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No. I. Descriptions of South African Sponges
collected in the South African Marine
Survey

Part II. The "Lithistidae," with a critical
survey of the desma-forming Sponges

BY

M. BURTON, M.Sc.

British Museum (Natural History)

I.

Descriptions of South African Sponges collected in the South African Marine Survey, Part II—The "Lithistidae"—with a critical survey of the desma-forming sponges.

By M. BURTON, M.Sc.

"LITHISTIDAE."

THE order Lithistida, as understood by Sollas (1888), consists of a heterogeneous collection of forms whose only affinity is the possession of curiously modified spicules known as desmas. Excluding these spicules, we find that the remaining portions of their skeletons have a peculiar diversity which suggests at once a polyphyletic origin for the Lithistida. Moreover, we find several species of sponges belonging to other genera of the Tetraxonida in which the skeleton consists in part of desma-like spicules or desmoids, such as *Crambe crambe* Auctt. among the Myxilleae, *Desmatiderma arbuscula* Topsent among the Mycaleae, *Hyalascus hogdsoni* Kirkpatrick* (1907, Pl. IV, fig. 1c) among the Hexactinellida, and *Lithochela conica* sp. n. among the Myxilleae. The only conclusion we can draw from these facts is that it is possible for all genera of siliceous sponges to contain one or more species possessing, to a greater or lesser extent, desmas, or, as they are often called, desmoids. This, together with the strikingly heterogeneous nature of the so-called Lithistida, leads inevitably to the inference that this supposedly natural order is nothing more than a collection of those siliceous sponges in which the presence of desmas has become a dominating feature.

On analysing the various species of the Lithistida we find such forms as *Corallistes*, with obviously tetraxon desmas and phyllo-triaenes, and microrhabds recalling the spicules of *Ecionemia*; *Taprobane herdmanni*, with oxea, desmas, and sigmata obviously related to the Gelliinae; *Callipelta ornata*, with a sanidaster suggestive of the similar spicule in *Sanidastrella*; *Siphonidium capitatum*, with monactinal spicules almost identical with those of *Sphaerotylus*; *Pleroma turbinatum*, with triaenes and metasters like those of *Thenea* and allied forms; *Neosiphonia susperstes*, with the triaenes and asters of a *Stelleta*; *Gastrophanella mammilliformis* sp. n., with the tylo-styles so characteristic of the Clavulidae.

It is clear, therefore, that the old and convenient family of the Lithistidae must be abandoned, and it must be accepted that the similarity of their skeletons is entirely a matter of convergence.

* Hexactinellida. National Antarctic "Discovery" Expedition, Natural

TABLE OF THE GENERA OF LITHISTIDAE, WITH SUGGESTIONS AS TO THEIR AFFINITIES.

Genus.	Most closely related to :	
	Family.	Genus.
<i>Corallistes</i> Schmidt.....	Theneidae or Pachastrellidae ?	—
<i>Pleroma</i> Sollas.....	" "	—
<i>Rhacodiscula</i> Zittel.....	" "	—
<i>Costifer</i> Wilson.....	" "	—
<i>Coscinospongia</i> Bowerbank....	" "	—
<i>Jereopsis</i> Schmidt.....	Theneidae	<i>Thenea</i>
<i>Daedalopelta</i> Sollas.....	Pachastrellidae	<i>Pachastrella</i>
<i>Theonella</i> Gray.....	Stellettidae	<i>Ecionemia</i>
<i>Discodermia</i> Bocage.....	"	"
<i>Rimella</i> Schmidt.....	"	"
<i>Neopelta</i> Schmidt.....	"	"
<i>Macandrewia</i> Gray.....	Stellettidae	<i>Ecionemia</i> or <i>Penares</i>
<i>Callipelta</i> Sollas.....	"	<i>Sanidastrella</i>
<i>Kaliopsis</i> Bowerbank.....	Stellettidae ?	—
<i>Neosiphonia</i> Sollas.....	"	—
<i>Azorica</i> Carter.....	Tetillidae ?	—
<i>Tretolophus</i> Sollas.....	"	—
<i>Microscleroderma</i> Kirkpatrick..	"	—
<i>Scleroderma</i> Schmidt.....	Tetillidae or Spirastrellidae ?	—
<i>Taprobane</i> Dendy.....	Gelliinae	—
<i>Lithobactrum</i> Kirkpatrick.....	Myxilleae ?	—
<i>Monanthus</i> Kirkpatrick.....	Axinellidae ?	—
<i>Petromica</i> Topsent.....	"	—
<i>Gastrophanella</i> Schmidt.....	Spirastrellidae ?	—
<i>Siphonidium</i> Schmidt.....	Polymastidae	<i>Sphacrotylus</i>
<i>Aciculites</i> Schmidt.....	"	"
<i>Plakidium</i> Lendenfeld.....	Incertae sedis	—
<i>Lophacanthus</i> Hentschel.....	"	—

In addition, there is so little known of the following—either they were described from insufficient material or the descriptions themselves were inadequate—that it is impossible even to hazard a guess as to their affinities. In many cases the genera are so inadequately known as to justify their being entirely ignored until such time as good re-descriptions are forthcoming:—

Collinellia Schmidt, *Sulcastrella* Schmidt, *Lyidium* Schmidt, *Setidium* Schmidt, *Poritella* Schmidt, *Amphibleptula* Schmidt, *Leiodermatum* Schmidt, *Sympyla* Sollas, *Vetulina* Schmidt, *Tremaulidium* Schmidt, *Arabescula* Carter, *Seliscothos* Zittel, *Brachiaster* Wilson, *Desmanthus* Topsent.

As a commentary on the inadequacy of the old ideas concerning the classification of the "Lithistida," it may be noted that both *Callipelta* and *Pleroma* have obvious affinities with the Stellettidae, yet the one has tetraxenid, the other mesaxenid, characters.

Although forming a not inconsiderable part of the South African sponge fauna, the "Lithistidae" are restricted to six species:—

- (1) *Discodermia natalensis* Kirkpatrick.
- (2) *Corallistes typus* Schmidt.
- (3) *Microscleroderma hirsutum* Kirkpatrick.
- (4) *Gastrophanella mammilliformis* n. sp.
- (5) *Monanthus plumosa* Kirkp., var. *digitata* var. nov.
- (6) *Macandrewia auris* Lendenfeld 1906A.

Species (1).—DISCODERMIA NATALENSIS Kirkpatrick 1903A.

From the 17 specimens in the collection, this species appears to be invariably pendunculate and to range from cup- to vase-shaped. The largest is 19 cms. high and measures 22 cms. across the mouth. The walls of the cup may be regular or much folded, or even undeveloped on one side, when the specimen approaches a flabellate condition. The colour is a golden-yellow when dry.

The specimens agree with the type in all respects but the ectosomal spicules, which are here almost invariably phyllotriaenes. Discotriaenes were only found on the oscular surfaces at the bases of the cups in R.N. 211 and in a small specimen from the Natal Museum Coll. In view of the small gulf separating phyllo- and discotriaenes, however, this can have little specific value, and I have no doubt as to the identity of these specimens with the above species.

Previously-known Distribution. Natal Coast (Kirkpatrick).

Registered Nos., Locality, etc. R.N. 211, 224, 228, 229, 240. Stn. 109. R.N. 294, Umblangakulu River, N.W. by N. 7½ miles, 50 faths. *Bottom*, sand and shells.

The only justification for separating the two genera *Discodermia* and *Theonella*, remarkably alike in all other respects, appears to be the presence of discotriaenes in the former and of phyllotriaenes in the latter. The discovery of specimens of an undoubted *Discodermia*, in which the discotriaenes are practically absent, suggests the need for uniting the two genera.

Species (2).—CORALLISTES TYPUS O. Schmidt 1870A.

This species is represented by 8 specimens, which fall naturally into two groups according to their external form:—(a) R.N. 61, 133, 208, 209, 296. In the form of a cup, with thin, much-folded walls, borne on a short, stout peduncle. The smallest measures 8 cms. across the mouth of the cup and stands 6 cms. high; the peduncle is 1 cm. high and 3 cms. across. The largest is 20 cms. across and 7 cms. high. In each case the cavity of the cup is continued down, leaving a hole in the base so that they come to resemble funnels broken off short at the neck. The margins of the cups are rounded and about 1 cm. thick. (b) R.N. 76, 205, 206, 207, 295. Ear-shaped to slightly cup-shaped with walls 1.5 cms. thick and somewhat square at the margins. The smallest is about 4 cms. high and 5 cms. across the plate, the largest about 4 cms. high by 7 cms. across.

All, except R.N. 76, are dried and the colour in this condition is a dull white faintly tinged with a light brick-red. The spirit-specimen is a dull white.

The present specimens agree very closely with the description given by Sollas (1888b), but a few small points concerning the spicules are worth noting:—

- (1) *Ovea* long, slender, somewhat curved, 1.0–2.16 and .018 mm. thick.
- (2) *Desmas*, as described by Sollas (l.c.).
- (3) *Dichotriaenes*, Rhabdome, usually sharply-pointed, but sometimes strongylote, .324–.864 mm. long and .027–.036 mm. thick just beneath the cladome. Cladome, total diameter .27–.36 mm. Primary cladi, .054–.072 mm. and secondary cladi .072–.108 mm. long. The cladi of these spicules frequently fail to branch, giving rise to short-shafted orthotriaenes. In R.N. 205 this has given rise to a condition where the two kinds of spicule are equally represented. In this latter case the cladi of the orthotriaenes are often as much as .24 mm. long.
- (4) Spirasters, .02–.028 mm. long. The extreme variability of these spicules is perhaps the most characteristic feature of this species (*vide* Sollas l.c.).

All specimens bear more or less extensive patches of a thin encrusting *Tetillid* sp. R.N. 133 bears in addition a small circular patch, about 2 cm. in diam., of a *Mycale obscura*.

The larger of the specimens are studded with a number of Polyzoa, Barnacles, etc.

Previously-known Distribution. Florida (Schmidt); Pernambuco (Sollas).

Registered Nos., Localities, etc. R.N. 61. Locality unknown. R.N. 76, 30.1.37 S., 31.11.15 E., 206 faths. *Bottom*, mud, sand, and shells. R.N. 133, 205, 206, 207, Sandy Point, N. $\frac{1}{2}$, E. 10 miles, 50 faths. *Bottom*, rock. R.N. 208, 209, 295, 296, Constable Hill, E.S.E. 15 miles, 100 faths. *Bottom*, dark mud, green tinge.

Species (3).—MICROSCLERODERMA HIRSUTUM Kirkpatrick 1903a.

The 12 specimens resemble so closely the two described by Kirkpatrick in shape, size, and spiculation that there is no need for further description.

All bear numerous patches of an encrusting Spirastrellid, while R.N. 230 bears, in addition, an encrusting *Stelletta farcimen*, Lfd., which consists of a low-lying mass of tangled, irregularly-arranged spicules. Large numbers of Anthozoa are embedded in the outer walls, while worm-tubes and Polyzoa are frequently to be found inside the cup.

Some of the cups contain a large quantity of sand and shell débris, and the question naturally presents itself, whether a sandy bottom be a direct disadvantage to sponges of this shape, as the deposition of quantities of sand within the cup itself must tend to clog the oscula, and so reduce the effective oscular surface.

It may be worthy of note that in all the cup-shaped Lithistids of this collection in which the peduncle remains intact, it is covered at the base by a reddish-brown cement. This appears to be secreted by the sponge for the purpose of securing itself firmly on a somewhat unstable sub-stratum.

Previously-known Distribution. Durnford Point, Natal (Kirkpatrick).

Registered No., Locality, etc. R.N. 225, 226, 230-239. Stn. 109.

Genus GASTROPHANELLA O. Schmidt.

Spirastrellidae, in which the only spicules are monocrepid desmas and tylostrongyles. There is a single oscule leading into an axial cloaca. The pores are distributed generally over the surface of the sponge and are not collected in special raised, poriferous areas.

Much difficulty is experienced in framing a diagnosis of the genus. The genus, however, is distinguished by the possession of an axial cloaca, and of special poriferous processes.

Species (4).—GASTROPHANELLA MAMMILLIFORMIS n. sp. (Pl. I, figs. 1-6).

The species is represented by a small mammilliform sponge, 13 mms. high by 9 mms. in diameter, which has been cut in two longitudinally. It has an irregularly expanded base, in which are embedded small pieces of shell. The surface is uneven.

There is a single osculum at the apex leading into a long axial cloaca, which receives the openings of the exhalant canals.

The inhalant and exhalant canals traverse the sponge, from the cloaca to outer surface, in an irregularly-radial fashion. The pores are situated at the bottom of uniporal chones at the junction of cortex and choanosome (Pl. I, fig. 5).

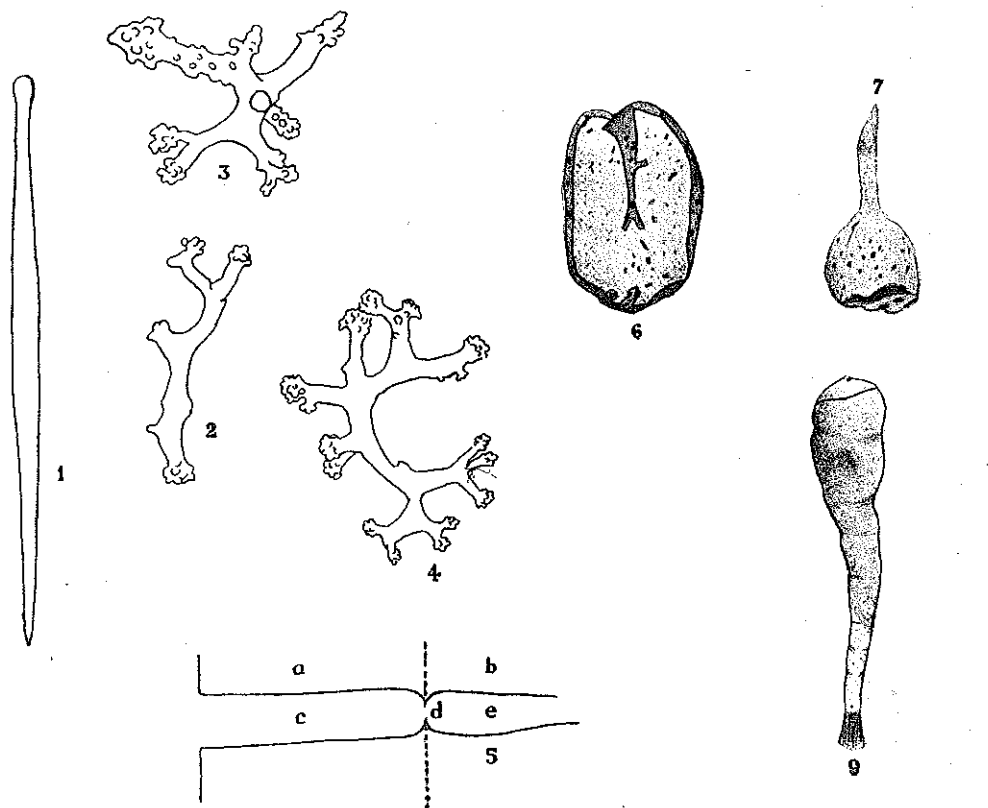
The walls of the poral chones are lined by desmas, those of the canals by a thin layer of collenchyma.

The cortex, .13 mm. thick, and with it the general surface, is a purple colour, due to the presence of a number of pigment-cells .008 mms. in diameter. The choanosome is a dull yellow.

The skeleton consists of monocrepid desmas and tylostrongyles. The former are copiously branched and tightly locked together. They are most difficult to separate whole, and after boiling out three times with nitric acid, my preparations contained only a few complete desmas. Yet, curiously enough, the sponge is extremely friable when cut into small slices, and great care had to be exercised to obtain satisfactory hand-sections. The tylostrongyles are but sparingly present, and are found for the most part at or near the surface with the tyloted ends towards the inside.

Spicules.—(1) *Desmas* (Pl. I, figs. 2-4), monocrepid and much branched. The epirhabd is smooth and about .108 mm. long and from .032–.06 thick. From young specimens it is clear that the epirhabd first bifurcates at each end, after which the branching becomes irregular. The ends of the branches bear capitula of small rounded tubercles.

(2) *Tylostrongyles* (Pl. I, fig. 1), .524 mm. long by .016 mm. at the thickest point.



The present species differs from the only other species of this genus in the shape, colour, the absence of velar diaphragms in the cloaca, and the absence of bundles of tylostrogyles.

Registered No. R.N. 210. Locality unknown.

Species (5).—*MONANTHUS PLUMOSA* Kirkp., var. *DIGITATA*, var. nov. (Pl. I, fig 8A).

This species appears to be of an extremely varied shape and habitat. In addition to the forms described by Kirkpatrick (1903A), two further varieties are now known. Of the present specimens, the first, R.N. 241, consists of a sub-spherical sponge, about 10 mm. in diameter, bearing an apical digitate process 15 mm. high. The other, R.N. 95B, forms part of a curious group of sponges in which the *Monanthus* is encrusting a *Pachastrella monilifera* O.S. and is in turn surmounted by a specimen of *Craniella* sp. It consists of a thin plate, about .5 cms. thick, from which arise several erect, digitiform processes. The colour is white in both specimens.

The surface membrane covering the whole sponge contains stout oxea arranged in a semi-plumose, semi-reticulate manner. The skeleton of the basal plate is composed of loosely articulated, smooth desmas and reticulately-arranged oxea. The digitiform processes or oscular tubes have an inner layer of plumose bundles of oxea arranged spirally.

Spicules.—(1) *Desmas*, with smooth epirhabd, which usually bifurcates at each end and often bears several lateral branches. Both terminal and lateral branches end, for the most part, in flattened or concave articular faces. Epirhabd about $.2-.36 \times .072$ mm.

(2) *Oxea*, smooth, sharply-pointed, curved, occasionally stylote, $.72-1.08 \times .036$ mm.

Registered Nos., Localities, etc. R.N. 95B, False Is., N. 8½ miles, 53 faths. Bottom, sand and shells. R.N. 241, 8 miles N.W. of O'Neil Peak, 55 faths. Bottom, brackish shingle.

Genus LITHOCHELA gen. nov.

Myxilleae, in which the skeleton is composed of longitudinal bundles of misshapen styli, surrounded by spongin and supported by radially-arranged simple, monocrepid desmas. Microscleres are tridentate isochelae.

Species (6).—*LITHOCHELA CONICA* n. sp. (Pl. I, figs. 9, 10; Pl. II, figs. 11-19).

The species is represented by three specimens which resemble the tap-root of a carrot in shape. The largest is 50 mms. high, 9 mm. in diameter at the top, and 3 mm. at the bottom. The smallest is about 40 mm. high. The colour in all is a brownish-yellow. One of them bears a rooting-tuft at the base. This has apparently been torn away in the other two. The pores appear to be very minute, about .036 mm. in diameter, and scattered more or less generally over the surface. At the apex is a somewhat flattened plate bearing in the centre a single papillate oscule, about 1 mm. in diameter.

The sponge consists of a stiff outer wall lined on the inside by a

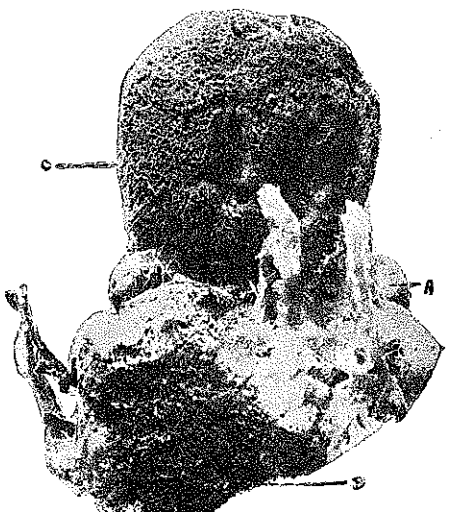
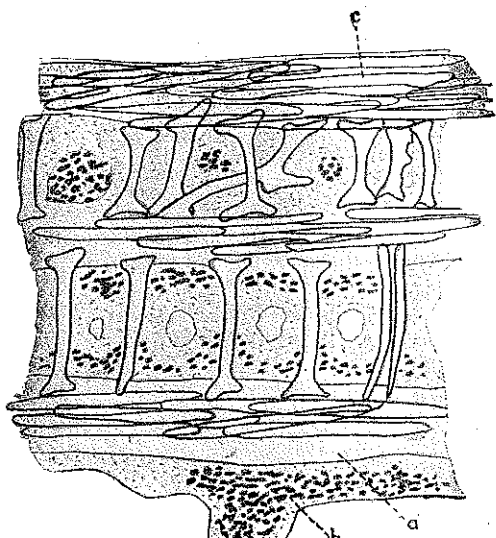
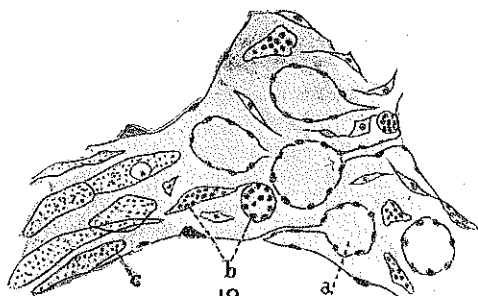
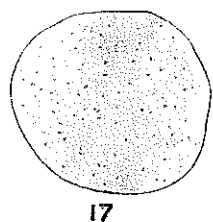
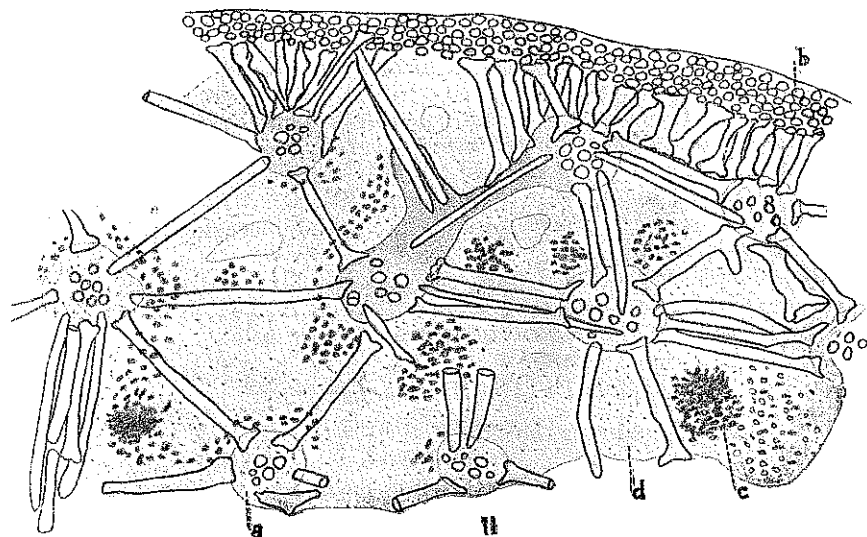
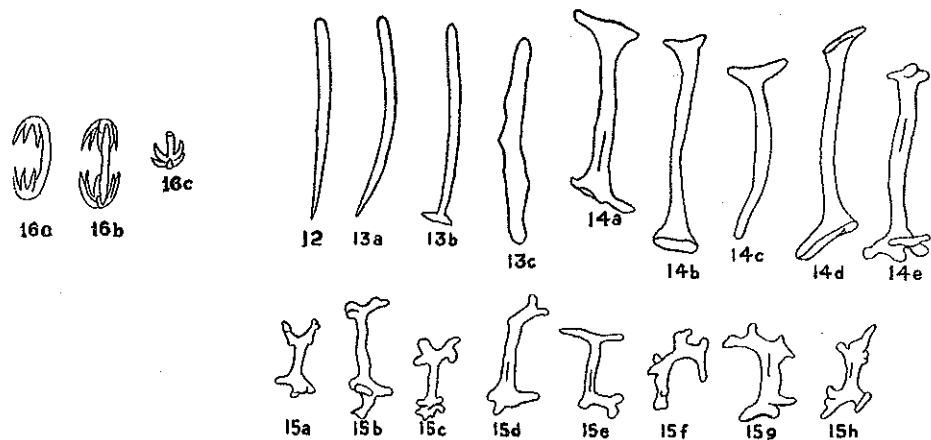


PLATE II.



the centre of the tube, but which now, for the most part, only partly fills the central cavity.

The skeleton is of a very curious type consisting of styli and desmas, with forms intermediate between the two, and chelae. The cortex consists of a feltwork of styli arranged, for the most part, in a regular layer parallel to the long axis of the sponge, but occasionally showing a marked tendency to reticulation. Beneath this outer layer and embedded in the body tissue are a number of polyspicular bundles of styli running parallel to the cortex, each bundle being surrounded by a layer of spongin. Arranged radially around the bundles along the whole of their length, with their ends embedded in the spongin and connecting the bundles in the manner of struts, are the desmas. The smaller desmas are found just below the cortex supporting it by means of the bundles immediately below. The whole skeleton thus forms a somewhat dense network of longitudinal bundles of styli and transverse radially-arranged desmas, a kind of girder and strut work, not unlike the skeleton of a *Euplectella* in principle. The chelae are scattered in the body tissues. The apical plate bearing the oscule contains an irregular reticulation of styli, together with chelae, but no desmas. The loose tissue of the central cavity contains irregularly scattered styli, desmas, and chelae. The rooting tuft is supported by irregular strands of styli and desmas, but no chelae. The axial canals of the styli extend throughout the length of the spicule, but occupy about one half the length of the spicule only in the desmas.

The spongin binding the styli consists of a clear matrix showing no signs of having been deposited in concentric layers, but exhibiting curious wisp-like markings. (Pl. II, figs. 17, 18.)

The similarity between the external form and the skeleton of *Lithochela* and *Euplectella* may probably be due to something more than mere coincidence, and may furnish a good example of convergent evolution when the little-known factors in the mechanics of growth and form are more fully understood.

The flagellated chambers are oval and about $.02 \times .016$ mm. From examination of thin sections stained with borax-carmin, they appear to be diplodal, although I have in no case seen two aphodi to any one chamber. Certainly they are at least aphodal.

The choanosome contains the usual stellate cells together with a number of granular, amaeoboid cells (probably nutritive) (fig. 19b), and yet another category of cells, occurring in large numbers in R.N.'s 169 and 204, which are a little problematic. They are somewhat euglenoid in appearance, of varying shape and size, granular in content, and usually arranged in dense bands parallel to the longitudinal bundles of spongin. Occasionally, a large clear vesicular nucleus with a small dark nucleolus may be seen. They are best seen in stained sections, when they are deeply-coloured and recall strongly, in general features, some of the Sporozoa, especially *Monocystis*. Their arrangement parallel to the spongin fibres suggests the possibility of their being spongoblasts, but I have not seen them directly apposed to the fibre in such a manner as to confirm this view. Also, their absence from the third specimen, except for a few scattered, isolated specimens, is direct evidence against this view.

Although the megascleres are here divided into three categories, no hard and fast line of demarcation actually exists, for the styli and desmas merge insensibly the one into the other.

Spicules.—(1) *Styli* (figs. 12-13), usually curved, often becoming strongly lute and irregular in outline, .36-.45 mm. long by .022 mm. thick.

(2) *Desmas* (fig. 14), consisting of a smooth epirhabd .27-.36 mm. long by .036 mm. thick, with the ends expanded into broad articular surfaces.

(3) Small *desmas* (fig. 15) consisting, in the simplest form, of a smooth epirhabd, about .18 mm. long by .02 mm. thick, with the ends branched and bearing articular surfaces. Frequently the epirhabd becomes shortened almost to a point of disappearance, while the terminal branches increase in number, giving rise to a small irregularly dendritic spicule.

(4) *Isochelae* (fig. 16), with curved, non-fimbriated shaft, and five sharply-pointed curved teeth at each end. Total length of spicule, .04 mm.

Registered Nos., Locality, etc. R.N. 169, 203, 204. Hangklip Bay, N. by E. 12½ miles, 100 faths. *Bottom*, green mud.

LIST OF STATIONS MENTIONED.

Stn. 109, off Natal coast. Lat., 39° 44' 12" S. Long., 31° 20' 45" E. Depth, 50 faths. *Bottom*, sand and shells.

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EXPLANATION OF THE PLATES.

- pl. 1
Figs. 1-6. *Gastrophanella mammilliformis*, n.sp. x 2.
Fig. 1. Tylostrongyle x 64.
Figs. 2-4. *Desmas* x 64.
Fig. 5. Diagram of inhalant chone. (a) cortex; (b) choanosome; (c) uniporal chone; (d) diaphragm at junction of cortex and choanosome; (e) inhalant canal x 230.
Fig. 6. Section of specimen showing axial cloaca. x 2.
Figs. 7-8. *Monanthus plumosa*, Kpk. var. *digitata*, var. nov.
Fig. 7. R.N. 241, natural size.
Fig. 8. R.N. 95b (A) *M. plumosa*, Kpk. var. *digitata*; (B) *Pachastrella monilifera*, O. S.; (C) *Craniella* sp. x 3.
Figs. 10-19. *Lithochela conica*, n.sp.
Fig. 10. Longitudinal section of wall (a) spongin fibre cored by longitudinal bundle of styli; (b) spongoblasts?; (c) cortical layer of styli. x 64.
Fig. 11. Transverse section of wall (a) spongin fibre; (b) cortical layer of styli; (c) spongoblasts?; (d) choanosome. x 64.
Fig. 12. Style x 64.
Fig. 13 a-b. Forms intermediate between styli and desmas. x 64.
Fig. 14 a-e. *Desmas*. x 64.
Fig. 15 a-h. Small sub-cortical desmas. x 64.
Fig. 16 a-c. *Isochelae*. x 250.
Fig. 17. Transverse section of spongin fibre. x 250.
Fig. 18. Longitudinal section of spongin fibre. x 250.
Fig. 19. Portion of choanosome showing (a) flagellated chamber; (b) granular amoeboid cells; (c) spongoblasts? x 250.
pl. 2