reach more than two-thirds up towards the nasals, while in *cuvieri* they articulated broadly with the latter bones. The bullæ were more rounded, and the pair of prominences on the basis of the skull over the basilar suture were much more developed than in the single old skull of *G. cuvieri* available. From *G. arabica*, to which there was a certain resemblance in the set and curvature of the horns, *G. merrilli* was distinguished by its conspicuously greater size.

The typical male skull of *G. merrilli* measured as follows:—greatest length 194 mm.; basal length (c.) 170; greatest breadth 88; muzzle to orbit 99; length of upper-tooth row 60.

Horns—♂. Length over curves anteriorly 241; basal circumference 108. ♀. Length 98; basal circumference 41.

Type. ♂, B.M. No. 4.12.18.1. Killed 11th December 1903. Presented by Dr. Selah Merrill through Dr. P. L. Selater.

Hab. Hizmeh, just north of Jerusalem.

The following extract from a letter from Dr. Merrill, dated 31st October 1904, will give an idea of where this new Gazelle was found:—

"The male Gazelle was brought to me Dec. 11th, 1903, and the female on February 7th, 1904. Both were shot by a hunter whom I know, and who has served me at times during several years past. His home is at Hizmeh, five or six miles north of Jerusalem; he is a plain simple man, and probably never goes as far as ten miles from his village. Hizmeh is near Wady Farah, two hours north-east of Jerusalem. All that region for many miles north of Wady Farah, where the tableland of Judea breaks down to the Jordan valley, is very wild and has never been very carefully explored."

Mr. Thomas had much pleasure in naming this new Gazelle, which represented a type quite new to the Palestine Fauna, in honour of its discoverer Dr. Selah Merrill.

The following papers were read:—

1. The Characters and Synonymy of the British Species of Sponges of the Genus *Leucosolenia*. By E. A. Minchin, University College, London.

[Received November 15, 1904.]

(Text-figures 91–98.)

I. Introductory.

The following memoir is an attempt to fix the nomenclature and to define the characters of the British species of Ascons belonging to the section for which, in my opinion, the name *Leucosolenia* is the correct taxonomic designation. In order to

carry out this intention a large number of specimens, including the types of earlier authors, have been carefully examined. This task has been forced upon me as the result of some investigations upon the development of the various forms of spicules in sponges of the genus *Leucosolenia*, which it is hoped to publish shortly. It was found that in describing the spicule-development it would be necessary either to use names for the species which were incorrect or else to employ a nomenclature at variance with that in the current literature dealing with these sponges. And since the utmost confusion exists with regard to the designation of these species both in the labels of museums and collections, no less than in even the most recent works dealing with them, it seemed worth while trying to give a thorough description of their distinctive characters once and for all. It was my original intention to have included the Mediterranean species in this memoir, but lack of material forced me to confine myself for the present to the British forms, which, moreover, are the more important from the taxonomic point of view, as including the earliest described sponges of the genus.

The generic name *Leucosolenia* Bwk. is used by different authors in different senses, but is employed in this memoir in the same sense as in my former publications [**15**, **16**], namely, to include those Ascons which form a natural group distinguished by the following characters:—

(1) The sponge-body or colony grows in a more or less erect form with relatively large, distinct oscular tubes. (2) All three kinds of spicules are present—monaxon, triradiate, and quadriradiate. (3) The triradiate systems have two paired angles, less than 120°, and an unpaired angle greater than 120°, corresponding to a straight median ray and two curved lateral rays. (4) The collar-cells have the nucleus apical in position, situated close under the origin of the flagellum. (5) The larva is an amphiblastula, and the first spicules formed are monaxons. Of these characters, all except (2) are family characters, distinguishing the *Leucosoleniidæ* from the *Clathrinidæ*; the latter having a reticulate form, equiangular triradiate systems, basal nucleus in the collar-cells, and parenchymula larva, the first spicules to be formed being triradiates. The presence of all three kinds of spicules distinguishes *Leucosolenia* from Haeckel's genus *Ascyssa*, in which monaxons alone are alleged to be present—a genus which, if it exists, should probably be placed in the family *Leucosoleniidæ*.

II. Historical Review and Criticism.

The earliest descriptions of species of Ascons were based entirely on outward form and appearance, and though the spicules were noticed and figured no use was made of differences in spiculation in order to distinguish the species. The external characters of an Ascon are not a very safe guide, as a rule, to its specific identification. In some cases, however, a species has a typical

form which enables one to recognise it almost with certainty, or at least to distinguish it from others belonging to the same fauna by simple inspection. That is the case particularly with *Leucosolenia botryoides*, the first-named Ascon species described in 1786 from the British coast (locality Emsworth, between Sussex and Hampshire) by Ellis and Solander [**7**] under the name *Spongia botryoides*. In this case the form is so characteristic that there can hardly be any doubt as to the species which is represented by the authors' figure. The next species of *Leucosolenia* to be described was the *Spongia complicata* of Montagu [**17**], also from the British coast; and in this case it is more difficult to be positive, but, on the whole, it is highly probable that Montagu's figures represent a specimen of the sponge for which his name is retained, following Haeckel, in this memoir. The arborescent mode of growth depicted is a feature extremely characteristic, if not absolutely distinctive, of this species, at least as far as the British fauna is concerned. On the other hand, more doubt attaches to the third species described, the *Spongia confervicola* of Templeton, 1836 [**22**], which is evidently a *Leucolosenia* from the figures, but of which the specific identity remains doubtful. Templeton's memoir is freely annotated by "G. J.," apparently George Johnston, and the footnote to *S. confervicola* is "*Spongia complicata* G. J." I am more inclined to the opinion, however, that the figure of *S. confervicola* represents a specimen of the later described species "*Ascandra variabilis*" of Haeckel, though Haeckel himself identifies it with *botryoides*. In any case, as the point cannot be determined, *Spongia confervicola* must be regarded as a *nomen nudum* without importance for taxonomic nomenclature. Johnston, in his work of 1842 [**14**], ignores both *Spongia complicata*, as Fleming [**8**] had done before him, and *S. confervicola*; both these authors recognise only *Spongia botryoides*, and regard Montagu's *S. complicata* as merely a variety of the former.

In the meantime different authors had subdivided the comprehensive genus *Spongia* into various genera, and Templeton was one of the last to employ the name for any calcareous sponge. Fleming in 1828 [**8**] proposed the generic name *Grantia* for all calcareous sponges, putting *G. compressa* Fabr. as the first, and *G. botryoides* Ell. & Sol. as the second species; *compressa* must therefore be regarded as the type species of *Grantia*. Grant in 1833 [**11**] proposed the genus *Leuconia* for calcareous sponges, putting as his first species *nivea*, which is therefore the type species of this genus. In 1834 de Blainville [**6**] proposed the name *Calcispongia* in exactly the same sense as *Grantia*, putting also *compressa* first and *botryoides* second, so that this generic name becomes a synonym of *Grantia*. A great advance was made by Bowerbank [**1**], who, in 1864, further subdivided the calcareous sponges. Pointing out that *Grantia botryoides* was quite different from either the *G. compressa* (Fabr.) or *G. nivea* (Grant) of Fleming, he retained Fleming's genus *Grantia* for *compressa*,

Grant's genus *Leuconia* for *nivea*, and placed *botryoides* in a new genus *Leucosolenia*. In making these changes Bowerbank acted with perfect correctness, according to accepted modern rules of nomenclature; and it is clear that for the species *botryoides* the generic name *Leucosolenia* has the priority over all other generic names for it, or for other species associated with it generically. *Leucolosenia* is, in short, the first generic name put forward which has an undoubted Ascon as the type species.

Bowerbank added various species to his genus *Leucosolenia*, amongst them forms which, in my opinion, cannot be associated generically with *botryoides*, and therefore do not belong to the genus *Leucosolenia* as here understood, but to that section of the Ascons for which I employ the generic name *Clathrina* (Gray, 1867). Moreover, Bowerbank did not properly understand the distinctions between the different species which he dealt with, so that different species are found confused together in his monograph in an extraordinary manner, and his descriptions are sometimes quite incorrect. Thus the specimen described and figured as *L. botryoides* in vol. i. of his monograph (p. 164, figs. 347, 348, pl. xxvi.) does happen to be a genuine specimen of *botryoides*. This can be seen at once from his figure 348, which is extremely characteristic, and I have been able to examine this specimen and have figured its spicules (text-fig. 98, figs. 27 *a–g*, p. 390). On the other hand, the specimen figured as *L. botryoides*, in vol. iii. pl. iii. fig. 1, is a specimen of the species described by Haeckel under the specific name *variabilis*, and the description given by Bowerbank of the triradiate spicules as "equiangular" (vol. ii. p. 28, vol. iii. p. 7) can be seen, even from his figures, to be incorrect. Bowerbank further described a new species under the name "*Leucosolenia contorta*." I hope to discuss the rather complicated question of the characters and synonymy of this species in another memoir, the true *contorta* being a *Clathrina*. I will only say here that amongst specimens identified by Bowerbank as *contorta* I have found a *Clathrina* species mixed up with specimens of *Leucosolenia complicata* and *variabilis*. Bowerbank himself considered (vol. ii. pp. 30, 31) that his species *contorta* might be synonymous with Montagu's species *complicata*, but was more inclined to regard Montagu's figure of the latter as being "a very characteristic figure of *Spongia botryoides* Ellis & Solander," and thought it better under the circumstances to reject the term *complicata* altogether. Finally, in vol. iii. of his monograph, Bowerbank described and figured a sponge found in Brighton Aquarium under the name of *Leuconia somesii* (pp. 334–332, pl. xci. figs. 6–17). A glance at his figures makes it obvious that this sponge is a *Leucosolenia*, but his description is inadequate for determination of the species. Having been able to examine Bowerbank's types of this species in the British Museum, I found them to be merely aberrant specimens of *Leucosolenia variabilis* (Haeckel), as Topsent had already suspected, characterised by the great development in the number and length of

the monaxons, and, as shown by Bowerbank's figures, a great tendency to the production of abnormal forms of triradiates (see text-fig. 95, figg. 18 *a–e* and 19 *a–h*, p. 379). *Leuconia somesii* may, in short, be characterised as an interesting aquarium variety of *Leucosolenia variabilis*, showing modifications parallel to those described by Bidder for *Sycon raphanus* *, growing in the Naples Aquarium. Bowerbank himself was struck by the resemblance of this sponge to a *Leucosolenia*, and particularly to the specimen figured by him in pl. iii. fig. 1, which, as stated above, was actually a specimen of *L. variabilis*; he remarks that the only other known British calcareous sponge with which this species is likely to be confounded is *Leucosolenia botryoides*, but "only in its young and immature state." *Leuconia somesii* must therefore be put as a synonym of Haeckel's species *variabilis*.

Enough has been said to justify the criticism made above that Bowerbank did not grasp the real distinctions between the species of his genus *Leucosolenia* †. It is the great merit of Haeckel, whose name marks the next epoch ‡ in our knowledge of calcareous sponges, that he was the first to understand the great importance of the spicules in specific determinations, and to give descriptions of the species by which they could be recognised clearly. It may be said, in short, that previous to Haeckel's great monograph no species of calcareous sponge was really adequately characterised, and that Haeckel was the first to show how this should be done. Hence, where previous descriptions of a calcareous sponge leave us in doubt as to its identity, *Haeckel's determination of its characters fixes the application of the name.*

Had Haeckel carried out his own method with accuracy and conscientiousness it would not have been necessary for the present paper to be written, but unfortunately this is far from being the case. Of the specimens which I have been able to examine, some have been through Haeckel's hands and have been identified by him, and these show, in many cases, the most extraordinary errors of identification, as will be evident from the descriptions and figures given below. It will be made clear, also, that in two cases at least he founded unnecessary species simply as the result of overlooking spicules in certain specimens which he found to be present in others of the same species. Haeckel's numerous species of Ascons require, one and all, a thorough re-examination, and there can be no doubt that a careful revision would result in

* Quart. Journ. Micr. Sci. v. xxxviii. p. 10.

† To the well-known monographs of Oscar Schmidt [**19, 20**], more or less contemporary with Bowerbank's writings, further reference is not necessary here, since of *Leucosolenia*, in the sense used in the present memoir, only two species are described, *L. lieberkühnii*, which is not a British form, and *L. fabricii*, which appears to be a synonym of *complicata*.

‡ Both of Haeckel's works, the 'Prodromus' (1870) and the 'Monographie' (1872), were published at dates between those of the second and third volumes of Bowerbank's 'British Spongiadæ;' but they were not noticed by Bowerbank, and belong in all respects to a subsequent epoch. Of Bowerbank's species, only *Leuconia somesii* was described after Haeckel's monograph, and is therefore not noticed by the latter.

many, perhaps the majority, of his specific names becoming synonyms.

There is, however, a further blemish on Haeckel's work, which has been the cause of all the universal confusion in the nomenclature of these sponges. Haeckel took no notice in his final monograph * of any generic names for calcareous sponges used before him. Making a clean sweep of all previous names, he set up twenty-one new genera, seven of which were Ascons. Such a proceeding could not, of course, be tolerated, being a flagrant violation of the rules of taxonomic nomenclature which have long been followed in this country, and now are universally accepted abroad also. Hence Haeckel's system has undergone various modifications at the hands of subsequent writers.

The first work of primary importance dealing with calcareous sponges after Haeckel was Poléjaeff [**18**], who reverted to Bowerbank's use of the name *Leucosolenia* to denote all Ascons. In works of later date some systematists have followed Poléjaeff in the use of the name *Leucosolenia*, as, for example, Topsent; others have used modifications of Haeckel's system, as, for example, Lendenfeld; and others, again, have used *Leucosolenia* in some special sense, as, for example, Breitfuss. In 1896 [**15**] I put forward a scheme of classification for Ascons which has not been followed by subsequent writers, but to which I still adhere. It would be foreign to the purpose of the present memoir to discuss the classification of Ascons generally, but in order to justify my use of the name *Leucosolenia* I put forward three propositions:—

(1) That the oldest Ascon genus, *Leucosolenia* Bowerbank, is a valid genus, founded in a perfectly correct manner, its type species being *L. botryoides*, the oldest described species of Ascon.

(2) That therefore the generic name *Leucosolenia* has priority over all others for this species, and the combination *Leucosolenia botryoides* is one that should never be disturbed.

(3) That therefore in any scheme of classification in which other Ascons are placed in the same genus as *botryoides*, they also should be termed *Leucosolenia*.

If these three propositions are accepted, it becomes of extreme importance to describe accurately the specific characters of *Leucosolenia botryoides*. I think I may claim to have done so in the present paper, and from the description below it will be immediately apparent that the restriction of the name *Leucosolenia* to Ascons without monaxon spicules, as done by Breitfuss, is an error, caused by Haeckel's incorrect description of the species *botryoides*.

As regards the specific determination of Ascons, the chief criticism which I have to make, with regard both to Haeckel and to post-Haeckelian systematists generally, is that sufficient account is not taken in their descriptions of the great variability of the

* In Haeckel's 'Prodromus' [**12**] he put forward a scheme of classification in which previous generic names were used, but in his 'Monographie' [**13**] he completely altered both his classification and his nomenclature.

spicules, not only in different specimens but even in any given specimen. In order to separate the essential from the accidental in the description of an Ascon, not only should many specimens be studied, if possible, but in each specimen all possible forms of spicules should be drawn. One instance from Haeckel's monograph will suffice to illustrate this point. Under the genus *Ascandra* (*t. c.* p. 81) the species *botrys*, which I have shown below to be a synonym of *botryoides*, is characterised as having "triradiates obtuse-angled, rays 8 times as long as thick," while the species *nitida* is distinguished from it by having "triradiates right-angled, rays 4 times as long as thick." Now if the reader will turn to my figures of the spicules of *botryoides* given below (text-figs. 97 & 98, pp. 388, 390), or, better still, will examine a specimen for himself, and compare the spicules with Haeckel's figures of the triradiates of *botrys* and *nitida**, it will be found that in *any specimen* the triradiates vary in slenderness from the types figured by Haeckel for *botrys* to those given for *nitida*, and that their paired angles vary from obtuse, in the more slender spicules, to right angles in the thicker forms. There is therefore *no argument to be drawn from Haeckel's descriptions and figures* against putting these species together and considering *botrys* and *nitida* as synonyms of *botryoides*. Whether they are really distinct or not can only be determined by fresh investigation of the specimens. Until that has been done we are justified in striking out two of the three names.

Another point in which variation occurs commonly is the relative frequency of a given type of spicule in different specimens. Thus in some specimens a form of spicule may be abundant, which in others may be so scarce that much searching may be necessary to find it†. As negative characters require much greater caution to affirm than positive ones, it is only after very careful investigation that one should declare a type of spicule to be absent in any specimen which agrees in all other respects with other specimens in which it is present; even then it would be most unsafe to separate such a specimen as a distinct species on this character alone. Yet it is in this way that Haeckel separated (in error, as it has proved) the species *botryoides* and *complicata* from their synonyms *botrys* and *pinus*.

The extreme uncertainty and doubt which attach to all identifications of Ascon-species in works dealing with them, have, it may be pointed out, one important consequence: that, namely, of rendering utterly worthless all statements concerning their geographical distribution. It is, indeed, my firm conviction that the study of the distribution of Ascons, perhaps of all Calcarea, requires to be commenced *de novo*, and to be preceded by an accurate study of their specific characters. Until it is possible to have

* The extremely fanciful, if artistic, curves which Haeckel introduces into his drawings of spicules must be discounted in making comparisons.

† Compare the very important observations of Topsent (Arch. Zool. Exp. (3) viii. p. 43) on the different types of spiculation in *Cliona celata* at different ages.

confidence in the correctness of the identification of a species, statements as to its occurrence and distribution are of no value whatever.

III. Methods and Material.

The present investigation has been directed mainly towards a thorough examination of the spiculation. For making preparations of calcareous spicules, the reagent used by me is Eau de Javelle. The piece of sponge selected is first of all, in the case of spirit-specimens, placed in water for a minute or two, and then put into a test-tube with a small quantity of Eau de Javelle, barely more than enough to cover the bit of sponge. In a few minutes the soft parts are dissolved, and with gentle shaking the sponge disappears, being resolved into a cloud of spicules. No heating is necessary, but the Eau de Javelle loses its powers after a few months, and should have been recently made up. The test-tube is then filled up with distilled water, shaken up well, and put aside to stand undisturbed until the spicules have fallen to the bottom, which they do in the course of a few hours. As much as possible of the liquid is then decanted off, care being taken not to disturb the spicules settled at the bottom, after which the test-tube is again filled up with distilled water, shaken up, and left to settle again. After a third washing with distilled water in this way, the Eau de Javelle is sufficiently removed, and the tube is then filled up with strong alcohol (90 per cent.), in which spicules settle much more quickly than in water*. After two washings with alcohol, the spicules are ready to be mounted. This is done simply by drawing them up with a pipette from the bottom of the alcohol in the test-tube, placing them on a slide, and burning off the alcohol, leaving the spicules dry on the slide. A drop of Canada balsam is then put on them, and on that a cover-slip. In this way very clean preparations of the spicules can be obtained. It is advisable, however, not to defer the examination of them too long, as even in Canada balsam they become corroded sooner or later, and in some samples of the mounting medium the corrosion proceeds rapidly. Hence attention should be paid to the purity, that is to say the non-acidity, of the Canada balsam employed.

For drawing the spicules I have used in all cases a camera lucida with Zeiss's ocular II. and objective D, giving a magnification of 320 (reduced in the illustrations in this memoir to 300). My method is first to draw the commoner forms of spicules seen, and then to hunt carefully through the slide and draw every spicule found differing at all markedly from those already drawn. The process is a tedious one, and it is too tiring to attempt the examination of more than two specimens a day at the utmost. But only in this way is it possible to frame an idea of the great

* The process of washing the spicule can be greatly hastened by using a centrifugal machine, but as there is great danger of their then becoming caked through interlocking of the spicule-rays, I have preferred the slower and surer method described above.

range of variations shown by the spicules in every specimen. It is, moreover, extremely easy to overlook inconspicuous forms of spicules. It was not until I had studied carefully many specimens of *botryoides* and *variabilis* that I became aware of the invariable presence in both of slender straight barbed monaxons (text-fig. 94, fig. 10 *k*, *l*, p. 377; text-fig. 97, fig. 22 *l*, *u*, &c., p. 388).

For the study of the species dealt with in the present memoir I have examined specimens from various sources. Besides those which I have collected myself at Plymouth, Roscoff, and elsewhere, or which have been sent me by friends, I have had access to specimens of historic importance in the private collection of Canon A. M. Norman, and in the collections of the British Museum and the Berlin Museum. Among those who have given me specimens my thanks are especially due to Mr. Walter Garstang, who sent me numerous specimens from the neighbourhood of Plymouth, and Monsieur E. Topsent, who sent me specimens from France. Canon Norman, with great liberality, placed his collection at my disposal and allowed me to examine all his specimens*. The information I acquired in this way was most valuable, since his collection comprised type specimens of Bowerbank and others, as well as many which had been through Haeckel's hands, identified by him, and returned with the labels written or endorsed by Haeckel with his own hand. Not less valuable, and more numerous, were the specimens in the British Museum of Natural History, for access to which I have to thank Dr. A. C. L. Günther, F.R.S., who permitted me to examine all the specimens, and Mr. Kirkpatrick, who most kindly looked them out for me and instructed me as to the various handwritings on the labels. For examination of the specimens in the Berlin Museum I am indebted to Dr. Weltner, who, by the kind permission of Professor Moebius, was so good as to send me small pieces of the Ascons in the Berlin collection, to enable me to study their spiculation.

A list of the specimens from various sources which I have thus been able to examine is given below, following the descriptions of the species, from which it will be seen that my identification of a specimen is often very different from that of its previous label. I have only to add that, in the case of each specimen mentioned, the spicules have been carefully drawn by me with the aid of the camera lucida in the manner described above. The illustrations to this memoir are tracings from a selection of the drawings so made.

IV. General Remarks on the Characters of the Species of *Leucosolenia*.

The external form and mode of growth in the genus *Leucosolenia*

* It is now ten years since I examined Canon Norman's specimens, and nearly as long since I obtained for study the specimens from the British and Berlin Museums. Much stress of other work has prevented the completion of these investigations.

are subject to considerable variations, due to the particular environment and conditions under which the sponge grows in each case. The variability of form is, however, combined always with constant and characteristic features, and may be compared with the different forms which a creeping plant will assume under different natural conditions. Too much has been made, in many works, of this variability, and not enough of the constancy which underlies it. No one who has a working acquaintance with Ascons can ever mistake a *Leucosolenia* for a *Clathrina*, except perhaps in the very youngest stages of growth; there is no need for me to repeat here what I have said in previous memoirs as to the diagnostic importance of the form of the sponge for distinguishing the two genera. It is, moreover, by no means difficult, indeed it is usually very easy, to recognise at sight all the species occurring in any particular locality, when one has once become intimate with their characteristic features. Yet from looking at Haeckel's plates of these sponges, the impression gained is that Ascons have no characteristic generic or specific features except in the spiculation. Haeckel's artistic pencil has misled him, and others, upon this point, and his plates fail to portray the natural appearance of the sponges.

Speaking generally, there are three principal types of body-form occurring in the species of *Leucosolenia*. If the sponge be growing on a bare rock, or on the stem of a large alga, it will creep over it, sending out anastomosing basal stolons from which oscular tubes arise at intervals. Such a specimen has been figured by me elsewhere [**16**, fig. 5]; it was found growing over a granite rock at Roscoff, and is now in the British Museum. This type of colony may be designated the *spreading* form; it is not at all common, since it may be supposed to be a rare occurrence for the sponge to find a rock-surface unoccupied by other competitors. More usually these sponges are found growing crowded up amongst algæ and various organisms, often in muddy situations, or creeping over the seaweeds, and they then assume a form which may be termed *bushy*; an example of this mode of growth has been figured by me in the case of a specimen of *L. lieberkühnii* [l. c. fig. 3] which came from the keel of a ship moored permanently in the Porto Militare at Naples, and which was growing in a luxurious forest of algæ, hydroids, barnacles, worm-tubes, &c. The bushy form is the commonest type of *Leucosolenia*-colony. In a third modification the sponge forms a creeping or *arborescent* growth usually closely applied to its support, but sometimes branching out under favourable circumstances into tree-like growths [l. c. fig. 4]. Although all these three modifications of form merge into one another, it is convenient to classify them into the three principal types noted above.

A few words upon the characters of the spicules will not be out of place here. The three kinds of spicules found in *Leucosolenia* may be classified into: (1) monaxon spicules, simple needle-like forms; (2) triradiate systems, with or without the addition of a

fourth or gastral ray. In the monaxons a proximal end imbedded in the wall of the sponge is to be distinguished from a distal end projecting freely into the water. The shaft of the monaxon is generally thickest towards the proximal end, at which it tapers rapidly to a blunt or moderately sharp point. The distal end usually has a barb or "lance-head," frequently rudimentary or absent. The barb is in reality a double bend in the axis of the spicule, and is comparable to a very thick bayonet, rather than to a spear-head*. In cases where it is absent, the distal ends of the monaxons become excessively sharp and fine.

A remarkable point with reference to the monaxons of *Leucosolenia*, which I have found to hold good, not only with regard to the species described in this memoir, but also for all other species that I have examined, is that the monaxons can be separated more or less easily into two varieties, distinguished by the fact that one kind appears very refringent, the other, by comparison, pale, under the microscope. The refringent monaxons are always scarcer than the pale ones, but their peculiar optical property makes it very easy to find them, especially under low powers (Zeiss, Oc II. Obj. B). In form the two kinds of monaxons may not differ essentially, but the refringent ones always show certain characteristics which may be summed up by saying that they tend to be straighter, more slender, and sharper than the others, and their distal barb is less distinct or absent. When examined by means of polarised light, the conditions are reversed, since the pale monaxons light up brightly between crossed prisms, while the refringent forms remain dark or feebly illuminated. This is particularly well seen in the small monaxons of *L. variabilis* (see below, p. 380), where the curved forms light up most brilliantly with crossed prisms, while the straight refringent forms remain quite dark or only slightly illuminated in all positions, when the stage of the microscope is rotated. This shows clearly that the difference between the two types is due to a difference in the relation of the axis of crystallisation to the form of the spicule.

The triradiate systems which do not acquire gastral rays do not differ in any other structural feature from those which, by doing so, become quadriradiates. In some cases the triradiates and quadriradiates may differ in size, and their relative abundance varies greatly in different specimens. In each triradiate system we have to distinguish, as has been said above, an unpaired or posterior ray, which in the oscular tube points away from the oscular opening, and two paired lateral rays; the latter make with the posterior ray paired lateral angles less than 120° and sometimes almost approaching 90°; the lateral rays at their junction enclose an unpaired anterior angle, which is greater than 120° in proportion as the lateral angles are less. The lateral rays are nearly always distinctly curved; the posterior ray is normally straight.

* This point is, unfortunately, not very well brought out in the drawings accompanying this memoir.

Since the triradiate systems lie in the wall of a hollow cylinder, the three rays are never in the same plane, but are disposed in such a manner that if the spicule be viewed in a direction corresponding to the axis of the unpaired ray, the two lateral rays appear to meet at an angle less than 180° on the gastral side, greater than 180° on the dermal side. This is an important fact to bear in mind when studying the spicules in preparations. If the spicule be lying on the slide with its dermal face uppermost, then the points of the three rays touch the slide, but their junction is raised off it; hence the spicule appears from this aspect perfectly symmetrical, with two lateral rays of equal length and similar curvature, but each of the three rays is slightly foreshortened. If, on the other hand, the spicule be lying on the slide with its gastral face uppermost it may lie so as to appear symmetrical, but more usually it is found lying with one lateral ray and the posterior ray flat on the slide, the other lateral ray pointing obliquely upwards. Hence when the two rays which lie flat are in focus the third ray is out of focus, and when drawn with the camera it appears foreshortened, giving the spicule an asymmetrical appearance. To this fact is due the foreshortened appearance of one of the two lateral spicule-rays in many of my drawings, especially of *L. botryoides*, in which the thickened T-shaped triradiate systems are very concave on the gastral face.

V. Description of the Species.

1. Leucosolenia complicata.

Spongia complicata Montagu, 1812, Wernerian Memoirs, ii. p. 97, pl. ix. figg. 2, 3.

Spongia botryoides pars Grant, 1826, Edinb. New Phil. Journ. i. p. 169.

Grantia botryoides pars Fleming, 1828, Hist. Brit. Animals, p. 525.

Grantia botryoides pars Johnston, 1842, Brit. Spong. and Lithophytes, p. 178.

Leucosolenia contorta pars Bowerbank, 1866, Mon. Brit. Spong. ii. p. 9; 1874, iii. pl. iii. figg. 5–10.

Leucosolenia botryoides Gray, 1867, P. Z. S. p. 555.

Leucosolenia fabricii O. Schmidt, 1869, Mitth. naturwiss. Ver. Steiermark, ii. p. 91.

Leucosolenia fabricii O. Schmidt, 1870, Grundz. Spong.-Faun. Atl. Geb. p. 73.

Olynthus hispidus Haeckel, 1870, Jena. Zeitschr. v. p. 237.

Olynthus pocillum Haeckel, 1870, l. c. p. 237.

Leucosolenia amœboides Haeckel, 1870, l. c. p. 243.

Leucosolenia (*Leucelia*) *complicata* Haeckel, 1870, l. c. p. 243.

Leucosolenia fabricii Haeckel, 1870, l. c. p. 243.

Asculmis seu *Ascandra armata* Haeckel, 1872, Kalkschw. pp. 77–79, pl. 13.

Ascortis seu *Ascandra fabricii* Haeckel, 1872, l. c. p. 71, pl. 11. fig. 3, pl. 12. figg. 3 *a*–3 *i*.

Ascandra complicata Haeckel, 1872, l. c. p. 93, pl. 15. figg. 1 *a*–1 *k*.

Ascandra pinus Haeckel, 1872, l. c. p. 105, pl. 16. figg. 3 *a*–3 *i* and pl. 19.

? *Ascandra contorta* Barrois, 1876, Embryol. d. q. Éponges d. l. Manche, Ann. Sci. Nat. (6) iii. p. 36.

Ascandra complicata Bowerbank and Norman, 1882, Mon. Brit. Spong. iv. p. 226.

Ascandra complicata Fristedt, 1887, 'Vega' Exped., Vetenskapl. Iakttagelser, iv. p. 406.

Leucosolenia pinus Topsent, 1891, Arch. Zool. Exp. (2) ix. p. 525.

Leucosolenia complicata Levinsen, 1893, Vid. Ud. Kanonbaaden 'Hauchs' Togter, v. p. 424.

Leucosolenia complicata Weltner, 1894, Wissensch. Meeresuntersuch. n. F. i. p. 325.

Leucosolenia complicata Minchin, 1896, Ann. Mag. Nat. Hist. (6) xviii. p. 359.

Leucosolenia complicata Bidder, 1898, P. R. Soc. lxiv. p. 69.

Ascandra complicata Breitfuss, 1898, Arch. Naturges. lxiii. i. p. 213.

Ascandra contorta Breitfuss, 1898, l. c. p. 214.

Ascandra fabricii Breitfuss, 1898, l. c. p. 214.

Ascandra fabricii Breitfuss, 1898, Mém. Acad. St. Pétersbourg, (8) vi. p. 7.

Ascandra contorta Breitfuss, 1898, l. c. p. 15, pl. i. fig. 1.

Ascandra fabricii Breitfuss, 1898, Arch. Naturges. lxiv. i. p. 285.

Ascandra contorta Breitfuss, 1898, l. c. p. 285.

Ascandra complicata Breitfuss, 1898, l. c. p. 285.

Ascandra fabricii Breitfuss, 1898, Ann. Mus. Zool. Acad. St. Pétersbourg, p. 17.

Ascandra complicata Breitfuss, 1898, l. c. p. 27.

Ascandra contorta Breitfuss, 1898, l. c. p. 27.

Leucosolenia complicata Minchin, 1900, in Lankester's Treatise on Zoology, ii. Sponges, p. 5, fig. 5.

Ascandra complicata Arnesen, 1901, Bergens Mus. Aarborg, 1900, no. 5, p. 13.

Ascandra armata Arnesen, 1901, l. c. p. 13.

Leucosolenia complicata Rousseau, 1903, Mém. Soc. Malac. Belgique, xxxvii. p. 7, fig. 3.

Leucosolenia fabricii Rousseau, 1903, l. c. p. 6, fig. 2.

Leucosolenia complicata Allen, 1904, J. Mar. Biol. Assoc. n. s. vii. p. 185.

I commence with this species as being the most easily identified of the three British Leucosolenias, although, curiously enough, it is more often found incorrectly determined than either of the others. While the systematists previous to Haeckel for the most part considered it a synonym of *botryoides*, recent authors have

generally confused it with *Clathrina contorta*, impossible as this might seem to anyone acquainted with the two species, and considering not only the sharp differences in spiculation, correctly described by Haeckel, but also the complete dissimilarity in external form and appearance between the two sponges; nothing could be imagined, in fact, more unlike than full-grown colonies of the two sponge species.

(a) *External Characters.*

Leucosolenia complicata occurs commonly in either the bushy or the arborescent form. My specimens from Plymouth are all of the former type; I have it not only from rock-pools along the shore, but also dredged from deep water off the Mewstone. This delicate sponge is rarely found in situations in which it is liable to be left dry at low tide. It forms compact colonies in which numerous closely-set oscular tubes arise from, and partly conceal, a basal growth of finer tubes forming a reticulum attaching it to the substratum. In my specimen from the Mewstone the oscular tubes show a marked tendency to assume the characteristic tree-like form, especially towards the centre of the bushy colony.

The largest specimens of *L. complicata* that I have seen were collected in the *Zostera*-beds at Roscoff, close to the Laboratory, where this beautiful sponge, favoured by the shelter afforded, grows in profusion and in the most luxuriant manner. As a rule, it does not grow on the *Zostera* itself but on the stronger and tougher algæ found associated with it. The sponge itself is so fragile that it is scarcely possible even to lift a large specimen out of the water without pieces breaking off, and I have found it impossible to transport them entire. These specimens, and all others which I have collected at Roscoff, show the typical arborescent form by which the sponge can be recognised at a glance, a mode of growth perhaps correlated with the clean granite rocks and sand, and the pure water, very free from mud and sediment, at Roscoff, while in Plymouth Sound the conditions are more estuarine. In the largest specimens from the Roscoff *Zostera*-beds the arborescent growth differs, in a manner which strikes the eye at once, in different portions of the sponge-colony. In the deeper parts, close to the stems of the supporting seaweed, the oscular tubes form a looser, more straggling growth, apparently due to the fact that they grow more rapidly in length than do the diverticula which arise from them. Higher up the oscular tubes are found growing vertically upwards, and at the same time sending out on all sides a profusion of diverticula which become oscular tubes and throw out other diverticula in their turn, with the result that the sponge assumes the pinetree-like form figured and described by Haeckel from the coast of Normandy under the name *Ascandra pinus* (Monographie, vol. ii. p. 105, vol. iii. pl. 19). Haeckel's figure represents this form fairly well, except that, as usual, he puts more curves into the branches than they should

have. The straightness of the oscular tubes is rather a marked feature of the "*pinus*" form. Where Haeckel's figure is most in error is in representing this tree-like form as an independent growth arising by a massive trunk from a solid rock-foundation, instead of being merely the upper part of a large colony. It is these pinetree-like portions which generally drop off by their own weight when the sponge is gathered, or become detached during transport of the specimen, and it was doubtless to a fragment of this kind that Haeckel's sense of artistic completeness supplied the lacking foundation. I have also found *L. complicata* at Roscoff growing amongst the stems of algæ on rocks and isolated boulders, in situations where it is left dry at the spring-tides, though not at ordinary tides. Under these conditions also the sponge shows the characteristic arborescent growth, but clings close to the seaweeds and is never independent of them to any great extent*.

Comparing different specimens of this sponge, I find that the most constant feature of its habit of growth is, that the erect and often very long oscular tubes never grow to any length without throwing out diverticula, which, in their turn, give rise to other diverticula and soon form oscula at their distal extremity. Hence the oscular tubes of *L. complicata* are always beset with diverticula to a greater or less extent, thus contrasting with the long, smooth, usually slender oscular tubes characteristic of *L. variabilis*. The body-wall is usually thinner and more delicate than in *variabilis*, and the natural contour is a pure creamy white, except when obscured by sediment and the numerous diatoms and other organisms which settle on the exterior of the sponge.

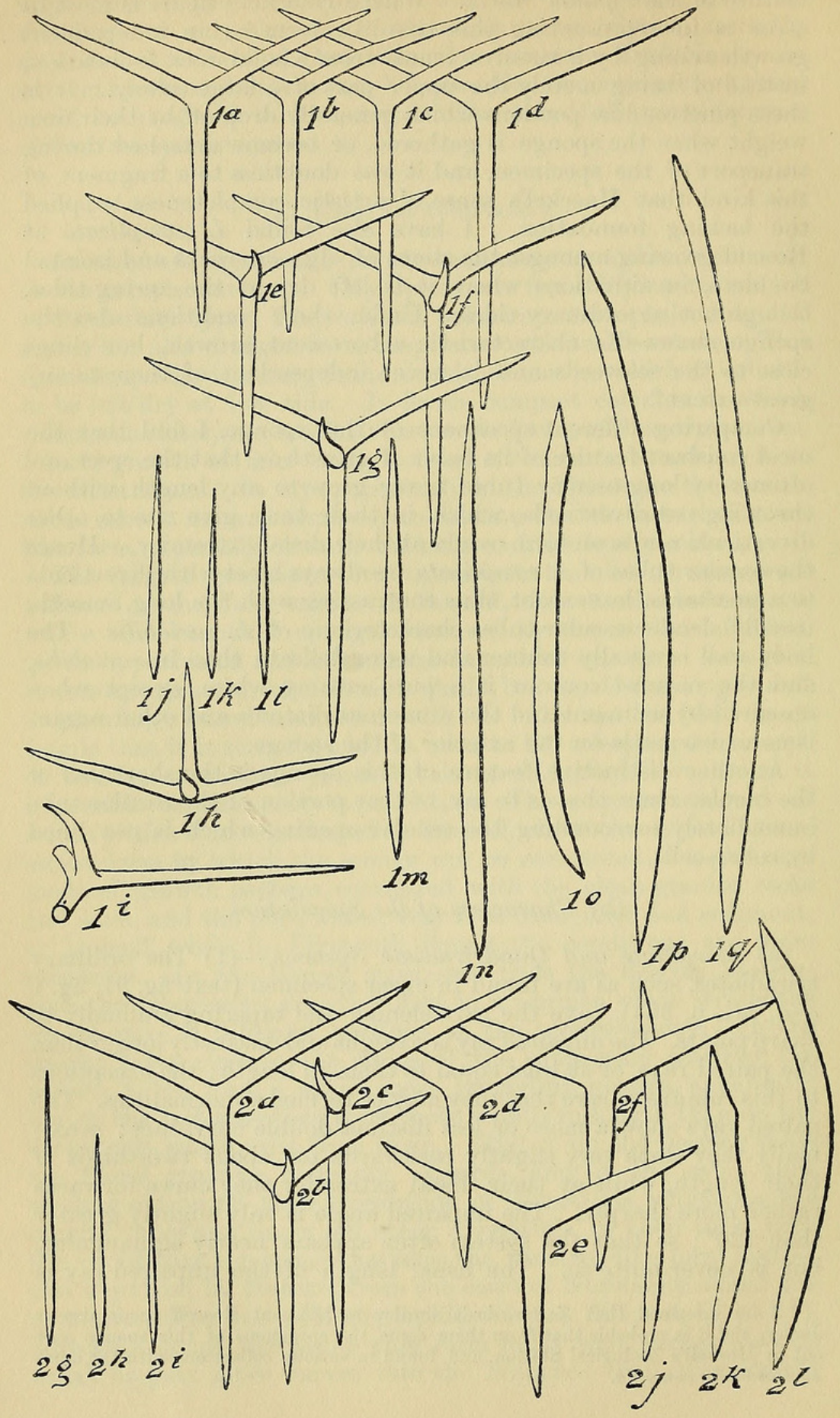
Another distinctive feature of this sponge is the shortness of the oscular rim—that is to say, of that portion of the oscular tube immediately surrounding the oscular opening which is not lined by collar-cells.

(b) *Characters of the Spiculation.*

(a) *Triradiate and Quadriradiate Systems.*—(1) The ordinary triradiates, such as are found in every specimen (text-fig. 91, fig. 1 *a–d*, &c., p. 364), have the rays slender and tapering gradually to sharp points. The unpaired ray is straight and distinctly longer than the paired rays, or at least equal to them in length; the exceptions to this rule are so rare that they may be termed abnormalities. The paired rays show a more or less distinct double curvature; proximally they slope very slightly backwards for about two-thirds of their length, while at their distal extremity they curve forwards rather more sharply. The unpaired angle is only slightly greater than 120°; so that the system often appears nearly equiangular, but is never quite so. The usual length of the unpaired ray is

* I am informed that *Zostera*-beds similar to those at Roscoff occur also at Jersey, and it is probable that from them come the specimens of this sponge sent out by Hornell's Zoological Station, and found in various collections with the label *Leucosolenia contorta*.

Text-fig. 91.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from 100 μ to 120 μ, the thickness about 6 μ; the paired rays range from 75 μ to 90 μ in length, with a thickness of about 7 μ. (2) Besides the ordinary triradiates just described, there occur in some specimens triradiates with shorter and more thickened rays (text-fig. 91, fig. 2 *d–f*, p. 364; text-fig. 93, fig. 7 *c*, p. 369). The proximal curve of the paired rays is scarcely noticeable; while the distal curve is rather accentuated. The length of the rays is about 70 μ or rather more in some specimens, the thickness 9 or 10 μ. (3) The ordinary quadriradiates have the basal rays similar to (1) and the gastral rays of moderate length, curving forwards at the tip, smooth and tapering evenly to a point (fig. 1 *i*). The gastral ray is implanted on the unpaired ray of the basal system, distinctly behind the central point of the junction of the three rays composing it. In some specimens the quadriradiates are, on the average, of slightly larger dimensions than the triradiates. (4) Occasionally a gastral ray is found developed on the thickened triradiates (2), but this is rather a rare type of spicule (text-fig. 93, fig. 7*e*, p. 369).

(b) *Monaxon Spicules.*—Three kinds occur constantly, and are the most diagnostic feature of the species. (1) Large spicules with distinct lance-heads (text-fig. 91, figg. 1 *o–q*, p. 364). The cylindrical shaft is always more or less curved, sometimes irregularly, and tapers rather rapidly to a sharp point at the proximal extremity, but at the distal end remains of even thickness or diminishes only very slightly and almost imperceptibly up to the large, broad, sharp-pointed lance-head. The length is usually from 190 to 280 μ, the thickness 9 or 10 μ. (2) Large spicules without lance-heads, belonging to the category of refringent monaxons (text-fig. 91, figg. 1 *m*, 1 *n*, p. 364). These are generally fewer in number than (1), and each is usually nearly straight or but slightly curved. The shaft is thickest about one-fourth of its length from the proximal end, whence it tapers rapidly to a point proximally and very gradually to a sharp point distally. Sometimes there is a slight indication of a rudimentary lance-head distally, but usually there is none. Length usually about 200 μ, greatest thickness 8 or 9 μ. (3) Small and slender spicules, usually with no trace of a lance-head, and, with rare exceptions, perfectly straight (text-fig. 91, figg. 1 *j* to 1 *l*, &c.). The shaft is thickest close to the proximal end, where it tapers rapidly to a point. From the region of greatest thickness the shaft tapers extremely gradually to the very sharp

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Explanation of Text-fig. 91 (opposite).

Spicules of *Leucosolenia complicata*.

Figg. 1 *a–q*. Spicules of a quite normal specimen from Roscoff, one of the same lot as that figured in Lankester's 'Treatise on Zoology,' part ii. Porifera, p. 5, fig. 4. *a–d*, triradiates; *e–i*, quadriradiates; *j–l*, slender monaxons; *m*, *n*, large monaxons without lance-heads; *o–q*, large monaxons with lance-heads.—Figg. 2 *a–l*. Specimen dredged on Duke Rock, Plymouth (Garstang), showing thickened triradiates in addition to ordinary forms. *a*, ordinary triradiate; *b* & *c*, quadriradiates; *d–f*, thick triradiates; *g–i*, slender monaxons; *j*, large monaxon without barb; *k* & *l*, large barbed monaxons.

distal extremity, which in some specimens shows slight indications of a lance-head, but more usually does not. These spicules are, as a rule, short, from 70 to 140 μ in length, the greatest thickness about 3 μ; but they are subject to extraordinary variations in length, which are described in more detail below.

Variations of the Spiculation.—(1) *As regards the relative number of the spicules.* In some specimens no examples of the thickened triradiates (*a*, 2) are to be found, or only after much searching; in others, on the other hand, they are relatively abundant (text-fig. 91, figg. 2 *d–f*, p. 364), and by their presence give a distinct facies to the general spiculation, which might lead at first sight to the impression that the specimen represented a distinct species or variety. The relative numbers of triradiates and quadriradiates are also subject to great variation.

The large barbed monaxons are always abundant, and constitute a marked feature of the species. Even more characteristic are the small slender monaxons (*b*, 3), which are usually very abundant; but in some specimens they are relatively scarce, and require to be searched for carefully. They are also very liable to be broken, by reason of their slender proportions. As pointed out below, through Haeckel having overlooked the monaxons in some specimens, he was led to make two species, *pinus* and *complicata*, characterised by their presence and absence respectively. I have never, however, found the small monaxons entirely absent in any specimen I have examined, not even in the specimen identified by Haeckel himself as *complicata* (text-fig. 92, figg. 3 *a–3 m*, p. 367). The large unbarbed monaxons (*b*, 2) are usually much less abundant than the other two kinds, but can always, in my experience, be found.

(2) *As regards the form and size of the spicules.* The triradiate systems vary considerably, both in length and thickness of the rays. Any specimen shows a considerable range of variations in this respect; but in some specimens the spicules show a tendency to be constantly smaller, in others again constantly larger. The greatest extremes of variation that have come under my notice, as regards length of the rays, are shown by the specimens Nos. 3 and 9 of my list given below. In the former, which was a very small

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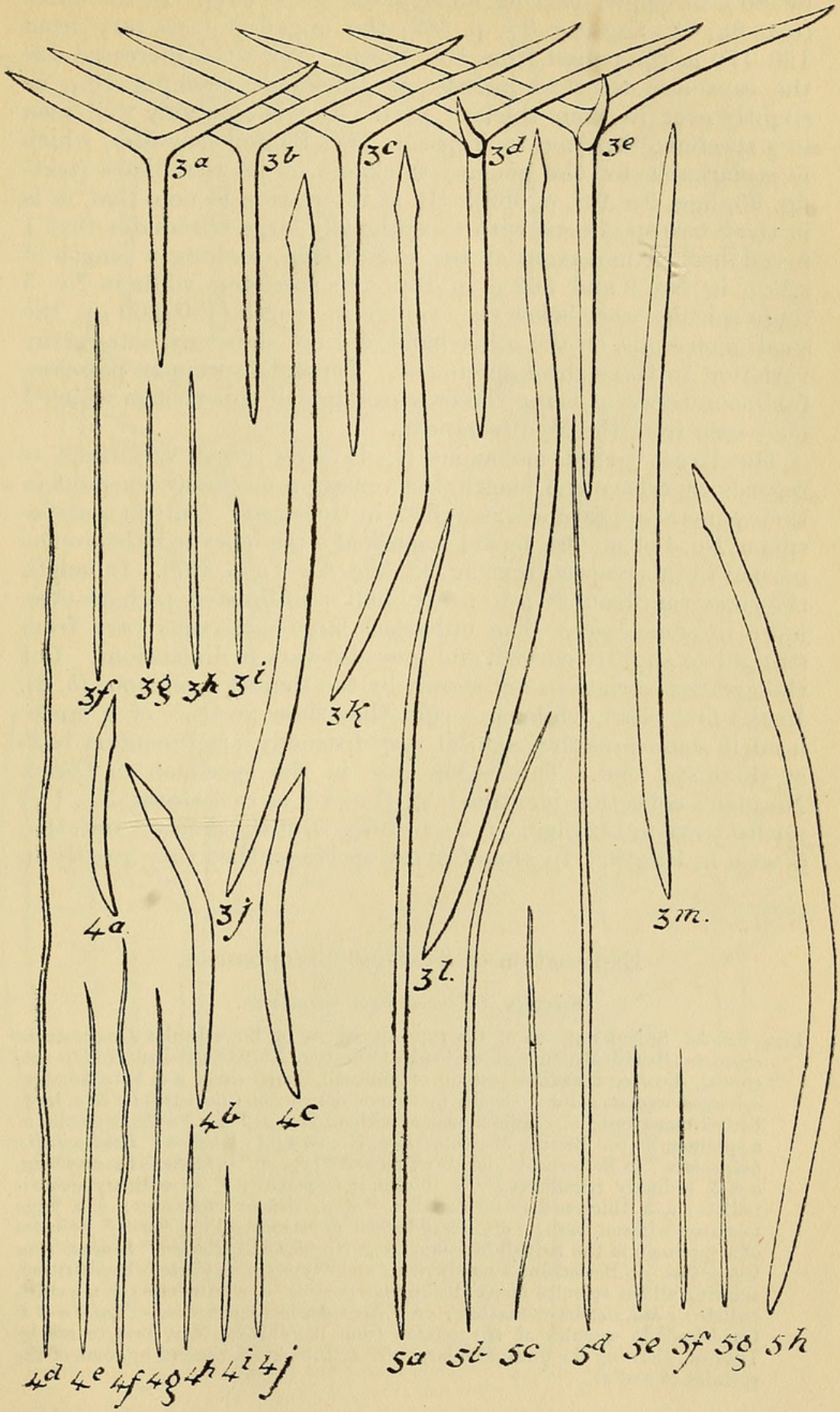
Explanation of Text-fig. 92 (opposite).

Spicules of *Leucosolenia complicata*.

Figg. 3 *a–3 m*. Specimen from Scarborough in Canon Norman's collection, identified by Haeckel as *Ascandra complicata*. *a–c*, triradiates; *d* & *e*, quadriradiates; *f–i*, slender monaxons (absent according to Haeckel), showing distinct traces of barbed heads; *j–l*, large barbed monaxons; *m*, large monaxon without barb.—Figg. 4 *a–4 j*. Specimen from North Harbour, Peterhead Beach (British Museum, Bowerbank Collection, No. 987), showing the remarkable length reached by some of the slender monaxons (*d–j*) and the small size and relative slenderness of the large barbed monaxons (*a–c*).—Figg. 5 *a–5 h*. Monaxon spicules of a specimen from the British Museum (Reg. No. 15.1.9.32–34), showing the manner in which some of the slender monaxons (*a–d*) are not only of great length but of unusual thickness and curvature. Other monaxons of the slender type are quite normal (*e–g*). *h*, one of the large barbed monaxons.

Text-fig. 92.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colony, the unpaired rays vary from 70–90 μ, the paired rays from 65–80 μ in length (text-fig. 93, figg. 6 *a*–6 *h*, p. 369). In the latter (text-fig. 93, figg. 8 *a*–8 *f*, p. 369) the unpaired rays vary from 120–170 μ, the paired from 105–125 μ. With the increased size the rays also tend to increase in thickness, reaching 10 μ or slightly over in their thickest part. This is especially well seen in a specimen sent me by Topsent from Banyuls-sur-Mer, which is remarkable for the general thickness of its triradiates (text-fig. 93, figg. 9 *a*–9 *d*, p. 369). It is interesting to note that it is in those two specimens with exceptionally large triradiates that I found barbed monaxons of the largest size, reaching a length of 425 μ in No. 9 and 360 μ in Topsent's specimen, while in No. 3 these spicules were below the average in length (150–200 μ); the small monaxons, on the other hand, did not show any noteworthy variation in those three specimens. Topsent's specimen possesses further interest as being the only example of this sponge which I have seen from the Mediterranean.

The large barbed monaxons (*b*, 1) show great variations as regards curvature and length, but remain remarkably constant in their general appearance, as well as in thickness. Only in one specimen, No. 4 of my list, have I remarked a tendency to be below the normal in this respect (text-fig. 92, figg. 4 *a*–4 *c*, p. 367). In length they may vary from 80 μ to nearly half a millimetre, perhaps even more in some cases. The unbarbed large monaxons vary from straight to slightly curved, and may also vary in dimensions. But the greatest variations are shown by the slender monaxons (*b*, 3). In the first place, while, as a rule, they show no trace of a lance-head, in some cases they exhibit very distinctly a rudimentary barb at the distal end. This is the case in the specimen in Canon Norman's collection identified by Haeckel as *complicata*, No. 1 of my list (text-fig. 92, figg. 3 *f*–3 *i*, p. 367). But the greatest variation is seen in length. In almost every specimen they vary greatly in

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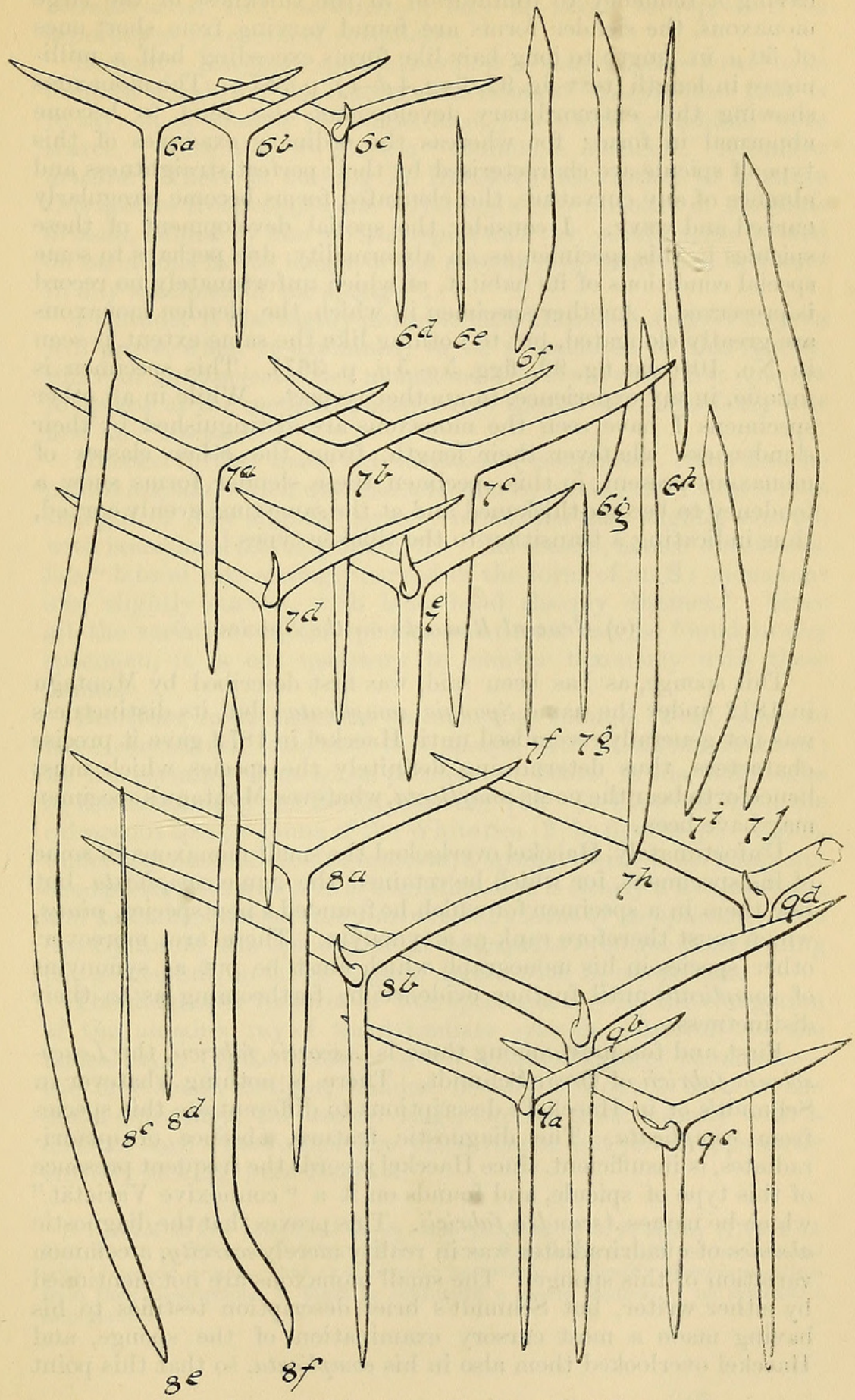
Explanation of Text-fig. 93 (opposite).

Spicules of *Leucosolenia complicata*.

Figg. 6 *a*–6 *h*. Spicules of one of the type specimens of Bowerbank's *Leucosolenia contorta* (British Museum, Bowerbank's Collection, No. 988, left-hand middle specimen), showing triradiate systems of unusually small size. *a* & *b*, triradiates; *c*, a quadriradiate; *d* & *e*, slender monaxons showing distinct barbs; *f* & *g*, large barbed monaxons; *h*, a large monaxon without barb.—Figg. 7 *a*–7 *j*. Spicules of a specimen in the British Museum (Reg. No. 95.4.6.1) labelled "*Leucosolenia botryoides*" in Bowerbank's handwriting and "type sp." in Carter's handwriting. *a* & *b*, ordinary triradiates; *c*, a thickened triradiate; *d*, an ordinary quadriradiate; *e*, a thickened quadriradiate; *f* & *g*, slender monaxons; *h*, a large monaxon without barb; *i* & *j*, large barbed monaxons.—Figg. 8 *a*–8 *f*. Spicules of a specimen in the British Museum (Reg. No. 95.4.6.2) labelled "*Leucosolenia botryoides*" in Bowerbank's handwriting and "type sp." in Carter's handwriting, showing all the spicules above the average in size. *a*, a triradiate; *b*, a quadriradiate; *c* & *d*, slender monaxons; *e* & *f*, large barbed monaxons.—Figg. 9 *a*–9 *d*. Quadriradiate spicules of a specimen from Banyuls-sur-Mer, sent to me by Topsent, showing the unusually large size and thickness reached by some of the spicules (*b* and *d*).

Text-fig. 93.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this respect; but in the specimen (No. 4) already referred to as having a tendency to diminution in the thickness of the large monaxons, the slender forms are found varying from short ones of 50 μ in length to long hair-like forms exceeding half a millimetre in length (text-fig. 92, figg. 4 *d*–4 *j*, p. 367). The monaxons showing this extraordinary development also tend to become abnormal in form; for whereas the ordinary examples of this type of spicule are characterised by their perfect straightness and absence of any curvature, the elongated forms become irregularly curved and wavy. I consider the special development of these spicules in this specimen as an abnormality, due perhaps to some special conditions of its habitat, of which unfortunately no record is preserved. Another specimen in which the slender monaxons are greatly elongated, but to nothing like the same extent, is seen in No. 10 (text-fig. 92, figg. 5 *a*–5 *g*, p. 367). This specimen is unique, in my experience, in another respect. While in all other specimens I have seen the monaxons are distinguished by their slenderness, whatever their length, from the other classes of monaxons present, in this specimen these slender forms show a tendency to become thickened and at the same time evenly curved, thus indicating a transition to the thicker types.

(c) *General Remarks on the Species.*

This sponge, as has been said, was first described by Montagu in 1812 under the name *Spongia complicata*; but its distinctness was not generally recognised until Haeckel in 1872 gave it precise characters, thus determining definitely the species which must henceforth bear the name *complicata*, whatever Montagu's specimen may have been.

Unfortunately, Haeckel overlooked the small monaxons in some of his specimens, for which he retained the name *complicata*, but saw them in a specimen for which he founded a new species, *pinus*, which must therefore rank as a synonym. There are, moreover, other species in his monograph which must be put as synonyms of *complicata* until further evidence be forthcoming as to their distinctness.

First and foremost among these is *Ascortis fabricii*, the *Leucosolenia fabricii* of Oscar Schmidt. There is nothing whatever in Schmidt's or in Haeckel's descriptions to differentiate this species from *complicata*. The diagnostic feature, absence of quadriradiates, is insufficient, since Haeckel records the frequent presence of this type of spicule, and founds on it a "connexive Varietät" which he names *Ascandra fabricii*. This proves that the diagnostic *absence* of quadriradiates was in reality merely *scarcity*, a common variation of this sponge. The small monaxons are not mentioned by either writer, but Schmidt's brief description testifies to his having made a most cursory examination of the sponge, and Haeckel overlooked them also in his *complicata*, so that this point

counts for nothing. Haeckel's figure of *fabricii*, evidently much reconstructed and embellished, may be taken to represent an arborescent specimen of *complicata*.

Secondly, Haeckel's species *Asculmis armata* appears to me to be founded simply on the converse variation of *complicata*—that is to say, on specimens (*Olynthus*-forms) in which triradiates were scarce. Here also we have a "connexive Varietät," *Ascandra armata*. There is nothing in Haeckel's description to separate this species from *complicata*. Haeckel's two varieties of *Asculmis armata*, named by him var. *norvegica* and var. *pocillum*, are formed on variations in the length of the gastral rays, which can be found in any specimen of the sponge *.

I consider it also highly probable that Haeckel's *Ascyssa acufera* will prove, when re-examined, to be a specimen of this species. Since in *Leucosolenia* the monaxons are always the first spicules to appear at the metamorphosis, every species of *Leucosolenia* is at first an "*Ascyssa*."

Haeckel further made two varieties of *complicata*. The first he named *hispida*, which was characterised by having the "lateral rays straight or only slightly curved; monaxons also slightly curved, with lance-head scarcely distinct." The second, named *amœboides*, has "lateral rays strongly curved in the form of an **S**; monaxons also slightly curved, with lance-head sharply distinct." Since all the variations of the spicules mentioned can be found in any specimen, it is not necessary to cumber taxonomy with these names.

Breitfuss, in his memoirs on calcareous sponges [**2**–**5**], seems to have consistently confused this species with *Clathrina contorta*; he has certainly done so, as pointed out below, in his 'Catalogue of the Calcarea in the Berlin Museum' [**3**]. In his work upon the calcareous sponge-fauna of the White Sea [**2**] he figures (pl. i. fig. 1), under the name *Ascandra contorta*, a sponge which is certainly not the species with which it is identified, but is clearly a *Leucosolenia*, and resembles the ordinary arborescent form of *complicata*. The description of the spiculation is inadequate even for determining the genus, but, so far as it goes, agrees with *L. complicata*.

The diagnostic features of this species are:—(1) the elongation of the unpaired ray of the triradiate systems relatively to the lateral rays; (2) the presence of two distinct forms of monaxons—the first small, straight, slender, usually without a barb at the distal extremity; the second large, curved, thick, usually with a distinct barb: the former are often scarce, but never apparently entirely lacking, *pace* Haeckel.

* Haeckel at first considered the *Spongia pocillum* of O. F. Müller (1776, Zool. Dan. Prodr. p. 256) and Fabricius (1780, Faun. Grœnland, p. 449) to be identical with *Asculmis armata*; but as it is quite impossible to identify *Spongia pocillum* from their descriptions, it must be considered a *nomen nudum*, of no systematic importance.

(d) *List of Specimens examined**.

(*a*) From Canon Norman's Collection.

1. Dried specimens collected at Scarborough by Bean, sent to Haeckel for examination, and returned by him with the following label in his handwriting :—

"*Ascandra complicata* H.
"(*Spongia complicata* Montagu).
"Scarborough (Bean)."

These specimens were of the utmost importance, as they showed that the small monaxons supposed to be absent in *Ascandra complicata* H. and present in *A. pinus* H. were simply overlooked by Haeckel in the specimens referred by him to the former species (see text-fig. 92, figg. 3*f–i*, p. 367).

2. Dried specimens labelled "*Leucosolenia contorta*, Guernsey," in Bowerbank's handwriting. According to information given me by Canon Norman, the specimens seen by me were not sent to Haeckel, but are of the same lot as the type sent to him, and are equally types of *Ascandra contorta* H. My preparation shows typical spicules of *Leucosolenia complicata* mingled with spicules of *Clathrina coriacea*. These two species often grow in the closest proximity; and I have a series of sections of *Clathrina coriacea* showing tubes of *Leucosolenia complicata* growing side by side with those of the *Clathrina*.

(*b*) From the British Museum.

3. Bowerbank Coll., No. 988. Seven dried specimens stuck on a card, and labelled in Bowerbank's handwriting "*Leucosolenia contorta*, Guernsey." These specimens are the types of Bowerbank's species *L. contorta*, figured by him in Mon. Brit. Spong. pl. iii. figg. 5–10. One specimen is much larger than the others; it is stuck at the top of the card, over the middle. The other six specimens are arranged in two vertical rows, three in each row, along the two sides of the card. Of the seven specimens I have examined six, that is to say, all except the right lower specimen, which is very small. The large specimen (Bowerbank's fig. 7) is a *Clathrina* sp. which agrees with Haeckel's *Ascandra contorta* in spiculation, except for the absence of monaxons, which I have not been able to find. The five smaller specimens examined by me are one and all of them unmistakable specimens of *Leucosolenia complicata*, but being very young colonies the spiculation is sometimes rather aberrant, especially in the triradiates; the three types of monaxons, however, show the specific characters quite invariably. The spicules are generally

* In the lists of specimens enumerated by me, I count only public specimens, so to speak, without mentioning the many examples I have studied in my own or other private collections.

small, as shown in text-fig. 93, fig. 6, p. 369, which is drawn from the left-hand middle specimen. The large monaxons are often short and stumpy, especially in the right-hand middle specimen, which is further unique, in my experience, in that the unpaired rays of some of the triradiates are shorter than the paired rays. In general, these young specimens do not show the characteristic elongation of the unpaired ray so markedly as the larger specimens examined by me.

4. Bowerbank Coll., No. 987. Labelled, in Ridley's handwriting, "*Grantia botryoides*. North Harbour, Peterhead Beach. No. 4, 1851. J. S. Bowerbank." A somewhat abnormal specimen of *L. complicata* (see text-fig. 92, figg. 4 *a*–4 *j*, p. 367).
5. Bowerbank Coll., No. 986. Bowerbank's label, copied by Ridley, is as follows—"*Grantia botryoides* John. Guernsey. Mr. Buckland."
6. Register No. 72.5.4.1 *a*. "*Leucosolenia botryoides*," Vigo Bay, Saville Kent.
7. Bowerbank Coll., No. 992 *a*. Dried specimens stuck on a card, labelled "*Grantia botryoides*," locality Orwell River.
8. Register No. 95.4.6.1. Labelled "*Leucosolenia botryoides*" in Bowerbank's handwriting and "type sp." in Carter's handwriting, meaning apparently Bowerbank's type (see text-fig. 93, figg. 7 *a*–7 *j*, p. 369).
9. Register No. 95.4.6.2. Labelled exactly as the last (see text-fig. 93, figg. 8 *a*–8 *f*, p. 369).
10. Register No. 85.1.9.32–34. Labelled "Calcarea, about 15 fathoms off Port St. Mary, I. of Man. J. Lomas, Esq." Rather an abnormal specimen of *complicata* (see text-fig. 92, figg. 5 *a*–5 *h*, p. 367).
11. Register No. 85.3.6.6. A beautiful specimen labelled "? *Leucosolenia botryoides*. Jersey, Saville Kent," in Carter's handwriting.

(*c*) From the Berlin Museum.

12. No. 1780. Labelled "*Ascandra contorta* H. Jersey"*.

2. Leucosolenia variabilis.

? *Spongia confervicola* Templeton, 1836, Magazine of Nat. Hist. ix. p. 470, fig. 67.

Grantia botryoides var. *himantia* Johnston, 1842, Brit. Spong. and Lith. p. 179, pl. xxi. fig. 3.

Leucosolenia (*Leuciria*) *variabilis* Haeckel, 1870, Jena. Zeitschr. v. p. 243.

* In the Catalogue of the Calcarea of the Berlin Museum, published by Breitfuss [3], this specimen, No 1780, and others are put down with the labels copied from the bottles, without, apparently, any attempt at verification. The author is evidently unacquainted with *Ascandra* (*Clathrina*) *contorta*, otherwise a glance at the specimen would have prevented his making this error: but it is surprising that he did not examine the spiculation.

Sycorrhiza corallorrhiza Haeckel, 1870, l. c. p. 249.

Ascandra variabilis Haeckel, 1872, Kalkschwämme, ii. p. 106, iii. pl. 16. figg. 4 *a*–4 *l* and pl. 18.

Ascortis corallorrhiza Haeckel, 1872, l. c. p. 73, pl. 11. fig. 4, pl. 12. figg. 4 *a*–4 *i*.

Leucosolenia botryoides Bowerbank, 1874, Mon. Brit. Spong. iii. pl. iii. figg. 1–4.

Leuconia somesii Bowerbank, 1874, l. c. p. 334, pl. xci. figg. 6–17.

Ascandra tenuis Schuffner 1877, Jena. Zeitschr. xi. (n. F. iv.), p. 406, pl. xxv. fig. 8.

Ascandra variabilis Bowerbank and Norman, 1882, Mon. Brit. Spong. iv. p. 227.

Ascandra botryoides Fristedt, 1885, K. Vetensk.-Akad. Handlingar, xxi. no. 6, p. 9.

Leucosolenia variabilis Topsent, 1891, Arch. Zool. Exp. (2) ix. p. 525.

Leucosolenia variabilis Topsent, 1894, Rev. Biol. Nord France, vii. p. 2.

Leucosolenia variabilis Minchin, 1896, Ann. Mag. Nat. Hist. (6) xviii. p. 359.

Ascandra variabilis Breitfuss, 1898, Arch. f. Naturges. lxiii. i. p. 215.

Ascandra variabilis Breitfuss, 1898, Arch. f. Naturges. lxiv. i. p. 286.

Ascandra corallorrhiza Breitfuss, 1898, l. c. p. 285.

Ascandra variabilis Breitfuss, 1898, Mém. Acad. St. Pétersbourg, (8) vi. p. 16.

Ascandra corallorrhiza Breitfuss, 1898, l. c. p. 9.

Ascandra variabilis Breitfuss, 1898, Ann. Mus. Zool. St. Pétersbourg, 1898, p. 28.

Ascandra corallorrhiza Breitfuss, 1898, l. c. p. 17.

Leucosolenia variabilis Minchin, 1900, in Lankester's Treatise on Zoology, ii. Sponges, p. 5, fig. 5.

Ascandra variabilis Arnesen, 1901, Bergens Mus. Aarbog, 1900, No. 5, p. 15.

Ascandra corallorrhiza Arnesen, 1901, l. c. p. 14.

Leucosolenia variabilis Rousseau, 1903, Mém. Soc. Malac. Belgique, xxxvii. p. 8, fig. 4.

Leucosolenia variabilis Allen, 1904, J. Mar. Biol. Assoc. n. s. vii. p. 185.

(a) *External Characters.*

L. variabilis is known to me both in the spreading and the bushy form. Of the former type I have two typical specimens, both from Roscoff. A portion of one of them has been figured by me elsewhere [**16**, p. 5, fig. 5]. It was growing on a granite rock, and an attempt was made to detach the piece of stone to which the sponge was attached by means of hammer and chisel; as a result of this somewhat violent treatment, the slab broke

across under the middle of the sponge-colony, which was thus detached in two halves and somewhat damaged, but still showing well the peculiarities of this mode of growth. The spiculation of this specimen was found to be normal in all respects. My second specimen of the spreading form was removed entire from the rock on which it grew; it is a small colony remarkable for the close network of basal tubes, giving the sponge almost the appearance of a *Clathrina*, were it not for the characteristically large oscular tubes. The spiculation of this specimen shows a comparative scarcity of monaxons and unusually small triradiate systems; in other respects, however, the characters are typical (text-fig. 95, figg. 14 *a*–14 *f*, p. 379). Johnston [**14**, pl. xxi. fig. 3] has figured a typical spreading specimen of *variabilis* under the name of *Grantia botryoides* var. *himantia*, which Haeckel has wrongly placed as a synonym of *Clathrina coriacea*.

L. variabilis occurs most commonly in the bushy form as a compact reticulum of fine anastomosing basal tubes from which arise the stouter oscular tubes, often closely packed and of considerable length. In this form it may be found in rock-pools attached between the stems of algæ, or creeping over the algæ themselves. In the former situation the basal portion of the sponge is often half buried in mud and sediment, and, doubtless in consequence of this, the oscular tubes grow to a great size and length. I have such a specimen from Plymouth, in which the oscular tubes average 1·5 cm. in length, reaching in some cases 2 cm.; the spiculation of this specimen (text-fig. 95, figg. 15 *a*–15 *f*, p. 379) is remarkable for the large size of the triradiate systems. It is more usual, however, for the sponge to form a creeping growth over the algæ themselves—either twining amongst the filaments of confervæ, as Haeckel's fig. 6 on pl. 18 of the 'Monographie' [**13**] shows fairly correctly, or spreading over the stems of stouter seaweeds. These creeping forms are commonly found at Roscoff in situations where they are left dry at all tides, growing amongst the stems of the dense growth of algæ covering isolated boulders on the seashore. The youngest colonies form a delicate network spreading over the seaweed stems and sending up oscular tubes at intervals, thus having a form similar to the spreading colonies already described; but with further growth the basal tubes form a compact tangled mass from which long oscular tubes arise or hang down as the case may be.

In all the modifications of form exhibited by this sponge the most constant feature is to be found in the oscular tubes, which show little or no tendency to throw out diverticula except near their base. Hence the sponge shows numerous oscular tubes arising from the basal reticulum, each long, slender, generally slightly curved and smooth, *i. e.* free from diverticula from near their base up to the oscular opening. We find the sharpest contrast, as has already been stated above, with *L. complicata* in this respect, and the typical arborescent form of the latter is never found in *L. variabilis*.

Haeckel has given a plate (Monographie, pl. 18) intended to represent the form-variations of *L. variabilis*, but, in my opinion, the greater number of his figures are untrue to nature. The most charitable interpretation that can be put upon this plate is to suppose that many of the specimens figured are incorrectly determined and are not *L. variabilis* at all. Thus fig. 12 is evidently a *Clathrina*, and fig. 15 is either a contracted *Clathrina*, probably *coriacea*, or possibly a specimen of *variabilis* in which, owing to rough usage, all the oscular tubes have been knocked off. Fig. 2 probably represents some of the Sycons which, as I have stated below, are commonly found growing in company with *L. variabilis*, and the same interpretation possibly applies to figg. 1 and 3, the latter being contracted; what figg. 10 and 13 may be I should not like to assert, but they are certainly not specimens of *variabilis*. On the other hand, figg. 8 and 14 are probably specimens of *variabilis*, which owe the extraordinary curves exhibited by their oscular tubes to shrinkage as the result of desiccation. The imaginative figures given by Haeckel on this and other plates are responsible for the general opinion, far from being true, that any Ascon may assume any form in which any other species of Ascon occurs.

As compared with other species, I find a tendency in *variabilis* for the oscular rim to be of greater length. In young specimens this is sometimes very marked indeed. The body-wall of *variabilis* is generally thicker and stronger than in *L. complicata*, and the sponge is evidently hardier, as seen from the more exposed situations in which it grows.

(b) *Characters of the Spiculation.*

(a) *Triradiate and Quadriradiate Systems.*—(1) The ordinary triradiates (text-fig. 94, figg. 10 *a*–10 *c*, &c., p. 377) have the rays slender or of moderate thickness and tapering gradually to sharp points. The unpaired ray is straight, and distinctly shorter than, very rarely as long as, the paired rays. The unpaired angle is always much greater than 120°. The paired rays usually show a distinct double curvature, each ray curving first backwards, then forwards

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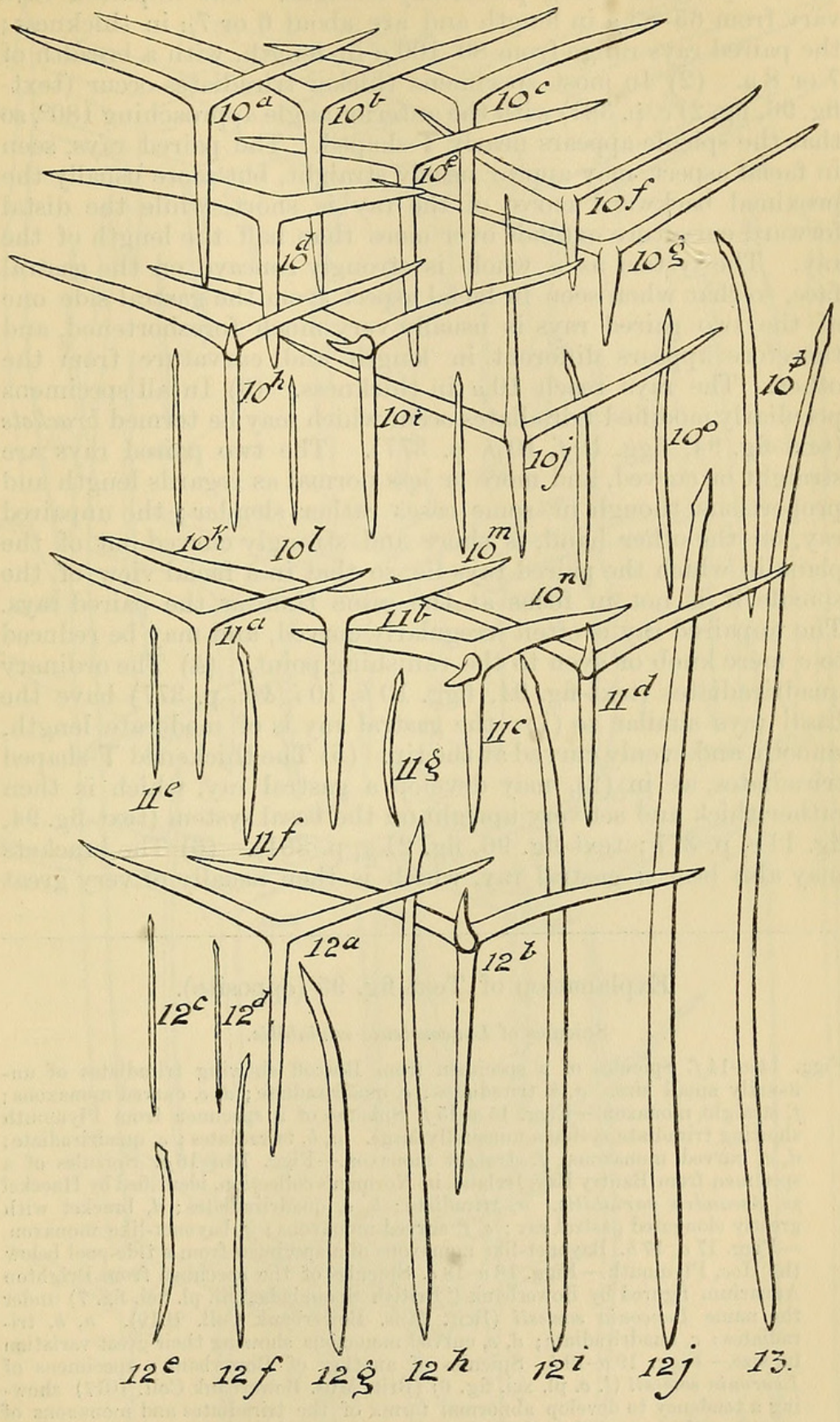
Explanation of Text-fig. 94 (opposite).

Spicules of *Leucosolenia variabilis*.

Figg. 10 *a*–10 *p*. Spicules of a specimen with monaxons not reaching a large size, from Roscoff. *a*–*c*, ordinary triradiates; *d*, *e*, T-shaped triradiates (in this specimen not greatly thickened); *f*, *g*, brackets; *h*, *i*, ordinary quadriradiates; *j*, bracket with long gastral ray; *k*, *l*, straight slender monaxons; *m*–*p*, ordinary curved monaxons.—Figg. 11 *a*–11 *g*. Spicules of another specimen from Roscoff, in which all the monaxons are small. *a*, *b*, triradiates; *c*, T-shaped quadriradiate; *d*, ordinary quadriradiate; *e*, straight slender monaxon; *f*, *g*, curved monaxons.—Figg. 12 *a*–12 *j*. Spicules of a specimen from Roscoff in which the monaxons vary up to a large size. *a*, triradiate; *b*, quadriradiate; *c*, *d*, straight slender monaxons; *e*–*j*, curved monaxons.—Fig. 13. Monaxon of large size from a Roscoff specimen.

Text-fig. 94.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at the distal extremity, but the curvature may be very slight, all three rays then being practically straight. The unpaired rays vary from 65–83 μ in length and are about 6 or 7 μ in thickness; the paired rays range from 80–100 μ in length, with a breadth of 7 or 8 μ. (2) In most specimens thicker triradiates occur (text-fig. 96, fig. 21 *c*, p. 381) with the anterior angle approaching 180°, so that the spicule appears nearly T-shaped. The paired rays, seen in facial aspect, may appear nearly straight, but more usually the proximal backward curve of the ray is short, while the distal forward curvature extends over more than half the length of the ray. The system as a whole is strongly concave on the gastral face, so that when seen in facial aspect from the gastral side one of the two paired rays is usually very much foreshortened, and therefore appears different in length and curvature from the other. The rays reach 10 μ in thickness. (3) In all specimens peculiarly modified triradiates occur which may be termed *brackets* (text-fig. 94, figg. 10 *f*, 10 *g*, p. 377). The two paired rays are straight or curved, and more or less normal as regards length and proportions, though in some cases rather slender; the unpaired ray, on the other hand, is short and strongly curved out of the plane in which the paired rays lie, so that in a facial view of the spicule it is not in focus at the same time as the paired rays. The unpaired ray is often irregularly curved, and may be reduced to a mere knob or even to the vanishing point. (4) The ordinary quadriradiates (text-fig. 94, figg. 10 *h*, 10 *i*, &c., p. 377) have the basal rays similar to (1); the gastral ray is of moderate length, smooth, and evenly curved at the tip. (5) The thickened T-shaped triradiates, as in (2), may develop a gastral ray, which is then rather thick and set very upright on the basal system (text-fig. 94, fig. 11 *c*, p. 377; text-fig. 96, fig. 21 *g*, p. 381). (6) The brackets may also bear a gastral ray, which is then usually of very great

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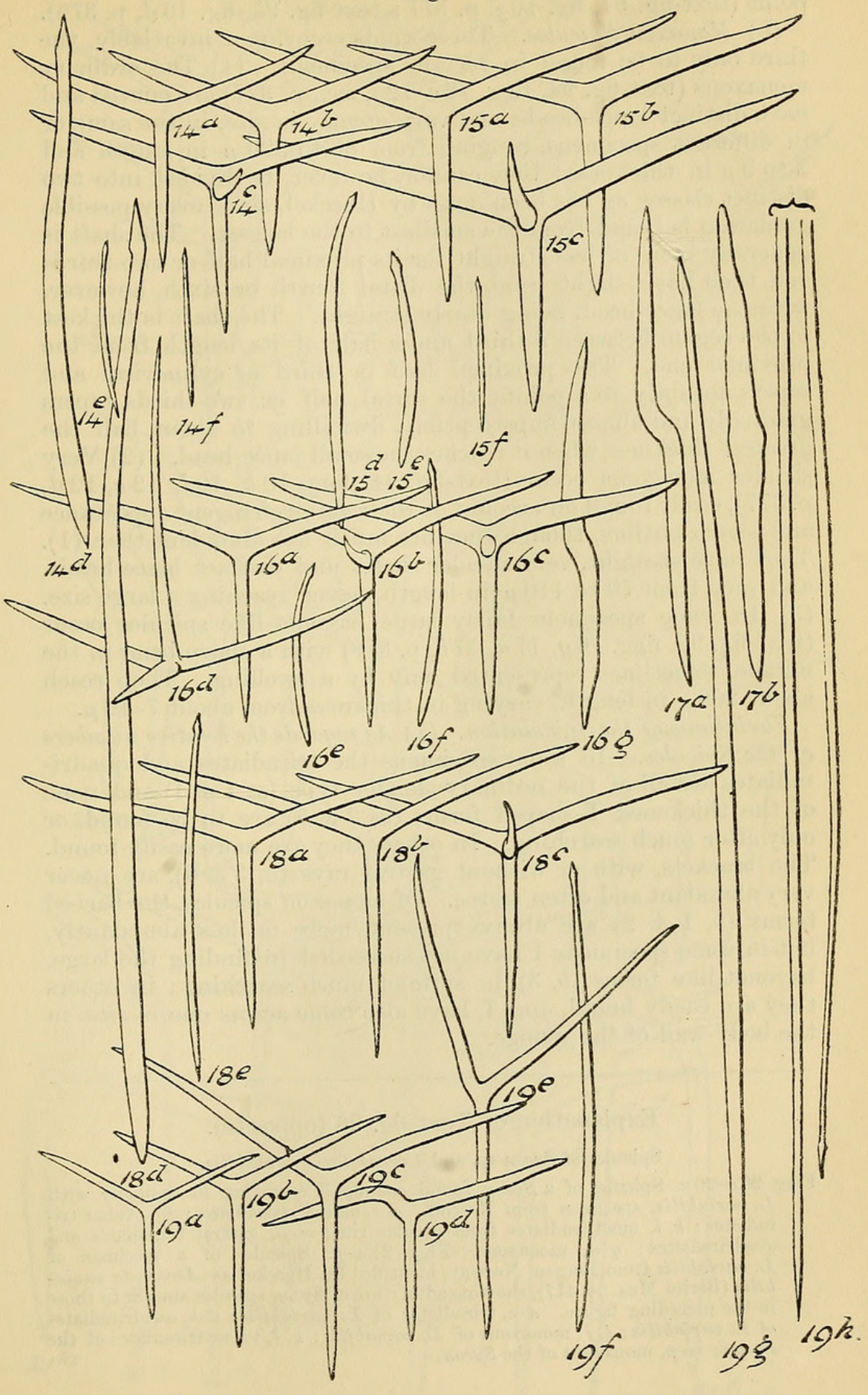
Explanation of Text-fig. 95 (opposite).

Spicules of *Leucosolenia variabilis*.

Figg. 14 *a*–14 *f*. Spicules of a specimen from Roscoff showing triradiates of unusually small size. *a*, *b*, triradiates; *c*, quadriradiate; *d*, *e*, curved monaxons; *f*, straight monaxon.—Figg. 15 *a*–15 *f*. Spicules of a specimen from Plymouth showing triradiate systems unusually large. *a*, *b*, triradiates; *c*, quadriradiate; *d*, *e*, curved monaxons; *f*, straight monaxon.—Figg. 16 *a*–16 *g*. Spicules of a specimen from Bantry Bay, Ireland, in Norman's collection, identified by Haeckel as *Ascandra variabilis*. *a*, triradiate; *b*, *c*, quadriradiates; *d*, bracket with greatly elongated gastral ray; *e*, *f*, curved monaxons; *g*, bayonet-like monaxon.—Figg. 17 *a*, 17 *b*. Bayonet-like monaxons of a specimen from a tide-pool below the Hoe, Plymouth.—Figg. 18 *a*–18 *e*. Spicules of the specimen from Brighton Aquarium figured by Bowerbank ('British Spongiadæ,' iii. pl. xci. fig. 7) under the name *Leuconia somesii* (Brit. Mus. Bowerbank Coll. 1019). *a*, *b*, triradiates; *c*, quadriradiate; *d*, *e*, curved monaxons showing their great variation in size.—Figg. 19 *a*–19 *h*. Spicules of another of Bowerbank's specimens of *Leuconia somesii* (*l. c.* pl. xci. fig. 6) (Brit. Mus. Bowerbank Coll. 1017) showing a tendency to develop abnormal forms of the triradiates and monaxons of great length, irrespective of thickness. *a*–*e*, triradiates; *f*–*h*, monaxons; *h*, on account of its great length, has been drawn in two pieces.

Text-fig. 95.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length, reaching 120 μ or more, and tapering gradually to a sharp point (text-fig. 94, fig. 10 *j*, p. 377; text-fig. 95, fig. 16 *d*, p. 379).

(b) *Monaxon Spicules.*—Three kinds occur, two invariably, the third only to be found in certain specimens. (1) The ordinary monaxons (text-fig. 94, figg. 12 *e*–12 *j*, &c., p. 377) are curved and have distinct lance-heads, and vary greatly in size, in the same or in different specimens, ranging from 80 to 320 μ in length and 2 to 9 μ in thickness; they cannot, however, be divided into two distinct classes as has been done by Haeckel, since every possible gradation is found from the smallest to the largest. The shaft is generally more or less straight for its proximal half or two-thirds and then has a slight bend, the distal fourth or sixth, however, with the lance-head, being nearly straight. The shaft is thickest in the region between a third and a half of its length from the proximal end. The proximal half or third is cylindrical and tapers abruptly to a point; the distal half or two-thirds tapers gradually and almost imperceptibly, dwindling to about half the greatest thickness when it reaches the small lance-head. (2) Very slender monaxons occur (text-fig. 94, figg. 10 *k*, 10 *l*, 12 *c*, 12 *d*, p. 377), easily found on account of their very refringent appearance and sharp outline, though they are much less abundant than (1). They have straight, very slender shafts and distinct lance-heads, and vary from 70 to 110 μ in length, never reaching a large size. (3) In some specimens fairly large bayonet-like spicules occur (text-fig. 95, figg. 16 *g*, 17 *a*, 17 *b*, p. 379) with a sharp bend in the middle, sometimes represented only by a swelling. They reach about 200 μ in length, varying in thickness from about 7–10 μ.

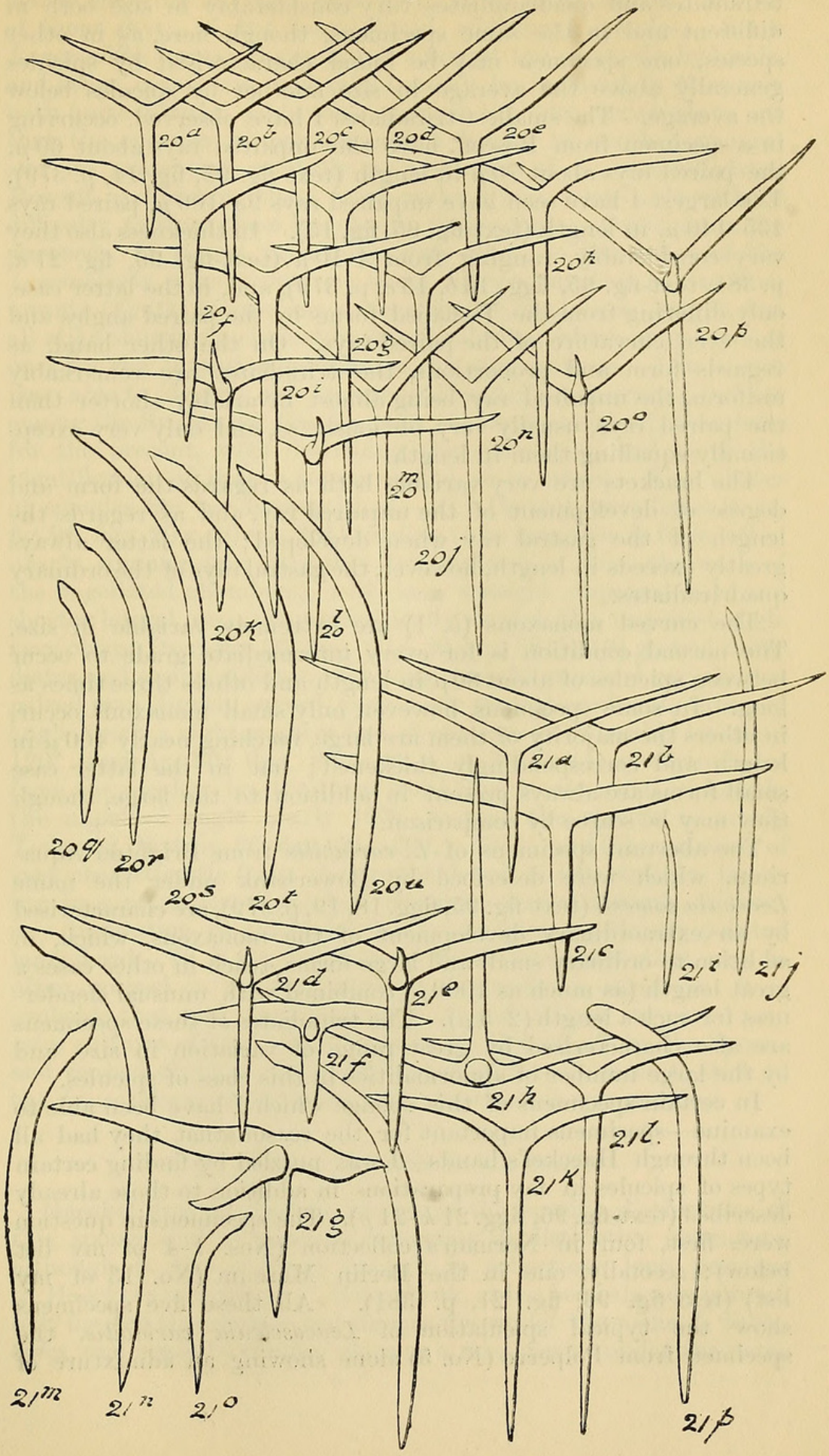
Variations of the Spiculation. (1) *As regards the relative numbers of the Spicules.*—In some specimens the triradiates and quadriradiates are all of the ordinary slender type (*a*, 1 & 4) and none of the thickened T-shaped forms (as 2 & 5) are to be found, or only after much searching. In others they are more easily found. The brackets, with or without gastral rays (*a*, 3 & 6), are never very abundant and often scarce. Of monaxon spicules, the barbed forms (*b*, 1 & 2) are always present more or less abundantly, but in some specimens I have not succeeded in finding the large, bayonet-like forms (*b*, 3), in spite of much searching; in others they are easily found, and I have also come across one *in situ* in the body-wall of the sponge.

Explanation of Text-fig. 96 (opposite).

Spicules of *Sycon* sp. and *Leucosolenia variabilis.*

Figg. 20 *a*–20 *u*. Spicules of a *Sycon* found commonly occurring in company with *L. variabilis*, specimen from Roscoff. *a*–*e*, dermal triradiates; *f*–*j*, tubar triradiates; *k*, *l*, quadriradiates from oscular rim; *m*–*p*, gastral triradiates and quadriradiates; *q*–*u*, monaxons.—Figg. 21 *a*–*p*. Spicules of a specimen of *L. variabilis* from Bergen, Norway, identified by Haeckel as *Ascandra variabilis* (Berlin Mus. no. 417), showing admixture of *Sycon* spicules similar to those in the preceding figure. *a*–*c*, triradiates of *L. variabilis*; *d*–*h*, quadriradiates of *L. variabilis*; *i*, *j*, monaxons of *L. variabilis*; *k*, *l*, tubar triradiates of the *Sycon*; *m*–*p*, monaxons of the *Sycon*.

Text-fig. 96.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(2) *As regards the form and size of the Spicules.*—The ordinary triradiates and quadriradiates vary considerably in size both in different and in the same specimens, though here, as in other species, one specimen may be found characterised by spicules generally above the average in size, another by spicules below the average. The smallest triradiates I have observed, occurring in a specimen from Roscoff, have the unpaired rays about 60 μ, the paired rays about 70 μ in length (text-fig. 95, fig. 14, p. 379). The largest I have seen have unpaired rays 95–100 μ, paired rays 135–140 μ, in length (text-fig. 95, fig. 15). In thickness also they vary considerably, ranging from 4–10 μ (text-fig. 96, fig. 21 *a*, p. 381, text-fig. 95, figg. 15 *b*, 15 *c*, p. 379), and, in the latter case, only differing from the T-shaped forms by the paired angles and the even curvature of the paired rays. On the other hand, as regards form and proportions, the triradiates are remarkably uniform, the unpaired ray being almost invariably shorter than the paired rays, usually very obviously so, and only very exceptionally equalling them in length.

The brackets are very variable both as regards the form and degree of development of the unpaired ray, and as regards the length of the gastral ray when developed; the latter always greatly exceeds in length, however, the gastral rays of the ordinary quadriradiates.

The curved monaxons (*b*, 1) are extremely variable in size. The normal condition is for every intermediate grade to occur between spicules of about 80 μ in length and others three times as long. In some specimens, however, only small monaxons occur, in others the majority of them are large, reaching nearly 400 μ in length and correspondingly thickened; but in the latter case small forms are always present in addition to the large, though they may be scarce by comparison.

The aberrant specimens of *L. variabilis* from Brighton Aquarium, which were described by Bowerbank under the name *Leuconia somesii* (text-fig. 95, figg. 18, 19, p. 379), are characterised by an extraordinary development of the monaxons, which, in addition to ordinary small and large forms, reach in other cases a great length (as much as 1000 μ) combined with unusual slenderness for such a length (2–5 μ). The triradiates of these specimens are also characterised by great range of variation in size, and by the large number of abnormalities in this class of spicules.

In certain specimens of this sponge which I have been able to examine—specimens important for the reason that they had all been through Haeckel's hands—I was puzzled by finding certain types of spicules in my preparations in addition to those already described (text-fig. 96, figg. 21 *k*–21 *p*). The specimens in question were, first, four in Norman's collection (Nos. 1–4 of my list below); secondly, one in the Berlin Museum (No. 13 of my list) (text-fig. 96, fig. 21, p. 381). All these five specimens show the typical spiculation of *Leucosolenia variabilis*, the specimen from Polperro (No. 5) alone showing an admixture of

the spicules of *L. complicata*, so that the two species were evidently growing in close proximity, as so often occurs; but all of them show, as has been stated, additional spicules. Since *L. variabilis* forms a dense tangle amongst the seaweeds, hydroids, and other organisms, and might easily be involved in this way with quite distinct calcareous sponges, the idea occurred to me that the spicules in question might belong to another sponge; and on examining carefully my specimens of *L. variabilis* from Roscoff, and picking them over under a lens, I was able without difficulty to trace these spicules to their source. Growing on the seaweeds, in closest proximity, very often, to the tubes of the *Leucosolenia*, were numerous small Sycons, ranging in size from minute *Olynthi* to specimens a centimetre or more in height, but all alike showing a characteristic spiculation, which accounted at once for the intrusive spicules in my preparations. I have not been able to identify this sponge in Haeckel's monograph, neither among the Sycons nor the Leucons. I content myself, therefore, for the present, with describing the spiculation, and leave the identification of it to a future period, or to others. Five classes of spicules can be distinguished:—(1) Dermal triradiates (text-fig. 96, figg. 20 *a*–20 *e*, p. 381) tending to be irregular in form, often nearly equiangular; (2) tubar triradiates (*i. e.* from the walls of the flagellated chambers), with long straight unpaired ray, and shorter lateral rays characteristically curved, the unpaired angle very obtuse (text-fig. 96, figg. 20 *f*–20 *j*, p. 381); (3) gastral triradiates and quadriradiates, with long straight unpaired ray, shorter paired rays slightly curved, gastral ray present or absent, unpaired angle nearly a right angle or less, at any rate considerably less than 120° (text-fig. 96, figg. 20 *m*–20 *p*, p. 381); (4) quadriradiates from the oscular rim, the three basal rays nearly equal in length, the unpaired angle nearly 180°, so that the spicule is nearly T-shaped (text-fig. 96, figg. 20 *k*, 20 *l*, p. 381); and (5) monaxons of very characteristic form, the proximal half nearly straight, tapering to a point, the distal half curving evenly outwards, without any diminution in thickness, to the conspicuous, bluntly pointed lance-head. It is the presence of these monaxons that was so often noticed in my specimens of *Leucosolenia variabilis*; it is probable that such monaxons may often find their way even into pure cultures of the *Leucosolenia*, for if thrown off by the Sycons and washed about in the water they might easily come to stick to the *Leucosolenia* or to the seaweed on which it was growing.

(c) *General Remarks on the Species.*

Haeckel was the first to recognize the specific distinctions of this sponge and to describe accurately its distinctive characters, although it was common enough in collections long previous to Haeckel's monograph. Bowerbank, as has been already pointed out, figured this sponge and its spicules under the name *L. botryoides*, and again in another place as a new species under the name

Leuconia somesii; why he should have called these specimens *Leuconia* is a mystery to me.

Haeckel gave the species the name *variabilis* on account of "the unlimited changeableness of its form as a whole, as well as of its specific skeleton-structure." I have already expressed my opinion upon Haeckel's figures of the external form; as regards the spiculation, *L. variabilis* is variable certainly, but not more so than other Ascons. The frequent association, mentioned above, of this species with a heterocœle sponge, and the constant contamination, so to speak, of spicule-preparations of the Ascon by spicules not properly belonging to it, may account for Haeckel's noticing in this instance the variability of the spiculation.

Haeckel described *variabilis* as having two kinds of monaxons, small and large; but from his figure it is evident that the smaller kind seen by him were the small curved monaxons, and he did not notice that they are connected by every possible gradation of size with the large ones. He overlooked the small straight monaxons, as I must also confess to have done till quite recently. Haeckel made four specific varieties—*cervicornis*, *confervicola*, *arachnoides*, and *hispidissima*,—based on variations of the relative numbers of the different sorts of spicules, and leading up to his so-called "connexive varieties," distinguished, in his usual way, by ringing the changes on the generic name, such as *Ascaltis*, *Ascortis*, *Asculmis*, or *Ascyssa variabilis*. None of these varieties appears to me to have any taxonomic value except *hispidissima*, which might be retained for forms such as were named by Bowerbank *Leuconia somesii*: *i. e.* for those in which the monaxons are excessively developed in size and number to form a furry protective covering. In my specimens from Roscoff, even from the same rock, I find some which, viewed with a lens, appear smooth, others which appear hispid; the difference between them is merely one of the length attained by the monaxons (compare figg. 10–13, text-fig. 94, p. 377). The same is true of *L. complicata*, and there can be no doubt that these sponges respond readily in this manner to differences in their surroundings.

Of other species of Ascons in Haeckel's monograph, I feel no doubt whatever that his *Ascortis corallorhiza* is founded on a specimen of this species with rather large and thick spicules (compare figg. 15 *a*–15 *f*, text-fig. 95, p. 379). Here also we have a connexive variety, *Ascandra corallorrhiza*, mentioned.

Systematists subsequent to Haeckel have for the most part recognized and identified this sponge correctly. A specimen, however, in the British Museum from Trieste, labelled *L. variabilis*, is certainly not this species. *L. variabilis* does not, to the best of my belief, occur in the Mediterranean; but it is impossible, I repeat, to make definite statements about the distribution of Ascons in the present confused state of their nomenclature *.

* Kirkpatrick, in 1901 (Brit. Mus. Rep. 'Southern Cross' Collections, p. 317), identified an Antarctic sponge as *L. variabilis*; but having been able, by the author's kindness, to examine the specimen I am in a position to state that it is not *L. variabilis* but a species, apparently new, allied to *L. complicata*.

The diagnostic features of this sponge are:—(1) The constant shortness of the unpaired ray of the triradiate systems relative to the lateral rays, and the wideness of the anterior angle, frequently nearly 180°; (2) the two kinds of monaxons, both barbed—straight refringent ones always slender and small, relatively scarce; and curved ones, varying from very small to very large, always abundant.

(d) *List of Specimens examined.*

(*a*) From Canon Norman's Collection.

1. Specimen from Bantry Bay, Ireland, with Norman's label "*Leucosolenia botryoides*," endorsed by Haeckel "*Ascandra variabilis*." (See text-fig. 95, figg. 16 *a*–16 *g*, p. 379.)
2. Specimens from Shetland, with label in Bowerbank's handwriting "*Grantia botryoides* Johnston, more largely developed than usual." Also a label by Norman "*Leucosolenia botryoides*, very large, Shetland," across which is written in Haeckel's handwriting "*Ascandra variabilis* H."
* These specimens are of the same batch as No. 8 below.
3. Specimens received by Norman from Haeckel, collected at Bergen, Norway, with printed label "*Ascandra variabilis* H."
4. Specimen received by Bowerbank as a type of *Leucosolenia contorta*, from Guernsey; sent to Haeckel for examination, and returned with label in Haeckel's handwriting as follows:—

"*Ascandra contorta* H.
"(*Leucosolenia contorta* Bwbk.)
"Guernsey. Bowerbank."

The specimen is a quite typical *variabilis*, with a slight admixture of *Sycon* spicules.

5. Specimens growing on seaweed with *Grantia compressa*, from Polperro, Cornwall, and identified by Haeckel as *Ascandra variabilis*: my preparations show a mixture of spicules of *variabilis* and *complicata*.

(*b*) From the British Museum.

6. Bowerbank Coll., No. 1017. The type specimen of Bowerbank's "*Leuconia somesii*," figured in Brit. Spong. iii. pl. xci. fig. 6. With label in Bowerbank's handwriting—"*Leuconia somesii* Bwk., sent to me by Mr. H. Lee, 15.9.73, said to have been found alive in the aquarium" (*i. e.* at Brighton). (See text-fig. 95, figg. 19 *a*–19 *h*, p. 379.)
7. Bowerbank Coll., 1018. Another specimen with Bowerbank's label "*Leuconia somesii*, Brighton Aquarium, sent by Mr. Lee, 5.11.73." Figured in Brit. Spong. iii. pl. xci. fig. 8.
8. Bowerbank Coll., 1019. Another specimen with label similar to the last. Figured in Brit. Spong. iii. pl. xci. fig. 7. (See text-fig. 95, figg. 18 *a*–18 *e*, p. 379.)

9. Bowerbank Coll., 985. Specimen figured in Brit. Spong. iii. pl. iii. fig. 1, with label in Bowerbank's handwriting "*Leucosolenia botryoides*, Shetland." A quite normal specimen of *variabilis* with fairly large spicules.
10. Bowerbank Coll., 979. Labelled in Bowerbank's handwriting "*Leucosolenia botryoides*, Shetland."
11. Bowerbank Coll., 964. Label as in the foregoing.
12. Register No. 47.9.7.112. Label "*Grantia botryoides* var." Holy Island, Johnston Collection.

[Register No. 83.12.4.17, labelled "*Ascandra variabilis* H. Adria, Triest," is a specimen of a species totally distinct from *variabilis*, which I have not yet been able to identify with certainty.]

(*c*) From the Berlin Museum.

13. No. 417. Specimens received from Haeckel; locality Bergen. My preparation shows quite typical spicules of *variabilis* mixed with those of a Sycon. (See text-fig. 96, figg. 21 *a*–21 *p*, p. 381.)

3. Leucosolenia botryoides.

Spongia botryoides Ellis & Solander, 1786, Nat. Hist. Zoophytes, p. 190, pl. lviii. figg. 1–4.

Spongia botryoides Montagu, 1812, Wernerian Mem. ii. p. 89.

Spongia botryoides pars Grant, 1826, Edinb. Phil. Journ. xiv. p. 339; Edinb. New Phil. Journ. i. p. 169.

Spongia botryoides pars Grant, 1827, Edinb. New Phil. Journ. ii. p. 135.

Grantia botryoides pars Fleming, 1828, Hist. Brit. Animals, p. 525.

Calcispongia botryoides de Blainville, 1836, Manuel d'Actinologie, p. 531.

Grantia botryoides pars Johnston, 1842, Brit. Spong. and Lithophytes, p. 178.

Leucosolenia botryoides Bowerbank 1864, Mon. Brit. Spong. i. p. 164, pl. xxvi. figg. 347, 348; (1866) ii. p. 28.

Grantia lieberkühnii Schmidt, 1866, Spong. Adriat. Meer. Suppl. ii. pp. 8, 20.

Leucosolenia botryoides Gray, 1867, Proc. Zool. Soc. 1867, p. 555.

Leucosolenia botryoides Schmidt, 1868, Spong. Adriat. Meer. Suppl. iii. p. 31.

Olynthium nitidum Haeckel, 1870, Jena. Zeitschr. v. p. 237.

Olynthium splendidum Haeckel, l. c. p. 237.

Leucosolenia (*Leuceria*) *botryoides* Haeckel, 1870, l. c. p. 243.

Leucosolenia granti Haeckel, 1870, l. c. p. 243.

Ascaltis botryoides Haeckel, 1872, Kalkschwämme, ii. p. 65, pl. 9. fig. 10, pl. 10. figg. 7 *a*–7 *e*.

Ascandra botrys Haeckel, 1872, l. c. p. 101, pl. 16. figg. 1 *a*–1 *f*.

Ascandra nitida Haeckel, 1872, l. c. p. 103, pl. 16. figg. 2 *a*–2 *q*, pl. 17. figs. 3, 7, 10, 13.

Ascandra botryoides Fristedt, 1885, K. Vetensk.-Akad. Handlingar, xxi. no. 6, p. 9.

Ascaltis botryoides Hanitsch, 1890, Trans. Liverpool Biol. Soc. iv. p. 223.

Leucosolenia botryoides Minchin, 1896, Ann. Mag. Nat. Hist. (6) xviii. p. 359.

Leucosolenia botryoides Breitfuss, 1898, Arch. f. Naturges. lxiii. i. p. 210.

Ascandra botrys Breitfuss, 1898, l. c. p. 213.

Leucosolenia botryoides Rousseau, 1903, Mém. Soc. Malac. Belgique, xxxvii. p. 5, fig. 1.

Leucosolenia botryoides Allen, 1904, J. Mar. Biol. Assoc. n. s. vii. p. 185.

(a) *External Characters.*

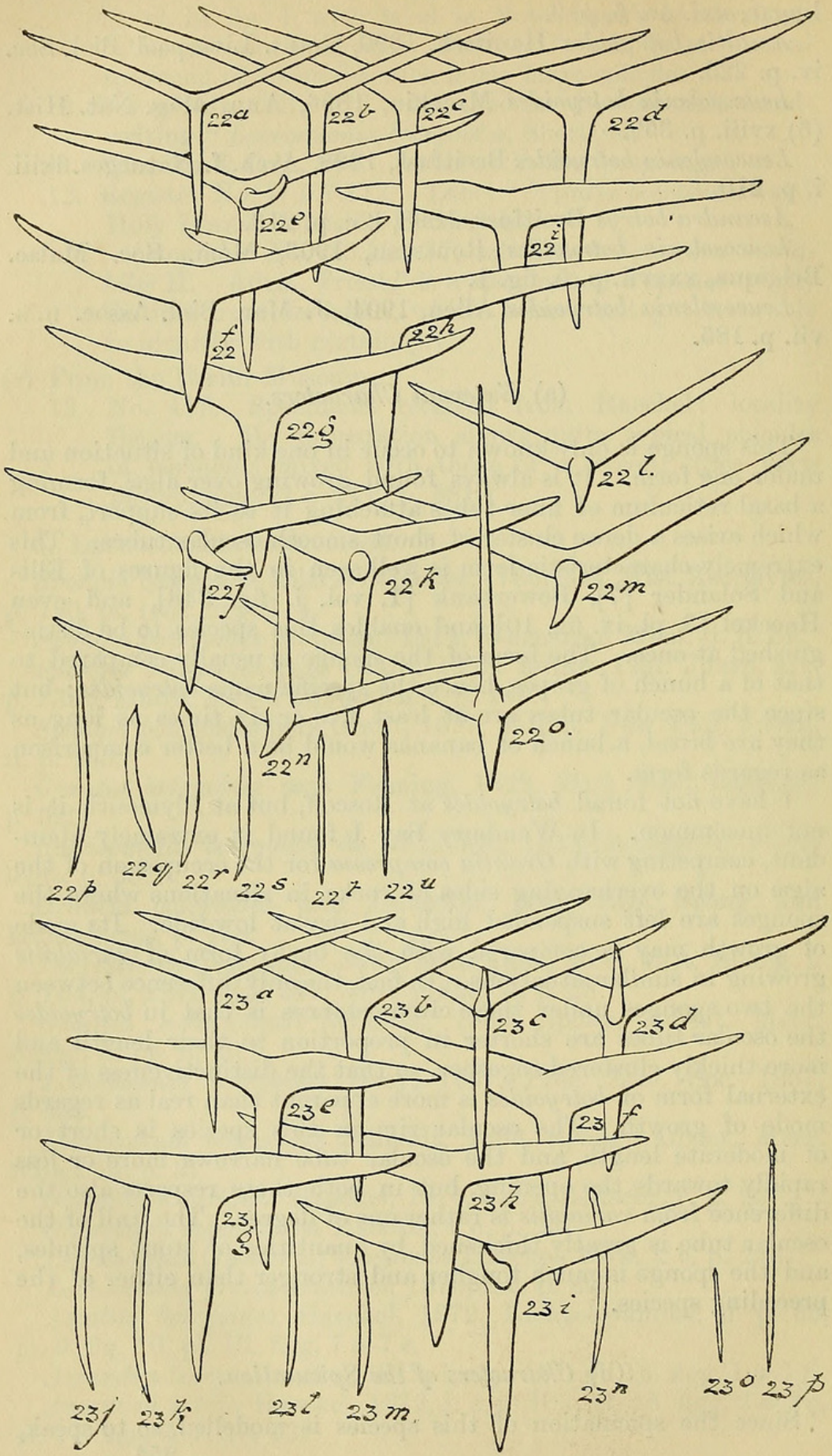
This sponge is only known to occur in one kind of situation and under one form. It is always found growing over algæ, forming a basal reticulum of finer tubes attaching it to its support, from which arises a dense cluster of short smooth oscular tubes. This extremely characteristic form is well seen in the figures of Ellis and Solander [**7**], Bowerbank [**1**, vol. i. fig. 348], and even Haeckel [**3**, pl. ix. fig. 10], and enables this species to be distinguished at once. The form of the sponge is usually compared to that of a bunch of grapes, hence the specific name *botryoides*; but since the oscular tubes are at least five or six times as long as they are broad, a bunch of bananas would be a better comparison as regards form.

I have not found *botryoides* at Roscoff, but at Plymouth it is not uncommon. In Wembury Bay I found it extremely abundant, competing with *Grantia compressa* for the occupation of the algæ on the overhanging sides of rocks, in situations where the sponges are left suspended high and dry at low tide. Its mode of growth may be compared with the bushy form of *variabilis* growing in similar situations. In fact, the only difference between the two sponges under these circumstances is that in *botryoides* the oscular tubes are shorter in proportion to their length and more thickly clustered together, so that the distinctiveness of the external form of *botryoides* is more apparent than real as regards mode of growth. The oscular rim in this species is short or of moderate length, and the oscular tube narrows more or less rapidly towards the opening, but in both these respects also the difference from *variabilis* is rather one of degree. The wall of the oscular tube is greatly thickened by quantities of stout spicules, and the sponge is much tougher and stronger than either of the preceding species.

(b) *Characters of the Spiculation.*

Since the spiculation of this species is modelled, so to speak,

Text-fig. 97.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almost exactly upon that of *L. variabilis*, and every class of spicule found in the one is found also in the other, it is only necessary to enumerate them in the same order as has been done for *L. variabilis*, and to give at the same time an account of their differences in the two species, and of their variations in the species under consideration.

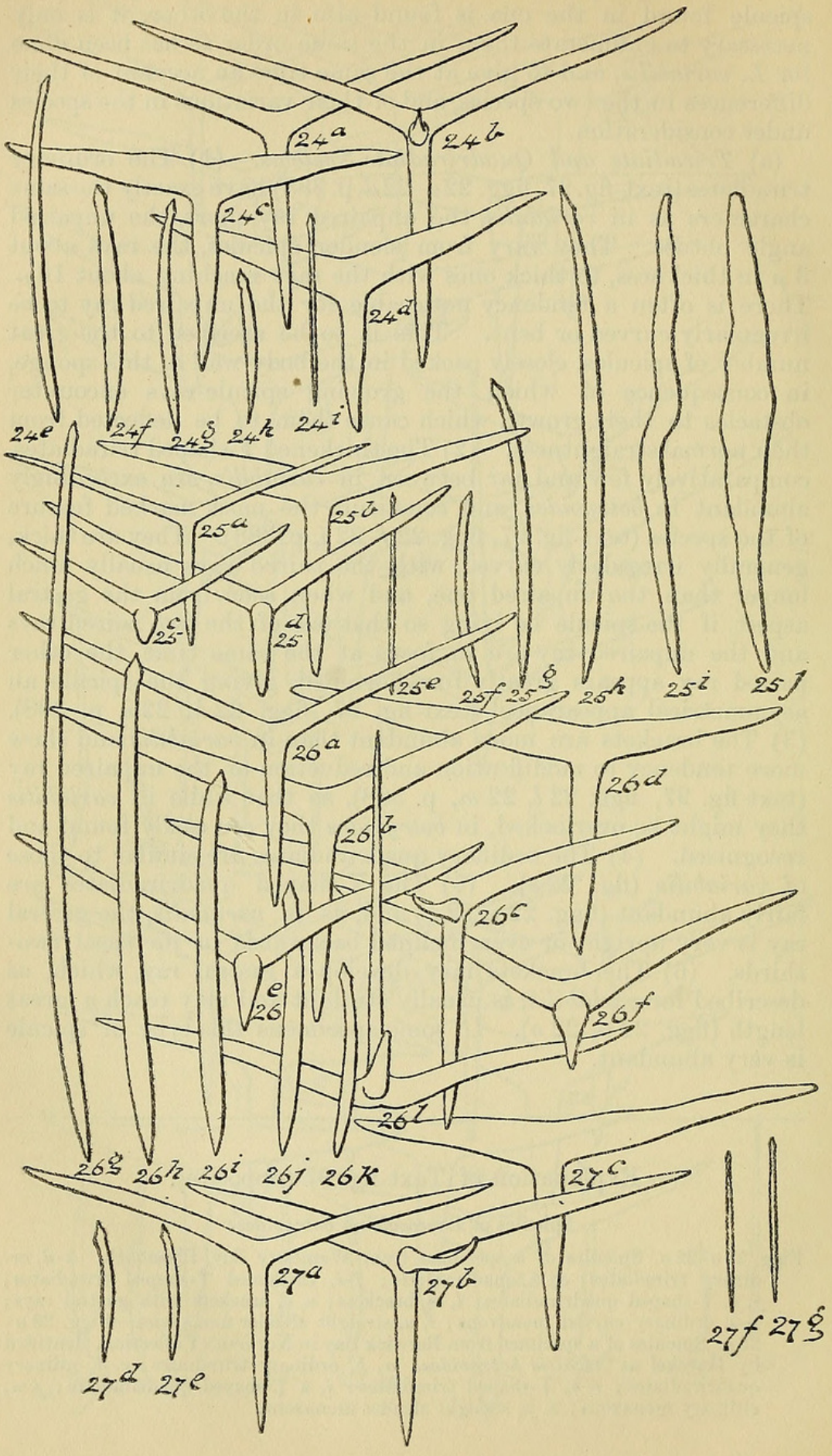
(a) *Triradiate and Quadriradiate Systems.*—(1) The ordinary triradiates (text-fig. 97, figg. 22 *a*–22 *d*, p. 388) have exactly the same characters as in *variabilis*, the unpaired ray short, the unpaired angle obtuse. They vary from slender spicules, the rays about 3 μ in thickness, to thick ones with the rays reaching about 10 μ. There is often a tendency noticeable for the unpaired ray to be irregularly curved or bent. This is to be ascribed to the great number of spicules, closely packed in the body-wall of this sponge, in consequence of which the growing spicule-rays encounter obstacles to their growth which cause them to be deflected from their normal straightness. (2) The thickened T-shaped triradiates, comparatively few and far between in *variabilis*, are exceedingly abundant in *botryoides*, and constitute the most marked feature of the species (text-fig. 97, figg. 22 *f*–22 *i*, p. 388). They are thick, generally irregularly curved, with the paired rays usually much longer than the unpaired one, and when seen from the gastral aspect, if the spicule be lying so that one of the two paired rays and the unpaired ray are in focus at the same time, the other paired ray appears greatly foreshortened, giving the spicule an asymmetrical appearance (text-fig. 97, figg. 22 *h*, 22 *i*, p. 388). (3) The brackets are more abundant than in *variabilis* and show more tendency to modification and reduction of the unpaired ray (text-fig. 97, figg. 22 *l*, 22 *m*, p. 388), so that while in *variabilis* they might be overlooked, in *botryoides* they are easily found and recognised. (4) The ordinary quadriradiates are similar to those of *variabilis* (fig. 22 *e*). (5) The T-shaped quadriradiates are fairly abundant (figg. 22 *j*, 22 *k*) and, as in *variabilis*, the gastral ray is very upright or even inclined backwards in its basal two-thirds. (6) The brackets may develop a gastral ray, which, as described for *variabilis*, is usually straight and may reach a great length (figg. 22 *n*, 22 *o*). In some specimens this type of spicule is very abundant.

Explanation of Text-fig. 97 (opposite).

Spicules of *Leucosolenia botryoides*.

Figg. 22 *a*–22 *o*. Spicules of a specimen from Wembury Bay, Plymouth. *a*–*d*, ordinary triradiates; *e*, a quadriradiate; *f*–*i*, thickened T-shaped triradiates; *j*, *k*, T-shaped quadriradiates; *l*, *m*, brackets; *n*, *o*, brackets with gastral rays; *p*–*s*, ordinary curved monaxons; *t*, *u*, straight slender monaxons.—Figg. 23 *a*–23 *p*. Spicules of a specimen from Berwick Bay in Norman's Collection, identified by Haeckel as *Ascaltis botryoides*. *a*, *b*, ordinary triradiates; *c*, *d*, ordinary quadriradiates; *e*–*h*, T-shaped triradiates; *i*, a T-shaped quadriradiate; *j*–*n*, ordinary monaxons; *o*, *p*, straight slender monaxons.

Text-fig. 98.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(b) *Monaxon Spicules.*—(1) The ordinary curved, barbed forms (text-fig. 97, figg. 22 *p*–22 *s*, p. 388) have the same characters as in *variabilis*; but they are usually short (60 μ–80 μ in length), and though they may vary in size, they never reach quite the length which they do in *variabilis*; I have found none exceeding 300 μ in length, and such dimensions are quite exceptional (text-fig. 98, fig. 26 *g*, p. 390). Further, they have a tendency to be less curved and slightly thicker, in proportion to their length, than in *variabilis*, and not to dwindle so much in thickness just below the lance-head as do the monaxons of the latter species; the features described are most marked in specimens in which the monaxons are for the most part short (fig. 22). The monaxons are always abundant and never absent, not even in the specimens identified by Haeckel as *Ascaltis botryoides* (fig. 23), in which, therefore, they are supposed to be wanting. (2) The slender, straight, refringent monaxons are always present and have the same characters as in *L. variabilis* (figg. 22 *t*, 22 *u*). (3) The bayonet-shaped monaxons are not to be found in most specimens, but in some they are fairly common (figg. 25 *i*, 25 *j*), and show the same features as in *L. variabilis*.

(c) *General Remarks on the Species.*

Since this sponge was first named by Ellis and Solander in 1786, it was for many years the species to which all British Leucosolenias were referred, both in works dealing with sponges and in the labels of museums and collections, until Haeckel in 1872 first pointed out the distinctive characters of the species and gave a diagnosis of it. Haeckel, however, as has been pointed out, wrongly separated this species into two, one with, the other without monaxons, so that the characters which he ascribed to his unnecessary species *botrys* are those which should be given to *botryoides*. It is incomprehensible to me how Haeckel came to

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Explanation of Text-fig. 98 (opposite).

Spicules of *Leucosolenia botryoides*.

Figg. 24 *a*–24 *i*. Spicules of a specimen from Portrush in Norman's Collection identified as *Ascandra botrys* by Haeckel. *a*, ordinary triradiate; *b*, ordinary quadriradiate; *c*, *d*, T-shaped triradiates; *e*–*h*, curved monaxons; *i*, straight slender monaxon.—Figg. 25 *a*–25 *j*. Spicules of a specimen from Heligoland in the Berlin Museum (No. 1777), showing the bayonet-like monaxons. *a*, triradiate, rather unusually slender; *b*, T-shaped triradiate; *c*, *d*, brackets; *e*, straight slender monaxon; *f*–*h*, curved monaxons, reaching a considerable length; *i*, *j*, bayonet-like monaxons.—Figg. 26 *a*–26 *l*. Spicules of a specimen from Liverpool in the Berlin Museum (No. 1763), showing the monaxons of great length. *a*, *b*, ordinary triradiates; *c*, quadriradiate; *d*, T-shaped triradiate; *e*, *f*, brackets; *g*–*k*, ordinary curved monaxons; *l*, bracket with gastral ray.—Figg. 27 *a*–27 *g*. Spicules of a specimen in the British Museum (Bowerbank Coll., 992), figured in Bowerbank, Brit. Spong. i. fig. 348 (see p. 164). *a*, ordinary triradiate; *b*, ordinary quadriradiate; *c*, T-shaped triradiate; *d*, *e*, ordinary monaxons; *f*, *g*, refringent monaxons.

make such a blunder*, since not only have I found monaxons well developed and abundant in his type specimen, No. 1 of my list below, but it is evident he himself saw them, since he founded one of his usual "connexive" varieties, *Ascandra botryoides*.

Haeckel further distinguished two varieties, *ellisii* and *solanderii*, the former with the "apical ray of the quadriradiates slightly curved, the lateral rays 7 or 8 times as long as thick, the unpaired angle 130°–150°"; the latter with the "apical ray of the quadriradiates straight, the lateral rays 5 or 6 times as long as thick, the unpaired angle 150°–180°." Since all these variations can be found in any specimen, Haeckel's two varieties may be struck out of the systematic list. As I have also pointed out above, there is nothing in Haeckel's description of *Ascandra nitida* to separate it from *botryoides*; *A. nitida* is, in fact, distinguished from *A. botrys* by the same characters practically as *Ascaltis botryoides* var. *solanderii* from var. *ellisii*.

Of writers subsequent to Haeckel, Fristedt alone [9] seems to have penetrated Haeckel's mistake, since he calls the species *Ascandra botryoides*, as Haeckel ought to have done. Fristedt has, moreover, gone a step further, and has put *variabilis* as a synonym of *botryoides*, in which he has been followed by Vasseur [23]. I have been sorely tempted to follow Fristedt's lead also, and to place both forms as well-marked varieties of one species, for which, of course, the name *botryoides* would have to be maintained; the form ordinarily known as *botryoides* could then be called *botryoides* var. *typica*, and the other *botryoides* var. *variabilis*. As has been shown above, the difference between the two forms is purely one of degree in every respect. As regards spiculation, they are in complete agreement, every form of spicule occurring in the one being represented also in the other, and the special features of *botryoides* are merely an exaggeration of those of *variabilis*. As regards external form, *variabilis* occurs in a variety of situations and consequently varies in form; the fact that in *botryoides* the habits both of situation and growth are constant, is in itself highly suggestive of its being a form-variety adapted to a particular environment. Examination of the sponge brings to light a further very important fact, bearing directly upon the question under discussion, namely, that the thickened triradiate systems so highly characteristic of *botryoides* are nearly absent, or comparatively scarce, upon the basal network of tubes by which the sponge is attached to its support, but are greatly developed as a protecting and supporting layer upon the erect

* The only source I can suggest for Haeckel's error with regard to the monaxons of *botryoides* is the fact that Bowerbank also failed to see monaxons in this species, and considered their absence as one of the characters distinguishing it from his *Leucosolenia contorta*. If my notion be correct, this is a curious case of successive incarnations of an error, manifesting itself first in Bowerbank 1866, then in Haeckel 1872, and for the last time, let us hope, in Breitfuss 1898. A still more remarkable point in this history is the fact pointed out above, that the specimen from which Bowerbank described the spiculation of *botryoides* was really a specimen of *variabilis* (Haeckel), while the specimen of "*contorta*" from which he figured monaxons was in reality a specimen of *complicata*!

oscular tubes. The basal network thus completely resembles *variabilis* in its spiculation. For these reasons I should certainly place the two forms as varieties of one species were I now describing them for the first time.

I refrain at present, however, from taking the step of uniting the two forms, for the reason that they have long been kept distinct, and that they are generally very easily recognised and distinguished from each other. To call them one species, definite proof of relationship should be obtained. If, for instance, larvæ of a typical specimen of *botryoides* were cultivated and found to give rise to *variabilis* as well as to *botryoides*, according to the conditions of growth, no one could doubt any longer that the alleged two species were one. The experimental test of their relationship should not be difficult to obtain; but until it has been obtained, the two forms may be provisionally kept distinct under their old names, in spite of the fact that the diagnostic features of *botryoides* are purely relative as compared with *variabilis*.

(d) *List of Specimens examined.*

(*a*) From Canon Norman's Collection.

1. Dried specimen received from Johnston and sent by him to Haeckel for examination; figured by Haeckel, Die Kalkschwämme, pl. 9. fig. 10. (Haeckel's figure is, however, very much reconstructed, and does not bear a close resemblance to the original.) With a label in Haeckel's handwriting :—

"*Ascaltis botryoides* Hkl.
"*Grantia botryoides* Johnston.
"*Leucosolenia botryoides* Bwbk.
"(vera !).
"Berwick Bay, Johnston."

Also with label by Norman :—

"*Leucosolenia botryoides.*
"Berwick Bay, Feb. 22nd, 1851.
"Dr. Johnston."

This most precious specimen is therefore one of Haeckel's types, and it shows clearly that, in a manner analogous to the case of *L. complicata* mentioned above, Haeckel overlooked the small but very abundant monaxons (see text-fig. 97, figg. 23 *a*–23 *p*, p. 388); that therefore the species should have been placed as *Ascandra botryoides* in his system; and that consequently the species *Ascandra botrys* H. should be struck out of the system, becoming a synonym of *L. botryoides*.

2. Dried specimen received from Dr. E. Perceval Wright, by whom it was sent to Haeckel for identification. With label in Wright's handwriting :—

"*Ascandra botrys*, Portrush, E. P. W.
"Specimens named by Haeckel."

(See text-fig. 98, figg. 24 *a*–24 *i*, p. 390.)

(*b*) From the British Museum.

3. Bowerbank Coll., 992. Dried specimen figured by Bowerbank, Brit. Spong. i. fig. 348; described p. 164. (See text-fig. 98, figg. 27 *a*–27 *g*, p. 390.)
4. Bowerbank Coll., 980. Dried specimen, with label in Bowerbank's handwriting—"*Leucosolenia botryoides*, Guliot Caves, Sark, J. S. B."
5. Bowerbank Coll., 981. Label in Bowerbank's handwriting —"*Leucosolenia botryoides* Bowk. Fowey. C. W. Peach. Very fine. O. C."
6. Bowerbank Coll., 981. Label in Bowerbank's handwriting —"*Leucosolenia botryoides*, Scarborough, Bean."
7. Register No. 47.9.7.109. Label "*Grantia botryoides*." Locality Berwick Bay, Johnston Collection.
8. Register No. 47.9.7.107. Label as last: locality Bangor, County Down, Ireland, Johnston Collection.
9. Register No. 87.6.25.4. Label "Calcareous Sponge, Shetland, E. M. Nelson, Esq."

   [The specimen No. 82.3.6.36, labelled "*Leucosolenia botryoides* B. Australia. ? sp.," in Carter's handwriting, is a totally distinct species.]

(*c*) From the Berlin Museum.

10. No. 1763, "*Ascaltis botryoides*," Liverpool. A specimen of *L. botryoides* in which the monaxons attain an unusually large size, though the designation *Ascaltis* implies their total absence!* (See text-fig. 98, figg. 26 *a*–26 *l*, p. 390.)
11. No. 1777. "*Ascandra botrys*," Heligoland. (See text-fig. 98, figg. 25 *a*–25 *j*.)

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* Breitfuss in his Catalogue [3] puts this specimen down as "*Leucosolenia botryoides*," and since the name *Leucosolenia* is used by him to denote Ascons in which monaxon spicules are lacking, it follows, either that he did not examine the specimen, or that he overlooked the very conspicuous monaxons.

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[*Addendum.*—Since the foregoing memoir was written and

read before the Zoological Society, a paper has appeared on the "Plymouth Marine Invertebrate Fauna" in the Journal of the Marine Biological Association (n. s. vii. 2, Dec. 1904), in which notes furnished by myself and Mr. Bidder are mixed up together with rather contradictory results (p. 185). Thus *Leucosolenia botryoides* is stated to occur "on the shore between tide-marks, not abundant except in certain localities (*E. A. M.*); rocks under the Hoe, in abundance (*G. P. B.*)." *L. variabilis* is put down as "common everywhere in rock-pools between tide-marks (*E. A. M.*)." The fact is that Bidder has not recognised *variabilis* and *botryoides* as distinct, and, taking the characters of *botryoides* from Bowerbank (whose figured specimen of this species was really *variabilis*), Bidder has not unnaturally identified sponges as *botryoides* which should have been named *variabilis*. Bidder's note on the occurrence of *botryoides* should therefore be transferred to *variabilis*, and then it will be perfectly correct. The true *botryoides* is certainly very far from abundant on rocks under the Hoe; I doubt if it ever occurs there.]

2. Descriptions of Thirty-two new Species of *Halticinæ* (Phytophagous Coleoptera) from South and Central America. By Martin Jacoby, F.E.S.

[Received November 25, 1904.]

List of the Species.*

Lactica nicotinæ.	Mexico.	Acanthonycha costatipennis.	Brazil.
„ decorata.	Peru.	„ antennata.	Brazil.
„ maculicollis.	Peru.	Sophraenella fulva.	Amazons.
„ posticata.	Peru.	Blepharida flavocostata.	Mexico.
„ discicollis.	Peru.	„ multimaculata.	Mexico.
„ rufobrunnea.	Peru.	Prasona peruviana.	Peru.
„ baeri.	Peru.	Systena melanocephala.	Peru.
„ argentinensis.	Argentine.	„ argentinensis.	Argentine.
Agasicles vittata.	Peru.	„ antennata.	Amazons.
Disonycha amazonica.	Amazons.	Pseudogona discoidalis.	Argentine.
„ peruana.	Peru.	„ militaris.	Panama.
„ albicincta.	Peru.	„ pallida.	Costa Rica.
Acanthonycha peruana.	Peru.	Oxygona amazonica.	Amazons.
„ geniculata.	Peru.	„ capitata.	Peru.
„ dimidiata.	Peru.	Crepidodera longicornis.	Peru.
„ stali.	Costa Rica.	Hippuriphila catharinæ.	Brazil.

Lactica nicotinæ, sp. n.

Flavous or fulvous, antennæ (the basal three joints excepted) black, head and thorax impunctate; elytra dark metallic blue or violaceous, finely punctured anteriorly, the posterior portion very obsoletely so.

Length 3–3½ millim.

Head impunctate, the frontal tubercles very distinct, carina short, not widened anteriorly, palpi robust; antennæ extending to

* The types of all the species described here are contained in the author's collection.