Mémoires de l'Académie Royale des Sciences et des Lettres de Danemark, Copenhague,
7me série, Section des Sciences, t. X, nº 1.

STUDIES

ON THE

CYCLOSTOMATA OPERCULATA

BY

G. M. R. LEVINSEN

WITH 7 PLATES AND 2 FIGURES IN THE TEXT

D. Kgl. Danske Vidensk. Selsk. Skrifter, 7. Række, naturv. og mathematisk Afd. X. 1

KØBENHAVN

HOVEDKOMMISSIONÆR: ANDR. FRED. HØST & SØN, KGL. HOF-BOGHANDEL

BIANCO LUNOS BOGTRYKKERI

1912

Pris: 4 Kr. 45 Øre

Det Kgl. Danske Videnskabernes Selskabs Skrifter,

6te Række.

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PREFACE.

Many years ago I undertook a study of the Danish cretaceous *Bryozoa* the results of which have not yet been published, and among the species studied by me were also a small number belonging to the family *Meliceritititidae* (Eleidae d'Orb.) to the members of which D'ORBIGNY ascribes a calcareous operculum the presence of which, however, has been denied by all the later authors who interprete the supposed operculum as a closure-plate of the same nature as that which has been found both in the *Cyclostomata* and the *Cheilostomata*. I came however to the result that D'ORBIGNY was right in his interpretation of the named structure, and I have published some remarks on this subject in my preliminary communication »Studies on Bryozoa« [1]). As later I wished to make a more comprehensive study of this interesting group I extended my investigations over a number of foreign species, and in this effort I have been supported by several colleagues abroad. In the first instance I owe a debt of gratitude to Dr. F. CANU the author of so many valuable works on fossil Bryozoa, who has not only sent to me a large number of French species defined by him, but also helped me to acquire materials containing cretaceous bryozoa from a number of French localities. A similar material from a few other French localities has been sent me by Mr. G. DOLLFUS, and to Mr. M. FILIOZAT who has made a special study of the cretaceous Bryozoa from Vendôme I owe the possession of a number of species from that locality. For the gift or loan of specimens I am also indebted to Mr. A. W. WATERS, Dr. E. PERGENS, Prof. Dr. G. STEINMANN, Bonn and Prof. Dr. H. WEGNER, Münster, and lastly I have been able to acquire a collection of cretaceous Bryozoa from the Chatham chalk, by the aid of Mr. W. GAMBLE. To all these gentlemen I offer my sincere thanks.

Zoological Museum of Copenhagen.
August 16, 1912.

G. M. R. LEVINSEN.

[1]) 16.

Historical Introduction.

GOLDFUSS [1]) was the first author, who described a species belonging to this division namely *Ceriopora gracilis* while the first genus *Meliceritites* has been instituted by ROEMER [2]) for the three species *Mel. gracilis* (Goldf), *Mel. Roemeri* (Hag) and *Mel. porosa* Roemer. The name *Meliceritites* is derived from *Melicerita*, a genus founded by MILNE EDWARDS [3]) for a fossil species of the present genus *Cellularia* (*Cellaria*), *Cel. Charlesworthii*, and the main character upon which the genus was founded is the arrangement of the zooecia in continuous transverse series, a character which at the present state of systematic knowledge cannot be regarded as sufficient for the institution of a genus, and therefore the name *Melicerita* must be regarded only as a synonym to *Cellularia*. ROEMER'S genus is defined in the following manner: »Runde Stämme deren sechsseitige Zellen mit einer Ecke und nicht wie bei allen bisher beschriebenen Arten, mit einer Seite nach oben gerichtet sind und die gemeinschaftliche Scheidewand zweier Zellen der höheren Reihe tragend«. After this definition he adds the following apparently contradictory information: »Gleiche Zellenbildung findet sich auch bei *Eschara* und hat MILNE EDWARDS hier darauf die Gattung *Melicerita* gegründet«. As stated above however it is not the form of the zooecial areas but the arrangement of them in transverse series which has induced MILNE EDWARDS to found a new genus for this species. It is easy to understand that ROEMER has derived the name of his new genus from *Melicerita* as the three species described by him agree with *Mel. Charlesworthii* in the possession of rhombic-hexagonal concave zooecial areas, surrounded by distinct ridges and, besides, arranged in transverse series, and as he has not seen the long tubular part of the zooecia hidden within the colony his only motive to divide *Meliceritites* from *Melicerita* seems to be the different form of the colony, which in the latter is a two-layered plate while in the former it is ramose with rounded branches.

v. HAGENOW [4]) is the first author who refers these forms to a special division which he named *Salpingina* and characterized in the following manner: »Angewachsene verästelte Polypenstöcke, mit langen Röhrenzellen, welche sich kurz vor der Mündung trompetenartig, fast sackförmig erweitern, und äusserlich mit einer kalkigen oder hornagtigen Membran verschlossen sind. In dieser Membran befindet sich die kleine, verschieden gestaltete Mündung, die warscheinlich bei Allen mit einer Klappe versehen war und die bei einigen Arten noch erhalten ist.« At another place he names this »Klappe« operculum: »Ein Operculum ist bei Einigen, vielleicht bei Allen vorhanden«. To this division he refers the two genera *Escharites* and *Inversaria* the former of which also comprises ROEMER'S *Meliceritites*. Apart from the circumstance

[1]) 1. p. 35, pl. X, figs 11 a—c. [2]) 6, p. 18, pl. V, fig. 13. [3]) 2, p. 345, pl. 12, fig. 19. [4]) 5. p. 55.

that HAGENOW's division only embraces freely growing species it is founded on the examination of a few badly conserved species of which only a single *Escharites gracilis* with certainty can be referred to the *Eleidæ*, and as species belonging to this division have never been found in the tertiary formation the following statement of the author distinctly shows that his *Salpingina* also embraces common cyclostomatous species: »Alle sind fossil und gehören dem Jura, der Kreide und der Tertiärbildung an«.

The presence of an operculum in the *Salpingina* should be a real difference from the *Cyclostomata*, but there is no evidence that the author has seen a real operculum in any of the species referred by him to this division. As a species provided with such an operculum he names *Escharites (Felicea) velata* Hag., but this species belongs to quite another division, the *Ceidae*, which are not provided with an operculum, and what HAGENOW has seen is only a closure-plate.

D'ORBIGNY [1]) in 1852 founded a division to which he gives the name *Centrifuginés operculinés* and which he defines as follows: »Cellule centrifuginée toujours pourvue d'un opercule. Colonie très variable dans sa forme composée de cellules généralement peu saillantes, mais toujours pourvues d'un opercule: partie testacée ou calcaire, s'ouvrant comme une porte pour laisser sortir l'animal«. As to the operculum he later adds: »D'ailleurs s'il pouvait encore rester quelques doutes à cet égard la presence de ces opercules encore restés en place dans beaucoup d'espèces fossiles, vient entièrement les lever et donner la preuve que cet opercule existait«. To this division D'ORBIGNY refers two families, the *Eleidae* and the *Myriozoumidae*, the last of which contains the exstinct genus *Foricula* and the recent genus *Myriozoum*. The last named genus, however, belongs to the *Cheilostomata*. The above quotation leaves no doubt that D'ORBIGNY has founded his division *Eleidae* on the presence of an operculum, and it is a curious fact that all the modern authors with the exception of the present though accepting this division, at the same time deny that its member possesses an operculum, explaining the calcareous plate which may be found closing the aperture of more or less zooecia as a closure-plate. Not a single author even mentions this statement of D'ORBIGNY.

HAMM [2]) in 1881, founded a very artificial division, the *Stigmatoporina* to which he besides two inoperculate cyclostomatous genera *Stigmatopora* Hamm (-*Hammia* Grey) and *Cyrtopora* Hag. also referred the operculate genus *Meliceritites*. He characterizes this division as follows: »Die Zellen sind ähnlich wie die der Tubuliporiden beschaffen. Statt dass sie aber in der mittleren Axe des Stammes entspringen legen sie sich rings um ein senkrecht stehendes, im Querschnitt rundliches Bündel von langen cylindrischen unter einander parallelen Röhren«. He divides the *Stigmatoporina* in two groups the second of which *(Meliceritites)* he characterizes by the trumpet-shaped distal enlargement of the zooecia: ». . zweitens in solche, deren Zellen lang, anfangs sehr dünn sind und erst an der Mündung sich plötzlich trompetenförmig erweitern«. As we have seen HAGENOW has al-

[1]) 7, p. 605. [2]) 8, p. 45.

ready used this character for his *Salpingina*, but HAMM has overlooked that the narrow tubes of the axial bundle are only the proximal parts of the zooecia, and as we shall see later, this error is repeated by MARSSON. As to the operculum spoken of by D'ORBIGNY he expresses the following opinion [1]): »Dieser Deckel ist indessen kein dem beweglichen Deckel der chilostomen Bryozoen analoges Organ, sondern eine einfache Kalkwand, mittelst deren sich das Thier bei zunehmendem Alter oder um sich gegen äussere Einflüsse zu schützen, in die Zelle einkapselt; er ist also ein blosses biologisches Produkt. Dem entsprechend findet sich derselbe nicht nur bei den Operculés von D'ORBIGNY, sondern ebenso bei den Clausidae D'Orbg., Diastopora, Terebellaria, Osculipora, Heteropora etc. also bei Formen von sehr verschiedener Natur. Zur Systematik darf er daher nicht verwendet werden«.

MARSSON [2]), in 1888, united the *Ceidea* and the *Eleidea* into a division *Metopoporina*, and the *Eleidea* he characterized as follows: ». . . . die Hauptzellen bei den cylindrischen Arten auf der Aussenseite eines centralen cylindrischen Bündels langer, Röhrenzellen entspringend, (ob auch bei den flachen, blattartigen Formen die Hauptzellen aus einer Schicht von Nebenzellen entspringen, bedarf einer weiteren Untersuchung), auf der Oberfläche des Stocks dicht an einander gedrängt, mit mehr oder weniger rhombisch-sechseckigen Stirnseiten ausmündend, die im vorderen Theile eine dreiseitige Mündung tragen«. In the diagnose of *Melicertites* he mentions the trumpet-shaped expansion of the zooecia, and the manner in which he speaks about the operculum seems to show that he interpretes it as a preliminary calcareous covering which later disappears: »Mündung . . . . anfangs durch eine Kalkmembran geschlossen und mehr hervortretend«.

PERGENS [3]) in 1890, separated the two groups, the *Ceidae* and the *Eleidae*, united by MARSSON in his *Metopoporina,* and the latter of them, to which he gives the name *Melicertitina* he defines in the following manner: »Les zoécies se dilatent vers l'extrémité en forme de trompette; l'orifice n'occupe qu'une partie du diamètre transversal des zoécies et est situé à leur partie distale. Les ovicelles sont situées à l'intérieur des colonies, entre les zoécies, ou occupant leur place, et communiquant avec l'extérieur par une ouverture triangulaire à base proximale et à pointe plus ou moins allongée«. The structures which PERGENS as D'ORBIGNY and MARSSON regards as ovicells are as WATERS has pointed out very like the Cheilostomatous avicularia, and the real gonozoocia have not been seen by PERGENS, who, besides, speaks about the supposed ovicells as if there were two different kinds, some placed within the colony and others taking the place of zooecia. This however is not the case. PERGENS as HAMM and MARSSON means that the zooecia of *Meliceritites* take their origin from a central bundle of narrow tubes, and like these authors he also denies the presence of a real operculum [4]): »les Operculés renferment deux familles: les *Myriozoumidœ* et les *Eleidœ*. Le type de la première est réellement pourvu d'un opercule, c'est donc un Cheilostome; les secondes n'ont pas d'opercule, mais souvent

[1]) 8, p. 9. [2]) 10, p. 45. [3]) 9, pp. 325, 391. [4]) 9, p. 320.

une membrane calcareuse transversale, caractère qu'elles partagent avec des *Heteropora*, des *Entalophora* et une quantité d'autres genres. —

WATERS[1]) who was the first to point out the likeness between the »cellules accessoires« or »cellules ovariennes« of D'ORBIGNY and the Cheilostomatous avicularia is inclined to think, that the *Eleidae* have been provided with a chitinous operculum. He says about that, referring to transverse sections of *Meliceritites Royana*: »In transverse sections (figs 5 and 11) a contraction formed by a curved plate is seen on each side just below the opening. Possibly an operculum has an attachment here, but of this I have not been able to satisfy myself«. He does not mention D'ORBIGNY's calcareous opercula, and, therefore, no doubt regards them in the same way as the other authors, namely as closure-plates. On the whole WATERS seems inclined to think that the *Eleidæ* are nearer related to the *Cheilostomata* than to the *Cyclostomata*.

GREGORY[2]) who regards the *Eleidae* only as a family of his suborder *Cyclostomata tubulata* defines this family as follows: »*Cyclostomata tubulata* in which the

[1]) 12, p. 48, pl. VI.

[2]) GREGORY (14, p. 285) when speaking about D'ORBIGNY's institution of the family *Eleidae* has quite misunderstood this author. He says as follows: »D'Orbigny founded this family in 1853 for a series of Bryozoa with anomalous characters, of which the most striking was the presence of a series of modified zoœcia that he described as »cellules accessoires«. These accessory structures are of two types, large superficial marsupial chambers, and cells with triangular or elongated apertures and a platform parallel to the surface of the zoarium. The marsupial chambers were described by d'Orbigny as »cellules ovariennes«, and they are clearly gonocysts or gonœcia. The nature of the second set is more important. D'Orbigny recognized that they sometimes occur on the same specimen as »cellules ovariennes«, and therefore cannot be ovarian. He suggested that they may be male cells or sperm-cells. Nevertheless Pergens and Marsson subsequently described them as ovicells«. Every reader must understand the above statement in that manner 1) that D'ORBIGNY has founded the family *Eleidae* chiefly on account of its possessing modified zooecia (»cellules accessoires«), and that he has only found such modified zooecia in the *Eleidae*. Further 2) that D'ORBIGNY has pointed out the presence of marsupial chambers (gonozoœcia) in the *Eleidae*, and 3) that he has interpreted some of the modified zoœcia found in the *Eleidae* as „cellules mâles". As to the first point the above quotation of D'ORBIGNY shows that he has founded the division *Centrifugines operculinés* not on account of its possessing modified zooecia, but because it possessed calcareous opercula, and for both the families belonging to this division he only mentions in somewhat different terms that they sometimes possess »cellules accessoires« which structures, besides, he has found not only in this division, but also in the *Cheilostomata* and the *Cyclostomata*. As to the two other points D'ORBIGNY has nowhere mentioned or pictured an Eleid gonozoœcium, and what he says about „cellules mâles" only concerns the *Cheilostomata*. The structure of the avicularia being at that time unknown D'ORBIGNY is evidently most inclined to look upon the modified zooecia as gonozoœcia (»cellules ovariennes«), but as in ESCHARA[1]) they are found together with zooecia wearing ooecia he cannot escape regarding the latter as »cellules ovariennes«, a view held further by all his predecessors, and therefore he asks whether they may not here be regarded as »cellules mâles«. In the representation he gives of the *Bryozoaires centrifuginés*, a division which besides some *Ctenostomata* comprises the present *Cyclostomata*, the *Eleidae*, the *Myriozoumidae* and the *Ceidae*, he says about these modified zooecia[2]): »Dans quelques genres

[1]) 7, p. 99. [2]) 7, p. 587.

apertures are lateral and subterminal, and which frequently have avicularia and spines. The marsupial chambers are gonocysts or gonoecia. Many of the zooecia may be closed by thin calcareous films«. The author here uses the term »lateral« in quite an unusual way; namely as a synonym to »subterminal«, and when he speaks about »spines« he no doubt means the small projections which in many species are found where three dividing ridges meet each other, and which by other authors have been called »tubercles«. However, he only uses this expression in the family diagnose, and nowhere in the descriptions of the single species. GREGORY distinguishes between gonocysts and gonoecia, and as gonocysts he designates the pyriform greatly enlarged gonozooecia which are provided with a small terminal aperture. He ascribes gonoecia to the genus *Nodelea*, but in *N. durobrivensis* he has found a gonocyst, and the gonoecium which he ascribes to *N. semiluna* is really an avicularium. To the genus *Foricula* he ascribes »a gonæcium or gonocyst«, but the piriform gonæcium (? gonocyst), which he assigns to *F. pyrenaica* is also an avicularium. He is inclined to think that the *Eleidae* have been provided with chitinous opercula, and the calcareous plates which in so many zooecia cover the aperture he interpretes in the same manner as his predecessors, namely as closure-plates.

The present author[1]), in 1902, in a preliminary paper expresses the view that D'ORBIGNY has been right in ascribing opercula to the *Eleidae* at the same time pointing out the difference between the operculum and the closure-plate.

LANG[2]), in 1906, distinguishes between »closed zooecia and normal zooecia« and uses the presence or absence, the frequence or rarity of the former as a specific character. He says about the closed zooecia: »Like the avicularia their physiological significance is a matter of conjecture«.

The Morphology.

The Zooecia.

The zooecia[3]) have essentially the same form and structure as those of the *Cyclostomata* being very long slender tubes, each of which rises from the proximal

nous voyons, mais très-rarement, des cellules differentes des autres, beaucoup plus grandes, et que nous regardons ici comme des cellules ovariennes servant à la reproduction des oeufs (pl. 735, 736, 741, 761, 777). Quelques genres seulement offrent de veritables vésicules ovariennes distinctes des cellules et placées du côté opposé, destinées aussi à produire les oeufs (pl. 770). While the cellules ovariennes pictured in pl. 761, 770 and 777 (belonging to *Multisparsa Luciana*, *Hoŕnera lichenoides* and *Reptomultisparsa diluviana*) are real cyclostomatous ooecia those figured in pl. 735, 736 and 741 are Eleid avicularia«. To GREGORY, therefore, is due the credit of being the first author who has found gonozoœcia in the *Eleidae*.

[1]) 16, p. 28. [2]) 19.

[3]) In the descriptions of the species the names „zooecia", „heterozooecia" and „kenozooecia" are used to designate that part of the named zooids, which is visible in the surface of the colony.

part of another tube, and only appearing on the surface of the colony with their distal parts, but while in most *Cyclostomata* the distal part of each zooecium keeps its character as a narrow cylindrical tube whether it projects with a shorter or longer free end or only with its frontal convex surface, I have hitherto only found this to be the case in a single species of this division, namely in *Meliceritites Dollfussi* Perg. (pl. IV, fig. 23, pl. V, figs. 9, 10.) in which the zooecia are provided with a shorter or longer freely projecting terminal part. As a rule the superficial or terminal part of the zooecia enlarges into a rather broad hexagonal, rhombic or qvadrangular area, the zooecial area, and the single areas are in most cases divided from each other by a meshwork of distinct ridges. These areas are very much like those found in the coilostegous *Cheilostomata,* for inst. in *Onychocella, Micropora, Membranicellaria* and *Cellularia* (*Cellaria*), and ROEMER[1]) therefore says: »Gleiche Zellenbildung findet sich auch bei *Eschara*«. The greatest likeness these areas show to those found in the genus *Cellularia* as has been pointed out in the historical introduction, but this likeness is a quite superficial one as in this genus the meshwork of ridges has nothing to do with the dividing walls and do not correspond to the single zooecia which have a quite different form[2]). In the *Melicertitidae* contrary the ridges are the edges of the walls dividing the single zooecial areas which may easily be seen by grinding away a part of the surface of the colony, there being left a system of hollows corresponding in size to the single areas. This meshwork of ridges which is only absent in some species presenting a convex surface, f. inst. in *Meliceritites micropora* (pl. III, fig. 10), is very often in the points of intersection provided with more or less prominent tubercles the presence and development of which is dependent on the manner in which the concave surfaces of the zooecial areas join the marginal ridges. The more the transition of the surface into the ridge is a gradual one the more developed are the tubercles (pl. II, figs. 10, 11, 23, pl. III, fig. 17) while on the contrary they are feebly developed or quite lacking in such species (pl. III, fig. 20, pl. V, figs. 1, 7, 9, 12.) where the ridge is more distinctly defined from the surface. While two contiguous concave surfaces gradually rising towards each other must form a roof-shaped ridge, three or four must where they meet, form a pyramid, but only in a few cases the single surfaces of these pyramids are distinctly defined (pl. V, fig. 19.) being generally rounded. In the circumference of an hexagonal area (pl. II, fig. 11) there can be found six tubercles three of which may be called »præoral« being placed immediately distally to an aperture while the other three each of which has its place between two apertures may be called »interoral«. When the zooecial areas are rhombic there can only be found præoral tubercles.

While concave or saddle-shaped zooecial areas surrounded by distinct ridges and sometimes provided with more or less distinct tubercles are also present in a number of cyclostomatous species, f. inst. in *Peripora pseudospiralis* Mich., *Spiropora*

[1]) 6, p. 18. [2]) 18, p. 209—212, pls. VII VIII.

macropora d'Orb. *Entalophora ramosissima* d'Orb. and *Ent. madreporacea* Goldf., the *Meliceritidae* always seem to show a distinct difference from the *Cyclostomata* therein that the zooecial tube the larger part of which is very narrow possesses a great and rather sudden distal enlargement while in the *Cyclostomata* the much wider zooecial tube only gradually widens distally without attaining the great distal enlargement. A transverse section of a cyclostomatous colony therefore shows a number of hollows gradually increasing in size from within outwards, (pl. VII, figs. 24, 25), while a corresponding section of a *Meliceritites* distinctly shows a contrast between numerous inner very small hollows and a single or double outer circle or series of much larger ones (pl. VII, figs. 10, 19, 23, 30). We see from these transverse sections that the above enlargement takes place especially in the direction from within outwards, and its presence in the *Meliceritidae* may possibly be explained from the fact that they have possessed an operculum, and a calcareous too, the relative great weight of which must have required strong occlusor muscles. We have seen in the historical introduction that HAMM, HAGENOW, MARSSON and PERGENS use the trumpet-shaped enlargement of the zooecia in the *Eleidae* as a systematic character. D'ORBIGNY does not mention it, but in his work he has given numerous figures of transverse sections which distinctly show the above contrast between the *Cyclostomata* and the *Meliceritidae*.

The aperture is placed in the distal part of the zooecium which in many species is more or less protruding. It is always provided with a straight or almost straight proximal margin, and the two lateral margins which are in most cases more or less convex, more seldom somewhat incurved (pl. II, fig. 23.) or almost straight, either run together in a distal curve or form a distal angle (pl. II, figs. 1, 23, pl. IV, fig. 22). It takes up a greater or smaller part of the zooecial area, which in a few species (pl. VI, figs. 12, 13, pl. VII, fig. 4) it almost fills, the suboral part of the area being very small. The aperture is in most species surrounded by a more or less developed peristomial thickening a greater or smaller distal part of which is formed by the marginal ridge but in many cases the proximal part of this thickening may be absent or only developed in old zooecia. Sometimes the apertures of contiguous zooecia are divided from each other by broad pillar-like swellings, representing both the dividing ridge, the lateral parts of the peristomial thickening (pl. II, fig. 11), and sometimes also the interoral tubercle (pl. III, fig. 18). The præoral tubercle is not rarely developed in the shape of a beak-like projection (pl. I, figs. 1, 2, pl. V, figs. 3, 4, pl. VI, fig. 13). We have seen in the historical introduction that D'ORBIGNY characterizes this division by the presence of a calcareous operculum while all the later authors interpret D'ORBIGNY's operculum as a closure-plate. Some of these authors, however, think that these forms have possessed a chitinous operculum, and the presence of an operculum seems, besides, to be a natural consequence of the assumption, that certain individuals of the colony must be explained as avicularia an avicularium being a modified zooecium provided with a strongly developed and modified operculum. There can be no doubt that D'ORBIGNY is right

in his interpretation of the named calcareous plate. The operculum is an arched calcareous plate provided with more or less distinct radiating striæ starting from the middle of the proximal margin, and in contrast to the closure-plate found in all the species examined it shows a distinct free margin, while the closure-plate is soldered together with the margin of the aperture, being really a growth starting from this margin and gradually extending over the aperture. Sometimes may be found closure-plates the middle part of which is not yet closed (pl. IV, fig. 6, 15). The very presence of the radiating striæ in the operculum is sufficient to show that we have here to do with an independent structure and not with a closure-plate, as such striæ which we f. inst. know from the zooecia of the *Cheilostomata* indicate that the calcification has taken place in radiating belts. At a time when the operculum was still in a membranous state, the calcification therefore started from the middle of the proximal margin and extended in radiating belts gradually outwards and distally. As the other calcareous surfaces the operculum shows a number of more or less distinct pores which in some species are disposed in two distally converging series (pl. I, fig. 1), while in others they are placed in the ends of small claviform projections which show a flabelliform arrangement (pl. 1, fig. 11). In *Melic. undata* the operculum shows a number of 1—4 curved impressions (pl. IV, fig. 11, 12, 16). The operculum fits into the aperture in two different manners. In a number of species the margin of the aperture is in the same manner as a door-frame or a window-frame provided with a more or less developed depression, the "oral ledge" decreasing in breadth towards the proximal margin and destined to support the margin of the operculum, when the zooecium is closed (pl. I, fig. 13; pl. III, figs. 10, 11, 23; pl. IV, figs. 18, 22) while in other species the margin of the aperture is only obliquely sloping inwards. The difference between these two cases, however, is not always easy to see, especially when the state of preservation is not, good. — As in most *Cyclostomata* the zooecial areas as well as the other surfaces are provided with numerous fine pores, but in a few species the pores are only to be found in the opercula, being in the zooecial and heterozooecial areas replaced by more or less numerous pits (*Melic. punctata*, *Melic. pyrenaica*).

The Heterozooecia.

d'Orbigny is the first author who has described and pictured the heterozooecia of the *Meliceritidae*, which he designates as "cellules accessoires" or "cellules ovariennes" the two terms being generally used by him as synonyms.

While Marsson and Pergens still look upon these individuals in the same manner as d'Orbigny, namely as gonozooecia Waters is of the opinion that they must be regarded as avicularia, and this view has been followed by the later authors. Canu names them "eleocellaires".

The heterozooecia consist as the zooecia of a long narrow tubiform part hidden within the colony and a superficial part, the heterozooecial area, which is more or

less different from the zooecial area, the aperture being especially of another form or of another size than the zooecial aperture. As a rule it is more elongate, and very often much larger, but in some cases it is much smaller and at the same time of a quite similar form. At the whole there is seen similar differences in the form of the aperture as are found in the avicularia of the *Cheilostomata*. The simplest form of heterozooecia is found f. inst. in *Mel. angulosa* (pl. II, figs. 8, 10), *Mel. Dollfusi* (pl. IV, fig. 23), *Mel. sarissata* (pl. II, fig. 1), *Mel. punctata* (pl. V, fig. 7) and *Mel. hexagona* (pl. V, fig. 3). In the aperture there may be discerned between the proximally situated "inner aperture" distally limited by a curved or angularly bent line and a generally larger or longer distal concave portion, which corresponds to the "oral ledge" of the zooecial aperture, and therefore must be designated in the same manner.

A sagittal section through a heterozooecium shows that the presence of this distinctly bounded oral ledge is due to the circumstance that the inner distal surface of the zooecial tube suddenly alters its direction forming an obtuse angle with the proximally situated part, and the edge thus formed just makes the distal boundary line of the inner aperture. In the heterozooecia of *Mel. Filiozati* n. sp. (pl. VI, figs. 7, 9) and *Mel. sqvamata* (pl. V, figs. 14—16), and in the large heterozooecium of *Mel. Roemeri* (pl. V, fig. 18) the oral ledge consists of a deeper median part and two more or less developed lateral thickenings while in a larger number of species f. inst. in *Mel. magnifica* (pl. 1, figs. 3—5, 7), *Mel. lamellosa, Mel. pentagonum* (pl. IV, fig. 22) and *Mel. gothica* (pl. II, fig. 24) these thickenings have been developed into two inwards sloping triangular processes, the "lateral processes" which conceal the larger part of the oral ledge and the inner aperture.

The thickness of these two processes (pl. 1, fig. 10) which may be coherent distally decreases towards the median line where they are divided from each other by a more or less narrow longitudinal fissure their free proximal margin being divided by a transverse fissure from the distal margin of the suboral area. When the state of preservation is not good the outer boundary of the two processes is not distinct, and the opening formed by the two fissures may be taken as the space once filled by the mandible. The aperture in all the species of this group is of an elongate triangular form. A fourth group of heterozooecia which have been found in *Mel. Steenstrupi* (pl. III, figs. 11, 12), *Mel. Canui* n. sp. (pl. III, figs. 19—27), *Mel. durobrivensis* (pl. IV, figs. 1–4) and *Mel. Roemeri* (pl. V, figs. 21—24) have that in common with the first mentioned, that the aperture lacks both lateral thickenings and lateral processes but these apertures have a form very like to or at least not very different from the zooecial aperture, and most of them are, moreover, much smaller than the latter. Also the heterozooecia themselves are as a rule much smaller than the zooecia, and the smallest heterozooecia found in *Mel. durobrivensis* only attain the sixth part of the length of the zooecia. A few of the heterozooecia found in *Mel. Canui* have the apertures provided with a comparatively narrow oral ledge, but as a rule the latter takes up the larger part of the aperture and is per-

forated either with a small rounded or with a narrow triangular or fissure-like opening. While the form of the apertures is constant in *Mel. durobrivensis* and *Mel. Steenstrupi*, in *Mel. Canui* and *Mel. Roemeri* it is subject to a rather great variation both as to form and size, and in the latter species the largest of them are ligulate and stretched beyond the distal angulate border of the zooecium. In *Mel. durobrivensis* these heterozooecia are found not only interspersed among the zooecia, but also constituting an incrusting base (pl. IV, fig. 19), and they seem here to play a similar role as the corresponding kenozooecia of a *Retepora*-colony [1]).

In most species I have found the aperture of more or less heterozooecia closed by a calcareous mandible (pl. I, figs. 1, 2; pl. II, figs. 3, 16, 18; pl. III, figs. 3, 20; pl. IV, figs. 1, 23; pl. V, figs. 5, 8, 17; pl. VI, fig. 2) which has a similar arched surface as the opercula and often shows more or less distinct radiating striæ. Sometimes it is as many mandibles of cheilostomatous avicularia provided with a hooked beak, being at the same time strongly arched not only from side to side but also proximally distally (pl. II, fig. 3).

In *Mel. Canui* and *Mel. durobrivensis* the semi-elliptical mandible is provided with distinct radiating striæ, and chiefly differs from the zooecial operculum in being much smaller. Lastly it might be of interest to compare these heterozooecia with those found in the *Cheilostomata*, and in ordre to make the difference between them more conspicuous we shall choose for comparison such presenting a maximum of outer likeness, f. inst. those found in a *Thalamoporella*-species [2]) and in *Mel. angulosa* (pl. II). Besides the likeness in the form of the aperture we may in both discern between an inner aperture and a distal concavity, but while the latter in *Meliceritites* is the distal inner surface of the zooecial tube it is in *Thalamoporella* formed by a free lamina (a cryptocyst) which rises from the lateral and the distal walls within the free margin. Besides the difference which the heterozooecia of the *Meliceritidae* show from those of the *Cheilostomata* in being long slender tubes the greatest part of which is hidden within the colony they present another constant difference from the latter therein that the aperture is always limited by a continuous calcified frame while in the *Cheilostomata* it is limited proximally by a membranous area of different extent. The group of heterozooecia above spoken of in which the larger part of the original aperture has been concealed by two triangular laminæ shows a certain likeness to the heterozooecia of certain species of *Onychocella* [3]) and *Rhagasostoma* in which the cryptocyst lamina has attained its greatest development, being only provided with a small perforation for the occlusor muscles, but the two laminae are two thick processes from the lateral parts of the oral ledge, and the two mutually vertical fissures which may be compared to the perforation in the avicularia of *Onychocella* and *Rhagasostoma* belong both to the opercular area while the proximal part of the latter perforation is placed within the suboral area. Lastly we shall remind of the different structure of the mandibles.

[1]) 18, p. 290, pl. X. [2]) 18, pl. VI a. [3]) 7, pl. 673, figs. 1, 4, 8.

In opposition to the *Cheilostomata* in which heterozooecia may also arise by a process of budding from the surface of the zooecia (dependent heterozooecia) the *Meliceritidae* only possess independent heterozooecia, and it is therefore a mistake when GREGORY in *Foricula aspera*[1]) interprets a pair of long narrow pits seated on each side of the aperture as avicularia.

As a result of the above comparison I must agree with the opinion set forth by GREGORY[2]) that the avicularia in both divisions have developed independently, and therefore are only parallel, not homologous structures.

The Kenozooecia.

Kenozooecia or bryozoids without an aperture (dactylethrae Greg) have been found in 12 of the 31 species examined. As a rule they have the same form and size as the zooecia, but as they lack an aperture they are provided with a uniform flat or concave frontal area within the marginal ridges. In *Mel. Steenstrupi* they are exceptionally much smaller than the zooezia. They are generally found interspersed among the zooecia (pl. VI, fig. 19) in greater or smaller numbers, but in a few species they take up together with a number of heterozooecia either the whole "dorsal" surface or a large part of it (pl. III, figs. 11, 14), and at the whole they are in most cases accompanied by heterozooecia, whether they appear in groups among the zooecia or take up a large part of the surface of the colony.

The Gonozooecia.

The gonozooecia (pl. VII) which have hitherto only been found in a small number of the species examined are zooecia provided with a large (1—2 mm. long), more or less convex terminal expansion, an ooecium which in most cases has a pyriform outline, but in the same species, nay in the same colony the form may be subject to great variation, being sometimes roundedly triangular, sometimes ovate or even circular. The distal end of the ooecium is provided with a transversely ovate, somewhat infundibuliform, frontally directed aperture, and proximally it generally ends in a shorter or longer tail-shaped process. When the thick porous frontal wall is removed, the flat or somewhat concave inner wall in most of the ooecia examined presents a uniform smooth surface which is only interrupted at the boundary between the caudal process and the rest of the cavity by a rhombic zooecial area surrounded by prominent ridges and closed by a concave calcareous film. Distally to this area which no doubt belongs to the gonozooecium may sometimes be seen a few more or less indistinct rhombic impressions of the same form and size as the zooecial areas, and when the inner wall of the ooecium has been dissolved by the use of strongly diluted acid, there appears a mosaic of rhombic zooecial areas each of which is closed by a concave calcareous film.

[1]) 14, p. 358. [2]) 14, p. 288.

In the ooecia of *Mel. lamellosa* (pl. VII, figs. 20—22) however, only a few zooecial areas are seen in the proximal part while in the rest of the cavity the zooecia are only represented by a number of more or less open tubes. In opposition to the ooecium of *Mel. magnifica* figured in Pl. VII, fig. 14, in which the inner wall has covered a number of undeveloped zooecia and heterozooecia I have found another small ooecium of the same species in which the corresponding individuals are provided with completely developed apertures. Also the gonozooecium the larger part of which is seen proximally to the tail-shaped process of the ooecium is provided with a completely developed aperture. A third different case I have found in a number of open ooecia belonging to the same species, all of which were placed not far from the growing edge in a superficial layer of growth (pl. VII, fig. 17). Here there projects in the proximal part of the ooecium a number of zooecia and heterozooecia of very different development while the rest of the inner wall presents a uniform smooth surface, the dissolution of which by the use of diluted acid denudes a layer of completely developed zooecia and heterozooecia belonging to an older part of the colony. In the ooecium figured in Pl. VII, fig. 17 there is seen in the proximal part a number of open zooecial areas, and the gonozooecium is in the same state of development, while that figured in fig. 18 shows a number of almost completely developed zooecia and heterozooecia. Proximally to the latter is seen a small triangularly rounded aperture, but the tail-shaped process seems to have been broken off.

By the aid of the above facts we may form the following picture of the development of the ooecia. When the gonozooecium begins to expand into the ooecium the inner wall of the latter covers a number of more or less developed zooids, which of course get chequed in their development while the adjacent zooids are able to continue their growth, which explains that the lateral margins of the ooecia are partly covered by a number of zooecia and heterozooecia. When the gonozooecium belongs to a superficial layer of growth and is placed near to the growing edge, the ooecium first covers the undeveloped zooids placed distally to the gonozooecium and thereafter a number of zooids belonging to the older part of the colony. The presence of freely prominent zooids in the proximal part of the ooecium must no doubt be explained in that manner that they have originally been covered by a bulging part of the inner wall of the ooecium, which has later been destroyed. A curious fact is the different state of development shown by the gonozooecia even in the same species.

The aperture of the ooecium leads into a short atrium partially divided from the rest of the ooecial cavity by a low ring-shaped ridge (pl. VII, figs. 21, 22, 28, 29) which from the inner wall passes obliquely forwards to the frontal wall. By the use of a great magnifying power its surface is seen to be provided with small projections which stand out as free irregular teeth on its distal margin (pl. VII, fig. 28). HARMER[1]) has pointed out a similar atrium in the ooecia of

[1]) 12 a, p. 170, pl. XII, fig. 10.

Crisia, and in *Cr. ramosa* Harmer he has found it partially separated from the rest of the cavity by a calcareous valve which however is not developed on the frontal wall. I have found a similar valve in *Cr. hamifera*[1]) n. sp., but in *Cr. eburnea*, (pl. VII, figs. 11, 12) *Cr. denticulata* and *Cr. aculeata* it is replaced by a similar continuous ring as that found in the ooecia of *Meliceritites*. It is provided with more or less finely ramose processes the character of which is distinctly different in the three species.

The Regeneration.

Besides the regeneration of the polypide which is no doubt a common feature in all *Bryozoa* a regeneration of the whole individual has been shown to take place[2]) in a number of species both in the *Ctenostomata* and the *Cheilostomata*, and such a regeneration I have also found in most species of the present division. While in the *Ctenostomata* this regeneration takes place in that manner that the old individual drops off, and a new one takes its place, in all species the zooecium of which is more or less calcified the new individual develops within the old zooecium, and that such a complete regeneration has taken place is evident from the fact that a new aperture is seen within the old one. In the *Cheilostomata* I have shown that this regeneration takes place in such a manner that the different forms of bryozoids may replace each other, and the same case I have found also in the *Melicerititidae*. The regeneration in this division has hitherto been overlooked or interpreted as a certain form of closure, f. inst. by GREGORY who in *Mel. durobrivensis* speaks about a closure by means of an inverted funnel-shaped cap pierced by a pore. Here we have to do with a regeneration of a new heterozooecium within an old zooecium. As I am later to give information of the regeneration in the single species described I shall here only give a short summary of the main features of this process.

In the *Meliceritidae* as in the *Cheilostomata* we can discern between the following four forms: [1]) the regeneration of a new zooecium within an old one (pl. III, figs. 2, 7; pl. IV, figs. 4, 8, 11, 14; pl. V, figs. 2, 4, 19; pl. I, figs. 3, 4, 16); [2]) the regeneration of a new zooecium within a heterozooecium (pl. II, figs. 5, 7, 12; pl. V, fig. 14); [3]) the regeneration of a new heterozooecium within an old one (pl. I, fig. 4; pl. II, figs. 6, 9, 20, 22; pl. III, figs. 6, 7; pl. V, fig. 15) and [4]) the regeneration of a new heterozooecium within an old zooecium, which is perhaps the most common form of regeneration (pl. I, figs. 18, 19; pl. III, figs. 1, 3, 4, 5, 27; pl. IV, figs. 3, 7, 10, 14). When a new large heterozooecium is regenerated within an old one it may fill the old aperture completely (pl. II, figs. 20, 22) or only a part of it, and in the latter case the space between the two apertures is gradually filled by a clo-

[1]) This species which is taken at lat. 33° 9 N., long. 129° 18 W. is in the dorsal surface provided with a number of hook-shaped appendages each of which through a corneous joint is fixed to the proximal part of an internode. [2]) 17.

sure-plate. As a rule this closure begins with the formation of three slender processes (pl. II, fig. 9) starting one from the end of the new aperture and the two others from the lateral margins of the old one. They unite about half the way between the end of the new and that of the old aperture, and the three open spaces are later filled, each by a calcareous lamina. A similar closure also takes place when a new zooecium is regenerated within a large heterozoœcium (pl. II, fig. 5). In the *Cyclostomata* a complete regeneration seems to be very rare, and I have hitherto only been able to find a few indistinct cases in *Entalophora madreporacea* and *Homera lichenoides*.

The Closure.

The closure of old zooecia by means of a calcareous film is a well-known fact both in the *Cheilostomata* and the *Cyclostomata*, and it seems to be more common in the latter than in the former division. The real operculum of the *Meliceritidæ*, which has been correctly interpreted by D'ORBIGNY has by all later authors been regarded as a closure-plate, and with the exception of WATERS who mentions a peculiar form of closure in *Meliceritites Royana* no author seems to have noticed a real closure in this division. I have found a closure in almost all the species examined, not only in the zooecia, but also in the heterozooecia, and as a rule the zooecia are closed by a concave or sometimes flat calcareous film (pl. I, figs. 4, 14, 16; pl. II, fig. 7; pl. III, figs. 7, 26; pl. IV, figs. 6, 7, 15; pl. V, figs. 2, 19; pl. VI, figs. 4, 10), which in the species provided with an oral ledge either starts from the inner margin of the latter or at a somewhat deeper level; and in that case the aperture is lastly closed in its proximal and middle part (pl. II, fig. 7; pl. III, fig 25). In the other species the closure starts from the margin of the aperture and gradually extends towards the centre (pl. IV, fig. 15). In *Mel. magnifica* (pl. I, fig. 7) and *Mel. plana* D'ORB. (pl. V, fig. 12) the closure takes place by means of 3—5 processes starting from the margin of the aperture and later coalescing into a cover perforated by 3—5 holes, which are gradually closed. A third form of closure I have found in *Mel. palpebrosa* (pl. VII, fig. 1, 4—9). In opposition to what is found in the operculum the closure-plate never presents a flabelliform striation.

The Colonies.

In opposition to the rich diversity of colonial forms or forms of growth shown by the *Cyclostomata* the number of colonial forms presented by the *Meliceritidae* is very small, and we can only discern between incrusting disciform colonies, one-or two-layered laminose fronds, and ramose colonies with cylindrical branches. The laminose colonies sometimes form hollow expansions f. inst. in *Mel. Vieilbanci* or a reticulate network, f. inst. in *Retelea pulchella* d'Orb. In many species the colo-

nies of which are incrusting or freely ramose there appears in the course of time new layers of zooecia over the old ones, and the old colonies therefore get many-layered.

According to D'ORBIGNY the formation of new layers takes place in three different manners. In the ramose colonies f. inst. in *Multelea magnifica* they are said to start from the proximal part of the colony whence they gradually and regularly extend distally. In the disciform colonies each layer may either f. inst. in *Semimultelea cupula* and *Sem. gradata* be formed by a single subcolony starting from the centre and extending towards the margin or f. inst. in *Reptomultelea tuberosa* and *Clausimultelea tuberosa* or the surface of the colonie may at the same time present a greater or smaller number of small disciform sub-colonies which at last must come in contact or fuse together. I have examined a large number of fragments of *Mel. magnifica*, and I have come to the result that the superficial layers are not formed in such a regular manner as D'ORBIGNY means, the fragments examined presenting in different parts of the surface a number of independent layers or patches of zooecia. Pl. VII, fig. 16, shows a fragment of a colony the one surface of which presents three different layers or sub-colonies. One surrounds the proximal part of the rudiment while another arising from the space between the two branches extends both upwards and downwards, and a third, a small round patch is seen to the link side between the two larger ones. The opposite surface of the fragment presented still two others. While I have not been able to find the ancestrulae of the new layers in *Mel. magnifica* I have seen a number of them in small fragments of *Mel. tuberculata* D'ORB. (pl. VI, fig. 3) and *Mel. Filiozati* n. sp. (pl. VI, fig. 7). As can also be seen in the figure of a young sub-colonie of *Semimultelea gradata* given by D'ORBIGNY such an ancestrula is only represented by the aperture, the rest of the zooecium being covered by the new zooecia which have arisen from it. But while this aperture in D'ORBIGNY's figure is seen in the centre of a small distinct sub-colony the margin of which is formed by undeveloped zooecia, the named fragments each presents a uniform continuous surface formed by zooecia and heterozooecia among which are seen a number of ancestrular apertures, some of which may often be placed so near to each other that two such apertures are only divided by the breadth of a zooecium. Each aperture which is obliquely ascending is placed in the centre of a small deepening, and the zooecia and heterozooecia surrounding two or more such apertures placed near to each other, may be more or less irregularly arranged, but I have never seen such an aperture making the centre of a distinct sub-colony, and the zooecia arising from the different ancestrulae seem to have accommodated themselves pretty well to each other during their growth. A fragment of this species 5 mm long and 3 mm broad presents 8 such ancestrular apertures, and another of a similar size 6. A single time I have seen a short cylindrical zooecium placed vertically between four zooecia and a kenozooecium, and it must no doubt be regarded as an ancestrula destined to take part in the formation of a new superficial layer.

Affinities.

As to the affinities of the present division there can be no doubt that the *Meliceritidae* are Cyclostomata, and in the first place this is distinctly shown by the form and development of the zooecia, these being long slender tubes each of which arises from the proximal part of another zooecium. The presence of numerous fine pores is also a cyclostomatous character, and rhombic or hexagonal zooecial areas divided by prominent marginal ridges may also be found in a number of *Cyclostomata*. The gonozooecia are provided with similar ooecial expansions as are found in the *Cyclostomata*, and the superficial layers of growth above spoken of are also found in a number of cyclostomatous species, but never in the *Cheilostomata*. The only two characters which might speak in favour of Cheilostomatous affinities are the presence of an operculum and of heterozooecia. Apart from the fact that the latter as the common zooecia are long slender tubes they differ from the cheilostomatous heterozooecia in possessing calcareous mandibles and in lacking a membranous suboral area. The opercula are also calcareous while the opercula in the great majority of the *Cheilostomata* are chitinous, a calcareous operculum being only present in a few cheilostomatous species. Therefore we must regard the presence of opercula and of heterozooecia as a case of parallel development.

We here propose to divide the Ordre *Cyclostomata* in two subordres, the *Cyclostomata inoperculata* and the *Cyclostomata operculata,* and the latter may be defined in the following manner.

Cyclostomata operculata.

Cyclostomata the zooecial tubes of which are much widened distally appearing on the surface of the colony as hexagonal, rhombic or qvadrangular mostly concave areas, in most cases divided from each other by a meshwork of ridges, in the knots of which are very often seen more or less developed tubercles. The subterminal aperture which has a straight or almost straight proximal margin is provided with a convex calcareous operculum showing more or less distinct radiating striæ. In most species are found heterozooecia the aperture of which is very often of a similar form as that found in the cheilostomatous avicularia. They always lack a membranous subopercular area and are provided with a calcareous mandible.

Family *Meliceritidae* Pergens.
Eleidae d'Orbigny.

The family *Meliceritidae* has been divided by d'Orbigny in 11 and by Gregory in 10 genera, and the generique characters have been taken partly from the form and mode of growth of the colony partly from the presence or absence of heterozooecia (avicularia). As to my opinion none of these characters are sufficient to serve as base for a generic division, and I have not yet been able to distinguish

between well divided groups based on structural diversities I prefer at present to acknowledge only a single genus, *Meliceritites*. The most significant structural diversity is to my opinion the presence or absence of an oral ledge, but when the state of conservation is not a good one it is not easy to see whether the aperture is provided with a feebly developed oral ledge or not. Also the diversities found in the heterozooecia may perhaps be of systematic significance, but to decide these different questions it should be necessary to possess a large and well-conserved material.

Meliceritites magnifica d'Orbigny.

Multelea magnifica d'Orbigny, Bryoz. crét, p. 649, pl. 740, figs. 1—9.
Melicertites magnifica Pergens, Revision d. Bryoz. p. 397.
Melicertites royana Waters, Annals Nat. Hist. [6] VIII 1891, p. 51, pl. VI, figs. 2, 4—6, 11.
Multelea magnifica Gregory, Cret. Bryoz. p. 316.
(pl I, figs. 3—10, pl. VII, figs. 13—19.)

The *Zooecia* which are divided by distinct marginal ridges are small and have when freely developed a more or less regular rhombic outline, but in most cases each zooecium is enclosed between two heterozooecia which greatly influence both the size and the form of the subopercular area, and in the zooecia enclosed between the proximal halves of two heterozooecia a large part of this area is covered by the distal part of a proximal heterozooecium. No distinct tubercles. The aperture which takes up the whole breadth of the zooecium in the distal part may be contained two or rarely three times in the length of the zooecium, but in most cases it is longer than the subopercular area. It is longer than broad, half-elliptical or roundedly triangular and surrounded by a raised peristome, sometimes provided with a small distal projection. The anter of the aperture is provided with a distinct but rather narrow oral ledge, and the convex operculum which sometimes shows a distinct flabelliform striation presents a more or less distinct triangular depression which from the proximal margin extends more or less far distally.

The *Heterozooecia* which are much larger than the zooecia are of a lengthened rhombic or hexagonally rhombic form with the four lateral margin more or less incurved. The opercular area which ends in a rounded apex may be very much protuding and obliquely ascending, and the inner aperture is concealed by a much concave covering (the »lateral processes«) the proximal half of which is provided with a narrow mediane fissure and the proximal margin of which by a similar transverse fissure is divided from the more or less protuding somewhat thickened distal margin of the concave subopercular area. The heterozooecia in this species are much more numerous than in any other hitherto described.

The *Closure* takes place in different ways. In many zooecia the aperture is closed by a concave lamina but in others (figs. 6, 7) I have seen a closure-plate of a similar appearence as the concave covering found in the opercular area of the heterozooecia, namely presenting two narrow fissures forming right angles with each other. Perhaps the latter form of closure is only the beginning of the concave

lamina. A second form of closure is that pointed out by WATERS. It starts by the growing forth from the margin of the aperture of 2—5 processes which later coalesce after which the smaller apertures between the processes are gradually filled out. Both forms of closure may be found in the same colony, but as a rule one of them is predominant.

The heterozooecia are closed by a filling out of the two fissures found in the opercular cover. —

The *Ooecia* are of very different form and size.

Kenozooecia have not been found.

Regeneration is found both of the zooecia and of the heterozooecia, but with the exception of a few indistinct cases always in that manner that old zooecia have been regenerated by new zooecia and old heterozooecia by new heterozooecia. There has be seen as many as three regenerations in a single zooecium or heterozooecium.

The *Colonies* are erect with cylindrical branches, and when old are surrounded by a number of superficial layers of new zooecia, which may arise in very different parts of the branches. The zooecia and heterozooecia show a disposition to arrange themselves in transvers series in such a manner that two series of zooecia are followed by a single series of heterozooecia, and in the most regular colonies these series form more or less complete, more or less unmixed, ringshaped belts surrounding the branches. Sometimes, however, the arrangement of the zooecia and heterozooecia may be more or less irregular, and the heterozooecia may sometimes be present in sparse numbers, irregularly distributed among the zooecia (var. royana Wat.). The zooecia placed between the distal halves of the heterozooecia are provided with a small narrow subopercular area, while in the other series of zooecia the subopercular area is as a rule much broader, but the proximal part of it is concealed by the distal end of the proximal heterozooecia.

Critical remarks. In D'ORBIGNY's figure 2 is seen distally to each transverse series of heterozooecia a transverse series of zooecia which differ from those placed proximally to the heterozooecia by the possession of a very small half-elliptical aperture. The zooecia of this series, however, do not differ from the other in the form of the aperture, and D'ORBIGNY's error must no doubt be explained in that way that he has seen in such a series a number of regenerated zooecia (see pl. 1, fig. 3), the structure of which he has misunderstood. For the rest D'ORBIGNY regards the heterozooecia as »cellules ordinaires« and the zooecia as »cellules accessoires«. — In longitudinal sections of many-layered colonies of this species WATERS means to have seen that the zooecia of the external layers arise from a plate covering the aperture of the subjacent zooecia. I do not agree with WATERS in that question, and to my opinion a longitudinal section of such a colony only shows that the inner wall of the external zooecia has quite coalesced with the frontal wall of the subjacent ones. That the operculum or the closing plate of an old zooecium should be able to give rise to a new zooecium is not very probable, and that each zooecium of the external layer should grow forth from a subjacent one does not correspond

with the fact that the surface of such a colony shows a number of smaller or larger patches or layers in which the single zooecia are arranged round a centre. In transverse sections of colonies of the same species WATERS has further seen »a contraction formed by a curved plate« placed »on each side just below the opening«. I have never been able to find the two curved projections figured hy WATERS but sometimes two 'slender conical processes which arise from a transverse section of the above covering found in the opercular area of the heterozooecia. — Of this species I have examined a large number of specimens from Villedieu (Coniacian).

Meliceritites trifolium n sp.

? Multelea semiluna d'Orbigny, Bryoz. crét. p. 646, pl. 739, figs. 8—11.
(Pl. 1, figs. 17—19.)

The *Zooecia* wich are divided by distinct marginal ridges are small, rhombic or hexagonal, not so much longer than broad, and their distal part is as a rule not entirely taken up by the aperture. There may be found more or less distinct tubercles. The surface wich may be concave, flat or even a little convex is more or less distinctly ascending toward the half-elliptical aperture the length of which may be contained two or two and a half times in the length of the zooecium. The aperture is provided with a distinct but rather narrow oral ledge and a distinct peristomial thickening, and the operculum is much convex and provided with distinct radiating striae.

The *Heterozooecia* which may be found in very different numbers are of a similar form and size as the zooecia; but the surface is much more concave and not ascending toward the aperture. The latter has a similar covering as that found in the heterozooecia of *Mel. magnifica*. It is provided with a narrow median fissure, and by a similar transverse fissure it is divided from the opercular area.

Ooecia have not been found.

Kenozooecia have not been found.

The *Closure* is effected in the zooecia by means of a concave lamina and in the heterzooecia by a filling out of the fissures.

The *Regeneration*. The only form of regeneration which I have seen distinctly in this species is the formation of new heterozooecia in old zooecia. In that case the aperture of the latter is taken up by a large arched projection, the frontal and proximal part of which is provided with a similar aperture as that found in the heterozooecia, only much smaller. In old colonies I have seen a very great number of the zooecia transformed in that manner.

The *Colonies* are free with cylindrical branches, and in some of them I have seen superficial layers of different extension.

In the presence of a similarly developed oral ledge, in the structure of the heterozooecia and in the form of the colony this species shows affinity to *Mel. magnifica*. —

I have examined a number of fragments from Bruillé Poncé. (Turonian).

Meliceritites angulosa d'Orbigny.

Nodelea angulosa d'Orbigny Bryoz. crét. p. 610, pl. 735, figs. 4–5 (non 6).
— ornata d'Orbigny op. cit. p. 612, pl. 736, figs. 12—16.
— transversa d'Orbigny op. cit. p. 613, pl. 736, figs. 5—8.
— pulchella d'Orbigny op. cit. p. 613, pl. 736, figs. 1—4.
— ogivalis d'Orbigny op. cit. p. 624, pl. 737, figs. 8—10.
— semiclausa d'Orbigny op. cit. p. 619, pl. 678, fig. 7, pl. 736, fig. 16.
Multinodelea tuberosa d'Orbigny op. cit. p. 615, pl. 736, figs. 9–11, 13—15.
Melicertites undata Gregory (non d'Orbigny) op. cit. p. 340, pl. XV, figs. 3, 4, pl. XVI, fig. 3.
(Pl. II, figs. 4—22.)

The *Zooecia* which are divided from each other by more or less developed marginal ridges are in most cases of a more or less distinct hexagonal form, and the semielliptical aperture is always provided with a distinct, but more or less developed oral ledge, and with a distinct peristomial thickening. It takes up in most cases the whole breadth ot the zooecium in the distal part; but while in some cases it is longere than the subopercular area in others it is shorter, and sometimes its length may be contained twice in the length of the latter. More or less developed tubercles. The operculum is convex and provided with radiating striae.

The *Heterozooecia* which are present in very sparse number and are very variable in form and size are dispersed singly or in pairs among the zooecia which they always surpass in length. Most of them have about the double length of the zooecia, but sometimes they are only a little longer. In opposition to the heterozooecia of *Mel. magnifica* and *Mel. trifolium* the inner aperture is always visible, not being concealed by »lateral processes«, but the form of the opercular area is subject to a very great variation, being dependent not only on the different relation between its length and its (largest) breadth, but also on the form of the lateral margins, and lastly on the manner in which the latter run together to form the distal end of the area. The relation named varies between 4:3 and 5:2, and the lateral margins may sometimes in the greater part of their length be parallel or allmost so, sometimes more or less convergent and sometimes more or less incurved. As to the last named difference the lateral margins run together to form an almost semicircular curve while in other cases they make an almost rectangular bend in ordre to form the feebly curved distal end. Also the relative length of the opercular and the subopercular area is subject to variation, and the former may sometimes be three times as long as the latter while in other cases it is only a little longer. In most cases it attains the double length. In a number of heterozooecia I have found an arched calcareous mandible which sometimes shows a similar striation as that found in the operculum.

Kenozooecia have not been found.

The *Ooecia* are of different form and size.

The *Closure* of the zooecia is effected by a concave lamina starting from the free edge of the oral ledge and developing in such a way that at a certain point

of time the closure-plate is perforated by a fissure-like opening seated in its proximal and median part (fig. 7).

The *Regeneration.* In a few cases I have found zooecia regenerated in old ones and more freqvent a regeneration of the heterozooecia, sometimes by a new heterozooecium sometimes by a zooecium (figs. 5, 7). Sometimes the new heterozooecium may fill out the whole aperture of the old one (fig. 20), but if that is not the case the space between the old and the new aperture is gradually closed by a calcareous lamina which however is not formed as a unity, but as more (as a rule three) plates filling out the spaces between as many calcareous processes. Fig. 9 shows the three calcareous processes, and in fig. 5, which presents a zooecium regenerated in a heterozooecium is seen a similar case in which the spaces between the three processes have been filled out. In fig. 7 is seen a more irregular case and in the case presented in fig. 22 the filling out of the narrow space between the old and the new aperture has been prepared by the formation of short connecting processes.

The *Colonies* are free with cylindrical branches, and in time increase in thickness by the formation of superficial layers several of which may be seen at the same time in different parts of the branch.

This species is subject to a very great variation in all respects, and I have tried in vain to divide the material examined in more different forms. We may discern between the following two chief-varieties which are however very far from being sharply limited.

Var. *latirostris.* The subopercular area is longer than or as long as the aperture, longer than broad; the oral ledge is narrow, and its height in the distal part does not attain a third part of the height of the aperture. The marginal ridges are narrow and the tubercles are small. The distal half of the heterozooecial aperture is broad.

Var *angustirostris.* The subopercular area is shorter than the aperture broader than long. The oral ledge is broad and its height in the distal part attains the third part of the height of the aperture. The marginal ridges and the tubercles are strongly developed.

I have examined colonies from Villedieu, Fécamp, Couture, Vendôme, St. Paterne, Evreux and from Chatham.

Meliceritites semiluna d'Orbigny.

Nodelea semiluna d'Orbigny, Bryoz. crét. p. 611, pl. 735, figs. 9—11.
— — Gregory, Cret. Bryozoa p. 307.
(Pl. VI, figs. 4—6.)

The *Zooecia* which have a more or less distinct rhombic or hexagonal outline and the subopercular area of which is as a rule convex or flat, and more or less distinctly ascending towards the aperture are rarely divided by indistinct marginal ridges, and as a rule there are no tubercles. The aperture which is about as long

as the subopercular area and takes up the whole breadth of the zooecium in its distal part is provided with a strongly developed, as a rule angularly bent oral ledge, the height of which in its distal part may be contained about three times in the height of the whole aperture. The form of the latter varies between half-elliptical and roundedly triangular, the lateral margins being in their proximal half sometimes almost parallel sometimes more or less converging distally. The peristomial thickening is rarely distinctly developed being in most cases coalesced with the convex subopercular areas of the adjacent zooecia, and the apertures of the zooecia in the same transverse series are in most cases divided by columnar projections formed wholly or partly by the lateral parts of the peristomial thickening. The proximal part of the peristome forms a more or less prominent lip. The operculum is very convex, but in such a manner that its proximal half is provided with a triangular flat, obliquely ascending area from the margins of which the surrrounding parts are gradually descending. It is provided with distinct radiating striæ.

The *Heterozooecia* which are about half as long as the zooecia are sparingly spread over the surface of the colony, singly or in pairs, the two heterozooecia belonging to a pair being either placed side by side or divided from each other by a single zooecium. The strongly projecting obliquely ascending aperture is as long as broad or a little longer and has a somewhat variable form, the two lateral margins being more or less converging distally. No »lateral processes«.

Ooecia have been found.

No *Kenozooecia.*

The *Closure* takes place by means of a concave or in most cases flat lamina which arises a little within the free edge of the oral ledge from which, therefore, it is distinctly defined. A similar closure I have seen also in a heterozooecium.

The *Regeneration.* I have seen cases of regeneration both of zooecia and of heterozooecia.

The *Colonies* are free, with cylindrical branches, and in some of the fragments examined I have found superficial layers.

Mel. semiluna is nearly related to *Mel. angulosa* and may perhaps be regarded as a constant variety of this species, from which it is most easily discerned by the lack of or the feeble development of the marginal ridges and the tubercles, the form of the operculum and the mode of closure. I have seen a number of fragments from Bruillé-Poncé (Turonian).

Meliceritites palpebrosa nov. nom.

Melicertites semiluna d'Orbigny, Bryoz. crét. p. 623, pl. 736, fig. 20—21.
non — — Gregory, Cretac-Bryoz. p. 343.
(Pl. VII, figs. 1—9.)

The *Zooecia* are chiefly represented by their large half-elliptical apertures which as a rule take up most of the surface of the colony. Marginal ridges and tubercles

are not developed. The aperture is provided with a very distinct, but rather narrow oral ledge, but a peristomial thickening is very seldom distinct, being in most cases coalesced with the surface of the small, triangular mostly convex subopercular area the height of which in most cases is contained about two times in the height of the aperture. The apertures placed in the same transverse series are in most cases divided from each other by columnar projections wholly or partly formed by the lateral parts of the peristomes. The operculum is convex with distinct radiating striae.

No *Heterozooecia.*

No *Kenozooecia.*

Ooecia have not been found.

The *Closure* as a rule takes place in a very singular manner. It starts by an enlargement of the oral ledge, and at the same time the distal and the proximal margins of the latter get connected by a number of vertical columnar projections divided by rounded pits. As this distal closure-plate gradually increases in size and in thickness the pits increase in length, at the same time diminishing in breadth, and the oral ledge thus gets transformed into a strongly arched structure very much like a cheilostomatous ooecium or an eye-lid. According to their age these distal closure-plates are either smooth or their surface presents a series of more or less distinct impressions, the vestiges of the original pits. Somewhat later than the distal also a proximal closing plate begins to develop, starting from the proximal margin of the aperture. In opposition to the distal plate the latter is as a rule concave or flat, and sometimes directed obliquely inwards. By and by the originally large aperture is transformed into a narrow fissure-like opening which is lastly filled out. This process of closure, however, shows a great variation even in the same fragment, the two plates being developed in very different degree, and in some cases the distal one may be very small (figs. 1, 9). In a few zooecia I have found the closure effected in the usual way by means of a concave or flat lamina (fig. 2).

Regeneration has not been found.

The *Colonies* are free with cylindrical branches, and I have seen no superficial layers.

I have seen rather numerous specimens of this species from Villedieu.

Meliceritites Lorieri d'Orbigny.

Vincularia Lorieri d'Orbigny, Bryoz. Crét. p. 61, pl. 601, figs. 18—20.
Melicertites semiclausa Pergens, Revision d. Bryoz. p. 394.
non Melicertites semiluna d'Orbigny, Bryoz. Crét., p. 623, pl. 736, figs. 20—21.
non Melicertites semiclausa Gregory, Cretac. Bryozoa, p. 328, pl. XIV, figs. 1—3.
(Pl. IV, fig. 18.)

The Zooecia which are at the utmost as long as broad and in most cases a little broader than long are not divided by distinct marginal ridges, and the peri-

stomial thickenings are either quite confluent with the suboral areas of the adjacent zooecia or indistinctly divided from the latter. Sometimes there may be found indistinctly defined tubercles between the zooecia of the same transverse series. The aperture which is broader than high has a broadly rounded anter and a well-developed sharply defined oral ledge which only decreases very little in heigth towards the proximal margin. A very much convex operculum has only been found in a small number of zooecia. The triangular flat suboral area is obliquely descending towards the aperture.

The *Heterozooecia* are very rare, and in each of the four fragments examined which have a length of 12—20 mm they have only been found in a number of 1—4. They are more than twice as long as the zooecia and are of a similar form as the heterozooecia figured in pl. II, fig. 19 and belonging to *Mel. angulosa*. The two lateral margins, however, are much more incurved, and the aperture therefore is almost completely hour-glass-shaped, the two dilatations being about of the same form and size and being connected by a very narrow median part, the breadth of which is contained about four times in the breadth of the proximal margin. The suboral area has the same form and size as in the zooecia. Each heterozooecium is bordered by two pairs of zooecia, and those belonging to the distal pair has a similar, but still more oblique position as in those seen in pl. II, fig. 18.

Ooecia have not been found.

No *Kenozooecia.*

The *Closure* takes place in great measure by the aid of a flat or somewhat concave lamina placed at the rule at a much deeper level than the oral ledge.

A *Regeneration* has not been found.

The *Colonies.* I have examined four incomposite cylindrical fragments each provided with 1—2 lateral branches. The zooecia, the apertures of which are generally placed very near to each other, are arranged in distinct transverse series, each containing about 20 zooecia.

Le Mans (*Cenomanian*).

In the specimens examined a number both of the closure-plates and of the opercula have undergone a more or less complete decalcification, and several of these structures are represented only by thin chitinlike membranes, which are left unaltered after a fragment has been dissolved in muriatic acid.

Meliceritites Canui n. sp.

(Pl. III, figs. 20—27.)

The Zooecia which are divided by distinct marginal ridges, are more or less regular hexagonal, twice as long as broad, and the large about half-elliptical aperture which only in its distal half takes up the whole breadth of the zooecium is a little shorter than the concave or mostly saddle-shaped subopercular area which is strongly ascending towards the well-developed peristome. The aperture is provided

with a distinct, but narrow peristomial thickening, and with a well-developed oral ledge the height of which in its distal part may be contained four or five times in the height of the whole aperture. The operculum is convex and provided with very fine radiating striae. No distinct tubercles.

The *Heterozooecia* have about the same form and size as the zooecia being only a little narrower, and the chief difference between them and the zooecia is that they are provided with a very small aperture which is either of a somewhat similar form or more elongate. They are provided with a well-developed oral ledge and with a more or less distinct peristomial thickening, but their height is somewhat variable and may be contained four or five times in the height of the whole heterozooecium. The operculum has a similar structure as that found in the zooecia.

The *Kenozooecia*. A somewhat variable number of kenozooecia of the same form and size as the heterozooecia are mixed with the heterozooecia, and these two forms of zooids take up about the one half of the surface in larger or smaller portions of the fragments examined.

Ooecia have not been found.

The *Closure*. I have seen a few zooecia closed by a concave lamina, and a larger number of wholly or partially closed heterozooecia. The closure starts from the edge of the oral ledge, and proceeds in that way that the last part of the aperture which is closed is a small median opening distally to the proximal margin.

The *Regeneration*. I have seen a few zooecia regenerated in old ones.

The *Colonies* are free, but I have only seen a number of small (long 4 mm) unbranched cylindrical pieces, each of which contains c. 10 longitudinal series of bryozoids.

Fécamp (Middle Senonian).

Meliceritites gracilis Goldfuss.

Ceriopora gracilis Goldfuss, Petref. Germ., vol. 1, p. 35, pl. X, figs. 11a—c.
non Meliceritites gracilis Roemer, Verstein. nordd. Kreideg., p. 18, pl. V, fig. 13.
non — — Canu, Bull. Soc. Géol. de France, 3e série, t. XXV. 1897, p. 752, pl. XXII, figs. 1—2.
Meliceritites gracilis Gregory, Cret. Bryoz., vol. 1, p. 324, figs. 38a—b.
(figs. a, b.)

The *Zooecia* which are divided by more or less distinct marginal ridges are as a rule rhombical or hexagonally rhombical, and the triangular aperture which takes up the whole breadth in the distal part of the zooecium and rarely attains the half length of the latter is a little longer than broad and provided with a well-developed oral ledge. There is a well-developed peristomial thickening the poster of which forms a prominent lower lip which is often left as a transverse bridge after the rest of the frontal wall has disappeared. The frontal wall is distinctly concave. An operculum has only been found in a single zooecium,

Heterozooecia and *Ooecia* have not been found.

The *Kenozooecia*. Only a single time two small kenozooecia have been found in an angle between two branches.

The *Closure* which has been found in many zooecia is effected by means of a flat or concave calcareous plate which as a rule starts from the free edge of the oral ledge and therefore fuses together with the latter. Sometimes, however, it starts at a deeper level, and in that case the marginal depression is distinctly divided from the closure-plate.

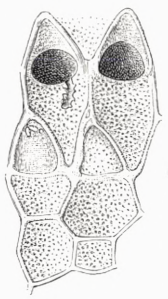

fig. a.
l. oral ledge.
o. operculum.
k. kenozooecium.

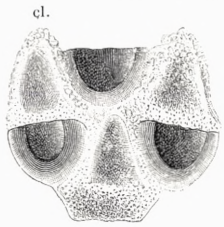

fig. b.
cl. closure-plate.

The *Colonies* are freely branched with cylindrical branches, in which the zooecia are arranged in more or less regular, alternating transverse series each of which in the primary or incomposite colony contains 14—16 zooecia. Gradually the colonies get multi-layered, and in one of the original specimens of Goldfuss there is found four different layers the outmost of which presents a number of different centra.

This species is as a rule badly preserved, and most zooecia have either lost the larger part of their frontal wall or this has been in different degree covered by incrustations. These circumstances together with the frequent closure of the zooecia are the causes why only very few apertures present the characteristical oral ledge the length of which attains more than the third part of the length of the whole aperture.

Of this species I have been able to investigate not only the original specimens of Goldfuss kept in the palæontological museum of Bonn (Prof. G. Steinmann), but also a number of exemplars from the palæontological museum of Münster (Prof. H. Wegner), which have been found in a conglomerate of gypsum at Essen. Under the name of *Ceriopora gracilis* Goldf. the latter were mixed with a number of species belonging to different families and genera, and among these I found besides another species of *Meliceritites* a species of *Entalophora* to which I must refer the figure which accompanies Roemer's description of *Mel. gracilis*. While the aperture of the latter species is longer than broad, and the zooecia are as a rule about twice as long as broad the aperture in Roemer's figure is broader than long and the zooecia only half a time longer than broad. The description, however, corresponds better to the original specimens than to the figure. I provisionally propose the name *Entalophora Roemeri* for this species of which I here give the following description. The hexagonal zooecia which are only half as long as broad are provided with a very concave frontal area and divided by strongly developed marginal ridges. The aperture which takes up the larger part of the breadth in the distal part of the zooecium, and together with the peristome about half the length of the whole zooecium is triangularly rounded, broader than high and pro-

vided with a strongly developed peristomial thickening, the proximal part of which forms an obliquely or even vertically ascending under lip. The fragments examined are elongate clavate, rounded or a little compressed and accreasing gradually in thickness towards the tip which is about double as thick as the proximal end. The fragment to which the zooecia belong, which are figured in Pl. VII (figs. 25—26), has a length of 10 mm and the thickness of the tip is 4 mm.

I think that the two specimens figured by GREGORY both must be referred to *Mel. gracilis* Goldf., but in that case they are figured in the inverted position, and the supposed aperture in GREGORY's figures seems to be identical with the opening seen in the proximal part of my figure b and which is due to a partial destruction of the frontal wall.

Meliceritites gothica nov. nom.

Melicertites gracilis Marsson (non Goldfuss), Bryoz. Rügen p, 46, pl. IV, fig. 8.
(Pl. I, figs. 11—14).

The *Zooecia* which are divided by distinct, more or less developed marginal ridges, are hexagonally rhombic, and the very concave suboral area is strongly, sometimes allmost vertically ascending towards the aperture which does not take up the whole breadth in the distal part of the zooecium. The tubercles are distinct but developed in very different degree. The aperture which is provided with a distinct peristomial thickening and a distinct, but rather narrow oral ledge has the form of a gothic arch, the lateral margins in their distal part running together to form a more or less distinctly angulate terminal portion while in their proximal part they are somewhat converging proximally or parallel. The supraoral tubercle forms a more or less developed beak-shaped projection. The convex operculum is provided with a distinct flabelliform striation, and, besides, with a number of small claviform projections, which are arranged in a similar manner and seem to be perforated.

The *Heterozooecia* are as a rule found in groups of 2—7, rarely singly, and they larger groups are generally mixed with a number of kenozooecia. They are as long as or somewhat longer than the zooecia and provided with a narrow, more or less projecting aperture of very different length the lateral margins of which are almost parallel or very little converging distally. The fissure-like opening which has a proximal triangular enlargement is bordered by two obliquely descending lateral thickenings.

Ooecia have not been found.

The *Kenozooecia* which are of the same form and size as the zooecia are found singly or in groups and as a rule together with heterozooecia.

The *Closure* is effected by means of a flat or concave lamina (fig. 14).

The *Regeneration*. There has been found both a regeneration of new zooecia in old ones, of new heterozooecia in old zooecia and rarely of new heterozooecia in old ones.

The *Colonies* are incomposite, and the cylindrical fragments examined contain c. 10 zooecia in each transverse series.

I have examined a rather scarce number of fragments from Rügen and from Möen, and while in the specimen from Rügen the aperture is only as long as the suboral area in those from Möen it is more than half a time longer.

Meliceritits gothica, var. acuminata n.

(Pl. II, figs. 23—24.)

The Zooecia are hexagonal, and the aperture which is not far from being double as long as broad has the form of an elongate triangle the lateral margins of which are somewhat convex in their proximal part and a little incurved in their distal half. The distal part of the oral ledge is strongly developed, and may sometimes be allmost half as long as the whole aperture. All other features as in the main form.

Very common in the chalk (upper Senonian) from Tullstorp (Sweden) and from Svinklöven (Jutland).

Meliceritites pentagonum n. sp.

(Pl. IV, fig. 22.)

The *Zooecia* which are divided from each other by well-developed marginal ridges are more or less distinctly hexagonal, and in most cases about half a time as long as broad. As a rule distinct tubercles. The large aperture which does not take up the whole breadth of the zooecium in its distal part is more or less distinctly pentagonal, the two distal sides of the pentagone being sometimes represented by a curve while the two proximal paired sides are always distinctly converging proximally. It is provided with a well-developed oral ledge the two halves of which form with each other an acute or sometimes right angle. The oral ledge which is very narrow within the two paired proximal sides does not as in other species attain its largest height in the middle line, but in the two lateral halves. There is a well-developed peristomial thickening, the distal strongly projecting part of which belongs to the marginal ridges, and this part together with the supraoral tubercle often forms a more or less prominent beak-like projection. All the hitherto examined specimens have lost their opercula.

The *Heterozooecia,* which are spread among the zooecia in groups of 2—9 are of somewhat variable size, the smallest of them, however, not being much smaller than the zooecia. They are provided with a long narrow proximally gradually widening aperture, the narrow opening of which is bordered by two lateral processes. The aperture is of very different length and in the largest of them it is longer than the concave suboral area and takes up the whole breadth of the heterozooecium in its distal third part.

Ooecia have not been found.

Kenozooecia of the same form and size as the zooecia are often found together with the heterozooecia in a number of 1—3.

The *Closure* takes place by means of a concave lamina.

The *Regeneration.* Besides a regeneration of new zooecia in old ones there is found very commonly a regeneration of heterozooecia in zooecia.

The *Colonies* are incomposite, and the examined cylindrical fragments contain 10—12 zooecia in each transverse series.

Numerous specimens from the chalk (upper Senonian) of Tullstorp (Sweden).

Meliceritites Roemeri v. Hagenow.

Ceriopora Roemeri v. Hagenow, Monogr. d. Rügenschen Kreide-Verst. (N. Jahrb. f. Mineral. 1839, p. 285, pl. V, figs. 7a—b.

Meliceritites (Ceriopora) Roemeri Roemer, Verst. nordd. Kreidegeb. 1841, p. 18.

Vaginopora Roemeri v. Hagenow, Geinitz Grundr. d. Versteinerungskunde, 1846, p. 602, pl. XXIIIb, fig. 20.

non Ceriopora velata v. Hagenow, Monog. Rüg. Kreide-Verst. (N. Jahrb. f. Mineral.) p. 285, pl. V, fig. 6.

Nodelea propinqva Marsson, Bryozoen Rügen, p. 47, pl. V, fig. 1.

non Meliceritites gracilis Marsson, Bryozoen Rügen, p. 46, pl. IV, fig. 8.

(pl. V, figs. 18—24.)

The *Zooecia* which are in most cases only half as long as broad are hexagonal and divided from each other by a meshwork of distinct ridges in the knots of which there is found more or less developed often prismatic tubercles. The half-elliptical aperture which may be a little longer than broad and does not take up the whole breadth of the zooecium in its distal part is as a rule much shorter than the concave suboral area. It is provided with a well-developed peristomial thickening, and in especially well preserved zooecia there is seen a distinct, but rather narrow oral ledge. All the specimens examined have lost their opercula.

The *Heterozooecia.* There is found two different forms of heterozooecia the larger of which is avicularia-like and provided with a long narrow aperture. They are present in very scarce number, and in most of the fragments examined there has been found only a single one, rarely two or three. They are always larger than the zooecia, and the longest of them have a length a little more than twice that of the zooecia. The aperture which is longer than the suboral area and three or four times as long as the breadth in their middle part is provided with a median depression bordered by two narrow lateral thickenings. The other form of heterozooecia is found in large numbers among the zooecia, rarely singly, but as a rule in groups of 2—10, in most cases mixed with a number of kenozooecia. They have the same form and size as the zooecia from which they differ in the form of the apertures which, however, is subject to great variation. The same is the case also with their size as their length may be contained five to two and a half times in the length of the zooecium. In opposition to the zooecial apertures they have a narrow, feebly developed, peristomial thickening and a broadly rounded

distal margin, but while the smaller of them are nearly circular apart from the straight proximal margin the larger of them are more or less ligulate with almost parallel or proximally somewhat converging lateral margins. While those heterozooecia that are provided with the smaller apertures like the zooecia have an angularly bent distal end, the distal end of the others corresponds to a smaller or larger distal part of the ligulate aperture. The larger part of the aperture is filled by a concave lamina which no doubt corresponds to the oral ledge in the zooecial aperture, but in most cases this lamina has been expanded by a more or less advanced closure, and there is only left a fissure-like or narrow triangular opening. Sometimes the whole aperture is filled, and only in a few cases there has been found a half-elliptical or semi-circular opening (fig. 19).

The *Kenozooecia* which have the same form and size as the zooecia are as a rule found together with a number of heterozooecia, but they are not so frequent as the latter.

The *Closure* is effected by means of a concave lamina but it is much more common in the heterozooecia than in the zooecia.

The *Regeneration.* A regeneration of new zooecia in old ones is not frequent, but in most fragments there is found a number of old zooecia the aperture of which have been filled by heterozooecia with a small aperture (fig. 19).

The *Colonies* are uni-layered, and the cylindrical branches bear alternate transverse rows of c. 15 zooecia.

I have found numerous specimens in the chalk from Tullstorp (upper Senonian) Sweden.

When GREGORY refers. v. HAGENOW's and ROEMER's descriptions of *Mel. Roemeri* to *Mel. gracilis* Marss. he relies upon the authority of MARSSON, who, however, is wrong in his supposition. In HAGENOW's figure of the former species the length of the aperture is contained about thrice in the length of the zooecium, and that is just the case in most exemplars of *Mel. propinqva*, while in *Mel. gracilis* Marss. the aperture is as long as or even longer than the suboral area. But also the very short and incomplete descriptions agree with *Mel. propinqva* and not with *Mel. gracilis.* v. HAGENOW designates the apertures as „Kreisrunden oder abgerundet dreieckigen . . . . Poren", but these terms cannot in any way be used about the elongate distally somewhat pointed apertures of *Mel. gracilis*, and when both authors speak about zooecia in which the aperture is only represented by a fine pore, they evidently speak about the heterozooecia. Such a heterozooecium is seen in HAGENOW's figure.

Meliceritites sqvamata Marsson.

Marsson, Bryozoen Rügen p. 47, pl. IV, fig. 9.
(pl. V, figs. 13—17.)

The *Zooecia* which at the utmost may be half a time longer than broad are in most cases as broad as long and even a little broader. They are hexagonal and

divided by distinct ridges, of which the two distal ones may often be more or less curved. The tubercles are either lacking or very feebly developed. The more or less strongly protruding, half-elliptical aperture which at the utmost takes up the half breadth in the distal part of the zooecium is a little longer than broad and about as long as the concave or saddle-shaped suboral area which rises obliquely towards the aperture. In well preserved zooecia there may be found a narrow oral ledge.

The operculum is radially striated, and its pores seem to be perforations of small rounded elevations.

The *Heterozooecia* which are present in rather scarce numbers are of very different size, the smaller of them being only as long as the zooecia while the larger may attain more than the double length of the latter. While the former have an elongate triangularly rounded aperture, the length of which is contained 3—2 times in the length of the whole heterozooecium the latter have an elongate ligulate aperture, which is longer than the suboral area. Distally to the triangular opening is seen a longitudinal depression, bordered by two marginal thickenings.

Ooecia have not been found.

Kenozooecia of the same form and size as the zooecia are found in most fragments, generally in groups of 2—10.

The *Closure* takes place by means of a concave lamina.

The *Regeneration*. There is not rarely found a regeneration of new zooecia in old ones, and when the new aperture is not sharply divided from the old, its presence may be inferred from that it is much smaller and much more protruding than the other. Another form of regeneration which is perhaps more frequent is that the aperture of an old zooecium is filled by a small heterozooecium, the roundedly triangular aperture of which is as a rule obliquely protruding, and I think that MARSSON statement: „Die Zellen besitzen an der Spitze oft auch ein kleines, zuweilen von einer Pore durchbortes Wärzchen" must be referred to this form of regeneration. In a few cases I have seen a zooecium regenerated in a large heterozooecium (fig. 14) and a new large heterozooecium in an old one (fig. 15).

The *Colonies* are incomposite, and the cylindrical branches have c. 10 zooecia in each transverse row.

Numerous specimens have been found in the chalk (upper Senonian) from Möen (Denmark) and from Tullstorp (Sweden).

Meliceritites Filiozati n. sp.

Clausimultelea tuberculata d'Orbigny, Bryoz. crét. p. 656, pl. 784, figs. 12—15.
(Pl. VI, figs. 7—10.)

The *Zooecia* which are in most cases twice as long as broad and more or less regularly rhombic, are divided by well-developed marginal ridges, and the suboral area is as a rule a little convex. No tubercles. The half-elliptical aperture, the

length of which is very often contained twice in the length of the suboral area is provided with a distinct but rather narrow oral ledge, and together with the narrow peristomial thickening very often takes up the whole breadth in the distal part of the zooecium. The convex operculum which has been lost in most zooecia presents a distinct flabelliform striation.

The *Heterozooecia* which are spread singly among the zooecia in rather scarce number are as long as or even longer than the zooecia. The aperture which in most cases is a little longer than the convex suboral area, is about half as long as broad, and the two allmost parallel lateral margin run together distally in a very broad curve. We may discern between two obliquely ascending lateral thickenings and a deep median somewhat hour-glass-shaped depression, in the proximal half of which is seen the half-elliptical inner aperture.

Ooecia have not been found.

Kenozooecia of a similar form and size as the zooecia are scattered among the latter in rather scarce numbers singly or more together.

The *Closure* takes place by means of a flat lamina which arises proximally to the oral ledge.

A *Regeneration* has not been seen.

The *Colonies.* I have examined a number of laminate fragments consisting of 3—4 layers of zooecia, and to judge from these the colony seems to have had a somewhat similar structure as that figured in d'ORBIGNY's pl. 784, fig. 12 and referred to *Clausimultelea tuberculata.* But while in this figure the sub-colonies which compose the different layers partly appear as sharply defined small discs, I have found no such in the few fragments of the present species, which present ancestrulae, but the small sub-colonies, the ancestrulae of which are sometimes placed very near to each other in a number of 2—7, are fused together, partly by the aid of Kenozooecia of very different form and size. The only visible part of such an ancestrula is the obliquely ascending aperture, and as the zooecia immediately surrounding it have an ascending frontal wall, each ancestrular aperture is the centre of a more or less deep depression, which may be elongate when two ancestrular apertures are placed very near to each other (fig. 7). In a single fragment I have found a short, cylindrical erect zooecium (fig. 8) arising between four zooecia and a kenozooecium, and I must regard it as an ancestrula destined to give rise to a new sub-colony.

A number of fragments from Fécamp (Middle Senonian).

Meliceritites tuberculata d'Orbigny.

?Clausimultelea tuberculata d'Orbigny, Bryoz. Crét. p. 656, pl. 784, figs. 12—15.
(pl. VI, figs. 1—3.)

The *Zooecia* which are divided by distinct ridges and generally present a convex or saddle-shaped distally obliquely ascending suboral area are of a rather

variable form and size, but in most cases they are about twice as long as broad and sometimes much longer. No tubercles. The aperture which is provided with a distinct but rather narrow oral ledge and a narrow peristomial thickening presents some variation in form and dimensions, but is generally half as long as broad, and the two lateral margins are somewhat converging proximally. The convex operculum shows a distinct flabelliform striation. —

The *Heterozooecia* which are spread among the zooecia singly or more together are about of the same length as the latter, and the beak-shaped more or less projecting distal end is as a rule much shorter than the concave suboral area. The narrow triangular obliquely ascending aperture is provided with an almost fissure-like opening bordered by two inwardly sloping lateral thickenings. In a single case I have found a calcareous mandible (fig. 2).

Ooecia have not been found.

The *Kenozooecia*, which have a similar form and size as the zooecia are in large numbers spread among the zooecia.

The *Closure* takes place by means of a concave lamina.

The *Regeneration*. In the fragments examined I have only seen the regeneration of a new heterozooecium from an old one (fig. 1).

The *Colonies*. I have examined a few laminate fragments consisting of a number of layers, and in one of them the zooecia are as in the above fragments of *Mel. Filiozati* arranged in groups around a number of ancestrulae.

The basin of Paris (Danian), Fécamp (Middle Senonian).

When I refer the present species and not *Mel. Filiozati* to *Clausimultelea tuberculata* d'Orb. it is because it agrees better with the figure given by D'ORBIGNY, not only in the form of the apertures but also in the large number of the kenozooecia. For the rest D'ORBIGNY's description as also his figure bear witness to a very superficial examination as the zooecia according to this author, quite in opposition to what is really the case, are only represented by their apertures. Also the relation between the apertures and the kenozooecia in the figure leaves no doubt, that the latter is constructed and not made according to nature.

Meliceritites pyrenaica d'Orbigny.

Foricula pyrenaica d'Orbigny, Bryoz. Crét. p. 658, pl. 741, figs. 16—18.
(Pl. VI, figs. 11—21.)

The *Zooecia* which are never divided by marginal ridges are subject to a very great variation both in respect to the form and size of the aperture and to the form and relative extension of the suboral area which never presents distinct pores, but always a small number of more or less developed pits. The aperture which in the best preserved zooecia shows a distinct or even well-developed oral ledge is in most cases semi-elliptical or makes a larger part of an ellipse, but it may also be semicircular, qvadrangularly rounded, and some times much broader than high (fig. 11).

The distal part which is not rarely provided with a more or less distinct beak-shaped projection (figs. 13, 14, 16) is sometimes angularly bent from side to side (figs. 13, 14), while in most cases it is broadly rounded, and within the proximal margin there is generally found a more or less distinct broad low projection, the median part of which is provided with an impression or indentation (figs. 12, 13, 17, 21). The operculum which has been found only in a very small number of zooecia shows a flabelliform striation and a number of pores. The suboral area which is always feebly developed is rarely broad and short, and in that case it is provided with a pit on each side (fig. 19). In most cases it is long and narrow and provided with 2—4 pits arranged in different manner, and sometimes the peristomes of the neighbouring zooecia come in contact with each other in such a manner that the suboral area is only represented by a proximal and a distal pit (fig. 12). The rich deposition of calcareous matter which takes place in this species may go on in a very different manner, and while in some colonies the pits increase both in number and in size, and the suboral area therefore shows a rich areolation (fig. 16), in others the pits are gradually effaced, and the suboral areas are transformed into an interlacing net-work of convex pillars (fig. 15).

The *Heterozooecia* which are present in very scarce number and not even found in all the fragments examined are as a rule a little longer than the zooecia. The more or less projecting aperture is triangularly rounded, a little longer than broad and the two lateral margins converge to form a rather broadly rounded distal curve. No lateral thickenings. The suboral area is provided with similar pits as those found in the zooecia, and there may be found a projection within the proximal margin (fig. 21).

Ooecia have not been found.

No *Kenozooecia.*

A *Closure* has not been seen with certainty in any of the fragments examined.

The *Regeneration.* In all the specimens examined a larger or smaller number of the apertures are much more projecting than the others, and when we have to do with a larger fragment which presents the original distal end tolerably intact we find that the number of these projecting apertures increases towards the proximal end, the surface of which is chiefly or exclusively composed of them. A consequence hereof is that the proximal end of such a fragment is much thicker than the distal, and for inst. in one from Villedieu which has a length of 13 mm., the distal end has a thickness of 1,5 mm. but the proximal end of 2,5 mm. The named prominent apertures are very often distinctly or even much larger than the common ones and of a different form (fig. 17), and their arrangement is always more or less irregular as a larger or smaller number of them have another direction than the common apertures. Sometimes we even find specimens in which these apertures are placed in all possible directions (fig. 20). I cannot doubt but that we have here to do with a process of regeneration which differs from that commonly found in this division therein that the aperture of the new zooecium proceeds so far be-

yond that of the old one, and at the same time the rich deposition of calcareous matter speedily effaces the limits between the two apertures and prevents us from deciding how many times a certain zooecium has been regenerated. In a specimen from Tours (fig. 11) the apertures are directed obliquely downwards, and some of the zooecia show a strongly developed dorsal surface provided with a number of deep pits.

Numerous specimens from Villedieu and Tours.

Meliceritites dichotoma (?) d'Orbigny.

Semielea dichotoma d'Orbigny, Bryoz. Crét. p. 637, pl. 638, figs. 6—8, pl. 738, figs. 10—11.
(Pl. V, figs. 1, 2.)

The *Zooecia* which are twice as long as broad are not divided by distinct marginal ridges, and the distally ascending suboral area is in most cases longer than the aperture which together with the well-developed peristomial thickening takes up the whole breadth of the zooecium in its distal part. No tubercles. The aperture which is as broad as long or even broader than long is provided with a well-developed oral ledge, and the two lateral margins either run together in a broad distal curve or in a curve more or less angularly bent. The convex operculum shows a distinct flabelliform striation. —

The *Heterozooecia* which are spread among the zooecia, rarely singly, mostly in groups of 2—8 have the same length as the zooecia, and the somewhat projecting distal half is provided with a triangular aperture, about twice as long as broad. All the heterozooecia examined were closed by a somewhat concave lamina.

Ooecia have not been found.

No *Kenozooecia.*

The *Closure* takes place by means of a flat or concave lamina which in the zooecia sometimes has started from the edge of the rim, sometimes at a deeper level. —

The *Regeneration.* I have seen many cases of regeneration both of new zooecia in old ones, of new heterozooecia in old ones and of heterozooecia in old zooecia. I have examined a hollow compressed fragment from Tours lent me by Dr. Pergens.

Meliceritites armata n. sp.

Hornera Steenstrupi Pergens (partim), Bryoz. de Faxe, p. 218, pl. XIII 2 a, 2 b.
(Pl. III, figs. 14—16.)

The *Zooecia* (long 0,8 mm.) which are divided by well-developed marginal ridges are about twice as long as broad, and the concave or saddle-shaped suboral area is obliquely ascending towards the somewhat projecting distal end. No tubercles. The aperture, the length of which in most zooecia is contained about three times in the length of the whole zooecium is about as broad as high and provided

with a strongly developed peristomial thickening. There is found a distinct, but narrow oral ledge, and the lateral margins as a rule converge a little proximally. The convex operculum is provided with a flabelliform striation.

The *Heterozooecia,* which in most fragments are found in a number of 2—10 either singly or two together are as a rule not spread among the zooecia, but together with the kenozooecia form a longitudinal belt which takes up about the third part of most fragments examined. They have a similar form and size as the zooecia, but are provided with a triangular distally rounded aperture, not twice as long as broad, the length of which is contained about three times in the length of the whole heterozooecium. It is provided with two lateral thickenings.

The *Kenozooecia* which have the same form and size as the zooecia together with the heterozooecia form transverse series, each containing 3 (2—4) zooids.

Ooecia have not been found.

The *Closure* is effected by means of a concave lamina.

The *Regeneration.* I have seen a regeneration of new zooecia in old ones, and a corresponding regeneration of heterozooecia.

The *Colonies* (Diam. 0,8—1 mm.) are incomposite, and the cylindrical fragments have their zooids arranged in regular transverse series, which, however, in most cases are more or less oblique. The zooecia which as a rule are bordered by parallel lateral margins in the larger part of their length, generally are found in a number of six in each transverse row, but in rare cases the extension of the longitudinal belt formed by the kenozooecia and heterozooecia may be diminished by the increase of the number of zooecia in one or more transverse series, and sometimes it may even be divided in more parts, one or more transverse series forming closed rings round the branch. —

Numerous specimens from Faxoe and Rejstrup (Danian), Denmark.

Meliceritites Steenstrupi Pergens.

Hornera Steenstrupi Pergens (partim), Bryoz. de Faxe. p. 218, pl. XIII, figs. 3, 4.
(Pl. III, figs. 12, 13.)

The *Zooecia* (long. 0,5 mm.) which are divided by well-developed marginal ridges are in most cases more than twice as long as broad, and the suboral area is obliquely ascending towards the aperture which together with the well-developed peristomial thickening takes up allmost the whole breadth in the distal part of the zooecium. No tubercles. The half-elliptical aperture lacks a distinct oral ledge, and its length is contained about two and a half time in that of the zooecium. The not very convex operculum shows a flabelliform striation.

The *Heterozooecia* which are much smaller than the zooecia and generally of an elongate sexangular form are never spread among the latter but together with a few kenozooecia form a longitudinal belt, which takes up a fourth to a sixth part of the extension of the fragments examined, and in which the zooids are arran-

ged in more or less oblique transverse series each containing 1—4 zooids. As in most of the latter the marginal ridges between the single zooids have vanished as also the apertures of the heterozooecia it is not easy to make up the relative number of the two forms of zooids, but the heterozooecia are at any rate much more numerous than the kenozooecia, and sometimes take up the whole belt especially when the latter is narrow. The very small aperture is allmost circular — apart from the straigth proximal corner —, and the larger part of it is filled by a concave lamina, the proximal part of which is perforated by a semicircular opening.

Ooecia have not been found.

The *Kenozooecia* which have the same form and size as the heterozooecia are spread among the latter in scarce number and seem as a rule to be placed in the middle of the longitudinal belt.

The *Closure* is effected by means of a concave lamina.

The *Regeneration*. Hitherto I have only seen a regeneration of new zooecia in old ones.

The *Colonies* (Diam. 0,4—0,8) are incomposite, and the cylindrical fragments show an arrangement of the zooecia in regular more or less oblique transverse series, each of which contains 6—11 zooecia. As a rule the apertures of the outermost zooecia in each transverse series are distinctly larger than the other.

Numerous specimens from: Faxoe and Rejstrup (Danian), Denmark. Of the two very distinct species which have been confounded under the name *Hornera Steenstrupi* the present is found in Faxoe in much larger numbers than the other (*M. armata*), and, therefore, I think it likely that it should keep the specific name given by PERGENS. According to the explanation of the plate this author refers the fragment figured to an old colony, no doubt because the marginal ridges between the heterozooecia and kenozooecia have been indistinct as is the case in most specimens of this species from Faxoe, while he has regarded the specimens of *Mel. armata* as young colonies of the same species because the corresponding areas are very distinct. PERGENS figure 4, however, shows sufficiently distinct the small narrow »dorsal« areas, and the smaller dimensions of the fragment figured is evident from the fact, that the figure, which has the same size as the figure 3 is pictured under a larger magnifying power. —

Meliceritites sarissata Gregory.

Reptomultelea sarissata Gregory, Cretac. Bryozoa, p. 322, pl. XVI, fig. 7.
(Pl. II, figs. 1—3.)

The *Zooecia* which are divided by very narrow more or less distinct marginal ridges, are generally rhombic, about twice as long as broad, and the convex or saddle-shaped suboral area, which is about of the length of the aperture, is strongly, almost vertically ascending towards the latter. No interoral tubercles. The aperture which together with the strongly developed peristomial thickening takes up the

whole breadth in the distal part of the zooecium is about a third part longer than broad, and provided with a distinct and sharply defined but narrow oral ledge. It is roundedly triangular with a pointed distal part, and the arched lateral margins which are somewhat incurved distally are more or less converging proximally. The præoral tubercle either forms a large rounded swelling or a more or less developed beak-shaped projection. The convex or saddle-shaped distally pointed operculum shows a flabelliform striation.

The *Heterozooecia* which are spread among the zooecia in rather scarce numbers are much longer than the latter. The aperture consists of a broad proximal part with distally converging lateral margins and a generally much longer (sometimes more than twice as long) narrow distal part with allmost parallel or very little converging lateral margins. The mandible is distinctly convex not only from side to side, but also proximally distally.

Ooecia have not been found.

The *Kenozooecia* have been found spread among the zooecia in scarce numbers singly or more together.

The *Closure.* A distinct closure has not been found.

The *Regeneration.* There has been found no regeneration in the fragment examined.

The *Colonies* are composite, and the fragment examined is a multilayered lamina fixed to a piece of flint from Chatham or Luton (middle chalk).

This species is evidently related to *Mel. sarthacensis.*

Meliceritites Sarthacensis d'Orbigny.

Reptelea Sarthacensis d'Orbigny, Bryoz. Crét. p. 640, pl. 604, figs. 9—10, pl. 738, fig. 15.
(Pl. I, figs. 1—2.)

The *Zooecia*, which are divided by distinct marginal ridges are more or less regularly rhombic, as a rule double as long as broad, and the suboral area which is often somewhat convex is as long as or a little shorter than the aperture. No lateral tubercles. The triangularly rounded aperture which is a little longer than broad has a narrow obliquely immersed oral ledge, and together with the well-developed peristomial thickening it takes up the whole breadth in the distal part of the zooecium. Its distal end is strongly projecting in the shape of a robust rounded beak (the præoral tubercle). The convex operculum shows a faint striation, and as a rule most of its pores are arranged in two distally converging longitudinal belts.

The *Heterozooecia* which are in most cases a little longer than the zooecia are spread among the latter in rather large numbers, and are provided with a triangular aperture which may sometimes be twice as long as broad, sometimes only a little longer. It has a broad proximal margin, and the two somewhat incurved lateral margin are strongly converging towards the narrow roundedly pointed distal

end. No lateral thickenings. In a large number of the heterozooecia I have found a calcareous mandible which is strongly arched not only from side to side, but also proximally distally.

Ooecia have not been found.

Kenozooecia of the same form and size as the zooecia have been found spread among the zooecia in very scarce numbers.

A *Closure* effected by means of a concave lamina has been found in a few zooecia.

A *Regeneration* has not been seen.

The *Colonies* are composite, and the only fragment examined is a hollow three-layered expansion from le Mans (Cenomanian).

Meliceritites micropora d'Orbigny.

Meliceritites micropora d'Orbigny, Bryoz. Crét. p. 624, pl. 737, figs. 4—7.
— — Pergens, Revision d. Bryoz. p. 397.
Nodelea micropora Gregory, Cret. Bryoz. p. 313.
(Pl. III, fig. 10.)

The *Zooecia* (long 0,3—0,5) which are of very variable size are hexagonal-ovate, about twice as long as broad, convex and divided by distinct furrows in the bottom of which there may be found very narrow and indistinct marginal ridges. The half-elliptical aperture, the length of which is often contained about three times in the length of the zooecium, is not provided with a distinct peristomial thickening nor with a distinct oral ledge. The convex operculum shows a distinct flabelliform striation.

Heterozooecia have not been found.

The *Ooecia*. A single elongate ooecium has been found.

The *Kenozooecia*. A few of these zooids have been found among the zooecia.

A *Closure* of the primary zooecia has not been found.

The *Regeneration* takes place in great measure, but never in such a manner that the old aperture is filled by the new one. On the contrary the proximal half of the former is taken up by a concave lamina, the suboral area of the new zooecium, the distal half of which is strongly arched and provided with a small semicircular aperture, and the latter is at last closed by a concave lamina. The continued deposition of calcareous matter gradually effaces the limits between the old aperture and the suboral area of the new zooecium, and at a certain point of time only the rest of the small aperture and a more or less distinct depression proximally to the latter indicate that a regeneration has taken place.

The *Colonies* are incomposite, and the two fragments examined are cylindrical with 20—25 zooecia in each of the irregular transverse series.

Villedieu.

Meliceritites hexagona d'Orbigny.

Elea hexagona d'Orbigny, Bryoz. Crét. p. 633, pl. 738, figs. 1—4.
(Pl. V, figs. 3—5.)

The *Zooecia*, which are divided by well-developed marginal ridges, are rhombic or hexagonally rhombic, rarely twice as long as broad, and the half-elliptical or triangularly rounded aperture, which is as a rule longer than the suboral area together with the well-developed peristomial thickening takes up the whole breadth in the distal part of the zooecium. While the inter-oral tubercles may be developed in very different degree and may often be quite absent, the supra-oral one is large rounded and forms a robust beak-shaped projection. No distinct oral ledge. The convex operculum presents a distinct flabelliform striation.

The *Heterozooecia*, which are spread singly among the zooecia in rather scarce numbers are sometimes only a little longer than the latter, sometimes about twice as long. In the larger of them we may discern in the aperture between a broad proximal part, the lateral margins of which are converging distally, and a narrow distal part of different length with about parallel margins. In the shorter of them, however, the somewhat incurved lateral margins are gradually converging distally in their whole length. The mandible is arched both from side to side and proximally distally.

Ooecia have not been found.

No *Kenozooecia*.

A *Closure* effected by means of a flat or concave lamina has only been distinctly seen in a small number of zooecia.

The *Regeneration* takes place in great measure, and in old colonies many apertures are very much projecting because the zooecia have been regenerated several times. There has also be found a regeneration of new heterozooecia in old ones.

The *Colonies*. I have examined a number of thick ribbon-shaped two-layered fragments from Vendôme (zone with *Crania ignabergensis*).

Meliceritites plana d'Orbigny.

Semielea plana d'Orbigny, Bryoz. Crét. p. 638, pl. 738, figs. 12—14.
(Pl. V, fig. 11.)

The *Zooecia*, which are more or less regularly rhombic and sometimes more than twice as long as broad, are divided by distinct ridges, and the suboral area which is as a rule more or less convex is much longer; sometimes about twice as long as the aperture. No distinct tubercles. The half-elliptical or triangularly rounded aperture which is a little longer than broad together with the well-developed peristomial thickening takes up the whole or almost the whole breadth in the distal part of the zooecium. No distinct oral ledge. The convex operculum shows a flabelliform striation.

The *Heterozooecia*, which are spread among the zooecia singly or in groups, have the same length as these, but the obliquely ascending distal end is provided with a small elongate triangular aperture the length of which is contained four to five times in the length of the whole heterozooecium. The fissure-like opening is bordered by two inwards obliquely descending thickenings.

Ooecia have not been found.

Kenozooecia have not been found in the two small fragments examined.

The *Closure* starts by the formation of a number of processes which rise from the margin and grow together in a more or less irregular manner, thus forming at a certain point of time a calcareous cover perforated by 3—5 hollows which later get closed.

The *Regeneration*. I have seen a few cases of regeneration both of zooecia and of heterozooecia.

I have examined two small laminar fragments one of which has only the locality France while the other which I have bought from Mr. W. GAMBLE is from St. Antoine du Rocher. Under the name of *Semielea plana* Mons. FILIOZAT has sent me three small fragments of another species which with the same right as the present might be referred to *Semielea plana* d'Orb. The zooecium and the aperture have the same form and structure, but the closure is effected by means of a concave lamina, and in one of them I have found a heterozooecium a little longer than the zooecia and the aperture of which has about the same form as in that figured in pl. II, fig. 9.

Meliceritites cenomana d'Orbigny.

Nodelea cenomana d'Orbigny, Bryoz. Crét. p. 609, pl. 761, figs. 11—13.
(Pl. III, figs. 17, 18.)

The *Zooecia*, which are not twice as long as broad, are rhombic or hexagonally rhombic and divided from each other by the well-developed peristomial thickenings together with the tubercles which are as a rule well-developed and sometimes very large. The half-elliptical or triangularly rounded aperture, which together with the peristome takes up the whole breadth of the zooecium in its distal part, is half a time longer than broad, much longer than the suboral area, and the supra-zooecial tubercle forms a more or less developed, sometimes very robust beak-shaped projection. No distinct oral ledge. The convex operculum is provided with a flabelliform striation.

The *Heterozooecia* which seem to be very rare are much larger than the zooecia and provided with a very large quadrangularly rounded aperture which is about twice as long as the suboral area. No lateral thickenings.

Ooecia have not been found.

No *Kenozooecia*.

The *Closure* takes place by means of a concave or flat lamina placed some way within the aperture.

The *Regeneration.* I have found a few zooecia regenerated.

I have examined two small well conserved fragments from le Mans (Cenomanian), lent me by Dr. PERGENS, and in these a number of the closure-plates and of the opercula have undergone a similar more or less complete decalcification as that found in *Mel. Lorieri.*

Meliceritites lamellosa d'Orbigny.

Elea lamellosa d'Orbigny, Bryoz. Crét. p. 632, pl. 625, figs. 11—15.
— — Pergens, Revision p. 398.
non Cea lamellosa d'Orbigny, Bryoz. Crét. p. 1007, pl. 787, figs. 11—13.
Elea lamellosa Gregory, Cretac. Bryoz. p. 299.
(Pl. III, figs. 1—9.)

The *Zooecia* which are as a rule rhombic or hexagonally rhombic and mostly twice as long as broad may be concave, flat or even a little convex and are divided from each other by more or less distinct ridges, the development of which may vary greatly even in the same colony. A more or less prominent tubercle may be developed not only at the distal end of the zooecium but also at the proximal corners of the aperture, and when the latter are placed in contiguous transverse series the tubercles of two adjacent apertures when sufficiently near to each other often fuse together into a single one. The development of the tubercles, however, is subject to great variation even in the same colony. The aperture the length of which is in most cases contained at least twice in the length of the whole zooecium takes up the whole breadth of the zooecium in its distal part and lacks an oral ledge, but is provided with a strongly developed peristomial thickening. It is half-elliptical or triangularly rounded and always longer than broad, but the relation between the length and the breadth is subject to rather great variation, and sometimes it is almost half a time as long as broad. The operculum shows a distinct flabelliform striation, and the greater part of its surface is more or less distinctly flattened.

The *Heterozooecia,* which are scattered over the colony in rather large numbers, partly singly, partly in groups up to four are in most cases longer and narrower than the zooecia, and their distal end is more or less obliquely ascending. It is provided with an elongate, roundedly triangular, distally protruding aperture, the lateral parts of which are covered by two very narrow, elongate triangular lateral processes between which is seen an opening in the shape of an inverted T.

Ooecia have been found.

Kenozooecia have not been found.

The *Closure.* I have not found a distinct case of closure in any zooecium, but in old heterozooecia.

The *Regeneration* takes place both in the zooecia and the heterozooecia, and in the former in a double manner, as an old zooecium may be replaced either by a new zooecium or by a heterozooecium, and in the first case there is seen a new oral margin within the old one. If an old zooecium is replaced by a heterozooecium (figs. 1, 3, 4, 5) the free, distal part of the latter gets another form than the corresponding part of the common heterozooecia, especially when it takes up the whole of the zooecial aperture, as in that case it must of course be much broader. The free part of such a heterozooecium is very much protruding, and one may discern between a posterior strongly convex, from side to side somewhat compressed, sometimes a little saddle-shaped surface and the frontal surface which as a rule forms a right angle with the frontal area of the old zooecium. We may compare this free part with a half somewhat compressed cone which rests on the surface of the cut and the basal surface of which wears the aperture. — Sometimes the named part does not take up the whole aperture (fig. 1) and in that case the difference of form is not so great. When a new heterozooecium is formed in an old one its free distal part, which is often vertically ascending partially covers the corresponding part of the old heterozooecium, the tip of which is seen protruding distally to it (figs. 5, 6, 7).

The *Colonies* have the form of free two- or more-layered laminae. Of this species I have examined or large number of fragments from Villedieu (Coniacian).

Meliceritites undata d'Orbigny.

Meliceritites undata d'Orbigny, Bryoz. Crét. p. 625, pl. 737, figs. 11—14.
non Meliceritites undata Gregory, Cret. Bryoz. p. 340, pl. XV, figs. 2—4, pl. XVI, fig. 3.
(Pl. IV, figs. 9—17.)

The *Zooecia*, which are divided by distinct more or less prominent ridges, are about twice as long as broad, and the suboral area generally presents a saddle-shaped concavity in the direction proximally distally. More or less developed tubercles. The half-elliptical aperture which is a little longer than broad lacks a distinct oral ledge, but is provided with a well-developed peristomial thickening, the lateral parts of which generally widen proximally, and these widened lateral parts belonging to two adjacent zooecia often coalesce with the interoral tubercle into a large rounded projection (fig. 17). The convex operculum is provided with a flabelliform striation, and with very few exceptions with 1—4 short arched, more or less distinct impressions turning the concavity proximally. When only a single impression is present it is seated in the proximal part.

The *Heterozooecia* which are scattered among the zooecia in rather small number, but not rarely two or more together, are of the same size as the latter, and their obliquely ascending more or less projecting distal end is provided with an aperture of somewhat different form and size, the length of which may be contained 3—6 times in the length of the whole heterozooecium. It is generally narrow

(figs. 12, 13) but sometimes of a semi-elliptical form (fig. 12). In the best preserved specimens I have found two narrow lateral processes.

Ooecia have not been found.

No *Kenozooecia.*

A *Closure* effected by means of a concave lamina has only been found in a few cases (fig. 15).

The *Regeneration* takes place in great measure, and in many of the fragments examined the larger part of the zooecia have been regenerated either by new zooecia (figs. 11, 16) or by heterozooecia (figs. 10, 14).

The *Colonies* are incomposite, and the cylindrical branches bear c. 14 zooecia in each transverse series.

Numerous specimens from Fécamp (middle Senonian).

Meliceritites Vieilbanci d'Orbigny.

Semielea Vieilbanci d'Orbigny, Bryoz. Crét. p. 636, pl. 637, figs. 7, 8.
Elea Vieilbanci Gregory, Cretac. Bryozoa p. 300, fig. 33, pl. 738, figs. 5—9.
(Pl. 1, figs. 15, 16.)

The *Zooecia,* the dividing ridges of which are often very indistinct, are generally about twice as long as broad, and their surface often presents a saddle-shaped concavity in the direction proximally distally. The broadly rounded, almost semicircular aperture, which is provided with a narrow and generally indistinct oral ledge has a strongly developed peristomial thickening and sometimes takes up the whole breadth of the zooecium in its distal part. Its length is contained 3—4 times in the length of the zooecium. The operculum is very convex and presents a distinct flabelliform striation.

Heterozooecia have not been found.

Ooecia have been found by Gregory.

No *Kenozooecia.*

The *Closure* is effected by means of a concave lamina (fig. 16).

The *Regeneration.* In most fragments examined a number of zooecia have been regenerated, but the protruding end of the new zooecium only in a few cases presents a half-elliptical aperture, the apertures being in most cases either perfectly closed or transformed into a narrow fissure which is no doubt the rest of the original aperture.

The *Colonies* are hollow free irregularly branched expansions with cylindrical or compressed branches. Some of the fragments examined show a beginning new layer in the form of one or more circular patches of different extension.

A number of fragments from Villedieu (Coniacian) and Bruillé-Poncé (Turonian).

Meliceritites durobrivensis Gregory.

Nodelea durobrivensis Gregory, Cret. Bryoz. p. 310, pl. XIV, figs. 4—13.
(Pl. IV, figs. 1—6, 8.)

The *Zooecia* which are divided by well-developed marginal ridges are generally rhombic or hexagonally rhombic, longer than broad, and the very concave suboral area takes up almost half the length of the whole zooecium. No distinct tubercles. The large aperture, which is surrounded by a strongly developed and very often obliquely ascending peristome, is a little longer than broad, and the lateral margins are generally distinctly converging proximally. No distinct oral ledge. The distal half of the aperture together with the peristome generally takes up the whole breadth of the zooecium. The very convex operculum is provided with a distinct flabelliform striation.

The *Heterozooecia*, which in most colonies are present in large numbers, rarely attain the size of the zooecia, and in most cases they are much smaller, sometimes only attaining half the length of the latter. They are rhombic very much concave and provided with a very small about half-elliptical aperture, the larger part of which is covered by a concave lamina, perforated by a narrow fissure, sometimes in the shape of an inverted T. In a number of them I have found an operculum of the same structure as that of the zooecia. Most of them are arranged in longitudinal series each consisting of 2—7 in such a manner that two succeeding heterozooecia are divided from each other by a pair of zooecia. In the more regular cases each two longitudinal series of heterozooecia are divided by two longitudinal series of zooecia, and, therefore, there may be seen on the surface of a fragment as many as 6 longitudinal series of heterozooecia. However, the arrangement as well as the size and the number of the heterozooecia is subject to great variation, and sometimes there may be seen groups of up to 14 adjacent heterozooecia.

Ooecia have been found.

No *Kenozooecia.*

A *Closure* by means of a concave lamina is rarely seen.

The *Regeneration* takes place in great measure, and the zooecia may be regenerated either by a new zooecium (figs. 4, 8) or by a heterozooecium (fig. 3). In the latter case the part of the heterozooecium enclosing the aperture may be more or less projecting, and the aperture of the new heterozooecium sometimes forms a right angle with the suboral area.

The *Colonies* are incomposite, and the fragments examined are cylindrical with 8—10 zooecia in each transverse series. I have examined a large number of fragments from Chatham (middle chalk) and Fécamp (middle Senonian).

Meliceritites durobrivensis, var. parviarmata Greg.

Meliceritites parviarmata Gregory, Cretac. Bryoz. p. 340, pl. XV, fig. 1.
(Pl. IV, figs. 7, 19—21.)

The *Zooecia,* which are divided by strongly developed marginal ridges are of rather different form and length, but in most cases they are twice as long as broad or even longer. No distinct tubercles. The aperture, the form of which is somewhat variable, may sometimes be almost half as long as broad, and the two lateral margins are in most cases more or less distinctly parallel. There is found a strongly developed peristomial thickening, and a very convex operculum with flabelliform striation. No distinct oral ledge.

The *Heterozooecia* which are present in large numbers are of very different form and size, the length of the smallest being contained 6—7 times in the length of the zooecia, while the larger of them may sometimes attain the length of the latter. Their distal end which is more or less projecting and sometimes forms allmost a right angle with the suboral area contains an aperture of the same form as that of the zooecium, but the larger part of it is closed by a concave lamina which is provided with an opening in the shape of an inverted T. Their distribution is very different as they are sometimes placed between the apertures of a number of adjacent zooecia, while in other cases they are irregularly heaped together, partly around the distal end of a zooecium (fig. 7), partly between a number of zooecia, and in some fragments of colonies which have been growing on shells and which are provided with an incrusting base the larger part of the latter is formed by heterozooecia. While that portion of this incrusting layer which immediately surrounds the proximal part of the free stem is composed chiefly of zooecia its peripherical part almost entirely consists of heterozooecia which therefore here seem to play a similar role as the kenozooecia forming the incrusting base of a *Retepora*-colony. One of the incrusting bases examined not only covers the one surface of a small fragment of a shell, but also a large part of the opposite surface, and here forms an extension 10 mm long and 6 mm broad, in which there is only found 3 zooecia.

An *Ooecium* has been found in one of the incrusting bases.

No *Kenozooecia.*

A *Closure* of the zooecia by means of a concave lamina has only been found in a few cases (fig. 7).

The *Regeneration.* There is found a regeneration both of new zooecia in old ones and of heterozooecia in zooecia (fig. 7).

I have examined a few fragments from Chatham, Luton, Gillingham (middle chalk) and Evreux (middle Senonian).

Meliceritites punctata d'Orbigny.

Myriozoum punctatum d'Orbigny, Bryoz. Crét. p. 663, pl. 783, figs. 4—7.
(Pl. V, figs. 6—8.)

The *Zooecia*, which are not divided by marginal ridges, are provided with more or less, large and deep pits, the number of which increases with age, and in old zooecia they are divided from each other by a rich net-work of prominent ridges. The half-elliptical aperture which lacks a distinct oral ledge is provided with a generally strongly developed and much raised peristomial thickening. The convex operculum presents a flabelliform striation.

The *Heterozooecia*, most of which are longer than the zooecia, are spread among the zooecia in rather large numbers, either singly or two placed near together. The elongate aperture is in the smaller of them triangular the two lateral margins converging distally in their whole length, but in the larger the distal half is bordered by two allmost parallel lateral margins. The concave surface distal to the inner aperture has no lateral projections or thickenings. In a few heterozooecia I have seen a calcareous mandible (fig. 8).

Ooecia have not been found.

No *Kenozooecia.*

A *Closure* by means of a concave lamina has only been seen in a few zooecia.

The *Regeneration.* While a distinct regeneration of new zooecia in old ones has not been seen, there can be no doubt that the form and position presented by some of the heterozooecia in a single of the colonies examined can only be explained from a regeneration of new heterozooecia in old ones. While the aperture of the common heterozooecia is about parallel to the axe of the colony the aperture of these heterozooecia forms an angle of up to 130 degrees with the surface of the latter, and in consequence hereof they are provided with two large, triangular or trapeziform lateral surfaces which show the same pitted appearence as the zooecia. How many times the regeneration has taken place in the single heterozooecia cannot be seen because of the rich deposition of calcareous matter which goes on over the surface of the whole colony and to which the pitted appearance is due.

The *Colonies* are incomposite, and the examined cylindrical fragments are provided with 10—14 zooecia in the transverse series.

I have examined a number of specimens from Vendôme (zone with *Crania ignabergensis*).

Meliceritites Dollfusi Pergens.

Meliceritites Dollfusi Pergens, Révision d. Bryoz. p. 395, pl. XIII, fig. 4.
Meliceritites lonsdalei Gregory, Cret. Bryoz. p. 335, pl. XV, figs. 5—9.
(Pl. IV, fig. 23.)

The *Zooecia* which are as a rule twice as long as broad are divided by more or less distinct marginal ridges, and the concave or saddle-shaped suboral area

ascends towards the strongly projecting distal part which rises in the form of a short tube. No tubercles. The aperture which lacks a distinct oral ledge and presents no peristomial thickening[1]) ranges between semicircular and triangularly rounded, and sometimes the distal end may be more or less distinctly pointed. The convex operculum presents a distinct flabelliform striation.

The *Heterozooecia* which may be twice as long as the zooecia are provided with a concave suboral area and a very elongate aperture, the breadth of which is contained about three times in the length. It attains its largest breadth at the distal margin, and the two lateral margins which are incurved in their middle part distally run together in a curve. There are no lateral thickenings. They are as a rule present in scarce numbers, but not rarely there may be found 2—4 placed near each other in the same transverse series, and in a single case I have found 7 forming an irregular, interrupted transverse row.

Ooecia have been found.

No *Kenozooecia.*

The *Closure* is effected by means of a concave lamina.

A *Regeneration* has not been found in the fragments examined.

The *Colonies* are incomposite, and the examined cylindrical fragments have 10—12 zooecia in each transverse series. One of them which is fixed to a fragment of a shell is provided with a basal expansion consisting of zooecia and heterozooecia of the same kind as those found in the free cylindrical part. The heterozooecia of this specimen (from Luton) are a little different from those found in the others as the lateral margins of the aperture are not incurved in the middle but converging distally.

Chatham, Gillingham, Luton (middle chalk) Fécamp (middle Senonian).

Meliceritites Dollfusi, var. tubuliformis n.

(Pl. V, figs. 9, 10.)

Of this form which I provisionally refer to *M. Dollfussi* I have only seen a single fragment 4 mm long and 1 mm broad. The most conspicuous difference is the length of the tubular distal part, which is about as long as the suboral area. Sometimes the frontal part of it is divided from the rest by two more or less distinct marginal ridges. The obliquely ascending aperture is half-elliptical or triangularly rounded, and the very convex operculum is distinctly striated. The Heterozooecia of which there is found three do not differ from those in *M. Dollfusi* and that seen in fig. 10 which seems to be shorter is not quite correctly figured as the distal part was broken off. — Evreaux (middle Senonian).

[1]) When Gregory in this species speaks about "well raised" peristomes, he confounds a raised peristome with a freely projecting distal part of a zooecium.

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Plate I.

(The numbering of the plates is to be changed into X 1.)

Plate I*).

Fig. 1. *Meliceritites sarthacensis* d'Orb. Distally is seen a heterozooecium which has been regenerated and proximally one provided with a calcareous mandible. × 34.
— 2. The same species. There is seen two heterozooecia, one of them with a calcareous mandible. × 34.
— 3. *Meliceritites magnifica* d'Orb. Of the six zooecia the four have been regenerated, and the apertures of the new zooecia have been closed by a concave lamina. (Not well executed). × 34.
— 4. The same species. Four of the zooecia and three of the heterozooecia have been regenerated and some of them twice. The aperture of the new zooecium at the rigth side has been closed by a concave lamina. × 34.
— 5. The same species with ooecium. × 20.
— 6. The same species with another form of ooecium. × 20.
— 6a. The same species. Two of the zooecia are provided with an operculum, and two are closed by a lamina presenting a ⊥-shaped opening. × 34.
— 7. The same species. There is seen two different forms of closure. × 34.
— 8. The same species. Different forms of closure from the same colony. × 47.
— 9. The same species. A regenerated zooecium with operculum. × 47.
— 10. The same species. A transverse section through a heterozooecium to show the lateral processes covering the larger part of the aperture. × 47.
— 11. *Meliceritites gothica* nov. nom. Three zooecia with opercula and one regenerated which has been replaced by a heterozooecium. × 34.
— 12. The same species. There is seen three kenozooecia, three zooecia with opercula, three closed heterozooecia and three zooecia, all of which have been regenerated by means of heterozooecia. × 20.
— 13. A zooecium of the same species. × 34.
— 14. The same species. The aperture is closed by a flat lamina which has arisen from the free edge of the oral ledge. × 34.
— 15. *Meliceritites Vieilbanci* d'Orb. Five of the zooecia have been regenerated. × 34.
— 16. The same species. There are seen four zooecia with opercula, two regenerated, two open and two closed by a concave lamina. × 34.
— 17. *Meliceritites trifolium* n. sp. Five zooecia with opercula. × 47.
— 18. The same species. There are seen six heterozooecia, and two zooecia regenerated by means of heterozooecia. × 47.
— 19. The same species. There is seen a heterozooecium, and three zooecia regenerated by means of heterozooecia. (In one of them the two lateral processes have been broken off.) × 47.

*) The present is the last plate lithographed by the excellent artist Mr. C. Cordts, but the execution bears witness to that he has not been able to lay the last hand on it before his death.

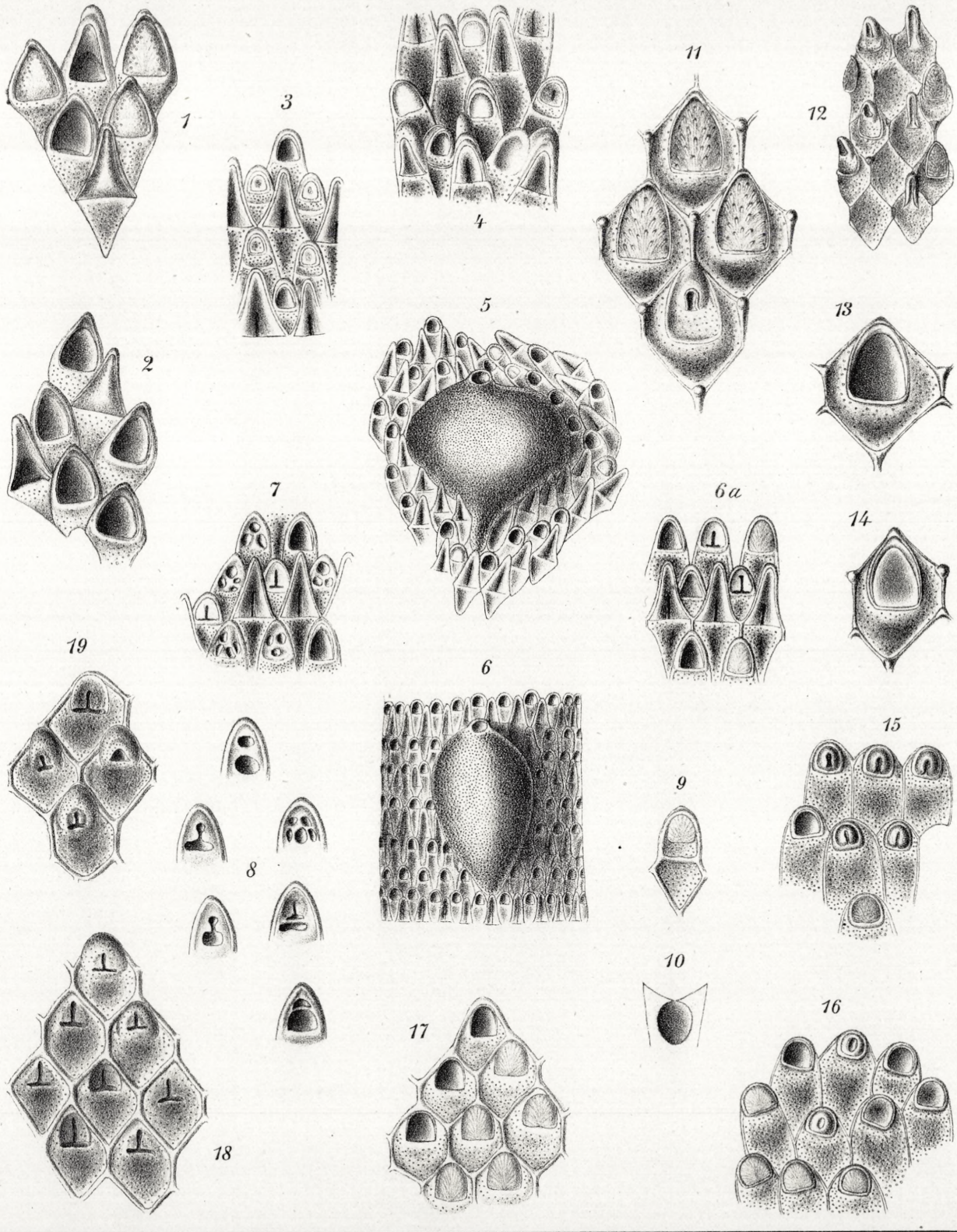
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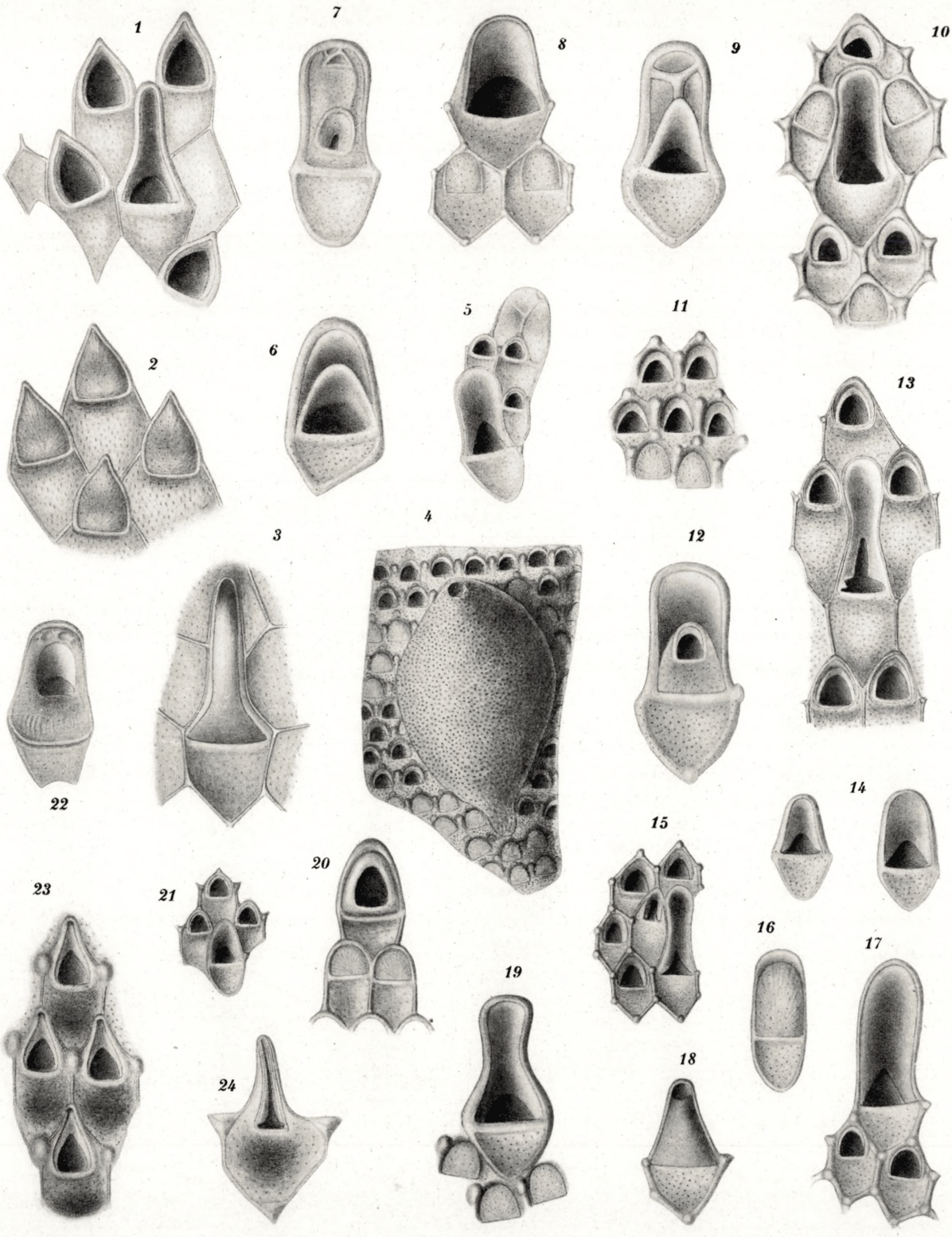
Plate II.

Plate II.

Fig. 1. *Meliceritites sarissata* Greg. Two Kenozooecia and a heterozooecium. × 34.
— 2. The same species. Zooecia with opercula. × 34.
— 3. The same species. A heterozooecium with mandible, surrounded by kenozooecia. × 34.
— 4. *Meliceritites angulosa* d'Orb. An ooecium. Villedieu. × 20.
— 5. The same species. Two heterozooecia of which the distal one has been regenerated by means of a new zooecium, and thereafter the remainder of the large aperture has been closed (compare with figs. 7 and 9). Villedieu. × 20.
— 6. The same species. Regeneration of a heterozooecium. The calcareous processes have not yet been formed distally to the new heterozooecium. Villedieu. × 34.
— 7. A new zooecium has been formed within an old heterozooecium, and the rest of the aperture has been closed, but the processes corresponding to those seen in figs. 5 and 9 are here very irregular. The zooecium is provided with a concave closure-plate which still has a small opening. Villedieu. × 34.
— 8. The same species. A heterozooecium. Villedieu. × 34.
— 9. Regeneration of a heterozooecium. Villedieu. × 34.
— 10. The same species. Fécamp. × 34.
— 11. The same species. Couture. × 20.
— 12. A zooecium in an old heterozooecium. Villedieu. × 34.
— 13. The same species. Chatham. × 34.
— 14. Two heterozooecia from the same colony, Couture. × 20.
— 15. The same species. At the left side of the heterozooecium is seen a zooid intermediate between a zooecium and a heterozooecium. Fécamp. × 20.
— 16. A heterozooecium with mandible. × Villedieu. × 20.
— 17. The same species.
— 18. Another heterozooecium with a mandible the distal part of which has been broken off.
— 19. The same species. Villedieu. × 34.
— 20. The same species. Regeneration of a heterozooecium. Bruillé-Poncé. × 34.
— 21. The same species. Villedieu. × 20.
— 22. Regeneration of a heterozooecium. Villedieu. × 34.
— 23. *Meliceritites gothica,* var. *acuminata.* × 34.
— 24. The same species. A heterozooecium.



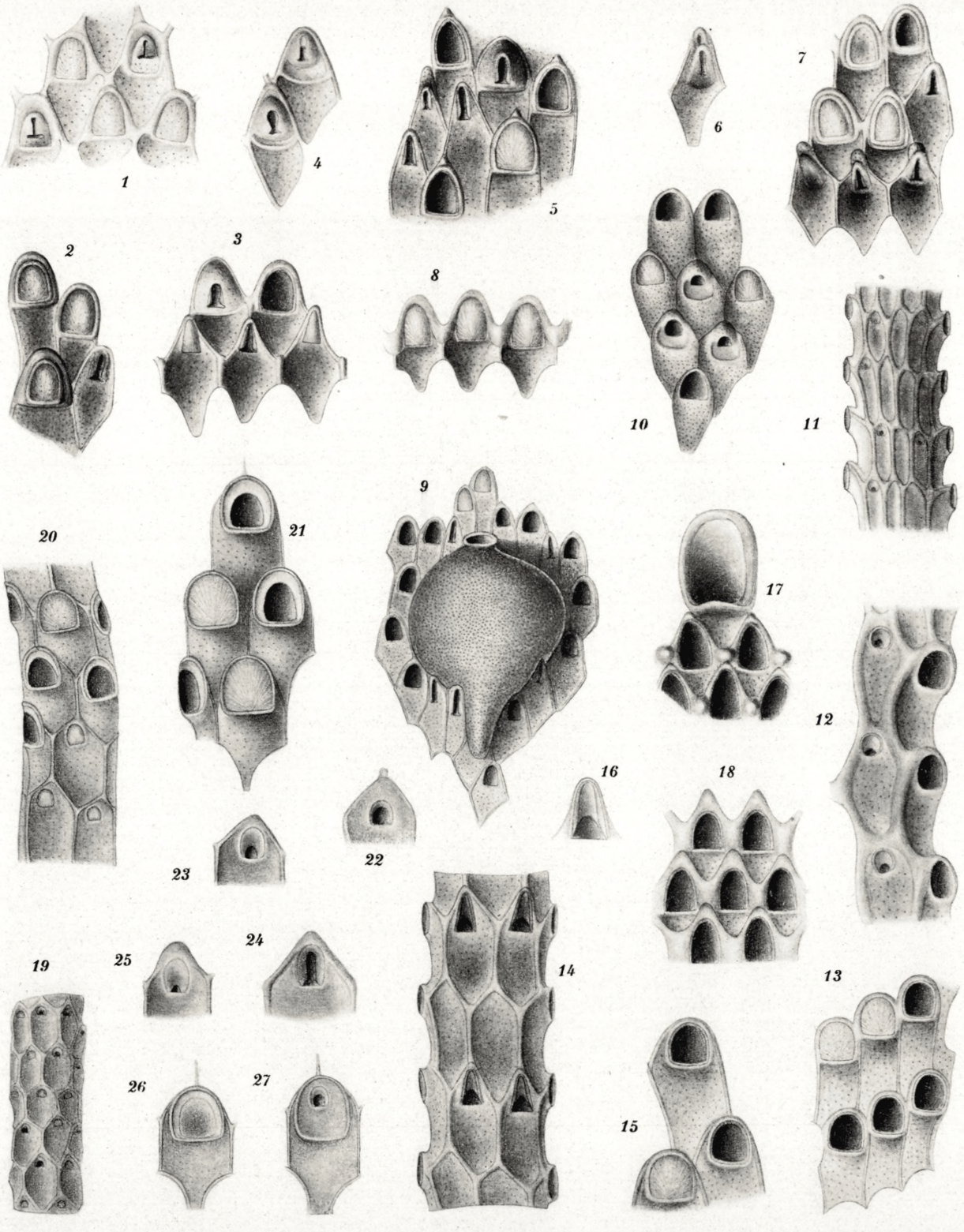
Levinsen del.

Pacht & Crone phototyp.

Plate III.

Plate III.

Fig. 1. *Meliceritites lamellosa* d'Orb. Three zooecia with opercula, and two heterozooecia in old zooecia, the aperture of which is not wholly taken up by the new zooids. The lateral margins of the heterozooecial apertures are not distinct. × 34.
— 2. The same species. Two regenerated zooecia with opercula and a heterozooecium. × 34.
— 3. The same species. Four heterozooecia one of which takes up the whole aperture of an old zooecium. Two of them are provided with a mandible. × 34.
— 4. The same species. Two heterozooecia in old zooecia. The aperture of the distal one is partly closed. × 34.
— 5. The same species. Four heterozooecia one of which takes up the whole aperture of an old zooecium. The distal one on the left side has been regenerated. × 34.
— 6. A regenerated heterozooecium. × 34.
— 7. The same species. Four regenerated zooecia, two of which are provided with opercula and one with a closure-lamina. Three regenerated heterozooecia. × 34.
— 8. The same species. × 34.
— 9. The same species. An ooecium. × 20.
— 10. *Meliceritites micropora* d'Orb. Three regenerated zooecia and two zooecia with opercula. × 34.
— 11. *Meliceritites Steenstrupi* Pergens. The hinder surface with the heterozooecia. × 20.
— 12. The same species. Three heterozooecia. × 34.
— 13. The same species. Two zooecia with opercula. × 34
— 14. *Meliceritites armata* n. sp. The hinder surface with kenozooecia and heterozooecia. × 20.
— 15. The same species. A zooecium with operculum. × 34.
— 16. The aperture of a heterozooecium. × 34.
— 17. *Meliceritites cenomana* d'Orb. A heterozooecium. × 34.
— 18. The same species. × 34.
— 19. *Meliceritites Canui* n. sp. The hinder surface with the heterozooecia. × 20.
— 20. The same species. Three heterozooecia. × 34.
— 21. The same species. Two zooecia with opercula. × 47.
— 22. A heterozooecium. × 47.
— 23. A heterozooecium the aperture of which is partially closed. × 47.
— 24. A heterozooecium with a very elongate aperture. × 47.
— 25. A heterozooecium the aperture of which is not far from being perfectly closed. × 47.
— 26. A zooecium with a closure-plate. × 47.
— 27. A heterozooecium which takes up the aperture of an old zooecium. × 47.



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Pacht & Crone phototyp.

Plate IV.

Plate IV.

Fig. 1. *Meliceritites durobrivensis* Greg. Five zooecia with opercula and three heterozooecia two of which are provided with opercula. Chatham. × 34.
— 2. The same species from Fécamp. Three heterozooecia. × 34.
— 3. The same species. Two large heterozooecia and three zooecia which have been regenerated by means of heterozooecia. Luton. × 34.
— 4. The same species. A regenerated zooecium with operculum. Chatham. × 34.
— 5. The same species. Chatham. × 34.
— 6. The same spccies. A zooecium the aperture of which is almost perfectly closed by a concave lamina. There is only left a small opening in the distal half. Chatham. × 34.
— 7. *Meliceritites durobrivensis,* var. *parviarmata.* There is seen a number of small heterozooecia two of which in old zooecia, one zooecium with operculum and another with a concave closure-lamina. Gillingham. × 34.
— 8. *Meliceritites durobrivensis* Greg. There are seen four regenerated zooecia, the distal of which has been regenerated twice while the two at the left side have been regenerated several times. Chatham. × 34.
— 9. *Meliceritites undata* d'Orb. × 34.
— 10. The same species. Three zooecia have been regenerated by means of heterozooecia. × 34.
— 11. The same species. Two regenerated zooecia with opercula.
— 12. The same species. Three heterozooecia one of which is intermediate between a heterozooecium and a zooecium. × 34.
— 13. The same species. Two heterozooecia. × 34.
— 14. The same species. A zooecium regenerated by means of a heterozooecium. × 34.
— 15. The same species. A zooecium with a concave closure-lamina which is not yet closed in the middle. × 34.
— 16. The same species. A regenerated zooecium with operculum. × 34.
— 17. The same species. × 34.
— 18. *Meliceritites Lorieri* d'Orb. Two zooecia with opercula. × 34.
— 19. *Meliceritites durobrivensis,* var. *parviarmata.* A portion of the incrusting base, consisting chiefly of heterozooecia. Chatham or Luton. × 20.
— 20. Two heterozooecia from the same colony. × 66.
— 21. The same form. A portion of a two-layered colony with numerous heterozooecia. Basin de Paris. × 34.
— 22. *Meliceritites pentagonum* n. sp. Three heterozooecia. Tullstorp. × 20.
— 23. *Meliceritites Dollfusi* Pergens. One of the two heterozooecia shows a calcareous mandible. Gillingham. × 20.

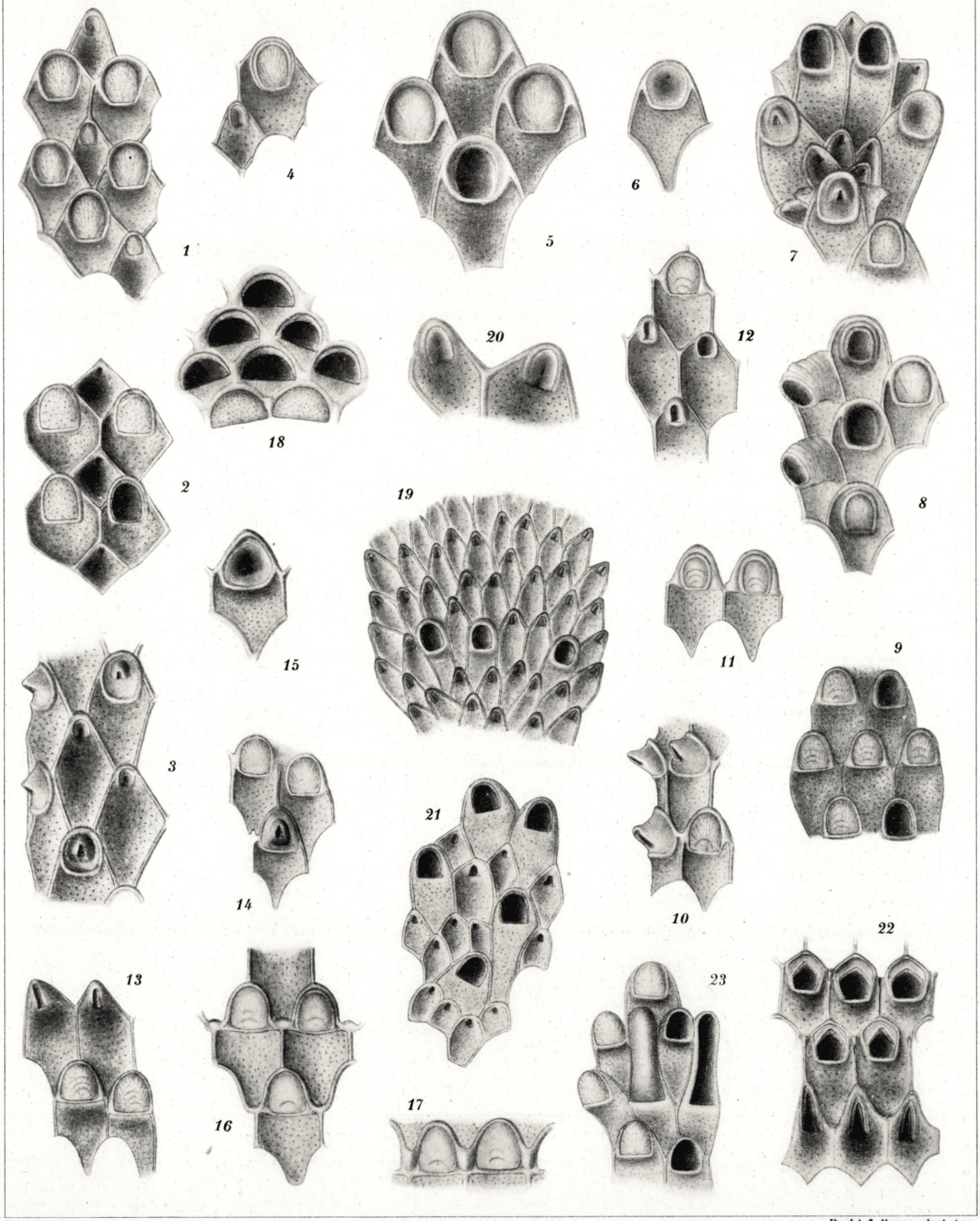

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Plate V.

Plate V.

Fig. 1. *Meliceritites dichotoma* d'Orb. Four zooecia with opercula and three heterozooecia the apertures of which have been covered by concave closure-plates. × 34.
— 2. The same species. There is seen a regenerated zooecium and two zooecia with closure-plates. × 34.
— 3. *Meliceritites hexagona* d'Orb. × 34.
— 4. The same species. The two zooecia on the left-hand side have been regenerated twice, and the peculiar appearance of the unusually large zooecium to the right must no doubt be explained by a repeated regeneration together with the circumstance that the limits between the different peristomes have been effaced. × 34.
— 5. The same species. A heterozooecium with mandible. × 34.
— 6. *Meliceritites punctata* d'Orb. The zooecia with opercula. × 34.
— 7. The same species. A heterozooecium. × 34.
— 8. The same species. A heterozooecium with mandible. × 34.
— 9. *Meliceritites Dollfusi* Pergens, var. *tubuliformis* n. A heterozooecium and a zooecium with operculum.
— 10. The same species. × 34.
— 11. *Meliceritites plana* d'Orb. Two heterozooecia. France. × 20.
— 12. The same species. Three zooecia with opercula and six with closure. St. Antoine du Rocher. × 34.
— 13. *Meliceritites squamata* Marsson. One of the smaller heterozooecia. Möen (Denmark). × 34.
— 14. The same species. A zooecium in an old heterozooecium. × 34.
— 15. The same species. A new heterozooecium in an old one. × 34.
— 16. The same species. A heterozooecium. × 34.
— 17. The same species. A heterozooecium with a broader aperture and with mandible. × 34.
— 18. *Meliceritites Roemeri* v. Hag. Tullstorp. × 20.
— 19. The same species. Distally is seen a small heterozooecium in an old zooecium, to the left a new zooecium in an old one and to the right a concave closure-lamina. × 34.
— 20. The same species. Three zooecia with a distinct oral ledge. × 34.
— 21. A kenozooecium and a small heterozooecium. × 34.
— 22. A small heterozooecium. × 34.
— 23. Two small heterozooecia with a more elongate aperture. × 34.
— 24. A small heterozooecium with a much larger aperture. × 34.

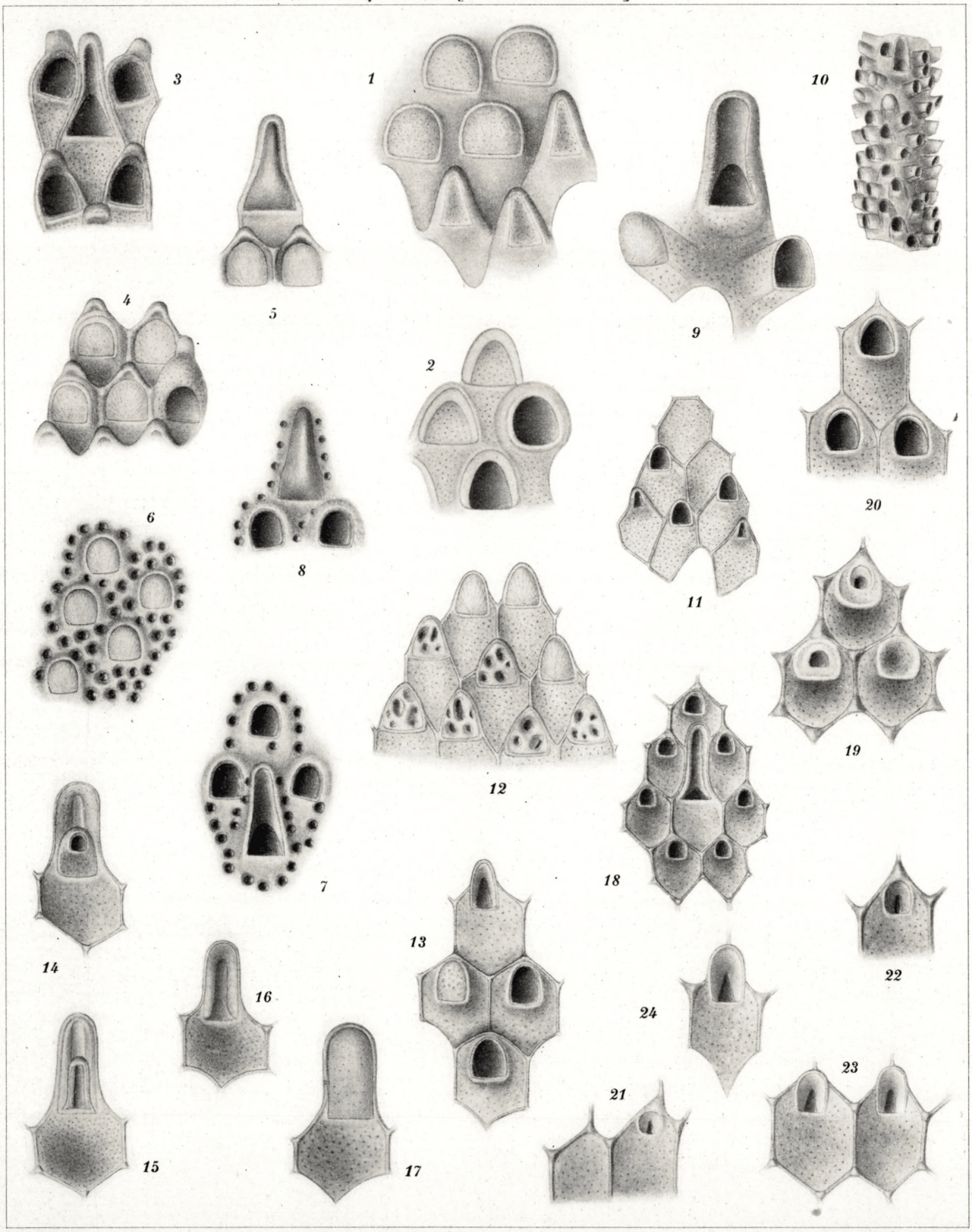

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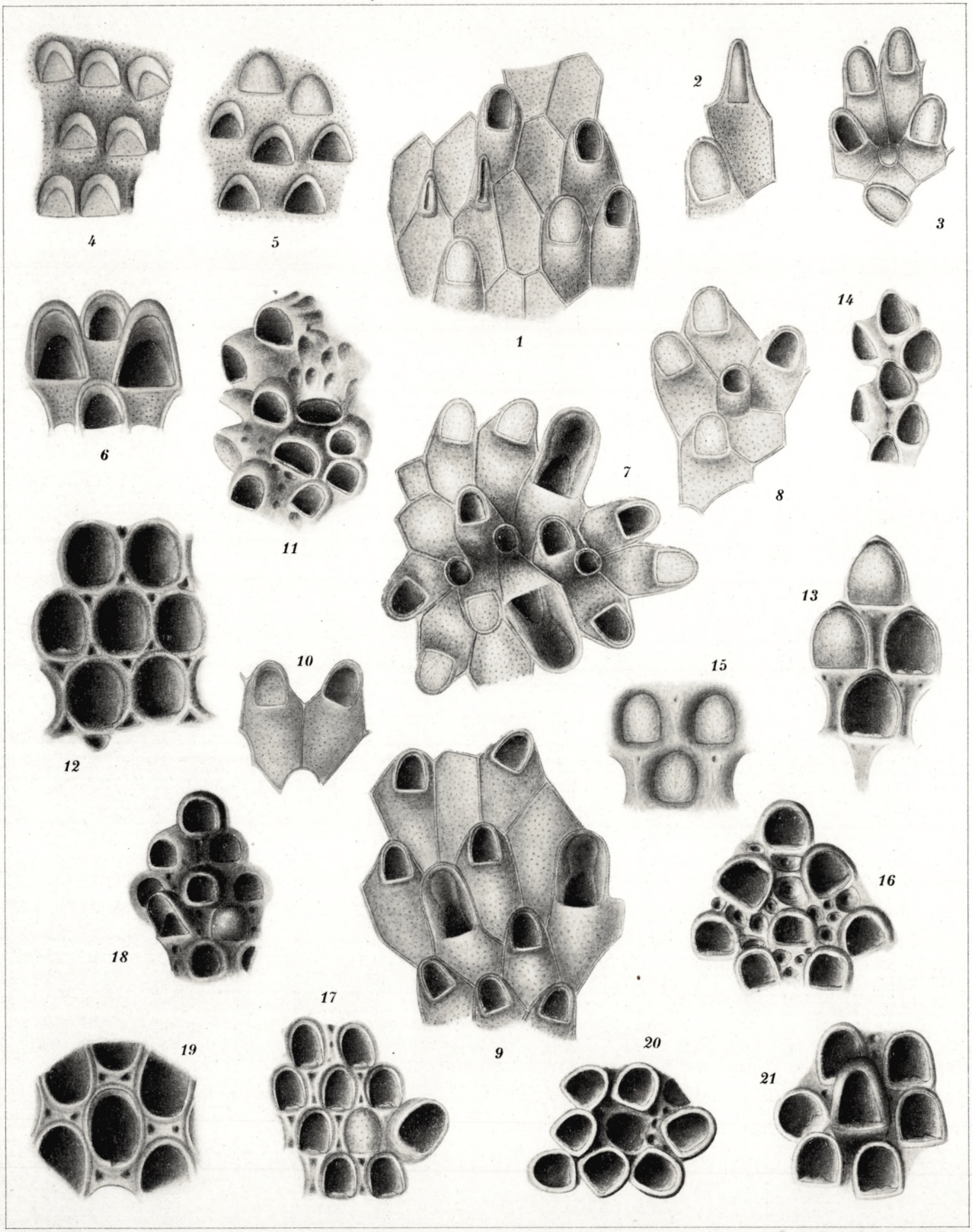
Plate VI.

Fig. 1. *Meliceritites tuberculata* d'Orb. There are seen eight kenozooecia, two zooecia with opercula and two heterozooecia one of which has been regenerated. Basin de Paris. × 34.
— 2. The same species. There is seen a heterozooecium with mandible. France. × 47.
— 3. The same species. Five zooecia and a kenozooecium surround an ancestrula of which only the aperture is seen. Basin de Paris. × 47.
— 4. *Meliceritites semiluna* d'Orb. All the zooecia are provided with a flat closure-plate, which rises from the free edge of the oral ledge. × 34.
— 5. The same species. Two zooecia with opercula. × 34.
— 6. The same species. Two heterozooecia. × 34.
— 7. *Meliceritites Filiozati* n. sp. There are seen the apertures of three ancestrulae, two kenozooecia and two heterozooecia. Fécamp. × 34.
— 8. Four zooecia and a kenozooecium surround the ancestrula of a future colony. Fécamp. × 34.
— 9. The same species. There are seen two heterozooecia and two kenozooecia. Fécamp. × 34.
— 10. The same species. One of the two zooecia is provided with a closure-plate which rises at a deeper level than the oral ledge. Fécamp. × 34.
— 11. *Meliceritites pyrenaica* d'Orb. All the apertures which are of very different form and size seem to have been regenerated, perhaps several times. Tours. × 20.
— 12. The same species. The suboral area is only represented by the pits. Villedieu. × 34.
— 13. The same species. Two zooecia with opercula. The beak and the proximal tooth are distinct. Villedieu. × 34.
— 14. The same species. The two strongly prominent zooecia seem to have been regenerated. Villedieu. × 20.
— 15. The same species. Three zooecia with opercula. The strongly developed suboral areas are convex owing to a rich deposition of calcareous matter, and the pits have almost vanished. Villedieu. × 34.
— 16. The same species. All the zooecia have no doubt been regenerated. Villedieu. × 20.
— 17. The same species. Zooecia from the distal end of a colony. The oral ledge and the proximal tooth are distinct, and only a single zooecium has been regenerated. Villedieu. × 20.
— 18. The same species. There are seen a heterozooecium and an operculum. Most zooecia have been regenerated. Villedieu. × 20.
— 19. The same species. The suboral area is short and broad and provided with two lateral pits. Villedieu. × 34.
— 20. The same species. The zooecia which have no doubt all been regenerated are placed in all directions. Villedieu. × 20.
— 21. The same species. Six zooecia surrounding a heterozooecium. They seem all to have been regenerated. Villedieu. × 20.



Levinsen del.

Pacht & Crone phototyp.

Plate VII.

Plate VII.

Fig. 1. *Meliceritites palpebrosa* nov. nom. Two zooecia with a convex closure-plate. × 34.
— 2. The same species. A zooecium with a flat closure-plate. × 34.
— 3. The same species. Four zooecia with opercula. × 34.
— 4. The same species. A zooecium with a beginning convex closure-plate. × 34.
— 5. The same species. Five zooecia with a convex closure-plate. The proximal part of the closure has in three of the zooecia been directed obliquely inwards. × 34.
— 6. A zooecium with a distal convex and a proximal concave closure-plate. × 34.
— 7. Three zooecia with a beginning distal and a well-developed proximal closure-plate. The proximal margin and a portion of the lateral margins of the aperture are still seen. × 34.
— 8. A zooecium with a convex closure-plate. × 34.
— 9. Two zooecia in which both the distal and the proximal part of the closure are well-developed. × 34.
— 10. *Meliceritites durobrivensis* Greg. A transverse section through a branch. Chatham. × 34.
— 11. A portion of the atrial ring in the ooecium of *Crisia eburnea*. Denmark. × 175.
— 12. The distal part of the ooecium of *Crisia eburnea* after the removal of the frontal wall. The atrial ring is seen. × 66.
— 13. An opened ooecium of *Mel. magnifica* after the adzooecial wall has been dissolved. The zooids covered by the ooecium are in this case completely developed. × 20.
— 14. An opened ooecium of *Mel. magnifica* after the adzooecial wall has been dissolved. The zooids covered by the ooecium have no calcified frontal wall. × 20.
— 15. An opened ooecium of *Mel. magnifica*. × 20.
— 16. A fragment of *Mel. magnifica* showing three different superficial layers. × 1.
— 17. An opened ooecium of *Mel. magnifica*, which belongs to the growing end of a superficial layer and the distal half of which covers an elder portion of the colony. The adzooecial wall has been dissolved. × 20.
— 18. An open ooecium of *Mel. magnifica* in the proximal part of which is seen a zooecium and three heterozooecia besides the aperture of the gonozooecium. It is likely to suppose that the former have originally been cowered by a bulging part of the adzooecial wall, which has later been destroyed. × 20.
— 19. *Mel. magnifica*. A transverse section of a branch with an ooecium. × 14.
— 20. An open ooecium of *Mel. lamellosa* d'Orb. The adzooecial wall together with a part of the underlying zooecial tubes have been dissolved. × 20.
— 21. An opened ooecium of *Mel. lamellosa*. The proximal half of the atrial ring is seen. × 20.
— 22. *Mel. lamellosa*. The distal end of an opened ooecium with the proximal half of the atrial ring. × 34.
— 23. *Mel. lamellosa*. A transverse section of a colony. × 20.
— 24. *Spiropora micropora* d'Orb. A transverse section. × 20.
— 25. *Entalophora Roemeri* n. sp. A transverse section. × 14.
— 26. Zooecia of *Ent. Roemeri*. × 20.
— 27. An opened ooecium of *Mel. angulosa* d'Orb. × 20.
— 28. *Mel. angulosa* d'Orb. The distal end of an opened ooecium with the proximal half of the atrial ring. × 66.
— 29. The distal part of an opened ooecium of *Mel. angulosa* d'Orb. seen from the proximal end. The whole atrial ring is seen. × 34.
— 30. *Mel. pyrenaica* d'Orb. A transverse section. × 11.

Levinsen del.

Pacht & Crone phototyp.