

from the Ceylon species; when dry they are zoned as in that species.

22. *Hirneola hispidula*, B. Ann. Nat. Hist. iii. p. 396 (no. 3).

A stipitate form which comes very near to *H. Wrightii*, B. & C., but the hymenium is strongly veined.

ERRATUM.

Vol. xv. p. 345, line 9, for "him" read "Fries."

XXXV.—*Report on a Collection of Marine Sponges from Japan, made by Dr. J. Anderson, F.R.S., Superintendent Indian Museum, Calcutta.* By H. J. CARTER, F.R.S. &c.

[Plates XII.—XIV.]

THIS collection of Japanese Sponges, purchased by Dr. J. Anderson, F.R.S., at Tsushima, and said to have come from "off Misaki, at the entrance to the Bay of Tokio (Yedo)," although small, is extremely interesting, on account of the little-known and new species which it contains. These consist of:—

Four species which belong to the order Hexactinellida in my classification, viz.: *Hyalonema Sieboldii*, Gray; *Farrea occa*, Bowerbank; *Periphragella Elise*, Marshall; and *Hexactinella ventilabrum*, n. sp., Carter.

One species of the group Lithistina, viz. *Racodiscula* (Zittel) *asteroides*, Carter.

Two of the order Psammonemata, three of Raphidonemata, one of Echinonemata, and one of Holorhaphidota, the latter a large fragment of a new species of *Pachastrella*.

Hyalonema Sieboldii, Gray.

As this species is so well known, all that need be said of it here is that there are twenty-nine stems, of which ten only have heads, and these of different sizes. Of the two largest, one is cylindrical with a flat top, 8 in. high and 6 in. in horizontal diameter; and the other, which is similar in form but a little smaller, scattered over with defined circular holes, respectively circumscribed by a white rim of condensed tissue, of various sizes under 1-12th in. in diameter, in each

of which is imbedded a parasitic isolated polyp—that is, without any stoloniferous connexion with its neighbours, and therefore unlike the *Polythoa* of the stem, which has a common sclerodermic union.

Farrea occa, Bk. (Pls. XII. and XIII. figs. 1–11.)

General form globular, stipitate, thick, shrubby, subsessile; structure originating in a short, round, hollow stem, about half an inch in diameter, which is extended below into an irregular, massive, root-like expansion, and divided above into two diverging branches, which, afterwards becoming subdivided repeatedly, form the head. Branches thick, short, cylindrical, hollow or tubular throughout, widely diverging at each division, about 5-12ths in. long by the same in diameter between the joints, dichotomously dividing repeatedly, as just stated, and more or less interuniting on the way; formed of an extremely thin and delicate reticulated wall or skeletal lamina which, in the upper part, is not thicker than the fibre of which it is composed, but rendered denser lower down, that is towards the base, by additional matter of a similar kind, that thus strengthens the support of the superstructure and causes this part to assume a whitish colour. Extremities of the branches open and dilated (Pl. XII.). During growth the termination of the branch, which is circular at first, becomes expanded upwards, then elliptical, and, finally, constricted or approximated in the centre, preparatory to division, when the same thing may be repeated and the divisions again divided singly; or one or both branches may unite with their neighbours respectively, when the result is a single tube that again divides dichotomously; and so on, till the whole head becomes formed of a series of short-jointed, hollow, dividing and interuniting branches, which thus gives rise to a clathrous structure of a globular form, as above stated. (The “branch” will hereafter be called “tubo-branch.”) Consistence firm, elastic. Colour translucent white. Pores in the dermal reticulation (Pl. XIII. fig. 11). Vents cloacal or general, *i. e.* consisting of the open ends of the tubo-branches, into which the smaller ones of the wall or sponge-tissue empty themselves. Surface of the tubo-branch outside uniformly even, covered by the pore-structure. Wall or skeletal lamina consisting of a cylindrical layer of reticulated, strong, glass-like fibre, in which the interstices are more or less quadrangular and oblong, the longest diameter being in the direction of the tubo-branch (Pl. XIII. fig. 1, *aaaa*), and the points of intersection marked on each side by a long, curved, spiniferous process or spur, which is directed upwards

(fig. 1, *b b*), thus supporting the sarcode or soft parts and its spicular contents, both externally and internally, that is on each side of the skeletal wall. Spiniferous process or spur about 15 to 25-1800ths in. long by 1 to 2-1800ths in. thick at the base; spines small, short, and broad, absent towards the fixed end. Interstices or meshwork generally presenting a tolerably regular aspect, but often just the opposite. Loose spicules of five forms, viz. :—(1) Sexradiate (dermal), with outer ray aborted or reduced to a mere globular tubercle, often surmounted by a single spine in the advanced form; shaft or internal ray straight and the four arms spread out horizontally, each somewhat curved towards the shaft, and all more or less inflated and abruptly pointed at the extremity; some plentifully and generally *microspined* (fig. 4, *a*), and others sparsely *macrospined* (fig. 4, *b*), the latter chiefly on the outer aspect; arms about 15-1800ths in. long, shaft about the same length, but all the rays varying a little in this respect, even in the same specimen, as well as the total size of the spicule itself. (The *macrospined* seems to be merely a sequence or advanced state of the *microspined* form.) (2) Acerate, straight, unsymmetrically fusiform, that is the outer or projecting part being thicker than the inner two thirds of the spicule, which is thus rendered long and whip-like; sharp-pointed at each end, spined at short intervals throughout, the spines long, smooth, and slender, respectively supported on bracket-like processes, which, being spirally arranged around the shaft, give it an irregular zigzag appearance, all sloping in the same direction, that is backwards or towards the sponge, at a very slight angle upon the shaft, whose outer or thickened end is extremely sharp, about 171-1800ths in. by 2-1800ths in. in its greatest dimensions, but very variable in this respect; longest spines, which are situated on the thickest part of the shaft, about 2-1800ths in. As this spicule necessitates a long description, and is common to almost all the Hexactinellida, I shall hereafter allude to it under the name of "barbula" (fig. 3 and fig. 8). (3) Nail-shaped, consisting of a long straight shaft, which is slightly inflated and pointed at the free end and expanded horizontally at the other into a circular head more or less spined at the circumference; shaft *microspined*, especially about the free end, which is slightly inflated and pointed, averaging in total length about 20 1800ths in.; head about 1½-1800ths in. horizontally (figs. 5, 5, and 7, *f*). This spicule is so very abundant and presents itself under so many different forms, that it might be as well to enumerate them serially thus:—(fig. 7, *a*) that in which the head consists of a simple, smooth, elongated, ovular,

narrow, club-like inflation of the shaft; (fig. 7, *b*) the inflation becomes enlarged towards the upper part, a tubercle is developed at the summit, and an indistinct row of small spines around the widest portion; (fig. 7, *c*) the tubercle passes into the form of an umbo, the row of spines into a projecting coronal structure, cut off by hour-glass contraction from the lower part of the inflation, over which are developed several other small spines which assume a more or less subsidiary coronal arrangement at the upper part; (fig. 7, *d*) the umbo disappears, and the summit becomes simply convex or dome-shaped, while the spines of the coronal structure still more project, are increased in size and reduced in number, the spines of the constriction below have also disappeared, and the upper part of the once simply inflated head is now found to be capped by the new development or corona; (fig. 7, *e*) finally the coronal spines may be greatly increased in size and reduced even to *four* only, the original ovular inflation still more constricted in the centre and its upper part devoted to the support of the four spines. Of course there is every intermediate form to be seen, from the simple, elongated, ovular inflation to the head with four simple spines, but "*c*" and "*d*" appear to be the most common. For this spicule, which also requires a lengthy description and is probably common to the Farreas, I would propose the name of "*clavula*." As with the dermal sexradiate, so with the *clavula* here, and indeed the *barbula* also, the development of the *macrospined* appears to be but a sequence of the *microspined* or simply smooth form. (But this is only what occurs generally throughout the development of a sponge-spicule, as I have long since stated, viz. "first the simple form and then the ornamentation.") (4) The rosette; sexradiate, consisting of four straight arms without central inflation, terminated respectively by four divergent rays around a central one; rays smooth and simply pointed, or more or less capitate and microspined, varying in number in each instance; average diameter of entire spicule, *i. e.* the rosette itself, about 15-6000ths in. (fig. 6 and fig. 9, *ab*). (5) A smaller sexradiate with all four arms equally developed; arms straight, pointed and spiniferous, issuing from the centre, which at first is not inflated, at equal angles to each other; variable in size, under 8-1800ths in. in diameter, and a variety of the foregoing (fig. 2, *ab*, and fig. 10). The dermal sexradiate no. 1 is chiefly confined to the surface, where, through the overlapping of its horizontal arms, it forms a quadrilateral lattice-work whose interstices are tympanized by the dermal sarcode in which the pores are situated (fig. 11). No. 2, the *barbula* (fig. 3), frequently projects more or less through the lattice-

work, when its large sharp end, with the long spines sloping backwards, presents a formidable appearance. No. 3, the clavula (figs. 5, 5), is chiefly gathered together in bundles of six, more or less, around the shaft of the dermal sexradiate, with their heads *en groupe* projecting a little above the knob which represents the aborted ray; or they may be scattered singly along the overlapping arms of these spicules (fig. 11, *a*). No. 4, the rosette (figs. 6 and 9), is plentifully distributed throughout the sarcod, about the skeletal fibre, and among the spicules generally, but with what arrangement in particular, if any, I have not been able to discover, saving that grouped together in the "mounting" they often appear to present a polyhedral structure. No. 5 (figs. 2 and 10) appears to be entirely confined to the thickening or additional structure at the lower part and base of the specimen, where its incorporation seems to lead to the short-jointed, radiato-reticulated, smooth fibre of which this is composed. Here it may be seen in its separate and thus perfect state, in the interstices, often attached by the end of *one* arm to the main fibre, and often end to end with one of its own like, by cementing siliceous material derived from the same source as the fibre, which is thus on its way to incorporate the whole, and therefore more or less obscures the original spiniferous character of the arm; while the skeletal fibre itself, which is *smooth*, at the same time that it is moulded upon the rest of the spicules (chiefly the dermal sexradiates), which thus become axially incorporated with it, presents in its entirety the quadrilateral form above described. Size of specimen 5 in. high by $6\frac{1}{2} \times 3\frac{1}{2}$ in. horizontally in its greatest dimensions. Tubo-branch 5 to 6-12ths in. in diameter; throughout about 5 to 6-12ths in. long between the divisions or joints, dichotomously dividing, until the whole specimen reaches the dimensions above given, which, on account of the extreme ends or growing parts having been broken off, must, as the fragments with the specimen prove, have, when entire, exceeded its present measurements by 2 or 3 inches.

Hab. Marine.

Loc. Japan; off Misaki, at the entrance to the Bay of Tokio (Yedo).

Obs. Ever since I saw and examined the skeletal fragments of *Farrea occa* in the detrital root-mass of *Euplectella cucumer*, then in the possession of the late Dr. Farre, now in the British Museum, I have been desirous of seeing an entire specimen of *Farrea occa* with the sarcod on, so that I might not only know exactly what the general form was, but the forms also of its loose spicules.

The latter I thought I had obtained when I got the deep-sea specimen dredged by H.M.S. 'Porcupine,' at the entrance of the English Channel, which is described and illustrated in the 'Annals' of 1873 (vol. xii. p. 17, pl. i. figs. 1 and 7); but being entirely overgrown by the fleshy sponge, *Corticium abyssi*, it was found, when extricated from this mass, to be entirely devoid of its originally loose spicules, saving some which had become incorporated with the skeletal, glassy fibre itself, among which was the scopuline spicule "Besengabel," represented by Schmidt as partly characteristic of his *Farrea facunda* (ib. pl. xvi. fig. 6, and Atlantisch. Spongienfauna, 1870, Taf. i. fig. 18).

Since then, or until the present time, when I received the above-described specimen from Dr. Anderson, which, although dry, has in many parts the dermal sarcode still on, I have not had my attention called to the subject, and hence the absence in this specimen of the "Besengabel" and every other form of scopuline spicule, together with the presence of the clavula, points out to me that it is a *Farrea*, although not *F. facunda*—therefore, in all probability, that species from which the skeletal fragments in the detrital root-mass of *Euplectella cucumer*, called by Dr. Bowerbank "*Farrea occa*," had been derived. It is remarkable, too, if not significant, that the clavula is present without the scopula in Saville Kent's "*Aulodictyon Woodwardii*" (Monthly Microscop. Journal, Nov. 1870, pl. lxiv. p. 249).

As I possess, from the root-mass of *Euplectella cucumer*, specimens of all the representations given by Dr. Bowerbank as illustrative of *Farrea occa*, in his "Monograph of the Siliceous Sponges" (Proc. Zool. Soc. 1869, pl. xxiv. figs. 1-7), and not only that, but am now acquainted with the sponges to which they respectively belong, I can confidently state, that his "fig. 1" is a fragment of *Dendrospongia Steerii*, Murie (Trans. Linn. Soc. ser. 2, Zool. vol. i. p. 219, tab. 36); "figs. 2-6," spicules of the genus *Samus*, Gray (Proc. Zool. Soc. 1867, p. 526), or, at all events, "4-6;" and "fig. 7," only, belongs to *Farrea occa*, whose skeletal fibre is smooth and spurred on both sides at the points of intersection of the quadrilateral structure, which, with the spurs a little worn down, I therefore assume to be *Farrea occa*, as I have before shown that Dr. Anderson's specimen cannot be *Farrea facunda* on account of the absence of the "Besengabel." Whether the fragments in the root-mass of *Euplectella cucumer* did or did not belong to *Farrea facunda*, there is no evidence to say, and thus I am free to apply the name of "*Farrea occa*" to Dr. Anderson's specimen.

The grouping of the heads of the *clavule* around the knob which represents the aborted outer ray of the dermal sexradiate, together with the lattice-work itself formed by these spicules (fig. 11), recalls to mind Dr. J. Millar's discovery of this kind of arrangement in the dermal structure of *Euplectella cucumer*, faithfully represented from one of Dr. Millar's own preparations which he gave to Dr. Bowerbank (Proc. Zool. Soc. 1875, p. 503, pl. lvi.); only that here it is the rosette which is brought to the surface and projected upon the point of the outer ray of the dermal sexradiate, which, instead of being aborted, as in *Farrea occa*, is fully developed. See also Prof. Schulze's representations of this ('Challenger' Reports, Sponges, Hexactinellidæ, *Euplectella aspergillum*, pl. A. figs. 3, 4, and 5). Lastly, there appears to have been something like this in the fossil species *Callodictyon angustatum*, Hinde, and *Porochonia simplex*, T. Smith, if not also in the two foregoing species (Hinde's Catalogue Foss. Sponges in the Brit. Museum, 1883, pl. xxx. figs. 4 b and 5 b).

As regards the general structure of *Farrea occa* there can be no doubt that it belongs to the family of Euritidæ, whose tubo-branched structure is faithfully represented in my illustration of *Eurete farreopsis* ('Annals,' 1877, vol. xix. pl. ix. fig. 1), which is taken from a photograph of the natural size of the specimen, but in such a position as to show the openings and structure of the tubo-branches, through which the basal structure or stem is necessarily concealed from view. Etymologically, the term "*Eurete*," *par excellence*, applies to the wall of *Farrea occa*; but its consisting only of a single skeletal layer together with the absence of a scopuline spicule (Besengabel) and the presence of the *clavula*, causes it to differ.

Again, the measurements of the spicules in the vitreous Hexactinellida are so variable that it is almost impossible to arrive at any that are satisfactory, on account of the addition of the siliceous slime to their exterior which is continually going on preparatory to their becoming incorporated with the skeletal fibre, after the manner of the spicules in the Keratose sponges; but whereas in the latter the contrast immediately renders them recognizable, the vitreous fibre, being of the same composition as the spicule, defies all attempt at separation in the recent specimen.

Lastly, the siliceous slime leads to the formation of skeletal fibre, which has its own specific character, as in the present species, viz. *Farrea occa*, in which it is smooth, while in the following species, viz. *Periphragella Elisæ* and *Hexactinella ventilabrum*, it is spiniferous.

Delicate as these spun-glass-like Hexactinellida appear to be, their resistance to destruction is very remarkable, owing to the toughness which is imparted to the silica by the presence of the albuminous element and the intricate union of their reticulated fibre, so that, while the thinner superstructure even of *Farrea occa*, when reduced to a single layer, is much tougher than it looks, the base, thickened with the additional matter, becomes almost unyielding. Hence, probably, these parts of *Farrea occa* alone are left in much-worn specimens at the bottom of the sea, and thus constitute the fragments which are often brought up in "swab" dredging without the superstructure.

Such resistance to destruction and the reparation of the most delicate parts which are essential to the life of the organism often indicate the presence of a preservative power which is far greater than we think, but how it should be so under the circumstances is utterly beyond our comprehension. Perhaps some might say that this pertinacity of vital force has been acquired by long progress in a certain direction, upon the principle of "vires acquirit eundo;" but then, how did the *first* impetus come about?

I should also add that this specimen of *Farrea occa* had been infested by a minute parasitic Hydroid, whose delicate stoloniac ccenosarc, together with its small sessile polypites, had thickly spread in and over the outer surface; but at present it is so hard and shrunken from desiccation that, beyond the presence of thread-cells and the general form, there is no possibility of arriving at more specific characters. Lest the dark round points in the illustration (Pl. XII.) should be mistaken for holes or vents, it should be mentioned that they represent the polypites of the Hydroid.

Periphragella Elisæ, Marshall.

Club-shaped, stipitate, hollow, cup-like, with extended base of attachment; slightly bent upon itself; wall thick, composed of tubo-branched, anastomosing, often dividing, labyrinthic, clathrous structure, whose interstices within form fenestral openings in the sides of the excavation, and whose outer part, especially in the lower portion, passes into a much smaller tubo-reticulated structure of the same kind, which, becoming diminished in size towards the surface, terminates there in still smaller branches, whose ends are free and open; stem round, short, descending upon an expanded, wide, arched, irregular, flat foot below, and above into the structure mentioned; the open state of the terminal branches of the smaller tubo-branched structure is apparently *natural*, from

similar defined circular apertures about 1-12th in. in diameter existing on the surface of the stem, close to the commencement of the structure below, where, by thickening of the tissue, all but the extreme ends of the branches have become imbedded, which thus look like vents; excavation deep, narrow, and conical towards the bottom, where it occupies the centre of the stem, fenestrated on its surface, as above described. The upper part of the specimen having been much worn away (for it had been dragged out of greenish sandy mud for preservation, where, being dead, it must have been buried for some time previously), I am unable to state how the *excavation* and its surrounding tubo-branched structure terminated *above*, but probably in the same characteristic form and with open mouths as in the smaller structure below. Consistence firm and elastic. Colour, pore-structure, and small excretory canal-system, that is of the fleshy part, when the specimen was fresh, probably the same as in the Euritidæ, together with the large excretory system, which consists of the tubo-branched canals terminating cloacally in open mouths on the outside of the excavation or surface of the specimen. Main fibre of the tubulated lamina reticular, consisting of a more or less quadrangular oblong network, in which the longest diameter of the interstices is in the direction of the tube, strengthened or thickened on each side by a less regularly reticulated growth, of which the smaller tubulated structure is almost entirely constructed, the more regular network being confined to the larger tubulation in the upper part of the head. Skeletal fibre reticulated sexradiately, not inflated at the joints, microspined throughout, formed upon small regular sexradiates, which may be seen in its interstices preparatory to becoming incorporated. Sexradiate spicule consisting of six fully-developed arms, straight, inflated, and abruptly pointed at the end, microspined throughout, especially over the end, averaging 34-6000ths in. in diameter, but very variable in size, owing to the thickening preparatory to incorporation. Three other forms of loose spicules, viz.: 1, the barbula, as already described and illustrated under *Farrea occa*; 2, scopuline spicule or "Besengabel," of which I have only met with one instance, and that only of the four capitate branches or rays of the head, the rest being incorporated with the skeletal fibre, whereby it had been thus retained, since, as usual in such buried specimens, all the *loose* spicules have disappeared; 3, the rosette (that only exists in one part of the foot which presents the freshness of life), sexradiate, without central inflation, arms straight, smooth, each supporting five rays, more or less, of which four

are divergent around the central one, which is also straight; rays microspined, straight and pointed, or florally arranged and capitate, the whole rosette about 15-6000ths in. in diameter, but variable in size, the smallest being those in which the rays are most numerous, florally arranged, and capitate. As the dermal sexradiate, together with its structure *in situ*, has, of course, been destroyed, the former is only met with here and there in the body-structure, where, as usual, it is characterized by the external ray having been reduced to a mere tubercle. Size of specimen (not including the expanded base, which, after having been much reduced in size by fracture, is still $3\frac{3}{4}$ in. in its longest diameter) $4\frac{1}{2}$ in. high. Stem 1 in. long by 7-8ths in. in diameter close to the head, increasing downwards towards the foot; head about 4 in. high by $3\frac{1}{2}$ in. in diameter at its upper part, diminishing in this respect towards the stem; excavation 4 in. deep by $1\frac{1}{4}$ in. wide at the brim; fenestral openings of the clathrous structure, which surrounds it, varying a little below $\frac{1}{3}$ in. in diameter.

Hab. Marine.

Loc. Japan; Misaki, at the entrance to the Bay of Tokio (Yedo).

Obs. Having long since received, through the kindness of Dr. W. Marshall, of Leipzig, a copy of his description, photographed representation, and forms of the spicules of his *Periphragella Elise*, in the Imperial Museum at Leyden, originally obtained at the Moluccas (*Zeitschrift f. wiss. Zool.* xxxv. Bd. Suppl. p. 177, Taf. xii. B, and xiv. figs. 26-31), together with a type specimen of the spiculation itself on a slide, I have no hesitation whatever in identifying with this species the above specimen from Japan; sufficient, together with its general form, having been extricated from it for this purpose. The characteristic globular heads of the rays on the scopuline spicule, with their short angular spines, are retained in the half-incorporated fragment to which I have alluded; and the barbula, although much reduced, like the rest of the structure, by that process of disintegrating dissolution which attacks these glassy sponges after death, is easily recognized.

Periphragella Elise, in its general form, differs from most specimens of the Euritidæ in the presence of a cup-like excavation in the midst of the tubo-branched structure, together with diminution in size of the branches of the latter towards the outer and lower parts of the head, and in its spicular forms, chiefly by that of the scopula or "Besengabel," which up to this time is peculiar in this respect.

It is, like the rest of the Euritidæ, analogous to the Kera-

tose sponges, in which the branches are tubulo-digitate and open at the ends, as in the tubulo-digitate *Chalinæ*; also, although in a minuter form, to the clathrotubular structure of the Calcareous sponges *Clathrina*, and the carneous *Hali-sarca lobularis*.

Hexactinella ventilabrum, n. sp. (Pl. XIV. figs. 1-10.)

Specimen, a large undulating somewhat compressed bowl, with irregularly plicated sides, approximated towards the ends and into a keel below; very thin wall and contracted sub-stipitate point of attachment; $7\frac{1}{2}$ inches high, 13 inches long horizontally and 8 inches across the most open or central part of the brim, which is rendered very irregular by its deep sub-plicate undulations; sides chiefly approaching each other towards the ends, which, not being actually united, are thus rendered rimous; base keel-shaped, owing to the angular approximation of the sides at the bottom, descending sub-funnel-shaped to the stem, which is excentric, about $1\frac{1}{2}$ in. in diameter, spreading out afterwards for attachment. Consistence firm, vitreous. Colour transparent white. Surface on both sides even and uniform; uniformly scattered over internally with circular apertures about $\frac{1}{12}$ in. in diameter and about the same distance apart (Pl. XIV. fig. 1), and externally with a dermal, quadrilateral, spicular reticulation, in the interstices of which the sarcode, although dry, is preserved (fig. 2, a). Vents on the inner side of the bowl, viz. the "apertures" just mentioned (fig. 1). Pores in the sarcode tympanizing the interstices of the dermal reticulation, about 1000th inch in diameter, more or less (figs. 2 and 9). Wall about 1-6th in. thick, composed of two layers, viz. one on each side of an irregular central plane of condensed tissue; each layer consisting of plumose fibre curving upwards and outwards florally from the central plane to the respective surfaces, strengthened by transverse fibres in their course (figs. 3 and 8); the whole, when the flat surface is placed between the observer and the light, presenting a fibrous, vertical, linear reticulation, formed by condensed tissue in the interior. Loose spicules of seven forms, that is including the skeletal fibre (fig. 4, a-g), viz.: 1, dermal sexradiate, with outer ray aborted and reduced to a round knob; arms and shaft gradually diminishing towards the free ends, which are abruptly pointed; knob and rays microspined throughout (fig. 4, g); ray about 25 by 2-1800ths in. in its greatest dimensions, but variable. 2, the barbula (see Pl. XIII. fig. 3). 3, smooth acerates, more or less flexuous from their

thinness; here and there stouter, when the usual sexradiate central inflation, which is characteristic of the hexactinellid spicule, may be detected on them (fig. 4, *e*); fine form about 50 by $\frac{1}{5}$ -1800ths in. in its greatest dimensions (fig. 4, *f*); stouter form about 60 by 1-1800ths in. (fig. 4, *e*). 4, scopuli-form spicule or scopula consisting of a smooth shaft, attenuated and sharp-pointed at the free end, furnished at the other with 2, 3, or 4 (usually 2 in this specimen) slightly divergent rays, diminishing in size outwards, but ending abruptly, that is without terminal inflation or head, thickly microspined throughout; spines towards the free ends recurved; total length of spicule 33-1800ths in.; ray about 5-1800ths in. long, but both very variable in this respect (figs. 4, *c*, and 5). 5, rosette, sexradiate, arms smooth, straight, radiating at equal angles from the centre, without inflation of the latter, terminating in five rays more or less, which are long, divergent, and pointed for the most part, but sometimes capitate (fig. 6, *a*), or more or less numerous and always capitate, arranged florally (fig. 6, *b*), the former accompanied by short and the latter by longer arms; or in a small variety the arms may be thick and elongated into a point without rays, but with four or more comparatively long spines on each arm, outwardly directed; size about 20-1800ths in. in diameter (fig. 7). 6, internal or skeletal sexradiate, much the same as the dermal form, but with all the arms equally developed; very variable in size (fig. 4, *b*, and fig. 10). 7, skeletal fibre, microspined, irregularly sexradiate, chiefly built on the foregoing spicule (fig. 4, *a*). No. 1 is for the most part confined to the dermis, where the arms, overlapping those of the neighbours, give rise to a quadrilateral reticulation, whose areas are frequently again divided into four triangular spaces by a sexradiate of the same kind situated in the centre (fig. 9); interstices throughout tympanized by the dermal sarcode in which the pores are situated. No. 2, the barbula, is scarce. No. 3 (fig. 4, *f*) in bundles, characteristically plentiful, especially in the dermal structure in its finer form, while the stouter one is chiefly found in the interior with nos. 4 and 5 (the scopula and the rosette), intermingled with the skeletal fibre, which is chiefly built on nos. 1, 3, and 6. Size of specimen given at the commencement.

Hab. Marine.

Loc. Japan, Misaki, at the entrance of the Bay of Tokio (Yedo).

Obs. This is an instance in which not only the general form but the internal structure so closely resembles *Phakellia ventilabrum*, Bk. (Mon. Brit. Spong. vol. iii. pl. xxii.), that, but

for the fibre being glossy and the spicules hexactinellid, while the fibre of *Phakellia ventilabrum* is keratose and the spicules "monactinellid," the two are almost identical, further illustrating the fact that there is a unity of plan in the Spongida as regards general form, whatever the nature of the material of construction may be.

On account of the addition of the central sexradiate to the quadrilateral areas of the dermal reticulation (fig. 9), the interstices of the latter become divided into triangular spaces very much like those of *Esperia*, which, together with the poriferous tympanizing sarcode, thus gives it a similar beauty; while the presence of the sarcode with the pores still existing in it, although dry now, shows that the specimen was taken *alive* and preserved with much care afterwards.

I have often thought with reference to the open state of the pores under such circumstances that—after having shown in my "Ultimate Structure of *Spongilla*" ('Annals,' 1857, vol. xx. p. 25, pl. i. figs. 6 and 7), that the "investing membrane" or dermal sarcode is composed of plastic nucleated cells, and that it is by their partial separation and alteration in form that the pores are alternately produced and closed—it might be asked how the pores are maintained in an open state during desiccation. In reply to which it may be stated that these plastic units, which in fact are the epithelial cells, are, like *Amæbæ*, so exceedingly slow in their movements that, under desiccation, they pass into a homogeneous dry membrane before they have time to go very far in the alteration of their form, and thus the pores remain open; thus too the cilia of the spongozoa is often preserved.

The fact of the pores in this species opening directly into large channels of the excretory canal-system whose vents are immediately opposite, *i. e.* on the other side of the wall (Pl. XIII. figs. 1, 2, and 9), recalls to mind what occurs in *Teichonella labyrinthica* ('Annals,' 1885, vol. xv. p. 119, pl. iv. fig. 7) in this respect, that is the nutritive particles which pass through the pores do not go on to the spongozoa (Geisselzellen) of the ampullaceous sacs, direct.

The presence of the smooth acerates, no. 3 (fig. 4, *e, f*), is, so far as my knowledge extends, a peculiarity in the Hexactinellida; at the same time they appear to me to be very like the smooth early form of the *barbula*, which also occurs in bundles of this form at an early period, as well as afterwards in their fully developed state. The uncapitate rays of the scopuliform spicule furnished for the most part with only two is also new to me *in situ*; while the only other case in which I have met with this form is in my mountings of the dust

from the detritus of the root-mass of *Euplectella cucumer*, which came from the Seychelles, in which it is very plentiful. It is equally unusual, too, to find a scopuline spicule in a form like that of *Hexactinella ventilabrum*.

Racodiscula (Zittel) *asteroides* (Crtr.).
(Pl. XIV. fig. 11, a-g.)

Form massive, thick, short, cylindrical, excavated cup-like, divided below into three or more root-lobes, which have been cut off, thus reducing the height to $3\frac{1}{2}$ in., with a maximum breadth horizontally of $2\frac{3}{4}$ in.; excavation conical downwards, about $2\frac{1}{2}$ in. deep, commencing in a closed, round, pointed end below, expanding upwards into an irregularly oval aperture above, about $1\frac{3}{4}$ by 1 in. in its greatest dimensions; wall about $\frac{3}{8}$ in. thick at the brim, increasing downwards as the wall of the excavation recedes from the surface. Consistence compact, heavy. Colour sponge-yellow-grey. Surface even. Pores not seen. Vents numerous, chiefly opening into the bottom of the excavation, also scanty and very large here and there on the surface, unless the latter be worm-holes. Spicules of four forms, viz.: 1, minute, elliptical, elongate, subdiscoid, microspined, about 3 by 1-6000ths in. in its greatest dimensions (fig. 11, d, g); 2, minute acerate, curved, fusiform, gradually sharp-pointed, thickly microspined all over, about 11 by $\frac{2}{3}$ -6000ths in. (fig. 11, c, f); 3, large acerate, comparatively long, smooth, curved, fusiform, also gradually sharp-pointed, 83 by $\frac{3}{4}$ -1800ths in. in its greatest dimensions (fig. 11, e); 4, tetractinellid spicules of the skeleton, which commence in a nail-like discoid form on the surface, consisting of a short pointed shaft and horizontal circular head of extreme thinness, in the centre of which may be seen the trifid central canal, indicating the number of branches into which it subsequently becomes transformed (the smallest seen measuring about 1-200th in. in diameter, fig. 11, a, b), then becoming (as it grows larger) irregular in form, curvilinear in outline, and finally trilobate; after this elk-horn-like and branched; finally filigreed at the ends of the branches, when that of the shaft or fourth arm also grows out into this form, and the whole interlocking on all sides with their neighbours, thus become inextricably mixed together, but never connected by direct union (for there is no glossy fibre here). Interlocking portions when fully developed rather diffuse than circumscribed or globular, as they are in some species. At this time this spicule may be at least 1-50th in. in diameter each way (or 35-1800ths of an inch), with all

four arms smooth, but of course very variable. Nos. 1 and 2 are chiefly confined to the dermal sarcode, where, in great abundance, they cover the nail-like disks, inside which, among the branched forms of the staple spicule, the acerates no. 3 appear in bundles, finally becoming lost inwards or only sparsely present as the staple spicule becomes developed into its ultimate or interlocking form. For analogous transitional forms of development into which the simple disk (fig. 11, *a, b*) passes on its way to produce the entire spicule I must refer the reader to my delineations of *Discodermia papillata* &c. ('Annals,' 1880, vol. vi. pl. viii. fig. 48, &c.), as there is no room in my plate for a repetition of this here.

Hab. Marine.

Loc. Japan, Misaki, at the entrance of the Bay of Tokio (Yedo).

Obs. This is the species to which Zittel has given the name of "*Racodiscula*," illustrated by the "trilobate" form of the staple spicule, together with some of the long acerates, broken off at the ends, as they generally present themselves in a fragment mounted in balsam in its natural state, together with some of the minute ellipsoids (Abh. d. k. bayr. Akad. ii. Cl. Bd. xiii. 2, 1878, p. 151, Taf. i. fig. 8, and 'Annals,' 1878, vol. ii. p. 480), which came from a vasiform thick-stemmed specimen about $4\frac{1}{2}$ in. high, $4\frac{1}{2}$ in. across the brim, and 3 in. deep in the excavation, also obtained from Japan. The presence of the minute ellipsoid makes it differ from all the species from the Gulf of Manaar whose respective spiculations I have illustrated ('Annals,' 1880, vol. vi. pl. viii.); but the transformation of the surface-disk into the branched and filigreed, staple, tetractinellid spicule is the same, whereby it can be seen that the trilobate form given by Zittel as illustrative of his genus "*Racodiscula*" is of no specific value, nor is the long acerate spicule no. 3 (fig. 11, *e*), which is found in many species and which Prof. Sollas discovered and first pointed out in the fossil genus *Siphonia* (Quart. Journ. Geol. Soc. Nov. 1877, p. 808, pl. xxvi. figs. 5 and 5*a*); but in no instance, I believe, have the minute spicules nos. 1 and 2, together with the earliest discoid forms of the tetractinellid (which led to Bocage's designation "*Discodermia*" in the recent species), been discovered *in situ* in the fossilized specimens, being too delicate probably to survive this transitional ordeal. The general form and structure of Dr. Hinde's *Trachysycon nodosum* ('Catalogue of Fossil Sponges in the British Museum,' 1883, pl. xii. figs. 3 and 3*b*) very much resembles the species above described.

Of the remaining specimens which belong to my order Psammonemata and the spiculiferous Keratosa respectively it might be observed *imprimis* that all appear from their sarcodeless state to have been gathered off a beach, and they consist of:—

1. Psammonemata.

A single specimen, which is thick, flat, and massive, composed of stiff amber-coloured keratose fibre, presenting small penicilliform sandy tufts or tags on the surface in the midst of a quantity of clear reticulated lateral tissue of the same kind.

Also an insignificant specimen of *Polytherces*, D. et M. (*Hircinia* transformed by *Spongiophaga communis*), which has overgrown some mussel-shells.

2. Rhaphidonemata.

One specimen of a solid, digitate, branched form of *Chalina* like *C. polychotoma*, but in which the spicule, instead of being acerate, fusiform, and sharp-pointed, as is usually the case, is acerate, curved, cylindrical, and round at the ends, sausage-like, about 1-300th in. long (Pl. XIV. fig. 12).

This is of much interest, because I have lately received from Mr. B. W. Priest a fragment of a similar species in which the spicule is of the same form but four times larger, and said to have come from the Mauritius (fig. 13), since it closely approaches both in general form and in that of the spicules the freshwater sponge "*Uruguayia*" from South America, in which no statoblast has yet been found ('Annals,' 1881, vol. vii. p. 100, pl. vi. fig. 17), thus favouring the opinion of some that such sponges at least have had a marine origin. For this variety I would propose the name of *Chalina polychotoma*, var. *mauritiana*. Like *Uruguayia coralloides*, too, the Mauritius specimen presents its spicule in several stages of development, but *none* are *microspined* like those of that species, and it has a minute acerate flesh-spicule.

Four specimens of *Tuba lineata*, var. *flabelliformis*, D. et M., vasiform, with appressed sides, wherein the spicules of the fibre, which are of the usual form, viz. acerate, fusiform, smooth, curved, and sharp-pointed, are scanty, while the keratose element of course predominates. Hence their tough consistence and brown colour.

Two other specimens of a similar kind, but more open, in which the same form of spicule *predominates* instead of the

keratose element, which is thus scanty; hence they are softer, not near so tough, and of a light grey colour, which causes them to resemble the open vase-like form called by Dr. Bowerbank "*Isodictya infundibuliformis*" (Mon. Brit. Spong. vol. iii. pl. liv.); but not being the same, it might, for distinction's sake, be termed "*Tuba poculum*."

3. Echinonemata.

One branched specimen, compressed throughout, with the ends flat and expanded, and the spicule of one form only, viz. stout, acuate, arranged in tufts on the surface over a dense interior. Colour brown. Species undescribed.

4. Holorhaphidota.

A portion only of a *Pachastrella*, $2\frac{1}{4}$ in. in its longest diameter, but which, being new, is sufficiently interesting for the following brief record of its spiculation, which consists of a very large acerate body-spicule, whose natural length amounts to 1-6th in. (Pl. XIV. fig. 14, *a* and *g*), a large quadriradiate zone-spicule (fig. 14, *b*) and a crust of minute microspined acerates, mixed with a few still more minute sceptrellæ and spinispirulæ, one form passing into the other (fig. 14, *c*, *d*, and *e*, *f*). The body-spicule radiates in bundles from a common centre; and the quadriradiate, whose shortest arm is directed inwards, has the other three rays spread over the surface among the small microspined acerates &c. Thus the spiculation very much resembles that of *Pachastrella amygdaloides* ('Annals,' 1876, vol. xviii. pl. xiv. fig. 22, &c.), only that the radiate spicule in the present instance has four instead of three arms; while the absence of the minute stelliform spicule, although the spiculation otherwise resembles that of a *Stelletta*, that is the large acerates are confined to the body and the quadriradiates to the surface &c., induces me to propose for it the name of "*Pachastrella stelletodes*." For measurements of the spicules I must refer the reader to the illustrations in which fig. 14, *a-d* are drawn to the scale of 1-48th to 1-1800th inch, *e* and *f* being enlarged views of *c* and *d* respectively, and *g* the natural length of the body-spicule.

EXPLANATION OF THE PLATES.

PLATE XII.

Farrea occa, skeleton of. From a photograph, about the natural size, of the specimen.

N.B.—The round black points represent the polypites of a parasitic Hydroid.

PLATE XIII.

N.B.—Figs 1-6 are drawn to the scale of 1-24th to 1-1800th inch, to show their relative proportions. The rest are, for the most part, more magnified views of the same, to show their detail.

Fig. 1. *Farrea occa*, fragment of skeletal fibre from the upper part of the specimen. *a a a a*, main fibre; *b b*, spurs, whose punctate surface is intended to indicate that they are for the most part covered with short spines; *c c*, ends of spurs supposed to have been broken off close to the base.

Fig. 2. The same. Fragment of skeletal fibre from the base of the specimen, showing—*a*, fibre; *b b*, small sexradiates.

Fig. 3. The same. The *barbula*, on whose surface the spines of the upper third *only* are represented.

Fig. 4. The same. The dermal sexradiate. *a*, *microspined* form; *b*, *macrospined* form.

Fig. 5. The same. The *clavula*, *in situ*.

Fig. 6. The same. The *rosette*.

Fig. 7. The same. A series of more magnified views of the head and shaft of the *clavula*, to show its transitional conditions from *a*, the simple, smooth, club-shaped, ovular form, to *b*, enlargement of the upper part of the inflation, incipient tubercle on the summit, and incipient row of spines across the body; *c*, development of tubercle into an umbo and the row of spines into a coronal form projecting beyond the surface of the body; inflation becomes constricted just below the crown, and the lower part roughened by spines, which often present a subsidiary coronal arrangement above; *d*, the umbo disappears, leaving a smooth, convex, dome-shaped summit, the coronal spines decreased in number but increased in size, the constriction between the two parts of the inflation increased and the spines on the lower portion gone; *e*, the coronal row of spines reduced in number to four, which are much increased in size and situated at the cardinal points of the upper part of the inflation, which, in this view, is seen to be devoted to their support or to the head, while the constriction which separates it from the lower part of the inflation that passes into the shaft is still more pronounced; *f*, the lower two thirds of the shaft, magnified upon the same scale, to show its terminal but pointed inflation and spinous surface. (All these representations are magnified to the scale of 1-12th to 1-6000th inch, to show their relative proportions.)

Fig. 8. The same. Fragment of the *barbula*, much magnified, to show the form and arrangement of its spines.

Fig. 9. The same. More magnified view of the *rosette*, showing the two

forms of rays in the same figure, viz. *a*, the pointed, and *b*, the capitate rays. For the sake of perspicuity only two or three of the rays are delineated.

Fig. 10. The same. More magnified view of the sexradiate of the basal structure.

Fig. 11. The same. Portion of the dermal structure, magnified upon the scale of 1-48th to 1-1800th inch, showing the sexradiate dermal spicules, the heads of the *clavulae* around the aborted external ray and the pores, all *in situ*. *a*, single *clavula*, occasionally seen along the line of reticulation.

PLATE XIV.

- Fig. 1.* *Hexactinella ventilabrum*, n. sp. Fragment of the inner surface, to show the vents. Natural size.
- Fig. 2.* The same. Fragment of outer surface, showing the dermal reticulation and subjacent apertures in the body-substance leading to the vents. *a*, portion covered by the dermal structure; *b*, portion from which it has been removed. Nat. size.
- Fig. 3.* The same. Vertical section of the wall, to show its plumose structure. Nat. size. All diagrams after nature.
- Fig. 4.* The same. Group illustrative of all the spicular elements, drawn to the scale of 1-24th to 1-1800th inch, to show their relative sizes. *a*, main fibre; *b*, sexradiate of the interior; *c*, scopula; *d*, rosette; *e*, hexactinellid acerate of the interior (stout form); *f*, the same of the dermis (finer form); *g*, sexradiate of the exterior or dermis. Diagrammatic after nature.
- Fig. 5.* The same. Scopula with three rays, much magnified.
- Fig. 6.* The same. Rosette, much magnified, showing—*a*, form with long simple pointed rays, sometimes capitate; *b*, with short rays, always capitate. Only two or three rays to each arm delineated, for the sake of perspicuity.
- Fig. 7.* The same. Another form of the rosette often met with. (Figs. 5, 6, and 7 drawn to the same scale.)
- Fig. 8.* The same. Vertical section of wall, magnified about four diameters, to show character and direction of the plumose fibre.
- Fig. 9.* The same. Fragment of dermal structure, to show reticular arrangement of the sexradiates and situation of the pores.
- Fig. 10.* The same. Sexradiate of the interior, more magnified, to show that its arms are spiniferous.
- Fig. 11.* *Racodiscula asteroides*. Spiculation of surface, magnified to the scale of 1-24th to 1-1800th inch. *a*, upper view of disk, showing the three arms of the central canal, which indicate the forthcoming upper three branches of the tetractinellid or staple spicule of the structure; *b*, lateral view of the disk, showing the spine on its under surface, indicating the position of the fourth branch; *c*, small microspined acerate; *d*, minute elliptical body or spicule; *e*, large smooth acerate; *f*, more magnified view of "*c*"; *g*, more magnified upper and lateral views of "*d*" respectively.
- Fig. 12.* *Chalina polychotoma*, var. *mauritiana*. Spicule of Japanese specimen.
- Fig. 13.* The same from the Mauritius specimen, together with a more curved form. (Figs. 12 and 13 magnified to the same scale, viz. 1-48th to 1-6000th inch, to show their sizes relatively.)

Fig. 14. *Puchastrella stelletodes*, n. sp. *a*, large smooth body-acerate; *b*, quadriradiate spicule of surface; *c*, small microspined acerate of the crust or surface; *d*, minute sceptrella (all magnified to the scale of 1-48th to 1-1800th inch); *e*, small microspined acerate, and *f*, sceptrella, respectively more magnified, to show their detail; *g*, large smooth body-acerate of the natural length.

XXXVI.—On three new Species of *Gonepteryx* from India, Japan, and Syria. By ARTHUR G. BUTLER, F.L.S. &c.

IN a collection from the North-west Provinces recently presented to the Museum by J. F. Duthie, Esq., I find an interesting new species of the genus *Gonepteryx*.

To those lepidopterists who regard the whole genus as consisting of one extremely variable and widely distributed species this unexpected novelty will doubtless be nothing more than another example of what they inaccurately call local varieties; to me it is a local form, and therefore a true species of the only kind existing in the Lepidoptera. I propose to call it *G. carnipennis*.

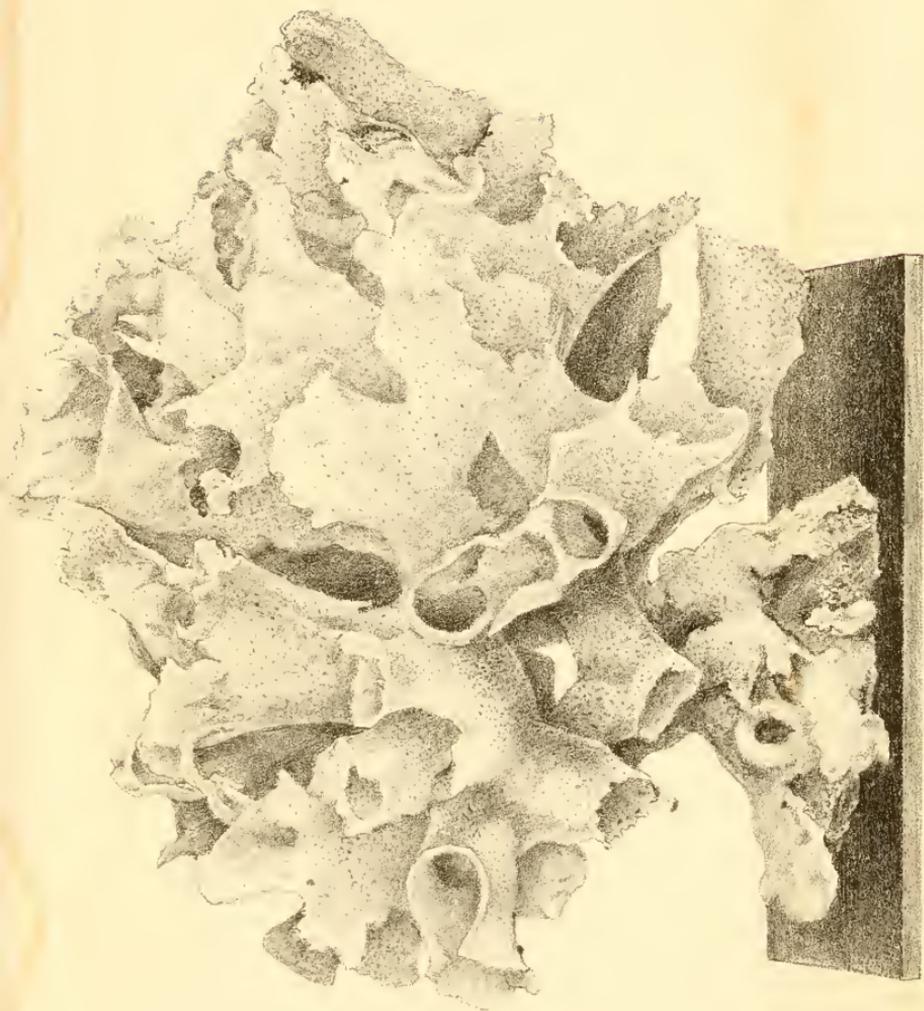
G. carnipennis belongs to the *ramni* group; and before pointing out how it differs from its two nearest allies, *G. ramni* of Europe and *G. nepalensis*, I may mention that I have before me specimens of the following species:—

G. ramni, *G. nepalensis*, *G. cleopatra*, *G. maderensis*, *G. cleobule*, *G. farinosa*, *G. aspasia*, and *G. zaneka*, besides two other species which are at present unnamed in our collection and hitherto undescribed.

Gonepteryx nepalensis was originally separated from *G. ramni* by Mr. G. R. Gray as a mere variety of the latter; but subsequently, in the 'Genera of Diurnal Lepidoptera,' p. 71, it was named by Edward Doubleday. Neither of these gentlemen, however, mentioned any character by which it could be distinguished from *G. ramni*. The following synopsis will readily separate the three species:—

a. Wings above in male yellow, in female greenish white.

1. Wings of both sexes with ill-defined marginal brown points; upper surface of male of a deep sulphur-yellow colour; secondaries of female decidedly greenish; wings below with *costal area of primaries and whole of secondaries decidedly greenish*. *G. ramni*. Europe.



nat. size.

