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Key to the Ethiopian species of the genus *Metania* GRAY, 1867 (Porifera, Metaniidae), with redescription of *Metania rhodesiana* and *M. godeauxi*, comb. n.

by Carla M. M. SILVA & Cecília VOLKMER-RIBEIRO

Abstract

Metania rhodesiana BURTON, 1938 and *Parametania godeauxi* (BRIEN, 1968), from the Ethiopian Region, are redescribed. The second species is transferred to genus *Metania* GRAY, 1867, whilst *Metania innominata* BURTON,1938 is established as a junior synonym of *M. rhodesiana*. New features of spicules, gemmules and skeleton structure are described and illustrated in SEM. A key is proposed to sort out the three species of *Metania* presently ascribed to the Ethiopian Region: *M. pottsi* (WELTNER, 1895), *M. rhodesiana* and *M. godeauxi*.

Keywords: Freshwater sponges, Taxonomy, Ethiopian Region, *Metania*, Metaniidae

Résumé

Metania rhodesiana BURTON, 1938 et *Parametania godeauxi* (BRIEN, 1968) de la Région Éthiopienne sont redécrites. La seconde espèce est transferée au genre *Metania* GRAY 1867 tandis que *Metania innominata* BURTON, 1938 est mise en synonymie junior de *M. rhodesiana*. Des nouvelles caractéristiques sont apportées pour les spicules, gemmules et structure du squelette et photographiées en MEB. Une clé dichotomique est presentée pour les trois espèces de *Metania* reconnues dans cette Région : *M. pottsi* (WELTNER, 1895), *M. rhodesiana* et *M. godeauxi*.

Mots-clés: Eponges d'eau douce, taxonomie, Région Ethiopienne, *Metania*, Metaniidae.

Introduction

The Neotropical species of the Gondwanic genus *Metania* of freshwater sponges were revised by VOLKMER-RIBEIRO & COSTA, 1992. The Australian and Oriental species were revised by the same authors in 1993. SILVA & VOLKMER-RIBEIRO, 1998 started a revisive study of the Ethiopian species of *Metania* with the redescription of *Metania pottsi* (WELTNER, 1895) which was established as a senior synonym of *Potamolepis schoutedeni* BURTON,1938, *Metania lyssostrongyla* BURTON 1938, *Metania vesparia* PENNEY & RACEK, 1968 (*partim*) and *Metania vanryni* BRIEN, 1968. The authors also confirmed the synonymization proposed by VOLKMER-RIBEIRO (1986) of the genus *Parametania* BRIEN, 1968 with *Metania* GRAY, 1867.
Metania rhodesiana BURTON, 1939, *Metania innominata* BURTON, 1938 and *Parametania godeauxi* BRIEN, 1968, from the Ethiopian Region, are now revised and a key is presented for the genus *Metania* in that region, thus completing its revision.

MATERIAL AND METHODS

The methodological procedures follow SILVA & VOLKMER-RIBEIRO (1998). Abbreviations used in the text: BMNH, The Natural History Museum, London, United Kingdom; MRAC, Musée Royal de l'Afrique centrale, Tervuren, Belgium; MCN , Museu de Ciências Naturais, Fundação Zoobotânica do Rio Grande do Sul, Porto Alegre, Brazil.

Results

Family Metaniidae VOLKMER-RIBEIRO, 1986

Key to the Ethiopian species of the genus *Metania* GRAY, 1867

Sponges with boletiform gemmoscleres which have a spiny shaft and a collar of spines under the lower rotule (VOLKMER-RIBEIRO, 1986) ..... Genus *Metania* GRAY, 1867

1. • Megascleres are strongyla, gemmoscleres with conspicuously variable shaft lengths, outer surface of the upper rotule smooth 2

   • Megascleres are oxea, gemmoscleres with little variation of shaft lenght, outer surface of the upper rotule irregularly covered with minute spines or rosettes ..... *Metania rhodesiana* [fig. 19]

2. • Gemmoscleres with a flat lower rotule with a continuous circular or polygonal outline ..... *Metania pottsi* [fig. 20]

   • Gemmoscleres with an umbonate lower rotule irregularly deeply cut into a variable number of irregular straight or incurved teeth ..... *Metania godeauxi* [fig. 21]

Systematic redescriptions

Metania rhodesiana BURTON, 1938
(Figs 1-10, 19, 22)

Metania rhodesiana BURTON, 1938: 464; PENNEY, 1960: 46; PENNEY & RACEK, 1968: 148, pl. XIV, figs. 16, 17.
Metania innominata BURTON, 1938: 464-465; PENNEY, 1960: 45; PENNEY & RACEK, 1968: 148. **Syn. n.**
?*Spongilla brieni* BURTON, 1938: 459, fig. 1.

EXAMINED MATERIAL

ZAMBIA [ex Rhodesia]:Lake Young (5m), 13. VIII. 1936, C. K. RICARDO leg., BMNH 1938:2:25:1 {holotype of *Metania rhodesiana*} (schizoholotype MCN 629), BMNH 1938:2:25:5 and 1938:2:25:7 {paratypes of *M. rhodesiana*} (schizoparatypes MCN 709 and 708, respectively); Lake Young, 9.V.1936, C. K. RICARDO leg., BMNH 1938:2:25:8 {holotype of *M. innominata*} (schizoholotype MCN 716); ZAIRE [ex Belgian Congo]: lake Upemba, VIII.1937, P. BRIEN leg., MRAC 201 {holotype of *Spongilla brieni*} (schizoholotype MCN 725).

DIAGNOSIS

Sponges forming irregular delicate, thin to branching crusts. Major distinction of main and secondary fibers conspicuous only at the basal portion of the skeleton which turns into a confuse reticulation at the sponge surface; megascleres in two categories, alpha megascleres long, stout and smooth oxea or styles, beta megascleres shorter and slimmer oxea, covered with rounded proeminences except at their tips; microscleres short to long, sparsely spined, harpoon-ended microxea abundant at the basal portion of the skeleton; gemmoscleres boletiform spicules with quite uniform sizes, stout, sparsely spined shaft and outer surface of upper rotule characteristically microsculptured; gemmules few, scattered at the basal portion of the sponge linked to the reticular fibers by a few slanting alpha megascleres.

REDESCRIPTION

Sponges forming flat 1,5-2,5 mm thick crusts (fig. 1) to coalescent branching growths with a smooth surface or surface shallowly sculptured into crests and furrows, oscula inconspicuous; dry specimens pale yellow to dark grey with firm but brittle texture. Skeleton a confuse reticulation of a few slim main fibers which branch and slightly protrude towards the surface and secondary, usually unispicular fibers or slanting megascleres, making up an irregular reticulum of circular or polygonal meshes, the larger ones containing the gemmules, and situated at the basal part of the skeleton (fig. 1). Spongin scarce.

Alpha megascleres (figs 1, 3, 7, 19) - Long, stout, smooth, straight to curved oxea with abruptly pointed extremities and sometimes middle inflated portions; some rare styles may be present. Dimensions: length 308.7-674.4 µm; width 12.3-37.0 µm.

Beta megascleres (figs 3, 7, 8, 19) – Rare, slim to stout, more often slightly curved oxea about 1/3 the length of the alpha megascleres, covered with conical spines or bumped proeminences, except at their abruptly pointed extremities. No precise localization could be detected for the beta megascleres due to their rarity. Dimensions: length 80.4-301.8 µm; width 2.7-5.3 µm.

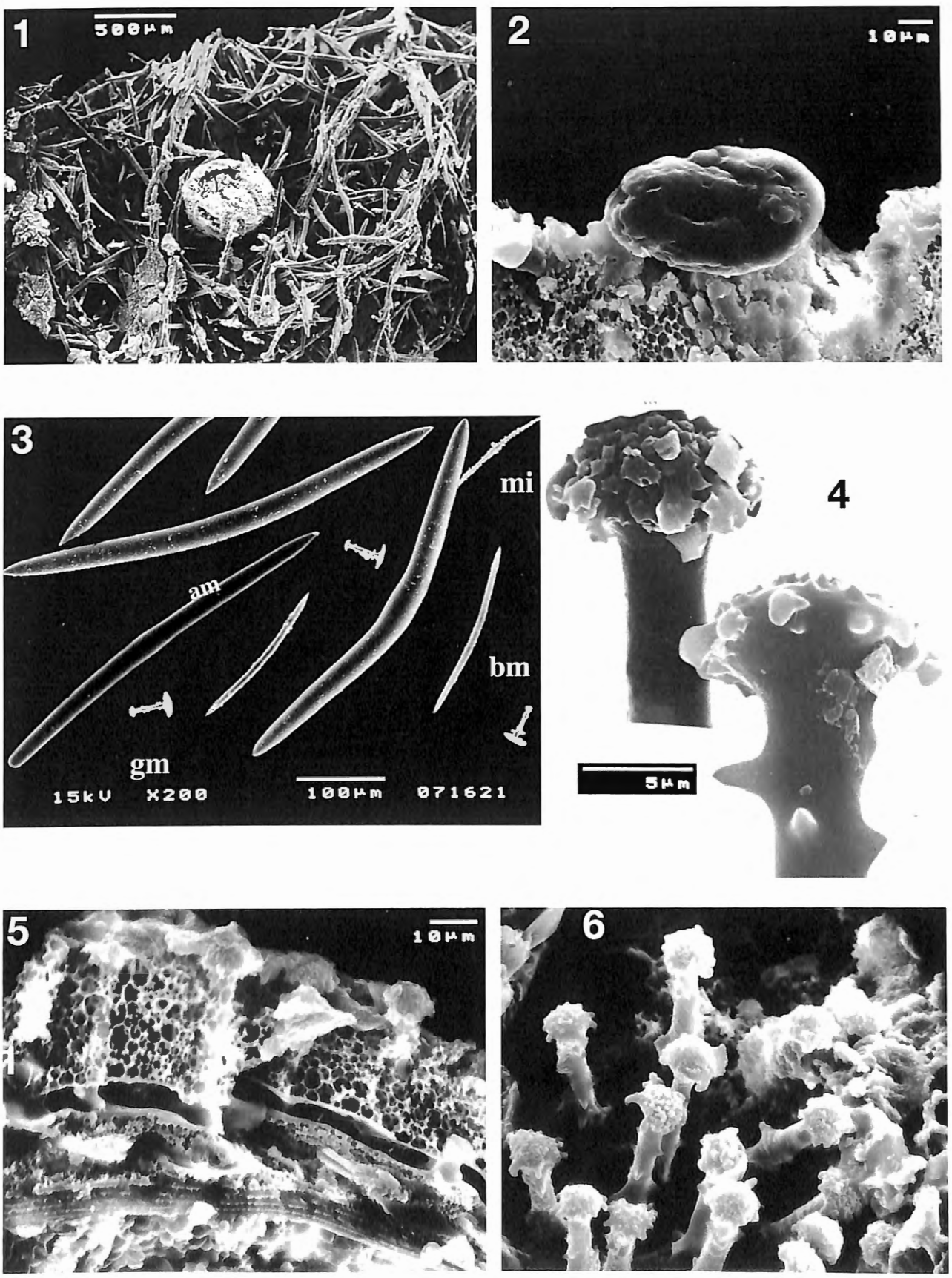
Microscleres (figs 1, 3, 7, 9, 19) – Slim, sparsely spined, curved to slightly curved microxea with abruptly pointed harpoon-ended extremities and conspicuous size variations, with several or a few larger straight spines provided with a crown of microspines at the central portion; the larger spines grade to shorter and curved ones towards the spicule extremities. Found throughout the sponge body, but more abundant near the gemmules, at the basal part of the skeleton (fig. 1). Dimensions: length 46.0-219.4 µm; width 1.84-9.2 µm.

Gemmoscleres (figs 3-7, 10, 19) - Regularly sized boletiform spicules with straight, stout, sparsely spined shaft, spines straight, conical or rounded, with a tendency to a helicoidal distribution along the shaft, and then forming lateral wings at the site of the collar of spines; spines sometimes reduced to the ones of the collar under the lower rotule. Lower rotule large, slightly umbonate or undulated, rarely flat, with polygonal outline and entire shallow incurved border (figs 7, 10, 19), inner face of lower rotule smooth or containing shallow radial expansions of the shaft which may reach the rotule border (fig.10). Upper rotule varying from a bumped expansion of the shaft bearing a few incurved irregular spines or hooks to well formed small umbonate rotules, provided at their borders with an irregular series of six or more blunt incurved hooks (figs 4, 6, 10). Surface of upper rotule characteristically covered with microsculptures (figs 6, 10), showing at high magnifications (5.000 x) (fig. 4) a variation from small proeminences found only at the central portion of the rotule to large irregular scales covering the whole rotule and its lateral hooks. Dimensions: length 40.7-64.5 µm; width 2.9-5.7 µm; upper rotule diameter 8.0-15.9 µm; lower rotule diameter 23.2-33.4 µm.

Gemmules (figs. 1, 2, 5, 6) - Rare, distributed close to the basal plate, a few scattered in the skeleton network, spherical, dark greyish, singly linked to the reticular fibers by slanting alpha megascleres (fig. 1). Foraminal tube short, straight, devoid of gemmoscleres and provided, at the apical portion, with a thick elliptical collar-like expansion (fig. 2). Gemmoscleres radially embedded in the pneumatic coat in one single layer, with the lower rotules regularly spaced and set at the top of the thick, foliated inner coat and projecting half of the shaft beyond the thin, partially formed pneumatic coat; pneumatic coat organized into three different regions, the upper one with larger, irregular air spaces, the middle one a continuous air chamber and the lower one with minute air spaces (fig. 5). The thin pneumatic coat and the missing outer coat (fig. 6) seen in the gemmules of the only gemmuliferous examined specimen, BMNH n° 1938:2:25:8, indicate that the sponge had not yet completed the gemmular sealing process. Dimensions: 400-500 µm. in diameter.

TYPE-LOCALITY

Lake Young (ex lake Shiwa Ngandu), 11°14'S/ 31°45'E, northeast of Chambeshi river (in the course of Mansha river), Northern Province, Chinsali district, Zambia.



Figs 1-6. *Metania rhodesiana* BURTON, 1938: 1. Skeleton fragment (MCN 716) showing the microscleres (arrows) and gemmule distribution at the basal portion; 2. detail of the gemmule foraminal tube; 3. spicular components: am = alpha megascleres, bm = beta megascleres, mi = microsclere, gm = gemmosclere; 4. microsculptured outer face of the gemmosclere upper rotules; 5. gemmule wall in cross section; 6. gemmoscleres upper rotules protruding from pneumatic coat at initial stage of formation.

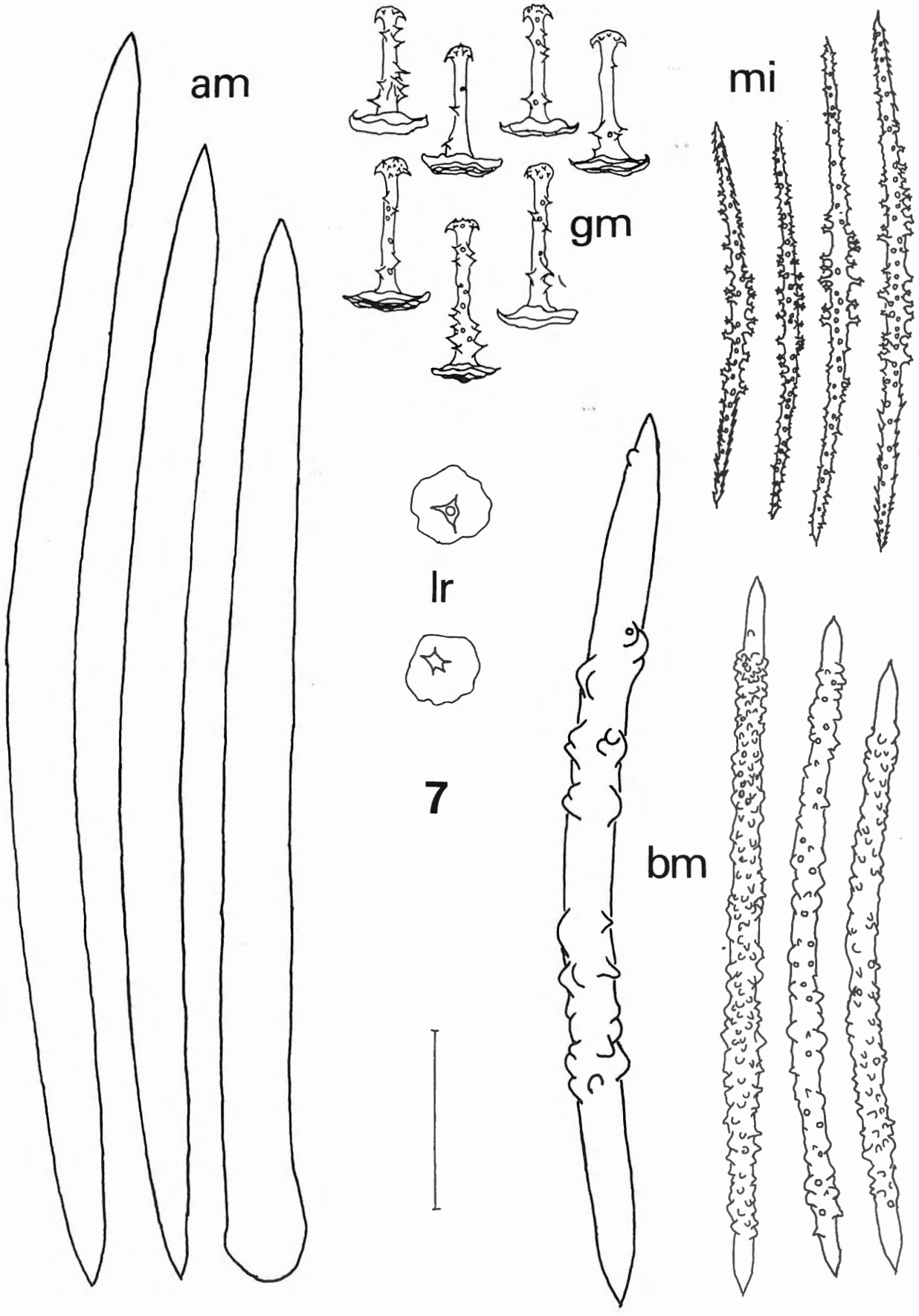
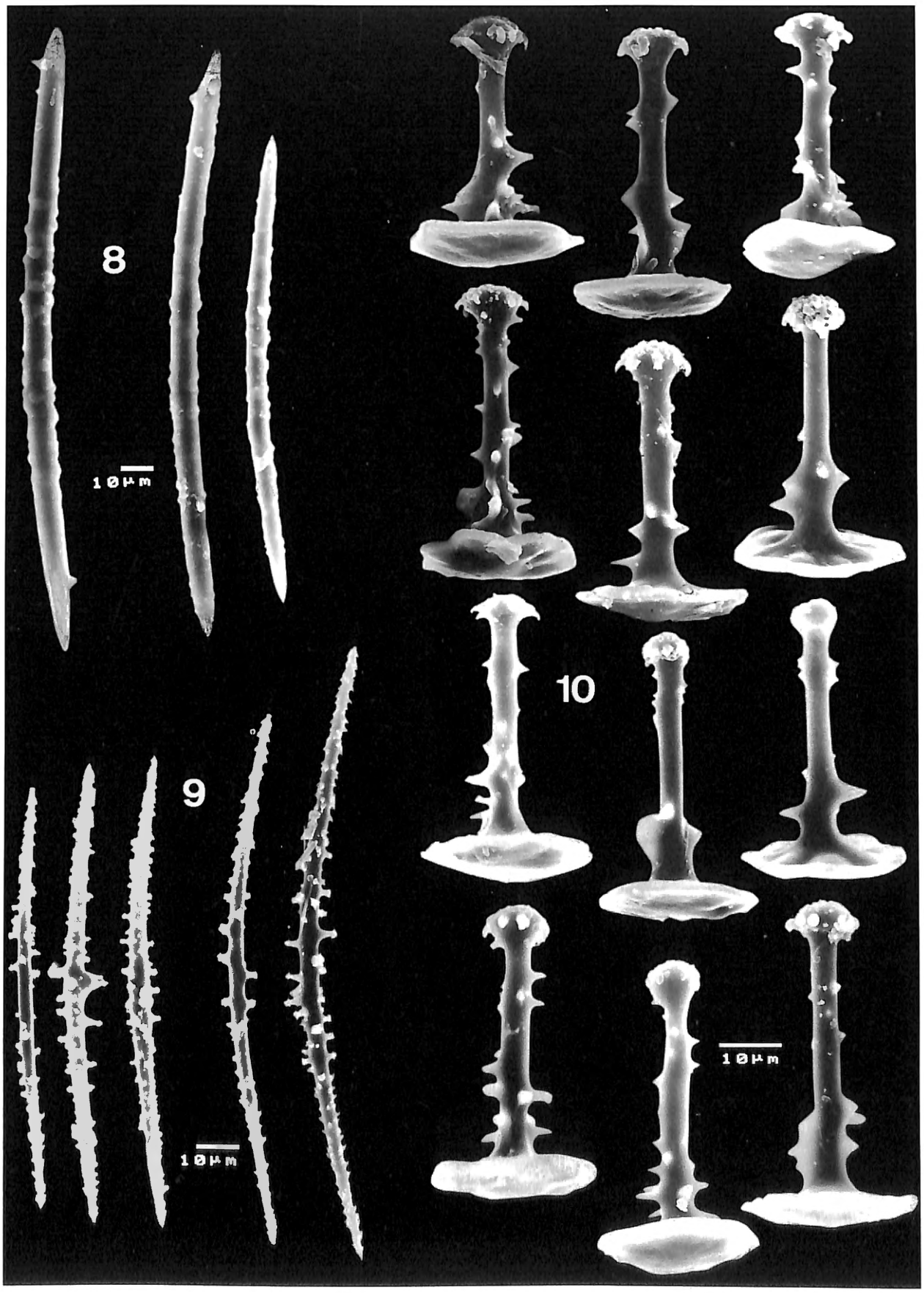


Fig. 7. *Metania rhodesiana* BURTON, 1938: Camera lucida drawings of the spicular components: am = alpha megascleres, bm = beta megascleres, mi = microscleres, gm = gemmoscleres, lr = profile of lower rotules. Scale: 50 µm.



Figs. 8-10. *Metania rhodesiana* BURTON, 1938: 8. beta megascleres; 9. microscleres; 10. gemmoscleres evincing the microsculptured upper rotules.

DISTRIBUTION

Restricted to the type-locality (fig. 22).

REMARKS

The studied material is represented by the holotype and two paratypes of *M. rhodesiana*, both without gemmules, the holotype of *M. innominata*, with a few gemmules and the holotype of *Spongilla brieni*, containig only immature gemmules not yet provided with gemmoscleres. The spicular slide of *M. rhodesiana* BMNH 1938:2:25:5, however, contained, one single gemmosclere, which is identical in size and shape to the gemmoscleres of *M. innominata*. The SEM study of the megascleres and microscleres showed that they are identical in shape and size in the two species, as already remarked by BURTON (1938). The specimens used in the description of these two species were collected by the same person, Miss C. K. RICARDO, in a same site, at different dates and seasons of the year, which may explain the absence of gemmules in the specimens of *M. rhodesiana* and the initial stage of gemmule formation in the material of *M. innominata*. The above facts lead us to think that only one species of genus *Metania*, i.e. *M. rhodesiana* thrives in lake Young, subjected to seasonal changes in water level.

The junior author's curiosity about Lake Young environment and a young woman collecting sponges around in 1936, revealed the following information which we consider an important part of this paper. Lake Young is locally named Lake Shiwa Ngandu (11° 14'S – 31° 45'E). The lake ..."had the name dedicated to Lieutenant E. D. YOUNG whom the Royal Geographical Society sent to search for Dr. David LIVINGSTONE in 1867....Dr. Kate RICARDO is the wife of Dr. Colin BERTRAM, a distinguished zoologist and Antarctic explorer "...(Dr. John HEMMING, personal communication, June 27, 1996)...." My wife's early work in Central Africa was on fishes... (Dr. C. BERTRAM, personal communication, September l, 1996) « ...The lake is about two miles below our house and is some four miles long, with the Mansya river running through it. ...Round the lake is swampy ground...There are weedy, swampy bits all round the edge of the lake..." (BERTRAM & OWEN, 1991)...."The Government Chemist, London, November 1937 gives for Shiwa Ngandu: Total alkalinity (Calc. as carbonate CO_3) 1.7, (no field pH measures given); Silica (SiO_2) 2.9mg/l; Na 1.7; PO_4 0.05; Specific gravity 1.0002... I think at one point they (Kate BERTRAM & Janet OWEN,1991, Letters from the Swamps) mentioned that the levels of these lakes would change a good deal seasonally..." (Dr. R. LOWE-MCCONNEL personall communication, July 6, 1998).

Spongilla brieni BRIEN 1938, also collected from a lentic environment, has smooth oxea megascleres and spined microscleres similar to those of *M. rhodesiana*. Until new specimens with gemmules are collected from lake Upemba, Zaire, allowing for a comparative study of the scleres and skeletal arrangement in both species, *S. brieni* is tentatively synonymized with *M. rhodesiana*. If such a study confirms the identity of the two species *Metania brieni* comb. n. will come out as a senior synonym *of M. rhodesiana* on account of page priority.

Metania godeauxi (BRIEN, 1968) comb. n.
(Figs. 11-18, 21, 22)

Parametania godeauxi BRIEN, 1968: 387-393, figs 3-5, pl. II, figs 11-24.

EXAMINED MATERIAL

ZAIRE [ex Belgian Congo]: Katanga, Luapula River, mouth of Kafubu River, VIII. 1963, J. GODEAUX leg., MRAC n° 1312 {holotype} (schizoholotype MCN 2982).

DIAGNOSIS

Skeleton strongly reticulated and with little distinction between the thick main and secondary multispicular fibers; megascleres smooth strongyla, microscleres abundant, heavily spined microxea provided with middle larger, microspined spines; gemmoscleres with lower rotule cut in an irregular number of straight or curved spines; gemmules free, not contained in capsules but tightly held in the meshes of the skeleton network.

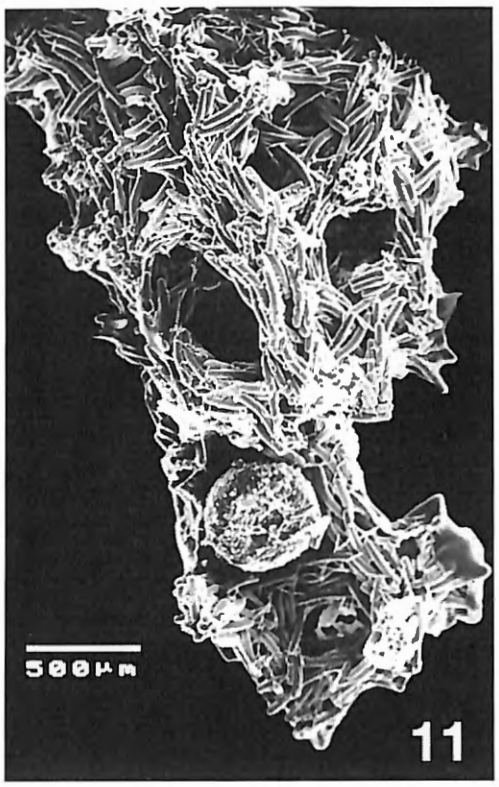
REDESCRIPTION

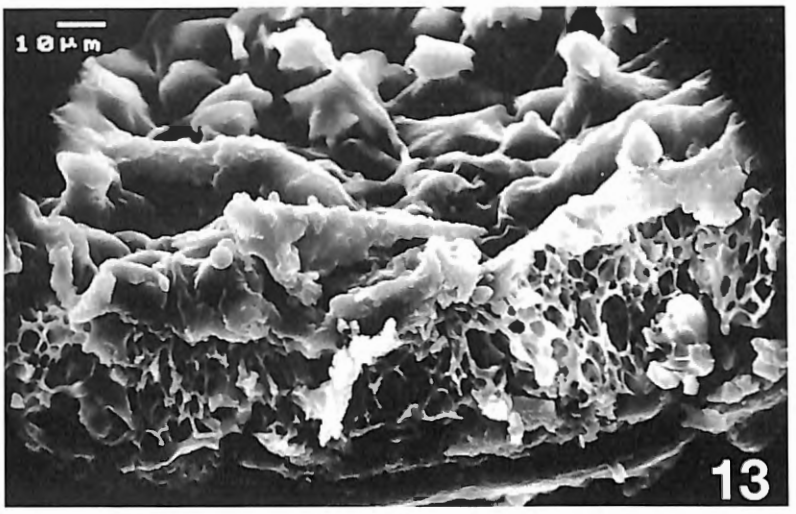
Sponges forming irregular crusts of beige color and hard consistency, 10cm wide and 2cm thick on trunks of dead trees accumulated at the river bottom and exposed during the dry season. Surface reticulated with irregularly distributed dome-like projections. Oscula visible as larger openings of the reticulum, irregularly distributed at the sponge surface but never on the top of the surface projections (BRIEN, 1968, pl. II, figs 11, 12). Main radial skeleton fibers stout, with little spongin binding the spicules together, slightly projecting their conical summits at the sponge surface; secondary fibers also stout, abundant, composing a closed anisotropic reticulum of small, polygonal meshes (figs. 11, 12; BRIEN, 1968, pl. II, figs 13,14); gemmules abundant, located in the basal part of the reticulum, not contained in capsules but singly, tightly fitted in the skeleton meshes (figs 11, 12), at the gemmular level thin sponging films charged with microscleres may close the skeletal reticulum, so that individual gemmular locci are formed. The microscleres are abundant thoughout the sponge skeleton and over the gemmules (fig. 12).

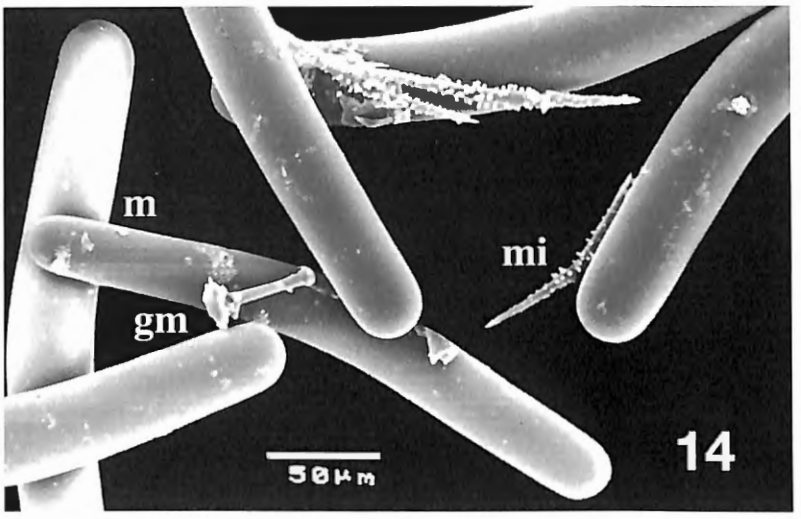
Megascleres (figs 11, 12, 14, 16, 21) – Smooth, long and stout, straight to slightly curved strongyla. Dimensions: length 178.6-273.6 μm; width 20.9-38.0 μm.

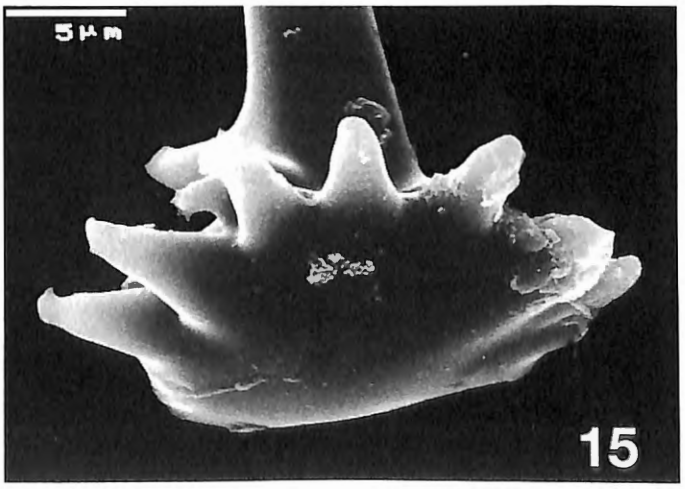
Microscleres (figs 12, 14, 16, 18, 21) – Abundant, slim, densely spined, slight to strongly curved microxeas of varibale sizes, with gradually, harpoon-pointed extremities. The middle portion of the sclere presents a number of larger straight or slightly curved spines, capped by a crown of conical microspines usually curved toward the spicule shaft. The spines grade to shorter and curved ones towards the spicule extremities. Dimensions: length 63.9-124.6 μm; width 2.53-6.4 μm.

Gemmoscleres (figs 14-17, 21) – Short, irregularly shaped boletiform scleres, yet some longer ones may occur, shafts stout, straight, densely spined, sometimes projecting its conical endings beyond the lower and/or upper rotules, collar of









Figs 11-15. *Metania godeauxi* (BRIEN, 1968): 11. Schizoholotype (MCN 2982). Skeleton with gemmule; 12. schizoholotype showing details of the gemmule surface and distribution of microscleres in the skeletal network (arrows); 13. gemmule wall in cross section; 14. spicular components: m = megascleres, mi = microscleres, gm = gemmosclere; 15. deeply cut profile of the gemmosclere lower rotule.

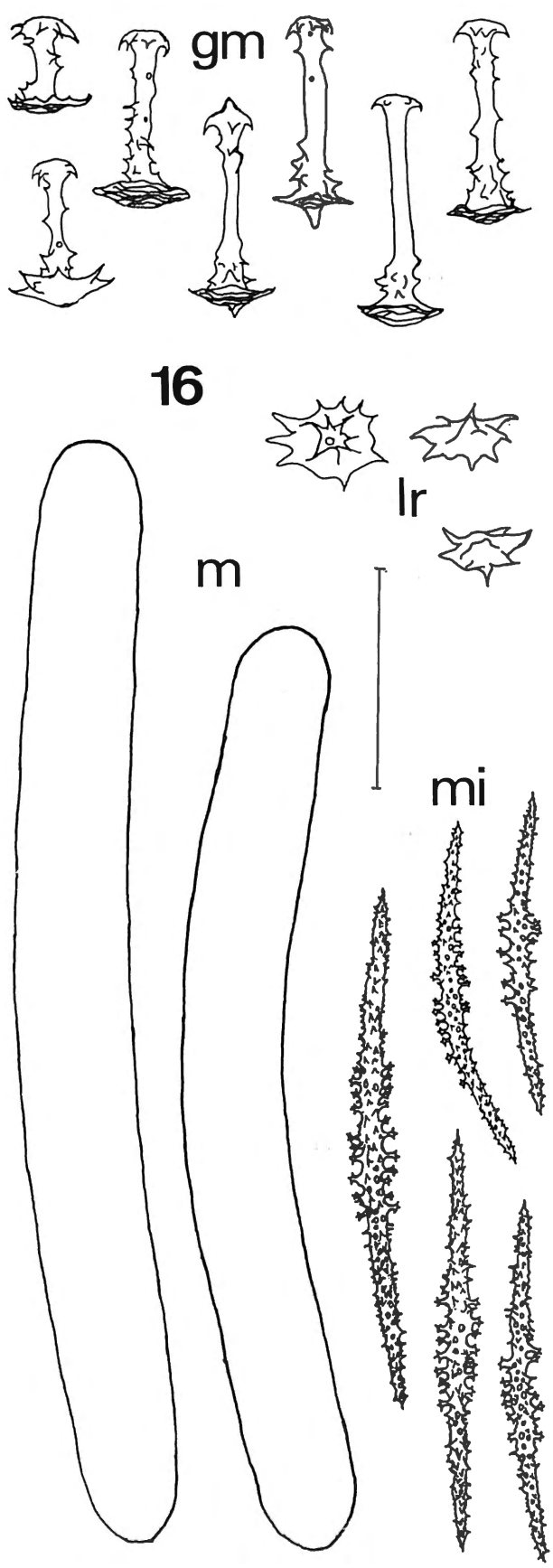


Fig. 16. *Metania godeauxi* (BRIEN, 1968): Camera lucida drawings of the spicular components: m = megascleres, mi = microscleres, gm = gemmoscleres, lr = gemmoscleres lower rotules. Scale: 50 μm.

spines conspicuous as a stout enlargement of the shaft under the lower rotule, spines of the collar with a regular or irregular distribution, lower rotule small, slightly umbonate with the border deeply cut into an irregular number of straight or curved blunt teeth, upper rotule progressing from a knob with some blunt hooks or spines turned towards the shaft to small, well developed umbonate rotules with the borders provided with an irregular number of also irregular spines or hooks turned towards the shaft. Dimensions: length 22.5-54.74 μm; width 2.3-4.6 μm; upper rotule diameter 8.05-16.1 μm; lower rotule diameter 18.4-26.4 μm.

Gemmules (figs 11-13) – Small, hemispherical, abundant, located in the lower portion of the skeleton, free but singly held in the reticular meshes. Foraminal tube short, slightly projected beyond the gemmule surface. Gemmoscleres radially embedded in one layer in the pneumatic coat with the lower rotules side by side embedded in the thin inner gemmular coat and part of the shaft and upper rotules of the longer gemmoscleres protruding from the outer gemmular coat. Pneumatic coat thick with irregularly sized polygonal, elliptical or circular air spaces. Dimensions: 400-500 μm.

TYPE-LOCALITY

Luapula River, near mouth of Kafubu River, Katanga, Zaire.

HABITAT

The preferential substrate of the specimens were the seasonally submersed parts of the vegetation found in the flooded valleys of the Kafubu River, particularly in its lower reach.

DISTRIBUTION

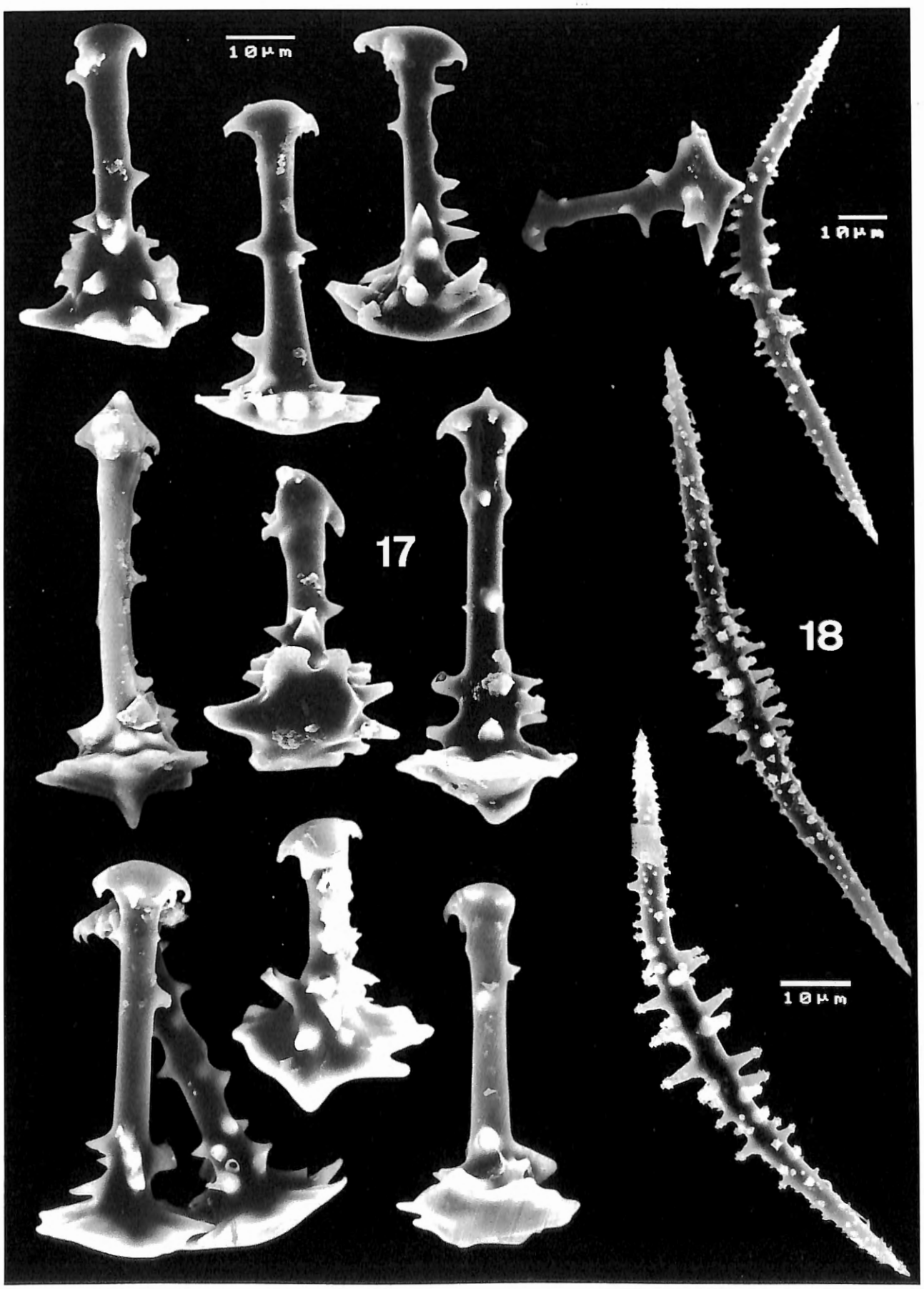
Restricted to the type-locality (fig. 22).

Discussion

A careful study of *Metania pottsi* (WELTNER, 1895) [SILVA & VOLKMER-RIBEIRO, 1998], *M. godeauxi* (BRIEN, 1968a) and *M. rhodesiana* BURTON, 1938, based upon SEM analysis of the skeleton, gemmules and spicules, resulted in the recognition of three species (figs 19-21) instead of the eight nominal species previously listed (PENNEY & RACEK, 1968) for the Ethiopian Region.

M. pottsi and *M. godeauxi* have a strongly reticulate skeleton in common, with polispicular fibers, sharp distinction between main and secondary fibers, smooth strongyles as megascleres, smooth upper rotules of gemmoscleres and gemmules in one or another way entangled inside the mother skeletal reticulum. Both species share the same lotic habitat i.e. seasonally exposed substrates in rivers of the Congo Basin. *M. rhodesiana* on the other hand seems bound to a lentic habitat, i.e. lakes of the African savanna, and as such appears as the ethiopic counterpart of *Metania spinata* from the Neotropical Region (VOLKMER-RIBEIRO *et al.*, 1998) which also has a more delicate skeleton, oxea alpha megascleres, spined beta megascleres and longer gemmoscleres.

Eleven species are thus presently recognized in genus *Metania*: five of them (VOLKMER-RIBEIRO & COSTA, 1992)



Figs. 17, 18. *Metania godeauxi* (BRIEN, 1968): 17. gemmoscleres; 18. microscleres.

Figs. 19-21. Camera lucida drawings for the spicular set of the three species of the genus *Metania* from the Ethyopian Region: 19. *Metania rhodesiana* BURTON, 1938; 20. *M. pottsi* (WELTNER, 1895); 21. *M. godeauxi* (BRIEN, 1968). am = alpha megascleres; bm = beta megascleres; m = megascleres; mi = microscleres; gm = gemmoscleres; lr = gemmoscleres lower rotules. Scale: 50 μm.

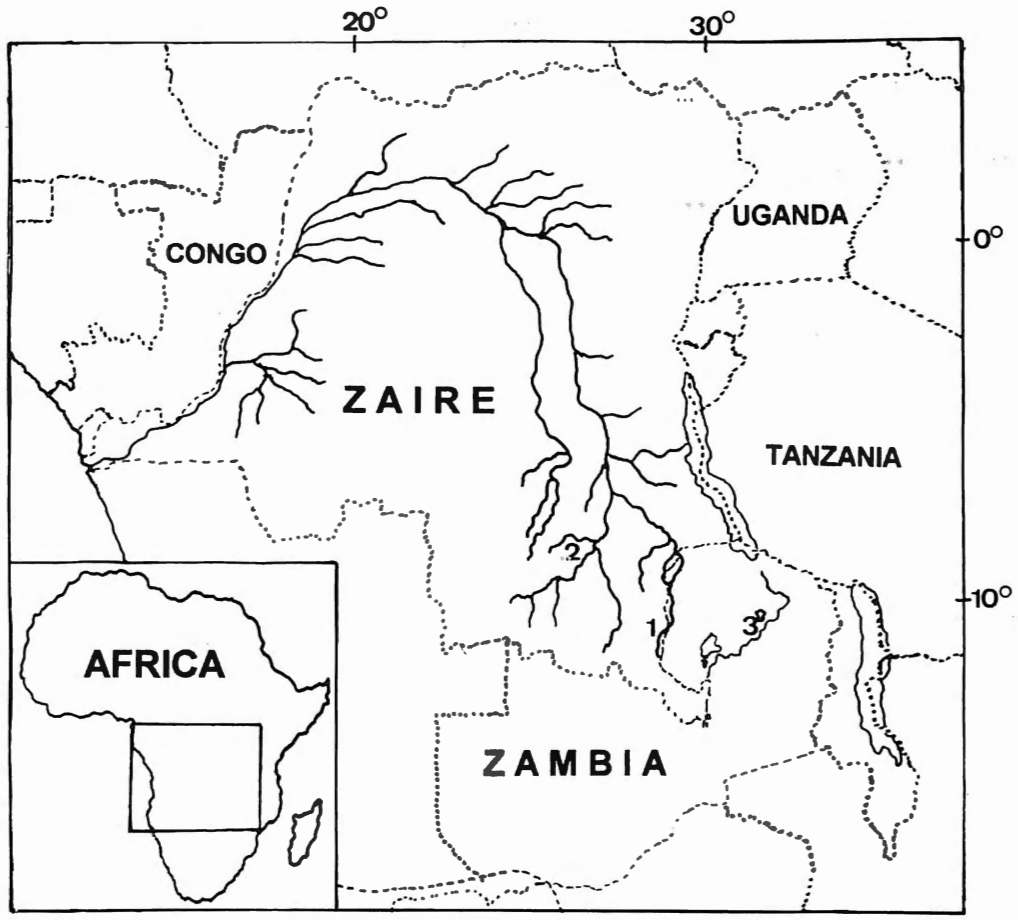


Fig. 22.
Distribution of *Metania godeauxi* (BRIEN, 1968) in Luapula River, Zaire [1] and *M. rhodesiana* BURTON, 1938 in Lake Upemba, Zaire [2] and Lake Young, Zambia [3].

in the Neotropical Region: *Metania reticulata* (BOWERBANK, 1863), *M. spinata* (CARTER, 1881), *M. subtilis* VOLKMER-RIBEIRO, 1979, *M. fittkaui* VOLKMER-RIBEIRO, 1979 and *M. kiliani* VOLKMER-RIBEIRO & COSTA, 1992; two (VOLKMER-RIBEIRO & COSTA, 1993) in the Oriental Region: *M. vesparium* (MARTENS, 1868) and *M. vesparioides* (ANNANDALE, 1908), one (VOLKMER-RIBEIRO & COSTA, 1993) in the Australian Region: *M. ovogemmata* STANISIC, 1979 and three in the Ethiopian Region: *M. pottsi* (WELTNER, 1895), *M. rhodesiana* BURTON, 1938 and *M. godeauxi* (BRIEN, 1968). The previously noticed gondwanic distribution of the genus (VOLKMER-RIBEIRO, 1986; SILVA & VOLKMER-RIBEIRO, 1998) is once more confirmed.

The SEM comparative study of the eleven *Metania* species evinces that *M. kiliani* is the only one provided with two classes of microscleres, one of them being anisochaelas, that *M. subtilis* and *M. godeauxi*, are the only ones missing beta megascleres, that *M. godeauxi* is the only species with the gemmosclere lower rotule deeply cut in an irregular number of straight or curved hooks and that *M. rhodesiana* is the only species to have the upper rotule covered with scales or spines.

With respect to habitat preference, *M. spinata* and *M. rhodesiana* are the only *Metania* species living in ponds or lakes (and thus lentic habitats) in the savanna areas of respectively the Neotropical and the Ethiopian Regions. All other species of *Metania* seem to have adapted to the seasonally flooded strips (semi-lotic habitats) of the world tropical rain forests. Freshwater sponges thriving in such habitats are subjected (VOLKMER-RIBEIRO, 1981) to a process of distribution which operates particularly along a vertical gradient, i.e. sustained rising and lowering of the water level. This was certainly demonstrated by the numerous specimens of *Metania* attached to trunks, branches and leaves of trees reached by the floodwaters in the Amazon and the Congo Rivers. As the gemmule is the basic means of dispersal in freshwater sponges, a selective adaptation to this type of environment should be demonstrable in the gemmular structure, which would allow such sponges in each season to occupy an ever larger portion of the vertical gradient (VOLKMER-RIBEIRO, 1981). This has in fact been proved by the gemmular retention in the body of the mother sponge, exhibited by all species of *Metania* from the five continental plates. The retention was seen to be favored by the formation of basal strata of gemmules, by gemmules held inside gemmular capsules or gemmules tightly fitted in the skeletal meshes, as for instance, in *M. godeauxi*. In this way occupation of the substrate for the next flooding period is guaranteed, and a new layer of living sponge forms on top of the dried one, so that a cross section throuhg the whole sponge allows for a rough counting of the immersion periods/years the specimen witnessed.

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Carla M. M. SILVA
Museu de Ciências Naturais
Fundação Zoobotânica do Rio Grande do Sul
Rua Dr. Salvador França, 1427, Jardim Botânico
Porto Alegre, RS, Brazil, 90690.000
silva@portoweb.com.br

Cecília VOLKMER-RIBEIRO
Museu de Ciências Naturais
Fundação Zoobotânica do Rio Grande do Sul
Rua Dr. Salvador França, 1427, Jardim Botânico
Porto Alegre, RS, Brazil, CEP 90690.000
Fellow researcher of CNPq. Brazil
cvolkmer@fzb.org.br