

No. I.—REPORT ON THE CALCAREOUS SPONGES COLLECTED BY  
H.M.S. "SEALARK" IN THE INDIAN OCEAN.

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(With Plates 1—5.)

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THE collection of calcareous sponges comprises only thirteen recognizable species, viz.:

	PAGE
1. <i>Leucosolenia gardineri</i> n. sp. . . . .	2
2. <i>Dendya prolifera</i> n. sp. . . . .	6
3. <i>Leucascus simplex</i> Dendy . . . . .	9
4. <i>Leucetta chagosensis</i> n. sp. . . . .	10
5. <i>Leucetta pyriformis</i> n. sp. . . . .	11
6. <i>Pericharax heteroraphis</i> Poléjaeff . . . . .	13
7. <i>Pericharax peziza</i> n. sp. . . . .	15
8. <i>Leucaltis clathria</i> (Haeckel) . . . . .	16
9. <i>Grantessa hastifera</i> (Row) . . . . .	19
10. <i>Grantia indica</i> n. sp. . . . .	20
11. <i>Leucandra echinata</i> Schuffner . . . . .	23
12. <i>Leucandra wasinensis</i> (Jenkin) . . . . .	24
13. <i>Leucilla proteus</i> n. sp. . . . .	25

It will be seen from this list that, though small, the collection contains a number of very interesting forms. Thus the genus *Dendya* has hitherto been known only from a single Australian species, *D. tripodifera*. *Leucascus*, another Australian genus, has only been recorded once since first described by myself in 1892. The genus *Pericharax* has not been met with since it was obtained by the "Challenger" and described by Poléjaeff in 1883, and the "Sealark" Expedition has not only rediscovered the type species but has also added a new one. *Grantessa hastifera* is a remarkable species only recently described by Row from the Red Sea under the name *Grantilla hastifera*, and its re-discovery by the "Sealark" has given the opportunity for reconsidering its systematic position. The most conspicuous and abundant species in the collection is *Leucaltis clathria* (Haeckel), hitherto generally known as *Heteropegma nodus-gordii* Poléjaeff, which appears to enjoy a remarkably wide distribution and has been described by various authors under different names.

As might be expected from the locality a large proportion of the species are apparently new, though some of these are very closely related to already known forms.

Of the six old species, *Leucascus simplex* has previously been obtained in Australian and New Zealand waters; *Pericharax heteroraphis* at Tristan da Cunha in the South Atlantic; *Leucaltis clathria* from the Amirantes, Ceylon, E. Africa, Australia, Florida, the Bermudas and Portugal; *Leucandra echinata* from the Amirantes and Mauritius, and probably Australia; *Leucandra wasinensis* from the East Coast of Africa, and *Grantessa hastifera* from the Red Sea.

The classification adopted in this paper is that elaborated by myself and my colleague, Mr R. W. H. Row, in a systematic and phylogenetic revision of the Calcarea which we hope to publish shortly. The appearance of the memoir in question will, I hope, render it unnecessary for me to discuss questions of taxonomy and phylogeny on the present occasion, and I content myself with giving diagnoses of the families and genera represented in the collection.

#### Family **Homocelidæ** Dendy and Row MS.

The whole of the gastral cavity and its various outgrowths lined by collared cells throughout the life of the sponge. Sponge colony rarely radiate, and if so the central individual retains the primitive ascon structure with a lining of collared cells and without a special gastral cortex. No subgastral sagittal radiates. No true dermal membrane or true dermal cortex.

#### Genus **LEUCOSOLENIA** Bowerbank (*emend.*).

Diverticula of the gastral cavity, if any, never radially arranged around a central tube. Skeleton composed of triradiate or quadriradiate spicules, to which oxea may be added. No uteoid dermal skeleton ever present. Nuclei of collared cells basal or apical.

#### SECTION B.

Without oxea. Sponge colony typically forming a reticulation of simple ascontubes.

##### 1. *Leucosolenia gardineri* n. sp.

(Plate 1, figs. 1, 2; Plate 3, figs. 1, 2, 3.)

This species is represented in the collection by two specimens, which, although coming from the same locality, differ considerably from one another in appearance. This difference, however, may be partly (though not entirely) accounted for by a difference in the condition of the specimens\*, the one (cxx. 7; Plate 1, fig. 1) being expanded and having more or less conspicuous and widely open vents, while in the other (cxx. 11; Plate 1, fig. 2) the vents are difficult to recognize and almost if not completely closed. Moreover the latter specimen is full of large maturing ova, and the mesogloea is densely

\* Cf. Minchin [1892].

charged with peculiar yellow bodies, which doubtless accounts for the fact that it is much more opaque in appearance than the former.

Both specimens are of the typical "Clathrina" form, the ascon-tubes being very slender and forming a very close-meshed reticulation, especially on the surface, which appears closely and minutely punctate from the presence of the very numerous pseudopores. It will be desirable to describe the two specimens separately, and they might even be considered as representing distinct varieties.

cx. 7. The reticulation of the ascon-tubes (Plate 1, fig. 1) is so close that the pseudopores are scarcely visible to the naked eye, and the whole colony appears at first sight to be enveloped in a continuous dermal membrane (pseudoderm). The entire sponge is about 25 mm. in greatest diameter by 15 mm. in height. It may be described as proliferously lobose; the lobes lamellar, ascending and folded, varying greatly in size and shape, and occasionally bearing an open vent at the summit. The colour in alcohol is white and the texture soft and delicate.

The canal system is of the reticulate type E\*, without pseudogasters or pseudoscula, but the ascon-tubes in the middle of the lamellæ form very wide gastral cavities (lined by collared cells) which open to the exterior through the vents. These central cavities are surrounded by a rather thin wall composed of the reticulation of smaller tubes, which open into them.

The specimen is not in a good condition for histological examination, but there appears to have been a rather copious endogastric network of slender connective tissue threads, as in *Leucosolenia proxima* Dendy. The collared cells are in a somewhat elongated condition, with basal nuclei. Their transverse diameter at the base is about 0.004 mm. and they line the gastral surfaces in a perfectly normal manner.

The skeleton exhibits the normal arrangement and the spicules may be classified as follows:—

(1) *Equiangular triradiates*; with straight, fairly sharply pointed rays (Plate 3, fig. 1, a). These are of two principal sizes, (a) with rays measuring about 0.14 mm. in length by 0.012 mm. in thickness at the base, characteristic of the pseudoderm, (b) with rays about 0.074 by 0.007 mm., characteristic of the deeper parts of the sponge.

(2) *Quadriradiates* (Plate 3, fig. 1, b), resembling the deep triradiates but with a very sharply pointed, perfectly straight apical ray, projecting into the gastral cavity at right angles to the three facial rays; length of apical ray about 0.05 mm., but variable.

cx. 11. The entire colony, a portion of which is represented in Plate 1, fig. 2, forms a dorsi-ventrally flattened crust, composed of low ridges and lobes and pierced by a few large holes which give it a coarsely clathrous character. The reticulation of the ascon-tubes on the surface is not quite so fine-meshed as in cx. 7, so that the innumerable pseudopores are easily visible to the naked eye. The vents are minute and difficult to recognize, situated on low rounded eminences. The entire sponge is some 40 mm. in maximum diameter, but not more than 3 or 4 mm. in height (thickness). The colour in spirit is light brown, apparently owing to the numerous yellow bodies which it contains.

\* Cf. Dendy [1891].

The canal system, except for the obliteration of the vents, due probably to temporary contraction, agrees closely with that of cxx. 7, and here again there appear to be remnants of an endogastric network.

The spiculation (Plate 3, fig. 2) differs from that of cxx. 7 only in the absence of any distinction between deep and dermal triradiates, all being of about the same size as the deep triradiates in the specimen above described.

The histology exhibits great peculiarities, which I am inclined to associate with the contracted condition of the sponge and with the presence of the numerous large ova. The mesogloea is much thickened, especially in the neighbourhood of the ova, which lie separately in spherical cavities not lined by any special epithelium\*. Frequently the presence of an ovum (Plate 3, fig. 3, *ov.*) causes a conspicuous inward bulging of the wall of the ascon-tube in which it lies. Most remarkable is the presence in the mesogloea of enormous numbers of small spherical bodies of a yellowish colour and varying from about 0.004 to 0.006 mm. in diameter. These bodies are abundant throughout the mesogloea but especially so immediately beneath the gastral surfaces of the tubes and around the large ova (Plate 3, fig. 3, *yb*). They lie in the meshes of a network formed of delicate strands of mesogloea with here and there small nucleated amoebocytes or stellate connective tissue cells (collencytes). They occasionally appear to adhere to the surface of an ovum or even to become embedded in the peripheral cytoplasm of the latter. Sometimes very similar bodies are actually found imbedded in the nucleus of the ovum but I do not think they can really be the same. These yellow bodies are so remarkable that I append a detailed account and discussion of the subject to the description of the species.

There are apparently no collared cells at all, the inner surfaces of the ascon-tubes (easily recognizable both by their position and by the projecting apical rays of the quadriradiates) being lined, at any rate to a large extent, by a flattened pavement epithelium, similar to and quite as well developed as that which lines the outer surface. This absence of collared cells from the gastral surfaces is highly remarkable, but in some extent in harmony with the observations of Minchin [1900] on contracted specimens of *Clathrina*, and with those of Weltner [1907] on the disappearance of the collared cells in *Spongilla (Ephydatia)* during the winter months. Whether or not, in the present case, the collared cells are represented by the yellow bodies in the mesogloea is to be discussed presently.

The ova are very large, attaining a diameter of about 0.086 mm., although they are evidently shrunk to some extent, so that they no longer fill the cavities in which they lie. They nearly all seem to be in about the same stage of growth (Plate 3, fig. 3). The cytoplasm is coarsely granular, or flocculent-looking; there is no vitelline membrane and no sharp outline to the cytoplasm. The nucleus is large and centrally placed, it usually has an irregular outline and no nuclear membrane. It is differentiated from the cytoplasm by its denser and much less coarsely granular appearance and frequently contains a small number (? from 1 to 3) of conspicuous spherical bodies (nucleoli?), etc.

\* Such an epithelium when present is probably derived from amoeboid wandering cells becoming flattened. A few such may sometimes be detected around the ovum.

resembling in appearance the yellow bodies of the mesoglaea (but more variable in size). In preparations stained first with borax carmine and subsequently with picro-indigo-carmine the cytoplasm of the ovum stains indigo-green, the nucleus much the same and the nucleolus (?) brighter green; whereas, in the same sections, the nuclei of the epithelial cells and those of the amœbocytes (? collencytes) are all stained bright red. As we shall see presently the yellow bodies in the mesoglaea also become stained green by this method.

*Leucosolenia gardineri* is evidently nearly related to *L. depressa*, Dendy [1891], from Port Phillip, Australia, but differs in the proportions of the spicules. Both are also evidently closely related to the common European species *Leucosolenia (Clathrina) coriacea*, of which I have already [Dendy, 1905] described a variety from Ceylon (*Leucosolenia coriacea*, var. *ceylonensis*). Possibly all should be regarded merely as varieties of the same species.

*Register Nos., Localities, &c.* cxx. 7, cxx. 11, both from Salomon (Chagos Archipelago), 10—14 fathoms.

#### The Yellow Bodies of *Leucosolenia gardineri* (cxx. 11).

These bodies (Plate 3, fig. 3, *yb*) were subjected to very careful examination\* with a view to determining their real nature. They appear to be insoluble in water, alcohol, xylol, ether and hydrochloric acid (5%), and even boiling with dilute hydrochloric acid for several minutes appears to have little or no effect upon them. Cold caustic potash (5%) has little effect upon them, except that they became very transparent and perhaps somewhat swollen. When boiled with caustic potash of the same strength, however, they slowly disappear.

Iodine, dissolved in potassium iodide, causes them to assume a deep orange colour. On adding strong sulphuric acid the colour deepens to brown and then black, and the bodies break up into minute black particles without showing any blue coloration. Schultze's solution also gives no blue colour.

From these observations I conclude that the bodies are certainly organic but that they contain neither starch nor cellulose and are not of vegetable origin.

Their staining reactions are very characteristic. They stain well with eosin but rather faintly with hæmatoxylin (Ehrlich's logwood) and borax carmine. With borax carmine followed by picro-indigo-carmine they stain bright green, while the ordinary tissue nuclei of course stain red.

Sometimes they stain uniformly and appear almost homogeneous in structure, but more often they exhibit a distinctly vesicular character, showing a thin wall with granular or reticulate contents apparently collected on its inner surface, as if coagulated or precipitated there. Thus they often appear like spherical nuclei with a deep-staining chromatin network and a very distinct nuclear membrane, but no surrounding cytoplasm. Their staining reactions, however, are not those of typical nuclei.

The most probable explanation of these yellow bodies seems to be that they are

\* All these observations were made upon spirit-preserved material.

metamorphosed collared cells. It is true that they are considerably larger than the latter and differ much in structure, but their arrangement in the mesoglea and the fact that there are no other collared cells in the sponge are very suggestive. It is possible that they may be concerned with the nutrition of the large ova, whose staining reactions are so curiously similar. I would suggest that the sponge having become full-fed, and the reserve material being stored up in the collared cells, the latter migrate inwards and are ingested by the probably amoeboid ova. During this process the sponge becomes contracted and its ordinary activities suspended. The collared cells are probably replaced again later on by metamorphosis of amoebocytes, which at first line the gastral cavities as a flattened epithelium.

The idea that the yellow bodies may be symbiotic algae also naturally suggests itself, but their chemical reactions and the fact that they contain no nuclei appears to me to be fatal to this view. I have also compared them carefully with the "yellow granules" of *Leucosolenia (Clathrina) coriacea*, but the latter are very much smaller and obviously quite different.

#### Genus DENDYA Bidder.

Sponge colony consisting of a large central individual lined by collared cells, from which radially arranged diverticula are given off. Skeleton composed of equiangular triradiates, to which quadriradiates may be added. Nuclei of the collared cells probably always basal.

This genus was proposed by Bidder [1898] for Carter's *Clathrina tripodifera*, of which I gave a full account in my Monograph of Victorian Sponges, Part I [1891]. Hitherto this has remained the only known species, but I have now to describe a new and very interesting form.

#### 2. *Dendya prolifera* n. sp.

(Plate 1, figs. 3, 4; Plate 3, figs. 4, 5.)

The single specimen of this very interesting species is unfortunately in a very poor state of preservation, especially as regards histological characters. It has now the form of a flattened sac (Plate 1, figs. 3, 4), but how far the flattening may be due to artificial compression I am not prepared to say. The sac is much broader at one end than at the other and the vent is situated at the narrow extremity. It is also slightly curved, with one margin convex and the other concave. The broad end has been artificially truncated, so that the central gastral cavity opens widely to the exterior at this end as well as at the vent. A good deal of the wall of the sac has also been torn away from one side. There is no indication of dorsiventral differentiation of the two flattened sides and the sponge probably grew either erect or pendent.

The thickness of the wall of the sac is very irregular and the surface very uneven, owing to the development of the very numerous proliferating radial tubes. These tubes are for the most part arranged in dense bunches, between which the thin, translucent gastral membrane is in many places plainly visible from the outside, especially in the neighbourhood of the vent, where it forms a thin oscular membrane or collar.

The length (or height) of the specimen is 31 mm. and the maximum breadth about 14 mm. The thickness of the wall of the sac near the broad end (made up chiefly of the radial tubes) is usually about 2 mm., but very variable.

The texture of the whole sponge is delicate and fragile, and the colour in alcohol pure white.

Owing to the bad state of preservation it is impossible to determine the distribution of the collared cells, but it is probable that they occur on the inner surface of the gastral membrane as well as in the radial tubes. The canal system makes a close approach to that of *Dendya tripodifera*, differing chiefly in the fact that the radial tubes are much less regularly arranged, while their blind outer ends, lying at very various levels, do not form an approximately even surface to the sponge, as they do in the Australian species.

The radial tubes appear first as minute hollow buds, growing outwards from the thin wall of the central gastral cavity (gastral membrane). Such buds occur not only in the neighbourhood of the osculum but also on the lower parts of the sponge wall between the bunches of more fully developed radial tubes. They may be quite solitary but are usually linked together in irregular networks. I have not been able to determine how this "linked" arrangement of the young radial chambers originates. Their appearance, when the sponge-wall is viewed from the outside, suggests that they arise from one another by budding, like yeast-cells. Probably some grow out directly from the wall of the central gastral cavity and then give rise to others by budding. When fully grown the tubes are arranged in bushily branched bunches (Plate 3, fig. 4), the smaller ones coming off from the larger ones and the largest only (i.e. the main stems of the bunches) opening direct into the central gastral cavity. These main stems usually measure about 0.3 mm. in diameter. Their branches become much narrower and closely crowded together, their walls actually fusing where they come in contact with one another, but without lateral communication of their gastral cavities. Different bunches of tubes, on the other hand, remain to a large extent separate from one another. The openings of the main tubes of the bunches are very conspicuous on the inner surface of the gastral membrane, usually arranged in small groups and varying very much in size (Plate 1, fig. 4).

Sometimes a group of chambers forms an irregular, rounded nodule, attached by a narrow stalk to the gastral membrane, and perfectly independent of its neighbours on all sides. One such nodule measures as much as 4 mm. in diameter, and the opening of its hollow stem into the gastral cavity, oval in outline, measures no less than 1.5 mm. in longer diameter. Usually, however, the openings in the wall of the gastral cavity are much smaller than this.

The prosopyles cannot be distinguished. They probably occur both in the gastral membrane and in the walls of the radial tubes.

The skeleton consists of triradiates and quadriradiates; I have found no oxea. The spicules all lie tangentially in the thin walls of the radial tubes or in the gastral membrane, and when an apical ray is developed it projects as usual into the gastral cavity or one of its outgrowths. In the gastral membrane (wall of the central cavity), as in the walls of the radial tubes, the spicules may be said to form a single layer, but their rays overlap one another copiously. Their arrangement is nowhere very regular, but in the gastral

membrane there is a more or less strongly marked tendency to orientation with one ray pointing away from the osculum, and in the radial tubes there is a distinct orientation with one ray pointing towards the blind end of the tube. In fact the radial tubes may almost be said to have an articulate tubar skeleton, albeit of an ill-defined character, the "joints" being very confused.

The spicules may be classified as follows:—

(1) *Triradiates of the gastral membrane* (Plate 3, fig. 5, a):—These vary in form from regular, equiradiate and equiangular to markedly sagittal. The angles, however, appear always to be equal. The rays are usually long and slender, usually straight but sometimes a little crooked, varying greatly in length, up to about 0.27 mm. with a diameter of about 0.01 mm. at the base. They are sharply and gradually pointed and sometimes the diameter increases slightly before tapering off to the apex.

(2) *Triradiates of the radial tubes* (Plate 3, fig. 5, c):—These are usually more or less markedly sagittal, owing to the greater length of the distal (basal) ray, but they remain equiangular. The paired rays, as usual, follow the curvature of the wall of the radial tube. At the blind distal ends of the radial tubes, where the spicules become much smaller, the sagittal character tends to disappear. The spicules in the walls of the radial tubes perhaps never become as large as the largest of those in the gastral membrane. In a triradiate from about the middle of a tube the distal ray measured about 0.12 mm. in length, and each of the oral rays about 0.085 mm., all with a diameter of about 0.0075 mm. at the base. A triradiate from the blind end of a tube was almost equiradiate, with rays about 0.07 mm. in length.

(3) *Quadriradiates*:—These differ from the triradiates only in the development of a slender and frequently crooked apical ray (Plate 3, fig. 5, e). They occur both in the gastral membrane (Plate 3, fig. 5, b) and in the walls of the radial tubes (Plate 3, fig. 5, d, e), but are much more conspicuous in the latter, where their apical rays measure about 0.09 mm. in length.

There can, I think, be no question of the close relationship of this species to the Australian *Dendya tripodifera*. It differs chiefly in the much less regular arrangement of the radial tubes and in the absence of the special "tripod" spicules from the distal end of these tubes.

*Register No., Locality, &c.* CVI. 2, Amirante Isles (Seychelles), 13.10.05, E. 16 39 fathoms.

#### Family *Leucascidæ* Dendy (*emend.*).

Sponge typically forming a massive colony, usually with several or many oscula, but may be integrated into a single individual with definite external form. With no large central gastral cavity lined by collared cells, but with an exhalant canal system devoid of collared cells. Flagellated chambers ranging from long, and possibly branched, with a tendency to radial arrangement around the larger exhalant canals, to small, approximately spherical and irregularly scattered. With a distinct and independent dermal membrane (or cortex), pierced by true dermal pores. Skeleton consisting mainly of



equiangular and equiradiate spicules, which may become sagittal at the oscular margins. Radiates of the chamber layer with no definite arrangement, but irregularly scattered in the walls of the large elongated chambers, or between the small spherical chambers. No subgastral sagittal radiates. Nuclei of collared cells probably always basal.

Genus *LEUCASCUS* Dendy.

Flagellated chambers greatly elongated, tubular, and sometimes copiously branched.

SECTION A.

No oxea present.

3. *Leucascus simplex* Dendy [1892].

(Plate 1, fig. 5; Plate 4, fig. 1.)

This species is represented in the collection by a considerable number of examples encrusting the branches of several specimens of a small gorgonid. The sponge forms irregular, more or less lobulated, cushiony masses (Plate 1, fig. 5), with small vents occurring singly here and there in prominent positions. Examination with a pocket lens shows the thin, pore-bearing dermal membrane, the groups of inhalant pores being especially conspicuous over the ends of the radially disposed inhalant channels. The colour in spirit is light brownish yellow and the texture soft and compressible and rather fragile.

The canal system agrees precisely with that which I described in the case of the Australian specimens, and of which I gave an illustration in my "Studies on the Comparative Anatomy of Sponges," Part V [1893, fig. 1]. The flagellated chambers are very long, copiously branched, and with their blind, outer ends directed more or less at right angles towards the dermal surface, where they are covered over by a thin cortex formed by the spiculiferous, pore-bearing dermal membrane. Internally the main stems of the branching systems of chambers open into wide exhalant canals which converge towards the vents. The thin walls of these exhalant canals are not lined by collared cells, but they are strengthened by numerous spicules.

The blind ends of the branches of the radial chambers form a sort of reticulate pattern beneath the thin dermal cortex, in the meshes of which lie the outer ends of the large inhalant channels, which run in between the groups of chamber-branches at right angles to the surface.

The skeleton consists of triradiate and quadriradiate spicules of fairly uniform size, irregularly scattered in the walls of the radial chambers and of the exhalant canals, and likewise in the dermal cortex, but nowhere forming more than a thin layer, though of course with overlapping rays.

The spicules (Plate 4, fig. 1) are all regular, with moderately stout, gradually sharp-pointed rays, measuring about 0.1 mm. in length by 0.01 mm. in diameter at the base. In the walls of the exhalant canals many of them have well-developed but slender, straight or nearly straight, very sharp-pointed apical rays, projecting into the lumen

of the canal and attaining a length nearly, if not quite, equal to that of the facial rays. The stronger development of these apical rays constitutes the only difference (and this is probably not constant) which I can detect between the Providence specimens of this species and those from Australia. As the spicules have not yet been properly figured I take the opportunity of doing so on this occasion.

*Previously known Distribution.* Near Port Phillip Heads, Bass Straits; and Watson's Bay, Port Jackson [Dendy 1892]; New Zealand [Kirk 1897].

*Register Nos., Locality, &c.* XIX. 4, XXII. 2, a number of specimens, all from Providence, 4.10.05, D. 4, 50—78 fathoms.

#### GENUS LEUCETTA Haeckel (*emend.*).

Canal system leuconoid, with small, spherical or subspherical flagellated chambers irregularly scattered through the chamber layer.

#### SECTION A.

No oxea present.

#### 4. *Leucetta chagosensis* n. sp.

(Plate 1, fig. 6; Plate 4, fig. 2.)

There are five specimens of this sponge in the collection, but two of them (cx. 10) are perhaps parts of the same.

The external form (Plate 1, fig. 6) is massive or encrusting, irregular, lobose, with rather large, scattered vents with slightly prominent margins. The thin dermal membrane covers over irregular, meandering subdermal cavities.

All the specimens are of much the same size; CXIX. 11, which may be regarded as the type, measures about 27 mm. in length by 18 mm. in breadth and 12 mm. in greatest thickness.

Texture fairly compact, firm and resilient, but friable.

Colour in alcohol ranging from white to rather dark brown; in the latter case probably stained by other specimens.

The canal system is typically leuconoid. The flagellated chambers are oval and measure about 0.156 by 0.104 mm. in diameter. They are eurypylous and each one probably has several prosopyles. The thin, pore-bearing dermal membrane overlies a system of subdermal cavities, which lie in the rather thick gelatinous ectosome, but are not to be sharply distinguished from the rest of the inhalant canal system, consisting of wide, irregular canals or lacunæ. Similar wide exhalant canals or lacunæ converge into the still wider oscular tubes, which are surrounded by a moderately thick layer of gelatinous mesogloea resembling the ectosome. The oscula are variable in size, commonly from 1 to 2 mm. in diameter.

The main skeleton is confused, and consists of triradiate spicules densely and irregularly scattered throughout ectosome and choanosome alike. In the dermal

membrane the spicules lie tangentially, and a few very large triradiates are scattered here and there amongst the small ones.

The spicules (Plate 4, fig. 2) are equiangular and approximately equiradiate triradiates, of three kinds:—(1) Small, with straight, conical, gradually sharp-pointed rays measuring about 0.19 by 0.0174 mm. (at base). These form the whole of the skeleton of the choanosome and the greater part of the dermal skeleton. (2) Large, with straight, conical, gradually sharp-pointed rays measuring about 0.59 by 0.046 mm. (at base). These occur sparsely scattered in the dermal membrane only. (3) Small, resembling (1) but rather smaller, and with two of the rays bent sharply back near their bases until they come to extend nearly at right angles to the third ray. These occur in the oscular margins, along or parallel to which their bent rays are extended.

As regards histology the condition of the specimens allows me to say very little, but it is worth observing that the nuclei of the collared cells are distinctly basal.

This species is evidently nearly related to *Leucetta microraphis* Haeckel, but my specimens of that species (from Port Phillip, Australia) have the large triradiates much larger (and especially stouter) and scattered all through the sponge instead of being confined to the dermal surface.

The specimens of *L. chagosensis* all came from the Chagos archipelago.

*Register Nos., Localities, &c.* LXIII., Lagoon, Diego Garcia, 8.7.05; cx. 10, Egmont Reef; CXII. 5, Egmont Lagoon; CXIX. 11, Salomon.

#### 5. *Leucetta pyriformis* n. sp.

(Plate 1, fig. 7; Plate 4, fig. 3.)

This pretty little species was represented in the collection by two specimens which closely resembled one another in external form, each being a single, small, pear-shaped individual with a single terminal vent at the broad end.

Specimen xc. 5, *A*, which may be taken as the type, is represented in Plate 1, fig. 7. It measured about 10 mm. in height by 5.5 mm. in greatest breadth. The texture was harsh owing to the presence of the very large triradiate spicules, which could be clearly seen on the surface with a lens, as shown in the photograph. The colour in spirit was light brown, but this may have been due to accidental staining by other specimens in the same jar.

The canal system is typically leuconoid. Wide inhalant canals commence beneath the thin, pore-bearing dermal membrane and run inwards at right angles to the surface, interdigitating with exhalant canals which open into the central gastral cavity. Both systems are of course more or less branched, and between them lie the rather large flagellate chambers, closely packed together and without order. The chambers are oval or nearly spherical, often polygonal from mutual pressure; they are eurypylous and have numerous prosopyles; they measure about 0.174 mm. in maximum diameter.

The dermal skeleton consists of several confused layers of large and small triradiates placed tangentially. The skeleton of the chamber layer also consists of large and small triradiates, thickly and irregularly scattered. There is a well-developed, though not very

thick, gastral cortical skeleton, continued for some distance into the main exhalant canals and consisting of small triradiates and quadriradiates with long, slender apical rays. There are no subgastral nor subdermal sagittal or pseudosagittal radiates, but small sagittal radiates\* occur as usual in the thin and rather narrow oscular collar.

The spicules are all equiangular and approximately equiradiate, and there are two chief forms:—

(1) Very large triradiates (Plate 4, fig. 3, *a*), with stout rays tapering gradually to fairly sharp points and measuring about 1.0 by 0.1 mm.

(2) Small triradiates (Plate 4, fig. 3, *b*), with rather slender rays measuring about 0.17 by 0.0125 mm.

Both forms are abundant and they occur intermingled at the surface and in the chamber layer, but the small ones are much more numerous than the large ones, while intermediate sizes (Plate 4, fig. 3, *c*) occur in much smaller numbers.

The quadriradiates of the gastral cortex differ only from the small triradiates in the development of the long, slender apical ray, while the sagittal triradiates of the oscular collar are but slight modifications of the ordinary small form, with the two oral arms bent back till they lie approximately at right angles to the basal arm.

The specimens are not well preserved from the histological point of view, but the nuclei of the collared cells are basal.

This species differs from *Leucetta chagosensis* in its well-defined external form, in the presence of the large triradiates in the chamber layer, as well as in the dermal membrane, in the spicular measurements and in the presence of the gastral quadriradiates. It comes closer to *Leucetta microraphis*, as represented by my Australian specimens, but again differs in the well-defined external form, consisting of only a single person of very definite shape.

It may quite possibly be identical with one of the numerous forms included by Haeckel [1872] under his *Leucetta primigenia*, but I do not think it possible to disentangle all these forms from one another.

*Register Nos., Localities, &c.* xc. 5, A and B, Cargados Carajos, 1.9.05, B. 29, 45 fathoms.

#### Genus PERICHARAX Poléjaeff (*emend.*).

Colony individualised, with large central cavity opening by a wide osculum and surrounded by a very thick wall. Canal system leuconoid, with subspherical, scattered chambers, and with subdermal cavities whose walls are supported by a special skeleton derived partly from inturned rays of tangential dermal triradiates. Skeleton of chamber layer confused, composed of equiangular triradiates of two very different sizes.

Poléjaeff [1883] proposed the genus *Pericharax* for the reception of two specimens obtained by the "Challenger" at Tristan da Cunha, which he regarded as representing two varieties of one and the same species, *Pericharax carteri*. The one variety he named

\* These have been dissolved out, but their spicule sheaths are still clearly recognizable and give the form quite distinctly.

*homoraphis* and the other *heteroraphis*. My examination of the type specimens in the British Museum collection has led me to the conclusion that not only are these two so-called varieties specifically distinct, but that var. *heteroraphis* alone belongs to the genus *Pericharax*, the other being probably a *Leucetta*, without the characteristic dermal spicules of *Pericharax*.

The genus has not been recorded since it was first described, but the rediscovery by the "Sealark" of *P. heteroraphis*, and of a new species closely related to it, in the Indian Ocean, and the careful study of these forms, has led me to accept the genus as a valid one and to characterize it as above. The position assigned to the genus, in the family Leucascidæ, is justified not only by the character of the skeleton, composed mainly of equiangular and irregularly scattered radiates, but also, as in the case of *Leucetta*, by the basal position of the nuclei of the collared cells.

#### 6. *Pericharax heteroraphis* Poléjaeff.

(Plate 1, fig. 8; Plate 5, figs. 1, 2.)

*Pericharax carteri* var. *heteroraphis* Poléjaeff [1883].

The single specimen in the collection (Plate 1, fig. 8) agrees very well with the description and figure of the external form of *P. carteri* given by Poléjaeff. It is almost globular and about 20 mm. in diameter. There is a single vent about 4 mm. in diameter, with a slightly prominent oscular margin; and the sponge has apparently been attached by the lower pole, opposite to the vent. The surface is smooth, and covered by a thin, pore-bearing dermal membrane which, under a pocket lens, exhibits a beautifully reticulate appearance. The texture is firm and compact, and the colour in spirit pale greyish yellow.

The large central cavity, which opens to the exterior through the osculum, is surrounded by a wall about 4 mm. thick, but gradually diminishing in thickness towards the oscular margin. The inner surface of this wall is pierced by numerous exhalant apertures, for the most part grouped in depressions.

There is a well-defined, gelatinous ectosome, about 0.26 mm. thick. This layer contains no flagellate chambers, but is broken up into trabeculæ, running vertically to the surface, by the numerous small subdermal cavities, which are roofed over by the thin, pore-bearing dermal membrane. The subdermal cavities open collectively into large, irregular inhalant lacunæ, which ramify inwards. Similar exhalant lacunæ, ramifying in the opposite sense, open into the large central cavity. In the mesogloea between the exhalant and inhalant lacunæ lie the spherical or subspherical flagellate chambers, thickly scattered, and each about 0.12 mm. in diameter.

The main skeleton consists of triradiate spicules, of two chief and very different sizes, scattered thickly and without order throughout the chamber layer of the sponge, the small spicules occupying the interstices between the large ones.

There is a well-developed dermal skeleton, composed of a dense reticulation of small, tangentially placed triradiates, the rays of which frequently lie parallel and in juxtaposition with one another to form multispicular meshes, continued below into the

supporting skeleton of the subdermal cavities. The latter is formed partly by small triradiates lying parallel to but beneath the surface, partly by inturned rays of some of the dermal triradiates, and partly by small triradiates which lie in planes more or less at right angles to the surface, with one ray pointing outwards and lying parallel to the inwardly-directed rays of the dermal triradiates in the trabeculæ between the subdermal cavities.

The figure given by Poléjaeff of the skeleton of the subdermal cavities in *Pericharax carteri*, var. *heteroraphis*, appears to be highly diagrammatic. He does not seem to have recognized the nature of the inwardly turned rays of the dermal triradiates, and figures the deep triradiates of the ectosome as markedly sagittal, and the whole as far too regular in arrangement. I believe, however, that the deeper spicules of the ectosome are sometimes sagittal, like many of those in the dermal membrane.

There is a thin gastral cortical skeleton, composed of quadriradiate spicules, which lines not only the central gastral cavity but also the larger exhalant canals, the surface of both of which bristles with the projecting apical rays. The spicules may be classified as follows:—

(1) Large triradiates of the main skeleton (Plate 5, fig. 1, *a*); equiangular and typically equiradiate; rays long, straight and gradually sharp-pointed, measuring, say, about 1.55 mm. long by 0.1 mm. in diameter at the base.

(2) Small triradiates of the main skeleton (Plate 5, fig. 1, *b*; fig. 2, *a*); equiangular and typically equiradiate; rays straight, slender and gradually sharp-pointed, measuring, say, about 0.18 by 0.015 mm. Intermediate sizes (Plate 5, fig. 1, *c*) between (1) and (2) occur in comparatively small numbers.

(3) Triradiates of the dermal skeleton (Plate 5, fig. 2, *b*); irregular, but probably really equiangular; with slender, irregularly curved rays, often unequal in length and often blunt at the apex. One of the rays (*x*) is frequently bent inwards out of the tangential plane, so as to take part in the formation of the skeleton of the subdermal cavities. Rays measuring, say, about 0.13 by 0.008 mm.

(4) Quadriradiates of the gastral cortex (Plate 5, fig. 2, *c*); equiangular and typically equiradiate, with long, straight, or nearly straight, slender facial rays, fairly sharply pointed and measuring about 0.18 by 0.0125 mm.; with a sharp-pointed apical ray, irregularly hooked\* at the extremity in a characteristic fashion and about 0.1 mm. long.

(5) Quadriradiates of the larger exhalant canals (Plate 5, fig. 2, *d*); similar to those of the gastral cortex, but with long, straight apical rays, measured up to 0.26 mm. in length; as usual, intermediate forms occur.

(6) Quadriradiates of the oscular collar (Plate 5, fig. 2, *e*); resembling those of the gastral cortex further in, but conspicuously sagittal owing to the sharp backward bending of the oral rays until they come to lie parallel to the oscular margin. These spicules are

\* This hooking does not occur in the "Challenger" specimen, but I cannot regard it as constituting a character of specific value.

abundant in the narrow membranous collar which surrounds the vent, and by no means confined to the actual margin.

The only histological feature that requires notice is the basal position of the nuclei of the collared cells in the spirit-preserved material.

*Previously-known Distribution.* Tristan da Cunha (Poléjaeff).

*Register No., Localities, &c.* CXVIII., Salomon (Chagos Archipelago), 15 fathoms, 10.6.05.

7. *Pericharax peziza*\* n. sp.

(Plate 1, fig. 9; Plate 5, figs. 3, 4.)

The single specimen (Plate 1, fig. 9) has the form of a shallow, thick-walled cup, the mouth of which is oval in outline. It has apparently been attached below to some foreign object, but there is no indication that it ever possessed a stalk. The mouth of the cup is obviously a greatly dilated osculum and is surrounded by a narrow, thin oscular margin, or collar. The outer surface of the cup is smooth, but appears minutely reticulate under a hand lens; the inner surface is perforated by the very numerous openings of the exhalant canals, which show but little tendency to grouping.

The longer diameter of the sponge measures 37 mm., the shorter diameter, at right angles to this, about 29 mm. The depth of the cup internally is about 14 mm. and the maximum thickness of the wall about 7 mm. The thin oscular margin is under 2 mm. in width.

The texture is firm but not very compact, and the colour in spirit pale wax yellow.

The canal system minutely resembles that of *P. heteroraphis*, excepting for the enormous dilatation of the osculum, which finds a parallel, but in a still more exaggerated condition, in *Grantia labyrinthica*. The gelatinous ectosome is about 0.26 mm. thick, and is broken up into trabeculae by the small subdermal cavities, roofed over by the thin, pore-bearing dermal membrane and opening below into the large inhalant lacunae. The ramifications of the inhalant lacunae roughly interdigitate with those of the exhalant lacunae, which open into the central gastral cavity. In the mesogloea between the two sets of lacunae are thickly scattered the spherical or subspherical flagellated chambers, each about 0.1 mm. in diameter.

The arrangement of the skeleton is also identical with that found in *P. heteroraphis*, and the spicules are very similar, though for the most part a little smaller in average dimensions, as follows:—

(1). Large triradiates of the main skeleton (Plate 5, fig. 3, *a*); equiangular and typically equiradiate; rays long, straight, slender and gradually sharp-pointed, measuring, say, about 1.4 mm. in length by 0.07 mm. in diameter at the base.

(2). Small triradiates of the main skeleton (Plate 5, fig. 3, *b*; fig. 4, *a*); equiangular and typically equiradiate; rays straight, slender and gradually sharp-pointed, measuring, say, about 0.18 by 0.015 mm. Intermediate sizes (Plate 5, fig. 3, *c*) between (1) and (2) occur in comparatively small numbers.

\* The specific name was suggested by the resemblance in external form to the fungus *Peziza*.

(3) Small triradiates of the dermal skeleton (Plate 5, fig. 4, b); irregular, but probably really equiangular; with slender, irregularly curved rays, often unequal in length and sometimes blunt at the apex. One of the rays ( $x$ ) is frequently bent inwards, out of the tangential plane. Rays measuring, say, about 0.1 by 0.0055 mm.

(4) Quadriradiates of the gastral cortex; equiangular and typically equiradiate; with long, straight, slender facial rays, fairly sharply pointed and measuring about 0.176 by 0.0125 mm.; with short, slightly crooked apical ray, not hooked and about 0.075 mm. long.

(5) Quadriradiates of the larger exhalant canals. Similar to (4) but frequently with very much longer, almost or quite straight apical rays, measured up to 0.29 mm. in length.

(6) Quadriradiates of the oscular collar; sagittal, but otherwise resembling those of the gastral cortex further in.

As in *P. heteroraphis*, the position of the nuclei of the collared cells is basal. The ectosome contains large numbers of pigment cells filled with minute granules of a golden brown colour. Similar, but less numerous pigment granules occur in the ectosome of *P. heteroraphis*, probably also in special cells.

This species is distinguished from *P. heteroraphis* chiefly by its remarkable external form.

*Register No., Locality, &c.* XXVI., Cargados Carajos, 31.8.05, 12 fathoms.

#### Family Leucaltidæ Dendy and Row MS.

Sponge colony tubular and ramified, or even anastomosing, with many oscula; or individualized, with large central cavity and single osculum. Wall of colony composed of at least two distinct layers, viz. a dermal cortex with a strongly developed skeleton of tangential radiates, and a chamber layer with skeleton greatly reduced or even absent. A thin gastral cortex or membrane may or may not be present. Skeleton composed, mainly at any rate, of equiangular radiates. No subgastral sagittal radiates. Nuclei of collared cells probably always basal.

#### Genus LEUCALTIS\* Haeckel (*emend.*).

Sponge colony tubular, ramified and anastomosing. Flagellate chambers elongated and branched, more or less radially arranged around the central gastral cavity.

I am now convinced that Bidder [1898] was quite right in considering this genus to be closely related to the radiate Homocœla as represented by Dendya; its apparent affinity with the Amphoriscidæ is evidently due to convergence.

#### 8. *Leucaltis clathria* Haeckel.

(Plate 2, figs. 1, 2.)

*Leucaltis clathria* Haeckel [1872].

*Heteropegma nodus gordii* Poléjaeff [1883].

\* This genus is generally known under Poléjaeff's name *Heteropegma*, but *Leucaltis* has priority.



*Leucaltis bathybia* var. *mascarenica* Ridley [1884].

*Heteropegma nodus gordii* von Lendenfeld [1885].

*Clathrina latitubulata* Carter [1886].

*Heteropegma nodus gordii* Dendy [1892].

*Heteropegma latitubulata* Dendy [1892].

*Heteropegma nodus-gordii* Dendy [1893].

*Heteropegma nodus-gordii* Hanitsch [1895].

*Heteropegma nodus Gordii* Bidder [1898].

*Heteropegma nodus-gordii* Dendy [1905].

*Heteropegma nodus gordii* Jenkin [1908].

This widely distributed species is well represented in the collection by a number of fine specimens. It is easily recognizable by its external form, consisting of an irregular mass of anastomosing tubes resembling a reticulate *Leucosolenia*, on an enlarged scale. This form has been well illustrated by Poléjaeff in the "Challenger" Report, and I need only add that the diameter of the tubes varies considerably in different specimens and is often much greater than represented in Poléjaeff's figures.

It is unnecessary to figure the typical external form again, but I give photographs of two specimens to show the range of variation in this respect (Plate 2, figs. 1, 2).

The wall of the tube always consists of three sharply defined layers, each with its own characteristic spiculation. On the outside we have the well-developed dermal cortex, supported by tangentially disposed triradiates and quadriradiates, of large but variable size. The quadriradiates are commonly larger than the triradiates and the apical ray projects inwards towards the gastral cavity, but the extent to which quadriradiates are developed varies very greatly in different specimens and they may be very scarce.

The middle layer consists of the branching, radially arranged tubes, lined by collared cells, whose walls are supported only by the very small, regular triradiates and quadriradiates, with very slender rays, and to some extent by the apical rays of the large dermal quadriradiates.

The inner layer is a thin gastral membrane, extending between the exhalant openings of the radial tubes and supported by a single layer of minute sagittal triradiates and quadriradiates. The ends of the facial rays are often swollen, but to a very variable extent, and the apical rays of the quadriradiates are often very long and thick in proportion to the slender facial rays.

The general anatomy has already been figured by Poléjaeff and myself, and the spicules have been figured more or less satisfactorily by Haeckel, Poléjaeff and Jenkin.

I am able to confirm Bidder's statement as to the basal position of the nuclei of the collared cells.

A careful examination of Haeckel's type-specimen of *Leucaltis clathria*, fragments of which were brought from Jena by my colleague, Mr R. W. H. Row, leaves no doubt that it is a "*Heteropegma*" and specifically indistinguishable from the species obtained by the "Challenger" and named by Poléjaeff "*Heteropegma nodus gordii*." Haeckel's figures of the large spicules are good. His fig. 3c is evidently a portion of the gastral membrane with the characteristic minute sagittal tri- and quadriradiates. The shape of

these small spicules is, however, not well represented; the sinuosity of the rays and the swelling of their extremities being exaggerated. He does not figure the characteristic small, regular tri- and quadriradiates of the chamber layer, though these are abundantly present in his specimen. The canal system of the sponge, though no longer well preserved, is evidently closely similar to that described by Poléjaeff and Dendy for "*Heteropegma nodus gordii*."

Similarly an examination of a specimen of Ridley's *Leucaltis bathybia* var. *mas-carenica*, received from the British Museum, proves conclusively that this also is really *Leucaltis clathria*.

In 1892 I showed that Carter's *Clathrina latitubulata* is in reality a "*Heteropegma*," but thought that it might be distinguished from *H. nodus gordii* of Poléjaeff by slight spicular peculiarities. Further investigation has convinced me that such differences in spiculation as exist cannot be regarded as of specific value.

*Previously known Distribution.* Coast of Florida (Haeckel); off Bermudas (Poléjaeff); Cape York, Torres Straits (Poléjaeff); near Port Phillip Heads (Carter, Dendy); Ceylon (Dendy); West Coast of Portugal (Hanitsch); Amirante group, Seychelles (Ridley), Wasin, E. Africa (Jenkin).

*Register Nos., Localities, &c.* XXXIX. 1 and xc. 3, Cargados Carajos, 45 fathoms; LXXVI. 3, XCII. 2 and cv. 1, Amirantes, 28—29 fathoms; cx. 11 and CXIII. 2, Egmont Reef.

#### Family **Sycettidæ** Dendy.

Flagellated chambers elongated, arranged radially round a central gastral cavity, their ends projecting more or less on the dermal surface and not covered over by a continuous dermal cortex strengthened by tangential dermal spicules. Tubar skeleton articulate, with subgastral sagittal radiates. Collared cells usually confined to the radial chambers in the adult, and probably always with apical nuclei.

#### Genus **SYCON** Risso (*emend.*).

Radial chambers usually more or less united in places where they come in contact with one another, always crowned distally with tufts of oxecote spicules. Properly defined inhalant canals usually present, which may be covered by a thin, pore-bearing dermal membrane without special skeleton.

#### *Sycon?* *sp.*

Three very minute Syconoid sponges were picked out from amongst other specimens from Coetivy, but when I came to examine them microscopically, I found that all the spicules had been completely dissolved out, presumably by some acid in the spirit in which they were kept. They probably belong to the genus *Sycon* and are most likely immature.

these small spicules is, however, not well represented; the sinuosity of the rays and the swelling of their extremities being exaggerated. He does not figure the characteristic small, regular tri- and quadriradiates of the chamber layer, though these are abundantly present in his specimen. The canal system of the sponge, though no longer well preserved, is evidently closely similar to that described by Poléjaeff and Dendy for "*Heteropegma nodus gordii*."

Similarly an examination of a specimen of Ridley's *Leucaltis bathybia* var. *mas-carenica*, received from the British Museum, proves conclusively that this also is really *Leucaltis clathria*.

In 1892 I showed that Carter's *Clathrina latitubulata* is in reality a "*Heteropegma*," but thought that it might be distinguished from *H. nodus gordii* of Poléjaeff by slight spicular peculiarities. Further investigation has convinced me that such differences in spiculation as exist cannot be regarded as of specific value.

*Previously known Distribution.* Coast of Florida (Haeckel); off Bermudas (Poléjaeff); Cape York, Torres Straits (Poléjaeff); near Port Phillip Heads (Carter, Dendy); Ceylon (Dendy); West Coast of Portugal (Hanitsch); Amirante group, Seychelles (Ridley), Wasin, E. Africa (Jenkin).

*Register Nos., Localities, &c.* XXXIX. 1 and XC. 3, Cargados Carajos, 45 fathoms; LXXVI. 3, XCII. 2 and CV. 1, Amiranter, 28—29 fathoms; CX. 11 and CXIII. 2, Egmont Reef.

#### Family **Sycettidæ** Dendy.

Flagellated chambers elongated, arranged radially round a central gastral cavity, their ends projecting more or less on the dermal surface and not covered over by a continuous dermal cortex strengthened by tangential dermal spicules. Tubar skeleton articulate, with subgastral sagittal radiates. Collared cells usually confined to the radial chambers in the adult, and probably always with apical nuclei.

#### Genus **SYCON** Risso (*emend.*).

Radial chambers usually more or less united in places where they come in contact with one another, always crowned distally with tufts of oxeote spicules. Properly defined inhalant canals usually present, which may be covered by a thin, pore-bearing dermal membrane without special skeleton.

#### *Sycon?* sp.

Three very minute Syconoid sponges were picked out from amongst other specimens from Coetivy, but when I came to examine them microscopically, I found that all the spicules had been completely dissolved out, presumably by some acid in the spirit in which they were kept. They probably belong to the genus *Sycon* and are most likely immature.

Family **Heteropiidæ** Dendy.

Flagellated chambers varying from elongated and radially arranged to spherical and irregularly scattered, with a distinct and continuous dermal cortex covering over the chamber layer and pierced by inhalant pores. Subgastral sagittal radiates and subdermal pseudosagittal triradiates present, with or without an articulate tubar skeleton. Nuclei of collared cells probably always apical.

The term "pseudosagittal" is proposed by myself and Mr Row, in our forthcoming paper on the classification and phylogeny of the Calcarea, for the subdermal spicules of this family to distinguish them from ordinary sagittal triradiates, as we have come to the conclusion that the "basal" ray is not homologous in the two cases. We have discussed the nature of these spicules in the paper referred to.

Genus **GRANTESSA** von Lendenfeld (*emend.*).

Canal system syconoid. Dermal cortex without colossal longitudinally placed oxea.

## SECTION A.

With large, usually radially arranged oxea, but without microxea.

9. *Grantessa hastifera* (Row).

(Plate 2, fig. 6.)

*Grantilla hastifera* Row [1909].

I have found three specimens of this interesting sponge associated with *Leucascus simplex* amongst the branches of an Alcyonarian (Gorgonid) colony.

The species was first described by Row from a single specimen from the Red Sea, but it is so well characterized that there can be no question of the specific identification. I cannot, however, agree with Row in referring it to his genus *Grantilla*.

Row's figure of the general anatomy as seen in transverse section is in the main correct; but the exhalant canals of the radial flagellate chambers are represented much too narrow, and the subgastral sagittal triradiates and subdermal pseudosagittal triradiates are represented of about the same size, while the subgastral spicules are really, on an average, a good deal stouter than the subdermal ones; moreover, the fine, hair-like oxea (trichoxea) which project from the dermal surface are omitted.

The spiculation is as follows:—

(1) Dermal triradiates; lying tangentially in the dermal cortex, as described and figured by Row.

(2) Subdermal pseudosagittal triradiates, with the two oral rays considerably curved in a plane at right angles to the basal ray and thereby giving rise to deceptive appearances of inequality according to the point of view.

(3) Subgastral sagittal triradiates, similar to, but typically stouter than the foregoing. The characteristic bending of the oral rays, in a plane parallel to the gastral surface, and the fact that they are of approximately equal length, are very clearly shown when the sponge wall is examined from the gastral surface as a transparent object.

(4) Gastral cortical triradiates, considerably more slender than the dermal triradiates; as described and figured by Row (fig. 3, *d*; misprinted 3, *a* in the text).

(5) Large oxea; piercing the sponge wall at right angles and sometimes projecting from both gastral and dermal surfaces. The outer end is very characteristically hastate much flattened and with a backwardly projecting tooth or barb on one side only something like a crochet needle. Row's figures of this spicule are fairly characteristic but the barb in my specimens may be more strongly developed.

(6) Trichoxea; slender hair-like oxea projecting from the dermal surface. These spicules are not mentioned by Row but they occur in his preparations as well as in my own. They do not appear to be true microxea.

In drawing up the above notes I have had the advantage not only of examining Mr Row's original preparations, but also of consulting him personally, and I am glad to say that he entirely agrees with me on all points.

As so little is known of the external form of the species, I give a photograph of one of the "Sealark" specimens (Plate 2, fig. 6).

*Previously known Distribution.* Red Sea.

*Register Nos., Locality, &c.* XXII. 1, A, B, C, Providence, 4.10.05, D. 478 fathoms.

#### Family **Grantiidæ** Dendy (*emend.*).

Flagellate chambers ranging from elongated and radially arranged to small spherical and irregularly scattered. With a distinct dermal cortex and a proper cortical skeleton of tangential radiates, sometimes supplemented by, and occasionally replaced by, oxea. Skeleton of chamber layer ranging from regularly articulate to irregularly scattered. Subgastral sagittal radiates typically present. No subdermal pseudosagittal triradiates. Subdermal quadriradiates, if present, always associated with a chamber-layer skeleton of confused triradiates. Nuclei of collared cells probably always apical.

#### Genus **GRANTIA** Fleming (*emend.*).

Canal system syconoid. Colossal longitudinal oxea, if present, projecting from the surface. Tubar skeleton articulate, composed of radiate spicules which may or may not be supplemented by oxea.

#### SECTION C.

With both large oxea and microxea.

#### 10. *Grantia indica* n. sp.

(Plate 2, fig. 3; Plate 4, figs. 4, 5.)

This beautiful little sponge is represented in the collection by two specimens of closely similar appearance. I select for description of the external form the one represented in the photograph (Plate 2, fig. 3), which I have labelled B, the other, which having been used for microtome sections and spicule preparations.

The sponge is a single Sycon person, which was evidently attached in life by a contracted base, but there is no stalk. The body of the sponge has an inflated appearance, especially on one side, and is surmounted by a well-developed oscular collar, not a mere fringe of spicules but a thin membrane supported by a special skeleton. The surface is coarsely bristly from the projection of large oxea, which point obliquely upwards. The specimen figured measures about 10 mm. in total height, including the oscular collar, and 4.8 mm. in maximum transverse diameter; while the height of the collar is about 3 mm. Specimen A was 9.25 mm. in total height, with a transverse diameter of 5 mm. in the middle of the body, but the height of the oscular collar was only 1.75 mm. The colour in spirit is pale yellow.

The wall of the sponge, about 1.25 mm. thick in the middle of the body, surrounds a wide gastral cavity. It gradually diminishes in thickness upwards to the base of the oscular collar. The canal system is like that of *Grantia*, with long, unbranched (sometimes? slightly branched) radial chambers, approximately circular in transverse section, united laterally with one another throughout their length, and with narrow, irregularly shaped inhalant canals in the interstices between them.

There is a thick dermal cortex (ectosome), with abundant mesogloea, overlying the distal ends of the radial chambers. This cortex is excavated by large, irregular subdermal cavities, which extend inwards, around and between the ends of the chambers, and communicate with the inhalant canals. The small dermal pores are scattered over the surface of the sponge.

There is also a thick gastral cortex, with abundant mesogloea which projects into the gastral cavity around the bases of the apical rays of the gastral quadriradiates. The gastral cortex is pierced by short exhalant canals, into which the radial chambers open either singly or in groups. The junction of each chamber with the exhalant canal is marked by a well-developed diaphragm.

The arrangement of the skeleton in most respects agrees with that of a typical *Grantia*. The dermal skeleton is composed of stout, tangentially placed triradiates, arranged in several layers, and the huge oxea project obliquely through it from deep down in the chamber layer. The triradiates of the dermal cortex sometimes appear to be invading the chamber layer. The gastral cortex is made up chiefly of the facial rays of large gastral quadriradiates, whose strongly developed apical rays project into the gastral cavity, accompanied by minute microxea. It also contains small quadriradiates which, in several close-set tiers, surround the exhalant canal of each radial chamber, with their apical rays projecting into the canal. The skeleton of the chamber layer is articulate and many-jointed, the proximal joints being formed by characteristic subgastral sagittal quadriradiates with minute, rudimentary apical rays and long, straight, centrifugally directed basal rays, often more or less grouped in bundles. The skeleton of the oscular collar is a close interlacement of oxea and radiates. The former run lengthwise and parallel with one another and with the basal rays of the radiates; the latter have very long, slender basal rays and stouter paired rays extended almost at right angles to the basal ray, and most of them have straight, sharp-pointed apical rays.

The spicules (Plate 4, figs. 4, 5), may conveniently be grouped in eight categories, as follows:—

(1) Triradiates of the dermal cortex; typically sub-equiangular and equiradiate, with centre of spicule slightly uplifted out of the facial plane; rays fairly stout, gradually sharp-pointed, measuring say about 0.22 by 0.02 mm. at the base, but variable.

(2) Triradiates of the articulate tubar skeleton; markedly sagittal, with widely extended oral rays; rays nearly straight and gradually sharp-pointed. In a typical example, from about the middle of the chamber layer, the paired (oral) rays measured about 0.15 by 0.0146 mm. and the basal ray about 0.27 by 0.012 mm.

(3) Subgastral sagittal quadriradiates; markedly sagittal, with widely extended oral rays, and long, slender, centrifugally directed basal ray, all gradually and sharply pointed and remarkably straight, except for the usual bending of the oral rays out of the facial plane in accommodation to the shape of the chambers or exhalant canals; with minute, very slender, apical ray, vestigial or sometimes (?) absent; paired rays measuring about 0.146 by 0.01 mm.; basal ray about 0.345 by 0.01 mm.

(4) Quadriradiates of the gastral cortex; large and stout, with gradually sharp-pointed facial rays which may or may not be differentiated sagittally, and with very strongly developed apical ray, usually curved and gradually sharp-pointed, sometimes as large or larger than the facial rays. In a fairly typical example all four rays measured about 0.27 by 0.02 mm.

(5) Triradiates and quadriradiates of the oscular collar; very strongly sagittal; paired rays extended almost in a line with one another, nearly straight, gradually and sharply pointed; basal ray much longer and more slender than the paired rays, straight, gradually and finely pointed. In a typical triradiate the paired rays measured about 0.25 by 0.01 mm., and the basal ray about 0.62 by 0.0083 mm. The orally directed apical ray, when developed, is rather short, straight or nearly so, gradually and sharply pointed, and measures about 0.075 by 0.0063 mm.

(6) Quadriradiates of the exhalant canals; these are much smaller than the gastral quadriradiates; their oral rays are usually considerably longer than the centrifugally directed basal ray, and curved around the exhalant canal; the apical ray is very slender, nearly straight, and all the rays are sharply pointed. The dimensions vary considerably; in a typical case the basal ray measures about 0.05 by 0.006 mm.; the paired rays about 0.07 by 0.006 mm., and the apical ray about 0.025 by 0.003 mm.

(7) Large oxea; nearly straight, fusiform, gradually and sharply pointed, nearly symmetrical but sometimes with a slight indication of hastate pointing at the outer end; occurring in the oscular collar and projecting from the dermal surface with their inner portions deeply imbedded in the chamber layer; outer ends generally broken off; a complete example of about average size measured 2.6 by 0.04 mm.

(8) Microxea; straight or slightly curved, slender, sharp-pointed at both ends, hastate, with a slight enlargement about  $\frac{1}{4}$  of the total length from one end; size about 0.09 by 0.003 mm. (in the thickest part); observed only on the gastral surface, and there only in small numbers.

All the above descriptions and measurements (1—8) are taken from spicules in sections, and not from boiled-out preparations, in which the isolated spicules cannot be referred with absolute certainty to their proper positions.

Microxea closely similar to those of this species occur abundantly on both dermal and gastral surfaces of *Grantia labyrinthica* [Dendy 1891, A].

*Register Nos., Localities, &c.* xc. 4, A, B, Cargados Carajos, 1.9.05, B. 29, 45 fathoms.

GENUS LEUCANDRA Haeckel (*emend.*).

Sponge usually a single person, or a colony of persons in which the component individuals are readily recognizable. Canal system leuconoid. Skeleton of chamber layer more or less confused, but frequently with vestiges of an articulate tubar skeleton in the form of subgastral or other sagittal radiates. Dermal skeleton of tangentially placed triradiates, which may sometimes develop an apical ray. Colossal longitudinally placed oxea, when occurring in the dermal cortex, never forming a smooth layer, but always projecting conspicuously from the surface.

SECTION A.

With large, usually radially arranged oxea, but without microxea.

11. *Leucandra echinata* Schuffner.

(Plate 2, fig. 4.)

*Leucandra echinata* Schuffner [1877].

*Leucandra echinata* Ridley [1884].

? *Leuconia echinata* Carter [1886].

? *Leucandra echinata* Dendy [1892].

Schuffner originally described his *Leucandra echinata* from Mauritius, and I have no hesitation in identifying two specimens in the "Sealark" collection with his species. The spicules were figured by Schuffner, but as the external form has not yet been figured I give a photograph of one of the "Sealark" specimens (Plate 2, fig. 4).

Carter, in describing his *Leuconia echinata* from near Port Phillip Heads, Australia, makes no mention of Schuffner, and it is very doubtful whether he intended an identification of the Australian with the Indian Ocean species. The two are, however, evidently very closely related and may be specifically identical, for my own observations on Australian specimens indicate a wide range of variation. It is even possible that both the Australian and Indian Ocean forms may ultimately be regarded as varieties of the European *Leucandra aspera* (O. Schmidt), but a complete revision of the species of *Leucandra* will be required to settle this and similar questions.

*Previously known Distribution.* Mauritius (Schuffner); Amirantes (Ridley); ? Australia (Carter and Dendy).

*Register Nos., Locality, &c.* LXXXIX. 1, xc. 4, C, both from Cargados Carajos, B. 29, 1.9.05, 45 fathoms.



12. *Leucandra wasinensis* (Jenkin).

(Plate 2, fig. 5.)

*Leucilla wasinensis* Jenkin [1908].

A single small specimen (Plate 2, fig. 5), which agrees so closely with the description given by Jenkin of his *Leucilla wasinensis* that I have no hesitation in making a specific identification, was obtained from Saya de Malha.

The specimen is a good deal smaller than that described by Jenkin, but the external form calls for no special comment, being that of a typical single Leucon person; the peristomial fringe of slender oxea is present, but inconspicuous, owing partly to erosion. All the spicule forms described and figured by Jenkin are present and a direct comparison with preparations of his sponge shows a close agreement between the two specimens in this respect. I find that, in the Wasin specimen, the outer ends of some of the large oxea are flattened, lancet-shaped, and this is apparently what Jenkin means by saying that they are "snake-headed." This does not appear to be a constant character, however, even in the type; I cannot say whether or not it occurs in the "Sealark" specimen, as the outer ends of nearly all the oxea are either broken off or more or less badly eroded. The triradiates of the chamber layer are a good deal smaller in the "Sealark" specimen than in the type, and this may be true to some extent also of the other spicules; but I do not consider that there is any difference of specific value.

The most remarkable feature of the species is the presence of well-developed, centripetally directed apical rays on many of the radiates of the dermal cortex. Formerly, I regarded this character as sufficient reason for the inclusion of a species possessing it in the genus *Leucilla*, and such species as the present certainly seem to show how the characteristic subdermal quadriradiates of the Amphoriscidæ have arisen, but apical rays so often appear on triradiates in all sorts of situations that I no longer regard their presence in the dermal cortical radiates as sufficient by itself to justify the exclusion of a species from the genus *Leucandra*. This point has been more fully discussed by Mr Row and myself in our revision of the Calcarea.

*Previously known Distribution.* Wasin, East Africa (Jenkin).

*Register No., Locality, &c.* VIII. 7, Saya de Malha, 6.9.05, C. 15, 55 fathoms.

Family **Amphoriscidæ** Dendy (*emend.*).

Flagellate chambers ranging from elongated and radially arranged to small, spherical and irregularly scattered. With a distinct dermal cortex supported by a skeleton of tangentially placed radiates, to which oxea may be added. Some or all of the dermal radiates with large apical rays, which project inwards through the chamber layer to a greater or less extent and form the principal part of its skeleton. No articulate tubar skeleton, but subgastral sagittal radiates may be present and sometimes, in the leuconoid forms, a confused skeleton of quadri-radiates in the chamber layer. Nuclei of collared cells probably always apical.

Genus *LEUCILLA* Haeckel (*emend.*).

Canal system leuconoid or sylleibid. Skeleton of chamber layer typically composed of the centripetally and centrifugally directed apical rays of subdermal and subgastral quadriradiates, but subgastral sagittal triradiates and confused chamber layer quadriradiates may be present, while the subgastral quadriradiates may be absent.

## SECTION B.

With large oxea or trichoxea, but no microxea.

13. *Leucilla proteus* n. sp.

(Plate 2, fig. 7; Plate 5, fig. 5).

There are several very small specimens of a *Leucilla*, attached to an *Avicula* shell in company with a number of other small organisms, for which it seems necessary to propose a new specific name.

R. N. CVI. 1, B (Plate 2, fig. 7) may be taken as typical. The sponge is more or less cylindrical in form, with a single vent at the free extremity. The length of the specimen selected was about 7 mm. and the diameter 2.5 mm. The colour in spirit was white.

The wall of the sponge, surrounding the central gastral cavity, is rather thin. The canal system is sylleibid, almost if not quite syconoid towards the osculum, where the flagellate chambers are thimble-shaped and more or less radially arranged.

The dermal skeleton consists mainly of the facial rays of large quadriradiates, with a marked tendency to become sagittal, especially towards the osculum, and then also to be oriented in the usual manner, with the unpaired ray pointing aborally.

The skeleton of the chamber layer consists mainly of the strong apical rays of these quadriradiates, which commonly extend right through it and even project into the gastral cavity. The comparatively slender basal rays of usually much less strongly developed subgastral sagittal triradiates traverse the chamber layer in the opposite direction. In one specimen at any rate there are irregularly scattered large radiates in the older parts of the chamber layer. (In the same specimen I have also observed numerous slender triradiates lying tangentially amongst the dermal quadriradiates. I am inclined to regard this specimen as more nearly adult than the others; it is also larger.)

The gastral skeleton is rather feebly developed, consisting of slender, tangentially placed triradiates and quadriradiates, and of the oral rays of the subgastral sagittal triradiates. Smaller quadriradiates may occur in the walls of the exhalant canals, towards the gastral surface.

In some specimens, if not in all, there is a very feebly developed oscular fringe of minute, slender oxea, and a few hair-like oxea may also occur, projecting here and there from the dermal surface.

The spicules may be described under the following heads:—

SECOND SERIES—ZOOLOGY, VOL. XVI.

(1) Quadriradiates of the dermal surface (Plate 5, fig. 5 *a, b*); with all four rays strongly developed, stout and fairly sharply pointed; facial rays lying tangentially to the surface, commonly more or less sagittal; apical ray directed centripetally through the chamber layer, either longer or shorter than facial rays; size variable, facial rays measuring say about 0.39 by 0.035 mm.

(2) Quadriradiates of the gastral surface (Plate 5, fig. 5 *d*); much smaller than (1), with slender, sharp-pointed facial rays and short, sharp-pointed apical ray projecting into the gastral cavity; facial rays measuring about 0.16 by 0.015 mm. These spicules become strongly sagittal towards the oscular margin, with the recurved oral rays stouter than the basal ray.

(3) Triradiates of the gastral surface (Plate 5, fig. 5 *e*); similar in all respects to (2), except for the absence of the apical ray, and like them becoming strongly sagittal at the oscular margin.

(4) Quadriradiates of the exhalant canals; much smaller than the gastral quadriradiates and with proportionally longer apical rays.

(5) Subgastral sagittal triradiates (Plate 5, fig. 5 *c*); with the two oral rays widely extended in a line with one another beneath the gastral surface and the basal ray directed centrifugally through the chamber layer. All rays gradually and sharply pointed. Size very variable, averaging perhaps about 0.18 by 0.02 mm. for the oral rays and 0.33 by 0.02 mm. for the basal ray.

(6) Oxea; these occur chiefly in the oscular margin, where they form a very feebly developed fringe. They are very slender, not very long, and very sharply pointed at each end; almost hair-like, but sometimes with a distinct swelling at some distance from the finely drawn out distal extremity, length say about 0.125 mm. These spicules seem to be intermediate between microxea and trichoxea.

This species is evidently very closely related to *Leucilla australiensis* (Carter)\*, and it may even prove to be specifically indistinguishable. The following differences may, however, be indicated.

(1) The external form is cylindrical rather than ovoid.

(2) The sponge wall is thinner.

(3) The skeleton of the chamber layer is almost entirely composed of the apical rays of the subdermal quadriradiates and the basal rays of the subgastral triradiates, whereas in *L. australiensis* there is a well developed skeleton of confused radiates in the chamber layer.

(4) Oxea are present. These may or may not be constant and it is possible that they may also occur in *L. australiensis*, though they have never been observed in that species except in one doubtful case where a very few were found (possibly accidental).

It is highly probable that all the specimens of *L. proteus* obtained by the "Sealark" are young and that some of the apparent differences between them and *L. australiensis* may disappear in later life.

*Register Nos., Localities, &c.* CVI. 1, A, B, C, D, &c., Amirante, 13.10.05, E. 16 39 fathoms.

\* [1886, p. 133.]

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## DESCRIPTION OF PLATES

## PLATE 1.

(All the Figures in this Plate are from photographs.)

- Fig. 1. *Leucosolenia gardineri* n. sp. R.N. CXX. 7.  $\times 4$ .  
 Fig. 2. *Leucosolenia gardineri* n. sp. R.N. CXX. 11.  $\times 5$ .  
 Fig. 3. *Dendya prolifera* n. sp.  $\times 2\frac{1}{2}$ .  
 Fig. 4. *Dendya prolifera* n. sp. Upper portion of specimen,  $\times 6\frac{1}{2}$ .  
 Fig. 5. *Leucascus simplex* Dendy. R.N. XXII. 2, A.  $\times 3$ .  
 Fig. 6. *Leucetta chagosensis* n. sp. R.N. CXIX. 11.  $\times 2\frac{1}{2}$ .  
 Fig. 7. *Leucetta pyriformis* n. sp. R.N. XC. 5, A.  $\times 5$ .  
 Fig. 8. *Pericharax heteroraphis* Poléjjaeff. R.N. CXVIII.  $\times 2\frac{1}{2}$ .  
 Fig. 9. *Pericharax peziza* n. sp. R.N. XXVI.  $\times 2$ .

## PLATE 2.

(All the Figures in this Plate are from photographs.)

- Fig. 1. *Leucaltis clathria* Haeckel. R.N. CXIII. 2.  $\times 2\frac{1}{2}$ .  
 Fig. 2. *Leucaltis clathria* Haeckel. R.N. XXXIX. 1.  $\times 2\frac{1}{2}$ .  
 Fig. 3. *Grantia indica* n. sp. R.N. XC. 4, B.  $\times 6\frac{1}{2}$ .  
 Fig. 4. *Leucandra echinata* Schuffner. R.N. LXXXIX. 1.  $\times 4$ .  
 Fig. 5. *Leucandra wasinensis* Jenkin sp. R.N. VIII. 7.  $\times 6$ .  
 Fig. 6. *Grantessa hastifera* Row sp. R.N. XXII. 1.  $\times 4$ .  
 Fig. 7. *Leucilla proteus* n. sp. R.N. CVI. 1, B.  $\times 6$ .

## PLATE 3.

- Fig. 1. *Leucosolenia gardineri* n. sp. R.N. CXX. 7. Spicules,  $\times 370$ .  
 a. Triradiates; b. quadriradiates.  
 Fig. 2. *Leucosolenia gardineri* n. sp. R.N. CXX. 11. Spicules,  $\times 370$ .  
 a. Triradiates; b. quadriradiates.  
 Fig. 3. *Leucosolenia gardineri* n. sp. R.N. CXX. 11. Part of a thin section stained with borax carmine and picro-indigo carmine,  $\times 666$ .  
 ep. flattened epithelial cells; nu. nucleus of ovum; ov. ovum (cytoplasm and yolk granules);  
 yb. yellow bodies.  
 Fig. 4. *Dendya prolifera* n. sp. Section through two branching diverticula of the central gastral cavity (radial tubes),  $\times 30$ .  
 c.g. central gastral cavity; b.d. branching diverticula (radial tubes).  
 Fig. 5. *Dendya prolifera* n. sp. Spicules,  $\times 278$ .  
 a. triradiates from the gastral membrane; b. quadriradiate from the gastral membrane;  
 c. triradiate from end of young radial tube; d. quadriradiate from middle of radial tube;  
 e. apical rays of quadriradiates from radial tube.

## PLATE 4.

- Fig. 1. *Leucascus simplex* Dendy. R.N. XXII. 2, A. Spicules,  $\times 278$ .  
 a. triradiates; b. quadriradiates; a.r. apical ray.  
 Fig. 2. *Leucetta chagosensis* n. sp. R.N. CXIX. 11. Spicules,  $\times 67$ .  
 Fig. 3. *Leucetta pyriformis* n. sp. R.N. XC. 5, A. Spicules,  $\times 107$ .  
 a. large triradiate from dermal surface; b. small triradiates; c. intermediate triradiate;  
 d. quadriradiate.

Fig. 4. *Grantia indica* n. sp. R.N. xc. 4, A. Spicules,  $\times 67$ .

a. triradiates; b. quadriradiates; c. oxea.

Fig. 5. *Grantia indica* n. sp. R.N. xc. 4, A. Spicules,  $\times 180$ .

a. equiangular triradiate, probably from dermal cortex; b. sagittal quadriradiate, probably subgastral; c. small quadriradiates, probably from exhalant canals; d. quadriradiates of gastral cortex, side view (a.r. apical ray); e. microxea.

## PLATE 5.

Fig. 1. *Pericharax heteroraphis* Poléjaeff. Spicules,  $\times 36$ .

a. Large triradiates of main skeleton; b. small triradiates of main skeleton; c. triradiates of main skeleton of intermediate size.

Fig. 2. *Pericharax heteroraphis* Poléjaeff. Spicules,  $\times 180$ .

a. small triradiates of main skeleton; b. triradiates of dermal skeleton (a. bent rays, foreshortened); c. apical rays of gastral quadriradiates, side view; d. quadriradiates, probably from larger exhalant canals (a.r. apical ray); e. quadriradiate, probably from oscular collar.

Fig. 3. *Pericharax peziza* n. sp. Spicules,  $\times 36$ .

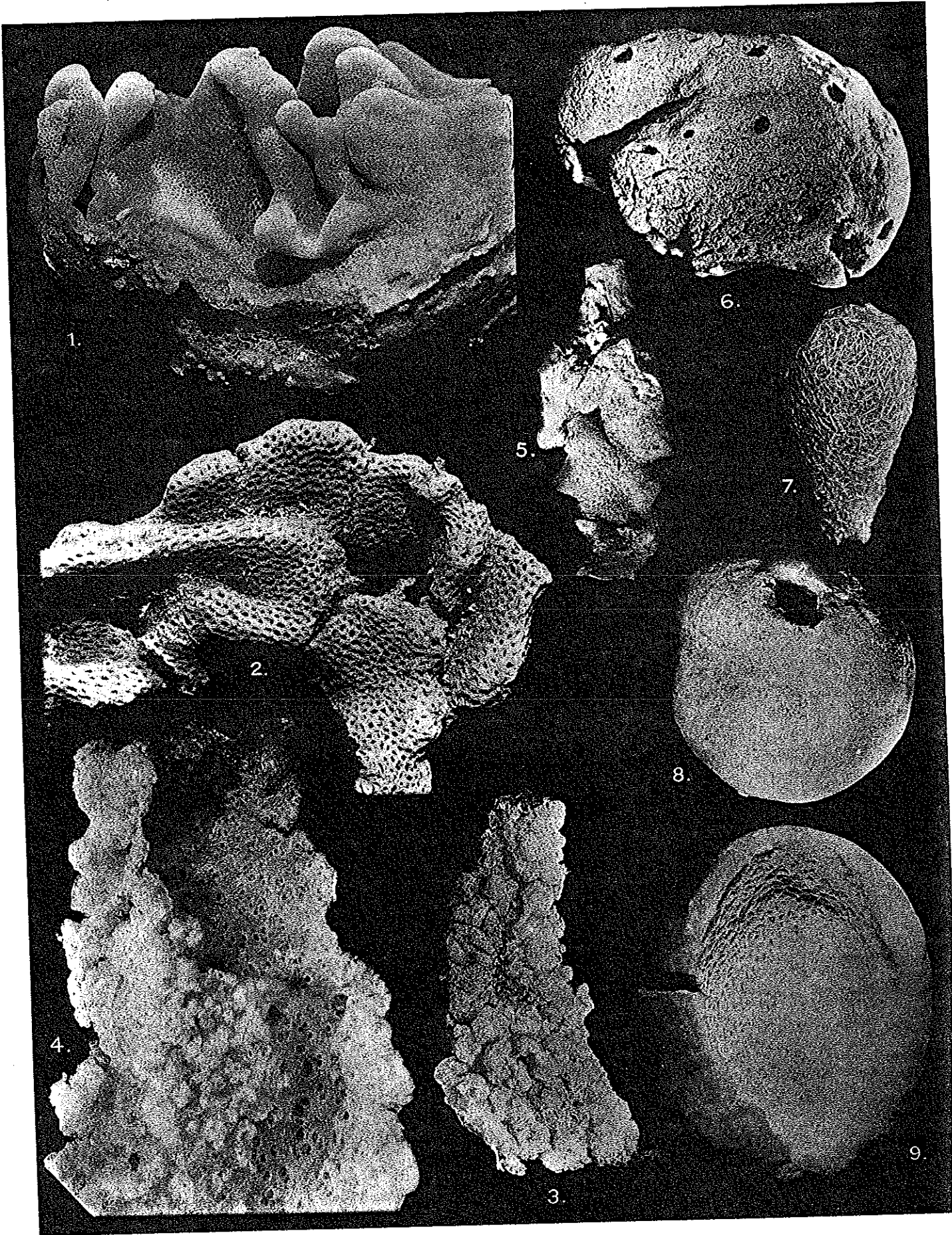
a. Large triradiate of main skeleton; b. small triradiates of main skeleton; c. triradiates of main skeleton of intermediate size.

Fig. 4. *Pericharax peziza* n. sp. Spicules,  $\times 180$ .

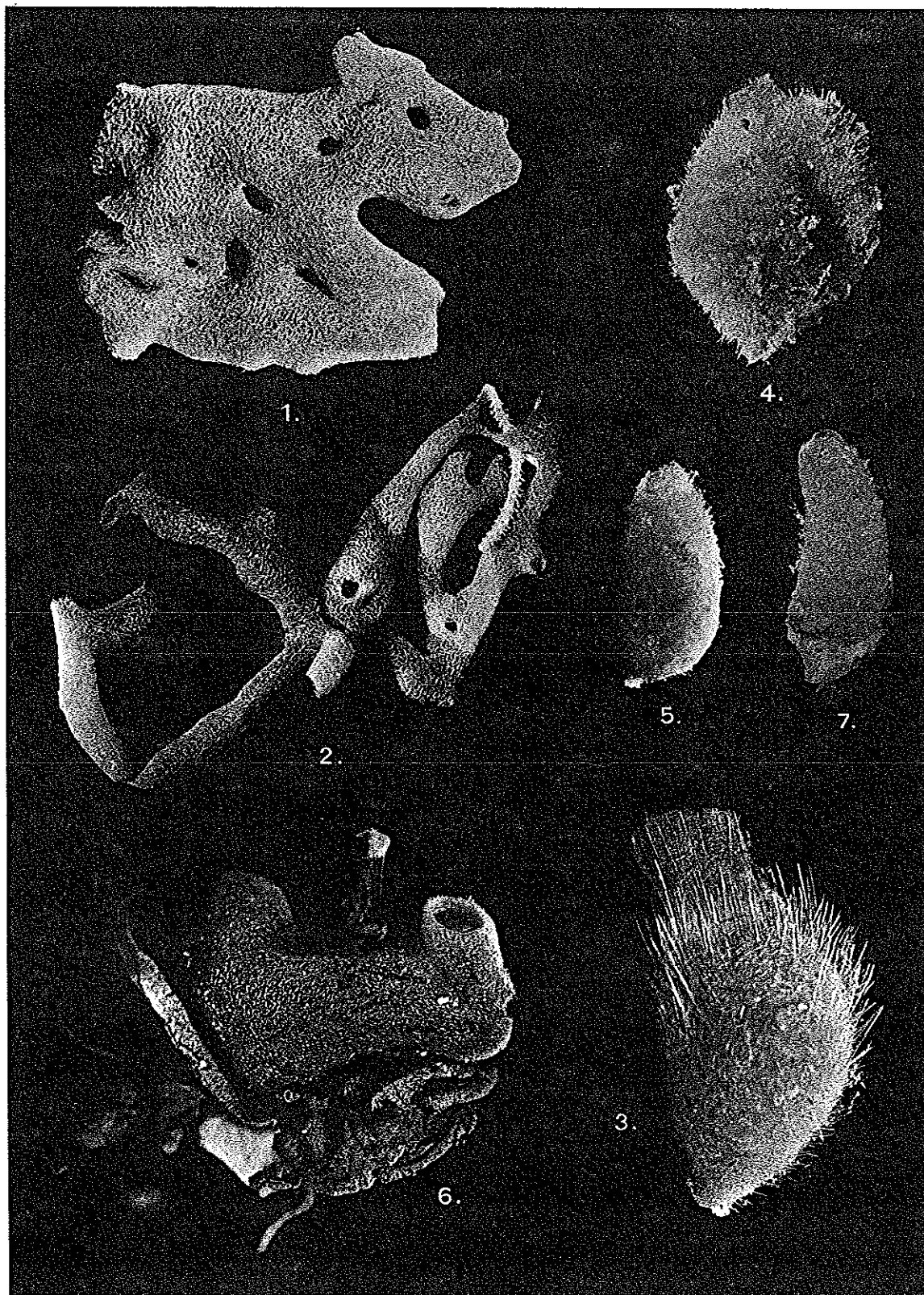
a. Small triradiates of main skeleton; b. triradiates of dermal skeleton (a. bent rays, foreshortened); c. quadriradiates (a.r. apical rays).

Fig. 5. *Leucilla proteus*, n. sp. Spicules,  $\times 106$ .

a. quadriradiates of dermal skeleton, side view (a.r. apical ray); b. quadriradiates of dermal skeleton, facial views; c. subgastral sagittal triradiates; d. gastral quadriradiate; e. gastral triradiate.

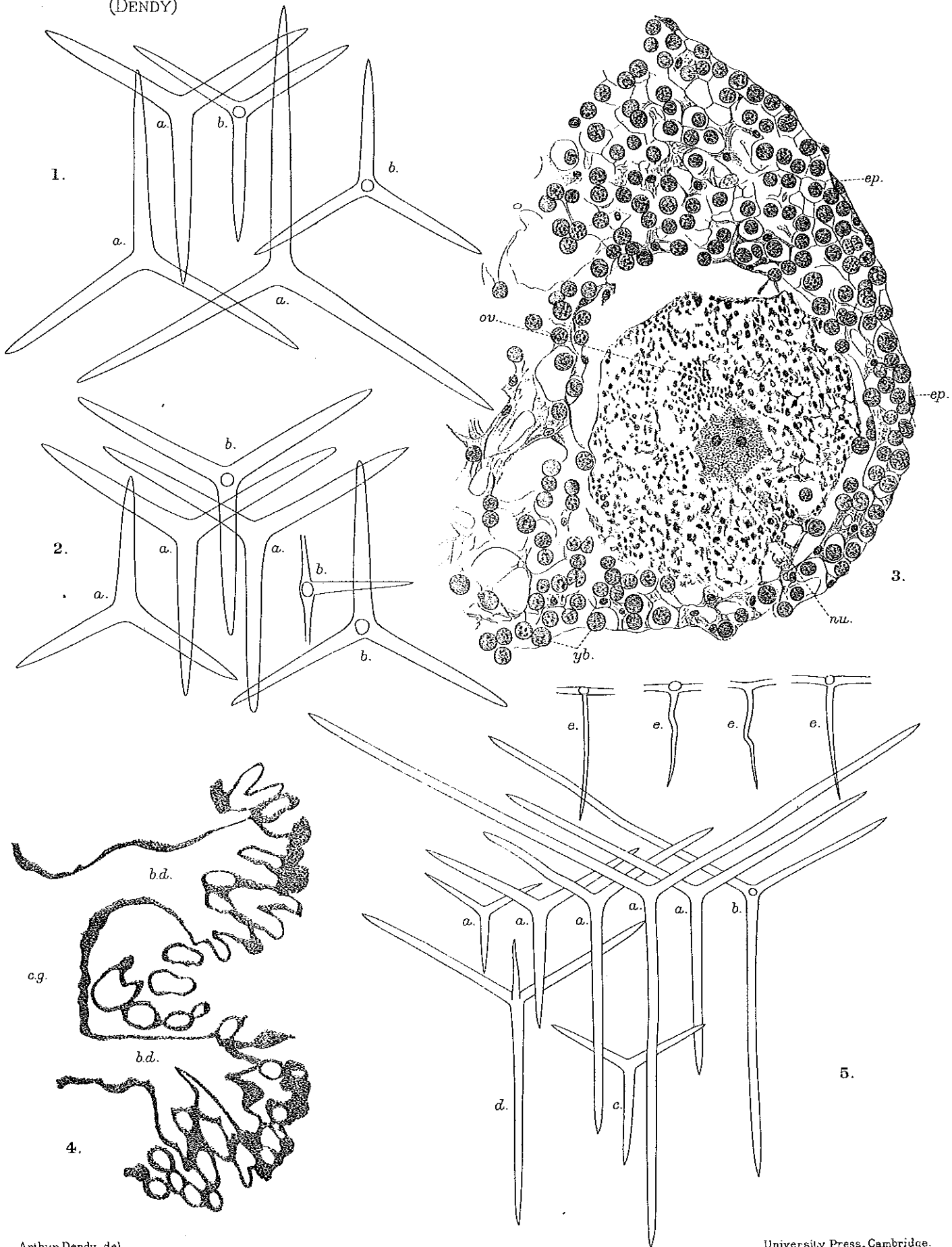


CALCAREOUS SPONGES



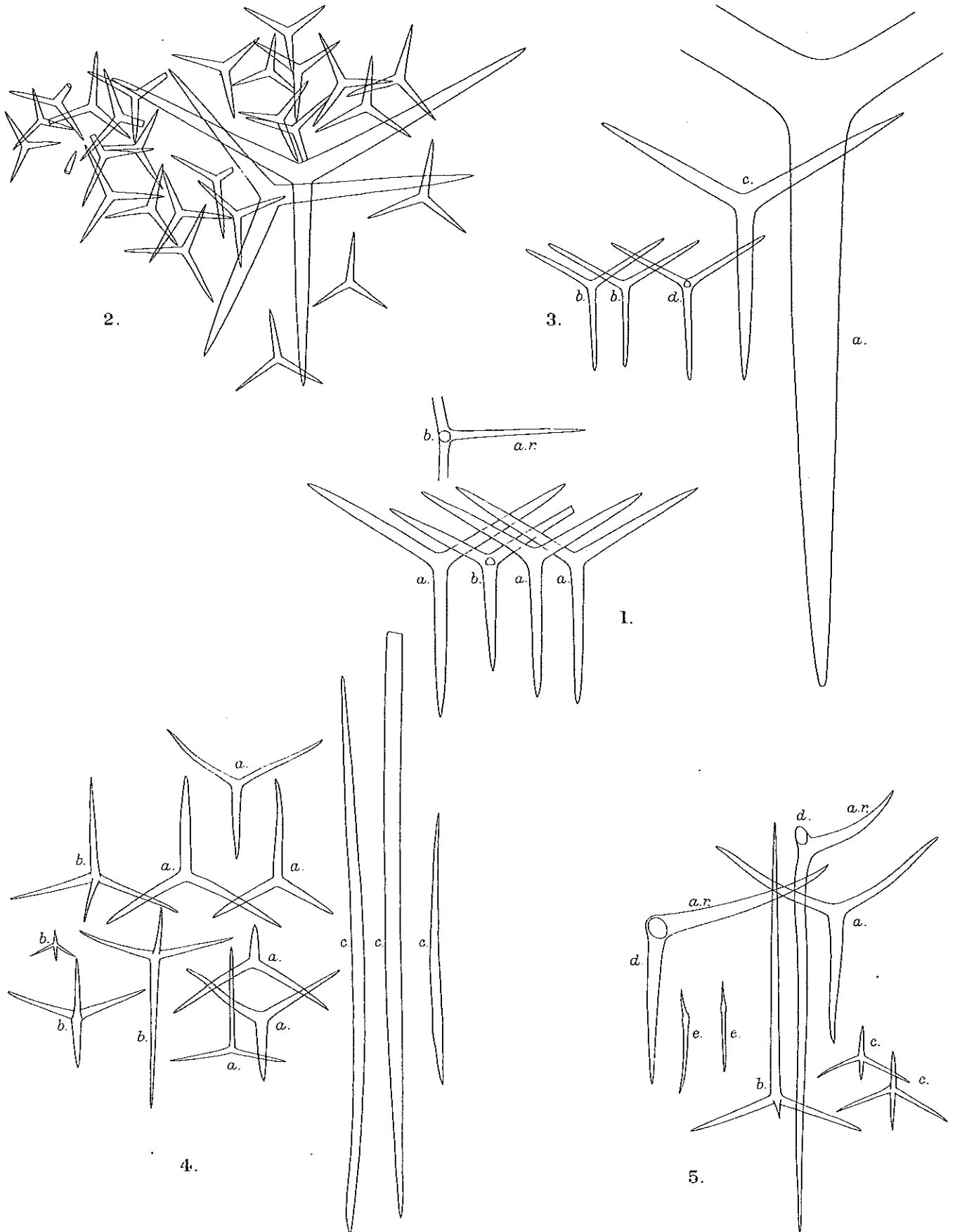
CALCAREOUS SPONGES

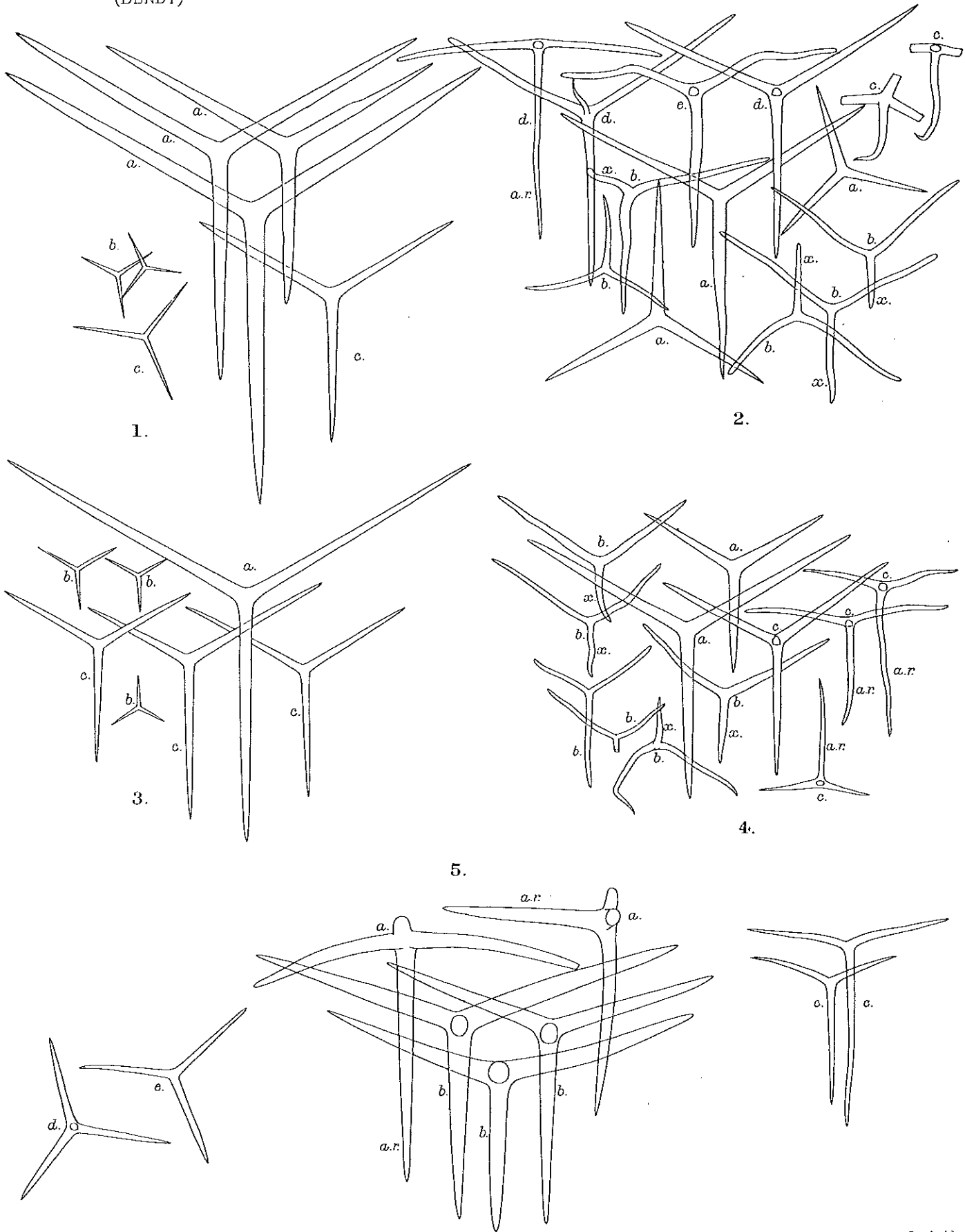




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