RESOLVING THE '*JASPIS STELLIFERA*' COMPLEX

JOHN A. KENNEDY

Kennedy, J.A. 2000 06 30: Resolving the '*Jaspis stellifera*' complex. *Memoirs of the Queensland Museum* **45**(2): 453-476. Brisbane. ISSN 0079-8835.

Five species included in synonymy with *Jaspis stellifera* (Carter, 1879) (Coppatiidae) by authors were re-evaluated from type material for the first time since originally described. Original descriptions were found to be mostly incomplete, with subsequent synonymies excessive. Only two (*Stellettinopsis coriacea* Carter, 1886 and *Stellettinopsis purpurea* Carter, 1886) are retained in synonymy with *J. stellifera*. *Stellettinopsis carteri* Ridley, 1884 is synonymised with *Rhabdastrella globostellata* (Carter, 1883) (Ancorinidae). *Stellettinopsis lutea* Carter, 1886 is retained in *Jaspis* and *S. tuberculata* Carter, 1886 is referred to *Stelletta*, both reinstated as valid species. Two new species (*Asteropus radiocrusta, Jaspis cristacorrugatus*) were described from one misidentified syntype of *S. tuberculata* Carter, 1886 and other new material superficially resembling '*J. stellifera*' of authors. Tropical and subtropical specimens of '*J. stellifera*', comprising much of the material described in the marine natural products literature, were found to have been misidentified specimens of *R. globostellata*, apparently lacking triaenes. With the exception of *R. globostellata*, which has a distribution throughout much of tropical and subtropical Indo-Pacific, species were found to have restricted distributions in Victorian and Tasmanian waters. ❐ *Porifera, Demospongiae, Coppatiidae, Ancorinidae, Jaspis stellifera, taxonomy, new species, revision, Australia.*

John A. Kennedy, Queensland Museum, South Brisbane 4101, Australia (e-mail: JohnK@qm.qld.gov.au); 20 October, 1999.

The name '*Jaspis stellifera*' (Carter, 1879) is widely cited in the marine natural products chemistry and other biological literature (e.g. Ravi et al., 1981; Ravi & Wells, 1982; McCaffrey & Endean., 1985; Fuerst et al., 1999; Wilkinson et al., 1999). This species has an alleged distribution throughout the tropical West Pacific region, also reportedly occurring along Australia's NE and S coasts, extending into Victoria and Tasmania (Hooper & Wiedenmayer, 1994). Chemical investigations of various populations of '*Jaspis stellifera*' discovered two molecule types: cyclic peptides and malabaricane-type triterpenes (van Soest & Braekman, 1999). However, van Soest & Braekman (1999) concur with Fusetani & Matsunaga (1993) that cyclic peptides are most probably products of various microsymbionts, since similar compounds have been isolated from many orders of Demospongiae, cyanobacteria and ascidians. Conversely, malabaricane-type triterpenes have been reported from specimens of '*J. stellifera*' from Fiji and the Great Barrier Reef (Ravi et al., 1981; Ravi & Wells, 1982), and are suggested as good markers for *Stelletta* s.l. (including closely related *Rhabdastrella*) (van Soest & Braekman, 1999). Consequently, van Soest & Braekman (1999) proposed that specimens of '*J. stellifera*' containing malabaricane triterpenes belong to *Stelletta*, lacking triaenes, and not to *Jaspis*.

Jaspis stellifera was erected by Carter (1879), as *Amorphina stellifera*, for material from Tasmania. Within the following decade, several morphologically similar species were described from Australia, including *Stellettinopsis lutea* Carter, 1886b, *S. tuberculata* Carter, 1886a, *S. coriacea* Carter, 1886a and *S. purpurea* Carter, 1886b, from Victoria, and *S. carteri* Ridley, 1884, from Torres Strait, N Queensland. Shaw (1927), under the direct supervision of Maurice Burton of the BMNH, synonymised all these species into *Jaspis stellifera*. Subsequently, '*J. stellifera*' was described from the Low Isles (Burton, 1934) and Heron Island (Bergquist, 1969) on the Great Barrier Reef, apparently filling the gap in distribution between Victoria in the south and Torres Strait in the north. In Bergquist's (1969) remarks, however, she disputed Shaw's (1927) inclusion of *S. coriacea* and *S. purpurea* in the synonymy of *Jaspis stellifera*, based on two inconsistencies in the published data, both of which are demonstrated here to be invalid or unsupported (see remarks for *J. stellifera*, below). Nevertheless, Bergquist's (1969) revised synonymy for *J. stellifera* was subsequently adopted by Wiedenmayer (1989), who examined whole type specimens only superficially, and this

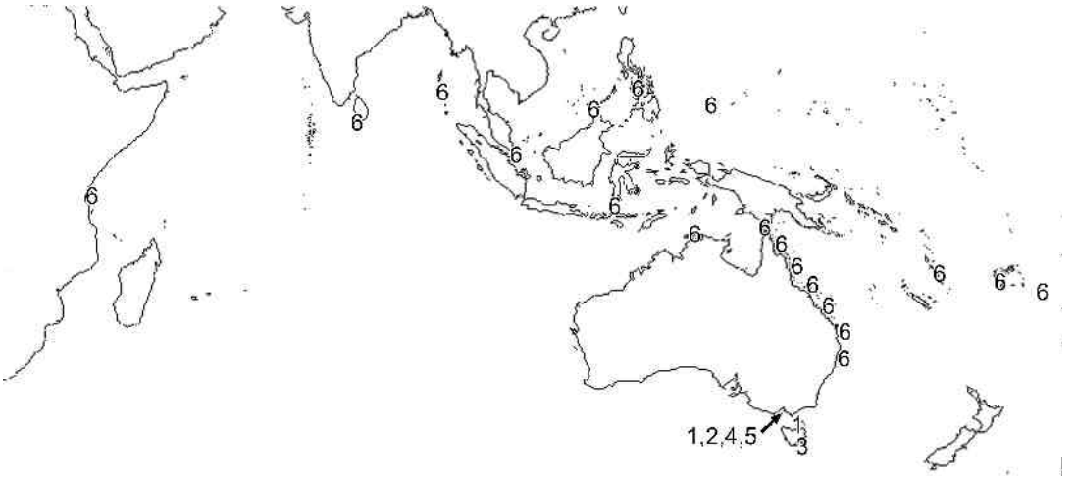

FIG. 1. Known distributions of species described in this paper. 1 = *Jaspis stellifera*; 2 = *Jaspis lutea*; 3 = *Jaspis cristacorrugatus*; 4 = *Asteropus radiocrusta*; 5 = *Stelletta tuberculata*; 6 = *Rhabdastrella globostellata.*

decision was perpetuated in the Porifera volume of the Zoological Catalogue of Australia (Hooper & Wiedenmayer, 1994).

In light of the probable widespread misidentifications of tropical West Pacific specimens of '*J. stellifera*', it is appropriate to re-evaluate this species complex, to produce a better informed synonymy and a revised distribution of species within this complex. Thus it was necessary to redescribe comprehensively all type material, given that most original descriptions of nominal species were incomplete, illustrated poorly and, as discovered here, often incorrect. This paper re-evaluates all *Jaspis* species described previously from Australia, since they are all contained in the '*J. stellifera*' complex, re-examining key voucher material and relevant type specimens, and providing a revision of species and their corresponding distributions.

MATERIALS AND METHODS

Histological techniques for light microscopy and scanning electron microscopy (SEM) follow Hooper (1996).

Morphometric analysis of spicules was conducted using a light microscope and camera-lucida, with reference to a template drawn from a stage micrometer. At least 25 spicules of each spicule category were measured in all specimens (except where noted). Measurements refer to length and width of monactinal spicules, rhabd length and clad length of tetractinal spicules, and diameter of astrose microscleres. Measurements refer to maximum dimensions of each spicule, denoted as size-range (and mean in parentheses) for each spicule type. All measurements are given in micrometres unless stated otherwise. Centrum percentages for each aster type were also noted.

Conventional morphological terms follow Boury-Esnault & Rützler (1997).

Abbreviations. AIMS, Australian Institute of Marine Science, Townsville; BMNH, The Natural History Museum, London; LMJG, Abteilung für Zoologie am Landes-museum Joanneum (Landes Museum Jubileum Graz), Graz; NTM, Northern Territory Museum of Arts and Sciences, Darwin; GBR, Great Barrier Reef, Queensland; NCI OCDN-, United Sates National Cancer Institute, Coral Reef Research Foundation shallow water collection contract, Chuuk State & Republic of Palau, (1992-present); NCI Q66C-, United States National Cancer Institute, Australian Institute of Science shallow water collection contract (1984-91); ORSTOM, Institut Français de Recherche Scientifique pour le Développement en Çoopération, Centre de Noumea; QM, Queensland Museum, Brisbane.

RESULTS

Changes to the synonymy of *Jaspis stellifera*, extending from the work of Shaw (1927) to Bergquist (1969) and the present study, are presented in Table 1. These data propose major changes to species groupings within the '*J. stellifera*' complex. Figure 1 summarises the revised known distributions for species included in this complex.

TABLE 1. Changing taxonomic status of the '*Jaspis stellifera*' complex. Bold type = species considered valid; species in parentheses are considered synonyms of the valid species preceding; 1,2 = originally syntypes for *Stellettinopsis tuberculata* (Carter); 3 = identified by Bergquist (1969) as *Jaspis stellifera* from Heron Island, Great Barrier Reef; 4 = included to avoid possible confusion with *Jaspis lutea*.

1879-1886 (6 species): ***Amorphina stellifera*** Carter, 1879; ***Stellettinopsis coriacea*** Carter, 1886a; ***Stellettinopsis purpurea*** Carter, 1886b; ***Stellettinopsis lutea*** Carter, 1886b; ***Stellettinopsis carteri*** Ridley, 1884; ***Stellettinopsis tuberculata*** Carter, 1886a
Shaw (1927) (1 species): ***Jaspis stellifera*** (syn. *Jaspis coriacea, Jaspis purpurea, Jaspis lutea, Jaspis carteri, Jaspis tuberculata*)
Bergquist (1969) (3 species): ***Jaspis stellifera*** (syn. *Jaspis lutea, Jaspis carteri, Jaspis tuberculata*); ***Jaspis coriacea***; ***Jaspis purpurea***
Current assignment (7 species): ***Jaspis stellifera*** (syn. *Jaspis coriacea, Jaspis purpurea*); ***Jaspis lutea***; ***Stelletta tuberculata***; ***Asteropus radiocrusta*** sp. nov.[1]; ***Crella* sp.**[2]; ***Rhabdastrella globostellata***[3] (syn. *Jaspis carteri*); ***Jaspis cristacorrugatus*** sp. nov.[4]

SYSTEMATICS

PORIFERA Grant
DEMOSPONGIAE Sollas
TETRACTINOMORPHA Lévi
ASTROPHORIDA Lévi, 1973

COPPATIIDAE Topsent, 1898

DEFINITION. Encrusting to massive growth forms; megascleres only oxeas forming a confused, vaguely radial choanosomal skeleton; megascleres also form a tangential layer in ectosome; triaenes absent; microscleres euasters (never sterrasters), sometimes sanidasters (modified from Hooper & Wiedenmayer, 1994).

REMARKS. A summary of synonymies and discussion of the family are provided by Hooper & Wiedenmayer (1994). Hajdu & van Soest (1992) suggested that the absence of triaenes is a suspect diagnostic character for the family and proposed that the concept of Coppatiidae be retained provisionally, pending more detailed re-evaluation of its probable polyphyletic nature.

Jaspis Gray, 1867

Coppatias Sollas, 1888: 206 (Type species: *Stellettinopsis coriacea* Carter, 1886, by originaldesignation).
Astropeplus Sollas, 1888: 416, 422 (Type species: *Astropeplus pulcher* Sollas, 1888, by monotypy).

TYPE SPECIES. *Vioa johnstonii* Schmidt, 1862: 78, by monotypy.

DEFINITION. Coppatiidae with euasters as microscleres.

REMARKS. Lendenfeld (1896) demonstrated that *Astropeplus pulcher* Sollas, 1888 (type species of *Astropeplus*) was synonymous with *Vioa johnstonii* Schmidt, 1862 (type species of *Jaspis*), but mistakenly placed it in *Xenospongia* Gray, 1858 (family Tethyidae). In recognising this, Topsent (1898) relegated *V. johnstonii* to *Coppatias* Sollas, 1888, rejected Gray's generic name *Jaspis* on the basis that it was of no scientific value, and then later reinstating *Jaspis* as a valid genus (Topsent, 1904). In ratifying this later decision, Dendy (1916) again synonymised *Coppatias* with *Jaspis*, the senior name.

Hajdu & van Soest (1992) questioned whether or not *Jaspis* constituted a monophyletic assemblage, since two species groups were recognisable based on the presence or absence of 'microxeas'. However, this is not accepted here as these 'microxeas' are considered to be a smaller category of oxeote megascleres. The existence of graded oxeote size-distributions with intermediate size categories often presents difficulties in differentiating between smaller ('microxeas') and larger oxeotes. Hence, the present concept of *Jaspis* retains both assemblages, although it is acknowledged that further work is required to reconcile the taxonomic significance of smaller oxeotes.

Jaspis stellifera (Carter, 1879)
(Figs 1, 2, Table 2)

Amorphina stellifera Carter, 1879: 344.
Stellettinopsis stellifera; Ridley, 1884: 477.
Coppatias stellifera; Sollas, 1888: 208.
Jaspis stellifera; Shaw, 1927: 422.
not *Jaspis stellifera*; Burton, 1934: 522.
Stellettinopsis coriacea Carter, 1886a: 126.
Coppatias coriaceus; Sollas, 1888: 207.
Jaspis coriacea; Hooper & Wiedenmayer, 1994: 143.
Stellettinopsis purpurea Carter, 1886b: 459.
Coppatias purpureus; Sollas, 1888: 207.
Jaspis purpurea; Hooper & Wiedenmayer, 1994: 143.

MATERIAL. HOLOTYPE: BMNH1869.1.22.25 (dry): Tasmania (also marked with Carter no 315.E.*h*.19). Holotype of *Stellettinopsis coriacea* Carter, 1886a BMNH1886.12.15.441 (dry): Port Phillip Heads, Victoria. Holotype of *Stellettinopsis purpurea* Carter, 1886b BMNH1886.12.15.51 (wet): Westernport Bay, Victoria. OTHER MATERIAL: BMNH unregistered (second specimen in same container as holotype and also marked

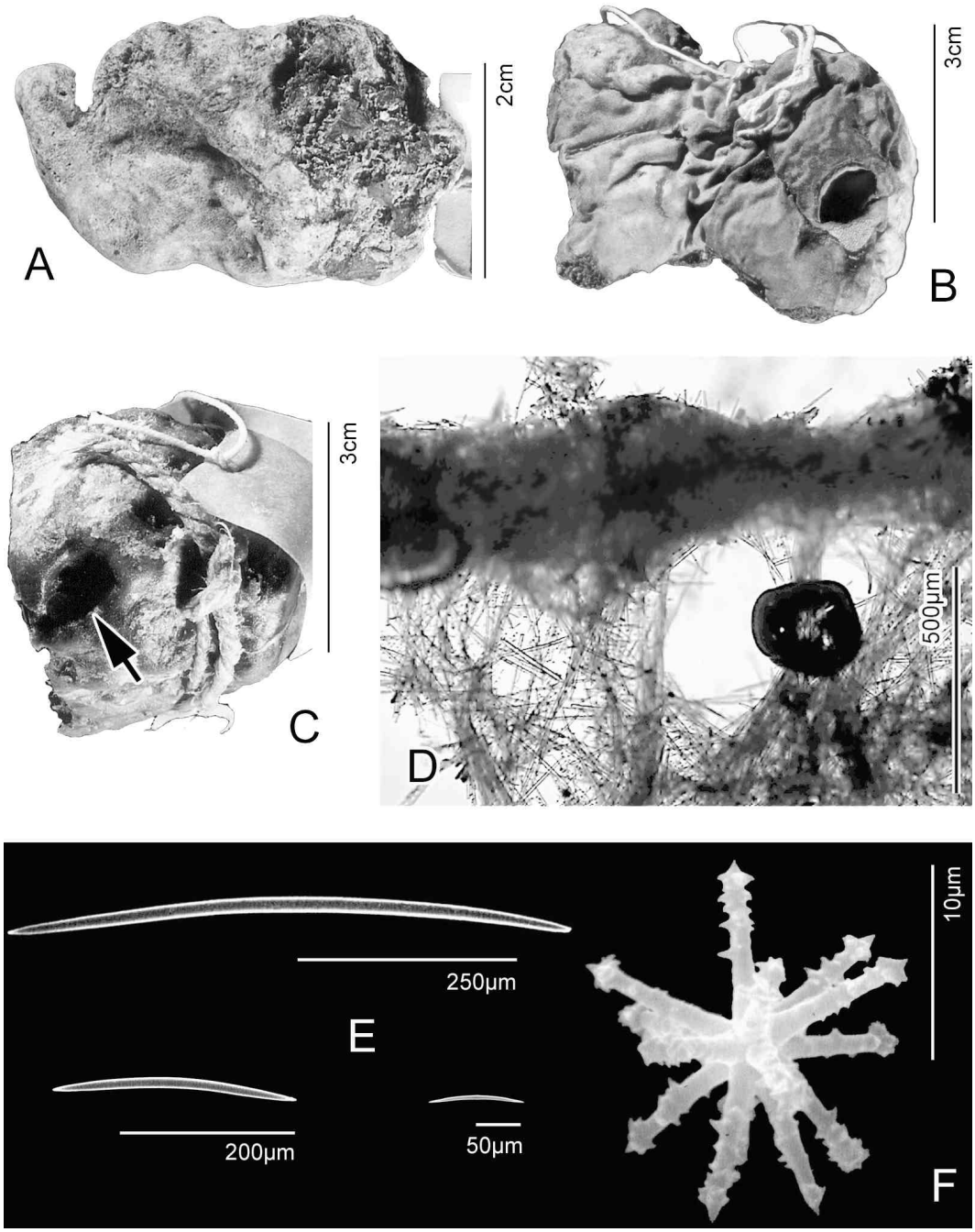

FIG. 2. *Jaspis stellifera* (Carter, 1879) (holotype BMNH1869.1.22.25). A, holotype; B, holotype of *S. coriacea* BMNH1886.12.15.441; C, holotype of *S. purpurea* BMNH1886.12.15.51 (arrow indicates position of oscule); D, section through peripheral skeleton; E, oxeas; F, oxyaster.

TABLE 2. Comparison between present and published descriptions of *Jaspis stellifera*. Measurements in µm, denoted as range (and mean) (N=25). L = length; W = width; D = diameter.

	Oxeas	Oxyasters
Holotype BMNH1869.1.22.25	L 113-(388)-726 W 3-(12)-16	D 11-(15)-22
Holotype (Original description Carter, 1879)	L 725; W 17	D 17
BMNH unregistered Bowerbank collection Carter no. 315,E,h,19	L 120-(354)-730 W 3-(10)-16	D 7-(12)-16
BMNH1886.12.15.441 holotype of *J. coriacea*	L 62-(265)-898 W 2-(8)-21	D 7-(11)-13
BMNH1886.12.15.51 holotype of *J. purpurea*	L 53-(347)-781 W 3-(10)-18	D 7-(10)-12
NMV F5193 (Wiedenmayer, 1989)	L 89-(364.8)-682.8 W 2-(9)-18	D 8-(12)-15

with Carter no. 315.E.*h*.19) (dry): South Australia, 1859, J.S. Bowerbank collection. COMPARATIVE MATERIAL: Holotype of *Vioa johnstonii* Schmidt, 1862 LMJG 15648/0 Sebenico, Adriatic Sea. Syntype of *V. johnstonii var.* Schmidt, 1868 LMJG 15256/0: Sebenico, Adriatic Sea.

HABITAT DISTRIBUTION. Subtidal to 37m depth, amidst dense algal growth; Westernport Bay and Port Phillip Heads, Victoria; Erith Island, Bass Strait; Tasmania.

DIAGNOSIS. Irregularly lobate-massive; dull pinkish purple-brown alive; surface optically smooth, even, unornamented; ectosomal skeleton consisting of a densely packed tangential arrangement of oxeas largely obscuring microscleres; choanosomal skeleton of singular and loose bundles of oxeas in confused arrangement, with scattered oxyasters; oxeas in wide size-range (length 53-(339)-898, width 2-(11)-21), microspined oxyasters (diameter 7-(12)-22).

DESCRIPTION. *Shape*. Holotype massive, amorphous, irregularly lobate, may envelop other materials such as algae, shells or detritus. Height 4.7cm, width 2.6x2.5cm. Other specimens up to 5.5x4.5x3.5cm.

Colour. Fresh specimens described as dull-purple to brownish-drab (5RP 5/6-8) (Wiedenmayer, 1989); dry holotype creamy-white (Munsell 2.5Y 8/3) with dark-pink (2.5R 5/4) diffuse patches scattered over surface, with greyish-beige (7.5YR 8/2) choanosome; ethanol preserved specimen dark greyish-purple (5RP 3/2) throughout.

Oscules. Not visible in dry holotype but Carter (1879) describes 'vents in pit-like depressions'; one incomplete specimen (BMNH1886.12.15.51) has a single apical depression approximately 4mm deep and 11mm in greatest width, containing several oscules up to 3mm diameter.

Texture. Firm, compressible, leathery.

Surface characteristics. Opaque, optically smooth, even, unornamented.

Ectosome. Thin, approximately 400-700 thick; skeleton composed of oxeas in confused arrangement, with oxyasters scattered throughout but largely obscured, and with clumped pinkish-purple pigment cells scattered over surface.

Choanosome. Permeated by canals approximately 0.15-1.10mm diameter, with smallest canals near periphery; skeleton comprised of loose, multispicular bundles of oxeas in confused arrangement, with abundant scattered oxeas and oxyasters; mesohyl contains clumps of scattered, dark-pinkish pigment bodies approximately 2-8 diameter, and spherical translucent and transparent bodies.

Megascleres. (Refer to Table 2 for spicule dimensions) Oxeas in one wide size-range, typically curved over their entire length; variations rare but include straight, lightly flexuous, singly and doubly bent, and styloid forms.

Microscleres. (Refer to Table 2 for spicule dimensions) Oxyasters with approximately 10-20 fine, lightly tapering rays with recurved microspines on distal two-thirds of rays, centrum approximately 13% of spicule diameter; variations rare, but include vestigial spination over full ray length, to exaggerated clumping of microspines on distal portion of ray, thus vaguely resembling tylote terminations.

REMARKS. The BMNH specimen box containing the holotype includes two specimens. Only one specimen is pierced by a tag bearing the registration number BMNH69.1.22.25, along with the locality 'Van Diemen's Land' (Tasmania). The other specimen is from the J.S. Bowerbank collection and comes from 'Southern Australia'. Carter gave both specimens his number '315, E, *h*, 19'. While both specimens are confirmed here to belong to *J. stellifera*, only the specimen bearing the BMNH tag is taken here to be the holotype.

Little information is added here to the original description except for some detail regarding spiculation. As previously noted by Wiedenmayer (1989), the oxeas have a wide size-range, with little concordance between length and width. While smaller oxeas are relatively abundant, the presence of many intermediate sizes precludes recognising more than one variable size-class of

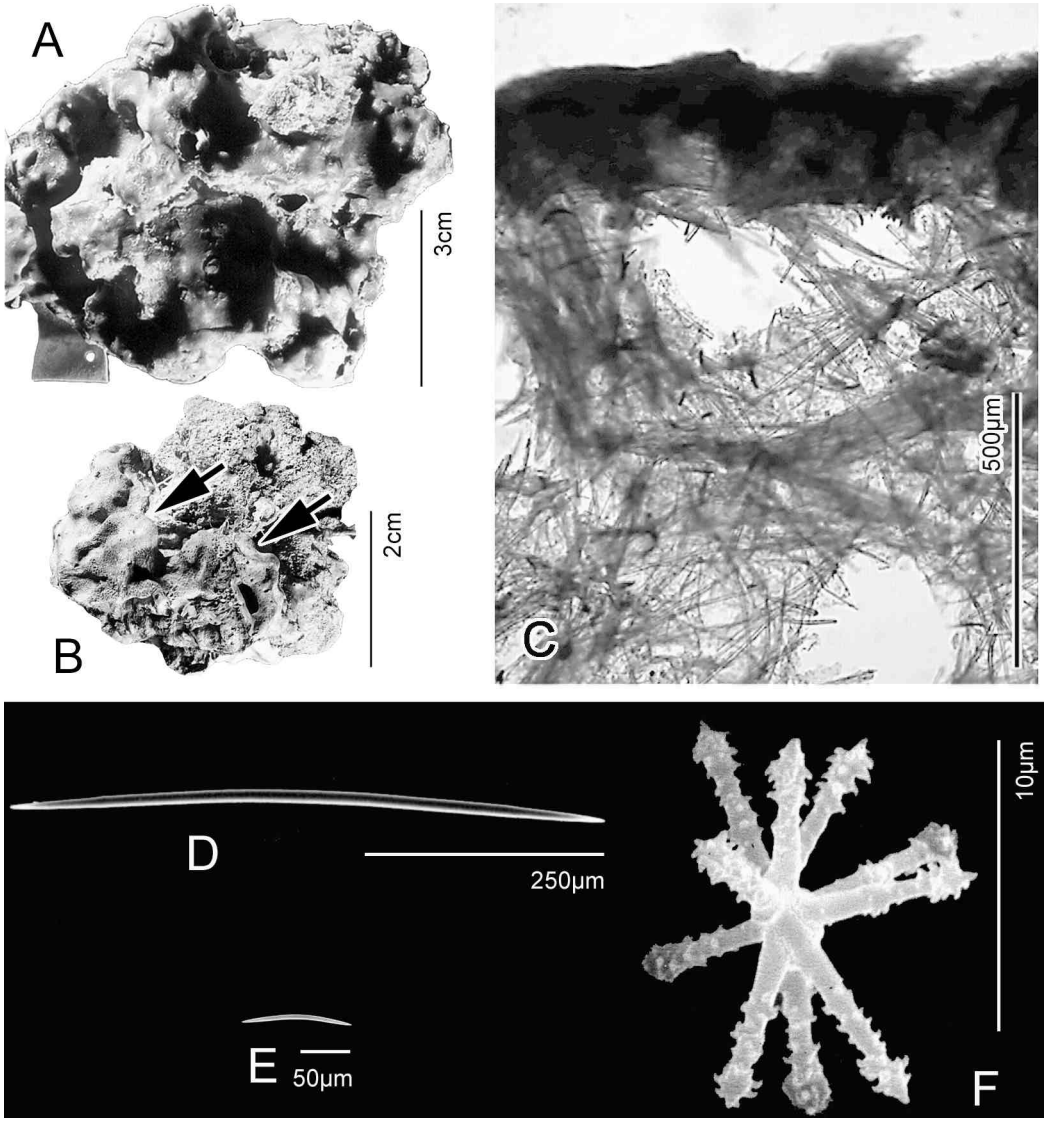

FIG. 3. *Jaspis lutea* (Carter, 1886) (lectotype BMNH1886.12.15.356). A, lectotype; B, paralectotype BMNH1886.12.15.93 (arrows indicate position of specimen on substrate); C, section through peripheral skeleton; D, large oxea; E, small oxea; F, oxyaster.

oxeas. SEM examination revealed that microspination of the oxyaster rays is commonly recurved toward the centrum. Spicule measurements undertaken here confirmed Wiedenmayer's (1989) suspicion that Carter provided only the measurements for the largest spicules, ignoring the range of spicule sizes actually present.

Stellettinopsis coriacea Carter, 1886a and *S. purpurea* Carter, 1886b are retained here in synonymy with *J. stellifera* (Carter, 1879), based on re-examination of all type specimens, revealing that they are morphologically identical in virtually all respects. This partially ratifies Shaw's (1927) synonymy for *J. stellifera*, and contrasts to Bergquist's (1969) revised syn onymy. While Shaw's synonymy was excessive, Bergquist's difficulty in accepting the inclusion of *S. coriacea* and *S. purpurea* was based on two

supposed inconsistencies in the published data, both of which are invalid. Firstly, Bergquist noted that Shaw's specimen reportedly did not have asters; secondly, she stated that '*Jaspis coriacea* and *J. purpurea* have two distinct categories of asters, a feature never noted in *J. stellifera*'. In this debate, it is unimportant whether or not Shaw's specimen had asters because it was not the type. Carter's (1879) original description of the holotype clearly described only one category of aster, confirmed here from re-examination of type material. Bergquist's (1969) second point of disputation is also unsupported since original descriptions of *S. coriacea* and *S. purpurea* also include only one category of aster, rather than two, also confirmed from re-examination of type material.

Original descriptions of *S. coriacea* and *S. purpurea* report the presence of 'microxeas', whereas re-examination of type material revealed that, as described above, these microxeas represent only smaller examples of a wide size-range of oxeas, with many intermediate sizes.

Comparison between *J. stellifera* and the type species of *Jaspis* (*Vioa johnstonii* Schmidt, 1862), including both type material and published descriptions (Dendy, 1916; Burton & Rao, 1932) confirms that *J. stellifera* is a true *Jaspis*. Both *J. johnstonii* and *J. stellifera* have a tangential ectosome composed of oxeote spicules and a choanosome containing oxeotes in confused and vaguely radial arrangement. Euasters are oxyasters, some with rays that are minutely microspined (a feature not described previously for the type species). *Jaspis johnstonii* differs in having a bimodal size distribution of oxeas (with the larger size-class primarily restricted to the choanosome), whereas *J. stellifera* has a wide, unimodal size-distribution. Irrespective, both clearly belong to the present concept of *Jaspis*, with the issue of unimodal versus bimodal oxeote size distributions remaining unresolved.

Examination of a slide of Burton's (1934) specimen (BMNH1930.8.13.86) identified as '*Jaspis stellifera*' from the Low Isles, GBR, revealed that it too had been misidentified (Hooper et al., 1999; present study). Burton's specimen clearly differs from *J. stellifera* in lacking a distinct ectosome and in having two categories of asters, one being slightly bipolar and resembling diplasters or short spirasters. Gross morphological differences cannot be commented on here since only a slide was available for examination, and Burton did not publish any descriptive detail regarding the specimen. It may well represent a new species, since it does not correspond to any *Jaspis* species described previously from Australian waters.

Wiedenmayer's (1989) description of a specimen of *J. stellifera* from southern Australia included only superficial comparison of his material with various type specimens (*Amorphina stellifera*, *Stellettinopsis tuberculata* and *S. lutea*). Because of circumstances preventing him from examining slides of these types, he was unable to reveal the distinctive nature of each of these species. This is discussed further below.

Jaspis lutea (Carter, 1886)
(Figs 1, 3, Table 3)

Stellettinopsis lutea Carter, 1886b: 459.
Coppatias luteus; Sollas, 1888: 207.

MATERIAL. LECTOTYPE: BMNH1886.12.15.356 (wet): Westernport Bay, Victoria, coll. J.B. Wilson. PARALECTOTYPE: BMNH1886.12.15.93 (dry): Westernport Bay, Victoria, coll. J.B. Wilson. OTHER MATERIAL: BMNH1954.2.12.256 (slide of type prepared by A. Dendy).

HABITAT DISTRIBUTION. Subtidal to 13m depth; Westernport Bay, Victoria.

DIAGNOSIS. Lobate-massive, agglomerating substrate fragments; surface lobate, tuberculate; ectosome distinct, comprising a fine layer of small oxeas overlaying tangentially-arranged larger oxeas; choanosomal skeleton primarily a confused arrangement of oxeas; oxeas in two size classes (larger oxeas length 180-(516)-712, width 6-(12)-19; smaller oxeas length 52-(81)-110, width 1-(3)-5), microspined oxyasters (diameter 8-(13)-18).

DESCRIPTION. *Shape*. Irregularly lobate, agglomerating calcareous substrates, sand and shell fragments. Types incomplete, with largest portion 8cm high, 12x8cm wide.

Colour. Live colouration unknown; wet lectotype has tan-brown surface (Munsell 2.5Y 5-7/6) with golden-brown choanosome (2.5Y 7/8); dry paralectotype has dull-creamy yellow surface (2.5Y 6-7/4) with dull golden-yellow choanosome (2.5Y 7/8).

Oscules. Numerous, approximately 0.5-8.2mm diameter, flush with, and regularly distributed over surface.

Texture. Firm, slightly friable, leathery.

Surface characteristics. Opaque, membranous, optically smooth, uneven, with clusters of lobate tubercles irregularly distributed over surface.

TABLE 3. Comparison between syntypes and published descriptions of *Jaspis lutea*. Measurements in µm, denoted as range (and mean) (N=25). L = length; W = width; D = diameter; * Spicule dimensions not included in Carter's (1886b) original description, but included by Sollas (1888).

	Large oxea	Small oxea	Oxyasters
Lectotype BMNH1886.12.15.356 wet	L 228-(535)-670 W 6-(12)-19	L 52-(83)-110 W 1-(3)-5	D 8-(13)-16
Paralectotype BMNH1886.12.15.93 dry	L 180-(496)-712 W 6-(11)-16	L 60-(79)-110 W 2-(3)-5	D 9-(13)-18
Resumé description* (Sollas, 1888)	L 684; W 15	Not described	D 18

Ectosome. Distinct from choanosome, approximately 400-600 thick; skeleton highly spiculose, densely packed, comprised of two layers; outer layer largely indistinct, very fine, approximately 50 thick, with small oxeas in confused arrangement; inner layer comprised of a tangential arrangement of both large and small oxeas; aquiferous canals, approximately 200 diameter, regularly traverse ectosome; oxyasters present but largely obscured by megascleres.

Choanosome. Permeated by large canals up to 11mm diameter; skeleton composed of a confused arrangement of single small and large oxeas, as well as large oxeas in loose paucispicular to multispicular bundles; oxyasters scattered throughout the choanosomal skeleton but slightly more abundant in canal linings.

Megascleres. (Refer to Table 3 for spicule dimensions) Oxeas, in distinctly bimodal size-distribution. Larger oxeas slightly curved over entire length, with very faintly telescoped points and occasionally with a few terminal microspines; variations rare but include styloid modifications.

Smaller oxeas, angular, with 1-2 bends and hastate terminations.

Microscleres. (Refer to Table 3 for spicule dimensions) Oxyasters, with 6-12 lightly tapering rays that have conical to recurved microspines on distal two-thirds; centrum approximately 15% of spicule diameter.

REMARKS. *Jaspis lutea* is reinstated as a valid species of *Jaspis*, distinct from *J. stellifera* in several important respects. There are important differences in spiculation, with *J. lutea* having two size classes of oxeas in a distinctly bimodal size-distribution (cf. *J. stellifera* having a unimodal, wide size-range of oxeote spicules). Skeletal differences include *J. lutea* having a more localised distribution of smaller oxeas, primarily in a distinct ectosome (cf. no such localisation of oxeote spicule types, and with a far less prominent ectosome). There are also differences in colour and external morphology, with *J. lutea* being golden yellow-brown and having a lobate-tuberculate growth form (cf. dull pinkish-purple-brown with an unornamented, irregularly lobate-massive shape).

Important information provided here, adding to Carter's (1886b) original description, includes the description of a second size-class of oxea (perhaps previously dismissed as merely smaller examples of a presumed unimodal size-distribution of oxeote spicules), the provision of spicule dimensions, and details of microspination on oxyaster rays.

Jaspis cristacorrugatus sp. nov.
(Figs 1, 4, 8A,B, Table 4)

ETYMOLOGY. Latin *crista*, ridge; Latin *corrugatus*, wrinkled; for the corrugated oscular ridge.

MATERIAL. HOLOTYPE: QMG312071 (NCI Q66C5149-N): W side of channel, in middle of Breaksea Island, Port Davey, Tasmania, Australia, 43°19.70'S, 145°57.60'E, exposed rock slope, boulders, walls, gullies, kelp, 10m depth, 17.ii.1991, coll. AIMS/NCI. PARATYPE: QMG312073 (NCI Q66C-5151-P): S end of Breaksea Island, Port Davey, Tasmania, Australia, 43°20.20'S,147°57.80'E, rocky slope to flat rocky bottom with many crevices and caves, 15m depth, 17.ii.1991, coll. AIMS/NCI.

HABITAT DISTRIBUTION. 10-15m depth, on rocky substrate with walls, gullies and outcrops; Port Davey, Tasmania.

DIAGNOSIS. Massive, subspherical to slightly lobate; leathery, firm; slate-grey alive; dark-brown to golden out of water; tan-brown in ethanol; slightly rugose surface; many small oscules in furrows between corrugations on wide oscular ridge; distinct ectosome, primarily of densely packed smaller oxeas; choanosome riddled with canals, and skeleton of single and paucispicular bundles of large oxeas in confused to loosely plumose reticulation vaguely ascending toward surface, with scattered smaller oxeas and oxyasters between tracts; oxeas in two size classes (larger oxeas length 290-(453)-629, width 2-(9)-15); smaller oxeas length 80-(133)-267, width 3-(5)-12); microspined oxyasters (diameter 6-(13)-21).

DESCRIPTION. *Shape.* Preserved specimen incomplete but when living was massive, subspherical, slightly lobate, with a thick,

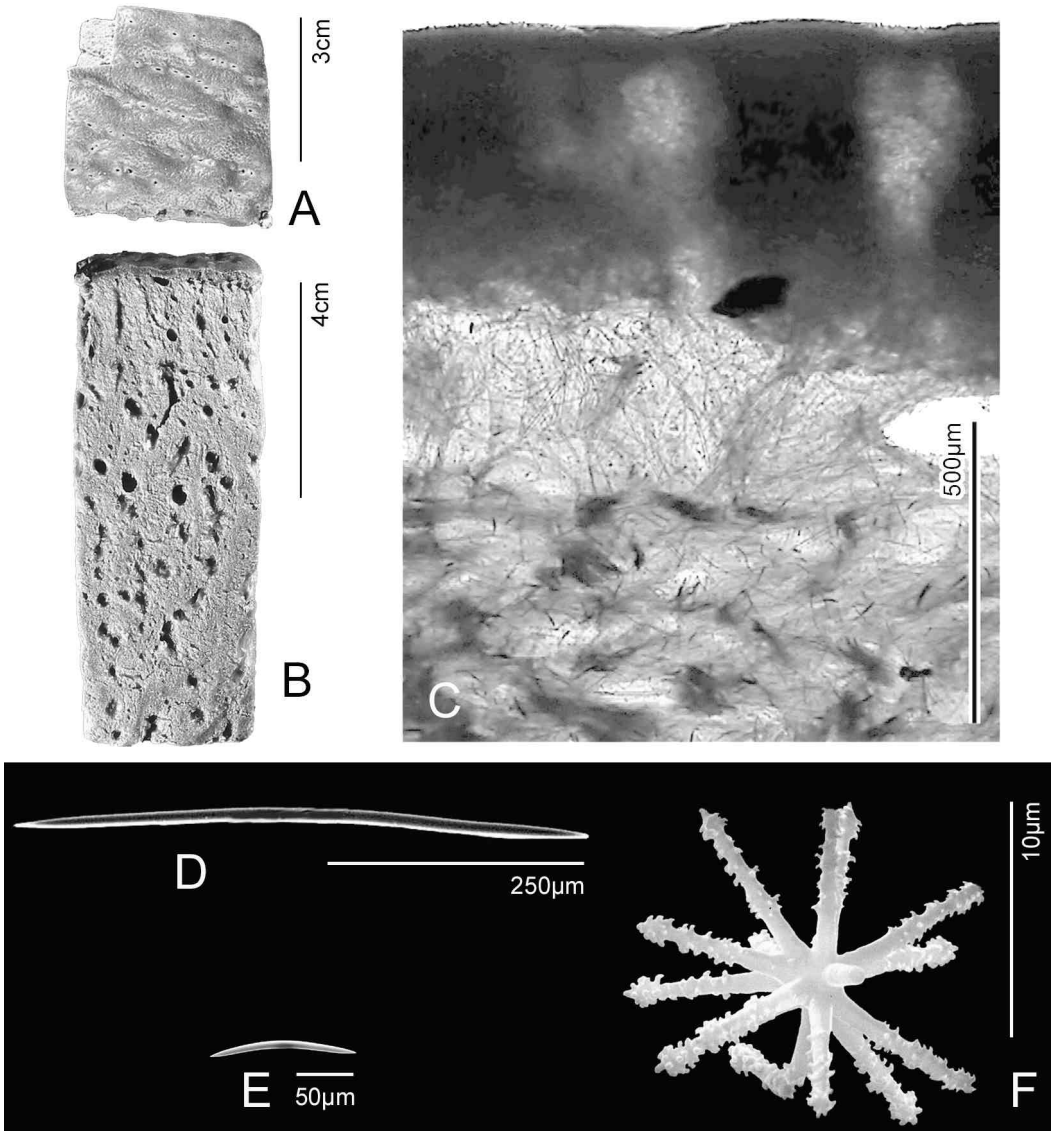

FIG. 4. *Jaspis cristacorrugatus* sp. nov. (holotype QMG312071). A, oscular ridge surface; B, perpendicular section; C, section through peripheral skeleton; D, large oxea; E, small oxea; F, oxyaster.

corrugated, oscular ridge along the apex (from photographic record, Fig. 8A-B). Height 15cm, width 20x20cm when alive and complete.

Colour. Slate-grey ectosome (Munsell 2.5Y 6/1) with lemon-yellow (2.5Y 8/5) in membrane surrounding oscules when alive; golden-yellow (7.5Y 7/8) to dark-brown (5YR 2.5/2) ectosome, with golden-yellow choanosome (7.5YR 7/8) when fresh; chocolate-brown (7.5YR 4/2) ectosome with tan-brown (7.5YR 5/6) membrane sur rounding oscules, with tan-brown (7.5YR 5/6) choanosome in ethanol.

Oscules. Many, small oscules, approximately 0.5mm diameter, clustered in linear arrangement, 1-2 oscules wide in furrows between corrugations of oscular ridge.

Texture. Very firm, rubbery, with leathery surface.

Surface characteristics. Opaque, optically smooth, uneven, with regularly distributed low rounded surface swellings tending toward slightly rugose.

Ectosome. Distinct from choanosome, 400-1400 thick, regularly traversed by aquiferous canals approximately 200 diameter; skeleton highly spiculose, with a densely packed layer of smaller oxeas in confused arrangement that largely obscures a scattering of oxyasters.

Choanosome. Riddled with aquiferous system canals up to 11mm diameter; skeleton of single oxeas and loose paucispicular bundles of oxeas in confused to vaguely plumo-reticulate arrangement; oxyasters present and slightly more abundant in aquiferous system linings.

Megascleres. (Refer to Table 4 for spicule dimensions) Oxeas, in distinctly bimodal size-distribution. Larger oxeas lightly curved over entire length, occasionally fusiform, with acerate to slightly telescoped points.

Smaller oxeas centrally curved, with hastate to slightly telescoped points.

Microscleres. (Refer to Table 4 for spicule dimensions) Oxyasters, with 9-15 lightly tapering rays that have recurved microspines primarily on distal two-thirds; centrum approximately 10-15% of spicule diameter. Variations rare but include vestigial spination, to clumping of spines near terminations, thus resembling tylotes when viewed under light microscopy.

REMARKS. Even though this material is described as a new species, and has not been previously synonymised with *J. stellifera*, it is included here because it may be easily confused with the newly reinstated *J. lutea* (if the subtle differences described here were not elucidated). Although *J. cristacorrugatus* is similar to *J. lutea* in spiculation and choanosomal skeletal structure, the two are clearly differentiated by several important characteristics. The external morphology is the most obvious difference between the two, with *J. cristacorrugatus* being massive in growth form (cf. *J. lutea* being irregular-lobate), and does not agglomerate foreign materials. Further, oscules are grouped into furrows across a thick oscular ridge (cf. regularly distributed over the surface). Significant differences in texture also differentiate the two species, with *J. cristacorrugatus* being very firm and rubbery (cf. crumbly and friable). The main differences in skeletal structure is that *J. cristacorrugatus* has an ectosome composed of smaller oxeas, lacking the underlying tangential layer of oxeas found in *J. lutea*.

ANCORINIDAE Schmidt, 1870

DEFINITION. Growth forms encrusting or massive, or more specialised with spherical body and long inhalant and exhalant tubes at opposite ends (the latter with a stellate, spicular, funnel-shaped end); megascleres long-shafted triaenes (with shaft directed inwards and clads on the surface) and oxeas; microscleres euasters and microrhabds; without sterrasters or amphiasters; triaenes may be absent or reduced (modified from Hooper & Wiedenmayer, 1994).

REMARKS. Ancorinidae Schmidt, 1870 is best known under its junior synonym Stellettidae Carter, 1875 (Hooper & Wiedenmayer, 1994). Hajdu & van Soest (1992) provide an informative discussion on the relationship between Ancorinidae and Coppatiidae.

Asteropus Sollas, 1888

TYPE SPECIES. *Stellettinopsis simplex* Carter, 1879: 349, by original designation.

DEFINITION. Ancorinidae with oxeas, oxyasters and sanidasters to which trichodragmata may be added.

REMARKS. Bergquist (1965, 1968) and Hajdu & van Soest (1992) proposed that two species groups exist within *Asteropus* based on microsclere type. They argued that species with true sanidasters may be placed in the '*simplex*'-like complex, whereas those with spiny microrhabds should be placed in the '*sarasinorum*'-like group, the latter ascribing the name *Melophlus* Thiele, 1899 and possibly valid at the subgeneric level.

Asteropus radiocrusta sp. nov.
(Figs 1, 5, Table 5)

Stellettinopsis tuberculata (in part) Carter, 1886a: 126.

ETYMOLOGY. *Radius*, Latin, ray; *crusta*, Latin, hard outer surface of a body; for the radial arrangement of megascleres in the cortical ectosome.

MATERIAL. HOLOTYPE: BMNH1886.12.15.146: Port Phillip Heads, Victoria, coll. J.B. Wilson (originally one of three syntypes of *Stellettinopsis tuberculata* Carter, 1886a).

HABITAT DISTRIBUTION. 3-6m depth; on granite boulders with algae; Port Phillip Heads, Victoria.

DIAGNOSIS. Massive, subspherical; ectosome forming a highly distinct cortex 2.4-3.1mm thick, of densely packed oxeas in radial arrangement, with sanidasters and few oxyasters scattered throughout; choanosome with oxeas in confused

arrangement, with oxyasters and few sanidasters scattered throughout; oxeas (length 530-(1063)-1730, width 5-(24)-44), microspined oxyasters (diameter 18-(25)-33), microspined sanidasters (length 9-(13)-18).

DESCRIPTION. *Shape.* Massive, subspherical, with slightly irregular surface. (Attached to the holotype is a second species of sponge that is subspherical and has a highly conulose, membranous surface).

Colour. Live colouration unknown; beige-grey (Munsell 7.5YR 6/2) cortical ectosome with light beige choanosome (7.5YR 7/4) in ethanol.

Oscules. None visible.

Texture. Harsh, firm, barely compressible.

Surface characteristics. Opaque, optically smooth, even, microscopically hispid and densely spiculose.

Ectosome. Approximately 2.4-3.1mm thick, forming a cortex that is highly distinct from choanosome; skeleton comprised primarily of oxeas arranged radially in loose multispicular bundles forming an almost continuous palisade, with oxea terminations commonly penetrating the surface; sanidasters are scattered throughout the ectosomal skeleton but are slightly more common at the surface, while oxyasters are rare; containing abundant subspherical pigment bodies approximately 25 diameter.

Choanosome. Skeleton consists of a confused arrangement of both single and very loose pauci-spicular bundles of oxeas, with an abundance of interstitial oxyasters, but few sanidasters.

Megascleres. (Refer to Table 5 for spicule dimensions) Oxeas in a single, wide size-range, typically curved over entire length, with lightly telescoped terminations; variations rare but include styloid forms.

Microscleres. (Refer to Table 5 for spicule dimensions) Oxyasters, with 7-14 tapering rays that have abundant, recurved microspines occurring along the entire ray length; centrum approximately 12% of spicule diameter.

Sanidasters, with conical microspines and approximately 10-16 rays in 2-4 whirls.

REMARKS. The holotype of this species was originally part of the syntype series of *Stelletinopsis tuberculata* Carter, 1886a. However, it is clearly different from the other syntype (now lectotype, BMNH1886.12.15.434) of *S. tuberculata*), with the most significant differences involving spiculation, skeletal structure and external morphology. *Asteropus radiocrusta* has a single size category of oxeas, as well as oxyaster and sanidaster microscleres (cf. *S. tuberculata* which has two sizes of slightly flexuous oxeas and triaenes as megascleres and only oxyasters as microscleres. These substantial differences in spiculation are alone sufficient to clearly separate these two taxa at the generic level. However, they also differ significantly in the skeletal structure of the ectosome, with *A. radiocrusta* having a highly distinct, thick cortical ectosome of oxeas in erect to plumose bundles, forming an almost completely radial palisade (cf. an arenaceous cortical ectosome with sand-grains largely obscuring scattered oxyasters). In addition, their respective growth forms are greatly different, with *A. radiocrusta* being small, subspherical and lacking surface ornamentation (cf. massive-lobate and covered with prominent, irregular tubercles and ridges).

TABLE 5. Spicule dimensions of *Asteropus radiocrusta*. Measurements in µm, denoted as range (and mean) (N=25). L = length; W = width; D = diameter.

	Oxeas	Oxyasters	Sanidasters
Holotype BMNH1886.12.15.146	L 530-(1063)-1730 W 5-(24)-44	D 18-(25)-33	L 9-(13)-18

The presence of sanidasters places the present species within the '*simplex*'-like group, as described above (see Remarks for the genus). *Asteropus simplex* (Carter, 1879) is the only other species of *Asteropus* described so far from Australia. *Asteropus radiocrusta* sp. nov. is similar to *A. simplex*, based on its original description, apparently falling within the published geographical distribution of *A. simplex* (Hooper & Wiedenmayer, 1994), which includes most of S Australia as well as New Zealand and the Indo-Malay region of the Indian Ocean. However, this purportedly extensive distribution of *A. simplex* is dubious since re-examination of a type slide of *A. simplex* from Carter's collection by Hajdu & van Soest (1992) revealed that the original description was incomplete, failing to recognise a second size category of oxyaster as well as the presence of trichodragmata. Consequently, *A. simplex* may also prove to contain a sibling species-complex, with its junior synonym, *A. haekeli* Dendy, 1905 (taxonomic decision by Dendy, 1924), certainly warranting its re-evaluation. Nonetheless, *A. radiocrusta* is clearly distinct from *A. simplex* by the absence of both the second size class of oxyaster and trichodragmata.

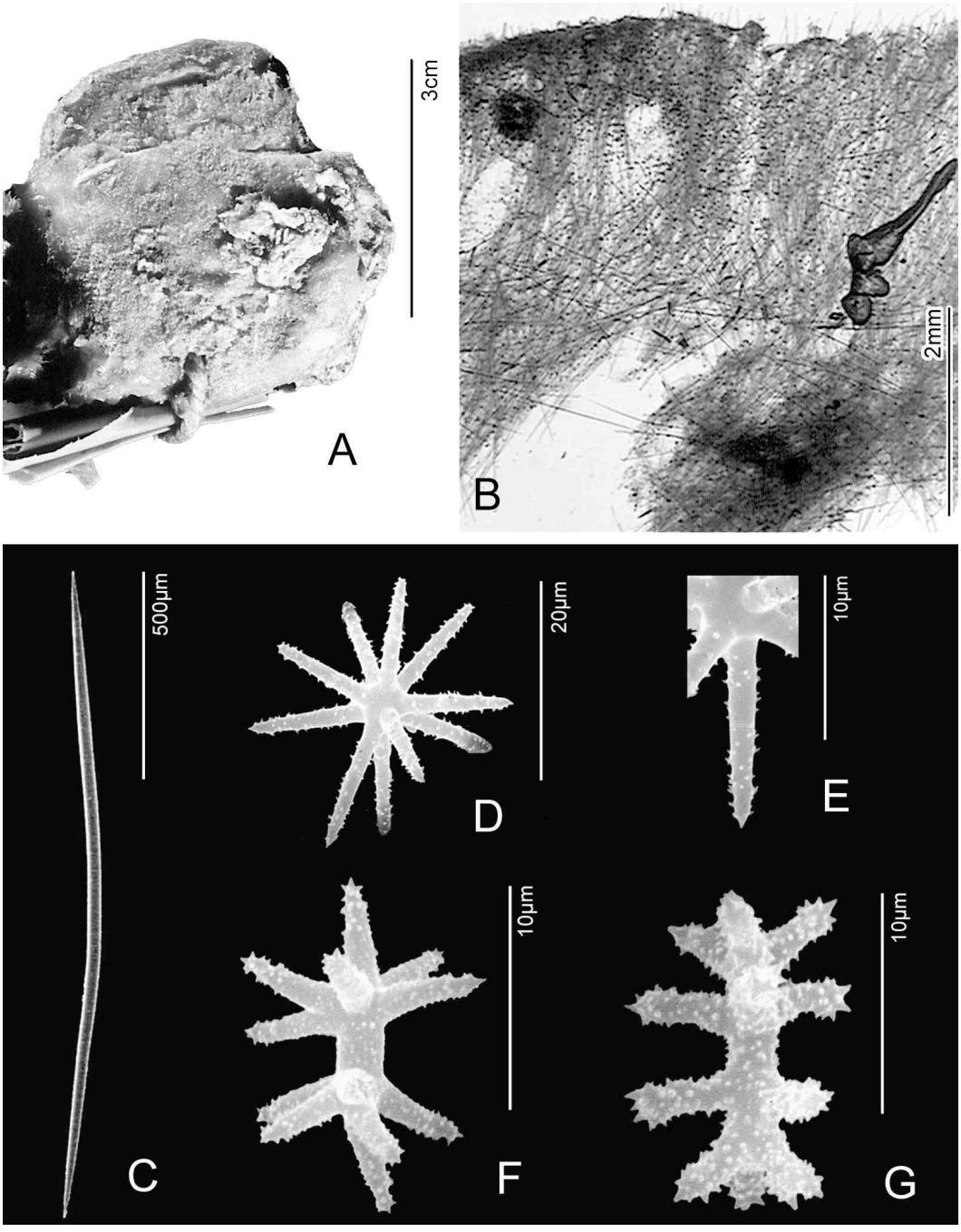

FIG. 5. *Asteropus radiocrusta* sp. nov. (holotype BMNH1886.12.15.146). A. holotype; B, section through peripheral skeleton; C, oxea; D, oxyaster; E, oxyaster ray; F, sanidaster with two whirls of rays; G, sanidaster with four whirls of rays.

In a revision of *Asteropus* from the Atlantic, Hajdu & van Soest (1992) described three species (*A. brasiliensis*, *A. vasiformis* and *A. niger*). *Asteropus radiocrusta* differs from each of these in spiculation, at least by the absence of trichodragmata or the second size-class of oxyaster. This, in conjunction with other morphological and wide biogeographic differences, indicates significant variation at the species level.

Stelletta Schmidt, 1862

Myriastra Sollas, 1886: 187 (Type species: *Myriastra subtilis* Sollas, 1886, by subsequent designation, see Sollas, 1888).
Pilochrota Sollas, 1886: 189 (Type species: *Pilochrota haekeli* Sollas, 1886, by subsequent designation, see de Laubenfels, 1936).
Anthastra Sollas, 1886: 191 (Type species: *Anthastra pulchra* Sollas, 1886, by subsequent designation, see Sollas, 1888).
Dorypleres Sollas, 1888: 426 (Type species: *Dorypleres dendyi* Sollas, 1888, by monotypy.).
Incertae sedis: *Astroplakina* Dendy & Burton, 1926: 230 (Type species: *Astroplakina stelligera* Dendy & Burton, 1926, by monotypy).
Incertae sedis: *Zaplathea* de Laubenfels, 1950 (Type species: *Zaplathea digonoxea* de Laubenfels, 1950, by original designation).

TYPE SPECIES. *Stelletta grubii* Schmidt, 1862, by subsequent designation (see Burton & Rao, 1932: 310).

DEFINITION. Ancorinidae with fine-centrum euasters (oxyasters, strongylasters or tylasters) only as microscleres.

REMARKS. Lendenfeld (1903) synonymised *Myriastra*, *Pilochrota* and *Anthastra* with *Stelletta*, disregarding the presence of a second category of aster in the latter. However, Dendy (1916) found it convenient to retain *Myriastra*, but agreed with merging *Pilochrota* into it, since both had only one category of aster. Similarly, de Laubenfels (1936) maintained *Myriastra* as separate from *Stelletta*, but Bergquist (1968) again ratified the synonymy of *Myriastra* with *Stelletta* after assessing that three specimens in her collection were *S. crater* Dendy, 1924 which possessed two mutually exclusive categories of asters.

Dorypleres has classically been considered to be closely related to *Jaspis*, and hence has been commonly placed in the Coppatiidae (or one of its junior synonyms), as either a distinct genus or a junior synonym of *Jaspis*. The genus was erected originally by Sollas (1888), without a generic diagnosis, but with a designated type species (*Dorypleres dendyi* Sollas, 1888), described as having two categories of aster. It was referred to *Jaspis* by Topsent (1904), although Burton & Rao (1932) noted that it did not conform to the typical structure of *Jaspis* 'having large oxeas only irregularly arranged, and asters of two kinds'. Indeed, Burton & Rao (1932) remarked how similar *J. dendyi* was to certain species of *Stelletta*, and were it not for the absence of triaenes, they claimed that they would have had little reservation in assigning the species to *Stelletta*. De Laubenfels (1954: 228) reversed Topsent's (1904) decision, restoring *Dorypleres* to generic status, defining the genus to include 'those species which have two or more distinct categories of asters, where *Jaspis* has just one category of aster'. This decision was subsequently reversed by Bergquist (1968: 33), noting that 'two categories of asters are not recognisable in sponges assigned to *Jaspis dendyi*', a point corroborated by the present author after examining a slide of type material (holotype BMNH1889. 1.1.100). Consequently, in agreement with Bergquist's (1968) remarks, *Dorypleres* cannot be reinstated, as de Laubenfels (1954: 228) suggested, for 'those species (of Coppatiidae) which have two or more distinct categories of aster', and in which he placed *Dorypleres splendens* de Laubenfels, 1954.

Hajdu & van Soest (1992) briefly discuss *Dorypleres*, highlighting the differences between it and *Jaspis* and remarking on its *Stelletta*-like nature (despite its lack of triaenes). They proposed that if the lack of triaenes was found to be a synapomorphic character, then *Dorypleres* may be reinstated as a *Jaspis*-like Stellettid lacking triaenes.

Recent morphological and chemical studies on jasplakinolide-containing sponges by Sanders et al. (1999) concluded in ratifying the synonymy between *Dorypleres* and *Jaspis*. They undertook morphological studies at the supraspecific level on several nominal *Jaspis* species (including *Dorypleres splendens* de Laubenfels, 1954), concluding that only one genus (*Jaspis*) was valid. This conclusion was based largely on similarities in skeletal composition and arrangement, the authors claiming that 'all species possess oxeas, a confused choanosomal arrangement and paratangential arrangement of small spicules at the surface' (Sanders et al., 1999: 526). Although strictly correct, they did not distinguish between the nature of the 'small spicules' comprising the ectosome of each species. *Dorypleres splendens* has an ectosome containing a thin crust of oxyasters, whereas *Jaspis*, including the type species, *J. johnstonii* (Schmidt, 1862), has a

tangential ectosome composed of oxeote spicules. In contrast to their supraspecific conclusions based on morphological comparisons, their conclusions based on chemical analyses pertain only to the species level of classification, and hence are unable to provide any reliable generic characteristic. Sanders et al. (1999) concluded that 'all of the jasplakinolide-containing sponges studied were found to be conspecific' and that '*Jaspis splendans* (de Laubenfels, 1954) is the senior-most available name for these specimens'. A consequence of this logic is that the present chemical name 'jasplakinolide' is misleading, since it pertains only to a single species ('*Dorypleres splendens*'), and not to a genus diagnostic marker, and perhaps should be renamed using some derivation of the species name '*splendens*' (perhaps 'splendenolide') (although nomenclaturally this is probably not a feasible proposition).

Since *Dorypleres* does not have a tangential ectosome of oxeote spicules, it falls outside the diagnosis of Coppatiidae, and is considered here to be a *Stelletta* lacking triaenes.

Sanders et al. (1999) also synonymised the monotypic genus *Zaplethea* de Laubenfels, 1950 with *Jaspis*, based on ectosomal skeletal arrangement of the type species (*Z. dogonoxea* de Laubenfels, 1950), again without elucidating the component spicule types. Their illustration of a cross section of the type specimen ectosome does not show the diagnostic tangential layer of oxeotes that is typical of Coppatiidae, and the original description (de Laubenfels, 1950) states that there is 'no sharply defined cortical region'. The twice-bent 'microxeas', described by de Laubenfels as being diagnostic for the genus, were interpreted by Sanders et al. (1999) as being a diagnostic feature at the species level only. It is speculated that *Zaplathea* is also a *Stelletta* lacking triaenes, like *Dorypleres* above, although further research is needed to confirm this.

Astroplakina Dendy & Burton, 1926, is a monotypic genus containing only *A. stelligera* Dendy & Burton, 1926. The type species is described as having a range of spicule types, ranging from diacts to octacts. It is apparent from the original figures that the diacts are oxeotes and the 'triacts to octacts' are oxyasters. Indeed, Dendy & Burton (1926) noted the similarities of these spicules to the oxy- or strongylasters of the Stellettidae (= Ancorinidae), particularly where the rays are microspined. Unfortunately, the skeletal structure was not described because the specimen was dry and unable to be sectioned adequately. As for *Zaplathea* and *Dorypleres*, *Astroplakina* is speculated to be a *Stelletta* lacking triaenes, although further confirmation is necessary, particularly relating to the ectosomal skeletal arrangment.

Stelletta tuberculata (Carter, 1886)
(Figs 1, 6, Table 6)

Stellettinopsis tuberculata Carter, 1886a: 126.
Coppatias tuberculatus Sollas, 1888: 207.
Stelletta arenitecta Wiedenmayer, 1989: 20.

MATERIAL. LECTOTYPE: BMNH1886.12.15.434 (dry): Port Phillip Heads, Victoria. OTHER MATERIAL: BMNH1954.2.12.253: marked 'slide of type' (prepared by A. Dendy).

HABITAT DISTRIBUTION. 3-6m depth; on granite boulders with algae; Victoria, Bass Strait.

DIAGNOSIS. Massive, with irregular tubercles, ridges and lobes; dull-purple to red-brown alive; numerous minute oscules in depressions between tubercles; distinctly arenaceous surface; cortical ectosome of sand-grains largely obscuring minute oxyasters; choanosomal skeleton primarily composed of oxeas in confused arrangement largely obscuring scattered oxyasters; megascleres flexuous; oxeas in two size classes differentiated mainly by their thickness (thicker oxeas length 630-(788)-863, width 11-(16)-19; thinner oxeas length 313-(521)-684, width 2-(5)-8), rare ortho/plagiotriaenes in two size classes (thicker triaenes rhabd length 670-(771)-821, clad length 10-(16)-20; thinner triaenes rhabd length 535-(611)-668, clad length 7-(7.5)-8), microspined oxyasters (6-(10)-12µm).

DESCRIPTION. *Shape.* Massive, covered with twisted, irregular nodulose ridges, lobes and tubercles on the top and sides, with furrows and depressions between; tubercles 3-12mm thick and 5-18mm deep. Height 7.2cm, width 5.5x 12cm.

Colour. Dull purple-brown (Carter, 1886a) to reddish-brown (Wiedenmayer, 1989) when fresh; dry lectotype with greyish beige-brown cortical ectosome (Munsell 2.5Y 7/4–5/2) and light beige choanosome (2.5Y 8/3).

Oscules. Numerous, almost indistinct oscules, approximately 0.5mm diameter, appear as slightly darker spots in the furrows and sulci between tuberculate lobes.

Texture. Dry lectotype is hard, stony, coarse; wet material is reported as firm, barely compressible, easily torn (Wiedenmayer, 1989).

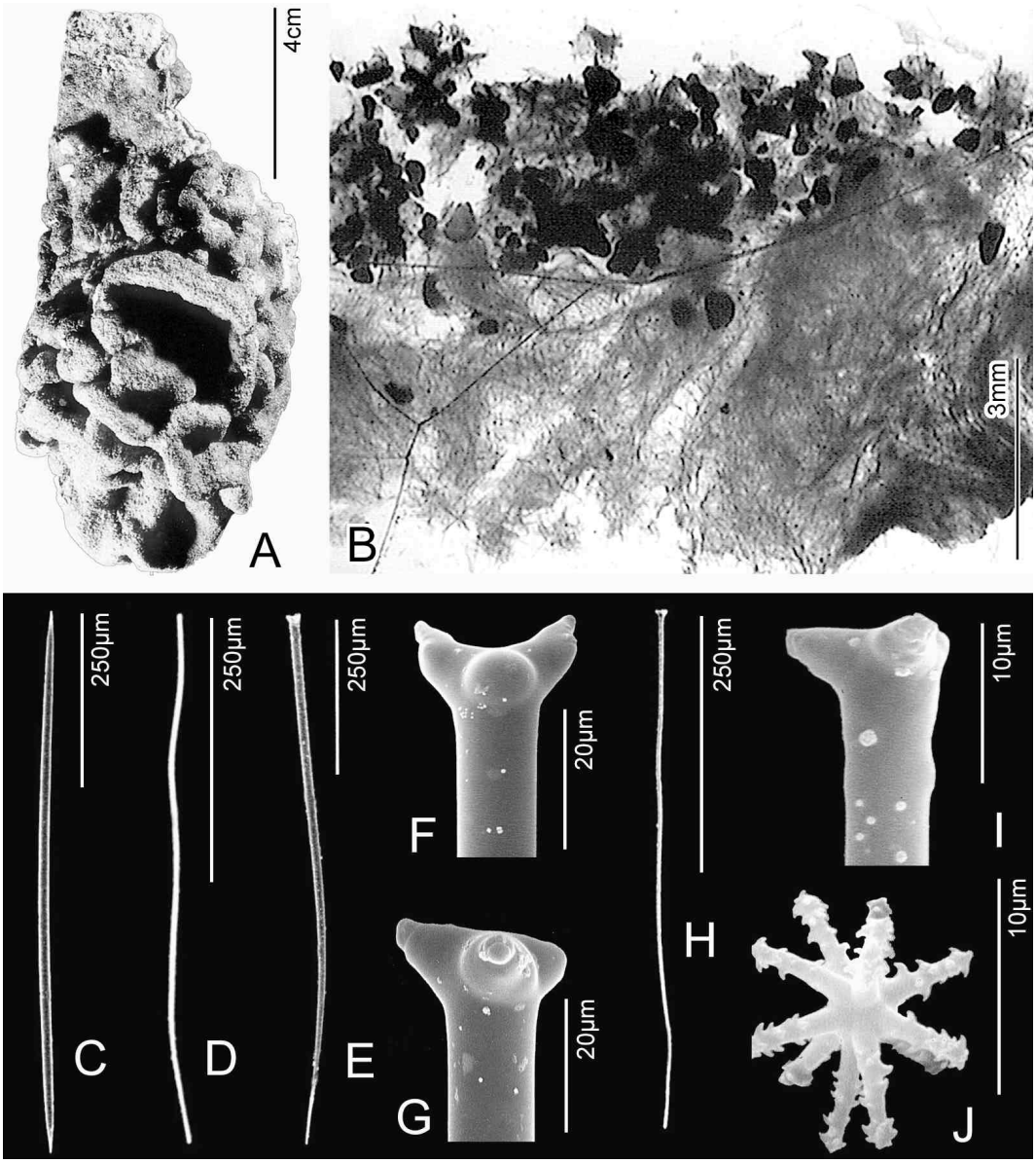

FIG. 6. *Stelletta tuberculata* (Carter, 1886) (lectotype BMNH1886.12.15.434). A, lectotype; B, section through peripheral skeleton (BMNH1954.2.12.253); C, thick oxea; D, thin oxea; E, thick ortho/plagiotriaene; F,G, cladomes of thick ortho/plagiotriaenes; H, thin ortho/plagiotriaene; I, thin ortho/plagiotriaene cladome; J, oxyaster.

Surface characteristics. Highly tuberculate and conspicuously arenaceous.

Ectosome. Approximately 1-2mm thick, forming a cortex that is distinct from choanosome due to the presence of abundant large sand-grains; minute oxyasters are scattered throughout but are largely obscured by the sand.

Choanosome. Skeleton comprised of a confusion of single and very loose paucispicular bundles of oxeas that largely obscure the abundant oxyasters

TABLE 6. Comparison between present and published descriptions of *Stelletta tuberculata*. Measurements in µm, denoted as range (and mean) (N=25 in present study except where noted). L = length; W = width; RL = rhabd length; CL = clad length; D = diameter.

	Oxeas (Thick)	Oxeas (Thin)	Triaenes (Thick)	Triaenes (Thin)	Oxyasters
Lectotype BMNH1886.12.15.434 Present study	L 630-(788)-863 W 11-(16)-19	L 313-(521)-684 W 2-(5)-8	RL 670-(771)-821 CL 10-(16)-20; (N=7)	RL 535-(611)-668 CL 7-(7.5)-8; (N=4)	D 6-(10)-12
Syntype, original description (Carter, 1886a)	L 762 W 13	Not described	Not described	Not described	D 8.5

in the dense matrix; ortho/plagiotriaenes present, with clads just below the cortical ectosome and rhabds directed vaguely inward.

Megascleres. (Refer to Table 6 for spicule dimensions) Oxeas in two size categories differentiated primarily by their thickness and extent of flexion; thicker oxeas lightly flexuous, infrequently fusiform, with acerate to finely telescoped ends.

Thinner oxeas similar in geometry but much more flexuous.

Ortho/plagiotriaenes in two size classes also differentiated by their thickness; rhabd terminations slightly telescoped; clads stumpy.

Microscleres. (Refer to Table 6 for spicule dimensions) Oxyasters with 10-17 lightly tapering rays that have 10-20 recurved spines on distal half, thus giving a slightly tylote appearance particularly when examined using light microscopy; centrum approximately 25% of spicule diameter.

REMARKS. The original description by Carter (1886a) was obviously based on specimen BMNH1886.12.15.434, nominated here as the lectotype, since the other two syntypes are clearly different species. One syntype (BMNH1886. 12.15.113) is a *Crella* of uncertain specific identity, and at first was thought to have been a mislabelled holotype of Carter's (1885) *Echinonema (Crella) incrustans* (BMNH1886. 12.15.123) (i.e. considering the similar registration numbers). However, this is not the case because this latter specimen was also examined by the author and is different again. The remaining syntype (BMNH 1886.12.15.146) is clearly yet another species (described above as *A. radiocrusta* sp. nov.).

Stelletta tuberculata is reinstated here as a valid species, distinct from *J. stellifera* in several important respects. *Stelletta tuberculata* has both oxeas and triaenes as megascleres (cf. *J. stellifera* which only has oxeas). Further, *S. tuberculata* has a highly arenaceous cortical ectosome of sand-grains, largely obscuring scattered minute oxyasters (cf. a tangential layer of oxeas in confused arrangement). The vestigial nature of the triaene clads makes it difficult to properly resolve their form as orthotriaene or plagiotriaene.

As Wiedenmayer (1989) remarked, there are very few *Stelletta* species that contain foreign detritus and relatively rare, reduced triaenes. He addressed the differences between these species in his remarks for *S. arenitecta*, which is synonymised here with *S. tuberculata.*

Rhabdastrella Thiele, 1903

Aurora Sollas, 1888: cxxxix, 187 (preoccupied, junior homonym of *Aurora* Ragonot, 1887 (Lepidoptera)) (Type species: *Stelletta globostellata* Carter, 1883, by original designation).
Rhabdastrella Thiele, 1903: 934; Bergquist, 1968: 54.
Diastra Row, 1911: 300; Bergquist, 1968: 54 (Type species: *Diastra sterrastraea* Row, 1911, by monotypy).
Aurorella De Laubenfels, 1957: 245 (nomen novum for *Aurora* Sollas, 1888); Wiedenmayer, 1989: 21.

TYPE SPECIES. *Coppatias distinctus* Thiele, 1900, by original designation.

DEFINITION. Ancorinidae with thick centred euasters (oxyspherasters or spherasters) in a cortical ectosome.

REMARKS. *Aurora* was originally proposed for Carter's *Stelletta globostellata* and *S. reticulata* because they possessed large oxyspherasters. Lendenfeld (1903) merged the genus with *Stelletta*, followed by Hentschel (1909). Dendy (1916) argued that it was desirable to retain Sollas's genus, since the large (oxy)spherasters form such a characteristic and well-defined feature, and are known from many species. He also proposed the addition of *Diastra sterrastrea* Row, 1911, *A. cribroporosa* Dendy, 1916 and *Coppatias (Rhabdastrella) distinctus* Thiele, 1900. Thus, he proposed the synonymy of *Rhabdastrella* and *Aurora*. He also suggested that the type species of *Aurora*, *A. globostellata*, did not have trichodragmata, as Sollas 1888 suggested (corroborated in the present study). Dendy also asserted that the loss of triaene megascleres has taken place several times within *Aurora*,

giving several examples of similar species differing in the presence of traienes.

De Laubenfels (1957) proposed the name *Aurorella* to replace the preoccupied *Aurora*, but still maintained it as distinct from *Rhabdastrella* (which he merged into *Dorypleres*). He restored *Diastra* to full and valid generic status based on the possession of sterrasters.

Bergquist (1968) synonymised *Aurora* and *Diastra* into *Rhabdastrella* on the basis of Dendy's (1916) argument. She used *Rhabdastrella* to receive all *Aurora* species because the latter name was pre-occupied, also drawing attention to Dendy's observation that three pairs of species within *Rhabdastrella* (s.s), *Diastra* and *Aurora* were only distinguishable by the presence or absence of triaenes. It appears that these observations have led to the modification of the definition of *Rhabdastrella* (e.g. Wiedenmayer, 1989: 21) to include the character 'with reduced triaenes or without triaenes …').

Hechtel (1983) used *Aurorella* as a subgenus of *Rhabdastrella* on the basis that it lacked triaenes. As has been suggested (Hajdu & van Soest, 1992) for the Ancorinidae (and Coppatiidae), the lack of triaenes is a suspect diagnostic character. Evidence is given here to support this, whereby *R. globostellata* is shown to have a gradation of triaene development, ranging from well-developed, through to vestigial or absent.

Rhabdastrella globostellata (Carter, 1883)
(Figs 1, 7, 8C-F, Table 7)

Stelletta globostellata Carter, 1883: 353-354.
Aurora globostellata Sollas, 1888: 187-188.
Stellettinopsis carteri Ridley, 1884: 476.
Coppatias carteri Sollas, 1888: 208-209.
Jaspis stellifera Bergquist, 1969: 69.

MATERIAL. HOLOTYPE: BMNH1883.5.3.1 (dry): Galle, Sri Lanka (Ceylon), coll. Dr. Ondaatji. HOLOTYPE of *Stellettinopsis carteri* Ridley, 1884 BMNH1882. 2.23.276 (wet): Prince of Wales Channel, Torres Strait, coll. R.W. Coppinger. OTHER MATERIAL: Australia – Western Australia, NTMZ3352, QMG301116, QMG301142; Northern Territory, NTMZ96, Z582, Z588, Z599, Z1325, Z2182, Z3248, QMG303634, G313548; Queensland, NTMZ4011, QMG300041, G301179, G303170, G303487, G303509, G304341, G304450, G304606, G304481, G304884, G305457, G305779, G306240, G313432, G313472, G313508, G313589, G314452, G314563, G314624, G315114, G315227, G315249, G315503. New South Wales, QMG301398. Fiji – QMG312735 (NCIOCDN-4165-M), QMG312803. Malaysia – QMG301224, G301227, G301228, G304613. Palau – QMG305951. Philippines – QMG312576. Tonga – QMG313264. Vanuatu – QMG306826, G306893 (ORSTOM R1624).

HABITAT DISTRIBUTION. Intertidal-53m depth; on coral reef, rocky outcrops, broken reefs, reef flats, drop-offs and overhangs; tropical and subtropical Indian and Pacific Oceans; Sri Lanka, Singapore, Zanzibar, Indonesia, Malaysia, Palau, Philippines, Vanuatu, Fiji, Tonga, Australia; N Western Australia, Northern Territory, Queensland, Great Barrier Reef, N New South Wales coast.

DIAGNOSIS. Massive, globular, subspherical; brown to yellowish-tan cortex, with yellow choanosome alive; apical depressions with numerous small oscules in clumps; ectosome of oxyspheraster; peripheral choanosomal skeleton variable, with plumose brushes of oxeas and orthotriaenes (sometimes absent) that have rhabds directed inward; deeper choanosome contains oxeas in confused arrangement, with oxyasters in variable abundance between specimens; oxeas (length 220-(814)-1521, width 0.5-(13)-38), orthotriaenes (rhabd length 70-(600)-1309, clad length 7-(104)-239), oxyspheraster (diameter 5-(36)-91), oxyasters (diameter 3-(28)-96).

DESCRIPTION. *Shape.* Dry holotype is incomplete, amorphous, and has an irregularly folded surface which Carter (1883: 353) described as 'corrugated'. Living and wet-preserved specimens are typically globular, subspherical, sometimes raised on a short, thick base that is attached at several points, commonly with one to several shallow, concave depressions (up to 5mm depth) on apical surface. Incomplete holotype 5.5cm long, 3.5x2.5cm wide; larger specimens up to 30cm high, 45x45cm wide.

Colour. Dry holotype has dull greyish beige-brown (Munsell 7.5YR 7/2-6/4) ectosome, with beige-tan choanosome (7.5YR 6/4). Living specimens have variable ectosomal colouration between specimens, ranging from from yellowish-tan (2.5Y 7/4) to deep chocolate brown (7.5YR 4/4), and occasionally dusty purple (10R7/2), however the choanosome is always vivid yellow (2.5Y 8/10).

Oscules. Not visible in incomplete, dry holotype, but Carter (1883: 353) originally describes 'vents congregated in one part of the surface'. Recently collected material typically has numerous (about 20-40) small oscules (1-4mm diameter) clustered in one to three, large concave depressions (up to 5cm deep) on apical surface, with larger oscules in more central regions of clusters.

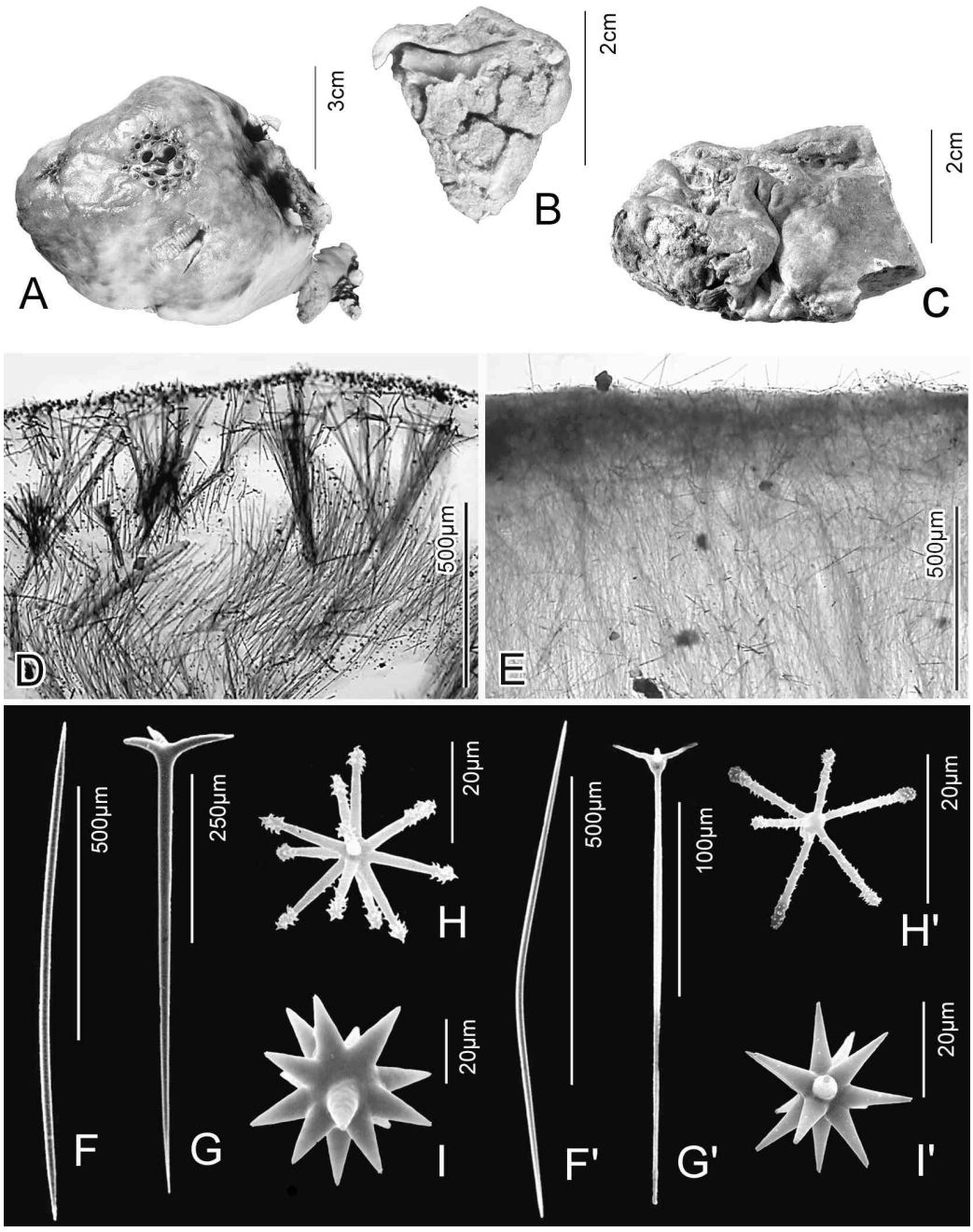

FIG. 7. *Rhabdastrella globostellata* (Carter, 1883). A, whole wet specimen from Vanuatu (QMG306893); B, holotype of *Stellettinopsis carteri* Ridley, 1884 (BMNH1882.2.23.276 wet: Torres Strait, Australia); C, holotype (BMNH1883.5.5.1 dry: Sri Lanka); D,E, sections through peripheral skeletons showing differences in structure between low latitude (D, specimen QMG306893: Vanuatu) and higher latitude (E, QMG313432: Heron Island, GBR, Australia) material; F, F' – I,I', examples of spiculation differences between specimens (F-I, holotype of *S. carteri* Ridley, 1884 BMNH1882.2.23.276: Torres Strait, Australia; F'-I', QMG306893: Vanuatu) (F,F', oxeas; G,G', orthotriaenes; H,H', oxyasters; I,I', oxyspherasters).

TABLE 7. Comparison between holotype and other material of *Rhabdastrella globostellata* by region. Measurements in µm, denoted as range (and mean). L = length; W = width; RL = rhabd length; CL = clad length; D = diameter.

Region/material	Oxeas	Orthotriaenes	Oxyspheraster euasters	Oxyaster euasters
Holotype, Sri Lanka, BMNH1883.5.3.1	L 628-(831)-1030 W 5-(14)-23	RL 223-(650)-857 CL 65-(126)-172	D 8-(25)-55	D 11-(25)-72
Holotype of *Stellettinopsis carteri* , Torres Strait, Qld, BMNH1882.2.23.276	L 730-(859)-1020 W 13-(18)-25	RL 560-(647)-810 CL 70-(93)-110. (rare)	D 6-(42)-64	D 23-(36)-46
Sabah State, Malaysia, 4specimens	L 611-(1072)-1521 W 4-(21)-33	RL 254-(835)-1309 CL 21-(127)-239	D 15-(43)-61	D 8-(26)-56
Philippines, 1specimen	L 790-(970)-1150 W 6-(18)-26	RL 326-(657)-946 CL 37-(102)-138	D 20-(46)-63	D 33-(48)-63
Palau, 1specimen	L 566-(756)-963 W 2-(7)-15	RL 320-(559)-753 CL 50-(104)-166	D 8-(34)-50	D 6-(15)-21
Vanuatu, 2specimens	L 310-(641)-875 W 2-(5)-9	RL 220-(431)-638 CL 7-(38)-85. (rare)	D 9-(27)-43	D 7-(22)-39
Fiji, 1specimen	L 570-(736)-940 W 3-(10)-16	RL 330-(356)-382 CL 43-(52)-65. (rare)	D 15-(36)-54	D 15-(18)-23
Tonga, 1specimen	L 599-(976)-1165 W 10-(20)-37	RL 654-(726)-848 CL 94-(148)-185	D 11-(40)-66	D 9-(15)-23
N Western Australia, 3specimens	L 472-(863)-1425 W 4-(12)-19	RL 219-(806)-1107 CL 53-(128)-215	D 11-(37)-72	D 10-(43)-71
Northern Territory, Australia,	L 687-(998)-1456 W 4-(19)-38	RL 367-(818)-1240 CL 53-(122)-215	D 6-(42)-91	D 11-(47)-96
Queensland, Australia, 13specimens	L 220-(541)-936 W 0.5-(6)-15	RL 70-(112)-247 CL 55 (Very rare: 2specimens)	D 5-(29)-55	D 3-(22)-45
N New South Wales, Australia, 1specimen	L 265-(527)-718 W 2-(7)-13	None	D 15-(36)-53	D 14-(24)-31

Texture. Dry holotype is hard; fresh and wet-preserved material is firm, compressible, and leathery.

Surface characteristics. Opaque, optically smooth, uneven, with low, rounded tubercles, corrugations, bumps and ridges forming a tuberculate surface becoming smoother toward the base; extent of tuberculation varies between specimens, ranging from prominently tuberculate to nearly completely smooth.

Ectosome. About 150-500 thick; skeleton composed exclusively of oxyspheraster. Variable degrees of packing of oxyspheraster occurs, ranging from very densely packed in tropical material, to relatively sparsely packed in subtropical specimens. Canals, approximately 70 diameter, regularly traverse the ectosome. Subectosomal region is relatively clear of microscleres.

Choanosome. Deeper choanosomal skeleton consists of a confusion of loosely scattered single oxeas and paucispicular bundles of oxeas. These bundles become more ordered in the peripheral choanosome, where they may also include orthotriaenes, forming variably distinct paucispicular plumose brushes, with the rhabds of the triaenes directed inward and clads supporting the ectosome. There is substantial variability in absolute abundance of microscleres and relative abundance of microsclere categories between specimens, without any obvious correlation between geographic regions or latitudinal gradients.

Megascleres. (Refer to Table 7 for spicule dimensions) Oxeas, slightly bent, with finely telescoped ends; variations very rare but include styloid forms and oxeas with terminations that are split or sharply bent (similar to promonaenes).

Orthotriaenes, with variable clad development, with rhabds tapering toward fusiform, hastate or faintly blunt terminations; each cladome contains three identical clads with shapes ranging from typical geometries, to lightly telescoped, sharply angled near tips, or stunted forms. Orthotriaenes more commonly observed and robust in tropical rather than subtropical specimens where they may be highly vestigial or apparently absent.

Microscleres. (Refer to Table 7 for spicule dimensions) Oxyspheraster euasters, with 9-18 conical rays; centrum approximately 29% of spicule diameter; rays may be entirely smooth or have up to 15 microspines on distal end.

Oxyaster euasters, with about 9-17 lightly tapering to isodiametric rays, with approximately 11-25 recurved microspines on the distal half,

thus giving a slightly tylote appearance under light microscopy; centrum approximately 10% of spicule diameter; variations very rare, with only one spicule displaying forward projecting microspination over entire ray length.

REMARKS. This is undoubtedly the same species referred to by Bergquist (1969) as '*J. stellifera*' from Heron Island, GBR, with the qualification that her specimens are representative of subtropical material found typically to have reduced spiculation. In agreement with her published remarks, and corroborated by more recent surveys of this region, it is one of the most common and more prominent species of sponges on the reef flat, easily recognisable for its massive, subspherical shape, brown exterior and distinctive (mango-like) bright-yellow interior. Spicule diversity and size are similar between Bergquist's (1969) and recent collections, with the qualification that the tylasters described by Bergquist are actually oxyasters with micropines clumped near the terminations and only seen properly under SEM. This species, however, is clearly different from *J. stellifera* in many significant respects.

While both species are essentially subspherical, they differ greatly in size and colouration, but most significantly in ectosomal skeletal structure and spicule compliment. *Jaspis stellifera* is about 4.7cm in largest dimension and pinkish-white to purple, whereas *R. globostellata* is at least up to 45cm in diameter and has a brown exterior and bright yellow interior. Both species have choanosomal skeletons that are essentially confused arrangements of oxeas, with oxyasters scattered in the interstices. However, the ectosome of *R. globostellata* has a distinct layer of oxyspherasters, in contrast to that of of *J. stellifera*, which is comprised of a tangential layer of oxeas. Further, *J. stellifera* has only oxeas and oxyasters as spicules, whereas *R. globostellata* also has orthotriaenes and oxyspherasters.

The synonymy of *Stellettinopsis carteri* Ridley, 1884 with *R. globostellata* is based on the presence of orthotriaenes and oxyspherasters in the holotype of *S. carteri* in addition to the oxeas and oxyasters as originally described. Further, spicule sizes (refer Table 7) lie within the range described for *R. globostellata.* Unfortunately, the type specimen is no longer complete, as originally described by Ridley (1884), now consisting only of a small fragment (height 8mm, width 21x25mm), with only a small portion of surface intact. However, the original description of the gross-morphology of *S. carteri* is consistent with characteristics of *R. globostellata* (e.g. having a 'short cylindrical stalk passing gradually into a massive, somewhat flattened upper portion'; colouration being tan with a yellow interior; and with an undulate, dimpled, corrugated surface). Unfortunately, the ectosome is barely intact in the holotype of *S. carteri*, and consequently it is difficult to ascertain its true nature. It is vaguely distinct from the choanosome (although not explicit in Ridley's (1884) original description), being smooth and probably composed of oxyspherasters. This synonymy is further supported by the type locality of *S. carteri* being well within the distribution of *R. globostellata.*

In *R. globostellata*, orthotriaenes were more abundant in specimens from more northerly tropical localities, where spiculation was generally more highly silicified. By comparison, specimens from more southern regions (central GBR to N NSW), typically lacked triaenes and spicules were more poorly silicified and less robust. This is similar to the latitudinal trend observed by Hooper & Bergquist (1992) for *Cymbastella* (Axinellidae), and Hooper (1996) for *Clathria (Thalysias) vulpina.* Failure to recognise the absence of triaenes in specimens may perpetuate mis identifications of this species in the future, and so the distinctive shape and colouration of this species will un doubtedly remain an important, albeit superficial, distinguishing features.

The reassignment of tropical sponges, previously misidentified as '*J. stellifera*', to *Rhabdastrella globostellata* is based primarily on morphological evidence and is supported by chemical evidence in the possession of malabaricane-type triterpenes (e.g. Ravi et al., 1981; Ravi & Wells, 1982), determined by van Soest & Braekman (1999) to be a good chemotaxonomic marker for Stellettids. It is possible that '*J. stellifera*' from Japanese waters are also misidentified specimens of *S. globostellata* since they too have been reported to contain malabaricane-type triterpenes (Tsuda et al., 1991; Kobayashi et al., 1996).

DISCUSSION

Examination of all type material previously assigned to, or associated with, '*Jaspis stellifera*' revealed that many important details were omitted from original descriptions. Failure to recognise these details has certainly contributed to an oversimplified synonymy for this species. For example, re-examination of type material showed clearly that the syntype series of

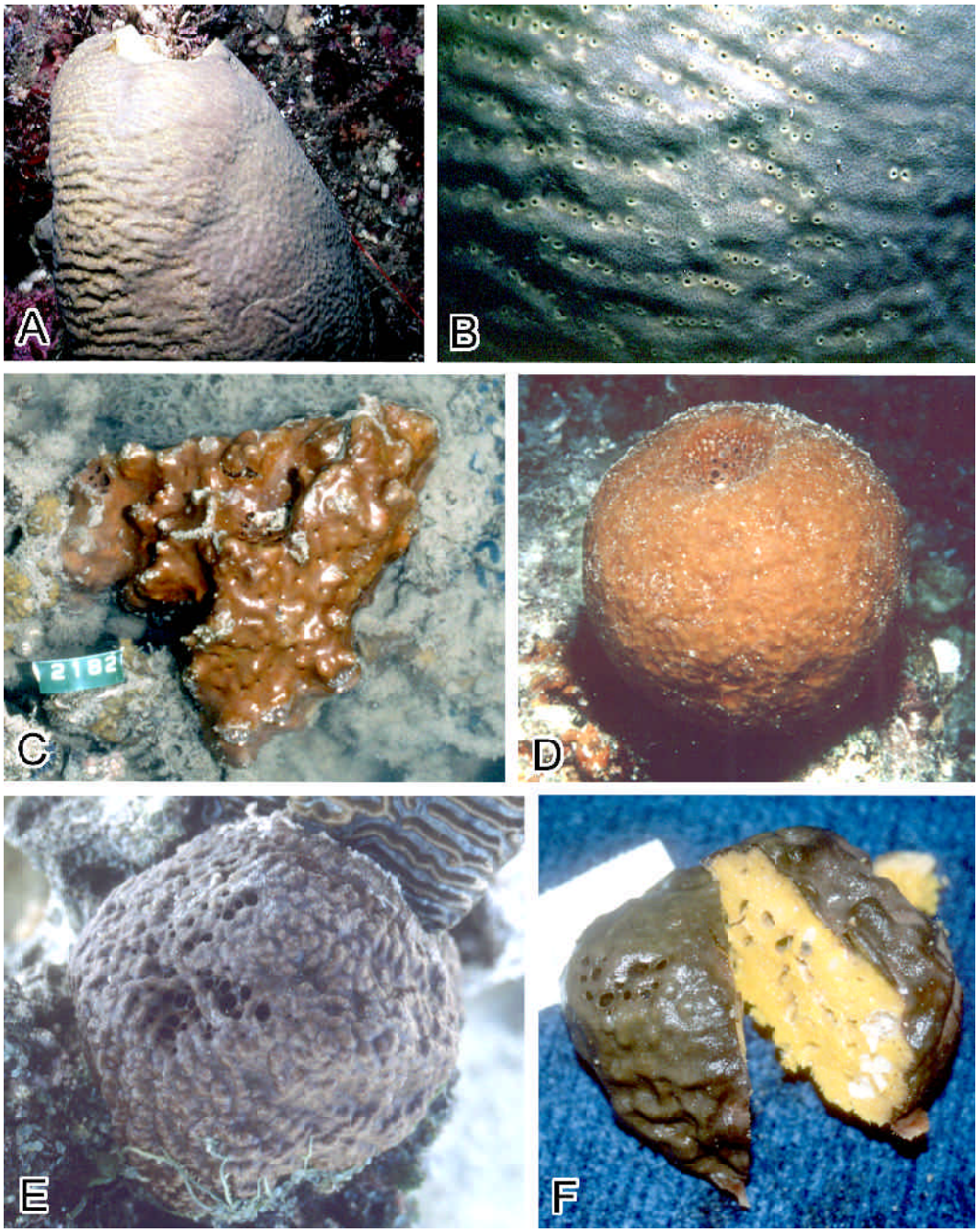

FIG. 8. A-B, *Jaspis cristacorrugatus* sp. nov. (QMG312071, Port Davey, Tasmania, 10m, photo NCI); A, specimen in situ; B, close-up view of oscular ridge surface. C-F, *Rhabdastrella globostellata* (Carter, 1883); C, NTMZ2182, Darwin, NT, intertidal, photo J. Hooper; D, QMG306893, Emae, Vanuatu, 20m, photo ORSTOM; E, QMG313432, Heron Island, Qld, intertidal, photo author; F, QMG304884, Mudjimba Island, Qld, 12m, photo J. Hooper.

f *Stellettinopsis tuberculata* was composite, containing specimens from different orders. This example is perplexing because the original synonymy was proposed by Shaw (1927), under the direct supervision of Maurice Burton at the BMNH, who had complete access to the vast type collections housed there. It is probable, therefore, that this synonymy was based on superficial comparison of type material rather than re-examination of histological preparations.

In recognising the oversimplification of Shaw's (1927) synonymy, Bergquist (1969) reinstated *J. coriacea* and *J. purpurea* as valid species, based on two supposed inconsistencies in the published literature, both of which were demonstrated here to be invalid. In contrast, the proposed synonymy of *J. stellifera*, based on redescribed type material, incorporates only *J. coriacea* and *J. purpurea*. Consequently, *J. stellifera* is not as widely distributed as reported by Hooper & Wiedenmayer (1994). Its corroborated distribution appears to be restricted to waters between Victoria and Tasmania. Most of the remaining species previously placed in the '*J. stellifera*' complex also appear to have very limited distributions, with the exception of *R. globostellata* which has an apparent widespread tropical/subtropical Indo-Pacific distribution.

The clue to misidentified tropical and sub-tropical populations of *R. globostellata* as '*J. stellifera*' is largely based on the presence of triaenes within specimens, even though these range from present to vestigial or sometimes absent in individual specimens. It was only through thorough examination of many specimens that this anomoly concerning presence/absence of triaenes was recognised. Triaenes were more common in tropical specimens, where spicules were generally more robust than in southern pop-ulations. The apparent lack of triaenes in some material, or failure to recognise their vestigial occurrence in other specimens, may lead easily to the misidentification of this species as *Jaspis* (which by definition lacks triaenes). The graded development of triaenes across tropical to subtropical waters has implications regarding the debate surrounding the relationship between Coppatiidae and Ancorinidae. According to present diagnoses, the presence of triaenes confirms that this species belongs to Ancorin-idae, whereas specimens lacking triaenes could be justifiably included in Coppatiidae. The rare, vestigial, or complete loss of triaenes in *R. globostellata* provides evidence supporting the proposition of Hajdu & van Soest (1992) that the absence of triaenes is a dubious synapomorphic character used to separate Coppatiidae and Ancorinidae.

ACKNOWLEDGEMENTS

I thank the following for their assistance with this study: Clare Valentine (BMNH, London), Ruth Desqueyroux-Faúndez (MNHN, Geneva), NTM, Darwin, for loan of specimens and type material; Pat and Lori Colin, CRRF Palau for material; John Hooper for collections from throughout tropical Australia, Fiji, Malaysia, Philippines, Tonga and Vanuatu; the Queensland Museum for facilities, field support, and materials; two anonymous reviewers for their valuable comments on the manuscript; and John Hooper for his mentoring, taxonomic guidance and valuable comments regarding this paper.

LITERATURE CITED

BERGQUIST, P.R. 1965. The sponges of Micronesia, part 1. The Palau Archipelago. Pacific Science 19: 123-204.

1968. The marine fauna of New Zealand: Porifera, Demospongiae, Part 1 (Tetractinomorpha and Lithistida). New Zealand Department of Scientific and Industrial Research Bulletin 188: 1-105.

1969. Shallow water sponges from Heron Island. University of Queensland Papers, Great Barrier Reef Committee, Heron Island Research Station 1(4): 63-72.

BOURY-ESNAULT, N. & RÜTZLER, K. (eds). 1997. Thesaurus of sponge morphology. Smithsonian Contributions to Zoology 596.

BURTON, M. 1934. Sponges. Scientific Reports of the Great Barrier Reef Expedition 1928-29. 4(14) 513-621 (British Museum (Natural History): London).

BURTON, M. & RAO, H.S. 1932. Report on the shallow-water marine sponges in the collection of the Indian Museum. Records of the Indian Museum 34(3): 299-356.

CARTER, H.J. 1875. Note introductory to the study and classification of the Spongida. Annals and Magazine of Natural History (4)16: 1-40, 126-145, 177-200.

1879. Contributions to our knowledge of the Spongida. Annals and Magazine of Natural History (5)3: 284-304, 343-360.

1883. Contibutions to our Knowledge of the Spongida – Pachytragida. Annals and Magazine of Natural History (5)11: 344-369.

1885. Description of sponges from the neighbour-hood of Port Phillip Heads, South Australia. Annals and Magazine of Natural History (5)16: 347-368.

1886a. Description of sponges from the neighbour-hood of Port Phillip Heads, South Australia.

Annals and Magazine of Natural History (5)18: 126-149.

1886b. Supplement to the descriptions of Mr. J. Bracebridge Wilson's Australian sponges. Annals and Magazine of Natural History (5)18: 445-466.

DENDY, A. 1905. Report on the sponges collected by Professor Herdman, at Ceylon, in 1902. Pp. 57-246. In Herdman, W.A. Report to the Government of Ceylon on the peral oyster Fisheries of the Gulf of Manaar. 3(18): 57-246 (Royal Society: London).

1916. Report on the Homosclerophora and Astrotetraxonida collected by H.M.S. 'Sealark' in the Indian Ocean. In Reports of the Percy Sladen Trust Expedition to the Indian Ocean in 1905, Volume 6. Transactions of the Linnean Society of London, Zoology 17: 225-271.

1924. Porifera. Part 1. Non-Antarctic sponges. British Antarctic ('Terra Nova') Expedition, 1910. Natural history report. 6(3): 269-392. (British Museum (Natural History), Zoology: London).

DENDY, A. & BURTON, M. 1926. Records on some deep-sea sponges from the Indian Museum collected by the R.I.M.S. 'Investigator'. Part 1. Hexactinellida and Tetraxonida (pars.). Records of the Indian Museum 28: 225-248.

FUERST, J.A., WEBB, R.I., GARSON, M.J., HARDY, L. & REISWIG, H.M. 1999. Membrane-bound nuclear bodies in a divers range of microbial symbionts of Great Barrier Reef sponges. Memoirs of the Queensland Museum 44: 193-203.

FUSETANI, N. & MATSUNAGA, S. 1993. Bioactive sponge peptides. Chemical Review 93: 1793- 1806.

GRAY, J.E. 1858. Description of a new genus of sponge (*Xenospongia*) from Torres Strait. Journal of Zoology 26: 229-230.

1867. Notes on the arrangement of sponges, with the description of some new genera. Proceedings of the Zoological Society of London 1867: 492-558.

HADJU, E. & SOEST, R.W.M. van 1992. A revision of Atlantic *Asteropus* Sollas, 1888 (Demo spongiae), including a description of three new species, and a review of the family Coppatiidae Topsent, 1898. Bijdragen tot der Dierkunde 62(1): 3-19.

HECHTEL, G. 1983. New species of marine Demosponges from Brazil. Iheringia. Serie Zoologica, Porto Alegre 63: 59-89.

HENTSCHEL, E. 1909. Tetraxonida. 1. Teil. 2(21): 347-402. In Michaelsen, W. & Hartmeyer, R. (eds) Die Fauuna Südwest-Australiens. (G. Fischer: Jena).

HOOPER, J.N.A. 1996. Revision of the Microcionidae (Porifera: Poecilosclerida: Demospongiae), with description of Australian species. Memoirs of the Queensland Museum 40: 1-626.

HOOPER, J.N.A. & BERGQUIST, P.R. 1992. *Cymbastella*, a new genus of lamellate coral reef sponges. Memoirs of the Queensland Museum 32(1): 99-137.

HOOPER, J.N.A., LIST-ARMITAGE, S.E., KENNEDY, J.A., COOK, S.D. & VALENTINE, C.A. 1999. Sponges of the Low Isles, Great Barrier Reef: an important scientific site, or a case for mistaken identity? Memoirs of the Queensland Museum 44: 249-262.

HOOPER, J.N.A. & WIEDENMAYER, F. 1994. Porifera. Pp. 1-624. In Wells, A. (ed.) Zoological Catalogue of Australia. Vol. 12. (CSIRO Australia: Melbourne).

KOBAYASHI, J., YUASA, K., KOBAYASHI, T., SASAKI, T. & TSUDA, M. 1996. Jaspiferals A approx G, new cytotoxic isomalabaricane-type nortriterpenoids from Okinawan marine sponge *Jaspis stellifera*. Tetrahedron 52(16): 5745-5750.

LAUBENFELS, M.W. de 1936. A discussion on the sponge fauna of the Dry Tortugas in particular, and the West Indies in general, with material for a revision of the families and orders of Porifera. (Tortugas Laboratory Paper No. 467) Carnegie Institute of Washington 30: 1-225.

1950. The sponges of Kaneohe Bay, Oahu. Pacific Science 4(1): 3-36.

1954. The sponges of the West-Central Pacific. Oregon State Monographs, Zoology 7: 1-306.

1957. New species and records of Hawaiian sponges. Pacific Science 11(2): 236-251.

LENDENFELD, R. VON. 1896. Die Clavulina der Adria. Acta Academiæ Cæsareæ Leopoldino-Carolinæ Germanicæ Naturæ Curiosorum 69: 1-251.

1903. Tetraxonia. Pp. 1-168. In Schulze, F.E. (ed.) Das Tierreich. Vol. 19. (Friedländer: Berlin).

LÉVI, C. 1973. Systématique de la classe de Demospongiaria (Démosponges). Pp. 577-631. In Brien, P,. Lévi, C., Sàra , M., Tuzet, O. & Vacelet, J. (eds) Traité de Zoologie, Anatomie, Systématique, Biologie. (Sér. ed. Grassé, P-P.) (Masson et Cie: Paris).

McCAFFREY, E.J. & ENDEAN, R. 1985. Antimicrobial activity of tropical and subtropical sponges. Marine Biology (Berlin) 89: 1-8.

RAGONOT, E.L. 1887. Diagnoses of North American Phycitidae and Galleriidae. (Paris).

RAVI, B.N., WELLS, R.J. & CROFT, K.D. 1981. Malabaricane triterpenes from a Fijian collection of the sponge *Jaspis stellifera*. Journal of Organic Chemistry 46: 1998-2001.

RAVI, B.N. & WELLS, R.J. 1982. Malabaricane triterpenes from a Great Barrier Reef collection of the sponge *Jaspis stellifera*. Australian Journal of Chemistry 35: 39-50.

RIDLEY, S.O. 1884. Spongiida. Pp. 366-482, 582-635. In Report on the zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. 'Alert' 1881-2. (British Museum (Natural History): London).

ROW, R.W.H. 1911. Reports on the marine biology of the Sudanese Red Sea, from collections made by Cyril Crossland, M.A., B.Sc., F.Z.S. XIX. Report on the sponges collected by Cyril Crossland in 1904-5. Part II. Non-Calcarea. Journal of the Linnean Society, Zoology 31: 287-400.

SANDERS, M., DIAZ, M.C. & CREWS, P. 1999. Taxonomic evaluation of jasplakinolide-containing sponges of the family Coppatiidae. Memoirs of the Queensland Museum 44: 525-532.

SCHMIDT, E.O. 1862. Die Spongien des Adriatischen Meeres. Pp. 1-48. (Wilhelm Engelmann: Leipzig).

1868. Die Spongien der Küst von Algier. Mit Nachträgen zu den Spongien des Adriatischen Meeres. (Drittes Supplement). Pp. 1-44. (Wilhelm Engelmann: Leipzig).

1870. Grundzüge einer Spongien-Fauna des Atlantischen Gebietes. (Wilhelm Engelmann: Leipzig).

SHAW, M.E. 1927. On a collection of sponges from Maria Island, Tasmania. Proceedings of the Zoological Society of London 1927: 419-439.

SOEST, R.W.M. van & BRAEKMAN, J.C. 1999. Chemosystematics of Porifera: a review. Memoirs of the Queensland Museum 44: 569-589.

SOLLAS, W.J. 1886. Preliminary account of the tetractinellid sponges dredged by H.M.S. 'Challenger', 1872-1876. Part 1. The Choristida. Scientific Proceedings, Royal Dublin Society 5: 177-199.

1888. Report on the Tetractinellida collected by H.M.S. 'Challenger', during the years 1873-1876. Pp. 1-458. In Report on the Scientific Results of the Voyage of H.M.S. 'Challenger', Zoology Vol. 25(63).

THIELE, J. 1899. Studien über Pazifischen Spongien. Zoologica, Stuttgart 24(2): 1-33.

1900. Kieselschwämme von Ternate, I. Abhhandlungen der Senckenbergischen Naturforschenden Gesellschaft 25: 19-80.

1903. Kieselschwämme von Ternate. II. Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft 25: 933-968.

TOPSENT, E. 1898. Introduction à l'étude monographique des Monaxonides de France. Classification des Hadromerina. Archives de Zoologie Expérimentale et Générale (3)6: 91-113.

1904. Spongiaires des Açores. Résultats des Campagnes Scientifiques sur son Yacht par Albert Ier Prince Souverain de Monaco 25: 1-280.

TSUDA, M., ISHIBASHI, M., AGEMI, K., SASAKI, T. & KOBAYASHI, J. 1991. Stelliferins A-F, new antineoplastic isomalabaricane triterpenes from the Okinawan marine sponge *Jaspis stellifera*. Tetrahedron 47(12-13): 2181-2194.

WIEDENMAYER, F. 1989. Demospongiae (Porifera) from northern Bass Strait, southern Australia. Memoirs of the Museum of Victoria 50(1): 1-242.

WILKINSON, C.R., SUMMONS, R.E. & EVANS, E. 1999. Nitrogen fixation in symbiotic marine sponges: ecological significance and difficulties in detection. Memoirs of the Queensland Museum 44: 667-673.