excellently described and figured by Professor Lilljeborg, of Upsala*, there is no difficulty in making a satisfactory comparison. This specimen was first named by Lilljeborg *Balænoptera robusta*; but it constitutes the type of the genus *Eschrichtius* of Gray—a designation which has been adopted by its discoverer in his subsequent and more detailed description above referred to. It was found in a field, imbedded partly in sand and partly in clay, at a depth of from 2 to 4 feet from the surface, 10 or 15 feet above the present sea-level, and 840 feet from the shore, in conjunction with shells of *Mytilus edulis* and *Tellina balthica* of precisely the same appearance as those now met with in the Baltic—indicating a period when the general physical features of the sea were as at present, though anterior to the elevation of the island to its present level.

In size the Cornish specimen was slightly inferior to the Swedish, the length of the mandible of the one being 7 feet 6 inches, of the other 7 feet 11½ inches (English); the remaining bones bear a corresponding proportion. The entire length of the Swedish skeleton was estimated at between 45 and 50 feet.

A single cervical vertebra, in a mutilated condition, cast ashore in Babbicombe Bay, Devonshire, in 1861, has been referred by Dr. Gray† to the same species; and Mr. Cope considers that a jaw-bone preserved at Rutger's College, New Brunswick, N.J., may belong to it‡.

These are the only known instances of the occurrence of this whale, which, if extinct, must have become so at a comparatively recent period. Its systematic position is of much interest, as it certainly cannot be placed in either of the three principal genera into which the existing whalebone-whales arrange themselves, viz. *Balæna*, *Megaptera*, and *Balænoptera*, but is in some respects an annectent form, though with certain peculiarities of its own.

XLVIII.—*Notes on the Classification of the Sponges.*

By Dr. J. E. Gray, F.R.S. &c.

In the 'Proceedings of the Zoological Society' for May 9, 1867, I published some notes on the arrangement of sponges, and descriptions of some new genera—in which I divided the genera into sections, orders, and families.

In the present paper I propose to make an alteration in the

* "On two Subfossil Whales discovered in Sweden," Nova Acta of the Royal Society of Sciences at Upsala, ser. 3. vol. vi. 1867; also Recent Memoirs on Cetacea (Ray Society), 1866, p. 278.

† Catalogue of Seals and Whales in the British Museum, 1866, p. 133.

‡ Proc. Acad. Nat. Sc. Philadelphia, 1868, p. 194.

general arrangement of the families, which is the result of a continued study of the sponges and of the various books and essays that have been written upon them.

I have thought it well to propose this arrangement, leaving the details of the genera for naturalists who are younger and have better eyes than I have or am likely to have at my advanced age.

In the 'Annals and Magazine of Natural History' for 1868, vol. i. p. 165, I did propose a revision of the arrangement of the families; but more experience in the study of these bodies has induced me to suggest a further modification, retaining the families suggested in the first paper, but abolishing the division of *Malacosporæ* and *Chlamydosporæ* (as it is nearly certain that what Dr. Bowerbank calls spores or ova in *Geodia* have nothing to do with generation), though retaining the section for the freshwater sponges, which have ova of very different structure from that found in marine sponges.

I believe the system I proposed in 1867 and 1868 may be much simplified by leaving out some of the larger divisions, though the groups separated by them are evidently natural. Thus, for example, misled by the confidence I placed in Dr. Bowerbank's observations, I called the spherical mass of spicules in *Geodia* ovisacs, which he says become converted into these balls; but my friend Mr. Carter states, in the 'Annals and Magazine of Natural History' for 1869, vol. iv. p. 17, that "on no occasion have I been able to discover any central cavity in any stage of their development;" and he calls them "globular crystalloids," considering them the same as the large stellate bodies in *Tethya*, called by Dr. Bowerbank "stellate spicules," while he describes the seed-like bodies of *Spongilla* as commencing in a simple spherical soft cell, looking like a white speck imbedded in the sponge, and finally becoming coated with its horny and siliceous spicular cortical coat.

This being the case, I propose to abandon the sections *Malacosporæ* and *Chlamydosporæ*, and to retain the orders *Sphærospongia* and *Potamospongia*, only rendering their characters more consistent with our present knowledge of the subject. This systematic distribution is considered only a first attempt at arranging the genera of sponges in a systematic order, according to an analytical method. It is doubtless very incomplete, but it has the advantage of being capable of any extension that may be required; and I shall consider it a step in advance if it allows naturalists to be able to say at once to what group a majority of the sponges they examine will belong. I am aware that there do occur sponges which are

intermediate between the orders—as, for example, Mr. Carter has described a Tethyoid sponge which has the defensive spicules of the *Hamispongia*, and there are some sponges which it is difficult to say if they belong to the *Astrospongia* or *Sphærospongia*; but such annectent or intermediate genera are found in all methods of arranging animals and plants. Dr. Bowerbank and Prof. Oscar Schmidt form genera for single species or for small groups of species, and at the same time place beside them genera of a most polymorphal character, containing an abundance of species, which would break up into natural groups having characters quite as marked as those which distinguish the limited genera which they admit. But all this must be left to younger eyes.

Some sponges have the habit of collecting and imbedding in their skeleton or sarcode spicules which are the remains of other sponges that have died and decayed in the sand on the sea-coast on which they live. Some species are so particular that they select one or more special kinds of spicules for this purpose; therefore it is necessary to determine with care the real spicules that naturally belong to the organization of the sponge and those that have been added to it.

It has been repeatedly stated that the external form of sponges does not afford any character for their distinction, and that they can only be distinguished by their microscopic structure. It is quite true that the microscopic structure and the form and arrangement of the spicules do afford most important characters for the distinction of the sponges, as they do in all other natural and artificial bodies; but the external character is quite as important, and the two together must be studied before a natural method of classifying these animals can be arrived at. This fallacy has arisen from the sponges having of late been chiefly studied by microscopists: since they found that the spicules form very pretty slides, of course they considered their method of study was the only one to be followed. I think no one can look at an extensive collection of sponges without being struck by the persistence of the forms which the species assume, and how the species naturally fall into groups according to their external form; and it is curious to see that the microscopists who write most strongly against any attention being paid to the external form, are themselves influenced by it in the formation of their genera. It is very true that some species are very polymorphous, as, for example, the *Voluspa polymorpha* of Miklucho-Maclay, from the North Pacific Ocean; but there are polymorphous species of Algæ and zoophytes, and yet the general forms of these animals and plants are used in their arrangement, and the polymorphism, as in this

case, is the exception and not the rule; if the example cited is confirmed by future research, then polymorphism will be one of the characters of the group.

Amateur naturalists and microscopists often complain of the brevity of the characters that I have given to the genera, forgetting that it is only necessary to give a character which separates it from the genera of the same family or section of the family to which it is referred. To make this analytic, the character often requires a considerable knowledge of the subject and of the structure of the group, while almost any body with a slight knowledge of the terms can easily make a long description of a sponge, which will probably contain the characters of the class, order, and family to which it belongs, but very likely not contain the essential character of the special sponge; or if it does contain it, it can only be discovered by repeated reading of the description, and comparison of it with equally prolix descriptions; so there can be no doubt of the advantage of the analytic method and of the great improvement that the Linnean system introduced. But to form them, and, perhaps, properly use them, requires preliminary and systematic study.

Ellis, in his 'Zoophytes,' mentions the existence of glassy spicules in sponges; but, I believe, the first person who figured them, and showed their structure in the different sponges, was Jules César Savigny, who figured several Egyptian species which had spicules, in the large and expensive work, published by order of Napoleon, to illustrate the history and antiquities of Egypt. I do not think that Savigny ever published the descriptions of his plates, the work being too large to be finished, and Savigny having unfortunately become blind in after life. It was one of the saddest of the many sad sights I saw in Paris, when I visited the two great naturalists, viz. Savigny and Lamarck, both stone-blind and suffering most abject poverty. I believe Savigny's only means of support was the small allowance he had from the Academy of Sciences; and he had to wander to the meetings of that body, led by a boy, that he might obtain the larger allowance given each time that he made his appearance in person. The last decade of Lamarck's life was even still more sad and tragic; but I believe that I have already recorded the greater part of this in another place. Indeed the end of the purely scientific man in France, uninfluenced by any thing but the love of nature, is most distressing. Fortunately I have never known men even with far lower scientific pretensions in such distress in this country. As soon as it was known that Ralfs was in difficulties, his wants were most amply provided for by public

subscription among scientific men; and I could refer to several cases where such were hardly known before they received similar sympathy, whatever might have been the cause of their distress respectively.

Section A. *THALASSOSPONGIA.* (Marine Sponges.)

Sponge marine, brown, red, or purple. Ova membranous, unarmed.

Subsection 1. *Leiospongia*, Gray, P. Z. S. 1867.

Sponge horny, without any spicules, or, when spicules are present, they are of the most simple kind, being either fusiform, needle-shaped, or pin-shaped, often varying in size in the same species, and sometimes strengthened with sand and other extraneous bodies.

Order I. KERATOSPONGIA.

Sponge consisting of horny fibres, often anastomosing and more or less elastic; sometimes purely horny, at others strengthened with grains of sand, broken spicules, or siliceous spicules, either enclosed in the centre of the fibres or scattered on the surface. The thickness and solidity of the horny coat vary in different families; sometimes it is very thick and hard, and at others it scarcely covers the spicules with a very thin coat.

A. *The skeleton of the sponge horny or only strengthened by grains of sand or foreign spicules borrowed from the sand.*

Fam. 1. **Spongiadæ**, Gray, P. Z. S. 1867, p. 508.

Skeleton formed of reticulated horny fibres.

a. The fibres of the skeleton homogeneous. *Spongia*, *Spongionella*, *Cacospongia*, *Phyllospongia* (Ehlers).

b. The fibres of the skeleton surrounded by a soft cortical substance. *Aplysina.*

c. The fibres with a central tube. *Verongia*, *Ianthella* (Gray).

Fam. 2. **Ceratelladæ**, Gray, P. Z. S. 1868, p. 575.

Sponge irregularly dichotomously branched; stem hard, solid, dilated at the base, with abundance of very minute, cylindrical, tortuous tubes; branches and branchlets tapering, formed of very tortuous cylindrical fibres forming loops, which produce a spicular surface.

Ceratella and *Dehitella*, Gray, P. Z. S. 1868, p. 579, figs. 1, 2.

Auliskia appears to be a sponge-fibre on which a horny

zoophyte has grown. Dr. O. Schmidt says it is a parasitic Alga, but I know no Alga of a horny texture!

Fam. 3. **Hircinidæ**, Gray, P. Z. S. 1867, p. 510.

Skeleton formed of two kinds of horny fibres:—the one thick, and with a central line of broken spicules or grains of sand within, reticulated, forming the base of the skeleton; the other very slender, forming radiating spicular tufts, which do not anastomose.

Hircinia, *Sarcotragus*, *Stematumenia*.

Fam. 4. **Dysideidæ**, Gray, P. Z. S. 1867, p. 511.

Skeleton formed of reticulated horny fibres, with sand or broken spicules of other sponges imbedded in the centre, and covered with a more or less thick coat of horny matter; brittle when dry.

Dysidea.

B. *Skeleton formed of anatomosing filaments having one or more series of spicules in the central line.*

Fam. 5. **Chalinidæ**, *l. c.* pp. 503 & 511.

Fam. 6. **Phakelliadæ**, *l. c.* pp. 503 & 516.

Fam. 7. **Halichondriadæ**, *l. c.* pp. 503 & 518.

Fam. 8. **Polymastiadæ**, *l. c.* pp. 503 & 527.

Add:—*Quasillina* (*brevis*), Bowerbank. Very like *Euplectella*, but without hexaradiate and other spines.

C. *Skeleton formed of anastomosing filaments or expanded fin-like lobes covered with diverging spicules on the outer surface.*

Fam. 9. **Ophistospongiadæ**, *l. c.* pp. 503 & 514.

* Spicules smooth. *Ophistospongia*.

** Spicules verticillately spined. *Ectyon*.

Order II. SUBERISPONGIA.

Skeleton massive, composed of sarcode densely charged with simple or pin-like spicules; without branched excretory system, which is replaced for the most part by areolar cavities inosculating and finally terminating in vents on the surface.

Fam. 1. **Suberitidæ**.

Suberita, *Spiculina*.

Fam. 2. **Raphiophoridæ**.

Raphiophora, *l. c.* p. 524; *Raphyrus*, *l. c.* p. 516; *Osculina*,

but the figure appears much embellished, and the papillæ are the excurrent canals.

Fam. 3. **Clioniadæ**, *l. c.* pp. 504 & 524.

Generally living in shells or rocks.

Ciocalypta probably belongs to this order, but is quite unknown to me.

Order III. ARENOSPONGIA.

Skeleton consisting of agglutinations of grains of sand, forming a subcircular disk, with spicules on the circumference and at the mouth of the oscules.

Fam. 1. **Xenospongiadæ**, *l. c.* pp. 504 & 547.

Sponge consisting of a subcircular disk of agglutinated siliceous spicules and sand, with a series of diverging filiform spicules on the circumference and around the oscules.

Halichondria patera, from Mr. Barlee, in the British Museum, and the type of *Halicnemia patera*, Bowerbank, seems to be allied to *Xenospongia* (1868).

Subsection 2. *Acanthospongia.*

Sponge armed with peculiar-shaped spicules, as well as the usual formed ones found in the other sections. Often several kinds in the same sponge.

Order IV. HAMISPONGIA.

Sponge horny or fleshy, strengthened with fusiform or needle-like spicules, interspersed with anchorate or bihamate spicules.

Esperiadæ, Gray, P. Z. S. 1867, pp. 504 & 531.
Desmacidon, O. Schmidt, Spong. Faun.

The fusiform spicules are generally imbedded in more or less abundant horny matter; but in some this horny matter is so small that the spicules appear to form fascicles in the sarcode.

Fam. 1. **Esperiadæ.**

Anchorate spicules with a large and a small or rudimentary fluke, attached to the keratose skeleton; bihamate and polyhamate spicules are often immersed in the sarcode.

Esperiadæ, sect. 1 & 2, P. Z. S. 1867, p. 532.
Esperia, *Mycale*, *Ægogropila*, *Menyllus*, *Alebion*, *Iophon*, *Carmia*, *Grapelia*.

Fam. 2. **Desmacidonidæ.**

Retentive spicules with a similar well-defined expanded unilateral fluke at each end (æquibianchorate), free in the sarcode, which also contains simple or bihamate spicules.

Esperiadæ, sect. 3, Gray, *l. c.* pp. 532 & 534.

The flukes of the bianchorate spicules are of very different shapes, as described in the paper above referred to; and the sponges are of very different forms, sometimes probably containing more than one family.

a. Ends of spicules divided into two or three spines. *Isodictya*, *Emplocus*, *Anchinoë*, *Microciona*, *Dendoryx*, *Pronax*, *Euthymus*, *Desmacidon*, *Hamigera*, *Hymedesmia*, *Tereus*, *Homœodictya*, Ehlers.

b. End of spicules concave, with a single central apical tubercle. *Corybas.*

c. End of spicules cup-shaped. *Ingallia.*

d. Spicule oblong, boat-shaped, concave on the sides. *Naviculina.*

Fam. 3. **Hamacanthidæ.**

Retentive spicules with a definite compressed sharp-edged fluke at each end, free in the sarcode. Sponge thin, coating.

Esperiadæ, sect. 4, Gray, *l. c.* pp. 532 & 538.

Hamacantha = *Desmacella.*

Fam. 4. **Gelliadæ.**

Defensive spicules simple or contorted, without any bianchorate spicules intermixed, free in the sarcode.

Esperiadæ, sect. 5, Gray, *l. c.* pp. 532 & 538.

a. Defensive spicules filiform. *Gellius*, *Biemna*, *Asychis*, *Oceanopia* (Norman).

b. Defensive spicules clavate at the end. *Dymnus* (*Damo*).

Order V. CORALLIOSPONGIA.

Skeleton with hexaradiate spicules covering the surface or imbedded in the sarcode, and very often simple or forked tricurvate spicules imbedded in the sarcode. The sarcode of this family is very fluid or very slight, and scarcely visible in the dried sponge.

The hexaradiate stellate spicules, which are the essential character of this order in the perfect state of development, consist of an elongate needle-shaped spicule, which has four diverging rays springing from about the centre of its length.

The primary spicules and rays are generally smooth and tapering to a point; but one or both ends of the primary spicule, and sometimes of the rays, are armed with spines which are recurved from the centre; sometimes these spines are so numerous and crowded that they imbricate one over the other. Very commonly when the transverse rays of the spicule form the outer surface of the sponge, or are attached to the internal skeleton of the sponge, one end of the central axis is reduced to a small tubercle in the centre of the rays. Sometimes one or even all of the lateral rays may be very small and so abortive as to be only represented by a small tubercle or swelling in the needle-shaped primary spicule; but when this is the case, there is always to be observed a tube crossing the central tube of the primary ray where the diverging rays would have been situated. The variations of the spicules are well figured in Schultze's work on *Hyalonema*, tab. iii. & iv.

The sponges of the genus *Axos* have the primary spicules and rays very short, and of equal thickness and length; they look like seven cubes, one of which is placed on each side of the central one.

The study of the variation which one kind of spicule may undergo, even in a single species, is most important; and it is to be regretted that Dr. Bowerbank, in his paper on the organization of sponges, has not paid more attention to this part of the subject, rather than giving his long and composite names to all the varieties of spicules that had occurred to him. This is a subject that must be studied in detail before we can hope to understand the organization of the sponges.

Sect. 1. *The hexaradiate spicules on the outer surface of the sponge.*

Fam. 1. **Pteronemadæ.**

Sponge oblong; outer surface formed of hexaradiate spicules; lower surface with elongate filiform spicules ending in three recurved lobes.

a. Anchoring filaments arising in a circle of tufts around the base of the sponge. *Pteronema*, Leidy, Kent, Microsc. Journ. 1870, = *Holtenia*, Thompson, P. Z. S. 1869, p. 32.

b. Anchoring spicules arising from all parts of the sponge. *Caliptera* = *Pheronema Grayi*, Kent, Microsc. Journ. 1870. *Vasella* = *Holtenia*, Smit.

Fam. 2. **Lanuginellidæ.**

Sponge cup-shaped, attached; surface of the sponge formed of abundant irregularly placed hexaradiate spicules, with very

long subulate ends, and with scattered spheres of very long radiating spicules with dilated ends.

Lanuginella, Kent, Microsc. Journ. 1870, tab. lxv.

Sect. 2. *Hexaradiate spines in the sarcode.*

A. *Sponge free, attached to the mud by numerous elongated filamentous spicules surrounding its base and having small recurved spines at the end. Skeleton formed of elongated cylindrical spicules more or less united by siliceous secretion.*

Fam. 3. **Euplectelladæ.**

Sponge tubular, free, formed of bundles of elongated thread-like spicules placed in horizontal transverse and oblique directions, often crossing each other, forming more or less irregular network, and often closed at the top by a netted lid formed of shorter spicules; the base with elongated free spicules terminating in three or four short spines, by which it is fixed to the mud. The sarcode mucilaginous, studded with differently shaped spines, some of which are many-rayed, stellate, with clavate arms.

Euplectelladæ, sect. A, Gray, P. Z. S. 1867, p. 528.

Euplectella.

Fam. 4. **Hyalothaumadæ.**

Sponge elongate, free, wider above, with anchoring fibres at the base. The filiform spicules united into bundles, which anastomose freely with each other, forming a solid framework.

Hyalothauma, Herklots and Marshall; ?*Semperella*, Gray, Ann. & Mag. N. H. 1868, xi. p. 373; *Eureta*, Semper.

B. *Sponge fixed; spicules united together by siliceous matter, forming a netted mass covered with sarcode, in which are scattered other differently shaped spicules. Spicules of skeleton forming a coral-like mass.*

Coralliospongia, Gray, P. Z. S. 1867, p. 505; Ann. & Mag. Nat. Hist. 1868, i. p. 165.

These sponges are hard and coral-like, the skeleton being formed of siliceous spicules anchylosed together, forming a hard siliceous mass, covered with sarcode. They contain a number of very curiously shaped spicules, which are generally free, of very different forms in the different genera: some have regular spines with three-spined ends, like *Tethya* and *Geodia*, which are sometimes bifid and forked at the end,

and others are trifid. In other genera the spine is short, and the lobe is slender and weak and forked at the end, which gradually pass into spicules which have the lobes variously divided into branches in a most unequal and irregular manner, gradually passing into others which have an orbicular horizontal disk at the end of the short spine instead of the lobes or hooks.

This order presents the greatest abundance of spicules and the most diversified forms of them. The spicules that form the greater part of the skeleton of these sponges are most frequently united together by an extra development of siliceous substance. Dr. Bowerbank has repeatedly denied that the latter is a true explanation of their structure, and calls them *siliceo-fibrous* sponges. Any one who will grind down any of the siliceous network of these sponges, so as to expose their internal substance, will see the perfect form of the spicules, and the additional deposit of siliceous matter which unites them together. This deposit is formed of thin concentric coats, like the spicules. The same thing may be seen by submitting a similar piece of the skeleton of the sponge to the action of a spirit-lamp, when the different layers of the cementing portion and spicules separate. This structure is well shown in Prof. Claus's beautiful work on *Euplectella*.

Dr. Bowerbank, in the 'Proceedings of the Zoological Society,' 1869, pp. 66 & 323, has published "a Monograph" of the "Siliceo-fibrous Sponges," illustrated with eight plates by Lens Aldous. I have the utmost confidence that these plates accurately represent the specimens in the slides placed before the artist; but knowing how many of the specimens so mounted were obtained and manipulated, I have great doubt of the fragments figured belonging to or fairly representing the structure of the species they are said to illustrate; at least, I know that they are taken from very different parts of the sponges. Thus what is figured as *Myliusia Grayii* was a very minute fragment which was nipped off from the upper margin of a minute sponge, about the size of a large thimble; and that which was described as *Dactylocalyx Prattii* is from a specimen cut from the expanded root of the sponge. Now it has never been proved that the structure of two such different parts of a sponge is identical, and therefore that fragments, taken from different parts, fairly represent the generic or even specific character of a sponge. The specimen which is described as the type of the genus *Myliusia* of Bowerbank, as distinct from my genus of that name, is taken from a very young and imperfectly developed sponge which, I believe, belongs to a very large species. It is to my mind very doubtful

if the microscopic structure of such a young specimen can be taken to fairly represent the structure of the adult sponge; and I am more inclined to this opinion as the specimen, which is very like it, but rather more developed, has, even according to Dr. Bowerbank, a different structure, and the same structure as the adult specimen which Dr. Bowerbank refers to another genus. At any rate, it has to be proved that these coral-like sponges do not change their structure from the very early and thin paper-like state till they arrive at their usual thick coral-like condition. Until this is proved, a genus founded on such materials, I am afraid, must be placed in the same category as a genus of sponges from the cocoon of the common leech, and of that founded on the Foraminifera so common on the fronds of Algæ on the south coast of England. At least I think that one must lose confidence in the system proposed in this paper when one finds that a sponge which M. Valenciennes and even Dr. Bowerbank himself formerly considered to be one species, under the name of *Iphiteon paniceum*, is now divided into two genera, viz. *Dactylocalyx pumiceus* and *Iphiteon panicea*—that, of two sponges which I had regarded as belonging to the same species, having the type specimens before me, both, like the former species, coming from the West Indies, one is, according to Dr. Bowerbank, *Dactylocalyx pumiceus*, and the other *Iphiteon Ingalli*. It is natural to conclude that that cannot be a natural division, when it separates into different genera specimens which are so nearly allied that naturalists who have had considerable experience in sponges have regarded them as the same species, as I am still inclined to regard them, even after Dr. Bowerbank's prolix descriptions and figures, as I think all the differences may be derived from his having taken his fragments from different parts of the sponge; and the unnatural character of the genus becomes more apparent when we observe that in the genus *Iphiteon* he places *Myliusia* and *Aphrocallistes*—genera which have been adopted by Percival Wright, Oscar Schmidt, and others. In the same manner the genus *Dactylocalyx*, though separating species that have been regarded as the same, includes in it my *Macandrewia*—sponges which at any rate have a very different external appearance and general form.

In the West Indies there are, according to Dr. Bowerbank:—

1. *Dactylocalyx pumiceus*, p. 77; *Iphiteon panicea*, p. 324; *Iphiteon Ingalli*, p. 331.

2. *Iphiteon callocyathes*; *Myliusia Grayii*; *Dactylocalyx polydiscus*.

From Madeira and the Azores:—

3. *Dactylocalyx Macandrewii*; *Dactylocalyx Masoni*; *Dactylocalyx Bowerbankii*, p. 94; ?*Dactylocalyx Prattii*.

I believe, from the examination of the specimens, that all these names belong to only three species, belonging to the three genera *Dactylocalyx*, *Myliusia*, and *Macandrewia*, each of which, unfortunately, has several synonyms.

It is to be observed, with one or two exceptions (and they are more apparent than real), that all the species in this monograph are founded on a single specimen—in other words, that each specimen that has come under Dr. Bowerbank's examination is regarded by him as a distinct species or genus. This being the case in this beautiful family of sponges, which have such distinctive external appearance and characters, which are to be so easily observed, and which come from so few localities, it leads one to inquire, is the way in which Dr. Bowerbank examines sponges a good one for the determination of genera and species? And it leads one to look at his 'History of British Sponges;' and there one observes the same descriptions of species from the specimens collected in the same locality or at the same time; and, judging by this monograph, I think that it explains the reason why in that work so many sponges are described as new species.

I am glad to see that the Ray Society is about to publish figures of the species of British sponges, which must increase our knowledge of *Spongiadæ*; but these figures, being taken from slides prepared for the microscope, instead of from the actual examination of *one specimen*, will thus, unfortunately, have all the uncertainty attached to them that belongs to the figures of this monograph.

Dr. Oscar Schmidt, who stayed some time at St. Leonards, in his just published 'Spongienfauna,' observes that *Diplodemia vesicula* "appears to be a fragment or a young state of a *Chalina*" (p. 77); and in speaking of *Hymeniacidon Bucklandi*, he observes that Dr. Bowerbank, in the diagnosis of this sponge, says, "*Tension-spicules tricurvate, few in number.*" "These siliceous bodies, belonging to *Desmacidon*, have, without doubt, got into the preparation merely by accident" (p. 76). Mr. Carter informs me that this is a mistake on Dr. Schmidt's part. The spicular composition of this sponge is exactly as Dr. Bowerbank describes it. Schmidt observes, under *Desmacidon Jeffreysii* (which he says is a species of *Esperia*, and which Dr. Bowerbank now calls the cloaca of a new genus, *Oceanopia*):—"The anchor-shaped siliceous bodies have escaped Bowerbank's notice in this spe-

cies. I suspect that that has been the case frequently, especially in the species of *Hymeniacidon*, which, according to his account, have knobbed spicules." Dr. Bowerbank does not mention them in the character of *Oceanopia*.

A friend observes:—"Indeed it is remarkable that one of the most practical men of the day in the examination of sponges, viz. Dr. O. Schmidt, has failed to identify the greater part of the sponges described by Dr. Bowerbank in his 'British Spongiadæ,' as may be seen by his attempt to synonymize the latter in his 'Atlantisch. Spongienfauna.'"

Surely the having the name of "Bowerbank" after each of the species can have had no influence in causing him to alter the generic names of the greater part of these sponges, and to make species of what I regarded as varieties; but it does look very suspicious to see the name of "Bowerbank" at full length after all the species but one in this monograph, placed there solely because he has changed the name. The same occurrence of this name may be observed in the work on British Sponges, where there are whole pages of names with the word "Bowerbank" at full length after each species. Botanists have observed that the having "*mihi*" or "*n. sp.*" after a name has influenced the manufacture of many nominal species; but that is not to be compared to the above system.

On a former occasion I have stated that Dr. Bowerbank assured me, in the presence of three other naturalists, in such a decided manner that there could be no misunderstanding, that the specimen of *Macandrewia azorica* that I described and figured was certainly the type of his manuscript species *Dactylocalyx Prattii*. In this work he describes *Dactylocalyx Prattii* for the first time, and gives East Indies, without any doubt, as the locality; but he afterwards states that Mr. Pratt "was not quite certain of his locality," at which I am not astonished, as my poor friend, for many of the latter years of his life, had entirely lost his memory—even more so than Dr. Bowerbank (for that is the excuse that his friends make for many of his statements); but he afterwards says that he found in the British Museum another specimen of the same sponge, brought from Formosa by Mr. Swinhoe (a sponge which I had called *Theonella*, P. Z. S. 1868, p. 565), and states that the acquisition of "this specimen from Formosa is in favour of Mr. Pratt's belief that the type one was really an East-Indian specimen;" and now he has described the Formosan specimen as *D. Prattii*, Bowerbank.

I do not see the force of this argument. Does Dr. Bowerbank think that Formosa in the Pacific Ocean is a part of

India? or is he not aware that it belongs to a different zoological region? I believe the specimen which Dr. Bowerbank first named is a sponge which Mr. Pratt obtained in Portugal, which he showed me along with the Hippurites which he collected during that excursion, and that it is most probably from Madeira or the Azores; and Dr. Bowerbank was right when he said that *Macandrewia azorica* was the type of his then *D. Prattii*. At any rate I should want much better authority than the very brief examination that Dr. Bowerbank bestowed on Mr. Swinhoe's specimen and the examination of the small piece which he cut away from its base, to convince me that the Formosa sponge is the same as Mr. Pratt's specimen, which is the type of Bowerbank's *D. Prattii*.

To obtain a clear view of the value of Dr. Bowerbank's very prolix and apparently minute descriptions, we have only to read the descriptions of *Isodictya robusta* and *Desmacidon Jeffreysia*, which he now informs us are only fragments of the same sponge which Mr. Norman has formed into a genus under the name of *Oceanopia*. It is remarkable that the sponges of the same or nearly the same locality, alike in general form and appearance, should belong to different genera and species. I think we may well say that the microscope may be a most deceptive aid in the hands of a man with strong predisposed opinions, who believes that he has nothing to learn, and works from slides prepared at different times, by different people, and, may be, from different species.

M. Bocage published a paper on new siliceous sponges of Portugal, in the 'Jornal des Sciencias Math., &c.' (1869), in which he has described some new genera, *Discodermia* &c. Dr. Oscar Schmidt, in his 'Spongien-Fauna,' which has just appeared, has noticed eighteen species of coral-sponges, dividing them into two families and ten genera; but, with the assistance of the detailed figures which accompany the book, and of microscopic slides containing parts of these sponges, which Dr. Schmidt has been kind enough to furnish me with, I have not been able to understand the characters of several of the genera and species. Indeed these coral-like sponges seem to have attracted much attention from many authors; but still, I may say, they appear to me to require a careful re-examination and illustration.

Fam. 5. **Macandrewiadæ.**

Sponge massive or expanded, fixed, fan-shaped or cup-shaped. Skeleton very irregularly reticulate, with roundish openings.

Macandrewia, *Theonella*, Gray, P. Z. S. 1868, p. 565.

The small cup-shaped specimen figured in the Proc. Zool. Soc. 1859, tab. 15, as *M. azorica*, has distinct conical vents on the inner surface; two much larger, circular, very sinuous specimens, also from the Azores, have only very minute vents on the upper surface; and the large circular sinuous specimen from Madeira, which is called *M. Bowerbankii*, has no visible vents on either surface: so I believe them to be only varieties. Mr. Carter observes, one should recollect that sponges often grow from the roofs of caves and rocks, dependent from above; and what appears, when the specimen is in a museum, to be the upper is in reality the lower surface, and the surface next the root is in reality the upper one.

Fam. 6. **Farreadæ.**

Sponge expanded or tubular. Skeleton nearly regularly reticulated, with four-sided openings.

Farrea, Kent, Microsc. Journ. 1870; *Sympagella*, O. Schmidt.

Fam. 7. **Dactylocalycidæ.**

Sponge massive or expanded or cup-shaped. Skeleton more or less regularly reticulated, with angular openings diverging from the centre.

Dactylocalyx, *Myliusia*, *Kaliapsis* (Bowk.), *Discodermia* (Bocage?).

Fam. 8. **Aphrocallistidæ.**

Sponge tubular; tube closed with a netted lid or a rounded end. Skeleton more or less regularly netted with angular openings.

Aphrocallistes, see Kent, Microsc. Journ. 1870.

C. *The sponge fixed, formed of fusiform spicules anchylosed together by siliceous coats. Hexaradiate spines in the sarcode.*

Fam. 9. **Corbitellidæ.**

Sponge tubular, attached, without any anchoring filaments at the base. The walls formed of irregular network or bundles of siliceous needle-shaped spicules loosely arranged in sheaves intersecting each other, and united by sarcode; spicules of skeleton and sarcode hexaradiate, free from one another.

Euplectelladæ, sect. B, Gray, P. Z. S. 1867, p. 530.

Corbitella and *Heterotella*, Gray, *l. c.*; *Habrodictyon*, W. Thomson.

I formerly regarded this family as a peculiar section of

Euplectelladæ, as I had not the opportunity of examining the sponges, and only knew them from having seen them in Paris and by the photographs of Dr. Wyville Thomson.

Dr. W. Thomson has since described them as a genus, observing, "as I am precluded from using either of Dr. Gray's names, I substitute *Habrodictyon*, which I had in MS. before I saw Dr. Gray's paper." Why he is precluded is not stated. When he sent me the photographs, with the permission to describe and name them (see Proc. Zool. Soc. 1867, pp. 530, 531), he did not communicate any name to me, or I would gladly have used his generic name; but I fear that now the question is out of both our hands, and must follow the recognized rules of nomenclature.

Fam. 10. **Askonematidæ.**

Sponge fixed, cup-shaped, formed of abundant elongate spicules, with scattered hexaradiate spines often denticulated on the edge of the rays; spicules with bifurcate ends repeatedly forked, and spherical groups of elongate spicules, which are capped at the end.

Askonema, Kent, Quart. Journ. Microsc. Science, 1870.

D. *Sponge fixed, formed of fusiform spicules imbedded in keratose matter. Hexaradiate spines in the sarcode.*

Fam. 11. **Carteriadæ.**

Sponge cup-shaped, formed of abundant netted fibres containing many fusiform spicules, with scattered six-rayed stellate spicules, ending in a circle of reflexed lobes; the rays are often abortive, producing a cylindrical axis terminating at each end in the reflexed lobe, and hence they have been called birotulate spines. Mr. Carter has found rudiments of side branches on the central axis, and some specimens have all the six lobes perfect and furnished with rays at the end, showing that the birotulate specimens are only the result of the more or less complete abortion of the lateral lobe, and that it belongs to this order.

Carteria, Gray, P. Z. S. 1867, p. 540.

Fam. 12. **Axidæ.**

Sponge arborescent, branched, with hexaradiate subcubical spicules, as if formed of six cubes placed on each side of a central one, and with three rayed stellate spicules.

Axos = *Echinospongia*, Gray, Ann. & Mag. N. H. 1870, vi. p. 272.

Order VI. SPHÆROSPONGIA.

Sponge generally massive, grumose; skeleton strengthened with numerous small spicules crowded into globular or stellate balls, and with elongate spicules terminating at the outer end in three recurved spines, which are simple or forked.

I. *The globular or oblong balls of spicules crowded, forming a coat to the outer surface of the sponge.*

Bowerbank regarded these balls of spicules as ovaria. I have called them in my arrangement of sponges ovisacs; but further research has convinced me that they have nothing to do with the ova.

A. *Sponge grumose, with elongate spicules, the long ones with two or three expanded or recurved acute branches.*

Fam. 1. Geodiadæ.

The spherical masses of spicules forming a thick external crust to the sponge.

a. Crust interrupted with a conical cloaca covered with a netted or perforated lid. *Geodia.*

b. The external crust continuous. *Cydonium* and *Pachymatisma.*

B. *Sponge calcareous, solid, with simple spicules between the outer layer and axis, which is formed of spheres of spicules.*

Fam. 2. Placospongiadæ.

Sponge branched, coral-like, with a central axis and a hard outer coat entirely formed of solidified spherules of spicules. The axis and outer lamina separated from each other by a layer of sarcode strengthened with bundles of spicules.

Placospongia.

II. *The stellate balls of spicules scattered in the outer surface and inner part of the sarcode.*

Tethyadæ, Gray, P. Z. S. 1867, p. 540.

Sponge oblong, massive, fleshy, armed with simple fusiform spicules, many having three prongs or three recurved points at the outer end or distal outward extremity, forming the surface or extending beyond the surface of the sponge, and

often imbedded in the sponge; stellate spicules in the sarcode all crowded together.

A. *Sponge short, globose, with elongate spicules having three acute recurved branches on the outer end, which support the outer surface, or extend beyond it.*

* *Sponge attached to rocks, with an expanded base.*

Fam. 3. **Tethyadæ.**

The tricurvate spicules extending beyond the outer surface of the sponge. *Tethya.*

See *Tethya arabica*, Ann. & Mag. N. H. 1869, iv. p. 3, pls. 1 & 2.

The young, just hatched, of *Tethya*, as is proved by Mr. Carter (see this Number, p. 413), is furnished with elongate rooting fibres, which are lost when the animal becomes attached. But in certain genera, as *Euplectella*, *Hyalothauma*, &c., which remain free, these fibres are retained during life; and it is doubtful if *Lophurella*, which is only rather more than a quarter of an inch long, may not be a young specimen in a state of change.

Fam. 4. **Donatiadæ.**

The tricurvate spicules supporting the outer surface of the sponge.

Tethyadæ, sect. I.*, Gray, *l. c.* p. 541.

Donatia &c.; add *Tethyopsis*, Stewart.

** *Sponge free, with elongate anchoring spicules ending in three or four recurved spines.*

Fam. 5. **Theneadæ.**

Sponge oblong, with many excretory pores above, with tufts of spicules beneath, and numerous stellate masses in the flesh on the underside.

Thenea, Gray, P. Z. S. 1867, p. 541, = *Tethya muricata*, Bowerbank, B. S. fig. 35, and figs. 304 & 305. *Dorvillia agariciformis*, Kent, Microsc. Journ. 1870. *Tisiphonia*, Wyv. Thomson; *Stelletta*, O. Schmidt. *Wyville-thomsonia Wallichii*, Perceval Wright, is said to be the young state of this species.

Fam. 6. **Lophurellidæ.**

Sponge oblong, with a single excretory pore above, and

with a depressed central cavity; lower part of the body with numerous scattered anchorate rooting spicules.

Lophurella, = *Tetilla lophura*, O. Schmidt, tab.

Dactylella, = *Tethya dactyloidea*, Carter, Ann. & Mag. N. H. 1869, vol. iii. p. 15.

**** Sponge free; base surrounded by a funnel-shaped expansion or disk formed of elongated spicules united together.*

Fam. 7. **Casuladæ.**

Casula = *Tethya casula*, Carter, Ann. & Mag. Nat. Hist. 1871, vol. viii. p. 99, pl. 4.

B. *Sponge without elongate tricurvate spicules, with stellate groups of spicules in the outer surface and inner part of the sarcode.*

Fam. 8. **Chondrilladæ.**

1. Stellate spicules of one kind. *Chondrilla.*
2. Stellate spicules of distinct kinds. *Corticium.*

III. *Sponge without globular balls of spicules or stars, but with elongate spicules, two- or three-rayed and recurved at the outer end, on the margin of the sponge.*

Fam. 9. **Ancorinidæ.**

Ancorina, Normania.

Section B. *POTAMOSPONGIA.* (Freshwater Sponges.)

Sponge freshwater, of a green colour; ova coriaceous, strengthened with variously shaped spicules placed in the substance of the ovisacs; they are found in the substance of the massive branched sponge, which is strengthened by fusiform spicules; sponge spiculose, with fusiform spicules in a sarcode.

Fam. 1. **Spongilladæ**, Proc. Zool. Soc. 1867, p. 550.

1. The spheres thick, smooth, armed with birotulate spicules. *Ephydatia, Dosilia.*

2. Spheres tessellated on the surface, and with sunken fusiform spicules. *Metania, Acalle, Drulia.*

3. Spheres covered externally with fusiform spicules. *Eunapius* and *Spongilla.*