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MORPHOLOGICAL AND SYSTEMATIC STUDIES

ON THE

CHEILOSTOMATOUS BRYOZOA

BY

G. M. R. LEVINSEN

WITH 27 LITHOGRAPHIC PLATES AND 6 FIGURES IN THE TEXT

PUBLISHED AT THE COST OF THE CARLSBERG FUND

TO BE OBTAINED FROM
»NATIONALE FORFATTERES FORLAG«
COPENHAGEN
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PREFACE

The studies embodied in this work were begun by me in the year 1896, after I had completed an essay on the *Bryozoa* in the Danish chalk-formation, which received the palæontological prize offered by the Royal Danish Society of Sciences. During my investigations on the fossil species I obtained a strong impression of the imperfect condition of the classification of the *Bryozoa*, as I was frequently in doubt as to which genus or family I should refer a given species to, and I became convinced of the necessity of making more detailed studies on the recent *Bryozoa* before thinking of publishing a work on the numerous *Bryozoa* from the Danish Chalk. I did not imagine, however, that this work would take such a long time.

In this work, which deals with the most difficult[1] and at the present time most numerous of the three orders of the *Bryozoa*, the *Cheilostomata*, I have made an endeavour to reform the classification, and as basis for such a reform I have first of all made a comparative study of the structural features of most importance in systematic regard. I have included all the families and most of the genera of which I have been able to examine material and which I might consider as well-founded. With regard to the species I have not followed the same procedure everywhere; in the case of some families and genera I have been content to name a number of the species belonging to them, whilst in other cases I have described more or fewer, partly new, partly older but not sufficiently investigated, interesting species. Of the interesting genus *Thalamoporella* I have described all the species I have had the opportunity to examine. The procedure I have followed in the individual cases has in part been determined by my material; but I may

[1] »Our real perplexities commence when we attempt to frame the families and genera, for in the case of the Polyzoa it is extremely difficult to seize the significant characters. This remark applies especially to the Cheilostomata.« Th. Hincks: British Marine Polyzoa. Introduction, pag. CXXVII.

add that the reason why there is only a small number of descriptions of species in the latter part of the work is, that I desired to come to an end with a work, which has already laid a heavy toll on too many years of my life.

As will be seen, I have been obliged to make great changes with regard to the delimitation of most families and genera, and if I have not been able to refer a larger number of the earlier described species to my genera, the reason is that I have only had opportunity to examine a small number of these species and the descriptions and figures published in many cases do not give sufficient information regarding their structure. I hope, therefore, that this work will lead to renewed investigation of the numerous species, which are preserved in museums and private collections, and which have not been examined since they were described.

The first Plates to this work were prepared in the year 1901, which will explain why a number of the generic names used on the Plates have later been replaced by others on the accompanying explanations. In some cases, namely, I have often been obliged to name the figures given on a Plate at a period when I was not yet certain to what genus a given species should be referred, and I have therefore been obliged provisionally to use the earlier given generic name; in other cases I have later been obliged to use another generic name, because it had been shown in the interval that an older had the priority. In many cases I have followed the view of the priority question expressed by the Rev. A. M. Norman in his »Notes on the Natural History of East Finmark Polyzoa«. In some few cases it has also been necessary to alter the specific name.

As the Danish coasts are extremely poor in *Bryozoa*, I have made several endeavours to obtain material from foreign countries which had been preserved in such a manner, that it was suited to the investigation of the nature of the calcification process and of the structure of the oœcia; but as these endeavours have led to no result I have been obliged to give up my attempt at solving the first question, and with regard to the structure of the oœcia I have been unable as a rule to give information on the internal membranous parts. I have used the microtome for these investigations in a number of cases; but the spirit material employed was too old to show what I wished to see.

That I have been able to include so many forms within the scope of my investigations is due for a great part to the help a number of colleagues in foreign countries have given me, and first and foremost my work will bear witness of my great indebtedness to Miss C. Jelly, the author of »A synonymic Catalogue of the Recent Marine Bryozoa«, to whom the Zoological Museum of Copenhagen owes the possession of so many interesting Australian and South African species. Mr.

R. Kirkpatrick (British Museum) and Dr. S. Harmer (earlier Cambridge, now Keeper of British Museum) have with great liberality and unfailing willingness lent me material from the collections in their charge, and a similar interest has been shown in my work by Canon A. M. Norman, Mr. A. W. Waters and the late Mr. C. N. Peal, to whose private collections I have very often had recourse. Mr. O. Nordgaard (Trondhjem) has always willingly sent me material of the Norwegian Bryozoa and my thanks are also due to Mr. F. Canu, Versailles, Mr. J. Gabriel, Abbotsford, Victoria, Prof. Dr. H. Theél, Stockholm, Mr. J. F. Whiteaves, Ottawa, Canada and Mrs. H. Eden (née Gatty) for assistance with material or loan of specimens.

Lastly, I would express my warmest thanks to the Directors of the Carlsberg Fund, who have voted me the means not only for the continuation of my many years' studies but also for the publication of this work.

TERMINOLOGY

Bryozoid. The common name for all the individuals of a colony.

Zoœcium (= autozoœcium). A chamber in which a polypide is or has been lodged.

Heterozoœcium. A chamber in which there is no polypide or only a vestige of one in the form of a small cellular body. On the other hand the chamber contains a powerful muscular apparatus for the movement of the operculum, which in the avicularium is called the »mandible« and in the vibraculum the »flagellum«.

Kenozoœcium. A chamber in which there is no polypide and as a rule no muscles and no aperture.

Gonozoœcium. A modified zoœcium set apart for reproductive functions.

Polypide. The alimentary canal with tentacles etc., belonging to a zoœcium.

Gymnocyst. A calcified part of a Bryozoid which arises by the transformation of a covering membrane.

Cryptocyst. A calcified part of a Bryozoid which arises within a covering membrane. A cryptocyst arising from the vertical walls may be called a »primary« cryptocyst and that arising from a frontal gymnocyst a »secondary« cryptocyst.

Ectocyst. A cuticle secreted by a covering membrane.

Epitheca. A membrane covering a calcified surface.

Rosette-plate (= communication-plate). A diaphragm, pierced by one or more exceedingly fine pores, occurring in the walls of adjacent Bryozoids. Through these pores pass fine branches of a tissue (the endosarc or the mesenchymatous tissue) which maintains the communication between all the members of the colony.

Pore-chamber. A small space situated in the boundary between two walls of a zoœcium, the inner part of which is provided with one or more rosette-plates.

Pores. Most of the so-called pores are not real pores, but only uncalcified (membranous) spots in different calcareous surfaces. In the present work such uncalcified spots are sometimes (e. g. in the Catenariidae) called »excisions«, »perforations«, »fissures« or »fenestræ«, and the last signification is as a rule used about unusually large and regularly arranged pores. Real pores are found in the rosette-plates, in the frontal shield of the *Cribrilinidae* and in the peristome of *Haswellia*, *Adeonella* etc. Uncalcified spots in calcified surfaces may be called »pseudopores«.

Ascopore. A pore leading into the compensation-sac.

Marginal (or oral) spines. Spines issuing from the inner margin of a gymnocyst. In very rare cases *(Crepidacantha Poissoni, Megapora hyalina)* they are found together with a strongly developed frontal cryptocyst.

Acropetalous spines. Spines issuing from the circumference of a pore (pseudopore).

Bilaminate spines. Spines (generally flat) the inner layer of which is formed by a cryptocyst while the outer layer is formed by a gymnocyst. They are only found in the family *Catenariidae* and reach their greatest development in the genus *Costicella.*

Lateral chambers. Bryozoids generally developed as kenozoœcia, found as a rule in a number of four on each side of an internode in the family *Catenariidae.*

Simple operculum. A well-chitinized or calcified separable operculum the hing-line of which stretches between the two proximal corners and as a rule coincides with the proximal edge of the aperture.

Compound operculum. A well-chitinized separable operculum, the hinge-line of which is placed distally to the proximal edge. Only the distal part of it corresponds to an opercular valve or a simple operculum. In the *Ascophora* the proximal part of it, the »accessorial part«, serves as operculum to the compensation-sac.

Peristome. A calcareous projection more or less completely surrounding the aperture of the zoœcium. The entrance to this, often tubular, projection is the »secondary aperture«.

Oœcium (= ovicell). A more or less calcified marsupium placed near the zoœcial aperture, into which the eggs pass from the zoœcium in order to be developed into larvæ.

Endozoœcial oœcia. Internal oœcia consisting of an endooœcium formed by the distal wall and of an ectooœcium formed by the covering membrane.

Hyperstomial oœcia. External two-layered oœcia, consisting of an endooœcium and a more or less developed ectooœcium.

Peristomial oœcia. Single-layered oœcia formed by the peristome. They are found in the families Tubucellariidae and *Lekythoporidae* and perhaps also the oœcia of the families *Conescharellinidae* and *Holoporellidae* may be referred to this division.

Endotoichal oœcia. Hollows formed by resorption in a thick calcareous frontal wall and at last opening outwards. They are found in the families *Cellulariidae, Membranicellariidae* and *Setosellidae.*

Acanthostegous oœcia. Marsupial spaces lying between the covering membrane and two series of concurrent spines. They are found in *Electra zostericola* and *El. (Heterooecium) amplectens.*

Double-valved oœcia. Oœcia consisting of two arched hollow valves (kenozoœcia). They are found in *Alysidium parasiticum.*

Basal mark. A curve seen on the basal surface of a hyperstomial oœcium, circumscribing that part of the frontal wall of the zoœcium, which takes part in the formation of the endooœcium's basal wall.

Basal. The surface with which an incrusting colony is fixed and the corresponding surface in a freely growing colony.

Frontal. The surface opposite to the basal and that in which as a rule the aperture is placed. Sometimes, however, the aperture may be terminal, viz., placed in the tip of the zoœcium.

Distal. The part of a zoœcium most remote from the primary zoœcium (the ancestrula) of the colony. When used about the single parts of a zoœcium, for instance the spines, it signifies the part most remote from the point or the surface of fixation.

Proximal. The part of a zoœcium nearest to the primary zoœcium of the colony. While in most Cheilostomata the zoœcia have separate lateral walls the terminal walls are as a rule common to two successive zoœcia in the same longitudinal row and therefore the distal wall of the proximal zoœcium is at the same time the proximal wall of the distal zoœcium. Only in very few cases is there found separate terminal walls (see pag. 11).

Morphological Part.

Calcification.

Different views. Different modes of calcification.

In his well-known paper on *Membranipora membranacea* H. Nitsche[1] expresses the view that calcification proceeds in the cuticle given off by the cells of the covering membrane, which at the places where such deposition takes place is divided into three layers and it is the middle layer characterized by its highly refracting power which is impregnated by the calcium salts. Nitsche arrived at this result exclusively from an investigation of the not yet calcified short spines, of which in this species one occurs at each of the posterior corners of the zooecium. According to Nitsche these spines are covered externally by a thick cuticle and beneath this there is a highly refracting layer intended for calcification but which does not quite reach out to the tip of the spine. Internally the whole cavity of the spine is covered by an exceedingly thin membrane, which according to Nitsche is the innermost layer of the cuticle, whilst he calls a net-work of cellular strings in the inner cavity the endocyst. On this view however there would be no continuous covering of endocyst in the interior of the spine, which does not seem very probable and it would therefore be most natural to call the thin, innermost layer of the wall as the endocyst and the cellular net-work as a portion of this endocyst, which has been designated the endosarc or the mesenchyme. I have not had the opportunity to investigate an uncalcified spine of *Membr. membranacea*, but if Nitsche's theory of the calcification is correct the spines when completely calcified must be covered with a cuticle. I have sought for this in vain however, both on the spines mentioned and on all other spines examined by me and I must therefore contest the correctness of Nitsche's view that the lime particles are deposited in a middle layer of the cuticle.

[1] 80. pp. 42, 76.

In a preliminary note[1] Ostroumoff makes some remarks on the calcareous skeleton in the *Bryozoa* and comes to a totally different result from Nitsche with regard to its formation. He has been able to show, namely, by means of silver impregnation, that the covering membrane of the zooecia has a distinctly cellular structure, over which he found a thin cuticle and under it the calcareous skeleton. He concludes from this that the chalk particles are deposited within the ectoderm cells (»par conséquence les particles calcaires se deposent dans l'intérieur de cellules ectodermiques«). At another place he states:[2] »Le squelette calcaire de nos Bryozoaires se place parmi les cellules de l'exoderme. Le dernier existe pendant toute la vie de l'animal ou comme couche sous-squeletaire (*Membranipora)* ou comme deux couches entre lesquelles se trouve le squelette (*Lepralia)*«.

Later in the main work[3] which deals with the *Bryozoa* from the Bay of Sebastopol, the writer expresses his opinion about the same subject in this way: »in the family *Escharidae* (such as for instance in *Lepralia*) the calcareous skeleton during its formation divides the ectoderm into two layers, an exterior lying over the skeleton, and which is readily seen on the opercular wall on living individuals as well as on those treated with silver nitrate, and an interior under the skeleton which can only be seen by means of silver impregnation. There is only one layer of cells in *Membraniporidae,* and this is only found below the skeleton«.

Ostroumoff's observations are based on the small number of species which are found in the Gulf of Sebastopol, and *Lepralia Pallasiana* is the only representative of the species of *Escharidae* which he has been able to examine; it belongs to the forms which develop a calcareous layer, the Cryptocyst, under the covering membrane of the frontal surface, but separated from this by an intermediate space, and having a cellular lining on both its surfaces. This is however not an absolute proof that calcification has taken place within the cells, so that Ostroumoff has just as little as Nitsche proved the correctness of his view. Pergens expresses a view similar to that of the Russian writer, partly in a small preliminary paper:[4] (»bei allen Arten, welche ich untersuchte, war von aussen immer die Cuticula und der Kalk innerhalb der Zelle gelagert«), partly in a paper concerning fossil *Bryozoa*[5], where he says: »Le derme est essentiellement constitué par un nombre variable de cellules aplaties à contour irregulier (Ostroumoff). Mes observations sur les larves qui viennent de se fixer m'ont démontré que c'est dans l'interieur de ces cellules que se fait le depôt de calcaire«. In contrast

[1] 88, p. 291; [2] 89, p. 577; [3] 90, pp. 58, 59; [4] 92, p. 506; [5] 93, p. 308.

to the two last mentioned writers, Calvet and Harmer look upon calcification as a cuticular formation, but while Calvet[1] thinks that calcification at any rate in the *Cheilostomata* takes place through the whole thickness of the cuticle, the following observation of Harmer[2] seems to suggest that he is inclined to share Nitsche's view of the calcification as proceeding in the central part of the cuticle: »In incinerated specimens the lateral walls of neighbouring zooecia may appear separated from one another by a narrow slit in place of the »raised line«. This is in fact the edge of a chitinous layer separating contiguous zooecia, and prolonged into the membranous epitheca. This agrees with the account given by Nitsche of the calcification of the zooecia of *Membranipora membranacea*, in which calcareous matter is said to be formed in the middle of the chitinous ectocyst, part of which is left on each side of it«. We shall return later to this statement. As I have not been able to examine living material I do not consider myself qualified definitely to decide which of the views is the right one, still it seems to me that the »cell-theory« is the one which explains the different phenomenona, which the calcification presents, in the easiest and most natural way, and it seems to me especially difficult to explain the presence of such solid spinous processes on the outer surface in a number of species (e. g. in *Holoporella columnaris*) as well as on the inner (e. g. in *Menipea roborata* Hincks and *M. ligulata* Mac Gill.) by the aid of the cuticular theory.

We may now consider a number of differences which the calcification presents, and to begin with we may distinguish between more or less compact or firm calcifications. The very different resistance which the calcified skeleton is able to offer against breaking and grinding shows sufficiently that the compactness and firmness can be different, and the firmest skeleton is undoubtedly found in the families of *Sclerodomidae* and *Reteporidae* just as we find the weakest in the families *Bicellariidae*, *Flustridae*, *Onchoporidae* and in certain species of *Membranipora*. If we regard parts of the skeleton of certain, very slightly calcified species (e. g. of *Membranipora membranacea*, *Electra pilosa*, *Flustra carbasea*, *Dendrobeania murrayana* and *Onchopora Sinclairi*) under a rather high magnification, it shows a grained or dotted appearance, but under a very high power (immersion) it dissolves into a dendritic network, the meshes of which enclose numbers of small uncalcified spots, which give a reddish light. Sometimes, however, the same wall may show more or less calcified parts. We thus find in *Dendrobeania murrayana* that the part of the basal wall, which touches the distal wall, is much more calcified than the other part, and in the middle of the basal wall in *Escharoides Jacksoni*

[1] 9, pp. 29 & 165; [2] 17, p. 227.

Water we find a large oval white spot which is less calcified than the rest of the basal wall, being formed by a net-work of meshes, and the white colour is due to the fact that the light is reflected from the numerous small surfaces of which this net work is composed. In *Membraniporina arctica*, *Smittina trispinosa*, var. *lamellosa* and *Sm. propinqua* the basal wall is covered by small snow-white, round spots of a similar structure. As to the manner in which the calcification takes place, we can distinguish between compound and simple walls, as a wall in some cases calcifies as a whole, while in other cases it calcifies in more or less separated pieces, which at any rate up to a certain period are separated from one another by sutures, and these sutures are in some cases very distinct for a long time, while in other cases they disappear very quickly. This concerns very often the frontal wall, and is due to the circumstance that this is very often provided with covering layers or sculpture of various kinds. As examples of species with simple walls we may mention *Membranipora membranacea*, *Electra pilosa*, species of the genera *Onychocella*, *Hippothoa*, *Thalamoporella*, and *Steganoporella* and also — it seems — all members of the families *Bicellariidae* and *Scrupocellariidae*. The parts into which a compound wall can be divided vary very greatly in size, and the smallest of them give the impression, not only from their exceedingly small size, but also from their shape, that they are calcified cells, as they have the same crenulated contour which as a rule seems to distinguish the ectoderm cells in the *Bryozoa*. This form of calcification, which we might call »cell mosaic« is for instance found on the basal wall in *Membranipora Savarti*, *Flustra denticulata* (Pl. XIX, fig. 10 c), *Porella concinna*, *Hippopodina feegeensis* Busk, *Smittina Landsborovi*, as well as on the lateral walls of *Flustra serrulata*. Gradually several of these very small cellular areas fuse together to larger ones, and in older zooecia the mark of division may quite disappear. In contrast to the very fine mosaic we find in the just-mentioned species, other species present a mosaic consisting of much larger but still comparatively small areas, which cannot very well be regarded as cells. This form of calcification, which we might call »plate mosaic«, we find very finely developed on the basal wall of *Flustra securifrons* (Pl. XIX, fig. 8 a) and we may here give a detailed description of its appearance in this species, which like most *Flustra* species has a perfectly uncalcified frontal wall. The composition of the different walls can best be seen, as everywhere in the *Bryozoa*, after they have been boiled for some time in alkali, or have been treated with eau de Javelle, which even in a cold condition has a far better effect than boiling alkali. Having dissolved all organic parts with such treatment, we find as a rule a row of square or hexagonal plates along the middle of every basal wall, while it seems as if a similar longitudinal row of plates on each side of the middle one has one half within the same zooecium, and the other half within the adjoining zooecium. These apparently half parts do not belong to each other however, as each of them passes over into and joins at a right angle to one of the small plates of which each lateral wall consists. That two adjoining rows of half plates seen from the surface of the colony can look like a row of whole plates, is due partly to the fact that they fit exactly ol each other, partly that from the surface we cannot see the halves adjoining one another in the vertical walls. Further, as the zooecia in one layer of the colony alternate with those in the second layer, a median row of plates in one layer will correspond to a double row of adjoining half plates in the other, and the two adjoining half plates are in size almost exactly like the opposite plate. The terminal wall is divided into two lateral halves by a suture, running medially through the single rosette-plate. At the borders between the single longitudinal rows we also find small uncalcified interspaces, while the plates in the single rows are separated by narrow sutures. I have in two previous papers[1] designated this manner of calcification as circular, because the calk particles in the individual small plates are circularly arranged round a small condensed shining spot, which we might call the »centre of calcification«, and which in the angularly bent plates is placed in the angle between the two pieces of each plate. The circular arrangement is most distinct close to the centre and vanishes gradually further out. Still, more or fewer zooecia show a less regular arrangement of the small plates in the marginal part of the colony, and the same can be seen in scattered zooecia in other parts of the colony. The basal surface may then either be broken up into an irregular mosaic of larger or smaller plates of different shape, or the median row of plates may be missing or represented only by very few plates. We can even here and there find a cell-mosaic. I have found a plate-mosaic like this on the lateral walls in *Flustra foliacea* (Pl. XIX, fig. 9 b), on the basal wall in *Porella saccata*, *Por. compressa*, *Smittina trispinosa*, *Sm. palmata* (Pl. XIX, fig. 5 b), *Sm. linearis*, *Discopora pavonella*, *Flustra serrulata*, *Fl. pisciformis* as well as on the front wall of *Inversiula inversa* and *Anarthropora monodon*. In contrast to what occurs in *Fl. securifrons* none of these species show a regular arrangement of the small plates, and in a number of them the latter appear in a very irregular and variable way, as they may appear together with other forms of calcification within the same colony, even on the same wall. Time does not allow me to enter into details, but I will just mention *Smittina trispinosa*, *Flustra serrulata* and *Fl. pisciformis* as examples of such species. While the small plates in

[1] 54, p. 246, 55, p. 3.

a number of the here mentioned species show plainly concentric lines of growth, they on the other hand show a distinct radiate arrangement in *Inversiula inversa* and *Anarthropora monodon* (Pl. XXIII, figs. 10 a, 11 a). These small plates which are only distinct in quite young zoœcia are each provided in the centre with a pore, the edge of which has radiate rods, and to judge from Hincks' drawing the front surface in the following species described by him is also divided into a number of small plates each of which has a pore in its centre, namely, »*Lepralia*«, *Pallasiana* (from Madeira), *Schizoporella cinctipora* Hincks, *Sch.*» *concinna* Hincks, *Arthropoma circinnata* Mac Gill., *Lepralia subimmersa* Hincks and *Lep.* *gigas* Hincks.

In numerous species which appear in free colonies either the basal wall or the frontal wall or both show a mode of calcification which we might call the bilateral, as the wall in question is calcified in two lateral halves, which meet in a longitudinal suture and as a rule each lateral half seems again composed of a row of pieces the dividing sutures of which meet the longitudinal suture obliquely. We may cite the structure of the basal wall in *Flustra foliacea* (Pl. XIX, fig. 9 a) as an example of this form of calcification. On this wall we find two systems of extremely fine stripes, which meet under proximally directed angles and divide the wall into two lateral halves, separated by a longitudinal suture; the two halves are again composed of a row of pieces, and these are separated by distally directed, slanting sutures which end in the main suture. Each of these lateral pieces is further joined to one of the pieces in which the respective lateral walls are divided. We can be sure that the above-mentioned fine stripes are lines of growth by treating the growing end of a branch with eau de Javelle; for after this has dissolved the uncalcified parts, the basal wall of the terminal zoœcium shows an angular incision which corresponds with the angle between the two systems of stripes. This form of calcification which can also present a number of modifications is for instance found in *Flustra Barleei*, *Fl. membranaceo-truncata*, *Fl. papyracea*, *Discopora verrucosa*, *Dis. pavonella*, *Dis. scabra*, *Smittina propinqua* (Pl. XIX, fig. 3 a), *Sm. reticulata*, *Sm. palmata* (on the frontal wall), *Arthropoma Cecili*, etc. and no doubt it appears in most cases on the frontal wall in species furnished with marginal pores, each of which serves as the starting-point for a suture which in most cases ends in the median suture. Still, a median suture may be absent in very short zoœcia and we find instead a number of fan-shaped, converging suture lines, as in *Discopora pavonella* (Pl. XIX, fig. 2 a). With exception of the walls which are provided with specially small pores (*Thalamoporella*, *Steganoporella*), all the surfaces (frontal walls, oœcia), which are furnished with scattered pores, are also provided with numerous sutural lines, as these start from each pore, and except for those which end in the free edge of the surface, all the others end either in a new pore or in another sutural line. In *Crisia eburnea* the calcification takes place in narrow longitudinal belts, and a similar mode of calcification is seen in the short and wide hollow protuberances, which are situated on each side of the aperture in several *Thalamoporella* (Pl. VI a, figs. 4 a, 5 a). Besides the form of striping, which is due to lines of growth, and which for instance is often very distinct in the *Hippothoa* species, the basal wall especially of the zoœcia often presents a distinct, longitudinal or fan-shaped striping which is most probably due to the arrangement of the separate lime particles. This form of striping is widely distributed in the species *Bicellariidæ* and *Scrupocellariidæ.*

Before leaving this subject I must shortly mention an apparent observation made by Nitsche[1], according to which the calcified frame of every zoœcium of *Membr. membranacea* after boiling in alkali is divided into three pieces, namely, in two double-folded end pieces each consisting of a terminal partition wall and a piece of the adjoining side-wall, as also of two lateral pieces. This view is nevertheless not correct. After boiling like this more or fewer zoœcia in a colony may indeed show cracks or bendings, but these are quite accidental, and not an expression for the mode of calcification of the zoœcia.

Cryptocyst and Gymnocyst.

Under the generic name *Onychocella* Jullien[2] has described several recent species of a type which had a great extension in the seas of the chalk period but which only has a small quantity of now living representatives. As is the case in a *Flustra* species, the whole of the frontal wall is covered with a membrane in which can be seen an opercular valve, but when we remove this membranous cover we find underneath it and separated from it by a distinct space a more or less concave calcareous layer, which distally has a semicircular aperture (opesia) through which the polypide can make its way out. This aperture which was formerly regarded as the orifice of the zoœcium in the fossil species is consequently separated by a space from the real orifice, which is situated in the covering membrane. In contrast to the membranous ectocyst Jullien designates this deeper-lying calcareous ectocyst as a Cryptocyst, and proposes on the basis of this observation to divide the cheilostomatous *Bryozoa* into two divisions, according to the presence of a single or double ectocyst. To the first division: *Monodermata,* he refers such forms as *Eschara foliacea, Lepralia hyalina, L. coccinea, Cellepora pumicosa* and *Flustra foliacea,* and to the other division: *Diplodermata,* besides

[1] 80, p. 42. [2] 12

the species of the genus *Onychocella, Biflustra delicatula, Vincularia abyssicola, Steganoporella Smitti*, etc. In a later paper[1] besides a number of new genera, species of the genera *Aetea, Microporella, Scrupocellaria, Bicellaria, Cribrilina, Lagenipora, Schizoporella, Smittia, Mucronella* and *Retepora* are referred by him to the *Monodermata*, while he classes species of the genera *Caberea, Membranipora* and *Setosella* to the *Diplodermata*. In a third paper however he has altered[2] his view of the extent of the *Diplodermata*, in that he now classes some of the forms which in the earlier papers he placed under the *Monodermata* to the *Diplodermata*, namely, all the families *Eucrateidae, Cellulariidae (= Scrupocellariidae), Bicellariidae, Notamiidae, Flustridae, Membraniporidae, Gemellariidae* and *Farciminariidae*. While a systematic classification on the basis of the structure of the frontal wall is still found in a work of Canu[3] from the year 1900, on the *Bryozoa* of the Cretaceous period, this classification seems quite given up in a later cooperative work by Jullien and Calvet[4], which after the death of the first mentioned writer has been carried on and published by the latter. Calvet[5] gives very important information about the structure of the frontal wall in a large work dealing with the structure and development of the ectoproct *Bryozoa*. Besides in *Eucratea Lafonti, Membranipora Rosseli* and the species of the genus, *Cellaria*, he has found a double ectocyst in the species examined by himself of the genera *Tubucellaria, Microporella, Chorizopora, Schizoporella, Lepralia, Umbonula, Retepora* and *Cellepora*, consequently in forms which according to Jullien's examination have a single ectocyst, while he has found a single ectocyst in the examined species of the genera *Aetea, Scrupocellaria, Caberea, Bugula, Flustra*, and in *Membranipora pilosa* and *Membr. Flemingi*. As to those forms which have a double ectocyst, he gives the interesting information that the interspace between the membranous exterior and the calcified interior layer (the Cryptocyst) is everywhere covered by epithelium, and moreover contains leucocytes and a mesenchymatous tissue. Except in the *Retepora* where the basal wall of the colony also has a double ectocyst, he only finds such an ectocyst on the frontal wall.

The result of the investigations above-mentioned is, consequently, that we can distinguish between skeletal parts which come into existence inside the covering membrane and independent of this (the Cryptocyst), and those which arise by transformation of the covering membrane. We may call these last-mentioned parts of the skeleton whose frontal surface consequently has no membranous lining (an "epitheca"): the "Gymnocyst".

[1] 43. [2] 45; [3] 11 a. [4] 46; [5] pp. 163—168.

Spines.

Under the name of »spines« we understand in this work only a sort of hollow projections of the outer surface of the zooecium, whereas we may designate all solid projections, issuing either from the outer or the inner surface, in a different manner, for instance as »spinous processes«, »denticles« or in a similar manner, according to the form and size of the projections in question. Such solid spine-like projections are present on the outer surface for instance in *Holoporella hastigera*[1] Busk, *Hol. columnaris*[2], in the species of *Farciminaria* (Pl. I, figs. 10 a—10 c) and most species of the genus *Spiralaria* (Pl. I, fig. 9 c), and on the inner surface e. g. in *Menipea roborata* (Pl. II, figs. 7 d—7 e), Hincks and *Men. ligulata* (Pl. II, fig. 8 c) Mac Gill. From the position, structure and mode of growth we can distinguish between three different main forms, which we may call marginal spines or folded spines, acropetal spines or annular spines and bilaminate spines.

1) *Marginal spines or folded spines.* While these spines may appear in larger or smaller numbers on the frontal wall of species with a membranous frontal area, in the circuit of which they are placed, they may also appear in numbers of 2—10 in forms where the frontal area is lacking, outside the anter of the aperture. All these spines originate, as Harmer[3] has already found in *Membraniporella nitida* and *Cribrilina annulata*, as crenulations or folds of the gymnocyst margin, which surrounds the membranous frontal area (Pl. IV, figs. 2 a—2 e) or the anter of the aperture, and the two lateral halves of the fold grow finally together in a longitudinal suture which is turned towards the zooecium, and which can often be seen for a long time even after the spine, by continued growth at the point, has reached its full length. As the fold is closed it comes to enclose a part of the frontal area, and the growing spine will constantly be finished off by a membrane, which is the condition for its further growth in length, and which only disappears when the point of the spine calcifies. These marginal spines, which are always formed by a Gymnocyst, present a certain likeness in their mode of formation to the hollow outgrowths of the rim which appear in various snails, for instance in *Pterocera chiragra*.

2) *Acropetal spines or annular spines.* These spines which are only found in a small number of *Bryozoa*, begin as a ring-shaped growth on the circumference of a rounded uncalcified part of a surface, and grow in other respects in the same way as the marginal spines by means of a membrane at their free end. To these belong the (as a rule) unpaired spine which is situated at the end of the membranous frontal area in the genus *Electra*, the unpaired spine in

[1] 8, p. 192; [2] 8, p. 194. [3] 19, p. 292.

Escharina spinifera, the two large distal projections which appear in a number of species of the genus *Thalamoporella* (Pl. VI a, figs. 4 a, 5 a) and the two corresponding projections in the genus *Claviporella* (Pl. XX, fig. 10 a). Undoubtedly also, the very long and thin spines which appear at the edge of the calcified, arched frontal wall of »*Lepralia*« *Poissoni* in a very unusual way, belong to this division, and also the likewise long and thin spines which somewhat scattered and in great numbers surround the anter of the aperture in *Schizoporella biserialis* Hincks[1], and which give the impression of having been formed round a number of the numerous scattered pores which appear in this species, in the same way as the very short arched projections which occasionally appear round oœcial pores, for instance, in the species of the genus *Claviporella*. The true acropetal spines like the marginal ones are always formed by a Gymnocyst, but in *Porella* (?) *cornuta* (Pl. XVIII, fig. 6 a) the endooœcium in a number of zoœcia is furnished with one or more hollow spine-like processes which in the same manner as the acropetal spines have a ring-like origin and are no doubt formed by chalk-particles deposited under the membranous ectooœcium. These projections, however, are in no inner connection with the oœcium and cannot therefore be looked upon as true spines.

3) The *bilaminate spines*, which have hitherto only been found in the family *Catenariidæ* and will be more fully spoken of under this family, spring from the free margin of a more or less developed sinus (the sternal sinus), from the margin of which also an inner Cryptocyst lamina takes its origin. As these spines issue from a margin in which a Gymnocyst and a Cryptocyst meet, they must of course be two-layered, their outer layer being formed by the Gymnocyst and the inner by the Cryptocyst. They attain their highest development in the genus *Costicella* (Pl. XII, figs. 1 a—1 d, Pl. XX, figs. 8 a—8 b, fig. 9 a).

The morphology of the zoœcium.

As is known we can in the cheilostomatous *Bryozoa* distinguish between six, as a rule well-separated, walls, namely, the two lateral, the two terminal, the basal and the frontal. It is generally difficult however to distinguish exactly between the lateral walls and the frontal wall (or basal wall) in species which appear in single rows, and in those zoœcia which arise by superficial gemmation and in most cases in more or less erect position (for instance in the *Cellepora* and *Holoporella* species) only the basal wall is sharply bounded, the other walls

[1] 30, p. 250.

running into each other. It would be most natural only to count the adjacent parts of two neighbouring zoœcia as lateral walls, and to regard the whole frontal surface of the zoœcium as the frontal wall, even if the lateral parts of it are sometimes almost vertically ascending.

In contrast to what takes place in the *Cyclostomata*, in which all partition walls are single and common for two adjoining zoœcia, the lateral walls in most of the *Cheilostomata* are independent, and after treatment for some time in eau de Javelle or with boiling alkali, most of the colonies can be broken up into a number of longitudinal rows of zoœcia. Still from this rule may be excepted a number of families and genera, as *Cellulariidæ*, *Catenariidæ*, *Myriozoidæ*, *Sclerodomidæ*, *Tubucellariidæ*, *Conescharellinidæ*, *Selenaria* and *Lunulites*, and even within genera, the species in which have independent lateral walls, for instance *Porella*, we can find species e. g. *P. saccata*, *P. compressa* and *P. tubulifera*, in which the lateral walls are common to two zoœcia. Such common lateral walls seem exclusively to appear in free growing species, while on the other hand several species with free growth have independent lateral walls, e. g. the members of the families *Scrupocellariidæ* and *Bicellariidæ*. The same is the case with the free-growing species of *Steganoporella* and *Thalamoporella*. If we make a section through a decalcified colony of one or other species which has independent lateral walls, e. g. *Steganoporella magnilabris*, we see plainly that there is no membrane between two adjoining lateral walls, but that each of these is in direct communication with and passes over into the frontal membrane of the corresponding zoœcium. The reason why the two lateral walls are separated by the above-mentioned treatment may be that the fluid dissolves a part of the organic matter which the walls contain, and that these then draw themselves together in a similar way as a piece of wood does when it dries up. With this also agrees that such a separation of adjoining walls takes place much easier in younger zoœcia than in older, in which the calcification is more advanced.

As a rule the terminal walls in contrast to the lateral are common to two zoœcia lying behind each other and there are only a few exceptions from this rule. One is presented by the species of the above-mentioned genus *Onychocella* (Pl. XXII, figs. 3 a—3 d, in which this wall can also be split into two after treatment with eau de Javelle, so that we might here speak about a separate distal and proximal wall. As the genus *Onychocella* commences in the Jurassic and has its widest extension in the Cretaceous period, we very likely have to do with a primitive condition. Separate terminal walls also exist in the kenozoœcia of *Retepora tessellata* (Pl. XXIII, fig. 1 a) and *Ret. lata* (Pl. XXIII, figs. 2 a—2 c), and

Membranipora Normani n. sp. (Pl. XXII, figs. 5 a—5 c) is also a partial exception to the above rule, as the obliquely ascending frontal part of the terminal wall can be split into two, which on the other hand does not seem to be the case with the horizontal part of this wall.

Of the two other walls we may first consider the frontal (or oral), which presents the most numerous modifications and is therefore systematically the most important. In a preliminary paper[1] I have proposed to divide the cheilostomatous *Bryozoa* into four groups: *Malacostega*, *Acanthostega*, *Coilostega* and *Camarostega*, which are to a larger or smaller degree based on the structure of this wall. Of these the first three correspond with the division instituted in this work under the name *Anasca*, which covers all the cheilostomatous *Bryozoa* with no compensation sac, while the fourth corresponds to the *Ascophora* provided with such a sac. Though I only intend to keep two of these names for systematic divisions, it would be practical to use adjectives corresponding to all the four names, in order through them to indicate essential differences in the structure of the frontal wall. This may namely be represented only by a membrane (malacostegous *Cheilostomata*) in a larger or smaller part of its extent, or is quite calcified (stereostegous *Ch.*). In the latter case the chalk cover may be arched (camarostegous *Ch*), or it may be depressed and encircled by projecting margins (coilostegous) *Ch.*). Finally, above the covering membrane there may be a chalk cover consisting of two rows of hollow spines connected with each other in different ways (acanthostegous *Ch.*), and lastly, we may just recall that the calcareous skeleton itself may either be a Gymnocyst, a Cryptocyst or a compound of both.

Before we try to give a view over the appearance and extension of the Gymnocyst and the Cryptocyst within the different families of the cheilostomatous *Bryozoa*, we may discuss some criteria, which might help to determine the presence of these two kinds of skeleton in cases where there is no possibility of deciding the question directly, namely, by observation of the membrane which should always cover the Cryptocyst. This applies not only in most cases to the dried *Bryozoa*, but the thin membrane is also torn away from many colonies preserved in spirit, and I may mention as an instance, that I have had to examine many spirit specimens of *Escharoides Jacksoni* before finding the covering membrane. The lateral and oral spines always, as mentioned before, spring from the border of a Gymnocyst, and therefore we can with certainty take it for granted that every calcification which appears within such a spine-bearing border or from a corresponding border in a non-spinous species is a Cryptocyst. Harmer[2]

[1] 56, p. 2; — [2] 19, p. 326.

concludes rightly therefore in saying that the calcification, which appears within the marginal spines in the primary zooecium of *Schizoporella vulgaris*, is a Cryptocyst, and such is found at the same place in many malacostegous *Cheilostomata*. A Cryptocyst of this sort is not only very plainly hollow or depressed, which is in contrast to the arched Gymnocyst, but also varies as a rule from the latter by having a more or less grained or rugged surface.

We can find all sorts of transitions between a completely membranous and completely calcified frontal wall among the forms without a compensation sac, and for which we have suggested the name: *Anasca*. The whole calcified part is sometimes a Gymnocyst, sometimes a Cryptocyst and sometimes, both kinds of calcification may appear at the same time, the Cryptocyst springing from the Gymnocyst where the latter passes over into the membranous area. We can distinguish between a distal part, a proximal part and two lateral parts for the Gymnocyst as well as for the Cryptocyst. The distal part is in most cases the least developed because of the position of the aperture in the distal part of the zooecium, and may in the Cryptocyst not seldom be quite missing, while the proximal part as a rule has the largest extension. A peculiar exception is found in the form which Busk describes as *Diachoris magellanica, v. distans*[1], but which must undoubtedly be regarded as an independent species. The proximal part is here very feebly developed, whilst the two lateral regions are very broad and only separated by a split in the middle line of the zooecium. In very few cases, as in *Membranipora delicatula*, the proximal part may grow out as a free lamina which is not connected with the lateral regions, and when such a lamina again meets these distally we have the peculiar condition known in *Calescharu denticulata*, in which the frontal wall is furnished with two long and narrow fissures. The distal part may in some avicularia, for instance in the lyre-shaped forms, exceed in extent the proximal (Pl. VI a, fig. 1 a, 2 a, 3 a). While a Gymnocyst in the *Flustridae* is either quite lacking or only represented by a faint marginal part, there can in a number of species, as e. g. *Fl. denticulata*, *Fl. carbacea*, *Fl. serrulata*, *Fl. biseriata*, *Fl. cribriformis* and *Fl. Schonaui*, n. sp., appear a feeble, more or less knotted Cryptocyst, the proximal part of which is most developed. While the Cryptocyst appears very late in *Fl. denticulata* and therefore can only be found in older parts of the colony, we find it very early developed in *Fl. serrulata* and *Fl. carbasea*, in which species it is only lacking in the very youngest zooecia. Longitudinal and transverse sections through such a colony (Pl. XXI, fig. 10 a—12 a) show that this Cryptocyst, which Waters[2] calls the chitino-

[1] 8, p. 59; [2] 109, p. 280.

calcareous band in *Fl biseriata*, begins a little below the upper edge of the vertical wall of the zoœcia. This Cryptocyst reaches a somewhat greater development in *Fl. cribriformis* and *Fl. Schonaui* (Pl. 1, fig. 7 a, 7 c), in which it shows a varying number of lines of growth, according to the age of the zoœcium. We may mention finally, that while the zoœcia in the free part of *Fl. foliacea* have no Cryptocyst, such is rather highly developed in the incrusting part of the colony and also, that it is well-developed in the avicularia of this species.

Of the forms which we have here classed to the family *Farciminariidae*, the frontal wall of most of them has neither a Gymnocyst nor a Cryptocyst, or there is only a faint trace of the last. On the other hand both of them appear rather well-developed in *Farciminaria appendiculata* (Pl. 1, fig. 11) and in *Nellia tenella* (Pl. 1, fig. 13). Within the family *Bicellariidae* we find a completely membranous frontal wall in most of the species referred to the genera *Buskia*, *Beania* and *Diachoris*. The Gymnocyst reaches its greatest development in *Dimetopia* and *Bicellaria*, because it may here attain more than half the length of the zoœcium (Pl. IV, fig. 5 and 8), while it only has a small extension in most of the *Bugula* species. With exception of *Bicellaria grandis* (Pl. IV, fig. 5 a), in which species we find a large distally freely projecting Cryptocyst lamina, I have not been able to find any trace of a Cryptocyst in any other *Bicellaria*; still it seems as if a slightly developed Cryptocyst can be found in almost all other members of the family, at least in the older zoœcia, in which it often seems to be represented by the proximal part, which shows distinct lines of growth. The whole of the Cryptocyst shows distinct lines of growth in the figure of the zoœcium of *Maplestonia simplex* shown in Pl. IV, fig. 9 a, but the proximal part is only slightly developed. With exception of the *Flustra*-like *Hoplitella armata* (Pl. II, fig. 10 a), in which the whole of the frontal wall is membranous, a larger or smaller part of this wall is calcified in the rest of the members of the family *Scrupocellariidae*, and they have as rule a Gymnocyst as well as a rugged or grained Cryptocyst, which in *Cellularia ornata* even seems to form the whole of the calcified part of the frontal wall. The Gymnocyst however forms most frequently the major part of this wall, and its proximal part in *Menipea aculeata* and *Men. clausa* attains nearly the two-thirds of the length of the zoœcium. The Cryptocyst seems to be strongly developed in most of the *Caberea* species. While the whole calcified part of the zoœcium in the *Aeteidae* is formed by a Gymnocyst, the conditions are very variable within the large family *Membraniporidae*. While the whole frontal wall is formed by membrane in *Membranipora membranacea* and related species, a larger or smaller part of it is calcified in most of the remaining forms, and this calcification is sometimes represented only by a Gymnocyst, sometimes only by a Cryptocyst and sometimes by both.

In the species belonging to the genus *Electra* (*E. pilosa*, *E. verticillata*, *E. bellula* etc.) we find a good-sized Gymnocyst, and the Cryptocyst is either quite lacking or is represented only by a very slight margin within the spines. In the genus *Callopora* a cryptocyst is developed in very varying degree and in *C. lineata*, *C. craticula*, *C. Dumerili* and *C. aurita* it is represented only by a slight granular margin in the circumference of the membranous area, while in other species as e. g. in *C. Flemingi* and *C. trifolium* it has grown to such an extent that the zooecium has only a little trifoliate aperture. Hincks calls it in such species »an inner lamina«. Finally, the calcified part of the frontal wall in *Memb. arctica*, *M. Rosseli*, *M. cornigera* etc. is only formed by a Cryptocyst, as is also the case in the species referred to the genera *Onychocella* and *Chaperia*.

The Gymnocyst may attain a very different degree of development in the forms of the family *Cribrilinidae*, and its development is naturally in inverse proportion to the extent of the characteristic area, which consists of two rows of mutually connected spines. While this area in some forms, e. g. *Membraniporella nitida* and *Cribrilina annulata*, constitutes the whole or almost the whole of the frontal wall, a smaller or larger part of the latter is in other species formed by the true Gymnocyst. *Cribrilina Gattyæ* and *Cr. chlitridiata* among recent forms are perhaps those in which the Gymnocyst reaches its largest relative development, and its proximal part may here sometimes reach the same length as the area. The area is of still smaller extent, and almost to be regarded as rudimentary in some species from the Danish cretaceous formation. A Cryptocyst seems to appear, within this division, only in species of *Membraniporella* as a narrow marginal region round the membranous area of the aperture.

In the forms which we have called »coilostegous«, namely, in the members of the families *Chlidoniidae*, *Alysidiidae*, *Cellulariidae*, *Microporidae*, *Steganoporellidae* and *Thalamoporellidae*, the frontal wall is formed by a depressed Cryptocyst, but in the last of these families the two marginal regions, which bound the opening distally and which often end in arched protuberances, are formed by a Gymnocyst and as a rule separated from the Cryptocyst by a well-marked boundary line.

The numerous families belonging to the division of *Ascophora* all have an arched calcified frontal wall, and as previously noted Jullien refers the representatives of this division, mentioned by him, to the *Monodermata*, by which he understands those forms which have no Cryptocyst. Calvet[1] however, for a number of these forms has proved that the arched calcified frontal wall is in reality a Cryptocyst, and according to my investigations this is the case with

[1] 9, p. 166.

most of the families in this division; still I have not been able to find a covering membrane in members of the families *Catenariidae*, *Hippothoidae*, *Eurystomellidae* and *Euthyridae*, nor in the genera *Inversiula* and *Anarthropora*, and I must therefore ascribe a Gymnocyst to all these forms.

The two divisions *Malacostega* and *Coilostega* in reality evenly grade into one another, and there is no doubt that the coilostegous forms have arisen from the malacostegous by the extension of the calcification all over the frontal wall. In some *Thalamoporella* species, for instance in *Th. expansa* (Pl. VI b, fig. 5 a), the operculum is surrounded by a completely calcified frame-work, while in most of the species it is connected with a small membranous area posteriorly. We find a similar relation between the species of the extinct genus *Rhagasostoma* and the species of *Onychocella*, between *Cellularia* and *Membranicellaria* and between *Micropora* and such *Membranipora* species as *Memb. argentea* Mac Gill.[1], in which the membranous area is only represented by an exceedingly small part proximally to the aperture. The close connection between the *Membraniporidae* and the forms now classed under *Micropora*, *Thalamoporella* and *Steganoporella*, seems never to have been doubted, and therefore older writers, such as Busk, simply refer such species to the genus *Membranipora*. Hincks[2] speaks about the relation between the *Membraniporidae* and *Microporidae* in the following way: »In the most typical forms, such as *M. membranacea* and *M. Lacroixi*, the entire area of the zoœcium is covered uniformly by a membrane, which lies a little below the level of the margin. In others this membrane is calcified to a greater or less extent, and a solid lamina is thus formed, which protects a certain portion of the cell. But even in such species, in which this process of calcification is carried furthest, and almost the whole front is hardened into a solid wall, its position within and below the marginal rim at once indicates the mode of growth, and reveals the true Membraniporidan structure«. That Smitt has a similar view appears from his placing the family *Cellariidae*, which has a completely calcified, depressed frontal wall, in his suborder *Flustrina*, and from the following statement on the family *Microporidae*[3]: »Thus in the full development of the type, the primary area, in the same manner as in *Escharina*, disappears, and as this was the most pregnant character of the section *Escharina*, here, also, we perceive the close proximity of that group, although yet the plain front side and the raised primary margins of the zoœcia remind us of the Flustrine nature«.

The answer to the question: whence the *Ascophora* have originated, is not quite so evident, as we have here a compensation sac, of which organ no trace

[1] 72, p. 179; [2] 22, p. 128; [3] 103, p. 13.

whatever has yet been found in any member of the division *Anasca*. Smitt and Hincks have both given an answer to this question, but as neither of them had any idea of the existence of this sac, the quite calcified, arched surface and the absence of the elevated margins were for them the most important differences from the other *Cheilostomata*. At any rate both Hincks and Smitt declare that these forms cannot be traced directly from the *Membraniporidae*, but that their origin must be sought for in the genus *Membraniporella*. Hincks[1] states in continuation of the above-given citation: »The passage to the old Lepralian type is not through such forms or through the genus *Micropora*, but through *Membraniporella* in which the calcareous covering is an outgrowth from the margin of the cell, overarching as it were the original membranous covering«; and a similar view of this form's importance as connecting link between the two mentioned divisions is expressed by Smitt, both in his work on the Scandinavian *Bryozoa* and in »Floridan Bryozoa«[2]. In the last work he says: »In the above described *Membraniporella Agassizii* we have seen one of the most evident connecting links between the Flustrine and Escharine types«. Harmer has a similar view of the importance of the acanthostegous forms as connecting link between the anascous and ascophorous, and he seems in a preliminary paper[3] inclined to suppose that the whole division *Ascophora* had an acanthostegous origin, while in his main work[4], he supports such an origin with certainty only for *Umbonula verrucosa* and for forms related to this species. Harmer in contrast to the two authors mentioned has given more detailed reasons for his view, which we must examine into here. Harmer has in fact observed, that the membrane, which originally alone represents the frontal wall in *Umbonula verrucosa* and *U. pavonella*, gradually becomes covered by a calcareous layer arising from the posterior and lateral margins of the zooecium, which itself is covered by a membrane (epitheca), and he therefore compares this process with that taking place in *Membraniporella* or *Cribrilina* in which the original membranous frontal wall is covered by two series of hollow spines. But while in the family *Cribrilinidae* the single spines at the outside are connected by lateral twigs they are in *Umbonula* according to Harmer fused together into a two-layered lamina, the calcified layer of which corresponds to the basal (or inner) half of the spines while the membranous cover corresponds to the frontal (or outer) half. The author further finds points of comparison, partly in the circle of pores, which appear on the margin of the calcified frontal wall in *U. verrucosa* and *U. pavonella*, and partly in the radial buttresses which separate every two of such neighbouring pores and

[1] 22, p. 128. [2] 103, p. 21. [3] 18, p. 13. [4] 19, p. 295, 331.

form the so-called areolae. The first of these is regarded as corresponding to the pores, through which the spines in a *Membraniporella* are connected with the cavity of the zooecium, and the latter is regarded as the adjoining edges of the spines which have formed the two-layered cover. Contrary to Harmer I must however regard the calcified frontal wall in *U. verrucosa* and *U. pavonella* as a Cryptocyst. It has in reality its origin below the primary covering membrane of the frontal wall, but there is soon formed on this a fold or out-pushing and the Cryptocyst (Pl. XIX, fig. 2 b, cr.) grows inside this one, though it is only towards the end of the development of the zooecium that it reaches to the distal part, and thus the frontal wall in all younger zooecia shows two proximally directed arched or angular lines not far from each other and springing from the same terminal points (Pl. XIX, fig. 2 a), of which the distal indicates the tip of the just mentioned fold and the proximal the growing edge of the Cryptocyst. The same is the case in the species of the genus *Rhamphostomella* (Pl. XIX, fig. 19 a). Finally these supposed pores like the other so-named pores in the *Bryozoa* are not at all apertures, but are filled by a membrane, which must be regarded as an uncalcified part of the wall. This membrane in *Umbonula* as well as in many other cases is provided with several small perforations and we have really to do with superficial rosette-plates here (see rosette-plates and pores).

As is well known the first zooecium in a colony, the so-called primary zooecium or »ancestrula« (Jullien), frequently shows characters different from those found in the later zooecia and not seldom such which are found in another division, family or genus. In the *Cheilostomata* it appears typically in the so-called »*Tata*«-form (Smitt), the greatest peculiarity of which is the possession of a membranous frontal area, which in most cases is surrounded by spines and as this form of ancestrula is found not only in malacostegous and acanthostegous *Cheilostomata* but also in a number of genera (*Schizoporella*, *Escharella*, *Escharoides*, *Microporella*, *Hippothoa*), within the division *Ascophora*, Smitt[1] and later writers e. g. Harmer[2], who have studied the question of the genealogy of the *Bryozoa*, are no doubt quite right in regarding the *Tata* as an ancestral form of the *Cheilostomata* and the frequency of this *Tata*-like ancestrula as evidence that not only the *Anasca* but also the *Ascophora* descend from malacostegous forms.

While the ancestrula in some cases (*Retepora Beaniana*, »*Lepralia* *Pallasiana*, »*Lepr.* *spathulifera* (?), *Smittina reticulata*) has the same structure as the common zooecia, in others it has such a structure that it must be regarded as a reflection of a later ancestral form, and sometimes we can even find in the same or in

[1] 103 a, p. 235. 99, p. 306; [2] 19, p. 321.

nearly related species two or three different forms of ancestrulæ, which as it were represent different stages of the development which these forms have passed through during the lapse of time. The idea that the ascopore, which appears in a number of genera, e. g. in *Haplopoma* and *Microporella*, must have arisen from the closure of the sinus in a schizostomous orifice, has several times been expressed, and with this agrees the fact, that *Haplopoma impressum* (Pl. XXII, fig. 9 a) as well as *Hapl. cornutum* (Pl. XXII, fig. 10 a) have an ancestrula with such an orifice. Neviani[1] has found an ancestrula with a similar orifice in *Microporella Malusii* but in another colony he has found one of Tata-form and in a third the semicircular orifice of the ancestrula was contained in a calcareous region which is surrounded by short spines. A similar variation in the structure of the ancestrula has been found by Jullien[2] in the genus *Hippothoa* (*Diazeuxia* Jullien). Harmer has given a list of 34 different ancestrulæ described or pictured in the literature, and I may here point out that Smitt has besides pictured the ancestrulæ of the following species: »*Lepralia spathulifera*[3] *Escharoides coccinea*[4], *Porella lævis*[5], *Escharella immersa*[6], *Esch. stenostoma*[7] and *Esch. emucronata*[8].

In all the hitherto found ancestrulæ with a modified *Tata*, which belong to ascophorous families with a cryptocyst, there is found a more or less developed depressed cryptocyst, at any rate at the period when they have produced new zoœcia, and the existence of this cryptocyst goes to prove, that these families descend from coilostegous forms. That Harmer[9] at any rate with respect to a part of these forms is of the same opinion is evident from what he says about the cryptocyst in the ancestrula of *Escharina vulgaris*: It appears to me to be of great importance to ascertain whether this calcified portion is of the nature of a cryptocyst or not; in other words whether the frontal membrane extends as far as the sharp ridge on the inner side of the base of the spines. I can hardly doubt that this is the case; and if so the Microporoid origin of Escharine forms in which the compensation sac develops as an invagination at the base of the operculum would appear to be indicated . I may just remark, that Harmer's Microporoid series in all essentials corresponds with my division *Coilostega* and his Escharine forms with my *Ascophora*. — Such a transformation from a coilostegous into an ascophorous form as that which Harmer and the author of the present work advocate, supposes, that the depressed or hollow cryptocyst of the former,

[1] 77 a. [2] 45, p. 28 34. [3] 100, Pl. XXVI, fig. 98; [4] 100, Pl. XXVII, fig 162, 163, [5] 100, Pl. XXVI, fig. 109—111 [6] 100, Pl, XXVII, fig. 167, 101, Pl. XXI, fig 31, [7] 101, Pl. XXI, fig. 29; [8] 101, Pl XXI, fig 27, [9] ~~18~~ 19, p 334.

has been in the course of time changed into an arched one and this change was, I think, a necessary supposition for the formation of a compensation sac, which could not find sufficient room within a depressed cryptocyst, and it would therefore be reasonable to suppose, that this has only been formed after the depressed cryptocyst's transformation into an arched one. While we know of no example of an ascophorous form with depressed oral wall, we can on the other hand mention several examples of forms, which though belonging to the division *Coilostega* (or to the related division *Pseudostega*) have a more or less arched frontal wall. In such cases either the whole frontal wall may be arched within a narrow projecting rim, or such a narrow rim may be wanting, and the largest portion of the frontal wall is then arched, while there is a smaller depressed portion in its distal or central part. We can mention the recent *Cellaria magnifica* Busk[1], *Macropora centralis* (?) Mac Gill. (Pl. VII, fig. 1 a), *Micropora nodulifera* Hincks[2] and *Aspidostoma giganteum* Busk (Pl. VI c, fig. 2 a), and the fossil »*Homolostega*« *erecta* Marss.[3], *Aspidostoma* (?) *Atalantha* d'Orb (Pl. VI c, fig. 5 a, b), *Aspid* (?) *Aegon* d'Orb (Pl. VI c, fig. 3 a) and »*Eschara*« *Aegle* d'Orb[4] as examples of species with such a structure. In the last species the frontal wall is arched in most of the zoœcia, while in a smaller number it is more or less depressed or flat.

In contrast to the modified *Tata*-form found in the genera *Escharoides*, *Escharella*, *Escharina* and *Porella* (*P. lævis*), which possesses a depressed calcareous lamina within the spines, the corresponding lamina in the modified *Tata* of *Hippothoa hyalina* found by Jullien[5] is not depressed but arched (bombé) and therefore does not seem to be a cryptocyst, but this corresponds very well with my examination, according to which the frontal wall in that genus is a Gymnocyst. Busk[6] figures some abnormally developed zoœcia of Electra pilosa, which are of no small interest. The spines are quite lacking in these, due to the fact that the calcification of the covering membrane has continued beyond the ordinary limit, so that the Gymnocyst has spread in irregular tongues over a large part of the surface, otherwise occupied by the membranous area of the aperture. In the frontal part of the two zoœcia is an open space which in shape and size might correspond to an operculum, and which is separated from the other calcified region by a low calcified bridge. It is evident that there has been an effort here to form a zoœcium with a perfectly calcified frontal wall, and by a similar effort the *Membranipora* species, which is reflected in the *Tata*-form of *Hippothoa hyalina* must in the course of time have changed into a *Hippothoa*, at the same time as

[1] 8, p. 93, [2] 25, p. 11; [3] 58 a, Pl IX, fig. 12; [4] 86, Pl. 664, fig 6; [5] 45, p 30, Pl. I, fig. 1; [6] 2, Pl. LXXI, figs. 3, 7.

the not yet wholly calcified part of the frontal membrane has formed a compensation sac by an invagination proximally to the operculum.

The basal wall like the frontal may also be membranous, as in *Membranipora membranacea* and *Electra pilosa*, and even in numerous, well-calcified, incrusting members of the division *Ascophora* the basal wall is slightly calcified or partly uncalcified, sometimes even quite membranous. I may for instance mention the incrusting species of the genera *Escharella, Escharina, Microporella, Hippothoa,* etc. The basal wall in the calcified state seems as a rule to be a Gymnocyst, and it is only in very few cases that it is covered with a membrane in species appearing in free colonies. Harmer[1] has for example shown that the free, one-layered colonies of *Euthyris clathrata* and *Euth. obtecta* (Pl. XV, figs. 2 c, 2 d) are provided over the whole surface with a covering membrane which is kept stretched by projections from the underlying Cryptocyst. A covering membrane over the whole surface of the colony is also present in *Urceolipora nana* (Pl. XV, figs. 1 a—1 e) and it seems also to be found in species of the genus *Cupularia*.

Under the names of *Steginopora* and *Disteginopora* d'Orbigny[2] has described a number of fossil species, which have possessed a double roof, of which the lower except in *St. irregularis* seems to have quite the same structure as the roof in *Cribrilinidae* and thus to be formed by spines connected with one another. On first consideration of the drawings given we should be inclined to suppose that the upper roof is formed by calcification of such a projecting membrane as the one we find in *Euthyris obtecta;* but according to Jullien's[3] investigations the upper roof is formed by a partial fusion together of very large spines, broadened out and plate-like at the ends, and this view is undoubtedly right. That this roof cannot be explained in the above-mentioned way appears clearly from the fact, that the membrane which corresponds with the mentioned projecting cover in *Euthyris*, has its place below the fused spines in *Cribrilinidae*. In a number of fossil *Cribrilina* forms as well as in the one-layered *Steginopora* species we find a varying number of robust projections at the back of the single zooecia, which Harmer[4] thinks have served as supports for a membranous cover, similar to the one which is found in *Euthyris*. Against this view speaks firstly the circumstance, that while the mentioned supports in *Euthyris obtecta* are slender, cylindrical rods, the projections in the mentioned *Cribrilina* species, with which Harmer compares them, have the form of tubercles, which are very differently developed in number and size in the different species, and their rounded endpart does not seem to have been connected with a membrane. Further, these

[1] 18, p. 16 and 19, pp 267, p. 277, 278; [2] 86, pp 235, 498, 499, [3] 41, p. 609 [4] 18, p. 17.

knots may sometimes be present and sometimes absent, even in closely related species; thus while they are found in *Semiescharipora ovalis*[1] they are wanting in *Repteschariporu convexa*[2]. Secondly, we must remember that while the whole surface of the colony is covered by a continuous membrane in the *Euthyris* species, every single zoœcium in the mentioned fossil species has been furnished with a separate frontal membrane, which has been situated below the roof formed by the spines. As shown before, the marginal spines always spring from a Gymnocyst and we must therefore assume that the Gymnocyst, which has formed the spines of the marginal zoœcia, has passed directly over into the basal wall of the colony from the free lateral edges of these zoœcia.

Rosette-Plates and Pores.

The adjoining zoœcia in a colony are, as known, connected by chords of mesenchymatous tissue, which extend from one zoœcium into another through pores in the partition-walls, but while these pores appear in the *Cyclostomata* as simple perforations of the wall, they are in the *Ctenostomata* and *Cheilostomata* very fine piercings in watch-glass-shaped, concave, thinned portions of these walls. These peculiar formations have been noticed for the first time by Smitt, on the lateral walls in *Flustra foliacea*[3] and are called by him communication-pores. He has not however seen the real pores, and seems to regard the whole, multiporous plate as an opening. Later Reichert[4] in a member of the division *Ctenostomata*, *Zoobothrion pellucidum*, has observed the same formations, which he calls »Rosettenplatten«, and in which he has seen the real pores. Among later writers Waters[5] first drew attention to the importance of these rosette-plates for the diagnosis of species and in a series of papers he gives information on their presence in several *Cheilostomata*, while the writer of this work has illustrated their occurrence in the Danish species. As this description[6] was however written in Danish, and for that reason less available, I may give here the results of those older investigations to which I have been able to add by later studies. Though I do not find the name rosette-plate good, I shall yet use it, partly in view of its priority and partly because Waters has used it in his many papers. The formations dealt with here may appear under two different forms, namely as common rosette-plates or as pore-chambers, and each of these can again be divided into single-pored, or single and multiporous or compound.

Rosette-Plates. A single-pored rosette-plate is a watch-glass-shaped, concave, thin portion of the wall, which as a rule is surrounded by a more or less devel-

[1] 86, Pl. 719, [2] 86, Pl. 720, [3] 99, p 126, Pl. XX, fig. 15, [4] 91, p. 267, [5] 109, p. 286; [6] 54, 55.

oped, more chitinised projecting marginal portion, the pore-ring, the outer opening of which in the most developed rosette-plates is smaller than the size of the plate a little in from it. Within the pore-ring we can distinguish between two portions, differing in thickness, a thicker outer area and an inner surrounded by the other, very much thinner and very small pore-area, which is pierced by an extremely fine pore, and distinguished by a strong bluish lustre, which at first glance makes it seem thickened. Such one-pored rosette-plates may appear singly (the distal wall of *Flustra securifrons*, *Fl. papyrea* etc., the distal wall of most *Reteporidae*), in a more or less numerous (of 2—12 plates) series (all walls in many species of *Smittina*, in *Adeonidae*, in most *Flustridae*), or in groups sometimes consisting of more scattered, sometimes of more closely placed plates (e. g. in *Catenariidae*, the distal wall in *Scrupocellariidae* and *Thalamoporellidae*). In cases where the single rosette-plates are close together, they have a square or hexagonal shape, and meet in a network of elevated ridges, which must be regarded as the pore-rings for the single rosette-plates

It is quite impossible to draw a sharp limit between a group of one-pored rosette-plates and a multiporous rosette-plate, as the only character, which can be regarded as peculiar for the multiporous compound rosette-plate, namely, a common pore-ring which surrounds all the single small plates, can be developed to very different degrees, and does not always appear to be constant even in the same colony or in the same zoœcium. This is the case with for instance *Arthropoma Cecili*, in which species the distal wall as well as the distal half of each side wall is furnished with an elongated or oval group of numerous uniporous rosette-plates. A pore-ring may be lacking on some walls and appear on others, not only in the same colony but also in the same zoœcium, and wherever it appears, it may either be exceedingly well developed, or only slightly indicated. Within the pore-ring (Pl. XVII, figs. 10 a, 10 b) which has a similar structure as in the uniporous rosette-plate, we have an area, the large area, which may be filled by the small plates to a very different degree, and while these for instance in *Arthropoma Cecili* often form only a longitudinal belt along the middle part, in *Lepralia Pallasiana* (Pl. XVII, fig. 10 a) they fill the whole or at any rate the largest part of the plate. The rosette-plates may show many different degrees of calcification, to some extent according to the degree of calcification of the species concerned. In most members of the family *Bicellariidae*, in species of the genus *Onychocella* and *Selenaria* we thus find rosette-plates, which with exception of the pore-ring are quite uncalcified; on the other hand we find e. g. in *Flustra foliacea* and *Flustra carbacea*, that the large area is calcified and the single small plates are uncalcified. The pore area is always uncalcified, while on the contrary the outer area in most cases consists of an outer calcified, and an inner uncalcified part, and in strongly calcified species (e. g. »*Lepralia*« *Pallasiana)* the inner uncalcified portion of the outer area is very small. The single small plates in a compound rosette-plate often show only a slight indication of a pore-ring, and when they are not much hollowed out the calcified portion of their outer area is often so little distinct from the large area, that it is only possible to find it by very favourable light. Just as we rather frequently find two rosette-plates fused together into a double plate with an outer area in common and two pore-areas in species, the distal wall of which is provided with a number of uniporous rosette-plates (e. g. in *Flustra foliacea, Fl. carbacea* and *Membranipora pilosa*), we also find in a multiporous rosette-plate a fusion of two or more small plates into one. A great deal of variation and very different kinds of fusion take place in the distal wall in *Membr. membranacea*[1]. In this appear as a rule two pear-shaped multiporous rosette-plates, but in many zooecia each of these is replaced by a whole series of smaller plates, of which some are uniporous, others multiporous with a very varying number of pores; the conditions may even be quite different on the two sides of the distal wall.

Pore-Chambers. I have used this name[2] for the small spaces which are situated in the angle between the basal wall of a zooecium and one of the perpendicular walls. In their typical form they have a triangular tranverse section, and we can distinguish between a basal wall, an inner wall and an outer one. The basal wall is a portion of the basal wall of the zooecium, the small rosette-plates are situated on the inner wall, and on the outer wall is the entrance to the chamber (Pl. XVII, fig. 10 c). If we examine their development in the newly formed zooecia in the growing part of the colony, we see that the inner wall is the part first formed and that the basal wall and outer wall are formed later. We can best make sure of their presence if we loosen a colony from its support and look at it from the basal surface; for in this position the inner walls of the elongated pore-chambers form curves within the lateral margins of the zooecium (Pl. IX, figs. 11 g, 12 a, Pl. XV, figs. 3 c, 4 c, Pl. XVIII, figs. 14 b, 11 a). There is as a rule only a small number of small plates placed in a single row and the neighbouring chambers are in most cases moved up so close together that the curves touch one another, or even so that the chambers have a common separating wall. While the vertical walls in all zooecia, which are furnished with ordinary rosette-plates, form right angles with the basal wall, the pore chambers are placed in such a way that their outer wall forms pointed angles with the

[1] 54, Tab. II, fig. 17; 55, Pl. IV, fig. 5, [2] 54, p. 250, 55, p. 7.

basal wall of the one and obtuse angles with the other of the two zoœcia, between which it serves as connection (Pl. XVII, fig. 10 c). The outer wall of the chamber forms obtuse angles with the frontal wall of the zoœcium and the pore-bearing, somewhat slightly concave inner wall forms obtuse angles inwardly and pointed angles outwardly with the base. What is said here applies to the pore-chambers of both the lateral and distal walls. Though rosette-plates and pore-chambers seem at first glance to be of quite different structure, they are connected by transitions. If we imagine a rosette-plate placed in such a way that its lower edge goes down into the angle between a lateral wall (or distal wall) and the basal wall, a removal of this edge into the basal wall would produce a pore-chamber, as what is just characteristic for such a formation is, that it belongs to two adjoining walls. I have found such transitions between common rosette-plates and pore-chambers in colonies of »*Lepralia*« *Pallasiana* from Sebastopol, which together with *Electra Zostericola* forms incrustations on *Zostera marina*. While colonies of this species from Denmark and from Port Jackson, New S. Wales, have only ordinary multiporous rosette-plates, we find more or fewer zoœcia in the colonies mentioned from Sebastopol, in which more or fewer rosette-plates are replaced by pore-chambers with differently developed basal wall. We can also find such transitions in the very variable species *Porella concinna* between rosette-plates and pore-chambers, which replace one another in different colonies. In contrast to the multiporous chambers which can be found in »*Lepralia*« *Pallasiana* and *Porella concinna* the few-pored chambers are usually constant within the species, and even sometimes in the genus or family. Besides in all members of the families *Hippothoidae* and *Celleporidae* typical pore-chambers appear in the genera *Callopora*, *Cribrilina*, *Puellina*, *Escharina* and in a number of species of the genera *Escharoides* and *Microporella*. In the members of the family *Celleporidae*, the colonies of which increase by superficial budding, the pore-chambers are only to be found in the zoœcia which form the first incrusting layer of the colony; in species of *Escharella* (Pl. XVII, fig. 1 c) the originally long and narrow pore-chambers, which are provided with a row of small single-pored rosette-plates, are divided by partition walls into a number of uniporous chambers, and the pore-chambers may be tubularly lengthened in species of the genus *Hippothoa*.

Before discussing the relation of a rosette-plate to the two zoœcia which it connects, we may again recall that on using boiling alkali or cold eau de Javelle we can not only loosen a colony from its support, but even as a rule separate it into single rows of zoœcia, on which we can without difficulty study the rosette-plates. While Nitsche[1] in his above-mentioned work on *Membr. membranacea* has rightly observed, that the single zoœcia have independent lateral walls, he gives a wrong view of the relation of the single zoœcia to the rosette-plates. He says namely: »Die Rosettenplatten eines jeden Zoöcium correspondiren nun mit den Rosettenplatten der umliegenden Zoöcien auf das genaueste«, and he gives in detail an explicit account of how the rosette-plates of each zoœcium are placed opposite to a corresponding rosette-plate in an adjoining zoœcium. If for instance we separate a row of zoœcia of a *Scrupocellaria* form (Pl. II, figs. 7 g, 8 e) each lateral wall in its distal half will show a multiporous rosette-plate, but in its proximal half an opening of the same shape and size. If we subject *Flustra foliacea* (Pl. I, fig. 8 b) to the same treatment, we find 2(—3) multiporous rosette-plates on its distal half, and 2(—3) openings on its proximal half. Because of the arrangement of the zoœcia in alternating longitudinal rows, one or more openings in the proximal half of a lateral wall will always correspond to and fit exactly opposite the same number of rosette-plates in the distal half of the corresponding lateral wall of the adjoining zoœcium. In *Gemellaria loricata* we have an example of a form, the zoœcia of which in contrast to the ordinary conditions are arranged in pairs. Each two of these zoœcia are as a rule connected by a single rosette-plate, which only belongs to the one zoœcium, while the opposite one has a corresponding opening in the wall. We may examine ever so many forms in this regard, but we will never find two rosette-plates opposite each other, but a rosette-plate on one wall always corresponds with an opening on the opposite wall. Strictly speaking the rosette-plate, as well as the apparently single lateral wall between two adjoining zoœcia, is also divided into two halves (Pl. XVII, fig. 10 b), which however in the case of the rosette-plate are very unequal in size, as the concave pore-bearing portion belongs to the one wall, while the opposite wall includes the pore-ring, which can then be seen on the inner (towards the inside of the corresponding zoœcium) surface of this wall as a more or less circular projection round the above-mentioned opening. The rosette-plates are arched inwardly towards the proximal zoœcium on the terminal partition-wall, which as already said is common to two zoœcia situated behind each other. The above-discussed arrangement of the rosette-plates can be illustrated in a very clear way by means of a variety of *Flustra securifrons*[2] with narrow branches found in the Kara Sea, in which the rather numerous uniporous rosette-plates are unusually strongly arched, so that they can be seen through the membranous oral wall. Inwardly arched rosette-

[1] ~~79~~, p. ~~42~~, [2] 53, Pl. XXVI, fig 9.
80, p. 421

plates are here only seen in the distal half of the zoœcium, and the first, outwardly arched plate, which can be seen proximally to the margin of the distal wall, only apparently forms an exception to the rule, because, namely, the distal wall ascends obliquely from the basal towards the frontal wall, and this plate belongs really to the distal zoœcium. We can easily convince ourselves that the same law applies to the pore-chambers if we examine the basal wall of a colony, which has such, as the lines in which the pore-chambers meet the basal wall shine through on its surface (Pl. IX, figs. 11 g, 12 a, Pl. XV, fig. 3 c). If we separate a row of zoœcia of a species which has well-developed pore-chambers, we find that a transverse section of the distal and proximal portions of a zoœcium has a very varying form, because the basal part of the lateral walls (or outer walls of the pore-chambers) in the distal half of the zoœcium meets the basal wall at a pointed angle (Pl. XVII, fig. 10 c), while the corresponding portion of the lateral walls in the proximal portion of the zoœcium, which is provided with openings to the pore-chambers, forms an obtuse angle with the basal wall. It is evident from this that the zoœcia of such a species, seen from the basal wall, are more or less plainly rhombic, even if when seen from the frontal surface they have an oval or rounded shape[1]. As the outer wall of the pore-chambers, as said before, forms obtuse angles with the frontal surface of the zoœcium the distal half of such a zoœcium will be surrounded by a marginal expansion (Pl. XVII, figs. 1 a, 1 c), formed by the pore-chamber. This expansion which in older zoœcia is covered by the surrounding neighbouring zoœcia may be easily seen in the marginal zoœcia of a growing colony. Just as the opening on the rosette-plate is smaller than its extent a little way inside this (fig. 10 b), the same applies to the opening of the pore-chamber, which is limited by two, more or less developed plates belonging to the outer wall, which plates we may call »lips«. They thus play a similar part to the projecting marginal portion of the rosette-plate which we have called the pore-ring, but while the latter always belongs to the opposite zoœcium the lips here are a part of the real pore-chamber, and the opposite zoœcium has only an opening corresponding to the opening between the lips.

In expressing as above the law with regard to the relation between the rosette-plates and the single zoœcium, namely, that the distal half of the zoœcium is furnished with rosette-plates and the proximal with corresponding openings, it should be understood that the word half, taken in a more restricted sense, only applies to such zoœcia as are arranged in regular quincunx, i. e. so that a

[1] 54, Pl. II, figs. 27—33, 55, Pl. IV, figs. 22—32.

terminal partition-wall between two zoœcia fits right opposite to a lateral wall in an adjoining zoœcium. On the other hand, if two adjoining zoœcia are placed in a different relation to one another, the distribution of the rosette-plates and the openings will also change. Even in those colonies where the quincunx arrangement is most regular, we will sometimes be able to find places where more or fewer zoœcia are arranged in a less regular way. If now two adjoining zoœcia, for instance in *Flustra foliacea*, are so placed in relation to one another that the one projects beyond the other by a quarter of its length, this quarter will be provided with a rosette-plate, while the other part of the lateral wall has nothing but openings, which correspond with the same number of plates in the adjoining zoœcium. The law ought really to be expressed in this way, that the part of the lateral wall of a zoœcium, which extends beyond the distal wall of the adjoining zoœcium, is furnished with rosette-plates, while the portion behind has openings. While most *Cheilostomata* are arranged in more or less regular quincunx, there are on the other hand species in which this arrangement can only be seen here and there, while the zoœcia are principally arranged in more or less regular transverse lines. This is for instance the case in *Smittina (Schizoporella) linearis*, and most of the zoœcia here will have either only rosette-plates or only openings on the side-walls. There is also a strong inclination to such an arrangement in *Membranipora monostachys*, and it is not unusual that a whole row of connected lateral walls have either only rosette-plates or only openings. *Electra pilosa* forms a peculiar exception from the common rule, and very likely this is also the case with the other *Electra* species. Although as a rule we have the true quincunx arrangement in this species, yet in a whole row of zoœcia on the same side we either find only rosette-plates or only openings. This difference is however accompanied by another, as the lateral walls which bear the rosette-plates are always much thicker and more strongly calcified than those with openings, and the last are very thin and after boiling in alkali often partly destroyed. We can now and then find a whole row of zoœcia, the lateral walls in which are thick and furnished with rosette-plates, but then both the corresponding rows of adjoining walls are thin and have openings.

We have up to the present only discussed the appearance of the rosette-plates on the vertical walls, but they may appear on the basal wall (posterior wall) as well as on the frontal surface, and in the first case both in two-layered and in one-layered colonies. Thus, in two-layered colonies, I have found them in *Smittina palmata* (Pl. XIX, fig. 5 b), *Porella saccata Por. compressa, Thalamoporella liovicha* (Pl. VI, fig. 7 i), *Steganoporella magnilabris* (Pl. V, fig. 5 b), *Dimorphozoum nobile* (Pl. IV, fig. 1 c, 1 d), *Microporella flabellaris* (Pl. XV, fig. 4 c) and *Micr.*

marginata (Pl. XV, fig. 3 c). On the other hand they are lacking for instance in *Flustra foliacea* and *Fl. securifrons.* They appear in the same way as the rosette-plates on the vertical walls, a rosette-plate on a zoœcium in the one layer corresponding with an opening in the opposite layer, but in none of the mentioned species are they found in all zoœcia of a colony, though for the rest they appear in very varying numbers. While they thus appear very scattered in *Steg. magnilabris,* they are found on by far the most zoœcia of *Microporella flabellaris* and *Mic. marginata,* and in the last species the connection between the zoœcia is as a rule a double one, every zoœcium possessing a rosette-plate as well as an opening.

Rosette-plates or pore-chambers may also appear on the basal wall of colonies with one layer. We thus find a number of uncalcified uniporous rosette-plates in *Euthyris obtecta* (Pl. XV, fig. 2 b) and *E. clilatrata*[1] where they might be considered as uniting the interior of the zoœcium with the space, which is bounded by the covering membrane, while a number of basal uniporous rosette-plates in *Hiantopora radicifera* (Pl. IV, fig. 6 b) serve as origin for the radical fibres which fasten the colony to its support. In the family which I have called *Petraliidae,* the species of which mostly appear in free colonies with one layer, the free basal wall is either furnished with rosette-plates or with pore-chambers from which radical fibres sometimes issue (e. g. in *Petralia tuberosa* Busk[2] and *P. dorsiporosa* Busk[2]).

We will now consider the appearance of the rosette-plates on the frontal surface. Busk[3] has already called attention to the fact that the species which he describes as *Carbasea Moseleyi,* possesses a number of formations in the distal half of the zoœcium, which quite correspond to rosette-plates, and these plates are also found in the distal part of the frontal wall in *Onchoporella bombycina* (Pl. XIII, fig. 9 a, 9 f), *Onchopora Sinclairi* (Pl. XIII, fig. 7 a, 7 b), *Calwellia bicornis* (Pl. XIII, fig. 8 a) and *Onch. dentata* (Pl. XIII, fig. 6 b), all of which species I refer to the family *Onchoporidae,* and to this family *Carbasea Moseleyi* and *Ichthyaria oculata* Busk[4] also probably belong. The rosette-plates in those species examined by me are furnished with a strongly developed pore-ring projecting into the interior of the zoœcium and are either round, uniporous or longitudinal, narrow and as if formed by a fusion together of from two to four uniporous plates placed in one row. To judge from figs. 4 a and 4 b the rosette-plates seem also to be uniporous in *Carbasea Moseleyi,* and the 8—10 small red spots, which Busk has found on the rosette-plates of the specimen stained with carmine,

[1] 19, Pl. XVI, fig 22. [2] 8, Pl. XVII, fig 7 d, Pl. XVIII, fig 4 b. [3] 8, p. 57. [4] 8, p 48

might be leucocytes, which can often be found fixed to the inner surface of many rosette-plates and which can easily be taken for pore-areas. *Euthyris obtecta* (Pl. XV, fig. 2 a) and *Urceolipora nana* Mac Gill. (Pl. XV, fig. 1 a) are also furnished with rosette-plates, and the marginal pores, which appear in a single or double row in numerous *Cheilostomata*, seem always to be rosette-plates, which are usually furnished with a single pore-area. We can for instance mention *Escharella immersa, Escharoides coccinea, Porella struma* and *Smittina palmata*. These rosette-plates are always without a pore-ring and are quite membranous, for which reason they quite disappear when boiled in alkali. Sometimes in many species — for instance in the species of *Cellepora* and *Holoporella* — they may come to lie at the bottom of shorter or longer canals, partly by the calcareous wall's growing in thickness, partly because the calcification takes place in such a way that the canals leading to these rosette-plates pierce the calcareous wall under very pointed angles. Such long canals can for instance be found in *Tessaradoma borealis* and *Escharella spinosissima*[1], and especially in the last species they are remarkable for their considerable length, so that even some of them may reach from the marginal portion almost right in to the middle line of the frontal wall. In other species these marginal pores are enclosed or overbuilt by small calcareous spaces which are furnished with a larger or smaller opening and which we may compare with the above-mentioned pore-chambers. We may mention *Smittina reticulata, Sm. palmata* (Pl. XIX, fig. 5 a), *Escharella variolosa, Discopora verrucosa* and *Disc. pavonella* as examples of species which possess such well-developed marginal cavities or areolæ. The three or four-sided areolæ are outwardly limited by a projecting line, which is simply a continuation of the lateral wall of the zoœcium, and are separated from one another by a number of transverse buttresses, which grow in length with age and in older zoœcia even touch one another in the middle of the zoœcium. Two adjoining lateral ridges will, as is the case with the lateral walls from which they spring, after boiling in alkali solution separate from one another, and if we look at such a separated row of zoœcia from the side we see these lateral spaces through the wall as light canals, which on superficial observation would seem to belong to the lateral walls. Still we must remember that the rosette-plates which lie at the bottom of these spaces are really placed on the frontal wall. It is not in all cases however that the superficial pore-chambers are externally bounded by such a projecting ridge; this is not the case e. g. in *Escharoides Jacksoni*, in which species these spaces are short, sac-like with an aperture facing

[1] 34. Pl. III, fig. 3.

towards the centre of the zoœcium. In *Haswellia australiensis* and *Hasw. coronata* the frontal wall is furnished with numerous pore-canals, each ending inwardly in a uniporous rosette-plate and as the rosette-plates belonging to the marginal pore-canals have their place in the outer part of the lateral walls, these rosette-plates thus form a connecting link between the common lateral rosette-plates and those belonging to the frontal wall. In species of the genus *Myriozoum* the whole of the frontal wall is furnished with closely placed, posteriorly directed sac-like pore-canals, each ending in a uniporous rosette-plate (Pl. XIX, fig. 16 a). In each canal is a chord of mesenchymatous tissue, which has a club-shaped widening towards the rosette-plate. In *Sclerodomus denticulatus* (Pl. XIX, fig. 18 a, 18 b) the frontal wall of the zoœcium is furnished with numerous curved, sac-like and widened pore-canals, which contain a similar chord of mesenchymatous tissue. Finally, I may mention that in all the species which have marginal pores and at the same time a median avicularium proximally to the aperture, the avicularium stands in connection with the first or sometimes also with the second pair of superficial rosette-plates, respectively through two or four shorter or longer canals, which issue from the distal part of the avicularian chambers. This is the case for instance with most species of the genus *Porella*.

All other so-called pores in the *Cheilostomata* are, as Pergens has already remarked, not real pores, and when this writer[1] states ces petits pores sont, en réalité, des cavités intersqueléttiques occupées par du tissu épidermique, en connection avec les parties squeléttiques et avec le parenchyme , this so far agrees with my observations, as I have always found the bottom of these pores closed by a membrane, which adheres directly to the calcareous skeleton and may with age be calcified to a more or less extent. In some of the species, for instance in ›*Lepralia Pallasiana*, a larger or smaller number of these pores may eventually become closed, and in *Smittina porifera* they may assume a very different appearance according to the different manner in which calcification proceeds. This membranous area in *Microporina borealis* is divided into a number of small areas by radiating calcareous ridges. The difference between such a pore and a rosette-plate is therefore only, that the latter is furnished with one or more very fine perforations, which are absent in the former. The pores as well as the marginal rosette-plates may as time goes on become surrounded by small chambers, and for instance in *Smittina porifera* and *Lepralia Pallasiana* a meshwork of ridges is formed over the whole surface. Regarding the pores of the oœcia, I need only remark that they are similar to those of the zoœcia.

[1] 93, p. 308.

The Compensation-Sac.

The compensation-sac was first noticed by Jullien[1], but the description which this writer gives of this important organ is not very detailed, and this might be one of the reasons why Jullien's discovery has either been quite overlooked or received with distrust by all later writers, until Harmer[2] rediscovered this organ and gave a fuller account of it. While I do not agree with Harmer in his view of the structure and development of the compensation-sac in *Discopora verrucosa* and the forms grouped with this species, my investigations agree otherwise with the general view he gives of this organ. It is a large thin-walled sac, which in the *Cheilostomata* provided with an arched calcified frontal wall (*Ascophora* mihi) lies immediately under this in the whole or the largest part of its extent and opens outwards either immediately proximally to the operculum, or occasionally further back, through an unpaired median opening, an »ascopore« (*Microporella, Inversiula, Tubucellaria, Onchoporella, Haplopoma, Adeona*). Its inner wall, which is attached distally to the proximal edge of the operculum, is on each side furnished with a row of muscular bundles, which in arrangement, grouping and attachment to the inner surface of the calcified lateral walls, correspond perfectly with the parietal muscles in the *Malacostega*, and there is no doubt that they have the same signification as these, because their contraction will extend the sac, thus causing it to be filled with water through its external opening with the final result that the polypide is extended. The observations made with regard to the first beginnings of this sac scarcely leave any doubt, that as a rule it is formed as an invagination of the original membranous frontal wall of the zooecium, whether the wall later on retains its membranous condition as in all groups furnished with a cryptocyst, or later becomes calcified as in *Hippothoidae* and *Catenariidae*. The first trace generally appears rather late, either distally to the operculum or to the median pore, and from there it gradually spreads over the rest of the frontal wall. A somewhat different mode of formation is found however in *Discopora verrucosa* and related forms. While Harmer[3] looks upon the compensation-sac as a true sac provided both with an inner and an outer membranous wall in all other forms examined by him, he has quite a different view of the corresponding formation in the above-mentioned forms. He states namely, that in these the membranous frontal wall provided with parietal muscles, which is seen on the quite young zooecia, later becomes covered by a fold, springing from the proximal and lateral margins, the inner lamella of which is calcareous and the superficial layer membranous, and the compensation-sac formed by this

[1] 45 a, p. 67–68. [2] 18 and 19. [3] 19, p. 293–297.

process possesses only an inner, membranous wall, the outer being calcareous. According to my investigations the fold which gradually covers the original membranous frontal wall is an evagination of this wall itself and therefore consists of two membranous layers, an inner which together with the primary frontal membrane forms the compensation-sac and an outer which forms the frontal membrane of the adult zoœcium. The calcareous layer seen within the covering membrane in the proximal part of the zoœcium, is a cryptocyst which grows into the cavity of the fold but only reaches its tip in the adult zoœcia, and therefore in all not quite developed zoœcia we see a curved or angularly bent line marking the free edge of this calcareous layer (Pl. XIX, fig. 2 a) proximally to the growing edge of the fold.

To make certain I have examined a number of longitudinal sections made with the aid of the microtome of *Umbonula pavonella* (Pl. XIX, fig. 2 b), in which the compensation-sac seems to show the same conditions as are found in *U. verrucosa.* The reason why I preferred the former species is only that our Museum's spirit-material of this species is of somewhat more recent date. Though the sections examined are not good, they are sufficient to establish the correctness of my view. While all the membranous or cellular portions are strongly stained and easily recognizable, which for example applies to the frontal membrane and the compensation-sac, all the calcareous walls appear as faintly stained, very fine lines. The ascending distal walls are more or less broken or folded in most of the sections, and this is also the case with the cryptocyst (cr) lying in the interior of the frontal evagination. Sections of younger zoœcia are only different in that the evagination is shorter.

Harmer has already drawn attention to the fact, that the above-mentioned »*Mucronella*« *pavonella* must be referred to the same genus as *Umbonula verrucosa* (*Discopora*), and to the same genus I must also refer the species of v. Lorentz's[1] genus *Ramphostomella.* In all these species the primary frontal membrane forms an evagination which encloses the cryptocyst and in young zoœcia of a certain development we see the free edge of this cryptocyst proximally to the free edge of the evagination (Pl. XIX, fig. 19 a).

Vestibulum.

Within the recent Bryozoa, as is known, an operculum only appears in the *Cheilostomata*, which in other respects are distinguished from the *Ctenostomata*

[1] 58, p.

by being more or less calcified as well as by having avicularia and oœcia. The possession of an operculum has been rightly regarded as the most important of the characters mentioned here, and it is therefore so much the more of interest that Waters[1] has shown that an operculum is lacking in the nutritive individuals of the genus *Bugula*. Nevertheless, that the species of this genus must certainly be regarded as *Cheilostomata* is evident, not only from the fact that they possess the other Cheilostome characters and are very closely related to the *Bicellaria* and other genera with an operculum, but also from the fact that they all have avicularia, which always have an operculum. Nitsche[2] has pointed out, and other writers confirmed, that the tentacular sheath from the proximal part of the zoœcium whence the polypide originates, grows forward as a solid chord, which is fastened to the inner frontal surface of the zoœcium in its distal part. Later, this chord obtains an inner cavity, which opens outwardly through a slit in the frontal wall of the zoœcium, and it is evident from this that the difference between the structure and development of the aperture in the *Cheilostomata* and *Ctenostomata* is conditioned by the different ways in which this chord-shaped formation is fastened to the inner surface of the zoœcium. In the *Cheilostomata* this attachment takes place in a semi-circular line and this results in the formation of a semi-circular opercular valve. As is known[3], we can distinguish in the tentacular sheath between two different regions: the true tentacular sheath, which in the retracted condition of the polypide encloses the tentacles, and a distal region, the vestibulum, which can be shut off from the true tentacular sheath by a muscular segment, the diaphragm, and as we shall see later the vestibulum may even in certain cases have another closing-apparatus placed distally to the diaphragm. As I have nowhere found in the literature a satisfactory account of the way in which the vestibulum is connected with the operculum as well as with the aperture of the zoœcium, I will try to give such here. If we imagine a zoœcium with the operculum quite open, but with the polypide drawn in, we can distinguish in the vestibulum between an inner or zoœcial, and an outer or opercular portion, of which the first is fastened to the edge of the aperture, and the latter to or a little within the edge of the operculum. Besides the two portions mentioned we also have on each side a triangular lateral portion (Pl. XIII, fig. 7 a) which connects the zoœcial and the opercular portions with each other, and which is folded into the vestibulum when the operculum is closed. The comparison between the vestibulum and a valved purse, the two metal guards of which might respectively correspond with the rim of the aperture and the rim of the operculum, which is

[1] 111, p. 12, [2] 80, p. ~~81—88~~. [3] 19, p. 272.
460, 462

used by several writers, is therefore not quite correct, and it would be far more correct to compare it with a division in a modern purse, in which the lateral walls when the purse is closed are folded into this. To explain the formation of such a vestibulum a simple horizontal dividing of the flat vestibular rudiment is not sufficient, as this would only lead to the formation of the zoœcial and the opercular walls. To explain the formation of the two free lateral walls it must, I think, be necessary to suppose that an invagination on each side has taken place together with the division of the chord-shaped rudiment.

The distal part of the vestibulum presents a number of differences, partly in the way in which it is fastened to the operculum, partly in its structure and nature, and we may here shortly mention some of the differences, the closer study of which however will require fresh investigation-material. While its frontal wall in a number of forms is fixed directly to the free edge of the operculum, as in most *Flustra* species, *Membranipora membranacea, Electra pilosa, Gemellaria loricata, Microporina borealis, Scuticella plagiostoma, Retepora Beaniana,* etc., in a number of other species it is fixed at a shorter or longer distance within the edge, in such a way that we must conclude that the frontal and basal walls have moved from each other after the division of the vestibular rudiment. For instance we find this the case in *Flustra abyssicola, Fl. carbasea,* in numerous members of the family *Membraniporidae* (*Callopora aurita, Tegella unicornis, Memb. arctica* etc.), in the family *Scrupocellariidae,* in the genera *Steganoporella, Bicellaria* and *Discopora,* in »*Lepralia*« *Pallasiana, Tubucellaria opuntioides* etc. In most of the *Cheilostomata,* and as it seems in all *Anaska* as well as in numerous *Ascophora,* the part of the frontal wall of the vestibulum, which adjoins the operculum, is more or less chitinized, whether this connection takes place in or within the edge of the operculum, and when such an operculum is isolated the chitinized portion of the vestibulum adheres to it as an arched chitinous ridge (the »opercular arch«) rising from its inner surface, which is lowest at its distal, central part, but which generrally on each side ends in a more or less triangular »flange«, which is a part of the above-mentioned lateral wall of the vestibulum and which goes directly over into the membranous part of this. If we compare opercula of the youngest and the oldest zoœcia in a colony, we sometimes (e. g. in *Microporina borealis*) find that the opercular arch is higher on the latter, and now and then this opercular arch shows distinct lines of growth. There is a cavity between the operculum and the frontal part of the vestibulum, the opercular cavity, and into this extend the occlusor muscles of the operculum, which in the forms with a well-developed opercular arch are generally fastened to this; if not, the opercular muscles are attached to the inner surface of the operculum itself.

Just as the part of the frontal wall of the vestibulum, which is connected with the operculum, may be chitinized, this may also be the case with a larger or smaller part of the inner wall of the vestibulum, as e. g. in *Euthyris clathrata* described by Harmer[1], in which species this writer has described a vestibular sphincter apparatus, similar to that which Hincks[2] formerly noticed in *Eurystomella bilabiata*. *In E. clathrata*[1] the somewhat chitinized inner part of the vestibulum first bends inwards and downwards into the zooecium and then again bends forwards and upwards in a semicircular fold, the chitinized part of which (labium) in the closed condition of the vestibulum, fits closely to the above-mentioned opercular arch, which in this way forms an under lip, while the labium forms the upper lip. Also in *Euthyris obtecta* according to Harmer's investigations there is a delicate labium. Hincks was the first to find a two-lipped vestibulum in »*Lepralia*« *bilabiata*, and as I have been able by the great kindness of Professor Whiteaves to examine Hincks' original specimen, I can confirm that the sphincter-apparatus like that in E. *clathrata* consists of an upper lip (labium), formed by the inner portion of the vestibulum, and an under lip, formed by the opercular arch, which Hincks calls »a semicircular chitinous rim, as it were soldered to the inner surface of the operculum«. I have found a quite similar two-lipped vestibulum in the closely connected species *Lepralia foraminigera*, while I have found a vestibular two-lipped sphincter-apparatus of an essentially different structure in the genus *Steganoporella*. It is placed at the proximal part of the operculum, and consists of two quite similar semicircular lips slightly chitinized at the free margin, both of which are folds of the vestibulum and have no connection with the opercular arch. From the zooecial aperture's distal rim or anter in quite a number of forms there springs a more or less developed, calcified portion reaching into the zooecium, in most cases in the form of a low, arch-shaped calcareous ridge, which seems to have originated from a partial calcification of the inner or basal portion of the vestibulum. Such a structure, which we may call a »vestibular arch«, is found in the family *Reteporidae* (Pl. XXIII, figs. 4 a—c), where it is as a rule crenulated, in *Macropora centralis* Mac Gill. (Pl. VII, fig. 1 a), in most species of the genus *Microporella* (Pl. XV), and in the genera *Escharina* (Pl. XVIII), *Escharella* (Pl. XVII) and *Escharoides* (Pl. XVII, figs. 5 b, c). It reaches its highest development in the two last-mentioned genera, and it is shown plainly in a number of figures in Busk's Crag Polyzoa[3]. The species which shows the highest degree of development of this portion is *Escharella diaphana* Mac Gill. (Pl. XVII, figs. 1 c, 1 d), and it is here in the same

[1] 19, p. 266. [2] 31 p. ~~23~~. 49 [3] 7, Pl. VI, figs. 4, 8; Pl. VII, figs. 1, 3 etc.

manner as the above-mentioned chitinous region in *Euthyris clathrata* bent strongly basally and afterwards again frontally so that it forms a hood-shaped cavity with a frontal concavity. This vestibular arch, which arises from the distal rim of the primary aperture must not be confounded with the arch-shaped cryptocyst-ridge, which in a number of species of the genera *Steganoporella* (Pl. V, figs. 5 a, 6 a, 3 a) and *Thalamoporella* is placed between the basal (horizontal), and the frontal (obliquely ascending) portion of the distal wall. Waters[1] who was the first to speak about it calls it an oral shelf. It was later mentioned by Harmer[2].

The operculum.

In its simplest form the operculum is a semicircular membranous valve, which passes evenly over into the frontal membrane and is only chitinous where it meets with the opercular arch. We might give a line running between the two corners of the opercular valve as a border towards the frontal membrane, and round this line, the hinge-line, the valve turns during the folding in and out of the polypide. Such an opercular form can be found in most of the *Malacostega*, in a number of *Coilostega*, as also in not a few members of the division *Ascophora*.

In contrast to the opercular form just described, in other forms we meet with an opercular valve which is separated in different ways from the frontal membrane, and in the simplest cases by its proximal rim being furnished with a chitinized thickening (basal sclerite, Harmer), which on each side is connected with the chitinous opercular arch. Besides in *Chlidonia Cordieri* and most *Steganoporella* species (Pl. V, fig. 3 c) such an operculum is found in a number of species of the genus *Thalamoporella*, e. g. in *Th. expansa* (Pl. VI b, fig 5 b), *Th. mamillaris, Th. Jervoisii* (Pl. VI a, fig. 4 e), etc., while in other *Thalamoporella* forms the operculum is only partially separated from the frontal membrane by means of a shorter or longer basal sclerite on each side (see Pl. VI b, fig. 6 a). The opercular valve can also be seen either entirely chitinized or calcified, and I have already mentioned earlier the few recent species which possess a calcified opercular valve. Within the group *Malacostega* I have found a completely chitinized operculum both in some, not yet described *Onychocella*-species (Pl. XXII, fig. 3 b) and in some members of the family *Scrupocellariidae*, namely in *Caberea Boryi* and *Cab. Darwini* Busk and in a new *Scrupocellaria* species. In these three species the operculum is enclosed by a completely calcified rim, the proximal part being bounded sometimes by two projections from the calcified lateral parts of the zoœcium (*C. Darwini*), sometimes also by the here highly developed plate-like

[1] 107 a, p. 51; [2] 17, p. 227.

spine, which as is known appears in very different degrees of development in a number of members of this family. As a similar enclosure of the operculum is also found in *Menipea clausa* Busk[1], *Men. Jeffreysi* Norman[2] and *Scrupocellaria marsupiata* Jull.[3], it seems probable that the operculum in these species has a similar structure. Besides in the species just mentioned, we find an independent opercular valve in the Coilostegous genera *Micropora* and *Cellularia*, and in the genera of the division *Ascophora*: *Microporella*, *Inversiula*, *Onchopora*, *Urceolipora*, *Chorizopora*, *Haploporna*, *Adeonellopsis* and *Tubucellaria*. While we may briefly call such an operculum as appears in most of the *Malacostega* an opercular valve, I would propose the designation »simple operculum« for any opercular valve, which is distinctly marked off from the frontal membrane, and can consequently be isolated as an independent formation. While the proximal edge of such an operculum forms as a rule a straight line it is more or less concave in a number of species of the genera *Cellularia* and *Thalamoporella*, so that the hinge-line falls a little proximally to the edge, and in such cases the simple operculum does not fill the whole zoœcial aperture, the proximal part of which is filled by a membrane. Within the division *Ascophora* the same thing appears in a new form from Singapore belonging to the family *Petraliidae*. Jullien[4] has founded a genus: *Chaperia*, the species of which were formerly referred partly to *Membranipora*, and partly to *Monoporella*, and Waters[5] says regarding this genus: »This group was indicated by Jullien under the name of *Chaperia*, but while he based it upon two lateral plates, which I have shown are for the attachment of the opercular muscles, and do not occur in all species, the important character is the form of the operculum, which is separable, and which has at each side an elongate protuberance for the attachment of the muscles.« In opposition to Waters I would maintain that the most important generic character is the two plates mentioned, which I have found in all species I have examined, whereas the operculum according to my investigations is subject to a fairly considerable variation. As Waters refers both *Memb. galeata* and *Memb. cristata* to *Ch. annulus* Manz., we must, before speaking about the operculum in the different forms, make the admission that our material is too small to venture on expressing an opinion as to the identity of the two last-mentioned forms, which in any case are very closely connected. In a species, which under the name of *Memb. cristata* has been sent me by Miss Jelly and which came from South Africa, the opercular valve occupies nearly the whole of the distal half of the large oval aperture of the zoœcium, and is in its proximal portion furnished within each lateral rim with a very

[1] 8, p. 20; [2] ~~80~~ 81, p. 416; [3] 43, p. 507; [4] 45, p. 61; [5] 112, p. 655.

thin and not very long sclerite sloping distally and inwards. The opercular valve as well as the membrane which occupies the rest of the aperture of the zoœcium, is thin and fine and not more chitinized than the membrane, which covers the calcified frontal surface of the zoœcium. In a new species from New Zealand, which is provided with six branched spines, the opercular valve and the membrane which occupies the rest of the oval zoœcial aperture, are not more chitinized than the rest of the covering membrane, but the opercular valve is at a considerable distance from the rim furnished with a continuous arched sclerite. We will call this species *Ch. arcifera.* While the operculum in *Ch. cervicornis* has a similar structure as in *Ch. cristata,* it shows some difference in a form which under the name *Memb. galeata,* v. *erecta* has been sent me from the British Museum. The two sclerites are somewhat shorter here, and the opercular valve as well as the membrane which fills up the rest of the aperture is here somewhat more chitinized and somewhat more yellow in colour than the covering membrane, without however the limit between these portions being very sharp. The aperture of the zoœcium is shorter and wider in *Ch. spinosa* than in the above species, and the largest part ($^3/_4$ or $^4/_5$) of it is taken up by the opercular valve, which is here furnished with two long and strong sclerites. The opercular valve and the membrane filling up the rest of the aperture form here a plate which in its stronger chitinization stands in great contrast to the covering membrane connected with it. Finally, the broad triangularly rounded aperture in *Ch. Capensis* is as in the other species filled by an opercular valve with two strong and short sclerites and a supplementary membrane, but both are here fused together into a strongly chitinized plate.

It is evident from the foregoing comparison that the portion which has been named by authors »the operculum« in *Ch. spinosa* and *Ch. capensis,* not only corresponds to the simple operculum in a *Cellularia, Micropora,* etc., but also with an adjoining portion of the original membranous cover. These two portions are here fused together to a chitinous plate, of which only the distal portion, which has a free rim and is connected with the vestibulum, can emerge from the zoœcium. Further, a consideration of the shape of such an operculum will alone be sufficient to come to this result, for since the hinge-line must be in a straight line, it is evident that an operculum which has an arched proximal rim cannot emerge from the zoœcium at its proximal portion. An operculum like that here mentioned we may call a »compound operculum«, understanding therewith an opercular formation in which the opercular valve is fused together with an adjoining portion of the original membranous cover to form a single, more or less strongly chitinized plate, in which we can distinguish between the valvular portion and the accessory portion. Within the division *Anaska* such a compound operculum appears not only in the mentioned *Chaperia* species but also in *Megapora ringens* and *Foveolaria elliptica* (Pl. VIII, fig. 7 b), but in these two species with the peculiar modification, that the valvular portion and the accessory portion are here connected by a low linear belt of thinner material in their whole breadth.

Besides in the members mentioned of the division *Anaska* a compound operculum appears in most members of the division *Ascophora*, and it may here be characterized as a double operculum, as it really has a double function. While the accessory portion of the operculum, which is placed proximally to the hinge-line in the *Anaska* forms mentioned, is connected with the covering membrane of the zoœcium, it is continuous with the basal or inner wall of the compensation-sac in the *Ascophora*, while the frontal wall of this sac is connected with either the distal rim of the covering membrane (in the forms which possess a Cryptocyst), or (where such is lacking) with the distal rim of the calcified frontal wall (*Hippothoidae* and *Catenariidae*). This was already shown by Jullien[1], who calls attention to the fact that the hinge-line of the operculum does not coincide with the proximal rim of the operculum, but lies more distally, while the opening which leads into the compensation-sac is placed immediately proximally to the operculum. When the valvular portion of such a compound operculum emerges from the zoœcium, the accessory portion will on the other hand go down into it and thus open the compensation-sac, to which it serves as operculum. In all such cases where an operculum ends in a proximal convex rim or a rim furnished with a projecting median portion, as for instance in all the species referred to the genera *Lepralia* and *Schizoporella*, it is evident that we have to deal with a compound operculum, as a simple operculum must always end in a proximally straight or concave edge. On the other hand, the presence of such an edge does not exclude the possibility, that the operculum may be compound, and the only certain way to settle the question is to find the hinge-line of the operculum. An articulation similar to that which takes place between the valvular portion of the operculum and the accessory portion in *Megapora ringens* and *Foveolaria elliptica* occurs within the division *Ascophora* in the genus *Arthropoma*, which includes the two species *A. Cecili* and *A. circinata*, because the small proximal process of the operculum is connected in a similar way with the valvular portion of the operculum.

We have already under the compensation-sac discussed the well-known fact, that a series of forms have a median pore, placed at a greater or less distance from the zoœcial aperture, which leads into the cavity of the zoœcium. It has

[1] 45 a

been proved for some of these forms that the compensation-sac opens out through this pore and there is hardly any reason to doubt, that this applies to all. Most of them have a simple operculum, and a compound operculum is only found in species of the genera *Onchoporella* and *Calwellia* (Pl. XIII).

Just as a simple operculum may either be quite chitinized or only separated from the covering membrane by a basal sclerite, a compound operculum may also be formed in these two ways. While for instance we have a completely chitinized operculum in the genera *Schizoporella*, *Escharina*, *Microporella*, *Myriozoum* as also in certain *Chaperia* species, the compound operculum in other forms is membranous or very slightly chitinized and only separated from the basal wall of the compensation-sac by a basal sclerite. This is the case for example with the operculum in *Eurystomella foraminigera*, *Hippopodina fegeensis*, *Cheilopora sincera*, *Smittina porifera*, in numerous species of the genus *Holoporella* and in all members of the family *Onchoporidae*. In most species of the genera *Escharella* and *Escharoides*, in all species of the genus *Discopora* and in a number of species within the genera *Smittina*, *Holoporella* and *Petralia* the aperture is covered up by a membranous operculum, the distal part of which is formed by an opercular valve, while the proximal portion goes immediately over into the compensation-sac.

The connection between the operculum and the zoœcial aperture in the *Cheilostomata* may take place in two different ways, which in a few instances are used at the same time, namely partly by direct connection between the proximal edges of the aperture and of the operculum, and partly by a connection of very slight extent which occurs at each end of the hinge-line. The first mode of connection is found in all the *Anaska*, and in those *Ascophora* in which the compensation-sac opens out through a median pore separated from the aperture of the zoœcium. The simultaneous occurrence of both modes of connection is found in a number of acanthostegous and coilostegous forms, for instance in *Figulina figularis*, as well as in the genera *Thalamoporella* and *Steganoporella* (Pl. V), and in the last mentioned genus, the species of which have an usually large and, owing to its chitinous armature, heavy operculum, this last connection is very firm, the tip of the strong and conical hinge-teeth being connected by a rather long and cylindrical chitinous band with the proximal corners of the strong opercular arch.

In all *Ascophora*, the compensation-sac of which opens out through a part of the aperture which can be closed by the proximal or accessory portion of the operculum, the operculum is only in firm connection with the aperture on each side of the hinge-line, and in most forms which have a well-developed opercular arch, a similar connection takes place between this and the aperture as that found in the genus *Steganoporella*.

We may mention *Emballotheca quadrata* (Pl. XX, fig. 11 a), *Euthyris clathrata*[1], *Calpidium ornatum* (Pl. XVIII, fig. 13 b), *Lepralia vestita* and *Pterocella alata* (Pl. XXI, fig. 4 a) as examples of species with large and strong hinge-teeth while on the other hand the hinge-teeth are quite lacking e. g. in species of the genera *Discopora* and *Escharoides*. In the forms which have no opercular arch at all, or in those with an imperfectly developed one, the connection takes place either on the very margin of the operculum or within this, and the first of these cases we find in the genus *Porella*. In *P. struma* for instance we find in each of the proximal corners an elongated thickening, which forms almost a right angle with the muscular ridge and which is in connection with the aperture. In *Myriozoum truncatum* on the other hand the proximal part of the operculum is on the inner surface surrounded with a strong marginal thickening and in the distal part of this on each side is found a rather large oval pit into which a rounded hinge-tooth is immersed.

The aperture, besides being furnished with hinge-teeth may have other protuberances or teeth, and of these we may now mention some which from their position must be supposed to support the operculum, or to counteract an external pressure on the latter. Such formations, which have their place either within the proximal or within the distal rim of the operculum, may appear sometimes in pairs, sometimes as a single, low plate, and are found in forms which have a simple operculum (*Cellularia*, *Microporella*, *Micropora*), partly in forms, the aperture of which has a small but sharply marked sinus (*Arthropoma*, *Escharina*, *Schizoporella*). In the *Cellularia* species, where in a smaller number of cases they may be found both within the proximal and the distal rim, they most frequently appear as small, paired, rounded or conical teeth, which may occasionally be long, like canine teeth, as in *C. rigida* (Pl. VIII, fig. 1 a), where they appear both proximally and distally. In a few species such a pair of teeth is replaced by an unpaired low plate, which is proximal in *C. angustiloba*[2], distal in *C. Charlesworthii*[3]. In the species of the genus *Microporella* (Pl. XV), we generally find in the whole breadth of the proximal margin a more or less developed supporting beam, sometimes with two small conical teeth, and such is also found in *Micropora centralis* (Pl. VII, fig. 1 a). To the same sort of formations as those just mentioned we must probably also class the curved and pointed tooth, which is placed on each lateral rim of the aperture within the

[1] 19, Pl. XVI, fig. 20—21. [2] ~~75~~, Pl. III, fig. 16a, [3] 7, Pl. X, fig. 4 a.
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operculum in *Petralia porosa*, *Pet. vultur* and in a new species from Singapore. These teeth, which without closer examination would be regarded as hinge-teeth, have really nothing to do with the suspension of the operculum, which takes place distally to them.

While these teeth all have their place on the inside of the operculum we also on the outside find unpaired as well as paired ones. A median tooth is found as is known in numerous species within the genera *Escharella* (Pl. XVII), *Escharoides* (Pl. XVII), *Exochella* (Pl. XVII), *Smittina* (Pl. XVIII, fig. 12 a), *Discopora* etc. and its frequent presence in species which have a membranous or slightly chitinized operculum, shows that it must be regarded as a protective formation. Lateral teeth appear on the peristome in certain species of the genus *Escharoides* (Pl. XVII), besides in the species of the genus *Exochella* (Pl. XVII), and Jullien[1] considers these teeth in *Ex. longirostris* (Pl. XVII, figs. 9 a, 9 c) to correspond with the hinge-teeth in *Smittina*, although they can grow together with the median tooth.

We have already called attention to the fact, that the occlusor muscles are most often fastened to the opercular arch, where such is in any way well-developed, and they are then as a rule fastened to the apex of a more or less developed triangular lateral portion, well-developed in *Euthyris clathrata*, but only slightly indicated in the low, but strongly chitinized opercular arch in the *Steganoporella* species, which is often placed a good way within the free margin of the operculum. Where the opercular arch is wanting, or only slightly developed the occlusor musles are as a rule fastened to the inner surface itself of the operculum, and we can here again distinguish between two cases, according as they are fastened to special ridge-shaped protuberances or to a pair of small, pit-like spots, which Waters has called »muscular dots«. Such muscular dots can for instance be found in the genera *Cellepora*, *Lekythopora*, *Arthropoma*, *Conescharellina* and *Schizoporella* (Pl. XVIII, figs. 3 e, 4 e, d), while muscular ridges appear in the genera *Porella*, *Escharina* (Pl. XVIII, fig. 2 e) and *Tubucellaria*.

We must finally remark upon the fact that the operculum in a number of Coilostegous forms consists of two layers, namely an external membrane, which forms a continuation of the covering membrane of the frontal wall, and an internal chitinized or calcified layer, which we must regard as the operculum's cryptocyst. Such an operculum with two layers is found, besides in the species of the genus *Cellularia*, in *Microporina borealis*, *Micropora coriacea*, *M. Normani* n. sp. (Pl. VIII, figs. 3 a, 3 b), *M. perforata*, as also in a species described in this work which I have identified with *Macropora centralis* Mac Gill. (Pl. VII, figs. 1 a, 1 d). In the last

[1] 45, p. 55.

as well as in *Micropora Normani* (Pl. VIII, fig. 3 b) the deeper layer of the operculum is calcified and has quite the same appearance as the cryptocyst of the frontal wall. In a figure drawn by Calvet[1], representing a longitudinal section through *Cellularia fistulosa*, it is seen very plainly, that the two layers of the operculum meet in the distal and the proximal rim, but that they are also separated by a space.

Within the division *Ascophora* an operculum with two layers has hitherto only been found in the interesting species *Enthyris clathrata* Harmer. It consists of two chitinized layers which are fused together along the proximal rim of the accessory portion of the operculum and in a median part connected with this, but otherwise they are separated by a distinct space.

We cannot leave this section without touching upon the terminology used for the description of the opening in the zoœcium which is covered by the operculum and by the frontal membrane. While Johnston[2] generally uses the word »aperture« not only for that portion of the zoœcium which is covered by the frontal membrane in the *Malacostega*, but also for the opening which is covered by the operculum in the *Coilostega* and *Ascopora*, Busk[3] in his catalogue only uses this name for the zoœcial opening in the *Malacostega* and the word »mouth« for the opening which is closed by the operculum in the *Coilostega* and *Ascophora*. Hincks[4] consistently maintains a similar distinction, using however the word »orifice« instead of »mouth«, and he also indicates by this the opening covered by the opercular valve in the frontal membrane of the *Malacostega*. In his general review of the genus *Membranipora* he makes the following statement: »The terminology employed in describing the members of this genus requires a word of explanation. The area is the portion of the cell surrounded by the raised margins. The aperture is that part of it which is not closed by a calcareous wall; and on this is placed the true orifice — a semicircular opening, with a valvular operculum«. Apart from a few inconsistencies Busk follows Hincks' terminology in his work on the *Bryozoa* of the »Challenger« Expedition; while Waters in his numerous works describes the opening which is covered by the operculum as an »oral aperture«, or simply as »aperture«, and he also uses the latter for the zoœcial opening in the *Membranipora*. Finally, Mac Gillivray[5] in a work on the tertiary *Bryozoa* of Victoria has felt himself obliged to replace Hincks' term »orifice« with a new term »thyrostome«, concerning which he writes: »The nomenclature is that in general use. The only innovation of any consequence I have made is the introduction of the term »thyrostome« (*θυρα στομα*) for the

[1] 9, Pl. VI, fig. 11. [2] 41 a. [3] 2. [4] 22. [5] ~~72~~, p. 2
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opening through which the tentacles and oral extremity of the polypide are protruded. The terms orifice, oral aperture and mouth are inaccurate and confusing and the proposed name will I think prove advantageous«.

It is evident from the above morphological considerations on the operculum, that when we exclude the small number of species which are furnished with a simple operculum, we have in all other Cheilostomatous *Bryozoa*, on the frontal side of the zoœcium, a larger or smaller opening (viz. an uncalcified portion) which is covered by an operculum in connection with a larger or smaller portion of the original frontal membrane. The relation between this portion and the opercular valve may be very different both in regard to the mutual size of the two portions and to their nature. In the *Malacostega* both are generally membranous and the opercular valve is as a rule many times smaller than the rest of the cover. We find a completely chitinized opercular valve however in a number of *Onychocella* species (Pl. XXII, fig. 3b), as well as in a number of species of the family *Scrupocellariidae*, and in quite a number of *Membranipora* forms the suplementary cover is greatly reduced in extent. This is for instance the case in *Callopora minax*, *C. trifolium*, certain varieties of *C. Flemingi*, *Rosseliana Rosseli* and *Membraniporina argentea* Mac Gill.[1], in the last of which it may be smaller than the opercular valve. In the *Ascophora* the suplementary cover, or as we before have called it the accessory portion, is frequently fused together with the opercular valve to a well chitinized, compound operculum, but in quite a number of forms (e. g. in *Discopora* species, certain *Escharoides* species, etc.) the structure of the operculum is not different from that we find in the *Malacostega*, because the opercular valve as well as the suplementary cover is membranous. On the other hand we find in a smaller number of *Malacostega* a well-chitinized, compound operculum, as in *Chaperia spinosa*, *Ch. capensis* and *Megapora ringens*, and I do not doubt that »*Lepralia*« *Poissoni* and *Dorypprella spathulifera*[2], both of which have a well-chitinized, compound operculum, must also be classed with the division *Malacostega*.

For these reasons we propose to keep the term »aperture«, which Johnston uses, for the frontal zoœcial opening in all *Cheilostomata*; for, even though it might be right to use a special term for the opening covered by a simple operculum, two separate terms would be unpractical, as the forms provided with a simple operculum occur as a rule in families together with forms which have a compound operculum. It can always be settled, by examination of the form of the operculum and the aperture, the position of the hinge-teeth and of the corresponding

[1] 74, vol. I, Pl. 37, fig. 2 [2] 84, p. 106.

parts of the operculum, which part of the aperture corresponds to the opercular valve, and if we require a special expression for this we may call this »the valvular aperture«.

Polymorphism in the Bryozoa.

As is known polymorphism also occurs in the *Bryozoa*, but in contrast to the case in the Hydroid polyps it is not present in all species, even not in all genera or families. We can distinguish between four main forms of individuals (Bryozooids):

Autozoœcia (Autozooids), which contain a polypide, consisting of a tentacular apparatus and a well-developed digestive canal.

Heterozoœcia (Heterozooids), which have no intestinal canal, and at most have a trace of a polypide in a small cell-body, furnished with a circle of fine bristles. The chamber contains a strong muscular apparatus for moving the operculum, which sometimes only covers the aperture, in which case the Heterozoœcium is called an Avicularium, and sometimes extends beyond this in the form of a whip, as in the so called vibraculum, but otherwise there is no sharp limit between these two forms of heterozoœcia.

Kenozoœcia (Kenozooids), which not only have no polypide, but as a rule no aperture and always no operculum. While the Autozoœcia might be regarded as alimentary individuals, the Heterozoœcia as defence individuals, the Kenozoœcia must be regarded as supporting, fastening and connecting individuals. To this class of individuals belong: the segments which compose the thread-like basal parts in numerous *Ctenostomata*, in the Cyclostome genus *Crisia*, and a smaller number of *Cheilostomata* (*Buskia*, *Alysidium* etc.), the segments which form the upright stems in *Stirparia*, *Alysidium* and *Chlidonia*, and certain portions of the branches of the last, the radical fibres and the chambers for the insertion of the radical fibres in *Scrupocellariidae*, *Catenariidae* etc., the peculiar lateral compartments in the *Catenariidae*, the modified marginal individuals, which appear for instance in *Flustra securifrons* and *Fl. carbasea*, the small chambers which form the encrusting base and the outer (basal) layer of the *Retepora* colonies, the peculiar cavities which appear among the zoœcia in *Membranipora Lacroixi*, *Cribrilina latimarginata* etc., the supporting tubes in the *Cyclostomata*, as also the small chambers which surround the oœcia in the family *Hippothoidae*, in many species of the family *Catenariidae* etc. (see under oœcia).

As a fourth class of colonial individuals we may perhaps in many species regard the egg-producing individuals (*Gonozoœcia*). While in many cases, e. g. in *Membranipora membranacea*, all individuals in the colony seem able to produce eggs, this function in other forms is in charge of special individuals, which may often differ greatly from the ordinary zooecia (*Adeonidae*, *Catenariidae*, certain *Hippothoa* species), and which occasionally have no polypide (*Hippothoa hyalina*). They are in most cases furnished with separate marsupial chambers, the so-called ooecia.

I may now make some mainly comparative observations on the structure of the Heterozooecia. If we look at the frontal surface of an avicularium, the operculum (or mandible) of which has been removed, we find that a greater or lesser part of this surface is occupied by an aperture covered by a membrane, within which there is often found a more or less developed cryptocyst. This part corresponds with the membranous area in the zooecia of a *Membranipora*, but while such an area in the zooecia is only found in the division *Malacostega*, it is found in the avicularian chamber in all Cheilostomatous *Bryozoa*. We may further discern between two different parts of this area, a distal, the opercular area, which is covered by the operculum and a proximal, the subopercular area, and the border between the two areas is formed by the hinge-line, which coincides with the proximal edge of the operculum. This border is in all *Ascophora* with the exception of the *Adeonidae* and of *Leieschara crustacea* also indicated by a calcareous cross-bar, arising from the prolongation and amalgamation of the two hinge-teeth, and besides in the genera *Nellia*, *Figulina*, *Arachnopusia*, *Micropora*, *Microporina* and a few *Membraniporina* (e. g. in *M. crassimarginata*) species, in which such a cross-bar is also present, the two hinge-teeth are separated in all other *Anaska*. Waters has already called attention to this difference.

The cryptocyst, which can be present both in the opercular and the subopercular area reaches its highest development in the heterozooecia of the genera *Onychocella*[1] and *Rhagasostoma*, the former of which is mainly and the latter exclusively represented by extinct species. The cryptocyst is here, as in certain fossil species, which for the present I refer to the genus *Aspidostoma* (Pl. VI c, figs. 3 a, 4 a), extended over the greater part of the frontal wall of the chamber and is only provided with a small opening of varying shape, which is intersected by the hinge-line of the operculum and through which the muscles make their way out to the operculum or mandible. In the avicularia of *Flustra foliacea* the cryptocyst extends over most of the subopercular area and something similar takes place in the avicularia in several *Thalamoporella* species (Pl. VI a). A well-developed cryptocyst is also found in the opercular area of the large avicularia in *Flustra abyssicola* as well as in that of the large lyriform or spoon-shaped

[1] 86, Pl. 675, figs. 2, 15

avicularia which occur in *Thalamoporella lioticha* (Pl. VI), *Thal. novae hollandiae* (Pl. VI a), *Cribrilina figularis* etc. On the other hand, a cryptocyst is quite lacking in the heterozoœcia in the families *Bicellariidae*, *Scrupocellariidae*, *Calenariidae* etc.

On account of the free movement required by the operculum (mandible) of the heterozoœcia, this is always simple (pag. 38), and naturally ends in a straight proximal edge. While the basal and frontal wall of the vestibulum in an ordinary zoœcium are connected by two free lateral walls, which on the closing of the operculum are folded, the latter are absent in a heterozoœcium, and the vestibulum is consequently here developed in the shape of two separate laminæ of which the basal takes up the opercular area, while the frontal, which proximally is joined to the basal, extends over the internal surface of the mandible. We saw above that in an ordinary zoœcium the frontal wall of the vestibulum may sometimes be attached to the edge of the operculum, sometimes at a greater or smaller distance within this. This is also the case with the heterozoœcium, only that the variation is still greater here. While for example the frontal lamina of the vestibulum is attached to the edge of the mandible itself in the small avicularia with a semicircular mandible, which is found in most species of *Flustra*, *Porella*, etc., in the large avicularia of *Flustra abyssicola* (Pl. XIX, fig. 13 a) it is only attached to a triangular median belt, which decreases in breadth distally and does not reach right out to the tip of the mandible and the latter is thus provided with two wing-shaped lateral parts. In the *Onychocella* species (Pl. XXII, fig. 3 d) the frontal lamina is only attached to the proximal part of the mandible over a small triangular area, and still further proximally the attachment takes place in the flagellum of the real vibraculum. As the vestibulum in the heterozoœcium as already stated consists of two separate laminæ and does not, as in the zoœcium, form a funnel-shaped tube, the frontal lamina comes into closer relation to the mandible, and for that reason the latter obtains the character of a two-layered plate, which between its two layers encloses a space, the mandibular cavity (Pl. XIX, 10 b, 13 a, 14 a, 15 a, 15 b), corresponding to the opercular cavity. While the mandible itself is always more or less strongly chitinized and as a rule provided with a rounded spot of thinner nature (the so called »lucida«), near its proximal portion the vestibular covering of the mandible may sometimes be perfectly membranous, sometimes more or less strongly chitinized over a larger or smaller portion of its surface. It seems thus to be completely membranous in the large avicularia found in a number of *Cellepora* species, while we very often find in the small avicularia with a semicircular mandible, which so frequently appear in *Flustra*, *Porella* and *Cellepora*, a distinctly chitinized marginal region, which consequently corresponds to the previously mentioned opercular arch. There is also a distinct contrast between the marginal region and the median region of the vestibular layer in the above-mentioned avicularian mandibles of *Flustra abyssicola* and *Onychocella* sp (Pl. XXII, fig. 3 d), because the marginal portion, which forms the lateral walls in the mandibular cavity is strongly chitinized and shines through the surface of the mandible as two brown ribs converging towards the apex. In the elongated pointed mandibles of *Flustra denticulata*, *Microporella marginata*, *Schizoporella longirostris* and *Scuticella plagiostoma* the vestibular layer is chitinized over the greater part of the length of the mandible, although at the proximal part of the mandible it changes to a softer part, and a longitudinal section through such a mandible (Pl. XIX, fig. 10 b) shows that the inner cavity towards the apex of the mandible dwindles to a very fine canal; this seems to suggest that the narrow solid tip is formed by a fusion of the two layers. It is not always, however, that such translucent lines arise from the vestibular layer, as many mandibles may be provided with two distally converging ridge-shaped thickenings which, like the ridges mentioned under the zoœcial operculum, are projections from the inner surface of the mandible itself. Such converging ridges are found in the mandibles in most species of *Porella*, in *Discopora*, etc.

Time does not permit us to enter into further details here regarding the muscles of the avicularia, and we may just recall that for the movement of the mandible there are abductors or openers, and adductors or closing muscles. While the first are always double, the latter are sometimes single, sometimes double, and in many cases two separated muscles are attached to the mandible by a single tendon. More rarely we also find parietal muscles (*Flustra* species, *Escharoides coccinea*).

Waters, as is known, has shown that the cavities provided with an elongated triangular opening in the extinct *Eleidae*, which were formerly taken to be oœcia, must in reality have been avicularia-like formations; they differ however from the cheilostomatous avicularia, in always lacking a membranous subopercular area. In a number of these species I have found a calcified mandible.

Oœcia.

Before giving a comparative account of the structure of the oœcia, we may summarise what the literature and especially the older contains regarding these formations. The first writer where we have been able to find anything about the oœcia, is John Ellis[1], who in his well-known work on the Corallines not only treats of the hydroid polyps, coral algae, various *Octactiniae*, sponges etc., but also of a number of *Bryozoa*. In a number of species of the genera *Bugula*, *Bicellaria* and *Scrupocellaria* he has noticed and figured the oœcia, which he terms »Balls, testaceous Spherules», or »testaceous Figures«[1]; but while he recognised, although in an imperfect way, the importance of the gonothecae for the reproduction of the hydroids polyps[2] (»I discovered that they were Matrices or Habitations of young Polypes, which are produced here and there, on the Sides of the Parent, as in the Freshwater Polype«), he does not seem to have reached to a similar comprehension of the oœcia. He only speaks in detail about the oœcia of a tropical *Bugula* species, *B. neritina*[3] and expresses here the very remarkable view that they are a sort of small snails, from the eggs of which the colony originates: »I plainly discovered it to be the connected Niduses or Matrices of certain testaceous Animals, like small snails or Neritæ« ... »Or let us suppose, that the testaceous Animal ... lays its eggs; these turn into vermicular-shaped Polypes, which, after they have fixed themselves to some marine Substance, rise up, and push forth into branches of small Polypes in their Cells«. The oœcia are thus figured on the accompanying drawings as small *Spirorbis* or *Planorbis*, and from this description Linné gave to this species the name »*neritina*«. Ellis expresses elsewhere a supposition that a similar relation obtains between certain *Bryozoa* and Bivalves: »The next class, which is the *Eschara* deserves our notice« ... »There appears a great probability of some of these being the Matrices or ovaries of certain Species of Shellfish, perhaps of the Bivalve Kind[4]. On *Flustra* (*Eschara*) *foliacea* he further writes[5]: »Upon examining some specimens lately, I discovered at the Entrance of many of the Cells a small testaceous Body, like a bivalve Shell«. As appears from the figure to which the writer refers, there is no oœcium whatever but an open zoœcial aperture, in which consequently the orifice itself represents the one, the operculum the other shell.

Pallas[6] suggests the view that the oœcia are ovaries, a view retained to the time of Huxley. It was however chiefly the oœcia in the incrusting forms (»*Eschara*«), which he was disposed to regard in this way, whereas on the other hand he is more doubtful on the question, whether the free plant-like forms (»*Cellularia*«) are provided with such. »In plurimarum, presertim lapidescentium Escharарum antiquioribus crustis passim, ad singularum cellularum oscula, observari solet bulla galeae instar cellulae ostio imminens, substantiae Escharae homo-

[1] 12, p 33—39. [2] 12, Introduction p. IX [3] 12, p. 35. [4] 12, Introduction p. XV [5] 12, p. 71, pl XXIX, E [6] 91, p. 36

genea & continua. Vascula seu Galericulae in Cellulariis statim considerandae, subanalogae; has in Escharis bullas ovaria forte esse suspicionem injiciunt«. It is very intelligible that the free, prominent, somewhat stalked oœcia in *Bugula* and *Bicellaria* would make a different impression on an observer than the oœcia in the incrusting forms. Also, they appear sometimes (in *Bugula neritina* and *Bicellaria ciliata*) not on the top of the zoœcium but fixed to the one side. In that case they correspond in their position as well as in their equipment with a stalk-like portion with the »bird's head« avicularia in *Bugula* and *Bicellaria*, and Pallas considers them therefore as organs of related nature. His above-quoted view, in which he terms these different stalked formations as organs somewhat related (subanalogae) to the oœcia in *Eschara* is further explained in another place[1], where he suggests that they are of service in fertilisation (seminificationi). On account of the resemblance to the gonothecae in the hydroid polyps he is disposed to consider the gonozoœcia in *Crisia* as ovaries[1]. »Ovariorum qvae in Sertulariis videbimus similes vesiculas in sola C. (Crisia) eburnea & falcata observatores invenerunt. An aliis qvoqve speciebus contigerint incertum. Reperti vero in C. neritina & avicularia Galericuli seu Calyculi singulares, in recenti stirpe spontaneo motu præditi, singulisque cellulis adpositi, qvorum certus usus hucusqve nos latet, seminificationi in his speciebus destinata organa fortassis esse reperientur«. It is evident from what he says further: »Lateralis inspectio . . . docet, bullulas istas esse galericulis s. nectariis caput aviculae referentibus, in C. avicularia, analoga organa«[2], that he considers the oœcia in *Bugula neritina* as organs of a similar nature as the »bird's head« avicularia. This view, that the oœcia and the avicularia are related formations we find again in several later writers, and with regard to the designation »Nectarium« which Pallas often uses for the stalked oœcia and avicularia, we find an explanation in Ellis and Solander's work.

In this work, published by Ellis' daughter after the death of the writers[3], it is said regarding *Flustra*: »The ovaries appear to be the pearl-like studs, which we find at the tops of the cells«, and regarding »*Cellaria*«: »the ovaries are uncertain, but most probably the little hemispherical covers, that appear over the cells, do that office«. Ellis returns here again to the oœcia in *Bug. neritina*: »In my observations on this genus I cannot pass over the singularity of the Cellaria neritina, or Snail-bearing Coralline. The likeness to Nerits of its rows of little round adhering bodies, which are open on one side, together with their shell-like figure . . . inclined me to believe at first that they were the young

[1] 91, p. 60. [2] 91, p. 68. [3] 13, pp. 11, 19—20, 29.

ones of such a small kind of shell-fish. But by comparing them with the figures of others of this genus, they appear rather to be what we have called Ovaries. Or perhaps they are young of the animal defended by a testaceous covering like a little shell-fish, which at the time of its maturity separates from its umbilical cord ..... from whence it drops and soon adheres to a proper substance as a base, beginning to form a Coralline like the parent animal.« There is discussed here also another peculiar view regarding the oœcia and the avicularia, both having been considered as nectaries: »A later writer, who is a strong advocate for the vegetation of Zoophytes, supposes these little pearl-like figures as also those like the heads of birds in the Birds-head Coralline (or Cellaria avicularis) to be their Nectariums, analogous to what is so called in the flowers of some plants.«

Lamouroux[1] also mentions the oœcia in *B. neritina*, and introduces us to several hypotheses regarding the functions of these formations. »On les a considerées comme des opercules que le polype construit à volonté, soit pour se mettre a l'abri du choc des corps exterieurs, soit pour hiverner, soit encore pour fermer sa demeure lorsqu'il a cessé de vivre. Il est probable qu'aucune de ces hypothèses n'approche de la verité, et je pense que ce sont des ovaires renfermant les germes de nouveaux individus; j'ai observé que ces corps vesiculaires sont quelque-fois très-entiers, et dans ce cas je les ai toujours vus remplis de petits corps globuleux; il paraît que ces ovaires s'ouvrent par une fente transversale; toutes les fois qu'elle existe, les ovaires sont vides.«

Milne Edwards[2] considers the oœcia in *Eschara* as well as the avicularia on the zoœcia as »vesicules gemmifères«, or »capsules gemmifères«. »Les observations de Loefling et de plusieurs autres naturalistes nous ont appris que ces vesicules (oœcia) sont des capsules gemmifères, et par conséquent nous sommes porté a croire qu'il doit en être de même ici, et que le tubercule pyriforme, dont nous venons de decrire les divers états (the avicularia in E. sulcata) doit être considéré comme étant un réceptacle contenant les gemmules et servant à leur livrer passage.«

Lamarck[3] also uses the name »vesiculæ gemmiferæ«, but just as often the name »ovaria« for the oœcia as well as for the gonothecæ in the hydroid polyps. The same doubt, which Pallas had, as to whether the free, plant-like forms (*Cellaria*) possess such formations, is repeated here: »Vesiculæ gemmiferæ nullæ, nisi bullæ qvæ in nonnullis speciebus extant«.

Reid[4] studied living specimens of *Bugula avicularia* with eggs in the oœcia.

[1] 52, p. 133—134. [2] 77, p. 48. [3] 51, p. 171. [4] 95.

Nevertheless we can only understand his view of the structure of the oœcium, and of the relation of the eggs to it, after reading Nitsche's later but fuller description of the oœcium in *Bicellaria ciliata*, which is built in a similar way.

Busk[1] introduces the name »ovicells«, which is still used by some writers, for the here discussed formations, but the older view of them as capsules, containing the ovaries, was first altered by Huxley's[2]: »Note on the reproductory organs of the Cheilostome Polyzoa.« He proposes here the now prevailing view of the oœcium as marsupial chambers, into which the eggs are brought from the zoœcium to develop into larvæ. He found namely in *Bugula avicularia*, that the egg is formed in the zoœcium where it is attached to the funiculus near the stomach and also that the originally empty oœcium at a certain time was seen to contain an egg, which was more developed than the one observed on the funiculus, and which after cleavage became an embryo provided with cilia.

Against Huxley's view Hincks[3] maintains, that the eggs from which the ciliated embryos are developed according to his investigations are formed in the oœcia (ovicells) of a shapeless, grained mass. As to the eggs which Huxley found in the zoœcia Hincks states that they are most common in zoœcia, the oœcia of which have emptied their contents, and they can even be found in zoœcia, the polypide of which are dead, from which it must be concluded that they are only set free on the dissolution of the soft content of the zoœcium. They are never ciliated at any stage of their development.

The first detailed account of an oœcium is given by Nitsche[4], who describes the development and structure of the oœcia in *Bicellaria ciliata*. He represents it as formed of two hollow, two-layered, bladder-shaped outgrowths from the margin of the zoœcium; the smaller, which is membranous, is grown over by the larger, the outer wall of which is calcified, and which in the full-grown condition forms a helmet-shaped body connected by a short stalked portion with the zoœcium. The membranous bladder serves as an operculum for the helmet-shaped portion, and its interior is penetrated by a muscular chord, by the contraction of which its rim withdraws from the edge of the oœcium so that the larvæ can get out. In the above-mentioned work of Reid attention had already been called to the fact that this membranous operculum of the oœcia in *Bugula avicularia*, which contains larvæ, undergoes rhythmical contractions (»This membrane was observed in a few instances where the ova were fully formed to contract and relax at intervals, and in this way it may assist in the escape of the ovum«). Without knowing Huxley's observations Nitsche arrived at the same result with regard

[1] 3; [2] 39, [3] 37, [4] 79

to the function of the oœcia. He has seen the formation of the egg in the zoœcium and while the oœcium originally was empty he found it at a certain time containing an egg, without being able to ascertain how it came there. He expresses the following supposition: »wahrscheinlich zwängt sich das Ei durch den hohlen Stiel der Ovicelle und tritt durch eine Oeffnung, welche ich an der Stelle, wo die beiden Blasen zusammenhängen, gelegen vermuthe, in den Raum zwischen den beiden Blasen.« Nitsche tries to explain Hincks' different view, that the eggs are formed by a granular mass in the oœcium in the following way, that the egg after its transference to the oœcium instead of developing further, sometimes dies away and dissolves into a shapeless mass. Finally, he states that the supposed eggs, which Hincks has observed in zoœcia without polypide, are only peculiar bodies which have arisen from a retrogressive metamorphosis of the polypide.

In »Contributions to the history of the Polyzoa«, where Hincks[1] introduces the new name »oœcium«, he admits the correctness of Nitsche's assertion, that the supposed eggs, which he had discussed earlier, are really the so-called »brown bodies«, and he assents to Huxley's view of the oœcia as marsupial chambers. He adheres however to the idea, that eggs can now and then be formed in the oœcia and maintains the correctness of the observations which he formerly made on this subject in a few *Bugula species* and *Bicellaria ciliata*. In his later published, principal work[2] he definitely expresses the view that the oœcium has an internal connection with the zoœcial cavity (»its interior is in direct communication with the perigastric cavity«), but otherwise there is no further information on the structure of the oœcia. They are indicated as »prominent«, »subimmersed« and »immersed« (*Flustra, Cellaria*), according as they are more or less prominent on the surface of the colony or hidden within this.

Vigelius[3] in his investigations on *Flustra membranaceo-truncata* has given a description of the structure and development of the oœcia in this species. While the oœcium and its operculum in *Bicellaria ciliata* arise as two outpushings from the frontal wall of the zoœcium, the oœcium in this species arises as an invagination from this wall, a short way distally to the operculum and it thus comes to protrude into the zoœcium as a hollow bladder, the interior part of which enters into connection with the distal wall of the zoœcium, which is here formed in a peculiar way. It consists namely of a horizontal, under part, which originally reaches right to the frontal wall of the zoœcium and of a distally and slightly basally inclined part, which grows together with the oœcial bladder.

[1] 38; [2] 22, [3] 105, p.

Later the horizontal part of the distal wall and the frontal wall of the zoœcium separate from one another. While the distal half of the oœcial bladder calcifies, the proximal half continues to be membranous, and Vigelius thinks that the egg passes along from the interior of the zoœcium upwards towards the oœcium between the distal wall and the frontal wall of the zoœcium by which action it pushes the membranous part of the oœcial bladder in front of it; he thinks that this membranous part is later reabsorbed, which enables fertilisation of the egg to take place through the aperture of the oœcium. The portion of the frontal wall of the zoœcium, which is situated between the operculum and the free edge of the oœcium, acts as operculum for the oœcium. This operculum is provided with two muscular bundles, which reach from its free edge to the basal wall of the zoœcium and which by their contraction are able to draw it inwards.

The present writer[1] in three papers, the last of which is a preliminary note has given a series of investigations on the oœcia and has shown there, that with the exception of oœcia, which are covered by kenozoœcia, the oœcia have no such inner connection with the zoœcium as Huxley, Nitsche, Hincks and other writers have supposed. In all other cases therefore the egg must pass into the oœcium through the outer opening of this marsupium. In the last paper the author has set up eight different types of oœcia, two of which (the epistomial and the mesotoichal) in the present work are classed under the hyperstomial.

In an important memoir chiefly dealing with the inner structure and with the embryology of the Cheilostomatous *Bryozoa* Calvet[2] has examined the oœcia of twenty one species belonging to the genera *Bugula*, *Flustra*, *Membranipora*, *Microporella*, *Chorizopora*, *Schizoporella*, *Lepralia*, *Umbonula*, *Retepora* and *Cellepora*. With the exception of »*Lepralia*« *Pallasiana*, in which he has found a membranous one-layered marsupium formed by a basal evagination of the vestibulum and of *Cellaria fistulosa* he has found the oœcium formed by two two-layered bladders, a superior more or less calcified and an inferior membranous one, the last of which is provided with muscular strings destined for the opening of the oœcial cavity during the setting free of the larvæ. He has not been able to find any communication between the oœcium and the zoœcial cavity and he therefore thinks that the egg, to get into the oœcium, must perforate the membranous bladder. As to the oœcium of *Cell. fistulosa* he states that an opening exists in the wall between the oœcium and the zoœcium.

In a very interesting paper Harmer[3] has set forth the supposition, that the oœcia may be looked upon as formed by hollow spines and he founds this view

[1] 54, p. 253. 55, p. 25 and 56, p. 11—18; [2] 9, p. [3] 19, p. 283—284.

especially on the structure and development of the oœcia in *Alysidium parasiticum* and *Euthyroides episcopalis.*

Before trying to give a division of the different forms of oœcia, I must expres my regret, that the material at my disposal has not allowed me to give a fuller account of these formations, of which in many cases I have only been able to examine the calcified portions. I hope, however, that my investigations will to a certain degree facilitate the work of the investigators who may be able to combine the desire to continue these studies with favourable conditions of procuring suitable material.

Endozoœcial oœcia (Pl. XXIV, figs. 6—11).

We indicate by this name the oœcia which are immersed in the zooecia, generally, however, in such a way that they appear more or less distinctly on the surface of these. Their main portion, the endooœcium, is formed by the zoœcium's distal wall, which in the free, frontal edge of the oœcium passes over into the much less developed ectooœcium, together with which it forms a fold, the oœcial fold. In the majority of cases the distal wall has a short horizontal portion, provided with rosette-plates, which bends over into the helmet-shaped or cup-shaped oœcium, and it is only in species of the genus *Retiflustra* (Pl. XXII, figs. 1 b, 2 a), that the basal rim of the distal wall lies higher than the free frontal edge of the oœcium.

If we only pay attention to the calcified portions, we should think that these oœcia were in internal connection with the proximal zoœcium, but with the exception of those oœcia, which are covered by kenozoœcia, there seems really always to be a membranous separating-wall between the zoœcium and the oœcium.

We can divide these oœcia into two groups, according as the distal of the two chambers, which bound the oœcium, is an ordinary zoœcium (autozoœcium), or a kenozoœcium. We must also refer the oœcia, which are enclosed in the avicularia, to this last-mentioned group.

a) Endozoœcial oœcia, which are enclosed in autozoœcia.

In the historical introduction we have referred to Vigelius' account of an oœcium belonging to this type, namely, the oœcium in *Flustra membranaceo-truncata*, and need only recall here that this oœcium, according to the description of that author, is formed by a bladder-shaped infolding of the frontal membrane of the zoœcium meeting the distal wall. As our Museum does not possess colonies of this species with developing oœcia, but on the other hand those of *Flustra securifrons*, the oœcia of which have essentially the same structure, we may test the correctness of Vigelius' investigations by means of this species. The oœcium in *Flustra securifrons* (Pl. I, figs. 5 a, b, c, Pl. XIX, figs. 8 b—8 n) whose inner part may be looked upon as a transformed distal wall, is a helmet-shaped calcified bladder, the basal portion of which issues from the short and horizontal portion of the distal wall at a pointed angle, while its free, frontal edge passes immediately over into the frontal membrane of the zoœcium, together with which it forms a fold, the oœcial fold. We may indicate the calcified bladder as the endooœcium, while an ectooœcium is only represented by the portion of the frontal membrane, which covers the distal part of the endooœcium. Between the operculum of the zoœcium and the free rim of the oœcium we see a membranous portion chitinized at the distal edge (Pl. I, fig. 5 b), the oœcial operculum, which is connected with another membranous region, the oœcial membrane (Pl. I, fig. 5 a, Pl. XIX, fig. 8 j), which issues from the basal wall of the endooœcium and forms a complete separating-wall across the oœcium. While this was originally situated close to the roof of the oœcium, in an egg-bearing oœcium it inclines the opposite way, so that it forms the floor of the oœcial chamber (Pl. I, fig. 5 a, fig. 2 a). In the angle between the oœcial operculum and the oœcial membrane is attached a muscular chord which originates from the basal wall of the zoœcium, and when it contracts, the oœcial operculum is drawn inwards and thereby permits the larva to escape. Finally, it may be mentioned that from the lateral walls of the zoœcium issue two flat, sloping calcareous ribs which as a rule meet in a suture distally to the zoœcial operculum (Pl. I, fig. 5 a, 5 b, 5 c, dw.).

The very earliest trace of an oœcium to be seen in *Flustra securifrons* from the surface of the colony, is a slightly inclined curved line, which at a distance from the operculum nearly equal to its height unites the two lateral borders of the zoœcium and rises from the attachment of the distal wall to the inner surface of the frontal wall of the zoœcium. Pl. XIX, fig. 8 b shows a longitudinal section through an early stage of an oœcium, which is a little older than that just mentioned and shows a distal wall, the basal portion of which is horizontal, while the rest rises distally forming an angular arch and joins the frontal wall, which still forms a straight line at this place. On the other hand, fig. 8 c shows a small indentation proximally to the frontal end of the distal wall, and this indentation increases in length or depth in the following figures 8 d, 8 e and 8 f, the last of which represents a longitudinal section through a completed oœcium. While it is quite easy to understand that Vigelius, who examined longitudinal sections of decalcified colonies, considered the indentation mentioned to have risen by an invagination of the frontal membrane, it is quite evident from the longitudinal sections (8 b—8 f) given here that the endooœcium is only formed by a continued growth of the distal wall, which however at the same time undergoes a strong flexion and alteration in shape. Thus, while the angle between the horizontal and vertical portions of the distal wall in fig. 8 b is right, and in fig. 8 c obtuse, it gradually becomes more and more acute on account of the endooœcium bending backwards towards the basal wall of the zoœcium, without doubt because of the counter pressure brought about by the growth-tension. While the portion between the horizontal part of the distal wall and the point of the indentation has nearly the same length in the examined longitudinal sections, the indentation on the contrary increases in length, and lastly the oœcial fold grows down over the oœcial membrane, which not long before occupied most of the frontal wall of the developing oœcium. At the same time as the developing oœcium is undergoing these alterations in shape, the whole zoœcium increases considerably in size, and the horizontal part of the distal wall in length.

As already mentioned in the above reference to Vigelius' investigations, he believes that the oœcial membrane dissolves later, so that the egg from the zoœcium can reach into the oœcium, but this view clearly proves to be wrong from the fact, that I have found eggs lying in the oœcia in *Fl. securifrons* and *Fl. membranaceo-truncata* (Pl. I, fig. 2 a), the floor of which is formed by such an oœcial membrane on which the egg rests. The egg must therefore have come into the oœcium from outside through the oœcial aperture, and possibly the altered position of the oœcial membrane is due to this transference. Figs. 8 g—8 n show a series of developmental stages of the oœcium mentioned, seen from the surface of the colony. In the earliest of these (8 g) the ascending part of the distal wall has not yet begun to calcify, and the deep sinus between the two rounded projections comes from the not yet closed uniporous rosette-plate. The other figures show the formation of the oœcial bladder, its partial closure and the formation of the two calcareous ribs.

While the rest of the oœcium-bearing members of the family have essentially the same structure of the oœcia as *Fl. securifrons*, we find a rather different structure in *Fl. foliacea* (Pl. I, figs. 8 a, 8 b; Pl. XXIV, fig. 8), as the oœcia here have an irregular egg-shape. Whilst, as already mentioned, a pair of cryptocyst-ribs occur in *Fl. securifrons* proximally to the operculum of the zoœcium, in a number of species, e. g. in *Fl. membranaceo-truncata* (Pl. I, figs. 2 a, 2 b, Pl. XXIV, fig. 6), *Fl. Barleei* (Pl. I, fig. 3 a), *Fl. Schönaui* (Pl. I, fig. 7 c) etc., a more or less developed cryptocyst-belt occurs just distally to the free edge of the oœcium, between this and the covering membrane; the originally separated lateral halves of this belt later fuse together. This belt reaches its highest development in *Fl. flustroides* (Pl. I, fig. 4 a; Pl. XXIV, fig. 7) and it may in time quite cover the oœcia, which in this species exceptionally project distinctly on the surface of the colony. In some species, *Fl. denticulata* (Pl. I, fig. 9 c), *Fl. florea* and partly in *Fl. flustroides* (Pl. I, fig. 4 b) the oœcia are situated inside the avicularia. With exception of the *Farciminaria* species (Pl. I, figs. 10 a—10 d), in which the oœcium is enclosed in a kenozoœcium, the oœcia in the other members of the family *Farciminariidae* seem to have essentially the same structure as in the *Flustridae*, but all of them project more or less on the surface of the colony. In the species of the genus *Columnaria* n. g. (Pl. I, figs. 12 a—12 d; Pl. XXIV, fig. 9), a part of the inner (basal) wall of the oœcium is on each side covered by a triangular cryptocyst-plate, which from each of the lateral borders of the zoœcium pushes itself in between the ectooœcium and the endooœcium and in *Nellia simplex* var (Pl. XXII, fig. 6 a) the frontal wall of the oœcium is provided with a cryptocystic belt, like that found in many *Flustridae*. I must also refer to this group the oœcia in *Micropora Normani* (Pl. VIII, figs. 3 a, 3 b), *Micr. perforata* (Pl. VIII, fig. 4), *Rosselia Rosseli*, *Bugulopsis Peachii*, *Bug. cuspidata*, *Menipea cervicornis* (Pl. II, fig. 4 b), *M. Buski* (Pl. II, fig. 3 c), *Urceolipora nana* (Pl. XV, figs. 1 a—1 c, Pl. XXIV, fig. 11), *Cheilopora sincera* (Pl. XXIV, fig. 4 a), *Gephyrophora polymorpha*, the oœcia in the species of the genus *Onychocella* (Pl. XXII, figs. 3 a—3 b, Pl. XXIV, fig. 10), in all members of the family *Sclerodomidae* (Pl. XIX, figs. 18 a, 18 b), as also in numerous members of the family *Catenariidae*, for instance in *Hincksiella pulchella* (Pl. XII, fig. 9 a), the species of the genus *Pterocella* (Pl. XII, figs. 5 a, 6 a), most of the *Catenaria* species, (Pl. XIII, figs. 2 a, 3 a, 3 b) etc. In the majority of the mentioned forms the oœcium projects more or less noticeably on the surface of the respective zoœcium, and it is only in a small number of cases, e. g. in *Urceolipora nana* and in the mentioned species of the *Catenariidae*, that it is quite hidden within this. While in a number of cases we only have to do with a membranous ectooœcium, as in *Micropora perforata*, *Bugulopsis Peachi*, *Cheilopora sincera*, etc., the ectooœcium in others is wholly or partially calcified, e. g. in the mentioned *Catenariidae*, in *Bugulopsis cuspidata* and *Menipea cervicornis*. Finally, in both cases there may appear between the endooœcium and the ectooœcium a more or less developed cryptocyst, as in *Bug. cuspidata*, *Menipea cervicornis* and *Gephyrophora polymorpha*[1], in the last of which the cryptocyst covers the whole frontal wall of the endooœcium. The cryptocyst in *Urceolipora nana* on the other hand has quite a different position, as it here covers the basal wall of the oœcium right down to the place where the oœcium issues from the short horizontal portion of the distal wall.

b) Endozoœcial oœcia, which are surrounded by kenozoœcia or heterozoœcia.

[1] 110, Pl. II, fig. 22.

The endooœcium, as in the foregoing group, is formed by the distal wall between two chambers lying in the same longitudinal row, but while the ectooœcium in that group was only represented by a more or less distinctly limited part of the frontal membrane of the covering zoœcium, it is here so to speak represented by the whole covering chamber, which is a kenozoœcium. We find everywhere a common operculum for the kenozoœcium and the oœcium. Such oœcia are found in *Didymia simplex* (Pl. IV, fig. 7 d), *Eucratea chelata*, *Bicellaria infundibulata* (Pl. IV, figs. 4 a—4 d), *Menipea crystallina* (Pl. IV, figs. 1 a, 1 b), *Cribrilina punctata* (Pl. IX, fig. 11 b), *Cr. annulata*, *Cr. Gattyae* (Pl. IX, fig. 12 a), *Escharella diaphana* (Pl. XVII, fig. 1 a), *Esch. abyssicola* (Pl. XVII, fig. 2 a), *Eurystomella foraminigera* (Pl. XVIII, figs. 14 a—14 b), *E. bilabiata*, besides in the *Farciminaria* species (Pl. I, figs. 10 a—10 c), most members of the family *Catenariidae* (Pls. XI, XII, XIII, XV), and the members of the family *Hippothoidae* (Pl. XXI, figs. 8 c, 8 b, 9 a, 9 c).

The fact that the endooœcial oœcia, besides appearing as a rule in certain families, appear sporadically in more or fewer forms in a number of other families would seem to suggest that they represent an old oœcial type, which perhaps was at some time general, but which later has been replaced by others. It deserves to be mentioned in this connection that they appear together with hyperstomial oœcia in *Cribrilina punctata* (Pl. IX).

2) **The hyperstomial oœcia** (Pl. XXIV, figs. 12—18). These oœcia like the endozoœcial consist of an endooœcium and an ectooœcium, which join at the free frontal edge of the oœcium and form together a fold, the oœcial fold: but they are always situated outside the cavity of the zoœcium, and the distal wall does not take part in their formation, even though they most frequently arise from or in the immediate neighbourhood of its frontal edge. The two layers of the actual oœcium are formed by the frontal membrane of the distal zoœcium, but between these a cryptocyst layer may sometimes appear, and in many cases the hyperstomial oœcia are provided with an oœcial cover. This type of oœcium, which appears in the majority of the *Cheilostomata*, presents numerous modifications, of which we may mention here the most important, but for the rest reference may be made to the different families.

We may begin with the oœcia in *Scrupocellaria scabra*, of which a series of developmental stages have been figured on Pl. II, figs. 5 a—5 f, as they appear when the colony is viewed from the surface and after treatment with boiling alkali or cold eau de Javelle. At the time when the frontal wall of the distal zoœcium is still quite membranous, the first trace of the oœcium appears as two small distal rounded calcareous plates, which arise from the frontal edge of the distal wall and soon join in a median suture. This small, bilabiate calcareous plate, which has arisen from calcification of a part of the frontal membrane of the zooecium, increases gradually in size, grows semicircular, and is finally grown round by a calcareous framework of the same origin. The just mentioned calcareous plate with a longitudinal suture in the centre, which forms a common wall for the zooecium and the ooecium, is the basal wall of the ooecium, the frontal part of which is formed by the further development of a fold, the ooecial fold, arising in the circumference of the plate named. The inner layer of this fold (the frontal part of the endoooecium) is a continuation of the plate, while the outer layer (the ectoooecium) is a continuation of the surrounding calcareous framework.

The calcification of the basal wall of the endoooecium takes place in *Callopora Dumerili* (Pl. IX, fig. 3 a), *C. aurita* (Pl. IX, fig. 4 a, Pl. XXIV, fig. 16), *Tegella unicornis, T. Sophiae* (Pl. IX, figs. 6 a—6 c) and *Cribrilina punctata* (Pl. IX, figs. 11 a—11 d) in the same way as in *Scrup. scabra*, and the ooecium in these is at a very early stage represented by two small separated calcareous plates, but the endoooecium in *Caberea Ellisi* (Pl. II, fig. 6 a) and *Dendrobeania Murrayana* (Pl. IV, figs. 2 a—2 e) on the other hand calcifies as a continuous plate, and this seems also to be the rule within the division *Ascophora*.

With exception of the ooecia in the family *Onchoporidae*, in which the endoooecium as well as the ectoooecium is membranous, the endoooecium seems elsewhere to be calcified, but in forms with a calcified ectoooecium it is very often extremely thin-walled and breakable, and often not easy to discover on dried material. The ectoooecium may sometimes be membranous, sometimes wholly or partly calcified, and in many cases its structure appears to be constant within the family or genus. We have for instance a calcified ectoooecium in the families *Reteporidae, Smittinidae* and *Discoporidae*, in the genus *Cellepora*, besides in most of the *Porella* species, but we find a membranous one in the genera *Schizoporella, Escharella, Escharoides* and *Petralia*. In the species of the genus *Callopora* (Pl. XXIV, fig. 16) a larger or smaller portion of the ectoooecium is membranous, and the rib, which Hincks mentions for a number of the species of this genus, marks just the proximal border for the calcified portion. The ectoooecium is also in numerous members of the family *Scrupocellariidae* provided with a larger or smaller uncalcified portion (Pl. II, figs. 7 a—8 a).

We have already mentioned previously, that a more or less developed cryptocystic region may appear in the endoooecial ooecia, between the two layers of the ooecium, and the same may be the case in the hyperstomial ones. Still I have up to now only found such a cryptocyst in the genus *Emballotheca* (Pl.

XVIII, figs. 13 a, Pl. XXIV, fig. 15), besides in all members of the family *Onchoporidae* (Pl. XIII, figs. 6—9, Pl. XXIV, fig. 12), and in both cases the whole frontal wall of the ooecium is provided with such a layer, which is placed between the ecto- and endoooecium. There is however this difference that while this layer in *Emballotheca* arises high up from the cryptocyst of the distal zooecium, in the family *Onchoporidae* it arises from the distal wall between the two zooecia.

We very often in species of the genus just mentioned meet with the very peculiar case, that the ooecium is formed by three to five adjoining zooecia and consequently consists of the same number of segments meeting in sutures, of which each single one includes a calcified endoooecial layer, a cryptocystic layer and a membranous ectooecial layer.

We have seen that the basal wall of the ooecium in *Scrupocellaria scabra* arises by calcification of a part of the original frontal membrane of the zooecium, and nearly one half of the hyperstomial ooecia might be in a similar relation to the zooecium, even though the size of this common wall for the zooecium and ooecium may be very variable in the different forms and sometimes present considerable differences in species of the same genus. It seems as a rule to be large in the families *Membraniporidae*, *Scrupocellariidae* and *Petraliidae*, as also in the genera *Escharella, Escharoides, Schizoporella, Escharina* and *Microporella*, while it is for example very small in *Dendrobeania Murrayana* (Pl. IV, figs. 2 a—2 e), *Porella compressa* and *Smittina trispinosa*. In the genus *Smittina* especially the relation between the zooecium and the ooecium seems to be subject to great variations, and while the common wall in some species is large or of fairly considerable size, e. g. in *S. borealis*, *S. Smitti* (Pl. XIX, fig. 4 a), S. palmata (Pl. XIX, fig. 5 a), it is as mentioned very small in *S. trispinosa*, and may again be quite lacking in other species (*S. reticulata*, *S. Lansborovi*, *S. linearis*). In the last case these ooecia, which we may call independent, consist of two layers in their whole extent, and are formed by the ooecial fold alone, while this fold in the previously mentioned cases arises in the circumference of a semi-circular area, namely, the partition-wall between the zooecium and the ooecium. Such independent ooecia seem to appear as a rule in the families *Bicellariidae*, *Reteporidae*, *Celleporidae*, *Myriozoidae* and *Discoporidae*, and they may also occur in the genera *Smittina* and *Porella* (e. g. in *P. saccata*); but as already mentioned there is no sharp distinction between independent and dependent ooecia, because the partition-wall may vary considerably in size. While the independent ooecia in the above-mentioned *Smittina* species attach themselves so closely to the frontal wall of the distal zooecium, that it is not possible to isolate them as a whole, the hyperstomial ooecia in the family *Bicellariidae* on the other hand are freely projecting, so that they can very easily be separated and the same is the case with the oœcia in the genus *Thalamoporella* and in most species of the genus *Discopora*, although to a less extent. In the family *Reteporidae* also the oœcia seem originally always to be free and able to be isolated, even though they later get firmly imbedded in the colony by covering layers, and they seem here, as in the family *Bicellariidae*, always to be provided with a narrow, almost stalked basal part, as is also the case with the oœcia in *Porella saccata*.

While the frequently mentioned wall between the zoœcium and the oœcium in Malacostegous forms only consists of a gymnocystic layer, it is on the other hand as a rule wholly or partly two-layered in the Ascophore forms which have a cryptocyst, as within the gymnocyst there is a cryptocystic layer, which sometimes covers its whole surface, sometimes only a larger or smaller part of it. This difference seems to depend on how far the oœcium appears at an earlier or later stage of development of the zoœcium. In species of the genera *Schizoporella*, *Escharina*, *Microporella*, *Petralia* and *Emballotheca*, besides in certain species of the genus *Smittina* (*S. Lansborovii*, *S. reticulata* and *S. linearis*) the oœcia first appear after the frontal wall of the zoœcium is completely formed, so that the basal wall of the oœcium, which arises by calcification of a portion of the frontal membrane, comes in its whole extent to lie up against the cryptocyst of the frontal wall, from which, however, as a rule, it seems fairly easily detachable. In *Emballotheca furcata* at the place where an oœcium is going to be formed, we find a deepened, semicircular area, surrounded by a low marginal ridge, and a similar deepened area might also be found in species of the genus *Petralia* (Pl. XVIII, fig. 5 a), as the oœcia here are in their basal half sunk into niche-like recesses.

On the other hand, in the genera *Escharella* (Pl. XVII), *Escharoides* (Pl. XVII), as also in certain species of the genera *Porella* (e. g. in *P. struma* Norman and *P. glaciata* Waters) and *Smittina* (*S. Smitti*, *S. borealis*, *S. palmata* etc.) the rudiment of the oœcium, as in *Scrupocellaria scabra*, is seen at a very early stage in the development of the zoœcium, and the cryptocyst, which from the beginning only appears outside or in the marginal region of the basal wall of the oœcium, as a rule gradually grows more or less far in over the basal surface, which as a rule however has a larger or smaller triangular, semicircular or semielliptical, proximal area which is not covered by the cryptocyst. In contrast to what takes place in the genera *Schizoporella*, *Escharina* etc. this cryptocystic layer is here firmly fused together with the gymnocyst wall of the oœcium, and it is in rare cases, as in *Escharoides coccinea* and *E. Jacksoni*, provided with wide pore-canals.

While a calcified ectooœcium does not seem to increase in thickness, and this is also the case with the endooœcium when it is covered by a calcified ectooœcium, an endooœcium as a rule seems to increase in thickness when the ectooœcium is membranous, and this seems generally to be the case with all calcareous walls covered by a membrane. This seems to suggest that the cells of this membrane deposit fresh layers of chalk on the outer side of the older ones. Such calcareous walls have as a rule a more or less rough surface, and rib-like or ramified thickenings also very often appear on them.

The hyperstomial oœcia are in many cases again covered by one or more calcareous layers, which sometimes arise from one or more of the adjoining zoœcia alone, sometimes also from the peristome of the zoœcium itself, and we give here as examples a number of species in which the oœcia have such a cover, for which may be proposed the name »oœcial cover«. In the species of the genera *Myriozoum* (Pl. XXIV, fig. 18) and *Haswellia* (Pl. XVI, fig. 2 a) the oœcia, which in their whole extent consist of two layers, are placed in niche-like depressions on the frontal wall of the distal zoœcium, and when the oœcium arches forward so as to form its frontal half, this is grown over by a frontal continuation of the niche, which quite closes round the oœcium. As soon as this closing has taken place, the oœcium can only be seen faintly as an imperfectly limited swelling, which in the course of time becomes less and less distinct, because the thick cryptocyst forming the frontal wall of the niche increases in thickness under the covering membrane, which is probably continued over the whole inner surface of the niche. Norman[1] would undoubtedly call these oœcia »cryptic«. A single, undivided oœcial cover, which arises from the frontal cryptocyst of the distal zoœcium, is also found in *Porella struma*, *Porella glaciata*, *Smittina Smitti*, *Smittina trispinosa* (Pl. XIX, fig. 7 a), *Smittina unispinosa*; in the last two the oœcial cover leaves a larger or smaller part uncovered, and in none of these species does it attain a thickness similar to that in the mentioned members of the family *Myriozoidae*. In contrast to the cases cited the oœcial cover in a number of species is formed of 3—5 calcareous plates joined by sutures, which sometimes arise merely from the adjoining zoœcia, sometimes also from the peristome. In *Smittina foliacea* (Pl. XXIV, fig. 5 a) a small proximal part of the zoœcium is uncovered, and the oœcial cover consists of three portions, which meet together in two proximal converging sutures. Of these the middle one comes from the distal zoœcium, and the two others, which come from the two lateral zoœcia, each have a large, free, triangular projection, placed distally to the oœcium, and covering over a part of the zoœcial aperture. On the other hand, the peristome in *Discopora Sarsi* (Pl. XXIV, fig. 2 a) and *Porella compressa* takes part in the

[1] 81, p. 115

formation of the oœcial cover and in *Porella saccata* we meet with an oœcial cover with many layers, because thin calcareous plates are constantly growing over the oœcium from the three surrounding zoœcia. A similar, many-layered oœcial cover seems also to be the rule in the family *Reteporidae*.

An oœcial operculum (Pl. XXIV, figs. 6, 7, 9, 10, 13, 14, 16 o. o.) has up to now only been found in *Bicellaria ciliata*, *Bugula Sabatieri*[1], *Callopora* (*Membranipora*) *Flemingi*[2] and *Microporella Malusi*[3], and it consists in these forms only of an evagination from the proximal zoœcium's membranous wall, as a rule distally to its operculum. Into this evagination extends a muscle, which is able to withdraw it and thus open the oœcium, both for the egg to enter the latter and for the larva to escape. The oœcial operculum seems to be quite lacking in *Porella saccata* and in the members of the family *Reteporidae*, and it is very likely to counterbalance this, that the oœcia in this family are furnished with a more or less developed, screen-like continuation, directed inwards, of the rim of the opening. In *Thalamoporella* we find a well chitinized oœcial operculum, which at its proximal part is connected with the zoœcial operculum, and which seems to be provided with a muscle on each side (Pl. VI, figs. 7 e, 7 o, 7 n, 7 g, 7 h).

3) **The peristomial oœcia.** These oœcia, which only consist of a single calcareous layer and have no covering membrane, are formed by the peristome, and may otherwise be very different in shape. In the family *Tubucellariidae*[4] (Pl. XVI, figs. 3 b, 4 a, 4 b, 5 a, 5 b, 5 d) they have the form of an irregularly pear-shaped expansion open at the end, while in the genus *Lekythopora* (Pl. XVI, figs. 6 a, 6 b, 7 a) they form a semi-globular expansion on the frontal wall of the long tube-like peristome. I must for the present also refer the helmet-shaped or cup-shaped oœcium in the genera *Holoporella* and *Conescharellina* (Pl. XXIII, fig. 8 a) to this type.

4) **The endotoichal oœcia.** These oœcia which are only found in the genera *Cellularia* (Pl. VII, figs. 4 a—4 f, Pl. VIII, 1 a—1 c, 2 a—2 c) and *Membranicellaria* (Pl. VII, figs. 2 a—2 c) are cavities in the thick frontal wall of the zoœcium, and it looks as if they are formed by a gradual resorbtion of the calcareous material of this wall. Thus by grinding longitudinally the older and younger parts of a colony we can find these oœcial cavities in all possible sizes, from quite small ones, situated in the middle of the thick wall, up to a size which takes up the largest part of the thickness, and opens outward. According to the investigations of Calvet[5]

[1] 9, p. 57. [2] 9, p. 262. [3] 9, p. 169. [4] My examination of these oœcia has been made on dried material, but Waters has later 116 given a full account of them, based on fresh spirit material. [5] 9, p. 264, pl. VI, fig. 11.

there is an opening between the zoœcium and the oœcium in the separating wall, but I must dispute its presence, as I have always by transverse grinding found the separating wall unbroken. Calvet has found an oœcial operculum with two layers, which is opened by a muscular apparatus.

5) **The double-valved oœcia** (Pl. VII, figs. 3 a, 3 h, 3 i, 3 j, 3 k, 3 l) which have hitherto only been found in *Alysidium parasiticum*, consist of two double layered, arched valves, the edges of which meet together and with the zoœcium bearing them form a bean-shaped body. They rise from zoœcia, the oral surfaces (Pl. VII, 3 c) of which form nearly a right angle with the longitudinal axis of the zoœcium, and the two valves arise in the lateral borders of the said surface on each side of the zoœcial aperture, which leads directly into the bottom of the oœcium. As each of the two hollow valves has an inner connection with the zoœcium through a pore-chamber, we must regard them as two kenozoœcia (see under *Alysidium parasiticum*).

6) **The acanthostegous oœcia.** We indicate by this name the cavities found in the two *Electra* species, *E. zostericola* (Pl. IX, fig. 2 b) and *E.* (*Heteroœcium*) *amplectens* (Pl. IX, figs. 1 a, 1 c), which externally are limited by two rows of hollow spines meeting together in the middle line of the frontal surface. The oœcial cavity in *E. zostericola* is bounded internally by the frontal membrane of the zoœcium, and externally by the mentioned spines, and according to Ostroumoff[1] this cavity contains developing larvæ. While the zoœcial operculum in the species mentioned is placed at the distal end of the oœcium-bearing zoœcium, in the corresponding zoœcia of *E. amplectens* it is situated proximally to the area formed by spines, and as this species has only been examined in dried condition, nothing is known as to how far the oœcial cavity also here is bounded in the same way as in *E. zostericola*.

Before leaving this subject, we may briefly touch upon the question of the egg's transference into the oœcium. The older view that the egg is carried from the zoœcium (or gonozoœcium) into the oœcium through an inner connection seems according to Jullien's investigations to hold good for *Hippothoa hyalina*, in which species the gonozoœcium and the oœcium form a common cavity, closed by a common operculum. According to Jullien[2] the zoœcium has no polypide but contains an ovary, and he supposes that the tentacular sheath is of service to the egg by carrying it over into the oœcium. A similar direct transference probably occurs also in all the cases where endooœcial oœcia are present with an operculum in common with the zoœcium (*Hippothoidae*, *Catenariidae*, etc.).

[1] 90, p. 19. [2] 45, p. 31.

On the other hand, we have noticed that the endozoœcial oœcia in *Flustra* are quite separated from the cavity of the zoœcium by the oœcial membrane, and a transference of the egg from the zoœcium into the oœcium can therefore only take place by the egg first leaving the zoœcium through its aperture and afterwards entering the oœcium on the withdrawal of the operculum of the latter. As we have nowhere been able, except in the above-mentioned case, to find an inner connection between the zoœcium and the oœcium, we cannot doubt but that the egg elsewhere always leaves the zoœcium through its aperture. This is undoubtedly most evident in the peristomial and the double-valved oœcia, because the zoœcial aperture leads directly into them, and the same is the case with the oœcia in *Thalamoporella*; but neither can we in any other *Bryozoa* find in the relation between the zoœcium and the oœcium any difficulty for such a transference. Without entering in particulars I shall here only state that in all the species with oœcia, examined by me, the position of the oœcium in relation to the zoœcial aperture is a such that when the operculum opens to a certain extent the egg will have no difficulty in reaching into the oœcium, whether the transference be effected by aid of the tentacular sheath or by an independent movement of the egg. Especially in the *Ascophora* this passage seems to be secured in the best possible way as in most members of this division the zoœcial operculum in a certain position closes a space which can be looked upon as a common vestibulum for the zoœcium and the oœcium, and a completely covered passage is thus formed between them. Least safe the passage seems to be in the family *Reteporidae* and the genus *Exochella* as there is a rather long way between the zoœcial aperture, and the oœcium and the zoœcial operculum cannot close the space between the zoœcium and the oœcium.

The systematic characters in the Cheilostomatous Bryozoa.

While we sometimes find in the literature, as in Hincks, Waters, Jullien and other writers, views concerning the larger or smaller value of different systematic characters, the systematic importance of a single character being sometimes dealt with, sometimes the relative importance of several characters, yet any connected or more complete review is lacking of those characters, which in the present state of our knowledge might be used for systematic purposes, as also a valuation of their relative importance based upon a sufficient number of examples for it is only in this way, that the reader becomes able to judge in the matter. We shall endeavour here to give such a review and we shall first distinguish between two different categories of characters, namely the »colonial« and the »zoœcial«, meaning by the first those which can be referred to colonial forms and the colony's composition of one or more different, individual forms, while the last are those which are found in the structure of the single zooecia.

Colonial form and mode of growth. Throughout the organic world wherever single individuals are united into colonies or in florescences we find a repetition of the same colonial forms or forms of growth. The colonies may be incrusting or free foliaceous or branched in various ways, the single individuals arranged in one layer or two, in one, two or more rows etc., and this harmony in the outer arrangement may often produce a surprising likeness between animal forms very different in structure, occasionally even between certain animal and plant forms. It is therefore easy to understand that the first investigators of the numerous aggregate animals of the sea, the single individuals of which only reveal their peculiarities on very close examination, have tried to arrange this variegated multitude after likeness in the colonial form. We may for example refer to Ellis' celebrated work on the Corallines[1], under which common name he not only classes hydroid polyps, *Bryozoa* and corals, but also certain calcareous *algae*. By and by as knowledge of the single individuals of the colonies advanced, the systematic importance of the colonial form becomes more and more limited, as it is gradually used for less and less extensive systematic units, and in the present day *Bryozoa* system, which is founded on Smitt's and Hincks' well-known works, it occupies a very subordinate position. As there is nevertheless too much importance still attached to the colonial form as systematic character, not only within the *Bryozoa*, but also within other aggregate animals, for instance the hydroid polyps, I do not think it unnecessary to discuss this question here, and I may first quote some observations concerning this made by Hincks[2]. After having spoken about the slight help, which the polypide, and the avicularia give us in systematic regards, he says: »There remain the characters of the cell itself and the habit of growth. It can hardly be deemed doubtful which of them should have the precedence in a natural system; we may go very much further, indeed, and say that in such a system the latter must hold a very secondary and subordinate place. The essential structure of the cell, as one of the primary zooecial forms, must certainly be accounted the most important point, both in itself and as a clue to relationship. The mere habit is, so to speak, a superinduced condition, which may be different in the most nearly related and similar in the most divergent forms; and groups based on it, instead of fitting in with natural affinities, are found to traverse them at all points«. A little further on[3] he also states: »In the Escharine group it seems to me that the families and genera

[1] 12 [2] 22, Introduction, p CXXVIII. [3] p CXXX.

should be based almost wholly on the zoœcial character; but I am certainly not prepared to hold that other structural elements should never be taken into account. The *Flustridae*, which seem to constitute a most natural group, have a true Membraniporidan cell, and hold their separate place by virtue of their corneous and foliaceous zoaria«. As a consequence of the weight the writer attaches to the colonial form in the family *Flustridae*, he refers an incrusting species *Flustra* (*Membranipora*) *flustroides* Hincks, which in its essential characters is a *Flustra*, to *Membranipora* at the same time that he indicates in its specific name its likeness or relationship to other *Flustra* species. *Gemellaria* is also a genus, which in Hincks is based essentially on the colonial form.

A. M. Norman[1] takes up a somewhat similar standpoint to that of Hincks, which he expresses as follows: »It has been argued by recent writers that the form which a colony of a polyzoon belonging to the *Cheilostomata* assumes is of no moment in generic character. *Electra pilosa* lends strong support to this view. Yet it is a view nevertheless in which I am not prepared in all cases to acquiesce. The zoœcial characters are unquestionably all important, but no lasting classification can be based on any part of the zoœcium, whether it be the mouth-opening, wall, rosette-plates or anything else. Why also in all instances is the ultimate growth and form of the zoarium to be excluded from generic character among certain families of the *Cheilostomata*, and at the same time to be recognized among the *Cyclostomata* and *Ctenostomata*, and even other groups of the *Cheilostomata*? This is surely scarcely consistent. In some instances, as for example in *Electra pilosa*, the form of the colony is of no generic and specific value, but in other cases it may be and, I believe, is«. To judge from this statement this writer seems more inclined than Hincks to use the colonial form as a systematic character, and this appears also in his last paper[2] on the *Bryozoa*, since he here maintains the old *Flustra* genus *Carbasea* rejected by Hincks, which is only based on the fact that the colony has a single layer. There is of course no doubt, that any character constantly appearing in a systematic division must be regarded as being of systematic value, and the same must also be the case with the colonial form. Wherever therefore this appears constantly within a genus or family it ought to be emphasized in the diagnosis. But the proof that the respective genus or family is a natural one is only given when evidence has been obtained of sufficiently great agreement between the single species in regard to the structure of the colonial individuals, since for instance the same form of colony may appear in the *Bryozoa* not only within the three natural main divi-

[1] 82, p. 122. [2] 83, p. 581.

sions: *Cheilostomata*, *Cyclostomata* and *Ctenostomata*, but in the first division also within a series of widely different families and genera. Thus the net-like connection of the branches of the colony, so common in the family *Reteporidae*, we also find in several *Cyclostomata* (*Reticulipora*, *Reticrisina*, *Retihornera*), in several species of the family *Adeonidae* (e. g. in *Adeona grisea*, *A. appendiculata*, *A. Wilsoni*), in the species of *Retiflustra* as also in *Membranipora sigillata*[1] and *Petralia undata*. A colony consisting of cylindrical, or polygonal internodes generally connected by flexible chitinous belts is found in such widely different forms as most species of the genus *Cellularia*, species of the genus *Tubucellaria*, the species of the genera *Farciminaria* and *Nellia*, *Microporina borealis*, *Schizoporella immersa* and species of the Ctenostome genus *Flustrella* (*Fl. dichotoma* and *Fl. Binderi*). We have here only mentioned some of the most peculiar forms of colony; for of the more common, e. g. free colonies with flat branches, we might cite numerous examples. This colonial form is the most prominent in the families *Flustridae* and *Bicellariidae*, and the particular stress which has been laid on the colonial form, as far as the first family is concerned, has, as we shall see later, resulted in several members of the family *Bicellariidae* being described under the name of *Flustra*. Just as the same form of colony may on the one hand appear within widely different families and genera, it is on the other hand not always constant even within the species, and numerous species can appear in two or three different forms of growth. The colonial form can therefore not at all be used as a specific character with certainty. One of the species which offers the most striking example of variation in regard to form of growth is *Electra pilosa*. While this species is at our coasts only known in an incrusting state, Norman has found it in the Throndhjem Fjord growing in free colonies of very different shape, sometimes with the zooecia in one row, sometimes in two, sometimes with *Flustra*-like or *Cellularia*-like branches, and this author gives altogether 10 different forms of growth for this species. The following may be mentioned as examples of species, which appear not only incrusting, but also in free, foliaceous, one- or two-layered colonies: *Membranipora arctica*, *Thalamoporella Rozieri*, *Th. lioticha*, *Steganoporella Buski*, *St. magnilabris*, *St. truncata*, »*Lepralia*« *Pallasiana*, *Smittina foliacea*, *Cheilopora sincera*, *Discopora pavonella*, *Disc. scabra*, *Disc. plicata*, *Escharella labiata*, *Disc. Sarsii*, *Esch. rosacea*, *Porella struma*, *Porella compressa*, *Porella Skenei*, *Smittina trispinosa*, *Sm. Lansborovi*. The question, how far it would be correct in any case to limit a species, genus or family from one or several others only on the basis of difference in the colonial form, must therefore be

[1] 103, p. 8.

answered absolutely in the negative, as agreement in regard to the form of colony, according to the data given above does not give any guarantee for real relationship.

When Norman points out the inconsistency of rejecting the form of colony as a systematic character in the *Cheilostomata* though it is used in the *Cyclostomata* and *Ctenostomata*, we must remark that as the zoœcia within the division of the *Cyclostomata* have nearly the same structure, it has been necessary to choose the characters from the way in which these zoœcia are arranged. I do not doubt however that the classification of the *Cyclostomata* also requires reform. I shall not in this work enter further into this question however, but only mention as an example that a new species from the Danish cretaceous formation *Diastopora carinata*, may appear both as round discs and as free cylindrical stems, which sometimes have a wide inner cavity, sometimes an axial canal, fine as hair. This species may thus be referred both to *Diastopora* and to *Cavaria*. Another species, *Diastopora compressa*, occurs both as unilamellate and as bilamellata expansions, and would consequently be referred to *Diastopora* as well as to *Mesenteripora*, the latter of which genera Pergens even refers to another family. On the whole, the classification seems to me more natural within the *Ctenostomata*. For the rest, in dealing with the classification it is impossible to be consistent in the sense that we must everywhere attach the same value to the same structural feature. It proves on the contrary that the same structural feature in different systematic divisions can have a very different systematic importance, so that characters which are constant in one genus or family in other corresponding divisions are not always constant even within the species.

The occurrence of one or several forms of individuals in the colony.

The fact, that a colony can contain one or more forms of individuals, which are absent in another, does not exclude the possibility, that the two colonies can belong to the same genus, or even to the same species. Considering first of all the heterozoœcia, their occurrence in many cases is, as known, very inconstant within the family, genus or species, because they can be absent in more or fewer genera within the family, and in more or fewer species within the genus. Even within the species their appearance is often inconstant, and we may cite the following species as examples, in which they can sometimes be absent, sometimes present: *Schizoporella unicornis*, *Sch. sanguinea*, *Escharina simplex*, *E. Alderi*, »*Lepralia*« *Pallasiana*, *L. pertusa*, *L. edax* and *Discopora verrucosa*. We can therefore not base a genus, nor even a species on the presence or absence alone of heterozoœcia. On the other hand, there is a whole series of families and genera, in which the heterozoœcia are either constantly occurring or always absent and in that case their appearance or absence will help to characterize the repective families or genera. For instance the absence of avicularia is to such a degree bound up with the notion *Electra*, that the discovery of an avicularia-bearing *Electra* species would rightly be looked upon as very remarkable. We may mention the *Adeonidae, Catenariidae, Celleporidae, Holoporellidae* and *Thalamoporellidae* as examples of families with constantly occurring avicularia, while these are absent in the *Aeteidae* and *Steganoporellidae*. They appear for instance constantly in the genera *Callopora* and *Exochella*, while they are absent in the genera *Membranipora* (s. str.) and *Electra*.

The oœcia present a similar inconstancy in their occurrence to the heterozoœcia, as they are quite absent in a number of families (e. g. *Adeonidae, Steganoporellidae* and *Aeteidae*), genera (e. g. *Beania, Membranipora* (s. st.) *Cupularia* and *Lunularia*) and species, and in many species they appear very inconstantly and by no means in all the colonies. For instance, in *Discopora verrucosa* we only find oœcia in the colonies from deeper water, never in coastal forms. Therefore a genus or species cannot be based only on the difference, that they have or are without oœcia, whereas a constant occurrence of these formations can be used as an auxiliary character. What has been said about the systematic value of the fact, that heterozoœcia or oœcia occur in a species, genus or family, does not exclude the different structure of the heterozoœcia and the oœcia from having a great systematic importance and we shall discuss this matter further in the following sections.

With regard to the kenozoœcia, their systematic importance is very diverse, and the small triangular spaces for instance, which appear between the zoœcia in different forms, are not always constant in the species. This applies for example to *Membranipora Lacroixi*. That the so-called radical fibres, which serve to fasten freely growing colonies of less solid materials, only have a very slight systematic importance, is evident, partly from the fact that they are found in so many families (e. g. *Flustridae, Bicellariidae, Cellulariidae, Scrupocellariidae, Catenariidae* etc.), partly because their occurrence is dependent on the free condition of the colony, which has no systematic importance. We may give here a few examples to show that the radical fibres can be present or absent in forms of growth of the same species as well as within closely related species. Such radical fibres can for example be found in *Steganoporella neozelanica*, which occurs in pillar-shaped trunks, while they are absent in an incrusting form, which Harmer considers as a variety, *var. magnifica*, of the same species. A similar relation is found between the freely growing species: *Microporella flabellaris* and *Mic. margi-*

nata and the incrusting *Micr. ciliata* as well as between a freely growing, richly branched Japanese *Microporella* which is closely related to *M. Malusi*, and the last-mentioned, as a rule incrusting species. Genera based on the presence of radical fibres (e. g. *Craspedozoum*, *Flustramorpha*) will for these reasons be just as artificial as genera based on the form of the colony, but this does not exclude that differences in the appearance of the radical fibres may sometimes be of use as auxiliary characters, e. g. in some genera of the family *Bicellariidae*. A much greater systematic importance must be given to the flat kenozoœcia, which in all freely growing *Reteporidae* not only form the incrusting part of the colony but also a covering of its basal (as a rule the outer) surface. Although on account of their position they can only occur in freely growing species, they are namely characteristic for the family *Reteporidae*, and are found in all members of this family, occurring as free colonies. A still greater systematic importance is held by the lateral chambers, so characteristic of the family *Catenariidae*, which may appear in each zoœcium up to four in number on each side, and which besides the importance they have for the distinction of the family also in many cases offer good generic and specific characters.

The Heterozoœcia, as is known, may sometimes occur independent or vicarious, taking the place of a zoœcium in the colony, sometimes dependent and situated on the zoœcia, and in the last case they may in one way be regarded as organs belonging to these. The vibracles, which appear on the basal wall in *Caberea* and other genera of the family *Scrupocellariidae*, occupy a peculiar intermediate position between the independent and dependent heterozoœcia; for while in other cases the latter are always connected with the zoœcia by a common wall, these vibracles have an independent basal wall, and can therefore be separated from the zoœcia. The difference between independent and dependent heterozoœcia is of systematic interest, in that certain systematic divisions (families and genera) only have independent heterozoœcia, others only dependent, while again others present both kinds, not seldom in such a way that they occur together. The independent heterozoœcia have their main extension in the division *Anaska*, where they appear unmixed in the families: *Flustridae*, *Cellulariidae* and *Thalamoporellidae*, besides in the genera *Onychocella*, *Selenaria*, *Cupularia* and *Lunularia*: The majority of the *Membraniporina* and *Cribrilina* forms may have dependent heterozoœcia, though independent ones do appear in not a small number of species, e. g. in *Membraniporina crassimarginata*, *M. cornigera*, *M. pyrula*, *M. plana*, *M. velata* and in *Figulina figularis*. While all the other species of the genus *Callopora* have dependent heterozoœcia, we find at the same time independent in *C. craticula*. Independent heterozoœcia seem to occur in all members of the family *Adeonidae* within the division *Ascophora*, but as a rule together with dependent ones. Otherwise they appear very seldom in this division, and are for instance found in *Schizoporella spongites*, *Arthropoma Cecili*, var., *Schizotheca fissa* and *Chorizopora Brongniarti*.

The most important difference in structure, which the heterozoœcia present in systematic regard is the presence or absence of a calcareous transverse bar between the opercular and the subopercular area. It is namely, except in a few cases, absent in the division *Anaska*, and, except in the family *Adeonidae* and *Leieschara crustacea*, it is found everywhere in the division *Ascophora*. The absence of such a transverse bar in »*Lepralia*« *Poissoni* and in *Dorypporella spathulifera* makes it probable that these forms belong to the division *Anaska*. On the contrary the difference between the aviculariam and the vibraculum, has generally taken no real systematic importance, and the same heterozoœcium may appear in the same genus, even occasionally in the same species, sometimes as an avicularium, sometimes as a vibraculum. This is the case e. g. in *Microporella ciliata*, and the genus *Microporella* as well as the genus *Escharina* may serve as examples of such a variable development of the two heterozoœcial forms. While the heterozoœcia within the division *Ascophora*, where they are mostly developed as avicularia, only very seldom show so great a modification in their structure that it can be used by the separation of families and genera, there is a much larger diversity in the structure of the heterozoœcia in the division *Anaska*, and most of the heterozoœcia, which by their peculiarities help to characterize the families and genera, are vibracles. While the peculiar, freely moveable, birdheaded avicularia are characteristic of the family *Bicellariidae*, we find more or less peculiar vibracle forms in the genera *Caberea*, *Scrupocellaria*, *Onychocella*, *Selenaria*, *Cupularia* and *Lunularia*. The avicularia in the family *Adeonidae* have a great systematic interest, as they not only differ from the avicularia in all other *Ascophora* by lacking the above-mentioned transverse bar, but they also show a constant character in the avicularia mandible, which is provided with a muscular process on each side at the proximal part. The occlusor muscles may also present differences, as they are as a rule double, more seldom single, and this is just the case in the *Adeonidae*.

The oœcia, as we have already noticed, appear in a series of widely different types, of which again a single one (the hyperstomial) shows fairly considerable modifications. Although their systematic importance is rather diminished by their inconstant appearance I must yet look upon them as some of the most important formations in systematic regard, and there is no doubt that they are far more important than the heterozooecia. While these very seldom present family or generic characters and it is for instance unusual to meet such peculiar, or in their character so constant, avicularia as those we find in the families *Bicellariidae* and *Adeonidae*, the ooecia in most families and in a number of genera present systematic characters of greater or less importance. We might here recall the ooecial structure in the families *Flustridae*, *Farciminariidae*, *Bicellariidae*, *Cellulariidae*, *Thalamoporellidae*, *Catenariidae*, *Hippothoidae*, *Tubucellariidae*, *Onchoporellidae*, *Alysidiidae*, etc. The most widely distributed ooecial type is the hyperstomial, which again may present a series of different modifications. While thus the ooecia in the *Bicellariidae* and *Reteporidae* are free, they are as a rule connected with the zooecium in the larger part of their basal wall. Other differences are; that the ectooecium may be membranous or calcareous, and that the calcareous surface of the ooecium may be entire or provided with pores, though the last-mentioned characters are not of the same use everywhere and present many exceptions. While the ectooecium in the genus *Scrupocellaria* may sometimes be entire and sometimes with pores, it is generally provided with pores in the genera *Cellepora*, *Discopora*, *Hippothoa* and *Smittina*, and only a very few species are exceptions from this rule. In the large family *Reteporidae* the ooecia are either entire or provided with a linear or three-foliate fissure, and only one single species is further provided with a few scattered pores.

Anatomical characters. These are the characters derived from the organs included in the zooecium, consequently from the polypide, the muscles, the compensation-sac, etc. The structure of the polypide has up to the present hardly been subject to any comparative study in the *Cheilostomata*, and it seems reasonable to suppose that such an investigation of this division, just as in the *Ctenostomata*, might show differences which would be of importance as distinguishing characters. Thus certain Ctenostome genera (*Bowerbankia*, *Vesicularia*, *Amathia*), as we know, are remarkable in that they possess a gizzard while the lophophore in *Flustrella* in contrast to the condition in *Alcyonidium*, is furnished with a ciliated longitudinal furrow and two vibratory threads. That there are also differences in the structure of the alimentary canal in the *Cheilostomata* appears from Busk's observation, that the coecum is absent in *Urceolipora nana* and *Carbasea Moseleyi*, the last species of which no doubt also belongs to the family *Onchoporidae*, in the other members of which we should therefore find possibly the same characters. The parietal muscles in the *Cheilostomata* may, as is known, appear in different ways. Whilst in the *Malacostega* they are attached at one end to the calcareous lateral walls, and at the other to the membranous frontal wall, in the *Ascophora* they are attached to the compensation-sac, which has arisen either as an invagination or as an outpushing from that cover. In *Steganoporella*, *Thalamoporella* and *Micropora uncifera* they are represented by a single bundle on each side reaching to the covering membrane through the two openings (»opesiulae« Jull.) in the cryptocyst, which appear in the forms mentioned, and still more remarkable is their appearance in *Microporina borealis*, as they here unite the cryptocyst with its covering membrane but are otherwise, as in *Malacostega*, placed in two longitudinal rows. Waters[1] has pointed out another structure which on closer investigation might prove a distinguishing character, namely the »suboral glands«, which are placed on each side proximally to the operculum. They seem to appear in most *Ascophora*, although according to Waters they may be absent in some few species, as in *Cheilopora sincera* and *Smittina palmata*, whilst up to the present they have not been found within the *Anaska*. While all the organs mentioned only presumably present distinguishing characters, the compensation-sac on the other hand is an organ of very great systematic importance, as it is the means of separating the *Cheilostomata* into two main divisions: *Ascophora* and *Anaska*. Against the common rule, it opens in a number of genera (*Microporella*, *Inversiula*, *Haplopoma*, *Adeona*, *Adeonellopsis*, *Calwellia*, *Onchopora*, *Onchoporella*, *Tubucellaria*) not immediately proximally to the operculum, but through a median pore (the Ascopore) further back, and a number of these forms (the species of *Haplopoma*, *Adeona* and *Adeonellopsis*) have been wrongly referred to *Microporella*.

Calcification. Though the difference in firmness or density of the calcareous skeleton can not be expressed quite exactly except by the aid of chemical analysis, it is in many cases already so distinct from a general zoological examination, that it must be regarded as a good auxiliary character in the distinction of a number of families. We find the weakest calcification in the families *Bicellariidae* and *Flustriidae* in which the frontal wall is wholly or mostly uncalcified, but on the other hand in the family Onchoporidae, the members of which have a completely calcified frontal wall, the calcification is not much more solid than in the *Bicellariidae*. The families *Adeonidae* and *Myriozoidae* are characterized by very thick-walled zooecia, while the very firmest and hardest calcareous substance is undoubtedly to be found in the *Reteporidae* and *Sclerodomidae*. The difference in regard to the firmness of the calcareous skeleton seems to be very slight within all natural families and must therefore be regarded as a good expression

[1] 108 ~~1~~. 6

for the relationship. On the other hand, the mode of calcification seems to have only a slight systematic importance, because it often varies, not only within the genus but also within the species (see pag. 5).

The frontal wall. As we have already fully discussed the differences, which occur in the structure of the frontal wall under the morphology of the zoœcium, we may content ourselves here with a brief reference to this question. While Jullien and later Canu attach such a great systematic importance to the cryptocyst, that they on the basis of it divide the *Cheilostomata* into two main divisions: *Diplodermata* and *Monodermata*, we can only from the investigations we have made on its extension in the different families (see pag. 13—16) regard it as an auxiliary character. It is for the present not easy to judge to what extent it can be used as such, since in many cases it is difficult to decide, whether dried or even spirit *Bryozoa* have a cryptocyst or not. We may for instance mention, that out of the whole material, which the zoological Museum of Copenhagen possesses of *Escharoides coccinea*, only a very few colonies of the genus show a distinct covering membrane. While the frontal wall in some forms, e. g. in the species of the genus *Electra*, the members of the families *Hippothoidae* and *Catenariidae* is only formed of a gymnocyst, and in others e. g. the *Onychocella* species only of a cryptocyst, both modes of calcification are represented on this wall in most of the *Cheilostomata*. The cryptocyst shows a very remarkable condition in *Steganoporella* and *Thalamoporella*, as it descends more or less deeply into the zoœcium through two (more seldom one single) openings proximally to the aperture and may even reach the opposite wall. Still more peculiar is the condition it shows in the genera *Cellularia* and *Membranicellaria*, because the surface of the colony is divided by a network of ridges into a number of areas, which do not correspond at all with the real zoœcia. We have also seen that the calcification of the frontal wall may take place to a very varying extent, so that we can find all possible transitions between a quite uncalcified and a quite calcified frontal wall, and the characters derived from the different extension of the calcification are therefore more or less relative.

The pores. I have already called attention to the fact, that a number of the so-called pores seem to have a similar structure to that of the rosette-plates; but as time and material have not allowed me to carry through such an examination everywhere, I shall here under the name of pores include all pore-like formations, which in contrast to the rosette-plates are situated on free surfaces. The pores are certainly amongst the formations, which have the least systematic importance, because in most families and genera where they appear, they are subject to great variation in occurrence. This does not exclude the possibility however that in a number of cases they may be good auxiliary characters. As a rule the pores are absent in the division *Malacostega*, where they no doubt are replaced by the membranous frontal area. In most species of the genus *Electra* however, we find pore-like spots which in reality are only thin places in the gymnocyst. On the other hand, we find pores in most other *Cheilostomata*, but they are constantly absent in the zoœcia of the genera *Cellularia*, *Hippothoa*, *Chorizopora* and *Euthyroides*. They appear generally only on the frontal wall, and on the basal wall only in the families *Euthyridae* and *Petraliidae*, the latter family of which mainly embraces free forms with one layer, and the basal wall is very often furnished with one or a few pore-chambers, more rarely with scattered pores. The pores on the frontal wall may appear as marginal pores, or as scattered; but this separation is not always sharp, because the marginal pores may appear in several rows, and thus gradually extend over a larger or smaller part of the surface, and quite apart from this transitional state the pores in several species may appear sometimes as marginal sometimes as scattered pores. This is for instance the case in *Porella concinna*, *Escharina Hyndmanni* and *Haplopoma impressa*. We may cite the *Steganoporellidae*, *Thalamoporellidae*, *Petraliidae*, *Hippopodinidae* and *Microporella* as examples of families and genera in which scattered pores appear constantly, while the pores are more variable in their occurrence within the genera *Escharella*, *Escharoides* and *Smittina*, as well as in the family *Adeonidae*. In the families *Reteporidae*, *Celleporidae* and *Holoporellidae* we find as a rule a very small number of pores, which are mostly situated on the marginal portion of the zoœcium, and in the family *Onchoporidae* we have external rosette-plates appearing in small number in the distal half of the zoœcium.

The spines in regard to their systematic importance may be compared with the pores, and their occurrence shows a similar lack of constancy. From their shape and structure we can distinguish between jointed and unjointed, single and branched spines. The joints seem only to be a practical arrangement, to enable longer spines to better resist pressure and blows, and as a rule consist in the spine at the proximal part being furnished with a chitinized belt which gives it a certain flexibility. In specially long spines such joints may be repeated up to nine times, and such articulated spines have thus a certain resemblance to the antennæ of many insects. They occur rather seldom and are only found in a number of *Retepora* species, in *Escharella diaphana* (Pl. XVII, fig. 1 a) as also in the species of the genus *Exochella*. All short spines are on the other hand unjointed. More or less strongly branched spines are also very rare and can be found in single, double or still larger numbers in various families and genera.

In the genus *Electra* the median acropetal spine is much branched in *E. bellula*, while the peculiar unilateral covering spine, which appears in the family *Scrupocellariidae* is branched in a number of species, as in *Scrupocellaria reptans* and *Menipea aculeata*. Further, branched oral and marginal spines appear in larger or smaller number in *Membraniporina cornigera*, *M. prolecta*, in several varieties of *Microporella Malusi*, in two species of the genus *Chaperia* (*C. annulus* and *C. cervicornis*), in *Hiantopora radicifera* and in some species of the family *Cribrilinidae*. The differences mentioned in the shape of the spine have, as will be seen from the given examples, generally a very slight systematic importance, and are not even always an expression for a difference of species. In the same way as there is hardly any family or genus, except those very poor in species, in which all the members have spines, so there are hardly many species, in which the number of spines is constant, and in many cases the variation is very considerable. We may give here a few instances of the variation in number of the spines in genus and species. In *Smittina* the number varies between 0 and 8, in *Escharella* between 0 and 10, in Chaperia between 0 and 8 and in *Callopora* between 0 and 13. In *Electra monostachys* the number varies between 1 and 18, and even the one is not always present, in *E. pilosa* between 4 and 12, in *Callopora lineata* between 6 and 12, and in *Bugula Murrayana* between 3 and 8. In discussing the systematic importance of the spines, we must still notice that the family *Cribrilinidae* is based solely on the mutual relation of the marginal spines, and that a plate-shaped or branched covering spine only appears in the family *Scrupocellariidae*. To this we must still add that this spine is far from being found in all the species of the family, and that the family *Cribrilinidae* is undoubtedly not a natural one. In contrast to the generally great inconstancy and variation of the spines, it may be mentioned that marginal spines are always lacking in numerous families, which are mostly rich in species, e. g. *Farciminariidae*, *Cellulariidae*, *Steganoporellidae*, *Thalamoporellidae*, *Adeonidae*, *Catenariidae*, *Celleporidae*, *Hippothoidae*, *Myriozoidae* and *Tubucellariidae*.

Finally, we may briefly refer to a new *Callopora* species, from the Færoes, which apparently shows the largest amount of variations in the number, structure and mutual relation of the spines, which have yet been found in any *Bryozoa*. While some zoœcia only have 4 short spines, others have a very varying number of longer ones, which sometimes have the same breadth in their whole length, sometimes the tip expanded or bifurcated. These longer spines in more or fewer zoœcia may be united with one another to form a cover, pierced by transverse furrows, just as we find in the species of the genus *Membraniporella*.

The primary aperture. In a number of species we meet two different forms of zooecial apertures, and most of these cases appear in ooecium-bearing species, the ooecium-bearing zooecia having another form of the aperture from the others. This condition occurs for example in most species of the family *Catenariidae*, the species of the genus *Hippothoa*, in *Cribrilina clithridiata* Waters, »*Schizoporella*« *filocincta* Rss., »*Sch.*« *subimmersa* Mac Gill, *Sch. spongites* Pall, »*Lepralia*« *bistata* Waters, etc. We also find two different forms of zooecial aperture in a smaller number of species which have no ooecia, for instance in a number of *Steganoporella* species, in *Euthyris obtecta*, *Euth. clathrata* and »*Lepralia*« *depressa*. Apart from these cases, the form of the aperture is constant within the same colony, and in the main constant within the species, though now and then it may show distinct variations in colonies from different places. This last condition is found for example in *Schizoporella spongites* (Pl. XVIII, fig. 4 c, d). On the other hand, the form of the aperture may have a rather different character in species, belonging to the same natural genus, and we may mention here some examples. In species of the genus *Thalamoporella* (Pls. VI, VI a, VI b, VI c) we frequently find a more or less sharply marked, wider or narrower, rounded sinus, but it is at times so faintly marked, that the aperture becomes irregularly circular and in a few species it is provided with a straight or almost straight proximal edge: Within the genus *Haswellia* an oral sinus is lacking in *H. gracilis* (Pl. XVI, fig. 1 b), while it is distinctly developed in the other species (Pl. XVI, fig. 2 b), and there is a sinus in *Exochella tricuspis* (Pl. XVII, fig. 9 b), which is wanting in *E. longirostris* (Pl. XVII, fig. 6 b). The form of the aperture also undergoes a somewhat considerable variation within the genus *Smittina*, as it sometimes has a more or less distinctly rounded sinus, sometimes is irregularly circular or quadrangularly rounded.

While the examples mentioned, which might easily be added to, make it already very doubtful, if it is right to attach the great systematic importance to the form of the aperture, which *Smitt.*, *Hincks* and other authors do, this doubt is further strengthened when we examine the whole extent of the differences, which the form of the aperture can present within the Cheilostome *Bryozoa*, and the appearence of these different forms of the aperture within a series of natural families.

We can refer the numerous forms of aperture to two different types, which however in reality grade evenly into one another, and which we may call the »holostome« and the »schizostome«. The holostome aperture may have the form of one continuous line of different shape (circular, oval, transversely oval), in which case the boundary between the distal (the anter) and the proximal (the poster) part of the edge of the aperture cannot be defined by the aid of the form of the aperture itself but either by the aid of hinge-teeth, or where such are missing by the points of suspension of the operculum. Again, the edge of the aperture is divided naturally into two different portions, a distal and a proximal, which meet at an angle on each side. The distal portion then generally forms a larger, more convex curve, the lateral parts of which may be parallel, converging or diverging, while in the proximal, smaller portion we find all possible conditions between a curve and a straight line. A review of a large series of holostome apertures shows us that forms of apertures such as the circular, the elliptic, the semicircular, etc. are mutually connected by such a number of transitions, that it is quite hopeless to base a systematic division only on the form of the primary aperture. In his well-known Monograph Hincks[1] uses the following designations for the form of the aperture in the holostome genera described by him: »semicircular« (*Chorizopora, Microporella, Porella*), »more or less semicircular« (*Phylactella*), »semicircular or suborbicular« (*Micropora*), »semicircular or semielliptical« (*Retepora*), »suborbicular or semicircular« (*Mucronella*), »suborbicular« (*Smittia*), »suborbicular or subquadrangular« (*Umbonella*), »orbicular or ranging from semicircular to semielliptical« (*Palmicellaria*). The designation »semicircular« is thus used to characterize the form of the aperture in eight of the ten genera here mentioned, either alone or in connection with the designations: »suborbicular«, »semielliptical« and »subquadrangular«, of which the first appears in the diagnosis of four, the second of two genera. We can easily see that the differences in the form of the aperture, which Hincks put down for the genera mentioned, are too vague and indefinite to be of any use in their distinction.

In contrast to the holostome the schizostome aperture has on its proximal edge a more or less deep sinus. If we take our starting point from a form such as *Arthropoma (Schizoporella) Cecili* or *Schizoporella spongites*, in which the sinus is very narrow, almost slit like, and if we imagine this as gradually widening on both sides, we will have a series of apertures with varying breadth of sinus until at last this disappears, because its sides run into the lateral edges of the aperture. On further extension the sinus becomes wider than the rest of the aperture, as it is in some of the species referred to the genus *Lepralia*. Still this picture only gives us a fractional part of the variations, which the schizostome aperture in reality presents, because a similar variation takes place partly in the depth or height of the sinus partly in the shape of its proximal rim, which may sometimes be straight and sometimes more or less curved. It is clear, that the schizostome aperture offers a far greater possibility for variations than the holostome,

[1] 22.

because besides the variation in the distal part of the aperture, we also have the possibility for a so to speak endless variation in the extent and shape of the sinus. That such a variation is not merely an abstract thought but really exists, will be admitted by all who on the one hand have examined large quantities of *Bryozoa*, and at the same time also have studied the considerable literature on this subject. The majority of those species, which have a schizostome aperture are referred by Hincks and later writers to the two genera *Schizoporella* and *Lepralia*. Though Hincks considers them to belong to two distinct families, it is in many cases a matter of guesswork, whether to class a species to one of the genera or to the other, because they can only be distinguished by a difference in the shape of the aperture. Yet the diagnoses of the two genera seem to be quite different, as a *Schizoporella* aperture is considered to have a sinus on the proximal edge, but *Lepralia* a horseshoe-shaped aperture, contracted at the sides. Since, however, such a proximal part of the aperture, so contracted, can in reality be regarded as a sinus the difference between the two kinds of apertures is reduced to a difference in the width of the sinus, and species with a narrow sinus have thus been referred to *Schizoporella*, and those with a wide sinus to *Lepralia*. The result of this consideration is then that the shape of the primary aperture, on account of the practically endless variations to which it is subject in the Cheilostome *Bryozoa*, cannot have any great systematic importance, and that it can at the very most only be used as a more or less constant, auxiliary character in the diagnosis of the genera.

We arrive at the same result on considering the question from another point of view. If we examine the aperture in a large number of forms belonging to a series of families, we find that quite corresponding forms of aperture, holostome as well as schizostome, reappear in all families which are rich in species, and we may thus draw the conclusion, that these different forms of aperture in each of these families have arisen independently. To mention some of the most prominent forms of aperture, we find for instance an aperture with a sinus in the following families: *Cribrilinidae* (e. g. in *Cribrilina clithridiata* Waters), *Thalamoporellidae*, *Myriozoidae*, *Escharellidae* (in *Schizoporella* and *Escharina*), *Smittinidae* (*Smittina linearis*, *S. porifera* etc.), *Hippothoidae* (*Hippothoa*, *Trypostega*), *Adeonidae* (several *Adeonella* species), *Reteporidae* (*Retepora imperati*, *Ret. sinuosa*, *Rhynchopora*, »*Schizoporella*« *scintillans*, etc.), *Catenariidae* (*Calpidium*, *Claviporella*, *Hincksiella*, etc.), *Euthyridae* (*Urceolipora nana*) and *Celleporidae*. A semicircular aperture with a simple operculum, which is furnished with a straight or slightly curved proximal edge, is found further in the following families: *Thalamoporellidae* (*Thal. expansa*, *Thal. Jervoisi*), *Microporidae*, *Cellulariidae*, *Escharellidae* (*Microporella*, *Inversiula*), *Hippothoidae* (*Haplopoma, Chorizopora*), *Adeonidae* (*Adeonellopsis*) and *Onchoporidae* (*Onchopora*).

Besides the shape of the aperture we must also consider its teeth-shaped projections, and I have already called attention to the fact, that we can distinguish between hinge-teeth, supporting teeth, and such protecting teeth as are placed outside the operculum. Teeth-like projections of different kinds are occasionally used by different writers, e. g. Smitt, Hincks, Waters, Jullien, as generic or family characters, and Jullien[1] has for instance founded a family *Smittidae* merely on the presence of a median tooth (lyrula) and two side-teeth (cardellae). To judge from the name he gives the two side-teeth (cardellae, from cardo a hinge), we would imagine that he regarded them as hinge-teeth, but in *Exochella* they belong to the peristome, and may even join together with one another or with the median tooth (*Ex. longirostris*). For the rest the author writes regarding all the three teeth: »c'est le dévelloppement du jeune peristome qui contribue à former la lyrula et les cardelles dans la famille des *Smittidae*«. There is no reason for attaching much systematic importance to these teeth-like projections, and they can at most be used as more or less constant auxiliary characters, particularly in the diagnosis of genera. Hinge-teeth seem to appear constantly, but in somewhat varying shape in the genus *Smittina* and to be wanting in the genus *Discopora*. In the genus *Thalamoporella* they are very distinct and well developed in a series of species, whilst in other species they are very slightly developed or absent, and they seem to appear very seldom in the genus *Holoporella*. Supporting teeth seem to appear constantly in the genus *Cellularia*, but as already mentioned they vary in shape and number. The median tooth, to which the greatest importance has been attached, seems to appear within most families which are rich in species, but in families which are only tolerably rich in species, it never seems to be constant, and it is not even always constant within the species. It is found in the family *Escharellidae*, in most species of the genus *Escharella*, in the family *Discoporidae* e. g. in *Discopora pavonella*, *D. scabra* and *D. plicata*, in the family *Petraliidae* e. g. in *Petralia castanea* and *P. bisinuata*, in the family *Holoporellidae* e. g. in *Holoporella tridenticulata*, in the family *Reteporidae* e. g. in *Retepora novae Zelandiae*, in the family *Adeonidae* e. g. in *Bracebridgia pyriformis*, and in the family *Cribrilinidae* in a variety of the fossil *Membraniporella crepidula* Hag.

As examples of species, in which the median tooth is sometimes present, sometimes absent, we may mention besides the last-mentioned: *Porella compressa*,

[1] 45, p. 52

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P. concinna, Smittina palmata, Discopora scabra and *D. plicata.* In the two last-mentioned species there may even in this regard be a difference between the single zooecia in the colony.

In connection with the aperture, we have still to mention as systematic character the previously discussed vestibular arch, which seems to appear constantly in the family *Reteporidae* and in most genera of the family *Escharellidae.*

The peristome or the secundary aperture, which forms a more or less perfect vestibulum to the true or primary aperture, appears only within the *Ascophora* and is even within this division represented in a very irregular way, as it may sometimes be absent in whole families (*Catenariidae, Petraliidae, Holoporellidae*), or genera (*Microporella*), whilst in others it appears to a very variable extent. A peristome may sometimes be developed round the whole circuit of the primary aperture (»*Lepralia*« *canthariformis*, the species of the genera *Haswellia* and *Tubucellaria, Retepora pectinata* Kirk, etc.), sometimes over only a larger or smaller portion of this, being sometimes interrupted distally (»*Phylactella*« *labrosa*, »*Ph.*« *collaris, Schizoporella armata* Var.), or proximally (many species of *Smittina* and *Retepora*). In some cases it is formed by continued growth of the edge of the primary aperture (»*Lepralia* *Pallasiana* Var, »*Lep.*« *canthariformis, Escharina simplex*), whilst in other cases it forms a wall outside this rim (»*Phylactella*« *labrosa*, »*Ph.*« *collaris*, »*Schiz.*« *armata* Var). It may be low, circular (*Escharina simplex*), funnel-shaped (»*Lep.*« *canthariformis*), or tube-shaped (*Retepora pectinata, Ret. phoenicea, Escharella spinosissima*, »*Phylactella*« *geometrica*) and in a number of cases provided with a pore on the frontal wall. It is occasionally furnished with teeth-like projections, which in number and position are like those, which in certain genera belong to the primary aperture. This applies for example to the genus *Exochella* and certain species of the genus *Escharoides.*

As the peristome is often very obvious it is easily understood why it has in many cases been used as a systematic character at the cost of others more important, but less prominent, and in Hincks' great work the following genera are besides the family *Porinidae* entirely or chiefly based on the structure of the peristome, namely *Porina, Lagenipora, Schizotheca, Porella, Escharoides, Smittia, Phylactella, Mucronella, Palmicellaria* and *Rhyncho*~~pora~~zoon. Of these genera I am only able to retain *Porella*, in the limitation given by Hincks.

In discussing the question of the systematic importance of the peristome, we may first call attention to the fact that the same peristome forms recur within a series of widely different families and genera. We thus find a collar-shaped peristome, furnished with a frontal incision in many members of the family

Reteporidae, in a series of species of the genus *Smittina*, in *Porella compressa* and *Discopora Sarsi*. A shorter or longer tube-shaped peristome with a pore on the frontal wall is found in the genera *Adeonella, Haswellia* and *Tubucellaria*, in certain *Retepora* species (*R. cellulosa, R. Couchi, R. complanata* etc.), in *Tessaradoma borealis*, »*Porina*« *tubulosa, Smittina Lansborovi*, var. *personata*), whilst a long tube-shaped peristome without pores is found in certain *Retepora* forms (*R. pectinata, R. phoenicea*), in certain *Cellepora* forms (*Cellepora tubulosa, C. bicornis*), *Lekythopora hystrix*, »*Phylactella*« *geometrica* etc. Next, I would point out, as a general result of my investigations on this point, that the peristome in many cases is very inconstant within the genus (e. g.: in the genera *Escharella, Smittina, Discopora, Petralia, Cellepora*, etc.), and Hincks even mentions a series of cases where the peristome in the same species may sometimes be present, sometimes absent, which for example is the case in »*Lepralia* *Pallasiana, Smittina trispinosa* and *Escharina Dutertrei*. Whilst the above-mentioned small peristomial teeth are found constantly in the small genus *Exochella*, their appearance is very inconstant in the genus *Escharoides*, and on the whole like Waters I cannot attach very great importance to the peristome, which however does not exclude the possibility that its apperance may be constant in a series of genera, e. g. in *Adeonella, Haswellia* and *Tubucellaria*.

The operculum. As all that has been said regarding the systematic importance of the form of the aperture, also holds good as a rule for the form of the operculum, we may here merely take note of the other differences, which appear in its structure. As already mentioned, we are able from the different relations of the operculum to the frontal cover and the compensation-sac to distinguish between an opercular valve, a simple and a compound operculum. These differences have however only partially a systematic importance. We have a series of examples of the fact that an opercular valve and a simple operculum may appear within the same genus: e. g. in *Steganoporella* and *Thalamoporella*, and especially in the last-mentioned we find a series of intermediate forms between the two kinds of operculum. We have other examples in the previously mentioned species of *Caberea* and *Scrupocellaria*, in which the presence of a simple operculum seems to be dependent on the strong development of the covering spine. That an opercular valve and a compound operculum can appear in the same genus, we have examples in the genera *Adeona, Porella, Escharella, Escharoides, Smittina, Holoporella* and *Chaperia*. Whilst for example we as a rule find a compound operculum in *Porella* and *Adeona*, there is an opercular valve in *Porella lævis* and *Adeona violacea*, and while there is generally an opercular valve in *Escharella* and *Escharoides* we find a well-chitinized compound operculum in *Escharella polita* and *Escharoides sauroglossa.*

But the contrast between a simple and a compound operculum is of greater systematic importance, and it seems as a rule to be an expression for a generic difference. We find a simple operculum within a series of Ascophore families (*Escharellidae, Hippothoidae, Onchoporidae, Adeonidae*[1]), and it is generally accompanied by a different mode of opening of the compensation-sac, which in these forms with a simple operculum with a single exception (*Chorizopora*), opens out through a median pore (see pag. 32). In spite of the above examples of variation, the structure of the operculum seems as a rule to show more constancy within the genus than for instance the shape of the aperture and the peristome and must be regarded as one of the best distinguishing characters. Referring for the rest to the separate families, we may just mention as examples that while a well-chitinized, compound operculum is found in *Schizoporella, Porella, Cellepora* and *Adeona*, a membranous operculum, which is not separated from the compensation-sac, is the rule in the genera *Escharella, Escharoides* and *Discopora.* The mode of attachment of the occlusor muscles seems also to be rather constant within the genus, and we may cite as examples that there are special muscular ridges or muscular processes in the genera *Porella, Escharina* and *Microporella,* while *Schizoporella, Cellepora, Arthropoma* and *Conescharellina* have muscular dots.

The rosette-plates are interesting examples of a structural feature which, though subjected in a number of cases to considerable variation within the genus, and even within the species, proves in most cases to be constant, not only within the genus, but also within the family. It is specially the rosette-plates of the lateral walls, however, which show this constancy, as those which appear on the distal wall in many cases show great variation, and we may cite the rosette-plates on the distal wall of *Membranipora membranacea* as a very pronounced example of such a variation (p. 24). Referring for the rest to the diagnoses of the separate families and genera, we may here cite the following families and genera, partly very rich in species, in which the rosette-plates of the lateral walls especially show either perfect constancy in structure and appearance, or only a small degree of variation, namely: *Farciminariidae, Scrupocellariidae, Bicellariidae, Cellulariidae, Steganoporellidae, Thalamoporellidae, Adeonidae, Reteporidae, Catenariidae, Hippothoidae, Celleporidae, Holoporellidae, Onchoporidae, Conescharelli-*

[1] see pag. 38.

nidae, *Myriozoidae*, *Escharella*, *Escharoides*, *Porella*, *Onychocella* and *Callopora*. On the other hand, the rosette-plates show variations in the families *Flustridae*, *Membraniporidae*, *Cribrilinidae* and *Microporidae*, but in still higher degree in the genera *Schizoporella* and *Smittina*. In these some species have single-pored, others multiporous, and again others mixed rosette-plates, and colonies from different localities may show a distinct difference in the number of pores in the rosette-plates e. g. in *Schizop. unicornis*, *Sch. sanguinea* and *Sch. longirostris*.

Synopsis of the Families and Genera

of Cheilostomatous *Bryozoa* treated of in the present work.

Subordo **Anasca.**

1. Division: *Malacostega.*

Fam. *Aeteidae:* Gen. *Aetea.*

Fam. *Bicellariidae:* Gen. *Dimorphozoum* n. g., *Bugula* Oken, *Stolonella* Hincks, *Beania* Johnst., *Hiantopora* Mac Gill., *Chaperia* Jullien, *Petalostegus* n. g., *Halophila* Busk, *Notamia* Flem., *Gemellaria* Sav., *Brettia* Dyster, *Cornucopina* n. g., *Didymia* Busk, *Eucratea* Lamour., *Dimetopia* Busk, *Kinetoskias* Kor-Dan., *Bicellaria* Blainv., *Bugularia* n. g., *Bicellarina* n. g., *Watersia* n. g., *Dendrobeania* n. g.

Fam. *Farciminariidae:* Gen. *Farciminaria* Busk, *Columnaria* n. g., *Nellia* Busk.

Fam. *Flustridae:* Gen. *Flustra* L., *Sarsiflustra* Jullien, *Kenella* n. g., *Retiflustra* n. g., *Spiralaria* Busk, *Heteroflustra* n. nom.

Subordo **Ascophora.**

Fam. *Catenariidae:* *Scuticella* n. g., *Cribricella* n. g., *Costicella* n. g., *Claviporella* Mac Gill., *Pterocella* n. g., *Calpidium* Busk, *Hincksiella* n. g., *Catenaria* Sav., *Strophipora* Mac Gill.

Fam. *Onchoporidae:* Gen. *Calwellia* Wyv. Th., *Onchopora* Busk, *Onchoporella* Busk, *Onchoporoides* Ortm.

Fam. *Euthyroidae:* Gen. *Euthyroides* Harmer.

Fam. *Euthyridae:* Gen. *Urceolipora* Mac Gill., *Euthyris* Hincks, *Pleurotoichus* n. g.

Fam. *Savignyellidae* n. f.: Gen. *Savignyella* n. g., *Halysisis* Norman.

Fam. *Hippothoidae:* Gen. *Hippothoa* Lamour., *Chorizopora* Hincks, *Haplopoma* n. g., *Trypostega* n. g.

(Anasca).

p 136 Fam. *Scrupocellariidae:* Gen. *Scrupocellaria* Van Ben., *Canda* Lamour., *Bugulopsis* Verrill, *Hoplitella* n. g., *Rhabdozoum* Hincks, *Caberea* Lamour., *Caberiella* n. g., *Menipea* Lamour.

p 143 Fam. *Membraniporidae:* Gen. *Membranipora* L., *Electra* Lamour., *Callopora* (Gray) Norman, *Megapora* Hincks, *Tegella* n. g., *Caleschara* Mac Gill., *Onychocella* Jullien, *Cupularia* Lamour., *Lunularia* Busk, *Selenaria* Busk.

Fam. *Cribrilinidae:* Gen. *Membraniporella* Hincks, *Cribrilina* Gray, *Puellina* Jullien, *Figulina* Jullien, *Aspidelectra* n. g., *Arachnopusia* Jullien.

2. Division: *Coilostega.* p 161

p 161 Fam. *Microporidae:* Gen. *Micropora* Gray, *Macropora* Mac Gill., *Hemiseptella* n. g., *Foraminella* n. g., *Calpensia* Jullien.

Group *Tubifera:*

Fam. *Steganoporellidae:* Gen. *Steganoporella* Smitt., *Siphonoporella* Hincks.

Fam. *Aspidostomidae* ~~n. f.~~: Gen. *Aspidostoma* Hincks, *Labiopora* n. g., *Crateropora* n. g.

Fam. *Thalamoporellidae:* Gen. *Thalamoporella* Hincks.

p 196 Fam. *Chlidoniidae:* Gen. *Chlidonia* Sav.

(Ascophora).

Fam. *Adeonidae:* Gen. *Adeona* Lamour., *Adeonellopsis* Mac Gill., *Adeonella* Busk, *Bracebridgia* Mac Gill.

Fam. *Reteporidae:* Gen. *Retepora* Imperato s. ext., *Rhynchopora* Hincks.

p 296 Fam. *Myriozoidae:* Gen. *Leieschara* Sars, *Myriozoum* Donati, *Haswellia* Busk, *Gephyrophora* Busk.

Fam. *Sclerodomidae:* Gen. *Sclerodomus* n. g., *Tessaradoma* Norman.

Fam. *Tubucellariidae:* Gen. *Tubucellaria* d'Orb., *Tubiporella* n. g.

Fam. *Conescharellinidae* n. f.: Gen. *Conescharellina* d'Orb., *Bipora* Whitel., *Flabellipora* d'Orb.

Fam. *Liriozoidae:* Gen. *Liriozoa* Ellis-Sol., *Gemellipora* Smitt.

Fam. *Lekythoporidae* n. f.: Gen. *Lekythopora* Mac Gill.

Fam. *Eurystomellidae* n. f.: Gen. *Eurystomella* n. g.

Fam. *Escharellidae* n. f.: Gen. *Escharella* Gray, *Anarthropora* Smitt, *Inversiula* Jullien, *Escharoides* Milne Edw., *Exochella* Jullien, *Schizoporella* Hincks, *Escharina* Gray, *Microporella* Hincks, *Arthropoma* n. g., *Emballotheca* n. g., *Cyclicopora* Hincks.

Fam. *Smittinidae:* Gen. *Porella* (Gray) Hincks, *Smittina* Norman (n. nom.), *Discopora* Lam.

(Anasca).

Fam. *Alysidiidae* n. f.: Gen. *Alysidium* Busk.

3. Division: *Pseudostega.*

Fam. *Membranicellariidae* n. f.: Gen. *Membranicellaria* n. g.

Fam. *Cellulariidae:* Gen. *Cellularia* Pallas.

(Ascophora).

Fam. *Celleporidae:* Gen. *Cellepora* L., *Siniopelta* n. g.

Fam. *Holoporellidae* n. f.: Gen. *Holoporella* Waters.

Fam. *Petraliidae* n. f.: Gen. *Petralia* Mac Gill.

Fam. *Hippoporinidae* n. f.: Gen. *Cheilopora* n. g., *Hippopodina* n. g.

Systematic Part.

Order Cheilostomata.

The *zoœcia,* to a larger or smaller extent calcified, as a rule furnished with an *operculum* (except *Bugula*). There can be found four different forms of individuals: *autozoœcia, heterozoœcia, gonozoœcia* and *kenozoœcia,* and in many cases the eggs are matured in special, outer or inner, calcareous marsupia, the so-called *oœcia.* The separating walls between the individual zoœcia are furnished with rosette-plates, and in colonies consisting of more rows we can as a rule distinguish between a horizontal or oblique distal wall and vertical lateral walls, which are most frequently independent. More rarely a lateral wall is common to two adjoining zoœcia, which on the other hand is almost always the case with the distal wall.

Suborder Anasca.

A compensation-sac is wanting, and the frontal wall is either wholly or in part membranaceous, or calcareous, depressed and surrounded by raised margins. In the heterozoœcia the opercular and the subopercular areas are as a rule not separated by a continous calcareous bar, but only partially by the hinge-teeth of the operculum.

1st Division: Malacostega.

The individual *zoœcia* are plainly marked off on the surface of the colony. The frontal wall quite or partially uncalcified and the operculum as a rule a membranous valve, the rim of which is chitinized, but which proximally passes over into the frontal membrane.

Family: Aeteidae.

(Pl. VI c, figs. 6 a—6 d).

The *zooecia*, which have no spines and the calcareous wall of which is densely covered with pores of different form, consist of two portions inclined towards one another at an angle, the lower of which is as a rule decumbent, adherent, while the upper, mostly tube-shaped part is provided at its expanded end with a small membranous frontal area. No cryptocyst. The diaphragm has a structure similar to that in the *Ctenostomata*. The *heterozooecia* and *ooecia* wanting. The distal wall furnished with a row of uniporous rosette-plates. The colony creeping, forming a meshwork of single rows of zooecia, from which free branches sometimes issue.

The partly thin, thread-shaped adherent part, from which the free upright part of the zooecia arises, is by Hincks compared to a stolon but this name can only be used for a basal portion, consisting of kenozooecia, as found within the order *Ctenostomata* in the families *Vesiculariidae*, *Triticellidae*, *Valkeriidae* and *Mimosellidae* and within the *Cheilostomata* in the genera *Chlidonia*, *Liriozoa* and *Stirparia*. In *Aetea* the whole colony is built up by autozooecia, and the fact, that the proximal part of the zooecium is thin and much elongated, does not entitle us to speak of a stolon in these species any more than in the species, which Hincks refers to the genus *Hippothoa*. The adherent parts of two successive zooecia are separated by a wall, which in *Aetea dilatata* is furnished with a row of 7 uniporous rosette-plates, and a similar separating wall is found everywhere, where one zooecium issues from another. In *Aetea truncata* according to Hincks new free zooecia may issue from the basal side of the ascending part of the zooecium. The calcareous wall of the zooecium is richly furnished with pores, which in different species can appear in different ways. Thus, while the whole calcareous surface in *Aetea dilatata* is furnished with round pores, the form of the pores varies in many other species at different places. For example, the distal part of the zooecium in *Aetea anguina* and also the broadest part of the adherent portion are furnished with small round or oval pores. In the narrower part of the adherent portion they fuse together to longer, slit-like spots (fig. 6 d), and in the largest part of the ascending portion (fig. 6 c) they become continuous, ring-shaped interruptions, and therefore the calcareous portions appear as a row of free rings situated above each other, which can be isolated without great difficulty. Sometimes however we find a short connecting branch between two successive rings, or a bifurcation of a single ring. Waters[1] has found an egg enclosed

[1] 111, p. 5, Pl. I, figs. 1—5

in a spherical, transparent body near the tip of the basal side of the ascending part of the zooecium in a large number of specimens of *Aetea anguina*, and considers this to be an ooecium. The great transparency of this little globe, which has enabled Waters to count the cell-divisions of the egg, seems to indicate, that it is not calcareous, and this fact in connection with its for an ooecium, very unusual position on the basal side of the zooecium, speaks decidedly against the ooecial nature of these globes. I must therefore regard the supposed ovicellular wall only as a shell membrane surrounding the egg.

Smitt[1] has already called attention to the great agreement between the members of this family and the *Ctenostomata*; but when he specially compares *Aetea* with the family *Vesiculariidae*, we must remark, that this genus shows a much greater agreement with the families *Cylindroeciidae* and *Victorellidae*, in which the zooecium according to Hincks also consists of an adherent and an ascending portion, while they have no real stolon. In all Ctenostome families, where the zooecia issue from a stem or stolon consisting of kenozooecia, the zooecia die away and can be renewed, whilst such a renewal does not take place where there is no stolon, as in the two above-mentioned families, and according to this, the peduncles in *Triticella* must belong to the stolon and not to the individual zooecia. Smitt[1] has also called attention to the fact that *Aetea*, in the cylindrical form of the zooecia and the rich development of pores, shows agreement with the *Cyclostomata*, and he imagines the possibility that the latter may have had a Ctenostome origin. Without entering further into this question I wish only to point out in this connection that in the Cyclostome species *Stomatopora gallica* d'Orb.[2] the zooecium, as in *Aetea*, consists of a decumbent and an ascending part. On the other hand, the agreement which an *Aetea* shows with such a species as *Mucronella cothurnica* Kirk. is of quite a superficial nature, as the ascending tube-shaped portion in the last-mentioned species is only a peristom and cannot therefore be compared with the ascending portion in an *Aetea*, which has an operculum near the tip.

Family Bicellariidae.

Eucratiidae Hincks, *Notamiidae* Hincks.

(Pls. III—V).

The *zooecia* as a rule slightly calcified and in most cases with a large membranous frontal area. Where a distal wall is developed (wanting in *Beania* and *Stolonella*) it is more or less ascending and its basal edge is then placed more or

[1] 99 a, p. 460. [2] 86, Pl. 759, figs. 1—3.

less proximally on the basal surface of the zoœcium. The lateral walls always independent, and each provided with 1 (rarely with 2) multiporous rosette-plate, which is often partially uncalcified. The *avicularia* when present dependent, most frequently capitate, pedunculate, freely movable, more rarely sessile and in that case often extremely long and slender. The *oœcia* as a rule hyperstomial, free, more rarely endozoœcial and then as a rule covered by kenozoœcia. The colonies free or creeping, generally branched and frequently provided with radical fibres.

With a few exceptions (e. g. *Hiantopora* and *Chaperia*) the calcification in this family is very feeble, and the least calcified *Cheilostomata* known are undoubtedly the *Beania* species, of which some contain so little calcareous material that it is only by using hydrochloric acid that we can make sure that there is any calcification at all in their walls. Whilst the whole frontal wall in the *Beania* species, in *Dimorphozoum nobile* and *Watersia militaris*, is membranous, in most members of the family a larger or smaller portion of it is calcified and forms a gymnocyst, which may sometimes, for instance in *Gemellaria loricata* and certain *Cornucopina* species, occupy two-thirds or three-fourths of the whole length of the zoœcium. From this gymnocyst in older zoœcia there arises not so seldom a small secundary cryptocyst (e. g. in *Didymia simplex*, *Gemellaria loricata*, *Dendrobeania Murrayana*). Except for the species of the genus *Beania* in which the individual zoœcia are connected by cylindrical tubes, two zoœcia in the same longitudinal row are in all other cases connected by a distal wall, which is always more or less ascending from the basal towards the front wall so that the distal end of the lower zoœcium projects more or less over the proximal end of the zoœcium above. It is usually furnished with a number of uniporous, more seldom with one or two multiporous, rosette-plates and not rarely (*Bugula*, *Halophila*, *Didymia*, *Bicellaria*, *Bicellarina*, *Bugularia*) the basal edge shows a peculiar angular bending (Pl. III, figs. 1 c, 2 d, Pl. V, figs. 1 a, 2 b). Each lateral wall is as a rule provided with 1 or rarely with 2 multiporous rosette-plates. Except for the pore-ring they are as a rule membranous, and it is therefore difficult to decide, from spirit-material, whether they are uni- or multiporous. In all cases where they are calcareous, e. g. in *Dendrobeania Murrayana*, *Dimorphozoum nobile*, *Bugularia dissimilis* etc., they are however multiporous. Whilst the dependent avicularia in most *Cheilostomata* attain their greatest breadth where they are fixed to the zoœcium, most avicularia in this family are provided with a shorter or longer movable peduncle or the proximal part of the avicularian chamber is slender pedunculiform. While the first have the peculiar resemblance to a bird's head which has given rise to the name avicularium the others which increase gradually in breadth toward the distal end have been described as trumpet-shaped. Common sessile avicularia appear however in *Hiantopora*, *Bugularia* (Pl. V, fig. 2 a), *Petalostegus* (Pl. IX, figs. 8 a, 8 b) and sometimes in *Chaperia*. The oœcia are as a rule hyperstomial, and might be considered as free, because the endooœcium only has a small portion of its basal wall in common with the frontal wall of the zoœcium. Whilst the endooœcium is always calcareous, the ectooœcium may be calcified completely (*Bicellaria ciliata*) or almost completely (*Dimetopia cornuta*), or sometimes quite or partially uncalcified (*Dendrobeania Murrayana*, *Bugularia dissimilis*, etc.). In a smaller number of cases the oœcia are immersed either in kenozooœcia or in ordinary zoœcia (»*Bugula*« *mirabilis*). With the exception of most *Chaperia* species and of »*Membranipora*« *Carteri*[1], which on account of its pedunculate, capitate avicularia must certainly be referred to this family, the colonies are never incrusting and appear in a greater variety of forms of growth than in any other family of the *Cheilostomata*. Apart from such genera as *Gemellaria*, *Notamia* and *Synnotum*, in which the colonies may be considered as two-layered, colonies with two layers are only found in *Walersia militaris* and *Dimorphozoum nobile*. Radical fibres appear in most genera and in very different ways (see the synopsis of the genera).

This family, like the *Aeteidae*, presents a series of points of contact with the *Ctenostomata*, and forms so to speak a connecting link between these and the *Cheilostomata*. This is nowhere more prominent than in the peculiar dimorphism in *Dimorphozoum nobile* (Pl. IV, figs. 1 a—1 e), as the zoœcia in the one layer of the colony are built in quite the same way as in an *Alcyonidium*, whilst in the opposite layer they possess an operculum, avicularia and oœcia. For the rest, however, the diaphragm in these zoœcia seems to be Ctenostome-like. We should also remember that an operculum is absent in species of the genus *Bugula*, as also that the diaphragm in *Encratea chelata* is said to be built in the same way as in the *Ctenostomata*. The generally slight calcification also agrees with this view, and finally a series of forms in this family shows quite similar modes of connection between the zoœcia as those we know in the majority of the *Ctenostomata*. Thus, *Beania* corresponds in this regard with the Ctenostome genera *Arachnidium* and *Buskia*, whilst the stolon or stem, which consists of kenozooœcia and which is widely distributed in the *Ctenostomata*, is again found in »*Bicellaria*« *glabra*, *Bugula* (*Stirparia*) *Haddoni* and *B.* (*Stirpaia*) *caraibica*.

When Busk, Hincks and other writers refer a number of genera of the family (*Encratea*, *Gemellaria*, *Notamia*, *Didymia*, *Dimetopia* etc.) to other families, the reason is, that these writers have laid greater stress on the form of colony

[1] 23, p. 82

or on the modes of connection of the zooecia. In their whole structure these forms undoubtedly belong to the family *Bicellariidae*. The peculiar contrast in *Epistomia* and *Synnotum*[1] between the proximal cylindrical and the distal widened portion of the zooecium as well as the possession of pedunculate avicularia, shows that the position of these genera is near to *Cornucopina*. In *Gemellaria* the distal wall is as in *Bugula*: angulate and furnished with a series of uniporous rosette-plates. We also find an angular distal wall in *Didymia*, the ooecia of which, like those in *Eucratea* and *Cornucopina*, are surrounded by kenozooecia, and *Dimetopia* has like most of the *Bicellariidae*, free ooecia. Finally, I have been obliged to set up new genera for the old *Flustra*-species, *Fl. nobilis*, *Fl. dissimilis* and *Fl. militaris* as also for *Bugula Murrayana*, *Bicellaria Alderi* and *Catenaria bicornis*. It is however with some doubt that I refer the last species to this family.

In the following synopsis of the numerous genera of the family, to which I have been under the necessity of adding 6 more, I have as main characters in the separation of the genera mainly used differences in the structure of the zooecia themselves, as e. g. the presence or absence of an operculum, the division of the zooecium in different segments by constrictions, the structure of the distal wall, and next the differences in the character of the ooecia. I have used the presence or absence of ooecia and avicularia, as well as the differences in the structure of the avicularia, as auxiliary characters.

Synopsis of the Genera.

1) The colony consists of two layers, the zooecia of which are of very different kinds (the zooecia in one layer are quite uncalcified, without operculum, in the other layer they are of the ordinary type; the distal wall consists of a horizontal, basal portion with a multiporous rosette-plate, and of a frontal ascending portion; free ooecia, freely movable avicularia) . . . . *Dimorphozoum* n. g.

1) If the colony consists of two layers, the zooecia of the two layers are of the same kind:

2) Zooecia without operculum; (the edge of the distal wall is angular; within this a row of single-pored rosette-plates; free ooecia, freely movable, capitate avicularia, radical fibres issue both from the frontal, basal and lateral aspects of the colony) *Bugula* Oken (Lev. mod.).

2) zooecia with an operculum:

[1] 111, p. 14.

3) The colonies, which never have a free, upright growth, are exclusively attached by radical fibres which either issue from a creeping stolon or from the basal surface of the individual zoœcia:

4) the colony is attached by radical fibres which issue from a creeping stolon; (the zoœcia which issue separately from the stolon, are furnished with two rows of spines, joined together in pairs and separated by a single row of transverse slits; no avicularia, no oœcia... *Stolonella* Hincks.

4) the colony is attached by radical fibres which issue from the basal surface of the individual zoœcia, and these are generally connected with one another by shorter or longer, wider or narrower tubes to form a network with larger or smaller apertures:

5) the zoœcia very slightly calcified; the connecting tubes between the individual zoœcia distinct; oœcia wanting; as a rule pedunculate, freely movable avicularia .... *Beania* Johnston (*Diachoris*).

5) The zoœcia strongly calcified; the connecting tubes between the single zoœcia indistinct, broad and short, and only visible from the basal surface; oœcia may be present; sessile avicularia; (from each avicularium issues a spine which is often much branched and may conceal a larger or smaller portion of the frontal membrane) .... *Hiantopora* Mac Gillivray.

3) the colonies have a free upright growth or are incrusting.

6) The distal part of the zoœcia provided internally with two lateral spaces open towards the frontal surface (sometimes combined to one single, horseshoe-shaped space), formed by two calcareous plates which issue from the lateral walls and converge towards the distal wall; avicularia and free oœcia may be present; the colony incrusting or laminate).. *Chaperia* Jullien.

6) The distal part of the zoœcia without lateral spaces:

7) There is a frontal shield, formed by five broad hollow spines lobed at the edge and separated by rows of pores; (a simple completely chitinized operculum; sessile avicularia) .... *Petalostegus* nov. gen.

7) No frontal shield:

8) No oœcia:

9) The distal, broader, more or less symmetrical part of the zoœcium is separated from a nearly as long, proximal, narrow, cylindrical part by a constriction:

10) The basal edge of the distal wall is angular; no avicularia; a constriction just distally to the distal wall . ... *Halophila* Busk (Lev. mod.).

10) The basal edge of the distal wall not angular; long-stalked fixed avicularia; no constriction distally to the distal wall... *Epistomia* Fleming.

9) The zoœcium not divided into a proximal, narrow cylindrical and a distal wider part (no avicularia).

11) The basal edge of the distal wall angular; (radical fibres issue from the lateral margin in the proximal part of the zoœcium .. *Gemellaria* Savigny.

11) The basal edge of the distal wall not angular....... .... *Brettia* Dyster.

8) Oœcia present:

12) The oœcia, which do not issue from the boundary between two zoœcia placed in the same longitudinal row, are covered by kenozoœcia; (the proximal part of the zoœcium separated from the distal by a more or less distinct constriction a little distally to the distal wall).

13) The oœcia are placed on zoœcia of ordinary size; zoœcia very asymmetrical, from the narrow tube-like proximal part widening into an obliquely funnel-shaped extremity, furnished with spines; as a rule there are found avicularia, the radical fibres, which go down along the basal surface of the colony, issue from a rosette-plate a good way distally on the basal aspect of the zoœcia .... *Cornucopina* n. g.

13) The oœcia are placed on zoœcia of smaller size; zoœcia symmetrical or only a little asymmetrical; no spines; no avicularia.

14) The basal edge of the distal wall angular; the oœcia-bearing zoœcia placed between two zoœcia in a bifurcation; (the frontal wall of the kenozoœcium membranous, furnished proximally with two calcareous processes; (no rosette-plate between two neighbouring zoœcia .... *Didymia* Busk.

14) the basal edge of the distal wall not angular; the oœcia-bearing zoœcia attached either proximally to the frontal area or to the basal surface of other zoœcia; the frontal wall of the kenozoœcium calcified .... *Eucratea* Lamouroux.

12) Free oœcia issue from the boundary between two zoœcia placed in the same longitudinal row:

15) The distal wall furnished with four uniporous rosette-plates, each of which is placed at the bottom of a separate chamber; (no avicularia) .... *Dimetopia* Busk.

15) The distal wall not formed in this way:

16) Each zoœcium has a strong muscle, which at its distal end is attached to the inner side of the external wall of the zoœcium, and at the other to a conical projection from the distal wall of the next

lower zoœcium; two successive zoœcia separated by a small uncalcified space; the distal wall has an uncalcified multiporous rosette-plate; the radical fibres which arise from the boundary between two zoœcia at their rim, run proximally and join, filling the spaces between the branches in the proximal part of the funnel-shaped colony) *Kinetoskias* Koren-Danielsen.

16) No such muscle; no uncalcified space between the zoœcia:

17) Each zoœcium consists of three sections separated by constrictions, of which the middle one is elongated, cylindrical, while the distal one is obliquely funnel-shaped (avicularia freely movable; the basal edge of the distal wall unequally asymmetrically angular; the radical fibres issue from the basal side of the zoœcium..... *Bicellaria* Blainville (mod.).

17) The zoœcia not divided into three segments separated by constrictions:

18) The basal edge of the distal wall is angular:

19) Distal wall with two multiporous rosette-plates; sessile avicularia .... *Bugularia* n. g.

19) Distal wall with small uniporous rosette-plates; free avicularia; (zoœcia widening from a narrow cylindrical proximal part into an obliquely funnel-shaped extremity; radical fibres issue from the lateral margins of the zoœcia) .... *Bicellarina* n. g. (B. Alderi Busk).

18) The basal edge of the distal wall not angular:

20) Distal wall very slightly ascending, with several uniporous rosette-plates; no avicularia; radical fibres issue everywhere from the covering membrane of the frontal surface in the two-layered colony.. *Watersia* n. g.

20) Distal wall consisting of a basal, horizontal part with a multiporous rosette-plate, and a frontal strongly ascending part; freely movable avicularia; radical fibres issue from the second (more seldom also from the first) rosette-plate of the marginal zoœcia .... *Dendrobeania* n. g.

In the above synopsis of the genera, in which the degree of relationship is not expressed by their consecutive order, I have not been able to take account of a series of earlier described forms, which I do not know from personal observation. So far as *Huxleya* is concerned, this genus is said to have a completely calcified, arched frontal surface, and does not seem to belong in any way to this family. *Brettia tubæformis* seems according to Hincks' figure to have an angularly bent distal wall and would therefore, according to the above given synopsis, have to be referred to *Gemellaria*. Regarding *Synnotum aviculare* I have no information about the structure of the distal wall, and if this, as in *Gemellaria loricata*, is angular, there might be some ground, in spite of the presence of avicularia, to refer it to the genus *Gemellaria*. A closer examination of those members of the family, which Busk has described in the Challenger Expedition's *Bryozoa* will no doubt lead to the setting up of several new genera, and Busk explains also that to avoid doing so he made his definition of the genus *Bugula* very elastic, whilst at the same time dividing the species into four groups.

It will for these species be of principal interest to find out whether they have an operculum or not, and also how their distal wall and oœcia are constructed. In *Bugula mirabilis* and »*Bugula*« *leontodon*, of which two species I have been able to examine a small fragment without oœcia, there is an operculum as well as an angular distal wall, and these together with two other species are referred to Busk's first group, where the oœcia which only appear in the median row of the colony, are enclosed in the proximal part of the higher placed zoœcium. The question is therefore, whether these species form a new genus or whether they can be included under *Didymia*, the oœcia of which however are surrounded by kenozoœcia. In *Bugula bicornis* the higher placed zoœcium arises far back on the basal side of the lower and meets with this in a circular disk. The form, which Busk mentions under the name of *Diachoris magellanica, v. distans*, but which he has not made the subject of any description, seems, to judge from the figure given, not only to be a separate species, but also to represent a new genus. The whole frontal wall seems namely to be calcified except for a median longitudinal slit, which proximally is much widened, and in front is continued right to the aperture, which is provided with a sinus.

Bugula Oken, char. emend.

The *zoœcium* without an operculum. Distal wall with a basal angular edge within which there is row of uniporous rosette-plates. Freely movable capitate *avicularia*; free *oœcia*. The colonies free, branched, the zoœcia in two or more rows.

Waters as is known has shown, that an operculum is wanting in *Bugula*, and Calvet has confirmed this observation for the French species. Whilst I am certain that an operculum is absent in the other *Bugula*-species, which are found in our Zoological Museum, I am not quite so sure of this for *B. caliculata*, because the individual zoœcia in the badly preserved colonies seem to me to show a trace of an operculum, and if there is not an even transition in this regard within the species we must very likely form a new genus for the species with an operculum. The angular bending of the distal wall may reach its maximum in *B. dentata* Lamx, where the two lateral halves in some zoœcia almost reach the proximal end (Pl. V, figs. 1 a—b).

Bugula caliculata n. sp.

Pl. III, figs. 1 a—1 q.)

The zoœcia, which from the narrow, proximal end increase in width distally, have on the outer distal angle a very short, curved spine, and on the inner a very long thread-like spine a little lower in position. In very young and developing colonies however the first 3—7 zoœcia have 2—3 long spines, and in such colonies the ancestrula is even provided with 6, of which the third (the lowest) on each side is placed at double the distance from the second as the latter from the first. The membranous portion of the frontal wall which in the ancestrula occupies nearly half the length of the zoœcium has in the common zoœcia a much larger extent. In the few single zoœcia succeeding the ancestrula there is found a constriction in the proximal part (figs. 1 d, 1 e).

The avicularia occur only in a relatively small number, and are situated a little within the outer lateral margin and a little distally to the proximal end of the zoœcium. Each zoœcium of a pair, where the bifurcation commences, is in most cases furnished with an avicularium, a rule, however with not a few exceptions, especially at the last bifurcations. Besides these, a number of avicularia occur apparently without any very definite position.

Oœcia small, globular, and their longitudinal axis is a continuation of that of the zoœcia.

The stem is jointed and consists of a row of long, narrow segments (kenozoœcia) widened a little at both ends and rounded quadrangular in section. The distal end of such a kenozoœcium is provided a little proximally to the joint constriction (fig. 1 l), with a distal wall, saddle-shaped from side to side and from the front to the base, which on each side is furnished with 1—5 small, uniporous rosette-plates, all of which may sometimes be separate, sometimes connected together in groups. This calcareous distal wall is continued internally along each of the two lateral surfaces of the kenozoœcium as a calcareous band (fig. 1 q) which as time goes on increases in width and in thickness. The two bands join together to a ring-shaped portion (figs. 1 l—1 m) at the proximal part of the segment, and the intention with the whole of this arrangement is evidently to strengthen the resisting power of the otherwise slightly calcified stem. Along the middle of the frontal surface of each segment we find an exceedingly narrow membranous frontal area, which even in its distal part is furnished with parietal muscles (figs. 1 m—1 n), which Kirkpatrick has also found in *B. (Stirparia) Haddoni.* New colonies arise from the stems of the older, taking their origin between two contiguous segments, and the youngest, which have a very small number of zoœcia, possess only a single stem-segment, which in time increases in length and seems to be formed by a constriction of the proximal part of the ancestrula (figs. 1 c, 1 d, 1 f). After the ancestrula follow two still solitary zoœcia, after which the first bifurcation commences. The older colonies, with from 3—17 joints, have only one solitary zoœcium, which according to the age of the colony sometimes has altogether 2—3 spines, and sometimes none at all, while the distal wall, as in the segments is connected with two calcified bands which are fused together in the proximal part of the zoœcium into a ring. A larger or smaller number of the older zoœcia according to their age show a similar transformation, and a comparison between the youngest and oldest colonies leaves no doubt about the fact, that the solitary zoœcia in the proximal portion of the colony are in time transformed to segments, while the proximal segment arises from a constriction of the proximal part of the ancestrula. I cannot determine with certainty how the other segments are formed, but as new colonies can arise between two segments, it seems reasonable to suppose, that new segments can also be formed between two older ones, and the fact that the segments may have a very different length favours this supposition. Nevertheless, I have nowhere found them so short that I could consider them as just beginning.

The radical fibres, which in the older parts of the stems issue in numbers from uniporous rosette-plates in the areas between the two strong, calcified bands, are simple calcified fibres, which partly cover the trunks, partly project freely from these. In some places they are pear-shaped, swollen in a part of their course and contain a strongly refractive, shining mass, while such swellings at other places project freely and thereby assume a great likeness to the gonotheca in the *Hydrozoa.* As far as the physiological importance of these swellings is concerned, I would put forward the supposition that they serve for the accumulation of reserve materials. Waters[1] has found quite similar formations in *Bugula (Stirparia) glabra* Hincks.

The colonies are frequently compound, and the small colonies have the form of stalked caliculate tufts, the branches of which show 6 bifurcations in the

[1] 111, p. 20, fig. 1

largest ones. In the largest the stalk or stem has a length of 31 mm., and the cup a height of 75 mm.

It is not quite clear to me whether the above-mentioned, quite young colonies have arisen by budding from the older colonies, or whether they originate from larvæ which have attached themselves. The fact that they arise as a rule between two segments, whilst a single one of them issues from the frontal surface of another zoœcium in a somewhat young colony, speaks in favour of the first view. While the one stem-segment in the very young colonies is very thin and rather short, I have observed in various colonies, both in young and in somewhat older, a thick and long, newly formed segment with a distinct terminal growth, arising sometimes between two stem-segments, sometimes between a stem-segment and the ancestrula, or between the two oldest zoœcia (fig. 1 g). In these cases the colony always seems to commence with the formation of a stem.

A number of colonies of this species were collected at Hongkong in shallow water by Captain Suenson.

I originally believed this species to be identical with *Stirparia Haddoni* Kirkpatrick[1], and the figures of this species are therefore indicated by the latter name on Plate III. A closer comparison with Kirkpatrick's description and figures has however convinced me of the independency of the species here described. *St. Haddoni* not only has no avicularia or spines, but differs further from *B. caliculata* in the strongly arched basal surface of the zoœcia, and their strong turning inwards towards the middle-line of the branch. In both these features *B. Haddoni* shows a great resemblance to the new species *B. caraibica* to be described later.

Bugula glabra (Hincks).

Stirparia glabra Hincks, Annals. nat. hist. 5. S. Vol. XI, pag. 196, Pl. VI, fig. 2.

Bicellaria glabra (Bicellaria stylites in tabula) Busk, Challenger, Zoology, Vol. X, Part I. pag. 35, Pl. VI, fig. 1 a.

Stirparia glabra Waters, Journ. Linnæan Soc., Zoology, Vol. XXVI, pag. 19 (Pl. III, fig. 3 a).

I have examined a very young colony of this species with 8 stem-segments and only 3 full-grown zoœcia, in which the ancestrula has only 3 long spines on each side, whilst a larger number (5—7) occur in the specimens examined

[1] 49, p. 603.

by Hincks and Busk. The distal wall is angularly bent, and to judge from the structure of these zoœcia this species can be referred neither to *Bicellaria* nor to *Cornucopina*. The structure of the oœcia is not known. The stem-segments have a structure quite similar to that of the last species, and the above-expressed suggestion, that new segments may be inserted between the older ones, is strengthened by the fact that every second segment of the specimen examined by Hincks is scarcely half the size of the others. There is also a very small segment (the fifth) in the colony examined by me. According to Waters' investigations, the radical fibres quite agree with those in *B. caliculata* and have especially the same kind of pear-shaped expansions.

The small colony which I have received through the kindness of Miss Jelly, comes from Port Phillip, Australia.

Bugula caraibica n. sp.

(Pl. III, figs. 2 a—2 n).

The **zoœcia**, which increase in width distally from the narrow proximal end, are turned inwards towards the middle of the branch, in such a way, that the frontal areas of two neighbouring zoœcia form nearly a right angle with one another, and they have thus, to judge from Kirkpatrick's figure, been subject to a much smaller turning than the zoœcia in *B. Haddoni*. The frontal end is cut off straight and the basal surface strongly arched with an almost semicircular transverse section. Almost in the middle of the distal margin of the basal wall there is in numerous zoœcia a rather strong spine (fig. 2 b), which may grow longer than the zoœcium, but is often very short. It seems to be quite wanting however in other zoœcia. There is very seldom a very short, external corner-spine. The distal wall is insymmetrically angular (fig. 2 d), and somewhat distally from this there is a ring-shaped constriction.

The **avicularia**, which occur in very small number, are placed outside the membranous frontal area in its proximal portion.

The **oœcia**, the outer layer of which is calcified, are more than half the length of the zoœcia, elongated, strongly arched and marked with radiating striæ. They are placed obliquely relatively to the zoœcia, and turned so much outwards that they can be seen in the whole of their extent from the basal aspect of the colony.

The segments (Kenozoœcia) of the stem are, seen in transverse section, circular or perhaps slightly quadrangularly rounded. Here also we find two calcified thickenings internally, arising from the distal wall and showing lines of growth. They meet in a ring at the proximal end of the segment, but otherwise they differ from the corresponding thickenings or bands in *B. caliculata* in several ways. Thus, their thinner middle portion passes evenly over into two thicker, rounded marginal portions (fig. 2 k), and further they are much broader, occupying more than half the periphery of the whole segment. They divide this into four, unequally large areas, of which the largest lies on the basal surface of the colony and the narrowest on the frontal surface. This last area which does not seem to have any membranous portion at all or to be provided with parietal muscles is not rarely divided into two or more areas behind one another, as the two calcareous thickenings may be connected by one or several transverse bridges. The distal wall (figs. 2 l—n, 2 j), which is saddle-shaped from side to side, is over its whole surface provided with extremely numerous, small uniporous rosette-plates, so that the whole distal wall might really be regarded as a large multiporous rosette-plate. In its whole extent it is attached internally to the wall of the segment by ascending, often branched chitinous rods, which are apparent from the outside and produce digitate and lobate figures.

The **colony** consists of a number of jointed stems which have two alternate rows of flabellate branches with four to five bifurcations and up to 40 linear segments with biserial zoœcia. Each of these branches is in connection with the stem through a multiporous rosette-plate, which is placed a little proximally to the end of a stem-segment (figs. 2 n, 2 i, 2 j), and such a rosette-plate is only found on that side of the segment where a branch issues. I have only in a few cases found two successive branches arising from the same side but never two branches placed at the same height. From each stem again 2—5 new stems arise, in most cases just opposite a branch, more rarely alternately with these, and in a few cases I have found a new stem arising just proximally to a branch. New stems which are in connection with the main-stems through multiporous rosette-plates seem to arise in a double way, partly by transformation of branches and partly independently. While the common branches are fixed by a zoœcium, the proximal part of which is provided with two rings, I have seen a number of branches only different from the others therein that 1—2 slender segments are interposed between the zoœcium and the stem, and most likely these branches are about to be transformed into new stems. A great number, however, of the young stems, which issue from the main-stems and for instance those, which are seen in fig. 2 a, cannot well have arisen in this way, which in the first instance may be inferred from their being generally placed opposite the branches, as two branches are never placed at the same heigth. In the next place these stems are characterized by their being provided with branches only at a very late period though there is a rather large difference in that respect. Only in a single stem with two segments I have found a little terminal branch showing a double bifurcation while a common branch on a main-stem as already said shows 4—5 bifurcations. In all the other young stems the tip is devoid of a branch, which no doubt has fallen of. While a terminal branch is a direct continuation of a stem and does not arise from a rosette-plate, the formation of a rosette-plate always precedes the formation of a branch, and even if all the lateral branches have dropped of, as is the case in many of the stems examined, their position and number is indicated by the respective rosette-plates. The examination of a number of stems shows that the first rosette-plate appears proximally to the partition-wall between the end-segment and the one next to it, and that the development of these formations goes steadily downwards. I shall here give a few instances showing the difference in the appearing of the rosette-plates.

a stem with:	
6 joints	The fifth segment with a beginning rosette-plate.
7 —	Rosette-plates on the six segments.
9 —	A Rosette-plate on the seventh segment. The partition wall between the eighth and the ninth segments is not wholly developed.
11 —	Rosetplates on the ninth and the tenth segments.
13 —	Rosetplates on the eleventh and the twelfth segments.

The number of segments in the trunk gradually increases by division of the older segments, and when two short segments follow one another this is a sign that a division has taken place lately. The proximal segment of the two has then not yet got the lateral rosette-plate, and the proximal end of the distal segment does not yet show the rounded swelling defined by a more or less distinct constriction, which is seen on the completed segment. A division like this is always introduced by the two strongly calcified lateral belts on each side sending prolongations towards one another, which at last join together to form a bridge.

The radical fibres, which issue from the proximal end of the stems serve exclusively to attach these to the surroundings. They are much branched, furnished with irregular expansions and swellings, and like the stem divided into sections (kenozoœcia), which internally are separated by multiporous rosette-plates, but externally have no distinct constrictions. We further find a multiporous rosette-plate everywhere where a new branch arises from an older one. While the radical fibres have in the beginning on arising from the stem a structure similar to the latter their wall soon becomes evenly calcified over the whole of its surface.

The colony examined consists of c. 20 zoœcia-bearing main trunks, of which the longest have forty odd segments and a length of 16.5 ctm. The segments have a length of 3—5 mm.

Christiansted lagoon, St. Croix (Fishery Inspector Mag. Chr. Lofting).

Dimorphozoum nov. gen.

The colony consists of two layers, the *zoœcia* of which are of exceedingly diverse nature. In the one layer (the Ctenostome) they are quite uncalcified and have no operculum, whilst in the other (the Cheilostome) they have an operculum and the structure general in the family. The last layer has besides the following characters: the distal wall consists of a basal horizontal portion with a multiporous rosette-plate, and of a frontal ascending portion; free *oœcia*; freely movable, club-shaped *avicularia*.

D. nobile (Hincks).

Flustra nobilis, Hincks, Annals nat. hist. 6 Ser.
Vol. 7, 1891, pag. 288, Pl. 6, fig. 5.
. . . . Waters Journ. R. micros. Soc. 1896,
pag. 281, Pl. 7, fig. 10—11.
(Pl. IV, figs. 1 a—1 f).

The *Cheilostome layer*:

The zoœcia are elongated hexagonal, and the frontal wall membranous in almost its whole extent. The distal edge furnished with 4 spines, which may vary considerably in size, and of which the middle ones are the longest. When they are not very small, each one of them sends out a small, distally directed branch from its proximal half. There are as a rule 4—6 bifurcated spines on the distal half of each lateral edge, which also vary considerably in size. The inner branch is generally the longest, and may occasionally reach more than half-way over the frontal area, it may also however be quite absent. The distal wall ends basally in a straight edge, and there is generally a more strongly calcified belt (fig. 1 d) both proximally and distally. It is provided with a very large, multiporous rosette-plate (fig. 1 c) and such is also found in the distal half of each lateral wall (fig. 1 b)[1]. On the basal wall of a great many zoœcia there are 1—4

[1] When I give the number of rosette-plates (109, p. 281) in the distal half of the lateral walls it is because in species with independent lateral walls it can easily be seen (p. 27) that the rosette-plates (or at any rate their main part) as a rule belong to the distal half of the lateral walls, the proximal part only possessing a corresponding number of openings, each surrounded by a pore-ring. In species with common lateral walls only the rosette-plates in the distal half of a lateral wall have their convexity turned inwards.

multiporous rosette-plates, which serve as connection with the zoœcia in the second layer, and are convex towards these (fig. 1 c).

The avicularia which Hincks wrongly gave as membranaceous do not seem to occur on all zoœcia, but are in most cases represented by two. We can occasionally find 4. They are not, as represented by Hincks, attached to the basal surface of the lower zoœcium, but to the proximal end of the higher. Each lateral edge namely sends out a narrow prolongation directed inwards, to which the avicularia are attached, and at the place of attachment of each avicularium we find a small uniporous rosette-plate. The avicularia are conical or club-shaped with a straightly cut frontal area, and the operculum, which is broadly chitinized in the margin, has in its proximal part a half-moon-shaped lucida (fig. 1 e).

The oœcia which up to the present have been overlooked, are free, without striation, provided with an uncalcified ectooœcium and very low. They are however somewhat higher when seen from the basal surface.

The *Ctenostome layer* consists of quite uncalcified, elongated hexagonal zoœcia with a two-lipped aperture, and they are in all respects much like the zoœcia in an *Alcyonidium*. I can give no information about the rosette-plates, as I have only examined dried colonies, and it was only after moistening these that the dried-up zoœcia of this layer showed their real nature. I have twice received material of this species from Miss Jelly, once a large colony labelled South Africa, and another time a number of fragments together with small colonies of *Chaperia capensis*, labelled Port Elisabeth. All these specimens, of which the last were richly furnished with oœcia, were quite covered with the layer of uncalcified zoœcia, and as the basal surface of the other zoœcial layer is at the same time richly furnished with rosette-plates, I have no doubt that the two layers really belong together; but it would be very desirable to make an examination of fresh material in order to determine this quite unique dimorphism with certainty.

The **colonies** are foliaceous with slightly lobate margin, attached by a dense mass of radical fibres, which in the Cheilostome layer arise from the margin of the zoœcia in their distal half.

Bugularia nov. gen.

The distal wall angular with two multiporous rosette-plates; the *oœcia* free; *avicularia* sessile, not pedunculate.

B. dissimilis (Busk).

Carbasea dissimilis Busk, Catalogue of Marine Polyzoa, Part 1. Cheilostomata pag. 51, Pl. 50, figs. 1—7.

— — Busk, Challenger, Zoology, Vol. X, Part 1, pag. ~~56~~. 55

Flustra dissimilis Waters, Journ. R. Micros. Soc. 1896, pag. 282.

(Pl. V, fig. 2 a—d).

The zoœcia elongated, quadrangularly tongue-shaped, with as a rule a much narrower proximal half, of which a larger or smaller part is calcified. Three pairs of spines may occur, of which frequently only a smaller number is developed. In colonies without oœcia only the first pair is generally present, but even these may be lacking or rudimentary in many zoœcia. In colonies with oœcia, it is rather difficult to find this pair of spines from the surface of the colony, as they are placed in a hollow on each side of the oœcium. The marginal zoœcia which are longer than the others, are drawn out into a plump corner-spine. The distal wall, which is furnished with two multiporous rosette-plates, is much bent angularly, and has besides a distinct saddle-shaped curve from the front to the basal side (fig. 2 b, 2 c). Each lateral wall is furnished in its distal half with two multiporous, strongly projecting rosette-plates. The basal surface of the zoœcia is coarsely striated transversely (fig. 2 b).

The avicularia which are placed in the middle of the proximal, calcified portion of the zoœcia are attached by means of a rather wide proximal part and the tips are turned in different directions.

The oœcia are not as free as they are in *Bugula*, rather a large part of their basal wall being firmly connected which the higher zoœcium. They are very large, furnished with an uncalcified ectooœcium, and the endooœcium besides a distinct double striation also has a characteristic system of lines bounding triangular or square apparently impressed meshes.

Cornucopina nov. gen.

Bicellaria p. p.

(Pl. IV, figs. 1 and 5).

The *zoœcia* widening from a long, tube-shaped proximal end obliquely upwards, funnel-shaped, with a ring-shaped constriction at a greater or less distance from the distal wall. The *oœcia*, which are not placed between two zoœcia in the same longitudinal row but on the zoœcial distal margin, which is directed outwards from the middle of the colony, are surrounded by kenozoœcia. In most species appear *avicularia*, which are generally capitate and pedunculate or trumpet-shaped. The radical fibres, which run down along the basal side of the colony issue far distally on the individual zoœcia. The colonies are elegant tufts with biserial branches.

This genus which will most probably be split up later into several includes the majority of the species in the old genus *Bicellaria*[1], and the only species known to me which remains in this genus is *B. ciliata*. One of the characters which, in a narrower sense, separates the genus *Bicellaria* from *Cornucopina*, is the sharp constriction between the wider funnel-shaped terminal portion of the zoœcium and the proximal cylindrical portion, and *Cornucopina grandis* in this structural feature approaches *Bicellaria*, as we find at the same place internally a narrow, ring-shaped, oblique, chitinous thickening. This species also occupies a special position within the genus in having a cryptocyst (fig. 5 a), already observed by Harmer[2], which extends under the larger part of the frontal membrane and reaches almost to the operculum. It is provided with finely curved and dentated edges, and it rises distally from the deeper, proximal part to end in a free, shovel-shaped plate. Two successive zoœcia are connected by a multiporous rosette-plate, which is surrounded by a calcareous ring, and this is again connected with a similar ring surrounding the adjacent rosette-plate of the lateral wall (fig. 5 a—5 b). Busk has overlooked the very large plump avicularia, which in this species here and there issue from the basal surface of the zoœcia a little proximally to the outer margins (fig. 5 c).

Beania Johnston.

Diachoris.

The very slightly calcified *zoœcia* are mutually connected by cylindrical tubes to a more or less open network, which is attached to the underlayer by radical fibres arising from the basal surface of the individual zoœcia; each tube is furnished with a multiporous rosette-plate; no *oœcia*; as a rule freely movable *avicularia*.

While all the species, which I have been able to examine of this genus, have an operculum, such according to Busk's[3] account and figures, is lacking in *Diachoris magellanica*, in which the aperture is said to be surrounded by a circular thickened rim. If this account is correct, this species must probably be regarded as the representative of a special genus, and this might then retain the old name *Diachoris*. In the species from Rapallo, which Waters calls *B.*

[1] 8, p. 31. [2] 19, p. 326. [3] 2.

magellanica[1], and of which species this writer has been so kind to send me a fragment, there is an operculum:

Hiantopora Mac Gill.[2], char. emend.

The strongly calcified *zoœcia* are connected by cylindrical processes, each of which is provided with a multiporous rosette-plate. The *oœcia* free; sessile *avicularia*; the colony attached by radical fibres, which issue from the basal wall of the individual zoœcia. From the proximal portion of the aviecularium rises a hollow spine, which as a rule is strongly branched and may cover over a larger or smaller part of the frontal membrane.

H. radicifera (Hincks).

Membranipora radicifera, Hincks, Annals nat. hist. 5 S. Vol. 8, 1881, pag. 5, Pl. 2, figs. 6, 6 a, 6 b.

(Pl. IV, figs. 6 a—6 e).

The zoœcia are broad, hexagonally rounded, with two short, blunt spines and a little further proximally on one, generally the left, lateral margin with a short bifurcated spine with two unequally long branches. The strongly arched basal surface runs out into six, a little lower placed, but also arched, somewhat broad and short tubes which are separated by broad and deep pit-like depressions and meet with corresponding processes from the neighbouring zoœcia. At the bottom of each pit is an oval hole, which opens on the frontal surface of the colony, but on account of the somewhat imbricate position of the zoœcia, these holes are not very distinct. They open on each side of the distal end of the zoœcium. Each tube is furnished with a large, multiporous, strongly calcified rosette-plate, occupying the whole of its breadth, and the arched basal surface of each zoœcium is furnished with 4—6 uniporous rosette-plates, which serve for connection with the numerous radical fibres, by the aid of which the colony is attached to its underlayer.

The avicularia are large, proximally furnished with a small, curved spine, and provided with a mandible, which is inclined to one side. Each zoœcium has such an avicularium attached along the one lateral margin and directed obliquely inwards, opposite the above-mentioned bifurcated spine.

The oœcia, which Hincks does not mention, are free, widest at the proximal end, cup-shaped or semi-conical, furnished with an obliquely ascending

[1] 111, p. 16, [2] 75, p. ~~22~~, 76, pp. 60—61

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frontal surface, and with a calcified, rugged ectooecium. On each side of the oecium is a small obliquely placed spine.

I have been able to examine a colony of this species from Port Phillip, Victoria (Miss Jelly).

To the genus *Hiantopora*, which Mac Gillivray has founded on »*Cribrilina*« *ferox*, I must, besides this species, also refer *Membranipora radicifera* as well as the form which Kirkpatrick has described under the name *M. radicifera, v. intermedia*, and which he considers as an intermediate form between *H. ferox* and *H. radicifera*. I agree with this writer as to the necessity of referring all three forms to the same genus; but whilst he refers them to *Membranipora*, I must, partly on account of their points of agreement with *Beania*, partly because of the free oecia, refer them to the family *Bicellariidae*, and although they must come close to *Beania*, they cannot for several reasons be included under this genus. Some of these reasons are: the strong calcification, the presence of oecia, which however have hitherto only been found in *H. radicifera*, and finally the presence of the sessile avicularia (in contrast to the pedicellate movable ones in *Beania*). Lastly this avicularium is in all three species furnished with a spine, which in each attains an extremely variable development, and in *H. ferox* covers the greater part of the frontal surface with its branches, and this is the reason why this species was formerly referred to the genus *Cribrilina*. In *H. radicifera* it is rather small undivided, conical, whilst it is much larger and richly branched in *H. intermedia*, but in contrast to the spine in *H. ferox* it projects freely here. Of *H. ferox* besides Kirkpatrick's original specimens I have been able to examine two others, namely one from Port Phillip (Miss Jelly) and another from Port Phillip Heads (Mr. J. Gabriel); they show all differences in the shape and development of the avicularian spine, so that the species seems to undergo great variation. It may be possible to set up several different species. All three species agree however in that this hollow avicularian spine which may in reality be looked upon as a hollow, branched continuation of the avicularian chamber, is not, as Kirkpatrick seems to believe, connected with the opposite margin of the respective zooecium, but mainly with parts of the surrounding zooecia, partly with their distal spine or distal margin, partly with their avicularia or with the branched prolongations of these. The tip of the avicularian spine is however often fused together with a small branched spine, which arises from the distal half of the opposite margin of the zooecium.

Mac Gillivray[1], who originally referred the genus *Hiantopora* to the family

[1] 75, p. ~~22~~ 208

Cribrilinidae, has in a later paper[1] made this genus into a special family *Hiantoporidae*, to which he also, besides some fossile forms, which I have not had the opportunity to examine, refers *Cribrilina monoceros*, and Hincks[2] stated already in an earlier work that the two species ought to be united into one genus, and that this genus ought to represent a new family. I cannot admit, however, that there is any relation between the two species which only show the external agreement, that a larger or smaller part of their frontal membrane is covered by branched projections; but whilst these are hollow and originate from the avicularia in *H. ferox*, they are solid and originate from the lateral margins in *C. monoceros*.

They thus show a difference in the only structural feature, which could be in favour of their being united to form one genus. As the genus *Hiantopora*, according to the foregoing definition naturally belongs to the familly *Bicellariidae*, I am unable to adopt Mac Gillivray's family.

Brettia Dyster.

? Maplestonia, Mac Gillivray.

(Pl. IV, figs. 9 a—9 b).

The distal wall is not angular; *oœcia* and *avicularia* wanting; the colony with single-rowed zoœcia.

I must for the present refer *Maplestonia* to this genus, as there is nowhere in the diagnosis given by Mac Gillivray a character sufficient to separate it from *Brettia*. I have been able to examine a small fragment of a colony of *M. simplex* with some few zoœcia, the frontal membrane of which is surrounded by a more strongly calcified cryptocyst with fine lines of growth, which also surrounds the distal wall. Otherwise the two species *M. cirrata* and *M. simplex* seem to show great differences, and the first[3] resembles *Catenaria* in its whole mode of growth.

The form, which Waters[4] has named *Brettia frigida* and of which he has been so kind to spare me a little branch, is, as he has himself supposed, identical with Smitt's *Bugula quadridentata*, which is only a growth-form or variety of *Dendrobeania Murrayana*. This species sometimes appears with multiserial (4—26 rows), sometimes only with uni- to fourserial branches (*B. quadridentata*) and of the last form I have through the kindness of Prosessor Theél, Stockholm been able to examine colonies from Spitzbergen. In contrast to the species of the genus *Bugula* as defined here, the distal wall in *D. Murrayana* is furnished with a multiporous rosette-plate, and in the distal part of each lateral wall, we find two

[1] 76, pp. 60—61. [2] 38 a, p. 179. [3] 67, p. 92. [4] 111, p. 51.

such plates, placed close together on a more strongly calcified and proximally sharply defined part of the zoœcium. The same is the case in *Brettia frigida*, and I shall only mention further, that whilst the zoœcia in the uniserial branches are as regards rosette-plates provided in quite the same way as the zoœcia in the many-rowed branches, they lack the holes on the other hand in the proximal portion of the lateral wall, which in the zoœcia with several rows, correspond with the rosette-plates on the neighbouring zoœcia.

Petalostegus nov. gen.

Catenaria p. p.

The membranous frontal area is covered by a circle of mutually connected plate-like or leaf-like hollow spines; a slightly chitinous, semicircular, simple operculum; sessile *avicularia*; free (?) *oœcia*; *zoœcia* in one row.

P. bicornis Busk.

Catenaria bicornis Busk, Challenger, Zoology, Vol. X, Pl. 1, pag. 14, Pl. 2, figs. 2 a, 2 b.

— — Waters, Challenger, Zoology, Vol. XXXI~~X~~ III, p. 9, Pl. 1, fig. 1.

(Pl. IX, figs. 8 a, 8 b).

The zoœcia widened upwards from a long, narrow, tube-shaped proximal part, oblique quadrangularly oval, strongly arched especially on the frontal surface, the largest part of which is formed by a membranous area, covered by five mutually coalesced hollow spines. These, which spring from the rim of the frontal area with a relatively narrow proximal part, have a broad rhombic form and are therefore in the marginal part of the frontal area separated by four wide, but low interspaces, which are bounded externally by the edge of the frontal area, internally by the proximal edges of the rhombic spines. At the two distal spines the corresponding space is formed by the aperture itself. The distal much longer portions of the spines are each furnished with 2—3 very short projections, which meet with corresponding projections from the adjacent spines, and the five radial sutures are thus provided with 2—3 larger or smaller oval pores. Of the five spines the proximal is the largest, and meets with the two distal in a triradiate suture, whilst the two others which are the smallest do not reach in to the middle of the area. The rhombic form of the three larger spines thus becomes somewhat modified, in such a way that the proximal spine is strictly irregularly hexagonal, and the two upper pentagonal. The aperture, which is placed a little proximally to the distal edge of the zoœcium, is almost semicircular, though in such a way that its distal curved edge (the anter) meets with the almost straight proximal edge in two almost parallel lateral margins. The aperture is occupied by a membranous opercular valve with a chitinous rim. On the basal surface in the distal part of the zoœcium between the two avicularia we find a small, more calcified, quadrilateral area.

The avicularia which are placed on each side of the distal part of the zoœcium, are somewhat strongly compressed with an elongated oval frontal surface which is turned outwards. Seen from the side they are trapez-shaped with a small hook-shaped curve.

The oœcia are lacking on the branches examined by me, but according to the description (»galeriform, lofty, terminal«) Busk gives, there is hardly any doubt that they are free.

The colonies have uniserial branches, and from each zoœcium issue two new ones, one from the tip, and one from a triangular projection on one (the right and the left in turns) of the lateral walls, a little above the centre of the wider terminal part of the zoœcium.

I have been able to examine a small branch of this species from the Challenger's station 280, which has been kindly placed at my disposal by Mr. Kirkpatrick from the British Museum. In favour of its reference to this family speak not only the agreements in mode of growth and zoœcial form with *Brettia*, but in still higher degree the free oœcia, since free oœcia do not appear in any other Malacostege family.

Chaperia Jullien[1].

The distal part of the *zoœcium* is furnished internally with two lateral spaces open towards the frontal surface (sometimes coalesced to a single horse-shoe-shaped one), formed by two plates which project from the side-walls and converge towards the distal wall. Each distal wall has 2 multiporous rosette-plates and the distal half of each side-wall a single one. Hyperstomial free *oœcia* with a completely calcified ectooœcium. The zoœcia which may sometimes have a membranous opercular valve, sometimes a chitinous compound operculum, are generally strongly provided with spines and have often a well developed cryptocyst. *Avicularia* sometimes trumpet-shaped, not always present. The colonies are incrusting.

To this genus belong the following species: *Ch. annulus* Manz (= *Ch. galeata* Busk), *Ch. cristata* Busk, *Ch. cervicornis* Busk, *Ch. cylindracea* Busk, *Ch. albispina* M. Gill.[2], *Ch. capensis* Busk, *Ch. patulosa* Waters[3], *Ch. tropica* Waters[4] etc.

[1] 45, p. 61. [2] 64, p. 116, pl. fig 10. [3] 115, p. 33. [4] 116 a, p. 168.

Family **Farciminariidae** Busk.

(Pl. I, figs. 10—13).

The *zoœcia* as a rule slightly calcified, occasionally with a small secondary cryptocyst, without true spines, furnished with an obliquely ascending distal wall, and separated by common lateral walls which are furnished with a small number (2—4) of uniporous rosette-plates. The *avicularia* dependent, sometimes depressed, sometimes strongly projecting. The *oœcia* are endozoœcial, generally more or less projecting, occasionally surrounded by kenozoœcia.

The colonies are, in the hitherto known forms, dichotomously branched tufts, with slender, prismatic, sometimes jointed segments, on which the zoœcia are arranged in longitudinal rows (generally 4—6) round an axis, formed by the adjoining separating-walls.

This family agrees with the *Flustridæ* in the possession of endozoœcial oœcia, and with most members of that family in its being furnished with uniporous rosette-plates. On the other hand it differs from the *Flustridæ* in possessing dependent avicularia, in the lack of hollow spines, in the absence of independent lateral walls as also in the form of colony.

Columnaria nov. gen.

Farciminaria, Busk p. p.

The *zoœcia* are without spinous processes; the distal wall has a number of scattered uniporous rosette-plates. The *oœcia* are strongly prominent and the endooœcium on each side partially covered by a little lamina of cryptocyst, which issues from the respective lateral wall of the zoœcium. Capitate *avicularia*, attached to the distal wall at their proximal part and firmly fixed with their basal wall to the frontal membrane of the distal zoœcium; the frontal wall of the avicularia without a calcareous transverse bar; the colony not jointed.

C. borealis n. sp.

(Pl. I, figs. 12 a—12 c).

The **zoœcia**, the whole frontal surface of which is membranous without a cryptocyst, have an elongated rectangular shape; the length is generally 4—4.5 times the breadth. The strongly ascending distal wall which is only half as broad as the frontal area, is elongated pentagonal, or rounded wedge-shaped and furnished with 5—9 rosette-plates placed in 2 longitudinal rows. The side-walls, whose distal half is furnished with 2 uniporous rosette-plates, increase in height towards the distal end and terminate in a triangularly rounded, projecting corner.

The **avicularia**, which appear in all zoœcia are attached to the distal end of the distal wall by their proximal, sometimes almost tap-like, proximal end, and by means of a uniporous rosette-plate are connected with the proximal zoœcium, whilst their more arched basal surface is grown together with the frontal membrane of the distal zoœcium. Seen from the frontal surface they are egg-shaped, seen from the side triangularly rounded, and their subopercular portion, which is turned in towards the distal zoœcium, forms an obtuse angle with the semicircular, outwards facing mandible which has a chitinous margin, but no lucida.

The oœcia are large, broad, flatly arched, rugged, and furnished with a protruding proximal rim, which is separated from the other part by a ring-shaped impression. From each of the distal zoœcium's calcified lateral margins issues a narrow, obliquely triangular calcareous plate, which pushes in between the endooœcium and the ectooœcium, and comes to lie over the former with its concave lower surface. It is furnished with a shorter inner, and a longer outer, free marginal edge.

The colony is bifurcated up to three times and the zoœcia arranged in four longitudinal rows.

A single colony of this species was taken by the Ingolf Expedition at lat. 60° 17′ N. long. 54° 05′ W., at a depth of 1715 fathoms.

All the *Farciminaria* species which Busk has described in the Challenger Report except *F. atlantica* undoubtedly belong to this genus.

Farciminaria Busk p. p.

The *zoœcia* have a larger or smaller number of small, spine-like processes, which are placed either on the frontal membrane or on the lateral margins; the *oœcia* are surrounded by kenozoœcia; an *avicularium* similar to that found in *Columnaria* occurs in a few cases; the colony not jointed.

F. uncinata Hincks.

Annals Nat. Hist. ser. 5, Vol. XIV, 1884, pag. 277, Pl. VIII, fig. 2.

(Pl. I, figs. 10 a–10 d).

The zoœcia, the whole frontal surface of which is membranous, evenly increase in breadth towards the broadedly rounded distal end, which is sometimes furnished with two short spine-like processes. The frontal surface a little proximally to the operculum has on either side a denticle similar to these, and a similar denticle, which varies somewhat in size and is sometimes double, arises from each lateral margin a little distally to the proximal end of the zoœcium. It points in towards the middle line of the zoœcium, and seems to be placed under the frontal membrane. The triangular distal wall has within its basal rim a small number (about 6) of uniporous rosette-plates, and the distal half of each side-wall is furnished with a single one.

No avicularia.

The oœcia are large, strongly prominent, flatly arched, roughly radiately striated on the frontal surface, with a varying number of large, cylindrical, club-shaped, knotformed or pointed processes. Hincks' statement on the oœcia: »surface smooth, divided into distinct areas by raised partitions«, must refer to these projections, which reach right out to the covering membrane of the oœcium. The oœcia are borne by zoœcia, which are furnished with a large operculum and with two proximal spinous processes facing inwards, but they lack the denticles, which otherwise occur on the frontal membrane. They are covered by kenozoœcia, which have no denticles, but are furnished with a narrow calcareous border just like the ordinary zoœcia, although this here does not reach right back proximally (fig. 10 b). The boundary between the kenozoœcium and the oœcium-bearing zoœcium, is formed by a distal wall, strongly bent at an angle, which has a transverse belt of scattered uniporous rosette-plates (10 d dw.), and which is furnished with a thickened, strongly calcified distal margin. If we cut away the frontal wall of an oœcium (fig. 10 e) we find outermost the narrow cavity of the kenozoœcium, within this the oœcium, and proximally to this the thickened margin of the distal wall, behind which we can detect a number of rosette-plates. The kenozoœcium is separated from the higher zoœcium by a distal wall of the ordinary structure (fig. 10 d).

The colonies form dense, very often bifurcated tufts, the branches of which have four rows of zoœcia.

Some colonies of this species from Port Phillip Heads, Victoria have been kindly sent me by Miss Jelly.

F. aculeata Busk.

Catalogue of Marine Polyzoa, Cheilostomata,
pag. 33, Pl. 44, figs. 4, 5, Pl. 45 (bis.) fig. 6.

The zoœcia hexagonally rectangular, a little within each lateral edge furnished with a longitudinal row of 4—5, very often bifurcated, upwards bent, chitinous denticles, and the distal margin of the zoœcium is as a rule furnished with 2—4 similar, but smaller spine-like processes. The separating walls are as in the preceding species.

No avicularia.

The oœcia have a similar shape and structure as in *F. uncinata*, but lack the numerous and strong processes, found in that species. On the other hand, the covering membrane, which belongs to the kenozoœcium, is furnished with numerous, pointed, scattered chitinous denticles, which thus correspond with those, found on the other zoœcia. The distal wall between the oœcium-bearing zoœcium and the kenozoœcium is, as in *F. uncinata*, much bent at an angle and furnished with a thickened margin. The kenozoœcium has no operculum as it has been figured by Busk.

The colony has a similar structure as in the foregoing species, but the zoœcia are arranged in 6 longitudinal rows. A colony from Port Phillip Heads, Victoria (Miss Jelly).

According to information kindly sent me by Mr. K. Kirkpatrick I must also refer *F. atlantica* Busk[1] to this genus.

Nellia Busk.

Farcimia, Pourtales.

The *zoœcia* without spinous processes; the distal wall has at its inner corner a single rosette-plate; the oœcia are in almost their whole extent immersed into the proximal part of the ordinary zoœcium, and project only very little on the surface of this; the avicularia are attached by a wide base or partially immersed, with calcareous transverse bar; the colony jointed.

N. appendiculata Hincks.

Annals Nat. Hist. ser. 5, vol. XI, 1883, pag. 199, Pl. VII, fig. 4.

(Pl. I, figs. 11 a—11 b).

The zoœcia wide, rounded rhombic, with a membranous frontal area which occupies almost the three-fourths of their length, and which, except for the projecting distal edge, is furnished with an immersed cryptocyst in the remaining marginal part. Each distal wall is furnished with one, and the distal half of each lateral wall with a single uniporous rosette-plate.

The avicularia which occur in pairs for each zoœcium are elongated, somewhat curved, tapering towards the proximal end and furnished with an arched outer surface. They are placed in such a way that with their inner lateral edge they border on the distal half of a lower zoœcium and with their outer lateral edge on the proximal half of a higher zoœcium in a neighbouring row. At the distal end there is an elongated frontal area perpendicular to the longitudinal axis of the avicularian chamber. The triangular mandible, which is directed obliquely outwards and proximally and which is furnished with a lucida, has like

[1] 8, p. 49.

the corresponding part of the avicularium a little hook. In a large number of avicularia the membranous covering of the frontal area is transformed into an acuminated tentaculiform process and in such avicularia there is no transverse bar.

The oœcia are almost semiglobular, but in the greater part of their extent immersed and only projecting externally as a slightly prominent pent-roof-shaped portion distally to the zoœcium, which portion is at the sides bordered by the avicularia. This projecting portion consists of two calcareous layers, the ectozoœcium being also calcareous.

The colony consists of somewhat short, cylindrical club-shaped segments with four rows of zoœcia and 3—4 zoœcia in each row.

Port Phillip (British Museum).

N. tenella Lamk.

Nellia oculata Busk, Catalogue Marine Polyzoa, Cheilostomata, pag. 18, Pl. LXIV, fig. 6, Pl. LXV (bis), fig. 4.

(Pl. 1, figs. 13 a—13 e).

The zoœcia elongated, quadrangularly rounded, with a proximal, calcareous portion, which may occasionally reach nearly one-fourth of the whole length of the zoœcium. The elongated, oval frontal area is surrounded by a thin projecting rim, and at its posterior marginal portion there is a small secondary cryptocyst. The distal part of the frontal area, which includes the operculum, is on each side separated from the remaining part by a small tooth-shaped projection of the lateral margin (fig. 13 c). The distal wall and the distal half of each lateral wall is furnished with a single uniporous rosette-plate.

The avicularia which appear in pairs on the proximal, calcareous part of the zoœcium, are rather small, and have a large part of their chamber immersed in the colony, which part is apparent, funnel-like, through the lateral walls of the zoœcium (fig. 13 b). At their proximal part they are provided with a small pit for the insertion of the radical fibre (fig. 13 e), and at their distal part sometimes with an oval, sometimes a pear-shaped frontal area. The mandible which has a similar, variable form and is furnished with a small, beak-like hook is turned away from the zoœcium.

The oœcia are immersed for the larger part of their extent and can only be seen from the outside as short, pent-roof-shaped projections (fig. 13 d), which on each side are separated from the lateral walls of the lower zoœcia by a curved suture (fig. 13 c). This projecting portion consists of two calcareous layers, as the ectooœcium is also calcareous; but it often however shows a narrow, uncalcified transversely placed area (fig. 13 c).

The colonies consist of four-rowed segments, and the individual rows may contain 4—12 zoœcia.

The species is represented in our Zoological Museum from the Bass' Straits, Port Denison, Queensland, Texas, West-Indies (St. Thomas), Ceylon and Siam, and colonies from different places show differences, partly in the size, position and shape of the avicularia, partly in the more or less strongly ascending distal wall, and in the number of zoœcia in the individual rows.

N. (?) **simplex** Busk.

Catalogue Marine Polyzoa, Cheilostomata, p. 19, Pl. LXV, fig. 1;
Pl. LXV (bis), fig. 3.
(Pl. XXII, fig. 6 a).

The zoœcia are elongated, narrow, tongue-shaped or roundedly rectangular, surrounded by projecting edges, which in their proximal half are sometimes slightly sinuated. Within each lateral wall in the whole of its length there is a low longitudinal ridge, and from this issues a cryptocyst, which especially distally is rather deeply immersed and attains more than half the length of the zoœcium. The aperture of the latter is almost half the breadth of the zoœcium. The distal wall is in its innermost corner furnished with a multiporous rosette-plate, while the distal half of each side-wall has a single uniporous plate.

No **avicularia** or **oœcia.**

The colonies have quadrilateral branches with 7 to 16 zoœcia in each row.

The Formosa-Channel, 35 fathoms, Suensson, lat. 32° 22′ N., long. 128° 42′ E., 170 fathoms (Suensson).

Kirkpatrick has referred fragments of a colony from Mauritius to this species, and the British Museum through that author has kindly permitted me to examine the preserved and mounted small branches, on which the account of Kirkpatrick is based. As I have not been able to examine this form completely, however, I can only say here, that the outer resemblance is sufficiently great to justify considering this form as a variety of *N. simplex*. The cryptocyst however is far less developed. The proximally slightly projecting oœcia are in the largest part of their surface only covered by the frontal membrane of the distal zoœcium (the ectooœcium), but a little proximally to their distal end also by a cryptocyst-bridge, which connects the two lateral margins of the zoœcium and is lowest in the middle, and which in Kirkpatrick's figure is seen as a low, and not very distinctly marked transverse belt almost midway across the frontal surface of the oœcium. The part of the oœcium lying proximally to this is furnished along the middle with a narrow ridge. This cryptocyst-bridge must undoubtedly have arisen from a fusion of two triangular laminæ like those we have described in *Columnaria borealis*.

Family **Flustridae.**

The *zoœcia* slightly calcified, with an aperture which occupies the whole frontal surface, or at any rate its largest part. Occasionally there is found a secondary cryptocyst. The distal wall is always provided with a varying number (1—13) of small, uniporous rosette-plates, and such also appear as a rule on the side walls, which only in a few cases are furnished with multiporous rosette-plates. Vicarious or independent *avicularia*. The *oœcia* are endozoœcial and immersed, generally in ordinary zoœcia, occasionally in avicularia or kenozoœcia. The colonies are in a few cases incrusting, in most cases free frondose, more or less richly branched, and with the free margin consisting of kenozoœcia.

As the family is defined here, the main weight is laid on the possession of immersed oœcia and vicarious avicularia, as well as on the slight calcification and the large frontal aperture, and I have therefore also referred »*Membranipora*« *flustroides* Hincks and *M. serrata* M. Gill. to this family; the latter species has been considered by Waters also as a *Flustra*. In conformity to the above definition of this family, I have been obliged to separate out a number of species, which partly have external oœcia, partly dependent avicularia. *Flustra*« *militaris*, »*Fl. crassa*, *Fl.*« *dissimilis* and »*Fl.*« *nobilis* are thus referred to the *Bicellariidae* and »*Fl.*« *armata* to the *Scrupocellariidae*. Since however the oœcia and avicularia are lacking in a number of species of this family as in most other families, and as a number of *Membranipora* species can have vicarious avicularia as well as a quite uncalcified frontal wall, it is difficult to draw a sharp line between this and the family *Membraniporidae*. *Membranipora serrulata* Busk is a species which has been regarded both as belonging to *Membranipora* and to *Flustra*. According to Busk's original description it possesses immersed oœcia, and if this were correct, it would have to be regarded as a *Flustra*, but I have not succeeded in finding oœcia in any of the specimens of this species, which our Museum has from the Kara Sea or from Greenland, nor are they found on Busk's original specimens in the British Museum. The species appears incrusting as well as in free, bilaminate growths, but it differs from the *Flustra* species, known to me, in having multiporous rosette-plates on the distal wall, as well as fully developed marginal zoœcia, and I therefore find it more natural to look upon it as a *Mem-*

branipora. Whilst the side-walls in the majority of the *Flustridae* have uniporous rosette-plates, we find multiporous ones in the three species *Fl. foliacea, Fl. carbasea* and *Fl. abyssicola,* and it might be considered as part of the evidence for the systematic importance of the rosette-plates, that none of these three species have the cap- or cup-shaped oœcia, which are common in the family. Only in *Fl. foliacea* (Pl. I, figs. 8 a—8 b) we can find oœcia of a very peculiar egg-shape, which must have arisen in this way, that the distal wall has simultaneously formed an upper as well as a lower cap- or cup-shaped expansion. The peculiar apparatus for the ejection of the larvæ, which Jullien has shown in *Fl. abyssicola,* also seems to suggest a very distant relationship to the other *Flustridae,* but for the rest, we shall not here enter further into these questions. In many cases the proximal portion of the oœcia is covered by a low cryptocyst-belt (Pl. I, figs. 2 b, 3 a, 6 a, 7 c), which originally arises out of two lateral halves which finally fuse together. It increases in height with age and may in time in *Fl. flustroides* (Pl. I, fig. 4 a) completely cover the oœcium. On the other hand, there is in *Fl. securifrons* a pair of flat, obliquely placed cryptocyst-processes distally to the zoœcial operculum (Pl. I, figs. 5 a—5 b, d. w.). In all the species, which occur in free colonies, their margin is formed by kenozoœcia ,which for the rest can appear in very different ways; sometimes (*Fl. foliacea, Fl. membranaceo-truncata, Fl. securifrons*) as chambers of a similar form and structure as the other zoœcia, but without an operculum, sometimes (*Fl. biseriata, Fl. cribriformis*) as narrow, tube-shaped marginal ridges, which here and there show internal separating walls. While such modified marginal individuals appear at several places within the division *Ascophora,* for instance in *Onchoporella bombycina* and *Microporella flabellaris,* I have not been able to find them in any members of the families *Bicellariidae* or *Scrupocellariidae,* and their presence or absence seems thus in doubtful cases to be available as a distinguishing character for these families. I must thus emphasize the fact, that I have not been able to find such marginal zoœcia in any of the above-mentioned species which up to the present have been incorrectly referred to the *Flustridae,* and that their appearance has nothing to do with the number of rows of zoœcia in the colony, is evident from the fact, that on the one hand they are lacking in the species mentioned, but on the other hand appear in *Fl. biseriata,* the true zoœcia of which are two-rowed.

Jullien has made a beginning with the splitting up of the old *Flustra* genus by founding the genus *Sarsiflustra,* and I will here propose the setting up of 4 other genera (or subgenera?), of which one must keep the name *Flustra,* as it will contain the species *Fl. foliacea,* on which the genus was originally based. As we thus have no name for the rest of the species, which not yet have been separated into genera and which accordingly must provisionally be characterized mainly in a negative way, I shall propose for these the name *Heteroflustra,* and the introduction of such a provisional name seems to me necessary in all similar cases.

Synopsis of the genera.

1) The side-walls with multiporous rosette-plates; if oœcia are present, they are egg-shaped, the distal wall forming at the same time a distal and a proximal cup-shaped arch;

2) the larvæ are ejected through a chitinous tube, which opens distally to the zoœcial operculum, and may be covered by a movable, calcareous valve; avicularia of the same size as the zoœcia, lyriform; the operculum with two large wing-shaped lateral expansions... *Sarsiflustra* Jull.[1]
mandible
(S. abyssicola Sars).

2) No such apparatus for the ejection of the larvæ; egg-shaped oœcia may occur and smaller avicularia, the operculum of which has no lateral expansions.. *Flustra* (L.) Lev.
(Fl. foliacea, L.
- carbasea, Ellis and Sol.)

1) The side-walls have uniporous rosette-plates; if oœcia are present, they are cup- or cap-shaped, the distal-wall only forming a single arch:

3) The oœcia immersed into the bottom of kenozoœcia (no avicularia, colony with two-rowed branches) .... *Kenella* n. g.
(K. biseriata Busk.)

3) The oœcia immersed in ordinary zoœcia or in avicularia (the colonies with several rows).

4) The distal wall, at any rate in the oœcia-bearing zoœcia, very often also in the ordinary zoœcia, meets with the basal wall in an angularly bent or curved line; the free edge of the oœcia on the frontal side of the colony lies much lower than the basal edge; the avicularia have the same size as the zoœcia, (the colonies much branched dichotomously, with frequently the branches meeting and thus forming an open network; radical fibres occur in the angles of the branches).... *Retiflustra* n. g.

4) The distal wall horizontal or very slightly curved; the free,

[1] 46, p. 43

frontal edge of the oœcia is almost at the same height as the basal; the avicularia smaller than the zoœcia:

5) The lateral walls within the covering membrane generally with numerous spine-like processes; the margins of the zoœcium have as a rule more or fewer (occasionally numerous) spines; the avicularia generally with a pointed mandible; the oœcia not rarely immersed in the avicularia .... *Spiralaria* Busk. (Hincksina Norm.)

5) The lateral walls never have spine-like processes, at most a single pair of spines: the mandible of the avicularia rounded, oœcia never immersed in avicularia .... *Heteroflustra* nov. nom.

Spiralaria Busk, char. emend.

? Hincksina Norman[1].

(Pl. 1, fig. 9a).

The lateral walls with as a rule a row of spine-like processes (or denticles) a short distance within the covering membrane; the edges of the aperture as a rule furnished with spines, sometimes over their whole length; the *avicularia* generally with beak-shaped, pointed mandible; the *oœcia* most often immersed in avicularia; the side-walls have numerous uniporous rosette-plates.

As will be seen from the above diagnosis, the characters on which the genus is based are not constant; but as these characters in the species which I refer to this genus supplement one another in such a way, that there can be little doubt that these species are closely connected, I must consider this genus as well-established, though its limits are not sharp. Besides in the species, which Busk originally described as *Spiralaria florea*[2], the above-mentioned, spine-like processes on the side-walls are also found in *Fl. dentigera*[3], *Fl. spinuligera*[3], *Fl. denticulata*[3], to the last of which Busk has referred two fairly distinct forms, and it seems on the whole to be subject to considerable variation. I may mention here the most important characters for the three forms in our Zoological Museum, which can be referred to *S. denticulata*.

A form from the Challenger St. 163 (var. inermis). There are no spine-like processes in a larger or smaller distal portion of the *zoœcium*, whilst in the proximal portion 1—11 appear on each side; no spines; typical *avicularia*, no *oœcia*.

A form from Bass' Straits. Strong, spine-like processes in almost the whole

[1] 83, p 585 [2] 6, p 153 [3] 109.

length of the *zoœcium* (up to 18 on each side), one or two pairs of spines on the distal part of the zoœcium, typical *avicularia*, the *oœcia* immersed in the avicularia.

A form from Victoria. The spine-like processes are much reduced and cannot be seen from the surface of the colony, appearing merely as small knobs. They seem also sometimes to be in very small numbers. Broad, flat, pointed spines appear in the whole length of the *zoœcium*. Typical *avicularia*, the *oœcia* immersed in the avicularia. The form which Busk[1] described in 1852 differs from the last mentioned in that the teeth are well-developed and the spines partially widened at the tip, with two or three branches.

Very close to *S. denticulata* is *S. florea*, which has well-developed, hook-shaped, denticles, 1—2 spines, typical *avicularia* and the *oœcia* immersed in the avicularia, whilst the *oœcia* are immersed in the ordinary zoœcia in *S. dentigera*, *S. spinuligera* and *S. serrata*[2], the last of which lacks the denticles, unless, as in the above-mentioned species from Victoria, they are here also so small that they cannot be seen from the surface of the colony. This last species, in which the *avicularian* mandible is much more beak-like than usual and elongated, is very variable in regard to its armature, as within the same colony we can find zoœcia with 1—2 or with numerous spines, widened at the end and branched two or three times.

The above diagnosis has been designed so as also to include ›*Membranipora*‹ *flustroides* and *Fl. octodon*[3], but the connection of these two species, and especially the last, with the others is not without some doubt. Instead of the typical, beak-shaped, elongated *avicularian* mandible they have rounded ones, and in the case of *Fl. octodon* it is really only the elongated form of the *zoœcia* and the possession of, for a *Flustra*, an unusually large number of spines, which can be taken as in favour of its relegation to the genus. Besides the presence of numerous rosette-plates and spines, the fact that some of the *oœcia* are enclosed in avicularia, a character not found outside the genus *Spiralaria*, is in favour of the relegation of *M. flustroides* to the genus.

Retiflustra n. g.

(Pl. I, figs. 6 and 7, Pl. XXI, figs. 1 and 2).

The distal wall, at any rate in the oœcia-bearing *zoœcia* and in most cases also in the others, meets with the basal wall of the colony in an angularly bent or curved line; the free edge of the *oœcia*, which are placed on the frontal side of the colony, is much lower than their basal edge; the zoœcia have no spines;

[1] 2, p. 49. [2] 61, p. 131 and 64, p. 3 [3] 2, p. 49.

the colony is strongly dichotomously branched with generally the branches connected so as to form an open network. Radical fibres arise from the marginal belt consisting of kenozoœcia in the approximal corners of the angles of the branches.

It is possible that we may be able to add to this diagnosis still one or more characters, taken from the structure of the *avicularia*; but for the present I only know the structure of the avicularia in the new species *R. Schönaui.*

R. Schönaui n. sp.

(Pl. I, figs. 7 a—7 d).

The zoœcia are of somewhat variable form, in most cases elongated, rectangularly oval, with a distal curved margin, often a little irregular, especially in the marginal portion of the branches. There is a more strongly developed cryptocyst than in any other member of the family. It appears as a marginal region along the whole extent of the zoœcium and shows distinct belts of growth; these are specially obvious in the strongly developed proximal region. The larger part of the basal wall of the zoœcium is uncalcified and has an oval form (fig. 7 d), only a belt along each side and a larger or smaller ($^1/_5$th—$^1/_3$rd) proximal portion being calcified. Owing to the slight strength of the calcification this oval only becomes distinct after it has been boiled in potash and only with reduced light. The calcareous part of the basal wall of the zoœcium, and especially its proximal part, shows occasionally a number of transversely or obliquely placed coarse striæ.

The distal wall, which is angularly bent and saddle-shaped in the direction from front to back, is furnished, with a transverse row of 6—8 uniporous rosette-plates, while the distal half of each side-wall has 2—4. Partly owing to the saddle-shaped curvature of the distal wall, partly because the basal edge is placed higher than the frontal, we can see a large part of the under side of the distal wall from the basal aspect of the colony. The branches are everywhere bordered by a narrow marginal region, which here and there shows an inner separating wall, and must be regarded as formed by kenozoœcia. It is only at the point where the branches bifurcate, consequently at the two ends of the oval perforations, that this region has a larger extent and shows basally a gymnocyst and on the frontal side a cryptocyst with belts of growth. Here and there a radical fibre issues from the approximal corner of such a perforation.

The avicularia (fig. 7 a) are very rare, and I have altogether only seen two. They are of the same size as the zoœcia, pointed proximally and almost pear-shaped. Contrary to the rule in *Malacostega,* they are far proximally provided with a calcareous transverse bar and with a small cryptocyst. Only a short proximal portion of the mandible was preserved.

The oœcia are low, bowl-shaped, and except in the quite young are covered by a cryptocyst-belt in the proximal portion. The basal edge of the distal wall, from which the oœcium issues, is placed higher than the top of this, and can therefore by a deep focussing from the frontal surface be seen distally to the oœcium. Such distal walls have the same saddle-shape as the others, and are like these furnished with a row of uniporous rosette-plates.

The colonies are composed of circular fenestrate laminæ, superimposed one upon the other, and growing spirally from a common centre, one from the other. The fenestræ are oval, somewhat pointed and generally much broader than the segment between them.

The larger part of my material however consists of isolated fragments, and only a single fragment shows three connected laminæ.

The species comes from the China Sea, lat. 26° 30′ N. long., 121° 10′ E., 42 fathoms, and has been taken by Telegraph-Engineer Schönau.

R. cribriformis Busk.

Carbasea cribriformis Busk,

Challenger Zoology, Vol. X, Part. I, pag. 58, Pl. XXXIX, fig. 8.

(Pl. I, figs. 6 a—6 b, Pl. XXII, fig. 2 a).

The zoœcia have a very variable form, most often elongated hexagonal, often rather irregular, with a straight distal margin. There is a faintly developed cryptocyst in the form of a narrow marginal expansion, the proximal part of which is a little more developed. The basal side of the zoœcia, which is more calcified than in the foregoing species, has a narrow, median uncalcified, longitudinal belt, which begins at the angle of the distal wall and as a rule reaches almost to the middle of the zoœcium. It is generally narrowest at the middle and widest proximally. On both sides of this we generally find a number of transversely or obliquely placed, coarse striæ, which in different zoœcia may have a very different strength and occupy a very different part of the basal side, and which are in reality more calcified and thickened regions of this. In a fragment from Port Darwin this system of stripes is so strongly developed with such a pronounced whitish colour, that the whole of the basal side of the colony seems even with naked eye to be spotted with white. Besides the longitudinal belt mentioned this fragment by reduced light under the microscope shows a large, pear-shaped, dark spot, the proximal border of which meets with that of the longitudinal belt, but is broader than this. It arises from the contrast between a more strongly calcified outer and a more slightly calcified inner (median) part. The distal wall is acute-angled and the two arms are a little concave. As in the foregoing species, it is at the same time saddle-shaped, and furnished with a transverse row of (up to 12) uniporous rosette-plates. The distal half of each side-wall has ca. 6 rosette-plates. The marginal region, which consists of kenozooecia, only differs from the marginal region in the preceding species by the part, which appears on the basal side of the colony, being much calcified and furnished with similar stripes to the zooecia. On the other hand, it has no distinct cryptocyst. The radical fibres issue from the proximal corners of a number of fenestræ.

Avicularia have not been found hitherto.

The oœcia are high, dome-shaped, with indistinct radiating striæ and generally in the middle provided with a shorter or longer, sometimes rather irregular ridge. A low cryptocyst belt covers their proximal part. Also here the basal part of the distal wall lies higher than the top of the oœcium and is thus seen distally to the latter at a deeper level (Pl. I, fig. 6 b, Pl. XXII, fig. 2 a). The distal wall belonging to the oœcium forms an angular or sometimes almost arched mark on the basal side of the colony, and the two arms are not concave but convex. The oœcia-bearing zooecia are, when looked at from the basal side, larger than the others, and the distal half of the above-mentioned uncalcified longitudinal belt is generally very broad.

The colonies have the same structure as in *R. Schönaui*, but the fenestræ are very much smaller and generally much narrower than the segments between them.

Of this species I have examined a fragment from Torres Straits (Cambridge) and one from Port Darwin (British Museum).

R. reticulum Hincks.

Flustra reticulum Hincks,

Annals Nat. Hist. ser. 5, Vol. X, 1882, p. 163, Pl. VII, fig. 4.

(Pl. XXII, figs. 1 a—1 c).

The zooecia of rather varying form, most often irregularly pentagonal or hexagonal with an evenly rounded frontal edge. A cryptocyst appears as an extremely slight marginal expansion. The basal wall is uniformly, but not strongly calcified with the exception of a rather small, round (circular, oval or pear-shaped) uncalcified spot almost proximally to the distal wall. Very rarely a few short. coarse stripes appear here and there. Contrary to the case in the two other species the distal wall is generally straight in the ordinary zooecia, and it has about 10 uniporous rosette-plates, some of which are placed opposite each lateral margin. The distal half of each lateral wall has 5—6 rosette-plates.

Avicularia wanting on the fragment examined. They have been described and figured by Hincks, but require a closer examination.

The oœcia are rather large and not rarely of an outline describable as quadrangularly rounded. Along their proximal margin two indistinct cryptocyst processes are seen, which are rather large at their starting-point but quickly become very low. A little distally to the proximal margin of the oœcium an extremely small pore is generally seen in the central line surrounded by a thickened portion, and from this a number of partially coarse striæ radiate. In contrast to the distal wall in the ordinary zoœcia the oœcia-forming distal wall meets the basal wall of the zoœcium in a curved line, which is sometimes on a level with the top of the oœcium, sometimes somewhat lower than the latter, but at all events considerably higher than the proximal margin of the oœcium. Contrary to the case in the two foregoing species the whole of the distal wall is transformed to an oœcium. It is accordingly convex in its entire extent and has no saddle-shaped basal part with rosette-plates.

The colonies, which are branched dichotomously, differ from those in the two preceding species therein, that the separate branches do not meet. The marginal portion, which consists of kenozoœcia, is wholly calcified on the basal side and most thickened in its outer half, for which reason the colony is seen surrounded by a white margin.

I have examined a fragment of this species from Victoria (The Zoological Museum of Cambridge, Dr. S. Harmer).

Family **Scrupocellariidae.**

Cellulariidae Hincks.

(Pls. II and XXII).

The zoœcia are as a rule strongly calcified, with a membranous frontal area occupying a larger or smaller part of the surface. An arched gymnocyst of larger or smaller extent is found in most species proximally to the frontal area, and there is usually a more or less well-developed, most often finely granular secondary cryptocyst. The margin of the aperture has as a rule 1—2 pair of spines distally, while from the approximate centre of the inner margin a spine, plate-like widened or branched at the end, very often arises and may cover a larger or smaller part of the frontal area. The distal wall, consisting of a horizontal basal and an obliquely ascending frontal part, has usually numerous, small, scattered, uniporous rosette-plates basally, while the distal half of each lateral wall has one multiporous plate. Besides dependent *avicularia*, found in most species, *vibracula* may also occur on the basal surface of the colony, and these are connected with the colony by an independent wall. The *ooecia* are generally hyperstomial with a wholly or partly calcified ectooœcium, more seldom endozoœcial. In the latter case they are sometimes enclosed in kenozoœcia. As a rule radical fibres occur, sometimes springing from a rosette-plate (or a pore-chamber), sometimes from a separate chamber connected with a vibraculum. The *colonies* are always free, very branched, most frequently with uni- or few-seried zoœcia, generally consisting of a single layer and in most cases jointed by means of chitinized transverse belts.

While a smaller number of species (e. g. *Hoplitella armata*, *Menipea flabellum*, *Men. spicata*[1] and the *Canda* species), have a membranous frontal area, occupying the whole or almost the whole of the frontal surface, a larger or smaller part of the latter is in the other species occupied by an arched gymnocyst which in some species (e. g. in *Menipea aculeata* Busk and *Men clausa* Busk) may be up to two-thirds of the length of the zoœcium. While the cryptocyst in many species (e. g. in the *Scrupocellaria* species, in *Caberea Ellisi*, *Menipea aculeata*, *M. cirrata*, *M. patagonica*) forms only a small depression in the margin of the aperture, it may in other species fill a larger part of the aperture inside the membranous frontal area in the form of a somewhat depressed, generally finely granular lamina. This cryptocyst attains its largest extent in *Menipea spicata*, *Caberea Darwini* and in the *Canda* species, but also in *Men. flabellum*, *Men. roborata* (figs. 7 b, 7 c), *M. crystallina*, *M. Buski* and several other *Menipea* species it may attain a considerable development. We have already mentioned that a number of species possess a wholly chitinized, simple operculum. As in *Dimorphozoum nobile* and *Dendrobeania Murrayana* the distal wall consists of a basal, horizontal or slightly oblique and a frontal, strongly ascending part (Pl. II, figs. 7 g, 7 h, 8 c), but while in these two species the former portion is furnished with a single, large, multiporous rosette-plate, it has generally in this family a great number of single-pored plates which are variously grouped. On examining a zoœcium from the frontal surface (Pl. II, fig. 7 a), the horizontal pore-bearing part of the distal wall is seen at a deep level at some distance proximally to the distal end of the zoœcium, and this is seen most clearly after a previous boiling in caustic potash. The avicularia always have their inner wall in common with the zoœcium on which they are placed; but as I have succeeded in isolating the vibracula in some species (*Caberea Ellisi*, *Canda arachnoidea*, *Caberiella benemunita*, *Scrupo-*

[1] 69, p 132

cellaria scabra) it seems natural to suppose that these heterozooecia in this family always have an inner wall of their own. In *Caberea* and *Caberiella* I have found a septum dividing the vibracular chamber into two, of which only the distal may contain the muscles. While the ooecia in the majority of this family are hyperstomial, they are endozooecial and more or less deeply immersed in *Bugulopsis Peachi*, *Bugulopsis cuspidata*, *Menipea crystallina*, *M. cervicornis*, *M. Buski*, *M. triseriata* and *M. spicata*. In *M. crystallina* they are enclosed in kenozooecia with a large membranous frontal area, while in the others they are immersed in ordinary zooecia, in such a way, however, as to appear more or les prominent on the zooecial surface. In *M. Buski* and *M. cervicornis* the distal part of the ooecium is covered by a granular cryptocyst. In a smaller number of species the ectooecium is wholly calcified, e. g. in *Scrupocellaria ternata*[1], *Scrupocellaria reptans* and *Scrup. scruposa*, but in most cases a larger or smaller proximal part is membranous and accordingly appears as a rounded or triangular area, clearly distinguishable from the calcified distal part. This is seen e. g. in *Caberiella benemunita* (Pl. XXII, fig. 8 a), *Menipea roborata* (Pl. II, fig. 7 a) and *M. ligulata* (Pl. II, fig. 8 a).

This family is one of the most natural and most sharply delimited, and the differences shown by the zooecia in respect to the armature of spines, development of gymnocyst and cryptocyst etc., are all subject to such great variation from species to species that no generic importance ought to be attached to them. The division of the genus has therefore hitherto been based chiefly on the structure and appearance of the heterozooecia, and for the present I am unable to delimit them in a more natural way. In earlier as well as in more recent times attempts have been made to divide the large genus *Menipea*, e. g. by Gray, Mc Gillivray and Waters. But as I consider it superfluous to enter into a critical examination of the genera *Emma*[2] and *Craspedozoum*[3], proposed by the two former authors, I shall limit myself to a closer examination of the divisions made by Waters[4]. This author discusses the subject as follows: In the description of the species, it is now shown that in the *Cellulariidae* there are two distinct kinds of articulation. In the larger number the new branch is given off from a small chamber formed for the purpose. As the type of this section *Menipea Buski* is figured (Pl. I, fig. 10); and I propose to restrict *Menipea* to those forms having this kind of articulation; and it will then include *M. Buski*, Mac G., *M. crystallina*, Gray, *M. cyathus*, Thompson, *M. cervicornis*, Mac. G., *M. compacta*, Mac. G. —

[1] In this species which has hitherto been referred to the genus *Menipea*, I have found a vibraculum, but without flagellum. [2] 2, p. 27 [3] 69, p 131 [4] 111, p. 2.

On the other hand, probably *M. cirrata*, Lamx., *M. gracilis*, Busk, *M. patagonica*, Busk, *M. funiculata*, Mac. G., *M. triseriata*, Busk, *M. flabellum*, L., *M. ternata*, Ell. & Sol., must, on this account, be elsewhere located; and in fact, before noting this distinction, it had been felt, that several species should be removed from the genus«. »In another section, including *Scrupocellaria*, the jointing consists of nothing more than a partial breaking through or thinning of the walls of the zooecia near the commencement of the branch. In the zooecia in which this breaking through of the wall of the zooecial chamber has commenced, the polypide is seen unaffected, partly above and partly below this incipient division (see Pl. I, figs. 11, 12).« In a subsequent work[1] he calls the group of species to which *M. flabellum* belongs by the temporary name *Flabellaris*.

In all *Bryozoa* that occur in jointed colonies, the jointing takes place in the same way, viz. the following. The zooecia, which are situated on the boundary between the two joints and which we may call »joint-zooecia«, have a shorter or longer, wider or narrower, uncalcified, chitinized and accordingly flexible transverse belt, which may sometimes be situated more distally, sometimes more proximally, but which always divides a joint zooecium into a distal and a proximal part, each belonging to its own ~~joint~~ INTERNODE. Thus, what Waters in *Menipea Buski* and other species calls a small chamber, is in reality only the proximal part of a joint-zooecium, and its proximal boundary is just the distal wall between the joint-zooecium and the zooecium on the proximal side of the latter. This articulation may show an apparent, but in fact very insignificant difference, when the colony is regarded from the frontal side, as the outer joint-zooecium in such species as *M. flabellum*, *M. cirrata*, *M. patagonica* etc. commences with a chitinized belt, while in such species as *M. Buski*, *M. cervicornis* and *M. crystallina* it begins with a small calcified portion, the »chamber« mentioned by Waters. In this however *M. cyathus* agrees with the species of the latter group, though as regards structure and form of colony it is more closely allied to the former. As mentioned before, the ooecia in a series of *Menipea* species are more or less deeply immersed but as a rule distinctly prominent on the surface of the zooecia. Even apart from the fact, that, by a division of the genus *Menipea* on the basis of this feature, we should be at a loss what to do with the species lacking ooecia, it is evident, that such a division must seem rather unnatural, as *M. cyathus*, which has hyperstomial ooecia by this proceeding would be separated from such species as *M. cervicornis*, *M. Buski* and *M. crystallina*, to which it is undeniably closely related.

[1] 112, p. 672.

Synopsis of the genera.

1) On the basal surface a larger or smaller number of zoœcia with a vibraculum connected with a chamber, from which a radical fibre may issue (avicularia always present):

2) The true vibraculum (the chamber for the radical fibres not included) divided by a septum into a distal and a proximal space, the former containing the muscles:

3) The very large, claw-shaped vibracula, present on all zoœcia, are directed obliquely inwards and basally, and meet from both sides at acute angles in the middle of the basal side of the colony, which they almost cover; the flagellum on one margin generally with pointed teeth; the radical fibres, which spring only from the chamber connected with the vibraculum, run down along the middle of the basal side of the colony as a continuous, raised bundle; (the colony not jointed) .... *Caberea* Lamouroux.

3) The small, curved or angularly bent vibracula, not present on all zoœcia, are far from reaching the centre of the colony; the flagellum without teeth; the radical fibres, of which some spring from the chamber connected with the vibraculum, others from a rosette-plate on the marginal zoœcia, form a bundle along each lateral margin of the colony .... *Caberiella* n. g.

2) The true vibraculum not divided into two spaces (the flagellum without teeth; the colony generally jointed; the vibracula covering only a smaller part of the basal surface of the colony):

4) The oœcium enclosed in the widened proximal half of a large avicularium, the distal, cap-like part of which bears the mandible and encloses the muscular apparatus. The frontal areas of the two rows of zoœcia meet at obtuse angles; the radical fibres, given off from and ending in a chamber connected with the vibraculum, form parallel connecting threads between the neighbouring branches...... *Canda* Lamouroux.

4) The oœcium not enclosed in an avicularium; the frontal areas of the two rows of zoœcia on the same level; the radical fibres form no parallel connecting threads between the neighbouring branches... *Scrupocellaria* van Beneden.

1) No vibracula:

5) No avicularia; (the oœcia more or less deeply immersed in the zoœcia) .... *Bugulopsis* Verrill. (Cellularia Hincks).

5) Avicularia occur:

6) Each marginal zoœcium with a large marginal avicularium, the greater part of which is immersed in the zoœcium and shows a strongly arched wall inside the latter; (the other zoœcia with a completely membranous frontal area and no avicularia; no spines; no oœcia; the colony with multiserial branches) .... *Hoplitella* n. g.

6) Where marginal avicularia are found they are never partially immersed:

7) A number of zoœcia on one margin of the branches have two huge, hollow spines on the proximal side of the frontal area; (a free stem formed by numerous radical fibres, etc.)............. *Rhabdozoum* Hincks.

7) No hollow spines proximally to the frontal area..... *Menipea* Lamouroux.

Caberiella n. g.

Small, narrow, curved or angularly bent *vibracula* appear on the basal side of a number of *zoœcia.* They are divided into a distal and a proximal cavity by a septum and occupy only a small part of the basal surface of the colony. *Avicularia* occur. The radical fibres are given off partly from a chamber connected with the vibraculum, partly from a pore-chamber. They form a bundle along each lateral margin of the colony.

C. benemunita Busk.

Menipea benemunita Busk,
Challenger Zoology, Vol. X, Part 1, pag. 19, Pl. IV, fig. 4.
(Pl. XXII, figs. 8 a—8 b).

The zoœcia are long and narrow with a gymnocyst occupying about two-thirds of the entire length of the zoœcium. There is a well-developed, deeply immersed, secondary cryptocyst, which is densely and finely granular especially in its distal half, and provided with a finely dentate inner margin. Right at the distal end it appears as a more deeply-placed, curtain-like lamina, the free margins of which end in 6—8 teeth. Besides the large, long, scutiform opercular spine, furnished with a bifurcate hollow and covering the greater part of the frontal area, the zoœcia have 3—4 spines distally, one on the same side as the opercular spine and 2—3 on the opposite (i. e. outer) side. Three spines only on the marginal zoœcia.

The avicularia, of which there are two proximally to the frontal area, are in the oœcia-bearing zoœcia situated on the distal part of the oœcium.

The vibracula are not found on all zoœcia, but seem to appear rather frequently and may be seen sometimes on 2—3 successive zoœcia. They are narrow, most often angularly bent and situated in such a way that their inner part is turned obliquely inwards and towards the proximal end. A radical fibre takes its origin from their outer part, while other radical fibres spring from a pore-chamber in the zoœcia, that have no vibraculum.

The oœcia are provided with fine radiating striae, and the largest part of the ectooœcium is uncalcified. The calcified part terminates in a somewhat projecting, angularly bent or arched, often somewhat sinuated margin.

The colony is not jointed. Its branches may have up to 7 rows of zoœcia.

By way of exchange I have acquired a small fragment of this species (from Challenger, St. 313) from the Zoological Museum at Dundee.

Hoplitella n. g.

Avicularia appear only on marginal *zoœcia* which all have a large avicularium, the inner half of which is immersed; the distal wall has on each side a long, narrow continuation running along the corresponding lateral wall; the entire frontal surface membranous; no *oœcia*; the colony not jointed.

H. armata (Busk).

Carbasea armata Busk,
Catalogue of Marine Polyzoa, Cheilostomata, p. 50, Pl. L, figs. 1, 2.
Flustra armata Waters,
Journ. R. Micros. Soc., 1899, p. 279—286.
(Pl. II, figs. 10 a—10 e).

The zoœcia, the entire frontal surface of which is membranous, are rhombic-like oval, each of their lateral margins, when seen from the frontal side, ending in an almost rectangular edge, bounded by two curved lines. While this edge in the zoœcia in the median part of the branch is generally situated a little distally to the centre on the inner and a little proximally to the centre on the outer lateral margin, it is, on approaching the margin of the colony, situated higher up on the former and further down on the latter, and this contrast is always greatest in the parts of the colony, which have the largest number of rows of zoœcia. The marginal zoœcia are much broader than the others, as they partly enclose the large avicularia, and as they stand in close relation to the avicularia, it will be more natural to treat them together with these. Immediately proximally to the distal edge of the zoœcium a large, semi-circular opercular valve is found. The basal horizontal part of the distal wall has a large, somewhat curved transverse group of up to 70 uniporous rosette-plates. On the boundary between the horizontal and the obliquely ascending part of the distal wall two narrow, tubular cavities issue (figs. 10 b, 10 d), which from each zoœcium sink down into the subjacent one. They are bounded outwardly by the lateral wall of the zoœcium and inwardly by a continuation of the distal wall, and in a transverse section proximally to the latter they are seen as two small, round holes (fig. 10 c). They touch the basal edge of the rosette-plate of the lateral wall and generally end just proximally to it (fig. 10 d). On the basal side of the colony the edge of the distal wall shows a number (6—10) of small, distally pointing, short, broader or narrower, sometimes bifurcate crenulations (figs. 10 b, 10 c), which are really outpushings from the lower into the higher placed zoœcium, and alternating with them is seen a number of much more faint ones pointing proximally.

The avicularia, only occurring on the outer lateral margin of the marginal zoœcia, are very large, turned towards the frontal surface of the colony and furnished with a well-developed beak and mandible hook. A great part of the avicularian chamber is enclosed in the zoœcium, and its strongly arched endozoœcial surface has about 10 scattered, uniporous rosette-plates (fig. 10 e). The marginal zoœcia have an obliquely triangular transverse section, ending outwards in a rounded edge, and the outer of the two above-mentioned, narrow lateral cavities passes obliquely across the basal side of the avicularium, being only visible from the basal surface of the colony. On the basal side the zoœcium is separated from the free part of the avicularium by the just mentioned cavity, and on the frontal side by its upper lateral margin, which runs obliquely outwards to a small indentation in the approximate centre of the lateral margin of the avicularium. A corner is formed here corresponding with that of the other zoœcia. In the outer half of a marginal zoœcium we may distinguish between a frontal and a basal, distal lateral margin, which together enclose the avicularium and mark the boundary between the free part of the latter and the part immersed in the zoœcium. On the other hand there is but a single proximal lateral margin, as the frontal and the basal lateral margins are here run together in an edge. Instead of the calcified lateral wall in the other zoœcia we thus find here but a strongly calcified rib, which however generally shows a distinct separation into two lateral halves, enclosing between them a rosette-plate (fig. 10 e).

No oœcia.

The colonies are unjointed, single-layered, dichotomously branched with

5—14 rows of zoœcia in the separate segments. The radical fibres spring from a pore-chamber in the proximal part of the marginal zoœcia. In the older part of the colony they form a flat bundle on the basal surface, immediately within each lateral margin, with oblique transverse connections at the base of the separate segments.

The colonies examined originate from Cape Town.

Menipea Lamouroux.

It will be evident from the above summary of the genera that the genus *Menipea* like the genus *Heteroflustra* is only negatively characterized, as it comprises all the species that cannot be referred to any of the other genera.

M. roborata Hincks.

Membranipora roborata Hincks, Annals Nat. Hist. ser. 5. Vol. VIII, 1881, pag. 128, Pl. 2, fig. 3.

Flustra membraniporides Busk, Challenger, Zoology, Vol. X, pars 1, pag. 54, Pl. XXXII, fig. 7.

Flabellaris roborata Waters, Journ. Linnean Soc., Zoology, Vol. XXVI, 1898, pag. 672, Pl. 48, figs. 10—11; Pl. 49, figs. 7—11.

Pl. II, figs. 7 a—7 k.)

The zoœcia long, hexagonal or hexagonally vase-shaped, often with an acutely projecting corner between the distal and the proximal part. The gymnocyst is very slightly developed on the zoœcia with no avicularia (e. g. some marginal zoœcia) and may on those with avicularia occupy about one-fourth of the whole length of the zoœcium. In the entire periphery of the frontal area a distinct, granular cryptocyst is seen, deeply immersed and strongly developed especially at the proximal end, and attaining its highest development in the marginal zoœcia. There may be four spines distally. The two central ones are very small and bud-shaped, but often wanting, while the other two are rather short, as a rule present, but often wanting in the marginal zoœcia. The marginal zoœcia, which are larger but rarely longer than the other zoœcia, are very asymmetrical and their obliquely outbending lateral wall has a straight or slightly convex frontal margin. On isolating a row of zoœcia after boiling in caustic potash it will easily be seen that the inner surface of the zoœcia (figs. 7 d—7 h) has a somewhat varying number of solid calcareous processes of different length and thickness, of which generally 1—4 may be seen through each lateral surface. In many zoœcia a larger or smaller part of such a calcareous process may protrude on each side of the proximal part of the aperture distally to the cryptocyst (figs. 7 b—7 c). The basal, horizontal part of the distal wall has a transversely oval or triangularly rounded, multiporous rosette-plate, generally with a frontal concavity (figs. 7 f, 7 h). In most zoœcia the distal wall between the rosette-plate and the basal wall is provided with a little rounded (sometimes two) pore-chamber descending into the lower zoœcium (figs. 7 d—7 e) and in its bottom furnished with one or more small uniporous rosette-plates.

The avicularia occur in two different forms of which one is found in the cavity of the zoœcium, while the other in zoœcia without oœcium is found on the proximal side of the membranous area, and in oœcia-bearing zoœcia on each side of the distal part of the oœcium. The external avicularium, which has a well-developed hook as well on the mandible as on the corresponding part of the chamber, is placed so, that the mandible is turned obliquely outwards and distally on the oœcia and obliquely inwards and proximally on the zoœcia. The boundary between the opercular and the subopercular area is formed by two nearly always concurrent, narrow, cylindrical, generally bent and often very irregular processes, of which one is usually longer than the other (figs. 7 c, 7 i). On the proximal side of the frontal area we find very seldom two, generally but a single avicularium which is then most often situated on the outer side (the one nearest the margin of the colony) and occupying more than half the space. If found on the marginal zoœcia it is however placed on the inner side, the reason of which may be, that there is a large pore-chamber on the outer side, from which a radical fibre takes its origin. In the ordinary zoœcia, at the proximal end of which there is but a single external avicularium, and in the marginal zoœcia with no external avicularium, an internal one is always found, arising from the internal side of the surface which from its position seems intended to have an external avicularium. The latter, which has both a mandibular and an avicularian hook, is oval, with the mandible pointing obliquely distally and inwards, and with but two short teeth on the boundary between the opercular and the subopercular area (figs. 7 d, 7 e, 7 g, 7 k).

The oœcia are rather high, rounded and the ectooœcium has a proximal, rounded triangular, membranous area, while its calcified part terminates in a somewhat projecting, angularly bent margin.

The colonies are bilaminate, dichotomously branched and their branches have up to 16 rows of zoœcia. A bundle of radical fibres springing from the pore-chambers in the proximal part of the marginal zoœcia runs along each lateral margin.

I have been able to examine a colony from Napier, New Zealand (Miss Jelly) and another from Port Jackson, New South Wales (Mr. Waters).

M. ligulata M. Gill.,

Craspedozoum ligulatum M. Gill., Transact. and Proceed. R. Soc. of Victoria, Vol. XXII, 1886, pag. 132, Pl. I, fig. 3.

(Pl. II, figs. 8 a—8 e).

In respect to form and development of spines, gymnocyst and cryptocyst **the zoœcia** essentially agree with the foregoing species. The marginal zoœcia are however generally furnished with all four spines, the two on the outer margin attaining the greatest development. A rather long, calcareous process, pointing basally and obliquely proximally, springs from the inner surface of the frontal wall on the proximal side of the zoœcial APERTURE ~~opening~~. It consists of a long, narrow, compressed rod, terminating in a quadrangular expansion with a finely dentate and striated margin (figs. 8 c, 8 e). This expansion again is composed of two unequal lateral halves, bent against each other in the shape of a roof, with the hollow downwards. These processes, which can easily be seen through the wall when an isolated row of zoœcia is viewed from the side, are subject to some variation, both as regards the absolute length and the proportional size of rod and terminal expansion. The lateral walls on the other hand have no processes. The distal wall has a large, broad, multiporous rosette-plate (fig. 8 d) deeply sinuated frontally, and as in the foregoing species we find one or more pore-chambers (fig. 8 d) between the rosette-plate and the distal wall. These are however generally larger and often of a peculiarly sinuated or twisted form (figs. 8 b, 8 d).

The avicularia, of which only a single form is found, have a long, narrow, triangular, pointed mandible and two small hinge-teeth on the boundary between the opercular and the subopercular area. In the zoœcia without oœcia there is generally only a single, rather large avicularium proximally to the membranous frontal area. It occupies the whole space in the proximal part of the zoœcium, and has not as in *M. roborata* a distinctly delimited, but empty area at the side. The mandible is most frequently turned to one of the sides. There is no internal avicularium, but in some few cases a small avicularium occurs in the distal part of the outer margin of the marginal zoœcia. Above each oœcium generally two small avicularia with the mandible turned obliquely distally and outwards.

The oœcia have as in the preceding species a proximal, membranous area which is here rounded and not bounded by an angularly bent distal margin.

The colonies are unilaminate, dichotomously branched and their branches have up to 8 rows of zooecia. They are as in the foregoing species bordered by a belt of radical fibres.

Of this species I have examined some colonies from Napier, N. Zealand, for which I am indebted to Miss Jelly.

Canda Lamouroux.

(Pl. II, fig. 9 a).

The *zooecia* are on the basal surface furnished with a *vibraculum* which (apart from the adjacent chamber of radical fibres) only contains a single cavity; the flagellum is not dentate. The frontal areas of the two rows of zooecia form obtuse angles with each other, and the neighbouring branches of the fan-shaped colony are connected by parallel radical fibres, which are always given off from or terminate in the chambers connected with the vibracula; no marginal *avicularia.*

The zooecia have at the distal end a shorter or longer spine on each side. They have no frontal gymnocyst, the calcification of the frontal surface being exclusively formed by a more or less granular, asymmetrical, deepened cryptocyst, the extent of which is different in the various forms. The ooecia are endozooecial, being enclosed in avicularia, and in the latter we may thus distinguish between a proximal, wider part, the ectooecium, whose frontal wall is furnished with a rounded, uncalcified portion, and a distal, cap-shaped part, the real avicularium. The boundary between the two parts is formed by an angularly bent transverse belt in which the ectooecium and the endooecium have coalesced. To communicate with the avicularium the zooecium has a small rosette-plate.

Of this genus four species have hitherto been described, chiefly on very relative characters and without any large material, and it may accordingly be difficult to decide for certain, how many of these species are maintainable. Our Museum is only in possession of a plentiful material of a West Indian species, besides a colony from Bass Straits of *C. arachnoides* and a small fragment of *C. retiformis,* sent from the British Museum. From the same Museum I have borrowed a preparation of *Canda simplex* Busk, for examination, but it was covered with heterogeneous bodies to such an extent, that it was impossible for me to decide whether this form, as I think probable, is identical with the above-mentioned West Indian, which accordingly I must give a special name.

On the basis of this material I may now give the following synopsis of the *Canda* species.

1) The colony jointed, the two inner zooecia in each bifurcation being divided into a distal and a proximal calcified portion, connected by a chitinous tube; the vibracula far from reaching the central suture of the branch. (The cryptocyst occupying about one-fourth of the whole length of the zooecium. The proximal margin of the vibraculum separated from the distal wall on the proximal side of it by a distance which is at least half as large as the breadth of this wall; not infrequently avicularia along the middle of the branch; no opercular spine) .... *C. arachnoides* Lam.

1) The colony not jointed; the vibracula almost reaching or surpassing the central suture of the branch;

2) The zooecia with a hammer-shaped opercular spine; the proximal margin of the vibraculum is separated from the distal wall by a distance which is about half as large as half the breadth of the latter; the vibraculum almost reaching the central suture of the branch; the cryptocyst is a little shorter than half the length of the zooecium .... *C. retiformis* Smitt[1].

2) No opercular spine; the proximal margin of the vibraculum almost reaching the distal wall; the vibraculum reaching or surpassing the central suture of the branch; the cryptocyst occupying about one-third of the whole length of the zooecium .... *C. caraibica* n. sp.

? C. simplex Busk[2].

? C. tenuis M. Gill.[3].

On account of the remark made by Busk[2], that the avicularia in the sutural line of the branch in *C. arachnoides* do not seem to be developed in connection with the separate zooecia, I may here call attention to the fact that Busk is wrong in his supposition. On splitting a branch into its two lateral halves it will easily be seen that these strongly compressed avicularia are given off from the free continuation of the inner lateral margin of the zooecia.

Rhabdozoum Wilsoni Hincks,

Annals Nat. Hist. V Ser., Vol. X, pag. 160, Pl. VIII, fig. 4.

This peculiar form, of which I have been able to examine specimens from Western Port and Port Phillip, Victoria, which I owe to the kindness of Mr. J. Gabriel and Miss Jelly, is by Hincks wrongly referred to the *Eucratiidae*, a

[1] 102, p. 16. [2] 8, p. 26. [3] 68, p. 107.

family including some of the genera which have been referred by me to the family *Bicellariidae*. That it must be referred to the *Scrupocellariidae* and not to the *Bicellariidae* is sufficiently evident from the stronger calcification and the structure of the distal walls, the *avicularia* and the *oœcia*. The last mentioned, which are hyperstomial and the basal wall of which is a part of the frontal wall of the zoœcium, have a mostly membranous ectooœcium, which has only a calcified marginal portion. The frontal gymnocyst is unusually large, whereas there is but a very slightly developed secondary cryptocyst, which in the oldest zoœcia terminates in a number of tooth-like processes. The basal wall of the zoœcia is acutely arched, transversely striated and each radical fibre takes its origin from a proximal pore-chamber.

Family **Membraniporidae.**

This family comprises all the Malacostegous forms which can neither be referred to the *Cribrilinidae* nor to any of the above-mentioned families, and which in contrast to these can only be characterized negatively, viz. by their not possessing the combination of characters peculiar to any of the above families. It shows greater variation and wider contrasts than any of the other Malacostegous families.

The frontal wall of the *zoœcia* is sometimes quite membranous, sometimes to a greater or smaller extent provided with a calcareous layer, which may be sometimes a gymnocyst (*Electra*), sometimes a cryptocyst (e. g. *Onychocella*) and most often a combination of both. Spines are sometimes wanting, sometimes found in great numbers in the whole periphery of the frontal area. The separate zoœcia communicate sometimes by uniporous or multiporous rosette-plates, sometimes by pore-chambers. The heterozoœcia have in some cases a calcified transverse bar and may appear both as avicularia and as vibracula. They are sometimes independent (vicarious), sometimes dependent, and sometimes both forms are found together (*Callopora craticula*). The oœcia are usually hyperstomial, in a single genus acanthostegous and in some cases endozoœcial (*Caleschara Rosseliana*), sometimes (*Oochilina*) surrounded by kenozoœcia. The colonies are most frequently incrusting, but in many cases free and then either laminate or forming richly branched tufts. Within this section so rich in species no small number of genera and a few families have subsequently been set up or proposed, e. g. by Busk, Waters, Jullien, Norman and others. Neither time nor my material permit me to give a criticism of all the genera proposed, but I must confine myself to set up a few new ones and to give new diagnoses of some older ones. A grouping of the numerous species described, according to their relationship, will require a considerable amount of work and much critical sense on account of the great variation within a series of structures.

Membranipora L.
Biflustra d'Orb (p. p.), Busk, Smitt.
Nichtina Canu.[1]

The *zoœcia*, the aperture of which is to a greater or smaller extent surrounded by a granular or denticulate, cryptocyst margin, have 2 spines at most, which are situated in the two proximal corners. On each side of the distal wall one multiporous rosette-plate or a series of uniporous or partly multiporous; each lateral wall with 2—4 multiporous plates. No *avicularia*; no *oœcia*.

In *M. membranacea* the cryptocyst appears only as an extremely narrow marginal portion, while in other species it attains not only a greater breadth, but also forms a large, proximal expansion, often terminating in a larger or smaller process. This is most strongly developed in *M. denticulata (danica) v. sculata*[2], in which it almost reaches the operculum as a free, quadrangular lamina. It is less developed in *M. delicatula* Busk. The cryptocyst attains its highest development in *M. oblonga* Busk[3], which represents a *Micropora*-like development of the genus. The two spines, which constantly appear in *M. membranacea* and in *M. tuberculata* and which in a number of species are more or less tuberculiform, attain their highest development in the latter species, in which they often coalesce into a single very large tubercle, and a similar coalescence takes place in a number of zoœcia of *M. Lacroixi* Aud[4] (non Busk, nec Hincks), figured by Savigny, the spines of which generally seem to have a triangular transverse section. In *M. Savarti* and *M. denticulata* these spines are not constant, and in a series of undescribed forms, which must be referred to other species, they are altogether absent. In my description of *M. membranacea* in »Zoologia Danica« I have already called attention to the great variation in the rosette-plates of the distal wall in this species. On either side there may be sometimes a large multiporous rosette-plate, sometimes a series of smaller, uniporous or partly multiporous ones. In all the forms examined by me multiporous rosette-plates are constantly found on the lateral walls.

As in all the numerous forms, I have had the opportunity of examining, no oœcia were found, which however are said to be present in the species from

[1] 11 a, p. 380. [2] 55, p. 51. [3] 7, p. 31. [4] While the species of Savigny is furnished with two spines which in some zoœcia are coalesced into a semiglobose tubercle the species, which Hincks calls *Memb. Lacroixii*, has a greater or lesser number of small triangular hollows kenozoœcia between the zoœcia.

Florida, determined by Smitt as *M. Lacroixi*, I must dispute the correctness of Smitt's determination. The unpaired swelling mentioned before, which is found in the proximal end of some zoœcia in *M. Lacroixi* Aud.[1], Smitt[2] explains as oœcia, which have been placed in an inverted position by Savigny's artist (»drawer«); but there is, I think, no reason to doubt the correctness of the figure.

Membranipora limosa Waters.

Journ. Linnean Soc., Zoology, Vol. XXXI, 1909, p. 140, Pl. 12, figs. 1—5.

(Pl. XXII, figs. 5a—5c).

The zoœcia, which are separated by distinct (in fresh colonies brown) sutures, are rather long, generally hexagonally rectangular with a curved distal edge. The narrow aperture, which is half as broad and a little more than half as long as the frontal wall, is provided with a semicircular oral valve. The whole of the calcified part of the frontal wall is formed by a cryptocyst, in which we can distinguish between a broad raised marginal portion furnished with parallel series of more or less coalesced tubercles, and of a depressed median part, the distal margin of which is armed with a little process of varying shape, most often bifurcate, sometimes almost fan-shaped with a number of small projecting teeth. The obliquely ascending distal wall, the triangular basal part of which may be split into a distal and a proximal half after treatment with Eau de Javelle, has in its inner part two (more seldom three), fine, slender, erect, somewhat curved calcareous rods, bent at the end like hooks, which project into the proximal part of the distal zoœcium and have the hooks directed away from the frontal wall. Each distal wall has in its inner, more horizontal part inside the posterior margin 6—7 uniporous rosette-plates or a smaller number of plates, of which some are multiporous. The distal half of each lateral wall has generally 2 (rarely a single) rosette-plates with 2 (1)—6 pores.

The colonies unjointed, slender, richly branched, with bifurcate branches which bear from 4—5 rows of zoœcia. The number of zoœcia in the separate rows is from 4—14.

The Formosa-channel, 30 fath. (Suensson), Nagasaki (Suensson).

As *M. membranacea* L. must be regarded as the type of the above characterized genus, and the name *Membranipora* ought therefore in future to be used only in this more restricted sense, we shall want a name to designate all such species as cannot be referred to particular genera. As such a temporary name I propose »*Membraniporina*«.

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[1] 98, Pl. 10, fig. 9.2. [2] 103, p. 18.

Electra Lamour.

Tendra Nordm. p. p., Pyripora Mc Coy p. p.,
Heteroœcium Hincks.

The frontal calcification of the *zoœcia* is essentially or exclusively a gymnocyst. There may be a circle of spines round the frontal area, of which an unpaired proximal one is generally the most constant and often the only one present. The distal wall is furnished within its proximal margin with a transverse row or a transverse belt of uniporous rosette-plates; the lateral walls have 2—3 multiporous plates. No *avicularia*. *Oœcia* absent or acanthostegous.

To this genus I refer *E. verticillata*, *E. pilosa*, *E. bellula*, *E. triacantha*, *E. distorta*, *E. zostericola*, *E. amplectens*, *E. monostachys*, *E. fossaria* and *E. catenularia* which like *E. fossaria* has a calcified operculum and can only be regarded as a form of the latter. I have some doubt whether the species, which has hitherto wrongly been called *M. Lacroixi*, and for which I propose the name of *M. hippopus*, can be referred to this genus.

E. zostericola Nordmann.

Tendra zostericola Repiachoff, Zeitschrift für wissensch. Zoologie, 25. B., 1875, pag. 129, Tab. 7—9.

Membranipora (Tendra) zostericola Ostroumoff, Die Bryozoen der Bucht von Sebastopol, pag. 18, Tab. 1, Fig. 13—14.

(Pl. IX, figs. 2 a—2 b).

As shown by the above-mentioned authors there is among the ordinary **zoœcia**, which have generally only two distal and sometimes one proximal, unpaired spine, a smaller number, in which as in the *Membraniporella* species the membranous frontal area is covered by two rows (10—17 pair) of hollow, very thin-walled spines, which meet in the central line of the zoœcium. Their form is extremely variable in the same zoœcium, as they are sometimes broad, sometimes narrow, sometimes single, sometimes bifurcate in a larger or smaller part of their length. Two opposite spines most often meet in a truncated terminal part, but it is not infrequent, that a greater or smaller number of them stretch a thin point across the end of an opposite spine. The bright spots seen at the outer part of each row are the translucent cavities of the separate spines. Of these the distal ones are the shortest, and the gymnocyst projecting here into a triangular portion, which has a curved margin distally, leaves a small transversely oval area for the opercular valve. The two rows of spines form a somewhat arched roof across the frontal membrane, and thus a space is formed which opens outwards immediately on the distal side of the operculum of the proximal zoœcium. These zoœcia, of which several may sometimes occur in succession, are supposed by Repiachoff to be equivalents of oœcia. But while according to the description of this author we should think that the cavity of the zoœcium itself acts as oœcial cavity, Ostroumoff informs us of the fact, that the embryos and larvæ are situated in the space between the spines and the frontal membrane. He speaks on this as follows[1]: »The lattice-like zoœcium (cellule treillissée Nordm.) serves as ovicell for the zoœcium on its proximal side. The cavity of the ovicell is formed on one side by the surface of the mantle (i. e.: frontal membrane), on the other by the concurrent spines. The egg, which is extruded from the lower zoœcium by the tentacles, comes into this cavity, and this may be easily seen by a transverse section through a lattice-like zoœcium containing embryos. Some embryos are usually found in this cavity.« On my enquiry Ostroumoff has however informed me, that he has not observed such a transference of the egg. Besides the ordinary zoœcia with 2—3 free spines a smaller number may be found, in which the frontal area is surrounded or partially covered by 1—9 pairs of spines of varying length, which however meet neither the spines springing from the same nor those from the opposite side.

A number of colonies of this species from Sebastopol were kindly sent to me by Dr. Ostroumoff.

E. (Heteroœcium) amplectens Hincks.

Membranipora amplectens Hincks, Annals Nat. Hist., ser. 5, Vol. VIII, 1881, pag. 129, Pl. III, fig. 7.

Heteroœcium amplectens Hincks, Annals Nat. Hist., ser. 6, Vol. IX, 1892, pag. 195.

(Pl. IX, figs. 1 a—1 e).

The ordinary zoœcia are pear-shaped oval and provided with a membranous frontal area occupying half the breadth of the zoœcium and between half and one third of its length. It is surrounded by seven spines, of which six are short and a proximal one long and strong. From the inner surface of the frontal area more than 30 small dentiform processes issue, of which the two distal ones are the longest. They are arranged in an oval which is not entirely closed proximally, and the distal half of which is immediately within the margin of the frontal area.

The oœcium-bearing zoœcia are broadly oval and have somewhat proxi-

[1] 90, p. 19.

mally to the centre an opercular valve, on the proximal side of which there is a long, strong spine. The two rows of flat spines, which cover the area on the distal side of the valve, generally meet in truncated ends. We may however sometimes, as in the corresponding formation in *E. zostericola*, see a spine stretching its terminal part across an opposite spine. The basal wall is only calcified in the distal, ribbed half of the zoœcium. A small piece of this species was kindly placed at my disposal by the late Mr. Peal.

Var. brevispina n. (fig. 1 e).

The ordinary zoœcia are larger, narrower at the base, the frontal area surrounded by 8—9 short spines, the proximal one but slightly stronger than the others. The dentiform processes are represented by about 10 extremely small tubercles, situated within the margin of the frontal area in the distal half of the latter.

The oœcium-bearing zoœcia are larger than in the principal form, have fewer spines and a semi-circle of 5 short spines proximally to the aperture.

A few colonies of this form have been found on *Hormophora Australasiae* in the herbarium of algæ in the Botanical Museum. Although we do not understand the significance of the situation of the aperture behind the area formed by the spines, we must still group this form of oœcium with the one found in *E. zostericola*.

Electra bicolor Hincks.

Membranipora bicolor Hincks,

Annals Nat. Hist., ser. 5, Vol. VII, 1881, pag. 148.

(Pl. IX, figs. 7 a—7 e).

The zoœcia very long, narrow (the length larger than the breadth by about $3^1/_2$ times), somewhat lyre-shaped, with a longitudinally oval, membranous frontal area, occupying about three-fourths of the whole length of the zoœcium and bounded by somewhat convex lateral walls. The smooth, arched gymnocyst passes into a cryptocyst, which first sinks obliquely distally and inwards and finally gives off towards the basal wall of the zoœcium a horizontal lamina ending in a denticulated margin (fig. 7 c). On the boundary between the oblique semi-elliptical and the horizontal denticulate part of the cryptocyst a triangular calcareous lamina takes its origin. It consists of two lateral halves, bent against each other at an angle open outwardly, and which meet in a thickened central ridge (figs. 7 a, 7 b). In rare cases the gymnocyst has a small tubercle-like expansion distally. The frontal margin of the distal wall is strongly thickened and crenulated, and on the proximal side of it the operculum is seen with a strongly chitinized margin. The lateral margins of the operculum form right angles with the distal margin. The distal wall has within its basal edge a transverse row of 3—5 small uniporous rosette-plates, while the distal half of each lateral wall has 2 multiporous ones.

The colonies examined form incrustings on *Amansia pinnatifida* from Australia. (The herbarium of algæ in the Botanical Museum). This species is most closely allied to *Membranipora nitens* Hincks, which must also be referred to the genus *Electra* and shows more distinct signs of the relationship than *E. bicolor.* It has as in *E. pilosa* an obliquely ascending distal wall, and the three prominent spines, so often occurring within the genus, viz. the unpaired proximal and the two distal, are here represented, the former by the large conical expansion and the latter by two somewhat compressed tubercles, which are connected by an arch-like ridge. The rosette-plates are of the same structure as in *E. bicolor.*

E. angulata n. sp.

(Pl. XXII, fig. 1 a).

The zoœcia of varying form and dimensions, with a distal arch-like or angulate margin and with a large, most often oval, membranous frontal area, occupying the greater part of the frontal surface. There is a slightly developed, granular, dentate, secondary cryptocyst. In respect to development of spines the zoœcia show great differences. The best provided ones, which in the colonies examined are in a great minority, have on the margin 12 not very thick spines, which reach the middle of the area or even surpass it. A larger or smaller number of them is however often wanting, and many zoœcia are altogether without spines. On the proximal gymnocyst we find in most zoœcia 2 (more rarely a single median and still more seldom 3) short, thick, conical spines, generally open at the end, which are situated half-way between the central line and the lateral margins. These spines may sometimes be rudimentary, and in many zoœcia (with or without marginal spines) they are absent. The distal wall, which is generally ascending towards the frontal surface and angularly bent from side to side or arch-like, has on either side a rather large, multiporous rosette-plate situated in one of the basal corners of the distal wall. The distal half of each lateral wall has a single multiporous rosette-plate.

On a ligneous core taken on the surface of the water near Koh Samit, Siam (Dr. Th. Mortensen).

In a variety of this species from lat. 22° 10′ V. long., 114° 30′ E. (Captain Suensson) the separate **zoœcia** attain considerably larger dimensions and are in the examined colony all provided with 20—24 marginal spines and with 1—3 short and thick proximal ones. The distal wall is more bent (at a right or an acute angle), and the distal half of each lateral wall may have 1—2 rosette-plates.

In referring the species, described above, to *Electra*, although the distal wall has two multiporous rosette-plates instead of a row of uniporous ones, the reason is that the rosette-plates of the distal wall in many species show rather great variation even in the same colony. Otherwise this species is most closely allied to *E. monostachys*. The peculiar doubling of the proximal spine may possibly explain the origin of the two proximal corner-spines in *Membranipora membranacea* and may then be considered as evidence of the development of *Membranipora* (sensu stricto) from *Electra*. Both genera agree in possessing few multiporous rosette-plates on the lateral walls and in their constant lack of avicularia and hyperstomial oœcia.

Callopora (Gray) Norman [1], char. emend.

Alderina Norman [2], Amphiblestrum Gray p. p., Ramphonotus Norman [3], Doryporella Norman [4].

(Pl. IX, figs. 3—4).

The *zoœcia*, which may have a varying number (0—16) of spines and a cryptocyst developed to a varying extent, are provided with a small number (5—6) of large few-pored pore-chambers. The *oœcia* are hyperstomial. The ectooœcium, the calcified part of which often ends in a projecting margin, has a larger or smaller uncalcified frontal portion. Dependent *avicularia* generally appear, more seldom independent ones as well. The former may appear distally to the oœcium in an oblique position and singly or in pairs, while in zoœcia without oœcia they may appear singly and in different positions on the proximal part of the zoœcium.

Of species known to me I must to this genus refer *Callopora lineata*, *C. craticula*, *C. Dumerili*, *C. aurita*, *Amphiblestrum Flemingi*, *A. trifolium*, *Ramphonotus minax*, *Alderina imbellis* and *Doryporella spathulifera*. Despite the great variation in a series of structures all the above-mentioned species are so closely connected that it appears to me to be necessary to refer them to the same genus. In all of them there is a small number of few-pored pore-chambers, and they all have hyperstomial oœcia with a partly uncalcified ectooœcium, which however may be of very varying extent. The calcification of the ectooœcium is least developed in *C. Dumerili*, in which species it appears only as a narrow mar-

[1] 83, p. 588. [2] 83, p. 596. [3] 83, p. 597. [4] 84, p. 106

ginal portion, and most developed in *C. aurita* (fig. 4 a). In *C. minax* its extent is similar to that in *C. imbellis* but is often indistinct, as it is not always sharply defined. In all of them there is a cryptocyst, the development of which is however not only different within the different species, but also varying according to locality and age of zooecia. Its development is slightest in *C. craticula* and *C. lineata*, in which it is only a narrow marginal portion inside the spines, greater in *C. Dumerili* and *C. aurita*, and still greater in *C. Flemingi, C. trifolium, C. imbellis* and *C. minax*. The last four species are evidently most closely allied. In the last-named species we find a strongly developed avicularium with an unusually high chamber (mounted on a pedicel Norman[1]); but in this difference I cannot find sufficient reason for setting up a new genus.

A later examination of some good colonies of *Doryporella spathulifera* has corroborated my view as to the systematic position of this species which I must refer to the present genus. As I am later to give a full description of this species in a work on the Ingolf Bryozoa I may here just mention a few points of its structure. The so-called median pore is the aperture of an avicularium of the same form as those found in the distal part of the zooecium and corresponding to that found proximally to the aperture in *C. Flemingi, C. minax* and *C. lineata*, and in the last species there may also as in *C. spathulifera* be found a spine distally to the avicularium. There are 6 rosette-plates in the proximal half of the zooecium.

In old colonies of *C. Flemingi, C. minax* and *C. spathulifera* there may be found a compound operculum, the opercular valve and the membrane filling the rest of the aperture being fused together into a separable chitinous lamina.

Megapora Hincks.

The *zooecia* have a strongly developed, partially depressed cryptocyst and an aperture surrounded by spines and with a well-developed vestibular arch. A compound operculum in which the valvular part and the accessory part are connected by a joint. A few few-pored pore-chambers. No *avicularia*. Hyperstomial *ooecia* whose ectooecium is calcified with the exception of a frontal triangular membranous part covering a corresponding very prominent granular part of the endooecium. The only species hitherto known are *M. ringens*, and *M. hyalina* Waters[2]. They are undoubtedly closely related to the *Flemingi*-group within the genus *Callopora*.

[1] 83, p. 597. [2] 115, p. 39.

Tegella n. g.

Callopora Norman p. p.

(Pl. IX., figs. 5—6).

The *zoœcia*, which have spines and a slightly developed cryptocyst, are provided with multiporous rosette plates. Hyperstomial *oœcia* with an incompletely calcified ectooœcium, which are again surrounded by *avicularia*.

Of species known to me *Callopora unicornis* and *C. Sophiae* belong to this genus.

Foveolaria Busk, char. emend.

The entire surface of the *zoœcium* is formed by a very thick, solid, much furrowed cryptocyst, which is deeply depressed in the whole periphery of the aperture. A very large, oval, compound operculum with a joint connecting the valvular part and the accessory part. Multiporous rosette-plates. Hyperstomial *oœcia* which are provided with a membranous ectooœcium and are finally hidden by covering calcareous layers. In most zoœcia a large *avicularium* proximally to the opening.

To this genus I can only refer *F. elliptica* Busk.

Caleschara Mac Gillivray[1], char. emend.

Rosseliana Jullien.

There is no gymnocyst, but on the frontal wall of the *zoœcium* a strongly developed, depressed cryptocyst, which is sometimes (*C. denticulata*) only perforated by a semi-circular opesia and two slit-like opesiulæ. No spines. No *avicularia*. Endozoœcial, but more or less distinctly prominent *oœcia*. All rosette-plates uniporous.

This genus agrees with the majority of the *Flustridae* both in its possession of endozoœcial oœcia and uniporous rosette-plates. Of species described only *C. denticulata* M. Gill. and *C. Rosseli* Aud. belong to it. An undescribed species from Siam makes an intermediate form between the two just mentioned species, its cryptocyst terminating in a free, dentate lamina, and if we imagine this lamina coalesced distally with the dentate lateral parts of the cryptocyst, we should have two slits similar to those found in the former species. —

[1] 74, Vol. 2, Dec V., p 15, Pl 18, fig 8

Onychocella Jullien [1].

Onychocellidae Jullien.

(Pl. XXII, figs. 3a—3d, pl. XXIV, fig. 10).

The frontal calcification of the *zoœcia* exclusively consists of a more or less developed, depressed cryptocyst. No spines. The operculum is sometimes a wholly chitinized simple operculum, sometimes a membranous opercular valve, and it is generally surrounded by an arch-like, chitinized thickening of the frontal membrane. The oblique, frontally ascending terminal walls are like the lateral walls two-layered, and both kinds of walls are provided with a few multiporous rosette-plates. The *avicularia* are independent (vicarious), with a strongly developed cryptocyst and a flagellum-like, lengthened mandible which has a single or double, thin, wing-like expansion. The *oœcia*, which may, I think, be considered endozoœcial, appear as low, not strongly prominent, swellings from the proximal end of the distal zoœcium, and they are separated on either side from the raised margin of the proximal zoœcium by a suture.

This genus is plentifully represented in the chalk-period, while only a small number of recent species are known.

It will be noticed that the above diagnosis corresponds not only with the genus *Onychocella* Jullien, but with the bulk of his family *Onychocellidae*, the latter comprising also a number of species, which must be referred to the new family *Membranicellariidae* set up by me. Although I have no doubt, that in time it will be necessary to acknowledge Jullien's family *Onychocellidae*, I shall at present refer these forms to a single genus, as they are not yet so well known, that the genus can be divided in a natural way. Jullien has set up no less than eight genera, all of which however seem to me to be based on rather unimportant differences.

Of this genus I have examined six recent species, among which one from Denmark Strait, *O solida* Nordg [2]. The latter possesses a simple, membranous opercular valve, while the others have a wholly chitinized, simple operculum, and this difference is in the examined species connected with another. The fact is that the free margin of the operculum is in all of them surrounded by an arched chitinous sclerite, but while in the five species this chitinous arch only reaches as far as the proximal corner of the operculum, it is in *O solida* Nordg. continued a long way on the proximal side of the latter and here serves as base of attachment for a parietal muscle. With the exception of *Onychocella Luciae* Jullien

[1] 42, p. 7. [2] 84 b, p. 8.

oœcia have hitherto not been made out with certainty, neither in fossil nor in recent species of this genus; but the reference of the above mentioned species to the genus *Onychocella* does not seem to me to be unquestionable. The presence of avicularia with wing-shaped lateral expansions is not conclusive. I have found quite similar avicularia in a tropical *Microporella* species. With regard to the zooecia themselves they seem to be more like those found in *Callopora Flemingi* and cognate species, as there seems to be a distinction between a strongly depressed cryptocyst surrounded by a projecting margin and an arched, proximal gymnocyst. The rather large oœcium issues from the latter and is in size, form and position unlike the oœcia, which I have found in a series of recent and fossil species of the genus, and which are very little conspicuous, so little in fact, that they have hitherto been overlooked.

While all the other zooecia have a sharp and deep sutural furrow in the whole of their periphery, which forms the boundary between the projecting margins of their own and those of the surrounding zooecia, such a sutural furrow is wanting in the distal end of the oœcium-bearing zooecia, and the proximal end of the distal zooecium does not as in the other zooecia end in a low, rounded, projecting margin, but in a somewhat higher, more or less distinctly prominent swelling (the frontal wall of the oœcium) which is but indistinctly marked off from the zooecium, and which seems to be covered by its frontal membrane. This slightly prominent, rounded pent-roof is on either side separated from the marginal cryptocyst of the proximal zooecium by a sutural furrow. In the interior the frontally ascending distal wall touches the distal end of this swelling, and between the zooecial operculum and the margin of the oœcium we find a slightly chitinized oœcial operculum. Reference may be made to the schematic figure (Pl. XXIV, fig. 10.), the dotted lines in which show how I picture the inner parts of this oœcium.

Cupularia Lamouroux.

The *zooecia* broadly rhombic, without frontal gymnocyst, but with a depressed cryptocyst perforated by a larger or smaller aperture. No spines. Each distal wall with one, and the distal half of each lateral wall with several (up to 6), scattered, uniporous rosette-plates. The lateral walls are common to the contiguous neighbouring zooecia. On the distal side of each zooecium we find an asymmetrical, independent *vibraculum* with a long flagellum and an angularly bent, kidney- or bean-shaped opening. No *oœcia*. The species hitherto described occur in free, discoidal colonies with a thick basal surface covered by a membrane, the radiating furrows of which correspond with radiately arranged zooecial rows.

While all the other species have only an opercular valve, we find in *C. Lowei* Busk a wholly chitinized simple operculum, enclosed by a complete calcareous frame, the cryptocyst being raised proximally to the operculum to the level of the latter and forming its proximal boundary. This species might thus justly be referred to the family *Microporidæ*. —

Lunularia Busk [1].

Lunulites Lamouroux, p. p.

The *zoœcia* quadrangularly rounded, without frontal gymnocyst, but with a depressed cryptocyst perforated by a larger or smaller aperture. No spines. Each distal and each lateral wall with a number of scattered, uniporous rosette-plates. The lateral walls are common to the contiguous neighbouring zoœcia. The symmetrical *vibracula* with a long flagellum and a deeply depressed, strongly developed cryptocyst occur in shorter or longer rows or scattered among the zoœcia. No *oœcia*. The species hitherto described appear in free, discoid colonies with a thick basal wall covered by a membrane, the radiating furrows of which correspond with the more or less radiately arranged zoœcia. —

This genus, which is plentifully represented in the chalk-period, has only a few recent species. Of these I have had the opportunity of examining a fragment of *L. capulus*, kindly placed at my disposal by the British Museum.

It will perhaps be justifiable to combine the two genera defined above into one family *Lunulariidae*.

Selenaria Busk, char. emend.

The *zoœcia* rhombic or rhombicly hexagonal, without a frontal gymnocyst, but with a depressed cryptocyst perforated by a larger or smaller aperture. No spines. Scattered among the zoœcia are a number of independent *vibracula* with an arched frontal surface perforated by numerous pores or by slits. A high ribbon-shaped lamina, issuing from the one lateral margin in the distal part of the vibracularian chamber stretches over towards the opposite margin and not far from this bends inwards towards the basal surface. It serves no doubt for the attachment of the flabellum. Distal wall with 2 multiporous rosette-plates, and the distal half of each lateral wall with a single one. Lateral walls are common to the contiguous neighbouring zoœcia. The *oœcia*, which seem to be endozoœcial, appear on the surface of the colony as low, rounded, pent-roof-shaped swellings. The colonies are free, discoid, with a deepened basal surface perforated by numerous pores

[1] 8, p. 208.

and provided with radiating furrows, which correspond with the radiately arranged zooecia.

Similar vibracula are found in the cretaceous species *Rhagasostoma elegans* v. Hag.

Family **Cribrilinidae.**

(Pl. IX, figs. 9—11).

The *zooecia* with a larger or smaller, membranous frontal area, covered by two rows of mutually coalesced, hollow, marginal spines, which form a frontal shield perforated by slits or pores.

The unnaturalness of this family may be sufficiently evident from the fact, that it is only based on a single character, which has moreover been taken from formations as variable and as inconstant in appearance as the spines. It is true that all such forms, in which the spines by their mutual connection form a shield broken through by slits or pores, have a certain outward similarity, which without a close examination may easily be considered a proof of real relationship. The fact is however that we might be equally justified in forming a family for all such *Membraniporidae*, in which spines are absent or for such as possess two rows of well-developed, unconnected spines. In reality we do not in the other structural features find such a degree of conformity as might justly be expected in a natural family. A careful examination leaves no doubt of the independent origin of such a frontal shield in many different forms. That Harmer has a similar conception of these forms, is evident from the following statement of his: »The existence of great differences between the opercula of different species at present referred to *Cribrilina* suggests that the genus is an unnatural one, representing a stage of evolution of the Lepralioid zooecium, which has been arrived at independently in several cases.« [1]

Electra monostachys (Pl. IX, figs. 2 a—2 b) and *E. angulata* n. sp. (Pl. XXII, fig. 4 a) constitute two of the best examples of the inconstancy of the spines. Here we may find in the same colony some zooecia, which are entirely without spines, and others provided with a larger number of these structures. In the face of this fact it would surely be impossible to make the presence or absence of spines the only distinction between two systematic sections. We are however able to mention two quite corresponding examples of the inconstancy of the frontal shield, viz, besides the above-mentioned *Electra zostericola* a new species from the Færoes which is related both to *Callopora Dumerili* and to *Membraniporella nitida*.

[1] 19, p. 329.

In this species we find within the same colony some zoœcia, which are provided with a frontal shield similar to that in *Membraniporella nitida*, and some which have either only 2—4 short distal spines or besides these a varying number of longer, unconnected ones. A partial coalescence of spines may also occur in several species. Thus, I find the first pair of spines coalesced in no small number of zoœcia on a colony of *Membraniporina pyrula*, Hincks from Victoria, and in the *Membr. defensa* described by Kirkpatrick a number of opposite spines (in the figured specimen 4 pair) may sometimes be connected. Such a coalescence of opposite spines also takes place in the whole length of the frontal area in *Stolonella clausa* Hincks, which belongs to the *Bicellariidae*, and a frontal shield formed by 5 coalescent broad spines occurs in *Petalostegus bicornis*, which I have thought it most correct to refer to the same family.

The natural consequence of the view expressed above would then be the splitting up of the family *Cribrilinidae* and the grouping of its forms with such forms of the *Membraniporidae*, to which they are most closely allied. As however the latter family cannot be regarded as natural either, it must perhaps be broken up into a larger or smaller number of smaller families, and the forms, which have a frontal shield, must be divided among them. My material of both these families is however too small for me to venture upon making definite proposals for a final arrangement of all these forms, and therefore for the present I prefer to keep the two families unaltered. As the members of this family have their nearest relations in the family *Membraniporidae*, it is quite natural, that we should find a similar extent of variation in most structures. The cryptocyst forms however an exception in this respect, as it is either completely wanting or appears only as an extremely faint margin within the spines *(Membraniporella)*. This is a natural consequence of the presence of the frontal shield, the latter making such protection unnecessary as in uncovered *Membraniporidae* may be rendered by the cryptocyst. The frontal shield may be of very different extent, occupying at times the entire frontal surface and in other cases but a smaller part of the latter. It is much reduced in certain forms occurring in the Danish chalk-formation. While in some cases we find an opercular valve only, a wholly chitinized (simple or complex) operculum is often present as in the members of the family *Scrupocellariidae*, in which the opercular spine is so strongly developed that it forms part of the boundary of the operculum. As in *Membraniporidae*, the rosette-plates may be multiporous, uniporous (e. g. *Membraniporella distans)* or there may be pore-chambers. The heterozoœcia may appear both as independent and dependent ones, as avicularia and as vibracula, and rather frequently we find a calcified transverse bar between the opercular and the subopercular area. The oœcia are hyperstomial or endozoœcial, and in the latter case they are surrounded by kenozoœcia in the hitherto examined species.

The authors, who have hitherto set up genera within this section, have chiefly attached importance to the structure of the frontal shield, i. e. to the structure of and the connection between the spines, of which it is composed. Here again we must maintain, that on account of the variable nature of the spines they are but badly suited to afford generic characters, and we must call attention to the fact, that the different varieties, which Hincks refers to *Cribrilina punctata*, show such great differences in the structure of the frontal shield, that some of them cannot even be entered under his diagnosis of the genus *Cribrilina*. I attach the greatest importance to the same structures that I have made use of in dividing the genera under *Membraniporidae*. For want of material I must however here confine myself to give diagnoses of the following 5 genera.

Membraniporella Hincks, Char. emend.

Lepralia (Johnston) Norman [1].

The aperture in the frontal shield has an opercular valve, and the shield is perforated by slits. There are pore-chambers with few pores, and the hyperstomial *oœcia* are provided with an ectooœcium but partially calcified. Dependent *avicularia* may occur.

This genus is here taken in a much more limited sense than by Hincks, and with the exception of the presence of the frontal shield the two species, that we have referred to it, correspond in all characters with the genus *Callopora* and show signs of being specially closely allied to *C. Dumerili*. This appears for one thing in the structure of the oœcia, the ectooœcium being in both species only calcified in its marginal portion. A frontal shield appears constantly in *M. nitida*, while this is not the case in an undescribed species from the Fœroes. In the latter we find in the same colony, besides a smaller number of zoœcia with a frontal shield, also some that are provided with but 2—4 distal, unconnected spines. This species thus forms a link between *Callopora* and *Membraniporella*.

Cribrilina Gray.

Cribrilina Jull. p. p., Gephyroles Norman 84, p. 100.

(Pl. IX).

The aperture in the frontal shield, which encloses an opercular valve, is usually provided with a more or less distinct proximal muero. Pore-chambers with few pores. The *oœcia* are hyperstomial or enclosed by kenozoœcia, and the wholly

[1] 84, p. 100.

calcified ectooœcium is generally provided with a larger or smaller number of perforations. Dependent *avicularia* may appear, and the shield is perforated by pores.

Cr. punctata, Cr. cryptoecium Norman[1], *Cr. annulata* and *Gephyrotes nitido-punctata* (Smitt) belong to this genus.

In *Cr. punctata* (fig. 11) we find in the same colony both hyperstomial oœcia and oœcia enclosed by kenozooœcia. On examining a longitudinal section af *Cr. annulata* (fig. 10) we might be inclined to regard the oœcia as formed by a large distal spine. A closer examination will show distinctly, however, that the endooœcium is formed by the distal wall, which has 4—5 uniporous rosette-plates. Moreover the surrounding kenozooœcium (10 a) is provided with pore-chambers. As in the species of *Retiflustra* the basal part of the oœcium lies higher (more distally) than its free, frontal margin (10 b).

Puellina Jullien[2], Char. emend.

Cribrilina Jull. p. p.

(Pl. IX, fig. 12 a).

The semi-circular aperture in the frontal shield is filled by a wholly chitinized, simple operculum. The shield is perforated by pores, of which those in its periphery serve as passage for short, tentaculiform evaginations from the frontal membrane, of which the first pair is considerably longer than the others. The *oœcia*, which are hyperstomial or enclosed by kenozooœcia, have a wholly calcified ectooœcium. Few-pored pore-chambers. Independent but not dependent *avicularia* may appear.

Cribrilina radiata, Cr. innominata and *Puellina Gattyæ* belong to this genus. The first-named species, which seems to have a wide distribution, will probably prove collective.

With regard to Harmer's contrary opinion[3] of the structure of the frontal shield in *P. radiata* I can only say, that in this matter I share the opinion of Norman.[4]

Figulina Jullien[5], Char. emend.

The aperture in the frontal shield, which has a more or less distinct sinus, is covered by a wholly chitinized compound operculum. Each distal wall with a row of uniporous, and each lateral wall with a number of multiporous rosette-plates. Hyperstomial *oœcia* whose ectooœcium is provided with a median suture

[1] 84, p. 102. [2] 44, p. 607. [3] 19, p. 326. [4] 84, p. 96. [5] 44, p. 608.

and with at least two pear-shaped perforations. Independent but no dependent *avicularia* may appear. The frontal shield with pores.

Cr. figularis, Cr. philomela v. armata and *Cr. clithridiata*[1] belong to this genus.

M. pyrula is a *Membraniporina* species which bears a close resemblance to *Cribrilina figularis*. I shall just mention that the oœcia have also in this species a median suture, and that the ectooœcium appears to have a large, uncalcified region on eather side. It is however not so well defined as in *Cr. figularis.*

Aspidelectra n. g.

Membraniporella Hincks.

The proximal part of the *zoœcium* with 1—2, thick, projecting, hollow spines; the frontal shield perforated by slits; each distal wall with 2 multiporous rosette-plates, and the distal half of each lateral wall with a single one; the aperture in the frontal shield with an opercular valve; no *avicularia*; no *oœcia.*

A. melolontha, the only species hitherto known, must certainly be traced to *Electra* and appears to show specially close relationship to *E. angulata*, with which species it agrees not only in possessing 1—2 projecting spines, but also in having an angularly bent distal wall with a multiporous rosette-plate in each of the two basal corners.

Arachnopusia Jullien[2], char. emend.

The frontal shield, which has a small number of large holes and *avicularia* of varying size, is formed by the coalescence of a number of branched, originally hollow, later partially solid spines, which spring from the lateral walls. A membranous opercular valve. The angular distal wall has a number of uniporous rosette-plates while the rosette-plates of the lateral walls have 1—3 pores. Hyperstomial *oœcia* with a wholly calcified ectooœcium and an oœcial cover formed by the adjoining frontal shields. The distal wall is in the oœcia-bearing zoœcia continued frontally beyond the proximal part of the oœcium into a lamina terminating in a rounded, sometimes crenulated margin, from which a membranous oœcial operculum takes its origin.

To this genus belongs *Cribrilina monoceros* M. Gill, which however comprises several rather different forms, that may possibly be considered independent species. *Cr. terminata* M. Gill.[3] may probably also be referred to this genus. It has at any rate a prolongation ending in a crenulated margin similar to that found

[1] 108, p. 5. [2] 45, p. 62. [3] 76, p. 59

in *A. monoceros*. It is in this species seen at the bottom of the aperture nearly on a level with the spines and separating the oœcium from the proximal zoœcium.

As I cannot discover any relationship between *Hiantopora ferox* and *Cribrilina monoceros*, but find the peculiarities of the latter species sufficiently well-marked to make it represent a genus of its own, I shall keep Jullien's genus *Arachnopusia*, but on a new basis, and I think it may for the present be ranked under the above mentioned artificial family *Cribrilinidae*.

2nd Division: Coilostega.

The frontal wall has within the covering-membrane a generally depressed, calcareous cover (the cryptocyst) surrounded by projecting margins, which either reaches the proximal margin of the operculum or is only separated from the latter by a small membranous portion. Spines of the usual form are usually wanting. The cryptocyst is as a rule provided with pores and most frequently with a foramen, the »opesiula« (sometimes confluent with the aperture) on each side, through which a parietal muscle passes out to the covering membrane. These foramina may be either simple perforations of the cryptocyst, or outgrowths from their proximal and inner margin may sink into the zoœcium to join the basal (sometimes a lateral or the distal) wall in different extention. In most cases these »opesiular outgrowths«, as we may call them, form in connection with the interjacent frontal wall and generally also with the basal wall a more or less complete tube, the »polypide tube«, enclosing a part of the polypide. There is either a wholly chitinized, simple operculum or a partially strongly chitinized opercular valve. The *avicularia* or *vibracula* are always independent. There may be hyperstomial, endozoœcial endotoichal or bivalvular *oœcia*.

The families *Microporidae*, *Steganoporellidae*, *Aspidostomidae*, *Thalamoporellidae*, *Setosellidae*, *Chlidoniidae* and *Alysidiidae* belong to this division.

Family **Microporidae.**

The semi-circular aperture, which is bounded proximally by the distal, ascending margin of the cryptocyst, has generally a more or less strongly chitinized (or calcareous), simple operculum, more seldom an opercular valve. Opesiulæ, when present, are always distinct from the aperture. Pores may be present or wanting and spines may appear. There may be *avicularia*, and the *oœcia*, when present, are endozoœcial or hyperstomial.

The family *Microporidae* is, in contrast to the following families, not quite natural, comprising as it does a series of genera which have independently attained the correspondence in form of aperture and structure of operculum that we have just pointed out.

Micropora Gray.

(Pl. VIII).

The two opesiulæ, which are more or less constant, have the form of simple perforations. Spines may appear. The *oœcia*, which have a membranous ecto-oœcium, are endozoœcial but very prominent, and the small *avicularia*, which are situated proximally to the aperture, are furnished with a complete cross-bar. Pore-chambers with few pores.

To this genus belong *M. coriacea* Esper, *M. perforata* Mac Gill. (Pl. VIII, fig. 4 a) and a species which has hitherto been confounded with M. coriacea, and for which I will propose the name *M. Normani*[1] (Pl. VIII, figs. 3 a—3 b). Of this species I have only seen a little fragment from Hastings, sent me by the late Mr. Peal, and having lost it I shall only mention, that the operculum is calcareous and that the distal half of the endooœcium lacks that cryptocyst cover, ending in an angular margin, which is found in *M. coriacea*.

Microporina n. g.

The two opesiulæ, which however are sometimes filled up, appear as simple perforations. Numerous pores. No *oœcia*, but *avicularia* with cross-bar occur. Each distal wall and the distal half of each lateral wall with a row (6—8) of one- or two-pored rosette-plates. A longitudinal series of parietal muscles is placed on each side between the cryptocyst and the covering membrane. *Cellaria borealis* Busk and *Micropora elongata* Hincks belong to this genus.

Macropora M. Gilliv., char. emend.

The *zoœcia* very thick-walled, provided with pores but without spines and without opesiulæ. The zoœcial aperture is provided with a well-developed vestibular arch. *Oœcia* and ordinary *avicularia* wanting, but among the zoœcia we find some which have an aperture of a very different form and whose distal margin is furnished with three membranous, feeler-like filaments. Pore-chambers.

[1] 56, p. 7, note

M. centralis Mac Gillivr.

A monograph of the tertiary Polyzoa of Victoria, Transact. Royal Soc. of Victoria, Vol. IV, 1895, pag. 55, Pl. VIII, fig. 3.

(Pl. VII, figs. 1 a—1 d).

The zoœcia which are bounded by a rounded granular marginal ridge are large (length 1.3 mm.), broad, hexagonal, thick-walled, very strongly arched and within the brown covering membrane finely tuberculated and provided with small, scattered pores. The aperture, which is situated at a shorter or longer distance from the distal margin of the zoœcium, is surrounded by a thick, wall-like peristom. It is large, almost semi-elliptical, but with the lateral margins somewhat converging proximally, where it is cut off straight. Within this proximal margin we find in the whole breadth of the aperture a ridge-like, raised part supporting the operculum, and within the distal margin of the aperture there is a strong vestibular arch which is somewhat angularly bent from side to side. The two proximal corners of the extremely thick, calcified, tuberculated operculum, covered like the rest of the frontal surface by the covering-membrane (fig. 1 c), are separated by an extremely small sinuation from the remaining part of the proximal margin, and accordingly a very small slit appears on each side. In each of the proximal corners is seen a small triangular-rounded hinge-tooth. Each distal wall and the distal half of each lateral wall is provided with a long pore-chamber (fig. 1 d), with a row of uniporous rosette plates.

Avicularia of general structure are wanting on the fragment examined, on which however was found a zoœcium with an aperture of peculiar structure (fig. 1 b). It is more oblong than the others, and the two distally somewhat converging lateral margins meet in a distal margin, which has a median sinus. In this an almost black, short, feeler-like filament takes its origin from the covering membrane, and some way further down there is a similar one issuing on each side. These filaments quite correspond with those discovered by Harmer in *Puellina radiata*. The proximal margin of the aperture is furnished with a low, broad denticle.

Of this species I have had the opportunity of examining a small fragment from Wanganui, which incrusts a shell-fragment, and which was sent to me by Miss Jelly labelled »*Monoporella crassatina*«, under which name I have mentioned it in »Studies on Bryozoa«[1]). *M. Clarkei* Tenison-Woods belongs to this genus, and in the figure Mac Gillivray[2] gives of this species we also see a zoœcium

[1] 56, p. 7. [2] 76, p. 55.

with a peculiarly formed aperture, whereas neither the description nor the figures of *M. centralis* give any indication of the presence of such zooecia in that species.

Hemiseptella n. g.

From the proximal margin of the primary aperture a horizontal lamina taking up the whole breadth of the frontal wall, descends some way into the *zooecium*. The primary aperture is more or less completely divided into a distal portion, containing an opercular valve with a strongly chitinized opercular arch and a proximal portion, represented by the two opesiulæ, the division being effected either by the concrescense of two or three laminate processes or in a very incomplete way by three (two lateral and a median) group of spinous processes. Small *avicularia*. No pores and no spines. No *oœcia*. The lateral walls are common to the contiguous zooecia. Large generally uncalcified rosette-plates with several (?) pores. Free branched colonies with pillar-like branches and strongly calcified zooecia.

To this genus belong *Vincularia gothica* Busk[1] (= *V. steganoporoides* Goldst.), *Vinc. labiata* Busk and »*Thalamoporella*« *Michaelseni* Calvet[2], in which last species the division between the opercular aperture and the two opesiulæ is very incomplete, being only formed by three separate groups of spinous processes.

To judge from the figures, a number of the species, referred by d'Orbigny[3], to the genera *Cellaria*, *Quadricellaria*, *Vincularia* and *Vincularina* are no doubt related to this genus, and *Vincularia gothica*[4] is at all events nearly related to *Hem. steganoporoides* Goldst. A similar form of aperture is found in *Semieschara bimarginata* d'Orb.[4], and in *Vincularina obliqua*[5] d'Orb. the little avicularium has the same position as the avicularium in *Hem. steganoporoides*.

Having examined a piece of *Hem. steganoporoides* and several pieces of *Hem. labiata*, all from the Challenger Expedition I have come to the result, that the two forms are only local varieties, not distinct species, and firstly *Hem. steganoporoides* in opposition to the contrary statement of Busk is furnished with a quite similar avicularium as is found in *Hem. labiata*. The chief difference however between the two forms is according to Busk to be found in the different origin of the central pier which separates the two opesiulæ, this pier being in *Hem. steganoporoides* formed as an ascending process from the proximal margin of the primary aperture, while in *Hem. labiata* it is formed as a descending process from the bridge, which is itself formed by a concrescense of two lateral processes. In a number of zooecia of *Hem. labiata* I have however found a more or

[1] 8, p. 72—73. 110, p. 13. [2] 11, p. 18. [3] 86. [4] 86, Pl. 654. [5] 86, Pl. 660.

less developed median laminate process springing from the proximal margin, while in others it is as in *Hem. Michaelseni* only represented by a group of spinous processes. Also the form of the proximal margin of the definite aperture, which according to Busk in *Hem. labiata* is always strongly projecting (»the strong projection forwards of the oral bridge«) is subject to great variation, being sometimes straight, sometimes more or less deeply sinuated and sometimes projecting. While the rosette-plates are as a rule membranaceous I have in the form *steganoporoides* found a number of plates showing a greater or lesser degree of calcification.

Foraminella n. g.

The somewhat arched frontal wall has no pores, but on each side a longitudinal series of (1—5) foramina (opesiulæ). A membranous opercular valve. Independent *avicularia* without cross-bar, with an elongate mandible, on the one side furnished with a wing-like expansion. Hyperstomial *oœcia* with a membranous ectooœcium. Pore-chambers.

The only representative of this genus is *Monoporella lepida* Hincks. As the name *Monoporella* must be kept for the first species, referred to this genus, *M. nodulifera* Hincks, which seems to be very different from *F. lepida*, I have been obliged to set up a new genus for this species.

Calpensia Jullien[1], char. emend.

The opesiular outgrowths join the lateral walls, forming a closed hollow on each side. A simple, feebly chitinized operculum. Numerous pores, but no spines. No *oœcia*. No *avicularia*. The distal wall consist of a basal horizontal and a frontal ascending part, the former being furnished with a narrow transverse group of small uniporous rosette-plates. The distal half of each distal wall with a single multiporous plate.

This genus to which only a single species, viz. *Micropora impressa* Moll can be referred, and which makes a transition to the following group *Tubifera*, is nearly related to the genus *Thalamoporella*, from which however, it differs in the lack of spicules, oœcia and avicularia. Besides, in no *Thalamoporella*, both the opesiular outgrowths reach the lateral walls, and only in one or two species is found a simple operculum with a straight proximal margin.

[1] 45, p. 78.

Group **Tubifera.**

Under the above name we may unite the three following families, in which the descending cryptocyst forms or takes part in forming a shorter or longer, more or less complete, more or less insymmetrical tube, the *polypide tube*, the frontal wall of which from a deeper level ascends towards the aperture. In all the members of this group a part of the cryptocyst descends more or less deeply into the *zoœcium*, generally in such a way as to join the basal wall with a shorter or longer basal edge on each side, but in a few cases these outgrowths from the cryptocyst only reach the basal wall (*Steganoporella Haddoni, St. Buski*) or the outgrowth on the one side only reaches the lateral wall (some *Thalamoporella*-species). While the frontal wall and the lateral walls of the polypide tube are always formed by the cryptocyst, the basal wall is in most cases formed by the basal wall of the zoœcium, and in such cases the outgrowths join this wall with a curved or angular edge on each side, the distally ascending parts of which indicate the form and direction of the tube (Pl. V, fig. 5 b, Pl. VI, fig. 5 d, Pl. VI a, figs. 1 b, 3 e, 4 b etc.). More rarely the polypide tube has a basal wall of its own, the two outgrowths from the cryptocyst bending round and uniting within the basal wall of the zoœcium, such forming a basal wall for the polypide tube. In that case the two outgrowths join the basal wall of the zoœcium in a continuous, curved or angular line and distally to this is seen the tube shining through the wall (Pl. VI, figs. 3 d, 7 i, Pl. VI c, fig. 1 f).

While in the *Thalamoporellidae* and in a few *Steganoporella*-species (Pl. V, fig. 3 a) the frontal wall of the polypide tube is distally on each side in connection with the lateral parts of the cryptocyst, this is not the case in the other members of the group, in which this frontal wall (the »median process« Harmer in the *Steganoporellidae*) is quite free. Thence follows, that in the *Thalamoporellidae* the opesiulæ are completely separated from the aperture while in the other *Tubifera* they are fused together with it, but this fusion can take place in different degrees, and while in most species of the genus *Steganoporella* and in the genus *Aspidostoma* the two opesiulæ are seen as two rounded sinuations from the aperture, they are completely melted together with it in *St. lateralis* and in the genera *Siphonoporella, Labiopora* and *Crateropora.*

In all such forms, in which the basal wall of the polypide tube is formed by the basal wall of the zoœcium, the opesiulæ or the corresponding parts of the aperture leads into two cavities (the »lateral recesses« Harmer), more or less completely separated from the polypide tube and from the remaining zoœcial cavity, but these two cavities are melted together in a single one in all these forms, in which the polypide tube has a basal wall of its own.

Synopsis of the families:

1) Zoœcia with calcareous spicula in the shape of compasses and bows; oœcia with two calcareous layers, springing from the whole anter of the aperture; the opesiulæ are always completely separated from the aperture . . . . *Thalamoporellidae* n. f.

1) Zoœcia without spicula; if oœcia are present they have only a single calcareous layer (the endooœcium) and are placed distally to the aperture of the zoœcium, which is distinctly visible:

2) No avicularia, no oœcia, generally two forms of zoœcia . . . *Steganoporellidae*.

2) Avicularia always and oœcia sometimes present; only a single form of zoœcia . . . . *Aspidostomidae*.[1]

Family **Steganoporellidae**.

The *zoœcia*, which in most cases occur in double form, are always without spines, but generally provided with pores. The frontal wall of the polypide-tube is usually free, as the two opesiulæ are generally not separated from the aperture of the zoœcium. The operculum, which is sometimes bounded by a chitinous sclerite proximally, sometimes continued immediately into the frontal membrane, is as a rule very large and then suspended by strong hinge-teeth. Each distal wall with 2 and the distal half of each lateral wall with 1—3 multiporous rosette-plates. No *avicularia*. No *oœcia*.

Synopsis of the genera.

The whole of the calcified part of the frontal area lying proximally to the aperture is a depressed cryptocyst; the aperture of the zoœcium is surrounded distally and laterally by a projecting margin; the zoœcia frequently occurring in two forms and provided with a large operculum armed with teeth, which is suspended by strong hinge-teeth; the polypide-tube is never continued proximally beneath the cryptocyst cover . . . . *Steganoporella* Smitt.

The proximal calcified part of the frontal wall is formed by a larger or smaller, arched gymnocyst; the aperture is not surrounded by a projecting margin; the zoœcia occurring only in single form

[1] This family has been put up by F. Canu (11 b, p. 276)

and provided with a small, always unarmed opercular valve; the polypide-tube is continued proximally beneath the cryptocyst cover .... *Siphonoporella* Hincks.

Steganoporella Smitt.

I had already studied a series of *Steganoporella* species and prepared the figures given on Pl. V, when I received Harmer's excellent monography of this genus. Accordingly I shall here only make a number of observations on the structure of this genus, especially with regard to the species examined by me.

While the operculum is in most species surrounded distally and laterally by a projecting margin formed by the gymnocyst, the whole of the remaining calcified frontal wall is a cryptocyst, as the covering-membrane starts from the narrow frontal edges of the lateral walls. Besides the polypide-tube the cryptocyst shows a distinction between a depressed central portion with pores and a raised, more or less strongly tuberculous marginal portion without pores, which may be less distinct in the proximal part of the zoœcium. In some species, e. g. in *S. lateralis* (Pl. V, figs. 7 a—7 d) we also find such a raised, non-porous, tuberculous portion immediately on the proximal side of the aperture of the zoœcium and the polypide-tube. In most species the lateral, raised marginal portion of the cryptocyst is continued distally between the hinge-teeth and forms an arched transverse ridge, the »oral shelf«, across the distal wall proximally to the distal margin of the opening. This distal cryptocyst, which springs from the angle between the basal, more horizontal and the frontal, more ascending part of the distal wall, is slightly developed in *S. neozelanica* (fig. 3 a) and quite absent in *S. neozelanica*, v. *magnifica* (fig. 4 a) and in *S. lateralis* (figs. 7 a, 7 b). While in all the other species the »opesiular outgrowths« terminate on the basal wall, they end in *S. haddoni* Harmer and *S. Buski* Harmer (figs. 6 a—6 c) on the distal wall, which accordingly in both these species forms the basal wall of the polypide-tube. The way in which these outgrowths join the basal wall in the species examined by me or, what comes to the same thing, the way in which the basal wall of the polypide-tube is formed, seems however to be subject to rather great variation within the same species or even within the same colony. This is easily seen through the basal surface of the colony, the lines in which the outgrowths join the latter being visible. In *St. magnilabris* as well as in *St. lateralis* Harmer the basal wall of the polypide-tube may sometimes be formed by the basal surface of the zoœcium, which is the case in the two upper zoœcia in fig. 7 d, but sometimes the polypide-tube has a basal wall of its own, which is seen in the 4 lower zoœcia in the same figure. In the piece of *St. magnilabris* represented in fig. 5 b the polypide-tube is in most zoœcia formed by the basal surface of the latter; but in this species it is as common to find polypide-tubes with an independent basal wall. Except in *S. lateralis*, the cylindrical polypide-tube of which has only a more or less strongly outwards bent distal margin (figs. 7 a—7 c), the quadrangular or trapeziform frontal wall of the polypide-tube is in the other species provided with more or less protruding, frontally directed marginal flanges. In *S. neozelanica* (figs. 3 a, 3 d) and *S. neozelanica*, var. *magnifica* (figs. 4 a, 4 c) these form a long and, especially in the former very narrow tube, which is closed internally by the frontal wall of the polypide-tube. The bottom of this tube is provided with pores which may also appear on the adjoining parts of the opesiular ingrowths.

Siphonoporella delicatissima Busk.

Membranipora delicatissima Busk, Quart. Journal micr. Sci., n. ser., Vol. 1, 1861, pag. 153, Pl. XXXIV, fig. 1.

Siphonoporella delicatissima Harmer, Quart. Journ. micr. Sci., n. ser., Vol. 43, 1900, pag. 231, Pl. 13, figs. 42, 43.

(Pl. VI, figs. 3 a—3 d).

The *zoœcia* narrow, rectangular or longitudinally hexagonal. With the exception of the arched, sometimes coarsely transversely striated gymnocyst developed in the proximal part of the zoœcium, which in its middle measures one-fifth at most of the whole length of the zoœcium, the frontal surface is otherwise membranous. The finely granular concave cryptocyst, which joins the gymnocyst in a semi-elliptical boundary line, sinks distally in the shape of a pent-roof towards the basal surface, which it reaches in a continuous line formed by two unequally large curves, which meet at an acute angle (fig. 3 d). The polypide-tube is situated closer to one lateral wall, while at the same time it inclines towards the opposite one. It is a rather long, cylindrical tube which generally increases in width distally and terminates in a somewhat expanded margin provided with a number of finer and coarser teeth, of which some may be rather long and pointed, sometimes branched. The surface of the polypide-tube may also be more or less nodulous, and these nodules may sometimes be annularly disposed. We may designate the side of the polypide-tube nearest the one lateral margin of the zoœcium as the inner and the other as the outer side. The freely projecting part of the polypide-tube just described is continued proximally under the pent-roof-shaped cryptocyst cover, and this proximal part, which is obliquely truncated at the end (fig. 3 c), is clearly visible through the cryptocyst. The boundary between the distally and proximally directed part of the polypide-tube is formed by a line, which passes obliquely proximally from the outer corner to the opposite lateral margin almost parallel with the proximal truncated part of the polypide-tube. The part of the basal surface of the polypide-tube, which lies distally to the just mentioned angularly bent line, has an independent wall, while the basal wall in the proximally directed part is exclusively or mostly formed by the basal wall of the zoœcium. The obliquely ascending distal wall has within its basal margin a multiporous rosette-plate on each side, and a similar plate is found in the distal half of each lateral wall. In the approximate centre of the distal margin of the cryptocyst a larger or smaller tubercle rises, from which five yellow, proximally connected bands take their origin. They appear to be fastened to the covering-membrane, and the same thing seems to be the case with a similar number of bands, which spring from the outer lateral wall. These bands are undoubtedly parietal muscles. Each of the margins of the colony shows a series of narrow kenozoœcia which have a wholly membranous frontal cover and no cryptocyst.

Besides a small fragment from King George's Sound, West Australia, for which my thanks are due to the late Mr. Peal, I have examined a number of colonies from Australia, found in the herbarium of algæ in the Botanical Museum. The species has hitherto been found only on *Amansia pinnatifida*.

Siphonoporella nodosa Hincks.

Annals Nat. Hist. ser. 5, Vol. 6, pag. 90, Pl. XI, fig. 10.

(Pl. VI, figs. 2 a, 2 b).

As I have only been able to examine a small fragment of this species (from Australia), which I lost before I had completed my examination, I shall here only make some comparative and supplementary observations. As in the preceding species we find here a proximal, but much stronger developed gymnocyst, a pent-roof-shaped cryptocyst and a polypide-tube, which is continued proximally under the cryptocyst roof. The distal part of the polypide-tube is however very short, and the whole of its basal wall is formed exclusively or mostly by the basal wall of the zoœcium. The distal wall is also here somewhat ascending and provided with two multiporous rosette-plates. The distal half of each lateral wall with 1—2 similar plates.

Family **Aspidostomidae.**

The *zoœcia*, in which a raised margin is often indistinctly or incompletely developed, are always without spines and have generally a strongly developed distal end, sometimes projecting in the shape of a pent-roof. The two opesiulæ appear as narrow incisions, which join the zoœcial aperture, and the short polypide-tube, which is not continued under the cryptocyst cover, is in most cases provided with marginal flanges. *Avicularia* are always present and sometimes hyperstomial *oœcia*, on each side of which we generally see a compressed, higher or lower process. The distal wall as well as the lateral walls may have sometimes uniporous, sometimes multiporous rosette plates.

Synopsis of the genera.

1) Oœcia occur, on each side of which a compressed process is generally seen; no distinct raised margins; frontal wall of polypide-tube quadrangular or trapeziform, surrounded by more or less strongly projecting flanges . . . . *Aspidostoma* Hincks.

1) No oœcia; distinct raised margins; frontal wall of polypide-tube not quadrangular and not surrounded by projecting flanges:

2) Polypide-tube bilabiate, on either side connected with the lateral wall by a vertical calcareous lamina; multiporous rosette-plates . . . . *Labiopora* n. g.

2) Polypide-tube not bilabiate, with an expanded distal margin, not connected with the lateral walls by vertical calcareous laminæ; uniporous rosette-plates . . . . *Crateropora* n. g.

Aspidostoma giganteum Busk. —

Eschara gigantea Busk, Catalogue of Marine Polyzoa, Part I, Cheilostomata, pag. 91, Pl. CXIX, fig. 3.

Aspidostoma crassum Hincks, Annals Nat. Hist. ser. 5, Vol. 7, pag. 160, Pl. X, figs. 6, 6 a.

Aspidostoma giganteum Busk, Challenger Zoology, Vol. V, Part I, pag. 161, Pl. XXXIII, fig. 3.

— — Jullien, Bryozoaires, Mission du Cap Horn, pag. 77, Pl. 6, figs. 5—6.

Aspidostoma gigantea Waters, Challenger Zoology, Vol. XXXI, pag. 28, Pl. I, figs. 16—18, Pl. III, figs. 20, 21.

Micropora cavata Waters, Quart. Journ. Geol. Soc., Vol. XXXIX, pag. 435.

(Pl. VI c, figs. 2 a—2 d).

The zoœcia, which may attain a length of up to 1.5 mm., are typically hexagonally lyre-shaped, but often of a rather irregular form. They are very thick-walled, almost without pores and provided with a close reticulation of small tuberculated ridges. They attain their greatest height in the strongly projecting and boldly arched distal end, the free margin of which generally terminates in two broad processes separated by a narrow incision and forming with each other an angle of 90° (figs. 2 a, 2 c). On the proximal side of the aperture and of the polypide-tube we find the central portion of the frontal surface provided with a more or less deep depression of somewhat different extent; but the greater part of the frontal surface of the zoœcium is always arched. In the middle of the depression there is generally an oblong thickening which reaches the polypide-tube with its distal end. The polypide-tube may sometimes be so completely covered by the arched distal end of the zoœcium that it is difficult to discern its frontal part, which is surrounded by strongly projecting, frontally directed flanges and has the form of a rectangle, the two sides of which are curved inwards a little. It is separated on either side by a long, oval incision — the two opesiulæ — from the lateral margins of the zoœcial aperture, and its lateral walls seem to reach the basal wall (fig. 2 d). The well chitinized and very low operculum [1]) has a somewhat convex proximal margin corresponding (as in the genus *Steganoporella*) to the distal margin of the polypide-tube and besides, it is furnished at each proximal corner with a prolongation fitting into the opesiular sinus. The distal wall as well as the lateral walls are provided with a row of 6—8 small, uncalcified, most probably uniporous rosette-plates.

The oœcia (fig. 2 a), of which a few specimens were found on the examined fragment, are strongly arched, longer than broad, and they have a honeycombed surface. They are enclosed between two long vertical swellings, which are continued proximally to the oœcium into two parallel processes that grade into the arched lateral parts of the frontal wall. Between these processes and the free margin of the oœcium we find a quadrangular opening forming something like a vestibule to the zoœcial aperture. The oœcia spring from the surface of a similar, distal prominent part as is found in the other zoœcia, but it is flatter, and the two swellings, which enclose the oœcium between them, might correspond with the two processes from the free margin of the distal end, occurring in the greater part of the other zoœcia. The oœcia have but a rather small opening.

The avicularia, which are scattered among the zoœcia but in much smaller numbers than the latter, are small, of a triangular outline and provided with an opening, which has almost the form of the figure eight.

The colonies form free, two-layered expansions.

Of this species I have examined a dry coloni from the Antarctic Ocean. To

[1] 110, p 29, pl. III, fig. 21.

judge from the various quoted descriptions and figures the species seems to be subject to considerable variation, or it may possibly be divided into several. In the form figured by Waters the oœcia are very low, and the processes issuing from the free margin of the distal end are sometimes digitately lobed. This may also be the case with the postoœcial processes, which may appear as very projecting, flat spines.

To the genus *Aspidostoma* I may provisionally refer the following three species from the French crétaceous formation: *Eschara Aegon* d'Orb. (Pl. VI, fig. 3 a), *E. Antiopa* d'Orb. (Pl. VI c, fig. 4 a) and *E. Atalantha* d'Orb. (Pl. VI c, fig. 5 a). In all three of them we find in the proximal part of the aperture a region surrounded by protruding margins, similar to that found in *A. giganteum*, and which may be the frontal wall of a similar polypide-tube. I have however not yet been able to satisfy myself as to whether it sends prolongations to the basal wall. There are other points of similarity, as the partially arched surface of the zoœcia, the more or less, projecting distal end, and in *E. Aegon* and *E. Antiopa* the presence of postoœcial processes. While these in *E. Antiopa* only take part in the delimitation of the large vestibule, they are in *E. Aegon* as well as in the just-mentioned form of *A. giganteum* freely projecting in the shape of flat, almost rib-like processes, which however have here coalesced into a flat, arched band, separated from the free margin of the oœcium by a transverse slit. In the above-mentioned three species there seems to have been no great number of small rosette-plates, as each distal wall shows one and each lateral wall two transversely oval openings, which may originate from as many multiporous rosette-plates.

I may here add that Cann in two valuable works[1] on tertiary *Bryozoa* has referred 4 new species to the genus *Aspidostoma*.

Crateropora falcata n sp.

(Pl. VI, fig. 1 a).

The zoœcia, which may attain a length af 1 mm, are generally hexagonally rounded or ligulate, but have sometimes a rather irregular form. With the exception of the proximal margin and a shorter or longer part of the adjoining lateral margins they are surrounded by a raised granular border, which increases in height distally and ends in i curved, strongly protruding distal portion, within the proximal margin of which is seen a low ridge parallel to its free edge of the zoœcium. The depressed, very tuberculous cryptocyst is provided with small,

[1] 11 a, p. 13—14 11 b, p. 278—279.

scattered pores. It sinks gradually towards the distal end and rises on either side of the polypide-tube under an obtuse angle into a steeply ascending, narrow portion, which forms the lateral margins of the aperture and fades away at the distal end.

The polypide-tube fills the entire width of the large, almost semi-circular aperture. It is short, of semicircular transverse section and provided with a collar-shaped outwards curved margin. As the opesiular outgrowths reach but half-way down on each lateral wall, the basal wall of the polypide-tube is formed only by the basal wall of the zoœcium.

Each distal wall which is strongly curved from side to side, and the distal half of each lateral wall have a row of small, uniporous rosette-plates.

Oœcia are not found.

Avicularia. On the small fragment only a single, small, trapeziform, falcate avicularium was found, the large, depressed cryptocyst of which is perforated by a small, oval opening. In the proximal end of this we see a small, triangular process, which shows traces of having originated by a concrescence of two lateral halves. On the whole this avicularium bears a close resemblance to that found in »Eschara« Antiopa, d'Orb. (Pl. VI c, fig. 4 a).

A small piece of this species was found on a dry *Tridacna*, locality not noted. In the structure of the zoœcia this species shows some resemblance to *Steganoporella patula* Mac Gillivr.[1], at any rate as they are represented in fig. 20. The avicularia have however another form, and this species is moreover said to be provided with oœcia occupying the place of a zoœcium. What the author calls an oœcium might, I think, more correctly be called a deformed zoœcium without aperture.

Labiopora crenulata n. sp.

(Pl. VI, fig. 1 a).

The zoœcia rectangular or longitudinally hexagonal, surrounded by a rather wide, but not strongly projecting, crenulated and transversely striated cryptocyst margin. The depressed part of the cryptocyst, which is somewhat tuberculated and with the exception of the part near the polypide-tube provided with numerous, rather large pores, reaches with its opesiular outgrowths the basal wall, which it meets in a continuous, straight, transverse line on the boundary of the distal fourth of the latter. The polypide tube, whose transverse section is rounded, has an independent basal wall and is distinctly bilabiate with a more pro-

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[1] 76, p. 54.

jecting basal lip, the free margin of which is strongly rounded, very often angularly curved, the frontal margin being more or less distinctly concave or sinuated. It is on either side connected with the lateral wall of the zoœcium by a vertical calcareous lamina. The distal wall, which is composed of a basal, horizontal and a frontal, obliquely ascending part, is on either side provided with a multiporous rosette-plate, and a similar plate is also found in the distal half of each lateral wall.

Oœcia wanting.

The avicularia, scattered in rather large numbers among the zoœcia, are a little larger than the latter but otherwise of similar form. The strongly developed cryptocyst has in its centre a quadrangularly oval opening with crenulated margins, and in the frontal third of this there is on either side a hinge-tooth. The cryptocyst is most depressed in the distal half of the broad, distally rounded, opercular area, which no doubt corresponds to the mandible. On the proximal side of the opening the cryptocyst is less depressed and surrounded by an indistinctly bounded, crenulated, marginal portion. There are a few pores in the proximal part.

Some *colonies* of this species occurred on the same specimen of *Tridacna* sp., on which I found *Crateropora falcata*.

Family **Thalamoporellidae** n. f.

(Pls. VI, VI a, VI b, VI c).

The *zoœcia*, which always occur in single form, have pores, free *calcareous spicules* in the shape of compasses or curves and very often two adoral, acropetalous spines, as a rule very short and wide. The membranous or very feebly chitinized operculum (or opercular valve) is more or less completely separated from the covering membrane by a single (Pl. VI, fig. 6 b, pl. VI a, figs. 3 a, 3 b, 4 c, pl. VI b, fig. 5 b) or double (Pl. VI, fig. 5 a, pl. VI b, fig. 3 a, 6 a) chitinous sclerite, on each side in connection with the opercular arch. The proximal border of the operculum is generally concave, more rarely straight, and in the first case does not fill up the entire aperture, which in most species is provided with a broad sinus. The two opesiulæ are separated from the aperture of the zoœcium, and consequently the frontal wall of the polypide-tube is not free. The distal wall, consisting of a basal, more horizontal and a frontal, more ascending part, has within its basal margin a crescentic collection of small, uniporous rosette-plates (rarely replaced by one or two multiporous), while the distal half of each lateral wall has a single (rarely two) multiporous plate. *Avicularia* occur and large very prominent hyperstomial *oœcia*, which arise from the whole periphery of the anter. Their calcified ectooœcium is generally devoid of pores, and their aperture is closed by a horizontal cup-shaped chitinized operculum which is connected at its base with the operculum of the gonozooœcium.

The zoœcia are usually rectangular, and the aperture has a somewhat raised anter and generally a more or less broadly rounded sinus between the two more or less distinct hinge-teeth. Immediately on the distal side of these is a more or less distinct line, (most clearly visible on Pl. VI b, figs. 2 a, 3 a & 6 a) which curves outwards and is continued into the line forming the boundary between the narrow marginal edge and the cryptocyst. In *Th. expansa* (Pl. VI b figs. 5 a —5 e) and *Th. mamillaris* (Pl. VI a, figs. 5 a—5 e) the aperture has contrary to the rule a proximal margin which is straight or almost straight, and in *Th. Rozieri*, var. *labiata* (Pl. VI, figs. 6 a—6 j) the sinus is filled more or less completely by a lip-shaped process. (figs. 6 f, 6 g). The line mentioned above, which curves outwards on the distal side of the hinge-tooth, forms the boundary between the cryptocyst and the gymnocyst, the latter occupying the region on the distal side of this line. While the aperture in some cases e. g. in *Th. novae hollandiae* (Pl. VI a, figs. 3 a—3 f) takes up the whole or almost the whole of the breadth of the zoœcium distally, so that the gymnocyst is exclusively or mostly represented by the anter of the aperture, it is in most cases present on either side af the aperture as an area developed to a varying extent and in different ways, which we may term the »adoral area«. This is sometimes developed in the form of a level or slightly arched surface, obliquely ascending towards the distal margin, or sometimes the whole or part of its surface is taken up by an acropetalous spine, most often short and wide with a broadly rounded terminal part, (Pl. VI a, figs. 4 a, 5 a) seldom more like an ordinary spine (Pl. VI b, figs. 1 b, 1 c, 2 a). The calcification of these spines takes place in a number of narrow longitudinal belts, and accordingly their surface is radially striated more or less sharply, and the growing spine also ends in a crenulated margin. The development of the adoral area is however subject to great variation within the species, and it may even be different on the two sides of the same zoœcium.

The cryptocyst, which forms the whole of the remaining calcified part of the frontal wall of the zoœcium within the raised margins of the lateral walls has as in the species of *Steganoporella* a more or less developed crenulated marginal part, and apart from the outgrowths from the two opesiulæ it has its greatest depth at the proximal end of the polypide-tube, that is to say, in a line carried through the proximal margin of the two opesiulæ. This line, which lies somewhat proximally to the centre of the zoœcium, forms the approximate distal limit for the appearance of pores. The two opesiulæ, which enclose between them the frontal wall of the polypide-tube ascending towards the aperture and which, contrary to the case in the *Aspidostomidae* and the majority of the *Steganoporellidae*, are always separated from the aperture, never seem to be developed quite alike, although the difference between them may be greater or smaller in the different species. To begin with, there is always a difference in size, and further the smaller of them generally sinks more or less obliquely towards the corresponding lateral wall, so that it either does not reach the basal wall at all, or only touches the latter to a smaller extent than the larger, the direction of which is more vertical to the base. In *Th. mamillaris* (Pl. VI a, figs. 5 a—5 e) only one opesiula appears to be present. The two lateral recesses, formed by the opesiular outgrowths, may in the different species be more or less completely separated from the polypide-tube and the zooecial cavity, and in the case of *Th. Rozieri*, var. *labiata* (Pl. VI, figs. 6 a—6 j) as well as in *Th. novae hollandiae* (Pl. VI a, figs. 3 a—3 f) they form two almost completely closed spaces, which however have a small foramen in their distal wall just within the distal margin of the opesiula. While in these two forms the outgrowths join the basal wall in a closed curved line springing from the lateral margin, the corresponding curved lines in the other forms lack a greater or smaller part of the distal boundary, as not only the distal wall of these lateral recesses, but also a greater or smaller part of the lateral wall of the polypide-tube is absent (Pl. VI a, fig. 4 b, Pl. VI b, figs. 1 e, 5 e, 6 b). These lateral recesses are most reduced in *Th. Rozieri* var. *californica* (Pl. VI b, fig. 2 d). A rare case in the genus *Thalamoporella* is found in *Th. lioticha* (Pl. VI, fig. 7 i) and in some zooecia of *Th. Harmeri* (Pl. VI c, fig. 1 f), the outgrowths in which, in the same way as in certain forms of *Steganoporella*, meet the basal wall in a continuous line, which takes up the entire breadth of the wall, while the polypide-tube has at the same time a basal wall of its own, and on the whole these opesiulae, in spite of the great variation they show, may afford good specific characters.

The structure of the distal wall is similar to that in *Steganoporella*, being composed of a horizontal or slightly ascending basal part and a steeply ascending short frontal part. As in the species *Steganoporella* a more or less well developed oral shelf springs from their junction.

The very peculiar calcareous spicules occurring in all the species of this genus are situated partly in the cavity itself of the zooecium, where the largest are always found, partly in the space between the cryptocyst and the covering membrane. They are found both in the avicularia and in the ooecia, and despite the great variation they are subject to, they generally afford good specific characters. The avicularia, which are as a rule smaller than the zooecia, though they may attain the size of the latter, have most often a strongly developed distal cryptocyst, and outside the opercular arch the mandible has in most cases wider or narrower, marginal expansions. The avicularia also generally offer good specific characters. With regard to the structure of the gonozoœcia and the ooecia reference may be made to the separate species.

A single genus **Thalamoporella**.

Synopsis of the species.

1) Spicules both in the form of curves and compasses.

2) The opesiular outgrowths generally meet the basal wall in a continuous, transverse line, which takes up the entire breadth of the wall; (the operculum without continuous proximal chitinous sclerite; the avicularian mandible vase-shaped; curves very slender; the largest not much shorter than the longest compasses) .... *T. liolicha* Ortmann.

2) The opesiular outgrowths never meet the basal wall in a continuous line, which takes up the whole of its breadth; (the basal wall of the polypide-tube formed by the basal wall of the zoœcium):

3) The two legs of the compasses are different, one being curved inwards and hooked at the end; (the operculum with continuous proximal chitinous sclerite; the surface of the zoœcia divided into 3—4 areas, separated by sutures) .... *T. Jervoisi* Hincks.

3) The legs of the compasses are not different.

4) The avicularian mandible has the form of an isosceles triangle with somewhat convex sides. Of the two opesiular outgrowths generally only one reaches the basal wall; (the operculum of older zoœcia with continuous proximal chitinous sclerite, or the latter is only broken for a short distance) .... *T. Rozieri* Aud.

4) The avicularian mandible is never triangular, but more or less regularly tongue-shaped or vase-like; the two opesiular outgrowths both reach to the basal wall, which they never meet in closed curved lines; (the proximal margin of the operculum on each side with a short chitinous sclerite) .... *T. granulata* n. sp.

1) Only compass-like spicules occur:

5) The proximal margin of the zoœcial aperture is straight or almost straight:

6) Only a single opesiular outgrowth reaching to the basal wall; the proximal margin of the opesiula is generally furnished with a row of partially furcate spine-like processes, and similar processes may ap-

pear on the other lateral half; the proximal margin of the operculum somewhat concave; the avicularian mandible triangular with linear terminal part . . . . *T. mamillaris* Lamx.

6) Two opesiulæ of about the same size, both reaching the basal wall; no spine-like processes; the zoœcial aperture with a large discoidal expansion distally, and the operculum, furnished with a corresponding expansion, has a proximal straight margin; the avicularian mandible semielliptical with triangular opercular arch . . . . *T. expansa* n. sp.

5) The proximal margin of the zoœcial with a broad and deep sinus:

7) Proximally to the opesiulæ each lateral margin is prolonged into a sharply projecting, thick-walled, semicircular or rounded triangular process, inclining towards the cryptocyst; (the proximal margin of the operculum with a continuous chitinous sclerite; the avicularian mandible triangular, only one opesiular outgrowth reaches the basal wall) . . . . *T. cincta* Hutton.

7) No such processes:

8) The opesiular outgrowths, of which in most (or all) zoœcia only one reaches the basal wall, meet the named wall in closed curved lines; (the avicularian mandible broad, quadrangularly rounded, in the proximal part narrowed; the smallest compasses with almost rectangular opening) . . . . *T. novae hollandiae* Hasw.

8) Both opesiular outgrowths reach the basal wall, on which they form no closed curved lines:

9) A short chitinous sclerite on either side of the proximal margin of the operculum, the lateral margins of which are parallel; the avicularian mandible narrow, claw-shaped, bent to one side . . . *T. falcifera* Hincks.

9) The proximal margin of the operculum with a continuous chitinous sclerite and with lateral margins convergent distally; the avicularian mandible has the form of an isosceles triangle; (on the basal surface the two opesiular outgrowths may form sometimes two separate lines, of which one is hook-shaped, sometimes a single continuous, often trapeze-shaped, transverse line; oœcia with pores) . . . . . . *T. Harmeri* n. sp.

Thalamoporella lioticha (Ortmann).

Micropora lioticha Ortmann Archiv f. Naturgesch. 56 Jahrg. 1, 1890, pag. 30, Taf. II, Fig. 11 a—b.

(Pl. VI, figs. 7 a—7 p, Pl. VI b, fig. 4 a).

The *zoœcia*, the length of which is between 0,79 and 0,99$^{mm.}$, have only slightly developed, indistinctly marked and sometimes quite reduced adoral areas, always without acropetal spines. A well — developed oral shelf. The aperture, measuring about one-fourth of the entire length of the zoœcium has a broad and deep, rounded sinus, the curved line of which would sometimes meet the rest of the margin in a circle, if it was not separated from the latter by the well-developed hinge-teeth. The proximal part of the operculum is on either side furnished with a short chitinous sclerite. The cryptocyst, which has rather small, widely scattered pores and small dispersed tubercles, has a distinctly projecting marginal portion, without distinct crenulation. Of the two opesiulæ the larger is at least twice the breadth of the other and formed like a long rounded trapezium. The opesiular outgrowths both reach the basal wall, which they generally meet in a continuous transverse line, occupying the entire breadth of the wall (fig. 7 i). The unusually narrow polypide-tube has an almost smooth and proximally much depressed frontal wall, and contrary to the common rule in this genus it has a basal wall of its own, which is however in the majority of the zoœcia very short, sometimes almost imperceptible, and at most attains half the length of the entire polypide-tube. Otherwise the polypide-tube is only represented by its frontal wall.

The spicules (fig. 7 c), which only seem to be present in the zoœcial cavity, occur both in the shape of curves and of compasses. The length of the latter may vary between 0,099 and 0,305$^{mm.}$ and the curves, which are unusually thin with sharply bent ends, measure from 0,039 to 0,179$^{mm.}$ The dimensions of both forms are a little different in the variety with prismatic branches.

The oœcia have, when seen from the front, a broad, obcordate outline, and a horizontal, rounded triangular, aperture whose somewhat protruding lateral margins meet into a roof-shaped ridge continued some way along the middle of the oœcium, thus giving the whole of this portion a sagittal outline. The short gonozoœcia have two opesiulæ of about the same size and a semi-oviform opening with a comparatively narrow sinus. Their membranous operculum has a little within the margin a narrow continuous chitinous arch. The gonozoœcia occur in continuous rows, separated by twos by a row of ordinary zoœcia.

The avicularia, which may attain a length similar to that of the zoœcia, while their breadth is considerably smaller, have a vase-shaped mandible, the opercular arch of which has the form of an isosceles triangle with the legs meeting a little inside the point. The shape of the post-opercular opening of the cryptocyst may vary a good deal, being sometimes rounded quadrangular and sometimes forming part of an oval. On the other hand the proximal margin of the well-developed distal cryptocyst always forms part of an oval.

The colonies may occur both incrusting and free, in the latter state sometimes as broader or narrower two-layered laminæ, sometimes branched with prismatic branches.

Besides some fragments of broader and narrower, two-layered colonies from Wladivostock-Nagasaki (lat. 33° 5′ N., long. 128° 22′ E.; lat. 33° 35′ N., long. 128° 22′ E.; lat. 33° 5′ N., long. 129° 24′ E.), (Telegraph-engineer Schönau), I have examined some small fragments of prismatic branches from Japan, found in the root-tuft of an *Euplectella* sp., (lat. 32° 12′ N., long. 128° 15′ E. Captain Suensson).

I have earlier although with some doubt identified this species with *T. Smitti* Hincks, and therefore the figures are designated with that name. I am, however, at present, inclined to think that *T. Smitti* is distinct from all the other species here described.

Thalamoporella Rozieri Aud.

Flustra Rozieri Audouin Descript. de l'Égypte, Hist. Natur., Tome 1, explic. sommaire d. Planches, pag. 239. Polypes Pl. 8, figs. 9^1 9^2.

Steganoporella Rozieri Hincks, Form. 1, 2 & 3 (non. 4) Annals Nat. Hist., ser. 5, Vol. VI, 1880, pag. 28, Pl. XVI, figs. 1, 3.

Membranipora Rozieri Busk, Catalogue of Marine Polyzoa, Part I, pag. 59, Pl. LXV, fig. 6.

Membranipora gothica Busk, Quarterly Journal micr. Science, Vol. IV, 1856, pag. 176, Pl. VII, figs. 5, 6, 7.

(Pl. VI, figs. 6a—6k; Pl. VIb, figs. 1a—3b).

The length of **the zoœcia** is between 0,48 and 0,79^{mm}, and the distinctly marked adoral areas may be developed, sometimes even in the same colony or in the same zoœcium, to a varying extent and in different ways. The aperture, the size of which may be contained from $2^1/_2$ to 4 times in the whole length of the zoœcium, has at least in the youngest zoœcia a broad and deep sinus, which however in a certain variety is wholly or partly filled by a somewhat projecting lip. The anter of the aperture is as a rule semi-elliptic or semi-oviform, but sometimes the lateral margins may be more or less approximately parallel. The proximal margin of the operculum is generally provided with a continuous chitinous sclerite, which is but rarely broken in the centre. Of the two opesiulæ the one as a rule only reaches the corresponding lateral wall and but seldom touches the basal wall in a small curved line. The other always reaches the basal wall, most frequently touching it in a closed (i. e. meeting the margin of the zoœcium with both ends), irregularly tongue-shaped, curved line, more seldom in an open, longer or shorter line, corresponding with a larger or smaller proximal part of the closed, curved line. The frontal wall of the polypide-tube is generally deeply depressed proximally.

The spicules appear both in the shape of curves and of compasses, but both these forms show a considerable range of variation not only as to dimensions but also in shape.

The oœcia, which need a closer examination, are very broad.

The avicularia, generally considerably smaller than the zoœcia, have a mandible in the shape of an isosceles triangle with lateral margins curving outwards a little. The opercular arch has also the shape of an isosceles triangle, and its two curved sides, situated a little inside the lateral margins, meet at the point of the mandible.

The description of this apparently widely spread and frequently occurring species is based on material from many different localities. The species is exceedingly variable, and as a necessary supplement to the account above I shall here give short descriptions of a number of varieties, which no doubt may be largely increased.

Var. A. (labiata).

(Pl. VI, figs. 6 a—6 j).

Length of **zoœcia** 0,45—0,57$^{mm.}$ The aperture measures, the sinus included, about one fourth of the whole length of the zoœcium. It has in a greater or smaller number of zoœcia a more or less developed, often dentate and longitudinally furrowed, somewhat projecting lip, which entirely or partly fills the original sinus. The two adoral areas are well developed, frequently with acropetal spines, seldom without. The margins of the two opesiulæ are often spinous, and only the one opesiular outgrowth reaches the basal wall, which it meets in a closed, narrow, tongue-shaped, curved line, pointing inwards and a little proximally. The distal wall of the two lateral recesses is only provided with a small, sometimes extremely small foramen.

Spicules. Length of curves varying between 0,026 and 0,186$^{mm.}$ and that of the compasses between 0,039 and 0,093$^{mm.}$; but besides the variation found within the same zoœcium both with regard to dimensions and form, some variation in both respects is also found in colonies from different localities. The variation is greatest in the curves, and they reach their maximum in the colony from the Formosa Channel, in which they also have a more even and less sharp curvature.

Localities: Paumben, India (Fristedt), covering algæ from a depth of 1—2 fathoms; Singapore, India (Consul S. Gad), covering algæ from low water; the Formosa Channel, lat. 23° 20′ N., long. 18° 30′ E., depth 17 fathoms, (Andréa). This last form, which is without spines and in which the above-mentioned lip attains its highest development and occurs at the earliest stage, is found in two-layered, free, maze-like, branching colonies with broad and flat, partly curved and twisted branches.

Closest to this variety some small colonies must be classed, which form coverings on algæ from Geograph Bay, W.-Australia (on *Vidalis spiralis*, Botanical Museum), from Jamaica (on *Bothryothamnion Seaforthi*, the herbarium of Prof. Lange) and from Wyecombe Bay (on *Sargassum scabripes*, Bot. Mus.). In all of these, well-developed acropetal spines are found, but the lip is slightly developed or absent, and in a greater or smaller number of zoœcia a division of the cryptocyst into several areas, separated by sutures, is found, similar to what is known in *Th. Jervoisi* and *Th. mamillaris*. In the colony from Geograph Bay the lateral margins of the aperture are almost parallel.

Var. B. (sparsipunctata).

(Pl. VI b, figs. 3 a—3 b).

Length of **zoœcia** 0,66—0,73^{mm}. The aperture, the size of which is a little more than one-third of the entire length of the zoœcium, has a broad and deep sinus. The more or less developed adoral areas have no spines, and the smooth cryptocyst has generally only a few scattered pores. In most cases, I think, both the opesiular outgrowths reach the basal surface. The larger meets the latter in a closed curved line, generally very large, angularly arch-shaped and pointing obliquely towards the proximal end. The other opesiular outgrowth also touches the basal wall in a closed curved line, which however is very small, and both curved lines have frequently one leg springing from the margin of the distal wall.

Spicules: Length of curves between 0,026 and 0,079^{mm}, of compasses between 0,073 and 0,33^{mm}.

Of this form I have examined some fragments of free, partly hollow, partly solid, vincularian colonies from Port Denison, Queensland (The Museum of Zoology at Cambridge, England).

Var. C. (prominens).

(Pl. VI b, figs. 1 a—1 f).

Length of **zoœcia** 0,53—0,66^{mm}. The aperture, the length of which may be contained $2^1/_2$—3 times in the whole length of the zoœcium, is furnished with a broad and deep sinus, and its lateral margins are parallel proximally. The two adoral areas may sometimes be flat, sometimes furnished with acropetal spines of extremely different width and length, but generally circular in transverse section. Of the two opesiular outgrowths only one reaches the basal wall, touching it in a rather long, open, generally hook-shaped or angularly bent line.

The **avicularia,** which vary considerably in size, may sometimes attain the size of the zoœcia, and their distal opercular part protrudes often sharply, sometimes almost vertically from the surface of the colony.

Spicules: The length of the rather slender curves varies between 0,026 and 0,113^{mm}, of the compasses between 0,066 and 0,33^{mm}.

Of this form I have examined a number of colonies from Torres Straits (Haddon), belonging to the Museum of Zoology at Cambridge. Some of these are incrusting, others make free, partly hollow expansions of one layer, and still others consist of a number of very differently shaped, partly two-layered and flat, partly cylindrical segments, which are movably joined by chitinized belts of a dark colour (fig. 1 a).

Var. D. (gothica).

Membranipora gothica Busk.

The zoœcia are of an elongated, hexagonal, rounded form, and their length is from 0,59—0,79^{mm} The aperture, the length of which may be contained $2^1/_2$—3 times in the whole length of the zoœcium, has a broad and deep, sometimes trapeziformly rounded sinus and takes up so great a part of the breadth of the zoœcium, that the adoral areas are much reduced or completely wanting. No spines. The two opesiulæ are only separated from the aperture by a narrow bridge, and but the one opesiular outgrowth reaches the basal wall, which it meets in a generally rather short line, bent like a hook. Numerous and partly rather large pores.

Spicules. The length of the curves is between 0,039 and 0,079^{mm} and of the compasses between 0,093 and 0,305^{mm}; as however most of the zoœcia were without operculum, and a great deal of the spicules appeared to be absent, the limits of the dimensions may prove to be somewhat wider.

Of this form I have had the opportunity of examining a piece of Busk's original specimen from Mazatlan, for which my best thanks are due to the Director of the British Museum.

Var. E. (californica).

(Pl. VI b, figs. 2 a—2 d).

The length of the **zoœcia** is between 0,59 and 0,80^{mm} and that of the aperture may be contained 3—$3^1/_2$ times in the entire length of the zoœcium. The two adoral areas may be level or provided with acropetal spines which are sometimes very small. But one of the two opesiular outgrowths and only in about half of the zoœcia, reaches the basal wall, which it joins in a very short, ascending, open, curved line. Nothing can be said with regard to the dimensions of the **spicules**, the small fragments examined having no doubt lost most of these structures, of which only a few curves were left.

A few, very broad **oœcia** were found, showing a striation starting from the central suture. The operculum of the gonozoœcium has two frontally convergent but not concurrent chitinous sclerites.

Of this form I have been able to examine some laminate fragments from California (Hinck's Collection), belonging to the Museum of Zoology at Cambridge.

Thalamoporella novae hollandiae Haswell.

Vincularia novæ hollandiæ Haswell, Proceed. Linnæan Soc. of New South Wales, Vol. V, Part I, 1880, p. 41, Pl. III, fig. 3.

(Pl. VI a, figs. 3 a—3 f).

The zoœcia, whose lateral margins are often more or less sharply angularly bent, are 0,066—0,079$^{\mathrm{mm}}$. long. The length of the large wide aperture, which has a broad and deep sinus, may be contained $2^1/_2$—3 times in the whole length of the zoœcium, and the adoral areas, always without spines, are much reduced or quite absent. The operculum has only in the older zoœcia a continuous, but extremely narrow proximal sclerite. As a rule only one of the two opesiular outgrowths reaches the basal wall, which it meets in a somewhat variable, but most often irregularly tongue-shaped, closed curved line, pointing obliquely towards the proximal end; one leg of the line may sometimes join the distal wall. The other may however also — in some cases in about half of the zoœcia — reach the latter in a much smaller, but also closed curved line. The cryptocyst is very tuberculous, surrounded by strongly developed, irregularly crenulated prominent margins and furnished with numerous, rather large pores. The polypide-tube is short and its frontal wall not much depressed.

Spicules. Only compasses occur, varying in length, between 0,066 and 0,505$^{\mathrm{mm}}$., as also in respect to the angular bending of the legs. In the smaller of them, which are also found between the cryptocyst and the covering membrane, the angle varies between 98° and 110°; but there is no definite limit between these and the longest, which are very slightly curved, and the size of the angle seems to increase according to the length.

Oœcia are not found.

The avicularia, which may attain about the size of the smaller zoœcia, are furnished with a strongly developed and deeply depressed cryptocyst. The mandible, the proximal part of which is contracted, has otherwise the form of a broad, oblique, rounded quadrangle, and only about the middle third is occupied by the mandibular cavity, which is irregularly vase-shaped and surrounded by a thin, wide marginal expansion.

The colonies are partly incrusting, partly free, with slender, hollow branches. I have examined a number of colonies of this species from Torres Straits and from Port Denison, Queensland, belonging to the Museum of Zoology at Cambridge.

Thalamoporella falcifera Hincks.

Steganoporella Rozieri, Form falcifera Hincks, Annals Nat. Hist., ser. 5, Vol. VI, 1880, pag. 28—29, Pl. XVI, fig. 2.

(Pl. VI b, figs. 6 a—6 e).

Length of **zoœcia** 0,53—0,66mm. The aperture, the size of which may be contained 3—4 times in the whole length of the zoœcium, has a broad and deep sinus and parallel or almost parallel lateral margins. The operculum has only a short chitinous sclerite on either side proximally. The clearly defined adoral areas are well developed and have generally small and low acropetal spines, which only take up a small part of their surface. The two opesiular outgrowths generally reach the basal wall, one of them only touching it in an extremely small, closed or open, curved line, while the other meets it in a considerably larger, open, recurved line. The finely tuberculous cryptocyst has widely scattered pores.

Oœcia are not found.

The avicularia are rather small with a very well developed, distal cryptocyst and a very narrow, pointed, sabre-like, curved mandible without a marginal expansion, the entire breadth being occupied by the mandibular cavity.

Of this species, which incrusts algæ, I have examined colonies from the Java Sea (Andréa), on *Sargassum buxifolium* from Campeche Bank, Yucatan on *Sargassum hystrix* (the herbarium of algæ in Botanical Museum), on *Sargassum* sp. from lat. 23° 30′ N., long. 40° W. (Andréa) and on *Vidalis spiralis* from Geograph Bay, Australia.

Thalamoporella Harmeri n. sp.

(Pl. VI c, figs. 1 a—1 h).

Length of **zoœcia** 0,53—0,57mm The aperture, the length of which may be contained a little more than $2^1/_2$ times in the whole length of the zoœcium, has a broad and deep, often trapeziformly rounded sinus The operculum is attached by two unusually strong hinge-teeth, and the whole of its marginal portion is unusually strongly chitinized, so that its surface shows a marked contrast between this yellow marginal part and a lighter, rounded triangular central part. The lateral margins of the operculum are more than usually convergent frontally, and, apart from its proximal concave margin, its form may be described as rounded triangular. The two distinctly marked, well developed adoral areas are furnished with two large acropetal spines, oval or circular in transverse section, which never show any distinct, radiate, but often an annular striation. Of the two opesiulæ the larger is of a rather long triangular shape and directed towards the proximal opposite corner. As a rule both opesiular outgrowths reach the basal wall, but with regard to the way in which they meet the latter we may distinguish between two different cases, which judging from the samples examined seem to be about equally frequent, occurring in detached patches at small intervals. In one case they meet the basal wall in two separate, open lines, of which one is extremely short, straight or curved, while the other is considerably longer and very hooked. In the other case we have, as in *Th. lioticha*, a single continuous transverse line, but often with an irregular angular bending, in which case the polypide-tube has a low basal wall of its own (fig. 1 f). Transitional stages are however also found between the two cases. The polypide-tube is very asymmetrical and its frontal wall, the proximal part of which is much depressed, is smooth on the greater part of its surface while on the other hand its distal margin is abundantly furnished with tubercles. The cryptocyst is otherwise smooth but has rather large, closely situated pores, which however often do not reach very far.

Spicules. Only compasses occur, the length of which may vary between 0,039 and $0{,}345^{mm}$ In the smaller of them, found both in the zoœcial cavity and between the cryptocyst and the covering membrane, the angle generally varies between 115^{0} and 123^{0}, while the largest, found only in the zoœcial cavity, are only slightly curved.

Oœcia occur in several places of the examined colony in more or less close groups, partly composed of more or less regular transverse series. Their surface, which shows a more or less distinct concentric striation, is furnished with a greater or smaller number (not exceeding about twenty) of rather large, pyriform pores. The gonozoœcia, which may become longer by a half than the ordinary zoœcia, have a very large aperture which apart from the sinus makes four-fifths of an ellipse. The operculum of the gonozoœcium has a closed, chitinous curved sclerite reaching the distal third of the operculum (fig. 1 e).

The avicularia, occurring in large numbers and somewhat smaller than the zoœcia, have a slightly developed distal, and a more strongly developed proximal cryptocyst. The mandible has as in *Th. Rozieri* the form of an isosceles triangle with lateral margins curving outwards, and has likewise two lateral expansions, which are separated from the mandibular cavity by the triangular opercular arch. The marginal portion of the mandible is chitinized to an unusual degree.

This species, which incrusts a red alga from Madagascar, belongs to the Museum of Zoology at Cambridge, and has been kindly lent me for examination of Dr. S. Harmer.

Thalamoporella granulata n. sp.

(Pl. VI a, figs. 1, 2; Pl. VI, fig. 5).

The length of **the zoœcia** may vary between 0,532 and 0,93^{mm}. The aperture, the size of which may be contained $3^1/_2$–4 times in the whole length of the zoœcium, has a broad and deep sinus, which is generally separated from the remaining semi-circular or semi-oval part by strongly developed hinge-teeth. The proximal margin of the operculum has on either side an extremely short chitinous sclerite. The two indistinctly marked adoral areas are usually slightly developed, but may be furnished with small, round aeropetal spines. The two opesiulæ show as a rule no great difference in size, and the opesiular outgrowths both reach the basal wall, meeting it in two open hooked lines, which may be equally large. The frontal wall of the polypide-tube is not very deeply depressed, and the cryptocyst, which has a strongly developed, crenulated or tuberculated marginal part, is on the whole of its frontal surface more or less strongly tuberculous. Numerous, rather large pores.

Spicules occur both in the shape of compasses and curves, and particularly the latter show rather a wide range of variation. The smaller spicules are also found between the cryptocyst and the covering membrane.

The oœcia, which are without pores, have a rounded triangular outline and a somewhat projecting aperture. The gonozoœcia are of about the same size as the ordinary zoœcia, and the chitinous arch of the operculum is not far from the margin.

The avicularia, which may reach and even exceed the length of the zoœcia, have a strongly developed distal cryptocyst. The mandible is sometimes narrow and tongue-shaped, sometimes broad and more or less regularly lyriform or vase-shaped.

Var. A. (stapifera).

(Pl. VI, figs. 5 a–5 e).

The zoœcia, whose length generally varies from 0,798 to 0,93^{mm}, are most often of a rounded hexagonal form, frequently unusually broad and flat. The adoral areas have often small, round acropetal spines. The cryptocyst very tuberculous and furnished with closely situated pores.

The avicularia, which are extremely rare, have a long, narrow, tongue-shaped mandible.

Spicules. The length of compasses found varies between 0,053 and 0,186^{mm}, and the length (height) of the curves between 0,033 and 0,039^{mm}. The latter, which are much higher than broad, have a peculiar stirrup-like shape, and the legs are rectangularly bent at the end, while at the same time the median knot is unusually strongly developed and conically pointed. It must however be remarked that the zoœcia in the colonies examined have lost most of their spicules.

This form has partly been found on a *Tridacna*, the locality of which is unknown, partly on a *Haliotis* from the Andaman or Nicobar Islands (de Roepstorff).

Var. B.

(Pl. VI a, figs. 1 a—1 f).

The zoœcia, the length of which varies from 0,598 to 0,731^{mm}, are usually rectangular, rarely furnished with somewhat angularly bent or curved lateral margins. The adoral areas have no spines, and the cryptocyst is less tuberculous and has fewer pores.

The avicularia are rather numerous and have a broad irregularly vasiform or lyriform mandible, the mandibular cavity of which hardly occupies one-third of the entire breadth and is bounded by two subparallel chitinous margins at the point concurrent.

Spicules. Length of compasses varying from 0,046 to 0,292^{mm}, and that of the unusually smal curves from 0,013 to 0,033^{mm}. They differ from the curves in Var. A. in being less high, in having a less developed median process and a more curved bending of the point of the legs.

Of this form I have examined some fragments of hollow colonies and some small one-layered laminæ from Torres Straits (Haddon), belonging to the Museum of Zoology at Cambridge.

Var. C. (tubifera).

(Pl. VI a, figs. 2 a—2 e).

The zoœcia, the length of which may vary from 0,532 to 0,731^{mm}, are frequently rectangular, sometimes however furnished with somewhat angularly bent or curved lateral margins. The adoral areas have no spines, and the cryptocyst is strongly tuberculous and has numerous pores. The polypide-tube has in by far the greater part of the zoœcia a distal continuation in the shape of a thin-walled calcareous tube whose basal wall as that of the proximal part of the tube is formed by the basal wall of the zoœcium. With its closed distal part it touches the distal wall at the basal part of the latter, so that the rosette-plates lie within its region, and its frontal wall springs from the inner surface of the bridge between the two opesiulæ, nearly at the distal third of the latter. This tube, also found in the avicularia and in the gonozoœcia, in the latter of which it has the form of a trapezoid (fig. 2 b), each obtuse corner of which ends opposite a rosette-plate, generally grows narrower upwards and is not infrequently furnished with a lateral branch, leading to one of the rosette-plates of the lateral walls. A little proximally to the closed end it has — probably for the extrusion of the polypide — an oval or round opening. In the avicularia this opening is situated, far back.

The avicularia, which are not uncommon, have judging from the form of the aperture, a regularly vase- or lyre-shaped mandible.

Spicules. Length of compasses varying from 0,086 to 0,399$^{mm.}$ and that of the curves from 0,039 to 0,066$^{mm.}$

Of this form I have been able to examine some fragments of uni-layered laminæ from Deboine Lagoon, Louisiades at New Guinea, belonging to the Museum of Zoology at Cambridge.

Thalamoporella expansa n. sp.

(Pl. VI b, figs. 5 a—5 e).

Length of **zoœcia** varying between 1,06 and 1,33^{mm} The aperture, measuring about one-third of the entire length of the zoœcium, has a most singular appearance on account of the peculiar structure of the distal wall. The frontal part of the latter namely ascends so sharply as to make the angle, that it forms with the cryptocyst of the higher zoœcium, approximately 180°, its form being that of a large, flat, slightly deepened, semi-circular, aureola-like extension distally to the other part of the aperture, which we may call the real aperture. This is of a semi-elliptical form with a proximal, slightly concave margin, which is sometimes completely filled by a low, slightly projecting dentate furrowed lip with a straight margin. The oral shelf, as usual springing from the boundary between the more horizontal part and the ascending part of the distal wall, is unusually well developed and in the shape of an arched lamina directed obliquely towards the zoœcial cavity. The operculum, which is more strongly chitinized than in the other species of this genus, has a straight proximal margin and is in conformity to the aperture, composed of two different portions, one corresponding with the aureola-like expansion, and one answering to the real aperture. While the former occurs as a uniform chitinous expansion, the latter is provided with a strongly chitinized proximal margin, and with a most chitinized opercular arch, the two arms of which have in their distal half a small rounded process for muscular attachment. The two adoral areas are furnished with two sometimes small and sometimes medium-sized, not very projecting spines of a round or oval section, and they are connected with each other by a very narrow and low, raised margin. The cryptocyst is extremely tuberculated, encircled by a well-developed, crennlated, tuberculous marginal ridge and furnished with closely situated, rather large pores. The two small opesiulæ, which are widely separated from the aperture, most frequently circular, more rarely oval, and in which the margin is usually more or less sinuated owing to the very tuberculous condition of the cryptocyst, generally show only a slight difference in size. The opesiular outgrowths both reach the basal wall, which they meet in two closed, quadrangularly rounded, somewhat distally bent curved lines, which show less difference in size than is usually the case in the species of this genus. The bridge between the two opesiulæ is short and broad, very slightly depressed and has contrary to the rule not infrequently a larger or smaller number of pores in its proximal half.

Spicules occur only in the shape of compasses, of which the smaller are rather strongly bent at an angle and also found between the cryptocyst and the covering membrane. Length varying from 0,039 mm. to 0,718$^{\text{mm.}}$

Oœcia are not found.

The avicularia, which are rare and much smaller than the zoœcia, have a very well-developed proximal cryptocyst, surrounded by a thick marginal ridge. The mandible is semi-elliptical and has a mandibular cavity in the form of an isosceles triangle.

Of this species I have examined firstly some colonies, incrusting Tridacna sp. without locality, and secondly some one-layered laminæ from Torres Straits, belonging to the Museum of Zoology at Cambridge.

In some of the polypide-less zoœcia I found a narrow, thin-walled, somewhat curved calcareous tube, passing through the whole length of the zoœcium and including the rosette-plates of the two opposite distal walls. It had several lateral branches, which reach the rosette-plates on the lateral walls, and in some cases at least I have found a round or oval opening in the frontal wall of the distal end of the tube. This tube is apparently of the same nature as the one, mentioned in *Th. granulata*, Var. *C.*, in which form it was only a continuation of the polypide-tube. Most likely we have here a peculiar form of regeneration.

Thalamoporella cincta Hutton.

Membranipora cincta, Hutton, Proceed. R. Soc. of Tasmania (1877), 1878.

Membranipora transversa, Hincks, Annals Nat. Hist., ser. 5, Vol. VI, 1880, p. 21, Pl. XI, fig. 9.

Diplopora cincta Mac Gillivray, Trans. and Proceed. R. Soc. of Victoria (1880), 1881, Vol. XVII, p. 15, fig. 1—1 c.

(Pl. XXII, figs. 7 a—7 d).

The zoœcia, which are rather long and rectangular, have a length of 0,598—0,6^{mm}. The large aperture, the size of which may be contained $3^1/_2$—4 times in the whole length of the zoœcium, has a broad and deep sinus, and the more or less developed adoral areas have always acropetal spines, most frequently of a somewhat compressed conical shape. The operculum, the concave proximal margin of which is in the whole of its length furnished with a well developed chitinous sclerite, has within each lateral margin a somewhat curved, chitinous ridge, which on its internal side is proximally connected with a much shorter chitinous part, distally ending in a small rounded expansion. Of the two opesiular outgrowths only one reaches the partly or wholly uncalcified basal wall with a shorter or longer part of its proximal margin, while the other, which is very small and sometimes difficult to distinguish from the frontal surface, only reaches the appertaining lateral wall. A little distally to the centre a short, but broad deepening occupies the whole breadth of the frontal surface, and at the bottom of this deepening the larger of the two opesiulæ is found on one side and on the other a deeply depressed part of the polypide-tube. The smaller of the two opesiulæ is generally situated immediately on the distal side of this deepening and in some cases at its distal end. While the region between the aperture and the deepening may be sometimes quite smooth, sometimes with rather numerous tubercles, but never with pores, the remaining part of the cryptocyst, which is extraordinarily, sometimes almost rectangularly arched, is furnished with numerous tubercles and small denticles in its distal part and numerous pores in its proximal part. Also the inner surface of the lateral walls is very tuberculous and spinous. In the proximal half of the zoœcium each lateral margin expands into a strong, somewhat compressed but thick process with two arched lateral surfaces and of a semi-circular or triangularly rounded outline. These processes, the outer surface of which is distinctly transversely striated, are more or less inclined towards the cryptocyst, and the two belonging to the same zoœcium may sometimes nearly reach each other. Contrary to the rule each distal wall is furnished with two multiporous rosette-plates.

Spicules. Only compasses are found, measuring from 0,053 to 0,265$^{mm.}$ and varying greatly with respect to the angle made by the legs. While the angle in the smaller ones is about 113^0, it approaches 180^0 in the longest, which are only found in the zoœcial cavity.

Oœcia are not found.

The avicularia, occurring less numerously among the zoœcia and only about half as large as the latter, are quadrangular or pentagonal, and the triangular mandible has rather curved lateral margins.

Of this species I have examined two dry colonies from Port Phillip, found in the collections of Algæ at the Botanical Museum. The zoœcia of the two colonies, which form a covering on cylindrical algal stems, are arranged in annular belts.

Thalamoporella Jervoisi Hincks.

Steganoporella Jervoisi Hincks, Annals Nat. Hist., ser. 5, Vol. VI, 1880, pag. 30, Pl. X, fig. 9.

(Pl. VI a, figs. 4 a—4 e).

The length of **the zoœcia** varies between 0,532 and 0,798^{mm} The aperture, the length of which may be contained 3—4 times in the whole length of the zoœcium, is unusually long and has a very slightly developed, sometimes almost imperceptible sinus small both in depth and breadth. The operculum, the chitinous arch of which is strongly developed, has a continuous, distally curved proximal sclerite and a greater or lesser part of the membrane filling the proximal part of the aperture is chitinized together with the operculum (not to be seen in the figure 4 c, which does not show either the thin marginal portion outside the opercular arch), the proximal margin being in this way either straight or a little convex. Each of the lateral margins has a slight incurvation and within this the opercular arch is provided with a small process for muscular attachment. The sharply defined adoral areas are well developed with large, cone-shaped-cylindrical, somewhat compressed acropetal spines. Of the two opesiulæ the larger is generally very narrow, almost slit-like and pointing obliquely and inwardly towards the proximal end. The other is very small. The opesiular outgrowths both reach the basal wall, the larger touching it in an open, hook-shaped curved line, while the other meets it in a very short, ascending line. The cryptocyst the central part of which is much depressed lacks a raised marginal portion and is most often divided by sutures into four segments, ascending towards the margins of the zoœcium, namely, a distal, a proximal and two lateral, joining each other in a short sutural line. It is however not uncommon that an area fuses with a contiguous one, as e. g. the proximal area and a lateral one in fig. 4 a. While the proximal area and the two lateral are more or less closely set with small scattered pores, the distal one is only furnished with small tubercles, which are most numerous just proximally to the aperture.

Spicules. Besides curves, the length of which is between 0,026 and 0,113^{mm}, a peculiar intermediate form occurs, with two unequally long arms, of which the longer is formed as an arm of a curve while the shorter is like that of a compass. Their length varies from 0,106 to 0,46^{mm}

Oœcia are not found.

The avicularia, of which none were found on the piece examined, are according to Hincks rather uncommon, very small and with a triangular mandible. Judging from the figure there is a calcified transverse bar between the opercular and the subopercular areas, a character not found in any of the other species.

Besides a fragment of the original specimen, which I owe to the kindness of Mrs. H. Eden (neé Gatty), I have examined a small colony from Port Phillip Heads, Victoria, sent me by Mr. J. Gabriel.

Thalamoporella mamillaris Lamx.

Membranipora mamillaris Hincks, Annals Nat. Hist., ser. 5, Vol. VI, 1880, pag. 88, Pl. X, fig. 9.

(Pl. VI a, figs. 5 a—5 e).

The length of **zoœcia** varying between 0,532 and 0,665$^{mm.}$ The aperture, the length of which may be contained 3—4 times in the whole length of the zoœcium, is bounded by two, more or less convergent lateral margins and by an almost straight proximal margin. The horizontal basal part and the ascending frontal part of the distal wall are not sharply delimited, and an oral shelf is wanting. But some way within the free margin of the aperture and parallel with it is a very narrow, low, glistening, usually beaded arch. The operculum, the arch of which appears to be situated immediately within the free margin, has a proximally incurved, extremely narrow chitinous sclerite, but the part of the covering membrane between the operculum and the distal margin of the cryptocyst is more chitinized than the rest of this membrane and is thus connected with the real operculum to a continuous whole. The two distinctly marked adoral areas are well-developed and have large, compressed, conical acropetal spines. Only one tongue-shaped opesiula is found, the direction of which is obliquely proximal and inward, and the opesiular outgrowth touches the basal surface in an open, hooked, curved line. The proximal margin of this opesiula has a series of from 3 to 7 distally-pointing spines, partly more or less branched, partly single, and both its margins are moreover furnished with larger or smaller laminate processes of varying shape, which generally point more or less obliquely towards the opesial cavity and are more rarely on a level with the opening of the latter. They may be curved, lobed, sinuous or even furnished with branched processes (fig. 5 b). On account of these marginal expansions the entrance to the opesial cavity is often made very narrow and in some cases by partial fusion of two such opposite portions reduced to a small hole. The cryptocyst, which in older zoœcia may have a raised margin which is rather broad especially in the proximal part of the zoœcium, is, as in *Th. Jervoisi*, divided into four, sometimes three segments, as the distal or the proximal one may have fused with one of the lateral parts. The opesiular opening quite separates the distal area from one of the lateral ones, and the area opposite that of the opesiula is in most cases furnished with from 2 to 5 partly single, partly branched spines. With the exception of a very tuberculous belt immediately on the proximal side of the aperture, tubercles only occur in very small numbers, the greatest number being found in the proximal area, which is also the only one to show a few small pores.

Spicules. Only compasses occur, the length of which varies from 0,033 to 0,133$^{mm.}$, and of which a great many are more or less strongly curved.

Oœcia are not found.

The avicularia are rather uncommon and much smaller than the zoœcia. They have a small triangular mandible with a rather long, linear terminal part. A larger or smaller part of the subopercular area is furnished with a very thin, not deeply depressed cryptocyst lamina ending in a dentate margin.

In one place a smaller number of narrow, abnormal zoœcia were found, the cryptocyst of which consisted partly of a generally very broad, and sometimes strongly prominent marginal portion, the inner edge of which is broadly crenulated, and partly of a depressed, more or less tuberculated median portion. The marginal portion, divided by sutural lines into numerous small areas corresponding to the crenulations may attain so great a breadth that its two lateral halves may coalesce sometimes in the distal and sometimes in the proximal part of the zoœcium. In the distal half of the zoœcium there is frequently a somewhat varyingly shaped, round or oval aperture without operculum.

A small colony of this Australian species was kindly placed at my disposal by the late Mr. Peal.

Family **Setosellidae**[1] n. f.

Setosella Hincks.

The *zoœcia* the frontal wall of which is perforated by two slit-shaped opesiulæ have a well chitinized simple operculum with a well developed opercular arch. No spines. The lateral walls which are common to the contiguous zoœcia are in their distal part provided with a large membranous, uniporous (?) rosette-plate. Obliquely, distally to each zoœcium is found an independent *vibraculum* without a cross-bar, with a long, strong, dentate flabellum. The *oœcia* are small rounded cavities in the frontal wall of the arched distal part of the gonozoœcium, the »oœcial area«, which is distinctly separated from the lateral parts by an impressed line. The oœcial cavity which is distinctly apparent on the outer surface opens out through a hole gradually increasing in size.

The oœcia of the present genus, which have hitherto been overlooked, belong to the same division of oœcia (p. 65), the *endotoichal*, found in the genera *Cellularia* and *Membranicellaria*, but while in these they are placed in the proximal part of the frontal wall, they are in *Setosella* placed in the distal part of this wall.

While the aperture of the common zoœcia is about as high as broad the aperture of the gonozoœcia is broader than high, with a somewhat convex proximal margin and with two acuminated corners.

On account of the oœcial form I have thought it necessary to set up a new family for this genus which is represented by a single species *S. vulnerata* Busk. Of this species colonies have been taken by the Ingolf Expedition at Lat. 25° 21′ N., Long. 63° 21′ W., at a depth of 170 fathoms.

Family **Chlidoniidae.**

The jointed colonies, springing from a stolonate network, consist of a stem, two main branches and a number of zoœcia-bearing secondary branches, and besides the *zoœcia* we may distinguish between three different forms of kenozoœcia, namely the partitions of the stolon, the stem-internodes and the bifurcate internodes of the main branches. Moreover, the main branches and the secondary branches end in a number of small cylindrical internodes, of which those in the secondary branches may be transformed into zoœcia. The zoœcia, which lack pores and spines, have a deeply depressed cryptocyst, pierced by a small trans-

[1] Neither this family nor the family *Crepidacanthidae* are named in the synopsis on p. 88, both families having been founded later.

verse slit, and have a simple, semi-elliptical operculum, ending in a straight proximal margin. The stem-internodes have a small depressed cryptocyst with one pore at the bottom; and excepting the partitions of the stolon the other individual forms have their inner cavity divided into a series of segments (generally four), separated by more or less sharp constrictions. The distal walls have a single-pored rosette-plate. *Oœcia* and *avicularia* wanting.

Chlidonia Cordieri Aud.

Eucratea Cordieri Audouin, Descript de l'Egypte, Hist. Natur., Tome 1, explic. sommaire d. Planches pag. 242, Polypes Pl. XIII, fig. 3_1—3_3.
Eucratea Cordieri Waters, Annals Nat. Hist., ser. 5, Vol. III, 1879, pag. 116, Pl. XV, figs. 9, 10, 11.
Chlidonia Cordieri d'Orbigny, Paléontologie Française, Terrain crétacés, Bryozoaires, 1850—52, pag. 40.
Cothurnicella dædala, Wyw. Thomson, Nat. Hist. Rev., Vol. V, pag. 146.
— — Wyw. Thomson, Dublin Univ., Zool. Bot. Assoc., 1859, pag. 85.
Chlidonia Cordieri Busk, Challenger, Zoology, Vol. X, 1884, pag. 8, Pl. XXVIII, fig. 11.
— — Hincks, Annals Nat. Hist., ser. 5, Vol. XVII, pag. 258.
— dædala Mc Coy, Zoologie of Victoria, dec. XI, pag. 35, Pl. CVIII, fig. 2.
— — Mc Gillivray, Catalogue of the Marine Polyzoa of Victoria, pag. 10.
Chlidonia Cordieri Waters, Journal Linnean Soc., Zoology, Vol. XXVI, 1896, pag. 18, Pl. 1, fig. 8—9.
— — Calvet, Bryozoaires Marins de la Region de Cette, pag. 13, Pl. I, fig. 1 et 2.

(Pl. VIII, fig. 6 a—6 y).

As our knowledge of this often examined species still leaves a great deal to be desired, I may here give a connected description of it. It occurs as compound colonies, a number of small colonies springing from a reticularly branched, filiform stolon (fig. 6 i), which may cover various substances. This stolonate network is composed of rather long partitions, separated two and two by a single-pored rosette-plate (fig. 6 e), which is surrounded by a thickened, diaphragmatic, projecting part of the inner wall. Each small colony (6 a, 6 b) is furnished with a jointed stem, bearing two main branches likewise jointed, each of which terminates in from 1 to 6 long cylindrical internodes. From each internode of the proximal (inner) half of such a main branch a secondary branch is given off, and excepting the extreme, or more rarely the two extreme secondary branches on each side, which bear a row (4—5) of cylindrical internodes like those of the terminal parts of the main branches, all the other secondary branches consist in the complete state of a row of zoœcia, of which each again ends in a row (3—4) of the cylindrical internodes. In such a small colony we may thus distinguish between four different forms of internodes, namely (1) stem-internodes, (2) bifurcate internodes of the main branches, (3) the zoœcia, and (4) the narrow cylindrical internodes. While the colony, when placed on a level, has the form of a stalked fan, the rays of which decrease in length from within outwards, it has in its natural position almost the shape of a ball with a pear-shaped incision on one side bounded by the two main branches (fig. 6 a).

The zoœcia (6 d, 6 e, 6 f), the two lateral surfaces of which meet in a pointed basal edge (6 s), have, when looked at sideways, an almost semi-circular outline, though the proximal half of the dorsal surface is a little incurved. The semi-elliptical aperture, situated in the distal part of the zoœcium, has an almost straight proximal margin and is covered by a slightly chitinized, simple operculum, the proximal margin of which is more chitinized, and the opercular arch of which is situated in the margin itself. Proximally to the aperture we find a rather deep cryptocyst depression, occupying almost half the length of the zoœcium and only separated from the aperture and the lateral surfaces by a narrow marginal portion. The proximal part of the zoœcium is arched, sometimes almost stalk-like narrowed and furnished with a very thick frontal wall (fig. 6 d). The cryptocyst is also very thick-walled, particularly the distal part, which projects into the zoœcium with a very rounded thickening (fig. 6 d), and in the frontal wall of this portion, proximally to the aperture, a small transversely oval hollow is seen. Further back, in the approximate centre of the length of the zoœcium and immediately on the proximal side of the above mentioned, very arched portion, is a somewhat larger, transversely oval area, which is removed a little from the central line, and which has a transverse slit in the whole of its breadth. In each zoœcium the inner cavity shows four distinctly separate segments, which we may indicate by the letters α, β, γ, δ (6 e), and the obliquely ascending distal wall, furnished basally with one single-pored rosette-plate, is situated between the segments β & γ.

The stem-internodes (figs. 6 t, 6 u, 6 v, 6 x), of which the lowest (6 i) has a long, narrow, chitinized proximal part, are long, spindle-shaped-cylindrical and when fully developed, very thick-walled. The inner lumen is as in the zoœcia divided into four segments of different width and shape, α, β, γ, δ, corresponding with those in the zooecia mentioned above. Here also an oblique distal wall is found between β and γ, which in the fully developed internode is only represented by a round, single-pored rosette-plate, and in the distal half of the segment γ is a narrow, oval cryptocyst depression, the bottom of which is perforated by a round pore, equivalent to the transverse slit in the zooecium. In a very young internode (6 v, 6 x) the calcareous wall is still very thin, and the inner segments accordingly of quite a different shape. The distal wall (dw) has here a considerable extent, and the cryptocyst not yet being formed an oval opening is seen in its place in the calcareous wall, covered by a membrane. The distal stem-internode (fig. 6 h), which bears the two main branches, is a transitional form between the stem-internodes and the bifurcate internodes of the main branches, and like these it is divided into two branches, of which however one is very short. The long branch has on its inner side a cryptocyst depression, perforated by a pore like that of the stem-internodes, and the short branch is formed by an α and a β springing from δ. Each branch has a single-pored rosette-plate, one situated between β and δ, and the other between β and γ. The long branch of the distal stem-internode may in different colonies be directed now to the right side now to the left.

The bifurcate branch-internodes (fig. 6 g), which form the proximal half of the two main branches, have each a δ and a γ in common; but while the branch of the internodes, which is connected with the next branch-internode, has an α and a β, which latter issues from the proximal part of γ, the branch connected with the zooecium has only a single segment, springing from the end of γ. The whole internode has only one rosette-plate, situated between β and γ. The bifurcate internodes, which bear the secondary branches consisting of cylindrical internodes of which generally only one, more seldom two occur on each side, are much more slender than the others and thus approach to the form of the succeeding internodes. In these also a single-pored rosette-plate is found between β and γ.

The cylindrical internodes, which as mentioned not only form the terminal part of the two main branches and of the zooecia-bearing secondary branches, but also form one or two secondary branches on each side, are very slender and thin, and their inner cavity has a contracted part at both ends. No rosette-plates are found between the single joints, and they might therefore hardly be regarded as individuals (Bryozoids).

The number of stem-internodes in the colonies examined is between two and fifteen, and the number of secondary branches ending in cylindrical internodes between nine and fifteen. The number of zooecia in the secondary branches increases from without towards the centre and varies in the outermost between one and four, in the most central ones between three and nine. The number of stem-internodes bears no particular relation to either the number of secondary branches or to the number of zoœcia in the latter. The number of stem-internodes very rarely exceeds twelve, fifteen having been found only once in a very small colony, the eight secondary branches of which had not yet any cylindrical internodes at the end.

Growth. The youngest colonies I have seen consist only of a few stem-internodes, and that they have not been fragments is sufficiently evident from the fact, that the apical internode had still but a very thin calcareous wall and ends in a membrane. The examination of numerons young colonies in different stages shows that such a colony is constantly increasing by direct growth, until the separate zoœcia-bearing secondary branches have attained to temporary completion by the formation of the apical cylindrical internodes; however, in the different colonies the secondary branches that have attained this temporary completion may contain rather a varying number of zoœcia, and there may also be found a rather great difference in the number of zoœcia between the outer and the inner secondary branches. In colonies with 13—15 secondary branches, the number of zoœcia of which varies between 2 and 9, this completion is probably always attained, and often it may even be attained by colonies with 10—12 secondary branches, the number of zoœcia of which is between 1 and 7. In all younger colonies, however, a larger or smaller number of secondary branches is found, which end in a funnel-shaped rudiment of a zoœcium closed at the end by a membrane, which is very rarely met with in secondary branches with more than 5 zoœcia.

After the formation of the cylindrical terminal internodes a further increase in the number of zoœcia in the separate secondary branches may take place by the transformation of these into zoœcia, and this transformation may take place in two different ways. In most cases a compressed, funnel-shaped body grows from the basal part of the internode (figs. 6 j, 6 m, 6 r) and surrounds the latter, which increases in extent and gradually obtains a wider lumen. Time has not permitted me to examine this development from stage to stage; but the various stages I have seen leave no doubt of the fact, that this funnel-shaped rudiment is the beginning of a zoœcium, as, apart from the cylinder arising from its centre, it quite agrees with the zoœcial rudiments which arise by direct growth. In the other, less frequent case the transformation takes place by a gradual swelling of such an internode (figs. 6 n—6 q), which is by and by furnished with an oval depression, presumably corresponding with the cryptocyst depression of the zoœcium, and further forward with a distal wall. Both these forms may be found in the same colony. Such a transformation of the cylindrical internodes is found in most of the more developed colonies in one or several secondary branches, and a growth in length and a division of the younger internodes take place at the same time.

We have already mentioned that in a colony at a certain stage of development the outermost or sometimes the two outermost secondary branches on each side are only composed of cylindrical internodes, and if we were to examine a number of colonies at different stages of development we should find that these whip-like secondary branches issue nearer the top stem-internode in the younger colonies than in the older ones. Thus, if we were to designate the internode of a main branch, issuing directly from the bifurcate, distal stem-internode, no. 1, the next no. 2 and so on, we should find that in colonies with 6—8 secondary branches the whip-like secondary branches issue from internode 3—4, in colonies with 9—12 from internode 4—6 and in colonies with 13—16 from internode 5—7. This fact can only mean that all the zooecia in a number of outer secondary branches arise by a transformation of cylindrical internodes. There is however no certain rule for the time of the appearance of the first whip-like secondary branch, as in some colonies it may appear later than in others. The outermost secondary branch on each side generally remains untransformed, and I have only in very few cases found 1—3 of the proximal internodes transformed into zooecia on one side of an older colony. A consequence of the conception that a number of the older whip-like secondary branches are transformed into zooecia-bearing ones and that new ones are formed outside these is, that the inner cylindrical internodes of the main branches must at the same time be transformed into bifurcate internodes.

Whilst all the colonies of this species examined by me have arisen by gemmation from a branched stolon connected with other colonies, a fact explaining the possibility that the development of a colony may begin with the formation of a number of individuals (stem-internodes and branch-internodes) without organs of nutrition, I have no doubt that a colony, proceeding directly from a larva, must begin with the formation of a zooecium. Of this species I have been able to examine numerous colonies obtained from a jointed calcareous alga taken at Ajaccio by Dr. Borgesen.

Family **Alysidiidae.**

The jointed colonies, springing from a stolonate network, consist of zooecia and gonozooecia, the latter borne by stem-like kenozooecia. The *zooecia*, the distal half of which has a depressed cryptocyst, are furnished with a simple opercular valve and with two opesiulæ, while the kenozoœcia, springing from the axial zoœcia, have a small depressed cryptocyst perforated by a pore. All septa have a series of single-pored rosette-plates. Bivalve *oœcia*, in which each valve must be considered a kenozoœcium. No *avicularia*.

Alysidium parasiticum Busk.

Catalogue of Marine Polyzoa, Part I, Cheilostomata, pag. 14, Pl. XIV, figs. 6—9.

(Pl. VII, figs. 3 a—3 o).

The zoœcia, which are rather elongated and trapeziformly rounded, steadily increase in breadth towards the arched, distal margin. The aperture, the slightly curved proximal margin of which is situated in the distal third of the zoœcium, is broader than long and has a glistening ridged distal margin, often with a series of small tubercles. There is a membranous opercular valve and the opercular arch is situated in the free margin itself. Almost the distal half of the frontal surface is furnished with a depressed cryptocyst, which also occupies the region between the aperture and the distal margin of the zoœcium. The post-oral cryptocyst, which stretches more than half-way back between the aperture and the proximal margin of the zoœcium and which has generally a number (most often 10—15) of glistening tubercles, is separated from the remaining arched part of the frontal surface by a semi-elliptical boundary ridge, which is very low in the middle but increasing in height distally and ending on each side at one of the horn-like spines, from which it is separated by a small notch. These two spines, situated at the margin of the zoœcium opposite the aperture and standing out almost vertically from the surface of the zoœcium, have generally a form resembling that of short cow's horns but are a little more compressed. In their proximal inner part each of them has a small hole, apparently leading into the inner cavity. On the proximal side of the aperture on each side is a rather small, irregularly rounded opesiula, the inner margin of which nearly always terminates in a short, most often rod-like process, seldom with two or several points. The two opesiulæ are always of different size, but while in the axial zoœcia this difference is slight, it is large in the others where the opesiula facing the axis of the colony is twice the size of the other. Immediately on the proximal side of the two opesiulæ is an oblique, glistening stria, which is however rather indistinct in the axial zoœcia, passing right across the zoœcium to the lateral margins. This stria, which in zoœcia of the second and third order is inclined towards the central line of the colony, originates from a low ridge on the inner surface of the cryptocyst, and immediately distally to it is the limit between the two parts of the cryptocyst of which one is ascending towards the aperture the other descending towards the above-mentioned semi-elliptical boundary ridge, the two parts forming an obtuse angle. The portion on the proximal side of the opening is also somewhat thickened. The contracted, proximal part of the zoœcium consists of a flexible chitinous mass decreasing in thickness as it continues through the thick-walled calcareous bottom, distally to which the narrow lumen suddenly expands into a spacious, asymmetrical cavity, furnished on one side with a blind sac-like continuation directed proximally, which we may term the proximal recess. All the zoœcia are on the whole very asymmetrical, which may be seen more or less distinctly in all the different structural features. Thus the basal recess and the larger of the two opesiulæ are situated on the same side of the zoœcium, towards which the above-mentioned inner ridge inclines and the semi-elliptical boundary ridge has also a more or less distinct inclination towards that side. While this side in the axial zoœcia is the right or the left alternately, it is in all other zoœcia the one facing the central line of the colony.

The obliquely ascending distal wall (figs. 3 d, 3 e), situated rather far back and bent in an arch from side to side, has within its basal margin a series of small single-pored rosette-plates, and according as the zoœcium is distally connected with one or three others its distal end is undivided or divided into three smaller pore-chambers. In an undivided pore-chamber I have found 8–9 rosette-plates.

On the dry colonies examined I found some branches ending in one or two long, narrow, somewhat bent, almost cylindrical internodes, which on the frontal side a little above the proximal end had a pear-shaped hole. It seems natural to suppose that all the terminal zoœcia end in this way, and it is possible that their function is similar to that of the cylindrical internodes in *Chlidonia*.

The oœcia are borne by separate, small branches (fig. 3 a), which may spring partly from most of the axial zoœcia and partly from a smaller number of the lowest zoœcia of the second order. They are situated a little proximally to or on a level with the semi-elliptical ridge half-way towards the margin of the zoœcium, and in the successive zoœcia alternately on the right and the left side. In each of these branches, which have an arch-like bending and stand out almost vertically from the surface of the colony, we may besides the two oœcial valves also distinguish between a gonozoœcium and a kenozoœcium, which unites the former with the zoœcium. In the stalk-like **kenozoœcium** (figs. 3 m, 3 n, 3 o), we may distinguish between a longer and thicker, calcified, ovally club-shaped central part and two shorter, cylindrical, somewhat bent terminal parts consisting of a yellow chitinous mass, of which the proximal one serves as a connection with the respective zooecium and the other as a connection with the gonozooecium. The central part has in the distal half of its less strongly arched frontal surface, which is turned towards the colony, rather a deep, oval cryptocyst depression, which is in its proximal part perforated by a round hole, and in its inner lumen we may distinguish between two narrower terminal portions, which are continued through the two chitinized terminal pieces, and a broader central portion, divided into two spaces by the somewhat oblique distal wall, the basal part of which has three single-pored rosette-plates (3o), and which meets the gymnocyst immediately on the distal side of the above-mentioned pore. In the possession of an oval cryptocyst depression, perforated by a pore, the kenozooecium answers to the stem-joints in *Chlidonia*.

Together with the appertaining ooecium **the gonozoœcium** (3 a, 3 h, 3 e) forms an elongated, rounded, somewhat compressed body, which is to a certain extent like a bean and the most arched part of which is turned away from the colony. The larger distal and more rounded half of this body is represented by the ooecium, formed by two arched, bilaminar valves (3 h, 3 l), the free margins of which meet and enclose a wide, hollow space. If these two valves are opened out from each other (3 h) it will be seen that they cover the whole of the distal cryptocyst-bearing part of the gonozooecium, which latter differs from an ordinary zooecium in several respects. While the zooecium may most properly be called rather flattened, the gonozooecium is despite its strongly arched gymnocyst somewhat compressed and seen from the side of a rounded, triangular outline (3 a, 3 k), with the two, somewhat outcurved sides of the triangle meeting in an acute angle pointing towards the kenozooecium. While in an ordinary zooecium the cryptocyst-bearing part forms an obtuse angle with the proximal part consisting of the gymnocyst, this angle is almost a right angle in the gonozooecium (fig. 3 k). The aperture is a little larger than in an ordinary zooecium, and as the gonozooecium seems to be quite symmetrical the two opesiulæ (fig. 3 e) are almost of the same size, and the above mentioned glistening stria on the proximal side of them is not inclined towards one side. The principal difference is however the absence of the two horns, the space for which is occupied by the two ooecial valves. If these be removed a lengthy, oval opening is found on either side in the margin of the gonozooecium, and the margins of this opening are continued proximally and distally into the raised line surrounding the depressed frontal area. The distal pore-chamber ends in a small, round opening surrounded by a chitinized margin, and one of the cylindrical internodes mentioned on an earlier occasion may have had its place here.

An **oœcial valve** (figs. 3 a, 3 h, 3 i, 3 k) is a strongly arched, rather thin-walled, bilaminar structure, the two layers of which are joined in the entire free margin of the valve. Its outline is like the one half of a transversely cut bean, and its straightly cut-off, proximal margin, which is in contact with the corresponding margin of the cryptocyst-bearing surface of the gonozooecium, forms on one side a right angle (towards the colony) and on the other side an obtuse angle with the curved line, that forms the further delimitation of the valve. The two valves are only connected with the gonozooecium in the periphery of the two elongated openings at its margin, and corresponding with these is a similar opening in the proximal margin of each valve. This connection is brought about by means of a slightly chitinized portion, which permits the valves to bend outwards when the larvæ are to be set free and appears on either side as a transversely oval, translucent spot, bounded proximally (towards the gonozooecium) by a slightly curved part of the separating ridge of the cryptocyst distally to the lateral pore-chamber (fig. 3 k) and distally by a curved thickened part of the ooecial valve (the »proximal arch«), which sends upwards two narrow, curved belts, originating from a partial fusion of the two layers of the valve. The inner surface of the valve also presents a chitinized portion proximally, which is bounded distally by a calcareous thickening connected with the just mentioned proximal arch. This thickening is placed lower, so that on examining the inner surface of the valve the basal arch will be seen projecting above it. The few younger stages (3 h, 3 k) I have found of such an ooecium show, that the two ooecial valves begin as two small, rounded, widely separated plates, situated immediately above the elongated openings in the margin of the gonozooecium, and that it is only later that they meet at their margins and expand over the entire periphery of the cryptocyst-bearing surface. Such a very young stage of ooecium has also been figured by Busk.

It still remains to give a morphological explanation of this singular form of ooecium. As the gonozooecium has no horn-like spines, which appear in all the other zooecia, it is an obvious conclusion that the two hollow ooecial valves may have arisen by a transformation of these spines, and in my preliminary statement[1] I have taken this view of the matter. However the conclusion cannot stand a closer examination. Besides the distal pore-chamber, situated in the side of the gonozooecium turned away from the colony, the gonozooecium has further two elongated lateral pore-chambers (figs. 3 a, 3 k), situated immediately on the proximal side of the place where the valves are attached, and the two elongated

[1] 56, p. 16.

openings in the margin of the gonozoœcium lead directly into the two pore-chambers, the inner wall of which has 6—8 small, single-pored rosette-plates. As a spine is never separated from the appertaining zoœcium by any septum furnished with rosette-plates, such being only found on the boundary between two bryozoids (or in a terminal zoœcium), we must set down the two oœcial valves as kenozoœcia, and the absence of the two spines is sufficiently explained by the fact, that the two valves leave absolutely no room for them. We have already on a former occasion called attention to the fact that a zoœcium which is only connected with a single daughter-zoœcium has only a single pore-chamber (3 c), and that the number of pore-chambers answers to the number of daughter-zoœcia. The gonozoœcium with its oœcium will accordingly correspond with a mother-zoœcium bearing two daughter-zoœcia and otherwise as we shall see later on, three daughter-zoœcia only occur on the lowest or the two lowest axial zoœcia of the colony (3 a). The chitinous connection between the gonozoœcium and its two valves is also in accordance with what we know from the other individuals of the colony.

The colonies form fine feathery tufts and take their origin from a system of branched, chitinous tubes covering various algæ. Besides the oœcia-bearing branches we may in a colony distinguish between zoœcia of first, second and third order. The zoœcia of the first order or the axial zoœcia form a slightly bent zigzag row, and in every zoœcium the broad, chitinized piece connecting it with the distally situated zoœcium is alternately on the right or the left side of the longitudinal axis of the zoœcium, on the same side as the larger opesiular opening. On the other side is the much narrower connecting belt with the obliquely, distally directed zoœcia of the second order, and from each of these two rows of zoœcia of the third order may issue. In each row there may be from two to four zoœcia. The axial zoœcia are longer than the others, the semi-elliptical ridge more angular, the two opesiulæ of less unequal size and the two horns less pointed and bent inwards a little. The principal difference in the zoœcia of the second order and those of the third order is that the two horns of the former are bent inwards as in the axial zoœcia. The lowest axial zoœcium has most frequently a branch on either side, as is also the case now and then in the lowest but one. In a number of the lower axial zoœcia radical fibres proceed from the proximal half of the frontal surface.

Of this species I have been able to examine a large number of dry colonies from South Africa (Miss Jelly).

3rd Subdivision: Pseudostega.

The boundaries of the separate *zoœcia* are not shown on the surface of the colony, which on the other hand is divided into a number of deepened areas, the number but not the extent of which corresponds with the separate zoœcia. No pores or spines. Independent *avicularia* without calcified transverse bar between the opercular and the subopercular area. The *oœcia*, situated in the distal part of each zoœcium, are inner spaces in the frontal wall of the zoœcia and open outwards through a variously shaped opening.

Family **Membranicellariidae** n. f.

The *zoœcia* have an oval aperture surrounded by a raised rim with only the distal part filled by a membranous opercular valve.

Membranicellaria (n. g.) **dubia** Busk.

? Melicerita dubia Busk, Challenger, Zoology, Vol. X, Part I, 1884, pag. 97, Pl. XXXIII, fig. 10.

(Pl. VII, figs. 2 a—2 e).

The surface of the colony is divided by distinct suture-like separating lines into broad depressed **areas** of a rhombic or hexagonally rhombic form (the two neighbouring areas sometimes only meeting in a lateral corner, sometimes in a shorter or longer edge) and in the greater part of their circumference they have a more or less distinctly bounded, rather narrow, thickened, prominent marginal part, which however most often disappears beyond the centre of the two proximal separating lines. Each area has a large, oval aperture in the centre, the distal margin of which is very slightly curved, and with the exception of this it is encircled by a pretty broad, projecting marginal portion. The entire surface of the cryptocyst is closely set with small round tubercles, which are most plentiful in the boundary ridges of the areas and in the marginal portion surrounding the aperture, and are arranged in more or less regular transverse rows. In the middle of the basal part of the distal wall a large, single-pored rosette-plate is seen, half surrounded by an arch-shaped collection of small, single-pored plates, and the distal half of each lateral wall has a similar group. The membrane covering the colony presents a system of linear, chitinous thickenings corresponding with the furrows between the separate areas, and a similar curved chitinous thickening separates the covering-membrane from the free margin of the opercular valve. The larger opercular valve has a membranous frontal surface, but a well chitinized and strongly developed opercular arch and lastly, it may be mentioned that the membrane covering the aperture has on either side towards the centre a parietal muscle attached to a very fine sclerite. That the areas mentioned, which as it were imitate zoœcial surfaces, in reality are bounded by quite a superficial system of furrows and ridges is easily discovered when a layer of zoœcia is isolated and the zoœcial basal walls are removed by grinding. It will then appear (2 b) that the elongated, hexagonal zoœcia are considerably longer and in the greater part of their length only about half as broad as the areas. The oval opening is situated in the distal part of each zoœcium and in the proximal part of the frontal surface of each zoœcium three or four areas meet.

The oœcia, which have been overlooked by Busk, have been found in a number of zoœcia in the fragment examined. Each oœcium is situated in the proximal part of a zoœcium and may be considered as a part of its cavity, which has obtained a distal and an inner wall of its own. Its frontal wall is a part of that of the zoœcium and this is also the case with the proximal wall. The frontal wall is somewhat arched and marked by three, confluent boundary lines between three areas, the marginal ridges of which are a little thickened at this place and have large, closely placed tubercles. Immediately on the distal side of the opercular valve the three-lobed opening of the oœcium appears. My material has not permitted me to investigate the development of these oœcia.

Avicularia were not found in the fragment examined; but according to the statement of Busk they occur in small number in the margin of the colony, and as far as we can judge from his figure the greater part of the subopercular area is uncalcified.

Of this species I have by the kindness of the Director of the British Museum been able to examine a small fragment of the original specimen of Busk.

To this family I must refer the following species described by d'Orbigny[1] from the French cretaceous formation, namely *Eschara Aceste* (Pl. 662), *E. Achates* (Pl. 662), *E. Acis* (Pl. 662 & 676), *E. Aega* (Pl. 663), *E. Amata* (Pl. 665), *E. Calypso* (Pl. 669), *E. Cymodoce* (Pl. 671), *E. Danae* (Pl. 675), *Biflustra rhomboidalis* (Pl. 691), *B. mæandrina* (Pl. 695), *B. Elea* (Pl. 678) & *B. echinata* (Pl. 695). In all these species occurring in free two-layered colonies, quadrangular or hexagonal rhombic areas are found arranged in transverse rows, with a larger or smaller, round or oval, generally central aperture, and the avicularia are as in *Membranicellaria dubia* usually placed in the margins of the colony. Of the just mentioned species I have myself had the opportunity of examining *E. Acis* & *E.*

[1] 86

Danæ, in which there is a similar relation between areas and zoœcia as in *M. dubia*. Oœcia appear to be found only in *B. Elea* & *B. echinata*, and they are here more conspicuous on the surface of the colony than in *M. dubia*. In the former they appear to have a trilobed opening like the one found in Busk's species. A fossil species, which may also with certainty be referred to this family, is *Biflustra Prazaki* Novak[1]. As the author gives not only a transverse section of a colony but also figures the basal aspect of an isolated zoœcial layer we here see a distinct contrast between the broad, rhombic areas and the long, narrow, hexagonal zoœcia. Until a closer examination has settled the question whether these species should be referred to one or to several genera we suggest that they be all referred to the genus *Membranicellaria*.

Family **Cellulariidae**[2] (non Hincks).

Cellariidae Hincks.
Salicornariadae Busk.
(Pls. VII & VIII).

The whole frontal wall of the *zoœcia* is a cryptocyst and they have a well chitinized, bilaminar, simple operculum with a straight or concave proximal margin. Within the proximal and sometimes also within the distal margin of the aperture is placed a pair of (or sometimes a single broad) supporting teeth.

The *oœcia* are hollow spaces in the thick frontal wall and arise by a resorption of the latter, which they finally break through. The subopercular area of the avicularia has an unusually strongly developed, sometimes almost complete cryptocyst. The colonies are most frequently jointed with cylindrical internodes, more seldom two-layered laminæ.

The depressed, rhombic or hexagonal *areas* are not only separated by the raised borders, in which the more or less sharply ascending lateral parts meet, but also by the distinct furrows which run along the middle of these borders. The aperture surrounded by a somewhat projecting margin is most frequently situated in or proximally to the distal third of the area, more seldom in its centre, and it is most often furnished with a more or less convex, more rarely straight proximal margin, which has generally short, rounded, conical, more seldom long and pointed teeth supporting the operculum. In a few cases a couple of similar teeth are also found in the distal margin of the aperture. The cryptocyst is more or less tuberculous and in a number of species (for instance in *Cell. divaricata*, *Cell. dubia*) it has within each area two long, curved, elevated

[1] 85, p. 91, Taf. III, figs. 20–25. [2] As to the use of the name Cellulariidae see 83, p. 577–78.

ridges, which may sometimes meet in the distal and proximal part of the area. The operculum, which has usually a proximal, concave, more seldom straight margin, consists of an outer membranous part, continuous with the covering-membrane, and an inner chitinized part, which is connected with the cryptocyst and must be regarded as an uncalcified part of the latter. This internal layer, which may have a variable sculpture and to the free margin of which the opercular arch is attached, shows in the species with the short, rounded supporting-teeth a light, rounded spot on the inner surface towards each corner, which is the mark left by one of the teeth. While the operculum is thus connected proximally with the cryptocyst and covering-membrane of the frontal wall, it has moreover a peculiar, suspensory apparatus on each side. On either side of it namely the inner surface of the covering-membrane is furnished with a curved, linear, chitinous thickening, a short lateral branch of which reaches as far as to the corresponding corner of the operculum, joining the chitinous layer of the latter. The two distally as well as proximally convergent chitinous thickenings are separated in most species, but in *Cell. magnifica* they meet distally as well as proximally, while in *Cell. atlantica* they meet only proximally. Lastly by a system of filiform chitinous thickenings the covering-membrane is divided into a number of areas corresponding to those of the cryptocyst, and these thickenings are situated in the separating furrows between the separate areas, being here firmly connected with the cryptocyst below. Busk wrongly supposes this filamentary net to be hollow.

The oœcia are as in the preceding family hollow spaces hidden within the surface of the zooecia and opening outwards distally to the zooecial aperture at the distal end of an area but in the proximal end of the zooecium. Their frontal wall is sometimes a little projecting sometimes a little depressed, and the outer opening may also be of a varying form. In most cases it is however transversely oval with a low but broad, rounded or quadrangularly rounded process in the proximal margin (Pl. VII, fig. 5 a, Pl. VIII, figs. 2 a, 1 a). In *Cell. fistulosa* the openings are however round at the distal end of a joint. The opening has a bilaminar operculum, which may be drawn into the oœcium by means of muscles. These peculiar oœcia seem to arise by a resorption of the thick frontal wall of the zooecia, and they begin with the formation of an extremely small cavity (Pl. VII, fig. 1 f, Pl. VIII, figs. 1 c, 2 b), gradually increasing in extent and ultimately opening outwards through the above-mentioned opening (Pl. VII, fig. 1 a, Pl. VIII, fig. 1 b), which is also formed gradually, the initial stage of it being a small slit or pore. By means of a number of longitudinal grindings we may find these oœcial spaces in different degrees of development and when they have attained a certain size their presence is already shown on regarding the frontal surface of the respective zooecia, the latter then being half transparent. Pls. VII and VIII show different stages in development of such ooecia in *Cell. australis*, *Cell. rigida* and *Cell. atlantica*.

The avicularia, only occurring in small numbers, vary much both in size and form, and the largest of them, the dimensions of which are similar to those of the zooecia, reach right to the axis of the colony, while this is not the case with the smaller of them, the latter being only wedged in between the zooecia. Judging from the figures given by Busk in his account of the *Bryozoa* of the Challenger Expedition we should imagine that these avicularia had constantly a complete subopercular cryptocyst. But although the latter may be unusually strongly developed, it is only in exceptional cases and in older zooecia, e. g. in *Cell. fistulosa*, that it reaches right up to the operculum. As a rule it has either one median or two symmetrical incisions distally, and in *Cell. malvinensis*, which is in fact one of the species figured by Busk, the median incision is separated from the opercular area by a tiny cryptocyst arch, which unites the two inner ends of the suspensory facets of the mandible.

The very peculiar fact, that the areas perceptible on the surface of the colony are by no means equal in size and extent to the zooecia, has hitherto escaped notice, and Busk's description of the separate superficial divisions as »areas« is in accordance with his incorrect conception of the above mentioned filiform chitinous thickenings as a system of hollow filaments shared in common by the whole colony, imbedded in and effecting the growth and the calcification of the separating walls, which he imagines to exist between the separate areas. There can however be no doubt that Busk thinks every area to correspond with a zooecium (»Zooecia completely immersed, each corresponding to an area«[1]). That the areas and the zooecia do not correspond in this family is most easily seen on isolating a single zooecial layer of *Cell. atlantica* and grinding away the basal wall (fig. 2 c), as the narrow elongated zooecia and the much shorter and broader rhombic areas may then be seen at the same time. In regarding a longitudinal grinding it will also be very obvious that the ooecia, the bottom of which is a part of the separating wall between two zooecia lying in the same longitudinal row, open in the distal part of an area but in the proximal part of a zooecium (Pl. VIII, figs. 1 a, 1 b, Pl. VII, fig. 4 f).

We may now by means of longitudinal and transverse sections make a closer inspection of the way in which the separate zooecia are mutually connected in

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[1] 8, p. 83.

a cylindrical segment. In the cavity of every zoœcium we may distinguish between a narrower proximal and a much wider distal part, curving outwards to the surface under a right or an obtuse angle (Pl. VII, figs. 4 a, 4 f, Pl. VIII, figs. 1 b, 1 c, 2 b). While the distal broader part, which bears the aperture, reaches the axis of the colony, the case is different with the narrower part which only reaches the frontal end of a separating wall, that separates the broad ends of two zoœcia for a short distance, but these two zoœcia are not situated in two adjoining longitudinal rows, but in two longitudinal rows separated by a third. The narrow proximal part of a zoœcium, which has a triangular transverse section (Pl. VII, figs. 4 b, 4 e) and is closed proximally by the part of the distal wall, which is furnished with rosette plates, does not join the corresponding part of another zoœcium but the broad part of the zoœcia in the two neighbouring rows, with which it is connected by a multiporous, in these zoœcia inwardly arched rosette-plate. Each zoœcium has thus on either side two multiporous rosette-plates, one arching inwards in the broad part, and one arching outwards in the narrow part. As a transverse section shows, the broad part of a zoœcium is nearest the axis separated by a separating wall from the broad part of another zoœcium, further outwards from the narrow part of a neighbouring zoœcium, and nearest the frontal side from the oœcium of the same zoœcium. A longitudinal section of a joint has a different appearance according to whether it is cut right through the axis or beside it, as in the latter case we may see not only the cavities of the two zoœcia, which have been mostly affected by the sections, but also a number of smaller cavities which have arisen by the intersection of the stellate, adjoining separating walls and lead into a number of intermediate zoœcia. This may easily be seen on imagining a section carried through fig. 4 e on Pl. VII. Time has not permitted me to enter thoroughly into the classification of this family. It may however be reasonable to suppose that the large genus *Cellularia* may naturally be divided into several, possibly according to differences partly in the chitinous ridges surrounding the aperture partly in the tooth-like processes of the latter. A generic division based only on the difference in form of colony, on the other hand, I cannot acknowledge as natural.

Of the species described in the work of d'Orbigny mentioned above the following may, I think, be referred to this family: *Eschara Bixa* (Pl. 668), *E. Artemis* (Pl. 667), *Escharinella elegans* (Pl. 683), *Escharella Argus* (Pl. 666), *Escharifora rhomboidalis* (Pl. 681) and *E. crassa* (Pl. 684), of which the three last named in contrast to the other members of this family have a smaller number of large pores surrounded by a raised margin. While none of these figures show any teeth in the aperture, the latter according to Waters is in *E. Argus* furnished with two distal and two proximal teeth as in *Cellularia rigida* and several other species. In *E. rhomboidalis* and *E. elegans* the structure of the oœcia seems to be similar to that in *Cellularia*.

Suborder Ascophora.

A compensation-sac occurs, which most often opens out immediately on the proximal side of the operculum, more rarely further back through a median pore (an ascopore). The operculum is generally a compound one more or less strongly chitinized, consisting of a distal valvular part bounded by the hinge-line and opening outwards, and of a proximal part opening inwards, which may be looked upon as the operculum of the compensation-sac. More rarely a simple operculum is found the proximal margin of which coincides with the hinge-line, and in that case the compensation-sac opens out through a median pore. The heterozoœcia have as a rule a calcified transverse bar between the opercular area and the subopercular area.

Family **Catenariidae**[1] nov. nomen.

Catenicellidae auct.

(Pls. X—XIII, Pls. XX, XXI, XXIII).

The frontal surface consisting of a gymnocyst has either a semi-circle of larger or smaller fenestræ (most often 5—7) or a number of scattered, larger or

[1] In one of the plates (Polypes, Pl. 13) accompanying the great work on Egypt Savigny who did not succeed in describing the *Bryozoa*, of which he has given so excellent figures, has at the bottom of the plate designated two species in the plate numbered as 1 and 2, as »Catenaires« and as he always in his plates designates the genera with a French name in the plural form very similar to the Latin generic name (e. g. Euphrosynes = *Euphrosyne*, Polynoés = *Polynoe*, Térébelles = *Terebella*, Gémellaries = *Gemellaria*, Chlidonies = *Chlidonia*) there cannot be the least doubt that the French name »Catenaires« corresponds to a Latin generic name *Catenaria*. Audouin, who has given names to Savigny's species, without regard to the generic name given by Savigny, refers the two species to the genus *Eucratea* and names them *E. Contei* and *E. Lafontii*. To this genus however, they do not belong. In Manuel d'Actinologie p. 462 Blainville admits that Savigny has established a genus *Catenaria*, but without justification modifies the name to *Catenicella*, and to this genus he refers *Catenaria Contei*, the name of which he changes to *C. Savignyi*. The definition Blainville gives of the genus *Catenicella* is partly made from Savigny's figures of *C. Contei* partly from *Hippothoa divaricata* which he thinks is perhaps identical with *C. Contei*, and Blainville has thus completely misunderstood the genus to which his name has ever since been associated. D'Orbigny has later instituted a genus *Catenaria* in which he placed *C. Lafonti*. I propose to keep the genus *Catenaria* Savigny with the type-species *C. Contei*, but whether Savigny's name is acknowledged or not, Blainville's name cannot in any case be maintained. If Savigny is acknowledged as author of the genus *Catenaria* then the name *Catenicella* is only a synonym and if not, it is in my opinion absolutely contrary to good sense that Blainville's name should be associated with a genus which he has not only completely misunderstood but of which he has not seen any species. In that case the genus must be named *Vittaticella* Maplestone.

smaller, sometimes extremely small pores. A cryptocyst may be found partly in the shape of a semi-circular or semi-elliptical calcareous lamina, which from the proximal margin of the primary aperture extends some way down the inner surface of the frontal area, partly within the above mentioned fenestræ. No marginal spines but sometimes short, acropetalous, adoral spines and more or less developed bilaminate spines. The aperture has a more or less strongly chitinized compound operculum, and the distal wall, consisting of a horizontal basal and an obliquely ascending frontal part, as well as the lateral walls, have a larger or smaller number of small, scattered, single-pored rosette-plates. The *zoœcia* are connected with a number of *lateral chambers*, most often kenozoœcia, frequently to a certain extent uncalcified, the typical number of which is four on each side. The second chamber (reckoned from the distal end of the zoœcium) is however in a greater or smaller number of zoœcia developed into an *avicularium*. The *oœcia*, usually situated on gonozoœcia of more or less peculiar structure, are endozoœcial and may be covered either by ordinary zoœcia or by kenozoœcia.

The free, highly branched colonies furnished with radical fibres, the zoœcia of which are all turned in the same direction, are jointed, consisting of internodes which may contain 1—3 zoœcia. Most frequently internodes with one and internodes with two zoœcia appear in the same colony, alternating in different ways.

The most peculiar character in this very natural and very distinctly defined family is the presence of the above mentioned lateral chambers. Waters[1] has called the one, which in a greater or smaller number of zoœcia is developed into an avicularium, the »avicularian chamber« and the two contiguous ones the »supra-avicularian« and the »infra-avicularian chamber«, while he calls the proximal one, which is independent of the avicularium, the »pedal chamber«. However the name of avicularian chamber cannot very well be applied as a special denomination of the above mentioned chamber, as it must be used in the ordinary sense of the word, i. e. as the name of the chamber in all avicularia, nor can it properly be applied with respect to the zoœcia in which this chamber is not developed into an avicularium. For this reason I propose to call these three chambers the »scapular«, the »supra-scapular« and the »infra-scapular« chambers. Each lateral wall of a zoœcium in connection with the lateral chambers mentioned has generally two separate groups of rosette-plates, a distal and a proximal, the number of plates in which most frequently varies between 10 and 4 but sometimes may be only one. In the genus *Hincksiella* the proximal group is wanting and the distal one represented by 1—2 rosette-plates. In the species of

[1] 107, p. 83.

the genus *Claviporella* the proximal one is also represented by a single rosette-plate. While the proximal group serves as a communication with the pedal chamber the distal group serves either as communication with the scapular chamber only as in *Scuticella plagiostoma*, *Sc. intermedia*, *Sc. ventricosa*, *Cat. margaritacea*, or as communication with the infra-scapular chamber as well, e. g. *Sc. amphora*, *Sc. lorica*, *Sc. Wilsoni* and the species of the genus *Catenaria*. If the scapular chamber is developed into an avicularium, its roof or distal wall (Pl. XI, figs. 1 c, 3 b, 3 c, 4 b) is furnished with a number of rosette-plates forming a communication with the supra-scapular chamber, while the proximal wall furnished in the same way (Pl. XI, figs. 1 c, 2 b, 3 a, 7 b) makes a septum for the infra-scapular chamber, which, as stated above, in a series of species may also be in direct communication with the zooecium. If on the other hand the scapular chamber has not attained this degree of development it will coalesce with or be only incompletely separated from the adjacent chambers. While as a rule there will be no difficulty in distinguishing the various lateral chambers belonging to the solitary zooecia or those belonging to the outer (abzooecial) sides of the bi-zooecial articulate parts, it may be more difficult to identify several of the lateral chambers belonging to the inner (adzooecial) sides of the two zooecia in a bi-zooecial segment. Moreover these two zooecia are not of equal value, as we must distinguish between a mother-zooecium springing from the proximally situated segment, and a daughter-zooecium without communication with the segment but issuing from the mother-zooecium.

If the adzooecial side of the daughter-zooecium is furnished with an avicularium, its three distal lateral spaces will always be clearly developed, e. g. in *Costicella hastata* (Pl. XX, fig. 8 b), *Pterocella alata* (Pl. XXI, fig. 1 a), *Catenaria elegans* (Pl. XXI, fig. 2 a) and *Cat. formosa* (Pl. XXI, fig. 3 a), whereas its pedal lateral chamber (d. IV) is usually wanting. It is however present in all the species of the genera *Costicella* and *Catenaria*, in *Strophipora Harveyi* as well as in *Scuticella sacculata*, Busk and *Sc. frigida*, Waters[1] which two species may be regarded as transitional forms between the genera *Scuticella* and *Catenaria*. Although the daughter-zooecium itself has lateral chambers it still takes the same place in relation to the mother-zooecium as the scapular chamber in a solitary zooecium, being in communication with the mother-zooecium through the group of rosette-plates described above as the distal, and the adzooecial, distal lateral chamber of the mother-zooecium which communicates with the daughter-zooecium through a group of rosette-plates, must accordingly be explained as the

[1] 115, pl. 1, fig. 1 a.

adzoœcial, supra-scapular (m. I) lateral chamber of the mother-zoœcium. This is clearly seen e. g. in *Scuticella maculata* (Pl. XX, fig. 5 b), in which species this chamber lies opposite the corresponding abzoœcial, supra-scapular lateral chamber, from which it is only separated by a short raised line. Although the daughter-zoœcium, as said before, may be considered the adzoœcial, scapular chamber of the mother-zoœcium, and we cannot for this reason expect to find an avicularium on the adzoœcial side of the mother-zoœcium, the species of the genus *Pterocella* (Pl. XXI, fig. 4 a) make an exception to the rule, a small adzoœcial avicularium being always present. The adzoœcial, pedal chamber of the mother-zoœcium (m. IV), which is always developed, is not difficult to find, and it then only remains to determine the adzoœcial, infra-scapular chamber of the mother-zoœcium (m. III). We have seen that an infra-scapular chamber is only independently developed in such zoœcia as are furnished with an avicularium with which they communicate through the proximal wall of the latter, but that in a series of species it also communicates with the zoœcium itself through some of the rosette-plates in the distal group. In accordance with our conception of the daughter-zoœcium as being the scapular chamber of the mother-zoœcium, we must consider the only lateral chamber that we have not yet explained as the adzoœcial, infra-scapular chamber of the mother-zoœcium. It is in most cases a very small, oval or pear-shaped, sometimes almost slit-like space, situated almost in the middle of the boundary line between the two zoœcia of the segment, and rarely attaining any considerable size. Its extent is largest in *Strophipora Harveyi* (Pl. XXI, fig. 6 a), in which besides extending a little into the daughter-zoœcium it also occupies half the frontal surface of the mother-zoœcium. In *Scuticella Wilsoni* it also attains a considerable size, filling as it does the greater part of the deep depression between the sternal areas of the mother-zoœcium and the daughter-zoœcium. In the species of the genus *Catenaria* this boundary chamber has like the ordinary infrascapular chamber a double inner communication (through rosette-plates), viz. both with the daughter-zoœcium and with the mother-zoœcium, while the corresponding chamber in *Scuticella* species only communicates with the mother-zoœcium. A similar difference, as already mentioned, is found within the genus *Scuticella*, all the rosette-plates of the distal group serving in some species as a communication with the scapular chamber, while in others some of them form a communication with the infrascapular one. With respect to the above chamber we must still notice that it generally occurs somewhat inconstantly within the genus, in *Scuticella margaritacea* for instance it is absent, while it is present in the form described in this work under the name of *Sc. margaritacea*, var. *connectens* (Pl. XX, fig. 3 b), but which perhaps ought to be considered a separate, though very closely allied species. In the genus *Catenaria* it seems to be constant.

We have already observed (pag. 215), that a more or less complete coalescence of the three distal lateral chambers into a single, wholly or partly membranous chamber takes place in all the cases in which an avicularium has not been developed. But in addition, the adzoœcial, pedal chamber of the daughter-zoœcium may fuse with the adzoœcial, infra-scapular chamber of the mother-zoœcium in the bizoœcial segment in several *Catenaria* species, e. g. in *Cat. Buski* and *Cat. fusca.*

As Mac Gillivray in the genus *Scuticella* speaks of an „epitheca", which is generally understood to be a membranous covering over a cryptocyst, I must expressly emphasize, that in this family a cryptocyst only occurs in the form either of the above mentioned, inner calcareous lamina or as an incomplete filling of the fenestræ of the sternal area. In a series of forms a large part of the surface of the zoœcium is indeed covered by a membrane; but in these cases it is the uncalcified external wall of the peculiar lateral chambers, which may in some cases cover the whole of the zoœcial surface, and it might be as justifiable to call the membranous frontal wall in a *Flustra* an epitheca in relation to the calcified basal surface. In all other cases a membrane is completely absent on the calcified surface of the zoœcium. These lateral chambers attain their greatest extent in *Strophipora Harveyi* (Pl. XXI, figs. 6 a—6 f), in which they cover nearly the entire surface of the zoœcium and are only separated by narrow calcareous ridges. They also reach a considerable development in *Scuticella Wilsoni* (Pl. XI, figs. 2 a—2 c, Pl. XX, figs. 2 a—2 b) in *Sc. amphora* (Pl. XI, figs. 3 a—3 c), *Sc. urnula* (Pl. XX, figs. 1 a—1 c, Pl. XI, figs. 4 a—4 b), *Calpidium ornatum* (Pl. XX, figs. 11 a—11 f) and *Cal. ponderosum* (Pl. XXI, figs. 5 a—5 f), in which species they chiefly cover the greater part or the whole of the basal surface. In *Sc. Wilsoni* (Pl. XI, figs. 2 a—2 c, Pl. XX, figs. 2 a—2 b) the greater part of the frontal surface is formed by the infra-scapular lateral chambers and the entire basal surface by the supra-scapular and the pedal, while the greater part of the basal surface in *Sc. amphora* (Pl. XI, figs. 3 a—3 b) is formed by the supra-scapular and the pedal and in *Sc. urnula* (Pl. XI, figs. 4 a—4 b) by the supra-scapular, the infra-scapular and the pedal chambers.

Finally, it must still be remarked that the gonozoœcia as well as the keno-zoœcia covering the oœcia may have lateral chambers in varying number and developed to a varying extent, and on the whole these chambers must be said to be of great systematic importance.

While in a smaller number of the species of this family a distinct sinus is found in the proximal part of the aperture, e. g. in *Hincksiella pulchella* (Pl. XII, fig. 9 a), *Scuticella margaritacea* (Pl. XX, figs. 3 a—3 b), *Sc. ventricosa*, var., *Cribricella rufa* (Pl. XII, figs. 7 e, 7 f), the species of the genus *Calpidium* (Pl. XX, fig. 11 a) etc., a much larger number show more or less distinctly, that such a sinus, which I propose to call the "sternal sinus", must have been present at an earlier stage but has later on become wholly or partly filled by outgrowths from the margins of this sinus. It seems in fact that the species of the genus *Catenaria* and *Strophipora Harveyi* are the only ones that show no traces of such a sternal sinus, while the most indistinct traces are found in the genus *Scuticella*, most species of which show a short sutural line in the middle of the proximal margin of the aperture (Pl. XX, figs. 1 a, 5 a, 5 b), arisen by a concrescence of two short ribs which have filled the sinus, a very small remnant of the latter being generally seen in the form of a little perforation behind the suture. If the two ribs are somewhat projecting, the original extent of the sternal sinus is clearly seen, as e. g. in *Scuticella Wilsoni* (Pl. XX, fig. 2 a). The vestige of this sinus is much more distinct in *Sc. urnula* (Pl. XX, fig. 1 a) and *Pterocella alata* (Pl. XX, fig. 4 a), in which it is filled by two larger distal and two or three smaller, almost tubercle-like proximal ribs. While the sinus in the *Calpidium* species (Pl. XX, fig. 11 a) is filled by the proximal part of the compound operculum, so also in *Claviporella* (Pl. XII, figs. 3 a—3 b, Pl. XX, figs. 10 a—10 b) the proximal part of the operculum takes part in filling it, but at the same time the proximal part of the very deep, primary sternal sinus is cut off, in the shape of an oval or slit-like opening, from the part filled by the opercular tongue by two ribs meeting in a sutural line, which in *Cl. aurita* show a distinct internal hollow. In the genus *Costicella* the sternal sinus not only attains its maximum size, but the ribs filling it appear in larger number, separated by transverse fissures and showing a distinct internal hollow, which is but rarely seen in the short rudimentary ribs, found in the majority of the species of this family. Thus in *Scuticella sacculata* (Pl. XII, fig. 2 a) a distinct internal hollow is found in the two lateral ribs.

To understand the structure of the ribs or spines, which wholly or partly fill the sternal sinus, we must bear in mind that the above mentioned, internal, rounded calcareous lamina, which may I think justifiably be defined as a cryptocyst lamina although it is covered by a gymnocyst, starts from the proximal margin of the primary aperture at a time when this has not yet become calcified, and as the sternal sinus forms indeed a larger or smaller part of this margin, this cryptocyst lamina must consequently in a greater or smaller extent be said to spring from the margin of the sinus. In this way it springs wholly or partly from the sternal sinus in the species of the genus *Costicella*, while this sinus only to a slight extent takes part in its formation in most species of the genus *Scuticella*. When the cryptocyst lamina expands on the inner surface of the frontal wall the ribs grow at the same time from the bilaminar, uncalcified marginal portion, in which the cryptocyst and the gymnocyst meet, and they must therefore themselves be considered bilaminar, although the two layers in most cases will be coalesced into one solid rib. In some cases e. g. in *Scuticella margaritacea*, var. *connectens* (Pl. XX, figs. 3 b, 3 c) these spines, between which there is left a part of the original sinus, remain uncalcified at the end, and this may be seen most plainly in the gonozoœcium.

While the above mentioned cryptocyst lamina is originally only continuous with the margin of the primary aperture and is otherwise free (Pl. XI, fig. 1 n cpl.), it gradually with growth coalesces with the inner surface of the frontal wall to a varying extent and in different ways; it is for instance distinctly seen in *Costicella hastata* (Pl. XII, figs. 1 a—1 d, see explanation of plates) that the hollow in the quadrangular, plate-like spines rising from the sternal sinus, is continued beyond their starting point up to the round fenestræ in the sternal area. The fact is that the regions, separating these hollow spaces from each other, are formed by a fusion or soldering of the cryptocyst lamina with the inner surface of the gymnocyst.

With the exception of a few species (*Calpidium ornatum*, *Pterocella gemella*) in which every internode consists of two or three zoœcia, we find in the others internodes with one and internodes with two zoœcia alternating more or less regularly with each other, but we may in this respect distinguish between two cases, which do not however show any important differences, as both may appear within the same genus. In one case a bizoœcial internode always takes its origin from a unizoœcial one, while here and there a series of successive single zoœcia may spring from the daughter-zoœcium of a bizoœcial joint. This is the case e. g. in *Scuticella plagistoma*, *Sc. intermedia*, *Sc. lorica*, *Sc. Wilsoni*, *Sc. amphora*, *Sc. maculata*, *Cribricella rufa*, *Crib. cribraria*, *Catenaria perforata*, *Cat. elegans* and *Cat. formosa*. In the other case one bizoœcial segment may on the contrary often follow another, which may be repeated at least three times, while at the same time an alternation of uni- and bizoœcial internodes may be seen in the neighbouring branches. This may be seen in *Scuticella ventricosa*, *Sc. margaritacea*, *Pterocella alata*, *Claviporella geminata*, *Catenaria Buski*, *Cat. fusca*, *Cat. laurina* and *Strophipora Harveyi*.

Synopsis of the genera.

1) The inner surface of the frontal wall with a rounded cryptocyst lamina (issuing from the proximal margin of the primary aperture), the free margin of which is most often distinctly visible through the frontal surface, especially through its fenestræ:

2) The hinge-teeth slightly developed and indistinct:

3) The frontal surface with numerous, scattered pores; the inner calcareous lamina short and broad and only seen distinctly from the inner surface of the frontal wall .... *Cribricella* n. g.

3) The frontal surface with from three to twenty odd (more rarely only a single) larger or smaller fenestræ or pores disposed in a continuous curve or in an angle; sometimes within the area bounded by the fenestræ transverse fissures more or less regularly arranged in pairs; the free margin of the internal calcareous lamina generally clearly visible through the fenestræ.

4) Within the area bounded by the fenestræ a larger or smaller number of transverse fissures separating more or less developed, generally hollow spines.

The lateral chambers wholly or almost wholly calcified; the adzoœcial, scapular chamber of the daughter-zoœcium developed into an avicularium .... *Costicella* n. g.

4) No transverse fissures found within the fenestræ; at most 2—5 rudimentary spines on the proximal side of the aperture; lateral chambers mostly membranous: the scapular chamber on the adzoœcial side of the daughter-zoœcium not developed into an avicularium........ *Scuticella* n. g.

2) Strongly developed hinge-teeth in the shape of robust, conical or cylindrical processes, generally freely projecting within the aperture:

5) The zoœcia with 2—4 cylindrical, acropetal spines distally, and a rudimentary circular pedal chamber proximally; the aperture with a deep, rounded sinus .... *Claviporella* Mac Gillivray.

5) No cylindrical acropetal spines:

6) The aperture, not surrounded by a protruding margin; the four lateral chambers forming on each side a continuous, wing-like marginal portion in the whole length of the zoœcium; the adzoœcial side of the mother-zoœcium with an avicularium.................. *Pterocella* n. g.

6) The aperture surrounded by an acutely protruding sometimes bilobate margin; the lateral chambers forming no wing-like marginal

portion (the adzoœcial side of the mother-zoœcium without an avicularium) .... *Calpidium* Busk.

1) No inner calcareous lamina within the frontal wall:

7) The lateral chambers occupying only a small part of the surface of the zoœcium; no longitudinal ridges dividing the frontal surface of the zoœcium into two lateral halves:

8) The frontal surface with a circle of small round fenestræ, and the zoœcium with a wing-like, protruding marginal portion on each side in the whole of its length; this marginal portion formed only by the supra-scapular and the scapular chambers, the latter of which is developed into an avicularium; hinge-teeth slightly developed and not protruding into the aperture; the latter furnished with a well developed sinus .... *Hincksiella* n. g.

8) The frontal surface furnished at most with extremely fine, scattered pores; no wing-like marginal expansions; the pedal lateral chamber very oblong, narrow, sometimes linear; hinge-teeth strongly developed, freely protruding into the opening; the latter has a concave proximal somewhat protruding margin; the aperture is ultimately closed by three calcareous processes issuing from the inner margin and meeting in the centre .... *Calenaria* Savigny. (Vittaticella Maplest.).

7) The lateral chambers occupying nearly the entire surface of the zoœcium and on the frontal surface only separated by a narrow, longitudinal ridge, divided into two by a furrow; this ridge has an annular expansion, perforated by a pore, on the proximal side of the aperture .... *Strophipora* Mac Gillivray.

Scuticella n. g

(Catenicella auct.)

The *sternal area* has 3—11 (in a single species only one) fenestræ or pores, disposed in a curve or an angle, and on its inner surface a rounded calcareous lamina springing from the proximal margin of the aperture. The hinge-teeth are rudimentary or indistinct and never freely protruding into the aperture, the proximal margin of which may be straight, concave or convex, sometimes with a small sinus or indentation, to which however the operculum never corresponds. The *lateral chambers* are wholly or mostly membranous, and the adzoœcial, scapular chamber of the daughter-zoœcium is never developed into an *avicularium*. In the old zoœcia the aperture is not only closed by a calcareous lamina springing from its inner margin, but a calcareous expansion is also formed under the sternal area, which joins the calcareous lamina that closes the aperture.

Of the numerous species of this genus we shall here only describe a few, making one of them, *Scuticella plagiostoma*, the object of a more detailed description.

Scuticella plagiostoma Busk.

Catenicella plagiostoma Busk, Voyage of Rattlesnake, pag. 358, Catalogue of Marine Polyzoa, Cheilostomata, pag. 8, Pl. V, figs. 1, 2.

(Pl. XI, figs. 1 a—1 p).

The asymmetrical, angularly oval **zoœcia** have an oblique aperture, the length of which is about one-third of the whole length of the zoœcium and its anter is almost semi-elliptical. From the two indistinct hinge-teeth the lateral margins bend outwards, converging again proximally, and the aperture is by this means provided with a short proximal expansion, which has a slightly convex margin forming an obtuse angle with the one and an acute angle with the other lateral margin of the aperture. The slightly chitinized operculum, surrounded by a more chitinized marginal portion, does not fill the lateral parts of the proximal expansion of the aperture and somewhat decreases in breadth from the hinge-line towards the proximal end.

The sternal area, occupying the greater part of the frontal surface, has 5 large, generally pear-shaped fenestræ covered by a membrane. They are separated by narrow ribs, which meet in the centre of the zoœcium in an oblong sternal portion. This often shows more or less distinct sutural lines as sign of the fusion and such a faint sutural line, ending in a fine pore, is seen almost vertically on the proximal margin of the aperture and a little closer to the acute-angled corner. It is due to the fusion of the two extremely small ribs, that fill the extremely small sternal sinus. Inside the inner half of the fenestræ we find the marginal portion of the oblique, semi-elliptical, cryptocyst lamina, which springs from the proximal margin of the aperture and originally hangs freely down on the inner surface of the sternal area (fig. 1 n, c. pl.). In time however it coalesces partly with the sternal ribs and partly with that cryptocyst, which gradually closes the outer part of the fenestræ. The distal wall (fig. 1 n, dw.) is composed of a basal, horizontal and a frontal, obliquely ascending part, of which the former is provided with numerous (up to 60) small, uniporous rosette-plates, disposed in a horseshoe-shaped group with the opening towards the frontal side of the zoœcium. The ascending part is distinctly visible through the operculum at the distal end of the aperture.

Each lateral wall is divided into two planes, bent towards each other at an angle (figs. 1 f, 1 g), and, excepting the one that separates the mother-zooecium from the daughter-zooecium in the bizooecial segment and which has in its proximal part more than 30 uniporous rosette-plates, each of these planes has towards its centre a small group of 4—10 rosette-plates. Through the proximal of these groups the zooecium directly communicates with the pedal chamber, and through the distal one either with the scapular chamber only or with the infra-scapular one as well, which is in many cases either not at all or only incompletely separated from the former. The scapular chamber is generally developed as an avicularium on both sides of the zooecium succeeding the mother-zooecium of the bizooecial segment (fig. 1 a), and on the external side of the solitary zooecium or zooecia springing from the daughter-zooecium of the same segment. If a series of (up to 4) zooecia starts from the latter, one or several of them is often provided with avicularia on either side; but only in very rare cases do we find an avicularium on a bizooecial segment. The two avicularia occurring on the same zooecium are generally of different size. This difference is however largest in the zooecium springing from the mother-zooecium of the bizooecial segment, as the avicularium situated on the same side as the acute-angled corner of the opening may be three times the length of the other. The avicularia, the opercular area of which has a strongly developed cryptocyst, have an angularly rounded roof, rising outwards into a more or less steeply ascending, rounded and pointed terminal part which in the large avicularium is very long and proximally to the distal point is furnished with a short hook. The roof of each avicularian chamber is provided with 4—10 rosette-plates, which serve for communication between the avicularium and the supra-scapular chamber. The latter has only membranous outer walls, formed by two outwardly ascending membranes, which meet at an acute angle and are separated from the avicularium only by a low, arch-shaped calcareous ridge on each side. The large avicularium, of the length of the zooecium, has its aperture turned obliquely towards the frontal surface of the colony, while the aperture of the small avicularium is turned in the opposite direction. While the large avicularium takes up the entire distal plane the small one occupies only the distal half of the latter, but in such a way that all the rosette-plates are situated within its margin, whereas the proximal wall of the avicularium forming the boundary towards the infra-scapular chamber has 4—6 rosette-plates (fig. 1 d). Apart from the low, ridge-like calcareous walls, which partly surround and partly separate them from each other, the infra-scapular as well as the pedal chamber are only covered by a membrane. But while the infra-scapular chamber corresponding to the small avicularium is situated immediately on the proximal side of the latter, the one corresponding to the large avicularium is placed basally to its proximal part (fig. 1 h), and a similar though not always as obvious a displacement of this lateral chamber may also be seen in a greater or smaller number of the single zoœcia, which may follow the daughter-zoœcium of the bizoœcial segment. With exception of the above mentioned case the scapular chamber of the other zoœcia is generally more or less incompletely calcified, and the calcareous walls, separating the complete avicularium from the supra-scapular and the infra-scapular chambers, are either altogether wanting or but incompletely developed. This chamber is generally least developed on the inner side of the zoœcium (fig. 1 g) immediately succeeding the often mentioned daughter-zoœcium. It is here mostly membranous and differs from the pedal chamber in one thing only, viz. that the surrounding marginal ridge in its frontal part terminates generally in a more or less developed spear-shaped process. In all the other cases (figs. 1 f, 1 e, 1 i), where this lateral chamber is not developed as an avicularium, its distal and frontal walls are membranous and only the lateral walls are calcified to a greater or lesser extent in different zoœcia, forming thus two, as a rule triangular calcareous laminæ connected with each other under an outwardly directed angle.

While, in this species, it is not difficult to decide the position of the various **lateral chambers** in the solitary zoœcia, the case is a little more complicated with respect to the bizoœcial segment, as the daughter-zoœcium, which has lateral chambers of its own, must according to its position be regarded as the adzoœcial, scapular chamber of the mother-zoœcium. As regards the two abzoœcial lateral walls, of which one belongs to the mother-zoœcium the other to the daughter-zoœcium, there can be no doubt, that the distal cavity corresponds to the three first, here unseparated lateral chambers, while the proximal one is the pedal. There then remain two lateral chambers, which are at the same time bounded by the mother- and the daughter-zoœcium (fig. 1 b), a distal one, mostly bounded by the distal part of the adzoœcial lateral wall of the daughter-zoœcium, which has about 8 rosette-plates, and a proximal one, mostly bounded by the proximal part of the adzoœcial lateral wall of the mother-zoœcium, which is provided with 6—7 rosette-plates, and only to some extent by the proximal, truncated end of the daughter-zoœcium. The distal chamber, the frontal wall of which is partially calcified and thus forms a triangular or rounded triangular calcareous lamina beside the aperture of the daughter-zoœcium, is in exactly the same relation to the daughter-zoœcium as the supra-scapular chamber is to the avicularium and must accordingly be regarded as the supra-scapular chamber of the mother-zoœcium. The proximal of the two cavities may with as much certainty be considered the pedal, adzoœcial chamber of the mother-zoœcium, being situated on the proximal surface of the respective lateral wall, through the rosette-plates of which it is in direct communication with the zoœcium. The infra-scapular chamber of the mother-zoœcium is wanting.

At a certain age an occlusion of the aperture gradually takes place (Pl. XI, figs. 1 o, 1 p), and the calcareous lamina which fills it, the oral cryptocyst, joins a cryptocyst expansion developing on the inner side of the sternal area and taking its origin from the outer part of the single fenestræ. In contrast to the several times mentioned, rounded cryptocyst lamina, the sternal cryptocyst, we may call this the marginal cryptocyst. After having reached a certain size the cryptocyst laminæ of the single fenestræ unite together and with the oral cryptocyst by means of a connective ridge formed across the inner surface of each sternal rib, and henceforth the marginal and the oral cryptocyst form a continuous ring-shaped expansion, gradually increasing in breadth. The oral cryptocyst issuing from the junction of the horizontal and the obliquely ascending parts of the distal wall is directed proximally and frontally and increases in extent simultaneously with a considerable increase in thickness on account of new calcareous layers being formed on its frontal surface. The sternal cryptocyst gradually coalesces not only with the ribs but on both sides of these also with the outer (fenestral) part of the marginal cryptocyst and this may lead to a complete occlusion of the fenestræ.

Setting aside the fact that from the daughter-zoœcium of the bizoœcial internode a number (up to 4) of successive, single zoœcia may sometimes arise, the last of which completes the branch, the uni- and bizoœcial segments otherwise alternate regularly in this species. With regard to the position of the separate zoœcia we must notice, that the mother- and daughter-zoœcium of the same segment have the acute-angled corners of their respective apertures directed towards each other, and the position of the apertures of the succeeding single zoœcia is the same. The above-mentioned, successive single zoœcia all have the apertures situated in the same way, whereas the aperture of the mother-zoœcium in the bizoœcial segment has an inverted position in relation to the lower zoœcium. The lateral branches, which always arise from the daughter-zoœcia, spring alternately from the right and the left side.

For the sake of completeness I must further add that the colony is provided with radical fibres, which form close bundles along the basal side of the separate branches and spring from the basal side of the zoœcium with which they communicate through a collection of numerous uniporous rosette-plates.

Oœcia are wanting in the colonies from the Bass' Strait, to which the above description refers, but they are found in some colonies of the variety *setigera* originating from the same place, which among other things differ from the main form in having the lateral chambers extended over more than two-thirds of the basal side of the zoœcium and their membranous walls ending in a number of scattered chitinous denticles.

A gonozoœcium with its covering kenozoœcium bears a certain resemblance to a helmeted head and springs from a single zoœcium, which again springs from the mother-zoœcium of a bizoœcial segment. The gonozoœcium and the covering kenozoœcium are of about the same size, and a transverse section through the centre of the entire complex has the form of a rounded trapezium with a larger frontal and a smaller basal side and with two sides converging basally. The wide aperture, the operculum of which has a more strongly chitinized marginal portion, is shared in common by the gonozoœcium and the kenozoœcium. It is bounded by a more strongly arched distal and a less strongly arched proximal margin, in the centre of which there is a short sutural line passing on to a small, transversely oval pore. The sternal area has 6—7 pear-shaped fenestræ disposed in an angle, of which the two distal are situated on a level with the median pore. The first pair of ribs, which limit the aperture proximally, pass without any distinct boundary into the broadly rounded inner cryptocyst lamina, while the second pair of ribs, which are provided with an acutely projecting terminal part, meet in the above-mentioned suture on the proximal side of the aperture. Finally, the gonozoœcium is on each side provided with two large, flat, generally trapeziform lateral chambers (fig. 1 l), of which the distal, which has 10—15 rosette-plates, corresponds to the three distal lateral chambers and the proximal, with about 10 rosette-plates, to the pedal chamber. The real ooecium is the helmet-shaped, arched distal wall of the gonozoœcium, the proximal, obliquely ascending part of which is provided with a very large number of uniporous rosette-plates. This ooecium is again covered by a kenozoœcium, in which we may distinguish between a large, uncalcified, saddle-shaped or horse-shoe-shaped central portion and two proximally continuous, but distally widely separated, calcified portions, a frontal and a basal one. The frontal surrounds the aperture distally and is composed of two strongly arched lateral halves, which from their proximal part, situated distally to the two lateral chambers, decrease in breadth towards the frontal end and are connected only by a very low portion on the distal side of the aperture. The basal part, which is bent towards the frontal side and which seen from the side is like the crest of a helmet, is rather narrow, frontally pointed and bounded by two curved, lateral margins (fig. 1 m). On either side between the two calcified portions the ooecium itself is provided with two long but also broad and close belts of pores, while the calcified portions are connected with the oœcium by a great many strong, cylindrical or conical spinous processes springing from the latter. A number of these processes outside the calcified portions serve to support the membranous part of the covering kenozoœcium. In the approximate centre of the basal region we find the starting point of a small, membranous, triangular chamber, which is provided with a series of chitinous denticles along each lateral margin, and which communicates with the oœcium through a triangular basal surface with two symmetrically arranged groups of 5—7 uniporous rosette-plates. A short, low, median, calcareous ridge springs from the proximal side of the basal surface and possibly originates from a median separating wall.

Scuticella ventricosa Busk.

Catenicella ventricosa Busk, Voyage of Rattlesnake, I, pag. 357, t. 1, fig. 1,
Catalogue of Marine Polyzoa, Cheilostomata, pag. 7, Pl. II, figs. 1, 2.
(Pl. XX, figs. 5 a—5 c (a), Pl. XI, figs. 6 a—6 b).

The zoœcia hexagonally oval with an aperture bounded by a slightly concave, proximal margin, which has an extremely short sutural line centrally. The sternal area is provided with 5—7 fenestræ converging at an acute angle, and the inner cryptocyst lamina is of a triangularly pointed form and may attain about half the length of the sternal area.

The lateral chambers. Except on the adzoœcial side of the daughter-zoœcium in a bizoœcial segment, the scapular chamber is everywhere developed as an avicularium with a small, oval mandible, and the supra-scapular chamber, the wall of which is only calcified in its outermost part distally to the avicularium, may end in a shorter or larger, ascending, pointed portion. Proximally to the avicularium we find an oval infra-scapular and a very long, somewhat broader, pedally and more frontally directed chamber, which occupies about two-thirds of the whole length of the zoœcium. It is separated from the infra-scapular chamber by a horizontal or somewhat oblique wall, and along its centre provided with a longitudinal row of 5—10 rosette-plates. Finally we find in the bizoœcial segment on the boundary between the mother- and the daughter-zoœcium a long, narrow, distally directed cavity (Pl. XX, fig. 5 b, m. III), which almost reaches the pedal chamber of the mother-zoœcium proximally, and which communicates with the mother-zoœcium through a row of 4 rosette-plates. It must be regarded as the adzoœcial, infra-scapular chamber of the mother-zoœcium.

The oœcium (Pl. XI, figs. 6 a—6 b). The gonozoœcium, which is about twice the length of the covering kenozoœcium, is most often situated on the mother-zoœcium of a bizoœcial segment, but is not infrequently found on a single zoœcium. The aperture has a small indentation in the middle of its proximal margin, while the structure of the sternal area and its cryptocyst lamina is similar to that of the zoœcia. Each of the lateral surfaces of the gonozoœcium communicates in the whole of its length with a large, long, lateral chamber provided with numerous rosette-plates, and this chamber, I believe, corresponds to the long pedal chamber in the zoœcium. The covering kenozoœcium a little distally to the aperture has a transversely oval fenestra on each side through which the real oœcium can be seen, and above each fenestra a small avicularium, which on the inner side is in communication with a supra-scapular and on the outer and basal side with an infra-scapular chamber.

Form of colony. The regular alternation of the uni- and bi-zoœcial internodes is often interrupted so that we may find several bizoœcial internodes succeeding each other.

Of this species I have examined colonies from the Bass' Strait.

Scuticella maculata Busk.

Catenicella ventricosa (var. maculata) Busk, Catalogue of Marine Polyzoa, Cheilostomata, Pl. III, fig. 4.

(Pl. XX, figs. 1 a—1 b, Pl. XI, figs. 7 a—7 e).

The zoœcia large, broad, angularly oval with a triangularly rounded aperture, which has an almost straight margin. The sternal area is of a structure similar to that in *C. ventricosa,* but it is provided with a broader and more rounded cryptocyst lamina, and immediately on the proximal side of the aperture we find a transversely placed, inner cavity opening out into the aperture on either side of the short sutural line.

The lateral chambers. The scapular chamber is generally developed as an avicularium only on the outer side of the single zoœcia, and the supra-scapular chamber has a steeply ascending, pointed, calcified outer wall. The form and the position of the infra-scapular and the pedal chambers are similar to those in *C. ventricosa,* but the two chambers are separated by an oblique or nearly vertical wall. Here too we find a long, narrow boundary chamber between the mother- and the daughter-zoœcium.

The oœcium (Pl. XI, figs. 7 a—7 e). The gonozoœcium, the length of which may be contained about $2^1/_2$ times in the entire length of the covering kenozoœcium, is generally situated at the end of a branch formed by 1—4 zoœcia springing from a mother-zoœcium, and more seldom takes its origin directly from a mother-zoœcium. The aperture has a small sinus in the middle of its proximal margin and on either side of this a robust, conical, obliquely ascending spine. The sternal area is provided with 5 small fenestræ, and each of the lateral surfaces of the gonozoœcium with a pear-shaped oval, most probably pedal, lateral chamber. The frontal surface of the covering kenozoœcium has 1—10 larger or smaller fenestræ of very variable form. When occurring in small numbers several of these fenestræ are very large and show by their lobate form, that they have arisen by coalescence of several smaller ones. We may distinguish between an outer, arch-shaped group and a group on the distal side of the aperture. All four lateral chambers are developed, and the scapular one appears as a small avicularium, while the two supra-scapular chambers have coalesced into one, which takes up the entire breadth of the kenozoœcium (fig. 7 a), and which has on either side a vertical, pointed, calcified outer wall. This chamber has besides a group of rosette-plates in the roof of each avicularium, a great many scattered plates in the median part, which is separated by a low ridge from the frontal as well as from the dorsal surface of the kenozoœcium. On the outer and the basal side of the avicularium there is a small, oval, infra-scapular chamber and separated from it a large, trapeziform pedal chamber.

Form of colony. Apart from the fact that rows of 1—5 single zoœcia, (which may arise from both a mother- and a daughter-zoœcium), may appear as terminal branches, the alternation of uni- and bi-zoœcial internodes is otherwise regular, and two bizoœcial internodes nowhere succeed each other.

Of this species I have been able to examine some fragments from Port Western, Victoria (Miss Jelly).

Scuticella margaritacea Busk.

Catenicella margaritacea Busk, Voyage of Rattlesnake, I, pag. 356, Catalogue of Marine Polyzoa, Cheilostomata, pag. 9, Pl. VI, figs. 1, 2, 3.

(Pl. XX, fig. 3 a, Pl. XI, figs. 5 a—5 e).

The zoœcia rhombic-oval with an aperture, the proximal, more or less concave margin of which is provided centrally with a small, well defined, sometimes however quite rudimentary sinus, the entrance of which is bounded by two extremely short spines directed somewhat distally and pointed at the end. These spines are sometimes widely separated, and the sinus then reaches its maximum (colonies from the Bass' Strait), sometimes almost concurrent at the ends and the sinus is then rudimentary or reduced to a pore (Port Phillip Heads). The operculum, which does not entirely fill the aperture, has a proximal, concave margin, and the sternal area is provided with five fenestræ disposed in an arch or angularly. The cryptocyst lamina is of a broad, rounded triangular form, and the strongly arched basal surface is divided into dendritically branched longitudinal belts.

The lateral chambers. The scapular as well as the infra-scapular chamber is turned slightly frontally. It is in most cases developed as an avicularium of very variable size, which may attain a considerable, sometimes enormous size especially in the branches consisting of single zoœcia only. The infra-scapular chamber, which has generally a long oval opening, terminates in a projecting, conical, membranous portion, which forms an angle with the avicularium. The pedal chamber, which in the zoœcia with a large avicularium almost reaches right up to the infra-scapular chamber, is usually separated from the latter by a rather short intermediate space. It is provided with a wholly frontal and at least in the single zoœcia longitudinally oval or pear-shaped opening. The infra-scapular, adzoœcial chamber of the mother-zoœcium is wanting in the bizoœcial segment.

The oœcium. The gonozoœcium, which is of about the same length as the covering kenozoœcium, takes its origin either directly from a mother-zoœcium or from an inserted single zoœcium. The aperture is provided with a broad, more or less regular, sometimes extremely indistinct sinus, in which the narrow distal ends of the two outermost of the 3—5 fenestræ of the sternal area often terminate. No spines. On either side 1—2 small, oval chambers, the distal of which is often very small or absent, sometimes on one sometimes on both sides.

The covering kenozoœcium has on either side a large, long, frontally pointed, basally broadly rounded, uncalcified portion, through which the oœcium can be seen. The latter is here provided with a longitudinally club-shaped, very dense collection of pores, the intermediate spaces of which partly project as tubercles. In the frontal portion between the two areas as well as along the distal and proximal margins of the latter the oœcium and the covering kenozoœcium are connected with each other by a great many robust spinous processes, and the kenozoœcium has in the centre of its frontal surface a chamber developed to a varying extent, which is sometimes mostly membranous and sometimes developed as a rather high avicularium. In the latter case it is connected on either side with a partially membranous chamber, of which the one side joining the opercular end of the avicularium is somewhat higher than the other. In spite of the median position of these chambers they may be regarded as corresponding to the three lateral chambers on one side in an ordinary zoœcium.

Form of colony. In the principal axis and the principal branches springing from it two bizoœcial segments succeed each other with a single zoœcium between (2, 2, 1, 2, 2, 1 . . . .).

Scuticella margaritacea, var. fissurata n.

(Pl. XX, figs. 3 b, 3 c).

This form, which may for the present be regarded as a variety, differs from the main form in the following characters. The relatively large sinus is bounded by two short, broad, hollow spines, which are open at the end and which form the greater part of the proximal margin of the aperture. The mother-zoœcium of the bizoœcial segment has a slit-like, adzoœcial, infra-scapular chamber. The frontal surface of the gonozoœcium is on either side provided with two rounded lateral chambers, and its aperture has a well-developed, rather deep sinus, which like the zoœcial aperture is bounded by two short, broad, hollow spines open at the end. The oœcium lacks the two groups of closely situated pores, and the kenozoœcium has at its top a high avicularium, which communicates with two unequally large, partially membranous lateral chambers.

Of this form I have examined colonies from Port Phillip, Australia.

Scuticella urnula Mac Gilliv.

Catenicella urnula Mac Gillivray, Transactions and Proceedings of the Royal Soc. of Victoria for 1886, Vol. XXIII, pag. 34, Pl. I, figs. 2, 2 a, 1887.

(Pl. XX, figs. 1 a—1 e, Pl. XI, figs. 4 a, 4 b).

The zoœcia large, rhombic-oval with a longitudinally rounded aperture, bounded by a concave proximal margin. The long, oval sternal area is provided with 5—7 pear-shaped fenestræ and with a long, tongue-shaped cryptocyst lamina, which often reaches the starting point of the proximal fenestra. The comparatively large, deep, sternal sinus is occupied by 2—5 ribs or spines, of which the two distal are very high and the proximal, when occurring, are very small and tubercle-shaped.

The lateral chambers. The scapular chamber is in most zoœcia developed as a good-sized, more or less complete avicularium with the aperture frontally directed and in the complete state with a short and broadly triangular mandible. It is, chiefly on account of its arched outer wall, well separated from the zoœcium, and the pointed lamina springing from its top, which forms the outer wall of the supra-scapular, for the rest membranous chamber, gives it a certain likeness to the lobe of an ear in a mammal. On the adzoœcial surface of the daughter-zoœcium it is a low membranous cavity, which, apart from a separating line but partly developed, has fused with the corresponding chamber of the mother-zoœcium. The scapular chamber is often more or less incompletely developed on one or on both sides of a greater or smaller number of the zoœcia succeeding the daughter-zoœcium. This incompleteness most often means the absence of the mandible and transverse bar in the aperture, and as a rule also a more or less incomplete calcification of the wall separating the scapular from the infra-scapular chamber. The infra-scapular and the pedal chambers, whose boundary ridges towards the frontal surface of the zoœcium give the latter a rhombic form, are separated by a ridge running obliquely basally and proximally. These chambers take up not only the lateral surfaces but also the greater part of the basal surface, along the middle of which they are separated by a rather narrow longitudinal belt (Pl. XI, figs. 1 a, 1 b). The infra-scapular chamber communicates with the zoœcium by up to 10 rosette-plates and with the avicularium by only 1—2. The mother-zoœcium is provided with a long, narrow, adzoœcial, infra-scapular chamber.

The oœcium. The gonozoœcium, which is considerably smaller than the covering kenozoœcium, is situated sometimes on a mother-zoœcium, sometimes on an inserted single zoœcium. The aperture has a very broad and deep sinus, consisting of a wider outer part, which is bounded by two arch-shaped, inwardly converging margins, and of a narrower inner part, which has a small, rounded process on either side. The sternal area is provided with 7—9 very narrow fenestræ and with a broad cryptocyst lamina, while each lateral surface is occupied by two large lateral chambers separated by an angulated ridge. The covering kenozoœcium distally to the aperture on either side has a very irregular, transversely oval or bean-shaped, often more or less sharply sinuated or lobed uncalcified portion with a cryptocyst depression in its marginal portion. On its surface we find 6—10 chambers of most variable form, which are covered by a membranous roof and bounded only by low ridges. Distally to and outside the two uncalcified areas there is on both sides either one very long and rounded or two adjacent chambers, a larger and a smaller one. On the basal side of the oœcium we find three, a smaller unpaired one proximally and two adjacent ones distally, the proximal half of which may sometimes be provided with a separating ridge. On the frontal side of this group we find again a separate one ending in a very thin point (figs. 1 b, 1 c), while its basal part has two bulgings which may be separated as independent chambers.

Form of colony. We may find rows of up to 5 single zoœcia springing from a daughter-zoœcium, but otherwise the alternation of uni- and bi-zoœcial internodes is regular.

Of this species I have examined a colony from Port Phillip Heads (Miss Jelly).

Scuticella sacculata Busk.

Catenicella sacculata Busk, Challenger, Zoology, Vol. X, Part I, pag. 12, Pl. 1, fig. 7.
(Pl. XII, fig. 2 a).

The zooecia, the surface of which is provided with a number of very small, widely scattered pores, are long, slender and constantly increasing in breadth from the very narrow proximal end towards the aperture, from which the lateral margins again converge distally. The aperture has a slightly concave proximal margin, and the extremely small sternal area has but a single, small, round fenestra proximally. The sternal sinus is occupied by three spines, of which the proximal, rudimentary one is solid, while the two others, which meet in a sutural line, have an inner cavity opening outwards through a small pore near the distal margin. The sternal cryptocyst lamina has an arch-shaped proximal margin, which is clearly visible on the frontal surface through the only opening of the latter.

The lateral chambers. The scapular chamber is everywhere except on the adzooecial side of the daughter-zooecium developed as a medium-sized, rather strongly projecting and somewhat ascending avicularium, which is directed outwards and slightly basally. The other chambers are wholly membranous and bounded only by low calcareous ridges. The supra-scapular one, of which but an extremely small part is seen on the basal surface, on the frontal surface almost reaches the distal margin of the aperture and the outer end of the roof of the avicularium. The infra-scapular one, which is directed laterally, is rather large and of an oblong, quadrangular or pentagonal form. It is separated by a small intermediate space from the very long and rather broad pedal chamber, which is situated a little more frontally and occupies about two-thirds of the whole length of the zooecium. Along its middle we find a row of 6—7 rosette-plates. The mother-zooecium is provided with a long, narrow, infra-scapular adzooecial chamber.

Oœcia have hitherto not been found.

This species may be regarded as a transitional form between *Scuticella* and *Catenaria*. I have been able to examine a small fragment of it, for which I owe thanks to the direction of the British Museum.

Costicella n. g.

The *sternal area*, which is provided with 1—14 fenestræ, disposed in a curved line, and with a cryptocyst lamina of a similar outline, is to a greater or smaller extent formed by a number of generally hollow spines, springing from the sternal sinus and separated by fissures. Hinge-teeth rudimentary or indistinct, never projecting freely in the aperture. The supra-scapular chamber with a calcified roof. The occlusion takes place in a similar way to that in *Scuticella.*

Besides in the above mentioned characters the four species here described correspond in the following. The scapular chamber is generally developed as a small avicularium also on the adzoœcial side of the daughter-zoœcium, and the first three lateral chambers form a more or less compressed, protruding and somewhat frontally directed, wholly or mostly calcified portion, which is separated from the frontally directed pedal chamber by a rather large intermediate space. There is a very small supra-scapular chamber on the adzoœcial side of the mother-zoœcium and a pedal chamber on the adzoœcial side of the daughter-zoœcium. The basal wall of the zoœcia has a more or less distinct, longitudinal striation. The gonozoœcia, situated either on a mother-zoœcium or on an inserted zoœcium, are always provided with at least two frontally directed lateral chambers, which must be regarded as the scapular and the pedal. The frontal surface of the covering kenozoœcium has two large, transversely oval fenestræ, and within each of these we find on the oœcium a long, dense collection of spinous processes and tubercles, among which numerous pores are generally discovered. Further a larger or smaller part of the frontal surface of the true oœcium is provided with robust spinous processes, which have coalesced with the inner surface of the kenozoœcium. On the top of the latter we sometimes find a small kenozoœcium, sometimes a small avicularium communicating on either side with a small calcified lateral chamber.

Costicella solida n. sp.

(Pl. XX, fig. 7 a, Pl. XII, figs. 1 k, 1 h).

The sternal area, which is not much longer than the aperture, has 5—6 fenestræ situated in a broad curve, within which a quadrangularly rounded cryptocyst lamina is seen. In the inner part of the area there are 5—7 very short spines separated by distinct fissures, which show great variation in respect to their mutual connection. The two distal ones are generally very high and plate-shaped, and each of them has most frequently a larger or smaller, often bifurcate, inner cavity, which is connected with a pore in the middle of the oral margin. In the others the inner cavity is usually wanting or if present extremely narrow.

The lateral chambers. The supra-scapular chamber has a triangular excision on its frontal surface near the aperture and a smaller one in the outermost, proximal part of the basal surface, while the infra-scapular and the pedal chambers have a rather large, oblong, frontal opening. On the adzooecial side of the daughter-zooecium the three distal chambers have coalesced into a single cavity, and an avicularium is accordingly wanting. The mother-zooecium has a very small, slit-like, infra-scapular adzooecial chamber.

The oœcium (Pl. XII, fig. 1 k). The gonozooecium, which sometimes springs from a mother-zooecium, sometimes from an inserted single zooecium, is approximately of the same size as the covering kenozooecium, and together they are of a broad, hexagonally rounded form with two parallel lateral margins curving inwards a little. The sternal area has 3 small fenestræ and 3—5 spines separated by short fissures. The two distal spines, which meet in the oral suture, have a large inner cavity connected with a large oval pore in the oral margin. The others are very short and generally have no inner cavity. Within the very broad fenestræ of the kenozooecium pores as well as numerous spinous processes are seen, while the supporting processes, which reach the calcareous roof of the kenozooecium, are most numerous in the portion between the two fenestræ. On the side of these fenestræ we find a continuation of this median portion, which goes as far as the aperture and is bounded by two lateral margins converging towards the latter. A small median chamber may appear on the top of the kenozooecium. It is always found in specimens from the Bass' Strait, in which it is very oblong and provided with one or several slit-like openings in the roof. On the other hand its appearance is very inconstant in colonies from Port Phillip, in which it is very small, oval and only calcified at its base.

Form of colony. In all the principal branches and sometimes also in some of the secondary branches two bizooecial internodes succeed each other (2, 2, 1, 2, 2, 1 . . . .).

Of this species I have examined colonies from Port Phillip and the Bass' Strait.

Costicella cuspidata n. sp.

Pl. XX, figs. 6 a—6 e).

The sternal area, which may be longer than the aperture by a half, is provided with 7—10 small fenestræ disposed in a broad curve, and within these there are 6—8 smaller ones, of which one is generally situated in the central line far back. In the central portion of the area we see three, more seldom four spines, of which the two large, plate-shaped distal ones have an inner, most frequently three- or four-branched cavity connected with as many pores, of which we usually find one on each side of the proximal margin of the aperture. Very often, perhaps in most cases, the cavities of the two large spines communicate through a broader or narrower transverse branch. In a small, most often triangular opening, situated proximally to the two large spines, we find generally but a single, very short, rudimentary, solid spine, more rarely two.

The lateral chambers. The supra-scapular chamber has a number of scattered pores, and in the proximal part of the basal surface a rounded excision, which is somewhat larger than these. The infra-scapular chamber has a small, round or oval opening proximally, and the small pedal chamber an oval or long frontal opening, which is much larger. The mother-zoœcium has no adzoœcial, infra-scapular chamber. It is characteristic of this species that the last of the zoœcia completing a row springing from a daughter-zoœcium has a terminal, compressed, narrow, rhombically rounded chamber (Pl. XX, fig. 6 b).

The oœcium. The gonozoœcium, which is but half as high as the covering kenozoœcium, is sometimes borne by a mother-zoœcium, sometimes by an inserted single zoœcium. It is provided with a rather broad but low frontal sinus, which is bounded on either side by a very short somewhat bent spine, and thus the single pair of spines do not meet as in the other species. The sternal area is much reduced and has 5 very small fenestræ, situated immediately on the proximal side of the aperture. Along its frontal, central line the covering kenozoœcium is provided with two rather large pores, which may be sometimes single, sometimes more or less deeply divided by a tongue springing from their distal margin. The two groups of pores and spinous processes within the long, lateral fenestræ meet in a median, generally angularly bent portion, which reaches the proximal of the two median pores. The small, terminal kenozoœcium is sometimes developed as an avicularium and then communicates with two small cavities.

Form of colony. In the principal branches two bizoœcial internodes succeed each other (2, 2, 1, 2, 2, 1 . . . .).

Of this species I have examined colonies from Port Phillip.

Costicella hastata Busk.

Catenicella hastata Busk, Voyage of Rattlesnake, I, pag. 355, Catalogue of Marine Polyzoa, Part I, p. 7, Pl. II, figs. 3, 4.

(Pl. XII, figs. 1 c, 1 d, 1 f, 1 g, 1 j, Pl. XX, figs. 8 a, 8 b).

The sternal area, which may be about twice the length of the aperture, has 7–9 fenestræ, disposed in a long curve, and as many hollow spines, of which each is provided with a pore in or towards the end. Each of the spines in the first pair has however often two, which then correspond with a bifurcate cavity.

The lateral chambers. The supra-scapular chamber, which may sometimes

(e. g. in a form from Twofold Bay) be very long and pointed, is, apart from a number of scattered pores, wholly calcified. The infra-scapular has a small, oblong opening on the basal side and a smaller one on the frontal side, and the pedal chamber has most often a long, narrow frontal opening. The mother-zoœcium has an extremely small, slit-like, adzoœcial, infra-scapular chamber (m. III).

The oœcium. The gonozoœcium, which is but half as long as the covering kenozoœcium, is situated on a mother-zoœcium. Its sternal area is as long as the aperture and provided with 4—5 small fenestræ and as many spines, of which the two distal are much higher than the others. Each of these has a large, inner cavity with generally three pores, of which two are seen just inside the oral margin. The other spines are short and narrow, and the inner cavity may often be wanting. The high kenozoœcium has distally to the aperture a longitudinal belt bounded by two parallel lateral margins. This belt reaches the two lateral fenestræ and has a small, oval pore proximally. Within each of the two long lateral fenestræ we see an oblong group of pores, the projecting reticulation of which does not, or but to a small extent, end in spinous processes. The supporting processes springing from the oœcium appear in great numbers over the larger part of the frontal surface. On the top of the kenozoœcium there is sometimes a small, rounded, compressed, wholly calcified cavity, sometimes an avicularium, which again communicates with two lateral cavities.

Form of colony. In the principal branches the uni- and bi-zoœcial internodes alternate according to the formula 2, 2, 1, 2, 2, 1 . . . .

Of this species I have examined colonies from Port Phillip and from Twofold Bay.

Costicella benecostata n. sp.

(Pl. XII, figs. 1 a, 1 b, Pl. XX, figs. 9 a).

The sternal area, which is about twice the length of the aperture, is provided with 8—14 small, round fenestræ, and with as many hollow spines separated by distinct fissures. Most of these spines are rather high, quadrangular and only the two or three proximal ones are conical. The first two spines are much higher than the others, but the inner cavity is often comparatively small. Further, the relative position of the two rows of spines may vary considerably, as they may sometimes be wholly or partly opposite, sometimes wholly or partly alternate.

The lateral chambers are much more calcified than in the other species, and with exception of the supra-scapular one, which has on its basal surface two small excisions, they have but a few pores. The scapular chamber, which is also developed as an avicularium on the adzoœcial side of the daughter-zoœcium, is very small, arched and rather strongly projecting. The adzoœcial, infrascapular chamber of the mother-zoœcium is not developed.

The oœcium. The gonozoœcium springs from a mother-zoœcium and is of about the length of an ordinary zoœcium, but much broader and 3—4 times as long as the small, cap-shaped, covering kenozoœcium. The structure of the sternal area is similar to that of the ordinary zoœcia, and this may also be said of the lateral chambers on the adzoœcial side with exception of the first one, which is smaller and more steeply ascending. On the adzoœcial side of the gonozoœcium the lateral chambers are much more faintly developed, situated almost vertically on the frontal wall, and the scapular chamber is not developed as an avicularium. No unpaired, median pores are found, and within the two transversely oval fenestræ, which are here quite frontal, we find but one group of spinous processes and no pores. On the top of the kenozoœcium there is a rather large, quadrangular or triangular chamber, compressed from front to base, which is sometimes undivided, sometimes divided by two septa into three cavities, of which the central one was not developed as an avicularium on any specimen I have examined.

Form of colony. The regular alternation of uni- and bi-zoœcial internodes is broken in the terminal part of the principal branches by two or three bizoœcial internodes succeeding each other (2, 2, 1, 2, 2, 1 . . . . or 2, 2, 2, 1 . . . .).

Of this species I have examined some fragments from Port Western.

Besides the four, above-described species which show a number of agreements with *Scuticella margaritacea*, it seems, that the following tertiary species described by Mac Gillivray[1] must be referred to this genus, viz. *Catenicella lineata*, *Cat. latifrons* and *Claviporella longicollis*.

Cribricella n. g.

The *sternal area* has numerous, scattered pores, of which the outermost are disposed in a distinct curved line, and a small, transversely oval cryptocyst lamina on its inner surface. The hinge-teeth are rudimentary or indistinct and never projecting freely in the aperture. The occlusion takes place in a way similar to that in *Scuticella*.

[1] 76, p. 14, 15, 21.

Cribricella rufa Mac Gillivray.

Catenicella rufa M. Gillivr., Transact. Royal Soc. of Victoria 1868, Vol. IX, pag. 126.

(Pl. XII, figs. 7 a—7 f).

The zoœcia are elongated, quadrangularly oval, and the sternal area is provided with numerous scattered pores, of which the outermost are not much larger than those situated further in. The aperture has a proximal concave margin with a small, rounded sinus centrally.

The lateral chambers. The scapular chamber is in most zoœcia developed as a generally rather small, frontally directed avicularium, which never appears on the adzoœcial side of the daughter-zoœcium. It is usually wanting on the inner side of the single zoœcia, which occur in rows and may spring both from a mother- and from a daughter-zoœcium, but in the latter case the opposite avicularium is often large. Of the other lateral chambers we see from the frontal surface only a part of the supra-scapular one, which has a membranous roof but a projecting calcified outer wall. The long, narrow infra-scapular chamber passing from the outer side of the avicularium obliquely towards the basal surface bends again more or less far down the latter surface and is at its terminal part almost parallel with the likewise long, narrow pedal chamber, which runs along the lateral margin of the zoœcium. The mother-zoœcium has a long, infra-scapular, adzoœcial chamber.

The oœcium. The gonozoœcium, which is somewhat shorter than the covering kenozoœcium and situated on a mother-zoœcium, is of the same length but twice the breadth of the zoœcia, and the structure of the sternal area is similar to that of the latter. Its wide aperture has a broad, but indistinctly marked sinus, on the proximal side of which a short, broadly rounded, inner cryptocyst plate is seen. Along each lateral margin we find a long, narrow, pedal chamber, basally to which there is a shorter, somewhat curved one, and the chambers correspond to those of the distal group. The large covering kenozoœcium is on its frontal surface provided with numerous, scattered, rather large pores, and the distal group of lateral chambers is generally represented on either side by an oblong, mostly membranous cavity, in which we may distinguish between a shorter and wider distal part, which can be seen from the frontal surface, and a longer, more narrow, somewhat curved part, which reaches halfway down the basal surface. The projecting wider part, which is often conical, may have more or less strongly calcified walls and often be provided with but a narrow, slit-like opening. In a single case it was only present on one side and then communicated with a very small avicularium. The pedal lateral chamber is represented by two (more seldom by three) membranous cavities of somewhat variable form and size.

Form of colony. While uni- and bi-zoœcial internodes seem to alternate regularly everywhere in the principal branches, we may find two bizoœcial internodes succeeding each other immediately on the proximal side of the oœcium.

Of this species I have examined colonies from Port Phillip and from Port Phillip Heads, Victoria (Miss Jelly).

Cribricella cribraria Busk.

Catenicella cribraria Busk, Voyage of Rattlesnake, I, pag. 359, Catalogue of Marine Polyzoa, Cheilostomata, pag. 9, Pl. V, fig. 3—4, Challenger, Zoology, Vol. X, Part I, pag. 11, fig. 6.

(Pl. XII, figs. 8 a—8 c).

The zoœcia broadly oval. The sternal area with numerous pores, of which those situated in the margin are much larger than those scattered inside. The aperture with a proximal concave margin, from the centre of which issues a sutural line. This line separates two short, plate-shaped, hollow spines, which are provided with small pores and may be strongly arched. There is a narrow, curved transverse slit on the proximal side of the aperture.

The lateral chambers. The scapular chamber is everywhere, also on the adzoœcial side of the daughter-zoœcium, developed as a large, compressed avicularium, the strongly concave frontal surface of which is bounded at both ends by a process. The supra-scapular chamber, which is almost wholly calcified, is long, narrow and provided with a curved terminal part. A very short lateral branch ending in a pore starts from the proximal half of its frontal side and its bent proximal end, which can be seen from the basal surface, likewise terminates in an uncalcified portion. The infra-scapular and the pedal chambers are well separated, long, narrow and provided with a longitudinal slit. An infra-scapular, adzoœcial chamber is wanting in the mother-zoœcium.

The oœcium. The gonozoœcium, which is twice as high as the covering kenozoœcium, is situated sometimes on a mother-zoœcium, sometimes on an inserted zoœcium. The sternal area is somewhat depressed and provided with numerous scattered pores, of which the inner ones are in part larger than on the zoœcium. The aperture has an almost straight proximal margin, and there are no hollow spines. Two very narrow lateral chambers with a slit-like opening are found along each lateral margin. The covering kenozoœcium has a distal, more strongly arched, indistinctly marked portion and on each side a large, pear-shaped or triangular fenestra. Within the latter the oœcium shows an irregular collection of very small pores. Numerous spinous processes are found outside the two fenestræ and in the region between them.

Form of colony. In the principal branches we find everywhere a regular alternation of uni- and bi-zoœcial internodes, and branches of up to 8 single zoœcia may spring from the daughter-zoœcium.

Of this species I have examined colonies from Port Western, Bass' Strait and from New Zealand (Akaroa). I only found a few oœcia on the latter.

Hincksiella n. g.

The *sternal area* has a number of fenestræ disposed in a curve, but no cryptocyst lamina. Hinge-teeth rudimentary or indistinct not projecting in the aperture. Of lateral chambers only the supra-scapular and the scapular occur, and these form together a wing-like flange on either side of the zoœcium. The occlusion takes place in a way similar to that in *Scuticella*.

Hincksiella pulchella Maplestone.

Catenicella pulchella Maplestone, Journal Micr. Soc. Victoria, Vol. 1, 1880, pag. 64, Pl. V, fig. 4.

— Busk, Challenger, Zoology, Vol. X, Part I, pag. 13, Pl. I, fig. 4.

(Pl. XII, figs. 9 a—9 c).

The zoœcia oval, with a longitudinally striated basal surface and with a slightly arched sternal area, which has 6—7 oval fenestræ on either side. The aperture has a proximal concave margin with a small sinus centrally, the entrance of which is narrowed by two short, somewhat bent, dentiform processes. The zoœcium is separated from the lateral chambers by very thick walls (fig. 9 c) and the zoœcial margins between the fenestræ and the lateral chambers are therefore very dark.

The lateral chambers form a wing-like flange in the entire length of the zoœcium. They are wholly calcified and apart from a pore at the end of the triangular, steeply ascending, supra-scapular chamber, they are otherwise without pores. The scapular chamber, which communicates distally with the zoœcium through 1—2 uniporous rosette-plates, is everywhere, also on the adzoœcial side of the daughter-zoœcium, developed as an avicularium and provided with a very small, proximally directed mandible. A pedal chamber is not developed and the adzoœcial, infra-scapular chamber of the mother-zoœcium is wanting.

The oœcium. In the two cases hitherto found the gonozoœcium is a mother-zoœcium situated on a single zoœcium. It is covered by a zoœcium of ordinary structure, which only shows any difference in having a number of scattered pores in its frontal wall which does not seem to be specially strongly arched. Nor does this covering-zoœcium complete the branch, but may be succeeded by at least one single zoœcium. The aperture of the gonozoœcium has a proximal concave margin with acute corners.

Form of colony. The alternation of uni- and bi-zoœcial internodes is regular. Of this species I have examined some small colonies from Port Phillip Heads.

Claviporella M. Gillivray, char. emend.

The aperture is provided with a more or less deep sinus and with two robust, strongly projecting hinge-teeth. Behind the aperture there is an inner cryptocyst lamina and most often an oval, median pore, a remnant from the primary frontal sinus. On either side of the aperture is a cylindrical acropetal spine, and the pedal chamber, situated far proximally, is rudimentary and only communicates with the zoœcium through a single rosette-plate. The occlusion takes place in a way similar to that in *Scuticella*.

Claviporella geminata W. Thomps.

Catenicella geminata W. Thompson, Nat. Hist. Review, V, 1858.
Proceed. Dublin Univ. Zool. and Botan. Associat. I, pag. 81, Pl. VII, figs. 3, 4.

(Pl. XII, figs. 3 a, 3 b).

The zoœcia, which excluding the lateral chambers are rounded trapeziform, have a number of very small scattered pores, and the sternal area generally shows 2—5, most often very small fenestrae. The aperture, the sinus of which is twice as long as broad, is surrounded by 2—4 acropetalous spines of very varying size, 2 distal, frontally directed ones and two lateral, the two former of which diverge very little and may attain the length of the aperture on the single zoœcia. On the mother-zoœcium they are but small, and this is always true of the lateral ones, which are most often rudimentary or absent on the single zoœcia. On the proximal side of the sinus a more or less distinct sutural line leads down to a small, very narrow pore, the margins of which are generally provided with small, dentiform processes. The two short, broad spines, which meet in the sutural line, do not show any vestige of an inner cavity.

The lateral chambers. The scapular chamber is everywhere, also on the ad-zoœcial side of the daughter-zoœcium, developed as a somewhat compressed avicularium of very variable size, the distal wall of which terminates in a beaked hook. This avicularium may sometimes attain the size of the zoœcium. The supra-scapular chamber is separated frem the avicularium by a straight wall. It is a compressed, roundedly triangular cavity, increasing outwards in height, which is wholly calcified with exception of a narrow, oval fissure in the inner part of its roof. The infra-scapular chamber is furnished with a right-angled or acute-angled corner, which forms almost a right angle with the frontal surface of the avicularium. It is compressed, trapeziform and calcified with exception of the surface forming an angle with the avicularium. On the adzoœcial side of the mother-zoœcium proximally to the avicularium of the daughter-zoœcium there is a small supra-scapular chamber and on the proximal side of the lateral spine we find an extremely small, rounded chamber, which must be regarded as the adzoœcial, infra-scapular chamber of the mother-zoœcium. A pedal chamber is wanting on the daughter-zoœcium, but found on both sides of the mother-zoœcium.

The oœcium. The gonozoœcium is a mother-zoœcium and differs from the ordinary zoœcia in wanting the two distal spines and in having a broader sinus in the aperture. The oœcium is covered by the distal zoœcium, which is accordingly provided on one side with a strongly arched expansion, the surface of which has a number of scattered, wart-like projecting pores.

Form of colony. The principal branches are composed solely of bizoœcial internodes, in which the mother-zoœcium bears a considerably larger avicularium than the daughter-zoœcium and appears alternately to the right and to the left. A single zoœcium may spring only from the daughter-zoœcium.

Of this species I have seen a few fragments from Port Phillip.

Claviporella aurita Busk.

Catenicella aurita Busk, Catalogue of Marine Polyzoa, Cheilostomata, pag. 8, Pl. IV, figs. 1, 2, 3.

(Pl. XX, figs. 10 a, 10 b).

The zoœcia oval or angularly oval with very few, scattered, fine pores, and with a sternal area provided with 3—5 rather small fenestræ. The aperture, the sinus of which is not longer than broad, is surrounded by 4 acropetalous spines of very variable size, two distal and two lateral ones, of which the two former, which diverge at a right or obtuse angle, are of a robust cylindrical form and may become a little longer than the aperture. The two lateral ones are considerably smaller and never seem to be wanting. A sutural line leads from the sinus down to an oval pore, and on either side of the suture we generally find an inner cavity belonging to the two short spines, which meet in the latter.

The lateral chambers. The scapular chamber, which in contrast to that in the preceding species, has no beaked hook, is not everywhere developed as an avicularium and is often absent on the one side of a single zoœcium as well as of a bizoœcial internode. While the three distal lateral chambers together form a body of a shape somewhat similar to that in the foregoing species, the extent of the three chambers separately is different, the scapular chamber being dilated both distally and proximally at the expense of the two other chambers, and the sinus, which in *Cl. geminata* is formed between the scapular and the infra-scapular chamber, is here formed by the former only, the septum between the two chambers having retreated much farther proximally. The supra-scapular chamber is separated from the scapular by an angulated septum and has a fissure in its roof. It is an extremely small, triangular or quadrangular cavity, which together with the distal part of the scapular chamber forms a rounded process, the form and position of which reminds one of the distal spines. The infra-scapular chamber is generally triangular and wholly calcified with exception of a small frontal pore. The pedal chamber appears in the same way as in the foregoing species. This may also be said of the above-mentioned chamber on the bizoœcial internode.

The oœcium. The gonozoœcium is a single zoœcium, and the covering kenozoœcium is of the length of the gonozoœcium and has a depression along the centre of the frontal surface, which is provided with a number of widely scattered pores. The aperture, which is provided with two distally converging, arch-shaped lateral margins, has a broad, trapeziformly rounded sinus, the proximal part of which is covered by the spines which meet in the sutural line. On either side of the aperture we find a distally directed, strong, conical, lateral spine of the length of the aperture, and outside this on either side a single, rounded quadrangular, lateral chamber with a small rounded pore.

Form of colony. Uni- and bi-zoœcial internodes alternate, but in such a way that two bizoœcial internodes succeed each other rather frequently. The single zoœcia may spring from the daughter-zoœcia in rows of up to 5. They are sometimes on the outer side provided with an avicularium, which may exceed the zoœcium in size, and such an enormous avicularium is found especially in a form from Akaroa (New Zealand).

Of this species I have examined colonies from Port Phillip, Auckland, Cape Wilson and New Zealand.

Claviporella pusilla Wilson.

Catenicellopsis pusilla Wilson, Quart. Journal Micr. Soc. Victoria, 1880, pag. 64.
— — Mac. Gillivray, Mc. Coy, Prodromus of the Zoology of Victoria, decade XI, pag. 29, Pl. 107, figs. 1—1 e.
(Pl. XII, figs. 1 a—1 f).

The zoœcia are pear-shaped, very strongly arched and provided with small, scattered pores. The small sternal area has but a single, very small fenestra besides the larger median one, situated proximally to the sutural line, and the two spines, meeting in the latter, have often an inner cavity. The aperture has a rather broad, rounded sinus, on the distal side of which we find two widely separated, slightly diverging, generally slender, cylindrical spines. Special lateral spines are wanting, the robust, spine-like process on either side of the aperture being the scapular chamber.

The lateral chambers. As far as I can see on the examined fragments the scapular chamber is everywhere developed into an avicularium with a small, triangular mandible (fig. 1 g). The chamber itself is of a short, thick, robust, cylindrical or conical form and is wholly calcified. A supra-scapular chamber seems to be wanting, and in the proximal part of the avicularian chamber is found a small, rudimentary, infra-scapular chamber. As in the other two species a rudimentary, pedal chamber is present, whereas there is no small chamber on the boundary between the mother- and the daughter-zoœcium.

The oœcium. The gonozoœcium is a mother-zoœcium. The form of its aperture is similar to that of the gonozoœcium in *Cl. aurita*, and here too a smaller or larger part of the sinus may be covered by the two spines. The scapular chamber on the adzoœcial side is not developed as an avicularium and is shaped like a strong, somewhat bent spine of the length of the aperture. At its proximal part there is a rudimentary, infra-scapular chamber. The covering zoœcium, the arched, covering part of which is provided with a number of scattered pores, lacks the small pore of the sternal area as well as the rudimentary pedal chamber. The internode is not completed by the covering zoœcium any more than in *Cl. geminata*.

Form of colony. In the principal branches uni- and bi-zoœcial internodes alternate regularly and rows of single zoœcia appear.

Of this species I have examined some dead colonies from Victoria, most zoœcia of which had been attacked by algæ and Foraminifera.

Pterocella n. g.

The *sternal area* has 3—7 fenestræ disposed in a curve and a rounded cryptocyst lamina on its inner surface. The aperture, the posterior part of which is trapeziform or arch-shaped, is provided with two strongly developed, freely projecting hinge-teeth. The lateral chambers form a wing-like marginal portion on either side in the whole length of the zoœcium. The mother-zoœcium has a small *avicularium* on its adzoœcial side. The occlusion takes place in a way similar to that in *Scuticella*.

Pterocella alata Wyv. Thompson.

Catenicella alata Wyv. Thompson, Nat. Hist. Review, 1858.
Proceed. Dublin Univ. Zool. and Botan. Associat. I, pag. 80, Pl. VI, fig. 4.
(Pl. XII, figs. 6 a, 6 b, pl. XXI, fig. 1 a).

The zoœcia oval with a number of very small scattered pores and a very strongly arched basal surface with undulating, longitudinal striæ. The sternal area, which is of about the same size as the aperture, is provided with 1—6 round or oval fenestræ, through which the margin of the inner calcareous lamina can be clearly seen. The plainly visible frontal sinus is occupied by 1—3 proximal, rudimentary or very slightly developed spines and further by the two large, distal ones which meet in a sutural line. The two latter sometimes show a small inner cavity. The anter of the aperture is semi-elliptical, and its poster has a straight median portion and two lateral parts obliquely ascending towards the hinge-teeth.

The lateral chambers form on either side a distally directed, rounded, triangular expansion, the top or the point of which lies at the end of the suprascapular chamber. The distance between the ends of the two scapular chambers is in a unizoœcial internode about the length of the internode, and the two lateral expansions form a distal angle of 120°—140° with each other. The scapular chamber, which is everywhere developed as an avicularium with an extremely small mandible, has the form of a long, compressed tube, and contrary to the case in all the above-described species an avicularium appears also on the adzoœcial side of the mother-zoœcium, where it is situated opposite the distal part of the aperture. It is here however considerably shorter and stands out almost vertically from the surface of the zoœcium. The wing-like expansions formed by the lateral chambers are widest in the supra-scapular chamber, from which they decrease in breadth proximally. The supra-scapular chamber, which has an ascending distal margin, is high, trapeziformly pointed and provided with a rounded triangular opening on the frontal surface in its proximal part. A similar, though somewhat smaller opening is found on the infra-scapular chamber while the pedal chamber has a large, oval opening. Immediately to the proximal side of the above mentioned, vertically protruding avicularium there is a narrow, almost slit-like cavity, the adzoœcial, infra-scapular chamber of the mother-zoœcium, and in the bizoœcial internode only the pedal chamber on the adzoœcial side of the daughter-zoœcium is on the whole wanting.

The oœcium. The gonozoœcium is a mother-zoœcium, and its sternal area has 3 fenestræ and 3 spines, which fill the broad but low frontal sinus. The two larger distal spines, which have an inner cavity and a mostly uncalcified frontal wall, are provided with a head-shaped, inwards and proximally bent terminal part, which is generally separated from the frontal sinus by a narrow fissure. The extremely small, unpaired spine is situated between the terminal parts of the two larger ones and separate these wholly or only partially. An avicularium is wanting on the abzoœcial as well as on the adzoœcial side of the gonozoœcium. On the latter side we find two widely separated lateral chambers, a rudimentary scapular one and a larger pedal, while the scapular and the pedal chambers on the former side are represented by an auriculate process with one or two narrow pores.

The broad oœcium is covered by the distal zoœcium, the small sternal area of which is provided with two extremely small fenestræ and two ribs or spines which meet in a suture, while the covering part of its frontal surface has a large, broad, bipartite fenestra, which is bounded proximally by the distal, curved margin of the aperture and distally by two curved lines that join centrally in a point directed towards the aperture. All the part of the oœcium to be seen through this perforation is provided with numerous, closely situated pores, the separating, raised reticulation of which ends in a number of tubercles and spinous processes. With exception of the proximal margin the part of the frontal surface of the oœcium covered by the zoœcium is provided with numerous, scattered, cylindrical spinous processes.

Form of colony. In this species two bizoœcial internodes generally succeed each other, the latter springing from a daughter-zoœcium.

I have examined a number of colonies from Port Phillip.

Pterocella carinata Busk.

Catenicella carinata Busk, Voyage of Rattlesnake, I, pag. 363. Catalogue of Marine Polyzoa, Cheilostomata, pag. 12, Pl. VI, figs. 4, 5, 6.

(Pl. XII, fig. 5 a).

The zoœcia quadrangularly oval, of a rounded triangular transverse section, the basal surface consisting of two lateral halves meeting at an acute angle. This surface has slightly undulating, longitudinal striæ and is provided with a low median ridge, which in its centre rises into a triangular, spine-like process. The sternal area is generally smaller than the aperture and provided with 3 fenestræ, and the extremely small frontal sinus is occupied by two rudimentary spines. The anter of the aperture is semi-elliptical and its poster concave.

The lateral chambers form on either side a triangular, acute-angled expansion, which is directed sometimes straight outwards, sometimes a little distally and the vertex or point lies at the end of the scapular chamber. The distance between the ends of the two scapular chambers is in an unizoœcial internode larger nearly by a half than the length of the internode, and the two lateral expansions form a distal angle of 180°–270° with each other. The scapular chamber has an extremely small mandible and is shaped like a long, narrow, compressed tube, and the two adjoining, triangular chambers have each a large, pear-shaped opening, which is larger in the supra-scapular chamber, the frontal and distal walls of which are uncalcified in their inner half. The pedal chamber has a long, oval opening. The mother-zoœcium in the bizoœcial internode is provided with a small avicularium, and proximally to the latter we find as in *P. alata* a narrow boundary chamber.

The oœcium. The oœcium as well as the gonozoœcium and the covering zoœcium bear a close resemblance to the corresponding parts in *P. alata* and I shall accordingly limit myself to pointing out the most important differences. On the gonozoœcium the sternal sinus is much less developed and occupied by two likewise slightly developed spines, which, however, also have a terminal part bent inwards and proximally. The most conspicuous difference is however found in the covering zoœcium, which is provided with two large fenestræ separated by a rather broad longitudinal belt.

Form of colony. In the small fragment from Napier, New Zealand, that I have examined, two bizoœcial internodes nowhere succeed each other.

Calpidium Busk, char. emend.

The *sternal area* has 5 fenestræ disposed in a curve and an inner cryptocyst lamina. The aperture, the anter of which is surrounded by a strongly projecting margin, has a trilobed or triangular sinus ending in a point, and is provided with two very strong hinge-teeth, projecting within the aperture. The rosette plates of the lateral chambers are placed in small rounded depressions and may therefore be looked upon as multiporous. The occlusion takes place in a way similar to that in *Scuticella.*

In the two species of this genus the lateral chambers occupy much more than one half of the surface of the single zoœcia as well as of the bi- and tri-zoœcial internodes. They occupy especially the greater part of the distal as well as of the basal surface, being separated here only by a number of elevated ridges, each furnished with a longitudinal furrow.

Calpidium ponderosum Goldstein.

Catenicella ponderosa Goldst., Journal Micr. Soc. Victoria, 1880, pag. 63.

(Pl. XXI, figs. 5 a—5 e, Pl. XIII, figs. 1 a—1 d).

The zoœcia are oval and the sternal area, which is longer by at least a half than the aperture, is provided with five large, pear-shaped fenestræ separated by narrow ribs, in the marginal portions of which a generally strongly developed cryptocyst appears. Inside the sternal area is a large, obliquely oval cryptocyst lamina. The aperture is oblong and separated by a constriction into an anter, the two lateral margins of which converge towards the constriction, and a triangularly trilobed poster. The sternal sinus is mainly preserved in the form of the small, triangular sinus of the aperture, but immediately on the proximal side of it an extremely short sutural line is seen, in which two very slightly developed and somewhat protruding ribs meet. Within each of the two processes bounding the constriction we see a robust, cylindrically conical hinge-tooth, which however does not project freely into the aperture itself, when the latter is seen from the frontal surface. The anter of the aperture is surrounded by a large, obliquely protruding, bilobed, umbellate expansion, the two triangularly rounded lateral halves of which are separated by a broad, but low, obtuse-angled incision.

The lateral chambers. The scapular chamber is not everywhere developed as an avicularium, and the latter is not infrequently wanting on one side in the single zoœcia as well as in the bi-zoœcial internodes. The three other lateral chambers have a membranous roof and occupy a very large part of the surface of the zoœcium. They attain their greatest extent on the basal surface, on which they are separated partly by a rather broad longitudinal belt, which is somewhat concave towards the centre and bifurcated in the bizoœcial joint, partly by the belt-shaped or ridge-like lateral branches, likewise concave and springing from the just-mentioned belt. The supra-scapular chamber reaches some way down the basal surface, but a still larger part of it can be seen on the frontal surface, where the two chambers are separated by a narrow ridge passing down to the incision between the two umbellate processes of the aperture, the free edges of which form part of the boundary of the two chambers. From the proximal end of each umbel the boundary ridge runs in a straight line towards the avicularium and then bends in an arch-shaped ridge, the distal part of which is parallel with the margin of the frontal area of the avicularium. The infra-scapular chambers, which are the largest, form the greater part of the basal surface of the zoœcium and a large part of its lateral surfaces, and each chamber is separated from the large, rounded quadrangular pedal chamber (fig. 5 b) by a ridge springing from the proximal end of the basal wall, which first passes obliquely distally and after another bending joins the sternal area. In the bizoœcial internode the greater part of the distal surface is occupied by a large membranous chamber, which sends a triangular portion down the frontal as well as the basal surface. This chamber is bounded on either side by a low ridge, which runs from the ring of the joint to the incision in the bilobate marginal expansion of the aperture (fig. 5 e). A thick but rather short horizontal ridge, situated immediately on the distal side of the intermediate space between the two apertures (fig. 5 e), incompletely divides the chamber into two parts, viz. a smaller frontal one and a larger distal and basal. Each of these communicates with the daughter-zoœcium through a small rosette-plate with 2—3 pores, and the entire chamber must be regarded as the adzoœcial, supra-scapular chamber of the mother-zoœcium. The adzoœcial infra-scapular chamber of the mother-zoœcium is wanting, and with regard to the other chambers in the bizoœcial joint reference may be made to the explanation of the plates.

The oœcium. The gonozoœcium, which is only about half as high as the covering kenozoœcium, is situated sometimes on a mother-zoœcium, sometimes on an inserted single zoœcium. The sternal area, which is a little smaller than the aperture, is provided with 5 elongated fenestræ somewhat pointed at the distal end, which increase in length towards the centre but all reach nearly right up to the proximal margin of the aperture. Inside this row of openings, which reminds one of a visor, a very broad, rounded cryptocyst lamina is seen. On the other hand a frontal sinus and ribs or spines are completely wanting. The greater part of the basal surface and of the lateral surfaces of the gonozoœcium is occupied by two lateral chambers, the proximal of which is the pedal, while the distal no doubt corresponds to the three distal chambers in an ordinary zoœcium. Of these the former is of a quadrangularly rounded form and enclosed on its distal as well as on its basal margin by the latter, which is triangularly kidney-shaped. On the basal surface both chambers of the lateral surfaces are separated by a central belt, which increases in breadth frontally and passes into a still broader belt separating the two large, long, bean-shaped fenestræ of the kenozoœcium, which may sometimes meet on the frontal surface, sometimes be separated by a narrow central belt. Inside each of the two fenestræ the oœcium is provided with a broad belt of closely situated pores, the separating reticulation of which terminates in a number of tubercles and spinous processes and these structures may also be present partly in the marginal portion of the two fenestræ partly along the distal margin of the aperture. On the top of the kenozoœcium we find an arrow-shaped, membranous chamber, which is sharply pointed frontally and deeply indented basally and the basal half of which is incompletely divided into two by a longitudinal ridge springing from the indentation. The frontal end of the ridge often terminates in a strong process, and on either side of it we find a group of uniporous rosette-plates.

Form of colony. The alternation of uni- and bi-zoœcial internodes is regular except in the lateral branches, which often spring from a daughter-zoœcium and which in every other bizoœcial internode bear only bi-zoœcial joints (up to 5). I have however sometimes seen such a branch completed by a single zoœcium.

Of this species a colony from Tasmania has kindly been placed at my disposal by Dr. Harmer.

Calpidium ornatum Busk.

Voyage of Rattlesnake, pag. 364, Catalogue of Marine Polyzoa, Cheilostomata, pag. 15, Pl. XII, XIII.

(Pl. XX, figs. 11 a—11 f).

The zoœcia are oval. The sternal area, which is longer than the aperture by about a half, is provided with 5 fenestræ of very different size, viz. two small distal ones, two larger median and one the largest proximal. Inside the sternal area we find an oval cryptocyst lamina, and further each perforation is provided with a well-developed cryptocyst, which in older zoœcia may hide the inner lamina entirely. The elongated aperture has a constriction somewhat proximally to the centre, and here we find two robust, conical, cylindrical hinge-teeth converging proximally, of which the terminal part only projects freely in the aperture. The poster of the aperture is trilobed, while its anter, which is surrounded by a strongly protruding, not bilobate margin, has two proximally converging lateral margins.

The lateral chambers. In every internode the scapular chamber generally seems to be developed as a small triangular avicularium on the outside of the two daughter-zooecia, whereas no other avicularia occur. The corresponding supra-scapular chamber appears on the distal surface as a small, triangular cavity, which is but incompletely separated from the cavity occupying the remaining part of the distal surface. It is moreover continued into a long, narrow depression on the outside of each daughter-zooecium. To understand the form and extension of the other chambers we must first study the system of projecting ridges, which separates them. On regarding a tri-zooecial internode from the distal surface (fig. 11 c) we see, that the latter is divided into two lateral halves by a longitudinal ridge, which passes from the distal margin of the aperture of the central zooecium to the annular facette of the joint and is continued from the basal side of the latter along the centre of the basal surface. Along the frontal margin of the distal surface a continuous transverse ridge may appear, situated vertically on the just-mentioned longitudinal ridge. The transverse ridge may pass beyond the centre of the apertures of the two lateral zooecia, but in many cases we find in its place two shorter or longer separate transverse ridges, which are not joined on to the longitudinal ridge. The greater part of the distal surface is occupied by two large lateral chambers covered by a membranous roof, which we may for the present term the distal chambers and which are each provided with a transversely situated, deep pit with 6—8 pores. On the frontal side of these, two long, pointed cavities are seen between the three zooecial apertures (fig. 11 a), each communicating through a pit with 1—3 pores sometimes with the daughter-zooecium, sometimes through a corresponding pit with the mother-zooecium as well. Considering the two daughter-zooecia as the scapular chambers of the mother-zooecium we must regard not only the two distal chambers but also the triangular ones on the frontal side of them as representing the supra-scapular chambers of the mother-zooecium. From the proximal half of the basal, median, longitudinal ridge two curved, more or less strongly ascending ridges start on either side, of which the proximal one forms the boundary of the sternal area for some distance (fig. 11 d), namely, opposite the median fenestra, and terminates in a small process just proximally to the avicularium. The cavity, bounded partly by this ridge, partly by the median ridge and by the margin of the sternal area, is the pedal chamber and on the frontal surface it has a very deep multiporous rosette-plate (fig. 11 d, d. IV). The distal of the two lateral ridges, which does not reach the margin, gives off from its proximal part a branch directed distally and then bending almost rectangularly outwards to join the supra-scapular chamber. The two large lateral chambers, occupying the greater part of the basal surface of the zoœcium and incompletely divided into two, are the two infra-scapular chambers (fig. 11 d, d. III), and each of their two parts has a separate pit with pores, of which a very small one is situated near the avicularium and a large, deep, oblong, multiporous one distally to the proximal lateral ridge. In the bi-zoœcial joints (figs. 11 e, 11 f) the basal surface of the zoœcium has a similar structure on the lateral half corresponding with the daughter-zoœcium, whereas on the lateral half corresponding with the mother-zoœcium we find instead of the branched distal ridge an unbranched one situated much higher up, which together with the median ridge forms the boundary of the undivided supra-scapular chamber. We find a similar contrast with regard to the infra-scapular chamber, which is also undivided in the half belonging to the mother-zoœcium. A longitudinal section through a tri-zoœcial joint dividing it into a frontal and a basal half shows that the two lateral surfaces of the mother-zoœcium join the daughter-zoœcia in the whole of their length and communicate with them through two groups of uniporous rosette-plates, a distal and a proximal group. Thus a daughter-zoœcium occupies the space which is otherwise occupied by the scapular and the pedal chamber, and we cannot therefore expect to find other chambers than the supra-scapular ones on the mother-zoœcium or on the adzoœcial side of the daughter-zoœcium. Accordingly the two large cavities, which we called the distal chambers, together with the two small triangular cavities distally to the avicularia, must be regarded as the supra-scapular chambers.

Oœcia have not been found.

Form of colony. The colony is composed principally of tri-zoœcial internodes, and a bi-zoœcial internode is found only at the base of each fresh branch. It is less branched than in the other species of this family and we may find up to 13 separate internodes in one bifurcation.

I am indebted to Miss Jelly for a fragment of this rare species from Victoria.

Catenaria Savigny.

Catenicella Blainville, Vittaticella Maplest.
Calloporella Mac Gillivr.[1]

A sternal area and an inner cryptocyst lamina wanting and the frontal surface only provided with extremely fine, scattered pores. The aperture, which has a

[1] 76, p. 8.

concave, thickened, protruding, proximal rim, has two well-developed, conspicuous hinge-teeth and is closed finally by three (one distal and two proximal) calcareous processes, springing from its inner margin and meeting in the centre. The pedal chambers, at any rate those of the single zoœcia and the mother-zoœcia, are very long, narrow and their frontal wall is quite uncalcified.

The peculiar occlusion we find in this genus is similar to that in *Melicertites Royana* pointed out by Waters[1]. Here also it is brought about by means of 3—4 calcareous processes, which meet in the centre of the aperture. If there are three, which is usually the case, they are however disposed in a different way from in the species of the genus *Catenaria*, as in the above species there are two distal and one proximal. The type-species of this genus is *Cat. Contei* Aud., of which Mr. Waters[2] has recently given a description.

Catenaria formosa Busk.

Catenicella formosa Busk, Voyage of Rattlesnake, I, pag. 360, Catalogue of Marine Polyzoa, Cheilostomata, pag. 9, Pl. VII, figs. 1, 2.

(Pl. XXI, fig. 3 a, Pl. XIII, fig. 2 a).

The zoœcia, the breadth of which may be contained $1^1/_2$ times in the length, are of a robust, angularly oval form, and the boundary between the flat frontal wall and the arched basal wall is formed on either side by a distinct marginal ridge. The aperture is provided with a proximal, strongly concave margin.

The lateral chambers. The scapular chamber, which in most zoœcia seems to be developed as an avicularium with a small mandible, is large, compressed, somewhat ascending and protruding almost straight outwards, being only slightly inclined frontally. The supra-scapular chamber is a low, narrow cavity, provided with a membranous roof in the whole of its length. The infra-scapular chamber is a small, wholly frontal cavity with a circular opening, through the centre of which the septum between the zoœcium and the avicularium can be seen; and the pedal chamber, which attains an unusually large breadth, though but seldom more than half the length of the zoœcium, is likewise frontal and has its starting point somewhat proximally to the opening of the infra-scapular chamber. It is considerably smaller on the daughter-zoœcium than on the other zoœcia and especially very small and oval on its adzoœcial side. In the bizoœcial joint we find a pear-shaped or oval boundary chamber (m. III). The adzoœcial side of the daughter-zoœcium is generally provided with an avicularium and the ad-

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[1] 108 a, p. 52. [2] 116 a, p. 130

zoœcial side of the mother-zoœcium with a membranous, supra-scapular chamber (m. I).

The oœcium. The gonozoœcium, the aperture of which is provided with a more strongly projecting but less strongly thickened under-lip than the ordinary zoœcia, is a single zoœcium, which may spring from a mother-zoœcium as well as from a daughter-zoœcium. In a colony from Victoria three gonozoœcia may appear immediately succeeding each other. The scapular chamber is developed as an avicularium with a small mandible, which is only visible from the side. It is very long, narrow and may sometimes almost reach the top of the oœcium, with the covering zoœcium of which it has coalesced. When seen from the frontal surface the two almost parallel avicularia have a quadrangularly columnar appearance, and each has a supra-scapular chamber with a membranous roof on the top and on the basal surface. The covering zoœcium, which is otherwise of the ordinary structure, has a large, quadrangularly or pentagonally rounded fenestra distally to the aperture of the gonozoœcium, and the oœcium shows on either side a broader or narrower, arch-shaped belt, which is quite white by reduced light and reddish by strong reflected light, originating from an incomplete calcification. Around it a rather large area is seen showing the boundaries for the coalescence of the oœcium with the lateral walls of the covering zoœcium.

Form of colony. The alternation of uni- and bi-zoœcial internodes is regular, but rows of single zoœcia may also appear.

Colonies from Victoria (Miss Jelly).

Catenaria elegans (Busk).

Catenicella elegans Busk, Voyage of Rattlesnake, I, pag. 361;
Catalogue of Marine Polyzoa, Cheilostomata, pag. 10, Pl. IX,
Challenger, Zoology, Vol. X, Part I, pag. 12, Pl. I, figs. 2, 3, 5.
(Pl. XXI, fig. 2 a, Pl. XIII, figs. 3 a, 3 b).

The zoœcia, the breadth of which may be contained $2^1/_2$ times in the length, are elongated, slender, with evenly arched sides without marginal ridges and with a frontal surface less arched than the basal surface. The proximal margin of the aperture is not very concave and forms almost right angles with the lateral margins.

The lateral chambers. The scapular chamber is everywhere, also on the adzoœcial side of the daughter-zoœcium, developed as an avicularium, which is directed almost straight outwards, but with a slight basal turning. The straight or slightly arched roof forms an approximately right angle with the longitudinal axis of the zoœcium. The supra-scapular chamber is a very small, low cavity with a triangularly rounded opening situated distally to the inner part of the avicularium. The infra-scapular chamber has an oval opening and is situated proximally to the frontal wall of the avicularium. It is principally in communication with the zoœcium, from which it is only separated by the small proximal wall of the avicularium. The narrow, likewise frontal, pedal chamber, which in the single zoœcia may attain half the length of the latter, is situated proximally and a little frontally to the infra-scapular chamber. There is a small, oval boundary chamber (m. III) on the bi-zoœcial internode, and the pedal chamber on the adzoœcial side of the daughter-zoœcium is very short, sometimes merely oval.

The oœcium. The gonozoœcium is as in the preceding species a single zoœcium. The proximal part of its operculum is covered by a thin, labiate process with a straight margin, and its avicularia differ from the ordinary zoœcia in having the mandible situated in their roof, so that it forms a right angle with the longitudinal axis of the gonozoœcium, while in the ordinary zoœcia it is parallel with this axis. The covering zoœcium has distally to the aperture of the gonozoœcium a rather large, irregularly rounded fenestra, on either side of which we find a long curve of up to 20 small, round spots, which correspond to the continuous belt in the preceding species.

Form of colony. Uni- and bi-zoœcial internodes alternate in such a way, that two bi-zoœcial internodes are often separated by two or several single zoœcia.

Colonies from Twofold Bay, St. 163 A, Challenger. The form described essentially corresponds with Busk's typical specimen from Bass Straits, which however differs in having larger, somewhat ascending and somewhat frontally turned avicularia.

Catenaria cornuta (Busk).

Catenicella cornuta Busk, Voyage of Rattlesnake, I, pag. 361, Catalogue of Marine Polyzoa, Cheilostomata, pag. 11, Pl. X, figs. 1, 2, 3.

(Pl. XIII, figs. 5 a, 5 b, Pl. XXI, fig. 1 a).

The zoœcia, the breadth of which may be contained about twice in the length, have a frontal surface almost as strongly arched as the basal surface and on either side a narrow marginal ridge, which bounds the pedal chamber basally.

The lateral chambers. In the examined colonies it is only in a smaller number of zoœcia that the scapular chamber is on one side developed as an avicularium, directed outwards and somewhat basally. Such a chamber may be found not infrequently on a daughter-zoœcium, the corresponding mother-zoœcium of which bears an oœcium, but otherwise it does not seem to appear in bi-zoœcial internodes. The avicularium has a somewhat ascending roof and a robust beaked hook. It communicates on its basal side with an extremely small supra-scapular chamber with an oval opening, and forms a deep sinus together with the trapeziform infra-scapular chamber, which has a truncated conical process and a rounded frontal opening. When not developed as an avicularium the scapular chamber appears as a generally long, compressed, conical, spine-like process, which ascends obliquely and is directed basally and on which the supra-scapular and the infra-scapular chambers are indicated by a perforation on each of its two surfaces. The proximal part of this process, which corresponds to the infra-scapular chamber, is however not infrequently conically projecting and separated from the other part of the spine by a deep sinus. The pedal chamber is of moderate breadth and its opening can only be seen when the zoœcium is regarded from the side. It reaches right up to the infra-scapular chamber and its length is two-thirds of the zoœcium. On the bi-zoœcial internode there is a small, oval boundary chamber (m. III).

The oœcium. The gonozoœcium is always a mother-zoœcium, and the oœcium is covered by a kenozoœcium. The latter generally ends in a shorter or longer conical spine, which must be regarded as an unpaired scapular chamber. More rarely we find a small cavity with a membranous roof. The kenozoœcium, the frontal wall of which is sometimes whole, sometimes provided with a median pore, has on either side a pedal chamber, which is placed on the basal surface and is provided with 3—6 uncalcified rosette-plates, disposed in a single or a double row. The proximal part of the operculum of the gonozoœcium is covered by a thin, erect under-lip, and on the abzoœcial side we find a spine-like scapular chamber opposite to the aperture, whereas the abzoœcial scapular chamber on the corresponding daughter-zoœcium is most often developed as an avicularium. In the examined colony the mother-zoœcium may be developed as a gonozoœcium in up to three succeeding bi-zoœcial internodes.

Form of colony. In this species up to four bi-zoœcial internodes often succeed each other, and rows of single zoœcia only are never seen.

Colonies from Port Phillip (Miss Jelly).

Strophipora Mac Gillivray.

A *sternal area* as well as an inner cryptocyst lamina are wanting in the zoœcia, and the whole of the frontal surface is covered by the two infra-scapular chambers, which are separated by a narrow longitudinal ridge in the central line of the frontal surface. A little proximally to the aperture we find a median pore surrounded by a ring which is continuous with the longitudinal ridge. The aperture is provided with well-developed, distinct hinge-teeth and has a proximal concave margin.

Strophipora Harveyi Wyv. Thompson.

Catenicella Harveyi Wyv. Thompson, Natural History Review, V, 1858, p. 137.
— Wyv. Thompson, Proced. Dublin Univ. Zool. and Botan. Associat. I, p. 81, Pl. VII, figs. 1, 2.
Strophipora Harveyi Mac Gillivray, Transact. R. Society of Victoria, 1895, Vol. IV, p. 17, Pl. II, figs. 9—12.

(Pl. XXI, figs. 6—6 f).

The zoœcia are of an oblong, quadrangularly oval form, and the frontal surface, which is less strongly arched than the basal surface, is most strongly arched immediately on the proximal side of the aperture, from which it descends towards the proximal end.

The lateral chambers. The scapular chamber is everywhere, except on the adzoœcial side of the mother-zoœcium, developed as an avicularium of medium size at least, which is always directed so much towards the frontal surface that the surface of the mandible can be seen, when the zoœcium is regarded from this side, and it may sometimes be altogether frontal. It has generally a somewhat ascending roof and may vary considerably in size, and in the single zoœcia at least a somewhat curved, rib-like thickening springs from its proximal end. The supra-scapular chamber is a large, more or less ascending, membranous, pointed cavity, while each half of the frontal surface is occupied by a large infra-scapular chamber, which communicates with the zoœcium through a longitudinal row of 1—5 very scattered rosette-plates. The two chambers are separated by a longitudinally furrowed, narrow median ridge, and each of them is separated from the adjoining pedal chamber by a similar lateral ridge. Each of them is generally separated from the supra-scapular chamber by two low ridges, the starting point of which is on a level with the transverse ridge of the avicularium and which pass, one to the margin of the aperture, the other to the lateral ridge. The membranous wall of the infra-scapular chamber runs out on each side into two conical expansions, which are situated close to the aperture, and a couple of similar expansions may also appear in the distal part of the basal surface. The two pedal chambers occupy the entire basal surface of the zoœcium and are likewise separated by a longitudinally furrowed median ridge, while again each chamber is divided into two unequally large parts by an extremely narrow, low, compressed, longitudinal ridge, which appears in its outer half and serves to support the membranous wall. The rosette-plates are disposed in a very scattered row near the lateral ridge.

With regard to the appearance of the various lateral chambers on the bi-zoœcial internode reference may be made to the figures and the accompanying explanation of the plates.

Oœcia were not found in the fragment examined.

Form of colony. In the examined fragment two bi-zoœcial internodes often succeed each other and also rows of up to four single zoœcia.

Of this species I have had the opportunity of examining a dry fragment of Wyv. Thompson's original specimen from Bass Straits (British Museum).

The genera **Stenostomaria** and **Ditaxipora** set up by Mac Gillivray[1] are closely related to *Strophipora*, and in both of them the whole or almost the whole of the surface of the zoœcium is occupied by the lateral chambers. Both genera contain only a single species, and in *Ditaxipora internodia* Waters, the internodes of which consist of 7—8 zoœcia disposed in two alternate rows, the greater part of the basal surface, judging from the figures, is formed by a single (outer) pedal chamber. The same author has founded the genus **Microstomaria**[2] on a single bi-zoœcial internode, and the longitudinal ridge represented in fig. 29 seems to show that this genus must also be related to *Strophipora*.

Family Onchoporidae.

The slightly calcified *zoœcia*, the frontal surface of which is covered by a closely adhering (chitinous?) membrane, are generally provided with a number of superficial, uni- or multiporous rosette-plates, which are most often situated in the distal part of the zoœcium. The distal wall, which is bent from side to side, has a number of uniporous or one multiporous rosette-plate, while the distal half of each lateral wall has a single multiporous plate. No *avicularia*. The strongly projecting hyperstomial *oœcia*, the aperture of which may be closed by the zoœcial operculum, consist of two membranous (chitinous?) layers, between which there is a cryptocyst layer, which springs from the distal wall. Free, branched colonies.

Synopsis of the genera.

1) The compensation-sac opens outwards through a crescentic ascopore.

2) The zoœcium consists of three different segments: a short proximal, a long stem-like middle and a widened distal one; (the operculum compound or simple) .... *Calwellia* W. Thomps.

[1] 76, pp. 16 and 22 [2] 76, p. 18.

2) The zoœcium not consisting of three different segments:

3) A simple operculum; the oœcia with a couple of proximal, free, rib-like processes . . . . *Onchopora* Busk.

3) A compound operculum; the oœcia without free, rib-like processes . . . . *Onchoporella* Busk. (Ichthyaria?)

1) The compensation-sac does not open outwards through a pore, but immediately on the proximal side of the operculum . . . *Onchoporoides* Ortmann [1].

Onchopora Sinclairi Busk.

Onchopora Sinclairi Busk, Quart. Journ. Micr. Sci., Vol. 5, 1857, pag. 192, Pl. XV, figs. 1—3.

— — Busk, Challenger, Zoology, Vol. X, part I, pag. 103, Pl. X, fig. 4.

Calwellia Sinclairi Harmer, Quart. Journ. Micr. Sci., n. s. Vol. 46, pag. 312, Pl. 18, fig. 60.

(Pl. XIII, figs. 7 a—7 h).

The zoœcia, which only slightly increase in breadth from their proximal, somewhat narrowed end towards the aperture, have a little proximally to the latter a linearly crescentic ascopore with frontally directed concavity and a crenulated proximal margin. A sutural line connects this ascopore with the aperture, the two curved lateral margins of which converge a little proximally. The aperture is surrounded by 6 rosette-plates. Of these the two smallest have 1—2 pores each and are situated between the aperture and the crescentic ascopore. The other four, which are very elongated and each provided with 3, more seldom with 2—4 pores, surround the remaining part of the aperture. There are moreover 5 round pores, of which three are situated among the four elongated rosette-plates and each of the other two between an oblong and a round rosette-plate. The distal wall is provided with numerous uniporous rosette-plates, and the distal half of each lateral wall with one extremely oblong multiporous plate.

The oœcia are large, strongly arched and in part strongly tuberculated. They are provided with rounded ridges, arranged in the shape of a fan and separated by impressed lines. On the basal surface a more thickened, triangularly oval portion is seen (fig. 7 f), on either side of which we find a few larger hollows separated by rib-like thickenings, which spring from the frontal wall of the just mentioned more thickened portion. From the proximal part of the latter a free,

[1] 87, p. 12.

rib-like process starts on either side. These processes are situated immediately within the proximal margin of the ectooœcium and they have a terminal portion, which is bent upwards a little.

The colonies form richly branched tufts, and the narrow columnar bifurcate branches have four longitudinal rows of zoœcia.

Judging from descriptions and figures the forms hitherto described under the name of *Sinclairi* present several differences from the form here described as well as from one another, and only a comparative examination will show how great an importance we ought to attach to these differences. For this reason I have retained Busk's name for the form examined by me, which originates from Akaroa Harbour, New Zealand (Suter).

Under the names of *O. picoensis* and *O. Grimaldi* Jullien[1] has described two species, which seem to me to be very little different. In these the two small rosette-plates between the aperture and the crescentic ascopore are said to be replaced by two small, round avicularia. As, however, avicularia have not hitherto been made out with certainty in this family, this information needs further confirmation, as Jullien's figures are not convincing.

Onchopora dentata Mac Gillivr.

Ureeolipora dentata Mac Gillivray, Transact. Royal Soc., Victoria, Vol. 21, 1884 (1885), pag. 109, Pl. I, fig. 1.

(Pl. XIII, figs. 6 a, 6 b).

The zoœcia, which increase greatly in extent from their narrow proximal part towards the distal end, are somewhat compressed, strongly arched and when seen from the side of a triangular outline. Along the distal margin they are provided with 5 short, widely separated spines, which are rounded at the end and surround the aperture. There are 6 transversely oval uniporous rosette-plates, of which two are found between the aperture and the ascopore, while each of the four others is situated between two spines. The operculum is almost semicircular with nearly parallel lateral margins, and the ascopore, which is connected by a sutural line with the aperture, is but slightly curved with proximally directed concavity. The distal wall, which is bent from side to side, is provided with a number of uniporous rosette-plates and terminates on either side in 3—5 digitiform prolongations, of which the frontal is the longest. The distal half of each basal wall has a large, pear-shaped, multiporous rosette-plate.

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[1] 48, p. 52—53, Pl. IV.

The oœcia are in all essentials of a similar form and structure as in the preceding species; but the two free, rib-like processes are not bent like a hook.

The colonies are richly branched, bifurcated and with the zoœcia arranged in two rows, which have their apertures turned in an opposite direction.

Colonies from Victoria.

Calwellia bicornis W. Thomps.[1]

(Pl. XIII, figs. 8 a—8 c).

The zoœcia are opposite, disposed in pairs and in such a way that the direction of each pair is vertical to that of the preceding or succeeding pair. While the distal terminal parts of a pair of zoœcia meet with their basal surfaces, the two corresponding proximal stem-like parts, which are of a triangular transverse section, are on the contrary separated in the whole of their length by the terminal parts of the proximally situated pair of zoœcia (fig. 8 c), each of them touching with its inner edge one end of the separating wall, which the two just-mentioned basal surfaces share in common. No rosette-plates are found in this wall, but there is a multiporous rosette-plate (fig. 8 a) in the distal end of each stem-like part on each of the two surfaces which are bent towards each other at an angle, and an inner communication is thus brought about between the stem-like part of the distally situated pair of zoœcia and the distal end of the proximally situated pair. Each stem-like part ends proximally in a small, sharply defined, rounded portion, and proximally to it is seen the narrow, angularly bent distal wall (figs. 8 a, 8 b) which is furnished with a multiporous rosette-plate centrally. The strongly arched distal portion of the zoœcia, which greatly increases in breadth from its very narrow proximal part towards the distal end, is on either side of the aperture provided with a short, robust spine, which is rounded at the end. The transversely oval aperture has a compound operculum. A sutural line connects it with the transversely oval crescentic ascopore, which has a slight distal concavity. On the proximal as well as on the distal side of the aperture we find two widely separated, transversely oval, uniporous rosette-plates.

Oœcia are wanting in the examined colonies; but Wyv. Thompson's figure shows that they are provided with finely, transversely striated ridges disposed in the shape of a fan. They are present in some colonies of *C. gracilis* Maples. originating from Bass' Strait, which species differs from *C. bicornis* for one thing in having a simple operculum with a straight proximal margin. In this species also

[1] 104, p. 92. Pl. IX, figs. 2, 2 a

the oœcia have a similar structure and lack the two free, rib-like processes found in the two above-described *Onchopora* species.

Colonies from Hawkes Bay (Miss Jelly).

Onchoporella bombycina (L.) Busk.

Carbacea bombycina Busk, Catalogue of Marine Polyzoa, Cheilostomata, pag. 52, Pl. 48, figs. 4—7.

Onchoporella bombycina Busk, Challenger, Zoology, Vol. X, Part I, p. 104.

(Pl. XIII, figs. 9 a—9 j).

The zoœcia are elongated, generally hexagonally rounded, and the large aperture has a semi-elliptical anter and a broadly rounded, obliquely outwards turned poster, which latter is separated on either side from the former by a distinct hinge-tooth. Outside each hinge-tooth we find a rather short, cylindrically conical spine, and a very small spine is situated at the distal end of the zoœcium. The large, widely open ascopore is made semilunar by a triangularly rounded tongue projecting into it distally, and the two lateral margins of this tongue are continued into two sutural lines, which diverge toward the aperture and sometimes can be traced to the corners of the poster. The ascopore seems therefore to be the remains of a triangular primary sinus, the greater part of which is later filled up. In the narrow marginal portion between the aperture and the distal end of the zoœcium we find 2—4 rosette-plates, which have altogether up to 6 pore-areas. If there are only two plates, they are very elongated and provided each with 2—3 areas. On the proximal side of the aperture 1—6 pore-areas are found along each lateral margin. They are situated in a longitudinal row and may be distributed on 1—4 rosette-plates, of which the longest hitherto found contain 4 areas. Most often an uneven number of pore-areas are found on the two sides of the same zoœcium and the larger number is generally present on the side, which is turned away from the central line of the branch. The largest number of pore-areas is generally found on the outer side of the marginal zoœcia.

The distal wall is bent from side to side and on either side terminates in a pointed portion. Along its basal margin we find a rather dense transverse belt of uniporous rosette-plates (fig. 9 g), while the distal half of each lateral wall is provided with an oval, multiporous plate.

The oœcia are large, strongly arched, with low, transversely striated, radiating ribs. The basal surface is provided with a more thickened central portion with rib-like processes, and the proximal part of the ectooœcium is calcified for a short distance on either side of the aperture.

The colonies are Flustra-like, one-layered, richly branched, with rather short segments and the margin of the colony is formed by a row of kenozoœcia. In the latter a deposition of calcareous matter takes place, which starts from the inner wall and finally fills the whole of the kenozoœcium with a strongly tuberculated, lobed, marginal thickening divided as if in transverse belts (figs. 9 e, 9 g). Radical fibres may issue from multiporous rosette-plates on the basal surface of the colony (figs. 9 c, 9 d).

Colonies from South Africa.

»*Carbasea*« *Moseleyi* Busk[1], which undoubtedly belongs to this family but seems to have no ascopore, is by Ortman[2] referred to a new genus *Onchoporoides*; it seems to have no median pore. The horseshoe-shaped marks, which can be seen in most zoœcia in Busk's drawing, unquestionably originate from the basal walls of the beginning oœcia.

Family **Euthyroidae** n. f.

The slightly calcified *zoœcia* have no pores and no covering-membrane. On the proximal side of the operculum they are provided with 1—3 pairs of flat, hollow spines, which meet in the central line and cover the entrance to the compensation-sac. A compound operculum. Lateral walls with multiporous rosette-plates. Independent *avicularia* may occur. The ectooœcium of the hyperstomial *oœcium* is provided with a pair of large fenestræ. Colonies free, branched, Flustra-like.

A single genus: **Euthyroides** Harmer[3].

Euthyroides Jellyae n. sp.

(Pl. XVI, figs. 8 a—8 e).

The zoœcia are elongated, rectangular, slightly arched, with a slightly curved distal wall, which has within its basal margin a zigzag belt of (12—14) small, uniporous rosette-plates. The distal half of each lateral wall with 2—3 multiporous rosette-plates. The aperture, which in the non-oœcia-bearing zoœcia is provided with two distinct, rounded hinge-teeth, has a quadrangularly rounded form, its anter being composed of three curved lines meeting at right angles, while its poster forms a more strongly curved line which is generally bent in the form of a saddle (fig. 8 d). The operculum is of a corresponding form and provided with a chitinous thickening along its proximal margin. Immediately on the proximal side of the operculum we find between the two hinge-teeth a very small

[1] 8, p. 56. [2] 87, p. 12. [3] 19, p. 280.

membranous portion, which is covered by two pentagonal, hollow spines, that meet in a suture. Between their opercular margin and the hinge-teeth there is a small sinus, and their form is subject to some variation so that the suture between them may be sometimes shorter, sometimes longer. At an earlier stage these spines are not yet present, and the operculum (fig. 8 b) at this time is proximally surrounded by a calcareous belt, separated by a yellowish, glistening margin from the rest of the calcareous wall. A resorption of the calcareous mass proximally to the operculum soon commences however, and the two spines gradually develop and cover the decalcified portion. Such a process does not seem to take place in *E. episcopalis.*

The oœcia are high, strongly arched, almost oviform, and the ectooœcium has on either side of the central line a large, triangularly rounded fenestra. Inside the narrow central belt there is a longitudinal ridge joining the endooœcium. The oœcia-bearing zoœcia have no distinct hinge-teeth and contrary to the case in *E. episcopalis* there is but one pair of spines proximally to the operculum.

Avicularia. On the examined fragment a single, independent, elongated and lyre-shaped avicularium was found, the wholly calcified subopercular area of which showed a distinct sutural line along the centre, while its opercular area was provided with a strongly developed cryptocyst perforated by an oblong opening. The mandible has at its proximal part two small, pointed lateral processes.

The form of colony seems to have been free, laminate or broad and Flustra-like. The small, dried fragment that I have examined of this form shows about 50 rows of zoœcia. It originates from North Australia and was given me by the late Mr. C. N. Peal.

The two species of the genus *Euthyroides* differ so much from all other ascophorous forms, that it has been necessary to refer this genus to a new family, the nearest relatives of which must undoubtedly be sought in the family *Cribrilinidae* and especially in the genus *Figulina.* The two species agree with this genus in regard to the structure of the rosette-plates and the presence of two large fenestræ in the oœcia. The avicularium found in *E. Jellyae* quite corresponds with that found in the *Figulina* species, and in most of the latter the form of the aperture is similar to that in the two just-mentioned species. There are other points of similarity, such as the well-developed hinge-teeth and the spines which are provided with a pore. In *F. chlithridiata* Waters the number of spines may sometimes be reduced to 3 on each side. — With regard to the structure of the oœcia the tertiary *Membraniporella tennicosta* described by Mac Gillivray [1],

[1] 76, p. 56.

which I must also refer to *Figulina*, bears a closer resemblance to the *Euthyroides* species than any of the other *Figulina* species. — The author does not mention avicularia, but at the top of his figure he has drawn something which is undoubtedly an independent avicularium, the opercular area of which is provided with a strongly developed cryptocyst.

Family **Crepidacanthidae** n. f.

Crepidacantha nov. gen.

The *zoœcia*, whose aperture has strong hinge-teeth and a compound well-chitinized operculum, are in the proximal half provided with 9—12 very long marginal spines and with 8—11 small uniporous pore-chambers alternating as a rule with small intermediate chambers, each of which has an uncalcified spot (a marginal pore) in its roof. Two frontal *vibracula* without a cross-bar. The hyperstomial, almost free *oœcia* consist of two calcified layers, of which the ectooœcium is provided with a number of pores.

C. Poissoni Aud., var **crinispina** n.,

Flustra Poissonii Audouin, Description de l'Égypte,
Histoire naturelle, Tome I, explication sommaire
des Planches, pag. 240; Polypes, Pl. 10, figs. 5_1—5_2.
Lepralia Poissoni Jelly, A synonymic catalogue of the recent
marine Bryozoa. 1889, pag. 131.
(Figs. 1—6).

The zoœcia, which have a broad, roundedly rhombic outline and are provided with narrow, transversely ovate, marginal pores (fig. 1), are very convex, and the frontal wall shows a number of finely undulating, dendritical, sutural lines. The aperture, whose distance from the distal end of the zoœcium is about as large as its own length, is longer than broad, provided with a prominent anter and constricted in the proximal third by two triangular, proximally converging processes within each of which is seen a strong conical hinge-tooth. The proximal margin of the aperture is provided with a broad, roundedly trapeziform process on each side of which there is a small rounded sinus. The operculum (fig. 5) which is well-chitinized, punctate, of a yellow colour and distinctly separated from the compensation-sac, is provided with a partly developed opercular arch consisting of two lateral ridges. In the distal half of the zoœcium there is found 9—12 very long and thin, marginal spines and a similar number of small quadrangular uniporous pore-chambers (figs. 2—3) alternating as a rule with a similar number of small intermediate chambers (figs. 2—3), each of which is in connection with one of the above-mentioned marginal pores. Each spine is placed distally to the opening of a pore-chamber. The small intermediate spaces which are generally quadrangular or triangular may sometimes be almost slit-shaped, and not rarely they are lacking between the 2—4 distal pore-chambers. This seems to be the rule in the oœcia-bearing zoœcia, and sometimes the two outermost of the 4 distal pore-chambers are separated from the innermost only by a slit-shaped sinus (fig. 3).

The vibracula which are placed on either side of the operculum and are partly immersed, have an ovate outline, and their frontal area shows a distal,

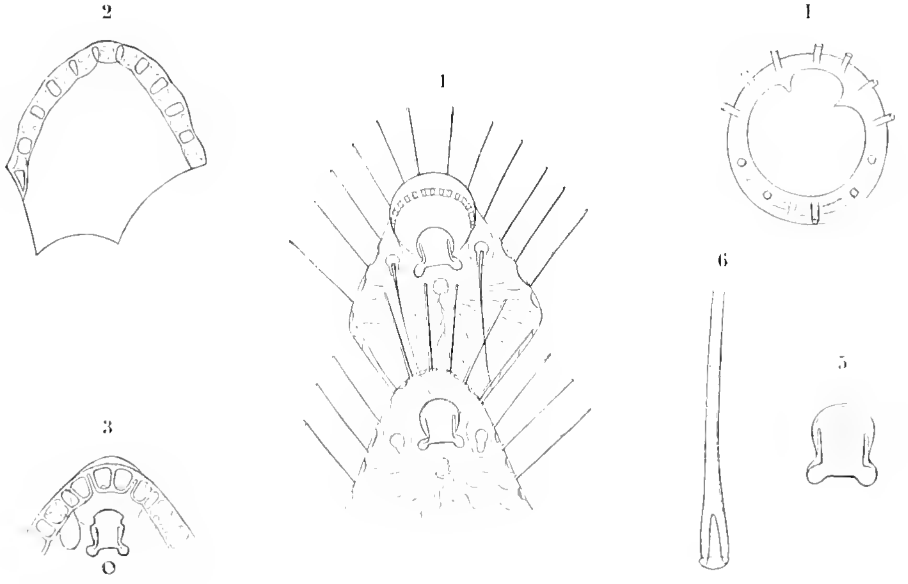

Fig. 1. Two zoœcia of Crep. Poissoni Aud., var. crinispina. × 55.
- 2. A zoœcium of the same form seen from the basal wall. As in fig. 3 pore-chambers alternate with intermediate spaces. × 55.
- 3. The distal part of a zoœcium with oœcium seen from the basal wall. × 55.
- 4 An ancestrula of another variety of the same species. × 175.
- 5. Operculum of Crep Poissoni, var. crinispina × 140.
- 6. The proximal part of the flagellum of the same form. × 200.

shorter, rounded suboperculur area and a proximal, longer and narrower opercular area. The flagellum (fig. 6) which is of about half the length of the zoœcium is very thin, without teeth and in its proximal end provided with a button-shaped expansion and a short conical cavity. Each vibraculum is in connection with a marginal pore.

The oœcia (figs. 1, 3), which are only formed by a single zooecium, are free with the exception of a small proximal portion of the endooœcium formed by a part of the zooecium's frontal wall distal to the aperture. They are strongly arched, not far from being globular and consist of two calcified layers of which the thick ectooœcium about the middle is provided with a low, girdle-shaped, proximally convex impression covered by a chitinous plate of the same form. Within the impression is seen an irregular series of mostly elongate pores separated by thick cylindrical pillars. In the oœcia-bearing zooecia the aperture is on each side provided with a small rounded protuberance (fig. 3) distally to the opercular ridge, and the aperture of the oœcium can be closed by the operculum.

Some colonies of this interesting species have been found incrusting shells at Koh Kram, Siam, at a depth of 30 fath. by Dr. Th. Mortensen.

Our Zoological Museum possesses a small colony of another variety from Port Phillip Heads, which has a nearly circular Tata-shaped ancestrula, surrounded by 12 marginal spines (fig. 4). The spines are not only much longer and stronger than those in the variety from Siam but are divided into ca. 8 internodes. The pore-bearing impression of the oœcium is almost circular and within it is seen a number of scattered pores.

In the form figured by Savigny the oœcium seems to be provided with scattered pores, separated by a number of parallel longitudinal ridges.

Before being able to make a thorough examination of the present species, I have set forth the supposition in the morphological part that it might belong to the Suborder *Anaska* and the reason for this supposition was chiefly the lack of the cross-bar in the vibracula together with a certain likeness to *Megapora ringens*. Later I have been able to examine some good colonies from Siam, and having seen that the operculum is in connection with a compensation-sac I cannot longer maintain this view, holding however at the same time that this genus has its nearest relatives in the division *Malacostega*. This appears not only from the lack of the cross-bar, but also from the presence of marginal spines surrounding a great deal of the calcified frontal wall. While a great number of the *Ascophora* are provided with marginal spines surrounding the anter of the aperture (»oral spines«), with the exception of *Crepidacantha* we find marginal spines placed in the circumference of the frontal wall only in the division *Malacostega* and only in a few ancestrulæ for instance in those of *Chaperia spinosa*[1] and *Microporella ciliata*[2] do we find such spines together with a well-developed cryptocyst. Though the species of the genus *Megapora* are provided with a completely calcified frontal wall

[1] 15, Pl. 5, fig. 3. [2] 19, p. 331, Pl. 15, fig. 6.

and with a well-chitinized compound operculum they must, I think, be referred to the *Malacostega*, being most nearly related to the genus *Callopora*. The species *hyalina* which Waters[1] with some doubt refers to the genus *Megapora* has besides 6 larger, distal, marginal spines 1—3 very small, seated outside the frontal area about half-way down, and as the second species *M. ringens* has an aperture of quite the same form as that found in *C. Poissoni*, I think that these two species are more nearly related to this interesting form than any other species hitherto described.

Having only examined dry colonies I have not been able to find a covering membrane, but as the very low side-walls of the zooecia, when isolated, are separated from the arched frontal wall by an impressed line, I cannot doubt, that this line indicates the distinction between a marginal gymnocyst and a frontal cryptocyst, and as the spines arise just proximally to this line they are not, as I originally thought, acropetal but marginal which can also be seen by a comparison with the ancestrula.

Family **Euthyridae.**

The *zooecia* are provided with a slightly calcified cryptocyst, and in a larger or smaller part of their surface the surrounding covering membrane is kept distended by ridge-like or rod-shaped processes from the cryptocyst, which has a number of superficial rosette-plates. The interzooecial walls have scattered, uniporous rosette-plates. A compound operculum. No spines and no heterozooecia. There may be endozooecial *ooecia* with a projecting, membranous ectooecium. Free, branched colonies.

Summary of the genera.

1) Ooecia occur; the aperture provided with a narrow sinus; (the covering-membrane is everywhere kept distended by narrow ridges from the cryptocyst) . . . . *Urceolipora* Mac Gillivr. (Calymmophora Busk).

1) No ooecia, but two different forms of zooecia; the aperture without sinus, but with an almost straight proximal margin:

2) The frontal cryptocyst forms a continuous calcareous surface; the covering-membrane is on the frontal as well as on the basal surface distended by means of rod-shaped processes from the cryptocyst . . . . *Euthyris* Hincks[2].

[1] 115, p. 39, 102. [2] 27, p. 161

2) The frontal cryptocyst is formed by a number of narrow, only partially meeting ribs; the covering membrane is kept distended only on the basal surface of the colony by means of the wedge-shaped, projecting, central portion of the separate zoœcia . . . . *Pleurotoichus* n. g.
(species *P. clathratus* Harmer[1]).

Urceolipora nana Mac Gillivr.

Urceolipora nana Mac Gillivray, Transact. and Proceed. Royal Soc. of Victoria, Vol. XIII, 1881 (for 1880), pag. 85, Pl. (without number, pag. 88), figs. 3 a—3 c.

Calymmophora lucida Busk, Challenger, Zoology, Vol. X, Part I, 1884, pag. 82, Pl. XXX, fig. 3.

(Pl. XV, figs. 1 a—1 f).

The zoœcia, which increase greatly in extent from the narrow proximal towards the distal end, have in the greater part of their length an oblong, oval transverse section (fig. 1 e) and when seen from the frontal or basal surface their form is somewhat vase-like (figs. 1 b, 1 d). The distal end of each zoœcium projects a great deal over the proximal part of the higher placed zoœcium with which it forms an acute angle. The covering membrane is kept distended from the cryptocyst by a number of narrow longitudinal ridges, which spring from the latter, but which are different on the two surfaces of the branch. To begin with, there is on both surfaces of the branch a zigzag longitudinal ridge, which runs in immediate proximity to the suture between the two rows of zoœcia (fig. 1 e) and is situated in each zoœcium on the part which lies between its own distal wall and that of the lower placed, opposite zoœcium. This zigzag ridge, which is most strongly developed on the side of the branch turned away from the twin-branch (the abramal side of the branch), is in each of the oœcia-bearing zoœcia continued into a collar-shaped, vertical part (figs. 1 a, 1 d) situated at the base of the oœcium, while in the ordinary zoœcia it is continued into the angle between two succeeding zoœcia of the same longitudinal row. The two ridges from the opposite sides of the zoœcium are here joined into a single one, which ends in the distal margin of the aperture some way from the central line on the abramal side of the aperture. On the adramal side of the branch each zoœcium is moreover in the greater part or in the whole of its length provided with a strong, somewhat curved longitudinal ridge (fig. 1 a), which is somewhat different in the zoœcia arising from oœcia-bearing zoœcia and in those springing from non-oœcia-

[1] 19, p. 266.

bearing zoœcia. In the former it springs from the lateral surface of the zoœcium close to the zigzag ridge and at a fairly great distance from the distal wall, and in the latter it starts from the approximate centre of the proximal part of the frontal surface. In both cases it ends in the above-mentioned, collar-shaped part at the base of the oœcium. To keep the covering-membrane extended there is further a very small, flat, most often trapeziform process situated on each side of the aperture. This process Busk wrongly takes to be an avicularium (figs. 1 a, 1 f).

Along the frontal margin of the abramal zigzag ridge we find on each zoœcium a longitudinal row of 5—7 small, widely separated, uniporous rosette-plates, and similar rosette-plates appear on both sides of the adramal arch-shaped ridges. Along the frontal margin of the ridge there are 6—8, while those on the other side of the ridge are more varying in number (3—7), and may sometimes be rather irregularly scattered. Finally each of the two frontal rows of rosette-plates is continued into a row or group of 4—8 plates situated on each side of the aperture.

The obliquely ascending distal wall has a basal trilobed margin and is provided with numerous, uniporous rosette-plates, which are scattered over its entire surface, and such plates appear also in a longitudinal belt or row, which passes through the whole centre of the basal surface (fig. 1 d).

The obliquely truncated aperture, which forms an obtuse angle with the frontal surface, has a semi-circular anter, while its poster is provided with a well-developed rounded sinus. The slightly chitinized operculum, which is of a corresponding form, has a somewhat curved, transverse row of round, bright spots.

The oœcia are of a most peculiar structure, being endozoœcial and at the same time having their endooœcium situated frontally to the cryptocyst of the zoœcium, which is much excavated to receive its strongly arched basal surface. There is a transparent ectooœcium, formed by the covering membrane, and a calcified, radiately striated endooœcium, which is somewhat narrowed at the base in the shape of a neck, and the form of which is that of a Phrygian cap rounded at the end. A large part of the frontal surface of the endooœcium is provided with numerous, round, attenuated spots. The distal wall belonging to the oœcium has rosette-plates not only in its basal trilobed part but also in the narrow part bounding the oœcium on either side. Finally, it may also be remarked that the oœcium can be closed by the operculum of the zoœcium.

The colonies are richly branched, bifurcated tufts with compressed branches each bearing two rows of zoœcia, with their basal surfaces towards each other.

Stat. 163 A, Challenger (British Museum).

Euthyris obtecta Hincks.

Annals Nat. Hist., Ser. 5, Vol. X, 1882, pag. 96, Pl. 16, figs. 32—37.
Harmer, Quart. Journ. Micr. Science, n. s. Vol. 46, 1903, pag. 277, Pl. 15, figs. 13—14.
(Pl. XV, fig. 2 a—2 f).

The zoœcia are slightly calcified, arched, from a narrow proximal end expanding distally, with a distal end obliquely ascending towards the frontal covering membrane. When seen from the frontal surface they seem to be cylindrically oval, while from the basal surface of the colony they are of a lyre-shaped outline. The strongly projecting covering membrane is directly connected with the separate zoœcia only in the periphery of the aperture of the latter, and besides only in contact with them through rod-shaped or ridge-like processes from their surface. The aperture is provided with two well-developed, rounded hinge-teeth. Its anter is semi-circular and rather high and its poster about half as high. In the latter we may more or less distinctly distinguish between two proximally converging lateral portions and a central portion. The accessory part of the operculum has a well-chitinized margin, on either side of which there is a small, tubercle-shaped process corresponding to a small, rounded indentation on the proximal side of each hinge-tooth. In the somewhat neck-shaped part of the zoœcium proximally to the aperture we find a circle of 8—10 superficial, uniporous rosette-plates and a larger number (15—20) are scattered over the entire basal surface. There are further numerous, uniporous rosette-plates in the basal part of the distal wall, and a zigzag row of about 8 such plates in the distal half of each lateral wall.

The connection between the projecting covering membrane and the cryptocyst is brought about, as far as the frontal and basal surfaces are concerned, by means of a number of thin, compressed, almost filiform calcareous prolongations, which join the covering membrane with a T-shaped terminal part. These structures appear on the frontal surface only on the two outer series of marginal zoœcia on either side, and on the series next to the outermost one they only appear in a number of 2—3 a little proximally to the aperture and near the outer margin. In the distal half of the marginal zoœcia they are present in a larger number of about 4—7. On the basal surface they are found in all zoœcia in a number of 4—12. On the middle row of zoœcia we find the distal half of each zoœcium provided with 4 such spines, which form a pretty regular quadrangle, being situated 2 by 2 a little inside each lateral margin. There is a larger number on the 3 lateral rows on either side. The innermost of them has generally one in the outer half besides the 4. The next row has usually one more, but in the outermost row the number is increased to 10—12, of which 5—6 are situated along the outer margin, 2—3 along the outer half of the distal margin, and the rest scattered over the distal half. In the older parts of the colony the projecting covering membrane of the marginal zoœcia is connected with the cryptocyst of the lateral walls by 3—5 compressed calcareous plates, which spring from each zoœcium and are separated by rounded openings. Each of these plates again joins the covering membrane with a thick, quadrangular expansion, which is situated vertically on the compressed part and is slightly bent from side to side in the shape of a roof. This quadrangular expansion has a densely tuberculated outer surface.

The colony is free, branched, with narrow branches, the zoœcia of which are only completely symmetrical in the central portion of the branch and become more and more asymmetrical towards the lateral margins.

Of this form I have examined only a small dry fragment from North Australia, which was kindly placed at my disposal by the late Mr. C. N. Peal. It differs in several respects, for one thing in possessing only a single form of operculum, from the form described by Hincks and Harmer, and perhaps it may be regarded as a distinct species.

Family **Savignyellidae** n. f.

The narrow, elongated, rather slightly calcified *zoœcia* have a frontal surface, provided with scattered pores, which is separated from the basal surface by a more or less sharp boundary line. The distal wall has a number of uniporous or multiporous rosette-plates in its periphery. Spines may appear round the aperture, proximally to which there may be a freely projecting avicularium. We may find free oœcia, two-layered from the proximal part, the ectooœcium of which has a membranous frontal side. The colonies are richly branched, jointed, and each internode consists of a single zoœcium.

Genera:

The aperture surrounded by spines, with a concave poster and with no sinus; an avicularium proximally to the aperture; distal wall with uniporous rosette-plates; oœcia present .... *Savignyella* n. g.
Catenaria d'Orbigny.
(*S. Lafonti* Audouin[1].)

The projecting aperture not surrounded by spines, but with a rounded sinus; distal wall with multiporous rosette-plates; avicularium and oœcium wanting.................................. *Halysisis* Norman[2].
(*H. diaphana* Busk[3].)

Time has not allowed of my entering into a close examination of the two species, which I think show sufficiently great conformity to belong to the new family that I have been obliged to found for them. It is possible that »*Catenaria*« *attenuata* Busk[3] may also be entered in this family. With regard to the question of their descent, they seem to me to show relationship particularly to *Bicellariidae*, and of characters that favour this opinion I may mention the slight calcification, the long slender form of the zoœcia, the form of colony and the structure of the oœcia. Also the freely projecting avicularium in *S. Lafonti* may be taken as evidence of such a relationship. While I have found a covering membrane on the frontal surface in *C. diaphana*, I have not succeeded in finding one in *S. Lafonti*, in which however according to the examination made by Calvet it must be supposed to be present. — The two just-mentioned species have by Busk[4] and later authors been called *Alysidium Lafonti* Aud. and *Catenaria diaphana* Busk. But it has been necessary to make two new generic names, as the name *Alysidium* must be kept for *A. parasiticum* Busk, and *Catenaria Contei* Aud. is the type of a genus belonging to the family *Catenariidae* (see pag. 213, note).

Family **Hippothoidae.**
Diazeuxidae Jullien.

The *zoœcia*, which have no covering membrane, are generally thin-walled, glistening, more or less distinctly longitudinally or transversely striated, and the calcification, which constantly increases simultaneously with the growth, takes place in transverse belts, of which a greater or smaller number often terminate in thin protruding margins, which surround the frontal surface like a belt.

[1] 98, pl. 13, figs. 2_1–2_7. [2] 84 a, p. 295. [3] 8, p. 14. [4] 2, pp. 13–14.

Ordinary spines are usually wanting, whereas short wide acropetal spines not seldom appear, partly on each side of the aperture, partly singly on its proximal side. *Avicularia* are very seldom present, but we frequently find very small, sometimes rudimentary zooecia, which are however provided with an aperture. The zooecia in the whole of their periphery have small uniporous or few-pored pore-chambers, and the pore-chambers of one zooecium not rarely join short prolongations of the other, by which means two neighbouring zooecia become separated by a row of small openings. The *ooecia* are sometimes situated on zooecia of ordinary structure, sometimes on gonozooecia of a peculiar form. They are covered either by kenozooecia, dwarf zooecia or by avicularia. The colonies are incrusting.

The zooecia have no covering-membrane, and when Calvet[1] talks of a cryptocyst in *Chorizopora Brongiarti*, the reason may be that he confuses it with the compensation-sac, the opening of which in this form needs however a closer examination. The fact is that *Chorizopora* possesses a simple operculum, but contrary to all the other genera of the section *Ascophora* in which this is the case (*Microporella*, *Inversiula*, *Adeona*, *Haplopoma*, *Tubucellaria*, *Calwellia* and *Onchopora*), it wants an ascopore, and as the proximal margin of the operculum seems to go close up to the corresponding proximal margin of the aperture, there seems to be no room for any opening between them. Excepting that Jullien[2] has found marginal spines in some ancestrulæ of *Hippothoa*-colonies, and that Kirkpatrick[3] has described a *Chorizopora*-form with two pair of spines in the distal end of the zooecium, ordinary spines are otherwise wanting in this family, whereas in all the four genera, though not in all species and varieties, the hollow expansions occur which I have mentioned in the diagnosis of the family. Hincks[4] calls the small chambers, which in *Trypostega venusta* are found partly scattered among the zooecia, partly surrounding the ooecia, avicularia; but as their aperture wants the transverse bar found in the avicularia in *Chorizopora* between the opercular and the subopercular area, I prefer to call them dwarfed or rudimentary zooecia, especially as except in the genus *Haplopoma* we find within the three other genera of the family individuals of different size, form or structure scattered among the ordinary zooecia. Thus, in *Chorizopora* we may find large numbers of very small chambers mixed with some avicularia, and the round aperture of these chambers seems to be covered only by a membrane, while the corresponding chambers in *Trypostega venusta* have a small chitinized operculum, which is different from that of the ordinary zooecia, but which does not how-

[1] 9, p. 166. [2] 15, p. 30. [3] 49, p. 615. [4] 22, p. 276—277.

ever cover the whole of the aperture. Finally we find in a number of species of the genus *Hippothoa* partly unusually small or unusually narrow zoœcia with aperture and operculum of the ordinary structure, partly dwarf zoœcia with a different form of operculum, which does not cover the whole of the aperture, and last of all kenozoœcia. In conclusion I may just mention that while the separate chambers of the colony are connected by small pore-chambers, the septum between the gonozoœcium and the kenozoœcium covering the oœcium is provided with a row (in *H. hyalina* with 4–6) of uniporous rosette-plates.

Synopsis of the genera.

1) The aperture with a simple operculum:

2) A median ascopore proximally to the aperture; oœcia covered by kenozoœcia; zoœcia with scattered pores .... *Haplopoma* n. g.

2) No median ascopore; oœcia covered by avicularia: the zoœcia with at most a row of pores on each side .... *Chorizopora* Hincks.

1) The aperture with a compound operculum, which is generally provided with a sinus:

3) Oœcia covered by kenozoœcia; zoœcia without pores... *Hippothoa* Lamour.

3) Oœcia covered by dwarf zoœcia with opercula; zoœcia with scattered pores .... *Trypostega* n. g.

Hippothoa Lamour.

Hippothoa Hincks, Schizoporella Hincks, Diazeuxia Jull.

The *zoœcia* have no pores, and the aperture is provided with well-developed hinge-teeth and has generally a sinus, more seldom a convex proximal margin. A compound operculum with a broader or narrower accessory part. The gonozoœcia bearing the oœcia have an operculum with a very small accessory part, and the oœcia are surrounded by kenozoœcia without aperture[1].

Of the numerous species belonging to this genus only a smaller number have been described. They differ in form of aperture and hinge teeth, in the absence or presence of acropetal spines, in position and structure of the gonozoœcia, in structure of the kenozoœcia, in mutual connection of the zoœcia, etc. The difference in position and structure of the gonozoœcia appears from the fact, that these individuals in some species (e. g. in *H. cornuta*) are situated on a level with the other zoœcia and are of similar size and form, while in other species (e. g. *H. hyalina* and *H. annularis*) they are situated on the frontal wall of the

[1] Pl. XVIII, fig. 9 a.

ordinary zoœcia, from which they differ in form and size. In the majority of species the kenozoœcia are provided with scattered pores, while in a smaller number of species and as it seems in all the species that may be referred to *Hippothoa* Hincks, they are entirely without pores but possess a median, projecting portion. In most species as in *Chorizopora Brongniarti* the zoœcia are separated by a number of small openings, which however are wanting in a series of species, e. g. in *H. annularis* and *H. cornuta.*

H. annularis Moll.

Lepralia annularis Busk, Catalogue of Marine Polyzoa, Cheilostomata, pag. 85, Pl. XCV, figs. 1, 2.

(Pls. XXI, figs. 7 a—7 f).

The zoœcia are elongated, triangular, trapeziform or rectangular, from the proximal end strongly ascending and terminating in a portion, which is strongly arched from side to side as well as distally proximally and almost hunched or expanded. The maximum height of this portion is attained approximately in the distal third of the body. On either side of the aperture and bent a little towards it there is a short, stout, wide expansion or acropetal spine, which is rounded at the end and looks like a horn. The anter of the oblong aperture (fig. 7 b) is provided with two lateral margins, which only converge slightly distally and meet in a curve. Its poster has in the centre a very small, transversely oval sinus bounded on each side by a trapeziform process, which is again separated from a small hinge-tooth by a very small indentation. The well-chitinized operculum (fig. 7 c), which has an accessory part corresponding to the sinus, is within each lateral margin provided with a long, almost cucumber-shaped groove, which is surrounded by a chitinized margin and probably serves as attachment for the opercular muscles. The distal wall (fig. 7 d) is angularly bent from side to side, and besides the two large distal pore-chambers, through which each zoœcium communicates with one or two others, we find in each lateral wall either 3—4 small pore-chambers or 3 openings, which correspond to as many pore-chambers in the neighbouring zoœcium. 1—4 small, superficial pore-chambers (fig. 7 e) are found on most zoœcia, most often on one side, but sometimes also on the other. They appear near the suture towards the neigbouring zoœcium and decrease in size distally. Of these pore-chambers the proximal one is situated near the distal wall.

The oœcia, which occur in shorter or longer, continuous, curved transverse rows (fig. 1 a), are borne by short, broad, conically cup-shaped gonozoœcia, which are situated on the frontal surface of the zoœcia and communicate with the latter through the just-mentioned superficial pore-chambers. They are covered by strongly arched, pentagonally rounded kenozoœcia, which are twice the length of the gonozoœcia, terminate at the top in a point and meet in parallel sutural lines. Besides a circle of marginal pores, which are partially covered by neighbouring zoœcia, there are still a few scattered pores in their distal part. The well-chitinized operculum (fig. 7 f), which has the form of a segment of a circle, has in its proximal margin two small, rounded sinuses corresponding to two rounded projections on the proximal margin of the aperture. A little inside each lateral margin we find a rounded process for muscular attachment.

The colonies occur as circular or fan-shaped discs on algæ, and, contrary to all the other species of this genus that I have examined, the zoœcia are arranged in continuous, arch-shaped transverse rows.

Two colonies of this species, without statement of locality, are found in the herbarium of algæ in the Botanical Museum.

H. cornuta Busk[1], var. holostoma n.

(Pl. XXI, figs. 8 a—8 g).

The zoœcia are elongated, generally pear-shaped, evenly ascending towards the distal end and provided proximally to the aperture with a large strongly projecting, hollow expansion (fig. 8 g) bent more or less distinctly in the shape of a knee, in which we may distinguish between a broader proximal part and a narrower, at the end broadly rounded distal part. The aperture is wholly or partly hidden by the latter part, when the colony is regarded from the frontal surface. On the boundary between the two above parts the expansion mentioned has an internal, transverse septum, which is perforated by a transversely oval pore. As in the foregoing species we find on either side of the aperture a horn-like expansion rounded at the end, which is however longer and more slender, less bent towards the aperture, but directed more distally. A smaller expansion is not infrequently found in the middle of the frontal surface, sometimes in the central line, sometimes towards one lateral margin. The basal surface of the zoœcium, which has a small uncalcified portion centrally, is on its inner surface, especially in its proximal half, provided with numerous, narrow, scattered, papilla-shaped processes, which have the free end turned towards the distal end. Contrary to the other species examined by me the aperture (fig. 8 c) has no sinus, and the bicusped hinge-teeth separate an almost semi-elliptic anter from a poster, the height of which is only about one-third of the former and its slightly

[1] 2, p. 84.

converging lateral margins meet in an almost straight or slightly curved margin. The well-chitinized operculum has on the other hand a broadly quadrangular, accessorial (fig. 8 d) and within each lateral margin a short, slightly curved muscular ridge. As in the preceding species we find two large distal pore-chambers bounded by the angularly bent distal wall, while each lateral wall has 3—4 communications with the neighbouring zooecia.

The oœcia (figs. 8 b, 8 c) occur in small numbers scattered among the zooecia, and the gonozooecia are provided with a large, broad, somewhat flat, lip-shaped, obliquely ascending expansion which is situated proximally to the aperture. The latter is wholly or partly hidden by the expansion and its proximal margin is slightly angularly bent. The operculum (fig. 8 f) has a small, compressed process on either side. The strongly arched kenozooecia have a number of scattered pores, which are however wanting in the steeply ascending portion distally to the aperture and the projecting central portion of the frontal surface is generally developed as an expansion, more or less sharply delimited.

As the form just-described differs in the want of a sinus in the poster of the aperture from *Lepralia hyalina*, var. *cornuta* described and figured by Busk [1] I originally felt inclined to consider them specifically different in spite of the corresponding development of expansions. But as I have had a later opportunity of examining an apparently closely related form from Victoria, the aperture of which is provided with a well-developed sinus (fig. 9 b), I must suppose all three forms to be varieties of one species, *Hippothoa cornuta* Busk, which is very variable, not least in the form of aperture. This variety may be termed *aporosa*. The three expansions are of a similar form and structure as in var. *holostoma*, and the median expansion especially is provided (fig. 9 a) with a similar septum perforated by a pore. The gonozooecium (fig. 9 c) has a similar lip-shaped expansion, but its aperture, like the zooecial aperture, is provided with a narrow, deep sinus, to which a process on the operculum (fig. 9 e) corresponds. The kenozooecium, which to judge from the figure only possesses a circle of marginal pores in Busk's form, is here at the outside furnished with a few median pores and is even more strongly arched than in var. *holostoma*, its surface being very hunched. A small colony from Victoria has been found on *Pterocladia lucida* in the herbarium of algæ in the Botanical Museum.

[1] 2, p. 84, Pl. XCV, figs. 3—5.

Haplopoma n. g.

The zooecia with scattered pores, a simple operculum and a median ascopore as an orifice for the compensation-sac. The ooecia covered by kenozooecia with scattered pores. No avicularia.

H. impressum Audouin.

Microporella impressa Hincks, British Marine Polyzoa, pag. 214, Pl. XXVI, figs. 9—11, Pl. XXIX, figs. 10, 11.

(Pl. XXII, fig. 9 a—9 b, 10 a—10 c, Pl. XVIII, fig. 11 a).

While Hincks and all later systematic authors have referred this species to the genus *Microporella*, with the species of which it agrees in the possession of a median ascopore, a simple operculum and pore-chambers, Barrois[1] in his great work on the larvæ has rightly recognised its relationship to *Hippothoa hyalina* and called attention especially to the great similarity of their larvæ, which belong to rather a peculiar type. He is however wrong in referring both these species to the same genus (*Mollia*).

The supposition, expressed on several former occasions, that the median ascopore has arisen by a constriction from an original sinus is also confirmed in this species, and Waters[2] has already called attention to the fact, that the primary zooecium in *H. impressum* (Pl. XXII, figs. 9 a—9 b) as well as in *H. bimucronatum*, Moll (Pl. XXII, figs. 10 a—10 c) is provided with a sinus, which is however both narrower and deeper in the latter than in the former. The primary zooecium in the latter species is moreover distinguished not only by possessing a curve of 9 pores, but also by having an operculum (fig. 10 c) similar to that found in the genus *Arthropoma*, the accessory part of the operculum, corresponding to the sinus, being separated from the principal part by a less strongly chitinized portion. This difference in the primary zooecia also speaks in favour of the opinion maintained by Waters, that *H. bimucronatum*, which was formerly considered but a variety of *H. impressum*, is a distinct species.

Genus Trypostega n. g.

The zooecia with scattered pores and a compound operculum. The ooecia covered by dwarf zooecia with scattered pores. No avicularia.

[1] 1, p. 171, Pl. 9, figs. 1—3, Pl. 16, fig. 2. [2] 115, p. 11

T. venusta Norman.

Schizoporella venusta Hincks (incl. syn.), British Marine Polyzoa, pag. 276, Pl. XXX, figs. 6, 7.

Lepralia inornata Gabb et Horn, Smitt, Kgl, Svenska Vetensk. Akad. Handlingar, Bd. 11, No. 4, 1873, pag. 61, Pl. XI, figs. 215—216.

(Pl. XIX, figs. 1 a—1 d, Pl. XXII, figs. 13 a—13 d).

The zoœcia are generally rounded rhombic, provided with numerous scattered pores, strongly arched and ascending towards the portion immediately on the proximal side of the aperture, which terminates in a strong, hollow, often irregularly tuberculated, conical, umbonate expansion (fig. 13 a). The oblong aperture nearly on the boundary of the proximal third has a pair of strong hinge-teeth, each of which is situated within a triangular, inwards projecting part of the lateral margin. Its anter has two proximally converging, lateral margins, and its triangular poster is bounded by a somewhat protruding, almost rectangularly curved margin. The well-chitinized operculum (Pl. XXII, fig. 13 c) is in its principal part provided with small, scattered tubercles and a little inside the margin with a well-developed opercular arch. The numerous small dwarf zoœcia, which are scattered among the zoœcia (Pl. XIX, fig. 1 a, Pl. XXII, fig. 13 d) are on the examined colony of a rounded quadrangular form. The very small, quadrangularly oval aperture is bounded proximally by a somewhat protruding margin and not wholly covered by the well-chitinized, finely dotted operculum (Pl. XXII, fig. 13 d), which has an almost straight or slightly concave proximal margin. The distal half of each zoœcium has a continuous curve of 5—6 large pore-chambers (Pl. XIX, fig. 1 b) and such are also found in the dwarf zoœcia.

The oœcia (Pl. XIX, fig. 1 b, Pl. XXII, fig. 13 a) are surrounded by dwarf zoœcia, which only differ from those appearing among the zoœcia by being larger and of a rounded pentagonal form.

Of this species I have been able to examine a small colony from Guernsey, which was sent me by the Rev. Norman, and another colony from Port Phillip (Miss Jelly), which in all essentials agrees with the British form, the only difference being its want of an expansion proximally to the aperture.

Lepralia claviculata Hincks[1] must certainly also be referred to this genus, but as the oœcia here seem to be enclosed by kenozoœcia without aperture, the diagnosis of the genus would have to undergo a small alteration to be made applicable also to this form.

[1] 34, p. 50.

Family **Adeonidae** Busk [1].

The *zoœcia*, the entire frontal surface of which is provided with a frequently strongly coloured covering membrane, are always without spines, extremely thick-walled and strongly calcified. There are generally pores, and the partition walls are provided with numerous (in the distal half of the zoœcium usually 14—16), small, uniporous rosette-plates disposed in a single row, which on account of the thickness of the walls appear at the end of long canals, and the pores appear in a similar way. Owing to the continued deposition of calcareous matter a secondary, sometimes even a tertiary, aperture is always present. This is more or less different from the primary one, which has most often a sinus or a concave proximal margin. The operculum is generally well marked off from the covering membrane. *Avicularia* are hardly wanting in any species and occur in most species both as dependent and independent. They are always without a calcified transverse bar between the opercular and the subopercular area, and at its base the mandible has on either side a strongly protruding muscular process. *Oœcia* are wanting, but gonozoœcia appear in most species. The latter are somewhat larger than the ordinary zoœcia, from which they further differ by possessing a broader aperture and by being generally better provided with pores. The colonies are usually free, two-layered, sometimes laminate, sometimes branched, more rarely incrusting.

This extremely natural and sharply delimited family was founded by Busk in his report on the *Bryozoa* of the Challenger Expedition. But just as the author did not succeed in comprehending this family in all its extent, overlooking as he did, that his *Mucronella pyriformis*, set up in the same work, also belongs to it, so also is his diagnosis of the family very incomplete, as of real, general, positive characters he mentions only one, viz. the above-mentioned peculiarity in the avicularian mandible, which however according to Waters [2] may also be found in members of other families. On the other hand, Waters [3] has pointed out that the median pore which according to Busk is found in all members of this family can not be regarded as a family character, as this pore in some species leads into the zoœcial cavity itself (*Adeona, Adeonellopsis*), while in others it leads into the space between the primary and the secondary aperture (*Adeonella*).

This incomplete diagnosis of the family may be one of the reasons for the fact, that in spite of its naturalness this family has not been adopted by a single

[1] 8, p. 177. [2] 106 a, p. 777. [3] 106, p. 283.

author, at least not for any length of time[1], or in the extent in which it was set up by Busk. With regard to the different opinions concerning this question, I may refer to the discussion of it by Gregory[2] under the title of: "The systematic position of the *Adeonellidae*", and I may here confine myself to the remark, that the species of *Adeona* and *Adeonellopsis* have by all authors been referred to the family *Microporellidae*, the two genera being sometimes retained, sometimes merged in *Microporella*.

Synopsis of the genera.

1) The zoœcia provided in the central line with a single or a group of connected ascopores:

2) With one or two simple ascopores .... *Adeona* (Lamour.).

2) With one or several stellate ascopores .... *Adeonellopsis* (Mac Gill.) Lev.

1) The zoœcia without such median ascopores:

3) The proximal part of the secondary aperture, which appears sooner or later, is transformed by a coalescence of two calcareous processes into a pore, which leads into the space between the primary and the secondary aperture .... *Adeonella* (Busk) Waters.

3) The proximal part of the secondary aperture is not transformed into a pore .... *Bracebridgia* Mac Gill.

In the above synopsis no regard has been paid to the form of the primary aperture or the structure of the operculum, for the reason, that the form of the primary aperture, to judge from the relatively small number of species examined in this respect, is subject to rather great variation within the separate genera.

Adeona violacea Johnston.

Microporella violacea Hincks, British Marine Polyzoa, pag. 216, Pl. XXX, figs. 1—4.
Adeonella insidiosa Jullien, Résultats des Campagnes scientifiques du Prince de Monaco, fascicule XXIII, Bryozoaires, 1903, pag. 54, Pl. VI, fig. 1.

(Pl. XIV, figs. 1 a—1 g).

The zoœcia, the finely tuberculated surface of which is covered by a black, strongly iridescent membrane, are elongated, hexagonal and provided with rather numerous pores, which are most closely situated in the marginal portion. The

[1] Mac Gillivray (69, p. 133) originally adopted Busk's family in all its extent, while in the following year (75, p. 209—13) he referred *Adeona* and *Adeonellopsis* to the family *Microporellidae* and *Adeonella* to *Escharidae*. In his last work (76, p. 90), he refers *Adeonella* to *Schizoporellidae*. [2] 16 a, p. 241.

ascopore is situated proximally to the centre of the body in a more or less developed depression. The primary aperture, which has no distinct hinge-teeth, is almost semi-circular and bounded by a proximal, nearly straight or slightly convex margin. The operculum (fig. 1 f) is not separated from the covering membrane, and with the exception of a narrow marginal portion it is membranous; only in old zoœcia the part corresponding to the secondary aperture may be slightly chitinized. The secondary aperture is of a somewhat variable, roundish form, most often somewhat broader than high, and with less concave, sometimes almost straight proximal margin. Each zoœcium has in its distal half 11—16 uniporous rosette-plates and in its proximal half as many openings. In most corners between the zoœcia we find very small rounded cavities covered by a membrane, which seem to be kenozoœcia.

Avicularia. A long, narrow, pointed avicularium is found in most zoœcia a little distally to the median pore. It is directed towards the aperture and may reach some way past the proximal margin of the latter. Instead of the avicularium we find in a smaller number of zoœcia (fig. 1 b) an annular opening, which leads into an elongated, sometimes somewhat swollen cavity.

The gonozoœcia, which are scattered singly or in groups among the zoœcia, are considerably larger than the latter and of an angularly oval form. Moreover they differ from the ordinary zoœcia by having a greater number of pores, a broader, transversely oval aperture and two coalesced ascopores. The avicularium is never developed, but is replaced by a cavity similar to that found in a smaller number of zoœcia.

Of this species I have examined a number of colonies from Syracuse (rocky and shelly bottom, 12—25 fm., Dr. H. J. Hansen), which occur partly incrusting on calcareous algæ, partly in free, one-layered expansions. They agree with a small colony from Guernsey (Norman) also in the possession of a single ascopore and of the small round kenozoœcia, and as the latter thus contrary to the descriptions of Hincks and Jullien, are not necessarily dependent on the presence of a double pore, I find no reason for regarding Hincks's var. *a* as an independent species, as Jullien does.

Adeonella serrata n. sp.

(Pl. XIV, figs. 2 a—2 g).

The zoœcia, the finely tuberculated surface of which is covered by a light-brown membrane, are generally rhomboidally vase-shaped, strongly arched and provided with scattered pores. The primary aperture, which is provided with well-developed hinge-teeth, has a large, well-defined, broadly rounded sinus and a separable, chitinized operculum, while the somewhat projecting secondary aperture is irregularly circular, sometimes short, transversely oval. Each zoœcium has about 12 rosette-plates in its distal half.

The gonozoœcia, which are considerably larger than the ordinary zoœcia, are provided with numerous pores, and the primary as well as the secondary aperture is much broader than in the zoœcia. The proximal margin of the secondary aperture is sometimes almost straight, sometimes rather projecting centrally, and it is separated from the large, peristomial pore by a high bridge. They appear everywhere along the margin of the colony on both surfaces and form a belt of up to three longitudinal rows.

The avicularia occur both as dependent and as independent, of which the latter may be larger than the gonozoœcia and especially attain a more considerable length. They have a well-developed cryptocyst and a long mandible, the two sides of which are sometimes almost parallel and meet in a curve at the end. They appear in larger or smaller numbers in the marginal portion of the colony, scattered sometimes singly, sometimes in smaller groups. Within each bifurcation 1—5 are always seen, of which the inner one or inner ones always go further inwards on the branch than in the other parts of the colony. The dependent avicularia which are found on the separate zoœcia in a number of 2—3, very seldom 4, are of a rather long, triangular form, and they have the point turned in every possible direction. If 3 are present the two are most often situated on either side of the peristomial pore at the same or nearly the same level, and if there are only 2, the one wanting is most often one of the distals. On the gonozoœcia the two distal ones are generally situated on either side of the peristomial pore and have the points turned obliquely inwards and distally.

The colonies are two-layered, richly branched, bifurcated, with compressed branches, which may attain a breadth of about $4^{mm.}$ As the daughter-branches belonging to the same mother-branch never lie at the same level, but are bent more or less strongly in different directions, the neighbouring branches coalesce in numerous irregular ways. The zoœcia on the separate branches are disposed in oblique, somewhat curved rows and each row terminates in two or sometimes three gonozoœcia. In the margin of the colony we find a more or less sharply broken row of single individuals, partly kenozoœcia of very different size, which may bear a small aviculariun, partly independent avicularia, the terminal part of which is strongly projecting, thus giving the branches an irregular, serrated appearance.

This species is present in great numbers from the Formosa Channel, Lat. 23° 20′ N., Long. 118° 30′ E., 17 fath. (Andréa).

Adeonella Jellyae n. sp.

(Pls. XIV, figs. 1a—1g, 1h, 1i).

The zoœcia, the finely tuberculated surface of which is covered by a brownish violet membrane, are rhomboidally hexagonal or vase-shaped and provided with scattered pores, which are most numerous in the marginal portion. The primary aperture, which only in the very youngest zoœcia lies immediately on the surface of the colony, has an almost quadrangularly rounded anter, the two almost parallel lateral margins of which meet in a curve. The more or less convex poster is provided with a sharply bounded, quadrangularly rounded sinus, the breadth of which is about one-third of the aperture and is almost as long as it is broad. There are well-developed hinge-teeth and a well-chitinized operculum. The secondary aperture, the development of which passes through many stages, attains the structure peculiar to the genus only in very old zoœcia. It is thus at a certain point of time provided with a large rounded sinus, the proximal part of which finally becomes a pore. The form of the real secondary aperture varies between round and semi-elliptical, often with an almost straight proximal margin. In the distal half of the zoœcium there are 14—16 uniporous rosette-plates.

The gonozoœcia are scattered in smaller numbers among the ordinary zoœcia. They are only a little larger than the latter and have an aperture of a somewhat different form. Its anter is almost semi-elliptical, and its slightly convex poster is provided with a rounded sinus, which is at its starting point about half as broad as the aperture.

The avicularia have a rather long, triangular mandible and appear both as independent and as dependent. The former, which may attain a size similar to that of the zoœcia and which have a rhomboidally vase-like form, are scattered over the surface of the colony, singly or in groups of up to 4. The dependent avicularia, which are not only found on the zoœcia and the gonozoœcia, but in rare cases also on the independent avicularia in a number of 1—2, are subject to some variation both with regard to number and position. There are generally two proximally to the aperture, which have the points turned obliquely proximally and towards the centre, but one of them may be directed distally in a smaller number of zoœcia. Very often we find proximally to these two still a third, the position of which may be very variable.

The colonies appear as bilaminate, foliaceous, folded and lobed expansions, which form labyrinthic and cellular masses by concrescense of the single lobes and laminate folds.

Port Elizabeth, South Africa (Miss Jelly).

This species is certainly closely related to »*Schizoporella*« *bimunita* Hincks[1], which undoubtedly must also be referred to the genus *Adeonella*.

Adeonella pygmaea n. sp.

(Pl. XIV, figs. 1 j, 1 k).

The zoœcia very small, finely tuberculated, as a rule rounded hexagonally or vase-shaped, with scattered pores. The primary aperture, which, in contrast to what is found in the foregoing species, is only seen on quite a few zoœcia at the end of the branches, has an approximately semicircular anter and its poster has a broad, rounded sinus, which at its beginning is as much as two-thirds of the whole breadth of the aperture. The operculum is well-chitinized. The secondary aperture is semicircular in its final form, with a sometimes almost straight, sometimes somewhat convex proximal margin, and the small median ascopore, which is placed in a depression, lies just as far from the aperture as the height of the latter.

Gonozoœcia were not observed.

The avicularia seem only to occur independently and each zoœcium is only provided with a single, fairly elongated, pointed avicularium situated on the outer (directed towards the corresponding lateral margin of the branch) side of the zoœcium, with as a rule its point directed obliquely inwards and towards the aperture.

The colonies are two-layered, free, branched, with narrow, compressed branches, but the colonies examined, which are situated in large quantity and in very different stages of development on a large colony of *Ad. Jellyae*, are undoubtedly very young, as the largest of them only has a length of $9^{mm.}$ and consists only of four branches. Whilst the younger colonies are quite light in colour, the older have a somewhat similar colour to that of the species on which they grow. Possibly they may be young colonies of *Ad. Jellyae*.

Adeonellopsis foliacea Mac Gill.

Trans. and Proc. R. Soc. Victoria, Vol. XXII, 1886 (for 1885), p. 131, Pl. II, fig. 1.

(Pl. XIV, figs. 5 a—5 d).

The zoœcia finely tuberculated, covered by a grayish-black membrane, as a rule rhombic, provided with scattered pores, which occur chiefly on the marginal

[1] 31, p. 290.

region and usually in very small number on the median region The primary aperture, which is provided in each corner with a strong, rounded hinge-tooth (fig. 5 b), is more than twice as broad as it is high, with an angularly arch-shaped anter and a faintly concave poster. The operculum well-chitinized with a short muscular ridge in each corner (fig. 5 c). The secondary aperture is surrounded by a prominent rim and lies at some distance from the distal margin of the zoœcium, often immediately proximally to the distal two-thirds of the zoœcium; it is broad, transversely oval. The area of ascopores is situated in a depression and lies more or less far back in the proximal half of the zoœcium; it is usually small being contained as a rule two or three times in the secondary aperture. It is divided by a separating ridge into 3—6 partitions and the margin of each of these is provided with a number of extremely thin denticles, which usually reach in to the middle of the section without however meeting.

The gonozoœcia, which are scattered sparingly over the surface of the colony, partly singly, partly in groups of 2—3, are more than twice as large as the zoœcia, from which they also differ, in addition to a richer development of pores and avicularia and a much more arched surface, by the possession of a much larger ascopore-area, which shows 16—20 small partitions, and by having a much broader and relatively lower aperture, the proximal rim of which is very convex.

The avicularia, which are provided with a fairly elongated, triangular mandible, occur both independently and dependently, the former of which have a similar form and size as most of the zoœcia, being very sparingly scattered over the surface of the colony. On the ordinary zoœcia there are as a rule three, very often four and sometimes five avicularia. The most constant of these is situated distally to the ascopore-area and its point is directed towards the aperture. One is usually placed on each side proximally to or at the side of the aperture and its point is usually directed in towards the middle line of the zoœcium, but its direction varies. One may occur in the distal part of the zoœcium and its point is usually directed towards the aperture and it seldom appears on the proximal part of the zoœcium. In addition to the avicularia corresponding to the above, 1—2 may also appear on each side of the gonozoœcium opposite the ascopore-area.

Of this species I have examined a fragment from Port Western, Victoria (Miss Jelly), consisting of a two-layered folded plate.

Bracebridgia pyriformis Busk.

Mucronella pyriformis Busk, Challenger, Zoology, Vol. X, Part I, p. 155, Pl. XX, figs. 5 a, 5 b.

Bracebridgia pyriformis Mac Gillivray, Trans. and Proc. R. Soc. Victoria, Vol. XXII, 1886 (for 1885), p. 135, Pl. II, figs. 6, 7.

(Pl. XIV, figs. 3 a—3 e).

The zoœcia, which are as a rule pear-shaped or vase-like and have a circle of widely separated pores somewhat distant from the margin, show over almost the whole of the frontal surface a sharp, wavy, transverse striation appearing in a number of broad, rounded ridges, somewhat curved and running mainly in the longitudinal direction of the zoœcium. One of these runs round the whole of the zoœcium, whilst another, which encircles the aperture, continues proximally to this as two keels running side by side, which finally run together into one. Between the marginal and the median ridges there are also one or several on each side, and sometimes we can distinguish a number which run obliquely inwards and are partially separated by the pores mentioned. The only part of the frontal wall of the zoœcium which does not show this characteristic striation is a small, depressed, semicircular or triangular region just proximally to the aperture. Mac Gillivray has once found an avicularium on this spot. The primary aperture, which has two small hinge-teeth, has a rounded, quadrangular form, and the two lateral margins slightly converging distally meet in an arch, whilst the proximal rim is slightly concave. The well-chitinized operculum is provided on each side of the proximal part with a short muscular ridge. Outside the primary aperture there is a low, but broad, somewhat trapeziform tooth, and between it and the secondary aperture a small, stout, conical projection. The secondary aperture is of an elongated, oval form and surrounded by a collar-like rim.

Gonozoœcia have not been found.

The avicularia (fig. 3 e) appear on the margins of the colony in a more or less interrupted row. They are stout, strongly arched, with a rounded, trapezium-shaped circumference and provided with a fairly short, rounded triangular mandible (fig. 3 d), which has its point directed towards the distal part of the branch.

The colonies are two-layered, branched with compressed branches.

A fragment from Victoria.

Family **Reteporidae** Smitt, char. emend.

(Pl. X, figs. 1—5; Pl. XXIII, figs. 1—5).

The *zoœcia*, which are composed of a very hard and thick calcareous mass, are as a rule only sparingly provided with pores and may have 2—8 spines, which are not rarely composed of a row of internodes. There is a more or less well-developed vestibular arch, which is usually beaded, and the separating walls between the single zoœcia are provided with uniporous, more rarely with few-pored rosette-plates, which may sometimes be placed in the inner wall of small pore-chambers. Each distal wall is usually provided with one and the distal half of each lateral wall with one uniporous rosette-plate. Dependent *avicularia* of varying form and size occur as a rule. The hyperstomial *oœcia*, which spring from a narrow, sometimes almost stalk-like proximal part and consist in their whole extent of two calcareous layers, are originally free, though as a rule more or less deeply immersed in niche-like depressions; but in older parts of the colony they may often be quite hidden under the covering layer which grows over them from the margins of the niche-like depression. Their frontal surface may sometimes be complete, sometimes provided with a slit-like or trilobed uncalcified part, almost never with scattered pores. An oœcial operculum seems to be always absent, but on the other hand the free margin of the oœcium is not rarely provided with a larger or smaller, obliquely inwards directed, median projection, which serves to reduce the size of the aperture. The *colonies* are not rarely incrusting, but usually free and in most cases occur in the form of a perforated network of sinuous or folded laminæ, which only consist as a rule of a single layer of true zoœcia (almost always directed towards the inner side of the colony). The opposite surface of the colony is however covered by one or several layers of *kenozoœcia*, the inner cavities of which are greatly reduced or quite absent and which agree with the zoœcia neither in form nor in size. A larger or smaller number of these kenozoœcia are provided with avicularia and the colony is fastened according to its age and size by means of a larger or smaller expansion formed by similar kenozoœcia.

This diagnosis of the family is based on the investigation of a large number of species, and the family is undoubtedly one of the most natural and most sharply defined. Whilst the aperture, operculum and the peristome are subject to large differences, we find as a rule distinct hinge-teeth and a more or less well-developed vestibular arch, which is usually provided in the neighbourhood of the margin with small, rounded projections. Such a crenulated arch can be seen on figures of *Ret. sinuosa* Kirkp.[1], *Ret. novae zelandiae* Waters[2] and *Rhynchozoon profundum* Mac Gill.[3], as well as on the accompanying figures of *Rhync. angulatum* n. sp. (Pl. XXIII, fig. 4 a). In those forms which have a strongly developed peristome, the arch named is difficult to see from the frontal surface and to examine it we must grind down the basal wall of the colony. This also applies to the hinge-teeth. The rosette-plates seem to show great constancy, and in the numerous species I have examined in this regard I have only found two in which the rosette-plates had several pores. Thus, the distal wall in *R. lata* is provided with a narrow, transversely oval rosette-plate with a row of 3—5 pores and in *Rhync. angulatum* some of the rosette-plates may have two pores. The rosette-plates in this species are exceptionally situated at the bottom of pore-chambers. The ooecia also in spite of smaller differences show great agreement in their structure.

The peculiar layer of kenozooecia, which covers the basal surface of the free-growing colonies and is of the same nature as the expansion attaching them to their under-layer, deserves closer description. With regard to this expansion Smitt[4] has correctly recognised in *Ret. elongata* (*Ret. Wallichiana* Busk), that it consists of imperfectly developed individuals, and he has even found some of them with an aperture. Hincks[5] describes these individuals as »aborted cells«, but as I have already shown in my Studies on Bryozoa he[6] has in so far misunderstood this expansion, that he regards it as the first formed part of the colony, whereas in reality it only arises after a number of ordinary zooecia have been formed. It then gradually increases in extent with the further growth of the colony. Pl. X, fig. 1 c shows a beginning colony of *R. Beaniana*, which shows in addition to a primary zooecium in the *Membranipora* stage two fully developed zooecia and the basal surfaces of two just beginning. Fig. 1 d on the other hand shows a slightly older colony with a small radical expansion and in figs. 1 g and 1 h parts of this are magnified to a greater extent. Both show beginning kenozooecia on the growing margin the membranous roof of which has disappeared in the previous boiling in caustic potash; their distal wall is provided with 1—2 small rosette-plates. If we examine the outer surface of a *Retepora* colony attached to its under-layer, e. g. the colony of *Retepora Beaniana* figured on Pl. X, 1 a, which is attached by its radical expansion to a tube of *Hydroides norvegica*, we see that the division into irregular, mostly avicularium-bearing areas shown by this expansion is continued without interruption or boundary on to the outer side of the free part of the colony, with this difference, however, that these areas

[1] 49 a, p. 269. [2] 108 c, Pl. VII, figs. 1—3. [3] 108, Pl. II, fig. 15. [4] 100, p. 200—201, Pl XXVIII, fig. 232. [5] 22, p. 388 [6] 22, p. 394, fig 18

are here somewhat larger and that only a small number of them bear avicularia. It seems reasonable to conclude therefore, that this division into areas is here also a sign, that this covering is composed of kenozooecia. Waters, who has extended our knowledge of the *Bryozoa* on so many points by bringing forward new or insufficiently known structural features, has also at several places made investigations on this characteristic division of the covering into areas. Thus, in his paper[1] on a part of the *Bryozoa* material of the Challenger Expedition he has called attention to the fact, not only that it shows stratification but also that it contains numerous cavities. In a later paper[2] he has further remarked, that by incineration it can be loosened from the true zooecia, and that the lines which divide it into areas are not merely superficial marks but that they extend right through it. As the incineration however makes this covering unsuitable for closer investigation, and boiling in caustic potash, by which means two-layered colonies can usually be divided into their two layers, here leads to no result, there seems no other way of isolating this kenozooecial layer than to grind down the zooecial layer, and this I have done with good results in the case of *Ret. tesselata*. A fragment of *Ret. lata*, which was sent me by the British Museum, shows quite exceptionally here and there a tendency of this layer to scale in small plates, and these thus offer favourable conditions for a closer investigation. After such a plate has been boiled for some time in caustic potash, we can by means of a needle isolate the single kenozooecia, which thus possess not only independent lateral walls, but also, what is never found in the ordinary zooecia in any *Bryozoa* with exception of the *Onychocella* species, independent distal and proximal walls. I have found the same thing in the kenozooecia of *Ret. tesselata* and it will probably prove to be the rule in this family. The above-mentioned kenozooecia of *Ret. lata* also appear to contain an inner cavity, which however is of an extremely variable and irregular form and consists, e. g. in the two connected kenozooecia figured on Pl. XXIII, fig. 2 a, of a number of small, more or less elongate cavities connected by narrow, canal-like parts. The cavities in adjacent kenozooecia are also connected in the same way, and the separating walls thus show a corresponding number of round openings or rosette-plates. Pl. XXIII, (figs. 2 b, 2 c) shows the same kenozooecium seen from the basal (zooecial) surface and from the one side. In the first case it shows a large, inner cavity, which however is in parts interrupted by calcified portions and is not seen with the same distinctness everywhere, as it lies at a somewhat different height at different places. It is in connection both on the distal wall and on the two lateral walls with the

[1] 110, pp. 19—21, figs. 7,9. [2] 115, pp. 77—78.

adjoining kenozoœcia by means of canal-like perforations. On the second figure, showing the lateral wall which has most connections, we find corresponding to these 7 small rosette-plates, the situation of which near to the basal surface shows, that the inner cavity belongs to the oldest part of the kenozoœcium, whilst the remaining part of the thickness of the wall has arisen from the later deposited calcareous layers. As Waters[1] has already remarked, every second layer extends further out than the foregoing and therefore the walls of the adjoining kenozoœcia dovetail into each other. The avicularia of the kenozoœcia, which are connected with the cavities mentioned, send out canals, which partly and often through separating walls stand in connection with corresponding canals from other avicularia (Pl. XXIII, fig. 1 a), and partly open out through pores on the outer surface. At the same time as the originally formed avicularia are overgrown by the gradually deposited calcareous layers, new ones are constantly formed, and we therefore find on the frontal wall partly quite superficial, partly more immersed and finally overgrown, though still distinct avicularia (Pl. X, fig. 5 c). As the kenozoœcia are dependent for their nourishment on the zoœcia, they must have an internal connection with these, and we therefore find on the basal wall of more or fewer zoœcia a small, round opening, which must correspond to just as many rosette-plates on the zoœcial surface of the kenozoœcia. In *Ret. tesselata*, which sometimes consists of two layers of ordinary zoœcia (Pl. X, fig. 4 c), the quite young kenozoœcia contain a large cavity (Pl. X, fig. 4 b), but it seems to disappear fairly quickly or to become reduced (fig. 4 a) and in older zoœcia to exist only in connection with an avicularium. If we grind down the frontal wall of the zoœcia in this species, we find on the basal wall a number of pores, which undoubtedly serve for connection with the kenozoœcia. Whilst Pl. X, fig. 4 b shows the growing edge of a colony ground down transversely, fig. 4 a shows a much older part of the colony similarly treated, and the three rows of cavities seem to indicate that we have here three layers of kenozoœcia. That the kenozoœcia may occur in several layers, the one outside the other, appears even more distinctly from Pl. X, fig. 2 b, which represents the proximal part of a colony of *Ret. mediterranea* ground down transversely. This part, which is seen from the side in fig. 2 a, shows in transverse section three originally separated branches, a narrower and two broader, which have become connected to one mass by means of numerous kenozoœcia, which at this place have not only overgrown both surfaces of the colony by several layers, but have also filled up the space between the single branches. On the transsected surface we see a transverse row

[1] 115, p. 78, Pl. VI, figs. 6 a—6 b.

of the mostly quadrangularly rounded sections of the zooecial cavities. Just as the kenozooecia mentioned seen from the surface (fig. 2 a) are of very different form and size, the same is the case with their transverse sections, and the inner cavity in some of considerable size is in others almost slit-like. In two of them (one on the left and one on the right side) there is only a distinct cavity in the one half, whilst in the other the two walls lie close up against one another, and this enables us to readily understand why these kenozooecia in many species, e. g. in *Ret. Beaniana* and *Ret. phoenicea*, have no inner cavity even in the youngest parts of the colony. On the kenozooecia arranged in layers we can distinguish between three kinds of walls, terminal separating walls which separate the kenozooecia at different heights, lateral walls which separate the kenozooecia at the same height and interjacent walls which separate the kenozooecia in different layers. Whilst the last are provided with pore-canals, the two others are provided with uniporous rosette plates (figs. 2 d and 2 e), which according to the extent of the chambers may sometimes be placed in a zigzag row, sometimes in a single row.

That we have here actually to do with layers which arise the one outside of the other, is specially distinct in those cases where for example a *Spirorbis* is fixed on a *Retepora* colony, as the tube of the worm then becomes covered by layers which grow up over it from the surface of the colony. This is seen for example on Pl. XXIII, fig. 3 a, which represents a section, obtained by grinding, through a colony of *Ret. cellulosa* from Oran. We see here a *Spirorbis* tube covered by an expansion, which on the one side is two-layered and on the other single, whilst on each side of the tube there is an elongated, triangular cavity, which separates the covering layer from that on which the tube rests. On Pl. X, fig. 2 c is shown a part of a colony of *Ret. mediterranea*, which is much younger than the fragment represented in fig. 2 b, but here also the frontal surface of the zooecia is covered by kenozooecia. Fig. 3 b shows a section, obtained by grinding, through the terminal part of a branch of *Ret. Wallichiana* and the kenozooecia here also are provided with a distinct cavity.

Time has not permitted me to enter further into the classification of this family, and I have been obliged to restrict myself partly to describe a single incrusting species, partly to mention a number of earlier described incrusting species, which must be referred to this family. These are for example, *Schizotheca fissa* Busk, *Schiz. divisa* Norman, *Rhynchozoon*[1] *bispinosum* Johnst., *Rhynch. longirostre* Hincks, *Rhynch. profundum* Mac Gill., *Rhynch. crenulatum* Waters, »*Mucronella tubulosa* Hincks, »*Schizoporella*« *armata* Hincks, *Schiz. lucida* Hincks, »*Schiz.*« *scintillans* Hincks etc.

[1] As to the name *Rhynchozoon* see 25, p. 125 and 38 b, Index.

Rhynchozoon angulatum n. sp.

(Pl. XXIII, figs. 1a—1h).

The zoœcia, which consist of a hard and thick calcareous mass and have as a rule a rhombic hexagonal outline, have a strongly arched frontal wall, which rises strongly from the proximal end and from the lateral margins up towards the oral rostrum or the oral avicularium. The margin of the zoœcium is provided with a number of fairly large scattered pores and marks of two spines are sometimes seen distally to the aperture, which is approximately terminal. The aperture, which is provided on each side with a more or less developed, as a rule stout, conical projection, is almost circular in the greater part of its circumference, but provided on its proximal margin with a slightly developed, low, rounded sinus. This on each side is bounded by a large, compressed quadrangular hinge-tooth, the distal edge of which is provided as a rule with a small incision dividing it into two lobes, only one of which can be seen from the frontal aspect. From the distal rim of the aperture and a part of the lateral margins arises a well-developed vestibular arch hanging down into the zoœcium, which is provided on its oral surface near to the free margin with a row of small, pearl-like nodules. The strongly chitinized, yellow operculum has two, small, muscular pits on its distal half and is provided on each side of the slightly marked sinus at the margin with an obliquely semicircular, thin region, arising from the fact that this part has been in connection with the hinge-tooth. Each distal wall is provided with 2—4 and each lateral wall in its distal half with 3 (2—4) uniporous or partly biporous rosette-plates, each of which is situated in a small pore-chamber.

The oœcia, the proximal part of which is very narrow, almost stalk-like and gradually increases in width distally, have their basal part immersed in niche-like hollows, the distal and marginal parts of their unperforated frontal surface being furnished with an oœcial cover arising from the distal zoœcium and ending in a curved or angularly bent proximal margin. The uncovered portion, the greater part of which is of a yellowish colour, ends in an obliquely inwards directed (fig. 1 f) trapeziform part with a straight proximal and incurved lateral margins.

Avicularia. A somewhat compressed avicularium, which is large, arched and almost triangular in section, is found on one or other side of most zoœcia in the neighbourhood of the proximal rim of the aperture; its fairly long, triangular mandible is directed obliquely outwards. In a smaller number of zoœcia an avicularium is either wanting or is placed on the proximal half of the zoœcium, and in both cases the proximal rim of the aperture runs out into a stout rostrum directed somewhat distally.

This species which occurs along with »*Schizoporella*« *scintillans* incrusts like that species oyster shells, from Stewart Island (Miss Jelly). It is nearly related to *Rhynchozoon bispinosum* and »*Schiz.*« *scintillans*, which must likewise be referred to the genus *Rhynchozoon*, and to judge from the species mentioned this genus seems to be characterized by the possession of a more or less well-developed sinus on the aperture, by its oœcia which have an entire frontal surface and are provided with an incomplete oœcial cover and by the possession of pore-chambers. In *Rhync. scintillans* however the operculum is provided with a strongly developed accessory part, the hinge-teeth not being in connection with the inner surface of the operculum but with its free margin.

Family **Myriozoidae** Smitt., char. emend.

The *zoœcia*, provided with a covering-membrane and more or less thick-walled, always lack spines and are furnished with numerous, sometimes more scattered, sometimes more closely placed pores, which in the very thick-walled forms appear as long canals. Both the distal wall and the lateral walls which are common to the adjoining zoœcia are provided with uniporous rosette-plates, which usually occur scattered, more rarely in uniporous pore-chambers. Dependent *avicularia* seem always to be present. The *oœcia* are as a rule hyperstomial and consist of two calcified layers free in their whole extent. They arise from a broad proximal part, are immersed in niche-like depressions and their frontal wall is covered and as a rule quite concealed by an oœcial cover originating from the cryptocyst of the higher situated zoœcium. More rarely they are endozoœcial. The colonies are seldom incrusting, as a rule free, usually branched with cylindrical branches, sometimes laminate.

Busk has instituted a genus *Gephyrophora*, and the most significant part of the generic definition is the following: »A prominent avicularian process on each side of the orifice, the two eventually inarching and forming a bridge in front of it«. This character, however, is not sufficient for the establishing of a new genus, as the bridge named is identical with that found in the species of the genus *Haswellia*. In the genus *Adeonella* as well as in the genus *Haswellia* the peristomial pore is formed in such a way that two peristomial processes unite to form an arch in front of the aperture. In *Hasw. australiensis*, *Hasw. auriculata* and *Gephyrophora polymorpha* each of these processes is provided with an avicularium, but while this in the two former species is very small in proportion to the process on which it is seated, it is in the latter so large that the process may seem to be only a part of the avicularium. The case is however quite the same. Nevertheless the genus *Gephyrophora* may perhaps be preserved on account of its possessing endozooecial ooecia.

This family is nearly related to the *Reteporidae*, from which they differ by the absence of spines, by a richer development of pores, by only possessing a weakly developed vestibular arch as also by differences in the structure of the ooecia. It is possible, however, that closer study of a larger number of forms of both families will prove it difficult to define them sharply from one another.

Synopsis of the genera.

1) A tubular peristome provided with two or more avicularia and with a suboral pore leading into the peristomial cavity:

2) Hyperstomial ooecia . . . . *Haswellia* Busk.

2) Endozooecial ooecia . . . . *Gephyrophora* Busk.

1) No peristome (hyperstomial ooecia):

3) Avicularia without transverse bar; pore-chambers . . . . *Myriozoella* n. g. (*Myr. crustaceum* Smitt.)

3) Avicularia with transverse bar; no pore-chambers . . . . . . *Myriozoum* Donati.

Haswellia australiensis Hasw.

Haswellia australiensis Busk, Challenger, Zoology, Vol. X, Part I, p. 172, Pl. XXIV, fig. 9.

Porina coronata var. labrosa Waters, Challenger, Zoology, Vol. XXXI, Part III, p. 32, Pl. II, fig. 8.

(Pl. XVI, figs. 2 a—2 b).

The zoœcia elongated, narrow, without separating furrows, provided with numerous pore-canals, the outer, oval openings of which are separated by arched ridges and show a more or less distinct tendency to be arranged in longitudinal rows. Whilst these openings in the younger parts of the colony are broader than or as broad as the ridges, they decrease in extent as time goes on and finally become quite closed. Each pore-canal ends inwardly in a uniporous rosette-plate with a calcified outer area. The operculum is well-chitinized and its anter makes the two-thirds of a circle. The accessorial part which is only separated from the anter by a very small rounded sinus on each side is rather large, rounded triangular and the lateral margins are a little concave. A very little indistinct muscular dot is placed on each side in the distal part of the operculum. The hinge-teeth are well-developed. The fairly short, obliquely projecting oral tube, which possesses only a small number of scattered pores, has an opening medially on its proximal wall, which is somewhat smaller in the oœcia-bearing zoœcia than in the others, and the bridge separating this from the secondary aperture is provided at its distal part with two small, triangular avicularia. Each distal wall is provided over its whole surface with uniporous rosette-plates, which are situated at the end of long canals owing to the thickness of this wall. Each lateral wall and each inner wall is provided with a smaller number of similar plates, on the lateral walls as a rule 2—3, whilst there may be up to 6 irregularly scattered plates on the basal wall. The outermost part of each lateral wall is further perforated by the inner terminal parts of a number of pore-canals, some of which end on the surface of the zoœcium, others on the distal wall. These inner terminal parts are sometimes bifurcated, sometimes sac-like widened, but always have two separate, uniporous rosette-plates, which belong each to its own side of the separating wall and these marginal rosette-plates thus form a connecting link between the common lateral rosette-plates and those belonging to the frontal wall.

The oœcia in conjunction with the peristome form large, mamma-like protuberances which are not sharply marked off from the zoœcia and they seem usually to occur on all zoœcia in one or in several (up to 6) successive circles, more rarely only on one or several zoœcia in one circle. Whilst the single oœcia are originally separated from their neighbours by fairly distinct depressions, they gradually fuse together almost entirely to form ring-shaped swellings, which make the oœcia-bearing branches easily recognizable. The oœcial cover, which like the rest of the zoœcium is provided with pore-canals, is connected with the distal wall of the oral tube, and through the secondary aperture can be seen the frontal wall of the actual oœcium formed by two calcareous layers, which can only be seen distinctly in longitudinal sections obtained by grinding.

The avicularia are fairly small, of a pyriform outline and provided with a triangular mandible. A somewhat larger avicularium, the ascending, freely projecting point of which is directed proximally, is situated as a rule on the boundary between every two zoœcia a little proximally to the peristomial pore, whilst a smaller immersed avicularium is situated on each half of the bridge which separates this pore from the secondary aperture. The two avicularia, the points of which are directed towards each other, are separated medially on the bridge by a faint depression and not by a tooth-like projection as in the colony examined by Busk.

The colonies are richly branched with irregular, bifurcated, cylindrical branches on which the zoœcia are arranged in whorls round a small, cylindrical cavity, thus giving rise to inner walls. The colonies are from the Formosa Channel, Lat. 23° 20′ N., Long. 18° 30′ E., 17 fathoms depth (Andréa).

Haswellia coronata Reuss

Cellaria coronata Reuss, Fossile Polyparien d. Wiener Tertiär beckens, Haidinger Naturwiss. Abhandl. 2ter Band, 1848, p. 62, T. VIII, fig. 3.

Eschara gracilis Lamx. Encyc. méth. p. 375.

(Pl. XVI, fig. 1 b).

The zoœcia elongated, without distinct separating furrows, with numerous scattered pore-canals, which have an inner wholly uncalcified rosette-plate. The well-chitinized operculum, the poster of which is not distinctly separated from the anter, may be called broadly egg-shaped, as it decreases evenly in breadth in its proximal half. It is provided within the margin on each side with a ridge-shaped thickening, which disappears both distally and proximally. There is a hinge-tooth on each side. The secondary aperture is broad, transversely oval, but has a bean-shaped appearance, because the inner surface of the peristome-tube is provided a little within the proximal margin of the aperture with a low, but broad, triangularly rounded projection. The peristomial pore is elongated in the ordinary zoœcia and round in the oœcia-bearing ones. Each distal wall has numerous, uniporous rosette-plates, which owing to the thickness of this wall are situated at the end of long pore-canals. The distal half of each lateral wall is provided with 2—3 scattered uniporous rosette-plates situated at the end of short pore-canals, which perforate the wall in an oblique direction, so that the rosette-plate lies on the internal surface of the wall and the entrance to the canal on the external. As in the preceding species the outer part of the lateral wall is perforated by the inner end of a number of pore-canals.

The oœcia as in the foregoing species are large swellings not sharply marked off from the distal zoœcium. The peristomial pore is round and the projection appearing within the secondary aperture in the ordinary zoœcia is wanting or weakly developed.

The avicularia, which are very small as a rule, generally seem to have a rounded form. On the circumference of the secondary aperture there are as a rule 1—3 more or less projecting on the distal margin and 1—2 on the proximal. One is also present as a rule on each side or only on the one side a little more proximally, almost halfway between the aperture and the peristomial pore. The last may sometimes reach a fairly considerable size and then have a broadly rounded, somewhat lyre-shaped opening. Further, there may also be 1—2 in the proximal part of each zoœcium. Round the aperture of the oœcium-bearing zoœcia the avicularia are always in smaller number and may sometimes be quite wanting.

The colonies bifurcated, with fairly broad, compressed, two-layered branches. Two colonies from Victoria.

Hasw. auriculata Busk [1] which this author with some hesitation refers to the genus *Haswellia*, doubtless belongs to this genus and is most nearly related to *Hasw. australiensis*. As in this species the bridge dividing the suboral opening from the secondary aperture is provided with two small avicularia (Pl. XIX, fig. 17 a). I have examined a fragment from the Challenger station 135 c.

Gephyrophora polymorpha Busk.

Gephyrophora polymorpha Busk, Challenger, Zoology, Vol. X, Part I, p. 167, Pl. XXXIV, fig. 2.

Schizoporella polymorpha Waters, Challenger, Zoology, Vol. XXXI, Part III, p. 29, Pl. II, figs. 21—24.

The zoœcia, usually tongue- or lyre-shaped, are fairly strongly arched, separated by distinct sutural furrows and provided with fairly densely placed, short pore-canals with a large inner opening. The well-chitinized operculum which is provided with two muscular dots is of an oval outline and the small accessorial part has a rounded poster, which is separated from the anter by a not very sharp bend on each side. The hinge-teeth are well-developed. The two lateral halves of the low, ring- or wall-shaped peristome are connected with each other by a strongly projecting, compressed arch, formed by the coalescence of two originally distinct processes, each bearing a large avicularium. Its central part which separates the points of the two avicularia has in most zoœcia the form of a large, projecting, quadrangular plate. The perforation lying between the bridge and the proximal part of the aperture corresponds to the peristomial pore in *Haswellia* and as in the species of that genus is much larger in the ordinary zoœcia than in those bearing oœcia. The distal wall and the lateral walls, which are thin, are provided with a large number of scattered, uniporous rosette-plates.

The oœcia, which are present in very large number, have when seen from the surface of the colony a similar appearance as in the two species described above, appearing as large, indistinctly marked off swellings which are either provided with pores over their whole surface or do not have these on a median part. They are however considerably more elongated than in the species of the genus *Haswellia* and in fact have quite a different structure. Thus, as Waters has shown, their zoœcial half is immersed into the cavity of the zoœcium itself. They have an unusually elongated form for oœcia and a thick cryptocyst layer is

[1] 8, p. 173.

inserted between the membranous ectooecium and the calcified endooecium. From Waters' statement[1] regarding this oecium: I propose to call this a concealed ovicell, retaining the expression immersed for those which give an external indication of their presence , one would conclude that the oecia in the specimen examined by Waters were not distinctly seen on the surface of the colony.

Avicularia. The peristomial arch is on each side provided with a large, robust, triangular, obliquely ascending avicularium, and the broad, trapeziform proximal part of the mandible grades over into an elongated part, the two, almost parallel lateral edges of which finally run together in a stout terminal hook.

Of this species I have examined several colonies with labyrinthine-like branchings and round or compressed, two-layered branches from the Cape and Port Elizabeth.

To the genus *Myriozoum* belong the species *M. truncatum*, *M. coarctatum*, *M. subgracile* and probably also the species described by Busk,[2] *M. honolulense*, *M. simplex* and *M. marionense*, in the last of which the oecial cover only reaches halfway down over the frontal surface of the oecium. To this genus I must also refer the two-layered, laminate »*Escharoides*« *occlusa* Busk[3] and the one-layered »*Schizoporella*« *biturrita* Hincks,[4] which shows several points of agreement with *Gephyrophora polymorpha*. The genus *Myriozoella* is only represented by a single species, the incrusting *M. crustacea* Smitt.

Family **Sclerodomidae** n. f.

The *zooecia*, which have a covering membrane but no spines, are very thick-walled and consist of a very solid and hard, finely striated calcareous mass, which is perforated by pore-canals, sometimes scattered, sometimes arranged within the lateral margins. The very small distal wall is provided with a number of uniporous rosette plates and the lateral walls with a varying number of rosette-plates with few (2—3) pores. There is a membranous or weakly chitinized operculum and a more or less well-developed peristome. Dependent *avicularia* are present and are frequently situated within or outside the peristome. The hyperstomial *oecia*, which have a membranous ectooecium, are only distinct on the surface of the colony in quite the youngest zooecia, as they are quickly covered over by a thickened layer or by the peristome. The colonies are free, branched.

Genera.

The peristome is funnel-shaped, immersed, not projecting, provided with avicularia; no peristomial pore; in the oecium-bearing zooecia

[1] 110, p. 29—30, Pl. II, figs. 21—24. [2] 8, p. 170. [3] 110, p. 26. [4] 29, p. 280.

the distal wall is provided with an expansion ending in a thickened, crenulated margin, which partly separates the oœcium from the zoœcium . . . . *Sclerodomus* n. g.
(Bifaxaria Busk, p. p.)

The peristome is tube-shaped, projecting, without avicularia, provided with a median opening; in the oœcium-bearing zoœcia there is no expansion of the distal wall. . . . . *Tessaradoma* Norman
(Porina d'Orb., p. p.)

S. denticulatus Busk.

Bifaxaria denticulata Busk, Challenger, Zoology, Vol. X, Part I, 1884, p. 82, Pl. XXIV, fig. 3.
Bifaxaria denticulata Waters, Challenger, Zoology, Vol. XXXI, Part III, 1888, p. 15, Pl. II, fig. 31.
— — Waters, Expéd. Antarctic Belge, Bryozoa, 1904, p. 59, Pl. VIII, figs. 14 a, b.
(Pl. XIX, figs. 18 a–18 e, Pl. XXII, fig. 14 a).

The zoœcia indistinctly separated, elongated, thick-walled, strongly arched, increasing evenly in width from the narrower, proximal end and obliquely ascending towards the secondary, terminal aperture, which at a certain age forms almost a right angle with the proximal part of the distal zoœcium. They consist of an extremely hard and solid, finely striated calcareous mass, which is provided with as a rule fairly densely placed, round or oval, scattered pores leading into long, more or less curved canals. As the colony gradually increases in thickness these pores come to be situated at the bottom of narrow, channel-like concavities, which increase considerably in length with age and give the surface of the colony a characteristic, grooved or longitudinally furrowed appearance. In quite young zoœcia the pores may even sometimes be extremely rare in a median belt along the frontal wall.

I have not been able to determine the form of the primary aperture, nor have I been able to find any operculum. In the youngest, undamaged zoœcia I have been able to find, there is a secondary, more or less regular, broad but low, semicircular aperture, within the proximal margin of which there is a low, but broad, oblique tooth-like projection (Pl. XXII, fig. 14 a), which on the one side grades into the lateral margin of the aperture and becomes gradually higher towards the other side, where it ends in a rounded, rectangular or obtuse-angled edge not far from the lateral margin. With the exception of quite few zoœcia, in which an outer, peristomial avicularium is wanting, the peristome in the younger zoœcia is swollen proximally and divided by an almost rectangular incision (fig. 14 a) into two, unequally large halves, the larger of which bears a fairly large avicularium, whilst the smaller is as a rule provided with a rounded swelling provided with some pores. As calcification increases, the incision mentioned entirely disappears, the aperture becomes circular and the avicularium comes to be placed deep within this. The very small distal wall, which is provided with ca. 7 scattered, uniporous rosette-plates, is in the oœcium-bearing zoœcia continued into a plate-like expansion ending in a thickened, crenulated margin (Pl. XIX, figs. 18 b, 18 c), and a partial separating wall is thus formed between the oœcium and the zoœcium.

Avicularia. As above mentioned, an avicularium is placed in the incision on the peristome. It springs from the neighbourhood of the free corner of the tooth-like projection and its triangular, rounded mandible takes an obliquely distal direction. There is also a second avicularium, which is only seen on grinding down the one half of the zoœcium, as it is situated deep down on the inner surface of the peristome, almost at a level with the proximal part of the oœcium. The mandible, as also in the second avicularium, is fairly short, triangular and as a rule situated transversely to the longitudinal axis of the zoœcium.

The oœcia, which had already been found by Waters and which occur on numerous zoœcia, are for the most part hidden, partly by covering layers and partly by the peristome, and only the proximal part of their frontal wall can be seen more or less deeply within the secondary aperture as a dependent flat part from the distal portion of the latter. This flat dependent part ends in a straight or weakly curved edge and is divided into two lateral areas by a narrow, median belt, which is possibly a calcified portion of the ectooœcium. In sagittal sections they show an elongated, helmet-shaped form (Pl. XIX, fig. 18 b).

The colonies, of which I have examined a number of fragments sent from the British Museum, are free, branched, with the zoœcia arranged in 4 alternating rows. The separate branches show as a rule a distinct contrast between a more strongly arched frontal side and a somewhat flatter basal side. Of the 4 zoœcial rows two open on the frontal side, whilst the two others have their openings on the margin of the branch, and from the frontal aspect of the branch we can at the same time see three rows of apertures, whilst from the basal aspect we can only see two.

Challenger St. 320.

Waters[1] places *Pustulipora rustica* d'Orb. and *Reteporella myriozoides*[1] in the

[1] 115, p. 60—61.

neighbourhood of this species, and to judge from this author's description of *Systenopora contracta*[1], I must also refer this form to the family *Sclerodomidae*. It agrees with *Sclerodomus denticulatus* in the numerous, scattered pore-canals, the covered-over oœcia and in the possession of an avicularium on the inner surface of the peristome. The species described by Waters under the generic name of *Cellarinella*[1] should also be referred to this family, and the author himself is also almost inclined to place them in the neighbourhood of *Systenopora*. To this family, lastly, I must also refer *Tessaradoma borealis*, which consists of a quite similar, hard and solid, finely striated calcareous mass as is found in *Sclerodomus denticulatus*, with which species it further agrees in the covered-over oœcia and in the structure of the rosette-plates. Another species of this genus is described by Waters[2] under the name of *Porina proboscidea*.

Of the remaining species which Busk refers to the genus *Bifaxaria* I have only been able to examine an extremely small fragment of *Bif. corrugata*, and there can be no doubt that this species belongs not only to another genus but even to another family than *Sclerodomus denticulatus*. The thick-walled calcareous mass, which is only perforated by some extremely fine, slit-like pores, seems to be somewhat brittle. The separating wall between the two zoœcial rows has a row of small, uniporous rosette-plates within each lateral margin, the avicularia seem to have no transverse bar etc. The slight information given by Waters[3] concerning the oœcia seems to indicate, that these are transformed zoœcia. All seems to show, that these forms take up a special position and a new description of them is very necessary.

Family **Tubucellariidae** Busk.

The *zoœcia*, which are covered by a membrane and have no spines, are more or less thick-walled and provided with densely placed pits or areas separated by ridges, each surrounding a pore. The lateral walls which are common to the adjoining zoœcia are provided with a number of, as a rule scattered, multiporous rosette-plates. *Avicularia* may be present. The *oœcia*[1] are at the end open spaces, formed by a strong expansion of the peristome (peristomial oœcia), and in the hitherto known members of this small family an ascopore is found. The colonies form either richly branched, jointed tufts or free, foliaceous one-layered expansions.

[1] 115, p. 56—57. [2] 115, p. 39. [3] 110, p. 15. [1] 116

Genera.

A more or less prominent tube-shaped peristome, proximally to which is found an ascopore:

A simple separable operculum, no vestibular arch, no avicularia *Tubucellaria* d'Orbigny.

A membranous opercular valve (?), a vestibular arch, each zoœcium with one or two avicularia at the height of the ascopore...... *Tubiporella* n. g.

Tubucellaria opuntioides Pallas.

Busk, Challenger, Zoology, Vol. X, part 1, 1884, p. 100, Pl. XXIV, fig. 7, Pl. XXXVI, fig. 19, pars.

(Pl. XVI, figs. 4a—4d).

The zoœcia elongated rhombic, arched, surrounded by weakly projecting edges. The pore-pits, which have a very small pore, are round or oval, and their network of separating ridges is beset with fairly large, scattered tubercles, of which 3—6 may surround each single pit. The obliquely ascending, tube-shaped peristome, which as a rule has a circular aperture and the distal wall of which is only to a small extent freely projecting, is contained 5—6 times in the length of the actual zoœcial tube. It shows a number of more or less sharp longitudinal ribs, the furrows separating which contain 2—4 larger or smaller pits. Proximally to the peristomial tube there is a more or less distinct, narrow, curved ridge (fig. 4d), which connects the two marginal ridges. A little proximally to this lies the ascopore, which is surrounded by a more or less prominent, wall-like margin, often beset with tubercles. Its opening on the inner surface of the zoœcium is provided with a distal, arched, half-roof. The somewhat ascending distal wall is provided with a large, triangular, oval or trapeziform, multiporous rosette-plate, which is divided by a network of ridges into a number of larger and smaller areas. The distal half of each lateral wall both on its abaxial and on its adaxial part is provided with 2—4 scattered rosette-plates with 2 (1)—6 pores, so that not only two neighbouring zoœcia, but also two zoœcia placed at the same level and separated by a neighbouring zoœcium are thus connected with one another by means of rosette-plates. The operculum which is not strongly chitinized makes a segment a little larger than a semicircle and the two lateral margins are feebly convergent towards the proximal margin. A very low, almost rudimentary opercular arch is placed a little distally to the median part of the operculum and a muscular process is found on each side within the lateral margin.

The oœcia, which may almost reach the same size as the zoœcia, have the form of robust cones inclined distally and somewhat inwards and enclose an almost elliptical cavity. Their surface is provided with numerous, more or less sharp and regular longitudinal ridges, the furrows between which contain pore-pits.

The colonies jointed, richly branched, with cylindrical internodes the length of which is 15—18mm. They have 8—10 longitudinal rows of zoœcia, with ca. 13 in each longitudinal row.

Port Elizabeth (Miss Jelly).

Like Busk[1] I regard the Mediterranean species *Tub. cereoides* as a distinct species.

Tubucellaria hirsuta Lamour.

Busk, Challenger, Zoology, Vol. X, part 1, 1884, p. 100, Pl. XXXVI, fig. 18.

(Pl. XVI., figs. 3 a—3 e).

The zoœcia rhombic-oval, strongly arched, not surrounded by marginal ridges. The pore-pits (fig. 3 e), which are elongated, drop-like, are provided at their proximal ends with a very small pore and the walls surrounding the pits are beset with numerous small, but fairly high tubercles, 8—10 of which surround each pit. The obliquely ascending peristome, the aperture of which is transversely oval and its length contained 3—3½ times in that of the zoœcial tube, may be more or less distinctly striated by faint longitudinal ribs beset with tubercles, and except in the two distal zoœcia in each internode its distal wall is only to a small extent freely projecting. The ascopore, which is situated somewhat proximally to the peristome, is surrounded by a horse-shoe-shaped wall beset with tubercles with the incision directed towards the peristome, and it is continued on the inner surface of the zoœcium as a short, free tube increasing in width inwardly. Immediately proximally to the peristome there is on each side a low, but fairly broad, arched, conical chamber, separated from the cavity of the zoœcium by a multiporous rosette-plate which is divided into a number of uniporous areas (fig. 3 d) by a circle of calcareous ridges (fig. 3 d). This chamber medially on the frontal plate is provided with an opening and from it rises a distally directed, hollow, slightly calcified tube which may be called a radical tube. In a number of the proximal internodes of the colony other tubes appear on some few (2—3) of the proximal zoœcia in addition to those mentioned; these tubes are widened

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[1] S. p. 100.

at the ends and bent like a hook. On a single internode there may be up to 6 and they arise from quite similar small chambers, which may sometimes be situated alongside the others, sometimes further down on the zoœcium. Each distal wall is provided with an oval, multiporous rosette-plate and the distal half of each lateral wall with 2—3 plates with 2—6 pores. In contrast to *T. opuntioides* these rosette-plates appear only on the abaxial part of the wall. The operculum (fig. 3 c), which is shorter than that of *T. opuntioides* is not strongly chitinized and has no chitinous arch. The two rounded lateral margins converge distinctly towards the proximal margin and a strong muscular process is placed within each of them.

The oœcia, which resemble the front part of an antique lamp, project more prominently but are less bent upwards and inwards than in the preceding species. They enclose a triangular, rounded cavity and their outer surface is distinctly striated by longitudinal ridges, the separating furrows of which especially in the proximal part contain numerous pore-pits.

In the **colony** each internode has a length of 4—5mm., and in each of the 4 longitudinal rows there are 3—5 zoœcia.

Port Phillip, Victoria (Miss Jelly).

In the species of this genus the colony is formed on quite the same lines as in the species of the genus *Cellularia*, and we may refer therefore to what has been said on p. 212, as also to the figs. 4 a, 4 c of Pl. VII, which give longitudinal and transverse sections of such colonies.

Tubiporella magnirostris Mac Gillivr.

Porina magnirostris Hincks, Annals Nat. Hist., 5 ser. XIV, 1884 p. 279, Pl. IX, fig. 6.
(Pl. XVI, figs. 5 a—5 d).

The zoœcia, which have a rhombic outline and a very uneven, but not strongly arched surface, are often partially separated from each other by very large and deep, irregular depressions, but not by distinct, regular sutural furrows. The pore-pits (fig. 5 c) at their bottom each have a large pore and their separating, arched network of ridges is beset with large, scattered tubercles; they soon change to deep pore-canals. The distinctly protruding, obliquely ascending, distally directed, cylindric-conical peristome, which has a somewhat concave frontal wall, is not much shorter than the actual zoœcium, and its aperture has a triangular, rounded form, as we can distinguish between a more strongly arched anter and a more slightly arched poster. It is provided to a varying extent with scattered tubercles, which appear most numerously and may often be greatly lengthened on the distal part. On the other hand, it may quite lack pore-pits, or these may appear to a number ot one or two. Immediately proximal to it is seen the more or less protruding, cylindric-conical ascopore. I have not succeeded in finding an operculum in the dry colony examined, and it may be concluded therefore that the operculum has been membranous. When the basal wall of the colony is ground down, there is seen a well-developed vestibular arch (fig. 5 b, 5 d). The very thick basal wall of the colony, which does not show zoœcial boundaries, is covered with numerous larger and smaller tubercles and perforated by pore-canals, which may have a larger or smaller opening. From the cavity of the zoœcium they are separated by multiporous rosette-plates, of which 5—8 may appear irregularly scattered. Each distal wall is further provided with 3—4 and the distal half of each lateral wall with 2—3. The number of pores in each plate lies between 4 and 12.

The oœcia (figs. 5 b, 5 d), which appear in fairly large number, are easily recognised from the peristomial tubes of the ordinary zoœcia by projecting straight outwards (not obliquely ascending) and by being arched, crater-shaped, with as a rule a transversely oval aperture; they are richly provided with pore-pits. It must also be remarked, that the appertaining gonozoœcia have a very narrow distal wall and often have no avicularia. The oœcium-bearing zoœcia appear very distinctly amongst the others on grinding down the basal half of the colony, as it is only possible to see the outer aperture in them from the basal side; this aperture in the ordinary zoœcia being hidden by the obliquely ascending peristome (fig. 5 b). The oœcia rarely occur singly, but as a rule in shorter or longer transverse rows scattered at greater or lesser distances over the surface of the colony.

The avicularia, which vary very considerably in size, appear as a rule either singly or doubly on each zoœcium, in the latter case one on each side. They are situated at a level with the peristomial pore, and the chamber which is freely projecting at least in the younger zoœcia has its point directed obliquely outwards and upwards. The mandible, which is broadly triangular at the proximal part, runs out in a long, bent point.

The **colony** occurs as a free, foliaceous expansion with a single layer of zoœcia.

Port Phillip (Miss Jelly).

Family **Conescharellinidae** n. f.

Selenariidae Busk p. p. Schizoporellidae Mac Gilliv. p. p.

The zoœcia, which are provided with a covering membrane and always lack spines, are in contrast to the general rule so placed that the proximal part of the operculum connected with the hinge-teeth is directed towards the growing margin of the colony. The separating walls, which are all single, are provided with small, uniporous rosette-plates, and the length of the frontal surfaces, which are not distinctly marked off from the surface of the colony, is considerable less than the depth of the zooecia. Immediately distally to each zooecial aperture there is a pore which leads into a cavity in the frontal wall. Dependent *avicularia* appear in all the species and in most of them peculiar, likewise dependent kenozooecia of unknown significance, *lunoecia*, the frontal wall of which is provided with a crescent-shaped slit. Freely projecting, helmet-shaped *ooecia* may appear, which seemed to be formed by a single calcareous layer and to have no covering membrane. They arise from the distal part of the peristome and may provisionally be called peristomial.

The colonies in the hitherto found species are free, either laminate, with the zooecia arranged in two layers or they have the form of a low cone or arched disc, the arched surface of which is formed by a layer of zooecia, whilst the inner and basal surfaces are formed by avicularia arranged in layers.

Whitelegge[1] who has given a synopsis of the hitherto known species expresses the supposition in his short paper, that a closer examination of these forms will lead to a new family being formed for them, and although one of the main reasons of the author for this supposition is based upon inaccurate examination, his conclusion is quite correct. Among the characters given in the above diagnosis he lays stress on the presence of the peculiar pore and the quite exceptional orientation of the zooecia.

The characteristic kenozooecia, for which we propose here the name »lunoecia« (Pl. XXIII, figs. 7 a, 7 b, Pl. XXIV, fig. 1 a), are like the frontal avicularia small, dependent chambers, each of which is connected with a zooecium by means of a uniporous rosette-plate. Their frontal surface is provided with a crescent-shaped slit with the convexity turned inwards towards the centre of the colony. Further, these lunoecia, concerning the significance of which I can offer no definite opinion, occur in somewhat small numbers and are found both in the oldest and the youngest parts of the colony. Their position with regard to and connection with the zooecia are most readily understood when we grind down the flat basal part of the colony in one of the more flatly arched species, e. g. *Conescharellina philippensis* (Pl. XXIV, fig. 1 a). We then readily see that both the lunoecia as well as the avicularia are separated by a wall from the zooecia and that this wall is provided with a uniporous rosette-plate. Further, all these superficial chambers

[1] 117.

seen in the whole colony seem to be in mutual connection with each other, often by means of a narrow, tube-shaped prolongation, and through one or several of these they seem as a rule to open out on the surface of the zooecia.

In the above-cited work Whitelegge puts forward the extremely peculiar view, that in these forms in contrast to what is known in all other calcified *Bryozoa* the new zooecia arise scattered amongst the fully developed and that the chambers which are here called lunoecia are just such rudiments of new zooecia, which according to the author may arise both in the oldest and youngest parts of the colony. This view is however quite incorrect and is in complete conflict with my investigations on these chambers. Further, it is readily seen that the new zooecia in all members of this family are formed at the free margin, and even the idea that new zooecia can be intercalated between the older in a well-calcified Bryozoa colony is so improbable that I have no hesitation in declaring such a process impossible. The improbability is further increased in that a number of these species have a very regular form, which is conditioned just by a regular mode of growth. Mac Gillivray[1] does not hesitate to accept Whitelegge's supposition, but with the modification that new zooecia according to him arise also between the marginal zooecia. In the species of the genus *Conescharellina* at the same time as new zooecia arise on the margin of the colony, the inner cavity gradually becomes filled with small avicularia, which stand in connection with the zooecia and with each other by means of small uniporous rosette-plates, and a longitudinal section through such a colony shows them to be arranged in horizontal layers. The small pore situated immediately distally to the aperture and which according to Whitelegge is covered externally by a membrane, leads into a small cavity in the wall of the zooecium, which sometimes projects on the inner surface. The ooecia, which have hitherto only been found in *Conescharellina philippensis* and *C. cancellata* (Pl. XXIII, figs. 8 a, 8 b), occur in the latter species in very small numbers and usually in the neighbourhood of the free margin of the colony. Their outer aperture leads into a space formed by the peristome, at the bottom of which is the zooecial operculum.

The rule in this family that all the other separating walls are single holds true also for those separating the zooecia in the two opposite layers in two-layered colonies. In these further the zooecia of the one layer extend in between those of the opposite layer in such a manner, that a section through the thickness of the colony shows the zooecia in the two layers to be separated by a zigzag line.

How far the division of the genera proposed here is natural must be determined by investigation of a larger material.

[1] 76, p. 88.

Synopsis of the genera.

1) The colony with lunœcia:

2) The colonies which have the form of a low cone or an arched disc only show a single layer of zooecia, whilst their inner cavity is occupied by numerous avicularia placed in horizontal layers; (oœcia may occur).. *Conescharellina* d'Orb.

2) The colonies are plate-like or fan-shaped, with two layers of zoœcia; (oœcia are not found)............................ *Bipora* Whitelegge.

1) The colonies, which have no lunœcia, are plate-like, two-layered; (no oœcia).. *Flabellipora* d'Orb.

Conescharellina angulopora Tenison-Woods.

Bipora angulopora Whitelegge, Annals Nat. Hist. 6 Ser., Vol I, 1888, p. 18.

(Pl. XXIII, figs. 7 a–7 f).

The primary aperture is elongated oval, distally rounded, proximally pointed and here provided with two elongated, rounded, triangular hinge-teeth, which bound a narrow, elongated sinus. The peristome is formed by two thick calcareous plates, distally separated and projecting straight outwards, which have a fairly strongly arched outer surface and reach almost to the proximal third of the aperture.

The operculum, which is extremely thick and of a brownish yellow colour, is strongly arched in the greater part of its inner surface while the outer surface has a corresponding concavity. The inner arched part which shows two small muscular dots and evenly grades into a lower marginal portion ends proximally in a narrow, tongue-shaped part, inserted in between the two hinge-teeth. Each zoœcium is separated from the adjacent zoœcia by four long, narrow separating walls and from one of the above-mentioned,,small, enclosed avicularian chambers by a small, innermost wall. Each of the four separating walls is provided within each lateral margin with a row of up to 8 small, uniporous rosette-plates.

The avicularia, appear in two different forms, those placed on the zoœcia and those occupying partly the flat base and partly a great inner portion of the conical colony. The latter we may call the basal avicularia. The former which occur in similar numbers to the zoœcia and the frontal area of which has a similar length as the zoœcial aperture, are provided with a broad, triangular mandible with its point directed as a rule obliquely distally towards the higher-placed zoœcial aperture in a neighbouring row and obliquely out from the surface of the colony. The strong transverse bar between the opercular and the subopercular areas is provided as a rule with three rods directed towards the apex of the avicularium, of which the middlemost is the longest. Some few pores are seen on the surface of the avicularium. The basal avicularia which as growth proceeds are inclosed in the interior of the colony have a very small, sometimes almost circular, sometimes short egg-shaped frontal area the cross-bar of which is provided with a single rod. The mandible is almost semicircular. The avicularian chambers, the length of which is not very different from the height of the zoœcia, are elongated vertically and the single chambers are in inner connection by means of a few single-pored rosette-plates. Each free wall is furnished with 5—8 pores surrounding the avicularian area.

The lunœcia occur in very small number and for each zoœcial row there is scarcely a single lunœcium. They may occur both in the zoœcial and in the avicularian rows, and there are usually proximally to each of them two, as a rule very small avicularia, the mandible of which is directed obliquely proximally (towards the broad end of the colony) and outwards. More rarely there is only a single one which has the mandible directed proximally.

The colonies are top-shaped and both the zoœcia and the avicularia are arranged in radiating, more or less regular rows. Further, there is an arrangement into one or partly two systems of oblique rows rising obliquely towards the tip, and the single rows are here accentuated by step-like depressions.

Colonies from Port Jackson and Port Stephens, Australia.

To the genus *Flabellipora* belong several species in the Copenhagen Zoological Museum and one of them is probably identical with d'Orbigny's *Fl. elegans*, but not with Waters' species of the same name. A colony from Port Jackson, which has quite the same fan-shaped appearance as Waters' species, probably belongs to this, for which I would propose the specific name *flabellaris*. Like the species of the genus *Conescharellina* it is provided with lunœcia, but the zoœcia are as in *Flabellipora* arranged in two layers. For this form the vacant generic name *Bipora* might be employed, but this can only be retained with the reservation, that the main difference between *Conescharellina* and *Bipora*, as this genus is understood here, appears to be constant; it is just the presence in the former genus of the above-mentioned, enclosed, small avicularia. The following statement of Waters[1] would indicate however that such avicularia may occur in the species mentioned: »others have between the layers a cancellous structure with numerous large openings, between which are small round avicularia«. In this case

[1] 107, p. 200.

the present species and others nearly related must then be included under the genus *Conescharellina*.

Family **Liriozoidae.**

Epicaulidiidae Hincks[1].

The slender, elongated *zoœcia*, which may have a single spine at the distal end, are provided as a rule with scattered pores and the lateral walls with one or several uniporous rosette-plates. The aperture has a broad and low sinus and a weakly chitinized operculum. *Avicularia* and *oœcia* are wanting. Free, jointed colonies, with the zoœcia arranged in pairs or in triads; in the latter case they arise from an axis consisting of kenooœcia.

Genera.

The colony consists of an axis of kenozoœcia, each of which bears two opposite triads of zoœcia. Of the 3 zoœcia, the longest, central one has the aperture directed outwards, whilst the two outer, which have a distal spine, have theirs directed obliquely inwards.... *Liriozoa* Lamarck.
(*Epicaulidium* Hincks.)

The colony consists of paired zoœcia, and in each pair the slightly spirally turned zoœcia have their basal sides directed towards each other; no spines .... *Gemellipora* Smitt[2], char. emend.

To the first genus belongs *L. tulipifera* Ellis & Sol (= *E. pulchrum* Hincks), and to the latter, which we here take in a more restricted sense than Smitt, belongs *G. eburnea* Smitt.

Family **Lekythoporidae** n. f.

(Pl. XVI, figs. 6 a—6 e, fig. 7 a).

The *zoœcia*, which have no spines, are solidly calcified, thick-walled and provided with a well-chitinized operculum. A strongly developed, sometimes immersed, sometimes freely projecting, tube-shaped peristome, the aperture of which is armed with one or usually with several (2—5) small avicularia. Scattered small or large *avicularia* may also occur. Both the distal wall and the lateral walls are provided with numerous small, scattered, uniporous rosette-plates, which are situated at the bottom of shorter or longer canals. The *oœcia* have the form of a hemispherical expansion of the frontal wall of the peristomial tube and become later hidden by covering calcareous layers. The colonies are free, more or less strongly branched.

To this family, which no doubt is most nearly related to the *Celleporidae*, I must refer *Lekythopora hystrix* Mac Gill.[3], *Turritigera stellata* Busk[4], »*Schizoporella*«

[1] 24, p. 156; 25, p. 135. [2] 103, p. 35. [3] 66, p. 194; 68, p. 113. [4] 8, p. 130.

challengeria Waters[1] (= *Myriozoum immersum* Busk) and *Orthopora compacta* Waters[2]. To the last author is due the demonstration of the peculiar oœcia in *T. stellata* and *S. challengeria*. I have been able to examine small fragments of the first three species, but my material has not been sufficient to settle the question, whether they should be referred to one or to several genera.

Family **Eurystomellidae** n. f.

No spines. The thick-walled and strongly calcified *zoœcia* lack a covering membrane and have either no pores at all or 2—5 extremely large fenestræ. The broad aperture, which has a concave proximal rim, is provided with a more or less strongly chitinized operculum surrounded by a continuous marginal thickening. No *avicularia*. The *oœcium* is enclosed in a kenozoœcium, the frontal wall of which is provided with a very large uncalcified part. Pore-chambers or groups of uniporous rosette-plates.

To this family I refer »*Lepralia*« *foraminigera* Hincks[3] (Pl. XVIII, figs. 14 a—14 c) and »*Lepralia*« *bilabiata* Hincks[4], and I regard them provisionally as belonging to the same genus *Eurystomella*. There may possibly be reason however to form a special genus for *L. bilabiata*. In this species the distal wall and the distal half of each lateral wall are provided with a group of numerous small, uniporous rosette-plates, whereas multiporous pore-chambers occur in *L. foraminigera*.

Family **Escharellidae** n. f.

The *zoœcia*, which are often armed with (2—8) spines, have as a rule a distinct vestibular arch, in many cases even strongly developed. If *avicularia* occur, they are as a rule lateral and there is never a median, symmetrically placed avicularium. Pore-chambers usually present, more rarely uni- or multiporous rosette-plates. The *oœcia* which are as a rule hyperstomial, very seldom endooœcial consist of a membranous, more rarely partially calcified ectooœcium and of a calcified endooœcium, which usually shows no pores and more rarely has small scattered pores.

Whilst I have found a covering membrane in the genera *Escharella*, *Escharoides*, *Schizoporella*, *Escharina* and *Cyclicopora*, I have been unable to find this in *Anarthropora*, *Exochella* and *Arthropoma*, of which genera I have examined colonies preserved in spirit. Though I am inclined to attach no little weight to this character, I have for several reasons not ventured to make this negative result decisive as to whether I should refer the genera mentioned to this family. In the first place,

[1] 110, p. 30. [2] 115, p. 75. [3] 28, p. 109. [4] 34, p. 19.

the covering membrane in many forms is extremely thin and very readily torn, and the absence of it in one or two colonies is no sure evidence, that it is lacking in the species examined. Secondly I have become somewhat doubtfull as to the systematic significance of this character, as in the genus *Microporella* some species, for instance *M. ciliata*, possess a covering membrane while it seems to be lacking in others. Thus I have not been able to find it in a fresh colony from Norway in which the young zoœcia in the growing margin show the membranous frontal wall well-preserved, and the same is the case with a nearly related species from Japan, appearing in two-layered, *Flustra*-like, richly branched tufts.

Escharella[1] Gray, char. emend.
Mucronella Hincks p. p.
Lepralia Hincks p. p.

The *zoœcia*, which usually have 2—8 spines, are provided with a well-developed, sometimes even strongly developed vestibular arch and usually with a more or less developed often mucronate peristome, which rarely embraces the distal margin of the aperture. The operculum is mostly thin, almost membranous, sometimes more or less strongly chitinized and in the first case the proximal margin of the aperture is generally protected by a median tooth. No *avicularia*. The *oœcia*, which in some species are endozoœcial and covered by kenozoœcia, have no pores. Marginal pores appear as a rule, rarely scattered pores. In the distal half of the zoœcium there are numerous small (12—18), uniporous, contiguous pore-chambers, which have arisen by division of three elongated, multiporous chambers (a distal and two lateral).

To this genus belong the following species: *E. immersa*, Flem. (= *Mucronella Peachii*, Johnst. + *M. ventricosa*, Hassall), *E. (Muc.) variolosa*, Johnst., *E. abyssicola*, Norman (= *E. laqueata*, Norm.), *E. (Muc.) microstoma*, Norman, *E. emucronata*, Smitt[2], *E. stenostoma*, Smitt[2], *E. (Muc.) spinosissima*[3], Hincks, *E. (Lepralia) polita*, Norman, *E. (Lepralia) multispinata*, Busk[4] and *E. (Muc.) diaphana*, Mac Gillivr.

The vestibular arch, which in this genus varies greatly in form and extent, reaches its greatest development in *E. diaphana* and *E. microstoma*, in which two species it reaches far into the zoœcium in the form of a pent-roof. A median tooth is lacking in *E. microstoma* and *E. polita*, and the two last possess a strongly chitinized operculum with a convex, proximal margin. The oœcia are surrounded by kenozoœcia in *E. diaphana*, *E. abyssicola*, *E. polita* and also, so far as I can determine on a small colony with a single, broken oœcium, in *E. microstoma*.

[1] 84, p. 116. [2] 101, p. 1129—30. [3] 28, p. 53. [4] 8, p. 160.

Escharella diaphana Mac Gillivr.

Lepralia diaphana Mac Gillivr., Mac Coy, Prodromus of the Zoology of Victoria, Vol. I, Decade IV, p. 22, Pl. 35, fig. 3.

(Pl. XVII, figs. 1 a—1 d).

The zooecia, which usually have a rounded rhombic form, are rather strongly arched, thin-walled, smooth and surrounded by raised lines, which end on each side at the inner part of the frontal spine. While these raised lines (formed by the free continuation of the lateral walls) in the proximal half of the zooecium are very low and separated from the arched frontal wall by a groove, in which a number of marginal pores can be more or less distinctly seen, they are very high in the distal half (provided with the pore-chambers), and here they lie close up to the lateral part of the frontal wall with which they partly coalesce, in such a manner that each marginal pore opens out on the frontal wall through a canal, which can only be seen in side view. The almost circular aperture is surrounded by 6 articulated spines and provided with a small median tooth, broader towards the tip and twice or sometimes three times cleft. The well-developed ascending and generally mucronate peristome is in most cases marked off from the rest of the frontal wall by a distinct line which meets the marginal furrow, and the vestibular arch (figs. 1 c, 1 d) is continued deep into the zooecium as a strongly arched lamina, with the convexity towards the basal wall of the zooecium and its concavity towards the aperture, through which it can readily be seen in zooecia boiled in caustic potash solution. Each of the lateral parts of this lamina is connected with the corresponding lateral wall of the zooecium by a calcareous, cylindrical rod growing out from the latter. Each zooecium is in its distal half provided with 16—20 closely-placed, uniporous pore-chambers forming a strongly projecting basal part, and similar pore-chambers occur in the circumference of the kenozooecia covering the ooecia.

The ooecia are endozooecial and the strongly arched, smooth frontal wall of the covering kenozooecia sometimes shows faint, radiating striae.

The colonies form crusts on algae, and on one of them was found a primary zooecium (fig. 1 a), the aperture of which was surrounded by 12 spines. The vestibular arch was in this less developed and seemed to lack the two calcareous rods.

Australia (The Botanical Museum of Copenhagen).

Anarthropora (part) Smitt.

The *zoœcia*, which have no spines and are provided with scattered stellate pores, have a well-developed vestibular arch. The primary aperture has a straight proximal margin and a membranous or very slightly chitinized operculum, which is not separated from the compensation-sac. A short tube-shaped peristome, which may have a small distal and a small proximal *avicularium*. No *oœcia*. Closely-placed uniporous pore-chambers. In this genus there is only a single species, *A. monodon* Busk.

Inversiula Jullien[1].

Microporella Hincks.

The *zoœcia*, which have no spines and are provided with scattered stellate pores, have a distinct vestibular arch. A simple, strongly chitinized operculum occurs, attached at its distal, straight margin. No peristome. A round ascopore. Two small, lateral *avicularia* proximally to the aperture. No *oœcia*. Densely-placed uniporous pore-chambers.

To this genus belong *I. inversa* Waters and *I. nutrix* Jullien.

The last two genera stand very close to each other and in addition to the common characters mentioned in the diagnoses, some agreements in the structure of the frontal wall may also be pointed out. We thus find a system of winding canals, which open outwards through a circle of marginal pores, and in younger zoœcia the wall is distinctly composed of a mosaic of radiate, striated small plates, each of which has a stellate pore in the centre.

Escharoides[2] Milne Edw.

Peristomella Lev.[3]; Mucronella Hincks p. p.

Romancheina Jullien[4] p. p.

The primary aperture, which may have up to 6 spines, is provided with a strongly developed vestibular arch, which has as a rule a thickened free margin. There is a strongly developed, often mucronate peristome, which may sometimes have an inner median tooth and is not separated from the primary aperture by any distinct boundary. The operculum is as a rule membranous, very rarely strongly chitinized and then forked at the tip. An *avicularium* may appear on each side, but is often wanting on one or the other side or even both on more or fewer zoœcia. The *oœcia*, which are not found in all species however, have a

[1] 45, p. 44. [2] 81, p. 116. [3] 56, p. 26. [4] 45, p. 60.

membranous ectooœcium, and the endooœcium may be provided with a number of very small scattered pores. Multiporous rosette-plates or multiporous pore-chambers occur as a rule, very seldom uniporous pore-chambers.

To this genus I must refer the following species: *E.* (Romancheina) *Martiali*, Jull.[1], *E.* (Mucronella) *coccinea*, Abildg., *E.* (?Smittia) *Jacksoni*, Waters[2], *E.* (Mucr.) *praestans*, Hincks, *E.* (Mucr.) *contorta*, Busk, *E. sauroglossa* n. sp., *E.* (Porina) *larvalis*, Mac Gill.[3] and *E.* (Mucronella) *labiata*, Boeck[4], the last species having no avicularia. Of the species mentioned *E Martiali* is provided with uniporous pore-chambers.

Escharoides praestans Hincks.

Mucronella praestans Hincks, Annals Nat. Hist., ser. 5, Vol. X, 1882, p. 168, Pl. VII, fig. 1.

(Pl. XVII, figs. 4 a—b).

The zoœcia hexagonal, ascending strongly both from the proximal end and from the sides towards the strongly projecting, spout-shaped peristome, which has no median tooth and often projects so freely, that regarding the zoœcia from the frontal aspect we can only see the distal half of the four spines. The zoœcia, the slightly tuberculated surface of which is marked with fine, radiating striæ, are provided at the margin with one or more circles of round pores separated by rib-shaped projections. Each lateral wall has 3—6 connections with neighbouring zoœcia, and these are represented sometimes by multiporous pore-chambers, sometimes by multiporous rosette-plates. On each distal wall there are either three pore-chambers or two with an intermediate rosette-plate, and one of the two adjacent half lateral walls is likewise provided with 2—3 pore-chambers, one of which however is also connected with the distal wall.

Oœcia are wanting on the colony investigated, but are described and figured by Hincks, from whose account it appears, that they must be provided with an oœcial cover, as otherwise they would not have pore-canals.

The avicularia, which are lacking on numerous zoœcia, appear only singly towards the one lateral margin and are of a considerable size. The strongly prominent chamber provided with some scattered pores has a well-developed cryptocyst and the lyre-shaped mandible tends obliquely outwards and proximally.

Found on a Mollusc shell from Stewart Island, New Zealand (Zoological Museum, Cambridge, Engl.).

[1] 45, p. 60. [2] 114, p. 87. [3] 107, p. 189. [4] 100, p. 27.

Escharoides sauroglossa n. sp.

? Smittia praestans Waters, Annals Nat. Hist. ser. 6, Vol. IV, 1889, p. 17, Pl. III, figs. 9—11.

(Pl. XVII, figs. 6 a—f).

Seen from the basal aspect the contour of the **zoœcia** is more or less regularly hexangular, and the evenly arched frontal surface, somewhat ascending towards the distal end, is provided with numerous, large, scattered pores, which are in part the outer openings of pore-canals. The peristome is medially provided with a fairly broad and deep, rounded sinus, and just behind or within the centre of this projects an elongated but strong tooth, which narrows from a broad base outwards. There is internally on each side of the sinus a strong, triangular, lateral tooth. The well-developed distal arch, the central part of which is somewhat prominent, has a finely tuberculated, somewhat thickened margin. The strongly chitinized operculum has a very characteristic form. It is longer than broad, and its broader proximal part, which is provided with a concave margin, runs out on each side into a short, hook-like projection. The two somewhat bent and distally converging lateral walls pass over in the distal half of the operculum into a narrow, recurved marginal part. The operculum is provided at the tip with a deep, rounded incision, and it thus comes to end in two, sometimes equally large, sometimes unequally large points. This operculum takes up such a position, that its forked end reaches over to the distal margin of the aperture, whilst the proximal part, which is connected with the compensation-sac, arises at a fairly long distance proximally to the median tooth. Each half of the distal lateral walls is provided with 2—3 multiporous rosette-plates and each distal wall with 2 multiporous pore-chambers and 1—2 interjacent rosette-plates.

Oœcia are wanting on the colonies investigated.

The avicularia, which vary greatly in size, occur in pairs, and the two belonging to the same zoœcium may sometimes be of the same, sometimes of very different size. The freely prominent avicularian chamber, which is provided with scattered pores, has a strongly developed cryptocyst and the mandible is obliquely lyre-shaped in the larger, obliquely oval in the smaller avicularia.

Two small, free, one-layered colonies are to hand from 33° 7′ N., 129° 20′ E. and 33° 8′ N., 129° 20′ E.; depth 36—40 fm. (Schonau).

In a small colony from Port Phillip, Victoria (Miss Jelly), the aperture has no sinus nor lateral teeth, and there is usually only a single avicularium. The operculum has almost even lateral margins and is only slightly indented at the point.

Exochella Jullien[1], char. emend.

The primary aperture, which is provided with 2—5 jointed spines, is separated by a distinct boundary from the peristome and furnished with a distinct, but not strongly developed vestibular arch. The operculum is slightly chitinized and not distinctly marked off from the compensation-sac. The peristome has three, sometimes coalesced teeth, a median and two lateral, which may appear again with greater or less distinctness in a secondary peristome. Normally there is an *avicularium* on each side, but in more or fewer zoœcia the one or both may be absent. There is apparently a membranous ectooœcium and in the distal half of the zoœcium there are 3 large, multiporous pore-chambers.

Exochella triccuspis Hincks.

Mucronella tricuspis Hincks, Annals Nat. Hist. ser. 5, Vol. VIII, 1881, p. 125, Pl. III, fig. 1.

(Pl. XVII, figs. 9 a—d).

The zoœcia, broadly rhombic, evenly arched, often with more or fewer, larger or smaller tubercles of varying form. A raised marginal line is as a rule indistinct and the marginal pores in part difficult to observe. The primary aperture, which has three spines, has a broad and low sinus (fig. 9 b) more or less sharply marked off from the lateral margins; in the full-grown zoœcia it can be distinctly seen through the frontal wall (fig. 9 a). The operculum (fig. 9 d) does not have distinct muscular ridges. There is a well-developed, tube-shaped peristome, which conceals the spines and the distal half springs from the frontal wall of the distal zoœcium or in the oœcium-bearing zoœcia from the proximal part of the oœcium.

The peristome is provided with three coalesced teeth, the central one widened at the end, hammer-shaped, and connected at the widened end with the two short, finger-shaped lateral teeth. Outside there is a new set of uncoalesced teeth, the central one not widened whilst the two lateral are strongly truncate, rounded projections.

The oœcia are furnished with finely, radiating striæ and enclose the spines.

The avicularia, the narrow elongated mandible of which points outwards, appear as a rule in pairs, sometimes almost at the same, sometimes at somewhat different levels.

Two small fragments from Victoria are to hand (Miss Jelly).

[1] 15, p. 55

Exochella longirostris Jullien.

Mission scientifique du Cap Horn, 1882—83, VI, Zoologie, 1888, Bryozoaires, p. 55, Pl. 3, figs. 1—4, Pl. 9, fig. 2.

(Pl. XVII, figs. 6 a—b).

The zoœcia elongated rhombic, evenly arched, provided with radiating striæ and rather densely covered with finer or larger tubercles. There is a distinct raised marginal line, and the very distinct marginal pores, of which there may be up to 10 on each side, lie in older zoœcia in deep pits separated by projecting ribs. The primary aperture, from the distal margin of which project up to 5 spines, has no sinus, but runs out into a low, quadrangular median tooth, which in younger zoœcia can be seen distinctly through the frontal surface.

The well-developed, tube-shaped **peristome**, the distal part of which has a similar origin as in *E. triscuspis*, is provided with a median tooth, frequently somewhat widened at the end and often with two or three cusps, and two finger-shaped lateral teeth, which as a rule do not reach the median tooth and at most touch this. Outside there is a new set, consisting of an unwidened median tooth and two bluntly rounded lateral teeth. The operculum has a faint muscular ridge at each of the proximal corners.

The oœcia are furnished with fine radiating striæ and enclose the spines.

The avicularia which sometimes are single, sometimes double, have a similar position and structure as in the previous species,

A small colony from the Challenger St. 315.

Exochella lobata n. sp.

(Pl. XVII, figs. 7 a—c).

The zoœcia hexagonal in circumference, strongly arched, often provided with a number of large, scattered tubercles and in the younger zoœcia with ca. 5 large marginal pores. The raised marginal lines are only feebly developed. There are four spines, the two central being much thinner than the two outer thick ones, which are not covered by the oœcium. Within each lateral margin the faintly chitinized operculum is provided with a muscular ridge (fig. 7 c).

The peristome, which is only developed proximally, runs out into a large, thick, broad, triangularly rounded rostrum, within which there are two sets of teeth. Of the teeth in the inner set, which are placed rather closely together and divided by two rounded gaps, the central are as a rule hatchet-like, whilst each of the lateral teeth have the form almost of half the blade of an axe. The teeth outside these have a somewhat similar form, but are much more elongated and in most zoœcia they are further more or less nodulous or lobate or even more or less deeply divided.

The oœcia, which are strongly arched and not rarely provided with one or several tubercle-like projections, show as a rule a narrow depressed margin immediately distally to the aperture, caused apparently by the thickening layers not reaching quite so far down.

The avicularia, which are placed nearer to the aperture than in the two species above described and in which the mandible points obliquely distally and outwards, appear sometimes double sometimes singly.

A small colony from Port Western, Victoria (Dr. Harmer).

Exochella Zelanica n. sp.

Mucronella diaphana, forma armata Hincks, Annals Nat. Hist. ser. 5, Vol. X, p. 167, Pl. VIII, fig. 3.

(Pl. XVII, figs. 8 a—e).

The zoœcia hexagonal, rhombic, thick, rather strongly arched, provided with small scattered pores and with 3—4 oral spines. They are surrounded by a strongly developed raised line which in the same manner as in *Escharella diaphana* may be partly coalesced with the lateral parts of the frontal wall and often has a freely projecting undulating edge (fig. 8 c). There are 6—7 marginal pores.

The peristome is only developed proximally and of the two sets of teeth the inner has a somewhat similar form as in the foregoing species, whilst the strongly projecting and prominent, central tooth of the outer set is large and broad, quadrangular or trapeziform, coalesced along its frontal surface with a somewhat narrower thickening of similar form.

The oœcia, which were not found on the colony examined, are according to Hincks provided with a thickened middle part.

The avicularia may occur both in pairs and singly, but their position and direction seem to undergo more variation than in the previous species.

I have seen a very small colony of this species, found on an Alga from the Akaroa Harbour, New Zealand; depth 6 fathoms.

Genus **Schizoporella** Hincks, char. emend.

Spines may appear. The aperture with a faintly developed vestibular arch and with a well-developed sinus, which may vary greatly both in depth and breadth. The operculum well-chitinized, with muscular dots. The *zoœcia* with scattered pores and as a rule with a small projection proximally to the aperture. An *avicularium* may occur on each side, but in more or fewer zoœcia the one or both may be absent. The *oœcia* consist of a calcified endooœcium and a membranous ectooœcium. Uni- or multiporous rosette-plates, which may sometimes be placed in pore-chambers.

Both the form of the sinus of the aperture and the rosette-plates undergo considerable variation in the species I have hitherto been able to refer to the genus *Schizoporella* as defined here. Thus, whilst the sinus is extremely narrow in *S. spongites* and *S. longirostris*, that in *S. unicornis* is broadly rounded and has more than a third of the whole breadth of the aperture. We have an intermediate form in regard to the development of this sinus in *S. sanguinea*, and for the rest local forms e. g. of *S. spongites* show how much this sinus varies. Similarly the rosette-plates undergo a considerable variation, as they are sometimes uniporous, sometimes multiporous or the two together and at the same time as the number of pores in the single rosette-plates increases, the number of the rosette-plates themselves decreases. In *S. unicornis* 2—3 rosette-plates with up to ca. 19 pores in each occur on the distal half of each lateral wall.

In addition to two new forms not described in this work I refer to this genus the following species: *S. unicornis* Johnst., *S. longirostris* Hincks, *S. spongites* (Pallas) Smitt, *S. sanguinea* Norman, *S. errata* Waters and *S. biaperta* Michelin.

Schizoporella longirostris Hincks.

Schizoporella unicornis, form longirostris Hincks, Annals Nat. Hist. ser. 5, Vol. XVII, 1886, p. 266, Pl. X, fig. 2.

(Pl. XVIII, figs. 3 a—g).

The zoœcia rhombic or trapeziform, strongly arched, with fairly small, densely placed pores, each situated in a deep pit. Proximally to the aperture there is usually a larger or smaller, often strongly projecting tubercle. The aperture, which apart from the sinus is almost quadrangularly oval, is provided with a very faint distal arch, which on each side passes over into a long, high, curved hinge-tooth. The deep and narrow sinus decreases evenly in breadth towards the end. The peristome is represented partly by a low wall, which may surround a larger or smaller part of the aperture and sometimes bears indistinct marks of 3—4 spines, partly by two small prominent, triangularly rounded projections, which partially cover the primary sinus and form a secondary sinus; sometimes they almost meet. The strongly chitinized, thick, yellow operculum, which on each side of the accessory portion shows a mark from a hinge-tooth, is proximally provided with a small, rounded, thin expansion. The distal half of the zoœcium is provided with numerous small rosette-plates, which are placed very close together and each of them is enclosed in a small pore-chamber with thick walls. Each rosette-plate has 1—5 pores and the largest number of rosette-plates, ca. 13, are found on the long wall (see fig. 3 a), along which the avicularium is situated. The pore-chambers here are also provided with the the thickest walls.

The oœcia are very strongly arched and provided with a strongly projecting central part. The numerous pores are immersed in pits, which are separated by a net-work of ridges and ribs.

The avicularia occur on most of the zoœcia in the colony examined, in which the primary zoœcium and a number of the oldest zoœcia are distinct. On some of them a very small avicularium with triangular mandible is found on the one side of the aperture, but however they seem to increase gradually in size in the zoœcia which appear later, at least to a certain extent, and they are in general provided with a long, narrow, pointed mandible. The more or less strongly arched chamber, which is provided with scattered pores, shows a somewhat different appearance in the basal part of the colony from in the part produced by superficial budding. Whilst namely the avicularia in the latter part of the colony are very prominent and show the mandible pointing in all possible directions, they are in the former part partially immersed in the zoœcia and situated along the one lateral wall of these with the mandible pointing outwards and obliquely distally.

A single small colony of this species was found on a Mollusc shell at Syracuse by Dr. H. J. Hansen; depth 12—25 fm. I have later obtained colonies of this species from Oran (Algiers), which in addition to small differences in the form of the aperture and operculum also show a slight difference in the structure of the rosette-plates, the number of pores lying between 3 and 8.

Schizoporella spongites (Pallas) Smitt.

Hippothoa spongites Smitt, Kgl. Svenska Vetensk. Akad. Handl. 11 B., No. 4, 1873, p. 42, Pl. VIII, figs. 161—163.

(Pl. XVIII, figs. 4 a—d).

The zoœcia are rectangular, weakly arched, with numerous, scattered, fairly large pores, between which there are larger or smaller tubercles. Frequently there is a tubercle-shaped projection proximally to the aperture. The anter of the aperture is broad, almost semicircular or semielliptical with lateral margins converging somewhat proximally, and its poster is on each side provided with a long, low hinge-tooth. The narrow sinus, somewhat contracted at its origin, is rounded at the end, and at its beginning there is as a rule a small, conical projection on each side, which is directed inwards. The operculum, the accessory part of which gradually becomes very narrow from the broad distal part, ends in a less strongly chitinized, disc-like part, which fits into the bottom of the sinus. Distally to this the accessory part is on each side provided with a longitudinal thickening. Each distal wall is provided within its basal margin with ca. 10 and each lateral wall in its distal half with ca. 5 uniporous rosette-plates.

The oœcia are of enormous size, equalling the smaller zoœcia in length with at the same time a breadth up to one and a half times that of the zoœcia. They are almost spherical and their very thick wall is mainly composed of a tuberculated net-work of ribs, with numerous scattered pores at the bottom of the meshes. They quite cover the distal half of the zoœcium to which they belong (as well as the proximal half of the distal zoœcium), and this is only seen on removal of the frontal wall of the oœcium. Such an oœcium must therefore during its formation send down a part on each side outside the respective avicularium, and these two parts meet proximally to the zoœcial aperture. The semicircular oœcial opening which cannot be seen from the frontal surface, is partially closed by two finger-shaped prolongations almost meeting at the tips, which spring from the two corners of the opening. There can here be no doubt that the eggs must pass directly from the zoœcial aperture into the oœcium (see pag. 67).

The avicularia appear in two different forms, the one of which has an elongated triangular, the other a lyre-shaped mandible. The former, which are of somewhat small size, appear on the single zoœcia to a number of 1—5 and usually on each side of the aperture, with the mandible directed obliquely outwards and distally. On the others the mandible may point in different directions. The avicularia with lyre-shaped mandible, which occur in much smaller numbers, are considerably larger, but vary however a good deal in size. In the basal part of the colony, where they are equal in size to the zoœcia, they always take the place of the zoœcia.

The species occurs as incrusting colonies, which have superficial budding.

West Indies, St. Thomas and St. John, 15—20 fathoms.

A colony from Aor, Malacca, shows several differences from that just described. Thus, the zoœcia have as a rule only a single avicularium on the one side of the aperture and the accessory part of the operculum has a similar form to that in *S. longirostris*, but lacks the small border at the tip.

Escharina[1] Gray, char. emend.

Schizoporella Hincks p. p., Mastigophora Hincks p. p.

The *zoœcia*, the aperture of which is as a rule provided with 3—8 spines, have a more or less well-developed vestibular arch, and the primary aperture has a sharply marked off, fairly deep sinus, the breadth of which is at least one-third of the breadth of the whole aperture. On each side of this the proximal rim of the aperture is provided with a long, narrow, often crenulated or finely denticulate hinge-tooth and the somewhat slightly chitinized operculum is provided with a muscular ridge within each lateral margin. Proximally to the aperture there is as a rule a small, tubercle-like projection. A *heterozoœcium*, which is sometimes developed as a *vibraculum* and sometimes as an *avicularium*, may occur on one or both sides, but is not rarely lacking on more or fewer of the zoœcia. The *oœcia*, which in rare cases seem to be endooœcial, consist of a calcified endooœcium without pores and of a membranous ectooœcium. The distal half of the zoœcium is provided either with three long, multiporous pore-chambers or with a larger number of single- or few-pored chambers placed close together.

To this genus belong the following species: *S. (Schizoporella) spinifera* Johnst., *S. (Schiz.) vulgaris* Moll., *E. (Schiz.) Alderi* Busk. *E. (Schiz.) simplex* Johnst., *E. (Mastigophora) Dutertrei* Aud., *E. (Mast.) Hyndmanni* Johnst. and *E. (Mast.) pes anseris* Smitt. Possibly *Schiz. longispinata* Busk and *Schiz. daedala* Mac Gill. should also be referred here.

Escharina pes anseris Smitt.

Hippothoa pes anseris Smitt, Kgl. Svenska Vetensk. Akad. Handl., 1873, Bd. 11, No. 4, p. 43, Pl. VII, figs. 159—160.

(Pl. XVIII, figs. 1 a—c).

The zoœcia broad, pentagonal or hexagonal, evenly arched, with numerous, small, densely placed pores, from the margin of which a number of fine points or rods radiate and these sometimes seem to form a connected network in the lumen of the pore. The pores may presumably become closed in time by this network, and according to Smitt's description the wall is without pores. The aperture is provided with a somewhat slightly arched distal margin, and the lateral margins which converge somewhat proximally form on each side a small, angularly pointed corner with the corresponding convex half of the proximal

[1] 84, p. 109.

margin, so that the sinus which is rounded at its bottom and narrowed at its beginning is bounded by a rounded trapeziform projection, which along its distal margin has a finely serrated hinge-tooth. The operculum, which is well-chitinized and provided with an extremely short and weak muscular ridge within each lateral margin, has two proximal, angularly pointed corners and a proximal, rod-shaped prolongation, which however is somewhat narrower than the sinus. The aperture is surrounded by a low, wall-like peristome, the proximal half of which is very flat. In the oœcium-bearing zoœcia the peristome is continued as a fairly high and as a rule flat belt down over the proximal part of the oœcium. There is a well-developed vestibular arch and 6—7 spines, which on the ordinary zoœcia form a connected arch, whilst on the oœcium-bearing zoœcia three are placed on each side proximally to the oœcium. On an extremely small colony, the place of origin of which is unknown, a somewhat large, projecting tubercle with a flat surface towards the aperture is found immediately proximally to the sinus of the aperture in most of the oœcium-bearing zoœcia, but in the single zoœcium of the colony without an oœcium there is instead a broad, arched ridge-like projection. This zoœcium is possibly not quite normal, as the form of the aperture seems also somewhat different. In the distal half of the zoœcium there are ca. 10 small pore-chambers.

The oœcia seem to be endozoœcial, the basal half arising within the distal, frontal wall of the zoœcium, whereas their frontal half appears distinctly on the surface of the zoœcium. They are fairly small and low, without pores and are present on most of the zoœcia of the colony.

Heterozoœcia. On each side of the aperture there is a large, somewhat projecting, oval heterozoœcium, which may be regarded as a vibraculum; but the flagellum has an unusual form as it consists of a short, thick, rod part and a lamina running out into three pointed lobes. For the reception of the thick rod part the distal part of the chamber has a broad and deep incision, and the calcified transverse bar is plate-like, compressed and widened in a greater or smaller part of the length. It may also be noted that the basal surface of the chamber is continuous with that of the zoœcium, for which reason the vibraculum like the pore-chamber can be seen through the basal surface of the zoœcium, and the same applies to the vibracula in *E. vulgaris*, and partly also to those in *E. Hyndmanni.* Of this species our Museum originally possessed only a small colony without indication of locality and the figures on Pl. XVIII were drawn from this. Later I have been able to supplement my description from the examination of several small colonies from Siam (Koh Kram; 30 fathoms) taken by Dr. Th. Mortensen.

Microporella Hincks, char. emend.
Diporula Hincks, Fenestrulina Jullien.

The *zooecia*, which may have up to 7 spines, possess a vestibular arch, developed to a varying extent, and a semicircular aperture provided with a straight or very slightly concave proximal rim In most species there is within this and in the whole of its breadth a higher or lower supporting beam as support and attachment for the operculum. The latter is simple, more or less chitinized and provided with a muscular process within each lateral margin. A peristome is wanting or only weakly developed. One or two lateral *heterozooecia* are present and a median ascopore, proximally to which there may often appear a tubercular projection. Multiporous pore-chambers occur as a rule and the *ooecia* consist of a calcified endooecium, which as a rule has no pores, and a membranous or partially calcified ectooecium.

The two genera *Escharina* and *Microporella* show such great agreement in their structure, that there can scarcely be any doubt that the former must be regarded as the mother-genus to the latter, and the greater or smaller resemblance which various *Escharina* species show to corresponding *Microporella* species, would seem to indicate that the transformation of an *Escharina* species to a *Microporella* species has occurred several times. Apart from the variation occurring in both species, the resemblance between *Escharina spinifera* and *Microporella ciliata* is so great, that we might well consider that the latter has descended directly from the former. The two species thus agree in the number of oral spines, in the possession of scattered pores, an avicularium and of three elongated pore-chambers. In both species there may be a tubercle-like projection proximally respectively to the ascopore and the sinus, and the former quite agrees in form with the proximal part of the sinus. Further, the ooecia agree, and the supporting beam in *Mic. ciliata* might be considered as having arisen by a fusion of the two long hinge-teeth in *E. spinifera*. The supporting beam mentioned is for the rest weakly developed in *Mic. ciliata* (Pl. XV, fig. 5 b), whilst it reaches its greatest development in *Mic. marginata* (Pl. XV, fig. 3 b). It seems to be quite wanting in *Mic. Malusi* (Pl. XV, fig. 7 a). Two other species which also show essential agreement are *Escharina pes anseris* and *Microporella flabelligera* n. sp., but the differences between them are too great to permit us to conclude that the latter has come directly from the former. They agree amongst other characters in possessing vibracula and endozooecial ooecia, and in both there may be a tubercle-like projection, which has its flat surface directed towards the aperture. Whilst in this genus there is as a rule a membranous ectooecium, the arched calcified ridge which surrounds the oœcium in *Mic. Malusi* arises from a calcification of the marginal part of the ectooœcium and in *Mic. decorata* the distal half of the ectooœcium is calcified. The distal half of the endooœcium is provided with scattered pores in *Mic. decorata* (Pl. XV, figs. 6 a—6 e) and sometimes also in *Mic. ciliata*. If the lack of a covering membrane in *Mic. Malusi* and allied species is corroborated by later examination, these species which also lack avicularia ought to be referred to a special genus for which the name *Fenestrulina* Jullien must be employed.

Microporella marginata Krauss.

Flustramorpha marginata Busk, Challenger Zoology, Vol. X, Part 1, 1884, p. 135, Pl. XX, fig. 8.

(Pl. XV, figs. 3 a—f).

The zoœcia rounded hexagonal, rather strongly arched, strongly tuberculated and provided with numerous scattered pores. The aperture is broader than long, and the somewhat projecting anter consists of a crenulated, arched distal margin and two lateral margins, somewhat convex inwards, which converge proximally. The supporting beam is well-developed, without lateral teeth. The operculum, which is strongly chitinized, is provided distally with a much crenulated marginal part and the muscles are attached to a small depression on each side within its proximal end. The ascopore which has dentated margins is half-elliptical and provided with an internal, narrow, elongated projection. Each zoœcium is provided in its distal half with 9—10 pore-chambers with 4—6 pores in each; 2—3 are destined for the distal connection. Further, the basal part of each zoœcium is provided in its distal half with a small, few-pored rosette-plate and in its proximal half with an opening corresponding to an opposite rosette-plate.

The oœcia, which seem to have no pores, are exceedingly prominent and the strongly arched middle part may be so strongly marked, that it sometimes has a hunched appearance.

The heterozoœcium is formed as a vibraculum and seems to be present on all the zoœcia in the colony. The large, strongly arched, oval chamber, the longitudinal axis of which is almost parallel with that of the zoœcium, is situated on one side of the zoœcium and does not reach over to the basal surface of the zoœcium. It is connected with the latter by means of 10—12 uniporous rosette-plates. Its frontal surface is directed distally and the sword-like flagellum, which is provided with an oblique, triangular proximal part, points outwards (fig. 3 f).

The colony is free, two-layered, dichotomously branched and the single branches, which only slightly increase in breadth distally, have 8—16 rows of zoœcia. The free margins of the colony are provided with a bundle of radical fibres, which arise from the pore-chambers in the outer walls of the marginal zoœcia, some of which have no aperture. At the beginning of the older bifurcations a bundle of radical fibres stretches obliquely across over the surface of a bifurcation to attach itself to the opposite margin of this, and this may sometimes occur on both surfaces at the same time. Each of these radical fibres (fig. 3 e) is provided with two longitudinal rows of large, multiporous rosette-plates, each of which is surrounded by a calcified ring formed originally by a number of small pieces separated by sutures. Sooner or later, however, all these calcareous rings become connected with each other. Further, other radical fibres also occur in a very peculiar manner, as they everywhere surround the single zoœcia and cover the sutural lines between these. The two layers of zoœcia, of which the colony consists, are connected with one another in such a way, that a longitudinal row of zoœcia in the one layer corresponds to a longitudinal row in the opposite layer; but the zoœcia in two such opposite longitudinal rows alternate and each zoœcium is connected with two zoœcia in the opposite row. This is seen amongst other things from the manner in which the rosette-plates and openings of the basal walls are arranged.

Of this species I have examined two colonies from South Australia (Miss Jelly, Dr. Holub).

Microporella flabellaris Busk.

Eschara flabellaris Busk, Catalogue of Marine Polyzoa, Cheilostomata, p. 91, Pl. CVII, figs. 7—10.

(Pl. XV, figs. 1 a—f).

The zoœcia rounded hexagonal, fairly strongly arched, tuberculated and provided with numerous scattered pores. The aperture is broader than long and provided with a somewhat projecting anter, the proximally converging, generally concave lateral margins of which sometimes grade directly over into the distal margin and are sometimes marked off from this by a more or less distinct angle. The supporting beam is well-developed with a more or less distinct, dentated edge, but without special lateral teeth. The operculum, which is well-chitinized with a marginal thickening on the anter, is provided with a faintly convex proximal margin, which on each side has a small, rounded thickening for a muscular attachment. The narrow ascopore, which has toothed margins, is broader than long and there is sometimes a tuberculated projection proximally to it. Each distal wall is provided with 2—3 multiporous pore-chambers. Whilst the distal lateral wall, which is opposite the vibraculum, is provided with a multiporous rosette-plate, the other distal lateral wall has a pore-chamber and this abuts upon the larger or smaller (in the figure fairly small) basal wall of the vibracular chamber. Through the basal surface of the distal half of each zoœcium (fig. 4 e), therefore, we can see 4—5 chambers and in rare cases only 3, in which case the vibraculum is wanting or does not reach to the basal surface. The basal surface in the majority of the zoœcia shows in its proximal half either a multiporous rosette-plate or an opening.

The oœcia, which have no pores, are strongly arched and tuberculated.

The heterozoœcia are developed as vibracula and occur singly on almost all the zoœcia in the colony. The large, projecting chamber, irregularly circular in circumference, which is situated on one side of the zoœcium at a level with the ascopore and with its longitudinal axis perpendicular to that of the zoœcium, is provided with a short mandible pointing outwards, which consists of a large, oblique, triangular proximal part and a not much longer, dagger-shaped terminal part (fig. 4 f).

The colonies are free, two-layered, dichotomously branched and the single branches, which are greatly widened at the end, have on each surface 8—45 rows of zoœcia. Similar bundles of radical fibres appear along the margins of the colony as in the previous species; but on the other hand, radical fibres are wanting round the single zoœcia. The basal wall of most zoœcia is in the proximal half provided either with a multiporous rosette-plate or with a corresponding opening and in opposition to what is found in *Mic. marginata* the zoœcia in the two layers of the colony correspond to each other.

Of this species I have examined a colony from South Africa (Miss Jelly).

Microporella flabelligera n. sp.

(Pl. XXIII, figs. 6 a—6 e).

The zoœcia edged oval, evenly arched, tuberculated and provided with scattered pores, which decrease in number outwards and which owing to the thickness of the wall appear as canals in older zoœcia. The aperture which is surrounded by 5, more rarely 6 spines dark at the base, the two outermost of which are bifurcated, has a half-elliptical form, and its proximal, somewhat concave margin grades over into the lateral margins on each side round a right-angled, rounded corner. There is a distinct vestibular arch and a faintly developed supporting beam. The operculum is strongly chitinized, dark-brown and provided on each side with a short muscular ridge, which runs out into a freely projecting terminal part. The ascopore, which is of a considerable size and circular, has no inner protuberance and its margin may to a larger or smaller extent be provided with teeth-like projections. Immediately on the proximal side of this there is a large, obliquely ascending projection, with its level surface turned towards the ascopore. The distal half of each zoœcium is provided with 3—4 elongated, multiporous pore-chambers.

The oœcia, which are endooœcial, but nevertheless prominent on the surface of the zoœcium, are broader than high and provided within the membranous ectooœcium with a cryptocyst layer, which proximally to the aperture may run out into an irregular projection. There is a spine on each side of the aperture.

The heterozoœcia, which occur in pairs on each zoœcium, are in the form of vibracula and are situated one on each side of and a little proximally to the aperture. The oval or pyriformly oval frontal area is as in *E. vulgaris* and *E. pes anseris* provided with a distal concavity for the reception of the long, narrow, dark-coloured flagellum, which from a triangular proximal part terminates in a point.

Of this species I have examined a single, extremely small, incrusting colony, which shows superficial budding; Syracuse, rocky bottom, 15—25 fm. (Dr. H. J. Hansen).

Arthropoma n. g.

Schizoporella Hincks p. p.

The zoœcia lack a covering-membrane and are provided with scattered pores. The aperture, which has a distinct but low vestibular arch, is provided with a narrow, deep sinus, and the well-chitinized operculum consists of two parts connected by an articulation (i. e. a more weakly chitinized connecting part), a principal part, which is provided with two muscular dots and an accessory part, which occupies the sinus. Avicularia may be present. The oœcia consist of a calcified endooœcium without pores and a membranous ectooœcium. The distal half of each zoœcium with three multiporous rosette-plates (often only groups of small, uniporous rosette plates) or three pore-chambers.

To this genus belong *A.* (*Schiz.*) *Cecili* Aud. and *A.* (*Schiz.*) *circinata* Mac Gill. Whilst the rosette-plates in the former may undergo a fairly considerable variation, even in zoœcia of the same colony, the elongated groups of small, uniporous rosette-plates being sometimes quite open, sometimes surrounded by a more or less projecting edge, we find in the latter species small pore-chambers with a single row of pores in each. Whilst *A. Cecili* in contrast to *A circinata* as a rule has neither spines nor avicularia, a remarkable, spine-bearing, independent avicularium, the mandible of which is provided with a similar accessory part as the zoœcial operculum, has been found by Kirkpatrick[1] in a variety of the

[1] 48, p. 21.

former from the China Sea. In his description of *A. circinata* Busk mentions a supposed bundle of muscles, which is attached to the accessory part of the operculum, but in reality it is only a connected part of the compensation-sac, which by foldings has assumed a longitudinally striated appearance.

Emballotheca n. g.

Schizoporella p. p., Lepralia p. p.

No spines. The *zoœcia* with numerous scattered pores. The aperture has a weakly developed vestibular arch and its poster is usually convex or provided with a low sinus, more rarely with a broad, tooth-like projection. The operculum, the muscles of which are attached near the lateral margins, is chitinized to a very varying extent and not always distinctly marked off from the compensation-sac. Well-developed hinge-teeth. Small *avicularia* with rounded mandible at the tip may occur in various positions, but are most frequently lateral with the mandible directed obliquely proximally or inwards. The hyperstomial *oœcium* consists of a membranous ectooœcium and a calcified endooœcium with or without pores, but between the two layers there is inserted a more strongly calcified cryptocyst layer, provided with pores, which is often formed by three or four zoœcia in common; in such a case it consists of just as many pieces separated by distinct sutures. The uniporous rosette-plates are fairly numerous.

To this genus belong *E. (Schizoporella) furcata* Busk, *E. (Lepralia) quadrata* Mac Gill. and *E. (Schiz.) subimmersa* Mac Gill.

The most striking character of this genus, which for the rest comes nearest to *Schizoporella*, is the presence of a cryptocyst layer between the two layers of the oœcium, which may sometimes be formed by the distal zoœcium alone, sometimes also by two or several adjacent zoœcia, and in the last case this layer consists of three or several pieces meeting in distinct sutures. The reason for this difference is simply, that the basal wall of the oœcium only extends in the first case over a part of the distal zoœcium, whilst in the last it also extends in over an adjacent part of the neighbouring zoœcia, each of which then takes part in the formation of its frontal wall. The earliest sign of such an oœcium is in *E. furcata* shown in zoœcia with frontal wall completely calcified, and it appears here as a hollowed-out area the boundaries of which are formed, sometimes merely by a low, arch-shaped cryptocyst ridge, sometimes also by the lateral margins of the zoœcium. The area mentioned like the rest of the surface of the zoœcium is covered by a membrane, and the part of this which covers over the area is destined to become the basal wall of the oœcium, whilst the low ridge is the first sign of the cryptocyst layer which grows into the oœcial fold. In those cases where the oœcial cover consists of several adjoining pieces, it is however only the distal piece which is early laid down as a low ridge, whilst there is yet no trace of the other parts which only appear later. Whilst I have not seen simple and compound oœcia on the same colony, colonies of the same species from different localities on the other hand present a difference in this regard. Thus, the oœcium is simple in an incrusting colony of *E. furcata* from Siam, which agrees in all essentials with a form from Singapore which appears in free, two-layered laminate colonies and in which the oœcium is compound. Whilst the form of *E. subimmersa* figured by Hincks has a compound oœcium, the oœcium in one of the colonies examined by me from Victoria is simple. The same difference is also seen in *E. quadrata*, and Mac Gillivray for example figures a Tertiary form of this species with a simple oœcium.

Emballotheca quadrata Mac Gill.

Lepralia quadrata Mac Gill., Mc Coy Prodromus of the Zoology of Victoria, Vol. I, Dec. V, pag. 42, Pl. 48, fig. 5.

Eschara elegans Mac Gill. (non Milne Edwards) Transact. and Proceed R. Soc. of Victoria, Part II, Vol. IX, 1869, p. 138.

(Pl. XVIII, figs. 13 a—13 e).

The zoœcia rectangular, slightly arched, tuberculated and provided with scattered, fairly large pores. The aperture, which is placed immediately proximally to the curved or angularly bent distal margin of the zoœcium, is rounded quadrangular, somewhat broader than long, and provided with two concave, proximally converging lateral margins, whilst the proximal margin runs out into a broad, but low, rounded or trapeziformly rounded, tooth-like projection. Each lateral margin is provided with a long and strong hinge-tooth, bent proximally and inwards, which seen from the aperture appears as a rule pointed, but which in reality ends in a fan-shaped, dentated, nodulous expansion. The operculum, which is but incompletely delimited from the compensation-sac, is surrounded by a more strongly chitinized marginal part, which is continued proximally into a recurved part on each side. Each distal wall is provided with ca. 8 and the distal half of each lateral wall with 3—5 uniporous rosette-plates.

The oœcia, which are provided with a thin-walled endooœcium perforated by pores, are circular in outline, evenly arched and very large, as they spread over a great part of the place occupied by the adjacent 4—6 zoœcia. The cryptocyst layer lying under the ectooœcium is, like the rest of the cryptocyst, provided with scattered pores and is thus composed of 4—6 sections meeting in sutures. The aperture of the gonozoœcia is considerably larger and broader than that of the ordinary zoœcia.

The avicularia occur extremely rarely and most frequently singly in the distal corners of the zoœcia, but on the gonozoœcia there is not rarely one on each side. They are concave, of a more or less regular, elongated oval form, and the opercular area, which is separated from the subopercular by an arched transverse ridge, is provided with a well-developed cryptocyst. The mandible points directly or obliquely proximally.

Of this species, which appears in free, two-layered plates, I have examined a dry fragment from Victoria (Miss Jelly).

Cyclicopora Hincks.

No spines and no distal arch. The zoœcia have scattered pores and the circular aperture, which has no hinge-teeth, is provided with a slightly chitinized operculum. No avicularia. The oœcia consist of a membranous ectooœcium and a calcified endooœcium provided with scattered pores. Multiporous rosette-plates.

The genus, which only comprises a single species *C. praelonga* Mac Gill. (*C. longipora* Hincks), is referred by Hincks to a separate family *Cyclicoporidae*, which is based in general on the simple structure of this form and not on definite positive characters. The most important, systematic character is shown in the oœcia, which agree essentially with the corresponding structures in the family *Escharellidae*, consisting of a membranous ectooœcium and a calcified endooœcium. They differ however from all other oœcia in this family, in that their basal wall is formed in the whole of its extent by a portion of the frontal wall of the distal zoœcium, whilst this only partially occurs in such genera as *Escharella* and *Escharoides*. This genus is therefore provisionally and with great doubt referred to the *Escharellidae*.

Family **Smittinidae.**

The *zoœcia* are seldom provided with 1—8 spines. A vestibular arch is wanting or weakly developed. The *avicularia* are rarely lateral and a median, symmetrically or asymmetrically placed avicularium appears most frequently. The *oœcia* have as a rule a calcified, very rarely a membranous ectooœcium which is usually provided with pores. Rosette-plates with one or several pores, more rarely pore-chambers.

The two families *Smittinidae* and *Escharellidae* are not sharply distinguished, and a comparison of the characteristics of the two families shows that the characters taken singly may appear in both families, though to a very different extent and in different combinations. The most constant difference is seen in the structure of the oœcia, but in this regard the genus *Porella* forms a connecting-link between the two families, as a number of species of this genus have a membranous ectooœcium and pore-chambers.

Porella (Gray) Hincks.

Spines are wanting or appear at most to the number of two. The primary aperture has a straight, slightly convex or somewhat concave proximal rim, which is often provided with a broad or low median tooth. Distinct hinge-teeth are as a rule present. A distinct peristome. The operculum, which in the rarest cases is somewhat strongly chitinized and sometimes not separated from the compensation-sac, is as a rule provided within each lateral margin with a more or less strongly developed muscular ridge. Immediately proximally to the aperture there is in most species a large *avicularium*, the chamber of which often takes up almost the whole of the breadth of the zoœcium, and its distally directed frontal area is in time enclosed within the peristome. The *oœcia*, which have no pores or at most a single one in the oœcial cover, have sometimes a membranous and sometimes a calcified ectooœcium. In the latter case there is in addition an oœcial cover formed in various ways. Multiporous rosette-plates, more rarely multiporous pore-chambers.

Numerous species belong to this genus, amongst which are *P. concinna* Busk, *P. marsupium* Mac Gill., *P. margaritifera* Quoy & Gaim., *P. acutirostris* Smitt, *P. minuta* Norm., *P. compressa* Sow., *P. glaciata* Waters, *P. plana* Hincks, *P. Skenei* Ellis & Sol., *P. saccata* Busk, *P. inflata* Waters (= *P. laevis* Smitt, pars), *P. princeps* Norman, *P. tubulifera* Heller.

The species may be divided into two groups (or perhaps genera) according to the structure of the oœcia, these in some species e. g. *P. acutirostris*, *P. marsupium* and *P. margaritifera* having a membranous ectooœcium, whilst the ectooœcium most probably in most species is calcified. Whilst in the former group the calcified endooœcium gradually increases in thickness under the covering membrane, an oœcial cover formed in different ways may appear in the second group. In *P. struma* and *P. glaciata* it is a single cryptocyst layer, which again is covered by the covering membrane, whereas in *P. saccata* it is many-layered, as thin calcareous layers, presumably gymnocyst layers, continually grow over the oœcium, not only from the distal zoœcium but also from the two neighbouring zoœcia, and we can see as a rule three, distinctly separated, thin covering plates on their surface. *P. saccata* ought perhaps to be referred to a distinct genus.

Porella margaritifera Quoy & Gaim.

Flustra margaritifera Quoy & Gaimard, Voyage de l'Uranie, Zoologie, p. 606, Pl. 92, figs. 7, 8.

Lepralia margaritifera Busk, Catalogue of Marine Polyzoa, Cheilostomata, p. 72, Pl. CI, figs. 5, 6.

Flustra margaritifera Jullien, Mission du Cap Horn, Bryozoaires, 1888, p. 58, Pl. 9, fig. 1.

Lepralia margaritifera Waters, Challenger, Zoology, Vol. XXXI, III, 1889, p. 26, Pl. III, figs. 15, 16.

(Pl. XVIII, fig. 8 a).

The zoœcia elongated, hexagonally lyre-shaped, strongly arched and provided with a circle of marginal pores. These soon come to lie in areas, bounded by ribs, which radiate in from the margin to the suboral avicularium; and with the continued deposition of the calcareous substance these areas are at length transformed to pear-shaped pits. The aperture has a semicircular anter, and we can distinguish in this between a straight or slightly convex, median part and two short, curved, distally diverging lateral parts. Small distinct hinge-teeth. The operculum, which is not separated from the compensation-sac, is weakly chitinized and provided on each side with a chitinous ridge, which is slightly angularly bent and its proximal portion is in the greater part of its length far removed from the margin. The strongly curved or angularly bent distal wall is provided on each side with a row or zigzag belt of small, uniporous rosette-plates, and the distal part of each lateral wall has one multiporous rosette-plate.

The oœcia, which on the colonies examined occur on the majority of the zoœcia, seem only to consist of a single, independent calcareous layer and have therefore probably been covered by a membranous ectooœcium. They are originally furnished with fine radiating striæ, but in older zoœcia they show concentric thickenings arising from the covering calcareous layer.

Avicularia. The suboral avicularium, which has a broad, triangularly rounded mandible and a broad, sac-like chamber, does not attain quite a third of the whole length of the zoœcium. In the older zoœcia it shows like the oœcium concentric thickenings. In one of the small colonies examined a number of zoœcia are provided immediately distally to the oœcium on the one side with an avicularium somewhat variable in size, which is of an irregular elliptic form, as it increases in breadth towards the distal part of the opercular area, and this especially in the larger avicularia is provided with a well-developed cryptocyst. In the younger zoœcia these avicularia, the mandible of which is as a rule directed obliquely distally and outwards, project freely from the surface of the zoœcium, but in the older zoœcia they become more or less deeply sunken owing to the above-mentioned deposition of calcareous layers. At their base we find as a rule two of the above-mentioned, original calcareous ribs, which from their position have not been able to share in the increase in thickness like the others.

Of this species I have examined some small, dry colonies from Foveaux Straits, N. Zealand (Dr. Harmer).

Porella (?) cornuta n. sp.

(Pl. XVIII, figs. 6 a—b, Pl. XXII, fig. 11 a).

The zoœcia elongated, quadrangular or hexagonal, fairly strongly arched, with closely placed, scattered, large, round or oval pores, between which are numerous small tubercles. The half-elliptic aperture is provided with a very broad but extremely low sinus, which has a straight or slightly convex, proximal margin and is marked off on each side from the lateral margins by a small, rounded, tooth-like projection Immediately distally to and inside this projection, there is on each side a rounded, triangular hinge-tooth, which is continued into a weakly developed vestibular arch. In the distal part of the aperture the peristome is only weakly developed, but in its proximal half there is on each side a collar-shaped, prominent, fairly thick projection, which on each side grades into the avicularium and in the oœcium-bearing zoœcia meets the proximal part of the oœcium, whilst in the other zoœcia it is sharply marked off from the low distal part of the peristome. The operculum (Pl. XXII, fig. 11 a), which has a similar form as the aperture, is only slightly chitinized but distinctly separated from the compensation-sac. On each side within the margin it has an elongated, strong ridge and the two ridges pass over both distally and proximally into a somewhat strongly chitinized, but not very distinct, connecting part. Each distal wall is provided with two and the distal half of each lateral wall with one multiporous rosette-plate.

The oœcia are as a rule elongated, more or less distinctly tapering upwards, strongly arched and with their frontal wall inclined down towards the aperture. They are in the beginning furnished with fine radiating striæ, but owing to later calcification this striation becomes more and more indistinct, and the older oœcia are not only provided with smaller and larger tubercles and with rib-like prominences of varying form, but most of them have even one or several, shorter or longer, sometimes very long, hollow spine-like processes of more or less regular form. There is often such a process standing out almost perpendicularly from the surface of the oœcium in the neighbourhood of the aperture on both sides or only on the one side, and a third frequently projects at the same time from the middle of the oœcium. The processes mentioned arise in this way, that some of the above-mentioned rib-like prominences are ring-shaped and continue to increase in height. The oœcium in a larger or smaller part of its circumference is connected with the zoœcium by means of rib-like prominences.

As I have been unable to find any more than a single independent calcareous layer, I conclude that there has been a membranous ectooœcium, by means of which the thickening layer has been formed. The oœcium lacks a basal mark and has presumably been formed later than the cryptocyst of the zoœcium.

Avicularia. Immediately proximally to the aperture of the zoœcium there is a strongly projecting avicularium, standing out at right angles, the chamber of which is almost of the same breadth as the aperture. Seen from the side it is pointed, triangular, and seen from its mandibular surface it has a rounded, triangular form. It is provided with an oval aperture but I have been able to find neither a mandible nor trace of transverse bar.

In the conchological collection of the Zoological Museum a single dry colony was found incrusting *Saxidomus purpuratus* from Yokohama.

The above-described species is only referred with some doubt to the genus *Porella.*

Smittina Norman[1] (nov. nom.) char. emend.

Escharella (with subgenera Escharella s. str. and Hærentia) Smitt,
Smittia Hincks, p. p., Schizoporella Hincks, p. p., Pseudoflustra Bidenkap.

Spines may be present to a number of 1—8. The aperture is provided with a more or less distinctly marked off, as a rule broad, rounded sinus, which sometimes takes up the whole of the proximal margin and the middle part of which is often occupied by a tooth of varying shape. There are well-developed hinge-teeth as a rule. The operculum is in most species membranous or weakly chitinized, often not marked off from the compensation-sac. A peristome may be absent or present in very different degrees of development. *Avicularia* may appear in very varying positions, but one is usually present proximally to the aperture. The *oœcia,* which in most cases are either independent or have only a small part of their endooœcial basal wall common with the frontal wall of the zoœcium, consist of two calcareous layers, of which the ectooœcium is with few exceptions provided with pores. As a rule there is a more or less developed oœcial cover. The rosette-plates are sometimes uniporous, sometimes with a few or many pores.

[1] 84, p. 120.

Of the species which I have been able to examine I must refer the following to this genus: *S. Lansborovi* Johnst., *S. reticulata* Mac Gilliv., *S. trispinosa* Johnst., *S. Jeffreysi* Norman, *S. unispinosa* Waters, *S. cheilostoma* Manz., *S. jacobensis* Busk, *S. (Porella) malleolus* Hincks, *S. arctica* Norman, *S. majuscula* Smitt, *S. porifera* Smitt, *S. reticulato-punctata* Hincks, *S. Smitti* Kirch., *S. (Pseudoflustra) solida* Stimps., *S. (Eschara) propinqua* Smitt, *S. (Lepralia) borealis* Waters, *S. (Schizoporella) linearis* Hassall, *S. (Schiz.) auriculata* Hassall, *S. (Schiz.) triangula* Hincks, *S. (Lepralia) foliacea* Ellis & Sol., *S. (Lepralia) Otto-Muetteriana* (= *S. Pallasiana*, var. *projecta* Waters), *S. (Lepr.)* collaris Jullien (= *Lepr. Pallasiana*, var. *strumata* Waters) and *S. (Lepralia) Pallasiana* Moll.

While originally I only referred to this genus species with uniporous rosette-plates, the aperture of which besides two well-developed hinge-teeth is provided with a median tooth and the ectooœcium of which is provided with pores, for instance *S. Lansborovi*, *S. reticulata* and *S. trispinosa*, I have been obliged gradually to extend the limits of the genus in the manner expressed in the above diagnosis, seeing that the species in which the three characters named are constant through transitions are connected with species which I was earlier inclined to refer to one or more other genera. As to the rosette-plates a number of species (e. g. *S. linearis*, *S. auriculata*, *S. malleolus* etc.) have on each lateral wall 3—5 uniporous plates while others (e. g. *S. porifera*, *S. reticulato-punctata*, *S. solida*, *S. Smitti*) have 2—3 with 1—5 pores and a third group (e. g. *S. propinqua*, *S. foliacea*, *S. collaris* and *S. Pallasiana*) have 1—3 with 6—30 pores, the number of rosette-plates decreasing in inverse proportion to the number of pores in each plate. A distinction between uniporous and multiporous rosette-plates cannot therefore in these species be used as a generic character. A median tooth which as systematic character is always more or less inconstant cannot be used here either as a decisive generic character, as it is not always constant even within the species. This applies for instance to *S. solida* and *S. Smitti*, in which two species a median tooth may sometimes be present and sometimes absent.

Quite apart from the fact that the proximal margin of the aperture in a number of species is provided with a median tooth, it also shows considerable differences in the form as well as in the breadth and the depth of its poster, which is very often furnished with a more or less distinct sinus. The sinus is narrowest in *S. linearis* and shows here considerable variation in forms from different localities Whilst in a form from Bergen, for example, it is half as broad as the aperture, in a form from Syracuse it attains only a fourth of the breadth. To exclude all doubt as to these forms being connected, I may remark, that in addition to both having the two lateral avicularia they are also provided with the peculiar large avicularia, which Hincks took to be oœcia. The broadest sinus is found in *S. collaris* and *S. Pallasiana,* in which two species it is the broadest part of the aperture. The operculum, which is never provided with muscular ridges, is in most species membranous or feebly chitinized and very often not or only indistinctly separated from the compensation-sac (e. g. in *S. Smitti, S. Lansborovi, S. reticulata, S. trispinosa*), while in other species such a separation is brought about either by its stronger chitinization (e. g. in *S. propinqua* et *S. borealis*) or by the development af a chitinous sclerite along its proximal margin in continuation of the opercular arch (e. g. in *S. solida, S. reticulato-punctata, S. collaris, S. Otto-Muelleriana, S. foliacea* and *S. Pallasiana*).

The avicularia may occur in very different positions and we can sometimes find both two lateral as well as a single median avicularium in the same species (e. g. *S. trispinosa* and *S. linearis*). This occurs for example in the same colony of the above-mentioned *S. linearis* from Syracuse. In this genus however there is usually a sometimes symmetrically, sometimes asymmetrically placed, median avicularium proximally to the aperture, and it may be noted as a contrast to the corresponding avicularium in the genus *Porella,* that the median avicularium in *Smittina* has its frontal area as a rule parallel to the surface of the zoœcium.

Whilst the ectooœcium is as a rule provided with numerous pores, the number of these may fall to 3 or 2 in *S. trispinosa* and the same number is also found in *S. foliacea.* In *S. arctica* there is only a single pore, and finally pores are quite wanting in *S. Smitti* and *S. majuscula.* An oœcial cover is present in most species but in very different development, sometimes only forming a marginal belt (e. g. in *S. Lansborovi, S. borealis, S. collaris*), sometimes concealing the whole frontal wall of the oœcium and developing together with it (e. g. in *S. Smitti, S. arctica, S. majuscula*). Its appearance in *S. trispinosa* var. *cucullana* (Pl. XIX, fig. 7 a) is characteristic, as it is provided there with a freely projecting, prominent margin, as also in *S. foliacea* (Pl. XXIV, fig. 5 a) where it consists of three parts, which are separated by two sutural lines converging towards the aperture. The middle part belongs to the distal zoœcium, whilst the two lateral parts belong to the two neighbouring zoœcia, and the two characteristic, large, flatly triangular projections, which partially cover the aperture of the oœcium-bearing zoœcia, are directly connected with the lateral parts of the oœcial cover. Only the proximal part of the oœcium is covered in *S. solida.*

Though calcareous oœcia have not been found in »*Lepralia*« *Pallasiana* I must refer this species to the present genus on account of the likeness it shows to *S. Otto-Muelleriana* in the structure of the aperture and the operculum, in the possession of scattered pores and of an occasionally present median avicularium proximally to the aperture.

Smittina acaroensis n. sp.

(Pl. XVIII, figs. 12 a—b).

The zoœcia are usually elongated, with an arched or angularly bent distal wall and as a rule with parallel lateral walls. They are provided with a single or double circle of marginal pores, soon separated from one another by ribs which after a time increase in height and length, and in the oldest zoœcia the whole surface is divided into a number of depressed areas; the latter may even conceal the chamber of the avicularium. The aperture, the distal margin of which is finely dentated and in the younger zoœcia bears the marks of 4 spines, is provided with a somewhat distinctly marked off, broad and deep sinus, the middle part of which is occupied by a fairly broad tooth, axe-like in shape and running out into two pointed corners. The two hinge-teeth are strong, triangular, somewhat pointed, more or less strongly striated and curved somewhat proximally. The operculum is membranous, not distinctly separated from the compensation-sac and provided on each side with a very faint chitinous ridge. The peristome is collar-shaped, prominent, and provided with an excision corresponding to the frontal area of the avicularium. Each distal wall is provided with 8 and the distal half of each lateral wall with 3—5 uniporous rosette-plates.

The oœcia, which are present in great number, are large, as a rule somewhat elongated, fairly strongly arched and provided midway with numerous, larger and smaller pores. An oœcial cover appears after some time and in older oœcia only leaves a narrow, central part free.

Avicularia. An avicularium is present proximally to the aperture, the length of which is almost a fourth of that of the zoœcium and which takes up the greater part of the breadth of the zoœcium. Its chamber, which is separated from the zoœcium by a broad, arched line, is provided at the margin with 3—5 pores, and the transverse bar which divides the oval frontal area into two parts, is provided with a short, proximally directed process. The subopercular area, which is turned towards the aperture, has a transversely oval opening.

The colonies occur as free, two-layered laminæ, and the species was found in mud from Akaroa Harbour, New Zealand (Suter); depth 6 fathoms.

Discopora[1] Lamarck.

Escharoides Smitt, part., Umbonula Hincks,
Mucronella Hincks, part., Ramphostomella[2] v. Lorenz.
(Pl. XIX, figs. 2 a—b, fig. 19 a).

Two to four spines occur very rarely. The primary aperture always lacks hinge-teeth, but is often provided with a fairly narrow, median tooth. The operculum is membranous and not separated from the compensation-sac. Symmetrically placed *avicularia* very seldom occur; but a larger or smaller part of the aperture is as a rule on its proximal margin occupied by a larger or smaller, usually strongly projecting avicularium, which may be lateral or median, but frequently has an asymmetrical position. The *oœcia*, which have a small basal mark, consist of two calcified layers, of which the ectooœcium is provided as a rule with pores. The distal half of each lateral wall is provided with 1—2 multiporous rosette-plates.

To this genus belong of the northern species: »*Escharoides*« *Sarsi*, »*Umbonula*« *verrucosa*, »*Mucronella*« *pavonella* (which Harmer has already referred to the genus *Umbonula*), as also the species of the genus *Ramphostomella*, v. Lorenz. To the latter genus v. Lorenz[2] refers 6 species, but the material investigated by me seems to show, that *R. costata* v. Lor. is not sufficiently distinct from *R. scabra*. To these has to be added *R. ovata* Smitt. The genus *Discopora* stands near to *Smittina*, from which it differs by the lack of hinge-teeth, by never possessing a symmetrical sinus, by always having some few multiporous rosette-plates, as also generally in the position of the avicularium. The limits between the two genera are however not so clearly marked but that we could imagine them disappearing on investigating a larger material.

The primary aperture, which may be more or less regularly circular or semicircular, has sometimes a concave, sometimes straight or somewhat convex proximal margin, and in the first case it may be provided with a more or less distinct, narrower or broader sinus (*D. Sarsi*, *D. spinigera*, *D. bilaminata*). Whilst the hinge-teeth are always lacking, a very inconstant median tooth may however appear in most species (lacking in *D. Sarsi* and *D. verrucosa*), and there are also in several species one, two or several, conical or trapeziform teeth, as a rule extremely small on the proximal margin of the aperture. Thus, such a tooth occurs as a rule on the one or both sides of the above-mentioned, asymmetrical sinus, and in *D. Sarsi* the number of these small teeth may sometimes mount

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[1] 84, p. 112. [2] 58, p. 93.

up to 4. There is only a single one however as a rule at the subopercular end of the avicularium, but not rarely there is a still smaller one centrally in the sinus. There is also sometimes such a small tooth in *D. plicata* on the oral margin of the avicularium, but so placed that it cannot be seen from the frontal surface of the zoœcium. Whilst a peristome is either quite wanting or weakly developed in those species, which either lack an oral avicularium (*D. pavonella*) or in which it has a more or less distinctly median position (*D. verrucosa, D. scabra*), it is on the other hand more strongly developed in the other species in which the oral avicularium is lateral. Here, namely, the peristome appears in the form of two projections from the proximal margin of the aperture separated by a triangular incision, and the one of these projections along with an adjacent part of the frontal wall of the zoœcium serves as the basal wall of the avicularium. What Hincks and v. Lorenz call an avicularium in their diagnoses of the genera *Umbonula, Escharoides* and *Ramphostomella* is in reality only the frontal part of the avicularium with the mandible, whilst the avicularian chamber, which contains the muscles, seems to have been either overlooked or regarded as something supporting the avicularium. In Hincks' diagnosis of the genus *Escharoides* it is said, namely, that the avicularium is enclosed within a sinus, formed by the peristome, while this in reality only applies to the frontal area of the avicularium, and in the diagnoses of *Umbonula* and *Ramphostomella* the avicularian chamber is described respectively as »a prominent umbo (? avicularian cell) . . . supporting an avicularium« and as »ascending rostra . . . bearing avicularia«.

The oœcia, which only have a small basal mark, show a similar variation in their structure as in the species of the genus *Smittina*. As a rule the pores are fairly numerous, though their number may sometimes vary considerably in a single species. Thus, in a colony of *D. bilaminata* I have found the number of pores varying between 7 and 2. In *D. Sarsi* there is only 1 or 2, and they are quite wanting in *D. ovata* which also differs from the other species in that the zoœcial wall is provided with scattered pores. An oœcial cover is present in most species and appears as a rule in sufficiently old oœcia as a covering lamina in the marginal region of the oœcium. It is well-developed in *D. verrucosa* and *D. scabra*, which resemble one another in most respects and differ chiefly in that the avicularian area in the latter is placed asymmetrically. An oœcial cover is most strongly developed in *D. Sarsi* (Pl. XXIV, fig. 2 a) and the oœcia are here rather quickly covered by 3—5 different calcareous laminæ meeting in a suture, the two proximal of which come from the peristome, the unpaired from the distal zoœcium and the remainder from two neighbouring zoœcia.

For the rest, all the species mentioned here will be made the object of more detailed investigation in a later work on the *Bryozoa* material of the Ingolf Expedition.

Family **Celleporidae**, char. emend.
Celleporidae Busk, Hincks, part.

No spines. The aperture as a rule circular with a broader or narrower, more or less sharply marked off sinus, more rarely with a simple, concave, proximal margin. Hinge-teeth may be absent or present. The operculum is always distinctly marked off from the compensation-sac, well-chitinized as a rule and provided with two muscular dots. A peristome more or less developed present as a rule. *Avicularia* seem to be always present, and in most species a more or less strongly projecting, almost always asymmetrically placed avicularium is present proximally to the aperture. Further, large scattered avicularia often occur. The hyperstomial *oœcia* are free and the ectooœcium is wholly or partially calcified. The basal zoœcia have a rhombic circumference and their distal half is as a rule provided with a number (ca. 8) of adjoining, uniporous or few-pored pore-chambers, more rarely with few, widely separated pore-canals. The colonies, which are encrusting or freely branched, as a rule show superficial budding, and the zoœcia are often more or less erect.

The aperture is provided as a rule with a sinus, the dimensions of which are subject to very considerable variation, as can be seen, for example, from the figures of the aperture and operculum given by Busk[1]. Whilst the opercular tongue and the sinus are in some species very narrow and sharply marked, in others the latter is broadly rounded and so faintly marked, that there is a plain transition to the almost quite circular aperture which is found in a smaller number of species, e. g. in *Cellepora pumicosa* and *Cell.* (*Lagenipora*) *socialis*. The form of the aperture seems therefore not available as a generic character and the same is also the case apparently with the peristome, which is sometimes developed to a very varying extent in the same species, e. g. in *C. Costazzi*. As the majority of the members of this family show superficial budding, the rosette-plates only appear on the zoœcia in the basal layer of the colony, and in the large majority of the species I have been able to examine, each zoœcium in its distal half shows a number of juxtaposed uniporous or few-pored pore-chambers, which are apparent through the basal wall when the colony is loosened from its under-layer. In two species, which occur in very small colonies, namely, in

[1] 8, Pl. XXX and XXXVI.

Cell. (*Lagenipora*) *socialis* and *Cell.* (*Celleporella*) *pygmaea*, on the other hand, there is on the circumference of each zoœcium a small number (6—8) of widely separated, thin canals by means of which each zoœcium is connected with its neighbours. At the bottom of each canal there is a rosette-plate with one pore. This agreement in regard to the interzoœcial connection cannot however be considered as an index of a close relationship between the two species mentioned, as we must refer them to two different genera owing to a presumably more important difference in the structure of the oœcia.

In the majority of the species belonging to this family the oœcium consists of two calcareous layers, of which the ectooœcium is as a rule provided with pores. These may however be lacking in a few species, for instance in *Cell. socialis* and in *C. ramulosa* the oœcia are only rarely provided with pores. In a small group of species, concerning which Waters[1] has already expressed the opinion that they should form a special genus owing to the structure of the oœcium, the ectooœcium is only partially calcified, and the frontal wall of the endooœcium has a flat, semilunar, semicircular or circular area which is covered by a membranous part of the ectooœcium, whilst the part of the endooœcium corresponding to the area is provided, sometimes with radiating grooves or fissures, sometimes with scattered pores. For this group we would propose the name *Siniopelta*. An oœcial cover may sometimes appear, for instance in *Cell. avicularis*[2] and *Cell. socialis*.

Cellepora Linné.

Cellepora Busk, Hincks part.; Celleporella Hincks part.;
Lagenipora Hincks, Schismopora Mac Gillivray part.;
Osthimosia Jullien.

The ectooœcium is wholly calcified and generally furnished with pores, in rare cases without such. With exception of *Cellepora Costazzi* all the species of *Cellepora* described by Hincks in British Marine Polyzoa belong to this genus, and with exception of *C. rudis* all those which Busk refers to the group § 2 in his Challenger *Bryozoa*. Other species have been described by Mac Gillivray, Waters, Jullien and others. To this genus I must also refer *Lagenipora socialis* Hincks, of which I have examined a number of colonies lent me by the British Museum and by Mr. Waters. The ectooœcium is without pores but wholly calcified and furnished with an oœcial cover which hides its basal half. Among the ordinary zoœcia there is a number of flat kenozoœcia which Hincks men-

[1] 113, p. 13; 108, p. 20. [2] 103, Pl. IX, figs. 194—96.

tions as a »common calcareous crust« and possibly the genus might be preserved on account of this character.

In his work on the British Zoophytes Johnston gives Fabricius as the author of the genus *Cellepora*, but the first author who used this name was in reality Linné in the XIIth edition of his Systema Naturae, and the first species he refers to this genus is *C. ramulosa*.

Genus **Siniopelta** n. g.

Cellepora Busk, Hincks, part.; Celleporella Hincks, part.;
Schismopora Mac Gillivray[1] part.; Osthimosia Jullien[2] part.

The endooœcium has a flat frontal area furnished either with radiating fissures or with pores and covered by a membranous part of the ectooœcium.

To this genus belong *C. Costazzi* Aud., *Celleporella pygmaea* Norman (*Cel. lepralioides* Norman), *Cellepora Borgi* Aud.[3] (*Lekythopora Watersi* Calvet[4]), *Lagenipora lucida* Hincks, *Cel. granum* Hincks, *Cel. costata* Mac Gill.[5], *Cel. platalea* Mac Gill.[6], *Cel. rota* Mac Gill.[7], *Cel. rudis* Busk etc.

The oœcia of *Cell. Borgi* are not as Calvet states frontal but spring from the distal rim of the aperture. The form of the peristome seems to be somewhat variable.

Family **Holoporellidae** n. f.

Spines may appear in a number of 2—5. The aperture, which only rarely has hinge-teeth, has a concave or almost straight proximal margin, which may sometimes be provided with 2—6 extraopercular teeth of different form. The operculum, which as a rule is weakly chitinized and often grades without boundary into the compensation-sac, is frequently provided with a ridge-like projection within each margin. A peristome may be absent or present, but is never strongly developed. A more or less strongly projecting, obliquely placed *avicularium* occurs as a rule proximally to the aperture, and large, scattered avicularia further often appear. The *oœcia*, which only occur in a small number of species, are widely open, consisting of a single calcareous layer, and in shape like a cap or bowl without pores; they seem to have no covering membrane. The zooœcia in the basal layer of the colony, which have a rectangular circumference, are provided both on the distal wall and on the distal half of each lateral wall with a row

[1] 76, p. 109. [2] 45, p. 64. [3] 98, Pl. 7, figs. 3,1—3,6. [4] 10, p. 68, Pl. 2, figs. 10—13. [5] 61, p. 136. [6] 68, p. 114. [7] 68, p. 116.

of (respectively ca. 4—6 and 3—4) small, uniporous rosette-plates. The colonies are incrusting and superficial budding occurs in most.

Whilst spines never occur in any member of the family *Celleporidae*, such are found on the other hand in a number of species of this family to a number of 2—6, e. g. in »*Cellepora*« *apiculata* Busk, *C. tridenticulata* Busk, *Cellepora brunnea* Hincks, *C. verrucosa* Mac Gill., *C. bicirrhata* Ortm., *C. triacantha* Ortm.[2] and »*Discopora*« *advena* Smitt. The aperture has a concave or straight proximal margin, and though this in very rare cases may have a slight, rounded incision centrally, it cannot be compared with the sinus in *Cellepora*. This sinus is in reality the interspace between the two hinge-teeth or the two corresponding places of suspension for the operculum, whereas in the species mentioned as in all the other species of the family *Holoporellidae*, the hinge-teeth or the corresponding places of suspension for the operculum are situated on the lateral margins, which are well-separated from the proximal margin. Another difference lies in this, that this excision is not as the sinus in *Celleporidae* occupied by an opercular tongue. Such a small, rounded incision is found for instance in »*Schizoporella*« *aperta* Hincks, which belongs in reality to this family. In not a few species the proximal margin of the aperture is provided with a row of 3—6 teeth of varying form but usually high or narrow, all of which are situated outside the operculum, so that none of them can be compared with hinge-teeth. Such teeth, which presumably serve to protect the operculum, are found in *C. tuberculata* Busk, *C. honolulensis* Busk, *C. Jacksoniensis* Busk, *C. tridenticulata* Busk, *C. polymorpha* Busk, *C. serratirostris* Mac Gill.[1], *C. bicirrhata* Ortm.[2], *C. transversa* Ortm.[2] and »*Discopora*« *advena* Smitt.

The oœcia, which occupy the greater part of the margin of the aperture, are widely open, have no pores and consist only of a single calcareous layer, which seems to lack a covering membrane; but as the oœcia-bearing species I have been able to examine were almost all dry specimens, I cannot determine this question with certainty. If a covering membrane is really lacking, they must probably be regarded as peristomial, but in any case they are very different from the oœcia in the *Celleporidae*. Good drawings of such oœcia are seen in Hincks' figures of »*Schizoporella*« *aperta*[3] and »*Monoporella*« *albicans*[4] and in Waters[5] figure of *Holop. Descostilsi* And. Superficial budding occurs in this family just as in the family *Celleporidae*, and the rosette-plates therefore only occur in the basal zoœcial layer. The zoœcia in this family in contrast to the foregoing have a rectangular circumference, and both the distal wall and the distal half of each

[1] 68, p. 114. [2] 87, p. 55. [3] 26, p. 126. [4] 26, p. 123. [5] 116 a, p. 162.

lateral wall are provided with a row of small uniporous rosette-plates, of which those of the distal wall are often separated by small calcareous thickenings, which can be seen through the basal wall of the colony.

This family is very rich in species and the majority of the species have been described by Busk, Mac Gillivray, Ortmann and others under the name *Cellepora*, which generic name however with them also embraces the species of the family *Celleporidae*. In his work on the Bryozoa of the Challenger Busk divides the genus *Cellepora* sens. ext. into two groups, mainly after the form of the aperture and the structure of the operculum, and with exception of *Cellepora rudis* which belongs to our new genus *Siniopelta* all the species which he refers to the group § 1 belong to the family *Holoporellidae*. From 1895 Mac Gillivray uses the name *Cellepora* exclusively for the species we have referred to this new family and forms a new name *Schismopora* for the species of the family *Celleporidae*. Since however *Cellepora ramulosa L.* is the typical species for the genus *Cellepora*, Mac Gillivray's use of this generic name is quite incorrect. As explained above, some few species are described under the generic names *Schizoporella*, *Monoporella* and *Discopora*.

A detailed, comparative investigation of the separate species will possibly make it necessary to set up several genera, but provisionally we must refer them all to a single genus.

Holoporella Waters[1].

Cellepora Busk, Hincks part.; Cellepora Mac Gilliv. (after 1895).
Monoporella Hincks part.; Schizoporella Hincks part.;
Discopora Smitt part.

The two families *Celleporidae* and *Holoporellidae*, the species of which compose the main part of the old family, *Celleporidae*, seem in all essential characters to be well-separated in spite of their great resemblance in appearance, due in part to the superficial budding and the more or less erect zooecia, in part to the strong armature which in both families has a very similar character. This armature appears in fact in a double form; we have in the first place a great development of avicularia, which occur not only on the single zooecia but as a rule also scattered over the surface of the colony as independent avicularia. In the second place we find in a great number of species the colony bristling with rostra or pointed projections, which sometimes belong to the zooecia, sometimes to the avicularia. The strong armature shown by these two families might

[1] 116 a, p. 159.

possibly be regarded as the result of the superficial budding and be intended to protect the numerous new zoœcial rudiments, which arise everywhere on the surface of the colony between and outside of the older zoœcia. This form of budding may also be rendered easier by the more or less erect position of the zoœcia, as the new zoœcia are in fact laid down in the hollows between the older, so that a larger or smaller part of the walls of the latter come to take part in the boundaries of the new zoœcia.

Family **Petraliidae** n. f.

The *zoœcia* which are only rarely provided with spines have scattered pores and an aperture somewhat variable in form, the proximal margin of which is in most cases provided with 1—3 extraopercular teeth. Hinge-teeth may be wanting or present. The operculum, which may be more or less chitinized, is often almost membranous and not distinctly separated from the compensation-sac. A peristome is wanting or only weakly developed. *Avicularia* occur in all the species in varying positions, but one or several, obliquely placed avicularia usually occur just proximally to the aperture, and these may be situated on a rostrum-like projection of varying form, which in rare cases may appear without being accompanied by avicularia. The *oœcia*, which are first laid down after the cryptocyst of the distal zoœcium is completed, consist of a membranous ectooœcium and a calcified endooœcium provided with very small, closely placed pores. An oœcial cover seems to be wanting. The distal half of each lateral wall is provided with 3—8, as a rule few-pored, very rarely uniporous rosette-plates. With few exceptions the colonies are free, one-layered, laminate, and in such cases the basal wall of the colony is provided either with numerous pores or more frequently with one or a few pore-chambers placed at the distal end, from which radical fibres sometimes issue.

To this family I must refer the following species, of which I only know the first 6 from personal observation: *Petralia undata* Mac Gillivr.[1], »*Lepralia*« *japonica* Busk, *L. rectilineata* Hincks, *Mucronella*« *castanea* Busk, *M. bicuspis* Hincks, *M. porosa* Hincks, *M. vultur* Hincks, *M. Elleri* Mac Gillivr.[2], *M. aviculifera* Hincks, *M magnifica* Busk, *M. bisinuata* Smitt, *M. Thenardi* Kirkp., »*Lepralia*« *dorsiporosa* Busk and *L. tuberosa* Busk. To these must be added two undescribed species from Singapore, of which the one, belonging to the same group of species as *M. porosa*, is remarkable for possessing two lateral plates for the attachment of the occlusor muscles of the operculum, similar to those known from the genus *Chaperia*. As

[1] 61, p. 141. [2] 61, p. 135

I only know so few of the above-mentioned species from personal observation, I must provisionally refer them all to a single genus *Petralia* Mac Gillivray; but I do not doubt that this will in time be divided into several.

In spite of the great variation shown by most of the characters the separate species in this family are so closely connected by many agreements that there can be no doubt about their near relationship. Spines which may appear in a number of 2—6 are only found in 6 species, namely, *P. magnifica*, *P. bicuspis*, *P. tuberosa*, *P. rectilineata*, *P. vultur* and *P. Elleri*. On the other hand, they are lacking in *P. porosa*, which is very nearly related to the two last-mentioned species. The aperture is provided as a rule with a more or less concave, more rarely straight or slightly convex, proximal margin and its form may be circular (*P. undata*, *P. magnifica*), quadrangularly rounded (*P. bisinuata*) or more or less elongated semicircular (*P. tuberosa*, *P. dorsiporosa* etc.). Each lateral margin is sometimes more or less distinctly incurved (*P. japonica*, *P. castanea*). Whilst teeth are quite wanting in *P. japonica*, *P. tuberosa*, *P. rectilineata* and *P. dorsiporosa*, there is a single median tooth in *P. castanea*, two very small teeth medially on the proximal margin in *P. undata* and in all the other species a median tooth and two lateral teeth, the latter of which may also be of somewhat different form. In *P. porosa* and nearly related species, where they are situated far out to the sides, they resemble in form and position the hinge-teeth in many *Smittina* species, but they cannot be compared with these as they are placed outside the operculum. In *P. bisinuata* the three teeth have obviously only arisen by the formation of two incisions in the proximal margin of the aperture, and in this regard an undescribed form from Singapore is of interest, as the concave proximal margin of the aperture is in some zoœcia quite entire, whilst others are provided with one or two incisions similar to those found in *P. bisinuata*.

The rosette-plates, which are present in fairly large to large numbers, are uniporous only in *P. bicuspis*, whilst in the other species examined by me they are provided with 3—10 pores.

Of the hitherto known species of this family only four are incrusting (*P. bicuspis*, *P. Thenardi*, *P. rectilineata*, *P. aviculifera*), whilst the others occur in free, one-layered, laminate expansions, and it may be considered as a good family character that the basal wall in all these species is provided with pores, which otherwise appear only very exceptionally on the basal wall of free, one-layered colonies within the division *Ascophora*. Whilst these pores occur scattered over the whole of the basal wall in *P. undata* and *P. japonica*, in all the other species they appear in one or more, rarely (*P. dorsiporosa*) several pore-chambers, which are situated at the distal end of the basal wall. In the undescribed form from Singapore just mentioned, which for the rest is most closely related to *P. japonica*, we find instead of the scattered pores in *P. japonica* such a distal pore-chamber in most of the zoœcia, and this may sometimes attain a third of the whole length of the zoœcium.

Petralia japonica Busk.

Lepralia japonica Busk, Challenger, Zoology, Vol. X, 1884, Part I, Cheilostomata, p. 143, Pl. XVII, fig. 5.

(Pl. XVIII, figs. 5 a—b).

The zoœcia quadrangularly or hexagonally tongue-shaped, covered by a yellowish brown membrane and provided both on the frontal and on the basal wall with numerous, scattered pores, between which there are larger and smaller tubercles. The pores of the frontal wall are however considerably larger and as a rule somewhat more numerous than those of the basal wall. The large, somewhat elongated aperture, which is provided with a thick, but not very prominent peristome, has a slightly concave proximal margin, and each lateral margin is provided in its proximal half with a part projecting inwards, within which there is a stout hinge-tooth. The operculum, which is well-chitinized and distinctly separated from the compensation-sac, has a stronger chitinized marginal ridge, which joins on to a muscular process almost medially on each lateral margin. The proximal margin however has only a continuation of this on each side. Each distal wall is provided with up to 16 and the distal half of each lateral wall with up to 8 multiporous, scattered rosette-plates with 4—7 pores.

The oœcia, which appear very seldom, have their basal half sunk into fairly deep pits, the base of which is formed by the cryptocyst, which is provided with pores, of the distal zoœcium. Their frontal surface, which may be more or less strongly arched, is provided with numerous, densely placed, small pores.

Avicularia. On the one lateral margin of the aperture, in the neighbourhood of the inwardly projecting part, we somewhat rarely find a small, circular or oval avicularium, almost entirely immersed but with the point somewhat projecting; its broadly rounded mandible is as a rule directed obliquely outwards and proximally, more rarely quite proximally.

Of this species I have examined some few colonies which occur in the form of one-layered, hollow expansions.

Formosa Channel, Lat. 23° 20′ N., Long. 118° 30′ E., 17 fathoms depth (Andréa).

Family **Hippopodinidae** n. f.

The somewhat thin-walled *zoœcia* have no spines and are provided with scattered pores. The primary aperture has a concave proximal margin and the slightly chitinized operculum is surrounded by a more strongly chitinized marginal part. Hinge-teeth and a peristome may be present or absent. Uniporous or multiporous rosette-plates. An *avicularium* may appear on the one or on both sides near the aperture. The *oœcia*, which are endooœcial yet project distinctly on the surface of the zoœcia, consist of a membranous ectooœcium and a calcareous endooœcium provided with scattered pores.

To this family belong the two genera *Cheilopora* and *Hippopodina*.

Cheilopora n. g.

Lepralia Hincks, part.; Mucronella Hincks, part.;
Hippoporina Nev., part.
(Pl. XXIV, fig. 4 a).

The distal wall has no expansion partly separating the *oœcium* from the zoœcium; multiporous rosette-plates; peristome present in the form of a lip-like projection.

To this genus belong »*Lepralia*« *sincera* Smitt, *Hippoporina circumcincta* Nev., »*Mucronella*« *praelucida* Hincks, *M. praelonga* Hincks and »*Lep.*« *Grimaldi* Jul.

Hippopodina n. g.

Lepralia part.

The horizontal part of the distal wall is continued into an expansion which forms a partial partition between the *oœcium* and the zoœcium; uniporous rosette-plates; no peristome.

Hippopodina feegeensis Busk.

Lepralia feegeensis Busk, Challenger, Zoology, Vol. X, 1884, Polyzoa, part I, p. 144, Pl. XX, fig. 9.
Lepralia feegeensis Mac Gillivray, Proceed. R. Soc. Victoria (n. s.), Vol. III, (1890) 1891, p. 81, Pl. X, figs. 1—3.
(Pl. XXIV, figs. 3 a—3 f).

The zoœcia, which have a very small depth (distance between frontal and basal wall) are usually more or less regularly rectangular, fairly broad and thin-walled, and the weakly arched frontal wall is provided with small, round pores, as a rule densely placed, which may however be wanting on the part round the aperture. Each of them is more or less surrounded by a raised wall, which is always highest and most strongly developed about the proximal half of the pore and sometimes only distinctly developed round this. The aperture, the anter of which is surrounded by a slight, collar-shaped peristome, varies somewhat in form, as its poster may sometimes be considerably narrower than its anter and sometimes almost reach this in breadth. Opposite its proximal fifth to third it is provided on each side with a triangular projection, within which there is a stout conical hinge-tooth, and whilst the anter of the aperture approximates to the two-thirds of the circumference of a circle, its poster is only strongly arched at the sides and almost straight or slightly convex in the middle. The weakly chitinized operculum is provided with a continuous marginal ridge. Each distal wall is provided inside its basal edge with ca. 10 and the distal half of each lateral wall with 5–8 uniporous rosette-plates.

The oœcia, which occupy the whole breadth of the zoœcium, are as a rule longer than broad and their somewhat strongly arched frontal wall is provided with numerous, densely placed, larger and smaller, round or oval pores. The raised network surrounding the pores shows a more or less distinct, concentric striation, and along the middle of each ridge especially there is a narrow, raised line, so that each pore comes to lie at the bottom of a 4–6 sided, deepened area. The membranous ectooœcium shows a corresponding division into areas, separated from each other by yellowish, presumably chitinized lines. The basal wall of the oœcium, which arises a little frontally to the basal wall of the zoœcium, rises obliquely up towards the frontal wall and is provided with ca. 10 scattered, round pores. The frontal wall of the oœcium projects a little beyond the frontal edge of the prolongation of the distal wall, so that the egg coming from the zoœcial aperture will be easily led over into the oœcium.

Avicularia appear on a larger or smaller number of zoœcia to the number of one or two, which are usually placed distally to the aperture, more rarely on the sides of this. They are triangular, but of very different length from different localities, and the longest of them have the mandible drawn out into a long, thin, terminal part. In them all the central third of the subopercular area is covered by a dark, chitinized, longitudinal belt, which is presumably a part of the covering membrane. These avicularia are fairly short on colonies from St. Thomas (from *Pododesmus falcatus*) and the mandible is directed obliquely distally and inwards. They are long and narrow on colonies from Singapore and they have here a similar position as on the specimen figured by Busk. On a colony taken from *Manicina areolata* (without locality) the avicularia have a similar form but are directed obliquely proximally and inwards.

The colonies form crusts on corals, on *Tridacna* sp. and on a sponge.

St. Thomas, Singapore (Schytt, S. Gad).

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Plate I.

Plate I.

Fig. 1 a. Two oœcia of *Flustra papyracea* Ellis and Sol. The proximal end of the opercular muscle of the oœcium is seen between the zoœcial operculum and the oœcium. × 23.

— 2 a. A longitudinal section through an oœcium of *Flustra membranaceo-truncata* Smitt. A low cryptocyst belt is seen between the oœcium and the covering membrane (the ectooœcium. The membranous wall separating the zoœcium from the oœcium is incorrectly indicated as the muscle of the oœcial operculum. This muscle is not seen in the figure. × 40.

2 b. An oœcium of the same species from the frontal aspect. The proximal part of the oœcium is covered with a cryptocyst belt, and the proximal ends of the muscles of the oœcial operculum are seen between this belt and the zoœcial operculum. × 40.

— 3 a. An oœcium of *Flustra Barleei* Busk. The same parts as in Fig. 2 b are seen here. × 40.

4 a. *Flustra Spiralaria flustroides* (Hincks), with oœcia. The two proximal oœcia are completely covered by the cryptocyst belt, whilst the four distal show the latter in different degrees of development. × 40.

4 b. An oœcium of the same species, enclosed in an avicularium. × 40.

— 4 c. Two oœcia of the same species; lateral view. × 40.

— 5 a. Longitudinal section through two oœcia of *Flustra securifrons* (Pallas). × 40. The muscle of the oœcial operculum (m. ov.) is seen in the angle between the oœcial operculum and its inner membranous continuation. d. w. cryptocyst process.

5 b. An oœcium of the same species from the frontal surface. The oœcial operculum, the proximal end of its muscle and the two cryptocyst processes (d. w.) are seen between the oœcium and the zoœcial operculum. × 40.

— 5 c. The distal wall — from the distal end — of a zoœcium with oœcium. The oœcial muscle and the two cryptocyst processes are seen. × 40.

— 6 a. A zoœcium with oœcium of *Flustra (Retiflustra) cribriformis* Busk. × 40.

6 b. The same species, from the basal surface. The uncalcified longitudinal belt is more dilated at the distal end of the three zoœcia with oœcia. × 23.

7 a. *Flustra (Retiflustra) Schönaui* n. sp., with a pear-shaped avicularium. The cryptocyst of the zoœcia shows lines of growth. × 40.

7 b. A young zoœcium with oœcium, of the same species. × 40.

7 c. An older zoœcium with oœcium, of the same species. The proximal part of the oœcium is covered by a cryptocyst belt. × 40.

7 d. The same species from the basal surface. × 23.

8 a. Two egg-shaped oœcia of *Flustra (Flustra) foliacea* L. × 40.

8 b. Two oœcia of the same species, lateral view. d. w. the distal wall. × 40.

Fig. 9 a. A zoœcium with oœcium of *Flustra (Spiralaria) denticulata* Busk. The oœcium is enclosed in an avicularium. × 40.

— 10 a. *Farciminaria uncinata* Hincks, wirh oœcium. × 23.

— 10 b. The same species. The oœcium and the surrounding kenozoœcium, lateral view. × 23.

— 10 c. The same species. The oœcium partly from the basal surface. × 23.

— 10 d. The same species. A longitudinal section through the gonozoœcium, the oœcium and the surrounding kenozoœcium. The distal wall (d. w.) between the gonozoœcium and the kenozoœcium is seen. m. ov. the membranous wall separating the zoœcium from the oœcium. × 23.

— 10 e. A longitudinal section through the same parts but parallel to the frontal wall of the gonozoœcium. The angular distal wall between the gonozoœcium and the kenozoœcium is seen. × 40.

— 11 a. *Nellia appendiculata* (Hincks). The two proximal zoœcia with oœcia. × 40.

— 11 b. The same species. A longitudinal section through two zoœcia with oœcia; only the endooœcium is seen whilst the likewise calcified ectooœcium has been overlooked. m. ov. the membranous wall between the zoœcium and the oœcium. × 40.

— 12 a. Two zoœcia with oœcia of *Columnaria borealis* n. sp. On each side of the oœcium in its distal half is seen a cryptocyst plate. × 17.

— 12 b. The same species. The membranous ectooœcium and the triangular cryptocyst plate (ekto) of the oœcium are seen. × 17.

— 12 c. Some zoœcia of the same species, the membranous parts of which have been removed. The lateral walls and the distal wall (d. w.) with rosette-plates in addition to the cryptocyst plate of the oœcium (ekto) are seen. × 23.

— 12 d. A longitudinal section through a zoœcium with oœcium. The membranous ectooœcium, the cryptocyst plate (ekto) of the oœcium and the membranous wall between the zoœcium and the oœcium (m. ov.) are seen. × 23.

— 13 a. *Nellia tenella* (Lam.). All the zoœcia with oœcia. × 100.

— 13 b. The same species. The two proximal zoœcia to the left without oœcia. An avicularium chamber is seen through one of the lateral walls of the middlemost zoœcium. × 40.

— 13 c. A zoœcium with oœcium. The ectooœcium shows an uncalcified transverse belt. × 75.

— 13 d. A longitudinal section through an oœcium of the same species. The membranous parts are not seen and the calcified ectooœcium is by a mistake not separated from the endooœcium. × 40.

— 13 e. An avicularium of the same species with pit for the insertion of the radical fibre. × 200.

1 Flustra papyracea Sol. 2 F. membranacea truncata Smitt. 3 Fl. Barleei Busk. 4 Fl. Flustroides Hincks. 5 Fl. securifrons Pall. 6 Fl. cribriformis Busk. 7 Fl. [illegible] n. sp. 8 Fl. foliacea L. 9 Fl. denticulata Busk. 10 Membranipora arcuata Hincks. 11 Farc. appendiculata Hincks. 12 Farc. [illegible] n. sp. 13 Farc. tenella Lam.

Plate II.

Plate II.

Fig. 1 a. *Menipea crystallina* (Gray). Two oœcia surrounded by kenozoœcia are seen in the proximal internode. × 40.

— 1 b. The same species. A longitudinal section through a gonozoœcium, an oœcium and a surrounding kenozoœcium. × 55.

— 2 a. A portion of *Menipea cyathus* Wyv. Th., from the basal surface. × 40.

— 2 b. A longitudinal section through a zoœcium of the same species. The distal wall with rosette-plates is seen. × 40.

— 3 a. A portion of *Menipea Buski* Wyv. Th. The distal zoœcium covers an endozoœcial oœcium, the distal part of which is covered by a granular cryptocyst. × 40.

— 3 b. A portion of the same species from the basal surface. × 40.

— 3 c. A longitudinal section through a zoœcium of the same species with oœcium. × 55.

— 4 a. A portion of *Menipea cervicornis* (Mac Gill.). The distal zoœcium covers an endozoœcial oœcium, the distal part of which is covered by a granular cryptocyst. × 40.

— 4 b. A longitudinal section through a zoœcium of the same species with oœcium. × 55.

— 5 a—f. A series of developmental stages of the oœcium of *Scrupocellaria scabra* (v. Ben.). The oblique frontal part of the distal wall is seen proximally to the developing oœcium. × 33.

— 6 a. *Caberea Ellisi* (Flem.). The proximal zoœcium with rudiment of oœcium. × 40.

— 7 a. *Menipea roborata* (Hincks), with oœcia. The proximal part of the ectooœcium is uncalcified whereby a triangular area is formed. The horizontal part of the distal wall (d. w.) is visible. × 40.

— 7 b. The same species without oœcia. Three of the zoœcia which show only a single avicularium have an internal avicularium (placed in the cavity of the zoœcium), this avicularium is attached just inside the small area beside the external avicularium. × 40.

— 7 c. The same species. The proximal end of a zoœcium with a single external avicularium. The ends of two interior robust spinous processes are seen in the proximal portion of the frontal area. × 75.

— 7 d. The proximal half of a zoœcium from the basal surface after the removal of the latter. An internal avicularium, four spinous processes and the horizontal part of the distal wall with its pore-chamber are seen. × 75.

— 7 e. The proximal half of another zoœcium treated in the same way. The mandible of the avicularium has been removed. × 75.

Fig. 7 f. Some zoœcia of the same species from the basal surface. The internal spinous processes, the pore-chamber of the distal wall and the heart-shaped rosette-plate are seen. × 40.

— 7 g. Some zoœcia of the same species, lateral view. The bent distal wall, the internal avicularium (a. v.) and a robust forked process are visible. × 55.

— 7 h. Some marginal zoœcia of the same species, lateral view. Two radical fibres are seen to originate from their chambers &c. × 40.

— 7 i. An external avicularium of the same species. × 55.

— 7 j. An internal avicularium of the same species, lateral view. × 75.

— 7 k. The same avicularium without mandible, from the frontal surface. × 75.

— 8 a. *Menipea ligulata* (Mac Gill.). × 40.

— 8 b. The same species from the basal surface. The pore-chamber and the rosette-plate of the distal wall are seen. × 40.

— 8 c. Some zoœcia of the same species, lateral view. The distal wall with its pore-chamber is seen and the peculiar internal processes, which are pointed in the zoœcium with oœcium and furnished with an expanded, dentated terminal part in the others. × 40.

— 8 d. A distal wall of the same species with a heart-shaped rosette-plate and two pore-chambers. × 200.

— 8 e. Some of the internal processes, more highly magnified. × 75.

— 9 a. *Canda arachnoides* (Lamx.). The oœcia are inclosed in avicularia. × 40.

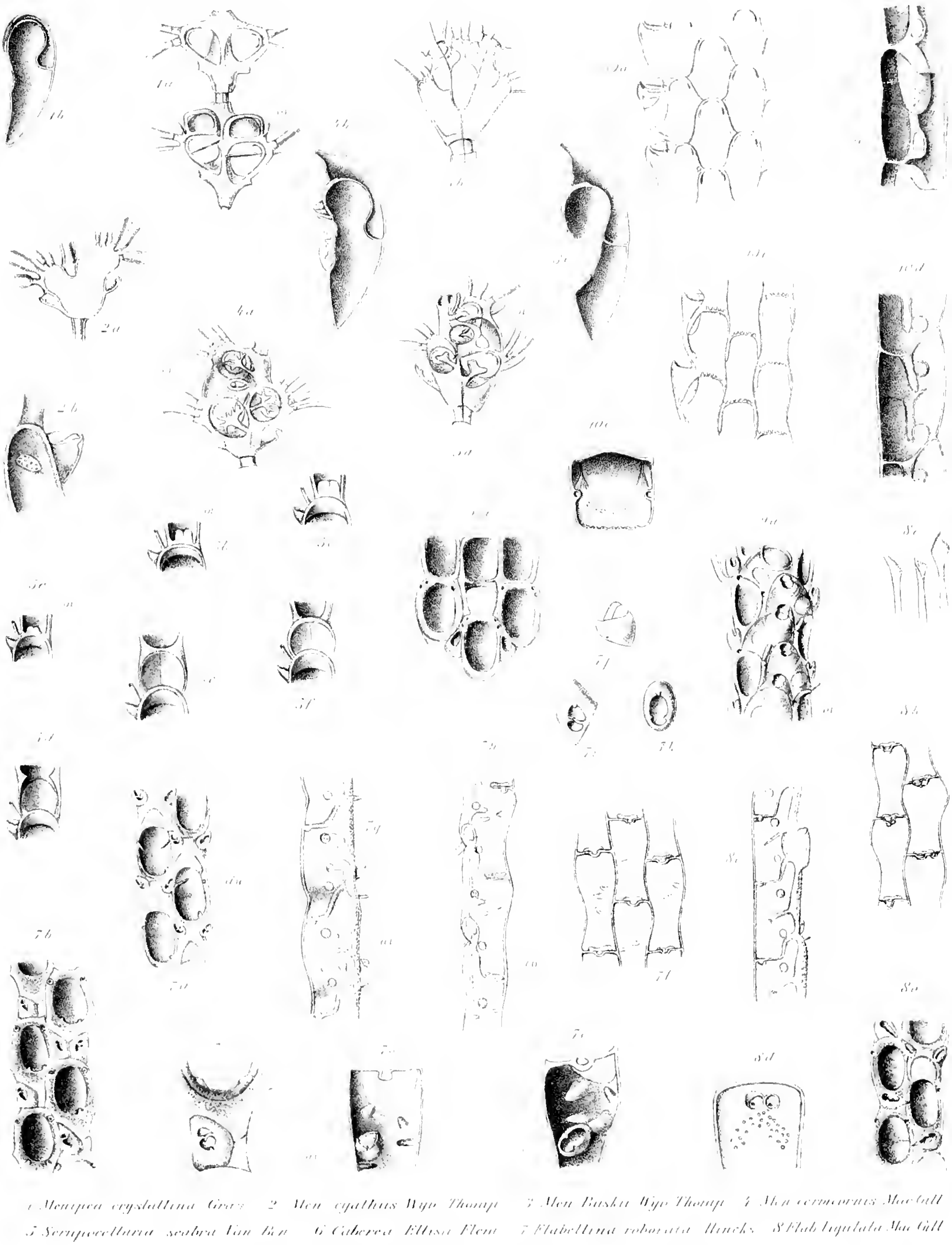
— 10 a. *Hoplitella armata* (Busk). × 23.

— 10 b. The same species, from the basal surface. The proximal part of the zoœcia is furnished with two long lateral expansions, but only with a single one in the marginal zoœcia. × 23.

— 10 c. The distal wall of the same species, from the proximal end. On each side is seen the transverse section of an expansion. The occlusor muscles of the operculum are also seen. × 55.

— 10 d. A longitudinal section through a zoœcium of the same species. The bent distal wall (d. w.) and one of the expansions are seen. × 40.

— 10 e. A longitudinal section through a marginal zoœcium of the same species. The internal aspect of the avicularium (a. v.) and the strong marginal thickening, which surrounds the rosette-plates, are seen. × 40.



1 Menipea crystallina Gray. 2 Men. cyathus Wyv. Thomp. 3 Men. Buskii Wyv. Thomp. 4 Men. cervicornis MacGill.
5 Scrupocellaria scabra Van Ben. 6 Caberea Ellisii Flem. 7 Flabellina roborata Hincks. 8 Flab. ligulata MacGill.
9. Cauda arachnoides Lamx. 10 Bugulella armata Busk.

Plate III.

Plate III.

Fig. 1 a. A composite colony of *Bugula calicula* n. sp. × 3.
— 1 b. The same species with oœcia. × 40.
— 1 c. Zoœcia of the same species with oœcia, from the basal surface. × 40.
— 1 d. An incipient colony of the same species. × 23.
— 1 e. Another incipient colony of the same species. × 23.
— 1 f. An incipient colony from the basal surface. × 23.
— 1 g. An old zoœcium and the adjacent internode of the stem, seen half from the basal surface. The calcified lateral border, which is a continuation of the distal wall, is seen. Between the zoœcium and the internode an internode of a new stem is beginning. × 40.
— 1 h. The proximal end of a young colony. × 40.
— 1 i. A part of a young colony, on which an internode of a new stem begins between the proximal zoœcium and the adjacent internode. × 40.
— 1 j. A part of a young colony from the basal surface. × 40.
— 1 k. Two stem-internodes. × 40.
— 1 l. The adjacent ends of two internodes of the stem. On the lower the distal wall and one of the lateral thickenings are seen, on the upper the two lateral thickenings annularly connected in the proximal end of the internode. × 100.
— 1 m. Two adjacent internodes of the stem, between which a new one is beginning. The lateral thickenings and the parietal muscles. × 100.
— 1 n. The distal end of a new-formed internode of the stem in an inverted position with parietal muscles. × 100.
— 1 o. A new-formed stem-internode beginning between two older ones. × 40.
— 1 p. An avicularium of the same species. × 100.

Fig. 1 q. A transverse section through a stem-internode to show the two lateral thickenings. × 100.
— 2 a. *Bugula caraibica* n. sp. × 1.
— 2 b. The same species. A part of a branch, from the frontal surface. An avicularium is seen. × 40.
— 2 c. The same species. Oœcia. × 40.
— 2 d. The same species, from the basal surface. Distal walls and oœcia are seen. × 40.
— 2 e. A young colony of the same species. × 17.
— 2 f. A somewhat older colony with a single long stem-internode. × 17.
— 2 g. A stem-internode of the same species. At the upper end the original place of one of the fan-shaped branches is seen. × 17.
— 2 h. Another internode of the stem of the same species. × 17.
— 2 i. The distal end of a stem-internode, more highly magnified. The internal supporting ribs of the distal wall are seen and the rosette-plates of the fan-shaped lateral branch. × 40.
— 2 j. The distal end of a stem-internode in another position. The bent distal wall with its rosette-plates and supporting-ribs is seen. × 40.
— 2 k. A transverse section through a stem-internode. The two lateral thickenings are seen. × 55.
— 2 l. The distal wall of an internode of the stem, viewed from above. × 75.
— 2 m. A longitudinal section through the uppermost end of a stem-internode. The distal wall with its rosette-plates and one of the lateral thickenings are seen. × 75.
— 2 n. Another longitudinal section through the uppermost end of a stem-internode. The distal wall's supporting-ribs are seen and the distal wall of the lateral branch. × 75.
— 3 a. Two stem-internodes of *Bugula glabra* Hincks. × 40.

1 Bugula (Stirparia) Haddoni Kirk. 2 Bug. (Stirp.) caraibica n. sp.
3 Bug. (Stirp.) glabra Hincks.

Plate IV.

Plate IV.

Fig. 1 a *Dimorphozoon nobile* (Hincks). The four lowermost zoœcia have low cup-shaped oœcia. × 23.

1 b Zoœcia of the same species, lateral view. As the lateral walls in the figure are not split, only rosette-plates are seen. × 23.

1 c A transverse section through a colony showing its two layers with extremely different forms of zoœcia. In two zoœcia the vertical part of the distal wall is seen with a multiporous rosette-plate. Three small vaulted rosette-plates are seen between the two layers. × 40.

— 1 d. The basal surface of some calcified zoœcia after the removal of the membranous zoœcia. The rosette-plate of the lateral wall is seen and on one of the zoœcia two uniporous rosette-plates. × 40.

— 1 e. The distal end of an avicularium of the same species × 75.

— 1 f Zoœcia of the Alcyonidium-layer of the same species × 23.

— 2 a 2 e. A series of developmental stages of the oœcium of *Dendrobeania Murrayana* (Johnst.); endo- the endooœcium; ecto- the ectooœcium. The first four figures show the ascending part of the distal wall, the two lateral halves of which meet at an angle. The first three also show that the spines arise as folds in the lateral margins of the zoœcium. × 40

3 a *Bicellaria ciliata* (L.). The uppermost zoœcium shows a rudiment of an oœcium, and the lowermost the mark left by a detached oœcium (ov). Proximally to this the forked distal wall is seen. × 40.

— 4 a c. A zoœcium with oœcium of *Cornucopina infundibulata* Busk in three different positions. The distal wall is seen in 4 b and 4 c. × 23

— 4 d A sagittal section through the same oœcium-bearing zoœcium, it shows that the oœcium is surrounded by a kenozoœcium. × 23.

— 5 a Two zoœcia of *Cornucopina grandis* (Busk), showing a finely dentated cryptocyst × 40.

Fig. 5 b. The same zoœcia, from the basal surface. × 40.

— 5 c. A zoœcium of the same species with a large avicularium. × 40.

— 5 d. The frontal surface of the avicularium × 40.

— 5 e. The avicularian mandible. × 55.

— 6 a. *Hiantopora radicifera* (Hincks). × 23.

— 6 b The same species, from the basal surface. × 23

— 6 c. An avicularian mandible of the same species. × 55.

— 7 a *Didymia simplex*, Busk. The central zoœcium with an oœcium enclosed by a kenozoœcium. × 40.

— 7 b. A zoœcium of the same species with oœcium, from the frontal surface. × 40.

— 7 c. A zoœcium of the same species with oœcium, from the basal surface. The arched distal wall is seen between the zoœcium and the kenozoœcium × 40.

— 7 d. A sagittal section through a zoœcium of the same species with oœcium. × 40.

— 8 a. *Dimetopia cornuta* Busk. × 40.

— 8 b. A zoœcium of the same species with oœcium, from the basal surface. The pore-chambers and the oval uncalcified part of the ectooœcium are seen. × 40.

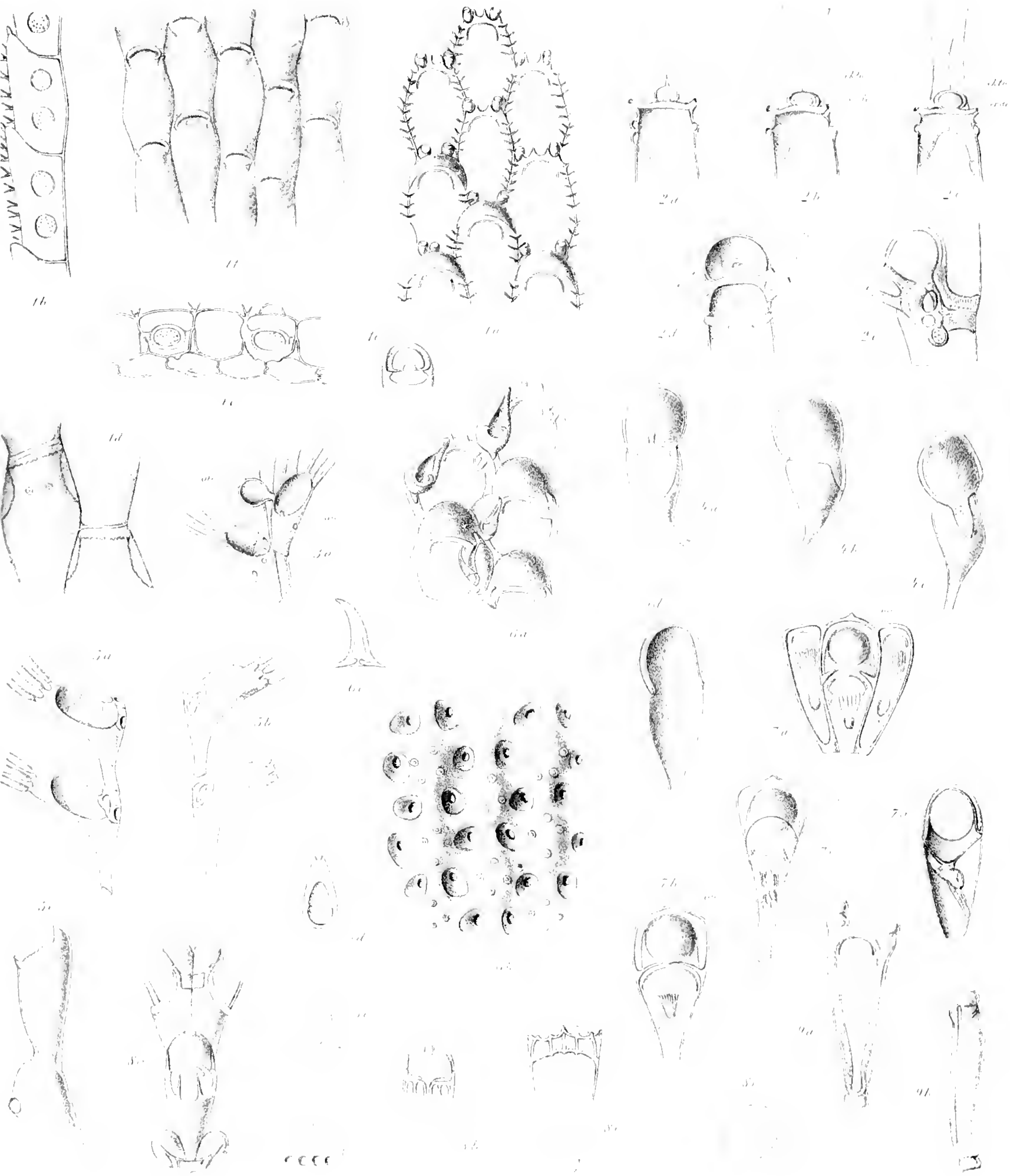
— 8 c. A zoœcium of the same species from the basal surface. The pore-chambers and their rosette-plates are seen. × 55.

— 8 d The distal wall of the same species, viewed from above. × 55.

— 8 e. A sagittal section through an oœcium of the same species. The outermost line seen at a part of the basal surface of the figure ought not to have been seen outside the ectooœcium as it gives the incorrect idea that a covering membrane is found here. × 75.

— 9 a. *Brettia simplex* (Mac Gilliv.). A zoœcium from the frontal surface. × 40.

— 9 b A zoœcium of the same species, lateral view. × 40.



1 Beania cibilis Hincks 2 Bugula Murrayana Johnst 3 Cellaria ciliata L 4 Bicell. infundibulata Busk
5 Bicell. grandis Busk 6 Beania costata 7 Didymia simplex Busk
8 Synnotum aviculare Busk Magn. Ma Gill

Plate V.

Plate V.

Fig. 1 a. *Bugula dentata* (Lamx.), from the basal surface. The distal wall is furnished with two very long descending lateral parts. × 40.

— 1 b. Zoœcia of the same species, lateral view. One of the distal wall's lateral parts with its rosette-plates (d. w.) is seen. × 40.

— 2 a. *Bugula dissimilis* (Busk). × 23

— 2 b. The same species, from the basal surface. The strongly angularly bent distal wall is seen. × 17.

— 2 c. A zoœcium of the same species with oœcium, lateral view. × 23.

— 2 d. The distal wall of the same species, viewed from above. × 40.

— 3 a. *Steganoporella neozelanica* (Busk). × 23.

— 3 b. The same species, lateral view. Two distal walls are seen (proximally to the first and third rosette-plate); in a line with the second and the fourth rosette-plate the polypide tube and an opesiular outgrowth are visible. × 23.

— 3 c. Four opercula of the same species. × 40.

— 3 d. Transverse section through four zoœcia of the same species. In two of these the distal wall with two multiporous rosette-plates are seen and in the two others a transverse section of the polypide tube and of the long canal which meets its frontal wall. × 23.

Fig. 4 a. *Steganoporella neozelanica* (Busk), var. *magnifica*. × 23.

— 4 b. The same form, from the basal surface. The polypide tube and the lines in which the two opercular outgrowths meet the basal surface are seen × 17.

— 4 c. The same form, lateral view. The same parts as in Fig. 3 b are seen. × 23.

— 5 a. *Steganoporella magnilabris* (Busk). × 23.

— 5 b. The same species, from the basal surface. Two rosette-plates and a corresponding opening are seen. × 17.

— 5 c. The same species, lateral view. × 23.

— 6 a. *Steganoporella Buski* Harmer. × 23.

— 6 b. The same species, lateral view. The cryptocyst joins the basal wall. × 23.

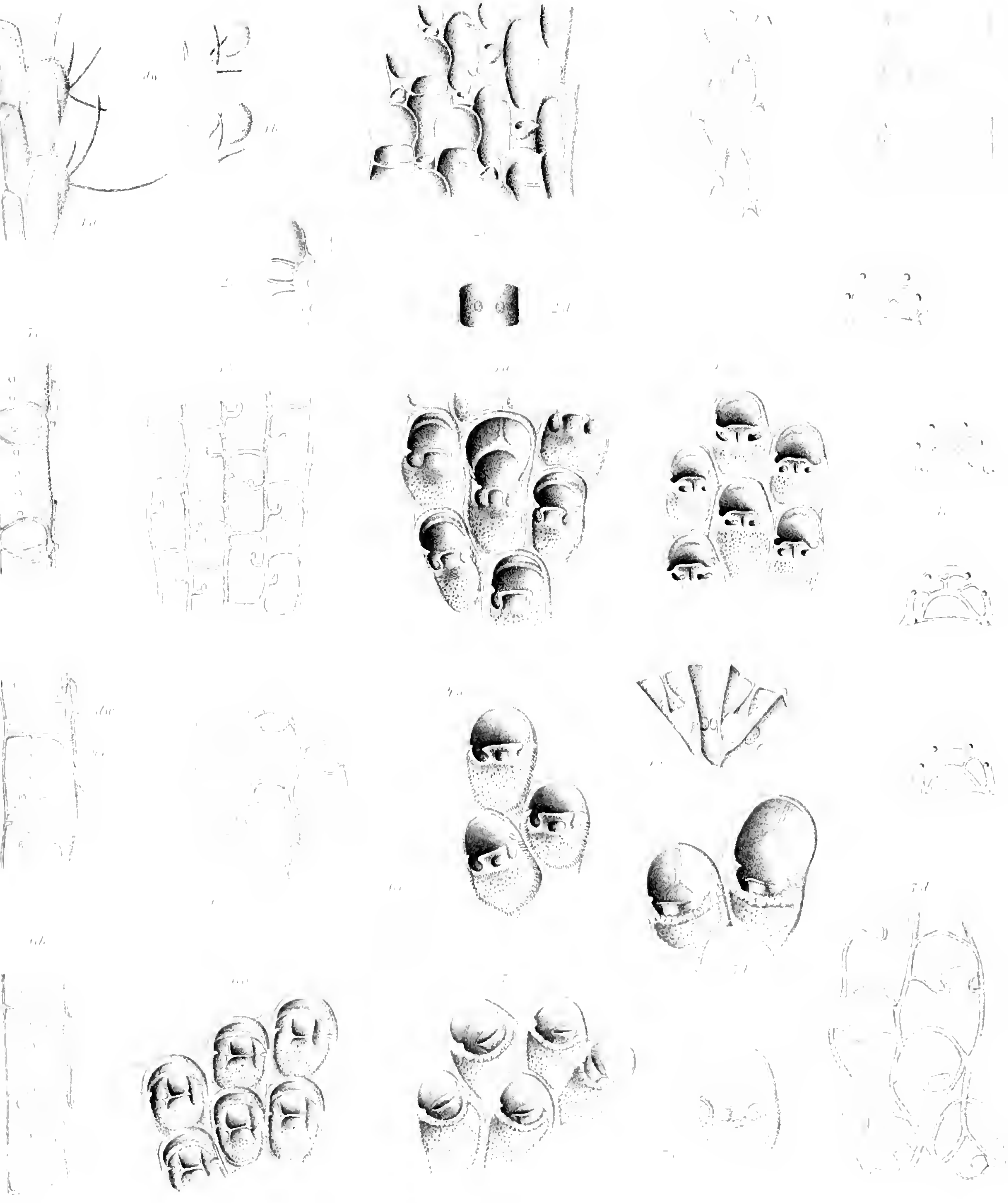
— 6 c. A distal wall of the same species. The lines in which the cryptocyst meets the distal wall are seen.

— 7 a. *Steganoporella lateralis* (Mac Gilliv.) × 23.

— 7 b. The same species. × 23.

— 7 c. A zoœcium of the same species with covering membrane and operculum. × 23.

— 7 d. The same species, from the basal surface. In the two distal zoœcia the basal wall of the polypide tube is formed by the basal wall of the zoœcium. × 23.



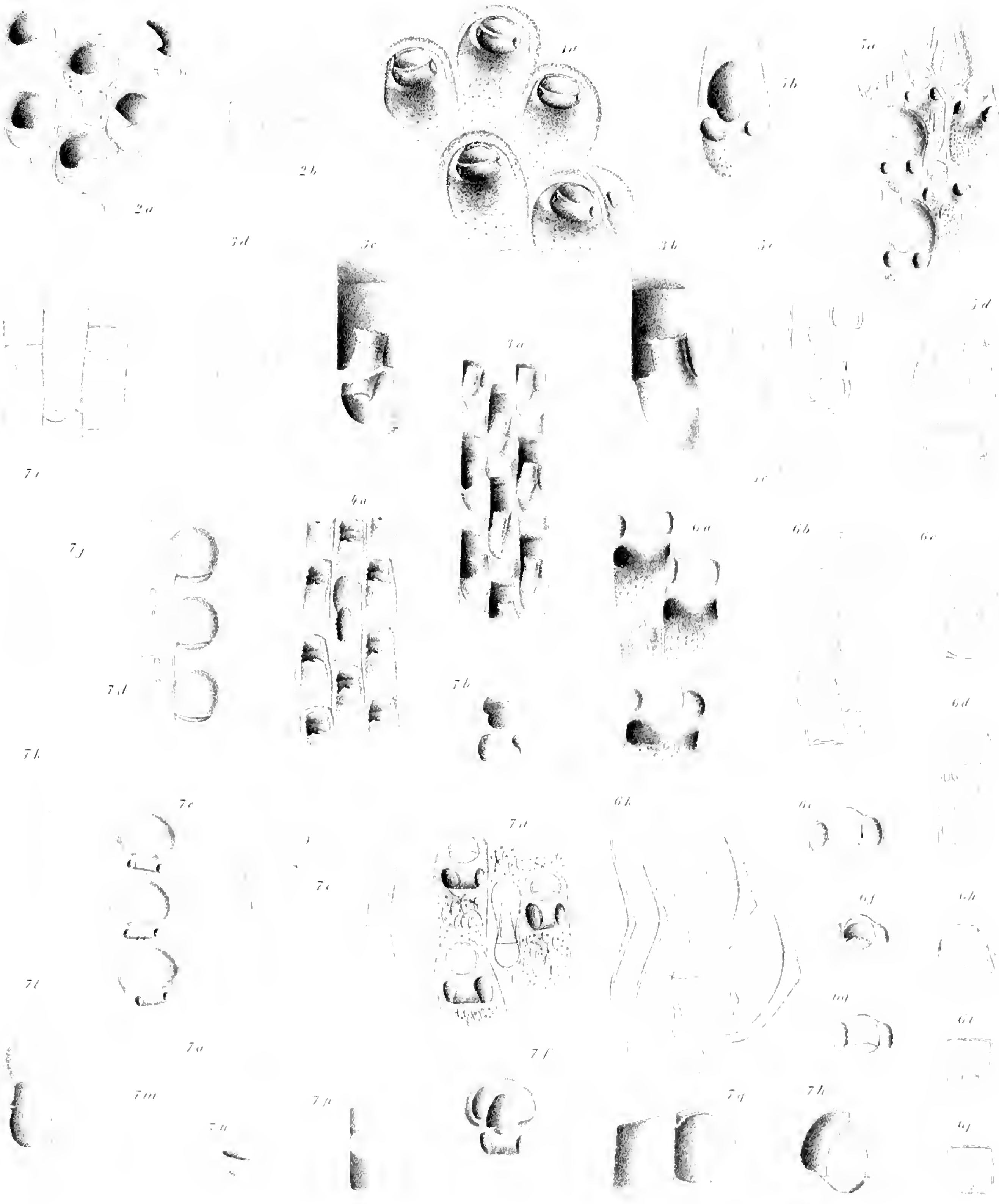
1 Bugula dentata Lamx. 2 Bug. dis... Busk. 3 Steganoporella neozelanica Busk. 4 Stegan. ... 5 Stegan. magnilabris Busk. 6 Stegan. Buskii Harmer. 7 Stegan. lateralis MacGill.

Plate VI.

Plate VI.

Fig. 1 a. *Crateropora falcata* n. sp. × 23.
— 2 a. *Siphonoporella nodosa* Hincks. × 40.
2 b. The same species from the basal surface. × 40.
3 a. *Siphonoporella delicatissima* (Busk). The covering membrane is removed. × 40.
3 b. A zoœcium of the same species, more highly magnified. × 75.
3 c. A zoœcium of the same species. As a great part of the frontal cryptocyst has been removed, the proximally directed part of the polypide tube can be seen. × 75.
— 3 d. The same species from the basal surface. The polypide tube is visible.
— 4 a. *Labiopora crenulata* n. sp. × 23.
5 a. *Thalamoporella granulata*, var. *stapifera* n. × 40.
— 5 b. A gonozoœcium of the same species, the oœcium of which has been removed. × 40.
5 c. Spicula of the same form. × 200.
5 d. Two zoœcia of the same form, seen from the basal surface.
5 e. A distal wall of the same form.
6 a. *Thalamoporella Rozieri* (Aud.), var. *labiata* n. × 55.
— 6 b. The same form, from the basal surface. × 40.
6 c. A zoœcium of the same species, from that lateral surface which is nearest to the deepest opesiular outgrowth. × 40.
6 d. A zoœcium of the same species, from the other lateral surface. × 40.
6 e. The distal end of a young zoœcium of the same form. The lip is not developed. × 55.
6 f. The distal end of an older zoœcium with a fully developed lip. × 55.
6 g. The distal end of an older zoœcium with operculum. × 55.
6 h. The operculum of the same form. × 100.
6 i. A distal wall of the same form, which is exceptionally furnished with two multiporous rosette-plates. × 40.

Fig. 6 j. A distal wall of the same form with a single multiporous rosette-plate. × 40.
6 k. Spicula of the same form. × 200.
— 7 a. *Thalamoporella lioticha* (Ortm.). × 23.
— 7 b. The distal end of a zoœcium of the same species. × 40.
— 7 c. Spicula of the same species. × 200.
— 7 d. A series of zoœcia of the same species with oœcia, lateral view. × 23.
7 e. A series of zoœcia of the same species with oœcia, from the frontal surface. × 23.
— 7 f. A gonozoœcium of the same species, with developing oœcium. × 40.
— 7 g. A schematic longitudinal section through the distal end of a gonozoœcium with oœcium of the same species.
— 7 h. An oœcium of the same species; as its frontal half is cut away, the operculum of the gonozoœcium can be seen. Lowermost the protruding oœcial operculum. × 40.
— 7 i. The same species from the basal surface. The descending cryptocyst divides the zoœcium into a smaller distal chamber and a larger proximal. The basal wall shows in every zoœcium a uniporous rosette-plate or a corresponding opening. × 23.
7 j. A zoœcium of the same species, from one of the lateral surfaces. × 23.
7 k. A zoœcium of the same species, from the other lateral surface. × 23.
7 l. An avicularium of the same species. × 40.
— 7 m. A distal wall of the same species. × 40.
7 n. A gonozoœcial operculum connected with the appertaining oœcial operculum. × 40.
— 7 o. The same two opercula in another position. × 40.
— 7 p. The distal end of a zoœcium of the same species after the removal of the basal surface. The independent basal wall of the polypide tube is seen. × 40.



1 Aspidostoma falcatum n. sp. 2 Siphonoporella nodosa Hincks. 3 Siphonop. delicatissima Busk. 4 Siphonop. crenulata n. sp.
5 Thalamoporella granulata n. sp. var. stapifera. 6 Thalamop. Rozieri Aud. var. labiata. 7 Thalamop. Smittii Hincks.

Plate VI a.

Plate VI a.

Fig. 1 a. *Thalamoporella granulata* n. sp. × 40.
1 b. The same species, from the basal surface × 23.
1 c. A gonozoœcium of the same species with a developing oœcium. The gonozoœcial operculum is seen × 40.
1 d. An avicularian mandible of the same species × 55.
1 f. Spicula of the same species. × 200.
2 a. *Thalamoporella granulata*, var. *tubifera* n. Within the aperture both of the zoœcia and of the avicularia, the remarkable continuation of the polypide tube (t) with its frontal aperture can be seen meeting the distal wall × 40.
2 b. The same form from the basal surface. The continuation of the polypide tube (t), which sends a lateral branch to a rosette-plate in two of the zoœcia, is visible inside. This continuation has a peculiar trapeziform shape in the gonozoœcium × 23.
2 c. A zoœcium of the same form, lateral view. It is seen, that the continuation of the polypide tube meets the basal part of the distal wall × 40.
2 d. Two gonozoœcia of the same form with oœcia. × 40.

Fig. 2 e. Spicula of the same form × 200.
— 3 a. *Thalamoporella novae hollandiae* (Hasw.) × 40.
— 3 b. The same species with a somewhat smaller avicularium. × 40.
3 c. Two avicularian mandibles of the same species. × 40.
— 3 d. The same species, from the basal surface. × 23.
3 e. Another colony of the same species, from the basal surface. × 23.
3 f. Spicula of the same species. × 200.
— 4 a. *Thalamoporella Jervoisi* (Hincks). × 40.
4 b. The same species from the basal surface. × 23.
4 c. Operculum of the same species × 40.
4 d. Spicula of the same species. × 200.
5 a. *Thalamoporella mamillaris* (Lamx.) × 40.
5 b. Five opesiulæ of different zoœcia, to show the variation in shape of the opesiular outgrowths and in the number and structure of the protecting spinous processes. × 75.
5 c. An avicularium of the same species. × 40.
5 d. An avicularian mandible of the same species. × 75.
5 e. Spicula of the same species. × 200.

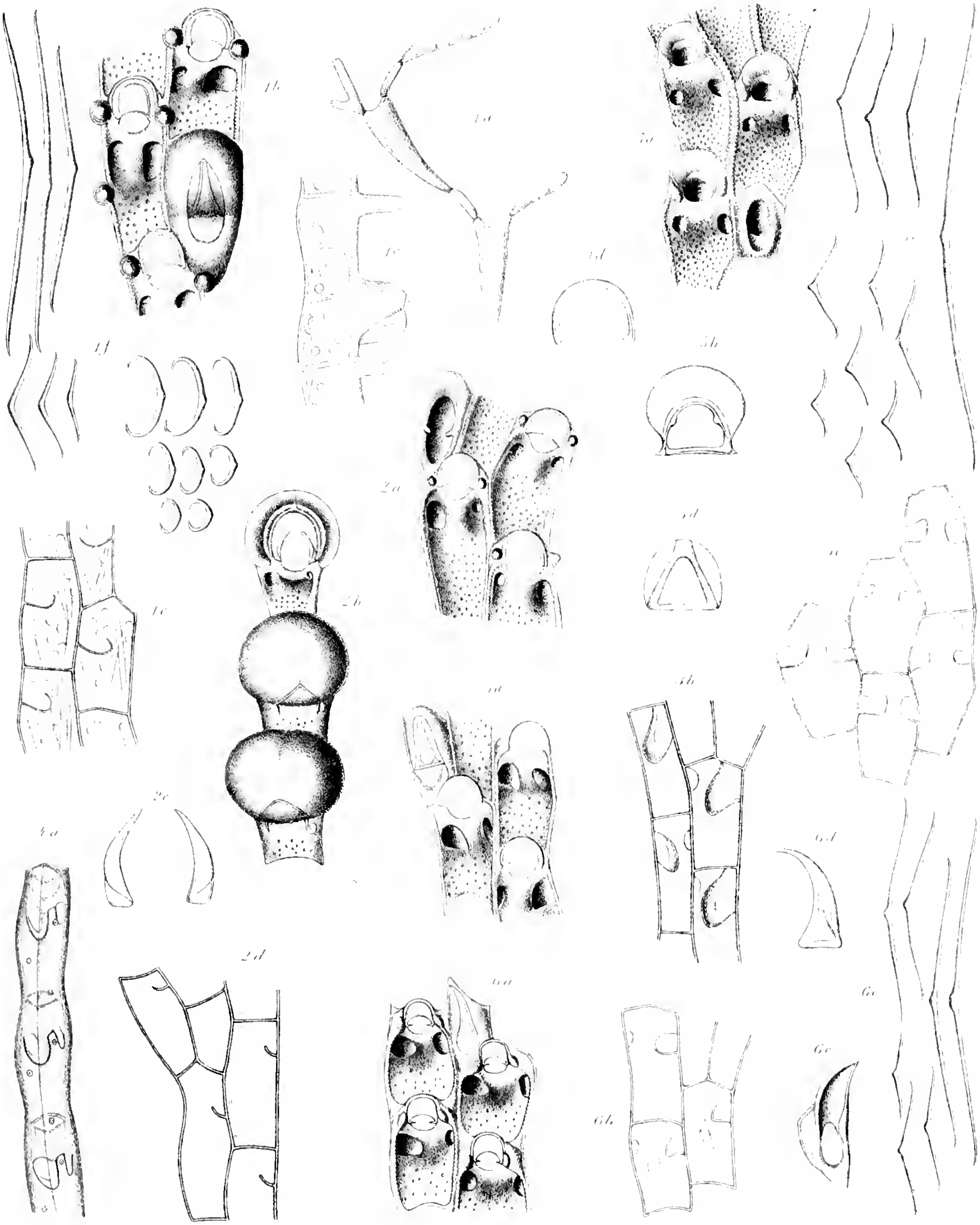
[illegible]
[illegible] hollandica Hasn [illegible] Thalet [illegible]

Plate VI b.

Plate VI b.

Fig. 1 a. *Thalamoporella Rozieri* (Aud.), var. *prominens* n. An irregularly jointed colony. × 12.
1 b. The same form. × 40.
1 c. Zooecia and an avicularium of the same form, lateral view. × 40.
1 d. An operculum of the same form. × 75.
1 e. The same form from the basal surface. × 40.
1 f. Spicula of the same form. × 200.
2 a. *Thalamoporella Rozieri* (Aud.), var. *californica* n. × 40.
2 b. Ooecia of the same form, of which the distal only appears as a rudiment. The distal gonozooecium is furnished with an operculum. × 40.
2 c. Chitinous thickenings on the gonozooecial operculum. × 100.
2 d. The same form from the basal surface. × 40.
3 a. *Thalamoporella Rozieri* (Aud.), var. *sparsipunctata* n. × 40.

Fig. 3 b. The same form from the basal surface. × 40.
4 a. *Thalamoporella liolicha* (Ortm.). A row of zooecia, from the basal surface. × 23.
5 a. *Thalamoporella expansa* n. sp. × 17.
— 5 b. Operculum of the same species. × 40.
— 5 c. The same species from the basal surface. × 17.
5 d. An avicularian mandible of the same species. × 40.
— 5 e. Spicula of the same species. × 200.
— 6 a. *Thalamoporella falcifera* (Hincks). × 40.
6 b. The same species from the basal surface. × 40.
— 6 c. An avicularian chamber of the same species. × 55.
6 d. An avicularian mandible of the same species. × 75.
6 e. Spicula of the same species. × 200.



[illegible] inopinata [illegible] var. [illegible] 2 [illegible] var. [illegible] 3 [illegible]
[illegible] spec. punctata. 4 Thalam. Smittii [illegible] 5 Thalam. sparsa n. sp. 6 Thalam. [illegible] Hincks.

Plate VI c.

Plate VI c.

Fig. 1 a. *Thalamoporella Harmeri* n. sp. × 23.

1 b. The same species with avicularium. × 40.

1 c. The distal end of a zoœcium of the same species. × 55.

1 d. An operculum of the same species. × 100.

1 e. The same species. A gonozoœcium with a developing oœcium. The gonozoœcial operculum is seen. × 40.

1 f. Zoœcia of the same species, from the basal surface. × 40.

1 g. Zoœcia from another part of the same colony, from the basal surface. × 40.

1 h. Spicula of the same species. × 290.

2 a. *Aspidostoma giganteum* (Busk). Two oœcia are seen. × 23.

2 b. A longitudinal section through two zoœcia of the same species. × 23.

2 c. A transverse section through two zoœcia of the same species. Uppermost a distal wall is seen and to the left of this the arched distal end of the zoœcium. Further down an intersected polypide tube is seen and on each side of this a recess which extends to the basal wall. × 23.

— 2 d. A transverse section through a zoœcium of the same species. The median projection of the zoœcium is seen beneath the polypide tube. × 23.

Fig. 3 a. *Aspidostoma* (?) *Aegon* (d'Orb.). The two projections at the proximal part of the oœcium are united so as to form an arch-shaped belt which covers the aperture of the gonozoœcium. To the left a gonozoœcium is seen, on which this belt is broken. × 40.

— 4 a. *Aspidostoma* (?) *Antiopa* (d'Orb.). The two projections at the proximal part of the oœcium have not united. × 40.

— 5 a. *Aspidostoma* (?) *Atalantha* (d'Orb.) with oœcia. × 40.

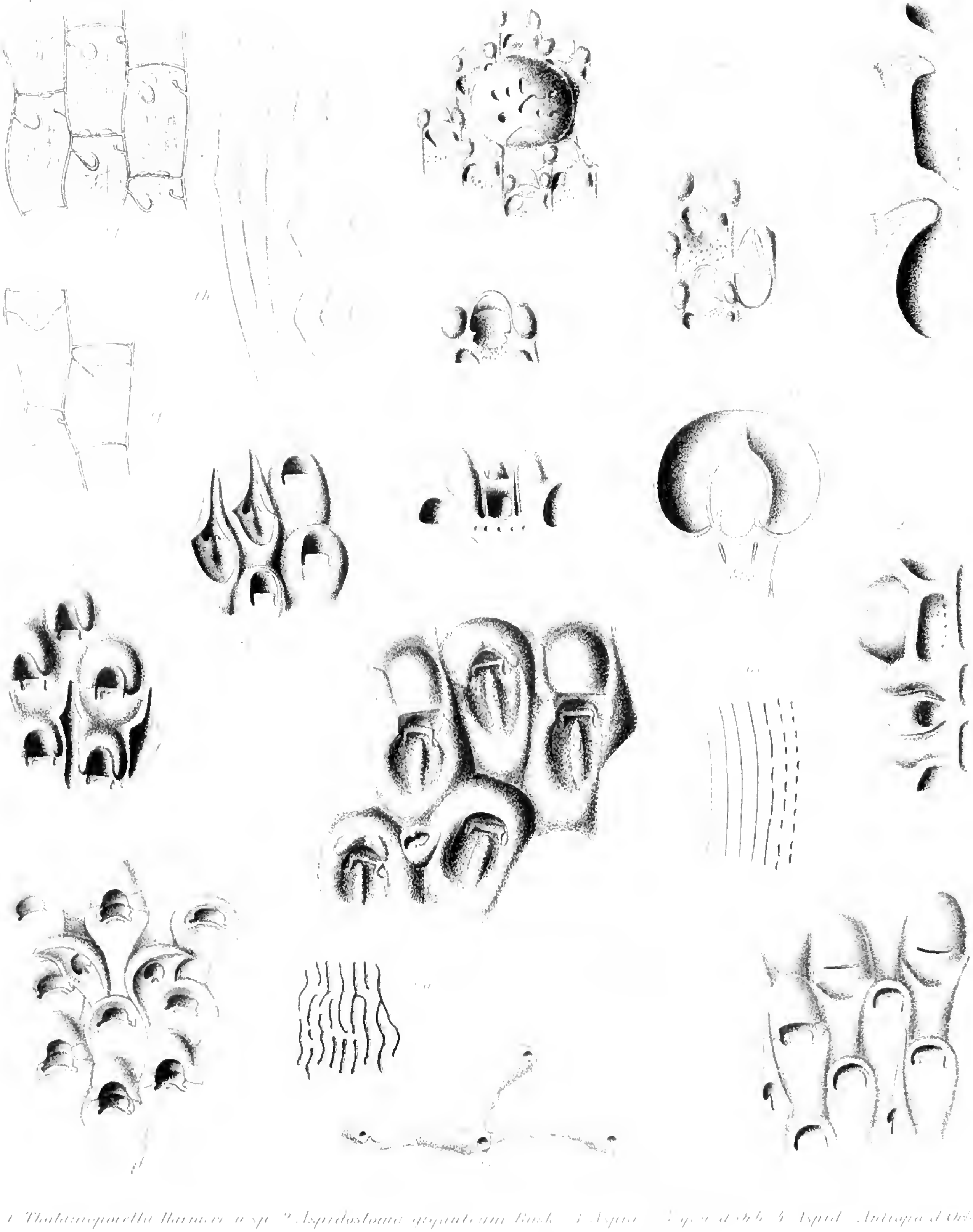
— 5 b. The same species without oœcia. × 40.

— 6 a. *Aetea dilatata* Busk. The incrusting portion of four zoœcia. The opening near the distal wall is from the broken perpendicular part of the zoœcium. × 40.

6 b. A distal wall with rosette-plates. × 200.

— 6 c. A part of the surface of the perpendicular part of a zoœcium on the border of the dilated distal end. The dark lines and spots are uncalcified areas. Immers.

6 d. A part of the surface of the incrusting part of a zoœcium. Immers.



1 Thalamoporella Harmeri n. sp. 2 Aspidostoma giganteum Busk. 3 Aspid. [illegible] d'Orb. 4 Aspid. Antiqua d'Orb.
5 Aspid. Malanitha d'Orb. 6 Vitea dilatata Busk.

Plate VII.

Plate VII.

Fig. 1 a. *Macropora centralis* Mac Gillis. × 23.
— 1 b. The aperture of a special form of zoœcium (avicularium?) of the same species. × 40.
— 1 c. An operculum with its surroundings of the same species. × 40.
— 1 d. A pore-chamber of the same species. × 40.
— 2 a. *Membranicellaria dubia* (Busk), with oœcia. The elongated hexagonal zoœcia are partly visible through the frontal surface, which is divided into hexagonal, rhombic areas. × 17.
— 2 b. The same species from the basal aspect after removal of the basal surface. The cavity of the elongated zoœcia is visible and the hexagonal, rhombic areas of the frontal surface are seen at the same time. On the distal portion of each zoœcium an oœcium (ov.) with its oblique, basal surface is seen. × 17.
— 2 c. Zoœcia of the same species with oœcia. The covering membrane is removed. × 17.
— 2 d. Rosette-plates of the same species. × 75.
— 2 e. Zoœcia of the same species. The separating walls of the elongated zoœcia are visible through the frontal surface, divided into broad areas. × 17.
— 3 a. *Alysidium parasiticum* Busk. A gonozoœcium with a double-valved oœcium is seen on the lowermost zoœcium. × 40.
— 3 b. A zoœcium of the same species. × 75.
— 3 c. A zoœcium of the same species from the basal surface. The bent distal wall is seen. × 75.
— 3 d. A longitudinal section through a zoœcium of the same species. × 75.
— 3 e. A gonozoœcium of the same species from the frontal oœcia-bearing surface, after the removal of the oœcium. The two elongated openings are seen, through which the oœcial valves have been in communication with the pore-chambers of the gonozoœcium. × 75.
— 3 f. A transverse section through the distal end of a zoœcium. A row of uniporous rosette-plates is very indistinctly seen. × 75.
— 3 g. The end of a branch of the same species with a cylindrical internode. × 40.

Fig. 3 h. A gonozoœcium with the oœcial valves open. × 55.
— 3 i. An oœcial valve from the internal surface. × 55.
— 3 j. A gonozoœcium with oœcium, seen from the basal edge. × 40.
— 3 k. A gonozoœcium with developing oœcial valves, lateral view. A lateral pore-chamber and a part of the basal one are seen. × 75.
— 3 l. The same gonozoœcium, from the basal edge. × 75.
— 3 m. The stem of the gonozoœcium. The distal wall (d. w.) and a uniporous rosette-plate are seen. × 75.
— 3 n. The stem of the gonozoœcium, lateral view. Opposite the proximal part of the oval depression the oblique distal wall is seen. × 75.
— 3 o. An oblique section through the middle part of the stalk-like kenozoœcium, seen from the basal surface. The three rosette-plates of the distal wall are seen. × 75.
— 4 a. A longitudinal section through *Cellularia australis* Hincks. Above the majority of the zoœcial chambers an oœcium (ov.) is seen. × 23.
— 4 b. A transverse section through a portion of the same species. The oœcial cavity (ov.) and the arched rosette-plates of the lateral walls are seen. × 40.
— 4 c. A transverse section through a portion of the same species. The oœcial cavity (ov.) and the rosette-plates of the distal wall are seen. × 40.
— 4 d. A portion of a longitudinal section of the same species, more highly magnified. A zoœcium with two rosette-plates and an oœcium (ov.) are seen. × 40.
— 4 e. A longitudinal section through the proximal part of an internode of the same species.
— 4 f. A longitudinal section through an internode of the same species, showing developing oœcia (ov.). × 23.
— 5 a. A row of zoœcia of *Cellularia fistulosa* (? L.) with oœcial fissures. × 40.

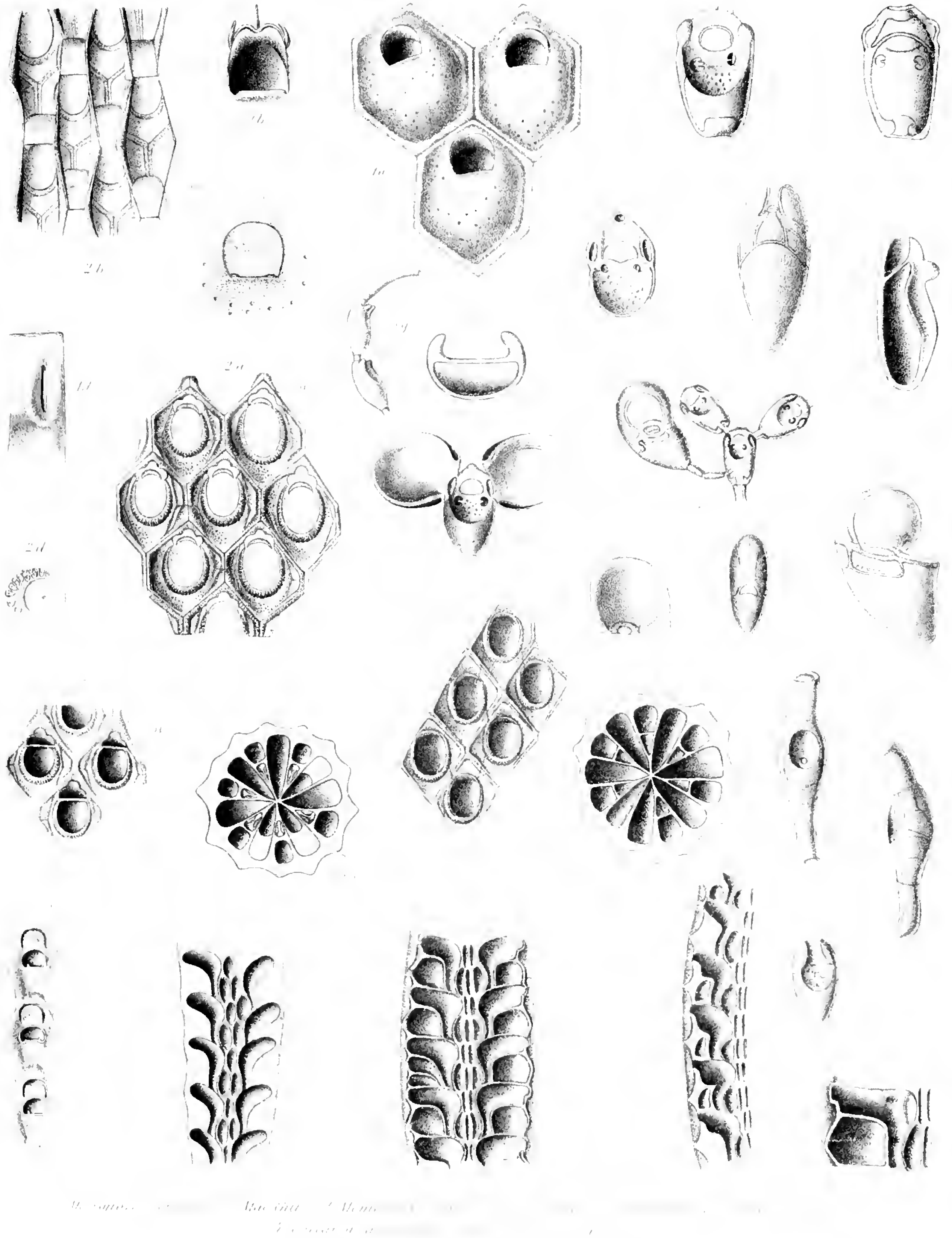


Plate VIII.

Plate VIII.

Fig. 1 a. *Cellularia rigida*, Mac Gilliv. The three zoœcia with oœcia. × 40.

— 1 b. A longitudinal section through two zoœcia with oœcia (ov). At the centre of the broad distal part of each zoœcium the narrow proximal part of a neighbouring zoœcium is visible. × 40.

— 1 c. A longitudinal section through a part of an internode, which shows developing oœcia (ov). × 40.

— 1 d. The same species. A section parallel with the frontal surface to show the elongated, narrow shape of the zoœcia. × 40.

— 2 a. *Cellularia atlantica* (Busk). Four oœcial apertures are seen. × 17.

— 2 b. A longitudinal section through a colony of the same species. Developing oœcia are seen. × 17

— 2 c. The same species, from the basal aspect after the removal of the basal surface. The cavities of the zoœcia and the oœcia are visible, and here and there external ridges which divide the frontal surface into areas. × 17.

— 3 a. *Micropora Normani n. sp.*, with calcified opercula. × 40.

— 3 b. A longitudinal section through a zoœcium of the same species with oœcium. × 40.

— 4 a. A longitudinal section through a zoœcium of *Micropora perforata* (Mac Gilliv.), with oœcium. × 40.

— 5 a. *Foraminella lepida* (Hincks). A rudiment of an oœcium is seen uppermost. × 40.

— 6 a. A colony of *Chlidonia Cordieri* Aud. × 12.

— 6 b. A colony of the same species with the branches in one plane. × 12.

— 6 c. An internode (kenozoœcium) of a main-branch with a zoœcium rising from it. The segments indicated by α, β, γ and δ correspond with similar segments in the internodes of the trunk and the main-branches. × 55.

— 6 d. A zoœcium, lateral view. The concavity of the frontal surface is seen greatly thickened in its distal half; in the distal part of this concavity a smaller one is seen, corresponding with the small distal pore in fig. 6 f. Farther backwards is a connection between the frontal concavity and the cavity of the zoœcium corresponding to the second pore in fig. 6 f. d. w. — the distal wall. × 55.

Fig. 6 e. Separating wall with rosette-plate in the stolonate net-work. × 200.

— 6 f. A zoœcium, from the frontal surface. × 55.

— 6 g. Two internodes (kenozoœcia) of a main-branch with some of the adjacent zoœcia. × 75

— 6 h. The forked distal internode of the stem. × 75.

— 6 i. A portion of the stolonate network with the proximal part of a stem. × 75.

— 6 j-m. Cylindrical internodes being transformed into zoœcia by the development of a cup-shaped expansion (the zoœcium in an embryo state) from the proximal part of the internode. × 55.

— 6 n-q. Cylindrical internodes which apparently are changing into zoœcia by a gradual swelling of the internode. × 55.

— 6 r. A cylindrical internode with its cup-shaped proximal expansion, from the frontal aspect. × 55.

— 6 s. A transverse section through a zoœcium. The thick frontal wall, the small concavity (corresponding with the distal pore in fig. 6 f.) and the rosette-plate of the distal wall are seen. × 55.

— 6 t. An internode of the stem, lateral view. Between β and γ a distal wall with a uniporous rosette-plate is seen. The funnel-shaped concavity is in communication through a pore with the interior of the zoœcium. × 75.

— 6 u. An internode of the stem, from the frontal surface. The oval funnel-shaped concavity with its pore is seen. × 74.

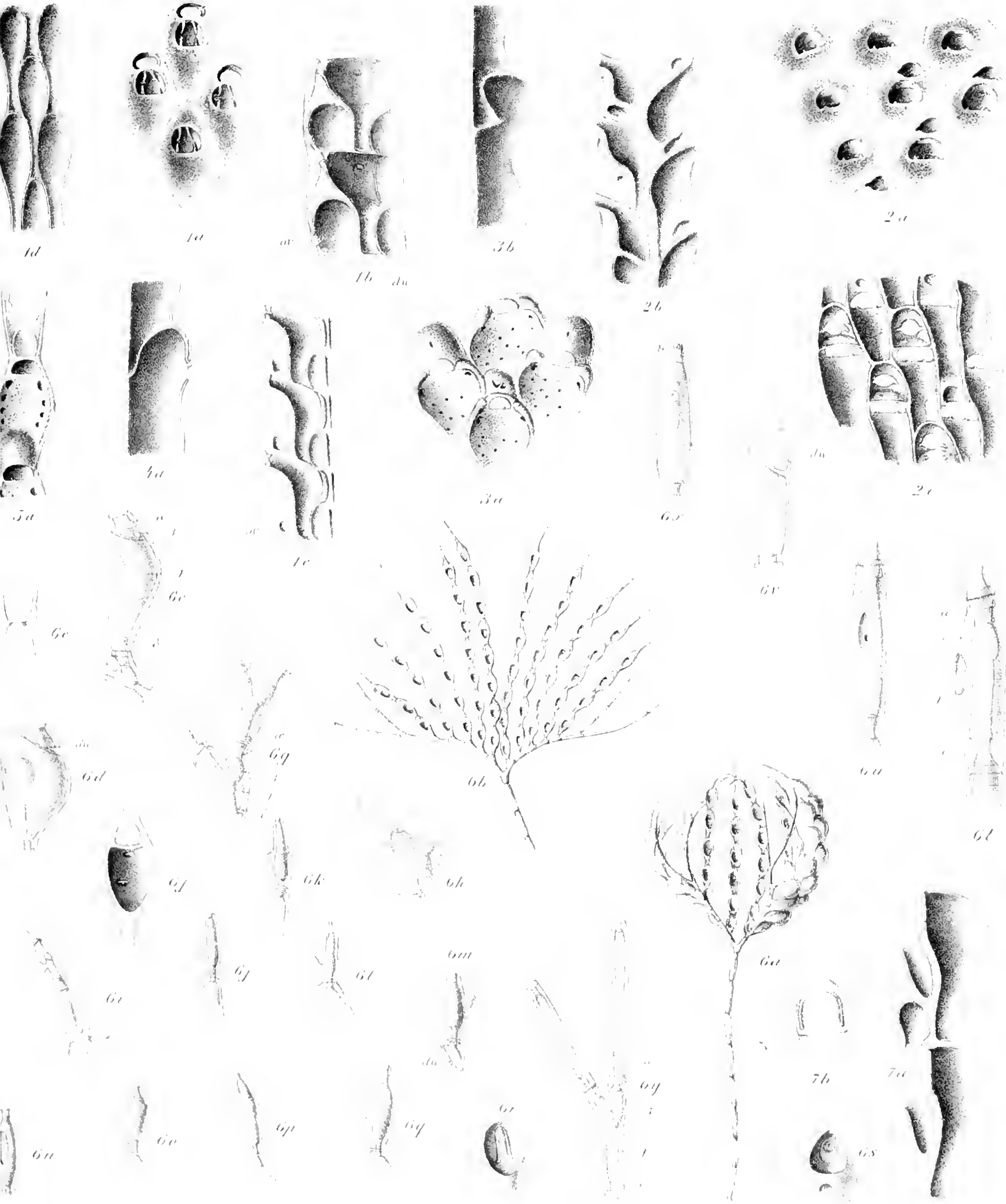
— 6 v. A quite young internode of the stem, the walls of which are still very thin. On account of this the extent of the distal wall (d. w.) is considerable, and the funnel-shaped concavity is not yet developed. In its place is found an oval opening. × 76.

— 6 x. A young internode of the stem, from the basal aspect. The uniporous rosette-plate is seen as also the oval opening. × 75.

— 6 y. A forked cylindrical internode connected with two single ones. Between β and γ the distal wall is seen with a uniporous rosette-plate. × 100.

— 7 a. A longitudinal section through *Foveolaria elliptica* Busk. An avicularian chamber and an oœcium are seen. × 23.

— 7 b. An articulated operculum of the same species. × 40.



1 Cellaria rigida Mac Gill 2 Cell. atlantica Busk 3 Micropora coriacea Esper 4 Micr. perforata Mac Gill 5 Micr. lepida Hincks 6 Chlidonia Cordieri Aud. 7 Foveolaria elliptica Busk

Plate IX.

Plate IX.

Fig. 1 a. *Electra (Heteroœcium) amplectens* Hincks, with oœcium. The small denticles are not only seen at the margin of the membranous area, but are also visible through the calcified wall of the frontal surface. × 55.

1 b. The frontal wall of the same species, from the internal surface. × 75.

1 c. A variety of the same species. The lowermost zoœcium has been regenerated. × 75.

2 a. *Electra zostericola* (Nordm.). The uppermost zoœcium with oœcium. × 40.

2 b. Two zoœcia of the same species. The upper with oœcium. × 55.

— 3 a. *Callopora Dumerili* (Aud.) Two developing oœcia in different developmental stages. × 55.

— 4 a. *Callopora aurita* (Hincks). Uppermost a developing oœcium is seen, lowermost an oœcium in which the proximal part of the ectooœcium is not calcified. × 40.

— 5 a-h. Different developmental stages of the oœcium and the covering avicularium of *Tegella unicornis* (Flem.). endo — the endooœcium, ecto — the ectooœcium. In fig. 5 d the uniporous rosette-plates, destined to connect the avicularium with the zoœcium, are seen distally to the oœcium. In fig. 5 e the first sign of the avicularium is seen as a transverse ridge proximally to the membranous frontal area. In 5 f—5 h the avicularium. × 40.

6 a-e. Different developmental stages of the oœcium and the covering avicularium in *Tegella Sophiae* (Busk). In 6 b which is younger than 6 a distally to the developing oœcium are seen two oval incisions which in fig. 6 a have closed themselves. It is the beginning of the two rosette-plates which should connect the avicularium with the zoœcium. Fig. 6 e corresponds in the degree of development of the avicularium with fig. 5 f. The two rosette-plates are seen. × 40.

Fig. 7 a. *Electra bicolor* (Hincks). × 55.

7 b. The same species. Reproduction of a zoœcium. × 75.

— 7 c. A transverse section through a colony. In two of the zoœcia the distal wall with rosette-plates is seen, in two the immersed cryptocyst. × 75.

— 8 a. *Petalostegus bicornis* (Busk). × 55.

— 8 b. A zoœcium of the same species, seen a little more from the side. × 55.

— 9 a. *Membraniporella distans* Mac Gilliv. × 55.

— 10 a. Two zoœcia with oœcia of *Cribrilina annulata* (Fabr.). The oœcia are covered by kenozoœcia and on these some pore-chambers are seen. × 40.

10 b. A longitudinal section of the same species through a zoœcium with oœcium. × 55.

— 11 a-c. Three different developmental stages of the oœcium of *Cribrilina punctata* Gray. × 40.

— 11 d. An oœcium of the same species. The endooœcium is visible through the broken ectooœcium. × 40.

— 11 e. The distal end of a zoœcium of the same species with oœcium, from the basal surface. The pore chambers of the zoœcium and kenozoœcium are seen. × 40.

— 11 f. *Cribrilina punctata*. Pore-chambers are seen on the three marginal zoœcia, of which the central abnormal one has no aperture. × 55.

— 11 g. The same species, from the basal surface. Pore chambers (p. ch). × 40.

— 11 h. Sagittal section through a zoœcium of the same species with oœcium. The oœcium is enclosed in a kenozoœcium. × 55.

— 12 a. *Puellina Gattyae* (Busk), with oœcia, from the basal surface. Both the zoœcia and the kenozoœcia enclosing the oœcia are furnished with pore-chambers. × 40.

1 Vecrsi amplectens Hincks 2 Fl. asterocia Norder 3 Membranipora Dumerilii Aud. 4 Memb. ... Hincks
5 Membr. unicornis Flem. 6 Membr. Sophiae Busk 7 Memb. bicolor Hincks 8 Petalostegus bicornis Busk
9 Membraniporella distans MacGill 10 Cribrilina annulata Fabr. 11 Cribr. punctata Hass. Cribr. Gattyae Busk

Plate X.

Plate X.

Fig. 1 a. *Retepora Beaniana* King, on *Hydroides norvegica*. The colony, of which the uppermost part is removed, is attached by a large plate-like expansion, formed by kenozooecia, and the external surface of the colony is likewise formed by a kenozooecial layer. × 12.

— 1 b. The same species. Ooecia in different developmental stages. × 10.

— 1 c. A developing colony of the same species, consisting of one ancestrula, two fully developed zooecia and two developing zooecia. × 10.

— 1 d. A somewhat older colony of the same species, in which a root-expansion of kenozooecia is already formed. × 17.

— 1 f. A young colony of the same species, viewed from above. × 12.

— 1 g. A portion of a root-expansion from the colony in 1 d) more highly enlarged. The distal walls furnished with a uniporous rosette-plate are seen between the youngest developing kenozooecia and the kenozooecia on the inner side. × 10.

— 1 h. A portion of the same expansion. A finished kenozooecium with avicularium is seen, and besides, four developing kenozooecia, which, like those shown in fig. 1 a, have had a membranous cover, which has disappeared after boiling in potash. × 10.

— 2 a. *Retepora cellulosa* Smitt. The proximal part of an old colony cut across transversally. The superficial kenozooecial layer is seen. × 12.

— 2 b. The same piece as shown in fig. 2 a, but the transversally cut surface is seen. The three groups (2, 1, 6) of small round apertures, almost in the centre of the section, are intersected zooecial chambers, which on both sides are covered by kenozooecia (see page 293). × 12.

Fig. 2 c. A transverse section through a much younger portion of the same colony. The zooecia are also here on both sides covered by kenozooecia. × 12.

— 2 d. A part of the transverse section in fig. 2 b, more highly magnified. The separating walls furnished with uniporous rosette-plates are seen betwen the kenozooecia placed above each other. × 40.

— 2 e. Another part of the same transverse section, in which the cavity of the kenozooecia is much narrower. × 40.

— 3 a. *Retepora Wallichiana*, Busk. Stalked ooecia. × 40.

— 3 b. A transverse section through a branch of the same. Three zooecia and two kenozooecia are cut through. × 40.

— 4 a. A transverse section through a branch of *Retepora tesselata* Hincks. The small holes are transverse sections of kenozooecia. × 23.

— 4 b. A transverse section through a younger portion of a colony of the same species. A layer of zooecia and a layer of kenozooecia are seen; in some of the former the uniporous rosette-plate of the distal wall is seen. × 23.

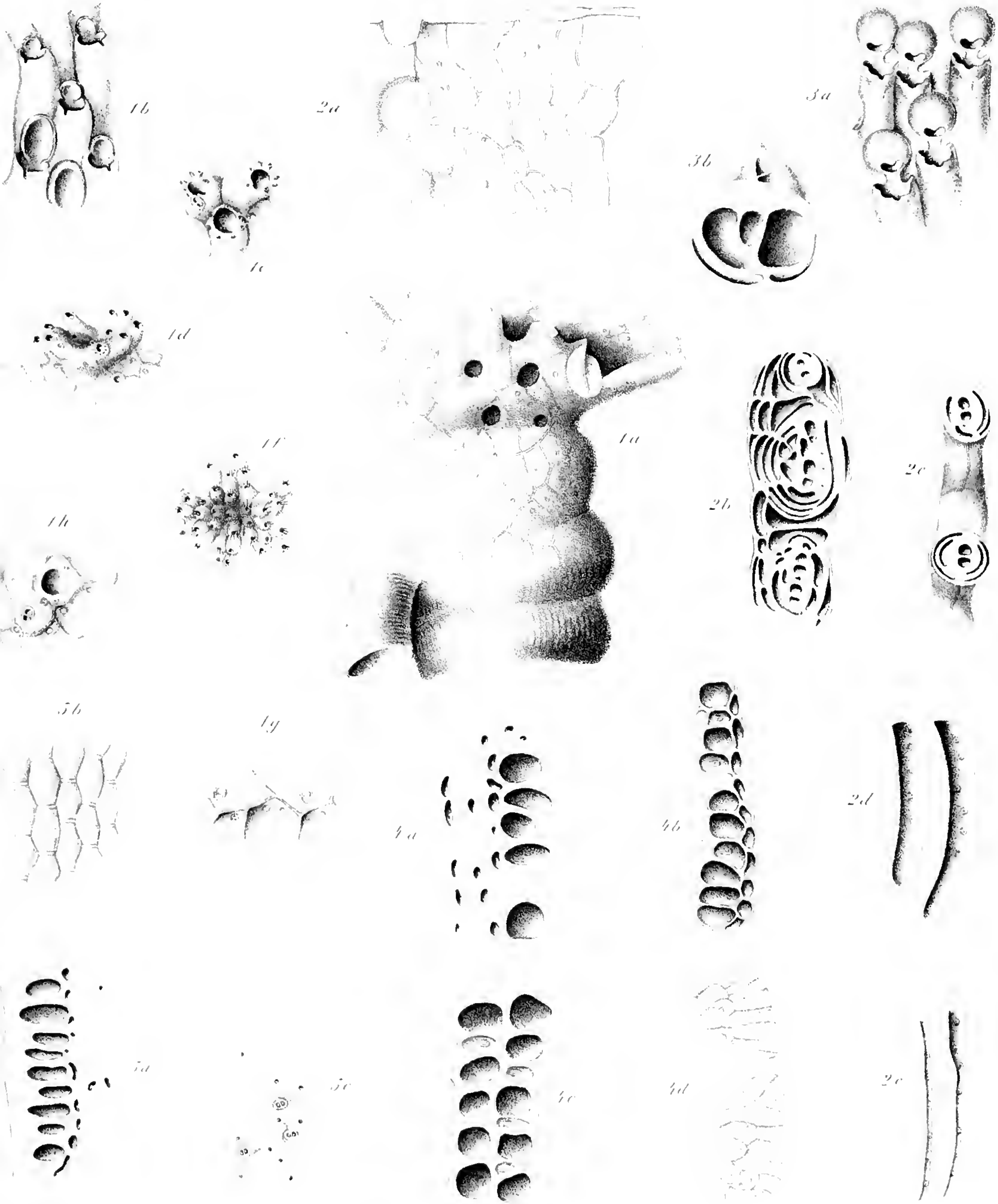
— 4 c. A transverse section through a colony of the same species with two layers of zooecia. × 23.

— 4 d. The same species. A portion of the kenozooecial layer. × 17.

— 5 a. A transverse section through a colony of *Retepora lata* Hincks. The small holes are from kenozooecia. × 23.

— 5 b. The same species. The zooecial layer, from the basal surface, after detachment of the kenozooecial layer. × 23.

— 5 c. The same species. A part of a kenozooecium with avicularia from which pore-canals issue to the surface. A covered avicularium is visible in the distal part. × 55.



1 Retepora Beaniana King   2 Retep. cellulosa Smitt   3 Retep. Wallichiana Busk
4 Retep. tessellata Hincks   5 Retep. lata Busk

Plate XI.

Plate XI.

Fig. 1 a. *Scuticella plagiostoma* (Busk). The lateral chambers are furnished with their membranous walls. × 23.

— 1 b. A bi-zoœcial internode of the same species, from the basal surface. Between the two zoœcia uppermost the adzoœcial supra-scapular chamber of the mother-zoœcium and lowermost its adzoœcial pedal chamber. The scapular and the infra-scapular chambers are united or incompletely separated. × 40.

— 1 c. The zoœcium which arises from the mother-zoœcium of the bi-zoœcial internode, from the basal surface. The floor of the two supra-scapular chambers is seen uppermost, whilst the membranous cover is removed. The latter is seen in fig. 1 a. The two infra-scapular chambers are also shown. × 40.

— 1 d. A part of the same zoœcium, from the surface furnished with the small avicularium. The infrascapular and the pedal chambers are seen. × 40.

— 1 h. A part of the same zoœcium, from the surface furnished with the large avicularium. The infrascapular chamber (on the basal surface) is seen and also the pedal; to the left of the tip of the avicularium the floor of the supra-scapular chamber. × 40.

— 1 e. The daughter-zoœcium of a bi-zoœcial internode, from the external surface. Uppermost the unseparated distal chambers (the scapular and the infrascapular), and under them the pedal chamber of the daughter-zoœcium and the adzoœcial pedal chamber of the mother-zoœcium. (see fig. 1 b.). × 40.

— 1 f. The mother-zoœcium of a bi-zoœcial internode. Uppermost the two unseparated chambers and under these the pedal chamber. × 40.

— 1 g. The zoœcium which arises from a daughter-zoœcium, from the internal surface (i. e. opposite an avicularium) see fig. 1 a.) Uppermost the distal unseparated chambers and below the pedal. × 40.

— 1 i. The same zoœcium, from the other surface. The corresponding chambers are seen. × 40.

— 1 n. A sagittal section through a zoœcium of *Scuticella plagiostoma* (Busk). The angularly bent distal wall (d. w.) and the cryptocyst plate (c. pl.) are seen. × 40.

— 1 k. A gonozoœcium of *Cat. plagiostoma*, var. *setifera*. × 23.

— 1 l. A gonozoœcium of the same form, lateral view. × 23.

— 1 m. A gonozoœcium of the same form, from the basal surface. × 23.

— 1 j. The separating wall between the covering kenozoœcium and the small spinous basal chamber. × 40.

Fig. 1 o. An old bi-zoœcial internode of *Scuticella plagiostoma*, v. *setifera*. The aperture is closed by a calcified plate, and this is further connected with a cryptocyst which is placed inside the sternal area and may finally form a continuous cover inside the last. × 40.

— 1 p. Another old bi-zoœcial internode of the same form. × 40.

— 2 a. A zoœcium of *Scuticella Wilsoni* (Mac Gilliv. On each side of the sternal area a large infra-scapular chamber is seen c. pl. cryptocyst plate. × 40.

— 2 b. A zoœcium of the same species, lateral view. To the left the infra-scapular chamber and to the right the supra-scapular and the pedal. × 55.

— 2 c. A zoœcium of the same species, from the basal surface. The whole basal surface is occupied by the supra-scapular and the pedal chambers. × 55.

— 2 d. The proximal end of the sternal area of the same species. The bridge between the two central fenestrae is not yet completed and its end is uncalcified. × 75.

— 2 f. The same part of a third zoœcium. The bridge between the two fenestrae is for the most part uncalcified. × 75.

— 3 a. A zoœcium of *Scuticella amphora* (Busk), lateral view. To the left the infra-scapular chamber, to the right the supra-scapular and the large pedal chamber. × 55.

— 3 b. A zoœcium of the same species, from the basal surface. The supra-scapular and the pedal chambers are seen. × 55.

— 3 c. A zoœcium of the same species with a very large avicularium. To the left the supra-scapular and the infra-scapular chambers. × 55.

— 4 a. A zoœcium of *Scut. urnula* (Mac Gilliv.), lateral view. The supra-scapular, the infra-scapular and the pedal chambers are seen. × 55.

— 4 b. A zoœcium of the same species, from the basal surface. The same three chambers are seen. × 55.

— 5 a. A gonozoœcium of *Scut. margaritacea* (Busk). × 40.

— 5 b. The same gonozoœcium, lateral view. × 40.

— 5 c. The same gonozoœcium, from the basal surface. × 40.

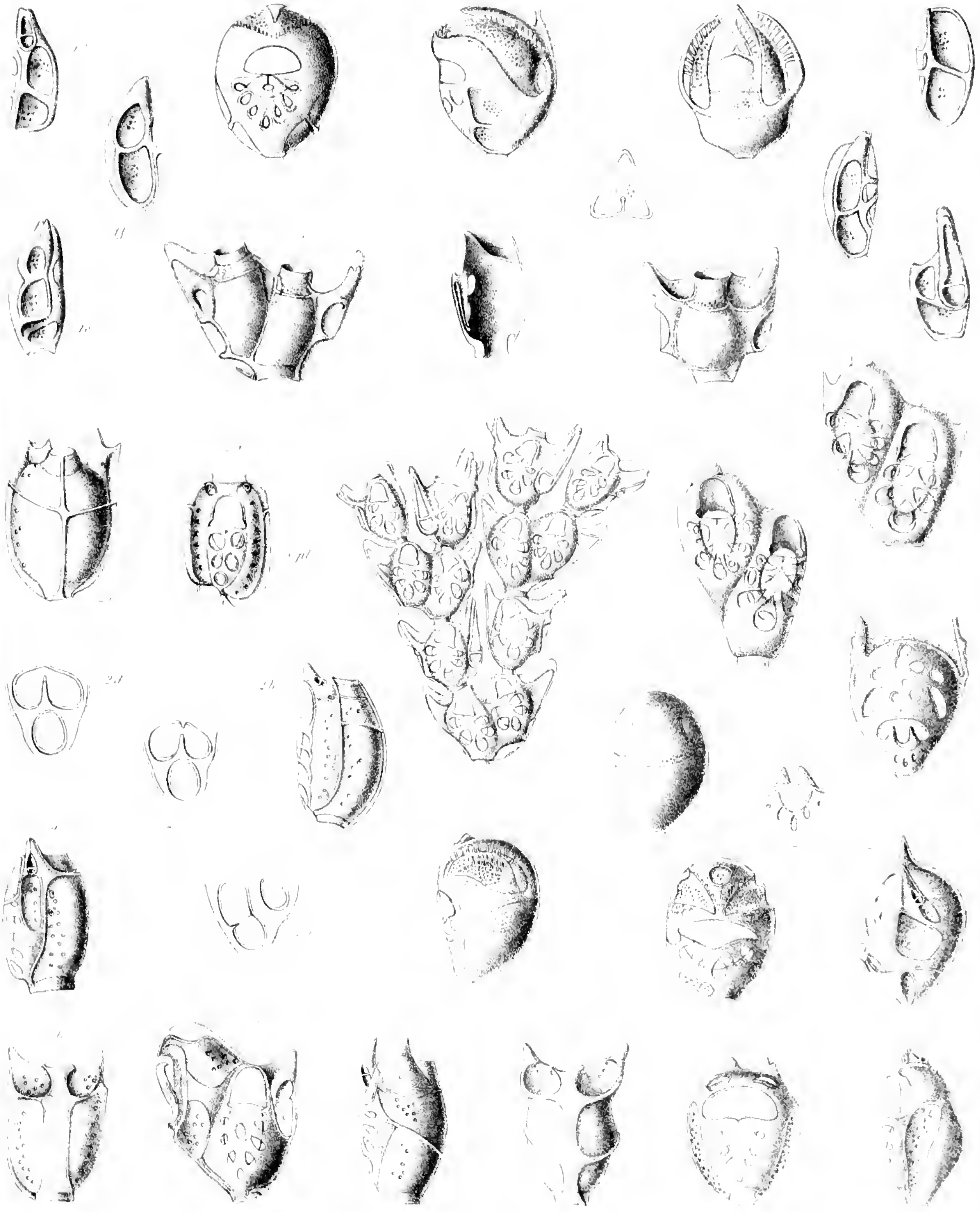
— 6 a. A gonozoœcium of *Scut. ventricosa* (Busk). × 40.

— 6 b. The same gonozoœcium, lateral view. × 40.

— 7 a. A gonozoœcium of *Scut. maculata* (Busk). × 23.

— 7 b. The same gonozoœcium, lateral view. × 23.

— 7 c. The sternal area of the gonozoœcium and the two spines, more highly magnified. The small cryptocyst plate is seen. × 40.



1 Catenicella plagiostoma Busk. 2 Cat. Wilsoni [illegible] 3 Cat. [illegible] 4 [illegible]
5 Cat. margaritacea Busk. 6 Cat. ventricosa [illegible] 7 Cat. [illegible]

Plate XII.

Plate XII.

Fig. 1 a. Sternal area and aperture of *Costicella benecostata* n. sp. (On the plate designated as *Cat. hastata*). × 100.

— 1 b. Sternal area and aperture of another zoœcium of the same species. × 100.

— 1 c. Sternal area and aperture of *Costicella hastata* (Busk) (from Twofold Bay). The long frontal sinus, which is not seen in the two preceding figures, is here distinctly visible. × 100.

— 1 d. A part of the sternal area of the same species, from the internal surface. Outermost the margin of the cryptocyst plate, further in the frontal sinus. × 100.

— 1 f. A gonozoœcium of the same species, lateral view. × 40.

— 1 g. A gonozoœcium of the same species, from the frontal surface. × 40.

— 1 j. The distal end of another gonozoœcium of the same species. × 55.

— 1 k. A gonozoœcium of *Costicella solida* n. sp. (The figure does not give a good representation of the structure of the sternal area). × 40.

— 1 h. A sagittal section through a gonozoœcium of the same species. The endozoœcial oœcium, formed from the distal wall and covered by a kenozoœcium is seen. × 40.

— 2 a. The distal end of a zoœcium of *Scuticella sacculata* (Busk) (wrongly indicated on the plate as *C. saccata*). × 100.

— 3 a. A trizoœcial internode with oœcium of *Claviporella* (on the plate, *Calpidium geminata* Wyv. Thom.). × 10.

— 3 b. A similar internode, on which the frontal wall of the oœcium and of the covering kenozoœcium has been removed. The basal wall of the endozoœcial oœcium is seen. × 10.

— 3 c. A sagittal section through the gonozoœcium and the oœcium of the same species. × 40.

— 3 d. A small avicularium of the same species. × 00.

— 4 a. *Claviporella* (on the plate *Calpidium*) *pusilla* Wils. Two zoœcia, lateral view. In the proximal part of each zoœcium the extremely small pedal chamber. × 26.

— 4 b. An internode of the same species with oœcium. × 40.

— 4 c. The distal end of a zoœcium of the same species, from the basal surface after the removal of the basal wall. The suture in which the two spines meet is not seen in this figure, but on the uppermost zoœcium in fig. 4 b. × 75.

Fig. 4 d. The proximal end of a zoœcium of the same species. The rudimentary pedal chambers are seen. × 75.

— 4 e. The inner wall of the pedal chamber, forming a uniporous rosette-plate. × 200.

— 4 f. The operculum of the same species. × 100.

— 4 g. The scapular and the infrascapular chambers of the same species. × 200.

— 5 a. An internode with oœcium of *Pterocella* (on the plate *Calpidium*) *carinata* (Busk). Neither this nor the following figure give a satisfactory representation of the structure of the sternal area. × 40.

— 6 a. An internode with oœcium of *Pterocella* (on the plate *Calpidium*) *alata* (Wyv. Thom.) × 40.

— 6 b. Sagittal section through the gonozoœcium, the oœcium and the covering kenozoœcium of the same species. × 40.

— 7 a. A zoœcium of *Cribricella rufa* (Mac Gilliv.), lateral view. The small supra-scapular chamber, the greatly bent infra-scapular and the slightly bent pedal chamber are seen. × 55.

— 7 b. A zoœcium of the same species, from the basal surface. The supra-scapular and the infra-scapular chambers are seen and less distinctly the pedal. × 55.

— 7 c. A gonozoœcium of the same species. × 40.

— 7 d. A gonozoœcium of the same species, lateral view. × 40.

— 7 e. A sagittal section through a gonozoœcium of the same species. × 23.

— 7 f. A portion of the sternal area of the same species, from the internal surface. The cryptocyst plate is seen. × 100.

— 8 a. A zoœcium of *Cribricella cribraria* (Busk), lateral view. × 55.

— 8 b. A zoœcium of the same species, from the basal surface. × 55.

— 8 c. A portion of the sternal area of the same species, from the internal surface. The cryptocyst plate is seen. × 100.

— 9 a. *Hincksiella pulchella* Maples., with oœcium. × 40.

— 9 b. A longitudinal section through a lateral margin of a zoœcium of the same species. Uppermost the small supra-scapular chamber and lowermost the inner wall of the long scapular chamber, which is connected with the zoœcium through two uniporous rosette-plates. × 75.

— 9 c. A transverse section through a zoœcium of the same species. The extremely thick walls, which separate the lateral chambers from the zoœcium, are seen. × 75.

[illegible] 7 C. [illegible] 8 [illegible] 9 Mucronella [illegible]

Plate XIII.

Plate XIII.

Fig. 1 a. A gonozooecium of *Calpidium ponderosum* Goldst.). × 23.

1 b. The same gonozooecium, from the basal surface. × 23.

1 c. The same gonozooecium, lateral view. × 23.

1 d. A sagittal section through a gonozooecium of the same species. The covering kenozooecium and the distal wall transformed into an ooecium are seen (d. w.). × 23.

2 a. A gonozooecium and a corresponding covering zooecium of *Catenaria* (on the plate *Vittalicella*) *formosa* (Busk). The internal ooecium is seen, and in both the zooecia the small, oval, infra-scapular chamber and the long, narrow, pedal chamber are seen. × 55.

3 a. A gonozooecium and a corresponding covering zooecium of *Catenaria (Vittalicella) elegans* (Busk). × 55.

3 b. A gonozooecium and a covering zooecium of the same species, lateral view. × 55.

— 3 c. Three old zooecia of the same species, the aperture of which is on the point of closing. × 40.

— 4 a. A bi-zooecial internode of *Catenaria* (*Villat.*) *fusca* (Mac Gilliv.). The aperture is partly closed. × 40.

5 a. A gonozooecium with appertaining daughter-zooecium of *Catenaria (Villat.) cornuta* (Busk). × 55.

5 b. A gonozooecium with appertaining daughter-zooecium of *Catenaria (Villat.) cornuta* (Busk), from the basal surface. × 55.

5 c. A gonozooecium of the same species, lateral view. The internal ooecium and the covering kenozooecium are seen. × 55.

— 6 a. *Onchopora* (on the plate *Calwellia*) *dentata* (Mac Gilliv.), from the basal surface. The finger-shaped expansions of the distal wall are seen. × 40.

6 b. The proximal end of a zooecium of the same species. × 75.

7 a. *Onchopora Sinclairi* (Busk). In two of the zooecia the operculum is open and the inwards directed, angularly bent lateral parts of the vestibulum are seen. × 40.

7 b. A zooecium with ooecium of the same species. × 40.

7 c. A sagittal section through an unfinished ooecium. The cryptocyst, which rises from the distal wall, is incorrectly drawn as connected with the membranous endoooecium (see pl. XXIV, fig. 12). × 40.

Fig. 7 d. A sagittal section through an ooecium of the same species. Here also the cryptocyst is drawn as connected with the endoooecium. ekto — the ectoooecium; endo — cryptocyst together with the endoooecium. × 40.

— 7 e. An ooecium of the same species, lateral view. × 40.

— 7 f. An undeveloped ooecium of the same species, from the frontal surface. × 40.

— 7 g. An ooecium of the same species, from the basal surface. × 40.

— 7 h. A transverse section through a branch of the same species. Two distal walls with rosette-plates and two compensation-sacs are seen. × 40.

8 a. *Calwellia* (on the plate *Onchoporella*) *bicornis* Wyv. Th. The one half of the distal wall of the lowermost pair of zooecia is seen and also two of the internal oval rosette-plates, through which the stalk-like proximal end of a pair of zooecia is in communication with the wider distal part of another pair. × 40.

— 8 b. A transverse section through a branch of the same species, between the stalk-like proximal part and the wider distal part. A pair of zooecia is seen from the distal end, and also the forked distal walls and four intersected stalk-like proximal parts. × 55

— 8 c. A transverse section through a branch of the same species, approximately through the middle of the wider distal part of a pair of zooecia. × 55.

— 9 a. *Onchoporella bombycina* (Busk). × 40.

— 9 b. A sagittal section through two zooecia of the same species with ooecia. ekto — the ectoooecium. The cryptocyst removed. × 40.

— 9 c. A sagittal section through two zooecia, furnished with radical fibres. The one descending part of the distal wall is seen. × 40.

— 9 d. Two zooecia of the same species with radical fibres, from the basal surface. × 40

9 e. A part of the margin of a colony. × 40.

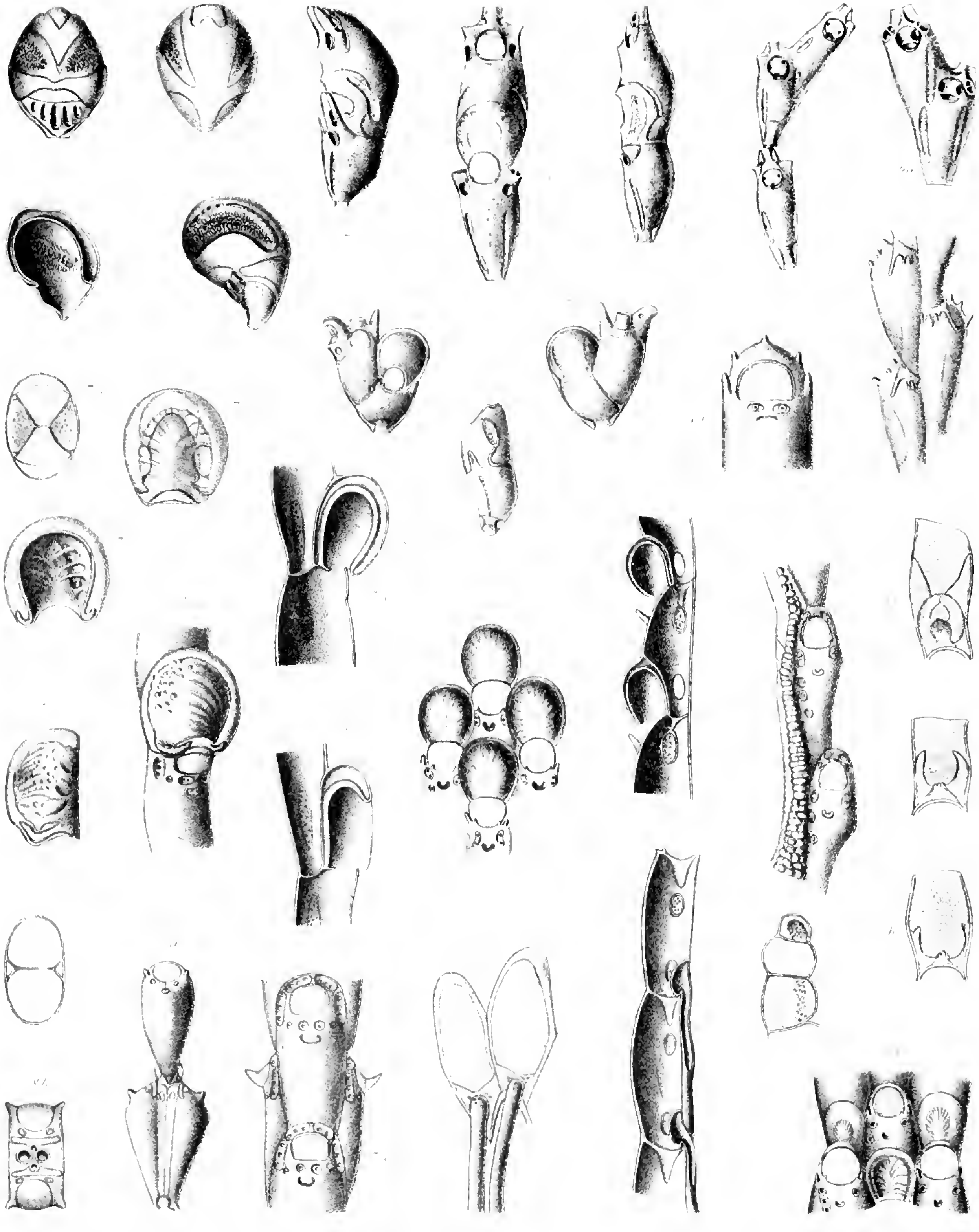
— 9 f. Zooecia of the same species with developing ooecia. × 40

— 9 g. Transverse sections of two zooecia and of a kenozooecium. × 40.

9 h. The first beginning of an ooecium. × 40.

— 9 i. Developing ooecium, a little older.

9 j. Developing ooecium, in which the basal surface of the cryptocyst is almost formed. × 90.



1 Calpidium ponderosum Goldst. 2 Vittaticella cornuta Busk 3 Vittaticella elegans Busk 4 Vittaticella fusca MacGill. 5 [illegible] cornuta Busk 6 Calwellia gracilis MacGill. 7 Calw. [illegible] Busk 8 Onchoporella bicornis Wyv. Th. 9 Onchop. [illegible] Busk

Plate XIV.

Plate XIV.

Fig. 1 a. *Adeona violacea* Johnst. Numerous marginal zooecia are seen, the frontal wall of which is still uncalcified. × 23.

1 b. Four zooecia of the same species. On two of the zooecia the avicularium is replaced by an elongated cavity which opens by means of a round pore. × 40.

— 1 c. Three zooecia of the same species, from the basal aspect, after removal of the basal surface. The primary aperture and the proximal margin of the secondary are seen. × 40.

1 d. Two gonozooecia of the same species. They are furnished with a similar cavity instead of avicularium, like the two zooecia in fig. 1 b. × 40.

— 1 e. An avicularian mandible of the same species. × 100.

— 1 f. An operculum of the same species. The somewhat more chitinized transverse oval part is the portion of the operculum, which corresponds with the secondary aperture. × 75.

— 2 a. *Adeonella serrata* n. sp. In a single zooecium the aperture is covered by a calcareous plate. × 55.

— 2 b. Two gonozooecia and an independent avicularium of the same species. × 55.

2 c. Three zooecia of the same species, from the basal aspect, after removal of the basal surface. × 55.

2 d. A mandible of an independent avicularium of the same species. × 40.

2 e. The mandible of a dependent avicularium, more highly enlarged. × 140.

2 f. The operculum of a gonozooecium of the same species. × 140

2 g. The operculum of an ordinary zooecium of the same species. × 140.

3 a. *Bracebridgia pyriformis* Mac Gillivr. × 40.

3 b. Four zooecia of the same species, from the basal aspect, after removal of the basal surface. × 55.

Fig. 3 c. A portion of the margin of a colony of the same species with two avicularia. × 55.

3 d. An avicularian mandible of the same species. × 140.

— 3 e. The operculum of the same species. × 140

— 4 a. *Adeonella Jellyae* n. sp. In two of the zooecia the pore of the secondary aperture is not yet constricted. × 40.

— 4 b. Two opposite rows of zooecia, lateral view. In the two adjacent median, longitudinal belts numerous (less distinctly drawn) uniporous rosette-plates are seen. × 40.

— 4 c. A zooecium and a gonozooecium of the same species, showing the primary aperture. × 40.

— 4 d. An independent avicularium of the same species. × 40.

— 4 e. The mandible of the independent avicularium. × 75.

— 4 f. The mandible of an independent avicularium. × 100

4 g. The primary aperture of the same species. × 75.

— 4 h. The operculum of a gonozooecium of the same species. × 100.

— 4 i. The operculum of an ordinary zooecium of the same species. × 100.

4 j. *Adeonella pygmaea* n. sp. (not *A. Jellyae*). Uppermost a single zooecium with the primary aperture. × 40.

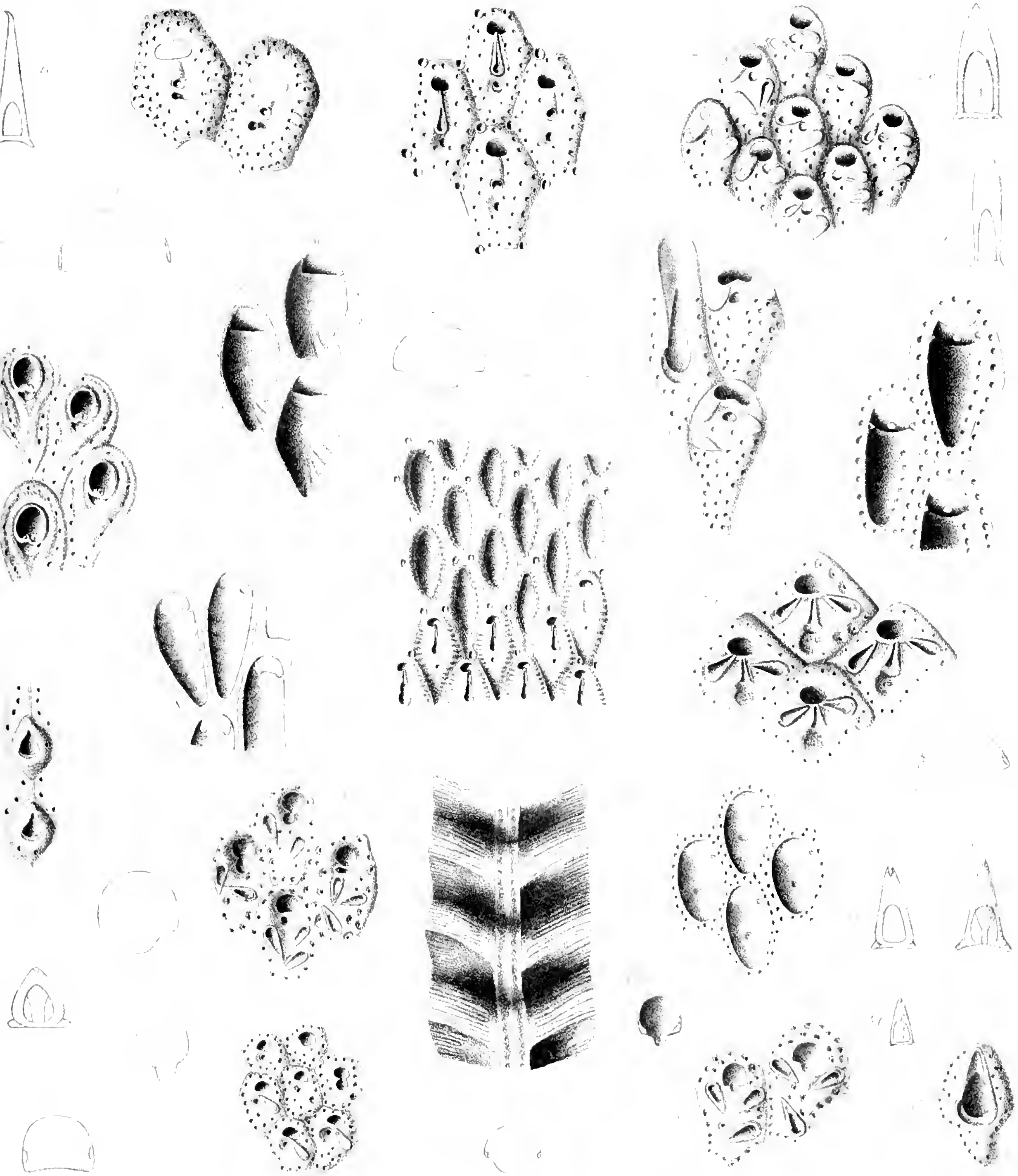
— 4 k. The operculum of a zooecium of same species. × 200

— 5 a. *Adeonellopsis coscinophora* (Reuss) × 55.

5 b. The same species, from the basal aspect, after removal of the basal surface × 40.

5 c. The operculum of the same species. × 140.

— 5 d. An avicularian mandible of the same species. × 100



[illegible] Adeonea serrata [illegible] Brac[illegible]
[illegible] Adeonella [illegible]

Plate XV.

Plate XV.

Fig. 1 a. *Urceolipora nana* (Mac Gilliv.), with open operculum. The figure only shows the strongest of the longitudinal ridges, which keep the covering membrane stretched. Three oœcia are seen. × 40.

1 b. Two zoœcia of the same species with oœcia, from the frontal surface. × 40.

1 c. A sagittal section through three zoœcia of the same species with oœcia. The covering membrane, the lowermost part of which represents the ectooœcium, is too thick, as it has been drawn with a double outline to make it distinct. (look Pl. XXIV., fig. 11.). × 40.

1 d. A zoœcium of the same species with oœcia, from the basal surface. The uniporous rosette-plates of the basal surface and of the distal wall are seen. × 40.

1 e. A transverse section through a branch. Two zoœcia and three of the ridges, which keep the covering membrane stretched, are seen. × 40.

1 f. A transverse section through the proximal part of an oœcium and through a portion of the adjacent zoœcium. The endooœcium is seen innermost and on each side of its aperture one of the trapeziform projections which contribute to keep the covering membrane stretched. On each side of the covering membrane internally is seen the collar-shaped ridge which surrounds the proximal part of the oœcium, and lowest down the separating wall towards the adjacent zoœcium. Outside the endooœcium the distal wall with its rosette-plates is seen. (On account of incorrect shading it seems to be arched.) × 55.

2 a. *Euthyris obtecta* (Hincks). On the marginal zoœcia the peculiar processes are seen, by which the covering membrane is kept outstretched. × 40.

2 b. Four zoœcia of the same species, from the basal surface. Besides the rosette-plates a number of filiform, calcified elongations are seen. × 40.

2 c. A sagittal section through two marginal zoœcia. The internal lateral processes are visible and also the connections between the cryptocyst and the covering membrane. × 40.

2 d. Sagittal section through ordinary zoœcia. × 40.

— 2 e. The processes of the lateral wall, from the outer surface. × 40.

Fig. 2 f. Operculum of the same species. × 100.

— 3 a. *Microporella marginata* (Krauss). × 40.

— 3 b. The distal end of a zoœcium of the same species. × 100.

— 3 c. Four zoœcia of the same species, from the basal surface. In addition to the marginal pore-chambers each basal, zoœcial surface shows a rosette-plate and an opening for communication with zoœcia in the opposite layer. × 40.

— 3 d. The operculum of the same species. × 140.

— 3 e. Radical fibres of the same species. × 40.

— 3 f. A vibracular flagellum of the same species. × 75.

— 4 a. *Microporella flabellaris* (Busk). × 40.

— 4 b. The distal end of a zoœcium of the same species. × 40.

— 4 c. The same species from the basal surface. Besides the basal wall of the pore-chambers the small triangular basal surface of the vibracular chamber is seen lowest down to the right on the four zoœcia. On some zoœcia the basal surface shows a rosette-plate, and on others an opening corresponding with a rosette-plate in an opposite zoœcium. × 40.

— 4 d. Radical fibres of the same species. × 40.

— 4 e. The operculum of the same species. × 140.

— 4 f. The avicularian mandible of the same species. × 55.

— 5 a. The first three zoœcia of a colony of *Microporella ciliata* (Pallas). The original aperture of the primary zoœcium, which is surrounded by spines, is almost closed to a pore. × 55.

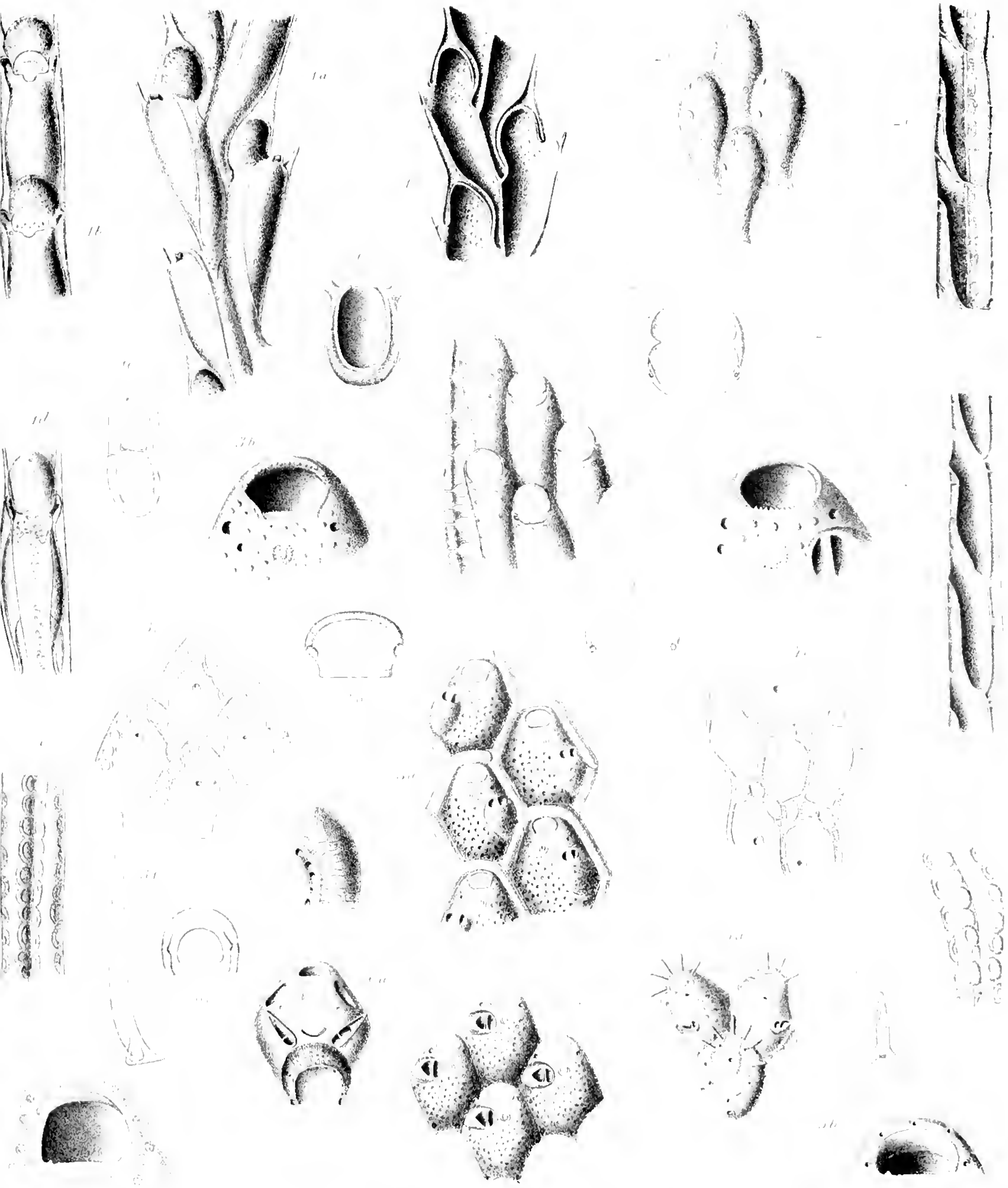
— 5 b. The aperture of *Microporella ciliata*. A well-developed vestibular arch is seen and the supporting beam is furnished with a pair of lateral teeth. × 200.

— 6 a. *Microporella decorata* (Reuss). The zoœcium is furnished with three distal pore-chambers, and the curved belts on the oœcium, at the base of which are seen the fine pores of the endooœcium, are canal-like cavities between the endooœcium and the distal calcified part of the ectooœcium. Between these canals, which open through a circle of pores, the two layers of the oœcium have united. × 40.

— 6 b. A portion of the oœcium more highly magnified. × 75.

— 6 c. An operculum of the same species. × 100.

— 7 a. The aperture of *Microporella Malusii* (Aud.). × 100.



1 Urceolipora nana M'Gill 2 [illegible] obtecta Hincks 3 [illegible] marginata Krau[illegible]
4 Microp. flabellaris Busk 5 Microp. ciliata Pall 6 [illegible] 7 [illegible]

Plate XVI.

Plate XVI.

Fig. 1 a. A sagittal section through a colony of *Haswellia coronata* (Reuss). Three oœcia are seen. × 17.

1 b. An operculum of the same species. × 110.

2 a. A sagittal section through *Haswellia australiensis* (Busk). The four lowermost zoœcia with oœcia. × 17.

2 b. An operculum of the same species. × 75.

3 a. *Tubucellaria hirsuta* (Lamx.). The four lateral zoœcia with peristomial oœcia. × 17.

3 b. A sagittal section through the same species. The two lowermost zoœcia with oœcia. × 23.

3 c. Operculum of the same species. × 75.

3 d. A separating wall with rosette-plates, the position of which is at the proximal end of each of the thread-shaped appendages. × 200.

3 e. A part of the surface of a zoœcium of the same species. The ascopore is seen distally. × 75.

4 a. *Tubucellaria opuntioides* (Pall.). Five oœcia are seen. × 12.

4 b. A sagittal section through the same species. Two oœcia are cut through. × 23.

4 c. An operculum of the same species. × 75.

4 d. The same species. A part of the surface of a zoœcium. The ascopore is seen distally. × 55.

5 a. *Tubiporella magnirostris* (Mac Gilliv.). Two peristomial oœcia are seen. × 23.

Fig. 5 b. The same species from the basal aspect after removal of the basal surface. Two oœcia (which are however not correctly shaded) are seen, and the three zoœcia show a distinct vestibular arch. × 23.

5 c. The same species. A part of the surface of a zoœcium. × 55.

5 d. A sagittal section through the same species. An oœcium is seen proximally, and the two zoœcia show a vestibular arch at the beginning of the peristomial tube. × 17.

6 a. *Lekythopora hystrix* Mac Gilliv. Three oœcia are seen. × 65.

6 b. A sagittal section through an oœcium of the same species. × 23.

6 c. An operculum of the same species. × 55.

7 a. A sagittal section through *Lekythopora stellata* (Busk). Two oœcia are seen. × 17.

8 a. *Euthyroides Jellyae* n. sp. × 40.

8 b. The distal end of a young zoœcium of the same species. The frontal surface is calcified right up to the operculum. × 75.

8 c. The distal end of an older zoœcium in which a resorption of the chalk has taken place proximally to the operculum. The two hollow spines are formed, which cover the entrance to the compensation-sac. × 75.

8 d. An operculum of the same species. × 100.

8 e. An avicularian mandible of the same species. × 40.

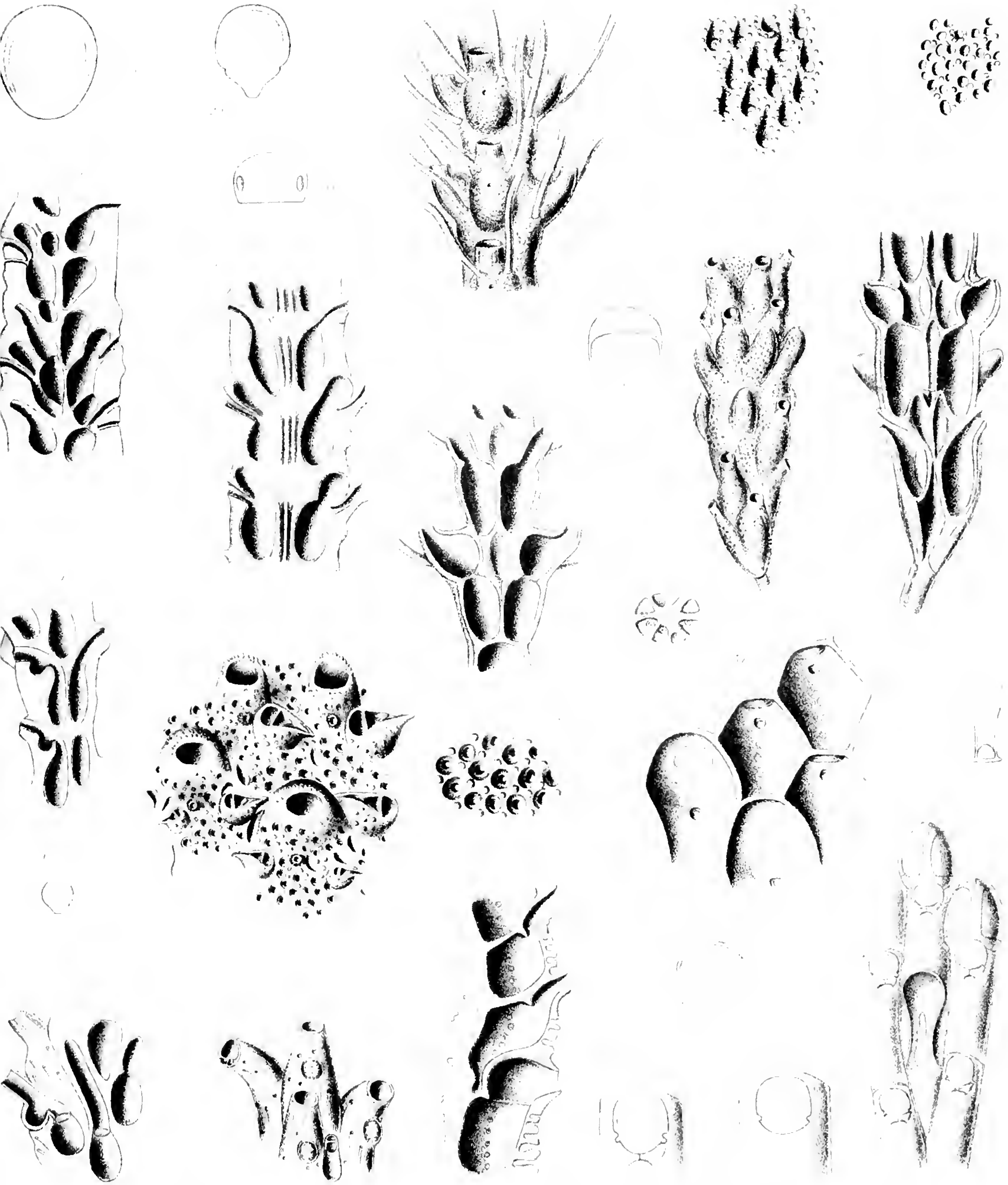


Plate XVII.

Plate XVII.

Fig. 1 a. *Escharella diaphana* Mac Gilliv. A young colony with the primary zooecium. Pore-chambers are seen on three zooecia. × 40.

— 1 b. Two zooecia of the same species. Pores are seen inside the marginal ridge. × 40.

— 1 c. The same species. The distal half of a zooecium, the frontal wall of which has been removed, so that the highly developed vestibular arch may be seen and the rods by which it is connected with the lateral walls. × 55.

— 1 d. The distal half of a zooecium of the same species, seen from the basal surface after removal of the basal wall. The basal wall of the vestibular arch is seen. × 55.

— 2 a. *Escharella abyssicola* Norman. A sagittal section through a zooecium with ooecium. The ooecium is surrounded by a kenozooecium, the frontal wall of which seems to be united with that of the ooecium. × 40.

— 2 b. The same species, from the basal surface. Three ooecia are present, the surrounding kenozooecia of which are furnished — like the zooecia — with pore-chambers. × 17.

— 3 a. *Escharella immersa* Flem. var. The basal portion of the endooecium is surrounded by the cryptocyst of the distal zooecium. × 40.

— 4 a. *Escharoides praestans* Hincks. × 40.

— 4 b. The same species from the basal surface. Pore-chambers. × 23.

— 5 a. *Escharoides sauroglossa* n. sp. × 40.

— 5 b. The same species, from the basal surface. The vestibular arch with its thickened margin is seen. × 40.

— 5 c. The distal end of a zooecium of the same species. Proximally to the spines the vestibular arch is seen. × 55.

— 5 d. An avicularian mandible of the same species. × 75.

— 5 e. A distal wall of the same species, with pore-chambers. × 40.

— 5 f. Three opercula of the same species. The smallest is not from the same colony as the two large ones. × 75.

Fig. 6 a. *Exochella longirostris* Jullien. × 55.

— 6 b. A zooecium of the same species, from the basal aspect, after removal of the basal surface. The primary aperture is seen and also the secondary and tertiary; further the vestibular arch. × 75.

— 7 a. *Exochella lobata* n. sp. × 75.

— 7 b. The distal end of a zooecium of the same species, from the basal aspect, after removal of the basal surface. The vestibular arch is seen in addition to the primary and secondary apertures. × 75.

— 7 c. An operculum of the same species. × 140.

— 8 a. *Exochella zelanica* n. sp. × 75.

— 8 b. A zooecium of the same species. Three pore-chambers are seen. × 75.

— 8 c. A zooecium of the same species, lateral view. The strong rostrum proximally to the aperture is seen and also the marginal ridge which is very prominent, running out into lobes. Inside the ridge pore-canals are seen. × 75.

— 9 a. *Exochella tricuspis* Hincks. × 75.

— 9 b. The distal end of a young zooecium of the same species, which shows the primary aperture. Three pore-chambers. × 75.

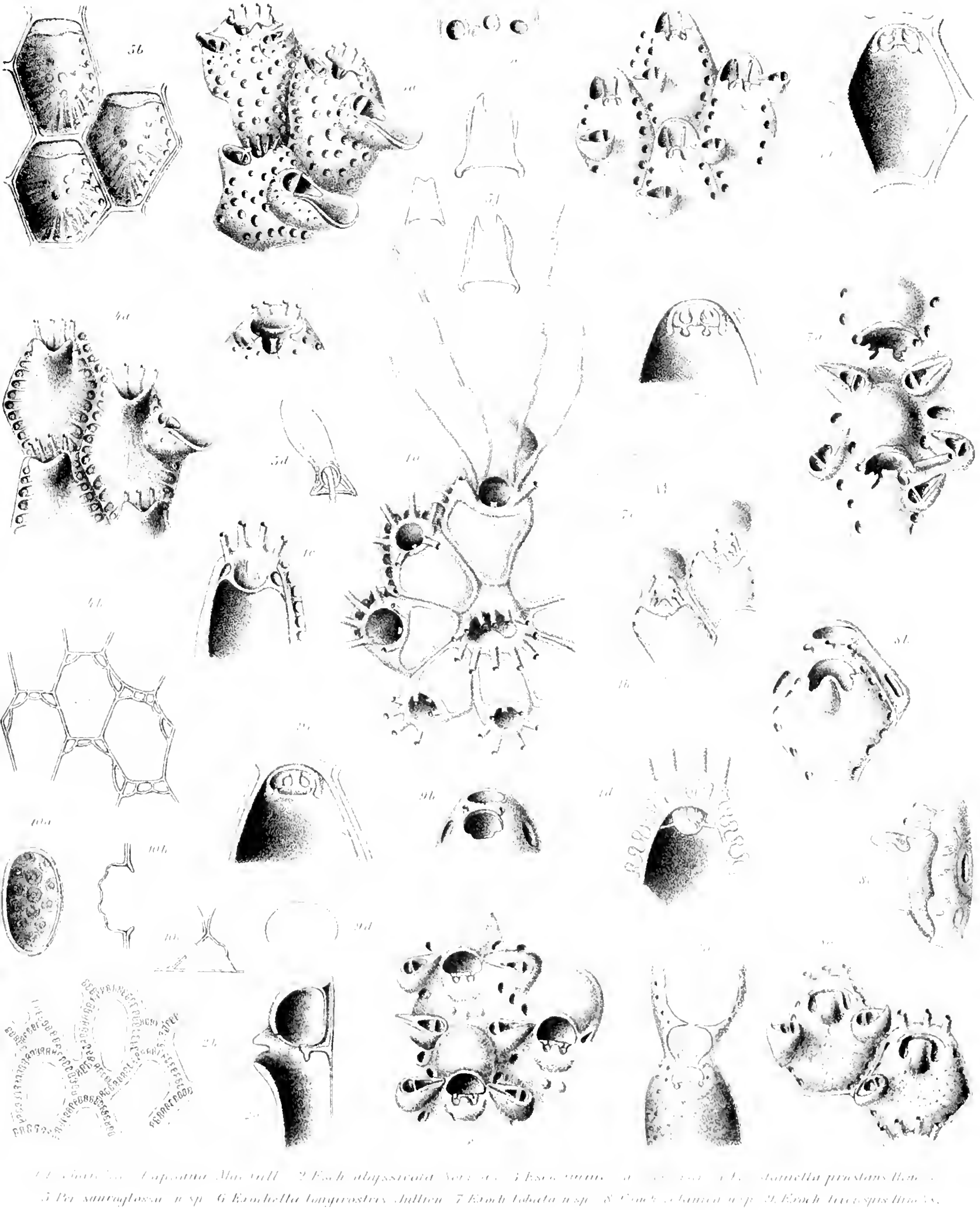
— 9 c. The distal end of a zooecium of the same species, from the basal aspect, after removal of the basal surface. The vestibular arch, the primary aperture and the three coalesced teeth of the secondary aperture are seen. × 75.

— 9 d. An operculum of the same species. × 140.

— 10 a. A multiporous rosette-plate of *Smittina Pallasiana* (Moll). × 350.

— 10 b. A schematic longitudinal section through a multiporous rosette-plate. To the right is seen the pore-ring.

— 10 c. A schematic longitudinal section through a pore-chamber. To the right the oblique wall on which the rosette-plates are situated.



[illegible] capitata Mac Gill. 2. Esch. abyssicola [illegible] 3. [illegible] 4. [illegible] porella praestans [illegible]
5. Per. sauroglossa n. sp. 6. Exochella longirostris Jullien. 7. Esch. lobata n. sp. 8. [illegible] n. sp. 9. Esch. tricuspis [illegible]
[illegible] Burkhammer

Plate XVIII.

Plate XVIII.

Fig. 1 a. *Escharina pes anseris* (Smitt). The distal end of a zoœcium with oœcium. × 75.

1 b. The distal end of an ordinary zoœcium. × 75.

1 c. An operculum of the same species. × 75.

— 2 a. *Escharina Dutertrei* (Aud.). The vestibular arch is seen and also the distal margin of the hinge teeth, which for the most part part are internal. × 75.

2 b. The same species. The distal end of a zoœcium, from the basal aspect, after the basal surface has been partly removed. The high hinge teeth are seen and also the vestibular arch and the processes springing from the latter. × 55.

2 c. An operculum of the same species. × 100.

3 a. *Schizoporella (Stylopoma) longirostris* Hincks. × 23.

3 b. The same species. A portion of a colony with superficial budding. × 23.

3 c. A zoœcial aperture of the same species. × 75.

3 d. A zoœcium of the same species from the basal surface. × 10.

3 e. An operculum of the same species. × 100.

3 f. An avicularium of the same species. × 75?

3 g. An avicularian mandible of the same species. × 75.

4 a. *Schizoporella (St.) spongites* (Pallas). An oœcium is seen, the frontal half of which is cut away. × 10.

4 b. The same species. An oœcium from the proximal end and distal walls with rosette-plates. × 10.

— 4 c. Operculum of the same species. × 100.

4 d. The same species. Operculum of a colony from Java. × 100.

5 a. *Petralia japonica* (Busk). The lowermost zoœcium to the left shows a hollow, from which the whole oœcium has been removed, the uppermost to the right shows on the other hand an oœcium with the frontal wall removed. × 10.

5 b. An operculum of the same species. × 75.

Fig. 6 a. *Porella* (?) *cornuta* n. sp. The oœcia are furnished with acropetal hollow spine-like processes. × 40.

6 b. An operculum of the same species. × 75. (A more correct figure is seen on Plate XXII, fig. 11 a).

7 a. *Arthropoma Cecili* (Aud.). A developing oœcium. × 40.

8 a. *Porella margaritifera* (Quoy & Gaim.). In the bottom of the avicularia the primary ribs of the frontal wall are seen. Both the oœcia and the avicularian chambers show concentric deposits of chalk. × 55.

9 a. A sagittal section through a gonozoœcium of *Hippothoa hyalina* L. The oœcium is surrounded by a kenozoœcium.

— 10 a. A sagittal section through a gonozoœcium of *Chorizopora Brongniarti* Aud. The oœcium is surrounded by an avicularium. × 55.

— 11 a. *Haplopoma impressum* (Aud.) from the basal surface. The zoœcia and the kenozoœcia surrounding the oœcia are furnished with pore-chambers. × 40.

12 a. *Smittina akaroensis* n. sp. The margin of the oœcia is furnished with an oœcial cover. × 55.

— 12 b. An operculum of the same species. × 100.

— 13 a. *Emballotheca quadrata* (Mac Gilliv.). Six different zoœcia take part in the formation of the oœcium figured. × 23.

13 b. The aperture of a zoœcium of the same species. × 75.

— 13 c. An operculum of a gonozoœcium of the same species. × 55.

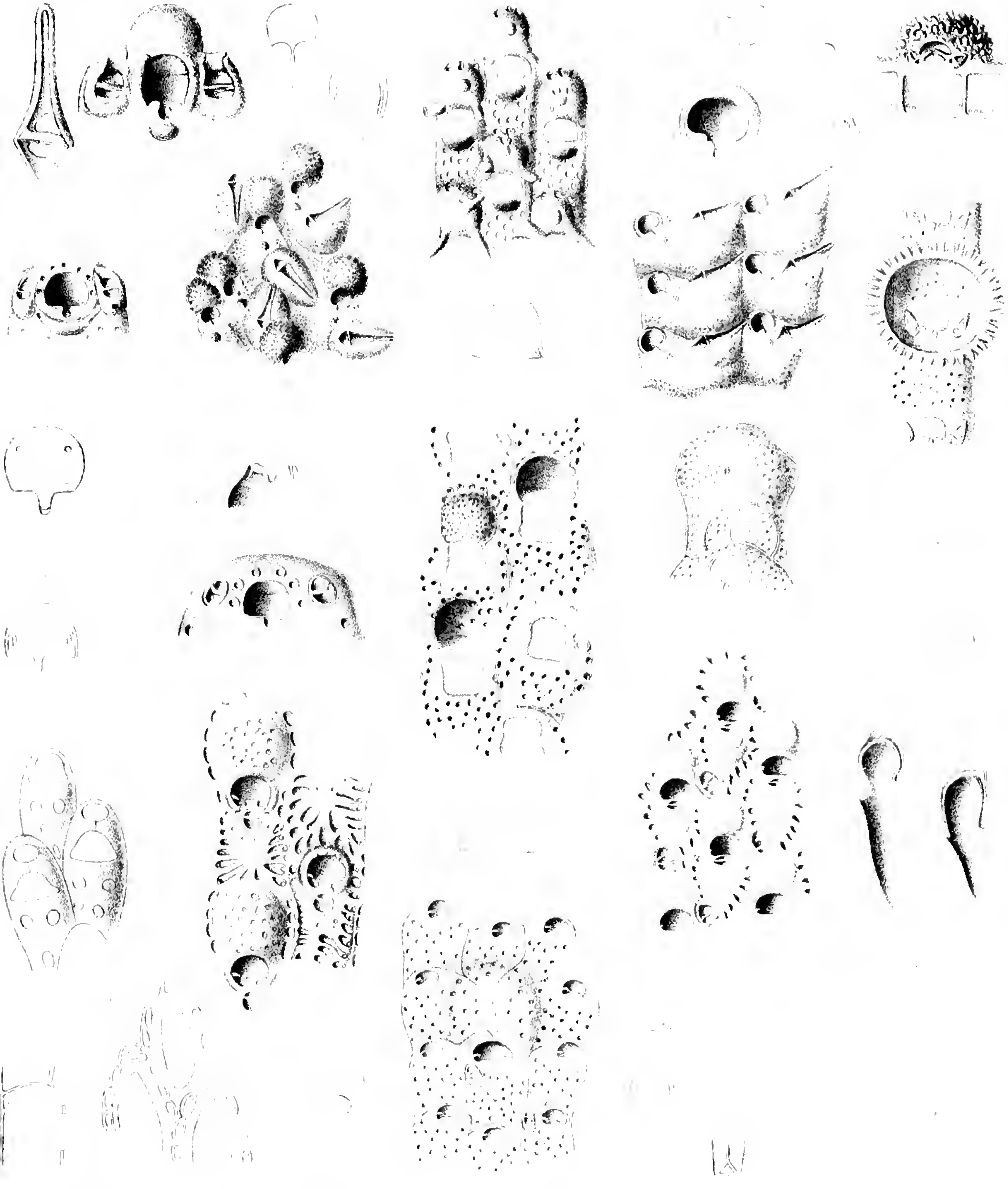
— 13 d. An operculum of an ordinary zoœcium of the same species. × 55.

— 13 e. An avicularian mandible of the same species. × 75.

14 a. *Eurystomella foraminigera* Hincks. Two gonozoœcia and an ordinary zoœcium. × 40.

14 b. The same three zoœcia, from the basal surface, which has a large uncalcified central part. × 40.

— 14 c. A sagittal section through a zoœcium with oœcium. The oœcium and the covering kenozoœcium are seen. × 40.



papillata Busk. 6 ... cornuta ... 7 ...
10 Chori... Levinsen. ... 11 ...
13 ...

Plate XIX.

Plate XIX.

Fig. 1 a. *Tryposlega venusta* (Norman). A zooecium and two dwarf-zooecia × 75.

1 b. The same species, from the basal surface. Two ooecia are seen surrounded by dwarf-zooecia, which, like the ordinary zooecia, are furnished with pore-chambers × 40.

1 c. An operculum of the same species. × 149.

1 d. An operculum of a dwarf-zooecium. × 200.

2 a. *Discopora paronella* (Alder). A portion of the margin of a colony with all the zooecia undeveloped. On the oldest zooecia the development of the avicularia has just begun, but the frontal surface of these is still a continuous membrane, and on four zooecia the frontal surface still consists of a row of independent calcareous plates separated by sutures. Distally to these plates is seen a dark curved line, the growing end of the fold which encloses the cryptocyst, and the internal layer of which becomes the external wall of the compensation-sac. × 23.

2 b. A sagittal section through a zooecium of the same species to show the compensation-sac (cs). The above-mentioned fold surrounds parts of the decalcified, broken cryptocyst (cr). × 75.

3 a. The zooecia of *Smittina propinqua* (Smitt), from the basal surface, which consists of a number of striated plates meeting in sutures. × 40.

4 a. *Smittina Smitti* Kirchenp. A developing ooecium. The ectooecium still consists of two separate halves × 40.

5 a. *Smittina palmata* (Sars), var. A developing ooecium. × 40.

— 5 b. The basal surface of a zooecium of the same species. Plate-mosaic with centres of calcification. A multiporous rosette-plate. × 40.

6 a. A zooecium of *Smittina Lansborovi* (Johnst.) with ooecium. An ooecial cover is seen, which partly appears in the margin of the zooecium partly forms two projections distally to the aperture × 40.

6 b. An ooecium of the same species, through the broken ectooecium of which the endooecium is seen × 100.

7 a. Two ooecia of *Smittina trispinosa*, var. *cucullata* n. with a hood-shaped ooecial cover × 40.

8 a. Some zooecia of *Flustra securifrons* (Pall.) after boiling in potash, to show the process of calcification of the basal wall (see pages 4—5). × 33.

8 b—f. Sagittal sections through a series of developing ooecia of the same species (see page 57). × 40.

8 g. A very early rudiment of an ooecium of the same species seen partly from the proximal end. The distal curved line is the line in which the distal wall joins the frontal membrane (fig. 8 b), and the bilobate part seen within the operculum belongs to the horizontal part of the distal wall. The [illegible] is the beginning of the ro[illegible] × 40.

Fig. 8 h—n. A series of developmental stages of the endooecium of the same species, seen from the surface. × 40.

9 a. Some zooecia of *Flustra* (Flustra) *foliacea* L., from the basal surface, after boiling in potash. The distal wall with its rosette-plates is seen and the composition of the basal wall in small plates (see page 6). A very fine striation parallel to the distal lines cannot be seen in this figure. × 40.

— 9 b. Two zooecia of the same species after boiling in potash. The lateral wall's composition of small plates is seen. × 40.

10 a. A transverse section through a branch of *Flustra* (*Spiralis*) *denticulata* Busk, cr: cryptocyst × 55.

— 10 b. A sagittal section through an avicularian mandible of the same species, to show the internal cavity which corresponds with the vestibular cavity in the operculum.

— 10 c. A portion of the basal surface of the same species, to show its composition of cell-like small plates (cell-mosaic). Immers.

11 a. Operculum of *Flustra housiformis* × 23.

12 a. A transverse section through a branch of *Flustra* (Flustra) *carbacea* Sol. cr.: cryptocyst × 40.

13 a. An avicularian mandible of *Sarsiflustra abyssicola* (Sars), to show the internal cavity × 23.

— 13 b. A transverse section through the same mandible in its middle part × 23.

— 14 a. A transverse section through an avicularian mandible of an *Onychocella* species, to show the mandibular cavity. × 40.

15 a. The avicularian mandible of *Scuticella plagiostoma* Busk × 75.

— 15 b. A transverse section through the end of the same mandible. × 75.

16 a. Pore-canals of *Myriozoum subgracile* d'Orb. Each of them contains an endosarcal cord and is, at its proximal part, furnished with a uniporous rosette-plate. Immers.

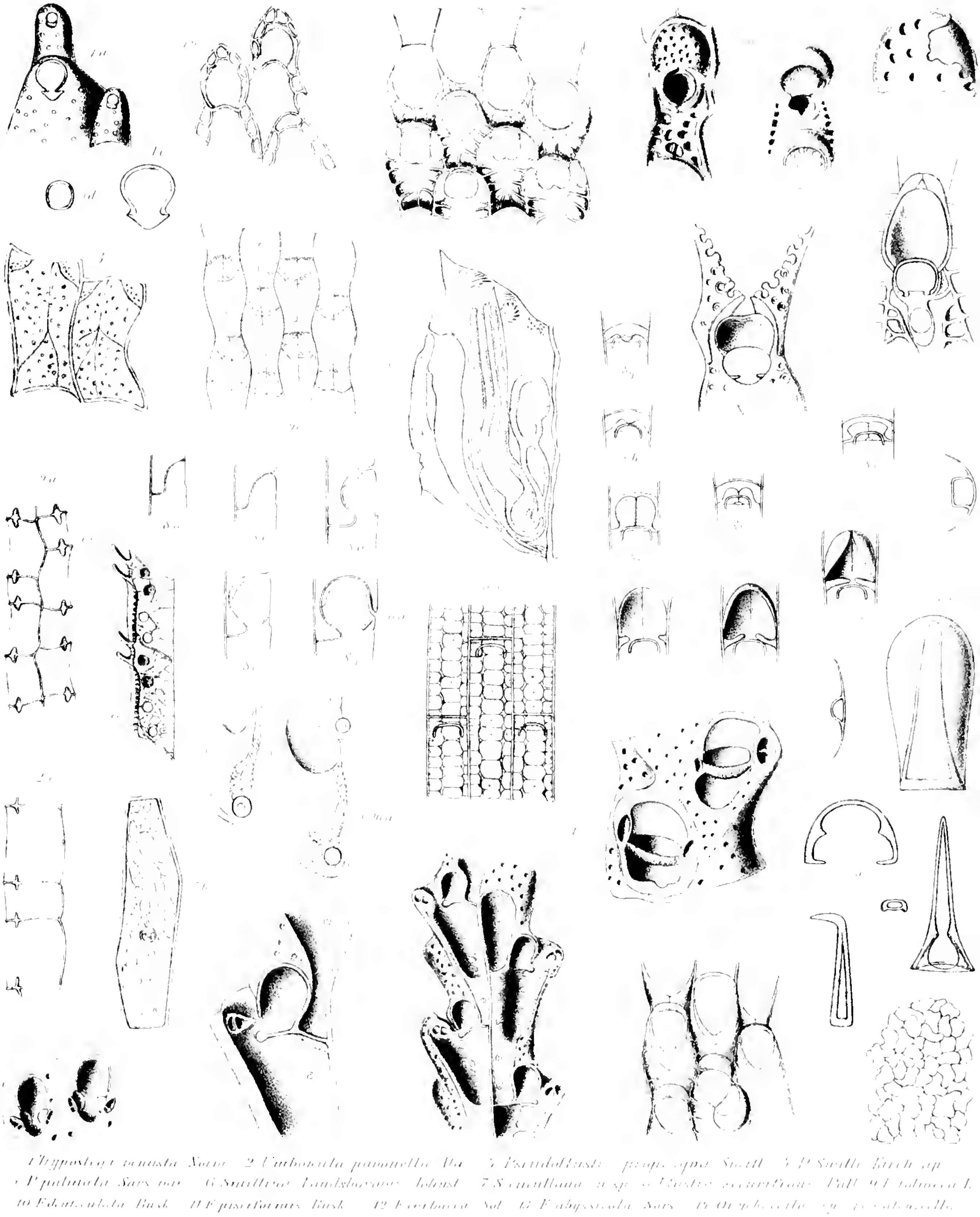
17 a. *Haswellia auriculata* (Busk). Each of the two-layered stalked, developing ooecia is placed in a hollow × 40.

18 a. A sagittal section through some ooecium-bearing zooecia of *Sclerodomus denticulatus* (Busk). The avicularium is seen on the internal surface of the peristome and the plate originating from the distal wall × 23.

18 b. A sagittal section through a zooecium with ooecium, more highly magnified × 40.

18 c. The same species. As a portion of the frontal surface has been ground away, the flat proximal part of the ooecial frontal surface is seen and the broadened crenulated margin of the plate originating from the distal wall. × 40.

19 a. *Discopora plicata* (Smitt). The distal of the two angular lines is the growing end of the fold or outpushing formed by the frontal membrane and enclosing the cryptocyst whose growing end forms another angular line. × 40.



1 Hypposteg. venusta Norm. 2 Umbonula pavonella Ald. 3 Pseudoflustra propinqua Smitt 4 P. Sollii Kirch. sp. 5 P. palmata Sars var. 6 Smittina landsborovi Johnst. 7 S. cucullata n. sp. 8 Flustra securifrons Pall. 9 F. foliacea L. 10 F. denticulata Busk 11 F. pisciformis Busk 12 F. carbasea Sol. 13 F. abyssicola Sars 14 Ortho... sp. 15 ... plagiostoma Busk 16 Myriozoum subgracile d'Orb. 17 Hiantella auriculata Busk 18 Sclerodomus ... Lass. 19 Rhamphostomella ... Smitt

Plate XX.

Plate XX.

Fig. 1 a. A zoœcium of *Scuticella urnula* (Mac Gilliv.). The fenestræ of the sternal area show a distinct cryptocyst × 55

1 b. A gonozoœcium from the frontal surface × 17.

1 c. The same gonozoœcium, lateral view × 23

1 d. The same gonozoœcium, from the basal surface × 23

1 e. The median chambers from the distal part of another gonozoœcium. The downwards directed point corresponds with that seen in fig. 1 b. × 40

2 a. A bi-zoœcial internode of *Scuticella Wilsoni* (Mac Gilliv.). m: mother-zoœcium, d: daughter-zoœcium, I: the supra-scapular chamber, II: the scapular chamber, III: the infra-scapular chamber, IV: the pedal chamber (fig. 2 b). × 40.

2 b. A bi-zoœcial internode of the same species, from the basal surface, less highly enlarged (see 2 a). × 23

3 a. A bi-zoœcial internode of *Scuticella margaritacea* (Busk). Compare with fig. 3 b. × 55.

3 b. A bi-zoœcial internode of *Scuticella margaritacea* (Busk), var. fissurata, n. For the letters and numbers see explanation to fig. 2 a. × 55

3 c. A gonozoœcium of the same form. × 40

4 a. A zoœcium of *Scuticella maculata* (Busk) (wrongly indicated on the Plate as *Cat. ventricosa*). × 40

4 b. A zoœcium of the same species, lateral view. Besides the scapular chamber the infra-scapular and the pedal are also seen. (on the Plate indicated as *Cat. ventricosa*). × 40.

5 a. A zoœcium of *Scuticella ventricosa* (Busk) (wrongly indicated on the Plate) × 40.

Fig. 5 b. A bi-zoœcial internode of the same species (see the explanation to fig. 2 a). × 40.

— 5 c. (wrongly indicated as 5 a). A zoœcium of the same species, lateral view. The scapular, the infra-scapular and the pedal chambers are seen. × 40.

6 a. The sternal area and the aperture of *Costicella cuspidata* n. sp. × 75.

6 b. The same species. A zoœcium which terminates a branch originating from a daughter-zoœcium × 40.

6 c. A gonozoœcium of the same species. × 40.

— 7 a. The sternal area and the aperture of *Costicella solida* n. sp. × 75.

— 8 a. A zoœcium of *Costicella hastata* (Busk), (from Port Phillip). × 75.

8 b. A bi-zoœcial internode of the same species (from Twofold Bay). See the explanation to fig. 2 a). The long internal, sternal sinus can be seen × 75.

— 9 a. A gonozoœcium of *Costicella benecostata* n. sp. × 55.

— 10 a. A zoœcium of *Claviporella aurita* (Busk). × 75.

10 b. A gonozoœcium of the same species. × 55.

11 a. A tri-zoœcial internode of *Calpidium ornatum* Busk. × 23

11 b. A tri-zoœcial internode of the same species, from the basal surface. × 23.

11 c. A tri-zoœcial internode of the same species, from the distal end. × 23.

11 d. A tri-zoœcial internode of the same species, lateral view. (See the explanation to fig. 2 a). × 23.

11 e. A bi-zoœcial internode of the same species, from the basal surface. × 23.

11 f. A bi-zoœcial internode of the same species, from the distal end. × 23.

1 Catenicella armata Mac Gill. 2 Caten. Wilsoni Mac Gill. 3 Caten. margaritacea Busk. 4 Caten. ventricosa Busk. 5 Caten. maculata n. sp. 6 Costicella cuspidata n. sp. 7 Costic. solida n. sp. 8 Costic. hastata Busk. 9 Costic. [illegible]costata n. sp. 10 Claviporella aurita Mac Gill. 11 Calpidium ornatum Busk.

Plate XXI.

Plate XXI.

Fig. 1 a *Catenaria* on the Plate *Vittaticella cornuta* Busk In the bizoœcial internode the mother-zoœcial, small, oval, infrascapular chamber is seen on the boundary between the mother- and the daughter-zoœcium × 55

2 a *Catenaria Vittaticella) elegans* (Busk The supra-scapular, the infra-scapular and the pedal chambers are seen. A boundary chamber (m III between the mother- and the daughter-zoœcium. × 55.

3 a *Catenaria formosa* Busk) The same chambers as in fig. 2 a. × 40

4 a. *Pterocella alata* (Wyv Th. The mother-zoœcial, fissure-like infrascapular chamber is seen proximally to the small avicularium. × 40

5 a. A zoœcium of *Calpidium ponderosum* Goldst The internal cryptocyst plate is seen and a strong cryptocyst formation in the five fenestræ ×. 55

5 b A zoœcium of the same species, lateral view. The supra-scapular chamber is seen and also the infra-scapular and the pedal × 40

5 c A bizoœcial internode of the same species, from the basal surface. The uppermost triangular cavity is the adzoœcial supra-scapular chamber of the mother-zoœcium. To the left is seen a supra-scapular, an infra-scapular and a pedal chamber; to the right the pedal chamber is on the other hand not visible; the infra-scapular is on this side divided into two. × 40.

5 d A zoœcium of the same species, from the basal surface. The sufra-scapular and the infra-scapular chambers are seen × 40.

5 e A bizoœcial internode, from the distal end. × 23

6 a *Strophipora Harveyi* Wyv. Th.. The supra-scapular and the infra scapular chambers are seen. × 40

6 b A bizoœcial internode of the same species, from the basal surface. The four pedal chambers are seen. × 40.

6 c A zoœcium of the same species, from the frontal surface. × 40

6 d A zoœcium of the same species, from the basal surface × 40.

6 e A zoœcium of the same species, lateral view. × 40

Fig. 6 f. A bizoœcial internode, from the distal end. × 55.

— 7 a *Hippothoa annularis* Moll), with oœcia. On the boundary between the zoœcia in the proximal row pore-chambers are seen for communication with eventual gonozoœcia. × 23.

7 b The distal end of a zoœcium of the same species. × 75

7 c. A zoœcium of the same species, lateral view. Three holes are seen for communication with the pore-chambers in a neighbouring zoœcium and two pore-chambers for the communication with eventual gonozoœcia. × 55

7 d. A zoœcium of the same species, from the basal surface. On each side of the angularly bent distal wall the entrance to a large pore-chamber is seen. × 55.

7 e. The operculum of the same species × 75.

7 f. Operculum common to the gonozoœcium and oœcium × 200.

8 a *Hippothoa cornuta* (Busk), var. ***holostoma*** n. × 40

8 b. A zoœcium of the same form with oœcium, lateral view. × 40

— 8 c. A zoœcium of the same form, from the distal end. × 75.

— 8 d. An operculum of the same form. × 200.

— 8 e. Four zoœcia of the same form, of which two with oœcia. × 40.

— 8 f. Operculum common to the gonozoœcium and oœcium. × 75.

— 8 g. A zoœcium of the same form, lateral view. The acropetalous spine has an internal septum. × 55.

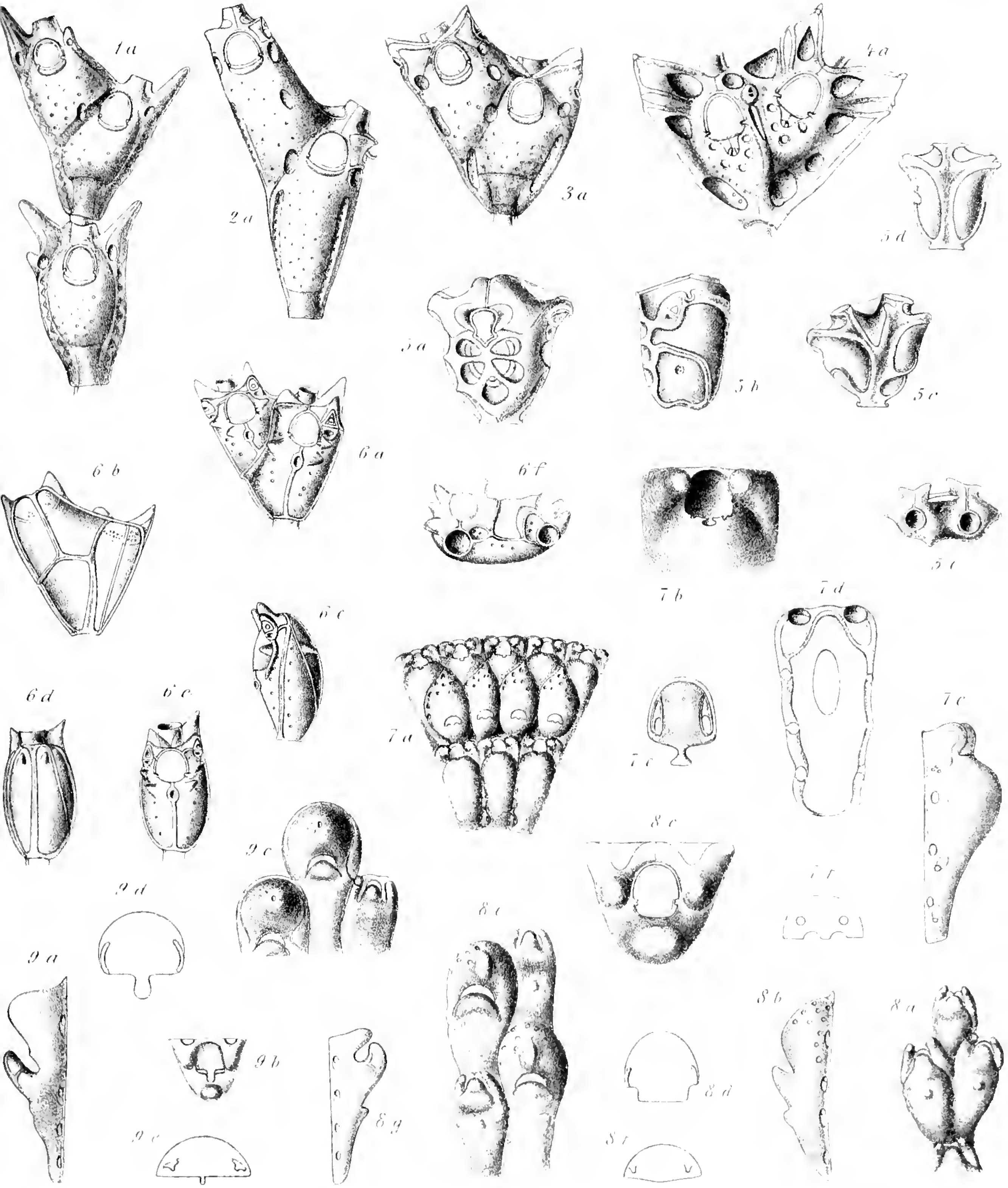
9 a An oœcium-bearing zoœcium of *Hippothoa cornuta* (Busk), var. *aporosa* n. lateral view. The acropetalous spine has two cavities divided by an internal septum. × 40.

9 b A zoœcium of the same form, from the distal end. × 75

— 9 c. Three zoœcia of the same form, of which two with oœcia The latter are distinctly visible through the surrounding kenozoœcia. × 40.

— 9 d. An operculum of the same species. × 200.

9 e. Operculum common to the gonozoœcium and oœcium. × 200.



1 Vittaticella cornuta Busk. 2 Vit. elegans Busk. 3 Vit. formosa Busk. 4 Pterocella alata Wyv. Th. 5 Calpidium ponderosum Goldst. 6 Strophipora Harveyi Wyv. Th. 7 Hippothoa annularis Moll. 8 Hip. cornuta Busk. var. holostoma n. 9 Hip. cornuta Busk. var. aporosa n.

Plate XXII.

Plate XXII.

Fig. 1 a. *Flustra (Retiflustra) reticulum* Hincks. × 23

— 1 b. A zooecium of the same species with ooecium, lateral view. × 40.

— 1 c. The same species from the basal surface. The uppermost zooecium in the central row is furnished with an ooecium × 23.

— 2 a. *Flustra (Retiflustra) cribriformis* Busk, from the basal surface. The two uppermost zooecia with ooecia. × 40.

— 3 a. *Onychocella* sp. The two uppermost zooecia with ooecia. × 40

— 3 b. A zooecium of the same species with ooecium. In the covering membrane of the aperture is seen a simple chitinized operculum, and in each of the two sinuses of the aperture the end of a parietal muscle. × 55

— 3 c. The same species. A zooecial operculum, above which an ooecial operculum. × 75.

— 3 d. An avicularian mandible of the same species. × 40.

— 4 a. *Electra angulata* n. sp. × 40.

— 5 a. *Membranipora limosa* Waters. × 55.

— 5 b. The distal wall of the same species with the peculiar spine-like processes. × 55.

— 5 c. A spine-like process more highly magnified. × 200.

— 6 a. *Nellia simplex* (?) Busk, from Mauritius. The distal part of the ooecium is furnished with a cryptocyst belt × 40.

— 7 a. *Thalamoporella cincta* Hincks × 40.

— 7 b. The same species, lateral view. The distal wall and the one opesiular outgrowth are seen × 40.

— 7 c. A transverse section through a zooecium, distally to the two large swellings and viewed from the distal end. The two swellings and one of the opesiulae are seen. × 40

Fig. 7 d. The operculum of the same species. × 100.

— 8 a. *Caberiella benemunita* (Busk). × 55.

— 8 b. The same species from the basal surface. A transversely placed vibraculum is seen. × 55.

— 9 a. *Haplopoma impressum* (Moll), with primary zooecium. In the margin of the zooecia internal pore-chambers are visible. × 55.

— 9 b. The operculum of the primary zooecium. × 140.

— 10 a. *Haplopoma bimucronatum* (Moll), with primary zooecium. × 55.

— 10 b. Operculum of the same species × 140.

— 10 c. Operculum of the primary zooecium of the same species. × 140.

— 11 a. Operculum of *Porella* (?) *cornuta* n. sp. × 75.

— 12 a. A developing ooecium of *Smittina Smitti* (Kirchenp). The development of the cryptocyst of the distal zooecium has begun. × 40.

— 13 a. *Tryposlega venusta* (Norman). Three small dwarf-zooecia are seen and a larger which surrounds an ooecium. × 40.

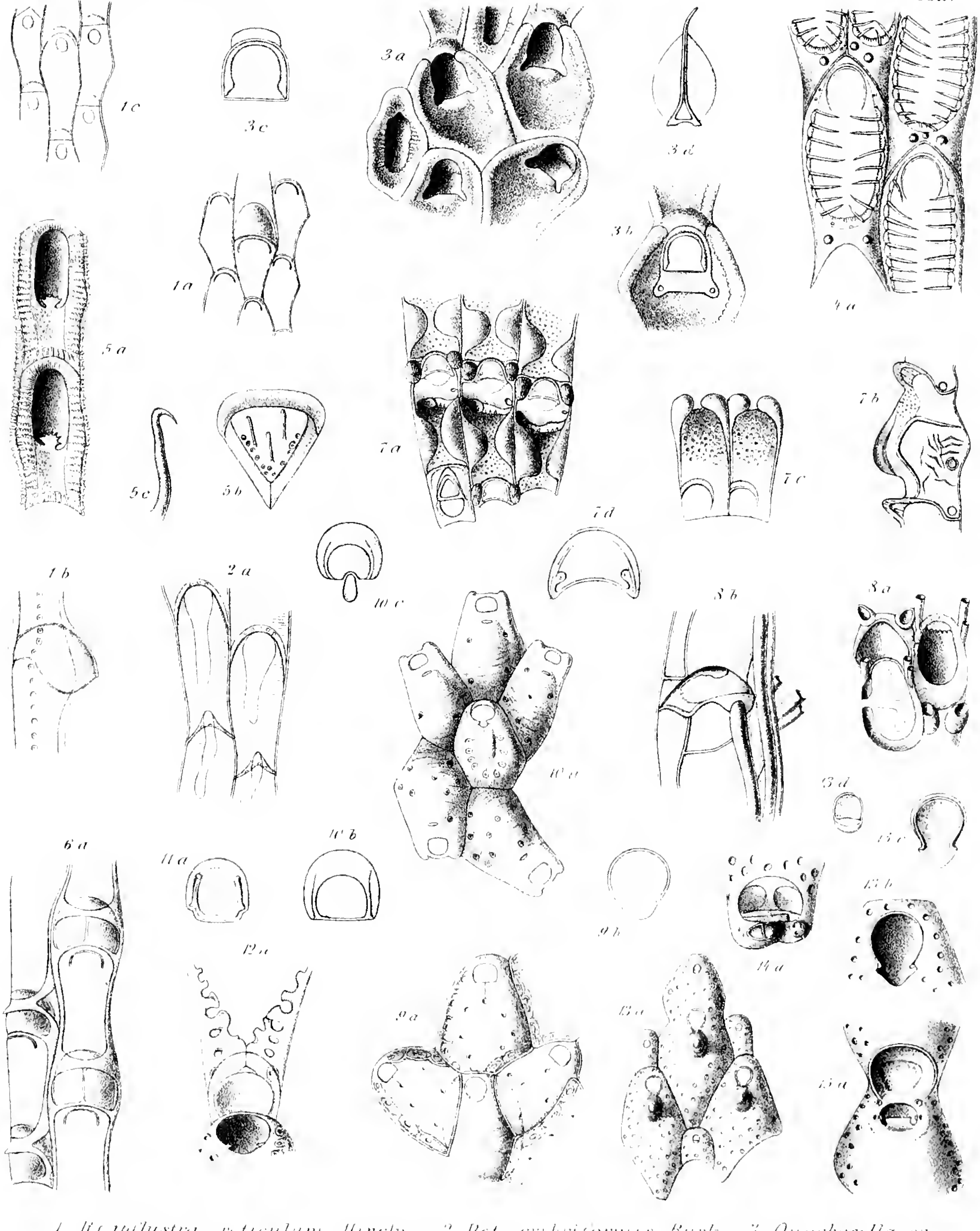
— 13 b. The distal end of a zooecium of the same species. × 75

— 13 c. An operculum of the same species. × 75.

— 13 d. The aperture of a dwarf-zooecium with operculum. × 200.

— 14 a. An ooecium of *Sclerodomus denticulatus* (Busk), and its surroundings, seen from the frontal surface. × 40.

— 15 a. A zooecium of *Escharella immersa* Flem. var. with developing ooecium. The part common to the zooecium and the endooecium (the basal mark*) is seen × 40



1 Retiflustra reticulum Hincks. 2 Ret. cribriformis Busk. 3 Onychocella sp. 4 Electra angulata n. sp. 5 E. Normani n. sp. 6 Nellia simplex Busk. 7. Thalamoporella cincta Hutton. 8 Caberiella benemunita Busk. 9 Haplopoma impressa Moll. 10. H. cornuta Busk. 11 Porella cornuta n. sp. 12 Smittina Smitti Kirchenp. 13 Tryposteqa venusta Norman. 14 Sclerodomus denticulatus Busk. 15 Escharella immersa Flem. var.

Plate XXIII.

Plate XXIII.

Fig. 1 a. A part of the kenozoœcial layer of *Retepora tessellata* Hincks. Three of the kenozoœcia are furnished with avicularia, from which porechannels pass out to the surface of the kenozoœcia. Four of these pore-channels are seen to perforate the lateral walls of the adjacent kenozoœcia. The opercular area of the avicularia is furnished with a well-developed cryptocyst. × 56.

2 a. Two kenozoœcia from *Retepora lata* Busk, seen from the inner concave surface. The inner, in size strongly reduced, very irregular cavities of the kenozoœcia are connected through pore-channels perforating the lateral walls. × 40.

2 b. A third kenozoœcium of the same species, seen from the inner surface and in such a position that the stratification of the basal wall can be seen. The inner cavity, which is much larger than that in the two other kenozoœcia, is placed near to the inner surface and there is seen a number of pore-channels and rosette-plates corresponding to the cavities in the adjoining kenozoœcia. × 40.

2 c. The same kenozoœcium seen from the left side-wall. Seven single pored rosette-plates are seen, the five hindermost of which correspond with the pore-channels seen in the left side of the figure 2 b. × 40.

3 a. A longitudinal section through a branch of *Retepora cellulosa* Smitt. On the right side are seen the zoœcia, while the rest of the branch is formed by the kenozoœcial layers, the youngest of which have covered a *Spirorbis*. × 12.

4 a. *Rhynchopora angulata* n. sp. × 55.

4 b. A zoœcium of the same species, seen from the left side-wall. On the left side is seen an avicularium. × 55.

4 c. Zoœcia of the same species, seen from the basal side after removal of the basal wall. × 55.

Fig. 4 d. Zoœcia of the same species with oœcia. × 55.

4 e. The same species. The aperture with the operculum in situ. The beaded vestibular arch is seen shining through the operculum. × 100.

4 f. The same species. Oœcium, seen a little from the proximal part to make the screen-like frontal lobe more distinct. This lobe cannot be seen in fig. 4 d. × 55.

4 g. Operculum of the same species. × 100.

4 h. Avicularian mandible of the same species. × 100.

5 a. Operculum of *Rhynchopora scintillans* Hincks). × 140.

6 a. Two zoœcia of *Microporella flabelligera* n. sp. × 40.

6 b. The same species. A zoœcium with oœcium. × 40.

6 c. Operculum of the same species. × 75.

7 a. *Conescharellina angulopora* (Ten-Woods). Between the two avicularia is seen one of the peculiar crescentic apertures, belonging to certain kenozoœcia. × 75.

7 b. The same species. A crescentic aperture and two avicularia. × 75.

7 c. Operculum of the same species. × 100.

7 d. A transverse section of the same operculum. × 200.

7 e. The aperture of the same species. × 75.

7 f. An avicularian mandible of the same species. × 200.

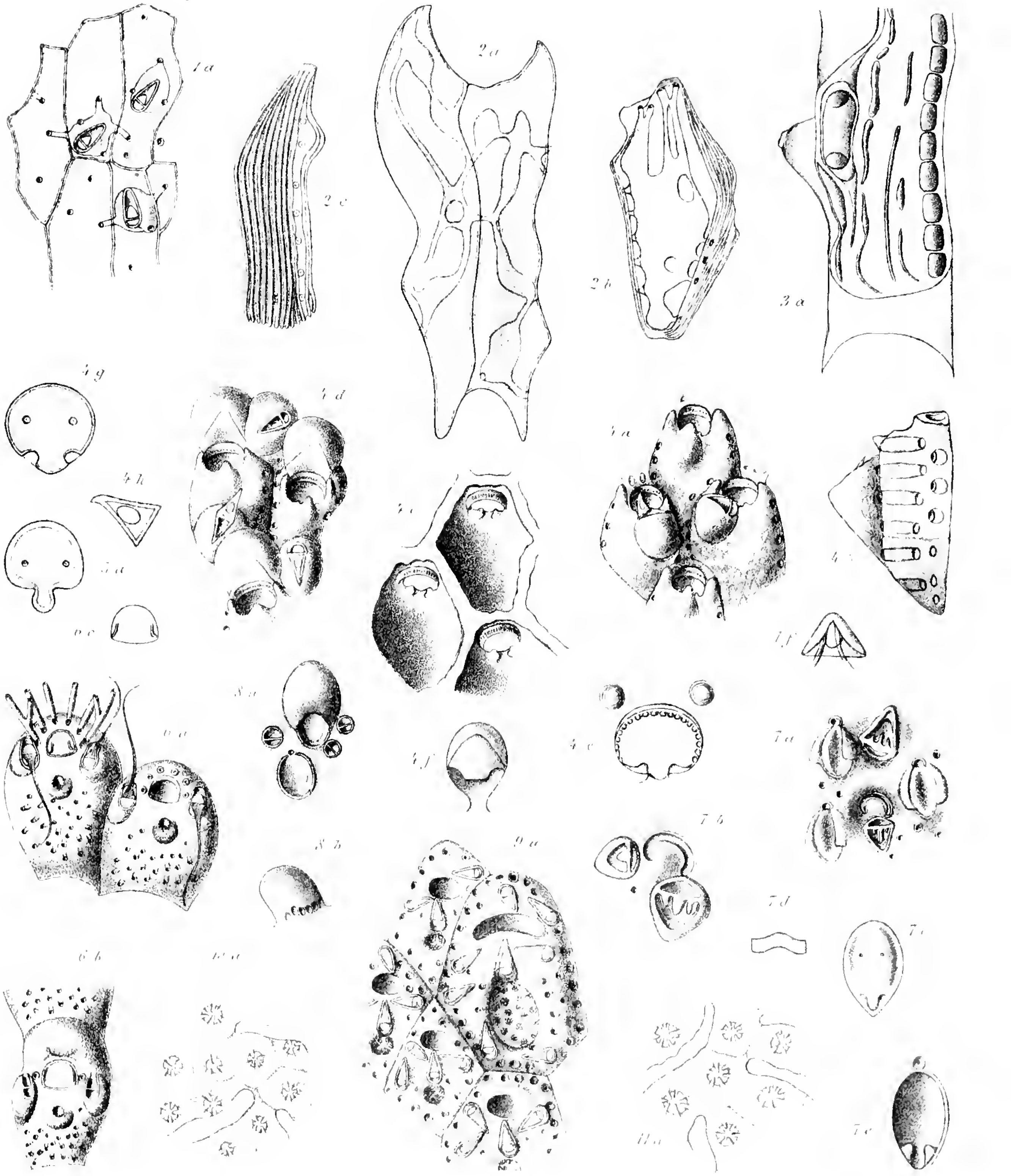
8 a. *Conescharellina cancellata* (Busk). Oœcium. × 55.

8 b. An oœcium of the same species, from the side. × 55.

9 a. *Adeonellopsis foliacea* Mac Gill. Four zoœcia and a gonozoœcium. × 40.

10 a. A part of the frontal surface of *Anarthropora monodon* (Busk). × 200.

11 a. A part of the frontal surface of *Inversiula inversa* (Waters). × 200.



1 Retepora tessellata Hincks 2 Ret. atlantica Busk 3 Ret. cellulosa Smitt 4 Rhynchopora angulata n. sp. 5 Lepr. serialibus Hincks 6 Microporella flabelligera n. sp. 7 Cosciniopsis angulopora Ten Woods 8 Bipora cancellata Busk 9 Adeonellopsis foliacea MacGill 10 Acanthopora ... nodon Busk 11 Watersia convexa Waters

Plate XXIV.

Plate XXIV.

Fig. 1 a *Conescharellina philippensis* (Busk). Five zooecia are seen from the basal side (after the removal of the frontal wall) showing a number of avicularian chambers, which are connected partly with the zooecial surface and partly with each other through rosette-plates and pore-channels. There is also seen one of the peculiar kenozooecia, which are provided with a narrow semilunate aperture. × 75.

2 a *Discopora Sarsi* (Smitt) from Tassiusak, East Greenland. The ooecia show a more or less developed ooecial cover. × 40.

3 a *Hippopodina feegeensis* (Busk). × 40.

3 b The same species with avicularia but without ooecia. × 40.

3 c. The same species with another form of avicularia. × 40.

3 d The same species with the avicularia in another position. × 40.

3 e A mandible of the same species. × 75.

3 f. A zooecium with ooecium of the same species, seen from the left side-wall. × 40

4 a *Cheilopora sincera* (Smitt). Two zooecia with ooecia seen from the left side-wall. × 23

5 a *Smittina foliacea* (Ellis & Sol.), with ooecia. Only a very small proximal part of the ectooecium can be seen, and the rest is concealed by a tripartite ooecial cover (see pag. 64). × 40

Fig. 6—18. In the following diagrammatic representations of different hyperstomial ooecia the black colour designates the calcareous parts, the red the membranaceous and the non-coloured portion the muscular. The dotted lines are only hypothetical. Reference letters: av. avicularium. ecto. Ectooecium. endo. Enooecium. Cr. Cryptocyst. c. m. Covering membrane op. Operculum. o. o. Ooecial operculum. o c. Ooecial cover. v. Vestibulum.

— 6. *Flustra membranaceo-truncata* (Smitt)

— 7. *Flustra flustroides* (Hincks).

— 8. *Flustra foliacea* L.

— 9. *Columnaria borealis* n. sp.

— 10. *Onychocella* sp.

— 11. *Urceolipora* nana Mac Gill.

— 12. *Onchopora Sinclairi* (Busk)

— 13. *Bugula* sp.

— 14. *Thalamoporella* sp.

— 15. *Emballotheca quadrata* (Mac Gill.).

— 16. *Callopora aurita* (Hincks).

— 17. *Schizoporella unicornis* (Johnst).

— 18. *Myriozoum coarctatum* (Sars).

1 Conescharellina philippinensis Busk. 2 Discopora Sarsi Smitt. 3 Hippopodina feegeensis Busk. 4 Cheilopora sincera Smitt. 5 Smittina foliacea Ell. & Sol. 6 Flustra membranaceo-truncata Smitt. 7 Fl. flustroides Hincks. 8 Fl. foliacea L. 9 Columnaria borealis n. sp. 10 Onychocella sp. 11 Urceolipora nana Mac Gill. 12 Calwellia Sinclairi Busk. 13 Bugula. 14 Thalamoporella. 15 Emballotheca quadrata Mac Gill. 16 Catenicella aurita Hincks. 17 Schizoporella unicornis Johnst. 18. Myriozoum coarctatum Sars.

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ERRATA AND REMARKS.

p. 2	line 3 from below	»irreguliers«	should be	irregulier.
- 5	6 - above	»ot«	-	to.
- 5	16 - -	»calk«	-	chalk.
- 6	8 - -	„*Schizoporella*"	-	»*Schizoporella*«.
- 8	— 3 — —	»*Cibrilina*«	-	*Cribrilina*.
- 12	— 8 — —	»*Coilestega*«	-	*Coilostega*.
- 18	- 3 below	»*Smittia*«	-	*Smittina*.
- 19	foot-note No. 9	18	-	19.
- 26	— - 1	79, p. 12	-	80, p. 121.
- 34	— - 2	81—83	-	160, 162.
- 36	— - 2	23	-	19.
- 38	— - 2	80	-	81.
- 42	— - 2	75, Pl. III, fig. 16	-	76, Pl. III, fig. 16 a.
- 44	— - 5	72	-	76.
- 48	line 12 from below	»laminae«	-	lamina.
- 76	foot-note No. 1	108 a	-	108 b.
- 82	line 7 from above	*Lepralia*:	-	*Lepralia*.
- 84	6 below	»*Rhynchopora*«	-	*Rhynchozoon*.
- 89	7 -	»*Aspidostomidae* n. f.«	-	*Aspidostomidae*.
- 103	7 —	»Vol. X«	-	Vol. X, Part. 1.
- 107	16 above	»Sec.«	-	Soc.
- 109	5 —	56	-	55.
- 111	foot-note No. 2	22	-	208.
- 112	— - 1	22	-	208.
- 114	line 16 from above	XXXI, 1		XXXI, III.
- 118	1 — below	»preceeding«	-	preceding.
- 122	3	»mee«	-	me.
- 124	12 — above	»operculum«	-	mandible.
- 129	6 below	»no«	-	not.
- 133	18 above	»joint«	-	internode.
- 140	12	»opening«		aperture.

p.	147	line	11	from below	195	should be	332.
	152	foot-note No.	1		»Vol. 2 . . . fig. 8«	— -	Vol. 1 . . . figs. 8 a—8 d.
-	153	-	2		84 b	— -	84 c.
-	153	-	4		7	-	271.
	168	line	7	from above	»observations«	— -	remarks.
	171		16	below	»Part I, *Cheilostomata*«	-	*Cheilostomata*.
-	171		12		»Vol. V«	-	Vol. X.
-	173	foot-note No.	1		14 a	-	14 c.
-	179	line	9	from above	»zoœcial«	-	zoœcial aperture.
-	180		1		»well developed«	-	well-developed.
-	181		16		28	-	379.
-	181		17		»Part I«	-	*Cheilostomata*.
-	185		11		11	-	10.
-	186		10		28–29	-	380.
-	192		7		21	-	89.
-	193		18		30	-	381.
-	194		18		»neé«	-	née.
	197		8		»Egypte«	-	Égypte.
-	197		16		1859	-	1858.
-	207		1		»Subdivision«	-	Division.
	212		19	below	»joint«	-	internode.
-	215		17	above	»articulate parts«	-	internodes or segments.
-	221		17		»opening«	-	aperture.
-	244		16		»Journal«	-	Quart. Journal.
	242		10		»M. Gillivray«	-	Mac Gillivray.
-	253		8		»joints«	-	internodes.
-	253		15		»joint«	-	internode.
-	253		9		»base«	-	beginning.
-	253		3	below	»*Calloporella*«	-	*Caloporella*.
-	253	foot-note No.	1		8	-	18.
-	254	line	3	from below	»joint«	-	internode.
	258		6	above	»Proced.«	-	Proceed.
-	259		10		»Bass Straits«	-	Bass' Strait.
	260		6		»a pore«	-	an ascopore.
-	260		9		192	-	172.
-	261	foot-note No.	1		18	-	16.
	264	line	10	from above	»pore«	-	ascopore.

266. To the synonymy of *Crepidacantha Poissoni*, var. *crinispina* may be added: Lepralia Poissoni Norman, Journ. Linnean Soc., Zoology XXX, 1909, p. 307, Pl. 11, figs. 7, 8.

270	line	8	from above	XIII	should be	XVII.
270		9		»Part 1«	— -	Part I.
272		5		96	-	165.
272		6 & 7		»Pl. 15, figs. 13—14«	-	Pl. 16, figs. 32–37.
281		11	below	»oœcria«	-	oœcia.

p. 282	line 14	from above	»base«	should be	proximal part.
- 297	— 16	—	»*crustaceum*«	— -	*crustacea.*
- 309	— 6	— below	»connection«	-	in connection.
- 313	— 10	— above	kenooœcia«	-	kenozoœcia.
- 317.	Figures showing the structure of the frontal wall in *Anarthropora monodon* and *Inversiula inversa* are seen in Pl. XXIII, figs. 10 a, 11 a.				
- 320	line 11	from above	»*triccuspis*«	should be	*tricuspis.*
- 321	— 16	— below	»species,«	-	species.
- 321	— 3	— above	»the the«	-	the
- 353	— 7	— —	»endooœcial«	— -	endozoœcial.

Mr. W. Lundbeck, the author of »Diptera Danica«, has made me acquainted with the fact that the name »*Bicellaria*« has been used already in 1823 for a genus of flies by Macquart (Soc. Sci., Lille, 1823, 155), and I propose therefore to change the Bryozoan name »*Bicellaria*« into »*Bicellariella*« and to name the corresponding family »*Bicellariellidae*«.

1884