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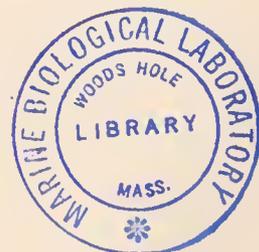
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1859

A MONOGRAPH

OF

THE FOSSIL POLYZOA

OF THE

C R A G.

BY

GEORGE BUSK, F.R.S., F.L.S., F.G.S., &c.

LONDON :

PRINTED FOR THE PALÆONTOGRAPHICAL SOCIETY.

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ADVERTISEMENT.

THE materials from which the following Monograph has been drawn up have been afforded by the copious and valuable collections of Crag Polyzoa placed, with their wonted liberality, at my disposal by Mr. Searles Wood and Dr. Bowerbank.

The work was originally undertaken by the late much-lamented M. Jules Haimes, but he was unable even to commence it before death put an end to the labours of one whose accurate knowledge and practised observation of similar fossil remains would have enabled him to treat the present subject far more satisfactorily than it has been in my power to do.

Though long accustomed to the study of recent Polyzoa, until the present undertaking was commenced I had formed but an imperfect idea of the difficulties attending the investigation and accurate discrimination of fossil forms.

With respect to the synonymy of species, so little assistance, with regard to the more minute though essential characters, can in most cases be derived from published descriptions and figures, with the sole exception almost of the admirable works of Hagenow and of Reuss, that it is almost impossible to arrive at any certainty without the direct comparison of specimens. And though no endeavours or time have been spared in the elucidation of this part of the subject, I am fully conscious that it still remains in an unsatisfactory state. In order to obviate some of the difficulties above referred to, the utmost care has been taken in the drawing of the figures to render the characters as clear and distinct as the condition of the specimens would allow. This could only be done by the adoption of a scale somewhat larger than that usually employed. It is consequently to be hoped that future inquirers will at any rate have little difficulty in recognising the species here intended.

I cannot conclude this reference to the figures without expressing my warm acknowledgments to Mr. George West, for the unwearied pains and great skill with which he has executed them from the actual specimens, as well as for the important aid which, in many cases, I have derived from his intelligent observations on points of structure to which his attention was drawn in the execution of his work, and which would otherwise probably have escaped my notice.

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ERRATA.

In page 123, line 14 from bottom, *omit* "not."

In page 182, after "*Cheilostomata*," pp. 8, 9, *add* p. 10.

After "Synoptical Classification of," *for* p. 12, *read* p. 13.

The initials *S. W.* indicate Mr. Searles *W*ood,
and *J. S. B.*, Dr. J. S. Bowerbank.

A

MONOGRAPH

OF

THE CRAG POLYZOA.

INTRODUCTORY OBSERVATIONS.

BEFORE proceeding to give an account of the fossil remains of a class of animals of which so little is generally known as of the Polyzoa, it will be necessary, if only for the due understanding of the descriptive terms employed, by those who may be wholly unacquainted with the subject, to say a few words respecting their structure and affinities. No very detailed remarks, however, are required for that purpose, and it is the less necessary, perhaps, to enter fully into the subject, seeing that it has been almost exhausted in the admirable Monograph of Professor Allman, on the "Fresh Water Polyzoa," to which the reader, who is desirous of further information, cannot do better than refer. But as that author's observations, after he has explained the structure and relations of the Polyzoa as a class, are confined more especially to that division of them which forms the subject of his own memoir, and which differs in several important particulars from those divisions to which the subjects of the present work belong, some additional details referring more directly to the latter, seem to be called for.

Thirty-one years ago, Dr. Grant, in some "Observations on the Structure and Nature of Flustræ," drew, for the first time, a distinction between the animals inhabiting those growths, and the Sertularian, or Hydroid Polypes, with which they had previously been associated. Shortly afterwards, the observations of M. Milne Edwards not only showed the propriety of this distinction, but indicated also the still more important fact of the close relationship, in many respects, between the structure of the Ascidian Molluscs and that of the animals in question, which he thence proposed to distinguish by the name of "*Polypes tuniciers*."

Another independent observer, however, Dr. John V. Thompson, of Cork, was also at work on the same subject, the results of whose researches, apparently commenced in 1820, were not published till December, 1830, in the first part of his "Zoological Researches and Illustrations." He, like M. Milne Edwards, recognising the close affinities presented in the structure of the animals to that of the compound Aseidians, was the first to propose for them an appellation wholly independent of their former incongruous allies, the hydroid "Polypes." The term he employed was "*Polyzoa*," it "being applied" as he says, "to a distinct class of Polypes hitherto in great measure confounded with the Hydroïda." But it is to be remarked that he used the word in the singular number, so that the plural term, "Polyzoa," as now employed, though etymologically more correct, is not in reality synonymous with that of Dr. J. V. Thompson. This fact, which appears to have been strangely overlooked till 1852, may fairly enough be used as an argument in their favour, by those who are inclined to prefer the Ehrenbergian term "Bryozoa." But as this preference, which is still extensively prevalent, more especially on the Continent, is based simply upon the supposed priority of Professor Ehrenberg's appellation, a claim which has been shown¹ to be wholly untenable, it is scarcely likely that British naturalists will refuse the honour justly due to Dr. J. V. Thompson, for what can scarcely perhaps be regarded as a sufficient reason.

With respect to the general affinities of the Polyzoa as a class, it may be stated that the MOLLUSCAN SUB-KINGDOM admits of subdivision into three great primary groups or provinces, separated by well-marked characters. These are—1. The CEPHALOPHORA, including the *Cephalopoda*, *Gasteropoda* and *Pulmonata*. 2. The ACEPHALA, embracing the *Lamellibranchiata*, and, according to many, the *Brachiopoda*. And 3. The MOLLUSCOIDA, to which belong, according to some, the *Brachiopoda*, the *Tunicata* or *Ascidiodida*, and the *Polyzoa*, whose affinity to the latter, at any rate, is generally admitted; whilst their relationship to the former is in many respects also unmistakeable.

Like many of the lower members, more especially of the Tunicate class, the Polyzoa all live in an associated form; the compound growth or "polyzoarium" (*cænæcium*, Allm.) being composed of a congeries of distinct individuals, arising by a process of continuous gemination, from a single primary parent. The colonies thus formed vary infinitely in form, appearance, and consistence. Some are phytoid and erect, whilst others are massive, creeping, or crustaceous. Some, soft and flexible, composed wholly or in part of a horny substance, form delicate growths which yield gracefully to every motion of the waves; whilst others, firm, rigid, and unyielding as the rocks they live upon, bid defiance to the ravages of time or tempest.

The class, or rather one order of it, is cosmopolite, its members being found from the

¹ On the Priority of the term "Polyzoa" for the Ascidian Polypes. ('Ann. Nat. Hist.,' 2d ser., vol. x, p. 352, 1852.)

extreme limits of the Arctic to those of the Antarctic Ocean. They are found also at all depths from above low-water mark to more than 100 fathoms deep. As regards geographical distribution, it may be remarked that, whilst many species appear to be universally distributed over the surface of the globe, many marine genera are confined to either the austral or the boreal hemisphere; and that one entire order, including the Fresh-water Polyzoa, is, so far as we know, limited to a portion of the North Temperate Zone.

With this wide though unequal geographical range and great apparent adaptability to external conditions, we may expect to find that the Polyzoa are of considerable importance in a geological point of view. Their remains are found accordingly in rocks of nearly every epoch, from the Paleozoic to the most recent. Though not numerous in species, they are plentiful in the Upper Silurian and Carboniferous Limestones; very abundant in the Jurassic and Cretaceous rocks, in some of which, as in Le Cotentin, the Departments of La Sarthe, Charente, &c., at Maastricht and Fauquemont, they appear even to constitute the principal bulk of the deposit. In fact, speaking geologically, the Cretaceous period seems to have formed the culminating point of the calcareous Polyzoa. But in the tertiary rocks, also, of different periods, their remains are nearly equally abundant, and more especially is this the case in the Miocene deposits of Brittany and Touraine; in Hesse Cassel; in the tertiary basin of Vienna; and also in North America, in New Jersey and Virginia; whilst their abundance in the older Pliocene deposits of Suffolk and Norfolk is evidenced in the present monograph.

As regards the general conditions under which the Polyzoa which occur in a fossil state have lived, M. D'Orbigny attempts to show, with every probability, that those most conducive to their multiplication, are:—1, a considerable depth of water, as is proved by their occurring in association with the remains of *Pentacrinus* and of *Brachiopoda*; 2, clearness or limpidity of the water; and 3, the existence of strong currents. But it should be remarked that these observations are true only of certain forms of Polyzoa, and of those chiefly which belong to the families or genera whose representatives or extinct allies are found in the fossil state. For it is well known that many species of a more fragile nature occur, as before said, even above low-water mark, and that some especially delight in shallow, muddy water. And this serves partly to explain a circumstance at first sight calculated to excite some surprise; namely, that whilst many recent genera, and even some recent species, belonging to certain divisions of the class, or to certain families, frequently occur in the fossil state, others which are known to exist under similar conditions at the present time, and are far more numerous, are wholly wanting. But very little consideration will show that the apparent deficiency at former periods does not necessarily prove the non-existence then of similar or of representative forms. It is obviously due to the circumstance that several entire orders, and many genera, have been unable to resist the attacks of external agencies; the inability arising either from the individual elements, though themselves sufficiently calcareous, being so joined together by perishable connexions as to have fallen entirely

asunder, or to the whole growth being composed of a similar decomposable organic material. In the former case the minuteness of the separate particles would render them wholly inappreciable; and as regards the latter it is clear that we can expect to find in the fossil state only those forms of Polyzoa the walls of whose cells contain such an amount of earthy matter as will enable them to maintain their figure when the organic material is removed. And since one or other of the above conditions obtains in a large proportion of the class, it is only of a limited number of families that we can expect to discover the fossil remains in the older sedimentary deposits.

The general structure and physiological relations of the animals composing this class, notwithstanding the diversified forms exhibited in their skeleton-remains, are extremely simple, and conformable to a very uniform type throughout.

It has been before said that the Polyzoa are always associated into compound growths, made up of a congeries of individuals, which though distinct yet retain some degree of inter-communication, comparable in kind perhaps, though not in degree, to what obtains in many of the compound Ascidians. That this community exists is proved by the otherwise inexplicable circumstance that the polyzoaria in many instances present elements common to the whole growth, and not belonging specially to any individual. The chief bond of connexion would appear to reside partly in the continuity of the external integument, and partly also, in all probability, in a slow interchange of the vital fluid with which the cavities of the cells are charged.

Each individual Polyzoon may be briefly described as possessing a saccular body and as having two orifices, an oral and an anal, which, however, are not at opposite ends of the body, but in close approximation. The oral orifice or mouth is surrounded with a single row of non-contractile tentacles, which are hollow, seated upon a thickened band or ring—the lophophore,—and furnished on the exterior with vibratile cilia, by whose action the nutriment is conveyed to the mouth, and a current kept up on the surface of the tentacles for the purpose of respiration.

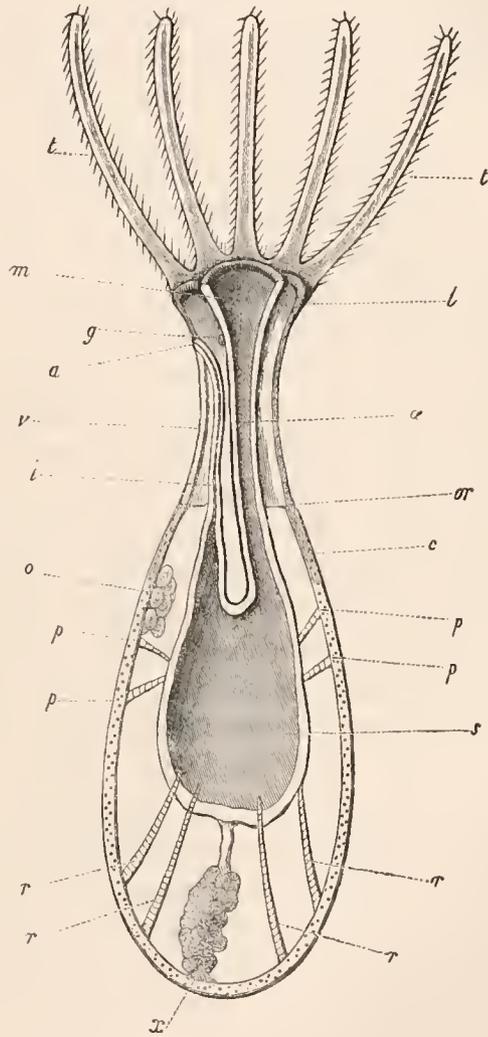
The walls of the saccular integument, which may be wholly membranous, or, as is more usual, partly soft and membranous, and partly calcareous and rigid, or fleshy, is attached round the neck, as it may be termed, immediately behind the lophophore, so as to form a completely shut sac, except where it is perforated for the passage of the fæces, but as the walls are there also continuous with those of the intestine, it results that a closed cavity is formed by them, in which are contained the alimentary and reproductive organs, together with the rudimentary nervous system. The upper part of this sac, or that immediately succeeding its attachment, invariably remains flexible and membranous, whilst the remaining portion is usually solidified by the deposition in its tissue of carbonate of lime, or of a horny substance resembling chitin or perhaps conchiolin, in chemical and physical properties.

The walls of the sac are constituted of two membranes, an internal and an external—the *endoderm* and *ectoderm*, or as they have been termed by Professor Allman, the *ectocyst*

and *endocyst*; but, inasmuch as their constitution is in all probability fundamentally the same throughout, that is to say, in the permanently membranous portion, as in the rigid part or true cell, the former terms would seem to be rather more appropriate. Be

Fig. 1.

- t.t.* Tentacles.
- l.* Lophophore.
- m.* Mouth.
- g.* Nervous ganglion.
- a.* Anus.
- æ.* Oesophagus.
- v.* Tentacular sheath, or vaginal portion of integument.
- i.* Intestine.
- or.* Orifice of calcareous cell.
- c.* Calcareous or rigid portion of integument.
- o.* Ovary.
- x.* Testis.
- s.* Stomach.
- p.p.* Protrusor muscles.
- r.r.* Retractor muscles.



this as it may, the solidifying material, whatever its nature, belongs to the external tunic, which is in all respects comparable to the external coat or test of an Ascidian, whilst the internal tunic is soft, transparent, and contractile. In consequence of the marked difference just indicated between the upper and lower portions of the integument, the latter in most cases forms a sort of cup or receptacle into which the upper or flexible portion, together with the parts attached to it, can be drawn by appropriate muscles. Now the parts attached, or in immediate connexion with this flexible portion, are—1, the

tentacles, which project externally; and 2, the alimentary canal with its immediate appendages, which is lodged in the cavity of the receptacle or "cell" as it is termed. As the tentacles are not contractile, and as, when the body is retracted, they are received completely within the "cell," it follows that the flexible part of the sac which admits of invagination must be at least equal in length to those organs. It is also evident that when retracted the tentacles will be lodged in a tubular sheath formed by the membrane in question, which has thence received the name of "tentacular sheath." The invagination and evagination of this sheath are effected by the action of special muscles, of which a full account will be found in Professor Allman's work above cited; and the evagination may be *perfect* as in most of the marine and some few of the fresh-water Polyzoa, or *imperfect* as in the greater number of the latter class. In which case may be perceived an approach to the formation of an atrium, or common cloacal cavity, such as exists in the Aseidians. The border line between the rigid and flexible portions of the tunic circumscribes an opening, as it were, through which the extrusion and protrusion of the soft parts of the animal take place. This opening, therefore, is termed the "orifice" or "mouth of the cell." In those instances where the cell is of a tubular form the orifice is usually of the same diameter as the tube, but where the cell is of an urceolate or other shape the orifice is usually of less diameter. In a systematic point of view this part of the cell, when the soft parts are removed, affords characters of great importance, as will be afterwards perceived. Other points of importance, presented on the exterior of the "cell" are—1, the condition of the surface, whether it be smooth, punctured, dotted, reticulated, &c.; and 2, the existence of certain external organs which will be afterwards more particularly referred to when we come to speak of the Cheilostomatus Sub-order. But one circumstance should be here mentioned. The surface of the cell is in almost all cases in recent Polyzoa covered with a horny cuticle or epidermis, apparently analogous to that on the outer surface of many shells. This epidermis is often so thick as materially to affect the aspect of the surface, by filling up perforations and smoothing asperities which would otherwise be evident. It is, of course, invariably absent in fossil specimens, and it is therefore in most cases necessary, and in all advisable, when a comparison is instituted between recent and fossil species, to remove the organic matter from the former. Owing to the intractable nature of the covering in question, the only or the most effectual way of doing this is by incineration in the flame of a spirit-lamp, sometimes aided by the blow-pipe.

Within the "cell" thus formed are contained all the soft parts of the animal. These, however, do not occupy the whole of the space, the remainder being occupied by a "clear fluid, in which float numerous particles of very irregular form and size; and in this fluid may be observed a constant rotatory motion, rendered apparent by the floating corpuscles as they are whirled away under the influence of the currents." The space within the "cell," thus filled with fluid, is termed the "perigastric" or "perivisceral space," and obviously corresponds with the space occupied by fluid which intervenes between the viscera and the walls of the body in most of the lower animals, whilst the fluid in

question, as in numerous other cases, performs the common functions of nutrition and respiration. The rotatory movement observed in it appears to be due, as remarked by Professor Allman, in part to the action of cilia with which the surface of the endoderm, more especially of that lining the tentacular sheath, is furnished, and in part to the varying contractions of the walls in the different and continual movements of the animal.

The chief bulk of the solid contents of the "cell" is formed by the alimentary canal and its appendages. Commencing at the base of the lophophore, this canal descends towards the lower part of the perivisceral space, and then turning abruptly upwards, ascends to reach the upper part of the tentacular sheath, which it perforates nearly on a level with the mouth. The alimentary tract admits of division in the usual way into an œsophagus, stomach, and intestine; to which, in some cases, may be superadded, a dilatable pharynx and a proventriculus or gizzard, furnished with a masticatory apparatus. The œsophagus is contracted and muscular; the stomach, which principally forms the lower part of the loop, is much dilated, and in many cases partially divided into cardiac and pyloric portions; the intestine, which proceeds directly from the stomach to the anus, is at first wide, but ultimately becomes much contracted. The whole tract appears to be lined with vibratile cilia, and on the external surface of the stomach are placed numerous brown hepatic granules. The mouth, at which the aliment enters, is placed, as already observed, within a circle of tentacles, and it may be either a simple orbicular contractile opening, or furnished with a peculiar, apparently protective organ, not unlike the epiglottis in form, and termed by Professor Allman, the epistome.

The nervous system of the Polyzoa is in a very rudimentary condition, being represented only by a small ganglion, usually of a yellowish colour, and placed as in the Ascidians, on the dorsal or rectal aspect of the œsophagus, and thus between the mouth and the anus. From it, in some few cases, fine nervous filaments have been seen to proceed.

The Polyzoa, so far as is known, are all hermaphrodite,¹ each individual being capable of furnishing both the elements required for sexual reproduction. The organs destined for this purpose are of the simplest kind, consisting of an *ovary* and *testis*. The ovary is a rounded, sessile, or shortly pedunculate, granular mass attached to the parietes of the cell, near its summit, in which the ova are developed by a gradual differentiation, and from which, when mature, they escape by dehiscence into the perivisceral chamber. The *testis* is situated at the bottom or lower part of the cell, usually in connexion with a long, cylindrical, granular appendage, passing from the fundus of the stomach to the bottom of the cell, and which has been termed by Professor Huxley, the "funiculus." From this testis the spermatozoa, like the ova, escape into the perivisceral space in vast numbers, and there perform their

¹ With the exception, as it would seem, according to Professor Kölliker, of *Alcyonidium gelatinosum*, Johnst. (*Halodactylus diaphanus*, Farre).

fertilizing function. No special exit appears in most cases to be provided for the escape of the impregnated ova, or of the embryos, which it may be presumed are liberated only after the decease or disruption of the parent.

The above brief exposition will perhaps serve to convey a sufficient general idea of the structure and affinities of the Polyzoa, but as several important modifications of the typical conformation are found in the various sections of this class, it will be necessary, before going farther, to explain the mode in which the primary divisions are formed. In doing this, I shall follow the arrangement proposed by Professor Allman,¹ merely making a few changes in the characters of some of the subdivisions.

Most of the terms employed for the purpose of this classification have already been explained; all that is necessary to add is, that by "front" of the cell is meant that aspect upon which the orifice is situated, whilst the "upper or superior" end is that nearest which it is placed.

¹ *Op. cit.*, p. 10.

SYNOPSIS OF PRIMARY DIVISIONS OF THE POLYZOA.

I. Lophophore bilateral, mouth with an epistome.

Order I. PHYLACTOLÆMATA, *Allm.*

(a) Arms of lophophore, free or obsolete. Consistence horny, subcalcareous.

Sub-Order I. LOPHOPEA (freshwater).

(b) Arms of lophophore united at the extremities. Consistence soft, fleshy.

Sub-Order II. PEDICELLINEA (marine).

II. Lophophore orbicular, or nearly so ; no epistome.

Order II. GYMNOLÆMATA, *Allm.*

(a) Polypide completely retractile ; evagination of tentacular sheath imperfect. Consistence horny or subcalcareous.

Sub-Order III. PALUDICELLEA (fresh-water).

(b) Polypide completely retractile ; evagination perfect ; orifice of cell sub-terminal, of less diameter than the cell, and usually closed with a moveable lip or shutter ; sometimes by a contractile sphincter ; cells not tubular. Consistence calcareous, corneous, or fleshy.

Sub-Order IV. CHEILOSTOMATA, *Busk* (marine).

(b) Cell tubular ; orifice terminal, of same diameter as the cell, without any moveable apparatus for its closure. Consistence calcareous.

Sub-Order V. CYCLOSTOMATA, *Busk* (marine).

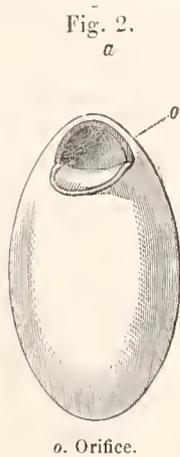
(c) Orifice of cell terminal, furnished with a usually setose fringe for its closure ; cells distinct, arising from a common tube. Consistence horny or carnose.

Sub-Order VI. CTENOSTOMATA, *Busk* (marine).

Of these Orders and Sub-orders, we may at once, in a palæontological point of view, dismiss from consideration all but the *Cheilostomata* and *Cyclostomata*, to which alone, so far as is at present certainly known, do any fossil remains belong. The reason of this has already been explained, or will be obvious upon a glance at the characters of the orders in the foregoing synopsis.

OF THE CHEILOSTOMATA.

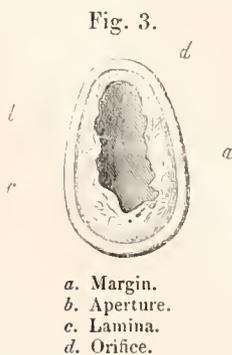
The members of this sub-order may perhaps be regarded as the most highly organized of the Polyzoa, inasmuch as in addition to the common attributes of the class, they are provided with certain organs not found in their allies. The points in which they differ from the Cyclostomata are—1, in the form of the cell, which is never a simple, open, cylindrical tube of pretty nearly uniform diameter throughout, but is either urceolate, turbinate, or of an elliptical or oblong figure, or, as in *Elca*, tubular, expanded, and closed at the extremity; 2, in the position of the orifice, which is never strictly terminal, but always either parallel or oblique to the axis of the cell, and sometimes placed near the centre of the front; 3, by the circumstance that the orifice is fitted with a special apparatus for its closure when the animal is retracted. In the greater number of



cases this purpose is effected by means of a membranous or horny, semicircular lip or shutter, the two angles of which are articulated to the sides of the orifice, and which is moved by special museles (fig. 2). Although from its extensive prevalence the sub-order has derived its name from the presence of this organ, it does not exist universally, the closure of the orifice in some cases, as in *Bugula*, being effected, as it would seem, by a sort of muscular sphincter instead.

The consistence of the cell-walls in the Cheilostomata varies from a soft fleshy, or a horny texture, to one either wholly or partially calcareous. But in many of the instances in which it is usually regarded as altogether corneous, or in which, at any rate, a considerable degree of flexibility is retained, incineration will show that a sufficient amount of calcareous matter is present to maintain the form of the cell, though of course in a most fragile condition, as is the case, for instance, in many *Flustra*, &c.

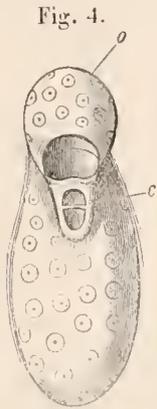
In a great many, moreover, of the more highly calcified Cheilostomata, the walls of the cell remain to some extent membranous. In these cases, when the animal matter is



removed, a greater or less space in or the whole of the anterior surface will appear open. This space (fig. 3 b) in the recent condition is filled up by a thin membrane, in which, in some instances, the orifice with its moveable lid, or surrounded with its sphincter, is placed. In many species also, belonging to the encrusting forms the posterior wall of the cell is apparently altogether deficient, the cavity being bounded behind by the surface of the shell, &c., upon which the cell is affixed; although it cannot be doubted that a membranous pellicle must intervene between this surface

and the perivisceral space of the Polyzoon.

The surface of the cell varies infinitely in appearance; it may be either smooth and entire, spinous or granulous; perforated with minute pores, or eribriform with larger openings; reticulate or ribbed, &c., all of which conditions, with certain precautions, afford excellent diagnostic characters. The margin of the orifice, sometimes termed the "*peristome*," may be simple or thickened, unarmed or beset with erect "*marginal spines*," which again may be either rigid or articulated at the base, simple or branched.



o. Ovicell.
c. Avicularium.

The Cheilostomata, moreover, as a class are especially distinguished by the position and form of an organ termed the "*ovicell*," and by the possession of certain external agents of offence and defence, termed "*avicularia*" and "*vibracula*."

The ovicell is not found in every species, and when present is in some cases so deeply immersed as to be inconspicuous. In a great many species, however, it is apparent in the form of a more or less rounded eminence situated above or behind the cell, as shown in fig. 4. The cavity of the organ is continuous with the perivisceral space, through a passage situated at the upper and back part of the cell, and through which it would appear the ova are conveyed as into a sort of marsupial pouch. This organ is

Fig. 5.

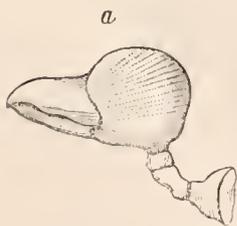


Sessile avicularium.

wanting in the Cyclostomata, in which its functions are apparently supplied by a dilatation of the body of the cell itself.

The other class of organs above referred to is also peculiar to the Cheilostomata, though wanting in many of them. For a detailed account of these interesting appendages the reader may refer to some "*Observations*" respecting them contained in the British Museum Catalogue of Marine Polyzoa, or to a paper on the subject in the '*Transactions of the Microscopical Society*.'¹ It will be sufficient here to remark that the avicularia are so termed from the strong resemblance the earliest and best known form of them presents to a bird's head (fig. 6). They may be subdivided, for the purpose of systematic description, into three sorts—the sessile (fig. 5), the immersed (fig. 4 c), and the pedunculate (fig. 6). But whatever its diversity of form, an avicularium

Fig. 6.



Pedunculate avicularium.

always consists of two parts, viz., a moveable mandible, and a cup furnished with a horny beak, with which the point of the mandible is capable of being brought into opposition. The cup contains muscles properly arranged for the elevation and depression of the mandible, and other parts which need not here be particularised.

The vibracula are organs very similarly constructed, but having, instead of a mandible, an elongated seta, capable of extensive movement principally in one plane.

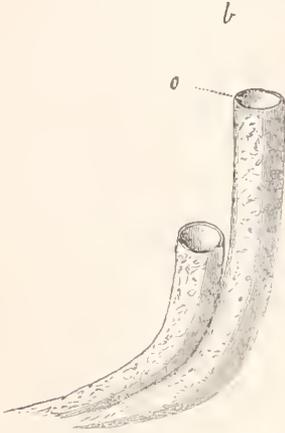
¹ '*Quart. Journ. Microscopical Science*,' vol. ii ('*Transactions*,' p. 26), 1854.

Both these organs, where they exist, are of very great use in the distinction of genera and species; the distinctions being drawn from the differences in position, form, and size, &c., of the organs in question. They are as useful, or nearly so, in this respect in the case of fossil remains as they are in that of recent species, for, although the moveable parts are of course deficient in the former, the remains of the cup are always perceptible in the form of openings and processes of various kinds and in various positions.

The true nature of these openings, &c., not having been understood, they have hitherto been erroneously interpreted or left wholly unnoticed, but in the following pages will be found to have been copiously employed.

In the Cyclostomata the conformation of the cell is simpler. It consists, as above remarked, of a rigid, cylindrical, calcareous tube, whose orifice is terminal and in most cases of about the same diameter as the tube. The *peristome* is usually simple; sometimes, how-

Fig. 7.



ever, slightly expanded, thickened, emarginate, or even denticulate. The orifice is never furnished with any special apparatus for its closure. The surface of the cells is either smooth and entire, or finely dotted and porous (fig. 7).

In both these sub-orders, as, in fact, in all the rest except the Ctenostomata, the cells arise immediately from one another, either in close contiguity or with the intervention of tubular processes; and the infinite diversity of form exhibited in the polyzoaries is mainly due to the direction in which the gemmation takes place, and which differs in almost every species. For instance, if each cell pullulate at a single point at the upper and back part, a polyzoary consisting of a linear series of cells, such as that of *Atea*, or of *Hippothoa*, or *Crisidia* will be presented; whilst if from each cell two are given off and remain in close apposition, a circularly expanded disc of greater or less regularity will be produced, as in *Lepralia*, *Patinella*, &c., and so on,¹ as was long ago pointed out by M. M. Edwards.

Having thus endeavoured to indicate the general relations, and so much of the nature of the Polyzoa as a class, and more particularly of the Cheilostomatous and Cyclostomatous Sub-Orders, as will render the descriptive terms employed intelligible, I will proceed to the proper subject of the memoir, viz., an account of the fossil species found in the Crag, commencing with the Cheilostomata, of which the families or genera may be conveniently arranged as in the following synopsis:

¹ 'Eng. Cyclop.,' art. Polyzoa, p. 5.

SYNOPTICAL CLASSIFICATION of the CHEILOSTOMATA.

Class POLYZOA.

ORDER II. GYMNOLÆMATA.

Sub-Order I. CHEILOSTOMATA.

§ 1 ARTICULATA. Polyzoarium divided into distinct internodes by flexible joints.

§§ 1. UNICELLULARES. Internodes formed of a single cell.

Fam. 1. *CATENICELLIDÆ*, Busk, Brit. M. Cat., part i, p. 3.

* Cell at each division of the branches geminate.

1. CATENICELLA.

** Cell at each division single.

2. ALYSIDIUM.

3. CHLIDONIA.

*** Cells bi-trilocular.

4. CALPIDIUM.

**** Cells forming the stem and primary branches slender and tubular, without a mouth.

5. EUCRATEA.

§§ 2. MULTICELLULARES. Internodes multicellular.

A. Cells disposed in the same plane.

Fam. 2. *CELLULARIIDÆ*.

(a) *Inarmatæ*. Neither avicularia nor vibracula.

6. CELLULARIA.

(b) *Armataæ*. With avicularia or vibracula, or with both.

α. With avicularia and vibracula.

7. SCRUPOCELLARIA.

β. With avicularia only.

8. MENIPEA.

9. EMMA.

γ. With vibacula only.

10. CANDA.

B. Cells disposed round an imaginary axis.

Fam. 3. *SALICORNARIIDÆ*.

* Surface areolated; front of cell depressed, closed.

11. SALICORNARIA.

** Cells with a raised border; front of cell partially open.

12. NELLIA.

*** Cells ventricose; peristome not produced.

13. ONCHOPORA.

**** Cells ventricose; peristome produced into a tube.

14. TUBUCELLARIA.

§ II. INARTICULATÆ. Polyzoarium continuous throughout.

§§ 1. FLEXILES. Texture more or less flexible. Polyzoarium erect, sub-erect, or decumbent and repent, never adnate.

A. UNISERIALES. Cells disposed singly in linear series.

Fam. 4. *SCRUPARIIDÆ*.

* Cell closed.

15. SCRUPARIA.

** Cell open in front.

α. Repent.

16. BEANIA, Johnst.

β. Erect.

17. BRETTIA, Dyster.

B. MULTISERIALES. Cells disposed quincuncially in contiguous series.

1. *Planæ*. Cells disposed in the same plane.

(a) *Ligulatæ*. Branches or divisions narrow, ligulate.

α. With dorsal vibacula or sessile avicularia.

Fam. 5. *CABEREIDÆ*.

* With dorsal vibacula.

18. CABEREA.

** With dorsal avicularia.

19. AMASTIGIA.

β. Avicularia, when present pedunculate; no vibracula.

Fam. 6. *BICELLARIIDÆ*.

* Cells turbinate, distant; oral and other spines.

20. BICELLARIA.

** Cells contiguous; unarmed.

21. HALOPHILA.

*** Cells elliptical, contiguous; with pedunculate avicularia.

22. BUGULA.

(b) *Foliaceæ*. Polyzoarium foliaceous, expanded, entire or lobed.

Fam. 7. *FLUSTRIDÆ*.

α. Cells contiguous.

* In two layers.

23. FLUSTRA.

** Cells in a single layer.

24. CARBASEA.

β. Cells discrete.

25. DIACHORIS.

2. *Cylindricaæ*. Cells disposed around an imaginary axis.

Fam. 8. *FARCIMINARIIDÆ*. Corneous; a large aperture.

26. FARCIMINARIA.

3. *Geminatæ*. Cells in pairs.

Fam. 9. *GEMELLARIIDÆ*.

(a) *Armataæ*. Furnished with avicularia.

27. NOTAMIA.

(b) *Inarmataæ*.

* Cells back to back in the same plane.

28. GEMELLARIA.

** Cells back to back, the alternate pairs at right angles.

† Each pair arising from that immediately below.

29. DIMETOPHA.

†† Each pair arising from the next but one below.

30. CALWELLIA.

THE CRAG POLYZOA.

*** Cells side by side.

31. DIDYMIA.

§§ 2. RIGIDÆ. Texture calcareous, rigid. Polyzoa immoveably fixed or wholly unattached; adnate and crustaceous, erect or massive.

A. ADNATÆ. Polyzoarium wholly adnate. Cells serial, series contiguous or distant,

(a) Series distant, repent.

Fam. 11. HIPPOTHOIDÆ.

* Cells urceolate, decumbent.

† Branches given off from the sides of a cell.

32. HIPPOTHOA.

†† Branches springing from the summit of a cell.

33. ALYSIDOTA.

** Cells tubular, erect.

34. ÆTEA.

(b) Series contiguous; polyzoarium crustaceous, spreading.

Fam. 12. MEMBRANIPORIDÆ.

† Cells depressed, or open in front, with a raised margin.

35. MEMBRANIPORA.

** Cells urceolate, closed in front.

36. LEPRALIA.

B. ERECTÆ. Polyzoarium erect, or massive; cells decumbent and serial; or sub-erect and confused.

(a) Cells sub-erect and confusedly heaped.

Fam. 13. CELLEPORIDÆ.

37. CELLEPORA.

(b) Cells decumbent serial, in one plane.

α. *Affixæ*. Immoveably fixed by a calcareous base.

Fam. 14. ESCHARIDÆ.

(a) Cells in a single plane.

* Two layers of cells.

† Series longitudinal.

38. ESCHARA.

†† Series transverse.

39. MELICERITA.

** A single layer of cells.

† Polyzoarium reticulate.

40. RETEPORA.

†† Polyzoarium entire.

41. HEMESCHARA.

β. *Liberæ*. Polyzoarium unattached, usually discoid, conical or irregular.

Fam. 15. *SELENARIIDÆ*.

* Vibracula inter-serial.

42. LUNULITES.

** Vibracula intra-serial.

43. CUPULARIA.

*** Vibracula scattered.

44. SELENARIA.

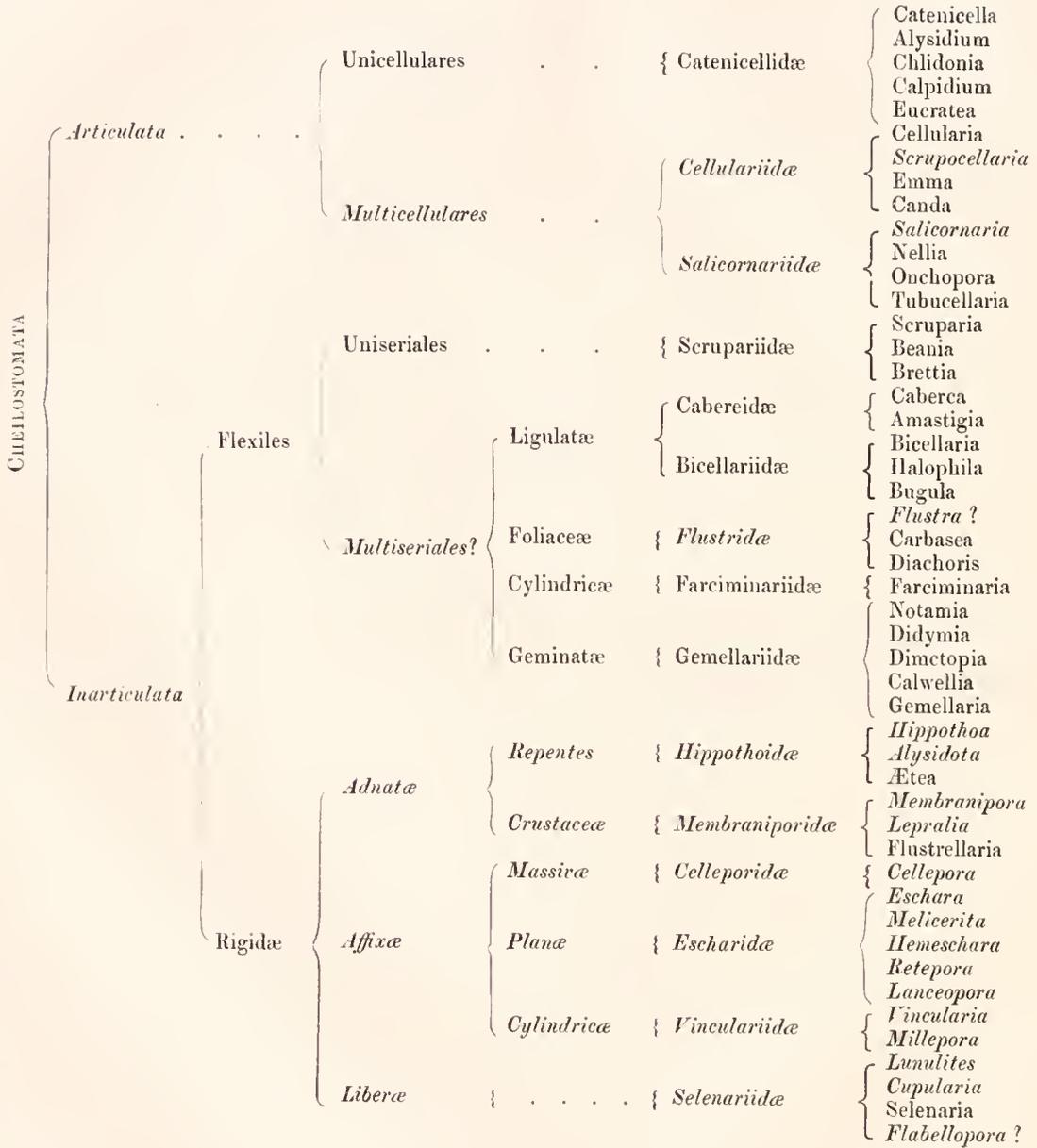
(c) Cells disposed around an imaginary axis.

Fam. 16. *VINCULARIIDÆ*.

45. VINCULARIA.

Or in a tabular form, as follows, in which those families, genera, &c., in which fossil species occur, are printed in italics :—

TABULAR VIEW of CHEILOSTOMATA.



§ I. ARTICULATA.

§§ 2. MULTICELLULARES.

Fam. I. CELLULARIIDÆ, *Busk*.*Genus* 1. SCRUPOCELLARIA, *Van Beneden*.

Cellulis rhomboidalibus, posticè sinuatis; angulo cellulæ superiore aviculario sessili, armato; vibraculo in sinu dorsali posito; aperturâ spinis marginalibus supra armatâ, operculo pedunculato subinde tectâ. Cellulis biserialibus, in singulo internodio numerosis.

Cells rhomboidal, with a sinus behind; a sessile avicularium on the upper and outer angle; a vibraculum seated in the dorsal sinus; aperture, with marginal spines above; sometimes protected by a pedunculate operculum. Cells biserial, numerous in each internode.

SCRUPOCELLARIA, *Van Beneden*, *Recherches*, &c., p. 42; *Busk*.

BICELLARIA (sp.), *Blainville*.

CELLULARIA (sp.), *Pallas*; *Fleming*; *Johnst.*

CELLARIA (pars), *Solander* and *Ellis*.

SCRUPARIA (sp.), *Oken*.

BACTRIDIVM, *Reuss*, *Foss. Polyp.*, d. Wien. Tertiärbeck, p. 55.

1. S. SCRUPOSA (?) *Lin.* Pl. I, fig. 6.

Cellulis subelongatis, angustis; aperturâ ellipticâ, 3—4 spinis marginalibus supra armatâ; ovicecellulâ glabrâ.

Cells subelongate, narrow; aperture elliptical, with three or four marginal spines above; oviceell smooth.

SERT. SCRUPOSA, *Lin.*

CELLULARIA SCRUPOSA, *Pallas*, *Johnston*.

SCRUPOCELLARIA SCRUPOSA, *V. Beneden*, l. c., pp. 43 and 50, pl. v, figs. 8—16. *Busk*, *Ann. Nat. Hist.*, 2 ser., vii, p. 85, pl. ix, figs. 8, 10. *Brit. M. Cat.*, part i, p. 25, pl. xxii, figs. 3, 4.

Habitat.—C. Crag, *S. W.* (*Recent*); Britain, ubique.

A single, small, and very imperfect fragment of a *Scrupocellaria* occurs in Mr. S. Wood's collection, whose condition renders it almost impossible to be certain of more than the generic character. The aspect of the specimen, however, when compared with that of broken fragments of *S. scruposa*, is sufficient to justify its provisional reference to that species, which it resembles perhaps more closely than it does either of the four species of *Bactridium*, noticed by Reuss, in the Vienna Tertiary Basin.

Fam. II. *SALICORNARIIDÆ*, *Busk.*

Cells disposed quincuncially around an imaginary axis; forming the cylindrical internodes of a dichotomously divided, erect, phytoid polyzoarium.

Genus I. *SALICORNARIA*, *Cuvier.*

Polyzoarii superficie in arcis angulatis divisâ; aviculariis immersis, irregulariter inter cellulas sparsis. Ovicellulis occultis, poro areæ summitate posito.

Surface of polyzoarium subdivided by ridges into more or less uniform, angular *areæ*; immersed avicularia dispersed irregularly among the cells. Ovicells concealed, opening at the summit of the area.

SALICORNARIA, *Cuvier*, R. An., 1817; *Johnston*; *Busk*; Auct.

SALICORNIA, *Schweigger.*

CELLULARIA (pars), *Pallas*; *Bruguère*; *Ellis* and *Solander.*

CELLARIA (pars), *Lamouroux*; *Lamarck*; *Blainville*; *Bosc*; *Reuss.*

— *Hagenow*; *D'Orbigny* (including *Cellarina*); *S. Wood*; *J. Morris.*

VINCULARIA, *Bronn.*

— (pars), *Defrance* et Auct.

GLAUCONOMA (pars), *Goldfuss.*

ESCHARA (sp.), *Linn.*; *D'Orbigny.*

ESCHARINELLA (sp.), *D'Orbigny.*

FARCIMIA, *Fleming*; *Couch.*

TUBULARIA (sp.), *Linn.*; *Olivi.*

ISIS (sp.), *Fabricius.*

FLUSTRA (sp.), *Linn.*

The distinction between *Vincularia*, *Defrance*, and *Salicornaria*, is sufficiently marked by the character that in the latter genus the polyzoarium is subdivided into distinct inter-

nodes, whilst in the former the branches are continuous, as in a branching *Eschara* or *Cellepore*. The junction between the separate joints or internodes in all recent Salicornariidæ is effected by means of flexible, chitinous tubes, and it is extremely rare to meet with an instance of rigid anchylosis between them. In one recent species, however, (*Sal. malvinensis*, nob.), the two internodes may occasionally be seen thus united, whilst the rest of the growth retains the flexible condition. This observation is of particular interest with regard to the fossil Salicornariæ of the Crag, in which a rigid connexion appears to be far more frequent, although, notwithstanding this frequency, little doubt can be entertained that it is what may be termed accidental or exceptional, as in *Sal. malvinensis*. It will be observed that even where anchylosis has taken place, the apparent branch is contracted at the point of junction, which is not the case in the true *Vinculariæ*, of which one well-marked recent species at any rate exists. It follows from this, therefore, that fragments of a fossil *Salicornaria* may, in most cases, be distinguished, among other characters, by their tapering towards the ends. The peculiar angular areolation of the surface, and the presence of scattered immersed avicularia, are other characters also sufficiently diagnostic of the genus, which we consequently fully agree with Dr. Hagenow in regarding as altogether distinct from *Vincularia*, DeFrance, a term which should be restricted to the continuous, cylindrical polyzoaria which seem to have predominated in past periods, whilst the true *Salicornariæ* appear to have been gradually increasing in number of species up to the recent epoch.

With respect to the appropriate appellation of the *genus*, the synonymy above given will show that great confusion has existed.

The *Salicornariidæ*, or species having articulated polyzoaries composed of cylindrical internodes, in which the cells are disposed around an imaginary axis, were originally confounded by Pallas under his genus *Cellularia*, and by Solander under that of *Cellaria*, with many others not possessing that peculiar characteristic. The term *Cellaria*, it is true, was afterwards restricted by Lamouroux to those species which had cylindrical branches, or rather in which the cells were disposed around a central axis; but as this definition would also include *Vincularia* and our genus *Onchopora* ("Quart. Journ. Mic. Soc.," iii, p. 320, 1855), it would not be equivalent to *Salicornaria*, as here understood. And as it might also be readily confounded with the more extensive *Cellaria* of Dr. Solander and most authors except Blainville, it seems hardly advisable that it should be readopted in again an altered sense. Among the other appellations already in use, none appears more suitable or less liable to be misunderstood than that of *Salicornaria* Cuv., which has moreover the advantage of having already been very generally adopted.

It is necessary to explain a few of the terms employed in the description of the *Salicornariidæ*, which appear to be demanded by some peculiarities belonging to them.

1. The angular spaces into which the surface of the internodes is divided, and each of which corresponds to the outline of a cell, are termed the *areæ*.

2. The orifice perceptible in many of the cells at the summit of the "area," and

which represents the opening of a concealed ovicell, is termed the *ovarian orifice* or *pore*.

3. The secondary openings, often of considerable size, observable at the apex of many of the cells, having been shown by observation of recent forms to belong to avicularia, are termed accordingly *avicularian openings*.

1. SALICORNARIA CRASSA, *S. Wood* (sp.) Pl. XXI, figs. 4, 6.

Internodiis crassis, clavatis, subcompressis; cellulæ orificio infrâ denticulo valido aeuto, interno utrinque munito. Ovicellulæ orificio dente conico unico infra armato; cellulæ facie anteriori lineâ elevatâ utrinque signatâ.

Internodes thick, clavate, sometimes compressed; a large tooth on each side of the orifice within the lower border; a single conical tooth on the lower border of the ovarian pore; a narrow raised line on the front of the cell on either side of the mouth, meeting below.

CELLARIA CRASSA, *S. Wood*, Ann. Nat. Hist., xiii, p. 17; Morris's Catal., p. 120.

Habitat.—Cor. Crag, *S. W.*

This species appears to exhibit a very great tendency to ossification of the junctions between the internodes; so much so, in fact, that most of the specimens present a bifurcate aspect at one end. The avicularian aræ are quadrangular, with a circular aperture, whence it is probable that the mandible was rounded or obtuse, as in *Sal. farciminoïdes*. The surface of the cells and of the ridges, so far as can be judged of in a fossil, are smooth or very finely granular; and the front of the cell within the area is very peculiarly marked by the presence of two slender, straight, raised lines or ridges, which, commencing at the sides of the area, about on a level with the upper border of the mouth, descend on either side and meet towards the lower part of the cell. These lines are shown, but not very distinctly, at *d*, fig. 4, and *c*, fig. 6. Rounded raised lines, much in the same situation, are occasionally to be seen in *Sal. farciminoïdes*, but these do not appear to meet below, and are far less constant in that species than the lines in question are in *S. crassa*. The single conical tooth in front of the ovarian opening is also characteristic of *S. crassa*. In *S. farciminoïdes* this opening is unarmed, and at first narrow and elongated longitudinally, whilst in *S. crassa*, at its earliest appearance, it is round and afterwards elongated transversely with the tooth in question on its lower margin. The proper form of the tooth is seen in the lowermost cell in *b*, fig. 4; in *d*, fig. 6, it is represented bifid, but this is an accidental appearance, and probably due to injury.

2. *S. sinuosa*, *Hassall*. Pl. XXI, fig. 5.

Internodiis cylindricis, equalibus vel superne subinde incrassatis. Arcæ elongatâ rhomboidali, hexagonâ, vel pyriformi; superficie delicate granuloso. Orificio subquadrangulâri, margine inferiori valde elevato; ovicellulæ orificio transverse elongato, dente bicuspidato lato infra armato. Avicularii mandibulo, triangulari, acuto.

Internodes cylindrical, uniform, or slightly incrassated above. Area elongated, rhomboidal, hexagonal, oblong or pyriform; surface finely granular. Orifice subquadrangular, with a much-raised lower lip; ovarian orifice elongated transversely, with a broad bicuspid tooth on the lower margin. Mandible of avicularium triangular pointed.

FARCIMIA SINUOSA, *Hassall*, *Ann. Mag. N. H.*, vi, p. 172, pl. vi, figs. 1, 2; *Johnston*; *Macgillivray*.

FARCIMIA SPATHULOSA, *Hassall*.

SALICORNARIA FARCIMINOIDES (var.), *Busk*, *B. M. Cat.*, p. 16; *S. Wood*; *J. Morris*.

Though at one time I entertained the opinion that *Sal. farciminoides* and *Sal. sinuosa* were one and the same species, I have long been convinced that they are specifically distinct. The distinction does not, however, arise so much from the prevailing form of the areæ in either, seeing that no fixed characters could be thence derived, but chiefly from the following particulars: 1. In *S. farciminoides* the mandible of the avicularium is semicircular, small, blunt, and looks upwards, whilst in *S. sinuosa* it is triangular, acutely pointed, and directed either straight or obliquely downwards. 2. The ovarian orifice in *S. farciminoides* is simple, and either round or elongated in a longitudinal direction, and in *S. sinuosa* narrow, slit-like and transverse, the lower border being formed by a wide bicuspid tooth. 3. In *S. farciminoides* the front of the cell often presents on each side within the area an elongated elevation or ridge, which is never perceptible in *S. sinuosa*. As to the identity of the fossil and recent forms, a close comparison of numerous specimens of both leaves no doubt whatever on my mind. The only difference between the two, of the least moment, is the frequency or rather the occasional occurrence in the former of anchylosis between the internodes, which has never offered itself to my observation in the latter. Scarcely any remark is required to point out the distinction of this species from its fossil congener, whose more robust and often compressed form, shortness and venation of the areæ, simple tooth at the ovarian pore, &c., allow of no hesitation on the subject.

§ II. INARTICULATA.

§§ 2. RIGIDÆ.

§§§ 1. ADNATÆ.

A. REPENTES.

Fam. III. *HIPPOTHOIDÆ*, *Busk*.

Cellularum sericibus distantibus, repentibus.

Series of cells distant, repent.

SCRUPARIADÆ (pars), *Gray*; *Busk*.

EUCRATIADÆ (pars), *Johnst*.

Genus 1. *HIPPOTHOA*, *Lamx*.

Cellulis urceolatis seu pyriformibus, decumbentibus. Ramis a lateribus cellulæ datis.

Cells urceolate or pyriform, decumbent; branches given off from the sides of a cell.

HIPPOTHOA, *Lamx*, *Exp. Meth.*, p. 82, 1821; *Johnst.*; *Busk*.

CATENICELLA (pars), *Blainville* (non *M. Edwards*).

TEREBRIPORA, *D'Orbigny*.

ALECTO (sp.), *CRISERPIA* (sp.), *Michelin*.

CATENARIA (sp.), *S. Wood*.

1. *H. PATAGONICA*, *B*. Pl. I, fig. 5.

Cellulis pyriformibus, infra attenuatis, irregulariter annulatis; orificio orbiculari, subtus inciso; ramis angulo prope recto divaricatis.

Cells pyriform, attenuated below, irregularly annulate; orifice orbicular, with a notch below; branches divaricate nearly at a right angle.

H. PATAGONICA, *Busk*, B. M. Cat., p. i, p. 30, pl. xvii, fig. 1.

ALECTO VESICULOSA (?), *Michelin*, Icon. Zooph., p. 319, pl. lxxvii, fig. 3.

Habitat.—C. Crag, on *Pecten*, *S. W.*; *Hippurite limestone*, St. Gregoire, near Rennes, *Michelin*. (*Recent*), Coast of Patagonia, Falkland Islands, on fucus, *Darwin*; Britain (?); Tasmania.

The Crag fossil corresponds in all respects with the Patagonian form. The circumstance that the latter would appear always to select a fucus for its base is probably in this genus one of little importance. A species bearing considerable resemblance to the present occurs in the Arctic sea, but is distinguishable by its mouth being larger and without the notch at the lower margin. The cells, moreover, and their tubular prolongation, are less distinctly annulated.

2. *H. ABSTERSA*, *S. W.* Pl. XXII, fig. 6.

Cellulis ovatis, clongatis, vel subpyriformibus, infra subattenuatis, seu potius productis; superficie glabro, compressis; orificio suborbiculari subtus inciso; ramis ascendentibus, confertis.

Cells ovate, elongate, or subpyriform, very slightly attenuated or produced below, smooth, compressed, or slightly raised in front; orifice suborbicular, with a notch below; branches ascending crowded.

L. ABSTERSA, *S. W.*, Ann. Nat. Hist., xiii, p. 19.

CRISERPIA PYRIFORMIS (?), *Mich.*, Iconog. Zooph., p. 332, pl. lxxix, fig. 6.

Habitat.—Coralline Crag, Walton, on inside of *Pholas*, *S. W.*; (?) Douè (Maine et Loire), *Mich.*; Red Crag, Sutton, on *Pectunculus glycimeris*.

3. *H. DENTATA*, *S. W.* Pl. I, fig. 7.

Cellulis angustis, ovatis, lanceolatis, seu pyriformibus; aperturâ ovali, margine spinoso; ramis angulo prope recto divergentibus.

Cells slender, ovate, lanceolate, or pyriform; aperture oval, margin spinous; branches divaricated nearly at a right angle.

CATENARIA DENTATA, *S. W.*, l. c., p. 19.

Habitat.—C. Crag, on shell, *S. W.*

The peculiar armature of the aperture in this species distinguishes it from *H. catenularia*, with which in some conditions it might otherwise readily be confounded.

Genus 2. ALYSIDOTA, Busk.

Cellulis urceolatis, uniserialibus ; ramis cellulæ summitate surgentibus.
Cells urceolate, uniserial ; branches springing from the summit of a cell.

ALYSIDOTA, Busk, Quart. Jour. Mic. Sc., iv, p. 311.

In the British Museum Catalogue of Marine Polyzoa, p. 82, pl. xcii, figs. 1, 2, a species of *Lepralia* is described and figured under the name of *C. labrosa*, in which the series of cells are not contiguous as in a true *Lepralia*, but divergent, branching out irregularly from a common point, around which the cells are sometimes crowded together without any definite order. Standing alone as it then appeared to do, this species was regarded as an aberrant *Lepralia*, a genus to which the present is undoubtedly very closely allied. But when a second well-marked form of the same kind was noticed by Mr. Alder, it seemed advisable that similar growths should be associated into a distinct generic group. The latter species, of which numerous specimens have since been collected by Mr. Barlee in the Orkneys, will be found described in the 'Quart. Journ. Micros. Sc.,' p. 311, and figured in pl. ix (Zoophytology), figs. 6, 7.

The genus stands between *Hippothoa* and *Lepralia*, though perhaps more closely allied to the latter than to the former, from which it is distinguished by the circumstance that the cells arise from each other by a broad base, or are, as it were, immediately contiguous without the intervention of a tubular prolongation, and that the branches divide for the most part dichotomously or irregularly, while in *Hippothoa*, owing to their always springing in opposite pairs from the sides of a cell, from which a third series is also continued in the original direction, the ramification may be termed trichotomous.

1. A. LABROSA, B. Pl. XXII, fig. 7.

Cellulis ovatis puncturatis ; orificio orbiculari, peristomate valde elevato, incrassato, expanso, supra sæpius emarginato ; ovicellulâ globosâ, glabrâ, recumbente.

Cells ovate punctured ; orifice orbicular, with a much-raised, thick, expanded peristome, which is often deficient above or behind ; ovicell globose, smooth, recumbent.

LEP. LABROSA, B., B. M. Cat., p. ii, p. 82, pl. xcii, figs. 1, 2.

Habitat.—Red Crag, on inside of a shell, *S. W.* (*Recent*) ; Belfast Bay, in deep water, on the inside of a dead shell, *W. Thompson*.

2. A. CATENA, *S. W.* (sp.) Pl. VII, fig. 7.

Cellulis ovatis, quadri costatis, costâ infimâ mediâ impari; sulcis longitudinaliter striatulis seu obscure punctatis; orificio suborbiculari; spinis tribus marginalibus.

Cells ovate, with four costæ on each side and a single median one below; sulci longitudinally striate, or obscurely punctate; orifice suborbicular; three marginal spines.

L. CATENA, *S. W.*, l. c., p. .

Habitat.—Cor. Crag, Sutton, *S. W.*, on the inside of a small bivalve.

This species appears to possess, in a remarkable degree, the power of excavating or eroding the surface of the shell upon which it grows, a property common to several other *Lepraliæ*, though the means by which it is exerted is very obscure.

B. CRUSTACEÆ.

Fam. IV. MEMBRANIPORIDÆ.

Polyzoario membranaceo-calcareo seu calcareo, incrustante, adnato, cellulis horizontalibus, quincuncialibus seu oppositis, contiguis composito.

Character.—Polyzoarium membranaceo-calcareous or calcareous, adnate, encrusting; cells horizontal, quincuncial, or opposite, series contiguous.

FLUSTRA (pars), *Linn.*

FLUSTRADÆ (pars), *Gray*, Cat. B. M., 145.

CELLEPORIDÆ (pars), *Johnston*, Brit. Zoophyt., 2d ed., p. 263.

MEMBRANIPORIDÆ, *Busk*, B. M. Cat., p. ii, p. 56.

SYNOPSIS OF GENERA.

(a) Cells more or less open or membranaceous in front, with raised margins; growth indefinite.

1. MEMBRANIPORA.

(b) Cells closed in front; contiguous; growth usually circumscribed.

2. LEPRALIA.

Genus 1. MEMBRANIPORA.

Polyzoario diffuso; cellulis anticè depressis, sæpius plus, minusve membranaceis sive apertis, margine elevato circumdatis.

Polyzoarium enerusting, spreading irregularly. Cells more or less irregularly disposed or quineuneial; margins raised; front depressed, often more or less membranaceous or open in front.

ESCHARA (pars), *Pallas.*

FLUSTRA (pars), *Linn.; Muller; Esper; Lamarck; Grant; Fleming; Risso; Johnst.,* Transact. Newc. Soc.; *Lamouroux,* Hist. d. Polytes, p. 96.

MEMBRANIPORA, *Blainville,* Man. d'Actinol., p. 447; *Johnston; Busk,* B. M. Cat., p. ii, p. 56; *W. Thompson; Hassall; Reuss* (1851, not 1847).

CELLEPORA (pars), *Hagenow; Reuss; D'Orbigny.*

DISCOPORA (pars), *Lamarck,* An. S. V., ii, p. 248, 1836.

ANNULIPORA (sp.), *Gray,* Append. B. M. List.

CONOPEUM (sp.), *Gray,* ib.

CALLOPORA (sp.), *Gray,* ib.

AMPHIBLESTRUM (sp.), *Gray,* ib.

MICROPORA (sp.), *Gray,* ib.

MARGINARIA (pars), *Ræmer; Hagenow.*

DERMATOPORA (pars), *Hagenow.*

In the genus *Membranipora*, the polyzoarium is adnate, creeping in an irregular manner over the surface of rocks, shells, or fuci. The cells are contiguous, sometimes disposed in parallel lines or series, sometimes very regularly quineuneial. The peculiar characters of the cell itself consist in its being either much depressed or partially open in front, that is to say, the calcareous wall of the cell is deficient for a greater or less extent, the vacancy or "aperture" being occupied in the recent state by a thin chitinous membrane, in which is placed the true orifice, with its moveable lip. In many cases, however, in advanced age the membrane becomes more or less completely calcified, but in this case the character of the genus is still manifested in the persistent elevated border which surrounds the cell, and constitutes a sort of frame. Some of the species are variously armed with spines, tubercles, and avicularia, whence good specific characters are derivable. Some exhibit very great varieties of aspect, according to their age, the situation in which they have lived, or the greater or less degree to which they may have been exposed to various external influences; and so great is this variety that it is difficult, even in recent or living forms, always to be certain of any given specimen. Numerous species, both recent or fossil, have been described, and their appearance on the globe appears to date from the Cretaceous period. But among the fossil forms, belonging more especially

to the *Marginaria* of Rœmer, some may perhaps be regarded as representing the much-worn remains either of other species of *Membranipora* or of *Lepralia*, in which only the outline, as it were, of the adherent cells is left.

SYNOPSIS OF SPECIES.

(a) Cells more or less open in front; usually no posterior calcareous wall.

a. Inarmatæ.

1. M. TUBERCULATA.
2. M. MONOSTACHYS.
3. M. SAVARTII.
4. M. ELEGANS.
5. M. DUBIA.

β. Armatæ. (Furnished with avicularia.)

6. M. TRIFOLIUM.
7. M. POUILLETII.
8. M. RYNCHOTA.
9. M. APERTA.

(b) Cells closed in front by a calcareous lamina; posterior wall calcareous.

a. Inarmatæ.

10. M. ORLONGA.
11. M. BIDENS.
12. M. ANDEGAVENSIS.
13. M. FISSURATA.

β. Armatæ.

14. M. OCEANI.
15. M. HOLOSTOMA.

§ 1. INARMATÆ.

1. *M. TUBERCULATA* (?) *Bosc.* Pl. II, fig. 1.

Cellulis subovalibus seu quadrangularibus; margine sulcato granuloso; aperturâ magnâ oram seabram, subinde denticulatam ostendente; supra utrinque tuberculo obtuso munitâ.

Cells suboval or quadrangular; margin sulcate, granular; aperture large with a rough, sometimes denticulate margin; a blunt tubercle on each side above the aperture.

FLUSTRA TUBERCULATA, *Bosc*, Vers., 2d ed., t. iii, p. 143 (ex. syn.)

FLUSTRA MEMBRANACEA, *Esper*, Flustra, pl. v.

FLUSTRA CRASSIDENTATA, *Lamarck*, II. n. d. An. s. V., 2d ed., t. ii, p. 224.

M. MEMBRANACEA, *S. Wood*, Ann. N. H., xiii; (var.) *Busk*, B. M. Cat.

MEM. TUBERCULATA, *Busk*, Q. I. Mic. Sc. (Zoophytology), vi, p. 126, pl. xviii, fig. 4.

Habitat.—C. Crag, Sutton; and Red Crag, *S. W.*, on *Maetra ovalis* (?) (*Recent*), Atlantic Ocean, Madeira, Rio de Janeiro, on *Sargassum fluitans*. *

The resemblance between the present species and the *M. tuberculata*, *Bosc* (sp.), of which abundant examples may be found on the vesicles of Gulf-weed, is so strong as to induce me to regard them as most probably identical, though some not unimportant differences may be pointed out between them.

The most striking of these is the circumstance that the recent *M. tuberculata* is found almost exclusively upon Gulf-weed, or, at any rate, upon some species of fucus, whilst the fossil encrusts dead shells. In the form and general appearance of the cells, when the animal matter has been removed by incineration in the recent species, the resemblance between the two is very striking, allowing, of course, for the greater sharpness of the recent form; but in one particular, a distinction is apparent even in this respect. In the recent *M. tuberculata* the spines are cylindrical, ascending, and more nearly approximated than they are in the fossil; in fact, so nearly do they occasionally approach each other in the living form as sometimes to coalesce into a single bifid tubercle. In the fossil, on the contrary, the spines, or rather the remaining bases of them, present an elliptical outline, the longer axis being oblique with respect to the longitudinal axis of the cell, and they never show any inclination to a nearer approximation. In the fossil form also the spines are often wholly wanting throughout the greater part of a patch, as is shown in *c*, fig. 1—but in the recent they are invariably present. As the deficiency, however, may perhaps, in great measure be owing to attrition (though of this there is no clear evidence), it cannot be relied upon as a certain diagnostic character.

2. *M. MONOSTACHYS*, *Busk*. Pl. II, fig. 2.

Polyzoario primum ramoso, deinde conferto; cellulis ovatis seu pyriformibus deorsum attenuatis, in seriebus linearibus dispositis. Aperturâ ovali margine tenui, granulosa; spinâ submarginali unicâ acuminatâ sub aperturam positâ. Aviculariis subinde inter cellulas sparsis.

Polyzoarium in the young state ramose; cells ovate or pyriform, attenuated downwards, and disposed in linear series. Aperture oval, margin thin, granular, a single acuminate submarginal spine below the aperture; avicularia sometimes scattered amongst the cells.

M. MONOSTACHYS, *Busk*, B. M. Cat., P. ii, p. 61, l. lxx.

M. NUDA, *S. Wood*, MS. label on specimen.

FLUSTRA PUSTULOSA (?), *D'Orbigny*, Terr. Cret., pl. dccxxv, figs. 22—25.

MEMB. NOBILIS (?), *Reuss*, Fossil Polyp., W., T. Beck, p. 98, pl. xi, fig. 26.

Habitat.—Red Crag, on *Maetra ovalis*, *Mya arenaria* and *Purpura lapillus* (?) (*Recent*) abundant on the Suffolk coast, in the mouth of the Deben, &c., on shells.

3. *M. SAVARTII*, *Aud.* Pl. II, fig. 6.

Area quadrangulari oblonga; marginibus incrassatis, granulosis, sulcatis; aperturâ magnâ subellipticâ.

Area of cells quadrangular oblong; ridges thick, granular, deeply sulcate; often a triangular space at each angle of the cell. Aperture large, subelliptical.

FLUSTRA SAVARTII, *Audouin*, Expl. i, p. 240; *Savign.*, Egypt, pl. x, fig. 10.

M. LACROIXII (var), *Busk*, Brit. Mus. Cat., part ii, pl. civ, fig. 1.

FLUSTRA DISTANS ? (pars ?) *Hassall*, Ann. N. H., vii, p. 369.

M. LIGERIENSIS (?), *D'Orbigny*, l. c., pl. devii, figs. 5, 6.

Habitat.—Red Crag, on *Solen.*, *S. W.* (*Recent*) Britain (?); Mediterranean.

4. *M. DUBIA*. Pl. III, fig. 12.

Polyzoario crasso; cellulis elongatis oppositis, discretis; marginibus incrassatis, glabris, supra arcuatis.

Polyzoarium thick; cells elongate, oblong, opposite, separated by elongate spaces; margin rounded, smooth, arched above.

Habitat.—C. Crag, on shell, *S. W.*

Though placed among the *Membraniporæ*, it is extremely doubtful whether the fragment here described be a *Membranipora*, or even a Polyzoon at all. If so, it should perhaps form the type of a new genus or even family.

§ 2. ARMATÆ.

5. *M. TRIFOLIUM*, *S. Wood*. Pl. III, figs. 1, 2, 3, 9.

Polyzoario discoidali, radiato, diffuso; cellulis elongatis, rhomboidalibus seu hexagonis; aviculario unico vel duobus in fronte cellulæ infrâ posito; ovicellulâ aream depressam triangularem ostendente.

Polyzoarium discoidal, radiate, indefinite, cells elongated, rhomboidal or hexagonal; one or two avicularia on the lower part of the cell in front within the area; surface smooth; ovicell with a triangular depression in front.

M. TRIFOLIUM, *S. Wood*, *Ann. Nat. Hist.*, xiii

Habitat.—C. Crag, on *Terebratula grandis*, and other shells; very abundant. Red Crag (?) *S. W.*

The peculiar trifoliate shape of the aperture at once distinguishes this species from all the other fossil *Membraniporæ* of the Crag, as well as from all living species with which I am acquainted, except, perhaps, *M. Flemingii*.

The avicularia are not always present, and instead of one in the median line on the front of the cell, there may be two, one on either side, arising apparently in the line of division between two cells. The double avicularia are usually found on those parts of the polyzoarium in which the ovicells exist; the latter consequently are commonly, if not always, seen to be crowned, as it were, with two avicularia, one on either side of the summit, as is often the case also in the recent *M. Flemingii*.

The only Red-Crag specimen which appears to belong to this species is too imperfect to allow of its identity being positively determined.

6. *M. POUILLETII*, *Audouin*. Pl. III, figs. 4, 5, 6.

Cellulis ovatis, deorsum latioribus; lamina 0; margine granuloso, tenui; supra, 4—6 spinis armato. Aviculariis sparsis seu subinde aviculariio utroque lateri ovicellulâ posito.

Cells ovate, broader below ; no lamina ; margin granular, thin ; from four to six oral spines above. Avicularia dispersed, sometimes one on each side of the ovicell.

FLUSTRA POUILLETII, *Audouin*, Expl., p. 240 ; *Savigny*, Egypt, pl. ix, fig. 12.

M. POUILLETII, *Alder*, Transact. Tyneside Nat. Field Club, p. 56, pl. viii, fig. 5.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain ; Mediterranean.

A very small fragment only has been observed, but with the characters so well displayed that little doubt can be entertained of its identity with the recent form.

7. M. RHYNCHOTA (*n. sp. ?*) Pl. III, fig. 7.

Polyzoario radiato ; superficie glabrâ ; aperturâ magnâ, oblongâ, deorsum latiori ; margine inerassato, spinâ (articulatâ ?) uno latere armato. Aviculario cylindrico ascendente, in fronte cellulæ posito. Ovicellulâ exiguâ, fossâ triangulari signatâ.

Polyzoarium radiate ; surface smooth ; aperture large, oblong, wider below, margin thickened ; a small marginal spine (probably articulated) on one side, about one third of the length of the cell from above ; a prominent, cylindrical, ascending avicularium on the front of the cell below. Ovicell small, with a triangular fossa in front.

M. TRIFOLIUM (? var.) *S. W.*

Habitat.—C. Crag, on shell, often overgrowing species of *Lepralia* or *Membranipora trifolium*. *S. W.*

The form of the aperture, and the position and presumed articulation of the marginal spine, give this form some resemblance to *M. Flemingii*, in which occasionally a single, very large, articulated spine may be observed on one side only of the aperture (*vide* 'B. M. Cat.', pl. lxxxiv, fig. 3). But in other respects, no relation whatever exists between the two. The long and strong cylindrical avicularium on the front of the cell, and which is very rarely absent, affords an easy diagnostic character to this species. When the ovicell is developed, as it appears in most cases to be, the avicularium of the cell above is elevated, as it were, by the rising ovicell of the cell below, which thus comes to be crowned, and in fact almost concealed, by the avicularium.

8. M. APERTA (*n. sp.*) Pl. III, fig. 13.

Polyzoario effuso, reticulari ; cellulis apertis ; margine superne elevato, glabro ; aviculariis magnis, elongatis, lanceolatis, inter cellulas dispositis.

Polyzoarium spreading, reticular; aperture occupying the whole front of the cell; margin projecting above, smooth; large, elongated, lanceolate avicularia interspersed among the cells.

Habitat.—C. Crag, *S. W.*, on *Tereb. grandis*, spreading over *Lepralia punctata*.

9. *M. OBLONGA* (*n. sp.*) Pl. II, fig. 3.

Polyzoario effuso, irregulari; arcis oblongis, rectangularibus; laminâ utrinque punctatâ; septis glabris, longitudinaliter sulcatis; orificio semiobiculari, labro inferiori recto; tuberculo rotundato utrinque supra aperturam. Ovicellulis immersis, inconspicuis.

Polyzoarium spreading irregularly; area of cell oblong, rectangular; lamina punctured at the sides; septa smooth, sulcate; orifice semicircular above, with a straight lower lip; slightly raised; a rounded tubercle on each upper angle; ovicells deeply immersed; inconspicuous.

Habitat.—C. Crag, on *Pecten*, and pebble, *S. Wood*.

10. *M. BIDENS*, *Hagenow*. Pl. II, fig. 4.

Arcis ovalibus, supra arcuatis; infra truncatis; cellulis clausis; superficie anteriori convexâ, glabrâ; orificio terminali, semilunari, labro inferiori dentibus duobus latis armato, ovicellulis immersis, inconspicuis.

Area oval, arched above, truncate below; front of cell convex, smooth; orifice quite at the summit, crescentic; lower lip with two broad teeth; septa smooth, sulcate, or simple; ovicells immersed, inconspicuous.

CELLEPORA BIDENS, *Hagenow*, Bryoz. Maäs. Kreideb. p. 9, pl. xi, fig. 16.

CELLEPORA HIPPOCREPIS (?), *Reuss*, Foss. Pol., W., T. Beck., p. 95, pl. xi, fig. 14.

Habitat.—C. Crag, on *Pecten* and other shells and pebbles, *S. W.* Chalk formation, Maastricht, *Hagenow*, *Goldfuss*.

Hagenow's figure of *M. bidens* appears to correspond in every respect with that of the Crag fossil, which is, therefore, referred to his species. The form of the cell and of the orifice in *M. (C.) hippocrepis*, Goldf., and of which a figure is also given by Hagenow (ib., fig. 17), appears to approach very nearly to that of *M. bidens*, so nearly, in fact, as almost to lead to the suspicion that the two forms are very intimately related, especially when it is remembered that they both occur in the same locality. A very considerable difference, however, in size, is apparent between the two; and although this may not

perhaps be a very decisive character, one of more importance exists in the presence in *M. (C.) hippocrepis*, of large, scattered, lanceolate avicularia among the cells, none of which are visible in the figure of *M. bidens*, nor in the Crag specimens.

11. *M. ANDEGAVENSIS*, *Michelin*. Pl. II, fig. 5.

Areis elongatis, supra arcuatis, lateribus subparallelis; cellulis clausis, laminâ depressâ, glabrâ, poro singulari medium supra utrinque perforatâ; orificio semilunari, elevato, margine simpliei; ovicellulis magnis, conspicuis.

Area elongated, sides nearly parallel, rounded above; surface of cell concave, smooth, with a single pore on each side above the middle; ridges simple, smooth; orifice sub-crescentic, raised; peristome simple; ovicell large, conspicuous.

ESCHARA ANDEGAVENSIS, *Mich.*, *Icon. Zoophyt.*, p. 329, pl. lxxviii, fig. 11.

Habitat.—C. Crag, on shell, *S. W. Doué, &c., Michelin*.

12. *M. FISSURATA* (*n. sp.*)¹

Areâ oblongâ supra arcuatâ, infra truncatâ; septis tenuibus, simplicibus, glabris. Orificio magno transverso, labro inferiori subreeto; laminâ utrinque fissuram longam curvatam ostendente.

Area oblong, arched above, truncate below; ridges narrow, simple, smooth; mouth large, arched above, lower lip nearly straight, or raised in the middle; a long curved fissure on each side of the front of the cell.

Habitat.—C. Crag, on *Eschara monilifera*.

A very well marked species, distinguishable at once by the elongated curved fissure on each side of the front of the cell. The septa between the cells are thin and very regularly arranged, and the calcareous lamina forming the front of the cell appears to be extremely delicate and fragile, so that the specific characters are only here and there apparent, even in a large patch. The species seems to be parasitic upon other Polyzoa, and when the front of the cells is entirely destroyed may be distinguished by the large size of the empty spaces left, the comparative thinness of their walls, and the absence of intercellular avicularia.

13. *M. OCEANI*, *D'Orbigny*. Pl. III, fig. 8.

Polyzoario effuso, irregulari; cellularum areis pyriformibus, superne depressis, parte depressâ lineâ elevatâ circumscriptâ, utrinque poro lunato signatâ; orificio suborbiculari,

¹ The figure of this species has been accidentally omitted.

elliptico, subinde trifoliato; peristomate plano. Cellulis pluribus, aviculario medio infra aream depressam posito, armatis. Ovicellulis parvis, prominentibus, rostro sulcato munitis.

Polyzoarium spreading irregular; cells pyriform; upper two thirds of front occupied by a broad oval space, bounded by a ridge, within which the surface is depressed; orifice suborbicular, elliptical, sometimes trifoliate; margin level; a crescentic pore on each side of the depressed area; surface smooth; an avicularium on many cells on the median line in front below the area; ovicell small, prominent, with a sulcate rostrum in front.

ESCHARINA (CELLEPORA OCEANI), *D'Orbigny*, Pal. Franc. (Terr. Cret.), pl. Dev, fig. 14.

Habitat.—C. Crag, inside of a small *Astarte Omalii*, and of a small Peeten.

The trifoliate form of the orifice, or, more properly speaking, of the aperture occasionally noticed in this species, appears to be due to an arrest in the calcification of the lamina filling up the oval area on the front of the cell; the lateral leaflets of the opening then representing the lunate pores visible in the cells where the calcification has proceeded to its full extent. With this form of the aperture, and the presence of the median avicularium at the lower half of the cell, *M. oceani* exhibits characters in common with *M. trifolium*, but attentive consideration has satisfied me that the two are distinct.

Of the identity of *M. oceani* with *M. D'Orbigny's* species, little doubt can be entertained on comparison with his figure, notwithstanding the great difference which would seem to exist in the respective ages of the rocks in which they occur.

14. *M. HOLOSTOMA*, *S. W.* Pl. III, fig. 11.

Polyzoario irregulari; areis cellularum ovalibus, pyriformibus, subhexagonis, vel supra areuatis et latioribus, infra angustioribus, apice truncatis; septis valde elevatis, granulosis, longitudinaliter sulcatis; laminâ superficiei granulosâ utrinque medium versus perforatâ; orificio suborbiculari, peristomate elevato; aviculariis magnis, ellipticis, numerosis inter cellulas dispersis.

Polyzoarium irregular; front of cell oval, pyriform, subhexagonal, or arched and expanded above, contracted below, and truncate at bottom; margin much raised, granular; a distinct line of separation between the margins of contiguous cells; surface of lamina granular; orifice suborbicular, peristome raised; an elliptical pore on each side about the middle; numerous large elliptical avicularia between the cells.

FLUSTRA HOLOSTOMA, *S. W.*, Ann. N. H., xiii, p. 20.

Habitat.—C. Crag, *S. W.*, on inside of a small *Pectunculus glycimerris*.

Genus 2. LEPRALIA, Johnston.

Polyzoario adnato, incrustante, irregulariter suborbiculari e puncto centrali radiante; e cellulis urceolatis, calcareis, decumbentibus, contiguis seu conjunctis, unico in strato dispositis composito.

Polyzoarium adnate, encrusting, spreading more or less regularly from a centre in a circular form; composed of a single layer of urceolate, calcareous, decumbent, contiguous or connected cells.

ESCHARA (pars), Pallas; Ellis and Solander; Moll; Linn.; Michelin.

CELLEPORA, Oth. Fabric., 1780; Gmelin (pars); Esper (pars); Lamarck, 1801 (pars); Oken (pars); Audouin (sp.); Lamouroux, 1812; Hagenow (pars); Reuss; D'Orbigny, 1852; Goldfuss.

FLUSTRA (pars), Audouin; Lamouroux.

DISCOPORA, Lamarck; Gray (pars); Rømer, 1845; Lamouroux (pars), not Fleming.

ESCHARINA, ESCHAROIDES, and DISCOPORA, Milne Edwards, 1837; Rømer, 1840; D'Orbigny, 1839-47; Van Beneden.

BERENICEA (sp.), Fleming, not Lamouroux.

LEPRALIA, Johnston; Gray (sp.); Busk; S. Wood; J. Morris; Hassall; Landsborough, &c.

CRIBRILLINA, HERENTIA, ESCHARELLA, PORELLA, CELLEPORELLA (all sp.), Gray.

MARGINARIA (pars), Rømer; Reuss; Hagenow.

MOLLIA (sp.), Lamouroux; D'Orbigny.

The preceding synonymy, which might without difficulty be considerably increased were it worth while, will perhaps be sufficient to show the advisability of the adoption of some term, which, though of more recent date, would avoid the ambiguity unavoidable in the use of a prior term already very largely employed in various senses. There can be no doubt that the term *Cellepora* originally proposed by O. Fabricius for four or five true species of *Lepralia*, should, so far as priority is concerned, have the preference. But as this term has been employed in the original sense only by two or three writers, and not very strictly even by them, and has by many more been applied to a widely different group of species, it appears very unadvisable that it should be again used in its original signification.

The term *Escharina* proposed by M. Edwards, in 1837, and which has been extensively adopted, is liable to the objection, that like other words ending in the same way, it has been employed as expressive of a family or tribe; nor does it moreover, as used by M. Edwards, include all the forms embraced under *Lepralia* as here understood. *Discopora* has some claims to adoption, but as it has never been restricted to the Lepraliæ proper, and has been applied by Dr. Fleming to a totally distinct genus, its use would now be attended with some confusion. The remaining appellation here adopted was originally proposed by

Dr. Johnston, and although it does not appear to have been used by any Continental writer, has been so generally employed by English naturalists, and is so appropriate and free from ambiguity, as to claim general approbation.

The very large number of species, both recent and extinct, included in the Genus *Lepralia*, renders it one of the greatest importance. It appears to date from the Cretaceous period, and species belonging to it abound in the tertiary beds, as well as at the present epoch. As might be expected in a group of related forms enjoying so wide a distribution in time, they are found to enjoy an equal existence in space. Of the numerous species some are found in all parts of the globe, from the Arctic to the Antarctic regions, many being apparently cosmopolite. This capacity for general diffusion appears to be conjoined with a power of adaptation to different circumstances, perhaps greater than resides in any other genus of Polyzoa; and thus arises a disposition to variation which adds very considerably to the difficulty of discriminating species. It is not improbable, also, that owing to this peculiarity, some of the presumed extinct forms might be traced by careful research into connexion with those still living. For the same reason, also, it is highly probable that continued study may show that many species now regarded as distinct are in reality only varieties. But notwithstanding this, there can be no doubt of the existence of a vast number of truly distinct forms, whose similitude renders it indispensably requisite, for the convenient determination of any particular species, to subdivide the genus into minor groups, which, however, must be regarded simply as artificial, and contrived solely for the purpose of convenient reference.

The following synopsis is pretty nearly the same in form as that employed in the British Museum Catalogue, Part ii, p. 63.

SYNOPSIS OF SPECIES OF LEPRALIA.

§ 1. ARMATÆ. (Furnished with avicularia or vibracula.)

(a) *With oral spines.*

1. <i>L. punctata</i>	.	.	.	.	p. 40, Pl. IV, fig. 1.
2. <i>L. innominata</i>	.	.	.	.	p. 40, Pl. IV, fig. 2.
3. <i>L. puncturata</i>	.	.	.	.	p. 41, Pl. VI, fig. 2.
4. <i>L. Woodiana</i>	.	.	.	.	p. 42, Pl. VII, figs. 1 and 3.
5. <i>L. ciliata</i>	.	.	.	.	p. 42, Pl. VII, fig. 6.
6. <i>L. Morrisiana</i>	.	.	.	.	p. 43, Pl. VII, fig. 8.

(b) *Without oral spines.*

7. <i>L. violacea</i>	.	.	.	.	p. 43, Pl. IV, fig. 3.
8. <i>L. plagiopora</i>	.	.	.	.	p. 44, Pl. IV, fig. 5.
9. <i>L. Edwardsiana</i>	.	.	.	.	p. 44, Pl. V, fig. 2.
10. <i>L. unicornis</i>	.	.	.	.	p. 45, Pl. V, fig. 4.
11. <i>L. ansata</i>	.	.	.	.	p. 45, Pl. VII, fig. 2.
12. <i>L. Brongniartii</i>	.	.	.	.	p. 46, Pl. VI, fig. 1.
13. <i>L. mamillata</i>	.	.	.	.	p. 46, Pl. VI, fig. 5.
14. <i>L. bicornis</i>	.	.	.	.	p. 47, Pl. VIII, fig. 5.
15. <i>L. biaperta</i>	.	.	.	.	p. 47, Pl. VII, fig. 5.

§ 2. INARMATÆ. (No avicularia or vibracula.)³(a) *With oral spines.*

16. <i>L. variolosa</i>	.	.	.	.	p. 48, Pl. IV, figs. 4 and 8; Pl. VIII, fig. 8.
17. <i>L. Peachii</i>	.	.	.	.	p. 48, Pl. V, figs. 6, 7, 8; Pl. VI, fig. 4.
18. <i>L. ventricosa</i>	.	.	.	.	p. 49, Pl. VI, figs. 3 and 6.
19. <i>L. Bowerbankiana</i>	.	.	.	.	p. 50, Pl. VII, fig. 4.
20. <i>L. lobata</i>	.	.	.	.	p. 50, Pl. VI, fig. 7.

(b) *Without oral spines.*

21. <i>L. hyalina</i>	.	.	.	.	p. 52, Pl. V, fig. 1.
22. <i>L. pyriformis</i>	.	.	.	.	p. 51, Pl. V, fig. 3.
23. <i>L. papillata</i>	.	.	.	.	p. 52, Pl. V, fig. 5.
24. <i>L. Haimeseana</i>	.	.	.	.	p. 52, Pl. VIII, fig. 1.
25. <i>L. Malusii</i>	.	.	.	.	p. 53, Pl. VIII, fig. 3.
26. <i>L. Reussiana</i>	.	.	.	.	p. 53, Pl. VIII, fig. 2.
27. <i>L. infundibulata</i>	.	.	.	.	p. 54, Pl. VIII, fig. 4.
28. <i>L. Pallasiana</i>	.	.	.	.	p. 54, Pl. IX, fig. 7.
29. <i>L. megastroma</i>	.	.	.	.	p. 54, Pl. VIII, fig. 5.

§ 1. ARMATÆ.

(a) *With oral spines.*1. *L. PUNCTATA*, *Hassall*. Pl. IV, fig. 1.

Cellulis subeylindricis, irregularibus, sæpe immersis, foraminosis; puncturis in seriebus transversis dispositis; orificio oblongo, transverso, subinde angustissimo, labio inferiori prominente, mucronato; utrinque avicularium ostendente. Supra 4—6 spinis marginalibus non raro absentibus. Ovicellulis pyramidalibus facie anteriori carinatis, subinde avicularium parvum summitate gerentibus.

Cells subeylindrical, irregular, often wholly immersed, foraminiferous; punctures in transverse rows; orifice oblong, transverse, occasionally very narrow; lower lip projecting, mucronate; 4—6 marginal spines above, often absent. Ovicell pyramidal, keeled in front, and sometimes crowned with a small avicularium at the summit; an avicularium on each side of the orifice (sometimes absent).

L. PUNCTATA, *Hassall*; *Johnst.*; *Busk*, B. M. Cat., pt. ii, p. 80, pl. xc, figs. 5, 6; pl. xcii, fig. 4; pl. xevi, fig. 3.

Habitat.—C. Crag, on shells, *S. Wood*; *J. S. B.* (very common). (*Recent*) Britain.

A very protean species in the recent state, though presenting very constant characters in the fossil.

2. *L. INNOMINATA*, *Couch*. Pl. IV, fig. 2.

Cellulis ovatis, utrinque sulcis 6—7 e lineâ centrali divergentibus, porosis signatâ; orificio semicirculari labio inferiori recto; facie cellulæ anteriori juxta orificium medio perforatâ, tubereulo obtuso utrinque munitâ; spinis marginalibus quinque. Ovicellulâ facie anteriori carinatâ; aviculariis inter cellulas raro sparsis.

Cells ovoid, with 6—7 grooves on each side radiating from a central line; a line of minute pores along each sulcus; orifice semicircular, straight below; a perforation in the median line close below the orifice, on each side of which is a blunt tubercle; five marginal spines. Ovicell keeled in front; avicularia sparingly scattered among the cells.

L. INNOMINATA, *Couch*; *Johnston*; *Gray*; *Busk*.

Habitat.—C. Crag, *S. W.* (*Recent*) Britain.

3. *L. PUNCTURATA*, *S. Wood*. Pl. VI, fig. 2.

Cellulis ovoideis, convexis, utrinque 5—6 sulcis porosis oruatis; orificio suborbiculari, labio inferiori incrassato, elevato, supra spinâ marginali mediâ unicâ et utrinque aviculario armato; ovicellulâ depressâ rotundatâ, antice punctis 3 signatâ.

Cells ovoid, convex; 5—6 sulci on each side; punctures along the sulci; orifice suborbicular, lower margin thickened, prominent; a single median marginal spine above; an avicularium on each side of the mouth; ovicell depressed, rounded, with three punctures in front.

L. PUNCTURATA (pars), *S. W.*, Ann. Nat. Hist., xiii, p. 18.

Habitat.—Red Crag, *S. W.*, on the inside of *Cytherea rudis* and (?) *Cardium vulgare*.

The only species with which the present can be confounded is *L. punctata*, a species very abundant in the Coralline, but also occurring in the Red Crag, to which *L. puncturata* seems to be confined. Both species have the front of the cell punctured in a somewhat similar manner, and both have an avicularium on each side of the orifice; so that in general aspect, on a superficial inspection, they might be very readily confounded. The differences between them, however, seem amply sufficient to separate them.

1. The ovicell in *L. punctata* is pyramidal, carinate in front and not punctured, and often has an avicularium on the summit; whilst in *L. puncturata* the ovicell is depressed and rounded, with three distinct puncta on its anterior surface, which is either quite smooth, or raised into a short umbo.

2. The lines of punctures in *L. punctata* are, for the most part, continued across the cell uninterruptedly, showing but little disposition to radiate from the centre; whilst in *L. puncturata* the lines of punctures are, in almost every instance, placed in grooves distinctly radiating from a central line, across which the punctures are not continued, as in *L. annulata*.

3. The cells in *L. punctata* are always deeply immersed, and usually disposed in linear series, whilst in *L. puncturata* they are very convex in front, distinct from their neighbours, and disposed quincunically.

4. The single median spine on the upper margin of the mouth is a further distinguishing characteristic of *L. puncturata*.

Finding several specimens marked *L. puncturata* in Mr. S. Wood's collection, I have retained his appellation for this form, although it would seem he did not himself distinguish it from *L. punctata*.

4. *L. WOODIANA* (*n. sp.*) Pl. VII, figs. 1 and 3.

Cellulis ovatis marginem circa serie unicâ punctorum oruatis, basim versus immersis, supra liberis, suberectis; facie anticâ granulosâ umbonę elevato supra excavato munitâ. Orificio semicirculari, labio inferiori recto, medio inciso, 4—6 spinis marginalibus supra armato. Aviculario minimo in partem cellulę supremam utrinque posito.

Cells ovate, immersed below; upper half free, raised; surface granular; a single row of punctures round the margin; orifice semicircular above, lower border straight, with a narrow fissure in the middle; 4—6 marginal spines above; a broad prominent umbo below the orifice, with a cup-like cavity above it; a very minute avicularium on each side of the orifice on the highest part the cell; ovicell depressed.

Habitat.—Cor. Crag, on *Tellina*, *S. W.*; (*Recent*) Belfast Bay, on *Venus rugosa*, Rev. T. Hincks.

This peculiarly formed species is characterised by the orifice, which has a straight lower border, having a narrow slit or fissure in the middle; and by the circumstance that below the orifice the surface is smooth and hollowed into a sort of cup, supported beneath by a broad eminence. The cells vary considerably in size in different parts of a patch.

5. ? *L. CILIATA*, *Linn.* Pl. VII, fig. 6.

Cellulis convexis, subhexagonis medio porum lunatum ostendentibus; superficie granulosâ, vel obscurè puncturatâ. Orificio lunato transversim elongato, elevato, libero, 4—6 spinis marginalibus supra armato; aviculario elevato, uno latere posito. Ovicellulâ subglobosâ, ostio simplici.

Cells quinccial, convex, subhexagonal, surface granular, or obscurely punctured; orifice crescentic, elongated transversely, raised and free; 4—6 marginal spines above; a lunate pore above the middle of the cell; a raised avicularium on one side of the cell; ovicell rounded; peristome not thickened.

CELLEPORA CILIATA, *Linn.*; *Fab.* (Faun. Grœnl., p. 434, No. 441).

ESCHARA VULGARIS, var. β , *Moll.*, *Seerinde*, p. 62, pl. iii, fig. 11.

LEPRALIA CILIATA, *Johnston*; *Busk*, Brit. M. Cat., part ii, p. 73, pl. lxxiv, figs. 1, 2.

L. INSIGNIS, *Hassall*, Ann. Nat. Hist., VII, p. 368, pl. ix, fig. 5.

FLUSTRA GENISII, *Aud.*, Expl., p. 239, *Savign.*, Egypt, pl. ix, fig. 5.

CELLEPORA CRENILABRIS, *Reuss* (op. c., p. 88, pl. x, fig. 22).

Habitat.—Cor. Crag on shell, *S. W.*, *J. S. B.* Vienna Basin, *Reuss.* (*Recent*) cosmopolite.

The resemblance at first sight between the fossil form and the more ordinary condition

under which *L. ciliata* occurs, will be found rather remote. But the transition from the delicate, transparent fucicolous *L. ciliata* of the south coast, growing within the laminarian zone, to the more robust, coarsely granular, thickened variety which occurs on shells from deep water, is too well marked in a sufficient series of specimens to leave any room for doubt as to the specific identity of the fossil and recent species. In specimens of the latter, dredged by the late lamented W. Thompson in deep water, (45 fathoms) in Belfast Bay, little or no difference can be perceived from the Crag fossil.

6. *L. MORRISIANA* (*n. sp.*) Pl. VII, fig. 8.

Cellulis ovatis, umbonatis, superficie raro punctatis, aviculario parvo utrinque armatis. Orificio semicirculari, supra spinis 6 marginalibus armato, labro inferiori recto. Ovicellâ resupinatâ, ostio patulo, peristomate inerassato.

Cells quineuncial, ovate; surface sparsely punctured; orifice semicircular, with a straight border below; 6 marginal spines above; a small umbo in front of the cell above the middle; a small avicularium on each side of the cell in front. Ovicell resupinate, its opening gaping with a thickened border.

CELLEPORA TRISTOMA (?), *Goldfuss*, Pet. Germ., p. 102, pl. xxxvi, fig. 12 (no oral spines), occurs on *Terebratula grandis* at Anspruch.

Habitat.—C. Crag on *Terebrat. grandis*, *S. Wood*. *J. S. B.*

From the appearance of the minute rounded openings on the so-termed avicularian processes it is possible they may have supported vibraeula like those of *L. Hyndmanni*.

(b) *Without oral spines.*

7. *C. VIOLACEA*, *Johnston*. Pl. IV, fig. 3.

Cellulis elongatis, subpyriformibus, marginem circa, subinde etiam per totam superficiem, punctatis, avicularium centrale, mandibulo sursum spectante, gerentibus; infra avicularium, foramen margine deelivo ostendentibus. Orificio semicirculari, labio inferiori recto.

Cells elongated, subpyriform, punctured round the margin and sometimes over the whole surface; a central avicularium, the mandible pointing directly upwards; below the avicularium a central depressed perforation. Orifice semicircular, straight below.

L. VIOLACEA, *Johnst.*, B. Zooph., 2 ed., p. 325, pl. lvii, fig. 9. *Busk*, B. M. Cat. part ii, p. 69, pl. lxxxvii, figs. 1, 2.

ESCHARELLA VIOLACEA, *Gray*.

Habitat.—C. Crag, on various shells, *S. Wood.* (*Recent*) Britain (south and east coast), Orkney (?); Gibraltar Bay.

This fossil differs from the usual form of the recent *L. violacea* in the more decided marginal puncturation. Generally, in *L. violacea*, obscure traces of such punctures are seen only in the very young cells at the margin of the crust; the older cells, which have acquired the peculiar blackish-blue tint, so characteristic of the living species, exhibiting no signs of punctures either on the surface or at the margin. The cells occasionally become much thickened and bossy. That punctures may exist, however, in this species, is evidenced not only in the fact that in the young cells distinct punctures may be perceived around the border in almost every specimen where such cells exist, but also that specimens sometimes occur in which the whole surface is freely punctured. An instance of this kind, from Hastings, is in my possession.

8. *L. PLAGIOPORA* (*n. sp.*) Pl. IV, fig. 5.

Cellulis pyriformibus, marginem circa puncturatis, punctis canaliculatis; aviculario magno mandibulo sursum oblique spectante, armatis; atque foramen depressum infra avicularium ostendentibus. Orificio semicirculari, labio inferiori recto.

Cells pyriform punctate round the border, puncta channelled; a large avicularium on the front of the cell, whose mandible is pointed obliquely upwards; a central perforation below the avicularium; orifice semicircular, with a straight border below.

CELLEPORA HECKELII (?), *Reuss* (l. c.), p. 85, pl. x, fig. 10.

Habitat.—C. Crag on shell; *S. Wood.*

This might be taken as a variety of *L. violacea*, but the very different size and position of the *avicularium* (much better marked in some specimens than it is in the one figured) which appears to be a very constant character, show their specific distinction.

9. *L. EDWARDSIANA* (*n. sp.*) Pl. V, fig. 2.

Cellulis alte immersis, superficie puncturatâ, inequali; orificio suborbiculari, infra uno latere late sinuato; sinu canaliculato ad avicularium magnum laterale tendente; peristomate valde incrassato, elevato. Ovicellulâ parvâ, subpyramidali.

Cells deeply immersed, surface punctured, uneven; orifice suborbicular, below with a wide sinus on one side, leading towards a large avicularium placed on the same side of the cell immediately below the orifice; peristome much thickened and elevated; ovicell small, subpyramidal.

Habitat.—C. Crag, on shell; *S. Wood.*

10. *L. UNICORNIS*, *Johnst.* Pl. V, fig. 4.

Cellulis late ovatis, superficie puncturatâ umbone centrali munitis. Orificio orbiculari infra medio inciso. Aviculario sessili, mandibulo acuto sursum et ad latus externum oblique spectante, in partem superiorem cellulæ utrinque posito. Ovicellulâ sulcis radiantibus signatâ.

Cells broad-ovate; surface punctured; a central umbo; orifice orbicular with a sinus below; a sessile avicularium on one or both sides at the upper part of the cell, the mandible pointing upwards and outwards. Ovicells with radiating grooves.

BERENICEA COCCINEA, *Johnston*, in *Transact. Newc. Soc.*, ii, p. 267, pl. xii, fig. 5.

LEPRALIA COCCINEA, *Johnst.*, *B. Zooph.*, 1st ed., p. 278, pl. xxxiv, figs. 1-3.

— *UNICORNIS*, *Johnston*, *Brit. Zooph.*, 2d ed., p. 321, pl. lvii, fig. 1.

— *SPINIFERA* (var.), *Busk*, *B. M. Cat.*, part ii, p. 69, pl. lxxx, figs. 5, 6, 7, and pl. xci, figs. 1, 2.

CELLEPORA TETRAGONA, *Reuss*, *Fossil Polyp. d., W., T. B.*, p. 78, pl. ix, fig. 19.

Habitat.—*C. Crag*, *S. Wood*, on shell. (*Recent*) Britain, Gibraltar Bay, *Landsb. Tertiary*, Vienna Basin, *Reuss*.

11. *L. ANSATA*, *Johnston.* Plate VII, fig. 2.

Cellulis ovatis seu oblongis, antice ventricosis, superficie foveolatâ, umbonatis. Orificio semicirculari, labio inferiori recto, medio inciso; aviculario elevato in partem superiorem cellulæ utrinque posito.

Cells oval or oblong, ventricose in front, surface pitted; orifice semicircular above, lower margin straight, with a central notch; an umbo close below the orifice; and on each side above a raised avicularium.

L. ANSATA, *Johnst.*, *Brit. Zooph.*, 2d ed., p. 307, pl. liv, fig. 12.

L. SPINIFERA (var.), *Busk*, *B. M. Cat.*, part ii, p. 69, pl. lxxxi, figs. 6, 7.

CELLEPORA DUNKERI, *Reuss*, *op. cit.*, p. 90, pl. x, fig. 27.

C. PROTUBERANS (?), *Id. ib.*, p. 89, fig. 26.

Habitat.—*C. Crag*, *S. W.* Vienna Basin, *Reuss.* (*Recent*) Britain.

12. *L. BRONGNIARTII*, *Audouin*. Pl. VI, fig. 1.

Cellulis ovatis seu pyriformibus transversim rugulosis, distantibus, spatiis reticulatis distinctis. Aviculario parvo ad apicem orificii supra armatis. Ovicellulâ pyramidali, aviculario cristatâ.

Cells ovate or pyriform, transversely rugose, distinct, separated by reticulated spaces or large openings; orifice suborbicular transverse; a minute avicularium on the summit of each cell above and behind the orifice; ovicell pyramidal, crowned with an avicularium.

CELLEPORA BRONGNIARTII, *Audouin*, *Explan.*, p. 240; *Savigny*, *Egypt*, pl. x, fig. 6.

LEPRALIA BRONGNIARTII, *Busk*, *B. M. Cat.*, part ii, p. 65, pl. 81, figs. 1-5.

— TENUIS, *Hassall*; *Johnston*.

— CATENATA, *Peach*, *MSS.*

— ASSIMILIS, *Johnston*; *Gray*.

— JACOTINI, *Gray*.

Habitat.—*C. Crag*, *Sutton*, *S. W.* (on shell). (*Recent*) Britain, Mediterranean, on shells, stones, or fucus.

13. *L. MAMILLATA*, *S. W.* Pl. VI, fig. 5.

Cellulis subrectis, magnis, supra liberis, coarctatis, infra ventricosis, superficie rugoso-granulatâ seu sulcatâ; basin circa serie unicâ vel multiplici punctorum ornatis. Orificio suborbiculari aculeum internum infra ostendente; peristomate anticæ et ad latera producto, posticæ late emarginato 2-4 spinis marginalibus superioribus. Ovicellulâ depressâ, globosâ, superficie granulosâ seu sulcatâ. Aviculario parvo utrinque ante ovicellulam posito.

Cells subrect, superiorly free and projecting; contracted above, ventricose below; surface coarsely granular or sulcate; a single or multiple row of pores around the base; orifice suborbicular, with a spinous process within the lower margin; peristome much produced in front and laterally, deficient posteriorly; 2-4 marginal spines above and behind; ovicell depressed spherical, surface granular or sulcate. A small avicularium on each side in front of the ovicell.

C. MAMILLATA, *S. Wood*, *Ann. Nat. Hist.*, xiii, p. 19; *J. Morris*, *Cat. B. Foss.*, p. 120.

I retain the name affixed by Mr. Wood to specimens in his collection, though not satisfied with him that it is the form intended by Blainville, under the same appellation.

The species is very distinct and well marked, at once recognisable by its great com-

parative size, in accordance with which the walls of the cells are very thick and strong. The peculiar production of the anterior part of the peristome into a sort of pointed spout, and the existence of an avicularium on each side in front of the ovicell, are amongst the other most striking peculiarities. It should be remarked that the avicularia are formed only on the fertile cells, no vestige of such organs being discernible in the cells not furnished with an ovicell.

14. *L. BICORNIS* (*n. sp.*) Pl. VIII, figs. 6, 7.

Cellulis ovatis, seu doliiformibus, umbonatis, superficie minute granulosa, marginem circa serie punctorum unicâ ornatis. Orificio orbiculari, processu cylindrico ascendente, avicularium apice gerente, utrinque munito. Ovicellulis globosis.

Cells ovate or barrel-shaped, surface finely granular with a single row of punctures around the margin; orifice orbicular; an ascending cylindrical process on each side of the orifice, having an avicularium on the apex; an elongated ascending conical umbo in front of the orifice; ovicells globose.

Habitat.—C. Crag, on shell, *S.W.*

15. ? *L. BIAPERTA*, *Michelin* (*sp.*) Pl. VII, fig. 5.

Cellulis quincuncialibus, seu serialibus, ovoideis, convexis, confluentibus, vibraculum elevatum uno latere in partem superiorem gerentibus. Orificio orbiculari, infra sinuato, peristomate simplici.

Cells quincuncial or serial, ovoid, convex, confused; surface smooth; orifice orbicular, with a sinus below; peristome simple; a projecting vibracular process on one side at the top of the cell.

ESCHARA BIAPERTA, *Michelin*, *Icon. Zooph.*, p. 330, pl. lxxix, fig. 3.

Bearing some resemblance to *L. Hyndmanni*, *Johnst.*, the species to which *M. Michelin* probably refers, *L. biaperta* is distinguished from it—1st, by the peristome never being thickened or raised, as it usually is in *L. Hyndmanni*; 2d, by the absence of pores at the border of the cell; and 3d, in the far higher position on the cell of the raised and perforated process, which doubtless represents the support of a *vibraculum* similar to that of *L. Hyndmanni*. The species, however, must be regarded as suspiciously near to *L. Hyndmanni*, which, it should be remarked, enjoys a tolerably extensive range in the present state of the globe, being found as far south, at any rate, as Madeira. *M. Michelin's* figure of the cell corresponds so closely with nature, that little doubt can be

entertained with respect to the identity of his species with that of the Crag; the only apparent discrepancy in his description is the statement, that in *L. biaperta* the cells are disposed in radiating lines, rather than in regular quincuncial order, as they appear to be in all the Crag specimens.

§ 2. INARMATÆ.

(a) *With oral spines.*

16. *L. VARIOLOSA*, *Johnst.* Pl. IV, figs. 4 and 8, and Pl. VIII, fig. 8.

Cellulis ovatis, immersis, in seriebus linearibus plerumque dispositis, marginem versus puncturatis seu areolatis, superficie granulosâ vel puncturatâ. Orificio orbiculari seu subquadrangulari, 2—4 spinis marginalibus approximatis supra armato; peristomate antice elevato, infra intusque denticulum bifidum ostendente. Ovicellulis altè immersis, ad marginem areolatis.

Cells oval, immersed, usually disposed in linear series, punctured or areolated round the margin, surface granular or punctured; orifice orbicular or subquadrangular, with two (or four) close-set marginal spines behind; peristome projecting in front; a bifid denticle within the orifice. Ovicells deeply immersed, areolated round the margin.

LEP. VARIOLOSA, *Johnst.*, *Brit. Zooph.*, 2d ed., p. 278, pl. xxxiv, fig. 4; *Busk*, *Brit. M. Cat.*, part ii, p. 75, pl. lxxiv, figs. 3, 4, 5, pl. lxxv.

Habitat.—C. Crag, on shell, *S.W.*

This is one of the more variable species of *Lepraha*, exhibiting such great diversity of aspect under different circumstances, as to cause considerable difficulty in its diagnosis. Three common varieties are represented in the Plates. At Pl. IV, fig. 4, is a variety without apparent spines, and at fig. 8, one in which the peristome is inordinately produced in front, whilst the two oral spines are perceptible; these are more clearly shown in the specimen figured in Pl. VIII, fig. 8, in which all the characters of the species are best exhibited.

17. *L. PEACHII*, *Johnst.* Pl. V, figs. 6, 7, 8; Pl. VI, fig. 4.

Cellulis quincuncialibus seu seriatis, ovatis, ventricosis, supra suberectis, umbonatis, superficie glabrâ vel granulosâ, serie unicâ punctorum basin circa ornatis. Orificio supra arcuato, infra coarctato, infra dente medio lato labium intus, armato; 4—6 spinis mar-

ginalibus supra munito. Ovicellulâ parvâ, erectâ, spinis marginalibus duabus utrinque fultâ.

Cells quincuneial or in linear series; ovate, ventricose, raised above; surface smooth or granular; a single row of minute punctures around the base. Orifice arched above, contracted below, with a broad median tooth within the lower border and 4—6 marginal spines above; a strong pointed umbo close below the orifice; ovicell small, erect, with two marginal spines in front on each side.

L. CILIATA (?), MS., *S. Wood*.

LEPRALIA PEACHII, *Johnst.*, Brit. Zooph., 2d ed., p. 315, pl. liv, figs. 5, 6; *Busk*, Brit. M. Cat., part ii, p. 77, pl. lxxxii, fig. 4, and pl. xcvii.

— *IMMERSA*, *Johnst.*, op. c., p. 325, pl. lvii, fig. 8.

ESCHARELLA IMMERSA, *Gray*.

BERENICEA IMMERSA, *Fleming*.

Habitat.—Cor. Crag, *S. W.*, *J. S. B.*, on various shells, very abundant. (*Recent*) Britain, from Orkney to the Isle of Wight; Beaufort Dyke, 110—147 fms.

The identity of this form with the recent *L. Peachii* admits, I think, of no doubt. Like that species, it is very protean in habit, but the specific characters are usually sufficiently marked to render its discrimination easy. These are: 1, the presence in most cases of six oral spines; 2, the large and usually flattened, but sometimes conical umbo below the orifice; 3, the appearance of the stumps at any rate, of *two* oral spines on each side in front of the ovicell.

18. *L. VENTRICOSA*, *Hassall*. Pl. VI, figs. 3, 6, 8.

Cellulis supra suberectis, distantibus, constrictis, infra ventricosis, ad basim immersis; superficie granulosa, basim circa serie punctorum unicâ plerumque ornatis. Orificio orbiculari, dente bifido, interno infra armato; peristomate valde elevato, antice producto, rostrato, 2 spinis marginalibus utrinque armato. Ovicellulâ parvâ, resupinatâ, subimmersâ, spinâ marginali unicâ utrinque fultâ.

Cells distinct and suberect above, immersed at the base; ventricose below, much contracted above; surface granular; a single row of punctures around the base; orifice orbicular, with a bifid denticle within the lower border; peristome much raised, produced in front into a prominent beak; four marginal spines, two on each side; ovicell small, reclined, subimmersed, with a single spine on each side in front.

LEPRALIA VENTRICOSA, *Hassall*; *Johnst.*, Brit. Zooph., 2d ed., p. 305, pl. liv, fig. 5; *Busk*, British M. Cat., part ii, pl. xci, figs. 5, 6; p. 78, pl. lxxxii, figs. 5, 6; pl. lxxxiii, fig. 5.

Habitat.—Cor. Crag, on various shells, *S. W.* (*Recent*) Britain, *ubique*.

Bearing a strong resemblance in most respects to large, coarse, overgrown specimens of *L. Peachii*, the present species may usually be readily distinguished by the great contraction of the upper part of the cell, and the production of the peristome often into a sort of funnel.

19. *L. BOWERBANKIANA* (*n. sp.*) Pl. VII, fig. 4.

Cellulis subscriatis, ovatis, oblongis, antice convexis, umbonatis; juniorum superficie delicatule scrobiculatâ, seniorum, presertim ad latera, puncturatâ. Orificio orbiculari, infra sinuato, tribusque spinis marginalibus supra munito.

Cells subserial, ovate, oblong, convex in front; surface of the young cells faintly scrobiculate, in the older punctate, especially at the sides; orifice orbicular, with a sinus below, and three marginal spines above; a conical umbo close below the orifice.

L. UNICORNIS, *Johnson* (MS.)

Habitat.—C. Crag, on *Terebratula grandis*, *S. W.*

This species bears a resemblance to some states of the recent *L. trispinosa*, from which it may be distinguished however: 1, by the invariable absence of any avicularium; 2, by the form of the orifice, whose border is always simply sinuated below, and never produced in the spout-like fashion of that part in *L. trispinosa*.

20. *L. LOBATA* (*n. sp.*) Pl. VI, fig. 7; Pl. XXII, fig. 4.

Polyzoario medio depresso, marginem versus incrassato, in lobis inæqualibus irregulariter diviso. Cellulis supra constrictis, infra latioribus, et ad basim alte immersis; superficie glabrâ. Orificio elevato, suborbiculari, labio inferiori, aviculario parvo, centrali, armato; spinis marginalibus duabus subinde connatis utrinque munito.

Polyzoarium depressed in the centre, thick and raised towards the margin, and partially divided into elevated lobes; cells contracted above, wider and deeply immersed at the base, surface smooth; mouth raised, suborbicular, lower border with a small avicularium in the middle; two marginal spines sometimes connate, on each side.

Habitat.—C. Crag, on *Pecten*, *S. W.*

The peculiar conformation of the polyzoarium in this species serves at once for its distinction. In tolerably perfect specimens the patch is small and thick, almost like that of an enerusting celled pore, cupped or depressed in the middle, and thicker towards the border, where it is usually divided into a certain number of elevations or suberect lobes.

The peristome differs very remarkably in different specimens, as may be seen upon comparison of fig. 7, Pl. VI, with fig. 4, Pl. XXII, though there can be no doubt of these figures representing different conditions of one and the same species, as shown by the existence of all intermediate forms in some part or another of the polyzoarium.

(b) *Without oral spines.*

21. *L. PYRIFORMIS* (?) *S. W.* Pl. V, fig. 3.

Cellulis elongato-ovatis seu pyriformibus, umbonatis; superficie obscurè punctatâ seu scrobiculatâ, longitudinaliter striatulâ. Orificio semicirculari, labio inferiori reeto. Ovicellulâ anticè carinatâ, superficie integrâ.

Cells elongato-ovate or pyriform; surface obscurely punctate or dotted, with a fine longitudinal striation; a central umbonal projection; orifice semicircular, straight below; ovicell keeled in front, obscurely punctured.

LEP. GRANIFERA (?).

Habitat.—C. Crag, *S. W.*, on various shells.

This species, which appears to be that intended by Mr. S. Wood under the same appellation, bears a strong general resemblance to the recent *L. granifera*. The principal differences between them being: that in the fossil there is no median pore a short distance below the orifice, which is invariably present in *L. granifera*, in which also the punctures on the front of the cell are usually more confined to the marginal portions, and not scattered uniformly over the surface. The characters in which the two forms agree are: the form of the orifice, the general aspect and form of the cells and the longitudinal striation of the surface, and the form, &c., of the ovicell, so that with the exception of the median pore there seems to be every reason to conclude that the fossil and recent forms should be placed together. But as I have not yet met with a specimen of *L. granifera* in which that pore was absent, nor one of *L. pyriformis* in which it existed, it is perhaps better to regard them as distinct though closely related.

The lower border of the orifice in this species usually presents a denticulate appearance, which is due apparently to a sort of crystallization of the carbonate of lime.

22. *L. HYALINA*, *Linn. (sp.)* Pl. V, fig. 1.

Cellulis subrectis, subcylindricis, clongatis seu compressis, antice elevatis; pariete tenui, superficie glabrâ seu transversim obscurè rugulosâ. Orificio orbiculari, sæpius infra sinuato, margine posteriori elevato, acuto. Ovicellulâ globosâ, erectâ, puncturatâ.

Cells suberect, subcylindrical, elongated or compressed, and raised in front; wall thin, transparent, smooth, or obscurely corrugated transversely; orifice orbicular, often with a sinus below, the posterior margin much raised, sharp. Ovicell globose, erect, punctured.

CELLEPORA HYALINA, *Linn.*; *O. Fabric*; *Esper*; *Lamx.*; *Bosc, &c.*

BERENICEA HYALINA, *Hassall.*

CELLEPORA PERSONATA, *Della Chiaje*, iii, p. 39, pl. xxxiv, figs. 17, 18.

ESCHARINA PERSONATA, *M. Edwards.*

LEPRALIA HYALINA, *Johnston*, B. Zooph., 2d ed., p. 301, pl. liv, fig. 1.

Var. β . Wall of cells thicker, and opaque.

LEPRALIA CYLINDRICA, *Hassall*, Ann. N. II., vii, p. 368, pl. ix, fig. 6.

Var. γ . Cells heaped, usually opaque.

CELLEPORA OVOIDEA (?), *Lamouroux*, Pol. Corall., pl. i, fig. 1, and *Expos. Méth.*, pl. lxxiv, figs. 4, 5; *Della Chiaje*, iii, p. 38, pl. xxxiv, fig. 33.

Habitat.—C. Crag, Sutton, *S. W.*, on shell.

(Recent) Britain, ubiquitous; California, var. β , *Dr. Sinclair*; Cape of Good Hope; W. Greenland, 73°20' N., 57°20' W., *Dr. Sinclair*; var. γ , E. Falkland Islands, 4—10 fms., *Darwin*.

23. *L. PAPILLATA* (*n. sp.*) Pl. V, fig. 5.

Cellulis ovatis seu pyriformibus, bipapillaribus, superficie puncturatâ, transversim rugulosâ, sive æquali. Orificio orbiculari, infra inciso.

Cells ovate or pyriform; surface punctate, corrugated transversely or even; orifice orbicular, with a sinus below; two small papillary elevations immediately below the orifice.

Habitat.—C. Crag, Sutton (on small *Pecten*), *S. W.*

24. *L. HAIMESEANA* (*n. sp.*) Plate VIII, fig. 1.

Cellulis ovato-clongatis seu pyriformibus, septo elevato sejunctis; superficie glabrâ, serie unicâ punctorum minimorum marginem circa ornatis. Orificio supra arcuato infra coarctato, labio inferiori recto, denticulo lato, rotundato, interno ostendente.

Cells ovato-elongate or pyriform, separated by distinct septa; surface smooth, with a single row of minute punctures round the border; orifice arched above, contracted, with a straight border below; a wide, rounded denticle within the lower lip.

Habitat.—C. Crag, *S. W.*, on shells.

25. *L. MALUSII*, *Audouin*. Pl. VIII, fig. 3.

Cellulis ovatis seu hexagonis; poris numerosis, stelliformibus, irregulariter sparsis ornatis, poroque centrali lunato signatis. Orificio supra arcuato, labio inferiori recto peristomate simplici. Ovicellulâ elevatâ, antice glabrâ, basin circa canaliculatâ seu perforatâ.

Cells ovate or hexagonal; surface perforated with numerous stellate pores; a central lunate pore. Orifice rounded above, straight below; peristome not thickened; ovicell prominent in front, smooth, grooved or perforated round the base.

ESCHARA MALUSII, *Audouin*, Expl. i, p. 239; *Savign.*, Egypt, pl. viii, fig. 8.

LEPRALIA MALUSII, *Busk*, Brit. Mus. Cat., p. 83, pl. ciii, figs. 1—4.

LEPRALIA BIFORIS, *Johnston*, Brit. Zooph., 2d ed., p. 314, pl. lv, fig. 4.

HERENTIA BIFORIS, *Gray*.

CELLEPORA MACRY, *W. Thompson* (not *Della Chiaje*?—nor *M. Edwards*).

Habitat.—C. Crag, on *Terebrat. grandis*, *J. S. B.* (*Recent*) Britain, common; South Patagonia (48 fms.); Falkland Islands, *Darwin*; New Zealand, *Dr. Lyall*; on shells, stone and fuci.

The peculiar stelliform appearance of the pores in the recent *L. Malusii* is perhaps necessarily wanting in the fossil, in which the appearance of puncta is altogether very indistinct. But the general aspect of the cells, the form of the mouth, and the existence of the central lunate pore, as well as the very peculiar perforations round the attached base of the ovicell, which are very apparent in the fossil, though accidentally not shown in the figure, appear to be amply sufficient to prove its identity with the recent, cosmopolitan species.

26. *L. REUSSIANA* (*n. sp.*) Pl. VIII, fig. 2.

Cellulis ovatis, supra contractis, superficie glabrâ; marginem circa serie punctorum minimorum unicâ ornatis. Orificio subquadrangulâ seu oblongo, transverso; peristomate producto, integro, incrassato, denticulum latum internum infra ostendente.

Cells ovate, contracted at top, surface smooth; a single row of minute punctures around the border of the cell; orifice subquadrangular or oblong, transverse; peristome produced, entire, thick; a broad tooth within the lower border.

Habitat.—C. Crag, *S. W.*

27. *L. INFUNDIBULATA* (*n. sp.*) Plate VIII, fig. 4.

Cellulis ovato-ventricosis; orificio oblongo, transverso; peristomate integro, valde producto sive expanso.

Cells ovato-ventricose; orifice oblong, transverse; peristome entire, much produced and expanded.

Habitat.—Red Crag, on shell, *S. W.*

This may prove to be only a variety of *L. Reussiana*, though presenting some apparently strongly distinctive characters, such as the absence of the marginal puncta and of the oral denticle. From *L. labrosa* (*Alysidota labrosa*), *Busk* ('B. M. C.,' pl. xcii), it appears to be distinguished, not only by its habit, but also by the smoothness of the surface, and the circumstance that the peristome is entire posteriorly.

28. *L. PALLASIANA*, *Moll.* Pl. IX, fig. 7.

Cellulis ovato-ventricosis, superficie puncturatis, subinde verrucosis. Orificio supra arcuato, medium infra coarctato; peristomate simplici, incrassato; labio inferiori recto, integro.

Cells ovato-ventricose, surface punctured, sometimes verrucose; orifice arched above, contracted below the middle; peristome simple, thickened. Lower lip straight.

ESCHARA PALLASIANA, *Moll.*, *Scerinde*, p. 64, pl. iii, fig. 13.

FLUSTRA HIBERNICA, *Hassall*, *Ann. Nat. Hist.*, vi, p. 172, pl. vii, fig. 1, and vii, p. 370.

LEPRALIA PEDILOSTOMA, *Hassall*, *Ann. Nat. Hist.*, vii, p. 368, pl. ix, fig. 4.

— *PEDILOSTOMA*, *Johnston*, *Brit. Zooph.*, 2d ed., p. 315, pl. liv, fig. 7; *Couch*.

CELLEPORA PALLASIANA, *Lamx.*, *Polyp. Flex.*, p. 95, No. 190.

LEPRALIA PALLASIANA, *Busk*, *B. M. Cat.*, part ii, p. 81, pl. lxxiii, fig. 1, 2.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain, south coast (very rare in the north); Jersey.

29. *L. MEGASTOMA*, *S. W.* (M.S.) Pl. VIII, fig. 5.

Cellulis ovatis, umbonatis, ad marginem poris canaliculatis ornatis. Orificio magno semiorbiculari, labio inferiori recto, integro, peristomate simplici.

Cells ovate, raised in the middle, with a single row of channelled pores round the border; orifice large, semicircular, with a straight lower lip and simple peristome.

Habitat.—C. Crag, *S. W.*, inside a large bivalve shell.

§§§ 2. AFFIXÆ.

A. MASSIVÆ.

Fam. V. *CELLEPORIDÆ*, Busk.

Polyzoarium c cellulis plus minusve verticalibus, confertis seu confusè superimpositis compositum.

Polyzoarium composed of cells more or less vertical to its axis or plane, heaped together or irregularly overlying each other.

Genus 1. *CELLEPORA*.

Polyzoarium calcareum, spongiosum, c cellulis urceolatis plus minusve verticalibus, confertis vel irregulariter quincuncialibus, superimpositis compositum.

Polyzoarium calcareous, spongy, composed of urceolate cells placed more or less vertical to its axis or plane, heaped together or irregularly quincuncial, and overlying each other.

CELLEPORA (pars), *O. Fab.*, 1780; *Gmelin* (pars), 1789; *Esper* (pars), 1791; *Lamarck* (pars), 1801; *Lamouroux* (pars), 1816, not 1821; *Blainville* (pars), 1834; *Reuss* (pars), 1847; *Hagenow* (pars), 1851; *Michelin*, 1847; *Johnston*.

CELLEPORARIA, *Lamouroux*, 1821; *D'Orbigny*, 1852.

SPONGITES, *Oken* (pars).

TUBIPORA, *Linn.* (pars).

MILLEPORA (pars), *Pallas*; *Solander*.

ESCHARA (pars), *Pallas*; *Ellis*; *Gmelin*.

MADREPORA (pars), *Esper*.

FLUSTRA (pars), *Solander*; *Stewart*.

REPTOCELLEPORARIA (sp.), *D'Orbigny*.

The species comprised in the genus *Cellepora*, defined as above, fall very naturally into two groups, which are distinct in habit and general appearance, though very closely alike in their internal constitution.

1. One of these groups, corresponding with the *Reptocelleporaria* of D'Orbigny, contains those species whose polyzoaries are adnate and incrusting, assuming more or less of a globose form, or that of thick, irregular, bossy masses, often of considerable size, though sometimes very minute. This group may be typified by the common *C. pumicosa* of our seas. The other subdivision embraces those species which affect an erect ramose mode of growth, consisting of a stem and irregularly dichotomous, tapering branches. These may be represented by *Cellepora ramulosa*.

Owing to the confused mode of growth of the polyzoarium in *Cellepora*, and the extreme diversities exhibited by the cells in different parts of one and the same specimen, it is in many cases difficult, even in recent species, to determine the true characters of any given fragment. In the case of fossils this difficulty is of course very greatly increased, and I have consequently found it almost impossible to assign positive characters in a great many instances. The definitions and distinctions of species here given must therefore be accepted with great hesitation, and regarded simply as the results of the best consideration of the subject the condition of the specimens has allowed.

SYNOPSIS OF SPECIES OF CELLEPORA.

1. Ramose, suberect.

1. <i>C. coronopus</i>	.	.	.	.	p. 57, Pl. IX, figs. 1 and 3.
2. <i>C. ramulosa</i>	.	.	.	.	p. 58, Pl. IX, fig. 2.
3. <i>C. compressa</i>	.	.	.	.	p. 58, Pl. IX, fig. 4.
4. <i>C. cespitosa</i>	.	.	.	.	p. 59, Pl. IX, fig. 5.

2. Adnate, incrusting, massive.

5. <i>C. edax</i>	.	.	.	.	p. 59, Pl. IX, fig. 6.; Pl. XXII, fig. 3.
6. <i>C. tubigera</i>	.	.	.	.	p. 60, Pl. IX, figs. 8 and 10.
7. <i>C. scruposa</i>	.	.	.	.	p. 61, Pl. IX, fig. 9.
8. <i>C. parasitica</i>	.	.	.	.	p. 61, Pl. IX, figs. 11 and 13.
9. <i>C. dentata</i>	.	.	.	.	p. 62, Pl. IX, fig. 12.

(a) *Ramose, not encrusting.*

1. *C. coronopus*, *S. Wood*. Pl. IX, figs. 1, 3.

Polyzoario magno, e ramis cylindraccis apice subattenuatis composito. Cellulis ventricosis, glabris, rostratis, subinde basi punctatis, ostio orbiculari, peristomate antice sinuato.

Polyzoarium large, ramose, branches cylindrical, tapering at the point; cells ventricose; orifice, orbicular, with a narrow sinus in front; a large preoral rostrum; surface entire, smooth; sometimes a few minute punctures around the base.

CELLEPORA CORONOPUS, *S. W.*, l. c., p. 18.

SCYPHIA CELLULOSA (?), *Münster, Goldf.*, Petref. Germ., p. 9, pl. xxxiii, fig. 12.

Habitat.—*C. Crag*, very abundant, *S. W.*, *J. S. B.*

The appearances represented in Goldfuss's magnified figure of *Scyphia cellulosa* are so precisely those of the present species, that the two might, with little hesitation, perhaps be regarded as identical, were it not that *Scyphia cellulosa* is represented as hollow, whereas all the *Crag* specimens are solid.

The external characters again of *C. coronopus* agree in many respects with those of *Cellepora cervicornis* as figured by Mr. Couch ('Corn. Fauna,' pt. iii, p. 111, pl. xx, fig. 1); but as that species is described in the text as having the branches compressed, and the cells arranged quincuncially, it probably, notwithstanding Mr. Couch's opinion to the contrary, corresponds with *Cellepora cervicornis* of Dr. Johnston, which is in all probability in reality *Eschara cervicornis* ('Brit. M. Cat.'). But a recent species of *Cellepora*, in habit having a very close resemblance to *Cellepora coronopus*, does exist in the Northern Seas. Specimens of this form were collected by Mr. M. Andrew, on the coast of Norway, and described by me in the 'Annals Nat. Hist.,' 2d Ser. xviii, p. 32, pl. i, fig. 1, under the appellation of *Cellepora cervicornis*. At first sight it appeared natural to suppose that the *Crag* fossil and this species were the same, but the minute characters are amply sufficient to show that they are quite distinct. In *Cellepora cervicornis (mili)* the cells are coarsely punctured and grooved; the mouth is of the same form as that of *C. coronopus*, but has on each side of it an avicularium, none of which appearances are any where traceable in *C. coronopus*. On the whole, therefore, this must be regarded as a distinct and, so far as I know, an extinct form.

2. *C. RAMULOSA*, *Linn.* Pl. IX, fig. 2.

Polyzoario ramoso; ramis cylindraceis attenuatis, apice bifidis. Cellulis ovatis elongatis, rarepunctatis, rostro magno avicularium uno latere ad basim ostendente munitis. Ostio suborbiculari peristomate simplici. Ovicellulâ globosâ, recumbente, punctatâ.

Polyzoarium ramose, branches cylindrical, tapering, forked at the extremities. Cells ovate, elongate, sparsely punctured; orifice suborbicular. A large ascending rostrum in front, with an avicularium on one side of it near the base. Ovicell globose, recumbent, punctured.

MILLEPORA PUMICOSA (pars), *Pallas*, *Elenchus*, p. 254.

CELLEPORA RAMULOSA, *Linn.*; *Johnst.*, *Trans. Newc. Soc.*, ii, p. 267, pl. xii, figs. 3, 4; *Brit. Zooph.*, 2d ed., p. 296, pl. lii, fig. 4; *Couch.*, *Corn. Faun.*, pt. iii, p. 110, pl. xx, fig. 2; *Busk*, *Brit. Mus. Cat.*, p. 87, pl. cix, figs. 1, 2, 3.

CELLEPORA LEVIS, *Fleming*; *Couch*; *Johnst.*

Habitat.—*C. Crag*, *Sutton*, *S. W.*, *J. S. B.* (*Recent*) *Britain*, *ubique*.

This species may always be distinguished by the lateral or sublateral position of the avicularium, by which it is distinguished from *Cellepora pumicosa*, when it occurs, as it often does, in a massive or adnate form around the base of the erect branching stems. In recent specimens the characters are, in most cases, rendered far more distinct by incineration.

3. *CELLEPORA COMPRESSA* (*n. sp.*) Pl. IX, fig. 4.

Polyzoario subramoso, magno, depresso, massivo; ramis brevibus, compressis angulatis seu subcylindraceis, truncatis. Cellulis ventricosis, alte immersis, sparse punctatis, rostro parvo munitis. Ostio suborbiculari, labio antico recto, subinde aperturâ rotundâ minimâ utrinque ornato.

Polyzoarium large, subramose, depressed, massive; branches short, compressed, angular or subcylindrical, truncate; cells ventricose, deeply immersed, surface sparsely punctured; orifice suborbicular, straight below, with small hollow rostrum in front; and often a rounded opening on each side.

Habitat.—*R. Crag*, (?) *C. Crag*, *S. W.*, *J. S. B.*

This species will be far more readily distinguished by its habit and general appearance, than by the minute characters; which, however, even in small fragments are sufficiently distinct from those of *Cellepora coronopus*, to render the diagnosis comparatively easy.

4. *CELLEPORA CESPITOSA* (*n. sp.*) Pl. IX, fig. 5.

Polyzoario solido, tuberoso; lobis brevibus, subconicis, obtusis inæqualibus, numerosis. Cellulis prorsus immersis, plerumque rostratis, valdè irregularibus, sparse punctatis; ostio orbiculari infra sinuato; cellularum interstitiis cancellatis.

Polyzoarium massive, with numerous irregular, short, subconical eminences or lobes; cells wholly immersed, very irregular, surface sparsely punctured; orifice orbicular, with a sinus below; usually a small rostrum in front of the orifice, often absent. Numerous irregular intercellular rounded openings.

Habitat.—C. Crag, Sutton, *S. W.*

It is extremely difficult to find a cell sufficiently perfect to show the minute characters of this Cellepore. But its peculiar aspect suffices for its identification. It approaches nearest to *C. compressa*, but its growth is much smaller; the short branches are cylindrical and rounded at the extremity, and the surface is less coarsely cellular.



(*b*) *Encrusting, adnate, massive.*

5. *C. EDAX* (*n. sp.*) Pl. IX, fig. 6; Pl. XXII, fig. 3.

Polyzoario massivo, crasso, mamillato, conchæ parvæ turbinatæ formam gerente. Cellulis ovatis, rhomboidalibus, erectis seu subdecumbentibus, umbonatis, superficie scabrâ, puncturatâ. Ostio supra arcuato, medium versus, constricto, utrinque denticulato, labio inferiori recto.

Polyzoarium forming a dense thick botryoidal mass having the form of a small turbinate shell; cells ovate, rhomboidal erect or subdecumbent, umbonate; surface punctured, rough, mouth rounded above, contracted below the middle, with a small denticle on each side, and straight below.

Habitat.—C. Crag, *S. Wood*, on a species of *Natica and Turritella*. (*Recent*) Coast of Devonshire; *Rev. T. Hincks*.

This is a very peculiar and interesting form. The rather dense crust, which has a botryoidal aspect, appears to have been in all cases formed by superimposed layers of cells covering most usually small turbinate *Natica*-like shells in most instances of the same species but in other cases a small *Turritella*. The specimens consequently are all very much alike, resembling small thick univalve shells, with a comparatively small circular mouth. But it is curious that it is extremely rare to find in these masses any remains of the original shell. In by far the greater number of instances this appears to have been entirely removed, the sides of the spiral canal being formed by the backs of the polyzoan cells usually disposed in parallel rows, much as they are on the concave surface of some *Lunulites*. When any remains of the original shell are

found, it appears to be reduced to extreme tenuity, and its outer surface to have been eaten away as it were by the parasitic incrustation. I am unable to determine the species of shell which appears to have constituted the most frequent nidus of this Cellepore, but it appears to have been of small size, with a circular mouth. It is to be remarked, also, that other shells, either entire or in fragments, together with minute pebbles, are occasionally found imbedded in the parasitic mass. A curious instance of an apparently living shell having been thus partially entombed is presented in a specimen affording lodgment to a minute *Anomia*, with a smooth subovate upper valve, and a very perfect under valve. The edge of the larger valve just appearing on the surface of the Cellepore, a small portion of the latter was cleared away, when the perfect *Anomia*, with the nacreous lustre quite perfect, and the valves in their undisturbed natural apposition fell out, leaving a cavity, one side of which, corresponding apparently to the lower valve, was smooth and accurately moulded to the surface of the imbedded shell, whilst the opposite was rough and porous, like the general surface of the polyzoary. From this it may probably be concluded that the *Anomia* was thus entombed alive, and that sufficient space was left for the movement of the upper valve. Not being certain that this is the var. γ of *Cell. pumicosa*, noted by Mr. S. Wood, under the term *C. pustulosa*, I have not introduced that synonym, and am the more inclined to omit it, since *C. edax* is altogether distinct from the *Cellepora pustulosa* of Goldfuss ('Petr.,' p. 102, pl. xxxvi, fig. 15). *Cellepora parasitica* of Michelin ('Icon. Zoophyt.,' p. 326, t. lxxviii, fig. 3), is in habit very similar to *C. edax*, but in that species the imbedded shell appears to be unaffected by the parasitic growth, and to retain its natural markings. The species of shell inhabited by it is also different, and the description given of the cells, insufficient as it and the figure may be, would lead to the conviction that the two cannot be identical, though undoubtedly closely allied.

Whilst these sheets are passing through the press, I have received, through the kindness of the Rev. T. Hincks, a specimen of a Cellepore found on the coast of Devonshire, in all respects identical with *C. edax* of the Crag. Like that species, the recent form presents the shape of a small turritid shell, probably a *Turritella*; but what is especially worthy of remark, the shell itself, so far as can be seen, is as completely removed as it is in the fossil Cellepore. That the destruction of the shell, cannot be regarded as accidental, but as due to a specific action in the parasitic growth, is rendered the more probable when it is found to take place in the recent as well as in the fossil state.

6. *C. TUBIGERA* (*n. sp.*) Pl. IX, figs. 8, 10.

Polyzoario adnato subhemispherico, seu eonico. Cellulis distantibus, sparse punctatis; processu unico tubuloso ascendente, avicularium summitate gerente plerumque uno latere tantum munitis.

Polyzoarium adnate, irregularly convex, or subconical. Cells distant, connected by ridges, sparsely punctured; orifice orbicular, with a sinus in front; cylindrical tubular processes supporting avicularia, arising from the front or side of a cell, or from the intercellular ridges.

Habitat.—C. Crag, on shell, *S. W.* (*Recent*) Britain, South and West Coasts, *G. B.*; Coast of France, *Jeffreys.* Lamlash Bay, Arran. *G. West.*

This species has been doubtlessly confounded with *Cellepora pumicosa*, with which it agrees very closely in external character; but the distinction between the two is obvious enough on closer examination. *C. tubigera* has a smaller mouth, with a sinus in front; and instead of the strong conical rostrum, with an avicularium in its inner aspect, so characteristic of *Cellepora pumicosa*, most of the cells are provided with slender subcylindrical ascending processes, having a small avicularium at or near the summit. The cells, also, are rather more punctured than they usually are in *Cellepora pumicosa*.

7. *C. SCRUPOSA* (*n. sp.?*) Pl. IX, fig. 9.

Polyzoario massivo, irregolari, adnato. Cellulis urceolatis?, contiguis, crassis superficie integrâ, subinde rostro minuto suborali armatis. Ostio orbiculari, antice sinuato.

Polyzoarium massive, irregular, adnate. Cells urceolate? contiguous; wall very thick; surface entire; orifice orbicular, with a sinus in front; sometimes a minute rostrum before the orifice.

Habitat.—C. Crag, on shell, ? *S. W.*

This species is given with much hesitation, for the only specimen at command is hardly in a state to admit of precise determination. The most striking peculiarity is the comparatively great thickness of the walls of the cells.

8. *C. PARASITICA*, *Michelin.* Pl. IX, figs. 11, 13.

Polyzoario incrustante, massivo, irregolari. Cellulis urceolatis, ventricosis, distantibus, subinde rostratis; spatiis inter cellulas punctatis. Ostio suborbiculari, antice sinuato.

Polyzoarium encrusting, massive, irregular; cells urceolate, ventricose, distant; intercellular spaces punctured; orifice suborbicular, with a sinus in front; occasionally a rostrum in front, or on one side of the cell.

Habitat.—Cor. Crag, on *Turritella planisphaera*; Red Crag, on *Nassa*, *S. W.*, Touraine, on *Gorgonia* and univalve shells, *Michelin*.

The habit of this species, which is obviously quite distinct from *C. edax* and *C. pumicosa*, is well expressed in M. Michelin's words: "incrustans, involvens."

9. *C. DENTATA* (*n. sp.*) Pl. IX, fig. 12.

Polyzoario adnato, repente; lepraliæformi. Cellulis subglobosis in crustâ calcarcâ denso ad dimidium immersis; rostro brevi, forti, conico avicularium gerente munitis. Ostio infundibuliformi, suborbiculari, antice dente lato interno armato.

Polyzoarium adnate, spreading; cells subglobose, half immersed in a dense calcareous layer; orifice infundibuliform, suborbicular, with a broad denticle within the anterior margin; a short, stout, conical rostrum supporting an avicularium in front of the orifice.

Habitat.—Cor. Crag, on shell, *S. W.*

A form intermediate between *Cellepora* and *Lepralia*. Agreeing with the former in the erect position of the cells and the ascending rostriform avicularium in front of the orifice, and with the latter in the nearly regular disposition of the cells in a single layer, except at the middle of the crust, when they become more irregularly heaped.

Fam. VI. *ESCHARIDÆ*, Busk.

Polyzoarium erectum, rigidum, compressum, foliaceum, ramosum, lobatum seu reticulatum; e cellulis decumbentibus ad unâ vel utramque faciem spectantibus compositum.

Polyzoarium erect, rigid, compressed, foliaceous, ramose, lobate, or reticulate. Cells disposed in the same plane, on one or both sides of the polyzoarium.

ESCHARIDÆ, *Busk*, B. M. C., p. 88; (pars) *Johnston*; *D'Orbigny*, Auct.

LEPRALIANA and RETEPORANA, *Gray*.

SYNOPSIS OF GENERA.

1. Two layers of cells.

a. Layers of cells inseparably united by a distinct calcareous septum.

1. *Eschara*.

2. *Melicerita*.

b. Layers readily separable.

3. Biflustra.

2. Cells in a single layer.

a. Reticulate.

4. Retepora.

b. Continuous.

5. Hemeschara.

Genus 1. ESCHARA, *Ray*.

Polyzoario erecto, foliaceo, integro vel subdiviso, sive e ramis angustioribus aut latioribus composito, cellulas in utraque facie gerente. Cellulis decumbentibus, quincuncialibus, in seriebus longitudinalibus dispositis. Lamellis conjunctis.

Polyzoarium erect, foliaceous and expanded, or ramose and lobate, with wide or narrow divisions. Cells decumbent, disposed in longitudinal series quincuncially on both surfaces; the layers inseparable.

ESCHARA (pars), *Ray; Ellis; Pallas; Lamarck.*

— *Johnston; D'Orbigny; Hagenow; Reuss; M. Edwards; Busk, &c.*

FLUSTRA (pars), *Linn.*

MILLEPORA (pars), *Solander.*

CELLEPORA (pars), *Esper.*

The characters above given are sufficient to distinguish all the species of this genus in their complete or mature condition; but it must be remarked, that as in the case of *Flustra foliacea*, so in some species of *Eschara*, the polyzoarium sometimes, in fact usually, as it would seem, spreads out into an adnate crust on the surface of the stone or shell upon which the growth is affixed. Detached portions of such a crust are indistinguishable from a *Lepralia*, and it is not improbable that this mistake has been often made, and it is one to which the paleontological observer is peculiarly liable.

The genus *Eschara* is naturally subdivided into two sections, which though running into one another, are usually sufficiently distinct for all practical purposes. In one of these divisions the polyzoarium is broad, expanded and foliaceous, variously folded and contorted, but not subdivided into distinct lobes. Of this division *E. foliacea* affords a good type. In the other division the polyzoary is divided into branching lobes of various forms, and differing considerably in width in different species—sometimes broad, short, and expanded, sometimes constituting narrow or even ligulate branches, occasionally so

slender as, except on careful inspection, to appear cylindrical. A transverse fracture, however, will, in doubtful cases, show the median plane parting the two layers of cells, and distinguishing any form of *Eschara* from a *Vincularia* or *Salicornaria*.

The cells in *Eschara* are of the open, urecolate form, decumbent, and generally confluent. In most cases they are of uniform character throughout the growth, but in some instances those at the margin of the branches or lobes differ from the others. Many, if not all the *Escharæ*, are furnished with avicularian organs, which are either situated in some part of the cell itself, or are what may be termed *intercellular*, replacing, in fact, one of the ordinary cells; and this appears to have been a frequent condition in the older fossil forms. In most *Escharæ* ovicells of the usual kind are met with, but in some these organs appear to be replaced by cells very different in form, and of far larger dimensions than the ordinary cells, and which are in some cases widely open, and in others closed in front by a cribriform calcareous plate. These larger cells, which have been termed by M. D'Orbigny "accessory cells" (cellules accessoires), were by that observer supposed to represent the habitations of male polypides; but as this explanation is irreconcilable with all we know respecting the sexual relations of the Polyzoa, it is clearly not admissible. The more probable supposition would appear, as above said, to be, that these are the fertile cells of the polyzoarium. I am unacquainted with any living *Eschara* furnished in this way, but it may be remarked that a very similar provision exists in the genus *Selenaria*, B., one of the living Lunulites.

The genus seems to have made its first appearance in the Jurassic period, to have been tolerably numerous in species in the Cretaceous and Tertiary, and probably at present to be still more prolific in species than at any former period, although, as remarked by M. Edwards, no fossil species has been clearly identified with one now existing; the *Eschara foliacea* of Michelin ('Icon. Zoophyt.,' pl. xiv, fig. 9) clearly not belonging to that species, if an *Eschara* at all. M. D'Orbigny remarks, that all the *Escharæ* of the Cretaceous period have the walls of the cell imperforate, whilst in the Tertiary and more recent forms they are usually perforated.

SYNOPSIS OF SPECIES OF *ESCHARA* (Fossil in the Crag).

(a) Foliaceous.

- | | | | | | |
|----------------------|---|---|---|---|---|
| 1. <i>E. pertusa</i> | . | . | . | . | p. 65, Pl. X, fig. 2. |
| 2. <i>E. incisa</i> | . | . | . | . | p. 65, Pl. X, fig. 3. |
| 3. <i>E. porosa?</i> | . | . | . | . | p. 66, Pl. XI, fig. 4. |
| 4. <i>E. sinuosa</i> | . | . | . | . | p. 66, Pl. X, fig. 6. |
| 5. <i>E. cornuta</i> | . | . | . | . | p. 67, Pl. VIII, fig. 5; and Pl. X, fig. 5. |

(b) Lobate or ramose.

- | | | | | | |
|-------------------------|---|---|---|---|-------------------------------|
| 6. <i>E. Sedgwickii</i> | . | . | . | . | p. 67, Pl. X, fig. 1. |
| 7. <i>E. monilifera</i> | . | . | . | . | p. 68, Pl. XI, figs. 1, 2, 3. |

*(a). Foliaceous.*1. *E. PERTUSA*, *M. Edwards*. Pl. X, fig. 2.

Polyzoario complanato; cellulis elongatis angustis, scriebus pororum 4 vel 5 longitudinalibus signatis, rostroque ascendente avicularium supra gerente munitis. Ostio supra rotundato, medium versus constricto, utrinque denticulato, labio inferiori recto.

Polyzoarium expanded; cells elongated, narrow; surface punctured with four or five longitudinal rows of pores; orifice rounded above, contracted below, with a small conchoidal denticle on each side below the middle, and a straight lower border. A projecting rostrum supporting an avicularium on its upper surface, immediately below the orifice; ovicells subglobose, smooth.

ESCHARA PERTUSA, *M. Edwards*, l. c., p. 9, pl. x, fig. 3; *S. Wood*, *Ann. Nat. Hist.*, xiii, p. 16; *Michelin* (?), *Icon. Zooph.*, pl. lxxix, fig. 2.

Habitat.—C. Crag, *S. W.*, *M. Edwards*; Doucè (?), *Michelin*.

The peculiar features of this well-marked form are—1. The narrow, elongated shape of the cells. 2. The projecting rostrate avicularium in front of the orifice, which in many of the cells is expanded into a large, hollow, egg-shaped protuberance, supporting on its summit the much enlarged avicularium. These organs were regarded by M. M. Edwards as ovicells, but their avicularian nature is sufficiently manifest, and, moreover, true ovicells exist in the usual situation. With respect to the latter, it may be remarked that they often present a rounded perforation in front, but which, from its appearance, would seem to be due to attrition, and not to represent a natural aperture.

2. *E. INCISA*, *M. Edwards*. Pl. X, fig. 3.

Polyzoario undato-flexuoso; cellulis junioribus ovalibus, puncturatis; senioribus immersis, obsoletè punctatis. Ostio suborbiculari, infra sinuato. Ovicellulis altè immersis inconspicuis.

Polyzoarium contorted; cells when young oval, punctured; when old, deeply immersed, with the punctures obsolete or nearly so; orifice suborbicular with a sinus below; ovicells deeply immersed.

ESCHARA INCISA, *M. Edwards*, l. c., p. 5, pl. ix, fig. 2; *Michelin* (?), *Icon. Zooph.*, p. 328, pl. lxxviii, fig. 7; *S. Wood*, l. c., p. 16.

Habitat.—C. Crag, Sudbourne, Sutton; *S. W.*, *M. Edwards*; Touraine, *Michelin*.

The form represented in our figure is referred with some little doubt to *E. incisa* of M. Edwards, and chiefly from the shape of the orifice. The only other fossil species having an orifice of the same or nearly similar form, are *E. sinuosa*, nob., and *E. monilifera*, M. E. The distinctions between the latter and *E. incisa* are too obvious to require remark. Those between *E. incisa* and *E. sinuosa* consist: 1. In the peculiar habit of the polyzoary in the latter, and its far greater thickness. 2. In the large size of the orifice of the cells, and its being always surrounded by large well-marked pores, with which the rest of the surface is also closely beset.

3. *E. POROSA*, *M. Edw.* Pl. XI, fig. 4.

Polyzoario valde flexuoso, contorto, cavernoso. Cellulis ovalibus vel pyriformibus, presertim ad marginem punctatis. Ostio angustato, transversali, supra rotundato, labio inferiori recto, subinde mucronato. Ovicellulis immersis punctatis.

Polyzoarium much contorted, cavernous; cells oval or pyriform; surface punctured especially around the border; orifice rounded above, narrow and elongated from side to side, with a straight or slightly mucronate lower lip; ovicells immersed, punctured.

E. POROSA, *M. Edwards*, l. c., p. 13, pl. xi, fig. 7; *S. Wood*, l. c., p. 17.

Habitat.—C. Crag, *S. W.*; Subapennine, *M. Edwards*.

This species is referred with some doubt to M. Edwards's *E. porosa*, but upon consideration of the general characters exhibited in his figures and description, there appears to be good reason for believing that the Subapennine and Crag fossils will be found identical.

4. *E. SINUOSA*, (*n. sp.*). Pl. X, fig. 6.

Polyzoario pedunculato, e lobis distinctis, sinuosis composito; cellulis immersis, superficie presertim circa ostium punctatâ; ostio suborbiculari, labio inferiori inciso, subinde tantum perforato.

Polyzoarium disposed in sinuous distinct folds, arising from a contracted peduncle which is attached by an expanded base; cells wholly immersed; orifice suborbicular with a narrow sinus below, and sometimes a small opening instead of the sinus; surface punctured around the orifice and usually in the interspaces also.

Habitat.—C. Crag, *S. W.*

The peculiar habit of growth in this species renders its diagnosis, when tolerably perfect, very easy. Small fragments, however, could not be so readily distinguished from overgrown specimens of other species, as for instance in the very old condition of the

recent *E. cervicornis*. Attention to the circular sinuated orifice which will be seen at the bottom of a funnel-shaped pit encircled by a row of puncta, will, however, in most cases be sufficient for its distinction.

5. *E. CORNUTA*, (*n. sp.*) Pl. IV, fig. 7, and Pl. X, fig. 5.

Polyzoario explanato irregulari; cellulis ovalibus seu rhomboidalibus, superficie granulosa, ad marginem seriatim punctatis, rostro magno avicularium gerente munitis. Ostio magno, rotundato, supra paulatim constricto, labio inferiori subrecto, peristomate supra spinâ unicâ vel duplici et infra utrinque spinâ marginali forti conicâ armato.

Polyzoarium expanded irregular; cells oval or rhomboidal; surface granular; a single row of large channelled pores round the border; orifice large, round, and contracted above; lower border straight, or slightly hollowed; a large conical spine on each side of the orifice below, and one or two spines of less size above; a prominent rostrate avicularium on the front of the cell.

Habitat.—C. Crag, *S. W.*, *J. S. B.*

(*b*) *Lobate or ramose.*

6. *E. SEDGWICKII*, *M. Edw.* Pl. X, fig. 1.

Polyzoario e lobis latioribus composito; cellulis oblongis, supra latioribus, superficie porosâ, ad marginem seriatim punctatis; aviculario immerso centrali, vel haud raro laterali et ostium juxta munitis. Ostio permagno, suborbiculari, infra subinde constricto, labio inferiori submucronato. Ovicellulâ magnâ, altâ, subglobosâ.

Polyzoarium broadly lobate; cells oblong, expanded above, surface punctured with a distinct row of pores around the border and orifice. Orifice very large, suborbicular, sometimes contracted and submucronate below; an immersed avicularium usually in the centre of the cell in front, but sometimes placed on one or both sides near the orifice; ovicell large, lofty, subglobose.

ESCH. SEDGWICKII, *M. Edw.*, l. c., p. 10, pl. x, fig. 8; *S. Wood*; *Michelin* (?), *Icon. Zooph.*, p. 328, pl. lxxviii, fig. 6.

Habitat.—Cor. Crag, Sudbourne, *S. W.*, *M. Edwards*; Doucè, *Michelin*.

The incipient "capsules gemmifères" of M. M. Edwards, are the central avicularia, which may be regarded as the most distinctive character of this species. In the majority

of specimens these organs occupy the centre of most of the cells, whilst in other instances, far more rare apparently, they will be found situated on other parts of the cell, as close to the orifice and below it on one or both sides, or on a level with it, that is to say, quite at the summit of the cell on one side, when the avicularium is generally of far larger size, and presents the form of an elongated spoon-shaped process.

E. Sedgwickii sometimes occurs in the crustaceous form.

7. *E. MONILIFERA*, *W. Edwards*. Pl. XI, figs. 1, 2, 3.

Polyzoario pedunculato, palmato, seu multiformi. Cellulis immersis, pyriformibus, elongatis, fronte carinatis, pororum serie longitudinali unicâ, duplicive ad latera ornatis; ostio orbiculari, infra sinuato vel canaliculato, avicularium utrinque ostendente. Ovicellulis nullis. Cellulis fertilibus (?) magnis, immersis, irregulariter inter vulgares sparsis.

Polyzoarium pedunculate, palmate, or multiform; cells immersed, pyriform, elongated, carinate in front, with one or two longitudinal rows of punctures on each side; orifice orbicular, sinuated, or channelled below; an avicularium on each side of the mouth. No ovicells. Fertile (?) cells large, immersed, dispersed irregularly throughout the polyzoary.

E. MONILIFERA, *M. Edwards*, l. c., p. 7, pl. ix, fig. 1; *Michelin*, l. c., p. 327, pl. lxxviii, fig. 10; *S. Wood*, l. c., p. 16.

Habitat.—C. Crag, Sudbourn, *S. W.*; *J. S. B.*; Faluns, Touraine, *M. E.*; Cléons (Loire-Inférieure), Sceaux, Thouarcé (Maine-et-Loire), *Mich.*

This species, which from the great abundance in which it occurs in the Coralline Crag, may be regarded as the characteristic Polyzoön of that formation, has been so well described by M. M. Edwards that it is scarcely necessary to do more than refer to his observations respecting it. The polyzoary exhibits extraordinary diversities of form; its lobes or divisions varying from slender subcylindrical and ligulate branches, to broad, wavy, foliaceous expansions. All the various forms, however, agree in the circumstance that the growth springs from a contracted, usually hollow, peduncle, slightly expanding at the base, by which it is attached to shells and rocks. The cells in the younger portions are elongated, pyriform and raised in front, especially at the upper part, into a sort of angular ridge or keel, and the surface on each side of the cell is marked with a longitudinal row of pores, the rows belonging to two contiguous cells, being separated by a somewhat raised line. The orifice is placed at the summit of the cell, and looks obliquely upwards and forwards; it is suborbicular, and sinuated in front or below, the sinus being sometimes produced into a channel. And on each side of the lower border of the orifice is a perforated process or tubercle, supposed by M. M. Edwards, as in other species, to represent a gemmiferous capsule. The form of the opening, however, clearly indicates

that these processes are avicularia. From their position and form, they are very characteristic of the species, even where most of the other characters are obliterated. No ovicells, like those in most other polyzoa, appear to exist in *E. monilifera*; but intermixed irregularly among the common cells, there will be observed in many specimens, though not in all, large openings, of a quadrangular form, four or five times the size of the mouths of a cell, and occupying in fact the entire front of a cavity at least twice the dimensions of a common cell. These openings are usually patent, but in many instances they are closed by a cribriform calcareous plate, and have below them a curious bracket-like shelf, at the upper angles, of which on either side may be noticed in some cases the traces of minute avicularia corresponding to those on each side of the mouth in the other cells. These peculiar cells, the "accessory cells" of D'Orbigny, may probably be taken, as before said, to represent the fertile cells of *E. monilifera*. One is represented, covered in by its cribriform plate, at *a* fig. 2, plate XI.

Very considerable differences of appearance in this *Eschara* are produced by age. In the older cells, as remarked by M. Edwards, the mouth, without much change of form, becomes immersed, and finally altogether filled up; the pores also are obliterated, and the surface appears solid, either marked by the ridges indicating the situation of the cells, or nearly smooth, with only indistinct undulating lines, more like those on the surface of a piece of a *Corallium*, than of the skeleton of any *Polyzoon*.

Genus 2. MELICERITA. M. Edwards.

Polyzoarium explanatum, c cellulis quincuncialibus in utrâque superficie et in seriebus transversis dispositis compositum. Lamellis conjunctis.

Polyzoarium composed of cells disposed quincuncially on both surfaces in transverse series; the two layers inseparable.

MELICERITA, *M. Edwards*, Sur l. Eschares foss., p. 25.

MELICERTINA, *Ehrenb.*

ULIDIUM, *S. Wood*, Ann. Nat. Hist., xiii, p. 17.

The distinction between this genus and that of *Eschara*, to which it is very closely allied, was first indicated by M. M. Edwards, who observes (l. c.) that the "mutual relation of the cells is essentially different from that which obtains in the latter genus." In *Eschara* each cell produces at its superior extremity another cell, so that the aggregate growth is eventually made up of parallel longitudinal series, the cells in the contiguous series being for the most part regularly alternate, and having their longitudinal axis coincident with that of the series to which they belong; the only interruption to this

uniformity consisting in the circumstance that occasionally one of the cells in a series will give origin to two, from which are continued two distinct series, and so on. Thus in *Eschara* the mouths of the cells are placed one above another in the longitudinal direction of the series, and alternate with those of the contiguous series on each side.

In *Melicerita*, on the contrary, the cells are disposed in transverse series, the summit of each cell corresponding to the line of junction of the cells in the series above; so that the mouths of the cells are opposite those on each side of them. As remarked by M. M. Edwards, this constant difference in the disposition of the cells may be taken to represent a corresponding difference in the organization of the animal. The peculiar disposition itself is to be explained upon the supposition that the buds are thrown out in *Melicerita*, not from the summit of the parent-cell, but from one side of the summit.

Besides the Crag Fossil, I have been able to find only a single species referrible to this genus, which thus appears to be of very limited importance. The species in question is the *Eschara Acasta* of D'Orbigny ('Terr. Crét.,' pl. delxii, figs. 7—9), which may be presumed to belong to the Cretaceous period.

1. M. CHARLESWORTHII, *M. Edw.* Pl. X, fig. 4.

Polyzoario foliaceo, explanatō; cellulis marginatis, hexagonis, fronte lineâ elevatâ utrinque ornatâ. Ostio transversali, semilunari, utrinque denticulato, dentemque latum bicuspidatum internum supra ostendente. Ovicellulis immersis, inconspicuis, aperturâ semilunari in apice cellulârûm positâ; aviculariis immersis inter cellulas sparsis.

Polyzoarium foliaceous, expanded; cells with a raised border, hexagonal; orifice transverse, crescentic, having a condyloid tooth on each side below, and a broad bicuspid denticle within the upper border; usually a raised line on each side of the front of the cell which converge below; scattered intercellular avicularia. Ovicells immersed, inconspicuous, opening by a crescentic slit within the summit of the cell.

MELICERITA CHARLESWORTHII, *M. Ed.*, l. c.; *D'Orbigny*; *J. Morris*.

MELICERTINA CHARLESWORTHII, *Ehr.*

ULIDIUM CHARLESWORTHII, *S. Wood*.

In this species, as well as in *M. Acasta*, D'Orbigny (sp.), the cells are bordered by raised ridges, which subdivide the surface of the polyzoarium into hexagonal areas, as in *Salicornaria*, with which, in some respects, the present genus would seem to correspond. This character, therefore, might perhaps be admitted into the generic definition. The mouth of the cell, which is placed about the middle of the hexagonal area, is crescentic in form, transverse, and surrounded with a raised peristome; within it, at the lower border, will be observed two condyloid teeth, like those often so much developed in *Salicornaria*, and a broad bicuspid plate or denticle depends within the upper margin. On each side

of the mouth is a raised line, the two meeting towards the lower part of the cell, also a particular in which *M. Charlesworthii* agrees with some *Salicornariæ*. Another point in which this agreement is perhaps still more manifest, is in the condition of the ovicell, which is itself, as in that genus, quite inconspicuous, though its orifice is manifest enough in a crescentic, or rather horse-shoe-shaped fissure, immediately within the angle which forms the summit of the cell-area. This opening is usually much enlarged by attrition or fracture, and then appears as a rounded orifice of considerable size.

Dispersed irregularly among the other cells, and apparently breaking their uniformity of arrangement, are smaller areas of irregular shape, containing an elongated, curved falciform opening. These are obviously large avicularia, which in this case replace the true cells, and do not belong to any individual cell. Many instances of a similar arrangement of avicularia exist also among the extinct *Escharæ*, especially among those belonging to the Cretaceous period.

Genus 3. BIFLUSTRA, *D'Orbigny*.

Polyzoario foliaceo seu ramoso; cellulis apertis, marginatis, quincuncialibus, in utrâque superficie in seriebus longitudinalibus dispositis. Lamellis, scriebusque cellularum facile disjungendis.

Polyzoarium foliaceous or ramose; cells open in front, with a distinct raised border, disposed quincuncially on both surfaces in longitudinal series. The two layers of cells readily separable, as are also the longitudinal series.

BIFLUSTRA, *D'Orbigny*, Recherches sur les Moll. Bryoz., Ann. d. S. Nat., 3d ser., xviii, p. 330.

M. D'Orbigny observes that his genus *Biflustra* stands in the same relation to *Membranipora* that *Eschara* holds with respect to *Cellepora (Lepralia)*; that is to say, that it is composed of free *Membraniporæ* applied back to back. He also states that there are both living and fossil species, and that the former inhabit deep water in both hot and cold regions; one species coming from Newfoundland, and a second from the seas around Manilla. The only living form, however, with which I am acquainted, referrible to this genus, is one from Australia, and probably, therefore, identical with that from Manilla, alluded to by the French observer. It appears, so far as I know, not to have been described; and as it is in all respects identical with the Crag Fossil, it must be regarded as of considerable interest.

It forms large foliaceous, cavernous masses, of a beautiful white aspect, and exceedingly light and fragile. The polyzoarium is composed of very regular quadrangular cells, with granular margins, and widely open in front, whilst behind they are closed by a

distinct wall. Each layer of cells being thus readily separable from the other, and not intimately united, as in *Eschara*. The dorsal surface of each layer, when they are separated, is smooth and longitudinally sulcate, or like a ridge and furrow roof, the ridges and furrows of the opposed surfaces fitting into each other. The longitudinal lines of cells are also easily separated laterally, though perhaps not quite so readily as in the other direction.

No description or figure of the recent species which was procured by Mr. M'Gillivray, in the voyage of the "Rattlesnake," has as yet been published. I have, therefore, given in Pl. I, fig. 1, magnified figures of portions of it, for comparison with similarly magnified figures of the fossil form (fig. 2). In the 'Paléontologie Française,' M. D'Orbigny describes and figures sixty fossil species of *Biflustra*, a number which doubtless very far exceeds that of the truly distinct forms. Among these, none are foliaceous or expanded, all being either subcylindrical and closely allied to *Vincularia*, or compressed and ramose, many of which might perhaps, with equal justice, be referred to *Eschara*. In the figures no indication is afforded that the two layers are readily separable; but as M. D'Orbigny includes this peculiarity in the generic character, it is to be presumed that the species depicted do possess it.

The genus consequently may be subdivided into two groups.

- (a) Polyzoarium foliaceous, expanded, subcylindrical, compressed.
- (b) Polyzoarium ramose.

The genus, as above defined, would seem to have commenced in the Cretaceous period, during which it attained its greatest development, the species afterwards appearing to become isolated and far less numerous up to the recent epoch, when they seem to have dwindled down to one or two.

1. B. DELICATULA (*n. sp.*) Pl. I, figs. 2 and 4; Pl. II, fig. 7.

Cellulis quadrangularibus, oblongis, supra arcuatis; septis, laminâque granulosis; apertura ovatâ, suborbiculari seu ellipticâ; dentem serratum internum infra ostendente.

Cells quadrangular, oblong, arched above; septa and lamina granular; aperture ovate, suborbicular, or elliptical; a serrate denticle within the lower margin.

Habitat.—C. Crag; occurring abundantly in large irregular fragments, *S. W.*, *J. S. B.* (*Recent*), Australia, Manilla?

Genus 4. RETEPORA, *Imperato*.

Polyzoario foliaceo, reticulato, infundibuliformi seu contorto, subpedunculato. Cellulis decumbentibus superficie superiori seu internâ tantum se ostendentibus.

Polyzoarium foliaceous, reticulate, infundibuliform, or contorted, subpedunculate; cells decumbent, opening on the upper surface only.

RETEPORA, *Imperato*; *M. Edwards* (note in *Lamarck*, An. S. Vert., 2d ed., ii, p. 275);

Johnston; *Busk*; *D'Orbigny*; *Risso*; *Reuss*.

— (pars), *Lamarck*; *Lamouroux*; *Blainville*; *Hagenow*; *Goldfuss*.

MILLEPORA (pars), *Linn.*; *Pallas*, &c.

The peculiar conformation of the polyzoary in *Retepora*, renders the species of which it is composed very readily recognisable generically. It is far otherwise, however, with respect to the diagnosis of the species themselves. Even in recent and living forms, and under the most favorable conditions of age and growth, it is not always very easy to obtain a satisfactory view of the minute characters upon which alone the distinctions between different species certainly rest. In the case of fossil specimens this difficulty is of course greatly increased, owing to the usually fragmentary condition in which they occur, and to the circumstance that the minute characters are either worn off or concealed by encrusting matter, so as to be rendered indistinct. The characters, therefore, here assigned to what would appear to be distinct species, must be understood as liable to future correction. The careful consideration of numerous specimens has shown pretty clearly that the forms described are distinct, *inter se*, but whether better absolute characters for each may not hereafter be assigned, cannot be affirmed.

The only genus with which that of *Retepora* can be confounded is *Hornera*, several species of which affect a very similar habit of growth, and consequently were formerly regarded as congeneric with the true Retepores. The distinction between them appears to have been first indicated by M. M. Edwards (l. c.). One broad distinction, obvious to the naked eye, exists in the circumstance that in the true Retepores the polyzoary is composed of pretty nearly equal-sized branches, anastomosing so as to constitute elliptical meshes, whilst in the reticulate *Horneræ*, it consists of tolerably straight, subparallel, wider branches, connected at uniform distances by short transverse ramuscules, at right angles to the former, by which arrangement the meshes or fenestræ are rendered more or less oblong or triangular.

In *Retepora* the cells open on one side only of the polyzoarium; the opposite or dorsal surface being smooth, or sometimes very finely granulous, and divided, as it were, into sections by lines, (*vibices*) which are usually raised above the surface. These lines do not

correspond with the outlines of individual cells, but seem, in cases where they are well developed, to be tubular, representing, in all probability, the radical tubes of some other cheilostomatous Polyzoa. There will, furthermore, be observed on the dorsal aspect, in some species, avicularia, variously placed with respect to the fenestræ, and whose situation appears to afford pretty constant specific characters.

1. R. CELLULOSA, *Linn. (sp.)* Pl. XII, fig. 1.

Polyzoario turbinato seu crateriformi, undulato, crispo; dorso vibicato et apud angulos fenestrarum inferiores, avicularia papilliformia exhibente. Cellulis subcylindræis superficie glabrâ. Ostio suborbiculari, labio inferiori rostriformi, uno latere aviculario armato.

Polyzoarium turbinate or crateriform, undulated, curled. Cells subcylindrical, surface smooth; orifice suborbicular, lower lip projecting, with an avicularium on one side; dorsal surface strongly vibicate; a papilliform avicularium at the lower angle of the fenestræ.

- RETEPORA ESCHARA MARINA, *Imperato*, Hist. Nat., p. 821, 1559.
 MADREPORA FORMA ROSE, *Marsigl.*, Hist. d. l. Mer., p. 149, tab. xxxiii, fig. 161, 1725.
 RETICULUM MARINUM., *Rumph.*, Amboin., vi, p. 247, t. lxxxvii, fig. 6, 1705.
 MILLEPORA (sp.), *Ellis*, Corallin., p. 72, tab. xxv, fig. d D, 1755.
 — RETEpora, *Pallas*, Elench., p. 243, 1766; *Borlase*, Cornw., p. 240, pl. xxiv, fig. 8.
 — CELLULOSA, *Linn.*, Syst. x; *Jameson*, Wern. Mem., i, 560; *Cavolini*, Pol. Mar., p. 64, tab. iii, figs. 12, 13, 1785; *Esper*, Mill., tab. i, 1791—8.
 — FORAMINOSA, *Ellis and Solander*, Zooph., p. 138, pl. xxvi, fig. 2, 1786.
 RETEpora CELLULOSA, *Lamk.*, Ann. S. Vert., tom. ii, p. 182, 1815—22, 2d ed., tom. ii, p. 276, 1836; *Lamx.*, Exp. Meth., p. 41, tab. xxvi, fig. 2, 1821; *Blainville*, Man. d'Actin., p. 433; *Alas*, pl. lxxvi, fig. 1; *Busk*, B. M. Cat., part ii, p. 94, pl. cxxi, figs. 3—8; pl. cxxiii, figs. 5, 6, 7; *Reuss*, Foss. Polyp. W. Tertiär-beck, p. 47, tab. vi, fig. 34, 1847; *Michelin*, Iconog. Zooph., p. 71, pl. xiv, fig. 10, 1847.
 — RETICULATA, *Johnst.*, Brit. Zooph., 2d ed., vol. i, p. 253 (ex. syn.), 1847.
 — FRUSTULATA (?), *Lamarck*, Ann. S. Vert., 2d ed., p. 279; *DeFrance*, Dict. des Sc. N., t. 45, p. 282; *Blainville*, Man. d'Act, p. 434.

Habitat.—Cor. Crag, *S. W.*; *J. S. B.*; in the Leithakalke of Eisenstadt and Mörbisch, in Hungary; Tertiary Marls of Freden Luitherst and Dickholz, and of Astrupp, near Osnabrück; on the Superga, Turin; South of France, *Reuss*; Angers, *Menard*; Douc and Vihier (Maine-et-Loire); St. Laurent des Mortiers (Mayenne), Angles and Vedennes (Vaucluse), L'Etang de Thau, near Cette (Hérault), *Michelin*. (*Recent*) Mediterranean; Britain, south and west coast.

The distinguishing characteristics of *Retepora cellulosa* are—the existence on one side of the lower lip, or a little below it, of an elongated slit-like avicularium; the absence of a

rostrate avicularium in front of the mouth; and the presence, pretty generally, of an avicularium usually raised on a small papilla at the lower angle of each fenestra on the back of the polyzoary. Although the fragments found in the Crag are small, very imperfect, and rather rare, yet the characters above mentioned have been satisfactorily made out. It is a living British species, but found, I believe, only on the south and south-west part of the coast, but it is abundant on the Coast of Spain and in the Mediterranean; and a form apparently undistinguishable from it occurs in the Southern Hemisphere, together with several others wholly distinct, though much resembling the European species in general aspect. In the absence of any precise account of the minute characters, it is impossible to decide upon the correctness of the various synonyms of fossil Retepores, and those, therefore, only have been introduced which appeared the most likely to be correct. For a similar reason, I have altogether omitted the forms noticed by Goldfuss, his descriptions and figures being wholly insufficient for their identification. His *R. vibicata* appears decidedly not to be *R. cellulosa*, the fenestræ being too wide, and the dorsal aspect very unlike that of the latter species.

2. *R. BEANIANA*, *King*. Pl. XII, figs. 2, 5, 6, and 7.

Polyzoario infundibuli—seu hypercrateriformi, undulato; dorso subvibicato, aviculariis, parvis, sparsis munito. Cellulis ovatis seu subcylindraceis, rostro gracili plerumque elongato et avicularium mandibulâ semicirculari paratum, apice gerente armatis. Ostio orbiculari spinâ marginali utrinque munito. Ovicellulâ fissurâ verticali ornatâ.

Polyzoarium infundibuliform or hypercrateriform, wavy; cells ovate or subcylindrical; orifice orbicular, with a slender rostrum projecting in front immediately below it, on the summit of which is an avicularium with a semicircular mandible; an oral spine on each side above; ovicell with a vertical slit in front; small avicularia scattered over the dorsal surface.

MILLEPORA CELLULOSA, *Jameson*, *Werner Mem.*, i, p. 560.

RETEPORA CELLULOSA, *Johnston*, *Mag. Nat. Hist.*, vii, p. 638, fig. 69.

— BEANIANA, *King*, *Ann. Nat. Hist.*, xviii, p. 237, 1846; *Johnst.*, *Brit. Zooph.*, 2d ed., i, p. 353, fig. 67, 1847; *Busk*, *Brit. M. Cat.*, part ii, p. 94, pl. cxxiii, figs. 1—5.

Habitat.—C. Crag, *S. W.* (*Recent*) Britain, N. E. *Bean*, *King*; Coast of Norway, *M. Andrew*; Arctic Sea, *S. E. Belcher*.

Owing to its being apparently wholly a northern form, the occurrence of *R. Beaniana* among the Crag fossils is of much interest. The principal characters by which it is distinguished from *R. cellulosa*, consist in the existence, in front of the orifice, of a prominent rostrum crowned with an avicularium, and of an oral spine at each upper angle. Of these characters, those which longest remain distinct in the older portions of a polyzoarium, are

perhaps the anti-oral avicularium, and the narrow slit in front of the ovicell; but as the latter condition is not confined to this species, the avicularium is, of all the characters, that most to be relied upon.

3. *R. NOTOPACHYS*. Pl. XII, fig. 4.

Fenestris rhomboidalibus, angustis; cellulis ovalibus immersis, seu inconspicuis, aviculario rostriformi centrali munitis; ostio orbiculari, infra sinuato seu inciso, supra spinis duabus marginalibus armatâ, ovicellulâ magnâ, fronte apertâ. Ramis posticé convexis, superficie lineis transversis signatâ, substantiâ crassâ sublaminatâ.

Fenestræ rhomboidal, narrow; cells deeply immersed, oval, or inconspicuous; orifice orbicular, with a sinus below, and a marginal line on each side above; a prominent avicularium on the front of the cell in the centre; ovicell large, open in front; dorsal surface convex, marked with deep, usually transverse, lines; substance of branches behind very thick, laminated.

Habitat.—C. Crag, in a hollow in a mass of *Cellepore*, *J. S. B.*

The peculiarly thick aspect of the polyzoarium, and the comparatively small fenestræ distinguish this species at first sight, but it is characterised more especially by the extraordinary thickness and density attained by the calcareous substance on the back of the polyzoary, and which is disposed in crescentic laminæ.

Although unable to refer *R. notopachys* to any other fossil or recent species, it should be remarked that an undescribed recent form, strongly resembling it in some respects, exists, but whose habitat I am not certainly acquainted with, though believing that it is from the Mediterranean, or some part of the Coast of Spain. The only fragments of this and the following species yet met with are too imperfect to convey any notion of its general form.

4 *R. SIMPLEX* (*n. sp.*) Pl. XII, fig. 3.

Fenestris ovalibus angustis acutis; cellulis altè immersis, subovalibus; subinde poro unico centrali ornatis; ostio orbiculari infra sinuato, supra spinis duabus marginalibus munito; superficie ramorum dorsali glabrâ vibicatâ.

Fenestræ oval, narrow, pointed at each end; cells deeply immersed, or obscurely oval; orifice orbicular, with a sinus below, and a spine on each side above; dorsal surface smooth, vibicate; sometimes a pore in the centre of the cell in front.

Habitat.—C. Crag, *S. Wood*.

This species, if really distinct from the preceding, which is doubtful, appears to be dis-

tinguished from its congeners by the entire absence of anything like an avicularian organ. The fragments in which it occurs, however, are so small and so much worn, that its true characters must be regarded as still doubtful.

Genus 5. HEMESCHARA (*n. gen.*).

Polyzoarium foliaceum, contortum seu lamellosum, c strato simplici cellularum quincuncialium compositum.

Polyzoarium foliaceous, contorted, or laminar, composed of a single layer of cells disposed quincuncially, and opening on one surface.

SEMIESCHARA, SEMIESCHARIPORA, and MULTESCHARIPORA (pars), *D'Orbigny*.

LEPRALIA (sp.), *Busk*, Brit. M. Cat.

ESCHARA (pars), *Auct.*

There are a certain number of *Escharidæ* which, from their peculiar conformation, appear to merit a distinctive generic appellation. In some respects approaching *Membranipora* and *Lepralia*, they differ from those genera in the circumstance that the polyzoarium is not adnate by its entire surface to a foreign body; whilst from *Eschara*, *Melicerita*, and *Biflustra*, they are distinguished by its being constituted of only a single layer of cells, the polyzoarium forming a continuous thin lamina, on one surface of which the cells open, whilst their backs are exposed in the other. The lamina is often turned back, as it were, upon itself, so as to enclose a cavity which communicates with the exterior by two or more contracted openings; but sometimes it would seem to be more expanded, and variously contorted and laminated, whilst in other cases, again, it assumes an arborescent form, consisting of a hollow cylindrical stem and branches.

In the formation of the cells themselves, the species thus associated may be subdivided into two sections, corresponding with *Membranipora* and *Lepralia*. In one of these sections the front of the cells, as in *Membranipora*, is for the most part open, and surrounded by a raised border; whilst in the other the cells are entire and convex in front, as in *Lepralia* and *Eschara*. Among recent species, an excellent type of the latter section is presented in *L. marionensis*, *Busk* ('Brit. M. Cat.'), and of the former, numerous (perhaps too numerous) instances will be found in the 'Paleontologie Française.'

Of the tubular, arborescent forms, at least one living instance exists, though apparently as yet undescribed; and of fossil, two may be cited, *Semieschारा cylindrica* and *S. arborea*, of *D'Orbigny* (l. c. pl. dccx).

One species only, referrible to this genus, occurs among the Crag fossils.

1. *H. IMBELLIS* (*n. sp.*) Pl. IV, fig. 6, and Pl. X, fig. 7.

Polyzoario convoluto; cellulis ovatis, subumbonatis ad marginem presertim punctatis; ostio semicirculari, labio inferiori recto peristomate simplici.

Polyzoarium convolute; cells ovate, punctured especially round the border, subumbonate in front; orifice semicircular, with a straight lower border and simple peristome.

ESCHARA PERTUSA (?), *Michelin*, l. c., pl. lxxix, fig. 2.

Fragments of this species may be confounded with *Eschara cornuta*, *Lep. variolosa*, and *L. haimescana*, and perhaps of *E. pertusa*, although little attention will suffice for their distinction. 1. The species is not adnate, although one layer overlies another. 2. From *E. cornuta* and *L. variolosa* it is distinguished by the unarmed orifice, whilst the absence of an introral denticle, and the presence of an umbonal projection on the front of the cell, distinguish it from *L. Haimescana*.

§§§ 3. LIBERÆ.

Fam. VII. *SELENARIIDÆ*, Busk, 1853.

Polyzoarium liberum orbiculare seu irregulare, conicum sive depressum, supra convexum, infra planum vel concavum; facie convexâ tantum cellulôsâ. Cellulis duplicis generis seriatim dispositis seu quincuncialibus.

Polyzoarium free (?), orbicular or irregular, conical or depressed, convex on one side, and plane or concave on the other; composed of a single layer of cells, usually of two kinds, which open on the convex surface only.

SELENARIADÆ, *Busk*, B. M. Cat., pt. ii, p. 97, 1852.

ESCHARIDÆ (pars), *D'Orbigny*, Ann. d. S. N., 3d ser., xvii, p. 284, 1852.

POLYPIERS FORAMINÉS (pars), *Lamarck*, An. S. Vert., 2d ed., ii, p. 299.

CELLARIÆ (pars), *Blainville*, Man. d'Actin., p. 448.

MILLEPORÉES (pars), *Lamouroux*, Exp. Meth., p. 44.

ASTERODISCINA, *Lonsdale*, Dixon's Geol., Sussex, p. 159.

Originally included by Lamarck among his "Polypiers foraminés," a heterogeneous group, containing also several genera of Foraminifera and true Corals, and by Lamouroux associated also with Foraminifera and some Corallines, in the order "Milleporées," the true systematic position among the Polyzoa, of the Selenariidæ or Lunulites, was first indicated by De Blainville ('Man. d'Actinol.,' p. 448, 1834), who placed them at the head

of his family *Cellariæa*, and close to *Flustra*. It is not to be wondered at, that the striking resemblance borne by some of the more flattened or depressed species to the foraminiferous Orbitulites, should have suggested a relationship between them. No two things, however, as is now well known, are farther apart.

The most striking peculiarity, perhaps, of the Selenariidæ, is the peculiar form and constitution of the polyzoarium. In all other known Polyzoa, except in the case of *Cristatella mucedo*, the polyzoary is attached in some way to a foreign base, upon which it is immoveably fixed or rooted. This adhesion is effected in three principal modes.

1. By the adhesion to some foreign body of the initial or primordial cell, whence the whole of the rest of the growth arises by repeated gemmation; the fixing of the polyzoary, as it increases in size, being assisted by means of corneous fibres or tubes—the so-called “radical fibres”—of most of the articulated Polyzoa.

2. By the successive cells creeping along the surface of the foreign base, to which they are individually attached, as in *Membranipora*, and many other genera.

3. By means of a strong, rigid, calcareous peduncle, upon which the after-growth is supported like a tree upon its trunk. This mode of adhesion is presented in *Eschara*, *Retepora*, and others of the rigid, unarticulated Polyzoa.

In the Selenariidæ, however, no indication is, in most cases, apparent that the polyzoarium has ever been attached. It never exhibits radical fibres or a calcareous stem, nor, in fact, does any part of the surface show marks of its having been adherent. On the contrary, in perfect recent specimens, the entire surface of both the concave and convex surfaces is covered with a continuous chitinous epidermis.

Other considerations, moreover, would lead to the supposition that, at any rate, some of the Selenariidæ enjoy, to a certain extent, the power of locomotion, and which faculty, it may be remarked, is not singular in them, since there is no doubt that the curious fresh-water Polyzoan above noticed—*Cristatella mucedo*—is capable of creeping about on the surface of aquatic plants, by means of the fleshy under surface of its polyzoarium. But locomotion in the Selenariidæ, if any possess it, must be effected in a different way. A peculiar attribute of the whole family, almost without exception, is the possession of powerful vibraular organs, which in several species, as for instance in *L. Capulus*, B., and *L. gibbosus*, B., have the setæ so formed, as apparently to be well adapted for employment as agents in locomotion. In other species, however, as in *C. Loweii* and *canariensis*, and perhaps in all the other *Cupulariæ*, the vibraulum would appear to be more especially adapted to its usual function, viz., that of a defensive or cleansing organ. Whilst in the curious *Selenaria maculata*, B., the extraordinary conformation of the seta, which closely resembles in outward aspect the curling proboscis of a Butterfly, leaves its function very obscure.

When it is stated that the polyzoarium in the Selenariidæ is unattached permanently to foreign bodies, it should be remarked that in very many cases a particle of coarse sand, or fragment of shell, or, it may be, a fragment of a dead polyzoary of the same species,

will be found in the apex of the cone; and from this point it would seem that the growth had started, as from a centre. The foreign particle, however, in all cases that have come under my observation, is of small size, and such as could be readily carried about with the rest of the growth.

It should also be noticed, that Hagenow ('Die Bryoz. d. Maästr. Kreidebild.,' p. 100) states that he has seen *L. semilunaris* and *L. Goldfussi*, attached by the entire surface upon Belemnites, but these, I think, must have been instances of accidental adhesion.

Besides the peculiar conformation of the polyzoary, one or two other points respecting the general structure of the Selenariidæ, should be adverted to. With no exception among living forms, and with very few, if in reality any, among the fossil, these Polyzoa are distinguished by the circumstance that the cells of which the polyzoary is composed are of two kinds, usually differing in size. The existence of these different kinds of cells has, of course, not escaped the notice of every one who has written on the subject of Lunulites; and although the true nature of the smaller or secondary cells was wholly unknown, they have been variously designated, as, "accessory cells" ("nebenporen"), "cellules avortées," "pores speciaux," &c., whilst some have confounded the opening of the smaller cell with the mouth of the true habitation of the polypide. With regard to the nature of the secondary cells, it has been supposed that they exhibited "a perfect analogy with the chambers in *Eschara* and *Escharina*, deemed to be receptacles for maturing gemmules;"¹ but as under the latter head two distinct things have been confounded, this analogy, though quite correct in part, morphologically throws no light upon the physiological function of the organs.

In fact, the question would probably never have been determined from the examination of fossil forms alone. And as, till very lately, but one living species had been discovered, and that described from a specimen in the same imperfect condition that all fossil ones are found in, the solution of the problem was extremely difficult, until an abundant supply of perfect recent specimens, of various species and genera, collected by Mr. M'Gillivray, in the voyage of the "Rattlesnake," allowed it to be decided in the most satisfactory manner. These specimens, which retained the chitinous parts of the skeleton as well as the calcareous, and in which, in fact, even the muscular tissue could be demonstrated after they had been moistened, proved that the smaller chambers are the cells of *vibracula*, and in the living state contain probably nothing but the muscular apparatus for the movement of the usually very long and strong seta, which has been adverted to above.

The constant presence, as it would seem, of this organ, and its apparent importance in the economy of the animal, naturally suggest its being employed in the classification of the Family. This idea appears to have occurred to Lamouroux, who, though acquainted only with two or three fossil forms, long ago suggested the subdivision of the Lamarekian

¹ Lonsdale, 'Q. Journ. Geol. Soc.,' i, p. 504, 1845.

Lunulites into *Lunulites* and *Cupularia*, regarding the two, however, only in the light of sub-genera. There can be no doubt of the propriety and advantage of such a division, which was consequently adopted by me in the 'Brit. M. Cat.,' in 1852, and is followed here, as will appear in the subjoined Synopsis of the genera.

With regard to the distribution of the Selenariidæ in time and space, it would seem, as regards the former, that they made their first appearance in the Cretaceous period, and are continued through the Tertiary up to the present time, in which the number of known species is about twelve.

The recent species at present known, and their distribution are—

(1) *Cupularia*.

1. *C. GUINEENSIS*, *B.*, B. M. Cat., p. ii, p. 98, pl. cxiv.
Habitat.—New Guinea.
2. *C. OWENII*, *Gray*, B. M. Cat., p. ii, p. 99, pl. cxv.
Habitat.—W. Africa; Madeira; Canaries.
3. *C. LOWEI*, *Gray*, MS., B. M. Cat., p. ii, p. 99, pl. cxvi.
Habitat.—Madeira; Canaries.
4. *C. STELLATA*, *B.*, B. M. Cat., p. ii, p. 99, pl. cxviii.
Habitat.—Philippines.
5. *C. PYRIFORMIS*, *B.*, B. M. Cat., p. ii, p. 100, pl. cxxiv.
Habitat.—St. Vincent.
6. *C. JOHNSONI*, *Busk*, Q. J. M. Sci., vi, p. 67, Zooph., pl. xxiii, figs. 1—5.
Habitat.—Madeira; Canaries.
7. *C. CANARIENSIS*, *B.*, Q. J. M. Sci., vi, p. 66, pl. xxiii, figs. 6—9.
Habitat.—Madeira; Canaries.

(2) *Lunulites*.

8. *L. GIBBOSA*, *B.*, B. M. Cat., p. ii, p. 100, pl. cxi.
Habitat.—Cape Capricorn, Australia.
9. *L. CAPULUS*, *B.*, B. M. Cat., p. ii, p. 100, pl. cxii.
Habitat.—Cape Capricorn, Australia.
10. *L. PHILIPPINENSIS*, *B.*, B. M. Cat., p. ii, p. 101, pl. cxiii.
Habitat.—Philippine Islands.
11. *L. CANCELLATA*, *B.*, B. M. Cat., p. ii, p. 100, pl. cxiii, figs. 4—7.
Habitat.—Philippine Islands.

(3) *Selenaria*.

12. *S. MACULATA*, *B.*, B. M. Cat., p. ii, p. 101, pl. cxvii.
Habitat.—Bass's Strait.

Of these twelve species it will be observed that eight are confined to the northern, and four to the southern hemisphere. Moreover, that of the former, five belong to the

same Atlantic region, being, with one exception (*C. Owenii*), confined to the Madeiran group of islands; whilst three seem to be peculiar to the Philippines.

Of the four austral species, one only belongs to the genus *Cupularia* (*C. guineensis*), which approaches in type very nearly to the Atlantic *C. canariensis*, whilst the other three, belonging to the genus *Lunulites*, would appear to be peculiar to the Australian seas.¹ With respect to the latter, it is furthermore interesting to remark, that they alone, among recent Selenariidæ, represent the more ancient fossil forms; as, for instance, those found in rocks of the Cretaceous period.

The known number of fossil species which it seems at all possible to identify from the, with few exceptions, very imperfect figures and descriptions of writers, amounts to between thirty and forty; although this number may be regarded as liable to considerable deductions or additions, there being little doubt that many species have been confounded together or separated from each other upon insufficient grounds. These fossil forms may be arranged as under.

(1) *Crag.*

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| 1. <i>C. OWENII</i> (?), <i>Gray.</i> | } = <i>C. DENTICULATA</i> , <i>Conrad.</i> |
| 2. <i>L. ALVEOLATUS</i> , <i>S. W.</i> | |
| 3. <i>C. CANARIENSIS</i> , <i>B.</i> | |
| 4. <i>LUNULITES CONICA.</i> | |
| 5. <i>L. POROSA</i> (<i>n. sp.</i>) | |

(2) *Miocene, or more recent than Eocene.*

6. *C. DENTICULATA*, *Conrad.* (*Crag.*)
7. *C. INTERMEDIA*, *Michellotti.*
8. *C. UMBELLATA*, *DeFrance.*
9. *C. VANDEBECKEI*, *Michelin.*
10. *L. ANDROSACES*, *Michellotti.*
11. *L. CONICA*, *DeFrance.* (*Crag.*)
12. *L. CUVIERI*, *DeFrance.*
13. *L. PUNCTATA*, *Leymerie.*

(3) *Eocene.*

14. *L. SEXANGULA*, *Lonsd.*
15. *L. DISTANS*, *Lonsd.*
16. *L. CONTIGUA*, *Lonsd.*
17. *L. RADIATA*, *Lamarck.*
18. *L. URCEOLATA*, *Lamarck* (not *Goldfuss*, *Lamouroux*).
19. *C. RHOMBOIDALIS*, *Münster.*
20. *C. HAIDINGERI*, *Reuss.*

¹ Whilst these pages are passing through the press, I have been favoured by my friend, Mr. R. K. Parker, with some fossil Polyzoa from a miocene deposit in St. Domingo, amongst which occur *Cupularia canariensis*, and a form which seems to be identical with *Lunulites* (*Cupularia*) *umbellata*, DeFrance, figured in Blainville's 'Man. d. Actinologie,' pl. lxxii, fig. 1.

(4) *Cretaceous.*

21. L. CLYPEIFORMIS, *D'Orbigny* (sp.)
22. L. DOMA, *D'Orbigny* (sp.)
23. L. HAGENOWI, *Bosquet*.
24. L. GOLDFUSSII, *Hagenow*.
25. L. MITRA, *Hagenow*.
26. C. MÜNSTERI, *Hagenow*.
27. L. SEMILUNARIS, *Hagenow*.
28. L. SPIRALIS, *Hagenow*.
29. L. BOURGEOISII, *D'Orbigny*.
30. L. CRETACEA (?), *Defrance* (? *D'Orbigny*).
31. L. TUBERCULATA, *D'Orbigny*.
32. L. PAPYRACEA, *D'Orbigny*.
33. L. REGULARIS, *D'Orbigny*.
34. L. PETALOIDES, *D'Orbigny*.
35. L. ROSACEA, *D'Orbigny*.
36. L. PLANA, *D'Orbigny*.
37. STICHOPORA CLYPEATA, *Hagenow*.
38. S. CONICA, *D'Orbigny* (! L. CONICA, *Defrance*).

The following may be regarded as uncertain, either as to position or genus.

39. L. SPONGIA (?), *Morren*.
40. L. DUCLOISII, *Lea* ; Claiborne, Alabama.
41. L. BOUEI, *Lea* ; Claiborne, Alabama.
42. L. QUINCUNCIALIS, *Dujardin*.
43. L. PINEA (?), *Risso* ; *Defrance*.
44. L. DEPRESSA (?), *Conrad*.

From this list it will be at once apparent that the genus *Lunulites* preponderates very greatly among fossil Selenariidæ ; and, moreover, that with the exception of one species, *C. Münsteri*, noticed by Hagenow as occurring in the Cretaceous formation at Rügen, no *Cupularia* is found before the Eocene period, in which again, there are but two at present known, *C. rhomboidalis*, Münst., *C. Haidingeri*, Reuss., which are clearly not identical. In the later Tertiaries, however, including the Crag, the number of *Cupularia* is equal, or nearly so, to that of the *Lunulites* ; whilst in the recent period, the former would appear to preponderate. It should also be remarked, that the recent *Cupularia* not only exceed in number of species all the known fossil forms, but in size also, and that superadded to them we have a distinct genus, *Selenaria*, probably more perfectly organised than any. The recent Lunulites, also, though far fewer in number than their fossil congeners, would appear in like manner to exceed all, or nearly all of the latter, in their development. The only fossil Lunulite apparently at all approaching in size some of the

recent species is *Lunulites radiata*, or some of the forms figured under that title. Among the representations of this species are some which bear a strong resemblance to *L. capulus*, B., though of far smaller dimensions.

SYNOPSIS OF GENERA.

- (a) Each cell with a vibracular chamber at its apex or distal extremity.
 - 1. CUPULARIA, *Lamx.*

- (b) The cells and vibracular chambers disposed in separate, usually alternate rows, radiating from the centre.
 - 2. LUNULITES, *Lamx.*

- (c) Certain of the cells of a different conformation to the rest, furnished with a vibraculum.
 - 3. SELENARIA, *Busk.*

- (d) No apparent vibracular chambers distinct from the true cell.
 - STICHOPORA, *Hagenow.*

- (e) Vibracula replaced by small avicularia ; mouth of cell circular.
 - 4. CONESCHARELLINA, *D'Orbigny.*

Of these four genera, two only are represented in the Crag fossils.

Genus 1. CUPULARIA, Lamx.

Cellulis singulis vibraculum apice gerentibus.

Each cell throughout the polyzoarium with a vibracular cell at its distal extremity.

CUPULARIA, *Lamouroux*, Exp. Meth., p. 44 (proposed as a sub-genus); *Busk*, B. Mus. Cat., P. i, p. 97.

LUNULITES (pars), *DeFrance*; *Deslongchamps*; *Goldfuss*; *Blainville*; *Lonsdale*, Journ. Geol. Society, i, p. 503; *Michelin*; *Reuss*.

— SPIRALIS, *Hagenow*, Geinitz. Grund., p. 623.

1. C. DENTICULATA, *Conrad*. Pl. XIII, fig. 1.

Polyzoario conico seu depresso, plerumque subelongato, oblongo, margine denticulatâ; cellularum areâ rhombicâ; aperturâ margine denticulatâ; laminâ granulosâ; vibraculi orificio auriculari, alte canaliculato. Superficie dorsali sulcatâ, glabrâ vel subrugosâ.

Polyzoarium conical or depressed, usually more or less irregularly oblong; area rhombic; aperture with a denticulate margin; lamina granular; vibracular opening auricular, deeply channelled; posterior surface sulcate, smooth, or rugose.

L. ALVEOLATUS (?), *S. Wood*, Annals N. H., xiii, p. 18.

C. DENTICULATA, *Conrad*, Silliman's Journal, Oct., 1841, vol. xli; *Lonsdale*, Q. Jour. Geol. Soc., 1845, vol. i, p. 503 (with fig.)

C. OWENII, *Gray* (?), Spicilegia Zool., pt. i, p. 8, t. iii, fig. 15; *Busk*, B. M. Cat., p. ii, p. 99, pl. cxv; *S. W.*, Ann. Nat. Hist., xiii, p. 18.

C. JOHNSONI, *Busk* (?), Q. J. M. Sc., vii, p. 67, Zooph., pl. xxiii.

Habitat.—C. Crag, Sutton, Ramsholt, *S. W.*; *J. S. B.*; Miocene formation, Williamsburg, *Lonsd.* (Recent) Coast of Africa, Madeira, Canary Isles, *Johnson*; *Macandrew*.

The very striking resemblance in all the most essential points between the species above cited as synonymous with *C. denticulata*, at any rate in the condition they present when all the animal parts are removed, renders it highly probable that they are all identical. At the same time, some not inconsiderable diversities exist, almost sufficient to lead to the supposition that they may be distinct. That is to say, that two separate species are represented by *C. Owenii*, Gray, and *C. Johnsoni*, nob., for of the identity of the latter with the Crag fossil, I entertain, upon the most careful investigation, scarcely the shadow of a doubt. The typical specimens of *Cup. Owenii*, in the British Museum, are very flat and extremely delicate, the posterior surface being smooth and shining, or very

slightly rugose in parts; whilst the upper part of the margin of the cell is not produced downwards so distinctly in the form of a horse-shoe as it is in *Cup. Johnsoni*, whose polyzoary, again, is very conical, in which respect the species seems to agree with the description of *C. denticulata*.

C. denticulata of the Crag appears to attain a larger size than the recent *C. Johnsoni*, and it varies very much in shape, more especially in the greater or less elevation of the cone, which in some cases is very much depressed, whilst in others its height equals, or slightly exceeds, the diameter. But one or two peculiarities will nearly in all cases be observed. The form of the disc is seldom if ever truly circular, but more or less oblong, and usually showing a disposition to become angular on one or two sides. A second peculiarity, which I have not noticed in the recent species, consists in the circumstance that in *C. denticulata* the cells are often disposed to run in parallel rows, from the side of which other parallel series run off at right angles; a disposition which does not appear to be manifested in the recent forms. When in tolerably perfect condition, no difficulty will be experienced in identifying specimens of *C. denticulata*, but when they are much worn, as is very frequently the case, in which state it is probably the *L. alveolatus* of Mr. S. Wood, the identification will not be found quite so obvious. In Pl. XIII, fig. 3, is a representation of the appearance presented by a worn specimen, in which it will be observed that the denticulate margin of the aperture is destroyed, the situation of the cell being indicated by a more or less quadrangular, oblong opening, above which the remains of the vibraular cavity will often be seen, represented by a shallow, eup-like depression, the intervening substance being rough, and usually more or less porous. In a more advanced stage of attrition, the vibraular cup is wholly removed, when the surface of the polyzoary throughout a considerable extent will exhibit nothing but parallel rows of oblong, shallow pits, some distance apart. In this state it would be very difficult in many cases, and in some perhaps impossible, to distinguish a specimen of *C. denticulata* from one of *C. canariensis*, without reference to the condition of the posterior surface, when the presence or absence of the large pores, and the subdivision or not of the ridges into quadrangular portions, will at once determine the species. In its worn condition, and in small fragments, *C. porosa* may also be mistaken for imperfect fragments of *C. denticulata*, but in *C. porosa*, the fossæ left by the worn-down cells are of a pyriform shape, and disposed very distinctly in oblique lines, whilst the vibraular eup is more usually wholly obliterated, owing to the circumstance that it is, when perfect, much shallower in that species than in *C. denticulata* or *C. canariensis*. The fine porosity, moreover, of the posterior surface in *C. porosa*, affords a further mark of distinction.

2. *C. CANARIENSIS*, *Busk*. Pl. XIII, fig. 2.

Polyzoario crateriformi, orbiculari, margine denticulatâ; cellularum areâ rhombicâ; aperturâ subquadrangulâ, oblongâ, margine integrâ; vibraculi orificio auriculari, alte canaliculato. Superficie dorsali sulcatâ, liris in areas quadrangulares poris majoribus 3—6 ornatas partitis.

Polyzoarium cup-shaped, orbicular; area rhombic; aperture subquadrangular, oblong, margin entire; lamina finely granular; vibracular opening auricular, deeply channelled; posterior surface sulcate, the ridges divided into quadrangular portions, in each of which are 3—6 rather large pores.

C. CANARIENSIS, *Busk*, Q. J. M. Sc., vii, p. 66, Zooph., pl. xxiii, figs. 6—9.

Habitat.—C. Crag, Sutton, Ramsholt, *S. W.* (*Recent*) Madeira and Canaries, *Johnson, M'Andrew*.

3. *C. POROSA* (*n. sp.*) Pl. XIII, fig. 5.

Polyzoario parvo, depresso, orbiculari, lapidis vel conchæ particulam haud raro apice includente; cellularum areâ subrhomboidali? aperturâ margine denticulatâ? vibraculi orificio —? Superficie dorsali delicatule sulcatâ, liris planatis, porosis, subrugosis.

Polyzoarium less than $\frac{1}{4}$ " in diameter, flattened, orbicular, often including a fragment of stone or shell at the summit; area subrhomboidal? aperture with a toothed margin? vibracular orifice —? posterior surface finely sulcate; ridges flattened, minutely porous, subrugose.

Habitat.—Cor. Crag, *S. W.*

The distinguishing characteristics in the more worn condition of *C. denticulata*, *canariensis*, and *porosa*, have already been adverted to, and it is unnecessary here to remark further upon them. *C. porosa* seems to be one of the smallest of the Selenariidæ, for specimens bearing all the marks of considerable age do not exceed, or rarely equal $\frac{1}{4}$ " in diameter. A very common circumstance in, and, so far as I am aware, peculiar to this species, is the existence at the summit of the disc, that is to say, on the convex side, of an angular particle of stone or shell, around and upon which the cells are formed, spreading over it like those of a *Lepralia*, and in some cases, entirely enclosing the foreign body, of which no part, it is to be remarked, is visible on the under or concave side, which is the usual site for similar particles in many other Lunulites.

Genus 2. LUNULITES.

Cellulis radiatim in scriebus cum vibraculorum seriebus plus minusve regulariter alternantibus dispositis.

Cells arranged in more or less regular series, radiating from the centre; vibracula in linear series, alternating more or less regularly with those of the cells.

LUNULITES, *Lamouroux*; *Busk*, B. M. Cat., p. ii, p. 100.

— (pars), *Auctorum*, including *Discofustrellaria*, *D'Orbigny*.

1. *L. CONICA*, *Defrance*. Pl. XIII, fig. 4.

Polyzoario cupuliformi vel depresso, subacuminato, annulato, solido vel cavo; cellularum aperturis supra arcuatis, infra trigonis, suborbicularibus vel hexagonis, in annulis concentricis, regularibus, rugis elevatis sejunctis, dispositis. Superficie dorsali sulcis bifurcatis, undulosis signata; liris porosis.

Polyzoarium cupuliform, subacuminate, annulated, solid, or hollow; apertures arched above and three-sided below, suborbicular or hexagonal; disposed in regular circles around the cone, the circles being separated by prominent ridges; vibracula in series alternating regularly with those of the cells. Posterior surface sulcate, sulci bifurcating and wavy; ridges porous.

LUNULITES CONICA, *Defrance*, Dict. des Sc. Nat., xxvii, p. 361; *Michelin*, Icon. Zooph., p. 323, pl. lxxvii, fig. 9.

Var. a. *Depressa*.

L. URCEOLATA, *Goldfuss*, Petref. Ger., p. 41, pl. xii, fig. 7; (?) *Cuvier* and *Brongniart*, Descr. Géolog. d. Env. de Paris, pl. viii, fig. 9; (?) *Bronn.*, Syst. d. Urwelt. Pflanz., pl. vi, fig. 10; (?) *Lamarck*, Ann. S. Vert., 2d ed., ii, p. 300 (ex. syn. expart.); (?) *Michelin*, Icon. Zooph., p. 175, pl. xlvi, fig. 6 (not *Lamouroux*, Exp. Meth., p. 44, pl. lxxiii, figs. 9—12).

CUPULARIA URCEOLATA (?), *Bronn.*, Leth. Geog., pl. xxxv, fig. 28.

Habitat.—C. Crag, Sutton, Red Crag, *S. W.*; Salles (Gironde), Ste. Maure, Mantelon (Indre-et-Loire), *Michelin*; ? Grignon, *Goldfuss*, *Cuvier*, and *Brongniart*; ? Parnes, Chaumont (Paris Basin); Faluns of Anjou and Touraine, *Michelin*.

The figure of *L. conica*, *Defrance*, contained in the 'Icon. Zoophyt.' of M. Michelin, who had access to M. *Defrance*'s collection, leaves no doubt of the identity of the Crag fossil with that species. Nor can there, I think, be much doubt that the form figured by *Goldfuss* (l. c.) corresponds with it also, and represents the depressed variety. The species figured

in Cuvier and Brongniart (op. c.), whose figure is copied in Bronn (Syst. d. Urwelt. &c.), and which is also represented in Michelin, 'Icon. Zooph.,' pl. xlvi, fig. 6, and is doubtless the form intended by Lamarck under the name of *L. urceolata*, though at first sight differing very considerably from *L. conica* of DeFrance, on closer inspection proves, I think, to be identical with it. The chief difference appears to consist in the truncated or blunt summit and depressed form of *L. urceolata*, whilst in *L. conica* the summit is usually more or less pointed. Not having had an opportunity of inspecting a specimen of the Grignon fossil, and consequently in ignorance of the character of the posterior surface, I cannot express a very decided opinion, but am strongly inclined, from the close resemblance between the two in the disposition of the apertures of the cells and of the vibracula in regular circles around the cone, to regard their identity as highly probable. *L. urceolata* of Lamouroux is, as he himself observes, more properly a *Cupularia*, and is, therefore, wholly out of the question, and it is very strange that it should have hitherto been so generally cited as a synonym of *L. urceolata*, Lamarck.

OF THE CYCLOSTOMATA.

The following "synoptical arrangement" will convey a sufficient idea of the mode in which, as it appears to me, the various genera of fossil and recent Cyclostomatous Polyzoa may be arranged; and it offers, perhaps, a classification as nearly natural as seems possible with our present very incomplete knowledge of the sub-order. Great difficulties attend the diagnosis of species in this class of Polyzoa, even in the recent condition; and these difficulties, far more than in the Cheilostomata, are necessarily enhanced in the case of fossil specimens.

Owing to the great comparative simplicity and uniformity of conformation in the individual cells, and the absence, for the most part, of adventitious organs, such as ovicells and vibracular or avicularian organs, our principal reliance in the distinction of genera and species must be placed on the general form of the polyzoary, and the mutual relation of the cells; but as in many cases these vary very greatly in different portions of one and the same polyzoary, it often happens, more especially in fossil forms, that it is almost impossible to determine whether two apparently distinct things may not be referable to one and the same species. These observations apply more forcibly, perhaps, to *Pustulipora*, *Idmonea*, and *Hornera*, than to any other genera, but should be taken into account in several others also.

SYNOPTICAL ARRANGEMENT of the POLYZOA CYCLOSTOMATA.

§ I. Articulatæ s. radicatæ		Crisiidæ	{	<i>Crisia</i> <i>Crisidia</i> <i>Hornera</i> <i>Terebellaria</i> <i>Cricopora</i> <i>Cyrtopora</i> <i>Idmonea</i> <i>Pustulipora</i>
	Cellulis distinctis	Idmoneidæ	{	<i>Mesentcripora</i> <i>Tubulipora</i> <i>Alecto</i> <i>Diastopora</i> <i>Patinella</i> <i>Discoporella</i> <i>Defrancia</i>
		Tubuliporidæ	{	<i>Stellipora</i> <i>Fungella</i> <i>Heteropora</i> <i>Neuropora</i> <i>Alveolaria</i> <i>Spiropora</i> <i>Heteroporella</i>
§ II. Inarticulatæ s. adfixæ	Cellulis indistinctis	Ceriporidæ	{	<i>Theonoa</i> <i>Fascicularia</i> <i>Lopholepis</i> <i>Apsendesia</i> <i>Fron dipora</i> <i>Truncatula</i> <i>Distichopora</i> <i>Plethopora.</i>
		Theonoidæ	{	
		Fron diporidæ	{	

NOTE.—The families and genera in *italics* contain living species.

Sub-order II. CYCLOSTOMATA. *Busk.*

Cellulis tubulosis, rigidis, ex parte liberis, et distantibus, seu connatis et immersis. Orificio terminali incerni.

Cells tubular, rigid, wholly immersed and connate, or partially free and distant; mouth terminal; unfurnished with any moveable appendage; usually of the same diameter as the cell.

TUBULIFORINA, *Milne Edwards; Hagenow; Johnston.*

AULOPORINA (pars), *Ehrenberg; Johnston.*

MYRIOPORINA (sp.), *Ehrenberg.*

CERIOPORINA (pars), *Bronn.*

§ I. ARTICULATÆ S. RADICATÆ.

Polyzoario ex internodiis inter se articulatis composito; perque tubulos corneos radicales affixo.

Polyzoarium divided into distinct internodes, usually connected by flexible joints; attached by horny tubes.

Fam. I. CRISIDÆ, *M. Edwards.*

The only family.

Genus I. CRISIDIA, *M. Edwards.*

Internodiis unicellularibus.

A single cell in each internode.

No species occurs among the Crag fossils.

Genus 2. CRISIA, Lamouroux.

Internodiis multicellularibus.

More than one cell in each internode.

1. *C. DENTICULATA* (?) *Lamk.* (sp.) Pl. I, fig. 8.

Cellulis connatis; orificio paullulùm producto; articulis nigris.

Cells closely aggregated; orifice short, tubular; joints black.

CELLARIA DENTICULATA, Lamarck.

CRISIA LUXATA, Fleming; Blainville.

— *DENTICULATA, M. Edwards; Johnston.*

— *PATAGONICA* (?), *D'Orbigny* (teste *Johnston*).

— *EBURNEA, Van Beneden.*

Habitat.—*C. Crag, S. Wood.*

The small and imperfect fragments apparently belonging to this species among the Crag fossils are hardly sufficient to allow of its certain identification, though enough to justify its being placed at any rate provisionally with the common recent species, which, or some very closely allied forms, such as *Crisia elongata* of Milne Edwards, and *C. patagonica*, D'Orbig., are found in all parts of the globe.

§ II. INARTICULATÆ S. ADFIXÆ.

Polyzoario continuo, inarticulato; ramoso vel simplici. Aut erecto et per basin calcaream affixo, aut adnato vel incrustante.

Polyzoarium continuous throughout, or not divided into distinct internodes; fixed immoveably by a calcareous base, or immediately adnate upon foreign bodies.

Fam. I. *IDMONEIDÆ*, Busk.

Polyzoario erecto, simplici seu ramoso; ramis cylindricis, vel subcompressis; liberis, sive inter se conjunctis.

Polyzoarium erect, simple or branched; branches cylindrical or subcompressed; free or anastomosing.

1. HORNERA. *Lamx.*

Polyzoario erecto, aut explanato et retiformi, vel ramoso. Cellularum orificiis ad unam ramorum faciem tantum spectantibus. Superficie anteriori inter orificia plerumque reticulatâ, fibrosâ seu suleatâ.

Polyzoarium ramosæ; branches dichotomous and free, or united by short transverse ramules so as to constitute a retiform expansion; cells opening on one side only of the branches, which surface is marked with wavy anastomosing ridges, in the more or less rhomboidal interstices of which the openings of the cells are situated.

HORNERA, *Lamouroux*, Exp. Meth., p. 41, 1821; *M. Edwards* (pars); *Reuss* (pars); *Blainville*; *DeFrance*; *Michelin*; *Hagenow*.

RETEPORA (pars), *Lamarck*; *Goldfuss*; &c.

SIPHODICTYUM, *Lonsdale*.

MILLEPORA (pars), *Linn.*; *Ellis and Soland.*; *Esper.*; &c.

Taking the common Mediterranean *Hornera frondiculata*, Lamx. ('Expos. Method,' p. 41, pl. lxxiv, fig. 7—9, or Milne Edwards, 'Mém. s. les Crisies, &c.,' p. 17, pl. ix, fig. 1), as the type of the genus, it may be defined very naturally as above. This definition, however, will exclude from it, besides *Idmonea*, one or two recent forms, which although agreeing with *Idmonea*, *Hornera*, and *Fron dipora*, in having the openings of the cells on one side only of the branches, yet in other respects approach *Pustulipora* so much more nearly that they should undoubtedly, if not erected into a distinct genus, be associated with *Pustulipora*. But as no instance of a polyzoarium constructed on this type is met with among the Crag fossils, though one appears to have existed in the Cretaceous period (*H. tubulifera*, 'Hag. Maast. Kreideb.' p. 26, pl. ii, fig. 1), it is unnecessary to say more about it in this place, further than to observe that in the forms in question the anterior surface of the branches does not exhibit the peculiar reticulated or fibrous aspect, so characteristic of the true *Horneræ*, though perhaps not entirely limited to them.

The genus thus constituted appears to be a very natural one; and it is divisible also into two very natural groups, according as the branches are free or mutually connected by

anastomosing ramuscles. In the latter case the growth bears a strong resemblance to that of a Retepore, with which genus consequently the *Horneræ*, or many of them, were formerly associated by Lamarck and others.

Of the genus as thus restricted, five or six recent species exist, divisible like the fossil into the "ramose" and "fenestrate." Three belonging to the former, and two or three to the latter.

The three ramose living *Horneræ* with which I am acquainted are :

1. H. FRONDICULATA, *Lamouroux.*
2. H. BOREALIS (*mihî*, MS.)
3. H. TRIDACTYLITES (*mihî*, MS.)

The first is the well-known Mediterranean form, originally figured by Ellis, subsequently named *Hornera frondiculata* by Lamouroux, and which has since been figured and described by Milne Edwards ('Mém. s. les Crisies,' &c., l. c.).

The second, is a species collected by Mr. M'Andrew on the Coast of Norway and Finmark, and by Captain Beaufort in lat. 61° 35' N., 90° 42' W., and which is not improbably the same as that mentioned by Lamouroux as occurring in Kamtschatka. This I formerly described and figured in the 'Ann. Nat. Hist.,' 2d ser. 18, p. 34, pl. i, fig. 7, under the erroneous appellation of *H. frondiculata*, from which subsequent investigation has shown it to be wholly distinct.

Of the third species I have specimens collected by Mr. Darwin on the shores of Patagonia and Tierra del Fuego, and by Mr. M'Gillivray in the Australian seas, but no description or figures of it have as yet been published. It probably represents the form noticed by Lamouroux as found in the Indian and Australian seas. It differs in all respects from the other two.

Of the fenestrate kind I am acquainted with two forms, apparently distinct species, both of which I believe to be, and one certainly is, Australian. No account of this species, of which very perfect specimens were brought by Mr. Gould from *South Australia*, has yet been published, although figures of it have been prepared. I propose to call it *Hornera gouldiana*.

Several fossil forms of *Hornera* have been noticed, and some of them figured; but from the want of precision in the details of the figures, and the absence of any determinate specific characters in the descriptions, it is extremely difficult to arrive at any satisfactory conclusions with respect to them. The best figures are those contained in Milne Edwards's excellent 'Memoir on the Crisidæ,' &c.; but even these are by no means sufficiently precise to convey a correct idea of the specific differences or resemblances.

I have, therefore, had the utmost difficulty in coming to any conclusion satisfactory to myself with respect to the fossil species of *Horneræ* contained in the Crag, and I would hardly venture even now, after the most laborious endeavours to ascertain the truth, to

assert that all the species I have marked as distinct, are really so, or that some of them, at any rate, besides *H. frondiculata* and *reteporacea*, may not be found, upon due comparison, to be identical with other previously described fossil forms. No genus in the whole of this Memoir has required more time or closer examination, and it is only after the most mature consideration that I have arrived at the not very certain conclusions here stated.

The same difficulty, however, as already observed, would be experienced in the investigation even of the living forms, were the inquiry limited to small detached and broken fragments, or to much-worn and injured specimens, such as are, for the most part, offered by the fossil remains. As in several other cyclostomatous genera, more especially among those belonging to the inarticulate section, the aspect of the polyzoary in *Hornera* differs so extremely in different parts, according to age, &c., that the mere inspection of fragments derived from different portions of one and the same individual growth, could not fail, from their extreme diversity, to lead to the conclusion that they belonged to distinct species or even genera. It may readily be conceived how much this difficulty is enhanced in the case of fossil specimens.

The earliest fossil forms clearly belonging to this genus are found, according to Hagenow, in the Cretaceous beds of Rügen and in Sweden, but no species of *Hornera* as here understood, is noticed by him in the Maastricht beds. *Hornera contortilis* of Mr. Lonsdale, found in the Cretaceous strata of New Jersey, however, appears to be a well-marked instance of the genus.

The number of species increases considerably in the Tertiary epoch, and more especially in the more recent strata, in which the genus seems to have attained its maximum development, at any rate in number of forms, if all that are enumerated be really distinct.

The best marked Tertiary fossil forms, of which we have any published available means of judging, are—

1. FENESTRATÆ.

1. *H. FLABELLIFORMIS*, *Blainville* (sp.)

RETEPORA FLABELLIFORMIS, *Blainv.*; *Michelin*, Icon. Zooph., p. 314, pl. lxxvi, fig. 1, = ? *H. FERUSSACII*, *Michelin*, ? Eocene. Miocene.

2. *H. SCORINOSA*, *Michel.* (sp.)

RETEPORA SCOBINOSA, *Mich.* l. c., p. 316, pl. vi, fig. 3. Miocene.

3. *H. RETEPORACEA*, *M. Edwards*, Mém. s. les Crisies, &c., p. 21, pl. x, fig. 2. Crag.

2. RAMOSÆ.

4. *H. STRIATA*, *M. Edwards*, l. c., p. 21, pl. xi, fig. 1. Crag. *Michelin*, l. c., p. 317, pl. lxxvi, fig. 7.

5. *H. AFFINIS*, *M. Edwards*, l. c., p. 19, pl. x, fig. 1. Upper tertiaries of Sicily.

6. *H. HIPPOLYTA*, *Defrance*, Diction. d. Sc. Nat., t. xxi, p. 43, pl. xlvi, fig. 2; *Blainville*, Man. d'Actin., p. 419, pl. lxxviii, fig. 3; *Bronn.*, Leth. Geogn., p. 880, pl. xxxvi, fig. 1; *M. Edwards*, l. c., p. 20, pl. xi, fig. 3.
- H. HIPPOLYTUS*, *HIPPOLYTHUS*, *HIPPOLITHUS*, *Michelin*, Icon. Zooph., p. 168, pl. xlvi, fig. 18; *Reuss*, Foss. Polyp. d. W. Tert. B., p. 42, pl. vi, figs. 23, 24; *Grignon*.
7. *H. LÆVIS*, *M. Edwards*, l. c., p. 20, pl. xi, fig. 2; Miocene, Dap.
8. *H. ANDEGAVENSIS*, *Michelin*, l. c., p. 318, pl. lxxvi, fig. 8.

Of which I have been able, with tolerable but not absolute certainty, to identify with Crag fossils—

1. *H. RETEPORACEA*, *M. Edwards*.
2. *H. STRIATA*, *M. Edwards*.
3. *H. AFFINIS*, *M. Edwards*.
4. *H. ANDEGAVENSIS*, *Michelin*.
5. *H. HIPPOLYTA*, *Defrance*.

§ 1. FENESTRATÆ.

Polyzoario retiformi, plus minusve foliaceo, e ramis in plano unico dispositis, perque ramuseulos breves transversos, crebros conjunctis composito.

Branches in one plane, connected by transverse ramuseules, so as to form a fenestrated frond.

1. *H. INFUNDIBULATA*. Pl. XIV, fig. 1.

Polyzoario undulato, infundibuliformi; ramis gracilibus, subeylindricis. Superficie *anteriori*, porosâ, fibrosâ; *posteriori* suleis longitudinalibus porosis ornatâ. Cellularum orificiis orbicularibus, sparsis.

Polyzoarium wavy, infundibuliform; branches slender, subeylindrical; mouths of cells orbicular, exserted or level; intermediate surface on the front of the branches fibropunctate; *posterior* longitudinally costate, with punctures along the sulei.

Habitat.—C. Crag, *S. Wood*.

The polyzoarium of this species forms tolerably regular infundibuliform growths, attaining in the largest specimens observed about an inch in diameter. The posterior surface is marked with parallel raised lines, between which the surface is concave, but scarcely to be termed suleate, and these spaces are furnished with rather distant, elongated pores.

2. *H. RETEPORACEA*, *M. Edwards*. Pl. XIV, fig. 2.

Polyzoario contorto, cavernoso; ramis contiguis, subcylindricis. Cellularum orificiis confertis, irregulariter dispositis, prominulis sive superficie æquatis, orbicularibus, expansis. Superficie *anteriori* porosâ; *posteriori* scrobiculatâ seu cribriformi (non sulcatâ).

Polyzoarium much contorted, cavernous; branches close, subcylindrical; mouths of cells crowded, disposed irregularly, exserted or level, orbicular, expanded; *anterior* surface porous; *posterior* pitted or cribriform (not sulcate).

H. RETEPORACEA, *M. Edwards*, l. c., p. 21, pl. x, fig. 2; *S. Wood* (!); *J. Morris* (!).

Habitat.—C. Crag, *M. Edw.*; *S. Wood*.

This is the only species among the Crag *Horneræ* in which the dorsal surface is not sulcate or costate, but, on the contrary, uniformly pitted, the pits in many cases becoming deep pores, giving the surface a cribriform aspect. In this character, as well as in the convoluted mode of growth, the present form agrees with *H. reteporeacea* of *M. Edwards*, who says of it, that the "face dorsale des branches est comme reticulée," although this appearance is not represented in his figure.

3. *H. CANALICULATA* (*n. sp.*) Pl. XIV, fig. 3.

Polyzoario explanato, flabelliformi (?); ramis crassis, subdistantibus; fenestris magnis, ellipticis seu ovatis. Cellularum orificiis immersis, sursum spectantibus; subquincuncialibus. Superficie *anteriori* obscure reticulatâ, rarissime punctatâ; supra orificia fossam canaliculatam non raro etiam porum unicum ostendente; *posteriori* subplanâ, granulosâ, longitudinaliter sulcatâ; sulcis poris distantibus, elongatis munitis.

Polyzoarium expanded, flabelliform (?); branches thick, rather distant; fenestræ large, elliptical or oval; mouths of cells immersed, looking upwards; with a canalicular depression, and usually a pore above; irregularly quincuncial; intermediate surface very rarely perforate, very obscurely reticulate; dorsal surface flattened, expanded at the border of the fenestræ, coarsely granular, deeply and irregularly sulcate; sulci with elongated, distant pores.

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

4. *H. RHIPIS* (*n. sp.*) Pl. XIV, fig. 4.

Polyzoario explanato, flabelliformi; ramis subcylindricis, contiguis; fenestris parvis irregularibus. Cellularum orificiis in sericibus transversis plerumque dispositis, integris seu infra emarginatis, subovatis, prominulis, peristomate tenui expanso circumdatis. Superficie *anteriori* poris raris, distantibus ornatâ; *posteriori* granulosâ, delicatule sulcatâ, poros minimos, distantes subinde ostendente.

Polyzoarium expanded, flabelliform, simple; branches subcylindrical, closely contiguous; fenestræ small, irregular; mouths of cells disposed in irregular transverse rows, entire or emarginate below, suboval, margin prominent, thin, expanding; *anterior* surface punctate, puncta rare, distant; *dorsal* finely granular, finely sulcate, without pores, or with very few minute ones.

Habitat.—C. Crag, S. Wood; J. S. B.

This species can only be confounded with *II. canaliculata*, from which, however, it is undoubtedly distinct. The more striking features by which they may be distinguished are:

1. In general aspect the polyzoary in *II. canaliculata* is constituted of far larger or wider branches, which are further apart and connected by fewer transverse ramules than in *H. rhipis*.

2. The dorsal surface of the branches in *II. canaliculata* is remarkably flattened or almost concave, deeply and coarsely scored by bifurcating, irregular sulci, which are furnished with large, tolerably frequent, elongated pores, whilst in *H. rhipis* the dorsal surface is not so flat, and almost even or marked with fine shallow sulci, which very rarely exhibit here and there a minute perforation.

3. A striking difference is observable in the condition of the mouths of the cells, which in *II. canaliculata* are disposed irregularly, or in some parts pretty regularly, in quincuncial order, depressed and usually emarginate above, in which direction they are continuous as it were, with a shallow ascending channel, whence the specific name; whilst in *II. rhipis* the mouths of the cells are placed with tolerable regularity in *transverse* rows, are entire or continuous all round with a thin, somewhat expanded border, which is contracted below sometimes almost into a sort of narrow spout, the intermediate surface being irregularly punctured.

Another character, apparently distinctive of the two, may also be found, though with more difficulty, in the circumstance that the walls of the tubes in *II. canaliculata* are closely perforated with minute puncta, which, so far as I can perceive, are wanting, or at any rate far less numerous, in the tubes of *H. rhipis*, in which species it is also to be remarked that the tubes themselves are much less than in *II. canaliculata*.

With respect to the general aspect of the two, or any characters that can be thence drawn, little can be said, for *II. canaliculata* has hitherto occurred only in broken fragments,

from which no very certain deductions as to the general habit of the growth can be drawn.

Finding it impossible to reconcile the characters of either of these species to any hitherto described, I have abstained from any conjectural synonymy, and would only remark that the only species with which it is probable one or other of them may have some relation is *Retepora (Hornera) flabelliformis* of Michelin ('Icon. Zoophyt.', p. 314, pl. lxxvi, fig. 1).

§ 2. RAMOSÆ.

Ramis undiquaque se tendentibus, liberis, seu rarò ramuseulis transversis, distantibus irregulariter conjunctis.

Branches spreading in all directions, free, or very rarely and irregularly united by transverse ramuseules.

5. H. HUMILIS (*n. sp.*) Pl. XIV, figs. 5, 6.

Polyzoario parvo, erecto; ramis brevibus, dichotomis, curvatis, inæqualibus, e trunco brevi centrali undiquaque surgentibus. Superficie *anteriori* reticulate sulcatâ, sulcis porosis; *posteriori* sulcis porosis delicatulis ornatâ. Cellularum orificiis orbicularibus, irregulariter dispositis.

Polyzoarium very minute, consisting of short, dichotomous, curved, unequal branches, diverging on all sides from a short trunk, which is affixed by a circular expanded base; *anterior* surface reticulato-sulcate, with pores in the sulci; mouths of cells orbicular, scattered; *posterior* finely sulcate, with rather large puncta in the sulci.

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

This abundant species is at once recognisable by its minute size and peculiar mode of growth, as well as by the regular fine striation of the posterior surface, and more especially of the common trunk and its expanded base. Considerable differences are observable in the minute characters, in some cases almost sufficient to justify the suspicion that more than one species may be included, but upon consideration these differences all appear to be reducible to a common type. The polyzoarium consists of short, cylindrical or subcylindrical, forked branches, springing from a common stem, of considerably greater diameter and expanding gracefully at the base. The celliferous surface is usually the uppermost, but in some instances, as at fig. 5, the openings of the cells seem to be mostly placed on the under side. The posterior or opposite surface is more or less distinctly and regularly sulcate or fluted, the surface being otherwise smooth, and the bottom of the sulci furnished with small rounded pores.

On the anterior aspect the surface between the scattered openings of the cells is uneven, usually retaining but indistinct traces of its original wavy fibrillation, or obscurely reticulate and punctured. The mouths of the cells are depressed, and either simple and orbicular or surrounded with a distinct annular peristome.

6. *H. PERTUSA* (*n. sp.*) Pl. XIV, fig. 7.

Polyzoario parvo, depresso, elongato; ramis brevibus, inæqualibus. Superficie *anteriori* porosâ; *posteriori* irregulariter sulcatâ, sulcis poros erebros magnos ostendentibus; cellularum orificiis orbicularibus, immersis, in seriebus longitudinalibus irregulariter dispositis.

Polyzoarium small, depressed, irregularly branched, elongated in one direction. *Anterior* surface very porous; mouths of cells orbicular, depressed, disposed irregularly in longitudinal series; *posterior* irregularly sulcate, with large frequent pores.

Habitat.—C. Crag, *S. Wood*.

Notwithstanding the general character of the growth in this species, in which it appears to approximate to the succeeding, it seems from its more minute characters to demand specific recognition.

7. *H. HIPPOLYTA* (?), *Defrance*. Pl. XIV, figs. 8, 9.

Polyzoario depresso; ramis cylindricis, divaricatis, gracilibus, inæqualibus. Superficie *anteriori* punctis perparvis ornatâ; *posteriori* longitudinaliter costulatâ, sulcis porosis. Cellularum orificiis in seriebus transversis, irregularibus dispositis, prominulis, integris supraque porum rotundum plerumque ostendentibus.

Polyzoarium ramose, depressed; branches cylindrical, divaricate, slender, uneven; mouths of cells usually disposed irregularly in transverse rows; raised, orbicular, usually with a pore above each; *anterior* surface nearly smooth, finely punctured; *posterior* finely sulcate; sulci with rare, minute puncta.

HORNERA HIPPOLYTA, *M. Edwards*, l. c., p. 21, pl. x, fig. 2.

— HIPPOLYTHUS, *Defrance*, Dict. d. Sc. Nat., xxi, p. 432, p. xlvi, fig. 3; *Blainville* (?); *Michelin*.

— HIPPOLITHUS, *Reuss*.

Habitat.—C. Crag, *S. Wood*; Grignon (Seine-et-Oise), Hauteville (Manche), *Michelin*; *M. Edw.*

S. H. LUNATA (*n. sp.*) Pl. XVI, fig. 4.

Polyzoario erecto (?); ramis furcatis, subcylindricis. Superficie *anteriori* indistincte fibro-reticulatâ, porosâ; *posteriori* obscure sulcatâ, minute punctatâ. Cellularum orificiis lunatis vel suborbicularibus, integris, superficie æquatis.

Polyzoarium erect (?), composed of forked, subcylindrical branches; mouths of cells lunate or suborbicular, simple, even with the surface; *anterior* surface indistinctly fibro-reticulate, punctured; *posterior* obscurely sulcate, finely punctate.

Habitat.—C. Crag, *S. Wood*.

The peculiar form of the mouth in this species renders it easy of recognition. As it occurs but sparingly and only in small broken fragments, the real character of the growth cannot be ascertained, but from what is apparent it was probably of small size, and consisted of irregular, tolerably straight, forked branches.

9. H. FRONDICULATA, *Lamouroux*. Pl. XV, figs. 1, 2; Pl. XVI, fig. 6.

Polyzoario subexplanato; ramis irregularibus e trunco forti surgentibus, cylindricis, teretibus vel subcompressis. Superficie *anteriori* reticulato-fibrosâ, porosâ vel cribriformi; *posteriori* reticulato-fibrosâ, costulis granulosis, glabrisve, sulcis poros elongatos gerentibus. Cellularum orificiis prominulis, emarginatis seu potius bifidis.

Polyzoarium irregularly branched, usually in one plane, and springing from a strong stem; branches cylindrical and tapering, or compressed; *anterior* surface strongly fibro-reticulate, irregularly punctured or cribriform in the rhomboidal spaces enclosing the mouths of the cells; mouth of cell exserted, emarginate, thence bifid; *posterior* surface reticulato-fibrous, granular or smooth, with elongated pores in the fissures.

HORNERA FRONDICULATA, *Lamx.*; *Milne Edwards*; *Blainville* (not *Busk*), *Ann. N. H.* 2d ser., xiii, p. 34.

RETEPORA FRONDICULATA, *Lamarck*.

MILLEPORA TUBIPORA, *Ellis and Solander*, p. 139, pl. xxvi, fig. 1.

MILLEPORA LICHENOIDES, *Linn.*; *Pallas*; *Esper*.

HORNERA AFFINIS, *M. Edwards*, l. c., 19, pl. x, fig. 1.

HORNERA ANDEGAVENSIS, *Michelin*, *Icon. Zoophyt.*, p. 318, pl. lxxvi, fig. 8.

Habitat.—C. Crag, *S. Wood*; Upper Tertiaries of Sicily, *M. Edwards*; *Doné, Mich.*

The remarkable difference in the appearance of this species, as shown in our figures of the natural size (figs. 1, 2, Pl. II, and fig. 6, Pl. III), and that represented, for instance, in M. M. Edwards' figure of the recent *H. frondiculata*, would startle any one not

acquainted with the protean habits of this perplexing genus. But having an abundant supply of well-preserved specimens of the true Mediterranean *H. frondiculata*, I have been able beyond all doubt to satisfy myself that it is perfectly correct to associate the small palmate forms depicted in figs. 1, 2, Pl. XV, with the large and expanded growth usually represented as that of *H. frondiculata*; nor can any hesitation, I think, be felt in placing *H. affinis*, M. Edwards, in the same category. With respect to *H. andegavensis*, Michelin, the mere comparison of the figure of that species in the 'Iconographie Zoophytologique' with a branch of *H. frondiculata* will at once show their complete identity, which appears to have been strongly suspected even by M. Michelin himself. Mere differences in the size and disposition of the branches are obviously, in this species, of no importance whatever. The chief specific characters appear to be—

1. The ramification being for the most part in the same plane, or nearly so.
2. The emargination of the border of the mouth, which thence assumes a bifid aspect.
3. The coarse perforation of the dorsal surface.

As before stated, I had formerly confounded with this species one which occurs in the Northern Seas, but which differs in all the above respects very widely from the true or Mediterranean form. The mouth, for instance, in *H. borealis* is cut off obliquely, so as to exhibit a single acute point, whilst to show the importance of attention even to a single minute character, in *H. tridactylites* (*nob.*) the oral margin is furnished with two, three, or more, acute denticles. All this renders it the more difficult to determine fossil species, in which the apparently important character derivable from the condition of the oral margin is, usually, wholly obliterated.

10. *H. STRIATA*, M. Edwards. Pl. XV, fig. 3; XVI, fig. 5.

Polyzoario cæspitoso; ramis cylindricis. Superficie *anteriori*, reticulato-fibrosâ et in areolas rhomboidales divisâ; *posteriori* sulcis, e lineâ media longitudinali oblique divergentibus ornatâ; sulcis minute punctatis; costis glabris vel subgranulosis. Cellularum orificiis in seriebus longitudinalibus plus minusve regulariter dispositis, parvis, orbicularibus, ad partem ramorum inferiorem annulo elevato incrassato, subinde uno latere acuminato marginatis.

Polyzoarium cespitose; branches cylindrical; mouths of cells disposed more or less regularly in longitudinal series, small, orbicular, those towards the lower part of the branches with a raised, slightly thickened, annular border, which is sometimes produced into an acute angle on one side; a pore above and below the mouth. *Anterior* surface marked with smooth reticulated ridges, forming nearly regular diamond-shaped areolæ; *posterior* sulcate,

the sulci usually diverging obliquely from an imaginary median line, and finely punctate; surface between the sulci smooth or subgranular.

HORNERA STRIATA, *M. Edwards*, l. c., p. 21, pl. xi, fig. 1; *Michelin*, *Icon. Zooph.*, p. 316, pl. lxxvi, fig. 7.

Habitat.—C. Crag, *S. Wood*; Doué, *Michelin*.

11. H. RHOMBOIDALIS (*n. sp.*) Pl. XV, fig. 4.

Ramis cylindricis, furcatis. Superficie *anteriori* reticulatâ, *posteriori* granulosâ vel rugosâ, seriebus punctorum obliquis ornatâ. Cellularum orificiis orbicularibus, peristomate paullulum incrassato marginatis, porumque supra gerentibus.

Polyzoarium composed of cylindrical, forked branches; *anterior* surface strongly and regularly reticulate; mouths of cells orbicular, border annular, slightly thickened, a pore above each; *dorsal* finely granular or rugose, punctured in oblique rows.

Habitat.—C. Crag, *S. Wood*.

Genus 2. IDMONEA, *Lamouroux*.

Polyzoario ramoso; ramis plerumque dichotomis liberis, vel subinde conjunctis; postice rotundatis, antice carinatis. Cellularum orificiis, in seriebus alternis, transversis vel obliquis et in earinâ mediâ angulatiâ conjunctis dispositis.

Polyzoarium ramose, branches dichotomous or irregularly divided; free or anastomosing; mouths of cells disposed in parallel, transverse or oblique, usually alternate, rows, on each side of the front of the branches, which is angular or earinate in the middle.

IDMONEA, *Lamx.*, *Exp. Meth.*, p. 80, 1821; *Defrance*; *Blainville*; *M. Edwards*; *Johnston*; *Lonsdale*; *Reuss*; *Michelin*; *Hagenow*.

IDMONEA (pars), *Ramer*; *D'Orbigny*.

RETEPORA (pars), *Lamarck*; *Goldfuss*; *Hagenow*.

RETICULIPORA, CRISINA, STICHOPIORA, TUBIGERA, SATEROCAVA, SEMICELLAKIA, *D'Orbigny*.

1. IDMONEA PUNCTATA, *D'Orbig.* (*sp.*) Pl. XV, fig. 5; Pl. XVI, fig. 3.

Polyzoario ramoso seu fenestrato; ramis subcylindricis; cellularum orificiis parvis, orbicularibus, prominulis, 3—4 singulis in seriebus. Superficie *anteriori*, *posteriorique* punctatâ.

Polyzoarium ramose or fenestrate; branches subcylindrical; mouths of cells small, orbicular, prominent, 3—4 in each series; surface, both *anterior* and *posterior*, uniformly punctured.

LATEROCAVA PUNCTATA (?), *D'Orbigny*, pl. Dcclxxii, figs. 11, 12.

Habitat.—C. Crag, *S. Wood*; Cretaceous (?), *D'Orbigny*.

2. *I. FENESTRATA* (*n. sp.*) Pl. XV, fig. 6.

Polyzoario irregulariter fenestrato vel reticulato; ramis subtrigonis non raro posticè angulatis. Cellularum orificiis quadrangularibus, prominentibus, 5—6 singulis in seriebus. Superficie *anteriori* cellularum planatâ delicatule maculatâ; *posteriori* minute reticulatâ, sulcatâ, porisque elongatis ornatâ.

Polyzoarium irregularly fenestrate or reticulated; branches subtrigonal, often angular behind; mouths of cells projecting quadrangular, 5—6 in each series; front of tubes flattened, surface finely dotted; dorsal surface very finely reticulate, sulcate, with elongated pores.

Habitat.—C. Crag, *S. Wood*, *J. S. B.*

Approaching in some respects the *Idmonea triquetra* of Lamouroux, as well as a recent species met with in South Africa, which if not identical with the Caen Fossil is undistinguishable from it without direct comparison, the present species not only in habit but in other particulars also appears to differ so materially from either, as to justify its distinction from them.

In *I. triquetra* (including the recent form above alluded to under that title) the front of the branches is acutely angular, whilst in *I. fenestrata* it is rather rounded than angular. The front of the tubular cells also in *I. triquetra*, though scarcely convex, is not nearly so much flattened as in *I. fenestrata*; nor is the dorsal surface in *I. triquetra* pitted like that of *I. fenestrata*, being either smooth or very finely sulcate. But a more obvious distinction exists in the general habit of the polyzoarium. In *I. triquetra* the branches are very much thicker and curiously curved, as is well shown in Lamouroux's figure, and in no specimen of the recent form, in fragments whose aspect precisely resembles that of *Idmonea triquetra*, do the branches ever anastomose so as to constitute the elongated elliptical meshes of *I. fenestrata*.

There does not appear to be any other fossil *Idmonea* with which the present species is likely to be confounded, unless perhaps it might be with *I. maculata*, Hag. ('Maastr. Kreideb.,' pl. ii, fig. 3). The resemblance, however, is only in general habit, which is certainly somewhat alike; but in *I. maculata* the cells are said to be 3—5 serial; and the anterior angle of the branches appears to be carinate, whilst the dorsal is described as

smooth, and finely streaked. One or two of the species of *Idmonea* figured under various generic names by D'Orbigny, might be thought to resemble *I. fenestrata*, but it seems scarcely worth while to discuss these similarities.

3. *I. DELICATULA* (*n. sp.*) Pl. XV, fig. 8.

Polyzoario ramoso ; ramis gracilibus furcatis, postice rotundatis, antice subangulatis, Cellulis 5—6 singulis in seriebus ; seriebus subalternantibus non raro oppositis, mediâque in lineâ conjunctis. Superficie *anteriori* cellularum convexâ, minutissime punctulatâ.

Polyzoarium composed of slender forked branches, rounded behind, subangular in front ; cells 5 or 6 in each series ; series subalternate, often opposite and meeting in the median line ; front of cell convex, very finely dotted ; dorsal surface of branches smooth, striated, dotted.

Habitat.—C. Crag, Sutton, *S. Wood*.

Owing apparently to the extreme thinness and fragility of their walls the openings of the cells in nearly every specimen of this most abundant species are so much worn away, that in fact the whole front of the cell is usually laid open, so that the surface presents a sulcate aspect—the sulci being interrupted at each successive series of cells. The dorsal surface when entire is quite smooth, and marked only by parallel longitudinal lines indicating the walls of minute elongated tubules ; and owing to the delicacy of their walls these tubules, like the cells, are in many cases laid open, consequently in the majority of specimens the dorsal surface exhibits a finely sulcated appearance.

4. *I. INTRICARIA* (*n. sp.*) Pl. XV, fig. 7.

Polyzoario e ramis cylindricis confusê intertextis et irregulariter conjunctis, e pedunculo communi basi dilatato surgentibus, composito. Cellularum orificiis in seriebus lateralibus, irregularibus, obliquis dispositis, non raro etiam sparsis. Superficie *anteriori* subconvexâ, punctulatâ, glabrâ ; *posteriori* glabrâ, lineis reticulatis signatâ, punctulatâ.

Polyzoarium composed of intricately interlaced and anastomosing subcylindrical branches, springing from a common peduncle, which is expanded at the base ; openings of cells in irregular, oblique, lateral series, and often scattered ; *anterior* surface subconvex, dotted, even ; *dorsal* smooth, marked with anastomosing lines, dotted.

Habitat.—Cor. Crag, Sutton, *S. Wood*.

The usually scattered or irregular disposition of the mouths of the cells gives fragments of this species, in many cases, the aspect, so far as that goes, of a *Hornera*. In other parts, however, the distinct serial arrangement of the openings on the sides of a branch, and the

evenness of the surface, show that it is more properly referable to *Idmonea*. In specimens of sufficient size, it is readily distinguishable by its peculiarly intricate mode of growth, not unlike, in miniature, that of *Intricaria bajocensis*, and in which it is nearly paralleled by a recent Australian *Idmonea* or rather *Pustulopora*, which has not yet received a name.

Genus 3. PUSTULOPORA, Blainville.

Polyzoario ramoso; ramis cylindricis clavatis seu teretibus, c cellulis elongatis superne liberis, et undequâque spectantibus composito.

Polyzoarium ramose; branches cylindrical, clavate or terete; composed of tubular cells, which open on all sides of the branch.

PUSTULOPORA, *Blainville*, Man. d'Act., p. 418, 1834 (pars); *M. Edwards*; *Hagenow* (sp.)
Maastr. Kreid. (not *Gein.* Grundr.) *Reuss*; *Michelin*.

ENTALOPHORA, *Lamouroux*, Expos. Meth., p. 80, 1821; *D'Orbigny* (pars).

CERIOFORA (pars), *Goldfuss* (?); *Hagenow* (?) *Gein.* Grund.

I have adopted *Blainville's* name for this genus, more for the reason that it has come into general acceptance, especially since its accurate definition by *Milne-Edwards*, than because I am satisfied it should have precedence of *Entalophora*, a term under which it appears quite clear that *Lamouroux* had intended to include similar forms. The prior appellation, however, having fallen into abeyance, except by *M. D'Orbigny*, whose genus *Entalophora*, moreover, is not confined to Cyclostomatous forms only, it seemed inadvisable, merely for the sake of somewhat pedantic propriety, here to revive it.

As it is very doubtful whether *Goldfuss* had any knowledge of forms really appertaining to the genus *Pustulopora* as now understood, I have not included his term *Ceriopora* among the list of synonyms; and the same observation applies to the *Ceriopora* of *Hagenow*, as defined in '*Geintz. Grundr.*' p. 593.

1. PUST. CLAVATA (*n. sp.*) Pl. XVII, fig. 1.

Ramis clavatis.

Branches clavate or thickened at the extremity; surface entire; tubes not annulated.

Habitat.—C. Crag, *S. Wood*.

The only forms with which this species can well be confounded, are:

P. GRACILIS, *Milne-Edwards*, Mém. s. les Crisies, &c., p. 28, pl. xi, fig. 4 (not *Michelin*,
Icon. Zoophyt., p. 210, pl. liii, fig. 2).

P. ECHINATA, *Ræmer*; *D'Orbigny*, l. c., pl. dcxxii, fig. 36; *Michelin*, Icon. Zoophyt., p. 211,
pl. liii, fig. 5.

ENTALOPHORA LINEARIS, *D'Orbigny*, op. cit., pl. dcxxii, fig. 6.

Habitat.—C. Crag, *S. Wood*.

But from all of these, as well as from the recent *P. proboscidea*, Milne-Edwards, and another recent Austral form, for which the name *P. delicatula* is proposed, the difference in size and habit, besides which in this genus we have scarcely any available characters, is so great as to leave no reasonable doubt that the Crag fossil is specifically distinct.

2. *P. PALMATA* (*n. sp.*) Pl. XVIII, fig. 2.

Polyzoario palmato, compresso; ramis ad basim compressis, superne cylindricis; cellulis obscurè annulatis.

Polyzoarium palmate, compressed, branches compressed at bottom, cylindrical above; tubes obscurely annulate.

Habitat.—C. Crag, *S. Wood*.

The cylindrical branches at once distinguish this species from *Entalophora pavonina* of D'Orbigny ('Terr. Cret.,' pl. DCXX, fig. 12), which is the only other fossil or recent form with which it could well be confounded. Even in small fragments it is distinguished from the preceding by the unevenness of the surface and the uncovered condition of the tubes.

3. *PUSTULOPORA SUBVERTICELLATA*, (*n. sp.*) Pl. XVIII, fig. 1.

Polyzoario e ramis gracilibus, cylindricis seu subcompressis, plerumque teretibus, furcatis, e trunco communi surgentibus composito. Cellulis immersis, extremitate vix prominulis. Superficie glabrâ porisque minimis ornatâ. Cellularum orificiis non raro in verticello dispositis.

Polyzoarium composed of slender, cylindrical or slightly compressed, usually tapering forked branches springing from a common stem not thicker than themselves; tubes completely immersed except at the extremity, which though uncovered scarcely projects above the surface, which is consequently nearly level, and everywhere studded with fine pores; openings of cells often irregularly verticellate.

Habitat.—C. Crag, *S. Wood*.

This most abundant species might almost as properly be arranged with *Cricopora*, Blainv., as with *Pustulopora*, but as, upon the whole, the openings of the cells are more generally irregularly distributed than disposed in regular whorls, it is perhaps better to leave it in association with *Pustulopora*. It presents a remarkable character in the fact that the surface of the branches is pretty nearly level, owing to the space between the cells being overlaid with what appears to be a secondary deposit, which covers the tubes completely, and allows only a small portion immediately below the opening to be seen. This deposit, however, like the walls of the tubes themselves, is perforated by pores, which

though still minute appear to be larger than in most other species where the same kind of porosity also exists. The outlines of the cells are shown through the deposit by dark-coloured, transparent lines, which give the surface a peculiar and very characteristic aspect.

Genus 4. MESENERIPORA, Blainville.

Polyzoario foliaceo ; cellulis in stratis duobus laminâ mediâ calcareâ sejunctis dispositis et ad utramque faciem spectantibus.

Polyzoarium foliaceous ; cells in two layers parted by a calcareous septum and opening on both surfaces.

MESENERIPORA, *Blainville*, *Man. d'Act.*, p. 432 ; *D'Orbigny* ; *S. Wood*.

DIASTOPORES BISERIALAIRES, *M. Edwards*, l. c., p. 40.

DIASTOPORA (pars), *Lamouroux* ; *M. Edwards* ; *Hagenow* ; *Reuss* ; *Michelin*.

BIDIASTOPORA (pars), *D'Orbigny*.

DITAXIA, *Hagenow*, *Maast. Kredeb*, p. 49.

CERIOPORA (pars), *Goldfuss*.

The expanded or foliaceous Cyclostomata are subdivided by Milne-Edwards into two great groups, distinguished by the character that in the one the tubes are almost wholly immersed and in the other partially free. To the former group he applies generally the appellation "Diastopores," and to the latter that of "Tubulipores." This division is natural, but it seems convenient that it should be carried still further, and in the doing of this with respect to the "Diastopores" no better classification can be adopted than that suggested by the same author, viz. into—1. "*Diastopores simples* ;" 2. *D. enveloppantes* ; 3. *D. biserialaires*. The groups thus formed, which may be regarded as of generic value, having to be provided with names it does not appear difficult to fit them with appropriate appellations from those already in use, as applied to some of the species, and thus to avoid the necessity of burdening science with new terms. I propose, therefore, to term the simple Diastoporæ of Milne-Edwards, *Diastopora* ; the enveloping, or laminated forms, *Berenicea* ; and the biserial, *Mesenteripora*, under which of course will fall *Ditaxia* of Hagenow.

1. *M. MEANDRINA*, *S. Wood*. Pl. XVII, fig. 2 ; Pl. XVIII, fig. 4 ; and Pl. XX, fig. 2.

Subglobosa, cavernosa, varie flexuosa seu contorta, laminis coalescentibus.

Polyzoarium subglobose, cavernous, foliations contorted, anastomosing.

DIASTOPORA MEANDRINA, *S. Wood*, Ann. N. H., xiii, p. 14.

D. EUDESIANA, *M. Edwards* (?), l. c. p. 33, pl. xiv, fig. 1.

DITAXIA COMPRESSA (?), *Goldfuss*; *Hagenow*, Maast. Kreideb., p. 50, pl. iv, fig. 10.

MESENTERIPORA NEOCOMIENSIS (?), *D'Orbigny*, Terr. Cret.

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

Another fossil species, *M. Michelinii*, Blainville, might be suggested as synonymous with the above, but as this is figured and described as having the foliations *not* anastomosing, I have not placed it even doubtfully in the list. Of the species given above with a mark of doubt, perhaps *Ditaxia compressa* of Hagenow, = (?) *Diast. Eudesiana* of Milne-Edwards, affords the nearest resemblance to the Crag form. But this may arise, perhaps, merely from the circumstance that they are the most correctly drawn figures, for in the absence of figures conveying a sufficient idea of the general habit, it is impossible to determine their identity or not with *M. meandrina*.

As in several other Cyclostomata, more especially of those belonging to the present family, the mouths of the tubes in this species are eventually closed with a calcareous lid, having, usually, a minute central perforation.

Genus 5. TUBULIPORA, *Lamarck*.

Polyzoario decumbente, plerumque adnato, integro aut diviso, e puncto excentrico procedenti. Cellulis superne liberis, ascendentibus, infra coalitis.

Polyzoarium adnate or decumbent; entire, or divided into lobes or branches; cells partially free and ascending, radiating from an excentric point.

TUBULIPORA (pars), *Lamarck*; *Blainville*: *Milne-Edwards*; *Johnston*; *Lonsdale*; *Michelin*; *Reuss*, &c.

— *Lamouroux*; *Hagenow*, Maast. Kreid.

CERIOPORA (pars), *Hagenow*, Gein. Grundr.

PHALANGELLA (sp.), *Gray*, Append. List. Brit. Rad., p. 149.

OBELIA (pars), *Gray*.

DIASTOPORA (sp.), *M. Edwards*.

CRISERPIA (?), *M. Edwards*.

Under the genus *Tubulipora* are here understood species in which the polyzoarium is sometimes closely adnate, sometimes affixed only by the base and simply decumbent, or else partially erect, and in which the tubes, though immersed at the base, are, in the perfect state, free for a considerable part of their length. The growth of the polyzoarium commences at a single cell or a pair of cells, whence it radiates so as to form either a flabelliform entire expansion, or one subdivided into irregular lobes or into linear branches; the point of origin being, however, always marginal or distinctly excentric, by which circumstance it is distinguished from that of the closely allied genus *Patinella* (nob.), in which the

starting point may be described as central. In *Diastopora* and *Berenicea* the growth is also excentric, the former being distinguished from *Tubulipora* by the discoid, margined polyzoary in which the cells are immersed quite or nearly to the extremity, and the latter by the polyzoarium forming a series of superimposed layers. Whilst its near ally *Alecto* is mainly distinguished by the creeping, irregularly branched polyzoary, whose cells are deeply immersed, and do not ascend in the same way as do those of *Tubulipora*.

1. TUBULIPORA PHALANGEA, *Couch*. Pl. XVIII, fig. 6.

Adnata, integra, vel sublobata. Cellulis suberectis, seriatis, e lineâ longitudinali mediâ ad utrumque latus curvatis.

Polyzoarium adnate, entire or sublobate, with a mesial division down each lobe; tubes slender, erect, serial.

TUBULIPORA PHALANGEA, *Couch*, *Corn. Faun.*, iii, p. 106, pl. xix, fig. 7; *Johnston*, *Brit. Zooph.*, p. 273, pl. xlvi, figs. 1, 2.

— VERRUCARIA (?), *M. Edwards*.

PHALANGELLA PHALANGEA, *Gray*.

TUBULIPORA PALMATA, *S. Wood*.

Habitat.—C. Crag, *S. Wood*. (*Recent*) Britain.

Mr. Couch's account of this species conveys so good an idea of it that it will be sufficient to quote what he says of its distinction from *T. serpens*, the only other species with which it could be confounded: "It is encrusting, circumscribed, oval, and the oval is divided at the margins into from two to five lobes or festoons. Through the centre of each lobe runs a line or depression from which the tubes diverge on either side, as in *Tubulipora serpens*. The tubes are comparatively long, and are not in contact with each other as viewed from above. They are numerous, and arranged in perpendicular rows; each row is formed of a single series of tubes, which are in contact with each other. This arrangement presents the appearance of Pan's pipes placed perpendicularly, the sets being separated from each other. *Tubulipora serpens* is a branched species, and is generally parasitical on other corallines, while this is an encrusting species and never branched."

2. T. FLABELLARIS, (?) *Fab. (sp.)* Pl. XVIII, fig. 3; Pl. XX, fig. 9.

Crustacea, flabelliformis, adnata; cellulis e puncto unico irregulariter radiantibus.

Polyzoarium crustaceous, fan-shaped, adnate; tubes radiating irregularly from a single point.

TUBIPORA FLABELLARIS, *Fab.*, Faun. Grænl. p. 430; *Johnston*, Brit. Zooph., p. 274, pl. xlvi, figs. 5, 6.

DISCOPORA PALMATA (?), *Risso*.

DIASTOPORA VASSIACENSIS, *D'Orbigny*, Terr. Cret., pl. dxxxxv, figs. 12, 13.

„ PLUMULA (?), *Reuss*, Foss. Polyp., d. W. T. B., p. 51, pl. vii, fig. 11.

Habitat.—Cor. Crag, *S. Wood*. (*Recent*) Britain.

Genus 6. ALECTO, *Lamæ*.

Polyzoario repente, adnato, irregulariter ramoso seu lobato; cellulis in ordine simplici vel in seriebus transversis, plus minusve regularibus dispositis.

Polyzoarium creeping, adnate, irregularly branched; cells in single series, or disposed in more or less irregular transverse rows.

(a) Cells uniserial.

Sp. O.

(b) Cells multiserial.

1. A. REPENS, *S. Wood*. Pl. XX, figs. 5, 8.

Ramis linearibus parvis abrupte curvatis, subalternantibus, subdichotomis, superficiei granulosa. Cellulis bi-, tri-, subinde multiserialibus.

Branches linear; cells bi-, tri-, rarely multiserial; minute, abruptly curved; irregularly alternating, subdichotomous; surface finely granular.

T. REPENS, *S. Wood*, Ann. Nat. Hist., vol. xiii, p. 141.

T. FIMBRIATA (?), *Michelin* (ex syn.), Icon. Zooph., p. 322, pl. lxxvii, fig. 7.

IDMONEA RAMOSA, *D'Orbigny*, p. 632, figs. 1, 2.

Habitat.—C. Crag, on the inside of a small Peeten; (?) R. Crag, on the inside of a shell, *S. Wood*; (?) Doué, *Michelin*.

2. A. DILATANS, *W. Thompson*. Pl. XX, figs. 6, 7.

Lobis ad marginem dilatatis. Cellulis multiserialibus, superficiei nitidissime punctulata.

Branches dilated at the ends ; cells multiserial, surface smooth, dotted.

ALECTO DILATANS, *W. Thompson ; Johnston.*

DIASTOPORA ECHINATA, *Reuss*, Foss. Polyp., d. W. T. B., p. 52, pl. vii, figs. 14, 15.

IDMONEA DIVARICATA (?), I. DEPRESSA (?), I. CENOMANA (?), I. ELEGANS (?), *D'Orbigny.*

Fam. IV. *DIASTOPORIDÆ*, Busk.

Polyzoario disciformi vel indefinito, adnato, sessili, vel stipitato.

Polyzoarium discoid or indefinite, adnate, sessile, or pedunculate.

Genus 7. DIASTOPORA.

Polyzoario adnato, discoideo vel flabelliformi, plerumque excentrico. Cellulis prorsus immersis ; orificiis horizontalibus vel obliquis, ellipticis.

Polyzoarium adnate, discoid or flabelliform, usually excentric ; tubes wholly immersed ; openings horizontal or oblique, elliptical.

'DIASTOPORES SIMPLES,' *M. Edwards*, l. c., p. 39.

DIASTOPORA (pars), *Lamouroux* (?); *Milne-Edwards ; Blainville* (?); *Reuss ; Hagenow ; Michelin ; D'Orbigny, &c.*

— *Johnston.*

TUBULIPORA (pars), *Johnst. ; Auct.*

1. *D. SIMPLEX*, (*n. sp.*) ? Pl. XX, fig. 10.

Polyzoario discoideo, adnato, cellulis antice convexis, superficie nitidè punctulatâ.

Polyzoarium discoid, closely adnate, tubes not flattened in front ; surface finely dotted.

Habitat.—C. Crag on shell, *S. Wood.*

Of published figures the nearest I am able to find resembling the present form is that of *D. obelia*, *Johnston*;¹ but as the species that author had in view grows in undefined

¹ It is difficult to perceive what reason can have induced the learned author of 'Brit. Zoophytes' to confound his *D. obelia* with the *Obelia tubulifera* of *Lamouroux*. The latter is a *Tubulipora* (*mili*), and has not a feature in common with the *D. obelia* of *Johnston*.

irregular patches, it would hardly appear that the two could be identical. But there is another form still existing in our seas of which no account seems yet to have been given, whose aspect, in some respects, far more nearly approaches that of *D. simplex*, though differing in the important particular that the upper side of the tubes is distinctly perceptible and depressed, or even channelled, whilst in *D. simplex* what is visible of that surface is convex and even.

One or two tertiary fossil species approaching the present in some respects are figured by Reuss, and one in particular, *D. flabellum* (op. e. pl. vii, fig. 9) might almost be regarded as a variety of it. The identification, however, is far too uncertain to justify its adoption at present.

Genus 8. PATINELLA, Gray (subg.).

Polyzoario disciformi, concavo. Cellulis ad marginem disci ascendentibus, orificio simplici, orbiculari; superficie integrâ, glabrâ, subinde obscurè annulatâ.

Disc concave or depressed in the centre; tubes ascending towards the margin; mouth simple, circular; surface not perforated.

MADREPORA (sp.), *Linn.*; *Pallas*; *Olivi.*; *Esper.*

MILLEPORA (sp.), *Ellis and Solander.*

DISCOPORA (pars), *Fleming* (not *Lamarck*); *Busk*, Brit. Cyclop., art. "Polyzoa," p. 16.

TUBULIPORA (pars), *Lamarck*; *Milne-Edwards*; auct.

PATINELLA, *Gray*, Supplement to List Brit. Rad., p. 137.

RUBULA (?), *DeFrance.*

ROSACILLA (? pars), *Rœmer.*

DISCOSPARSA (sp.), *D'Orbigny.*

1. *P. PROLIGERA*, (*n. sp.*)? Pl. XIX, fig. 1; Pl. XX, fig. 3.

Sessilis; cellulis plerumque coalitis, ad centrum tantùm subinde ex parte liberis; disci margine supra proliferâ.

Polyzoarium sessile; tubes rarely distinct and only towards the centre; cellular border wide and thick, proliferous from the upper surface.

Habitat.—C. Crag, *S. Wood.*

The only species bearing any resemblance to the present in its peculiar proliferous habit is one named by M. D'Orbigny ('Terr. Cret.,' pl. declvii, figs. 5—10) *Discosparsa marginata*. His *Seminultea cupula* (ib. pl. deexli, figs. 1—4), appears also to throw out buds from the upper surface, but more from the centre than towards the margin. With these exceptions I have been unable to find a similar condition in any other form.

The true characters of the species are apparent only in a few specimens, in which the centre of the disc exhibits the proper openings of the cells, which are disposed much in the same way as in much-worn and thickened specimens of *Patinella patina*. One peculiarity of *P. proligera* is the great width, thickness, and rotundity of the cellular border, in which also the alveolar orifices of the cells are peculiar, from their large size and elongated, rhomboid shape, and by which peculiarity even small fragments of the species may often be distinguished without difficulty.

The discs are frequently much contorted, of which an instance is represented in Pl. XX, fig. 3.

Genus 9. DISCOPORELLA, Gray.

Polyzoario sessili vel adnato, disciformi convexo vel subconico rarissime depresso. Cellulis horizontalibus plerumque in lineas radiantibus vel irregulariter dispositis, orificio denticulato vel emarginato; superficie interstitiali cancellatâ.

Polyzoarium sessile or adnate; discoid, centre usually elevated or subconical, rarely depressed; tubes horizontal, usually disposed in radiating lines, or irregularly; mouth toothed or emarginate; intertubular surface cancellous.

DISCOPORELLA, *Gray*, List Brit. Rad., Suppl., p. 138.

DISCOPORA (pars), *Fleming* (not *Lamarck*); *Busk*, Brit. Cyclop., art. "Polyzoa," p. 16.

MADREPORA (pars), *Fabr.*; *Esper*.

TUBULIPORA (pars), *M. Edwards*; *Johnston*; auct.

1. D. HISPIDA, *Johnst.* (?) Pl. XVIII, fig. 5.

Adnata; cellulis in lineis radiantibus dispositis, orificio bi-tridenticulato.

Polyzoarium adnate; cells in radiating lines, with a bi-tridenticulate mouth.

DISCOPORA HISPIDA, *Fleming*; *Blainv.*, *Hassall*; *Couch*.

TUBULIPORA HISPIDA, *Johnst.*

— ORBICULUS (?), *Lamarck*.

Habitat.—C. Crag, *S. Wood*; (*Recent*), Britain.

This is but doubtfully identified with the recent form, although the presumption is very strong that it is the same with one of the probably several species confounded under the appellation.

2. *D. GRIGNONENSIS* (?), *M. Edw. (sp.)* Pl. XX, fig. 4.

Sessilis vel adnato. Cellulis elongatis sparsis; orificio emarginato.

Polyzoarium sessile or adnate; cells elongate, scattered; mouth notched.

TUBULIPORA GRIGNONENSIS, *M. Edwards*, Mém. sur les Crisiés, p. 13, pl. xiii, fig. 2.

Habitat.—C. Crag, *S. Wood*.

Genus 10. *DEFRANCIA*, *Bronn*.

Polyzoario disciformi, solitario seu sociali, convexo vel concavo, stipitato vel sessili. Cellulis in costis elevatis e centro radiantibus et ad peripheriam disci latioribus, dispositis.

Polyzoarium discoid, solitary or associated, convex or concave, pedunculate or sessile; cells disposed in distinct elevated ridges, radiating from the centre and increasing in width towards the periphery.

DEFRANCIA, *Bronn*. (? 1825); *Hagenow*; *D'Orbigny*; *Reuss* (pars); *Busk*.

TUBULIPORA (pars), *M. Edwards*; *Michelin* (sp.)

LICHENOPORA, *D'Orbigny* (pars); *Michelin* (non *Defrance*).

BICAVEA, *UNICAVEA*, *D'Orbigny*.

CERIOPIORA (pars), *Goldfuss*; (*Hagenow* in *Geintz. Grund.*); *Auct.*

PELAGIA, *Lamouroux*; *Michelin*.

STELLIPORA (?), *Hag.*

Habitat.—C. Crag, *S. Wood*; Grignon, *Milne-Edwards*; *Michelin*.

The species belonging to this genus are numerous, and appear to have existed from a very ancient period, some, according to Hagenow, being found in the oolitic, more in the cretaceous, and fewer again in the tertiary formations, whilst several exist in the living state.

The polyzoarium may be either *solitary*, or a number may grow together in such close contiguity as to become fused, as it were, into a common mass, usually of a more or less globose form, though sometimes expanded and encrusting; these may be termed the *associated*.

In the solitary species, again, the discoid or expanded portion may be either *sessile* and immediately adnate, or *pedunculate*; and any of these divisions may be furthermore split up into lesser groups, according as the surface between the elevated costæ upon which alone the cells open, is *smooth* and entire, or *porous*. The importance of the latter character was first pointed out by Dr. Hagenow ('Maast. Kreideb.', p. 42), and was employed by me in an 'Account of the Polyzoa collected on the Coast of

Norway and Finmark,' ('Annals N. H.,' 2 ser. xviii, p. 35.) It will be found of great convenience in the primary distinction of species.

The subdivisions of the genus may consequently be thus synoptically expressed :

(a) Solitariae.

α. *Pedunculatae*.

1. Interspaces smooth.
2. Interspaces porous.

β. *Sessile*.

1. Interspaces smooth.
2. Interspaces porous.

(b) Sociales.

α. *Globosæ*.

1. Interspaces smooth.
2. Interspaces porous.

β. *Crustaceæ*.

1. Interspaces smooth.
2. Interspaces porous.

(a). SOLITARIÆ.

α. *Pedunculatae*. 1. Interspaces smooth.

1. *D. STRIATULA*, (*n. sp.*) Pl. XVII, fig. 5.

Stipitata. Superficie disci inferiori stipisque glabrâ, integrâ, lineis parallelis, longitudinalibus delicatulis, ornatâ, obscure annulatâ.

Under surface of disc and surface of peduncle smooth, imperforate, marked with delicate, parallel longitudinal lines, and faintly annulated.

Habitat.—C. Crag, Sutton; *S. Wood*.

In some conditions of the recent *D. truncata* (so termed) inhabiting the Northern Seas in deep water, a superficial inspection might confound that species with the present, though very little closer observation will show that the two are quite distinct. In the so termed *D. truncata*, of which figures will be found in the paper above referred to on the Norway Polyzoa, the surface between the costæ, and the outer surface of the entire growth are like a honeycomb, and the tubes connate quite to the mouth, whilst in *D. striatula* a considerable

portion of the tubes is free, and the surface imperforate. The only other recent pedunculate *Defrancia* with which I am acquainted, and which so closely resembles *Ceriopora stellata* of Goldfuss that I have designated it by the same specific appellation, occurs in the same locality as *D. truncata*, but no mistake can arise with respect to it.

The most nearly allied fossil forms are :

1. *DEFRANCIA MICHELINII*, *Hag.* = *CERIOPORA DIADEMA*, *Goldf.*, from the Cretaceous beds of Maastricht.
2. *D. BRONGNIARTII*, *M. Edwards* (sp.), also a Cretaceous fossil.

But the differences between these and *D. striatula* are so obvious as not to require any special remark.

β. *Sessile.* 2. Interspaces cancellous.

D. RUGOSA, (*n. sp. ?*) Pl. XIX, fig. 3.

Disciformis, adnata ; superficie cancellatâ ; cellulis magnis, paucis, valde elevatis.

Discoid, adnate ; surface coarsely cancellated ; tubes large, few much elevated.

Habitat.—C. Crag, *S. Wood.*

It is difficult to assign any well-marked characters to this species, of which the specimens are too imperfect for complete description, and it may consequently be found to correspond with some already recorded form.

Fam. V. *CERIOPORIDÆ*, Busk.

Polyzoario solido seu lamelloso ; erecto seu decumbente, simplicii vel ramoso. Cellulis contiguus, confertis.

Polyzoarium, solid or lamellar ; erect or decumbent (sometimes encrusting ?) ; simple or branched. Cells contiguous, crowded.

Genus 11. *FUNGELLA*, *Hagenow.*

Polyzoario stipitato, capitato ; capitulo simplicii vel lobato. Cellulis coalitis, omnibus sursum spectantibus.

Polyzoarium pedunculate, capitate; capitulum simple or divided into lobes; the contiguous tubes opening irregularly on the upper surface.

FUNGELLA, *Hag.*, Maast. Kreideb., p. 37.

FRONDIPORA (sp.), *Michelin*; (? *Blainville*).

1. *F. QUADRICEPS*, (*n. sp.*) Pl. XVII, fig. 3.

Capitulo quadrifido; lobis singulis medio excavatis seu depressis. Cellularum orificiis in cristis irregularibus e centro radiantibus plerumque positis, subinde autem totam superficiem occupantibus; stipe porosâ, infra attenuatâ.

Capitulum quadrifid; each lobe depressed in the centre; openings of cells disposed to run in crests radiating from the centre, or uniformly over the surface, stem porous, attenuated downwards.

Habitat.—C. Crag, Sutton; *S. Wood*.

This species bears so close a resemblance to *Fungella prolifera*, *Hag.* ('Maast. Kreideb.' p. 37, pl. iii, fig. 6), that it is difficult at first sight to perceive that there is much if any difference between them. The following distinctions, however, will be found to exist. In *F. prolifera* the stem is described as smooth, longitudinally striated and ringed transversely, whilst in *F. quadriceps* the surface of the stem is entirely covered with distinct elongated pores. The fourfold division of the capitulum appears to be a constant character in *F. quadriceps*, but which, though shown in the figure, is not specially adverted to in the text. Neither does Dr. Hagenow notice the depressed centre of each lobe and the radiating disposition of the openings of the cells, often so manifest in *F. quadriceps*, and showing the close relationship of the genus to *Defrancia*.

2. *F. MULTIFIDA?* (*n. sp.*) Pl. XVII, fig. 4.

Stipe brevissimo, ad basim incrassato. Capitulo in lobis bifidis numerosis subcompressis vel rotundis diviso. Cellularum orificiis æqualibus per totam superficiem dispositis. Stipis superficie glabrâ, lineis delicatulis areas hexagonas circumscribentibus ornatâ.

Peduncle very short and thick, expanded at the base; capitulum divided into numerous bifid subcompressed or circular lobes, which are convex on the surface; openings of the cells of uniform size and disposition; surface of base and peduncle smooth, divided into hexagonal areas by reticulating lines.

FRONDIPORA MARSILLII, *Michelin*, *Icon. Zooph.*, p. 68, pl. xiv, fig. 4 (not *Blainville*).

Habitat.—C. Crag, *S. Wood*.

It is with great hesitation that I place this form in the genus *Fungella* at all, inasmuch as I think it very probable that it represents merely the young or ineipient condition of *Fascicularia tubipora*. I should have had no doubt about this had that well-marked and gigantic species occurred among those described by M. Michelin, whose figure and description of *Fron dipora Marsillii* (strangely confounded by him with the wholly dissimilar *F. Marsiglii* of Blainville), shows beyond dispute that that species is identical with ours. But since *Fascicularia tubipora* is not noticed by Michelin, and could hardly, had it existed in the beds examined by him, have been overlooked, this circumstance leads to the suspicion that his *F. Marsillii* could not be the young state of that species.

3. FUNGELLA INFUNDIBULATA. Pl. XVII, fig. 6.

Polyzoario infundibuliformi, vel cyathiformi. Cellularum orificiis ad marginem capituli incrassatum et rotundatum positis. Stipis superficie alte sulcatâ.

Polyzoarium infundibuliform or cupped; cells opening all round the thickened, rounded margin of the cup; peduncle strongly sulcate.

Habitat.—C. Crag, Sutton; *S. Wood*.

The peduncle in this species of *Fungella* is deeply and irregularly grooved, owing, manifestly, to the destruction of the wall of the cells constituting its exterior. The interior of these open tubes exhibits a closely punctate surface, like that of the interior of the tubes in *F. quadriceps* and *F. multifida*, though the puncturation seems to be closer in *F. infundibulata* than in the others.

Genus 12. HETEROPORA, *Blainville*.

Polyzoario erecto, cylindraceo, simplicei vel ramoso. Superficie aperturis duplicis generis, *orificiis* nempe et *ostiolis* ornatâ.

Polyzoarium erect, cylindrical, undivided, or branched; surface even, furnished with openings of two kinds; the larger representing the *orifices* of the cells, and the smaller the *ostioles* of the interstitial canals or tubes.

HETEROPORA, *Blainville*, Man. d'Actin., p. 417, 1834; *Lamarck*; *Lonsdale*; *Hagenow*, 1851;

Reuss; *Michelin*; *J. Morris*.

CERIOFORA (pars), *Goldfuss*; *Hagenow*, 1846; *D'Orbigny*.

MILLEFORA (pars), *Lamouroux*.

ENTALOPHORA (pars), CERIOFORA, MULTICRESCIS, SEMICRESCIS *D'Orbigny*.

As remarked by Mr. Lonsdale,¹ "the genus *Heteropora*, established in 1834 by M. de Blainville on three species of Prof. Goldfuss's *Ceriopora*, has not been described either by its founder or by other authorities with sufficient fulness to enable an opinion to be formed of its complete characters, or of the nature of the minor openings, one of the assigned essential structures." Nor consequently could its true systematic position be regarded as fully established. Though unnoticed among the rest of the Tubuliporidans by M. Milne-Edwards in his excellent Memoirs on those Polyzoa, published in 1838, it would seem that he had surmised its true relations when he edited the second edition of Lamarck in 1836. It is there placed among the heterogeneous "Polypiers foraminés," of Lamarck, together with its natural allies *Pustulopora*, *Chrysaora*, *Theonaa*, and *Terebellaria*, whence it may be concluded that its true affinities were at any rate beginning to be appreciated. But to Mr. Lonsdale is undoubtedly due the merit of clearly indicating upon sufficient grounds the real position of the genus, which has been tacitly accepted by all subsequent writers.

The essential character of the genus has been drawn from the existence on the surface of the Polyzoarium of two kinds of pores, a *larger* and a *smaller*. The former representing the orifices of the true polypide-cells, and the latter those of interstitial canals or tubular passages of greater or less length, and which are of smaller size though far more numerous than the true cells, and in some instances differ from them not only in size, but also in structure. The true nature of these interstitial passages is at present obscure; and as no living species belonging to the genus has, so far as I know, yet been met with, one important source of information respecting the relations of these canals to the rest of the economy is wanting. We may be allowed, however, to presume that these passages are analogous in function to the openings of other kinds which are found, affording communication apparently between the polypide-cell and the circumambient water in many other cases, such as the canals which lead from the bottom of the cells to the under surface in several species of *Cupularia* and *Lunulites*, the pores and openings of various kinds in numerous species of *Eschara*, *Lepralia*, &c.; and, to come to nearer allies, to the minute pores which exist in the walls of the cells in all the *Crisiida*, *Pustulopora*, *Idmonca*, &c., but more particularly to the perforations which are so manifest both in front and behind in the *Horneræ*. In fact, in transverse fractures of some species of this genus, minute tortuous canals may be traced from the smaller pores on the anterior surface into the interior of the branch; resembling, except in their diminutive size and paucity of numbers, the interstitial canals of *Heteropora*. This view of the nature of the interstitial canals is further borne out by the circumstance that in one or two of the species here referred to *Heteropora*, for want of a more eligible situation, the small size and comparative fewness of the ostioles and passages, conjoined with a strongly marked disposition to reticulation on the surface, a close approach is made to *Horneræ*. *Heteropora* of this kind are represented by *H. reticulata*.

¹ 'Miocene Fossils of N. America,' Q. J. Geol. Soc., vol. i, p. 500, 1845.

The cell-tubes in *Heteropora*, when traced internally, are seen to enter the branch at first nearly horizontally, and gradually curving downwards, to descend vertically in the centre of the branch, which thence comes to be occupied by a sort of pith, composed of pretty nearly equal-sized, polygonal contiguous tubes. The interstitial canals rarely appear to enter into this pith, usually terminating where the cell-tubes begin to assume the perpendicular direction. In cases such as that of *H. pustulosa* (Pl. XX, fig. 1, *d*), or of *Heteroporella radiata* (Pl. XIX, fig. 2, *d*), where the interstitial canals are of large size, nearly equal in fact to the cells themselves, they may be distinguished from the latter by their peculiar moniliform aspect, an appearance which is due to the existence of partial, transverse, nearly equidistant septa. As it is not impossible that this peculiar condition of the tubes might give rise to the mistaking of one of these Polyzoa for a true coral, such as *Favosites* or *Chatetes* for instance, it will be as well to explain how it appears to arise. In *Heteroporella radiata*, and in *Heteropora pustulosa*, and in other species also, of what may be termed true *Heteropora*, the ostioles will often be found completely closed by a calcareous, depressed lid, which in the majority of cases, however, is perforated in the middle. Now it would seem that the imperfect septa above noticed in the canals, represent the remains of these hymen-like lids, which have been left behind at successive stages of growth.

In *H. clavata* the interstitial orifices, or many of them, exhibit a stellate appearance, owing to the projection into their interior of numerous minute rays; affording thus another curious, false resemblance to a true coral. This appearance, however, is not peculiar to *Heteropora*, for a similar condition exists in the beautiful pores, for instance, which ornament the front of the cells in *Lepralia Malusii*, and may be observed in certain pores, no doubt of exactly the same nature as those in *Heteropora* in at least one recent species of *Discoporella*.

The species furnished with these two kinds of orifices appear to be naturally divisible into two groups, which may perhaps be regarded as generic, according as they are encrusting or at least adnate, or massive, erect, and cylindrical. For the former I venture to propose the term *Heteroporella*, *n. g.*, and to restrict that of *Heteropora* to the latter.

1. HETEROPORA PUSTULOSA (*n. sp.*)? Pl. XX, fig. 1; Pl. XIX, fig. 6.

Irregulariter ramosa; ramis curvatis, teretibus. Orificiis peristomate incrassato, quadrifido munitis et ostioliis 5 foveolatis circumcinctis; tubulis interstitialibus, moniliformibus, et in diametro cellulis propè paribus.

Polyzoarium branched irregularly; branches curved, tapering; cell-orifices with a

thickened, annular, quadrifid border; ostioles depressed, foveolate, about 5 around each orifice; interstitial tubes nearly as large as the cells, moniliform, not punctured.

HETEROPORA TORTILIS (?), *Lonsdale*, l. c., p. 500, with fig.

MULTIZONOPORA RAMOSA (?), *D'Orbigny*, Terr. Cret., pl. dclxxii, figs. 1, 3.

HETEROPORA INTRICATA (?), *Mich.*, l. c., p. 320, pl. lxxv, fig. 6.

ENTALOPHORA IRREGULARIS (?), *D'Orbigny*, l. c., pl. dexvii.

HETEROPORA DICHOTOMA, *S. W.*, MS.

Habitat.—Sutton; *S. Wood*; *J. S. B.*; (?) Cretaceous and Oolite, *D'Orbigny* and *Michelin*.

Of the above synonyms those which appear the most likely to prove correct are *Heteropora tortilis*, *Lonsdale*, and *Multizonopora ramosa*, *D'Orbigny*, which probably corresponds with his *Entalophora irregularis*, but is clearly not the same as *H. ramosa* of *Michelin*. The specific name consequently could not be adopted, even were the identity of his form with the Crag fossil satisfactorily established. All that need be remarked respecting it is that the representation of the natural size of *M. ramosa* given by *M. D'Orbigny* suits very exactly to *H. pustulosa*, and that there is nothing in his diagrammatic, magnified figure against the supposition that they may be the same.

With respect to *H. tortilis* of *Mr. Lonsdale*, it may be remarked that his excellent account and very intelligible figures show that the two forms are at any rate closely allied. The geological position also of *H. tortilis* is an additional argument in favour of its correspondence with the Crag fossil. The chief difference seems to exist in the absence in *H. tortilis* of the peculiar annular thickening of the mouths of the cells in the better preserved portions of the specimens which forms a striking character in *H. pustulosa*, and which, had it existed in his species, could hardly ~~not~~ have escaped the observant eye of *Mr. Lonsdale*, who, on the contrary, expressly says of the American species that the edges of the larger orifices are "sharp."

omit N
See p. 2

2. HETEROPORA CLAVATA, *Goldfuss* (sp.) Pl. XIX, fig. 7.

Polyzoario simplicis, clavato, inferne valde attenuato. Superficie cancellatâ. Cellularum orificiis orbicularibus, simplicibus, superficie æquatis vel depressis, ostiis quinque magnis circumcinctis.

Polyzoarium simple, club-shaped, much attenuated at the base; surface cancellous; cell-orifices circular, simple, level or depressed; ostioles large, about 5 around each cell-orifice.

CERiopora CLAVATA, *Goldfuss*, Petr. Germ., p. 36, pl. x, fig. 15.

HETEROPORA ANAMOLOPORA, *Reuss*, Foss. Polyp., d. W., *T. B.*, p. 34, pl. v, figs. 17, 18 (not *Hag.*).

CERiopora THELEOIDEA (?), *Hag.*, Maast. Kreideb., p. 52, pl. v, fig. 5.

Habitat.—C. Crag, *S. Wood*.

The regular clavate form of this species, apparently at all ages, will at once serve to distinguish it from any of its congeners. In Plate XIX, fig. 6, the young state of *H. pustulosa* is represented, and at a time when the division into branches has but just commenced. In outward form, therefore, it may be conceived that at a still earlier period that species might be confounded with the present; but even then no difficulty in the diagnosis is, I think, to be apprehended, if the minuter characters are attended to. In referring this species to the *C. clavata* of Goldfuss, I am guided solely by the general aspect, so that the identification should not be taken for more than it is worth. Dr. Reuss's *H. anamolopora* (a tertiary form) is clearly the same as *C. clavata*, Goldfuss, and it is difficult to understand how he could have confounded it with the wholly distinct *C. anamolopora* of Goldfuss.

2. *H. RETICULATA* (*n. sp.*)? ¹

Ramosa; ramis dichotomis, cylindraceis, truncatis; superficie sulcatâ seu reticulatâ fibrosâ. Cellularum orificiis simplicibus, parvis, orbicularibus, superficie æquatis, distantibus, sparsis. Ostioliis minimis elongatis irregulariter inter et circa orificia dispositis. Cellulis angustis æqualibus, parietibus imperforatis; tubulis interstitialibus perangustis.

Polyzoarium dichotomously branched; branches cylindrical, truncate; surface sulcate or fibro-reticulate; cell-orifices simple, small, orbicular, level with the surface, wide apart, scattered; interstitial orifices very small, elongated, disposed some around the larger orifices, others in the longitudinal sulci and reticulations on the surface; tubes of cells narrow, of uniform diameter, walls not perforated; interstitial canals very narrow.

CERIOPORA DICHOTOMA (?), (pars), *Goldfuss*, *Petrefact. Germ.*, p. 34, pl. x, fig. 9, *d, e*, and ? *f*.

HETEROPORA DICHOTOMA, *Hagenow*, *Maast. Kreideb.*, p. 47, pl. v, fig. 15; *Reuss*, *Foss. Pol.*, d. W., *T. B.*, p. 35, pl. v, fig. 20 (not *Michelin*).

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

If regard were paid only to the figures in Goldfuss, above cited, and which represent merely the natural size and general aspect, no hesitation could be felt in assigning the Crag fossil to the same species as the one there represented, and which appears to be quite distinct from that represented in the same figure under *a, b, c*. But doubts arise with respect to this identification, when we come to examine the excellent and minute figures of the Goldfussian species, and even taken, as it would seem,

¹ By accident it was discovered that no figure of this species had been prepared until the last plate was completed.

from the same specimen by Hagenow ('Maast. Krcideb.,' pl. v, fig. 15). In these figures, if they really represent the form intended in fig. 9 *d*, and *e*, of Goldfuss, which is not quite clear, the minute characters are not those of the Crag fossil, nor can they be in any way reconciled with them. The entire absence of any reference by Dr. Hagenow to the peculiar reticulate sulcation of the surface, which is so obvious and striking a characteristic of our *H. reticulata*, leads to the supposition that so careful and accurate an observer could not have had that form under observation. And the same remark will apply to Reuss' figure of *H. dichotoma*, which is clearly the same as Hagenow's. In this doubtful state of the question, and considering, moreover, that the variety marked *d* and *e* in Goldfuss's figure cannot be regarded as the typical form of his species, which is rather that marked *a*, *b*, *c*, it seems advisable to designate the Crag fossil by a distinctive appellation, and for the present to drop that of *dichotoma*, which evidently, as originally constituted, includes at least two, and perhaps three, distinct forms.

At the same time Goldfuss' figure so closely resembles that of *H. reticulata*, that I am very strongly inclined to think that direct comparison of his specimen with the Crag species would show that they are really identical. His species, it is true, belongs to the Cretaceous period, but there seems no reason to doubt that some one or other of the forms assigned by him to it also existed in the Tertiary period, and it may, therefore, be presumed that the one now in question may have survived up to that of the Crag deposit.

The peculiar characteristic of *H. reticulata* is the coarsely sulcate or reticulate aspect of the surface, which bears, in some respects, a strong resemblance to that of a *Hornera*, whence, as well as from the smallness of the interstitial pores and canals, this species may be regarded as intermediate between *Hornera* and *Heteropora*.

3. *H. LÆVIGATA?* *D'Orbigny*, (*sp.*) Pl. XIX, fig. 5 (young state).

Ramosa; ramis elongatis cylindraceis, fortibus, teretibus. Superficie scrobiculatâ, ad ramorum basim nitide reticulate-fibrosâ. Cellularum *orificiis*, simplicibus, orbicularibus, superficie æquatis, in zonis annularibus vel irregulariter sinuosis aggregatis; *ostiolis* parvis, in scrobiculis positis; cellulis parietibus rugulosis, perforatis; tubulis interstitialibus perangustis moniliformibus.

Polyzoarium composed of elongated, cylindrical, strong, tapering branches; surface pitted, and at the base of the branches finely fibro-reticulate; orifices of cells simple, orbicular, level with the surface, assembled into zones, either annular, or meandering irregularly over the surface; ostioles small, situated in the pits; cell-tubes wrinkled, walls perforated; interstitial tubes very small and moniliform.

CERiOPORA DICHOTOMA (?), *Goldfuss*, pl. x, fig. 9, *a*, *b*, *c*.

ZONOPORA LÆVIGATA, *D'Orbigny*, Terr. Crét., pl. dcclxxi, figs 7, 8.

MULTIZONOPORA LIGERIENSIS (?), *Id. ib.*, pl. dcclxxii, figs. 4—6.

Habitat.—C. Crag, Sutton, *S. Wood*; Cretaceous, *D'Orbigny*; (?) *Goldfuss*.

Though not much inclined to adopt any of M. D'Orbigny's species, about which, at any rate, the doubt always exists whether they are his own or not, his figures above cited leave so little doubt of their representing a form identical with the Crag fossil, that I have no hesitation in referring them to the same species.

With respect to the synonym cited from Goldfuss, as there are no means of judging correctly with respect to the *Heteropora* really intended by him, except what are afforded by his very defective figures, it is impossible to determine whether the present species is represented in his plate or not. All that can be said is, that the external resemblance, and the apparent zonular disposition of the cell-orifices, would lead one to suppose that it may be so.

In the same way that the preceding species might be regarded as intermediate between *Hornera* and *Heteropora*, so may this be looked upon as a link between these two genera and *Cricopora*, and perhaps as affording an additional proof of the artificiality of the not very satisfactory classification we are at present compelled to adopt of these Polyzoa.

The distinctive specific characters are found in the partially pitted and partially fibro-reticulate condition of the surface; the peculiar zonular disposition of the cell-orifices; the curious wavy formation of the cell-walls, which is well shown in Pl. XIX, fig. 5; and the smallness or shortness of the interstitial pores and canals.

Genus 13. HETEROPORELLA (*n. gen.*)

Polyzoario disciformi et adnato, sive incrustante et indefinito; superficie porosâ, aperturis duplicis generis ornatâ; *orificiis* nempe cellularum, et *ostiolis* interstitialibus.

Polyzoarium discoid and adnate, or indefinite and incrusting; surface uniformly porous, with openings of two distinct kinds.

REPTOMULTICAVA (?), *D'Orbigny*.

The relations of this genus have been noticed in the remarks appended to the account of *Heteropora*, with which the present agrees in all respects except its habit. In *Heteropora* the growth is erect, and usually, though not always, branched, whilst in *Heteroporella* it is expanding and discoid, or indefinite and incrusting; the one, in fact, standing in the same relation to the other that *Lepralia* does to *Eschara*. Consequently, the same explanation with respect to the two kinds of pores will apply to *Heteroporella* as was offered in the case of *Heteropora*.

1. *H. RADIATA* (*n. sp.*) Pl. XIX, fig. 2.

Disciformis, subadnata. Superficie inferiori integrâ rugisque concentricis ornatâ. Cellularum orificiis, subovalibus, simplicibus superficie æquatis; ostiis interstitialibus parvis, orbicularibus, foveolatis.

Polyzoarium discoid, adnate by a broad base, the unattached part of the under surface covered with a thick, entire, calcareous layer, marked with annular ridges; mouths of cell-tubes suboval, simple, even with the surface; intermediate orifices small, circular, placed at the bottom of funnel-shaped depressions.

Habitat.—C. Crag, Sutton, *S. Wood*.

Were it not for the existence of the interstitial tubes, which are of a moniliform character, as in *Heteropora pustulosa*, this form would be hardly distinguishable from a *Defrancia* or *Discopora*, with which it is undoubtedly closely allied.

2. *H. PARASITICA* (*n. sp.*) Pl. XXII, fig. 5.

Incrustans, indefinita (?) Cellularum orificiis orbicularibus, simplicibus, superficie æquatis; ostiis, orbicularibus, simplicibus, sparsis.

Incrusting, indefinite (?). Orifices of cells circular, simple, even with the surface; intermediate openings circular, simple, irregularly scattered among the others.

Habitat.—Cor. Crag, on shell, *S. Wood*.

This is a very doubtful form, but as I am unable to refer it to any known species, it may be, provisionally at any rate, regarded as independent. In the figure the orifices of the cells appear as if surrounded with an annular thickening, but this is not apparent in the specimen, at any rate so distinctly as it is represented by the artist. The entire surface between the openings appears irregularly areolated, and as if formed by the closed orifices of cells, sealed up, as it were, by calcareous matter, as may frequently be observed in other cyclostomatous Polyzoa.

Fam. VI. *THEONOIDÆ*, Busk.

Polyzoario massivo, subgloboso vel irregulari; cellulis contiguis, confertis.

Polyzoarium massive, subglobose, or irregular; cells contiguous, crowded

Genus 14. ALVEOLARIA, (n. gen.)

Polyzoario massivo globoso; superfieie in areas hexagonas vel polygonas septis longitudinaliter suleatis subdivisâ. Cellularum orificiis per totam aream distributis.

Polyzoarium massive, globose; surfac divided into hexa- or polygonal areas by raised lines, which are finely sulcate longitudinally. The interior of the area uniformly occupied by the openings of the eells.

1. A. SEMIOVATA, (*n. sp.*) Pl. XIX, fig. 4; Pl. XXI, fig. 3 (section).

Sp. unica.

BLUMENBACHIUM, *Sowerby*, König Icon., 75, fig. 69.

Habitat.—C. Crag, *S. Wood*; *J. S. B.*

This is one of the most curious and peculiar forms of eyelostomatous Polyzoa met with in the Crag, and apparently confined solely to that formation. In its massive, hemispherical form and general aspect, when worn smooth and covered with extraneous matters, it resembles the two species of *Fascicularia*, with which it is associated, but in its real structure it differs most widely from them, as well as from any hitherto known Polyzoon.

In Pl. XIX, fig. 4 (*a*), a polygonal eup-shaped object, cellular within, and smooth or slightly wrinkled on the exterior, and at (*b*) in the same figure, the entire upper surface of one, and portions of the same surface of seven other similar eup-shaped growths will be seen in close apposition. They represent, in fact, a number of hexagonal or pentagonal hollows, separated by raised lines, and, on close inspection, it will be seen that these ridges are not simple, but that each is marked with a fine longitudinal furrow, indicating the lines of contact of two contiguous alveoli. The entire growth, in short, is composed of an aggregation of eup-shaped bodies, resembling that figured at (*a*); and in well-preserved specimens, which appear to be very abundantly met with, the real structure may be readily made out, even when they are of very large size; and besides these, many specimens in an earlier stage of development will be found, showing the process of growth still more satisfactorily.

Genus 15. FASCICULARIA, *Milne-Edwards*.

Polyzoario massivo globoso sessili, e fasciculis cellularum prorsus coalitarum et e basis centro ad peripheriam undequaque radiantibus composito.

Polyzoarium globose, massive; constituted of distinct bundles of contiguous tubes; the bundles radiating from the centre of the base, in all directions, towards the periphery.

FASCICULARIA, *Milne-Edwards*, 1836 (*M. S.*); *Lyell*; *S. Wood*.

THEONOA (sp.), *S. Wood*; (sp.) *Auct.?*

MEANDRIPORA, *D'Orbigny*.

APSENDESIA (pars), *Blainville*; *Lamx.* (?).

This genus, which, though named, does not appear hitherto to have been fully described, may be regarded at present as quite peculiar to the Crag, and in all probability to the Coralline Crag, for though found in the Red Crag there can be little doubt, as observed by Mr. S. Wood, that these stray specimens have been introduced from the underlying coralline beds.

The peculiarity of the structure of the polyzoarium consists in its being made up of radiating bundles of tubes, which bundles, in one of the two species, are cylindrical, and of pretty nearly uniform dimensions throughout, whilst in the other they are more irregular in size and form. A striking distinction, also, is observable in the mutual relation of the bundles of tubes to each other in the two species. In one, the cylindrical bundles are united, at regular distances apart, by what may be termed tabular, horizontal septa, indicating probably periodical lines of growth, and which lines are thus concentric to one another. In the other species the bundles of tubes anastomose more irregularly, approaching each other and coalescing for some distance, and then separating again. In consequence of which the appearance of periodical lines of growth, though obvious enough, is not so distinct as in the other species, and the aspect of the surface is also rendered widely different, which presents in the one case rounded eminences, on which the tubes open, and in the other undulating anastomosing ridges.

The only genera with which the present can be confounded, are *Apsendesia* and *Theonoa* of Lamouroux. With respect to the former, as defined by that author himself, there seems, upon reference to his description and figure¹ of the typical species *A. cristata*, —“subglobosa vel hemispherica; laminis exsertis, rectis, diversè convolutis, uno latere lamelliferis”—to be no reason whatever to regard it as in any way allied to Fascicularia, except in outward configuration; nor, in fact, is it certain that it is a Polyzoon at all. It is otherwise, however, with the genus as defined by M. de Blainville,² who, as it would

¹ ‘Exp. Meth.’ p. 81, pl. lxxx, figs. 12—14.

² ‘Man. d’Actin.’ p. 408.

seem, after inspection of specimens derived from the Lamouroux Collection, characterises the genus as follows: "Cellules subpolygonales, petites, poriformes, irrégulièrement disposées, et occupant le bord supérieur et externe de crêtes ondules, sinueuses, lisses d'un côté, plissées d' l'autre, constituant un polypier calcaire, globuleux ou hémisphérique, divergeant de la base à la circonférence."

It is probable, that in drawing up this character, the learned author had in view not so much, if perhaps, at all the *Apsendesia cristata* of Lamouroux, as two other forms associated by himself with it, and which would appear to constitute, as it seems to me, two distinct genera, or at any rate one. These species are *A. dianthus*, Blainv., and *A. cerebriformis*, Blainv. The former derived from the Jurassic beds at Caen, and probably really representing the *Ap. cristata* of Lamouroux; and the latter procured from the tertiary beds of Anjou, and which, in all probability, is the same as *Fascicularia aurantium*, Milne-Edwards, of the Crag.

Lamouroux describes his genus *Theonoo* as constituted of a massive, conical or coarsely cylindrical, undulated, simple or lobed polyzoarium, whose surface is covered with numerous holes or deep depressions, very irregular in their form and disposition, and not perforated at the bottom, whilst the intermediate, raised portions of the surface are occupied by the openings of the cells.

This account would point at some resemblance in structure, perhaps, between *Theonoo* and *Fascicularia*, but in the absence of more precise indications with respect either to *Apsendesia* or *Theonoo*, it seems better to adopt the appropriate appellation suggested by Milne-Edwards, and since employed by several geological writers, in preference to either of the older terms.

1. FASCICULARIA TUBIPORA (*n. sp.*) Pl. XXI, fig. 1.

Cellularum fasciulis distantibus, cylindræis, septis transversis, concentricis, pari intervallo distantibus, connexis. Superficie polyzoarii tuberosâ, tuberibus cancellatis, interstitiis glabris, areolisque hexagonis ornatis.

Tubes assembled into distinct cylindrical bundles, united at uniform distances apart by horizontal, tabular, concentric laminae; surface covered with rounded eminences, upon which the cells open uniformly all over; intermediate surface smooth, and marked with hexagonally reticulating lines.

Habitat.—C. Crag, *S. Wood*; *J. S. B.* Red Crag?, *S. W.*

The masses formed by this species, which seems to be very abundant, vary in size from one inch or less, to upwards of six in diameter. When worn smooth on the surface, and covered, as is often the case, with an adherent layer of sand, they look like anything else than what they are. In this condition it is next to impossible, in many

cases, to distinguish them from *F. aurantium*. But if one of the masses be split vertically, the peculiar arrangement of the bundles of tubes, closely resembling that of *Tubipora musica*, will at once solve all doubts. In cases where the surface is less worn, the circular eminences afford an obvious character.

In speaking of *Fungella multifida* (p. 119), it is suggested that that species may probably merely represent the young state of *Fascicularia tubipora*. This is a matter for future determination, but the mere inspection of the figures will show sufficient ground for the suspicion that they may stand in the relation suggested.

2. *F. AURANTIUM*, *Milne-Edwards*. Pl. XXI, fig. 2.

Cellularum fasciculis confertis, sæpius irregulariter coalitis; polyzoarii superficie rugosâ; rugis anastomosantibus sinuosis, cancellatis; interstitiis striatis.

Tubes assembled into compound bundles, which anastomose irregularly with each other, and project on the surface in elongated, tortuous, anastomosing ridges, upon which the cells open; intermediate surface striated.

APSENDESIA CEREBRIFORMIS (?), *Blainville*, Man. d'Actin., p. 409; *M. Edw.* in *Lamarck*, 2d ed., ii, p. 290; *Michelin*, Icon. Zooph., p. 314, pl. lxxv, fig. 5.

FASCICULARIA AURANTIUM, *Milne Edwards*, (*M. S.*, 1830); *Sir C. Lyell*, Man. Elem. Geol., 5th ed., p. 172, fig. 154; *J. Morris*.

Habitat.—C. Crag, *S. Wood*; *J. S. Bowerbank*; Valduc (Bouches-du-Rhône), Doué (Maine-et-Loire), *Michelin*.

ADDENDA AND CORRIGENDA.

1. *ESCHARA SOCIALIS* (*n. sp.*) Pl. XXII, fig. 1.

Polyzoario pedunculato, e centro disci orbicularis, incrustantis surgenti. Cellulis sub-ovalibus seu hexagonis, immersis, inæqualibus, sparse punctatis. Orificio orbiculari, infrâ emarginato. Aviculario parvo mandibulâ acutâ ascendenti, ad unum latus prope orificium posito.

Polyzoarium pedunculate, springing on a slender peduncle from the centre of an orbicular, incrusting, discoid expansion. Cells oval or hexagonal, immersed; surface uneven, sparsely punctured. Orifice orbicular, notched below. Usually a small avicularium with an acute mandible pointing upwards, on one side, close to and below the orifice.

Habitat.—C. Crag, *S. Wood*, on shell.

This is a very curious form, and for some time it was uncertain where to place it. The only specimens met with are very imperfect, and present the aspect of several short, broken stumps, arising in close contiguity from the centre of circular expansions, firmly adnate to the surface of a shell. What the form of the perfect growth may be it is at present impossible to say. In most cases the cells have become completely solidified, or filled up by earthy matter, so that all vestige of the orifice, and nearly so of the internal cavity, is absent. Owing to this circumstance, the surface of the broken peduncle presents a curious appearance. This portion of the polyzoary seems to be made up of solid conical prisms, at the apex of which may sometimes be observed all that remains of the cavity of the cell, but in nearly all cases a transverse septum, separating the prisms on the two sides of the peduncle, may be noticed, as in others of the branched *Escharæ*. The only species of *Eschara* with which this can be supposed to have any connexion is *E. incisa*, but at present no sufficient ground exists for their being associated.

2. LEPRALIA EDWARDSIANA (p. 44).

When the above appellation was given to this species, I had overlooked the circumstance that M. D'Orbigny had given it, in 1839, to a species of *Lepralia* (*Escharina*) from the Coast of Patagonia.¹ I propose, therefore, to term the Crag fossil *L. milneana*, which will equally recal the name of the eminent naturalist and physiologist to whom we are so deeply indebted for our knowledge of recent and fossil Polyzoa, as well as in all other branches of zoological science.

3. FLUSTRA DUBIA (*n. sp. ?*) Pl. I, fig. 3.

Cells subpyriform, pointed at the summit. Many closed in front?

Habitat.—C. Crag, *S. Wood*.

Only one minute fragment of this curious growth has been met with in Mr. Scarles Wood's Collection. It has been assigned to the genus *Flustra* for want of any more appropriate allocation—but it is extremely doubtful whether it will not, on further investigation of larger specimens, be found to be erroneously placed there, and to represent a distinct generic type. From its extreme fragility it would seem so far to have agreed with *Flustra* as to have been more or less flexible when living.

¹ 'Voy. d. l'Amer. mérid.' ('Polypiers,' p. 12, pl. v, figs. 1—4).

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DESCRIPTION OF PLATES.

N.B.—In most cases two enlarged figures are given of each species, one of which is magnified twenty-five and the other fifty diameters.

PLATE I.

Fig.

1. *Biflustra delicatula* (recent).
2. „ „ (fossil), p. 72.
3. *Flustra* (?) *dubia*, p. 131.
4. *Biflustra delicatula*, p. 72.
 - a. Posterior aspect of lamina.
 - b. Horizontal section.
 - c. Longitudinal section.
5. *Hippothoa patagonica*, p. 24.
6. *Scrupocellaria scruposa* (?) p. 19.
7. *Hippothoa dentata*, p. 26.
 - a. Magnified 25 diameters
 - b. Magnified 50 diameters.
8. *Crisia denticulata*, p. 93.

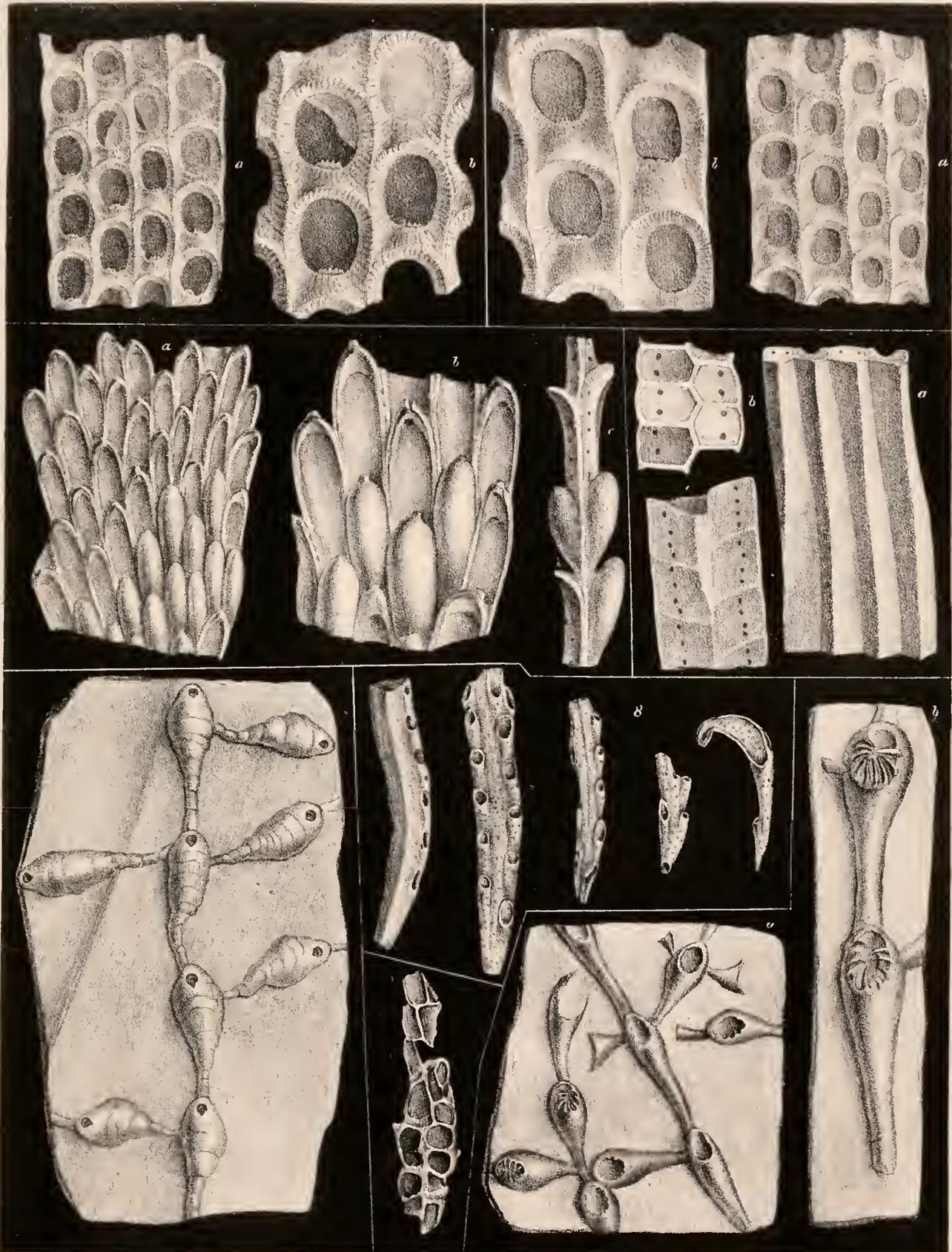
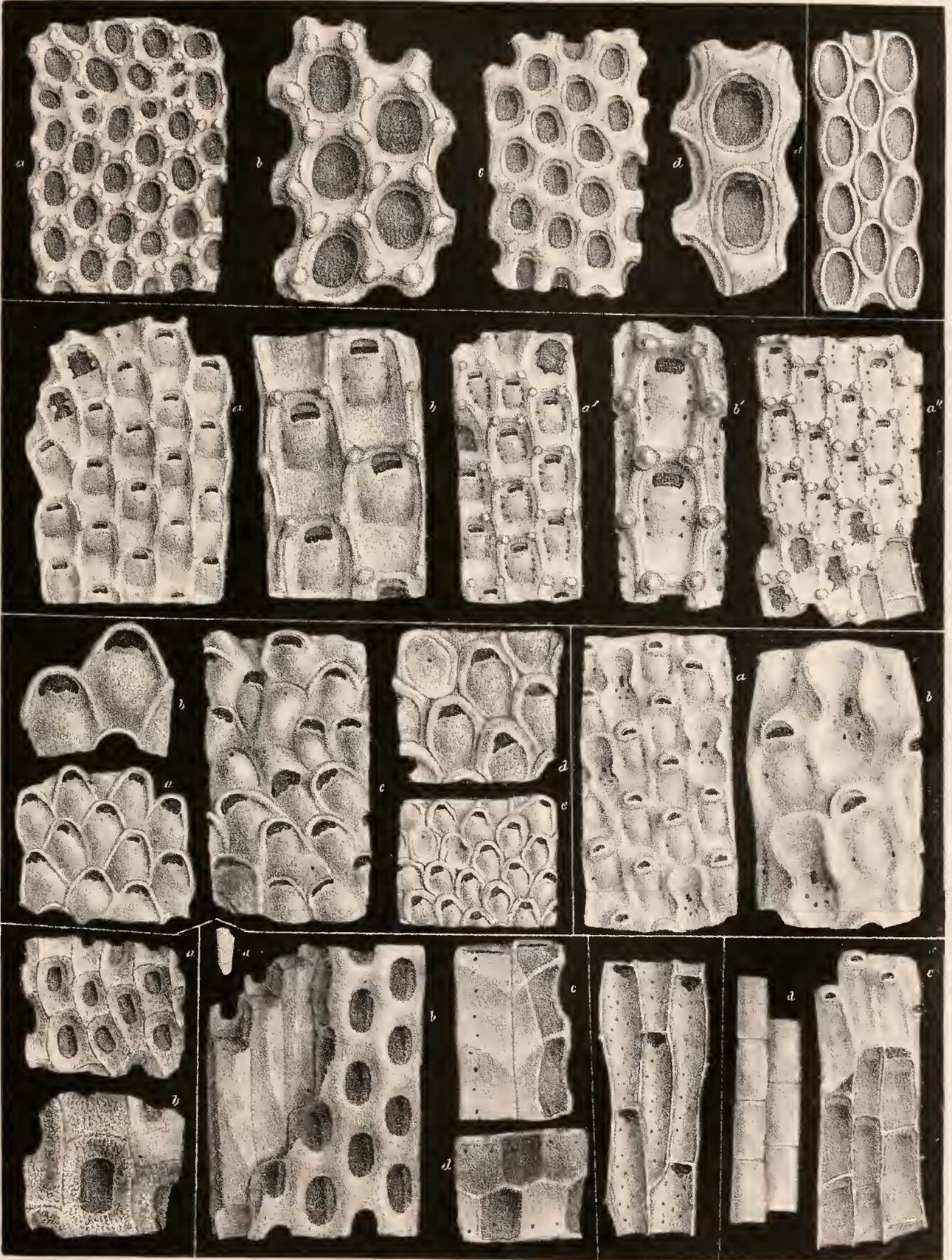


PLATE II.

Fig.

1. *Membranipora tuberculata*, p. 30.
 - a. Portion with the tubercles distinct, magnified 25 diameters.
 - b. Ditto magnified 50 diameters.
 - c. Portion with the tubercles worn off or absent, magnified 25 diameters.
 - d. Ditto magnified 50 diameters.
2. *M. monostachys*, p. 31; magnified 25 diameters.
3. *M. oblonga*, p. 34.
 - a, a', a''. Magnified 25 diameters.
 - b, b'. Magnified 50 diameters.
4. *M. bidens*, p. 34.
 - a, c, e. Magnified 25 diameters.
 - b, d. Magnified 50 diameters.
5. *M. andegavensis*, p. 34.
 - a. Magnified 25 diameters.
 - b. Magnified 50 diameters.
6. *M. Savartii*, p. 31.
 - a. Magnified 25 diameters.
 - b. Magnified 50 diameters.
7. *Biflustra delicatula* (older or worn condition), p. 72.
 - a. Natural size of fragment.
 - b. Portion, magnified 25 diameters.
 - c. Longitudinal section.
 - d. Horizontal section.
8. *Eschara monilifera* (?) (back view of broken fragment).
9. *Membranipora andegavensis* (older state).
 - c. Front, magnified 25 diameters.
 - d. Back of detached portion, magnified 25 diameters.



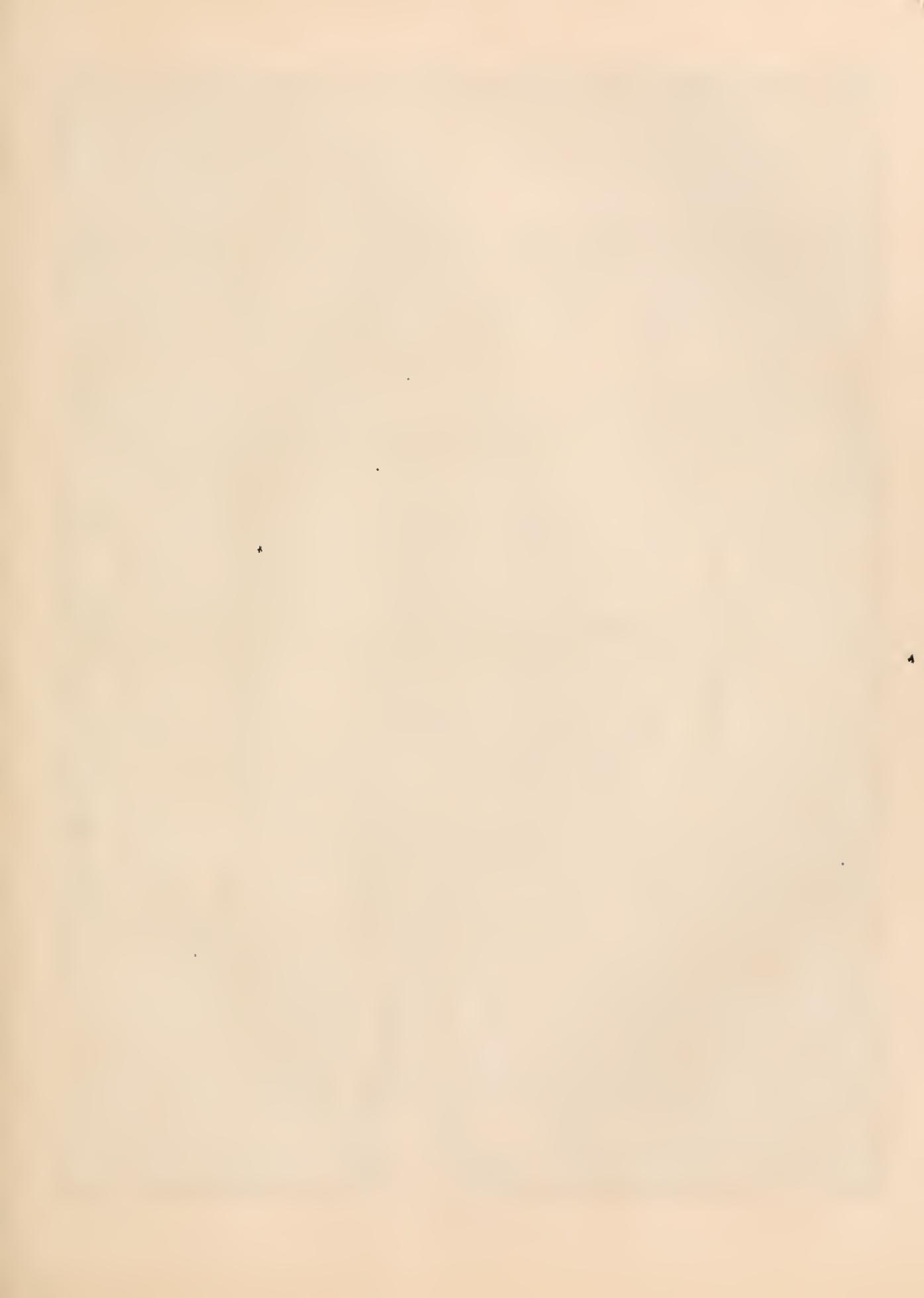


PLATE III.

Fig.

- 1—3, and 9. *Membranipora trifolium*, p. 32.
- 4—6. *M. Pouilletii*, p. 32.
7. *M. rhynchota*, p. 33.
8. *M. Oceani*, p. 35.
10. * *.
11. *M. holostoma*, p. 36.
12. *M. dubia*, p. 31.
13. *M. aperta*, p. 33.

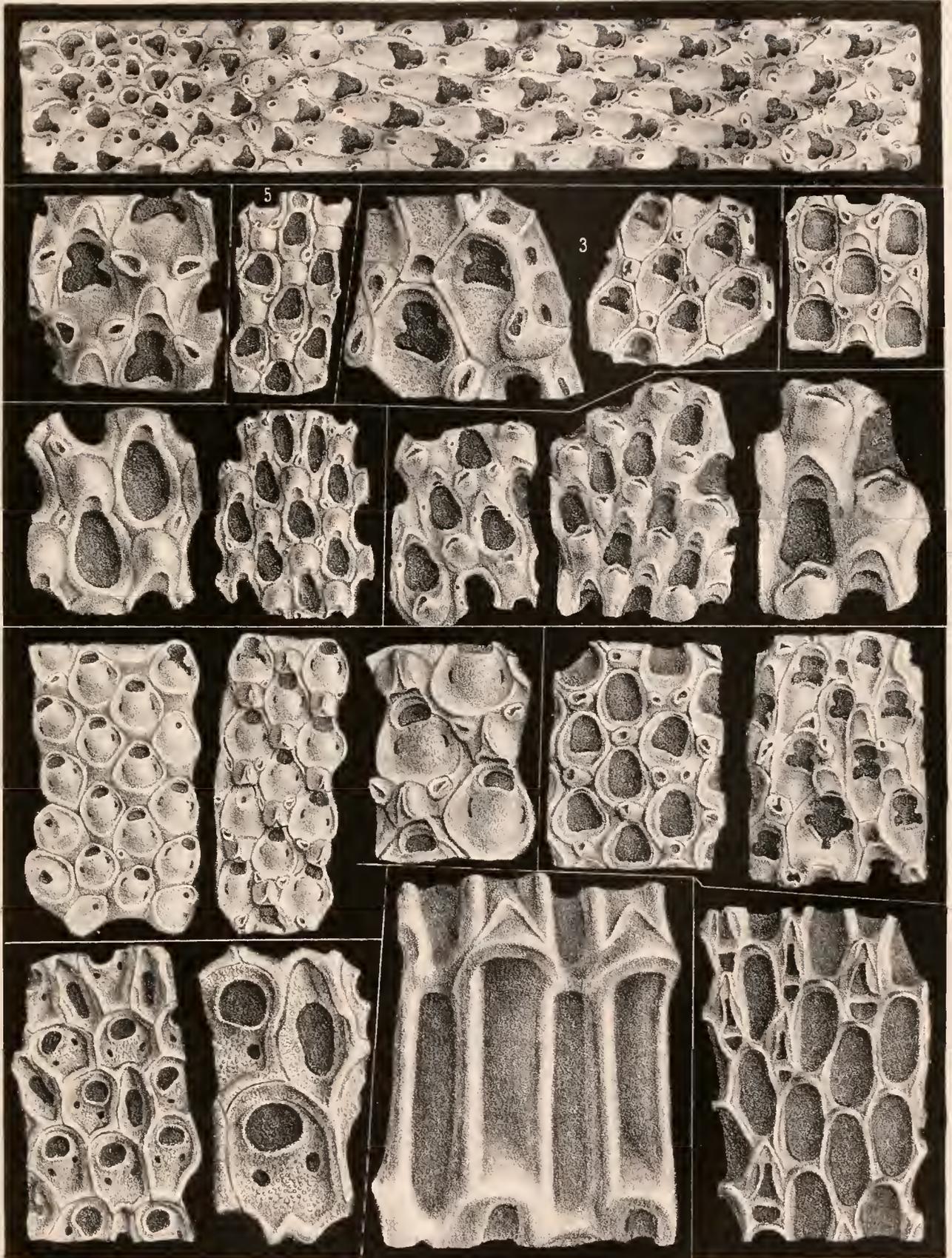


PLATE IV.

Fig.

1. *Lepralia punctata*, p. 40.
2. *L. innominata*, p. 40.
3. *L. violacea*, p. 43.
4. *L. variolosa*, p. 48.
5. *L. plagiopora*, p. 44.
6. *Hemeschara imbellis*, p. 78.
7. *Eschara cornuta*, p. 67.
8. *Lepralia variolosa* (var.), p. 48.

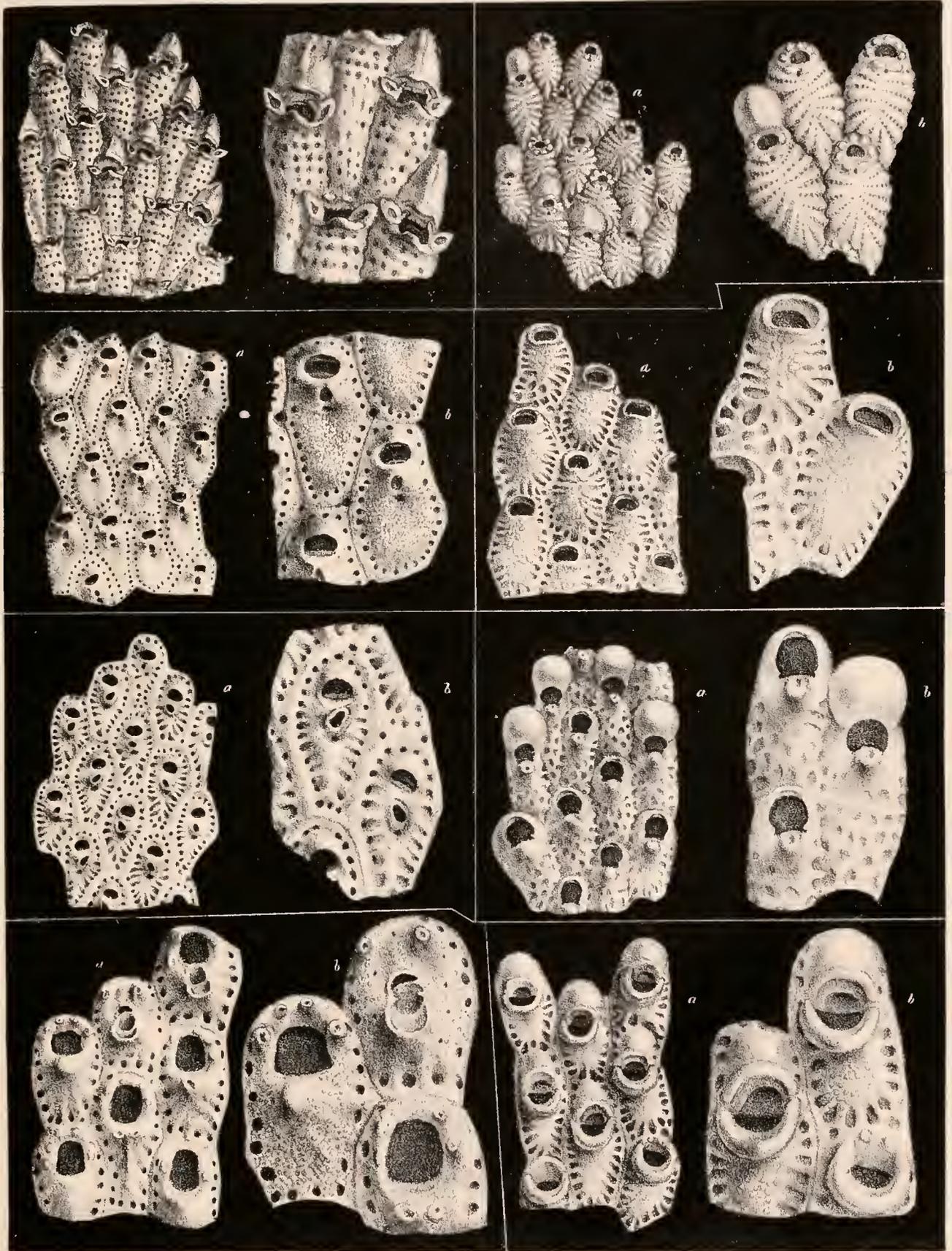
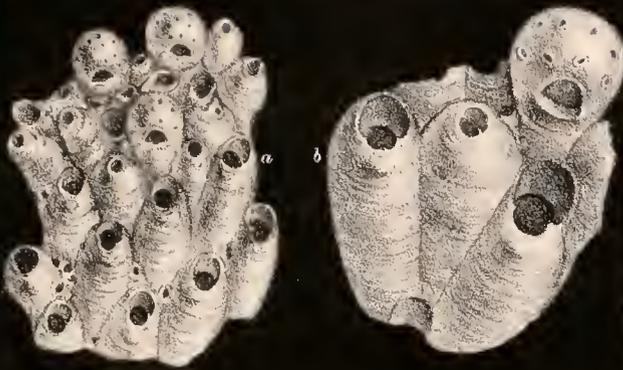


PLATE V.

Fig.

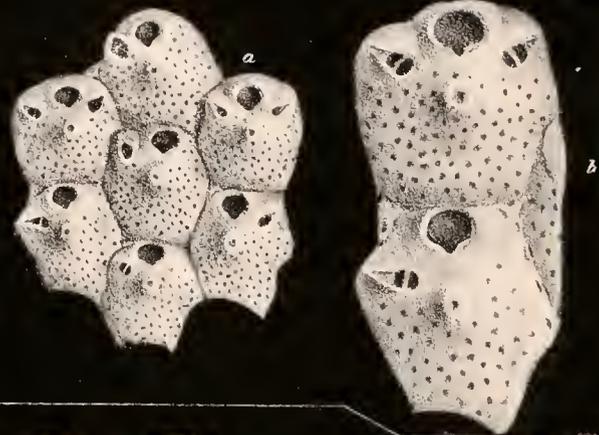
1. *Lepralia hyalina*, p. 52.
2. *L. Edwardsiana*, p. 44.
3. *L. pyriformis*, p. 51.
4. *L. unicornis*, p. 45.
5. *L. papillata*, p. 52.
- 6, 7, 8. *L. Peachii*, p. 48.

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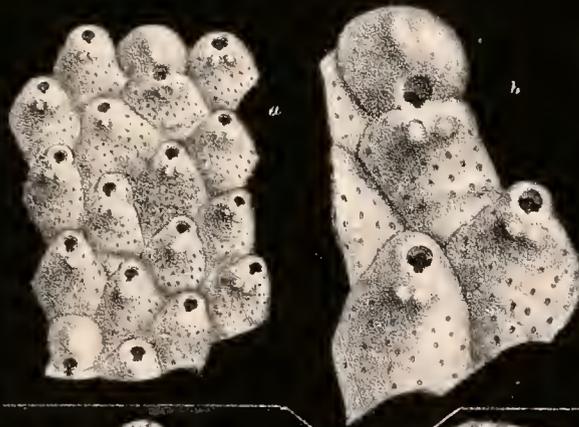
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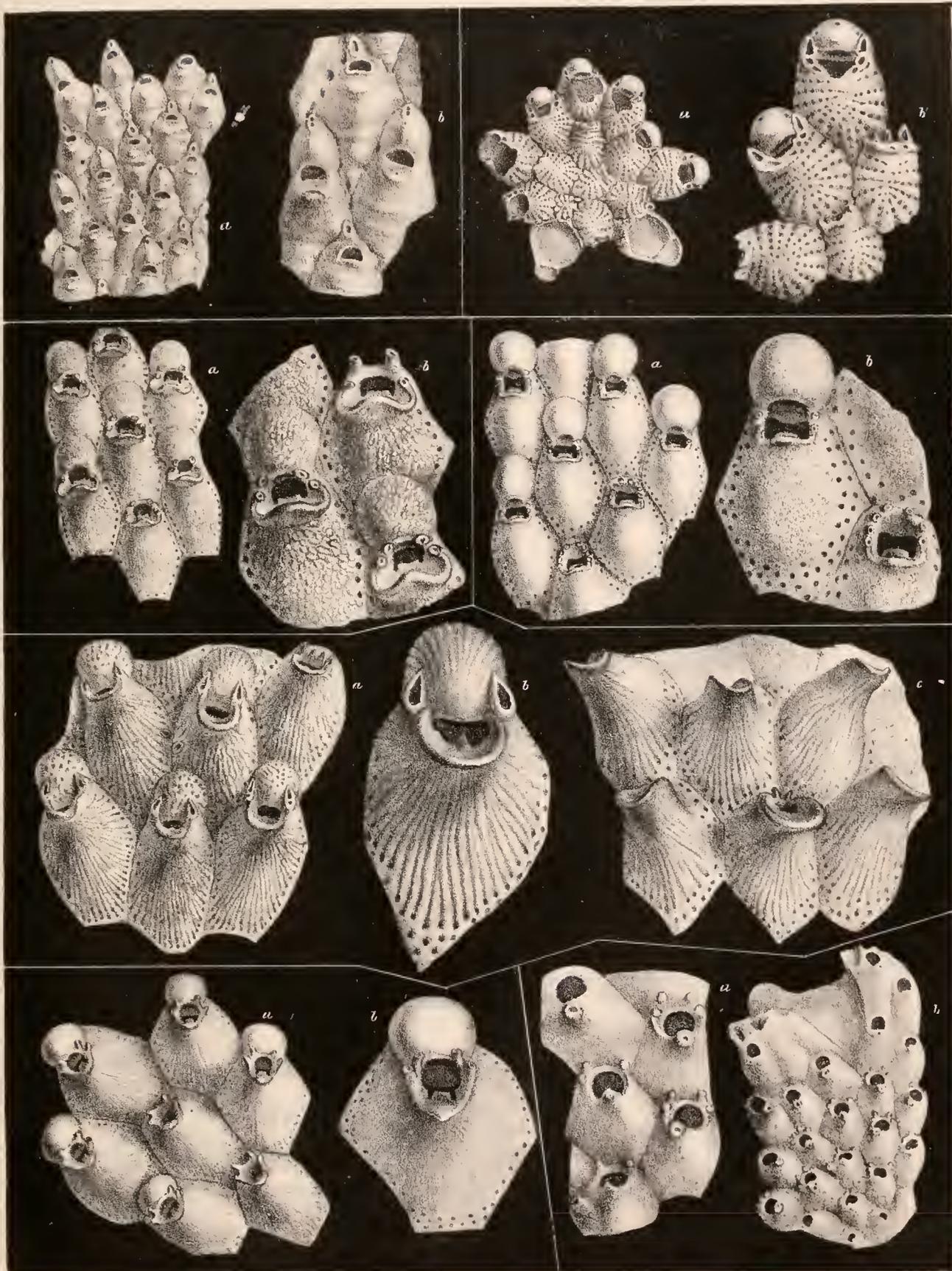


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PLATE VI.

Fig.

1. *Lepralia Brongniartii*, p. 46.
2. *L. puncturata*, p. 41.
3. *L. ventricosa*, p. 49.
4. *L. Peachii*, (var.), p. 48.
5. *L. mamillata*, p. 46.
6. *L. ventricosa*, (var.), p. 49.
7. *L. lobata*, p. 50.



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PLATE VII.

Fig.

1 and 3. *Lepralia Woodiana*, p. 42.

2. *L. ansata*, p. 45.

4. *L. Bowerbankiana*, p. 50.

5. *L. biaperta*, p. 47.

6. *L. ciliata*, p. 42.

7. *Alysidota catena*, p. 27.

8. *Lepralia Morrisiana*, p. 43.



PLATE VIII.

Fig.

1. *Lepralia Haimeseana*, p. 52.
2. *L. Reussiana*, p. 53.
3. *L. Malusii*, p. 53.
4. *L. infundibulata*, p. 54.
5. *L. megastoma*, p. 54.
- 6, 7. *L. bicornis*, p. 47.
8. *L. variolosa* (var.), p. 48.

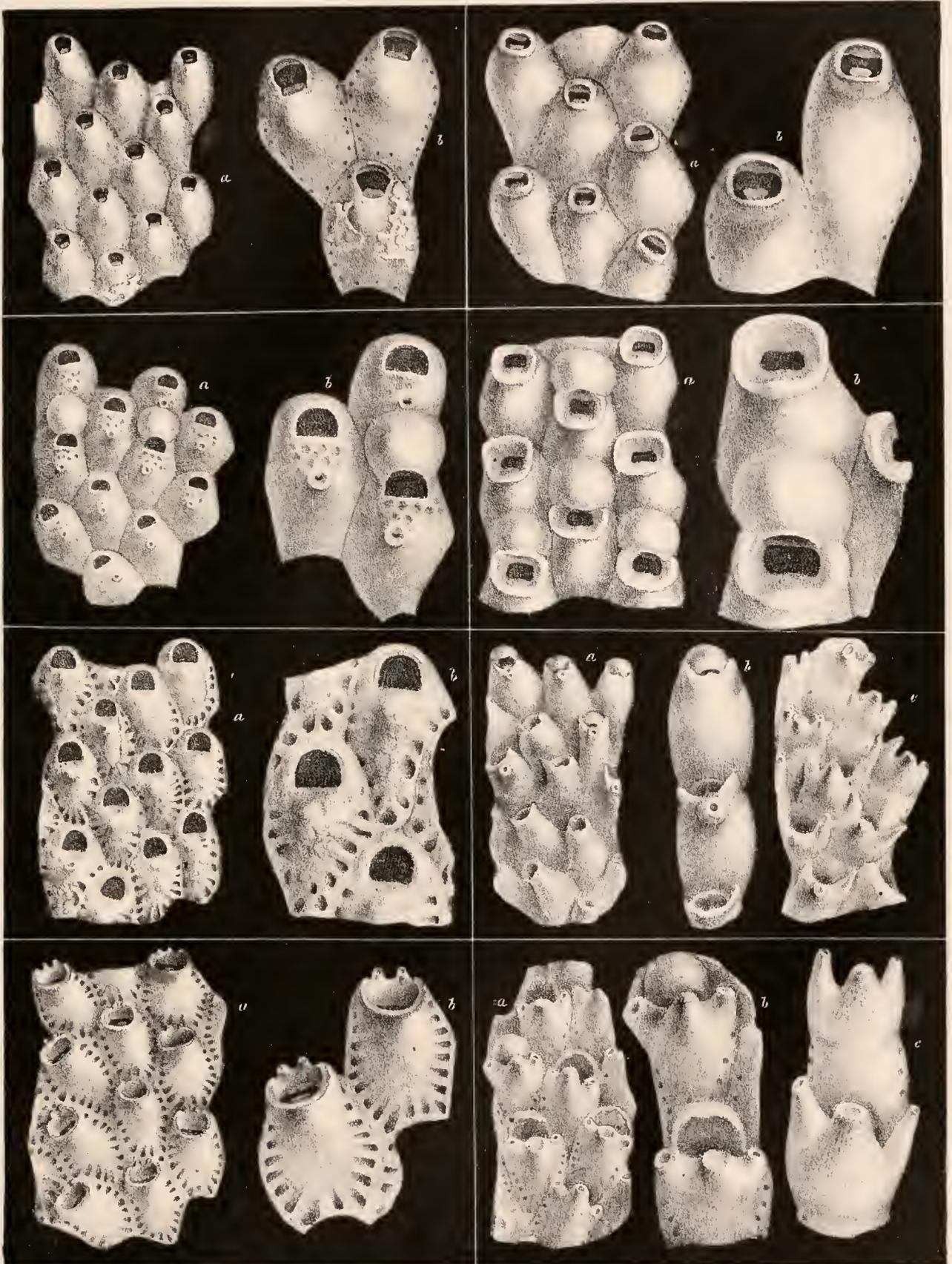


PLATE IX.

Fig.

- 1 and 3. *Cellepora coronopus*, p. 57.
2. *C. ramulosa*, p. 58.
4. *C. compressa*, p. 58.
5. *C. cespitosa*, p. 59.
6. *C. edax*, p. 59.
7. *Lepralia Pallasiana* (?), p. 54.
- 8 and 10. *Cellepora tubigera*, p. 64.
9. *C. scruposa*, p. 60.
- 11 and 13. *C. parasitica*, p. 61.
12. *C. dentata*, p. 62.

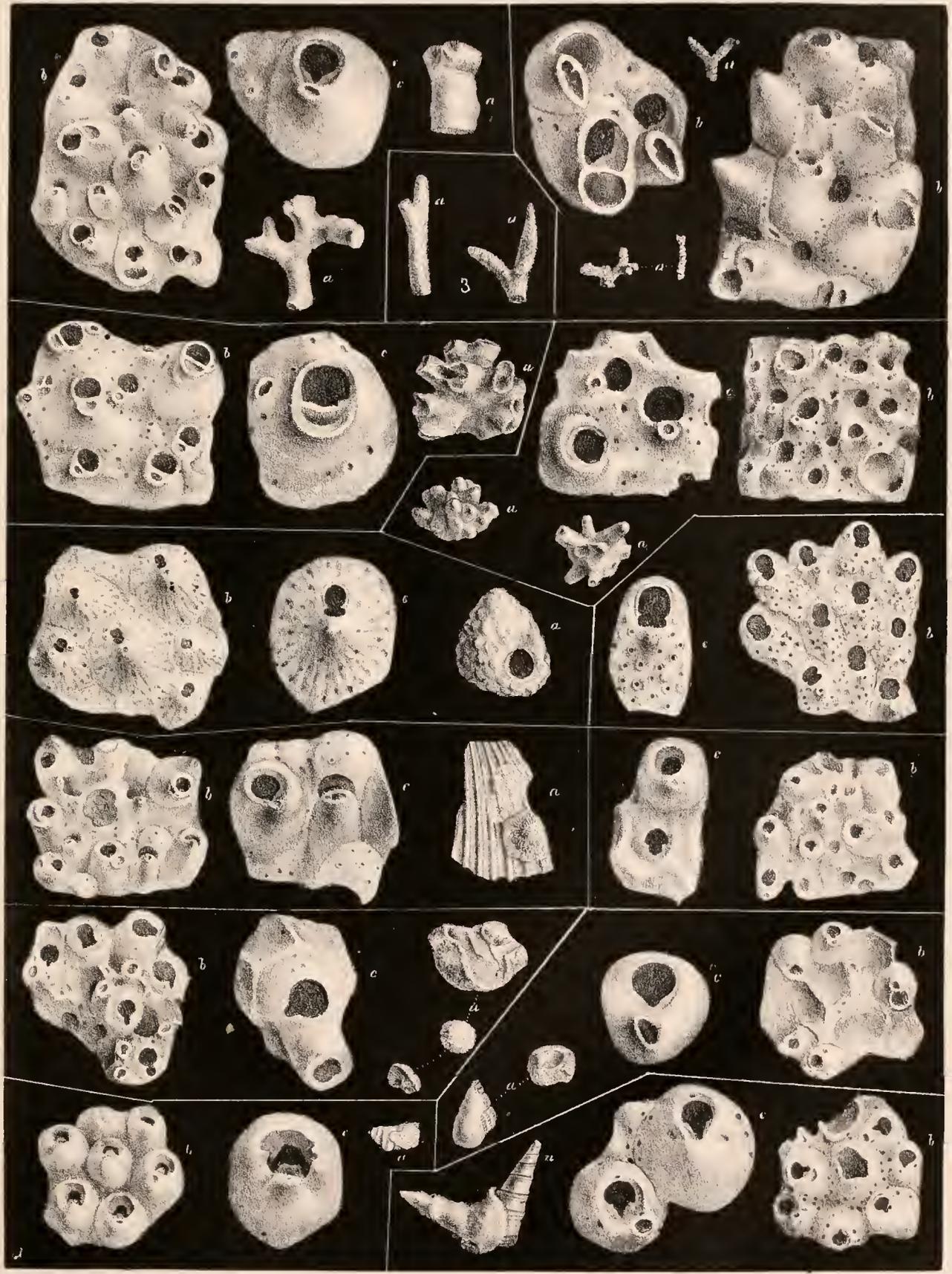


PLATE X.

Fig.

1. *Eschara Sedgwickii*, p. 67.
2. „ *pertusa*, p. 65.
3. „ *incisa*, p. 65.
4. *Melicerita Charlesworthii*, p. 70.
 - a. Portion magnified 50 diameters.
 - b. Portion magnified 25 diameters.
 - c, c. Fragments, natural size.
 - d. Old or worn condition, magnified 25 diameters.
 - e. Section.
5. *Eschara cornuta*, p. 67, natural size.
6. „ *sinuosa*, p. 66.
 - a. Portion of surface, magnified 25 diameters.
 - b. Older state, magnified 25 diameters.
 - c, c. Natural size.
 - d. Section, magnified 25 diameters.
7. *Hemeschara imbellis*, p. 78 (natural size).

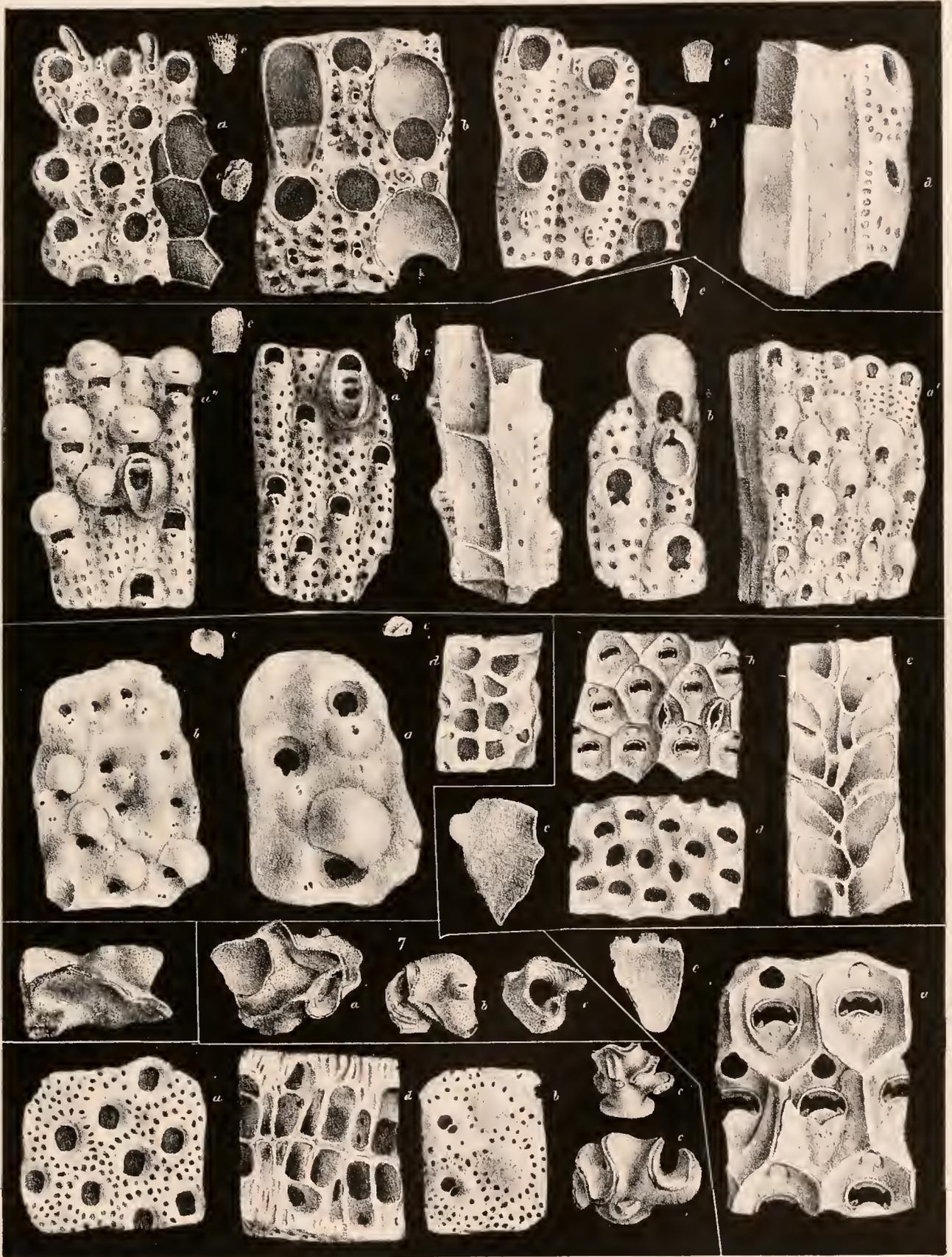


PLATE XI.

Fig.

1. *Eschara monilifera*, p. 68.

a, a, a, a, a, a, a, a, a. Various forms, natural size.

a', a'. Portions, magnified 6 diameters.

b, c, d. In different conditions, magnified 25 diameters.

2. *E. monilifera.*

a. Portion, showing one of the fertile (?) cells, closed with a cribriform plate.

b, b, b. Portions at different ages.

3. *E. monilifera.*

a. Portion of surface nearly smooth.

b. Transverse section.

c. Longitudinal section.

d. Portion in which the front of the cells is worn off.

e. Back view of incrusting polyzoary (*vide* also Pl. II, fig. 8).

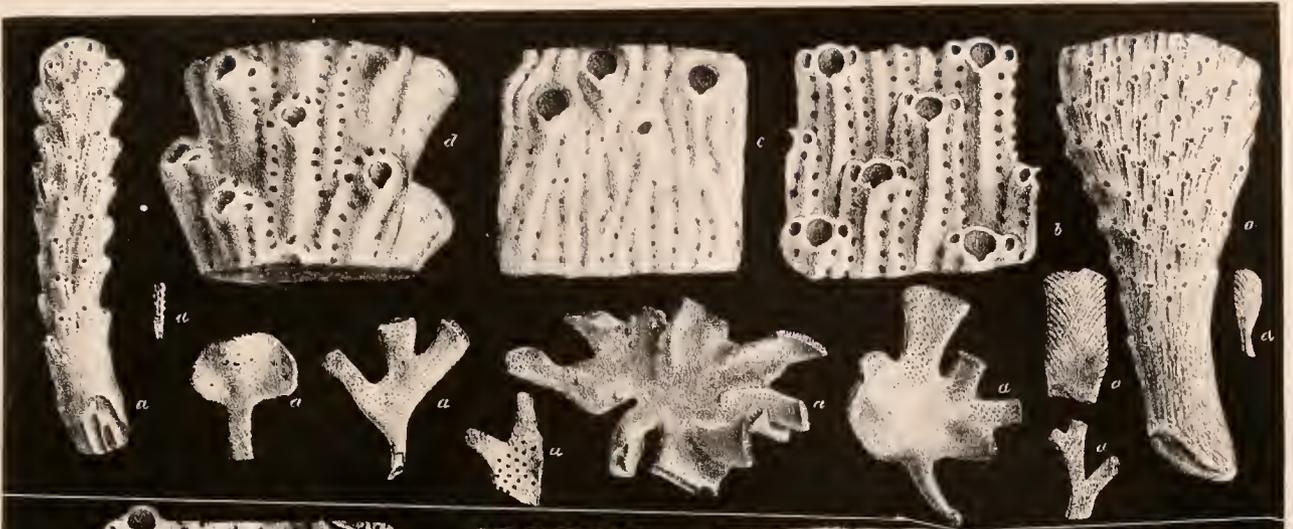
4. *E. porosa*, p. 66.

a. Natural size.

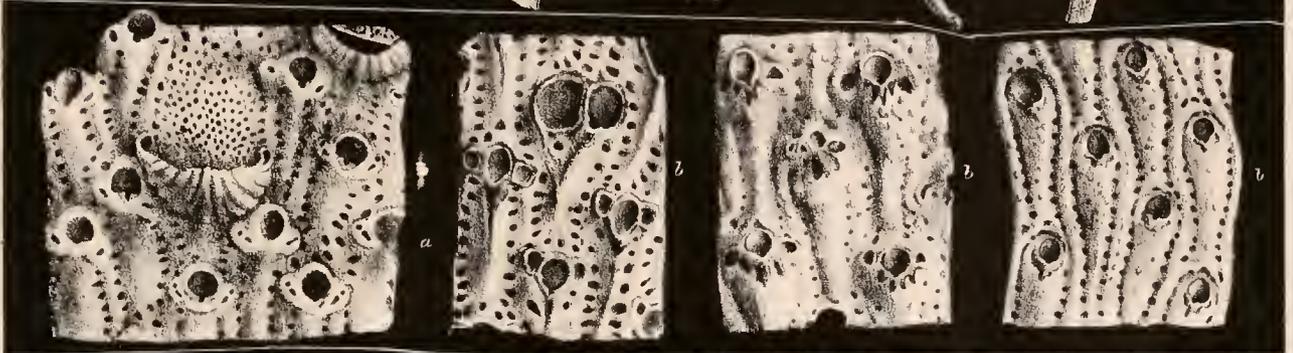
b, c, d, e. Various aspects at different ages, magnified 25 diameters.

f. Section, magnified 25 diameters.

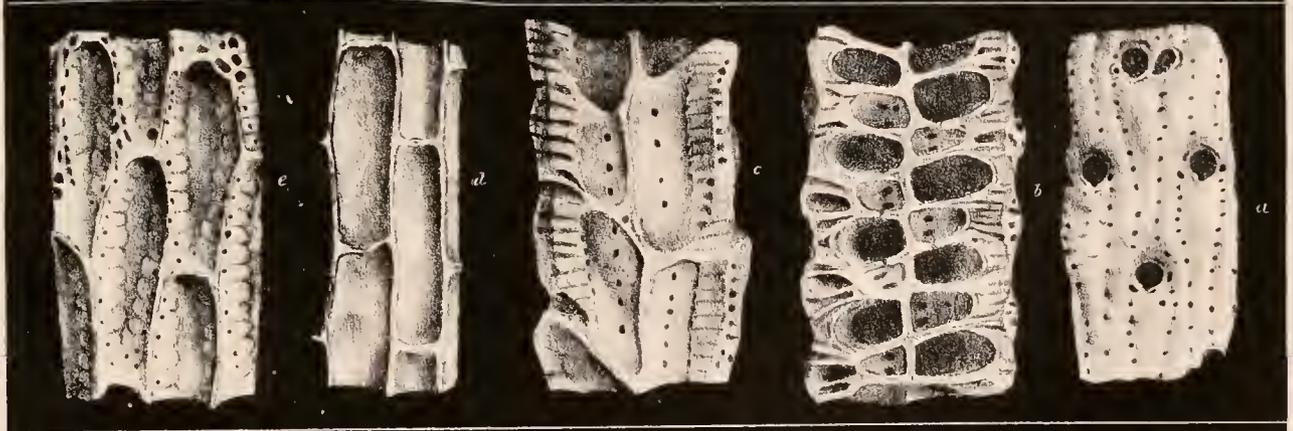
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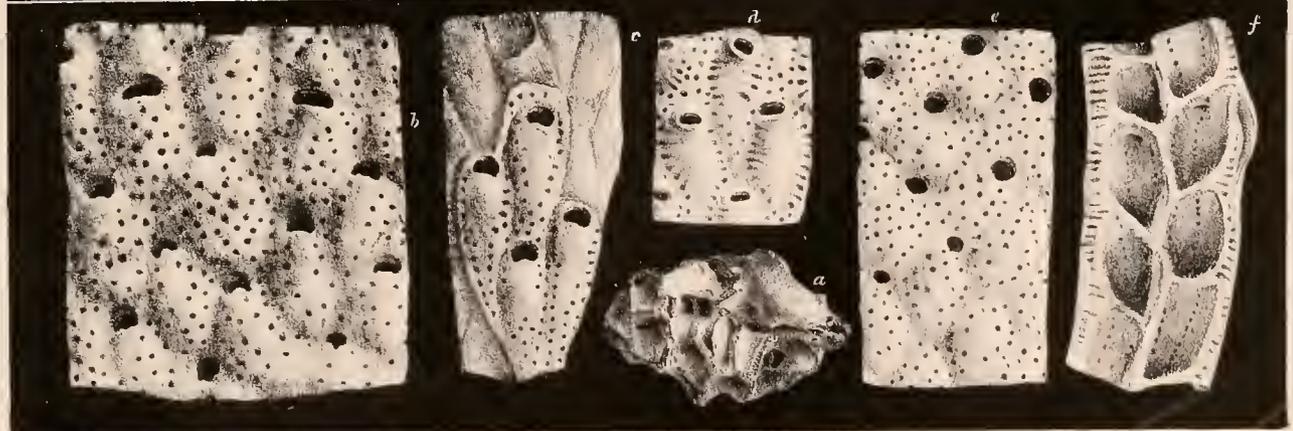


PLATE XII.

Fig.

1. *Retepora cellulosa*, p. 74.

- a.* Anterior surface, magnified 25 diameters.
- b.* Anterior surface, magnified 50 diameters.
- b'*. Posterior surface, magnified 25 diameters.
- c.* Fragment (natural size).

2. *R. Beaniana*, p. 75.

3. *R. simplex*, p. 76.

- a, d, e, f.* Anterior surface, in different conditions of age and attrition, magnified 25 diameters.
- b.* Anterior surface, magnified 50 diameters.
- b'* Posterior surface, magnified 50 diameters.
- c, c, c, c.* Fragments (natural size).

4. *R. notopachys*, p. 76.

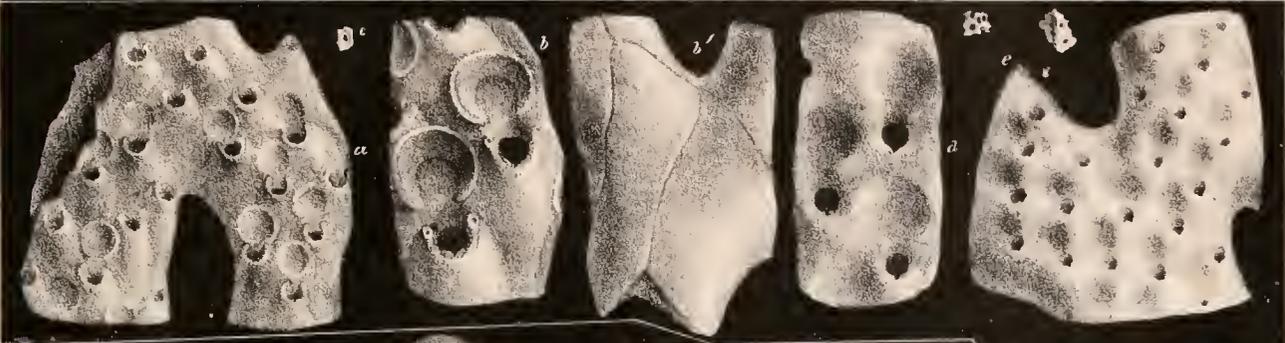
- a.* Anterior surface, magnified 25 diameters.
- b.* Anterior surface, magnified 50 diameters.
- b'*. Posterior surface, magnified 50 diameters.
- c.* Fragment (natural size).
- d.* Section, magnified 25 diameters.

5, 6, 7. *R. Beaniana*.

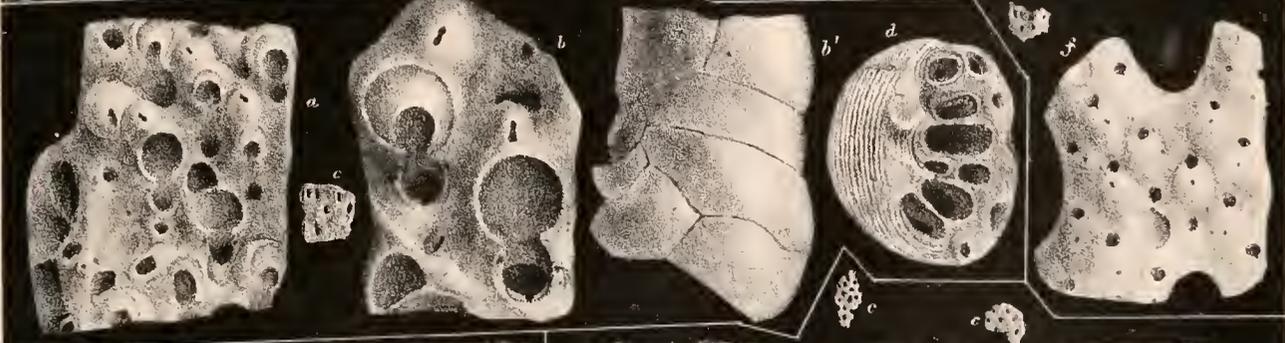
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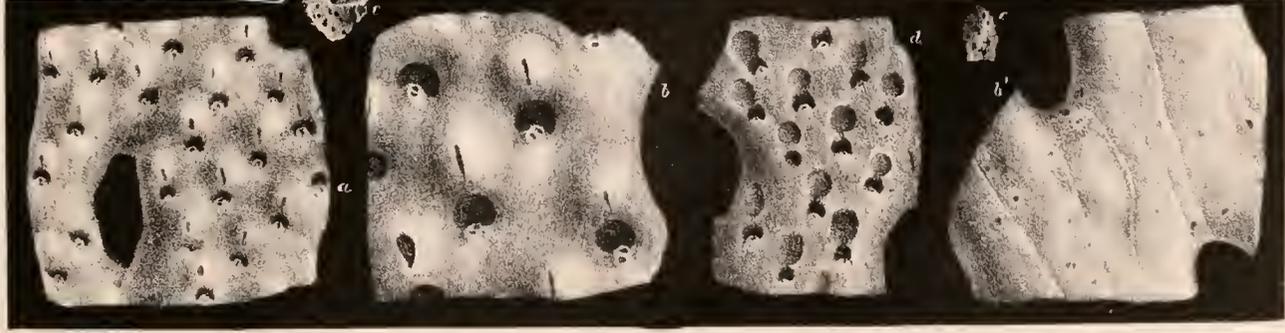




PLATE XIII.

Fig.

1. *Cupularia denticulata*, p. 85.
 - a. Natural size.
 - b. Anterior surface, magnified 25 diameters.
 - c. Anterior surface, magnified 50 diameters.
 - d. Posterior surface, magnified 25 diameters.
 - e. Section, magnified 25 diameters.
2. *C. canariensis*, p. 87.

(Letters as above.)
3. *C. denticulata* (worn condition).

(Letters as above.)
4. *Lunulites conica*, p. 88.
 - a, a. Natural size.
 - b. Anterior surface, magnified 25 diameters.
 - c. Anterior surface, very much worn, magnified 25 diameters.
 - d. Posterior surface, magnified 25 diameters.
 - e. Section, magnified 25 diameters.
5. *Cupularia porosa*, p. 87.
 - a. Natural size.
 - b. Anterior surface, magnified 25 diameters.
 - c. Posterior surface, magnified 25 diameters.
 - d. Fragments of larger specimens.
 - e. Section, magnified 25 diameters.
6. *Lunulites conica* (much worn).

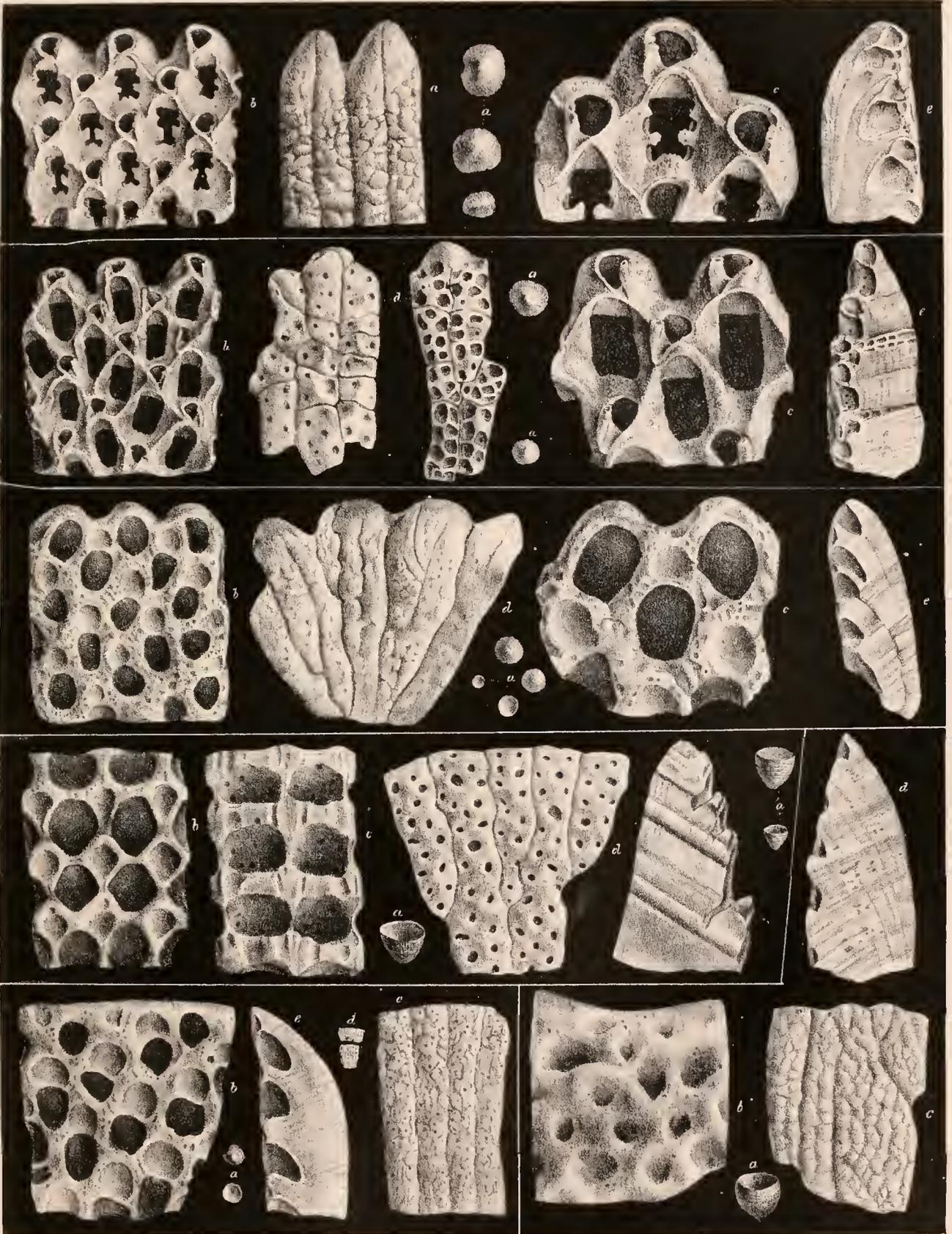


PLATE XIV

Fig.

1. *Hornera infundibulata*, p. 97.
2. „ *reteporacea*, p. 98.
3. „ *canaliculata*, p. 98.
4. „ *rhipis*, p. 99.
- 5, 6. „ *humilis*, p. 100.
7. „ *pertusa*, p. 101.
- 8, 9. „ *hippolyta*, p. 101.

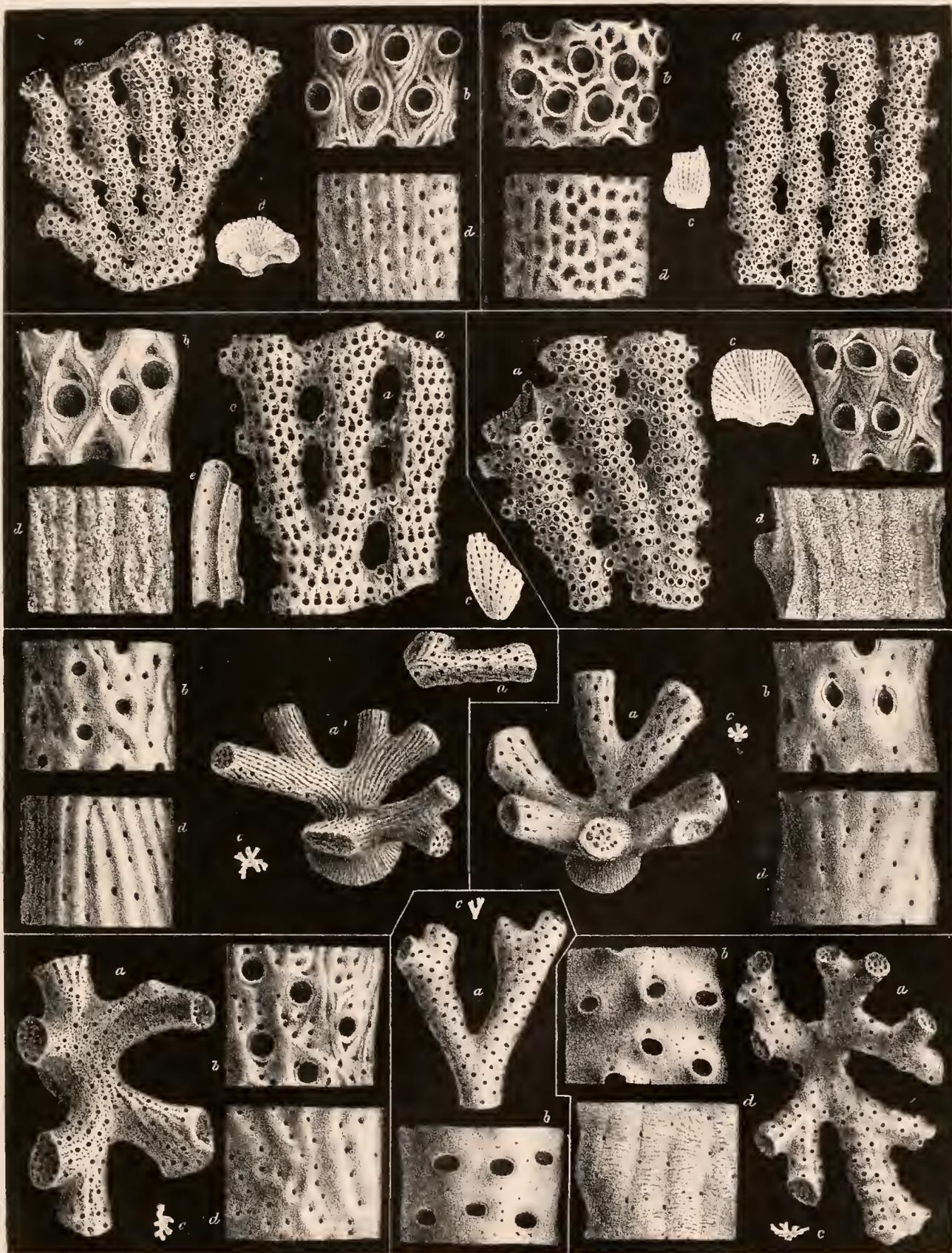




PLATE XV.

Fig.

- 1, 2. *Hornera frondiculata*, p. 102.
3. ,, *striata*, p. 103.
4. ,, *rhomboidalis*, p. 103.
5. *Idmonca punctata*, p. 104.
6. ,, *fenestrata*, p. 105.
7. ,, *intricaria*, p. 106.
8. ,, *delicatula*, p. 106.

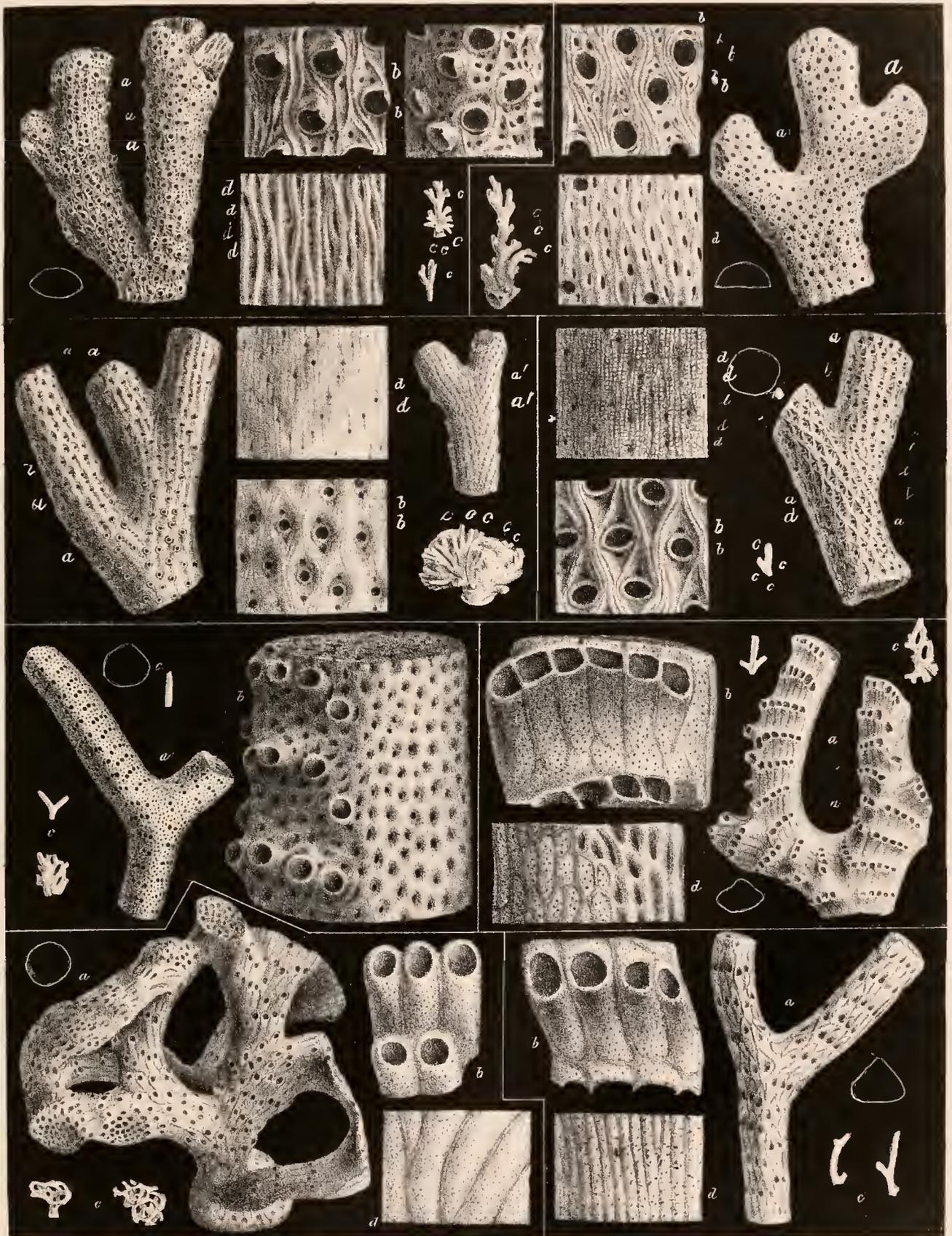


PLATE XVI.

Fig.

1. *Hornera rhomboidalis*, p. 103.
- 2, 6, 7. „ *frondiculata*, p. 102.
3. *Idmonea punctata*, p. 104.
4. „ *luñata*, p. 102.
5. *Hornera striata*, p. 103.
8. *Idmonea intricaria* (fragment), p. 106.

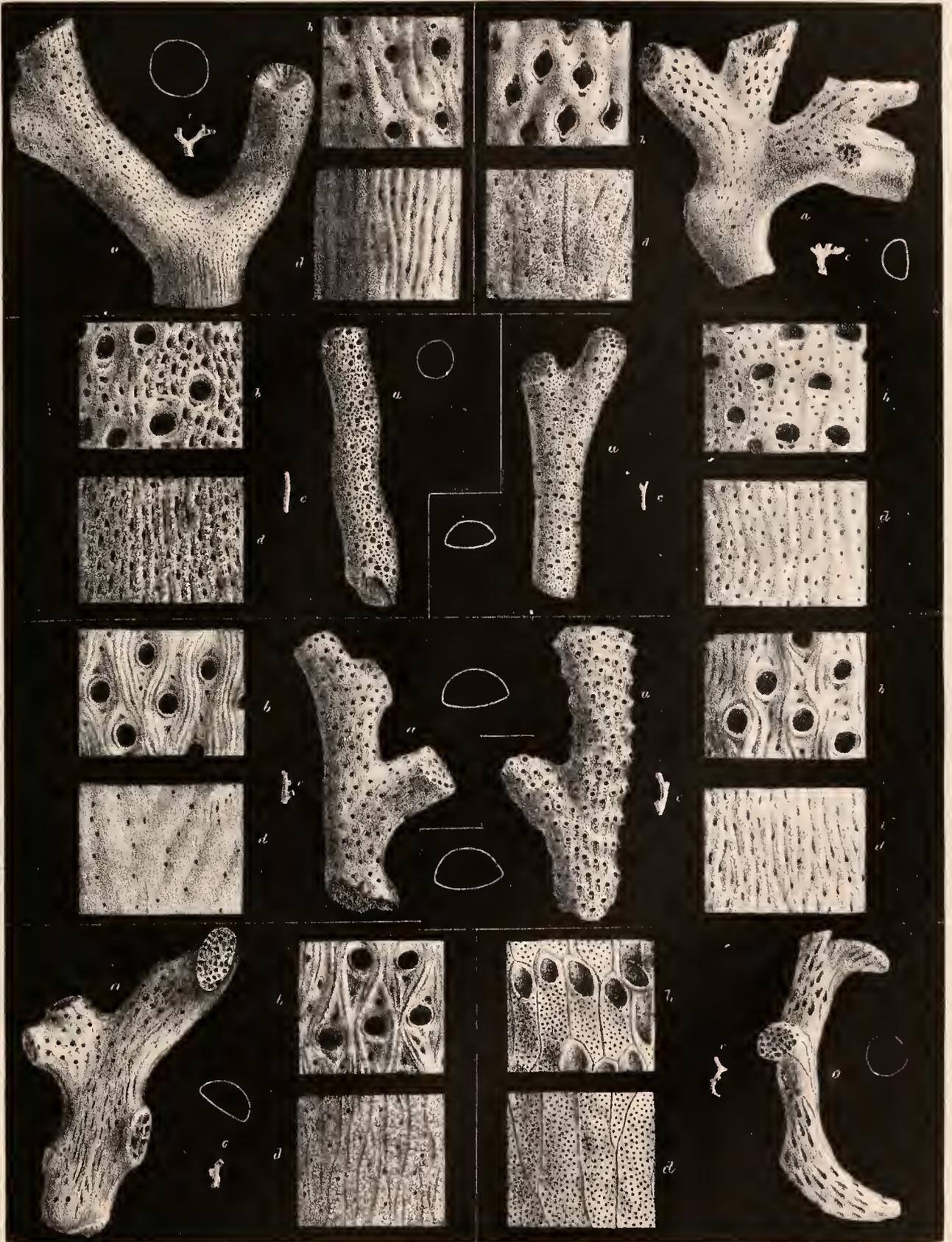


PLATE XVII.

Fig.

1. *Postulopora clavata*, p. 107.
2. *Mesenteripora meandrina*, p. 109.
3. *Fungella quadriceps*, p. 119.
4. „ *multifida*, p. 119.
5. *Defrancia striatula*, p. 117.
6. *Fungella infundibulata*, p. 120.

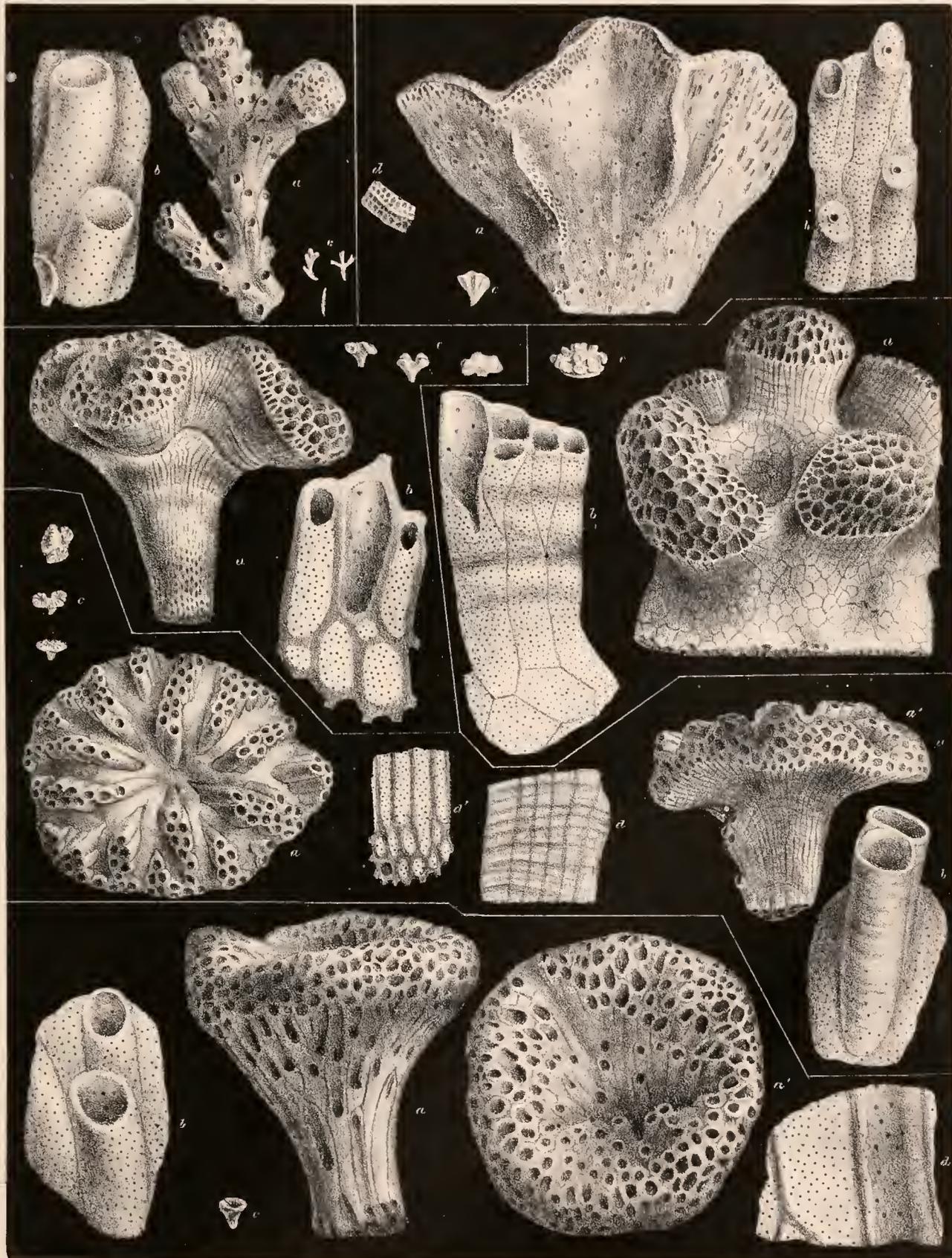
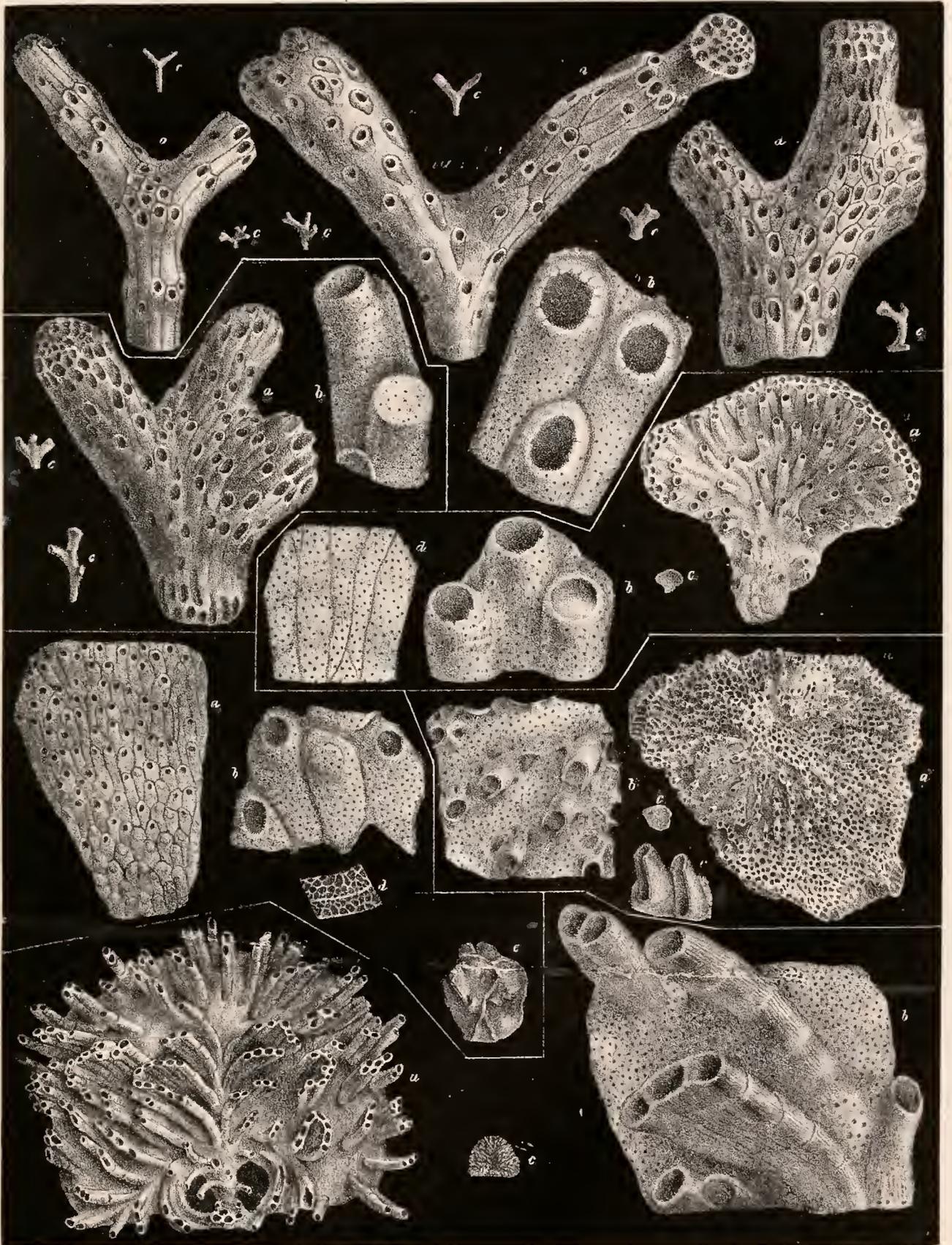


PLATE XVIII.

Fig.

1. *Pustulopora subverticellata*, p. 108.
2. „ *palmata*, p. 108.
3. *Tubulipora flabellaris*, p. 111.
4. *Mesenteripora meanarina*, p. 109.
5. *Discoporella hispida*, p. 115.
6. *Tubulipora phalangea*, p. 111.



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PLATE XIX.

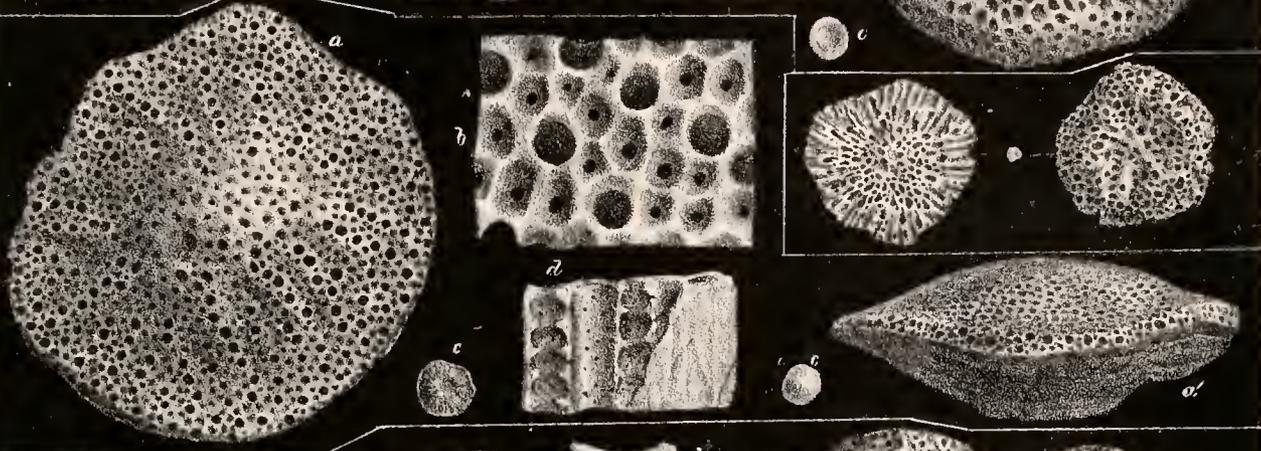
Fig.

1. *Patinella proligera*, p. 114.
2. *Heteroporella radiata*, p. 127.
3. *Defrancia rugosa*, p. 118.
4. *Alveolaria semiovata*, p. 128.
5. *Heteropora laevigata*, p. 125.
6. „ *pustulosa*, p. 122.
7. „ *clavata*, p. 123.

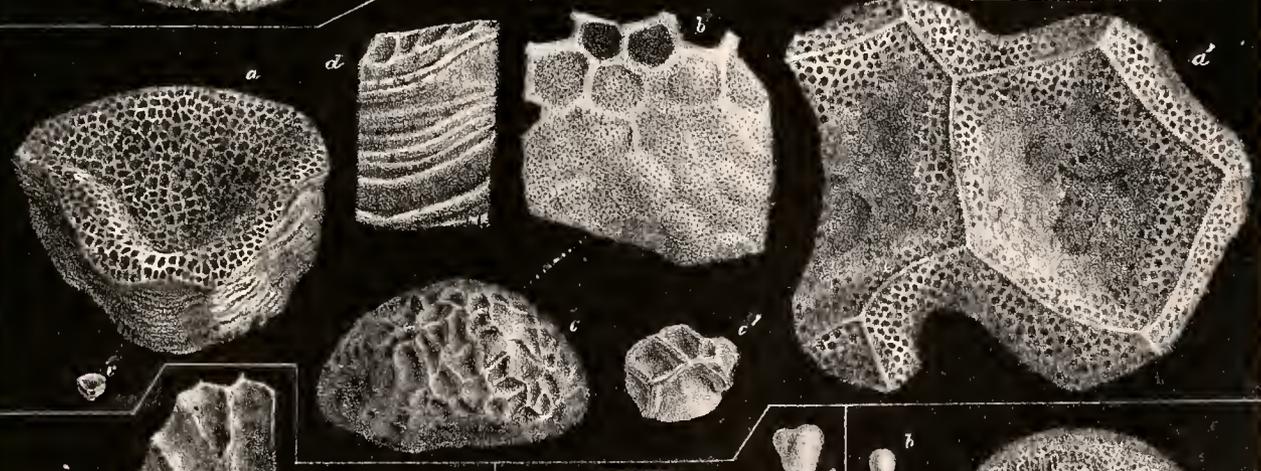
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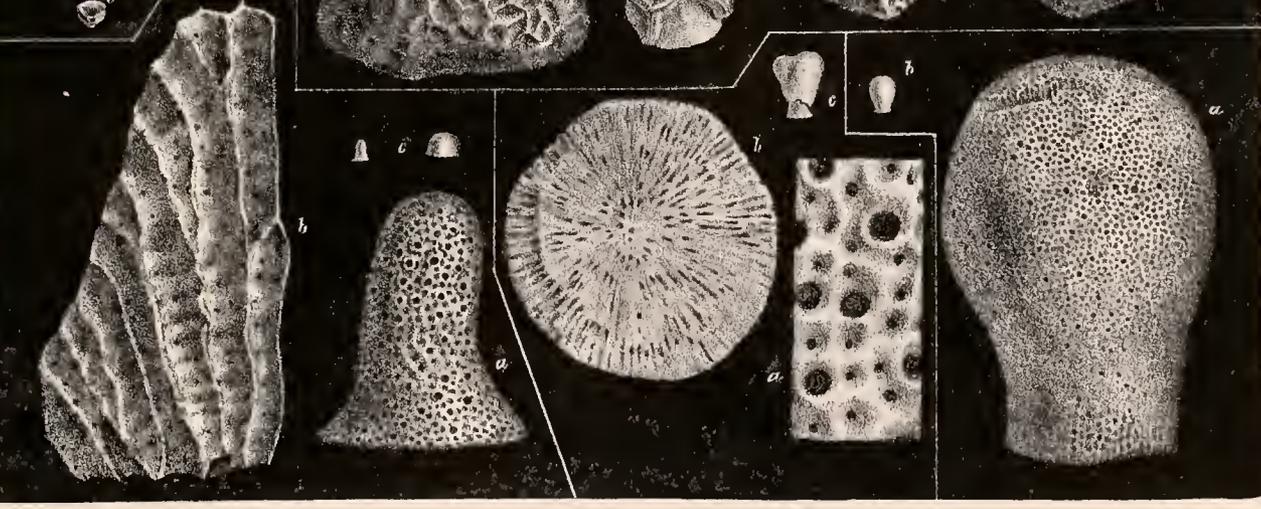


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PLATE XX.

Fig.

1. *Heteropora pustulosa*, p. 122.
2. *Mesenteripora meandrina*, p. 109.
3. *Patinella proligera*, p. 114.
4. *Discoporella Grignonensis*, p. 116.
- 5, 8. *Alecto repens*, p. 112.
- 6, 7. „ *dilatans*, p. 112.
9. *Tubulipora flabellaris*, p. 111.
10. *Diastopora simplex*, p. 113.

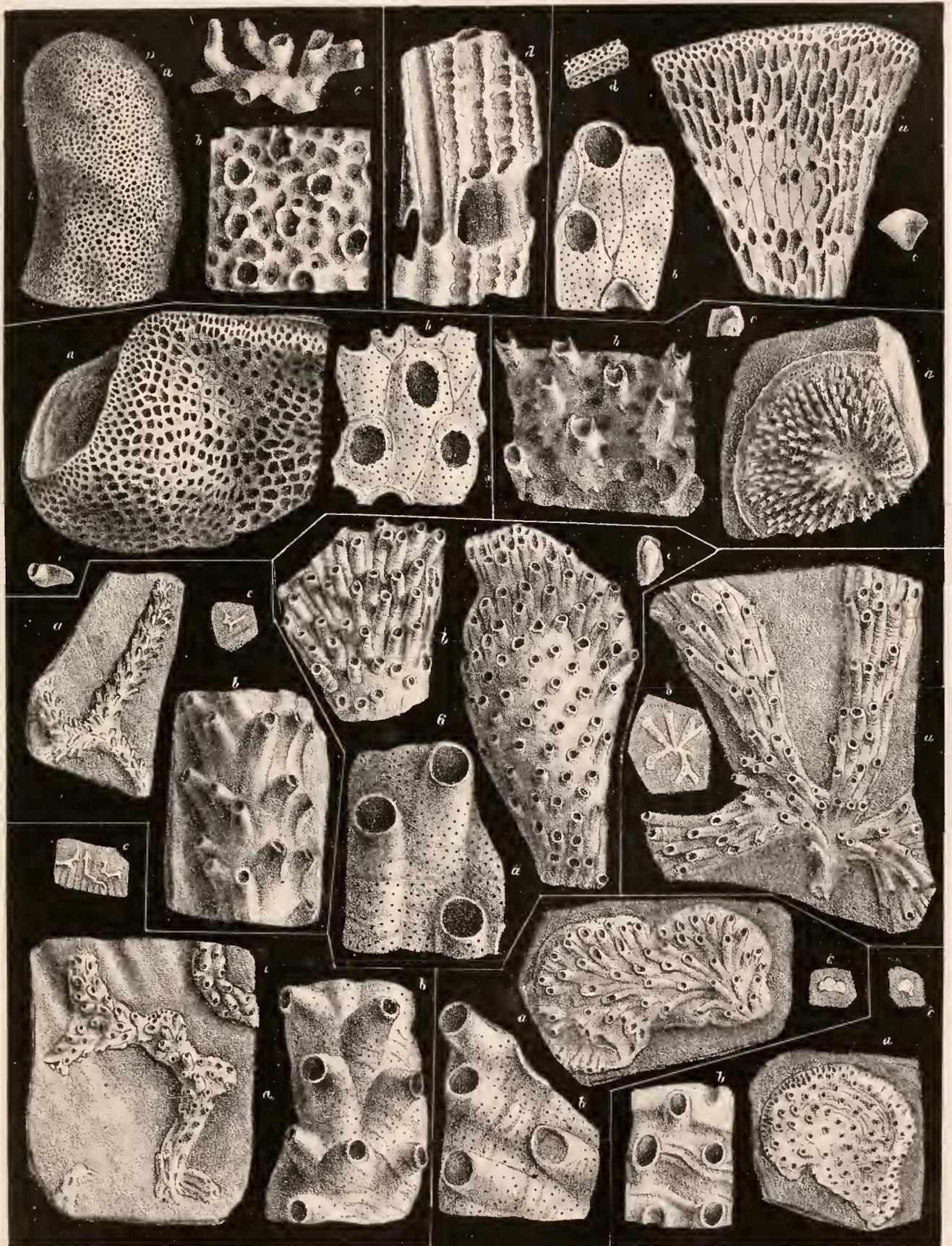


PLATE XXI.

Fig.

1. *Fascicularia tubipora*, p. 130.
2. „ *aurantium*, p. 131.
3. *Alveolaria semiovata*, p. 128 (section).
- 4, 5. *Salicornaria sinuosa*, p. 23.
5. „ *crassa*, p. 22.

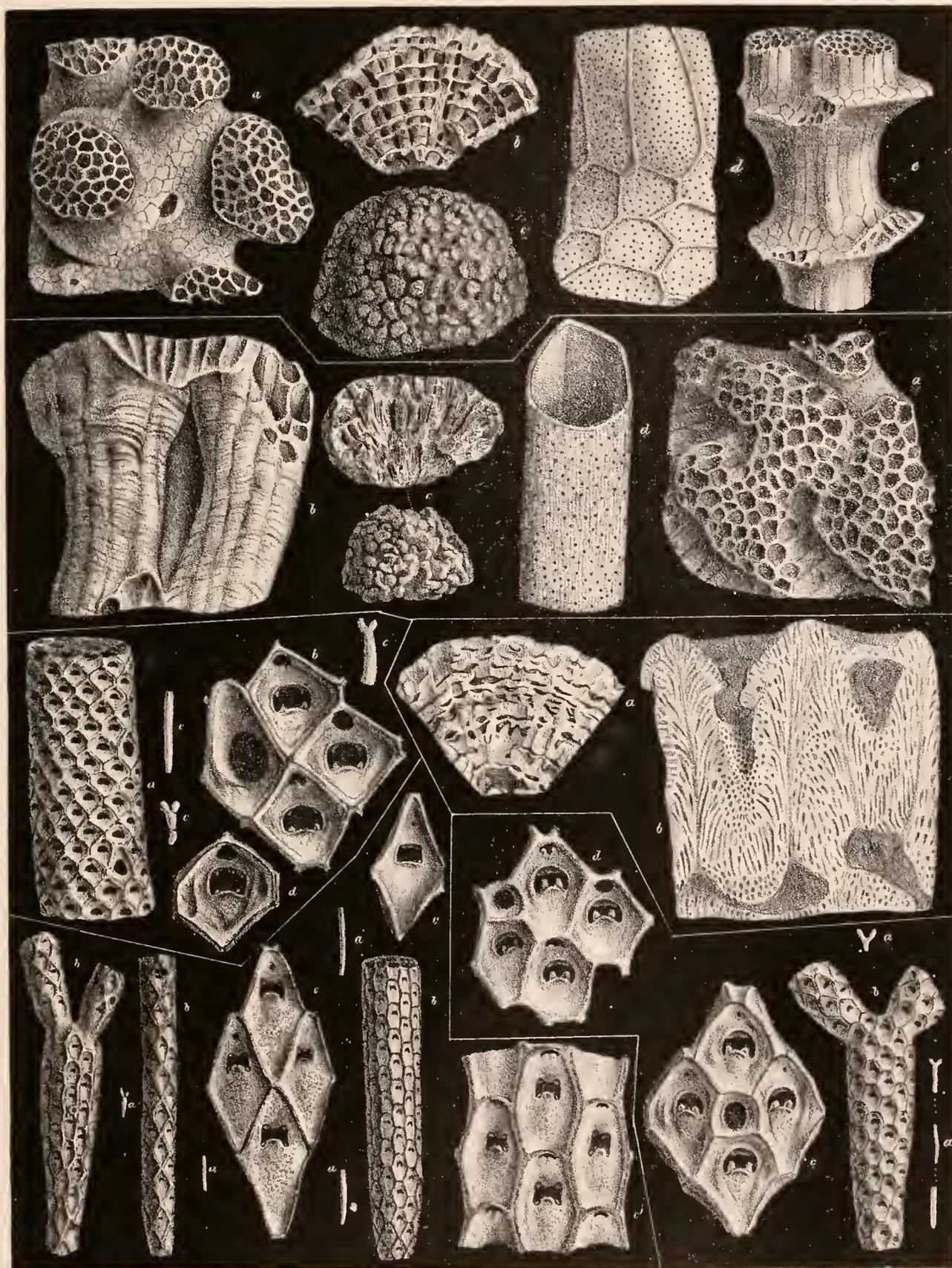


PLATE XXII.

Fig.

1. *Eschara socialis* (?), p. 131.
2. *Cellepora tubigera*, p. 60.
3. *Cellepora edax*, p. 59.
4. *Lepralia lobata*, p. 50.
5. *Heteroporella parasitica*, p. 127.
6. *Hippothoa abstersa*, p. 25.
7. *Alysidota labrosa*, p. 26.

