Fossil Cyclostomatous Bryozoa from Australia

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46. Fossil Cyclostomatous Bryozoa *from* Australia. By Arthur Wm. Waters, Esq., F.G.S. (Read June 25, 1884.)

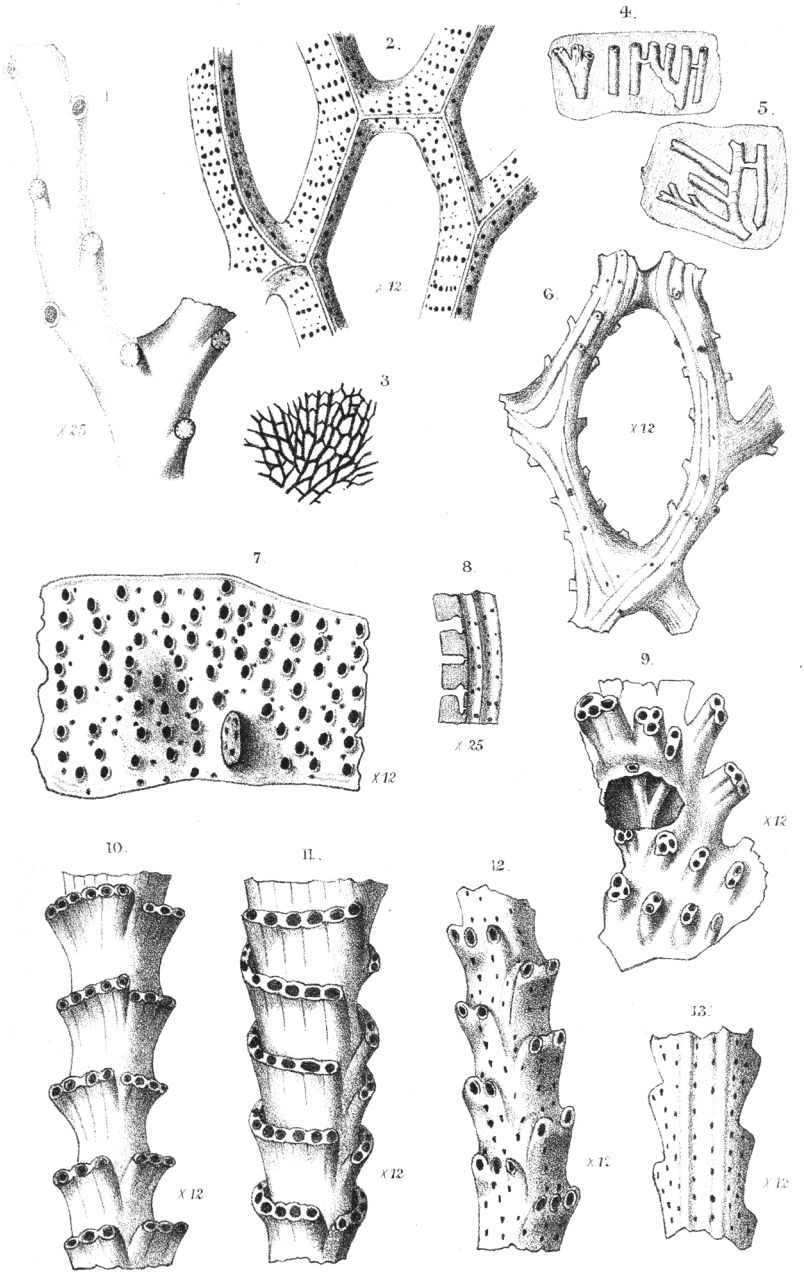
[Plates XXX. & XXXI.]

I have already described in the Journal of this Society the Chilostomatous Bryozoa from Curdies Creek, S.-W. Australia (vol. xxxvii.), Mount Gambier, South Australia (vol. xxxviii.), Bairnsdale, Gippsland (vol. xxxviii.), and Muddy Creek, Waurn Ponds, and Bird Rock, Victoria (vol. xxxix.). But the Cyclostomata I kept back, in order to deal with them all together; and since I completed my last paper I have received for description from Prof. Tate an interesting collection from Murray Cliffs and Aldinga *, South Australia, and all are now considered together. I have also in my hands a collection of fossils (belonging to Miss E. C. Jelly) from Napier, New Zealand, to which I allude in the text.

The determination of the Cyclostomata presents much greater difficulties, and is much more unsatisfactory than that of the Chilostomata, as there are fewer characters which can be used, so that classification has been made to depend principally upon the mode of growth—a character which has frequently proved of no value in the Chilostomata. Until within a recent period this was in both considered the main characteristic; but now, thanks to the labours of Smitt, Hincks, and other recent workers, it has been shown to be of secondary importance in the classification of the Chilostomata, which, however, possess many distinctive characters, such as the

* The Chilostomata from the "older Tertiary" of Aldinga and the River Murray Cliffs are very similar to those already described from the other Australian localities; and although they have not yet been thoroughly examined, a provisional list will show this similarity:—

Membranipora cylindriformis, *W.*, M. Cl.
—— radicifera, *Hincks*, M. Cl.
—— rhynchota, *Busk*, M. Cl.
—— aperta, *Busk*, Ald.
Micropora patula, *W.*, Ald. and M. Cl.
Monoporella crassatina, *W.*, Ald. and M. Cl.
—— sexangularis, *Goldf.*, Ald.
Steganoporella magnilabris, *B.*, M. Cl.
Cribrilina terminata, *W.*, M. Cl.
—— figularis, *Johnst.*, M. Cl.
—— radiata, *Moll*, M. Cl.
Microporella elevata, *Woods*, M. Cl. and Ald.
—— coscinopora, *Rss.*, M. Cl.
—— symmetrica, *W.*, M. Cl.
—— introversa, *W.*, M. Cl.
Microporella (Lunulites) magna, *Woods*, Ald.
Porina coronata, *Rss.*, Ald. and M. Cl.
Lepralia burlingtoniensis, *W.*, Ald. and M. Cl.
—— edax, *Busk*, M. Cl.
—— depressa, var. as from Bairnsdale, Ald.
Smittia Tatei, *Woods*, Ald. and M. Cl.
—— seriata, *Rss.*, M. Cl.
Schizoporella simplex, var., Ald.
—— vulgaris, *Moll*, Ald.
—— phymatopora, *Rss.*, M. Cl.
—— striatula, *Sm.*, M. Cl.
—— fenestrata, *W.*, M. Cl.
Mastigophora Dutertrei, *Aud.*, M. Cl.
Rhynchopora bispinosa, *Johnst.*, M. Cl.
Retepora.
Cellepora fossa, *Hasw.*, Ald. and M. Cl.
—— verruculata, *Sm.*, M. Cl.
Lekythopora hystrix, *MacG.*, M. Cl.
Lunulites guineensis, *Busk*, Ald.
Selenaria maculata, *B.*, M. Cl.
—— parvicella, *Woods*, M. Cl.



A. T. Hollick lith.

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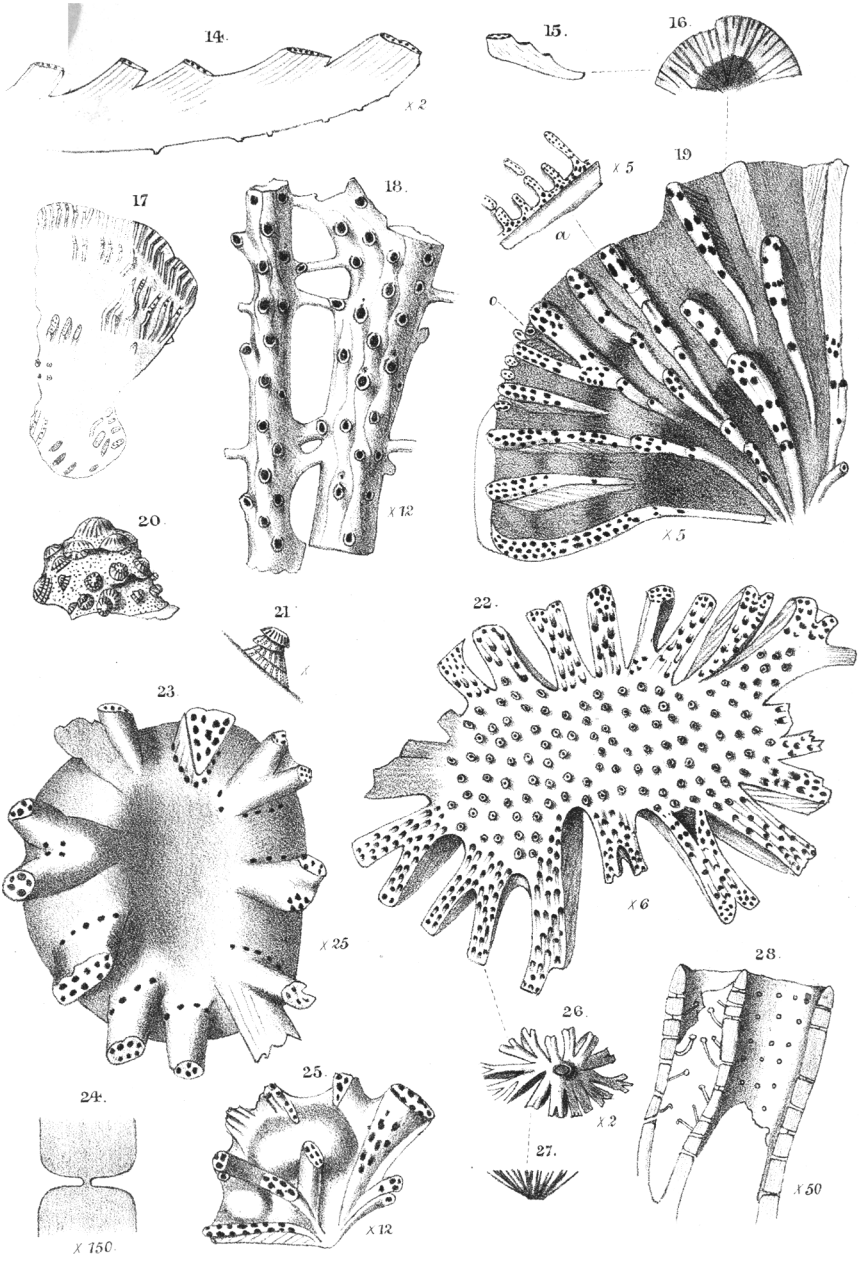
AUSTRALIAN CYCLOSTOMATOUS BRYOZOA.



A. T. Hollick lith.

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AUSTRALIAN CYCLOSTOMATOUS BRYOZOA.

form of the cell or zoœcium, together with the shape of the aperture (which is, perhaps, best indicated by the shape of the operculum); the presence, in a large number of cases, of a suboral pore or suboral avicularium, giving, in their various modifications, useful characters; and the position and nature of the avicularian and vibracular appendages furnish further means of recognition, though their presence or absence does not seem in all cases to be of much importance. Besides these we have the ovicell, which by its form frequently gives most valuable characters; and the shape, position, and number of the rosette-plates are also, where available, of the greatest value.

Before turning to the description of the Australian Cyclostomata, I have, during the last few years, spent a great deal of time in examining whether there are not other characters, besides the mode of growth, which may be used; and although the results are not encouraging, yet by means of more careful observation I believe that it will ultimately be possible to arrive at a more natural system than obtains at present. It will be best to consider the structures as far as possible in the same order that was adopted in discussing the characters of the Chilostomata.

The zoœcia being all tubular and quite simple, there is no variation here corresponding to the various shapes of the Chilostomata; and again, as the form of the aperture is always round or slightly elliptical, the only character here available is that of size (pointed out as useful by Smitt some years ago), which seems to be fairly constant in the same species. The variation in size is not very great, ranging only from about 0·03 millim. to 0·2 millim. in all species measured, but anything greater than 0·16 millim. or less than 0·07 millim. is very exceptional. There is also no operculum, which gives such useful characters in the operculated division; but, on the other hand, the zoœcial tubes are closed up by a calcareous plate, usually at a short distance from the aperture; and in a paper on the "Closure of the Cyclostomatous Bryozoa" (Journ. Linn. Soc. vol. xvii. p. 400, pl. xvii.), I have pointed out that the position of these closures, together with the nature of the perforations, is a character of considerable importance, although it is neither so available nor so important as the horny operculum.

Among the Palæozoic fossils there is in one or two a structure which may represent the suboral pore or avicularium; and as long as we do not know the signification of the "adventitious tubules" of *Diastopora obelia* &c., we may be justified in asking if they may not possibly have had an homologous origin.

No Cyclostomata have avicularia or vibracula, and there does not seem to be any structure to in any way take their place.

The ovicells are of the greatest value, but, unfortunately, are not found so frequently as in the other suborders. As yet but very few have been described, and with fossils the number known is extremely limited; but this to a certain extent arises from their having been neglected; for in my collection I have a much greater number of fossil ovicells than the total number which have so far been described fossil.

In a large number of Cyclostomata the ovicell is a nearly globular or pyriform sac, as in *Crisia*; in others it is an irregular inflation, partly enclosing some of the zoœcia; and in nearly all these cases the wall of the ovicell has small pores, of the same size as those in the zoœcial wall, but much closer together than in any other part of the zoarium. In *Idmonea radians*, Lamk., however, there is a much more elaborate structure; for here the front has large ridges and large openings, but at the side there are plates surrounded by raised borders, and these plates are perforated by very numerous pores placed close together *. In *Hornera* the ovicell is usually, or perhaps always, on the dorsal surface; and as this is the case in *Idmonea irregularis*, perhaps it should be removed to *Hornera*, for which there seemed before some reasons; in other genera the ovicell occurs on the front.

In the Lichenoporidæ the ovicell is, as a rule, an irregular inflation; but in a specimen of *Lichenopora* which no doubt is *L. novæ-zelandiæ*, Busk, the ovicell is considerably raised, and occupies the whole of the centre of the zoarium. The central part of this raised ovicell is flat, and is surrounded by a raised meandering line, and in this flat portion there is a semicircular opening.

There is considerable variety in the form and size of these ovicellular openings, and it seems that this character should always be given, if possible, in describing any species. The opening is very frequently infundibuliform; sometimes directed forwards; in other cases, as *Tubulipora*, sp., directed backwards. In *Hornera lichenoides*, Smitt, and in my specimens of *H. frondiculata*, the opening is lateral; but Mr. Busk gives it as superior.

The next character of the Chilostomata mentioned was that furnished by the rosette-plates, and I have shown that there is a great detail variety in the way in which the connexion between the various zoœcia takes place through these rosette-plates. In the distal wall the number of these plates varies from 1 to 4, and in the lateral wall from 2 to 8 or more; and further, the rosette-plate itself varies in shape and size, and also in the number of openings or connecting-points. Having made preparations of the rosette plates of a large number of species, I find that almost all show some characteristic points, and consider that they furnish most useful specific characters; but in the Cyclostomata there are no rosette-plates, and so we are led to ask What is the equivalent of so important a structure? and can it be used in classification? In order to answer this question, I have prepared a large number of sections of the calcareous framework of recent and fossil Cyclostomata, and find that in the walls of the tubular zoœcia there are usually two kinds of pores or openings: first, the very small ones which open to the exterior of the zoarium, and these we will call surface-pores; it is these which cause the dotted surface familiar in *Crisia*, most *Idmoneæ*, *Tubuliporæ*, *Stomatoporæ*, *Entalophoræ*,

* From Naples I have an *Idmonea*, perhaps *I. triforis*, Hell., with very curious ovicells. In the place of a series of zoœcia there is a raised chamber, in shape like the bag of a bagpipe, with a few large pores on the surface, giving it much the appearance of the ovicell of *Hornera frondiculata*,

Filisparsæ *, &c.; and further, I find that the size (0·008 millim.) of these pores varies but very little, having preparations of recent, Tertiary, Cretaceous, and even Palæozoic forms of many genera showing scarcely any variation in this respect. This structure is well shown in sections figured by J. Beissel, especially in pl. x. fig. 127, in his paper "Ueber die Bry. der Aachener Kreide," Nat. Verh. Holl. Maat. Weten. Haarlem, xxii^{e} Deel—a most valuable work, which does not seem to have received the attention it deserves. These, I take it, are the homologues of the much larger pores in the front of nearly all Chilostomata, which there also cause the zoœcial ornamentation. Besides these, there are in the interior of the Cyclostomatous tube much larger pores, and these I have found to occur with a certain amount of regularity, and approximately at certain distances apart; so that when a zoœcial tube is cut open correctly along its axis, one or two rows of these pores are seen, and the position of the rows and the distance apart of these interzoœcial pores seem to be of specific importance. Having noticed this much, it is not unnatural to consider these pores the homologues of the rosette-plates of the Chilostomata, and upon more careful examination we find support for this view. This can best be studied where the pores are long, as, for instance, in *Heteropora pelliculata* †, Waters, in which a diaphragm or plate, seemingly perforated in the centre, occurs in the middle of the pore-tube (see Plate XXXI. fig. 24): and thus it seems entirely to correspond to the simplest of the rosette-plates among the Chilostomata.

As already indicated, probably the typical distance and the order of these pores will in most cases be distinguishable; yet there is not an absolute regularity, and it must be remembered that in the Chilostomata when the number of rosette-plates increases so does the irregularity; when there are four or six lateral plates it is by no means uncommon to find that one of these is replaced by two smaller ones; but then upon examining the walls of two or three cells the type can be made out.

In such genera as *Entalophora* &c. there are always the fine surface-pores ‡, although sometimes from the state of preservation or fossilization this is not apparent, and a great number have been incorrectly described as without this structure; but in some genera, such as *Hornera*, some *Idmoneæ*, such as *Idmonea radians*, and a number of others both living and fossil, there are, over part of the

* There are also such pores on the dorsal surface of *Lichenopora*; and as this dorsal surface is attached to stones, &c., it is in such cases difficult to understand their use.

† There is no doubt at all that *H. neo-zelanica*, Busk, is only a synonym for *H. pelliculata*. The New-Zealand specimens, for which I am indebted to Prof. H. A. Nicholson, had evidently been dead some time, and the exterior was slightly stained and corroded; but the interior was well preserved, and the internal characters are identical in these and the Japan specimens; and the difference in the shape of growth is not greater than in the series of Japanese specimens in the British Museum.

‡ In recent *Idmonea Milneana*, these "dots" are raised; but here also they are perforated, as pointed out by Mr. S. O. Ridley, so that this only indicates an elongation of the pore-tube.

surface at any rate, and sometimes over all, larger openings giving a peculiar ornamentation to the surface; these large surface-openings do not, however, enter directly as such into the zoœcial tube, but at the base there are one or more minute openings leading to the zoœcial cavity (see Pl. XXX. fig. 8). In *Idmonea radians* these large exterior openings all occur at the junction of two zoœcia; and in some *Hornerœ*, as *H. reticulata*, the posterior surface is divided into reticulations, in each of which there is one or more of these large openings.

Still another character which may be of some use in testing the correctness of classification is the presence of "numerous minute rays" (Crag. Polyz. p. 122) in the zoœcia and canaliculi, or as I called them in *Lichenopora radiata* (Bry. Naples. p. 276) "delicate hair-like teeth," which occur in several *Lichenoporœ* and then have globular terminations.

In *Heteropora pelliculata*, Prof. Nicholson has figured them (Ann. & Mag. Nat. Hist. 1880, p. 8), but he does not seem to have noticed that they had globular terminations, though in sections made from a specimen which he kindly gave me I find this to be the case (see Pl. XXXI. fig. 28).

In what I call *Heteropora cervicornis* (Recent Heterop. Journ. R. Micr. Soc. vol. ii. p. 392), which MacGillivray has since described as *Densipora corrugata*, there are short obtuse teeth inside the zoœcia, and in some Cyclostomata these are still further reduced, so that the inner surface appears irregular without definite teeth. This is, however, a character that will probably but seldom be available in studying fossils.

The examination of the Chilostomata has shown that the mode of growth is in most cases of secondary importance, and that the form of the zoœcia must be considered as of far greater value. This not unnaturally leads us to see that with the Cyclostomata also slight differences of growth must not be used as generic characters; but we must not allow this to carry us too far, though what has been learnt in the Chilostomata will convince us that so long as the classification of the Cyclostomata is based upon so few characters we may yet be far from a natural one.

Such characters as whether there is one layer of cells, as in the *Lepraliœ* of the older writers, or two, back to back, as in *Escharа*, or whether the zoarium is reticulate, have been unhesitatingly abandoned as of no generic value; and in the same way there are reticulated *Idmoneœ*, *Hornerœ*, *Filisparsœ*, and many other genera, and the differences between *Diastopora*, and *Berenicea* or *Mesenteripora* cannot be considered as very great; but in the Cyclostomata there are some such characters as the occurrence of definite bundles of zoœcia in *Frondipora*, *Fasciculipora*, &c., which must be looked upon as of far different importance, and in the same way the presence of interspaces *, forming cancelli, between the zoœcia does so far seem a character of great value, and these seem to indicate a different origin of the zoœcial tube.

* By using the word "interspaces" it will be seen that I do not accept Prof. Nicholson's suggestion that the cancelli "were occupied by a set of zoöids."

There is in certain Chilostomata a tendency for one layer of zoœcia to grow superposed upon the preceding one, as, for instance, in *Schizoporella sanguinea*, *Micropora impressa*, Moll. In *Nodelea*, from the Chalk, this is also the case, and upon this peculiarity the genus *Multinodelea* was founded; but from specimens of *Nodelea angulosa* I collected from the Chalk of Royan it is clear that it occurs in both forms, and the same thing is frequently found in the Cyclostomata, and probably should but seldom be used as a generic character.

In a specimen of *Diastopora lamellosa*, Mich., from the Oolite, there is the usual growth, consisting of two layers of zoœcia growing back to back, but on one side there are two other layers superposed on the original one.

This is not the place to fully discuss the various classifications of the fossil Cyclostomata, but none yet seems at all satisfactory. Beginning with d'Orbigny's, although many of the principles adopted were undoubtedly good, yet he carried it out so unsatisfactorily that what is good in it has been too much neglected; and coming next to Busk's in the Crag Polyzoa we certainly cannot now accept any classification which separates under two quite distinct divisions *Pustulopora* and *Spiropora*, the one falling under the section "cellulis distinctis" and the other under that "cellulis indistinctis," and I must confess my utter inability to understand in the least what this division means, and what it is based upon. Again, while *Discoporella* and *Defrancia* are united in one family, *Fungella*, *Frondipora*, and *Fascicularia* are placed in three; and a study of Mr. Busk's synoptical table cannot fail to leave us impressed with the difficulty of the classification of the fossil Cyclostomata. Before the third part of the catalogue of British-Museum Bryozoa was written, Smitt's classical work had appeared, and of course was to a large extent followed; but I am inclined to look upon the removal of *Defrancia* from the Fasciculinæ as a slip on the part of Mr. Busk.

Next comes the work of my friend Mr. Hincks; but the range of recent British Cyclostomata is so small that it does not help us much in considering general classification. I certainly cannot follow him at present in separating *Hornera* from *Idmonea* in the families Horneridæ and Tubuliporidæ.

Although it would be impossible here to give a complete history of all that has been attempted in the way of arrangement, we must mention the efforts of Dr. H. Hamm; but certainly the thesis (Die Bry. des Mastr. Ober-Senon. 1 Th. Cyclost. Berlin, 1881), does not deal with the difficulties in a way which recommends itself to my mind; for it is not new genera and families that are wanted, but to show the connexion of those now used, instead of creating on a slender basis fourteen new genera of fossil Cretaceous Cyclostomata, where genera already exist in overwhelming superabundance; and further his third type, the Stigmatoporina, is certainly doubtful, as it is largely, if not entirely, composed of Chilostomata*, *Multelea magnifica*, d'Orb., and

* *Elea*, *Myriozoum* and some others may possibly have to be grouped together as a division of the Chilostomata; but, with opercula and avicularia, they have nothing in common with the Cyclostomata.

others having distinct avicularia; and probably *Meliceritites* should be entirely abandoned. On the other hand, however, Dr. Hamm has done service in showing the importance of the manner in which the new zoœcia arise in the colony.

Mr. Vine has brought together in the British Association Reports a vast amount of material bearing upon the classification of Cyclostomata up to the age of the Cretaceous, and it must be of great use for future workers. For my own part I much doubt if we are yet in a position to frame anything approaching to a natural and final classification of the older forms; but this opinion may arise from my extremely small acquaintance with Palæozoic Bryozoa; but neither do I think we have nearly arrived at that point with the recent and neozoic forms, and until this is the case we can hardly expect to be quite sure about the older ones; and I have often urged upon my friend Mr. Vine that more information concerning the minute structure would be most valuable from so good a worker.

For my own part I must at present be content with making known further material which should be of some use in assisting towards more definite ideas of the group, and while I have given some indications as to various directions for investigation, a collection like the present, where many are not perfectly preserved, where few have ovicells, and where there is often only an isolated specimen, is not favourable for testing any system.

However we attempt to arrange the Cyclostomata, the divisions are found not to be very distinct, and many of the genera generally accepted must be discarded. To take an example, the growth of a typical *Spiropora*, such as *S. verticillata*, may seem marked enough to form a genus *Spiropora*; but in several specimens of *Spiropora conferta*, Rss., from Val di Lonte, there are parts of the colony where the complete circle of zoœcia is most typical, whereas in other parts of the same colony the cells are arranged irregularly quincuncially, and this is especially the case near the bifurcations. Here part of the colony might be determined as *Spiropora conferta*, Rss., and the other part as *Entalophora pulchella*, and on this account I have dropped the genus *Spiropora* and united it to *Entalophora*; again, *Filisparsa* comes very near to *Entalophora*, and in its turn *Filisparsa* approaches such a form as *Idmonea irregularis*, Meneg., which is most difficult to place, as sometimes the cells are so distinctly serial as to give it every appearance of *Idmonea*, while at other times the appearance is that of *Filisparsa*; but the ovicell of the Mediterranean *Filisparsa* is on the front of the zoarium, and that of *I. irregularis* on the dorsal surface, which would seem to indicate that it should probably be relegated to *Hornera*.

The available characters in the Cyclostomata being much fewer than in the Chilostomata, we are on this account not likely to find the first as useful palæontologically; and further as they are less highly differentiated, it should not surprise us to find them more persistent through various periods; and *Entalophora verticillata*, which may be said to be as simple as any known form, consisting as

it does of the zoœcial tubes placed round an imaginary axis, each row having the openings at equal distances with the regularity of vegetative repetition, occurs widely from the Palæozoic to these Australian beds.

For the same reasons we cannot feel as sure that similar specimens from widely separated strata are identical, since there may have been differences in the organic structures which have left no record, and therefore there is more uncertainty than with the Chilostomata, because the correlation of a number of characters is a justification for considering the species identical. On the other hand I consider that so long as no difference is discoverable, the name already adopted must be used, however great the interval in space or time may be between the two. This may seem an unnecessary remark, for with shells and other fossils it is generally recognized; but the contrary mode of proceeding has occurred frequently with authorities on the Bryozoa; for instance, Ulrich names a fossil *Mitoclema cinctosa* (a new genus and species), because no Entalophoridæ are "known to occur in older strata than Jurassic." On page 685, I refer to this as apparently not differing from the European Chalk fossils. Again Dr. Fischer (in Bry. Echin. et Foram. p. 27) protests vigorously against giving the same name to specimens from different latitudes, and still more if from Secondary or Tertiary deposits. This he considers dangerous, and that we should doubt the perfection of our means of investigation.

The results, however, obtained by the leading workers during the last ten years have shown what an extremely surprising wide distribution many of the common and highly developed Chilostomata have; and to me it seems that to give two names to what we cannot distinguish because one is European and the other Australian, or because one is of Tertiary age and the other of Secondary, is only hiding our want of knowledge behind a name. Certainly one of the reasons that make d'Orbigny's 'Paléontologie Française' so difficult to use is, that however much the fossil Bryozoa might correspond, yet, if from different strata, they were almost sure to receive two christenings.

In the fossils now described many are found to have a wide range, and this has already partly been dealt with; but another factor lies in the fact that the genera of Cyclostomata to be mentioned are, apparently, mostly not shallow-water forms, whereas many of the Chilostomata no doubt lived at a less depth. With the exception of occasional *Crisiæ*, *Tuburiporæ*, and *Stomatoporæ*, I did not find any Cyclostomata in the Bay of Naples in shallow water; and it seems that most of this suborder are found in comparatively deep water. This may arise to a large extent from the difference in structure, as probably the greater protection given by the horny operculum makes the Chilostomata more able to live in the shallower, and consequently more disturbed and less pure water; and any fauna from a deep zone is likely to be more persistent than one nearer the surface.

The various collections furnish 34 species, of which 12 at least

are known living, and most of the rest are closely related to living species; and no doubt the number of these would be much larger if the living Cyclostomata had received adequate attention. One cannot be distinguished from a Palæozoic fossil, while nine are, as far as examination is available, identical with European Cretaceous species, and most of the others have Cretaceous representatives, from which they differ but little. But stress has already been laid on the want of details for comparison and classification; and although so many show in the calcareous framework so close a resemblance to those found in the European Chalk, yet no one is at present able to say that there have not been differences which we cannot now distinguish.

This, including a few additions in the list of the Chilostomata in Professor Tate's collection, brings the total number of Australian fossil Bryozoa discussed up to 197, of which 90 are already known living.

	Page.	Living.	Orakei Bay (*Stol.*).	Curdies Creek.	Mt. Gambier.	Bairnsdale.	Muddy Creek.	R. Murray Cliffs.	Aldings.	Allies and Localities.
1. Crisia unipora, *d'Orb.*	683	...	...	*	...	...	...	...	...	European Chalk.
2. Idmonea atlantica, *F.*	683	*	*	*	*	*	...	...	...	Miocene, Pliocene of Europe.
3. —— Milneana, *d'Orb.*	684	*	*	*	*	*				
4. —— radians, *Lamk.*	684	*	...	...	*					
5. —— Hochstetteriana, *St.*	684	...	*	*	...	*				
6. —— bifrons, nov. sp.	685	...	...	...	...	...	...	...	*	Cretaceous.
7. Entalophora verticillata, *Goldf.*	685	...	...	...	*	...	...	...	...	Cretaceous, Palæozoic.
8. —— raripora, *d'Orb.*	686	*	*	*	*	*	*	*	*	Cretaceous.
9. —— neocomiensis, *d'Orb.*	686	...	*	*	*	*	*	...	...	Cretaceous and Miocene.
10. Filisparsa orakeiensis, *Stol.*	687	...	*	*	*	*				
11. Hornera frondiculata, *Lamx.*	687	*	...	*	*	*	...	*	...	Pliocene.
12. —— foliacea, *MacG.*	688	*	...	...	*	*	...	*		
13. Stomatopora granulata, *M.-Ed.*	688	*	...	...	...	*	...	...	...	Waurn Ponds; Cretaceous.
14. Diastopora suborbicularis, *H.*	689	*	...	...	*	...	*	...	...	Waurn Ponds.
15. —— patina, *Lamk.*	689	*	...	...	*					
16. Reticulipora, sp.	689	...	...	...	*	...	...	...	...	Allied to *R. dorsalis*, W.
17. —— transennata, nov. sp.	689	...	...	...	...	...	...	...	*	
18. Discotubigera clypeata, *Lamx.*	690	...	...	?	...	...	...	...	*	Oolitic.
19. —— iterata, nov. sp.	690	...	...	...	...	...	...	...	*	
20. Pavotubigera flabellata, *d'Orb.*	691	...	...	...	...	...	...	...	*	
21. —— dimidiata, *Res.*	691	...	...	...	*	...	...	...	...	Miocene.
22. —— gambierensis, nov. sp.	692	...	...	...	*					
23. Defrancia exaltata, nov. sp.	692	*	...	...	*					
24. Supercytis digitata, *d'Orb.*	692	...	...	...	...	...	...	*	...	Cretaceous.
25. Fasciculipora, sp.	693									
26. Fascicularia conjuncta, nov. sp.	693	...	...	...	...	...	...	*		
27. Lichenopora hispida, *Flem.*	694	*	...	...	*	*	*	*	...	Waurn Ponds: Miocene, Pliocene
28. —— radiata, *Aud.*	694	*	...	*	*	*	*	...	...	Napier, New Zealand (fossil).
29. —— aldingensis, nov. sp.	695	...	...	...	...	...	...	...	*	
30. —— cochloidea, *d'Orb.*	695	...	...	...	*	...	...	...	...	Cretaceous.
31. —— boletiformis, *d'Orb.*	695	...	...	...	...	...	...	...	*	Cretaceous.
32. —— variabilis, *d'Orb.*	696	...	...	...	...	...	...	...	*	Cretaceous.
33. Heteropora, sp.	696									
34. —— aldingensis, nov. sp.	696									

Crisia.

There are fragments from Curdies Creek representing more than one species, some of which may be *C. eburnea* and *C. elongata*; but I am unable to identify the broken joints.

1. CRISIA UNIPORA, d'Orb. Pl. XXX. fig. 1.

Idmonea unipora, d'Orb. Pal. Franç. p. 737, pl. 613. figs. 1–10.
Crisina unipora, d'Orb. Prodr. p. 265.
Crisina elegans, d'Orb. Pal. Fr. pl. (only) 613.

A specimen from Curdies Creek is undoubtedly the same as d'Orbigny's, though a trifle larger, nearly $\frac{1}{4}$ of a millimetre, instead of $\frac{1}{5}$, and the zoœcial tubes project rather more. Whether this is to belong to *Idmonea*, *Filisparsa*, or *Crisia* is very doubtful. The puncturing is the same as that of some *Crisiæ* from the same locality, but the distance apart of the zoœcia is about double as great as we find in most recent *Crisiæ*, in which it is usually only a little greater or less than 0·25 millim., though in *Crisia cornuta* the distance is sometimes as great as in the fossil, in which it is about 0·45. On the other hand, the closure of the zoœcial tube is terminal, whereas in *Filisparsa* and *Idmonea* it is a little distance down the throat of the zoœcial tube. If it is to be looked upon as a *Crisia*, then it is interesting to find it unjointed; but if it is considered a *Filisparsa*, then it is interesting to find the regularity of a *Crisia*. Width of zoœcial aperture 0·1 millim.

Loc. Senonien: Fécamp (Seine-Inf.); Vendôme (Loir-et-Cher); Curdies Creek, Australia.

2. IDMONEA ATLANTICA, Forbes.

Idmonea radians, V. Ben. (non Lamk.) Bry. de la Mer du Nord. Bull. Brux. xvi. pt. 2. p. 646, pl. i. figs. 4–6.
Idmonea inconstans, Stol. Foss. Bry. Orak. Bay, p. 116, pl. xviii. figs. 7, 8.

For synonyms see Hincks, Brit. Mar. Polyz. p. 451, pl. lxv. figs. 1–4. The distance of the series of zoœcia apart is from 0·6 to 0·8 millim., which is about the same as figured by Smitt (Krit. Fört. pl. iv.). The main character seems to be that the zoœcial openings are all on the upper part of the branches, so that at each side the lower part is without zoœcial tubes. There are some stouter fragments which at first I thought should be called *I. serialis*, Stoliczka; but it seems as though they should only be considered a stouter variety, and perhaps may be *I. australis* of MacGillivray and *I. lineata* of Hagenow and Manzoni. I do not see that *I. communis* (d'Orb. pl. 750. figs. 6–10) differs in any structural particular from the present species.

In a specimen from Bairnsdale the ovicell which occurs near the bifurcation is elongate-pyriform, embracing the zoœcia, about 1·5 millim. long, and the position of the ovicell is the same in the typical *I. atlantica* and the stouter variety.

Loc. Living: Arctic and European seas; North Atlantic; Florida (*Sm.*); Madeira (*I.*). Fossil: Miocene, Eisenstadt, Steinabrunn, (*Manz*); Astian and Sicilian of Sicily (*Seg.*) and Pruma (*A. W. W.*); Canadian Postpliocene (*Dawson*); Orakei Bay (*Stol.*); Curdies Creek, S.W. Victoria; Mount Gambier, Bairnsdale.

3. Idmonea Milneana, d'Orb.

Idmonea Milneana, d'Orb. Voy. dans l'Amér. Mérid. vol. v. p. 20, pl. ix. figs. 17–21; Smitt (?), Floridan Bryozoa, p. 8, pl. iii. figs. 14–16; Busk, Cat. Mar. Polyz. pt. iii. p. 12, pl. xi; Haswell, on Cyclost. Polyz. Port Jackson, Proc. Linn. Soc. N. S. Wales, vol. iv. p. 351; MacGillivray, Zool. of Victoria, decade vii. p. 29, pl. lxviii. fig. 1; Busk, Note on Foss. Polyz. near Mt. Gambier, Q. J. G. S. vol. xvi. p. 261; Ridley, Zool. Coll. of 'Alert,' Proc. Zool. Soc. 1881, p. 56.

Idmonea Giebeli, Stoliczka, Olig. Bry. von Latdorf. p. 81, pl. i. fig. 6.

Idmonea Giebeliana, Stol. Foss. Bry. Orakei Bay, p. 115, pl. xviii. figs. 4, 6.

Idmonea notomale, Busk, Cat. Mar. Polyz. pt. iii. p. 12, pl. xii. a.

The specimens from Curdies Creek show the minute pores on the front and dorsal surface to be quite similar in size and frequency. Although this is widely distributed, the ovicell is, as yet, only known in the Capri specimen, in which it occurs very little raised, mostly in the centre of the zoarium, embracing the zoœcia. Zoarium 0·8–1·5 millim. wide, width of zoœcial tube about 0·15 millim. The thickness of the margin of the tube must, to a large extent, depend upon the locality of growth. In a specimen from Mt. Gambier, in the collection of Mr. Etheridge, jun., there is a spine on the dorsal surface, as described by Mr. Ridley.

Loc. Living: Iles Malouines (*d'Orb.*), Terra del Fuego; Patagonia, 30 fathm.; Chonos Archipelago? (*B.*); Florida? (*Sm.*); Sydney (*Hasw.*); Port Phillip Heads, Victoria, 10–15 fathm. (*MacG.*); Tom Bay, S.W. Chili, 0–30 fathm. (*Ridley*); Capri. Fossil: Oligocene, Latdorf; Orakei Bay (*Stol.*), Mt. Gambier, Curdies Creek, Bairnsdale.

4. Idmonea radians, Lamk.

Retepora radians, Lamk. Anim. sans vert. ii. p. 183.

Idmonea radians, Stoliczka, Foss. Bry. d. Orakei Bay, p. 116, pl. xviii. figs. 9–10.

I thus name, with some doubt, a few delicate specimens from Mt. Gambier, about 0·3 millim. wide, and with the series 0·4–0·5 millim. apart.

5. Idmonea Hochstetteriana, Stol. Pl. XXX. figs. 12, 13.

Crisina Hochstetteriana, Stoliczka, Foss. Bry. der Orakei Bay, p. 113, pl. xviii. fig. 3.

Branches of zoarium triangular; zoœcia projecting in alternate series of 2–3 zoœcia, long pores down the centre of the zoarium, and also along the centre of the zoœcia; dorsal surface slightly ridged, with long pores in longitudinal lines.

This is related to *Idmonea radians*, Lamk., a living species, which is more slender; and the series of zoœcia are in that species nearer together. There are in *I. Hochstetteriana* at least eight double series of zoœcia without any fresh bifurcation; whereas in my specimens of *I. radians* the branching is much more frequent.

The ovicells are unknown, but in *I. radians* they occur at the bifurcation as an elongate raised protuberance, with very large pores on the front, between which there are irregular ridges; at the sides there are two large areas surrounded by a double line, and these areas are perforated by a very large number of minute pores.

I am doubtful whether *Crisina Hochstetteriana*, Smitt, from Florida, is identical with the fossil, though it is, at any rate, closely allied to it; but neither of these are closely allied to *I. marionensis*, Busk.

Loc. Orakei Bay (*Stol.*); Curdies Creek, Bairnsdale.

6. IDMONEA BIFRONS, nov. sp. Pl. XXX. figs. 10, 11.

Tubigera disticha, d'Orb. Pal. Fr. p. 723, pl. 746. figs. 2–6.

Idmonea disticha, Hag. Bry. Maastr. p. 30, pl. ii. fig. 8.

Zoarium nearly round, slightly compressed laterally, with series of 7–10 zoœcia on each side of two mesial lines, one of which must be considered as on the front, the other on the dorsal surface, series 0·7 millim. apart; zoœcia fairly exserted, diam. 0·1 millim.

The genus *Tubigera* was made by d'Orbigny for forms of which this is the most typical, and there seems to have been much confusion concerning that genus and also this species; for it is not the same as the *Idmonea* named *disticha* by Goldfuss, Reuss, Manzoni, or Michelin. If the genus *Tubigera* is retained, then perhaps *Bisidmonea*, d'Orb., should be joined with it. The figure of *Idmonea* (*Retepora*) *disticha*, Goldf., apparently relates to two or three species, but certainly not the present; and subsequently d'Orbigny calls the *Idmonea disticha* of Reuss *Crisina disticha*, so that he uses the specific name in two of his genera; but now both are considered to belong to *Idmonea*.

This looks like a connecting-link between the *Spiropora* form of *Entalophora* and typical *Idmoneæ*. It differs from most *Idmoneæ* by the series nearly meeting at the back, so that there is no dorsal surface.

Loc. Les Loches (Loir-et-Cher) (*d'Orb.*); Maestricht (*Hag.*), Aldinga.

7. ENTALOPHORA VERTICILLATA, Goldf.

Ceriopora verticillata, Goldf. Petr. Germ. i. p. 36, pl. ii. fig. 1.

Spiropora antiqua, d'Orb. Pal. Fr. p. 710, pl. 615. figs. 10–18, pl. 745. figs. 15–19.

Spiropora neocomiensis, d'Orb. loc. cit. p. 708, pl. 784. figs. 1, 2.

Spiropora verticillata, Novak, "Beitr. z. Kenntn. der Bry. der böhm. Kreide," Denkschr. k. k. Akad. Wien, vol. xxxvii. p. 34, pl. viii. figs. 7–12.

Spiropora calamus, Gabb & Horn, Monogr. Foss. Polyz. Second. and Tert. Form. of N. America, p. 166, pl. xxi. fig. 55.

Mitoclema cinctosa, Ulrich, Amer. Pal. Bry. Journ. Cincinn. Soc. Nat. Hist. vol. v. p. 159, pl. vi. figs. 7, 7 *a*.

For further synonyms see d'Orbigny and Novak.

Specimens in the collections of the Geological Society and of

Mr. Etheridge, jun., are exactly similar to some I have from the Valangian of St. Croix (Jura), and also to specimens collected from the Chalk of Maestricht and of Royan. The internodes are about 0·1 millim. long, and there are usually 8–10 in a complete circle. The ovicells are as yet unknown. The size of the Palæozoic form is, according to Ulrich's description, about the same size as the European specimens.

Loc. This species was very common and widely distributed in the European Chalk. It is found in almost all localities in the Senonian of France and Belgium and also in the Cretaceous of N. America (*G. & H.*), in the Pläner of Plauen and Strehlen (*Nov.*), in the Greensand of Essen, in the Valangian of the Jura, and in the Trenton strata, High Bridge, Kentucky (*Ulr.*). Mt. Gambier.

8. Entalophora raripora, d'Orb.

Entalophora raripora, d'Orb. Prodr. Pal. Strat. p. 267; Pal. Franç. p. 787, pl. 621. figs. 1–3, pl. 623. figs. 15–17; Beissel. Bry. Aachener Kreidebildung, p. 82, pl. x. figs. 120–128; Novak (pars), Beitr. z. Kenntn. d. Bry. der böhm. Kreide, p. 32.

Pustulopora virgula, Hag. Bry. Mästr. p. 17, pl. i. fig. 3.

Entalophora icauensis, d'Orb. Pal. Franç. p. 781, pl. 616. figs. 12–14.

Entalophora attenuata, Stol. Bry. von Latdorf, p. 77, pl. i. fig. 1; Reuss. (?) Bry. Crosaro, p. 74, pl. xxxvi. figs. 1, 2.

Entalophora anomale, Manzoni, Bri. Mioc. Austr. ed Ungh. p. 10, pl. ix. fig. 33.

Entalophora Haastiana, Stol. Bry. Orakei Bay, p. 102, pl. xvii. figs. 4, 5.

Pustulopora proboscidea, Busk, Cat. Mar. Polyz. pt. iii. p. 21, pl. xvii. *a* (right figure). Also Milne-Edwards; Heller; and Waters, Bry. of Bay of Naples, Ann. & Mag. Nat. Hist. ser. 5, vol. iii. p. 274, 1879.

I have prepared sections of recent specimens, and also some from the Chalk, Miocene, and Pliocene, without being able to find any difference. The aperture is about 0·16 millim. diam.

Loc. Fossil: From the Valangian of St. Croix and Pontarlier (Cant. Vaud), general in the European Senonian. Miocene: Austria, Hungary, and Italy. Pliocene: Italy, Sicily; also from Orakei Bay (*Stol.*), Curdies Creek, Muddy Creek, Bairnsdale, Mt. Gambier, Aldinga, and River Murray Cliffs.

9. Entalophora neocomiensis, d'Orb.

Entalophora neocomiensis, d'Orb. Pal. Fr. p. 782, pl. 616. figs. 15–18.

? *Bidiastopora neocomiensis*, d'Orb. loc. cit. p. 800, pl. 784. figs. 9–11.

Cricopora pulchella, Rss. Polyp. Wien, p. 40, pl. vi. fig. 10.

Spiropora pulchella, Rss. Foss. Anth. u. Bry. von Crosaro, p. 287 (75), pl. xxxvi. figs. 4, 5.

Pustulopora pulchella, Manzoni, Bri. del Mioc. Austr. ed Ungh. p. 11, pl. ix. fig. 35.

Bidiastopora Toetoeana, Stoliczka, Foss. Bry. der Orakei Bay, p. 100, pl. xvii. figs. 2, 3.

The zoœcial tubes are about 0·08–0·09 millim. in diameter, and there is about 0·6 millim. distance between the aperture of a zoœcium and the following one on the same axial line. Some specimens that I collected from St. Croix and Pontarlier are over 0·1 millim. in diameter, and I have still larger specimens which are identical with *Bidiastopora neocomiensis*, and sometimes they are quite compressed, and these seem in the Jurassic fossils to indicate a transition from the $\frac{1}{2}$-millim. *Entalophora* to the large *Bidiastopora*.

A specimen from Curdies Creek is slender (0·5 millim. diam.), with only few zoœcia round the zoarium; but some specimens from Bairnsdale are twice as large, and consequently have more zoœcia.

Loc. Fossil: Valangien, St. Croix and Pontarlier (Jura) (*A. W. W.*). Miocene: Austria and Hungary, and Crosaro, Val di Lonte (*Rss.*); Orakei Bay (*St.*), Curdies Creek, Mt. Gambier, Bairnsdale, and Muddy Creek.

10. Filisparsa orakeiensis, Stol.

Filisparsa orakeiensis, Stoliczka, Foss. Bry. der Orakei Bay, p. 111, pl. xviii. figs. 1, 2.

The zoœcial tubes are about 0·08 millim. in diameter, which is about half the size of those of *F. tubulosa*, from the Mediterranean and from Holborn Island, Australia. I now find upon examination of specimens, that *F. tubulosa*, Busk, and *F. varians*, Rss., are closely allied, if not identical.

In a badly preserved specimen from Mt. Gambier there is a raised subglobular ovicell on the dorsal surface, near the bifurcation, with the aperture terminal. This ovicell, consisting of a distinct chamber, corresponds with that of *Idmonea? irregularis*, Menegh., while in *Filisparsa tubulosa* the ovicell is on the front surface, and instead of being a distinct chamber, is an irregular enlargement. The ovicell is only known in these two species of *Filisparsa*, and possibly when more are known they will have to be differently classified. In the recent Australian *Filisparsa*, the closure, which is near the end of the zoœcial tubes, has minute perforations just similar to the surface-pores.

Dr. Jullien * proposes to make a new genus *Tervia* for the *Filisparsa* of d'Orbigny; but I do not see what reason there can be for this change of name.

Loc. Fossil: Orakei Bay (*Stol.*); Curdies Creek, Bairnsdale, and Mt. Gambier.

11. Hornera frondiculata, Lamx.

Hornera frondiculata, Lamouroux, Expos. Méth. p. 41, pl. 74. figs. 7, 8, 9; Busk, Crag. Polyz. p. 102, pl. xv. figs. 1, 2, pl. xvi.

* Dragages du Travailleur; Bryozoaires; Bull. Soc. Zool. de France, t. vii. 1882, p. 500.

fig. 6; Cat. Mar. Polyz. pt. iii. p. 17, pl. xx. figs. 1, 2, 3, 6; Waters, Bry. of Naples, p. 275.

Hornera porosa, Stoliczka, Olig. Bry. von Latdorf, p. 79, pl. i. f. 3.

From the River-Murray Cliffs there is a well-preserved specimen which exactly corresponds with some recent ones I have from Naples, and this served as a key to the Curdies-Creek collection, from which there are a number of fragments, which, viewed separately, might have been considered as representing several species. Towards the growing end the ridges forming the lozenge spaces are smooth, whereas towards the base they are transversely nodulated. On the dorsal surface this nodulation occurs equally in the younger and older portions. In some cases the mouths of the tubes are much exserted, and often cut away towards the dorsal end, thus giving a bifid appearance; in other parts they are entire, and sometimes scarcely at all raised. The closure, with one pore, is near the termination of the zoœcial tube. This is closely allied to, if not identical with, *Hornera verrucosa*, Rss. (Septarienth. p. 81), and it is also allied to *H. striata* and *H. lichenoides*.

Loc. Oligocene: Latdorf. Pliocene: of Italy and Sicily, English Crag; Curdies Creek, River Murray Cliffs, Bairnsdale, Mt. Gambier. Living: Mediterranean.

12. Hornera foliacea, MacG. Pl. XXXI. fig. 18.

Hornera foliacea, MacG., Australian Polyzoa, R. Soc. Vict. 1868, p. 17.

Retihornera foliacea, Busk, Cat. Mar. Polyz. pt. iii. p. 19, pl. xiii. figs. 1, 2, pl. xix.

Zoarium in *Retihornera*-form. In the fossils the aperture seems to be about 0·04 to 0·05 millim. broad; the fenestræ are sometimes as much as 1 8 millim. long and 0·4 millim. broad. According to Mr. Busk's figures the fenestræ were rather shorter in the specimens he represents.

The transverse tubules do not seem to have any oral apertures, though as they often arise from the immediate vicinity of the apertures in the main branch, it frequently appears as if they belonged to the transverse bar; but this is not the case.

Loc. Living: Portland Bay; Wilson's Promontory; Tasmania (*MacG.*). Fossil: Bairnsdale, Mt. Gambier, River Murray Cliffs.

13. Stomatopora granulata, M.-Edw., var. minor.

There is a small specimen of uniserial *Stomatopora* from Bairnsdale, with aperture about 0·06–0·07 millim., but from one such specimen it is impossible to speak confidently about the identification. A specimen in my collection, from the Valangien of St. Croix, which I believe to be *S. granulata*, has the aperture about 0·12 millim.

There is a second specimen of this from Waurn Ponds, which seems sometimes to become biserial.

14. DIASTOPORA SUBORBICULARIS, Hincks.

Diastopora suborbicularis, Hincks, Brit. Mar. Polyz. p. 464, pl. lxvi. fig. 11.

I am not yet quite sure as to what must be looked upon as specific characters in *Diastopora*, and therefore call this *suborbicularis* with some hesitation.

The zoarium is growing on *Microporella cellulosa*, form *Adeona*, from Muddy Creek, and is about 5 millim. in diameter.

The apertures of the zoœcia are about 0·08 millim. in diameter, which is about the same as in Mr. Hincks's specimen, and slightly smaller than in specimens from Naples, which I called *D. flabellum*. The zoœcia are separated by distinct lines, but probably this depends upon the conditions of growth. The oœcia are about 0·5 millim. in diameter, and are circular rather than oval, and I have not found any oœcial tube. The surface of the oœcia is punctured with very fine pores close together. The *D. flabellum* of the Mediterranean has a tangential inflation of considerable width, and the oœcial tube is directed inwards, namely, towards the centre of the zoarium. There is also a specimen from Mt. Gambier, but this is not so well preserved. A specimen from Waurn Ponds has an ovicell similar to that of my Naples specimen.

15. DIASTOPORA PATINA, Lamk.

From Mt. Gambier there is a fragment consisting of about half of a caliculate colony which must have been the same size as specimens in my collection from the coast of France and from Capri (dredged at about 200 metres). This is closely allied to *Discosparsa laminosa*, d'Orb., from the Cenomanian.

Loc. Living: British, Northern, and French seas; the Adriatic and Capri.

16. RETICULIPORA, sp.

There is a compressed branch from Mt. Gambier, about 0·7 millim. wide, with series 0·5 millim. apart, and with 7 or 8 zoœcia in a series, which does not seem to differ in any way from my *Reticulipora dorsalis* from Naples; but from the one fragment I am not prepared to say that they are identical.

17. RETICULIPORA TRANSENNATA, nov. sp. Pl. XXX. figs. 2, 3, 6, 7. Section also figured in "Closure of the Cyclostomatous Bryozoa," Journ. Linn. Soc. vol. xvii. pl. xvii. fig. 5.

Zoarium reticulated, large. The specimen sent over from Aldinga must have been at least 6 inches in diameter. The fenestræ of the reticulations are 2–4 millim. long, and average about $\frac{2}{3}$ as broad; branches (laminæ) much compressed, about 0·5 millim. in section, and about 2 millim. deep, covered transversely with subparallel rows of 8–12 slightly exserted tubular zoœcia, 0·07–0·08 millim. diam., 0·4 millim. apart. Besides the zoœcial openings, there are smaller non-tubular ones; sometimes these are below the zoœcia, at others

at the side, and there may be three or four to each zoœcium; on the dorsal surface of the zoarium there are smaller openings than these lateral ones just mentioned. On the front the lamina is very marked, and rises above the zoœcia on each side, and there is a tendency for this to divide up the centre of the lamina, and I find the same tendency in the *Reticuliporæ* from the Chalk of Royan. In *Biflustra* the two layers of cells being readily separable was made a generic characteristic, but perhaps it depends to a large extent upon the condition of fossilization.

The closure occurs at some little distance before the zoœcial tube becomes free (see Journ. Linn. Soc. vol. xvii. pl. 17. fig. 5), viz. about 0·13 millim. from the termination of the zoœcia, and in one or two cases there is a second closure a very short distance behind the first.

This species is closely allied to *Reticulipora obliqua*, d'Orb. Pal. Franç. p. 906, pl. 610. figs. 1, 6, pl. 768. figs. 1–2, from the Senonian, but I do not think they can be considered the same species.

18. Discotubigera clypeata, Lamx. Pl. XXXI. figs. 15, 16, 19.

Pelagia clypeata, Michelin, Icon. Zooph. p. 229, pl. lv. fig. 3.
Apseudesia clypeata, Haime, Bry. Form. Jur. p. 202, pl. vii. fig. 7.

This genus was first described as *Pelagia* by Lamouroux; but as the name had already been used for an Acaleph, it had to give way, and was partly replaced by *Defrancia*; but this seems to have been used for such various things that it is not always clear what has been meant, nor can we feel satisfied whether both *Defrancia* and *Discotubigera* should be retained.

The zoœcia are raised up in rays in the same way as in *Lichenopora*; but there are no interstitial pores, and therefore I believe the genera are widely separated.

We must extend d'Orbigny's definition of *Discotubigera* to species growing more or less free.

The specimen from Aldinga is 20 millim. in diameter, with about 40 principal bi-triserial rays, with zoœcial openings about 0·12 millim. The rays near the centre are very narrow, and one or a pair of cells often terminate at a short distance from the centre, and others also terminate before the fasciculine openings. Near the circumference there are short rays inserted between the main ones. Near the border there is a slight ovicellular inflation, and there is one tubular opening (see *o*, fig. 19). The general resemblance to such a coral as *Montlivaltia discus*, Woods, is extremely striking.

As the description of Lamouroux is not sufficient for certain specific comparison I do not quote his locality.

Loc. Oolitic: Lebisey, Ranville (*M.*), Luc (*H.*), Nantua and Marquise (*d'Orb.*), Aldinga. A small fragment from Curdies Creek apparently belongs to this species.

19. Discotubigera iterata, nov. sp. Pl. XXXI. figs. 14, 17.

The specimen from Aldinga is only a fragment of a colony which was clearly more or less discoid; the radius of the part preserved is about 35 millim. The multiserial rays must be very numerous, as

there are 24 in 20 millim. The zoœcial apertures are not continuous along the ray, but, instead, the ray becomes elevated at intervals, forming elongate fasciculi, with their openings directed upwards. These interruptions take place with considerable regularity, so that the fasciculi of neighbouring rays rise up at equal distance from the centre of the zoarium, which may be a constant character, or it may merely arise from the growth at the circumference being arrested and then recommencing simultaneously at all points. The position of the zoœcia is marked by faint lines on the flat surface of the ray. It will be seen that the structure of this species closely resembles that of *Pavotubigera flabellata*, d'Orb. Pal. Fr. p. 767, pl. 752. figs. 4–8.

20. PAVOTUBIGERA FLABELLATA, d'Orb.

Pavotubigera flabellata, d'Orb. Pal. Franç. p. 767, pl. 752. figs. 4–8.

? *Semitubigera lamellosa*, d'Orb. loc. cit. p. 749, pl. 750. figs. 16–18.

This does not seem to differ from the Meudon specimen, except in there being two or three confluent colonies, and perhaps on that account it might be called var. *extensa*.

The mode of growth of this species is very similar to that of *Tubulipora*; but in that genus the zoœcia are freer, and the rays are not multiserial.

One of the colonies is much more symmetrical than the others, and therefore approaches nearly to the figure of *Semitubigera lamellosa*, d'Orb. Zoœcia 0·1 millim. diam.

Loc. Cretaceous: Meudon; Aldinga.

21. PAVOTUBIGERA DIMIDIATA, Rss. Pl. XXXI. fig. 25.

Defrancia dimidiata, Reuss, Foss. Polyp. d. Wien. Tert. p. 39, pl. 6. fig. 6.

The specimen from Mt. Gambier is but badly preserved and incomplete, and it is therefore impossible to speak with certainty as to the structure, but in the fragment the zoœcia are bi-multiserial in fanlike rays, with a large inflation about the width of two rays, forming the ovicell.

I do not think the *Tubulipora dimidiata*, Manzoni, is the same as the *Defrancia dimidiata* of Reuss, though perhaps *T. pluma*, pl. xvii. fig. 68 (only), Manz. Bri. Mioc. Austr. ed Ungh., may be. No undoubted recent *Tubulipora* has biserial rays, and therefore at first it seemed advisable to separate it from that genus on this account; but the examination of a fossil from Napier, New Zealand, which is closely allied to *Multifascigera campichiana*, d'Orb., shows that this is not a sufficient reason. This New-Zealand fossil, and also a recent specimen of the same, resemble an adnate *Idmonea*, with outlying rows of zoœcia beyond the main ones; and in some the rows are all bi-multiserial, and this was at first taken to be a marked character of the species; but in one large growth the rows are nearly always uniserial, though here some few colonies and parts

of colonies occur with biserial rows. This is extremely important in helping us to appreciate the classificatory importance of this character.

If, however, all these are to be called *Tubulipora*, it would become a most unwieldy genus, certainly with intermediate forms, but many, seen apart, would, at first sight, seem widely divergent. Although it may be only an arbitrary division, it will, I think, assist us in study if we for the present confine *Tubulipora* to those species only in which the end of the zoœcial tube is free, and in which there is no symmetrical arrangement.

22. PAVOTUBIGERA GAMBIERENSIS, nov. sp. Pl. XXX. fig. 9.

Zoarium apparently adnate. Zoœcia in bundles of two or more, erect, connate; ovicell an inflation of a portion of the surface between the zoœcia; surface of zoœcia evidently finely punctate.

23. DEFRANCIA EXALTATA, nov. sp. Pl. XXXI. fig. 23.

Zoarium incrusting, oval, with the rays rising from near the centre, and sometimes dividing, and much raised round the border; rays multiserial, large pores round the base of the rays.

This, like most of the Mt. Gambier fossils, is but badly preserved, and therefore it is impossible to feel quite sure about the determination, but it seems to be the same as an undescribed species from the Bay of Naples, which, however, may be the *D. verrucaria* of Heller (non Fabr. or M.-Edw.). In the Naples specimen an inflation of one half of the central portion forms the ovicell, and the ovicellular opening is tubular, a little larger than a zoœcial tube, and occurs between the base of two rays.

This is related to the *Defrancia diadema*, Goldf., Hag., and d'Orb. I have also a colony from the Miocene of Brendola colle Berici, N. Italy, which has eight rays which do not divide. In *Tubulipora Brongniarti* (Manzoni, Mioc. Austr. ed Ungh. pl. xviii. fig. 73) there are more rays, and these are figured as starting from the centre of the colony.

24. SUPERCYTIS? DIGITATA, d'Orb, Pl. XXXI. figs. 22, 26, 27.

Supercytis digitata, d'Orb. Pal. Franç. p. 1061, pl. 798. figs. 6–9.

Zoarium stipitate, fasciculi bifurcated, starting from the base, laterally compressed, the upper surface forming a horizontal plane. The fasciculi consist of a number of parallel zoœcia, usually three or four side by side, directed obliquely upwards so that the openings of these tubes are seen all along the fasciculi. The central portion of what must be called the capitulum is flat and covered with a finely perforated calcareous wall, out of which rise the ends of the central zoœcia slightly exserted, giving this portion the appearance of a *Diastopora*, such as *D. sarniensis*. Central zoœcia 0·1 millim. in diameter. Zoarium about 11 millim. in the longer diameter, and about 7 millim. in the shorter.

This is very closely allied to *Pelagia insignis*, Michelin, from the grès verts of Mans, and possibly may be identical.

It is unfortunate that Busk should have named a species *Fasciculipora digitata*, seeing that the specific name was already employed by d'Orbigny. The species described by Busk is very similar to this, and is apparently described from an imperfectly preserved specimen, and therefore we cannot be sure of the relationship *. A recent specimen of *F. digitata*, B., from New Zealand has no central covering, and is much smaller than the present specimen, as are also those described by d'Orbigny and Busk. There is also a fossil from Napier, New Zealand, which has a number of capituli in shape like the present, but grouped together, and arising from a common base; but there the central portion seems covered with a calcareous wall, without any zoœcial openings.

This is, as far as I am aware, the first time that any central covering like the present has been found; and until more perfect specimens of allied species have been examined there will be some doubt as to its relationship, and the generic and specific name can only be used provisionally.

Loc. Cretaceous of Meudon, Sainte Colombe, Lavardin, Fécamp (France); Murray Cliffs.

25. FASCICULIPORA?

There are small fragments from Curdies Creek, Bairnsdale, and Mt. Gambier, which might be *F. ramosa*, d'Orb.; but as I have pointed out ("Bry. of the Bay of Naples," Ann. & Mag. Nat. Hist. 1879, iii. p. 279), the young colonies of *Frondipora* have this form.

26. FASCICULARIA CONJUNCTA, nov. sp. Pl. XXX: figs. 4, 5.

? *Fasciculipora ramosa*, J. E. Tenison-Woods, Corals and Bryozoa of Neoz. Period in New Zealand. Pal. of New Zealand, pt. iv. p. 31.

The specimens from the River-Murray Cliffs do not seem to differ from Mr. Wood's description; but the fossil in my hands is so much imbedded in matrix that it is impossible to give exactly the zoarial form, though I think that it must have been more or less globular, and many inches in diameter. The fasciculi are nearly round, about 1·5 millim. in diameter, connected here and there by small multitubular connexions at right angles to the fasciculi. The zoœcial tubes are about 0·15 millim. internal diameter, and there are at irregular long intervals plates (tabulæ) across the tubes. There are minute pores on the surface, as in *Frondipora* and most other Cyclostomata.

* Since this paper was read I have received from Professor Hutton some fossil specimens of *Supercytis*(?) from Shakespeare's Cliff, Wanganui (New Zealand), in which the central part has a calcareous cover; but instead of the zoœcia rising through the finely punctured cover, they only come up to it, and that in long rows or fasciculi, as seen by the outlines of the zoœcial walls. The outer surface is, in the upper part, striated, showing the outlines of the zoœcia; the basal part shows irregular hexagonal divisions.

This, I believe, is the *Fasciculipora digitata* of Busk.

The dilatation of the fasciculi at the summit occurs in these specimens only where the fasciculi are beginning to branch.

This differs from *Fascicularia tubipora*, Busk, in not having the fasciculi united by what Busk calls "horizontal tabular concentric laminæ;" these are probably represented by the small multitubular connexions, and in a specimen of *Fascicularia tubipora* collected in Rametto, near Messina, Sicily, from the Pliocene, there is, besides the larger "laminæ," an occasional connexion like that of *F. ramosa*.

F. tubipora also occurs from Napier, New Zealand.

The genera *Fascicularia* and *Fasciculipora* seem most closely allied.

Loc. Mt. Brown beds (Upper Eocene of Hector), New Zealand, River Murray Cliffs.

27. Lichenopora hispida, Flem.

For synonyms see Hincks's Brit. Mar. Polyz. p. 473; but as to *Discocavea aculeata*, d'Orb., I am in doubt. *Discoporella echinulata*, Rss., Die foss. Polyp. des W. Tert. p. 50, Taf. vii. fig. 6; Manzoni, I Brioz. foss. del Mioc. d'Austr. ed Ungh. p. 15, pl. xiv. fig. 56.

Specimens from Muddy Creek, Murray River, and Waurn Ponds correspond most closely with a simple colony from Naples.

In each case the zoœcial openings are about 0·1 millim. to 0·2 millim. in diameter, and in the Naples and River-Murray specimens the central cancelli are rather over 0·07 millim., while the interradial cancelli are 0·06 millim.; but in the Muddy-Creek specimen the central and interradial cancelli are of about the same size, viz. 0·06–0·07 millim.

In the Muddy-Creek specimen I am able to see a distinct row of spicular denticles a short distance down the zoœcial tube. This small colony of about 2 millim. diam. is not well preserved, whereas those from Murray Cliffs are less damaged, and are about 5–6 millim., and the radial arrangement of the zoœcia is more distinct. A specimen from Waurn Ponds may be a variety. The zoarium is 10 millim. in diam., and the zoœcia are 0·07 in regular uniserial distinct rows towards the centre.

In the central part of the Naples specimen there is at the junction of the wall of each opening a small protuberance reminding us of the "Spiniform corallites," of Prof. A. Nicholson ("Structure of Heteropora," &c. Ann. & Mag. Nat. Hist. 1880, p. 14, fig. 4).

Loc. Miocene: Eisenstadt and Mörbisch (*M.*). Pliocene: Crag, Italy (Reggiano in the Zanclian, Astian, Sicilian, and Saharian of *Seguenza*); Scotch Glacial deposits (*Geikie*). Post-Pliocene of Canada (*Dawson*). Mt. Gambier, Bairnsdale, Muddy Creek, Murray River, Waurn Ponds. Living: European seas generally.

28. Lichenopora radiata, Aud.

The zoœcial opening in specimens from the Mediterranean and also in the fossils is 0·07–0·08 millim., and in the specimen from Adelaide is only a trifle smaller.

Loc. Living: British, Mediterranean, Holborn Islands, Queensland (*A. W.*), Semaphore (Adelaide) (*A. W.*). Fossil: Pliocene, Bruccoli, Sicily; Curdies Creek, Muddy Creek, Bairnsdale, Mt. Gambier, Napier (New Zealand).

29. LICHENOPORA ALDINGENSIS, nov. sp.

Zoarium depressed in the centre, with about 20 primary bitriserial rays, with about 50 zoœcia in each ray. Mouths of the zoœcia about 0·12 millim. in diam., which is half the size of the openings of the cancelli.

This is much larger than *Discoporella californica*, B., but is allied.

30. LICHENOPORA COCHLOIDEA, d'Orb. in *Domopora*-form.

Domopora cochloidea, d'Orb. Pal. Franç. p. 990, pl. 781. figs. 5–7.

Defrancia cochloidea (?), Hag. Bry. Maastr. Kreide, p. 42, pl. iv. fig. 8.

In a specimen from Mt. Gambier, one colony grows out of the top of another. Each colony is considerably raised, but concave in the centre, about 2–4 millim. in diameter. In the young colonies there are 10 rays of zoœcia, with large openings, and between these and round the border very small cancelli. The zoœcial tubes are about 0·8 millim., and the cancelli 0·3 to 0·4 millim. in diameter.

Loc. Fossil: Senonian of Sainte Colombe (Manche), Mt. Gambier.

31. LICHENOPORA BOLETIFORMIS, d'Orb. (non Rss.), in *Tecticavea*-form. Pl. XXXI. figs. 20–21.

Tecticavea boletiformis, d'Orb. Pal. Franç. p. 991, pl. 781. figs. 8–12.

There are two colonies of this species from Aldinga; one forms a globular mass, slightly hollow in the centre, of about 30 millim. in diameter; the other is growing on a Chilostomatous Bryozoan, and forms a conical mass 14 millim. high. The fresh colonies commence by growing over the previous one in a tectiform manner, but afterwards they become confluent, forming continuous sheets over the whole previous growth. In the early stage, therefore, this entirely corresponds with the Belgian fossil.

The rays are biserial, with openings but little larger than the interradial and central cancelli. The apertures vary from 0·09 millim. to 0·13 millim.

Although this ultimately attains a form closely resembling *Radiopora*, the structure is different; for here each colony spreads from its own calcareous basis, whereas in *Radiopora* the zoœcial tubes of one layer are continued into the next. Reuss has named what appears, from the description and figure, a true *Radiopora*, *R. boletiformis*, which does not seem to be allied to our form. The mode of growth of the present species resembles that of *Defrancia prolifera*, Rss. F. Polyp. pl. vi. fig. 1.

Loc. Senonian; Cypli (Belgium); Aldinga.

32. LICHENOPORA VARIABILIS, d'Orb.

Bimulticavea variabilis, d'Orb. Pal. Franç. p. 983, pl. 779. figs. 9–13.

A colony from Aldinga consists of a number of confluent zoaria, the raised part of which measures about 4 millim., the distance from the centre of each colony being about 5–6 millim., with six or eight multiserial rays. The central cancelli are but very slightly larger than the others. The width of the zoœcia is about 0·1 millim.

In the Australian fossil I am not able to make out that there are in any part two layers, as figured by d'Orbigny, but in a section which I cut I find in certain of the zoœcial tubes, at a distance from the surface, several tabulæ occurring at comparatively short intervals.

Loc. Cretaceous: Meudon (France); Aldinga.

33. HETEROPORA.

There are some small pieces of *Heteropora* from Curdies Creek which are too imperfect for determination. *Heteropora pelliculata*, W., occurs abundantly fossil at Napier, New Zealand.

ADDENDUM.

34. IDMONEA ALDINGENSIS, nov. sp.

The front of the zoarium is rounded, with the rows of connate zoœcia regularly placed 0·35–0·4 millim. apart, with five zoœcia to each lateral series. Zoœcia not much exserted; aperture about 0·13 millim.

The appearance is much the same as that of *Clavitubigera convexa*, d'Orb. (Pal. Fr. pl. 746. f. 12–15), with the exception that the dorsal surface is concave; but this is probably not a character of much moment.

Loc. Aldinga.

EXPLANATION OF PLATES XXX. & XXXI.

PLATE XXX.

Fig. 1. *Crisia unipora*, d'Orb., ×25.
2. *Reticulipora transennata*, nov. sp., front surface, ×12.
3. Ditto, natural size.
4, 5. *Fascicularia conjuncta*, nov. sp., in matrix, natural size.
6. *Reticulipora transennata*, nov. sp., dorsal surface, ×12.
7. Ditto, frond, seen laterally.
8. Section of *Hornera frondiculata*, Lamx., from Naples, showing the large pores which are united to the interior by means of small ones, also showing the interzoœcial pores, ×25.
9. *Pavotubigera gambierensis*, nov. sp., Mt. Gambier, ×12.
10. *Idmonea bifrons*, nov. sp., front, ×12.
11. Ditto, dorsal surface, ×12.
12. *Idmonea Hochstetteriana*, Stol., front, ×12.
13. Ditto, dorsal surface.

PLATE XXXI.

14. Ray of *Discotubigera iterata*, nov. sp., ×2.
15. Ray of *Discotubigera clypeata*, Lamx., natural size.
16. *Discotubigera clypeata*, Lamx., natural size.
17. *Discotubigera iterata*, nov. sp., natural size.
18. *Hornera* (*Retihornera*) *foliacea*, Mac G., ×12.
19. *Discotubigera clypeata*, Lamx., ×5, *a*, as seen from the side, showing the ends of the rays, ×5.
20. *Lichenopora boletiformis*, d'Orb., natural size
21. Ditto, growing colonies about ×2.
22. *Supercytis digitata*, d'Orb., ×6.
23. *Defrancia exaltata*, nov., from Mt. Gambier, ×25.
24. Interzoœcial pore of *Heteropora pelliculata*, Waters, ×150.
25. *Pavotubigera dimidiata*, Rss., from Mt. Gambier, ×12.
26. *Supercytis digitata*, seen from below, ×2.
27. The same, from the side, natural size.
28. Section of *Heteropora pelliculata*, W., recent, from New Zealand, showing the interzoœcial pores and the hair-like spines, ×50.