



First record of a living species of the genus *Janulum* (Class Demospongiae) in the Southern Hemisphere

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Abstract

A new species of the enigmatic sponge genus *Janulum* de Laubenfels, 1936 was discovered recently on the Louisville Seamount Chain, in International Waters to the east of New Zealand; two small specimens were found encrusting the interstices of the stony coral *Solenosmilia variabilis* Duncan at a depth of 1200–1600 m. *Janulum imago* sp. nov., is described and compared with the genus type *J. spinispiculum* (Carter, 1876) from the North Atlantic. *Janulum* was also recorded from the Late Eocene Oamaru Diatomite of southern New Zealand in 1892, but was misidentified as genus *Plocamia* Schmidt (Order Poecilosclerida Topsent, Family Microcionidae Carter). Fossil species *Janulum princeps* sp. nov. is also described herein and represents the first record of this North Atlantic-Arctic Ocean genus in the Southern Hemisphere. The validity of *J. filholi* (Topsent, 1890), the second and only other North Atlantic species currently assigned to *Janulum*, is considered in the context of *J. spinispiculum* and the new species *J. imago* sp. nov.

Key words: Porifera, International Waters, Louisville Seamount Chain, Late Eocene, Oamaru Diatomite, new species

Introduction

Specimens of a new species of the enigmatic sponge genus *Janulum* de Laubenfels, 1936 were recently collected from International Waters to the east of New Zealand on Forde Guyot, Louisville Seamount Chain, between 1200 and 1600 m (Fig. 1). Prior to this discovery, the genus was only known in the Southern Hemisphere from a microfossil spicule illustrated from the Oamaru Diatomite (Late Eocene) (Hinde & Holmes 1892; Wiedenmayer 1994), identified at the time as a species of *Plocamia* (Order Poecilosclerida Topsent, Family Raspailiidae Nardo). The genus *Janulum* was established by de Laubenfels (1936) for *Isodictya spinispiculum* Carter, 1876, first described from Cape Vincent, southern Portugal, but now known from the Azores (Topsent, 1904) and off the west and north coast of Ireland, the Western Mediterranean Sea (Vacelet 1969; Boury-Esnault *et al.* 1994; Pansini & Longo 2008; Calcinaï *et al.* 2013), the North Atlantic including Denmark Strait and Iceland (Lundbeck, 1902), and the Arctic Ocean including the Barents Sea, northern Norway and Spitzbergen (Hentschel, 1929).

The systematic position and phylogenetic affinity of *Janulum* is currently under debate and ongoing investigation. On the basis of spicule and skeletal characteristics the genus was considered, albeit questionably, to be reminiscent of plocamiform genera such as *Lithoplocamia* Dendy (Family Raspailiidae) by Hooper (2002), but on the basis of molecular data (Redmond *et al.* 2013), the genus is strongly supported within Order Haplosclerida (in part Haploscleromorpha Cárdenas, Pérez & Boury-Esnault, 2012 in Redmond *et al.* 2013).

The second species attributed to *Janulum*, *Reniera filholi* Topsent, 1890, has a fragile skeleton in the form of an isodictyal reticulation of curved acanthose strongyles; it was suggested by de Laubenfels (1936) that *R. filholi* might also be referred to *Janulum*, a move that was completed by Redmond *et al.* (2013).

The objective of this work is to redescribe the genus type species *Janulum spinispiculum*, describe the fossil and Recent Louisville Seamount species of *Janulum*, and to consider briefly the systematic position of the genus in relation to other sponge taxa.

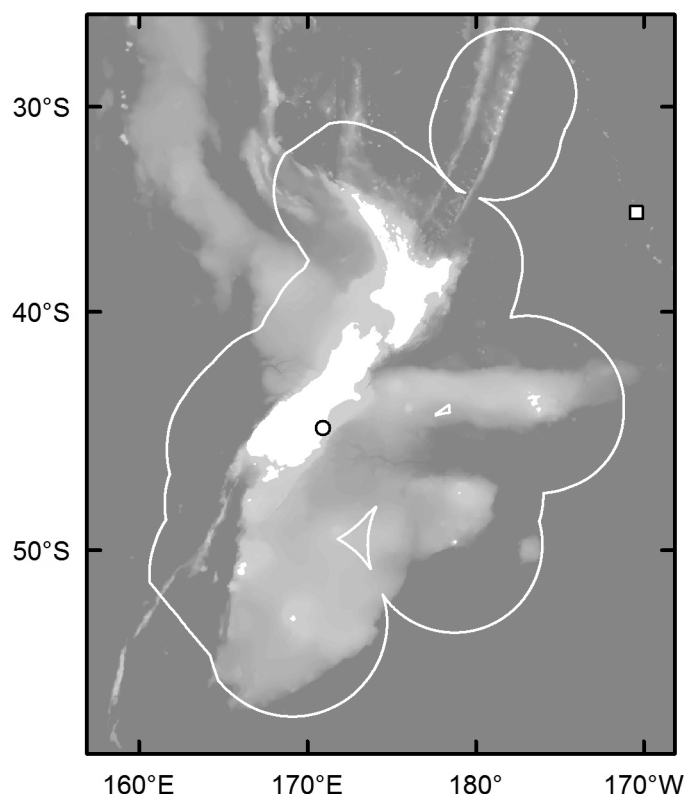


FIGURE 1. Study area showing the collection locality for *Janulum imago* **sp. nov.**, Forde Guyot, Louisville Seamount Chain in International Waters to the east of New Zealand, and location of the Oamaru Diatomite (Late Eocene) from which *J. princeps* **sp. nov.** was illustrated by Hinde & Holmes (1892); □ *Janulum imago* **sp. nov.**; ○ *Janulum princeps* **sp. nov.**

Material and methods

New Zealand specimens were collected on the Louisville Seamount Chain (Fig. 1) by epibenthic sled onboard the National Institute of Water & Atmospheric Research (NIWA) research vessel *RV Tangaroa*; the collection station is cited as NIWA Stn TAN0XXX/XX. Specimens collected on BIOSYS/HERMES 2005 cruise (June/July 2005) on board the Dutch research vessel *RV Pelagia*, targeting cold water reefs off southeast Rockall Bank, northwest of Ireland. Samples were mainly collected by boxcores, occasionally by rectangular dredge (Van Duyl & Duineveld 2005; Van Soest *et al.* 2007). Specimens from the West Coast of Ireland were collected by ROV *Holland I* deployed from *RV Celtic Explorer* (Cruise CE10004) from 26–27 May 2010.

Specimens were frozen immediately upon collection and then preserved in 70% ethanol. Histological sections of the specimens were prepared by embedding a small cross-section in paraffin wax then sectioning with a microtome at 100 µm. Due to the difficulty of sectioning these extremely fragile specimens, sections were transferred in the paraffin strip to microscope slides, flooded with clearing agent Histoclear and examined and photographed directly under a light microscope. Spicule slides and Scanning Electron Microscopy (SEM) spicule preparations were made following the methods of Boury-Esnault & Rützler (1997). Clean spicules for SEM examination were spread on a plastic disc, air-dried, and coated with platinum for 600 seconds. Spicules were viewed on a Philips XL30S FEG SEM. Spicule measurements in the species descriptions are given as a mean and range of the length [mean (min-max)] x width [mean (min-max)], n=20 per specimen unless stated otherwise, given for the holotype and/or paratype(s) and other material listed in the tables.

Primary and secondary type materials of *Janulum imago* **sp. nov.** are accessioned within the NIWA Invertebrate Collection (NIC) at the National Institute of Water & Atmospheric Research (NIWA; formerly New Zealand Oceanographic Institute, NZOI), Greta Point, Wellington (prefix NIWA). Other material is in the registered collections of the Ulster Museum, Belfast, Northern Ireland (prefix BELUM Mc), the Naturalis Biodiversity Center, Leiden, The Netherlands (prefix ZMA Por.), and Musée Océanographique de Monaco (MOM). Taxonomic authority for the new species described in this paper is restricted to authors Michelle Kelly & Rob van Soest.

Systematics

Class Demospongiae Sollas

Order Incertae

Family Incertae

Remarks. The history of *Janulum* is highly convoluted and is reviewed here. The type species of *Janulum*, *J. spinispiculum*, was originally described as a species of *Isodictya* Bowerbank, established (with *Halichondria* Fleming, *Hyalonema* Gray and *Spongilla* Lamarck) for ‘skeletons continuously reticulate in structure, but not fibrous’. Subsequent authors assigned this species to the monotypic genus *Metschnikowia* Grimm, established for *M. tuberculata* Grimm, 1877 from the brackish to freshwater Caspian Sea, a species with stout, entirely spined oxeas in a fragile isotropic reticulation of polygonal meshes (Lundbeck 1902; Hentschel 1929). Vacelet (1969) determined however, that the ‘acanthostrongyles’ of *spinispiculum* were clearly different from the ‘acanthoxeas’ of *M. tuberculata*, assigning his specimens to the genus *Janulum*. Although Vacelet’s concept of this species was clearly haplosclerid, *Janulum* was considered to be a poecilosclerid taxon at that time; de Laubenfels (1936) envisaged *Janulum* in his Acarniidae Laubenfels, now synonymised with Microcionidae. The spicule illustrated by Hinde & Holmes (1892) from the Oamaru Diatomite was also considered to be poecilosclerid in origin; Hinde & Holmes (1892) identified the spicule as the “dumb-bell spicule of *Plocamia*” (Family Microcionidae).

Hooper (2002) considered the peculiar strongyles of *J. spinispiculum* to be reminiscent of those in plocamiform Raspailiidae, such as species of *Lithoplocamia*. Species of *Lithoplocamia* have a dense secondary regular isodictyal or irregular subisodictyal reticulation of acanthostrongyles, in addition to a primary skeleton of radial plumose tracts and a specialised ectosome of long slender oxeas forming sparse bouquets at the end of the primary tracts. There are many additional spicule forms in *Lithoplocamia* spp.: subtylostyles, oxeas, diactinal or pseudodiactinal acanthostrongyles, and sometimes echinating acanthostyles (Hooper 2002). Furthermore, these species are relatively fibrous indicating a degree of spongin development.

Hooper (2002) described the skeleton of *J. spinispiculum* as fibrous, forming an “areolate wide-meshed isodictyal reticulation with fibres cored by regular lines of acanthostrongyles arranged end-to-end (plocamiform arrangement)”. This description is not in accordance with Carter’s original 1864 description of the type specimen which is very clear: “The interior consisting of an areolar structure easily crushable and composed of sarcoderm charged with one kind of spicule only, which is arranged in bundles end to end, and crossing each other in accordance with the kind and form of the areolar structure common to the Isodictyosa.” In this description the sarcoderm is mesohyl, not fibre, and there is no mention of a primary radiating or plumose skeleton, or specific ectosomal skeleton. Hooper (2002) also suggested that Carter (1876) might have overlooked expected additional plocamiform spicule types, but this work and that of Redmond *et al.* (2013) confirms that the peculiar spined strongyles are the only spicules present in the two known living species.

Redmond *et al.* (2013) put forward molecular evidence that strongly supports the reassignment of *J. spinispiculum* to the Order Haplosclerida (in part Haploscleromorpha Cárdenas, Pérez & Boury-Esnault, 2012 in Redmond *et al.* 2013) in a clade with a species of *Oceanapia* Norman and the genus type of *Siphonodictyon*, *S. mucosum* Bergquist. Vacelet (1969) and Boury-Esnault *et al.* (1994) considered *Janulum* to be haplosclerid. Wiedenmayer (1994) determined that the characteristic spicules were ‘clearly petrosid’, assigning them to the disused Family Nepheliospongiidae, which, with Family Petrosiidae van Soest, Phloeodictyidae Carter, and

Calcifibrospongiidae Hartman, form the Suborder Petrosina Boury-Esnault & van Beveren (Order Haplosclerida Topsent). Work in progress to sequence the species *J. imago* **sp. nov.** will hopefully further illuminate the relationship of *Janulum* to haplosclerid taxa (Erpenbeck D. pers. comm.).

Genus *Janulum* de Laubenfels

Janulum de Laubenfels, 1936: 79.

Type species. *Janulum spinispiculum* (Carter, 1876) (type by original designation).

Diagnosis. Encrusting sponges with a smooth or lobed to columnar, distinctly punctate surface, with a firm to crisp, fragile texture in life. Colour in life ranges from pale yellow to cream to translucent pale blue. Choanosomal architecture consists of a single category of peculiar spined strongyles arranged in a delicate isodictyal reticulation of single spicules. Ectosome a tangential isodictyal reticulation. Spined strongyles are straight or bent abruptly at each end; typically ends bend to the same side of the spicule but may also bend to opposite sides. Strongyles possess sharp concave spines concentrated in the middle of the strongyle, ends are rounded, smooth, slightly expanded. Spines project perpendicular to the shaft and are aligned in what appear to be short linear spiralling arrays. A few spicules, often thin and immature, may be entirely smooth (modified and expanded from Vacelet (1969) and Boury-Esnault *et al.* (1994)).

Janulum spinispiculum (Carter, 1876)

(Fig. 2; Table 1)

Isodictya spinispiculum Carter 1876: 310, Pl. 15, Fig. 42.

Metschnikowia spinispiculum, Lundbeck 1902: 52, Pl. 12, Fig. 4; Topsent 1904: 243, Pl. 5, Fig. 1; Hentschel 1929: 901, 987.

Janulum spinispiculum, de Laubenfels 1935: 79; Boury-Esnault *et al.* 1994: 132, Fig. 102; Vacelet 1969: 210, Fig. 54; Calcinai *et al.* 2013: 6, Fig. 3.

Lithoplocamia spinispiculum, Hooper 2002: 506 (with question).

Material examined. ZMA Por. 19460, 19461: BIOSYS/HERMES 2005, boxcore 24, southeast Rockall Bank, 55.506° N, 15.786° W, 680 m, 27 Jun 2005, collected by 50 cm boxcore from RV *Pelagia*; ZMA Por. 19579, BIOSYS/HERMES 2005, boxcore 60, southeast Rockall Bank, 55.444° N, 16.076° W, 780 m, 30 Jun 2005, collected by 50 cm boxcore from RV *Pelagia*; ZMA Por. P. 8676, slide, Porcupine Seabight, southwest of Ireland, 852 m, coll. L.A. Hendry, Scottish Association for Marine Science, Jun 2003; ZMA Por. P. 8672, 8673, East of Iceland, from Copenhagen Museum's Lundbeck collection; BELUM Mc7745, Mc7798, Mc7812, West Coast of Ireland, RV *Celtic Explorer* Cruise CE10004, 54.063° N, 12.413° W, 1469 m, 26 May 2010, collected by ROV *Holland I*; BELUM Mc7816, West Coast of Ireland, RV *Celtic Explorer* Cruise CE10004, 54.058° N, 12.547° W, 1350 m, 27 May 2010, collected by ROV *Holland I*. **Other material.** *Janulum filholi* (Topsent, 1890), MOM 04 0078: Holotype, Campagnes de l' Hirondelle Stn 105 (1892), 927 m.

Distribution. Northeast Atlantic region: southern Portugal, Azores, Rockall Bank; Mediterranean Sea: Alboran and Ionian Seas, Canyon de la Cassidaigne; North Atlantic: Iceland; Arctic Ocean: Barents Sea, northern Norway and Spitzbergen.

Description. Very thinly to relatively thickly encrusting, often very small, 1–2 cm², 1–2 mm thick, with a smooth, porous, membranous surface (Fig. 2A), or erect, almost cylindrical, irregularly lobate with an encrusting base (Fig. 2B), about 25 mm thick, texture firm, friable. Colour in life white, pale cream, dull yellow. BELUM Mc7745 was a pale cream crust on coral, with a pattern of channels on the surface (Fig. 2A).

Skeleton. Choanosome, a regular, areolate, multispicular isodictyal reticulation of spined strongyles with no fibre or tract development, spongin limited to the skeletal nodes (Fig. 2D). Ectosome a tangential isodictyal reticulation of individual spicules.

Spicules. Strongyles, (Fig. 2C, E; Table 1) with sparse, distinctive, prominent sharp concave spines concentrated in the middle of the spicule in short linear arrays, smooth at the extremities. Spicules may

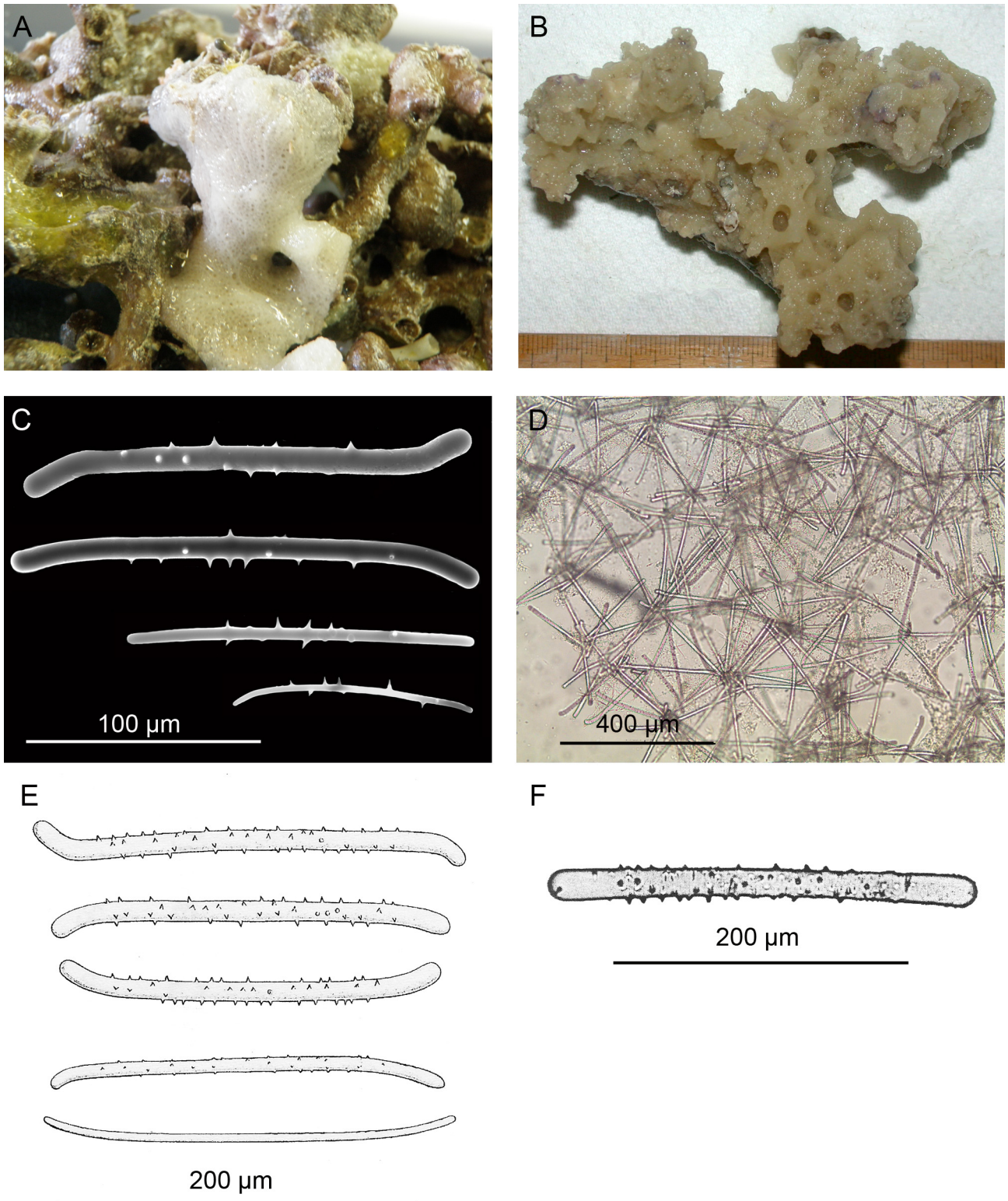


FIGURE 2. Morphology and megascleres of northeast Atlantic *Janulum spinispiculum* (Carter, 1876): **A.** BELUM Mc7745, West Coast of Ireland, deck photo, specimen 40 mm high x 30 mm wide; **B.** ZMA Por. 19461, southeast Rockall Bank, 680 m, specimen 10 cm long; **C.** lightly spined strongyles showing a range of morphologies, ZMA Por. 19461, photo E.J. Beglinger; **D.** thick section showing isodictyal arrangement of spined strongyles, BELUM Mc7745 (Fig. 2D reproduced with permission from Redmond *et al.* 2013; Fig. 5a); **E.** spined strongyles from Lundbeck (1902, Pl. XII, Fig. 4a–b), as *Metschnikowia spinispiculum*, east of Iceland; **F.** spined microfossil strongyle from a Neogene deep-sea core (about 3–23 Ma) from west of Iceland (reproduced from Bukry, 1978, Pl. 7, Fig. 20).

TABLE 1. Spicule dimensions (µm) of *Janulum* spp. Given as length [mean (min-max)] x width [mean (min-max)], n=20 if not indicated otherwise.

	Locality	Strongyles (µm)
<i>Janulum spinispiculum</i> (Carter, 1876)		
	Northeast Atlantic (Portugal)	
Carter (1876) Type species	North of Cape St Vincent, southern Portugal, 136–680 m	208 x 8
Topsent (1904) (As <i>Metschnikowia spinispiculum</i>)	Princess-Alice Bank, Azores, 200 m (Campagne of 1897), Pico et São Jorge Islands, 1250 m (Campagne of 1902)	—
	Northeast Atlantic (Ireland)	
ZMA 19460 BIOSYS/HERMES 2005	South-East Rockall Bank, 55.506° N 15.786°W, 680 m	223 (198–249) x 11 (9–12), n=10
ZMA 19461 BIOSYS/HERMES 2005	South-East Rockall Bank, 55.506° N 15.786°W, 680 m	222 (183–267) x 11 (10–13), n=10
ZMA 19579 BIOSYS/HERMES 2005	South-East Rockall Bank, 55.444° N 16.076° W, 780 m	200 (159–258) x 11 (8–13), n=10
ZMA Por.P.8676 slide, cruise ARKx1x13a Sp.6	Porcupine Seabight, Southwest of Ireland, 852 m	240 (204–261) x 12 (10–14), n=10
BELUM Mc7745	West Coast of Ireland, 1469 m	211 (192–225) x 12 (10–14)
BELUM Mc7798	West Coast of Ireland, 1469 m	225 (205–242) x 12 (8–15)
BELUM Mc7812	West Coast of Ireland, 1469 m	228 (196–252) x 12 (9–17)
BELUM Mc7816	West Coast of Ireland, 1350 m	232 (198–250) x 12 (9–15)
	Mediterranean Sea	
Vacelet (1969)	Canyon de la Cassidaigne, Mediterranean, 235 and 300 m	130–230 x 3–10 (Stn 24) 100–190 x 3–5 (Stn 35)
Boury-Esnault, Pansini & Uriz (1994)	Albaron Sea, western Mediterranean, 550 m	199 (148–218) x 8(5–9)
Calcinai <i>et al.</i> , (2013)	Ionian Sea, Straits of Sicily, Mediterranean, 539–639 m	172.3 ± 37.6 (115–220) × 7 ± 2.9 (2.5–10) 172.3 ± 37.6 (115–220) × 6.3 ± 2.4 (2.5–10)
	North Atlantic (Iceland)	
Lundbeck (1902) (As <i>Metschnikowia spinispiculum</i>)	East of Iceland, 307 m and Denmark Strait, 567 m	208–238 x 10–12
ZMA Por.P.8672 and 8673 slides from Lundbeck (1902)	East of Iceland, 307 m	235 (222–252) x 13 (12–14), n=10
	Arctic Ocean	
Hentschel (1929) (As <i>Metschnikowia spinispiculum</i>)	Spitzbergen, Svalbard Archipelago, northern Norway, Arctic Ocean, 192 m	208–238 ^{Note 1}
<i>Janulum</i> sp.		
Bukry (1978, Pl. 7, Fig. 20) Neogene core	West of Iceland	288 x 20
<i>Janulum princeps</i> sp. nov.		
Hinde & Holmes (1892: Pl. 7, Fig. 51) Holotype	Oamaru Diatomite, Runangan (Late Eocene)	160 x 20
<i>Janulum imago</i> sp. nov.		
NIWA 94196 Holotype	Louisville Seamount Chain, 1200–1600 m	268 (240–310) x 14 (10–18)
NIWA 93421 Paratype	Louisville Seamount Chain, 1200–1600 m	285 (250–320) x 15 (13–18)
NIWA 94185 Paratype	Louisville Seamount Chain, 1200–1600 m	282 (260–310) x 15 (10–18)

Note 1. Hentschel (1929: 901) Part I listed specimens of *Metschnikowia spinispiculum* from Spitzbergen but did not provide any spicule dimensions. In an overview (Part 2) of Arctic species he includes a fuller description of the species with spicule dimensions that appear to be taken directly from Lundbeck (1902).

have slightly swollen ends and may be straight or slightly bent at one or both ends, to the same or opposite sides. Immature spicules may be entirely smooth and may occasionally have mucronate ends. Spicule lengths and widths range from 159–267 x 8–17 µm in the Northeast Atlantic, 100–230 x 3–10 µm in the Mediterranean Sea, 208–252 x 10–14 µm to the east of Iceland, and 208–252 x 8–14 µm in the Arctic Ocean (Table 1).

Substrate, depth range and ecology. Found on stones (Carter 1876) and on the interstices of dead corals at 550 m depth at Gibraltar (Boury-Esnault *et al.* 1994). Collected from red and white corals on deep Mediterranean coral bank habitats at 623 and 539 m depth by Calcinai *et al.* (2013). Rockall Bank samples were all from cold water coral reefs, growing on dead branches of *Lophelia* and *Madrepora*, at depths of 680–780 m. Porcupine Seabight material came from 852 m. West coast of Ireland samples collected from cold water coral reefs, overgrowing dead *Lophelia*, 1350–1470 m.

Remarks. *Janulum spinispiculum* has a North Atlantic – Arctic Ocean distribution and varies considerably in depth from about 140 m off the coast of Portugal to about 1500 m on the Rockall Plateau region in the Northeast Atlantic. Spicule lengths and thickness vary accordingly (Table 1), with the shortest spicules being found in specimens in the Western Mediterranean, and the longest in specimens collected from the Rockall Bank area and east of Iceland region. The sponge also has a variable gross morphology that ranges from thinly encrusting patches to thickly encrusting with lobes.

Bukry (1978) figured a spined strongyle from a Neogene deep sea core (3–23 Ma) from the west of Iceland (Fig. 2F) that is more heavily spined and longer and thicker (Bukry 1978, Pl. 7, Fig. 20: spined strongyle 288 x 20 µm) than any spicule recorded from *J. spinispiculum* from Iceland (Fig. 2E) (Lundbeck 1902, Pl. 12, Fig. 4a–b: 208–238 x 10–12 µm), and the largest spicule measured from *J. spinispiculum* is 267 µm (ZMA 19461) which is somewhat smaller than the microfossil spicule. The microfossil spicule is considerably longer than the average length of spicules for *J. spinispiculum* for the general region (about 200–240 µm), suggesting that *Janulum* was present in the North Atlantic sometime during the Neogene but likely to be a species distinct from *J. spinispiculum*.

Janulum princeps Kelly & van Soest sp. nov. (Late Eocene)

(Fig. 1, 3A, Table 1)

Plocamia ? Hinde & Holmes 1892: 186, Pl. 7, Fig. 51.

Janulum sp. Wiedenmayer 1994: 79, Fig. 34, 1–3.

Material examined. None. Holotype named as the fossil species represented by the microfossil spicule cited in Hinde & Holmes (1892: 217, Pl 7, Fig. 51) as *Plocamia*? sp.

Type locality. The exact location of the original material is not specified other than it came from the Oamaru Diatomite member of the Waiareka Volcanic Formation at three possible locations in the Oamaru District (Lautour 1889; Edwards 1991): Cormacks Siding, near Weston (NZ Fossil Record Locality J41/f8888); Jackson's Paddock, Spring Hill Road, near Weston (NZ Fossil Record Locality J41/f8914); Bain's Farm, near Weston (NZ Fossil Record Locality J41/f8059).

Age. Runangan (Late Eocene) (36.4–34.6 Ma) (Edwards 1991).

Spicules. Megascleres—Strongyle (Fig. 3A, Table 1) bent abruptly at each end, ends bent to the same side of the spicule. Lightly spined, conical spines perpendicular to the shaft, aligned in short linear spiralling arrays, ends rounded and smooth, 160 µm long x 20 µm thick (modified from Hinde & Holmes 1892).

Substrate, depth range and ecology. A recent interpretation of the Oamaru Diatomite is that it started accumulating in a narrow basin to the east of a formerly active submarine volcanic ridge, at about 100–150 m water depth, under quiet subtropical offshore near-surface waters (Edwards 1991). The phylogenetic diversity of the Oamaru Diatomite is impressive with about 110 sponge species in 43 genera, considered to be an underestimate because Hinde & Holmes (1892) examined material from a restricted location and the sample was very small. The fauna consisted of 10% hexactinellid sponges and c. 90% demosponges, and was a mixture of what are typically deep-water and shallow reef genera today (Kelly & Buckeridge 2005).

Etymology. Named as the first record of the genus *Janulum* in New Zealand, recorded from the Oamaru Diatomite (*princeps*, first; L.).

Remarks. The Late Eocene microfossil spicule illustrated by Hinde & Holmes (1892) is indistinguishable from the peculiar spined strongyles so characteristic of living species of *Janulum* (Fig. 2, 3). The length of the

illustrated spicule (160 μm) (Fig. 3A) is shorter than the spicules of Northern Hemisphere *J. spinispiculum* (c. 200–240 μm ; Table 1) and the spicules of *J. imago* **sp. nov.** from the Louisville Seamount Chain (c. 240–320 μm) described below. The spicule was originally described as a “dumb-bell spicule of *Plocamia*” (Family Raspailiidae), but the identification was uncertain given that no additional information on spiculation, skeletal architecture or morphology was available at the time.

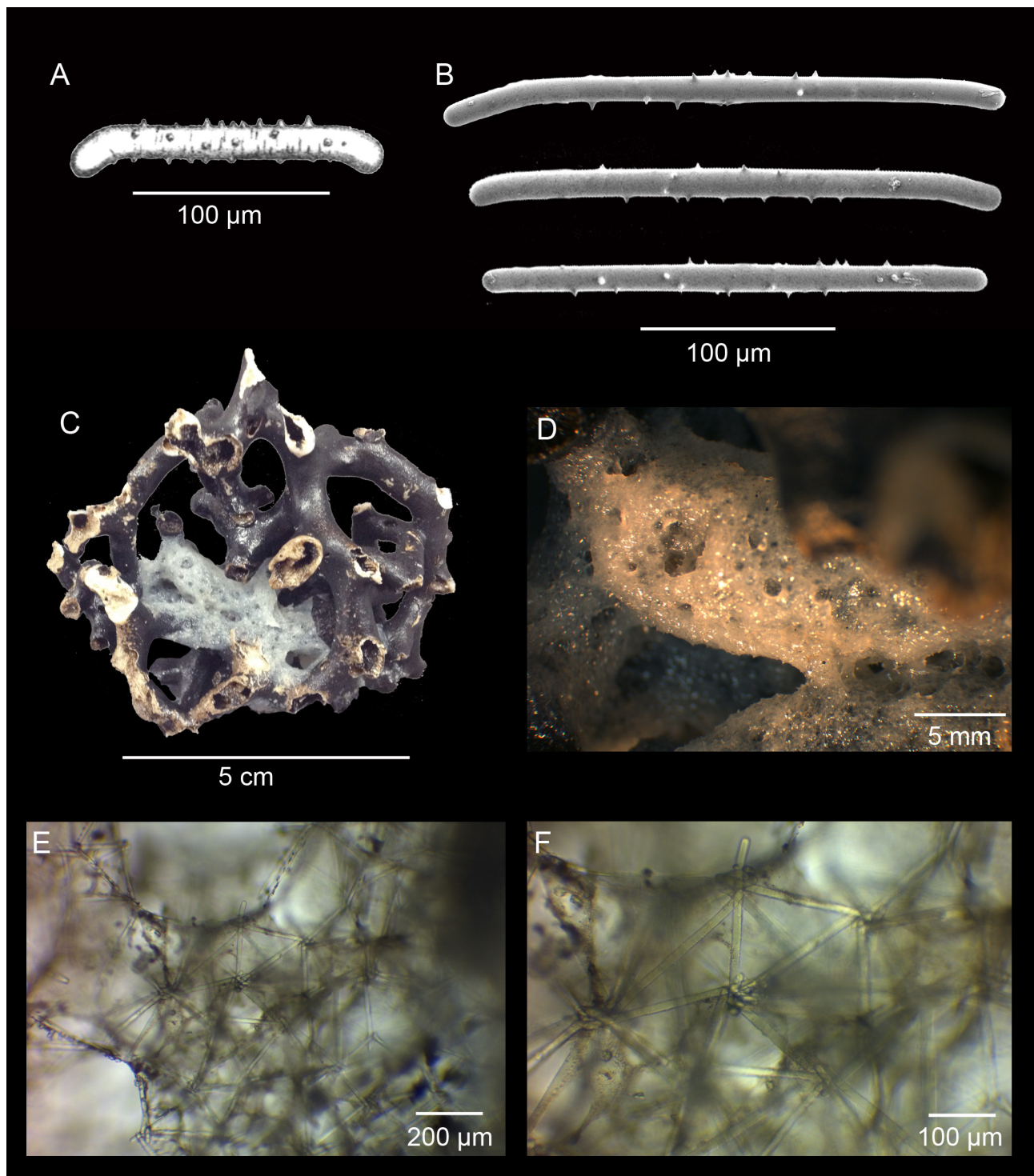


FIGURE 3. Morphology and megascleres of New Zealand *Janulum* species: **A.** *Janulum princeps* **sp. nov.**, spined strongyle, length 160 μm , width 20 μm , reproduced from Hinde & Holmes (1892: Plate 7, Fig. 51); *Janulum imago* **sp. nov.**, holotype NIWA 94196; **B.** spined strongyles showing a range of curvature of the ends of the spicules; **C.** preserved holotype encrusting the stony coral *Solenosmilia variabilis*; **D.** close-up of surface showing oscules and larger perforations; **E.** view through sponge surface showing choanosomal isodictyal reticulation and tangential reticulation lining two canals; **F.** close-up view of strongyles in isodictyal reticulation.

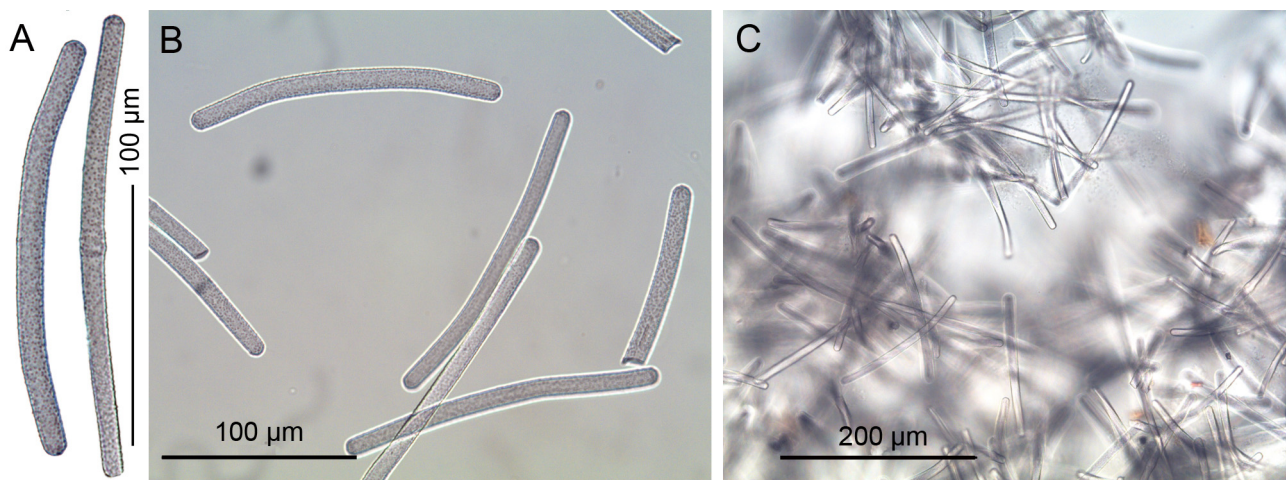


FIGURE 4. Megascleres and skeletal arrangement of *Janulum filholi* (Topsent, 1890), unregistered, Monaco Oceanographic Museum, Station 105 (1892), 927 m: **A, B.** acanthose strongyles; **C.** thick section showing multispicular isodictyal arrangement of acanthose strongyles in the skeleton (Fig. 4B, C reproduced with permission from Redmond *et al.* 2013; Fig. 5d, c).

Because of the striking similarity of the Oamaru Diatomite microfossil spicule to the unique, diagnostic spined strongyles of *J. spinispiculum*, and because the microfossil spicule is shorter than those of living *J. imago* **sp. nov.**, we have taken the step of naming the fossil species with confidence. It is interesting to note the absence of spicules resembling those of *J. princeps* **sp. nov.**, in the recent review of the siliceous sponge fauna of southern Australia, around the same period of the Late Eocene (Łukowiak 2015). *Janulum princeps* **sp. nov.** is the first record of the genus in New Zealand, the South Pacific and Southern Ocean waters.

Janulum imago* Kelly & van Soest **sp. nov.*

(Fig. 1, 3B–F, Table 1)

Material examined. Holotype—NIWA 94196, Paratypes—NIWA 93421, 94185: TAN1402/31, Lot 224, Forde Guyot, Louisville Seamount Chain, International Waters, 35.317° S, 170.452° W, 1205–1600 m, 11 Feb 2014, collected by epibenthic sled from RV *Tangaroa*.

Type location. Forde Guyot, Louisville Seamount Chain.

Distribution. Known only from Forde Guyot, Louisville Seamount Chain.

Description. Thinly encrusting in the interstices of stony coral *Solenosmilia variabilis* (Fig. 3C), holotype, about 4 cm length, 2 cm wide and 1–2 mm thick. Surface follows undulations of coral substrate and is punctate with flush oscules 1 mm diameter. Larger, elongate openings are also present (Fig. 3D). Interior cavernous. Texture in life firm, crisp, but very delicate and friable. Colour in life is translucent pale blue (Fig. 3C).

Skeleton. Choanosome and ectosome a cavernous, extremely fragile isodictyal reticulation of megascleres (Fig. 3E, F). Ectosome undifferentiated from underlying choanosome, consisting of a tangential isodictyal reticulation with the ends of spicules visible occasionally, protruding from the surface membrane (Fig. 3D).

Spicules. Megascleres—Strongyles (Fig. 3B, F; Table 1), faintly to acutely curved at each end, ends are orientated towards the same side or opposite sides of the spicule. Perfectly straight spicules and those with an acute bend at only one end are less common. Some spicules are slightly sinuous. Lightly spined, concave spines project perpendicular to the shaft, aligned in short spiralling linear arrays, ends rounded and smooth, slightly enlarged. Spines appear to be hollow in some spicules, 278 (240–320) × 15 (10–18) µm.

Substrate, depth range and ecology. Encrusting the interstices of dead stony coral rubble of the species *S. variabilis*, a CITES protected species and important habitat former in deep water around New Zealand (Tracey *et al.* 2011). Forde is an elongated guyot, a seamount with a flat top, oriented northwest-southeast with a summit plateau at 1000–1100 m deep with flanks that are deeply incised with gullies and ridges. The plateau edge and upper flanks are exposed bedrock with sand and intact stony coral (Clark *et al.* in press 2015).

Etymology. Named for the “echo” of the genus *Janulum*, first recorded from the Late Eocene in the region of

Zealandia that formed the Oamaru Diatomite, now found living on the Louisville Seamount Chain (*imago*, echo; L.).

Remarks. *Janulum imago* **sp. nov.** is a small, fragile sponge, inhabiting a similar deep-water dead coral habitat to the genus type *J. spinispiculum* in the Mediterranean (Boury-Esnault *et al.* 1994; Calcinaï *et al.* 2013). The spined strongyles are remarkably similar in their overall shape and ornamentation to those of *J. spinispiculum* (c. 200–240 µm), but those of *J. imago* **sp. nov.** are almost 100 µm longer and are double the thickness. The spicules of *J. imago* **sp. nov.** are also much longer than the spicule of *J. princeps* **sp. nov.** illustrated in Hinde & Holmes (1892: 160 µm long x 8 µm thick), clearly differentiating it from the fossil species.

Discussion

Janulum spinispiculum, *J. princeps* **sp. nov.** and *J. imago* **sp. nov.** are unique amongst marine Porifera in the possession of small strongyles with smooth flexed or straight ends and a central portion of the shaft that is lightly and linearly spined. The ends of the spicules are always smooth without spines and more often than not are abruptly bent towards the same side of the spicule. *Janulum filholi*, originally described as a species of *Reniera* (Order Haplosclerida, Family Chalinidae Gray) and recently transferred to *Janulum* by Redmond *et al.* (2013), differs from the species above in the possession of gently curved, occasionally centrotylote strongyles that are acanthose or roughened in their entirety (Fig. 4A, B) in a chalinid skeleton arrangement (Fig. 4C). They are not spined as in the unique spicules of *Janulum* spp. and the overall form of the spicule is that of a curved strongyle similar to those in several species of *Haliclona* Grant (Family Chalinidae).

Reniera filholi was transferred to *Janulum* by Redmond *et al.* (2013) on the basis of what they perceived to be shared characters: both species have non-smooth diactinal spicules in a typically chalinid skeletal arrangement. We disagree with this move as the comparison is superficial and the spicules are vastly different: those of *J. filholi* are curved strongyles and those of *Janulum* spp. are abruptly flexed to straight strongyles, those of *J. filholi* are acanthose or roughened in their entirety while those of *Janulum* spp. are lightly covered in single perpendicular spines in spiralling lines around the centre of the shaft only. We conclude that *J. filholi* is probably not congeneric with other species of *Janulum*; we hereby transfer the species to *Haliclona sensu lato incertae sedis*. We also relegate the species to Family Chalinidae *incertae sedis* until the affinity of haplosclerid species possessing acanthose or roughened oxeas is resolved.

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