This new genus incorporates two species from the Galápagos Islands, described and illustrated as *Cacospongia* species by Desqueyroux-Faúndez & Van Soest (1997), now with the new combinations *Scalarispongia similis* (Thiele, 1905) and *Scalarispongia incognita* (Desqueyroux-Faúndez & Van Soest, 1997). Their description of *Scalarispongia similis* includes a reference to the occasional presence of tertiary fibres. Tertiary fibres are typified by those which occur in the thorectid genus *Luffariella*; these fibres are usually restricted to the meshes of the secondary reticulum, and their diameter is ≤ 20% of secondary fibre diameter (see also Boury-Esnault & Rützler 1997). The tertiary fibres of *Scalarispongia similis* are not illustrated but the measurements presented indicate that, on average, they are roughly half the diameter of secondary fibres, and thus should be considered as a dichotomy within the secondary fibres, rather than as tertiary fibres.

Scalarispongia n. gen. is also known to occur in the Caribbean. Fattorusso *et al.* (1992) reported on secondary metabolites found in a sponge they called *Cacospongia* cf. *linteiformis*. Examination of histological slides made from a specimen provided by the authors showed that this species should also be assigned to *Scalarispongia*. Hence, *Scalarispongia* n. gen. is known to occur in the Mediterranean, the Galápagos Islands and the Caribbean.

It should be made clear that although the fibre skeleton is diagnosed as typically rectangular in *Scalarispongia* n. gen., this is variable. Fibres may display a more meandering path, rather than a geometrically perfect rectangular arrangement. These sponges have only light to moderate axial coring in their primary fibres, in contrast to those of *Semitaspongia* n. gen., which have primary

fibres moderately cored to fully charged with foreign material. More species need to be examined to ascertain whether or not this has any relevance as a generic character.

The new genus, *Semitaspongia*, has been proposed to accommodate a group of New Zealand sponges previously thought to belong to *Cacospongia*, but which do not have the secondary fibre reticulum development of *Cacospongia* or the highly regular fibre reticulum of *Scalarispongia* n. gen. *Semitaspongia* n. gen. is also distinguished by the moderate to high collagen deposition within the mesohyl. A curious feature of most of these new species is the arrangement of some areas of choanosome within areas of collagen such that choanocytes appear almost as lines of footprints in single-file (Fig. 3F). Bergquist (1980) highlighted the difficulty in separating *Cacospongia* from *Aplysinopsis*, and *Aplysinopsis* from *Thorecta*. In addition, *Taonura* is similar histologically to *Cacospongia*, and the two new genera established here may exacerbate the problems of definition. The key characters for recognizing *Thorecta* are the cortical armour, the rather sparse fibre with respect to flesh, and the fine, very regular skeletal fibres, which are arranged in direct relation to the surface. *Aplysinopsis* also has a regular, though thin, cortical armour, but these species are unmistakably collagenous or fleshy. *Cacospongia* is easily distinguished by its well-developed secondary fibre skeleton, which is more abundant than the primary fibres, though not as dominant as seen in members of the Spongiidae. *Scalarispongia* n. gen. has a quite dense, highly regular, often ladder-like skeletal reticulum, without the cortical armour of *Thorecta*.

The spherulous cells of *Scalarispongia scalaris*, investigated by Donadey (1982), are also slightly different from those of *Aplysinopsis* (Bergquist pers. obs.). Further histological and ultrastructural research is required to clearly characterize these differences, and to provide other parameters for distinguishing between genera.

Semitaspongia n. gen. is distinguished by its structured mesohyl, with a well-defined cortical region and relatively large zones of collagen interspersed with blocks or tracks of choanosome. The only other genus amongst this group that is similarly collagenous is *Aplysinopsis*, which has an upright form, thin cortical armour and a sparse skeleton. This is in contrast to the low, unarmoured species of *Semitaspongia* n. gen., which have a skeleton of moderate density. *Taonura* also has a very regular skeleton, but has a fine microconulose unarmoured surface and does not have the broad-based, usually lamellate or digitate forms of *Thorecta* and *Aplysinopsis*. These genera contrast in form with the low, encrusting, pad-like or cushion forms of *Cacospongia*, *Scalarispongia* n. gen. and *Semitaspongia* n. gen.

We include a key to the genera mentioned in the preceding paragraphs.

There are a number of *Cacospongia* species described in the literature, and these should all be reassessed, to review generic assignments over the last 120 years, in light of the new genera described here. Several species have already been assigned to other genera, besides the two species above, e.g. *Cacospongia ramosa* (Thiele) de Laubenfels (1948) is now recognized as *Pseudoceratina purpurea* (Carter) fide Bergquist (1965), and *Cacospongia vesiculifera* Poléjaeff, 1884

1a. Armoured surface 2
1b. Unarmoured surface 3
2 *(1)* a. Distinct cortical armour; very regular fibre skeleton ..... *Thorecta*
2b. Thin, dispersed cortical armour; irregular fibre skeleton ..... *Aplysinopsis*
3 *(1)* a. Upright forms, on a basal stalk ..... *Taonura*
3b. Low forms 4
4 *(3)* a. Well-developed secondary fibre skeleton ..... *Cacospongia*
4b. Equal abundance of primary and secondary fibres 5
5 *(4)* a. Heavily collagenous mesohyl; irregular skeleton ..... *Semitaspongia*
5b. Low to moderate mesohyl collagen; very regular skeleton ..... *Scalarispongia*

is *Psammocinia vesiculifera* (Poléjaeff) (Bergquist 1980; Hooper & Wiedenmayer 1994).

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