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CATALOGUE

OF

THE FOSSIL BRYOZOA (POLYZOA)

IN THE

DEPARTMENT OF GEOLOGY,
BRITISH MUSEUM (NATURAL HISTORY).

THE CRETACEOUS BRYOZOA (POLYZOA).

VOLUME III.
THE CRIBRIMORPHS.—PART I.

BY

W. D. LANG, Sc.D., F.G.S.

WITH EIGHT PLATES.

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PREFACE.

So many additions have been made to the collection of Cretaceous Bryozoa (Polyzoa) during recent years, that the anticipated volume of Cheilostomata by Dr. W. D. Lang will now extend to two volumes. The work has been prepared so far as possible on the same plan as the previous instalments by Dr. Gregory, but the classification of the fossils has been much influenced by certain general palæontological principles which have only of late become evident. These principles are explained and discussed in the Introduction to the present volume.

The drawings for the Plates have been made by Miss Gertrude M. Woodward, but nearly all the text-figures have been prepared by the author himself. The Trustees are indebted to the Council of the Geological Society of London for text-figures 7, 8, 9, and to Messrs. Macmillan & Co., Ltd., for text-figures 2, 3, 4.

A. SMITH WOODWARD.

Department of Geology,
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March 17, 1921.

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Part I. INTRODUCTION.

A. BIOLOGICAL*.

I. The Criteria of Relationship.

§ 1. To write a systematic treatise on any group of organisms is soon found to be the problem of presenting in an intelligible manner a multitude of differences. Even if intelligible, such a treatise is wont to be wearisome to any but a specialist in the group described, and this may be partly, if not mainly, due to a paucity of idea permeating a wealth of material. In a work of this kind, the numerous slightly-differing forms are described in detail, and are so arranged as to present an ordered whole in which the connecting idea is *genetic relationship*. This is the sole theory which may be said to be common to all modern biological systematic treatises. A science, and therefore a scientific treatise, is a marshalling of observed facts and the statement of inferences that may logically be drawn from them. Many would restrict the definition to the first function, and so rob science of all idea; whereas a science is a synthesis of fact and theory.

In systematics, then, the observed facts are the differences presented between form and form; and the fundamental theory is

* In his Presidential Address to Section C of the British Association at the Cardiff Meeting, my colleague, Dr. Bather, has rather severely handled some of the views published elsewhere and now put forward in this Introduction, which was written more than two years ago. Had I written it now for the first time, doubtless I should not have placed these views in quite the same setting, not so much on account of Dr. Bather's criticism, as owing to an inevitable and gradual development in biological opinion. Since, however, the aim of the Introduction is to explain the method followed in the systematic part, and since this aim is not impaired either by destructive criticism of the views propounded or by modifications of these views due to developing thought, the Introduction may well stand as originally written. I hope to have an opportunity elsewhere of replying to Dr. Bather's severe though friendly criticism.

that all the forms are genetically related. It is evident that those who would banish theory from a systematic treatise are not free agents. For in using Linnæan nomenclature they implicitly accept a theory of genetic relationship *. Congeneric species are more nearly related than those belonging to different genera; and, though relationships are but vaguely implied, their existence is certainly postulated for the biologist of to-day in the Linnæan binomial system.

The systematist is thus faced with a large number of more-or-less closely-related forms, and his task is to marshal these so as best to express their inter-relationships. If he has reason to suppose that he can do this, however imperfectly, it appears to be a waste of time to discuss the exact systematic status of any one of his divisions. Their value is purely relative; and to say that this character has intrinsically a generic and that a specific importance appears to reduce systematics to an almost childish level, and makes the systematist the slave of his system. As a matter of practice, in this work the ultimate systematic groups are regarded as species, these grouped into genera, and the genera into families (or sub-families where convenience requires it); and it need not be a matter for care, if, indeed, such a question is not essentially absurd, whether a given species, genus, or family bears the same systematic status as a species, genus, or family among, say, Molluscs or Vertebrates. By "ultimate systematic group" is meant an assemblage of morphically similar individuals more closely related to each other than to those of another group, and indivisible by morphological methods into groups of similar nature. Thus, individual variation is theoretically excluded, though in practice it may cause difficulty.

It might be objected that more than the theory of relationship implicit in the Linnæan system of nomenclature has been assumed in the foregoing paragraph; that Linnæan nomenclature merely postulates a number of genera within each of which are species bearing the relationship consequent on possessing a common ancestor; and that no implication is made as to the inter-relationships of the genera—they might be "special creations." But a

* It is true that Linnæus himself publicly professed no such view: he described every species as a separate creation. But no one can use Linnæus's system to-day without implying belief in a genetic relationship, at least between the species of a genus.

theory of *descent with modification* is now universally held, according to which all organisms are so related that they have a common origin, and the systematic groups of higher status bear one to another a relation similar to that of the specific groups.

§ 2. We start, then, to marshal our facts—that is, to arrange our differing forms,—committed to a theory of descent, but unhampered by any preconception of the status of systematic groupings other than their relative value. Clearly, it is next desirable to inquire into the criteria of relationship. The most obvious criterion, and to many it may seem at first the only criterion of relationship, is similarity of form. The **morphological criterion** is intuitively applied whenever a mixed collection of natural objects is viewed, be they shells, insects, or other organisms. To sort such a collection into groups of similar forms is generally supposed sufficiently to indicate the species represented. But experience shows that the morphological criterion offers many pitfalls; and the phenomenon of *homœomorphy* *—the expression of convergent and parallel evolution—is now recognised as far commoner in all groups of organisms than was formerly supposed †. Now, since by definition homœomorphs have a different ancestry, it is obvious that any structural expression of this will show that the similarity of two organisms is due to homœomorphy. Such is evidently the case with certain Ammonites, where the different ancestry is shown by differences in the earlier whorls. *Recapitulation of ancestral history* in the growth-stages of the individual thus affords a second criterion of relationship ‡.

The group of animals represented in this work, namely, some Cretaceous Cheilostome Polyzoa, are peculiar for being, without exception, colonial. The law of recapitulation shown in the growth

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* Homœomorphous: S. S. Buckman, 1887–1907, p. 368 (1893). Homœomorphy; S. S. Buckman, 1895, p. 458. Homœomorph; S. S. Buckman, 1887–1907, p. xlviii (1889).

† It may be reiterated that homœomorphy is rather morphic approximation than morphic identity:—" The criterion for homœomorphy is rather the ease of seeing a resemblance than the difficulty of detecting a difference between the homœomorphs " (W. D. Lang, 1917, p. 87).

‡ E. R. Cummings (1910) has issued an excellent *résumé* of the palæontological work bearing on recapitulation which had been published up to 1910.

of the individual shell, or œcium, is not generally easy to observe, since the œcium grows as a whole, and not serially; so that the earlier stages are masked in the later. On the edge of the colony, however, œcia in various stages of growth may be observed. But the colony, or asty, has growth-stages of its own, shown in the œcia that compose it. The earlier œcia of the asty have a different form from the later ones; thus the asty, like the individual, shows growth-stages, and these recapitulate to some extent the phylogeny of the form concerned. This "colonial ontogeny" has been termed by Ruedemann *Astogeny* *, and Cumings † uses the terms *nepiastic*, *neanastic*, *ephebastic*, and *geronastic* to apply to the colonial stages and to conform with the terms nepionic, neanic, ephebic, and gerontic of individual development. The **astogenetic criterion** is often of use in determining or corroborating the general relationships of a given form.

Homœomorphy, however, with its correlative phenomenon of recapitulation, is but one aspect of the morphological criterion and its attendant difficulties. The phenomena of Mendelism (though they generally concern diverse forms within a species, and are thus mere manifestations of mongrelism) present instances of apparently similar forms of different gametic composition. Such is the case when "dominance" is complete; and, again, Bateson has described albinoes ‡ whose gametic composition was different. It is not possible to apply Mendelian experiment to fossils. But the operation of Mendelian laws must not be ignored in its possible bearing on evolutionary phenomena; and the cases cited above show that morphic identity is not an infallible criterion for genetic relationship. To put the thought in other words:—*The morphic expression of the difference between two forms is by no means proportional to the fundamental or genetic difference.*

The third criterion of relationship involves the time factor, and, though negative in its application, is of very great value. In a group of fossils like the Cretaceous Cheilostomes, the forms will

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* Or, rather, adjectivally, Astogenetic; R. Ruedemann, 1904, p. 526. The principle of Astogeny was pointed out by Ruedemann in Graptolites (R. Ruedemann, 1902, p. 591); see also E. R. Cumings, 1904, p. 50, and W. D. Lang, 1904, p. 316.

† E. R. Cumings, 1904, p. 50.

‡ In Rabbits, see W. Bateson, 1909, p. 75.

be found to have been gathered from many horizons represented by sediments deposited at different times in the Earth's history during the Cretaceous epoch. Now, the relative order in which the described forms lived on the Earth will be known in so far as it is possible to correlate the deposits from which the specimens have been collected. Therefore, in constructing a supposed phylogeny (that is, a scheme of relationships), it is obvious that an ancestral form must not post-date its offspring. The **stratigraphical criterion** of relationship must be applied to check a supposed phylogeny. It is true that an apparent contradiction may arise when an ancestral form persists in time along with forms to which it has given rise, or even after these have perished, and when it has not yet been found in the lowest part of its stratigraphical range; but, except with "radicals" (like *Andriopora*), such cases must be treated with great suspicion, and must not be admitted as probable without strong reasons drawn from other sources. Again, the stratigraphical criterion may be applied to the great encouragement of the investigator, if, when a lineage has been traced through consecutive horizons and a later term expected to occur at a higher horizon, such a form is at length found. The predictive use of stratigraphy in a case like this produces one of the most satisfactory corroborations experienced by the systematist.

II. Calcium Carbonate.

§ 3. We have travelled far from the simple position from which we started, namely, the intelligible arrangement of large numbers of differing forms—an arrangement based solely on a theory of descent with modification. We have recognised three criteria for testing relationships, namely, those afforded by Morphology, by Astogeny, and by Stratigraphy; and in doing so have recognised the phenomena of Homœomorphy and the results of Mendelian research, and have accepted without question the general application of the law of Recapitulation, especially as expressed in post-embryonic growth-stages. All these considerations involve methods of evolution and leave untouched and unprejudiced all causes, proximate or final.

In considering the *rôle* played by calcium carbonate in evolution, a proximate cause is suggested, and thus a concept introduced different from those hitherto applied. If calcium carbonate takes the important part in the evolution of Cheilostome Polyzoa claimed for it in this work, it is probable that its influence in Evolution generally has been much under-rated. It may be mentioned merely as a coincidence that the mineralogical history of most sedimentary rocks (at least as far as Britain is concerned) subsequent to their deposition is largely the natural history of calcium carbonate; and that the evolution of Cheilostome Polyzoa is largely the story of the struggle between the organism and that intractable medium; but it emphasises the neglect on all sides of the importance and interest of the mineral.

In examining any group of fossils, it must always be remembered that we are dealing almost entirely with skeletal structures; that, in so far as the evolution of organisms is shown in fossils, only where it has affected the skeleton can it be expressed. It is well, then, to review the Recent members of a fossil group, in order to estimate how far their evolution can have been expressed only in their soft parts, and therefore lost to us in their palæontological history. But the morphology of Recent Cheilostome Polyzoa is essentially the morphology of the skeleton. The purely soft parts vary but little, and afford few features useful for classification, nor do they suggest that evolution has affected them either profoundly or in detail without affecting the skeleton also *.

§ 4. The skeleton of Recent Polyzoa consists of chitin more or less impregnated with calcium carbonate. It is convenient to recognise three divisions of Recent Cheilostomes, namely, those whose skeleton is entirely chitinous or with but traces of calcium carbonate, those with a small amount of calcium carbonate, and those in which so much calcareous matter is present that the chitin-factor is negligible or absent †. On the whole, the chitinous forms are morphologically simpler and the calcareous the most advanced. It follows that evolution, as expressed in the skeleton, proceeds from the less to the more calcareous. Now, it is

* The Compensation Sac may be quoted as a soft structure with an evolutionary history and one whose presence or absence affects classification (e.g., G. M. R. Levinsen, 1909, pp. 32, 88, 91, 213); but it is evident that its presence or absence is correlated with the structure of the intraterminal front-wall; see S. F. Harmer, 1901, p. 13.

† See, for this whole discussion W. D. Lang, 1916[2], pp. 74–76; 1919, pp. 206; 1919[2], p. 64; 1919[3], pp. 105–107; 1919[4], pp. 194–196.

reasonable to suppose that in Cretaceous times there were similarly Cheilostomes with chitinous, with partly calcareous, and with wholly calcareous shells; but, owing to the perishable nature of chitin, only those with enough calcareous matter in their skeleton to enable it to cohere when its chitinous factor perished were preserved as fossils. The known Cretaceous Cheilostomes, then, include the partly and wholly calcareous forms alone out of the complete Cheilostome fauna; and the chitinous forms have left no trace. As with the Recent forms, the more complex are the more calcareous, and evolution has clearly proceeded on similar lines. But when a Cretaceous lineage can be followed to any considerable length, the amount of calcium carbonate in the skeleton becomes so pronounced that, not only does the skeletal structure become secondarily simple by the piling up of calcareous matter, so that further evolution is inconceivable, but the very life-processes of the organism appear to be in danger of obstruction, so constricted and tunnel-like become all the apertures in the skeleton, by which the organism communicates with its environment *.

Very important conclusions follow from this. First, if the majority of Cretaceous lineages are found to end in forms not only incapable of further evolution, but apparently becoming extinct under the products of their secretory activity, it follows that few, if any, Cretaceous genera persisted into Tertiary times; and that the ancestors of Tertiary and Recent forms must be sought in the chitinous Cretaceous species which have left no remains. Again, if all or most of the Cretaceous Cheilostomes perished under an increasing superfluity of calcareous secretion, it points to a derangement of metabolism resulting, in the first place, in the secretion of calcium carbonate and its impregnation of a chitinous skeleton, and, in the second place, in the progressive increase of this secretion. The departure from current belief in this view is seen when it is followed to its conclusion by applying it to the secretion of calcium carbonate generally. It is usual to consider a calcareous shell as an adaptation for protection. But to regard it (and its chitinous predecessor) as primarily a fortuitous metabolic product,

* It is true that not many lineages can be followed to such an extreme development. But it could hardly be otherwise with the fragmentary phylogenies at our disposal. What is significant is that when term links with term into a lineage, progress is *in that direction*.

is not to deny the shell a protective function. Rather, it is to emphasise the inevitability of the shell; its subsequent adaptation to protective purposes, though in keeping with organic behaviour, and to be expected from our knowledge of organisms, is yet but a secondary phenomenon. Moreover, as evolution proceeds, the shell becomes absurdly over-adequate for protection (a Hippurite-shell, for instance, comes readily to mind) and, unless the tendency ever to secrete more calcium carbonate is checked, becomes a burden too heavy for the organism's bionomy, and ultimately causes its extinction.

§ 5. So important does this view seem with regard to the evolution of shelled organisms (and invertebrate palæontology mainly deals with these) that it is worth reviewing some manifestations of calcium carbonate outside the Cheilostome Polyzoa. In the Cyclostome Polyzoa, for example, the skeleton is typically tubular; and in these, as in most other organisms with tubular shells, the animal can move along within the tube, and in many cases can limit the temporary after-end of its abode with a calcareous partition called variously tabula, septum, diaphragm, etc. Such an organism can, without inconvenience to itself, lay down an unlimited quantity of calcium carbonate by merely lengthening the end of its tube and moving up as the tube grows longer. Besides Cyclostome Polyzoa, Worms, some Molluscs, and even Corals may be included in this division; indeed, any organism that can move away from its shell as fast as this causes inconvenience falls into this category. Foraminifera, for instance, need never be impeded by their secretions, and, with the rest, compose a whole group of shell-bearing creatures for whom the problem of calcium carbonate secretion has never become acute.

The Arthropods are another group which have had to face a similar problem, and have solved it in a very similar manner. It is true that, except in certain Crustacea, the chitinous skeleton is not complicated with calcareous salts. Instead of a tube, their skeleton has the form of a chitinous jacket, which may originally have been a diffuse excretion of nitrogenous waste that merely scaled off in small fragments. But, as soon as the secretion was copious enough to form a protective skin, a means had to be found to render possible the growth of the organism beneath. This is accomplished by a periodic ecdysis of the chitinous integument;

and in this way an indefinite amount of chitin can be excreted. Now, in Evolution, chitin is nearly always the precursor of calcium carbonate, and, in the case of the highest Crustacea, calcium carbonate mixed with calcium phosphate; and, in so far as both chitin and calcium carbonate form a skeleton which sooner or later hampers the organism, the problems presented by both may be considered together and compared one with the other. It is of interest, too, that, where the chitinous skeleton of Arthropods is reinforced with calcium salts, ecdysis becomes a far more critical process than when chitin only is involved. And the huge claws of the most specialised Decapods suggest depositories for superfluous calcium salts rather than adaptations towards effective action or passive defence*; though secondarily they may and do become useful in both capacities†.

Of the shell-bearing organisms not hitherto considered, the Molluscs are extraordinarily instructive; and mainly because, in several instances, and in independent groups, they have overcome the calcium carbonate danger, and, during phylogeny, have come to secrete progressively less shell. Some species can even dissolve away shell already formed‡. Of the various molluscan orders, the Lamellibranchs offer least modification in this respect. A general thickening of the shell, and the production in some cases of highly ridged and spinous ornament, indicates an increasing output of calcium carbonate turned into protective channels. But

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* The shell of a Crab is of no avail against *Octopus*, which first paralyses the crab with a poison and then, cutting a hole in the carapace with its beak, sucks out the inside (see W. T. Calman, 1911, pp. 89–90, and G. Smith, 1909, p. 192); though Sinel's observations show that *Octopus* does not bite a Crustacean, but tears it piecemeal with its arms and feeds its mouth with pieces (see Sinel, 1906, pp. 220–221).

† *E. g.*, for strainers in *Calappa* (G. Smith, 1909, p. 186); for fighting rival males, and to charm the female by bright coloration and polite waving in *Gelasimus*, as well as for defence by closing the burrow (A. Alcock, 1902, pp. 217–219, and W. T. Calman, 1911, p. 106).

‡ *E. g.*, the species of *Murex*, which dissolve away the spiny varices on that part of the shell which becomes involute as the outer whorl grows round it. In this connection it is of interest to note that the Lamellibranch *Lithophaga* secretes an acid, by means of which, presumably, it excavates limestone rocks (W. T. Calman, 1919, p. 26); by an extension of this principle a shelled organism could control the size and thickness of its calcareous secretions.

in many lineages the calcareous burden is so increased that locomotion is impeded and the shell becomes fixed, lying on one side; it consequently loses its symmetry, and an ostreiform condition is reached. Where further thickening is especially concentrated on the "ventral" valve, the "dorsal" valve tends to resemble an operculum, and a gryphæiform shell is produced *; or, in the case of Rudistæ, the "ventral" valve becomes a vast pillar of calcium carbonate with a lid-like "dorsal" valve perched upon it. The shell is protective, indeed; but no tooth in the ocean could cope with armour half the thickness of a Hippurite-shell †, or, having done so, would relish its rocky mouthful with a little succulence somewhere hidden among it. A shell, then, of half the thickness of a Hippurite-shell is over-adequate for protection, and such a shell as *Radiolites*, like those of the ultimate terms of Cretaceous Cheilostome Polyzoan lineages, can have no evolutionary future, but appears to be succumbing to a superfluity of calcium carbonate.

While it would be manifestly absurd to deny to the Gastropod shell the function of protection, a general view of some of these shells makes it appear that it is not this function that has determined the amount of calcium carbonate they contain. *Patella vulgata*, Linnæus, closely fitted to its depression in the rock when danger threatens, remains secure and immovable under the protection of its shell until the rising tide enables it to renew its activities ‡. And merely to imagine any creature biting *Nucella* [*Purpura*] *lapillus* (Linnæus) is to admit the protective value of its shell; though it is possible that the pharyngeal teeth of *Labrus* can crush even this. Moreover, as we dislodge individuals of this abundant species in clambering over the rocks they cling to, and note how soundly they bounce from the hard surfaces into the pools below, we are aware how their thick shells can be a real protection to these easily detached forms when, with a rising tide in rough weather, the waves break over them §. But go down the

* F. L. Kitchin, 1912, pp. 59–60.

† F. B. Loomis, 1905, p. 841.

‡ *Patella*, however, succumbs to the attacks of *Purpura*, which bores its shell and sucks it out (J. Sinel, 1906, p. 207).

§ In this connection, see remarks in A. H. Cooke, 1895, pp. 90, 91, on correlation of shape of shell of *Purpura lapillus* with the situations in which it occurs.

foreshore on to the *Fucus*-covered reefs, and notice there the massive, nearly globular shells of *Littorina littoralis* (Linnæus), and, further down, on *Laminaria*, but still within the wave-break of the lowest tides, find *Patina pellucida* (Linnæus), whose shell (at least when young *) may be broken with the tap of a finger. Exposed to much the same environment, it is probable that they share the same dangers, and there is no apparent reason why one should have a more solid, and one a delicate shell. If it be argued that *Patina* is defended by its invisibility (for the mollusc is said to be nearly invisible against a background of seaweed) it may be answered that the *Littorina* is said to be similarly protected by its resemblance to the float-bladders of *Fucus vesiculosus* †. It is more probable that though the shell is of value for protection in both cases, yet its solidity is dependent on the stage of evolution reached by each lineage with regard to the amount of calcium carbonate it cannot help depositing. Hard by, *Aplysia* or some Æolid may be crawling in equal safety with *Patina*, the Nudibranch entirely naked and *Aplysia* with a poorly calcified shell nearly completely imbedded in the soft tissues. These two forms have escaped all danger from calcium carbonate by acquiring the power to secrete, during evolution, less and less shell-substance. They do not appear to be at any disadvantage in going uncovered ‡. Again, even *Labrus* might hesitate before making a serious attempt on *Murex tenuispina*, Linnæus; but it does not follow from this that spines are primarily developed upon Gastropod shells for defensive purposes. In evolution they are one with varices and all other shell-sculpture, and it may be predicted of most primitive unadorned Gastropod lineages that they will develop longitudinal and transverse sculpture at a progressively increasing rate, finally producing varices, spines, and a great thickening of the mouth. The inevitableness of the sequence, hardly hinted at in some lineages (e. g., *Littorina*) and carried to extremes in others

* It is in this young thin-shelled condition that it lives on the fronds of Laminaria; when older, it lives on the stalk and among the rhizoids, see A. H. Cooke, 1895, p. 69. Such older shells may often be found among the rhizoids of *Laminaria* thrown up on the foreshore.

† See A. H. Cooke, 1895, p. 69.

‡ C. Darwin (1871, vol. i, p. 326–7) agrees with Hancock that it is extremely doubtful whether even the colours of Nudibranchs usually serve as a protection.

(*Murex*, *Aporrhais*), is more in keeping with a theory of compulsion from within than adaptation to external conditions, though spines may be an efficient protection, and complication of the shell-mouth may cover extensions of the mantle forming anterior and posterior canals.

The Cephalopods are, perhaps, the most instructive of Molluscan orders. It is significant that, of the three Cephalopod stocks, namely, the Nautiloids, the Ammonoids, and the Belemnoids, those with the most complex shells—the Ammonoids—have become totally extinct; and the Nautiloids which in Silurian times underwent an outburst of evolutionary activity producing a variety of shell-structures, have only persisted in the comparatively simple *Nautilus*. But those Belemnoids which, during Evolution, have diminished or done away with their shells, have not only outlasted the Ammonoids and the Nautiloids (except *Nautilus*), but are now the dominant marine invertebrates; indeed, except for vertebrates, *Octopus* is the incarnation of efficiency among marine creatures, and endowed with an intelligence almost diabolical*. Of all molluscan shells, the Ammonite is the most complex; and this complexity largely consists of that frilling of the septa to form the suture-line where the septa meet the shell. Various explanations have been put forward to account for the suture-line, such as an adaptation for holding the soft-parts to the shell, or for strengthening a shell reduced almost to the thinness of paper. The thinness of the shell of Ammonites is almost certainly correlated with the complex suture; but our utter ignorance of Ammonite bionomy makes speculation on the shell very uncertain. If, however, for bionomic reasons, the thickness of the Ammonite-shell is much reduced, and if the Ammonite is not able to resorb any of the calcium carbonate it is impelled to secrete, then, since this secretionary activity must find an outlet, it is possible that the frilling of the septal edge may furnish a means, and that the complex suture is but an expression of the deposition of superfluous calcareous matter in such a manner as may not be a hindrance, but even of use to the organism †. Calcium carbonate secretion, however, cannot have been the sole reason for the extinction of Ammonites; this was probably primarily due to profounder

* Compare J. Sinel, 1906, pp. 216–224.

† See W. D. Lang, 1919, p. 64.

causes. For all surviving Ammonites were wiped out in the latest Cretaceous or earliest Tertiary times irrespectively of the developmental stage the shell had reached.

§ 6. It is, perhaps, permissible, before leaving this subject, to wander still further afield. Hitherto, skeletons of calcium carbonate have been considered, which, during evolution, have often had chitinous precursors. Chondrin, a precursor of bone, is allied to chitin, and bone is solidified by calcium salts. Calcium salts also compose the hard matter of teeth. Without suggesting that all bony vertebrates are in danger of racial destruction caused by an increasing deposit of these salts, we may ask * whether bone- or tooth-formation has never escaped control; whether, for instance, the canine teeth of the Machærodonts were really useful adaptations, or were, rather, uncontrolled developments of the already large Carnivorous canine, and a hindrance rather than a help in the animal's bionomics. Again, were the antlers of *Megaceros* † really effective weapons, or did their upkeep sap the constitutional energies of a body disproportionally small? It is hard to conceive of any use for the tusks of *Elephas ganesa* ‡; the head appears to be little more than a pair of sockets for their support; and one can almost imagine the relief with which this elephant laid down its burden under a merciful extinction. Though such views have been advocated before, they seem to be worth recalling, since they are so much in keeping with those just suggested with regard to the secretion among invertebrates of calcium carbonate.

Finally, it is hoped that exception will not be taken to the apparently disproportionate importance in evolution assigned to the secretion of calcium carbonate. Among organisms, any character, structure, or evolutionary process is probably not due to any one cause, but a resultant of several. And, if an ever-increasing superfluity of calcareous matter is invoked as a cause for this or that evolutionary result, it must be insisted on that it is not therefore claimed as an only cause, and that there are not other contributory

* *E. g.*, with F. B. Loomis, 1905, p. 840; H. F. Osborn, 1906, pp. 854–6; A. S. Woodward, 1910, p. 466. It is only fair to add that W. D. Matthew has claimed a use for the Machærodont canine (1901, pp. 385–7), and reiterated this claim (1910, pp. 305–7).

† F. B. Loomis, 1905, p. 843; A. S. Woodward, 1910, p. 466.

‡ *Cf.* E. D. Cope, 1880, p. 177.

factors. But it is suggested that, as a cause, it is deeply-seated in a fundamental variation in the organism's metabolism, a variation resulting first in the secretion of calcium carbonate, and then aggravated by a progressive increase of the secretion. And to emphasise the importance and far-reaching effects of this conclusion, an *excursus* was made into the field of general zoology, with the result that we have travelled rather far from the doomed lineages of Cretaceous Cheilostome Polyzoa. We will gradually retrace our steps.

III. Inhibitions.

§ 7. Extravagances of growth, especially among Vertebrates, whether growth as a whole, as in the case of the great Dinosaurs, or the growth of parts, such as antlers, teeth, or other emergences (cases of which were mentioned in the last section) have been referred to as being caused by a loss of equilibrium. Such a view recalls Galton's illustration of a polygon, stable when based on a side, but unstable when rocked on to an angle, and liable to pass with increasing momentum to a new condition of stability on an adjacent side, if the rocking carries the centre of gravity over a certain point; only, in the cases now considered, the new condition of stable equilibrium is extinction.

In connection with extravagances of growth in Vertebrates, it has been suggested that the original condition of equilibrium is controlled by those substances called hormones, contained in the secretions of the ductless glands *, and that hormones act as inhibiting agents limiting the growth that otherwise would continue indefinitely. This is borne out, if it was not suggested, by the well-known instances of the known effect on growth of secretions of some of the ductless glands †. But that potentialities in an organism are controlled by inhibiting agents, and become actual only as such inhibitions are removed, is an extension of the theory that extravagances of growth are due to loss of control by hormones, and receives some corroboration from other lines of research. For instance, the idea of inhibiting factors is a commonplace in Mendelian theory. As an example, it may be recalled that the factor for grey coloration in mice inhibits the appearance of other colours, and, if this factor is absent, the factor for black coloration

* See A. Dendy, 1912, p. 278. † See A. Keith, 1919, pp. 301–5.

is released. This, in turn, inhibits the factor for chocolate coloration, which becomes actual when the factors for grey and for black are absent. Inhibitions are not only seen in these phenomena of epistasis (as they are called). Sex-limited characters may obviously be said to be inhibited by the presence of the factor for that sex which the character in question does not accompany. Lately, Bateson has gone further *, suggesting that every character falling under Mendelian law is produced by the removal of a Mendelian inhibiting factor; but this view appears to lead to improbabilities so great as almost to appear absurd. It will be again referred to; but, meanwhile, it may be noted that factor and agent are here used with different connotations.

Palæontologists have long been familiar with a phenomenon of evolution whereby a group of organisms, after a period of slow development of comparatively few forms, bursts with some suddenness into a vigorous phase of evolutionary activity, producing new departures in great variety and in abundance of individuals. These outbreaks have been spoken of as "expression points" † in lineages; and Vaughan has called them "bursts" ‡. This phenomenon is often seen in the lineages of Cretaceous Cribrimorph Polyzoa. For instance, the genus *Pelmatopora* § is found first at one of these expression points in its evolutionary history. Along with a very primitive and simple form—*Pelmatopora calceata*—there appears in lowest Senonian times a bewildering number of derived forms, all with an increasingly complex skeleton, and capable of being sorted into many lineages differing from one another only in points of detail. But so varied, yet so continuous is the wealth of forms, that the task of unravelling the lineages is by no means a simple one; and it would better express the situation to describe it as an evolutionary flux in which many lineages may be dimly discerned and out of which a few, comparatively well-defined lineages emerge and continue into Middle or Upper Senonian times. On entering the higher horizons, one of these lineages undergoes a second evolutionary outburst, repeating the characteristics of the first. It is as if at these expression-points some obstruction was removed,

* W. Bateson, 1915, pp. 17, 18.

† E. D. Cope, 1868, p. 270.

‡ A. Vaughan, 1915, p. 3.

§ See W. D. Lang, 1919 [3], p. 107; 1919 [4], pp. 210–215, 220.

and pent-up forces were released, laying down calcareous matter copiously, and building up therewith the great variety of skeletal structures described. This is quite in keeping with the supposition that calcium carbonate secretion is controlled by inhibiting agents; that these may be released gradually or suddenly; and that a sudden release constitutes an expression-point in the evolution of a stock as shown in the development of a skeleton.

Now, just as the production of calcium carbonate (whether as a direct catabolic product, or whether precipitated from the sea-water when this meets some other catabolic product—for instance, an ammonium compound) was considered to be an incident of catabolism, so it is probable that inhibitive agents are metabolic products, and their absence due to accidents of metabolism. But metabolism may be seriously affected by environment, and so it comes about that environment may provide the first stimulus whereby inhibitions are ultimately removed, and an expression-point reached in the evolution of a lineage. Change of locality has been known to affect fertility in man *, and more often than not it affects the fertility of a higher animal kept in captivity †. Thus the changes in environment may be expected to affect profoundly the metabolism, and so the inhibitive agencies of other organisms. Such a view, however, postulates the inheritance in some way of acquired characters ‡.

IV. Orthogenesis.

§ 8. In the last section, the secretion of calcium carbonate was considered to be controlled by inhibitive agents, in the removal of which it is possible that the environment may play a part; and this is suggested by the periodic nature of the release. But there is another aspect of calcium carbonate secretion exemplified in the evolutionary history of Cretaceous Cribrimorph Polyzoa that points to qualities in the organism more fundamental than inhibitions. When lineage after lineage of Cretaceous Cribrimorphs is examined, it is seen that the calcareous matter, though built into skeletons differing in proportion and detail, yet is always piled up according to the same architectural plan—a plan repeated in each lineage,

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* See C. Darwin, 1875, pp. 188–90.

† See C. Darwin, 1859, pp. 8–9.

‡ For some illuminating ideas on environment, recapitulation, and heredity, see A. Dendy, 1915, pp. 383–397.

however the detail may vary. Thus, if any primitive Cribrimorph is found, it may be predicted within certain limits what its evolutionary history is going to be; and such a prediction may be corroborated in the subsequent discovery of later terms in the lineage. To be more explicit—given a Membranimorph with well-developed terminal spines, it may be said with certainty that, either the lineage will go no further than a specialised Membranimorph, or, if it has a further history, the spines will arch over and form a Cribrimorph intraterminal front-wall (see fig. 5, p. xxxvii); that this Cribrimorph front-wall will (if the lineage continues) become more and more solidified; that, if further evolution takes place, secondary calcium carbonate will be laid down either in the interœcial valleys, or in connection with the aperture, or in both places simultaneously; finally, if the lineage persists still longer, the areas of the secondary tissue will grow above the level of the intraterminal front-wall, and, spreading laterally, will fuse one with another to form a secondary (really tertiary) front-wall. Again, where a secondary aperture is formed, it will be built on one of but a few general designs; and these few designs are repeated independently again and again in different lineages. For instance, a very common method of forming the proximal shield of a secondary aperture is by the fusion of a median process of the apertural bar with the proximal pair of apertural spines: this is seen in the Tricephaloporinæ, the Kelestominæ, and Pelmatoporinæ (*Sandalopora*) among the Pelmatoporidæ; in the Andrioporidæ (*Pancheilopora*, fig. 73, p. 155); in the Lagynoporidæ (figs. 30, 31, p. 62); and in the Rhacheoporidæ (fig. 114, p. 253). And independent instances of other methods could be quoted (see § 25).

Now, while it is conceivable that the environment might so affect an organism as to throw out of gear its normal metabolism, it seems improbable that it should be directly responsible for causing independent groups of lineages of Cheilostome Polyzoa to run through a similar evolutionary history, especially as all stages of this history may occur simultaneously in different lineages under presumably the same environmental conditions*. Such a phenomenon

* This phenomenon of a similar evolution being repeated again and again in independent lineages has been noticed and insisted on by Buckman in Ammonites and Brachiopods, which repeatedly pass respectively through smooth, costate, and spinous, and smooth, costate, and plicate stages both in their phylogeny and ontogeny.

points rather to compulsion from within—to an inherent tendency in the ancestral form which becomes actual as its evolution is worked out in its offspring, although these are distributed among many divergent lineages. Such a potentiality in a radical form, becoming actual many times over in its descendants, introduces an element of inevitability in evolution, and makes it possible to speak of the evolutionary aim of a lineage, without thereby implying anything of what is usually understood by teleology. Such predetermined evolution is very like what has been termed Orthogenesis by Eimer *, and my friend Dr. F. L. Kitchin has spoken of it as Programme-Evolution.

But it is desirable to examine more closely into the nature of this potentiality (or these potentialities). It is the quality inherent in a radical organism whereby all its descendant modifications develop according to a common general plan; its expression is controlled by inhibiting agents, which may ultimately be removed by environmental means; this release is apt to occur periodically, and to result in the realisation or actualising of potentiality pent up and hitherto repressed because the process by which it is expressed (in the case of Cretaceous Cribrimorphs, the secretion of calcium carbonate) is similarly inhibited until the accumulating pressure becomes so insistent that it is relieved, so to speak, at a touch. Then expression has free play (as seen in expression-points of a lineage) and potentialities are freely realised, until more or less stable equilibrium is re-established by the deposition of calcium carbonate (in the case under consideration), the pressure is relieved, and inhibitions become again effective.

It is convenient, before going further, to disentangle several concepts that may have become confused, owing perhaps to the informal manner of their introduction. First, there are the potentialities just described, *qualities* inherent in the ancestral forms and lying behind all other factors of evolution, but dependent on these for their actualization. Then, there are processes producing the expression of potentialities (in the case under consideration, the secretion of calcium carbonate); these are *functions*. Thirdly, there are *structures* or *characters* (the calcareous skeleton) resulting from processes and rendering the potentialities actual. Besides these, there are the inhibitive agents which may be

* G. H. T. Eimer, 1896, p. 147; reported in 'Nature,' 1895, vol. lii, p. 554.

substances—metabolic products, such as hormones controlling these processes. But the production of calcium carbonate is one condition, and its progressively increasing output another, which, though in practice appears to follow inevitably on the first, in theory may be considered as distinct; and it may be that the removal of one inhibition is needed to produce calcium carbonate secretion at all, and that the progressive removal of others results in progressive increase of the calcareous secretion.

There remains to be considered the Mendelian factor or determinant. As generaly understood, this is a substance or structure in the nucleus of a gamete; at any rate, it has its structural counterpart in the nucleus, though itself may be considered as a quality. The presence or absence of a given factor, or determinant, means the presence or absence of a corresponding character in the organism. Thus, if the Mendelian factor is regarded as a quality, it corresponds with our potentiality, and if as a substance, it comes nearest to our inhibitive agent; and this resemblance becomes more marked when a claim of Mendelians is considered, namely, that a new character cannot be produced, except by the removal of an inhibiting factor. But the necessity of a structural counterpart in the gamete's nucleus, corresponding to each several factor (in the sense of potentiality) leads to the revolutionary idea advocated by Bateson (see above, p. xv). For potentiality was seen to be greatest in a radical form, and it follows that the simpler the organism the greater the potentiality. But, if every potentiality has a structural counterpart in the nucleus of the gamete, it follows that the simpler the organism the more complex structurally is its nucleus. This paradox appears to arise from confusing a potentiality with its localised structural counterpart.

V. Periodicity.

§ 9. The Cretaceous Cribrimorphs exemplify yet another aspect of evolution *. It was remarked in the last section that an outburst of evolutionary activity occurred in the genus *Pelmatopora* in lowest Senonian times, and that a second outburst occurred at a higher horizon; and it was implied that the release of pent-up potentialities tended to be periodical. Periodicity appears to be a

* See W. D. Lang, 1919[4], pp. 218–20.

deeply-rooted principle of organic evolution, and its method of expression was described in an account of evolution within the Coral-genus *Parasmilia* *; moreover, successive cycles of rise and fall of ornament have been described in Ammonites †, and periodicity has also been noticed in the evolution of Cretaceous Star-fishes ‡. Periodicity in evolution is no mere indefinite repetition of identical stages; it is essentially a progress, and a new period is a repetition of an earlier period *in a new aspect* or *upon a higher plane*. The essence of a period is a progression of three stages, namely an anabasis, or up-leading to the acme, or fulfilment of the evolutionary aim, followed by a greater or less catabasis or phase of transition to a new period. The outbursts of evolutionary activity in *Pelmatopora* illustrate this three-fold process. The acme in lowest Senonian times was preceded by an anabasis along the lineage of *Pelmatopora calceata*, and the gradual dying down of the evolutionary outburst was a transitional period, or catabasis, leading to the anabasis of a fresh period in the lineage of *P. pero*, which, in turn, reached a fresh acme in middle Senonian times, and underwent catabasis high in the zone of *Actinocamax quadratus*. But this second period was not a mere repetition of the first. The first period resulted in the complication of the intraterminal front-wall. The second period did not continue this complication. Starting with forms in which the intraterminal front-wall had already reached its limit of complexity, the genus took on a new phase of skeleton-building activity, and applied itself to the complication of a pair of aviculœcium-like structures appearing on the distal edge of the aperture.

Periodicity is again shown during Polyzoan evolution in the general œcial shape. It is assumed that the Membranimorphs are the most primitive Cheilostomes, and that they have been derived from Cyclostomes, or at least from an ancestor with a tubular œcium. Now, the Membranimorph œcium is box-like, not tubular; and even among Cyclostomes there is a tendency to develop a box-like œcium, such as that of *Haploœcia* and of the Eleids. The Cribrimorphs, in turn, are derived from Membranimorphs, and they

* W. D. Lang, 1909, pp. 288–9.

† See S. S. Buckman, 1887–1907, p. 433 (1894), and p. cc (1905); W. D. Lang, 1919[2], pp. 62, 63; W. D. Lang, 1919[3], pp. 107–8, fig. 20 *d*.

‡ W. K. Spencer, 1913, p. 156.

show a tendency to revert to a tubular œcium; but in those in which this is most marked it is the secondary aperture that, by becoming very enlarged and tubular, imparts a tubular aspect to the whole œcium. This return to a tubular form is of interest in connection with calcium carbonate secretion. It was noted before that the Cyclostomes were not troubled with a superfluity of calcareous matter, because, adding to the end of their tubular œcium, and periodically moving up the tube, they could lay down an indefinite deposit without inconvenience to themselves. The advanced Cribrimorphs that form a tubular secondary aperture would similarly be able indefinitely to prolong this, but they cannot move up their tube as it is formed, and they must, therefore, simultaneously elongate their distal ends. Thus the reversion to a tubular œcium is not an exact repetition of a previous condition.

Again, the evolution of Cheilostome Polyzoa is largely the history of the development of a calcareous intraterminal front-wall masking one composed of chitin. The Cribrimorphs build this up in a characteristic fashion, overarching the original chitinous front-wall. But, having formed a complex and much-solidified structure of calcium carbonate, some of the most advanced Cribrimorphs form yet another front-wall at a higher level, by the expansion and fusion of secondary apertural and interœcial tissue. Such three-decked Cribrimorph derivatives are termed Steganomorphs. The periodicity thus shown results in front-walls of three different types: the first, a flat chitinous sheet; the second, an arched fusion of calcareous spines variously reinforced with secondary calcareous matter; and the third, an overflowing layer of calcium carbonate supported pillar-wise upon interœcial and circum-apertural tissue. It may not be possible to trace the characteristic features of periodic law in every case, masked as they are by superposed evolutionary processes. But the examples quoted point to periodicity being a fundamental manifestation of evolution.

VI. Recapitulation.

§ 10. The phenomena of Recapitulation were considered earlier, in connection with their use as criteria of relationship. And it was noticed that the colony, like the individual, exhibited growth-stages of its own which recapitulate ancestral characters; and that this phenomenon has been termed Astogeny. But there is a third phenomenon of recapitulation which was not then described, since it required further explanation, and was more conveniently postponed for future consideration. It is convenient now to examine it. For, though but seldom applicable to Cretaceous Cribrimorphs, it is exhibited in various groups of Polyzoa, and appears to be fundamental to branched organisms generally. Therefore, in investigating any Polyzoan group, it is advisable to be aware of this aspect of recapitulation.

Briefly, the phenomenon is this. In a branching organism, there is a tendency to recapitulate earlier growth-stages at each branch; but a more proximal branch will exhibit earlier stages at its base than a more distal branch; so that the branches arranged in order of their occurrence show, on the whole, as well as in their individual parts, a progression of character, just as the main stem does. This principle has been claimed for Corals *, as well as Polyzoa †, and it provides an explanation for what is a very obvious phenomenon in certain plants ‡. For instance, if a branch of *Solanum jasminoides* is examined, the leaves will be seen to become progressively more complex as they are followed from the proximal end of a branch distally; and they finally undergo a catabasis, becoming simpler again at the distal end of a branch. Now, the branch springing from the axil of a complex leaf will be found to begin with a simple leaf, and to repeat the growth-stages of the main branch from which it sprang. And the same phenomenon may be seen in other plants. Such recapitulation in a branch is comparable with what R. T. Jackson has called the phenomenon of "localised stages" §, which he illustrates largely by plant examples. He also shows how recapitulation can be seen in seedlings, a phenomenon long recognised; but the extension of this to branches has not yet met with general recognition.

In Cheilostome Polyzoa this phenomenon is best shown in the branching asty of uniserial Membranimorphs, such as *Herpetopora* ||. But it is to some extent seen also in uniserial and pauciserial

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* W. D. Lang, 1909, pp. 290–1.

† W. D. Lang, 1905, p. 260; 1913, p. 173; 1914, p. 6.

‡ C. P. Chatwin & W. D. Lang, in F. A. Bather, 1911, p. 312.

§ R. T. Jackson, 1899.

|| W. D. Lang, 1914, p. 6.

Andrioporidæ. It is not necessary to go into its detailed application here, but an examination of the principle is desirable in this general view of the evolutionary principles supposedly governing the development of Cretaceous Cribrimorph Polyzoa.

VII. Summary.

§ 11. This review of the biological principles involved in the systematic arrangement of Cretaceous Cribrimorph Polyzoa began with an examination of the task before the systematist in its simplest aspect; and this was seen to be the intelligible marshalling or arrangement of a mass of more or less slightly differing forms in accordance with the theory that all are inter-related and descended from a common ancestor. Upon this simple position were imposed various theoretical considerations, which were suggested—or, at least, whose relative importance was suggested—by the considerations involved in trying to arrange systematically the Cretaceous Cribrimorph Polyzoa consistently with the theory of relationship and a common ancestry. It is not supposed that these theoretical considerations will be accepted without criticism, or even accepted at all; nor that their relative importance, if they are true, is accurately gauged. Rather, they are presented as aspects of evolution forced upon the author during the work of systematic arrangement, and are intended to create an atmosphere in which this systematic arrangement can more easily be understood. If, accepted in this spirit, they render the work more intelligible and, consequently, more useful, their object as far as this work is concerned will have been attained. Their ultimate truth, of course, is of fundamental importance, and by no means a matter of indifference to the author; but, for the use and understanding of the systematic part, it becomes a secondary matter.

At the risk of being tedious, it yet appears desirable to attempt to sum up the ideas presented in the previous sections; and, in so doing, to follow a different order, beginning rather with the more fundamental concepts, and proceeding to the more superficial. An organism, then, is regarded as a synthesis of structure and function, and as possessing tendencies* for structural development, limited

* The question of the origin of these tendencies is not touched upon. But my friend Dr. Kitchin, who agrees with me in recognising their importance, considers that they are not present *ab initio*, but that they arise as evolution proceeds, and that the environment has a share in their origin.

in scope, but expressed simultaneously along an unlimited number of descendant lineages. The result is a repetition, with varying detail, of a fundamental architectural plan in various lineages, suggesting inevitability in evolution, and evoking the term Programme-evolution. Expressions of structure and function are periodic in their manifestation, and the recapitulation of racial development in the development of the individual, the colony, or, even the branch of a colony, is one manifestion of periodic law. Metabolism itself is another of its manifestations, consisting, as it does, of an up-grade—anabolism, or building up of protoplasm; an acme, or the attainment of protoplasm; and a catabolism, or the breaking down of protoplasm. Inasmuch, however, as these processes are simultaneous, it is, perhaps, more philosophical to regard protoplasm as a synthesis of anabolism and catabolism—a concept rather than a substance, a state rather than a structure. If, to a row of three marbles touching one another, a fourth be added by rolling it against one end of the row, instantly the marble at the other end will start away. The row of four marbles (assuming that there is no other method of attaining it) is a concept—it never actually exists; it is a synthesis of the adding a marble to one end of the row (anabolism) and the simultaneous subtraction of one from the other end (catabolism).

Now, metabolism is obviously a very complex process, or, rather, collection of processes, full of most delicate adjustments; and it is conceivable that environmental conditions may easily affect it in minor, if not in major, directions; and even a small disturbance of metabolism may be permanent and, if accumulative, ultimately may destroy the organism. (Of course, to assume that the disturbance of metabolism by environmental conditions is permanent with regard to the race, means that an acquired character is in some way inherited—a point on which the author would be unwilling to take a dogmatic view.) It is also conceivable that metabolic processes may themselves be controlled by others, and that substances may be produced by metabolic action whose function it is to control other functions.

In the case of the Cretaceous Cheilostome Polyzoa, the ancestral form must be considered as having at some time or other begun to secrete chitin, probably as a means of nitrogenous secretion—a purely catabolic process,—and secondarily to use this secretion as a protective shell. In this organism lay the tendency, upon a slight disturbance of its metabolism, to follow up chitin secretion with the secretion of calcium carbonate; and this tendency was kept in check by inhibitive agents. In its chitinous descendants it every now and then happens that this inhibition is removed, showing on how delicate a balance equilibrium is maintained. Whenever in the evolution of chitinous lineages this equilibrium is lost, and calcium carbonate secretion is begun, not only does the process prove irreversible, but it increases in intensity, until, in the final terms of the lineages, all the energies of the organism are given over to calcium carbonate secretion and the Polyzoan becomes buried under the products of its own activities. Lineages which secrete calcium carbonate are, therefore, doomed lineages. The release of calcareous matter is not regular, but occurs in periodic bursts, as if the insistence of the unsecreted calcium carbonate increased up to a point when an inhibition could no longer restrain it, and then it was poured out freely, thus relieving the situation until increasing need for deposit was again felt.

It may be objected that hitherto nothing has been said of the action of Natural Selection upon variations of structure. There is no desire to deny to Natural Selection the preservation of any useful variation of skeletal structure, if it can find one. But the evolution of Cretaceous Cheilostomes suggests that, in so far as Natural Selection is present, its action is rather a negative one—insuring that the superfluous calcareous matter shall be laid down where it is least in the organism's way, than that the structure it builds should be directly useful. And, though it is possible that the main types of front-wall may originally have been determined with reference to the organism's advantage in the struggle of life, and are so far reflections of modifications of the soft tissues, yet it is impossible to imagine the details of skeletal structure here recognised as diagnostic of Cretaceous genera and species generally being of any use or otherwise to the organism; and it seems reasonable to look upon them as complications due to the necessity of piling up superfluous calcium carbonate where it least interferes with the organism's bionomy. The symmetry of the patterns is no more than a direct consequence of the symmetry of the soft parts.

It is hoped that enough has been said (if it has been intelligibly expressed) to clear the systematic portion of this work from any charge of being without informing idea. Even so, especially in some cases, such as the welter of forms presented by the genus

Pelmatopora in its first outburst of evolutionary activity, the need for far more light and clearer guiding principles is felt. And it is realised that we are far from understanding the processes of evolution, and catch only here and there hints of its true methods.

B. TERMINOLOGICAL.

I. Morphology and Auxology *.

§ 12. Cheilostome Polyzoa are marine colonial animals. The individuals of the colony are of microscopic size, and have a box-like body-wall with a skeleton of horny or shelly consistency, from

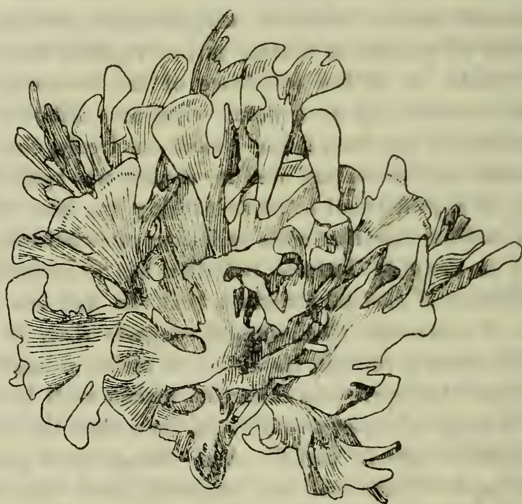


Fig. 1.—The asty, or colonial skeleton, of *Flustra foliacea* (Linnæus), a Recent Polyzoan, with a chitinous or horny skeleton; very commonly thrown up by the tide on the British coast.

which the mouth-parts can be extruded. Strands of soft tissue connect the individuals of a colony, passing through **Communication-Pores** † of the skeleton. It is not proposed to deal with the

* Auxology—the Science of Growth: see Bather & Buckman, 1892, p. 420.

† In life, these pores are filled with a sieve-like skeletal tissue through which the connecting strands pass. Hincks (1880, pp. iii, viii) calls these diaphragms *Communication-plates*. In the fossil all this detailed structure is lost, and only the comparatively large hole in the skeleton remains. This hole is the Communication-pore (*Kommunikations-por*, Smitt, 1868, p. 426, pl. xx, fig. 15).

morphology of the Cheilostome Polyzoa much beyond explaining those terms which are used in the systematic part of this work, but their general appearance may be gathered from an examination of figs. 1–4. The terms "zoœcium" and "zoarium," however, though generally appearing in the description of fossil forms, are not used here—and this requires some explanation.

The body-wall of Recent Polyzoa forms a somewhat rigid vessel in which are hung the viscera and, when retracted, the protrusible pharynx with its circle of tentacles and their appurtenances (see fig. 4). This vasiform body-wall was termed the *Zoœcium* by

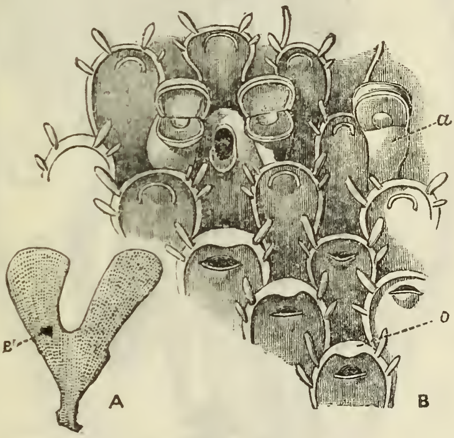


Fig. 2.—The asty, or colonial skeleton, of the Recent *Flustra foliacea* (Linnæus). A, natural size; B′, indicating the portion magnified 30 diameters in B: *a*, aviculœcium with closed mouth, to the left of which are seen two aviculœcia with open mouths; *o*, ovicell, forming the upper part of an œcium; ovicells are seen on three consecutive œcia; the operculum, which closes the orifice of the œcium, is seen in different positions in the individuals figured. After S. F. Harmer, 1901, 'The Cambridge Natural History,' vol. ii, p. 466, fig. 232.

Smitt *, and further defined by Hincks as the "home of the polypide" †. It consists of the ectoderm and its secretions, and the

* Smitt, 1866, p. 115. Smitt spells the word "Zooœcia" (plural). Claparède, in 1871 (p. 139), quoting Smitt's work, speaks of "Zooœcien"; and Hincks (1880, p. vi) spells it "Zoœcium."

† Hincks, 1880, p. vi.

somatic mesoderm; while the viscera and the eversible pharyngeal parts, collectively the *Polypide* *, may be regarded as comprising the splanchnic mesoderm and the endoderm. All Cheilostomes

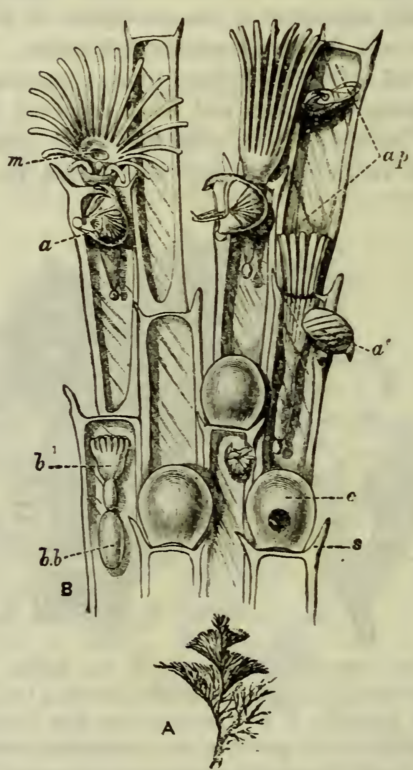


Fig. 3.—The polyzoary of the Recent *Bugula turbinata*. Alder, represented as seen when alive. A, natural size; B, a portion × 50 diameters: *a*, *a'*, avicularia, in different positions; *ap*, aperture of a zoœcium; *b*, a polypide-bud, attached by its stomach to *b.b*, a "brown body"; *m*, mouth of polyzooid, surrounded by the circle of tentacles; two polyzooids on the right show the tentacles partially expanded; *o*, ovicell; *s*, marginal spine. Some avicularia have been omitted in B. After S. F. Harmer, 1901, 'The Cambridge Natural History,' vol. ii, p. 468, fig. 233.

* Allman, 1856, p. 8.

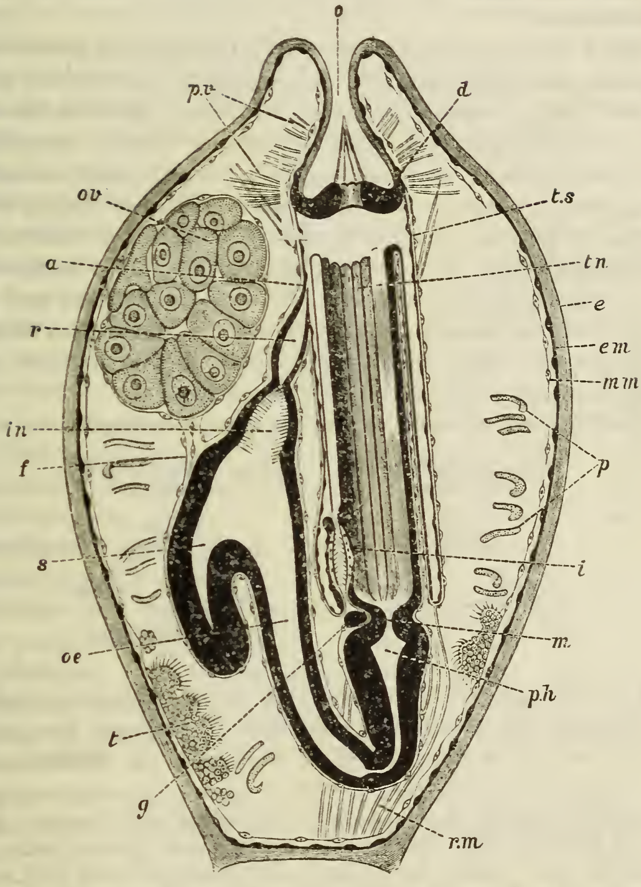


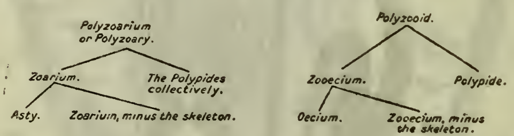
Fig. 4.—Diagram to show the anatomy of a polyzoid of the Recent *Alcyonidium albidum*, Alder. The polypide is retracted and lies entirely within the zoœcium: *a*, anus; *d*, diaphragm; *e*, œcium (in this case of gelatinous consistency); *em*, ectoderm; *f*, funiculus; *g*, ganglion; *i*, intertentacular organ; *in*, intestine; *m*, mouth; *mm*, somatic mesoderm; *o*, orifice; *oe*, œsophagus; *ov*, ovary; *p*, parietal muscles; *ph*, pharynx; *p.v*, parieto-vaginal muscles; *r*, rectum; *r.m*, retractor muscles (contracted); *s*, stomach; *t*, testis; *tn*, tentacles; *t.s*, tentacle-sheath. After S. F. Harmer, 1901, 'The Cambridge Natural History,' vol. ii, p. 469, fig. 234 (modified from H. Prouho, 1892, Arch. Exper. Zool. ser. ii, vol. x, pl. xxiii, fig. 3).

are colonial, and the sum-total of the zoœcia was called by Busk the *Zoarium* *.

Now it is not usual to find preserved as a fossil any part of the organism except the skeleton. Consequently, it is the hard parts of organisms possessing calcareous or siliceous skeletons that are found most abundantly as fossils, and are most used in unravelling the relationships of the forms and in discovering principles underlying their evolution. It is convenient, then, in dealing with fossils, to have a definite term for the "shell" or skeleton as distinguished from the tissue that secretes it. There already exist such terms in the *theca* of Corals, the *conch* of Molluscs, and the *tegulum* of Brachiopods. I have, therefore, used the term **Œcium** to denote the "shell" of Polyzoa, in distinction to zoœcium, and **Asty** for a colony of œcia, rather than zoarium †.

The following scheme tabulates the terms mentioned :—

Terms applicable to the colony. | Terms applicable to the individual.



§ 13. The embryonic shell of Corals is the *prototheca*, that of Brachiopods the *protegulum*, and that of Molluscs the *protoconch*; so the embryonic shell of Polyzoa is the **Protœcium** ‡.

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* Busk, 1875, p. 2. Busk appears to have slipped into "Zoarium" from an easy familiarity with "Polyzoarium," the term used by other authors of about this date. Hincks, for instance, used "Polyzoary" until 1877, when in one paper (1877, pp. 100, 107) he uses both terms. Busk, in the reference given, uses "Zoarium" without any explanatory remark, as if the word was already in use. Allman (*loc. cit.*) calls the zoarium the "*Cœnœcium*." He says "the cœnœcium is composed almost universally of two perfectly distinct tunics; to the external I have given the name *Ectocyst*, and to the internal that of *Endocyst*." These terms have come to be used (*e. g.* by Canu, 1900 [2], p. 336) for "œcium" and "the rest of the zoœcium," respectively. But it is evident, from Allman's definition, that they are colonial, not individual, terms and tissues rather than structures.

† Lang, 1916, p. 81. For a criticism of this use, see Harmer in Lang, 1919, pp. 219–220.

‡ Cumings, 1904, p. 50.

In Cheilostome Polyzoa, the protozoœcium and the following (brephic) zoœcium are indistinguishable * (owing to **Tachygenesis** †, or accelerated development), and the resulting zoœcium is known as the *Ancestrula* ‡. Its shell is the **Ancestrœcium** §, which is thus the first individual of a fossil Cheilostome colony. Palæontologists are accustomed to recognise, besides the **Embryonic** and **Brephic** (infantile) stages, just mentioned, **Neanic** (adolescent), **Ephebic** (adult), and **Gerontic** (old age) stages ||. These apply to the individual, and are sometimes exhibited by Polyzoan œcia at the edge of a colony, where individuals of various ages occur ¶. But the later stages entirely mask the earlier, since Polyzoan œcia do not grow serially like Ammonites or Gastropod-shells. The asty, on the other hand, does grow serially, and has stages corresponding with those of the œcium, and seen in the differing forms of the œcia accordingly as they are placed nearer the proximal end or distal part of the asty. These colonial growth-stages are termed **Brephastic, Neanastic, Ephebastic,** and **Gerontastic** **, and the œcia composing them may be known as **Brephœcia, Neanœcia, Ephebœcia**, and **Gerontœcia** respectively. Thus a neanœcium is an œcium occurring in the neanastic stage of the asty, and similarly with the rest. The embryonic stage of the asty is represented by the protœcium, and so needs no distinctive name; and, in the Cheilostomes, as has been remarked above, the ancestrœcium represents both the embryonic and brephic stages of the asty, so there is no need for the term "brephastic" in the Cheilostomata.

§ 14. The œcia of most Cretaceous Cribrimorph Polyzoa are dimorphic: that is, there are normal œcia—**Orthœcia**, and **Heter-**

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* Cumings, 1905, p. 170.

† Hyatt, 1893, p. 77.

‡ Jullien, 1888, p. 29: "ancestrule."

§ Lang, 1913, p. 172.

|| These are Bather's and Buckman's (1892, p. 421) emendations of Hyatt's terms (1889, pp. 8-21).

¶ Fig. 19 *b* in Lang, 1919 ³, p. 106, represents one such individual of *Polycephalopora turgida* in a neanic growth-stage.

** Cumings, 1904, p. 50. Cumings, however, uses "Nepiastic" for "Brephastic," in correspondence with Hyatt's "Nepionic" (A. Hyatt, 1893, p. 94). Bather and Buckman, however (*op. cit.* p. 429), suggest "Brephic" for Hyatt's original "Næpionic" (1889, p. 9), on the ground that the latter is an "impossible corruption of νήπιος."

œcia *. Heterœcia are generally **Aviculœcia** (fig. 6) or the skeletons of *Avicularia* † (fig. 3). Avicularia are zoœcia reduced to little more than a snapping *mandible* (the modified *operculum*) and its base or **Rostrum** ‡ (fig. 6), and probably subserve a protective purpose by pinching, and thus preventing other organisms, especially the larvæ of other Polyzoa, from settling on the surface of the zoarium, and by discouraging in this manner outsiders generally §. The mandible is not preserved in fossils, but there is present the rostrum on which it bites, corresponding to the apertural rim of the orthœcium, and a small proximal portion representing the rest of the orthœcium. The two portions are often divided by a constriction and sometimes by a complete calcareous bar (see, especially in the Tricephaloporinæ, Vol. IV). The aviculœcia may themselves be dimorphic, and sometimes they are incompletely so, grouping themselves around two modes with comparatively few intermediate forms—in which case the difference is chiefly one of size.

Aviculœcia differ in size, shape, position, and the direction in which the rostrum points, and they may thus differ within a given genus, subfamily, or family; but similarities in the aviculœcian characters sometimes distinguish even the larger groups. Thus very large, sub-circular aviculœcia characterise the Lagynoporinæ (figs. 22–32, pp. 46–66), while they appear to be absent in the Leptocheiloporinæ (figs. 34–38, pp. 72–78); the long, pointed, and distally-directed aviculœcia of *Castanopora* (Vol. IV) persist during evolution, while the shorter, blunter, and proximally-directed aviculœcia disappear; and the Thoracoporidæ are characterised by large spatulate aviculœcia (figs. 18–19, p. 34). It is also possible to show that there are tendencies common to all groups for the aviculœcia to undergo definite and similar changes during evolution. Thus, primitively, the aviculœcia are monomorphic, numerous,

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* Heterozoœcium (Levinsen, 1909, p. v). "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.'"

† Busk, 1851, p. 84.

‡ Harmer, 1909, p. 719.

§ See, in this connection, Harmer, 1901 [2], p. 486; and 1909, pp. 719–20.

small, short, and with blunt rostra, indifferently oriented and sporadically distributed. During the evolution of any group in which they show these characters, they tend to become dimorphic, fewer, larger, longer and with pointed rostra, definitely oriented and definitely placed. In any one group any of these changes may not be exhibited, also any character may be emphasised disproportionally to the rest. Thus, in *Ichnopora*, the aviculœcia become more markedly dimorphic (though later tending to become monomorphic again), less numerous, longer, and with more pointed rostra; but have always (as *Ichnopora*) been distally-directed, and, by definition, there is always an apertural pair; while an increase of size is by far the most remarkable feature in their evolution. Again, the aviculœcia may be in declining evolution, or **catagenesis***, with respect to some characters, and in **anagenesis**†, or ascending evolution, in regard to others. For instance, in *Castanopora* they are dimorphic in the more primitive species, and secondarily monomorphic in the more advanced; and they appear to be generally catagenetic during evolution within the genus *Anaptopora* (pp. 22–25).

It is probable that the evolution of aviculœcia in the Cretaceous Cribrimorphs is not as simple as the above account would imply. It must be remembered that the various families are supposed to be derived independently from different Membranimorph stocks; and that the history of Membranimorph aviculœcia is a gradual and often traceable divergence of aviculœcia from orthœcia, beginning with only a slight difference. Such aviculœcia (see fig. 2) are monomorphic, few, large, short and with blunt rostra, distally directed and sporadically distributed, but tend also to become more numerous, smaller, longer, and with sharp rostra, and indifferently orientated; and, finally, to become dimorphic, again fewer, again larger, definitely oriented and definitely placed with regard to the orthœcia. It is conceivable that, having reached a stage in this evolution, a second genesis of aviculœcia may take place, so that in a given form the aviculœcia may be dimorphic because they are of two evolutionary generations, one kind being small and more advanced, and the other kind larger and more primitive. But such forms as *Castanopora* (Vol. IV), *Pliophlœa charmanensis* (fig. 85, p. 182), *P. ostreicola* (fig. 86, p. 186), and *Taractopora*

* Hyatt, 1889, p. 74. † Hyatt, 1889, p. 71.

confusa (fig. 20, p. 39), rather suggest dimorphism of aviculœcia diverging from a common type than a dimorphism of aviculœcia in a Membranimorph ancestor. Again, there is dimorphism in the aviculœcia of the more advanced species of *Pelmatopora* (Vol. IV) derived from *P. brydonei*, in which a second kind of (supposed) aviculœcium has apparently arisen suddenly as a discontinuous variation. And the same may be true of the little aviculœcia of *Prosotopora flacca* (fig. 110, p. 244).

The *sudden* appearance of small paired aviculœcia is particularly noteworthy; it happens repeatedly in Andrioporine lineages, and creates the suspicion that these already highly-specialised avicularian individuals have had a long previous developmental history, diverging in the first instance from orthœcia, and passing through a stage of "vicarious aviculœcia" before appearing in their present, highly differentiated form. If this is so, they are potentially present in *Andriopora mockleri* and in its ancestor the hypothetical primitive Andrioporine (see p. 87); and some inhibiting agent is present in these earlier forms, entirely preventing the expression of aviculœcia. This suggestion has already been made with regard to a similar situation among Recent Membranimorphs by Harmer (1909, pp. 723–31), who hints that such an inhibiting factor may be truly Mendelian and act in a Mendelian manner; also that different kinds of avicularia may appear indifferently in the same species, owing to a process akin to Mendelian segregation taking place during budding. Without claiming such a connection—that is, without calling in the Mendelian inhibiting factor—we have already seen (pp. xv, xvi) that the evolution of Cribrimorphs generally suggests potentialities suppressed by inhibitions; and it is interesting to arrive at a particular instance where a similar situation has already been explained as due to a similar principle, namely inhibition; and that, further, a particular process of inhibition already recognised and claimed as generally operative in organic inheritance—namely, the Mendelian inhibitive factor—is called in to account for this situation.

But the particular instance is somewhat different from the general instances with which we have compared it. The potentiality in them was such as produced a general structure of a new kind, matched only by similar structures in parallel lineages. In the case of the inhibited aviculœcia, the potentiality was such as reproduced a pre-existing structure as soon as the inhibition was removed.

And the latter concept is more in keeping with the Mendelian theory. For we have already seen (p. xix) that to insist, as the Mendelians do, that a new character is only a suppressed character, and arises only by the removal of an inhibitive factor which has a structural counterpart in the nucleus of the gamete, is also to demand that the simplest organisms have the most complex nuclei—a difficult position to maintain.

§ 15. Besides the aviculœcia, other heterœcia are developed in some forms, such as *Pliophlœa subvitrea* (fig. 90, p. 191), blister-like individuals, with small, more or less circular apertures. They are termed **Cenœcia** *, and are supposed to be skeletons of polypide-less polyzooids.

§ 16. **Ovicells** (fig. 6) are the brood-pouches of Cheilostomata. When present, they are borne distally to some of the apertures, and often look like hoods or bonnets set on the œcial heads. Such are probably originally formed of spines, like the intraterminal front-walls of Cribrimorphs—indeed, in some cases, e.g. *Pliophlœa striata* (fig. 84, p. 182), *Leptocheilopora gasteri* and *L. tenuilabrosa* (figs. 34–35, p. 72), and *Andriopora homunculus* (fig. 46, p. 104), their costal origin is evident. Sometimes they appear to be entirely absent from a species; but when present in Cretaceous Cribrimorphs, they are of two kinds, namely, **hyperstomial** †, the kind already described as bonnet-like; or **endozoœcial** ‡, more or less globular, but deeply-seated chambers, lying distal to the apertures of the orthœcia and opening into these, but not as a rule projecting much above the general surface of the asty. Levinsen (1909) describes other types of ovicell, and attaches much systematic significance to any given type, though he quotes the case of both hyperstomial and endozoœcial ovicells occurring in *Cribrilina punctata*. In conformity with this opinion, it is found that the ovicell is of the same type throughout any given family of Cretaceous Cribrimorphs. Thus endozoœcial ovicells occur in the Pelmatoporidæ (except, perhaps, the Castanoporinæ), *e.g.*, in *Morphasmopora jukes-brownei*, in *Tricephalopora ansata*, in *T. saldeanensis*, in *T. sherborni*, in *Cœlopora latebrosa*, and in

* "Kenozoœcium," Levinsen, 1909, p. v.

† Levinsen, 1909, p. 60.

‡ Levinsen, 1909, p. 56.

Pelmatopora quadrata; in the Rhacheoporidæ, *e. g.*, in *Prosotopora flacca* and *P. bicornis* (figs. 110 *b* and 111 *b*, p. 244), and *P. arrecta* (fig. 112 *b*, p. 250); and in the Calidoporidæ, *e. g.*, in *Calidopora novaki* (fig. 93, p. 202), *C. auritulus* (fig. 95, p. 206), and in *C. aurita* (fig. 96, p. 208); while hyperstomial ovicells occur in the Andrioporidæ, *e. g.*, in *Andriopora homunculus* (fig. 46, p. 104), in *Eucheilopora labiosa* (fig. 68, p. 147), in *Pancheilopora magnilabrosa* (fig. 73, p. 155), and in *Pliophlœa striata* (fig. 84, p. 182); in the Lagynoporidæ, *e. g.*, in *Leptocheilopora gasteri* and *L. tenuilabrosa* (figs. 34–35, p. 72); in the Myagroporidæ; in the Otoporidæ (Plate I, fig. 2); in the Ctenoporidæ (Plate I, fig. 5); in the Thoracoporidæ (Plate I, fig. 6); and in the Taractoporidæ (Plate I, fig. 7).

§ 17. The orthœcia of calcareous Cheilostome Polyzoa are somewhat box-shaped, and in the Membranimorphs (fig. 5 *a*), from which Cribrimorphs are to be derived, the lid of the box, or **Front-wall**, has a composite structure. Laterally and proximally it is calcareous, and slopes outwards, gradually becoming continuous with the lateral walls; but all the middle and distal parts are occupied by a flat and chitinous roof. The line of the change of slope is the **Termen** *, and it nearly divides the calcareous from the chitinous portions of the front-wall; but there is often within the termen proximally and laterally a small calcareous bevel—the beginning of a calcified *Cryptocyst* †. The **Extraterminal front-wall** *, then, in Membranimorphs, is entirely calcareous, and the **Intraterminal front-wall** * mostly chitinous, but there is generally a calcareous bevel, a calcified cryptocyst, or *Lamina* ‡, which may, however, be of very small extent. Like a little hinged lid in the chitinous intraterminal front-wall is the chitinous *operculum*, covering the *orifice* through which the polypide is extruded. In fossil Membranimorphs the chitinous front-wall is not preserved, and the hole where it was is called the **Aperture**. Many Membranimorphs have a series of spines on the termen, the **Terminal**

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* Lang, 1914, p. 6; termen is a fictitious word implying a "boundary"—plural "*termina*"; adjectival form "*terminal*," as the existing word derived from *terminus*.

† Jullien, 1881, p. 274. ‡ Busk, 1859, p. 10.

spines *. Those that lie distal to the opercular hinge are the **Apertural spines** *, and those lying proximal to the opercular hinge are the **Costal spines**, because in Cribrimorphs (fig. 5 *b*) the aperture is contracted so as to be surrounded by the former spines only, while the latter are converted into **Costæ** *.

It is probable that if any lineage of Membranimorphs with large terminal spines has a further evolutionary history, it develops into

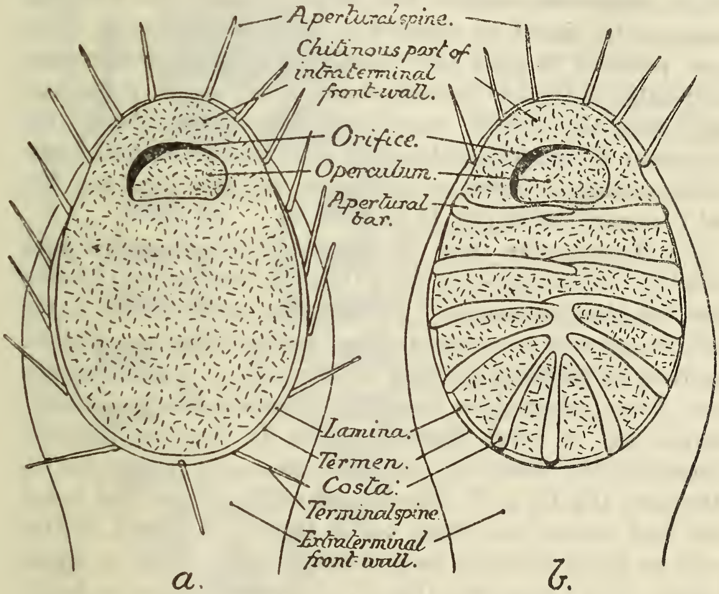

Fig. 5.—Diagrams to show the derivation of a Cribrimorph (*b*) from a Membranimorph (*a*). The chitinous parts are stippled.

a Cribrimorph lineage. This is effected by the over-arching of the terminal spines and their fusion with their opposite and lateral neighbours, so that a second intraterminal front-wall is formed above the primary chitinous front-wall (fig. 5 *b*). The spines of the first costal pair, on overlapping and fusing one with the other, form the **Apertural bar** (fig. 5 *b*). This is generally symmetrical; but its origin from overlapping costal spines is shown by its asymmetry in certain primitive Cribrimorph families, namely, the

* Lang, 1916[2], p. 76.

Otoporidæ (see *Otopora auricula*, fig. 16, p. 29) and the Ctenoporidæ (see *Ctenopora pecten*, fig. 17, p. 31). It is upon the nature of the secondary intraterminal front-wall, and of the costæ which compose it, that the families of Cretaceous Cribrimorph Polyzoa are largely founded. Eleven such families have been recognised, and it must be supposed that they have independently evolved from as many Membranimorph stocks. It is also possible that some of the sub-families comprised in a single family really had an independent evolution from Membranimorph ancestors, and, consequently, should be regarded as independent families. The most primitive families have loosely-constructed intraterminal front-walls, or front-walls built of few widely-spaced costæ, and may show their recent origin from Membranimorphs by the asymmetry of the apertural bar, even when the intraterminal front-wall is strongly solidified, as in *Otopora auricula* (fig. 16, p. 29) and *Ctenopora pecten* (fig. 17, p. 31).

The Myagroporidæ (figs. 11, 12, p. 18) are among the most primitive Cribrimorphs—in fact, they are intermediate between these and Membranimorphs. The spine-like costæ overlap in the mid-line, and only sometimes are fused among themselves; and the apertural bar resembles the other costæ in this, as in other respects. Such forms intermediate between Membranimorphs and Cribrimorphs may be called **Myagromorphs**. In the more primitive Otoporidæ, the costæ are not fused or hardly fused, and in *Anotopora* (fig. 15, p. 26) the elements of the apertural bar do not even bend towards each other; but in *Otopora* (fig. 16, p. 29) the costæ are firmly welded in the mid-line, though there are no lateral fusions. The Ctenoporidæ (fig. 17, p. 31) are a primitive family with a very peculiar formation of the intraterminal front-wall. The widely-separated, spine-like costæ just overlap medianly, but all are firmly welded to an underlying sheet of calcareous tissue, which forms a solid, arched, intraterminal front-wall. In the Thoracoporidæ (figs. 18, 19, p. 34), the costæ are spine-like and widely spaced, merely overlapping or firmly fused in the mid-line; but there are no lateral fusions.

In the preceding four families, the costæ on the whole retain their primitive spine-like form; in the following six families they are generally flattened, often considerably so, and as a rule make for a more solid intraterminal front-wall. In the Taractoporidæ (figs. 20, 21, p. 39), the costæ are few, wide, flat, widely-spaced and firmly-fused in the mid-line, and there are no lateral fusions. The Calpidoporidæ (figs. 92–98, pp. 202–211) have flat, widely-spaced costæ with no lateral fusions, but with a wide **Median area of fusion** (fig. 6)*, and a very stout symmetrical apertural bar. The intraterminal front-wall is more solid than in the preceding families,

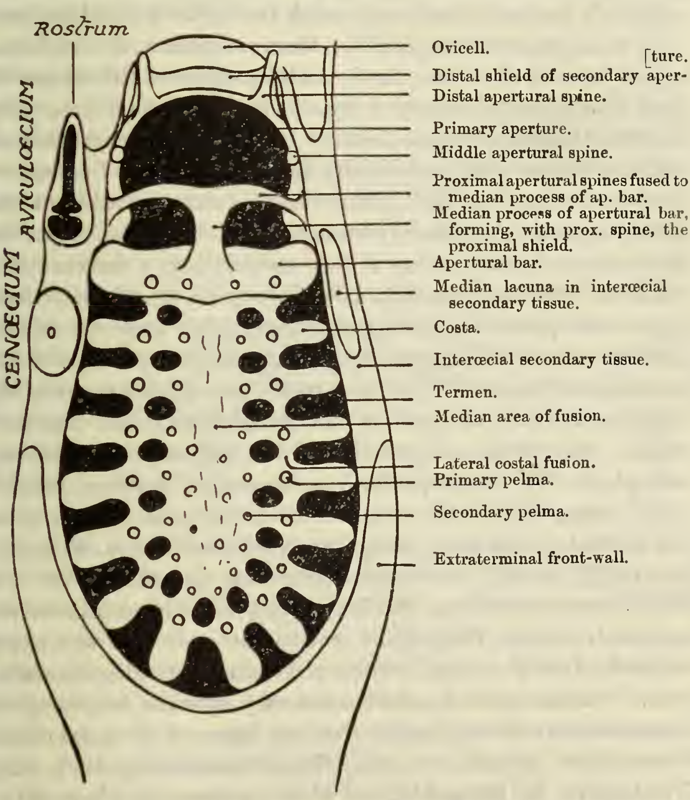

Fig. 6.—Schematic diagram of a Cribrimorph, to show the terms given in this work to various structures.

and more like the well-formed front-walls of all except the most primitive forms of the four succeeding families. The Disheloporidæ (figs. 99–105, pp. 220–228) and Rhacheoporidæ (figs. 106–115, pp. 234–253) have a firmly-knit intraterminal front-wall composed of flattened costæ, generally in close contact, but not fused laterally;

* Lang, 1916, p. 84.

and the median area of fusion has a more or less well-marked median seam formed by the solid up-turned ends of the costæ. There is not much further development of intraterminal front-wall in these families. In the Disheloporidæ there are sometimes well-marked pelmatidia on the costæ (fig. 105, p. 228); but these are somewhat irregularly arranged, and do not mark the levels of costal fusions.

In the eight preceding families there are seldom, if ever, lateral fusions between the costæ. In the Andrioporidæ and Pelmatoporidæ these **Lateral costal fusions** * (fig. 6) often abound and are present in all but the most primitive forms. In the Lagynoporidæ they are still very unusual, but occasionally are evident (as in *Lagynopora horsleyensis* (fig. 28, p. 58). Otherwise, the intraterminal front-wall of the Lagynoporidæ generally resembles that of the Rhacheoporidæ, but the costæ do not turn up at their ends to form a median seam; and some of the Lagynoporidæ (*Prodromopora*, fig. 25, p. 50) have a far more primitive intraterminal front-wall than any known Disheloporid or Rhacheoporid. The general shape, too, of the intraterminal front-wall (as of the œcium generally) is squat in the Lagynoporidæ and elongate in the Disheloporidæ and Rhacheoporidæ. No further complication of the Lagynoporid front-wall takes place. The Andrioporidæ have somewhat flattened, closely-placed costæ, often with numerous lateral fusions. There is no well-marked median seam, though in some forms (*e. g.* in *Æolopora*, figs. 75–77, p. 161, *Andriopora frequens*, fig. 48, p. 109, and *Eucheilopora crassescens*, fig. 71, p. 150) the solid costal ends are up-turned. In the Pliophlœine section the costæ are very much flattened, of very unequal widths, and bear longitudinal rows of pores. Further general solidification may give rise to a complete intraterminal front-wall hardly showing traces of its costal origin in very faint radiating grooves (*Corymboporella*, fig. 58, p. 126, *Tricolpopora*, fig. 66, p. 141, and *Holostegopora*, fig. 61, p. 131); while a tertiary front-wall is developed in *Hippiopora equestris* (fig. 74, p. 157), which thus becomes a **Steganomorph** †.

It is in the Pelmatoporidæ that the intraterminal front-wall reaches its highest development among Cretaceous Cribrimorphs. Some of the eight sub-families may possibly be independently

* Lang, 1916, p. 83.

† Steginomorph [*sic*], Lang, 1916[2], p. 76, named after d'Orbigny's genus *Steginopora*, which would be more properly written *Steganopora*.

derived from Membranimorph ancestors; but all are characterised by costæ with hollow upturned prolongations, presumably continued in the living organism as free spines, but appearing in the fossil as a row of broken ends. These broken ends, if small, are called **Pelmatidia** *, if large **Pelmata** * (fig. 6); and it is characteristic of them that, during evolution, they appear to move along the costæ away from the mid-line, and are followed by **Secondary** and **Tertiary pelmata** or **pelmatidia** (see fig. in Vol. IV and Lang, 1919[4], p. 198, figs. 2–5). It is probable that, during evolution, pelmatidia give rise to pelmata, since secondary and tertiary pelmata first appear as pelmatidia, and later enlarge into pelmata. The costæ are generally fairly closely-placed, but in the primitive sub-family Francoporinæ they are widely separated, and they are somewhat widely-spaced in the Opisthornithoporinæ. Pelmata are attained only in the Diacanthoporinæ and the Pelmatoporinæ—all the other sub-families have pelmatidia only. The Kelestominæ and Diacanthoporinæ have no further developments of the intraterminal front-wall, but a general closing up of the intercostal spaces, a widening of the median area of fusion, and a retreat of the pelmatidia and pelmata, respectively, from the mid-line; but in the Tricephaloporinæ, Pnictoporinæ, Castanoporinæ, Pelmatoporinæ, the intraterminal front-wall may become remarkably complex. In the first two sub-families just mentioned, this is brought about by the over-riding and, to some extent, the over-arching of the costal intraterminal front-wall by secondary tissue, derived either from a proximal growth in the neighbourhood of the apertural bar, by lateral expansion of interœcial secondary tissue, or by both methods simultaneously. In the Castanoporinæ, the intraterminal front-wall is very greatly complicated by numerous lateral costal fusions and by the multiplication of pelmatidia, but there is hardly any development of secondary tissue in this sub-family. *Ubaghsia*, however, forms a tertiary front-wall, or **Lamina peristomica** †, composed at least partly of the expansions of its enlarged and branched apertural spines. The Pelmatoporinæ at first complicate their intraterminal front-wall in the same way as the Castanoporinæ, namely by multiplying the lateral costal fusions and the

* Lang, 1916, p. 83.

† Jullien, 1886, p. 609. It was this structure in *Ubaghsia*, *Steganopora*, and *Disteganopora* that Jullien so named.

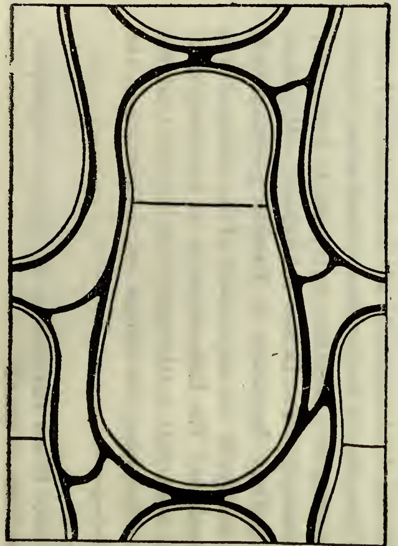

Fig. 7.—Diagram of an œcium and portions of six others, very much enlarged, to show how secondary tissue arises as contour-like ridges and buttress-like spurs in the interœcial valleys. (Secondary tissue is the thick black line.)

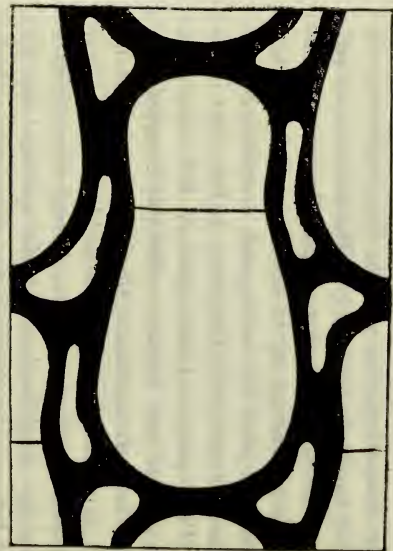

Fig. 8.—Diagram representing a further development of the condition represented in fig. 7. The secondary tissue (thick black) has increased in amount.

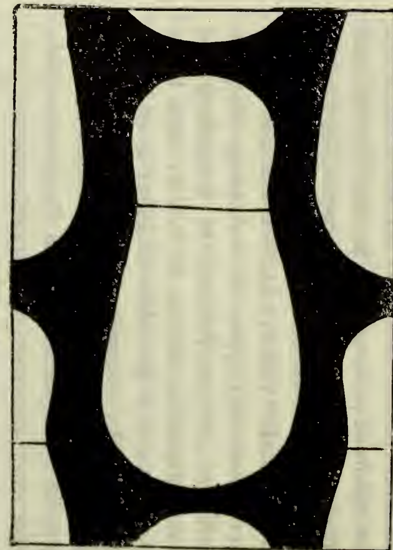

Fig. 9.—Diagram showing still further development of secondary tissue (thick black), which now completely fills the interœcial valleys and has no median lacunæ.

pelmata. In their later developments, some of them (*Ichnopora* and *Batrachopora*) form a more or less complete tertiary front-wall by means of expansions of the secondary apertural rim.

The systematic history of the intraterminal front-wall has been reviewed in summary detail, because it is mainly on the characters of this structure that the families and sub-families are founded. It is possible to give a more general account of the other structures, since there is a greater sameness in their developments.

§ 18. The *extraterminal front-wall* probably is primitively large, but as a rule had already become comparatively small before Cribrimorphs had emerged from Membranimorphs. In *Pelmatopora calceata*, however, it is probably primitively large, as it is also in the uniserial Andrioporidæ. But in certain forms it has apparently secondarily increased in size, as in *Tricephalopora triceps*, *T. tripartita*, and *T. sherborni*. In a great many forms the extraterminal front-wall is concealed beneath **Interœcial secondary tissue** * (fig. 6). This generally first arises as contour-like ridges on the extraterminal front-wall in the neighbourhood of the termina, and of buttress-like spurs connecting these contour-like ridges across the interœcial valleys (fig. 7). As more secondary tissue is laid down, these ridges and spurs increase in thickness, until the interœcial valleys appear filled with secondary tissue, which, however, has large **Median lacunæ** † at the bottoms of which the extraterminal front-walls are still visible (fig. 8). Finally, the lacunæ are filled up, and the whole interœcial valley is obliterated by secondary tissue, which even overflows the termen and covers or over-arches the intraterminal front-wall (fig. 9).

§ 19. The *costæ* generally first increase in number, but very often decrease again catagenetically.

§ 20. The *apertural bar* at first is asymmetrical, as has already been noticed in *Otopora* and *Ctenopora*. In less primitive forms it shows no signs of asymmetry, but is a broad bar that may remain low and flat, and have no medial proximal projection as in *Leptocheilopora* (figs. 34–38, pp. 72, 75, 78); or it may become flattened in a more or less vertical plane, and form a low shield-like proximal

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* Lang, 1916, p. 84. † Lang, 1919, p. 208.

rim of a secondary aperture, as in *Andriopora homunculus* (fig. 46, p. 104); or, again, it may bear a **Median process** * (fig. 6), which may be spiniform (*Calpidopora diota*, fig. 94, p. 206) and even fuse with the proximal pair of apertural spines (fig. 6, and *Lagynopora lagena*, fig. 30, p. 62); or it may be broad and flattened (*Calpidopora auritulus* and *C. aurita*, figs. 95–6, pp. 206, 208). Where the apertural bears a process, this is often seen to be double, and each of the two costæ of which the apertural bar consists contributes half. And in the Pelmatoporidæ, where each half of the bar bears one or two pelmata or pelmatidia, these structures are borne on the proximal part of the bar, which tends to bend away from the distal spine-bearing part, and thus a diamond-shaped depression is formed in the middle of the apertural bar. In the Kelestominæ this diamond-shaped depression becomes a perforation, and each component costa of the apertural bar is seen to be bifid; the proximal and distal prongs of each half fuse with their opposite respective prong, thus enclosing a diamond-shaped space. In the Tricephaloporinæ secondary tissue is deposited in the middle of the apertural bar, and extends proximally in a tongue-shaped mass over the median area of fusion of the intraterminal front-wall.

§ 21. The *apertural spines* (fig. 6) are primarily six in number, and primarily are exceedingly small. Their primary number and size are retained in the more primitive Andrioporidæ, but the evolution of this family is shown in the enlargement of the apertural spines. Six larger spines are also retained in the Pnictoporinæ, generally in the genus *Hexacanthopora* (figs. 22–24, pp. 46, 50) of the Lagynoporidæ, and as far as the neanastic stages of *Lagynopora* in the same family. In the Castanoporinæ the number of apertural spines may be four, five, six, or even (in *Ubaghsia*) seven or eight. But the ancestrœcium of *Castanopora dibleyi* shows only four apertural spines, and it is probable that in this sub-family there is a secondary increase in number. In most families of Cretaceous Cribrimorphs the primary six apertural spines have been reduced to four; and this reduction is shown by the ancestrœcia, which often have five (*Hesperopora occidentalis*) or six (*Morphasmopora jukes-brownei*). Besides, the transition is well seen in *Lagynopora lagena* (fig. 30, p. 62), whose ancestrœcium

* Lang, 1916, p. 83.

has six, neanœcia five, occasionally six, and epheboecia four apertural spines. It is very usual in Cretaceous Cribrimorphs for the proximal pair of apertural spines to fuse with the median process of the apertural bar, thus forming a double-hoop-like proximal shield of a secondary aperture (fig. 6). This occurs in the Pelmatoporidæ, in the genera *Kelestoma*, *Morphasmopora*, *Tricephalopora*, and probably in *Sandalopora*; in the Lagynoporidæ, probably in *Prodromopora* (fig. 25, p. 50), and certainly in *Lagynopora* (fig. 30, p. 62); and in the Rhacheoporidæ in *Diancopora* (fig. 114, p. 253), and, possibly, in *Geisopora* (fig. 113, p. 250). Since this structure is so often broken in fossils, it is possible that it is even more widely spread, and occurs in other forms with a median process of the apertural bar. In *Morphasmopora* the proximal apertural spines, besides being fused to the median process of the apertural bar, are enormously enlarged. In the Pnictoporinæ they fuse hoop-wise over the apertural bar, and also hoop-wise with the median pair of apertural spines. In other cases where a secondary aperture is formed the proximal apertural spines are simply outgrown by the rising proximal shield, and disappear, or in some cases appear to become involved in the pillar-like structure upon which the apertural aviculœcia are raised when these form part of the proximal apertural shield.

As far as I am aware, the only genera in which a median pair of apertural spines undergoes any modification beyond a general enlargement (as in the Andrioporinæ and Castanoporinæ) are *Pnictopora* and *Auchenopora*. In the former genus each median apertural spine fuses hoop-wise with the proximal apertural spine on one side and with the fused distal apertural spines on the other side; and in the later genus they are involved in a general fusion with the distal apertural spines (see fig. 78, p. 165).

The distal apertural spines seldom have an evolutionary history beyond a general enlargement. Where hyperstomial ovicells are present, they stand like pillars on each side of the ovicell's mouth. Often, as in *Pelmatopora*, they are left behind by the general upgrowth of secondary tissue that forms the distal rim of the secondary aperture, and disappear from that structure. In some cases, however, they form the distal shield of the secondary aperture, and generally accomplish this by fusing to form a plate, as in *Prosotopora arrecta* (fig. 112 *b*, p. 250). This distal shield may be isolated, and then may branch freely, as in *Ichnopora denticulata*;

and the distal apertural spines attain their greatest development when, fusing and branching, they expand laterally and form at least part of a tertiary front-wall, as figured by Jullien in *Ubaghsia*. We have also seen, in *Auchenopora* (fig. 78, p. 165), that they fuse with the median apertural spines as well as with each other to form a plate-like shield. On the other hand, as we have seen in *Pnictopora*—and it possibly happens also in *Pachydera*,—the fused distal apertural spines may not remain free, but may fuse hoop-wise with the neighbouring structures of the apertural rim.

In many of the primitive, small, blunt aviculœcia it is possible to see apertural spines on the rim of the rostrum (fig. 71, p. 150; fig. 79, p. 165).

§ 22. The **Primary aperture** (fig. 6) varies a good deal in shape. Primitively it tends to be **Sub-semicircular** (fig. 10 *a*) or **Semi-circular** (fig. 10 *b*), whence it passes through **Super-semicircular** (fig. 10 *c*) and **Sub-normal** (fig. 10 *d*) to **Normal** (fig. 10 *e*). A normal aperture may pass to **Super-normal** (fig. 10 *i*) or to **Cribriline** (fig. 10 *f*); and a cribriline aperture may become **Super-cribriline** (fig. 10 *j*) or **Pliophlœan** (fig. 10 *g*). This evolution must not, however, be strained. It is easy to see how a normal aperture may become distinctly pliophlœan without passing through a cribriline stage. Finally, by a general loss of peculiar shape any aperture may become **Sub-circular** (fig. 10 *h*).

§ 23. Much of the morphology of the **Secondary Aperture** * has been anticipated in the descriptions of the apertural bar and the apertural spines. In all cases the secondary aperture may be considered as composed of distal and proximal pieces—the **Distal** † and **Proximal Shields** † (fig. 6). Sometimes, as in *Auchenopora* (fig. 78, p. 165), these halves are left quite separate, so that there is a gap between them, and the secondary apertural rim is incomplete. Sometimes there is only a proximal shield (in most species of *Ichnopora*); sometimes, as in *Decurtaria*, there is only a distal shield. But often the two halves are joined, either by fusion hoop-wise (*Pnictopora*) or by a general up-growth of secondary tissue in the lateral parts of the aperture. The distal shield is formed either by a general up-growth of secondary tissue round the

* Lang, 1916 [2], p. 76. † Lang, 1916, p. 82.

distal parts of the primary aperture, obliterating the distal apertural spines (e. g. *Morphasmopora*); and this may involve one or more pairs of aviculœcia (in the advanced species of *Pelmatopora* and in *Decurtaria*); or, by a fusion of the distal apertural spines, as has already been described in connection with these structures. The proximal shield is often formed by the fusion of the proximal pair of apertural spines with a median projection of the apertural bar, as described above; and, in *Pnictopora*, we have seen it formed by the fusion of the proximal apertural spines hoop-wise above the apertural bar; or it is formed simply, as in *Andriopora homunculus* and species allied to it, by a more or less vertical

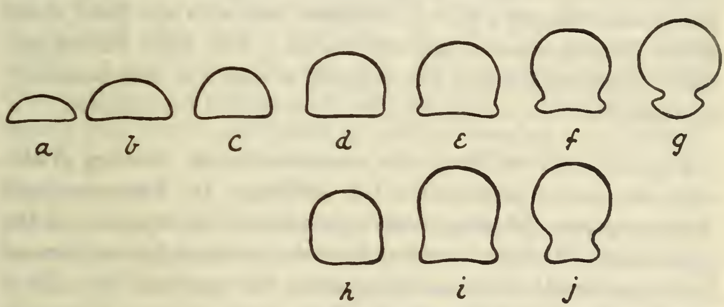


Fig. 10.—Shapes of primary apertures: *a*, Sub-semicircular; *b*, Semicircular; *c*, Super-semicircular; *d*, Sub-Normal; *e*, Normal; *f*, Cribriline; *g*, Pliophlœan; *h*, Sub-circular; *i*, Super-normal; *j*, Super-cribriline.

thickening of that structure. In *Phrynopora*, *Ichnopora*, *Batrachopora*, *Pachydera*, and *Diceratopora* (fig. 115, p. 253), the proximal shield is formed of a pair of aviculœcia, which are carried up on pedestals above the level of the apertural bar, and, inclining towards one another, finally fuse hoop-wise over the apertural bar. Since the first of the above-mentioned genera belongs to the Castanoporinæ, the last to the Rhacheoporidæ, and the middle three to the Pelmatoporinæ, it is evident that this structure, like the proximal shield formed by the fusion of the proximal spines with the median process of the apertural bar, has appeared more than once, and independently. In *Tricephalopora* (see figs. in Vol. IV) the proximal shield of the secondary aperture seems to involve both the processes just mentioned, since the lower part appears to be formed by the fusion of the proximal apertural spines with the median process of the apertural bar (these structures being very much thickened merely leave two lateral fenestræ); and the upper portion is formed of the fusion of an apertural pair of aviculœcia above the fused proximal apertural spines, enclosing a median fenestra. In *Pachydera* the proximal apertural shield, formed by the fusion above the apertural bar of an apertural pair of aviculœcia, is continued by a repetition of this process. Thus, what is probably a second pair of aviculœcia fuses above the fusion of the first pair, forming a second fenestra above the first, and the process is even repeated so that a third is formed. At the same time the proximal pair of apertural spines fuses hoop-wise with apertural aviculœcia, forming a pair of fenestræ; and with the fused distal spines, forming a second pair of fenestræ. And these fusions and their consequent fenestræ are repeated, so that the final secondary aperture resembles a chimney with three tiers of five fenestræ.

§ 24. The last structure to be considered is the *tertiary front-wall*, or *lamina peristomica* (of Jullien). In *Ichnopora* and *Batrachopora*—Pelmatoporinæ—it consists of the expansion of the proximal shield of the secondary aperture, which is flat and formed by the apertural aviculœcia fusing above the apertural bar. It is possibly present in *Phrynopora*—Castanoporinæ,—and, if so, it is similar to that of *Ichnopora* and *Batrachopora*. In *Ubaghsia*—Castanoporinæ—it appears to be formed partly thus and partly by the fused expansions of the branched apertural spines. In *Tricephalopora* and its derivative *Haplocephalopora*—Tricephaloporinæ—the tertiary front-wall is formed partly by the proximal migration of the fenestra and its enclosing tissue over the top of the intraterminal front-wall. This enclosing tissue is formed by the fusion of the apertural aviculœcia above the apertural bar, and partly by a general up-growth of the interœcial tissue enwrapping the intraterminal front-wall (see figs. in Vol. IV). In *Phractoporella*—Tricephaloporinæ—the tertiary front-wall is formed by the fusion of a tongue of tissue spreading from the middle of the apertural bar proximally over the median area of fusion of the intraterminal front-wall, with the interœcial secondary tissue spreading laterally over the intraterminal front-wall. In *Hippiopora*—Andrioporidæ—a tertiary front-wall appears to be formed in much the same manner as in *Phractoporella*, but is complicated by a median aviculœcium riding above the apertural bar (fig. 74, p. 157). *Hippiopora* appears to be the only described Cretaceous Cribrimorph outside the Pelmatoporidæ which possesses a tertiary front-wall.

§ 25. It has been claimed (see p. xvii) that the evolution of Cretaceous Cribrimorph Polyzoa is such that it is possible, within certain limits, to predict its course in any given lineage. Since the chief structures of this group have now been generally reviewed, also the broad lines of evolution of these structures, it is possible to get a general idea of the limits within which the evolution of a given lineage can be predicted, and to test the scope of the claim.

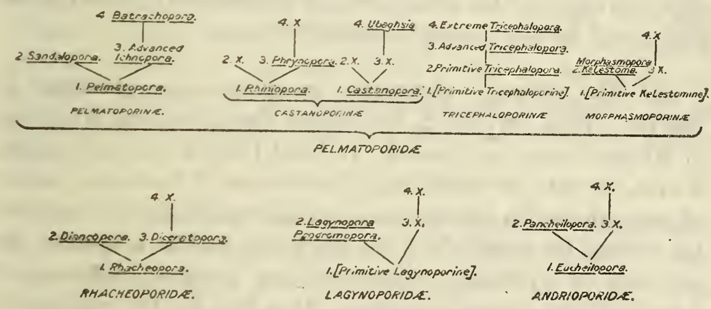
The asty of a primitive Cretaceous Cribrimorph is incrusting and unilaminar, and the œcia may be uniserial. It may safely be predicted that, during evolution, the œcia will become either caudate or multiserial, the asty will either become multilaminar, while remaining incrusting, or will become erect. On becoming erect the asty may remain unilaminar, or become bilaminar or cylindrical.

It is probable that the œcia of any primitive Cribrimorph are dimorphic; and it is impossible to predict whether aviculœcia will be lost or retained. The general evolution that may be predicted for aviculœcia has already been formulated: namely, from being monomorphic, numerous, small, short and with blunt rostra, indifferently oriented and sporadically distributed, the aviculœcia pass to being dimorphic, fewer, larger, longer and with sharper rostra, definitely oriented and definitely placed. But at any moment the aviculœcia may be dropped, or one kind of the dimorphic œcia may disappear, and then, perhaps, the other. The orthœcia lengthen in shape and increase in size, though occasionally catagenesis will overtake the latter (as any other) character. The costæ at first will increase in number, then almost certainly decrease by catagenesis. The shape of the aperture of a primitive form will be semicircular or even sub-semicircular, and will follow the evolution sketched above (p. xlvi).

It may safely be predicted that the primitive Cribrimorphs will solidify the intraterminal front-wall. Thus, the costæ, from being spiniform, will become flatter, and, from being far apart, will be drawn closer together; they also tend to form lateral fusions. But it will depend on the family or sub-family how otherwise the solidification of the intraterminal front-wall is brought about. The various methods have been discussed above. Sooner or later, the primitive Cribrimorph, besides solidifying the intraterminal front-wall, will lay down secondary tissue in the interœcial valleys and complicate the aperture. But it is not possible to predict, unless the sub-family of the form under consideration is known, whether one, two simultaneously, or three tracts will be used by the organism for laying down superfluous calcium carbonate, or, if more than one be chosen, the comparative emphasis that will be laid on the different tracts; nor yet if one or more will be attended to successively. For instance, the Castanoporinæ concentrate upon the intraterminal front-wall and finally give slight attention to the aperture, but (except in the genera *Anornithopora* and *Carydiopora*) they neglect the interœcial valleys, and are without interœcial secondary tissue. But *Pelmatopora*, while filling in the interœcial valleys, simultaneously complicates the intraterminal front-wall, and then turns to the complication of the aperture.

Again, it has been seen that there are only three or four plans on which the secondary aperture is built; and, so far as the proximal shield is concerned, only two methods that are usual. It is impossible to predict, even within a sub-family, what method a given lineage will employ; but it is fairly safe to predict that the proximal shield will be formed either by the fusion of the proximal apertural spines with the median process of the apertural bar, or by the fusion of apertural aviculœcia hoop-wise above the apertural bar—since the only other known methods are by a general upgrowth of the apertural bar in a vertical plane, and, in one case (*Pnictopora*), by the fusion of proximal pair of apertural spines with each other hoop-wise over the apertural bar. It is interesting, in this connection, to note the parallelism in the Rhacheoporidæ with the Pelmatorinæ and Castanoporinæ, on the one hand, and with the Lagynoporidæ on the other. *Rhacheopora* has no secondary aperture, but a plain apertural bar. From it both *Diancopora* and *Diceratopora* are derived. In *Diancopora*, the proximal shield of the secondary aperture is formed by the fusion of the proximal pair of apertural spines with the median process of the apertural bar; in *Diceratopora* by the fusion of apertural aviculœcia hoop-wise over the apertural bar. Primitive *Pelmatopora*, like *Rhacheopora*, has no secondary aperture, but a plain apertural bar; but from it both *Sandalopora* and *Ichnopora* are derived, and *Sandalopora* has a proximal shield formed as in *Diancopora*, while *Ichnopora* has one formed as in *Diceratopora*.

Again, *Rhiniopora*, like *Rhacheopora* and primitive *Pelmatopora*, has no secondary aperture, but a plain apertural bar, and its derivative *Phrynopora* has a proximal shield formed as in *Ichnopora* and *Diceratopora*; but there is no derivative of *Rhiniopora* corresponding with *Diancopora* and *Sandalopora*. Finally, *Lagynopora* is comparable with the two last genera, in having a proximal shield formed in the same way, But primitive Lagynoporinæ having no secondary aperture and a plain apertural bar have yet to be found; nor is there any known Lagynoporid lineage with a proximal shield formed as in *Diceratopora* and *Ichnopora*. This kind of comparison can be extended, and the following table shows several series exhibiting parallel homœomorphy :—



PARALLEL EVOLUTION.

1. Forms in which the apertural bar is simple, or, if possessing a process, this does not fuse with the proximal pair of apertural spines; and there is no true secondary aperture.
2. Forms in which the apertural bar bears a median process, which, fusing with the proximal pair of apertural spines, forms the proximal shield of a secondary aperture.
3. Forms in which the proximal shield of a secondary aperture is formed by the fusion of apertural aviculœcia hoop-wise over the apertural bar. Note: in *Tricephalopora* this fusion is formed (in phylogeny) above the fusion described in (2), in forms whose proximal shield is at first formed as in (2), and not as the development of an independent lineage.
4. Forms with a tertiary front-wall formed, at least partly, by the expansion of a fusion formed as in (3).

II. SYSTEMATIC NOMENCLATURE.

§ 26. In the systematic part of this work I have tried (with the exceptions noted) to follow the Rules and Recommendations for Zoological Nomenclature laid down at the International Congress at Monaco, 1913*. Thus, all **Trivial names** are written with a small letter, all **Generic names** with a capital letter. The author's name simply follows the trivial name he made†, if, when founding the species, he placed it in the genus in which it stands quoted; but in round brackets, if, on founding the species, he placed it under another genus. And so the rules are followed in other matters, including the law of Priority. Pit-falls, however, are numerous in the devious ways of Nomenclature; and I take this opportunity of acknowledging with many thanks the kind and ready help afforded me, not only in nomenclature, but also in bibliographic matters by Mr. C. D. Sherborn. Constantly, and often at a moment's notice, has he placed his skill and experience at my service. At the same time, the responsibility for any given finding and for any mistakes is entirely mine.

§27. The ultimate systematic groupings are considered as **Species**. Thus *Varieties*‡, *Individual Variations*, and *Mutations* in Waagen's sense are ignored. In fossil Polyzoa there are seldom, if ever, the data for establishing the first, and it becomes a matter of personal opinion whether an individual variation or a mutation has evolved far enough from the original to rank as a species. In any case, for systematic and evolutionary purposes, difference of form is all that primarily matters. It is then for the evolutionist to account for the difference of form, and for the systematist to place it in his system. If it can be placed and accounted for, it seems trivial to care about its exact systematic status. Thus, suppose a variety has been named as if it were a species: for all that is known to the contrary it is an incipient species, and only circumstances determine whether it finally becomes one or not.

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* See 'Congrès International de Zoologie,' 1914.

† With an intervening comma.—This is in keeping with the practice in former volumes of this Catalogue, though contrary to Art. 22 of the Rules and Recommendations of the International Congress, which forbids the interposition of any mark.

‡ I should define a Variety as a group of individuals within a species similarly differing from the type-specimen, but not necessarily appearing simultaneously nor sprung from the same parents; and an Individual Variation as an individual differing from the type-specimen, but not falling under any described variety. Neither term bears any implication as to the amount of the variation or as to its heritability.

But if the difference has been noted, the different form named, and the species from which it has been derived is known, or at least surmised, that is all that is required; and, knowing nothing of its after developments, it is as reasonable to call it a species, implying that it had an evolutionary future, as it is to call it a variety, implying that it was obliterated before it became specifically distinct. And it involves a simpler terminology. The same argument could be applied to a *Sub-species* (a step further from a variety), or even to an individual variation or to a Waagenian mutation. In all cases the difference is the important factor, and the biologist's task is to describe and account for the difference, or, at least, to indicate its significance, if he can. Important, though small, differences are liable to be masked, and may altogether escape notice, if the differing forms are, so to speak, all jumbled together in one bag, which is tied at the throat and labelled "species," to the great comfort and convenience of the systematist, who considers that he is thereby absolved from looking inside.

§ 28. The **Genera** are merely groups of species, so arranged that those species within a given genus are more nearly related to each other than they are to those of another genus. In so far as the phylogeny of species is completely known, so does it become more difficult to define the genera. If the complete phylogeny of a group of species were evident, all the generic limits would be arbitrary; and so with families and orders. It is, therefore, often difficult to decide in which genus a boundary-species should be placed. For instance, *Pelmatopora d'orbignyi* might, without impropriety, be placed in *Ichnopora*. Nevertheless, the genera in this work have not the remotest affinity with Gregory's *Circuli* *. However widely unrelated the supposed species of any genus may prove on further research to be, a supposed relationship is the sole sanction for their present grouping; on the other hand, relationship is the one quality which the members of a circulus need not possess—consequently, they are far more likely to prove homœomorphs than congeners.

As the species is to the genus, so is the genus to the **Family**. It was not originally intended to complicate the system with

* Gregory, 1896, p. 22.

Sub-families, but it was ultimately found more convenient to do so. And for this reason: it was seen that the known genera of Cretaceous Cribrimorphs could be grouped into eleven divisions, such that, while the common ancestor of each group could be supposed to be a Cribrimorph, it was impossible to imagine an ancestor common to any two of the eleven groups which was not a Membranimorph. But one of the families fell at once into two main groups, one into three, and one (the Pelmatoporidæ) into eight. These groups within each family are so different that it is possible that they were derived independently from Membranimorphs—in which case the families would be increased from ten to twenty. On the other hand, it is possible that a Cribrimorph ancestor was common to all the sub-groups of a given family. So this supposed relationship was indicated by recognising sub-families in four of the ten families of Cretaceous Cribrimorphs.

§29. Following the international convention, the family- and subfamily-names end, respectively, in -idæ and -inæ*; and the name is taken from that of the typical genus. Where new generic names are employed, they are generally founded upon a Greek word indicative of some trait of the type-species; but in a few cases upon a proper name, and in all cases they end in *-pora* or *-porella*. This convention is used for the sake of biologists who are not Polyzoa-specialists, in order that they may recognise by the termination of an unfamiliar generic name the phylum to which it belongs; but it has the disadvantages of bringing monotony into the nomenclature of the group and of causing longer generic names. Also, in the cases where proper names are employed, it transgresses Recommendation C of Article 8 of the International Code. *Francopora* and *Kankopora* (derived from Kaňk, in Bohemia) transgress in this respect. The type-species of the genus, or **Genotype**, is the species on which the genus was founded. It often happened, in past works, that no species was selected as the genotype on the foundation of a genus, yet several species were indicated as coming within the genus. Such equally-placed species are **Genosyntypes**, and it is the duty of a subsequent worker to select a suitable genosyntype to be the type of the genus. The first species definitely selected after the foundation of

* 'Congrès International de Zoologie,' 1914, Article 4.

a genus with genosyntypes is the **Genolectotype**. The conditions for the selection of a genolectotype are duly set forth in the International Code*.

§ 30. As with the genus, so with the species: the specimen on which a species is based is the **Type-specimen**, or **Holotype** †. Where a species is founded upon several specimens *indifferently*, each is a **Syntype** (sometimes called a *Cotype*); when a species is founded upon several specimens and one of them has been designated (by the original author or another) as the holotype, then the other specimens are **Paratypes**. A specimen selected by a subsequent author as the type from a number of syntypes is a **Lectotype**. A **Topotype** is a specimen of a named species from the locality and horizon of the holotype; a **Metatype** is a topotype identified by the nomenclator himself; and an **Idiotype** one such, but not a topotype. Other terms for various degrees of type-specimens have been employed, but are not used in this work. Where a new trivial name is used, it is founded upon the name of a person or place, or upon a Latin word indicating some quality actual or fancied in the species described. While often using place-names, I have comparatively seldom employed the names of persons, such appearing somewhat inappropriate in connexion with these minute and obscure remains. On the other hand, to name a species after a confrère is a pleasant way of showing appreciation of his work, or gratitude to a keen and generous collector. In the case of a genotype, it is very usual to echo in Latin form the meaning of the Greek-derived generic name. The systematic account is full of examples; and often, where several new species in a genus have to be named, the idea in the generic name is carried through all or most. It is hoped that these touches of fancy have lightened the inevitable ponderousness of the necessary nomenclature.

The enclosure of the generic name of a species within square brackets is to show that, in my opinion, it is likely, though not certain, that that species belongs to that genus. And, throughout the work, words enclosed in square brackets may be taken as

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* 'Congrès International de Zoologie,' 1914, Article 30.

† For these and the following terms see Buckman & Schuchert, 1905.

indicating my opinion interpolated in matter which is not my own.

Following is a list of all the genera to which Cretaceous Cribrimorphs have been referred by various authors, with the genotype either as originally established or as subsequently selected (see W. D. Lang, 1917) :—

List of Genera to which Cretaceous Cribrimorphs have been referred, with their Genotypes.

Adeona, Lamouroux, 1816, p. 478; genosyntypes, *A. grisea*, *A. elongata*, and *A. foliacea*, Recent Australian forms, which are not even Cribrimorphs. Leymerie, who ascribes his species *A. scobina* to this genus, spells it *Adeone*.

Æolopora, Lang, 1916, pp. 383, 390; genotype, *A. distincta*, Lang, 1916, p. 390.

Anaptopora, Lang, 1916, p. 402; genotype, *A. disjuncta*, Lang, 1916, p. 402.

Andriopora, Lang, 1916, pp. 382, 383; genotype, *A. homunculus*, Lang, 1916, p. 384.

Angelopora, Lang, 1916, pp. 382, 387; genotype, *A. nuntia*, Lang, 1916, p. 387.

Anornithopora, Lang, 1916, p. 93; genotype, *A. involucris*, Lang, 1916, p. 93.

Anotopora, Lang, 1916, pp. 402, 403; genotype, *A. inaurita*, Lang, 1916, p. 403.

Antropora, Lang, 1916, pp. 86, 91; genotype, *A. cavernosa*, Lang, 1916, p. 91; *Antropora* is preoccupied by Norman, 1903 [2], p. 87; genotype, *Membranipora granulifera*, Hincks, 1880 [2], p. 72, pl. ix, fig. 4; Recent; Madeira: see *Cœlopora*.

Argopora, Lang, 1916, pp. 382, 385; genotype, *A. segnis*, Lang, 1916, pp. 385, 386.

Auchenopora, Lang, 1916, pp. 383, 390; genotype, *A. guttur*, Lang, 1916, p. 390.

Baptopora, Lang, 1916, p. 84; genotype, *B. immersa*, Lang, 1916, p. 84.

Barroisina, Jullien, 1886, p. 605; genotype, *Reptescharipora elegantula* v. Hgenow sp; Beissel, 1865, pp. 60, 11, 90, pl. vii, fig. 82; non *Cellepora* (*Escharina*) *elegantula*, Hag., von Hagenow, 1851, p. 90, pl. x, fig. 13. Beissel's form is here considered as a synonym of *Cellepora cornuta*, nob., von Hagenow, 1839, p. 271, which is referred to the genus *Pliophlœa* Gabb & Horn, of which genus therefore *Barroisina* is considered a synonym.

Batrachopora, Lang, 1916, pp. 101, 110; genotype, *B. ranunculus*, Lang, 1916, pp. 110, 111.

Beisselina, Canu, 1913, p. 138; genosyntypes, *Eschara striata*, Goldfuss; *Porina pachyderma*, Marsson; *Eschara boryana*, von Hagenow; *Beisselina punctata*, n. sp. Genolectotype, *Eschara striata*, Goldfuss, 1826, p. 25, pl. viii, fig. 16, see Canu & Bassler, 1920, p. 322.

Calpidopora, Lang, 1916, pp. 403, 404; genotype, *C. diota*, Lang, 1916, p. 404.

Carydiopora, Lang, 1916, pp. 93, 94; genotype, *C. nucula*, Lang, 1916, p. 94.

Castanopora, Lang, 1916, pp. 93, 94; genotype, *C. castanea*, Lang, 1916, p. 95.

Cellepora, Linnæus, 1767, p. 1285; genosyntypes—six Recent species, of which *Cellepora pumicosa*, Linnæus, is taken by Hincks (1880, p. 398) as the genolectotype.

Cœlopora, Lang, 1917, p. 169; genotype, *Andropora cavernosa*, Lang, 1916, pp. 91, 92.

Collarina, Jullien, 1886, p. 607; genotype, *Lepralia cribrosa*, Waters (non Heller), 1879, p. 36; Recent.

Corymbopora, Lang, 1916, pp. 382, 385; genotype, *C. religata*, Lang, 1916, p. 385. *Corymbopora* is preoccupied by Michelin, 1846, p. 213; genotype, *C. menardi*, Michelin, 1846, p. 213, pl. liii, fig. 10; see *Corymboporella*.

Corymboporella, Lang, 1917, p. 169; genotype, *Corymbopora religata*, Lang, 1916, p. 385.

Costula, Jullien, 1886, p. 604; genotype, *Escharella arge*, d'Orbigny, 1851, pl. 666, figs. 7–9, 1852, p. 219 (see p. 7).

Cribrilina, Gray, 1848, p. 116; genotype, *Lepralia punctata*, Hassall, 1841, p. 368; Recent; Kingstown Harbour, Ireland.

Ctenopora, Lang, 1916, p. 403; genotype, *C. pecten*, Lang, 1916, p. 403.

Decurtaria, Jullien, 1886, p. 606; genotype, *Semiescharipora cornuta*, Beissel, 1865, pp. 58, 11, 90, pl. vii, figs. 77–81.

Dermatopora, von Hagenow, 1851, pp. 87, 98; genosyntypes, *Cellepora* (*Dermatopora*) *monilifera*, von Hagenow, 1851,

p. 98, pl. xi, fig. 1; *Cellepora lyra*, von Hagenow, 1839, p. 269, pl. iv, fig. 8; *Cellepora ornata*, Goldfuss, 1826, pp. 26, 248, pl. ix, fig. 1; *Cellepora* (*Dermatopora*) *faujasi*, von Hagenow, 1851, p. 99, pl. x, fig. 19. Genolectotype, *Cellepora* (*Dermatopora*) *monilifera*, von Hagenow, 1851, p. 98, pl. xi, fig. 1, see Lang, 1917, p. 170.

Diacanthopora, Lang, 1916, p. 100; genotype, *D. bispinosa*, Lang, 1916, pp. 100, 101.

Diancopora, Lang, 1916, pp. 398, 400; genotype, *D. ancora*, Lang, 1916, p. 400.

Diceratopora, Lang, 1916, pp. 398, 400; genotype, *D. bivia*, Lang, 1916, p. 400.

Discopora, Lamarck, 1816, p. 164; genosyntypes, nine recent species, of which Gray (1848, p. 126) has chosen *Cellepora verrucosa*, Esper, 1790, p. 239, pl. ii, figs. 1, 2 (= *Tubipora verrucosa*, Linnæus, 1758, p. 789) as genolectotype. At the same time, Gray explains that the *Cellepora verrucosa* of Esper is not the *C. verrucosa* of Lamarck. Until the identity of *Cellepora verrucosa* is determined, the interpretation of *Discopora* must remain uncertain.

Dishelopora, Lang, 1916, p. 400; genotype, *D. bicuspis*, Lang, 1916, pp. 400, 401.

Distanseescharella, d'Orbigny, 1853, p. 463; genosyntype, *Cellepora familiaris*, von Hagenow, 1839, p. 274; *Escharina inflata*, Römer, 1840, p. 14, pl. v, fig. 5; *Escharina radiata*, Reuss, 1846, p. 68, pl. xv, fig. 19; genolectotype, *Cellepora familiaris*, von Hagenow, 1839, p. 274; see Lang, 1916, p. 387.

Disteginopora, d'Orbigny, 1852, p. 235; genotype, *Eschara horrida*, d'Orbigny, 1850, p. 264; see also under *Thoracophora*.

Eschara, Linnæus, 1758, p. 804; genosyntypes: *E. foliacea*, Linnæus, 1758, p. 804; *E. fistulosa*, Linnæus, 1758, p. 804; *E. fragilis*, Linnæus, 1758, p. 805; *E. divaricata*, Linnæus, 1758, p. 805; and *E. verticillata*, Linnæus, 1758, p. 805; genolectotype, *E. foliacea*, implicitly chosen by Linnæus (1761, p. 539), who, in establishing the name *Flustra*, which he wished should supplant the name *Eschara*—"Nomen *Escharæ* in *Flustram* transmutavi, cum prius Morbi homonymon"—mentions three species of *Flustra*, of which the first two are *E. foliacea* and *F. fistulosa*, and the other does not occur among the genosyntypes of *Eschara*; again, in 1767, pp. 1300, 1301, Linnæus gives six species of *Flustra*, of which the first, *F. foliacea*, is the only genosyntype of *Eschara*; it seems clear, then, that *Eschara foliacea* was in Linnæus's mind as typical when the genus *Eschara* was founded—besides, *F. foliacea* is commonly recognised as the genolectotype of *Flustra*; see also under *Flustra* and Lang, 1917, p. 170.

Escharella, Gray, 1848, p. 125; genosyntypes, *Berenicea immersa*, Fleming, 1828, p. 533; *Lepralia violacea*, Johnston, 1847, p. 325, pl. lvii, fig. 9; *Lepralia variolosa*, Johnston, 1838, p. 278, pl. xxxiv, fig. 4; all Recent; genolectotype, *Berenicea immersa*, Fleming, selected by Norman, 1903 [2], p. 117.

D'Orbigny, apparently, independently founded *Escharella* (1852, p. 218) with the genosyntypes *Eschara edwardsiana*, von Hagenow, 1851, p. 70, pl. viii, fig. 12; *Escharella arge*, d'Orbigny, 1851, pl. 666, figs. 7–9, 1852, p. 219; and *Escharella ramosa*, d'Orbigny, 1851, pl. 684, figs. 9–11, 1852, p. 220; but, since the genus is preoccupied, d'Orbigny's genotype need not be considered.

Escharina, Edwards in Lamarck, 1836, pp. 218, 230; genotype, *Eschara vulgaris*, Moll, 1803, p. 55; Recent.

Escharifora, d'Orbigny, 1851, p. 208; genosyntypes, *Escharifora argus*, d'Orbigny, 1851, p. 209; *E. circe*, d'Orbigny, 1851, p. 210, *E. rhomboïdalis*, d'Orbigny, 1851, p. 210, and *E. crassa*, d'Orbigny, 1851, p. 211; none Cribrimorph; genolectotype, *E. argus*, see Canu, 1913, p. 146.

Escharipora, d'Orbigny, 1842, p. 220; genotypes, seventeen Senonian species, of which the following have been referred to other genera, *E. raripora*, d'Orbigny, 1852, p. 234, pl. 703, figs. 16–18, to *Graptopora*; *E. pentapora*, d'Orbigny, 1851, pl. 685, figs. 5–8, 1852, p. 224. *E. ovalis*, d'Orbigny, 1852, p. 233, pl. 703, figs. 13–15, *E. regularis*, d'Orbigny, 1851, pl. 685, figs. 9–12, 1852, p. 224 (all three synonymous, according to Canu, 1900 [2], p. 451), to *Polycephalopora*; *E. mumia*, d'Orbigny, 1851, pl. 687, figs. 4–6, 1852, p. 233, *E. striata*, d'Orbigny, 1851, pl. 686, figs. 9–12, 1852, p. 229 (synonymous with *E. mumia*, according to Canu, 1900 [2], p. 450), *E. chrysalis*, d'Orbigny, 1851, pl. 686, figs. 6–8, 1852, p. 228, *E. elegans*, d'Orbigny, 1851, pl. 684, figs. 13–15, 1852, p. 222 (probably

= *E. striata*), to *Pelmatopora*; *E. filiformis*, d'Orbigny, 1852, p. 232, pl. 700, figs. 13–15, *E. leporina*, d'Orbigny, 1851, pl. 686, figs. 13–16, 1852, p. 230, to *Ichnopora*; *E. insignis*, d'Orbigny, 1851, pl. 687, figs. 1–3, 1852, p. 231, to *Baptopora*; *E. pretiosa*, d'Orbigny, 1852, p. 227 (= *E. magnifica*, d'Orbigny, 1851, pl. 686, figs. 1–5), to *Castanopora*; *E. incrassata*, d'Orbigny, 1851, pl. 685, figs. 1–4, 1852, p. 223, to ? *Rhacheopora*; and *E. neptuni* (d'Orbigny), 1850, p. 264, to ? *Prosotopora*.

The three remaining species are *E. inornata*, d'Orbigny, 1851, pl. 686, figs. 17–19, 1852, p. 230; *E. plana*, d'Orbigny, 1851, pl. 685, figs. 17–19, 1852, p. 226; and *E. prolifica*, d'Orbigny, 1851, pl. 685, figs. 13–16, 1852, p. 225. Of these, *E. inornata* has been selected as the genolectotype of *Escharipora*, see Lang, 1917, p. 170.

Escharoides, Edwards in Lamarck, 1836, pp. 218, 259; genosyntypes, eleven Recent and eight fossil species, of which Verrill, 1879, p. 149, has chosen *Cellepora coccinea*, Abildgaard, 1806, p. 30, pl. cxlvi. figs. 1–2, Recent, as genolectotype.

Eucheilopora, Lang, 1916, pp. 382, 387; genotype, *E. labiosa*, Lang, 1916, pp. 387–8.

Flustra, Linnæus, 1761, p. 539; genosyntypes, *F. foliacea* (Linnæus), 1761, p. 539, *F. fistulosa* (Linnæus), 1761, p. 539, and *F. pilosa*, Linnæus, 1761, p. 539. In establishing the name *Flustra*, however, Linnæus states positively that he is replacing the name *Eschara*—"nomen *Escharæ* in *Flustram* transmutavi"—by *Flustra*. Therefore *Eschara* and *Flustra* are, by definition, synonyms. And since Linnæus himself had no power to supplant one of his own names, *Eschara* must stand, and *Flustra* fall. Since, however, the name *Flustra* is invariably used for *F. foliacea*, the genolectotype of this genus and of *Eschara* (see under *Eschara*), while *Eschara* is used variously, it would be desirable to standardise the name *Flustra* and delete *Eschara* from Zoological nomenclature. See Lang, 1917, p. 171.

Francopora, Lang, 1916, p. 84; genotype, *F. canui*, Lang, 1916, p. 84.

Geisopora, Lang, 1916, pp. 400, 401; genotype, *G. protecta*, Lang, 1916, p. 401.

Graptopora, Lang, 1916, p. 405; genotype, *G. scripta*, Lang, 1916, p. 405.

Haplocephalopora, Lang, 1916, pp. 86, 89; genotype, *H. uniceps*, Lang, 1916, p. 89.

Hesperopora, Lang, 1916, pp. 93, 98; genotype, *H. occidentalis*, Lang, 1916, p. 98.

Hexacanthopora, Lang, 1916, p. 394; genotype, *H. sexspinosa*, Lang, 1916, p. 394.

Hippiopora, Lang, 1916, pp. 383, 389; genotype, *H. equestris*, Lang, 1916, p. 389.

Hippothoa, Lamouroux, 1821, p. 82; genotype, *H. divaricata*, Lamouroux, 1821, p. 82; Recent.

Hippothoida, Vine, 1893, p. 316; a misprint for "*Hippothoa*."

Holostegopora, Lang, 1916, pp. 383, 390; genotype, *H. epsomensis*, Lang, 1916, p. 390.

Hoplocheilina, Canu, 1911, p. 261; genotype, *Eschara osculifera*, Reuss, 1872, p. 106, pl. xxvi, figs. 2–4.

Hybopora, Lang, 1916, pp. 383, 389; genotype, *H. gibba*, Lang, 1916, p. 389.

Hystricopora, Lang, 1916, pp. 398, 399; genotype, *H. horrida*, Lang, 1916, p. 399.

Ichnopora, Lang, 1916, pp. 101, 108; genotype, *I. vestigium*, Lang, 1916, p. 109.

Kankopora, Lang, 1916, pp. 382, 388; genotype, *K. kankensis*, Lang, 1916, p. 388.

Kelestoma, Marsson, 1887, p. 99; genotype, *K. elongatum*, Marsson, 1887, p. 99.

Lagodiopsis, Marsson, 1887, p. 99; genotype, *Multescharipora francqana*, d'Orbigny, 1852, pl. 734, figs. 6–8, 1853, p. 497. [Here considered congeneric with *Murinopsia*, Jullien.] See also Lang, 1917, p. 171.

Lagynopora, Lang, 1916, pp. 394, 395; genotype, *L. lagena*, Lang, 1916, p. 395.

Lekythoglena, Marsson, 1887, p. 90; genosyntypes, *L. ampullacea*, Marsson, 1887, p. 91, *L. effigurata*, Marsson, 1887, p. 91; genolectotype, *L. ampullacea*, Marsson, see Lang, 1916, p. 390.

Lepralia, Johnston, 1838, p. 277; genosyntypes, seven Recent species, of which Norman (1903 [2], pp. 99, 100) has chosen *Lepralia nitida*, Johnston, i.e. *Berenicea nitida*, Fleming (non

Cellepora nitida, Fabricius), 1828, p. 533, as the genolectotype. While accepting Norman's solution of a difficult problem, I would point out that it appears arguable with equal propriety that *Lepralia* is synonymous with *Escharoides*, Edwards. But when two solutions are equally tenable, and one has already been deliberately chosen, it would be contentious not to follow this ruling. See also Lang, 1917, p. 171.

Leptocheilopora, Lang, 1916, p. 396; genotype, *L. tenuilabrosa*, Lang, 1916, pp. 396, 397.

Membranipora, de Blainville, 1830, p. 411; genosyntypes, eight Recent and Tertiary, two Cretaceous, and one Devonian species, of which the genolectotype is *Flustra membranacea*, Linnæus, 1767, p. 1301; see Norman, 1903, p. 585.

Membraniporella, Smitt, 1873, p. 10; genotype, *Lepralia nitida*, auctt., but with reference to Smitt, 1868, pp. 366, 401, on the former page of which it is clear that *Lepralia nitida*, Johnston (1838, p. 277, pl. xxxiv, fig. 7), is meant; and this is accepted by Hincks (1877 [2], p. 526). This is the genolectotype of *Lepralia*—see under *Lepralia*,—of which *Membraniporella* is thus a synonym.

Monoceratopora, Lang, 1916, pp. 383, 389; genotype, *M. unicornis*, Lang, 1916, p. 389.

Morphasmopora, Lang, 1916, p. 85; genotype, *Cribrilina jukes-brownei*, Brydone, 1906, p. 297, text-fig. 9 on p. 298.

Multescharipora, d'Orbigny, 1853, p. 495; genosyntypes, *Cellepora pinguis*, von Hagenow, 1851, p. 88, pl. x, fig. 15; *Multescharipora insignis*, d'Orbigny, 1852, pl. 720, figs. 11–15, 1853, p. 496; *Multescharipora francqana*, d'Orbigny, 1852, pl. 734, figs. 6–8, 1853, p. 497; of these, the first is almost certainly a *Tricephalopora*, the last is the genotype of *Lagodiopsis* (= *Murinopsia*), while *M. insignis* is possibly congeneric with *Polycephalopora*. It is best, therefore, to choose *M. insignis* as the genolectotype of *Multescharipora*, and if it can be certainly established that *M. insignis* is congeneric with *Polycephalopora hydra*, the genus *Polycephalopora* must be abandoned, becoming synonymous with *Multescharipora*.

Mumiella, Jullien, 1886, p. 605; genotype, *Semiescharipora mumia*, d'Orbigny, 1852, pl. 718, figs. 9–12, 1853, p. 483.

Murinopsia, Jullien, 1886, p. 608; genotype, *Semiescharipora galeata*, Beissel, 1865, p. 55, pl. vi, figs. 70–75, pl. vii, fig. 76.

Myagropora, Lang, 1916, p. 406; genotype, *M. muscipula*, Lang, 1916, p. 406.

Nannopora, Lang, 1916, pp. 382, 386; genotype, *Reptescharella pygmea*, d'Orbigny, 1852, pl. 716, figs. 7–8, 1853, p. 468.

Oligotopora, Lang, 1916, pp. 382, 388; genotype, *O. novaki*, Lang, 1916, p. 388, =*Lepralia pediculus*, Novák, non von Reuss.

Opisthornithopora, Lang, 1916, p. 84; genotype, *Reptescharella flabellata*, d'Orbigny, 1852, pl. 716, figs. 9–12, 1853, p. 469.

Otopora, Lang, 1916, pp. 402, 403; genotype, *O. auricula*, Lang, 1916, pp. 402, 403.

Pachydera, Marsson, 1887, p. 100; genotype, *P. grandis*, Marsson, 1887, p. 100, pl. x, fig. 14.

Pancheilopora, Lang, 1916, pp. 383, 390; genotype, *P. magnilabrosa*, Lang, 1916, p. 390.

Pelmatopora, Lang, 1916, p. 101; genotype, *P. pero*, Lang, 1916, pp. 102, 105.

Phractopora, Lang, 1916, pp. 86, 89; genotype, *P. constrata*, Lang, 1916, p. 89. *Phractopora* is preoccupied by Hall, 1883, p. 154, genotype *P. cristata*, Hall, 1883, p. 154. See *Phractoporella*.

Phractoporella, Lang, 1917, p. 172; genotype, *Phractopora constrata*, Lang, 1916, p. 89.

Phrynopora, Lang, 1916, pp. 93, 97; genotype, *P. bufo*, Lang, 1916, pp. 97, 98.

Pliophlœa, Gabb & Horn, 1862, p. 150; genotype, *Flustra sagena*, Morton, 1834, p. 79, pl. xiii, fig. 7.

Pnictopora, Lang, 1916, p. 92; genotype, *P. suffocata*, Lang, 1916, p. 92.

Polycephalopora, Lang, 1916, pp. 86, 90; genotype, *P. hydra*, Lang, 1916, p. 90; see also under *Multescharipora*.

Polyceratopora, Lang, 1916, pp. 382, 385; genotype, *Lepralia euglypha*, Novák, 1877, p. 92, pl. i, fig. 10, 11.

Porina, d'Orbigny, 1853, p. 432; genosyntypes, thirteen species, of which two are Recent, seven Tertiary, and four Cretaceous; of these, the Recent, *Eschara gracilis*, Lamarck, 1816, p. 176, is the genolectotype, see Lang, 1917, p. 172.

Prodromopora, Lang, 1916, p. 394; genotype, *P. præcursor*, Lang, 1916, p. 394.

Prosoporella, Marsson, 1887, p. 100; genotype, *Semiescharipora cornuta*, Beissel, 1865, p. 58, pl. vii, figs. 77–81; this species is the genotype of *Decurtaria*, Jullien, 1886, which thus has the priority over *Prosoporella*.

Prosotopora, Lang, 1916, pp. 398, 399; genotype, *P. arrecta*, Lang, 1916, pp. 399–400.

Pustulopora, de Blainville, 1830, p. 382; genosyntypes, *Ceriopora madreporacea*, Goldfuss, *C. radiciformis*, Goldfuss, *C. pustulosa*, Goldfuss, and *C. verticillata*. Of these species the first is an *Entalophora* (Lamouroux, 1821, p. 81), the second a *Ceriopora* (Goldfuss, 1826, p. 32), the third the genotype of *Hammia* (Gregory, 1899, p. 281), and the fourth a *Spiropora* (Lamouroux, 1821, p. 47). Gregory, having already referred three species to existing genera, should not have chosen the remaining species, *Ceriopora pustulosa*, for the genotype of a new genus *Hammia*, but have retained it as the genolectotype of *Pustulopora*, especially as the trivial name echoes the generic. That is, *Pustulopora pustulosa* is the genotype of *Pustulopora* "by tautonymy" (see rule as to "absolute tautonymy," Congrès International de Zoologie, 1914, Article 30, *d*). Since one of these four species must be selected as the genolectotype of *Pustulopora*, I choose *P. pustulosa* as the most suitable; and thus Gregory's *Hammia* (Gregory, 1899, p. 281) becomes a synonym of *Pustulopora*.

Reptescharella, d'Orbigny, 1853, p. 464; genosyntypes, six Recent, three Tertiary, and twelve Cretaceous species, of which *Escharina lorieri*, d'Orbigny, 1851, legend to pl. 604, figs. 11–12 (*Reptescharella lorieri*, d'Orbigny, 1853, p. 466), is the genolectotype, see Lang, 1917, p. 172.

Reptescharellina, d'Orbigny, 1853, p. 451; genosyntypes, twelve Recent, twelve Tertiary, and five Cretaceous species, of which *R. horrida*, d'Orbigny, 1852, pl. 715, figs. 7–9, 1853, p. 456, from the Senonien of Tours, Vendôme, and Royan, is the genolectotype, see Lang, 1917, p. 172.

Reptescharinella, d'Orbigny, 1853, p. 428; genosyntypes, two Recent, one Tertiary, and eight Cretaceous species, of which *Cellepora subgranulata*, von Hagenow, 1851, p. 91, pl. xi, fig. 15, from the Maastrichtian of Maastricht, is the genolectotype, see Lang, 1917, p. 172.

Repteschariporа, d'Orbigny, 1853, p. 489; genosyntypes, one Recent, two Tertiary, and eleven Cretaceous species, of which *R. meudonensis* d'Orbigny, 1852, pl. 719, figs. 17–19, 1853, p. 491, is the genolectotype, see Lang, 1917, p. 172.

Reptocelleporaria, d'Orbigny, 1852[2], p. 679 [name only], 1853, p. 421; genosyntypes, three Recent, ten Tertiary, and two Cretaceous species, of which *R. cretacea* d'Orbigny, 1852, pl. 713, figs. 17–18, 1853, p. 423, from the Senonian of Meudon, is the genolectotype, see Lang, 1917, p. 172.

Reptoporella, d'Orbigny, 1853, p. 474; genotype, *R. regularis* d'Orbigny, 1852, pl. 717, figs. 6, 7, 1853, p. 475; this species is possibly congeneric with *Leptocheilopora tenuilabrosa* Lang, 1916, pp. 396–7, and, if so, the name *Leptocheilopora*, Lang, 1916, p. 396, must give place to *Reptoporella*.

Rhabdopora, Lang, 1916, pp. 404, 405; genotype, *R. virgata* Lang, 1916, p. 405.

Rhacheopora, Lang, 1916, p. 398; genotype, *R. suta* Lang, 1916, pp. 398, 399.

Rhiniopora, Lang, 1916, pp. 93, 96; genosyntypes, ten Cretaceous species, of which *R. aspera* Lang, 1916, pp. 96, 97, is the genolectotype, see Lang, 1917, p. 172.

Sandalopora, Lang, 1916, pp. 101, 107; genotype, *S. soccata* Lang, 1916, p. 108.

Schistacanthopora, Lang, 1916, p. 393; genotype, *S. fissa* Lang, 1916, p. 393.

Schizoporella, Hincks, 1877[2], p. 527; genotype, *Lepralia unicornis* Johnston, 1847, p. 320, pl. lvii, fig. 1, Recent.

Semieschara, d'Orbigny, 1852, p. 364; genosyntypes, four Recent, two Tertiary, and nineteen Cretaceous species, of which *S. flabellata* d'Orbigny, 1852, p. 367, pl. 708, figs. 1–4, is the genolectotype, see Lang, 1917, p. 172.

Semiescharipora, d'Orbigny, 1853, p. 479; genosyntypes, one Tertiary and thirteen Cretaceous species, of which *S. complanata* d'Orbigny, 1852, pl. 718, figs. 17–20, 1853, p. 484, is the genolectotype, see Lang, 1917, p. 172.

Siphoniotyphlus, Lonsdale, 1850, p. 300; genotype, *S. plumatus* Lonsdale, *loc. cit.*

Steginopora, d'Orbigny, 1853, p. 499; genosyntypes, *S. irregularis* d'Orbigny, 1852, pl. 720, figs. 16–19, 1853, p. 500; *S. ornata* d'Orbigny, 1852, pl. 721, figs. 1–4, 1853, p. 501; *S. aculeata* d'Orbigny, 1852, pl. 721, figs. 5–8, 1853, p. 502; *S. pulchella* d'Orbigny, 1852, pl. 721, figs. 9–12, 1853, p. 503; genolectotype, *S. ornata* d'Orbigny, 1852, pl. 721, figs. 1–4, 1853, p. 501; see Lang, 1916, p. 100.

Stichocados, Marsson, 1887, p. 101; genotype, *S. verruculosus* Marsson, 1887, p. 101, pl. x, fig. 15.

Taractopora, Lang, 1916, p. 407; genotype, *T. confusa* Lang, 1916, p. 407.

Thoracophora, Jullien, 1886, p. 610; genotype, *Eschara horrida* d'Orbigny, 1850, p. 264, which is the genotype of *Disteginopora*; *Thoracophora* is therefore a synonym of *Disteginopora*.

Thoracopora, Lang, 1916, p, 408; genotype, *T. costata* Lang, 1916, p. 408.

Tricephalopora, Lang, 1916, p. 86; genotype, *Cribrilina triceps* Marsson, 1887, p. 98, pl. x, fig. 12.

Tricolpopora, Lang, 1916, pp. 383, 389; genotype, *T. trisinuata* Lang, 1916, p. 389.

Trilophopora, Lang, 1916, pp. 391, 393; genotype, *T. trifida* Lang, 1916, p. 393.

Ubaghsia, Jullien, 1886, p. 610; genotype, *Steginopora reticulata* Ubaghs, 1865, p. 55, pl. ii *a*, fig. 7.

III. Stratigraphical Nomenclature.

§ 31. It is not proposed to enter into Cretaceous Stratigraphy much further than is necessary to explain the scheme given in tabular form below and the subsequent list of horizons that have yielded Cretaceous Cribrimorphs.

The upper division of the Cretaceous **Epoch**—the Upper Cretaceous—is divided into five **Stages**, namely, from below upwards, Albian, Cenomanian, Turonian, Senonian, and Danian. Sometimes the Turonian is divided into a lower Ligerian and an upper Angoumian **Sub-stage**; and four sub-divisions of the Senonian are frequently used, namely, from below upwards, Coniacian, Santonian, Campanian, and Maastrichtian. The lower two sub-stages, also, have together been termed Emscherian, and the upper pair Aturian, but these terms are not often used. On the other hand, subordinate divisions, namely **Zones**, are continually spoken of by every worker on Cretaceous horizons.

§ 32. Much misunderstanding of the zone might be obviated if the following definitions were accepted and kept in mind * :—(1) A zone is the sediment laid down throughout the world during a given period of the Earth's history. (2) The given period (*Hemera*) † is that indicated by the zone in a given locality—the type-locality. (3) The name of the zone is a convenient label, but does not necessarily bear any implications concerning the relations of the zone to the fossil whose name the zone bears, except that the fossil occurs, or was thought to occur by the author of the zonal name, in the zone, or some part of it, in the type-locality. From (1) it follows that a zone can only be absent from any locality (*a*) if no sediment was being deposited in that locality during its hemera, and (*b*) if sediment was deposited and has since been denuded; from (2) that a zone's boundaries are theoretically fixed when the zone is first defined, and subsequent adjustments can only properly be made in other than the type-locality; and from (3), that (*a*) the vertical range of the zonal fossil has no necessary connection with the thickness of the zone, and (*b*) the absence of the zonal fossil in any locality gives no occasion for the alteration of the name of the zone in that locality. It is probably true that a strict application of the above principles to the zones given in the table below would not result in leaving them defined as they are there. But this is not the place to revise Cretaceous Stratigraphy, and the limits given to the zones are those generally used by Chalk-workers, though as to the detailed limits some of these workers may differ among themselves.

§ 33. Following the Stratigraphical scheme is a list of all the horizons I have been able to find, from which Cretaceous Cribrimorph Polyzoa have been recorded; and these horizons, many of them merely local, are as accurately and as minutely correlated with the horizons in the general scheme as has been found possible.

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* This interpretation of the zone represents, apparently, Oppel's idea when he founded the zone; see Oppel, 1856–8.

† Buckman, 1893, p. 481; and 1902.

DANIAN			
SENONIAN	ATURIAN	DORDONIAN or MAASTRICHTIAN.	Extreme top of zone of *Belemnitella mucronata*.
		CAMPANIAN	Zone of *Belemnitella mucronata*.
			Zone of *Actinocamax quadratus*.
			subzone of *Actinocamax quadratus*.
			subzone of *Offaster pillula*.
			subzone of *Echinocorys scutatus* var. *depressa*.
	EMSCHERIAN	SANTONIAN	Zone of *Marsupites testudinarius*.
			subzone of *Marsupites*.
			subzone of *Uintacrinus*.
			Zone of *Micraster coranguinum*.
		CONIACIAN	Zone of *Micraster cortestudinarium*.
TURONIAN	ANGOUMIAN		Zone of *Holaster planus*.
			Zone of *Terebratulina gracilis* (= *T. lata*).
	LIGERIAN		Zone of *Rhynchonella cuvieri*.
			Zone of *Actinocamax plenus*.
CENOMANIAN			Zone of *Holaster subglobosus*.
			Zone of *Schlœnbachia varians*.
			Zone of *Pecten (Chlamys) asper*.
ALBIAN			Zone of *Schlœnbachia rostrata*.
			Zone of *Hoplites interruptus*.
			Zone of *Douvilleiceras mammillatum*.

List of Horizons whence Cretaceous Cribrimorph Polyzoa have been recorded.

Åhussandsten (also Grès d'Åhus). Senonian, top of zone of *A. quadratus* and zone of *B. mucronata*; S. Sweden.

Albian. Lowest stage of Upper Cretaceous. See table.

Angoumian. Upper part of the Turonian. See table.

Arrialoor Group. Senonian of Southern India.

asper; zone of *Pecten asper.* Lowest zone of the Cenomanian. See table.

Aturian. Higher sub-stage of the Senonian. See table.

Bathonian. Highest stage of the Lower Oolite.

Calcaire à Polypiers. An horizon in the Bathonian Beds of Northern France.

Campanian. Lower part of the Aturian. See table.

Cenomanian. Lowest stage but one of the Upper Cretaceous. See table.

Chalk Marl. Cenomanian. The Chalk Marl of Cambridge is at about the horizon of the zone of *Schlœnbachia varians.*

Coniacian. Lower part of the Emscherian; = zone of *Micraster cortestudinarium.* See table.

coranguinum; zone of *Micraster coranguinum.* Lowest zone of the Santonian; lowest but one zone of the Senonian. See table.

cortestudinarium; zone of *Micraster cortestudinarium.* Lowest zone of the Senonian. See table.

Craie à baculites. = Senonian, zone of *B. mucronata*, or Maastrichtian.

Craie à Thécidées. Senonian.

Craie avec l'Ostrea vesicularis; of Royan. Senonian, zone of *B. mucronata*, or Maastrichtian.

Craie blanche. = Campanian.

Craie chloritée; part of the Craie tuffeau of Ciply (Binkhorst van den Binkhorst, 1859, p. 87).

Craie de Schaasberg. Maastrichtian, bottom bed, Bed xix of Ubaghs (1879, table opposite p. 196).

Craie marneuse sans silex; of Friedrichberg, Galoppe, Slenaken, and Vaals. = Kreidemergel ohne Feuerstein. Campanian, Bed xxi of Ubaghs (1879, table opposite p. 196).

Craie Tuffeau (also Kreidetuff). Maastrichtian—see Ubaghs (1879, table opposite p. 196).

cuvieri; zone of *Rhynchonella cuvieri.* Turonian, upper part of Ligerian. See table.

Danian. Highest stage of Upper Cretaceous. See table.

depressa; subzone of *Echinocorys scutatus*, var. *depressa.* Lowest subzone of the zone of *Actinocamax quadratus* and lowest part of the Campanian. See table.

Dordonian. See Maastrichtian. See table.

Emscherian. Lower sub-stage of the Senonian. See table.

Essener Grünsand. Cenomanian.

fastigatus; zone of *Micraster fastigatus.* Lowest Aturian, lower part of the zone of *A. quadratus* in the Rheims district. See De l'Apparent, 1906, Traité de Géologie, 5th ed., p. 1445.

Gosauschichten, beds with *Hippurites cornuvaccinum.* Coniacian.

gracilis; zone of *Terebratulina gracilis.* Turonian, lower part of the Angoumian. See table.

Grès d'Åhus. See Åhussandsten.

Hilsconglomerat. Lower Cretaceous, Neocomian.

interruptus; zone of *Hoplites interruptus.* Middle zone of the Albian. See table.

Korycaner Schichten. Cenomanian of Bohemia.

Kreidemergel ohne Feuerstein. See Craie marneuse sans silex.

Kreide-tuff. See Craie tuffeau.

Ligerian. Lower part of Turonian. See table.

lunata; zone of *Ostrea lunata.* Part of zone of *B. mucronata.*

Maastricht Beds. = Maastrichtian of Maastricht.

Maastricter Kreide. = Maastrichtian of Maastricht.

Maastrichtian. Highest Senonian. See table.

mammillatum; zone of *Douvilleiceras mammillatum.* Lowest zone of the Albian. See table.

mammillatus; lag med, or zone of, *Actinocamax mammillatus.* Upper part of the zone of *Actinocamax quadratus* (see table) of S. Sweden. See also Trümmer Kalk mit *Belemnitella subventricosa.* Possibly (Spencer, 1913, pp. 149–150) it may also include the base of the zone of *B. mucronata.*

Marne de Kunraad. Maastrichtian.

Marnes sans silex. See Craie marneuse sans silex.

Marsupites; zone of. Highest zone of the Emscherian. See table.

Marsupites; sub-zone of. Higher part of *Marsupites*-zone. See table.

mucronata; zone of *Belemnitella mucronata.* Highest zone of the Campanian. See table.

Neocomian. Lower Cretaceous.

Obere Bryozoen-schichte. Ubaghs, 1865, p. 38, Bed f.=Bed vii, Couche à Bryozoaires I, Ubaghs, 1879, table opposite p. 196. Maastrichtian of Limbourg.

Ober Kreidemergel. Campanian or Santonian.

Ober Quadermergel. Campanian or Santonian.

pillula; subzone of *Offaster pillula.* Middle subzone of zone of *Actinocamax quadratus.* See table.

Plänermergel. Emscherian.

planus; zone of *Holaster planus.* Highest zone of the Turonian. See table.

plenus; zone of *Actinocamax plenus.* Lowest zone of Turonian. See table.

Quadermergel. Campanian or Santonian.

quadratus; zone of *Actinocamax quadratus.* Lower part of the Campanian. See table.

quadratus; subzone of *Actinocamax quadratus.* Highest part of the zone of *Actinocamax quadratus.* See table.

Rocanean. Rather low in the Argentine Cenomanian *fide* Ameghino (1906, Am. Mus. Nacional de Buenos Aires, vol. xv (series 3, vol. viii) p. 498); but the Cribrimorph forms suggest Coniacian.

rostrata; zone of *Schlœnbachia rostrata.* Highest zone of the Albian. See table.

Senonian. Highest stage but one of the Cretaceous. See table.

subglobosus; zone of *Holaster subglobosus.* Highest zone of the Cenomanian. See table.

Teplitzerschichten. Turonian of Northern Bohemia.

Trochiliopora Bed. A band of Chalk, about 10 ft. thick, about 17 ft. above the base of the zone of *M. coranguinum,* and 35 ft. above a strong tabular flint band mentioned by Rowe. See Gaster, 1920.

Trümmerkalk mit *Belemnitella subventricosa.* Upper part of the zone of *Actinocamax quadratus* of S. Sweden. =Lag med *Actinocamax mammillatus* of Hennig, q. v.

Uintacrinus, subzone of. Lower part of *Marsupites* zone. See table.

Untere Pläner. Cenomanian of Saxony.

varians; zone of *Schlœnbachia varians*. Middle zone of the Cenomanian. See table.

Vincentown Limesand. Danian of New Jersey, U.S.A.

Weisse Schreibkreide of Rügen. Senonian, zone of *Belemnitella mucronata*.

C. HISTORICAL.

1. The Collection.

§ 34. Most of the Cretaceous Cribrimorph material in the Museum Collection has been acquired in comparatively recent years. There are a few specimens which were obtained by the older collectors, Mr. T. J. Bayfield, Mr. J. W. Davis, Professor Rupert Jones, Professor Morris, Mr. J. B. Ogle, and Dr. N. T. Wetherell. Several Trimingham forms come from the collection of Mr. A. C. Savin, of Cromer; and most of such Maastricht material as the Museum possesses is from the late Professor J. G. S. van Breda's collection. There are also certain Chatham specimens in the collection of the late Mr. G. R. Vine, who was an ardent collector of fossil Polyzoa, and published many papers dealing with them *.

But by far the greater part of the collection has been acquired since Dr. A. W. Rowe published the first of his papers on the English coast Chalk †, thus stimulating a large body of amateurs to extend his researches inland, especially in the neighbourhood of London. It is true that, before Rowe's work appeared, Mr. W. Gamble had already largely collected in the Chatham area, in conjunction with Mr. G. R. Vine. But he continued his collecting into the time of which I am speaking, and thus connected the two groups of amateurs ‡. It is the material obtained by these later collectors (all members of the Geologists' Association and familiar with the Chalk through the excursions of that body), added to the very large series from Chatham acquired from Mr. Gamble, that forms the bulk of the Museum Collection of Cretaceous Cribrimorphs. Of these collectors, the Museum is indebted to none more than to Mr. C. T. A. Gaster of Lewes, who for many years has patiently collected, bed by bed, very large quantities of Polyzoa from the Sussex coast and the inland pits in the neighbourhood of

* Vine, 1884–5, 1891, 1893. † Rowe, 1900. ‡ Gamble, 1896.

Lewes and Worthing, cleaned the material, and sent it to me for examination, generously allowing the Museum to keep any specimens needed for the Collection. A glance at the systematic part of this work will show how impoverished, not only the Collection, but the described fauna would be, were the species removed of which Mr. Gaster has provided most, if not all, the specimens. There is one other worker I should like especially to mention. The number of interesting and new forms described from the Cambridge Chalk Marl is due to the thorough industry of the late Mr. F. J. Möckler, who, having arranged at Cambridge for sacks filled from various horizons of the Chalk Marl to be sent to him, washed all this material and worked the residue, picking out the minute organisms and sorting out the different forms. No one who has not himself tried work of this kind can fully appreciate the labour involved in thus treating, say, a pound of marl. Mr. Möckler also washed and sorted the residue of Chalk Marl from Kent, and of other Chalk material, but it was the Chalk Marl of Cambridge that he most thoroughly surveyed in this manner.

§ 35. There are no Cretaceous Cribrimorph Polyzoa in the Museum from the Chalk of either Yorkshire or Lincolnshire; and I understand, from conversations with Chalk-workers, that all Polyzoa are rare in the Chalk of these counties, especially of Yorkshire. Mr. R. M. Brydone, F.G.S., kindly presented to the Museum metatype-specimens of the Trimingham forms described in his first paper on Polyzoa, published in 1906; and several important Trimingham specimens come from the collection of Mr. A. C. Savin: otherwise a single specimen from the T. G. Bayfield Collection is the only Norfolk Cretaceous Cribrimorph in the Museum Collection. The Chalk Marl of Cambridge has already been mentioned. Hertfordshire is represented by a specimen from Hertford, presented by Professor J. W. Gregory, F.R.S.; and some material washed from flint-meal by Mr. Möckler from near Boxmoor. Buckinghamshire, Oxfordshire, and Berkshire are represented by a large series collected by Mr. L. Treacher, F.G.S., whose work in the Thames Valley is well known. Mr. H. O. White, F.G.S., has presented a few specimens from Hampshire; and Dr. H. P. Blackmore, F.G.S., some from the neighbourhood of Salisbury. The Chatham Chalk is chiefly represented by Mr. Gamble's collecting and by specimens from the Vine collection;

but there is also a specimen from Charlton from the Ogle collection, one from Keston presented by the late Professor T. Rupert Jones, a specimen from Strood, presented by Mr. W. Wright, F.G.S., and one from Meopham, S. of Gravesend, presented by G. E. Dibley, Esq., F.G.S., who has also presented some from Grays, Essex. There is a specimen from Margate in the Wetherell collection, presented by Mr. G. Potter, F.G.S. The Surrey Chalk is represented by some material from Epsom, collected by the late Mr. Möckler, and from Worms Heath, collected by Mr. C. P. Chatwin, F.G.S., and washed by Mr. Möckler. Mr. C. T. A. Gaster has presented specimens from Surrey, and from Sussex (Lewes, the coast, and from pits in the neighbourhood of Worthing). Other specimens from the Sussex coast have been presented by Mr. C. D. Sherborn, Esq., F.G.S., and by Mr. H. D. Schloss. Mr. T. H. Withers, F.G.S., has presented some specimens from pits N. of Worthing, whence the author has also collected Cribrimorph Polyzoa for the Collection; Mr. W. Wright, F.G.S., a specimen from near Chichester; and Miss Mary Salter a specimen from the I. of Wight.

Most of the French material was obtained by exchange with Monsieur F. Canu of Versailles, whose work on fossil Polozoa is well known. And I should like to take this opportunity of heartily thanking him for his ever-ready help and kind assistance in my work. Mr. Canu has examined the material on which d'Orbigny worked when he was preparing the volume on Polyzoa in the Paleontologie Française; and has compared his own material with d'Orbigny's, naming it accordingly. This valuable collection, named by comparison with d'Orbigny's types, Mr. Canu sent over to me in lots of ten slides at a time, and allowed photographs to be taken, so that the Museum might have them for reference. In this way it is possible to interpret some of d'Orbigny's species, which otherwise, owing to inferior figures, would be indeterminable. I take this opportunity also for thanking Mr. Canu for supplying me with information about some French localities which I was unable unaided to find on the map. Such Bohemian material as the Museum possesses was purchased from Dr. A. Frič of Prague. The few specimens from Maastricht are from the van Breda collection; and those from the Danian of Faxe are partly from the collections of the late J. W. Davis and Miss Caroline Birley, and some purchased from S. Jensen Pindborg. A very large quantity of material from Rügen was purchased from Mrs. Agnes Laur of Dresden, and this has yielded a great number of Cribrimorphs. Finally, some Danian material from New Jersey, received in exchange from the United States National Museum, contains examples of the Cribrimorphs described by Morton, Gabb, and Horn, as well as one or two new species.

§ 36. The Collection of Cretaceous Cribrimorphs is almost entirely mounted on mahogany microscope-slides (having cells with opaque background), since it is impossible without a considerable magnifying-power to see the diagnostic characters of these minute organisms. Where the forms incrust sea-urchins or other shells, it is necessary to cut off the piece of shell incrusted; and when the shell is silicified, this may be a matter of considerable difficulty. Calcareous shells may be filed through without much trouble. Sometimes Polyzoa incrust shells of *Inoceramus* which are thicker than the depth of the microscope-slide; and the only method of dealing with these is to grind them down to the required thickness. Again, when the shell is silicified, this is a considerable labour; but any other method only results in splitting up the *Inoceramus*-shell into prisms at right angles to the required direction.

It is often a matter of considerable difficulty to clean the surface of a Polyzoan. I know of no method other than by soaking in water and by persevering brushing with bristle-brushes graded according to the delicacy of the surface to be cleaned. Occasionally, an obstinate grain may be picked off with a needle while the object is viewed under the microscope; but this method often results in the removal of some of the subjacent Polyzoan with the grain.

All the specimens are painted with water-colour paint, in order to make visible the details of structure. Chalk Polyzoa, especially, are almost invisible in any detail beneath a high power, unless thus treated. Experience alone shows how deeply any given specimen should be stained, but, up to a certain point, the higher the magnification the deeper should be the tinting. Indigo water-colour has been almost exclusively used on the Museum Collection; but doubtless other colours might be found as good, or even superior to indigo. Indigo has the advantage of being a staining paint—it gets into the surface, thus differentiating its texture, instead of covering it with an opaque layer.

Type-specimens and figured specimens are noted by a green disc on the slide; paratypes, metatypes, and other specimens of historical interest are similarly noted by a red disc. The line-figures in the text do not represent actual specimens, though in most cases they were drawn from the type. But they are the author's *diagrams* of the species, and not figures of specimens, type- or otherwise. On the other hand, the figures in the Plates are drawings of actual specimens, and the specimen represented is indicated in the explanation. I acknowledge with appreciation and thanks the care and skill with which Miss G. M. Woodward has accomplished a tedious and intricate task, a work especially difficult to one who has not made a special study of the objects to be drawn.

II. The Localities.

§ 37. The following is a list of localities, with their detailed positions, as far as these are known, from which Cretaceous Cribrimorph Polyzoa have been recorded in the past and in this work. When possible, the exact horizon is given at which the Cribrimorphs were found in each locality; and where the horizon is not indicated in the record, the vertical range of Cretaceous beds at the locality is given. The localities marked with an asterisk are those from which specimens in the Museum Collection have been obtained.

Mr. C. T. A. Gaster of Lewes has kindly allowed me to publish his provisional determinations of the horizons of those pits in the neighbourhood of Worthing from which he has collected specimens. It must be understood, however, that the exact subzone of some of these pits has not been finally determined, and that further collecting may necessitate some readjustment of the supposed subzonal boundaries.

List of Localities whence Cretaceous Cribrimorph Polyzoa have been obtained, as recorded in this and in former Works.

[Specimens in the Collection have come from those localities marked with an asterisk.]

Aachen; see Aix-la-Chapelle.

Aix-la-Chapelle; Rhine Provinces, Germany. Upper Senonian.

Aldenborough; near Salisbury. ? Misprint (Vine, 1893, p. 323) for Alderbury, S.E. of Salisbury. Senonian.

Alresford; N.E. of Winchester, Hants. Senonian, zone of *A. quadratus.*

Alton; Hants. Turonian, zone of *H. planus*; near Alton.

Andover; Hants. Senonian, zones of *M. coranguinum* to *A. quadratus*, subzone of *O. pillula.*

Annetorp; S.E, of Malmö, S. Sweden. Danian.

**Arreton Down*; S.E. of Newport, I. of Wight. Senonian, zone of *A. quadratus.*

Avington; N.E. of Winchester, Hants. Zone of *A. quadratus*, subzone of *E. scutatus* var *depressa*; Pit 996 of Brydone (1912, p. 95), $\frac{1}{8}$ mile S. of Avington House.

Balsberg; E. of Fjelkestad, N. of Kristianstad, S. Sweden. Senonian, higher part of zone of *A. quadratus* (Trümmerkalk with *B. subventricosa* and *A. mammillatus*).

Barnakällegrotten; N. of Sölvesburg, E. of Kristianstad, S. Sweden. Senonian, higher part of zone of *A. quadratus* (Beds with *A. mammillatus*).

Basingstoke; Hants. Zone of *M. coranguinum*; Pit 199 of Brydone (1912, p. 53), L. S. W. Ry., east of junction east of Basingstoke Station.

Beachy Head; Sussex. Turonian and Senonian.

Beauvais; Oise, France. Senonian.

Bedhampton; W. of Havant, Hants. Senonian, zone of *B. mucronata.*

**Bedwyn Ry.-Station*; Wilts, S.W. of Hungerford, Berks. Senonian, zone of *M. coranguinum.*

**Beltout*; W. of Beachy Head, Sussex. Senonian, zone of *M. coranguinum*; between Beltout and Birling Gap.

Bilin; S.W. of Teplitz, Bohemia, S. of Dresden, Germany. Cenomanian, Untere Plänerkalk.

**Birling Gap*; W. of Beachy Head, Sussex. Senonian, zone of *M. coranguinum*; between Birling Gap and Beltout.

**Blackwoodstown* (or *Blackwoodtown*); New Jersey, S.E. of Philadelphia, Pennsylvania, U.S.A. Danian, Vincentown Limesand.

Bois de Barade; near Gensac, d'Aurignac, S.W. of Boulogne-sur-Gesse, N.W. of Saint-Gaudens, Haute-Garonne, France. Maastrichtian.

Bogingary (or *Bogengarrie*); N.W. of Cruden, Aberdeenshire. Chalk flints in Drift.

**Borstal Manor*; S.W. of Chatham, Kent. Turonian, zone of *H. planus*, and Senonian, zone of *M. cortestudinarium*. Horizon determined by W. Gamble.

**Boundstone Lane*; see Lancing Ring.

**Bourne End*; E. of Marlow, Bucks. Senonian, low in zone of *M. coranguinum*. Horizon determined by L. Treacher.

**Boxmoor*; Herts. Senonian, base of zone of *M. cortestudinarium*; Nash Mills, S.E. of Boxmoor.

Bramford; N.W. of Ipswich, Suffolk. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*.

**Bridgwick Pit*; Malling, Lewes, Sussex. Turonian, zone of *H. planus*, Horizon determined by C. T. A. Gaster.

**Brighton*; Sussex. Senonian, zone of *Marsupites*.

Broadstairs; N.E. of Ramsgate, Kent. Senonian, zone of *M. coranguinum*.

Broughton; S.W. of Stockbridge, Hants. Senonian, zone of *A. quadratus*, sub-zone of *O. pillula*.

Brown Candover; N. of Alresford, Hants. Senonian, zone of *A. quadratus*, sub-zone of *E. scutatus* var. *depressa*; pit 923 of Brydone (1912, p. 90), by road near brow of hill, $\frac{1}{8}$ mile N. of Ruby's Farm, Brown Candover; and pit 924 of Brydone (1912, p. 90), $\frac{1}{6}$ mile N.W. of Brown Candover church.

**Cambridge*; Cambridgeshire. Cenomanian, Chalk Marl, zone of *S. varians*; Norman and Saxon Pits, N.E. of Cambridge.

Carlshamn; S. Sweden. See Karlshamn.

Cazeneuve; N.E. of Saint-Gaudens, Haute-Garonne, France. Maastrichtian.

**Charlton*; S.W. of Woolwich, Kent. Senonian, zone of *M. coranguinum*.

**Charman Dean*; N. of Broadwater, N. of Worthing, Sussex. Senonian, zone of *A. quadratus*; Pits 9 & 10 of Gaster, subzone of *A. quadratus*, and Pit 8 of Gaster, probably subzone of *A. quadratus*, but possibly of *O. pillula*, between Charman Dean and Upton Lane. Horizons determined by C. T. A. Gaster.

**Chatham*; Kent. Highest Turonian and Lower Senonian; see also Strood, Gillingham, Luton, and Borstal.

Chavot; S. of Epernay, S. of Rheims, Marne, France. Senonian, lower part of *A. quadratus*-zone.

**Chazy Farm*; Oxon, W. of Caversham, Reading. Senonian, high in zone of *M. coranguinum.*

Cheriton; E. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 952 of Brydone (1912, p. 92), degraded pit a little S.E. of East Down Farm; pit 965 of Brydone (1912, p. 93), $\frac{1}{3}$ mile W. of Hockley House; and pit 968 of Brydone (1912, p. 93), degraded pit 150 yds. S.W. of Hockley House.

**Chilton Candover*; N. of Alresford and W. of Alton, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 908 of Brydone (1912, p. 89), degraded pit $\frac{1}{4}$ mile N.W. of Chilton Wood Cottages.

Chokanadapooram; N.N.E. of Arrialoor, N.E. of Trichinopoly, Madras, S. India. Senonian, Arrialoor Beds.

Ciply; S. of Mons, Belgium. Maastrichtian.

Clarendon; E. of Salisbury, Wilts. Senonian, zone of *B. mucronata.*

**Cliff End*; E. side of Cuckmere Haven, Sussex. Senonian, zone of *M. coranguinum.*

Coltishall; N. of Norwich, Norfolk. Senonian, zone of *B. mucronata.*

**Compton*; road-cutting S. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *O. pillula.*

**Cookham Dean Common*; N.W. of Maidenhead, Berks. Senonian, low in zone of *M. coranguiuum.* Horizon determined by L. Treacher.

**Coombs Pit*; West Horsley, N.E. of Guildford, Surrey. Senonian, zone of *M. coranguinum*; pit 264 of Young (1908, p. 444).

**Coulommiers*; E. of Vendome, Loir-et-Cher, France. Senonian, Santonian.

**Cuckmere Haven*; Sussex. Senonian, zones of *M. coranguinum* and *M. cortestudinarium*; see also Cliff End.

**Dankton Lane*; Sompting, N.E. of Worthing, Sussex. Senonian, zone of *A. quadratus*, probably sub-zone of *E. scutatus* var. *depressa*; Pit 5 of Gaster, N.E. of Sompting church. Horizon determined by C. T. A. Gaster.

Dieppe; Seine Inférieure, France. Senonian.

**Earl's Pit*; near Strood, N.W. of Chatham, Kent. Senonian, zone of *M. coranguinum.*

East Dean; N.W. of Romsey, Hants. Senonian, zone of *A. quadratus*, sub-zone of *A. quadratus*.

**East Harnham*; S. of Salisbury, Wilts. Senonian, zone of *A. quadratus*.

**East Hill*; Rottingdean, E. of Brighton, Sussex. Senonian, zone of *A. quadratus*, subzone of *O. pillula*.

**East Marden*; N.W. of Chichester, Sussex. Senonian, zone of *M. coranguinum*.

East Meon; S.E. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 946 of Brydone (1912, p. 91); degraded pit $\frac{1}{3}$ mile, S. of Peake Farm [N.E. of West Meon].

East Standen; S.E. of Newport, I. of Wight. Senonian, zone of *M. coranguinum*; probably=pit 30 of Rowe (1908, p. 266) between Little East Standen and Great East Standen.

Epernay; S. of Rheims, Marne, France. Senonian, zone of *M. fastigatus* = lower part of zone of *A. quadratus*.

**Epsom*; Surrey. Senonian, top of zone of *M. coranguinum* and zone of *Marsupites*; Medical College Pit.

Essen; Westphalia, Germany. Neocomian, Hilsconglomerat; and Cenomanian, Essener Grunsand.

**Exceat Farm*; E. of Seaford, Sussex. Senonian, zone of *M. coranguinum*; pit between Cliff End and Exceat Farm. Horizon determined by C. T. A. Gaster.

**Exceat New Barn*; E. of Seaford, Sussex. Senonian, zone of *Marsupites*, *Uintacrinus* Band; pit above Exceat New Barn. Horizon determined by C. T. A. Gaster.

Falkenberg; see Fauquemont.

**Fauquemont* (also Falkenberg, Valkenburg, and Valkenberg); E. of Maastricht, Limbourg, Holland. Maastrichtian; Craie tuffeau and Craie de Schaasberg.

Faxe; Sjælland, Denmark. Danian.

Fécamp; N.E. of Le Havre, Seine Inférieure, France. Emscherian, chiefly Coniacian.

Fief-neuf; N.W. of Pons, S.E. of Saintes, S.E. of Rochefort, Charente-Inférieure, France. Santonian (Coniacian not far off).

Freshwater; I. of Wight. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*.

Friedrichberg; W. of Aix-la-Chapelle, Rhine Provinces, Germany. Upper Senonian [*quadratus* zone], Kreidemergel Feuerstein.

Folx-les-Caves; W. of Liége, Belgium. Upper Senonian and Maastrichtian.

Gadebusch; N.W. of Schwerin, Mecklenburg, Germany. Upper Senonian or Danian Drift.

Galoppe; see Gülpen.

Gehrden; S.W. of Hanover, Germany. Campanian, Oberer Kreidenmergel.

Gensac d'Aurignac; S.W. of Boulogne-sur-Gesse, N.W. of Saint-Gaudens, Haute-Garonne, France. Maastrichtian.

Geulem (also Geulhem); N.E. of Maastricht, Limbourg, Holland. Maastrichtian, Craie tuffeau.

**Gillingham*; N.E. of Chatham, Kent. Senonian, low in zone of *M. coranguinum*. Horizon determined by W. Gamble.

Goodworth Clatford; S. of Andover, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus*, var *depressa*; pit 935 of Brydone (1912, p. 91); degraded pit at Cowdown Farm, Goodworth Clatford.

Gravesend; Kent. Senonian, zone of *M. coranguinum*.

Grimme; bei Löcknitz, West of Stettin, Pomerania, Germany. Senonian, zone of *B. mucronata*.

Gülpen (also Galoppe); Limbourg, Holland, N.W. of Aix-la-Chapelle, Germany. Senonian [Campanian], Kreidemergel ohne Feuerstein.

**Hangleton Lane*; Highdown Hill, E. of Angmering, S.E. of Arundel, Sussex. Senonian, zone of *Marsupites*, western pit, top of Hangleton Lane, Highdown Hill; zone of *A. quadratus*, subzone of *E. scutatus*, var *depressa*, eastern pit, top of Hangleton Lane, Highdown Hill. Horizons determined by C. T. A. Gaster.

**Harefield*; N. of Uxbridge, Middlesex. Senonian, zone of *M. coranguinum*.

**Hertford*; Herts. Senonian, top of zone of *M. cortestudinarium* and base of zone of *M. coranguinum*.

**Highdown Hill*; see Hangleton Lane.

**Highfield*; Highfield Fisherton, W. of Salisbury, Wilts. Senonian, zones of *M. coranguinum* and *Marsupites*.

**Hindover*; N.E. of Seaford, Sussex. Senonian, lowest third of zone of *M. coranguinum*. Horizon determined by C. T. A. Gaster.

Hinton Ampner; E. of Winchester, Hants. Zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 981 of Brydone (1912, p. 94); degraded pit at junction of lanes $\frac{5}{12}$-mile E.S.E. of Black House, Hinton Ampner.

**Hope Gap*; W. of Cuckmere Haven, Sussex. Senonian, zone of *M. cortestudinarium*.

**Houndean Bottom*; W. of Lewes, Sussex. Senonian, zone of *M. coranguinum*. Horizon determined by C. T. A. Gaster.

Hundorf; S.W. of Teplitz, Northern Bohemia. Turonian, Teplitzer schichten, Oberer Plänerkalk of Reuss.

**Hurley Bottom*; Berks, E. of Henley, Oxon. Senonian, zone of *M. coranguinum*. Horizon determined by L. Treacher.

Kamajk; near Caslau, S.E. of Kuttenberg, S.E. of Prague, Bohemia. Cenomanian, Korycaner-schichten.

**Kaňk*; N.W. of Kuttenberg, S.E. of Prague, Bohemia. Cenomanian, Korycaner-schichten.

Karlshamn (also Carlshamn); S. Sweden. Senonian, high in zone of *A. quadratus*, Trümmerkalk with *Belemnitella subventricosa* and *Actinocamax mammillatus*.

**Keston*; Kent, S.E. of Croydon, Surrey. Senonian, zone of *M. coranguinum*.

Kilmeston; S.E. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 970 of Brydone (1912, p. 93), ¼-mile S.W. of Kilmeston Church; pit 971 of Brydone (1912, p. 93), degraded pit 300 yards E.N.E. of Down Farm, Kilmeston; pit 973 of Brydone (1912, p. 93), road-bank at cross-roads, 150 yards S. of Dean House, Kilmeston.

Kingsgate; E. of Margate, Kent. Senonian, zones of *M. coranguinum* and *Marsupites*.

**Kintbury*; W. of Newbury, Berks. Senonian, zone of *A. quadratus*.

Klüz (Klüzer Orts); N.W. of Wismar, Mecklenburg, Germany. Senonian Drift.

Köpinge; N.E. of Ystad, S.E. of Malmö, S. Sweden. Senonian, zone of *mucronata*.

Kristianstad (district); S. Sweden. Senonian, upper part of zone of *A. quadratus*, beds with *A. mammillatus*.

Kunraad; E. of Fauquemont, E. of Maastricht, Limbourg, Holland. Maastrichtian.

La Bonneville; S.W. of Evreux, Eure, France. Coniacian or Campanian.

**Lambley's Lane*; Sompting. See Upton Lane.

**Lancing Ring*; N.E. of Worthing, Sussex. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pits 3 and 4 of Gaster, S. of Lancing Ring, pit 3, E. of Boundstone Lane, and pit 4, W. of it. Horizons determined by C. T. A. Gaster.

Languesse; see Longuesse.

**La Ribochère*; Loir-et-Cher, E. of La Chartre-sur-le-Loir, Sarthe, France. Senonian, Coniacian.

Latoue; N.E. of St. Gaudens, Haut-Garonne, France. Maastrichtian.

**Lavardin*; S.E. of Montoire, Loir-et-Cher, France. Turonian.

Leaves Green; S. of Keston, S. of Bromley, Kent. Senonian, zone of *M. coranguinum*.

Le Mans; Sarthe, France. Cenomanian.

Les Phelippeaux; Charente. Senonian, Campanian, zone of *B. mucronata*.

Les Roches; West of Vendôme, N.W. of Blois, Loir-et-Cher, France. Senonian.

**Lewes*; Sussex. Turonian and Senonian. See Bridgwick Pit, Houndean Bottom, Mount Harry, Offham Hill, and Malling Hill.

Lisle; N.E. of Vendôme, N.W. of Blois, Loir-et-Cher, France. Senonian.

Longuesse; N.W. of Paris, France. Campanian. Mis-spelt Languesse, Lang, 1916, pp. 88, 397.

Loudwater; S.E. of High Wycombe, Bucks. Senonian, top of zone of *M. cortestudinarium* or base of zone of *M. coranguinum*. Great Western and Great Central Ry.-cutting, E. of Loudwater Station on Great Western Railway.

Lower Wield; N.E. of Alresford, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 903 of Brydone (1912, p. 89), beside "Yew Tree" P. H., Lower Wield.

**Lüneburg*; Hanover. Senonian, zone of *B. mucronata.*

**Luton*; S.E. of Chatham, Kent. Senonian, zone of *M. cortestudinarium.* Horizon determined by W. Gamble.

**Maastricht* (also Mastricht, Maëstrich, Maëstricht, Maestricht, St. Petersberg, Mt. St. Peter, Montagne de St. Pierre); Limbourg, Holland. Senonian, Maastrichtian. Montagne de St. Pierre is just outside Maastricht, on the south.

Malchin; Eastern Mecklenburg. Danian Drift.

Mallica Hill; see *Mullica Hill.*

**Malling Hill*; N.E. of Lewes, Sussex. Turonian, zone of *H. planus.* See also Bridgwick Pit.

Malmö; S. Sweden. Danian.

Mancy; S. of Epernay, Marne, France. Senonian, lower part of zone of *A. quadratus.*

**Margate*; Kent. Senonian, zone of *Marsupites.*

**Medical College Pit*; Epsom, Surrey. Senonian, top of zone of *M. coranguinum* and base of zone of *Marsupites.*

Medsted; N.E. of Alresford, Hants. Senonian, zone of *M. coranguinum*; pit 393 of Brydone (1912, p. 62), $\frac{1}{4}$ mile S. of Heath Green Farm, Medsted.

Meudon; S.W. of Paris, France. Senonian, Campanian, zone of *B. mucronata*, probably lower and middle parts.

**Möen*; S. of Sjælland, S.E. Denmark. Danian.

Monléon; Hautes-Pyrénées, S.W. of Boulogne-sur-Gesse, N.W. of Saint-Gaudens, Haute Garonne, France. Maastrichtian.

Montagne de St. Pierre; see Maastricht.

Moulinaux; Meudon, S.W. of Paris. Senonian, zone of *B. mucronata*, probably lower and middle parts.

**Mount Harry*; N.W. of Lewes, Sussex. Senonian, lower third of zone of *M. coranguinum*; summit of Downs, Mount Harry. Horizon determined by C. T. A. Gaster.

Mount St. Peter; see Maastricht.

Mouthiers; S. of Angoulême, Charente, France. Turonian and Lower Senonian.

Mullica Hill (also Mallica Hill); S.W. of Woodbury, New Jersey, S. of Philadelphia, Pennsylvannia, U.S.A. Danian, Vincentown Limesand.

**Nash Mills*; S.E. of Boxmoor, Herts. Senonian, zone of *M. cortestudinarium.* Flint meal from Flint-heaps at Nash Mills.

Nefgraben (also Nefgrab); W. of Gosau, S.E. of Salzburg, Austrian Tyrol. Coniacian.

Neubrandenberg; Mecklenburg-Strelitz, Germany. Danian Drift.

**Newhaven*; Sussex. Senonian, zone of *A. quadratus.*

**Newlands Farm*; S.E. of Odiham, Hants. Senonian, zone of *Marsupites*, *Uintacrinus*-band.

**North Lancing*; N.E. of Worthing, Sussex. Senonian, zone of *A. quadratus*, top of subzone of *E. scutatus* var. *depressa*, or possibly subzone of *O. pillula*; pit 2 of Gaster, by reservoir near Hill Barn, North Lancing. Horizon determined by C. T. A. Gaster. In Lang, 1916, this pit was considered to be in the *O. pillula* subzone.

**Norwich*; Norfolk. Senonian [zone of *B. mucronata*].

Nôtre Dame du Thil; N.W. of Beauvais, Oise, France. Upper Senonian.

**Odiham*; Hants. Senonian, zone of *Marsupites*; see Roke Farm and Newlands Farm.

**Offham Hill*; N.W. of Lewes, Sussex. Senonian, zone of *M. cortestudinarium*; chalk-pit W. of large pit, Offham Hill. Horizon determined by C. T. A. Gaster.

**Old Nore Point*; W. of Newhaven, Sussex. Senonian, zone of *A. quadratus*; E. side of Old Nore Point.

Olinge; see Vestra Olinge.

**Otterbourne*; S. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*; Southampton Waterworks Pit.

Peine; E. of Hanover, Germany. "Unterer Kreide."

Pérignac; S.E. of Saintes, S.E. of Rochefort, Charente Inférieure, France. Dordonian (and Senonian close by).

Pinnow; S.E. of Schwerin, Mecklenburg. Upper Senonian or Danian Drift.

Plauen; Dresden, Saxony. Cenomanian, Untere Pläner.

**Poncé*; N.E. of La Chartre-sur-le-Loir, Sarthe, France. Upper Turonian; between Ruillé and Poncé.

Pons; S.E. of Saintes, S.E. of Rochefort, Charente Inférieure, France. Senonian, Angoumian.

Poodoopolliam; S.E. of Arrialoor, N.E. of Trichinopoly, Madras, S. India. Senonian, Arrialoor Group.

Port Brehay; or Port Bréhet, N.E. of Gourbesville, N.W. of Carentan, Manche, France. Senonian, Campanian, zone of *B. mucronata*, probably middle and lower parts.

**Portsdown*; N. of Portsmouth, Hants. Senonian, zone of *A. quadratus*.

**Quidhampton*; N.W. of Salisbury, Wilts. Senonian, zone of *M. coranguinum*.

Rancocas Creek; New Jersey, N.E. of Philadelphia, Pennsylvania, U.S.A. Danian, Vincentown Limesand.

Rheims; Marne, France. Campanian, zone of *A. quadratus*, lower part; =" zone à *Micraster fastigatus*."

Río Negro; Argentine, S. America, lat. 39° S.; Rocanian (=Cenomanian [to Lower Senonian]).

Roca (also General Roca); on Río Negro just E. of its confluence with Río Limay and Río Neuquen, Argentine, S. America, lat. 39° S.; Rocanean (=Cenomanian [to Lower Senonian]).

**Roke Farm*; S.E. of Odiham, Hants. Senonian, zone of *Marsupites*.

**Romsey*; S.W. of Winchester, Hants. Senonian, zone of *A. quadratus*.

Roquefort; E.N.E. of Saint-Gaudens, Haute-Garonne, France.

**Rottingdean*; E. of Brighton, Sussex. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; see also East Hill, Rottingdean.

Rousselières; S. of Mouthiers, S. of Angoulême, Charente, France. Senonian, Coniacian; near it also are Turonian and Santonian.

Royan; S. of Rochefort, Charente-Inférieure, France. ? Dordonian and Campanian, probably *B. mucronata*-zone; Craie avec l'*Ostrea vesicularis*.

**Rügen I.*; German Baltic. Senonian, zone of *B. mucronata*.

**Ruillé*; N.E. of La Chartre-sur-le-Loir, Sarthe, France. Upper Turonian.

**St. Avertin*; S.E. of Tours, Indre-et-Loire, France. Senonian, Coniacian.

Ste. Colombe; near Mouthiers, S. of Angoulême, Charente, France. Senonian, Craie à Thécidées.

Ste. Colombe; S. of Valognes, Manche, France. Craie à baculites.

St. Gaudens; Haute-Garonne, France. Maastrichtian. N. of St. Gaudens.

St. Marcet; N. of St. Gaudens, Haute-Garonne, France. Maastrichtian.

**St. Paterne*; N.W. of Tours, Indre-et-Loire, France. Senonian, Coniacian.

St. Petersberg; see Maastricht.

**St. Rimay*; E. of Montoire, N.W. of Blois, Loir-et-Cher, France. Turonian, Craie Marneuse.

Saintes; S.E. of Rochefort, Charente Inférieure, France. Senonian, Santonian.

**Salisbury*; Wilts. Senonian; see also Aldenborough, Clarendon, East Harnham, Highfield, Quidhampton, and Witherington.

**Saltdean*; E. of Brighton, Sussex. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*.

Saltholm; E. of Copenhagen, Denmark. Danian.

Salzberg; near Quedlinburg, S.W. of Magdeburg, Saxony. Lower Senonian, Plänermergel.

Satow [=Satow-Niederhagen]; N.E. of Wismar, Mecklenburg. Danian Drift.

Schillinge; near Bilin and W. of Leitmeritz, Bohemia. Cenomanian, Untere Plänerkalk.

Schlenaken (Slenaken); Limbourg, Holland, W. of Aix-la-Chapelle, Germany. Senonian, Campanian, Marnes sans silex.

**Seaford*; Sussex. Senonian, zone of *M. cortestudinarium*.

**Seven Sisters*; E. of Cuckmere Haven, Sussex. Senonian, zone of *M. coranguinum*; westernmost of Seven Sisters.

Shawford; S. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*.

Soberton; S. of Meonstoke, S.E. of Winchester, Hants. Senonian, zone of *M. coranguinum*; pit 559 of Brydone (1912, p. 70), excavations for bank at fold-yard, ¼ mile W. of Lower Grenville Copse, Soberton.

**Sompting*; N.E. of Worthing, Sussex. Senonian, zone of *A. quadratus*; see also Charman Dean, Dankton Lane, and Upton Lane (Lambley's Lane).

Stafversvad; N.E. of Kristianstad, S. Sweden. Senonian, zone of *B. mucronata*, Åhussandsten.

Steinholz; near Quedlinburg, S.W. of Magdeburg, Saxony. Lower Senonian, Pläner Mergel.

Strehlen; Dresden, Saxony. Turonian, Ober Pläner.

**Strood*; N.W. of Chatham, Kent. Senonian, zone of *M. coranguinum*; Earl's Pit.

**Southampton Waterworks Pit*; see Otterbourne.

**Span Hill*; Oxon, N.W. of Sonning, Berks. Senonian, high in zone of *M. coranguinum*.

**Telscombe Staircase*; W. of Newhaven, Sussex. Senonian, zone of *A. quadratus*, subzone of *O. pillula*; 1 mile E. of Telscombe Staircase.

Tichborne; E. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 958 of Brydone (1912, p. 92), degraded pit, ⅔ miles S. of Ovington House, Tichborne; pit 955 of Brydone (1912, p. 92) by Slab Pond, Tichborne.

Timber Creek; New Jersey, S.E. of Philadelphia, Pennsylvania, U.S.A. Danian, Vincentown Limesand.

**Tours*; Indre-et-Loire, France. Senonian, Coniacian.

Tourtenay; N.E. of Thouars, N.E. of Bressuire, Deux Sèvres, France. Cenomanian; le plaine au nord de Tourtenay.

Trimingham (also *Trimmingham*); S.E. of Cromer, Norfolk. Senonian, zone of *B. mucronata*.

Upham; S.E. of Winchester, Hants. Senonian, zone of *A. quadratus*.

**Upper Basildon*; N.W. of Pangbourn, Berks. Senonian [high in] zone of *M. coranguinum*. Horizon determined by L. Treacher.

**Upton Lane* (also Lambley's Lane); Sompting, N.E. of Worthing, Sussex. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*, pit 7 of Gaster, N.W. of Sompting Church; probably subzone of *A. quadratus*, pit 8 of Gaster, between Upton Lane and Charman Dean. Horizons determined by C. T. A. Gaster.

Vaals; Limbourg, Holland, W. of Aix-la-Chappelle, Germany. Senonian, Campanian, Craie marneuse sans silex.

**Valkenberg* (also *Valkenburg*); see Fauquemont.

Vendôme; N.W. of Blois, Loir-et-Cher, France. Senonian.

Vestra Olinge; N.W. of Kristianstad, S. Sweden. Senonian, higher part of zone of *A. quadratus*, beds with *Actinocamax mamillatus*.

Villavard; E. of Montoire, N.W. of Blois, Loir-et-Cher, France. Senonian.

Vincentown; New Jersey, E. of Philadelphia, Pennsylvania, U.S.A. Danian, Vincentown Limesand.

**Warlingham*; S.E. of Croydon, Surrey. Senonian, zone of *M. cortestudinarium*; Lower Pit, Sline's Oak, Worms Heath, Warlingham.

Warnford; S.E. of Winchester, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pits, described by Brydone, 1912, pp. 93, 94; 975, degraded pit $\frac{1}{3}$ mile W.N.W. of Riversdown Farm; 978, degraded pit at 400 yards S.E. of Riversdown Farm; 979, degraded pit, $\frac{1}{3}$ mile N. of Jackass Coop House; 983, degraded pit at junction of Green and Bosen Hill Lanes; 984, degraded pit $\frac{7}{12}$ mile N.N.W. of Wheely Down Farm.

**Warningcamp Hill*; N.E. of Arundel, Sussex. Senonian, zone of *A. quadratus*, probably subzone of *A. quadratus*, large pit on Warningcamp Hill; and subzone of *O. pillula*, pit by roadside between Burpham and Arundel, W.N.W. of Warningcamp Hill. Horizons determined by C. T. A. Gaster.

**West Horsley*; N.E. of Guildford, Surrey. Senonian, zone of *M. coranguinum*; Coomb's Pit, pit 264 of Young (1908, p. 444).

West Tytherley; N.W. of Romsey, Hants. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*.

West Tisted; E. of Winchester, Hants. Senonian, top zone of *Marsupites*.

Weybourne (also *Weybourn*); W. of Cromer, Norfolk. Senonian, zone of *B. mucronata*.

Whitchurch; E. of Andover, Hants. Senonian, zone of *M. coranguinum*.

**Whitchurch*; Oxon, N. of Pangbourn, Berks. Senonian.

Winchester; Hants. Senonian, zone of *A. quadratus*, subzone of *A. quadratus*.

Witherington; S.E. of Salisbury, Wilts. Senonian, zone of *M. coranguinum*.

**Wivelrod*; W. of Alton, Hants. Senonian, zone of *M. coranguinum*.

**Wooburn Green*; S.W. of Beaconsfield, Bucks. Senonian, zone of *M. coranguinum*. Horizon determined by L. Treacher.

Woodmancott; N. of Alresford, Hants. Senonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; pit 909 of Brydone (1912, p. 89), degraded pit just S. of Lone Farm, Woodmancott.

**Worms Heath*; see Warlingham.

Zarrentin; S.W. of Schwerin, Mecklenberg, Germany. Upper Senonian or Danian Drift.

Zbislav (or *Zbislaw*); E. of Kuttenberg, S.E. of Prague, Bohemia. Cenomanian, Korycaner-schichten.

§ 38.—III. List of the Species of Cretaceous Cribrimorph Polyzoa arranged in Stratigraphical Order.

Danian.

Auchenopora guttur.
Pliophlœa palea.
—— gluma.
—— sagena.
Trilophopora trifida.
[Tricephalopora] prolifera.
Tricephalopora cerberus.
Haplocephalopora uniceps.
Hesperopora occidentalis.
—— danica.
Stichocados compositus.
—— moenensis.
Diacanthopora bispinosa.
—— marginata.
—— abbotti.
—— distans.
Pachydera densa.

Senonian, Aturian, Maastrichtian.

Pliophlœa brongniarti.
—— elegantula.
—— cornuta.
[Tricephalopora] coronata.
—— pinguis.
Tricephalopora scobina.
[Phractoporella] boryana.
[Polycephalopora] plicatella.
Cœlopora variolaria.
—— pustulosa.
[Hesperopora] walfordi.
[Rhiniopora] perforata.
Rhiniopora aviculosa.
—— jurassica.
Castanopora guascoi.
Ubaghsia reticulata.
[Batrachopora] signata.
Batrachopora hyla.
—— ornata.
Decurtaria allecta.

Senonian, Aturian, Campanian, Zone of Belemnitella mucronata.

[Leptocheilopora] vulnerata.
[Leptocheilopora regularis.]
—— magna.
Andriopora levinseni.
—— aggregata.
Distansescharella familiaris.
Lecythoglena ampullacea.
Pliophlœa pupoides (or, perhaps, Maastrichtian).
Pliophlœa striata.
—— ostreicola.
—— subvitrea.
—— cornuta.
Schistacanthopora fissa (or, perhaps, Maastrichtian).
Prosotopora neptuni (or, perhaps, Maastrichtian).

Geisopora protecta.
Kelestoma elongatum.
—— gradatum.
—— scalare.
Morphasmopora jukes-brownei.
—— brydonei.
[Tricephalopora] vermicularis.
—— galeata.
—— crepidula.
—— bedhamptonensis.
—— castrum.
Tricephalopora triceps.
—— tripla.
—— tripartita.
—— sherborni.
—— obducta.
—— obtecta.
—— gastropora.
Phractoporella trifaux.
—— operta.
—— constrata.
Polycephalopora hydra.
—— multiceps.
Cœlopora cormoran.
—— spelunca.
—— specus.
—— cavernosa.
—— lunaris.
Stichocados verruculosus.
—— ordinatus.
Rhiniopora aspera.
—— asperula.
—— hispida.
—— cacus.
—— horrida.
—— scabra.
Phrynopora bufo.
—— arcifera.
Castanopora dibleyi.
—— nucifera.
—— juglans.
—— castanea.
—— glandulosa.
[Disteganopora horrida.]
Ubaghsia demorgani.
—— meudonensis.
Batrachopora perforata.
—— ranunculus.
—— ovalis (or, perhaps, Maastrichtian).
—— convexa.
—— crassa.
—— royanensis (or, perhaps, Maastrichtian).
—— aurita (or, perhaps, Maastrichtian).
—— coaxans.
Pachydera grandis.
Decurtaria cornuta.
Murinopsia galeata.
—— francqana.

Senonian, Aturian, Campanian, Zone of Actinocamax quadratus, *Subzone of* A. quadratus.

[Lagynopora furcifera.]
Æolopora stellata (rare).
—— nebulosa.
Pliophlœa charmanensis.
—— subvitrea.
Prosotopora tæniata.
[Tricephalopora] bramfordensis.
—— somptingensis.
Polycephalopora shawfordensis.
Carydiopora gasteri.
Anornithopora involucris.
Pelmatopora somptingensis (locally abundant).
—— gregoryi.
—— palmata.
—— damicornis.
—— bidens.
—— lancingensis.
—— promontoriorum.

Senonian, Aturian, Campanian, Zone of Actinocamax quadratus, *Subzone of* Offaster pilula.

Lagynopora amphora.
Leptocheilopora arcuata.
[Tricephalopora] t-formis.
Polycephalopora multiplex.
—— turgida.
Pelmatopora simplex.
—— danktonensis.
—— bidens.
—— promontoriorum.
—— ranunculoides.

Senonian, Aturian, Campanian, Zone of Actinocamax quadratus, *Subzone of* Echinocorys scutatus *var.* depressa, *upper part.*

[Hexacanthopora kintburiensis.]
Hippiopora equestris.
Æolopora stellata.
Polycephalopora multiplex.
Anornithopora implumis.
—— irrostrata.
Pelmatopora simplex.
—— coryli.
Pelmatopora danktonensis.
—— bidens.
—— lancingensis.
—— collium.
—— promontoriorum.
—— ranunculoides.
—— lacuum.

Senonian, Aturian, Campanian, Zone of Actinocamax quadratus, *Subzone of* Echinocorys scutatus *var.* depressa, *middle and lower parts* (*or not particularised*).

Hexacanthopora kintburiensis.
—— brightonensis.
Lagynopora saltdeanensis.
—— urceolus.
Leptocheilopora arcuata.
Argopora improba.
Angelopora missa.
Pancheilopora magnilabrosa.
Hippiopora equestris.
Æolopora stellata.
[Tricephalopora] t-formis.
Tricephalopora saltdeanensis.
Phractoporella subcastrum.
Polycephalopora trigemina.
Polycephalopora multiplex.
—— turgida.
Carydiopora nucella.
Pelmatopora simplex.
—— coryli.
—— marsupitum.
—— roedeanensis.
—— danktonensis.
—— bidens.
—— lancingensis.
—— saltdeanensis.
—— promontoriorum.
—— ranunculoides.

Senonian, Aturian, Campanian, Zone of Actinocamax quadratus, *exact horizon not determined.*

Lagynopora ampulla.
Leptocheilopora filliozati.
Polycephalopora quadrigemina.
Pelmatopora gyrinoides.
Decurtaria cornuta.
Murinopsia galeata.

Senonian, Aturian, Campanian, exact horizon not determined.

[Lagynopora vasculum.]
Leptocheilopora longuessensis.
[Rhacheopora] incrassata.
[Prosotopora neptuni.]
Tricephalopora longuessensis.
[Polycephalopora] insignis.
—— bulbifera.
Castanopora magnifica.
Disteganopora horrida.
Ubaghsia ocellata.

Upper Senonian, exact horizon not determined.

Rhiniopora labiata.
Rhiniopora radiata.

Senonian, exact horizon not determined.

Argopora pigra.
Graptopora semicostata.
—— raripora.
Baptopora insignis.
[Tricephalopora] brevis.
[Polycephalopora] rustica.
—— pentapora.
Steganopora ornata.
—— aculeata.
Pelmatopora chrysalis.
—— striata.
—— interrupta.
[Ichnopora] dentata.

Senonian, Emscherian, Santonian, Zone of Marsupites.

Hexacanthopora sexspinosa.
—— kintburiensis.
—— brightonensis.
Leptocheilopora tenuilabrosa.
Distansescharella discreta.
Æolopora stellata (rare).
Dishelopora claviceps.
Polycephalopora trigemina.
Carydiopora nucula.
—— myristica.
Castanopora retrorsa.
Pelmatopora coryli.
—— marsupitum.
—— roedeanensis.
—— ranunculoides.

Senonian, Emscherian. Santonian, Zone of Micraster coranguinum, *upper part.*

Lagynopora horsleyensis.
[Leptocheilopora tenuilabrosa.]
Holostegopora epsomensis.
Pancheilopora parvilabrosa.
Æolopora distincta.
[Dishelopora claviceps.]
Dishelopora binoculata.
Pelmatopora suffulta.
—— pero.
—— brydonei.
—— quadrivolucris.
Ichnopora denticulata.

Senonian, Emscherian, Santonian, exact horizon not determined.

Lagynopora ollula.
Pliophlœa columbina.
Graptopora scripta.
Castanopora ornata.

Senonian, Emscherian, Santonian, Zone of Micraster coranguinum, *lower part (or not particularized).*

Myagropora muscipula.
Thoracopora pontifera.
Taractopora obscurata.
Prodromopora præcursor.
Lagynopora birlingensis.
—— lagena.
Leptocheilopora gasteri.
Andriopora linearis.
—— porrecta.
Angelopora nuntia.
Eucheilopora labiosa.
Æolopora distincta.
Monoceratopora unicornis.
Pliophlœa cicatricifera.
Dishelopora bispinosa.
—— bicuspis.
—— binoculata.
—— claviceps.
Rhacheopora suta.
Prosotopora flacca.
—— bicornis.
Prosotopora arrecta.
Diceratopora bivia
Tricephalopora pustulosa.
Pnictopora suffocata.
—— alligata.
—— strangulata.
—— obstructa.
Pelmatopora crepidaria.
—— solearis.
—— pauciclavia.
—— quadrata.
—— suffulta.
—— gasteri.
—— repleta.
—— plantaris.
Sandalopora socculus.
—— caligata.
Ichnopora filiformis.
—— vestigium.
—— denticulata.

Senonian, Emscherian, exact horizon not determined.

Francopora canui.
[Tricephalopora] capitata (Rocanean, more exact horizon assumed).
Pelmatopora filliozati.
Pelmatopora insignis (Rocanean, more exact horizon assumed).
Ichnopora filiformis.
—— leporina.

Senonian, Emscherian, lower part of Zone of Micraster coranguinum, *or upper part of Zone of* M. cortestudinarium.

Thoracopora raptrix.
Argopora segnis.
Monoceratopora gamblei.
Dishelopora bispinosa.
—— valvata.
Rhacheopora suta.
—— bidens.
Diancopora ancora.
Pelmatopora calceata.
—— solearis.
[—— insignis.]
Sandalopora soccata.
—— caligata.
Ichnopora vestigium.
—— porigera (Arrialoor Group, exact horizon assumed).

Senonian, Emscherian, Coniacian, Zone of Micraster cortestudinarium.

Myagropora cavea.
—— muscipula.
Thoracopora pontifera.
[—— costata.]
Taractopora confusa.
—— obscurata.
—— rostrata.
Lagynopora lagena.
Andriopora arion.
—— limax.
—— linearis.
—— gasteri.
—— gallica.
—— frequens.
Argopora segnis.
Angelopora nuntia.
Nannopora paternensis.
—— pygmæa.
—— lepida.
Distansescharella d'orbignyi.
Tricolpopora trisinuata.
Eucheilopora pediculosa.
[Eucheilopora labellosa.]
Eucheilopora labiosa.
[Eucheilopora lepida.]
Eucheilopora crassescens.
[Eucheilopora radiata.]
[Monoceratopora lewesiensis.]
Dishelopora cuckmerensis.
—— claviceps.
Hystricopora horrida.
Rhacheopora vallata.
[—— obliqua.]
—— larvalis.
—— bidens.
Prosotopora bicornis.
Baptopora immersa.
Opisthornithopora flabellata.
Tricephalopora prænuntia.
—— ansata.
Pnictopora suffocata.
—— obstructa.
Pelmatopora solearis.
—— larva.
—— d'orbignyi.
—— fragilis.
—— fecampensis.
Sandalopora supplosa.
—— soccata.
—— caligata.
Ichnopora socia.
—— amica.
—— campestris.
—— vestigium.
—— cavia.
—— cunicula.
—— asella.

Turonian.

Thoracopora costata (zone of *H. planus*).
Lagynopora pediculus.
Andriopora homunculus (zone of *H. planus*).
Oligotopora novaki (Teplitzer schichten).
Eucheilopora barbata (zone of *H. planus*).
[Eucheilopora radiata.]
Monoceratopora lewesiensis (zone of *H. planus*).
Rhabdopora virgata.
—— virgulata.
—— tigrina.
Sandalopora gallica.
—— lavardinensis.

Cenomanian.

Anaptopora disjuncta.
—— cantabrigiensis.
—— mockleri.
Anotopora inaurita.
Otopora auricula.
Ctenopora pecten.
Andriopora brevis.
—— mockleri.
Polyceratopora euglypha.
Corymboporella religata.
Kankopora kankensis.
—— inflata (also recorded from the Neocomian; but see p. 129).
Hybopora gibba.
Calpidopora subfallax.
—— novaki.
—— mumia.
—— diota.
—— auritulus.
—— aurita.

IV. Bibliographical.

§39. Much of the literature of Cretaceous Cheilostomes generally, and, consequently, of Cretaceous Cribrimorphs, consists of scattered references in papers mainly concerned with other matters; or of small papers buried in various periodical publications. The Cretaceous Cheilostomes have never been treated as a whole, though it is true that d'Orbigny's 'Paléontologie Française' contains references to most extra-French forms described up to his time. But the last instalment of d'Orbigny's work was published in 1854, and, naturally, a great deal of matter concerning Cretaceous Polyzoa has been published since. Works occupied largely or wholly with Cretaceous Polyzoa are local in scope, and a review of the more important literature on Cretaceous Cribrimorphs is best accomplished by considering it according to localities.

The English Cretaceous forms were first listed and described in numbers by G. R. Vine in many scattered papers; but he mentions only two new Cribrimorphs. W. Gamble published a list of the Chatham forms. But a very large number of new forms have more lately been described by R. M. Brydone in a series of papers in the 'Geological Magazine.' These papers are illustrated with reproductions of excellent micro-photographs. They contain descriptions of many new Cribrimorphs. Many new British Cribrimorphs were also diagnosed by the Author in the 'Annals and Magazine of Natural History' for 1916, and some of these were further dealt with in the 'Philosophical Transactions of the Royal Society' for 1919.

A very large number of French Cretaceous Cheilostomes were described in d'Orbigny's 'Paléontologie Française,' 1851–4, and these included many Cribrimorphs. This work was revised in 1900 by F. Canu, who worked through d'Orbigny's material. Canu has also listed many species in several papers he has written on the Cretaceous of various French districts. J. Jullien, in 1886, described several new and remarkable Cribrimorphs from the Campanian of the neighbourhood of Paris; and in 1912, G. Lecointre described a species from the Cenomanian of Le Mans.

The few known German continental Cretaceous Cribrimorphs have been described in the works on the German Cretaceous by F. A. von Römer and A. E. von Reuss. But the German locality whence Cribrimorphs have been described in numbers is the Island of Rügen. K. F. von Hagenow first described the Rügen Polyzoa in the 'Neues Jahrbuch' for 1839 and 1840; and in 1887 they were monographed by T. F. Marsson. Some Scandinavian Cribrimorphs from the Upper Senonian were described in 1892 by A. Hennig. Cretaceous Cheilostomes from Maastricht were first described by G. A. Goldfuss in 1826, and among them *Batrachopora* [*Cellepora*] *ornata*—the earliest-described Cretaceous Cribrimorph. Several other Cribrimorphs are described in K. F. von Hagenow's monograph of the Maastricht Polyzoa in 1851; J. C. Ubaghs described a new Cribrimorph from this district in 1865; and E. Pergens another in 1894. Upper Senonian Polyzoa from Aix-la-Chapelle form the subject of a paper by J. Beissel, in 1865, and among them are a few Cribrimorphs. Bohemian forms have been dealt with by A. E. von Reuss (1846), O. Novák (1877), and F. Počta (1892); a Cribrimorph was described in 1854 by A. E. von Reuss from Gosau in the Austrian Tyrol.

A solitary Asian Cretaceous Cribrimorph is that described by F. Stoliczka in 1872 from Southern India.

The Danian beds of New Jersey have in the past yielded four Cribrimorph forms, one of which was named as long ago as 1834 by S. G. Morton; and the other three by W. Gabb and G. H. Horn in 1862. And two Cribrimorphs from the Rocanean beds of the Argentine were described by Canu in 1911.

New species from France, Lüneburg (Hanover), Rügen, Maastricht, Bohemia, and New Jersey were diagnosed by me in 1916, and a new Rügen form in 1919.

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It is a matter for regret that I have received Canu's and Bassler's large Monograph on the Early Tertiary Bryozoa of America too late to correlate their results with this work and incorporate into it such matter as pertains to the Cretaceous Cribrimorph forms. The evolutionary outlook of these authors, their methods of approaching the subject, even their systematic views, differ so widely from mine that any attempt to correlate the two works promises to be a task of some difficulty, though it should prove of great interest.

The following is a list of authors referred to in the text, with the titles of their works:—

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(The page-references in small roman figures between [ ] refer to the preceding Introduction.)

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Part II. SYSTEMATIC.

1. CHARACTERS OF THE FAMILIES.

It has been remarked above that the Cretaceous Cribrimorphs fall into eleven groups, which may be regarded as independently derived from Membranimorphs; and these eleven groups have been treated as families. Moreover, of these families, the Lagynoporidæ have been divided into two, the Andrioporidæ into three, and the Pelmatoporidæ into eight sub-families. The Pelmatoporidæ contains about as many species as all the other families together, and will be dealt with in a separate volume *. It is generally easy to distinguish a Pelmatoporid at once by the presence of conspicuous pelmata or pelmatidia (see fig. 6). These structures, however, may be masked, especially by the presence of invading secondary tissue, generally in the form of a tertiary front-wall; moreover, pelmatidia occasionally occur in other families. If ovicells are present in the Pelmatoporidæ, they are endozoœcial; but endozoœcial ovicells are also present in the Calpidoporidæ, the Rhacheoporidæ, and, probably, the Disheloporidæ. It is desirable, therefore, to distinguish the Pelmatoporidæ from those three families. When pelmatidia occur in those families, they tend to be irregularly arranged, to be several on a costa, and in the latter case do not mark the levels of costal fusions (see figs. 99–105). In the Pelmatoporidæ, when there are several pelmatidia on a costa (as in the Castanoporinæ), they occur at regular intervals and there are lateral fusions at each pelmatidium. The Pelmatoporid, then, may be known by the possession of endozoœcial ovicells, conspicuous, regularly-arranged pelmata or pelmatidia, and if there are several pelmatidia on a costa, by their correlation with the lateral costal fusions.

* The Pelmatoporid sub-families Kelestominæ and Pelmatoporinæ have already been reviewed (Lang, 1919 and 1919 [1]).

When it is remembered that the families of Cretaceous Cribrimorphs are supposedly based on different Membranimorph stocks, and (at least theoretically) pass from primitive Myagromorphs to complex Steganomorphs (Introd., § 17) along parallel and similar lines and according to an orthogenetic trend, or programme-evolution, thus producing parallel series of homœomorphs, it is not surprising that their diagnoses should be more difficult of enunciation than those of genera, and still more than those of species. It is hardly possible to state a common character that is not liable to exception. Indeed, one is almost driven to define, not diagnose, a given family as containing all the possible descendants of a supposed ancestral form. We must, therefore, not expect our diagnoses to be all-sufficient, and a margin of vagueness must be allowed to the definitions contained in the key. It is hardly possible, for instance, to define the Pelmatoporidæ otherwise than as Cretaceous Cribrimorphs with endoœcial ovicells and well-defined pelmata or pelmatidia; yet, as we have seen, in some forms the ovicells are not apparent and the pelmata or pelmatidia are obscured, while, on the other hand, pelmatidia (or pelmatidium-like structures) are sometimes present outside the Pelmatoporidæ.

If the Pelmatoporidæ are considered as sufficiently diagnosed, it is convenient next to consider the three families grouped with the Pelmatoporidæ as distinguished from the other Cretaceous Cribrimorphs in having endozoœcial ovicells and in occasionally possessing pelmatidia or a median seam formed of the up-turned ends of the costæ. The most primitive of these three families is the Calpidoporidæ (figs. 92–98), for the costæ are generally widely separate and never very closely-placed; interœcial secondary tissue is well developed, and the aviculœcia tend to be curved. In the Disheloporidæ (figs. 99–105) the costæ are closely-placed, not much flattened, and often bear rather conspicuous, irregularly arranged pelmatidia; there is little or no secondary tissue; a pair of apertural aviculœcia occurs, each of which lies immediately proximal to one of the proximal apertural spines; and there is an occasional sporadic aviculœcium in the interœcial valleys. In the Rhacheoporidæ (figs. 106–115) the costæ are much flattened, closely-placed, do not bear pelmatidia, and have their ends up-turned in the median line to form a seam; the aviculœcia generally are not confined to apertural pairs lying immediately proximal to the proximal apertural spines, nor are there usually only occasional aviculœcia in the interœcial valleys; the œcia, too, are generally less coarse than those of the Disheloporidæ.

In the families with hyperstomial ovicells, pelmata and pelmatidia appear to be altogether absent. It is true, however, that costal emergences occur in some Andrioporidæ, such as *Andriopora gallica*, *A. frequens*, *Eucheilopora pediculosa*, and the genus *Æolopora*; but these appear rather as solid bosses than as broken ends of hollow spines. Also the pores on the Pliophlœine costæ sometimes suggest pelmatidia. This group with hyperstomial ovicells contains some very primitive families in which the apertural bar has not yet been formed, or, if formed, is asymmetrical, still showing its origin from the overlapping ends of two costæ. These families are the Ctenoporidæ, the Otoporidæ, and the Myagroporidæ. The Ctenoporidæ (fig. 17) are quite distinct from all other Cretaceous Cribrimorphs in their intra-terminal front-wall formed of a solid, domed ground-tissue, on which rest the spine-like, widely-spaced, Myagromorph costæ, and to which the costæ are firmly fused. Otherwise, especially in the asymmetrical apertural bar, the Ctenoporidæ resemble the Otoporidæ, but their aviculœcia are small and sub-circular. The Otoporidæ (figs. 13–16) contain Myagromorphs and true Cribrimorphs, and chiefly differ from the Myagroporidæ in their lack of interœcial secondary tissue and their aviculœcia, which, though secondarily small and but very slightly elongate or pointed, normally are decidedly elongate, pointed, and even curved. The Myagroporidæ (figs. 11, 12) are Myagromorphs, generally with abundant interœcial secondary tissue and small, sub-circular aviculœcia.

In the remaining four families the apertural bar is well formed and symmetrical, except in *Thoracopora raptrix*, in which it is not yet formed. Nevertheless, the Thoracoporidæ, Taractoporidæ, and the genus *Prodromopora* of the Lagynoporidæ are primitive and have very widely-spaced costæ. The Thoracoporidæ (figs. 18, 19) have spine-like costæ, little or no interœcial secondary tissue, and large, spatulate aviculœcia. The Taractoporidæ (figs. 20, 21) have few, flattened costæ, very wide proximally and rapidly tapering distally; much secondary interœcial tissue, and sub-circular aviculœcia. Both families have four apertural spines.

In the Lagynoporidæ and the Andrioporidæ the apertural spines are often exceedingly minute. When visible in the Andrioporidæ they are always six in number. They are always very minute in the sub-family Leptocheiloporinæ of the Lagynoporidæ; but in the sub-family Lagynoporinæ they are large, and their evolution can be traced passing from six in *Hexacanthopora* and in the earliest stages of *Lagynopora* to four in the ephebœcia of *Lagynopora*. In both the Lagynoporidæ (except *Prodromopora*) and the Andrioporidæ the costæ are closely-placed; and in both families lateral costal fusions occur, rarely in the former family but commonly in the Andrioporidæ. Otherwise, obvious lateral costal fusions are unknown outside the Pelmatoporidæ. The Lagynoporidæ (figs. 22–38) are rather large forms, with large, sub-circular aviculœcia and a very large, distally-placed communication-pore. The Andrioporidæ (figs. 40–91) typically are very small forms, with small, variously-shaped aviculœcia.

The following key summarises the differences between the families and sub-families of Cretaceous Cribrimorphs; but the sub-families of the Pelmatoporidæ are omitted, since they will be dealt with in a further volume:—

Key to the Families of Cretaceous Cribrimorph Polyzoa, and to the Sub-families considered in this Volume.

A. Ovicells hyperstomial; pelmata and pelmatidia absent.

- I. Costæ forming the apertural bar not fused, or, if fused, the apertural bar is asymmetrical; no lateral costal fusions; apertural spines four.
  - a. Costæ spiniform, or but slightly flattened; widely separated, and hardly fused medianly, to closely placed and firmly fused medianly; but not fused beneath to an underlying ground-tissue.
    - 1. Generally much interœcial secondary tissue; aviculœcia sub-circular (figs. 11, 12) A. Myagroporidæ.
    - 2. Little or no interœcial secondary tissue; aviculœcian rostra elongate, and tending to become curved (figs. 13–16) .... B. Otoporidæ.
  - b. Costæ spiniform, widely separated, and hardly fused in the mid-line; but firmly fused beneath to an underlying ground-tissue which forms a solid, arched intraterminal front-wall; aviculœcia small and sub-circular (fig. 17) .... C. Ctenoporidæ.

II. A well-formed, symmetrical apertural bar always present (except in *Thoracopora raptrix*, which may be known from members of the preceding families by its long, spatulate aviculœcia).

- *a.* Costæ widely separated; apertural spines four.
  - 1. Costæ spine-like; aviculœcia long and spatulate; little or no interœcial secondary tissue (figs. 18, 19) .... D. THORACOPORIDÆ.
  - 2. Costæ flattened, and wide proximally, rapidly tapering distally; aviculœcia sub-circular; plentiful interœcial secondary tissue (figs. 20, 21).................... E. TARACTOPORIDÆ.
- *b* Costæ closely-placed (except in *Prodromopora*, which may be known from members of the preceding families by its large, subcircular aviculœcia); apertural spines often six.
  - 1. Larger forms, about ·66 mm. long; lateral costal fusions very unusual; a very large, distally-placed communication-pore on each orthœcium; aviculœcia large and sub-circular (figs. 22–38) ...... F. LAGYNOPORIDÆ.
    - *α.* A median process of the apertural bar present, which ultimately fuses with the proximal pair of apertural spines; aviculœcia generally present; apertural spines four to six (figs. 22–33)... a. Lagynoporinæ.
    - *β.* No median process on the proximally bent apertural bar; aviculœcia rare or absent; apertural spines minute, probably always four (figs. 34–38) ... b. Leptocheiloporinæ.
  - 2. Smaller forms, generally less than ·5 mm. long; lateral costal fusions often abundant; aviculœcia small; apertural spines often minute, when visible, six (figs. 40–91) .... G. ANDRIOPORIDÆ.
    - *α.* Costæ not specially flattened, and bear neither a median row of pores nor a median slit; nor do they occasionally fuse with their neighbours completely to produce a costa of double width ... a. Andrioporinæ.
    - *β.* Costæ decidedly flattened, and bear a median row of pores; a costa occasionally appears completely to fuse with its neighbour, forming a costa of double width (figs. 82–91) .... b. Pliophlœinæ.
    - *γ.* Costæ bear a median slit .... c. Schistacanthoporinæ.

B. Ovicells endozoœcial (unknown in Disheloporidæ); pelmata or pelmatidia generally present, or the up-turned edges of the costæ form a median seam (except in *Rhabdopora* and *Graptopora*).

I. Pelmata absent, pelmatidia sometimes present; the up-turned edges of the costæ form a median seam (except in *Rhabdopora* and *Graptopora*); apertural spines four.

a. Costæ generally widely separate; much interœcial secondary tissue; aviculœcia tend to be curved (figs. 92–98) .... H. CALFIDOPORIDÆ.

b. Costæ closely-placed; often little or no interœcial secondary tissue; aviculœcia straight.

1. Œcia comparatively coarse; a pair of apertural aviculœcia present, each of which lies closely proximal to a proximal apertural spine; pelmatidia present, and sometimes prominent (figs. 99–105) ...... I. DISHELOPORIDÆ.

2. Œcia comparatively delicate; if aviculœcia appear near the aperture, they do not take up a definite position with respect to the apertural spines; pelmatidia absent or, at least, never conspicuous (figs. 106–115) .... J. RHACHEOPORIDÆ.

II. Pelmata or pelmatidia conspicuously present; apertural spines four to eight (see Vol. IV) . K. PELMATOPORIDÆ.

2. SPECIES WHOSE SYSTEMATIC POSITION IS DOUBTFUL.

Escharella arge, d'Orbigny.

Escharella Arge, d'Orb. 1851 ; d'Orbigny, 1851, pl. 666, figs. 7–9, 1852, p. 219, 1854, p. 1097 ; Sénonien ; Royan (Charente-Inférieure).

Escharella arge, d'Orb. ; Pictet, 1857, p. 110, pl. xc, fig. 13 [a copy of d'Orbigny, 1851, pl. 666, figs. 7–9] ; Sénonien.

Escharella Arge, d'Orb. ; Coquand, 1860, p. 181 ; Campanien ; Royan.

Costula Arge (d'Orbigny) ; Jullien, 1886, pp. 602, 604 ; terrains crétacés genotype of *Costula*.

Cribrilina (*Costula*) *Arge* (d'Orb.) ; Canu, 1900 [2], pp. 445–6, text-fig. 57 on p. 446 [a copy of d'Orbigny, 1851, pl. 666, fig. 8].

Escharella Arge ; Canu, 1900 [2], p. 457 ; "ne correspond pas."

Cribrilina Arge (d'Orb.) ; Canu in Douvillé, 1910, p. 63 ; Maëstrichtien ; Royan.

Escharella arge ; Lang, 1916, p. 408 ; Senonian ; Royan.

Membraniporella aurita, Hennig.

Membraniporella aurita nova species Hennig ; Hennig, 1892, pp. 38, 47, 48, pl. ii. figs. 34–35 ; lag med *Belemnitella mucronata* ; Stafversvad, Kristianstadsområdet.

Membraniporella aurita, Hng. ; Hennig, 1894, pp. 508, 527 ; Åhussandstenen, lag med *Belemnitella mucronata* ; Stafversvad.

Membraniporella aurita Hng. ; Hennig, 1910, p. 659 ; assise à *B. mucronata*, région de Kristianstad ; Grès d'Åhus.

? *Morphasmopora aurita* (Hennig) ; Lang, 1916, p. 85 ; *mucronatus*-zone ; Sweden.

Cribrilina collaris, Marsson.

Cribrilina collaris n. sp. ; Marsson, 1887, pp. 98, 109, pl. x, fig. 10 ; Senon, Weisse Schreibkreide ; Rügen.

Cribillina collaris Marss. ; Deecke, 1895, p. 80 ; Senon ; Rügen.

Cribrilina collaris (Marss.) ; Canu, 1900 [2], p. 445.

Cribrilina collaris, Marsson ; Lang, 1916, p. 410 ; *mucronatus*-zone Rügen.

Semiescharipora complanata, d'Orbigny.

Semiescharipora complanata, d'Orb., 1851 ; d'Orbigny, 1852, pl. 713, figs. 17–20, 1853, p. 484, 1854, p. 1093 ; Sénonien ; environs de Vendôme (Loir-et-Cher).

Semiescharipora complanata ; Canu, 1900 [2], p. 457 ; "usé."

Semiescharipora complanata ; Lang, 1916, p. 408 ; Senonian ; Vendôme.

Semiescharipora complanata, d'Orbigny ; Lang, 1917, p. 172 ; genolectotype of *Semiescharipora*.

Membranipora crenulata, d'Orbigny.

Membranipora crenulata, d'Orb., 1851 ; d'Orbigny, 1852, pl. 728, figs. 13–15, 1853, p. 547, 1854, p. 1093 ; Cénomanien ; Le Mans (Sarthe).

Membranipora crenulata ; Canu, 1900 [2], p. 381 ; "Costulidée brisée."

Membranipora crenulata d'Orb. ; Canu, 1900 [2], p. 449 ; Cénomanien.

Probably not *Reptoporella regularis,* d'Orb., 1851 ; d'Orbigny, 1852, pl. 717, figs. 6–7, 1853, p. 475, 1854, p. 1097 ; Sénonien ; Sainte Colombe (Manche) ; as suggested by Canu, 1900 [2], p. 449 [see *Leptocheilopora regularis* (d'Orbigny)].

Eschara edwardsiana, von Hagenow.

Eschara Edwardsiana, Hag. ; von Hagenow, 1851, p. 70, pl. viii, fig. 12 ; Maastrichter Kreidebildung ; Maastricht.

Escharella Edwardsiana (Hagenow) ; d'Orbigny, 1852, p. 219 ; Sénonien ; Maëstrich.

Escharella Edwardsiana (v. Hagen) ; Pictet, 1857, p. 110 ; craie de Maestricht.

Escharella Edwardsiana, d'Orb. ; Ubaghs, 1879, p. 217 ; Maastrichtien Supérieur ; Limbourg.

Escharella Edwardsiana, d'Orb. ; Mourlon, 1881, p. 116 ; Maastrichtien ; Limbourg.

Eschara Edwardsiana, H. ; Vine, 1885, p. 163 ; Maestricht Beds.

Eschara edwardsiana ; Lang, 1916, p. 409 ; Maastrichtian ; Maastricht.

Reptescharipora exigua, d'Orbigny.

Reptescharipora exigua, d'Orb., 1851 ; d'Orbigny, 1852, pl. 719, figs. 20–22, 1853, p. 491, 1854, p. 1098 ; Sénonien ; Meudon, près de Paris.

Disteginopora Francqana, d'Orb., 1851 ; d'Orbigny, 1852, pl. 734, figs. 9–11, 1853, p. 498, 1854, p. 1098 ; Sénonien, craie blanche ; Meudon, près de Paris (*fide* Canu, 1900 [2], p. 454).

Disteginopora Francquana, d'Orb. ; Pictet, 1857, p. 113 ; craie de Meudon.

Disteginopora Francqana d'Orbigny ; Jullien, 1886, p. 612.

Reptescharipora exigua d'Orb. ; Canu, 1900 [2], p. 454 = *Disteginopora Francqana* d'Orb.

Steginopora (*Steginopora*) *Francqana* d'Orb. ; Canu, 1900 [2], p. 454 ; Sénonien.

Reptescharipora exigua ; Lang, 1916, p. 408 ; Senonian, Meudon.

Disteginopora francqana ; Lang, 1916, p. 408 ; Senonian, Meudon.

Cribrilina falcoburgensis, Pergens.

Cribrilina falcoburgensis, sp. n. ; Pergens, 1894, p. 188, text-fig. 7 on p. 188 ; Maestrichlien [*sic*] ; Fauquemont.

Cribrilina falcoburgensis, Pergens ; Lang, 1916, p. 410 ; Maastrichtian ; Fauquemont.

Membraniporella (*Cribrilina*) *Falcoburgensis,* Perg. ; Brydone, 1918, p. 1.

Membraniporella fallax, Brydone.

Membraniporella fallax, nov.; Brydone, 1910, pp. 482, 483, pl. xxxvi, figs. 6–8; zone of *M. cor-anguinum*, Gravesend; top of zone of *Marsupites*, Hants.

Membraniporella fallax Brydone; Lecointre, 1912, p. 355; Coniacien; Angleterre.

Membraniporella fallax, mihi; Brydone, 1913, p. 438.

Membraniporella fallax; Lang, 1916, p. 409; *Marsupites*- and *cor-anguinum*-zones; Hants and Kent.

Membraniporella gabina, Brydone.

Membraniporella Gabina, sp. nov.; Brydone, 1917, pp. 494, 496, pl. xxxii, fig. 8; zones of *A. quadratus* and *B. mucronata*; I. of Wight and Hants.

Steganopora gravensis, Brydone.

Steginopora [sic] *Gravensis*, nov.; Brydone, 1910, pp. 481, 483, pl. xxxvi, figs. 4–5; zone of *M. cor-anguinum*; Gravesend.

Steginopora gravensis; Lang, 1916, p. 409; *coranguinum*-zone; Gravesend.

Escharipora immersa, Gabb & Horn.

Escharipora immersa, n. s.; Gabb & Horn, 1862, p. 149; Cretaceous; Timber Creek; N.J.

Escharipora immersa, Gabb & Horn; Meek, 1864, p. 3; Cretaceous; N.J.

Escharipora immersa, Gabb & Horn; Cook, 1868, p. 722; Cretaceous; New Jersey.

Escharipora immersa, Gabb & H.; Vine, 1885, p. 168; Cretaceous; Timber Creek, N.J.

Escharipora immersa Gabb & Horn; Nickles & Bassler, 1900, p. 156; Cretaceous; Timber Creek, New Jersey.

Escharipora immersa G. & H.; Johnson, 1905, p. 5.

Cribrilina immersa (Gabb & Horn); Weller, 1907, pp. 341, 167; Vincentown Limesand; Timber Creek and north bank of Rancocas Creek, a quarter of a mile N.W. of Vincentown, New Jersey.

Escharipora immersa, Gabb & Horn; Lang, 1916, p. 410; Danian; New Jersey.

Reptescharella inæqualis, d'Orbigny.

Reptescharella inæqualis, d'Orb., 1851; d'Orbigny, 1852, pl. 716, figs. 1–3, 1853, p. 467, 1854, p. 1097; Sénonien; Meudon, près de Paris, Nôtre Dame-de-Thil, près de Beauvais (Oise), Dieppe (Seine-Inférieure), Saintes (Charente-Inférieure), Les Roches (Loir-et-Cher).

Reptoescharella inæqualis, d'Orb.; Coquand, 1860, p. 150; Santonien; Saintes.

Reptescharella inæqualis d'Orb.; Peron, 1888, p. 225; Zone à *Micraster fastigatus*; environs de Reims et d'Épernay.
Reptescharella inæqualis; Canu, 1900 [2], p. 457; "Ne correspond pas."
Reptescharella inæqualis, D'Orb.; Brydone, 1906, p. 297.
Reptescharella inæqualis; Lang, 1916, p. 408; Senonian, France.

Cellepora incisa, von Hagenow.

Cellepora incisa nob.; von Hagenow, 1839, p. 275, pl. iv, figs. 11 *a*, *b*; Kreide; Rügen.
Escharina (*Cellepora*) *incisa* v. Hag.; Römer, 1840, p. 13; obere Kreide; Rügen.
? Non=*Escharina radiata* N.; Römer, 1840, p. 13, pl. v, fig. 4; untere Kreide; bei Peine; as stated by Giebel, 1848, p. 18 [see *Eucheilopora radiata*].
Non=*Escharina inflata* N.; Römer, 1840, p. 14, pl. v, fig. 5: Hilsconglomerat; bei Essen; as stated by Giebel, 1848, p. 18 [see *Kankopora inflata*].
Cellepora incisa v. Hg.; Boll, 1846, p. 207; obere Weisse Kreide; Baltic.
Cellepora incisa v. Hag.; Geinitz, 1846, p. 613; Rügen.
Cellepora incisa Hag.; Bronn, 1848, p. 255.
Escharina incisa Roe.; Bronn, 1848, p. 472.
Cellepora incisa Hagenow; Giebel, 1848, p. 18; =*E. radiata* Römer=*E. inflata* Römer.
Escharina incisa Roe.; Bronn, 1849, p. 131; Kreide.
Cellepora incisa v. H.; Geinitz, 1849–50, pp. 248–9; Kreide, obere Quadermergel; Rügen.
Escharina incisa V. Hag.; d'Orbigny, 1850, p. 262; Sénonien; Bohème, Rügen.
Cellepora incisa, Hagenow; Lang, 1916, p. 410; *mucronatus*-zone; Rügen.

Escharipora inornata, d'Orbigny.

Escharipora inornata, d'Orb., 1851; d'Orbigny, 1851, pl. 686, figs. 17–19, 1852, p. 230, 1854, p. 1097; Sénonien; Sainte-Colombe (Manche).
Cribrilina (*Cribrilina*) *inornata* (d'Orb.); Canu, 1900 [2], p. 447; Sénonien.
Escharipora inornata; Lang, 1916, p. 408; Senonian; Sainte-Colombe.
Escharipora inornata d'Orbigny; Lang, 1917, p. 170. Genolectotype of *Escharipora*.

Semiescharipora irregularis, d'Orbigny.

Semiescharipora irregularis, d'Orb., 1851; d'Orbigny, 1852, pl. 719, figs. 9–12, 1853, p. 487, 1854, p. 1098; Sénonien; Saintes, Pons (Charente-Inférieure).
Reptescharipora rustica, d'Orb., 1851; d'Orbigny, 1852, pl. 720, figs. 9–10, 1853, p. 494, 1854, p. 1098; Sénonien; Royan (Charente-Inférieure). [*Fide* Canu, 1900 [2], p. 456.]

Semiescharipora irregularis, d'Orb.; Coquand, 1860, p. 150; Santonien; Saintes.

Semiescharipora irregularis d'Orb.; Ubaghs, 1865, p. 54; Saintes, Pons, Charente-Inférieure.

Semiescharipora irregularis d'Orb.; Canu, 1900 ^{2}, p. 456; =*Reptescharipora rustica* d'Orb.

Steginopora (*Thoracophora*) *rustica* (d'Orb.); Canu, 1900 ^{2}, p. 456; Sénonien; =*Semiescharipora irregularis* d'Orb.

Reptescharipora rustica, D'Orbigny; Brydone, 1910, p. 260.

Semiescharipora irregularis; Lang, 1916, p. 408; Senonian: Saintes, Pons.

Reptescharipora rustica; Lang, 1916, p. 409; Senonian; Royan.

Steganopora irregularis, d'Orbigny.

Steginopora [sic] *irregularis*, d'Orb., 1851; d'Orbigny, 1852, pl. 720, figs. 16–19, 1853, p. 500, 1854, p. 1098; Sénonien; Saintes (Charente-Inférieure).

Steginopora irregularis, d'Orbigny; Pictet, 1857, p. 113, pl. xc, fig. 17 [copy of d'Orbigny, 1852, pl. 720, figs. 16 & 19]; Craie blanche.

Steginopora irregularis d'Orb.; Jullien, 1886, p. 612.

Steginopora irregularis, d'Orb.; Canu, 1900, p. 409; Tours.

Steginopora (*Steginopora*) *irregularis* d'Orb.; Canu, 1900 ^{2}, p. 455; Sénonien.

Steginopora irregularis d'Orbigny; Levinsen, 1909, p. 21.

Steginopora irregularis; Lang, 1916, p. 408; Senonian; Saintes.

Membraniporella juvenis, Hennig.

Membraniporella juvenis nova species Hennig; Hennig, 1892, pp. 39, 40, 47, 48, pl. ii, figs. 36–37; Lag med *Actinocamax mammillatus*; Barnakällegrottan, Kristianstads-området.

Membraniporella juvenis, Hng.; Hennig, 1894, pp. 508, 527, pl. ii, fig. 9 Åhussandsten, zone of *Act. mammillatus*: Barnakällegrottan.

Membraniporella juvenis Hng.; Hennig, 1910, p. 659; assise à *A. mammillatus*; région de Kristianstad.

Membraniporella juvensis [sic]; Lang, 1916, p. 409; Upper Senonian; Sweden.

Cribrilina lævis, Hennig.

Cribrilina lævis nova species Hennig; Hennig, 1892, pp. 37, 47, 48, pl. ii, figs. 29–30; Lag med *Belemnitella mucronata*, Köpinge, Ystads-området; Lag med *Actinocamax mammillatus*, Balsberg, W. Olinge, Barnakällegrottan, Kristianstads-området.

Cribrilina lœvis [sic] (Hennig); Canu, 1900 ^{2}, p. 445.

Cribrilina lævis Hng.; Hennig, 1910, p. 659; assise à *A. mammillatus*; région de Kristianstad.

Cribrilina lævis; Lang, 1916, p. 409; Upper Senonian; Sweden.

Cellepora (Escharina) lessoni, von Hagenow.

Cellepora (*Escharina*) *Lessoni*, Hag.; von Hagenow, 1851, p. 89, pl. x, fig. 10 Maastrichter Kreidebildung; Maastricht.

Repteseharella Lessoni (de Hagenow); d'Orbigny, 1853, p. 464; Sénonien; Maëstrich.

Reptescharella Lessoni (Hagenow); Pictet, 1857, p. 110; Maestricht.

Lepralia Lessoni (Hag.); Ubaghs, 1879, p. 221; Maastrichtien Supérieur; Limbourg.

Lepralia Lessoni (Hag.); Mourlon, 1881, p. 119; Maastrichtien; Limbourg.

Cellepora (*Escharina*) *Lessoni* H.; Vine, 1885, p. 164; Maestricht Beds.

Cellepora (*Escharina*) *lessoni*; Lang, 1916, p. 409; Maastrichtian; Maastricht.

Escharina lorieri, d'Orbigny.

Escharina Lorieri, d'Orb.; d'Orbigny, 1851 ?, legend to pl. 604, figs. 11–12

Reptescharella Lorieri, d'Orb., 1851; d'Orbigny, 1853, p. 466, 1854, p. 1093; Cénomanien; Le Mans (Sarthe).

Reptescharella Lorieri, d'Orbigny; Pictet, 1857, p. 110 · Cénomanien.

Membraniporella Lorieri (d'Orb.); Canu, 1900 [2], p. 444; Cénomanien.

Escharina lorieri; Lang, 1916, p. 409; Cenomanian; Le Mans.

Reptescharella lorieri d'Orbigny; Lang, 1917, p. 172; genolectotype of *Reptescharella*.

Reptescharipora meudonensis, d'Orbigny.

Reptescharipora Meudonensis, d'Orb., 1851; d'Orbigny, 1852, pl. 719, figs. 17–19, 1853, p. 491, 1854, p. 1098; Sénonien; Meudon, près de Paris.

Reptescharipora Meudonensis; Canu, 1900 [2], p. 457. "Ce qui est dans le tube est *Reptescharipora convexa* d'Orb."

Reptescharipora meudonensis; Lang, 1916, p. 409; Senonian; Meudon.

Reptescharipora meudonensis d'Orbigny; Lang, 1917, p. 172; genolectotype of *Reptescharipora*.

Membraniporella monastica, Brydone.

Membraniporella monastica, nov.; Brydone, 1909, pp. 398, 400, pl. xxii. figs. 1–3; Trimmingham.

Membraniporella monastica; Lang, 1916, p. 409; *mucronatus*-zone; Trimingham.

Mumiella mumia (d'Orbigny).

Semieseharipora mumia, d'Orb., 1851; d'Orbigny, 1852, pl. 718, figs. 9–12, 1853, p. 483, 1854, p. 1097; Sénonien; Sainte-Colombe (Manche).

? Non *Semieseharipora mumia*, D'Orb.; Salter, 1857, p. 85, pl. ii, fig. 1; Chalk-flint; Bogingarry, Aberdeenshire.

Mumiella mumia (d'Orbigny); Jullien, 1886, p. 605; terrains crétacés; France; genotype of *Mumiella*.

Mumiella mumia (d'Orb.); Canu, 1900 [2], p. 444, text-fig. 55 on p. 444 [a copy of part of d'Orbigny, 1852, pl. 718, fig. 10].

Semiescharipora mumia; Lang, 1916, p. 409; Senonian; Sainte-Colombe.

Reptescharella ovula, d'Orbigny.

Reptescharella ovula, d'Orb., 1851; d'Orbigny, 1852, pl. 715, figs. 17–19, 1853, p. 466, 1854, p. 1093; Cénomanien; la plaine au nord de Tourtenay (Deux-Sèvres).

Reptescharella ovula, d'Orbigny; Pictet, 1857, p. 110; Cénomanien.

Reptescharella ovula, d'Orb.; Gabb & Horn, 1862, p. 147.

Membraniporella ovula (d'Orb.); Canu, 1900 [2], p. 443; Cénomanien.

Reptescharella ovula; Lang, 1916, p. 409; Cenomanian; N. of Tourtenay.

Escharoides peltata, F. A. Römer.

Escharoides peltata N.; Römer, 1840, p. 14, pl. v. fig. 7; Untere Kreide; bei Peine.

Cellepora peltata Röm.; Geinitz, 1846, p. 613; Peine.

Cellepora peltata Hag.; Bronn, 1848, p. 255.

Escharoides peltata Roe.; Bronn, 1848, p. 473.

Escharoides peltata Roe.; Bronn, 1849, p. 132; Kreide.

Cellepora peltata (Röm.); Geinitz, 1849–50, pp. 248–9; Untere Kreide; Peine.

Escharina peltata (Rœmer); d'Orbigny, 1850, p. 262; Sénonien; Hanovre, Peine.

Cellepora peltata (Rœmer); d'Orbigny, 1853, p. 395; Sénonien; Hanovre, Peine.

Escharoides peltata, Römer; Lang, 1916, p. 410; Senonian; Peine.

Escharipora plana, d'Orbigny.

Escharipora plana, d'Orb., 1851; d'Orbigny, 1851, pl. 685, figs. 17–19, 1852, p. 226, 1854, p. 1097; Sénonien; Lisle, près de Vendôme (Loir-et-Cher).

Membraniporella plana (d'Orb.); Canu, 1900 [2], p. 444; Sénonien.

Escharipora plana; Lang, 1916, p. 409; Senonian; Vendôme.

Escharipora prolifica, d'Orbigny.

Escharipora prolifica, d'Orb., 1851; d'Orbigny, 1851, pl. 685, figs. 13–16, 1852, p. 225, 1854, p. 1097; Sénonien; Environs de Sainte-Colombe (Manche).

Escharipora prolifica; Canu, 1900 [2], p. 457; "Ne correspond pas."

Escharipora prolifica; Lang, 1916, p. 409; Senonian; near Sainte-Colombe.

Cellepora prona, Stoliczka.

Cellepora prona, Stoliczka; Stoliczka, 1872, pp. 12, 33, pl. i, fig. 1; Arrialoor Group; North of Poodoopolliam.

Cellepora prona, Stoliczka; Lang, 1916, p. 410; Arrialoor Group; Poodoopoliam.

Steganopora pulchella, d'Orbigny.

Steginopora [sic] *pulchella*, d'Orb., 1851; d'Orbigny, 1852, pl. 721, figs. 9–12, 1853, p. 503, 1854, p. 1098; Sénonien; Vendôme (Loir-et-Cher).

Steginopora pulchella d'Orb.; Jullien, 1886, p. 612.

Steginopora (*Steginopora*) *pulchella* (d'Orb.); Canu, 1900 [2], p. 455; Sénonien.

Steginopora pulchella; Lang, 1916, p. 409; Senonian; Vendôme.

Steginopora pulchella d'Orbigny; Lang, 1917, p. 173.

Reptescharipora punctata, d'Orbigny.

Reptescharipora punctata, d'Orb., 1851; d'Orbigny, 1852, pl. 720, figs. 4–5, 1853, p. 493, 1854, p. 1098; Sénonien; environ de Tours (Indre-et-Loire).

Reptescharipora punctata; Canu, 1900 [2], p. 457; "un seul usé."

Reptescharipora punctata; Lang, 1916, p. 409; Senonian; Tours.

Eschara pupoides, Reuss.

Eschara pupoides n. sp.; Reuss, 1872, p. 107, pl. xxvi, fig. 5; untere Pläner; Plauen.

Cribrilina (*Cribrilina*) *pupoides* (Rss.); Canu, 1900 [2], p. 447.

? Non=*Eschara Neptuni* d'Orb., 1850; d'Orbigny, 1850, p. 264; Sénonien; Tours; as suggested by Canu, 1900 [2], p. 447; [see *Prosotopora neptuni* (d'Orbigny)].

? *Eschara pupoides*, Reuss; Frič, 1911, pp. 61–62, text-fig. 258 on p. 61; Korycaner Schichten; Kamajk.

Eschara pupoides, Reuss; Frič, 1911, p. 98; Cenoman; Sachsen.

Eschara pupoides; Lang, 1916, p. 410; Cenomanian; Saxony.

Cribrilina quadrisulcata, Hennig.

Cribrilina quadrisulcata nova species Hennig; Hennig, 1892, pp. 38, 47, 48, pl. ii, figs. 31–32; Danien; Annetorp, Malmö-området.

Cribrilina quadrisulcata, Hng.; Hennig, 1899, p. 148; Yngre Krita [Danian]; Sweden.

Cribrilina quadrisulcata (Hennig); Canu, 1900 [2], p. 445.

Cribrilina quadrisulcata Hng.; Hennig, 1910, p. 659; Danien; région de Malmö.

Cribrilina quadrisulcata; Lang, 1916, p. 409; Danian; Annetorp, Sweden.

Escharella ramosa, d'Orbigny.

Escharella ramosa, d'Orb., 1851 ; d'Orbigny, 1851, pl. 684, figs. 9–11 (non 9–10 as legend to plate), 1852, p. 220, 1854, p. 1097 ; Sénonien ; Meudon, près de Paris.

Escharella ramosa, d'Orb. ; Pictet, 1857, p. 110 ; Sénonien.

Escharella ramosa ; Canu, 1900[2], p. 421 ; "Ne correspond pas."

Escharella ramosa ; Lang, 1916, p. 409 ; Senonian ; Meudon.

Cellepora scutigera, von Reuss.

Cellepora scutigera m. ; von Reuss, 1854, pp. 135, 134, pl. xxvii, fig. 6 ; Gosauschichten, hippuriterführenden Mergeln, beds with *Hippurites cornu-vaccinum* ; Nefgraben.

Cellepora scutigera Rss. ; Felix, 1908, p. 296 ; Gosauschichten ; bei Gosau.

Cellepora scutigera, Reuss ; Lang, 1916, p. 410 ; Turonian ; Nefgrab.

Semiescharipora simplex, d'Orbigny.

Semiescharipora simplex, d'Orb., 1851 ; d'Orbigny, 1852, pl. 718, figs. 1–4, 1853, p. 481, 1854, p. 1097 ; Sénonien ; environs de Fécamp (Seine-Inférieure).

Semieschara simplex ; Canu, 1900[2], p. 458 ; "Original manque. Ce qu'il y a dans les tubes est *Cribrilina fragilis*."

? *Cribrilina simplex* (d'Orb.) ; White, 1910, p. 61 ; Zone of *Act. quadratus* ; Alresford district.

Semiescharipora simplex ; Lang, 1916, p. 409 ; Senonian ; Fécamp.

Lepralia undata, Reuss.

Lepralia undata n. sp. : Reuss, 1872, p. 104, pl. xxv, fig. 5 ; untere Pläner ; Sachsen.

Lepralia undata, Reuss ; Frič, 1911, p. 98 ; Cenoman ; Sachsen.

Lepralia undata ; Lang, 1916, p. 410 ; Cenomanian ; Saxony.

Membraniporella weybournensis, Brydone.

Membraniporella Weybournensis ; Brydone, 1918, p. 3 ; Senonian, zone of *B. mucronata* ; Weybourne, Norfolk.

3. SYSTEMATIC ACCOUNT OF THE SPECIES.

A. MYAGROPORIDÆ, Lang, 1916.

Myagroporidæ, fam. nov.; Lang, 1916, p. 406.

Diagnosis.—Cretaceous Myagromorphs of fair size (about ·66 mm. long), with a large development of interœcial secondary tissue; ovicells hyperstomial; pelmata and pelmatidia absent; aviculœcia sub-circular, small.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium*, and Santonian, zone of *M. coranguinum*. Southern England.

Remarks.—The Myagroporidæ are not likely to be confused with any other Cretaceous forms, except the Myagromorphs *Anaptopora* and *Anotopora* of the Otoporidæ, and *Thoracopora raptrix* of the Thoracoporidæ. The sub-circular aviculœcia distinguish the Myagroporids from these forms, though in *Anaptopora mockleri* they are hardly elongate and but slightly pointed; in *Anotopora* they are absent; and in *Thoracopora* they are large and spatulate. *Myagropora cavea* is primitive even for a Myagromorph, but *M. muscipula* developed a large growth of interœcial secondary tissue—the converse of most of the Castanoporine Pelmatoporids, which have a complex intraterminal front-wall with little or no interœcial secondary tissue.

I. MYAGROPORA, Lang, 1916.

Myagropora, gen. nov.; Lang, 1916, p. 406.

Diagnosis.—As for the family.

Distribution.—As for the family.

Genotype.—*Myagropora muscipula*.

Remarks.—The two species of *Myagropora* form a short lineage showing advance in habit and condition of the asty, in œcial size and shape, as well as in development of interœcial secondary tissue.

Key to the Species of *Myagropora*.

A. Asty incrusting (or, possibly, erect) and unilaminar; œcia about ·4 to ·5 mm. long, and oval; a comparatively small development of interœcial secondary tissue (fig. 11)	1. *M. cavea.*
B. Asty erect, cylindrical; œcia about ·5–·66 mm. long, and elliptical; a great development of interœcial secondary tissue (fig. 12)..	2. *M. muscipula.*

1. Myagropora cavea, Lang.

Myagropora cavea, sp. n.; Lang, 1916, p. 406; low in *M. cortestudinarium*-zone; S.E. of Boxmoor, Herts.

DIAGNOSIS.—*Myagropora* with an incrusting (or, possibly, erect), unilaminar asty; with oval œcia, about ·45 mm. long; with little interœcial secondary tissue.

DESCRIPTION.—Asty incrusting (or, possibly, erect), unilaminar; œcia dimorphic; orthœcia about ·4–·5 mm. long and ·3–·4 mm. wide, oval; the extraterminal front-wall is of fair extent and but little hidden by interœcial secondary tissue; the intraterminal front-wall is well-arched and consists of eight or ten spine-like costæ, widely separated laterally, with no lateral fusions, and arching over towards the mid-line, where they meet, but do not fuse, or but slightly fuse; the apertural bar is incomplete, and its two halves resemble the normal costæ; the apertural spines are four in number, and the proximal pair is considerably larger than the distal pair and directed vertically; aperture semicircular; aviculœcia irregularly distributed, with sub-circular apertures, tending to be constricted laterally, and directed obliquely upwards; ovicells hyperstomial.

DISTRIBUTION.—Senonian, Coniacian, low in zone of *M. cortestudinarium*; Nash Mills, S.E. of Boxmoor, Herts.

TYPE-SPECIMEN.—D. 25543. F. Möckler collection.

REMARKS.—*Myagropora cavea* differs from *M. muscipula* in its colonial habit and condition, in its œcial size and shape, by the poverty of its interœcial secondary tissue, and in the arrangement of its aviculœcia. In all these characters the change is in the direction indicated (Introd., § 25) as normal to all evolving Cribrimorph lineages. It is probable, then, that *M. muscipula* is derived from *M. cavea*; and the horizons at which they are found do not contradict this supposition.

Figures.—Text-fig. 11. Orthœcium and two aviculœcia.

Specimens.—D. 25543. Type-specimen. Distribution and collection as given above.

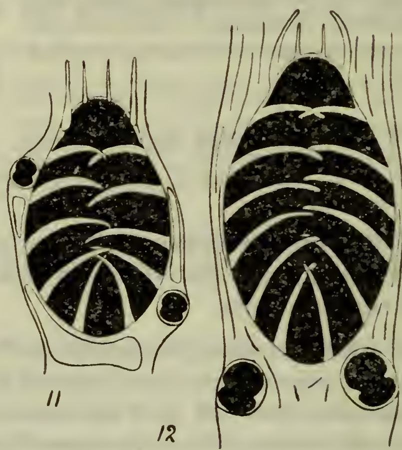


Fig. 11.—*Myagropora cavea*. Fig. 12.—*M. muscipula*. Diagrams of orthœcia and their accompanying pairs of aviculœcia, from above. × about 75 diameters. In fig. 12 the aviculœcia are wrongly orientated.

2. Myagropora muscipula, Lang.

Myagropora muscipula, sp. n.; Lang, 1916, p. 406; low in *M. cortestudinarium*-zone; S.E. of Boxmoor, Herts.

Diagnosis.—*Myagropora* with an erect, cylindrical asty; with oœcia about ·6 mm. long, and elliptical; with much interœcial secondary tissue.

Description.—Asty erect, cylindrical; œcia dimorphic; orthœcia about ·5–·66 mm. long, and ·25–·4 mm. wide, elliptical; extraterminal front-wall entirely concealed beneath a very abundant interœcial secondary tissue which fills the interœcial valleys and tends to overflow the intraterminal front-walls; the intraterminal front-wall consists of about ten spine-like costæ, widely separated laterally, with no lateral fusions, and arching over to meet in the mid-line, but not fusing, or hardly fusing there; apertural bar imperfect, the two halves resembling the other costæ; apertural spines four, the proximal pair of the same size as the costæ, but vertically directed, and the distal pair smaller. Aviculœcia very numerous and somewhat irregularly distributed, but tending to be arranged in pairs in the interœcial secondary tissue covering the proximal strip of extraterminal front-wall of each orthœcium; with comparatively large and laterally-constricted apertures, sub-circular, but rather wider distally than proximally, directed obliquely, proximally, upward and towards the mid-line of the orthœcium they accompany.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium*, and Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen.—**D. 25501.** F. Möckler collection.

Remarks.—See under *M. cavea* (p. 17).

Figures.—Text-fig. 12. Orthœcium and two aviculœcia. The aviculœcia should be directed proximally and towards each other.

Plate I, fig. 1. Part of the type-specimen. Senonian, low in the zone of *M. cortestudinarium*. Boxmoor, Herts. × about 22 diameters.

LIST OF SPECIMENS.

D. 25501. D. 25470–500. D. 25502–3. Type-specimen and thirty-three paratypes. **D. 25483** shows the remains of ovicells, and a particularly small orthœcium; **D. 25494** shows an orthœcium renewed by an aviculœcium which is, consequently, very large. Senonian, Coniacian, low in the zone of *M. cortestudinarium*. Nash Mills, S.E. of Boxmoor, Herts. F. Möckler coll. 1912.

D. 20633–4. Two paratypes. [Senonian, Coniacian.] Whitchurch, Oxon, N. of Pangbourn, Berks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 4239. D. 29083–92. Eleven paratypes. Senonian, Coniacian, or lowest Santonian. Chatham, Kent. Collected by W. Gamble, Esq. 1900.

D. 25346–58. Thirteen paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*. Seaford, Sussex. F. Möckler collection. 1912.

D. 28292. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Pit W. of large pit, Offham Hill, Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 27062. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Lower Pit, Sline's Oak, Worms Heath, Warlingham, Surrey. F. Möckler collection. 1912.

D. 24933. Paratype. Senonian, Coniacian, base of zone of *M. cortestudinarium.* Luton Valley, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 24433–7. D. 24797–8. D. 24878. Eight paratypes. Senonian, Coniacian, high in zone of *M. cortestudinarium.* Luton, S.E. of Chatham, Kent, Collected by W. Gamble, Esq. 1911.

D. 20639–60. Twenty-two paratypes. D. 20651 and D. 20657 show ovicells. Senonian, Coniacian, top of zone of *M. cortestudinarium* or Santonian, base of zone of *M. coranguinum.* Great Central and Great Western Ry.-Cutting near Loudwater, S.E. of High Wycombe, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 20673–89. D. 20763–86. Forty-one paratypes. D. 20680, D. 20777, and D. 20785 show ovicells. Senonian, Santonian, low in zone of *M. coranguinum.* Bourne End, E. of Marlow, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 24543–8. Six paratypes. Senonian, Santonian, low in zone of *M. coranguinum.* Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 20635–8. D. 20663–72. Fourteen paratypes. Senonian, Santonian, zone of *M. coranguinum.* Wooburn Green, S.W. of Beaconsfield, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 20661–2. Two paratypes. Senonian, Santonian, zone of *M. coranguinum.* Cookham Dean Common, N.W. of Maidenhead, Berks. Collected by L. Treacher, Esq., F.G.S. 1911.

B. OTOPORIDÆ, Lang, 1916.

Otoporidæ, fam. nov.; Lang, 1916, p. 401.

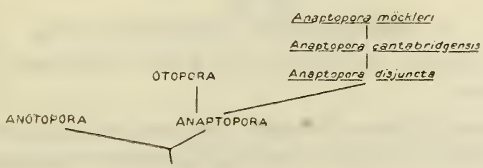
Diagnosis.—Cretaceous Myagromorphs or Cribrimorphs of varying sizes with hyperstomial ovicells; no pelmata or pelmatidia; an apertural bar not yet formed, or, if formed, asymmetrically fused; spiniform or but slightly flattened costæ with no lateral fusions; little or no interœcial secondary tissue; aviculœcia, if present, somewhat or decidedly elongate and pointed, and, where decidedly so, with curved rostra.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Remarks.—It is obvious that the Otoporidæ are a very primitive family, since two of the three genera are Myagromorphs; and even *Otopora*, a true Cribrimorph, exhibits a primitive feature in the apertural bar, which is asymmetrical, and shows distinctly that it is composed of two overlapping costæ. In less primitive Cribrimorphs, the apertural bar forms a symmetrical rod, and there is no irregularity to show that the two costæ of which it is composed overlapped before fusion took place. This character distinguishes Otoporids from all other families except the Ctenoporidæ; but the Ctenoporid front-wall sufficiently marks that family. The Myagromorph Otoporids, on the other hand, are not easily distinguished from other Myagromorphs. Their aviculœcia, when present, are always more or less elongate and pointed; but they are catagenetically disappearing in *Anaptopora*, and have completely vanished in *Anotopora*. Other primitive features of the Otoporidæ are the large development of extraterminal front-wall, the absence of interœcial secondary tissue, and the absence of even an incipient secondary aperture.

Evolution is seen to be mainly directed towards acquiring a solid, intraterminal front-wall. As already noticed (Introd., § 17), the costæ are not even fused in the mid-line in the most primitive forms, the Myagromorphs *Anaptopora* and *Anotopora*. In the latter genus, the first pair of costæ—those that in true Cribrimorphs form the apertural bar—are not even bent towards one another in the mid-line, but stand vertically. On the other hand, *Anotopora* is more advanced than *Anaptopora* in its erect, cylindrical asty and, probably, in its lack of aviculœcia. The aviculœcia of *Anaptopora* and *Otopora* are an apertural pair, smaller, though not very small, in the former genus; and, in the latter genus, larger and with rostra curved towards the aperture of the orthœcium they accompany. Moreover, in *Anaptopora* there is an apparent catagenesis of the aviculœcia, and these tend to dwindle in size and to become blunt. The evolution, then, of the aviculœcia appears to have proceeded from an apertural pair to none; from a smaller to a larger size, and again, catagenetically, to a smaller size; and from a straight, or nearly straight, and less pointed, to a decidedly curved and pointed rostrum, again, in *Anaptopora*, catagenetically becoming blunter and straighter.

The relationships, then, of the Otoporidæ may be expressed as follows:—



Key to the Genera of *Otoporidæ*.

A. Costæ widely separate, not fused in the mid-line, or very slightly so.
- I. Aviculœcia present; the first pair of costæ resembling the rest (figs. 13, 14) .... I. *Anaptopora.*
- II. Aviculœcia absent; the first pair of costæ rather larger than the rest, and standing vertically (fig. 15) .... II. *Anotopora.*

B. Costæ firmly fused in the mid-line, and closely adjacent laterally (fig. 16) .... III. *Otopora.*

I. ANAPTOPORA, Lang, 1916.

Anaptopora, gen. nov.; Lang, 1916, p. 402.

Diagnosis.—Myagromorph Otoporidæ with aviculœcia; the first pair of costæ resembles the rest.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Genotype.—*Anaptopora disjuncta.*

Remarks.—*Anaptopora* is the most primitive genus of Otoporidæ, since, while possessing costæ imperfectly fused in the mid-line, it still retains its apertural aviculœcia. Evolution within the genus shows an advance in colonial habit and condition, and a tendency for the aviculœcia to dwindle and become blunt. On the whole, the three species form a single lineage—*A. disjuncta*–*A. cantabrigiensis*–*A. mockleri*—on these principles; but the proximally-directed aviculœcia of *A. mockleri* render it quite possible that this species had an independent origin.

Key to the Species of *Anaptopora*.

A. Aviculœcia comparatively large, pointed, and distally directed.
- I. Asty incrusting, unilaminar (fig. 13) .... 1. *A. disjuncta.*
- II. Asty erect, cylindrical .... 2. *A. cantabrigiensis.*

B. Aviculœcia comparatively small, blunt, and proximally directed; asty erect, cylindrical (fig. 14) ... 3. *A. mockleri.*

1. Anaptopora disjuncta, Lang.

Anaptopora disjuncta, sp. n.; Lang, 1916, p. 402; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—*Anaptopora* with comparatively large, pointed, and distally-directed aviculœcia; and an incrusting, unilaminar asty.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm. long and ·44 mm. wide, elliptical; extra-terminal front-wall of considerable extent, especially proximally; the intraterminal front-wall consists of about thirteen spine-like costæ, which are widely separated laterally and not fused or very occasionally slightly-fused in the mid-line; apertural bar resembles the costæ, but probably its two halves are fused in the mid-line; aperture semicircular or sub-semicircular; apertural spines minute, probably four in number; aviculœcia, an apertural pair situated laterally with regard to the apertures of the orthœcia, with apertures divided by a constriction into a sub-circular proximal portion and an acutely-pointed rostrum which tends to curve towards the aperture of the orthœcium it accompanies; ovicells hyperstomial, composed of radiating costa-like pieces, with a median keel or crest and an aperture, in consequence, pointed above.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Type-specimen.—**D. 23269.** F. Möckler collection.

Remarks.—*Anaptopora disjuncta* is the most primitive species of the genus, having an incrusting asty, and showing no diminution in the size of the aviculœcia.

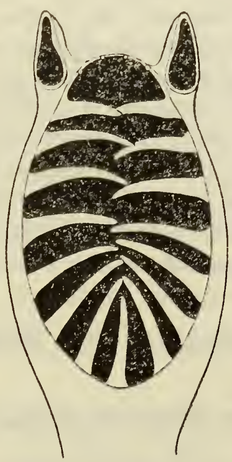


Fig. 13.—*Anaptopora disjuncta.* Diagram of an orthœcium and a pair of apertural aviculœcia, from above. × about 75 diameters.

Figures.—Text-fig. 13. Orthœcium and a pair of aviculœcia.

Plate I, fig. 2. Part of the type-specimen. Cenomanian, Chalk Marl. Cambridge. × about 27 diameters.

LIST OF SPECIMENS.

D. 23269. Type-specimen. Cenomanian, Chalk Marl, 15 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 21944. Paratype. Cenomanian, Chalk Marl. Cambridge. Collected by F. Möckler, Esq. 1911.

D. 21666. Paratype. Cenomanian, Chalk Marl, 5 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1911.

D. 21721. D. 23256–68. D. 23281. D. 28534. Sixteen paratypes. **D. 23261** shows the protœcium; and **D. 23262** the composite nature of the ovicells. Cenomanian, Chalk Marl, 20 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1902, 1911–12.

2. Anaptopora cantabrigiensis, Lang.

Anaptopora cantabridgensis [sic], sp. n.; Lang, 1916, p. 402; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—*Anaptopora* with comparatively large, pointed, and distally-directed aviculœcia; and an erect, cylindrical asty.

Description.—Asty erect, cylindrical; œcia dimorphic; orthœcia about ·66 mm. long and ·44–·5 mm. wide, oval-elliptical; extraterminal front-wall of considerable size, especially proximally; the intraterminal front-wall consists of ten or twelve spine-like costæ, widely separated laterally, and not fused, or but slightly fused in the mid-line; the apertural bar resembles the normal costæ, but possibly is fused in the mid-line; the apertures are semicircular; the apertural spines are probably four in number, but, if so, the distal pair are minute; the aviculœcia consist of an apertural pair with rather large apertures divided by a constriction or a bar into a proximal more or less circular portion and a triangular rostrum.

Distribution.—Cenomanian, Chalk Marl, 20 ft. from the base. Cambridge.

Type-specimen.—**D. 21788.** F. Möckler collection. 1911.

Remarks.—*Anaptopora cantabrigiensis* is probably derived from *A. disjuncta* by an advance in colonial habit and condition. The aviculœcia, too, being blunter, and apparently having no tendency towards a curvature of the rostrum, suggest that they are in catagenesis or declining evolution.

Specimens.—D. 21788. Distribution and collection as given above.

3. Anaptopora mockleri, Lang.

Anaptopora möckleri [sic], sp. n.; Lang, 1916, p. 402; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—*Anaptopora* with comparatively small, blunt, and proximally-directed aviculœcia; and an erect, cylindrical asty.

Description.—Asty erect, cylindrical; œcia dimorphic; orthœcia about ·55 mm. long and ·37 mm. wide, oval-elliptical; extraterminal front-wall of rather small dimensions; the intraterminal front-wall consists of about eight or ten spine-like costæ, widely separated laterally, and probably not fused in the mid-line; apertural bar probably resembling the normal costæ; the apertures are semicircular; apertural spines probably four in number; aviculœcia an apertural pair, distally placed with regard to the apertures of the orthœcia, each with oval aperture, somewhat pointed distally and directed proximally and towards the mid-line of the orthœcium whose aperture it accompanies.

Distribution.—Cenomanian, Chalk Marl, 20 ft. from the base. Cambridge.

Type-specimen.—D. 21853. F. Möckler collection. 1911.

Remarks.—*Anaptopora mockleri* possibly is derived from *A. cantabrigiensis* by further catagenesis of the aviculœcia. These are blunter and smaller than the aviculœcia of *A. cantabrigiensis*; but the fact that they are proximally directed makes it quite likely that *A. mockleri* had an independent origin.

Figures.—Text-fig. 14. Orthœcium and its apertural aviculœcia.

Specimens.—D. 21853. Distribution and collection as given above.

II. ANOTOPORA, Lang, 1916.

Anotopora, gen. nov.; Lang, 1916, pp. 402–3.

Diagnosis.—Myagromorph Otoporidæ with no aviculœcia; the first pair of costæ rather larger than the rest, and standing vertically.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Genotype.—*Anotopora inaurita.*

Fig. 14.—*Anaptopora mockleri.* Diagram of an orthœcium (with the intra-terminal front-wall much restored) and its apertural aviculœcia, from above. × about 75 diameters.

Fig. 15.—*Anotopora inaurita.* Diagram of an œcium from above. × about 75 diameters.

Remarks.—In *Anaptopora* the first pair of costæ, which, during evolution, becomes the apertural bar, resembles the remaining costæ, and the two halves, bending over towards the mid-line, overlap and touch one another, or even slightly fuse. In *Anotopora* the first pair of costæ is larger than the rest, points straight upwards, and does not even approximately form an apertural bar. *Anaptopora* and *Anotopora* lie, therefore, on different lines of development, and diverge from a common ancestor.

1. Anotopora inaurita, Lang.

Anotopora inaurita, sp. n.; Lang, 1916, pp. 402–3; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—As for the genus.

Description.—Asty erect, cylindrical; œcia monomorphic, nearly 1·00 mm. long (the intraterminal front-wall and aperture occupy about ·6 mm.), and about ·25 mm. wide; the extraterminal front-wall is of considerable extent, occupying proximally a strip of about ·4 mm. long and ·2 mm. wide, and forming a very narrow lateral fringe to the intraterminal front-wall; the intraterminal front-wall is (with the aperture) about ·6 mm. long and ·25 mm. wide, and elliptical in shape; it is composed of about ten spine-like over-arching costæ, lying at a considerable distance from one another, having no lateral fusions, and, if touching, hardly fusing in the mid-line; the first pair of costæ are larger than the rest and do not form an apertural bar, but are directed vertically; the apertures are very small, semicircular or sub-semicircular; apertural spines, if present, very minute. Ovicells hyperstomial, composed of ten or twelve costa-like bars.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Type-specimen.—D. 21789. F. Möckler collection.

Remarks.—See under the genus *Anotopora*.

Figures.—Text.-fig. 15. Diagram of an œcium.

Plate I, fig. 3. The type-specimen. Cenomanian, Chalk Marl. Cambridge. × about 27 diameters.

LIST OF SPECIMENS.

D. 21789. D. 21852. Type-specimen and paratype. Cenomanian, Chalk Marl, 20 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1911.

D. 28535–6. Two paratypes. D. 28535 shows an ovicell. Cenomanian, Chalk Marl, 50 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1902.

III. OTOPORA, Lang, 1916.

Otopora, gen. nov.; Lang, 1916, pp. 402–3.

Diagnosis.—Otoporidæ with the costæ firmly fused in the midline and closely adjacent laterally.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Genotype.—*Otopora auricula*.

Remarks.—*Otopora* shows a great advance upon *Anaptopora* and *Anotopora* in the solidification of the intraterminal front-wall. This is composed of costæ firmly fused in the mid-line, broader and less spine-like than those of the other two genera, and closely adjacent, though, apparently, not fused laterally. The aviculœcia are more elongate-pointed than those of *Anaptopora* and more decidedly curved towards the mid-line of the orthœcium they accompany. The apertural bar is well-formed, but shows its primitive nature in its lack of symmetry. *Otopora* is probably derived from *Anaptopora.*

1. Otopora auricula, Lang.

Otopora auricula, sp. n.; Lang, 1916, pp. 402–3; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—As for the genus.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·6 mm. long and ·36–·4 mm. wide, oval-elliptical; extraterminal front-wall of considerable size, especially proximally; the intraterminal front-wall is rather flatly-arched, and consists of about fifteen to twenty rather wide costæ, closely adjacent laterally, but with no lateral fusions, and firmly united in a broad, median line; the two halves of the apertural bar are asymmetrically fused in the mid-line; the bar is about as wide as the normal costæ, but somewhat flattened in a vertical plane, and curved proximally; apertures sub-circular; apertural spines four in number and rather large; the proximal pair lie against the ends of the apertural bar; aviculœcia a pair (one of which is often wanting) placed laterally with regard to the aperture of every orthœcium; they have distally-directed apertures divided by a constriction into a semicircular proximal portion and a rostrum with a long drawn-out apex curved towards the mid-line of the orthœcium which the aviculœcium accompanies; ovicells hyperstomial, with a median keel or ridge causing the aperture to have a mucronate projection on the upper edge of its outline.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Type-specimen.—D. 23044. F. Möckler collection.

Remarks.—See under the genus *Otopora*.

Figures.—Text-fig. 16. Orthœcium and aviculœcia.

Plate I, fig. 4. Part of the type-specimen. Cenomanian, Chalk Marl. Cambridge. × about 28 diameters.

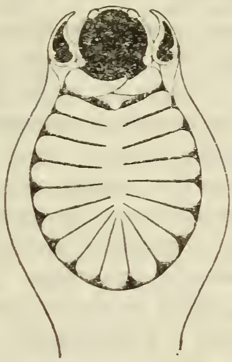


Fig. 16.—*Otopora auricula.* Diagram of an orthœcium and its pair of apertural aviculœcia, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 23044. D. 23110. D. 23072. D. 23041–3. D. 23045. Type-specimen and six paratypes. Cenomanian, Chalk Marl, 10 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 23100. Paratype. Cenomanian, Chalk Marl, 5 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 23250–1. Two paratypes. Cenomanian, Chalk Marl, 15 ft. from base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 21709–20. D. 23241–9. Twenty-one paratypes. Cenomanian, Chalk Marl, 20 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1911–12.

C. CTENOPORIDÆ, Lang, 1916.

Ctenoporidæ, fam. nov.; Lang, 1916, p. 403.

Diagnosis.—Cretaceous Cribrimorphs with hyperstomial ovicells and no pelmata or pelmatidia; the costæ are spine-like, widely-spaced, with no lateral fusions, overlapping and not fused or hardly fused in the mid-line, but all fused to a solid subjacent ground-tissue that forms a complete, dome-like intraterminal front-wall. The apertural bar is imperfectly formed—that is, the costæ of which it is composed overlap, forming an asymmetrical structure.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Remarks.—The very remarkable intraterminal front-wall of the Ctenoporidæ separates the family from all the other Cretaceous Cribrimorph Polyzoa. Otherwise, in its often very imperfectly-fused costæ as well as its imperfect, asymmetrically-fused apertural bar, the family resembles to some extent the Otoporidæ. The aviculœcia of the Otoporidæ, however, are more or less pointed, while those of the Ctenoporidæ are uncompromisingly blunt. The Ctenoporidæ also show a primitive character not known in the Otoporidæ—namely, uniserial early stages. Both families have but little secondary tissue, either in the interœcial valleys or in connection with the aperture. With regard to secondary tissue, such evolutionary effort as is shown is concentrated on the intraterminal front-wall.

I. CTENOPORA, Lang, 1916.

Ctenopora, gen. nov.; Lang, 1916, p. 403.

Diagnosis.—As for the family.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Genotype.—*Ctenopora pecten.*

Remarks.—See under the family Ctenoporidæ.

1. Ctenopora pecten, Lang.

Ctenopora pecten, sp. n.; Lang, 1916, p. 403; Cenomanian, Chalk Marl; Cambridge.

Diagnosis.—As for the genus.

Description.—(a) *Ephebœcia.*

Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. long and ·25 to ·34 mm. wide, oval-elliptical; extraterminal front-wall of small extent, except proximally, where there is a considerable strip; the intraterminal front-wall is well-arched and consists partly of about twelve or fourteen spine-like costæ which overarch and meet, but are not fused, or but slightly fused in the mid-line, are widely separated laterally and have no lateral fusions; but their undersides are firmly fused to a complete, solid, arched intraterminal front-wall with a roughened or slightly granular surface; the costæ, then, forming a Myagromorph front-wall, are laid upon and fused to a complete, solid intraterminal front-wall, whose origin is unknown; the apertural bar in general resembles the normal costæ, but is proximally bent and tends to be flattened in a vertical plane, with a median ridge; the two halves, however, are not quite symmetrically fused, and in this respect resemble the corresponding structure in the Otoporidæ; the apertures are sub-circular to slightly pliophlœan; apertural spines four in number, but minute; the aviculœcia are irregularly distributed, but tend to be arranged so that one accompanies the aperture of every orthœcium; it is then directed obliquely, distally and away from the aperture of the orthœcium it accompanies; the aviculœcia are small, with oval apertures, constricted at about the middle, and provided with minute apertural spines; they tend to be surrounded with cenœcial tissue; ovicells hyperstomial, elongate, with a median keel.

(b) *Neanœcia.*

Asty uniserial, incrusting; œcia dimorphic; orthœcia about ·33 mm. long and ·16–·22 mm. wide, oval-elliptical; extraterminal front-wall of very small extent, even proximally; intraterminal front-wall resembling that of the ephebœcia, but with from six to eight costæ only; apertural bar and aperture resembling those of

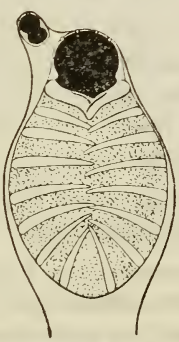


Fig. 17.—*Ctenopora pecten.* Diagram of an orthœcium and an accompanying aviculœcium, from above. × about 75 diameters.

the ephebœcia, but the former has no median ridge; apertural spines four in number, and comparatively much stouter than those of the ephebœcia; aviculœcia resembling those of the ephebœcia.

DISTRIBUTION.—Cenomanian, Chalk Marl. Cambridge.

TYPE-SPECIMEN.—D. 21691. F. Möckler collection.

REMARKS.—See under the family Ctenoporidæ.

FIGURES.—Text-fig. 17. Orthœcium and aviculœcium.

Plate I, fig. 5. Part of the type-specimen. Cenomanian, Chalk Marl. Cambridge. × about 27 diameters.

LIST OF SPECIMENS.

D. 21691. D. 21681–90. D. 21692–708. D. 23252–4. D. 27895. Type-specimen and thirty-one paratypes. The type-specimen shows neanœcia and ephebœcia. Cenomanian, Chalk Marl, 20 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1911–12.

D. 23255. Paratype. Neanœcia and ephebœcia. Cenomanian, Chalk Marl, 15 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 23037–40. D. 23077. D. 27896–900. Ten paratypes. D. 23040 shows neanœcia and ephebœcia. Cenomanian, Chalk Marl, 10 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. 23098–9. Two paratypes. Cenomanian, Chalk Marl. 5 ft. from the base. Cambridge. Collected by F. Möckler, Esq. 1912.

D. THORACOPORIDÆ, Lang, 1916.

Thoracoporidæ, fam. nov.; Lang, 1916, p. 407.

DIAGNOSIS.—Cretaceous Myagromorph and Cribrimorph Polyzoa with widely-spaced costæ; hyperstomial ovicells; no pelmatidia, pelmata or lateral costal fusions; four apertural spines; little or no interœcial secondary tissue; and large, spatulate aviculœcia.

DISTRIBUTION.—Turonian, zone of *H. planus*; Senonian, Coniacian, and possibly also lowest Santonian. Kent and Hants.

REMARKS.—The Thoracoporidæ are Myagromorphs and primitive Cribrimorphs of small to moderate size (·3–·5 mm. long) derived from Membranimorphs with an ovate-shaped aperture. The consequent ovate shape of the intraterminal parts is a useful characteristic; and the rather large, long, spatulate aviculœcia are diagnostic. The aviculœcia in general shape resemble those of the Eleidæ, which Canu (1900[2], p. 341) has termed *eleocellaria* ("éléocellaires"). In the few species known there is little sign of the piling up of superfluous calcium carbonate in any of the three tracts familiar in other Cribrimorph families, namely in the intraterminal front-wall, in the neighbourhood of the aperture, and in the interœcial valleys. It is possible that further developments of this family have yet to be discovered.

I. THORACOPORA, Lang, 1916.

Membraniporella [partim]; Brydone, 1916, pp. 99–100.
Thoracopora, gen. nov.; Lang, 1916, p. 408.
Membraniporella [partim]; Brydone, 1918, pp. 1, 4.

Diagnosis.—As for the family.

Distribution.—Turonian, zone of *H. planus* to Senonian, Santonian, zone of *M. coranguinum*. S. of England.

Genotype.—*Thoracopora costata.*

Remarks.—Two main lineages of *Thoracopora* are represented by the known species. In *T. raptrix* the œcia are of considerable size, and the aviculœcia very long and spatulate; moreover, the median fusion of the costæ is either absent or very slight. In the other lineage, while the œcia retain what is probably a primitively small size, the intraterminal front-wall is more advanced than in *T. raptrix*, since the costæ are firmly fused in the mid-line. *T. pontifera* has smaller and less spatulate aviculœcia than *T. costata*, and is possibly a catagenetic derivative of that species.

Key to the Species of *Thoracopora*.

A. Orthœcia larger, about ·5 mm. long; aviculœcia large and spatulate; costæ not fused, or but slightly fused medianly (fig. 18) .... 1. *T. raptrix.*
B. Orthœcia smaller, about ·35–·4 mm. long; costæ firmly fused in the mid-line.
{ I. Aviculœcia smaller, hardly spatulate .... 2. *T. pontifera.*
{ II. Aviculœcia larger, decidedly spatulate (fig. 19) ...... 3. *T. costata.*

1. Thoracopora raptrix, Lang.

Thoracopora raptrix, sp. n.; Lang, 1916, p. 403; Lower Senonian; Chatham, Kent.

Diagnosis.—Myagromorph *Thoracopora* about ·5 mm. long, with large, spatulate aviculœcia.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. long, and ·38 mm. wide, ovate; extra-terminal front-wall of fair extent, especially proximally, and not hidden by interœcial secondary tissue; the intraterminal front-wall is well arched, and consists of about seven spine-like costæ, widely separated laterally, having no lateral fusions, and hardly fused or slightly fused in the mid-line; apertural bar resembling the costæ; apertural spines four in number, the proximal pair being of about the same size as the costæ, and resembling them, but vertically directed; the distal pair smaller; apertures semi-circular; aviculœcia large, numerous, sporadically distributed, and somewhat irregularly, but on the whole distally, directed; apertures divided by a constriction or a bar into a sub-circular proximal portion and a long spatulate rostrum; ovicells hyperstomial.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium* or Santonian, base of zone of *M. coranguinum*. Chatham, Kent.

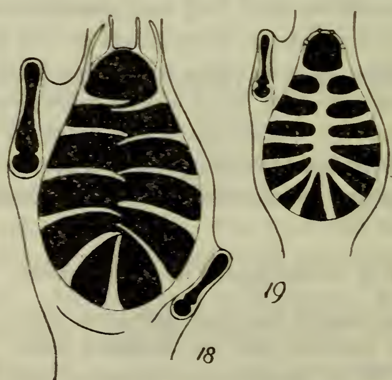


Fig. 18.—*Thoracopora raptrix*. An orthœcium and two aviculœcia, from above. × about 75 diameters.

Fig. 19.—*T. costata*. An orthœcium and an aviculœcium, from above, about 75 diameters.

Type-specimen.—D. 11135. Collected by W. Gamble, Esq. 1901.

Remarks.—*Thoracopora raptrix* is probably on a line of development different from that of *T. pontifera* and *T. costata*, having larger œcia and a Myagromorph front-wall.

Figures.—Text-fig. 18. Orthœcium and two aviculœcia.

Specimens.—D. 11135. Distribution and collection as above.

2. Thoracopora pontifera (Brydone).

Membraniporella pontifera, nov.; Brydone, 1916, pp. 99, 100, pl. vi, fig. 8; zone of *M. cortestudinarium*, Hants; zone of *M. coranguinum*, Gravesend.

Thoracopora pontifera (Brydone); Lang, 1916, p. 408; *M. coranguinum*-zone; Gravesend.

Diagnosis.—*Thoracopora* with orthœcia about ·35 mm. long; the costæ are firmly fused in the mid-line; the aviculœcia are comparatively small and short, and hardly, if at all, spatulate.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium* and Santonian, zone of *M. coranguinum*. Kent and Hants.

Type-specimen.—That figured by Brydone, 1916, pl. vi, fig. 8, is hereby selected.

Remarks.—*Thoracopora pontifera* is possibly catagenetic in its comparatively small and short aviculœcia, in which case it may be derived from *T. costata*.

Specimens.—None in the Collection.

3. Thoracopora costata, Lang.

Thoracopora costata, sp. n.; Lang, 1916, p. 408; *M. coranguinum*-zone; Luton, S.E. of Chatham, Kent.

Membraniporella Altonensis, sp. nov.; Brydone, 1918, pp. 1, 4, pl. i, figs. 1, 2; zone of *H. planus*; near Alton, Hants.

Diagnosis.—*Thoracopora* with orthœcia about ·4 mm. long; the costæ are firmly fused in the mid-line; the aviculœcia are comparatively large and decidedly spatulate.

Description.—Asty incrusting, unilaminar to multilaminar; œcia dimorphic; orthœcia about ·4 mm. long and ·25 mm. wide, ovate; extraterminal front-wall of fair extent, especially proximally, and not hidden by interœcial secondary tissue; the intraterminal front-wall is well-arched, and consists of about twelve narrow costæ, fairly widely-spaced laterally, having no lateral fusions, and firmly united in a median line of fusion; apertural bar undifferentiated and resembling the costæ; aperture super-semicircular to normal; apertural spines probably four in number, and prominent; aviculœcia not very numerous, rather large, sporadically distributed, distally directed, and with narrow, spatulate apertures; ovicells hyperstomial. The type-specimen shows a number of "closed" œcia, *i. e.*, œcia entirely sealed up by a complete intraterminal front-wall which covers even the aperture (see Levinsen, 1902, p. 28).

Distribution.—Turonian, zone of *H. planus*, Norfolk (Dr. Rowe's collection), Chatham, Sussex, Hants (Brydone); and Senonian, Santonian, zone of *M. coranguinum*, Chatham.

Type-specimen.—**D. 24406.** Senonian, Santonian. Luton, S.E. of Chatham. W. Gamble collection.

Remarks.—It is possible that there has been some mistake in localizing the type-specimen. It is labelled as coming from the base of the *M. coranguinum*-zone at Luton, near Chatham. Most Luton material is from the *M. cortestudinarium*-zone; and all the other known specimens of *Thoracopora costata* (including one from the Chatham district) are from the zone of *H. planus*. For the relationship of *T. costata*, see under the other species of *Thoracopora*.

Figures.—Text-fig. 19. Orthœcium and aviculœcium.

Plate I, fig. 6. Part of the type-specimen showing two complete orthœcia, with broken ovicells; portions of several broken orthœcia, some with broken ovicells; and on the left several "closed" orthœcia, some broken. Luton, S.E. of Chatham. × about 29 diameters.

LIST OF SPECIMENS.

D. 24406. Type-specimen. Senonian, Santonian, base of zone of *M. coranguinum* (but see under Remarks, above). Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 28531–2. Paratypes. Turonian, zone of *H. planus*. Borstal, S.W. of Chatham, Kent. Collected by W. Gamble, Esq. 1906.

D. 29904. Turonian, zone of *H. planus*. Bridgwick Pit, Malling, Lewes. Collected by C. T. A. Gaster, Esq., and presented by him, 1919.

E. TARACTOPORIDÆ, Lang, 1916.

Taractoporidæ, fam. nov.; Lang, 1916, p. 406.

DIAGNOSIS.—Cretaceous Cribrimorph Polyzoa with hyperstomial ovicells; no pelmata or pelmatidia; with flattened, widely-spaced costæ, wide proximally, but tapering rapidly towards the mid-line, and having no lateral fusions; a wide, well-formed apertural bar; four apertural spines; much interœcial secondary tissue; numerous sub-circular aviculœcia.

DISTRIBUTION.—Senonian, Coniacian, zone of *M. cortestudinarium*, and Santonian, zone of *M. coranguinum*. Southern England and France.

REMARKS.—Like the Myagroporidæ, the Taractoporidæ are derived from a Membranimorph stock whose evolutionary energy was centred in the development of interœcial secondary tissue before it turned to the elaboration of an intraterminal front-wall. The result in both cases is that a great development of interœcial secondary tissue accompanies a very primitive intraterminal front-wall; but in the former family this wall is Myagromorph, and the costæ composing it are spine-like and cylindrical, though pointed at the ends; in the Taractoporidæ, on the other hand, the intraterminal front-wall is truly Cribrimorph, and the costæ are flat, wide proximally, but rapidly tapering distally, giving a distinctive character to the family. Moreover, in the Taractoporidæ, the numerous aviculœcia, rising up through the secondary interœcial tissue, spread laterally and come in contact with one another, overlapping and obscuring the intraterminal front-walls, and forming an incomplete tertiary front-wall. This great development of aviculœcian and interœcial secondary tissue renders the features of any one specimen very obscure, often so as to appear as a confused mass of aviculœcia separated by irregular pits. The result is that the specific determination of any casual specimen is a very difficult and often an unsatisfactory matter.

I. TARACTOPORA.

Membraniporella [partim]; Brydone, 1916, pp. 99, 100.
Polycephalopora [partim]; Lang, 1916, p. 90.
Taractopora, gen. nov.; Lang, 1916, p. 407.

Diagnosis.—As for the family.

Distribution.—As for the family.

Genotype.—*Taractopora confusa.*

Remarks.—There appear to be two lines of evolution exhibited in the three known species of *Taractopora*. One, consisting of *T. confusa* and *T. obscurata*, has a greater development of aviculœcian and secondary tissue, while it retains a primitively small number of costæ; and has dimorphic aviculœcia. The other, represented by the species *T. rostata*, increases the number of costæ with an increase of interœcial secondary tissue; and the aviculœcia appear to be all of one size.

Key to the Species of *Taractopora*.

A. Costæ about six; aviculœcia dimorphic—larger and smaller.
  - I. Less secondary tissue; asty generally unilaminar and probably incrusting (fig. 20). .... 1. *T. confusa.*
  - II. More secondary tissue; asty multilaminar and incrusting (fig. 21).. 2. *T. obscurata.*

B. Costæ eight to ten; aviculœcia apparently monomorphic; much interœcial secondary tissue; asty incrusting .... 3. *T. rostrata.*

1. Taractopora confusa, Lang.

Taractopora confusa, sp. n.; Lang, 1916, p. 407; low in *M. cortestudinarium*-zone; S.E. of Boxmoor, Herts.

Diagnosis.—*Taractopora* with about six costæ; aviculœcia dimorphic; comparatively little secondary tissue; and probably an incrusting, generally unilaminar asty.

Description.—Asty probably incrusting and, at least generally, unilaminar, though in late life it may become multilaminar, like that of an ephebastic *Taractopora obscurata*; œcia dimorphic; orthœcia about ·4 mm. long and ·3 mm. wide, oval; extra-terminal front-wall much obscured by interœcial secondary tissue and aviculœcia; the intraterminal front-wall is well-arched and composed of about six wide, flattened costæ, rapidly tapering to a point, widely separated laterally and with no lateral fusions, but firmly united in a median line of fusion; apertural bar very thick and with a flattened median process; apertural spines four in number and small; aperture semicircular; aviculœcia dimorphic, the larger having apertures more than twice as large as the apertures of the smaller, and about as large (though quite differently shaped) as those of the orthœcia; very numerous; sporadically distributed, variously orientated, with blunt, oval apertures divided by a constriction or a bar into a smaller proximal portion and a larger rostrum; ovicells hyperstomial.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium.* Southern England.

Type-specimen.—D. 25538. F. Möckler collection.

Remarks.—*Taractopora confusa* is the most primitive of the three known species of this genus, and probably gave rise of *T. obscurata*; possibly, also, by an increase in the number of costæ, to *T. rostrata.*

Figures.—Text-fig. 20. Orthœcium and aviculœcia.

Plate I, fig. 7. Part of the type-specimen, showing three complete orthœcia; a complete ovicell belonging to an œcium outside the figure; one large aviculœcium; and several small aviculœcia. Senonian, zone of *M. cortestudinarium.* Nash Mills, Boxmoor, Herts. × about 29 diameters.

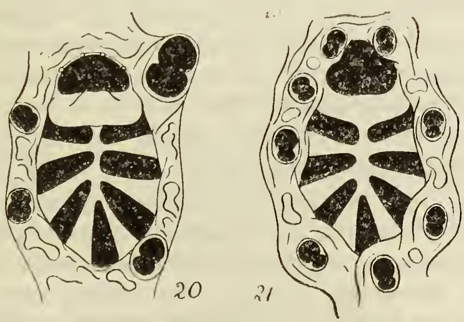


Fig. 20.—*Taractopora confusa.* Diagram of an orthœcium, one large and three small aviculœcia, from above. × about 75 diameters.

Fig 21.—*Taractopora obscurata.* Diagram of an orthœcium and eight aviculœcia, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 25538. D. 25541. D. 25545–7. Type-specimen and four paratypes. Senonian, Coniacian, low in the zone of *M. cortestudinarium*. Nash Mills, S.E. of Boxmoor, Herts. F. Möckler collection. 1912.

D. 24773. Paratype. Senonian, Coniacian, top of zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 25254. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Seaford, Sussex. F. Möckler collection. 1912.

D. 29099. Paratype. Senonian [Coniacian, zone of *M. cortestudinarium*]. Chatham, Kent. Collected by W. Gamble, Esq. 1898.

2. Taractopora obscurata (Brydone).

Membraniporella obscurata, nov.; Brydone, 1916, pp. 99, 100, pl. vi, figs. 9, 10; zone of *M. cortestudinarium*; Sussex, Hants, Kent.

? *Polycephalopora obscurata* (Brydone); Lang, 1916, p. 90; *M. cortestudinarium*-zone; S. of England.

Taractopora obscurata (Brydone); Lang, 1916, p. 407; *M. cortestudinarium*-zone; Seaford, Sussex.

Diagnosis.—*Taractopora* with about six costæ; aviculœcia dimorphic; much secondary tissue; and a multilaminar, incrusting asty.

Description.—Asty incrusting, multilaminar; œcia dimorphic; orthœcia about ·4 mm. long, and ·3 mm. wide, oval; extraterminal front-wall entirely hidden beneath an abundant interœcial secondary tissue, which, with the aviculœcia, tends to obscure even the intraterminal front-walls and to form an incomplete tertiary front-wall; the intraterminal front-wall is rather flatly-arched and consists of about six flattened, rapidly-tapering costæ, widely-spaced and without lateral fusions, but firmly united in a median line of fusion; apertural bar wide; apertural spines probably four, but generally obliterated by an upgrowth of interœcial secondary tissue and aviculœcia; aperture normal to sub-circular; aviculœcia sporadically distributed, dimorphic, the smaller ones being very numerous, rather larger than the smaller aviculœcia of *T. confusa*, and tending to group themselves around the apertures of the orthœcia; they are enveloped in so much secondary tissue that they touch one another and tend to form a tertiary front-wall far above the level of the costate intraterminal front-wall; they are variously directed, with oval or sub-circular blunt apertures with lateral constrictions.

DISTRIBUTION.—Senonian, Coniacian, zone of *M. cortestudinarium*, and Santonian, zone of *M. coranguinum*, lower part. S. of England.

TYPE-SPECIMEN.—That figured by Brydone, 1916, pl. vi, fig. 9, is hereby selected.

REMARKS.—*Taractopora obscurata* is probably derived from *T. confusa*, having greater development of interœcial secondary tissue and rather larger aviculœcia.

FIGURES.—Text-fig. 21. Orthœcium and eight aviculœcia.

LIST OF SPECIMENS.

D. 24317–8. Two worn asties, probably of this species. Senonian, Coniacian, base of the zone of *M. cortestudinarium*. Borstal Manor Pit, S.W. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 28528–9. Senonian, Coniacian, zone of *M. cortestudinarium*. Chatham, Kent. Collected by W. Gamble, Esq. 1906.

D. 19512–4. Senonian, Coniacian, zone of *M. cortestudinarium*. Seaford, Sussex. **D. 19513** shows dimorphic aviculœcia. F. Möckler collection. 1910.

D. 27051–3. Senonian, Coniacian, zone of *M. cortestudinarium*. Lower pit, Slines Oak, Worms Heath, Warlingham, Surrey. F. Möckler collection. 1912.

D. 24193. Senonian, Coniacian, middle of zone of *M. cortestudinarium*. East end of High Street, Chatham, Kent. Shows dimorphic aviculœcia. Collected by W. Gamble, Esq. 1911.

D. 11118. D. 11297. D. 29093. Senonian, Coniacian, zone of *M. cortestudinarium* or Santonian, zone of *M. coranguinum*. Chatham, Kent. **D. 11297** is a very worn specimen, and **D. 29093** shows dimorphic aviculœcia. Collected by W. Gamble, Esq. 1901.

D. 24380. D. 24382. Senonian, Santonian, low in zone of *M. coranguinum*. Luton, S.E. of Chatham, Kent. **D. 24380** shows dimorphic aviculœcia. Collected by W. Gamble, Esq. 1911.

D. 11159. D. 11161. Senonian, Santonian, base of zone of *M. coranguinum*. Chatham, Kent. Both well-preserved. Collected by W. Gamble, Esq. 1901.

D. 24476. D. 24615. Senonian, Santonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. **D. 24615** shows dimorphic aviculœcia. Collected by W. Gamble, Esq. 1911.

D. 24339–40. Senonian, Santonian, zone of *M. coranguinum*. The Quarry, Strood, N.W. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

3. Taractopora rostrata, Lang.

Taractopora rostrata, sp. n.; Lang, 1916, p. 407; Coniacian; Fécamp, France.

Diagnosis.—*Taractopora* with eight to ten costæ; aviculœcia apparently monomorphic; much secondary tissue; and an incrusting asty.

Distribution.—Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France.

Type-specimen.—In the collection of Monsieur F. Canu, of Versailles. A photograph of the type-specimen is in the Collection.

Remarks.—*Taractopora rostrata* is probably on a different line of evolution from *T. confusa* and *T. obscurata*. The aviculœcia, apparently, are monomorphic, and the costæ more numerous than in the other species.

Specimens.—None in the Collection.

F. LAGYNOPORIDÆ, Lang, 1916.

Lagynoporidæ, fam. nov.; Lang, 1916, p. 393.

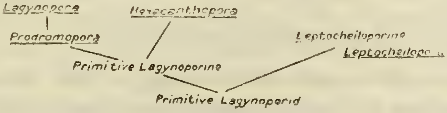
Diagnosis.—Cretaceous Cribrimorph Polyzoa of moderate size, generally about ·66 mm, long; with hyperstomial ovicells; with no pelmata or pelmatidia; with a well-formed and symmetrical apertural bar; with closely-placed costæ (except in *Prodromopora*) generally without lateral fusions; with six, five, or four apertural spines; with occasional, generally large, sub-circular aviculœcia; and with a large, distally-placed communication-pore.

Distribution.—Upper Turonian to Senonian, Campanian; chiefly in the zones of *Marsupites* and *A. quadratus*. North-western Europe.

Remarks.—The Lagynoporidæ possibly have affinities with *Monoceratopora* in the Andrioporinæ (see below), and are chiefly noticeable for their fairly large, wide orthœcia, their lack of secondary tissue except in the apertural region, their rather large, sub-circular, occasional aviculœcia, and the large communication-pore, visible at the distal ends of those orthœcia which lie at the periphery of the asty. They readily fall into two sub-families representing widely divergent lines of evolution, and characterised by the presence or absence of secondary structures built upon the apertural bar. The Leptocheiloporinæ have an apertural bar which is only differentiated to the extent of becoming proximally bent, and thus of giving the aperture a pliophlœan shape. The Lagynoporinæ, on the other hand, always exhibit a tendency to erect a median process on the apertural bar, and, during evolution, this enlarges and fuses with the proximal pair of apertural spines.

The aviculœcia were, probably, primitively dimorphic; but both large and small kinds of aviculœcium have apertures of a characteristically sub-circular shape, are indifferently orientated, and occasional in occurrence. In the Leptocheiloporinæ both kinds disappear; but in certain Lagynoporinæ the smaller kind only. In *Lagynopora amphora*, however, it is the smaller that are retained, while the larger vanish.

Of the Lagynoporidæ, *Prodromopora*, a Lagynoporine genus, is the most primitive known form, since the costæ are widely separate, and the median line of fusion, though firmly-knit, is thin. But *Prodromopora* has already a slight median process on the apertural bar, and the number of spines in ephebastic individuals is four, while in the neanœcia it is six. Therefore it is necessary to imagine a more primitive form with six apertural spines and without a median process on the apertural bar as the common ancestor of the Lagynoporinæ and Leptocheiloporinæ—that is, a primitive Lagynoporid; and one with six apertural spines and a median process on the apertural bar as the common ancestor of the Lagynoporine genera—that is, a primitive Lagynoporine. From the latter form *Hexacanthopora* may be directly derived and, by the suppression of one pair of apertural spines, *Prodromopora*. *Lagynopora* may be derived from *Prodromopora* by the more complete fusion of the costæ and by the formation of a secondary aperture. The following phylogeny may help to make these relations clear:—



Key to the Subfamilies of Lagynoporidæ.

A. The apertural bar has a median process which ultimately fuses with the proximal pair of apertural spines to form the proximal shield of a secondary aperture; aviculœcia occasional .... a. Lagynoporinæ.

B. No median process on the apertural bar, but this is sharply bent proximally; aviculœcia rare or absent .... b. Leptocheiloporinæ.

a. LAGYNOPORINÆ, Lang, 1916.

Lagynoporinæ, subfam. nov.; Lang, 1916, pp. 393–4.

Diagnosis.—Lagynoporidæ, in which the apertural bar has a median process which ultimately fuses with the proximal pair of apertural spines to form the proximal shield of a secondary aperture; aviculœcia occasional.

Distribution.—Upper Turonian to Senonian, Campanian, zone of *A. quadratus*. North-western Europe.

Remarks.—See under the family Lagynoporidæ.

Key to the Genera of Lagynoporinæ.

A. Six apertural spines in at least some of, generally all, the ephebœcia .... I. *Hexacanthopora*.

B. Only four apertural spines in the ephebœcia.

  I. Costæ thin and widely separate; median process of apertural bar thin .... II. *Prodromopora*.

  II. Costæ wider and more or less closely juxtaposed; median process of apertural bar strongly developed.. III. *Lagynopora*.

I. HEXACANTHOPORA, Lang, 1916.

Hexacanthopora, gen. nov.; Lang, 1916, p. 394.

Diagnosis.—Lagynoporinæ in which (at least) some ephebœcia have six apertural spines.

Distribution.—Senonian, Santonian, zone of *Marsupites* to Campanian, zone of *A. quadratus*. Southern England.

Genotype.—*Hexacanthopora sexspinosa*.

Remarks.—The exact relationships of the three species of *Hexacanthopora* are not altogether clear; but evolution seems to have resulted in an increase of œcial size, a decrease in the number of costæ, a tendency to reduce the number of apertural spines, and a tendency to lose the smaller of two kinds of aviculœcia. *H. brightonensis* is thus seen to be the most advanced (though its size is not so great as that of *H. kintburiensis*) and *H. sexspinosa* the most primitive.

Key to the Species of *Hexacanthopora*.

A. Apertural spines always six on the ephebœcia.

I. Œcial length about ·6 mm.; costæ about 17	...	1. *H. sexspinosa.*
II. Œcial length about ·75 mm.; costæ about 14	...	2. *H. kintburiensis.*

B. Apertural spines six, five, or even four on the ephebœcia.

I. Œcial length about ·75 mm.; costæ about 14	...	2. *H. kintburiensis.*
II. Œcial length about ·66 mm.; costæ 12 or 13	...	3. *H. brightonensis.*

1. Hexacanthopora sexspinosa, Lang.

Hexacanthopora sexspinosa, sp. n.; Lang, 1916, p. 394; *Marsupites*-zone; Odiham, Hants.

Diagnosis.—*Hexacanthopora* with œcia about ·6 mm. long and with about 18 costæ; all the ephebœcia have six apertural spines.

Description.—(1) *Ephebœcia.* Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·6 mm. long and ·4 mm. wide, oval to elliptical; extraterminal front-wall of very small extent, except proximally, where there is a strip of varying, but considerable, breadth; there is no interœcial secondary tissue; the intraterminal front-wall is flatly arched, and consists of from sixteen to eighteen closely-placed, somewhat flattish costæ which have no lateral costal fusions, but are firmly united in a wide median band of fusion, across which, however, the costal outlines can be traced; apertural bar with a slight proximal bend, but the angle thus formed is largely filled with a stout, wide, and flattened median process; there is no sign, however, of this process fusing with the proximal pair of apertural spines, as it does in *Lagynopora*; apertural spines six in number, stout, and hollow; aperture normal to cribriline, small compared with the œcial size; aviculœcia dimorphic, both kinds, especially the smaller, rare; the smaller kind are more or less distally directed, and have somewhat elongate, slightly constricted, and blunt apertures; the larger vary in size, but generally have an aperture as large as that of an orthœcium; they are indifferently orientated, little longer than wide, with a somewhat pointed aperture divided by a constriction into a very much smaller proximal portion and a very large rostrum; ovicells hyperstomial.

(2) *Ancestrœcium.* Length about ·15 mm., width about ·07 mm., elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of twelve closely-placed costæ which have no lateral fusions, but are united in a median line of fusion; apertural bar bearing a slight, but wide median process; apertural spines hollow, rather slight, and, apparently, six in number; aperture normal.

Distribution.—Senonian, Santonian, zone of *Marsupites.* Southern England.

Type-specimen.—**D. 21205.** Roke Farm, S.E. of Odiham, Hants. L. Treacher collection.

Remarks.—*Hexacanthopora sexspinosa* appears to be the most primitive of the three species of *Hexacanthopora*, having smaller œcia and more costæ than both the other forms, showing no reduction in the number of the apertural spines, and retaining a small form of aviculœcium.

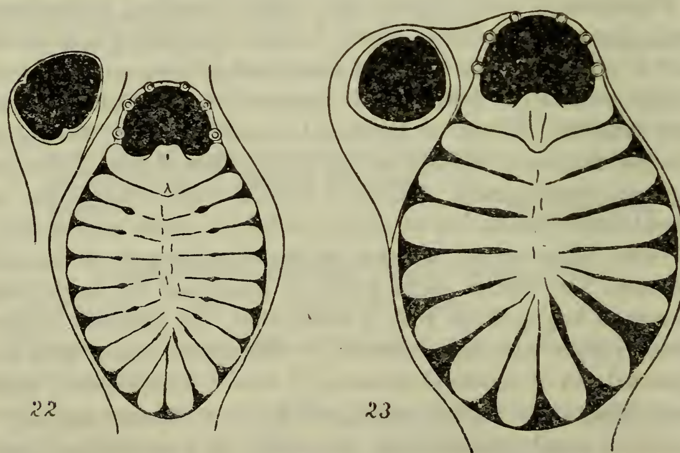


Fig. 22.—*Hexacanthopora sexspinosa.* Diagram of an orthœcium and one of the larger kind of aviculœcium, from above. × about 75 diameters.

Fig. 23.—*Hexacanthopora kintburiensis.* Diagrams of orthœcia and aviculœcia, from above. × about 75 diameters.

FIGURES.—Text-fig. 22. Orthœcium and aviculœcium.

Plate I, fig. 8. Part of the type-specimen. Two orthœcia have broken ovicells. Senonian, zone of *Marsupites*. Odiham, Hants. × about 30 diameters.

LIST OF SPECIMENS.

D. 21205–6. Type-specimen and paratypes. Senonian, Santonian, zone of *Marsupites*. Roke Farm, S.E. of Odiham, Hants. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 21207. Paratype. Senonian [Santonian, zone of *Marsupites*]. Odiham, Hants. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 29101. Paratype. Senonian [Santonian, zone of *Marsupites*]. Margate, Kent. Ex Wetherell Collection, presented by G. Potter, Esq., 1899.

2. Hexacanthopora kintburiensis, Lang.

Hexacanthopora kintburiensis, sp. n.; Lang, 1916, p. 394; *A. quadratus*-zone; Kintbury, Berks.

DIAGNOSIS.—*Hexacanthopora* with œcia about ·75 mm. long and with about 14 costæ; ephebœcia with 4, 5, or 6 apertural spines.

DESCRIPTION.—Asty unilaminar, incrusting; œcia dimorphic; orthœcia about ·75 mm. long and ·5 mm. wide, oval; extra-terminal front-wall of very small extent, except sometimes a fairly considerable proximal strip; the intraterminal front-wall is considerably flattened and consists of about fourteen wide, rather closely-placed costæ which have no lateral fusions, but are firmly united in a wide median band of fusion, on which, however, the costal boundaries are clearly marked; apertural bar wide and slightly bent proximally, with a stout, flattened median process; apertural spines stout, hollow, and six in number, but reduced to five or even four in some ephebœcia; apertures normal or slightly cribriline; aviculœcia occasional, large, with blunt, indifferently orientated apertures, nearly as large as those of the orthœcia, with a very slight constriction near the proximal end; ovicells hyperstomial.

DISTRIBUTION.—Senonian, Santonian, zone of *Marsupites*, and Campanian, zone of *A. quadratus* (probably only in the lower part). Southern England.

Type-specimen.—D. 21204. Senonian, Campanian, zone of *A. quadratus*. Kintbury, Berks.

Remarks.—*Hexacanthopora kintburiensis* shows an advance upon *H. sexspinosa* in its larger size, in the small number of costæ, and in the apparent loss of the smaller kind of aviculœcium. In its size, it is more advanced than *H. brightonensis*; but that species, on the other hand, shows fewer costæ.

Figures.—Text-fig. 23. Orthœcium and aviculœcium.

Plate I, fig. 9. Part of the type-specimen; six orthœcia, one with a broken ovicell, and two aviculœcia are shown; a large communication-pore, probably belonging to the neighbouring aviculœcium appear on the right at the top of the figure. Senonian, zone of *A. quadratus*. Kintbury, Berks. × about 25 diameters.

LIST OF SPECIMENS.

D. 21204. Type-specimen. In one ephebœcium the apertural spines are doubled. Senonian, Campanian, zone of *A. quadratus*. Kintbury, W. of Newbury, Berks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 29896. A rather poorly-preserved specimen showing traces of the ancestrœcium, neanœcia, and ephebœcia. Senonian, Santonian, *Marsupites*-zone, band of *M. testudinarius*. Western pit on top of Hangleton Lane, Highdown Hill, E. of Angmering, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 29895. A rather poorly-preserved specimen showing traces of the ancestrœcium, neanœcia, and ephebœcia. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Pit 4 of Gaster, western pit S. of Lancing Ring and W. of Boundstone Lane, N.E. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 29070. Paratype. Senonian, zone of *A. quadratus*. Near Romsey, Hants. Presented by Dr. H. P. Blackmore, F.G.S., 1897.

D. 2631. Paratype. Senonian [Campanian, zone of *A. quadratus*]. Salisbury, Wilts. G. R. Vine collection. 1893.

3. Hexacanthopora brightonensis, Lang.

Hexacanthopora brightonensis, sp. n.; Lang, 1916, p. 394; *Marsupites*-zone; Brighton.

Diagnosis.—*Hexacanthopora* with œcia about ·66 mm. long, and with but 12 or 13 costæ; ephebœcia with 4, 5, or 6 apertural spines.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm., or less, in length and about ·44 mm. wide, oval; extraterminal front-wall of very small extent, even proximally; the intraterminal front-wall is rather flatly-arched and consists of about twelve or thirteen rather closely-set, wide costæ which have no lateral fusions, but are solidly united in the mid-line of the œcium; the apertural bar is wide, stout, and has a stout median process; the apertural spines on the ephebœcia are four, five, or six in number; the apertures are normal to cribriline; aviculœcia apparently of the large kind only, fairly numerous, irregularly distributed, with indifferently orientated, nearly circular apertures of nearly the same size as those of the orthœcia, and with a constriction nearer the proximal end; distal communication-pore very large; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *Marsupites*, and Campanian, subzone of *E. scutatus* var. *depressa*. Sussex.

Type-specimen.—D. 28890. Senonian, Santonian, zone of *Marsupites*. Brighton.

Remarks.—In all the chief characters, except size, *Hexacanthopora brightonensis* shows an advance on the other two species. The partial diminution in the number of apertural spines shows an ancestral tendency, hitherto resisted in this genus, at last becoming actual as it does early in the evolution of the other genera of Lagynoporidæ. The tendency is also noticeable, but less so, in *H. kintburiensis*.

Figures.—Text-fig. 24. Orthœcium and aviculœcium.

LIST OF SPECIMENS.

D. 28890. Type-specimen. Senonian, Santonian, zone of *Marsupites*. Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1915.

D. 28891. Paratype, showing neanœcia and ephebœcia. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between the last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 29897. An asty showing ancestrœcium, neanœcia, and ephebœcia. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs W. of Chimney-shaft, Roedean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

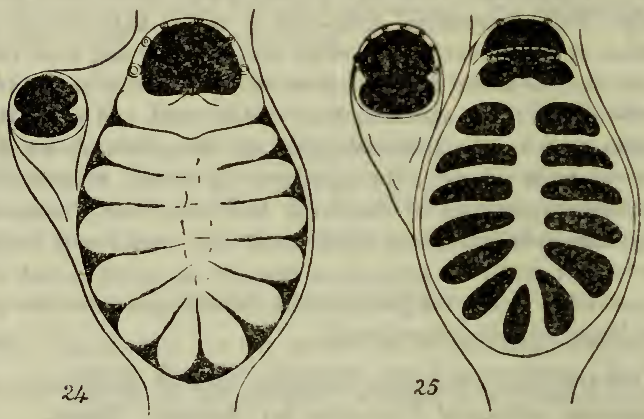


Fig. 24.– *Hexacanthopora brightonensis.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 25.—*Prodromopora præcursor.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

II. PRODROMOPORA, Lang, 1916.

Prodromopora, gen. nov.; Lang, 1916, p. 394.

Diagnosis.—Lagynoporinæ in which the ephebœcia have but four apertural spines; the costæ are thin and widely separated; the median process of the apertural bar is thin.

Distribution.—Senonian, Coniacian. Kent.

Genotype.—*Prodromopora præcursor.*

Remarks.—*Prodromopora* is probably the direct ancestor of *Lagynopora*, which has closely-placed costæ and a stout median process of the apertural bar. But the reduction of the apertural spines to four shows an advance upon *Hexacanthopora*, which thus diverged at an earlier period.

1. Prodromopora præcursor, Lang.

Prodromopora præcursor, sp. n.; Lang, 1916, p. 394. *M. coranguinum*-zone; Gillingham, N.E. of Chatham, Kent.

Diagnosis.—As for the genus.

Description.—(a) *Ephebœcia.* Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·6 mm. long and ·4 mm. wide, oval-elliptical or somewhat ovate; extraterminal front-wall of small extent laterally, somewhat expanded proximally; the intraterminal front-wall is well-arched and consists of ten or twelve thin costæ separated from each other laterally by more than their own width, with no lateral fusions, but united in a thin median line of fusion; apertural bar thin and resembling the normal costæ, and with a comparatively slender median process which probably was produced to fuse with the proximal pair of apertural spines; apertural spines hollow, four in number, of considerable size, especially the proximal pair; apertures sub-normal to normal; aviculœcia occasional, large, with apertures as large or larger than those of the orthœcia, blunt, subcircular, with a slight constriction dividing the aperture into a smaller proximal portion, and a larger rostrum with a bevel within the rim; the rostrum is surrounded with spines; ovicells hyperstomial.

(b) *Neanœcia.* Length about ·33–·40 mm.; breadth about ·22–·26 mm., ovate; apertural spines six in number.

(c) *Ancestrœcium.* Length about ·28 mm., breadth about ·2 mm., oval; apertural spines six.

Distribution.—Senonian, Santonian, zone of *M. coranguinum.* Gillingham, N.E. of Chatham, Kent.

Type-specimen.—D. 8351. Collected by W. Gamble, Esq. 1906.

Remarks.—See remarks under the genus *Prodromopora.*

Figures.—Text-fig. 25. Orthœcium and aviculœcium.

Plate II, fig. 1. Part of the type-specimen, showing two complete and four broken orthœcia, with ovicells, some of which are broken, and an aviculœcium. Senonian, zone of *M. coranguinum.* Gillingham, Kent. × about 25 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

III. LAGYNOPORA, Lang, 1916.

[*Lepralia* [partim]; Reuss, 1874, pp. 129–30.]
[*Lepralia* [partim]; Frič, 1889, p. 90.]
Cribrilina [partim]; Vine, 1893, pp. 316, 336.
[*Cribrilina* [partim]; Canu, 1900², p. 445.]
Cribrilina [partim]; Jukes-Browne, 1904, p. 490.
Cribrilina [partim]; Brydone, 1910, pp. 391–2, 482.
Lagynopora, gen. nov.; Lang, 1916, pp. 394–6.

Diagnosis.—Lagynoporinæ in which the ephebœcia have only four apertural spines; the costæ are wide and more or less closely juxtaposed; the median process of the apertural bar is strongly-developed.

Distribution.—Upper Turonian to Senonian, Campanian, zone of *A. quadratus*. North-western Europe.

Genotype.—*Lagynopora lagena.*

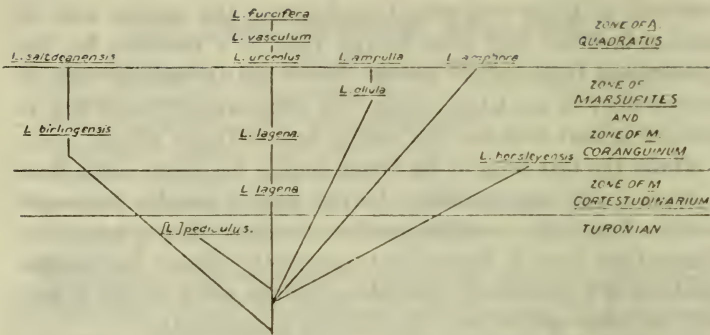
Remarks.—Early in the evolutionary history of *Lagynopora* several stocks appear to have diverged. One, represented by the lineage *L. birlingensis*–*L. saltdeanensis*, retained a small œcium and costæ that were relatively thin and widely-spaced, though not to such an extent as the costæ of *Prodromopora*. In this lineage, too, the aviculœcia are comparatively small. *Lagynopora horsleyensis* acquired solidity of the intraterminal front-wall by means of strong and conspicuous lateral costal fusions—the first time these have been noticeably present in the forms hitherto mentioned. In [*L.*] *pediculus* and *L. lagena* the same end was reached by the costæ becoming wider and more closely juxtaposed, and thereby causing any lateral fusions that may be present to be very inconspicuous. In [*L.*] *pediculus* also, the widening of the extraterminal front-wall caused the œcia to appear more widely-spaced.

The remaining species can be derived from *L. lagena* or a somewhat more primitive form; and their front-walls are solidified by the expansion of the median area of fusion. In the lineage *L. urceolus*–*L. vasculum*–*L. furcifera*, the number of costæ is comparatively large with a slight tendency to increase; in the lineage *L. ollula*–*L. ampulla*, the number of costæ is small to start with and increases somewhat. In the former lineage the intraterminal front-wall is fairly well-arched to flat, and the median area of fusion at first not very wide, though there is a tendency for the intraterminal front-wall to become flatter and the median area of fusion wider; in the latter lineage the intraterminal front-wall is flattened to start with and the median area of fusion already wide. *L. ollula*, the first term in the latter lineage, has fewer costæ than *L. lagena*, and was probably derived from a similar but more primitive form with a smaller number of costæ. *L. amphora* is an offshoot from near *L. lagena*, but apparently retains the smaller aviculœcia of a primitively dimorphic condition and loses the larger, while the other species tend to retain the larger kind.

It is clear, then, that the evolution of *Lagynopora* is primarily characterised by the method of solidifying the intraterminal front-wall. A primitive lineage (*L. birlingensis–L. saltdeanensis*) advanced a little way towards approximating the costæ. *L. horsleyensis* advanced a little further in this direction, and then produced lateral fusions, while *L. amphora* retained the still somewhat widely-spaced costæ. *L. ollula* and *L. ampulla*, having reached the same point of approximation of the costæ, further solidified the intraterminal front-wall by expanding the median area of fusion. *L. pediculus* and *L. lagena* went a step further in juxtaposing the costæ, and *L. urceolus*, *L. vasculum*, and *L. furcifera*, having reached the stage of *L. lagena*, expanded the median area of fusion, just as *L. ollula* and *L. ampulla* had done before.

The costæ, too, in *Lagynopora* show peculiarities in their evolution. It is usual, in any group of Cribrimorphs, for the costæ first to increase in number and then catagenetically to diminish. While *Prodromopora*, from which *Lagynopora* may be derived, has but ten or twelve costæ, the most primitive species of *Lagynopora* have already about eighteen. But the lineage *L. ollula–L. ampulla* must have diverged before the number of costæ had reached this number, and consequently the costæ show anagenetic evolution. In the lineage *L. lagena–L. urceolus–L. vasculum–L. furcifera* the costæ are also in anagenesis and raise their normal number of eighteen up to twenty. But in the lineage *L. birlingensis–L. saltdeanensis* the costæ are in catagenesis.

The following phylogeny tabulates these supposed relationships:—



Key to the Species of *Lagynopora*.

A. Orthœcia small, up to ·55 mm. long; costæ rather widely spaced, with no lateral fusions.

- I. Costæ about 17 (fig. 26) .... 1. *L. birlingensis.*
- II. Costæ about 14 (fig. 27) .... 2. *L. saltdeanensis.*

B. Orthœcia larger, generally ·66 mm. or more long; costæ more closely juxtaposed than in A.

- I. Lateral costal fusions very obvious (fig. 28)......... 3. *L. horsleyensis.*
- II. Lateral costal fusions obscure or absent.
  - *a.* Costæ not more than 16, not very closely approximated.
    - 1. Intraterminal front-wall well-arched; median area of fusion comparatively narrow; œcial length about ·66 mm. (fig. 29) .... 4. *L. amphora.*
    - 2. Intraterminal front-wall flattened; median area of fusion very wide.
      - *α.* Costæ 10–11; œcial length about ·58 mm. . 5. *L. ollula.*
      - *β.* Costæ 12–16; œcial length about ·8 mm. (fig. 31) 6. *L. ampulla.*
  - *b.* Costæ generally more than 16, and closely approximated; œcial length about ·67 mm.
    - 1. Intraterminal front-wall well-arched; median area of fusion narrow.
      - *α.* Œcia distant .... 7. [*L.*] *pediculus.*
      - *β.* Œcia closely approximated (fig. 30) .... 8. *L. lagena.*
    - 2. Intraterminal front-wall flattened; median area of fusion wide (fig. 32) .... 9. *L. urceolus.*
    - 3. Intraterminal front-wall flattened; median area of fusion very wide.
      - *α.* Costæ 16–18 (fig. 33) .... 10. *L. vasculum.*
      - *β.* Costæ 18–20 .... 11. *L. furcifera.*

1. Lagynopora birlingensis, Lang.

Lagynopora birlingensis, sp. n.; Lang, 1916, p. 395; *M. coranguinum*-zone; W. of Beachy Head, Sussex.

Diagnosis.—*Lagynopora* of small size (orthœcia about ·55 mm. long), with about 17 rather widely-spaced costæ without obvious lateral fusions.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·55 mm. long and ·36 mm. wide, elliptical; extraterminal front-wall comparatively extensive, especially proximally; the intraterminal front-wall is well-arched and consists of about seventeen rather thin and distally-placed costæ, with no lateral fusions and united in a rather wide median area of fusion; apertural bar hardly thicker than the costæ, with a median projection that fuses with the proximal pair of apertural spines; apertural spines four in number (at least in the ephebœcia), and rather small; apertures normal to cribriline; aviculœcia dimorphic, both kinds fairly numerous, sporadically distributed, with more or less circular apertures, which, even in the larger kind, are decidedly smaller than those of the orthœcia and, at least in the larger kind, bear spines on the distal rim; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*. Between Birling Gap and Beltout, W. of Beachey Head, Sussex.

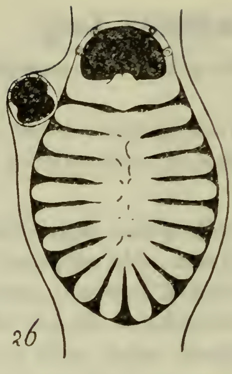
Type-specimen.—D. 28254. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

Remarks.—*Lagynopora birlingensis* is a very primitive form, approaching *Prodromopora* in the thinness and distant spacing of the costæ. The intraterminal front-wall is, however, far more consolidated than in the genus, though less so than in the other species of *Lagynopora*, except *L. saltdeanensis*.

Figures.—Text-fig. 26. Orthœcium and aviculœcium.

Plate II, fig. 2. Part of the type-specimen showing six orthœcia, two of which have ovicells; the right-hand one of these has the fusion of the apertural bar with the proximal pair of apertural spines complete. Two smaller and two larger aviculœcia also are shown. Senonian, zone of *M. coranguinum*, W. of Beachy Head, Sussex. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.



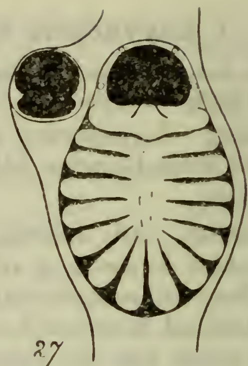


Fig. 26.—*Lagynopora birlingensis.* Diagram of an orthœcium and one of the larger aviculœcia, from above. × about 75 diameters.

Fig. 27.—*Lagynopora saltdeanensis.*—Diagram of an orthœcium and one of the larger aviculœcia, from above. × about 75 diameters.

2. Lagynopora saltdeanensis, Lang.

Lagynopora saltdeanensis, sp. n.; Lang, 1916, p. 395; *A. quadratus*-zone, *E. depressa*-subzone; E. of Brighton, Sussex.

Diagnosis.—*Lagynopora* of small size (œcia about ·5 mm. long), with about 14 rather widely-spaced costæ without obvious lateral fusions.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. long and ·33 mm. wide, elliptical; extra-terminal front-wall of small extent, but there is often a considerable proximal strip; the intraterminal front-wall is well-arched and consists of fourteen or fifteen rather thin and widely-spaced costæ, without lateral fusions, but united in a rather narrow median area of fusion; the apertural bar is thicker than the costæ, and has a stout median process that probably fuses with the proximal pair of apertural spines; apertural spines four in number and rather small; apertures normal; aviculœcia dimorphic, both kinds occasional, sporadically distributed, with more or less circular apertures; in the larger kind the apertures are about as large as those of the orthœcia; ovicells hyperstomial.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between the last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex.

Type-specimen.—D. 28896. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

Remarks.—If, as is probable, *Lagynopora saltdeanensis* is a descendant of *L. birlingensis*, the lineage is in catagenesis in regard to the number of costæ, and to a small extent in point of œcial size. It is of interest that in both forms a dimorphic condition of the aviculœcia is retained, while in the other species, except *L. amphora*, the smaller aviculœcia tend to vanish.

Figures.—Text-fig. 27. Orthœcium and aviculœcium.

Specimens.—Type-specimen. Distribution and collection as above.

3. Lagynopora horsleyensis, Lang.

Lagynopora horsleyensis, sp. n.; Lang, 1916, pp. 395–6; [high in] *M. coranguinum*-zone; West Horsley, Surrey.

Diagnosis.—*Lagynopora* of large size (œcia about ·66 mm. long), with rather closely-placed costæ with very obvious lateral fusions.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm. long and ·4 mm. wide, elliptical; extraterminal front-wall of small extent, although a considerable proximal strip may be present; the intraterminal front-wall is fairly well-arched, and consists of about eighteen fairly wide costæ, not very closely placed, each with two or more pairs of lateral costal fusions, and united in a median band of fusion; apertural bar but slightly wider than the costæ, and with a wide median projection that probably fuses with the proximal pair of apertural spines; apertural spines four in number, hollow, and fairly stout; aperture normal to slightly cribriline; aviculœcia apparently of the larger kind only, occasional, sporadically distributed, with more or less circular apertures, which are large, but smaller than those of the orthœcia; orthœcia with a very large, distally-placed communication-pore; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*, probably high in the zone. Southern England.

Type-specimen.—D. 28908.

Remarks.—In *Lagynopora horsleyensis* the front-wall has the costæ approximated more closely than in *L. birlingensis* and *L. saltdeanensis*, and it is further solidified by means of lateral fusions. These fusions, being absent or very obscure in the species hitherto considered, occur in *Leptocheilopora gasteri*, become quite a usual feature in the Andrioporidæ, a family described later in this work, and are characteristic of some subfamilies of the Pelmatoporidæ to be treated in another volume. At the same time, *L. horsleyensis* appears to have lost the smaller of the supposed ancestral dimorphic aviculœcia.

Figures.—Text-fig. 28. Orthœcium and aviculœcium.

Plate II, fig. 3. Part of the type-specimen showing an aviculœcium; three complete orthœcia, one of which has a complete and one a broken ovicell; a broken orthœcium with a broken ovicell; and part of another broken orthœcium. Senonian, zone of *M. coranguinum*. West Horsley, Surrey. × about 27 diameters.

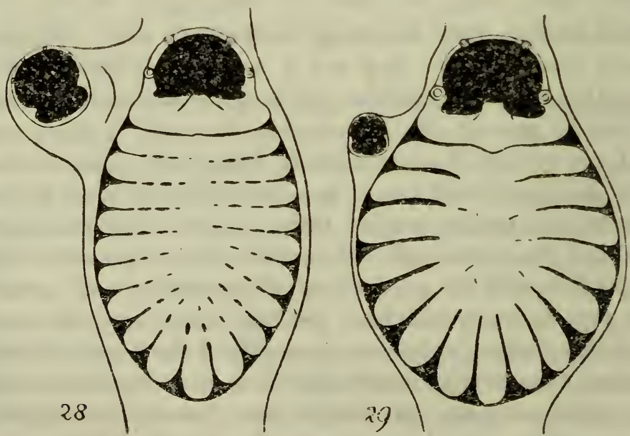


Fig. 28.—*Lagynopora horsleyensis*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 29.—*Lagynopora amphora*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 28908. Type-specimen. Senonian, Santonian, zone of *M. coranguinum*, probably high in the zone. Pit 264 of G. W. Young, Coomb's Pit, West Horsley, N.E. of Guildford, Surrey. Collected by C. T. A. Gaster, Esq., and presented by him. 1916.

D. 29899. Senonian, Santonian, zone of *M. coranguinum*, probably high in the zone. Pit in Houndean Bottom, W. of Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1919.

4. Lagynopora amphora, Lang.

Lagynopora amphora, sp. n.; Lang, 1916, pp. 395–6; *A. quadratus*-zone, *O. pillula*-subzone.

Diagnosis.—*Lagynopora* of large size (œcia about ·66 mm. long), with about 15 rather closely-placed costæ; lateral costal fusions rare or absent; the median area of fusion comparatively narrow; and the intraterminal front-wall well-arched.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm. long and ·49 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is fairly well-arched and consists of fourteen to sixteen rather wide and fairly closely-juxtaposed costæ, with no lateral fusions, but a wide median band of fusion; the apertural bar is rather wider than the costæ, is bent proximally, and has a stout, flattened median process that probably fuses with the proximal pair of apertural spines; apertural spines four in number and not much enlarged; aperture cribriline; aviculœcia occasional, sporadically distributed with more or less circular apertures not half as large as those of the orthœcia.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *O. pillula*. E. of Telscombe Staircase, W. of Newhaven, Sussex.

Type-specimen.—D. 28255. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

Remarks. — It is probable that *Lagynopora amphora* has retained the smaller aviculœcia of an originally dimorphic condition, and lost the larger ones. The species is not so primitive as *L. birlingensis* and *L. saltdeanensis* in the approximation of the costæ, but these are wider apart than in *L. lagena* and its derivatives.

FIGURES.—Text-fig. 29. Orthœcium and aviculœcium.

SPECIMENS.—Type-specimen. Distribution and collection as above.

5. Lagynopora ollula, new species.

Cribrilina furcifera, nov.; Brydone, 1910, pp. 391–2, pl. xxx, fig. 8; Kingsgate, Kent.

Non *Cribrilina furcifera*, nov.; Brydone, 1910, pp. 391–2, pl. xxx, figs. 6, 7.

Lagynopora furcifera (Brydone, 1910, pl. xxx, fig. 8); Lang, 1916, p. 395.

Non *Lagynopora furcifera* (Brydone, 1910, pl. xxx, figs. 6, 7); Lang, 1916, p. 395.

DIAGNOSIS.—*Lagynopora* of medium size (œcia about ·58 mm. long); with 10 or 11 rather closely-placed costæ; lateral costal fusions rare or absent; the intraterminal front-wall is considerably flattened; and the median area of fusion occupies considerably more than one-half of the intraterminal front-wall.

DISTRIBUTION.—Senonian, Santonian. Kingsgate, Kent.

TYPE-SPECIMEN.—That figured by Brydone, 1910, pl. xxx, fig. 8.

REMARKS.—*Lagynopora ollula* probably diverged from the main *Lagynopora* stock before this had developed a large number of costæ; it also shows primitive characters in the approximation of the costæ, which is not very close, and in the œcial length which is not so great as that of most species of the genus. On the other hand, the flattened and much solidified intraterminal front-wall shows a considerable advance on those species hitherto considered.

SPECIMENS.—None in the Collection.

6. Lagynopora ampulla, Lang.

Lagynopora ampulla, sp. n.; Lang, 1916, pp. 395–6; *A. quadratus*-zone; W. of Newhaven, Sussex.

DIAGNOSIS.—*Lagynopora* of large size (œcia about ·8 mm. long); with about 14 fairly closely-placed costæ; lateral costal fusions rare or absent; the intraterminal front-wall is considerably flattened; and the median area of fusion occupies considerably more than one-half of the intraterminal front-wall.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·6 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is much flattened, and consists of twelve to sixteen wide and somewhat closely-placed costæ, with no obvious lateral fusions, but joined in a broad median area of fusion occupying most of the intraterminal front-wall, across which, however, the outlines of the component costæ can usually be traced; apertural bar a little wider than the costæ, and proximally bent; it has a stout median process that fuses with the proximal pair of apertural spines to form the proximal shield of a secondary aperture; apertural spines stout, four in the ephebœcia, and five in the neanœcia; apertures normal; aviculœcia occasional, with very small, nearly circular apertures; ovicells hyperstomial; distal communication-pore very large.

Distribution.—Senonian, Campanian, zone of *A. quadratus*. E. side of Old Nore Point, W. of Newhaven, Sussex.

Type-specimen.—D. 28256. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

Remarks.—*Lagynopora ampulla* is probably to be derived from *L. ollula*, by an increase in size and in the number of costæ. The small aviculœcia make it probable that this stock, like *L. amphora*, retained the smaller and lost the larger aviculœcia of an ancestral form which possessed both smaller and larger kinds, as does *L. lagena*.

Figures.—Text-fig. 31. Orthœcium and aviculœcium.

Specimens.—Type-specimen. Distribution and collection as above.

7. [Lagynopora] pediculus (von Reuss).

Lepralia pediculus n. sp.; von Reuss, 1874, pp. 129–30, pl. xxiv, fig. 16; Ober-Pläner; Strehlen.

Non *Lepralia pediculus* Reuss; Novák, 1877, pp. 93, 82, 119, pl. i, fig. 12; Teplitzer Schichten; Hundorf [See *Oligotopora novaki* Lang.]

Non *Lepralia pediculus* (Reuss); de Morgan, 1882², p. 125; Sénonien; Bohême.

Lepralia pediculus, Reuss; Frič, 1889, p. 90; Strehlen.

Non *Lepralia pediculus*, Reuss; Frič, 1889, p. 90; text-fig. 97; Teplitzer Schichten; Hundorf. [See *Oligotopora novaki* Lang.]

Cribrilina pediculus (Rss.); Canu, 1900², p. 445.

Lagynopora pediculus (Reuss); Lang, 1916, pp. 395, 389; Upper Turonian; Strehlen, Germany.

Diagnosis.—[*Lagynopora*] of large size (œcia about ·66 mm. long); with about 16 closely-approximated costæ; lateral costal fusions rare or absent; intraterminal front-wall fairly well-arched; œcia widely-spaced.

DISTRIBUTION.—Upper Turonian, Ober-Pläner, Strehlen, Dresden, Saxony.

TYPE-SPECIMEN.—That figured by von Reuss, 1874, pl. xxv, fig. 16, is hereby selected.

REMARKS.—*Lepralia pediculus*, if a *Lagynopora*, appears to be closely related to *L. lagena*; but the widely-spaced œcia at once distinguish it from that species.

SPECIMENS.—None in the Collection.

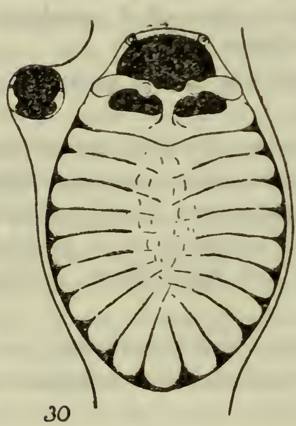

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Fig. 30.—*Lagynopora lagena*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 31.—*Lagynopora ampulla*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

8. Lagynopora lagena, Lang.

Lagynopora lagena, sp. n.; Lang, 1916, p. 395; Lower Senonian; Chatham, Kent.

Cribrilina nitidiformis, sp. n.; Vine, 1893, pp. 316, 336. Chatham Chalk. [Nomen nudum.]

Cribrilina nitidiformis, Vine; Jukes-Browne, 1904, p. 490; zone of *M. cortestudinarium*; Charlton, Kent.

Cribrilina nitidiformis, Vine; Lang, 1916, p. 410; Lower Senonian; Chatham.

DIAGNOSIS.—*Lagynopora* of large size (œcia about ·66 mm. long); with about 18 closely-approximated costæ; lateral costal fusions rare or absent; intraterminal front-wall fairly well-arched; œcia closely approximated.

DESCRIPTION.—(a) *Ephebœcia.* Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm. long and ·4 mm. wide, oval-elliptical; extraterminal front-wall of very small extent; the intraterminal front-wall is fairly well-arched and consists of about eighteen rather wide and closely-juxtaposed costæ which have no obvious lateral fusions, but are firmly united in a wide median band of fusion, across which the outlines of the component costæ are plainly visible; the apertural bar is wide, and has a stout, wide median process that fuses with the stout proximal pair of apertural spines to form the proximal shield of a secondary aperture; apertural spines four; the distal pair are stout, though not so thick as the proximal pair, and they are free; the primary aperture is normal in shape; aviculœcia dimorphic, the smaller kind rare, the larger sporadically distributed, occasional, with nearly circular, constricted apertures, about the size or slightly smaller than those of the orthœcia; ovicells hyperstomial.

(b) *Neanœcia.* About ·45–·5 mm. long and ·3–·33 mm. wide, oval-elliptical; costæ about fourteen; apertural spines five, occasionally six.

(c) *Ancestrœcium.* About ·35 mm. long and ·17 mm. wide, elliptical; apertural spines six.

DISTRIBUTION. — Senonian, Coniacian, zone of *M. cortestudinarium,* and Santonian, zone of *M. coranguinum.* Kent, Surrey, and Buckinghamshire. Mr. Gaster also has a specimen from the *M. coranguinum*-zone of Hindover, Sussex.

TYPE-SPECIMEN.—**D. 4042.** Lower Senonian, Chatham, Kent.

REMARKS.—*Lagynopora lagena* is the lowest term in a series continued in *L. urceolus–L. vasculum–L. furcifera.* This lineage, while retaining a primitively large number of costæ and even slightly increasing this number, is advanced in the degree of consolidation of the intraterminal front-wall by the close juxtaposition of the costæ; and, in the three last terms, by the widening of the median area of fusion. Supposed ancestral dimorphic aviculœcia of the smaller kind are still occasionally present; those of the larger kind are generally to be seen, but are not abundant. In *L. urceolus* the latter alone are apparent; while it seems that even these are lost in *L. vasculum* and *L. furcifera.* The median area of fusion is wider in *L. urceolus* than in *L. lagena*, and still wider in the last two species; while the costæ increase from about seventeen to about nineteen in *L. furcifera.*

FIGURES.—Text-fig. 30. Orthœcium and aviculœcium.

Plate II, fig. 4. Part of the type-specimen showing six orthœcia with ovicells. One of these shows unbroken the fusion between the proximal pair of apertural spines and the median process of the apertural bar. Lower Senonian, Chatham, × about 25 diameters.

LIST OF SPECIMENS.

D. 4042. D. 4027–8. D. 4046. D. 4238. D. 4969–70. D. 4974–6. D. 11280. D. 27978–9. Type-specimen and twelve paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*, or Santonian, zone of *M. coranguinum*. Chatham, Kent. Collected by W. Gamble, Esq. 1898, 1901.

D. 2633. D. 2640. Paratypes of *Lagynopora lagena* and syntypes of *Cribrilina nitidiformis* Vine. Senonian, Coniacian, zone of *M. cortestudinarium*, or Santonian, zone of *M. coranguinum*. Chatham, Kent. G. R. Vine collection. 1893.

D. 27039–40. Paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*. Lower Pit, Slines Oak, Worms Heath, Warlingham, Surrey. F. Möckler collection. 1912.

D. 24236–8. D. 27854–6. Six paratypes. Senonian, Coniacian, high in zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1906, 1911.

D. 21209. Paratype. Senonian, Santonian, zone of *M. coranguinum*. Wooburn Green, S.W. of Beaconsfield, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 29102. Paratype. Senonian, Santonian, zone of *M. coranguinum*. Keston, Kent, S.E. of Croydon, Surrey. Presented by Prof. Rupert Jones, F.R.S., 1891.

D. 24385. Paratype. Senonian, Santonian, zone of *M. coranguinum*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 8135. D. 24136. D. 24519–20. D. 24525. D. 24539. D. 24541. D. 24592. Eight paratypes. **D. 24519** shows smaller aviculœcia as well as the larger kind. **D. 24525** shows a renewed œcium reversed in direction. Senonian, Santonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1903, 1911.

9. Lagynopora urceolus, Lang.

Lagynopora urceolus, sp. n.; Lang, 1916, pp. 395–6; *A. quadratus*-zone, *E. depressa*-subzone; E. of Brighton.

Diagnosis.—*Lagynopora* of large size (œcia about ·7 mm. long); with about 17 closely-approximated costæ; lateral costal fusions rare or absent; intraterminal front-wall flattened; median area of fusion wide.

Description.—(a) *Ephebœcia.* Asty incrusting, unilaminar, œcia dimorphic; orthœcia about ·7 mm. long and ·46 mm. wide, oval-elliptical; extraterminal front-wall of very small extent; the intraterminal front-wall is flatly arched, and consists of about seventeen rather wide costæ which have no obvious lateral fusions, but a very wide median band of fusion occupying about half the intraterminal front-wall, and retaining but obscurely the outlines of the component costæ; the apertural bar is a little wider than the costæ and has a proximal bend and a rather narrow median process that probably fuses with the proximal pair of apertural spines; apertural spines four in number and considerably thickened; apertures normal; aviculœcia apparently of the larger kind only, occasional, sporadically distributed, with more or less circular apertures as large as those of the orthœcia.

(b) *Neanœcia.* Orthœcia about ·5 mm. long and ·36 mm. wide, oval-elliptical; costæ about fifteen; apertural spines six in number, and not so stout compared with the œcial size as those of the ephebœcia.

(c) *Ancestrœcium.* About ·3 mm. long and ·16 mm. wide, elliptical; costæ twelve or thirteen; apertural spines six in number and slender.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. E. of Brighton, Sussex.

Type-specimen.—**D. 28889.**

Remarks.—*Lagynopora urceolus* is probably derived from *E. lagena* by a flattening and solidification of the intraterminal front-wall.

Figures.—Text-fig. 32. Orthœcium and aviculœcium.

Plate II, fig. 5. Part of the type-specimen showing six orthœcia and the aperture and broken ovicell of a seventh. Two of the six orthœcia have complete ovicells, and two have broken ones. The remaining two are on the edge of the asty and show the large distal communication-pore. Senonian, subzone of *E. depressa*. E. of Brighton. × about 26 diameters.

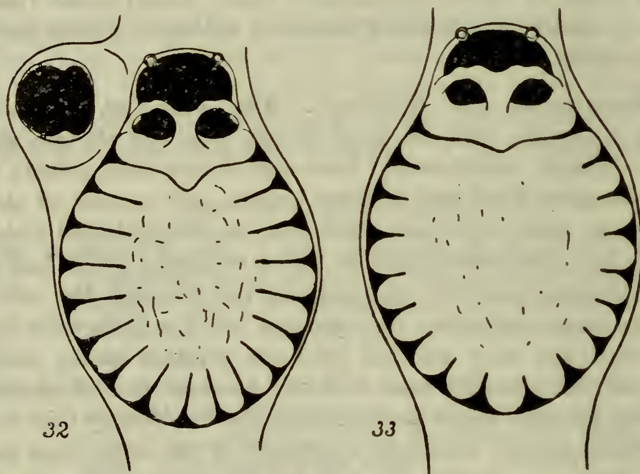


Fig. 32.—*Lagynopora urceolus*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 33.—*Lagynopora vasculum*. Diagram of an orthœcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 28889. Type-specimen. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1915.

D. 29898. From the same horizon. Cliffs W. of Chimney-shaft, Roedean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

10. **Lagynopora vasculum**, new species.

Cribrilina furcifera, nov.; Brydone, 1910, pp. 391–2, pl. xxx, fig. 6; Andover, Hants.

Non *Cribrilina furcifera*, nov.; Brydone, 1910, pp. 391–2, pl. xxx, figs. 7, 8; Bramford, Suffolk, and Kingsgate, Kent.
Non *Lagynopora furcifera* (Brydone); Lang, 1916, p. 395; Senonian, Suffolk.
Lagynopora furcifera (Brydone, 1910, pl. xxx, fig. 6); Lang, 1916, p. 395.

DIAGNOSIS.—*Lagynopora* of large size (œcia about ·68 mm. long); with about 17 closely-approximated costæ; lateral costal fusions rare or absent; intraterminal front-wall flattened, and the median area of fusion occupies considerably more than half the intraterminal front-wall.

DISTRIBUTION.—Senonian [Campanian]; Andover, Hants.

TYPE-SPECIMEN.—That figured by Brydone, 1910, pl. xxx, fig. 6.

REMARKS.—*Lagynopora vasculum* appears to be intermediate between *L. urceolus* and *L. furcifera*, having a flatter intraterminal front-wall and a wider median area of fusion than the former, and fewer costæ than the latter species.

FIGURES.—Text-fig. 33. An orthœcium.

SPECIMENS.—None in the Collection.

11. Lagynopora furcifera (Brydone).

Cribrilina furcifera, nov.; Brydone, 1910, pp. 391–2, 482, pl. xxx, fig. 7; Bramford, Suffolk.
Non *Cribrilina furcifera*, nov.; Brydone, 1910, pp. 391–2, pl. xxx, fig. 6; Andover, Hants. [=*L. vasculum*, see above.]
Non *Cribrilina furcifera*, nov.; Brydone, 1910, pp. 391–2, pl. xxx, fig. 8; Kingsgate, Kent. [=*L. ollula*, see above.]
Lagynopora furcifera (Brydone); Lang, 1916, p. 395; Senonian, Suffolk.
Cribrilina furcifera, Bryd.; Brydone, 1917, p. 492.

DIAGNOSIS.—*Lagynopora* of large size (œcia about ·68 mm. long); with about 19 closely-approximated costæ; lateral costal fusions rare or absent; intraterminal front-wall flattened, and the median area of fusion occupies considerably more than half the intraterminal front-wall.

DISTRIBUTION.—Senonian [Campanian, zone of *A. quadratus*, subzone of *A. quadratus*]; Bramford, Suffolk.

TYPE-SPECIMEN.—That figured by Brydone, 1910, pl. xxx, fig. 7, is hereby selected.

REMARKS.—*Lagynopora furcifera* is a derivative of *L. vasculum*, with more numerous costæ. In founding the species a type-specimen of *Cribrilina furcifera* was not chosen, though from Brydone's description it is clear that he regarded the specimen on pl. xxx, fig. 7, as typical. The locality for this is Bramford, Suffolk; and, since the subzone of *A. quadratus* occurs there (see Brydone, 1917, p. 494), it is probable that this is the horizon of the type-specimen.

Specimens.—None in the Collection.

b. LEPTOCHEILOPORINÆ, Lang, 1916.

Leptocheiloporinæ, subfam., nov.; Lang, 1916, pp. 394, 396.

Diagnosis.—Lagynoporidæ in which there is no median process on the apertural bar, but the apertural bar is sharply bent proximally; aviculœcia rare or absent.

Distribution.—Senonian, Santonian, and Campanian. North-West Europe.

Remarks.—See under the family Lagynoporidæ.

I. LEPTOCHEILOPORA, Lang, 1916.

[*Reptoporella*; d'Orbigny, 1853, pp. 474–5, 1854, p. 1097.]
[*Repteporella* (sic); Pictet, 1857, p. 111.]
[*Cribrilina* (*Cribrilina*) [partim]; Canu, 1900[2], p. 449.]
Cribrilina [partim]; Brydone, 1910, pp. 391–2.
Cribrilina [partim]; White, 1912, p. 43.
[*Cribrilina* [partim]; Brydone, 1914, pp. 97, 99.]
Leptocheilopora, gen. nov.; Lang, 1916, pp. 396–7.
Reptoporella?; Lang, 1917, p. 172.
Leptocheilopora; Lang, 1917, p. 172.

Diagnosis.—As for the sub-family.

Distribution.—As for the sub-family.

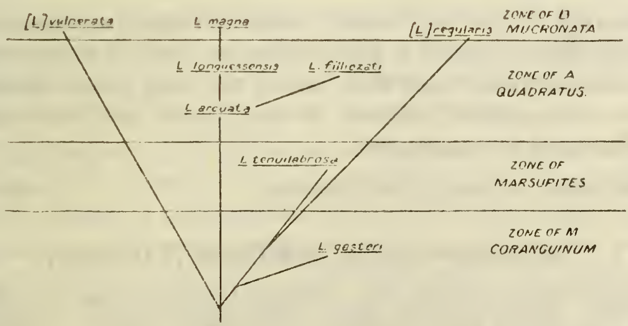
Genotype.—*Leptocheilopora tenuilabrosa*.

Remarks.—It is very doubtful whether *Reptoporella regularis* d'Orbigny is congeneric with *Leptocheilopora tenuilabrosa* Lang. Should this prove to be the case, *Reptoporella* must replace *Leptocheilopora*, since *R. regularis* is the genotype of *Reptoporella* (see Lang, 1917, p. 172). Evolution within *Leptocheilopora* appears to have resulted in a larger œcium, a larger number of costæ, an increase in size of apertural spines, a general solidification and flattening of the intraterminal front-wall, and a progression from a normal or sub-circular to a pliophlœan aperture.

L. vulnerata, if a *Leptocheilopora*, is an isolated form of very small size. Early in the evolution of the genus, while the apertural spines were yet small and the aperture undifferentiated, *L. gasteri* and *L. tenuilabrosa* must have diverged from the main stock, the former showing a tendency to lateral costal fusions, and both having somewhat flattened intraterminal front-walls and ovicells obviously built of costal elements. [*L.*] *regularis*, if a *Leptocheilopora* is probably allied to these two species.

L. arcuata–L. longuessensis–L. magna form a fairly continuous lineage, with the œcial size, the size of the apertural spines, and number of costæ increasing, and the aperture passing from sub-circular or normal to pliophlœan. *L. filliozati* was probably derived directly from *L. arcuata* by a greater solidification of the intraterminal front-wall. It is noteworthy that all the known species have an incrusting unilaminar asty.

The following phylogeny expresses these supposed relationships:—



Key to the Genus *Leptocheilopora*.

A. Œcia less than ·5 mm. long .... 1. [*L.*] *vulnerata*.

B. Œcia from ·5 to ·66 mm. long.

- I. Apertural spines minute or absent; intraterminal front-wall somewhat flattened.
  - *a.* Ovicells not obviously furrowed .... 2. [*L.*] *regularis*.
  - *b.* Ovicells evidently formed, like the intraterminal front-wall, of fused costæ.
    - 1. Rather obvious lateral costal fusions (fig. 34) . 3. *L. gasteri*.
    - 2. Lateral costal fusions obscure or absent (fig. 35). 4. *L. tenuilabrosa*.

II. Apertural spines comparatively large; intraterminal front-wall well-arched.
a. Intercostal furrows clearly-marked.
1. Costæ 12–14; aperture sub-circular to slightly pliophlœan (fig. 36) .... 5. *L. arcuata*.
2. Costæ 16–20; aperture pliophlœan (fig. 37) ... 6. *L. longuessensis*.
b. Intercostal furrows very obscure; costæ about 16. 7. *L. filliozati*.
C. Œcia nearly 1·00 mm. long (fig. 38) .... 8. *L. magna*.

1. [Leptocheilopora] vulnerata (Brydone).

Cribrilina vulnerata, sp. n.; Brydone, 1914, pp. 97, 99, pl. iv, figs. 3–4; Trimingham and Weybourne Chalk.

Leptocheilopora vulnerata (Brydone); Lang, 1916, p. 396; *B. mucronata*-zone; Trimingham and Weybourne, Norfolk.

Diagnosis.—[*Leptocheilopora*] of very small size (·40–·42 mm. long); with a much-consolidated intraterminal front-wall.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Norfolk.

Type-specimen.—That figured by Brydone, 1914, pl. iv, fig. 3, is hereby selected.

Remarks.—It is very doubtful whether *Cribrilina vulnerata* Brydone should be placed in *Leptocheilopora*. But, if so, its evolution must have been apart from that of the other known species, for its intraterminal front-wall is consolidated, while the œcial length remains extremely small.

Specimens.—None in the Collection.

2. [Leptocheilopora] regularis (d'Orbigny).

Reptoporella regularis, d'Orb., 1851; d'Orbigny, 1852, pl. 717, figs. 6–7, 1853, p. 475, 1854, p. 1097; Sénonien; Sainte Colombe (Manche). Genotype of *Reptoporella*.

Non *Membranipora crenulata* d'Orb., 1851; d'Orbigny, 1852, p. 728, figs. 13–15, 1853, p. 547, 1854, p. 1093; Cénomanien; Le Mans (Sarthe); as stated by Canu, 1900 [2], p. 449.

Repteporella [sic] *regularis*, d'Orb.; Pictet, 1857, p. 111; Craie blanche; Sainte Colombe.

Cribrilina (*Cribrilina*) *regularis* (d'Orb.); Canu, 1900 [2], p. 449; Sénonien.

? *Leptocheilopora regularis* (d'Orbigny); Lang, 1916, p. 397; Senonian; Sainte-Colombe, France.

Reptoporella regularis d'Orbigny; Lang, 1917, p. 172.

Diagnosis.—[*Leptocheilopora*] with œcia about ·5 mm. long;

probably with minute apertural spines; and with ovicells not obviously built up of costæ.

Distribution.—Senonian [zone of *B. mucronata*, Craie à *baculites*]. Sainte Colombe, S. of Valognes, Manche, France.

Type-specimen.—That figured by d'Orbigny, 1852, pl. 717, fig. 7, is here selected.

Remarks.—If *Reptoporella regularis* is a Lagynoporid, d'Orbigny's artist has drawn an œcium situated at the periphery of the asty, and showing the large, distally-placed communication-pore characteristic of the family. He has then reproduced this œcium several times over, so that the large communication-pore appears distally to every œcium, and looks, in the figure, like an aviculœcium. The structure and systematic position of the species, however, as of the genus *Reptoporella* of which *R. regularis* is the genotype, remains conjectural.

Specimens.—None in the Collection.

3. Leptocheilopora gasteri, new species.

Diagnosis.—*Leptocheilopora* with oœcia about ·58 mm. long; with very small apertural spines; with a flattened intraterminal front-wall; with rather obvious, but irregular, lateral costal fusions; and with ovicells evidently formed of costa-like bars.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, about ·58 mm. long and of very varying width, oval to elliptical; extraterminal front-wall of very small extent except proximally, where sometimes there is a rather wide strip; the intraterminal front-wall is rather flatly arched, and consists of eighteen or twenty closely-placed costæ, with numerous, irregular, but rather obvious lateral fusions, and united in a rather narrow median band of fusion, whose mid-line sometimes bears a seam-like ridge; apertural bar hardly wider than the normal costæ, and with but a slight proximal bend; apertures sub-circular; apertural spines four in number, and very small; aviculœcia apparently absent; ovicells hyperstomial, and each composed of about ten or twelve closely-placed flattened pieces resembling the costæ of the intraterminal front-wall.

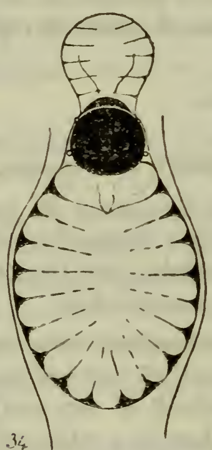
Distribution.—Senonian, Santonian, zone of *M. coranguinum*. W. of Lewes, Sussex.

Type-specimen.—**D. 29901.** Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

Remarks.—*Leptocheilopora gasteri* resembles *L. tenuilabrosa* in having ovicells which show their component elements; but it differs from that species in having more costæ, rather larger apertural spines, and rather obvious, irregular, lateral costal fusions.

Figures.—Text-fig. 34. Œcium with ovicell.

Plate II, fig. 6. Part of the type-specimen consisting of five œcia, two of which have ovicells, one complete, showing furrows, and the other broken. Senonian, zone of *M. coranguinum*. Lewes, Sussex. × about 27 diameters.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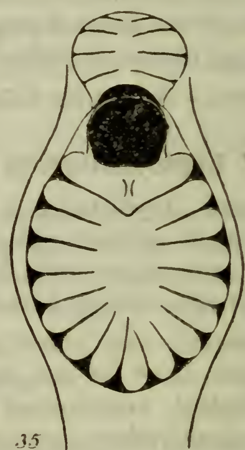
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Fig. 34.—*Leptocheilopora gasteri*. Diagram of an œcium with an ovicell, from above. × about 75 diameters.

Fig. 35.—*Leptocheilopora tenuilabrosa*. Diagram of an œcium with an ovicell, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 29901–2. Type-specimen and paratype. Senonian, Santonian, zone of *M. coranguinum*. Pit in Houndean Bottom, W. of Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

4. Leptocheilopora tenuilabrosa, Lang.

Leptocheilopora tenuilabrosa, sp. n.; Lang, 1916, pp. 396–7; *Marsupites*-zone; Brighton, Sussex.

Leptocheilopora tenuilabrosa Lang; Lang, 1917, p. 172.

Cribrilina tumuliformis, sp. nov.; Brydone, 1917, pp. 51, 53, pl. iii, figs. 7 & 8; *M. coranguinum*- and *Marsupites*-zones; Kent.

Diagnosis.—*Leptocheilopora* with œcia about ·58 mm. long; with apertural spines minute or absent; with a flattened intraterminal front-wall; with ovicells evidently formed of costa-like bars; lateral costal fusions obscure or absent.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, about ·58 long and ·43 mm. wide, oval; extraterminal front-wall of fair extent, especially proximally; the intraterminal front-wall is somewhat flatly arched, and consists of fourteen or fifteen fairly closely-placed costæ, without lateral fusions, but united in a more or less wide median band of fusion; apertural bar hardly wider than the costæ, and with a sharp proximal bend; aperture sub-circular; apertural spines minute, apparently four in number; aviculœcia apparently absent; ovicells hyperstomial, and each composed of eight or ten closely-placed, flattened elements, in shape generally resembling the costæ of the intraterminal front-wall.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*, Kent, and zone of *Marsupites* in Hants, Kent, and Sussex.

Type-specimen.—D. 28892. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1915.

Remarks.—*Leptocheilopora tenuilabrosa* appears to have developed a fairly compact intraterminal front-wall without any enlargement of the apertural spines; and in this respect, as well as in its ovicells, to be isolated from the other species of the genus, except *L. gasteri*, which has, however, obvious lateral costal fusions; and, perhaps, [*L.*] *regularis*, which, if a *Leptocheilopora*, probably is allied to this species.

Figures.—Text-fig. 35. Œcium with ovicell.

Plate II, fig. 7. Six œcia of the type-specimen, three of which have ovicells, and of these one only is complete and shows the furrowed front-wall. Senonian, zone of *Marsupites*. Brighton. × about 27 diameters.

LIST OF SPECIMENS.

D. 28892. Type-specimen. Senonian, Santonian, zone of *Marsupites*. Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 21210. Paratype. Senonian, Santonian, zone of *Marsupites*. Roke Farm, S.E. of Odiham, Hants. Collected by L. Treacher, Esq., F.G.S. 1911.

5. Leptocheilopora arcuata, Lang.

Leptocheilopora arcuata, sp. n.; Lang, 1916, pp. 396–7; *A. quadratus*-zone; E. of Brighton, Sussex.

Diagnosis.—*Leptocheilopora* with œcia about ·58 mm. long; with comparatively large apertural spines; with a well-arched intraterminal front-wall consisting of 12–14 clearly-marked costæ; and with an aperture sub-circular to slightly pliophlœan.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, about ·58 mm. long and ·4 mm. wide, oval; extraterminal front-wall of small dimensions, but there is often a proximal strip of some size; the intraterminal front-wall is well-arched, and consists of twelve to fourteen rather wide and closely-placed costæ with no obvious lateral fusions, and united in a wide median band of fusion, whose mid-line is often marked by a seam-like ridge; the apertural bar is slightly wider than the costæ, and has a considerable proximal bend; the aperture is sub-circular to slightly pliophlœan; the apertural spines are four in number (five in some neanœcia), and considerable, though not much enlarged; ovicells hyperstomial—not, apparently, furrowed.

Distribution.—Senonian, Campanian, zone of *A. quadratus*. S. of England.

Type-specimen.—D. 28294. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

Remarks.—*Leptocheilopora arcuata* stands at the base of a lineage of which the later terms are *L. longuessensis* and *L. magna*. The lineage is marked by a increase in size and in the number of costæ, a flattening of the intraterminal front-wall, and an advance in the shape of the aperture. *L. filliozati* also is probably derived from *L. arcuata*, but has an intraterminal front-wall considerably more consolidated than that of *L. longuessensis* and *L. magna*, and unaccompanied by any great advance in other characters.

FIGURES.—Text-fig. 36. An œcium.

Plate II, fig. 8. Two partial and five complete œcia of the type-specimen; two of the latter bear broken ovicells. Senonian, zone of *A. quadratus*. Brighton. × about 30 diameters.

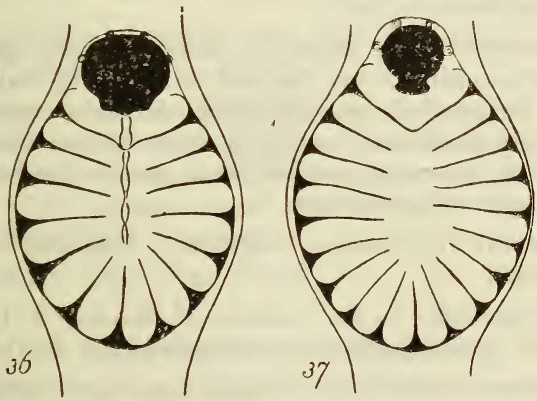

Fig. 36.—*Leptocheilopora arcuata*. Diagram of an œcium, from above. × about 75 diameters.

Fig. 37.—*Leptocheilopora longuessensis*. Diagram of an œcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 28294. Type-specimen. Senonian, Campanian, zone of *A. quadratus*. Between Rottingdean and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 28895. Paratype. Senonian, Campanian, zone of *A. quadratus*, subzone of *O. pillula*. Pit on East Hill, Rottingdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1915.

D. 28893–4. Paratypes. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1915.

D. 4279. D. 4290. D. 4296. Three paratypes. Senonian, Campanian, zone of *A. quadratus*. East Harnham, S. of Salisbury, Wilts. W. Gamble collection. 1898.

6. Leptocheilopora longuessensis, Lang.

Leptocheilopora languessensis [sic], sp. n.; Lang, 1915, pp. 396–7; Campanian; Languesse [*sic*], France.

Diagnosis.—*Leptocheilopora* with œcia about ·6 mm. long; with apparently large apertural spines; with a well-arched intraterminal front-wall consisting of 16–20 clearly-marked costæ; and with a pliophlœan aperture.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, about ·6 mm. long and ·48 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is well-arched, and consists of about eighteen costæ; the apertural bar has a sharp proximal bend; aperture decidedly pliophlœan; apertural spines stout.

Distribution.—Senonian, Campanian. Longuesse, Seine-et-Oise, France.

Type-specimen.—In the collection of Monsieur F. Canu, of Versailles. A photograph of the type-specimen is in the Collection.

Remarks.—*Leptocheilopora longuessensis* may be derived from *L. arcuata* by a slight increase in œcial size, an increase in the number of costæ, an advance in apertural shape, and an increase in the size of the apertural spines.

Figures.—Text-fig. 37. Diagram of an œcium, from above, × about 75 diameters.

Specimens.—None in the Collection.

7. Leptocheilopora filliozati (Brydone).

Cribrilina Filliozati, nov.; Brydone, 1910, pp. 391–2, pl. xxx, figs. 9–10; *A. quadratus*-zone; Hants.

Cribrilina filliozati Brydone; White, 1912, p. 43; zone of *A. quadratus*; Winchester district.

Leptocheilopora filliozati (Brydone); Lang, 1916, p. 396; *A. quadratus*-zone; Hants.

Cribrilina Filliozati, Bryd.; Brydone, 1917, p. 51.

Diagnosis.—*Leptocheilopora* with oœcia ·58–·72 mm. long; probably with comparatively large apertural spines; and with a fairly well-arched intraterminal front-wall with the intercostal furrows nearly obliterated.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, ·58–·72 mm. long and ·4–·5 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is fairly well-arched and composed of about sixteen costæ, whose outlines are much obscured by the great consolidation of the intraterminal front-wall; apertures cribriline to pliophlœan.

Distribution.—Senonian, Campanian, zone of *A. quadratus*. Hants.

Type-specimen.—That figured by Brydone, 1910, pl. xxx, fig. 9, is hereby selected.

Remarks.—*Leptocheilopora filliozati* appears to resemble closely *L. arcuata*, but to have a much more firmly consolidated intraterminal front-wall, so that the furrows between the costæ are obscure. The apertures also are more advanced. It is probably a direct derivative of *L. arcuata*.

Specimens.—None in the Collection.

8. Leptocheilopora magna, Lang.

Leptocheilopora magna, sp. n.; Lang, 1916, pp. 396–7; *B. mucronata*-zone; Lüneburg, Hanover.

Diagnosis.—*Leptocheilopora* with œcia about 1·00 mm. long.

Description.—Asty incrusting, unilaminar; œcia apparently monomorphic, about 1·00 mm. long and ·66 mm. wide, oval-elliptical; the extraterminal front-wall is of very small extent; the intraterminal front-wall is very flatly-arched and consists of about eighteen very wide and very closely-placed costæ having no apparent lateral fusions, but united in a wide median area of fusion; apertural bar as wide or hardly wider than the costæ, and with a sharp proximal bend; aperture decidedly pliophlœan; apertural spines four in number and small.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Lüneburg, Hanover.

Type-specimen. **D. 19623.** F. Möckler collection.

Remarks.—*Leptocheilopora magna* may be derived from *L. longuessensis* by a great increase in œcial size and a flattening and greater consolidation of the intraterminal front-wall. It is possible, however, that the apertural spines of *L. longuessensis* are more enlarged than those of *L. magna*, and, if so, *L. magna* is in this respect not so advanced as *L. longuessensis* and so cannot be directly descended from that form. It is probably, however, connected with the *L. arcuata–L. longuessensis* lineage.

Figures.—Text-fig. 38. An œcium.

Plate II, fig. 9. Part of the type-specimen, comprising four œcia and parts of three others. Senonian, zone of *B. mucronata*. Lüneburg, Hanover. × about 23 diameters.

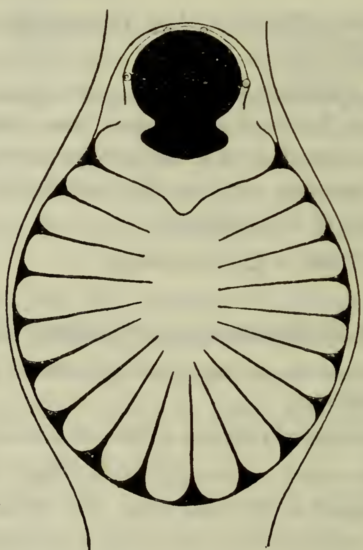

Fig. 38.—*Leptocheilopora magna*. Diagram of an œcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 19623. D. 19622. Type-specimen and paratype. Senonian, Campanian, zone of *B. mucronata*. Lüneburg, Hanover. F. Möckler collection. 1910.

G. **ANDRIOPORIDÆ**, Lang, 1916.

Andrioporidæ, fam. nov.; Lang, 1916, p. 381.

Diagnosis.—Uniserial and multiserial Cretaceous Cribrimorphs of minute size (generally ·3–·5 mm. long) and nearly always incrusting; ovicells hyperstomial; pelmata and pelmatidia absent; with a well-formed and symmetrical apertural bar; with closely-placed costæ generally with numerous, rather obvious, but not very regular lateral fusions; apertural spines six in number, often minute; interœcial secondary tissue scanty.

Distribution.—Cenomanian to Danian.

Remarks.—Three types of Cribrimorph structure distinguish as many sub-families of the Andrioporidæ; and it is possible that these three groups are not really closely related. But, if they are closely related, two of them (namely, the Schistacanthoporinæ and the Pliophlœinæ) are derived from the third (the Andrioporinæ). The first-mentioned sub-family comprises but a single aberrant form from Royan. The Pliophlœinæ are, on the whole, a compact, well-marked group, almost entirely consisting of the numerous species of *Pliophlœa.* But the main interest of the family turns upon the evolution of the radical genus *Andriopora* and its developments in the various genera into which it passes. *Andriopora* and its nearer derivatives compose the Andrioporinæ.

Andriopora has all the notes of a radical genus; for every other genus of the Andrioporidæ can be ultimately derived from it; most of the genera of the Andrioporinæ can be directly derived from one or other of its species; again, while all its species contain one or more fundamentally primitive characters, some, in addition, show considerable advancement in other characters; and the genus has a long range in time, namely, from Cenomanian to Danian—a range conterminous with that of the Cretaceous Cribrimorph Polyzoa. As with any other radical genus, that species from which another genus arose is often on neutral ground, since the diagnostic characters of the new genus in question are at least foreshadowed in the species of *Andriopora* from which it is derived, or there would be no evidence for deriving the new genus from that particular species. This is less obvious in the case of genera to which more specialised genera—that is, those which are not radicals—gave rise.

From the fact that *Andriopora* is such a typically radical genus, and that it occurs as low as the Cenomanian, it will have been inferred that the Andrioporidæ are, on the whole, a primitive group among the Cribrimorph families. But it is hardly profitable to compare the different families in this respect, since they appear to bear no nearer relation to one another than their ultimate descent from a common Membranimorph ancestor. Their respective proximate Membranimorph ancestors were probably very different. Consequently it is hardly to be looked for that they should have evolved along the same lines. Nevertheless, as has been pointed out (Introd. §§ 15, 25), there are common features in the evolution of all the families which point to a fundamental tendency in the common ancestor. This predetermines the general evolution of the diverging lineages of its descendants, and leaves the details of that evolution to be controlled by other factors (among them the environment). In all likelihood, the main method of these other factors is to remove inhibitions in various directions, thus allowing the fundamental potentialities to become actual in these directions in varying degrees. Thus it was suggested (Introd. §§ 3, 8, 15) that the dominant feature in the skeletal evolution of the Cretaceous Cheilostomes was the deposition of an ever-increasing superfluity of calcium carbonate; and this was primarily directed towards the formation of a calcareous front-wall. The most fundamental potentiality, then, of that Ancestral Cheilostome which gave rise to the Cretaceous forms was tendency to lay down its superfluous calcium carbonate in the front-wall. It accomplished this in several different ways. One way was by the production of terminal spines, which, becoming enlarged, bending over towards those on the opposite side and fusing with them, formed an arched intraterminal front-wall. The factor determining the adoption of this Cribrimorph plan, rather than another plan of front-wall production, may have been ultimately environmental, and the method the removal of an inhibition against the production and subsequent amplification of terminal spines. But it is probable that the environmental or other factors which caused this removal operated in different Membranimorph stocks at different times; the immediate result of the removal was the assertion of the underlying potentiality and its expression in the formation of a Cribrimorph front-wall, which thus arises independently in many Membranimorph lineages.

But there are other features common to the evolution of the Cribrimorph families besides the mere development of a Cribrimorph intraterminal front-wall. In most families evolution proceeds with the general solidification of this structure, either by producing an ever-widening median area of fusion, or by means of lateral costal fusions, or by both methods. The details of these processes differ, as, indeed, they do in the sub-families and genera of each family. As before, it is possible to conceive these differences as having been brought about by a method of removing inhibitions by diverse means.

Again, it is generally seen that secondary calcium carbonate is independently laid down in three several directions, namely, in the intraterminal front-wall, in the interœcial valleys, and in connection with the aperture; and, though any two (or all three) processes might proceed simultaneously and at different rates, yet, on the whole, that directed towards the complication of the intraterminal front-wall precedes in evolution the infilling of the interœcial valleys (the Myagroporidæ furnished a notable exception); and the complication of the aperture generally comes last. From the view-point suggested above, three inhibitions are released in varying degrees, and more or less simultaneously, but generally in the order mentioned. A potentiality having become actual, and having, apparently, had full play, it becomes dissipated, so that catagenesis is seen in the character concerned. In the Andrioporidæ, complication of the intraterminal front-wall was the main—in fact, almost the only—concern of secondary deposition; there is hardly any development of interœcial secondary tissue; and, with few exceptions, the complication of the aperture is confined to the thickening of the apertural spines and to slight modifications of the apertural bar. Particularly is to be noted the absence of fusion between the proximal pair of apertural spines and a median process of the apertural bar—a phenomenon common to several families and already seen in the Lagynoporine genera (see p. 44). It is possible that *Lagynopora* may be found to have been derived from an Andrioporine stock; but this, should it be the case, would be, besides *Pancheilopora*, the only known instance of such a fusion taking place in an Andrioporid or an Andrioporid-derivative.

In their deposition, then, of secondary calcium carbonate, the Andrioporidæ have not advanced as far as some of the other families of Cribrimorphs; and they exhibit a simple nature in other characters. The apertural spines, for instance, are very minute or non-existent in the most primitive forms, and are six in number when evidently present. In some other families, *e. g.*, in the Lagynoporidæ just considered, the primary six are reduced to four. That is, the Membranimorph ancestor of the Andrioporidæ had not yet acquired apertural spines to an appreciable extent at a time when its remaining terminal spines had already developed into a Cribrimorph intraterminal front-wall, and the evolutionary future of its apertural spines is (except, perhaps, in *Monoceratopora*) an anabasis all the way. The other families, on the other hand, are each descended from a Membranimorph which

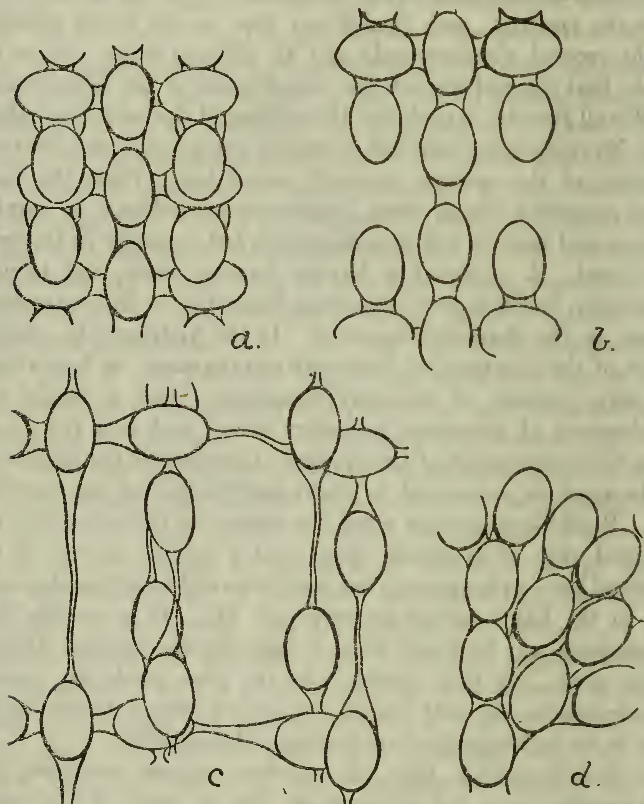

Fig. 39.—Methods of budding and branching in Cheilostome Polyzoa.
a. Bilateral branching in every œcium. *b.* Bilateral branching in some œcia only. *c.* Bilateral branching with cauda-formation. *d.* Unilateral branching in some œcia only with reduction of angle of branching.

already had six, often well-formed apertural spines, and these have had a chequered subsequent history, becoming modified in various directions in different lineages, and often undergoing catagenesis in respect of numbers.

Another primitive character of the Andrioporidæ is a colonial one. It is probable that the Ancestral Cheilostome exhibited **bilateral branching** * : that is, every œcium produced a terminal and two lateral buds; and the latter were directed at right angles to the main stem (fig. 39 *a*). It is evident that, when the lateral buds developed and, in turn, budded again, their lateral buds would over-run and incrust the lateral buds of the neighbouring œcia of the main-branch (it is assumed that this primitive form had an incrusting asty, and it is remarkable that nearly all the Andrioporidæ are incrusting forms); and further budding would increase the congestion. Two methods of avoiding this over-crowding were adopted. First, the lateral budding was suppressed in the majority of individuals, at least of those on lateral branches, producing a uniserial asty with occasional paired lateral branches (fig. 39 *b*), but still with much over-incrusting. Such a form is the Membranimorph *Herpetopora danica* †. Another plan, having in view the spreading of the colony over more space, and so avoiding overlapping and overcrowding, was the production of **caudate œcia** ‡. Species which have adopted this plan have œcia whose proximal ends are greatly elongated—in fact, drawn out into long, tail-like terminations. Thus a series of a few œcia cover a relatively enormous stretch of ground, and give plenty of immediate room for bilateral branching (fig. 39 *c*). But, as might have been foreseen, this method is only a palliative, and but postpones the evil, which can only be cured by a change in the principle of branching. The incrusted space is more equally allotted among the individual œcia, but ultimately becomes as crowded as before, and the newer branches of the asty continually over-run the older. The type-specimen of *Herpetopora anglica* § shows into what difficulties this improved method may yet land a species. A new principle is needed. This was found in the simultaneous suppression of one lateral bud, and the change of angle of branching from a right angle to an angle of 45°, or, finally, of less than 45° (fig. 39 *d*). Thus three modifications of the original plan of budding have now come

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* Lang, 1914, p. 6.

† Lang, 1914, p. 7, pl. ii, figs. 6, 7.

‡ Œcia divided into caudal and capitular portions, see Lang, 1914, p. 6.

§ Lang, 1914, p. 6, pl. ii, figs. 1–3.

into force: (1) the suppression of both lateral buds on most œcia; (2) the reduction of the angle of branching; and (3) the supression of one lateral bud on those œcia which still exhibited lateral budding (**unilateral branching**). When these three modifications come into action simultaneously, the resulting asty has its œcia radiating fan-wise in linear series, with fairly frequent unilateral branches giving rise to new radial series and filling up the gaps between the diverging lines of œcia; there is no over-incrusting, for, owing to the angle of branching being small, instead of a right angle, the linear series of œcia diverge radially, instead of cutting across each other's paths. The fourth modification, cauda-formation, did not concern the asty as a whole, but affected the individual œcia; and, as a matter of evolution, the formation of caudæ had no important future in any of the lineages that adopted it. From the point of view of the deposition of calcium carbonate it was an interesting experiment. For by indefinitely lengthening the cauda, an indefinitely increasing amount of calcium carbonate can be deposited; and such a method approximates the skeleton to a tube with an occasional swelling. The formation of a tubular skeleton has been a refuge for organisms oppressed by a superabundance of skeletal matter; but it appears as a condition necessary for permanent success that the animal shall be able to desert the proximal end of its tube and inhabit only distally. Cauda-formation cannot fall in with this condition, and the strain upon the organism of having to support an indefinitely-prolonged cauda of protoplasmic tissue, which yet has to carry out the colonial relations between œcium and œcium, although the organs of nourishment are of relatively decreasing proportions, appears to have condemned this method to ultimate failure.

The Andrioporidæ exhibit these expressions of a uniserial condition in the genera *Andriopora* and *Corymboporella*, and in the neanastic stages of certain genera derived from the former. In most species of *Andriopora* bilateral branching has been abandoned except in an occasional œcium (or sometimes a row of consecutive œcia), so that the general appearance of the asty is one of long, unbranched, or seldom-branched rows of œcia; but in many species a lessening of the angle of branching is observed, and, occasionally, unilateral branching. *A. porrecta* and *Corymboporella* have adopted cauda-formation.

A final example may be mentioned of what is probably a primitive feature exhibited by the Andrioporidæ. Its claim to primitiveness is its clumsiness. In other Cribrimorph families the apertural bar is often complicated to an extraordinary degree by deposits of secondary calcium carbonate, laid down either as modifications of the apertural bar itself or in connection with structures which invade the apertural bar from above and come to lie over it. In certain Andrioporid genera also, namely, *Corymboporella*, *Hybopora*, and *Pancheilopora*, secondary calcium carbonate is deposited in connection with the apertural bar. But in these genera it is simply dumped down, so to speak, upon the apertural bar until it forms an immense hump or boss showing no refinement of architecture. It is true that some attempt at refinement occurs in *Pancheilopora*; but this merely consists of the proximal spreading of this (here somewhat spiniform) lump of secondary tissue, and ultimately the fusion with it of the proximal apertural spines.

Generally speaking, evolution in the Andrioporidæ may be said to run the following (on the whole) expected course:—(1) From a uniserial to a multiserial asty; (2) from smaller to larger œcia; (3) from primitively squat to long-shaped, and, again, to catagenetically squat œcia; (4) from a loosely-knit to a solidly-fused intraterminal front-wall; (5) from few to many costæ; (6) from a simple to a variously modified, but seldom very complicated, apertural bar; (7) from very small to secondarily thickened apertural spines; (8)—implicit in the two last—from simple to a secondary aperture; (9) from no aviculœcia, through small, paired, blunt aviculœcia, to pointed, paired aviculœcia (and, possibly, in one case, to larger aviculœcia); and (10) from contiguous œcia to a condition of wide interœcial spaces occupied by aviculœcia resting on what are probably cenœcia.

There remains to be considered the general evolution of the intraterminal front-wall. In the most primitive forms, the costæ, though lying closely beside one another, are merely united in a median band of fusion. The end of the costa, however, tends to be up-turned and somewhat enlarged at this point, or slightly constricted proximally to it. But the up-turned portion is a solid boss, not a hollow, spine-like process, as in the Pelmatoporidæ. As evolution proceeds, this swollen costal head travels proximally along the costa and away from the mid-line (just as the Pelmatoporid pelma travels); so that, in the less primitive forms, the median line of fusion expands into a wide area. But intercostal perforations often appear, though somewhat irregularly, in the median area of fusion, and thus lateral costal fusions are cut off from the main area of fusion. The Andrioporid costæ, as a rule, lie so close together that the exact number and disposition of the lateral fusions are determined with difficulty; nor do they appear to have such a regular evolution, at least in the Andrioporinæ, as they have in the Pelmatoporidæ, whose costæ are generally more widely spaced. But it is of interest to find the same principle underlying the complication of the intraterminal front-wall in both families.

The following are the three sub-families of the Andrioporidæ, with their diagnostic characters:—

A. The costæ are not specially flattened, and bear neither a median row of pores nor a median slit; nor does one costa appear occasionally to fuse with its neighbour completely to form a costa of double width .... a. Andrioporinæ.

B. The costæ are more or less flattened, and bear a median row of pores; a costa appears occasionally to fuse with its neighbour to form a costa of double width .... b. Pliophlœinæ.

C. The costæ bear a median slit .... c. Schistacanthoporinæ.

a. ANDRIOPORINÆ, Lang, 1916.

Andrioporinæ, subfam. nov.; Lang, 1916, p. 382.

Diagnosis.—Andrioporidæ in which the costæ are not specially flattened, and bear neither a median row of pores nor a median slit; nor does one costa appear occasionally to fuse with its neighbour completely so as to form a costa of double width.

Distribution.—Cenomanian to Danian.

Remarks.—To consider the evolution of the Andrioporinæ is to anticipate that of *Andriopora*; for many of the other Andrioporine genera are directly derived from the various species of that genus. But very early in the evolution of the family, before any known species of *Andriopora* are found, three main lineages had, apparently, already diverged. The hypothetical ancestral Andrioporine was a uniserial form with bilateral branching; with minute, non-caudate, squat-shaped œcia; few and loosely-fused costæ; no aviculœcia (these were certainly potentially present, since, when they do appear, they are already highly differentiated from orthœcia, and show no signs of that origin which it is difficult to deny them, namely, a passage through "vicarious" forms—that is, through aviculœcia showing comparatively little difference from orthœcia); undifferentiated apertural bar; sub-semicircular aperture; and no, or very minute, apertural spines. These last were soon acquired, and immediately began to reflect in their modifications the sub-family's evolution. In one stock, the apertural spines, six in number, remain small and undifferentiated. It embraces the species *Andriopora mockleri*, *A. arion*, *A. limax*, *A. linearis*, *A. porrecta*, and *A. homunculus*, as well as the derived genera *Argopora* and *Angelopora*; and probably from this stock the Pliophlœinæ also arose. A second main lineage, represented only by the genus *Monoceratopora*, is characterised by the enlargement of the proximal pair only of the apertural spines; it possibly also loses the distal pair, since it is difficult clearly to see more than four apertural spines altogether. *Monoceratopora* is also characterised by the possession of unpaired aviculœcia placed in the mid-line and distally with regard to the aperture of every orthœcium; it is also larger than most Andrioporinæ. Thus, on the whole, it is a well-marked and aberrant genus. A third main lineage retains six apertural spines and enlarges them all. *Polyceratopora* and its derivative *Oligotopora* soon broke away from this main stock before enlargement of the apertural spines had proceeded to any great length, and *Corymboporella* later, but this genus remained uniserial and developed caudate œcia. From the *Corymboporella*-stock, before cauda-formation had conspicuously set in, the Cenomanian genus *Kankopora* and its derivative *Hybopora* diverged. Post-Cenomanian members of this third main lineage are the species *Andriopora levinseni*; *A. aggregata* with the allied genus *Lecythoglena*; *Andriopora gasteri* with the group of genera allied to it, namely, *Eucheilopora*, *Pancheilopora*, *Hippiopora*, *Nannopora*, *Distansescharella*, *Tricolpopora*, and *Holostegopora*; and *Andriopora gallica*, its derivative *A. frequens* with the derived genera *Æolopora* and *Auchenopora*, as well as, probably, the Schistacanthoporinæ.

The following is a key to the Andrioporine genera :—

A. Asty uniserial, incrusting.
- I. Aviculœcia generally present; intraterminal front-wall clearly costate and the costæ more or less intimately fused (figs. 40–50) .... I. *Andriopora.*
- II. Aviculœcia absent; intraterminal front-wall entirely fused, traces only of the costæ remaining; the apertural bar forms a hump (fig. 58)... VI. *Corymboporella.*

B. Asty multiserial (except sometimes in the neanastic stages), and incrusting.
- I. No secondary aperture formed.
  - a. Median area of fusion not surrounded by a circle of bosses.
    - 1. Apertural bar not forming a hump.
      - α. Aviculœcia numerous, or, if few, not medianly placed.
        - I. Furrows between the costæ plainly visible.
          - a. Apertural spines not markedly thickened.
            - 1. Apertural bar not flattened, and not much produced vertically to form a rudimentary proximal shield.
              - α. Apertures very primitive—subsemicircular (fig. 56) .... IV. *Polyceratopora.*
              - β. Apertures not very primitive.
                - a. Œcia larger, not so squat; apertural spines not at all thickened (figs. 51–53) ...... II. *Argopora.*
                - b. Œcia smaller, squat; apertural spines slightly thickened.
                  - 1. Œcia not separated by much circum-aviculœcian tissue. X. *Nannopora.*
                  - 2. Œcia separated by much circum-aviculœcian tissue (? cenœcia) (figs. 64, 65)... XI. *Distanseschrella.*
            - 2. Apertural bar much flattened vertically, forming a rudimentary proximal shield (figs. 54, 55) ... III. *Angelopora.*
          - b. Apertural spines decidedly thickened.
            - 1. Apertural bar produced into a median spine (figs. 67–71) .... XIII. *Eucheilopora.*
            - 2. Apertural bar not so produced.
              - α. Aviculœcia absent (fig. 59) ...... VII. *Kankopora.*
              - β. Aviculœcia few, pointed (fig. 57). V. *Oligotopora.*

II. Furrows between the costæ almost, or quite, invisible (fig. 66) .... XII. *Tricolpopora.*

β. Aviculœcia comparatively few, and, as a rule, placed distally to the orthœcia; proximal pair of apertural spines more or less thickened (figs. 79–81) .... XIX. *Monoceratopora.*

2. Apertural bar forms a hump (fig. 60) .... VIII. *Hybopora.*

3. An aviculœcium placed medianly on the apertural bar; secondary tissue covers the intraterminal front-wall (fig. 74) .... XV. *Hippiopora.*

b. Median area of fusion surrounded by a ring of bosses; apertural spines thickened (figs. 75–77) XVI. *Æolopora.*

II. A secondary aperture more or less formed.

a. Proximal shield of secondary aperture formed by the upward growth of a flattened, shield-shaped apertural bar which does not display any thickened median spine; distal shield formed by the fusion of the distal apertural spines (fig. 78)....................................... XVII. *Auchenopora.*

b. Proximal shield of secondary aperture formed by the general upward growth of the apertural bar and the backward growth of its median spine, the end (at least) of which fuses with the median line of fusion of the intraterminal front-wall; apertural spines retain their identity and do not form, in the absence of ovicells, a complete distal shield (figs. 72, 73). XIV. *Pancheilopora.*

C. Asty erect, cylindrical.

I. Intraterminal front-wall not so completely fused; ovicells with radial sculpture .... XVIII. *Lecythoglena.*

II. Intraterminal front-wall completely fused (fig. 61) IX. *Holostegopora.*

I. ANDRIOPORA, Lang, 1916.

Hippothoa; Reuss, 1872, p. 100.

Hippothoa [partim]; Marsson, 1887, pp. 92, 108.

Cribrilina [partim]; Vine, 1893, pp. 316, 336.

Hippothoida; Vine, 1893, p. 316.

Hippothoa [partim]; Deecke, 1895, p. 79.

Cribrilina [partim]; Jukes-Browne, 1904, p. 490.

Hippothoa; Frič, 1911, p. 98.

Cribrilina [partim]; White, 1913, p. 38.

Andriopora, gen. nov.; Lang, 1916, pp. 382–5.

Hippothoida; Lang, 1917, p. 171.

Hippothoa; Lang, 1917, p. 171.

Diagnosis.—Andrioporinæ having an incrusting and uniserial asty; aviculœcia are generally present; the intraterminal front-wall is clearly costate; and the costæ are more or less intimately fused.

Distribution.—Cenonanian to Danian.

Genotype.—*Andriopora homunculus.*

Remarks.—All the unserial species of Andrioporidæ fall into the genera *Andriopora* and *Corymboporella*, though primitive species of other genera may have uniserial neanastic stages. *Corymboporella* may be distinguished by the lump or tubercle of secondary tissue piled upon the apertural bar; it also differs from most of the species of *Andriopora* in its intraterminal front-wall which is completely fused, so that traces only of the component costæ can be seen; and in the caudæ of its œcia, which are very long.

We have seen (pp. 86–87) that the hypothetical ancestral Andrioporine is considered to have been an *Andriopora* with bilateral branching; with minute, non-caudate œcia; few and loosely-fused costæ; no aviculœcia; undifferentiated apertural bar; sub-semicircular aperture; and no, or but very minute apertural spines: and that three main lineages soon diverged from this primitive form; in the first, all the apertural spines remained comparatively undeveloped; in the second, only the proximal pair became enlarged; and, in the third, all the apertural spines were thickened (see p. 92).

At the base of the first of these diverging main lineages stands the primitive form, *Andriopora mockleri* (fig. 40), and, possibly, below *A. mockleri*, *A. brevis*. Now the apertural bar of *A. mockleri* is quite undifferentiated, and it became modified in two directions: either the width increased without further modification, giving rise to such a form as *A. arion* (fig. 41); or, it tended to become flattened in a vertical plane, and so to form a rudimentary apertural shield. A further modification of the latter structure arose in *A. limax* (fig. 43), in which there is a median spine on the somewhat flattened apertural bar. Now, it was remarked in connection with the general evolution of the Andrioporidæ that the œcia tended to pass from a primitive, squat shape (an essentially Membranimorph character) to an elongate shape (a primitive Cribrimorph character), and, finally, to a secondarily squat shape. *A. mockleri* has comparatively elongate œcia, and in its derivatives hitherto considered, the œcia have become progressively more elongate. But the lineage arising from *A. mockleri*, and, chacterised by a wide apertural bar flattened in the vertical plane, divides into a series in which the œcia become secondarily squat, and develop caudæ, and one in which the elongation of the œcium is still carried on, and the asty becomes more compact. The first series contains the species *A. linearis* and *A. porrecta* (figs. 44–45); the second, the species *A. homunculus* and its derivative genus *Angelopora* (figs. 46, 54–55).

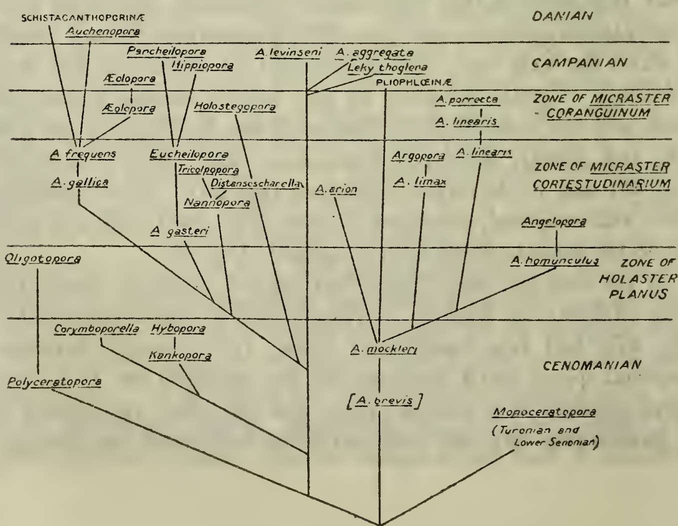
To sum up, *Andriopora mockleri* gave rise to *A. arion* on the one hand (and, probably, the Pliophlœinæ diverged from this stock), and another stock which, in turn, divided, producing *A. limax* (and its derivative genus *Argopora*, figs. 51–53) on the one hand, and another stock, which, again divided into the *A. linearis* –*A. porrecta* lineage, and one consisting of *A. homunculus* and its derivative genus *Angelopora*. These species of *Andriopora* have undifferentiated apertural spines.

There is no known species of *Andriopora* at the base of the second main lineage, that in which only the proximal pair of apertural spines enlarges and which contains the genus *Monoceratopora* (figs. 79–81).

There are no very primitive known species of *Andriopora* in the third main lineage, namely, that in which all the apertural spines are enlarged; and it is necessary to assume the existence of an *Andriopora* very low down in this lineage, of squat shape and with sub-circular apertures, from which the genus *Polyceratopora* (fig. 56) and its derivative, *Oligotopora* (fig. 57), may be derived. After this offshoot, the main stem, apparently, developed more differentiated apertures, and gave off in Cenomanian times a branch in which the œcia were still minute and no aviculœcia had been developed. Certain members of this branch became multiserial, while still the intraterminal front-wall was loosely-knit, grew in size, and, finally, developed aviculœcia; these were *Kankopora* (fig. 59) and its derivative *Hybopora* (fig. 60). Other members, while still uniserial, developed a firmly-knit front-wall, and gave rise to the caudate genus *Corymboporella* (fig. 58).

By the time the main lineage had reached Coniacian times, two other offshots arose from it; one, represented by *Andriopora gasteri* (fig. 47), had few loosely-knit costæ, very strongly developed apertural spines, and a tendency for the apertural bar to be produced upwards in a median spine; and the other, represented by *A. gallica* (fig. 42), had more and better-knit costæ, less strongly-developed apertural spines, and an undifferentiated apertural bar. *A. gasteri*, becoming multiserial, gave rise to *Eucheilopora* (figs. 67–71) with its derivatives *Hippiopora* (fig. 74) and *Pancheilopora* (figs. 72–73); while from near *A. gasteri*, but nearer to the main lineage, arose the genera *Nannopora* (figs. 62–63), *Tricolpopora* (fig. 66), and *Distansescharella* (figs. 64–65). *Andriopora gallica*, on the other hand, gave rise to *A. frequens* (fig. 48), with a better-fused intraterminal front-wall, more strongly developed apertural spines, squatter œcia, and an asty tending to be multiserial. In all three species, namely, *A. gasteri*, *A. gallica*, and *A. frequens*, the costal ends tend to turn upwards and to be slightly constricted so as to form beads or bosses on the median area of fusion. This tendency is an established and striking character in *Æolopora* (figs. 75–77), a derivative of *Andriopora frequens*. The last-named species also gave rise to *Auchenopora* (fig. 78) and, probably, the Schistacanthoporinæ. The genus *Holostegopora* (fig. 61) probably arose from close to where the *Andriopora gasteri* and *A. gallica* lineages diverged from the main lineage. *A. levinseni* (fig. 49) is the final term of the main lineage, remaining uniserial and comparatively undifferentiated until nearly Danian times. The genus *Lecythoglena* probably diverged from this stem in the hemera of *B. mucronata*; also the species *Andriopora aggregata* (fig. 50), which has a more compacted front-wall than *A. levinseni*.

The following table shows these supposed relationships:—



Key to the Species of *Andriopora.*

A. Apertural spines not markedly thickened.

- I. Apertural bar not produced vertically, nor much compressed in a vertical plane.
  - *a.* Costal fusions less perfect; costæ about 16 or fewer.
    - 1. Œcia shorter; apertural bar not very wide.
      - *α.* Caudæ short, or none; capitula rounded ... 1. *A. brevis.*
      - *β.* Caudæ longer; capitula not so rounded (fig. 40)........ 2. *A. mockleri.*
    - 2. Œcia longer; apertural bar very wide; caudæ shorter; capitula long and narrow (fig. 41)... 3. *A. arion.*
  - *b.* Costal fusions more perfect; costæ about 18; a tendency to solid, upturned ends of costæ in median line of fusion (fig. 42) .... 11. *A. gallica.*
- II. Apertural bar produced vertically, or flattened in a vertical plane to form a rudimentary proximal shield.
  - *a.* Apertural bar very slightly flattened and produced vertically in a median spine; costæ 16 to 18 (fig. 43) .... 4. *A. limax.*
  - *b.* Apertural bar somewhat flattened and sloping proximally; aviculœcia, if present, directed away from the mid-line of the orthœcium they accompany; costæ 12–15.
    - 1. Caudæ short (fig. 44)........ 5. *A. linearis.*
    - 2. Caudæ long (fig. 45) .... 6. *A. porrecta.*
  - *c.* Apertural bar much flattened in a vertical plane; aviculœcia directed towards the mid-line of the orthœcium they accompany; costæ 15–22 (fig. 46) 7. *A. homunculus.*

B. Apertural spines decidedly thickened.

- I. Œcia stout, caudæ short, or none.
  - *a.* Costæ slightly fused; apertural bar with a median process; costæ about 12 (fig. 47) ...... 10. *A. gasteri.*
  - *b.* Costæ firmly fused; apertural bar not specially modified; costæ about 18 (fig. 48) .... 12. *A. frequens.*
- II. Œcia meagre; caudæ long.
  - *a.* Costæ slightly fused, about 9 in number (fig. 49). 8. *A. levinseni.*
  - *b.* Costæ firmly fused, about 15 in number (fig. 50). 9. *A. aggregata.*

1. Andriopora brevis (von Reuss).

Hippothoa brevis n. sp.; Reuss, 1872, p. 100, pl. xxiv, fig. 1; Untere Pläner; Saxony.

Hippothoida brevis, Reuss; Vine, 1893, p. 316.

Hippothoa brevis, Gein.; Frič, 1911, p. 98; Cenomanian; Saxony.

Andriopora brevis (Reuss); Lang, 1916, pp. 383–4; Cenomanian; Saxony.
Hippothoida brevis Vine; Lang, 1917, p. 171.
Hippothoa brevis Reuss; Lang, 1917, p. 171.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is not produced vertically, nor much compressed in a vertical plane; the costal fusions are less perfect; the costæ are less than sixteen in number; the caudæ are short, or there are none; and the capitula are rounded.

Distribution.—Cenomanian, Untere Pläner, Saxony.

Type-specimen.—That figured by von Reuss, 1872, pl. xxiv, fig. 1, is here selected.

Remarks.—It is difficult, from von Reuss's figure and description alone, to interpret *Andriopora brevis*. But, if the above interpretation is right, it stands at the base of those lineages of *Andriopora* in which the apertural spines remain unenlarged, and is ancestral to *A. mockleri*, which has longer caudæ, less squat œcia, and more costæ.

Specimens.—None in the Collection.

2. Andriopora mockleri, Lang.

Andriopora möckleri [sic], sp. n.; Lang, 1916, pp. 383–4; Chalk Marl; Cambridge.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is not produced vertically, nor much compressed in a vertical plane; the costal fusions are less perfect; the costæ are about 14 in number; the caudæ are well-developed and the capitula rather elongate.

Description.—Asty uniserial, incrusting; œcia monomorphic; capitula about ·35 mm. long and ·16 mm. wide; caudæ from a half to as long as the capitula; extraterminal front-wall well-arched, consisting of a narrow band encircling the capitulum, thinning out distally and widening proximally to form a somewhat triangular proximal end of the capitulum, and tapering into the cauda; the intraterminal front-wall is well-arched, is elliptical in shape, and occupies all the upper part of the capitulum except the extreme proximal end; it consists of about fourteen costæ, lying close together, having no lateral fusions, but united in a median line of fusion; apertural bar narrow and, apparently, undifferentiated;

apertural spines, if present, minute; aperture super-semicircular to sub-normal.

Distribution.—Cenomanian, Chalk Marl. Cambridge.

Type-specimen.—D. 23020. Cenomanian, zone of *S. varians*, Chalk Marl, 10 ft. from the base. Cambridge. F. Möckler collection. 1912.

Remarks.—Except, possibly, *Andriopora brevis*, *A. mockleri* is the most primitive species of its genus. It is of interest, therefore, to compare it with the hypothetical primitive *Andriopora*. The characters of this hypothetical form were given above (p. 87). It was a uniserial form with bilateral branching; with minute, non-caudate, squat-shaped œcia; few and loosely-fused costæ; no aviculœcia; undifferentiated apertural bar; sub-semicircular aperture; and no, or but very minute, apertural spines. *A. mockleri* differs from this form: (*a*) in probably having largely lost bilateral branching; (*b*) in the development of caudæ; (*c*) in a slight increase of the œcial length compared with breadth; (*d*) in an increase in the number of costæ; and (*e*) in an advance to a super-semicircular aperture. And this progress is in keeping with the development postulated for the Andrioporidæ in general (p. 85). Two lines of evolution diverge from *A. mockleri*. In the one, represented by *A. arion*, the apertural bar becomes wider, but is not flattened in a vertical plane. In the other, the apertural bar becomes flattened in a vertical plane to form a rudimentary proximal shield; and to it belong the species *A. limax* (with its derivative genus *Argopora*), *A. linearis*, *A. porrecta*, and *A. homunculus* (with the genus *Angelopora*). The Pliophlœinæ also are probably derived from a form near *A. mockleri*.

Figures.—Text-fig. 40. An œcium.

Plate III, fig. 1. The type, consisting of four imperfect œcia. Cenomanian, Chalk Marl. Cambridge. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

3. Andriopora arion, Lang.

Andriopora arion, sp. n.; Lang, 1916, pp. 383–4; low in *M. cortestudinarium*-zone; S.E. of Boxmoor, Herts.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is not produced vertically, nor flattened in a vertical plane; costal fusions are less perfect;

costæ about fourteen in number; œcial capitula are long-elliptical in shape and the caudæ are short; the apertural bar is very wide.

Description.—Asty uniserial, incrusting; œcia dimorphic; orthœcia about ·57 mm. long (of which about ·4 mm. is occupied by the capitulum and ·17 mm. by the cauda) and ·16 mm. wide; extraterminal front-wall very small laterally, and mainly consisting of the cauda proximally; the intraterminal front-wall is well-arched and consists of about fourteen closely-placed costæ with no lateral fusions, but firmly united in a median line of fusion; apertural bar flat and very wide; apertural spines very small;

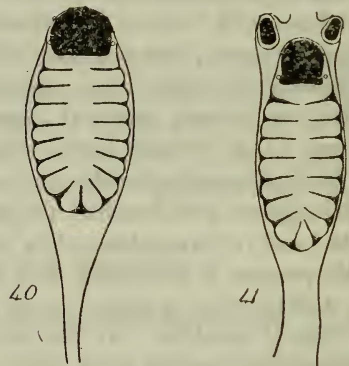


Fig. 40.—*Andriopora möckleri.* Diagram of an œcium, from above. × about 75 diameters.

Fig. 41.—*A. arion.* Diagram of an orthœcium and its accompanying pair of aviculœcia, from above. × about 75 diameters.

aperture super-normal to cribriline or super-cribriline; aviculœcia paired, one of each pair lying distally and laterally with respect to the aperture of each orthœcium, directed distally and away from the mid-line of the aperture it accompanies, small, with blunt, oval apertures slightly constricted near the middle; possibly with minute spines on their distal rims.

Distribution.—Senonian, Coniacian, [low in the] zone of *Micraster cortestudinarium*; Nash Mills, Boxmoor, Herts.

Type-specimen.—D. 25544. F. Möckler collection. 1912.

Remarks.—*Andriopora arion* shows a further advance on *A. mockleri* in the greater size of the œcia, the greater length of the capitula compared with their breadth, the greater breadth of the apertural bar, the shape of the aperture, and the acquisition of aviculœcia. The shorter caudæ may represent a catagenesis of this feature. But, possibly, *A. arion* broke away from *A. mockleri* before the latter had acquired its long caudæ; or, more probably, the cauda of anyone œcium varies in length according to the position on its branch of that œcium, that is, whether it is nearer to or further from a main stem; and, if more of the specimen were preserved, this might be apparent.

Figures.—Text-fig. 41. An orthœcium and aviculœcia.

Plate III, fig. 2. The type-specimen, consisting of three orthœcia with their attendant aviculœcia. Senonian, zone of *M. cortestudinarium.* Nash Mills, Herts. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

4. Andriopora limax, Lang.

Andriopora limax, sp. n.; Lang, 1916, pp. 384–5; *M. cortestudinarium*-zone; Luton, S.E. of Chatham, Kent.

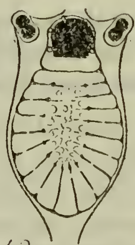
Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is slightly flattened in a vertical plane and has a slight median spine; costæ 16–19.

Description.—Asty incrusting, uniserial, tending to become multiserial through a decrease in the angle of branching; œcia dimorphic; orthœcia about ·44 mm. long and ·18 mm. wide, elliptical with no caudæ or very short caudæ; extraterminal front-wall of very small size; the intraterminal front-wall is well-arched and consists of about eighteen closely-placed costæ, firmly united in a wide median area of fusion; this area is sometimes perforated towards its periphery (*e.g.*, in specimen **D. 28517**), showing how the costal heads have retreated from the mid-line and are joined by lateral fusions; apertural bar somewhat flattened in a vertical plane, and with a slight median projection or spine; apertural spines very minute; aperture sub-normal; aviculœcia paired, one of each pair lying laterally and somewhat distally with respect to the aperture of each orthœcium, directed distally and away from the mid-line of the aperture they accompany; very small, with blunt, oval apertures slightly constricted near the middle; their much thickened distal rims possibly bear minute spines.

Distribution.—Senonian, zone of *M. cortestudinarium.* S. England.

TYPE-SPECIMEN.—D. 21953. Luton, Kent. W. Gamble coll.

REMARKS.—The apertural bar of *Andriopora limax* has developed in a manner different from that of *A. arion*. Both may be derived from *A. mockleri*, but in the case of *A. arion* the apertural bar remained flat and became wider; while *A. limax* is to be derived from a form derived, in turn, from *A. mockleri*, in which the apertural bar became flattened in a plane approaching the vertical. From this hypothetical *A. mockleri*-derivative are descended, on the one hand, *A. limax*, and, on the other hand, a form from which the lineages of *A. linearis* and *A. homunculus* arise. *A. limax* differs from both these in the median process or spine that its apertural bar develops, and from *A. linearis* in the plane of flattening of the apertural bar, which is more vertical. *A. limax* also shows an advance upon *A. mockleri* by the greater size of the œcia; the greater comparative length of the œcia; the greater number of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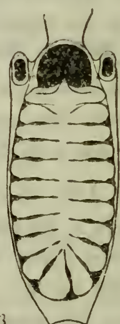
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Fig. 42.—*Andriopora gallica*. Fig. 43.—*A. limax*. Diagrams of orthœcia each with a pair of aviculœcia, from above. × about 75 diameters.

the costæ and their more complete fusion in the median area; the shape of the aperture; and the presence of paired aviculœcia. The significance of the last character has been fully discussed (Introd., § 14). The absence of caudæ is probably primitive, in which case *A. limax* broke away from *A. mockleri* before the latter had developed caudæ; or it may be due to catagenesis in this character. *A. limax* is the probable ancestor of the genus *Argopora*.

FIGURES.—Text-fig. 43. Orthœcium and aviculœcia.

Plate III, fig. 3. Four complete orthœcia of the type-specimen, and an ovicell accompanying part of a fifth orthœcium; five aviculœcia also are shown. Senonian, zone of *M. cortestudinarium*. Luton, Kent. × about 27 diameters.

LIST OF SPECIMENS.

D. 4041. D. 11122. D. 27901. D. 28516–7. D. 29100. Six paratypes. Lower Senonian. Chatham, Kent. Collected by W. Gamble, Esq. 1898, 1901.

D. 27880. Paratype, showing well the character of the apertural bar. Senonian, Coniacian, [low in the] zone of *M. cortestudinarium*. Nash Mills, S.E. of Boxmoor, Herts. F. Möckler collection. 1912.

D. 21953. D. 21952. D. 21954. Type-specimen and two paratypes. Senonian, Coniacian, lowest third of zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 27008. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Lower pit, Sline's Oak, Worms Heath, Warlingham, Surrey. Collected by C. P. Chatwin, Esq., F.G.S. F. Möckler collection. 1912.

D. 25037. D. 25116. Two paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*. Seaford, Sussex. F. Möckler collection. 1912.

D. 20579. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Seaford, Sussex. Collected by C. D. Sherborn, Esq., F.G.S. 1911.

D. 28244. Paratype, showing well the character of the apertural bar. Senonian, Coniacian, zone of *M. cortestudinarium*. Between Hope Gap and Cuckmere Haven, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 16th January, 1915.

5. Andriopora linearis, Lang ex Vine MS.

Cribrilina linearis, sp. n.; Vine, 1893, pp. 316, 336; Upper Chalk; Chatham [nomen nudum].

Cribrilina linearis, Vine; Jukes-Browne, 1904, p. 490; zone of *M. cortestudinarium*; Charlton, Kent [name only].

Cribrilina lineata [sic] Vine; White, 1913, p. 38; zone of *M. coranguinum*; Fareham and Havant district, Hants [name only].

Andriopora linearis (Vine); Lang, 1916, p. 384; Lower Senonian; Chatham, Kent.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is somewhat flattened in a more or less vertical but somewhat backwardly-sloping plane; it has a slight median ridge, but not, as a rule, any median spine; the aviculœcia are directed away from the mid-line of the aperture they accompany; the costæ are about 15; the œcia have no caudæ or but short caudæ.

Description.—Asty incrusting, uniserial; œcia dimorphic; orthœcia about ·5 mm. or less long and ·28 mm. wide, oval-elliptical, and non-caudate or but shortly caudate; extraterminal front-wall consisting mainly of a lateral selvedge and somewhat wider proximal portion ; the intraterminal front-wall is well-arched but not so vaulted as in *A. arion*, and consists of about fourteen to sixteen closely-spaced costæ, firmly united in a wide median band of fusion ; the swollen costal heads have retreated to some distance from the mid-line and are connected by strong fusions, and there are sometimes perforations in the median area of fusion ; apertural bar wide, and flattened in a plane that does not approximate so nearly to the vertical as in *A. limax*, but slopes backwards ; there is a median ridge that carries the backward extension of the apertural bar to something of a point, but there is not as a rule any tendency to a vertically-directed spine, as in *A. limax*; this is primarily due to the tilt of the plane of flattening, which in *A. limax* carries the proximal edge more vertically, so that any extension of the median ridge appears as a vertical or even distally-directed projection ; whereas in *A. linearis*, with its backwardly-sloping plane of flattening, any extension of the median ridge has to be considerably pronounced to appear to be in any sense a median spine ; apertural spines, if present, very minute ; aperture normal to cribriline in shape ; aviculœcia paired, one of each pair lying laterally and somewhat distally with regard to the aperture of each orthœcium (though occasionally, as in specimen **D. 2792**, redundant aviculœcia occur), directed distally, somewhat upwards and away from the mid-line of the aperture they accompany ; very small, with blunt, oval apertures slightly constricted at about the middle ; with very much thickened distal rims, which may bear minute spines.

Distribution.—Senonian, Coniacian, zone of *Micraster cortestudinarium*, and Santonian, lower part of the zone of *M. coranguinum*. Southern England.

Type-specimen.—**D. 2638.** Lower Senonian. Chatham, Kent. G. R. Vine collection.

Remarks.—Though Vine named *Cribrilina linearis* in 1893, he did not give any figure or description ; and, were it not that his type-specimen, labelled as such by Vine himself, is among his specimens in the Museum Collection, it would not be possible to determine his species with certainty. As it is, his name *Cribrilina linearis* is strictly a *nomen nudum* ; but, since no other name claims the species, Vine's name may very well be adopted.

Owing to the existence of Vine's type-specimen, there can be no doubt as to what Vine meant by *Cribrilina linearis*; consequently there should be no valid objection to citing Vine as the author of the name. It is, however, necessary to write "Vine, MS." to prevent infringement of the ruling of Articles 21 and 25 *a* of the Nomenclature Code adopted by the 9th International Zoological Congress.

Andriopora linearis closely resembles *A. limax*, but differs from that species in being larger, wider in proportion to its length, having rather fewer costæ, a more advanced aperture, but mainly in the apertural bar, which is somewhat flattened, as in *A. limax*, but the plane of flattening more inclined backwards, so that emergences in the mid-line are more apparent as prolongations of the proximal edge than as vertically-directed spines. It is also of interest that *A. limax* nearly always incrusts a Polyzoan with a cylindrical asty of small diameter, such as *Entalophora*; and is

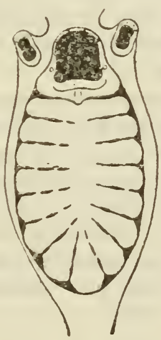

Fig. 44.—*Andriopora linearis*. Diagram of an orthœcium and its accompanying aviculœcia, from above. × about 75 diameters.

characteristic of, if not confined to, the *Micraster cortestudinarium*-zone; while *Andriopora linearis* generally incrusts a flat surface and is found in both the *Micraster cortestudinarium*- and *M. coranguinum*-zones.

Figures.—Text-fig. 44. Orthœcium and two aviculœcia.

Plate III, fig. 4. Seven orthœcia of the type-specimen, two of which bear broken ovicells, and all have a pair of accompanying aviculœcia. Lower Senonian. Chatham, Kent. × about 27 diameters.

LIST OF SPECIMENS.

D. 2638. D. 2637. D. 347. D. 2792. D. 4152. D. 4219. D. 4991. D. 11124. D. 11289. D. 12201. D. 27904. D. 29094–5. Type-, paratype-, and eleven other specimens, of which **D. 2792** has, in places, redundant aviculœcia. Lower Senonian. Chatham, Kent. G. R. Vine (**D. 2637–8. D. 2792**) and W. Gamble collections. 1893, 1898, 1900–1.

D. 24883. Senonian, Coniacian, base of the zone of *Micraster cortestudinarium.* Luton Valley, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 21947–8. Two asties. Senonian, Coniacian, zone of *Micraster cortestudinarium.* Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 24356. D. 28527. Two asties. Senonian, Coniacian, zone of *M. cortestudinarium.* Chatham, Kent. Collected by W. Gamble, Esq. 1906, 1911.

D. 8361. D. 27852. Two asties. Senonian, Coniacian, top of zone of *Micraster cortestudinarium.* Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1906.

D. 21188. Senonian, Santonian, zone of *Micraster coranguinum.* Wooburn Green, S.W. of Beaconsfield, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 29039–42. Four asties. Senonian, Santonian, zone of *Micraster coranguinum.* East Marden, N.W. of Chichester, Sussex. Presented by W. Wright, Esq., F.G.S., 22nd Sept., 1916.

D. 8210. An asty showing well the characters of the apertural bar. Senonian, Santonian, zone of *Micraster coranguinum.* Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1905.

D. 21945–6. Two asties. Senonian, Santonian, zone of *Micraster coranguinum.* Earle's Pit near Strood, N.W. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

6. Andriopora porrecta, Lang.

Andriopora porrecta, sp. n.; Lang, 1916, p. 384; *M. coranguinum*-zone; Charlton, Kent.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is somewhat flattened in a more or less vertical, but somewhat backwardly-sloping plane; the apertural bar has a slight median ridge, but not, as a rule, any tendency to a median spine; the costæ number about 12; the œcia have long caudæ.

Description.—Asty uniserial, incrusting; œcia probably monomorphic; œcia with caudæ as long or longer than the capitula; capitula about ·33 mm. long and ·12 mm. wide, elliptical; extraterminal front-wall confined to the cauda, a narrow proximal strip of the capitulum, and a narrow lateral selvedge of the capitulum; the intraterminal front-wall is well-arched and consists of about twelve fairly closely-placed costæ firmly united in a median area of fusion; the costal heads have retreated to some distance from the mid-line and are more firmly fused than the prolongations of the costæ in the mid-area of fusion; apertural bar somewhat flattened in a vertical plane; apertural spines minute; apertures cribriline.

Distribution.—Senonian, Santonian, zone of *Micraster coranguinum*. Charlton, Kent.

Type-specimen.—D. 7308. J. B. Ogle collection. 1891.

Remarks.—*Andriopora porrecta* may be derived directly from *A. linearis* by a lengthening of the caudæ, by a catagenetic reduction in the number of costæ, by a catagenetic reduction in the size of the œcium and in its comparative breadth, by an advance in the shape of the aperture, and, possibly, by the loss of aviculœcia. It is possible that *A. porrecta* may be an extreme gerontastic stage of *A. linearis*; but a specimen belonging to Dr. Rowe of Margate, and kindly lent by him to me for study, shows œcia like those of *A. linearis*, but possessing long caudæ and aviculœcia, and is probably a gerontastic *A. linearis*. The costæ in Dr. Rowe's specimen are more numerous than those of *A. porrecta*, the œcia longer and comparatively wider, and the apertures less advanced. It is still possible, however, that *A. porrecta* shows a still further advanced astogenetic stage and not a phylogenetic stage of *A. linearis*. It is convenient, however, until this point is established, to give *A. porrecta* the latter status and to regard it provisionally as a distinct species.

Figures.—Text-fig. 45. An œcium.

Plate III, fig. 5. Two complete œcia of the type-specimen. Senonian, zone of *M. coranguinum*. Charlton, Kent. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

7. Andriopora homunculus, Lang.

Andriopora homunculus, sp. n.; Lang, 1916, pp. 384, 383; *H. planus*-zone; Borstal, S.W. of Chatham, Kent.

Diagnosis.—*Andriopora* in which the apertural spines are not markedly thickened; the apertural bar is considerably flattened in a strictly vertical plane, so as to form a small proximal shield of a secondary aperture; the aviculœcia are generally directed towards the mid-line of the aperture they accompany; the costæ number 15–22; the œcia have no caudæ or but very short caudæ.

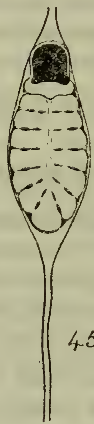

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Fig. 45.—*Andriopora porrecta.* Diagram of an œcium, from above. × about 75 diameters.

Fig. 46.—*A. homunculus.* Diagram of an orthœcium with an ovicell and its accompanying pair of aviculœcia, from above. × about 75 diameters.

Description.—Asty incrusting, uniserial; œcia dimorphic; orthœcia about ·55 mm. long and ·25 mm. wide, long-elliptical; extraterminal front-wall of very small extent laterally and somewhat wider proximally; the intraterminal front-wall is well-arched and consists of about eighteen to twenty-two closely-placed costæ united in a median line of fusion; as a rule, lateral costal fusions do not appear to be present, even at a long distance from the mid-line; apertural bar flattened in a strictly vertical plane, producing a small, but well-defined proximal shield to the secondary aperture; apertural spines minute; apertures super-semicircular to normal; aviculœcia, generally a pair accompanying the aperture of every orthœcium, placed laterally and somewhat distally with regard to these apertures, distally directed, but generally inclined so that they point somewhat towards the mid-line of the œcium they accompany; small, blunt, with but slightly-lengthened, constricted apertures; ovicells hyperstomial, and formed like the intraterminal front-walls of flattened spines.

Distribution.—Turonian, zone of *H. planus*. Borstal Manor, S.W. of Chatham, Kent.

Type-specimen.—D. 8212. W. Gamble collection. 1905.

Remarks.—*Andriopora homunculus* may be distinguished at once from the other species of *Andriopora* with minute apertural spines by the large number of its costæ and the strictly vertical position of the plane of flattening of the apertural bar. It may be derived from an ancestor common to it and the *A. linearis*–*A. porrecta* lineage; but, while in *A. linearis* the œcia became squat and developed caudæ, and the apertural flattening did not attain a truly vertical position, in *A. homunculus* the œcium becomes more elongate, acquires more costæ, the asty becomes more compact, and the plane of flattening of the apertural bar becomes strictly vertical. *Andriopora homunculus* further evolves into *Angelopora* by becoming multiserial and acquiring a more consolidated front-wall.

Figures.—Text-fig. 46. Orthœcium with an ovicell and aviculœcia.

Plate III, fig. 6. Seven complete orthœcia of the type-specimen. Some orthœcia bear broken ovicells and most have a pair of aviculœcia accompanying their apertures. Turonian, zone of *H. planus*. Borstal Manor, Kent. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

8. Andriopora levinseni, Lang.

Andriopora levinseni, sp. n.; Lang, 1916, pp. 384–5; *B. mucronata*-zone; Rügen.

Diagnosis.—*Andriopora* in which the apertural spines are decidedly thickened; the œcia are meagre and the caudæ (probably) long; the costæ are about 8 or 9 in number and but slightly fused.

Description.—Asty incrusting, uniserial; œcia ? monomorphic, probably caudate, the capitula being about ·33 mm. long and about ·16 mm. wide, elliptical; extraterminal front-wall very small; the intraterminal front-wall is much arched and consists of about eight or nine rather widely-spaced costæ united in a median line of fusion, but, apparently, with no intercostal fusion; apertural bar of about the same thickness as the costæ, but with a median boss or tubercle; the six apertural spines are decidedly thickened; aperture cribriline to super-cribriline.

Distribution.—Senonian, Campanian, zone of *Belemnitella mucronata*. Rügen.

Type-specimen.—D. 28235. Agnes Laur collection. 1909.

Remarks.—The species of *Andriopora* hitherto considered all had apertural spines so minute that in many cases it was difficult to demonstrate with certainty that they possessed these structures.

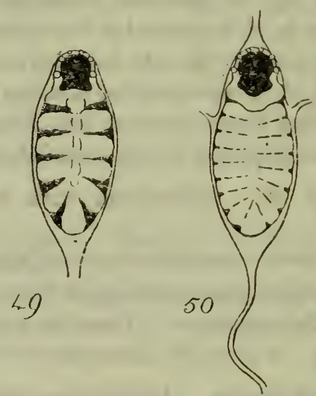

Fig. 49.—*Andriopora levinseni*. Diagram of an œcium, from above. × about 75 diameters.

Fig. 50.—*A. aggregata*. Diagram of an orthœcium, from above. × about 75 diameters.

Early in the evolutionary history of *Andriopora* it must be supposed that a stock arose in which the apertural spines tended to become enlarged; and that comparatively primitive members of this stock persisted until the highest Senonian times. For *A. levinseni* is such a form, exhibiting, as it does, primitive characters, such as a loosely-knit intraterminal front-wall of few costæ and a small elongate œcium, with a somewhat crudely-elaborated apertural bar; and, at the same time, enlarged apertural spines and an advanced apertural shape. From *A. levinseni* or a very similar form, it is possible that *A. aggregata* arose.

FIGURES.—Text-fig. 49. An œcium.

Plate III, fig. 7. The type-specimen. Senonian, zone of *B. mucronata*. Rügen. × about 27 diameters.

SPECIMENS.—Type-specimen. Distribution and collection as above.

9. Andriopora aggregata (Marsson).

Hippothoa aggregata n. sp.; Marsson, 1887, pp. 92, 108, pl. ix, fig. 10; Senon, Weisse Schreibkreide; Rügen.

Hippothoa aggregata Marss.; Deecke, 1895, p. 79; Senon; Rügen.

Andriopora aggregata (Marsson); Lang, 1916, pp. 384–5; *B. mucronata*-zone; Rügen.

DIAGNOSIS.—*Andriopora* in which the apertural spines are markedly thickened; the œcia are meagre, the caudæ long; the costæ are about 14–16 in number and each is united to its neighbour by several lateral fusions.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia with long caudæ; the capitula are about ·33 mm. long and ·16 mm. wide; the extraterminal front-wall is confined to the caudæ, and to a narrow proximal strip and very narrow lateral strips of the captula; the intraterminal front-wall is rather flatly arched, and consists of about fifteen closely-set costæ, firmly knit by lateral fusions towards their proximal ends, and more or less irregularly fused at intervals between these lateral fusions and the mid-line, where there is a strong line of fusion; the costæ lie so close together that there are no definite perforations between the lateral costal fusions, as in the advanced forms of Pelmatoporidæ; apertural bar wider and thicker than the normal costæ; the six apertural spines are decidedly enlarged; the apertures are cribriline to slightly pliophlœan in shape; aviculœcia occasional, irregularly placed, very small, with elongate, rather blunt apertures; ovicells hyperstomial.

DISTRIBUTION.—Senonian, Campanian, zone of *B. mucronata*. Rügen.

TYPE-SPECIMEN.—That figured by Marsson, 1887, pl. ix, fig. 10, is hereby selected.

REMARKS.—*Andriopora aggregata* may be derived from a form near *A. levinseni* by an increase in the number of costæ, a great compaction of the intraterminal front-wall, and an advance from a cribriline to a slightly pliophlœan aperture. The last character is of interest, as outside the Pliophlœinæ this type of aperture is not definitely attained in the Andrioporidæ. *A. levinseni* has, moreover, a differently developed apertural bar, having on it a median boss or tubercle; while in *A. aggregata*, the apertural bar is more or less uniformly thickened and widened.

FIGURES.—Text-fig. 50. An orthœcium.

Plate III, fig. 8. Four orthœcia of specimen **D. 16617**, of which one bears an ovicell. Senonian, zone of *B. mucronata*. Rügen. × about 27 diameters.

LIST OF SPECIMENS.

D. 16506. D. 16617. D. 16644. D. 16895. Upper Senonian, Campanian, zone of *B. mucronata*. Rügen. Agnes Laur collection. 1906, 1909.

10. Andriopora gasteri, Lang.

Andriopora gasteri, sp. n.; Lang, 1916, pp. 384–5; *M. cortestudinarium*-zone; Cuckmere Haven, Sussex.

DIAGNOSIS.—*Andriopora* in which the apertural spines are markedly thickened; the œcia are short compared with their length, with no caudæ or with very short caudæ; the costæ are loosely-fused and 10–12 in number; the apertural bar has a median process.

DESCRIPTION.—Asty uniserial, incrusting; œcia dimorphic; orthœcia about ·33–·4 mm. long and ·25–·3 mm. wide, oval; the extraterminal front-wall is well-arched, and consists of about 10–12 not very closely-placed costæ with no lateral fusions, but firmly united in a broad median area, and tending there to have the extreme distal ends pinched up into a median ridge; apertural bar narrow, with a median tubercle produced into a spine; the six apertural spines are considerably thickened; aperture super-semicircular to normal; traces of aviculœcia are present, but not perfectly enough preserved for the characters to be clearly determined.

DISTRIBUTION.—Senonian, Coniacian, zone of *M. cortestudinarium*. Between Hope Gap and Cuckmere Haven, Sussex.

TYPE-SPECIMEN.—**D. 28249.** Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

REMARKS.—*Andriopora gasteri* is a somewhat isolated form, belonging to that main group of *Andriopora* which is characterised by enlarged apertural spines, but breaking off from the primitive lineage of this main stock (which is known by the simple, yet high-zonal *A. levinseni* and the more complex *A. aggregata*) in Turonian or Cenomanian times. This branch-lineage itself soon divided into a group of forms represented by *A. gasteri* and the derived genera *Eucheilopora*, *Pancheilopora*, and *Hippiopora* (while the allied genera *Nannopora*, *Tricolpopora*, and *Distansescharella* must have diverged close to this group—genera characterised by few loosely-knit costæ, very strongly-developed apertural spines, and a tendency for the apertural bar to be produced upwards in a median spine); and a second group, represented by

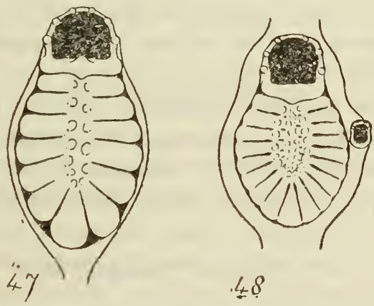

Fig. 47.—*Andriopora gasteri.* Diagram of an orthœcium, from above. × about 75 diameters.

Fig. 48.—*Andriopora frequens.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Andriopora gallica, its descendant *A. frequens*, the genera *Æolopora* and *Auchenopora*, and probably the sub-family Schistacanthoporinæ, with more closely-knit costæ, less strongly-developed apertural spines, and an undifferentiated apertural bar.

Figures.—Text-fig. 47. An orthœcium.

Plate III, fig. 9. Part of the type-specimen, consisting of five orthœcia, two of which are broken, and the aperture of a sixth. One of the broken orthœcia bears a broken ovicell and close to the other is an aviculœcium. Senonian, zone of *M. cortestudinarium.* Cuckmere Haven, Sussex. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

11. Andriopora gallica, Lang.

Andriopora gallica, sp. n.; Lang, 1916, pp. 383–4; Coniacian; Fécamp, France.

Diagnosis.—*Andriopora* with but slightly thickened apertural spines; the apertural bar is not produced vertically nor much compressed in a vertical plane; the costæ are firmly-knit and their solid distal ends are upturned in the median area of fusion; costæ about 18.

Description.—Asty incrusting, uniserial, with a tendency to become multiserial; œcia dimorphic; orthœcia non-caudate, about ·33 mm. long and ·25 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is somewhat flatly-arched, and consists of about eighteen closely-placed and well-knit costæ, whose solid distal ends are somewhat constricted from the rest, are upturned, and have retreated a little way from the median area of fusion, which is, consequently, wide; it is also rugose with structures that appear to be the results of further constrictions of the extreme distal ends of the costæ; there are also, apparently, a certain number of irregularly placed intercostal lateral fusions, but the costæ lie so close together that the distribution, or even the presence, of these cannot be definitely determined; the apertural bar is comparatively thin and undifferentiated; the six apertural spines are but slightly thickened; the aperture is small and normal; aviculœcia confined to one, or a pair, placed laterally with regard to the aperture of every or nearly every orthœcium; they are distally and obliquely directed away from the mid-line of the aperture each accompanies; they are very small, with constricted, elongate, and somewhat blunt apertures.

Distribution.—Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France.

Type-specimen.—D. 28480. In exchange with F. Canu, 1914.

Remarks.—*Andriopora gallica* has the least differentiated apertural spines of all the species of *Andriopora* in the branch characterised by an enlarged condition of these structures. Thus, it diverged from the lineage to which *A. gasteri* belongs before that lineage had acquired greatly-thickened apertural spines. In most other respects, especially in the compaction of the intraterminal front-wall, *A. gallica* has advanced beyond *A. gasteri*; and the tendency to constriction of the solid distal ends of the costæ observable in the latter species is still more marked in the former; moreover, in *A. gallica* these nipped-off ends retreat somewhat from the mid-line. On the other hand, the apertural bar of *A. gallica* shows no such median process as appears in *A. gasteri*. *A. gallica* (or, rather, a form in which the aviculœcia are not so far advanced in evolution) gives rise to *A. frequens*, which is probably the common ancestor of the genera *Æolopora* and *Auchenopora*, and of the sub-family Schistacanthoporinæ.

Figures.—Text-fig. 42 (p. 98). Orthœcium and two aviculœcia.

Plate III, fig. 10. Four orthœcia and four aviculœcia of the type-specimen. Coniacian. Fécamp, France. × about 27 diameters.

LIST OF SPECIMENS.

D. 28480. D. 28481. D. 28483. Type-specimen and two paratypes. Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France. In exchange with Monsieur F. Canu, 1914.

12. Andriopora frequens, Lang.

Andriopora frequens, sp. n.; Lang, 1916, pp. 384–5; *M. cortestudinarium*-zone; Cuckmere Haven, Sussex.

Diagnosis.—*Andriopora* in which the apertural spines are decidedly thickened; the œcia are short compared with their length; the costæ are firmly fused, and about 18 in number; the apertural bar is undifferentiated.

Description.—Asty incrusting, uniserial, becoming multiserial in its later stages; œcia dimorphic; orthœcia non-caudate, about ·33 mm. long and ·28–·3 mm. wide, very shortly oval; extra-terminal front-wall often rather wide laterally; the intraterminal front-wall is rather flatly-arched and well compacted, and consists of about eighteen closely-placed costæ whose solid distal ends tend to be separated by a constriction from the rest, are upturned, and removed to some distance from the mid-line, so that there is a wide median area of fusion in which further tubercle-like off-nippings of the costæ lie somewhat irregularly; there is a fairly regular line of lateral costal fusions close to the proximal ends of the costæ, and probably other costal fusions occurring irregularly between these and the median area of fusion ; apertural bar comparatively thin and undifferentiated ; the six apertural spines are decidedly, though not excessively, enlarged ; the apertures are normal ; aviculœcia are comparatively rare and sporadically distributed in the interœcial valleys ; they are not very small, and have more or less circular apertures with five or six minute, distally-placed apertural spines.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium.* Sussex.

Type-specimen.—D. 28252.

Remarks.—*Andriopora frequens* closely resembles *A. gallica*, but has the apertural spines more decidedly thickened. It is probably derived from a form closely resembling *A. gallica*, but with less specialised aviculœcia ; for the aviculœcia of *A. frequens* have a more or less circular outline, and are sporadically distributed ; while the aviculœcia of *A. gallica* are elongate and more definitely distributed. *A. frequens* is probably the ancestor of the genera *Æolopora* and *Auchenopora*, and of the sub-family Schistacanthoporinæ.

Figures.—Text-fig. 48 (p. 109). Orthœcium and aviculœcium.

Plate III, fig. 11. Part of the type-specimen, consisting of an aviculœcium and ten orthœcia. Senonian, zone of *M. cortestudinarium.* Sussex. × about 27diameters.

LIST OF SPECIMENS.

D. 28252. D. 28251. Type-specimen and paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Between Hope Gap and Cuckmere Haven, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, January 1915.

II. ARGOPORA, Lang, 1916.

Argopora, gen. nov.; Lang, 1916, pp. 382, 385–6.

Diagnosis.—Multiserial incrusting Andrioporinæ in which there is no secondary aperture ; the median area of fusion has not a margin of solid spines or tubercles ; the apertural bar does not form a hump, nor is it much flattened in the vertical plane; the aviculœcia are numerous and not medianly and distally placed with regard to the apertures of the orthœcia; the furrows between the costæ are plainly visible; the apertural spines are not at all thickened; the apertures are not sub-semicircular; the œcia are comparatively large (about ·5 mm. long) and not very squat in shape.

Distribution.—Senonian, Coniacian to Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Southern England.

Genotype.—*Argopora segnis.*

Remarks.—*Argopora* may be derived directly from *Andriopora limax* by a greater solidification of the intraterminal front-wall and by becoming multiserial. There is a general tendency during its evolution for the œcia to increase in size and the costæ in number. Thus, *Argopora segnis* attains the length of about ·5 mm., but has about the same number of costæ as *Andriopora limax*; while a second lineage, represented by *A. pigra* and *A. improba*, increases the number of costæ to about twenty, and but gradually increases in œcial length. Another phase of evolution is expressed in *Argopora pigra*, characterised by an isolation of the aviculœcia in tissue which is either the greatly enlarged extraterminal front-walls of each aviculœcium, or cenœcial tissue on which the aviculœcia rest. This tendency to the isolation of aviculœcia occurs independently in several groups of the Andrioporinæ, and is specially characteristic of the genus *Distansescharella* in that sub-family, besides being frequent in the sub-family Pliophlœinæ. In *Argopora pigra* secondary tissue is piled up around the isolated aviculœcia.

Key to the Species of *Argopora*.

A. Costæ about 16; œcial length about ·5 mm. (fig. 51) ... 1. *A. segnis.*
B. Costæ about 20.
- I. Smaller (œcia about ·33 mm. long); much secondary tissue round the aviculœcia (fig. 52) .... 2. *A. pigra.*
- II. Larger (œcia about ·4 mm. long); little or no secondary tissue round the aviculœcia (fig. 53) .... 3. *A. improba.*

1. Argopora segnis, Lang.

Argopora segnis, sp. n.; Lang, 1916, pp. 385–6; Lower Senonian; Chatham, Kent.

Description.—Asty multiserial, with a tendency to be uniserial in neanastic stage, incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. long, and about ·2 mm. wide, elliptical; the extraterminal front-wall is of very small extent; the intraterminal front-wall is well-arched and consists of about sixteen closely-placed costæ, which are well-knit and have frequent, though, apparently, irregularly-arranged, lateral fusions, some of which occur towards the proximal ends of the costæ; the apertural bar is thin and comparatively undifferentiated; the apertural spines are exceedingly small; the apertures are normal; the aviculœcia consist of a pair placed laterally with regard to the aperture of each orthœcium; they are directed distally and somewhat obliquely away from the mid-line of the aperture they accompany; they are rather small, with somewhat elongate apertures.

Distribution.—Senonian; Coniacian or lowest Santonian. Chatham.

Type-specimen.—D. 4047.

Remarks.—*Argopora segnis* closely resembles *Andriopora limax*, from which it is probably derived. But, besides being multiserial, the intraterminal front-wall is more compacted and the œcia are somewhat larger.

Figures.—Text-fig. 51. Orthœcium and two aviculœcia.

Plate III, fig. 12. Part of the type-specimen, consisting of five complete orthœcia, four of which have ovicells, of a broken orthœcium, and of ten aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 4047. Type-specimen. Senonian, Coniacian, zone of *M. cortestudinarium*, or Santonian, base of zone of *M. coranguinum*. Chatham, Kent. Collected by W. Gamble, Esq. 1898.

D. 29881. Senonian, Coniacian, zone of *M. cortestudinarium*. Pit on Offham Hill, west of large pit, N.W. of Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

2. Argopora pigra, Lang.

Argopora pigra, sp. n.; Lang, 1916, pp. 385–6; Coniacian or Campanian; La Bonneville, France.

Diagnosis.—*Argopora* with about 20 costæ; œcia about ·33 mm. long; and with much secondary tissue surrounding the aviculœcia.

Distribution.—Senonian, La Bonneville, S.W. of Évreux, Eure, France.

Type-specimen.—In the collection of Monsieur F. Canu of Versailles.

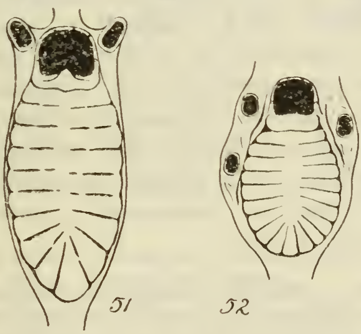

Fig. 51.—*Argopora segnis.* Diagram of an orthœcium and two aviculœcia, from above. × about 27 diameters.

Fig. 52.—*Argopora pigra.* Diagram of an orthœcium and three aviculœcia in the secondary interœcial tissue, from above. × 75 diameters.

Remarks.—*Argopora pigra* is chiefly remarkable for the abundant secondary tissue surrounding the aviculœcia and the tendency for the aviculœcia to be isolated by an enlargement of their intraterminal front-walls. This tendency is more noticeable in the Pliophlœinæ, where it is a characteristic feature, but it occurs sporadically in different Andrioporine genera, and is well expressed in *Distansescharella.*

Figures.—Text-fig. 52. Orthœcium and three aviculœcia.

Specimens.—Only a photograph of the type is in the Collection.

3. Argopora improba, Lang.

Argopora improba, sp. n.; Lang, 1916, pp. 385–6; *A. quadratus*-zone, *E. depressa*-subzone; E. of Brighton, Sussex.

Diagnosis.—*Argopora* with about 20 costæ; œcia about ·4 mm. long, with little secondary tissue around the aviculœcia.

Description.—Asty multiserial, incrusting, and unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and ·2 mm. wide, oval to elliptical; extraterminal front-wall extremely small; the intraterminal front-wall is somewhat flatly arched and consists of about twenty closely-placed costæ which are firmly-knit by numerous lateral fusions; as in the Andrioporinæ generally, however, the costæ are so closely-placed that the intercostal fusions are necessarily very short, and it is difficult to make out their exact distribution; the apertural bar is but little differentiated; the apertural spines are not enlarged; the aperture is normal; the aviculœcia are not altogether regularly distributed, but on the whole are arranged in pairs, one pair to each orthœcial aperture; they are rather small, with oval or elliptical apertures, but occasionally are somewhat isolated and surrounded by interœcial secondary tissue like those of *A. pigra*.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between the last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex.

Type-specimen.—D. 28912. Collected by C. T. A. Gaster, Esq., and presented by him, January 1916.

Remarks.—*Argopora improba* is more nearly allied to *A. pigra* than to *A. segnis*, having numerous costæ and a tendency for the aviculœcia to be isolated as well as surrounded by interœcial secondary tissue. It is larger, however, than *A. pigra*, and the secondary tissue is not nearly so strongly developed.

Figures.—Text-fig. 53. Orthœcium and two aviculœcia.

Specimens.—Type-specimen. Distribution and collection as above.

III. ANGELOPORA, Lang, 1916.

Angelopora, gen. nov.; Lang, 1916, pp. 382, 387.

Diagnosis.—Multiserial, incrusting Andrioporinæ in which there is no secondary aperture, or, at most, an imperfectly-developed proximal apertural shield; the median area of fusion has no margin of solid spines or tubercles; the aviculœcia are numerous, and not medianly and distally placed with regard to the apertures of the orthœcia; the furrows between the costæ are plainly visible; the apertural spines are not at all thickened; the apertural bar

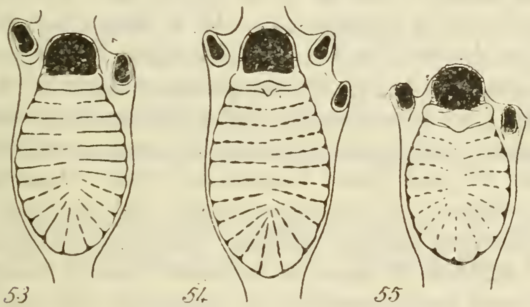

Fig. 53.—*Argopora improba.* Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

Fig. 54.—*Angelopora nuntia.* Diagram of an orthœcium and three aviculœcia, from above. × about 75 diameters.

Fig. 55.—*Angelopora missa.* Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

does not form a hump, but is much flattened in a vertical plane, forming a rudimentary proximal shield.

Distribution.—Senonian, Coniacian to Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Southern England.

Genotype.—*Angelopora nuntia.*

Remarks.—*Angelopora* is derived from a species of *Andriopora* near *A. homunculus*. In fact, *Angelopora nuntia* closely resembles that form, but, besides being multiserial, has a better consolidated intraterminal front-wall, and the aviculœcia are directed obliquely away from the mid-line of the orthœcium they accompany, instead of towards it, as in *Andriopora homunculus*; the œcia, too, are slightly smaller than those of *A. homunculus*, presumably a catagenetic feature; and the aviculœcia are more elongate than those of *A. homunculus*, are somewhat pointed, have, moreover, a slight tendency to isolation, as in *Argopora*, and, correlated with their isolation, become secondarily more numerous. It is possible that *Angelopora missa* is derived from *A. nuntia*, as suggested by its more consolidated intraterminal front-wall and the greater development of its proximal shield, as well as by its horizon. But, if so, both in œcial size and in the number of costæ it is catagenetic. If *A. nuntia* is derived from *Andriopora homunculus*, the œcial size is already catagenetic, and it is not surprising to find the diminution still greater in *Angelopora missa*; nor is it unusual to find a catagenesis in the number of the costæ. But the aviculœcia of *A. missa* resemble the blunt aviculœcia of *Andriopora homunculus* rather than the more pointed structures of *Angelopora nuntia*, and they have not the same tendency to become "isolated" like the aviculœcia of that species. If, then, *A. missa* is descended from *A. nuntia*, catagenesis must have overtaken the aviculœcia also—an unusual phenomenon.

Key to the Species of *Angelopora*.

A. Œcia about ·44 mm. long; costæ about 20; intraterminal front-wall rather flatly-arched; proximal shield not high; apertural spines minute .... 1. *A. nuntia*.

B. Œcia about ·36 mm. long; costæ about 17; intraterminal front-wall well arched; proximal shield very high; apertural spines larger .... 2. *A. missa*.

1. Angelopora nuntia, Lang.

Angelopora nuntia, sp. n.; Lang, 1916, p. 387; *M. coranguinum*-zone; Wooburn Green, Bucks.

Diagnosis.—*Angelopora* with œcia about ·44 mm. long; with about 20 costæ; with a flatly-arched intraterminal front-wall; with a low proximal shield; and with minute apertural spines.

Description.—Asty multiserial, incrusting, and unilaminar; œcia dimorphic; orthœcia about ·44 mm. long, and about ·18–·2 mm. wide, oval-elliptical; extraterminal front-wall minute; the intraterminal front-wall is somewhat flatly arched and consists of about twenty costæ, each of which has about four pairs of lateral fusions, and, since these tend to occur at corresponding levels on all the costæ, they often form concentric contour-like bands on the intraterminal front-wall; the apertural bar is much flattened in a vertical plane, so as to form an almost plate-like, though low, proximal shield; the apertural spines are minute; the apertures are normal; aviculœcia generally arranged in pairs, one of each pair on each side of the aperture of every orthœcium; but they also tend to aggregate in the interœcial spaces, and to be surmounted by a more or less wide expanse of tissue, apparently formed of their extraterminal front-walls, and thus to become "isolated"; they are generally distally directed, and those that are paired are directed obliquely and away from the mid-line of the aperture they accompany; their apertures are somewhat pointed and elongate.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium*, and Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen. D. 21214.

Remarks.—See under the genus *Angelopora*.

Figures.—Text-fig. 54. Orthœcium and three aviculœcia.

Plate III, fig. 13. Part of the type-specimen consisting of six orthœcia, four of which bear ovicells, and of eight aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 21214–6. Type-specimen and two paratypes. Senonian, Santonian, zone of *M. coranguinum*. Wooburn Green, S.W. of Beaconsfield, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 4040. D. 4048. D. 4060. Three paratypes. Senonian, Coniacian, zone of *M. cortestudinarium* or Santonian, base of zone of *M. coranguinum*. Chatham, Kent. Collected by W. Gamble, Esq. 1898.

D. 14965. A paratype. [Senonian, Coniacian, zone of *M. cortestudinarium.*] Dover, Kent. C. F. Cockburn collection, bequeathed, 1910.

D. 8378. D. 28533. Two large and well-preserved asties; paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*. Chatham, Kent. Collected by W. Gamble, Esq. 1906.

D. 8176. D. 8360. Paratypes. Senonian, Coniacian, upper part of zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1903, 1906.

D. 28245. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Between Hope Gap and Cuckmere Haven, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 11464–6. Three paratypes. Senonian, Coniacian, top of zone of *M. cortestudinarium* or Santonian; base of zone of *M. coranguinum*. Hertford. Presented by Prof. J. W. Gregory, F.R.S., 1899.

D. 24516–8. D. 28234. Four paratypes. Senonian, Coniacian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

2. Angelopora missa, new species.

Diagnosis.—*Angelopora* with œcia about ·36 mm. long; with about 17 costæ; with a highly arched intraterminal front-wall; with a high proximal shield; and with small but not very minute apertural spines.

Description.—Asty multiserial, incrusting, and unilaminar; œcia dimorphic; orthœcia about ·36 mm. long, and ·18–·2 mm. wide, oval-elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is highly arched and consists of about seventeen costæ with numerous lateral fusions; the whole intraterminal front-wall is much consolidated; the apertural bar is much flattened in a vertical plane, and the median part thickened and drawn up into a slight projection; thus a rather high proximal shield is formed; apertures normal; apertural spines small, but not so minute as those of *A. nuntia*; aviculœcia numerous, rather irregularly distributed than disposed in pairs in connection with the normal apertures, small, somewhat elongate, with blunt, distally beaded apertures.

Distribution.—Senonian, Santonian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex.

Type-specimen.—D. 29882. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

Remarks.—See under the genus *Angelopora*.

Figures.—Text-fig. 55. Orthœcium and two aviculœcia.

Plate III, fig. 14. Part of the type-specimen, consisting of eight orthœcia, two of which bear ovicells, and of seven aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

IV. POLYCERATOPORA, Lang, 1916.

Lepralia [partim]; Novák, 1877, pp. 92, 82, 119.
Lepralia; Vine, 1885, p. 170.
Cribrilina [partim]; Canu, 1900 [2], p. 445.
Lepralia; Frič, 1911, pp. 61–2.
Polyceratopora, gen. nov.; Lang, 1916, pp. 382, 385.

Diagnosis.—Multiserial, incrusting Andrioporinæ in which no secondary aperture is formed; the median area of fusion is not surrounded by a circle of solid spines; the apertural bar does not form a hump, nor is it compressed in a vertical plane; the aviculœcia are very numerous; the furrows between the costæ are plainly visible; the apertural spines are but very slightly thickened; the apertures are very primitive—semicircular.

Distribution.—Cenomanian, Korycaner Schichten. Bohemia.

Genotype.—*Lepralia euglypha*, Novák.

Remarks.—*Argopora*, *Angelopora*, and the Pliophlœinæ are developments of the most primitive group of *Andriopora*—those whose apertural spines remain minute. The genera next to be considered are all distinguished by having their apertural spines more or less enlarged. *Polyceratopora* must have diverged from the primitive *Andriopora*-stock at a very early stage, before the apertural spines were more than slightly enlarged, and before the aperture had advanced in development even as far as that of *Andriopora mockleri*. The aviculœcia retain their primitive numbers, or even increase in number, and tend to "isolation," *i. e.* are surrounded by an extended extraterminal front-wall, or, possibly, are superposed upon cenœcia.

1. Polyceratopora euglypha (Novák).

Lepralia euglypha nov. spec.; Novák, 1877, pp. 92, 82, 119, pl. i, figs. 10–11; Cenoman, Korycaner Schichten; Kàmajk and Zbislav, Bohemia.
Lepralia euglypha, Novàk; Vine, 1885, p. 170; Cretaceous; Bohemia.

Cribrilina euglypha (Nov.); Canu, 1900[2], p. 445.
Lepralia euglypha, Nov.; Frič, 1911, pp. 61–2, text-fig. 257 on p. 61; Cenomanian, Korycaner Schichten; Kamajk and Zbislav, Bohemia.
Polyceratopora euglypha (Novák); Lang, 1916, p. 385; Cenomanian, Korycaner Schichten; Bohemia.

Diagnosis.—As for the genus.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·28 mm. long and about ·2 mm. wide, broadly oval; extraterminal front-wall of very small extent; the intraterminal front-wall is well-arched, and consists of about fifteen to eighteen closely-placed costæ united in a wide median band of fusion, and possibly with some lateral fusions; apertural bar rather wide; the six apertural spines are slightly enlarged compared with those of the primitive species of *Andriopora* and their derivatives, but still small; the apertures are very small and primitively-shaped, being semicircular; the aviculœcia are arranged in pairs, one pair to every orthœcial aperture, but, in addition, there are a fair number scattered about in the interœcial valleys, and all are surrounded with a more or less extensive extraterminal front-wall, *i. e.* are "isolated," so that the orthœcia are often separated from one another by a considerable space; the aviculœcial apertures are small and oval.

Distribution.—Cenomanian, Korycaner Schichten. Bohemia.

Type-specimen.—That figured by Novák, 1877, pl. i, figs. 10, 11, is hereby selected.

Remarks.—See under the genus *Polyceratopora*.

Figures.—Text-fig. 56. Orthœcium and four aviculœcia.

LIST OF SPECIMENS.

D. 28491–2. Two asties. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia. 1897.

V. OLIGOTOPORA, Lang, 1916.

Lepralia [partim]; Novák, 1877, pp. 82, 93, 119.
Lepralia; de Morgan, 1882[2], p. 125.
Lepralia [partim]; Frič, 1889, p. 90.
Lepralia; Brydone, 1910, p. 482.
Lepralia [partim]; Lang, 1916, pp. 388–9.
Oligotopora, gen. nov.; Lang, 1916, pp. 382, 388.

Diagnosis.—Multiserial, incrusting Andrioporinæ with no secondary aperture; the median area of fusion is not surrounded by a circle of solid spines; the apertural bar does not form a hump, nor is it flattened to form a small proximal shield; the aviculœcia are few and pointed, but not as a rule medianly placed with regard to the apertures of the orthœcia; the furrows between the costæ are plainly visible; the apertural spines are decidedly thickened.

Distribution.—Turonian, Teplitzer Schichten. Bohemia.

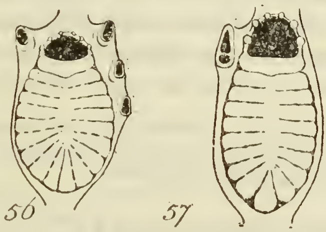

Fig. 56.—*Polyceratopora euglypha.* Diagram of an orthœcium and four aviculœcia, from above. × about 75 diameters.

Fig. 57.—*Oligotopora novaki.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Genotype.—*Lepralia pediculus*, Novák, non von Reuss.

Remarks.—*Oligotopora* may be derived from *Polyceratopora* by a reduction in the number of the aviculœcia and a greater elongation and pointing of their apertures; also by a considerable enlargement of the apertural spines. Its horizontal occurrence is in keeping with this view of its evolution, since it is found in the Turonian of Bohemia, while *Polyceratopora* occurs in the Cenomanian of that country.

1. Oligotopora novaki, Lang.

Lepralia pediculus Reuss; Novák, 1877, pp. 93, 82, 119, pl. i, fig. 12; Teplitzer Schichten; Hundorf.

Non *Lepralia pediculus* n. sp.; von Reuss, 1874, pp. 129–30, pl. xxiv, fig. 16; Oberer Pläner; Strehlen. [See *Lagynopora pediculus* (von Reuss).]

Lepralia pediculus (Reuss); de Morgan, 1882[2], p. 125; Sénonien; Bohême.

Lepralia pediculus, Reuss; Frič, 1889, p. 90, text-fig. 97; Teplitzer Schichten; Hundorf.

Non *Lepralia pediculus*, Reuss ; Frič, 1889, p. 90 ; Strehlen.
Lepralia pediculus, Rss., Novak ; Brydone, 1910, p. 482.
Oligotopora novaki, sp. n. ; Lang, 1916, p. 388 ; Turonian, Teplitzer Schichten ; Hundorf, Bohemia ; genotype of *Oligotopora*.

Diagnosis.—As for the genus.

Distribution.—Turonian, Teplitzer Schichten. Hundorf, S.W. of Teplitz, northern Bohemia.

Type-specimen.—That figured by Novák, 1877, pl. i, fig. 12.

Remarks.—*Lepralia pediculus* of Novák is manifestly different from *L. pediculus* of von Reuss, which is provisionally placed in the genus *Lagynopora* in the family Lagynoporidæ (see p. 61). For further remarks, see under the genus *Oligotopora*.

Figures.—Text-fig. 57. Orthœcium and aviculœcium.

Specimens.—None in the Collection.

VI. CORYMBOPORELLA, Lang, 1917.

Corymbopora, gen. nov. ; Lang, 1916, pp. 382, 385.
Non *Corymbopora* ; Michelin, 1846, p. 213.
Corymboporella, n. gen. ; Lang, 1917, p. 169.

Diagnosis.—Uniserial incrusting Andrioporinæ having œcia with long caudæ, and a solid intraterminal front-wall showing traces only of the costæ of which it is composed ; the apertural bar rises into a median hump ; aviculœcia are absent.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Genotype.—*Corymbopora religata*, Lang.

Remarks.—*Corymboporella* is a specially interesting form, since, while retaining the primitive uniserial asty of *Andriopora*, and employing the primitive device of cauda-formation, it has attained a complete intraterminal front-wall, and only the furrowing of its solid surface indicates that this front-wall is fundamentally formed of fused costæ. The genus also shows advance in the slight enlargement of the apertural spines ; and the apertures are normal or slightly cribriline. But in spite of its complete intraterminal front-wall, *Corymboporella* betrays its primitive character by a clumsy device (exhibited also by *Hybopora* and *Pancheilopora*) for depositing superfluous calcium carbonate, This consists in piling up skeletal matter into an immense hump on the middle of the apertural bar. The hump is so large that it overflows the apertural bar and covers a good deal of the intraterminal front-wall, thus effectually masking the costal nature of this structure over a considerable area.

The lineage of which *Corymboporella* is an ultimate term appears to have diverged in Cenomanian times from the main Andrioporid lineage characterised by a tendency to enlarged apertural spines, shortly after that lineage had given rise to *Polyceratopora* and *Oligotopora*. The more advanced aperture and the tendency to pile superfluous calcium carbonate in a hump on the apertural bar are the characteristic features of the *Corymboporella* lineage.

1. Corymboporella religata (Lang).

Corymbopora religata, sp. n.; Lang, 1916, p. 385; Cenomanian, Korycaner Schichten; Kaňk, Bohemia.

Corymboporella religata (Lang); Lang, 1917, p. 169.

Diagnosis.—As for the genus.

Description.—Asty uniserial, incrusting; œcia monomorphic, caudate, with capitula about ·25 mm. long and nearly as wide, oval to sub-circular, and with caudæ as long or longer; extraterminal front-wall confined to the cauda and very narrow lateral and proximal strips of the capitulum; intraterminal front-wall well arched, and consisting of from ten to twenty costæ completely fused together so as to form a solid front-wall, but retaining their individuality to the extent of being separated by imperforate grooves; a very large hump of secondary tissue almost obliterates the apertural bar, and occupies the distal and median regions of the intraterminal front-wall; the apertural spines are apparently six in number, and but slightly enlarged; the apertures are normal or cribriline in shape.

Distribution.—Cenomanian, Korycaner Schichten, Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—**D. 28488.**

Remarks.—See under the genus *Corymboporella*.

Figures.—Text-fig. 58. Œcium.

Plate IV, fig. 1. Part of the type-specimen. × about 27 diameters.

LIST OF SPECIMENS.

D. 28488. D. 28484–7. D. 28489. Type-specimen and five paratypes. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, Bohemia. 1897.

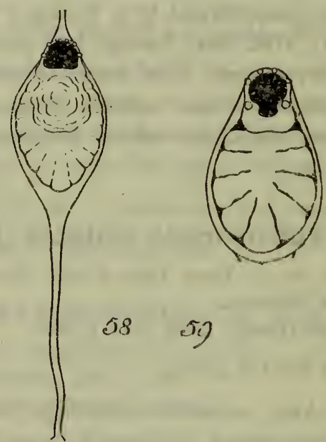

Fig. 58.—*Corymboporella religata.* Diagram of an œcium, from above. × about 75 diameters.

Fig. 59.—*Kankopora kankensis.* Diagram of an œcium, from above. × about 75 diameters.

VII. KANKOPORA, Lang, 1916.

Escharina [partim]; Römer, 1840, p. 14.
Cellepora (*Escharina*) [partim]; Geinitz, 1846, p. 613.
Escharina [partim]; Bronn, 1848, p. 472.
Escharina [partim]; Giebel, 1849, p. 18.
Escharina [partim]; Bronn, 1849, p. 131.
Cellepora (*Escharina*) [partim]; Geinitz, 1849–50, pp. 248–9.
Escharina [partim]; d'Orbigny, 1850, p. 175.
Distanseseharella [partim]; d'Orbigny, 1853, p. 463.
Distansescharella [partim]; Pictet, 1857, p. 110.
Escharina; Simonowitsch, 1871, p. 2.
Lepralia [partim]; von Reuss, 1874, pp. 128–30.
Kankopora, gen. nov.; Lang, 1916, pp. 382, 388.
Escharina [partim]; Lang, 1917, p. 170.

Diagnosis.—Multiserial, incrusting Andrioporinæ with no secondary aperture; the median area of fusion is not surrounded by a circle of bosses; the apertural bar does not form a hump, nor is it produced vertically in a median spine; the aviculœcia apparently are absent; the furrows between the œcia are plainly visible; the apertural spines are decidedly thickened; the apertures are advanced in shape, being cribriline or slightly pliophlœan.

Distribution.—Cenomanian.

Genotype.—*Kankopora kankensis.*

Remarks.—*Corymboporella* was seen to be an ultimate term of a supposed lineage that diverged during Cenomanian times from the main lineage of *Andriopora* characterised by enlarged apertural spines, soon after the divergence of the lineage represented by *Polyceratopora* and *Oligotopora*. And the lineage to which *Corymboporella* belongs was seen to be characterised by an aperture of advanced shape, and by a tendency to pile superfluous calcium carbonate in a lump over the apertural bar. A branch of this lineage, becoming multiserial before the intraterminal front-wall had attained so complex a condition as that of *Corymboporella*, is represented by *Kankopora* and its derivative *Hybopora*. Neither aviculœcia nor the hump on the apertural bar had been acquired by this lineage when *Kankopora* appeared.

Of the two species of *Kankopora*, it is probable that *K. inflata* is derived from *K. kankensis* by a slight increase in the number of costæ.

Key to the Species of *Kankopora*.

A. Costæ about 8; intraterminal front-walls lie more closely together .... 1. *K. kankensis.*
B. Costæ about 12; intraterminal front-walls more widely-spaced .... 2. *K. inflata.*

1. Kankopora kankensis, Lang.

Kankopora kankensis sp. n.; Lang, 1916, p. 388; Cenomanian, Korykaner Schichten; Kaňk, Bohemia.

Diagnosis.—Kankopora with about 8 costæ and closely-placed intraterminal front-walls.

Description.—Asty multiserial, incrusting, unilaminar; œcia monomorphic, about ·33 mm. long and ·2 mm. wide, oval; extraterminal front-wall of very small extent; the intraterminal front-wall is somewhat flatly-arched and composed of about eight costæ which, while retaining their individuality, are very intimately fused, do not, apparently, have definite lateral fusions, but have a very wide median band of fusion; the apertural bar is low and very wide, especially laterally; the apertural spines are decidedly, though not greatly, thickened; the apertures are cribriline to somewhat pliophlœan in shape.

Distribution.—Cenomanian, Korycaner Schichten, Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—**D. 28494.**

Remarks.—See under the genus *Kankopora.*

Figures.—Text-fig. 59. Œcium.

Plate IV, fig. 2. Part of the type-specimen, showing seven complete œcia, one of which bears an ovicell. × about 27 diameters.

LIST OF SPECIMENS.

D. 28494–6. Type-specimen and two paratypes. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia. 1897.

D. 28514–5. Two asties, probably of this species, from the same horizon and locality as the last. 1897.

2. Kankopora inflata (F. A. Römer).

Escharina inflata N.; Römer, 1840, p. 14, pl. v, fig. 5; Hilsconglomerat; bei Essen.

Cellepora inflata (*Escharina i.*) Röm.; Geinitz, 1846, p. 613; Hilsconglomerate; bei Essen.

Escharina inflata Ror; Bronn, 1848, p. 472.

Escharina inflata Römer; Giebel, 1848, p. 18.

Non=*Cellepora incisa* von Hagenow; as stated by Giebel, 1848, p. 18.

Non=*Escharina radiata* Römer; as stated by Giebel, 1848, p. 18.

Escharina inflata Roe.; Bronn, 1849, p. 131; Neocomien.

Cellepora inflata (*Escharina*) Röm.; Geinitz, 1849–50, pp. 248–9; Grünsand; Essen.

Escharina inflata, Rœmer; d'Orbigny, 1850, p. 175; Cénomanien; Westphalie, Essen.

Distanseścharella inflata (Roemer); d'Orbigny, 1853, p. 463; Cénomanien; Essen. [Genosyntype of *Distansescharella.*]

Distanseschareila inflata (Roemer); Pictet, 1857, p. 110; Craie; Essen.
Escharina inflata Roemer; Simonowitsch, 1871, p. 2; Grünsand; Essen.
Lepralia inflata Röm. sp.; von Reuss, 1874, pp. 129, 128, 130; Cenoman, Essen—*fide* Römer.
? Non *Lepralia inflata* Röm. sp.; von Reuss, 1874, p. 130; obere Pläner, Strehlen.
Kankopora inflata (Römer); Lang, 1916, pp. 388, 387; Cenomanian, Hilsconglomerat; Essen, Germany.
Escharina inflata, Römer; Lang, 1917, p. 170.

Diagnosis.—*Kankopora* with about 12 costæ and widely-spaced intraterminal front-walls.

Distribution.—Neocomian, Hilsconglomerat, and Cenomanian, Essener Grünsand. Essen, Westphalia.

Type-specimen.—That figured by Römer, 1840, pl. v, fig. 5, is hereby selected.

Remarks.—*Kankopora inflata* is remarkable for having been originally described in 1840 by Römer, and recorded in 1846 by Geinitz from the Neocomian, a horizon lower than has been claimed for any other Cribrimorph. Later, Geinitz records this species from the "Grünsand"—Cenomanian of the same locality,—Essen, and it is therefore possible that Römer was mistaken in referring it to the Neocomian. If from the Cenomanian, it is from the same stage as *Kankopora kankensis*, and thus at an appropriate horizon. It is possibly a derivative of that species, having more costæ.

Specimens.—None in the Collection.

VIII. HYBOPORA, Lang, 1916.

Hybopora, gen. nov.; Lang, 1916, pp. 383, 389.

Diagnosis.—Multiserial, incrusting Andrioporinæ with no secondary aperture; the median area of fusion is not surrounded by a circle of solid spines; secondary tissue is piled up in a hump on the apertural bar.

Distribution.—Cenomanian, Korycaner Schichten. Bohemia.

Genotype.—*Hybopora gibba*.

Remarks.—*Hybopora* may be derived from *Kankopora*, from which it differs chiefly by the presence of a hump of secondary tissue on the apertural bar, by the acquisition of a few aviculœcia, by the more numerous costæ, and, possibly, by a less-differentiated aperture (which would exclude direct descent). The piling up of the hump is a device used also by *Corymboporella*, and is, presumably, potential in the lineage to which that genus, *Kankopora*, and *Hybopora* belong. A somewhat similar hump is also present in *Pancheilopora*.

1. Hybopora gibba, Lang.

Hybopora gibba, sp. n.; Lang, 1916, p. 389; Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—As for the genus.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and about ·2 mm. wide, elliptical; extraterminal front-wall of very small extent; the intraterminal front-wall is well-arched and consists of about fourteen closely-placed costæ united in a wide median area of fusion, but having, apparently, no lateral fusions; apertural bar largely concealed by a large mass of secondary tissue forming a median hump; apertural spines apparently six in number and but slightly enlarged; apertures super-normal to cribriline in shape, but, possibly, a pliophlœan continuation may be hidden beneath the hump on the apertural bar; aviculœcia small, few, sporadically distributed, distally directed, with elongate, constricted, and pointed apertures.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—**D. 28493.**

Remarks.—See under the genus *Hybopora*.

Figures.—Text-fig. 60. Orthœcium and aviculœcium.

Plate IV, fig. 3. Part of the type-specimen, showing six more or less complete orthœcia and an aviculœcium. × about 27 diameters.

LIST OF SPECIMENS.

D. 28493. D. 28497–8. Type-specimen and two paratypes. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia. 1897.

IX. HOLOSTEGOPORA, Lang, 1916.

Holostegopora, gen. nov.; Lang, 1916, pp. 383, 390.

Diagnosis.—Andrioporinæ with an erect, cylindrical asty, and a completely-fused, solid, intraterminal front-wall.

Distribution.—Senonian, Santonian, high in the zone of *M. coranguinum*. Epsom, Surrey.

Genotype.—*Holostegopora epsomensis.*

Remarks.—It is only on its general appearance that *Holostegopora* is placed among the Andrioporinæ; for the intraterminal

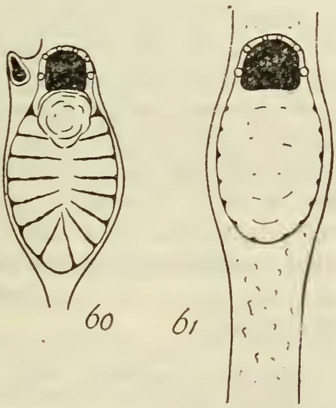

Fig. 60.—*Hybopora gibba.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 61.—*Holostegopora epsomensis.* Diagram of an œcium, from above. × about 75 diameters.

front-wall is quite solid, and does not, as in *Corymboporella*, for instance, show traces of the costæ of which it is assumed to be ultimately composed, unless the slight bead-like swellings on the termen and occasional pittings are signs of former costæ. Apart, however, from its intraterminal front-wall, its structure generally resembles that of the Andrioporinæ, and it may be placed provisionally among them, on the supposition that the intraterminal front-wall has become completely solidified, as it has almost become in *Corymboporella*, *Tricolpopora*, and *Hippiopora*. *Holostegopora* then appears to have arisen from the general lineage of *Andriopora gasteri–A. gallica*, which is characterised by an enlargement of the apertural spines. It is not closely connected with any other form, and probably diverged soon after the stock just mentioned had left the main Andrioporine lineage (see p. 92).

1. Holostegopora epsomensis, Lang.

Holostegopora epsomensis, sp. n.; Lang, 1916, p. 390; top of the *M. coranguinum*-zone; Epsom, Surrey.

Diagnosis.—As for the genus.

Description.—Asty erect, solid, cylindrical; œcia monomorphic, about ·66 mm. long and ·22 mm. wide, long-elliptical; extraterminal front-wall of small extent laterally and distally, but occupying nearly the proximal half of the œcium; it is flat, or slightly arched, and with a pitted surface; the intraterminal front-wall is well-arched and solid, but shows on the termen slight bead-like swellings which probably indicate the proximal ends of the costæ of which the intraterminal front-wall is presumably composed; there are also occasional pits on the intraterminal front-wall; the six apertural spines are considerably enlarged; the aperture is cribriline in shape.

Distribution.—Senonian, Santonian, high in the zone of *M. coranguinum*. Epsom, Surrey.

Type-specimen.—D. 23959.

Remarks.—See under the genus *Holostegopora*.

Figures.—Text-fig. 61. Œcium.

Plate IV, fig. 4. The type-specimen, showing, frontally, a complete œcium and two incomplete œcia and, laterally, six œcia mostly incomplete. × about 27 diameters.

LIST OF SPECIMENS.

D. 23959. D. 23613. D. 23647. Type-specimen and two paratypes. Senonian, Santonian, zone of *M. coranguinum*, top part of the zone. Medical College Pit, Epsom, Surrey. F, Möckler collection. 1912.

X. NANNOPORA, Lang, 1916.

Repteschiarella [partim]; d'Orbigny, 1853, p. 470; 1854, p. 1097.
Rupteschiarella [sic]; d'Orbigny, 1853, p. 468.
Repteschiarella [partim]; Vine, 1885, pp. 115, 156.
? Non *Cribrilina* (*Repteschiarella*); Vine, 1893, p. 323.
? *Cribrilina* (*Repteschiarella*); Gamble, 1896, p. 6.
Cribrilina (*Cribrilina*); Canu, 1900[2], p. 448.
? *Repteschiarella* [partim]; Canu, 1900[2], p. 448.
? *Cribrilina* [partim]; Jukes-Browne, 1904, p. 490.
Nannopora, gen. nov.; Lang, 1916, pp. 382, 386.
? *Repteschiarella*; Lang, 1916, p. 408.

Diagnosis.—Multiserial, incrusting Andrioporinæ of very small size and with no secondary aperture; the median area of fusion is not surrounded with a margin of solid spines or tubercles; the apertural bar does not form a hump, nor is it flattened nor produced vertically to form a rudimentary proximal shield; the furrows between the costæ are plainly visible; the apertural spines are but slightly thickened; the apertures are not very primitive in shape; the œcia are very small, squat, and not widely separated by circum-aviculœcian tissue.

Distribution.—Senonian, Coniacian. Northern France and ? Southern England.

Genotype.—*Repteschiarella pygmæa*, d'Orbigny.

Remarks.—*Nannopora*, with its derivative genera *Distans-escharella* and *Tricolpopora*, probably diverged from the lineage from which *Holostegopora* was derived, but before *Andriopora gasteri*, with its median spine on the apertural bar, was evolved. Its three species probably form a single lineage, becoming more specialised in apertural shape, and, finally, tending to a slight "isolation" of the aviculœcia, such as is diagnostic of *Distans-escharella*.

Key to the Species of *Nannopora*.

A. Apertures sub-normal .... 1. *N. paternensis*.
B. Apertures cribriline.
  I. Orthœcia close together .... 2. *N. pygmæa*.
  II. Orthœcia somewhat widely separated .... 3. *N. lepida*.

1. Nannopora paternensis, Lang.

Nannopora paternensis, sp. n.; Lang, 1916, p. 386; Coniacian; St. Paterne, France.

Diagnosis.—*Nannopora* with sub-normal apertures.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·33 mm. long and ·25 mm. wide, oval to sub-circular; extraterminal front-wall of very small extent; the intraterminal front-wall is somewhat flatly-arched and consists of about sixteen closely-placed costæ firmly knit by numerous, apparently irregularly-distributed lateral fusions; apertural bar undifferentiated; apertural spines probably six in number and but little enlarged; apertures sub-normal; aviculœcia, a pair to the aperture of each orthœcium, each one of the pair directed distally and away from the mid-line of the œcium it accompanies, with elongate but rather blunt apertures divided by a constriction into a more or less circular proximal portion and a more or less oval rostrum; the extraterminal front-walls of the aviculœcia are rather large, but do not separate the orthœcia to any great extent; ovicells hyperstomial.

Distribution.—Senonian, Coniacian. St. Paterne, N.W. of Tours, Indre-et-Loire, France.

Type-specimen.—D. 28455.

Remarks.—See under the genus *Nannopora*.

Figures.—Text-fig. 62. Orthœcium and its aviculœcia.

Plate IV, fig. 5. The type-specimen, consisting of eleven more or less complete orthœcia, of which three bear ovicells, and of about seventeen aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28455–6. Type-specimen and paratype. Senonian, Coniacian. St. Paterne, N.W. of Tours, Indre-et-Loire, France. In exchange with Monsieur F. Canu. 1914.

2. Nannopora pygmæa (d'Orbigny).

Reptescharella pymea [sic]; d'Orbigny, 1852, pl. 716, figs. 7–8.

? *Reptescharella costata*, d'Orb., 1851; d'Orbigny, 1852, pl. 716, figs. 16–18; 1853, p. 470; 1854, p. 1097; Sénonien; Tours (Indre-et-Loire); [*fide* Canu].

Rupteschareila [sic] *pygmea*, d'Orb.; d'Orbigny, 1853, p. 468; Sénonien; Sainte-Colombe (Manche).

Reptescharella pygmæa; d'Orbigny, 1854, p. 1097.

Reptescharella pygmea, D'Orb; Vine, 1885, p. 115 [non=*Cribrilina radiata*, Moll, as there doubtfully claimed].

Reptescharella pygmæa, D'Orb.; Vine, 1885, p. 156 [non=*Cribrilina innominata*, Couch, as there doubtfully claimed].

? Non *Cribrilina* (*Reptescharella*) *pygmæa*, d'Orb.; Vine, 1893, p. 323; zone of *B. quadrata*; East Harnham, Salisbury.

? *Cribrilina pymea* [sic] d'Orb. (*Reptescharella*); Gamble, 1896, p. 6; Chalk, Chatham.

Cribrilina (*Cribrilina*) *pygmœa* [sic] d'Orb.; Canu, 1900 ², p. 448; Sénonien.

? *Reptescharella costata* d'Orb.; Canu, 1900², p. 448.

? Partim *Cribrilina pygmæa*, d'Orb.; Jukes-Browne, 1904, p. 490; zone of *Hol. planus*, Charlton; zones of *Marsupites* and of *Act. quadratus*, Salisbury.

Nannopora pygmæa (d'Orbigny); Lang, 1916, p. 386; Senonian; Sainte-Colombe, France.

? *Reptescharella costata*; Lang, 1916, p. 408; Senonian; Tours.

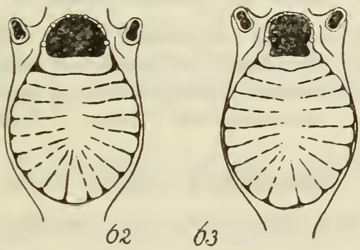

Fig. 62.—*Nannopora paternensis*. Diagram of an orthœcium and its aviculœcia, from above. × about 75 diameters.

Fig. 63.—*Nannopora pygmæa*. Diagram of an orthœcium and its accompanying aviculœcia, from above. × about 75 diameters.

Diagnosis.—*Nannopora* with cribriline apertures and having the orthœcia lying close together.

Description.—Asty multiserial, incrusting and unilaminar; œcia dimorphic; orthœcia about ·33 mm. long and ·25 mm. wide, oval to sub-circular; extraterminal front-wall of very small extent; intraterminal front-wall somewhat flatly-arched and consisting of about sixteen closely-placed costæ firmly knit by numerous, apparently irregularly-distributed lateral fusions; apertural bar undifferentiated; apertural spines apparently six in number and but little enlarged; apertures cribriline in shape; aviculœcia having somewhat large extraterminal front-walls, but these do not appreciably separate the orthœcia; they are generally arranged as a pair to the aperture of every orthœcium, and are directed distally and away from the mid-line of the aperture they accompany; with rather elongate, blunt, and constricted apertures.

Distribution.—Senonian, Coniacian. Northern France and, possibly, Southern England.

Type-specimen.—That figured by d'Orbigny, 1852, pl. 716, figs. 7–8, is hereby selected.

Remarks.—See under the genus *Nannopora*.

Figures.—Text-fig. 63. Orthœcium and its aviculœcia.

Plate IV, fig. 6. Part of specimen **D. 28454**, showing five complete orthœcia, parts of others, and eight aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28454. Senonian, Coniacian. St. Avertin, S.E. of Tours, Indre-et-Loire, France. In exchange with Monsieur F. Canu. 1914.

D. 28482. Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France. In exchange with Monsieur F. Canu. 1914.

3. Nannopora lepida, Lang.

Nannopora lepida, sp. n.; Lang, 1916, p. 386; [Senonian]; Tours or Villedieu, France.

Diagnosis.—*Nannopora* with a cribriline aperture and with the orthœcia somewhat widely separated.

Distribution.—Senonian, Coniacian. Tours, Indre-et-Loire, France.

Type-specimen.—In the collection of Monsieur F. Canu.

Remarks.—In *Nannopora lepida* the orthœcia are more widely-separated by the large extraterminal front-walls of the aviculœcia than they are in *N. paternensis* and *N. pygmæa*. But this separation is not nearly so considerable as in the genus *Distansescharella*, which is probably an extension of *Nannopora* in this direction.

Specimens.—Only a photograph of the type-specimen is in the Collection.

XI. DISTANSESCHARELLA, d'Orbigny, 1853.

Cellepora [partim]; von Hagenow, 1839, p. 274.
Cellepora [partim]; Boll, 1846, p. 207.
Cellepora [partim]; Geinitz, 1846, p. 613.
Cellepora [partim]; Bronn, 1848, p. 254.
Cellepora [partim]; Bronn, 1849, p. 132.
Cellepora [partim]; Geinitz, 1849–50, pp. 248–9.
Distansescharella [partim]; d'Orbigny, 1853, p. 463.
Distansescharella [partim]; Pictet, 1857, p. 110.
Cribrilina (*Distansescharella*); Canu, 1900[2], p. 452.
Distansescharella; Lang, 1916, pp. 382, 386–7.
Distansescharella; Lang, 1917, p. 170.

DIAGNOSIS.—Multiserial, incrusting Andrioporinæ with no secondary aperture; the median area of fusion is not surrounded with a margin of solid spines or tubercles; the apertural bar does not form a hump, nor is it flattened or produced vertically to form a rudimentary proximal shield; the furrows between the costæ are plainly visible; the apertural spines are but slightly thickened; the apertures are not very primitive in shape; the œcia are small, squat, and widely separated by the aviculœcia, which are very numerous and more or less isolated by their extensive extraterminal front-walls.

DISTRIBUTION.—Senonian, Coniacian to Campanian, zone of *B. mucronata*.

GENOLECTOTYPE.—*Cellepora familiaris*, von Hagenow (see Lang, 1916, p. 387).

REMARKS.—D'Orbigny founded *Distansescharella* upon three genosyntypes, namely *Cellepora familiaris*, von Hagenow, *Escharina inflata*, Römer, and *Escharina radiata*, von Reuss (non Römer); and of these, *Cellepora familiaris*, apparently, best exemplifies what d'Orbigny, in founding the genus, attempted to express. Consequently, this species was chosen as the genolectotype. But the characters of *Cellepora familiaris* cannot be sufficiently determined for specific or even generic recognition; and, consequently, the genus would have had to have been abandoned for lack of diagnostic characters, had not Canu, who had examined d'Orbigny's types, labelled a specimen of his "*Distansescharella*," according to d'Orbigny's collection. This specimen appears to differ from *Nannopora* only in the comparatively widely-spaced orthœcia, which are separated by the extensive extraterminal front-walls of the numerous aviculœcia. Until, then, *Distansescharella familiaris* is sufficiently diagnosed, Canu's specimen (*D. d'orbignyi*) may be used to define *Distansescharella*. This species is probably a direct descendant of *Nannopora lepida*. A third species, *D. discreta*, is also provisionally placed in this genus. The œcia of *D. discreta* are somewhat less squat than those of *Nannopora* and the other species of *Distansescharella*, and generally recall those of *Andriopora linearis*, but have fewer costæ. But if the form is directly descended from *A. linearis*, it cannot be congeneric with *Distansescharella d'orbignyi*, if this (as we suppose) is derived from *Nannopora lepida*. *Distansescharella d'orbignyi*, then, with about twenty costæ, and *D. discreta*, with from ten to twelve costæ, are provisionally placed with *D. familiaris*, the genolectotype of *Distansescharella*, pending the exact definition of the last-named species.

1. Distansescharella familiaris (von Hagenow).

Cellepora familiaris nob.; von Hagenow, 1839, p. 274; Kreide; Rügen.

Cellepora familiaris v. Hg.; Boll, 1846, p. 207; obere weisse Kreide; German Baltic.

Cellepora familiaris v. Hag.; Geinitz, 1846, p. 613; Rügen.

Cellepora familiaris Hag.; Bronn, 1848, p. 254.

Cellepora familiaris Hag.; Bronn, 1849, p. 132; Kreide.

Cellepora familiaris v. H.; Geinitz, 1849–50, pp. 248–9; Kreide, oberer Quadermergel; Rügen.

Distansescharella familiaris (de Hagenow); d'Orbigny, 1853, p. 463; Sénonien; Rügen. [Genosyntype of *Distansescharella*.]

Distansescharella familiaris (Hagenow); Pictet, 1857, p. 110; craie; Rugen.

Cribrilina (*Distansescharella*) *familiaris* (Hag.); Canu, 1900[2], p. 452; Rügen.

Distansescharella familiaris (von Hagenow); Lang, 1916, pp. 386–7. [Genolectotype of *Distansescharella*.]

Distansescharella familiaris (von Hagenow); Lang, 1917, p. 170.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen.

Type-specimen.—That described by von Hagenow, 1839, p. 274, is hereby selected.

Remarks.—See under the genus *Distansescharella*.

Specimens.—None in the Collection.

2. Distansescharella d'orbignyi, Lang.

Distansescharella d'orbignyi, sp. n.: Lang, 1916, p. 387; Coniacian; Villedieu.

DIAGNOSIS.—*Distansescharella* with about 20 costæ.

DESCRIPTION.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·37 mm. long and ·23 mm. wide, oval; extraterminal front-wall of small dimensions; intraterminal front-wall somewhat flatly-arched and consisting of about twenty closely-placed and firmly-fused costæ; apertural bar undifferentiated; apertural spines probably six in number and somewhat thickened; apertures cribriline; aviculœcia very numerous, sporadically distributed, distally directed, with extensive extraterminal front-walls causing the orthœcia to appear widely-spaced; with somewhat elongate, blunt, constricted apertures.

DISTRIBUTION.—Senonian, Coniacian. Villedieu, France.

TYPE-SPECIMEN.—In the collection of Monsieur F. Canu.

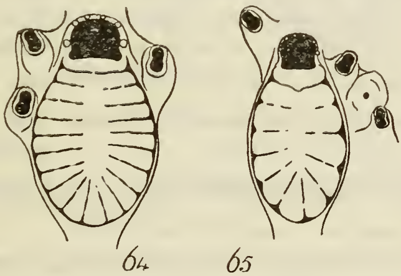

Fig. 64.—*Distansescharella d'orbignyi.* Diagram of an orthœcium and three aviculœcia, from above. × about 75 diameters.

Fig. 65.—*Distansescharella discreta.* Diagram of an orthœcium, three aviculœcia, and a cenœcium, from above. × about 75 diameters.

REMARKS.—See under the genus *Distansescharella.*

FIGURES.—Text-fig. 64. Orthœcium and three aviculœcia.

SPECIMENS.—Only a photograph of the type-specimen is in the Collection.

3. Distansescharella discreta, new species.

DIAGNOSIS.—*Distansescharella* with 10–12 costæ.

DESCRIPTION.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·33 mm. long and ·2–·25 mm. wide, oval to elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of about ten to twelve well-knit costæ, with lateral fusions; apertural bar wide, slightly raised medianly; apertures cribriline; apertural spines six in number and hardly, if at all, enlarged; aviculœcia numerous, irregularly distributed with very large extraterminal front-walls, and blunt, oval, constricted apertures with minute distal spines; here and there the asty is composed of cenœcia with circular apertures mixed with aviculœcia to the exclusion of orthœcia.

Distribution.—Senonian, zone of *Marsupites*. Cliffs E. of Brighton, Sussex.

Type-specimen.—**D. 29880.** Collected by C. T. Gaster, Esq., and presented by him, Dec. 1919.

Remarks.—See under the genus *Distanseschcarella*.

Figures.—Text-fig. 65. Orthœcium, three aviculœcia, and cenœcium.

Plate IV, fig. 7. Part of the type-specimen showing eight complete orthœcia, one of which has a complete and one an incomplete ovicell, ten aviculœcia, some of which are surrounded by cenœcial tissue, and three cenœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

XII. TRICOLPOPORA, Lang, 1916.

Tricolpopora, gen. nov.; Lang, 1916, pp. 383, 389.

Diagnosis.—Multiserial Andrioporinæ with no secondary aperture; the median area of fusion of the intraterminal front-wall is not surrounded by a circle of solid spines or bosses; the apertural bar does not form a hump; the aviculœcia are rather few, but not medianly placed with regard to the orthœcia; the furrows between the costæ are nearly obliterated, so that the intraterminal front-wall is solid, and the costæ are hardly visible on its arched surface.

Distribution.—Senonian, Coniacian. St. Avertin, S.E. of Tours, Indre-et-Loire, France.

Genotype.—*Tricolpopora trisinuata.*

Remarks.—*Tricolpopora* is possibly a development of *Nannopora*. There must, however, have been a catagenesis in the number of costæ, and then a complete fusion of these to form a solid intraterminal front-wall, leaving traces only of the component costæ to indicate its origin. The aperture, also, is more advanced, and the aviculœcia rather fewer than in *Nannopora*.

1. Tricolpopora trisinuata, Lang.

Tricolpopora trisinuata, sp. n.; Lang. 1916, p. 389; Coniacian; St. Avertin, France.

Diagnosis.—As for the genus.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and ·3 mm. wide, broadly oval; extraterminal front-wall of small extent; intraterminal front-wall somewhat flatly-arched, solid and plain except for six or eight obscure, radiating ridges that, presumably, indicate its costal

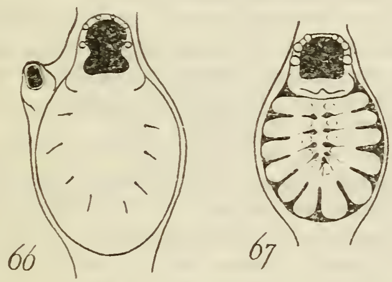

Fig. 66.—*Tricolpopora trisinuata.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 67.—*Eucheilopora pediculosa.* Diagram of an orthœcium, from above. × about 75 diameters.

origin; apertural bar undifferentiated; aperture cribriline to pliophlœan, or somewhat trifoliate; apertural spines probably six in number, and but slightly enlarged; aviculœcia occasional and sporadically distributed.

Distribution.—Senonian, Coniacian. Northern France.

Type-specimen.—**D. 28447.**

Remarks.—See under the genus *Tricolpopora.*

Figures.—Text-fig. 66. Orthœcium and aviculœcium.

Plate IV, fig. 8. Two complete œcia and two aviculœcia of the type-specimen, which incrusts a Cyclostome Polyzoan. × about 27 diameters.

LIST OF SPECIMENS.

D. 28447. D. 28446. D. 28448. Type-specimen and paratypes. Senonian, Coniacian. St. Avertin, S.E. of Tours, Indre-et-Loire, France. In exchange with Monsieur F. Canu. 1914.

XIII. EUCHEILOPORA *, Lang, 1916.

[*Escharina* [partim]; Römer, 1840, p. 13.]
[*Cellepora* (*Escharina*) [partim]; Geinitz, 1846, p. 613.]
[*Escharina* [partim]; Reuss, 1846, p. 68.]
[*Cellepora* [partim]; Bronn, 1848, p. 255.]
[*Escharina* [partim]; Bronn, 1848, p. 472.]
[*Escharina* [partim]; Giebel, 1848, p. 18.]
[? Non *Cellepora* [partim]; Giebel, 1848, p. 18.]
[*Eschara* [partim]; Giebel, 1848, p. 20.]
[*Escharina* [partim]; Bronn, 1849, p. 132.]
[*Cellepora* [partim]; Geinitz, 1849–50, pp. 248–9.]
[*Escharina* [partim]; d'Orbigny, 1850, p. 262.]
[*Distansescharella*; d'Orbigny, 1853, p. 464 (non p. 463).]
[*Reptescharella* [partim]; d'Orbigny, 1853, p. 465.]
[*Distansescharella* [partim]; Pictet, 1857, p. 110.]
[*Reptescharella* [partim]; Pictet, 1857, p. 110.]
[(*Escharina*) *Cellepora*; Frič, 1869, p. 222.]
[*Lepralia* [partim]; Reuss, 1872, p. 104.]
[*Cribrilina* [partim]; Hincks, 1880, p. 190.]
[? *Cribrilina*; Vine, 1884, p. 173.]
[? *Cribrilina* [partim]; Vine, 1885, p. 116.]
[? *Cribrillina* [partim]; Pergens, 1887, p. xxxvii.]
[? *Cribrillina* [partim]; Pergens, 1887[2], p. lx.]
[*Lepralia* [partim]; Frič, 1911, p. 98.]
Eucheilopora, gen. nov.; Lang, 1916, pp. 382, 387–8.
[*Escharina* [partim]; Lang, 1917, p. 170.]

Diagnosis.—Multiserial Andrioporinæ with no true secondary aperture; the median area of fusion of the intraterminal front-wall is not surrounded with a circle of solid spines or bosses, though there is a tendency for the distal ends of the costæ to be thus nipped off; the aviculœcia are few or numerous, but not medianly placed with regard to the orthœcia; the furrows between the costæ are plainly visible; the apertural spines are considerably thickened; the apertural bar is produced in a more or less vertical or proximally-directed median spine.

Distribution.—Turonian, zone of *H. planus*, to Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*; mostly Coniacian. North-western Europe.

Genotype.—*Eucheilopora labiosa.*

Remarks.—*Eucheilopora* appears to be a multiserial develop-

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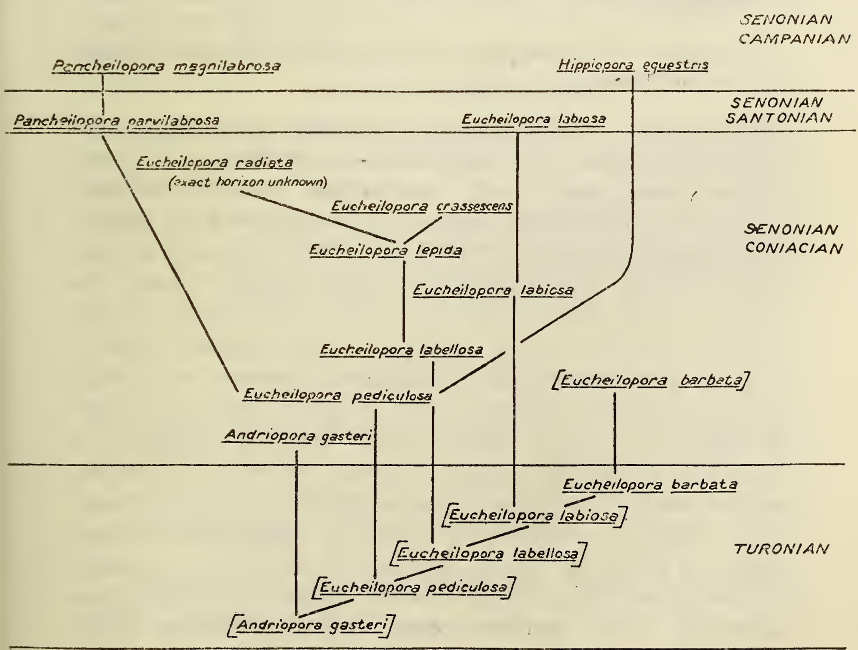
* The references below in [ ] apply to the doubtful *E. radiata*.

ment of *Andriopora gasteri*, based upon the species *Eucheilopora pediculosa*. From this radical form, not only the other species of *Eucheilopora*, but, probably, the genera *Pancheilopora* and *Hippiopora* were derived. Evolution within the genus appears to have produced a greater number of costæ, a greater œcial size, and a greater length of the œcium compared with its breadth. The aviculœcia of *Eucheilopora* are distinctive, but are absent in *E. pediculosa* (as in its supposed ancestor *Andriopora gasteri*), and usually but few in number in the other species, except in *E. radiata*, in which, apparently, they are absent; they have short, blunt, often nearly circular apertures, and tend to be dimorphic.

All the species occur in the zone of *M. cortestudinarium*, except the Turonian *E. barbata*. Since, however, this form appears to be derived from *E. labiosa*, it is probable that at least the species *E. pediculosa* and *E. labellosa*, as well as their ancestor *Andriopora gasteri*, also occur as low as the *H. planus*-zone.

The probable relationships of the species of *Eucheilopora* and the derived genera are expressed in the following phylogeny :—



Key to the Species of *Eucheilopora*.

A. Costæ about 10 or 11; œcia small—about ·33 mm. long (fig. 67, p. 141) .... 1. *E. pediculosa.*

B. Costæ about 14 or 16.
- I. Smaller, œcia about ·33 mm. long .... 2. *E. labellosa.*
- II. Larger, œcia about ·4 mm. long.
  - *a.* Costæ about 14; median process of apertural bar more erect; aperture cribriline (fig. 68) ... 3. *E. labiosa.*
  - *b.* Costæ about 16; median process of apertural bar flat and sharply bent proximally; aperture somewhat pliophlœan (fig. 69) .... 4. *E. barbata.*

C. Costæ 20–24.
- I. Aviculœcia present.
  - *a.* Smaller, about ·33 mm. long (fig. 70) .... 5. *E. lepida.*
  - *b.* Larger, about ·5 mm. long (fig. 71) .... 6. *E. crassescens.*
- II. Aviculœcia absent .... 7. [*E.*] *radiata.*

1. Eucheilopora pediculosa, Lang.

Eucheilopora pediculosa, sp. n.; Lang, 1916, p. 387; Lower Senonian; Hertford.

Diagnosis.—*Eucheilopora* with œcia about ·33 mm. long and with 10 or 11 costæ.

Description.—Asty multiserial, incrusting, unilaminar; œcia probably dimorphic. (a) *Ephebœcia*—about ·33 mm. long and ·22 mm. wide, broadly oval; extraterminal front-wall of small extent; the intraterminal front-wall is somewhat flatly arched, and consists of about eleven fairly-spaced costæ united in a broad median area of fusion reaching to about halfway between the mid-line and the termen; the ends of the costæ tend to be constricted as beads or solid spines, but this character is not a prominent feature as it is in *Æolopora*; apertural bar, though thin, yet somewhat flattened in an obliquely vertical plane, and produced into a small median spine; apertural spines six in number and decidedly enlarged; apertures cribriline; aviculœcia rare or absent. (b) *Neanœcia*—about ·22 mm. long and ·11 mm. wide, elliptical; intraterminal front-wall well-arched and consisting of about ten costæ; apertural bar flattened in a nearly vertical plane with a slight median process; apertural spines exceedingly small; aperture normal. (c) *Ancestrœcium*—about

·16 mm. long and ·08 mm. wide, elliptical; intraterminal front-wall very well-arched, consisting of less than ten costæ; apertural bar thin, and the flattening, if any, is in a completely vertical plane; apertural spines, if present, minute; aperture super-semi-circular.

DISTRIBUTION.—Senonian, Coniacian, zone of *M. cortestudinarium.* Hertfordshire.

TYPE-SPECIMEN.—D. 11463.

REMARKS.—*Eucheilopora pediculosa* closely resembles a multi-serial *Andriopora gasteri*, and probably is directly descended from that species. In turn, *Eucheilopora pediculosa* is the ancestor of *E. labellosa* and so of the other species of *Eucheilopora*, and probably too of the genera *Pancheilopora* and *Hippiopora.*

FIGURES.—Text-fig. 67. Orthœcium.

Plate IV, fig. 9. The entire type-specimen, except some broken peripheral œcia. The ancestrœcium, one or two neanœcia, and some half-dozen more-or-less perfect ephebœcia are shown. × about 27 diameters.

LIST OF SPECIMENS.

D. 11463. Type-specimen. Senonian, Coniacian, zone of *M. cortestudinarium.* Hertford. Presented by Prof. J. W. Gregory, F.R.S. 1899.

D. 25542. Paratype. Some of the œcia in which the median process of the apertural bar is poorly developed show an asymmetrical fusion of costæ forming the apertural bar. Senonian, Coniacian, low in the zone of *M. cortestudinarium.* Nash Mills, S.E. of Boxmoor, Herts. F. Möckler collection. 1912.

2. Eucheilopora labellosa, Lang.

Eucheilopora labellosa, sp. n.; Lang, 1916, pp. 387–8; Coniacian; Lille, France.

DIAGNOSIS.—*Eucheilopora* with œcia about ·33 mm. long and about 14–15 costæ.

DISTRIBUTION.—Senonian, ? Coniacian. Lisle, N.E. of Vendôme, Loir-et-Cher, France.

Type-specimen.—In the collection of Monsieur F. Canu.

Remarks.—*Eucheilopora labellosa* is probably directly derived from *E. pediculosa* by an increase in the number of costæ and by the acquisition of aviculœcia.

Specimens.—Only a photograph of the type-specimen is in the Collection.

3. Eucheilopora labiosa, Lang.

Eucheilopora labiosa, sp. n.; Lang, 1916, pp. 387–8; *M. cortestudinarium*-zone; Lewes, Sussex.

Diagnosis.—*Eucheilopora* with œcia about ·4 mm. long, with about 14 costæ, with the median process of the apertural bar erect, and with a cribriline aperture.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic. (a) *Ephebœcia*—about ·4 mm. long and about ·3 mm. wide, oval to elliptical; extraterminal front-wall of fair extent; the intraterminal front-wall is well-arched, and consists of fourteen or fifteen fairly closely-lying costæ, firmly united in a wide median area of fusion, and with a tendency to be constricted at the margin of the median area so as to form a row of solid beads (but this is not a conspicuous feature as it is in *Æolopora*), and to be similarly constricted in the median line, so as to form an irregular median ridge; apertural bar thin laterally, widening medianly, and produced into a median spine; aperture normal to cribriline; apertural spines enlarged; aviculœcia occasional, sporadically distributed, distally directed, short, sub-circular, with nearly circular apertures, and dimorphic, the smaller ones being smaller than the apertures of the orthœcia, and the larger having apertures nearly as large as those of the orthœcia; ovicells hyperstomial, with a median ridge or keel. (b) *Neanœcia*—about ·33 mm. long and ·2 mm. wide, oval; the intraterminal front-wall consists of about twelve costæ; apertures super-semicircular to cribriline. (c) *Ancestrœcium*—about ·18 mm. long and ·12 mm. wide; costæ about nine in number; aperture semicircular to super-semicircular; apertural spines six and somewhat enlarged.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium* and Santonian, zone of *M. coranguinum*. Kent and Sussex.

TYPE-SPECIMEN.—D. 28250.

REMARKS.—*Eucheilopora labiosa* may be derived from *E. labellosa* by an increase in the œcial size and by the acquisition of a distinct dimorphism of the aviculœcia, which, if present in *E. labellosa*, is not prominent.

FIGURES.—Text-fig. 68. Orthœcium with ovicell and aviculœcia.

Plate IV, fig. 10. Most of the type-specimen. The ancestrœcium is shown, three or four neanœcia, and more than a dozen ephebœcia, many of which have ovicells (some broken). There are also seven or eight aviculœcia. × about 27 diameters.

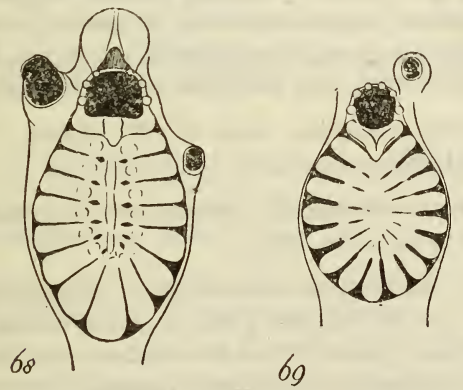


Fig. 68.—*Eucheilopora labiosa.* Diagram of an orthœcium with ovicell, a larger and a smaller aviculœcium, from above. × about 75 diameters.

Fig. 69.—*Eucheilopora barbata.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 28250. Type-specimen. Senonian, Coniacian, zone of *M. cortestudinarium.* Chalk Pit, Offham Hill, Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 29905–6. Two asties, probably of this species, but the number of costæ appears fewer. Senonian, Santonian, zone of *M. coranguinum.* Keston, Kent, S.E. of Croydon, Surrey. Collected bv G. E. Dibley, Esq., F.G.S., and presented by him, Dec. 1919.

4. Eucheilopora barbata, new species.

Diagnosis.—*Eucheilopora* with œcia about ·4 mm. long; with about 16 costæ; with the median process of the apertural bar flat, and proximally directed; and with a slightly pliophlœan aperture.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and about ·25–·3 mm. wide, oval to elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of about sixteen closely-placed costæ united in a wide median area of fusion around whose margin the slightly constricted original costal ends tend to form a circlet of bosses, but not prominently as in *Æolopora*; apertural bar thin laterally, but very wide medianly and produced in a median proximally directed tongue; aperture slightly pliophlœan; apertural spines six in number, and enlarged; aviculœcia fairly numerous, generally small, but slightly dimorphic, sporadically distributed, with subcircular constricted apertures.

Distribution.—Turonian, zone of *H. planus.* Old Pit, Malling Hill, Lewes.

Type-specimen.—D. 29886. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

Remarks.—*Eucheilopora barbata* may be derived from a form resembling *E. labiosa,* but with a less specialised median spine on the apertural bar. In *E. labiosa* this median spine is erect; in *E. barbata* it is flattened so as to form a proximally-directed, beard-like continuation of the apertural bar (hence the name). *E. barbata* also has more costæ than *E. labiosa,* and a more advanced aperture. But *E. labiosa* occurs in the zone above *E. barbata,* and it is possible that not only it, but *E. pediculosa, E. labellosa,* and *Andriopora gasteri,* will all be found as low as the *H. planus* zone, since all these latter forms appear to precede *E. labiosa* in phylogeny.

Figures.—Text-fig. 69. Orthœcium and aviculœcium.

Plate IV, fig. 11. Part of the type-specimen. One orthœcium has no ovicell; the others have ovicells, broken or complete; there are two aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

5. Eucheilopora lepida, Lang.

Eucheilopora lepida, sp. n.; Lang, 1916, pp. 387–8; Coniacian; Lisle.

Diagnosis.—*Eucheilopora* with œcia about ·33 mm. long and about 20–24 costæ; aviculœcia are present.

Distribution.—Senonian, ? Coniacian. Lisle, N.E. of Vendôme, Loir-et-Cher, France.

Type-specimen.—In the collection of Monsieur F. Canu.

Remarks.—*Eucheilopora lepida* generally resembles *E. labellosa*, from which it is probably derived; but its costæ have increased in number to more than twenty, from the fourteen or fifteen of the ancestral species.

Figures.—Text-fig. 70. Orthœcium and aviculœcium.

Specimens.—Only a photograph of the type-specimen is in the Collection.

6. Eucheilopora crassescens, Lang.

Eucheilopora crassescens, sp. n.; Lang, 1916, pp. 387–8; *M. cortestudinarium*-zone; Cuckmere Haven, Sussex.

Diagnosis.—*Eucheilopora* with œcia about ·5 mm. long and with about 20–24 costæ; aviculœcia are present.

Description.—Asty incrusting, multiserial, and unilaminar; œcia dimorphic. (a) *Ephebœcia*—about ·5 mm. long and ·33–38 mm. wide, elliptical; extraterminal front-wall rather extended; the intraterminal front-wall is well-arched, and consists of from twenty to twenty-four thin, rather closely-placed costæ, which probably have occasional, irregularly arranged lateral fusions and are united in a median line of fusion where the extreme distal ends are constricted off from the remainder of each costa, and constitute a moniliform ridge along the mid-line; apertural bar thin, with a median spine; aperture rather large, super-normal to cribriline; apertural spines six in number and much enlarged; aviculœcia numerous, sporadically distributed, and often lying in the mid-line and distally with regard to the ovicell of an orthœcium; of varying sizes, but on the whole dimorphic, the smaller kind rather large for an Andrioporid aviculœcium, and the larger kind having apertures nearly as large as those of the orthœcia; the apertures are subcircular, very slightly constricted laterally, and slightly wider distally than proximally; they have six distally-placed apertural spines; ovicells hyperstomial. (b) *Neanœcia* or ? *ancestrœcium*—a very early individual, which is either the ancestrœcium or an early neanœcium, is about ·3 mm. long and ·15 mm. wide; intraterminal front-wall well-arched, consisting of about twelve fairly closely-placed costæ which are fused medianly, but apparently have no lateral fusions, nor do their nipped-off ends form a prominent median seam; apertural bar thin, with no, or but a very slight, median spine; apertural spines six in number and much enlarged; aperture super-normal.

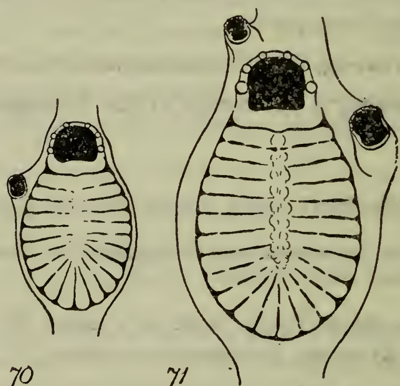


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Fig. 70.—*Eucheilopora lepida.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 71.—*Eucheilopora crassescens.* Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium.* Southern England.

Type-specimen.—D. 28190.

Remarks.—*Eucheilopora crassescens* is probably derived from *E. lepida* by an increase in œcial size. The tendency to dimorphism of the aviculœcia is of interest as an evolution parallel with that of *E. labiosa*, in which the aviculœcia are decidedly dimorphic.

Figures.—Text-fig. 71. Orthœcium and two aviculœcia.

Plate IV, fig. 12. Part of the type-specimen consisting of seven more-or-less complete, and one broken orthœcium, all of which have ovicells (all but one broken); and of twelve aviculœcia, of varying size, but of which one is especially large. × about 27 diameters.

LIST OF SPECIMENS.

D. 28910. D. 28253. Type-specimen and paratype. Senonian, Coniacian, zone of *M. cortestudinarium*. Cliffs between Hope Gap and Cuckmere Haven, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 4973. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium*, or Santonian, low in zone of *M. coranguinum*. Chatham, Kent. Collected by W. Gamble, Esq. 1898.

7. [Eucheilopora] radiata (F. A. Römer).

Escharina radiata N.; Römer, 1840, p. 13, pl. v, fig. 4; untere Kreide; bei Peine.

Cellepora radiata (*Escharina r.*) Röm.; Geinitz, 1846, p. 613; untere Kreide; bei Peine.

Escharina radiata Roemer; Reuss, 1846, p. 68, pl. xv, fig. 19; untere Plänerkalk; Schillinge bei Bilin.

Cellepora radiata Hag.; Bronn, 1848, p. 255.

Escharina radiata Rœ.; Bronn, 1848, p. 472; Kreide.

Escharina radiata Römer; Giebel, 1848, p. 18.

Non=*Escharina inflata* Römer; as stated by Giebel, 1848, p. 18. [See *Kankopora inflata*.]

? Non=*Cellepora incisa* Hagenow; as stated by Giebel, 1848, p. 18.

Eschara radiata Röm.; Giebel, 1848, p. 20; Plänermergel; Salzberg and Steinholz.

Escharina radiata Roe.; Bronn, 1849, p. 132; Kreide.

Cellepora radiata (*Escharina*) Röm.; Geinitz, 1849–50, pp. 248–9; unterer Pläner; Böhmen.

Escharina radiata, Rœmer; d'Orbigny, 1850, pp. 262; Sénonien; Hanovre, Peine.

Distansescharella radiata (Reuss, non Rœmer); d'Orbigny, 1853, p. 464; Craie de Bohême. [Genosyntype of *Distansescharella*, see p. 137.]

Reptescharella radiata (Rœmer); d'Orbigny, 1853, p. 465; Hanovre, Peine.

Distansescharella radiata (Reuss); Pictet, 1857, p. 110; Craie; Bohême.

Reptescharella radiata (Roemer); Pictet, 1857, p. 110; Craie; Hanovre.

(*Escharina*) *Cellepora radiata*, Gein.; Frič, 1869, p. 222; unterer Plänerkalk; Schillinge, bei Bilin.

Lepralia radiata Röm. sp.; Reuss, 1872, p. 104; unterer Pläner, Schillinge bei Bilin; untere Kreide, Peine.

Cribrilina radiata, Moll; Hincks, 1880, p. 190; Cretaceous; France.

Non *Cribrilina radiata*, Moll; Hincks, 1880, p. 185, pl. xxv, figs. 1–9; Tertiary and Recent.

? *Cribrilina radiata*, Moll.; Vine, 1884, pp. 173, 175; Upper Chalk; Beachy Head.

? Non *Cribrilina radiata*, Moll; Vine, 1885, pp. 115, 116; Chalk, England; Yellow Limestone (Cretaceous), Timber Creek, N. America.

Non *Cribrilina radiata*, Moll; Vine, 1885, p. 116; Tertiary and Recent.

? *Cribrillina* [sic] *radiata*, Moll; Pergens, 1887, p. xxxvii; Crétacé superieur.

Non *Cribrillyna* [sic] *radiata*, Moll; Pergens, 1887, p. xxxvii; Tertiary and Recent.

? *Cribrillina* [sic] *radiata*, Moll; Pergens, 1887[2], p. lx; Crétacé superieur; France.

Non *Cribrillina* [sic] *radiata*, Moll; Pergens, 1887[2], p. lx; Tertiary and Recent.

Non *Cribrilina radiata*, Moll; Vine, 1893, p. 316.

Non *Cribrilina* (*Cribrilina*) *radiata* (Moll); Canu, 1900[2], p. 445, text-fig. 56 on p. 445 [a copy of Hincks, 1880, pl. xxv, fig. 1].

Lepralia radiata, Röm. sp.; Frič, 1911, p. 98; Cenoman; Sachsen.

Eucheilopora radiata (Römer); Lang, 1916, pp. 387–8; Senonian or Turonian; Peine, Germany.

Escharina radiata Reuss; Lang, 1917, p. 170.

Diagnosis.—*Eucheilopora* with no aviculœcia and about 20 costæ.

Distribution.—Turonian or Senonian. Near Peine, E. of Hanover, Germany.

Type-specimen.—That figured by Römer, 1840, pl. v, fig. 4, is hereby selected.

Remarks.—*Escharina radiata*, Römer, is probably a *Eucheilopora*, if Römer's figure gives a fair idea of the species. No aviculœcia are shown, and the costæ are about twenty in number; but the details of structure are not clearly enough drawn to certify even the genus. If a *Eucheilopora*, it is possibly derived from *E. lepida*.

Specimens.—None in the Collection.

XIV. PANCHEILOPORA, Lang, 1916.

Pancheilopora, gen. nov.; Lang, 1916, pp. 383, 390.

Diagnosis.—Multiserial, incrusting Andrioporinæ with a secondary aperture which has a proximal shield primarily formed by the general upward growth of the somewhat vertically-flattened apertural bar into a more or less pronounced hump and the backward growth of its median spine, which typically fuses with the median ridge of the intraterminal front-wall; ultimately the proximal pair of apertural spines fuses with the apertural bar; the four distal apertural spines retain their identity, and, in the absence of ovicells, do not form a complete distal shield.

Distribution.—Senonian, Santonian to Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Surrey and Sussex.

Genotype.—*Pancheilopora magnilabrosa*.

Remarks.—*Pancheilopora* appears to be a derivative of *Eucheilopora*, and probably of *E. pediculosa*, produced by an increase in size and in the number of costæ, and especially by the differentiation of the apertural bar to form the proximal shield of a secondary aperture. This differentiation primarily consists in the piling up of secondary calcium carbonate on the apertural bar to form a hump, much as in *Corymboporella* and *Hybopora*; *Pancheilopora parvilabrosa* hardly advances beyond this stage. But there is also a proximally-directed process connecting the hump with the mid-line of the intraterminal front-wall; and, ultimately, the proximal pair of apertural spines fuses with the apertural bar. The tendency for the distal ends of the costæ to be constricted off as a row of solid beads also shows the affinities of *Pancheilopora* to *Eucheilopora*.

Of the two species of *Pancheilopora*, *P. magnilabrosa* is derived from near *P. parvilabrosa* by an increase of œcial size and a greater development of the proximal shield, which ultimately embraces the proximal apertural spines. The intraterminal front-wall, however, does not appear to be quite so closely compacted as that of *P. parvilabrosa*, and in this respect is less advanced than in that form.

Key to the Species of *Pancheilopora*.

A. Œcial length about ·33 mm.; intraterminal front-wall with no conspicuous median ridge or seam; apertural bar produced into a high proximal shield with a short sharp median process, which does not fuse with the proximal pair of apertural spines; proximal shield not extended proximally over the median seam of the intraterminal front-wall (fig. 72). 1. *P. parvilabrosa*.

B. Œcial length about ·4 mm.; intraterminal front-wall with a conspicuous median ridge or seam; apertural bar produced into a high proximal shield with no projecting median process, but produced proximally over the median seam of the intraterminal front-wall and, ultimately, fused with the proximal pair of apertural spines (fig. 73) ...... 2. *P. magnilabrosa*.

1. Pancheilopora parvilabrosa, new species.

Diagnosis.—*Pancheilopora* with œcia about ·33 mm. long; with no conspicuous median seam on the intraterminal front-wall; the highly produced apertural bar has a short sharp median process, but does not project proximally over the median seam, and is not fused with the proximal pair of apertural spines.

Description.—Asty incrusting, multiserial, unilaminar; œcia monomorphic, about ·33 mm. long and about ·2 mm. wide, elliptical; extraterminal front-wall rather extensive on all sides, so that the œcia appear somewhat widely-spaced; the intraterminal front-wall is well-arched and consists of about fifteen well-fused costæ with numerous irregularly-arranged lateral fusions and with constricted ends that tend to form beads in the median area of fusion; the whole intraterminal front-wall is well-compacted, so that the outlines of the costæ are somewhat obscure; apertural bar flattened in a vertical plane to form a proximal shield and produced in a short, sharp, median, vertically-directed spine; there is also a slight proximal extension of the apertural bar, but this does not appreciably over-ride the intraterminal front-wall; apertures cribriline; apertural spines apparently six in number and somewhat enlarged; the proximal pair lie close against the ends of the apertural bar; aviculœcia apparently absent; ovicells hyperstomial.

Distribution.—Senonian, Santonian, high in zone of *M. coranguinum*. Horsley, N.E. of Guildford, Surrey,

Type-specimen.—**D. 29883.**

Remarks.—See under the genus *Pancheilopora*.

Figures.—Text-fig. 72. Œcium.

Plate V, fig. 1. Part of the type-specimen consisting of eight more-or-less complete œcia, one of which (with broken front-wall) bears an ovicell, and parts of several others. × about 27 diameters.

LIST OF SPECIMENS.

D. 29883–4. Type-specimen and paratype. Senonian, Santonian, high in zone of *M. coranguinum*. Coomb's Pit, Horsley, N.E. of Guildford, Surrey. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

2. Pancheilopora magnilabrosa, Lang.

Pancheilopora magnilabrosa, sp. n.; Lang, 1916, p. 390; *A. quadratus*-zone, *E. depressa*-subzone; E. of Brighton, Sussex.

DIAGNOSIS.—*Pancheilopora* with œcia about ·4 mm. long; with a conspicuous median ridge or seam on the intraterminal front-wall with which a proximal projection of the apertural bar fuses; the high apertural bar forms a proximal shield, and finally fuses with the proximal pair of apertural spines, but has no prominent, free, median projection.

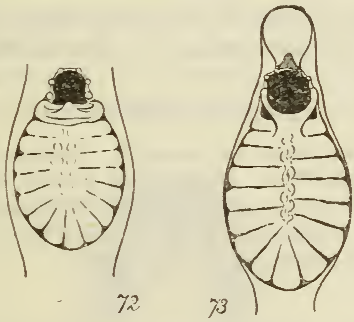

Fig. 72.—*Pancheilopora parvilabrosa.* Diagram of an œcium, from above. × about 75 diameters.

Fig. 73.—*Pancheilopora magnilabrosa.* Diagram of an œcium and an ovicell, from above. × about 75 diameters.

DESCRIPTION.—Asty multiserial, incrusting, and unilaminar; œcia monomorphic, about ·4 mm. long and ·23 mm. wide, elliptical but narrowing somewhat distally; extraterminal front-wall of small extent; the intraterminal front-wall is rather flatly-arched, and consists of about fifteen closely-placed costæ which have not obvious lateral fusions, but a median band of fusion varying in width, but generally narrow, on which the constricted distal ends of the costæ form a median seam or paired row of beads; the apertural bar is flattened in a vertical plane and has a median, proximally directed projection or ridge which joins the median beaded ridge of the intraterminal front-wall; ultimately the proximal pair of apertural spines fuses with the apertural bar, thus helping to form a proximal shield; the remaining four enlarged apertural spines normally represent the distal shield of the secondary aperture without further modification; but when an ovicell is present, the upper part of its apertural rim joins with the rim of the proximal shield to form a more-or-less circular secondary aperture; aviculœcia apparently absent; ovicells hyperstomial.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Sussex.

Type-specimen.—D. 29103.

Remarks.—See under the genus *Pancheilopora*.

Figures.—Text-fig. 73.—Œcium and an ovicell.

Plate V, fig. 2. Part of the type-specimen consisting of nine œcia, six of which bear ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 29103–4. Type-specimen and paratype. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between the last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1916.

XV. HIPPIOPORA, Lang, 1916.

Hippiopora, gen. nov.; Lang, 1916, pp. 383, 389.

Diagnosis.—Multiserial Andrioporinæ with no secondary aperture; with an intraterminal front-wall mostly hidden by an aviculœcium medianly placed above the apertural bar, and by secondary tissue, thus appearing solid and showing few or no traces of its Cribrimorph origin; the aviculœcium medianly placed above the apertural bar of each orthœcium is distally directed and has a more or less circular aperture borne on a somewhat tubular process.

Distribution.—Senonian, Campanian, zone of *A. quadratus* below the subzone of *A. quadratus*. Sussex.

Genotype.—*Hippiopora equestris*.

Remarks.—The systematic position of *Hippiopora* depends upon the nature of its primary intraterminal front-wall. There are indications that this is formed of costæ, and that, therefore, *Hippiopora* is a Cribrimorph. Further, it is placed but provisionally in the Andrioporinæ owing to its general Andrioporine appearance. If it is an Andrioporine, it is likely to be a derivative of *Eucheilopora*.

1. Hippiopora equestris, Lang.

Hippiopora equestris, sp. n.; Lang, 1916, p. 389. *A. quadratus*-zone, *O. pillula*-subzone; North Lancing, Sussex. [But see below.]

Diagnosis.—As for the genus.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and ·35 mm. wide, oval; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched and apparently solid, but mostly concealed by

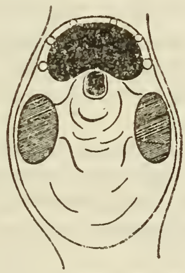

Fig. 74.—*Hippiopora equestris.* Diagram of an orthœcium with an aviculœcium upon the apertural bar, from above. × about 75 diameters.

an aviculœcium which rides upon the apertural bar, and by a layer of secondary tissue which extends proximally from the aviculœcium and enwraps the proximal end of the orthœcium; laterally, glimpses of the primary intraterminal front-wall may be seen, and there are indications that it is formed of costæ; in ephebœcia there is a further band of secondary tissue joining the aviculœcia and bearing a large median lacuna; the apertural bar is concealed beneath a medianly-placed aviculœcium, but has a median distally directed projection; the apertural spines are six in number and enlarged; the apertures are large and sub-circular, with a large indentation proximally formed by the median projection of the apertural bar; aviculœcia, one placed medianly on the apertural bar of each orthœcium; distally-directed, somewhat tubular in shape, and with a more or less circular aperture.

Distribution.—Senonian, Campanian, zone of *A. quadratus* below subzone of *A. quadratus.* Sussex.

Type-specimen.—D. 28909.

Remarks.—Besides from the localities mentioned below, *Hippiopora equestris* has been found by Mr. C. T. A. Gaster in the subzone of *O. pillula* at East Hill, Rottingdean. For further remarks, see under the genus *Hippiopora.*

Figures.—Text-fig. 74. Orthœcium and aviculœcium.

Plate V, fig. 3. The type-specimen, consisting of six complete œcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28909. Type-specimen. Senonian, Campanian, zone of *A. quadratus*, top of subzone of *E. scutatus*, var. *depressa.* Pit 2 of Gaster, by reservoir near Hill Barn, North Lancing, E. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1916.

D. 29887. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus*, var. *depressa.* Cliffs between last groyne E. of Rottingdean Gap and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

XVI. ÆOLOPORA, Lang, 1916.

Æolopora, gen. nov.; Lang, 1916, pp. 383, 390.

Diagnosis.—Multiserial Andrioporinæ with no secondary aperture; the median area of fusion is surrounded with a margin of solid spines or beads, which are the upturned original distal ends of the costæ; the apertural spines are considerably thickened.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*, to Campanian, zone of *A. quadratus*, subzone of *A. quadratus.* Southern England.

Genotype.—*Æolopora distincta.*

Remarks.—The chief diagnostic character of *Æolopora* is the margin of solid spines or beads that surrounds the median area of fusion of the intraterminal front-wall. A tendency to this arrangement has already been noticed in *Andriopora gasteri* and its derivative genera *Eucheilopora* and *Pancheilopora*, and again in the species *Andriopora gallica* and *A. frequens*. In *Æolopora* this tendency is considerably developed, so that the circlet of beads stands out boldly on the intraterminal front-wall. *Æolopora* is probably directly derived from *Andriopora frequens*, showing more advanced development in its multiserial asty, its medianly-produced apertural bar, and the intensified beading of the costal ends. *Æolopora stellata* appears to be a high-zonal development of *Æ. distincta*, having a more differentiated apertural bar, and the beads, consequently, on this structure not developed or poorly developed. *Æ. nebulosa* may be derived from *Æ. stellata* by an increase in size, by a catagenetic decrease in the number of costæ, by a further strengthening of the apertural bar, and, probably, by a loss of aviculœcia.

Key to the Species of *Æolopora*.

A. Beads surrounding the median area of fusion 14–16 in number, those on the apertural bar being well-developed; apertural bar less flattened in a vertical plane; œcial length about ·33 mm. (fig. 75) .... 1. *Æ. distincta.*

B. Beads surrounding the median area of fusion 12–14 in number, those on the apertural bar being absent or poorly developed; apertural bar more flattened in a vertical plane; œcial length about ·33 mm. (fig. 76) ... 2. *Æ. stellata.*

C. Beads surrounding the median area of fusion 10–11 in number, there being none on the apertural bar, which is considerably thickened, flattened in a vertical plane, and has a median projection; œcial length about ·4 mm (fig. 77)... 3. *Æ. nebulosa.*

1. Æolopora distincta, Lang.

Æolopora distincta, sp. n.; Lang, 1916, p. 390; *M. coranguinum*-zone; Upper Basildon, Berks.

Diagnosis.—*Æolopora* with from 14 to 16 beads surrounding the median area of fusion, those on the apertural bar being well-developed; apertural bar less flattened in a vertical plane; œcial length ·33 mm.; aviculœcia present.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·33 mm. long and about ·22 mm. wide, oval; extraterminal front-wall of small extent; intraterminal front-wall well-arched, and consisting of about thirteen or fifteen rather widely-spaced costæ with no lateral fusions but united in a wide median area of fusion; at the margin of the median area of fusion each costa bears a bead, which, to judge from comparable instances, is the original constricted distal end of the costa, which has retreated from the mid-line; the ring of beads thus formed stands out from the general surface, and, appearing white in a specimen which has been painted to bring out the details of structure, gives the impression of a constellation—hence the generic and trivial names; the apertural bar is somewhat flattened in a vertical plane, and each of the costæ of which it is composed retains the bead formed by its constricted distal end, and this takes its place in the ring of beads; apertures cribriline to somewhat pliophlœan; the six apertural spines are considerably enlarged; aviculœcia occasional, sporadically distributed, generally distally directed, large, with blunt sub-circular apertures divided by a constriction into a smaller proximal portion and a larger rostrum; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen.—D. 28062. Upper Basildon, Berks.

Remarks.—See under the genus *Æolopora*.

Figures.—Text-fig. 75. Orthœcium and aviculœcium.

Plate V, fig. 4. Part of the type-specimen, consisting of six more-or-less perfect orthœcia and one aviculœcium. Three of the orthœcia have complete ovicells, and one a broken ovicell; there is also shown the complete ovicell of a seventh orthœcium. × about 27 diameters.

LIST OF SPECIMENS.

D. 28062. D. 21212–3. D. 28052–61. D. 28063–6. Type-specimen and sixteen paratypes. Senonian, Santonian, [high in the] zone of *M. coranguinum*. Upper Basildon, N.W. of Pangbourn, Berks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 23326–8. D. 23950. Four paratypes. Senonian, Santonian, high in the zone of *M. coranguinum*. Medical College Pit, Epsom, Surrey. F. Möckler collection. 1912.

D. 28246. Paratype. Senonian, Santonian, zone of *M. coranguinum*, about 40 ft. from the base of the zone (20 ft. below the "strong *coranguinum*-tabular" of Rowe). Between Beltout and Birling Gap, W. of Beachy Head, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 29888. Senonian, Santonian, [high in the] zone of *M. coranguinum.* Coomb's Pit, W. Horsley, N.E. of Guildford, Surrey. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

2. Æolopora stellata, Lang.

Æolopora stellata, sp. n.; Lang, 1916, p. 390. *A. quadratus*-zone, *O. pillula*-subzone [but see below]; North Lancing, Sussex.

Diagnosis.—*Æolopora* with from 12 to 14 beads surrounding the median area of fusion, those on the apertural bar being absent or poorly developed; apertural bar more flattened in a vertical plane; œcial length ·33 mm.; aviculœcia present.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·33 mm. long and ·22 mm. wide, oval;

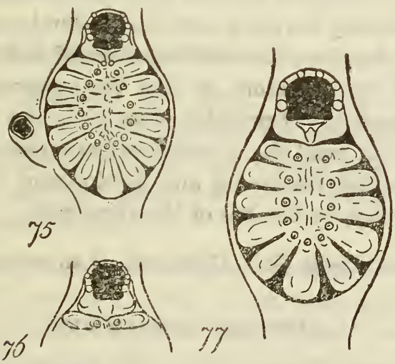

Fig. 75.—*Æolopora distincta.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 76.—*Æolopora stellata.* Diagram of the distal end of an orthœcium, from above. × about 75 diameters.

Fig. 77.—*Æolopora nebulosa.* Diagram of an œcium, from above. × about 75 diameters.

extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of about twelve or fourteen rather widely-spaced costæ without lateral fusions, but united in a wide median area of fusion, at the head of which each costa bears a bead or solid spine; this bead is probably the original constricted distal end of the costa which, during evolution, has migrated from the mid-line; the apertural bar is considerably flattened in a vertical plane, and, unlike the apertural bar of *Æ. distincta*, does not normally bear a median pair of beads; the apertures are cribriline; there are six enlarged apertural spines; the aviculœcia are few in number, sporadically distributed, irregularly, but generally distally directed, large, with blunt oval apertures, divided by a slight constriction into a smaller proximal portion and a larger rostrum; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *Marsupites*, and Campanian, zone of *A. quadratus*.

Type-specimen.—D. 28911. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. North Lancing, Sussex.

Remarks.—*Æolopora stellata* is obviously a high-zonal derivative of *Æ. distincta*, having a more highly-developed apertural bar, and merging, therefore, the constricted costal ends in the general thickening of that structure, so that the apertural bar does not appear to be beaded. It probably, also, gives rise to *Æ. nebulosa* by an increase in œcial size, a catagenetic decrease in the number of costæ, a further thickening and development of the apertural bar, and, probably, by the loss of the aviculœcia.

Figures.—Text-fig. 76. Distal end of an orthœcium.

LIST OF SPECIMENS.

D. 29893. Senonian, Santonian, zone of *Marsupites*, *Uintacrinus*-band. Medical College Pit, Epsom, Surrey. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 29891. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Pit 4 of Gaster, western pit below Lancing Ring, W. side of Boundstone Lane, N.E. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 29885. D. 29892. Senonian, Campanian, zone of *A. quadratus*, subzone of *E. scutatus* var. *depressa*. Cliffs between last groyne E. of Rottingdean Gap, and Saltdean, E. of Brighton, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 28911. D. 28918–21. Type-specimen and four paratypes. Senonian, Campanian, zone of *A. quadratus*, top of subzone of *E. scutatus* var. *depressa*. Pit 2 of Gaster, by reservoir near Hill Barn, North Lancing, E. of Worthing, Sussex. Collected by C. T. A.

Gaster, Esq., and presented by him, Jan. 1916. Formerly Pit 2 of Gaster was supposed to be in the subzone of *Offaster pillula*.

D. 29889–90. Two specimens from the same horizon and locality as the last. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 28965–6. Two paratypes. Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Pit 7 of Gaster, Upton Lane (=Lambley's Lane), Sompting, N.E. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1916.

D. 28986. Paratype. Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Pit 10 of Gaster, western pit E. of Charman Dean, N. of Broadwater, Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1916.

D. 3248. Paratype. Senonian, Campanian, zone of *A. quadratus*. Near Romsey, Hants. Presented by Dr. H. P. Blackmore, F.G.S., Nov. 1897.

3. **Æolopora nebulosa**, new species.

Diagnosis.—*Æolopora* with 10 or 11 beads surrounding the median area of fusion; with none on the apertural bar, which is considerably thickened, flattened in a vertical plane, and medianly produced in a spine-like projection; œcial length about ·4 mm.; aviculœcia apparently absent.

Description.—Asty multiserial, incrusting, unilaminar; œcia apparently monomorphic, about ·4 mm. long and ·3 mm. wide, oval; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of about ten or eleven rather widely-spaced costæ which have no lateral fusions, but are united in a wide median area of fusion; at the edge of this area each bears a solid bead probably representing the original constricted distal end of the costa, which, during evolution, has migrated from the mid-line; apertural bar thick, flattened in a vertical plane, and produced medianly in a spine-like projection; aperture cribriline; apertural spines six in number, and considerably enlarged.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Southern England.

Type-specimen.—**D. 29061.** Sompting, Sussex.

Remarks.—See remarks under the genus *Æolopora* and under the species *Æ. stellata*.

Figures.—Text-fig. 77. An œcium.

Plate V, fig. 5. The type-specimen, consisting of thirteen complete œcia, two of which bear broken ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 29061. Type-specimen. Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Pit 7 of Gaster, Upton Lane (= Lambley's Lane), Sompting, N.E. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Sept. 1916.

D. 3251. D. 29052–3. Three paratypes. Senonian, Campanian, zone of *A. quadratus*. East Harnham, S. of Salisbury, Wilts. Presented by Dr. H. P. Blackmore, F.G.S., Nov. 1917.

XVII. AUCHENOPORA, Lang, 1916.

Auchenopora, gen. nov.; Lang, 1916, pp. 383, 390.

Diagnosis.—Multiserial Andrioporinæ with a secondary aperture, whose proximal shield is formed by the upward growth of a flattened shield-shaped apertural bar which does not display a thickened median spine, and whose distal shield is formed by the fusion of distal apertural spines.

Distribution.—Danian. Faxe, Sjælland, Denmark.

Genotype.—*Auchenopora guttur.*

Remarks.—*Auchenopora* may be derived from a form like *Andriopora frequens* by the development of a secondary aperture whose proximal shield is formed by the apertural bar, and whose distal shield is composed of fused apertural spines. The rim of the secondary aperture is incomplete, as there is a gap between the proximal and distal shields.

1. Auchenopora guttur, Lang.

Auchenopora guttur, sp. n.; Lang, 1916, p. 390; Danian; Faxe, Denmark.

Diagnosis.—As for the genus.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·37 mm. long and ·25 mm. wide, elliptical; the extraterminal front-wall is of small extent; the intraterminal front-wall is somewhat flatly arched and consists of about fifteen closely-placed costæ; apertural bar very much flattened in a vertical plane, having a plate-like form, with a slight median projection; it forms the proximal shield of the secondary aperture; the secondary aperture is sub-circular; there are at least four apertural spines, which are joined to form a distal shield by the infilling of the intervening spaces with secondary tissue; whether a third (proximal) pair of apertural spines is present is doubtful, but it is possible that they lie alongside and are fused with the proximal shield of the secondary aperture; aviculœcia few, sporadically distributed, distally directed, with somewhat narrow, slightly pointed, but not very elongate apertures; ovicells hyperstomial.

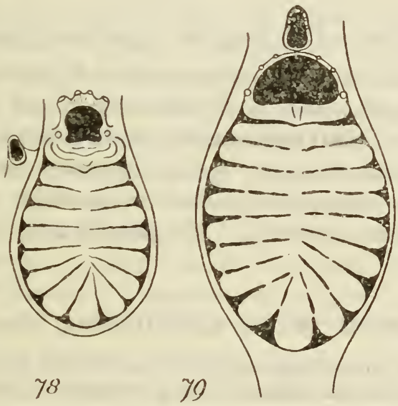

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Fig. 78.—*Auchenopora guttur.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Fig. 79.—*Monoceratopora lewesiensis.* Diagram of an orthœcium with its attendant aviculœcium, from above. × about 75 diameters.

Distribution.—Danian. Faxe, Sjælland, Denmark.

Type-specimen.—D. 28219.

Remarks.—See remarks under the genus *Auchenopora.*

Figures.—Text-fig. 78. Orthœcium and aviculœcium.

Plate V, fig. 6. Part of the type-specimen, consisting of nine orthœcia, one of which bears an ovicell, and of three aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28219. D. 28217–8. Type-specimen and paratypes. Danian, Faxe, Sjælland, Denmark. 1914.

XVIII. LECYTHOGLENA, Marsson, 1887.

Lekythoglena [sic] nov. gen. [partim]; Marsson, 1887, pp. 90–1, 108.
Lekythoglena [partim]; Deecke, 1895, p. 79.
Lekythoglena; Lang, 1916, pp. 383, 390.
Lekythoglena; Lang, 1917, p. 171.

Diagnosis.—? Andrioporinæ with an erect cylindrical asty; the intraterminal front-wall is more or less completely-fused, but its cribrimorph origin can plainly be seen; the hyperstomial ovicells have a radial structure.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen Island.

Genolectotype.—*Lekythoglena ampullacea*, Marsson.

Remarks.—Of the two species described by Marsson under his new genus *Lecythoglena*, *L. ampullacea* (selected as genotype—see Lang, 1916, p. 390) alone shows definite cribrimorph structure, and, judging from Marsson's figure, is probably an Andrioporine. Until, however, an actual specimen is examined, its systematic position must remain doubtful. It is possibly allied to *Andriopora levinseni*.

1. Lecythoglena ampullacea, Marsson.

Lekythoglena [sic] *ampullacea* n. sp.; Marsson, 1887, pp. 91, 108, pl. ix, fig. 7; Weisse Schreibkreide; Rügen. [Genolectotype of *Lecythoglena*.]
Lekythoglena ampullacea Marss.; Deecke, 1895, p. 79; Senon; Rügen.
Lekythoglena ampullacea, Marsson; Lang, 1916, p. 390; *B. mucronata*-zone; Rügen, Germany. [Genolectotype of *Lecythoglena*.]
Lekythoglena ampullacea, Marsson; Lang, 1917, p. 171.

Diagnosis.—As for the genus.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen I.

Type-specimen.—That figured by Marsson, 1887, pl. ix, fig. 7, is hereby selected.

Remarks.—See remarks under the genus *Lecythoglena*.

Specimens.—None in the Collection.

XIX. MONOCERATOPORA, Lang, 1916.

Monoceratopora, gen. nov.; Lang, 1916, pp. 383, 389.

Diagnosis.—Multiserial Andrioporinæ in which the proximal pair of apertural spines tends to be enlarged, while the distal pairs remain minute; the aviculœcia are few, and tend to be arranged medianly and distally with regard to the orthœcia; no secondary aperture is formed.

Distribution.—Turonian, zone of *H. planus*, to Senonian, Santonian, zone of *M. coranguinum*. Southern England.

Genotype.—*Monoceratopora unicornis.*

Remarks.—The three known species of *Monoceratopora* give but few indications of the trend of evolution within the genus. One species, *M. unicornis*, appears to have evolved along a different line from the other two, having the proximal pair of apertural spines less enlarged than those of *M. gamblei*; the costæ, too, are fewer; the apertural bar has a median spine, and the aperture is more advanced than in the other two species. In *M. lewesiensis* and *M. gamblei* the apertures are very primitive, being semicircular or (in *M. gamblei*) sub-semicircular. The latter case is probably a specialization tending towards a lower, instead of, as usual, a higher and super-semicircular shape. If this is so, it is possible that *M. gamblei* is descended from *M. lewesiensis*, although, at first sight, its apertures might be supposed to indicate a more primitive nature.

Very characteristic of all three species are the generally numerous, small, somewhat pointed aviculœcia occurring at the distal ends of the orthœcia.

Key to the Species of *Monoceratopora*.

A. Costæ about 17; apertures semicircular or sub-semicircular; apertural bar comparatively undifferentiated.

- 1. Proximal apertural spines less enlarged; apertures semicircular (fig. 79) .... 1. *M. lewesiensis.*
- 2. Proximal apertural spines more enlarged; apertures sub-semicircular (fig. 80) .... 2. *M. gamblei.*

B. Costæ about 12 to 15; apertures sub-normal; apertural bar flattened in a vertical plane and with a median projection (fig. 81).. 3. *M. unicornis.*

1. Monoceratopora lewesiensis, Lang.

Monoceratopora lewesiensis, sp. n.; Lang, 1916, p. 389; *H. planus*-zone; Malling Hill, Lewes, Sussex.

Diagnosis.—*Monoceratopora* with about 17 costæ and a comparatively undifferentiated apertural bar; the proximal apertural spines are very slightly enlarged, and the apertures are semicircular.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·55 mm. long and about ·35 mm. wide, oval-elliptical; extraterminal front-wall of very small extent; the intraterminal front-wall is very flatly-arched, and consists of about seventeen fairly widely-spaced costæ united in a median band of fusion, and each having about two lateral fusions with each neighbouring costa; apertural bar rather narrow and slightly flattened in a vertical plane; apertural spines apparently six in number, the proximal pair being slightly enlarged; the apertures vary in shape, but on the whole they are semicircular; aviculœcia numerous, generally one to each orthœcium, and situated distally with respect to it; they are small, distally (and somewhat upwardly) directed, with short, pointed triangular apertures having at least two, probably three, pairs of apertural spines; ovicells hyperstomial.

Distribution.—Turonian, zone of *H. planus*. Southern England.

Type-specimen.—D. 28248.

Remarks.—See remarks under the genus *Monoceratopora*.

Figures.—Text-fig. 79. Orthœcium and aviculœcium.

Plate V, fig. 7. Part of the type-specimen, consisting of six complete orthœcia, of which five bear a distally-placed aviculœcium and one a broken ovicell; two other aviculœcia are shown, and another broken ovicell. × about 27 diameters.

LIST OF SPECIMENS.

D. 28248. Type-specimen. Turonian, zone of *H. planus*. Old chalk-pit, Malling Hill, Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

D. 4972. Paratype. Turonian, zone of *H. planus*, or Lower Senonian. Chatham, Kent. Collected by W. Gamble, Esq. 1898.

2. Monoceratopora gamblei, Lang.

Monoceratopora gamblei, sp. n.; Lang, 1916, p. 389; Lower Senonian; Chatham, Kent.

Cribrilina Seafordensis, sp. nov.; Brydone, 1917, pp. 51, 53, pl. iii, fig. 9; *M. cortestudinarium*-zone; Seaford, Sussex.

Diagnosis.—*Monoceratopora* with about 17 costæ and a comparatively undifferentiated apertural bar; the proximal apertural spines are decidedly enlarged, and the apertures are sub-semicircular.

Description.—Asty multiserial, incrusting, unilaminar; œcia dimorphic; orthœcia about ·58 mm. long and ·3 mm. wide, elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is somewhat flatly-arched, and consists of about seventeen fairly widely-spaced costæ united in a wide median area of fusion, and each having one or two lateral fusions with its neighbour; the apertural bar is narrow and slightly flattened in a vertical plane; the apertural spines are probably six in number, and the proximal pair is considerably enlarged; the apertures are sub-semicircular; the aviculœcia are numerous, and one is generally medianly placed at the distal end of every orthœcium; they are small, distally (and somewhat upwardly) directed, with pointed, shortly-triangular apertures divided by a constriction into a very small proximal portion and a much larger rostrum; they have more than one pair of apertural spines; ovicells hyperstomial.

Distribution.—Senonian, Coniacian or Lowest Santonian. Southern England.

Type-specimen.—D. 28530.

Remarks.—*Monoceratopora gamblei* is probably derived from *M. lewesiensis*, and shows an advance upon that species in the somewhat greater œcial length, in the wider median area of fusion, as well as in the proximal apertural spines, which are decidedly larger than those of *M. lewesiensis*. But the apertures are sub-semicircular, and it is natural to suppose that these are more primitive structures than the apertures of *M. lewesiensis*, since, in evolution, the aperture generally increases in length compared with width. But it is probable that, in this case, the specialisation of the aperture follows the unusual direction of producing an extremely short aperture from one of a primitive semicircular shape.

Figures.—Text-fig. 80. Orthœcium and aviculœcium.

Plate V, fig. 8. Part of the type-specimen, consisting of five complete orthœcia, four of which bear a distally-placed aviculœcium and one an ovicell. Another ovicell, four other aviculœcia, and portions of other orthœcia also are shown. × about 27 diameters.

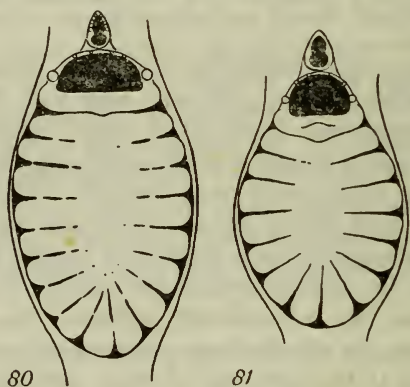


Fig. 80.—*Monoceratopora gamblei.* Diagram of an orthœcium and its attendant aviculœcium, from above. × about 75 diameters.

Fig. 81.—*Monoceratopora unicornis.* Diagram of an orthœcium with its attendant aviculœcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 28530. D. 11121. D. 11405. Type-specimen and two paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*, or Santonian, low in zone of *M. coranguinum*. Chatham, Kent. Collected by W. Gamble, Esq. 1901.

3. Monoceratopora unicornis, Lang.

Monoceratopora unicornis, sp. n.; Lang, 1916, p. 389; *M. coranguinum*-zone; W. of Beachy Head, Sussex.

Diagnosis.—*Monoceratopora* with about 12 to 15 costæ; with the apertural bar flattened in a vertical plane and with a median spine-like projection; the proximal pair of apertural spines is very slightly enlarged; the apertures are sub-normal in shape.

Description.—Asty multiserial, incrusting and unilaminar; œcia dimorphic; orthœcia about ·45 mm. long and about ·3 mm. wide, oval to elliptical; extraterminal front-wall of small extent; the intraterminal front-wall is well-arched, and consists of about twelve to fifteen fairly widely-spaced costæ united in a wide median band of fusion, but with no obvious further lateral fusions; the apertural bar is decidedly flattened in a vertical plane, and medianly produced in a spine-like process; the apertural spines are probably six in number, and are exceedingly small, but the proximal pair are larger than the others; the apertures are sub-normal to normal in shape; the aviculœcia are rather rare, but, where they do occur, they are placed medianly and distally in respect to the apertures of the orthœcia; they are small, distally directed, with shortly-pointed, somewhat triangular apertures divided by a constriction into a smaller proximal portion and a larger rostrum; the orthœcia are remarkable for the large distal communication-pore situated beneath the distal end of the aperture; ovicells hyperstomial.

Distribution.—Senonian, Santonian, zone of *M. coranguinum.* Sussex.

Type-specimen.—D. 28247. Between Birling Gap and Beltout, W. of Beachy Head. Collected by C. T. A. Gaster, Esq., and presented by him, Jan. 1915.

Remarks.—*Monoceratopora unicornis* has evidently developed along different lines from *M. lewesiensis* and *M. gamblei.* While retaining comparatively small proximal apertural spines, it has produced a more advanced aperture and apertural bar than the other species; its costæ also are fewer in number, either primitively so, or reduced by catagenesis. The large distal communication-pores in this species (and possibly they also occur in *M. gamblei*) are remarkable. They resemble those of *Lagynopora,* and it is possible that the Lagynoporidæ are derived from this stock, since the Lagynoporinæ resemble *M. unicornis* in other particulars, such as the prominence of the proximal apertural spines and of the median process of the apertural bar. *Monoceratopora* also is prominent among the Andrioporinæ for its great œcial size, which approximates to that normal for the Lagynoporidæ.

FIGURES.—Text-fig. 81. Orthœcium and aviculœcium.

Plate V, fig. 9. Part of the type-specimen, consisting of seven more-or-less complete orthœcia, one of which has a distally-placed aviculœcium, and three of which bear broken ovicells. Two communication-pores and another broken ovicell also are shown. ×about 27 diameters.

SPECIMENS.—**D. 28247.** Type-specimen. Distribution and collection as given above.

b. PLIOPHLŒINÆ, Lang, 1916.

Pliophlœinæ, subfam. nov.; Lang, 1916, pp. 382, 391.

DIAGNOSIS.—Andrioporidæ in which the costæ are more or less flattened, and bear a median row of pores; a costa appears occasionally to fuse with its neighbour to form a costa of double width.

DISTRIBUTION.—Senonian, Santonian to Danian, chiefly *B. mucronata*-zone.

REMARKS.—Except for the doubtfully-placed genus *Trilophopora* the Pliophlœinæ consist of *Pliophlœa* only. *Trilophopora*, if a Pliophlœine, is descended from *Pliophlœa*. The affinities of the Pliophlœinæ, therefore, are discussed under the genus *Pliophlœa*.

Key to the Genera of Pliophlœinæ.

A. Furrows between the costæ plainly visible .... I. *Pliophlœa*.
B. Only traces of the furrows between the costæ and pores on the costæ are visible upon a complete intraterminal front-wall.................................... II. *Trilophopora*

I. PLIOPHLŒA, Gabb & Horn, 1862.

Flustra; Morton, 1834, p. 79.
Cellepora [partim]; von Hagenow, 1839, p. 271.
Escharina (*Cellepora*) [partim]; Römer, 1840, p. 14.
Escharina?; Lonsdale in Lyell, 1845, pp. 71–2.
Cellepora [partim]; Boll, 1846, p. 206.
Cellepora [partim]; Geinitz, 1846, p. 613.
Escharina?; Lonsdale in Lyell, 1846, pp. 317–18.
Cellepora [partim]; Bronn, 1848, p. 254.
Escharina [partim]; Bronn, 1848, p. 472.
Flustra [partim]; Bronn, 1848, p. 501.

Escharina [partim] ; Bronn, 1849, pp. 131–2.
Cellepora [partim] ; Geinitz, 1849–50, pp. 248–9.
Cellepora [partim] ; von Hagenow in Geinitz, 1849–50, pp. 248–9.
Escharina [partim] ; d'Orbigny, 1850, p. 263.
Cellepora (*Escharina*) [partim] ; von Hagenow, 1851, pp. 89–90.
Cellepora (*Escharina*) ; Bronn & Römer, 1851, p. 105.
? *Eschara* [partim] ; Kade, 1852, p. 28.
[*Reptescharella* [partim] ; d'Orbigny, 1853, p. 470, 1854, p. 1097.]
Reptescharinella [partim] ; d'Orbigny, 1853, p. 429.
Repteschari pora [partim] ; d'Orbigny, 1853, p. 490.
Repteschari pora [partim] ; Pictet, 1857, p. 112.
Cellepora [partim] ; Binkhorst van den Binkhorst, 1859, pp. 54, 122, 129, 149, 152.
Escharina ? ; Gabb, 1859, p. 19.
[*Reptescharella* [partim] ; Coquand, 1860, p. 183.]
Pliophlœa ; Gabb & Horn, 1862, p. 150.
Pliophlœa ; Meek, 1864, p. 3.
Repteschari pora ; Beissel, 1865, pp. 11, 60, 90.
Pliophlœa ; Conrad in Cook, 1868, p. 722.
Plioptæa [sic] ; Credner, 1870, p. 218.
Cellepora [partim] ; Schlüter, 1870, p. 940.
Cellepora [partim] ; Quenstedt, 1879, p. 312.
Lepralia [partim] ; Ubaghs, 1879, pp. 139, 221.
Repteschari pora ; Ubaghs, 1879, pp. 139, 217.
[*Lepralia* [partim] ; Mourlon, 1881, p. 119.]
Repteschari pora ; Mourlon, 1881, p. 116.
Cellepora [partim] ; de Morgan, 1882, p. 39.
Cellepora (*Escharina*) [partim] ; Vine, 1885, p. 164.
Escharina ? ; Vine, 1885, p. 168.
Pliophlæa [sic] ; Vine, 1885, p. 168.
Barroisina [partim] ; Jullien, 1886, p. 605 [see under *P. cornuta*].
Schizoporella [partim] ; Jullien, 1886, p. 603.
Repteschari pora ; Marsson, 1887, p. 99.
Schizoporella ; Marsson, 1887, pp. 99, 109.
Cellepora [partim] ; Lundgren, 1888, p. 10.
Schizoporella ; Oswald, 1890, p. 110.
Cellepora [partim] ; Hennig, 1892, p. 3.
[? *Lepralia* ; Vogel, 1892, p. 94.]
Cellepora ; Pergens, 1894, p. 188.
Schizoporella ; Deecke, 1895, p. 80.
Cribrilina (*Barroisina*), Canu, 1900 [2], pp. 445–6.
[*Reptescharella* [partim] ; Canu, 1900 [2], p. 457.]
Flustra ; Nickles & Bassler, 1900, p. 151.
Escharina ? ; Nickles & Bassler, 1900, p. 152.
Pliophlœa ; Nickles & Bassler, 1900, p. 156.
Plioplœa [sic] ; Johnson, 1905, p. 5.

Cribrilina [partim]; Weller, 1907, pp. 167, 340.
Cribrilina; Brydone, 1909, pp. 399, 400.
Schizoporella; Brydone, 1909, p. 399.
[*Cribrilina* [partim]; Canu in Douvillé, 1910, p. 63.]
Cribrilina [partim]; Brydone, 1914, pp. 97, 99.
Pliophlœa; Lang, 1916, pp. 391–3.
Barroisina; Lang, 1917, p. 169.

Diagnosis.—Pliophlœinæ in which the furrows between the costæ are plainly visible.

Distribution.—Senonian, Santonian, to Danian; chiefly zone of *B. mucronata*.

Genotype.—*Flustra sagena*, Morton.

Remarks.—The inter-relations of the numerous species of *Pliophlœa* are by no means easy to determine. It is probable that *Pliophlœa* is derived from *Andriopora*, and, if so, it would be from a simple form at about the evolutionary level of *A. arion*. *Pliophlœa*, however, is to be distinguished from *Andriopora* by the row of pores that is present on every costa, as well as by the more flattened shape of the costæ. It is not clear whether these pores are the broken bases of hollow spines, like the pelmata and pelmatidia of the Pelmatoporidæ; and their nature is, for the moment, obscure. But, whatever their nature, if *Pliophlœa* has arisen from *Andriopora*, they are a new acquisition, since nothing in the structure of the Andrioporine costa suggests them.

The aviculœcia of *Pliophlœa* also differ from those of *Andriopora*. In the latter genus the aviculœcia are typically in pairs, one aviculœcium placed on each side of the aperture of every orthœcium. In *Pliophlœa* there is a general tendency for the aviculœcia to become sporadically distributed and more numerous. In certain genera of the Andrioporinæ a similar tendency was observed; also a peculiar tissue arose around the aviculœcia, isolating them from each other and causing the orthœcia to be more widely-spaced. This tendency becomes very marked in *Pliophlœa*, and the tissue around the aviculœcia often appears swollen and hollow; moreover, the aperture in the middle of an area of this tissue is sometimes not obviously aviculœcian, but a mere pore, suggesting that the swollen tissue surrounding the aviculœcian apertures is not the extraterminal front-wall of the aviculœcium whose aperture it surrounds, but what Levinsen calls a kenozoœcium (here called cenœcium), that is, the front-wall of an atrophied œcium. Whatever the nature of these blister-like front-walls surrounding the aviculœcia (developed, it is true, also in certain Andrioporinæ, such as *Distansescharella discreta*), they render the isolation of aviculœcia a well-marked character of the genus *Pliophlœa*.

During the evolution of *Pliophlœa*, as in other groups, the apertures of the aviculœcia tend to pass from a blunt to a more pointed shape. The apertures, too, of the orthœcia pass from a cribriline to a pliophlœan shape. There is also a general solidification of the intraterminal front-wall, by which the costæ tend to lose their individuality, and an increase in the number of intercostal fusions.

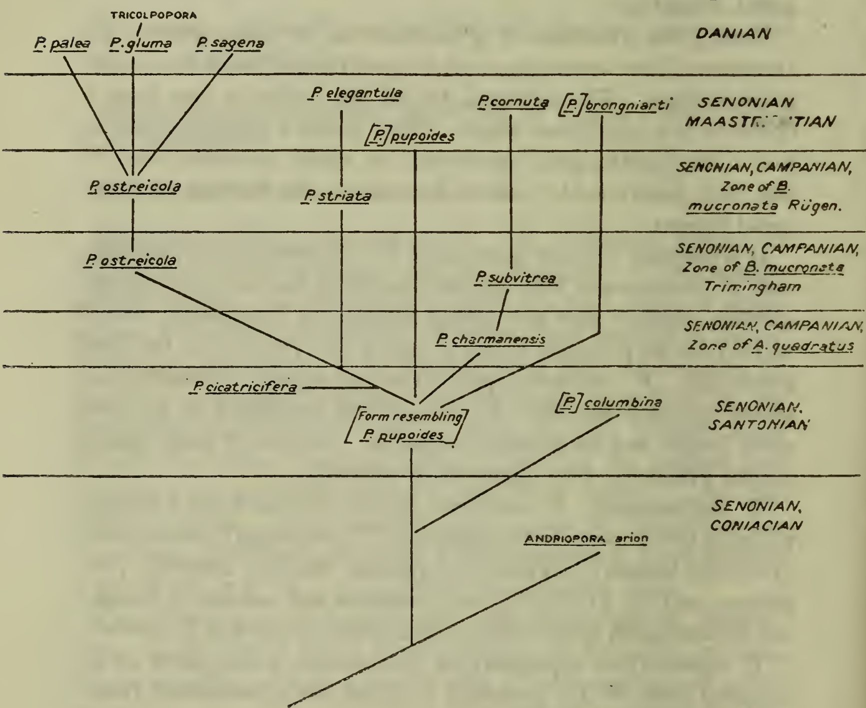
It is not clear whether the species [*P.*] *columbina*, [*P.*] *pupoides*, and [*P.*] *brongniarti* have perforations along the costæ, and, consequently, whether they are rightly included in *Pliophlœa*; but, if so, they are all primitive forms, of which [*P.*] *pupoides* is the most generalised, [*P.*] *columbina* peculiar for developing a median process on the apertural bar, and [*P.*] *brongniarti* specialised by its great œcial length and its pointed aviculœcia. In none of these species are the aviculœcia very numerous or isolated.

P. charmanensis, *P. subvitrea*, and *P. cornuta* form a lineage, probably based upon a form resembling [*P.*] *pupoides* (but occurring at a lower horizon) in which the aperture becomes markedly pliophlœan, and the aviculœcia very numerous and isolated in groups; the intraterminal front-wall is more completely fused in *P. cornuta*.

P. cicatricifera is probably an independent development of an ancestral form of [*P.*] *pupoides*, in which the intraterminal front-wall is considerably solidified.

From the supposed ancestral form resembling [*P.*] *pupoides* may be derived yet another main stock, which immediately divides, on the one hand, into the *P. striata–P. elegantula* lineage, and, on the other, into that based on *P. ostreicola*. The tendency of this main stock is to develop a large number of lateral costal fusions. In the *P. striata–P. elegantula* lineage, the number of lateral fusions is not so great; its evolution is shown in the more pointed aviculœcia of *P. elegantula*. *P. ostreicola* has more lateral costal fusions, but otherwise is a comparatively undifferentiated form with a hardly-cribriline aperture and blunt aviculœcia. *P. sagena*, *P. palea*, and *P. gluma* may all be independently derived from *P. ostreicola*. The genus *Tricolpora* may have been descended from *P. gluma*.

The following phylogeny expresses these supposed relationships :—



Key to the Species of *Pliophlœa*.

A. Apertures cribriline or not markedly pliophlœan.

I. Lateral costal fusions not obvious.

a. Apertural bar with a wide median projection (fig. 82) .... 1. [*P.*] *columbina*.

b. Apertural bar not so produced.

1. Œcia long (·5–·66 mm.) and narrow (fig. 83). 2. [*P.*] *brongniarti*.

2. Œcia not thrice as long as wide.

a. Aviculœcia broad and blunt.

1. Œcia about ·33 mm. long .... 3. [*P.*] *pupoides*.

2. Œcia about ·5 mm. long (fig. 84) .... 4. *P. striata*.

β. Aviculœcia narrow and more or less pointed.

1. Aperture hardly cribriline.
   - a. Intercostal furrows conspicuous ...... 5. *P. elegantula.*
   - b. Intercostal furrows almost vanish ... 6. *P. cicatricifera.*

2. Aperture cribriline to slightly pliophlœan.
   - a. Aviculœcia more numerous, tending to be arranged in pairs directed towards the mid-line of the orthœcium they accompany (fig. 85) ... 7. *P. charmanensis.*
   - b. Aviculœcia less numerous, or, if paired, the pairs tend to be directed away from the mid-line of the orthœcium they accompany (fig. 87) ... 9. *P. palea.*

II. Lateral costal fusions obvious.

- a. Costæ 13–15.
  - 1. Apertures as wide as, or wider than, long (fig. 86) 8. *P. ostreicola.*
  - 2. Apertures longer than wide (fig. 88) .... 10. *P. gluma.*
- b. Costæ 16–18 (fig. 89)................................ 11. *P. sagena.*

B. Apertures markedly pliophlœan.

- I. Intraterminal front-wall more arched (fig. 90) ... 12. *P. subvitrea.*
- II. Intraterminal front-wall flatter .... 13. *P. cornuta.*

1. [Pliophlœa] columbina, Lang.

Pliophlœa columbina, sp. n.; Lang, 1916, p. 392; Santonian; Coulommiers, France.

Diagnosis.—[*Pliophlœa*] with a cribriline aperture; with no obvious lateral costal fusions; with a wide, flat, median projection on the apertural bar.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. or less in length and about ·25 mm. wide, oval-elliptical; extraterminal front-wall of small extent and much hidden by secondary tissue and aviculœcia; intraterminal front-wall flattish, and composed of from eight to ten flattened, closely-spaced costæ with no apparent lateral fusions, wide, but of unequal widths, and united medianly in a fairly wide band of fusion; apertural bar wide and flat, with a wide, tongue-like median projection; apertural spines probably six in number, but small; apertures normal to somewhat cribriline; aviculœcia numerous, apparently sporadically distributed, distally directed, rather large, with blunt, somewhat elongate and slightly constricted apertures.

Distribution.—Senonian, Santonian, Coulommiers, E. of Vendôme, Loir-et-Cher, France.

Type-specimen.—D. 27749. In exchange with Monsieur F. Canu. 1914.

Remarks.—The preservation of the type-specimen of [*Pliophlœa*] *columbina* is such that the presence of pores on the costæ cannot be clearly determined. It is, therefore, uncertain whether the species belongs to *Pliophlœa* at all. Its general aspect suggests this genus; but it differs from the other species by possessing a tongue-shaped median projection on the apertural bar.

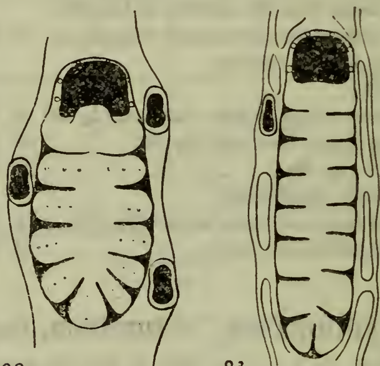


Fig. 82.—[*Pliophlœa*] *columbina*. Diagram of an orthœcium and three aviculœcia, from above. × about 75 diameters.

Fig. 83.—[*Pliophlœa*] *brongniarti*. Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

Figures.—Text-fig. 82. Orthœcium and three aviculœcia.

Plate V, fig. 10. Part of the type-specimen, consisting of three more or less complete orthœcia and about nine aviculœcia. × about 27 diameters.

Specimens.—D. 27749. Type-specimen. Distribution and collection as above.

2. [Pliophlœa] brongniarti (von Hagenow).

Cellepora (*Escharina*) *Brongniarti*, Hag.; von Hagenow, 1851, p. 90, pl. x, fig. 14; Maastrichter Kreidebildung; Maastricht.

Reptescharipora Brongniarti (de Hagenow); d'Orbigny, 1853, p. 490; Sénonien; Maëstrich.

Repteschoripora Brongniarti (Hagen.); Pictet, 1857, p. 112; Craie blanche; Maestricht.

Lepralia Brongniarti (Hag.); Ubaghs, 1879, p. 221; Maastrichtien Supérieur; Limbourg.

Lepralia Brongniarti (Hag.); Mourlon, 1881, p. 119; Maastrichtien; Limbourg.

Cellepora (*Escharina*) *Brongniarti*, H.; Vine, 1885, p. 164; Maestricht Beds.

? *Lepralia* cf. *Brongniarti* Hag. spec.; Vogel, 1892, p. 94; Kreide; Maestricht.

Pliophlœa brongniarti (Hagenow); Lang, 1916, pp. 391–2; Maastrichtian; Maastricht.

Diagnosis.—[*Pliophlœa*] with a cribriline aperture; with few or no lateral costal fusions; with no wide median projection on the apertural bar; with œcia of considerable length (·5–·66 mm.), and very narrow.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·5–·66 mm. long and ·12–·18 mm. wide, elongate-elliptical; extraterminal front-wall of small extent and considerably hidden by interœcial secondary tissue; the intraterminal front-wall is flattish and consists of from ten to fourteen very wide, flattened costæ with no, or very few, lateral fusions, but firmly united in a median band of fusion; apertural bar resembling the normal costæ; apertural spines small, and probably six in number; apertures normal to slightly cribriline; aviculœcia comparatively few, sporadically distributed, distally directed, with elongate, rather sharply-pointed apertures.

Distribution.—Senonian, Maastrichtian. Maastricht, Limburg, Holland.

Type-specimen.—That figured by von Hagenow, 1851, pl. x, fig. 14, is hereby selected.

Remarks.—[*Pliophlœa*] *brongniarti*, if a *Pliophlœa*, is peculiar for the great length of the œcia compared to their width, as well as for their considerable actual length; the apertures of the orthœcia are undifferentiated; while those of the aviculœcia are of an advanced shape. The species appears to have no close connection with other forms of *Pliophlœa*, and, if the apparent absence of pores on the costæ is not due to imperfect preservation, it must be excluded from the genus. The great length of the orthœcia is not shown in von Hagenow's figure, but is very apparent in the specimens in the Collection.

Figures.—Text-fig. 83. Orthœcium and aviculœcium.

LIST OF SPECIMENS.

D. 3490–1. D. 3494–7. D. 3570. Seven specimens incrusting the cylindrical aste of Cyclostome Polyzoa. Senonian, Maastrichtian. Maastricht, Limburg, Holland. Van Breda collection. 1871.

3. [Pliophlœa] pupoides (d'Orbigny)

Repteacharella pupoides, d'Orb., 1851; d'Orbigny, 1852, pl. 716, figs. 13–15, 1853, p. 470, 1854, p. 1097; Sénonien; Royan (Charente-Inférieure).
Repteacharella pupoïdes, d'Orb.; Coquand, 1860, p. 183; Campanien; Royan.
Repteacharella pupoides; Canu, 1900[2], p. 457 ("ne correspond pas").
Cribrilina pupoides d'Orb. (sub *Repteacharella*) non Hagen.; Canu in Douvillé, 1910, p. 63; Maëstrichtien, Royan; Campanien, Charentes.
Pliophlœa pupoides (d'Orbigny); Lang, 1916, p. 391; Senonian [Campanian]; Royan, France.

Diagnosis.—[*Pliophlœa*] in which the apertures are cribriline; the lateral costal fusions are absent or not apparent; the apertural bar has no median projection; the œcia are about ·33 mm. long and about half as wide; and the aviculœcia are broad and blunt.

Distribution.—Senonian, Campanian. Royan, S. of Rochefort, Charente Inférieure, France.

Type-specimen.—That figured by d'Orbigny, 1852, pl. 716, fig. 14, is hereby selected.

Remarks.—D'Orbigny's species is here interpreted after a specimen in the collection of Monsieur F. Canu, of Versailles, from Roux, and labelled "*Cribrilina* [*Repteacharella*] *pupoides* d'Orb." The specimen, which Mr. Canu kindly allowed me to examine, is very poorly preserved, and a photograph of it in the Collection shows practically nothing of the structure. The species is but tentatively included in *Pliophlœa*.

Specimens.—None in the Collection. A photograph of Mr. Canu's specimen.

4. Pliophlœa striata, Lang.

Pliophlœa striata, sp. n.; Lang, 1916, p. 391; *B. mucronata*-zone; Rügen.

Diagnosis.—*Pliophlœa* with cribriline or slightly pliophlœan apertures, in which lateral costal fusions are not conspicuous; the apertural bar has no wide median projection; the orthœcia are about ·52 mm. in length and about ·22 mm. wide; the aviculœcia are broad and blunt.

Description.—Asty incrusting, unilaminar; œcia dimorphic;

orthœcia about ·52 mm. long and ·22 mm. wide, long-elliptical; extraterminal front-wall of very small extent and largely hidden by aviculœcia; the intraterminal front-wall is flattish, and composed of about fifteen much-flattened, closely-placed costæ, usually very wide, but varying considerably in width, having, apparently, a few lateral fusions, but these are not at all obvious; each costa has an irregular, more-or-less median row of pores, sometimes more than one row, and all are united medianly in a narrow line of fusion; the apertural bar closely resembles the normal costæ; apertural spines, if present, are exceedingly minute; apertures cribriline to slightly pliophlœan; aviculœcia numerous, nearly always a pair, one on each side of the aperture of every orthœcium, and, in addition, others intercalated in the interœcial valleys; occasionally isolated aviculœcia occur surrounded by what is probably cenœcial tissue, and in their neighbourhood are often what appear to be cenœcia with small circular pore-like apertures; the front-walls of these cenœcia, as well as the cenœcial tissue surrounding the aviculœcia, are covered with minute pores like those on the costæ of the orthœcia, but the pores are quite irregularly arranged; the hyperstomial ovicells also have pores, but these are arranged in rows, as in the costæ, and the ovicells are obviously costate like the intraterminal front-walls of the orthœcia; the aviculœcia are all distally directed, with oblong, blunt apertures constricted at about the middle.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen.

Type-specimen.—**D. 15415**. Agnes Laur collection.

Remarks.—*Pliophlœa striata* differs from *P. elegantula* mainly in the fairly broad, blunt aviculœcia; but also in the development of the cenœcia and the cenœcial tissue surrounding the aviculœcia. *P. elegantula* is probably derived from a form near *P. striata*; and *P. striata* from a comparatively undifferentiated form resembling [*P.*] *pupoides*, though [*P.*] *pupoides* itself is from a higher horizon.

Figures.—Text-fig. 84. An orthœcium, four aviculœcia, a cenœcium, and an ovicell.

Plate V, fig. 11. Part of the type-specimen, consisting of ten more-or-less complete orthœcia (six of which have ovicells), the apertural ends (with ovicells) of two others, twenty-four aviculœcia, and two cenœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 15415. D. 15103. D. 16522. D. 17999. D. 18000. D. 18002–4. Type-specimen and seven paratypes. Senonian, Campanian, zone of *B. mucronata.* Rügen. Agnes Laur collection. 1906, 1909. **D. 15103** was presented by Frau Agnes Laur, July 1901.

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Fig. 84.—*Pliophlœa striata.* Diagram of an orthœcium, four aviculœcia, a cenœcium, and an ovicell, from above. The pair of aviculœcia lying just distal to the aperture is omitted. × about 75 diameters.

Fig. 85.—*Pliophlœa charmanensis.* Diagram of an orthœcium, with two small apertural aviculœcia and one large sporadic aviculœcium, from above. × about 75 diameters.

5. Pliophlœa elegantula (von Hagenow).

Cellepora (Escharina) elegantula, Hag.; von Hagenow, 1851, p. 90, pl. x, fig. 13; Maastrichter Kreidebildung; Maastricht.

Cellepora (Escharina) elegantula, Hgw.; Bronn & Römer, 1851, p. 105, pl. xxix[2], fig. 15 [a copy of von Hagenow, 1851, pl. x, fig. 13]; Maastrichter Kreide.

? *Eschara elegantula* v. Hgw.; Kade, 1852, p. 28.

Repteschariporа elegantula (de Hagenow); d'Orbigny, 1853, p. 490; Sénonien; Maëstrich.

Repteschariporа elegantula (Hagen.); Pictet, 1857, p. 112; Maestricht.

Non *Repteschariporа elegantula* v. Hagenow, sp.; Beissel, 1865, pp. 60, 11, 90, pl. vii, fig. 82; Senonien, Kreidemergel ohne Feuerstein; Friedrichberg und Slenaken bei Gülpen [= *Pliophlœa cornuta* (von Hagenow), q. v.].

Cellepora elegantula Hag.; Quenstedt, 1879, p. 312.

Lepralia elegantula (Hag.); Ubaghs, 1879, p. 221; Maastrichtien Supérieur; Limbourg.

Repteschariporа elegantula, Hag. sp.; Ubaghs, 1879, pp. 139, 217; Sénonien (Craie Marreuse sans silex) and Maastrichtien Supérieur; Limbourg.

Lepralia elegantula (Hag.); Mourlon. 1881, p. 119; Maastrichtien; Limbourg.

Repteschariporа elegantula, Hag. sp.; Mourlon, 1881, p. 116; Sénonien and Maastrichtien; Limbourg.

Cellepora (*Escharina*) *elegantula*, H.; Vine, 1885, p. 164; Maestricht Beds.

Schizoporella elegantula (Hagenow); Jullien, 1886, p. 603.

Cellepora elegantula, Hag.; Pergens, 1894, p. 188.

Non *Cellepora elegantula*, Hag., [as interpreted by] Beissel; Brydone, 1909, p. 399. = *Cribrilina Beisseli* (new name). See under *Pliophlœa cornuta*.

Pliophlœa elegantula (von Hagenow); Lang, 1916, pp. 391–2; Maastrichtian; Maastricht.

Cellepora (*Escharina*) *elegantula*, Hag.; Lang, 1917, p. 169.

Diagnosis.—*Pliophlœa* with normal to somewhat cribriline apertures, with no apparent lateral costal fusions, with no marked median projection on the apertural bar, with œcia about twice as long as wide, with sharp narrow aviculœcia, and with conspicuous intercostal furrows.

Distribution.—Senonian, Maastrichtian. Maastricht, Limburg.

Type-specimen.—That figured by von Hagenow, 1851, pl. x, fig. 13, is hereby selected.

Remarks.—*Pliophlœa elegantula* appears to resemble closely *P. striata*, from which it is probably derived; but the aviculœcia are narrow and pointed. It differs from *P. cicatricifera* in having more conspicuous intercostal furrows.

Specimens.—None in the Collection.

6. Pliophlœa cicatricifera (Brydone).

Cribrilina cicatricifera, sp. nov.; Brydone, 1914, pp. 97, 99, pl. iv, figs. 1–2; zone of *M. coranguinum*; Gravesend.

Pliophlœa cicatricifera (Brydone); Lang, 1916, pp. 391–2; Senonian; England.

Cribrilina cicatricifera, Bryd.; Brydone, 1917, p. 52.

Diagnosis.—*Pliophlœa* with normal to somewhat cribriline apertures; with no apparent lateral costal fusions; with no marked, wide, median projection on the apertural bar; with œcia not quite twice as long as wide; with narrow, not very blunt aviculœcia; and with intercostal furrows very inconspicuous.

Distribution.—Senonian, zone of *M. coranguinum*. Gravesend.

Type-specimen.—That figured by Brydone, pl. iv, figs. 1–2, is hereby selected.

Remarks.—*Pliophlœa cicatricifera* is chiefly remarkable for its inconspicuous intercostal furrows, showing in them a tendency for the intraterminal front-wall to become solid by the disappearance of the furrows. The species may be considered as independently derived from a primitive form resembling [*P.*] *pupoides*. Such a form has already been supposed to have given rise to [*P.*] *brongniarti* and the *P. striata–elegantula* lineage.

SPECIMENS.—None in the Collection.

7. Pliophlœa charmanensis, new species.

DIAGNOSIS.—*Pliophlœa* with cribriline to slightly pliophlœan apertures; lateral costal fusions not conspicuous; the apertural bar has no wide median projection; the œcia are about twice as long as wide; the aviculœcia are narrow and not very blunt, numerous, tending to be arranged in pairs, and directed towards the mid-line of the orthœcium they accompany.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·57 mm. long and ·29 mm. wide, elliptical; extraterminal front-wall of small extent and concealed beneath aviculœcia and cenœcial tissue; the intraterminal front-wall is well-arched, and consists of about sixteen closely-placed costæ which are not as wide as is usual in *Pliophlœa*; they have lateral fusions, but these are very inconspicuous, and there is a comparatively narrow median line of fusion; apertural bar somewhat V-shaped; apertural spines, if present, minute; apertures cribriline to somewhat pliophlœan; aviculœcia numerous, of varying sizes, but tending to be dimorphic, distally directed, with somewhat elongate, constricted apertures, having the rostrum more-or-less extended, and thinner at the end than the proximal portion, but not sharp; the more numerous smaller aviculœcia tend to be arranged in pairs, one of each pair on each side of the aperture of every orthœcium, and, as a rule, directed towards the mid-line of that orthœcium; the largest aviculœcia are rare and quite twice the length of the smallest; while intermediate sizes occur not infrequently; the shape of the larger is, on the whole, the same as that of the smaller; the larger often, and the smaller generally, are surrounded with perforated cenœcial tissue; and genuine cenœcia also are occasionally present; ovicells hyperstomial.

DISTRIBUTION.—Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Sussex.

TYPE-SPECIMEN.—D. 28802.

REMARKS.—*Pliophlœa charmanensis* is allied to *P. ostreicola*, but has more advanced apertures and less obvious costal fusions than that species.

FIGURES.—Text-fig. 85. Orthœcium, with two small apertural aviculœcia and one large sporadic aviculœcium.

Plate V, fig. 12. Part of the type-specimen, consisting of six more-or-less complete orthœcia, three of which bear ovicells; the ovicell and aperture of another orthœcium; the proximal ends of others; and seventeen aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28802. D. 28803. Type-specimen and paratypes. Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Pit 7 of Gaster; Upton Lane (=Lambley's Lane), Sompting, N.E. of Worthing, Sussex. Collected by T. H. Withers, Esq., F.G.S., and presented by him, October 1915.

D. 29059. Paratype. From the same horizon as the type-specimen. Pit 9 of Gaster; eastern pit E. of Charman Dean, N. of Broadwater, N. of Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, September 1916.

8. Pliophlœa ostreicola (Brydone).

Cribrilina ostreicola, nov.; Brydone, 1909, p. 399–400, pl. xxiii, figs. 1–2; Trimmingham.

Pliophlœa ostreicola (Brydone); Lang, 1916, p. 391–2; *B. mucronata*-zone; Trimingham, Norfolk.

Cribrilina ostreicola, Bryd.; Brydone, 1918, p. 1.

DIAGNOSIS.—*Pliophlœa* in which the apertures are cribriline or slightly pliophlœan, and as wide as, or wider than, long; the intercostal fusions are obvious; and the costæ are 13–15 in number.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·45–·55 mm. long and 27 mm. wide, elliptical; extraterminal front-wall of very small extent, and largely hidden by aviculœcia; the intraterminal front-wall is rather flat, and consists of about twelve to fifteen closely-placed and somewhat flattened costæ with pores on the upper surface and intercostal fusions that are often obvious; a comparatively narrow median line of fusion; apertural bar very slighly V-shaped, otherwise undifferentiated; apertural spines minute, probably six in number; apertures cribriline to slightly pliophlœan and very short compared with their width; aviculœcia dimorphic, the smaller kind very numerous, irregularly distributed in the interœcial valleys, and occasionally isolated in cenœcial tissue; their apertures are distally directed, somewhat elongate, constricted and blunt; the larger aviculœcia are rare, sporadically distributed, from a half to nearly as long as the orthœcia, with elongate, blunt, distally directed apertures, much wider distally and constricted so as to be divided into a small proximal portion and a very large rostrum; very rarely, aviculœcia of intermediate size and form occur; ovicells hyperstomial.

Fig. 86.—*Pliophlœa ostreicola.* Diagram of an orthœcium, two smaller aviculœcia, one of which is surrounded with cenœcial tissue, and one of the larger kind of aviculœcia, from above. × about 75 diameters.

Distribution.—Senonian, Campanian, zone of *B. mucronata.* Trimingham, Norfolk, and Rügen, Germany.

Type-specimen.—That figured by Brydone, 1909, pl. xxiii, fig. 2, is hereby selected.

Remarks.—From the species hitherto considered *Pliophlœa ostreicola* differs in having conspicuous intercostal fusions, thus showing a line of evolution in which the intraterminnl front-wall becomes solidified by this means. The dimorphic aviculœcia are a characteristic feature of this species.

Figures.—Text-fig. 86. An orthœcium and three aviculœcia.

Plate VI, fig. 1. Part of specimen **D. 15237**, showing five complete orthœcia, thirteen aviculœcia, and two complete and two broken ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 29043. [Senonian, Campanian, zone of *B. mucronata*. Norfolk.] Presented by W. Wright, Esq., F.G.S., September 1916.

D. 15237. Senonian, Campanian, zone of *B. mucronata*. Rügen I. Presented by Frau Agnes Laur, July 1901.

9. Pliophlœa palea, Lang.

Pliophlœa palea, sp. n.; Lang, 1916, pp. 391–2; Danian; Faxe, Denmark.

Diagnosis.—*Pliophlœa* with a cribriline to a slightly pliophlœan aperture; without obvious lateral costal fusions; with no wide median projection on the apertural bar; with œcia about once-and-a-half as long as wide; with narrow, more or less sharp aviculœcia, which are not numerous (though many cenœcia are present), and, in so far as they are paired, are directed obliquely away from the mid-line of orthœcium whose aperture they accompany.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long, and about ·25 mm. wide, oval; extra-terminal front-wall hidden by aviculœcia and cenœcia; the intra-terminal front-wall is rather flat and consists of from sixteen to twenty closely-placed, rather thin costæ, with numerous lateral fusions, which are not, however, very obvious, and with a narrow median band of fusion; apertural bar bent in a proximally-directed curve, and somewhat flattened in a vertical plane; apertural spines small, probably six in number; apertures cribriline to slightly pliophlœan; aviculœcia not very numerous, tending to occur in pairs, one of each pair on each side of the apertures of the orthœcia, and generally directed distally and obliquely away from the mid-line of the aperture they accompany; with somewhat elongate, rather sharp, and constricted apertures; numerous cenœcia with circular pores are interspersed among the aviculœcia.

Distribution.—Danian. Faxe, Sjælland, Denmark.

Type-specimen.—**D. 28221.** S. J. Pindborg. 1914.

Remarks.—*Pliophlœa palea* is possibly derived from *P. ostreicola* by a greater solidification of the intraterminal front-wall, causing the lateral costal fusions to become less evident.

Figures.—Text-fig. 87. Orthœcium, two aviculœcia, and two cenœcia.

Plate VI, fig. 2. Part of the type-specimen, showing six orthœcia (some very imperfect), six aviculœcia, and two cenœcia. × about 27 diameters.

Specimens.—D. 28221. Type-specimen. Distribution and collection as above.

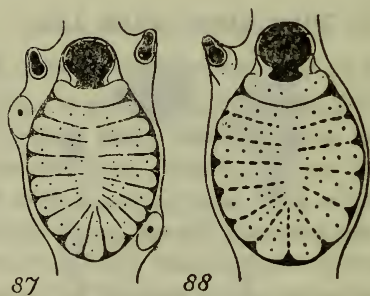


Fig. 87.—*Pliophlœa palea.* Diagram of an orthœcium, two aviculœcia, and two cenœcia, from above. × about 75 diameters.

Fig. 88.—*Pliophlœa gluma.* Diagram of an orthœcium and an aviculœcium, from above. × about 75 diameters.

10. Pliophlœa gluma, Lang.

Pliophlœa gluma, sp. n.; Lang, 1916, pp. 391–2; Danian; Faxe, Denmark.

Diagnosis.—*Pliophlœa*, in which the apertures are cribriline to slightly pliophlœan and longer than wide; the lateral costal fusions are obvious, and the costæ about 13 in number.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·4 mm. long and ·3 mm. wide, oval; extraterminal front-wall of small extent and somewhat hidden by aviculœcia; the intraterminal front-wall is flattish, and consists of about thirteen wide flattish costæ united to one another laterally by numerous fusions, and medianly by a somewhat narrow band of fusion; apertural bar bent proximally, but otherwise resembling the normal costæ; apertural spines minute; apertures cribriline or somewhat pliophlœan and longer than wide; aviculœcia numerous and small, generally one only or a pair accompanying the apertures of the orthœcia, but occasionally massed several together in the interœcial valleys, and somewhat isolated by cenœcial tissue; the apertures are elongate and constricted.

Distribution.—Danian. Faxe, Sjælland, Denmark.

Type-specimen.—**D. 28223.**

Remarks.—*Pliophlœa gluma* is perhaps derived from *P. ostreicola*, from which it differs chiefly in the more advanced shape of the apertures.

Figures.—Text-fig. 88. Orthœcium and an aviculœcium.

Plate VI, fig. 3. Part of the type-specimen, showing five complete orthœcia (one with an ovicell), and six aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28223. D. 28222. D. 28224. Type-specimen and paratypes. Danian. Faxe, Sjælland, Denmark. S. J. Pindborg. 1914.

D. 28220. D. 29020–4. Six specimens, probably of this species, from the same horizon and locality as the last. S. J. Pindborg. 1914.

D. 19476. A specimen, probably of this species, from the same horizon and locality. Miss Caroline Birley bequest, 1907.

11. Pliophlœa sagena (Morton).

Flustra sagena, (S. G. M.); Morton, 1834, p. 79, pl. xiii, fig. 7; Cretaceous; New Jersey.

Escharina ? sagena (Morton); Lonsdale in Lyell, 1845, pp. 71–2, text-figs. *a*, *b*, *c* on p. 71; Cretaceous; Timber Creek, New Jersey.

Escharina ? sagena (Morton); Lonsdale in Lyell, 1846, pp. 317–18, text-figs. *a*, *b*, *c* on p. 317; Timber Creek, New Jersey.

Escharina sagena (Mort.); Bronn, 1848, p. 472.

Flustra sagena Mort.; Bronn, 1848, pp. 472, 501.

Escharina sagena Lonsd.; Bronn, 1849, p. 132; Kreide.

Escharina sagena, Lonsdale; d'Orbigny, 1850, p. 263; Sénonien; Etats-Unis, New-Jersey.

Reptescharinella sagena (Lonsdale); d'Orbigny, 1853, p. 429; Sénonien; Etats-Unis, New Jersey. [Genosyntype of *Reptescharinella*.]

Escharina ? Sagena (S. G. M.); Gabb, 1859, p. 19; Cretaceous; United States.

Pliophlœa sagena (Morton); Gabb & Horn, 1862, p. 150, pl. xx, fig. 34; Cretaceous; Timber Creek and near Mullica Hill, New Jersey. [Genotype of *Pliophlœa*.]

Pliophlœa sagena, (Morton); Meek, 1864, p. 3; Cretaceous; N.J., North America.

Pliophlœa sagena. Morton sp.; Conrad in Cook, 1868, p. 722; Cretaceous; New Jersey.

Plioptæa [sic] *sagena* Morton; Credner, 1870, p. 218; Kreide, New Jersey; Kreide-tuff, Brownville.

Non=*Eschara dichotoma*, Goldfuss; as stated by Credner, 1870, p. 218.

Escharina ? sagena, Lonsd.; Vine, 1885, p. 168; Cretaceous; Timber Creek, New Jersey, N. America.

Pliophlæa [sic] *sagena*, G. & H.; Vine, 1885, p. 168.

Non=*Membraniporella nitida*, Johnst.; as stated by Vine, 1885, p. 168.

Flustra sagena Morton; Nickles & Bassler, 1900, p. 151.

Escharina ? sagena (Morton); Nickles & Bassler, 1900, p. 152.

Pliophlœa sagena (Morton); Nickles & Bassler, 1900, p. 156.

Plioplœa [sic] *sagena* G. & H.; Johnson, 1905, p. 5; Cretaceous.

Cribrilina sagena (Morton); Weller, 1907, pp. 340, 167, pl. xxiv, figs. 11–12; Vincentown Limesand; north bank of Rancocas Creek, ¼ m. N.W. of Vincentown, Timber Creek, and near Mullica Hill.

Pliophlœa sagena (Morton); Lang, 1916, pp. 391–2; [Danian]; New Jersey, U.S.A.

Diagnosis.—*Pliophlœa* with cribriline or slightly pliophlœan apertures; with obvious lateral fusions; and with 16–18 costæ.

Description.—Asty erect, bilaminar, or multilaminar; œcia dimorphic; orthœcia about ·44 mm. long and ·22 mm. wide, elliptical; extraterminal front-wall of very small extent and much hidden by aviculœcia; the intraterminal front-wall is flat and consists of a very variable number, but often of sixteen or more costæ of very unequal widths, some being quite twice as wide as others, suggesting a complete fusion of neighbouring costæ; there are numerous and obvious lateral fusions, and a pronounced median row of pores; these, however, appear to be independent of the lateral fusions, and not to occur, like the pelmata and pelmatidia of the Pelmatoporidæ, at the nodes of a lattice-like front-wall; the apertural bar is compressed in a vertical plane, and somewhat bent proximally; apertural spines minute; apertures cribriline to supercribriline or even slightly pliophlœan; aviculœcia numerous, fairly regularly arranged in pairs, one of each pair on each side of the aperture of every orthœcium, distally and obliquely directed away from the mid-line of the aperture they accompany; with elongate, rather blunt, and restricted apertures.

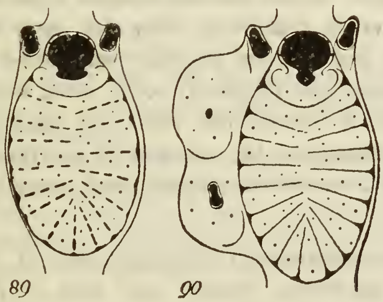
Distribution.—Danian, Vincentown Limesand. New Jersey, U.S.A.

Type-specimen.—That figured by Gabb & Horn, 1862, pl. xx, fig. 34; in the collection of the Academy of Natural Sciences, Philadelphia. See Johnson, 1905, pp. 4, 5.

Remarks.—*Pliophlœa sagena* is the genotype of *Pliophlœa*, and is chiefly remarkable for the flat costæ, wide, but of very unequal widths, with numerous lateral fusions and a median row of pores that do not, apparently, correspond in position to the lateral costal fusions. It may be derived from such a form as *P. ostreicola* by an advance in the shape of the apertures and in the number of the costæ, as well as by the increased flatness of the costæ and irregularity in their width. Possibly the last-mentioned character is partly due to an occasional fusion of two neighbouring costæ.

Figures.—Text-fig. 89. Orthœcium and a pair of aviculœcia.

Plate VI, fig. 4. Part of specimen **D. 19155**, showing seven complete orthœcia with their pairs of apertural aviculœcia. × about 27 diameters.



89 90

Fig. 89.—*Pliophlœa sagena*. Diagram of an orthœcium and a pair of apertural aviculœcia, from above. × about 75 diameters.

Fig. 90.—*Pliophlœa subvitrea*. Diagram of an orthœcium, two apertural aviculœcia, an interœcial aviculœcium surrounded with cenœcial tissue, and a cenœcium, from above. × about 75 diameters.

LIST OF SPECIMENS.

D. 5280. D. 18740–2. D. 18936–40. D. 18955–7. D. 18978. D. 19047. D. 19155. D. 19187–91. D. 19259–65. D. 19275–7. D. 19280. D. 19328–32. Fragments of thirty-six asties. Danian, Vincentown Limesand. Near Blackwoods Town, New Jersey. Ulrich colln. 1898; also in exchange with United States National Museum. 1899.

12. Pliophlœa subvitrea (Brydone).

Cribrilina subvitrea, nov.; Brydone, 1909, pp. 399–400, pl. xxiii, figs. 3–4; Trimmingham.

Pliophlœa subvitrea (Brydone); Lang, 1916, pp. 391, 393; *B. mucronata*-zone; Trimingham, Norfolk.

Diagnosis.—*Pliophlœa* with a markedly pliophlœan aperture; and a well-arched intraterminal front-wall.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·5 mm. long and ·25–·3 mm. wide, elliptical; extraterminal front-wall hidden by aviculœcia and cenœcial tissue; the intraterminal front-wall is well-arched, and consists of fifteen to twenty or more flattened costæ of varying widths, and lying so closely together that the furrows between them tend to be obliterated; no lateral costal fusions are evident; apertural bar bent proximally at nearly a right angle; apertural spines minute; apertures extremely pliophlœan in shape; aviculœcia numerous, irregularly arranged, though tending towards a pair accompanying the aperture of every orthœcium; they also occur massed in the interœcial valleys and are then generally surrounded with cenœcial tissue; true cenœcia also frequently occur, often several together; the cenœcial tissue is covered with pores like those on the costæ, but irregularly arranged; the aviculœcial apertures are distally directed, elongate, somewhat pointed, and constricted near the proximal end.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*, Sussex; and zone of *B. mucronata*, Trimingham, Norfolk.

Type-specimen.—That figured by Brydone, 1909, pl. xxiii, figs. 3 & 4, is hereby selected.

Remarks.—*Pliophlœa subvitrea* and its probable derivative *P. cornuta* are remarkable among the species of *Pliophlœa* for the extremely pliophlœan apertures. The species is possibly derived from *P. charmanensis* by a further solidification of the intraterminal front-wall and specialisation of the aperture.

Figures.—Text-fig. 90. Orthœcium, two apertural aviculœcia, an interœcial aviculœcium surrounded with cenœcial tissue, and a cenœcium.

Plate VI, fig. 5. Part of specimen **D. 15597**, showing three complete orthœcia and the apertures of three others, four complete cenœcia, and seventeen aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 29894. Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Pit 9 of Gaster, the eastern pit E. of Charman Dean, N. of Broadwater, Worthing, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, Dec. 1919.

D. 15597. D. 15605. D. 15609. D. 15633. D. 15669–71. Senonian, Campanian, zone of *B. mucronata*. Trimingham, Norfolk. A. C. Savin collection. 1910.

13. Pliophlœa cornuta (von Hagenow).

Cellepora cornuta nob.; von Hagenow, 1839, p. 271; Kreide; Rügen.

Escharina (*Cellepora*) *cornuta* v. Hag.; Römer, 1840, p. 14; Obere Kreide; Rügen.

Cellepora cornuta v. Hg.; Boll, 1846, p. 206; Obere Weisse Kreide; Baltic.

Cellepora cornuta v. Hag.; Geinitz, 1846, p. 613; Rügen.

Cellepora cornuta Hag.; Bronn, 1848, p. 254.

Escharina cornuta Roe.; Bronn, 1848, p. 472.

Escharina cornuta Roe.; Bronn, 1849, p. 131; Kreide.

Cellepora cornuta, v. H.; Geinitz, 1849–50, pp. 248–9; Kreide; Rügen.

Cellepora cornuta, v. H.; von Hagenow in Geinitz, 1849–50, pp. 248–9; Obere Quader Mergel; Balsberg.

Cellepora (*Escharina*) *cornuta*, Hag.; von Hagenow, 1851, p. 89, pl. x, fig. 11; Maastrichter Kreidebildung, Maastricht; Rügen, Balsberg.

Non = *Cellepora* (*Escharina*) *elegantula*, Hag.; von Hagenow, 1851, p. 90, pl. x, fig. 13; Maastrichter Kreidebildung; Maastricht [see Beissel, 1865, p. 60].

Reptescharipora cornuta (de Hagenow); d'Orbigny, 1853, p. 490; Sénonien, Maëstrich.

Reptescharipora cornuta (Hagen); Pictet, 1857, p. 112; craie blanche; Maestricht.

Cellepora cornuta, v. Hag.; Binkhorst van den Binkhorst, 1859; p. 54, Craie de Schaasberg près de Fauquemont; p. 122, Craie Tuffeau de Limbourg; p. 129, craie de l'isle de Rügen; pp. 149, 152, Marnes sans silex de Vaals, Slenaken, près d'Aix-la-Chapelle.

Reptescharipora elegantula v. Hgenow, sp.; Beissel, 1865, pp. 60, 11, 90, pl. vii, fig. 82; Sénonien supérieur, Kreide Mergel ohne Feuerstein; Friedrichberg und Slenacken bei Gülpen.

Non *Reptescharipora elegantula* Hg.; Beissel, 1865, p. 11; Maastrichtian, Maastricht.

Cellepora cornuta Hag.; Schlüter, 1870, p. 940; Balsberg and Rügen.

Lepralia cornuta (Hag.); Ubaghs, 1879, pp. 139, 221; Sénonien (Craie marneuse sans silex) and Maastrichtien; Limbourg.

Lepralia cornuta (Hag.) ; Mourlon, 1881, p. 119 ; Sénonien and Maastrichtien Limbourg.

Cellepora cornuta (Hag.) ; de Morgan, 1882, p. 39 ; Balsberg (fide Schlüter).

Cellepora (*Escharina*) *cornuta*, H. ; Vine, 1885, p. 164 ; Maastricht Beds.

Barroisina elegantula (Hagenow d'après J. Beissel) ; Jullien, 1886, p. 605 ; terrains crétacés. [Genotype of *Barroisina*.]

Schizoporella elegantula (Hagenow) ; Jullien, 1886, p. 603.

Schizoporella cornuta von Hagenow sp. ; Marsson, 1887, pp. 99, 109 ; Senon, Weisse Schreibkreide, Rügen ; Senon, Maastrichter Kreidetuff.

Reptescharipora elegantula (v. Hagenow), Beissel ; Marsson, 1887, p. 99.

Cellepora cornuta Hag. ; Lundgren, 1888, p. 10 ; zone of *A. mammillatus* ; Kristianstad district.

Schizoporella cornuta v. Hag. sp. ; Osswald, 1890, p. 110 ; Kreidelagern ; Klützer Orts, Mecklenburg.

Cellepora cornuta v. Hag. ; Hennig, 1892, p. 3 ; Balsberg.

Schizoporella cornuta Hag. ; Deecke, 1895, p. 80 ; Senon, Rügen.

Cribrilina (*Barroisina*) *elegantula* (Beissel) ; Canu, 1900[2], pp. 445–6, text-fig. 58 on p. 446 [a copy of Beissel, 1865, pl. vii, fig. 82].

Cribrilina Beisseli [new name] ; Brydone, 1909, p. 399.

Schizoporella cornuta, Hag. sp. ; Brydone, 1909, p. 399.

Pliophlœa cornuta (Hagenow) ; Lang, 1916, pp. 391–3 ; Maastrichtian ; Maastricht ; = *Reptescharipora elegantula*, Beissel, non v. Hagenow, = *Cribrilina beisseli*, Brydone.

Reptescharipora elegantula v. Hagenow sp., Beissel ; Lang, 1917, p. 169.

Diagnosis.—*Pliophlœa* with an extremely pliophlœan aperture ; and a flattish intraterminal front-wall.

Description.—Asty incrusting, unilaminar ; œcia dimorphic ; orthœcia about ·5 mm. long, or less, and ·25 mm. wide, elliptical ; extraterminal front-wall of small extent, and much obscured by aviculœcia ; the intraterminal front-wall is much flattened, and consists of about twelve or fourteen closely-placed flattened costæ of unequal widths ; there are no obvious lateral fusions, but the furrows between the closely-placed costæ tend to vanish ; apertural bar bent proximally in a sharp angle ; apertural spines minute ; apertures extremely pliophlœan ; aviculœcia small and numerous, somewhat irregularly arranged, but generally a pair accompanying the aperture of every orthœcium, with an occasional additional aviculœcium in the interœcial valleys ; distally directed, with elongate, somewhat pointed, constricted apertures ; cenœcia occasionally present ; ovicells hyperstomial.

Distribution.—Senonian, Campanian, zone of *B. mucronata* ;

Rügen and probably other localities in Northern Europe. Maastrichtian; Maastricht district, Limburg, Holland.

REMARKS.—*Pliophlœa cornuta* is allied to *P. subvitrea*, and probably derived from it by a greater consolidation and flattening of the intraterminal front-wall, and by a catagenetic decrease in the number of costæ.

FIGURES.—Plate VI, fig. 6. Part of specimen **D. 15117**, showing six complete orthœcia, three of which bear ovicells, and eleven aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 11909. D. 15116–7. D. 15120. D. 15416. D. 16523. Senonian, Campanian, zone of *B. mucronata*. Rügen. Presented by Frau Agnes Laur, July 1901.

II. TRILOPHOPORA, Lang, 1916.

Trilophopora, sp. n.; Lang, 1916, pp. 391, 393.

DIAGNOSIS.—Pliophlœinæ in which the intraterminal front-wall is completely fused, leaving only traces of costal furrows and of costal pores.

DISTRIBUTION.—Danian. Faxe, Sjælland, Denmark.

GENOTYPE.—*Trilophopora trifida*.

REMARKS.—In spite of the completely-fused intraterminal front-wall, it is probable that *Trilophopora* is a derivative of *Pliophlœa*. The apertures are slightly pliophlœan, and cenœcial tissue appears in connection with the aviculœcia, as in *Pliophlœa*. *Trilophopora trifida* resembles most closely *Pliophlœa gluma*, and it is from this species that it may provisionally be derived.

1. Trilophopora trifida, Lang.

Trilophopora trifida, sp. n.; Lang, 1916, p. 393; Danian; Faxe, Denmark.

DIAGNOSIS.—As for the genus.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·36 mm. long and about ·26 mm. wide, oval; extraterminal front-wall of very small extent, except, perhaps, proximally, and somewhat hidden by aviculœcia; the intraterminal front-wall is well-arched and solid, but has traces of its presumed costal origin in radiating ridges, which are most pronounced in the neighbourhood of the apertural bar, where three, or sometimes more, diverging crests are very apparent; on the proximal part of the front-wall a slight contour-like, or somewhat transverse, ridge is sometimes visible, which may represent the termen, in which case the proximal part of the extraterminal front-wall is considerably extended; occasional pores are present on the intraterminal front-wall; apertural bar occasionally somewhat proximally bent; apertural spines minute; apertures generally cribriline, but occasionally slightly pliophlœan; aviculœcia numerous, small, and generally,

Fig. 91.—*Trilophopora trifida*. Diagram of an orthœcium and two aviculœcia surrounded with cenœcial tissue, from above. × about 75 diameters.

if not always, surrounded with a variable amount of cenœcial tissue; with somewhat elongate, rather blunt, slightly constricted apertures.

Distribution.—Danian. Faxe, Sjaelland, Denmark.

Type-specimen.—D. 28229.

Remarks.—See remarks under the genus *Trilophopora*.

Figures.—Text-fig. 91. Orthœcium and two aviculœcia surrounded with cenœcial tissue.

Plate VI, fig. 7. Part of the type-specimen, showing seven complete orthœcia and four aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28229. D. 28225–8. D. 28230. Type-specimen and five paratypes. Danian. Faxe, Sjaelland, Denmark. 1914.

c. SCHISTACANTHOPORINÆ, Lang, 1916.

Schistacanthoporinæ, subfam. nov.; Lang, 1916, pp. 382, 393.

DIAGNOSIS.—Andrioporidæ in which the costæ bear a median slit.

DISTRIBUTION.—Senonian, [Campanian or] Maastrichtian. Royan, S. of Rochefort, Charente Inférieure, France.

REMARKS.—*Schistacanthopora fissa* from the Campanian or Maastrichtian of Royan is probably most closely allied to the Andrioporinæ and Pliophlœinæ, but is distinguished from these by the median longitudinal slit on the costæ. The nature of this slit is by no means obvious; and it may bear some relation to the median pores on the costæ of *Pliophlœa*. *S. fissa* is provisionally placed in the Andrioporidæ, but in a subfamily by itself. It is possibly derived from an *Andriopora*, such as *A. frequens*.

I. SCHISTACANTHOPORA, Lang, 1916.

Schistacanthopora, gen. nov.; Lang, 1916, p. 393.

DIAGNOSIS AND DISTRIBUTION.—As for the sub-family.

GENOTYPE.—*Schistacanthopora fissa*.

REMARKS.—See remarks under the sub-family Schistacanthoporinæ.

1. Schistacanthopora fissa, Lang.

Schistacanthopora fissa, sp. n.; Lang, 1916, p. 393; Maastrichtian; Royan.

DIAGNOSIS.—As for the sub-family.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·45 mm. long and ·27 mm. wide, oval-elliptical: extraterminal front-wall of small extent; the intraterminal front-wall is flattish, and consists of about sixteen costæ, each bearing a median slit; apertures normal to cribriline; aviculœcia small, not very numerous; ovicells hyperstomial.

DISTRIBUTION.—Senonian, [Campanian or] Maastrichtian. Royan, S. of Rochefort, Charente Inférieure, France.

TYPE-SPECIMEN.—In the collection of Monsieur F. Canu.

REMARKS.—See Remarks under the sub-family Schistacanthoporinæ.

SPECIMENS.—Only a photograph of the type-specimen.

H. CALPIDOPORIDÆ, Lang, 1916.

Calpidoporidæ, fam. nov.; Lang, 1916, p. 403.

DIAGNOSIS.—Multiserial Cretaceous Cheilostome Polyzoa of fair size (œcia about ·75 mm. long) and with endozoœcial ovicells (ovicells, however, have not been observed in *Graptopora*); with elongate œcia whose intraterminal front-walls are but slightly arched and composed of stout, flattened, parallel-sided costæ separated by wide intervals and having no lateral fusions; the costæ occasionally bear pelmatidia, and their upturned ends (except in *Rhabdopora* and *Graptopora*) form a median seam; there are four apertural spines; there is much interœcial secondary tissue; the aviculœcia tend to have curved rostra.

DISTRIBUTION.—Cenomanian, Turonian, and Lower Senonian. Northern France and Bohemia.

REMARKS.—The Calpidoporidæ are the first family considered in which the ovicells are endozoœcial. The intraterminal front-wall is primitive, the costæ being widely separated and never drawing close nor developing lateral fusions; its only advance is a widening during evolution of the median area of fusion. The aperture fares no better in complication of structure, since the only attempt at a secondary aperture is the widening of the median process of the apertural bar in certain species of *Calpidopora* to form a proximal shield. The interœcial secondary tissue, on the other hand, is generally greatly developed; consequently, it is in this direction that evolutionary activity appears to have been mainly directed. This simple evolutionary process (which, at the most, consists of piling up secondary tissue in the interœcial valleys, and produces no complex structures, such as the lattice-work intraterminal front-wall of the Pelmatoporidæ or the elaborate secondary apertures of that and of other families) suggests that the Calpidoporidæ are a primitive group of Cheilostomata; and their stratigraphical position bears this out. *Calpidopora* is a Cenomanian, and *Rhabdopora* a Turonian genus; and the only genus that attains the Senonian is *Graptopora*.

In a family with such narrow limits of development, there is not much scope for great generic diversity. Such differences as exist between the genera suggest that they have independently diverged from a common ancestor, each developing along its own limited line. *Calpidopora* differs from *Rhabdopora* mainly in the position of its pair of apertural aviculœcia; while in both genera the median area of fusion is narrow and the number of costæ moderate. Within *Calpidopora* evolution is mainly shown in the development of the apertural bar and the characters of the aviculœcia; while in *Rhabdopora* the habit and condition of the asty show progressive development. *Graptopora* has very few costæ and a very wide median area of fusion, while the characters of the asty and the œcial shape afford indices of its evolution.

It is of interest to notice the tendency in this family, exemplified in *Calpidopora*, for the aviculœcia to acquire curved rostra. This was seen, among the Otoporidæ, in *Otopora*, another Cenomanian genus (see fig. 16, p. 29).

Key to the Genera of Calpidoporidæ.

A. Median area of fusion comparatively narrow; aviculœcia with more-or-less pointed apertures.
- I. Aviculœcia paired, situated laterally rather than proximally with regard to the apertures of the orthœcia (figs. 92–96) .... I. *Calpidopora.*
- II. Aviculœcia sporadically distributed or, if paired, situated proximally rather than laterally with regard to the apertures of the orthœcia (fig. 97)... II. *Rhabdopora.*

B. Median area of fusion very broad; aviculœcia with comparatively blunt apertures (fig. 98) .... III. *Graptopora.*

I. CALPIDOPORA, Lang, 1916.

Eschara [partim]; Počta, 1892, pp. 32–3, 42.
Cribrilina [partim]; Canu, 1900 [2], p. 445.
Eschara [partim]; Frič, 1911, p. 62.
Membraniporella; Lecointre, 1912, p. 354.
Calpidopora, gen. nov.; Lang, 1916, pp. 403–5.

Diagnosis.—Calpidoporidæ with a comparatively narrow median area of fusion; aviculœcia with more-or-less pointed apertures, in pairs, situated laterally rather than proximally with regard to the apertures of the orthœcia.

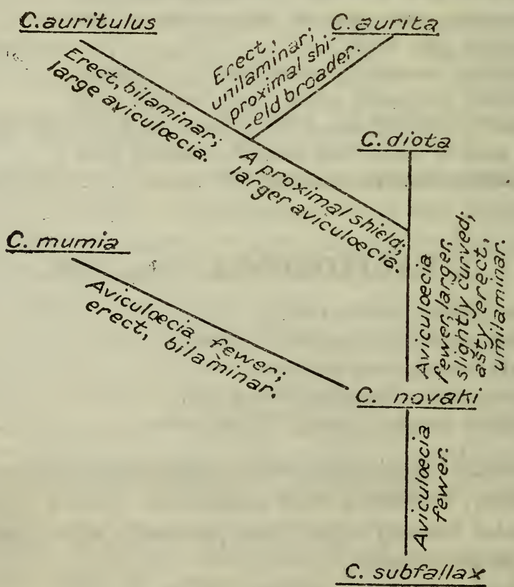
Distribution.—Cenomanian. France and Bohemia.

Genotype.—*Calpidopora diota.*

Remarks.—Evolution in *Calpidopora* appears to be shown by the development of the apertural bar, by the increase in size of the aviculœcia, by a decrease in their number, by the greater curvature of their pointed rostra, and by an advance in the habit and condition of the asty.

The most primitive species appears to be *C. subfallax*, and from this may be derived the lineage of *C. novaki* with fewer aviculœcia, and *C. mumia* with a bilaminar asty. *C. diota* may arise from *C. novaki* by an increase in size of the aviculœcia, by the slight curvature of their apertures, and by an advance in colonial habit. Both *C. auritulus* and *C. aurita* have the median process of the apertural bar flattened to form a proximal shield; but *C. aurita*, though more developed in this respect, and in the size of its aviculœcia, is less advanced than *C. auritulus* in the condition of the asty. Both may have been derived from near *C. diota*.

The following phylogeny expresses these relationships :—



Key to the Species of *Calpidopora*.

A. Apertural bar with unflattened median projection.
- I. Aviculœcia minute, with straight or very slightly-curved apertures.
  - *a*. Incrusting, unilaminar.
    - 1. A pair of aviculœcia accompanying the aperture of each orthœcium, and numerous sporadically-distributed aviculœcia (fig. 92) ..... 1. *C. subfallax*.
    - 2. A pair of aviculœcia accompanying the aperture of each orthœcium, and very few occasional aviculœcia (fig. 93) ..... 2. *C. novaki*.
  - *b*. Erect, bilaminar ..... 3. *C. mumia*.
- II. Aviculœcia slightly larger with slightly curved apertures; asty erect, unilaminar (fig. 94) ..... 4. *C. diota*.

B. Apertural bar flattened, so as to form a proximal shield.
- I. Proximal shield narrow; aviculœcia larger than in (A), but still small, curved, and pointed; asty erect, bilaminar (fig. 95) ..... 5. *C. auritulus*.
- II. Proximal shield broader; aviculœcia larger, curved, and pointed; asty erect, unilaminar (fig. 96) ..... 6. *C. aurita*.

1. Calpidopora subfallax (Lecointre).

Membraniporella subfallax n. sp.; Lecointre, 1912, p. 354, pl. xiv, fig. 5; Cénomanien; Le Mans.

Calpidopora subfallax (Lecointre); Lang, 1916, p. 404; Cenomanian; Le Mans, France.

Diagnosis.—*Calpidopora* with a very slight unflattened median projection on the apertural bar; aviculœcia minute, with straight apertures, one pair accompanying the aperture of every orthœcium, and numerous sporadically distributed aviculœcia; asty incrusting and unilaminar.

Distribution.—Cenomanian. Le Mans, Sarthe, France.

Type-specimen.—That figured by Lecointre, 1912, pl. xiv, fig. 5, is hereby selected.

Remarks.—*Calpidopora subfallax* appears to be the most primitive known *Calpidopora*. It differs from *C. novaki* in its more numerous aviculœcia. In the last-named species the aviculœcia almost entirely consist only of apertural pairs; but in *C. subfallax* there are also numerous sporadically distributed aviculœcia.

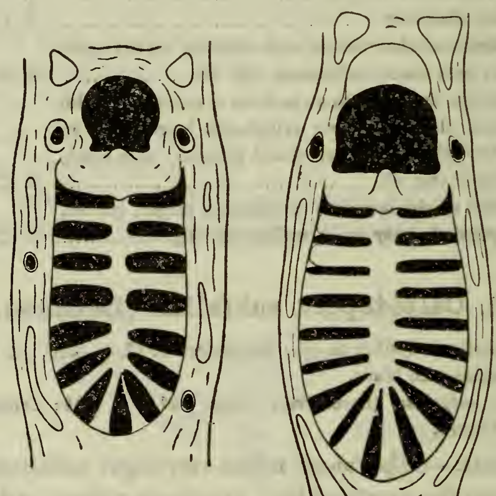
Figures.—Text-fig. 92. Orthœcium and four aviculœcia.

Specimens.—None in the Collection.

2. Calpidopora novaki, Lang.

Calpidopora novaki, sp. n.; Lang, 1916, p. 404. Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—*Calpidopora* whose apertural bar has an unflattened median process; the aviculœcia are minute, with straight or very



92 93

Fig. 92.—*Calpidopora subfallax*. Diagram of an orthœcium and four aviculœcia, from above. × about 75 diameters.

Fig. 93.—*Calpidopora novaki*. Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

slightly curved apertures, and consist of a pair accompanying the aperture of every orthœcium; the asty is incrusting and unilaminar.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·36 mm. wide, long-elliptical; extraterminal front-wall hidden by interœcial tissue with elongate median lacunæ; the intraterminal front-wall is much flattened, and consists of sixteen or eighteen flattened costæ with considerable gaps between them, without lateral fusions, and united in a thin median band of fusion; apertural bar rather wider than an average costa, undifferentiated except for a slight median spine or projection; aperture normal; apertural spines obscured by interœcial secondary tissue; aviculœcia small, a pair (not always quite symmetrically placed) accompanying the aperture of every orthœcium, lying laterally rather than proximally with regard to the aperture; also an occasional aviculœcium in the interœcial secondary tissue; apertures more or less pointed, and straight, or but slightly curved; ovicells endozoœcial.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—**D. 28508.** A. Frič. 1897.

Remarks.—*Calpidopora novaki* resembles very closely *C. subfallax*, from which it may be derived. But it has very few sporadic aviculœcia, while *C. subfallax* has many.

Figures.—Text-fig. 93. Orthœcium and two aviculœcia.

Plate VI, fig. 8. Part of the type-specimen showing four complete orthœcia with endozoœcial ovicells, parts of three other orthœcia, and eleven aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

3. Calpidopora mumia (Počta).

Eschara mumia nov. spec.; Počta, 1892, pp. 32–3, 42, pl. iv, figs. 10–11; Korycanské vrstvy; Kaňk.

Cribrilina mumia (Pocta); Canu, 1900[2], p. 445.

Eschara mumia, Poč.; Frič, 1911, p. 62; Korycaner Schichten; Kaňk.

Calpidopora mumia (Pocta); Lang, 1916, p. 404; Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—*Calpidopora* whose apertural bar has an unflattened median process; the aviculœcia are small, with straight or very slightly curved apertures, and a pair, generally asymmetrically placed, accompany the aperture of every orthœcium; the asty is erect and bilaminar.

Description.—Asty erect, bilaminar; œcia dimorphic; orthœcia nearly 1·00 mm. long and about ·33 mm. wide, long-elliptical; extraterminal front-wall largely concealed by secondary tissue, which is not very abundant, and has large median lacunæ; the intraterminal front-wall is flattish, and consists of a varying number, usually more than twenty, widely-spaced, flattened costæ of varying widths, with no lateral fusions, and united in a comparatively narrow median band of fusion; apertural bar hardly wider than the normal costæ, and undifferentiated except for a small, median, spine-like projection; aperture normal; apertural spines small, apparently four in number, but tending to be obscured by the apertural aviculœcia and by upgrowths of secondary tissue; aviculœcia, a pair accompanying the aperture of every orthœcium, often asymmetrically placed, but lying laterally rather than proximally with regard to the apertures, generally very small, with straight or very slightly curved, more-or-less pointed apertures constricted in the middle.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—That figured by Počta, 1892, pl. iv, fig. 10, is hereby selected.

Remarks.—Though no aviculœcia are shown in Počta's figures of *Eschara mumia*, the specimens in the Collection from the same horizon and locality, and here referred to this species, have aviculœcia in the numbers and position appropriate to *Calpidopora*. The general resemblance of these specimens to Počta's figures makes it almost certain that they are his *Eschara mumia*. *Calpidopora mumia* may be derived from *C. novaki* by the acquisition of an erect bilaminar asty.

LIST OF SPECIMENS.

D. 28499–D. 28507. Nine fragmentary asties. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia. A. Frič. 1897.

4. Calpidopora diota, Lang.

Calpidopora diota, sp. n.; Lang, 1916, p. 404; Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—*Calpidopora* whose apertural bar has an unflattened median process; the aviculœcia are hardly as small as those of *C. novaki*, and the apertures are slightly curved.

Description.—Asty erect, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·26 mm. wide, elliptical; extra-terminal front-wall obscured by secondary tissue, which has median lacunæ; the intraterminal front-wall is flattish, and consists of about sixteen to twenty widely-spaced flattened costæ of unequal widths, with no lateral fusions, but united in a comparatively narrow median band of fusion; apertural bar but little wider than an average costa, and undifferentiated except for a small median spine-like projection; aperture normal; apertural spines probably four in number and small, but much obscured by the apertural aviculœcia and secondary tissue; aviculœcia are an asymmetrically-disposed apertural pair, hardly as small as those of *C. novaki*, and with pointed rostra curved towards the mid-line of the aperture they accompany.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—D. 28509. A. Frič. 1897.

Remarks.—*Calpidopora diota* differs from *C. novaki*, from which it may be directly derived, mainly in its aviculœcia with slightly curved apertures. Such aviculœcia are very rare in other families, but occur in the Otoporidæ (fig. 16), another Cenomanian family.

Figures.—Text-fig. 94. Orthœcium and two apertural aviculœcia.

Plate VI, fig. 9. The type-specimen, consisting of four complete orthœcia, several partial orthœcia, and about a dozen aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

5. Calpidopora auritulus, Lang.

Calpidopora auritulus, sp. n.; Lang, 1916, p. 404; Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—*Calpidopora* whose apertural bar is flattened to form a narrow proximal shield; aviculœcia comparatively large, with curved pointed apertures; asty erect, bilaminar.

Description.—Asty erect, bilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·26 mm. wide, long-elliptical; intraterminal front-wall obscured by an abundant interœcial secondary tissue with median lacunæ; the intraterminal front-wall is much flattened, and consists of about twenty flattened costæ of varying widths, rather more closely placed than in the species of *Calpidopora* hitherto described, with no lateral fusions, but united in a comparatively narrow median band of fusion; apertural bar with a flattened, though not very wide, median process which forms the proximal shield of a secondary aperture; aperture normal to cribriline; apertural spines probably four in number, and small, but

Fig. 94.—*Calpidopora diota.* Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

Fig. 95.—*Calpidopora auritulus.* Diagram of an orthœcium, two aviculœcia, and an ovicell, from above. × about 75 diameters.

concealed by the apertural aviculœcia and secondary tissue; aviculœcia comparatively large, a symmetrically-placed pair accompanying the aperture of every orthœcium, with pointed rostra directed distally and towards the mid-line of the aperture they accompany and curved in the same direction; ovicells endozoœcial, but projecting to a considerable distance from the distal end of the orthœcium into whose aperture they open.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—**D. 28513.** A. Frič. 1897.

Remarks.—*Calpidopora auritulus* may have been derived from *C. diota* by the differentiation of the apertural bar, by the enlargement of the aviculœcia, and by advance in the habit and condition of the asty.

Figures.—Text-fig. 95. Orthœcium, two aviculœcia, and an ovicell.

Plate VI, fig. 10. Most of the type-specimen, consisting of seven complete orthœcia with endozoœcial ovicells, portions of five others, and more than a dozen aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

6. Calpidopora aurita, Lang.

Calpidopora aurita, sp.n.; Lang, 1916, pp. 404–5; Cenomanian, Korycaner Schichten; Kank, Bohemia.

Diagnosis.—*Calpidopora* whose apertural bar is flattened to form a wide median projection; aviculœcia larger than those of *C. auritulus*, with curved, pointed apertures; asty erect, unilaminar.

Description.—Asty erect, unilaminar; œcia dimorphic; orthœcia about ·8 mm.–1·00 mm. long and ·26 mm.–·33 mm. wide, long-elliptical; extraterminal front-wall hidden beneath an abundant interœcial secondary tissue with but few median lacunæ; the intraterminal front-wall is much flattened, and consists of about twenty flattened costæ of varying widths, but, on the whole, wide, rather closely-spaced for *Calpidopora*, with no lateral fusions, but united in a comparatively narrow median band of fusion; apertural bar produced into a wide proximal shield; aperture normal; apertural spines probably four in number, and small, but obliterated by circum-apertural tissue; aviculœcia, an apertural pair generally symmetrically placed, and an occasional sporadic aviculœcium in the interœcial secondary tissue; with large, shortly-pointed apertures directed distally and towards the mid-line of the aperture they accompany, and slightly curved in the same direction.

Distribution.—Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia.

Type-specimen.—D. 28511.

Remarks.—*Calpidopora aurita*, on the whole, is a further development of *C. auritulus*, having slightly larger orthœcia, a wider proximal shield, and larger aviculœcia. The asty, however, is unilaminar and consequently not so advanced as that of *C. auritulus*. In the occasional presence of sporadic aviculœcia it is even

Fig. 96.—*Calpidopora aurita*. Diagram of an orthœcium, two aviculœcia, and an ovicell, from above. × about 75 diameters.

less advanced than both *C. auritulus* and *C. diota*. Therefore, while on the whole the lineage *C. diota*–*C. auritulus*–*C. aurita* stands, it should probably rather be expressed as in the phylogeny on p. 200.

Figures.—Text-fig. 96. Orthœcium, two aviculœcia, and an ovicell.

Plate VII, fig. 1. Part of the type-specimen, showing four complete orthœcia, parts of two others, and about thirteen aviculœcia, Most of, if not all, the orthœcia have endozoœcial ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 28511. D. 28510. D. 28512. Type-specimen and two paratypes. Cenomanian, Korycaner Schichten. Kaňk, N.W. of Kuttenberg, S.E. of Prague, Bohemia. A. Frič. 1897.

II. RHABDOPORA, Lang, 1916.

Rhabdopora, gen. nov.; Lang, 1916, pp. 404–5.

Diagnosis.—Calpidoporidæ in which the median area of fusion of the intraterminal front-wall is comparatively narrow; aviculœcia with more or less pointed apertures, often in apertural pairs, and then situated proximally rather than laterally with regard to the aperture they accompany.

Distribution.—Turonian. Loir-et-Cher and Sarthe, France.

Genotype.—*Rhabdopora virgata.*

Remarks.—Evolution within *Rhabdopora* is confined to the habit and condition of the asty, a slight decrease in the number of costæ, and an increase in the size of the aviculœcia. The three species *R. virgata–R. virgulata–R. tigrina*, with, respectively, an incrusting unilaminar, an erect unilaminar, and an erect bilaminar asty, form a lineage.

Key to the Species of *Rhabdopora*.

A. Asty incrusting, unilaminar .... 1. *R. virgata.*
B. Asty erect, unilaminar (fig. 97) .... 2. *R. virgulata.*
C. Asty erect, bilaminar .... 3. *R. tigrina.*

1. Rhabdopora virgata, Lang.

Rhabdopora virgata, sp. n.; Lang, 1916, p. 405; Turonian; N.E. of Chartre-sur-Loir, France.

Diagnosis.—*Rhabdopora* with an incrusting unilaminar asty.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·25 mm. wide, elliptical; extraterminal front-wall hidden by interœcial secondary tissue with median lacunæ; the intraterminal front-wall is much flattened, and consists of about fifteen widely-spaced, flattened, but rather narrow costæ, with no lateral fusions, but united in a narrow median band of fusion; apertural bar apparently undifferentiated, or with a slight median spine; apertures normal; apertural spines four in number, and of fair size, but tending to be obliterated by circum-apertural tissue; aviculœcia very small, with shortly-pointed apertures, an apertural pair placed proximally rather than laterally with regard to the apertures of the orthœcia they accompany; and an occasional aviculœcium situated in the interœcial secondary tissue; with apertures distally directed, and turned, in the apertural pair, towards the mid-line of the aperture they accompany.

Distribution.—Turonian. Between Ruillé and Poncé, N.E. of La-Chartre-sur-le-Loir, Sarthe, France.

Type-specimen.—**D. 28429.** In exchange with Monsieur F. Canu. 1914.

Remarks.—*Rhabdopora virgata*, with its incrusting asty, stands at the base of the lineage *R. virgata–R. virgulata–R. tigrina*, which shows a progressive advance in the habit and condition of the asty.

Specimens.—Type-specimen. Distribution and collection as above.

2. **Rhabdopora virgulata**, Lang.

Rhabdopora virgulata, sp. n.; Lang, 1916, p. 405; Upper Turonian; N.E. of Chartre-sur-Loir. France.

Diagnosis.—*Rhabdopora* with an erect unilaminar asty.

Description.—Asty erect, unilaminar; otherwise as *R. virgata*, but the costæ tend to be fewer, and the aviculœcia larger; ovicells endozoœcial.

Distribution.—Upper Turonian. Between Ruillé and Poncé, N.E. of La Chartre-sur-le-Loir, Sarthe, France.

Type-specimen.—**D. 28431.**

Remarks.—*Rhabdopora virgulata* appears to differ from *R. virgula* chiefly in its more advanced colonial habit, which is erect, instead of incrusting. The costæ, moreover, are rather fewer and the aviculœcia slightly larger.

FIGURES.—Text-fig. 97. Orthœcium and two aviculœcia.

LIST OF SPECIMENS.

D. 28431–2. Type-specimen and paratype. Upper Turonian. Between Ruillé and Poncé, N.E. of La Chartre-sur-le-Loir, Sarthe, France. In exchange with Monsieur F. Canu. 1914.

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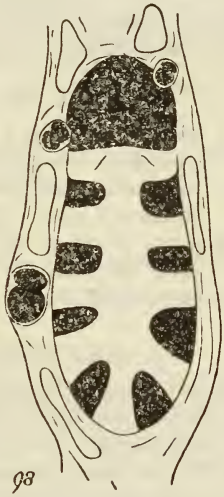

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Fig. 97.—*Rhabdopora virgulata.* Diagram of an orthœcium and two aviculœcia, from above. × about 75 diameters.

Fig. 98.—*Graptopora scripta.* Diagram of an orthœcium, two smaller aviculœcia, and one larger aviculœcium, from above. × about 75 diameters.

3. Rhabdopora tigrina, Lang.

Rhabdopora tigrina, sp. n.; Lang, 1916, p. 405. Turonian; N.E. of Chartre-sur-Loir, France.

DIAGNOSIS.—*Rhabdopora* with an erect bilaminar asty.

DESCRIPTION.—Asty erect, bilaminar; otherwise as *R. virgata*, but the costæ are rather fewer, and the aviculœcia larger; ovicells endozoœcial.

DISTRIBUTION.—Turonian. Between Ruillé and Poncé, N.E. of La Chartre-sur-le-Loir, Sarthe; and St. Rimay, E. of Montoire, N.W. of Blois, Loir-et-Cher, France.

Type-specimen.—D. 28425.

Remarks.—*Rhabdopora tigrina* may be directly derived from *R. virgulata*, from which it appears to differ only in the colonial condition, which is bilaminar instead of unilaminar.

Figures.—Plate VII, fig. 2. Part of the type-specimen, showing five more-or-less complete orthœcia and nine aviculœcia. Endozoœcial ovicells are seen distally placed with regard to the apertures of the orthœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28425. D. 28423–4. D. 28426–8. D. 28433–6. Type-specimen and nine paratypes. Turonian. Between Ruillé and Poncé, N.E. of La Chartre-sur-le-Loir, Sarthe, France. In exchange with Monsieur F. Canu. 1914.

D. 4605. A poorly preserved asty, probably of this species. Turonian, Craie Marneuse. St. Rimay, E. of Montoire, N.W. of Blois, Loir-et-Cher, France. 1898.

III. GRAPTOPORA, Lang, 1916.

Escharipora [partim]; d'Orbigny, 1852, p. 234, 1854, p. 1097.
Semiescharipora [partim]; d'Orbigny, 1853, p. 486, 1854, p. 1098.
Escharipora [partim]; Canu, 1900 [2], p. 451.
Semiescharipora [partim]; Canu, 1900 [2], p. 451.
Graptopora, gen. nov.; Lang, 1916, pp. 404–6.

Diagnosis.—Rhabdoporidæ with a wide median area of fusion of the intraterminal front-wall, and with few costæ.

Distribution.—Senonian, Santonian. N.W. France.

Genotype.—*Graptopora scripta*.

Remarks.—With the genotype, *Graptopora scripta*, are here placed two of d'Orbigny's species, namely, *Semiescharipora semicostata* and *Escharipora raripora*. The descriptions and figures of these, however, are too vague for the exact relationships between the three species to be determined.

Key to the Species of *Graptopora*.

A. Œcia very long, about thrice as long as wide; œcia tapering at both ends; asty erect, unilaminar .... 1. *G. semicostata*.
B. Œcia little more than twice as long as wide.
  I. Œcia fairly parallel-sided; asty erect, unilaminar (fig. 98) .... 2. *G. scripta*.
  II. Œcia tapering at both ends; asty erect, bilaminar . 3. *G. raripora*.

1. Graptopora semicostata (d'Orbigny).

Semiescharipora semicostata, d'Orb., 1851; d'Orbigny, 1852, pl. 719, figs. 1–4, 1853, p. 486, 1854, p. 1098; Sénonien; environs de Tours (Indre-et-Loire).

Non=*Escharipora pentapora*, d'Orb., 1851; d'Orbigny, 1851, pl. 685, figs. 5–8, 1852, p. 224, 1854, p. 1097; Sénonien, la craie à Thécidées; environs de Sainte-Colombe (Manche); as suggested by Canu, 1900 [2], p. 451. [See *Polycephalopora pentapora* among the Pelmatoporidæ in Vol. IV.]

Semiescharipora semicostata d'Orb.; Canu, 1900 [2], p. 451.

Graptopora semicostata (d'Orbigny); Lang, 1916, p. 405; Senonian; Tours, France.

Diagnosis.—*Graptopora* in which the œcia are about thrice as long as wide and taper at both ends; the asty is erect and unilaminar.

Distribution.—Senonian. Tours, Indre-et-Loire, France.

Type-specimen.—That figured by d'Orbigny, 1852, pl. 719, fig. 2, is hereby selected.

Remarks.—Canu states that, of the two worn specimens representing this species in d'Orbigny's collection, one œcium on the better-preserved piece appears to resemble d'Orbigny's *Escharipora pentapora*. The figures of these two species, however, are so different that it seems impossible that this specimen can be that on which d'Orbigny's figure was founded.

Specimens.—None in the Collection.

2. Graptopora scripta, Lang.

Graptopora scripta, sp. n.; Lang, 1916, p. 405; Santonian; Coulommiers, France.

Diagnosis.—*Graptopora* in which the œcia are little more than twice as long as wide, and are fairly parallel-sided; asty erect, unilaminar.

Description.—Asty erect, unilaminar; œcia dimorphic; orthœcia about ·7 mm. long and ·3 mm. wide, elliptical with fairly parallel sides; extraterminal front-wall concealed by a plentiful interœcial secondary tissue with large median lacunæ; the intraterminal front-wall is much flattened, and consists of about seven or eight wide flattened costæ, very widely separated, with no lateral fusions, but united in a very broad median area of fusion occupying at least half the total area of the intraterminal front-wall; apertural bar very wide, but undifferentiated except for a slight but wide median projection; apertures normal, but rather pointed distally; aviculœcia of varying sizes, and on the whole irregularly distributed, but with a tendency for an apertural pair to be placed at the lateral-distal corners of the apertures of the orthœcia, and directed obliquely, often proximally, and variously towards or away from the mid-line of the orthœcium whose aperture they accompany; the size of the aviculœcian aperture varies from about an eighth to nearly a half that of the apertures of the orthœcia; it is sub-circular or oval, slightly more pointed distally, and divided by a constriction or bar into a rather smaller proximal portion and a rather larger rostrum; ovicells have not been observed.

Distribution.—Senonian, Santonian. Coulommiers, E. of Vendôme, Loir-et-Cher, France.

Type-specimen.—D. 27750.

Remarks.—*Graptopora scripta*, the genotype of *Graptopora*, differs from the other two species here included in this genus, chiefly by its œcial shape. The peculiarities of the aviculœcia, clearly seen in this species, distinguish *Graptopora* from the other Calpidoporidæ.

Figures.—Text-fig. 98 (p. 211).—Orthœcium, two smaller aviculœcia, and one larger aviculœcium.

Plate VII, fig. 3. Part of the type-specimen, showing eight more-or-less complete orthœcia and about ten aviculœcia. ×about 27 diameters.

LIST OF SPECIMENS.

D. 27750. D. 28403–11. Type-specimen and nine paratypes. Senonian, Santonian. Coulommiers, E. of Vendôme, Loir-et-Cher, France. In exchange with Monsieur F. Canu. 1914.

D. 28412–6. Five asties, probably of this species, from the same horizon and locality as the above. In exchange with Monsieur F. Canu. 1914.

3. Graptopora raripora (d'Orbigny).

Escharipora raripora, d'Orb., 1851; d'Orbigny, 1852, p. 234, pl. 703, figs. 16–18, 1854, p. 1097; Sénonien; environs de Tours (Indre-et-Loire).

Non = *Escharipora pentapora*, d'Orb., 1851; d'Orbigny, 1851, pl. 685, figs. 5–8, 1852, p. 224, 1854, p. 1097; Sénonien, la craie à Thécidées; environs de Sainte Colombe (Manche); as stated by Canu, 1900[2], p. 451. [See *Polycephalopora pentapora* among the Pelmatoporidæ in Vol. IV.]

Escharipora raripora d'Orb.; Canu, 1900[2], p. 451.

Graptopora raripora (d'Orbigny); Lang, 1916, pp. 405–6; Senonian; near Tours, France.

Diagnosis.—*Graptopora* whose œcia are little more than twice as long as wide, and taper at both ends; asty erect, bilaminar.

Distribution.—Senonian. Environs de Tours, Indre-et-Loire, France.

Type-specimen.—That figured by d'Orbigny, 1852, pl. 703, fig. 17, is hereby selected.

Remarks.—*Graptopora raripora* appears to differ from *G. scripta* chiefly in the condition of the asty and in the shape of the œcia. D'Orbigny's figure of *Escharipora pentapora* is so different from that of *E. raripora* that it is impossible to think that they could have been drawn from specimens of the same species. Thus, though Canu, who has examined d'Orbigny's collection, considers the two species the same, I would suggest that the specimen *Escharipora pentapora* examined by Canu was not the specimen figured by d'Orbigny. (See also remarks on *Graptopora semicostata* on p. 213.)

Specimens.—None in the Collection.

I. DISHELOPORIDÆ, new family.

Disheloporinæ, subfam. nov. [partim]; Lang, 1916, pp. 397, 400.

Rhacheoporinæ, subfam. nov. [partim]; Lang, 1916, pp. 397–8.

Diagnosis.—Multiserial Cretaceous Cheilostome Polyzoa, probably with endozoœcial ovicells; orthœcia of fair size (·66 mm. to nearly 1·00 mm. long) and of a long shape; intraterminal front-wall formed of closely-placed costæ without lateral fusions, but firmly fused in the mid-line, and tending to form a raised median seam, as in the Rhacheoporidæ; primitively, each costa bears several pelmatidia, which, however, tend to disappear during evolution; apertural spines four; a rather small aviculœcium accompanies each proximal apertural spine and tends to be involved in the apertural rim; there is little or no interœcial secondary tissue; the apertural bar is low and wide, and during evolution tends to become wider and proximally bent so as to give the aperture a pliophlœan shape.

Distribution.—Senonian, zones of *M. cortestudinarium* to *Marsupites*, in Southern England and Northern France.

Remarks.—The Disheloporidæ comprise the genus *Dishelopora* of the former sub-family Disheloporinæ and the genus *Hystricopora* formerly included in the sub-family Rhacheoporinæ. The Disheloporinæ were originally considered as a sub-family of the Rhacheoporidæ, owing to the apparent lack of pelmatidia and to the tendency to form a median seam. The finding, however, by Mr. C. T. A. Gaster, of well-preserved specimens of *Dishelopora binoculata* (see D. 29903) clearly showing pelmatidium-like structures, made it clear that *Dishelopora* was closely allied to *Hystricopora* (an aberrant genus formerly placed provisionally in the Rhacheoporinæ near *Rhacheopora*); also that *Dishelopora* and *Hystricopora* were probably not closely allied to the Rhacheoporidæ, and possibly might be considered with the Pelmatoporidæ. But, if placed in the Pelmatoporidæ, these two genera form a very isolated group, resembling most the Castanoporinæ with their numerous pelmatidia and general lack of interœcial secondary tissue, but differing greatly in other respects from that sub-family, notably in not possessing the numerous lateral costal fusions—a characteristic Castanoporine feature. Indeed, in all the sub-families of Pelmatoporidæ (except the Diacanthoporinæ) there is a tendency for the primary pelmata or pelmatidia to move away from the mid-line, either leaving an ever-widening median area of fusion, or followed along the costa by secondary and tertiary pelmata or pelmatidia, which, arising in the mid-line (as do the primary pelmata or pelmatidia), mark the point on the costa whence lateral fusions arise. It is probable, then, that the apparent pelmatidia of Disheloporidæ are merely emergences from the costa and, not having the evolutionary history of true pelmatidia, do not indicate any relationship between the Disheloporidæ and the Pelmatoporidæ.

The Disheloporidæ are best known by the characteristically flattened and proximally bent apertural bar, causing a pliophlœan shape of the aperture; but in the more primitive forms this is not so apparent. The two genera *Hystricopora* and *Dishelopora* have evolved along rather different lines. *Hystricopora* resembles a primitive *Dishelopora* with comparatively few costæ, but the apertural spines of the distal pair, approaching, often fuse to form the distal shield of a secondary aperture.

Key to the Genera of Disheloporidæ.

A. Apertural spines of the distal pair do not approach and fuse to form a distal shield (figs. 99–104) ...... I. *Dishelopora*.

B. Apertural spines of the distal pair approaching fuse to form a distal shield (fig. 105) .... II. *Hystricopora*.

I. DISHELOPORA, Lang, 1916.

Cribrilina [partim]; Brydone, 1910, pp. 390, 392.
Dishelopora, gen. nov.; Lang, 1916, pp. 400, 401.

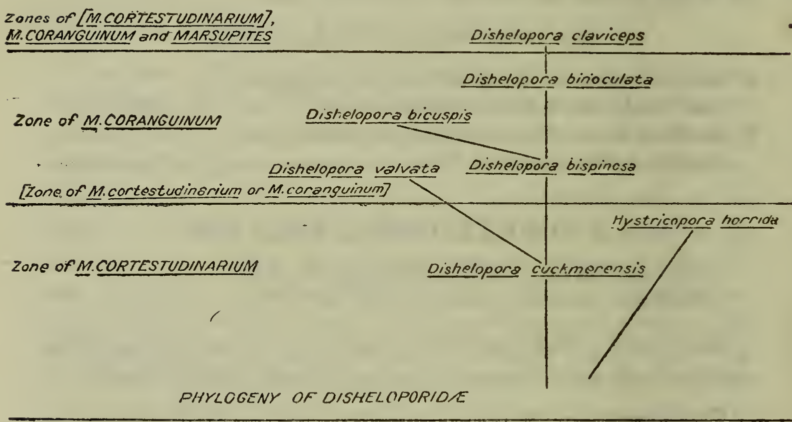
Diagnosis.—Disheloporidæ in which the spines of the distal apertural pair do not approach or fuse to form a distal shield.

Distribution.—Senonian, zones of *M. cortestudinarium* to *Marsupites*; Southern England.

Genotype.—*Dishelopora bispinosa*.

Remarks.—Evolution in *Dishelopora* appears to have proceeded along the following lines:—(1) differentiation of the apertural bar; (2) increase in œcial size; and (3) decrease in the number of costæ.

The most primitive form appears to be *D. cuckmerensis*, in which the apertural bar is not specially differentiated, whose œcial length is about ·68 mm., and whose costæ number between twenty and thirty; it occurs in the zone of *M. cortestudinarium*. *Dishelopora bispinosa* may be derived from *D. cuckmerensis* by a decrease in the number of costæ. *D. valvata* also arose, probably, from *D. cuckmerensis* or a smaller precursor, by the differentiation of the apertural bar to form a broad median projection, and by a decrease in the number of costæ. From *D. bispinosa* diverged two lineages, the one, represented by *D. bicuspis*, differentiating the apertural bar by producing on it a median spine; and the other, consisting of *D. binoculata* and *D. claviceps*, widening the apertural bar and producing in it a still more pronounced proximal bend, giving the aperture a very decided pliophlœan shape. In both lineages there is an increase in size and a decrease in the number of costæ. All the species hitherto described are incrusting forms. The following phylogeny indicates the supposed relationships of the species of *Dishelopora* and includes the genus *Hystricopora* :—



Key to the Species of *Dishelopora*.

A. Apertural bar not specially differentiated; œcial length about ·68 mm.–·7 mm.
- I. Costæ 20–30 (fig. 99) .... 1. *D. cuckmerensis.*
- II. Costæ 16–20 (fig. 100) .... 2. *D. bispinosa.*

B. Apertural bar with broad median process; costæ 16–20; œcial length about ·6 mm. (fig. 101) .... 3. *D. valvata.*

C. Apertural bar with a narrow spiniform median process; costæ about 16; œcial length about ·8 mm. (fig. 102). 4. *D. bicuspis.*

D. Apertural bar very much widened and proximally bent, with no obvious spine; apertures markedly pliophlœan; costæ 12 to 16.
- I. Œcial length about ·7 mm. (fig. 103) .... 5. *D. binoculata.*
- II. Œcial length about ·9 mm. (fig. 104) .... 6. *D. claviceps.*

1. Dishelopora cuckmerensis, Lang.

Dishelopora cuckmerensis, sp. n.; Lang, 1916. pp. 400–1; *M. cortestudinarium*-zone; Cuckmere Haven, Sussex.

Diagnosis.—*Dishelopora* with an undifferentiated apertural bar; orthœcia about ·68 mm. long, and with 20–30 costæ.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·68 mm. long and ·28 mm. wide, elliptical; extra-terminal front-wall fairly well-developed, especially proximally; the intraterminal front-wall is well-arched, and consists of about twenty-five closely-placed, flattened costæ without lateral fusions, and united in a thin median seam; apertural bar rather wider than the normal costæ, slightly proximally bent, and without a median process, or, at most, with a very slight median ridge; aperture normal to sub-circular; apertural spines four in number and rather small, the proximal pair often obscured by the pair of apertural aviculœcia; aviculœcia small, with sub-circular apertures; a pair always accompanies the aperture of every orthœcium, and is in intimate connexion with the apertural rim, tending to obscure the proximal pair of apertural spines which are generally situated immediately distally to the aviculœcia; other occasional aviculœcia are sporadically distributed in the interœcial valleys.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium*. Cliffs between Hope Gap and Cuckmere Haven, Sussex.

Type-specimen.—D. 28298. Collected by C. T. A. Gaster, Esq., and presented by him in 1915.

Remarks.—*Dishelopora cuckmerensis* is the most primitive known species of the genus; being, except for *D. valvata*, the smallest in size, having the largest number of costæ, and having an undifferentiated apertural bar.

Figures.—Text-fig. 99. Orthœcium and its two apertural aviculœcia.

Plate VII, fig. 4. Part of the type-specimen showing nine orthœcia, each with a pair of apertural aviculœcia, and six sporadic aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

2. Dishelopora bispinosa, Lang.

Dishelopora binspinosa, sp. n.; Lang, 1916, pp. 400–1; low in *M. coranguinum*-zone; Hindover, Sussex.

Diagnosis.—*Dishelopora* with an undifferentiated apertural bar; orthœcia about ·7 mm. long, and with 16–20 costæ, Description.—Asty unilaminar, incrusting; œcia dimorphic; orthœcia about ·7 mm. long and ·35–·4 mm. wide, elliptical; extra-terminal front-wall of considerable extent, especially proximally; the intraterminal front-wall is fairly well-arched, and consists of about eighteen flattened, rather wide, and closely-placed costæ with no lateral fusions and united in a thin median seam; the apertural bar is wide, with a slight proximal bend, but without a process or any differentiation more than a slight median ridge; aperture normal to sub-circular; apertural spines four in number and rather small, the proximal pair often more or less obscured by the apertural

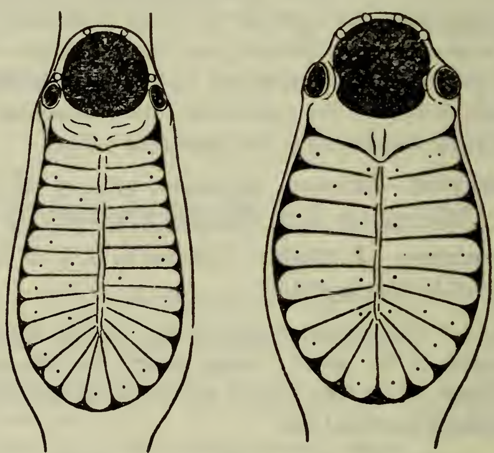


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Fig. 99.—*Dishelopora cuckmerensis.* Diagram of an orthœcium and its two apertural aviculœcia, from above. × about 75 diameters.

Fig. 100.—*Dishelopora bispinosa.* Diagram of an orthœcium and its two apertural aviculœcia, from above. × about 75 diameters.

aviculœcia; aviculœcia small, with blunt, more or less circular apertures; there is always a pair accompanying the aperture of every orthœcium, and an occasional sporadic aviculœcium in the interœcial valleys.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*; Southern England.

Type-specimen.—D. 28922.

Remarks.—*Dishelopora bispinosa* may be derived from *D. cuckmerensis* by a slight increase of œcial size and a decrease in the number of costæ.

Figures.—Text-fig. 100. Orthœcium and its two apertural aviculœcia.

Plate VII, fig. 5. Four complete orthœcia of the type-specimen, each with a pair of apertural aviculœcia, and three sporadic aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28922. Type-specimen. Senonian, Santonian, zone of *M. coranguinum*, *Trochiliopora* Bed, about 20 ft. from the base of the zone. Hindover, N.E. of Seaford, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him in 1916.

D. 21203. Paratype. Senonian, Coniacian, top of zone of *M. cortestudinarium* or Santonian, base of zone of *M. coranguinum*. Great Central Railway-cutting, near Loudwater, S.E. of High Wycombe, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

3. Dishelopora valvata, Lang.

Dishelopora valvata, sp. n.; Lang, 1916, pp. 400–1; Lower Senonian; Chatham, Kent.

Diagnosis.—*Dishelopora* whose apertural bar has a wide median process.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·6 mm. long and ·27–3 mm. wide, elliptical; extra-terminal front-wall of rather small extent, except proximally; there is a small amount of interœcial secondary tissue especially distal to the apertures; the intraterminal front-wall is rather flatly-arched, and consists of about eighteen rather thin, closely-placed costæ with no lateral fusions, and united in a thin median seam; the apertural bar is not very wide, but has a broad median process which forms a proximal shield of a secondary aperture; the secondary aperture is not, however, further developed, except for the apertural aviculœcia and a certain amount of secondary tissue on the distal side of the aperture; aperture sub-circular to normal; apertural spines four in number and rather small, but the proximal pair tends to be obscured by the apertural aviculœcia, and the distal pair by upgrowth of secondary tissue; aviculœcia small, sometimes with elongate rostra, a pair accompanying the aperture of every orthœcium, and an occasional sporadic aviculœcium in the interœcial valleys; what are probably endozoœcial ovicells may be seen above certain œcia in the type-specimen.

Distribution.—Senonian, base of Santonian or Coniacian. Chatham, Kent.

Type-specimen.—**D. 4964.** W. Gamble collection. 1898.

Remarks.—*Dishelopora valvata*, except for its somewhat smaller œcia, may be derived from *D. cuckmerensis* by the differentiation of the apertural bar to produce a wide median process and by a diminution in the number of costæ. It is possible that the œcia are catagenetically smaller, but, since the evolution of the genus shows a general increase in œcial size, it is more probable that *D. valvata* diverged from the lineage of *D. cuckmerensis* before that species had attained its full œcial dimensions.

Figures.—Text-fig. 101. Orthœcium with its pair of apertural aviculœcia.

Plate VII, fig. 6. Part of the type-specimen, including seven more-or-less complete orthœcia and thirteen aviculœcia. It is probable that ovicells are present above the two complete orthœcia on the right of the top row. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

4. Dishelopora bicuspis, Lang.

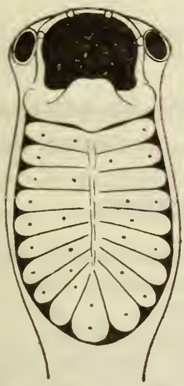
Dishelopora bicuspis, sp. n.; Lang, 1916, pp. 400–1; *M. coranguinum*-zone; Wooburn Green, Bucks.

Dishelopora claviceps (Brydone); Lang, 1916, pp. 400–1; Senonian, England.

Non *Cribrilina claviceps*, nov.; Brydone, 1910, pp. 390, 392, pl. xxx, figs. 2–5.

Diagnosis.—*Dishelopora* whose apertural bar bears a narrow spiniform median process.

Description.—(1) *Ephebœcia.* Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and ·3–·45 mm. wide, long-elliptical; extraterminal front-wall of small extent, except proximally; the intraterminal front-wall is fairly well-arched and consists of from fourteen to nineteen rather widely-spaced, coarse, somewhat flattened costæ, without lateral fusions and united in a thin median seam; apertural bar not much thicker than a normal costa, and with a median projection, sometimes flattened but never broad; aperture super-normal to super-cribriline; four apertural spines, the proximal pair generally obscured by the apertural aviculœcia that lie immediately proximal to them; aviculœcia small, with more or less circular apertures; a pair accompanying the aperture of every orthœcium, and an occasional aviculœcium in the interœcial valleys.



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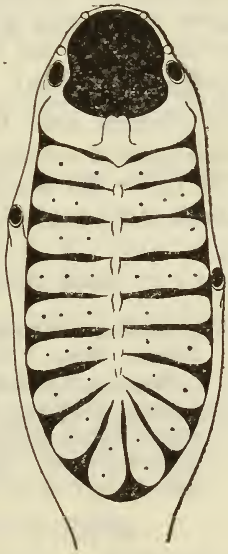

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Fig. 101.—*Dishelopora valvata.* Diagram of an orthœcium with its pair of apertural aviculœcia, from above. × about 75 diameters.

Fig. 102.—*Dishelopora bicuspis.* Diagram of an orthœcium, its two apertural aviculœcia, and two sporadic aviculœcia, from above. × about 75 diameters.

(2) *Neanœcia.* Orthœcia about ·6 mm. long and ·4 mm. wide, oval-elliptical; extraterminal front-wall of considerable extent, especially proximally; the intraterminal front-wall is well-arched and consists of about twelve widely-spaced, slightly-flattened costæ with no lateral fusions and united in a thin median seam; otherwise resembling the ephebœcia.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen.—**D. 21203.** Wooburn Green, Bucks. L. Treacher collection.

Remarks.—*Dishelopora bicuspis* may have been derived from *D. bispinosa* by the acquisition of a narrow median process of the apertural bar, by an increase in size, and by a diminution in the number of costæ. By a confusion (Lang, 1916), *Cribrilina claviceps*, Brydone was considered to be represented by specimen **D. 28300**, now provisionally placed under this species; while the true *Cribrilina claviceps* was described as *Dishelopora biforis* (see under *Dishelopora claviceps*).

Figures.—Text-fig. 102. Orthœcium, its two apertural aviculœcia, and two sporadic aviculœcia.

Plate VII, fig. 7. Six more-or-less complete orthœcia and fourteen aviculœcia of the type-specimen. × about 27 diameters.

LIST OF SPECIMENS.

D. 21202. Type-specimen. Senonian, Santonian, zone of *M. coranguinum*. Wooburn Green, S.W. of Beaconsfield, Bucks. Collected by L. Treacher, Esq., F.G.S. 1917.

D. 28300. A specimen, possibly of this species, but having a wider and more proximally-bent apertural bar. Senonian, Santonian, zone of *M. coranguinum*. Beltout, West of Beachy Head, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

5. Dishelopora binoculata, Lang.

Dishelopora binoculata, sp. n.; Lang, 1916, pp. 400–1; *M. coranguinum*-zone; Gillingham, Kent.

Diagnosis.—*Dishelopora*, whose apertural bar is very wide and proximally bent, with no obvious median process; length about ·7 mm.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·7 mm. long and ·36–·35 mm. wide, long-elliptical; extraterminal front-wall of rather small extent and somewhat obscured by a small development of interœcial secondary tissue; the intraterminal front-wall is fairly well-arched and consists of about sixteen rather closely-placed, flattened costæ, generally of considerable width, but varying a good deal in this respect, bearing each about four or five pelmatidia, but without lateral fusions, and united in a thin median seam ; apertural bar flattened and very wide, with a considerable proximal bend and a median proximal point; it bears pelmatidia on its proximal edge; aperture pliophlœan; apertural spines four, but much obscured, the proximal pair by the apertural aviculœcia lying proximal to them, and the distal pair by secondary tissue ; aviculœcia small, with more or less triangular, pointed apertures, a pair accompanying the aperture of every orthœcium, and an occasional aviculœcium in the interœcial valleys.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen.—**D. 8167**. W. Gamble collection.

Remarks.—*Dishelopora binoculata* may have been derived from *D. bispinosa* by the differentiation of the apertural bar. It leads on, in turn, to *D. claviceps*, which is a larger coarser form.

Figures.—Text-fig. 103. Orthœcium with its pair of apertural aviculœcia.

Plate VII, fig. 8. Six complete orthœcia of the type-specimen, each bearing a pair of apertural aviculœcia; two sporadic aviculœcia ; and two aviculœcia accompanying apertures outside the figure. × about 27 diameters.

LIST OF SPECIMENS.

D. 8167. Type-specimen. Senonian, Santonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1903.

D. 29903. Senonian, Santonian, upper part of zone of *M. coranguinum*. Coomb's Pit, West Horsley (pit 264 of G. W. Young), N.E. of Guildford, Surrey. Collected by C. T. A. Gaster, Esq., and presented by him, 1919.

6. Dishelopora claviceps (Brydone).

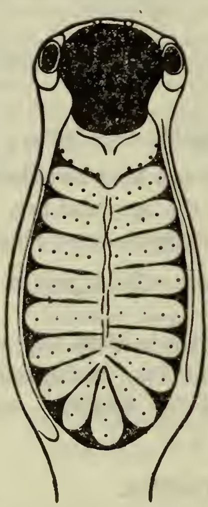
Cribrilina claviceps, nov.; Brydone, 1910, pp. 390, 392, pl. xxx, figs. 2–5; *M. coranguinum* and *Marsupites* zones; Gravesend and Hants.

Non *Dishelopora claviceps* (Brydone); Lang, 1916, pp. 400–1; Senonian; England.

Dishelopora biforis, sp. n.; Lang, 1916, pp. 400–1; *M. cortestudinarium*-zone; Luton, S.E. of Chatham.

DIAGNOSIS.—*Dishelopora* whose apertural bar is very wide and proximally bent, with no obvious median process; length about ·9 mm.

DESCRIPTION.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·9 mm. long and about ·4 mm. wide, elliptical; extraterminal front-wall of small extent and somewhat obscured by



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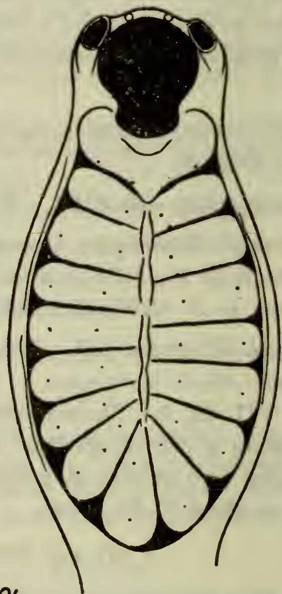

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Fig. 103.—*Dishelopora binoculata.* Diagram of an orthœcium with its pair of apertural aviculœcia, from above. × about 75 diameters.

Fig. 104.—*Dishelopora claviceps.* Diagram of an orthœcium with its pair of apertural aviculœcia, from above. × about 75 diameters.

contour-like ridges of secondary interœcial tissue; the intraterminal front-wall is rather flatly arched and consists of about fourteen rather closely-placed, flattened costæ of very unequal widths, without lateral fusions and united in a median seam; the apertural bar is flattened, very wide, and with a considerable proximal bend; the aperture is pliophlœan; there are four apertural spines, small and much obscured, the proximal pair by the apertural aviculœcia, and the distal pair by secondary tissue growing up round the distal end of the aperture; aviculœcia rather large for *Dishelopora*, with oval, somewhat pointed apertures, a pair accompanying the aperture of every orthœcium, and an occasional sporadic aviculœcium in the interœcial valleys.

Distribution.—Senonian, Coniacian, top of *M. cortestudinarium*-zone to Santonian, *Marsupites*-zone. Kent, Sussex, and Hants.

Type-specimen.—That figured by Brydone, 1910, pl. xxx, figs. 2 & 3, is hereby selected.

Remarks.—Although *Dishelopora binoculata* has hitherto been found only in the *M. coranguinum*-zone, while *D. claviceps* occurs also at the top of the zone below, it is likely that *D. binoculata* will also be found as low as the top of the *M. cortestudinarium*-zone, and that *D. claviceps* is derived from *D. binoculata* by an increase in œcial size.

Figures.—Text-fig. 104. Orthœcium with apertural aviculœcia.

LIST OF SPECIMENS.

D. 8362. The type-specimen of *Dishelopora biforis*, Lang. Senonian, Coniacian, zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1906.

D. 28299. Paratype of *Dishelopora biforis*, Lang. Senonian, Santonian, zone of *M. coranguinum*, about 120 ft. from base of the zone (50–60 ft. above " strong *coranguinum*-tabular " of Rowe). Cliffs, Seaford Head, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 29910. Idiotype of *Cribrilina claviceps*, Brydone. Senonian, Santonian, zone of *M. coranguinum*. Grays, Essex. Collected by G. E. Dibley, Esq., F.G.S., and presented by him, 1919.

D. 29911. Senonian, Santonian, zone of *Marsupites*. Collected by C T. A. Gaster, Esq., and presented by him, 1919.

II. HYSTRICOPORA, Lang, 1916.

Hystricopora, gen. nov.; Lang, 1916, pp. 398–9.

Diagnosis.—Disheloporidæ in which the distal pair of apertural spines approach and fuse to form a distal shield.

Distribution.—Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France.

Genotype.—*Hystricopora horrida*.

Remarks.—*Hystricopora* may have been derived from a primitive *Dishelopora* in which the apertural bar was not differentiated, by the drawing together and eventual fusing of the distal pair of apertural spines. Originally it was doubtfully placed near *Rhacheopora* in the Rhacheoporidæ.

1. Hystricopora horrida, Lang.

Hystricopora horrida, sp. n.; Lang, 1916, p. 399; Coniacian, Fécamp, France.

Diagnosis.—As for the genus.

Description.—Asty erect, unilaminar; œcia dimorphic; orthœcia about ·6 mm. long and ·4 mm. wide, elliptical; extraterminal

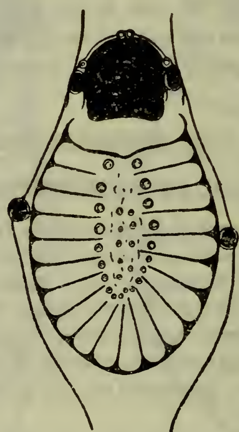


Fig. 105.—*Hystricopora horrida*. Diagram of an orthœcium with its pair of apertural aviculœcia, and two sporadic aviculœcia, from above. × about 75 diameters.

front-wall of fair extent, not concealed by interœcial secondary tissue; the intraterminal front-wall is rather flatly arched, and consists of about eighteen or twenty closely-placed, slightly-flattened costæ, with no lateral fusions, and united in a median line of fusion; the costæ bear pelmatidia, especially towards their distal ends; apertural bar undifferentiated and hardly wider than the normal costæ; apertures super-normal to super-cribriline; apertural spines four, the proximal pair obscured by the apertural aviculœcia and the distal pair close together and often fused to form a distal shield; aviculœcia, an apertural pair placed just proximally to the proximal pair of apertural spines, and occasional sporadic aviculœcia in the interœcial valleys; small, often borne on pedestals, and with sub-circular apertures.

Distribution.—As for the genus.

Type-specimen.—D. 28460. In exchange with Mr. Canu. 1914.

Remarks.—See under the genus.

Figures.—Text-fig. 105. Orthœcium with its apertural aviculœcia and two sporadic aviculœcia.

Plate VII, fig. 9. The type-specimen, consisting of nine complete orthœcia, each with a pair of apertural aviculœcia, and about ten sporadic aviculœcia. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

J. RHACHEOPORIDÆ, Lang, 1916.

Rhacheoporidæ, fam. nov. [*partim*]; Lang, 1916, p. 397.
Rhacheoporinæ, sub-fam. nov. [except *Hystricopora*]; Lang, 1916, pp. 397–8.
Disheloporinæ, sub-fam. nov. [except *Dishelopora*]; Lang, 1916, pp. 397, 400.

Diagnosis.—Cretaceous Cheilostome Polyzoa with endozoœcial ovicells (only definitely determined in *Prosotopora*); the œcia are of fair size (about ·66 mm. long), narrow and delicately built; pelmatidia or pelmatidium-like structures are absent, or, at least, not conspicuous; the costæ are numerous, much flattened, of unequal widths, closely placed, have no apparent lateral fusions, and are turned up at their distal ends, forming a generally conspicuous median seam; secondary tissue generally well developed; four apertural spines; the aviculœcia have straight rostra; and, if they occur in the neighbourhood of the aperture, they do not generally take up a definite position with regard to the apertural spines.

Distribution. — Senonian; chiefly Coniacian. North-west Europe.

Remarks.—The chief diagnostic characters of the Rhacheoporidæ are the long slender œcia, with numerous flattened costæ of unequal widths and having upturned distal ends that form a prominent median seam on the intraterminal front-wall; also endozoœcial ovicells, and the absence of pelmatidia and lateral costal fusions. *Rhacheopora* is a radical genus, from which the other genera can be derived. It has no secondary aperture, while in the derived genera a secondary aperture is aimed at and often attained. Various ways in which a secondary aperture may be built have been described above (Introd., § 23), and it was remarked (Introd., § 25) that though it might confidently be expected that during its further evolution any primitive Cribrimorph stock would sooner or later build up a secondary aperture after a few well-defined methods, yet it was impossible to predict which method or methods would be followed by the descendant lineages. This position is well illustrated by the Rhacheoporidæ. *Rhacheopora*, a primitive genus, does not attain to a secondary aperture; but its descendant lineages may confidently be expected to acquire one, building it up after one or other of a few defined methods. Accordingly, we find the proximal shield in *Geisopora* formed merely by a general upward growth of the apertural bar flattened in a vertical plane; in *Prosotopora* by a wide median process of the apertural bar, in *Diancopora* by the fusion of the proximal pair of apertural spines with a process of the apertural bar, and in *Diceratopora* by the fusion hoop-wise over the apertural bar of a pair of apertural aviculœcia. In *Prosotopora* only those orthœcia bearing ovicells have a partial secondary aperture; in the other three genera a partial or complete secondary aperture is present on all the œcia.

At least two stocks, then, arose from *Rhacheopora*, namely, one in which the whole apertural bar, or a part of it, grew in height; and one, the genus *Diceratopora*, in which the apertural bar remained undifferentiated. Whether *Geisopora*, in which the apertural bar grows upwards as a whole, gave rise to *Prosotopora*, in which only a broad section grows upwards, and this in turn produced *Diancopora* with a median process of the apertural bar, does not appear certain; but the distribution of these forms renders it unlikely, since *Geisopora* is a Rügen species occurring at a higher horizon than *Prosotopora* and *Diancopora*.

Key to the Genera of Rhacheoporidæ.

A. No secondary aperture acquired by any of the œcia (figs. 106–109) .... I. *Rhacheopora*.

B. The ovicell-bearing orthœcia have, in the advanced species, a secondary aperture, of which the proximal shield is formed by a wide process of the apertural bar and the distal shield of the fused apertural spines; in the less advanced species there is no true secondary aperture, but dimorphism of the orthœcia correlated with the presence of ovicells occurs, and is shown by the shape of the apertural bar (figs. 110–112) . II. *Prosotopora.*

C. All the orthœcia have at least the proximal shield of a secondary aperture.

- I. Proximal shield of secondary aperture formed by a general upward growth of the flattened apertural bar; the distal shield is poorly developed and formed by a general upgrowth of apertural secondary tissue (fig. 113) .... III. *Geisopora.*
- II. Proximal shield formed by the fusion of a median process of the apertural bar with the proximal pair of apertural spines; the distal shield is formed as in *Geisopora* (fig. 114) .... IV. *Diancopora.*
- III. Proximal shield formed by the fusion of a pair of apertural aviculœcia hoop-wise over the apertural bar, which takes no part in forming the proximal shield; the imperfect distal shield is formed by another pair of apertural aviculœcia which replace the distal apertural spines (fig. 115) .... V. *Diceratopora.*

I. RHACHEOPORA, Lang, 1916.

[*Escharipora* [partim]; d'Orbigny, 1852, p. 223, 1854, p. 1097.]
[*Semieschariporа* [partim]; d'Orbigny, 1853, p. 481, 1854, p. 1097.]
[(*Eschara*) *Escharipora*; Bronn & Römer, 1851, p. 100.]
[*Escharipora*; Pictet, 1857, p. 112.]
[*Eschara* [partim]; Stoliczka, 1872, p. 15.]
[? *Cribrilina* (*Semiescharipora*); Gamble, 1896, p. 6.]
[*Escharipora* [partim]; Canu, 1900[2], p. 451.]
[*Membraniporella* ?; Canu, 1900[2], p. 444.]
[? *Cribrilina* [partim]; Jukes-Browne, 1904, p. 490.]
Rhacheopora, gen. nov.; Lang, 1916, pp. 398–9.
[*Escharipora*; Brydone, 1918, p. 1.]

DIAGNOSIS.—Rhacheoporinæ in which there is no secondary aperture other than that produced by the general upward growth of interœcial secondary tissue—the apertural bar has no median process, and the apertural spines remain simple; the ends of the costæ form a simple, thin, but conspicuous median seam.

Distribution.—Senonian, Coniacian. Southern England and Northern France.

Genotype.—*Rhacheopora suta.*

Remarks.—*Rhacheopora* is the most primitive genus of the Rhacheoporidæ, and forms a radical from which the other genera may be derived by the acquisition after one method or another of a partial or complete secondary aperture.

The species of *Rhacheopora* fall into two series. In *R. vallata* and its derivative *R. suta*, the œcia remain primitively small; while in the remaining species the œcia are considerably longer. In both main lineages the evolutionary tendencies are an advance in the habit and condition of the asty, an advance in œcial length, an increase in the number of costæ and in the amount of interœcial secondary tissue, and an advance in apertural shape. [*R.*] *obliqua*, if a *Rhacheopora*, stands at the base of the second lineage, which continues with *R. larvalis* and *R. bidens*. It is doubtful whether the remaining species, [*R.*] *incrassata*, belongs to this genus; but, if so, it would appear to be derived from *R. bidens*, but to have catagenetically fewer costæ.

Key to the Species of *Rhacheopora.*

A. Œcia small (·66 mm. long or less); aviculœcia often directed away from the mid-line of the orthœcium whose aperture they accompany.
- I. No great abundance of interœcial secondary tissue; asty incrusting, unilaminar (fig. 106) ...... 1. *R. vallata.*
- II. More abundant interœcial secondary tissue; asty erect, cylindrical (fig. 107) ...... 2. *R. suta.*

B. Œcia large (more than ·66 mm. long); aviculœcia directed towards the mid-line of the orthœcium whose aperture they accompany.
- I. Less interœcial secondary tissue; asty erect, unilaminar.
  - *a.* Costæ about 26; one aviculœcium only to the aperture of each orthœcium ...... 3. [*R.*] *obliqua.*
  - *b.* Costæ about 27–30; generally two aviculœcia to the aperture of each orthœcium (fig. 108) ...... 4. *R. larvalis.*
- II. More interœcial secondary tissue.
  - *a.* Costæ about 30; asty erect, unilaminar (fig. 109). 5. *R. bidens.*
  - *b.* Costæ about 16; asty erect, bilaminar ...... 6. [*R.*] *incrassata.*

1. Rhacheopora vallata, Lang.

Rhacheopora vallata, sp. n.; Lang, 1916, pp. 398–9; *M. cortestudinarium*-zone; Lewes, Sussex.

Diagnosis.—*Rhacheopora* with œcia about ·66 mm. long; aviculœcia often directed obliquely upwards, proximally, and away from the mid-line of the orthœcium whose aperture they accompany; asty incrusting and unilaminar; without a great amount of interœcial secondary tissue.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·66 mm. long and ·22 mm. wide, long-elliptical; extraterminal front-wall concealed beneath interœcial secondary tissue which often has large median lacunæ, and does not completely fill the interœcial valleys; the intraterminal front-wall is flattish, and consists of about eighteen to twenty-five much-flattened, closely-placed costæ of very unequal widths, with no lateral fusions, but united in a thin median seam; apertural bar resembling the costæ, but a little wider; aperture super-normal to super-cribriline; apertural spines four in number and of moderate size; aviculœcia numerous, generally one or a pair accompanying the aperture of each orthœcium, and additional aviculœcia here and there in the interœcial secondary tissue; tubular, with more-or-less pointed triangular apertures, generally directed obliquely upwards, proximally, and away from the mid-line of the orthœcium they accompany.

Distribution.—Senonian, Coniacian, zone of *M. cortestudinarium*. Sussex and Kent.

Type-specimen.—D. 28302. Offham Hill, Lewes.

Remarks.—*Rhacheopora vallata* is probably a primitive form, which, while retaining a short œcium, gave rise to *R. suta* by becoming erect and cylindrical, and by increasing the amount of interœcial secondary tissue. The other species of *Rhacheopora* belong to a lineage with greater œcial length.

Figures.—Text-fig. 106. Orthœcium and four aviculœcia.

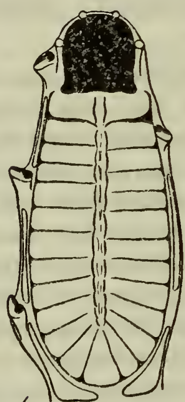
LIST OF SPECIMENS.

D. 28302. Type-specimen. One œcium is of quite abnormal length. Senonian, Coniacian, zone of *M. cortestudinarium*. Pit west of large pit, Offham Hill, Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 28728. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Cliffs between Hope Gap and Cuckmere Haven, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 19508. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Seaford, Sussex. F. Möckler collection. 1910.

D. 4090. Paratype. Senonian, Coniacian, or lowest Santonian. Chatham, Kent. Collected by W. Gamble, Esq. 1898.



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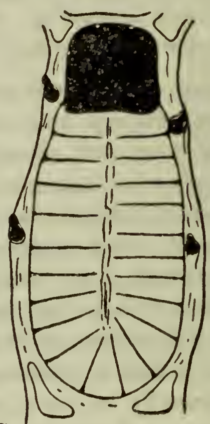

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Fig. 106.—*Rhacheopora vallata.* Diagram of an orthœcium and four aviculœcia, from above. × about 75 diameters.

Fig. 107.—*Rhacheopora suta.* Diagram of an orthœcium and four aviculœcia, from above. × about 75 diameters.

2. Rhacheopora suta, Lang.

Rhacheopora suta, sp. n.; Lang, 1916, pp. 398–9; Lower Senonian; Chatham, Kent.

Diagnosis.—*Rhacheopora* with œcia about ·66 mm. long or less; aviculœcia often directed obliquely upwards, proximally, and away from the mid-line of the orthœcium whose aperture they accompany; asty erect, cylindrical; interœcial secondary tissue very abundant.

Description.—Asty erect, cylindrical; œcia dimorphic; orthœcia about ·66 mm. long or less, and ·33 mm. wide, elliptical; extraterminal front-wall entirely concealed by the abundant interœcial secondary tissue which fills the interœcial valleys and tends to overflow the intraterminal front-walls; it often has elongate, more or less triangular lacunæ; the intraterminal front-wall is much flattened, and consists of about twenty closely-placed, very much flattened costæ of very unequal widths, with no lateral fusions, and united in a thin median seam; the apertural bar resembles the costæ; apertures super-normal to super-cribriline; apertural spines four and of fair size, but immersed on their outer sides in apertural secondary tissue; aviculœcia numerous, generally a pair to the aperture of each orthœcium, though not as a rule symmetrically placed with regard to the aperture, with more or less pointed triangular apertures, often directed obliquely or nearly vertically upwards, proximally, and away from the mid-line of the orthœcium whose aperture they accompany.

Distribution.—Senonian, Coniacian, and Lowest Santonian. Kent and Bucks.

Type-specimen.—**D. 4225.** Chatham, Kent.

Remarks.—*Rhacheopora suta* is evidently a derivative of *R. vallata*, with an erect cylindrical asty, and more interœcial secondary tissue.

Figures.—Text-fig. 107. Orthœcium and four aviculœcia.

Plate VIII, fig. 1. Part of the type-specimen, showing four complete orthœcia and eleven aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 4225. D. 27908. Type-specimen and paratype. Senonian, zone of *M. cortestudinarium* or base of zone of *M. coranguinum.* Chatham, Kent. Collected by W. Gamble, Esq. 1898.

D. 21197–9. Three paratypes. Senonian, top of zone of *M. cortestudinarium* or base of zone of *M. coranguinum.* Great Central Ry.-Cutting, near Loudwater, S.E. of High Wycombe, Bucks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 24410. Senonian, base of zone of *M. coranguinum.* Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

3. [Rhacheopora] obliqua (d'Orbigny).

Semiescharipora obliqua, d'Orb., 1851; d'Orbigny, 1852, pl. 717, figs. 12–15, 1853, p. 481, 1854, p. 1097; Sénonien; Fécamp (Seine Inférieure).

Cribrilina obliqua d'Orb. (*Semiescharipora*); Gamble, 1896, p. 6; Chatham Chalk.

? *Membraniporella obliqua* (d'Orb.); Canu, 1900[2], p. 444; Sénonien.
[?] *Cribrilina obliqua*, d'Orb.; Jukes-Browne, 1904, p. 490; zone of *M. cor-testudinarium*; Charlton, Kent.
Rhacheopora obliqua (d'Orbigny); Lang, 1916, p. 398; Senonian; Fécamp, France.

Diagnosis.—[*Rhacheopora*] with œcia about 1·00 mm. long; with aviculœcia probably tending to be directed towards the mid-line of the orthœcium whose aperture they accompany; with little interœcial secondary tissue; with an erect unilaminar asty; with about 26 costæ; and generally with one aviculœcium accompanying the aperture of each orthœcium.

Distribution.—Senonian [Coniacian]. Fécamp, N.E. of Le Havre, Seine Inférieure, France; and possibly, also, Southern England.

Type-specimen.—That figured by d'Orbigny, 1853, pl. 717, fig. 13, is hereby selected.

Remarks.—It appears probable that d'Orbigny's *Semieschari-pora obliqua* is a *Rhacheopora*; but from his description and figure the detailed characters are not at all clear. It is possible that it is a somewhat primitive form, but of large œcial size, and that it stands at the base of the lineage composed of the species *R. larvalis*, *R. bidens*, and [*R.*] *incrassata*. A specimen in the Collection, **D. 4109**, collected by Mr. W. Gamble from the Lower Senonian of Chatham, possibly belongs to this species.

Specimens.—None in the Collection, unless that just mentioned.

4. Rhacheopora larvalis, Lang.

Rhacheopora larvalis, sp. n.; Lang, 1916, pp. 398–9; Coniacian; Fécamp, France.

Diagnosis.—*Rhacheopora* with œcia about ·8 mm. long; the aviculœcia have sharply-pointed elongate rostra directed towards the mid-line of the orthœcium whose aperture they accompany; there is not much interœcial secondary tissue; costæ 27–30; generally two aviculœcia to the aperture of each orthœcium.

Description.—Asty erect, unilaminar; œcia dimorphic; or-thœcia about ·8 mm. long and ·26 mm. wide, long-elliptical; extraterminal front-wall entirely hidden by interœcial secondary tissue, which is not, however, very abundant, and often contains longitudinal median lacunæ; the intraterminal front-wall is much flattened, and consists of from twenty-seven to thirty flattened, closely-placed costæ of unequal thickness, with no lateral fusions, but united in a thin median seam; apertural bar considerably thicker than an average costa; aperture sub-circular to supernormal; apertural spines four in number and of fair size; aviculœcia numerous, generally a pair accompanying the aperture of every orthœcium, but the aviculœcia composing each pair are generally not arranged symmetrically with regard to the aperture of the orthœcium; they have elongate, pointed rostra, divided by a constriction from the more-or-less circular proximal portion of the aperture.

Distribution.—Senonian, Coniacian. Fecámp, N.E. of Le Havre, Seine Inférieure, France.

Type-specimen.—**D. 28466.**

Remarks.—*Rhacheopora larvalis* is probably to be derived from [*R.*] *obliqua* (if that species is here correctly interpreted), from which it differs chiefly in the greater number of costæ.

Figures.—Text-fig. 108. Orthœcium and three aviculœcia.

Plate VIII, fig. 2. The type-specimen, consisting of two complete orthœcia and four aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

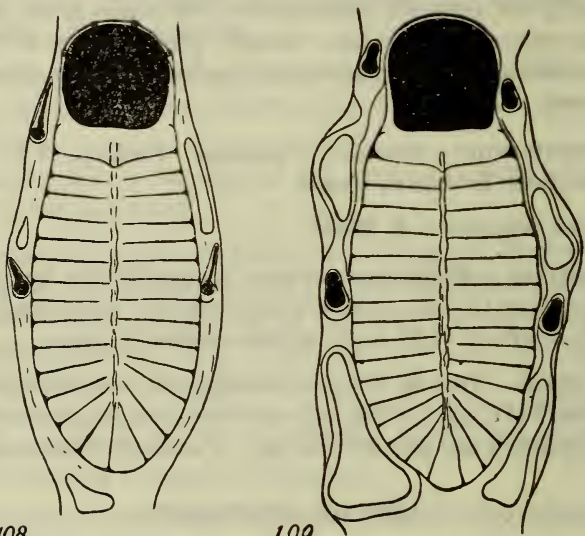
D. 28466. D. 28463–5. Type-specimen and three paratypes. Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France. In exchange with Monsieur F. Canu. 1914.

5. **Rhacheopora bidens**, Lang.

Rhacheopora bidens, sp. n.; Lang, 1916, pp. 398–9; Lower Senonian; Chatham, Kent.

Diagnosis.—*Rhacheopora* whose œcia are about ·8–·9 mm. long; whose aviculœcia, generally a pair accompanying the aperture of every orthœcium, are directed towards the mid-line of the aperture they accompany; with an abundant interœcial secondary tissue; with an erect unilaminar asty.

Description.—Asty erect, unilaminar; œcia dimorphic; orthœcia about ·8–·9 mm. long and ·3–·4 mm. wide, long-elliptical; extraterminal front-wall entirely hidden beneath an abundance of interœcial secondary tissue that tends to overflow the intraterminal front-walls, and has large triangular and elongate lacunæ; the intraterminal front-wall is flattish, and consists of about thirty flattened, closely-placed costæ of unequal widths, with no lateral fusions, and united in a thin median seam; apertural bar about as



108 109

Fig. 108.—*Rhacheopora larvalis.* Diagram of an orthœcium and three aviculœcia, from above. × about 75 diameters.

Fig. 109.—*Rhacheopora bidens.* Diagram of an orthœcium and four aviculœcia, from above. × about 75 diameters.

wide as, or a little wider than, an average costa; apertures supernormal to super-cribriline; apertural spines four in number and of normal size, but swamped by apertural secondary tissue; aviculœcia, generally a pair accompanying the aperture of every orthœcium, but not symmetrically placed with regard to the aperture; with more or less pointed triangular apertures directed towards the mid-line of the orthœcium whose aperture they accompany.

Distribution.—Senonian, Coniacian, or Lowest Santonian. Kent and Sussex.

Type-specimen.—D. 28539. Chatham, Kent.

Remarks.—*Rhacheopora bidens* may have been derived from *R. larvalis*, from which it differs chiefly in the greater development of interœcial secondary tissue. But there is also a slight increase of œcial length and of the number of costæ, as well as an advance in apertural shape.

Figures.—Text-fig. 109. Orthœcium and four aviculœcia.
Plate VIII, fig. 3. Part of the type-specimen, showing five complete orthœcia, parts of two others, and twelve aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 28539. D. 2616. Type-specimen and paratype. Senonian, zone of *M. cortestudinarium* or base of zone of *M. coranguinum*; Chatham, Kent. G. R. Vine collection. 1893. D. 2616 is Vine's No. 70 G.

D. 4086. Paratype. From the same horizon and locality as the type-specimen. Collected by W. Gamble, Esq. 1898.

D. 20596. Paratype. Senonian, zone of *M. cortestudinarium*. Seaford, Sussex. Presented by C. D. Sherborn, Esq., F.G.S. 1911.

6. [Rhacheopora] incrassata (d'Orbigny).

Escharipora incrassata, d'Orb., 1851; d'Orbigny, 1851, pl. 685, figs. 1–4, 1852, p. 223, 1853, p. 1097; Sénonien, Meudon, près de Paris.

(*Eschara*) *Escharipora incrassata*, d'O.; Bronn & Römer, 1851, p. 100, pl. xxix [2], fig. 4 [a copy of d'Orbigny, 1851, pl. 685, figs. 1–3].

Escharipora incrassata, d'Orb.; Pictet, 1857, p. 112, pl. xc, fig. 16; Sénonien, Craie blanche; France.

Eschara incrassata, (d'Orbigny); Stoliczka, 1872, p. 15.

Escharipora incrassata d'Orb.; Canu, 1900 [2], p. 451.

Non = *Cribrilina* (*Decurtaria*) *pentapora* d'Orb.; as stated by Canu, 1900 [2], p. 451. [See *Polycephalopora pentapora* in the following volume.]

Rhacheopora incrassata (d'Orbigny); Lang, 1916, pp. 398–9; Senonian; Meudon, France.

Escharipora incrassata, D'Orb.; Brydone, 1918, p. 1.

Diagnosis.—[*Rhacheopora*] whose œcia are 1·00 mm. or more in length; with much interœcial secondary tissue, about 16 costæ, and an erect bilaminar asty.

Distribution.—Senonian [Campanian]. Meudon, S.W. of Paris.

Type-specimen.—That figured by d'Orbigny, 1851, pl. 685, fig. 3, is hereby selected.

Remarks.—It is very doubtful whether *Escharipora incrassata* is a *Rhacheopora*. Its horizon adds to the doubt, for *Rhacheopora* otherwise is confined to the Coniacian. Except for the number of costæ, which is about sixteen, [*R.*] *incrassata* might be derived from *R. bidens*, having a greater œcial size and a more advanced condition of asty. If this is so, the costæ have undergone catagenesis in respect of number.

Specimens.—None in the Collection.

II. PROSOTOPORA, Lang, 1916.

[*Eschara* [partim]; d'Orbigny, 1850, p. 264.]
[*Eschara*; d'Orbigny [1851], legend to pl. 603, figs. 7–9.]
[*Escharipora* [partim]; d'Orbigny, 1852, p. 221, 1854, p. 1097.]
[*Escharipora* [partim]; Coquand, 1860, p. 181.]
[*Cribrilina* (*Cribrilina*) [partim]; Canu, 1900 [2], p. 447.]
[*Cribrilina* [partim]; Canu in Douvillé, 1910, p. 63.]
Prosotopora, gen. nov.; Lang, 1916, pp. 398–400.
Membraniporella [partim]; Brydone, 1917, pp. 50, 53, 495.

Diagnosis.—Rhacheoporidæ in which there is a dimorphism of the orthœcia correlated with the presence of endozoœcial ovicells; the ovicell-bearing œcia have a modified apertural bar which, in advanced species, constitutes the proximal shield of a secondary aperture; there is a corresponding distal shield in advanced forms, composed of the fused distal pair of apertural spines.

Distribution.—Senonian, zones of *M. cortestudinarium* and *M. coranguinum*. Southern England and Northern France.

Genotype.—*Prosotopora arrecta*.

Remarks.—The simplest forms of *Prosotopora* approximate to *Rhacheopora*, from which genus *Prosotopora* is evidently derived. But even the most primitive species show a slight modification of the apertural bar in those œcia which bear ovicells. Within the genus evolution is seen in the intensifying of this dimorphism and the development of a secondary aperture in the ovicell-bearing œcia, in the increase in size of the orthœcia, in the number of the costæ, in the amount of interœcial secondary tissue, and in the change of habit and condition of the asty. The known species, however, do not appear to be directly connected. It is probable that *P. tæniata* and *P. flacca* are allied, but the former in its dimorphic aviculœcia and in their disposition appears to be more primitive than the latter with trimorphic aviculœcia, yet it comes from a horizon several zones higher than that of *P. flacca*. It is very doubtful whether [*P.*] *neptuni* belongs to the genus; but, if so, it may have been derived from *P. bicornis*. Each of the species *P. bicornis*, *P. flacca*, and *P. arrecta* has its own developmental peculiarities. *P. bicornis* has many costæ with a poorly-developed dimorphism. *P. arrecta* is by far the most highly-developed of the three species in all the main characters, except the trimorphism of aviculœcia which characterises *P. flacca*. The last-mentioned species is the most primitive in all other characters, but has trimorphic aviculœcia. The three species, therefore, belong to as many different lineages.

Key to the Species of *Prosotopora*.

A. Spines of the distal apertural pair do not fuse or form the distal shield of a secondary aperture; dimorphism of the orthœcia not strongly marked.

I. Aviculœcia strongly dimorphic or trimorphic.

a. Costæ about 20; œcial length about ·85 mm.; many larger aviculœcia, each with a smaller one at its proximal end; also an occasional large aviculœcium of a third size (fig. 110) .... 1. *P. flacca*.

b. Costæ more than 20; œcial length 1·2 mm.–1·3 mm.; comparatively few larger aviculœcia, but very many smaller ones irregularly distributed .... 2. *P. tæniata*.

II. Aviculœcia not markedly dimorphic.

a. Costæ about 30; œcial length about ·9 mm.; asty incrusting, unilaminar (fig. 111) .... 3. *P. bicornis*.

b. Costæ about 40; asty erect, bilaminar .... 4. [*P.*] *neptuni*.

B. Spines of the distal apertural pair fuse one with another and, in those orthœcia which bear ovicells, form a wide distal shield: dimorphism of the orthœcia strongly marked; aviculœcia monomorphic; costæ about 20; œcial length about ·9 mm.; asty erect, cylindrical (fig. 112) .... 5. *P. arrecta*.

1. Prosotopora flacca *, new species.

Diagnosis.—*Prosotopora* in which the apertural spines, though somewhat thickened, do not take a prominent part in the formation of a secondary aperture, and those of the distal pair do not fuse to form a distal shield; the aviculœcia are markedly trimorphic, two of the three kinds being equally numerous, the smaller being placed on the proximal ends of the larger; costæ about 20; œcial length about ·85.

Description.—Asty incrusting, unilaminar; œcia dimorphic, the orthœcia being again dimorphic and the aviculœcia trimorphic, the former slightly and the latter markedly so; orthœcia of both kinds about ·85 mm. long and ·35–·4 mm. wide, elliptical; extraterminal front-wall concealed by aviculœcia and interœcial secondary tissue; the latter is poorly developed and has large median lacunæ; the intraterminal front-wall is flatly arched, and consists of about twenty flattened, closely-placed costæ of unequal widths, with no lateral fusions, but united in a thin median seam; the apertural bar is thicker than an average costa and is sharply bent proximally in those œcia without ovicells, and less sharply bent in those bearing ovicells; apertures of those œcia without ovicells, pliophlœan; of those with ovicells, cribriline to slightly pliophlœan; apertural spines four, rather thick, but becoming obliterated with the upgrowth of apertural secondary tissue; aviculœcia trimorphic, (*a*) a larger prominent kind arranged in pairs more or less symmetrically, one on each side of the aperture of every orthœcium; the rostra of this kind are elongate, pointed, and directed obliquely, distally, and towards the mid-line of the orthœcium whose aperture they accompany; proximally, the aviculœcian aperture is rounded, with a wide, shelf-like, depressed intraterminal front-wall; on the proximal part of what appears to be an extensive extraterminal front-wall of each of the larger aviculœcia is situated (*b*) one of the smaller kind—the apertures of these are sub-circular or oval, and blunt, directed as the aperture of the larger aviculœcia they accompany, but turned rather more towards the mid-line of the orthœcium they accompany; (*c*) often lying between the smaller kind and the œcium they accompany are squeezed the apertures of a third, low-lying and inconspicuous kind, shaped like those of

* With "drooping" aviculœcia, contrasted with those of *P. arrecta*.

the larger kind, but somewhat smaller than them; ovicells endozoœcial.

Distribution.—Senonian, zone of *M. coranguinum*. Quidhampton, N.W. of Salisbury, Wilts.

Type-specimen.—D. 29068.

Remarks.—*Prosotopora flacca*, except for its aviculœcia, is the most primitive species of *Prosotopora*; the small difference between the ovicell-bearing orthœcia and those without them, and the correlated poor development of a secondary aperture, the small number of costæ, and the small amount of interœcial secondary tissue, are all primitive characters. On the other hand, the trimorphism of the aviculœcia is probably a secondary development, and makes it unlikely that *P. flacca* is a radical species from which *P. bicornis* and *P. arrecta* were derived.

Figures.—Text-fig. 110. (*a*) Orthœcium without an ovicell, four larger prominent and four smaller aviculœcia; (*b*) aperture and ovicell of an ovicell-bearing orthœcium and two aviculœcia.

Plate VIII, fig. 4. Part of the type-specimen showing three complete and one incomplete ovicell-bearing orthœcia; one complete orthœcium without an ovicell (on the right), and an incomplete orthœcium with no ovicell (below); eleven large raised aviculœcia; nine small aviculœcia; and five large low-lying aviculœcia. × about 27 diameters.

LIST OF SPECIMENS.

D. 29068. D. 29065–7. Type-specimen and paratypes. Senonian, zone of *M. coranguinum*. Quidhampton, N.W. of Salisbury, Wilts. Presented by Dr. H. P. Blackmore, F.G.S., 1897.

2. Prosotopora tæniata (Brydone).

Membraniporella tæniata, sp. nov.; Brydone, 1917, pp. 50, 53, 495, pl. iii, figs. 3, 4; zone of *A. quadratus*, subzone of *A. quadratus*; Hants.

Diagnosis.—*Prosotopora* in which the apertural spines do not take a prominent part in the formation of a secondary aperture, and those of the distal pair do not fuse to form a distal shield; the aviculœcia are markedly dimorphic, the larger being comparatively few, and the smaller very numerous and not placed in any definite position with regard to the larger; costæ more than 20; œcial length 1·2–1·3 mm.

Distribution.—Senonian, Campanian, zone of *A. quadratus*, subzone of *A. quadratus*. Hants.

Type-specimen.—That figured by Brydone, 1917, pl. iii, fig. 3, is hereby selected.

Remarks.—At first sight *Prosotopora tæniata* so closely resembles *P. flacca* that there is no doubt of their close relationship; and, although in Brydone's figure of the former species endozoœcial ovicells and correlated dimorphism of the apertural bar

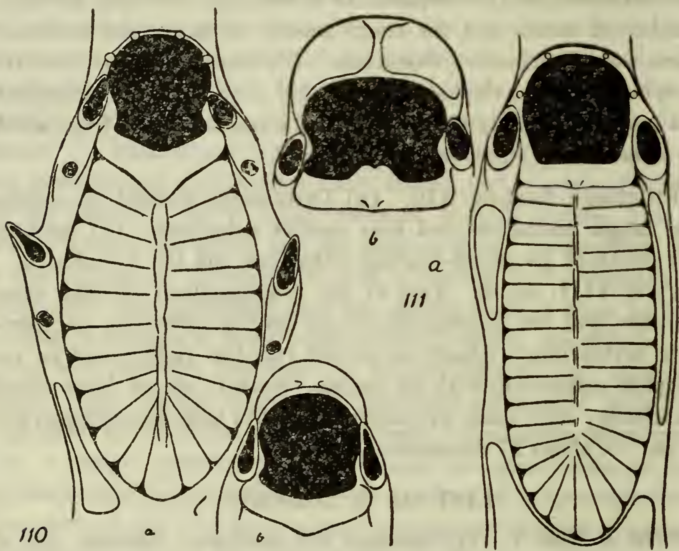


Fig. 110.—*Prosotopora flacca.* Diagrams (*a*) of an orthœcium without an ovicell, four larger prominent, and four smaller aviculœcia; and (*b*) of the aperture and ovicell of an ovicell-bearing orthœcium, and two aviculœcia, from above. × about 75 diameters.

Fig. 111.—*Prosotopora bicornis.* Diagrams (*a*) of an orthœcium without an ovicell, and two aviculœcia; and (*b*) of the aperture and ovicell of an ovicell-bearing orthœcium, and two aviculœcia, from above. × about 75 diameters.

cannot be clearly perceived, yet, considering how inconspicuous and even hardly visible endozoœcial ovicells can be, it is exceedingly probable that they occur on most of the figured œcia of *P. tæniata*; and that such an orthœcium as that on the extreme right, above the figure "3," with its comparatively bent apertural bar has no ovicell, while that in the lower right-hand corner, with a comparatively straight apertural bar, bears an ovicell.

But important differences between the species are revealed in the relative number, position, and heteromorphism of the aviculœcia. The definite position of the paired larger aviculœcia in relation to the apertures of the orthœcia, and the constant position of a smaller aviculœcium on the proximal end of each larger aviculœcium, as well as a third kind of aviculœcium, suggest that *P. flacca* is a more specialised form than *P. tæniata* with its few sporadically distributed larger and numerous smaller aviculœcia. Yet *P. flacca* (unless some mistake has been made) was found in the *M. coranguinum*-zone, while *P. tæniata* occurs as high as the subzone of *A. quadratus* in the *A. quadratus* zone.

Specimens.—None in the Collection.

3. Prosotopora bicornis, Lang.

Prosotopora bicornis, sp. n.; Lang, 1916, pp. 399, 400; *M. cortestudinarium*-zone; Luton, S.E. of Chatham, Kent.

Diagnosis.—*Prosotopora* in which the apertural spines do not keep pace with the growth of secondary apertural tissue, and consequently are not prominent, but contrariwise difficult to see, nor do those of the distal pair fuse; aviculœcia monomorphic; œcial length about ·9 mm.; costæ about 30; asty incrusting (or, possibly erect), unilaminar.

Description.—Asty incrusting (or, possibly, erect), unilaminar; œcia dimorphic; orthœcia themselves dimorphic, since the presence of an ovicell modifies the form of the apertural bar and the aperture; they are about ·9 mm. long and ·3 mm.–·4 mm. wide, long-elliptical; extraterminal front-wall entirely hidden by interœcial secondary tissue which is abundant, but has wide median lacunæ, especially proximally; the intraterminal front-wall is much flattened, and consists of about thirty very closely-placed flattened costæ of varying widths, with no lateral fusions, and united in a thin median seam; the apertural bar is wider than the average costa, and, in œcia without ovicells, has a small median tubercle, but, in œcia with ovicells, it bears a wide median process flattened in a transverse plane, and clearly consisting of right and left halves; aperture super-normal to super-cribriline in those œcia without ovicells, and widely cribriline in the ovicell-bearing œcia ; apertural spines four, not enlarged, and tending to be swamped by secondary tissue growing up around the aperture; aviculœcia numerous, small, a pair more or less symmetrically placed with regard to the aperture of every orthœcium, directed obliquely upwards, distal-wards, and towards the mid-line of the orthœcium whose aperture they accompany; the more or less semicircular proximal portion of the aperture is not divided by any constriction from the pointed triangular rostrum, but has a wide, depressed, shelf-like intraterminal front-wall ; ovicells endozoœcial.

DISTRIBUTION. — Senonian, Coniacian, and lowest Santonian; zones of *M. cortestudinarium* and *M. coranguinum*. Southern England and Northern France.

TYPE-SPECIMEN.—**D. 24388.** Senonian, zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent.

REMARKS.—*Prosotopora bicornis* is probably on a different lineage from *P. arrecta*; for, while its greater œcial size and number of costæ probably indicate a condition in advance of that species, the secondary aperture of *P. arrecta* is more complex than that of *P. bicornis* owing to the enlargement and modification of the distal pair of apertural spines. It is possible that *P. bicornis* gave rise to [*P.*] *neptuni*.

FIGURES.—Text-fig. 111. (*a*) Orthœcium without an ovicell, and two aviculœcia; (*b*) aperture and ovicell of an ovicell-bearing orthœcium, and two aviculœcia.

Plate VIII, fig. 5. Part of the type-specimen, showing three complete orthœcia, parts of three others, and eleven aviculœcia. The lowest complete orthœcium and the partial orthœcium on its right bear ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 24388. D. 24387. D. 24389. Type-specimen and paratypes. Senonian, Coniacian, zone of *M. cortestudinarium*. Luton, S.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911.

D. 488. D. 2617. D. 2635. D. 2815–6. D. 4031. D. 4037. D. 4101–2. D. 4218. D. 4977. D. 11120. D. 11139. D. 11363. D. 29082. Fifteen paratypes. Senonian, zone of *M. cortestudinarium* or base of zone of *M. coranguinum*. Chatham, Kent. G. R. Vine and W. Gamble collections. 1893, 1898, 1901, 1910.

D. 25548–51. Four paratypes. Senonian, Coniacian, zone of *M. cortestudinarium.* Nash Mills, S.E. of Boxmoor, Herts. F. Möckler collection. 1912.

D. 27038. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Lower Pit, Sline's Oak, Worms Heath, Warlingham, Surrey. F. Möckler collection. 1912.

D. 20595. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Seaford, Sussex. Presented by C. D. Sherborn, Esq., F.G.S. 1911.

D. 20188. Paratype. From the same horizon and locality as D. 20595. Purchased of F. Butler. 1910.

D. 28301. Paratype. Senonian, Coniacian, zone of *M. cortestudinarium.* Pit west of large pit, Offham Hill, Lewes, Sussex. Collected by C. T. A. Gaster, Esq., and presented by him, 1915.

D. 21193–5. Three paratypes. Senonian, top of zone of *M. cortestudinarium,* or base of zone of *M. coranguinum.* Great Central Ry.-cutting near Loudwater, S.E. of High Wycombe, Bucks. Collected by R. Treacher, Esq., F.G.S. 1911.

D. 21196. Paratype. Senonian, Santonian, low in zone of *M. coranguinum.* Cookham Dean Common, N.W. of Maidenhead, Berks. Collected by L. Treacher, Esq., F.G.S. 1911.

D. 8131. D. 24409. D. 24608–9. Four paratypes. Senonian, Santonian, low in the zone of *M. coranguinum.* Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1903, 1911.

D. 28459. Paratype, Senonian, Coniacian. Fécamp, N.E. of Le Havre, Seine Inférieure, France. In exchange with Mr. F. Canu. 1914.

4. [Prosotopora] neptuni (d'Orbigny).

Eschara Neptuni, d'Orb., 1850; d'Orbigny, 1850, p. 264; Sénonien; Tours.

Eschara Neptunii, d'Orb.; d'Orbigny [1851], legend to pl. 603, figs. 7–9.

Escharipora neptuni, d'Orb., 1851; d'Orbigny, 1851, pl. 684, fig. 12, 1852, p. 221, 1854, p. 1097; craie sénonienne avec l'*Ostrea vesicularis*; Royan (Charente-Inférieure).

Escharipora Neptuni, d'Orb.; Coquand, 1860, p. 181; Campanien; Royan.

Cribrilina (Cribrilina) Neptuni d'Orb.; Canu, 1900², p. 447.

[Non=*Eschara pupoides,* n. sp.; Reuss, 1872, p. 107, pl. xxvi, fig. 5; untere Pläner; Plauen; suggested as possibly identical by Canu, 1900², p. 447.]

Cribrilina Neptuni (d'Orb.); Canu in Douvillé, 1910, p. 63; Maëstrichtien; Royan.

Prosotopora neptuni (d'Orbigny); Lang, 1916, p. 399; Senonian; Royan.

Diagnosis. — [*Prosotopora*] in which the apertural spines apparently do not take a prominent part in the formation of a secondary aperture, nor, apparently, do those of the distal pair fuse; about 40 costæ; asty erect, bilaminar.

Distribution.—Senonian [Campanian]; Royan, S. of Rochfort, Charente Inférieure, France.

Type-specimen.—That figured by d'Orbigny, 1851, pl. 684, fig. 12, is hereby selected.

Remarks.—If a *Prosotopora*, [*P.*] *neptuni* may have been derived from *P. bicornis* by attaining an erect bilaminar asty and by greatly increasing the number of costæ. D'Orbigny's description and figure, however, leave the determination of this species very uncertain; and the locality—Royan—makes it probable that the horizon is at least as high as the *B. mucronata*-zone, while the other species of *Prosotopora* (except the *A. quadratus*-zone *P. tæniata*) occur in the Coniacian and lower Santonian.

Specimens.—None in the Collection.

5. Prosotopora arrecta, Lang.

Prosotopora arrecta, sp. n.; Lang, 1916, pp. 399, 400; *M. coranguinum*-zone; Gillingham, N.E. of Chatham, Kent.

Diagnosis.—*Prosotopora* in which the apertural spines of the distal pair fuse one with another, and in the ovicell-bearing œcia are expanded laterally to form a wide distal shield; in the ovicell-bearing œcia, too, the double median process of the apertural bar is laterally-expanded and forms the proximal shield of a secondary aperture; œcial length about ·9 mm.; costæ about 19; asty erect, cylindrical; interœcial secondary tissue abundant; aviculœcia monomorphic.

Description.—Asty erect, cylindrical; œcia dimorphic; the orthœcia themselves being markedly dimorphic in correlation with the presence or absence of ovicells; orthœcia are about ·9 mm. long and ·3–·35 mm. wide, elliptical; extraterminal front-wall entirely hidden by interœcial secondary tissue which is very abundant, tends to overflow the intraterminal front-walls, and occasionally has rather narrow median lacunæ; the intraterminal front-wall is flattish, and consists of about nineteen flattened closely-placed costæ, of rather variable width, with no lateral fusions, and united in a thin median seam; the apertural bar is considerably wider than an average costa, and has a stout double median process; in œcia which do not bear ovicells, the process is comparatively narrow; but in those with ovicells it is very wide, flattened, and forms the proximal shield of a secondary aperture; the ends of the process appear more or less broken, suggesting that they may have been fused to some other structure (as in *Diancopora*); the apertures are cribriline in œcia without ovicells, and sub-semicircular in those with them; apertural spines four; the proximal pair grows alongside, and finally is swamped by, a pair of apertural aviculœcia; those of the distal pair fuse and, in those œcia which have ovicells, expand to form a broad distal shield lying above the ovicell and distal to its aperture; aviculœcia in pairs, one pair accompanying the aperture of every orthœcium, and symmetrically placed with regard to this aperture; arrect, that is borne on pedestal-like projections, and with pointed apertures obliquely and upwardly directed; the apertures are, moreover, obliquely and distally directed, turning towards the mid-line of the orthœcium whose aperture they accompany; the proximal, more or less circular portion of the aperture has a wide, depressed, shelf-like intra-terminal front-wall.

Distribution.—Senonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent.

Type-specimen.—**D. 8134.**

Remarks.—*Prosotopora arrecta* is more advanced in most particulars than *P. bicornis*, but the number of costæ is fewer, and, unless this is catagenetic, it is likely that *P. arrecta* is not descended from *P. bicornis*, but from a more primitive form.

Figures.—Text-fig. 112. (*a*) Orthœcium without an ovicell, and two aviculœcia; (*b*) aperture and ovicell of an ovicell-bearing orthœcium, and two aviculœcia.

Plate VIII, fig. 6. Part of the type-specimen, showing four complete orthœcia, parts of five others, and fourteen aviculœcia. Two of the complete orthœcia and the partial one in the right-hand lower corner bear ovicells. × about 27 diameters.

LIST OF SPECIMENS.

D. 8134. D. 24515. D. 24536–7. Type-specimen and three paratypes. Senonian, Santonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1903, 1911.

III. GEISOPORA, Lang, 1916.

Geisopora, gen. nov.; Lang, 1916, pp. 400, 401.

Diagnosis.—Rhacheoporidæ in which all the orthœcia are similarly modified towards a secondary aperture; a proximal shield is formed by a general upward growth of the flattened apertural bar; the distal shield is poorly developed and formed by a general upward growth of apertural secondary tissue.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen.

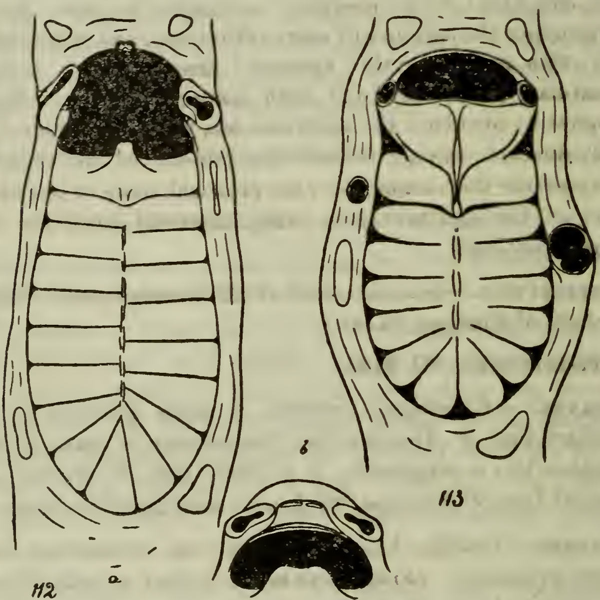


Fig. 112.—*Prosotopora arrecta*. Diagrams (*a*) of an orthœcium without an ovicell, and two aviculœcia, and (*b*) of the aperture and ovicell of an ovicell-bearing orthœcium, and two aviculœcia, from above. × about 75 diameters.

Fig. 113.—*Geisopora protecta*. Diagram of an orthœcium, two apertural aviculœcia, and a smaller and a larger sporadic aviculœcium, from above. × about 75 diameters.

Genotype.—*Geisopora protecta*.

Remarks.—*Geisopora* is best placed among the Rhacheoporidæ; but its systematic position is not free from doubt. Both in structure and in horizon it is considerably removed from *Rhacheopora* and the other Rhacheoporid genera, and retains but a feeble remnant of the characteristic median seam; the costæ are few for a Rhacheoporid, and some of the aviculœcia attain a considerable size; ovicells have not been observed. Otherwise the genus has a Rhacheoporid aspect, and may provisionally be considered as a derivative of *Rhacheopora*.

1. Geisopora protecta, Lang.

Geisopora protecta, sp. n.; Lang, 1916, p. 401; *B. mucronata*-zone: Rügen, Germany.

Diagnosis.—As for the genus.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·7 mm. long and ·35 mm. wide, elliptical; extra-terminal front-wall entirely concealed beneath interœcial secondary tissue, which is greatly developed and tends to overflow the intraterminal front-walls; the intraterminal front-wall is flattish, and consists of about twelve very wide, flattened, closely-placed costæ without lateral fusions and united in a median band of fusion with a rather feebly developed median seam; apertural bar very wide, and produced vertically to form the proximal shield of a secondary aperture; the secondary aperture is circular, and its rim is closed laterally by the apertural aviculœcia, and distally by a general upgrowth of apertural secondary tissue; aviculœcia (1) a small pair involved in the apertural rim; (2) small sporadic aviculœcia enveloped in the interœcial secondary tissue; (3) larger sporadic aviculœcia with more or less circular apertures, some about half the size of the apertures of the orthœcia.

Distribution.—Senonian, Campanian, zone of *B. mucronata*. Rügen I.

Type-specimen.—**D. 15421.** Frau Agnes Laur collection. 1909.

Remarks.—See remarks under the genus *Geisopora*.

Figures.—Text-fig. 113. Orthœcium, two apertural aviculœcia, and a smaller and a larger sporadic aviculœcium.

Plate VIII, fig. 7. The type-specimen, consisting of six more-or-less complete orthœcia, and about a dozen aviculœcia of various sizes. × about 27 diameters.

Specimens.—Type-specimen. Distribution and collection as above.

IV. DIANCOPORA, Lang, 1916.

Diancopora, gen. nov.; Lang, 1916, pp. 398, 400.

Diagnosis.—Rhacheoporidæ in which all the orthœcia have the proximal shield of a secondary aperture; it is formed by fusion of a median process of the apertural bar with the proximal pair of apertural spines; what there is of a distal shield is formed by a general upgrowth of apertural tissue involving the distal pair of apertural spines.

Distribution.—Senonian, zone of *M. cortestudinarium* or base of zone of *M. coranguinum*. Chatham, Kent.

Genotype.—*Diancopora ancora*.

Remarks.—*Diancopora* may be derived from *Rhacheopora*, or even from a primitive *Prosotopora*, by the acquisition of a secondary aperture by all the orthœcia. The distal shield, however, is not formed as in *Prosotopora arrecta* by the fusion and expansion of the distal pair of apertural spines, but by the general upgrowth of secondary tissue in the neighbourhood of the spines, which become involved in it.

1. Diancopora ancora, Lang.

Diancopora ancora, sp. n.; Lang, 1916, p. 400; Lower Senonian; Chatham, Kent.

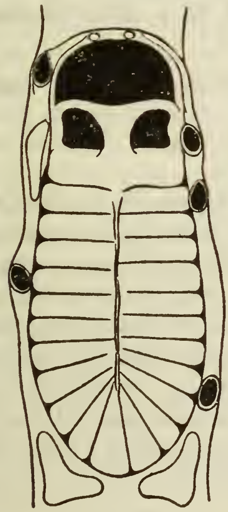
Diagnosis.—As for the genus.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·8 mm. long and 3 mm. wide, elliptical; extraterminal front-wall of small extent and much obscured by aviculœcia and a scanty interœcial secondary tissue with large median lacunæ; the intraterminal front-wall is flattish, and consists of twenty-two, or more, closely-placed, flattened costæ of varying widths, with no lateral fusions, and united in a thin median seam; the apertural bar is considerably thicker than an average costa and bears a wide median process which fuses with the proximal pair of apertural spines to form the proximal shield of a secondary aperture; the apertures are cribriline; the apertural spines are four in number, the proximal pair fused to the median process of the apertural bar, and the distal pair distinct, but tending to be involved in the general upward growth of secondary tissue in its neighbourhood; the aviculœcia are very numerous, irregularly disposed in the interœcial secondary tissue, and often one grows up alongside each apertural spine of the proximal pair; the apertures are more or less pointed, and distally and upwardly directed.

Distribution.—Senonian, zone of *M. cortestudinarium* or base of zone of *M. coranguinum*. Chatham, Kent.

Type-specimen.—D. 4035.

Remarks.—See under the genus *Diancopora*.



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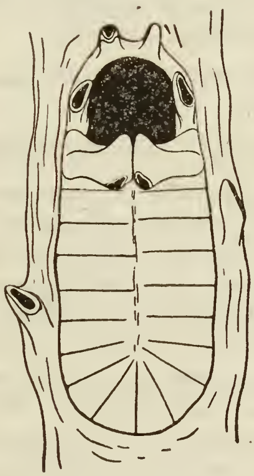

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Fig. 114.—*Diancopora ancora*. Diagram of an orthœcium and five aviculœcia, from above. × about 75 diameters.

Fig. 115.—*Diceratopora bivia*. Diagram of an orthœcium with its six apertural aviculœcia and two sporadic aviculœcia, from above. × about 75 diameters.

Figures.—Text-fig. 114. Orthœcium and five aviculœcia.

Plate VIII, fig. 8. Part of the type-specimen, showing five complete orthœcia, parts of two others, and about a dozen aviculœcia. The fusion of the apertural bar with the proximal apertural spines is shown in the lowest complete orthœcium. × about 27 diameters.

LIST OF SPECIMENS.

D. 4035. D. 4025. Type-specimen and paratype. Senonian, zone of *M. cortestudinarium* or base of *M. coranguinum*. Chatham, Kent, Collected by W. Gamble, Esq. 1898.

V. DICERATOPORA, Lang, 1916.

Diceratopora, gen. nov.; Lang, 1916, pp. 398, 400.

Diagnosis.—Rhacheoporidæ in which all the orthœcia have a secondary aperture, of which the proximal shield is formed by a pair of aviculœcia, which fuse hoop-wise over the undifferentiated apertural bar; the imperfect distal shield consists of a second pair of aviculœcia, which replace the distal apertural spines; the secondary apertural rim is imperfectly completed by a third, intermediate pair of apertural aviculœcia.

Distribution.—Senonian, zone of *M. coranguinum*. Southern England.

Genotype.—*Diceratopora bivia*.

Remarks.—In *Prosotopora* and *Geisopora* the proximal shield of the secondary aperture, in so far as it is developed, consists of an upward growth of the apertural bar, and in *Diancopora* this bar, in the form of a median process, fuses with the proximal pair of apertural spines. In *Diceratopora*, on the other hand, the proximal shield is formed entirely of a pair of aviculœcia that fuse hoop-wise over the apertural bar, and the bar itself takes no part in the formation of a secondary aperture. The Rhacheoporid genera *Diancopora* and *Diceratopora* bear respectively to *Rhacheopora* a relation analogous to that borne by *Sandalopora* and *Ichnopora* to *Pelmatopora* in the Pelmatoporidæ, as far as the architecture of the proximal shield is concerned (Introd., § 25 and table). This relation, however, does not hold for the distal shield.

1. Diceratopora bivia, Lang.

Diceratopora bivia, sp. n.; Lang, 1916, p. 400; *M. coranguinum*-zone; Gillingham, N.E. of Chatham, Kent.

Diagnosis.—As for the genus.

Description.—Asty incrusting, unilaminar; œcia dimorphic; orthœcia about ·7–·8 mm. long and about ·35–·4 mm. wide, elliptical; extraterminal front-wall entirely hidden beneath a most abundant interœcial secondary tissue, which is piled over the interœcial valleys, converting them into high interœcial ridges, with occasional shallow median lacunæ, so that the summits of the ridges lie far above the level of the intraterminal front-walls; the intraterminal front-walls are flat, and consist of about fifteen to eighteen closely-placed flattened costæ, without lateral fusions, and united in a thin median seam; apertural bar considerably wider than a normal costa, flat and plain, or with a very slight median ridge (the continuation of the median seam); primary aperture cribriline; apertural spines obliterated by apertural secondary tissue, which, in conjunction with three pairs of aviculœcia, rises up round the primary aperture to form a secondary aperture; aviculœcia very numerous, consisting of three pairs accompanying the aperture of every orthœcium, and an occasional pair in the interœcial secondary tissue; the aviculœcia are small, carried upon long pillar-like bases, with more-or-less triangular pointed apertures, which are obliquely and upwardly directed; the most proximal of the three apertural pairs is larger than the others, and its more-or-less vertically-directed apertures are borne medianly on the proximal face of the hoop formed by the elongate bases which are much flattened and, bending towards one another, fuse above the apertural bar; the apertures are also inclined towards the mid-line of the orthœcium whose aperture they accompany, so that the aperture of each member of the pair is directed towards its fellow.

Distribution.—Senonian, Santonian, zone of *M. coranguinum*. Southern England.

Type-specimen.—**D. 24534.** Gillingham, N.E. of Chatham, Kent.

Remarks.—See under the genus *Diceratopora*.

Figures.—Text-fig. 115. Orthœcium with its six apertural aviculœcia and two sporadic aviculœcia.

Plate VIII, fig. 9. Four complete orthœcia of the type-specimen, each with its aperture surrounded by four aviculœcia (though in some cases one or more is broken away) as well as the pair forming a hoop over the apertural bar. Several sporadic aviculœcia also are shown. × about 27 diameters.

LIST OF SPECIMENS.

D. 24534. D. 24535. D. 8295. Type-specimen and paratypes. Senonian, Santonian, zone of *M. coranguinum*. Gillingham, N.E. of Chatham, Kent. Collected by W. Gamble, Esq. 1911, 1905.

D. 21192. Paratype. Senonian, Santonian, zone of *M. coranguinum*. Bedwyn Station, Wilts, S.W. of Hungerford, Berks. L. Treacher collection. 1911.

INDEX TO SYSTEMATIC NAMES OF POLYZOA.

Numbers in Clarendon type refer to the main account in the systematic portion.

GENERAL INDEX.

Numbers in Clarendon type refer to the page where the term in question is defined.

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PLATE I.

Fig. 1. *Myagropora muscipula* (pp. 18–20). Zone of *M. cortestudinarium*. Boxmoor. × about 22 diam.

Fig. 2. *Anaptopora disjuncta* (pp. 22–24). Chalk Marl. Cambridge. × about 27 diam.

Fig. 3. *Anotopora inaurita* (pp. 26–27). Chalk Marl. Cambridge. × about 27 diam.

Fig. 4. *Otopora auricula* (pp. 28–29). Chalk Marl. Cambridge. × about 28 diam.

Fig. 5. *Ctenopora pecten* (pp. 30–32). Chalk Marl. Cambridge. × about 27 diam.

Fig. 6. *Thoracopora costata* (pp. 35–36). On p. 36 'left' should read 'right.' Lower Senonian. Luton, Chatham. × about 29 diam.

Fig. 7. *Taractopora confusa* (pp. 38–40). Zone of *M. cortestudinarium*. Boxmoor. × about 29 diam.

Fig. 8. *Hexacanthopora sexspinosa* (pp. 45–47). Zone of *Marsupites*. Odiham. × about 30 diam.

Fig. 9. *Hexacanthopora kintburiensis* (pp. 47–48). Zone of *A. quadratus*. Kintbury. × about 25 diam.

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PLATE I.

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PLATE II.

Fig. 1. *Prodromopora præcursor* (p. 51). Zone of *M. coranguinum.* Gillingham, Chatham. × about 25 diam.

Fig. 2. *Lagynopora birlingensis* (pp. 55–56). Zone of *M. coranguinum.* W. of Beachy Head. × about 27 diam.

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Fig. 8. *Leptocheilopora arcuata* (pp. 74–76). Zone of *A. quadratus.* Brighton. × about 30 diam.

Fig. 9. *Leptocheilopora magna* (pp. 77–78). Zone of *B. mucronata.* Lüneburg. × about 23 diam.

Plate II.

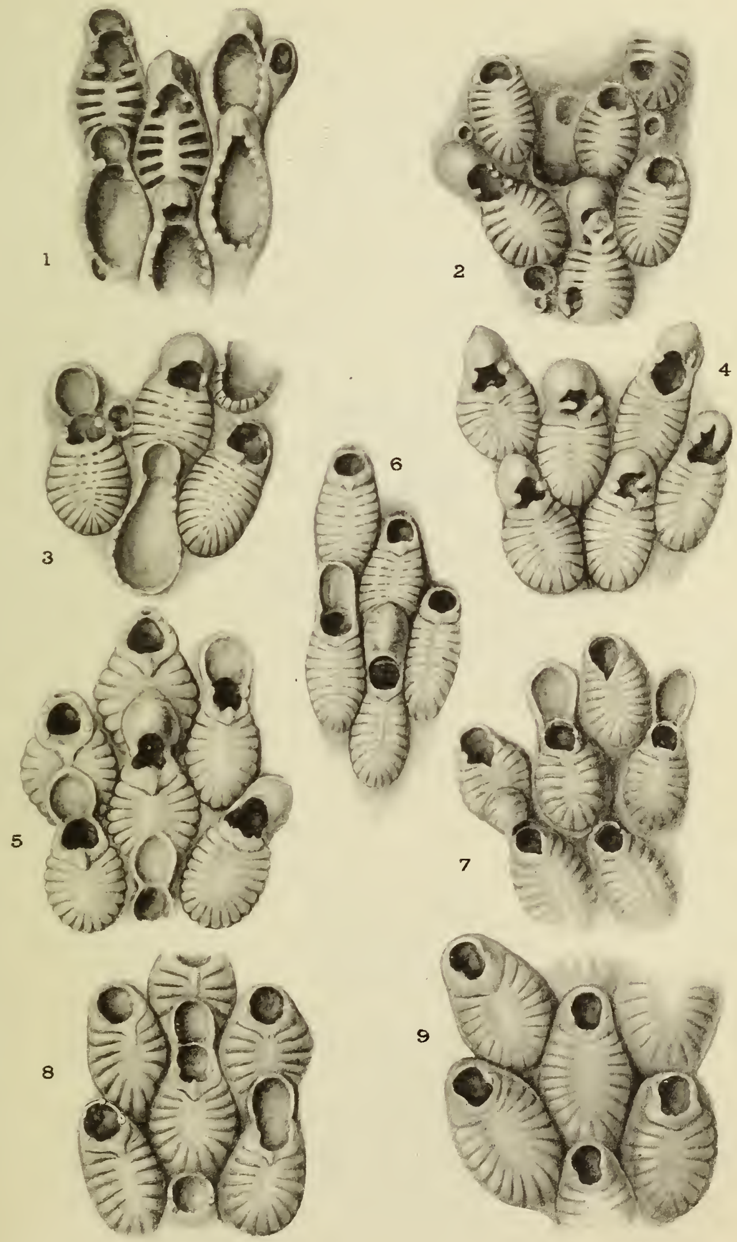

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PLATE III.

All × about 27 diameters.

Fig. 1. *Andriopora mockleri* (pp. 94–95). Chalk Marl. Cambridge.

Fig. 2. *Andriopora arion* (pp. 95–97). Zone of *M. cortestudinarium.* Nash Mills, Boxmoor.

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Fig. 8. *Andriopora aggregata* (pp. 107–8). Zone of *B. mucronata.* Rügen.

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Fig. 12. *Argopora segnis* (p. 114). Lower Senonian. Chatham.

Fig. 13. *Angelopora nuntia* (pp. 118–19). Zone of *M. coranguinum.* Wooburn Green.

Fig. 14. *Angelopora missa* (pp. 120–21). Subzone of *E. scutatus,* var. *depressa.* E. of Brighton.

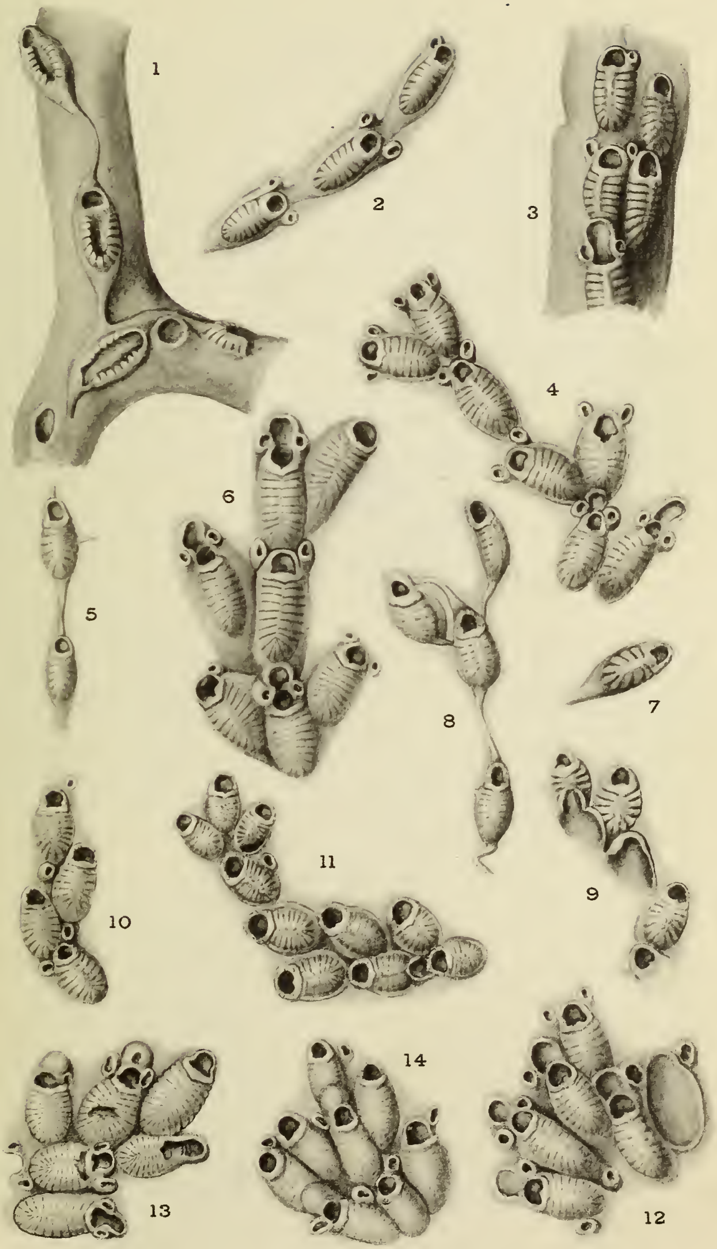

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PLATE IV.

All × about 27 diameters.

Fig. 1. *Corymboporella religata* (pp. 125–26). Cenomanian. Kaňk, Bohemia.

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Fig. 10. *Eucheilopora labiosa* (pp. 146–47). Zone of *M. cortestudinarium*. Lewes, Sussex.

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Fig. 12. *Eucheilopora crassescens* (pp. 149–51). Zone of *M. cortestudinarium*. Cuckmere Haven.

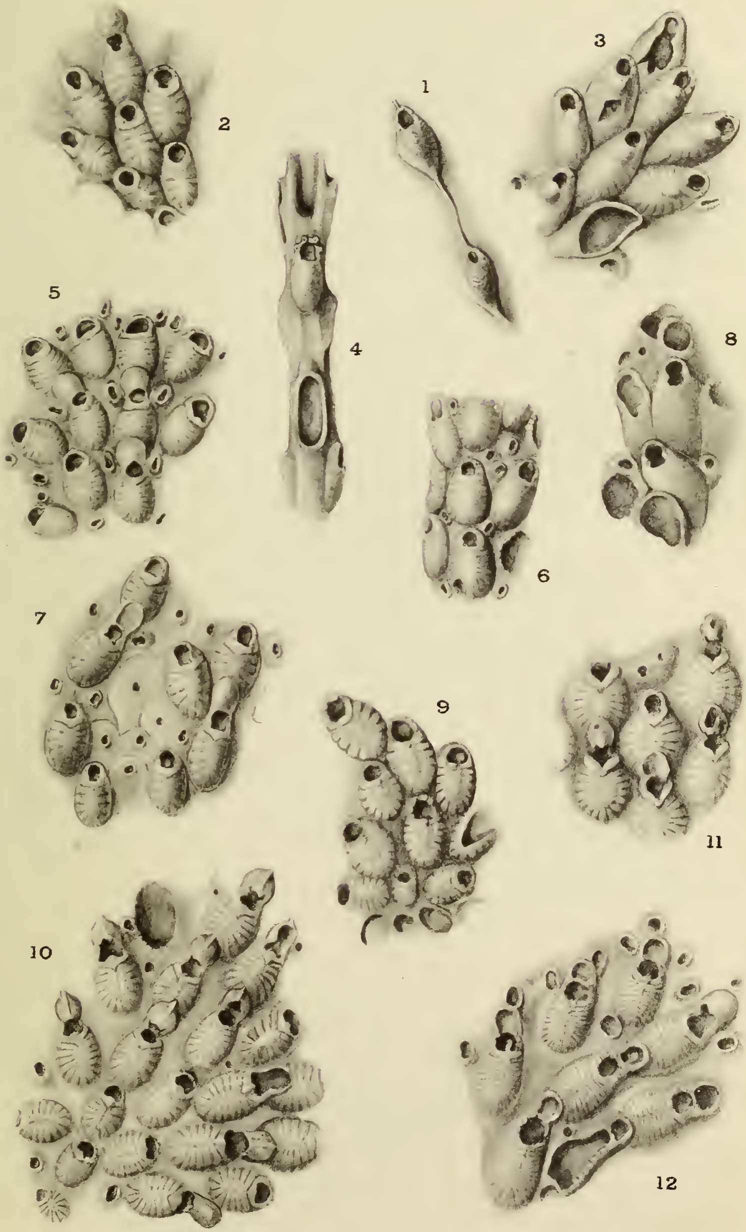

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PLATE V.

All × about 27 diameters.

Fig. 1. *Pancheilopora parvilabrosa* (p. 154). Zone of *M. coranguinum*. Horsley.

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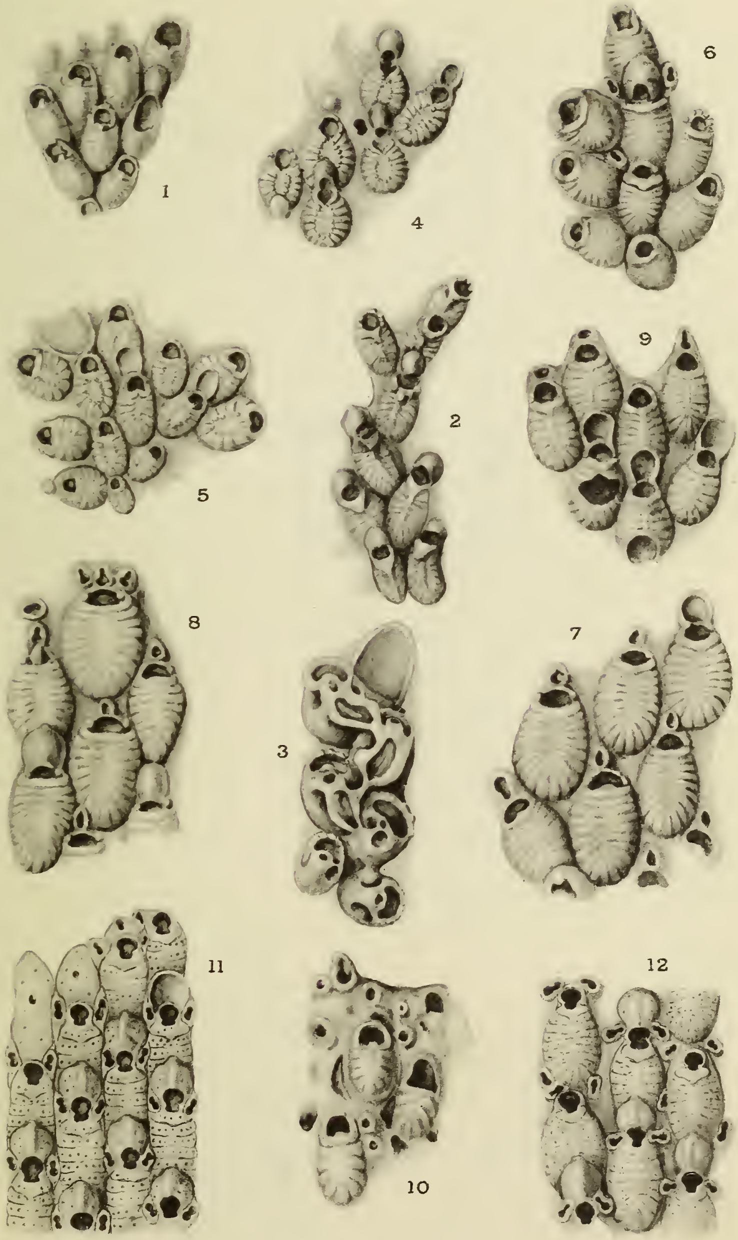

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PLATE VI.

All × about 27 diameters.

Fig. 1. *Pliophlœa ostreicola* (pp. 185–87). Zone of *B. mucronata.* Rügen.

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Fig. 10. *Calpidopora auritulus* (pp. 205–07). Cenomanian. Kaňk, Bohemia.

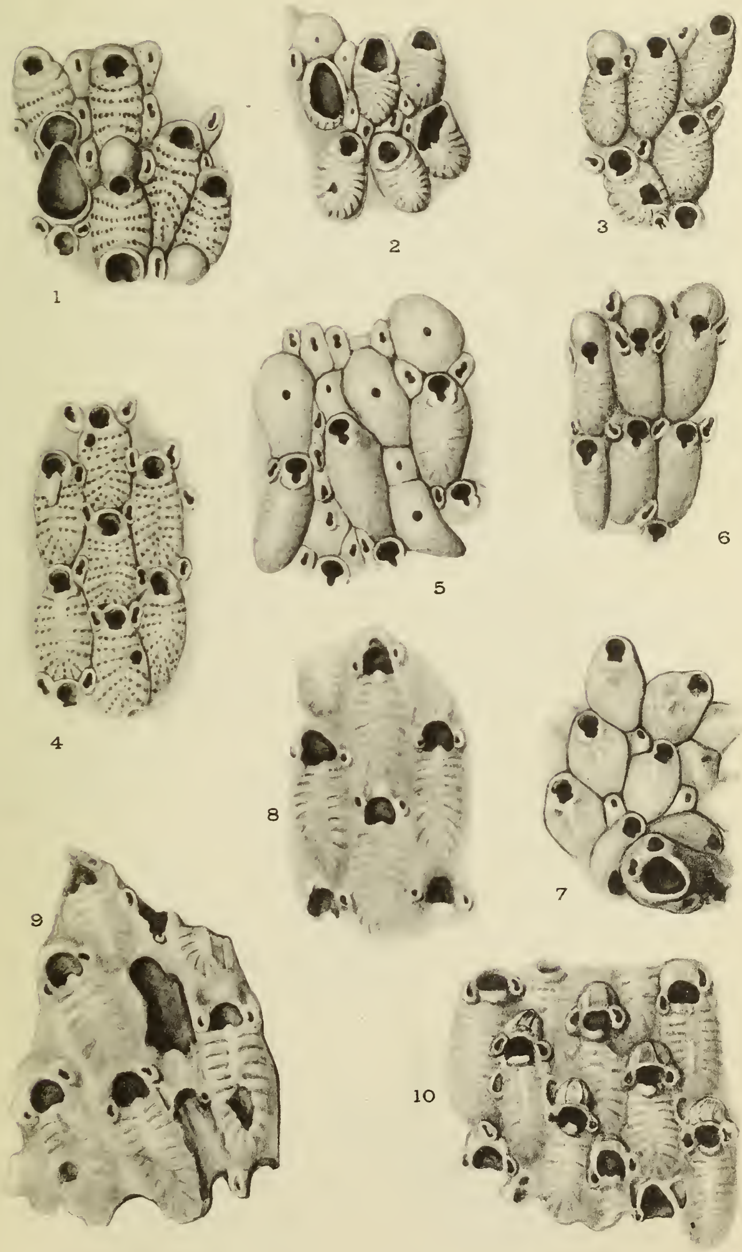

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PLATE VII.

All × about 27 diameters.

Fig. 1. *Calpidopora aurita* (207–09). Cenomanian. Kaňk, Bohemia.

Fig. 2. *Rhabdopora tigrina* (pp. 211–12). Turonian. Sarthe, France.

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Fig. 9. *Hystricopora horrida* (pp. 228–29). Coniacian. Fécamp, France.

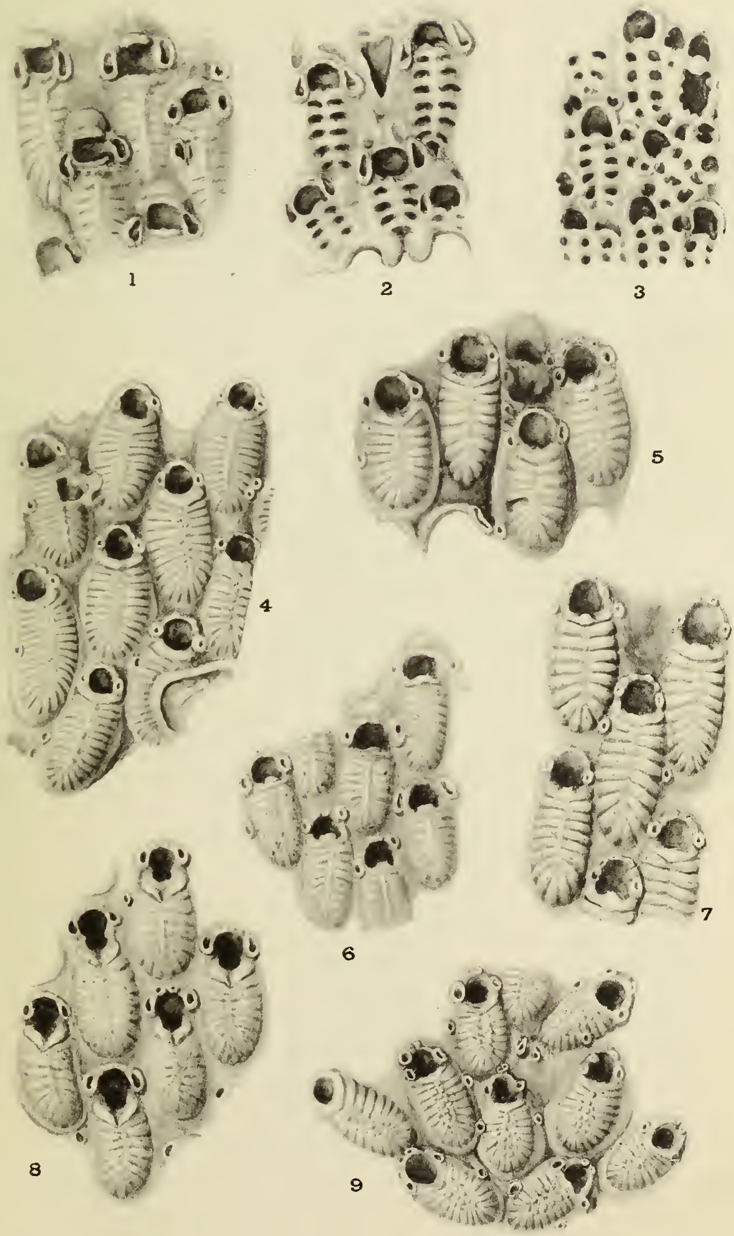

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PLATE VIII.

All × about 27 diameters.

Fig. 1. *Rhacheopora suta* (pp. 234–35). Lower Senonian. Chatham.

Fig. 2. *Rhacheopora larvalis* (pp. 236–37). Coniacian. Fécamp, France.

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Fig. 9. *Diceratopora bicia* (pp. 254–55). Zone of *M. coranguinum*. Gillingham, Chatham.

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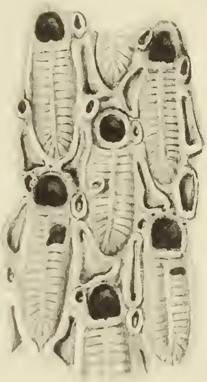

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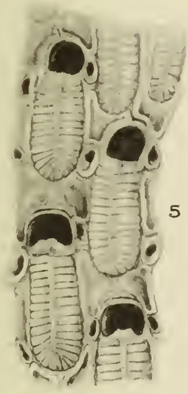

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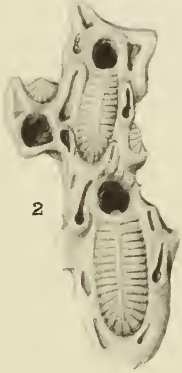

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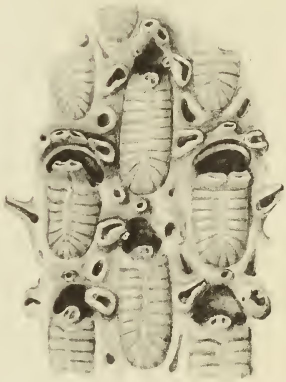

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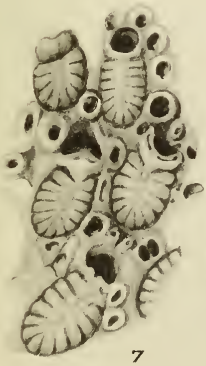

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