THE

VOYAGE OF H.M.S. CHALLENGER.

ZOOLOGY.

REPORT on the CALCAREA dredged by H.M.S. Challenger during the years 1873–76. By N. POLÉJAEFF, M.A. of the University of Odessa.

INTRODUCTION.

IN December 1882 I received from Mr. John Murray, for the purpose of scientific investigation, all the Calcarea brought home by the Challenger Expedition. The investigation has been conducted in Graz, at the Institute of Prof. F. E. Schulze, and indebted as I am to Prof. F. E. Schulze for the whole of my spongiological education, I am now still more under obligation to him for the encouraging interest which he has manifested in the progress of this investigation, for his liberality in placing at my disposal all his own Calcarea, and for the kindness with which he procured me access to the precious collection which Prof. Oscar Schmidt presented to the Joanneum at Graz. For all this I express to Prof. F. E. Schulze my heartfelt gratitude. I have also to fulfil the agreeable obligation of thanking Dr. E. v. Marenzeller of Vienna, Prof. J. Steenstrup of Copenhagen, Dr. G. C. J. Vosmaer of Naples, and particularly Mr. H. J. Carter of Budleigh-Salterton, for the amiability with which my requests, if in any way realisable, were received and answered.

The Calcarea of the Challenger Expedition have been found to belong to thirty species, twenty-three of which are quite new. The greater part of the specimens being very well preserved, and there being amongst them many very interesting forms, I considered it my duty not to limit myself to a simple description of the collected material, but to try to solve some questions which, thanks to recent investigations, have been brought before the scientific world. The principal question, which logically includes in itself all the others, concerns the systematic arrangement of the class Calcarea, proposed by Prof. Hæckel in his monograph, Die Kalkschwämme.

Although it is twelve years since this work made its appearance, yet no serious attempt has been hitherto made to criticise Prof. Hæckel's systematic principles, although there has been no want of consciousness that such an attempt was desirable. Some zoologists, it is true, captivated by the ingenuity of the system established by Hæckel, not only proclaimed the Monograph an "Epoche machendes Werk" (Keller), which I quite agree with, but went so far as to express their conviction that there could be nothing further added to the natural history of the class Calcarea, all having been done by the illustrious professor of Jena. Other voices, however, were heard, which spoke of the necessity of a revision; as for instance, those of Leuckart, P. Wright, and more decidedly Metschnikoff and Claus.

A complete revision of all the Calcarea described up to this time is at present scarcely possible. The originals are scattered over all Europe, if not over the whole world, and some of them are not to be obtained at all. I have done my utmost in this direction, and I think that, including the Challenger specimens, the number of forms at my disposal is sufficient to permit me to hope that the systematic arrangement of the group Calcarea here proposed will serve as a sufficiently sure basis for further investigations.

I limit myself in this paper to a revision of the families and genera, this being the most important part of the task. With respect to the species established by Hæckel and later investigators, I am disposed on the whole to accept them. There are among them some doubtful ones, but a discussion of these would lead me beyond the range of my proper work, and I defer it to another opportunity. I think it also superfluous to give here a historical report of the literature of the group. Prof. Hæckel's Monograph gives this very amply up to the date of its publication, and the memoirs of the last twelve years being principally embryological, I shall refer to them, when necessary, in the sequel. A short historical report is also to be found in Dr. Vosmaer's paper on *Leucandra aspera*.[1]

In accordance with the above, I propose to divide my memoir into two chapters; the first will be devoted to general morphological and systematic questions, the second to the description of the forms collected during the cruise of the Challenger.

[1] Aanteekingen over Leucandra aspera, &c., Leiden 1880, pp. 1–34.

I.—MORPHOLOGICAL OBSERVATIONS.

In the class of Calcarea, Prof. Hæckel distinguishes three families—Ascones, Sycones, and Leucones, characterising them according to the properties of their canal system. In each family he establishes seven genera, taking the character of the spicules (whether triradiate, quadriradiate, or acerate) as the generic character, seven combinations being thus possible. The form of the spicules is reserved for the establishment of specific characters. The classification constructed upon these principles Prof. Hæckel calls "natural,"[1] and puts it in opposition to his former classification published in the year 1869.[2] It cannot be denied that in comparison with the system of the Prodromus, the arrangement proposed in the Monograph is a great advance; the arrangement of the Monograph, although still rather artificial, is incomparably more natural than that of the Prodromus, and shows that its author had made great progress in the recognition of the organisation of the calcareous sponges. There is, however, a great difference between a *more* natural and a *really* natural system. A natural system is the last link of a long chain of investigations, it is the crown of all former studies, it becomes possible only when the majority of the representatives of a group of animals has been examined and described. The very fact that of the thirty species brought home by the Challenger Expedition, twenty-three present quite new forms, proves clearly how few Calcarea we know, and how very many forms are still to be discovered. And therefore, till the right time comes for making a summary of our knowledge, nothing but attempts at a natural arrangement can be given. The system of Prof. Hæckel is no essay. Having founded his genera upon all the possible combinations of the three kinds of spicules, he thereby restricted the number of genera for ever, and, even though he had been thoroughly justified in this by the forms he had for examination, he would still have been premature in classifying the Calcarea in the manner he did. But it is sufficient to peruse the Monograph attentively in order to find that the justification just mentioned did not exist. For instance, characterising one species of Leucones—*Leucetta corticata*—Prof. Hæckel writes as follows:—"*Leucetta corticata* is one of the most peculiar Leucones, and possesses a near ally only in *Leucaltis clathria*."[3] The same, *mutatis mutandis*, is said

[1] Kalkschwämme, Bd. i. p. 79.
[2] Prodromus eines Systems der Kalkschwämme, *Jenaische Zeitschr.*, Bd. v. pp. 236–254, 1870.
[3] Kalkschwämme, Bd. ii. p 130.

in the description of *Leucaltis clathria*,[1] and yet in his system *Leucetta corticata* belongs to one genus, *Leucaltis clathria* to another. In the hypothetical genealogical tree of the genera of his natural system Prof. Hæckel assigns a different origin to the species belonging to the same genus, as for instance, deriving the species of the genus *Ascortis* partly from the genus *Ascandra*, partly from the genus *Ascetta;* the species of the genus *Ascandra* partly from *Ascaltis*, partly from *Ascortis*, &c. Nevertheless, all the species of *Ascortis* or *Ascandra* are, according to him, to be united in one genus, not to be divided into two or more—a direct contradiction to the description Prof. Hæckel gives of his system in the words :—"constructed upon the phylogenetical principles of the theory of descent (ausgeführt nach den phylogenetischen Principien der Descendenz-Theorie").[2] Being further obliged to acknowledge the great variability of the spicules with respect to their character whether triradiate or quadriradiate, as well as the inconstancy in the presence of the acerate form, Prof. Hæckel creates a new kind of variety, which he calls "connexive," and regards as illustrating the transition of one genus into another, and he asserts that these "connexive" varieties are "exceedingly instructive for the understanding of the origin of species (höchst lehrreich für die Erkenntniss des Ursprungs der Arten"[3]). This would indeed be very instructive, if there were in the Monograph a successful attempt to prove that the seven genera of each of the three families of Calcarea are really natural; such an attempt would have been especially desirable, for in some species presenting "connexive" varieties the constancy in the form of their spicules is comparatively pronounced (*Ascetta primordialis*, *Leucetta primigenia*), and one might come to the conclusion that the generic character is in some cases more variable than that distinguishing the species. The proofs in question, however, are not to be found; the words "natural genus," "natural species," are used repeatedly, and the "naturalness" of the new system is very often urged, but there is only one passage in the whole Monograph which, although by no means proving the naturalness of Prof. Hæckel's system, alludes to the manner in which its author arrived at his systematic ideas. In the year 1871, on the coast of Lesina, Hæckel happened to find many colonial specimens of an Ascon which was composed partly of *Clathrina clathrus*, O. Sch., and partly of *Nardoa labyrinthus*, O. Sch., *i.e.*, of two forms which, found growing separately by O. Schmidt, had been referred by him to two quite different genera. Both the sponges grew into each other without any definite boundary, and a close investigation showed that throughout the whole colony the spicules were of precisely the same form.[4] Oscar Schmidt, in referring his *Clathrina clathrus* and *Nardoa labyrinthus* to two different genera, was guided by their external differences. The discovery of Prof. Hæckel proved that such guidance is very uncertain, and so far as this discovery caused him entirely to abandon the principles of classifying the calcareous sponges previously adopted, this discovery must be called very fortunate; but if Prof. Hæckel

[1] Kalkschwämme, Bd. ii. p. 159. [2] *Loc. cit.*, p. 5. [3] *Loc. cit.*, p. 23. [4] *Loc. cit.*, p. 33.

came to his later systematic ideas really in consequence of the discovery just mentioned, the medal has a reverse. For, having adopted the principle of classification according to the spicules, Prof. Hæckel fell into the same error which characterises the system adopted in the Prodromus. The difference between a colony of Calcarea, in which, according to their spicular characters, one individual belongs to one genus, the other to another, and a genus such as *Thecometra* or *Sycometra* of the Prodromus, is of quantitative not qualitative nature. The existence of such colonies is indeed very instructive, but it proves nothing but the great variability of the spicules, nothing but the utter impossibility of giving to the presence or absence of quadriradiate or acerate spicules the significance of a generic character.

The interesting experiments of Schmankewitsch are certainly still present in the memory of every zoologist. They aroused great attention, and there was considerable doubt as to their reliability. But they merely amounted to a demonstration of the transition of one *species* into another, under the influence of *different* conditions. Now, in *Ascaltis darwinii*, *Ascandra lieberkühnii*, and in *Ascandra variabilis*, we have, according to Hæckel, to deal with colonial forms, which, under the *same* conditions, consist partly of the representatives of one *genus*, partly of another. As I said before, there is in the Monograph no trace of an argument to prove the naturalness of its twenty-one genera. I have only to add that, had such an attempt been made, and had the argument been lucid and logical, yet in view of such examples every impartial investigator would look on it with distrust, and consider the argument to be sophistical. Prof. Hæckel calls his system "natural," but no system paying attention to but one character and not to the whole organisation can claim that designation. And so far as concerns its twenty-one genera, the system proposed by Prof. Hæckel, however ingenious, is yet not less artificial than that of the animal kingdom established by Linné. I do not consider it necessary to dwell longer on this question, but formulate my conclusion thus :—

The spicules of Calcarea being very variable in every direction, could not serve as a basis for the distinction of genera, even if there were in the calcareous sponges no other characters fit for very distinct systematic definitions.

I pass on to the other characters. One of them—the arrangement of the canal system—is used by Prof. Hæckel as a family character.

The great difference between an Ascon, a Sycon, and a Leucon had been already recognised in some measure by the earlier spongiologists (Bowerbank, Lieberkühn, O. Schmidt), although the meaning of the difference was, so to speak, rather dimly felt, not appreciated at its full value. It is the great merit of Prof. Hæckel that he laid stress upon these differences, the more so because, as we shall see, his knowledge of the internal organisation of Calcarea was far from perfect. With respect to the Ascones, I have nothing further to say, Prof. Hæckel's erroneous opinion upon their histological structure, as well as upon the histology of the Calcarea in general, having been already refuted by the investigations of F. E. Schulze,[1] Metschnikoff,[2] and Vosmaer.[3] Everybody feels now convinced that all the Calcarea, like other sponges, possess an ectoderm, mesoderm, and endoderm, and that what Hæckel calls "exoderm" is ectoderm and mesoderm together. I would only call attention to one histological peculiarity stated by Hæckel to be present in some Ascones, viz., to the presence in certain varieties of *Ascetta primordialis*, *Ascetta clathrus*, *Ascaltis canariensis*, and *Ascaltis lamarckii*, of *several* layers of endodermic cells.[4] Some more precise statements on this point are very desirable.

There remains a good deal more to be said about the organisation of Sycones and Leucones, particularly of the latter. The pages of the Monograph dedicated to the canal system of the Leucones (Bd. i. pp. 224–237) are among the weakest portions of the whole work. Prof. Hæckel did not succeed in making out the real features of their organisation. This, however, might have been expected. A true and clear exposition of the anatomical structure of the sponge, in its chief modifications, being the merit of Prof. F. E. Schulze exclusively, is an acquisition of the last ten years. Everyone is a son of his time, and now, though we find many of Prof. Hæckel's conceptions to be erroneous, we must not forget that, compared with the very imperfect ideas of Bowerbank, O. Schmidt, and others upon the same subject, they represented in their time a considerable advance, and rendered subsequent investigations possible. There were, besides, some other causes whose retarding influence must be noticed. I speak of Prof. Hæckel's phylogenetic hypothesis with respect to the derivation of Sycones and Leucones from Ascones: the Sycones by means of strobiloid gemmation, the Leucones by means of the thickening of walls and the ramification of the canals.[5]

I turn firstly to the Sycones. Having adopted the idea that every radial tube of a Sycon represents an Ascon, Hæckel naturally sought after a homologue to the osculum; he believes it to be found in the large "dermal ostium" on the tubes of *Sycetta primitiva*, *Sycaltis perforata*, and some other species of Sycones[6] and lays stress upon their morphological significance, ascribing to them also an important physiological function. According to him, these conjectural "dermal ostia" are in some cases the only openings through which water runs into the interior of the radial tubes. Such was the way in which Hæckel was led to his statement as to the existence of "intercanalless Sycones," under which category he described the following forms:—*Sycetta stauridia*, *Sycilla cyathiscus*, *Sycilla cylindrus*, *Sycilla urna*, *Sycilla chrysalis*, *Sycyssa huxleyi*, *Sycaltis glacialis*, *Sycaltis testipara*, *Sycaltis ovipara*, *Sycaltis perforata*, *Sycortis lævigata*, *Syculmis synapta*,

[1] Ueber d. Bau u. d. Entwickel. v. Sycandra raphanus, *Zeitschr. f. wiss. Zool.*, Bd. xxv. Suppl. p. 247, 1875; Die Metamorph. v. Sycandra raphanus, *ibid.*, Bd. xxxi. p. 290, 1878.

[2] Spongiologische Studien, *ibid.*, Bd. xxxii. p. 349, 1879.

[3] Ueber Leucandra aspera, &c., *Tijdschr. d. Ned. Dierk. Vereen.*, Dl. v. p. 144, 1881.

[4] Kalkschwämme, Bd. i. p. 144. [5] *Loc. cit.*, p. 340. [6] *Loc. cit.*, p. 260.

Sycandra arctica, *Sycandra ramosa*, *Sycandra compressa*, *Sycandra utriculus*, and *Sycandra hystrix*. For my own part I must emphatically deny their "intercanalless" nature. It will be proved later that the seventeen species just named belong not to seven, but only to three genera, *Sycon*, *Grantia*, and *Amphoriscus*. I found amongst the Challenger sponges the representatives of all the three genera. I had examined also *Sycon utriculus* (*Sycandra utriculus*, H.), *Grantia compressa* (*Sycandra compressa*, H.), and *Amphoriscus chrysalis* (*Sycilla chrysalis*, H.), and wish to lay stress upon the fact that the specimens of *Sycon utriculus* and *Amphoriscus chrysalis* were obtained from the collections revised twelve years ago by Prof. Hæckel himself, and that *Grantia compressa* is a sponge so well known that there can be no doubt that the specimens I have had for investigation belonged to this species. Though not nearly so regular as in some other cases, the intercanals could always be very easily found—their course in *Sycon arcticum* and *Grantia tuberosa* is represented in Pl. III. figs. 5 and 6, in *Amphoriscus poculum* and *Amphoriscus elongatus* in Pl. IV. figs. 4 and 5. And there is no doubt that what Hæckel declares to be "dermal ostia" and "dermal pores" in the individuals of his "Syconusa-type" were merely the pores of the intercanals, and that what he calls "conjunctive pores" (*loc. cit.*, p. 260), these latter uniting, according to him, the cavities of the radial tubes, were nothing but the common pores on the side-walls of the radial tubes connecting these latter with the intercanals. To any one who will notice Prof. Hæckel's remark (*loc. cit.*, Bd. i. p. 248) that these "conjunctive pores" are best to be observed in sections of *dry* Sycones, the error into which he fell will be easily comprehended. The refutation of these erroneous statements has not only an anatomical, but also a systematic weight. There is in the genus *Sycandra* a whole sub-genus, whose principal character is, according to Hæckel, the non-existence of the intercanals, and I fancy I am very near to the truth in my supposition that it was merely the finding of quite evident intercanals which induced Dr. Vosmaer, in his report on the sponges collected by the "Willem Barents,"[1] to put a query before his diagnosis of the three Calcarea determined by him as *Sycandra compressa*, *Sycandra utriculus*, and *Sycandra arctica* (*loc. cit.*, p. 4). These three Sycones possess such a characteristic set of spicules that I really cannot find any other explanation, except the above mentioned, for Dr. Vosmaer's remark that the specimens in question being very small he could not obtain sections enough for a thorough examination.

With regard to the Leucones, there are in Prof. Hæckel's Monograph still more serious errors. He distinguishes four modifications of their canal system. The first modification is termed "dendroid" ("baumförmig"), and is characterised as follows:—"The dendroid type is the most primitive and simple, but nevertheless the rarest modification. It is to be found in *Leucetta primigenia*, *Leucyssa cretacea*, *Leucandra*

[1] Vosmaer, Report on the Sponges dredged up in the Arctic Sea by the "Willem Barents," in the years 1878 and 1879, *Niederländ. Archiv f. Zool.*, Supplement-Bd. i. 1882.

bomba, and some other species. Beginning with the gastric surface, we find here numerous large canals, which ramify tolerably regularly, like the branches of a tree, towards the dermal surface. The branches, broad at their beginning, become smaller and more numerous in their course towards the dermal surface, and pass at last into the finest small canals, opening by pores on the dermal surface. The canals are, either throughout their whole extent or for the greater part of it, covered with flagellated endodermal cells. Only the outermost ends of the finest canal-branches (near the dermal pores), and the innermost ends of the largest canal-trunks (near the gastric cavity), remain free from the flagellated epithelium. The anastomoses of the branches are either wanting altogether or few in number."[1] The diagram illustrating this description refers to *Leucandra bomba* (*loc. cit.*, Bd. iii., pl. xl. fig. 9). I was not able to obtain this sponge. I hoped to find it in the Godeffroy Collection in Hamburg, which was kindly sent to me by the administration of the museum; but this expectation was not realised. I found, however, amongst the Challenger Calcispongiæ three specimens of *Leucetta primigenia*, of a form even more instructive with respect to the question of the existence of the dendroid canal system than *Leucandra bomba*. "*Leucetta primigenia*," says Hæckel,[2] "as the conjectural radical form of the Leucones, is so closely allied in the properties of its skeleton to the general radical form of all the Calcarea, *i.e.*, *Ascetta primordialis*, that it can be derived immediately from this latter. The wall of *Ascetta primordialis* requires only to grow thicker, its variable dermal pores require only to become constant canals, and to ramify in the wall, in order to realise the transformation of *Ascetta primordialis* into *Leucetta primigenia*." We shall soon see that Leucones have had quite a different course of development; at any rate, with regard to the canal system of *Leucetta primigenia*, Prof. Hæckel's statements do not correspond with the reality. A close examination of the three specimens above mentioned showed that their canal system possesses just the same character, and, with the exception of some trifling differences, the same peculiarities as that of *Spongelia*, *Aplysilla*, &c. Its detailed description will be given later; at present we have only to notice that a dendroid modification of the canal system does not exist at all.

"The retiform ('netzförmig') modification of the canal system takes origin from the dendroid in the following manner: the anastomoses of the ramifying canals grow more numerous and occur not only between the finer branches, but also between the larger ones. When this structure has obtained its highest development, the wall-parenchyma of a Leucon seems to be pierced by a dense net of canals, like a gland rich in blood-vessels. This modification is not rare . . . . . . it is to be found, for instance, in *Leucetta trigona*, *Leucaltis crustacea*, *Leucandra cataphracta*, and *Leucandra stilifera*." In these words Hæckel describes his "retiform" type, illustrating it by a diagram referring to *Leucandra stilifera;* but I am forced to deny its existence, as also that of the

[1] Kalkschwämme, Bd. i. p. 228.

[2] *Loc cit.*, Bd. ii. p. 122.

dendroid type. I submitted *Leucandra stilifera* and *Leucandra cataphracta* to a careful examination, and can find no essential difference between their canal system and that of *Leucetta primigenia*. The distinctions merely concern the size of the flagellated chambers, the average width of the exhalent and inhalent canals, &c., all which is of little consequence. In both cases the constituent parts of the canal system are the same, viz., inhalent canals, flagellated chambers, and exhalent canals, and the properties of these component parts do not differ from those in *Aplysilla*, *Reniera*, &c.

Prof. Hæckel's third type of canal system, called by him "racemose" ("traubenförmig"), corresponds more closely with the reality. This is illustrated by eight diagrams referring to *Leucandra ananas* (*loc. cit.*, Bd. iii., pl. xl. figs. 1–8). Here we have for the first time in the Monograph to deal with real inhalent canals, flagellated chambers, and exhalent canals. Still, so far as concerns the properties of these three constituent parts, the description is erroneous, as has already been pointed out by Dr. Vosmaer with respect to *Leucandra aspera*,[1] and *Leucaltis solida*.[2]

Prof. Hæckel describes his "racemose" type as follows :—"The branch-canals, which proceed from the gastric surface, and ramify centrifugally towards the dermal surface, are in certain places dilated into vesicles, mostly spherical in form, and it is only these swellings or chambers which are covered on their inner surface with flagellated epithelium, this latter being completely absent from all the other surfaces of the canal system."[3] Dr. Vosmaer's observations by no means agree with the description just quoted. He states that the inhalent canals, if ramifying, do so exactly in the opposite direction to that indicated by Hæckel, their communication with the outer world being effected by the dermal pores, and with the flagellated chambers by the pores in the walls of these latter; that the flagellated chambers each possess in addition to the pores a larger opening by which the water streams into the exhalent canal system; that these openings are of smaller diameter than that of the corresponding exhalent canal; that, in a word, the canal system of *Leucandra aspera* and *Leucaltis solida* is in its chief characters closely allied to that, for instance, of *Aplysilla*, as described by F. E. Schulze.[4] I thoroughly agree with Dr. Vosmaer's conclusions. In addition to *Leucandra aspera* and *Leucaltis solida*, I examined *Leucandra nivea*, *Leucandra johnstonii*, *Leucandra ananas*, and in all these cases, as well as in all the Leucones of the Challenger collection, I found the structure of the canal system presenting just the same characters. Nor did I find anything that would indicate a modification resembling the fourth and last type, described by Hæckel under the name of "vesicular" ("blasenförmig"), as follows :—"The vesicular type takes origin from the racemose type simply by the extension of the flagellated chambers into larger cavities of irregular outline, which come into

[1] *Niederländ. Archiv f. Zool.*, Suppl.-Bd. i. p. 148. 1882.
[2] Voorloopig berigt omtrent h. onderzoek aan de Nederl. werktafel in h. Zoöl. Stat. te Napels. Haag (?) 1881, p. 5
[3] Kalkschwämme, Bd. i. p. 231.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxx. p. 406, 1878.

contact with each other and anastomose, thus forming still larger sinus-like spaces."[1] This modification is, according to Hæckel, rare; it is to be found in *Leucilla amphora*, *Leuculmis echinus*, *Leucandra fistulosa*, *Leucandra cucumis*, *Leucetta corticata*, and *Leucaltis clathria*: in the two latter forms, however, it is not so well-marked.[2] The corresponding diagram refers to *Leucandra fistulosa*. The only specimen of this form I was able to obtain proved to be so badly preserved that there was nothing to be seen in the sections but spicules. There were, however, in the Challenger collection, some specimens which compensated me—at least in some degree—for this mischance. In *Leucilla uter*, n. sp., I found a form closely allied to *Leucilla amphora*; on the other hand, *Leucetta vera*, n. sp., and *Leucetta hæckeliana*, n. sp., show such an unmistakably intimate relationship to *Leucaltis clathria*, that there are just differences enough to separate these forms into distinct species.

The corresponding illustrations are given in Pl. VI. fig. 2*a*, and Pl. VIII. figs. 1 and 7. In the forms just mentioned I could discern neither the network of ramifying canals in Hæckel's sense, nor the fusion of the flagellated chambers, the structure of their canal system quite corresponding in its chief characters with that of all other Leucones. However, in one case (*Leucilla uter*) I found the flagellated chambers not to be round, but of an elongated, cylindrical form, and also of much larger dimensions than usual; and in another case (*Leucetta vera*) there were the smaller, more roundish chambers in addition to the cylindrical ones. I fancy that Prof. Hæckel must have seen something of this kind, and that it was just the difference in the size of the flagellated chambers which gave him the idea of a vesicular type of canal system. I think also that Prof. Hæckel must have had to deal with very badly-preserved specimens, and thus, having had no other guide but his phylogenetic speculations, came to conclusions which, seen from a modern point of view, sometimes appear rather singular.

I might now pass on to the question which has necessitated this digression, viz., the systematic value of the properties of the canal system, but that can be answered thoroughly only when we have acquired a perfectly clear conception as to the phylogenetic relations subsisting between the three families of Calcarea.

As I remarked before, Prof. Hæckel considers the Sycon to be equivalent to a colony of Ascones, which has originated by means of a strobiloid gemmation. According to him, every radial tube of the Sycon is the homologue of a whole Ascon, its conjectural dermal ostium a homologue of the osculum, its pores of the pores perforating the wall of an Ascon (comp. *Sycetta primitiva*, Kalkschwämme, Bd. iii. pl. xli.). Now, the case is quite different with regard to the Leucones. According to Hæckel, the Leucon is nothing but an Ascon whose walls have grown thick and whose pores have changed into canals[3]

Prof. F. E. Schulze[4] was the first to pronounce an opinion upon this subject,

[1] Kalkschwämme, Bd. i. p. 234.
[2] Kalkschwämme, Bd. i. p. 235.
[3] Kalkschwämme, Bd. i. p. 347.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxv., Suppl., p. 225, 1875.

denying the possibility of establishing the homology of the Ascon with the radial tube. M. Barrois[1] also, supported by facts drawn from the domain of embryology, remarked the great affinity between Sycones and Leucones, not Ascones; but it is the merit of Dr. Vosmaer[2] to have submitted the question to a detailed and critical examination.

Relying upon the observations of F. E. Schulze and Barrois, as well as upon his own anatomical researches into *Leucandra aspera*, H., Vosmaer urges that the radial tubes are nothing but a kind of flagellated chambers; he refutes the strobiloid gemmation hypothesis, on the ground of the difference in the disposition of the spicules in the radial tubes and in the walls of an Ascon, which had been already made out by Prof. Schulze, and which can be really regarded as a decisive proof against Hæckel's speculative hypothesis. As a second argument against it, he compares the disposition of the anchor-like spicules in *Sycandra raphanus* and in *Syculmis synapta*—an observation also due to Prof. F. E. Schulze, but, as Barrois had already shown,[3] hardly possessing any phylogenetic value. Finally, Vosmaer develops his own views as to the phylogenetic affinities of the three families of Calcarea; and I here quote the most important passages with some abbreviations:—

"The Ascones present the simplest form of the canal system. The thin wall of the sponge consists of three parallel layers, ectoderm, mesoderm, and endoderm. Here and there the cells separate, and thus give origin to the pores (Hæckel's 'Lochcanäle'). The water, flowing along the outer surface, enters through the pores into the interior, and washing the endodermic cells runs out through the osculum. Now, it is evidently advantageous to the sponge, that the surface washed by the water be extensive. One may consequently well imagine any increase in the surface to be a favourable factor in the struggle for existence. If in an Ascon such an extension of the surface, particularly of the layer of the flagellated cells ('in's Besondere der Kragenzellenschicht') take place, the layer just named will form folds and invaginations. Let us suppose that in such a manner small lateral pouches are formed, and again that these pockets grow larger and develop along the whole wall regularly; it is evident that we have before us the picture of a primitive Sycon. All this is quite in harmony with the facts of embryology. Hæckel, Barrois, Schulze, and others, have shown that an Olynthus-phase is passed through in the development of the Sycon, and yet Olynthus is nothing but a primitive Ascon. Lieberkühn had previously observed that the radial tubes are only invaginations of the gastric wall, and that the wall of the radial tubes is covered with flagellated epithelium, which is wanting on the gastric wall of the sponge. That this latter is covered with pavement-cells, Lieberkühn did not know; nor Hæckel either. Schulze first discovered it in the year 1875."[4]

[1] Embryologie de quelques éponges de la Manche, *Ann. d. Sci. Nat.*, sér. 6 (Zool.) t. iii. art. 11, p. 52, 1876.
[2] Ueber Leucandra aspera, *Tijdschr. d. Ned. Dierk. Vereen.* Dl. v., p. 156, 1881.
[3] *Loc. cit.*, p. 31.
[4] *Loc. cit.*, pp. 156, 157.

And further: "Supposing that these invaginations of the gastric wall take place near one another, not so regularly, and that on their walls secondary invaginations arise in their turn; supposing that along with this a stronger growth of the connective tissue takes place, it becomes obvious that the ectoderm and endoderm cannot continue to progress side by side, in other words, that both the layers of epithelium can no more, as in the Ascon and partly in the Sycon, run parallel to each other. We have seen that in the Sycon the flagellated epithelium is confined to the radial tubes alone; if now in the case just mentioned it recede still more, we have the picture of the exhalent canal system of a Leucon. The ectoderm, which at first lay close upon the endoderm, is often displaced from the latter by the connective tissue; it cannot follow the invaginations of the endoderm throughout. And yet both the layers are, so to speak, attracted one to another, and where there is a less quantity of the mesoderm, the original pores break through. One may also picture to oneself the matter in this manner, that the ectoderm in its turn becomes invaginated, and that in this way the primitive form of the inhalent canal system originates. From what has been said above, there follows:—(1) that the radial tubes are a kind of flagellated chambers, although not complete homologues of these; (2) that Sycon being immediately derivable from Ascon, can also change into Leucon; (3) that the so-called simple Leucon is homologous with a simple Sycon or a simple Ascon, each of the three having the value of an individual ('individuum' of the third order)." [1]

If I understand Dr. Vosmaer rightly, he considers Leucones and Sycones to be divergent branches of the same bough of the genealogical tree, although not in the same sense as Prof. Hæckel. It will be proved, by and by, that it is not the case, that Leucones descend from Sycones, still less from a form representing a secondary, not primary, Sycon-type. Independently of this, I completely agree with the first and the third of his conclusions. Like Dr. Vosmaer, I regard the radial tubes as nothing but a kind of flagellated chambers; I also consider a Sycon as well as a Leucon to be homologous with an Ascon. But though agreeing with these two conclusions, I cannot do so with their postulates. Vosmaer says: "Now it is evidently profitable to the sponge that the surface washed by the water be great, and, considering an eventual extension of the flagellated epithelium-layer to be a favourable factor in the struggle for existence, he tries to explain by it the metamorphosis of an Ascon into a Sycon. This opinion of Dr. Vosmaer has no foundation in fact. He regards a Sycon as better fitted for the struggle for existence than an Ascon. I am forced to remark that had Vosmaer been perfectly logical he would have come to an exactly opposite conclusion. For, compared with an Ascon, a Sycon is more scantily provided with flagellated epithelium: each of its tubes being physiologically equivalent to an Ascon, we have there the whole inner surface deprived of flagellated, and covered with pavement, cells. This is the difference between a Sycon and a colony of

[1] *Loc. cit.*, pp. 159, 160.

Ascones, and this is just the circumstance to which Vosmaer does not pay sufficient attention. "And an Olynthus," says Dr. Vosmaer further, "is nothing but a primitive Ascon." I understand the Olynthus otherwise. The Olynthus is a neutral being, and the Ascon one of its modifications, the Sycon another. An Olynthus may increase longitudinally only, without lateral growth, and in that case it will give origin to an Ascon, the most marked peculiarity of which, in comparison with all other sponges, consists in the slight development of its mesoderm, in other words, in very marked thinness of its walls. An Olynthus may also grow in all directions, in length as well as laterally. This lateral growth would consequently necessitate a larger increase of the mesoderm. Its strong development is not a matter of absolute necessity: a good number of Calcarea (Ascones), though almost devoid of mesoderm, prosper notwithstanding. The mesoderm is, however, a very important constituent part of the organisation of the sponge, for in it the skeleton and generative elements are situated, and it is evident that under certain circumstances its strong development might have proved to be of great importance—the majority of sponges are rich in mesoderm, and we know that its early development is one of the chief characters differentiating the Porifera from the Cœlenterata proper. Its strong growth, however, according to the law of correlation of the organs and with respect to Olynthus, cannot remain without consequence. Let us now suppose—and this supposition will be, if not proved in the scientific sense of the word, at least shown to be probable—let us suppose that the cells which are charged with the feeding of the sponge are chiefly pavement-cells, indifferently of ecto- or endodermic origin, and not flagellated cells. The lateral growth in the Olynthus must in any case have a limit, for, its walls becoming thicker, the outer surface covered with pavement-cells must, sooner or later, according to geometrical laws, become too small to feed the whole. If this limit be passed, a change in the organisation becomes necessary, the surface covered with pavement-cells must, in some way or other, grow larger. In order to form a Sycon, pocket-like invaginations are formed in the Olynthus; we have seen, however, that these invaginations, viz., radial tubes, bring about an absolute not comparative enlarging of the outer as well as of the inner surface, and that, alone, they would be of no use; every thin-walled radial tube, like an independent Ascon, would be able to take care of its own feeding, but would be of no service to the comparatively thick-walled central tube representing the supporting apparatus of the whole. We should therefore expect here a corresponding accommodation, and this accommodation I see in the substitution of pavement-cells for the flagellated cells covering its inner surface in the embryonal stage of development, the radial tubes taking upon themselves alone the function of the circulation of the water. To sum up, I formulate my conclusions in the following manner:—

The Ascones and the Sycones are two fundamentally different modifications of the Olynthus, their chief distinction consisting in the unequal development of the mesoderm, its larger distribution in the Sycon having brought about the differentiation of the endodermic elements into flagellated and pavement-cells.

All this was stated on the supposition that it is principally pavement-cells which take in the nutritious particles. We have now to search into the corresponding physiological statements. The question has its own literature, but the statements of Lieberkühn,[1] Hæckel,[2] Carter,[3] Keller,[4] Metschnikoff,[5] Vosmaer,[6] and Krukenberg[7] upon the subject are so very conflicting, that it must be regarded as very fortunate that science has recently been enriched by the new detailed observations of an investigator conscious of these contradictions. I speak of the beautifully illustrated memoir of Dr. v. Lendenfeld on the Aplysinidæ of the South Sea.[8] His physiological statements are the result of numerous, and, as it seems, very carefully-made experiments. It is the more to be regretted that v. Lendenfeld was not quite impartial in the execution of the task. I do not mean to say that the experimenter was under the influence of the ideas on the morphology of the Sponge upheld by the late Prof. Balfour, but I think that had Dr. v. Lendenfeld begun his experiments in order to answer the question "Which cellular elements in the Sponges do carry on the nutritious process?" instead of "Are these elements of endodermic or ectodermic origin (*loc. cit.*, p. 251)?" he would have come to rather different conclusions. Dr. v. Lendenfeld suggests that—(1) all free surfaces of the Sponge are able to take in the food—a very important observation, for it reconciles in some measure the contradictory statements of former observers; and that (2) while the particles of carmine having entered the pavement-cells covering the subdermal cavities do pass into amœboid cells of the mesoderm in order to make their way from the superior part of the Sponge to the zone of the flagellated chambers, and to be afterwards pushed out by the flagellated cells, the flagellated cells neither retain the particles of carmine taken in from the water, nor deliver them to the mesodermic cells, but throw them out shortly after having imbibed them.

Dr. v. Lendenfeld tells us further, that the particles of carmine, taken in by the pavement-cells of the subdermal cavities, having been finally pushed out by the flagellated cells, appear altered in their form, presenting now rounded not sharp edges as they did before; and that this is not the case with the particles taken up by the flagellated cells. If now Dr. v. Lendenfeld comes to the conclusion that the flagellated cells are excretory organs of the sponge, I find this conclusion very natural and even plausible, although not quite beyond the reach of doubt, his experiments having been made with carmine and not with really nutritious material. At all events, however, I agree with him that the flagellated cells are not to be regarded as special organs concerned in the feeding of the sponge. For against this there are objections from a, so to speak, mechanical point of view.

[1] *Archiv f. Anat. u. Physiol.*, p. 385, 1857.
[2] Kalkschwämme, Bd. i. p. 372.
[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. iv. p. 374, 1879.
[4] *Zeitschr. f. wiss. Zool.*, Bd. xxx. p. 570, 1878.
[5] *Ibid.*, Bd. xxxii. p. 371, 1879.
[6] Voorloopig berigt, &c., p. 5.
[7] *Vergleichend-physiologische Studien*, Bd. i. p. 65, 1879.
[8] *Zeitschr. f. wiss. Zool.*, Bd. xxxviii. p. 234, 1883.

Let us imagine a sponge (*e.g.*, a Sycon) under its usual conditions. The cilia of the flagellated cells are in movement, and the water enters through the pores into the radial tubes in order to make its way to the osculum; let us pursue the direction taken by a particle coming through the pores into the Sponge. If such a particle, having entered the radial tube, be constrained to follow the most rapid course of the water, viz., that in the middle of the tube, it is evident that it will reach the gastric opening of the tube without any contact with the flagellated cells; now, if precipitated by the whirlpool occasioned by the cilium of the next flagellated cell in an oblique direction towards the wall of the tube, the possibility is not excluded that, following this direction, it will reach the comparatively slow current of the water close to the flagellated cells, and be taken in by one of them; but, even though this may happen, such an issue cannot occur very often, for the comparatively slow flowing of the water near the surface of the wall is of a somewhat vortex-like nature, the waves caused by the cilia being, even at this spot, more or less felt; and if, on the other hand, the particle be lifted by the wave of the cilium into its superior part, the particle, passed on from one wave to another, will make its way by fits and starts, but still, like those following the current in the middle of the radial tube, without any contact with the flagellated cells. There are in the radial tube two kinds of motions of the water, the rapid and direct current in the middle, and the vortex-like near its walls, and both are unfit for the purpose of bringing the particles in contact with the flagellated cells. Therefore, though not denying that the flagellated cells may occasionally take in nutritious particles, I cannot admit that this is their chief function—they have besides another task of a motor character.

I find it, however, very doubtful whether the nutritive function must be ascribed, as Dr. v. Lendenfeld does, to the ectodermic pavement-cells exclusively. He states that the flagellated cells take in the particles of carmine in order to push them out forthwith; he states also that the endodermic pavement-cells take in the particles of carmine too, but there is in the paper no suggestion that these latter particles would be pushed out in their turn; and if we reflect upon the fact that (1), from the mechanical point of view, the ecto- and endodermic pavement-cells are exactly under the same conditions, the water advancing calmly and slowly along the outer surface of the sponge, and forming no whirlpools between the gastric openings, these latter being of smaller diameters than those of the radial tubes; that (2) mesodermic amœboid cells, sparsely scattered near the flagellated chambers, are quite as numerous near the layer of pavement-cells of the exhalent canal system as near the subdermal cavities; that (3) the ecto- and endodermic pavement-cells are histologically (at least in Calcarea) quite equivalent; and that (4) there is no room for the supposition that the nutritious particles having entered the sponge organism could all be absorbed by the pavement-cells of the subdermal cavities; if we reflect upon all this, I think we must come to the conclusion that there are no reasons for ascribing different functions to the ectodermic and endodermic pavement-cells.

Now, so far as concerns the histological identity of both these kinds of elements, this identity finds expression even in the modifications which the pavement-cells undergo under certain circumstances. Usually very thin, and provided with fine-grained protoplasm, the pavement-cells appear sometimes far thicker and their granules much larger and more numerous. I have often observed such modifications, and nowhere better than in *Leucetta vera*, n. sp. (Pl. VIII. fig. 8). Sometimes these coarse-grained cells form the epithelium either of the exhalent or of the inhalent canals; in most cases, however, both that of the exhalent and that of the inhalent canals indiscriminately. Since I always found in the same sponge surfaces covered with common pavement-cells, in addition to the surfaces covered with coarse-grained cells, the supposition that the large granules present a constant constituent part of the cells, characteristic of the species, is not admissible. On the other hand, the character of the modification in the cells in question proves that it stands in immediate connection with the nutritive process, and there being, as I remarked before, no distinction in this respect between ecto- and endodermic pavement-cells, I see in this a new reason for ascribing the nutritive function to the pavement-cells both of endo- and ectodermic origin. I must add that the expression "nutritive function" has been used by me with the meaning "reception of the food," and not inclusive of digestion, all cellular elements of the sponge-organism being probably capable of this latter function. A corollary of the highest importance deduced from the foregoing remarks has already found its application.

Let us now turn from the Sycones to the phylogenetic affinities of the Leucones. There are amongst the Sycones described by Prof. Hæckel a good number of forms which, compared with *Sycetta primitiva*, *Sycandra raphanus*, &c., must be regarded as considerably modified Sycones, the differences pervading the whole plan of their organisation. I speak of the type represented in the Monograph by the species *Sycetta stauridia*, *Sycilla urna*, *Sycilla chrysalis*, *Sycilla cylindrus*, *Sycilla cyathiscus*, *Sycaltis glacialis*, *Sycaltis testipara*, *Sycaltis ovipara*, and *Syculmis synapta*. Every impartial investigator, when comparing, for instance, *Sycandra raphanus* with *Sycilla chrysalis*, would refer them to two distinct genera. "In die bis jetzt bekannten Sycortisformen passt *Sycortis sycilloïdes* nicht gut herein," writes Schuffner, describing a calcareous Sponge of the type of *Sycilla chrysalis*, "es schliesst sich dieselbe in ihrer Zusammensetzung und in dem Bau des Skelets der Radialtuben vielmehr an eine Sycilla oder Sycaltis-form an."[1] This is my opinion too.

Prof. Hæckel, constant to his principles of classification by the spicules, assigns no systematic significance to these differences of organisation, yet they did not escape him. So he distinguished[2] two types of radial tubes, characterising them by differences in the

[1] "*Sycortis sycilloïdes* does not seem to be appropriately placed along with the hitherto known forms of *Sycortis*. In its composition and inthe structure of the skeleton of its radial tubes it is more nearly allied to *Sycilla* or *Sycaltis*." Beschreibung einiger neuer Kalkschwämme, *Jenaische Zeitschr.*, Bd. xi. p. 422, 1877.

[2] Kalkschwämme, Bd. i. p. 319.

disposition of their spicules. In one case—Hæckel's "articulated" ("gegliedertes") tubar skeleton—the spicules, usually triradiate, lie in the walls of the radial tubes in many rows, one row behind the other, their basal ray being directed towards the dermal extremity of the tube, whilst the lateral rays diverge towards its gastric ostium; in the second case—Hæckel's "non-articulated" ("ungegliedertes") tubar skeleton—there are no transverse palisades, formed by the lateral rays of the triradiate or quadriradiate spicules (*Sycandra arctica*, H.); moreover, there are no special tubar spicules, but only tubar rays of the dermal or subdermal and subgastric triradiate or quadriradiate spicules. For instance, in *Sycilla cyathiscus* (Kalkschwämme, Bd. iii., pl. xliii. fig. 9) the subgastric quadriradiate spicules lying with their facial rays in the gastric wall, parallel to its inner surface, send their apical rays centrifugally towards the dermal surface, and these apical rays joining the centripetally directed apical rays of the corresponding subdermal quadriradiate spicules form the supporting skeleton for the radial tubes. If the question be asked, which Sycones must be considered to be more primitive, these with articulated tubar skeleton or those with unarticulated one, there can be but one answer:—these with the articulated.

The embryology of the Sycones of the type of *Sycilla cyathiscus* remains certainly still to be explored, but there are in the development of the Sycones of the second type no phases which would lead us to assume that the non-articulated form of tubar skeleton might be a primary one. On the contrary, the ontogeny of *Sycandra raphanus* shows obviously that Prof. Hæckel's conjecture that *Sycetta primitiva*, *Sycaltis conifera*, and, generally speaking, the Sycones with free radial tubes are the most primitive forms of the family, is quite in harmony with the facts of the case. Now, the tubar skeleton in the forms with free radial tubes is always articulated, and, as it is evident that a non-articulated tubar skeleton could not have been developed before the formation of a cortex which was produced by the fusion of the distal ends of the radial tubes, there can be no doubt that the articulated tubar skeleton has brought about the possibility of the formation of the non-articulated, and not *vice versa*. For the rest, this can be proved by means of anatomical comparison, there being amongst the Sycones hitherto described many intermediate stages connecting the extreme forms of these two different types. From *Sycetta primitiva*, through *Sycandra coronata* and *Sycandra raphanus*, we come to *Sycandra arctica*, the radial tubes of which, grown together in their superior part, give rise to a structure closely resembling a cortex, and it is only the form and disposition of the spicules of its skeleton which force us to regard the outer surface of this sponge as still lacking an independent cortical layer. In *Sycandra compressa*, *Sycortis lævigata*, *Sycetta strobilus*, &c., we already find specimens with a perfectly distinct cortical layer, provided with a quite independent skeleton. This latter consists certainly of spicules homologous with those in the distal end of the radial tubes of, for instance, *Sycandra arctica*, but so much modified, and having adopted such a different disposition, that one would take them for an entirely new formation. And if in *Sycandra compressa* the individuality of the radial tubes still finds its expression in the disposition of the acerate spicules, the radial tubes in *Sycortis lævigata* or *Sycetta cupula*, enclosed between two distinctly parallel layers, that of the cortex and that of the gastric surface, show as yet not the slightest trace of any independence. The tubar skeleton of these latter sponges is still articulated; but, owing to the presence of an independent cortex, its transformation into the non-articulated, under certain conditions, may be very easily imagined.

Let us admit that some of the dermal triradiate spicules, for instance, in *Sycortis lævigata*, develop a fourth apical ray—this ray will have a centripetal direction; and again let us imagine that the subgastric triradiate spicules grow larger, so that their centrifugally directed basal ray approaches more or less nearly the dermal extremity of the tube; it is evident that the tubes thereby receive a new system of supporting spicules, which render the former one—the articulated skeleton—superfluous. There are not always present, however, quadriradiate spicules, which, lying with their facial rays in the plane of the dermal surface, support with their apical rays the radial tubes. Such spicules may be triradiate also, as is the case with *Sycaltis glacialis* (Kalkschwämme, Bd. iii., pl. xlv. fig. 5), *Amphoriscus poculum*, n. sp. (Pl. IV. fig. 4), &c.

Now I have found—and this is a very interesting fact—that in *Amphoriscus poculum* and in *Amphoriscus flamma* (Pl. V. fig. 3*b*), these subdermal triradiate spicules have precisely the same form as those of the cortex, the former differing from the latter only in the fact that one of their rays exceeds the others in length. According to the position of these subdermal triradiate spicules, their longer ray being directed centripetally, and their two remaining rays diverging towards the dermal surface, one would say that their longer ray is the basal. This, however, is not admissible. Its length being variable, there are in the species just named many subdermal triradiate spicules, which, if removed from the soft parts of the sponge, would certainly be confounded with the spicules of the cortex, and, as their position also is not quite constant, their rays lying sometimes in a plane forming an acute or an obtuse angle with the longitudinal axis of the sponge, the only deduction possible is that these subdermal triradiate spicules are nothing but spicules of the cortex, modified with respect both to their form and to their position, and that, consequently, their longer centripetally directed ray is one of the lateral rays. This conclusion is of great moment, for, in connection with other anatomical and embryological facts, before communicated, it presents a conclusive proof that the Sycones with non-articulated tubar skeleton owe their origin to Sycones whose tubar skeleton was articulated. The transformation of the first type into that characteristic of the family Leucones can now be followed step by step.

There are amongst the Sycones which are characterised by a non-articulated tubar skeleton, forms in which the radial tubes, instead of ending each with its own gastric ostium meet by threes, by fours, and even more around the same opening. This is the case, for instance, in *Amphoriscus elongatus*, n. sp., and, if we compare the corresponding picture (Pl. IV. fig. 5) with that showing the inner organisation of my *Leucilla connexiva* (Pl. VI. fig. 1*a*), the way in which the Leucones have been developed from the Sycones will be quite clear. What is to be regarded as an exceptional arrangement in a Sycon becomes the rule in a Leucon. The invagination of the gastric surface, shallow in the Sycon, becomes deep in the Leucon; the irregularities in the disposition of some of the subgastric and subdermal spicules also arise gradually, and it is not every one of these spicules which retains its place between two neighbouring radial tubes; this, moreover becomes physiologically unnecessary, for a diminution in the size of the radial tubes follows their rising towards the dermal surface. The invaginated part of the gastric cavity, presenting in its simplest form a cone without secondary lateral sacs, may produce branches in its own turn. We find this condition depicted in Pl. VI. fig. 2*a*.

The radial tubes—here more correctly called flagellated chambers—although still of cylindrical form are short and comparatively small, and though the subdermal quadriradiate and the subgastric triradiate spicules preserve their former disposition, there are to be found in the parenchyma spicules scattered without any evident order. Now the ramifying of the invaginated parts of the gastric surface may go further and further; hand in hand with this the flagellated chambers become smaller; their form also undergoes a modification; elongated in the preceding cases, they now grow more or less round. The intercanals, whose function is to provide the flagellated chambers with water, following the modification in the disposition of these latter, already somewhat irregular in the Sycones with non-articulated tubar skeleton, ramify more and more; it becomes quite impossible to find any order in the disposition of the spicules in the parenchyma; and if we examine Pl. VI. fig. 3*a*, which gives a true idea of the typical organisation of the Leucones, we shall find in the species to which the illustration refers (*Leuconia multiformis*, n. sp.) but one trace of its origin from the Sycones, viz., the subgastric triradiate spicules, which send their basal ray towards the cortex, their curved lateral rays lying in the plane of the gastric surface. These triradiate spicules being in most cases very thin in comparison with the stout triradiate ones of the parenchyma, no physiological signification can be assigned to them, and I think there can be no other explanation of their presence except that of a phylogenetic character. In *Leuconia typica*, n. sp., presenting a form closely allied to *Leuconia multiformis*, these interesting subgastric triradiate spicules are no longer to be found, and the spicules of the cortex, as well as those of the gastric surface, are the only constituent parts of the skeleton which follow a fixed law in their disposition. I do not speak of the quadriradiate spicules accompanying in certain species the exhalent canals in all their windings, for they are exact homologues of the quadriradiate spicules of the gastric surface. In some cases, for instance in *Pericharax* *carteri*, n. sp., or in *Leucetta hæckeliana* (Pl. VIII. fig. 1), these quadriradiate spicules being present in the exhalent and absent in the inhalent canals, both the systems of the canals can be readily distinguished from one another, and I am inclined to see in this fact an anatomical confirmation of the conceptions of Prof. F. E. Schulze,[1] according to whom the pavement-cells of the inhalent canal system are of ectodermic, those of the exhalent of endodermic, origin.

I have now to make a summary of my conclusions; I formulate them as follows:—

The Leucones are nothing but modified Sycones with non-articulated tubar skeleton; their flagellated chambers are complete homologues of the radial tubes; their exhalent canals owe their origin to the invaginations of the inner cavity, and their inhalent canals are to be regarded as homologous with the intercanals of the Sycones.

There are no further complications of the canal system in the group Leucones which require particular explanation; and now—since I have completed its definition, including its development, and since some corrections concerning Hæckel's statements as to the canal system of the Sycones have been made, as there is nothing to be added to Prof. Hæckel's description of this system in the Ascones—I can return to the important question put some pages before, whether the properties of the canal system can be really used as characters for the definition of families. It is quite evident that this question must be answered in the affirmative. For it is the canal system which is, in Calcarea, the principal vital organ, and it is the type upon which the mutual disposition of the component parts of the second important organ, the skeleton, as well as the greater or smaller development of the connective tissue, depends. And there are in the Calcarea, beside the form and the quality of the spicules and the external form of the animals, both of which are very variable, no other characters of systematic value. Most of them—some Ascones (Keller,[2] Barrois[3]), and very probably *all* Sycones and Leucones—have the same kind of development, characterised by the well-known Amphiblastula; and although the species *Ascetta blanca*, *Ascetta primordialis*, *Ascetta clathrus*, and probably some other Ascones, have a larva of a different type, this difference, even in the eyes of a professional embryologist, is of no greater value than to prompt him to the following remark:—"Wenn dies (development of some species of *Ascandra* like that of *Sycandra* and *Leucandra*,) sich durch unmittelbare Beobachtung bestätigen sollte, so würde das nur zeigen, dass zwischen der Gattung *Leucandra* und *Sycandra* eine nähere Verwandschaft als zwischen *Ascandra* und *Ascetta* besteht";[4] not that *Leucandra*, *Sycandra*, and *Ascandra* ought to be put together in order to oppose them systematically to *Ascetta*; and even this opinion, the embryological facts being of a very precarious nature, can still

[1] Die Plakiniden, *Zeitschr. f. wiss. Zool.*, Bd. xxxiv. p. 437, 1880.

[2] Ueber d. Anat. u. Entwick. einiger Spongien, 1876, p. 32.

[3] Embryologie, &c., p. 35.

[4] Even if this (development, &c.) should be confirmed by direct observation, it would merely show that between the genera *Leucandra* and *Sycandra* there is a nearer relationship than between *Ascandra* and *Ascetta*. E. Metschnikoff, *Zeitschr. f. wiss. Zool.*, Bd. xxxii. p. 370, 1879.

be disputed. We come, therefore, in accordance with Prof. Hæckel, to the conclusion that to the properties of the canal system the greatest systematic value must be assigned. It is, however, not to be forgotten that in different cases this value is not equal.

The canal system of the Leucones is nothing but a simple modification of that of the Sycones, and a modification in the direction of a further development. Not so with the Ascones as compared with the Sycones. As I endeavoured to show when discussing the question of the affinities of the Calcarea amongst themselves, the canal systems of both these families are products of quite different modes of development, that of the Ascones presenting a modification in one direction, that of the Sycones in another; and if we now give expression to this phylogenetic difference, the division of the Class Calcarea into two Orders becomes necessary.

But it is high time to state the arguments which lead me to regard the Calcarea as a Class and not as a Sub-class or Order. Of course, the systematic position of the group Porifera in the animal kingdom is at present ambiguous. It is, however, clear that, if the group is to be regarded as an independent type, this type is not to be opposed to all the other types combined, as Balfour has proposed, and, on the other hand, if the sponges are to be united with Cœlenterata, this could take place only if they were erected into a separate sub-type within this type. As far as the well-known hypothesis of the late Prof. Balfour[1] is concerned, I refer the reader to a detailed critique in Mr. Marshall's[2] paper "On the ontogeny of *Reniera filigrana*." What I may have to add on my own part will not occupy more than a few words. Balfour sees in the Amphiblastula a colony of Infusoria, and founds his further conclusions on the fact that the cells in the larva which become invaginated are not coarse-grained and dark-coloured, but transparent monociliated cells of cylindrical form (E. Metschnikoff,[3] F. E. Schulze[4]). It is, however, questionable whether the Amphiblastula is really a larva of primary characters.

There are Calcarea whose development is marked out by a larva of quite different type (Parenchymula), and Metschnikoff's Vergleichend-embryologishe Studien[5] make it very probable—if not certain—that it is indeed Parenchymula that shows the most primitive features of a Metazoon; and as the Blastula of the Calcarea in question presents a vesicle whose cellular elements do not differ one from another, it is evident that the chief character of the Amphiblastula is of a secondary nature. Its further development, viz., the invagination of the clear cylindrical cells, is indeed very striking, but this phenomenon is also common to the development of some other animals (*Lumbricus*, Kowalevsky,[6] *Oxyuris*, Natanson[7]), and this latter circumstance renders its value for any phylogenetic speculations still more dubious.

[1] *Quart. Journ. Micr. Sci.*, vol. xix. p. 103, 1879.
[2] *Zeitschr. f. wiss. Zool.*, Bd. xxxvii. p. 240, 1882.
[3] *Ibid.*, Bd. xxiv. p. 1, 1874.
[4] *Ibid.*, Bd. xxxi. p. 262, 1878.
[5] *Ibid.*, Bd. xxxvi. p. 433, 1881; Bd. xxxvii. p. 286, 1882.
[6] *Mém. Acad. St. Petersb.*, sér. 7, t. xvi. Mém. 12, p. 22, 1871.
[7] *Trans. Fifth Meeting of Naturalists in Warsaw*, Sect. of Zool. and Comp. Anat. (Russ.).

The Sponges also are not to be placed among the Cœlenterata as a class, as suggested by Ganin.[1] The peculiarities of their canal system, the early development of the mesoderm, the circumstance that it is just the mesoderm which in them gives origin to the generative products, and finally, the absence of cnidoblasta and nervous elements, these latter having been recently observed in the Hydroida also (Jickeli)[2]; all these differences taken together, though perhaps not justifying the establishment of a new type, are yet important enough to entitle the Sponges to occupy an independent subdivision of the Cœlenterata in the position of a sub-type. That within this sub-type, the Calcarea, constituting a quite isolated group, are to be opposed as an independent Class to all other Sponges is so evident that I hope no further arguments in favour of the position will be deemed necessary, and this Class I propose, in accordance with my foregoing statements, to divide into two Orders :—

Homocœla, including the single Family of Asconidæ (Ascones), and

Heterocœla, including the Families of Syconidæ (Sycones), Leuconidæ (Leucones), and Teichonidæ (Teichonia, Teichonellidæ).

The necessity for the establishment of this third Family, the Teichonidæ, having been urged some years ago by Mr. Carter,[3] who described two calcareous sponges which differ from all the Calcarea hitherto known, by one peculiarity of such vital importance that the establishment of a new Family was really the only issue. This peculiarity consists in the differentiation of the outer surface of the sponge into two quite different parts,—that bearing oscula and that bearing pores,—and I am the more disposed to agree with Mr. Carter, as I found amongst the Challenger Calcarea some specimens which are constant to the main character differentiating the genus *Teichonella*, C., from other Calcarea, although they differ from it in their general shape—which in a form so highly organised is not without significance—and in their spiculation so much that I really cannot place them as a third species in that genus, but must create a new one for their reception.

I have now done with Orders and Families; I return to the genera. It was stated that the properties of the constituent parts of the skeleton as to whether they be composed of triradiate, quadriradiate, or acerate spicules are by no means to be utilised as generic characters; and hence that the seven genera established by Prof. Hæckel in each of his three Families are not natural, but artificial.

How then is a natural classification to be devised? The answer is easy :—by the consideration of all the organs of the animal in their mutual correlation. Hæckel has pointed out the high systematic significance of the canal system, and he clearly understood, moreover, that the disposition of the spicules depends upon its modifications, and that the disposition of the spicules in its own turn influences their form. He dedicates to these questions a considerable number of pages (*loc. cit.*, Bd. i. pp.

[1] Contributions to the Anatomy and Embryology of the Sponges, Warsaw, 1879, p. 83 (Russ.).

[2] *Morphol. Jahrb.*, Bd. viii. p. 373; *Ibid.*, p. 580, 1882.

[3] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 35, 1878.

296–327), and, agreeing with him thoroughly upon the matter, I see no reason to repeat here what has already been quite sufficiently discussed. I refer the reader to the passages in question in the Monograph, and can only express my astonishment that Hæckel having made out the existence of the correlations above mentioned in such a brilliant manner, did not give them any application in his system.

It was, however, the right way, and if the following out of these principles amount to nothing with reference to the Asconidæ, it only proves, either that the Ascones are not to be divided into many genera at all, or that our knowledge of this group is insufficient. I think both suppositions have some truth in them. At all events, there is at present no possibility of giving a detailed system of this Order. The exterior shape is in this group—perhaps with exception of the forms provided with solid peduncle—really without any significance, at least it is quite unfit for the establishment of genera. The *Wagnerella* of Mereschkowsky,[1] proved to be a Protozoon[2], and, except the still doubtful *Mœbiusspongia parasitica*, Duncan,[3] there are in the Family only two groups which admit of a generic distinction, the distinction consisting in the differences of the embryonic development, characterised in some cases by Parenchymula, in others by Amphiblastula. Unfortunately the embryology of most of the Asconidæ is still surrounded by the mist of uncertainty, and it is only to five species (*Ascetta primordialis*, *Ascetta blanca*, *Ascetta clathrus*, *Ascandra lieberkühnii*, and *Ascandra contorta*,) that the foregoing remark can be applied. Therefore, till zoology shall have been enriched by more extended investigations upon this matter, I propose to unite provisionally all the Asconidæ under the same generic name, and, following the law of priority, I propose the name—

Leucosolenia, Bowerbank[4].

The necessity for such a temporary measure is by no means satisfactory, but still it is always better to confess frankly that our knowledge is imperfect, and that there remains much still to be done, than to allow ourselves to be led astray by the assurance, however flattering, that everything is already completed and the question exhausted.

We have every reason to consider ourselves much more advanced with respect to the Heterocœla. There are to be found characters of undoubted generic significance, *i.e.*, characters of sufficient constancy, and allowing numerous modifications, either in the direction of a further development, or in the direction of different variations. The nature of the spicules proclaimed by Prof. Hæckel as furnishing good generic characters, satisfies only the second condition, and therefore they are unfit for generic distinctions, apart from the consideration that in a group of such a low organisation as Calcarea a generic character

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. i. p. 70, 1878.
[2] Paul Mayer, *Zool. Anz.*, No. 32, p. 357, 1879.
[3] *Journ. Roy. Micr. Soc.*, vol. iii. p. 377, 1880.
[4] *Phil. Trans.*, London, vol. clii. p. 1093, 1862.

cannot be expressed by the property of a single organ, but must be of consequence for the whole structure of the animal. I hope the genera I am about to characterise will be found to be more "natural," and if my diagnoses be not quite sharp and have sometimes rather a conditional character, I must confess it is just in this that I see a reason for hoping that my genera are not artificial. Nature does not conform to our definitions, and if each of two genera, apparently closely allied one to the other, admit of a sharp, distinct diagnosis, it proves nothing but that the intermediate connecting forms do not now exist, but have died out.

In the Family of Syconidæ I distinguish the following six genera:—

1. *Sycon*, Risso[1] (sensu mutato).

Syconidæ with articulated tubar skeleton, with radial tubes either quite free or, if grown together, in such a manner that the individuality of every tube, owing to the absence of any independent cortex, may be easily discerned.

A detailed definition of this genus, as well as of the genera *Grantia* and *Amphoriscus*, has already been given. I group in it the following species:[2]—

Sycon primitivum, H.
sagittiferum, H.
coniferum, H.
ciliatum, F.
coronatum, E.S.
lingua, H.
quadrangulatum, S.
capillosum, S.
ampulla, H.
raphanus, S.
setosum, S.
villosum, H.
ramosum, H.

Sycon arcticum, H.
quadratum, Sch.
boreale, Sch.
schmidtii, H.
tabulatum, Sch.
elegans, Bk.
humboldtii, L.
barbadense, Sch.
arboreum, H.
gelatinosum, B.
utriculus, S.
hystrix, H.

[1] Hist. Nat. de l'Eur. mérid., vol. v. p. 368.

[2] B. = Blainville, Bk. = Bowerbank, C. = Carter, G. = Gray, E.S. = Ellis and Solander, F. = Fabricius, H. = Hæckel, J. = Johnston, L. = Lieberkühn, MM. = Miklucho-Maclay, R. = Ridley, S. = O. Schmidt, Sch. = Schuffner; n. sp. after the name of a species indicates, of course, that it is new; a ?, the doubt of the author as to whether the species is really to be placed in the genus.

2. *Grantia*, Fleming[1] (sensu mutato).

Syconidæ with articulated tubar skeleton, with radial tubes which have lost every trace of individuality, owing to the formation of a cortex, which is quite independent, however thin, its skeleton consisting mainly of triradiate spicules.

I include in this genus the following species :—

Grantia strobilus, H.	*Grantia perforata*, H.
cupula, H.	*compressa*, F.
lævigata, H.	*tuberosa*, n. sp.

3. *Ute*, O. Schmidt[2] (sensu mutato).

Syconidæ, the skeleton of whose strongly developed cortex consists principally of large acerate spicules, lying in several layers parallel to the outer surface.

There are at present only two forms which belong to this genus :—

Ute glabra, S.	*Ute argentea*, n. sp.

The main character distinguishing these two species is found in the properties of the tubar skeleton; in one case it is articulated, in the other non-articulated. This character is used by me with reference to the genera *Grantia* and *Amphoriscus* as a generic distinction, and of course it is possible that *Ute argentea* stands to the genus *Amphoriscus* in the same relation as *Ute glabra* to the genus *Grantia;* but so long as the embryology of *Ute argentea* is not known, there being no intermediate stages to decide the question, both the species must be united in one special genus since their main character so sharply differentiates them from all other Syconidæ.

4. *Heteropegma*,[3] n. gen.

Syconidæ with articulated tubar skeleton, the skeleton of whose strongly developed cortex, consisting of triradiate and quadriradiate spicules, is quite different from that of the parenchyma with respect to their size.

The tubar skeleton of this genus being articulated, it cannot be denied that the differences dividing *Heteropegma* from *Grantia* are quantitative rather than qualitative in nature. Yet the distinctions are great enough, and I am still more inclined to regard

[1] Hist. of Brit. Anim., p. 524, 1824.

[2] Spong. d. adriat. Meeres, Suppl. 1, p. 23, 1864.

[3] From ἕτερος—different, and πῆγμα—framework, skeleton.

Heteropegma as an independent genus, since it seems to play in the Family of Syconidæ the same part as *Leucetta* (s.m.) amongst the Leuconidæ, and this latter genus now contains four very good species. The agreement in the plan of organisation of both these genera is striking, and at first sight it would appear very likely that the genera *Leucetta* and *Heteropegma* form an independent branch in the genealogical tree of the Heterocœla, and consequently ought to be regarded as representatives of a new family. Still, in order to render this hypothesis plausible, it would be necessary—in view of the peculiarities of the internal organisation of *Heteropegma nodus gordii* (Pl. IV. fig. 1*a*)—to prove that the canal system of *Leucetta* has been developed from that of *Heteropegma* not by invagination of the inner surface between the radial tubes, but by the further ramification of the radial tubes themselves. Of course the possibility of such a transformation is not excluded; at any rate both are at present to be distributed in different families, the more so as there exists a form (*Leucetta imperfecta*, n. sp.) which on valid grounds can be regarded as a connecting link between the genera *Leucetta* and *Leuconia*.

The genus includes provisionally but one species :—

Heteropegma nodus gordii, n. sp.

5. *Amphoriscus*, Hæckel[1] (sensu mutato)

Syconidæ with non-articulated tubar skeleton, the supporting spicules of whose com paratively thin cortex are either triradiate or quadriradiate, or both triradiate and quadriradiate associated together.

I include in this genus the following species:—

Amphoriscus stauridia, H.	*Amphoriscus oviparus*, H.
urna, H.	*synapta*, H.
cyathiscus, H.	*sycilloides*, Sch.
cylindrus, H.	(?) *atlanticus*, R.
chrysalis, S.	*poculum*, n. sp.
glacialis, H.	*elongatus*, n. sp.
testiparus, H.	*flamma*, n. sp.

With regard to the systematic position of *Sycyssa huxleyi*, characterised by Hæckel amongst others also as having a non-articulated tubar skeleton, one can frame only conjectures. As described by Prof. Hæckel,[1] this very strange form stands quite isolated.

[1] Prodromus, p. 238.

6. *Anamixilla*,[2] n. gen.

Syconidæ without any special tubar skeleton, the supporting spicules of the parenchyma disposed in it like those in the Leuconidæ; in most cases, however, more or less parallel to the outer surface.

A certain analogy exists between *Anamixilla* and *Heteropegma*, and this analogy consists in the possession of a kind of spiculation which does not influence the form of the radial tubes. The tubar spicules of *Heteropegma* are too minute for it; the tubes of *Anamixilla* have no special skeleton at all, the spicules of their parenchyma showing an irregular "leuconoid" disposition. And, accordingly, the form of the radial tubes in both the cases is inconstant, they are of irregular outlines, may take an oblique course, and show an inclination to ramify.

The genus *Anamixilla* is hitherto represented by a single species :—

Anamixilla torresi, n. sp.

This species must undoubtedly be regarded as the representative of a new genus, for its organisation contains a new principle, and it is more than probable that there will be found Calcarea adhering to this principle, but presenting different variations in regard to the form and quality of their spicules.

I let the genus *Anamixilla* follow the genus *Amphoriscus;* a close relationship between these two genera cannot certainly be proved, but may be considered as very plausible, owing to the presence in my *Anamixilla torresi* of the peculiar subgastric triradiate spicules, so characteristic and of so great importance for most forms of the genus *Amphoriscus*. In *Anamixilla torresi* these subgastric sagittal spicules, compared with the large triradiate spicules of the parenchyma, are evidently too small and slender to be of any important physiological significance, and therefore can be regarded, not without reason, as an index of the phylogenetic affinities of the genus.

In the Family Leuconidæ I distinguish the following genera:—

Leucilla, Hæckel[3] (sensu mutato).

Leuconidæ with flagellated chambers of an elongated, cylindrical form, recalling that of the radial tubes of the Syconidæ, with the skeleton of the parenchyma bearing some traces of a certain regularity in the arrangement of its constituent parts, owing to the disposition of the subgastric and subdermal spicules opposite to each other.

[1] Kalkschwämme, Bd. ii. p. 259.

[2] From ἀναμίξ, confusedly, pell-mell.

[3] Kalkschwämme, Bd. ii. p. 132.

The properties of this genus have already been discussed in such a detailed manner that no further explanatory remarks are necessary. I ascribe to the genus *Leucilla* the following species :—

Leucilla connexiva, n. sp.	*Leucilla capsula*, H.
uter, n. sp.	(?) *crustacea*, H.
amphora, H.	(?) *echinus*, H.

Leuconia, Bowerbank.[1]

Leuconidæ with the spicules of the parenchyma, irregularly disposed throughout and with flagellated chambers of more or less regularly rounded contour.

The connecting link between the genera *Leucilla* and *Leuconia* I see in *Leuconia multiformis*, n. sp., the relationship resting upon grounds quite analogous to those which induced me to associate my genus *Anamixilla* with the genus *Amphoriscus*. But if the phylogenetic affinities of some species of *Leuconia* are clear, this is by no means the case with respect to many other forms, which for want of detailed comparative investigations are to be temporarily referred to the same genus. Moreover, I feel certain that, in the course of time, my *Leuconia* will be subdivided at least into four, possibly even into more, quite independent genera. I say this with reference, for instance, to the species *Leuconia alcicornis*, G., *Leuconia elongata*, Sch., *Leuconia cataphracta*, H., which I am quite sure will be sooner or later elevated to be the representatives each of a special genus. The same will probably take place with respect to the species *Leuconia johnstonii*, C., *Leuconia stilifera*, S., *Leuconia saccharata*, H., *Leuconia ochotensis*, MM.; and, on the other hand, with regard to the species *Leuconia fistulosa*, Bk., *Leuconia pumila*, Bk., *Leuconia levis*, n. sp. At present, however, the realisation of these subdivisions would be scarcely season able ; it will be well to await further and more detailed comparative investigations, and provisionally I group in the genus *Leuconia* all the Leuconidæ which do not belong either to the genus *Leucilla*, to the genus *Leucetta*, or to the genus *Pericharax*.

Leucetta, Hæckel[2] (sensu mutato).

Leuconidæ, the skeleton of whose strongly developed cortex is quite different from that of the parenchyma.

The peculiarities of this genus, which has an analogue amongst the Syconidæ in *Heteropegma*, consist in the possession of a strongly developed cortex and of two quite different skeletons, that of the cortical layer being characterised by large spicules, that of

[1] Brit. Spongiad., i. p. 164, 1864.

[2] Kalkschwämme, Bd. ii. p. 116.

the parenchyma by minute ones. These two characters are causally related to each other. A thick cortex with a strongly developed spiculation, presenting a solid support for the body of the Sponge, the parenchyma can extend itself on it like a crust, and the spicules of the parenchyma becoming unnecessary, grow small. I think that when, as for instance, in *Leucetta clathria*, H., the apical rays of the cortical quadriradiate spicules are strongly developed, these apical rays possess rather a defensive than supporting function; projecting from the inner surface their sharp ends present an armament protecting the inner cavity; and when such protection becomes useless, we see either that there are no quadriradiate spicules at all in the cortex (*Leucetta corticata*, H.), or very few, whose apical rays remain far short of the inner surface (*Leucetta hæckeliana*, n. sp.).

The genus is represented by five species, namely:—

Leucetta imperfecta, n. sp.	*Leucetta hæckeliana*, n. sp.
vera, n. sp.	*corticata*, H.

Leucetta clathria, H.

Two have been described by Hæckel, three were collected by the Challenger. I retain for the genus the name *Leucetta*, there being no doubt that the species described by Hæckel under the generic name of *Leucetta* prior to his *Leucetta corticata* all belong to the genus *Leuconia*.

Pericharax,[1] n. gen.

Leuconidæ with distinct subdermal cavities.

In vol. i. p. 237 of his Monograph, Prof. Hæckel states that the subdermal cavities (intermarginal cavities of Bowerbank) are of rare occurrence in the Calcarea, and that he met with them only in one case, namely, in his *Leucandra cucumis*. This is quite true; in most cases the inhalent canals in the same animal sometimes begin with a dermal dilatation, sometimes, on the contrary, they are narrow near the outer surface, and grow larger and broader in their centripetal course. *Leucandra cucumis* presents, however, an exception. Here, according to Hæckel, one can speak of real, well-marked subdermal cavities; they are all on an average of the same dimensions, of the same form, and even possess their own skeleton. The same I find in two specimens from Station 135 (Tristan da Cunha). In these forms the subdermal cavities, which are nothing but dilated dermal parts of the inhalent canals (intercanals), are not so strongly developed as in *Leucandra cucumis*, but are still quite distinct and also—at least in one specimen—

[1] From περί, around, and χάραξ, palisade.

possess their own skeleton, the spicules constituting their support being of quite a different form from all other spicules of the sponge. I think this peculiarity is important enough to be regarded as a generic character, and as there are in the Monograph of Prof. Hæckel nine Leuconidæ described under the name of *Leucandra* prior to our *Leucandra cucumis*, three of them being in addition quite new forms, I think it preferable to unite temporarily the forms with evident subdermal cavities under a new name. I propose the name *Pericharax*, till we receive more detailed information as to the systematic position of *Leucandra caminus*, H., *Leucandra lunulata*, H., and *Leucandra crambessa*, H.

The Family Teichonidæ consists at present of only two genera, of which the first is,—

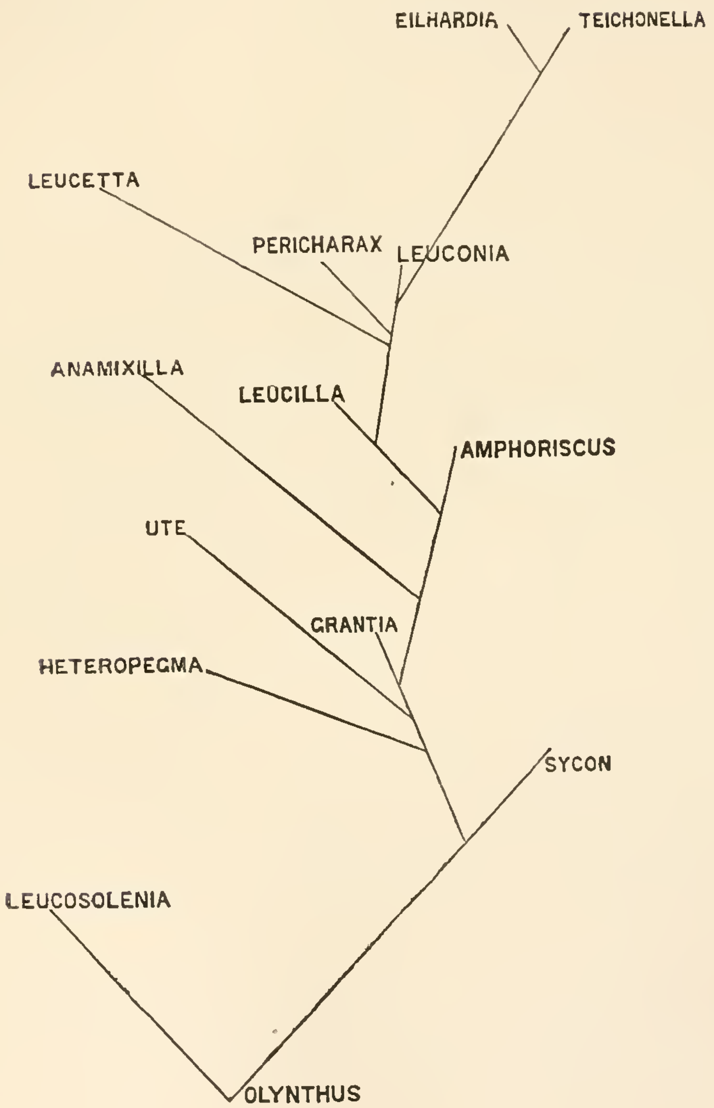
Teichonella, Carter.[1]

It contains two species, *prolifera* and *labyrinthica*, and Mr. Carter characterises it as follows :—"Vallate or foliate, without cloaca. Vents numerous, confined to the margin or general on one side of the lamina only; naked." This definition, compared with that given by Bowerbank[2] to his genus *Leucogypsia*, renders it evident that the expression "without cloaca" is used by Mr. Carter in a somewhat different sense. The Australian specimen of my *Leucondra dura* (Pl. II. fig. 3) would have been referred by Bowerbank to the genus *Leucogypsia*. Like *Leucogypsia gossei*, Bwk., it possesses no evident cloaca; still it does not belong to the Teichonidæ,[3] the main character of this Family consisting in the differentiation of the outer surface into two planes, one bearing oscula, the other pores exclusively. But whether the oscula in Teichonidæ are homologous with the oscula of Hæckel or the oscula of Bowerbank, it is difficult to say; the question can be decided only by means of embryological observations. Amongst the Challenger Calcarea I have a specimen (*Leuconia typica*, var. *massa*), provided with a low and comparatively broad, calyciform inner cavity. It may be that the oscular plane of our Teichonidæ is homologous with the surface of this calyciform cavity, and is nothing but the gastric surface of a Syconid or Leuconid, modified with respect to its form and position. It may also be that the Teichonidæ are allied to the forms like my *Leuconia dura*, *i.e.*, that a Teichonid is, from a morphological point of view, a colony with dislocated oscula and pores. It must be noticed that, in view of F. E. Schulze's statements as to the ontogeny of *Sycandra raphanus*, this latter supposition is more plausible. At any rate the peculiarity in question is to be considered as a family character, the more so as there is no possibility of putting my *Eilhardia* in the genus *Teichonella* as a species, the differences in the spiculation and exterior form being too considerable. The diagnosis of this genus will be as follows :—

[1] *Ann. and Mag. Nat. Hist.*, ser. 5, vol. ii. p. 39, 1878.
[2] Brit. Spongiad., vol. i. p. 165, 1864.
[3] Mr. Carter (*loc. cit.*, p. 35) calls the Family "Teichonia" and "Teichonellidæ" indifferently. In order to render it uniform with the names Asconidæ, Syconidæ, and Leuconidæ, I propose to call it Teichonidæ.

Eilhardia, n. gen.

Teichonidæ of calyciform shape; that surface which carries pores supported by triradiate and minute acerate spicules, that which bears oscula supported by large acerate spicules.



I have now finished my account of the genera; their conjectural mutual phylogenetic affinities may be expressed graphically by the above diagram.

The first half of my task is therewith accomplished, and the best conclusion I can give to it will consist in signalising the merits of the investigator whose name has been so frequently repeated in these pages. Of Prof. Hæckel's statements many have proved to be erroneous, but it must not be forgotten that it was his Monograph that called forth and facilitated later investigations, and if we are forced to agree to a certain extent with the judgment of M. Barrois upon the work just mentioned, that "l'imagination y a trop souvent pris la place de l'observation scientifique et froide," every one will also agree with the other judgment of the same naturalist, that with the appearance of Prof. Hæckel's Monograph "l'histoire des Éponges entra dans une phase nouvelle."[1]

I might now pass on to the description of the forms brought home by the Challenger Expedition. I prefer, however, at this point to summarise the few observations of histological interest which I was able to make during the examination of the Challenger material. I have already spoken of the interesting modifications which the pavement-cells undergo under certain circumstances. The flagellated cells are so sensitive to every kind of preservation that I can state nothing new about their properties.

There consequently remains only the mesoderm to be discussed. Besides its usual cellular elements, distinguished by Prof. Schulze[2] as amœboid and stellately ramified cells, which I was able to discern in all the Challenger Calcarea, in two cases (*Ute argentea* and *Leuconia multiformis*) I observed some very remarkable elements which seem to be intimately connected with the formation of the skeleton. Their form is shown on Pl. VI. fig. 3*c*. In comparison with the other elements of the mesoderm, these cells are pretty large, but flatly compressed, and forming with their protoplasm—perhaps under the influence of the preservation in alcohol—a kind of irregular network; all are provided with a comparatively large oval, or round nucleus. Such cells I found always in twos and threes upon spicules, upon large acerate spicules of *Ute argentea*, and large triradiate spicules of the parenchyma of *Leuconia multiformis*. It is known (Metschnikoff[3]) that calcareous spicules develop in the interior of the mesodermic cells. It may, however, happen—and this is very plausible—that in the cases where the spicula reach a considerable size, some other mesodermic cells are also concerned in their growth.

In addition to the spicules, there are in the sponge generative elements which in their turn are products of the mesoderm. Indubitable young ova—at least in large numbers—I have observed only in two cases: in *Leucetta vera* and in *Pericharax carteri*. In *Pericharax carteri* the ova were of the extraordinary size of 0·3 mm. in diameter, and seemed, like ova of *Spongilla* (Ganin[4]), to be surrounded by an endothelium. Larvæ I found in the following species:—*Sycon raphanus*, *Sycon arcticum*,

[1] Embryologie, &c., p. 8.
[2] *Zeitschr. f. wiss. Zool.*, Bd. xxv. Suppl. p. 253, 1875.
[3] *Ibid.*, Bd. xxxii. p. 370, 1879.
[4] Contributions, &c., p. 14.

Heteropegma nodus gordii, *Leucilla uter*, *Leuconia typica*. In all these cases the larvæ belonged to the type known under the name of Amphiblastula.

As far as the spermospores are concerned, I can only corroborate my former statements[1] as to their existence in the Calcarea, as well as in reference to the mode of their development. I have observed them in *Leucosolenia poterium* (?), in most of the Syconidæ, in *Leucilla uter*, *Leuconia multiformis*, *Leuconia typica*, *Leucetta hæckeliana*, *Eilhardia schulzei*, in *Sycon arcticum* and *Leucilla uter* together with Amphiblastulæ. In one specimen of *Leucosolenia poterium* (?) the spermospores were pretty numerous; but in almost all cases I found them outside the walls of the sponge, close to the flagellated cells. I was not able to account for this strange phenomenon, till Dr. Vosmaer kindly showed me this spring in Naples some sections with spermospores made from an Asconid exceedingly well preserved. As the observation belongs to Dr. Vosmaer and not to me I cannot here enter into particulars; I can only say that what I have seen in his preparations gives a very simple explanation of how Prof. Hæckel arrived at his statements[2] as to the endodermic origin of the spermospores. Be that as it may, their *mesodermic* origin is beyond all doubt, and, apart from the Syconidæ and Leuconidæ, I found in one case in the same *Leucosolenia poterium* (?) one spermospore lying quite obviously in the mesoderm. No mistake was possible, for it was found in a spot forming a common meeting-point of several branches of the colony, so that the mesoderm appeared in the section, not as usually happens in the Asconidæ as a, so to speak, mathematical line, but as a plane of comparatively broad surface. In this (Pl. III. fig. 1), as well as in other instances, a thin membrane around the spermospore was to be discerned very easily. In two cases this membrane had a slight thickening upon it as represented in the figure just alluded to, which I am inclined to regard as corresponding to the place of the nucleus of the covering cell. This supposition will appear to the reader very natural if he compare the picture just mentioned with the fig. 2*f*, Pl. VI. representing two spermospores of *Leucilla uter*. The few spermospores I was able to discover in *Leucetta hæckeliana* were found lying, not in the parenchyma, but in the cortex, not very far, however, from the zone of the flagellated chambers (Pl. VIII. fig. 2).

It is a very interesting fact that the mode of development of the spermospores, as I have described it in *Sycandra raphanus*, by no means seems to be confined to the Class Calcarea. I have also found the same in a horny sponge (an Aplysinid), and I shall return to the matter in my Report on the Challenger Keratose Sponges; and as in the form just mentioned the spermospores are also very small, there can—in view of F. E. Schulze's statements as to the spermatogenesis in *Aplysilla*,[3] *Spongelia*,[4] and

[1] *Sitzungsb. d. math.-naturw. Cl. d. k. Akad. d. Wiss. Wien*, Bd. lxxxvi. p. 277, 1882.

[2] Kalkschwämme, Bd. i. p. 150.

[3] *Zeitschr. f. wiss. Zool.*, vol. xxx. p. 412, 1878.

[4] *Ibid.*, vol. xxxii. p. 145, 1879.

Hircinia,[1]—be but one alternative possible: either the physiological explanation I have given[2] of the existence in the spermospores of a covering cell is really right, or, if the covering cell is of a more profound morphological signification, it ought to be present in the spermospores of all the Sponges. This last supposition is, of course, very plausible; I must add, however, that hitherto my search for this structure in *Aplysilla* and *Halisarca* has proved unsuccessful.

[1] *Ibid.*, vol. xxxiii. p. 28, 1880.

[2] *Loc. cit.*, p. 292.

II.—DESCRIPTION OF SPECIES.

Class CALCAREA, Bowerbank.

Porifera whose skeleton is composed of calcareous spicules.

Order HOMOCŒLA, Poléjaeff.

Calcarea without separate flagellated chambers, the whole of whose inner surface is covered with flagellated cells.

Family Asconidæ (Ascones), Hæckel.

Of the characters of the Order.

Leucosolenia, Bowerbank.

Of the characters of the Family.

Leucosolenia poterium (?) Hæckel, sp. (Pl. III. figs. 1, 2).

Ascetta primordialis, var. *poterium*, Hæckel, Kalkschwämme, Bd. ii. p. 16.
Clathrina poterium, Ridley, Proc. Zool. Soc. Lond., 1881, p. 133.

One of the four varieties established by Prof. Hæckel for his *Ascetta primordialis*, the variety *poterium* has recently been elevated by Mr. Ridley to the rank of an independent species. In this course Mr. Ridley was supported by the fact that the sponge, having been previously found only in Australia, was also dredged in the year 1878 in Tom Bay, south-west Chili, and proved, furthermore, to be constant in its main characters, notwithstanding the distance between these two localities. As properties distinguishing the

Note.—The technical terms:—gastric, subgastric, tubar, subdermal, and dermal, are used here with the meanings applied to them by Hæckel in his Kalkschwämme. All the measurements were made with instruments by R. Winkel, of Göttingen. The specimens were examined by means of sections stained with picro-carmine and mounted in Canada balsam. The indication of the colour refers to the specimens preserved in spirit.

form in question from *Ascetta primordialis*, H., Mr. Ridley states—1, that the minimum diameter of its largest spicule-rays exceeds 0·02 mm.; and 2, that it possesses a special dermal set of triradiate spicules, considerably larger than those subjacent to them.

Now I have numerous specimens from the Australian coast, all of which, presenting the auloplegma-form and being provided with pseudostomata, differ from *Clathrina poterium*, R., only in one important character, viz., the presence in the membrane of the pseudostome of sagittal, occasionally irregular triradiate, spicules, of the size of the smaller subdermal spicules, and just of the same form as the oscular triradiate spicules in my *Leuconia dura* (Pl. VII. fig. 7). If my supposition be true, and if such triradiates were wanting in the Australian specimens examined by Prof. Hæckel, and in the American ones described by Mr. Ridley—all these specimens having always presented the auloplegma-form—only for the reason that the delicate pseudostomial membrane was torn off in the dredging,—the species *Leucosolenia poterium* would receive still sharper determination, both by its constancy in form (auloplegma) and by the presence of peculiar triradiate spicules in the peristomial membrane. This latter character I consider to be particularly important, for the triradiate spicules in question I find in all the specimens I have of my conjectural *Leucosolenia poterium*, while with respect to the special dermal set of larger triradiate spicules, these specimens present a series of transition-forms, beginning with those whose outer spicules are almost of the same size as those of the interior of the colony, and ending with forms whose dermal triradiate spicules are, each ray, 0·3 mm. long, and 0·035 mm. in diameter; in all these cases the rays of the subdermal spicules, in accordance with Prof. Hæckel's statements, being 0·12 to 0·18 mm. long, and 0·006 to 0·01 thick. Some subdermal spicules show an incipient fourth ray.

I found in the specimens neither ova nor larvæ, and the spermospores, sparsely scattered here and there, were the only generative elements I observed in the examination (Pl. III. figs. 1 and 2).

Colour.—White and yellowish.

Habitat.—Station 163, April 4, 1874; lat., 36° 56′ S., long., 150° 30′ E.; off Twofold Bay, Australia; depth, 120 fathoms,.

Leucosolenia lamarckii, Hæckel, sp.

Ascaltis lamarckii, Hæckel, Kalkschwämme, Bd. ii. p. 60.

The two specimens of this species were found attached side by side to an alga, both presenting the auloplegma-form, and each being provided with a pseudostome. The larger specimen has rounded angles, the smaller is an oval cylinder; the longitudinal axis of the larger attains a length of 9 mm., that of the smaller one does not exceed 5 mm. The measurements of the spicules agree with those of Hæckel for his *Ascaltis lamarckii*, var. *agassizii*; all the spicules, however—not only the larger triradiate—showing a tendency towards sagittal differentiation, and the rays of the larger triradiate spicules being of still greater dimensions and rather stouter. They attain the length of 0·5 mm. with a diameter of 0·06 mm. I do not think that these differences would justify the establishment of a new variety.

Hitherto *Leucosolenia lamarckii* has been found only in the Atlantic; its distribution is now extended into the Pacific.

Colour.—White.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth 30 to 35 fathoms; rock.

Leucosolenia blanca, Miklucho-Maclay, sp. (Pl. I. fig. 2; Pl. III. fig. 3).

Guancha blanca, Miklucho-Maclay, Jenaische Zeitschr., Bd. iv. p. 220, 1868.
Ascetta blanca, Hæckel, Kalschwämme, Bd. ii. p. 38.

No auloplegma-forms of *Leucosolenia blanca* had previously been observed with well-developed peduncle. Miklucho-Maclay (*loc. cit.*, p. 223) states that the Sponge can occasionally sink down instead of growing upright, and extend upon the ground in the form of a bolster. Such bolster-like specimens are the only colonies presenting the auloplegma-form, but their peduncles become rudimentary. Now both the specimens of this species collected by the Challenger, although without any trace of the osculum, are provided with a peduncle one and a half times as long as the longitudinal axis of the colony itself. Taking into consideration that the specimens observed by Miklucho were found in shallow water, while those of the Challenger Expedition, on the contrary, were dredged up from the depth of 450 fathoms, and further, that while no colonial specimens of Miklucho-Maclay exceeded 3 to 4 mm. in length, and 1·5 to 2·5 mm. in diameter, the larger Challenger specimen is 25 mm. long, with a broadest diameter of 15 mm.; taking all this into consideration, I think it very probable that the typical *Leucosolenia blanca* belongs to the comparatively deep-water forms. If this could be proved, the possession of a solid peduncle might be used as a generic character, and a new genus, *Guancha*, established amongst the Asconidæ. This conjectural genus would consist of *Leucosolenia blanca*, presenting a transition form to the sessile Asconidæ, of the species described by Metschnikoff,[1] and characterised by the horn-shaped triradiate spicules in the peduncle, and of my *Leucosolenia challengeri*.

Future investigations will decide the question, and meanwhile I establish for my two specimens a third variety with the following diagnosis:—

Leucosolenia blanca, var. *bathybia* (Pl. I. fig. 2).—Basal ray of the triradiate spicules not more than 1·2 to 1·5 times as long as lateral rays.

[1] Spongiologische Studien, *Zeitschr. f. wiss. Zool.*, Bd. xxxii. p. 361, 1879.

As I remarked before, the peduncle is solid, the endodermic cavities of the adjacent tubes not extending deeper than its superior part. Its cellular elements consist of amœboid cells, distinguished by very large granules (Pl. III. fig. 3); there are also amongst them common amœboid cells, such, for instance, as F. E. Schulze[1] describes in *Sycandra raphanus*. The same elements are also to be found in the mesoderm of the tubes, but much more sparsely than in the peduncle. The outer epithelium of the tubes proved also to be coarse-grained; that of the peduncle could not be discerned. I regard these coarse-grained mesodermic cells as carrying nutritious elements, and explain their predominence in the peduncle by its solidity.

The larger Challenger specimen is represented in Pl. I. fig. 2.

To the habitat of *Leucosolenia blanca*, as given by Hæckel (*loc. cit.*, p. 39), must be added the Mediterranean Sea. The Sponge has been found in the Gulf of Naples (Vosmaer[2]), and there are also at the Institute in Graz some specimens from the Adriatic.

Colour.—Pale yellowish.

Habitat.—Station 75, July 2, 1873; lat. 38° 37′ N., long. 28° 30′ W.; off the Azores; depth, 450 fathoms; sand.

Leucosolenia challengeri, n. sp. (Pl. I. fig. 1; Pl. III. fig. 4).

This form can be distinguished from other species of *Ascetta*, in the sense of Hæckel, by the presence of a special set of triradiate spicules covering the outer surface of the colony, these spicules being all sagittal, while the triradiate spicules of the interior are all regular. The only specimen I find in the Challenger collection presents the soleniscus-form, the diameter of the tubes, *i.e.*, individuals of the colony, varying from 0·3 to 0·8 mm.; the pseudopores are still narrower, rarely exceeding 0·28 mm. in diameter; the oscula, sparsely scattered here and there, possess the same dimensions, or are rather larger. The whole forms an irregularly oval body 30 mm. long and 20 mm. broad in its thickest part, presenting a compact web of minute tubes and terminating in a short (2 mm.) peduncle. This latter is solid, at least in its interior part, and so far as the state of preservation permits one to judge, contains cellular elements like those in the peduncle of *Leucosolenia blanca*.

Skeleton.—Two forms of spicules are to be distinguished,—regular and sagittal triradiate.

The regular spicules are very like those of *Leucosolenia coriacea*, John., var. *multicavata*, H. (Kalkschwämme, Bd. ii. p. 25); their rays (0·18 mm. long) are slender (16 to 20 times

[1] Ueb. d. Bau. u. Entw. v. Sycandra raphanus, *Zeitschr. f. wiss., Zool.*, Bd. xxv., Suppl. p. 253, 1875.

[2] Voorloopig berigt omtrent h. onderzoek aan de Nederl. werktafel in h. Zool. St. te Napels, Haag, 1881, p. 5.

as long as thick), cylindrical, with rounded ends; the basal ray is sometimes rather longer than the lateral; some of them show an incipient fourth apical ray.

The sagittal triradiate spicules are on an average of the same size as the regular; their rays, compared with those of the latter, are more conical, although there is no want of intermediate stages. They are inconstant in their outlines. With some of them the irregularity consists only in their not being flat, the point of meeting of the rays not lying in the same plane as their ends, the basal ray being in this case either of the length of the lateral rays or rather longer; but such a form is comparatively rare. The greater part also show variation in their angles, the angle formed by the basal and each of the lateral rays varying from 120° to 92°; the length of the basal ray is in this case variable (0·12 to 0·25 mm.); it is either straight or undulating, the lateral rays being horn-shaped, and curved more or less one towards the other.

There exists also on the outer surface of the colony another constituent part of the dermal set, namely, large regular triradiate spicules, each ray attaining a length of 0·8 mm., and a diameter of 0·06 mm.; but these spicules are so extremely rare, that they are of no consequence for systematic purposes.

Colour.—Yellowish.

Habitat.—Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; Cape York, Australia; depth, 8 fathoms; coral sand.

Order HETEROCŒLA, Poléjaeff.

Calcarea with separate flagellated chambers lined with flagellated cells, the remaining parts of the inner surface being covered with pavement-epithelium.

Family Syconidæ (Sycones), Hæckel.

Heterocœla whose large cylindrical flagellated chambers (*tubi radiales*, auctorum), show a radial disposition with respect to the central cavity, communicating with it directly without the mediation of any exhalent canals.

Sycon, Risso.

Syconidæ with articulated tubar skeleton, with radial tubes either quite free or, if grown together, united in such a manner that the individuality of every tube may be easily discerned, owing to the absence of any independent cortex.

Sycon raphanus, O. Schmidt.

Sycon raphanus, O. Schmidt, Spong. d. adriatisch. Meeres, Bd. i. p. 14, 1862.
Sycandra raphanus, Hæckel, Kalkschwämme, Bd. ii. p. 312.

There are amongst the Challenger Syconidæ two specimens which I determine as *Sycon raphanus*, var. *tergestinum*, H., their skeleton presenting no difference from that of the variety just named, and the chief specific character of *Sycon raphanus*, *i.e.*, the slenderness of the subgastric triradiate spicules in comparison with other spicules of the skeleton, being expressed very clearly. Most of these slender spicules are clearly triradiate, some of them are provided with a short apical ray, rarely exceeding 0·05 mm. in length. This is, however, no special character of the Challenger specimens; I have also observed it in those from the Adriatic, and think it to be common to the whole species. Both the specimens proved to be full of Amphiblastulæ.

Colour.—Pale yellowish.

Habitat.—Station 135, October 16, 1873. Island of Tristan da Cunha. Depth, 60 to 90 fathoms; rock, shells. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Sycon arcticum, Hæckel, sp. (Pl. III. fig. 5).

Sycandra arctica, Hæckel, Kalkschwämme, Bd. ii. p. 353.

Sycon arcticum can be easily distinguished from all other species of the genus by the equal size of its tubar, gastric, and subgastric spicules, by their slenderness, and by the circumstance that most of the tubar spicules are not triradiate but quadriradiate, with a more or less developed apical ray.

There is also, according to Hæckel, another more important distinction, viz., the absence of the intercanals; but we have already seen that this is erroneous. The intercanals are in *Sycon arcticum*, as in every *Sycon*, in their usual places, and their course is represented on Pl. III. fig. 5. Both the Challenger specimens of the species, one from the Philippine Islands, the other from the Bermuda Islands, must be determined as var. *maximum*, H. I did not find any generative elements in the former; but, on the contrary, the specimen from the Bermuda Islands proved to be full of larvæ (Amphiblastulæ) and spermospores.

Sycon arcticum has hitherto been considered to be an exclusively arctic sponge; its distribution must now be extended southwards, but it is to be noticed that while its arctic forms belong to the largest of the Syconidæ, their body reaching 50 mm. in length

(Hæckel), neither of the Challenger specimens exceeds 18 mm., including the collar fringed by fine linear acerate spicules 4 mm. in length.

Colour.—White and yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms; mud. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Sycon arboreum, Hæckel, sp. (Pl. I. fig. 4).

Sycandra arborea, Hæckel, Kalkschwämme, Bd. ii. p. 331.

There are four specimens of this Sponge in the Challenger collection, each presenting a colony of 9 to 13 individuals (Pl. I. fig. 4). The measurements of the spicules agree with those of Hæckel, the only differences being the length of the apical ray of the gastric quadriradiate spicules, which, usually exceeding the extreme length of 0·08 mm. given by Hæckel, not seldom reaches 0·25 mm., and the length of the acerate spicules of the collar, which are never longer than 1 mm., and often still shorter (0·5 to 1 mm.). The specimens were not particularly well preserved, but nevertheless, strange to say, the epithelium of the outer surface could be discerned more perfectly than I had ever seen it before, even by the aid of the osmic acid and gold methods. Accordingly, the course of the intercanals could be studied very easily, and I must state that the intercanals and the radial tubes of *Sycon arboreum*, as well as those of *Sycon elegans*, *Sycon raphanus*, *Sycon quadrangulatum*, &c., are by no means regular enough to admit of their geometric outlines being utilised for systematic purposes (Hæckel [1]), much less for the subdivision of the genus into sub-genera. Moreover, such a subdivision is unnecessary, for all the species of *Sycon* hitherto described can be very easily distinguished one from another by means of other characters.

The Challenger specimens of *Sycon arboreum*, like those examined by Hæckel, are all from the southern or eastern coast of Australia.

Colour.—Dirty yellowish.

Habitat.—Station 162, April 2, 1874; off East Moncœur Island, Bass Strait, Australia; depth, 38 to 40 fathoms; sand.

Grantia, Fleming.

Syconidæ with articulated tubar skeleton, with radial tubes which have lost every trace of individuality, owing to the existence of a thin, yet quite independent, cortex, its skeleton consisting principally of triradiate spicules.

[1] Kalkschwämme, Bd. ii. p. 290.

Grantia tuberosa, n. sp. (Pl. I. fig. 6; Pl. III. figs. 6–13).

This Sponge differs from all other species of the genus by its large acerate spicules, which sometimes stand perpendicularly to the surface of the Sponge, but usually turn down into the parenchyma, not only piercing it in an oblique direction, but also—and this is very often the case—lying parallel to the outer surface, and thus either perpendicularly to the longitudinal axis of the Sponge, or parallel to it, or forming with it a more or less acute angle. This is a very interesting fact, for it indicates how a cortex of acerate spicules longitudinally disposed,—the chief character of the genus *Ute*—might have taken origin.

The species is represented in the Challenger collection by a complete specimen and some fragments. The first is of tubular form with extended base, 15 mm. long and 6 mm. broad in the middle; the thickness of the walls reaches 1 mm., the diameter of the osculum 2·25 mm. On one side of the outer surface are to be seen two nodular prominences, perpendicular to the longitudinal axis of the Sponge—probably incompletely developed gemmæ. Such a transverse gemmation has been also observed in *Amphoriscus stauridia* (Hæckel[1]). The outer surface is smooth, the inner surface slightly roughened by the apical rays of the gastric quadriradiate spicules. The radial tubes are irregular in their outlines, and show a tendency to ramify; the tubar pores are in this species larger and more numerous than I have ever seen them; the disposition of the tubar spicules is not so regular as is usually the case in the tubes with articulated skeleton.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate or quadriradiate, of tubar triradiate, of large acerate, of minute cortical acerate, and of cortical sagittal and irregular triradiate spicules.

Gastric quadriradiate spicules.—All the rays of the same diameter (0·012 mm.), tapering from the base to sharp points; basal ray straight, often rather shorter than lateral rays, these latter being on an average 0·3 mm. long; lateral rays smooth, either straight or slightly curved, forming with basal ray an angle of about 115°; apical ray curved, rarely longer than 0·08 mm.

Subgastric triradiate spicules.—All the rays of the same diameter (0·02 mm.); basal ray straight, tapering from the base to a sharp point, reaching 0·38 mm. in length, forming with each of the lateral rays an angle of about 110°; lateral rays sharp-pointed, curved, often undulating, either lying in the same plane with basal ray or forming with one another an angle varying from 180° to 165°. Many of the subgastric triradiate spicules are provided with embryonal fourth rays, occasionally reaching 0·04 mm. in length, but half as thick as the other rays.

Tubar triradiate spicules.—All the rays sharp-pointed, of the same diameter (0·02 mm.), lying in the same plane; basal ray straight, its length varying from 0·12 to 0·28 mm.; lateral rays curved outwards, often undulating, 0·25 mm. long, each forming with basal ray an angle varying from 112° to 130°.

[1] Kalkschwämme, Bd. ii. p. 246.

Large acerate spicules.—Either straight or slightly curved, spindle-shaped, tapering from the middle to a sharp point at either end, reaching 1·2 mm. in length and 0·065 mm. in diameter.

Minute acerate spicules.—Of the same form as the large acerate spicules, on an average 0·05 mm. long and 0·0025 mm. thick; scattered without any order in heaps, or isolated amongst the cortical triradiate spicules.

Sagittal triradiate spicules of the cortex.—Lateral rays smooth, sharp-pointed, either straight or slightly curved, either inwards or outwards, forming with the basal ray an angle varying from 90° to 100°; 0·1 to 0·3 mm. long, the proportion between the length and the thickness varying from 20 : 1 to 35 : 1; basal ray straight, tapering from the base to a sharp point, three to five times as short and usually twice as thin as the lateral rays.

Irregular triradiate spicules of the cortex.—All the rays approximately of the same size, reaching 0·07 mm. in length, 0·003 mm. in diameter. Too rare to be of any systematic importance.

Colour.—White.

Habitat.—Off St. Vincent, Cape de Verde Islands; July, 1873.

Ute, O. Schmidt.

Syconidæ, the skeleton of whose strongly developed cortex consists principally of large acerate spicules lying in several layers parallel to the outer surface of the Sponge.

Ute argentea, n. sp. (Pl. I. fig. 3; Pl. IV. fig. 3; Pl. V. fig. 1*a*–1*p*).

There is in the Challenger collection only one specimen of this species; it presents an elongated tube, 40 mm. long, with a diameter of 3 mm., becoming rather narrower at either end. The thickness of the walls does not exceed 0·5 mm., that of the cortex reaches 0·25 mm.; the outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The specimen is bare-mouthed, and like the second species of the genus, *Ute glabra*, distinguished by the silvery lustre of its outer surface. The radial tubes are of cylindrical form; their course, as well as that of the intercanals, can be seen on Pl. IV. fig. 3. The tubar skeleton is non-articulated, and this is the chief character differentiating *Ute argentea* from *Ute glabra*.

Skeleton.—The skeleton of *Ute argentea* is so very complicated, that I prefer to describe it in separate divisions as follows:—

Skeleton of the gastric surface.—This consists of an outer layer of quadriradiate, of an inner layer of quadriradiate or triradiate, and of minute acerate spicules, scattered amongst those just mentioned without any regular order.

Outer quadriradiate spicules.—Basal and lateral rays straight, sharply or rather bluntly pointed, all of the same diameter (0·01 mm.), and usually of the same length (0·25 mm. on an average); basal ray forming with each of lateral rays an angle of 115°; apical ray curved, tapering from the base to a sharp point, reaching 0·15 mm. in length with a diameter of 0·01 (Pl. V. fig. 1*d*).

Inner quadriradiate spicules.—Basal ray straight, tapering from base to sharp point, usually rather thinner than lateral rays, forming with each of them an angle of about 100°, length inconstant, varying from 0·18 mm. to 0·5 mm.; lateral rays curved inwards, tapering from the base to sharp points, reaching 0·3 mm. in length, 0·0125 mm. in diameter; most of them are truly quadriradiate, their apical ray being occasionally longer (0·2 mm.) than that of the outer quadriradiate spicules; its length is, however, variable, and there are amongst the inner quadriradiate spicules others with a merely embryonal apical ray, and even quite deprived of it (Pl. V. figs. 1*e*, 1*f*).

Minute acerate spicules.—Straight or slightly curved, spindle-shaped, tapering from the centre to a sharp point at either extremity, usually 0·1 mm. long, 0·002 mm. in diameter.

Skeleton of the radial tubes.—The tubar skeleton consists of subgastric triradiate spicules, reaching with their centrifugally directed basal ray the zone of the cortical acerate spicules, of tubar acerate spicules lying parallel to the basal ray just mentioned, and of tubar quadriradiate spicules scattered here and there at the bottom of the radial tubes.

Subgastric triradiate spicules.—All rays of the same thickness (0·013 mm.); basal ray straight, tapering from the base to a sharp point, its average length 0·3 mm.; lateral rays slightly curved inwards, forming with basal ray an angle varying from 100° to 110°, rarely exceeding 0·15 mm. in length (Pl. V. fig. 1*a*).

Tubar quadriradiate spicules.—All rays in different planes, lateral rays forming one curve, basal and apical rays another; basal ray bluntly pointed, cylindrical, 0·0025 mm. thick, rarely longer than 0·003 mm.; lateral rays straight or slightly curved, tapering from the base to sharp points, each forming with basal ray an angle of about 110°, reaching 0·05 mm. in length, with a diameter of 0·002; apical ray slightly curved, sharp-pointed, of the same diameter as lateral rays, but usually three times shorter (Pl. V. fig. 1*g*).

Tubar acerate spicules.—Straight or slightly curved, tapering from the centre to sharp points, rarely longer than 0·3 mm., with a diameter of 0·005.

Skeleton of the cortex.—The skeleton of the cortex consists of large spindle-shaped acerate, of minute acerate, and of sagittal triradiate spicules, with the basal ray directed towards the closed end of the Sponge.

Large acerate spicules straight or slightly curved, tapering from the centre to a sharp point at either end; length varying from 1 to 3 mm., diameter from 0·05 to 0·12 mm.

Minute acerate spicules.—Like those of the gastric surface spindle-shaped, straight, or slightly curved, tapering from the centre to the sharp points; rarely exceeding 0·15 mm. in length, and 0·0028 mm. in diameter.

Sagittal triradiate spicules.—Basal ray smooth, either of cylindrical form or tapering from the base to a sharp point, reaching 0·75 mm. in length, with a diameter of 0·005; lateral rays sharp-pointed, forming with basal ray an angle of 112°, either straight or more frequently slightly curved, usually inwards, twice as thick as basal ray; length inconstant, varying from 0·025 mm. to 0·12 mm.

Colour.—White.

Habitat.—Station 163, April 4, 1874; lat. 36° 56′ S., long. 150° 30′ E.; depth, 120 fathoms; off Twofold Bay, Australia.

Heteropegma, n. gen.

Syconidæ with articulated tubar skeleton, the supporting skeleton of whose strongly developed cortex consists of triradiate and quadriradiate spicules, quite different in size from those of the parenchyma.

Heteropegma nodus gordii, n. sp. (Pl. I. fig. 7; Pl. IV. figs. 1*a*–1*d*).

This species, represented in the Challenger collection by two specimens, forms colonies of a rather Asconoid appearance. The tubes, sometimes standing vertically, sometimes lying horizontally, ramify and interlace, thus constituting a kind of knot in which neither beginning nor end can be discerned. The individuality of the tubes is expressed only by oscula, these latter being naked. In one specimen, from Australia, the oscula are numerous, while, if present at all, they seem to be much more scanty in the other, from Bermudas. It must be said, however, that this latter specimen was quite crushed and crumpled.

The size of the oscula is inconstant, varying from 0·25 to 1 mm. in diameter. Both the surfaces are rough. The average thickness of the walls is 1 mm., the diameter of the inner cavity 1 mm. in the Australian specimen, 2 mm. in that from Bermudas. The radial tubes are of irregular outline, and show a great tendency to ramify (Pl. IV. fig. 1*a*).

The specimen from Bermudas proved to be sterile; but in the radial tubes of that from Australia I found some Amphiblastulæ.

Skeleton.—The skeleton consists of minute tubar and gastric quadriradiate, of much larger triradiate and quadriradiate cortical, and of triradiate oscular, spicules.

Skeleton of the parenchyma.—The typical modifications of the tubar and gastric quadriradiates are represented on Pl. IV. fig. 1*a*; there are also amongst them triradiate spicules of the same outlines and size, but they are not numerous. The tubar quadriradiate spicules are regular, their rays either tapering from the base to a sharp point, or of cylindrical form with truncated ends; in both cases the proportion between the length and the thickness of the rays at their base remaining the same (30 : 1), their length being 0·06 mm., their diameter 0·002 mm. These regular spicules of the radial tubes are connected by all possible intermediate stages with sagittal and irregular quadriradiate spicules supporting the inner surface. Constant as to the thickness of their rays, only near the osculum exceeding 0·002 mm., the gastric quadriradiate spicules vary extremely with regard to the comparative length of the rays, as well as with regard to their form and their angles. The apical rays, which, in the tubar quadriradiates do not exceed the length of the facial rays, and are often still shorter, grow much longer in the gastric quadriradiate spicules, and near the oscular part of the tube attain 0·18 mm. in length, 0·005 mm. in diameter, the corresponding facial rays rarely exceeding the length of 0·06 mm., the lateral rays remaining of the same diameter (0·005 mm.), the basal ray growing rather thinner.

Skeleton of the cortex.—The triradiate and quadriradiate spicules of the cortex are regular, their rays sharp-pointed, more or less stout, the proportion between their length and thickness varying from 6 : 1 to 12 : 1. With respect to their dimensions, the quadriradiate are connected with the triradiate spicules by intermediate stages; the length of the rays of the quadriradiate reaching 1 mm., that of the rays of the triradiate not exceeding 0·6 mm. These spicules lie apart from the centripetally directed apical ray of the quadriradiate spicules, parallel to the outer surface, but the direction of their basal rays is variable.

Skeleton of the osculum.—The skeleton of the border of the oscular circle consists exclusively of rectangular sagittal triradiate spicules, marked out by their horn-shaped lateral rays, lying parallel to the line of the border. Their size is extremely inconstant, the length of the rays varying from 0·05 to 0·25 mm., and the proportion between the length and the thickness from 10 : 1 to 20 : 1 The comparative length of the basal ray is also variable; in most cases, however, this ray is shorter and rather thinner than the lateral.

Colour.—Yellowish-grey.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 186, September 8, 1874; lat. 10° 30′ S., long. 142° 18′ E.; Cape York, Australia; depth, 8 fathoms; coral sand.

Amphoriscus, Hæckel.

Syconidæ with non-articulated tubar skeleton, the supporting spicules of whose comparatively thin cortex are either triradiate or quadriradiate, or both triradiate and quadriradiate together.

Amphoriscus poculum, n. sp. (Pl. IV. fig. 4; Pl. V. figs. 2*a*–2*f*).

The single specimen representing this species in the Challenger collection is of tubular elongated form, 36 mm. long. 4 mm. broad in its middle and superior part; towards the closed end the tube becomes rather narrower. The individual is bare-mouthed; the outer and inner surfaces are slightly roughened by the cortical and gastric triradiate spicules respectively; the average thickness of the walls does not exceed 0·6 mm.

From the species showing the closest relation to it, *Amphoriscus poculum* can be distinguished by the following characters:—from *Amphoriscus stauridia* (*Sycetta stauridia*, H., Kalkschwämme, Bd. ii. p. 245), by the presence of acerate spicules; by the sagittal dermal and gastric triradiate spicules, the corresponding ones in *Amphoriscus stauridia* being regular; by the irregular subdermal triradiate spicules, which are sagittal in *Amphoriscus stauridia*. From *Amphoriscus sycilloides* (*Sycortis sycilloides*, Schuffner[1]) it is distinguished by the presence of acerate spicules in the body of the Sponge itself, which occur in *Amphoriscus sycilloides* only in the peristome; by the sagittal subgastric triradiate spicules, these being irregular in *Amphoriscus sycilloides;* and by the form of the dermal and gastric triradiate spicules.

Skeleton.—The skeleton consists of gastric triradiate, of subgastric triradiate, of subdermal triradiate, of dermal triradiate and of acerate spicules.

Gastric triradiate spicules.—Sagittal; all rays in the same plane, and of the same diameter (0·015 mm.); basal ray straight, tapering from the base to a sharp point, length inconstant, usually one and a half times as long as lateral rays, often much shorter; lateral rays curved outwards, cylindrical, either sharply or rather bluntly pointed, each forming with basal ray an angle of about 110°, 0·25 mm. long on the average.

Subgastric triradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm.); basal ray straight, tapering from the base to a sharp point, usual length 0·38 to 0·45 mm; lateral rays sharp-pointed, curved, often angularly bent in their middle or basal part, rarely exceeding 0·275 mm. in length, forming with each other an angle varying from 170° to 140°, and with the basal ray an angle varying from 100° to 120°.

Subdermal triradiate spicules.—Irregular; all rays usually of the same thickness (0·015 mm.), but of different lengths, lying in the same plane; basal ray straight, tapering from the base to a sharp point, rarely exceeding 0·1 mm. in length, occasionally rather thinner than lateral rays, forming with each of these latter an angle of about 120°; lateral rays curved forwards, sharp-pointed, of different lengths, the longer, directed centripetally, reaching 0·35 mm., often, however, considerably shorter, scarcely longer than the shorter lateral ray, the length of which varies from 0·12 to 0·15 mm. The reasons which led me to regard the centripetally directed ray as one of the laterals are expounded in the morphological part of this memoir (p. 18).

Dermal triradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm.), usually sharp-pointed; basal ray straight, length inconstant, not exceeding 0·425 mm.; lateral rays curved, each forming with basal ray an angle of about 120°; average length, 0·25 mm.

Acerate spicules.—Usually spindle-shaped, often lanceolate, sharp-pointed; the lanceolate straight, the spindle-shaped either straight or slightly curved; attaining a length of 1 mm., and a diameter of 0·05 mm.; a few much shorter and stouter, the proportion between the length and the thickness being 6 : 1. Sparsely scattered in the parenchyma, their free

[1] *Jenaische Zeitschr.*, Bd. xi. p. 420, 1877.

ends projecting from the outer surface being usually broken off; piercing the wall perpendicularly to the longitudinal axis of the Sponge.

Colour.—Pale-yellowish.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Amphoriscus elongatus, n. sp. (Pl. IV. fig. 5; Pl. V. figs. 4*a*–4*e*).

This species is represented in the Challenger collection by one specimen in the form of an elongated tube, 50 mm. long., 3·5 mm. broad, growing rather narrower towards the lower end; near its free end the Sponge divides into two tubes, standing close together, and each terminating with a naked osculum. The outer surface is roughened by the cortical spicules, the inner surface is similarly roughened by the apical rays of the gastric quadriradiate spicules. The thickness of the walls does not exceed 0·6 mm. By its subdermal quadriradiate spicules the species can be distinguished from *Amphoriscus glacialis* (*Sycaltis glacialis*, H.), the corresponding spicules in the form just named being triradiate; the subgastric triradiate spicules differentiate this form from *Amphoriscus oviparus, urna, chrysalis*, &c., the corresponding spicules being represented in these latter species by quadriradiate ones.

The important anatomical peculiarity of *Amphoriscus elongatus*, namely, the tendency of the radial tubes to meet in threes, in fours, or in larger numbers around the same shallow invagination of the gastric cavity, is represented on Pl. IV. fig. 5.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of subdermal quadriradiate, of dermal triradiate, and of minute dermal acerate spicules, sparsely scattered in the cortex perpendicularly to the outer surface of the Sponge.

Gastric quadriradiate spicules.—All rays of the same diameter (0·016–0·02 mm.), either sharply or bluntly pointed; basal ray straight, reaching 0·45 mm. in length, forming with each lateral ray an angle varying from 115° to 122°; lateral rays either straight or slightly curved inwards, usual length 0·25 mm.; apical ray stout, curved, its length not exceeding 0·18 mm.

Subgastric triradiate spicules.—Sagittal; rays of the same dimensions and showing the same variations with regard to their angles as those of the corresponding spicules in *Amphoriscus poculum*, the sole distinction concerning the form of the lateral rays, these latter being not angularly curved but undulating. In accordance with the strong development of the subdermal quadriradiate spicules, the subgastric ones are not numerous, and show a tendency to grow smaller and thinner.

Subdermal quadriradiate spicules.—Sagittal; all rays sharp-pointed, usually of the same dimensions, their average length being 0·6 mm. and diameter 0·07 mm.; basal ray—occasionally rather shorter than lateral rays—straight; lateral rays slightly curved inwards, each forming with basal ray an angle of about 118°; apical ray straight, either of the length of facial rays or rather longer.

Dermal triradiate spicules.—Basal ray straight, tapering from base to sharp point, with a diameter of 0·015 mm.; length inconstant, not exceeding 0·45 mm.; lateral rays straight, cylindrical, rarely longer than 0·25 mm., one and a half times as thick as basal ray, each forming with this latter an angle of about 115°.

Dermal acerate spicules.—Slender, spindle-like, attaining a length of 0·1 mm. and a diameter of 0·0025 mm.

Colour.—Pale yellowish.

Habitat.—Station 145, December 27, 1873; lat. 46° 40′ S., long. 37° 50′ E.; off Prince Edward Islands; depth, 310 and 150 fathoms.

Amphoriscus flamma, n. sp. (Pl. I. fig. 5; Pl. V. figs. 3*a*–3*g*).

The species is represented in the collection by a colony of twenty tubular individuals, almost all of which are turned towards the same side, the whole producing the effect of the many tongued flame of a wood fire blown by the wind from the vertical direction. Each individual is provided with an osculum fringed by fine linear acerate spicules. The outer surface of the tubes is bristly, the inner surface is roughened by the apical rays of the gastric quadriradiate spicules. The diameter of the tubes is in different individuals of different sizes, varying from 3 to 7 mm. The average thickness of the walls is 1 mm. The form to which *Amphoriscus flamma* shows the closest relation is *Amphoriscus poculum*, but the presence of quadriradiate, the number of acerate, and the larger size of the subgastric and subdermal triradiate spicules necessitate the establishment of a new species.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of subdermal triradiate, of dermal triradiate, and of stout acerate spicules, piercing centripetally the wall of the Sponge, and projecting from the outer, often also from the inner, surface, as well as of fine acerate spicules of the osculum.

Gastric quadriradiate spicules.—Basal ray straight, either sharply or bluntly pointed, 0·15 to 0·25 mm. long, forming with each of the lateral rays an angle of about 125°; lateral rays curved outwards, of cylindrical form, length varying from 0·3 to 0·45 mm.; apical ray curved, 0·15 mm. long or less, usually sharply, not seldom bluntly pointed, like the lateral rays 0·01–0·0125 mm. thick, the basal ray being either of the diameter of the other rays or rather thicker.

Subdermal triradiate spicules.—Of the same form as the corresponding spicules in *Amphoriscus poculum*, but of different dimensions; all rays of the same diameter (0·03 mm.); average length :—basal ray 0·28 mm., shorter lateral ray 0·38 mm., longer lateral ray 0·5 mm.

Subgastric triradiate spicules.—Just of the same form as the subgastric triradiate spicules in *Amphoriscus elongatus*, but of larger size; basal ray reaching 0·7 mm., lateral rays 0·36 mm. in length, and 0·045 mm. in diameter. Some are provided with a rudimentary fourth ray.

Dermal triradiate spicules.—Sagittal; all rays of the same diameter, the proportion between the length and the thickness varying from 10 : 1 to 18 : 1; lateral rays curved forwards, reaching 0·5 mm. in length, each forming with basal ray an angle of about 120°; basal ray straight, its length not exceeding that of lateral rays, usually still shorter.

Stout acerate spicules.—Either spindle-shaped or of irregular form (Pl. V. fig. 3*c*); straight or slightly curved, some reaching over 2 mm. in length, with a diameter of 0·1 mm., most not exceeding 1 mm. in length and 0·06 mm. in diameter.

Fine acerate spicules of the peristome.—2 mm. and above in length and 0·0025 mm. in diameter, occasionally still thinner, sharp-pointed at both ends, the free end being, however, broken off in most cases.

Colour.—White.

Habitat.—Bahia; shallow water.

Anamixilla, n. gen.

Syconidæ without any special tubar skeleton, the supporting spicules of the parenchyma disposed in it like those in the Leuconidæ; in most cases, however, more or less parallel to the outer surface.[1]

Anamixilla torresi, n. sp. (Pl. IV. figs. 2*a*–2*c*).

The single specimen of *Anamixilla torresi* of the Challenger collection presents a colony of tubular individuals of similar aspect to *Amphoriscus flamma*; some individuals are bare-mouthed, some mouthless. The thickness of different individuals varies from 1 to 9 mm.; the width of the walls is more constant, reaching 1 mm. on the average. The inner surface is slightly roughened by the apical rays of the gastric quadriradiate, the outer surface in a still higher degree roughened by the cortical triradiate spicules.

Skeleton.—The skeleton consists of gastric quadriradiate, of gastric triradiate, of subgastric triradiate, of parenchymal triradiate, and of dermal triradiate spicules.

Gastric quadriradiate spicules.—All rays of the same diameter (0·02 mm.); basal ray straight, either sharply or bluntly pointed, of conical form, length varying from 0·16 to 0·4 mm., occasionally rather thicker than lateral rays, forming with each of these an angle of about 115°; lateral rays curved outwards, often slightly undulating, tapering from the base to a sharp point, usual length 0·35 to 0·4 mm.; apical ray curved, sharply pointed, its length not exceeding 0·06 mm.

Gastric triradiate spicules.—Rays smooth, tapering from the base to sharp points, reaching 0·4 mm. in length, with a diameter of 0·015 mm.; basal ray straight, lateral rays slightly

[1] With the exception of the subgastric triradiate spicules, disposed like those in the genus *Amphoriscus*, if these be not an exclusive attribute of the only species of the genus hitherto known, *Anamixilla torresi*.

curved inwards, each forming with basal ray an angle of about 110°; some of them are provided with embryonic apical rays, reaching occasionally 0·2 to 0·3 mm. in length.

Subgastric triradiate spicules.—Sagittal; lateral rays either lying in the same plane or forming with one another an angle varying from 180° to 140°; all rays of the same diameter, varying from 0·02 to 0·05 mm.; basal ray straight, tapering from the base to a sharp point, reaching 0·8 mm. in length; lateral rays curved, often undulating, usually half as long as basal ray, often of the same length, occasionally even longer, not exceeding, however, 0·8 mm.

Triradiate spicules of the parenchyma.—Either quite regular, or showing a slight tendency to sagittal differentiation; rays sharply pointed, maximum size about 1 mm., diameter varying from 0·1 to 0·125 mm.

Dermal triradiate spicules.—Regular, more slender than the triradiate ones just described; rays either tapering from the base to sharp points or of cylindrical form; average size of the rays 0·3 mm. in length by 0·02 mm. in diameter.

Colour.—Pale yellowish.

Habitat.—Torres Strait, Australia, September 7, 1874; depth, 3 to 11 fathoms.

Family Leuconidæ (Leucones) Hæckel.

Heterocœla, whose usually round flagellated chambers communicate with the central cavity not immediately but by means of its more or less deep lateral invaginations (exhalent canals), the corresponding opening of the flagellated chambers being of less diameter than that of the subjacent exhalent canals; with quite irregular disposition of the spicules in the parenchyma.

Leucilla, Hæckel (sensu mutato).

Leuconidæ with flagellated chambers of an elongated, cylindrical form, recalling that of the radial tubes of the Syconidæ, with the skeleton of the parenchyma bearing traces of a certain regularity in the arrangement of its constituent parts, owing to the disposition of the subgastric and subdermal spicules directly opposite to each other.

Leucilla connexiva, n. sp. (Pl. VI. figs. 1*a*–1*e*).

I can give but little information with regard to the external shape of this species. There is not in the Challenger collection one complete specimen of this interesting form, but only some fragments which have fortunately proved quite fit for anatomical examination. Both the surfaces are rather rough; the thickness of the walls is about 0·8 mm.; the disposition of the openings of the exhalent canals is far from being so regular as that of the gastric openings of the radial tubes. The internal structure can be seen on Pl. VI. fig. 1*a*, but it must be noticed that, occasionally, the exhalent canals, like those in *Leucilla uter*, n. sp., give origin to secondary lateral invaginations.

Skeleton.—The skeleton consists of gastric triradiate, of subgastric triradiate, of triradiate spicules of the parenchyma, of subdermal and dermal triradiate spicules.

Gastric triradiate spicules.—All rays more or less cylindrical; basal ray straight, thinner than lateral rays, average size 0·325 by 0·015 mm.; lateral rays either straight or slightly curved outwards, each forming with basal ray an angle of about 110°; size 0·2 to 0·325 by 0·02 mm.

Subgastric triradiate spicules.—Sagittal; all rays of the same diameter of 0·028 mm.; basal ray straight, tapering from the base to a sharp point, reaching 0·55 mm. in length, forming with each of the lateral rays an angle varying from 110° to 120°; lateral rays sharp-pointed, slightly undulating, rarely longer than 0·3 mm., forming with each other an angle varying from 170° to 145°.

Triradiate spicules of the parenchyma.—All rays of the same diameter, not exceeding 0·045 mm., usually sharp-pointed; basal ray straight, forming with each of the lateral rays an angle varying from 115° to 120°, length inconstant, not exceeding 0·4 mm.; lateral rays either straight or slightly curved, often undulating, attaining a length of 0·5 mm., forming with one another an angle varying from 180° to 150°; not numerous, more or less imitating in their disposition the subgastric triradiate spicules.

Subdermal triradiate spicules.—In general of the same form as the corresponding spicules in *Amphoriscus poculum* and *Amphoriscus elongatus*. All rays of the same diameter (0·02–0·025 mm.), sharp-pointed; basal ray straight, rarely longer than 0·18 mm., forming with the longer lateral ray an angle of about 110°, with the shorter of about 118°; lateral rays curved outwards, the shorter often undulating, its length not exceeding 0·2 mm., the longer curved only at its base, almost straight further on, attaining a length of 0·4 mm. These spicules are disposed in such a manner that the angle formed by the basal ray and the shorter of the lateral rays is turned to the outer surface, the longer lateral ray being directed centripetally.

Dermal triradiate spicules.—More or less stout, the proportion between the length and the thickness of the rays varying from 7 : 1 to 12 : 1, some almost regular, all rays being of the same length, not exceeding 0·8 mm., and their angles of 120°; most either sagittal or irregular, the deviations consisting either in the differentiation of the plane of the ends of the rays and that of their crossing, or in the unequal length of the rays, or in the sagittal differentiation of the angles formed by basal and lateral rays, these angles varying from 120° to 125°, and the corresponding lateral rays growing rather curved outwards.

Colour.—Dirty yellowish.

Habitat.—Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Leucilla uter, n. sp. (Pl. VI. figs. 2*a*–2*f*).

From *Leucilla connexiva*, the form I am about to describe can be distinguished by its subdermal quadriradiate spicules, and by the absence of special cortical spicules, the function of these latter being performed by the facial rays of the quadriradiate spicules just mentioned. The main character differentiating *Leucilla uter* from *Leucilla amphora*, H., and *Leucilla capsula*, H., consists in the presence of the subgastric triradiate spicules, the corresponding ones being in these latter forms quadriradiate (Kalkschwämme, Bd. ii. p. 132, and p. 134).

The external form of this Sponge is variable; the specimen from the Bermudas is of irregular outline, presenting a sack 10 mm. wide at the bottom, and 8 mm. broad at the free end, the length of the longitudinal axis being 12 mm. Both the specimens from the Philippine Islands are of tubular elongated form, growing narrower towards both ends, the smaller specimen (the size of the larger could not be measured, its lower end having been broken off) reaching a length of 60 mm. with a maximum diameter of 7 mm., that of the larger specimen being 13 mm. The walls of this latter are 2 mm. thick, those of the smaller specimen 1 mm., those of the specimen from the Bermudas 1·5 mm. In all these specimens the outer surface is roughened by the cortical spicules, the inner surface bristly, owing to the apical rays of the gastric quadriradiate spicules, curved as usual towards the free end of the Sponge.

The specimen from the Bermudas was found to contain spermospores, and more or less developed larvæ (Amphiblastulæ).

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric triradiate, of parenchymal quadriradiate, of dermal quadriradiate spicules (not differing with regard to their form and size from those of the parenchyma), and of fine dermal acerate spicules.

Gastric quadriradiate spicules.—Sagittal; all rays of the same diameter (0·02 mm. on an average), more or less sharply pointed; basal ray straight, length inconstant, varying from 0·25 to 0·35 mm., forming with each of the lateral rays an angle of about 110°; lateral rays curved outwards, reaching a length of 0·4 mm.; apical ray curved, half as long as lateral rays. Towards the osculum these quadriradiate spicules grow smaller (lateral rays 0·3 mm. long, with a diameter of 0·0125 mm.), the concave lateral rays becoming straight and convex.

Subgastric triradiate spicules.—Sagittal, of the form of the corresponding spicules in *Leucilla connexiva*, but marked out by a great variability in the absolute and relative length of their rays; all rays sharp-pointed and of the same diameter, the proportion between their length and thickness varying from 12 : 1 to 20 : 1; length, as above mentioned, inconstant, not exceeding, however, 0·6 mm. in basal, and 0·42 mm. in lateral rays; some are provided with a rudimentary fourth apical ray.

Quadriradiate spicules of the parenchyma and dermis.—All rays of the same diameter, rarely exceeding 0·05 mm.; facial rays usually of the same length, varying from

0·4 (rarely shorter) to 0·6 mm.; basal ray straight, tapering from the base to an approximately sharp point, forming with each of the lateral rays an angle of 105° to 110°; lateral rays either straight or slightly curved inwards, sharp-pointed; apical ray straight, tapering from the base to a sharp point, never projecting from the inner surface, length varying from 0·4 to 1·2 mm.

Dermal acerate spicules.—Straight, fine, linear, sharp-pointed, surface smooth, length not exceeding 0·4 mm., with a diameter of 0·0025 mm.; not numerous; projecting from the outer surface.

Colour.—White and yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms.

Leuconia, Bowerbank.

Leuconidæ with an irregular disposition of the spicules of the parenchyma throughout; with roundish flagellated chambers.

Leuconia multiformis, n. sp. (Pl. I. fig. 8; Pl. II. fig. 1; Pl. VI. figs. 3*a*–3*c*; Pl. VII. figs. 1*a*–1*h*).

There are in the Challenger collection more than fifteen specimens, which, however different with regard to their external shape, are to be all referred to this species; two of the most typical representatives may be seen drawn in their natural size on Pl. I. fig. 8, and Pl. II. fig. 1. The chief character distinguishing this form from all the species of *Leuconia* hitherto known—so far at least as the existing descriptions permit us to form a judgment—is to be found in its subgastric triradiate spicules, which are of the same shape as those in *Amphoriscus* and *Leucilla*. It is for the last time that we meet with this interesting shape, and here in *Leuconia multiformis* they are in most cases so slender, in comparison with other constituent parts of the skeleton of the parenchyma, that their phylogenetic signification seems to be beyond all doubt. At any rate, together with peculiarities in form and size of other spicules of the skeleton, they present a character allowing of a distinct definition of the species.

According to the greater or less predominance of the large acerate, and to the presence or absence of minute acerate spicules, I subdivide the species into three varieties with the following diagnoses:—

Leuconia multiformis, var. *goliath*.

Outer surface naked, acerate spicules either not projecting at all from the cortex or standing isolated at greater or less distances from one another. On the gastric surface triradiate spicules more numerous than quadriradiate.

Leuconia multiformis, var. *capillata*.

Outer surface fur-like; osculum usually fringed with fine linear acerate spicules; gastric skeleton consisting mainly of the quadriradiate form.

Leuconia multiformis, var. *amorpha*.

Gastric skeleton, besides triradiate and quadriradiate, consisting also of minute acerate, spicules, sometimes lying isolated, sometimes filling all the interstices between the triradiate and quadriradiate spicules just mentioned. Outer surface more or less bristly. The minute acerate spicules are occasionally to be found in the parenchyma and on the outer surface too.

One of the specimens belonging to the variety *goliath* attains a length of 233 mm., and is the largest calcareous sponge hitherto known. The external form of the varieties *goliath* and *capillata* is that of an elongated tube; the specimens of the variety *amorpha* in the collection are of irregular outline, rather sac-like. The varieties *amorpha* and *goliath* are from Bermudas, the variety *capillata* from Zebu.

Skeleton.—The skeleton consists of gastric quadriradiate and triradiate, of subgastric triradiate, of quadriradiate and triradiate spicules belonging to the parenchyma, of dermal triradiate, of large acerate, of minute acerate, and of fine linear acerate spicules of the peristome.

Gastric quadriradiate and triradiate spicules.—Basal ray straight, tapering from the base to a sharp point, usually half as long as lateral rays, with a diameter of 0·02 mm.; lateral rays slightly curved inwards, of rather cylindrical form, yet sharply pointed, each forming with basal ray an angle of 100° to 105°, average size 0·45 by 0·015 mm.; apical ray of the same thickness (0·015 mm.), curved, sharply pointed, length varying from 0 to 0·15 mm.

Subgastric triradiate spicules.—Sagittal; all rays of the same average diameter (0·035 mm.), smooth, tapering from the base to an approximately sharp point; basal ray straight, its length not exceeding 0·75 mm.; lateral rays undulating, forming with each other an angle varying from 180° to 150°, rarely exceeding 0·45 mm. in length.

Quadriradiate spicules of the parenchyma.—To be found only in the walls of the exhalent canals, too rare to be of any systematic significance; usually of the form and size of gastric quadriradiate spicules, sometimes twice as long and thick, with lateral rays curved outwards; this latter form is connected with the common gastric quadriradiate by intermediate stages.

Triradiate spicules of the parenchyma.—All rays of the same average diameter (0·065 mm.), either lying in the same plane throughout their whole length or bent in such a manner that the plane of the junction of the rays is different from that of their ends; sharp-pointed, rarely longer than 0·7 mm., the comparative length of basal ray being slightly inconstant; some quite regular, the greater part sagittal, the angle formed by basal and each of lateral rays varying from 120° to 110°. There are also in the parenchyma spicules of approximately the same dimensions, characterised by a rudiment of the fourth ray, by the undulating lateral rays, and by the comparative length of the basal ray—twice as long as the lateral. I cannot decide whether these are modified triradiate spicules of the parenchyma or of the subgastric region, or quadriradiate spicules of the parenchyma grown considerably larger. They are not numerous.

Dermal triradiate spicules.—Sagittal; all rays in the same plane, either rather cylindrical or tapering from the base to a sharp point; basal ray straight, lateral rays curved outwards, each forming with basal ray an angle of about 120°; absolute length very variable, in most cases lateral rays 0·4 mm.; basal ray 0·3 to 0·4 mm., the proportion between the length and the thickness of the rays being 20 : 1.

Large acerate spicules.—Usually not longer than 6 mm., occasionally reaching 10 mm. (var. *goliath*—immediately under the osculum, projecting from the inner surface), with a diameter never exceeding 0·05 mm.; either spindle-shaped, tapering at either end from the centre to a sharp point, or lanceolate; occasionally of irregular outlines, one end being sharp-pointed, the other truncated or irregularly spherical.

Linear acerate spicules of the peristome.—Attaining a length of over 5 mm., with a diameter of 0·005 mm., either straight or slightly curved.

Minute acerate spicules.—Spindle-shaped, tapering from centre to sharp points, rarely exceeding 0·125 mm. in length, and 0·0025 mm. in diameter.

Colour.—White, cream-white, and dirty yellowish.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 209, January 22, 1875; lat. 10° 10′ N., long. 123° 55′ E.; Philippine Islands; depth, 95 to 100 fathoms; mud.

Leuconia typica, n. sp. (Pl. VII. figs. 2*a*–2*c*).

The three specimens representing this species in the Challenger collection are to be referred to two varieties with the following diagnoses :—

Leuconia typica, var. *tuba:* tubular, gastric cavity narrow elongated; apical rays of gastric quadriradiate spicules not longer than 0·06 mm., usually still shorter; fine linear acerate spicules reaching 0·3 mm. in length.

Leuconia typica, var. *massa:* lumpy, stout, massive, the longitudinal axis shorter than the transverse; gastric cavity considerably reduced, calyciform; apical rays of gastric quadriradiate reaching 0·1 mm. in length; fine acerate spicules not longer than 0·15 mm.

Both the specimens of the variety *tuba* are 25 mm. long, the average thickness of the walls being 3 mm. The specimen of the variety *massa* is 8 mm. high, 18 mm. broad at its lower end, and the average thickness of its walls reaches 5 mm. In both varieties the outer and inner surfaces are rough. In its spiculation the species shows a close relation both to *Leuconia multiformis* and to *Leuconia caminus* (*Leucandra caminus* H.), but still the differences are considerable. The main character separating the form in question from *Leuconia multiformis* is the absence of sagittal subgastric triradiate spicules; by its distinctly sagittal dermal triradiate spicules the species can be also very easily distinguised from *Leuconia caminus.*

The round flagellated chambers in this species have particularly regular outlines, and are smaller than in any other case, their diameter rarely exceeding 0·04 mm. In one specimen of the variety *tuba*, I discovered many spermospores, but unfortunately it was not well preserved. The specimen of the variety *massa* proved to be full of Amphiblastulæ.

Skeleton.—The skeleton consists of gastric quadriradiate spicules, quadriradiate spicules of the parenchyma, not differing however, either in form or size, from those of the gastric surface, triradiate spicules of the parenchyma, of dermal triradiate and of parenchymal acerate spicules.

Gastric quadriradiate spicules.—Basal ray straight, tapering from the base to a sharp point usually shorter (0·18 mm.) and rather thinner than lateral rays, forming with each of these latter an angle varying from 105° to 110°; lateral rays more or less cylindrical, either straight or slightly curved forwards, rarely exceeding 0·225 mm. in length, with a diameter of 0·015 mm.; apical ray curved, more or less sharply pointed, in the var. *tuba* wedge-shaped, length not exceeding 0·06 mm., in the var. *massa* reaching 0·1 mm. In both cases, however, the length of the apical ray is variable, and there are amongst the quadriradiate spicules many triradiate spicules also.

Triradiate spicules of the parenchyma.—Most quite regular; rays straight, smooth, tapering from the base to sharp points; reaching 0·75 mm. in length and 0·065 mm. in diameter.

Dermal triradiate spicules.—Sagittal; all rays of the same length, rarely exceeding 0·35 mm., and of the same diameter (0·02 mm.), either tapering from the base to sharp points, or of a more cylindrical form; basal ray straight, lateral rays curved forwards, forming each with basal ray an angle of about 115°.

Acerate spicules.—In the walls of the body (sparsely scattered here and there in the parenchyma, either isolated or in groups) fine, linear, straight, occasionally slightly curved, reaching 0·3 mm. in the variety *tuba*, not exceeding 0·1 mm. in the variety *massa*, diameter 0·001 mm.; near the osculum (var. *tuba*) piercing the wall in perpendicular direction, either spindle-shaped or rather cylindrical, but sharp-pointed, straight or slightly curved, 0·1 mm. long, 0·004 mm. in diameter.

Colour.—Grey and dirty yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas, 32 fathoms; mud.

Leuconia rudifera, n. sp. (Pl. VII. figs. 3a–3c).

There are in the Challenger collection only some fragments of this interesting species; they seem to belong to two specimens: in one case the walls are 5 mm. thick, in the other not above 3 mm. One fragment bears an osculum fringed with fine linear acerate spicules. Both the surfaces are rough. With regard to its spiculation, the species is intimately allied to *Leuconia typica*, but is distinguished from it, as well as from all other Leuconidæ, by its remarkable minute verticillate acerate spicules (Pl. VII. fig. 3‴).

Skeleton.—The skeleton consists of gastric verticillate acerate, of gastric quadriradiate, of parenchymal triradiate, of dermal triradiate, and of acerate spicules of three different kinds.

Gastric quadriradiate spicules (occasionally to be found also in the walls of the larger exhalent canals).—All rays of the same diameter (0·015 mm.); basal ray usually undulating, rarely longer than 0·2 mm., like lateral rays sometimes sharply, sometimes bluntly pointed; lateral rays either straight or slightly curved, each forming with basal ray an angle varying from 100° to 105°, length not exceeding 0·36 mm.; apical ray curved, tapering from the base to a sharp point, not longer than 0·1 mm., not seldom rather thinner than facial rays.

Verticillate acerate spicules.—I call these spicules acerate, for the transitional stages between them and the common spindle-shaped acerate form can be easily found; these intermediate stages are to be seen on Pl. VII. figs. 3a–3a‴, and it is evident that the three larger teeth on the free end of these spicules are homologous with the smaller teeth on their middle part. Cylindrical in their free half, which projects from the inner surface, these acerate spicules seem to be flat in their more extended half, situated in the parenchyma; they reach 0·064 mm. in length, and 0·0008 mm. and 0·0014 mm. in diameter.

Triradiate spicules of the parenchyma.—Very inconstant in their outlines, either regular, or sagittal, or irregular. The typical fundamental form can be characterised as follows:—regular; rays tapering from the base to sharp points, 0·35 mm. in length, with a diameter of 0·034 mm. Such triradiate spicules are really to be found, but usually they undergo more or less considerable modifications, either in the direction of a sagittal differentiation, the basal ray growing rather longer than the lateral, and its angles varying from 120° to 110°, or in the direction of an irregular differentiation, all the rays or all the angles growing more or less unequal. In most cases the rays are sharp-pointed.

Dermal triradiate spicules.—All rays of the same diameter, the proportion between their length and thickness varying from 17:1 to 23:1; basal ray straight, tapering from the base to an approximately sharp point, forming with each lateral ray an angle of about 115°, length not exceeding 0·35 mm.; lateral rays curved, often undulating, usually of the length of basal ray, sometimes rather shorter or longer. In two cases I could discern in the dermal triradiate spicules an incipient apical ray.

Acerate spicules.—Of three kinds. *Large acerate spicules of the parenchyma.*—Straight, probably exceeding 2·5 mm. in length, with a diameter of 0·06 mm., projecting from outer surface. They are extremely rare, and having always found them with the free end broken off, I can give no more precise statements as to their length. *Small acerate spicules of the parenchyma.*—Also rare, sparsely scattered here and there in the parenchyma near the outer surface, either in small heaps or isolated, usually situated perpendicularly to the surface, often showing no order in their disposition; average size: 0·3 mm. by 0·0025 mm. *Linear acerate spicules of the peristome.*—Fine, smooth, either straight or slightly curved, sharp-pointed, reaching 3 mm. in length and 0·005 mm. in diameter, often still thinner.

Colour.—Pale yellowish.

Habitat.—Station 36, April 23, 1873; off Bermudas; depth, 32 fathoms; mud.

Leuconia levis, n. sp. (Pl. VII. figs. 4*a*–4*d*).

The two specimens of the Challenger collection for which I establish this new species present elongated thin-walled tubes almost of the same diameter throughout their whole length, and only growing narrower close to the lower end like a wedge. The larger specimen is 50 mm. long, 7 mm. thick; the thickness of the walls is about 0·75 mm. The outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The chief character of the species consists in the slenderness of its spicules. This is also common to *Leuconia fistulosa*, Bk., and *Leuconia pumila*, Bk., yet the size of the spicules, their form and their disposition, distinguish *Leuconia levis* from *Leuconia pumila*; on the other hand, the absence of the acerate spicules and the comparative shortness of the apical ray of the gastric quadriradiate spicules do not allow us to unite this form with *Leuconia fistulosa*, the rays of whose spicules are still more slender.

Skeleton.—The skeleton consists of gastric quadriradiate, of subgastric quadriradiate, of parenchymal triradiate, and of dermal triradiate spicules.

Gastric quadriradiate spicules.—All rays of the same average diameter of 0·015 mm.; facial rays cylindrical, either sharply or bluntly pointed, apical ray tapering from the base to a sharp point; basal ray straight, forming with each lateral ray an angle of 118°, usually twice as long as lateral rays, often still longer, not exceeding, however, 0·45 mm.; occasionally rather shorter; lateral rays either straight or slightly curved, often rather undulating, their average size 0·175 mm.; apical ray curved, rarely longer than 0·09 mm.

Subgastric quadriradiate spicules (lateral and apical rays in the plane of the gastric surface, basal ray directed centrifugally).—All rays smooth, tapering from the base to sharp points; facial rays of the same average diameter (0·0125 mm.); apical ray rather thinner; basal ray straight, usually 0·3 mm. long, forming with each of lateral rays an angle varying from 110° to 115°; lateral rays undulating, forming one with the other an angle of about 170°; apical ray curved, rarely longer than 0·1 mm. These quadriradiate spicules are connected by intermediate stages with the larger triradiate spicules of the parenchyma, which are furnished also here and there with short apical rays.

Triradiate spicules of the parenchyma.—Of two kinds; larger, sagittal, their basal ray in most cases directed centrifugally, and smaller, either regular or sagittal or irregular, scattered in the parenchyma without any order. *Larger triradiate spicules.*—All rays in the same plane and of the same diameter (0·015 mm.), occasionally rather thicker; basal ray straight, like lateral rays tapering from the base to a sharp point, length 0·38 mm. on the average; lateral rays either straight or more or less curved, often undulating, each forming with basal ray an angle varying from 115° to 125°, average length 0·2 mm. *Smaller triradiate spicules.*—Form variable (Pl. VII. fig. *4d*–*4d'''*); length of rays not exceeding 0·075 mm., the proportion between the thickness and the length being 1 : 10; not numerous.

Dermal triradiate spicules.—Of exactly the same size and form as the larger triradiate spicules of the parenchyma, the only distinction being that the angle between basal and each lateral ray is more constant (120°), and that the lateral rays are usually neither straight nor undulating, but slightly curved.

Colour.—Dirty yellowish.

Habitat.—Station 145, December 27, 1873; lat. 46° 40′ S., long. 37° 50′ E.; off Prince Edward Islands; depth, 150 fathoms.

Leuconia crucifera, n. sp. (Pl. VII. figs. *5a*–*5d*).

This species is represented in the Challenger collection by a single fragment belonging to the inferior part of the animal. The fragment is of compressed form, 10 mm. long, with a maximum diameter of 8 mm. The thickness of the walls is 0·8 mm. The outer surface is bristly, the inner surface slightly roughened by the apical rays of the gastric quadriradiate spicules. These are all more or less cruciform, all the rays lying in the same or almost in the same plane. By this character the species can be very easily distinguished from all other Leuconidæ. There are indeed some forms which, like *Leuconia nivea*, *Leuconia johnstonii*, &c., possess cruciform quadriradiate spicules also; but in these species these are always minute, while here in *Leuconia crucifera*, on the contrary, they are of considerable size.

Leuconia crucifera and *Leucosolenia blanca* are of particular interest as forms inhabiting the greatest depth (450 fathoms) from which Calcarea have been hitherto obtained.

Skeleton.—The skeleton consists of gastric quadriradiate, of parenchymal triradiate, of dermal triradiate, and of stout acerate spicules, piercing the parenchyma obliquely, and projecting with their free end from the outer surface, and of slender acerate spicules, scattered here and there on the outer surface in small bundles.

Gastric quadriradiate spicules.—Basal ray centrifugally, apical ray centripetally directed, lateral rays lying parallel to the inner surface; all rays of the same average diameter (0·015 mm.), lying in the same or almost in the same plane; basal ray straight, tapering from the base to a sharp point, forming with each of lateral rays an angle varying from 96° to 100°, average length 0·25 mm.; lateral rays straight, occasionally slightly curved, either cylindrical or tapering from the base to approximately sharp points, usual length 0·2 mm.; apical ray straight, cylindrical, bluntly pointed, forming with basal ray an angle varying from 180° to 165°, of the same length as the lateral rays, often rather shorter and thinner.

Triradiate spicules of the parenchyma.—Sagittal; always of the same average diameter (0·018 mm.), usually tapering from the base to sharp points, forming three angles of 120°; basal ray straight, reaching 0·3 mm. in length, often shorter (0·2 mm.); lateral rays curved forwards, their average length 0·2 mm.; many of them show a rudiment of the fourth ray, occasionally reaching 0·1 mm. in length, which, like that of the gastric quadriradiate spicules, lies almost in the same plane as the facial rays, being, however, always sharp-pointed.

Dermal triradiate spicules.—Of the size and form of the triradiate spicules of the parenchyma, the only distinction being that the angles formed by basal and lateral rays, which are in the last named spicules usually of 120°, and if varying showing an inclination to grow more acute, here in the dermal triradiate spicules show on the contrary an inclination to grow more obtuse, varying from 120° to 125°.

Stout acerate spicules.—Spindle-shaped, either straight or slightly curved, reaching 3 mm. and more in length, the average proportion between the length and thickness being 30 : 1; piercing the parenchyma in an oblique direction, the oral angle formed by them and the longitudinal axis of the Sponge varying from 60° to 45°.

Slender acerate spicules.—Either spindle-shaped or more or less cylindrical, straight; surface either smooth or rather rough; average size, 0·8 mm. by 0·0025 mm.

Colour.—Dirty white.

Habitat.—Station 75, July 2, 1873; lat. 38° 37′ N., long. 28° 30′ W.; off the Azores; depth, 450 fathoms; sand.

Leuconia ovata, n. sp.

I have already taken occasion to express in this paper[1] my assurance that the genus *Leuconia*, as I restricted it, is a temporary one, and that its subdivision into many quite independent genera can be predicted. The statement was also made, that one of these conjectural genera will embrace forms like *Leuconia saccharata*, H., *Leuconia ochotensis*, M.M., &c. The name of this new genus would be—according to the law of priority—*Baeria*, Miklucho-Maclay, and its chief characters a strongly developed cortex

[1] Page 28.

and a predominance of minute acerate spicules. From this point of view the species I am going to describe is of particular interest. In the main features of its organisation it does not differ from *Leuconia multiformis*, *Leuconia typica*, &c., its cortical layer being represented by a thin dermal membrane; but its spicular characters are so strikingly similar to those of *Leuconia* (*Baeria*) *saccharata*, H.,[1] that a close parentage of both these forms is evident; and *Leuconia saccharata*, even in spite of its, I must add, very doubtful subdermal cavities, is one of the most typical representatives of our conjectural genus.

Leuconia ovata is represented in the Challenger collection by one specimen from Christmas Harbour. The specimen is of ovoid form, yet rather compressed, 30 mm. long., 18 mm. broad in the middle, its walls 4–5 mm. thick, in the interior half growing gradually thinner towards the free end. Both the surfaces are smooth. As I remarked before, no deviations are to be noticed with respect to the internal organisation; as in most Leucones, the flagellated chambers are of roundish outline, their diameter 0·06 mm. on an average, the pores and vents (gastric openings) of variable size and irregularly disposed. The specimen proved to be sterile.

Skeleton.—The skeleton consists of minute acerate spicules, coating the gastric and dermal surfaces, of gastric triradiate, of parenchymal triradiate, and of dermal triradiate and quadriradiate spicules.

Minute acerate spicules.—Some of these are just of the same form, and most of the same dimensions, as the corresponding ones in *Leuconia saccharata*, every spicule being composed of two parts—of a shorter spiny and of a longer smooth; but while *Leuconia saccharata* is, according to Hæckel, quite constant to this characteristic form of its minute acerate spicules, those in *Leuconia ovata* show a considerable variability; sometimes they are spiny on their whole surface, sometimes, on the contrary, they are smooth in both their parts, sometimes the shorter is smooth and the longer spiny. Also, with respect to the angle formed by their longer and shorter parts, these acerate spicules are inconstant, there being amongst them all possible intermediate stages between such spicules as drawn by Hæckel for his *Leucandra saccharata* (*loc. cit.*, pl. xxxviii. fig. 13) and common spindle-shaped acerate spicules. Characteristic of both surfaces, the minute acerate spicules lie in the parenchyma perpendicular to the longitudinal axis of the Sponge, the shorter spiny ends of the dermal acerate spicules being directed centrifugally, those of the gastric spicules centripetally.

Gastric triradiate spicules.—These are also of the form and size of the corresponding spicules of *Leuconia saccharata*, but more variable with respect to the length of their rays, that of the lateral varying from 0·15 mm. to 0·3 mm., that of the basal ray from 0·08 mm. to 0·2 mm. In most cases the basal ray is $\frac{1}{2}$–$\frac{3}{4}$ as long as the lateral, but occasionally its length reaches, and even surpasses, that of the lateral. Some of them—not many—are provided with a short (0·02 mm. to 0·08 mm.) apical ray. The basal ray of the gastric triradiate spicules

[1] Kalkschwämme, Bd. ii. p. 229, Bd. iii. pl. xxxiii. figs. 3*a*–3*e*, pl. xxxviii. fig. 13.

is directed towards the closed end of the animal, and only near the gastric openings their disposition becomes irregular.

Triradiate spicules of the parenchyma.—Like those in *Leuconia saccharata* in most cases regular, but with rays not exceeding 0·45 mm. in length, usually still shorter (0·3 mm. and less). In the first case the proportion between the length and the thickness of the rays is like *Leuconia saccharata* 10 : 1 ; the rays of the smaller spicules are more slender, the corresponding proportion varying from 12 : 1 to 20 : 1. The sagittally and irregularly differentiated triradiate spicules of the parenchyma are too rare to be of any systematic significance.

Dermal triradiate spicules.—Not differing from those of the parenchyma, and showing the same variations with respect to size and slenderness, with only this distinction that the cases of sagittal differentiation—the lateral rays growing more or less curved forwards—are more numerous.

Dermal quadriradiate spicules,—Rare. Sagittal ; basal and centripetally directed apical ray straight, lateral rays curved forwards, often undulating ; all rays tapering from the base to approximately sharp points, rarely longer than 0·4 mm., with a diameter of 0·03 mm. to 0·04 mm.

Colour.—Violet-greyish.

Habitat.—Station 149, off Kerguelen Island ; January 29, 1874 ; depth, 70 fathoms.

Leuconia loricata, n. sp. (Pl. II. fig. 2 ; Pl. VII. figs. 6*a*–6*b*).

The chief characters of this species, represented in the Challenger collection by a single specimen, 30 mm. long. and 8 mm. broad, are the following:—(1) a strongly-developed cortex 0·5 mm. thick, the width of the whole wall being 2 mm., consisting of several parallel layers of sagittal triradiate spicules ; (2) a quite irregular disposition of the parenchymal spicules, only those which are near the inner surface lying more or less parallel to it ; (3) minute spined acerate spicules scattered everywhere in the body, but chiefly coating the inner surface. The structure of the canal system presents no deviations from the general type.

Skeleton.—The skeleton consists of minute spined acerate spicules, of triradiate spicules of the parenchyma, of cortical triradiate, of cortical stout and linear acerate, and of acerate spicules of the peristome.

Spined acerate spicules.—The modifications of their form, and the intermediate stages between them and common spindle-shaped minute acerate spicules, although rare in *Leuconia loricata* yet still to be found, are given on Pl. VII. fig. 6*a*–6*a*''''. Their average length is 0·025 mm., with a diameter of 0·002 mm. Numerous on the inner surface, they are very rare in the parenchyma and in the cortex.

Triradiate spicules of the parenchyma.—Either quite regular or rather sagittal and irregular; rays straight, tapering from the base to sharp points; surface more or less smooth; the proportion between the length and thickness 8 : 1; the length, 0·6–1 mm.

Cortical triradiate spicules.—Sagittal; all rays lying in the same plane, tapering from the base to a more or less rounded end, usually of the same thickness, the proportion between this latter and the length varying from 10 : 1 to 16 : 1; basal ray straight, sometimes rather thinner than lateral rays, forming with each of these latter an angle of 115°; lateral rays either straight or slightly curved forwards, 0·325–0·5 mm. long, usually somewhat shorter than basal ray, often of the same length, sometimes even rather longer. In the wall of the collar these triradiate spicules become smaller, their rays being rarely longer than 0·15 mm., with a diameter of 0·0125 mm., and show a regular disposition, their basal ray being directed towards the closed end of the animal.

Stout accrate spicules.—Sparsely scattered in the wall perpendicularly to the outer surface, often projecting from it; spindle-shaped, tapering from the centre to a sharp point at each side, either straight or slightly curved; rarely exceeding 0·75 mm. in length and 0·04 mm. in diameter.

Slender accrate spicules of the same shape as and disposed similarly to the last-mentioned form, rarely longer than 0·3 mm. with a diameter of 0·0025 mm.

Accrate spicules of the collar straight or curved, either sharply or bluntly pointed; 0·5–1 mm. long, and 0·018 mm. in diameter.

Colour.—Pale yellowish.

Habitat.—Station 163A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Leuconia fruticosa, Hæckel, sp. (Pl. II. fig. 4).

Sycothamnus fruticosus, H., Prodromus, p. 240.
Lipostomella clausa, H., Prodromus, p. 249.
Leucetta primigenia, H., Kalkschwämme, Bd. ii. p. 118.

This species is represented in the Challenger collection by three specimens of somewhat Asconoid aspect, owing to the considerable reduction of the inner cavity (Pl. II. fig. 4). Each specimen is provided with an osculum, surrounded in all three cases with a collar, while all the specimens examined by Prof. Hæckel were either mouthless or bare-mouthed. Two specimens are pear-shaped, the larger attaining a length of 23 mm. and a diameter of 19 mm.; the third is of quite irregular outline, rather resembling an incrustation, the thickness of the body exceeding, however, 5 mm. in its narrowest part. The measurements agree closely with those given by Hæckel for his variety *isoraphis*. In two specimens (from Balfour Bay) the triradiate spicules are all of the same size (0·15 mm. long), the proportion between the length and the thickness of the rays being 12 : 1, and the rays of conical form. In the specimen from Station 150 the majority of the spicules are also 0·15 mm. long, but there are, moreover, chiefly on the outer surface, spicules reaching 0·2 mm. in length; in both cases the proportion between the length and the thickness of the rays being 15 : 1, and the rays of rather cylindrical form. According to his theoretical speculations, Hæckel gave to the species in his Monograph another name. We know, however, that the speculations alluded to have no real foundation, and therefore I propose to return to the older specific name of the Sponge in question.

Colour.—Dirty yellowish.

Habitat.—Station 149, Balfour Bay, Kerguelen Island, January 19, 1874; depth, 20 to 60 fathoms. Station 150, February 2, 1874; lat. 52° 4′ S., long. 71° 22′ E.; near Heard Island; depth, 150 fathoms; rock.

Leuconia dura, n. sp. (Pl. II. fig. 3; Pl. VII. figs. 7*a*–7*a‴*).

This species is represented in the collection by many colonial and solitary forms from the Bermudas, and by one colonial specimen from Australia. This latter may be seen drawn in its natural size on Pl. II. fig. 3. All the specimens are either bare-mouthed or provided with a collar, and their inner cavity is either still distinguishable, although more or less short and narrow, or reduced (Australian specimen) to a small hollow space just under the osculum. The skeleton consists principally of large and small regular triradiate spicules, the latter showing occasionally the rudiment of the fourth ray (Australian specimen). The measurements of these smaller and larger regular triradiate spicules agree closely with those given by Hæckel for his *Leucetta primigenia*, var. *microraphis* (specimen from Bermudas), and var. *megaraphis* (specimen from Australia). There are, however, two distinctions: in *Leuconia dura*, in company with the regular spicules, are also others, which, although of the same dimensions as the smaller regular triradiate spicules, are yet either sagittally, or sometimes, though not often, irregularly differentiated. These chiefly sagittal spicules are to be found only in the region of the osculum; they prove, consequently, the permanence of the presence of this latter, and this forms the second difference, the varieties of *Leuconia fruticosa* being, according to Hæckel, sometimes furnished with oscula, sometimes mouthless. The spicules in question are represented on Pl. VII. fig. 7; they have, apart from their size, just the same form as the corresponding triradiate spicules of *Leucosolenia poterium* (?), *Leucetta vera*, and *Leucetta hæckeliana*. We learn from this coincidence that the horn-shaped form of spicule is very well adapted for constituting the skeleton of the borders of the osculum or of the membrana oscularis. It is not, however, always the case. The corresponding spicules in *Leuconia fruticosa* just described show no difference in their form from the other spicules of the sponge, and as the regular triradiate spicules are comparatively very constant in their outlines, I think I am right in concluding that their local differentiation into sagittal ones in my *Leuconia dura* proves the constancy in the presence of the osculum, and thus justifies the establishment of a new species.

Colour.—Yellowish and greyish.

Habitat.—Station 36, April 23, 1873, off Bermudas; depth, 32 fathoms; mud. Station 186, September 8, 1874; lat. 10° 30′ S., long. 142°–18′ E.; Torres Strait, Australia; depth, 8 fathoms; coral sand.

Pericharax, n. gen.

Leuconidæ with distinct subdermal cavities.

Pericharax carteri,[1] n. sp. (Pl. II. fig. 5; Pl. VII. fig. 8).

The species is represented in the collection by a whole specimen and a fragment of another. The first is shown on Pl. II. fig. 5. It reaches 40 mm. in length, with a maximum diameter of 22 mm., the thickness of the walls being 5 mm., in the second specimen not exceeding 3 mm. The outer surface is smooth, the inner roughened by the apical rays of the gastric quadriradiate spicules. From *Pericharax cucumis* (*Leucandra cucumis*, H.—Kalkschwämme, ii. p. 205) the species can be distinguished by the following characters:—1, the skeleton of the parenchyma and of the subdermal cavities consists not of quadriradiate but of triradiate spicules; 2, the subdermal spicules are not larger than those of the parenchyma, but equal to some of these and smaller as compared with others.

The species itself is to be subdivided into two varieties; the gastric spicules and those of the parenchyma are of the same size and form in both specimens, but in one the skeleton of the subdermal cavities consists of regular triradiate spicules, not differing from the smaller spicules of the parenchyma, in the other of sagittal and irregular triradiate spicules, although of the size of the smaller triradiate spicules of the parenchyma, yet of a different form. The first variety may be named "*homoraphis*," the second "*heteroraphis*." In both these varieties the "gastric ostia" are very large, their diameter reaching 0·75 mm. The exhalent canals are also of considerable dimensions, their surface almost in all their length being armed with quadriradiate spicules.

One specimen, var. *homoraphis*, proved to be sterile, in the other I found ova of an extraordinary size, their diameter being 0·3 mm. on an average.

Skeleton.—The skeleton consists of regular gastric quadriradiate spicules, following the course of the invaginations of the inner cavity; of larger and smaller regular triradiate spicules of the parenchyma, and of dermal triradiate spicules, as well as of those of the subdermal cavities, regular in one variety, sagittal and irregular in the other.

[1] I dedicate this species to Mr. H. J. Carter, F.R.S., as a token of my deep respect for his scientific labours.

Gastric quadriradiate spicules.—Regular, facial rays straight, smooth, tapering from the base to approximately sharp points, their average length being 0·15 mm., and their diameter 0·01–0·013 mm.; apical ray of the same diameter, sharp-pointed, either straight or curved, often irregularly bent; sometimes very short, rudimentary, usually 0·2–0·25 mm. long.

Triradiate spicules of the parenchyma.—The greater part of these consists of spicules not differing from the quadriradiate ones just described, except in the absence of the fourth ray; amongst them are scattered here and there much larger triradiate spicules, which differ from them only in size. The rays of these larger triradiate forms sometimes exceed 1 mm. in length, the proportion between the length and thickness varying from 10:1 to 12:1; they are connected with the smaller triradiate variety by intermediate stages.

Dermal and subdermal triradiate spicules.—In the variety *homoraphis* these do not differ, either in their size or in their form, from the smaller triradiate ones of the parenchyma; in the variety *heteroraphis* they remain of the same size, but become sagittal and irregular. Their typical modifications are represented on Pl. VII. fig. 8. They form in this variety also the skeleton of the collar; the fragment of the var. *homoraphis* I possess has its oscular part broken off.

Colour.—Greyish.

Habitat.—Station 135, October 1873; Island of Tristan da Cunha; depth, 60 fathoms; rock, shells.

Leucetta, Hæckel.

Leuconidæ, the skeleton of whose strongly developed cortex is quite different from that of the parenchyma.

Leucetta imperfecta, n. sp. (Pl. VII. figs. 9*a*–9*e*).

This species, like the following, *Leucetta vera*, is represented in the Challenger collection by a single specimen, which is bare-mouthed, of tubular, elongated, cylindrical form, 35 mm. long and 5 mm. in diameter, the thickness of the wall being 1·25 mm., that of the cortex 0·35 mm. Both the surfaces are rather rough. The characteristic peculiarities of the species consist in the form of its pigmy triradiate, and in the presence in the parenchyma of large quadriradiate spicules, not differing either in size or in form from those of the cortex; these last are not numerous, but they are there, and most of them having just the same disposition as the large subgastric quadriradiate spicules in *Leucilla amphora*, H. (Kalkschwämme, iii. pl. xxiv. fig. 8), the species may be regarded as a connecting link between the genera *Leucetta* and *Leucilla*.

Skeleton.—The skeleton consists of minute gastric quadriradiate, of minute triradiate and quadriradiate and of large quadriradiate spicules of the parenchyma; of cortical triradiate spicules lying in several layers parallel to the outer surface, and of cortical quadriradiate spicules, their facial rays lying in the cortex parallel to the cortical triradiate spicules, and their apical ray, the free end of which only exceptionally projects from the inner surface, piercing the parenchyma in a centripetal direction.

Gastric quadriradiate spicules.—All more or less regular; facial rays straight, smooth, tapering from the base to approximately sharp points, 0·06 mm. long, diameter varying from 0·006 mm. to 0·008 mm.; apical ray either straight or curved, often irregularly bent, sharply pointed; length inconstant, reaching 0·08 mm.

Minute quadriradiate and triradiate spicules of the parenchyma.—Quadriradiate just of the same form and dimensions as those of the gastric surface, not numerous; triradiate still smaller, their rays rarely exceeding 0·025 mm. in length, and 0·002 mm. in diameter; some of them are regular, their straight and smooth rays tapering from the base to sharp points; but such regular triradiate forms are extremely rare; most present only two rays, forming an angle varying from 120° to 160°, the basal ray having become rudimentary, and being represented only by a small process at the crossing of the lateral rays.

Quadriradiate spicules of the parenchyma and cortex.—Both of the same form and the same very inconstant dimensions, the length of their rays varying from 0·3 mm. to 1 mm., and even more. Regular; rays smooth, tapering from the base to sharp points, usually ten times as long as thick.

Dermal triradiate spicules.—Like the quadriradiate just described, regular, but more inconstant with respect to the proportion of the length of their rays to their thickness; this proportion varies from 10 : 1 to 16 : 1. Rays smooth, of conical or cylindrical form, bluntly pointed; average length, 0·6 mm.

Colour.—Yellowish.

Habitat.—Station 163 A, June 3, 1874; off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Leucetta vera, n. sp. (Pl. VIII. figs. 7–10).

The specimen representing this species in the Challenger collection is of tubular form, about 40 mm. long and 7 mm. broad in its superior half, the inferior half presenting a kind of peduncle 3 mm. in diameter; the peduncle does not, however, differ anatomically from the superior part of the animal. The osculum is surrounded by a low collar; the outer surface is smooth, the inner slightly roughened by the apical rays of the gastric quadriradiate spicules. The thickness of the wall differs in different parts of the body, varying from 1 to 2·6 mm.; that of the cortex is more constant (0·4 mm. to 0·5 mm.). The structure of the canal system is very peculiar, the differences in the size and form of the flagellated chambers being in no other case so striking as here. In the peduncle and in the gastric half of the superior part of the body the flagellated chambers are, although very variable in size, at least all more or less regularly round. On the contrary, near the cortex they are elongated, cylindrical, very similar to the radial tubes of the Syconidæ, and, following their course, the inhalent canals become elongated and tubular also (fig. 7). The exhalent canals—occasionally also the inhalent—are in their turn characterised by an interesting peculiarity in the histological character of the pavement cells of their surface, these cells, as well as the granules of their protoplasm, being here incomparably larger than usual (fig. 8). Of the generative products I found in the specimen only young ova. In its spiculation the species shows a great affinity to *Leucetta clathria* H. (sp.), but the form and dimensions of the spicules of the parenchyma are so very different, that the establishment of a new species is necessary.

Skeleton.—The skeleton consists of gastric and parenchymal quadriradiate, of cortical quadriradiate spicules, disposed like those in *Leucetta imperfecta*, and of cortical triradiate spicules.

Gastric and parenchymal quadriradiate spicules.—Usually regular; rays smooth, tapering from base to approximately sharp points, facial rays straight, apical ray either straight or undulating, length varying from 0·05 mm. to 0·1 mm., the proportion between the length and the thickness being 10 : 1. Some of them occasionally become sagittal, the angle between the basal and each of the lateral rays becoming more acute; in the parenchyma such sagittal quadriradiate spicules show an inclination to lose their apical ray.

Cortical quadriradiate spicules.—Regular or sagittal, the angle between basal and lateral rays varying from 120° to 112°; all rays smooth, tapering from the base to sharp points, the proportion between the length and the thickness being 10 : 1; basal and apical rays straight; lateral rays either straight or slightly curved; facial rays rarely longer than 0·8 mm., length of the apical ray inconstant, varying from 0·6 mm. to 2 mm., its free end projecting occasionally from the inner surface.

Cortical triradiate spicules.—Regular; rays conical, tapering from base to sharp points, 0·45 mm. long, with a diameter of 0·0375 mm.; near the osculum these triradiate spicules become smaller and sagittally differentiated, adopting the form of the oscular triradiate spicules of *Leucosolenia poterium* (?), *Leuconia dura*, &c.

Colour.—Greyish.

Habitat.—Off Kerguelen, January 1874; depth, 10 to 100 fathoms.

Leucetta hæckeliana, n. sp. (Pl. II. fig. 6; Pl. VIII. figs. 1–6).

This species, which I dedicate to the illustrious author of the Kalkschwämme, shows, like *Leucetta vera*, a very close relation to *Leucetta clathria*, H., but the differences in spiculation are still considerable enough to separate these two forms into different species. The cortical quadriradiate spicules are in *Leucetta hæckeliana* strikingly rare, their apical ray never projects with its free end from the outer surface; the gastric and parenchymal quadriradiate spicules are, although similar in size to those in *Leucetta clathria*, yet of quite different outline, and finally, *Leucetta clathria* was found in the form of a mouthless colony (Kalkschwämme, ii. p. 159), while all the specimens of my *Leucetta hæckeliana* are provided with an osculum, the collar of which possesess its own skeleton, different from those of the cortex and of the parenchyma. Three individuals of this psecies are represented on Pl. II. fig. 6. The largest of them reaches 65 mm. in length, with a maximum diameter of 10 mm.; the walls are 2·5 mm. to 3 mm. thick, the cortex strongly developed. The outer surface is smooth, the inner slightly rough.

Skeleton.—The skeleton consists of gastric and parenchymal quadriradiate spicules, and of dermal triradiate and quadriradiate spicules.

Gastric and parenchymal quadriradiate spicules.—Either regular or sagittal, the lateral rays becoming more or less curved, or even irregular, all rays instead of being straight, becoming irregularly bent and of different lengths; all rays of the same average diameter (0·005 mm.), tapering from the base to sharp points; facial rays 0·02 mm. long, the length of the apical ray inconstant, varying from 0·02 mm. to 0·08 mm. The gastric quadriradiate spicules follow the course of the exhalent canals throughout their whole length, and their presence or absence on the surface of the cavities of the parenchyma shows whether we have to do with an exhalent or inhalent canal system.

Dermal quadriradiate spicules.—Extraordinarily rare; regular; all rays of the same length, not exceeding 0·75 mm. by 0·075 mm., smooth, tapering from the base to sharp points.

Dermal triradiate spicules.—Regular, rays of a rather cylindrical form, 0·55 mm. long, 0·03 mm. in diameter, lying in the cortex in several parallel layers, becoming smaller in the low collar and sagittally differentiated, the angles between basal and lateral rays becoming more acute (120°–95°), and the lateral rays themselves, like those in the oscular triradiate spicules of *Leucetta vera* becoming horn-shaped.

Colour.—Cream white.

Habitat.—Station 163A, June 3, 1874, off Port Jackson, Australia; depth, 30 to 35 fathoms; rock.

Family Teichonidæ (Teichonia, Teichonellidæ), Carter.

Heterocœla with outer surface differentiated into two different planes, one bearing pores, the other oscula.

Eilhardia, n. gen.

Teichonidæ of calyciform shape. The surface carrying pores supported by triradiate and minute accerate spicules, that bearing oscula propped by large accerate spicules.

In honour of the naturalist whose extensive and precise investigations have marked a new era in Spongiology, I name this genus *Eilhardia*, and the single species of the genus at present known *schulzei.*

Eilhardia schulzei, n. sp. (Pl. II. fig. 7; Pl. IX. figs. 1–10).

This form is doubtless the most beautiful of all the calcareous Sponges hitherto known. The shape of its body is calyciform, the concave surface is dull, the convex has a silvery lustre. The convex surface bears low volcano-like oscula, disposed at approximately equal distances one from another; their diameter does not exceed 0·4 mm., usually being still less. The concave surface may be compared to a sieve, its pores, inconspicuous to the naked eye, are found under the microscope to be round and disposed close together; their average diameter is 0·06 mm. (Pl. IX. fig. 3). The walls of the calyx, 3 mm. to 4 mm. thick near the centre, grow gradually thinner to its free blade-like margin.

The species is represented in the collection by two complete specimens, one young, 7 mm. broad, 4·5 mm. high, with but few oscula; the other of considerably larger size (the longer diameter of the calyx 35 mm., the shorter 22 mm., the height 20 mm.), and by a fragment belonging apparently to a specimen of still larger dimensions. The larger complete specimen is represented on Pl. II. fig. 7.

The internal organisation (Pl. IX. fig. 1) does not differ from that of Leuconidæ.

Skeleton.—The skeleton of the sieve-like surface consists of sagittal triradiate and minute acerate spicules; that of the parenchyma of large regular, often sagittal triradiate, and of minute acerate spicules; that of the convex oscular surface of large acerate and subdermal triradiate; that of the oscula themselves of an exterior layer of large acerate, of a middle layer of sagittal triradiate, of an inner layer of quadriradiate, and of minute acerate spicules, supporting the ring-like border at the external opening of the osculum (Pl. IX. fig. 2). The minute acerate spicules are in all parts of the body of the Sponge of the same outline.

Minute acerate spicules.—The most typical variations are given on Pl. X. fig. 10. Usually 0·05 mm. long, with a diameter of 0·0025 mm.

Triradiate spicules of the sieve-like surface.—Sagittal; all rays lying in the same plane, of the same diameter, tapering from the base to approximately sharp points; lateral rays curved forwards, slightly undulating, each forming with basal ray an angle varying from 115° to 120°, reaching 0·75 mm. in length (usually not longer than 0·5 mm., often still shorter), the proportion between the length and the thickness being 15 : 1; basal ray straight, length inconstant, either rather exceeding that of lateral rays or equal to it, or even shorter.

Triradiate spicules of the parenchyma.—Regular, with pronounced inclination to sagittal differentiation by the shortening of basal ray; all rays of the same diameter, the proportion between their length and thickness varying (in lateral rays) from 10 : 1 to 12 : 1; lateral rays smooth, tapering from the base to sharp points; basal ray, if not shortened, also sharp-pointed, if shortened, often truncated, in both cases, however, of conical form; size extremely inconstant, the length varying (in lateral rays) from 0·15 mm. to 1·8 mm. In two cases I found these triradiate spicules showing a rudimentary fourth apical ray.

Subdermal triradiate spicules of the convex surface.—Sagittal; all rays lying in the same plane; basal ray straight, tapering from the base to a sharp point, $\frac{1}{2}$–$\frac{3}{4}$ as thick as lateral rays and either longer than these latter (not more than twice, however), or of the same length, or even shorter, forming with each of them an angle varying from 110° to 115°; lateral rays either straight, or slightly curved, average length 0·6 mm., the proportion between the thickness and the length varying from 1 : 10 to 1 : 12. In the spaces between the oscula these triradiate spicules lie pretty regularly, their corresponding rays being disposed more or less parallel one to another, their basal ray turned to the closed end of the Sponge, and the angle between the lateral rays towards the sharp margin dividing the sieve-like surface from that bearing oscula. Near these latter, as well as near the margin just mentioned, their disposition becomes irregular, they lose their characteristic shape, presenting all possible transition-forms to the sagittal triradiate spicules of the sieve-like surface, and, on the other hand, growing smaller, to the rectangular triradiate ones of the oscular skeleton.

Large acerate spicules of the convex surface.—Lying in several layers almost parallel to the surface, causing its smoothness and silvery lustre. Form, length, and comparative thickness extremely variable, either spindle-, club-, or lance-shaped, or of quite irregular outline, reaching 1 mm. in length (usually shorter), the proportion between their length and thickness varying from 8 : 1 to 30 : 1.

Oscular acerate spicules.—Spindle- or lance-shaped, usually twenty-eight times as long as thick, rarely longer than 0·55 mm., often considerably shorter.

Oscular triradiate spicules.—Sagittal, basal ray forming with each of lateral rays an angle of 90°; basal ray straight, tapering from the base to a sharp point, usually half as thick as lateral rays, often still thinner, occasionally almost of the same diameter; length inconstant, rarely longer than 0·05 mm., often not exceeding 0·01 mm. or still shorter; lateral rays either straight, or slightly curved inwards, usually sharply pointed, ten times as long as thick, average length 0·1 mm.; connected as regards their form and size with the sagittal subdermal triradiate spicules of the oscular surface by a long series of intermediate stages.

Oscular quadriradiate spicules.—Like the rectangular triradiate, nothing but modified sagittal triradiate spicules of the oscular surface; lateral rays either straight or slightly curved forwards, tapering from the base to approximately sharp points, average length 0·2 mm. by 0·02 mm., basal ray usually rather shorter, straight, sharp-pointed, forming with each of lateral rays an angle of about 110°; apical ray curved, not seldom undulating, sharp-pointed like the facial rays, usually rather thinner than these latter; length varying from 0·06 to 0·2 mm.

Colour.—White.

Habitat.—Station 163A, June 3, 1874, off Port Jackson; depth, 30 to 35 fathoms; rock. Station 163, April 4, 1874; lat. 36° 56′ S., long. 150° 30′ E.; depth, 120 fathoms; off Twofold Bay, Australia.

In order to render conspicuous the comparative richness of the Challenger Stations in Calcarea, I give here the following Table, showing also the depths from which the Sponges were dredged.

	Bermudas.	Azores.	Cape de Verde Islands.	Bahia.	Tristan da Cunha.	East of Prince Edward Island.	Kerguelen Island.	Eastern Coast of Australia.				Philippine Islands.
								Bass Strait.	Twofold Bay.	Port Jackson.	Torres Straits.	
Leucosolenia poterium (?),	...	...	...	...	...	...	...	...	120	30–35	...	...
lamarckii,	...	...	...	...	...	...	...	...	...	30–35	...	...
blanca,	...	450	...	...	...	...	...	...	...	...	...	...
challengeri, n. sp.,	...	...	...	...	...	...	...	...	...	...	8	...
Sycon raphanus,	...	...	...	...	60–90	...	...	...	...	...	...	95–100
arcticum,	32	...	...	...	...	...	...	...	...	...	...	95–100
arboreum,	...	...	...	...	...	...	...	38–40	...	...	...	...
Grantia tuberosa, n. sp.,	...	...	?	...	...	...	...	...	...	...	...	...
Heteropegma nodus gordii, n. sp.,	32	...	...	...	...	...	...	...	...	...	8	...
Ute argentea, n. sp.,	...	...	...	...	...	...	...	...	120	...	...	...
Amphoriscus poculum, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
elongatus, n. sp.,	...	...	...	...	...	150	...	...	...	...	...	...
flamma, n. sp.,	...	...	...	s.w.	...	...	...	...	...	...	...	...
Anamixilla torresi, n. sp.,	...	...	...	...	...	...	...	...	...	...	3–11	...
Leucilla connexiva, n. sp.,	...	...	...	...	...	...	...	...	...	...	...	95–100
uter, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	95–100
Leuconia multiformis, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	95–100
typica, n. sp.,	32	...	...	...	...	...	...	...	..	...	...	...
rudifera, n. sp.,	32	...	...	...	...	...	...	...	...	...	...	...
levis, n. sp.,	...	...	...	...	...	150	...	...	...	...	...	...
crucifera, n. sp.,	...	450	...	...	...	...	...	...	...	...	...	...
ovata, n. sp.,	...	...	...	...	...	...	70	...	...	...	...	...
loricata, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
fruticosa,	...	...	...	...	...	...	20–150	...	...	...	...	...
dura, n. sp.,	32	...	...	...	...	...	...	..	...	...	8	...
Pericharax carteri, n. sp.,	...	...	...	...	60	...	70	...	...	...	...	...
Leucetta imperfecta, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
vera, n. sp.,	...	...	...	...	...	...	10–100	...	...	...	...	...
haeckeliana, n. sp.,	...	...	...	...	...	...	...	...	...	30–35	...	...
Eilhardia schulzei, n. sp.,	...	...	...	...	...	...	...	...	120	30–35	...	...

Note.—s.w. = shallow water; the figures in the columns indicate the depth in fathoms; the species discovered by the Challenger are indicated by the letters n. sp.

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,,	3.—*Ute argentea*, n. sp., ...	×	1·5
,,	4.—*Sycon arboreum*, Haeckel, ...	×	2
,,	5.—*Amphoriscus flamma*, n. sp.; natural size.		
,,	6.—*Grantia tuberosa*, n. sp., ...	×	2
,,	7.—*Heteropegma nodus gordii*, n. gen. and sp.; natural size.		
,,	8.—*Leuconia multiformis*, n. sp., var. *goliath*; natural size.		

1 *Leucosolenia Challengeri*
2 *Leucosolenia blanca*
3 *Ute argentea*
4 *Sycon arboreum*
5 *Amphoriscus flamma*
6 *Grantia tuberosa*
7 *Heteropegma nodus Gordii*
8 *Leuconia multiformis var. Goliath*

PLATE II.

PLATE II.

Figure	1.—*Leuconia multiformis*, var. *capillata*; natural size.		Diam.
,,	2.—*Leuconia loricata*, n. sp., ...	×	2
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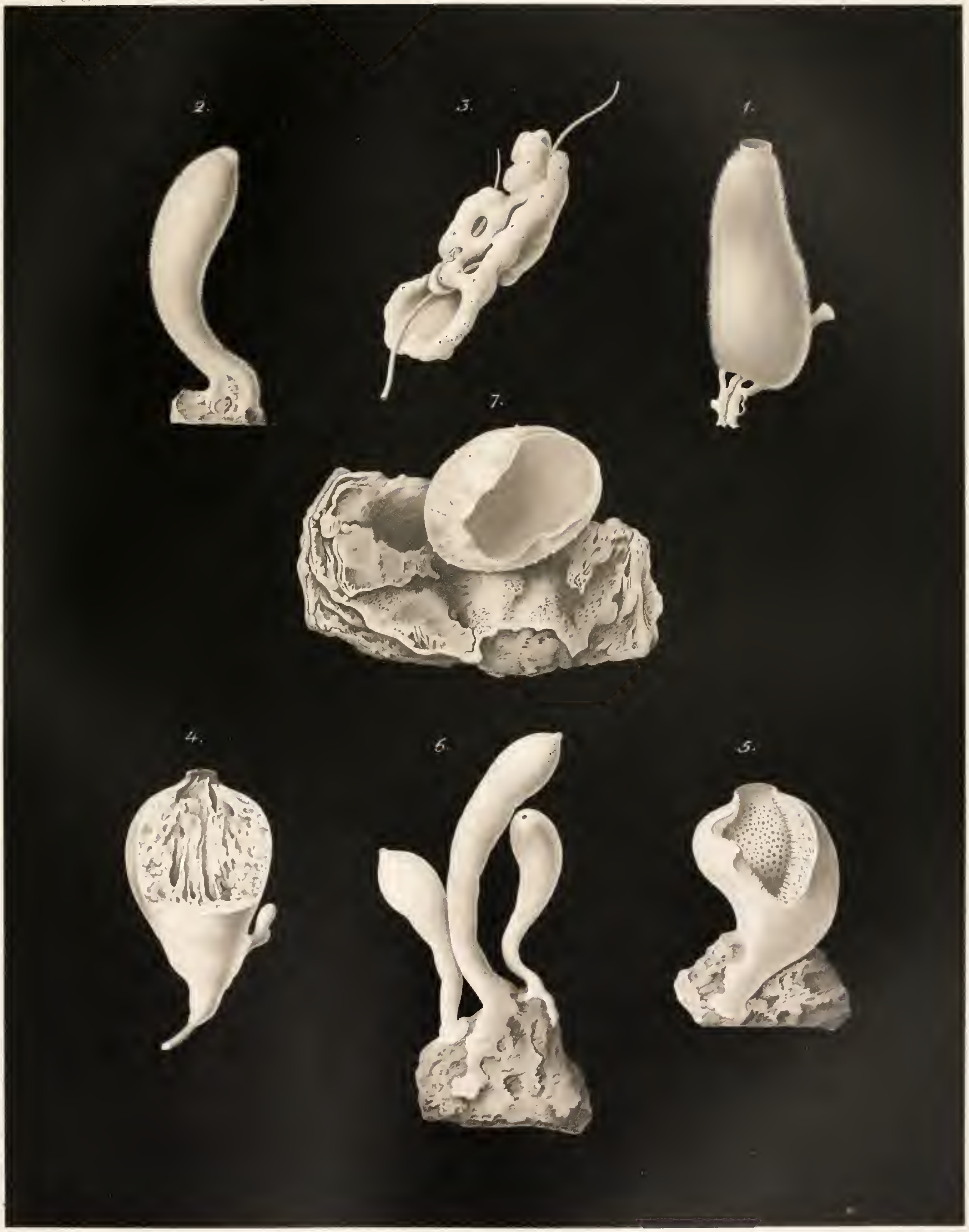
,,	4.—*Leuconia fruticosa*, Hæckel, ...	×	2
,,	5.—*Pericharax carteri*, n. gen. and sp.; natural size.		
,,	6.—*Leucetta hæckeliana*, n. sp.; natural size.		
,,	7.—*Eilhardia schulzei*, n. gen. and sp.; natural size.		



1. Leuconia multiformis var capillata
2. Leuconia loricata
3. Leuconia dura.
4. Leuconia fruticosa
5. Pericharax Carteri
6. Leucetta Haeckeliana
7. Eilhardia Schulzei

PLATE III.

PLATE III.

Figures 1, 2.—*Leucosolenia poterium*, Hæckel, sp. — Diam.

Fig. 1. Portion of a section through a colonial specimen, showing a spermospore lying in the mesoderm,	. .	×	500
Fig. 2. A spermospore with ripe spermatozoa,	. . .	×	1200

,, 3.—*Leucosolenia blanca*, Miklucho-Maclay.

Large coarse-grained amœboid cells of the peduncle,	. .	×	500

,, 4.—*Leucosolenia challengeri*, n. sp.

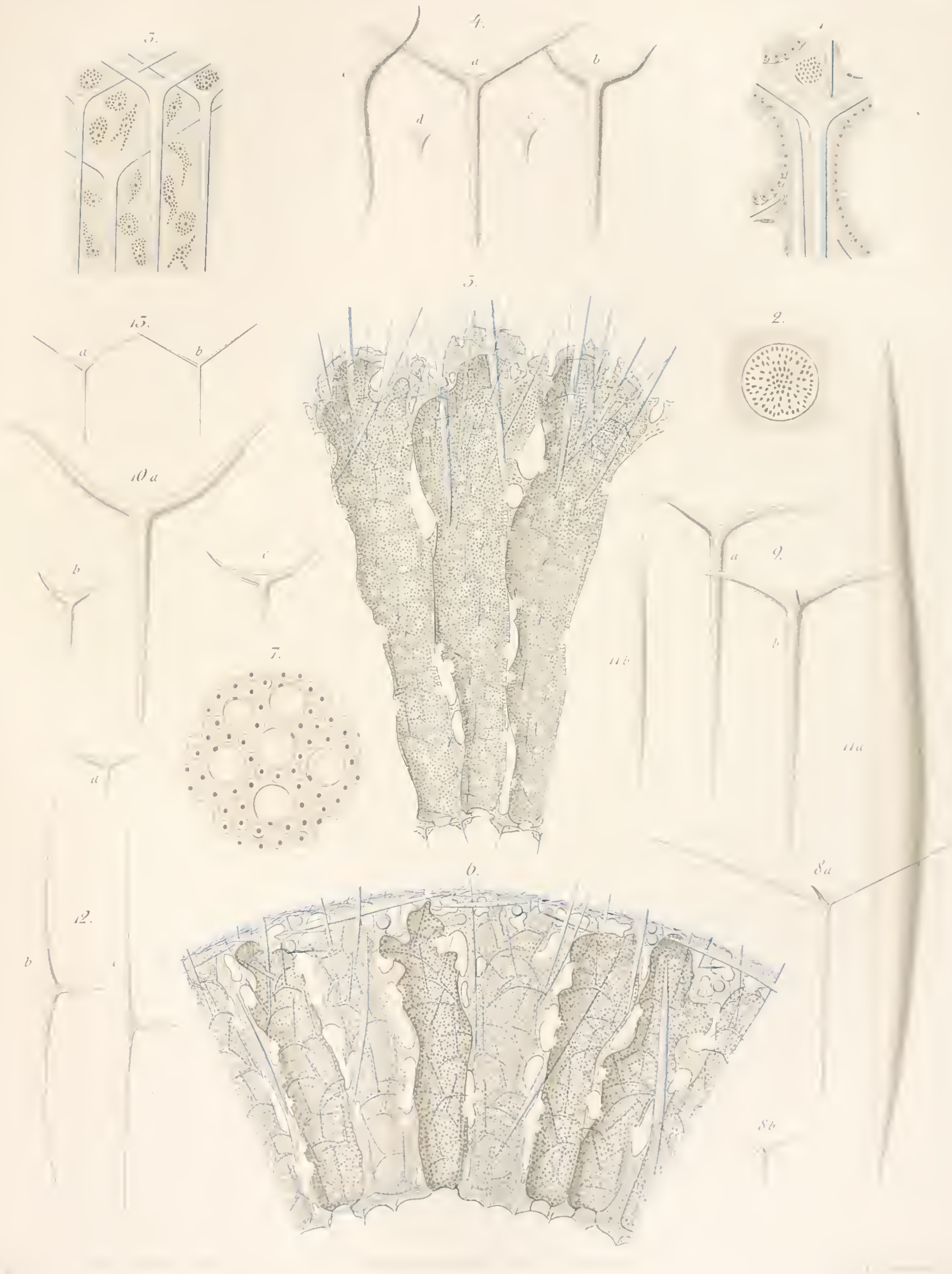
(*a*) A triradiate spicule from the interior part of the colony,	.	×	400
(*b*) A triradiate spicule from the outer surface,	. . .	×	400
(*c*) Do. profile view,	. . . .	×	400
(*d*, *e*) Do. embryonal,	. . . .	×	400

,, 5.—*Sycon arcticum*, Hæckel.

Portion of a horizontal section, showing the course of the radial tubes and intercanals,	. . . . .	×	50

,, 6–13.—*Grantia tuberosa*, n. sp.

Fig. 6. Portion of a horizontal section,	. . .	×	50
Fig. 7. Portion of the wall of a radial tube with its pores,	.	×	400
Fig. 8. Gastric quadriradiate spicules (*b*, embryonal),	. .	×	200
Fig. 9. (*a*) A subgastric triradiate spicule,	. . .	×	200
(*b*) A subgastric quadriradiate spicule,	. . .	×	200
Fig. 10. Tubar triradiate spicules (*b*, *c*, embryonal),	. .	×	200
Fig. 11. Acerate spicules (*b*, embryonal),	. . .	×	200
Fig. 12. Sagittal triradiate spicules of the cortex (*a*, embryonal),	.	×	200
Fig. 13. Irregular triradiate spicules of the cortex,	. .	×	200

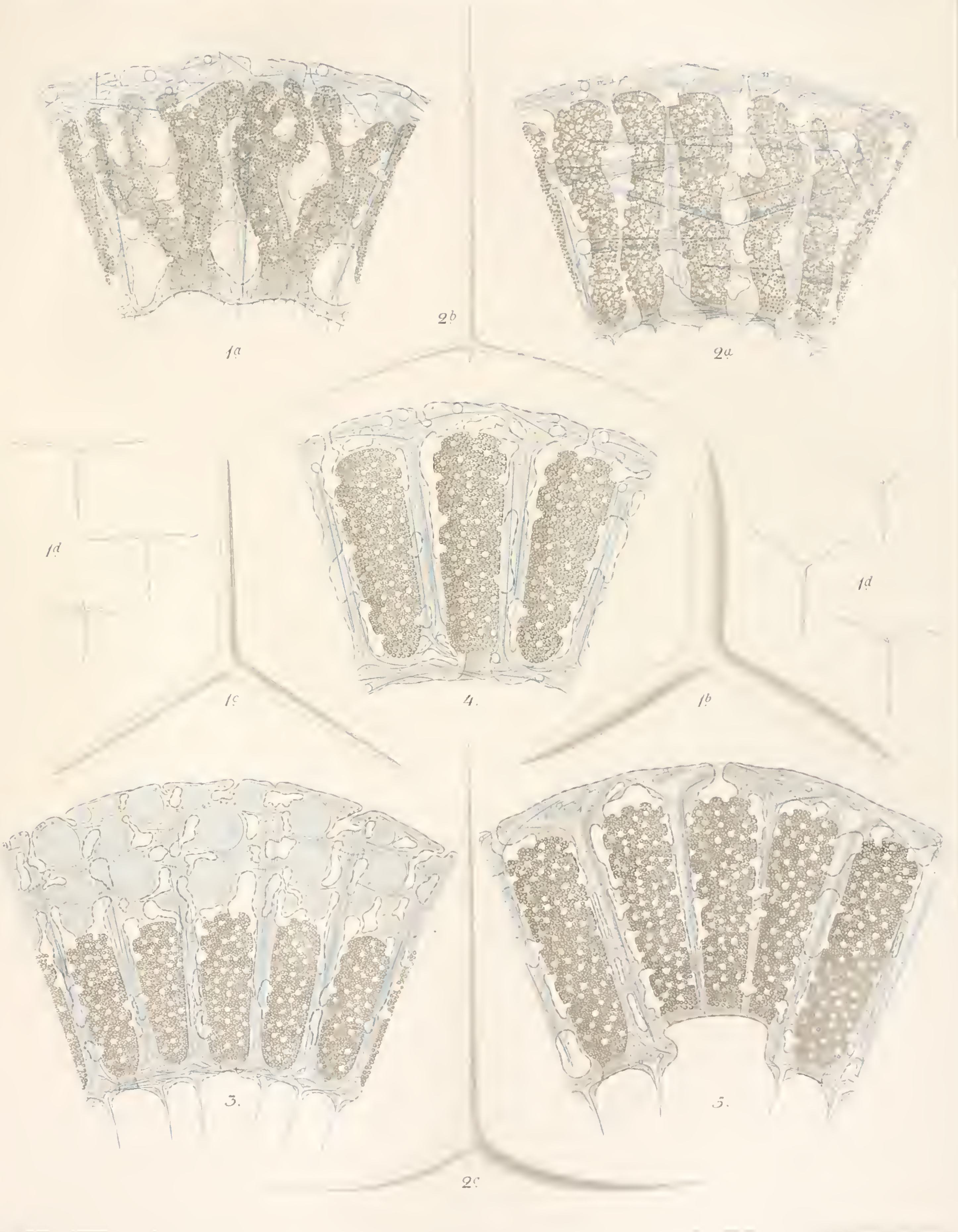


1-2 L[illegible] poterum ?
3 [illegible] blanca
4 Leuco[illegible]
5 Sy[illegible]
6-13 Grantia tul[illegible]a

PLATE IV.

PLATE IV.

				Diam.
Figure 1.—*Heteropegma nodus gordii*, n. gen. and sp.				
	(*a*)	Portion of a horizontal section,	×	50
	(*b, c*)	Two triradiate spicules of the cortex,	×	100
	(*d*)	Tubar and parenchymal quadriradiate spicules,	×	200
,, 2.—*Anamixilla torresi*, n. gen. and sp.				
	(*a*)	Portion of a horizontal section,	×	50
	(*b*)	A gastric quadriradiate spicule,	×	200
	(*c*)	A subgastric triradiate spicule,	×	200
,, 3.—*Ute argentea*, n. sp.				
		Portion of a horizontal section,	×	100
,, 4.—*Amphoriscus poculum*, n. sp.				
		Portion of a horizontal section,	×	100
,, 5.—*Amphoriscus elongatus*, n. sp.				
		Portion of a horizontal section,	×	100



1. Heteropegma nodus Gordii — 3. Ute argentea
2. Anamixilla Torresi — 4. Amphoriscus [illegible]
5. Amphoriscus elongata.

PLATE V.

PLATE V.

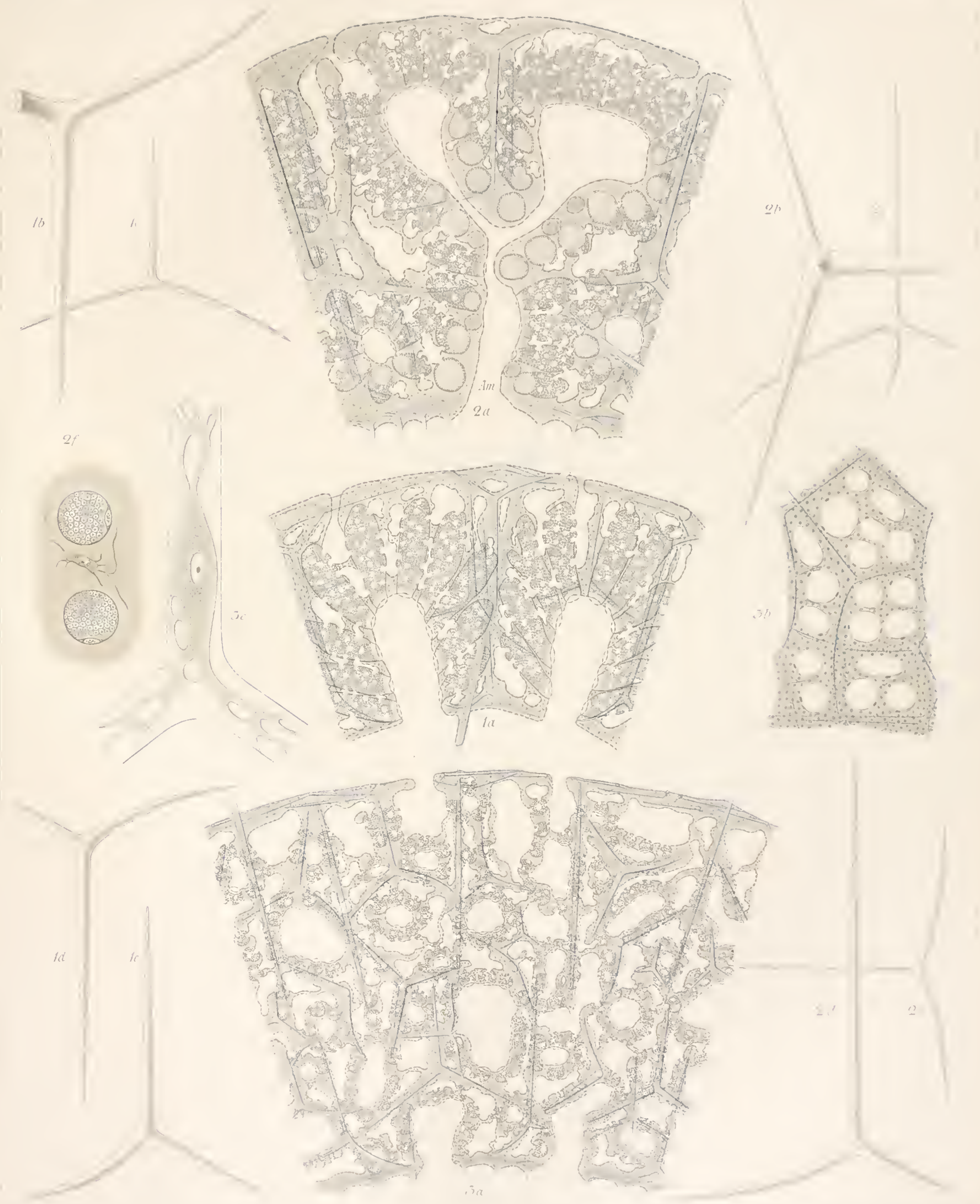
		Diam.
Figure 1.—*Ute argentea*, n. sp.		
(*a*) A subgastric triradiate spicule, ...	×	200
(*b*, *c*) Two tubar acerate spicules, ...	×	200
(*d*, *e*) Two gastric quadriradiate spicules, . . .	×	200
(*f*) Do. embryonal, ...	×	200
(*g*) A tubar quadriradiate spicule, ...	×	400
(*h*, *l*) Two gastric acerate spicules, ...	×	200
(*m*, *n*) Two dermal triradiate spicules, . . .	×	200
(*o*) A young dermal acerate spicule, . . .	×	200
(*p*) Do. fully developed transverse section, . .	×	200
,, 2.—*Amphoriscus poculum*, n. sp.		
(*a*) A subgastric triradiate spicule, ...	×	200
(*b*) A subdermal triradiate spicule, . . .	×	200
(*c*) A dermal triradiate spicule, ...	×	200
(*d*) Do. embryonal, ...	×	200
(*e*) A gastric triradiate spicule, . . .	×	200
(*f*) A parenchymal acerate spicule, ...	×	200
,, 3.—*Amphoriscus flamma*, n. sp.		
(*a*) A subgastric triradiate spicule, ...	×	200
(*b*) A subdermal triradiate spicule, ...	×	200
(*b*[1]) Do. embryonal, ...	×	200
(*c*) A gastric quadriradiate spicule, ...	×	200
(*d*, *e*) Two young parenchymal acerate spicules, . .	×	200
(*f*) The same, fully developed (transverse section), . .	×	200
(*g*) A linear acerate spicule of the peristome, . . .	×	200
,, 4.—*Amphoriscus elongatus*, n. sp.		
(*a*) A subgastric triradiate spicule, ...	×	200
(*b*) A subdermal quadriradiate spicule, . . .	×	200
(*c*) A gastric quadriradiate spicule, ...	×	200
(*d*) A dermal triradiate spicule, ...	×	200
(*e*) A minute acerate spicule, ...	×	200


1e
1m
1d
1q
1p
1a
1b
1c
1h
1l
2b
2
2c
2a
3b'
3b
3a
4b
4d

PLATE VI.

PLATE VI.

			Diam.
Figure 1.—*Leucilla connexiva*, n. sp.			
	(*a*) Portion of a horizontal section,	×	50
	(*b*) A dermal triradiate spicule,	×	100
	(*c*) A gastric triradiate spicule,	×	100
	(*d*) A subgastric triradiate spicule,	×	100
	(*e*) A subdermal triradiate spicule,	×	100
,, 2.—*Leucilla uter*, n. sp.			
	(*a*) Portion of a horizontal section; *Am.* = Amphiblastulæ,	×	50
	(*b*) A dermal quadriradiate spicule,	×	100
	(*c*) A gastric quadriradiate spicule,	×	100
	(*d*, *e*) Two subgastric triradiate spicules,	×	100
	(*f*) Two spermospores,	×	1000
,, 3.—*Leuconia multiformis*, n. sp.			
	(*a*) Portion of a horizontal section,	×	30
	(*b*) Piece of the dermal surface,	×	100
	(*c*) A conjectural calcoblast,	×	800



lla connexva. 2 Leucilia
3 Leuconia multiformis

PLATE VII.

PLATE VII.

		Diam.
Figure 1.—*Leuconia multiformis.*		
	(*a*) A gastric quadriradiate spicule, ...	× 100
	(*b*) A subgastric triradiate spicule, ...	× 100
	(*c*) A sagittal parenchymal triradiate spicule, . . .	× 100
	(*d*) A young regular parenchymal triradiate spicule, . .	× 100
	(*e*) A dermal triradiate spicule, ...	× 100
	(*f*) Two minute acerate spicules, ...	× 100
	(*g*) A spindle-like large acerate spicule (transverse section), .	× 100
	(*h*) A young lance-like acerate spicule, . . .	× 100
,, 2.—*Leuconia typica*, n. sp.		
	(*a*) A gastric quadriradiate spicule, ...	× 100
	(*b*) A parenchymal triradiate spicule, . . .	× 100
	(*c*) A dermal triradiate spicule, ...	× 100
,, 3.—*Leuconia rudifera*, n. sp.		
	(*a–a'''*) Four minute gastric acerate spicules, . . .	× 1000
	(*b*) A gastric quadriradiate spicule, . . .	× 100
	(*c*) A dermal triradiate spicule, . . .	× 100
,, 4.—*Leuconia levis*, n. sp.		
	(*a*) A gastric quadriradiate spicule, ...	× 100
	(*b*) A subgastric quadriradiate spicule, . . .	× 100
	(*c*) A larger parenchymal triradiate spicule, . .	× 100
	(*d–d'''*) Four smaller parenchymal triradiate spicules, . .	× 100
,, 5.—*Leuconia crucifera*, n. sp.		
	(*a*) A gastric quadriradiate spicule, ...	× 100
	(*b*) A parenchymal triradiate spicule, . . .	× 100
	(*c*) A parenchymal quadriradiate spicule, . . .	× 100
	(*d*) A large acerate spicule (transverse section), . . .	× 100
,, 6.—*Leuconia loricata*, n. sp.		
	(*a–a''''*) Five minute acerate spicules, ...	× 2000
	(*b*) A dermal triradiate spicule, ...	× 100
,, 7.—*Leuconia dura*, n. sp.		
	(*a–a'''*) Four oscular triradiate spicules, . . .	× 100
,, 8.—*Pericharax carteri*, n. gen. and sp.		
	Ten subdermal spicules in their natural disposition (var. *heteroraphis*), ...	× 100
,, 9.—*Leucetta imperfecta*, n. sp.		
	(*a–e*) Five minute triradiate spicules, ...	× 500

PLATE VIII.

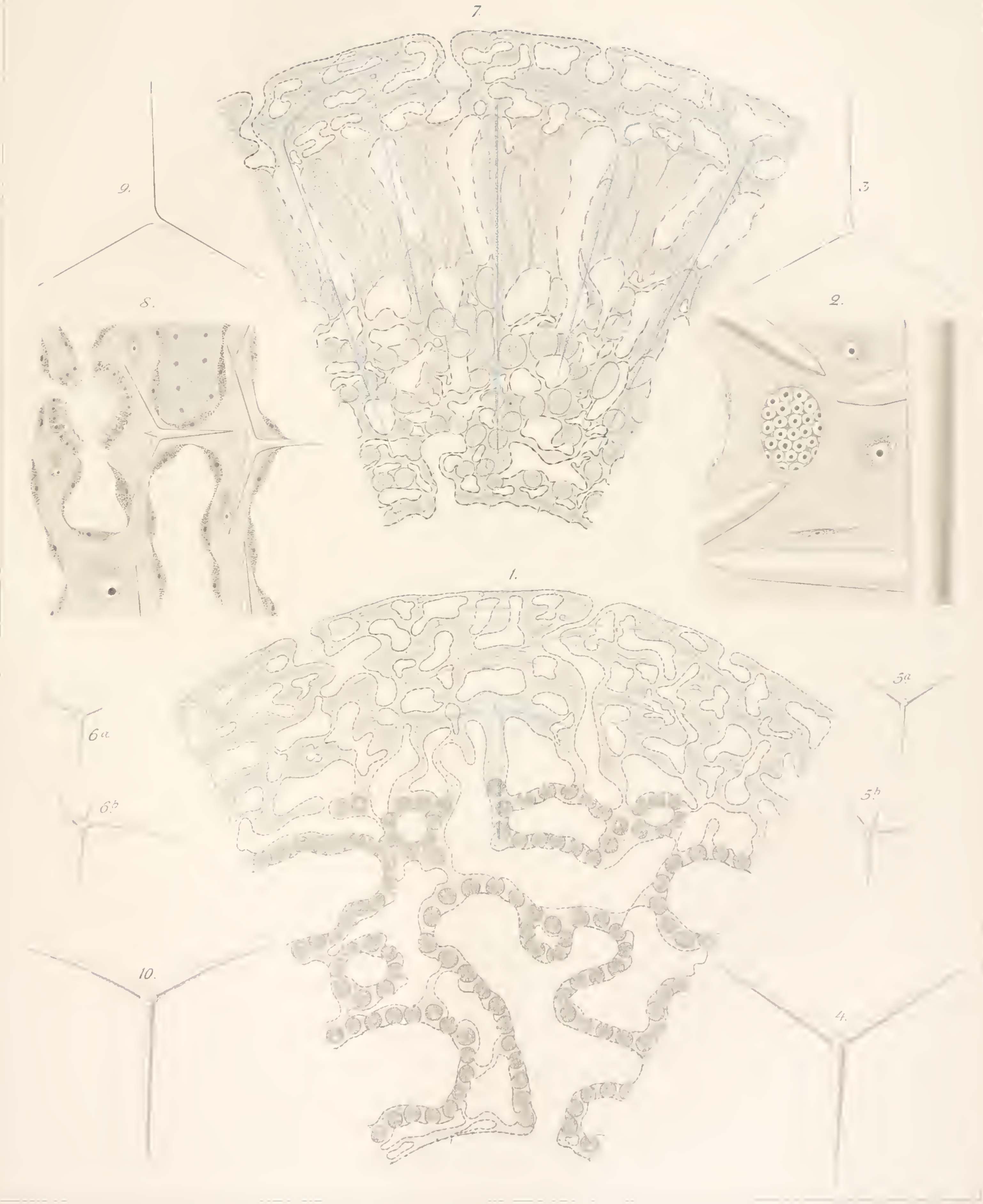
PLATE VIII.

Figures 1–6.—*Leucetta hæckeliana*, n. sp.

			Diam.
Fig. 1.	Portion of a horizontal section, . . .	×	30
Fig. 2.	Portion of a section through the cortical layer, showing some mesodermic cells and one spermospore, . .	×	1500
Fig. 3.	A cortical triradiate spicule, . . .	×	30
Fig. 4.	A cortical quadriradiate spicule (from the top), . .	×	30
Fig. 5.	A regular minute quadriradiate spicule (*a*, from the top, . *b*, profile view), ...	×	400
Fig. 6.	A sagittal minute quadriradiate spicule (*a*, from the top, *b*, profile view), ...	×	400

" 7–10.—*Leucetta vera*, n. sp.

Fig. 7.	Portion of a horizontal section, . . .	×	30
Fig. 8.	Portion of a section through the parenchyma near the inner surface, showing large, coarse-grained, pavement cells, .	×	300
Fig. 9.	A cortical triradiate spicule, . . .	×	30
Fig. 10.	A cortical quadriradiate spicule (from the top), . .	×	30

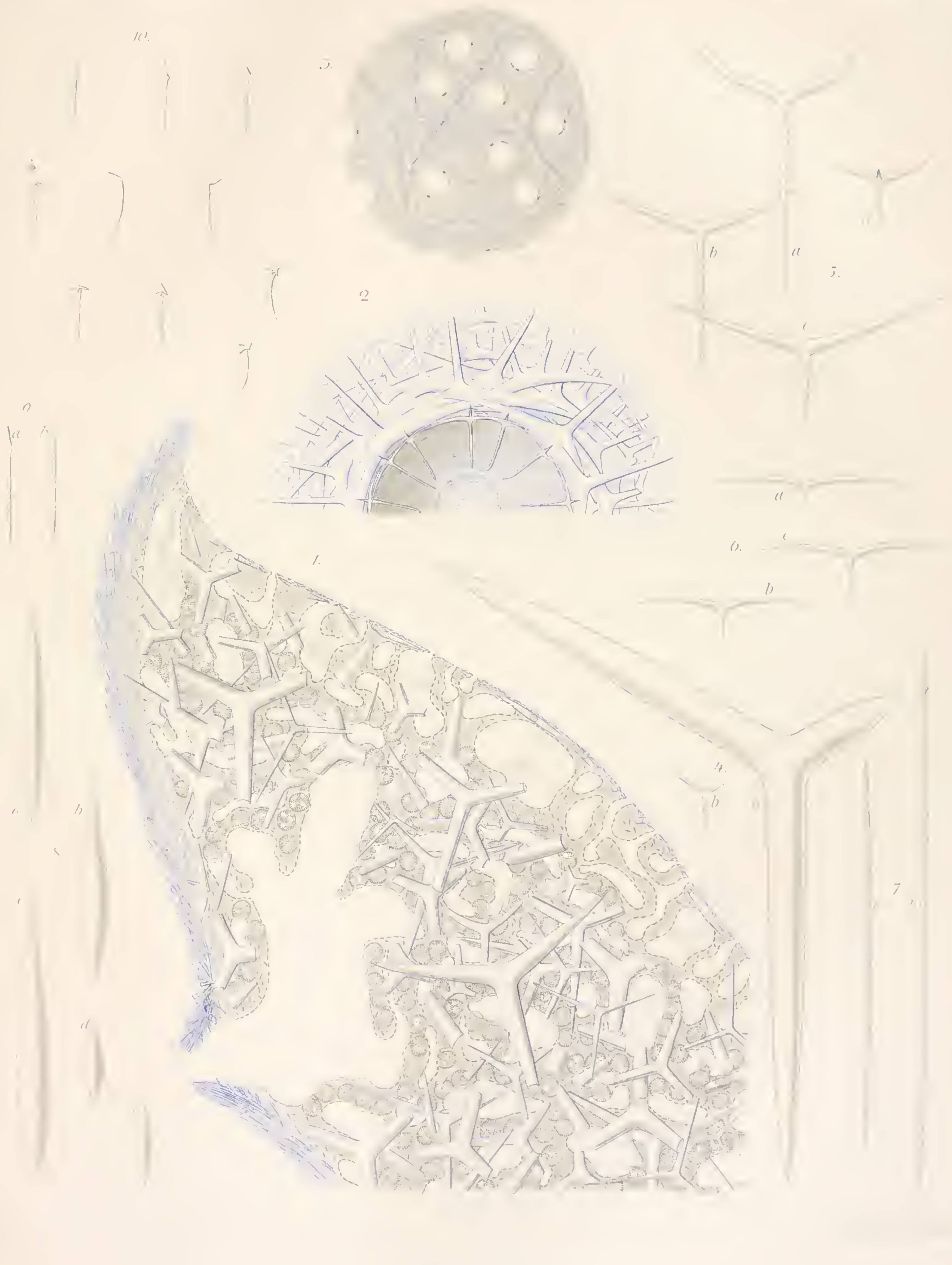


[illegible] Leucetta Haeckeliana. 7 [illegible]

PLATE IX.

PLATE IX.

Figures 1–10.—*Eilhardia schulzei*, n. gen. and sp.		Diam.
Fig. 1. Portion of a vertical section, . . .	×	30
Fig. 2. One half of an osculum (from within), . .	×	75
Fig. 3. Portion of the sieve-like surface, . . .	×	120
Fig. 4. Two parenchymal triradiate spicules; (*b*, embryonal), .	×	100
Fig. 5. (*a*) A triradiate spicule of the sieve-like surface, .	×	50
(*b*, *c*) Two triradiate spicules of the convex surface, .	×	50
(*d*) An oscular quadriradiate spicule, . . .	×	50
Fig. 6. Three oscular triradiate spicules, . . .	×	200
Fig. 7. Two slender acerate spicules of the convex surface, .	×	100
Fig. 8. Five stout acerate spicules of the convex surface (*d*, *e*, embryonal), ...	×	100
Fig. 9. Two acerate spicules of the osculum, . . .	×	100
Fig. 10. Minute acerate spicules of the sieve-like surface, . .	×	300



Eilhardia schulzi.