XXIV.—*Description of some Sponges obtained during a Cruise of the Steam-Yacht 'Argo' in the Caribbean and neighbouring Seas.* By Thomas Higgin, F.L.S.

[Plate XIV.]

Last winter Mr. Reginald Cholmondeley, of Condover Hall, Shropshire, chartered the 'Argo,' a new steam-yacht of over 700 tons burthen, for a voyage to the West Indies, with the primary object of increasing his already fine collection of birds; but desiring to extend the advantages of the trip to the Liverpool Museum, he courteously invited the Committee to name a gentleman to accompany him as his guest on behalf of that institution; and the Rev. H. H. Higgins of Rainhill, so well known as an enthusiastic and devoted worker for and supporter of the Museum from its foundation, was selected for this complimentary and important work. The yacht left the Mersey early in January 1876, and returned in May following, having visited most of the West-India Islands, the coast of Central America, the southern shore of the Gulf of Mexico, Florida, and the Bahamas.

The sponges now described and figured form part of the valuable collection brought home by Mr. Higgins; and it is a matter of great satisfaction that in one of them, perhaps the most beautiful in form, an opportunity is afforded of naming it after him generically and thus connecting his name permanently with the expedition and its results, while it may express in a slight degree our sense of the obligations under which he has placed us by so many years of patient work at the Museum, and in the interests of natural history and science generally during his long residence in the neighbourhood of Liverpool. I shall commence, then, with the species *Higginsia coralloides*, which may be considered as typical of the genus *Higginsia*.

Higginsia coralloides, n. g. et sp. (Pl. XIV. figs. 1–5.)

General form flabellate, consisting of lobate compressed branches of irregular and luxuriant growth, united clathrously or continuously, rising from a short dense stem; surface deeply furrowed in a vertical direction, the ridges between the furrows being narrow and in the young growths serrated with tooth-like projections, passing in the older portions into rounded or tubercled prominences, thus giving the sponge (which now in its dried state is white) its peculiarly coral-like appearance.

The structure is a spiculiferous network of lozenge-shaped

reticulation, in which the spicules are held firmly in position by tough hardened sarcode, not generally enclosed in this horny material, but cemented together by it where they touch or cross each other, the fibre being echinated by smooth spicules which project from its interior into the interstices at various angles, and the surface hirsute. Spicules of two kinds—namely, smooth acerates forming the skeleton-structure, and spined acerates, chiefly confined to the sarcode and the surface of the sponge. The skeleton-spicule is a smooth, stout, curved acerate, whose ends are slightly bent outwards, measuring 0·025 inch in length by 0·001 inch in the middle, its strongest part (fig. 2), associated with which are fine slender straight acerates in small quantity, sometimes longer than the others, measuring only 0·0002 inch in diameter (fig. 3). The spicules of the sarcode are likewise acerate and only slightly bent, variable in size, but averaging in their largest forms 0·008 inch in length by 0·00025 inch in diameter in the middle, found generally throughout the sponge, but especially in the furrows of the surface, where they are congregated together in masses and lie in a horizontal position.

Size of specimen 7 inches in height, with a similar breadth; length of stem from basal attachment to first lateral projection $1\frac{1}{2}$ inch, diameter of stem 1 inch by $\frac{5}{8}$ to $\frac{3}{4}$, diameter of flabellate portion $\frac{1}{2}$ to $\frac{5}{8}$ inch.

Colour, in its present dried state, cream-white.

Loc. Carinage Harbour, Grenada, West Indies.

This beautiful sponge, which is the only example of the species in the 'Argo' collection, was obtained by the Rev. H. H. Higgins from Mr. Thomas G. Rowley of St. George's, Grenada, and is said to have been got by diving. As regards its skeleton, it is in excellent preservation and very perfect; but it has been carefully cleaned and consequently has lost much of its sarcode, together, probably, with many of the spined acerates, which in the living state existed in large quantities in the form of a matted surface-covering, since, as before stated, masses of them still remain in the furrows.

Although this sponge is the only example of the species in the 'Argo' collection, the genus is represented by other specimens in the Liverpool Museum, and also by several sponges from South Africa in the British Museum. In all cases the skeleton-structure is made up of smooth spicules, either of the acerate form only, or of acerates and acuates in varying quantities, more or less bent rather than curved in the centre; and the fibre is always more or less echinated, the spicule of the sarcode being in every instance a spined acerate.

All the specimens so far known are, with one exception,

flabelliform; and most are characterized by the presence of the tough horny material usual in sponges of this family. The individuals of the genus brought together from different localities resemble each other so much that the differences between them appear only sufficient to make them varieties of one and the same species. Those in the Liverpool Museum from the west coast of Africa, therefore, have had given to them a distinctive name having reference only to the locality whence they were obtained, whilst the one from the south-west of Ireland, though differing in form, has been regarded as the British representative of the genus.

Higginsia coralloides, var. *liberiensis*.

Two sponges possessing spicules similar to those of *H. coralloides*, but differing from it in size, colour, and texture, brought by Captain Davis from Cape Palmas, where they had been obtained by dredging, were presented to the Liverpool Museum some months ago by Mr. R. J. Keen, one of our most indefatigable collectors and contributors. They are fan-shaped, of the same growth and form as the Grenada sponge, but are of a dirty yellowish-brown colour, and the largest does not exceed 3 inches in height. The hardened sarcode, which holds together the spicules composing the skeleton-network of these sponges, is *not* of the same tough nature as that generally found in sponges of this order; and though the stem has the usual dense appearance, there is a comparative absence of the tenacity which is ordinarily a characteristic feature in the Echinonemata. The skeleton-spicule is a smooth bent acerate, measuring 0·026 inch in length by 0·0013; and the subskeleton-spicule is a straight, smooth, hair-like spicule of the same form, but of greater length; while the sarcode spicule is a spined acerate, sometimes gradually curved but oftener bent elbowlike in the middle, measuring 0·003 inch in length by 0·00025 at its thickest part.

Higginsia coralloides, var. *arcuata*.

This sponge, regarded as the British representative of the West-Indian species, was obtained by the Rev. H. H. Higgins whilst on a visit to the south of Ireland about three years ago, and brought home in spirits before any others of the same genus had come into the possession of the Liverpool Museum. It is not of erect growth, like the others, but was found growing on the rock in masses of about 2 inches in diameter by 1 to 1½ inch in thickness, of a fleshy nature and deep brown-red colour. The main lines of the skeleton-structure

consist of smooth, bent, acerate spicules extending vertically from the base, and connected by secondary lines at various angles, both being echinated with spicules; while the surface-covering consists of a thick layer of dark-coloured sarcode (shrunk much by drying), which is thickly strewn with small spined acerates lying in it confusedly in a horizontal position. The smooth acerates are 0·012 inch by 0·00025, and the spined acerates 0·0003 by 0·000143 inch respectively. Thus they are less than half the size of those of *H. coralloides*.

Loc. Bantry Bay, Ireland.

Colour dark brown-red.

Respecting the other known species of the genus, Mr. Carter states that "there are several specimens in the British Museum of a sponge which came from Port Elizabeth, in South Africa, that can only be considered a variety of *Higginsia coralloides*. They are flabelliform, compressed, clathrous, stipitate, composed of branches radiating from a hard stem, which, subdividing, anastomosing, and covered with short erect laminæ interuniting interruptedly between themselves, give to the whole a dendriform clathrous aspect. Colour reddish brown-yellow, almost white when washed out. Texture compact, hard. Spicules of two kinds, viz. echinating or flesh-spicule and skeleton or axial. The former small, acerate, and spined throughout; spines erect. The latter, or larger, of which there are two forms, viz. smooth curved or bent in the centre, acerate and acuate respectively, mixed with long sub-skeleton-spicules of the same form but straighter."

Higginsia would form a genus of Mr. Carter's group Pluriformia, in the first family of Echinonemata, namely *Ectyonida*.

Donatia parasitica, n. sp. (Pl. XIV. figs. 6–8.)

When examining *H. coralloides* for its spicule complement, the presence of globostellate spicules with conical pointed rays, and of smaller stellates with capitate spined rays, was always observed; and so constantly were these spicules found in greater or less quantity in every part of the sponge examined, that they might have been erroneously grouped with the spicules proper to it, had not Mr. Carter strongly expressed the opinion that they were probably only accidental and would prove to belong to a sponge similar to that noticed by him in connexion with *Polytrema* on a crab's claw (Ann. & Mag. Nat. Hist. 1870, vol. v. p. 392). A diligent search was therefore made, and the crevices of the nullipore were carefully examined; and at length a small laminiform sponge was found, which proved to be the species which had supplied the

stellate spicules to the erect sponge. Only one patch of this sponge, however, could be discovered, though it must have been abundant in the neighbourhood, and may have existed in quantity on the nullipore, but had been removed by cleaning; the one example of the species remaining, however, is so far uninjured and undisturbed that its original form and mode of growth can be easily observed.

It consists, in its dried state, of a thin layer of sarcode very densely charged with stellate spicules, whose rays are smooth, pointed or spino-capitate respectively (figs. 6 and 7), while the surface of the sponge bristles with the pointed shafts of erect, long, spinulate spicules arranged separately but near each other, with their large ends imbedded in the sarcode amongst the stellates. The spino-capitate rayed spicules are half the size of the smooth pointed or conically rayed ones, which measure rather more than 0·001 inch, rays included; and the spinulate spicules, which are subterminally inflated, are in their largest forms 0·02 or $\frac{1}{50}$ inch in length by $\frac{1}{3500}$ inch in diameter.

The spiculation of this sponge denotes its relationship to the Suberitida, in which family there is less hesitation in placing it since Mr. Carter has expressed the opinion (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 229) that the spiculous suborder of Carnosa, viz. Gummimida, will eventually be found to pass into the suborder Suberitida. Its forms of spicules respectively indicate a close alliance to those of *Tethya lyncurium* (Johnston), which is also sometimes found laminiform in growth; and therefore it must be regarded as a species of the genus *Donatia* (= *T. lyncurium*) constituted by the late Dr. J. E. Gray (Proc. Zool. Soc. 1867, p. 541).

As regards spicules a similarity also exists between this sponge and *Columnitis squamata*, Schmidt (Grundzüge einer Spongienfauna des Atlantischen Gebietes, p. 25, Taf. v. figs. 3, 4), which possesses a subterminally inflated spinulate spicule basally imbedded in sarcode, charged with globostellates with conically pointed rays, and with other stellates whose rays are abruptly terminated; but it is difficult from Dr. Schmidt's description and figures to recognize any essential difference between *C. squamata* and the British examples of *T. lyncurium*, which it resembles so closely in its spiculation and in the section of the cortical layer so well seen in Dr. Schmidt's fig. 3. This sponge, therefore, seems clearly to find its proper place in the genus *Donatia*.

Its spicules closely resemble those of Mr. Carter's sponge on the crab's claw, the stellates being exactly the same both in form and size; but the pin-like spicules of Mr. Carter's sponge

have ovate not subterminally inflated heads, and they are not much more than half the size of those in the specimen found in connexion with *Higginsia coralloides*, as I learn from a mounted fragment of the former kindly sent to me by Mr. Carter for comparison.

When looking for this sponge, small portions of another interesting species were found on the nullipore, to which some allusion has already been made by Mr. Carter in his observations on *Hymeraphia microcionides* (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 391). It has been seen only in very small quantity; but its remarkable spiculation renders a passing notice of it desirable. It is laminiform in growth, the thin sarcodous layer being full of spined quadriradiate spicules (fig. 9) closely packed together, amongst which are based long acuates erect, making the surface hirsute; no flesh-spicules. With it was seen a fragment of a variety of *Dercitus niger*, which Mr. Carter has also observed as often found in company with a boring *Cliona* (Ann. & Mag. Nat. Hist. 1876, vol. xviii. p. 410). His valuable guidance, too, in distinguishing species of obscure forms (communicated in his observations on the sponges dredged up on board H.M.S. 'Porcupine') having rendered the reading of the spiculation of genera so much more easy and plain than formerly, and also having so much facilitated the separation of different species found growing together, I have no doubt that Mr. Carter is right in regarding this sponge as a species of *Hymeraphia* with some characteristics of *Microciona*.

Halichondria birotulata, n. sp. (Pl. XIV. figs. 11–15.)

In the October issue of the 'Annals' (1876, ser. 4, vol. xviii. p. 315) Mr. Carter records some additional observations on the flesh-spicules of *Halichondria abyssi*, and refers to a sponge from the West Indies, of which several good examples now exist in the Liverpool Museum, about to be described under the specific name *birotulata*. The specimens thus alluded to form part of the 'Argo' collection.

Soon after the publication of Mr. Carter's description of *H. abyssi* (Ann. & Mag. Nat. Hist. 1874, vol. xiv. p. 245) some fragmentary portions of a branched littoral sponge of a dark brown-purple colour were brought from Jamaica by Capt. J. A. Perry, apparently very nearly allied to Mr. Carter's deep-sea species; and being new, efforts were made (unattended, however, with any success) to obtain whole specimens from that locality, the only example known being a very fine one in the possession of Dr. Allen of that island, from which the fragments of branches mentioned had been obtained. In the

mean time the Rev. H. H. Higgins had secured by means of a diver several examples of the species at Puerto Cabello, on the coast of Caracas, some of which he preserved in spirit, while the rest were brought home in a dried state. The acquisition of these specimens shows us the sponge growing under different outward forms, and affords the opportunity of careful examination of the species.

Its peculiar feature, as its specific name denotes, is the birotulate flesh-spicule hitherto only observed in *Spongilla* and some of the hexactinellid sponges, viz. *Hyalonema*. Although extremely minute, the form of this spicule is precisely that of the large one familiar to us in *Hyalonema*, from which it only differs in size and in the number of rays forming the umbrella-like heads. In his remarks (*loc. cit.*) Mr. Carter observes that the minute flesh-spicule in *H. abyssi* (considered by him to be the "embryonic form" of the large one with bent shaft) is a complete birotulate, "each dome-shaped or umbrella-like head of which is composed of twelve spines webbed together," exactly like that which is found in the West-Indian littoral sponges, in which, however, it only appears in the minute form, and in them, therefore, must be considered to be a maturely developed spicule.

In form *H. birotulata* is massive, lobate, with uniformly even but roughly reticulated surface, extending laterally into irregular lobes, or into long, procumbent, straggling, compressed branches, which unite where they touch and cross each other, or into numerous pyramidic erect prominences growing close together and united at the base, crumb-of-bread-like and of dark brown-purple colour. The skeleton-structure is an areolar multispicular network, the main lines of which extend from the base towards the surface, or in the direction of the long axis of the branch, gradually tending outwards and ending abruptly in lengths free for some distance from subsidiary fibre, and thus producing aculeate surface-prominences. The dermal sarcode, which is strengthened with a quantity of fine acuate spicules lying in it confusedly, has a dull glaze when dry; it is not pierced with numerous small pores, but the openings in it are all rather large, making it difficult to distinguish the incurrent from the excurrent orifices where the latter are not larger than the others. In the growing portions the dermal sarcode is supported on the projecting ends of the skeleton-fibre; but in the older parts the subdermal cavities have lost their surface-covering of sarcode, and the sponge thus becomes pitted or honeycombed in appearance. Thin sarcode densely charged with the peculiar flesh-spicule tympanizes the interstices of the network, dividing the mass

into the usual cavities, which cavities communicate with each other by means of the ordinary sphinctral openings in these sarcodic expansions. The skeleton-spicules are of two forms, namely a subcylindrical one, which is curved at the distance of one third of its length, sometimes found pointed at the long end so as to form a curved acuate, and a long fine straight acuate spicule not only associated with this, but found also in considerable numbers in the dermal sarcode. The subcylindrical spicule (fig. 12) measures 0·0068 inch in length by ·0003 at its thickest part; and the long fine acuate (fig. 13) is 0·01 inch long by 0·0002 inch in diameter. The flesh-spicule is of one form only, viz. a minute birotulate, each umbrella-like extremity of which is divided into twelve rays or ribs connected with each other and with the shaft by the usual falciform expansions (figs. 14 and 15), measuring 0·00053 inch in length, the diameter of the heads being 0·00016 inch and the diameter of the shaft one tenth of that of the heads. This minute flesh-spicule is liable to be passed over and its beauty and form unobserved; for the composition of the umbrella-like head is not *distinctly* seen with a lower power than a $\frac{1}{7}$th objective. Mr. Laurence Hardman of Rock Ferry, who kindly undertook to verify the counting of the number of rays or flukes, was fortunate enough to discover on the slide submitted to him a few rotulate extremities broken off from their shafts and lying flat on the cover, the form of which was beautifully seen under a $\frac{1}{20}$th. The finding of these heads in this convenient position rendered the counting of the rays easy, and enabled a correct drawing of an end view of one of them to be made (fig. 15).

Size. The specimens from the Spanish main are of the massive and pyramidic form. In the latter the erect growth is not more than 3 inches in height, with a base of from 2 to 3 inches in diameter; while among the massive forms, which cover pieces of coral, the largest specimen has a basal attachment of 6 to 7 inches, and extends laterally in an irregular lobe 5 to 6 inches. The branched form, known to us only by the specimen in the possession of Dr. Allen of Jamaica, is stated by him to extend to the distance of 2 feet from its root or base, the diameter of the branches not exceeding 1 inch by $\frac{1}{2}$ to $\frac{3}{4}$ inch.

Loc. Puerto Cabello, Caracas, and Bay of Kingston, Jamaica.

In the 'Argo' collection there are some specimens of a branched sponge from Nassau resembling the Jamaica example in outward form, colour, skeleton, and structure, possessing a skeleton-spicule of slender cylindrical form, but lacking

altogether the flesh-spicule. In them the horny element is rather more developed than in Dr. Allen's sponge, and it yet remains to be considered how far they are related to *H. birotulata*; they will therefore be more particularly referred to when the rest of the collection comes to be described.

EXPLANATION OF PLATE XIV.

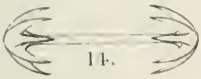
Fig. 1. *Higginsia coralloides*, half actual size, after a photograph by Mr. John Chard, Liverpool Museum.
Fig. 2. Smooth bent acerate skeleton-spicule of same, scale 0·001 to 0·0625 inch.
Fig. 3. Smooth straight acerate subskeleton-spicule of same, scale 0·001 to 0·0625 inch.
Fig. 4. Spined bent acerate surface-spicule of same, scale 0·001 to 0·0625 inch.
Fig. 5. Same spicule, scale 0·001 to 0·125 inch.
Fig. 6. Smooth conically spined stellate spicule of *Donatia parasitica*, scale 0·0002 to 0·083 inch.
Fig. 7. Spino-capitately rayed spicule of same, scale 0·0002 to 0·083 inch.
Fig. 8. Subterminally inflated spinulate spicule of same, scale 0·0004 to 0·0416 inch.
Fig. 9. Entirely spined quadriradiate spicule of *Hymeraphia* unnamed, scale 0·0002 to 0·0416 inch.
Fig. 10. Bent acuate spicule of same sponge, scale 0·0004 to 0·0416 inch.
Fig. 11. *Halichondria birotulata*, short branch, actual size, from a drawing by my daughter, Eva Higgin.
Fig. 12. Subcylindrical skeleton-spicule of same, scale 0·0004 to 0·0625 inch.
Fig. 13. Acuate subskeleton-spicule of same, scale 0·0004 to 0·0625 inch.
Fig. 14. 12-rayed birotulate flesh-spicule of same, five rays only at each end shown, to avoid confusion of lines; scale 0·0005 to 1 inch.
Fig. 15. End view of one of the umbrella-shaped extremities of same spicule, scale one 1900th to 1 inch.

XXV.—*On the Structure of the Lower Jaw in* Rhizodopsis *and* Rhizodus*. By R. H. Traquair, M.D., F.G.S., F.R.S.E., Keeper of the Natural-History Collections in the Museum of Science and Art, Edinburgh.

Among the detached and broken-up remains of the Coal-measure fish known as *Rhizodopsis sauroides*, one of the most frequently observed is a bone of a somewhat narrow and elongated form, truncated and somewhat expanded at one extremity, which may be assumed to be the anterior, and pointed at the other or posterior. One margin, nearly straight,

* Read before the Royal Physical Society of Edinburgh, Feb. 21, 1877.

11.



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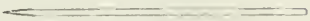
15.



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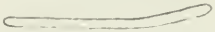

12.

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2. 3. 4. 5. 9. 8. 10. 7. 6.

R Mintern lith. Mintern Bros. imp.