Studies on the Comparative Anatomy of Sponges.

I. On the Genera Ridleia, n. gen., and Quasillina, Norman.

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With Plate XLII.

Some months ago, when going over the large collection of Sponges in the British Museum, I came upon a curious little specimen,[1] which a cursory examination soon showed to be of exceptional interest. I was therefore led to make a careful investigation of the minute anatomy, and soon discovered that the specimen in question was the type of a new genus of Monaxonid Sponges allied to Quasillina on the one hand, and Suberites on the other. For purposes of comparison, I was further led to make as complete a re-examination as possible of the minute anatomy of Quasillina, which led to an almost complete confirmation of what Dr. Vosmaer has already published on the subject, and also to the discovery of some interesting new points.

As, therefore, the present paper treats of the anatomy of two distinct though closely allied genera, I have thought it desirable to divide it into two main parts. These two parts are, however, very intimately connected with one another, and perhaps the chief interest of the paper lies in the comparison

[1] Labelled, "H. M. S. 'Porcupine,' Station 82," and registered in the collection 83, 12, 13, 69.

of the two types and in the conclusions to be drawn therefrom. Hence I propose, at the end of the paper, to give a short summary in which the points of difference and of resemblance between the two genera will be pointed out and discussed.

Some of the sections were cut in the laboratory of the Zoological Society, at the Zoological Gardens, and others in the laboratory of the Royal School of Mines, South Kensington, and I have great pleasure in taking the present opportunity of expressing my thanks to the authorities of both these institutions, and especially to Professor G. B. Howes and Mr. Beddard, for the great facilities for work afforded to me.

With regard to the figures illustrating this paper, I feel that a few words of explanation are desirable. None of the figures, excepting those of mere external form and of spicules, are intended for exact representations of individual preparations. What I have been unable to make out in one section I have found in others, or vice versâ, and the figures are the result of the repeated examination of a large number of preparations. In drawing them, however, the camera has been largely used, and, although they are to a certain extent diagrammatic, I believe them to be far more instructive than any mere facsimile drawings of individual sections could be. Figure 7 is a pure diagram showing what I believe to be the arrangement of the canal system in Ridleia oviformis, after having repeatedly examined a large number of sections, both transverse and longitudinal.

In his report on the Hexactinellida of the "Challenger" Expedition,[1] Professor Schulze, who is undoubtedly the greatest living authority on the anatomy of Sponges, observes: "If I had attempted to copy the individual sections exactly as they appeared, the essential and typical could not, as a rule, have been distinguished from the unessential and accidental, except, of course, by giving a larger number of illustrations than seemed justifiable for such a slight possible advantage," and with this I most heartily agree.

[1] P. 4.

I. The Genus Ridleia, n. gen.

This genus, which I wish to dedicate to my friend and late colleague, the Rev. S. O. Ridley, who is so well known for his work on Sponges, may be diagnosed as follows:

"Sponge corticate, with a highly-developed system of fibrous tissue. Consisting of a single solid body terminating above in an osculum which leads into a well-defined oscular tube with fibrous walls. Spicules monactinal, styli or tylostyli, confined almost entirely to the ectosome. Skeleton composed chiefly of stout longitudinal bands of spicules situate in the inner portion of the ectosome, and of tufts of small spicules projecting at the surface of the Sponge. Canal system canalicular, flagellated chambers diplodal."

A generic diagnosis based upon a single species, especially when only a single specimen is present, must be more or less tentative, and very possibly future investigations upon fresh material will lead to a modification of the above.

Ridleia oviformis, n. sp.

External Characters.—The single specimen in the collection (fig. 1) consists of an egg-shaped body terminating above in a slight papilla upon which lies the small osculum, and thinning out below into a flattened peduncle. The peduncle appears, from the existence of certain flattened surfaces (*a a*), to have been attached to pebbles during life, in a manner similar to that which occurs in Quasillina (fig. 8).

The specimen is 15 mm. in height and 7 mm. in greatest breadth. It has a very compact, cork-like consistence, and its colour in spirit is pale yellow.

The osculum (figs. 1 and 2, *o*) is single, very minute, and situate on a small papilla at the summit of the Sponge.

Arrangement of the Skeleton.—The skeleton is almost entirely confined to the ectosome, or that outer portion of the Sponge in which there are no flagellated chambers. Its most important constituent is a ring of stout, longitudinally dis-

posed bundles of large spicules (fig. 3, *l. sp.*), situate in the inner portion of the ectosome. Outside of these comes a broad zone of irregularly interlacing, separate, large spicules, which occupy the greater portion of the ectosome, and which give support to the numerous bundles or tufts of small spicules (fig. 3, *sp. b.*) which project outwards at the surface of the Sponge. The only remaining portion of the skeleton is a zone of somewhat obliquely disposed and not very well-defined bundles of small spicules (fig. 3, *i. sp.*) occurring in the outermost portion of the choanosome. These bundles are separated from the well-defined longitudinal bundles occurring in the inner portion of the ectosome by the two layers of fibrous tissue, which I shall describe later on. The remainder of the choanosome appears to be entirely free from spicules, a fact which is probably to be accounted for by its dense, cork-like consistence rendering their presence unnecessary.

The Spicules.—The spicules are all tylostyli of various sizes, each consisting of a long, straight, or slightly curved, cylindrical shaft, terminating at the base in a subglobular head, and at the apex in a fine point. They are of two chief sizes. The larger ones (figs. 4 and 5) are straight, or nearly so, and measure up to about 0·9 mm. in length, with a diameter in the thickest portion of the shaft of about 0·014 mm. The small spicules (fig. 6), which are almost confined to the surface brushes and to the innermost zone of longitudinal bundles, differ somewhat in shape from the large ones. They are very slender, frequently somewhat curved, and they taper very gradually to almost imperceptible fineness at the apex. They measure about 0·2 mm. in length by 0·002 mm. in maximum diameter of the shaft.

The Ectosome.—In describing the ectosome and choanosome, I shall, of course, leave out of account the spicular elements, which have been more conveniently treated of apart.

The ectosome (fig. 3, *ect.*) is composed for the most part of a transparent, gelatinous-looking tissue, containing ill-defined fibres and other mesodermal cells. Towards the outside it becomes more granular and stains more deeply, and no doubt

it is limited externally by an epithelium of flattened cells, which, however, I have not made out in my sections. The most remarkable character about it, however, is the presence, in its innermost portion, of two well-developed layers of fibrous tissue. In the outer layer (fig. 3, *l. f.*) the fibres are arranged longitudinally, and in the inner layer (fig 3, *c. f.*) horizontally or circularly. The outermost layer is not perfectly continuous, but is occasionally interrupted by strands of fibres given off towards the outside of the Sponge from the inner layer. In short, the outer fibrous layer consists of bundles of densely packed, longitudinally disposed fibres, wedged in between the inner fibrous layer and the stout longitudinal skeleton-bundles described above (fig. 3, *l. sp.*). The inner layer is about 0·024 mm. thick, and is composed of densely packed, circularly arranged fibres, giving off, as already described, occasional outgrowths towards the circumference. At intervals one can distinctly make out much elongated, granular nuclei. In parts there are distinct traces of a second layer of longitudinal fibres internal to the layer of circular fibres. The histological characters of the different layers appear to be thoroughly identical. The individual fibres are capable of separation from one another, and are then seen to be very slender and greatly elongated. They are, I believe, identical with the myocytes of Sollas,[1] and I attribute to them a contractile function.

While speaking of the fibrous tissue, I may also notice that the central oscular tube of the Sponge (fig. 2) is encased in a thick sheath of fibrous tissue, continuous in the neighbourhood of the osculum, with the true ectosomal layer. Here, again, we distinguish between two chief layers of fibres, circular and longitudinal. The circular fibres occur on the inside, i.e. next to the lumen of the tube, and the longitudinal on the outside. Fibrous tissue also occurs to a greater or less extent in connection with the main branches of the canal system.

The Choanosome. — The term choanosome has been applied by Sollas, in his 'Preliminary Report on the Tetrac-

[1] Article "Sponges," in 'Encyclopædia Britannica,' ed. ix, p. 419, fig. 21, *e*.

tinellida of the "Challenger" Expedition,"[1] to that internal portion of the Sponge body which contains the flagellated chambers, as distinguished from the ectosome, in which, it will be remembered, there are no flagellated chambers at all.

In Ridleia oviformis the choanosome (fig. 3, *ch.*) is almost entirely filled up by the closely-packed flagellated chambers which are embedded in a very sparingly developed granular ground-substance, in which it is difficult to make out any cellular constituents. A remarkable character in the choanosome, and to a certain extent in the ectosome also, of the specimen under description, is the occurrence of great numbers of minute, highly refringent, yellowish granules, which, from the fact that they occasionally exhibit a moniliform arrangement, I believe to be bacteria of some description. They are especially abundantly developed around the flagellated chambers, and around the inhalant and exhalant canaliculi. They occur both in stained and unstained preparations, and I am inclined to believe that they were present in the living Sponge.

The fibrous tissue surrounding the various parts of the canal system has already been described in connection with the similar tissue in the ectosome.

The Canal System.—The canal system is characterised by its canalicular character, or, in other words, by the absence of irregular lacunæ, such as exist in Halichondrine Sponges. The pores (fig. 3, *p.*) are minute, and scattered apparently without order and rather sparsely over the general surface of the Sponge. They may be seen in sections leading into the narrow, elongated subdermal cavities, which penetrate the various layers of the ectosome and terminate in slightly expanded spaces (subcortical crypts of Sollas) beneath the layer of circular fibres. These subcortical crypts, one of which is shown in fig. 3, are the only portions of the canal system which can be considered as at all lacunar. From them the inhalant canaliculi, leading sooner or later to the flagellated chambers, take their origin.

[1] 'Sci. Proc. Roy. Dub. Soc.,' vol. v, pt. vi, p. 177.

The flagellated chambers are more or less elongated or pear-shaped sacs, measuring about 0·05 mm. in length by 0·03 mm. in transverse diameter. They are provided with narrow excurrent and incurrent canaliculi as represented in the diagram, fig. 7. The canaliculi are extremely difficult to make out, but I have repeatedly examined a large number of sections, both transverse and longitudinal, and have satisfied myself of their existence. Their lumina, possibly owing to the contraction of the Sponge in spirit, are especially obscure, being only very occasionally discernible. They commonly appear as short, slender cords, leading to the proximal or distal end of the chamber, as the case may be, and are chiefly visible owing to the presence around them of the minute refringent granules already referred to. As usual in ordinary spirit specimens little can be made out concerning the collared cells. They appear to be very minute, and all I have succeeded in observing are their small nuclei and a number of irregular, gelatinous-looking processes projecting into the lumen of the chamber, and probably representing the remains of the flagella. The exhalant canaliculi unite together and open ultimately into the central oscular tube, whence the stream of water is discharged through the single osculum at the summit of the Sponge (fig. 2, *o*.).

I have endeavoured to represent in fig. 7, in a purely diagrammatic form, what I believe to be the relations of the flagellated chambers to the exhalant and inhalant canaliculi. It thus appears that the flagellated chambers are of the type described by Sollas as "diplodal," although the inhalant canaliculi appear to be but short. It is worthy of note that I have seen in one instance a flagellated chamber apparently opening direct out of a subcortical crypt without the intermediation of a canaliculus. It is obvious that such an occurrence would be most likely to take place, if anywhere, where the canal system is lacunar, and, as already pointed out, the subcortical crypts are the only portions of the canal system in Ridleia oviformis which are lacunar.

II. The Genus Quasillina, Norman.

The only species of this genus as yet described is Bowerbank's Quasillina (Polymastia) brevis, a common Shetland form, living in moderately deep water. As the somewhat complicated history and synonymy of this Sponge have lately been fully treated of by various authors,[1] I need not enter into the question here, but will proceed at once to the description of its general form and minute anatomy.

Quasillina brevis, Bowerbank sp.

External Characters.—Externally the Sponge is seen to consist of a usually somewhat flattened, oval body, perched on the summit of a short stalk (fig. 8). At its lower extremity the stalk is somewhat expanded, and the expanded portion is generally attached to a small pebble. At its upper extremity the body terminates in a slight mammiform prominence, at the summit of which there is a single minute osculum (figs. 8 and 9, *o*.).

The osculum is usually so much contracted and so difficult to make out that its existence has, until quite recently, been a matter of some doubt; and Vosmaer,[2] who has given by far the most complete account of the genus yet published, observes that he "never saw an opening at the top larger than those where the sea-water enters." Ridley and Dendy[3] have, however, demonstrated that an osculum is, at any rate sometimes, present, and my recent researches on the arrangement of the canal system in the body of the Sponge justify us in assuming that there is always one, although it is frequently found more or less completely closed up in preserved specimens.

According to Vosmaer (loc. cit.) the general shape of the

[1] Vide Ridley and Dendy, 'Report on the Monaxonida of the "Challenger" Expedition,' p. 225.

[2] 'Sponges of the "Willem Barents" Expedition, 1880-81,' p. 20.

[3] 'Report on the Monaxonida of the "Challenger" Expedition,' p. 226, woodcut, fig. 10.

Sponge is subject to considerable variation, but such strongly marked deviations from the ordinary type as he figures have not come under my notice, and I believe the essential characters remain fairly constant.

Certain rectangular marking on the surfaces of the Sponge, due to the arrangement of the skeleton in the ectosome, are very characteristic; their nature will be best understood by reference to fig. 8.

One of the most obvious of the characters of the species is the general flaccidity and emptiness of the body. Thus, Bowerbank[1] remarks, "When divided longitudinally the parietes of the Sponge did not exceed in the dried state the fourth of a line in thickness at any part, and the internal cavity extended the whole length of the Sponge. The greater number of them were more or less in a compressed state, but in some there were strong indications that this was due rather to collapse than to natural form," and Norman[2] begins his diagnosis of the genus with the words "Sponge consisting of a single clavate hollow body." I lay especial stress upon this character as it will be found later on to be very intimately connected with the arrangement of the canal system, and is one of those characters in which the two genera, Ridleia and Quasillina, differ very markedly from one another. I may forestall my account of the canal system so far as to state that the hollow condition insisted upon by Bowerbank and Norman is chiefly a post-mortem character, due to the shrinkage of the loose and delicate choanosome.

A full-grown specimen is usually less than an inch in height, and less than half an inch in greatest width. Fig. 8 represents the Sponge of the natural size.

Arrangement of the Skeleton.—This portion of my subject has already been more or less fully treated of by Bowerbank, Norman, and Vosmaer (locc. citt.), and, as I have but little to add, I may dismiss it briefly.

[1] 'Mon. Brit. Spong.,' vol. ii, p. 64.

[2] "Last Report on Dredging among the Shetland Isles," 'Brit. Assoc. Rep. for 1868,' p. 329.

By far the larger and most important portion of the skeleton lies within the ectosome. It may be best studied by cutting out a portion of the body wall (ectosome) and examining it as a transparent object with a low power of the microscope. A number of stout longitudinal bands or bundles of large spicules radiate upwards from the peduncle to the osculum, more or less parallel with one another, but sometimes branching. These bundles occur in the innermost portion of the ectosome. They support on their outer surfaces a layer of large, transversely, or obliquely disposed spicules arranged in rather confused and irregular bands. The spicules of both these systems are more or less parallel with the surface of the Sponge, but we now come to a third system of spicules placed at right angles to the surface of the Sponge, and consequently at right angles also to the other spicules. This third system consists of innumerable tufts or brushes of small spicules (fig. 9, *sp. b.*), whose apices project from the surface of the Sponge, and whose bases rest upon the spicule bands of the second system. These tufts are placed at a little distance from one another, and, when viewed from the surface, are seen to be arranged in a somewhat reticulate manner, so as to leave certain irregular spaces free from their presence. Within the choanosome the skeleton is very feebly developed, but is not so poorly represented as in Ridleia. It consists chiefly of separate bundles of small stylote spicules, each bundle (fig. 11) being composed of a number of spicules arranged parallel to one another. These structures closely resemble, on an enlarged scale, the well-known "trichite bundles" or "trichodragmata" of some Halichondrine Sponges (e. g. Esperella Murrayi), and I attribute to them the same function as has been attributed to the trichodragmata by Mr. Ridley and myself. In our report on the Monaxonida of the "Challenger" Expedition we suggest that these last serve, like straw in mortar, to bind together the soft, gelatinous tissue in which they lie. The trichodragmata are, of course, bundles of microsclera or flesh spicules; the occurrence of similar isolated bundles of megasclera has not, I believe, hitherto been noted. As they are

composed of styli the term "stylodragmata" might be applied to them. The presence of the stylodragmata in Quasillina, while they are absent in Ridleia, is probably to be attributed to the much less compact character and consequently greater need of support of the choanosome in the former Sponge.

The Spicules.—The spicules are nearly all styli (i. e. monactinal spicules simply rounded off at the base and pointed at the apex), but occasionally the base is swollen into a head, when the spicule becomes tylostylote.

They are, as already indicated, of two chief kinds.

(1) Large, straight, or slightly curved, fusiform styli, usually gradually sharp-pointed at the apex and narrowing considerably towards the base. These measure up to about 0·9 mm. in length, with a maximum diameter of 0·0144 mm.

(2) Small, slightly curved styli, very gradually sharp-pointed at the apex, but not so markedly fusiform as the large ones. These spicules are all of pretty much the same length, viz. about 0·24 mm., but the variation in thickness is very remarkable. Both stout and slender ones occur mixed up promiscuously in the surface tufts, the stout ones measuring about 0·0096 mm. in diameter, and the slender ones only about 0·002 mm. The two sizes appear to keep fairly distinct from one another, and one cannot help being struck by the general absence of intermediate stages. The stouter ones appear much more distinctly fusiform than the slender ones.

The Ectosome.—The ectosome consists of a somewhat granular but jelly-like matrix, with small, nucleated, multipolar cells embedded in it. It stains more deeply towards the outside, and on the extreme outside I have detected what appear to be traces of a single layer of flattened epithelial cells. This epithelium appears also to line the subdermal cavities in the ectosome. Fibrous tissue appears to be entirely absent, at any rate in most parts.

Here, however, we are met with a considerable difficulty in deciding the exact limits of the ectosome. In the wall of the oscular tube there is a very well-developed system of fibrous tissue, which seems hitherto to have entirely escaped observa-

tion, and as the wall of the oscular tube, at any rate in its upper portion, seems to me to have as much claim to be regarded as ectosome as it has to be regarded as choanosome, I shall describe it in this place. The osculum (fig. 9, *o.*) leads direct into a widely-expanded canal, the oscular tube, about 0·8 mm. in diameter. The walls of this canal present a series of well-defined circular ridges of fibrous tissue. Owing to the fact that the oscular tube does not run parallel with the plane of section, the section figured shows these fibrous ridges (fig. 9, *f. r.*) in transverse section in the upper portion of the tube, and in vertical longitudinal section in the lower portion. The ridges themselves do not necessarily run parallel with one another but may branch and anastomose. Each consists, for the most part, of a dense band of slender fibres (fig. 12) running round the oscular tube, and showing here and there elongated granular bodies, which I believe to be nuclei. The fibres themselves exhibit a very distinct, wavy outline, strongly calling to mind the appearance of ordinary white fibrous connective tissue. This fibrous band is covered on the outside by a layer of curious, granular, flocculent-looking tissue, the nature of which I do not at present understand (fig. 12, *f.*). I have little doubt that these rings of fibrous tissue around the oscular tube act as sphincter muscles, whereby the diameter of the tube is regulated. The concentration of the fibrous tissue in distinct annular bands is probably to be regarded as indicating a higher degree of differentiation than that which occurs in Ridleia, where the fibrous tissue forms a continuous sheath.

The Choanosome.—Owing to the lacunar character of the canal system the choanosome is much less dense and compact than in Ridleia. The amount of mesodermal tissue in proportion to the rest of the choanosome is also greater, and it exhibits numerous deeply staining, irregularly shaped cells (probably the amœboid cells) embedded in a coarsely granular and at the same time somewhat gelatinous-looking matrix (fig. 10, *m. c.*).

The Canal System.—We owe by far the greater portion of our knowledge of the arrangement of the canal system in

this Sponge to the researches of Dr. Vosmaer (loc. cit. supra), and I am able to do little more than confirm the results which he has arrived at.

As already stated, the canal system is lacunar. The scattered pores (fig. 9, *p.*) lead into expanded subdermal cavities (*s. c.*) lying between the tufts of spicules in the ectosome. These in turn communicate with a system of more or less lacunar inhalant channels in the choanosome. The inhalant lacunæ are separated from the exhalant lacunæ by strands of mesodermal tissue in which the flagellated chambers are embedded (fig. 10, *f. c.*). Many flagellated chambers communicate directly with one and the same inhalant or exhalant lacuna, but occasionally I have seen traces of what appear to be short and rather wide canaliculi (fig. 10, *a*). These would seem to be developed when the situation of the chamber prevents it from opening immediately into a wide canal or lacuna.

The chambers themselves are usually somewhat elongated, but their actual shape is a good deal affected by the state of contraction of the tissues. Good-sized examples measure about 0·045 mm. in length and 0·02 mm. in transverse diameter.

The exhalant channels open into branches of the oscular tube, whence the water is discharged through the osculum.

Thus it would appear that the canal system of Quasillina belongs essentially, as stated by Vosmaer, to his third type, while that of Ridleia belongs to his fourth type. I believe, however, that the canalicular and non-canalicular types of canal system cannot be sharply defined from one another, and that they will be found to pass by insensible gradations into one another.

General Conclusions.

The genera Ridleia and Quasillina are shown by their spiculation, skeleton arrangement, and general form to be closely allied, and it is not until we have examined properly prepared stained sections that we are able satisfactorily to

comprehend the points of distinction between them. We then see that they differ to such an extent in their minute anatomy that we cannot include them both in the same genus.

From the foregoing description it appears that the first exhibits the canalicular and the second the lacunar type of canal system; in Ridleia the inhalant and exhalant channels are canalicular, and the flagellated chambers are provided with special inhalant and exhalant canaliculi, while in Quasillina the inhalant and exhalant channels are for the most part lacunar, and the flagellated chambers open directly into them without the intermediation of narrow canaliculi. At the same time there is some evidence to show that these two types of canal system cannot be sharply defined from one another, and that flagellated chambers with, and others without special canaliculi may coexist in the same Sponge.

It is noteworthy that in Quasillina the chambers, although usually opening directly into the lacunæ of the canal system, are elongated in form like those of Ridleia, and not, as in the Halichondrina, where such a mode of opening is typical, spherical, or subspherical.

Both genera are remarkable for the development of the fibrous tissue. In Ridleia it is largely developed in the ectosome proper, and in the wall of the oscular tube, being arranged in well-defined layers of longitudinal and circular fibres. In Quasillina, on the other hand, it is almost entirely absent from the ectosome proper, but is well developed in the wall of the oscular tube, where it forms definite annular ridges in which the close-packed fibres (myocytes) have a distinct, wavy outline.

The mode of occurrence of the fibrous tissue in this and in other genera in which it occurs, indicates that its function is a contractile one, or, in other words, that the fibres are muscular fibres. The annular bands of fibres around the oscular tube of Quasillina are probably to be regarded as sphincter muscles.

The genus Quasillina has been recognised for a long time as a member of the sub-family Suberitidæ. It is, however,

a very aberrant one, and the new genus Ridleia forms a connecting link between it and the other members of its subfamily.

Probably Quasillina is to be regarded as a more highly modified form than Ridleia. I have already pointed out that the arrangement of the fibrous tissue in definite bands indicates a higher degree of modification than that which exists in Ridleia, where it forms more or less continuous sheaths, and the occurrence of the stylodragmata appears to me to be an adaptive modification resulting from the lacunar character of the canal system, and the general delicacy of the choanosome. Stylodragmata occur, so far as I am aware, in no other members of the group.

Professor Schulze, in his 'Report on the "Challenger" Hexactinellida,' and elsewhere, has expressed the opinion that the polyactinal type of spicule is the primitive form from which the monactinal type has been derived by abortion of the rays. Although in a previous paper[1] I upheld, for reasons therein given, the contrary hypothesis, I am now inclined to regard Professor Schulze's view as the more correct one.

It is, I believe, generally admitted that the swollen base, or head, of a typical Suberitid spicule, together with the corresponding enlargement of the axial thread, indicates the position where other rays were at one time united with that one which now alone remains. In the typical Suberitidæ, then, and in Ridleia, all rays but one have disappeared, but their former presence is still indicated by the head of the tylostylote spicules. In Quasillina the spicules are still more modified, and even the head has, in most cases, disappeared.

Judging, then, from the condition of the fibrous tissue and of the spicules, we should expect the canal system of Quasillina to be less primitive that that of Ridleia, and, in general, the lacunar type of canal system, as it occurs in the Monaxonida, with chambers opening directly into wide

[1] Dendy and Ridley, "On Proteleia Sollasi," 'Ann. and Mag. Nat. Hist.,' ser. 5, vol. xviii, p. 153.

lacunæ, to be less primitive than the canalicular type, in which the chambers are provided with special canaliculi. There is not sufficient evidence at present to show whether or not this is the case, but I think it not impossible that it may be so.

EXPLANATION OF PLATE XLII.

Illustrating Mr. A. Dendy's paper "Studies on the Comparative Anatomy of Sponges. I. On the Genera Ridleia, n. gen., and Quasillina, Norman."

FIGS. 1—7.—Ridleia oviformis.

Fig. 1. Entire Sponge, × 2. *o.* Osculum. *a a.* Flattened surfaces, by which the Sponge has probably been attached to pebbles.

Fig. 2. Longitudinal section, taken at right angles to the surface shown in Fig. 1, × 5. *o.* Osculum, leading into oscular tube; the black line indicates the distribution of the fibrous tissue. (The figure is rather diagrammatic; the canals radiating towards the centre are exaggerated.)

Fig. 3. Portion of transverse section, × 44. *ect.* Ectosome. *ch.* choanosome. *p.* Pore, leading into slit-like subdermal cavity. *e. c.* Exhalant canals converging towards the centre of the Sponge. *l. f.* Layer of longitudinal fibres cut across. *c. f.* Layer of circular fibres. *sp. b.* Bundles of small spicules projecting at surface. *l. sp.* Longitudinal bundles of spicules cut across. *i. sp.* Oblique fibres of spicules within the choanosome cut across. (A little diagrammatic.)

Figs. 4 and 5. Two of the larger tylostyli × 190.

Fig. 6. One of the small tylostyli × 500.

Fig. 7. Diagram of diplodal canalicular canal system, as it occurs in Ridleia oviformis, × 190. *i. c.* Inhalant canal, giving off narrow canaliculi to *f. c.*, the flagellated chambers, which communicate again by narrow canaliculi with *e. c.*, an exhalant canal.

FIGS. 8—12.—Quasillina brevis.

Fig. 8. Entire Sponge attached to a pebble, nat. size. (After Ridley and Dendy, 'Report on the "Challenger" Monaxonida.') *o.* Osculum.

Fig. 9. Part of longitudinal section passing through the osculum, × 23. *o.* Osculum. *p.* Pores. *s. c.* Subdermal cavities. *l.* Lacunæ of canal