Tetractinellid and hadromerid sponges of the Sultanate of Oman

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Soest, R.W.M. van & E.J. Beglinger. Tetractinellid and hadromerid sponges of the Sultanate of Oman. Zool. Med. Leiden 82 (53), 31.xii.2008: 749-790, figs 1-17.– ISSN 0024-0672.
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Key words: Porifera; new species; checklist; Oman; Gulf of Arabia.
The Sultanate of Oman harbours rich populations of sponges, especially in the four coral reef areas (Musandam Peninsula, Muscat coast & Daymaniyat islands, coasts of Masirah Island, and the Khuriya Muriya Islands). Up till now, apart from a few incidental samples, the sponges of Oman were known only from five dredge stations made by the John Murray Expedition 1933-1934 off the south coasts of Oman, near the Khuriya Muriya Islands, between 13.5 and 1415 m. Descriptions of the sponges obtained in these dredges were published by Burton (1959) and the specimens are deposited in the collections of the Natural History Museum, London. To complement these dredge samples, we recently obtained samples collected by SCUBA and shore collecting, mostly from the northern part of Oman, deposited in the collections of the Zoological Museum of the University of Amsterdam. We studied the combined Oman collections of the Amsterdam and London Museums. In the present contribution we treat the species belonging to the tetractinellid and hadromerid Demospongiae. The sponges of the Zoological Museum of Amsterdam are fully described and illustrated, those of the John Murray Expedition are annotated and illustrated here with habit photographs, as these were entirely lacking from Burton's (1959) report. The collection studied here contains 30 species, two of which are new to science, six are up till now known only from Oman waters, while the remaining 24 species are shared with other areas. The Indian subcontinent shares the most species with Oman, followed by East African areas, while the nearby Arabian coasts share only few species, probably due to the poor knowledge of sponges from this region.

Introduction

The Sultanate of Oman occupies the south-eastern corner of the Arabian Peninsula and is located between latitudes 16°40′ and 26°20′N and longitudes 51°50′ and 59°40′E. The coastline extends 1,700 km, from the Strait of Hormuz in the north, to the Republic of Yemen in the south, and borders on three sea regions: the Arabian or Persian Gulf, the Gulf of Oman and the Arabian Sea. Despite the paucity of records, the Sultanate of Oman harbours rich populations of sponges, especially in the four coral reef areas (Musandam Peninsula, Muscat coast & Daymaniyat islands, coasts of Masirah Island, and the Khuriya Muriya Islands). Apart from a few incidental samples recorded by *e.g.* Carter (1869) and Sarà & Bavestrello (1995), to date the sponges of Oman were known only from five dredge stations made by the John Murray Expedition 1933-1934 off the south coasts of Oman, near the Khuriya Muriya Islands, between 13.5 and 1415 m. About 100 species of sponges have been recorded. Recently, all Oman samples of the John Murray Expedition, kept in the collections of the Natural History Museum, London (BMNH), were re-examined and Burton's conclusions were reviewed in the light of the most recent update of the classification of the Porifera, the Systema Porifera (Hooper & van Soest, 2002).

In 1998, in the course of the EC-MAS3 'Symbiosponge' project, sponges were collected in several localities along the coast of Oman for the purpose of detecting novel bioactive compounds. In 2002, an additional collecting trip with similar purpose was

held. A number of incidental samples were donated by colleagues investigating other animal groups (*e.g.* mollusca and crustaceans). All these specimens are deposited in the Zoological Museum of the University of Amsterdam (ZMA).

Several of the recently collected sponges appear new to science. In a series of publications on the sponge fauna of the Western Indian Ocean we will describe these. Earlier topical studies in this intended series appeared between 2002 and 2007 (Van Soest & Beglinger, 2002; Van Soest et al. 2006; Erpenbeck et al. 2007) and we now present a follow-up study on the tetractinellid and hadromerid sponges of Oman. We include descriptions and illustrations on the ZMA material, but also present notes and illustrations on the material collected by the John Murray expedition.

Material and methods

Fresh specimens were collected using SCUBA and snorkling by Raquel Gómez and Robert G. Moolenbeek in November 1998, as part of the EC-MAS3 'Symbiosponge' Project, and in December 2002 under contract to UniBioScreen (Université Libre de Bruxelles). Specimens were photographed in situ or on deck before preservation in alcohol 96%. Subsamples of many sponges were collected for testing of biological activity and for cell biological observations, and the results of these tests have been or are being released elsewhere. The specimens are fully described below and in forthcoming publications. Prior to 1998, incidental collecting by R.G. Moolenbeek and H. Dekker in 1991, and by J.H. Stock & J.J. Vermeulen in 1996, yielded small collections of sponges from various parts of the Oman coasts. Preserved samples are incorporated in the collections of the Zoological Museum of Amsterdam.

For microscopical studies, tangential and perpendicular sections were made with a surgical blade. These were air-dried on a hotplate, subsequently mounted in Canada balsam, and examined using 100-400 × magnification. Dissociated spicule preparations for SEM and spicule size measurements were made by cooking fragments of specimens in concentrated HNO_3 and washing the spicule suspension five times in distilled water. Spicule sizes given below (minimum-mean-maximum, length × width) are based on 25 measurements for each spicule type.

A further input for this study are the samples collected by the John Murray Expedition 1933-34 to the Northwestern Indian Ocean, identified and described by Burton (1959). The area covered by this expedition comprised the east coast of Africa, notably Zanzibar, the southern part of the Gulf of Aden, the southern Red Sea, the coasts of Oman and Yemen, and the Maldives. The samples are in an excellent state of preservation in the collections of the Natural History Museum, London, where they have been reexamined by one of us (RvS) in April 2005. During this visit, many specimens were photographed as the original report of Burton (1959) contains no habit illustrations. Names given by Burton (1959) are revised based on examination of the specimens and the original microscopic slides, but no formal redescriptions of the Murray material are made below.

Collecting localities of sponges described here are given in fig. 1 and table 1. These also include the collecting stations from Oman made by the John Murray Expedition. All geographic coordinates are given in decimal units.

The systematic descriptions of the ZMA material and the remarks on Murray specimens are presented in the order of the Systema Porifera (Hooper & van Soest, 2002a), of

Fig. 1. Map of the Sultanate of Oman showing the approximate locations where the samples have been obtained (asterisks). The larger asterisk to the west of Muscat indicates several stations made on the Daymaniyat islands. Map downloaded and modified from official internet site of the Sultanate of Oman.

which also the classification is followed in all but a few cases.

For a preliminary determination of the regional affinities of the described fauna, the list of Oman sponges was compared with sponges recorded from adjacent South Ara-

Table 1. Sponge collecting localities off the coasts of Oman

Locality	Latitude	Longitude	Depth (m)	Date (DMY)
John Murray Exped. stat. 43	17.483	55.783	95	28-10-1933
John Murray Exped. stat. 45	18.058	57.042	38	29-10-1933
John Murray Exped. stat. 53	19.3667	57.8833	13.5	02-11-1933
John Murray Exped. stat. 54	21.8333	59.8667	1046	03-11-1933
Khuriya Muriya Islands, Al Hallaniyah main island	17.4922	55.96667	intertidal	12-11-1991
N coast, Juzor ad Daymãniyãt (Daymaniyat Islands), N side	23.8607	57.9644	18.3	17 -11-1998
Muscat, Haramal road, Government building	23.5711	58.6221	littoral	06-11-1998
Muscat, Hramal Road, Government Building	23.5711	58.6221	8.2	09-11-1998
Masirah Island, Ras Hilf	20.7033	58.8728	13	14-11-1998
Cat Island, E side of Fisheries Insititute	23.5819	58.6103	3-7.7	09-11-1998
Muscat, Mina Al Fahal, SW Point	23.673	58.497	littoral	12-2002
Muscat, Bandar Khairan (= Ras al Khayran)	23.75	58.75	19.3	08-12-2002
Muscat, Hramal Road, Government Building	23.571	58.6221	6.1	07-12-2002
Dhofar, Mirbat, Shark Island	16.94723	54.79885	5.5	14-12-2002
Dhofar, Mirbat, Hino	16.9663	54.7542	12	15-12-2002
Muscat, Dibab, sink hole	23.07	59.054	0-5	19-12-2002

bian localities, Red Sea, Maldives, East Africa (Madagascar, Kenya, Zanzibar), Seychelles, Indian subcontinent, and some areas further away (Australia, Indonesia, Philippines). Such lists were extracted from an informal database kept by one of us (RvS) used previously in *e.g.* Van Soest (1994) to determine sponge distribution patterns. Sources for the lists comprise published records only. A further resource was the World Porifera Database (Van Soest et al. 2005, consulted on May 14, 2008).

Results

Class Demospongiae
Order Homosclerophorida
Family Plakinidae

Plakortis spec.
(fig. 2a)

Dercitopsis minor sensu Burton, 1959: 181 (not: *Plakinastrella minor* (Dendy, 1905).

Material.— BMNH 1936.3.4.41, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933; BMNH 1936.3.4.42, Gulf of Aden, 11.895 N 51.22 E, 73-220 m, John Murray Exped. stat. 24, 19-10-1933.

Remarks.— *Dercitopsis minor* sensu Dendy (1905) is a *Plakinastrella*, but the present specimens have predominantly diods and some triods in a large size range and no calthrops were detected. A further specimen from the adjacent Gulf of Aden also conforms to *Plakortis* and appears to be the same species (here included in fig. 2a). These specimens are likely to be members of one of the *Plakortis* species described by Pulitzer-Finali (1993) from East Africa, but no definite identification was possible at this stage.

The Murray expedition recorded *Dercitopsis ceylonica* Dendy, 1905 from 182 m in the Zanzibar area (stat. 111). The two small fragments of 2 and 1.5 cm diameter (BMNH 1936.3.4.184) were reexamined and appear to conform to the genus *Plakinastrella*.

Order Spirophorida
Family Tetillidae

Acanthotetilla hemisphaerica Burton, 1959

Acanthotetilla hemisphaerica Burton,1959: 201, text-figure 5; Van Soest, 1977: 2, pl. I figs a-b, pl. II figs c-d, text-fig. 1; Van Soest & Rützler, 2002: 86, Figs 1A-B.

Material.— Holotype BMNH 1936.3.4.530, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— This specimen is extensively redescribed in Van Soest (1977) and in Van Soest & Rützler (2002).

Cinachyrella arabica (Carter, 1869)
(figs 2b, 3a-d)

Tethya arabica Carter, 1869: 3, pl. 1 figs. 1-8.
Cinachyra voeltzkowi Lendenfeld, 1897: 101, pl. 9 figs. 35-53 (new synonymy).

Material.— BMNH unnumbered microscopic slide, labelled *Tethya arabica* Carter, Oman; ZMA Por. 14608, Oman, Haramal Road, 23.5711 N 58.6221 E, littoral, coll. R.Gómez, Symbiosponge Project, 98/IO/NOV06/RG/012; BMNH 1908.9.24.77a, fragment labelled '*Cinachyra voeltzkowi*, type from Zanzibar'.

Description.— Globular sponge (fig. 2) of 4-5 cm, with upper surface heavily covered by dark sediment and algae (now consisting of three fragments). Scattered porocalices and a few oscules on the upper surface, 4-5 mm diameter. Spicules not protruding far beyond the surface, so the surface appears 'short-shaven'. Stalked buds present.

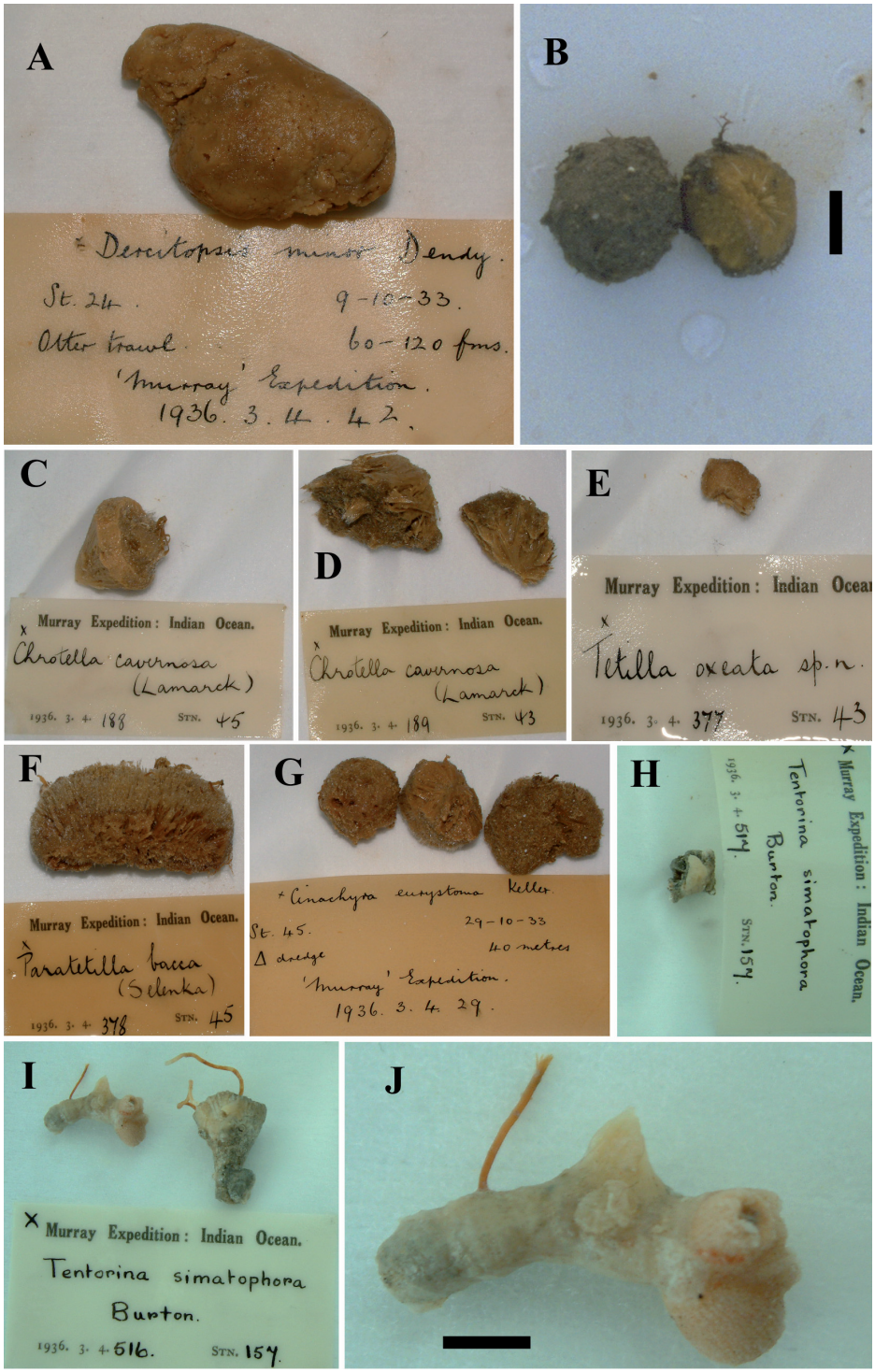
Colour.— Orange, buds are yellow.

Skeleton.— Spirally radiate (as usual for the genus).

Spicules.— Oxeas, protriaenes, anatriaenes, sigmaspires. The megascleres are often broken in the preparations, so lengths are tentative. Oxeas (fig. 3a), sharply pointed, large size range, but not divisible in size categories, range from 1.9 up to 3.5 mm in length and up to 40 μm in diameter. Protriaenes and more often prodiaenes (fig. 3b), range 1.2-2 mm in length and 7-9 μm in diameter, cladomes 40-50 μm, cladi 35-102 × 3-6 μm. Anatriaenes (fig. 3c) similar in length to protriaenes, up to 2 mm × 8-9 μm, cladomes 35-75 μm, cladi 20-40 × 6-7 μm. A considerable proportion shows very short stunted cladi. Sigmaspires (fig. 3d) 7-12 μm.

Habitat.— On large stones between the tide marks.

Remarks.— Microscopic slides of Carter's type from Oman (BMNH unnumbered, labelled *Tethya arabica*) and a fragment of Lendenfeld's type of *Cinachyra voeltzkowi* confirmed that both species are synonymous and match the newly collected ZMA material.


A
Murray Expedition: Indian Ocean.
St. 24. 9-10-33.
Otter trawl. 60-120 fms.
'Murray' Expedition.
1936. 3. 4. 42.
B
C
Murray Expedition: Indian Ocean.
Chrotella cavernosa (Lamarck)
1936. 3. 4. 188 STN. 45
D
Murray Expedition: Indian Ocean.
Chrotella cavernosa (Lamarck)
1936. 3. 4. 189 STN. 43
E
Murray Expedition: Indian Ocean.
Tetilla oxeata sp. n.
1936. 3. 4. 377 STN. 43
F
Murray Expedition: Indian Ocean.
Paratetilla bacca (Selenka)
1936. 3. 4. 378 STN. 45
G
Cinachyra cavernosa Keller
St. 45. 29-10-33
Δ dredge 40 metres
'Murray' Expedition.
1936. 3. 4. 29.
H
Murray Expedition: Indian Ocean.
Tentorina simatophora Burton.
1936. 3. 4. 514. STN. 154.
I
Murray Expedition: Indian Ocean.
Tentorina simatophora Burton.
1936. 3. 4. 516. STN. 154.
J

◀ Fig. 2. A, *Plakortis* spec. (as *Dercitopsis minor* sensu Burton, 1959, not *D. minor* Dendy, 1905), John Murray Exped., BMNH 1936.3.4.42, B, *Cinachyrella arabica* (Carter, 1869), ZMA Por. 14608, (scale bar 2 cm), C, *Cinachyrella australiensis* (Carter, 1886) (as *Chrotella cavernosa* sensu Burton, 1959), John Murray Exped., BMNH 1936.3.4.188, D, *Cinachyrella* spec. (as *Chrotella cavernosa* sensu Burton, 1959), John Murray Exped., BMNH 1936.3.4.189, E, *Craniella oxeata* (Burton, 1959 as *Tetilla*), John Murray Exped., BMNH 1936.3.4.377, F, *Paratetilla corrugata* Dendy, 1922 (as *Paratetilla bacca* sensu Burton, 1959), John Murray Exped., BMNH 1936.3.4.378, G, *Paratetilla corrugata* Dendy, 1922 (as *Chrotella eurystoma* sensu Burton, 1959, not Keller, 1891), John Murray Exped., BMNH 1936.3.4.29, H, *Tentorina sigmatophora* Burton, 1959, John Murray Exped., topotypical specimen BMNH 1936.3.4.517, I, *Tentorina sigmatophora* Burton, 1959, John Murray Exped., type specimens, BMNH 1936.3.4.516, J, *Tentorina sigmatophora* Burton, 1959, John Murray Exped., detail of 2I, lectotype specimen (scale bar 1 cm).

Cinachyrella australiensis (Carter, 1886)
(fig 2c)

Chrotella cavernosa sensu Burton, 1959: 200 (in part) (not: *Cinachyrella cavernosa* sensu Lamarck, 1813).

Material.— BMNH 1936.3.4.188, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— The material recorded by Burton under the name *Chrotella cavernosa* appears to be referable to two different species, one of which is clearly the widespread *Cinachyrella australiensis*, among others on account of the large numbers of short rugose oxeas. *Chrotella* is a junior synonym of *Tetilla*, a genus without porocalices. It was misapplied by Burton (1959). The use of the species name *C. cavernosa* (Lamarck, 1815) is unwarranted since we do not know the origin of *Tethya cavernosa* Lamarck, nor is the redescription by Topsent (1931) sufficient for recognition at the species level.

Cinachyrella spec.
(fig 2d)

Chrotella cavernosa sensu Burton, 1959: 200 (in part) (not: *Cinachyrella cavernosa* sensu Lamarck, 1815).

Material.— BMNH 1936.3.4.189, Oman, 17.483 N 55.783 E, 95 m, John Murray Exped. stat. 43, 28-10-1933, two fragments.

Remarks.— These fragmented specimens are not mentioned in Burton (1959), but they were labelled *Chrotella cavernosa* as well. This is a distinctly separate species lacking the rugose oxeas of *C. australiensis* and possessing large anatriaenes with broad cladomes.

Craniella oxeata (Burton, 1959)
(fig. 2e)

Tetilla oxeata Burton, 1959: 199, fig. 4.
Tetilla cranium sensu Burton, 1959: 198 (not: *Craniella cranium* (Müller, 1776) (in part?)).

Material.— Holotype: BMNH 1936.3.4.377, Oman, 17.483 N 55.783 E, 95 m, John Murray Exped. stat. 43, 28-10-1933, labelled *Tetilla oxeata*; BMNH 1936.3.4.380, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933, labelled *Tetilla cranium*.

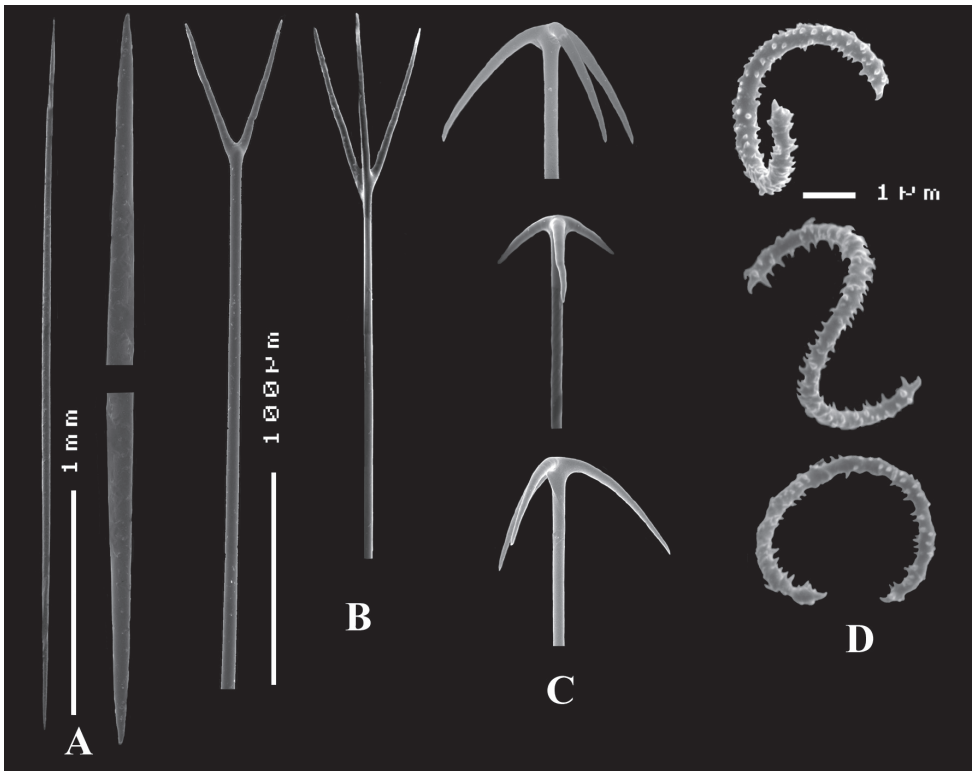


Fig. 3. *Cinachyrella arabica* (Carter, 1869), ZMA Por. 14608, A, oxeas, B, prodiaene and protriaene, C, anatriaenes, D, sigmaspires.

Remarks.— This is a clear *Craniella* on account of the possession of cortical short oxeas. Both specimens share a rather loose radiate structure, clearly different from European *Craniella cranium*. Burton reports a second Oman specimen under *Tetilla cranium*, but this could not be found.

Paratetilla corrugata **Dendy, 1922**
(fig. 1f-g)

Paratetilla bacca var. *corrugata* Dendy, 1922: 23, pl.I fig. 7.
Paratetilla bacca sensu Burton, 1959: 200 (not: Selenka, 1867).
Chrotella eurystoma sensu Burton, 1959: 200 (not: *Cinachyra eurystoma* Keller, 1891) (in part).

Material.— BMNH 1936.3.4.378, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933, labelled *Paratetilla bacca*; BMNH 1936.3.4.29, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933, 3 specimens labelled *Cinachyra eurystoma*.

Remarks.— The Oman specimens recorded as *Chrotella eurystoma* differ from Keller's type of *Cinachyra (= Cinachyrella) eurystoma* by the possession of calthrops-like triaenes, a defining character for *Paratetill*a. They also lack the protriaenes with wide

cladomes and undulating cladi which appear to characterize this *Cinachyrella* species, as could be verified by examining a slide of Keller's type, BMNH 1908.9.24.73, labelled 'TYPE Keller, Red Sea'. The John Murray specimens differ from the widespread *Paratetilla bacca* proper by the possession of numerous long trichodragmata, approx. 125 μm long. Dendy (1922) described a variety *corrugata* from the Seychelles, possessing similar trichodragmata and it is here established that this variety is of specific rank and includes the present specimens. Thomas' (1973) record of *Paratetilla bacca* appears to belong to *P. corrugata* as well.

Further Spirophorida from adjacent areas include the enigmatic *Tentorina sigmatophora* Burton (1959) described from 229 m depth off the Maldives. The species was assigned to the family Spirasigmidae by Hooper & Van Soest (2002b). The habit of this species was never pictured so far, and the indicated holotype material consists in fact of two discrete specimens assigned to a single registration number, BMNH 1936.3.4.516, while there is a third specimen from the same station but assigned its own registration number, BMNH 1936.3.4.517. The opportunity is here taken to publish images of the type specimens in figs 2h-j. Since Burton's description refers to a 'small conical sponge' it is clear he meant the specimen pictured left in fig. 2i and magnified in fig. 2j and accordingly this is here designated the lectotype, with the specimen to the right in fig. 2i the paralectotype. The status of the third specimen (fig. 2h) remains debatable, but technically this is a topotypical non-type specimen.

Order Astrophorida
Family Ancorinidae

Asteropus moolenbeeki spec. nov.
(figs 4a-b, 5a-e)

Material — Holotype ZMA Por. 17037, Khuriya Muriya Islands, Al Hallaniyah main island, intertidal, 17.4922 N 55.96667 E, 12-11-1991, coll. R.G.Moolenbeek & H.Dekker, moo91/61; paratype ZMA Por. 17029, same data as holotype.

Description.— Encrusting, with laterally flattened irregular digitations, now fragmented, 4.5 cm in widest expansion, digitations up to 4 cm high and 1 cm diameter (fig. 4a, b). Surface optically smooth but rough to the touch, texture incompressible. Oscules not apparent, but a few openings less than 1 mm diameter are found on one of the fragments.

Colour.— Live colour not noted, in alcohol black to blackish brown, slightly lighter inside.

Skeleton.— Thoroughly confused mass of oxeas, with an indistinct tangential crust at the periphery, grading into a more dense skeletal arrangement in the interior.

Spicules.— Oxeas, sanidasters, euasters. Oxeas (fig. 5a), perhaps separable into two categories, the smaller of which is concentrated in the surface crust, sizes overall 486-1295 × 7-36 μm, smaller: 486-*593.6*-760 × 7-*14.8*-19 μm , larger: 881-*1053.3*-1295 × 23-*28.0*-36 μm. Sanidasters (fig. 5d, e), concentrated at the surface, but also less prominently present in the choanosome, likewise separable into two categories; thinner, straight, thin-rayed sanidasters (fig. 5d), 12-*15.2*-18 × 1-*1.4*-1.6 μm, which show fewer spines under SEM; and thicker, irregular, thick-rayed sanidasters (fig. 5e), 12-*13.3*-15 × 2.5-*2.66*-3 μm, which show

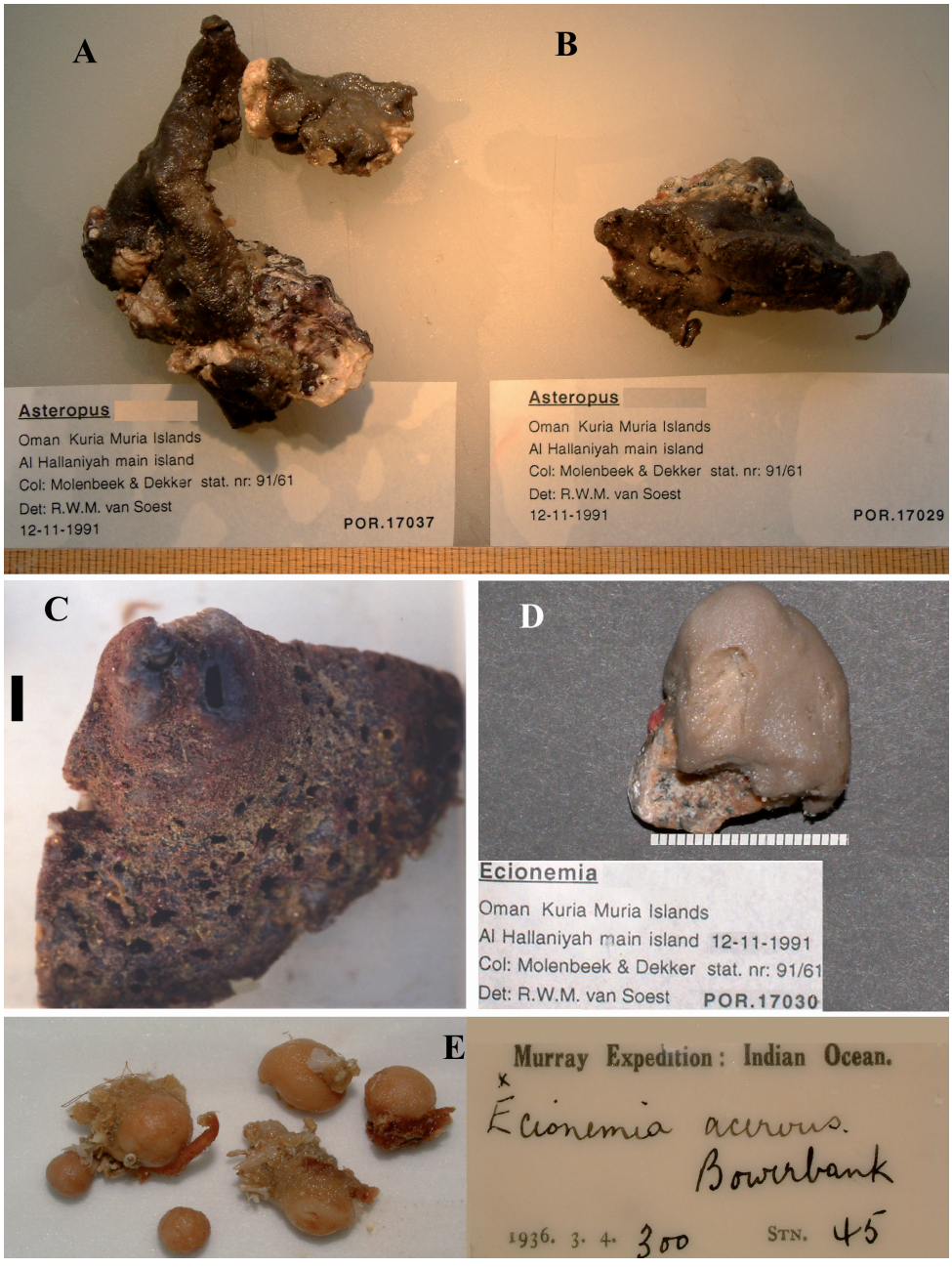


Fig. 4. A-B, *Asteropus moolenbeeki* spec. nov., A, holotype ZMA Por. 17037, B, paratype ZMA Por. 17029, C, *Asteropus arenosus* spec. nov., holotype ZMA Por. 17475 (scale bar 2 cm), D-E, *Ecionemia cinerea* Thiele, 1900, D, ZMA Por. 17030, E, John Murray Exped., BMNH 1936.3.4.300 (as *Ecionemia acervus* sensu Burton, 1936, not Bowerbank, 1864).

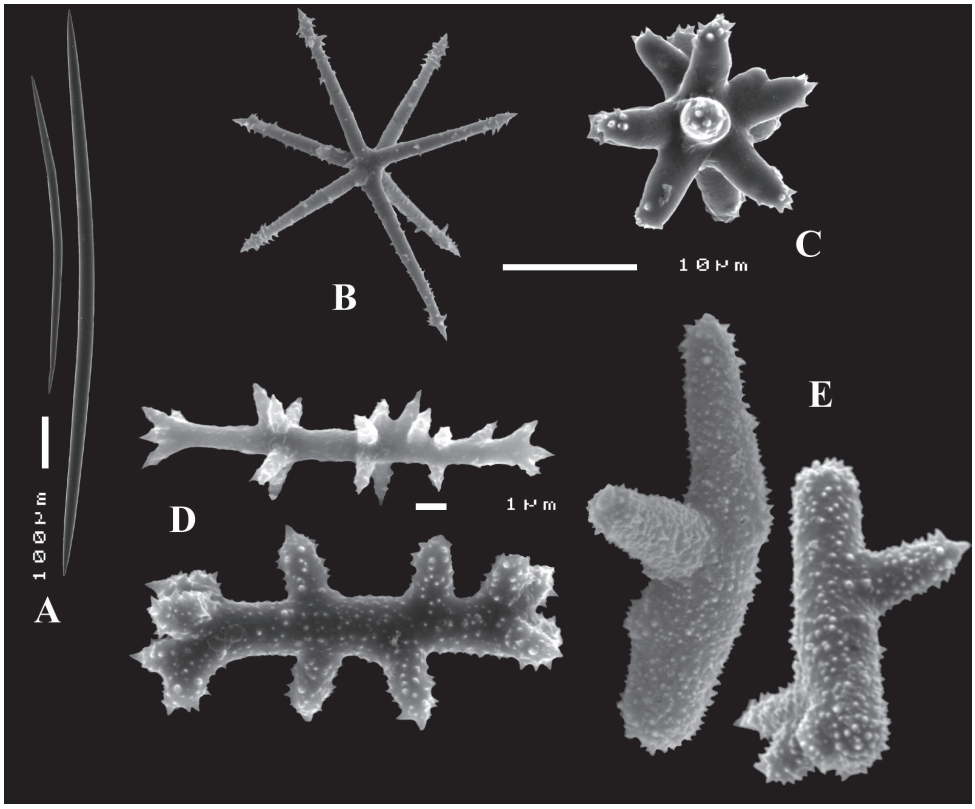


Fig. 5. *Asteropus moolenbeeki* spec. nov., ZMA Por. 17037, A, oxeas, B, oxyaster, C, strongylaster, D, thin sanidasters, E, thick, irregular sanidasters.

overall dense spination under SEM (sanidaster thickness measured excluding rays). Oxyasters (fig. 5b), thin-rayed with 6-10 sparsely spined rays, moderately common in the choanosome, 21-27.9-36 μm. Strongylasters (fig. 5c), with 8 thick rays, with spines only at the end, quite rare, so only a few could be measured: 13-19 μm.

Ecology.— Collected from among intertidal stones. The flattened condition of the digitations may be simply an effect of growing in crevices of tightly packed stones.

Etymology.— Named after Robert G. Moolenbeek, curator of Mollusca of the Zoological Museum of Amsterdam, in acknowledgement of his efforts to promote knowledge of the Oman marine fauna.

Remarks.— Among the described material of the genus *Asteropus*, the present specimens conform most closely to New Caledonian specimens described by Lévi (1967). His material shares habit, colour and general spicule sizes, although no mention is made of euaster shape. The Oman species is also close to the original reports of *Asteropus simplex* (Carter, 1879a as *Stellettinopsis*) from West Australia (Freemantle). This is described as a tawny-brown coloured lobate mass with undulating surface. Oxeas and sanidasters are approximately in the same size range. Discrepancies are the upper size of the oxyasters: Carter's material has a range up to 60 or more μm (reexamination by

Hajdu & van Soest, 1992) and the oxyasters are apparently divisible in a smaller and larger size category. The present specimens have likewise two euaster categories, but the size is smaller and they are separable on shape as well as size. Carter did not mention the presence of trichodragmas in *A. simplex*, but these were noted in Hajdu & van Soest's reexamination. Such trichodragmas have not been found in the present material.

Subsequent records of *Asteropus simplex* by a large number of authors extended the shapes, spicule size ranges and categories, geographic locations and habitats to an unconvincing amalgamated 'species' with a variety of shapes occurring all over the world and at a depth range from intertidal down to 126 m. Early attempts to distinguish individual species among this complex, *e.g. Asteropus haeckeli* Dendy, 1905, were later quenched into a single widespread *A. simplex*. This situation lasted until the 1990s, when Hajdu & Van Soest (1992) described the Central West Atlantic *Asteropus*, arriving at four separate *Asteropus* species differing in shape and spicule sizes. This was followed by Kennedy (2000), who erected *A. radiocrusta* for a specimen from South East Australia. It is here suggested that small differences in Indo-Pacific specimens might be evidence of a species complex rather than a single widespread variable species. Table 2 lists the Indo-West Pacific records of *Asteropus* specimens to aid in a future revision.

Asteropus arenosus spec. nov.
(figs 4c, 6a-c)

Material — Holotype: ZMA Por. 17475, Dhofar, Mirbat, Hino, 16.9663 N 54.7542 E, 12 m, 15-12-2002, coll. R.G.Moolenbeek, Symbiosponge Project, 02/IO/DEC15/RM/041.

Description.— Morphology (fig. 4c): the holotype is a large inverted-conical mass of 30 cm diameter at the base tapering upwards and ending in a 3 cm large vent at a height of 20 cm. Smaller apertures (oscules?) of approx. 1.5 cm in widest diameter are spread over the lateral surfaces. Inside there are large canals and cavities. The surface looks and feels rough and prickly. The specimen was largely used up for chemical research, but a wedge-shaped fragment of 8 × 4 × 4 cm was retained as voucher. Surface covered by sediment, algae and other sponges.

Colour.— Brown outside, greyish inside.

Skeleton.— Thoroughly confused mass of oxeas interspersed with sanidasters and oxyasters. No clear ectosomal region.

Spicules.— Oxeas, sanidasters, and euasters. Oxeas (fig. 6a) in two clearly separated size categories; large, thick, fusiform, abruptly pointed oxeas, 858-*1894.3*-2777 × 36-*60.5*-78 μm; and small, thin oxeas with elongated points, often curved or flexuous, 298-*454.8*-646 × 4-*7.3*-12 μm. The latter are concentrated in the peripheral region. Sanidasters (fig. 6c), straight, usually with four verticils of rays, relatively uniformly shaped and sized, 15-*19.3*-23 × 1.2-*2.2*-3.1 μm. Oxyasters (figs 5b), with a small centre and 5-9 irregularly spined rays, occasionally smooth: 27-*34.9*-41 μm.

Ecology.— On stones, in sandy environment and covered by it, in clear water at 12 m.

Etymology.— The name refers to the sandy habitat in which the holotype was found.

Table 2. Records of Asteropus from the Indo-West Pacific region

Author	Name	Shape, colour	Oxeas	Oxyasters	Sanidasters	Locality
Carter, 1879	simplex	massive lobate,	1315 × 28	21-67	17	W Australia, no depth
Dendy, 1905	haeckeli	encrusting, pale grey	1900 × 65	40	16	Sri Lanka, no depth
Hentschel, 1909	simplex (a)	lobate, grey	536-1750 × 10-39	17-25	16-20	W Australia 0.5-3.5 m
	simplex (b)	erect, grey	944-2525 × 30-72	29-48	13-17	W Australia 5.5 m
Dendy, 1916a	simplex	massive, pinkish grey	1700 × 70	30	20	India, 11-18 m
Dendy, 1916b	simplex	massive, dark brown	2100 × 65	50	20	Cargados, 54 m
Dendy, 1924	simplex	digitate, dark brown	2500 × 68	40	20	New Zealand,126 m
Dendy & Frederick, 1924	simplex	massive, purple brown	not given	not given	not given	W Australia, no depth
Wilson, 1925	simplex	pear-shaped, brown	2500-3100 × 85-100	40-70	12-20	Philippines, 67 m
Lévi, 1967	simplex	encrusting, black grey	600-1400 ×	22-25	10-12	New Caledonia
Bergquist, 1968	simplex	conical, yellow	2016-2915 × 57-81	25-58	14-22	New Zealand, 54-108 m
Bergquist, 1969	simplex	massive, white	800-1250 × 10-28	20-38	10-22	N Australia
Tanita, 1970	simplex	globular, massive	1000-2400 × 16-30	20-28	10-14	Japan
Vacelet et al. 1976	simplex	not given	not given	not given	not given	Madagascar, no depth
Tanita & Hoshino, 1989	simplex	lobate, dark brown	1000-2000 × 35-42	20-23	15-17	Japan, 7-46 m
Pulitzer-Finali, 1993	simplex	(a) ancrusting, dark grey (b) large, greenish black	950-2500 × 40-85	25-50	11-20	Kenya, 1-25 m
Kennedy, 2000	radiocrusta	massive, grey (alc.)	530-1730 × 5-44	18-33	9-18	SE Australia, 3-6 m
present paper	moolenbeeki. sp. nov.	digitate, black	486-1295 × 7-36	21-36 (oxy) 13-19 (strong.)	12-18 (2 cat.)	Oman, intertidal
present paper	arenosus sp. nov.	conical, brown	(1) 858-2777 × 36-78 (2) 298-646 × 4-12	27-41	15-23	Oman, 12 m

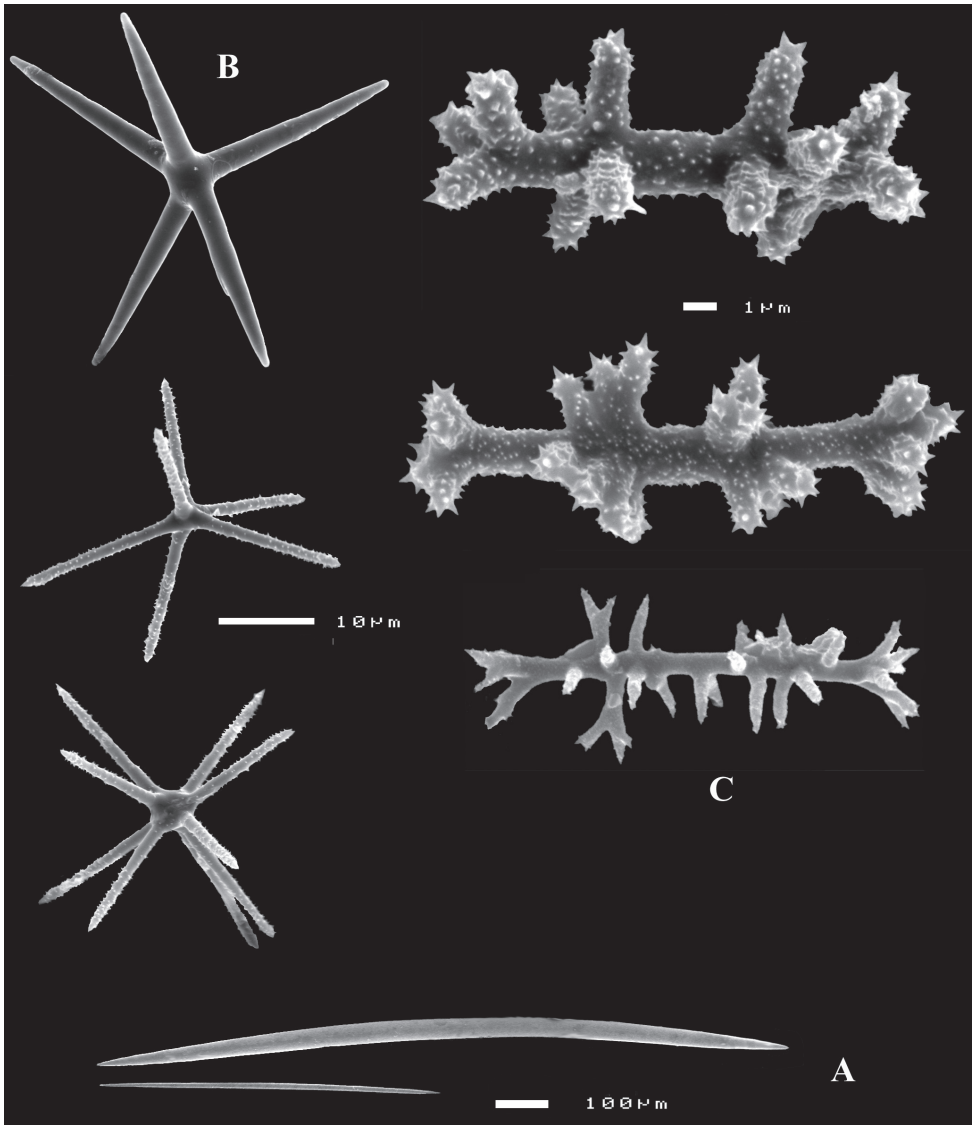


Fig. 6. *Asteropus arenosus* spec. nov., ZMA Por. 17475, A, oxeas, B, oxyasters, C, sanidasters.

Remarks.— The present specimen is close to the type of *Asteropus*, West Australian *A. simplex* (see Table 2), but differs clearly in the differentiated smaller and larger oxea categories, while also the upper size of the oxyasters stays well behind the largest sizes recorded for *A. simplex*. The present species is quite different in morphology and spicule size and shape from the previous Oman species: the large oxeas are much longer and thicker than those of the encrusting specimens, there is a much clearer separation of oxea categories. The sanidasters show much less variation in size and shape.

Compared to descriptions from elsewhere in the Indo-West Pacific (table 2), the

present material is similar to Dendy's (1916b) *A. simplex* material from Cargados Carajos in spicule dimensions. Possibly this concerns the same species.

The specimen could also be conspecific with at least part of Pulitzer-Finali's (1993) Kenyan *A. simplex* material. It is quite possible that the two growth forms recorded by Pulitzer-Finali are the same types as described here from Oman. He mentions one specimen from 1 m depth, an irregular cushion filling rock crevices, dark grey in colour. A second specimen is large and greenish black in life. Unfortunately, Pulitzer-Finali did not separately measure the spicules, but gave overall sizes covering a large range, especially in the oxeas and oxyasters.

Ecionemia cinerea Thiele, 1900
(figs 4d-e, 7a-g)

Ecionemia cinerea Thiele, 1900: 32, pl.II fig. 8.
Ecionemia nigrescens Thiele, 1900: 34, pl. II fig. 9 (new synonymy).
Ecionemia acervus sensu Burton, 1959: 194 (not: Bowerbank, 1864: 173).
?*Ecionemia carteri* Dendy, 1905: 79, pl. I fig. 5, pl. III fig. 1 (as *Ecionema*).

Material.— ZMA Por. 17026 anhud 17030, Khuriya Muriya Islands, Al Hallaniyah main island, 17.4922 N 55.96667 E, 12-11-1991, coll. R.G.Moolenbeek & H.Dekker, 91/61; BMNH 1936.3.4.300, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933, labelled as *Ecionemia acervus*.

Description— Oblong, globular cushions, maximum 2.5 × 2 × 2 cm. One of the ZMA specimens is encrusted with barnacles (figs 4d, e). Surface rough to the touch, provided with some clustered apertures of less than 1 mm diameter. Consistency incompressible.

Colour.— Brown-grey in alcohol.

Skeleton.— Radiate, especially in the periphery where bundles of oxeas and triaenes are arranged at right angles to the surface, cladi of the triaenes spread widely and overlapping to carry the dense ectosomal layer of microrhabds. In between the cladi, brushes of oxeas and individual oxeas penetrate the ectosomal microrhabd layer causing the rough surface. The ectosomal microrhabd layer is pierced regularly by ostia of 20-40 μm diameter.

Spicules.— Oxeas, orthotriaenes, anatriaenes, microrhabds, tylasters, strongylasters. Oxeas (fig. 7a); large, fusiform, mingled into the subectosomal triaene bundles and dominating the choanosome, 1819-1902 × 35-56 μm; and small, thin, ectosomal, 120-300 × 2-4 μm. Orthotriaenes (fig. 7b), from the subectosomal bundles, 2400-2800 × 23-50 μm, cladi 108-200 × 27 μm; one small plagiotriaene like spicule was observed, size 300 × 6 μm with cladi of 33 × 5 μm. Anatriaenes (fig. 7c), from the subectosomal bundles, 2500-2520 × 1-18 μm, cladi 18-48 × 3-18 μm; a single broken small anatriaene (fig. 7d) was observed, size approx. 300 × 1.5 μm, cladi 5 μm. Microrhabds (fig. 7g), single size, relatively fat and densely spined, with some of the spines showing bifid endings, 12-17 × 3-4 μm. Tylasters (fig. 7e) of the ectosomal and subectomal regions, small and numerous, 8-11 μm in diameter with 10 or more rays. Strongylasters (fig. 7f), of the subectosomal region, larger than the tylasters and with fewer rays, often irregular or asymmetrical, 15-26 μm in diameter, with 2-8 rays.

Ecology.— Intertidal down to 38 m.

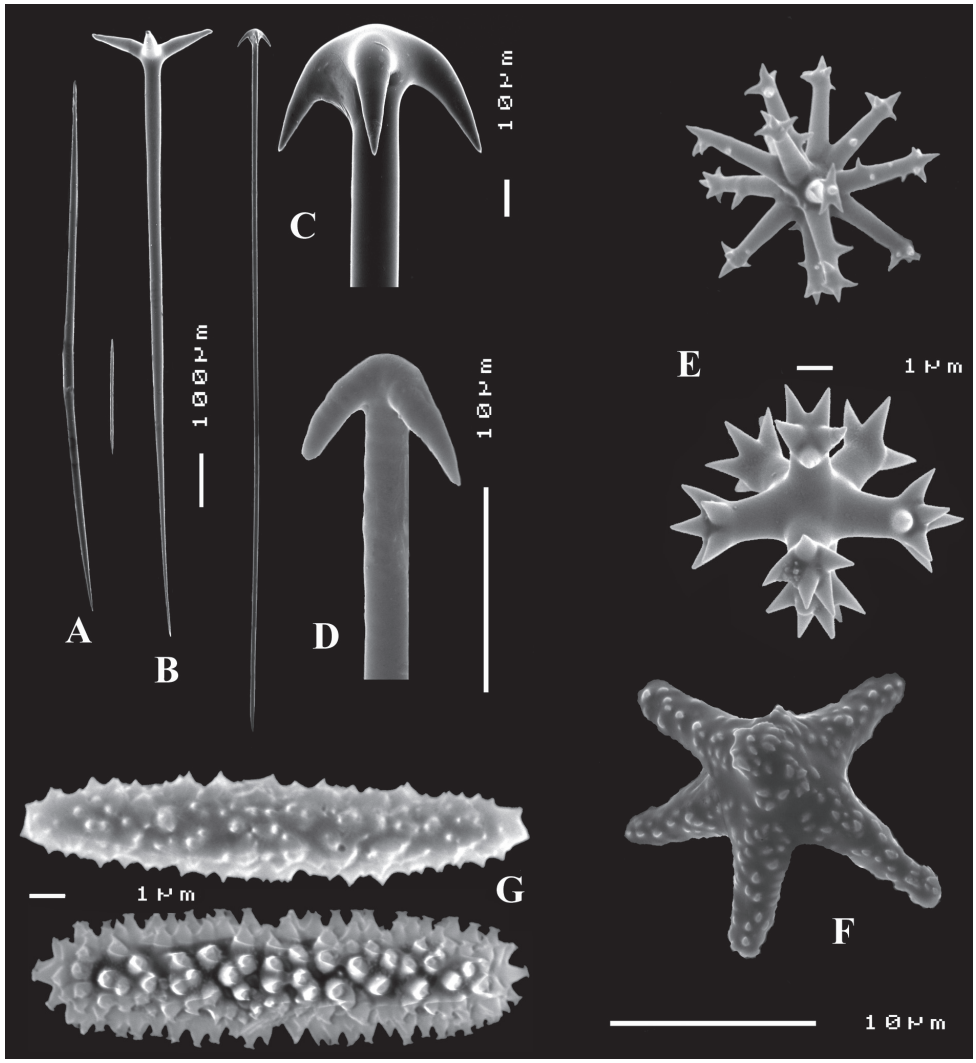


Fig. 7. *Ecionemia cinerea* Thiele, 1900, ZMA Por. 17030, A, oxeas, B, orthotriaene, C, large anatriaenes, D, small anatriaene, E, tylasters, F, strongylaster, G, acanthomicrorhabds.

Remarks.— The specimens and slide in BMNH of Burton's Oman material of *E. acervus* conforms to the ZMA specimens. Although Thiele's material from the Moluccas was not reexamined, the specimens from Oman appear to differ only in one aspect from the description of Thiele: the presence of numerous small anatriaenes in the Moluccan material, instead of which we found only a single small plagiotriaene and a single small anatriaene in one of the Oman specimens. The significance of the occurrence of such small spicules in *Ecionemia* and other Astrophorida remains to be established. The position of these small anatriaenes in Thiele's material is the same as that of the small oxeas, of which many are broken. Possibly, some of the small oxeas are broken small anatri-

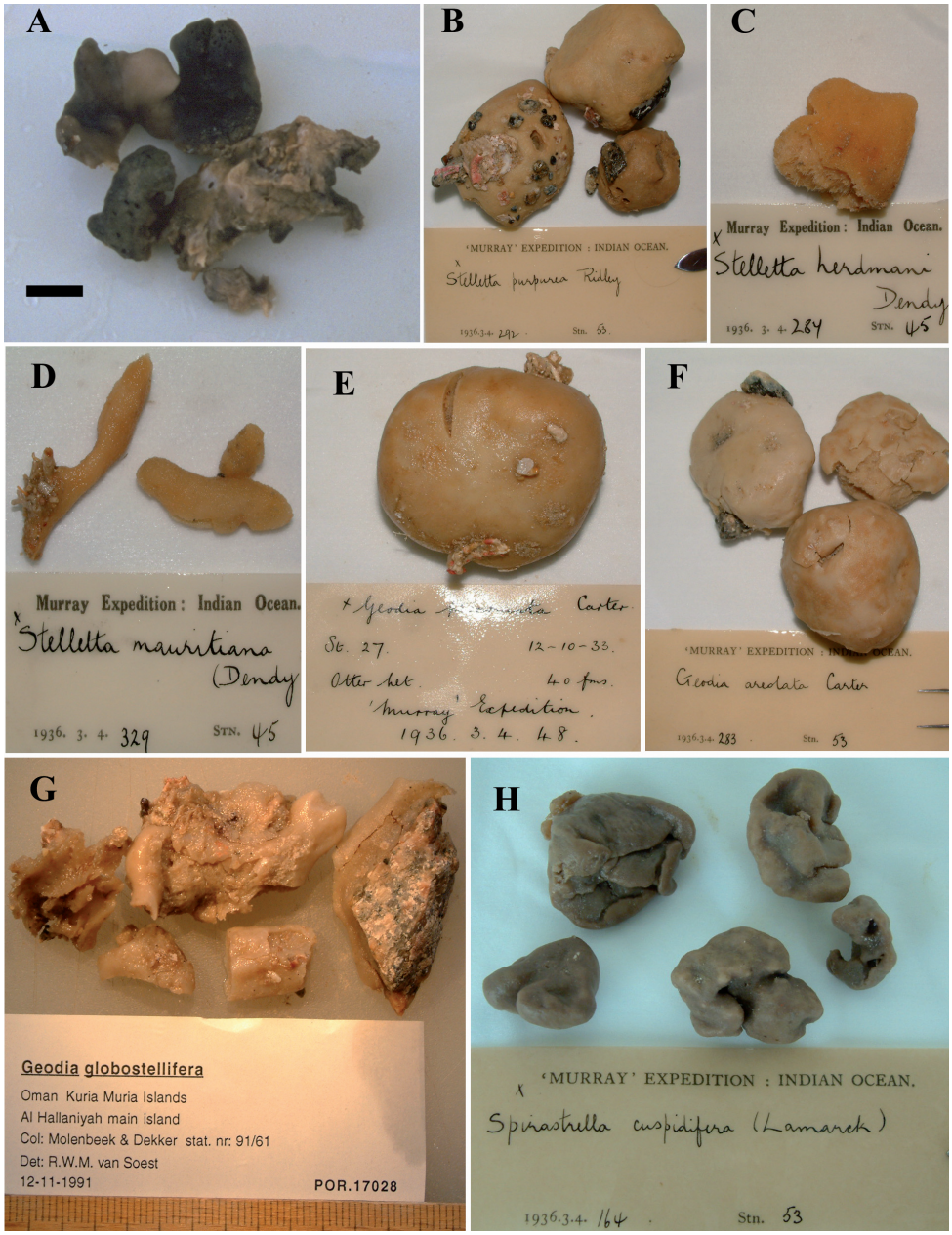


Fig. 8. A, *Ecionemia solida* (Lévi, 1965), ZMA Por. 14609 (scale bar = 1 cm), B, *Stelletta purpurea* Ridley, 1884, John Murray Exped., BMNH 1936.3.4.292, C, *Stelletta herdmani* Dendy, 1905, John Murray Exped., BMNH 1936.3.4.284, D, *Stelletta mauritiana* (Dendy, 1916), John Murray Exped., BMNH 1936.3.4.329, E, *Isops perarmata* (Bowerbank, 1873), John Murray Exped. (as *Geodia*), BMNH 1936.3.4.48, F, *Geodia areolata* Carter, 1880, John Murray Exped., BMNH 1936.3.4.283, G, *Geodia globostellifera* Carter, 1880, ZMA Por. 17028, H, *Spheciospongia tentorioides* (Dendy, 1905), John Murray Exped. (as *Spirastrella cuspidifera* sensu Burton, 1959, not Lamarck, 1814), BMNH 1936.3.4.164.

aenes, but this remains speculative. Thiele mentions an occurrence of separate protriaenes of the same size as the orthotriaenes, and we observed these also in our material, but we feel that the variability in cladi arrangement in the orthotriaenes overlaps with the distinction of separate ortho-, plagio-, and protriaenes in this species. We prefer here to emphasize the overall similarity in shape, skeleton and spicule complement, including separate categories of small tylasters (called chiasters by Thiele, but depicted as tylasters) and strongylasters with irregular ray number, and identify the Oman specimens with confidence to *E. cinerea*. Thiele's *E. nigrescens* (not reexamined) appears so close that it is here considered a junior synonym based on page priority.

Carter's (1887) *E. bacillifera* from the Mergui Archipelago (Birma) appears also close to the present material, but Carter did not mention separate euaster categories, and the same applies to Sri Lankan *E. carteri* Dendy (1905). Both could easily be the same species on account of geographic proximity, but establishing this was beyond the purpose of the present paper.

Contrary to what is stated in Uriz (2002), not all material of the holotype of *Ecionemia acervus* is lost, as there is a microscopic slide in BMNH labelled 'Bk 1414 Fiji Islands' which appears to be from the type. It conforms to the original description. Like the Oman material, but not mentioned in Uriz (2002), there are ectosomal bundles of thin oxeas. This species has a persistent ovoid or globular shape and a single category of microrhabds, like our Oman specimens, but spicule sizes and eausters are clearly different. Hooper & Wiedenmayer's (1994) synonymization of *E. cinerea* and *E. acervus* is thus unjustified.

Ecionemia solida (Lévi, 1965)

(figs 8a, 9a-e)

Stellettinopsis solida Lévi, 1965: 9, fig. 7.

Material.— ZMA Por.14609, Oman, Haramal Road, 23.5711 N 58.6221 E, littoral, coll. R. Gomez, Symbiosponge Project, 98/IO/NOV06/RG/013; MNHN DCL. 353, Dahlak Archipelago, Eritrea, southern Red Sea, fragment from holotype.

Description.— Encrusting masses under and between stones, enveloping the stones and consolidating shells and sediment, forming lobes up to 5 cm in thickness. Consistency firm but easily damaged. Surface optically smooth but rough to the touch. On the exposed parts sieve-like concentrations of exhalant openings. Most of the specimen was used up for natural products research leaving two fragments, the largest of which is 3 × 2 × 1.5 cm (fig. 8a).

Colour.— Live colour dark grey when exposed to the light, whitish at the sides. Internally beige coloured. These colours are maintained in alcohol.

Skeleton.— Architecture peripherally radiate, with bouquets of oxeas and triaenes carrying an ectosomal crust of microrhabds and microasters. Many megascleres penetrate the surface and make the sponge rough to the touch. Among these there is a distinct category of thin wispy oxeotes, which may be a separate spicule category.

Spicules.— Oxeas, plagio/orthotriaenes, microrhabds and several categories of euasters. Oxeas (fig. 9a), thick, fusiform, curved, occasionally with stylote ending, 625-940 × 4-22 μm; many thinner wispy growth(?) stages, 172-300 × 1-1.5 μm. Triaenes (fig. 9b),

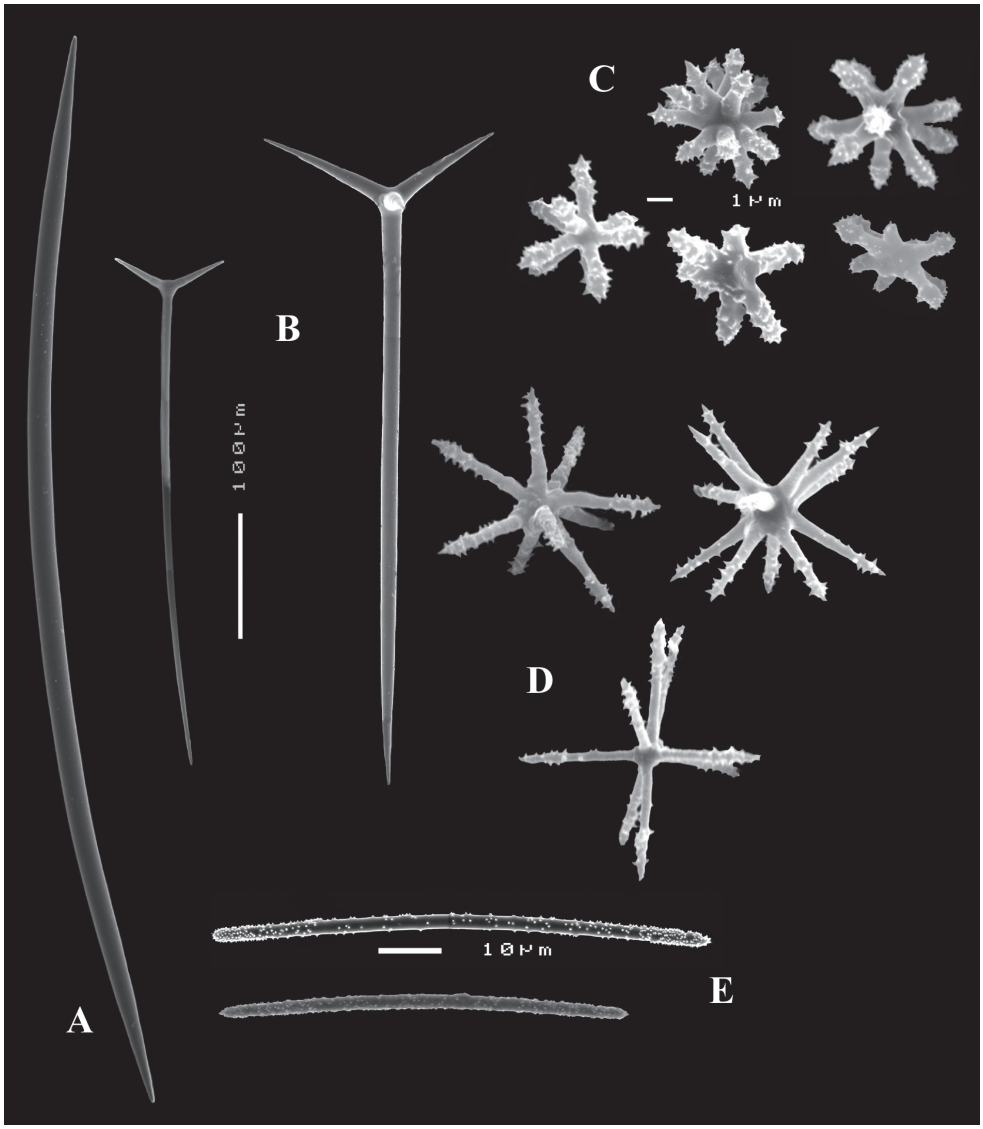


Fig. 9. *Ecionemia solida* (Lévi, 1965), ZMA Por. 14609, A, oxea, B, plagiotriaenes, C, tylasters, D, oxyasters, E, acanthomicrorhabds.

predominantly plagiotriaenes, but the larger mature forms are orthotriaenes, very variable in shape and size, 306-720 × 4-13 µm, cladi 28-90 × 4-10 µm. Acanthose microrhabds (fig. 9e), long, straight, occasionally centrotylote, with rounded or more commonly tapering ends, 63-96 × 1.5-3 µm. Tylasters (fig. 9c), numerous, tiny, thick-centred, multirayed, 2- 6 µm. Oxyasters (fig. 9d), multirayed, similar to tylasters but slightly larger, 9-10 µm. Rare anthasters, six-rayed, spined at the ends of the rays, 14-18 µm (they were so rare that repeated attempts to get them on SEM stubs failed). The asters were unusually variable

in shape, ray thickness and number, with a substantial amount of malformed or irregular shapes.

Ecology.— Intertidal, among and underneath stones.

Remarks.— The specimens from Oman were compared to a fragment and slide of the Paris Museum type from the Dahlak Archipelago, southern Red Sea. Lévi (1965) did not mention the presence of triaenes, but these were nevertheless found to be not uncommon in the type. The other spicule types, including oxeas of 550-1000 × 5-35 μm (confirmed by remeasurements), acanthose microrhabds of 75-90 × 3 μm (ditto), and eausters of 7-8 μm diameter (remeasured as 5-15 μm), are in accordance with the present specimen. Lévi did not provide further subdivision of the asters, but in the type slide all three categories mentioned above were found: tylasters/strongylasters of 5-9 μm, oxyasters of 12-15 μm and rare anthasters (only one was found measuring 13 μm in diameter with 6 profusedly spined rays). These measurements are closely similar to the specimen from Oman, with the oxeas and triaenes on average thicker, acanthose microrhabds somewhat thicker and the oxyasters slightly larger, but these differences are clearly not significant.

In his discussion of *Stellettinopsis solida*, Lévi a.o. refers to *Stellettinopsis cherbonnieri* Lévi, 1961 from Aldabra as a closely related species. We were able to compare a fragment and slide of this species (MNHN DCL 359) and can confirm the relatedness. However, this species appears distinct as there are no triaenes in the type, the oxeas are on average longer and thicker, and the skeletal architecture is more definitely radiate, while the dominant aster type is a spheroxyaster forming a dense layer at the surface. This condition is unlike that in our specimen and in the type of *Stellettinopsis solida*. The two species share the presence of anthasters and microrhabds of approximately 100 μm length. *Stellettinopsis cherbonnieri*, by its lack of triaenes, would seem to be a member of the genus *Melophlus* Thiele (1900) rather than *Ecionemia*, but *Melophlus* specimens have a mass of paratangential smaller oxeas at their surface, whereas *S. cherbonnieri* has a strongly radial arrangement without such paratangential spicules.

Indeed, the microrhabds found in these two species (*E. solida* and *E. cherbonnieri*) are unusually long for species of *Ecionemia*, but this is shared with *E. laviniensis* Dendy, 1905 from India (also reported by Thomas (1973) from the Seychelles and by Pulitzer-Finali (1993) from Kenya), with similar length of 100 μm. However, this species has dichotriaenes and much smaller oxeas. Other species with relatively long microrhabds of 40-50 μm are two South Australian *Ecionemia* species, *E. corticata* (Carter, 1879a as *Stellettinopsis*) and *E. robusta* (Carter, 1883 as *Stelletta*), but these are also quite clearly distinct in spicule characters.

Red Sea species *E. arabica* (Lévi, 1958 as *Hezekia*) and *E. spinastra* Lévi, 1958 differ from our species in possessing commonplace small microrhabds of 10-20 μm length and much larger triaenes. The first of these apparently lacks asters. Such differences exist also with other *Ecionemia* species recorded from more distant localities.

***Stelletta purpurea* Ridley, 1884**
(fig. 8b)

Stelletta purpurea; Burton, 1959: 192

Material.— BMNH 1936.3.4.292, Oman, 19.3667 N 57.8833 E, 13.5 m, John Murray Exped. stat. 53, 02-11-1933.

Remarks.— Conforms to the description of the type.

Stelletta herdmani Dendy, 1905
(fig. 8c)

Stelletta herdmani; Burton,1959: 192

Material.— BMNH 1936.3.4.284, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933; BMNH 1905.7.2.17, type of *S. herdmani*, Sri Lanka.

Remarks.— The type of *S. herdmani* from Sri Lanka, was reexamined and found to conform with the Oman specimen.

Stelletta mauritiana Dendy, 1916
(fig. 8d)

Stelletta mauritiana; Burton, 1959: 192.

Material.— BMNH 1936.3.4.329, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— See discussion in Burton (1959: 192), where some doubt about the identity of the Oman material is expressed. We have no further comment. A revision of *S. mauritiana*, including all recorded specimens, is necessary to reach firm conclusions.

Family Geodiidae

Isops perarmata (Bowerbank, 1873)
(fig. 8e)

Geodia perarmata; Burton, 1959: 195.

Material.— BMNH 1936.3.4.47, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— A widespread Western Indian Ocean species. The origin of the type is unknown, but subsequent specimens were reported from South Africa and Sri Lanka. The species is here transferred to *Isops* as there seem to be no cribriporal apertures.

Geodia arabica (Carter, 1869)

Cydonium arabicum Carter, 1869: 4, pl. I figs. 9-16.
?Geodia sphaeroides; Burton, 1959: 195.

Material examined.— none (not found in the BMNH collections).

Remarks.— A distinct globular species with large megascleres (up to 5 mm long) and elliptical sterrasters of more than 100 μm. The surface is hispid from protruding megascleres. The specimen was recorded from Masirah Island, and subsequently from

the Red Sea (Topsent, 1892). Burton (1959) recorded *Geodia sphaeroides* (Kieschnick, 1896) from adjacent areas (Maldives and Middle Arabian Sea); this material is possibly assignable to *G. arabica*, as it has a dense pelt of projecting spicules and uniporal apertures. Whether it conforms to Kieschnick's species from Indonesia (Ternate) is unclear at this stage.

Geodia areolata Carter, 1880
(fig. 8f)

Geodia areolata; Burton, 1959: 195.

Material.— BMNH 1936.3.4.278 & 279, both from Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933; BMNH 1936.3.4.283, Oman, 19.3667 N 57.8833 E, 13.5m, John Murray Exped. stat. 53, 02-11-1933.

Remarks.— The type specimen from India has not been examined. A photo of the Oman material from station 53 is provided here (fig. 8f), in which the globular form and the areolate surface is visible. Burton remarked that the maximum oxyaster diameter in the Oman material was 45 μm, whereas Carter gives 17 μm, which seems a large discrepancy. More research is necessary to establish the conspecificity.

Geodia globostellifera Carter, 1880
(figs 8h, 10a-g)

Geodia globostellifera; Burton, 1959: 195.

Material.— ZMA Por. 17028, Khuriya Muriya Islands, Al Hallaniyah main island, intertidal, 17.49222 N 55.96667 E, 12-11-1991, coll. R.G. Moolenbeek & H. Dekker, moo91/61, nr. 4.
(N.B.: the BMNH specimen, Oman, 17.483 N 55.783 E, 95 m, John Murray Exped. stat. 43, 28-10-1933, could not be found in a recent search).

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Description.— Fragments of a massively encrusting sponge, agglutinating and covering small stones and rubble, with several upright digitations 1-2 cm high, 1 cm diameter (fig. 8h). Surface smooth but rough to the touch. One fragment shows a cribriporal patch, presumably exhalant. Cortical skeleton approximately 1-1.5 mm thick, difficult to cut or tear. Interior pulpy, clearly separated from the cortex.

Colour.— Pale grey in alcohol.

Skeleton.— The cortex consists of a dense crust of sterrasters and small asters mixed with small cortical oxeas, carried by the cladi of a subdermal layer of parallel bundles of orthotriaenes and oxeas. Choanosomal skeleton confused with ill-defined bundles of oxeas and interspersed oxyasters. A single small anatriaene was found, which may be proper.

Spicules.— Orthotriaenes, oxeas, sterrasters, euasters. Orthotriaenes (fig. 10a), with recurved cladi with in some younger stages plagiotriaene or protriaene shapes, but obviously being the same spicule category, 498-*1101.3*-1520 × 9-*40.0*-52 μm, cladi 64-*189.2*-362 × 5-*16.0*-36 μm. Oxeas (fig. 10b) of the choanosome: thinly fusiform, sharply pointed, 880-*1146.0*-1407 × 12-*15.9*-25 μm; of the cortical layer: thin, sharply pointed, 102-*172.1*-206 × 2-*3.2*-4 μm. Sterrasters (figs 10c, d) globular, evenly rounded, with many

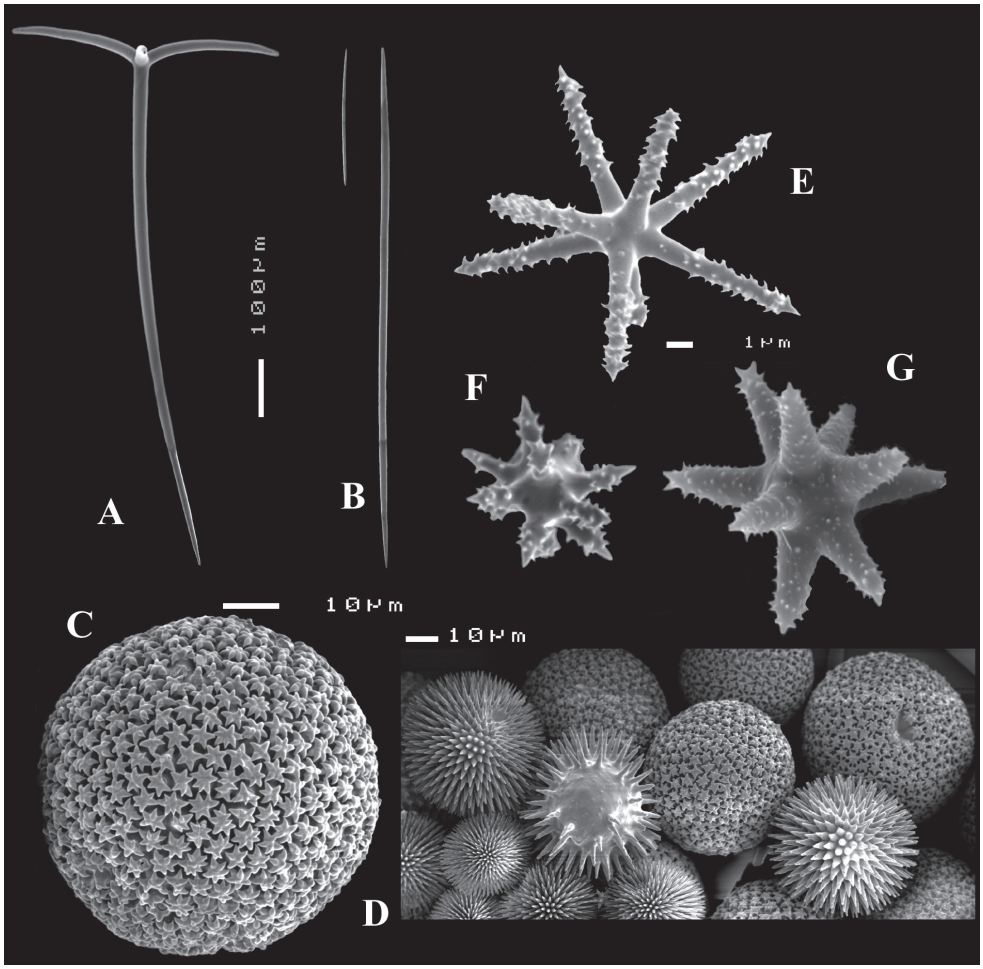

Fig. 10. *Geodia globostellifera* Carter, 1880, ZMA Por. 17028, A. orthotriaene, B, oxeas, C-D, sterrasters, E, oxyaster, F, tylaster, G, strongylaster.

smaller growth stages (fig. 10d), 42-*60.6*-81 μm, measured using only mature sterrasters with rays secondarily branched. Small, multirayed spheroxyasters (fig. 10f) of the cortical sterraster layer, 4-*7.4*-12 μm diameter. Larger, multirayed spheroxyasters (fig. 10g) of the choanosome, rare, 15-18 μm diameter. Oxyasters of the choanosome (fig. 10e), usually 8-rayed, with spined rays, 14-*20.4*-33 μm diameter.

Ecology.— Encrusting intertidal stones and insinuating crevices. Burton's Oman record was from 95 m.

Remarks.— There are a few discrepancies between the original material from the Gulf of Manaar, India, and our material, especially the larger size of the structural oxeas (up to 2390 μm in length in the type), but most aspects and spicule sizes and categories are similar, so the identification is made with confidence. Other records of this species are from North Australia (Ridley, 1884 and Bergquist & Tizard, 1987) and likewise these

record larger oxeas than in our material (up to 3000 μm in Ridley's material). Bergquist & Tizard (l.c.) call the triaenes in their material plagiotriaenes, but it is here assumed that they were similar in shape to Carter's and Ridley's triaenes, which are clearly orthotriaenes in the adult spicules. Some of the younger triaenes have their cladi more or less straight (plagiotriaene-like) or even in-curved (protriaene-like). All records so far agree that this species is encrusting and has a spiculation of orthotriaenes, oxeas, cortical oxeas, small globular sterrasters and three further euaster categories: small cortical spheroxyasters, larger choanosomal spheroxyasters, and large choanosomal oxyasters. It is widespread in the tropical Indian Ocean and adjacent Western Pacific.

Geodia punctata Hentschel, 1909 from Western Australia is closely similar in most features, but no mention is made of cortical oxeas, and almost all spicule categories are smaller than in our specimens. If cortical oxeas have been overlooked by Hentschel, his material fits better with ours, than Carter's or Bergquist's material. *G. punctata* would in that case be a likely junior synonym of a rather more variable *G. globostellifera*. This species appears one from a complex of closely similar encrusting *Geodia* species, characterized by the possession of relatively short orthotriaenes, relatively small sterrasters, and tiny ectosomal spherasters, to which a.o. can be counted *G. paupera* Bowerbank, 1873 (no original locality known), *G. exigua* Thiele, 1898 (Japan),

Order Hadromerida
Family Clionaidae

Spheciospongia tentorioides (Dendy, 1905)
(figs 11a-c, 12a-b)

Spirastrella tentorioides Dendy, 1905: 125, pl. V fig. 7.
Spirastrella cuspidifera; Burton, 1959: 208 (in part) (not: *Spongia cuspidifera* Lamarck, 1814).

Material.— ZMA Por. 17031, Oman, Khuriya Muriya Islands, Al Hallaniyah main island, 17.49222 N 55.96667 E, 12-11-1991, coll. R.G. Moolenbeek & H. Dekker, stat. 91/61; ZMA 16571, Oman, Masirah island, 13 m, 14-11-1998, R.G. Moolenbeek; ZMA Por. 17468, Oman, Dhofar, Mirbat, Shark Island, 5.5 m, 16.94723 N 54.79885 E, 14-12-2002, coll. R.G. Moolenbeek, Symbiosponge Project, 02/IO/DEC14/RM/034; BMNH 1936.3.4.472, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933, labelled as *Spirastrella cuspidifera*; BMNH 1936.3.4.164, Oman, 19.3667 N 57.8833 E, 13.5 m, John Murray Exped. stat. 53, 02-11-1933, labelled as *Spirastrella cuspidifera*.

Description.— Erect masses, tending to have a narrow base and a broader lobate-convoluted upper surface (fig. 11a). Individual lobes grouped together in the sandy habitat to form local concentrations which issue from a broader buried mass. Upper surface convoluted. Size of individual lobate masses up to 6 cm high, 3-4.5 cm wide. Surface of individual lobes and convolutions smooth, no clearly marked oscules are apparent. Consistency hard, but easily broken. Internal structure cavernous, with many large canals penetrating deep into the buried parts.

Colour.— Grey-white coloured with brown spots (fig. 11b), which disappear in preservation resulting in a uniformly pale-beige or reddish brown colour (alcohol preservation) (fig. 11c).The buried parts show a grading colour from brownish to white.

Skeleton.— Largely confused, with vague tracts, but at the surface there is a dense

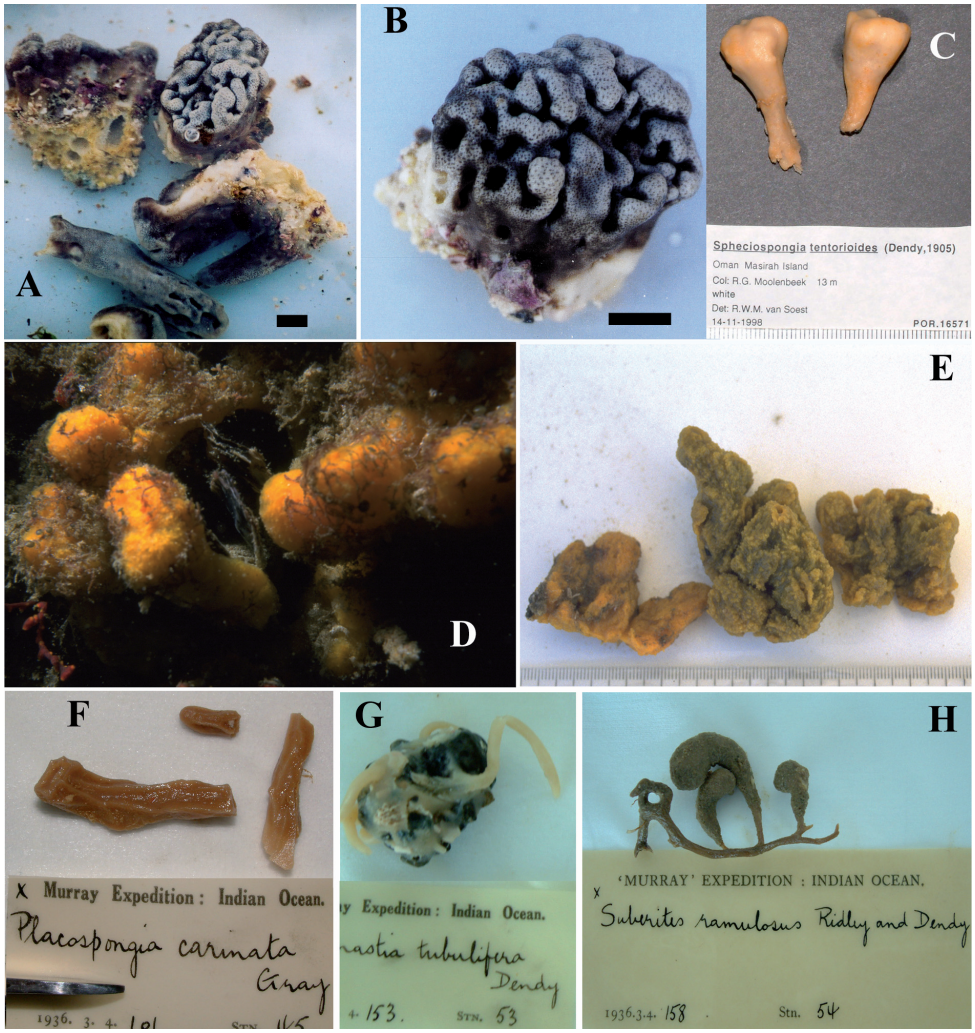

Fig. 11. A-C, *Spheciospongia tentorioides* (Dendy, 1905), ZMA Por. 17031 (A-B), ZMA Por. 16571 (C) (scale bars 1 cm), D-E, *Hemiasterella bouilloni* (Thomas, 1973), ZMA Por 14643, F, *Placospongia carinata* (Bowerbank, 1858), John Murray Exped., BMNH 1936.3.4.101, G, *Polymastia tubulifera* Dendy, 1922, John Murray Exped., BMNH 1936.3.4.153, H, *Rhizaxinella ramulosa* (Ridley & Dendy, 1886, as *Suberites*), John Murray Exped., BMNH 1936.3.4.158.

layer of intercrossing megascleres, which do not form a distinct palisade but orientation is points-outward. Microscleres concentrated at the surface, but not forming a clear crust.

Spicules.— Tylostyle megascleres and spiraster microscleres. Tylostyles (fig. 12a) fusiform, curved, with elongate or subterminal head, in a large size range, 174-*409.9*-588 × 7-*12.8*-21 µm. Spirasters (fig. 12b), variable in length, with one or two spined spiral curves, smaller ones not infrequently more or less straight, 12-*16.9*-27 µm.

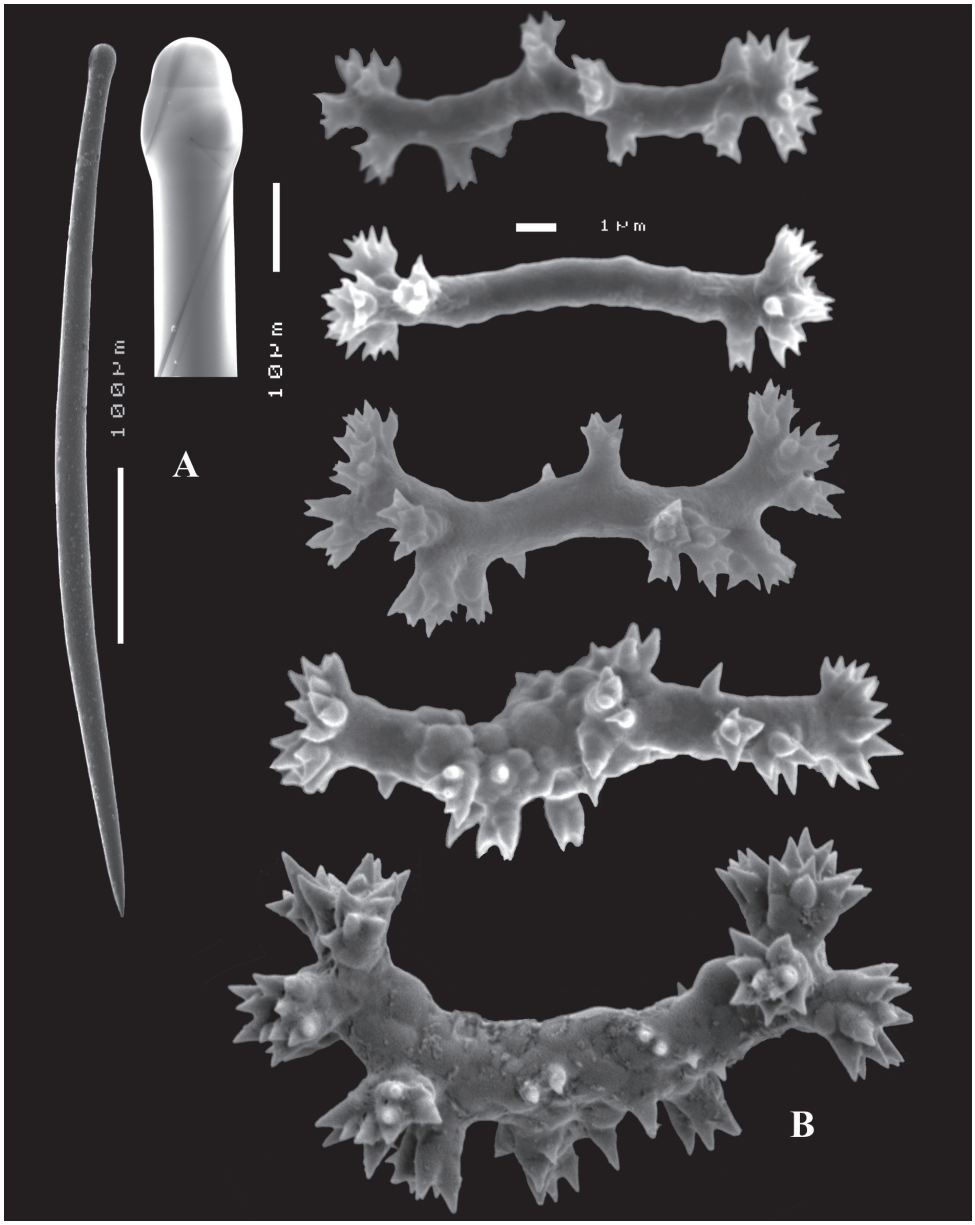

Fig. 12. *Spheciospongia tentorioides* (Dendy, 1905), ZMA Por. 17031, A, tylostyle, B, spirasters.

Ecology.— Sandy flats in clear water among reef corals, depth 0-13 m.

Remarks.— Dendy's (1905) holotype, BMNH 1907.2.1.24 of this species from the Gulf of Manaar, Sri Lanka, was compared with the present specimens. The type material consists of a pale-coloured, small mass of pointed lobes, with spiculation similar to that of the present specimens.

Burton's (1959) specimens of *Spirastrella cuspidifera* which consist of small knobby fragments appear to belong to the present species. The assignment to *Spirastrella cuspidifera* (Lamarck, 1814) is clearly erroneous, because this is a Caribbean species belonging to a different genus (i.e. *Cervicornia*, cf. Rützler, 2002).

Elsewhere in the Western Indian Ocean (Seychelles) a similar species, *Spirastrella globularis* Dendy, 1922 (reassigned as *Spheciospongia globularis* by Van Soest et al. 2005) was recorded, with a globular head on a thinner stalk. The microscleres are described to possess three or four spiral curves, which would appear to be a difference with *S. tentorioides*.

Spheciospongia inconstans (Dendy, 1887) reported from the Indian subcontinent and the Seychelles differs clearly in having a blackish brown colour and a morphology consisting of groups of volcanoe-shaped cones. Spiculation is similar to that of *S. tentorioides*.

Family Hemiasterellidae

***Hemiasterella bouilloni* (Thomas, 1973)**
(fig. 11d-e, 13a-d)

Jaspis bouilloni Thomas, 1973: 65, pl. III fig. 15, pl. V figs 4-4A, pl. VIII figs 1-2; Thomas, 1981: 37; Pulitzer-Finali, 1993: 259 (? only in part).

Material.— ZMA Por. 14643, Oman, N coast, Juzor ad Daymãniyãt (Daymaniyat Islands), N side, 23.8607 N 57.9644 E, 18.3 m, 17 -11-1998, on stones, coll. R.Gómez, Symbiosponge Project, 98/IO/NOV17/RG/049; ZMA Por. 17437; Oman, Muscat, Bandar Khairan (= Ras al Khayran), 23.75 N 58.75 E, 19.3 m, 08-12-2002, coll. R. Gómez, Symbiosponge Project, 02/IO/DEC8/RG/005; ZMA Por. 17741, Oman, Muscat, Mina Al Fahal, 23.6733 N 58.497 E, 12-2002, coll. R.G. Moolenbeek.

Description.— Cushions with digitate-lobate outgrowths which tend to fuse (figs 11d, e). Digitations/lobes club-shaped, up to 4 cm high, 1cm diameter. Surface in live specimen uneven, micronulose, in preserved state (alcohol) this is more pronounced, presumably due to contraction. No oscules were visible in live specimen, nor are these identified in preserved state. Consistency compressible, almost soft; cheesy-rubbery inside when cut. Inhabited by crabs and polychaetes.

Colour.— Colour bright yellow, but somewhat obscured by encrusting algae.

Skeleton.— Surface skeleton is formed by a dense crust 30-40 μm in thickness of the smaller category of microscleres. These leave free a regular pattern of rounded porefields of 40-60 μm diameter (preserved condition). Megascleres loosely axially oriented in the digitations, occasionally confused, little spongin. In apical parts of the digitations, megascleres of the same size as those of the interior fan out at irregular intervals, on the average 400-500 μm apart, towards the surface where they cause the microconules by pushing up the surface crust. Microscleres including the larger category of asters are scattered among the megascleres in moderate quantities.

Spicules.— Oxeas, oxyasters. Oxeas (fig. 13a), 531-*688*-792 × 8-*12.3*-16 μm; approximately 10% of the megascleres consist of styles, strongyles or strongyloxeas, but these are obviously the same spicule category as the oxeas. Microscleres two distinct categories of oxyasters: large asters (fig. 13b) usually provided with three or four, very

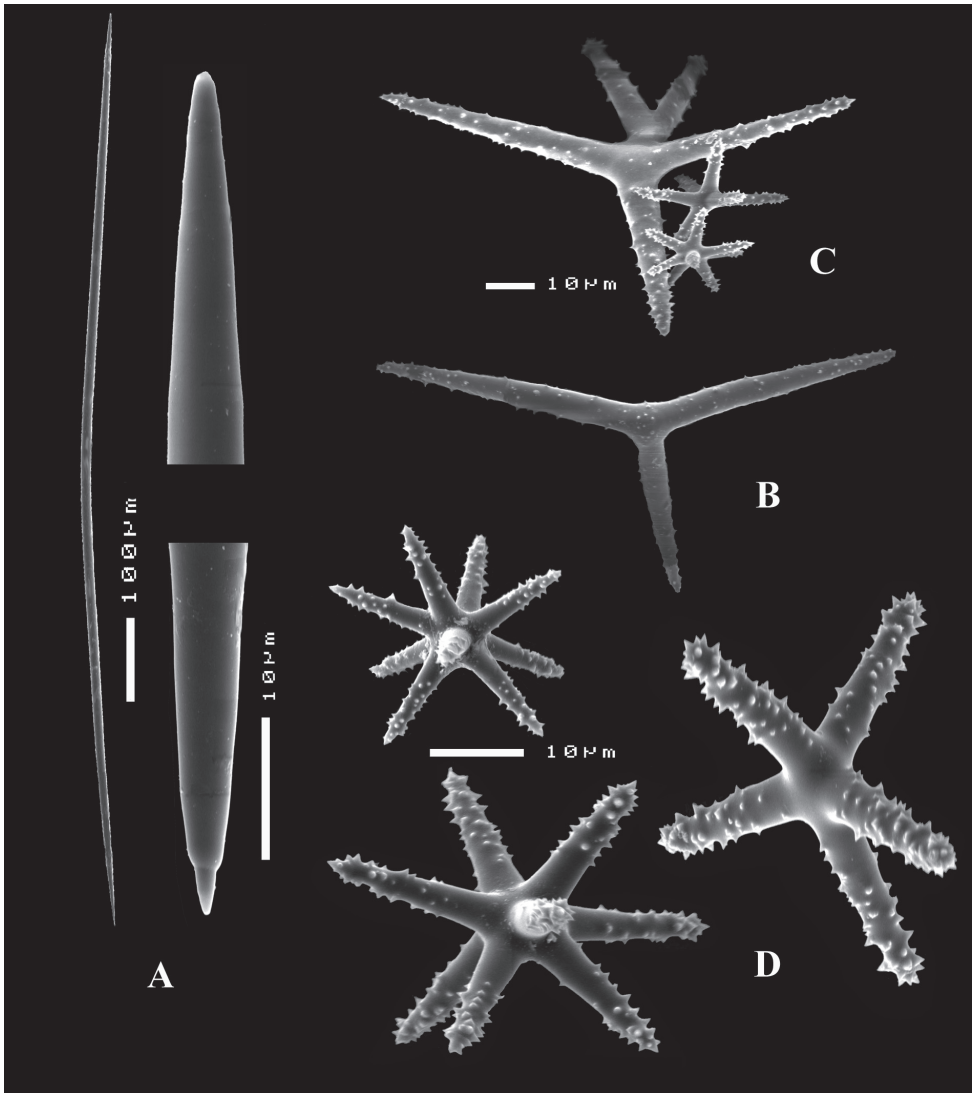

Fig. 13. *Hemiasterella bouilloni* (Thomas, 1973), ZMA Por. 14643, A, oxea, B, large oxyaster, C, large oxyaster and small oxyasters, D, small oxyasters.

occasionally five or six rays, which are invariably lightly spined all-over, entire aster: 90-*105.8*-132 µm, rays: 63-*69.8*-75 µm (3-*3.5*-6 rays); small asters (fig. 13d), with 4-8 rays, which are spined terminally to about halfway, leaving the centre smooth (occasionally entirely smooth rays in smallest, apparently 'juvenile' asters), entire asters 12-*30.2*-36 µm rays 4-*14.9*-21 µm (4-*6.7*-8 rays).

Ecology.— On stones at 18.3-19.3 m depth, in clear warm water.

Distribution.— Oman (Muscat region on N coast), Seychelles (Mahé), Kenya (Mombasa, Zanzibar), 2-19.3 m.

Remarks.— The Oman material matches the description of Thomas (1973) closely, both in morphology and in spicule sizes and categories. Thomas did not differentiate the asters in separate categories, but his illustrations (Pl. V figs 4, 4A) are unmistakable. The only small difference is the lower upper size of the asters, 101 μm against 132 μm in our material. Thomas mentions a predominance of oxeas with centrotylote swellings, not seen in the Oman specimen, but this appears of little significance. Most of Pulitzer-Finali's (1993) specimens were described as encrusting or massive, with orange colour, and the small aster category in a very small size of 9-14 μm (compared to 12-36 in our material), next to the large asters with reduced ray number. Combined, these features may indicate that Pulitzer-Finali's material could belong to a closely related but distinct species.

The present species was originally described from the Seychelles and was assigned to the genus *Jaspis*. This genus has a crust of tangential smaller oxeas and euasters over a choanosomal confused mass of larger oxeas. We reassign *Jaspis bouilloni* to *Hemiasterella* because the axial-radiate arrangement of megasclere bundles perpendicular to the surface and diversity of aster-shapes conforms to that genus rather than to *Jaspis*. A problematic point is the fact that so far the genus *Hemiasterella* has predominantly vase-shaped members and the genus definition of Hooper (2002) emphasizes this. Several vasiform species of *Hemiasterella* (*H. typus* Carter, 1879b, *H. vasiformis* Kirkpatrick, 1902, *H. minor* Kirkpatrick, 1902, *H. complicata* Topsent, 1919, *H. intermedia* Dendy, 1922, *H. strongylophora* Lévi, 1956 and *H. magna* Pulitzer-Finali, 1993) occur in the Western Indian Ocean, including areas adjacent to Oman waters (Burton, 1959). *H. complicata* shares with our new species the shape and size of the megascleres: oxeas/strongyles/styles of 600-1000 × 6-25 μm, but asters do not exceed 50 μm and all have 5 or more rays. All other vase-shaped species have styles as megascleres. Although the present species does not show the characteristic vase shape of *Hemiasterella* its skeletal structure is quite similar to that of typical *Hemiasterella*. Digitate forms of *Hemiasterella* like the present species so far have been reported only from the Atlanto-Mediterranean region (*H. elongata* Topsent, 1928 from the Cape Verde Islands, and *H. aristoteliana* Voultsiadou-Koukoura & Van Soest, 1991 from the Eastern Mediterranean), and from Antarctica (*H. digitata* Burton, 1929).

Family Placospongiidae

Placospongia carinata (Bowerbank, 1858)

(fig. 11f)

Placospongia carinata; Burton, 1959: 213.

Material.— BMNH 1936.3.4.101, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— The sample contains several branching fragments conforming to the type description.

Family Polymastiidae

Polymastia tubulifera Dendy, 1922
(fig. 11g)

Polymastia tubulifera Dendy, 1922: 148, pl. 4 fig.6, pl. 18 fig. 7; Burton, 1959: 206.

Material.— BMNH 1936.3.4.153, Oman, 19.3667 N 57.8833 E, 13.5 m, John Murray Exped. stat. 53, 02-11-1933.

Remarks.— The Murray material ((fig. 11g, label text '(Pol)ymastia tubulifera' not entirely reproduced) conforms to Dendy's Indian Ocean type specimen. This is a characteristic *Polymastia* with several long thin papillae and a smooth surface. Burton (1959) reported two additional *Polymastia* species from adjacent areas: *P.clavata* Burton, 1959 from Zanzibar and the Gulf of Aden, which has peculiar hair-like tylostyles, and *P. murrayi* Burton, 1959 from the Maldives and the Gulf of Aden, which is a bristly-hispid but otherwise typical *Polymastia*.

Further polymastiids from adjacent areas (Zanzibar and Gulf of Aden) are the species recorded as *Tentorium semisuberites* and *Radiella sarsi* by Burton (1959), which are likely to be undescribed species, as these species are of North Atlantic origin.

Family Suberitidae

Rhizaxinella ramulosa (Ridley & Dendy, 1886)
(fig. 11h)

Suberites ramulosus Ridley & Dendy, 1886: 487; Ridley & Dendy, 1887: 207; Burton, 1959: 203.

Material examined.— BMNH 1936.3.4.158, Oman, 21.8333 N 59.8667 E, 1046 m, John Murray Exped. stat. 54, 03-11-1933.

Remarks.— By its habit and skeletal characteristics (palisade of smaller tylostyles and radiating large tylostyles) this species is a likely member of *Rhizaxinella* rather than *Suberites*. No material of the other mentioned Murray Exped. localities (stat. 43 off Oman and stat. 157 from the Maldives) was found in the collections of BMNH. Ridley & Dendy's (1887) var. *cylindrifera* is perhaps more like the Murray material than the typical variety, but both are very likely to represent a single species.

Other Murray Exped. material from adjacent areas are *Suberites domuncula* from the Gulf of Aden, which probably belongs to an undescribed species as it possesses centrotylote microrhabds, *Pseudosuberites kelleri* (Burton, 1930 as *Suberites*), *Pseudosuberites hyalinus* sensu Burton, 1959 (which has the largest tylostyles approx. 1500 μm in length, clearly in excess of what is known of Atlantic *P. hyalinus*) likewise from the Gulf of Aden, and *Protosuberites longispiculus* Burton, 1959 (as *Laxosuberites*) from the Maldives.

Family Tethyidae

***Tethya seychellensis* (Wright, 1881)**
(figs. 14a-b, 15a-d)

Alemo seychellensis Wright, 1881: 13.

Material.— ZMA Por. 14605, Oman, Muscat, Hramal Road, Government Building, 23.5711 N 58.6221 E, 8.2 m, 09-11-1998, coll. R. Gómez, Symbiosponge Project, 98/IO/NOV6/RG/009.

Description.— Ball-shaped, with verrucose surface partially overgrown with filamentous algae. Numerous stalked buds present. Apical oscule, slightly raised above the surface in living condition (fig. 14a, b).

Colour.— Live colour red with greenish tinge. Orange inside.

Skeleton.— A thin cortex, 0.8-1.3 mm thick, traversed by relatively thin tracts of strongyloxeas that only divide once or twice inside the cortex. In the cortex the megasters are arranged in two separate layers, one subdermally beneath the crust of microsters consisting of the larger sizes, the other at the inner border of the cortex containing predominantly smaller megasters, leaving a midcortical area almost free from asters.

Spicules.— Strongyloxeas, microsters, megasters and choanosomal oxyasters.

Strongyloxeas (fig. 15a), often with rounded apices (thus better named 'strongylostyles'), 341-*763.9*-1380 × 6-*8.4*-14 μm. Microsters (fig. 15c) in the form of tylasters, with 8-9 rays, forming the outside crust and scattered individually in the cortex and the choanosome, 11-*14.0*-18 μm. Megasters (fig. 15b) with 12-23 pointed rays, 31-*46.5*-66 μm. Oxyasters (fig. 15d), with 6-10 branching rays, sparingly present in the choanosome, 25-*33.8*-42 μm.

Ecology.— Among stones and octocorals at a depth of 8 m.

Remarks — Sarà et al. (1993) recorded separated smaller and larger megascleres in specimens from the Maldives, but although the size range they measured is the same as ours, we could not easily separate them. The astrose microscleres of the present specimen and those of Maldives material are quite similar in shape and size.

This species is considered cosmotropical in distribution, with specimens recorded from widespread Indo-West Pacific and Central West Atlantic localities. It is likely that *T. seychellensis* forms a complex of cryptic species sharing the peculiar cortical and spicular characters described above. Differences in micromorphology of the asters and spicule sizes between these populations may possibly aid in distinguishing them, as will genetic studies.

***Tethya omanensis* Sarà & Bavestrello, 1995**
(figs 14c-d, 16a-d)

Tethya omanensis Sarà & Bavestrello, 1995: 25, figs 1-3.

Material.— ZMA Por. 17482, Oman, Muscat, Dibab sink hole, 23.070 N 59.054 E, 0-5 m, 19-12-2002, coll. R. Gómez, Symbiosponge, 02/IO/DEC19/RG/48.

Description.— Small ball-shaped sponges (from the original sample three specimens were retained), optically smooth, but faintly grooved surface outlining warty

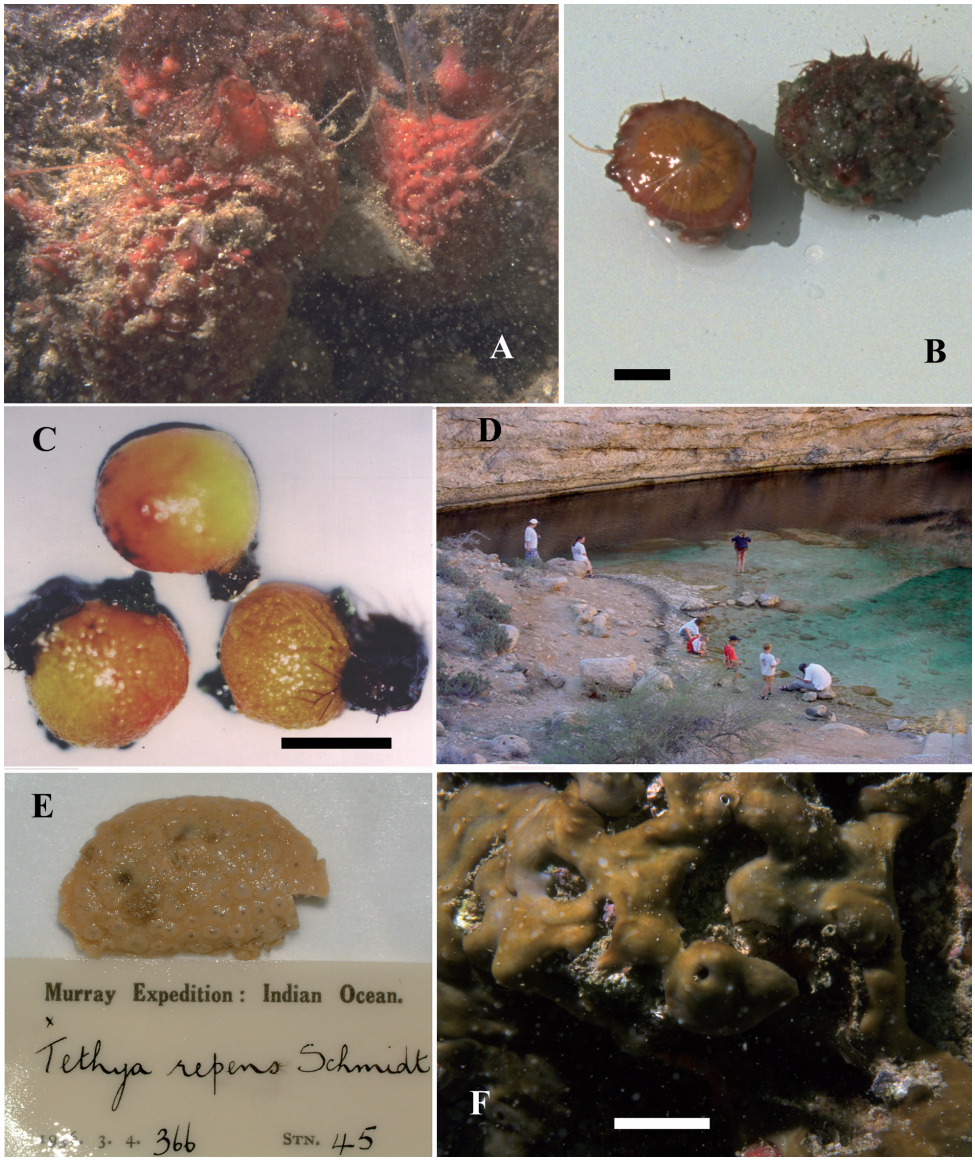

Fig. 14, A-B, *Tethya seychellensis* (Wright, 1881), ZMA Por. 14605 (scale bar B = 2 cm), C, *Tethya omanensis* Sarà & Bavestrello, 1995, ZMA Por. 17482 (scale bar = 1 cm), D, sinkhole habitat of *T. omanensis*, E, *Stelletethya murrayi* Sarà & Bavestrello, 1996 (as *Tethya repens* sensu Burton, 1959, not Schmidt, 1870), John Murray Exped., BMNH 1936.3.4.72; F, *Chondrilla australiensis* Carter, 1873, ZMA Por. 14622 (scale bar = 1 cm).

areas (fig. 14c). Usually one, but up to three, apical oscules. The body shrinks notably upon collecting, and the size in alcohol is uniformly 1.5 cm in diameter. Cortex quite thin, formed by a 0.1 mm thick micraster layer and a 0.5-0.7 mm thick layer of megasters. Subdermal lacunae shrunk to small size in preserved material.

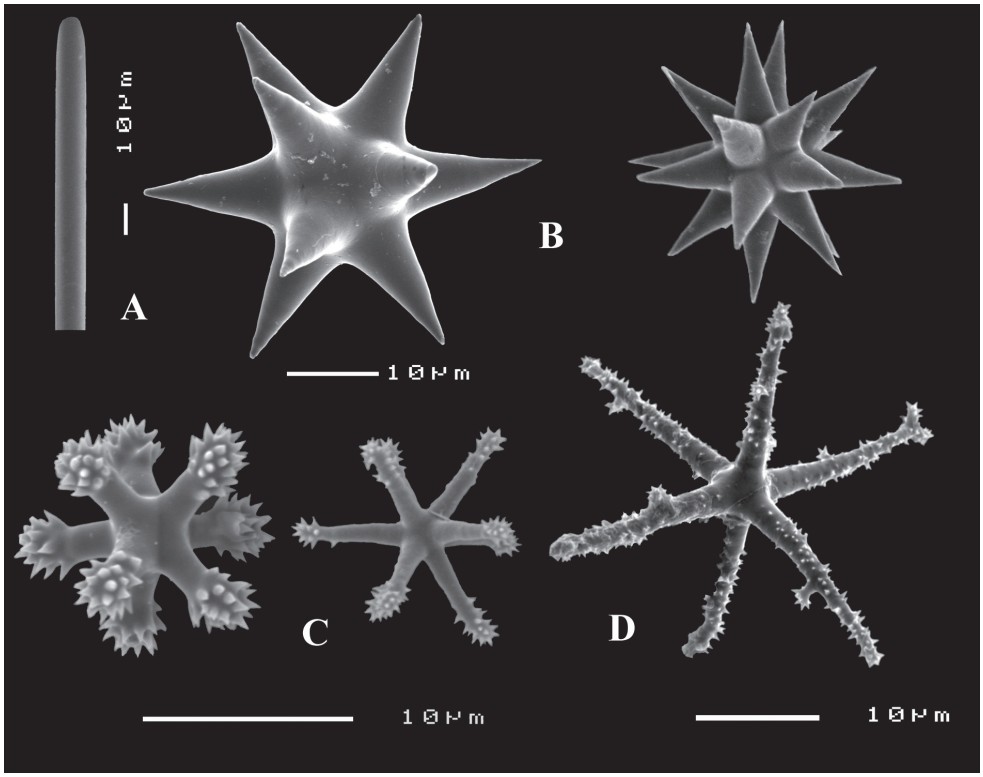

Fig. 15. *Tethya seychellensis* (Wright 1881), ZMA Por. 14605, A, strongyloxea, B, megasters, C, micrasters, D, oxyaster.

Colour.— Orange to light orange in living condition, yellow-brown interiorly, whitish in alcohol.

Skeleton.— Choanosomal bundles of strongyloxeas relatively crowded together, not widely flaring. Subdermally, many diatoms are found inside the sponges.

Spicules.— Strongyloxeas, micrasters and megasters, with a strong tendency to develop rounded silica-bodies with reduced rays and ornamentation. Strongyloxeas (fig. 16a), usually with slight subterminal swelling ('subtylote'), occasionally with a mucron at the rounded end, 505-*844.1*-1188 × 12-*17.5*-23 µm. Megasters (fig. 16b) in a large size range, usually heavily silicified with conical or mammiform rays, occasionally forming smooth round balls (fig. 16c), 24-*47.2*-72 µm. Micrasters (fig. 16d) in the form of strongylospheraster and tylasters, occasionally anthaster-like, a good proportion heavily silicified and with reduced rays (fig. 16e), 7-*15.2*-21 µm.

Ecology.— On vertical sides of wall of inland sinkhole (fig. 14d), between tunicates, algae and some other sponges. This is the type locality of the species.

Remarks.— This is a distinct species lacking oxyasters and possessing a strongly silicified complement of asters, which may be caused by the restricted inland habitat, as a similar silicification was observed in *Tethya irregularis* Sarà & Bavestrello (1998) from inland sink holes in Tenerife (Canary Islands).

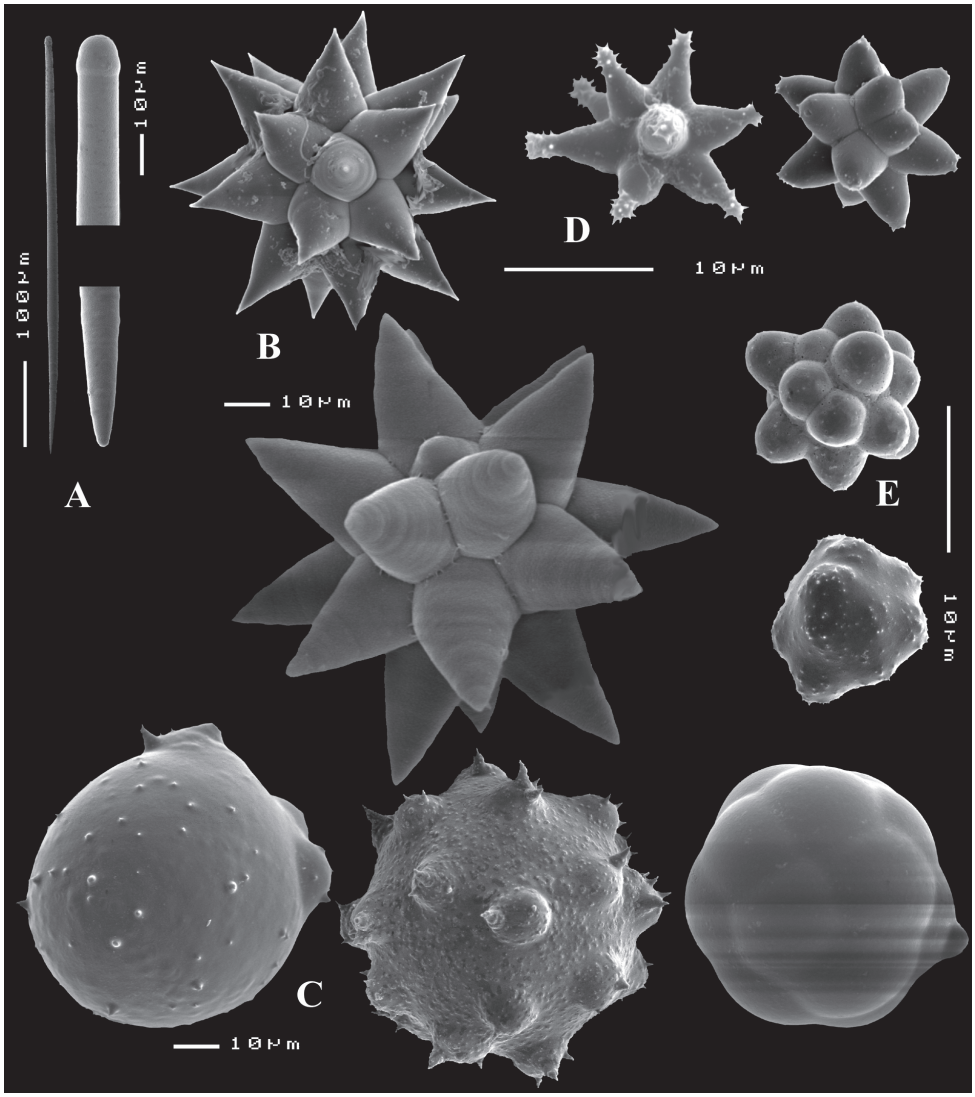

Fig. 16. *Tethya omanensis* Sarà & Bavestrello, 1995, ZMA Por. 17482, A, strongyloxea, B, megasters, C, silicified modified megasters, D, microsters, E, silicified modified microsters.

Stellitethya murrayi Sarà & Bavestrello, 1996
(fig. 14e)

Tethya repens; Burton, 1959: 215 (not: Schmidt, 1870).
Stellitethya murrayi Sarà & Bavestrello, 1996: 257, figs 3-4.

Material.— Holotype BMNH 1936.3.4.72, labelled as *Tethya repens*, 18.058 N 57.042 E, Oman, 38 m, John Murray Exped. stat. 45, 29-10-1933; paratype BMNH 1936.3.4.366, same data as the holotype.

Remarks.— Sarà & Bavestrello (1996) erected a new species for Burton's Indian Ocean material assigned to *T. repens*, which is a Caribbean species. Synonyms of *T. repens* quoted by Burton (*Donatia fissurata* var. *extensa* Hentschel, 1909, *D. tylota* Hentschel, 1912, *D. stellagrandis* Topsent, 1918 and *Tethycordyla thyris* de Laubenfels, 1934) are unjustified, as they are entirely based on the large size of the megasters. Paratype specimens from stat. 53 (Oman) were not found in the collections of the Natural History Museum (2004). The species was also recorded in adjacent areas (Zanzibar and Maldives) from deeper water.

Order Chondrosida
Family Chondrillidae

Chondrilla australiensis Carter, 1873
(figs 14f, 17a-b)

Chondrilla australiensis; Burton, 1959: 197.

Material.—ZMA Por. 14622, Oman, Cat Island, E side of Fisheries Insititute, 09-11-1998, 3-7.7 m, 23.5819 N 58.6103 E., coll. R. Gómez, Symbiosponge Project, 98/IO/NOV09/RG/027; BMNH 1936.3.4.72.244, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Description.— Encrusting stones, approx. 0.3 cm in thickness, surface slippery smooth, distinct smell. Two fragments have been retained, the largest is 4 × 2.5 × 0.5 cm (fig. 14f). Consistency rubbery. Oscules small, white-rimmed, evenly distributed over the surface. Pores evenly distributed, 20-250 μm in diameter, at 50-100 μm distance from each other (observed in preserved fragments).

Colour.— Live colour mottled greenish brown.

Skeleton.— Spicules only found in the upper 30% of the tissue in cross sections, density 90 asters per 100 × 100 μm.

Spicules.— Euasters divisible in two categories. Large size range of spherasters (fig. 17a), 25-30 blunt-ending 'rays', length of rays approx. 15% of aster-diameter, 15-31 μm; oxyspherasters (fig. 17b) with spined apices of the rays, 4-17.5 μm.

Ecology.— On horizontal and vertical sides of rocks at 3-38 m depth in clear warm water.

Remarks.— The BMNH and ZMA specimens are closely similar in appearance and spicule characteristics. The specimens also morphologically resemble Mediterranean *Chondrilla nucula* Schmidt, 1862, but this has a more uniform aster size and the smaller oxyspheraster category is lacking.

Chondrosia aff. *reniformis* Schmidt, 1862
(fig. 18a)

Chondrosia reniformis; Burton, 1959: 197.

Material.— ZMA Por. 17435, Oman, Muscat, Hramal Road, offshore from Government Building, 6.1 m, 23.5711 N 58.6221 E, 07-12-2002, coll. O. Eerland, Symbiosponge Project, 02/IO/DEC7/OE/003; BMNH 1936.3.4.72.285, Oman, 19.3667 N 57.8833 E, 13.5 m, John Murray Exped. stat. 53, 02-11-1933.

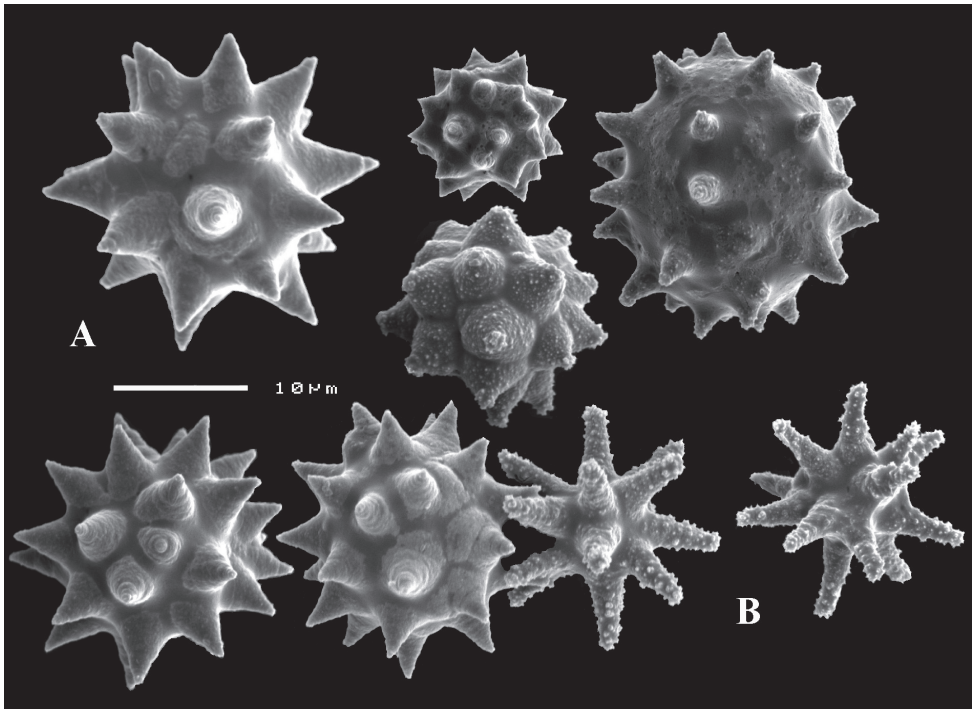

Fig. 17. *Chondrilla australiensis* Carter, 1873, ZMA Por. 14622, A, spherasters, B, oxyspherasters.

Description.— Encrusting vertical sides of rocks, less than 1 cm in thickness (fig. 18a). Consistency tough, underside softer. Slippery smooth, no oscules apparent. Pores uniformly distributed, size 60 × 40 μm lying 30 μm apart. Brown spots at the surface penetrate some distance into the cortex.

Colour.— Characteristic brown spots on a white background, underside grey.

Ecology.— On vertical sides of rocks at 6-13.5 m.

Remarks.— The specimens from both localities are strikingly similar to each other and to *Chondrosia reniformis*, which also frequently displays a spotted surface. It is likely, that the Oman specimens belong to a different species, but morphological characters to distinguish them from *C. reniformis* appear lacking.

Order 'Lithistida'
Family Scleritodermidae

***Microscleroderma hirsutum* Kirkpatrick, 1903**
(fig. 18b)

Microscleroderma hirsutum Kirkpatrick, 1903: 173, pl. V fig. 1; Burton, 1959: 217.

Material.— BMNH 1936.3.4.72.168, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

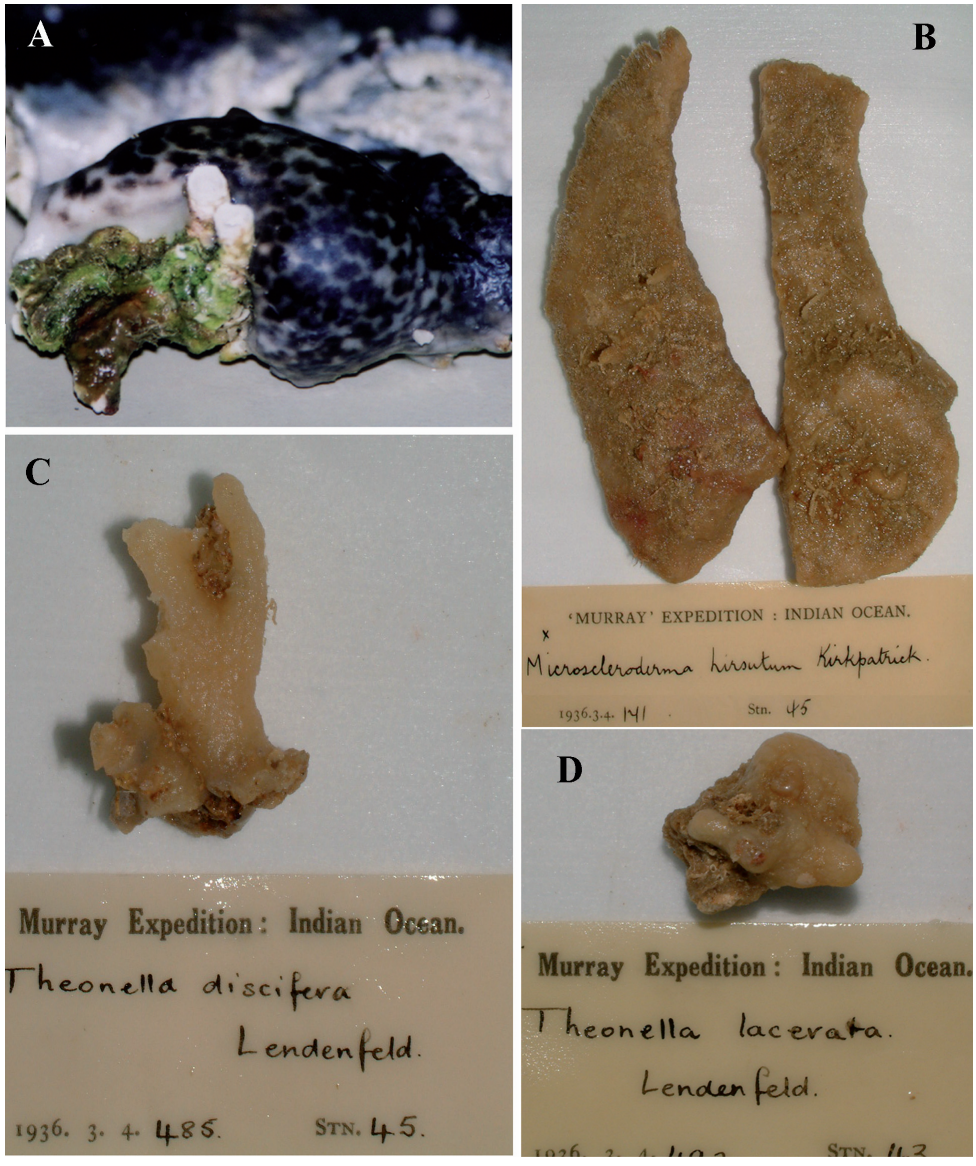

Fig. 18. A, *Chondrosia aff. reniformis* Schmidt, 1862, ZMA Por. 17435, B, *Microscleroderma hirsutum* Kirkpatrick, 1903, John Murray Exped., BMNH 1936.3.4.72.168, C, *Discodermia discifera* (Lendenfeld, 1907) (as *Theonella*), John Murray Exped., BMNH 1936.3.4.72.485, D, *Discodermia discifera* (Lendenfeld, 1907) (as *Theonella lacera* sensu Burton, 1959, not Lendenfeld, 1907).

Remarks.— Skeleton: very strong bundles of long oxeas, > 4mm in length, 30-40 microns in diameter, with stair-stepped apices, protruding far beyond the surface. Sigmaspires common, approx. 20 μm.

Microscleroderma herdmani (Dendy, 1905)

Taprobane herdmani Dendy, 1905: 103, pl. I fig. 8, pl. IV fig. 2; Burton, 1959: 217.

Material.— BMNH 1936.3.4.72.168, Oman, 18.058 N 57.042 E, 38 m, John Murray Exped. stat. 45, 29-10-1933.

Remarks.— A second specimen was collected in the Gulf of Aden. This is a common Indian Ocean lithistid.

Family Theonellidae

Discodermia discifera (Lendenfeld, 1907)
(fig. 18c-d)

Theonella discifera Lendenfeld, 1907: 351, pl. XLIII, figs 5-18; Burton, 1959: 216.
Theonella lacerata sensu Burton, 1959: 216 (not: *Theonella lacerata* Lendenfeld, 1907)

Material.— BMNH 1936.3.4.72.485, Oman, 18.058 N 57.042 E, 38 m (John Murray Exped. stat. 45, 29-10-1933), labelled as *Theonella discifera*; BMNH 1936.3.4.492, Oman, 17.483 N 55.783 E, 95 m, John Murray Exped. stat. 43, 28-10-1933, labelled as *Theonella lacerata*.

Remarks.— The ectosomal triaenes are discotriaenes, including some that are entirely rounded and unindented. The surface of the discotriaenes of the specimen labelled *Theonella lacerata* bears numerous warts. The centrotylote acanthomicroxeas have a fairly large size range. Choanosomal oxeas / strongyles are up to 1000 μm.

A third Murray Expedition specimen was found off Zanzibar.

We compared the Murray specimens with a slide of the type of *Theonella lacerata* (labelled 'Valdivia' 08.2.9.2.8) and discovered a strong difference in the choanosomal desmas, which are smooth-shafted in the type, but strongly warty in the Murray specimen. We maintain the two species as distinct, but the Murray specimens appear to belong to only a single species.

Regional affinities

Although the data presented here comprise only a sub-sample of the Oman sponge fauna, some trends in regional affinities are apparent. Endemism is, with six species restricted to Oman waters out of a total of 30 species recorded here, relatively modest (20%). This is hardly surprising from a coastal area connected directly to long coastal regions of Arabia, East Africa and the Indian subcontinent. Still, the status of some species is uncertain as they are assigned to widespread taxa (*e.g. Cinachyrella australiensis, Geodia globostellifera, Tethya seychellensis, Placospongia carinata, Chondrilla australiensis,* and *Chondrosia reniformis*), which future studies may reveal to be cryptic members of a species complex.

One of the striking results is that the areas immediately adjacent to the Oman coasts, Yemen (3 species shared), the Arabian Gulf (no species shared) and the southern Red Sea (3 species shared) do not share the highest number of species with Oman, as the Indian subcontinent (13), East Africa (9), the Maldives (3), the Seychelles (6), and further

away the West and North coast of Australia (6), and Indo-Malayan area (6) all share more species than the nearby coasts. The explanation is without doubt the poor state of our knowledge of the sponges of the coasts of Arabia, compared to much better studied areas of the Indian subcontinent and the East coast of Africa.

Acknowledgements

Rob G. Moolenbeek (ZMA, University of Amsterdam) and Raquel Gómez (Netherlands Cancer Institute, Amsterdam) are thanked for their collecting activities, aided by Henk Dekker (ZMA) and Oscar Eerland (Amsterdam). They also made several of the in situ and on deck photos. Dr Adil Mohammed Al Qasim of the Marine Science and Fisheries Centre in Muscat is thanked for the use of facilities during the stay at Muscat. Martin Day (RAF-O) provided Scuba facilities on Masirah. Clare Valentine (Natural History Museum, London) hosted the visit of one of us (RVS) for the study of the John Murray Expedition specimens. Prof. Claude Lévi (MHNH, Paris) allowed us to make microscopic slides of museum specimens in his care.

Collecting trips were made possible by grants of the EU (MAS3 CT97-0144) and UniBioScreen (Brussels). A visit to the Natural History Museum was financed by SYNTHESYS GB-TAF grant 538.

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Received: 29.vii.2008
Accepted: 19.xi.2008
Edited: N.J. de Voogd