## 7. Contributions to a General History of the *Spongiadæ*. By J. S. Bowerbank, LL.D., F.R.S., &c.—Part VI.

[Received April 4, 1874.]

(Plates XLVI. & XLVII.)

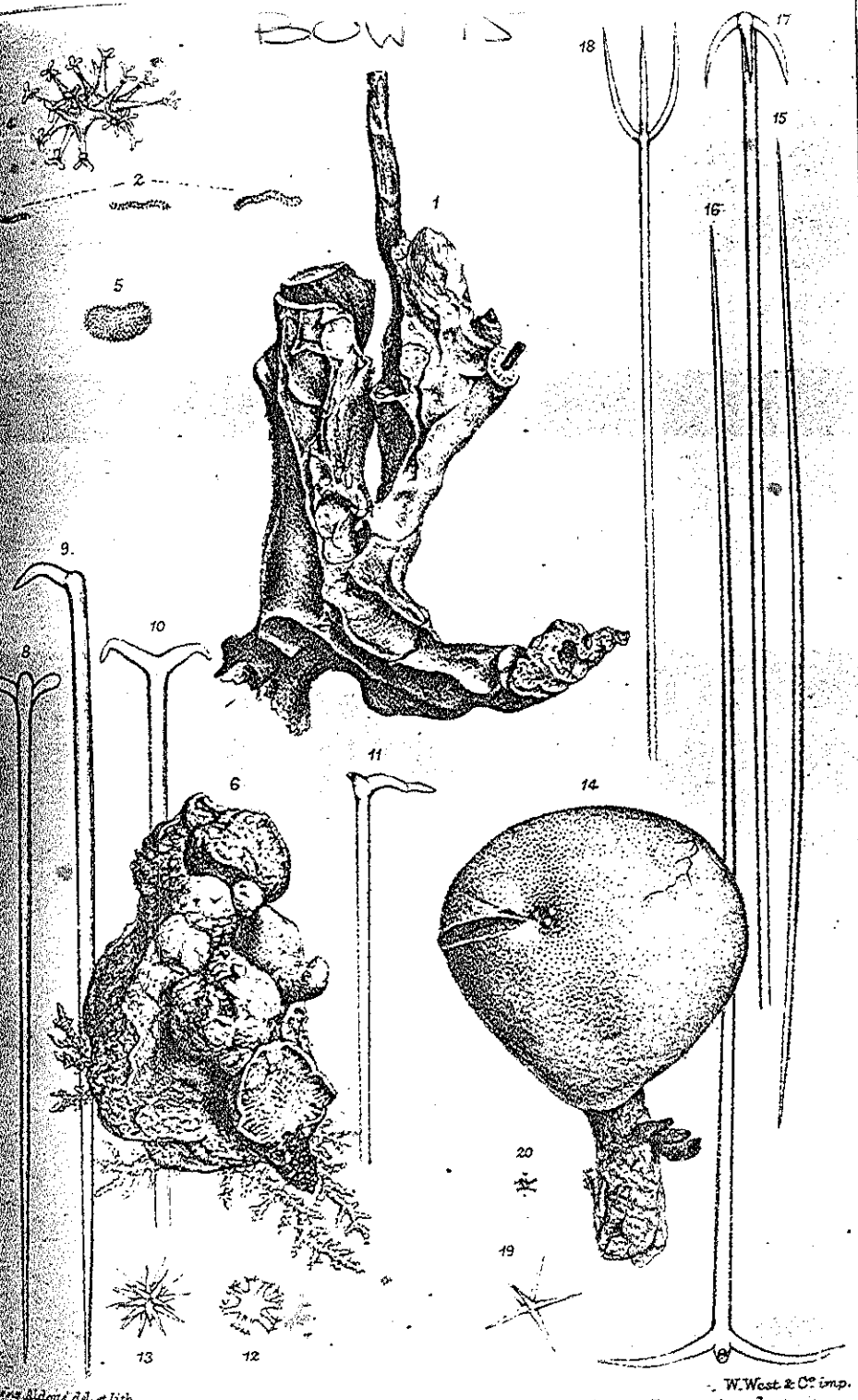
Geodia carinata, Bowerbank. (Plate XLVI. figs. 1–5.)

Sponge sessile, coating stems of *Gorgonia* or Fuci. Surface smooth, but furnished with numerous longitudinal carinæ. Oscula simple, dispersed, few in number. Pores inconspicuous. Dermal membrane thin and pellucid, furnished abundantly with multiangulated cylindrical spicula. Skeleton—fasciculi multispiculous, compact; spicula attenuato-spinulate, bases coincident. Interstitial membranes furnished abundantly with arborescent elongo-subsphero-stellate retentive spicula, variable in degree of development. Ovaria oval or kidney-shaped, component spicula slender and delicate. Surface-rete very minute.

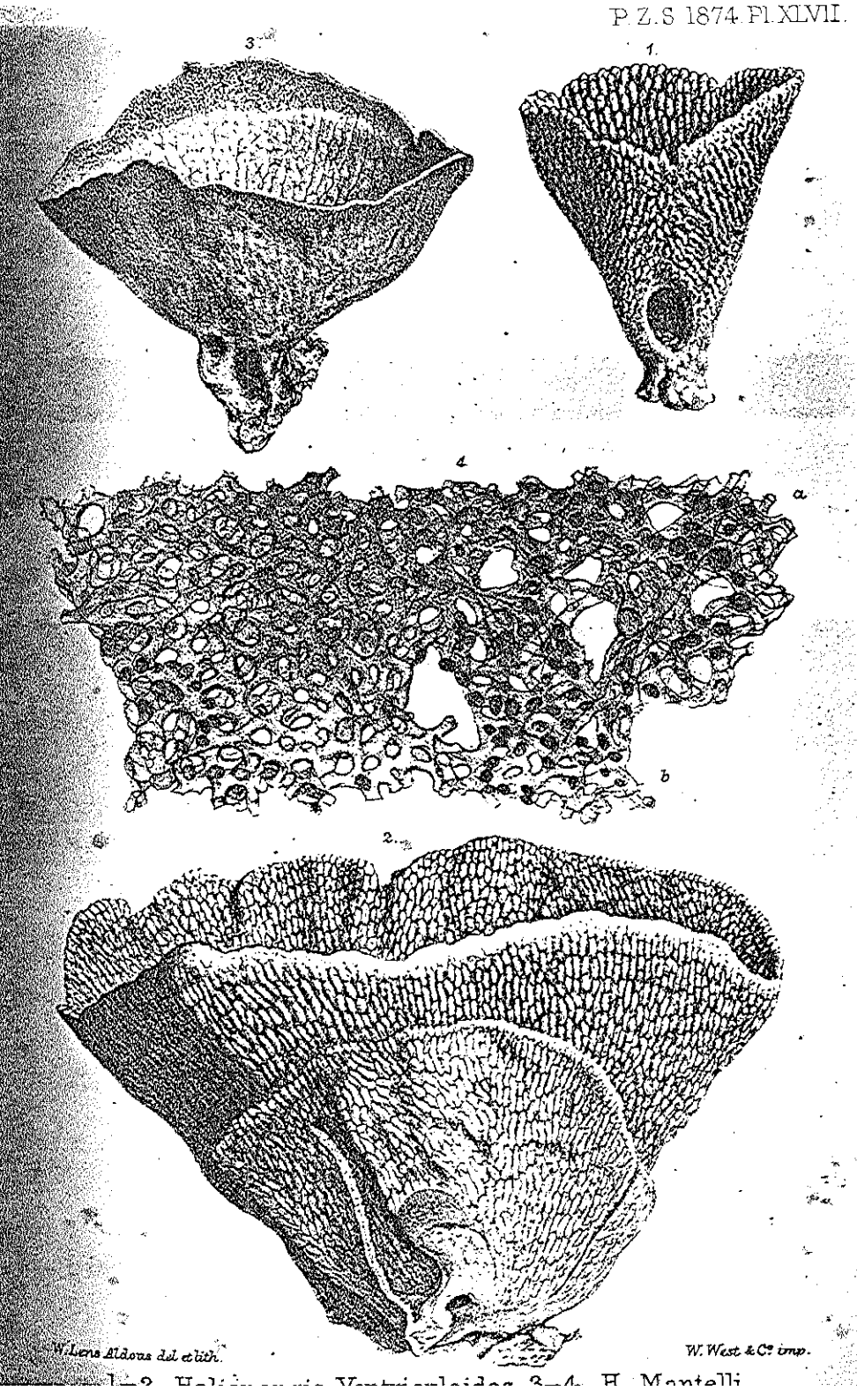
Colour in the dried state light fawn-yellow.
*Hab.* South Sea (*Mr. Thos. Ingall*).
Examined in the dried state.

I received the figured specimen of this singular species from my late friend Mr. Thos. Ingall in 1854, and I then described and named it in MS.; and subsequently the multiangulated cylindrical spicula of the dermis were described and figured in my paper on the "Anatomy and Physiology of the *Spongiadæ*," in the Philosophical Transactions of the Royal Society for 1858, p. 314, plate xxvi. fig. 10, and also the arborescent elongo-subsphero-stellate retentive spicula of the interstitial membranes in p. 308, plate xxv. fig. 19 of the same part for 1858. Shortly after I had examined and named the species I saw a similar specimen in the British Museum arranged among the Corals; and I stated to Dr. Baird that it was a sponge and told him the name I had assigned to it, and he forthwith removed it from the case and placed it among the Sponges. Subsequently I obtained a second specimen by purchase in the year 1864. The whole three specimens were similarly parasitical and very closely resembled each other in their external characters, and especially so in their singularly carinated striation. On taking sections at right angles to the surface of the sponge, I found that these elevated ridges were produced by the projection of lines of skeleton-fasciculi through the dermal crust of the sponge to immediately beneath the dermal membrane, but in no instance did they appear to perforate that organ. The greater portion of these carinated elevations were in a longitudinal direction; but occasionally short transverse ridges are found connecting the longitudinal ones with each other.

The dermal membrane is thin and pellucid, and when in a fine state of preservation it is literally crowded with innumerable minute




1–5, Geodia carinata. 6–13, G. imperfecta. 14–20, G. reticulata.




W. Lens Aldous del. et lith.

W. West & Co. imp.

1–2. Heliopora Ventriculoides. 3–4. H. Mantelli.

multiangulated cylindrical retentive spicula; they are so minute as to require a power of five or six hundred linear to render their forms distinctly to the eye. The number of angles in these spicula vary from two or three to six or seven; and in some cases the angulation is very distinctly and regularly produced.

From the thin coating nature of the sponge the skeleton-arrangement is not so readily demonstrable as in many other species of the genus. The fasciculi are abundantly spiculous and very compactly constructed. The bases of the spicula are all coincident and proximal, while all the apices are distal as regards the direction of the fasciculi.

The interstitial membranes are in many parts literally crowded with the arborescent elongo-subsphero-stellate retentive spicula, and they are also dispersed in considerable quantities amongst the ovaria in the dermal crust. These spicula are singular and very characteristic organs. The specimen figured is a very fully developed one. They vary in degree of development to a very considerable extent; and in some the central mass is very thin and elongate.

In the dermal crust of the sponge none but fully developed ovaria are to be found; but they are dispersed in considerable numbers on all parts of the interstitial membranes, and in every stage of development from an elongately oval loosely aggregated mass of very minute spicula to the compact and fully matured organ. The spiculous structure of these ovaria is very much finer and more minute than in any other species of *Geodia* with which I am acquainted.

GEODIA IMPERFECTA, Bowerbank. (Plate XLVI. figs. 6–13.)

Sponge massive, tuberous, sessile. Surface smooth. Oscula simple, minute, dispersed. Pores inconspicuous. Dermal membrane unknown. Skeleton—fasciculi rather loosely constructed; spicula subfusiformi-acerate, rather stout and short. Connecting spicula attenuato-patento-ternate; radii rarely perfectly developed, distal terminations recurved, not very numerous. Interstitial membranes—retentive spicula sphero-stellate with cylindro-subfoliate radii, numerous; and attenuato-stellate, variable in form, occasionally subsphero-stellate more or less. Ovaria oval, depressed.

Colour in the dried state cream-white.

*Hab.* South sea.

Examined in the dried state.

I obtained four specimens of this species from a dealer in objects of natural history; they are each attached to the basal portion of a specimen of *Oculina rosea* from the South Sea; the figured specimen is the largest of the four. The whole of them possess the same description of tuberous massive form; the smallest two did not exceed an inch in length by about half an inch in breadth. The oscula are so small as to require the aid of a lens of two inches focus to render them readily apparent. I could not find any remains of the dermal membrane on either of the specimens. The connecting-

spicula afford the most prominent specific characters of the species. The normal form is that of a regular attenuato-expando-ternate connecting spiculum, the three radii of which are as nearly as possible equal; but they are very rarely found in this state. Sometimes one or two of the terminal radii are absent or only partially developed, or one or more of them terminate hemispherically. If the radii are completely produced, their apices are mostly recurved or they assume various contortions. If I had had the type specimen only for examination, I might have imagined that these malformations and contortions of the radii were those of the individual only; but I carefully examined microscopically the other three specimens to see whether their spicula agreed in the imperfect development of the radii of the ternate connecting ones of the type specimen; and I found in all of them the same contorted or undeveloped condition of their radii that forms so striking a character in the type one.

The interstitial membranes are abundantly furnished with the two forms of stellate retentive spicula, which, from their structural peculiarities, afford very efficient specific characters. The sphero-stellate ones with cylindro-subfoliate radii are rather the more numerous of the two forms: they do not differ to any great extent in their diameter; a perfectly developed one measured extreme diameter $\frac{1}{1818}$ inch. The attenuato-stellate ones vary considerably in their amount of development; many of them have comparatively a small number of radii, and in such cases they are frequently subsphero-stellate: but this does not appear in the fully developed forms, where the radii are too numerous to be counted; a large one of this description measured extreme diameter $\frac{1}{1200}$ inch.

The ovaria are more or less oval and are depressed to a considerable extent; their length is frequently nearly twice that of their diameter. They are abundantly dispersed on the surfaces of the interstitial membranes, and may be seen in every stage of development, from a minute multistellate form to that of the adult ovarium.

GEODIA RETICULATA, Bowerbank. (Plate XLVI. figs. 14–20.)

Sponge massive, sessile. Surface smooth, minutely reticulated. Oscula small, congregated irregularly. Pores inconspicuous, evenly dispersed. Dermal membrane unknown. Skeleton—fasciculi compact, abundantly spiculous; spicula fusiformi-acerate, rather slender; connecting spicula attenuato-patento-ternate, stout and long, numerous, radii moderately long; and recurvo-ternate long and rather slender, numerous; also, rarely, porrecto-ternate long and slender. Interstitial membranes—tension-spicula fusiformi-acerate small and slender, often flexuous; retentive spicula attenuato-stellate very numerous, radii few; also cylindro-stellate, exceedingly abundant and very minute, radii rather numerous. Ovaria small, spherical, rather numerous.

Colour in the dried state cream-white.

*Hab.* Mexico (*Mr. Thos. Ingall*).

Examined in the dried state.

I received this sponge from my late friend Mr. Thos. Ingall, labelled "Mexico." It is firmly based on the remains of the stem of a fucus. The surface, to the unassisted eye, has a minutely reticulated appearance, arising from the closely disposed and exceedingly numerous porous depressions; but in the living state it would most probably be quite smooth. The oscula were congregated in an irregular group near the basal attachment; they are simple in structure and very small, the largest of them scarcely a line in diameter. The internal structure is remarkable for the abundant varieties of its spicula. The skeleton-fasciculi are composed of numerous, somewhat slender, fusiformi-acerate spicula; and the fasciculi are very much strengthened near the surface of the sponge by the incorporation in their substance of the shafts of the numerous connecting spicula, those of the patento-ternate ones frequently being nearly twice the diameter of those of the skeleton and considerably longer; both the patento-ternate and the recurvo-ternate ones are numerous; but the porrecto-ternate forms are of rare occurrence and are frequently very slender. The interstitial membranes are abundantly supplied with the two forms of retentive spicula, and especially so with the smallest of the two forms. A fully developed one, of the largest size, measured $\frac{1}{1000}$ inch extreme diameter; and two of the smaller description were $\frac{1}{3000}$ inch and $\frac{1}{4288}$ inch in diameter; and the latter one was not the smallest one in the field of view. The radii of the largest form were always acutely terminated, while those of smaller ones were truncated or slightly expanded at their distal terminations. The retentive spicula are very characteristic of the species, from their minuteness and great abundance on the interstitial membranes; while, on the contrary, the tension-spicula are comparatively of rare occurrence.

The ovaria are abundantly dispersed on all parts of the interstitial membranes in various stages of development.

HALISPONGIA VENTRICULOIDES, Bowerbank. (Plate XLVII. figs. 1 & 2.)

*Sponges from Otaheite*, Ellis and Solander's Natural History of Zoophytes, p. 206, tab. 59. figs. 1, 2, 3.

*Spongia otahitica*, Esper, vol. ii. tab. of Sponges lxi. (copied from Ellis and Solander).

Sponge cup- or fan-shaped, thin; pedicle short and stout. Surface rather prominently ridged or mammillated in lines radiating from the base to the distal margin, ridges or mammæ more or less elongated, margin of cup thick and rounded. Dermis retiform; rete abundantly arenulous. Oscula simple, minute, dispersed, few in number. Pores inconspicuous. Skeleton—primary fibres abundantly arenulous; secondary fibres rarely arenulous.

Colour in the dried state ochreous yellow.

*Hab.* South Sea, Otaheite.

Examined in the dried state.

The prevailing form of this species is the cup-shaped one, subject to a considerable amount of variation. The specimen represented by

fig. 2, Plate XLVII., is very regularly cup-shaped, but with the addition of a small fan-shaped offset from its base; and in a third cup-shaped one in my possession numerous thin fan-shaped ridges are projected from the outer surface, some of which are more than half an inch in height: and I have had several fan-shaped ones of very considerable dimensions: one in my possession is very little short of 14 inches in breadth; and many years since I gave a still larger one to the British Museum. A remarkable circumstance, which seems to prevail in the cup-shaped specimens, is that they all appear to have an orifice near the bottom of the cup, as represented in fig. 1, Plate XLVII.; but it does not always exhibit the same regularity; in the specimen represented by fig. 2, it is much larger and more irregular in form. The ridged or mammillated surface-structure is the same in every form or size of the species.

The dermal rete is a strong closely constructed network, so laden with particles of sand that the keratose-fibres are rarely to be distinctly seen. The oscula are situated on the mammæ or ridges of the exhalant or inner surface of the cup, and they are so minute as to be scarcely visible without the aid of a 2-inch lens.

The primary fibres of the skeleton are mostly disposed at right angles to the outer and inner surfaces of the sponge, and each fibre has usually a single closely packed series of arenaceous particles of nearly equal size; and the distal fibres of the skeleton may be frequently seen projected beyond the outer surface, each terminated with a single molecule of sand encased in a thin coat of transparent keratode. The secondary or internal connecting fibres are mostly destitute of arenaceous matters; a few short lengths of broken sponge-spicula are occasionally found embedded in them; their general line of disposition is at right angles to the primary fibres.

This species is especially interesting as exhibiting a very close alliance with Dr. Mantell's fossil species of *Ventriculites radiatus*, described and published in his work on the Geology of Sussex, p. 468, and figured in tables x., xi., xii., xiii., & xiv. of that work. The author instituted the genus *Ventriculites* for the reception of a series of fossil forms which were considered by him to be silicified *Alcyonia*; and in p. 168 he gives the following as its generic and specific characters:—

"*Generic character*.—Body inversely conical, concave, capable of contraction and expansion; original substance spongious (?) or gelatinous (?), external surface reticulated; internal surface covered with openings or perforated papillæ; base imperforated, prolonged into a stirps, and attached to other bodies.

"*Specific character*.—Infundibuliform; external integument composed of cylindrical, anastomosing fibres, radiating from the centre to the circumference; inner surface covered with perforated papillæ formed by the open extremities of short transverse tubuli; stirps fixed by radical processes."

The learned author accounts for the great variety of forms assumed by these animals as "partly attributable to the various forms of expansion and contraction in which the originals were introduced into the mineral kingdom, and partly to the mode in which their remains are occasionally preserved." With our present knowledge of the protean nature of the Spongiadæ, the great variety of forms exhibited by these fossils may be naturally and more readily accounted for than by imagining them to have possessed the power of contraction and dilatation; and the enveloping flint, which affords no indication of the form or structure of the enclosed sponge, is now known to be attributable to the ventriculite sponge having, in its living state, been covered by a parasitical species of sponge, the whole being subsequently fossilized as one body.



Specimens of Mantell's *Ventriculites radiatus* embedded in flint are by no means uncommon. If one of these exhibiting the natural surface of either the internal or external surface be immersed in a basin with water containing 10 or 12 per cent. of hydrochloric acid until the whole of the calcareous matter has been removed, and then, when dried, if it be examined by direct light with a linear power of about 50, the silicified fibrous structure will be frequently found in a beautiful state of preservation, and when compared with that of the recent sponge *Halispongia ventriculoides*, the fibrous tissues of the two are so much alike as almost to induce a belief that they belong to the same species under different circumstances.

I have two thin sections at right angles to the natural surfaces of a specimen of Mantell's *Ventriculites radiatus* from near the bottom of the cup embedded in flint; viewed by transmitted light with a power of 50 linear, they present precisely the structural characters we see in our recent *Halispongia ventriculoides*. There is the same arrangement of the fibrous structure, the primary ones abundantly arenulous; and the internal secondary ones are destitute of sand, and, what is strongly indicative of a close alliance, there are several fibres projecting from the external surface terminated by a single grain of sand as in the recent sponges; and the external surface of the fossil sponge is as abundantly arenulous as that of the recent one.

In Ellis and Solander's work there are neither generic nor specific descriptions given of the sponges figured; and Esper copies Ellis and Solander's figures and designates the specimen as *Spongia otahitica*. I do not see that this specific designation has any pretensions to stand; and I have therefore named the species *ventriculoides*, as more consistent with its ancient alliances, and as forming a bond of union with the very closely allied species of Mantell's *Ventriculites radiatus*.

HALISPONGIA MANTELLI, Bowerbank. (Plate XLVII. figs. 3 & 4.)

Sponge cup-shaped, thin; pedicel short. Surface, outer one smooth and even; inner one furnished with depressed ridges, radiating from the bottom of the cup to the distal margin; distal margin attenuated. Dermis retiform, abundantly arenulous. Oscula simple, dispersed, very minute, inconspicuous. Pores dispersed, visible by the aid of a 2-inch lens. Skeleton—primary fibres abundantly arenulous; secondary fibres rarely arenulous.

Colour light ochreous yellow.

*Hab.* South Seas.
Examined in the dried state.

The specimen figured is the only one that I have seen. I obtained it by purchase from a dealer, along with other sponges and specimens of *Oculina rosea* from the South Seas. The external characters of this sponge at once separate it from the nearly allied species *H. ventriculoides*. The outer surface exhibits but very faint traces of the primary radial lines of the skeleton that are so prominently exhibited in *H. ventriculoides*; and on the inner surface the radial lines are so much depressed as to be scarcely termed elevated. The retiform dermis is abundantly supplied with arenaceous particles of nearly uniform size. The oscula are nearly all obsolete; the few seen by the aid of a lens of two inches focus were minute simple orifices. The pores are readily to be seen by the aid of the lens; they are very numerous on the outer or inhalant surface of the sponge, and are equally dispersed on all parts of its surface. The primary lines of the skeleton are abundantly arenulous, the grains of sand usually forming a single series very equable in size.

The secondary skeleton-fibres rarely ever contain sand particles; but a few small fragments of siliceous spicula are occasionally seen in some of them, and they always appear to be disposed in accordance with the axis of the fibre. This species appears to be closely allied to Mantell's *Spongus Townsendi*, p. 164, tab. xvi. fig. 9, 'Geology of Sussex.' The only portion of the ventriculite sponge in Mantell's figure that is visible is the extremely thin distal margin of the sponge; and in this character it closely resembles our recent specimen. I have not been fortunate enough to meet with a good specimen of Mantell's *S. Townsendi*; but I have a portion of what is apparently one of them completely immersed in flint; and, as far as can be judged by a polished section at right angles to its surfaces, it is very similar in its structure to our recent specimen of sponge, and there is a total absence of the sinuous outline that would be exhibited by a similar section of a specimen of Mantell's *Ventriculites radiatus*.

## DESCRIPTION OF THE PLATES.

### PLATE XLVI.

*Geodia carinata*, Bowerbank.

Fig. 1 represents the type specimen of the species surrounding the remains of the stem of a large *Gorgonia*, natural size.
2. Three of the multiangulated cylindrical spicula from the dermal membrane, magnified 530 linear.
3. One of the attenuato-spinulate skeleton-spicula, magnified 123 linear.
4. A fully developed aborescent subsphero-stellate retentive spiculum from the interstitial membranes, magnified 530 linear.
5 represents one of the ovaria, magnified 250 linear.

*Geodia imperfecta*, Bowerbank.

Fig. 6 represents the type specimen, parasitical on *Oculina rosea*, natural size.
7. An average-sized subfusiformi-acerate skeleton-spiculum, magnified 80 linear.
8, 9, 10, 11. Varieties of the undeveloped or malformed attenuato-patento-ternate connecting spicula, magnified 80 linear.



Fig. 12. A fully developed sphero-stellate retentive spiculum with cylindro-subfoliate radii, magnified 530 linear.
13. A fully developed attenuato-stellate retentive spiculum, magnified 530 linear.

*Geodia reticulata*, Bowerbank.

Fig. 14 represents the type specimen parasitical on the remains of the stem of a fucus, natural size.
15. One of the fusiformi-acerate skeleton-spicula, magnified 80 linear.
16. A well-developed attenuato-patento-ternate connecting spiculum, magnified 80 linear.
17. A portion of one of the long and rather slender recurvo-ternate connecting-spicula, magnified 80 linear.
18. A portion of one of the porrecto-ternate connecting spicula, magnified 89 linear.
19. One of the attenuato-stellate retentive spicula, magnified 530 linear.
20. An average-sized cylindro-stellate retentive spiculum, magnified 530 linear.

### PLATE XLVII.

*Halispongia ventriculoides*, Bowerbank.

Fig. 1. A small but very perfect specimen of the species, with the remarkable orifice at the base of the sponge, natural size.
2. A well-formed cup-shaped specimen of the species, with a fan-shaped offset attached to its base, natural size.

*Halispongia Mantelli*, Bowerbank.

Fig. 3 represents the type specimen of the species, natural size.
4. A section of *H. Mantelli* at right angles to its external and internal surfaces, exhibiting the reticular structure of the skeleton with the embedded particles of sand at both surfaces: *a*, the external surface; *b*, the internal one: magnified 60 linear.

## 8. On a small Collection of Birds from Bulama, one of the Bissagos Islands, W. Africa. By R. BOWDLER SHARPE, F.L.S., F.Z.S., &c., Senior Assistant, Zoological Department, British Museum.

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I am indebted to Major Bulger for the opportunity of examining a small collection made by his brother Lieut. Bulger in Bulama Island; and as no one has before collected in the locality, I give a short list of the species. Major Bulger has sent me the following note on the locality whence these birds come, which I cannot do better than reproduce:—

"The Bissagos or Bijuga Islands lie on the west coast of Africa, between 11° 40′ and 10° 50′ N. lat., and 15° 30′ and 16° 30′ W. long., opposite the mouth of the river Bulola or Rio Grande. They form a group of about twenty islands, enclosed by a reef. Most of them are inhabited; but some are nearly bare rock, and only visited occasionally. The largest, Marshi, is above 15 miles long. The islands Carache, Corbele, Cazegut, Gallinas, Orango, Canyabac and Bulama are much smaller. On Bulama the English formed a settlement in 1792; but it was abandoned in 1793 on account of its un-