BEAUFORTIA

BULLETIN ZOOLOGICAL MUSEUM

UNIVERSITY OF AMSTERDAM

Vol. 52, no. 2 July 26, 2002

A NEW SPECIES OF *BIEMNA* (PORIFERA, POECILOSCLERIDA) FROM THE SULTANATE OF OMAN

R. W. M. VAN SOEST & E. J. BEGLINGER

Institute for Biodiversity and Ecosystem Dynamics (Zoölogisch Museum), University of Amsterdam, P.O. Box 94766, 1090 GT Amsterdam, Netherlands
soest@science.uva.nl, beglinger@science.uva.nl

ABSTRACT

Recent (1998) collecting off the coasts of Oman in the course of the EC-MAS3 funded 'Symbiosponge' project yielded three species of the genus *Biemna* Gray, 1867 (Demospongiae, Poecilosclerida, Mycalina, Desmacellidae) not previously known from the area. One of these appeared to be new to science and is described as *Biemna omanensis* n.sp.. Its distinguishing features comprise the possession of oxea megascleres, which is of rare occurrence in *Biemna*, and a full complement of microscleres including microxeas, sigmas, commata, all of which are divisible in two non-overlapping size categories, and raphides. One of the other two species conformed to an earlier described species *Biemna ciocalyptoides* Burton, 1959, which was discovered to be a junior synonym of *Biemna ehrenbergi* (Keller, 1889) (new combination). The third species is the common and widespread *Biemna tubulata* Dendy, 1905.

Key words: Porifera, Oman, *Biemna*, new species

INTRODUCTION

The Sultanate of Oman occupies the southeast 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 marine regions: the Arabian Gulf, Gulf of Oman and the Arabian Sea. From the Oman coasts about 100 species of sponges have been recorded, and an additional 30 species are known from nearby South Arabian localities. Most of these sponges were collected by the John Murray Expedition, 1933-34, and reported by Burton (1959).

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. Several of these sponges appear new to science and in an ongoing series of publications we will describe these. The present study deals with a new species of *Biemna*, and also includes descriptions of two other *Biemna* species already known from nearby areas, but not yet from Oman waters.

The genus *Biemna* is recognizable among

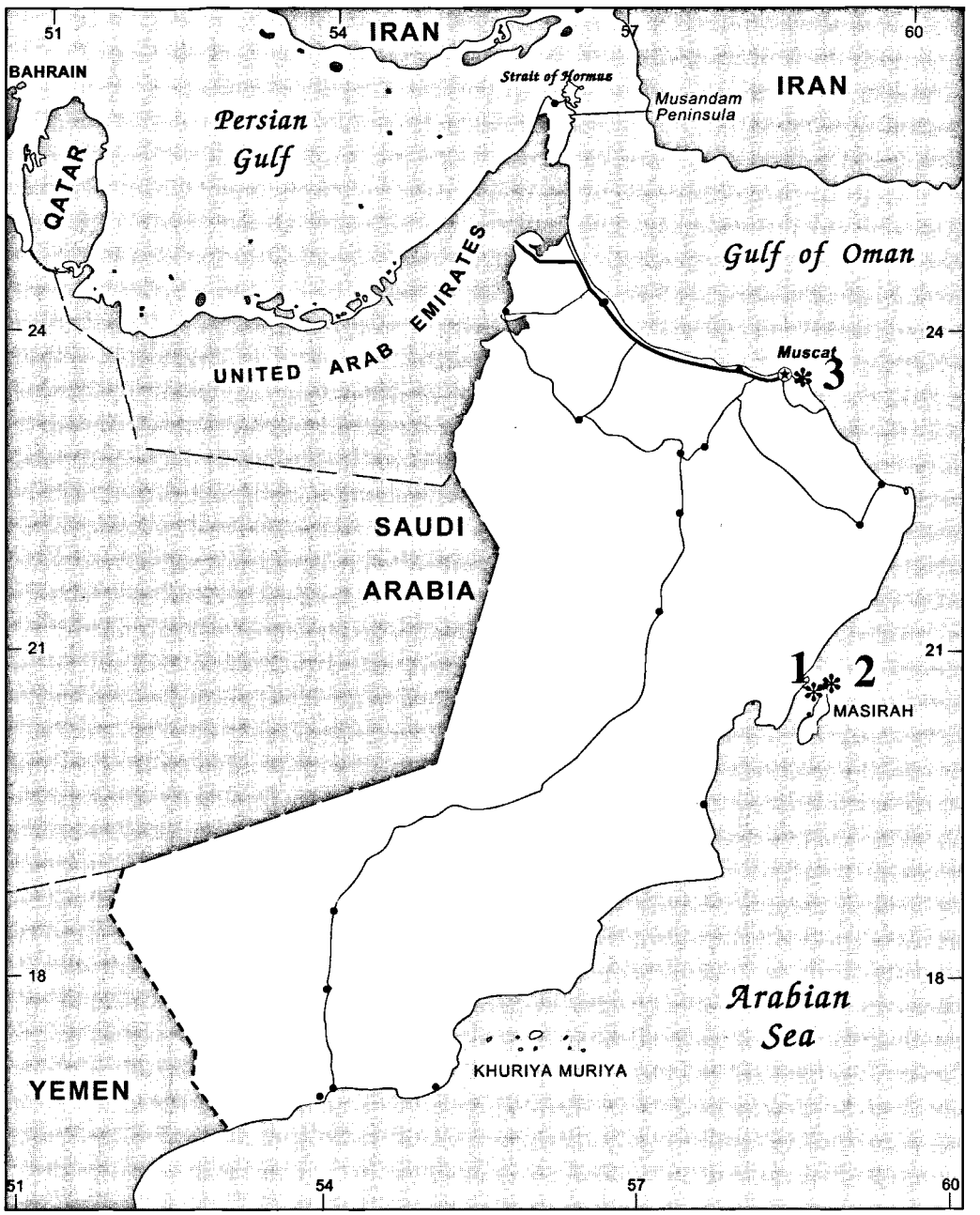

Fig. 1. Map of the Sultanate of Oman. Localities of *Biemna* species are indicated by *. 1 = *B. omanensis* n.sp., 2 = *B. ehrenbergi*, 3 = *B. tubulata*.

Desmacellidae on the combination of microscleres (sigmas, microxeas, commata, raphides) and a confused to plumose arrangement of the megascleres (Hajdu & Van Soest, 2002). Closely related genera are *Neofibularia* with a reticulate skeleton of strongyles, and *Desmacella* with a plumose skeleton of tylostyles. *Biemna* is represented in the Indian Ocean by approximately 12 species (review in Hooper, 1996). Some of these records from the western Indian Ocean concern species with allegedly wide Indo-Pacific distributions, but may eventually turn out to be new taxa.

MATERIALS AND METHODS

Specimens studied were collected using SCUBA and snorkeling by Raquel Gomez and Robert G. Moolenbeek, Zoological Museum of Amsterdam (ZMA) in November 1998. Collecting localities are given in Fig. 1. Specimens were photographed in situ or on deck before preservation in 70% alcohol. Subsamples were collected for testing of biological activity and for cell biological observations. Preserved samples were incorporated in the collections of the Zoological Museum of Amsterdam. For comparison, *Biemna* material from the ZMA collections (Red Sea, Seychelles, Curaçao) was consulted, and a slide made from type material of the Humboldt Museum, Berlin (ZMB) was examined, obtained with permission from the curator Dr D. Kühlmann, now retired.

For microscopical studies, tangential and perpendicular sections were made with a scalpel; these were dried on a hotplate, subsequently mounted in Canada balsam, and examined using 100-400x magnification. Furthermore, a fragment of approx. 3 mm^3 was cooked in concentrated HNO_3, the residue was washed and centrifugated 5 times in distilled water, and suspended in 96% alcohol; spicule suspensions were pipetted on SEM stubs and on microscopic glass slides; the dried spicules were mounted in Canada balsam for light microscopy and sputtered with gold for examination under SEM.

Spicule size data are based on 25 measurements for each spicule category.

SYSTEMATIC DESCRIPTIONS

Class Demospongiae
Order Poecilosclerida
Suborder Mycalina
Family Desmacellidae
Genus *Biemna* Gray, 1867

Biemna omanensis n.sp.
Figs. 2A-I

MATERIAL. - Holotype: ZMA POR. 14640, Sultanate of Oman, Masirah Island, N point, 20.70°N 58.78°E (dec. coord.), on wreck of S.S. 'Electra' and on nearby stones, depth 7.6 m, 98/IO/NOV15/RG/046, coll. R. Gomez & R.G. Moolenbeek, 15-XI-1998.

DESCRIPTION. - Thick cushion, of approx. 10 cm diameter and thickness (Fig. 2A) (the actual retained holotype is a large fragment of this specimen, the largest part having been sacrificed for chemical investigations). Surface with numerous irregular projections and villi of approx. 1.5 cm high. Surface in between the villi covered in sediment and algae, leaving small oscules visible. Colour yellow, but sediment covered parts greyish. Consistency soft, easily crumbled. Touching with bare hands causes severe burning sensation and prolonged itching.

Skeleton: basically alveolar to confused, with many spicules and microscleres strewn without direction. Parallel tracts of 5-10 spicules thick support the villi. Surface skeleton mostly absent, but in the surface membrane there is a discontinuous cover of microxeas and sigmas carried by projecting tracts of megascleres. Microxeas and other microscleres are also very common in the interior.

Spicules: megascleres oxeas (Fig. 2B), smooth, symmetrically curved, sharply pointed, 230-255.7-286 x 7-8.3-10 μm. Microscleres microxeas, sigmas, and commata, and raphides, all of which may occur in dragmata. Microxeas, straight, rugose/microspined, in two non-overlapping size categories: 123-140.4-147 x 2-2.9-4 μm (Fig. $2C_1$-C_2) and 63-75.5-87 x 2-2.8-4 μm (Fig. $2D_1$-D_2). Thin sigmas occur in two non-overlapping size categories, 27-31.6-37μm (Fig. 2E) and 10-12.1-14 μm (Fig. 2F). Commata in two non-overlapping size categories, 27-37.5-51 μm (Fig. $2G_1$-G_2) and 14-16.8-18 μm (Fig. 2H). Raphides (Fig. 2I), thin, possibly thin growth stages of the larger microxeas, 112-123.2-135 x 0.5 μm.

DISTRIBUTION. - Known only from the type locality, N point Masirah Island, Oman, on hard substrate in sandy environment.

BIOACTIVITY. - The sponge methanolic extract was found to be mildly active against brine shrimp larvae and several parasitic fungi.

ETYMOLOGY. - Named after the Sultanate of Oman.

DISCUSSION. - No species of *Biemna* have previ-

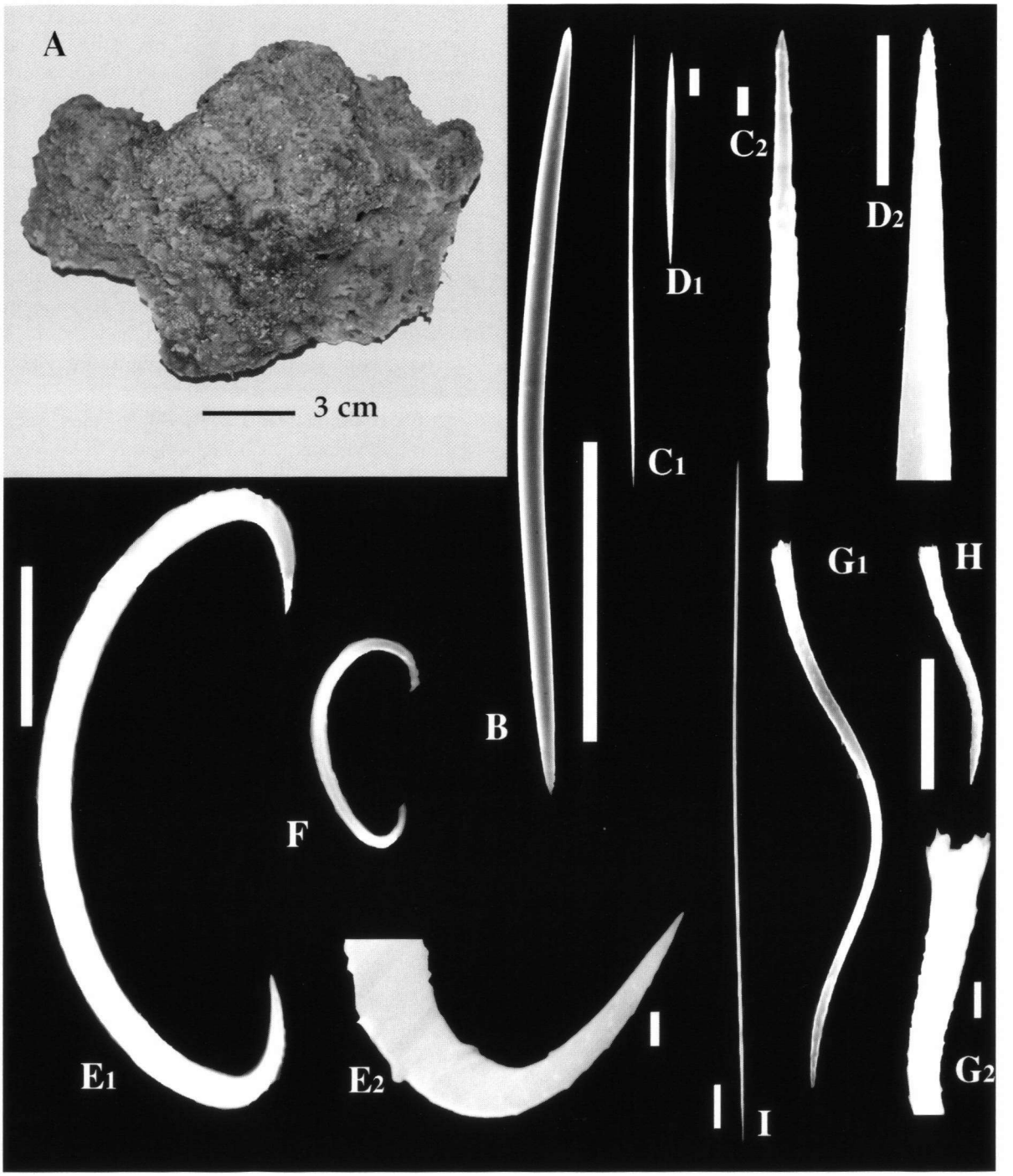

Fig. 2. *Biemna omanensis* n.sp. A, photo of habit taken immediately after collection. B-I, SEM photos of spicules, size bars indicate 100 μm (B), 10 μm (C_1, D_1, E_1, F, G_1, H), and 1 μm (C_2, D_2, E_2, G_2). B, oxea. C, large microxea. D, small microxea E, large sigma. F, small sigma. G, large comma. H, small comma. I, raphide.

ously been reported from Oman waters. From the Gulf of Aden at the opposite end of the south coast of the Arabian peninsula, Burton (1959) recorded two species of *Biemna*, *B. ciocalyptoides* Burton, 1959 from 11°57'12"N 50°35'E, 37 m, and *B. fortis* (Topsent, 1897) from two localities:

11°53' 42"N 51°13'12"E, 73-220 m, and 11°57' 12"N 50°35'E, 37 m. The former species is a junior synonym of *B. ehrenbergi* (Keller, 1889, see below). Both species have styles for megascleres, both have much larger megascleres (up to 1000 x 30 μm) and lack commata. Below we record the occurrence of *B. tubulata* in Oman waters; this has a tubular habit and smaller microxeas.

Hooper (1996) provides an overview of all *Biemna* species recorded from the Indian Ocean. None of them possess oxeas as megascleres. Just outside the Indian Ocean, from Philippine waters, an oxea-bearing species was reported, *Biemna gellioides* Lévi & Lévi, 1989. This species has much larger oxeas (500-600 μm); microxeas are drawn (Lévi & Lévi, 1989: fig. 46.3), but in the text these are called raphides, and they are clearly much smaller than those of *B. omanensis* n.sp.; sigmas are similar to those of *B. omanensis* n.sp., but commata are apparently lacking.

Elsewhere, in the Caribbean, a *Biemna* with oxeas is also found, *B. cribaria* (Alcolado & Gotera, 1986), with synonym *B. oxeata* Van Soest & Stentoft, 1988. This has larger oxeas (300-550 μm), larger sigmas (50-77 and 20-26 μm), and raphides in two size categories (50-80 and 10-20 μm). No commata or rugose microxeas are reported.

The dermatitis produced by this sponge is reminiscent of *Biemna laboutei* Hooper, 1996 and is also found in several other species of *Biemna* and the closely related *Neofibularia*. *B. laboutei* from Madagascar is a ramose orange species, with styles as megascleres, lacking commata, and thus clearly differs from our new species.

Figs $2G_1$-G_2 and 2H (as well as Figs 4G-H of *B. tubulata*) are the first SEM images made of commata of Desmacellidae. Previously, only those of *Merlia* (Merliidae) were examined under SEM and like those of the *Biemna* commata, these are microspined/rugose. A new and apparently unique feature for *Biemna* commata is the crown of spines found on the heads. Under light microscopy, such a detail is only barely visible and so far has escaped observation by sponge taxonomists. This ornamentation is here regarded as a synapomorphy for *Biemna* species possessing commata, since both the present species and *B. tubulata* appear to possess similar adornment. It is predicted that commata of other *Biemna* species also have crowns of spines on their commata.

A further feature revealed by SEM and worthy of emphasis are the roughened ends of the sigmas in this genus (Fig. $2E_2$). This feature is shared with *Neofibularia* (e.g. Van Soest, 1984).

Biemna ehrenbergi (Keller, 1889) n. comb.
Figs. 3A-G

Acanthella ehrenbergi Keller, 1889: 395.
Biemna ciocalyptoides Burton, 1959: 227, text-fig. 14 (not: *Sigmaxinella ciocalyptoides* Dendy, 1897: 242; nec *Biemna (Allantophora) ciocalyptoides*; Hallmann, 1916: 514, pl. XXX figs 6-8).

MATERIAL. - ZMA POR. 14641, Sultanate of Oman, Masirah Island, NE point, (dec. coord.) 20.70°N 58.90°E, depth 11.8 m, 98/IO/NOV15 /RG/047, coll. R. Gomez & R.G. Moolenbeek, 15-XI-1998.

DESCRIPTION. - From a massive base buried in the sandy bottom arise cylindrical to conical fistules (Fig. 3A) of 5-6 cm length, 1-2 cm in thickness, with the surface provided with characteristic longitudinal, somewhat corrugated, grooves. The fistules end in one or more thin projections. Colour noted as mustard-brown in life, pale brown in alcohol. Consistency firm to hard.
Skeleton: axially compressed in the fistules, with thick columns of megascleres, 10-20 in cross section, ascending longitudinally and extra-axial thinner bundles and single megascleres directed towards the surface. In the main body, spicules are arranged in confusion. Spongin is visible in variable quantities. Numerous microscleres are strewn throughout the interior and in the surface membrane.
Spicules: styles (Fig. $3B_1$-B_2), smooth, robust, curved, 596-740.0-806 x 21-27.9-33 μm. Microxeas (Fig. 3C), often in dragmas, thin, raphide-like: 36-41.0-45 x 1 μm; sigmas, often in sigmodragmas, in three size categories, 54-61.6-66 μm (Fig. 3D), 21-29.0-35 μm (Fig. 3E), and 13-13.8-15 μm (Fig. 3F); trichodragmas, flexuous, 240-270 x 13-30 μm, individual raphides (Fig. 3G) 177-197.3-215 x 0.5 μm.

BIOACTIVITY. - The methanolic extract was found to be mildly active against brine shrimp larvae and several species of parasitic fungi.

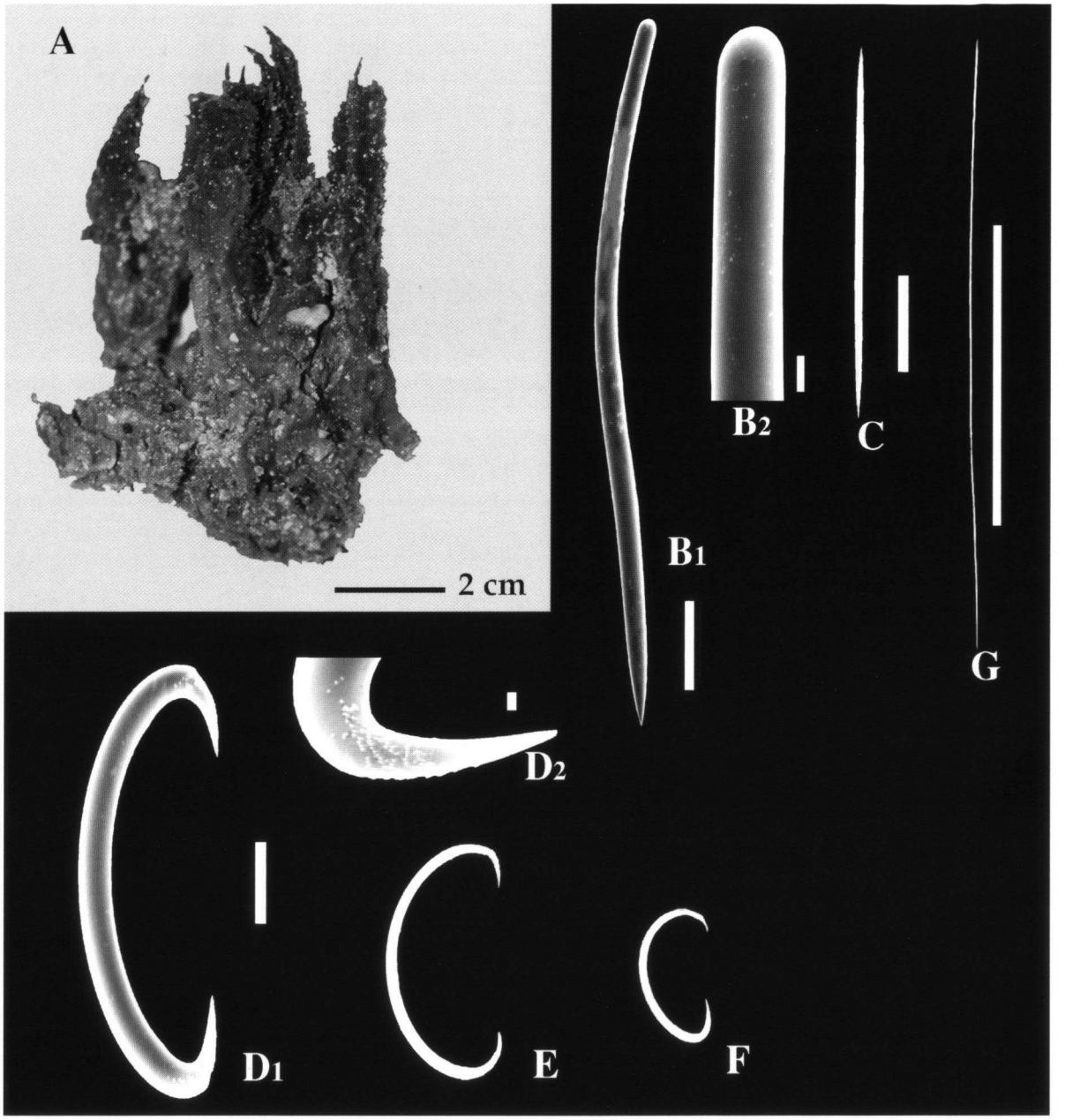

Fig. 3. *Biemna ehrenbergi* (Keller, 1889). A, photo of habit taken immediately after collection. B-G, SEM photos of spicules, size bars indicate 100 μm (B_1, G), 10 μm (B_2, C, D_1,E, F), and 1 μm (D_2). B, style. C, microxea. D, large sigma. E, middle sigma. F, small sigma. G, raphide.

DISTRIBUTION. - Red Sea, South Arabia, Seychelles.

DISCUSSION. - We were able to confirm the specific identity of our material with *Acanthella ehrenbergi* Keller, 1889 by examination of a slide of the ZMB holotype. Our material is closely similar to *Biemna ciocalyptoides* Burton, 1959, described from nearby Gulf of Aden. This is stated to have a massive pyramidal base with numerous fistular, aculeate processes, which adequately conforms to the habit of the Oman material. The spicules of Burton's specimen appear very similar in shape and size, the differences being a slightly smaller size of the styles, the presence of microxeas of only 40 μm, and trichodragmas not exceeding

270 µm. The microxeas mentioned by Burton measured 160 µm, and this may conceivably be straight raphides from the trichodragmas which were observed to be that size, as the distinction between microxeas and raphides may be difficult to assess in dissociated spicule mounts. The absence of the small microxeas and the longer trichodragmas remain discrepancies of some concern, but it is proposed here to consider Burton's sample conspecific with ours.

As Hooper (1996) pointed out, *Biemna ciocalyptoides* was already in use for the combination *Biemna ciocalyptoides* sensu Dendy, 1897 (as *Sigmaxinella*). Dendy provided no illustrations, but the habit was extensively redescribed by Hallmann, 1916, who included several photos. From these descriptions, it is clear that it is similar in growth form to the South Arabian species, but differs substantially in spicule dimensions: styles are clearly smaller (500 x 18 µm), sigmas occur only in a very small category (17 µm), and trichodragmas were cited as 30 µm. The latter may have included microxeas, of which no mention is made, however. Clearly, there is no match in these spicule sizes and categories with South Arabian specimens, and accordingly - and in conjunction with Hooper, 1996 - we conclude that the two are to be regarded as distinct species.

Fortunately, a senior synonym of *B. ciocalyptoides* sensu Burton is available in *Biemna ehrenbergi* (Keller, 1889 as *Acanthella*). The existence of an earlier name for this species is here reported for the first time. Keller (1889) described *Acanthella ehrenbergi* in doubtful terms and also omitted to add an illustration, which explains why a clear assignment to its proper place in the sponge classification was lacking so far. Reexamination of a slide made from the ZMB holotype, nr. 157, revealed that large numbers of sigmas and raphides supplement the skeleton of robust styles. The spiculation comprises styles, commonly also stair-stepped oxeote modifications of 500-700 x 20 µm, sigmas I 55-60 µm, sigmas II 20-28 µm , sigmas III: 12 µm; trichodragmas 220-250 x 30-65 µm, individual raphides shorter, of variable length, hair-thin (microxeas are not discernible as a separate spicule category). Thus *A. ehrenbergi* is a clear *Biemna*. Its habit is described as 'massive pillar-shaped' with on the upper side finger-shaped projections of several cm high and 1.5 cm thick. In dry condition, the two specimens are cited as black. This contrasts with the beige to yellow-grey colour in alcohol reported for the Southern Arabian material. However, in the Seychelles, where the species appears common (see Van Soest, 1993 as *Biemna ciocalyptoides* sensu Burton), colours of live specimens and alcohol specimens varied from pale brown to dark wine-red. Apparently, colours are variable for reasons so far unknown. All these combined similarities suggest that the South Arabian material described above is best considered *Biemna ehrenbergi* until more detailed analysis of population differences between Red Sea, Arabian Sea and the Seychelles is made.

Hooper (1996) suggested that *Biemna seychellensis* Thomas, 1973 is conspecific with this species (that is: with *B. ciocalyptoides* sensu Burton), but Thomas described commata in his material, which are absent from *B. ehernbergi*. The length of the trichodragmas is given as 28-48 µm only, which contrasts with the characteristic trichodragmas of 160+ µm in *B. ehrenbergi*. As far as the habit can be deduced from Thomas' description of the dried material, this appears also different.

Biemna tubulata (Dendy, 1905)
Figs. 4A-I

Desmacella tubulata Dendy, 1905: 155, pl. IX fig. 4.
?Biemna microxa Hentschel, 1911: 316, fig. 15.
Toxemna tubulata; Hallmann, 1917: 673.
?Biemna anisotoxa; Vacelet & Vasseur, 1971: 90, fig. 42 (not: *B. anisotoxa* Lévi, 1963).

MATERIAL - ZMA POR. 14604, Sultanate of Oman, Hramal Road, near government building, (dec. coord.) 23.57°N 58.62°E, 8 m, between stones in sandy environment, 98/IO/NOV06 /RG/008, coll. R. Gomez & R.G. Moolenbeek 6-XI-1998.

DESCRIPTION. - Groups of thin-walled tubes (Fig. 4A), 3-5 cm high, 1.5 cm diameter, with vents approx. 1 cm in diameter, growing from a base lodged between and under small stones and octocorals. Part of the body may consist of lobate outgrowths. Surface microconulose, slightly rough, often encrusted with sand grains. Colour: orange-yellow in life, cream to light beige in alcohol. Consistency very soft, easily torn.

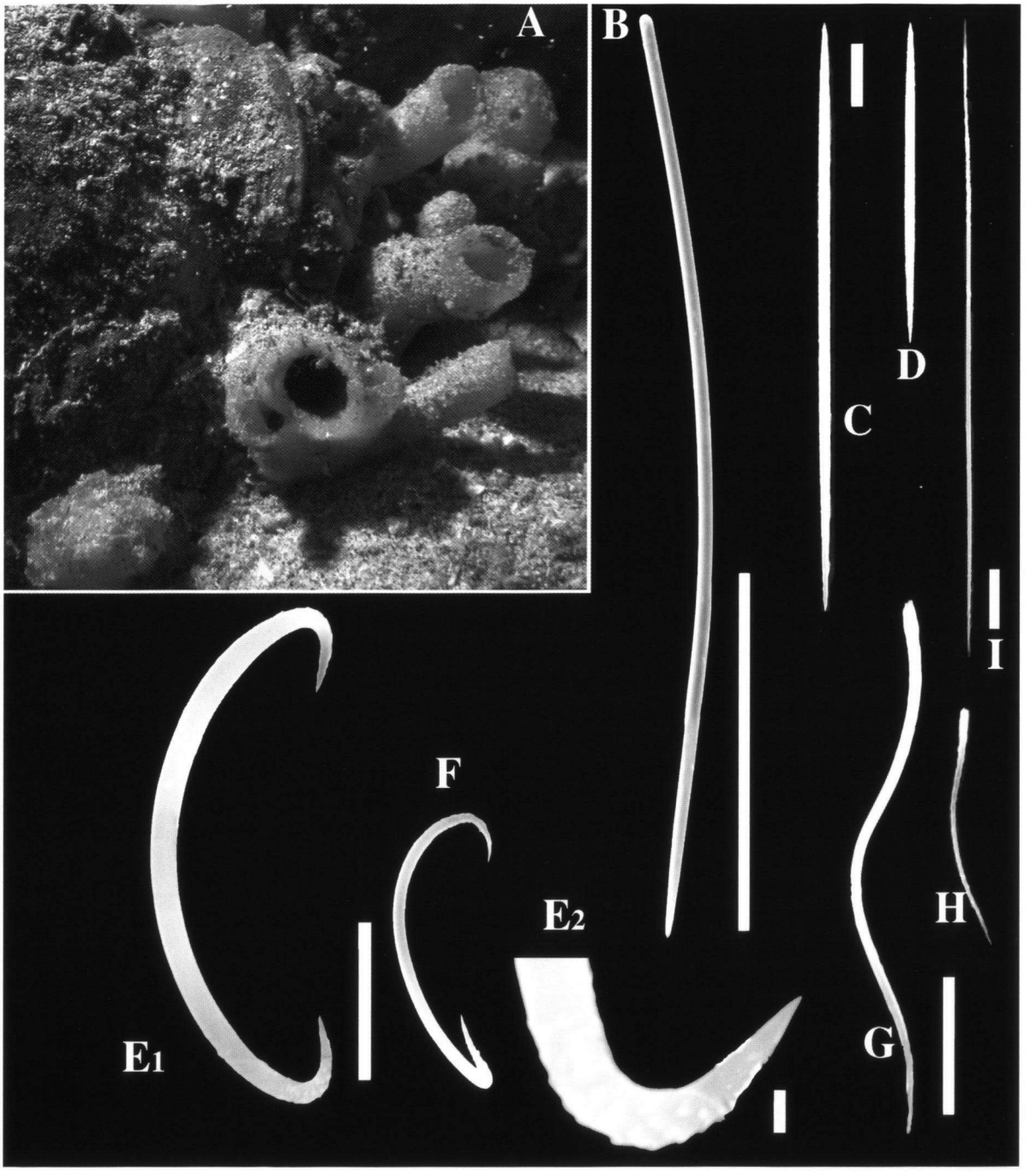

Fig. 4. *Biemna tubulata* (Dendy, 1905). A, photo of habit taken in situ. B-I, SEM photos of spicules, size bars indicate 100 μm (B), 10 μm (C, D, E_1, F, G, H and I), and 1 μm (E_2). B, style. C, large microxea. D, small microxea. E, large sigma. F, small sigma. G, large comma. H, small comma. I, raphide.

Skeleton: surface membrane carried by an ill-defined tangential skeleton made up of single megascleres and a dense mass of raphides. In cross section, the surface conules are observed to be formed by protruding megascleres and thick bundles of raphides. The choanosomal skeleton is made up of a lax, confused arrangement of megascleres, without visible consolidating spon-

gin, and a profusion of raphides and sigmas.
Spicules: thin, smooth, curved styles (Fig. 4B), 295-306.2-324 x 4-5.2-6 μm, microxeas in two non-overlapping size categories, 75-88.8-114 x 1.5-2.1-3.5 μm (Fig. 4C), and 21-28.4-37 x 1 μm (Fig. 4D); thin sigmas two size categories, which appear to be almost overlapping, 24-30.6-39 μm (Fig. 4E), and 14-17.1-21 μm (Fig. 4F); commata in two non-overlapping size categories, 28-36.2-45 μm (Fig. 4G), and 12-14.1-18 μm (Fig. 4H), trichodragmas, 135-160.4-180 x 18-31.0-45 μm, individual raphides (Fig. 4I), 91-105.3-123 x 0.5 μm.

BIOACTIVITY. - The rough methanolic extract was not active against test organisms, but one of the further refined fractions was strongly active against brine shrimp larvae.

DISTRIBUTION. - Sri Lanka, India, Seychelles, Providence (Indian Ocean), South Arabia, SW Australia.

DISCUSSION. - This species has been recorded from all corners of the Indian Ocean. Compared to the original description of Dendy from Sri Lanka, our specimen differs in having commata, not mentioned by Dendy. However, Dendy (1916) reported 'toxas' of 29-32 μm, which could represent the commata.

Biemna fistulosa (Topsent, 1897 as *Desmacella*) from Indonesia is reminiscent of this species, but differs in having sigmas of up to 60 μm, clearly in excess of the sigmas of the type and of our material.

Biemna anisotoxa sensu Vacelet & Vasseur, 1971 from Madagascar could very well be specimens of this species, as their shape is tubular, and the only difference in the spicule complement of their specimens is the lack of differentiated size categories of commata (called 'microstyles toxiformes'). Lévi's (1963) type from South Africa appears different. It has three size categories of sigmas and lacks tubes, so this remains a valid species.

Hooper (1996) suggested that Hentschel's (1911) *B. microxa* from SW Australia is a junior synonym of *B. tubulata*. No conclusion can be drawn until the type has been reexamined and the presence of commata is established, as these were not mentioned by Hentschel. The shape of the sponge is given as 'massive with wide canals'.

The species was also recorded from the West Indian region (e.g., Van Soest, 1984: 133), but that has subsequently been assigned to a separate species, *B. caribea* Pulitzer-Finali, 1986, because it differs in having a less clearly tubular habit. Spicule sizes and categories are remarkably similar, but the smaller microxea category differs by being clearly shorter in *B. tubulata*.

ACKNOWLEDGEMENTS

Oman sponges were collected and photographed by Raquel Gomez and Robert G. Moolenbeek. This study as well as the fieldwork was financed under grant EC-MAS3-CT97-0144. 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.

REFERENCES

ALCOLADO, P. M. & G.G. GOTERA, 1986. Nuevas adiciones a la fauna de poriferos de Cuba. Poeyana **331**: 1-19.

BURTON, M. 1959. Sponges. In: Scientific Reports. John Murray Expedition, 1933-34. **10** (5): 151-281.

DENDY, A. 1897. Catalogue of Non-Calcareous sponges collected by J. Bracebridge Wilson, Esq., M.A., in the neighbourhood of Port Phillip Heads. Part III. Proc. R. Soc. Victoria (n.s.) **9**: 230-259.

DENDY, A. 1905. Report on the sponges collected by Professor Herdman, at Ceylon, in 1902. In: Herdman, W.A. (ed.). Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar. **3** (suppl. 18): 57-246.

DENDY, A. 1916. Report on the non-Calcareous sponges collected by Mr. James Hornell at Okhamandal in Kattiawar in 1905-06. Rept. Government of Baroda on the Marine Zool. of Okhamandal in Kattiawar. Part II: 93-146.

GRAY, J. E. 1867. Notes on the arrangement of sponges, with the descriptions of some new genera. Proc. zool. Soc. London **1867**: 492-558.

HAJDU, E. & R. W. M. VAN SOEST, 2002 (in the press). Family Desmacellidae. In: Hooper, J. N. A. & R. W. M. van Soest (eds). Systema Porifera. Kluwer Academic/ Plenum Press, New York, London.

HALLMANN, E. F. 1916. A revision of the genera with microscleres included, or provisionally included, in the family Axinellidae; with descriptions of some Australian

species. Part II. Proc. Linn. Soc. N. S. W. **41** (163): 495-552.

HALLMANN, E. F. 1917 [1916]. A revision of the genera with microscleres included, or provisionally included, in the family Axinellidae; with descriptions of some Australian species. Part III. Proc. Linn. Soc. N. S. W. **41** (164): 634-675.

HENTSCHEL, E. 1911. Tetraxonida. 2. In: Michaelsen, W. & R. Hartmeyer (eds). Die Fauna Südwest-Australiens **3** (10): 279-393.

HOOPER, J. N. A. 1996. A toxic *Biemna* from Madagascar (Demospongiae: Poecilosclerida). In: Ph. Willenz (ed.). Recent advances in sponge biodiversity inventory and documentation. Bull. Inst. r. Sci. nat. Belg., Biologie **66** (suppl.): 123-133.

KELLER, C. 1889. Die Spongienfauna des rothen Meeres (I. Hälfte). Z. wiss. Zool. **48**: 311-405.

LÉVI, C. 1963. Spongiaires d'Afrique du Sud. (1) Poecilosclérides. Trans. R. Soc. S. Afr. **37** (1): 1-72.

LÉVI, C. & P. LÉVI, 1989. Spongiaires (MUSORSTOM 1 & 2). In: Forest, J. (ed.). Résultats des Campagnes MUSORSTOM, Volume 4. Mém. Mus. natn. Hist. nat. Paris (A, Zoologie) **143**: 25-103.

PULITZER-FINALI, G. 1986. A collection of West Indian Demospongiae (Porifera). In appendix, a list of the Demospongiae hitherto recorded from the West Indies. Ann. Mus. Civ. Storia Nat. Genova **86**: 65-216.

SOEST, R.W.M. VAN 1984. Marine sponges from Curaçao and other Caribbean localities. Part III. Poecilosclerida. Stud. Fauna Curaçao Carib. Isl. **66** (199): 1-167.

SOEST, R.W.M. VAN 1993. Sponges of the Seychelles. In: J. van der Land (ed.). Oceanic reefs of the Seychelles. Leiden, Netherlands: 65-74.

SOEST, R.W.M. VAN & N. STENTOFT, N. 1988. Barbados Deep-Water Sponges. Stud. Fauna Curaçao Carib. Isl. **70** (215): 1-175.

THOMAS, P.A. 1973. Marine Demospongiae of Mahe Island in the Seychelles Bank (Indian Ocean). Annls. Mus. r. Afr. cent., Sci. zool. **203**: 1-96.

TOPSENT, E. 1897. Spongiaires de la Baie d'Amboine. (Voyage de MM. M. Bedot et C. Pictet dans l'Archipel Malais.) Rev. suisse Zool. **4**: 421-487.

VACELET, J. & P. VASSEUR, 1971. Éponges des récifs coralliens de Tuléar (Madagascar). Téthys (suppl. **1**): 51-126.

Received: April 4, 2002