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A BRYOZOAN FAUNA OF DANO-MONTIAN AGE FROM BORYSZEW AND SOCHACZEW IN CENTRAL POLAND

Abstract. — The strata met with in the Boryszew boring (193—207m. from a heap) and Sochaczew boring (193.5—267.2 m.) yielded a fauna of 28 species of Bryozoa. Among them are 6 new species, two new genera: *Dysnoetocella* and *Pavobeisselina* and one new subgenus: *Vibracella* (*Discovibracella*). Although by far the largest number of the species (22) occurs in the Baltic Danian also and thus seems to prove Danian age of the strata in question, there are reasons which seem to support a somewhat younger age: for example the occurrence of *Dysnoetocella aenigmatica* n.gen., n.sp. in the Albert Canal near Vroenhoven (Belgium), where a bryozoan fauna is found very similar to that of the Montian of Ciply near Mons. In the Montian of Ciply also *Vibracella* (*Discovibracella*) *oculata* n. subg., n.sp. occurs very frequently, which is found only in the uppermost strata of the Danian, in part associated with *Vibracella* (*Vibracella*) *pozaryskae. Lunulites saltholmensis* Berth. so far also occurs only in the Upper Danian. Although Montian age cannot be demonstrated with certainty as long as no unobjectionable bryozoan fauna of Montian age overlying an authentic Danian fauna is at hand for comparison, and as long as it is not known which species of the Danian bryozoan fauna continue into the Paleocene (Danian and Paleocene are considered here as equivalent and independent stages), it seems best to consider the beds under discussion as transition beds between Danian and Paleocene or as lowermost Paleocene. This would also agree with the micropalaeontological results of Brotzen and Pożaryska (1957). The bryozoan fauna met with in the Danian and Paleocene of the boring near Sochaczew is very similar to that from Boryszew. *Pachythecella anhaltina* (Voigt) was found there in the Danian as an additional species, but judging from the samples at hand the total number of species is smaller. The material from Sochaczew offered no new points of view concerning the age of the bryozoan fauna from Boryszew.

INTRODUCTION

Some years ago I received, through Prof. Krystyna Pożaryska (Palaeozoological Institute of the Polish Academy of Sciences, Warsaw), bryozoan material from the Boryszew boring near Sochaczew (between Warszawa and Łódź). There, glauconitic arenaceous marls had been met with at a depth of 193 to 207 m., below strata of Upper Tertiary age.

They contained a fauna rich in Foraminifera (Brotzen & Pożaryska, 1957), small corals (Różkowska, 1955), spines of echinoids (Kongiel, 1958), brachiopods and Bryozoa. Investigation of the material promised unusually valuable results, for the fauna belongs to the boundary between Danian and Paleocene, the Bryozoa of which are still nearly unknown. I was the more interested in this fauna, because I have been studying rich bryozoan material from the Belgian and Dutch Montian and Dano-Montian for many years; besides, I have abundant faunas of the Baltic Danian from Denmark, Sweden, and the north German drift boulders at my disposal.

I am much obliged to Prof. W. Pożaryski and Prof. K. Pożaryska for lending the material to me and for further samples of the Sochaczew boring which I received when the manuscript was nearly finished. Likewise, I thank Dr E. Van de Poel in Brussels who sent me all of the bryozoan material of the Belgian Montian from the Institut Royal des Sciences Naturelles in Brussels, and Dr M. Meijer in Maastricht, to whom I owe numerous samples of the so-called "Post-Maastrichtian" together with the material from the vicinity of Maastricht and from the Albert Canal near Vroenhoven, Belgium. For guidance in European Danian localities and sending of Danian bryozoan material I am indebted to Dr O. Berthelsen (Copenhagen), Dr F. Brotzen (Stockholm), Prof. D. P. Najdin (Moscow), Prof. A. Rosenkrantz (Copenhagen), Dr Wienberg Rasmussen (Copenhagen) and Mr J. Wind (Lystrup).

This material was greatly enlarged by my own collections from Sweden, Denmark, France, Belgium, the Netherlands and the U.S.S.R., so as to offer a broad basis for the investigation.

The state of preservation of the Polish material is not very good as compared to the Belgian-Dutch or Danish material. The delicate zoaria are very fragile, partly worn, and have been damaged by the surrounding sediment, the grains of which have often caused impressions in the walls of the zooecia; even without that, the zooecia are often much corroded. Under these circumstances the preparation, which is indispensible for good photographs, was often extremely difficult. For that reason the photographs are not always entirely satisfactory.

Since so far neither Cretaceous nor Paleocene Bryozoa are known from Poland, it seemed advisable to give illustrations of the species dealt with and, in some cases, add illustrations of specimens from other localities. This applies particularly for some specimens with gonozooecia or gonozooids (ovicells), which are important in order to understand the forms under discussion and the modern classification of the Cyclostomata.

Unfortunately, for a number of Cheilostomata correct generic assignment remains questionable. Considering the extreme differentiation of Upper Cretaceous and Lower Tertiary Cheilostomata, the number of existing genera is by no means sufficient. The classification, therefore, often remains unsatisfactory and is purposely considered provisional in this paper; often it seemed inadvisable to create new genera without examining better preserved material. For investigations of this kind, which are beyond the scope of this paper, the moderately well preserved material from the boring near Boryszew and Sochaczew is not sufficient.

My special thanks are due to the Deutsche Forschungsgemeinschaft for support of my work on Bryozoa over a period of many years, and to the Ministerium für wissenschaftliche Forschung (Bad Godesberg) for a grant covering the costs of the translation, which was made by Prof. U. Lehmann.

The type specimens from the Boryszew boring belong to the collection of the Palaeozoological Institute of the Polish Academy of Sciences in Warsaw. They are serially marked: Coll. Warszawa Br. II/1-66.

The other specimens figured for comparison are in the Coll. Voigt, Hamburg, if not stated otherwise. The number given refers to the photo catalogue of the author.

The statement "Dano-Montian" given for the stratigraphic position is supposed to refer to the still somewhat uncertain geological age of the strata under discussion in the Dano-Montian transition region.

SYSTEMATIC DESCRIPTIONS[1]

Order **Cyclostomata** Busk, 1852

Genus *Entalophora* Lamouroux, 1821

Entalophora proboscidea (Milne-Edwards, 1838)

(Plate I, figs. 8-9)

1899. *Entalophora virgula* (v. Hagenow); J. W. Gregory, Catalogue..., vol. 1, p. 218, Pl. 10, figs. 1-4; Pl. 11, figs. 16-18.

1920. *Mecynoecia proboscidea* (M. Edw.); F. Canu & R. S. Bassler, North American..., p. 726, Pl. 108, figs, 1-15.

Material and description. — There are eight fragments present from Boryszew. Special treatment of this cosmopolitan and still living species is not necessary. Not everything, though, which is included in this species by the authors, seems actually to belong to it. This has already been pointed out by Canu and Bassler (see above). A complete list of synonyms in the older literature was published by Gregory (1899).

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[1] In the systematic descriptions the families, to which the genera should be attributed, are omitted. This is connected with the fact that the assignment of the genera to the families given by Bassler (*in* Moore, 1953), particularly in Cyclostomata, does not always correspond to my conception. The detailed discussion of the taxonomic problems is, however, beyond the scope of the present paper.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (193.5 — 195.7 m., 212.3 — 215 m.) borings, Poland.

Everywhere throughout the Upper Cretaceous of northern, central and western Europe; Danian of the Baltic area, Crimea, Dano-Montian of the Curfs quarry close to Berg in the Geul valley near Maastricht (Netherlands), Montian[2] (Tuffeau de Ciply) close to Ciply near Mons (Belgium). Cretaceous to Recent.

Entalophora benedeniana (v. Hagenow, 1851)

(Plate I, figs. 1-7)

1851. *Pustulopora benedeniana* v. Hagenow; F. v. Hagenow, Die Bryozoen..., p. 17, Pl. 1, fig. 6.

?1851. *Entalophora filiformis* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 791, Pl. 622, figs. 1-4.

?1886. *Entalophora corneti* Meunier & Pergens; A. Meunier & E. Pergens, La faune..., p. 12, Pl. 3, fig. 5.

Material and description. — The nine fragments from Boryszew do not differ in any respect from the material found at the localities named below. Everywhere there are very narrow, fragile ramose little stems 0.3 — 0.4 mm. thick, the surface of which is so delicate that the oval peristomes of 0.15 to 0.22 mm. in length are usually broken off. In their places, there are oblong shallow pockets or facettes (for example Plate I, figs. 1, 2, 4, 6). Since the zooecia are very long and run parallel to each other along a considerable part of the surface, their inner walls, perforated by a few larger pores, become visible through the half-opened front face. As a rule, 6 to 8 longitudinal rows of zooecia are present. Their length at the zoarial surface varies greatly. Sometimes the apertures touch each other like the ones on v.Hagenow's figures, sometimes they are separated by wide interspaces, as v.Hagenow also remarked. Thus, the morphology of the species is unusually variable.

In the rare specimens which are completely preserved, the peristomes even project in a tube-like fashion, giving an entirely different impression of the species' habit (Pl. I, fig. 3).

Particularly difficult is the discrimination from the younger branches of more vigorous species like *E. madreporacea* (Goldf.). Owing to the extreme variability and the various states of preservation of the species, the differentiation between the two forms remains somewhat uncertain.

That *E. benedeniana* cannot actually represent the narrow distal branchlets of *E. madreporacea* is demonstrated by its numerous densely perforated gonozooids; they differ from those of *E. madreporacea* by their more inflated, bubble-like shape. Their length reaches 1 mm. They

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[2] Based on the results presented by Wienberg Rasmussen and Marlière at the "Paleogene Colloquium" in Bordeaux (1962), Danian age should be accepted for the Tuffeau de Ciply series.

possess a very distinct distal oeciostome which, in well preserved specimens, is curved downwards like a hook (Pl. I, figs, 5 and 7). They are perforated by pores which are much more closely crowded than in the pseudopores of the zooecia.

Plate I, fig. 4 shows very narrowly spaced, though damaged peristomes in its lower part and a gonozooid. Although the narrowly spaced peristomes are not characteristic for the species, we have chosen a specimen which in this respect approaches the original figure as closely as possible and, in addition, possesses a gonozooid. A peristome preserved at the margin of the gonoecium proves that this specimen also formerly had longer projecting peristomes.

Remarks. — I had the opportunity to examine the original specimens of *Entalophora filiformis* d'Orbigny from the Coniacian of Fécamp. They are so similar to our specimens from Maastricht and the Danian and Montian that I should like to believe them identical, although this can hardly be demonstrated and although d'Orbigny's figure seems to contradict this view. *Entalophora montensis* (Meunier & Pergens, 1886, p. 13, Pl. 3, fig. 4) and *Pustulopora corneti* (Meunier & Pergens, 1886, p. 12, Pl. 3, fig. 5) from the Belgian Montian very probably are synonyms of this species and are both not specifically different from each other, in spite of their different appearance.

P. corneti possesses only remnants of ring-like oval peristomes and, incidentally, longer zooecia. Quite analogous specimens occur frequently in the Tuffeau de Ciply and in the somewhat younger Calcaire de Mons.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (193.5 — 195.7 m., 197.9 — 200 m.) borings, Poland.

Upper Maastrichtian of Maastricht, Baltic Danian, Danian drift boulders of northern Germany, Dano-Montian of the Curfs quarry close to Berg in the Geul valley near Maastricht (Netherlands), and Montian (Tuffeau de Ciply) of Ciply near Mons (Belgium).

Genus *Spiropora* Lamouroux, 1821

Spiropora verticillata (Goldfuss, 1827)

(Plate II, figs. 1-5)

1827. *Ceriopora verticillata* Goldfuss; A. Goldfuss, Petrefacta..., vol. I, p. 34, Pl. 11, fig. 1.

1851. *Ceriopora verticillata* Goldfuss; F. v. Hagenow, Die Bryozoen..., p. 20, Pl. 1, fig. 12.

1851. *Ceriopora reussi* v. Hagenow; *Ibid.*, p. 21, Pl. 1, fig. 13.

1899. *Spiropora verticillata* (Goldfuss); J. W. Gregory, Catalogue..., vol. I, p. 258 (pars), Pl. 11, fig. 5 (bibliography).

non 1922. *Mecynoecia?* (*Spiropora*) *verticillata* (Goldfuss); F. Canu & R. S. Bassler, Studies..., p. 13, Pl. 1, figs. 16-17.

Material and description. — We have 25 fragments of this species, which is frequent in the whole Upper Cretaceous and lowermost Tertiary. All of them belong to the narrow form which v.Hagenow described from Maastricht as *Ceriopora reussi.* In spite of all morphologic transitions between the narrow (diameter about 0.5 mm.) and the broad form (diameter about 1.0 to 1.5 mm.) the suspicion remains that they may represent different species after all. Usually, in the *reussi*-form, not only the circles of the apertures stand farther apart than in the real *Spiropora verticillata* (about 1.5 mm. as compared with 1 mm. in the broad form), but also the fine pseudopores on the outer wall of the zooecia stand farther apart. Finally, the gonozooids are much less numerous in spite of abundant material.

The very characteristic gonozooids demonstrate that completely different species are erroneously hidden in what is generally named *Spiropora verticillata.* Thus, for example, the specimen figured by Canu & Bassler, 1922 certainly does not belong to the typical *Spiropora verticillata,* for the latter possesses an entirely different type of gonozooid. The locality "Maastricht", named for the specimen under discussion, must be considered as doubtful. It has a typical "*Mecynoecia*"-gonozooid (in the sense of Canu's classification founded on ovicells), whereas I always found a different type of gonozooid in the real *S. verticillata.* Since this type has not yet been described, some figures of specimens with gonozooids may be shown. These gonozooids form very long, pipe-like sacs which follow the whorls of the apertures in a ring-like fashion and which proceed from one whorl to the other by elongate, vertical insertions. The specimen figured Plate II, figs. 4 a-b, from the Santonian of Hannover, which I received from Dr Hiltermann (Hannover), has an unusually well preserved gonozooid, whereas in the specimen from Kunrade (Pl. II, fig. 3) only the cavity is visible. This type of ovicell is very constant and has so far never been observed in other genera of the Cyclostomata. I intend to treat it presently in another connection.

In connection with the discovery of the ovicell this form cannot be assigned to the family Diastoporidae (Bassler, 1953), neither to the Entalophoridae nor to any of the families based on the structure of the ovicells (= gonozooids).

It is important to note that *Spiropora neocomiensis* d'Orb., which up to now (Gregory, 1899; Canu & Bassler, 1926) has always been considered a synonym of *Spiropora verticillata* (Goldf.), possesses typical "*Mecynoecia*"-gonozooids and in addition a chambered central canal in the axis of the zoaria. Therefore, the external similarity of the whorled zoaria is based solely on homeomorphy. These observations were made on a large zoarium from the Hauterivian of Landeron (Switzerland) which was kindly sent to me by Prof. Hölder (then of Tübingen) for investigation.

These examples demonstrate that identifications of Cyclostomata require utmost attention even in cases of seemingly full external identity.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (different depths, between 193.5 — 250 m.) borings, Poland.

Everywhere in central, western and northern Europe in the Upper Cretaceous; very frequent in the Baltic Danian and in the Danian of the Crimea, in the Danian of the Curfs quarry close to Berg, Geul valley near Maastricht (Netherlands) (here especially the *reussi*-form in many hundreds of specimens), and in the Montian (Tuffeau de Ciply) close to Ciply near Mons (Belgium).

Genus *Idmonea* Lamouroux, 1821

Idmonea subgracilis d'Orbigny, 1850

(Plate III, figs. 7-9)

1851. *Crisina subgracilis* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 738, Pl. 614, figs. 6—10.

1899. *Crisina (Tervia) subgracilis* (d'Orb.); J. W. Gregory, Catalogue..., Pl. 1 (parte), p. 169; Pl. 9, figs. 4-5 (non Pl. 11, figs. 11-12).

Material and description. — A small, very poorly preserved fragment from Boryszew (Plate III, figs. 7 *a*-*b*) belongs to this easily recognizable species, which is very widespread in the Danian. The material from the Danian cannot be distinguished from that from the type locality (Coniacian of Fécamp). Among my material there is a beautiful specimen from the Maastricht Tuffaceous Limestone with a large gonozooid; it forms a shallow swelling on the front face of the colony. The globular inflated gonozooids which Gregory figures, Plate 11, figs. 11—12, must belong to another species. Plate III, fig. 9 shows a forked fragment from a Danian drift boulder found at Daerstorf near Hamburg.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (250 — 254 m.) borings, Poland.

Coniacian to Montian. In the Baltic — north German area it is frequently found in the White Chalk of the Maastrichtian and in the Danian. It is also found in the Dano-Montian of the Curfs quarry close to Berg, Geul valley (Netherlands), and in the Montian (Tuffeau de Ciply) of Ciply near Mons (Belgium).

Idmonea filiformis d'Orbigny, 1851

(Plate II, figs. 8-9)

1851. *Idmonea filiformis* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 744, Pl. 750, figs. 1-5.

Material and description. — Two small fragments are conspecific with a species which occurs frequently in the Baltic Danian, and which I consider to be *I. filiformis*. D'Orbigny's original specimens from the

Coniacian of Fécamp, which I examined and photographed, agree in all features with those from the Danian and Dano-Montian, except that they are somewhat thinner and have fewer apertures in a row. The material from the Maastricht Tuffkreide shows still thicker little stems and sometime still more zooecia in the transverse rows.

Typical is the even, sometimes concave dorsal face, which may also show arched zones of growth.

One specimen from the Curfs quarry possesses a frontal gonozooid.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Coniacian to Dano-Montian; not rare in the Baltic and north German region, in the Maastricht White Chalk and in the Danian. Also found in the Dano-Montian of the Curfs quarry close to Berg in the Geul valley (Netherlands) and in the Montian (Tuffeau de Ciply) of Ciply near Mons (Belgium).

Genus *Crisisina* d'Orbigny, 1847

According to the present state of taxonomy, *Crisisina* comprises forms of „*Idmonea*" with long, thread-like kenozooecia on the dorsal face and oval capsular closed gonozooids, which develop laterally or dorsally. Bassler in the Treatise (1953) names *Crisisina cenomana* (d'Orb.) as type of the genus.

I obtained some specimens of this species from the Cenomanian of the Isle Madame (Charente) from Dr P. Marie (Paris). They possess the typical gonozooids as well as the fine striations on the dorsal face, which is caused by possession of kenozooecia. Neither feature was pointed out by d'Orbigny in his description of the species. These specimens differ from *Crisisina carinata* Roemer, 1840, only by their smallness and delicacy (diameter 0.5 mm). Thus, there is virtually no reason for separating *Cr. cenomana* from Roemer's species. Neither d'Orbigny's figure, though, nor that of Pergens (1889, Plate 12, fig. 3, p. 344) allows a conclusion as to the possible identity of the two species; the latter already figured a gonozooid — though badly preserved.

Bassler (1953) justly included the "species" *Coelophyma laevis* v. Hagenow, 1851, Pl. 2, fig. 15, which represents the gonozooids of *Crisisina carinata* Roemer in *Crisisina*. V. Hagenow, still unaware of the real nature of these structures, had considered them to be independent organisms of unknown affinity growing on the bryozoans and had named them "*Coelophyma*". For *C. leavis*, however, he stated that it grows on *Truncatula repens* and *truncata*, which is certainly not indicated by his figure, although *Truncatulipora* (=*Truncatula*) and *Osculipora* possess capsulate gonozooids of the same type.

Canu & Bassler in 1922 still reproduced this figure of v. Hagenow with *Osculipora truncata* (Goldf.).

Bassler (1953, Fig. 16-3a) was incorrect, however, in allocating *Coelophyma granulatum* v.Hag. (1851, p. 106, Pl. 2, fig. 17) to *Crisisina*, although without giving its name, because this represents the gonozooid of Goldfuss' *"Retepora=Idmonea lichenoides"*, which has nothing to do with *Crisisina* and is marked by possession of vacuoles distributed over the whole wall of the zoarium. Bassler in 1953 makes this species the type of the genus *Reteporidea* d'Orb., 1849, whereas he had formerly, together with Canu (1922, p. 125) called it *Polyascosoecia*.

Unfortunately, though, the confusion is still greater; therefore, I will point out some additional errors.

Thus, Canu and Bassler (1922) founded the new cytisid genus *"Diplodesmepora"*, grouping single- and double-rowed forms with the same type of gonozooids. The allegedly new single-rowed form, *Diplodesmepora alternata,* however, is nothing else than the well-known *Idmonea carinata* of Roemer; but v. Hagenov had not recognized it either, when he described his species of *Idmonea* from Maastricht, *"Idmonea sulcata"* and *"Idmonea lineata"*. Probably, they are only bad states of preservation of *Crisisina carinata* Roem. *"Idmonea pseudodisticha"* v.Hag. very likely belongs here too; it looks so different only because its peristomes are preserved. *Idmonea pseudodisticha* (non v.Hag.) of Marsson (1887, p. 28, Pl. 2, fig. 8) is *Heterocrisina communis* d'Orbigny (see p. 432), as was shown by an investigation of the original specimens of d'Orbigny.

The very form, which v.Hagenow (1851) had separated from Goldfuss' *Retepora disticha* as an independent species *I. pseudodisticha,* was unfortunately figured by Bassler in the Treatise (1953, figs. 15, 2 a-b) as type of the genus *Biretepora* d'Orbigny, established in 1849 for *Retepora disticha* Goldf. If *Idmonea pseudodisticha* v.Hag. is synonymous with *Crisisina carinata* (see p. 429), which now seems true, then *Biretepora* d'Orbigny is a synonym of *Crisisina.* But d'Orbigny, in his Paléontologie Française (1850—1854), does not mention the name *Biretepora* again, not even when describing *Tubigera disticha* d'Orb. (=*Retepora disticha* Goldfuss); it seems that he had abandoned the name as being superfluous; it should be suppressed. Besides, *Retepora disticha* Goldf. appears a second time in the Treatise (Bassler, 1953, p. G 54) as type of the genus *Tubigera* d'Orbigny, 1853, which is untenable. Here only *Idmonea disticha* (Goldf.) in the sense of v.Hagenow can be concerned, excluding his *I. pseudodisticha,* though, as is also shown by d'Orbigny's list of synonyms of *Tubigera disticha* (d'Orbigny, 1853, p. 723).

A final synonym of *Crisisina,* as we define the genus today, would be *Heterocrisina* Gabb & Horn (1860) with the type species *H. abbottii* Gabb & Horn, if the specimens figured by Ulrich & Bassler (1907, Pl. 22, figs. 3—4) under this name actually belong to this species. But this is certainly not the case, for the two specimens figured as well as the material at my disposal (more than 100 specimens) from the Vincentown

Limesand of Vincentown (U.S.A.), the type locality of Gabb & Horn, belong to *Crisisina carinata* (Roem.) or are so similar to this species that I cannot distinguish them from the abundant European material from the Campanian, Maastrichtian, Danian and Montian. They differ from the real *Heterocrisina abbottii* not only specifically, but even generically. At any rate the figure of Gabb & Horn, which Bassler reproduced in the Treatise (Fig. 26, 5 a-b), equals *Idmonea communis* d'Orb. (=*Idmonea pseudodisticha* Marsson, non v.Hagenow). A specimen included in my material from Vincentown (Plate III, figs. 6 *a*-*c*), equalling exactly the figure of Gabb & Horn, confirms my view; besides, its specific agreement with *Idmonea communis* d'Orb. is complete, and I now place the latter species with *Heterocrisina* (compare p. 432).

The name *Heterocrisina*, thus, applies only to the "*communis* forms", not to the "*carinata* forms". Probably neither Gabb & Horn, nor later Ulrich & Bassler noticed the differences between the two groups and lumped them under the name "*Heterocrisina abbottii*". This conclusion is drawn from the fact, that *carinata* is much more common in the Vincentown beds than *communis* (=*H. abbottii*), whereas Gabb & Horn name only the latter species.

I had received *Idmonea carinata* Roem. from Vincentown from Bassler himself under the name "*Heterocrisina abbottii*"; this led me to place the *carinata* group with *Heterocrisina* (Voigt, 1960 *c*, p. 229) which must now be revised.

Till now, the nature of the dorsal kenozooecia (accessory cells) was not clear. Canu & Bassler believed that they had found nematopores with their *Diplodesmepora alternata*, which certainly is a synonym of *Crisisina carinata*. This interpretation was probably influenced by their view that it belonged to the family Cytididae (= Cytisidae) which always possess nematopores.

Buge considered the long dorsal kenozooecia of *Idmonea carinata* (1948, p. 184) as firmatopores and, therefore, placed the species into the genus *Idmidronea* Canu & Bassler.

This genus, however, has large frontal gonozooids which are quite different from the oval capsulate gonozooids of *Crisisina*, where they always appear in lateral or dorsal position.

Canu & Bassler claim that the firmatopores are always descending, the nematopores ascending. Now indeed our thin sections of *Crisisina carinata* from Maastricht do not exactly correspond to Canu & Bassler's figures of sections in that no basal lamella seems to be developed, in contact with which the firmatopores might grow downwards. Rather, Plate IV, figs. 6—7 seem to indicate that there is no definite distinction between the zooecia and the long thread-like tubes on the dorsal face. It seems that primarily both of them are built in the same way, but that the dorsal tubes remain kenozooecia instead of becoming zooecia, and close together to form a dense bundle and thus a supporting layer for the zooecia. They grow upwards exactly like the zooecia, and no dividing lamella like the one Canu & Bassler (1920, p. 642, fig. 203) figure as characteristic for the firmatopores is observable anywhere. In old specimens from Maastricht they even grow up rather irregularly at the dorsal face of the stems.

Therefore, it is probably more correct to do without a strict classification of these accessory kenozooecia and not to distinguish "nematopores" from "firmatopores" in every case.

In summation, the following features are found in *Crisisina* and *Heterocrisina*:

I. Genus *Crisisina* d'Orb., 1847 (Fam. Cytisidae d'Orb., 1854)
   Syn. *Coelophyma* v. Hag., 1851 (pars)
   „ *Diplodesmepora* Canu & Bassler, 1922 (pars, *D. alternata* Canu & Bassler, 1922)
   „ *Biretepora* d'Orb., 1849 with *Idmonea pseudodisticha* v. Hag., 1851 (= *Retepora disticha* Goldf.), pars.

Type of genus: *Crisisina cenomana* d'Orb., 1847 (= *Idmonea carinata* Roemer, 1840)

Gonozooids oval capsules, dorsal or lateral, without visible oeciostome; rows of peristomes frontal or obliquely lateral-frontal, dorsal face with long ascending kenozooecia (?"firmatopores").

II. Genus *Heterocrisisina* Gabb & Horn, 1860 (Fam. Tubuliporidae Johnston, 1838)
   Type of genus: *H. abbottii* Gabb & Horn, 1860 (= *Idmonea communis* d'Orb., 1852).

Gonozooids forming a longitudinal frontal swelling between the rows of peristomes; rows of peristomes opening laterally; dorsal face with "nematopores".

Crisisina carinata (Roemer, 1840)

(Plate IV, figs. 1—7)

1840. *Idmonea carinata* Roemer; F. A. Roemer, Die Versteinerungen..., p. 21. Pl. 5, fig. 20.
1851. *Idmonea lineata* v. Hagenow; F. v. Hagenow, Die Bryozoen..., p. 33, Pl. 2, fig. 13.
1851. *Idmonea sulcata* v. Hagenow; F. v. Hagenow, *Ibid.*, p. 32, Pl. 2, fig. 12.
?1851. *Idmonea pseudodisticha* v. Hagenow; F. v. Hagenow, *Ibid.*, p. 31, Pl. 2, fig. 9.
1851. *Coelophyma laevis* v. Hagenow; F. v. Hagenow, *Ibid.*, p. 105, Pl. 2, fig. 15.
1851. *Coelophyma constrictum* v. Hagenow; F. v. Hagenow, *Ibid.*, p. 106, Pl. 2, fig. 16.
1853. *Idmonea cenomana* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 732, Pl. 614, figs. 1—5.
?1853. *Idmonea cytherea* d'Orbigny; A. d'Orbigny, *Ibid.*, p. 746, Pl. 750, figs. 11—15.
1887. *Idmonea striolata* Marsson; T. Marsson, Die Bryozoen..., p. 28, Pl. 2, fig. 9.

1899. *Retecava carinata* (Roemer); J. W. Gregory, Catalogue... (pars), vol. I, p. 197, Text-fig. 17.
1907. *Idmonea abbottii* (non Gabb & Horn); E. O. Ulrich & R. S. Bassler, Bryozoa..., p. 321, Pl. 22, figs. 3—4.
1922. *Diplodesmepora alternata* Canu & Bassler; F. Canu & R. S. Bassler, Studies..., p. 60, Pl. 27, figs. 12—18.
1925. *Idmonella carinata* (Roemer); G. M. R. Levinsen, Undersøgelser..., (pars), p. 431.
1925. *Idmonea carinata* (Roemer); E. Voigt, Über das Vorkommen..., Pl. 1, fig. 5.
1960c. *Heterocrisina carinata* (Roemer); E. Voigt, Bryozoen..., Pl. 2, fig. 1.

Material and description. — Three small, badly preserved fragments belong to this species, which was widespread in the late Cretaceous and Montian. Characteristic is the wedge-shaped cross section of the stems and the fine striation of the dorsal face; it consists of very long and thin kenozooecia. The gonozooids are laterally or dorsally developed capsulae without oeciostome, as I have observed them in large numbers from other localities. The peristomes are usually broken off. Well preserved specimens from Maastricht show that originally the rows of peristomes projected considerably, thus completely changing the appearance of the zoaria. The gonozooids of a specimen from Maastricht show remnants of the long peristomial tubes (Pl. IV, fig. 4). Therefore, *Idmonea pseudodisticha* v. Hag. might belong to this species. Till now I have assigned this species to the genus *Heterocrisina* Gabb & Horn, but today I feel compelled to add it to *Crisisina* d'Orbigny 1847 (see p. 429).

Unfortunately, the taxonomic situation of this species is extremely complicated, and this is not the place to explain the various reasons for the list of synonyms given above; it will follow elsewhere.

For comparison, two specimens from the Vincentown Limesand of New Jersey are figured on Pl. IV, figs. 2 and 3, one of them with a dorsal gonozooid. They are like the figures of Ulrich & Bassler, 1907, but not like the original figure of *Heterocrisina abbottii* Gabb & Horn.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (197.9—200 m.) borings, Poland.

Common in the whole Upper Cretaceous (Cenomanian to Danian); very frequent also in the Dano-Montian of the Curfs quarry close to Berg, Geul valley (Netherlands), as well as in the Albert Canal near Vroenhoven and in the Montian of Ciply near Mons (Belgium), and also in the Crimea and in the Vincentown Limesand of New Jersey (USA).

Genus *Heterocrisina* Gabb & Horn, 1860

Type of genus: Heterocrisina abbottii Gabb & Horn, 1860 (synonym of *Idmonea communis* d'Orbigny, 1853).

Diagnosis. — Zoarium idmoneiform, erect, dichotomously branching, subquadrate in cross section; peristomes in alternating rows on the flanks of the zoarium, not opening frontally; dorsal face with short upright closed kenozooecia (nematopores), which produce an oblong network or anastomosing longitudinal striations on the dorsal face; gonozooids frontal, between the lateral rows of the zooecia and dispersing them to some extent, with oeciostome.

Remarks. — The genus *Heterocrisina* was established by Gabb and Horn for an *Idmonea* from the Vincentown Limesand of New Jersey which was thought to be intermediate between *Filicrisina* d'Orb. and *Bicrisina* d'Orb. The diagnosis (Gabb & Horn, 1860, p. 404) was: "Colony dendroid, fixed at its base, from which slightly flattened branches arise dichotomous. Branches provided with cells on their upper surface. Cells oval, having their long diameter directed alternately to the opposite sides of branch. Laterally the cells are arranged in rows with flutings from one row of cells to the other, below branches irregularly striate. The increase takes place only by additions to the extremity. The genus occupies an intermediate place between *Filicrisina* and *Bicrisina*, the former having one row of cells. On the upper surface, the latter two, while *Heterocrisina* from the peculiar arrangement of the cells on the upper surface appears to occupy a transitory place between the one and two rowed Crisinidae."

In 1862, the genus was placed in synonymy by its authors (Gabb & Horn, p. 174) because of allegedly better material, and now the species is assigned to *Bicrisina*, for ostensibly an elongate pore below each aperture causes "the appearance of fluting". Such a pore does not exist, as a rule, though, and classing the species with *Bicrisina* is not justified. If pores are observed, they can be overgrowing kenozooecia in old age.

Gregory (1899, p. 205) includes the species with *Retecava*. Based on the original figure, he believes the characteristic feature to be the increase in size of the apertures in a forward-outward direction.

This feature, however, seems merely to be based on a state of preservation, the outer peristomes being more opened by abrasion. This may also be observed with the Maastricht specimens of *Heterocrisina communis* d'Orb. (= *Heterocrisina abbottii* Gabb & Horn).

Bassler (1953, p. G 60, figs. 5 a-b), mistaking this species for *Crisisina carinata* Roem. (see p. 430), characterized the genus as follows: "Like *Diplodesmepora* but with a single row of tubes to fascicle." This diagnosis implies possession of dorsolateral capsular gonozooids, such as occur indeed with *Crisisina carinata* (Roem.) in the Vincentown Limesand, but have never been observed in the *communis* group.

My former usage of the name *Heterocrisina* for the group of *Idmonea (Crisisina) carinata* (Roem.) was induced by Ulrich & Bassler (1907), who erroneously identified American material of *Idmonea carinata* (Roem.) from Vincentown as *Heterocrisina abbottii*. This is explained in detail on page 428. Thus, under the name „*Heterocrisina abbottii*" not only two entirely different species, but even two different genera were summarized, and probably already by Gabb & Horn (1860). This explains the confusion of the two species by Ulrich & Bassler.

Marsson (1887) and Levinsen (1925) also confused the *carinata* group with the *communis* group. Levinsen grouped *Idmonea carinata* and *Idmonea communis* together with *Idmonea insignis* Marss. and *Idmonea subcompressa* v. Hag. in his genus *Idmonella,* the dorsal face of which is completely composed of kenozooecia ("Støtterør").

Since this diagnosis of *Idmonella* applies for the *communis* group. I have hitherto placed *Idmonea communis* with *Idmonella.* Bassler, however, in 1953 made *Idmonea insignis* the type of the genus *Idmonella.* As long as the gonozooid of the latter is not known, the question must remain open whether *Idmonella* is a synonym of *Heterocrisina.*

Heterocrisina communis (d'Orbigny, 1852)

(Plate III, figs. 1-6)

1852. *Idmonea communis* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 745, Pl. 766, figs. 6—10.

1887. *Idmonea pseudodisticha* (non v. Hagenow); T. Marsson, Die Bryozoen..., p. 28, Pl. 2, fig. 8.

1860. *Heterocrisina abbottii* Gabb & Horn; W. M. Gabb & G. H. Horn, Descriptions..., p. 404, Pl. 69, figs. 45—47.

non 1907. *Idmonea abbottii* (Gabb & Horn; E. O. Ulrich & R. S. Bassler, Bryozoa..., p. 321, Pl. 22, figs. 3—4.

Material and description. — Two fragments, of which one possesses a gonozooid, are present from Boryszew. Characteristic is the blunt front edge and the regular alternation of two short rows of peristomes, in which the outermost peristome may sometimes be somewhat larger than the others. The normally flattened dorsal face carries fine striae which may grade into short meshes and hexagons. They correspond to relatively short kenozooecia (nematopores) running obliquely towards the outside. In older specimens they may even encroach upon the flanks and the front face, thus simulating perforation by cancelli. Long, thin kenozooecia, however, similar to firmatopores, like the ones in the preceding species, are never found. Marsson already figured these kenozooecia correctly (compare Pl. III, fig. 5).

Curiously, this species has over and over again been mistaken for *Crisisina carinata* (Roem.), although it is built quite differently and although the gonozooid also evidences the diversity of the two species. Its gonozooid is figured here for the first time (Pl. III, figs. 2, *a-b,* 4). It forms an oblong swelling on the front face of the stems, which pushes the rows of the zooecia apart and possesses a distinct oeciostome at its upper distal extremity. Its surface is finely perforate. These findings were confirmed repeatedly by more than 35 gonozooids from various localities.

Remarks. — *Heterocrisina abbottii* Gabb & Horn, of which my material contains a typical specimen from the Paleocene Vincentown Limesand of New Jersey, U.S.A. (Pl. III, figs. 6 *a*-*c*) cannot be distinguished from this species. The increase in size of the peristomes in an anterior direction is not constant and may also be found in the typical *Heterocrisina communis*. It is probably mainly due to more damage done to the outer peristomes.

Since, however, *Idmonea communis* d'Orb. represents a very characteristic group which occupies a special position by its frontal gonozooids and by the distinctive dorsal kenozooecia, the name can now be used for this group (for details see above on *Heterocrisina*).

Occurrence. — Dano-Montian of Boryszew and Sochaczew (different depths, between 193.5—206.6 m.) borings, Poland.

Throughout the Upper Cretaceous of north-western Europe in strata of Campanian and Maastrichtian age; very frequent in the Danian of Denmark and Sweden and in Danian drift boulders of northern Germany; Dano-Montian of the Curfs quarry near Berg, Geul valley (Netherlands) and of the Albert Canal near Vroenhoven (Belgium); Montian of Ciply (Tuffeau de Ciply) near Mons (Belgium); also in the Vincentown Limesand of New Jersey (U.S.A.).

Genus *Stigmatoechos* Marsson, 1887

Stigmatoechos punctatus Marsson, 1887

(Plate IV, figs. 8 *a*-*b*)

1878-1881. *Retepora furcillata* Quenstedt; F. A. Quenstedt, Petrefaktenkunde..., p. 350, Pl. 155, figs. 42—43.

1887. *Stigmatoechos punctatus* Marsson; T. Marsson, Die Bryozoen..., p. 32, Pl. 3, fig. 3.

1922. *Stigmatoechos punctatus* Marsson; F. Canu & R. S. Bassler, Studies..., p. 48, Pl. 9, figs. 11—18.

Material and description. — The only representative of this species is 0.7 mm. wide and is quite like the abundant material of this species from the west and north European localities.

The apertures are arranged in oblique, alternating rows on the frontal face, the rows are 0.5 mm. apart and gear into each other irregularly in the center. The dorsal face is smooth, but our somewhat corroded specimen shows clearly the scaling off of calcareous layers which compose the wall. Marsson previously mentioned and figured this lamination of the wall. The entire surface of the zoarium is perforated by very fine pores.

The above-named "*Retepora*" *furcillata* Quenstedt from the Rügen White Chalk is identical with Marsson's species, as was verified by an examination of Quenstedt's type specimen kept in the collection of the Geologisch-Paläontologisches Institut of the University of Tübingen. The figure is so bad, though, that we want to do without granting priority to Quenstedt's name. In this we are in accordance with the recently introduced regulation of the International Rules of Zoological Nomenclature, following which a name need not be replaced by a newly discovered older synonym, if it has been used for at least 50 years.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Maastrichtian White Chalk of north-western Germany, Rügen and Denmark; Danian of Denmark, Sweden and Crimea; Dano-Montian of the Curfs quarry near Berg, Geul valley (Netherlands).

Genus *Meliceritella* Levinsen, 1925

Meliceritella steenstrupi (Pergens & Meunier, 1886)

(Plate II, figs. 6 *a-b*, 7)

1886. *Hornera Steenstrupi* Pergens & Meunier; E. Pergens & A. Meunier, La faune des Bryozoaires..., p. 218, Pl. 13, figs. 2—5.

1912. *Meliceritites Steenstrupi* (Pergens & Meunier); G. M. R. Levinsen, Studies..., p. 39, Pl. 3, figs. 11—13.

1925. *Meliceritella Steenstrupi* (Pergens & Meunier); G. M. R. Levinsen, Undersøgelser..., p. 418.

Material and description. — The zooecia (4 specimens) are arranged on the frontal face in regular transverse rows of six zooecia each. The dorsal face shows an oblong hexagonal network of kenozooecia which are closed by a perforated calcareous lamella. The peristomes are distinctly triangular and thus demonstrate that they belong to the family Eleidae d'Orbigny.

I found the hitherto undescribed gonozooid at the dorsal face of one specimen from the Dano-Montian of the Curfs quarry near Berg, Geul valley (Netherlands); it forms an oblong, globular sac, corresponding in its form to the gonozooids of the Eleidae.

Filicrisina verticillata d'Orbigny, very common in the Maastrichtian and Upper Campanian, is also *Meliceritella*, although this is not at once clear from the somewhat inaccurate figure of d'Orbigny (1852, Pl. 769, figs. 5—10). This species as well as *M. steenstrupi* possesses a very typical feature of the Eleidae in the characteristic zooecia with trumpet-shaped distal expansions.

Levinsen was lead to include the family Eleidae in the Cheilostomata by their possession of opercula and avicularia, but this is proven wrong by the sac-like gonozooids and by the nature of the long tube-like cells perforated by pseudopores.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Common in the Danian of Denmark and Sweden, as well as in Danian drift boulders of northern Germany and in the Dano-Montian of the Curfs quarry near Berg, Geul valley (Netherlands) and Montian of Belgium (Tuffeau de Ciply near Mons).

Order **Cheilostomata** Busk, 1852

Genus *Stamenocella* Canu & Bassler, 1917

The genus *Stamenocella* comprises a very characteristic, small group of closely allied species. The diagnosis of the genus by Canu & Bassler must be extended to include the fact that the zoaria which widen towards the top always possessed chitinous radicells. This was stated by Canu & Bassler (1920, p. 169) for one species only (*S. midwayanica*), leaving the impression that it might be an articulated form. Judging from the numerous material now at my disposal, this is not the case. The large marginal avicularia are also very characteristic, although not constant.

Stamenocella pristis (Levinsen, 1930)

(Plate VI, fig. 9)

1925. *Membranipora pristis* Levinsen; G. M. R. Levinsen, Undersøgelser..., p. 324, Pl. 8, fig. 3.
1930. *Stamenocella pristis* (Levinsen); E. Voigt, Morphologische..., p. 450, Pl. 14, fig. 5.
?1930. *Stamenocella filiformis* Voigt; E. Voigt, *Ibid.*, p. 450, Pl. 14, figs. 8—9.
1962. *Stamenocella pristis* (Levinsen); O. Berthelsen, Cheilostome Bryozoa..., p. 103, Pl. 9, fig. 6.

The only two fragments present are badly preserved, but they agree well in all characteristics with my material from the Danian of Denmark and the north German Danian drift boulders.

It must be emphasized that the specimens may look extraordinarily different depending on the state of preservation and age, as well as on their position within the zoarium. The few specimens figured in the literature till now only give a very incomplete impression of the manifold habit of this species. Very probably *St. filiformis* Voigt represents the thin cylindrical proximal ends of the stalks of this species which was fixed at the base by radicells. Recent finds of *St. filiformis* Voigt from the upper Danian of Hvallöse (Jutland) and from Danian flint drift boulders from the vicinity of Hamburg seem to indicate this, for they widen distally and then become very similar to the narrow specimens of *St. pristis.*

Special reference is necessary to sometimes rather large avicularia which may appear edgewise in regular intervals and make the zoarium look like a saw-blade. They are only slightly developed in the figure given by Levinsen. Calcareous lamellae appear in large numbers at the zooecia in the basal part of the zoarium; they close the opesia and show a horizontal slit in the center. Lamellae of this type are very characteristic for this species.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (193.5—195.7 m.) borings, Poland.

Danian in Denmark, Danian flint boulders of northern Germany, Danian of the Crimea, Dano-Montian of the Curfs quarry near Berg, Geul valley, vicinity of Maastricht (Netherlands) and Montian (Tuffeau de Ciply) of Ciply near Mons (Belgium).

Genus *Pithodella* Marsson, 1887

Pithodella cincta Marsson, 1887

(Plate VI, fig. 10)

1887. *Pithodella cincta* Marsson; T. Marsson, Die Bryozoen..., p. 53, Pl. 5, fig. 7.
1925. *Membranipora oculata* var. *cincta* Levinsen; G. M. R. Levinsen, Undersøgelser..., p. 327, Pl. 2, fig. 20—b (c?).
1930. *Pithodella cincta* Marsson; E. Voigt, Morphologische..., p. 444, Pl. 12, figs. 21—24.
1962. *Pithodella cincta* Marsson; O. Berthelsen, Cheilostome Bryozoa..., p. 95, Pl. 8, figs. 2—3.

Material and description. — Three fragments, unfortunately badly preserved, belong to this species. They form octagonal, compressed, little stems about 1.0 — 1.5 mm. in thickness and agree completely with the abundant material from the Danian. The two spinal marks which are regularly present in the typical form of the Danian are also visible. The long oval opesia measure 0.37 — 0.45 mm.

In the Danish Danian and in Danian drift boulders of northern Germany there may be found, together with the typical form, numerous specimens, the areal border (opesial border) of which possesses a considerable number of spines. It has not become clear yet if these specimens possibly represent another species after all (compare Levinsen, 1925, Pl. 2, fig. 20-c).

The specimens of Danian age show avicularia much more often than those from the Maastrichtian White Chalk. Berthelsen pointed out that till now neither Marsson nor Voigt (1930) have mentioned avicularia in specimens of Senonian age. Therefore it is important that avicularia could be ascertained on specimens from Rügen as well as from Basbeck near Hemmoor, although more rarely than on material from the Danian. Here also vicarious avicularia are found the same size as the autozooecia.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Frequent in the Lower and Upper Maastrichtian of the north German and Baltic White Chalk (Rügen, Hemmoor, Basbeck, Denmark), as well as everywhere in the Danian of Denmark and Sweden and in the Danian drift boulders of northern Germany and on the Crimea.

Genus *Frurionella* Canu & Bassler, 1926

Canu and Bassler include the genus in the family Calloporidae Norman. Considering the extraordinarily intense calcification of the frontal wall of the zooecia, however, it is more than doubtful whether it actually belongs to the membranimorph Anasca. The whole aspect of the zoaria also rather indicates a member of the Ascophora. Lack of an ascopore is no argument to the contrary. *Beisselinopsis* Voigt has no ascopore either, although its external aspect is very similar to that of *Beisselina*. This applies even more for *Pseudobeisselina* Wiesemann (Wiesemann, 1963, p. 50); its type species *Pseudobeisselina compressa* (Goldf.) can be distinguished from *Beisselina striata* (Goldf.), which is exceedingly similar in the cumulating stage, only by its lack of an ascopore. This fact had escaped me (Voigt, 1960a) when I called this species a synonym of *Beisselina striata* (Goldf.). *Pachythecella lundgreni* (Pergens & Meunier) (comp. p. 450) also lacks an ascopore.

Now the inner view of the frontal wall in *Frurionella daniensis* Berth. (Pl. VII, fig. 6) as well as in *F. polonica* n.sp. (Pl. VIII, figs. 5-6) shows an exceedingly intense calcification of the original frontal area (Arealfeld = Polypidlumen sensu Wiesemann, 1963); in opened zooecia, this appears as a large, oval vacuity in the distal part of the zooecium. This part of the frontal wall evidently corresponds to what W. D. Lang called "intraterminal frontwall" in membranimorph and cribrimorph Cheilostomes.

In the Membranimorpha, however, this frontal area is calcified either not at all or only in part, but in *Frurionella*, exactly as in *Beisselina*, the largest part of this area is so intensely calcified, that even in young branches the boundaries of the zooecia are no longer perceptible at the exterior surface of the zoaria. Therefore the aperture of *Frurionella* is not an "opesium", but an "orificium".

On examination, the type species of *Frurionella parvipora* Canu & Bassler, 1926, shows exactly the same result, as I could state together with Wiesemann, based on original material of this species from the Ripley formation at Coon Creek (Tennessee); it had obligingly been sent to me by Dr R. Boardman, Washington (U.S. National Museum).

Evidently some of d'Orbigny's species of *Flustrella* belong here, as for example *F. polymorpha* d'Orb., the inner structure of which coincides with that of *Frurionella* completely.

Frurionella daniensis Berthelsen, 1962

(Plates VII, figs. 4-6; VIII, fig. 7)

1962. *Frurionella daniensis* Berthelsen; O. Berthelsen, Cheilostome Bryozoa..., p. 105, Pl. 9, figs. 8—9; Pl. 10, fig. 1.

Material and description. — More than 20 fragments from Boryszew belong to this species which varies very much with age and state of preservation. It has commonly five alternating longitudinal rows of zooecia, which are not marked off externally; they are located on each of the two broadsides of the slightly compressed little stems. The roundish-oval orifices possess a fine rim and are 0.12 — 0.17 mm. long. Their dimensions and distances are the same as those of the specimens of Danian age from Voldum (Denmark). In older and more corroded specimens the orifices appear larger and their outline is more rounded. Sometimes the lower margin in the interior of the orifice is cut off straight. Occasionally also a small and very concealed avicularium appears here. The avicularia are dimorphous. Sporadically there are large, mostly marginal vicarious avicularia and numerous small ones between the apertures which in part indicate rhomboid arrangement.

Usually there is a somewhat larger avicularium in the middle between every two apertures; sometimes two of them are arranged rather regularly one above the other; then the upper, larger one, forms a shallow bubble-like protuberance, whereas the lower, smaller one, is deeply immersed. Thus the difference in appearance of the zoaria is emphasized so much that at first sight there seem to be different species. At the lower border of the proximally cropped aperture a little mucro often appears.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (between 193.5 — 210.6 m.) borings, Poland.

Middle and Upper Danian (Herfolge) in Denmark, very frequent in drift boulders of Danian age in northern Germany and in Danian of the Crimea.

Frurionella polonica n.sp.

(Plate VIII, figs. 1-6)

Holotypus: Plate VIII, fig. 4 (Coll. Warszawa Br. II/No. 34).

Locus typicus: Boryszew boring near Warszawa.

Stratum typicum: Greensand marl of Dano-Montian age.

Derivatio nominis: Lat. *polonicus* = Polish, named after the country of origin of the species.

Diagnosis. — A specimen with exceedingly large (0.2 — 0.25 mm.) orifices and also very large sporadic frontal avicularia which reach up to 0.3 mm. in length. The arrangement of the orifices is relatively irregular.

Material and description. — There are 16 fragments, mostly not well preserved and somewhat corroded, which form cylindrical to slightly compressed, dichotomously branching, 1.0 — 1.5 mm. broad stems. The zooecia are arranged in three to five irregularly alternating longitudinal rows at both broadsides of the stems.

The very large, round orifices, surrounded by a fine seam, form indistinct quincunxes on the surface of the zoarium, on which single small avicularia are distributed. These, however, are only indistinctly recognizable on a few specimens. On others they seem to be lacking completely. Isolated or more numerous frontal zooecia of considerable size may be found between the zooecia. Here and there they are lacking completely. In the interior of the orifice at the bottom, a little tooth-like process (mucro) appears at times (Pl. VIII, figs. 1 *a*-*b*).

Opened zooecia demonstrate that here also there is no ascopore present.

Measurements (in mm.):

Diameter of the orifices	0.17—0.25
Length of the large frontal avicularia	0.20—0.30
Length of the small frontal avicularia	0.10
Length of the aperture of the small frontal avicularia	0.05

Remarks. — In view of the great variability of *Frurionella daniensis* Berthelsen the question is justified if not possibly *Fr. polonica* n.sp. may represent fragments of the same species with only exceedingly large apertures, especially since some specimens of *Fr. daniensis* may become very similar to our species.

The independence of the latter species, however, is proved by the fact that no specimens occur in the Danish-Swedish Danian which may be placed with *Fr. polonica*. Besides, no large avicularia seem to occur at the broadsides of the zoaria of *Fr. daniensis*. The little tooth-like process in the interior of the orifice is also found only here. It has nothing to do with an avicularium in this place.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (between 193.5 — 254 m.) borings, Poland. Danian of the Crimea.

Genus *Coscinopleura* Marsson, 1887

Coscinopleura angusta cf. *minor* Voigt, 1956

(Plate VII, figs. 1-3)

1956. *Coscinopleura angusta minor* Voigt; E. Voigt, Untersuchungen..., p. 50, Pl. 6, figs. 1—5.

Material and description. — In spite of certain slight differences I do not hesitate to identify about 600 fragments present from Boryszew and Sochaczew with the subspecies *minor* of *Coscinopleura angusta* Berthelsen established by me in 1956 — adding a "cf.", though. The flat branches are 1.3 to 2.0 mm. wide and possesses 4—6 alternating rows of zooecia; of the latter about 9 may be counted for each 5 mm. of length. The width of the opesia of the fertile zooecia (Pl. VII, fig. 3) is almost 0.2 mm. This size has also been measured at specimens from Ciply (Belgium) and from the Curfs quarry near Berg, Geul Valley (Netherlands). My remark of 1956, that the dimensions of the opesia in fertile zooecia of this subspecies are particularly small, was based on too scanty material. Since new and better preserved material shows considerably larger dimensions, the size proves not to be a significant difference in the two subspecies. The width of the opesium in normal zooecia is about 0.12 mm. and may also be reached by *C. angusta angusta* Berthelsen; thus the differences are also smaller in this respect.

Nevertheless, the Polish specimens seem to differ by a somewhat larger number of coscinopores in the marginal vibracularia (coscinozooecia), 17 pores per coscinozooecium being counted on several branches (at others 13—14 pores). Very often five to six pores may be counted at the inner margin of the coscinozooecia instead of four, as Berthelsen announces for his *C. angusta*. The dimensions stated for the material from Belgium and the Netherlands (average in all 12.1 — 14.7) are somewhat smaller; whereas there, mostly 14—15 pores are counted, here there are often 13—19. The question as to whether these variations are due to differences in stratigraphic position or to biologic factors, remains unanswered for the time being.

Thus, there is no complete agreement of the Polish material with that from Holland and Belgium, but the differences are too small to justify separation of another subspecies. I consider the very variable and in addition insignificant differences in size of the zooecia less important than the number of pores of the coscinozooecia, although even there we do not yet know how much ecologic conditions may influence their number.

However, it seems important that no substantial differences are detectable between the material of Danian (247—260 m.) and Paleocene age (193.9 — 247 m.) in the boring near Sochaczew.

From that follows that a form which is very close to the subspecies *minor* exists in Poland since Danian time and seems to represent the real *C. angusta angusta*. Nevertheless, it must be admitted that many specimens approach the latter very closely and that in some coscinozooecia only 7—10 pores are noticed, although on the same specimen twice this number may be reached.

The term "coscinozooecia" suggested by me in 1956 for the marginal vibraculoecia may be open to critizism, for they are not real "zooecia", but represent vibracularia and not polypids. It is justified, however, for the term heterozooecium comprises vibraculoecia as well as aviculoecia, although it also contains no polypid.

This species is much more frequent than all other bryozoan species from Boryszew. In this respect it is like *Coscinopleura digitata* (Morton), which is by far the most frequent bryozoan species in the Paleocene of North America (Vincentown Limesand).

Occurrence. — Dano-Montian of Boryszew and Sochaczew (different depths, between 193.5 — 265.2 m.) borings, Poland.

Dano-Montian of the Curfs quarry near Berg, Geul valley (Netherlands), strata of the same age at the Albert Canal near Vroenhoven and Montian of Ciply (Tuffeau de Ciply) near Mons (Belgium).

Genus *Lunulites* Lamarck, 1816 [3]

Lunulites saltholmensis Berthelsen, 1962

(Plate VI, figs. 1—5)

1962. *Lunulites saltholmensis* Berthelsen; O. Berthelsen, Cheilostome Bryozoa..., p. 153, Pl. 16, figs. 3—5.

Material and description. — 33 fragments are present, the comparison of which with *L. saltholmensis* proves identity with this form from the Upper Danian. Only the specimen (figured Plate VI, fig. 5) from the Danish upper Danian of Saltholmen, which Dr Berthelsen kindly gave me, possesses somewhat wider zooecia and, therefore, looks a little different; but this is not always so.

The diameter of complete zoaria may have reached 10 mm. Characteristic is the strictly radial arrangement of the zooecia with regularly intermediate rows of lanceolate avicularia. Two avicularia thus are referable to each zooecium and flank its distal border. Since the zooecia and opesia increase gradually in size towards the border, as is the case with most *Lunulites*, fragments often look quite different depending on their more marginal or more apical origin, especially because the smaller zooecia of the apical region are always longer than wide. The radial arrangement of the zooecia therefore always implies increasing width in a distal direction. The fertile zooecia, the ooecia of which are very poorly developed, are distinguished by their much larger opesia, as is shown by the specimen on Plate VI, fig. 4, from the boring near Sochaczew. On Plate VI, fig. 1 there are some fertile zooecia at the margin of the zoarium.

The zooecia of the apical region are mostly much calcified and have closed apertures, sometimes with 2 or 5 pores. The term "hydrostatic zooecia" of Canu & Bassler is merely hypothetic and not supported by any kind of observations.

At the concave side the rows of zooecia are characterized by shallow ribs which increase by marginal insertion of new rows. Very important is the presence of sporadic inconspicuous pores on these ribs, exhibited by the Polish as well as by the Danish specimens.

These pores are a transitional feature between the Cretaceous forms of *Lunulites* which are always free of pores and the Tertiary porous ones, a criterion, thus, of stratigraphic as well as phylogenetic importance. The development of this system of pores seems to be combined with the development of a fine channelling on the lateral walls of the zooecia, which, too, is distinctly shown only by the stratigraphically younger *Lu-*

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[3] I follow the opinion of Canu and Bassler (1931, p. 7) that the symmetrical heterozooecia of *Lunulites* should be regarded as avicularia and not as vibracularia. The *Lunulites* avicularia have long setose mandibles (cf. Bassler, 1953, p. G171) but they are not always auriculate as stated erroneously by Bassler.

nulites. All strictly radial species of *Lunulites* divide easily into wedge-shaped segments; at their edges the above-mentioned arched channellings stand out clearly.

In appearance *L. saltholmensis* reminds one very much of *L. cretacea* Defr. (d'Orbigny, 1852, p. 349, Pl. 704, figs. 2—6), the apical zooecia of which are also not closed. In spite of the external similarity, the pores on the concave side demonstrate that *L. saltholmensis* is not only different, but also phylogenetically younger. A fragment from Boryszew (Pl. VI, fig. 3) shows the zooecia arranged regularly in longitudinal and transverse rows, distinctly seen from the interior. The avicularia are not opened but are located below the straight longitudinal ribs.

The inner structures of *Lunulites* as well as those of the concave lower surface have proved to be very characteristic and to add considerably to the diagnosis of the various species which are often very similar to each other.

Measurements (in mm.):

Zooecia	Opesia	
	of normal zooecia	of fertile zooecia
Lz = 0.32 – 0.37 lz = 0.27 – 0.32	ho = 0.10 – 0.13 lo = 0.13	ho = 0.15 lo = 0.13 – 0.15

Occurrence. — Dano-Montian of Boryszew and Sochaczew (different depths, between 193.5 — 241.5 m.) borings, Poland.

Upper Danian in Denmark, scattered in drift boulders of Danian age in the vicinity of Hamburg; Dano-Montian of the Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands); Danian of the Crimea.

Lunulites sp.

(Plate VI, figs. 6—8)

Material and description. — There are 15 poorly preserved, in part somewhat corroded fragments of another species of *Lunulites* present which I cannot attribute yet to any known species and which is possibly new; therefore its characteristic features are briefly described.

It is a cupuliform *Lunulites*, 7—8 mm. in diameter, with very regular radial arrangement of the zooecia, between which there lie straight rows of deeply immersed avicularia. These appear as marked furrows. The zooecia are subquadrate, deepened like a dish and surrounded by a distinct, distally arching rim. The opesia are rounded-quadrangular to transversely oval, without opesiulae, increasing in size towards the margin, leaving only little space for the cryptocyst in the distal zooecia and generally closed in the apical (central) part. The avicularia are deeply lowered into the interzooecial furrows; their apertures are 8-shaped with the lateral prominences situated in the distal half. They are rounded distally.

The concave surface of the zoarium (Pl. VI, fig. 7) shows arched low ribs with characteristic transversely arranged fine granulations consisting of sporadic fine pores. The rows of avicularia form narrower ribs inserting from the margin.

The colonies are very fragile. They are broken easily along the rows of avicularia into triangular segments or into isolated rows of zooecia. This species differs from the preceding by shorter and wider zooecia and by transversely oval or rounded opesia.

Measurements (in mm.):

Lz = 0.20 — 0.30 ho = 0.07 — 0.15
lz = 0.24 — 0.30 lo = 0.07 — 0.16

Occurrence. — Dano-Montian of Boryszew and Sochaczew (different depths, between 207.6—267.2 m.) borings, Poland.

Genus *Vibracella* Waters, 1891

Vibracella (Vibracella) pozaryskae n.sp.

(Plate V, figs. 1—2)

Holotypus: Specimen figured in Plate V, fig. 1 (Coll. Warszawa Br.II/No.17).
Locus typicus: Boryszew boring near Warszawa.
Stratum typicum: Glauconitic arenaceous marls of Dano-Montian age.
Derivatio nominis: *pozaryskae* — after Prof. Krystyna Pożaryska from the Palaeozoological Institute of the Polish Academy of Sciences.

Diagnosis. — A species with free leaf-shaped zoarium of *Pavolunulites*-form, with irregularly shaped, hexagonal to pyriform zooecia and triangular to semicircular opesia, which may show a more or less well developed lower lip (may be lacking). Vibracularia are smaller than zooecia, numerous, located in the gap between every 4 zooecia, ear-shaped, strongly asymmetrical.

Material and description. — The description is based on numerous specimens from the Upper Danian of Hvallöse (Jutland, Denmark) (Pl. V, fig. 2) and one zoarium from Boryszew. Whereas the latter forms a convex scutiform plate of fan-like shape, the Danish specimens are all broken into smaller pieces. The zooecia are somewhat irregularly arranged in quincunx as in *Pavolunulites*. They are as long as wide, surrounded by sharp furrows, irregularly pentagonal to hexagonal, hexagonal-pyriform, distally arched or ogival, proximally tapering or horizontally cropped, sometimes even with concave proximal margin due to contact with the curved distal margin of the proximal zooecium; cryptocyst bowllike, smooth; opesium rounded-triangular, variable in size, occupying about one half to two-fifth of the cryptocyst; the distal zooecia bordering the zoarium may be much larger. This can clearly be demonstrated not on the type specimen, but on the Danish material. Especially the marginal zooecia often possess exceptionally large apertures without a notch, reminding one of membranimorphous forms.

Probably the calcification of the cryptocyst has not yet been accomplished here. The proximal margin of the opesium is straight or forms a lower lip; thus mostly two opesiulae develop. The interzooecial ear-shaped vibracularia are numerous and always smaller than the autozooecia. Their rhomboid appearance corresponds less to their proper shape than to that of the space between every four zooecia. Distally and proximally they often end in thin tails. Their small roundish oval aperture is deeply submerged and protected under a hemisphaerical lateral wall which is vaulted inwards. It tapers to a blunt angle and rises high above the surface of the zoarium. At times it is the right, at times the left lateral wall which causes this striking asymmetry of the vibracularia.

Special peculiarities are sealed zooecia. In them, a narrow horseshoe-shaped furrow is visible at the distal margin of the zooecium, which corresponds to the shape of the operculum. Below it runs a narrow furrow, often opened to form a slit, which connects the former opesiulae transversely. This furrow is generally constricted in the middle and corresponds to the transverse slit of the closed zooecia of *Vibracella (Discovibracella) oculata* n.subg., n.sp. (p. 445).

The dorsal face of the zoarium shows the bordering furrows of the zooecia. The latter are even and shallow. No ooecia have been observed.

Measurements (in mm.).

Holotype from Boryszew	Specimens from Hvallöse	
Lz = 0.38 — 0.50	Zooecia	Lz = 0.37 — 0.50
lz = 0.38 — 0.40		lz = 0.30 — 0.40
ho = 0.12 — 0.18	Opesia	ho = 0.12 — 0.15
lo = 0.13 — 0.15		lo = 0.12 — 0.15
Lv = 0.30 — 0.35	Vibra-	Lv = 0.25 — 0.32
lv = 0.18 — 0.25	cularia	lv = 0.17 — 0.25

Remarks. — The only species with which our find might be compared is *Pavolunulites buski* Reuss (Reuss, 1867, Pl. 1, fig. 6, p. 14) from the Lower Oligocene of Calbe/Saale.

According to the shape of the vibracularia, which are either badly preserved or inaccurately figured, this is a *Vibracella*. The opesia of it are lower and wider, and possess very large opesiulae.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Uppermost Danian at Hvallöse (Jutland, Denmark), 45 fragments; flint drift boulder of Danian age from Wakendorf in Holstein (Germany), 3 fragments; Dano-Montian of the Curfs quarry near Berg in the Geul valley close to Maastricht (Netherlands), 2 specimens; Danian of the Crimea.

Subgenus *Vibracella* (*Discovibracella*) nov.

Type species: *Vibracella* (*Discovibracella*) *oculata* n.subg., n.sp.; Dano-Montian.
Stratigraphic range: Maastrichtian — Eocene.
Derivatio nominis: composed of the generic name *Vibracella* Waters, 1850, and Lat. *discus* = disk.

Diagnosis. — Zoarium round, orbicular to dome-shaped, with radially arranged zooecia; zooecia and vibracularia like those of *Vibracella*; opesium large, widely opened; membranimorphous closed zooecia with median transverse slit in the center are very common.

Remarks. — A species similar to the type species is found in the Maastrichtian of Chef du Pont (Cotentin, Manche). From Eocene strata *Vibracella* (*Vibracella*) *orbicularis* Canu (1907, p. 32, Pl. 4, fig. 12—14) belongs to this subgenus. The sealed zooecia with a transverse slit, significant for the type species, are lacking here, but this must obviously not be considered as a generic or subgeneric character.

In my opinion, the pronounced *Lunulites*-form requires a subgeneric separation; all Cheilostomata growing in the true *Lunulites*-form are generically independent. *Pavolunulites* d'Orbigny also ought to be kept separated from *Lunulites*, for generally it still seems to possess primitive avicularia and no avicularia with setose mandibles or true vibracularia and is not represented in the Tertiary. Therefore fussion of *Lunulites* and *Pavolunulites* as carried out by Bassler (1953), seems not to be justified, since the free disciform zoaria which always possess a high radial symmetry, seem to be conditioned by a special mode of life; notwithstanding all that I do not believe that *Lunulites* was a free swimming form as it was emphasized by Canu & Bassler. According to Canu & Bassler the "vibracularia" of *Lunulites* in the sense of earlier authors should be considered as avicularia as shown by Waters, 1919.

Vibracella (*Discovibracella*) *oculata* n.subg., n.sp.

(Plate V, figs. 3 — 7)

Holotypus: Specimen figured on Plate V, fig. 3 (Musée Inst Royal in Brussels).
Locus typicus: Ciply near Mons in Belgium (more than 200 specimens).
Stratum typicum: Tuffeau de Ciply, Lower Montian.
Derivatio nominis: *oculata* — Lat. *oculus* = eye, with regard to the eye-like transverse slit of the sealed zooecia.

Diagnosis. — A specimen measuring 2.5—4 mm. in diameter, with numerous small zooecia, the large roundish opesium of which occupies the largest part of the zooecium, with rare small vibracularia and very numerous sealed zooecia; their calcified inflated covering, which is extended above the cryptocyst, possesses a narrow transverse slit in the center.

Material and description. — The zoarium (2 specimens) is orbicular or scutiform in outline, is normally not absolutely circular, but a little irregular or polygonal. It is similar to *Lunulites*; there usually is a grain of the sediment or shell-fragment in the center, which has served as basis for attachment of the ancestrula. In contrast to *Lunulites,* however, the base remains visible up to older stages, whereas *Lunulites* nearly always completely builds it into the zoarium. If the basis is too large, the zoarium remains encrusting; this was observed only four times (e.g. Pl. V, fig. 4) and may at times be observed in real *Lunulites* also.

The zooecia which radiate irregularly towards the margin are very numerous and remain about equal in size from the center to the periphery. They are pentagonal to hexagonal, without distinct longitudinal axis. They border on each other in sharp edges without a visible separating furrow; the apertures occupy almost the whole width. The nearly round or roundish-triangular opesium is set in deeply and leaves hardly space enough for a slightly developed sloping cryptocyst. In the immature marginal zooecia the opesia are sometimes particularly large, for here the cryptocyst is still barely calcified.

Very significant are the frequent zooecia closed by a convex calcareous lamella; regularly they show a narrow transverse slit rather exactly in the center. The sealed zooecia, which often stand together in groups are hexagonal in outline; in them, the oblong shape is more easily recognizable than in the normal ones. They are separated by furrows; and as they project over the level of the ordinary uncalcified zooecia, they often make the surface of the zoarium look rather uneven. The ear-shaped vibracularia are relatively small and scarce, therefore they are easily overlooked. They are asymmetrical, either the right or the left wall being drawn up to form an arched roof, under which the orifice is located. The ancestrula, which is generally sealed in older zoaria is hardly smaller than the other zooecia. Plate V, fig. 4 shows an encrusting juvenile specimen with only slightly closed zooecia.

The cryptocystal part is relatively large in the zooecia of the ancestral region; the opesium, therefore, occupies only about half the length of the zooecia, and the opesia are distinctly lengthened transversely. In the morphology of the zooecia the ancestral part reminds one much more of the other, normal, species of *Vibracella.* In most cases the apex of the zoarium is somewhat deepened.

No ooecia have been found.

The concave basal face of the zoarium (Pl. V, fig. 6*b*) in the apex very regularly shows the base mentioned above or its cavity, if it has weathered or fallen out. From here a number of ribs radiate as in *Lunulites.* Concentric growth lines may often be observed.

It is noteworthy that a sessile species of Foraminifera often has settled on specimens from Ciply and is located in the apex of the basal face.

The "calcified" zooecia deserve special interest. They represent not only, as often in Cheilostomata, a calcareous lamella covering the opesium, but the calcareous lamella rather stretches over the whole cavity of the zooecium as a convex roof extending over the opesium as well as over the cryptocyst, as can easily be verified by scraping off the considerably thick and solid calcareous cover. The transverse slit which appears regularly seems to result from the junction of two breaks or punctiform pores. A similar transverse slit on *Vibracella* (*Vibracella*) *pozaryskae* corresponds to the lower border of the opesium or to the two opesiulae which form passageways for the parietal muscles.

Remarks. — This very distinctive species is completely isolated and therefore cannot be mistaken for any other form. It is not impossible, though, that *Lunulites intermedia,* figured and described wholly insufficiently by Morren (1832, p. 44, Pl. 13, figs. 1—5): "ex stratis calcareis albis agris Ciplyani prope montes Hannioniorum" represents our species. This view is supported by the fact that the apertures of the uncalcified zooecia stand farther apart then in any other species of *Lunulites,* that the center of the apex is concave, and by the remarks that the species differs from other species (namely such as described by Goldfuss) of *Lunulites* "... irregulari pororum positione". Besides, there is no other species known from Ciply, neither from the Maastrichtian nor from the Montian, to which Morren's description is referable.

With the diagnosis "*Lunulites* convexo-planus, apice depresso, concavo; latere convexo cellularum ostiolis orbiculatis poroso; latere concavo laevi", not much of significance is said. Identification of *L. intermedia* with our species, on the other hand, is in contradiction with the allegedly completely smooth lower surface and the regularly radiating arrangement of the zooecia shown on Morren's figure. Unfortunately, nothing could be ascertained concerning the whereabouts of Morren's original specimens. Therefore, for the time being, we must leave things as they are.

Measurements (in mm.):

Zooecia	Opesia	Vibracularia
Lz = 0.30 — 0.33 lz = 0.25 — 0.37	ho = 0.10 — 0.20 lo = 0.15 — 0.22	Lv = 0.17 — 0.20 lv = 0.20 — 0.25

As to the measurements, it must be remarked that the extreme numbers for the width of the opesia refer to the apertures of the marginal zooecia, which seemingly are too "large" because the cryptocyst is not calcified. Equally, the marginal zooecia are sometimes wider than the average.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Dano-Montian of Albert Canal near Vroenhoven (Belgium) at km. 24 (Dr Meijer), Dano-Montian of the Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands), Danian drift boulder "A" from Wohltorf near Hamburg and the Danian of the boring "K" near Grevenhorst (Schleswig-Holstein, Germany) between 1147 and 1150 m. (Prof. Wicher, 1954).

Genus *Puncturiella* Levinsen, 1925

Puncturiella cf. *sculpta* (d'Orbigny, 1851)

(Plate VII, fig. 8)

?1851. *Vincularia sculpta* d'Orbigny; A. d'Orbigny, Paléontologie..., p. 72, Pl. 655, figs. 16—18.
1886. *Vincularia sculpta* d'Orbigny; E. Pergens & A. Meunier, La faune des Bryozoaires..., p. 231.
1892. *Steganoporella sculpta* (d'Orbigny); A. H. Hennig, Studier..., p. 35, Pl. 1, fig. 20.
?1959. *Puncturiella sculpta* (d'Orbigny); E. Voigt, Revision..., p. 44.
1962. *Puncturiella sculpta* (d'Orbigny); O. Berthelsen, Cheilostome Bryozoa..., p. 155, Pl. 17, fig. 2.

Material and description. — A single, but well preserved specimen from the boring near Boryszew is under consideration. It is perfectly equal to the material from the Baltic Danian and the Belgian Montian.

However, there are some small though constant differences from *Puncturiella sculpta* d'Orbigny from the Maastrichtian of the Cotentin, the original specimens of which I was able to examine in Paris. I collected additional material of it from the same horizon near Chef du Pont (Pl. VII, fig. 7) and Port Fiolet.

Aside from the somewhat smaller size of the zooecia (see below), especially the cryptocyst is different in the French Maastrichtian specimens. There are not only few pores present, but these are arranged in the peripheral marginal furrows, whereas the central arched part (polypidian convexity) shows only a few pores (up to about 20) which in addition are arranged in longitudinal rows. In the Danian and Montian specimens, on the contrary, the cryptocyst is almost flat and smooth and the pores in it are rather numerous (about 35—40) and evenly distributed. Marginal furrows at the periphery of the cryptocyst are absent or hardly indicated.

Till now, these differences have been unknown, since d'Orbigny's drawing is totally wrong; for it shows neither the pores of the cryptocyst nor the avicularia above the opesium.

The former, it is true, are hardly detectable in the somewhat crystallized chalk of the Cotentin, but the avicularium is always present. In *Eschara Argia* d'Orbigny (1851, p. 128, Pl. 660, figs. 10—12), which also belongs to *Puncturiella*, the rows of pores of the cryptocyst and the avicularia above the aperture are also not depicted in d'Orbigny's figure. His type specimen shows them.

In addition, in the real *P. sculpta* from the Cotentin the zooecia are always a little smaller; their length here amounts to between 0.5—0.8 mm., the average length is around 0.6 mm. as opposed to 0.8—

0.85 mm. in the Danian and Montian specimens; even 0.92 mm. and 1.09 mm. of length have been observed (Berthelsen, 1962).

Although the dimensions may overlap in the two groups of forms, in direct comparison the difference is at once evident.

Under these circumstances it may be advisable to separate the younger form as a subspecies, especially since it seems to be independent stratigraphically. This cannot be done, however, before better preserved specimens of the real *P. exsculpta* are at hand, which would allow the pores in the cryptocyst to be counted with certainty.

Remarks. — Almost without exception the species *Vincularia exsculpta* Marsson from Rügen as well as *P. sculpta* show pores in the marginal furrows of the cryptocyst. Therefore, I united the two forms in 1959. The very well preserved specimens from Rügen, however, are so very different from the Dano-Montian form that I hesitate now to unite them as a single species. In the Tuffeau de Ciply (Lower Montian) there occurs a broader bilamellar (ecological?) modification of our form which corresponds completely to the figure on Berthelsen's Plate 17, fig. 1. Very similar, but still larger (Lv = 0.9—1 mm.) is *Micropora* (?) *pulchra* Canu & Bassler (1933, p. 36, Pl. 8, fig. 5) from the Vincentown Limesand (U.S.A.).

Measurements of *Puncturiella* cf. *sculpta* (in mm.):

Danian drift boulder from Wohltorf near Hamburg	Lz = 0.67—0.92 lz = 0.18—0.25	ha = 0.05—0.07 la = 0.11—0.12
Dano-Montian, Curfs quarry near Berg, Geul valley (Netherlands) .	Lz = 0.57—0.70 lz = 0.20—0.22	ha = 0.07—0.08 la = 0.12—0.13
Boring near Boryszew	Lz = 0.68—0.80 lz = 0.18—0.22	ha = 0.06—0.07 la = 0.12—0.13

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Found frequently in the Baltic Danian (Denmark, Sweden, Danian drift boulders of northern Germany); three specimens from the Dano-Montian of the Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands); Danian of the Crimea.

Genus *Taenioporina* Marsson, 1887

Taenioporina articulata Voigt, 1930

(Plate IX, figs. 5-6)

1886. *Vincularia areolata* (non d'Orbigny); E. Pergens & A. Meunier, La faune des Bryozoaires..., p. 232, Pl. 13, fig. 1.

1930. *Taenioporina articulata* Voigt; E. Voigt, Morphologische..., p. 534, Pl. 37, figs. 17—18.

1962. *Taenioporina articulata* Voigt; O. Berthelsen, Cheilostome Bryozoa..., p. 208, Pl. 26, fig. 1.

Material and description. — The specimen figured on Plate IX, fig. 5 is 1.3 mm. wide and typical for the species, although not well preserved, in contrast to the specimen figured (fig. 6), from a Danian drift boulder from Daerstorf near Hamburg. It shows very distinctly the salient ridges and thread-like ribs which cover the surface of the dichotomous cylindrical branches and which may even cross the apertures in older specimens (Berthelsen). Likewise, they show the small pores flanking the fields framed by the ridges. In our specimen the apertures are placed somewhat more irregularly than usual. In the Danian drift boulder from Daerstorf near Hamburg we even found a fragment with an ooecium. It forms a globular swelling above the aperture.

This species probably represents a new genus. Its attribution to *Taenioporina* (Voigt, 1930) had been only provisional.

Taenioporina arachnoidea (Goldf.), the type species from the tuffkreide of Maastricht, is totally different. The only feature in common is the presence of thread-like ridges on the surface of the zoarium. The most closely related genus seems to be *Ochetosella* Canu & Bassler from the Tertiary of North America.

The ridges begin to be built close to the aperture. They frame it and continue from its lower border in an arch to the upper border of the next zooecium below. Here they mark the border of the zooecia rather distinctly. In the slender distal branchlets the orifice contracts to form a small slit (rimula), thus still indicating differentiation into anter and poster. This statement fits well to the absence of an ascopore, which till now has never been observed.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

It is widespread in the Maastrichtian White Chalk of Rügen, in the Danish and Swedish Danian as well as in the flint drift boulders of Danian age in northern Germany, but is nowhere frequent. It is also found in the Danian of the Crimea and in the Dano-Montian of the Curfs quarry near Berg, Geul valley close to Maastricht (Netherlands) and in the Montian of the Tuffeau de Ciply near Mons (Belgium).

Genus *Pachythecella* Canu & Bassler, 1934
(pro *Pachytheca* Canu, 1913, non Schlüter, 1885)
Pachythecella lundgreni (Pergens & Meunier, 1886)

(Plate IX, figs. 1-4)

1886. *Foveolaria lundgreni* Pergens & Meunier; E. Pergens & A. Meunier, La faune des Bryozoaires..., p. 242, Pl. 11, fig. 3.

1925. *Monoporella lundgreni* (Pergens & Meunier); G. M. R. Levinsen, Undersøgelser..., p. 400, Text-fig. 27.

1930. *Pachytheca lundgreni* (Pergens & Meunier); E. Voight, Morphologische..., p. 520, Pl. 33, figs. 8—9.

1962. *Pachythecella lundgreni* (Pergens & Meunier); O. Berthelsen, Cheilostome Bryozoa..., p. 206, Pl. 25, figs. 5—6.

Material and description. — Nine slender cylindrical, dichotomously branching little stems, 0.6—1.4 mm. in diameter, with zooecia standing in mostly 6—8 (on young branches 4) alternating longitudinal rows. Their external border is visible only on very young branches as I have seen in specimens from other localities. The round or transversely oval, somewhat protrusive peristomes of the specimens from Boryszew show only remnants of the long prolongations which project considerably in especially well preserved specimens and which have been figured by Pergens & Meunier, too, although probably somewhat exaggerated.

The margin of the peristomie may widen so much outwards, trumpet-like, that the appearance of the zoarium is changed completely. The transverse diameter of the peristomie may then increase to 0.4 mm as opposed to the normal 0.2 mm. Often the margin is produced into a median mucro and curved inwards (Pl. IX, fig. 3).

The oral avicularium is not always placed below the aperture, but often also within the peristomie and thus not visible externally or appearing only after the protruding apertural margins have been ground down.

Very small avicularia (diameter 0.08—0.10 mm.) which are immersed into the surface of the zoarium at irregular intervals may simulate ascopores, but often they are still clearly discernible as avicularia by their pivot. Till now no ascopore has been found anywhere. If it existed, it ought to be visible on the entirely smooth outer surface of young branches as well as on the inner surface of the outer wall of zooecia that have been broken up.

Even excellently preserved siliceous internal casts (Pl. IX, fig. 4) from drift boulders of Danian age, on which the oral avicularia are visible, show no ascopores. Here they ought to be visible as filling of the ascoporan canal as in *Beisselina* from the same drift boulders, in which they are always present as internal casts. The filling of one or two very small pores such as are visible in the narrow proximal part of many Ascophora, cannot be considered as indicating an ascopore, for this must always be expected in the central voluminous part of the zooecia (the polypidian vacuity). The opening of a spiramen was not traceable either. Specimens from the Danian of Herfolge (Denmark) possess a very fine canal which is observable as a light-coloured line on the inner side of the peristomie. It seems very uncertain whether it functioned as an outlet for the ascus.

Absence of an ascopore is important in so far as the ascus forms an essential generic feature for *Pachythecella*. Canu (1913) mentions extraordinarily wide funnel-shaped apertures of the ascopores on the type species *P. filiformis*; this rouses suspicion that actually they may be frontal avicularia seen in longitudinal section. It seems advisable to leave our species provisionally with *Pachythecella* as long as the matter has not been examined with new material of the real *P. filiformis* from the type locality (Royan).

Remarks. — It must be pointed out that the form from the White Chalk of Rügen and Denmark described as *Acropora, Porina,* or *Pachytheca filiformis* by Marsson (1887, p. 83, Pl. 8, fig. 2) and, following him, by Levinsen (1925, p. 408) and Voigt (1930, p. 520, Pl. 33, figs. 4—7) does not correspond at all to *Porina filiformis* d'Orbigny from Royan. This became evident when I had the opportunity to investigate and photograph d'Orbigny's type. Surprisingly the above-named species *Acropora filiformis* of Marsson turned out to be identical with *Entalophora variegata* d'Orbigny (1850, Pl. 622, figs. 18—21) from the Upper Campanian of Meudon. D'Orbigny did not recognize this species as belonging to the Cheilostomata, deceived by the orbicular protruding peristomies. The typical small avicularia between the apertures are also present in *"Entalophora" variegata.* For the time being, therefore, the species from Rügen and Denmark, which is also found in the Maastrichtian White Chalk of Lüneburg and Hemmoor, and which was identified by Marsson as *Acropora filiformis,* must be identified as *Pachythecella variegata* d'Orbigny; as explained above, though, the question concerning the proper genus is not definitely settled.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Frequent also: in the Danish and Swedish Danian, in drift boulders of Danian age in northern Germany and in the Dano-Montian of the Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands).

Genus *Beisselinopsis* Voigt, 1951

This genus differs from *Pavobeisselina* by absence of an ascopore and therefore it is not closely related to *Beisselina* (compare p. 458). On the other hand, the frontal wall in young zoaria is perforated by a considerable number of pores (?tremopores) which later on may be overgrown and closed. The symmetrically built, fan-shaped zoaria were fastened to the bottom by radicells.

As the ascopore is lacking, this genus cannot be assigned together with *Beisselina* to the Porinidae d'Orbigny. A determination of its taxonomic position requires further investigations.

Beisselinopsis cf. *hiltermanni* Voigt, 1951

(Plate IX, figs. 9-10)

Material and description. — Three very badly preserved specimens belong to a species of *Beisselinopsis* which is rare in the Danian and which has come to my hand from Faxe, Voldum, Hvallöse, and from drift boulders of Danian age from Havighorst near Hamburg. They form fan-shaped, flat, usually elongate zoaria reaching 2.5 mm. in width.

They are easily mistaken for *Pavobeisselina oblita* Kade, but differ from that species by their sieve-like perforated front wall which is flat or sometimes a little convex in distal zooecia, by absence of an ascopore and by lack of the numerous small avicularia. In their place isolated avicularia are observed to the right or left below the aperture. In some specimens from the Upper Danian of Hvallöse the frontal pores form irregularly arranged, small, oval slits or holes; their number is 20—25, which is twice as much as the number of pores in the specimens from the Upper Maastrichtian.

It is not easy to decide whether this species is conspecific with *Beisselinopsis hiltermanni* Voigt or with *B. dietzi* (Voigt, 1951, Pl. 10, figs. 9—10).

Although the specimens of the two forms then known to me look quite different, it must be emphasized that in the meantime, with the material much enlarged, the differences have proved to be less than I had formerly thought. Possibly they are mainly based on different stages of age and preservation, for *B. dietzi* from Ilten is much worn in comparison with the well preserved types of *B. hiltermanni* from the Aachen Maastrichtian chalk. The avicularia, which occur more or less frequently to the right and left below the aperture in *B. dietzi*, occur in *B. hiltermanni*, too, and at times the latter species becomes broad and fan-shaped in the same way as it was at first considered characteristic for *B. dietzi*. Thus the figured specimen from Boryszew (Pl. IX, fig. 9) as well as that from Hvallöse (Pl. IX, fig. 10) widen distally rather quickly. Often the number of pores, however, seems to be greater in this form and increases in the younger material from the Danian. Unfortunately, exact figures are hard to get, for especially the smaller pores disappear again in old age and are difficult to count.

The figured specimen from Boryszew is much corroded and shows the pores only very indistinctly. The avicularia below the apertures are recognizable only allusively. This type of preservation renders good photographic reproduction very difficult. The specimen figured, by its broad, fan-shaped form and by the regular avicularia on both sides below the orifice, reminds one more of *B. dietzi* than of *B. hiltermanni*. This uncertainty leads me to add a "cf." to the identification.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

It is found in the lower Upper Maastrichtian of Vetschau near Aachen, Tuffeau of St. Symphorien near Ciply (Belgium) and Maastricht (Netherlands). It also occurs in the Middle Danian near Voldum (Jutland) and Faxe (Seeland) as well as in the Upper Danian near Hvallöse (Jutland) and also in flint drift boulders of Danian age from Havighorst near Bergedorf east of Hamburg.

Genus *Beisselina* Canu, 1913

Wiesemann (1963) recently restricts the genus *Beisselina* to the few species more closely related to *B. striata* (Goldfuss). The majority of the forms hitherto placed here, therefore, following Wiesemann, should no longer be included in the genus *Beisselina*. However, as long as no other genera are defined to include the remaining forms, nothing else is left than provisionally to treat the forms concerned under this name, for I do not want to forestall the further current investigations of Wiesemann.

The only species from Boryszew, which still belongs to *Beisselina* in the sense of Wiesemann, is *B. munita* n.sp.

The forms belonging to *Beisselina* and related genera represent one of the most difficult groups of fossil Bryozoa. They are not only extremely variable, but the surface of the zoaria also looks very different in the different age classes; therefore, the neat separation of species often offers considerable difficulties even with well preserved material. This is caused by increasing calcification of the zooecia during astogenesis. In addition, the forms belonging to this group possess a complicated inner structure which can only be analysed by sections or natural internal casts, or, even better, by artificial casts (Wiesemann, 1960).

Beisselina munita n.sp.

(Plates: X, figs. 1-7; XI, figs. 1-2)

Holotypus: Plate X, fig. 3 (Coll. Warszawa Br. II/No. 44).

Locus typicus: Boryszew boring near Warszawa.

Stratum typicum: Arenaceous glauconitic marls of Dano-Montian age.

Derivatio nominis: munita — Lat. *munire* = to fortify; name refers to the large protective avicularia.

Diagnosis. — It is a *Beisselina* of the *striata* group, distinguished by the following features: zoaria 2—4 mm. broad, compressed, peristomes seldom conspicuous, rare avicularia of the type of *B. celleporoides* Voigt on the narrow sides of the zoarium, [= Kanten-Aviculoecien] very large projecting avicularia on the zoarial surface with elongate, tongue-shaped, distally rounded mandible and rarely observed and feebly developed cumulating stage.

Material and description. — The zoaria (41 specimens) look very different, as in all *Beisselina*, depending on state of preservation and age. On the younger branches the apertures are arranged in fairly regular alternating longitudinal rows; often the distinctly visible ascopore is located not in the middle between two apertures, but in the upper third of the zooecium. Typically rhomboidal apertural areas as in *B. striata*, the margins of which are occupied by pores and small avicularia, are not developed. A medium-sized rounded avicularium above the aperture is regularly observed, its rounded mandible pointing proximally. Usually it is somewhat immersed, but it may protrude as well. The number of the smaller avicularia and pores changes and gives great variation to the appearance of the different specimens. Older specimens by their larger number of pores give an unsettled picture. Many of these pores are placed at the ends of a common ditch-like deepening which thus appears "yoked".

Measurements (in mm.):

L_z = 0.63—0.80 (measured from the inside)
l_z = 0.20—0.25
Peristomice 0.15

Remarks. — The species differs from *B. striata* (Goldf.) and *B. pustulosa* (v. Hag.) by its large avicularia, from *B. striata* in addition by occasional possession of avicularia on the zoarial edges (Pl. XI, fig. 2). Most similar probably is *B. celleporoides* Voigt (cf. Voigt, 1960a, p. 701, Pl. 31, figs. 10—12) from which it differs as well by the much larger (about 0.42—0.60 mm. compared with 0.30—0.38 mm.) avicularia set up on the surface of the zoarium as by the cumulating stage observed here only rarely. For comparison, the avicularia on the zoarial edges of this species are figured on Plate XI, fig. 3. Apart from this, the stems of *B. celleporoides* are much broader, thicker and stouter (3—4 mm.), but this may have ecological causes. *Beisselina aviculifera* Wiesemann (1963, Pl. 3, figs. 1—6) has much more pointed macro-avicularia. Seen from the interior, the zooecia of our new species are only indistinctly separated into polypidian and funicular cavities (Pl. X, figs. 6—7). The ascopore here forms a transversely oval opening in the upper third of the zooecium. In *B. celleporoides* the polypidian cavity is wider and the inner aperture mostly covered, thus giving an entirely different aspect (Pl. XI, fig. 4).

Wiesemann (1963, p. 35) believes that the specimen figured by me (1930, Pl. 37, fig. 4) as type of *B. celleporoides* Voigt does not belong to this species as characterized in the text and figured in my paper (1960*a*, Pl. 31, fig. 10), but represents the cumulating stage of *Psilosecos angustidens* Levinsen, which may be strikingly similar to that of *B. celleporoides*. Since the original specimen is destroyed and cannot be examined as to the presence of a denticle in the interior of the aperture, the unmistakable specimen figured as cited above (Voigt, 1960a) is to be considered as the neotype.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (between 193.5—250 m.) borings, Poland.

"Beisselina" pauperata n.sp.

(Plate XI, figs. 5-9)

Holotypus: Plate XI, fig. 5 (Coll. Warszawa Br. II/No. 52).
Locus typicus: Boryszew boring near Warszawa.

Stratum typicum: Glauconitic arenaceous marl of Dano-Montian age.

Derivatio nominis: pauperata — Lat. *pauper* = poor; refers to the zoarial surface exhibiting only a few avicularia.

Diagnosis. — A *Beisselina* distinguished by slightly compressed, almost cylindrical zoaria which are 1.0—1.5 mm. in diameter, with altogether 8—10 alternating longitudinal rows of zooecia, of which the large swollen peristomes project in a circular or goitrous fashion.

The zoarial surface is relatively smooth and poor in avicularia or other pores. The ascopore is large, always distinctly visible and placed in the center of the zooecium. Of the three kinds of avicularia, the large ones of about 0.50 mm. in length are relatively rare. The medium-sized ones are located rather regularly above the peristomice with their rostrum directed downwards and immersed deeply. Smaller avicularia are irregularly scattered on the surface of the zoarium.

Description. — There are 11 fragments of this very characteristic species. Only rarely the little stems show a distinct marginal edge in which the two lamellae of the bilamellar zoarium meet. Mostly it does not develop and often the zooecia open at the zoarial margins as well as on the broadsides. The very narrow pieces are cylindrical. By the relatively few large peristomes and the small number of avicularia the surface of the zoarium appears rather bald, although three different kinds of avicularia are present; the large ones are rather rare and are lacking on many specimens. The smaller pores are not always identifiable with certainty as avicularia. The ascopore is transversely oval and also recognizable at the inside of the zooecia in specimens that have been broken up. There it shows a small median process at the upper margin, directed proximally.

Measurements (in mm.):

Length of the zooecia (= distance between the peristomes)	0.62—0.78
Length of the polypidian vacuity (without funicular vacuity)	0.32—0.33
Diameter of the peristomes	0.22—0.25
Diameter of the peristomices	0.12—0.15
Length of the large avicularia	0.42—0.45
Length of the avicularian aperture	0.17—0.18

Remarks. — The present species differs so much from all species of „*Beisselina*" described and undescribed, which are known to me, that it must be considered as new. By its relatively smooth surface covered by only a few avicularia, it reminds one of the relatively slightly calcified young branches of many species of „*Beisselina*" which are less filled with avicularia and secondary calcareous tissue.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (216.3—219.8 m.) borings, Poland. Danian of the Crimea.

"*Beisselina*" *nobilis* Levinsen, 1925

(Plate IX, figs. 7, 8)

1925. *Monoporella nobilis* Levinsen; G. M. R. Levinsen, Undersøgelser..., p. 403, Pl. 7, fig. 81.
1930. *Beisselina nobilis* (Levinsen); E. Voigt, Morphologische..., p. 525, Pl. 33, figs. 21—22.
1962. *Beisselina nobilis Levinsen*; O. Berthelsen, Cheilostome Bryozoa..., p. 197, Pl. 23, figs. 5—7.

Material and description. — Only a small fragment of a broad little stem was found, which corresponds absolutely to the specimens from the Danian in structure and in size. The small frontal avicularia, which are arranged very regularly, are preserved with their pivot. The apertures are 0.55 mm. apart in a vertical direction.

It is worth mentioning that the broad bilamellar, rarely bifurcate zoaria develop from long cylindrical little stems, which possess only one row of zooecia each and taper proximally. Accordingly, the zoaria probably possessed radicles and were fastened to the bottom by flexible fibers.

These basal sections look entirely different from the distal ones and are easily mistaken for a different species.

Provisionally, I also add this species to „*Beisselina*", from which it differs not only by its way of attachment to the bottom, but also by two little pores at the inside of the frontal wall. They are located at the place where the ascopore would be expected. Wiesemann (1963, p. 61) already mentions a possibly bipartite ascopore. Plate IX, fig. 8 shows these two pores at the inner frontal wall of a specimen from the Dano-Montian of the Curfs quarry at Berg (southern Limburg, Netherlands), which belongs to this or to a very closely related species.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Danian in Denmark and Sweden and drift boulders of Danian age in northern Germany. Rare forerunners occur already in the Maastrichtian white chalk.

Genus *Pavobeisselina* nov.

Type species: *Eschara oblita* Kade, 1852; Dano-Montian.

Diagnosis. — Zooecia like *Beisselina,* but zoarium small, symmetrically fan-shaped, without encrusting base, with numerous pores at the pointed basal end which indicate attachment by radicells or by a chitinous stalk (see Pl. XIV, figs. 2—3).

Remarks. — The genus differs from *Beisselina* not only by its way of attachment to the bottom, but also by the fan-shaped zoarium. In this respect it equals the genera *Parmularia* MacGillivray, 1887, *Bathysto-*

mella Strand, 1928, *Lanceopora* d'Orbigny, 1851, *Flabellopora* d'Orbigny, 1852, and *Beisselinopsis* Voigt, 1951.

The external similarity of *Pavobeisselina* with *Beisselinopsis* is so striking that the forms belonging to the former genus were at first united with *Beisselinopsis*. However, I stated in 1951 that *Beisselinopsis* possesses no ascopore. Therefore, it cannot be closely related to *Beisselina*. For the time being, therefore, it cannot be decided to what family *Beisselinopsis* belongs (compare p. 452).

The ascopore of *Eschara oblita*, the type species of our new genus, is very constantly placed closely below the orifice. From the outside it is often not visible, but it is always present at the inner side of the frontal wall. Levinsen in 1925 also figured it (Pl. 7, fig. 83c) with *Pavobeisselina oblita* Kade, considered by him to be *Porina flabellata* d'Orbigny. More recent investigations by grinding of the zoaria always verified the correctness of this observation.

Pavobeisselina is closely related to *Beisselina*. Nevertheless it must be pointed out that large vicarious avicularia obviously are not developed even on the marginal edges of the zoarium. Also the outer layers of differently shaped zooecia are missing which are so very characteristic of older zoaria of some *Beisselina* and which completely envelop the bilamellar axis of the zoarium (= cumulating stage, in the sense of Wiesemann; 1963, p. 25).

Pavobeisselina oblita (Kade, 1852)

(Plates VIII, fig. 8; XIV, figs. 1-3)

1852. *Eschara oblita* Kade; G. Kade, Die losen Versteinerungen..., p. 29, Pl. 1, fig. 18.
1925. *Porina flabellata* (non d'Orbigny) (partim); G. M. R. Levinsen, Undersøgelser..., p. 405, Pl. 7, figs. 83 a-c.
1930. *Beisselina flabellata* (non d'Orbigny) (partim); E. Voigt, Morphologische..., p. 525, Pl. 34, fig. 11.
1962. *Beisselinopsis oblita* (Kade); O. Berthelsen, Cheilostome Bryozoa..., p. 201, Pl. 24, fig. 6.

Material and description. — The material present (about 20 fragments) consists of 2—6 mm. wide, bilamellar, fan-shaped zoaria with arching distal margins. Almost always the basal part is broken off, but in one fragment the intact lower surface with the pores of the radicells could be found (Pl. XIV, fig. 3).

The zooecia are arranged in very regular quincunxes. The zooecia as well as the roundish peristomices increase in size continually. Therefore fragments of different age and state of preservation look very different. The ascopores are difficult to distinguish in the tangle of small pores which are arranged mostly in diagonal furrows, but sometimes rather irregularly. On preparation of the inner cavity, though, they are always discernible. At times rather regular little avicularia sit in a niche of the outlet, hardly visible from the outside. The remaining pores, the function of which remains uncertain, are also often occupied by avicularia. These pores never pierce the frontal wall as they do in *Beisselinopsis.*

Remarks. — Following Levinsen, I formerly identified this very characteristic species as *Escharifora flabellata* d'Orbigny, a species from the lower Upper Maastrichtian of the Cotentin, but now I believe, in agreement with Berthelsen, that the species of the Dano-Paleocene must be separated from it. Probably, *Escharifora flabellata* d'Orbigny (1852, p. 460, Pl. 715, figs. 10—12) is a *Beisselinopsis*; but this cannot be stated definitely without examination of the internal structure.

Beissel's artificial siliceous internal cast of *Escharifora flabellata* d'Orb. (Beissel, 1865, p. 54, Pl. 6, fig. 67) from the Aachen Maastrichtian White Chalk shows no true ascopore either. Kade's original specimen from glacial drift from the Schanzenberg near Meseritz is apparently lost. Nevertheless, there is no doubt as to the Danian age of the specimen figured by him.

Occurrence. — Dano-Montian of Boryszew and Sochaczew (between 207.6—231 m.) borings, Poland.

The species is very frequent also in the Danian of Denmark and Sweden (Limhamn near Malmö) and in north German drift boulders of Danian and Paleocene age. It is somewhat rarer in the Danian of the Crimea where I found it recently, guided by Prof. D. P. Najdin (Moscow).

It is found as well in large numbers in the Lower Montian of Ciply near Mons (Belgium), of the Albert Canal near Vroenhoven and in the Curfs quarry near Berg (Southern Limburg, Netherlands).

Genus *Porina* d'Orbigny, 1852

Originally, species like the following (*P. salebrosa* Marss.) with peristomial avicularia have been excluded from *Beisselina* and included in *Acropora* Reuss. 1869, by Canu when he established his genus *Beisselina.* Canu had suggested that the genus *Porina* should be suppressed because it was defined too inaccurately. Brydone (1930, p. 51), who does not acknowledge *Beisselina* Canu, protests and retains the name *Porina* for the English species of *Beisselina.* After *Acropora* had been dropped as a homonym (already used for a coral by Oken), the new name *Acroporana* Strand, 1928, has not been accepted either; for *Acropora* would be a synonym of *Porina* anyway (Bassler, 1953, p. G193).

In opposition to the original conception of Canu to exclude species with peristomial avicularia from the genus *Beisselina,* Canu & Bassler later on tacitly described even species of this kind as *Beisselina,* as for instance *B. intermedia* (Canu & Bassler, 1933, p. 75, Pl. 18 figs. 2—3) or *B. lonsdalei* (*l. c.*, p. 79, Pl. 18, fig. 4). Then *Porina salebrosa* and related forms also ought to be included in *Beisselina*. Since Wiesemann (1963, p. 61), however, based on the internal structure, has a more restricted conception of the genus *Beisselina* and no longer considers the majority of the species hitherto placed here, including the present one, as *Beisselina*, we leave our form with *Porina* for the time being.

Porina sp. aff. *salebrosa* Marsson, 1887

(Plates: XII, figs. 3-4; XIII, fig. 5; Text-fig. 1)

The following citations are given for comparison:

1887. *Porina salebrosa* Marsson; T. Marsson, Die Bryozoen..., p. 86, Pl. 8, fig. 10.
1913. *Acropora salebrosa* (Marsson); F. Canu, Etudes..., p. 137, fig. 3.
?1925. *Porina salebrosa* Marsson; G. M. R. Levinsen, Undersøgelser..., p. 407, Pl. 7, fig. 84.
1930. *Acropora salebrosa* (Marsson); E. Voigt, Morphologische..., p. 519, Pl. 35, fig. 17.
1962. *Porina salebrosa* Marsson; O. Berthelsen, Cheilostome Bryozoa..., p. 195, Pl. 23, figs. 1—4.

Material and description. — Three fragments from Boryszew belong to a species within the group of *Porina salebrosa* Marsson from the Lower Maastrichtian of Rügen, but differ somewhat from it by the shape of the large avicularia. This species is also frequent in the Danian of Voldum.

The fragments present agree with the abundant material from the Danian. In the thicker stems, the width of the compressed zoaria amounts to more than 2 mm., but thinner stems of only about 1 mm. in diameter occur also. As to the avicularia, the very frequent small ones must be distinguished from the much rarer large ones. The small ones are in part arranged in a circle on the more or less distinct apertural bulge, in part they are found scattered on the zoarial surface. The large avicularia are relatively rare. From the surface of the zoarium they rise with their rostrum directed obliquely upwards in a distal direction. They are longish-triangular and produced into a long, slightly rounded point (Fig. 1). Their length amounts to between 0.32 and 0.40 mm. The length of the zooecia is about 0.60—0.72 mm. and the inside diameter of the orifices 0.10—0.12 mm.

In the true *Porina salebrosa* Marsson from the Maastrichtian of Rügen and Hemmoor (Pl. XII, figs. 1—2; Pl. XIII, figs. 1—2) the avicularia are wider at the base, and in the distal part above the pivot the margins run upwards in a curved line, a slight inflection appearing here. The aperture of the avicularium has the shape of an equilateral triangle and is only a little longer than wide. In the material from Voldum and Boryszew, however, the base is somewhat narrower and the margins run to the point almost in a straight line; in addition, the aperture is narrower and longer (compare Text-fig. 1 and Pl. XII, figs. 3—4). Besides, in the specimens from the White Chalk of Rügen and Hemmoor there is a denticle in the middle of the pivot (figured already by Levinsen), which is not always preserved, though (Text-fig. 2).

Remarks. — It would absolutely be justified to express the observed differences, which are constant, by a new species or subspecies name. I refrained from doing so, however, because it would be more suitable to do so as part of a revision of the whole group, which has been taken in hand already by Wiesemann. In the Maastrichtian, Danian and Montian there is a wealth of similar forms, the interrelation of which needs thourough investigation before a single form is separated by a special name.

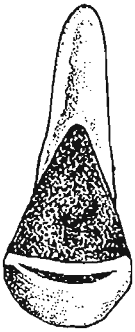

Fig. 1. — Large avicularium of *Porina* sp. aff. *salebrosa* showing the narrow mandible and the pivot without median process (comp. Fig. 2).

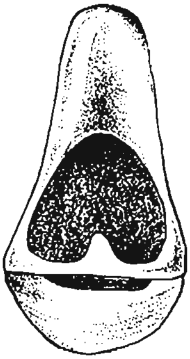

Fig. 2. — Large avicularium of *Porina salebrosa* Marsson showing the mandible which is wider and blunt and has a median process on the pivot.

By its large avicularia, the present form differs also from that of the Danian (Berthelsen, 1962), usually identified as *Porina salebrosa* Marsson. According to Berthelsen, in it the length of the large avicularia is only between 0.21 and 0.31 mm. There seems to be no agreement with Levinsen's *P. salebrosa* var. *faxensis* (unfortunately not figured). Hardly discernible only from the figures is *Beisselina intermedia* (Canu & Bassler) from the "Danian" or Paleocene of New Jersey (Vincentown Limesand, Pl. XIII, figs. 6—7). Here, however, hitherto not described, there are very typical avicularia at the zoarial margin (Pl. XIII, fig. 7) which have not been observed in our form; besides, the large avicularia on the surface of the zoarium are less pointed.

The inner structure of our form equals that of *P. salebrosa* in so far as the inner opening of the ascopore does not lead directly into the polypidian cavity as in *Beisselina*, but into a vestibule separated from it by a narrow median lamella which covers the ascopore. The median lamella bifurcates proximally into two branches (Pl. XIII, fig. 5) leading to selvage-like struts. In *Porina salebrosa*, they rest radially on the holocystal inner wall (Pl. XIII, fig. 3). The ascopore becomes visibly only after their removal (Pl. XIII, fig. 4).

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Middle Danian of Voldum (Jutland) and drift boulders of Danian age in northern Germany.

Genus *Dysnoetocella* nov.

Type species: Dysnoetocella aenigmatica n.gen., n.sp.; Montian or Dano-Montian of Belgium and Poland. (Fam. incertae sedis).

Derivatio nominis: Gr. *dysnoetos* = difficult to understand; referring to the structure of the zooecial frontal wall, analogous to *Dysnoetopora*.

Diagnosis. — Zoarium free, dendroid, consisting of two different modifications of zooecia, of which one forms the bilamellar axis and the other a cumulating tissue enveloping this axis. The zooecia of the bilamellar "*Eschara*"-stage are irregularly shaped, large and box-like. They possess large, oval apertures with a peristome that projects a little outwards. They are overgrown by a second modification of smaller cumulating zooecia, which envelop them in numerous layers. They originate by budding from the zooecia of the first generation of the "*Eschara*"-stage and increase also by budding from out of the apertures. They are very irregular, differing in size, pocket-shaped and directed obliquely upwards. They form the surface of the zoarium and appear in part opened to their whole width, in part closed by a frontal wall which leaves a somewhat irregular opening of variable size. Ooecia and avicularia have not been observed.

Remarks. — For the present, the systematic position of this new genus is entirely obscure. Superficially it reminds one of the strange cyclostomatous genus *Dysnoetopora* Canu & Bassler, but the internal structure makes it quite evident that our new genus is a representative of the Cheilostomata (Pl. XVI, figs. 1—2). The large box-shaped zooecia of the bilamellar stage which have shown septulae, and the lack of pseudopores demonstrate their cheilostomatous nature. For comparison a longitudinal section of *Dysnoetopora celleporoides* Canu & Bassler is figured on Plate XVI, fig. 3, showing the basic difference in the nature of the zooecia of the two genera which look so similar from the outside.

The genus reminds one of certain species of *Beisselina* such as *B. striata* (Goldf.) or *B. celleporoides* (Voigt, 1960a, p. 700 and following), Wiesemann, 1963, p. 24) or *Pseudobeisselina* (Wiesemann, 1963, p. 53) by its strong development of the secondary cumulating stage. But it differs not only by lack of any avicularia and by the considerable difference in size of the two zooecial modifications, but especially by the relatively slight calcification of the zooecial walls, which is hardly different from that of the Anasca. Even if lack of an ascopore in itself must not speak against its belonging to the Ascophora as for example in *Pseudobeisselina* or *Frurionella*, nevertheless the unusually slight calcification of the frontal walls, which is almost like that of *"Membranipora"*, might be considered as an indication for the anascan nature of this form.

Curiously, the bilamellar stage either alone or combined with the beginning of the cumulating stage has not been found yet, whereas it has always been found in *Beisselina* and other genera possessing such a cumulating stage (*Pseudobeisselina* Wiesemann, 1963, *Kleidionella* Canu & Bassler, *Psilosecos* Canu & Bassler, cf. Wiesemann, 1963, p. 35). This may perhaps permit the supposition that a bilamellar stage lasting for some time as in the other genera did not even exist. Possibly the bilamellar axis projected only a little beyond the cumulating stage at the distal extremity. In the future, therefore, special attention ought to be paid to specimens of this kind which would allow observation of the still unknown primary outside of the axial zooecia.

Recently (Voigt, 1960a), in a paper on different growth stages of some cheilostomatous Bryozoa, I have particularly pointed to this "secondary" stage in the astogenesis of some species of *Beisselina* and called the difference of the zooecia in the primary bilaminar "*Eschara*"-growth form from the many-layered secondary stage "dimorphism". Wiesemann (1963, p. 15), in his recently published monograph on *Beisselina*, treats this question anew and distinguishes three stages in the forms which show this phenomenon of growth, namely: 1) the encrusting stage of the base, 2) the bilamellar, and 3) the cumulating stage. We accept this division here.

However, he refuses the term "dimorphous" for the zooecial difference of the second and third stage with the argument that the alleged difference is merely caused by the different way of budding. Whereas in the bilamellar stage budding occurs distally through the normal budding canals and the densely crowded zooecia must adopt the shape of regular hexagons, the zooecia of the cumulating stage bud from the zooecia of the bilamellar stage and, growing freely, adopt irregular forms.

To this I want to remark that here the term "dimorphous" is to be understood in a descriptive sense only and that we cannot do without it, as is especially well demonstrated by the new genus *Dysnoetocella*. That I have never seen a primary feature in the hexagonal shape of the zooecia, follows already from the statement: "The polygonal outline of an individual cell is no basic feature of the animal concerned, but a necessity resulting from the union or budding of a number of individuals of the same kind" (Voigt, 1930, p. 388, translated). Of course here the term "dimorphism" is not to be understood in the sense of a polymorphism conditioned functionally, but it only means the statement that the zooecia of the cumulating stage differ morphologically from those of the bilamellar stage and may thus simulate specific or generic difference within the same species.

In *Beisselina* and *Pseudobeisselina* till now ooecia (ovicells) never have been observed on the zooecia of the cumulating stage. This is confirmed by Wiesemann. Also apparently no septulae and dietellae are being built here, which are always found when splitting the bilamellar stage and which occur also in monoserial forms like *Fissuricella* (Voigt, 1959) even if no lateral buds are built.

Although this difference may be explained by the different mode of budding, it is indisputable that in *Dysnoetocella* there exists also a fundamental morphological difference between the zooecia of the two stages (Pl. XV, fig. 4; Pl. XVI, figs. 1—2).

Here the zooecia of the cumulating stage are not only much smaller — at most half the length of the "normal" zooecia of the bilamellar stage — but they are also more pocket-like in shape; their aperture is much larger relative to its length, and their frontal wall is at first in part even not calcified, the aperture thus equalling an opesium rather than an orifice.

The problem seems to be contained in the fact that here the multilamellar structure of the zoarium is not attained, as would be normal, by self-incrustation (= coating by new layers of zooecia originated regularly by distal budding, using the bilamellar zoarium as base), but by direct simultaneous budding from out of the zooecia of the bilamellar stage.

Now it is very remarkable that *Psilosecos angustidens* (Levinsen, 1925, p. 397, Pl. 7, fig. 75) may also possess unilamellar layers with distal budding on the bilamellar zooecia, besides the cumulating zooecia, which to my knowledge never occurs in *Beisselina*. Besides, in *Beisselina celleporoides* the distance between the ascopore and the aperture is usually smaller in the cumulating zooecia than in the "normal" zooecia of the bilamellar stage, and this not only on the outside, but already on the inner wall of the zooecium. Likewise, the cummulating zooecia never calcify as much as the normal ones and, therefore, often still show a straight proximal margin of the aperture. This is lost by the extended tube-like growth of the zooecial aperture in the bilamellar stage, the secondary aperture (peristomice) then always being circular.

All these features lead me to maintain the term "dimorphous" for the two modifications of zooecia.

Dysnoetocella aenigmatica n.sp.

(Plates XIII, figs. 8-9; XV, figs. 1-5 *a-b*; XVI, figs. 1-2)

Holotypus: Plate XV, fig. 1 (Coll. Voigt, photo catalogue No. 3660).
Locus typicus: Albert Canal near Vroenhoven (Belgium).
Stratum typicum: Tuffkreide of Montian age ("Post-Maastrichtian").
Derivatio nominis: aenigmatica — Lat. *aenigmaticus* = enigmatical, mysterious.

Diagnosis. — Zoarium cylindrical, dichotomously branching. The slightly compressed bilamellar axis consists of zooecia 1.0—1.2 mm.

long. Their oval orifices are visible only from the inside in broken specimens and occupy one half to one third of the zooecial length.

Material and description. — One fragment only from Boryszew (Pl. XV, figs. 5 *a-b*). The zooecia of the cumulating stage are at most half as long, narrow, pocket-like and slanting upwards. They alone form the surface of the zoarium. Its appearance is irregularly spongy due to the orifices developed in various sizes and to the zooecia packed into each other in a pocket-like fashion.

Remarks. — Since the zooecia run obliquely into the zoarium, always only part of the real length is visible from the outside, which partly explains the apparent differences in size. Some of the orifices are very large and oval (Pl. XV, fig. 1), some are exceedingly small and then irregularly roundish-oval or polygonal to square (Pl. XV, fig. 3). On the type specimen their size varies from 0.1 to 0.3 mm.

The surface of the zoarium therefore looks strange and is difficult to understand, compared with other Cheilostomata. It remains doubtful whether the aperture is to be considered an orifice or an opesium. Judging from the only slight calcification of the irregularly developed frontal wall, it might be supposed that the large openings are caused only by wear, since a similar situation is found in *Beisselina* and in *Pseudobeisselina*. Their very regularly oval shape, however, opposes this view; therefore, they are rather to be considered as still uncalcified and therefore not preserved chitinous frontal walls, resembling the Membranimorpha. For this reason, a similar form from the North American Midwayan was allocated to *Conopeum* by Canu & Bassler (1920, see below). The aperture is the larger, the larger that part of the zooecium is which rises to the surface of the zoarium. The "smaller" the zooecia are, the larger is the share of the calcified frontal wall and correspondingly smaller the aperture. Occasionally the aperture may be observed to taper, due, apparently, to the frontal wall breaking out in a wedge-like fashion; similarly, lateral constrictions are not to be considered as condyli or cardelles, but are faked by newly built crystals of calcite.

Many small gaps and pocket-like cavities between the zooecia make the picture still more bewildering. They seem to be immature zooecia in the process of budding. In longitudinal or transverse sections, diaphragms or projecting walls seem to occur within the zooecia, dividing the zooecial cavity. This seems to be brought about by the zooecia of the cumulating stage budding out of the aperture of the next lower zooecium, in a closely crowded sequence. In well preserved specimens, every zooecium contains a hole in the bottom, leading into the next lower zooecium.

There is only one small fragment from Boryszew belonging to this very peculiar form (Pl. XV, figs. 5 *a-b*). Without doubt it is conspecific with a number of specimens from the Lower Montian of the Albert Canal near Vroenhoven, south of Maastricht, which I received from Dr M. Meijer (Maastricht). The description, therefore, is based on this material. Special attention was given to this species, because it is one of the most important stratigraphically and hitherto not found in the Danian.

The only species whatever with which this form can be compared is *Conopeum damicornis* Canu & Bassler (1920, p. 87, Pl. 3, figs. 3—8) from the Midwayan (Clayton Limestone) of the Owl Creek (Miss., U. S. A.). The internal structure seems to be the same in principle, but the difference in size between the zooecia of the bilamellar and of the cumulating stage seems to be much smaller, and in our species the opesial denticles and the small interopesial cavities are missing. The American species is certainly not a *Conopeum* and I would not hesitate to consider it congeneric with our form. Noteworthy too is their almost equal age.

Occurrence. — Dano-Montian of Boryszew boring, Poland.

Montian of the Albert Canal near Vroenhoven (Belgium), at 23.85 and 24.0 km.

BRYOZOA FROM THE SOCHACZEW BORING

Having finished work for the present paper, I received from Prof. K. Pożaryska additional bryozoan material from the deep boring near Sochaczew close to the Boryszew boring.

As far as possible, the most important data have been included in the text. Since the fossil material was obtained from drill cores, more exact stratigraphic statements were possible here. According to informations by Mrs. Pożaryska, the material comes from depths between 193.5 and 267.2 m. and reaches from the Paleocene to the Maastrichtian, the dating having been made by Foraminifera. Thus, it represents an important addition to the fauna of Boryszew.

Bryozoa have been identified from the following samples:

193.5—195.7 m.	*Entalophora proboscidea* (Milne-Edwards)
	E. benedeniana (v. Hag.)
	Spiropora verticillata (Goldf.)
	Heterocrisina communis (d'Orb.)
	Stamenocella pristis (Lev.)
	Frurionella daniensis Berth.
	Fr. polonica n.sp.
	Coscinopleura angusta cf. *minor* Voigt
	Lunulites saltholmensis Berth.
	Beisselina munita n.sp.
195.7—197.9 m.	*Coscinopleura angusta* cf. *minor* Voigt
197.9—200.0 m.	*Entalophora benedeniana* (v. Hag.)
	Spiropora verticillata (Goldf.)
	Crisisina carinata (Roem.)
	Heterocrisina communis (d'Orb.)
	Coscinopleura angusta cf. *minor* Voigt

201.8—202.8 m.	*Spiropora verticillata* (Goldf.) *Coscinopleura angusta* cf. *minor* Voigt
202.8—205.8 m.	*Coscinopleura angusta* cf. *minor* Voigt
205.8—207.6 m.	*Coscinopleura angusta* cf. *minor* Voigt *Beisselina munita* n.sp.
207.6—210.6 m.	*Spiropora verticillata* (Goldf.) *Frurionella daniensis* Berth. *Fr. polonica* n.sp. *Coscinopleura angusta* cf. *minor* Voigt *Lunulites saltholmensis* Berth. *Lunulites* sp. *Pavobeisselina oblita* (Kade)
212.3—215.0 m.	*Entalophora proboscidea* (Milne-Edwards) *Coscinopleura angusta* cf. *minor* Voigt
216.3—219.8 m.	*Coscinopleura angusta* cf. *minor* Voigt *Beisselina pauperata* n.sp.
226.6—229.6 m.	*Coscinopleura angusta* cf. *minor* Voigt *Lunulites* sp.
229.6—231.0 m.	*Coscinopleura angusta* cf. *minor* Voigt *Pavobeisselina oblita* (Kade)
231.0—234.0 m.	*Coscinopleura angusta* cf. *minor* Voigt *Lunulites saltholmensis* Berth. *"Beisselina" munita* n.sp.
237.7—241.5 m.	*Lunulites saltholmensis* Berth.
241.5—245.0 m.	*Coscinopleura angusta* cf. *minor* Voigt
245.0—250.0 m.	*Spiropora verticillata* (Goldf.) *Coscinopleura angusta* cf. *minor* Voigt *Beisselina munita* n.sp.

at 247.5 m. Paleocene — Danian boundary[4]

250.0—254.0 m.	*Idmonea subgracilis* d'Orb. *Frurionella polonica* n.sp. *Coscinopleura angusta* cf. *minor* Voigt
254.0—256.3 m.	*Coscinopleura angusta* cf. *minor* Voigt *Beisselinopsis* sp. *Stichopora pentasticha* v. Hag. (reworked?)
256.3—257.5 m.	*Coscinopleura angusta* cf. *minor* Voigt
257.5—259.5 m.	*Coscinopleura angusta* cf. *minor* Voigt
259.5—260.6 m.	*Heterocrisina communis* (d'Orb.) *Coscinopleura angusta* cf. *minor* Voigt
260.6—262.2 m.	*Coscinopleura angusta* cf. *minor* Voigt *Pachythecella anhaltina* (Voigt)
262.2—263.8 m.	*Coscinopleura angusta* cf. *minor* Voigt
263.8—265.2 m.	*Coscinopleura angusta* cf. *minor* Voigt

at 266.0 m. Danian — Maastrichtian boundary

265.2—267.2 m.	Typical bryozoan fauna of Maastrichtian age with: *Membranipora marssoni* Voigt *Floridina* sp. *Lunulites* div. sp.

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[4] Further investigation on Foraminifera resulted in placing the boundary Danian — Lower Paleocene not so high, at the depth of 262.2—260.6 m.

Coscinopleura sp.
Escharifora sp.
"Beisselina" sp.
Stichopora pentasticha v. Hag.

To this faunal list the following remarks must be made:

Whereas the Maastrichtian — Danian boundary appears quite distinct and is characterized by some new species hitherto unknown from the Baltic White Chalk, this cannot be said about the Danian — Paleocene boundary drawn at 247.5 m. Apparently the number of species present from the separate samples is too small to reveal a marked faunal change. According to the boundary line given above, *Frurionella polonica* n.sp., which is characteristic for Boryszew and as yet unknown in the Baltic Danian, still occurs in the uppermost Danian (250—254 m.).

Coscinopleura angusta cf. *minor* Voigt is present in almost all samples and is here represented in the whole section of the Dano-Montian. In the Polish Danian it seems to be vicarious for *Cosc. angusta angusta* Berth., which prevails in the Baltic Danian.

All bryozoan species found in the Dano-Montian of Sochaczew occur in Boryszew too with the exception of *Pachythecella anhaltina* (Voigt), present in one fragment in the Danian sample 260.6—262.2 m. (Pl. VII, fig. 9) and *Stichopora pentasticha* v. Hag. in the sample 254—256.3 m., which is possibly redeposited.

In the meantime Berthelsen (1962, p. 203, Pl. 25, figs. 1—3) again figured the former species which was described by me (Voigt, 1930, p. 521, Pl. 33, fig. 12) as *Pachytheca* (= *Pachythecella) anhaltina* from Danian drift boulders in Anhalt. The same or at least a closely related form is found in the Dano-Montian of the Curfs quarry near Berg southern Limburg, Netherlands) and in the Tuffeau de Ciply near Mons (Belgium). It possesses no ascopore, it is true, just like the other species of *Pachythecella*, but it should probably be separated from them generically and is likely to represent a new genus.

Stichopora pentasticha however, found at 254—256.3 m. in the Danian and found frequently in the Maastrichtian at 265.2—267.2 m., does not fit into the Danian at all, judging from our experience so far. Perhaps it is reworked, although its state of preservation is relatively good.

STRATIGRAPHIC RESULTS

The investigation of the Bryozoa from the Boryszew boring yielded 28 species, 6 of which are new. These are:

Vibracella (Vibracella) pozaryskae n.sp.
V. (Discovibracella) oculata n.subg., n.sp.
Frurionella polonica n.sp.
Beisselina munita n.sp.
"Beisselina" pauperata n.sp.
Dysnoetocella aenigmatica n.gen., n.sp.

Of these, *Beisselina munita* n.sp. and *Lunulites* sp. have been found only in the borings near Boryszew and Sochaczew; therefore they are useless for a stratigraphic comparison. Thus only 26 species are at hand for stratigraphic use.

The only bryozoan faunas to be considered are the following:

1. The extremely rich bryozoan fauna of the Danian in Denmark and Sweden and of the Danian Baltic flint drift boulders, the included chalk contents of which yield extraordinarily beautiful material. A modern treatment of the Cheilostomata of Danian age was published by Berthelsen 1962.

2. The Danian fauna of the Crimea, where I have collected rich material, is not described so far. 14 species of the Boryszew fauna have been recognized in the Crimea localities Salachik, Belbek and Mangup Kale. *Frurionella polonica* and *„Beisselina" pauperata* — not known in the Baltic region — occur in some Danian localities of the Crimea.

3. The — yet unpublished — bryozoan fauna from the beds overlying the Maastricht tuffkreide in the Curfs quarry near Berg or Geulhem, Geul valley, close to Maastricht (compare W. & K. Pożaryski, 1959, p. 38). It is excellently preserved, but in part mixed with redeposited fossils of the Maastricht tuffkreide and occurs in holes and burrows in a hardground contained in the top of the Upper Maastrichtian (Voigt, 1958).

In numerous papers, Hofker (1955, 1956 etc.) described the strata overlying the Upper Maastrichtian tuffkreide and developed in the same facies, and attributed them to the lowermost Paleocene; in principle, this statement had already been made by Triger (1860) more than a hundred years ago. Hofker must be given credit for having stated the great difference of this fauna from that of the Maastricht tuffkreide and for having proved its younger age. His conclusions are based on Foraminifera. We are not in agreement with all of them, though. This applies especially for his view (Hofker, 1951) that the Danian is stratigraphically equivalent to the Upper Maastrichtian tuffkreide. However, we cannot discuss this question in detail here (Voigt, 1960).

The fauna overlying the Maastricht tuffkreide contains numerous faunal elements of the Danian, among others *Crania brattenburgica geulhemensis* Kruytzer & Meijer (1958), a subspecies of the form hitherto well known as *Crania tuberculata* Nilss. which is a key species of the Upper Danian and Lower Paleocene in Denmark. On account of this *Crania,* Kruytzer & Meijer consider these strata as Danian. Wienberg Rasmussen (1962) reaches the same conclusion based on crinoids. Since, in addition, numerous bryozoan species of these strata occur in the Baltic Danian, this conclusion may be correct.

Nevertheless, we still call these strata "Dano-Montian" because they also contain many other forms which are not known from the Danian. Therefore I do not want to commit myself before my research on the bryozoan fauna of the Dano-Montian is concluded.

Apart from the badly preserved *Lunulites saltholmensis*, *Coscinopleura* sp. and *Pavobeisselina oblita*, which occur in Paleocene drift boulders (so-called "aschgraues Palaeocängestein mit der Fauna von Copenhagen" in northern Germany), we do not know which bryozoan species of the Danian pass into the overlying strata of Paleocene age in Denmark and Sweden, where Bryozoa are very rare. Therefore the possibility still remains that the "Post Maastrichtian" sediments of the Curfs quarry are somewhat younger than the Danian, as suggested by Hofker. The "Post Maastrichtian" strata with nearly the same fauna are also found in the Albert Canal near Vroenhoven (Belgium), only a few kilometers from Maastricht. They have especially been exploited by Dr M. Meijer, to whom the author owes much material from these localities. The upper strata contain a fauna which is very similar to that of the Lower Montian of Ciply near Mons.

4. The fauna of the Lower Montian, which contains numerous Bryozoa in the "Tuffeau de Ciply" near Mons in Belgium, especially in its basal layers. The question, whether the Montian is an independent stage (Hofker, 1956, 1959) or coincides in part or completely with the Danian (Wienberg Rasmussen, 1962) is still undecided (compare Marlière, 1955, 1957; Loeblich & Tappan, 1957).

Before this problem is solved, of course, every attempt at fitting our fauna into the Danian or Montian is problematic. Therefore we do not yet know if the difference between the bryozoan fauna of the Belgian and Dutch Danian or Dano-Montian from that of the Baltic Danian is due to difference in age or if only another faunal province is concerned. It is to be hoped that the present investigation of this fauna will result in an answer to this question.

5. The fauna of the Vincentown Limesand in New Jersey (USA), which for a long time has been considered as unquestionably Danian (Canu & Bassler 1933). More recently it is considered Paleocene (Hofker, 1955; McLean, 1955). Here we can do without a comparison with this fauna, for it contains a number of similar species, indeed, but only very few really conspecific forms. These, however, are cosmopolitan species like *Crisisina carinata* (Roem.) and *Heterocrisina communis* (d'Orb.), the longevity of which is too great to allow any conclusions.

If we begin to answer the question as to Danian or Paleocene (Montian) on the basis of the faunas quoted as Nos. 1—3 — assuming independence of the two stages — this question seems to answer itself, according to our Table 1: of 26 species available for comparison, 22 occur in the Baltic Danian also!

Even the new species *Vibracella (Vibracella) pozaryskae* and *V. (Discovibracella)* oculata are already known to me from Jutland or from Danian drift boulders.

As against that, correspondence seems much less with the fauna of the Curfs quarry near Berg, Geul valley, with 20 species in common and with the Tuffeau de Ciply near Mons (Lower Montian) with only 14 species; it must be considered, though, that here the similarity diminishes with the distance towards the southwest. Whereas the Polish Dano-Montian Basin forms the direct continuation of the Baltic Basin (Pożaryski & Pożaryska, 1960), the connections towards the Netherlands and Belgium are less clear. The Basin of Mons already forms an appendage to the Paris Basin; even assuming stratigraphic equivalence of Danian and Montian, therefore, certain faunistic differences would be easy to understand.

Although of altogether 28 species, 22 occur in the Baltic Danian too (see Table 1, p. 473), it must be pointed out that these 22 species (including *Vibracella* (*Vibracella*) *pozaryskae* n.sp. and *V.* (*Discovibracella*) *oculata* n.subg., n.sp.) do not represent at all the normal bryozoan fauna of the Danian, as it may be isolated from every flint boulder containing Bryozoa in northern Germany and as it may be observed everywhere in Denmark and Limhamn near Malmö as well. Here, in addition, there are very many other, in part extremely frequent species which are lacking in the sample at hand, whereas other species are present which normally are only rare. Although it must be admitted that a casual drill record certainly contains not more than a fragment of the fauna actually present, nevertheless it is evident that a faunal association presents itself which differs somewhat from that normally found in the Danian.

That this fauna, however, is still representative to a certain degree, follows from the samples from the boring near Sochaczew, comprising a section of 73 m.; the bryozoan fauna is like that at Boryszew.

As yet, *Vibracella* (*Vibracella*) *pozaryskae,* apart from the Danian of Belbek (Crimea), is known to me only in the uppermost Danian of Hvallöse in Jutland and from a drift boulder of Danian age found in the vicinity of Hamburg. According to Berthelsen, *Lunulites saltholmensis* occurs only in the Upper Danian. *Vibracella* (*Discovibracella*) *oculata* is so far known to me in the Baltic Danian only from drift boulders, and only in very rare, small fragments. *Pavobeisselina oblita* (Kade) is found in the whole Danian, but it is especially frequent in the Upper Danian and belongs to the frequent characteristic species of the "Dano-Montian" of the Curfs quarry and of the Lower Montian near Ciply (Tuffeau de Ciply). The most common species, *Coscinopleura angusta* cf. *minor,* is so far known only in the Belgian-Dutch Dano-Montian or Montian respectively and has not yet been found in the Baltic Danian. This does not yet prove Upper Danian age for the bryozoan fauna of Boryszew, for the bryozoan fauna of the Upper Danian in Denmark is composed of many additional species not represented here.

Unfortunately, the Lower Paleocene in Scania, from which Brotzen described his standard foraminiferal fauna (1948), contains almost no Bryozoa at all. In Denmark it is hardly otherwise, and the Paleocene drift boulders of northern Germany are very poor in Bryozoa as well; occasionally they contain *Pavobeisselina oblita, Coscinopleura* sp., and badly preserved species of *Lunulites*; therefore, we do not know how far the typical Danian species pass into the Paleocene. It is highly improbable that almost all of them die out at the Danian-Paleocene boundary, especially since there is a large number of Danian bryozoan species in the Montian of Belgium; we must admit, though, that possibly Danian and Montian overlap in part.

Be that as it may, the above remarks show that the fauna from Boryszew may at the most be of Upper Danian age, unless lowermost Paleocene age is considered to be more probable.

This conception may be supported not only by the occurrence of *Coscinopleura angusta* cf. *minor* Voigt, but also by the fragment of *Dysnoetocella aenigmatica* n.gen., n.sp. To my knowledge, both of them do not occur in the real Baltic Danian, but in the "Dano-Montian" in the Netherlands and in Belgium. So far, the later-named species has been found in one locality only in the Albert Canal near Vroenhoven, together with a bryozoan fauna which is quite similar to that of the "Tuffeau de Ciply".

As long as we possess no larger unquestioned bryozoan fauna from the European Paleocene, the Paleocene age of which is actually beyond doubt in so far as it follows stratigraphically on top of genuine Danian, there is no possibility to recognize a Paleocene bryozoan fauna as such. Therefore we can unfortunately not draw direct conclusions from the fauna concerning its age. Indirect conclusions only make it probable that it is somewhat younger than the sediments of Danian age in Denmark and Scania.

With that we approach the result of Brotzen & Pożaryska (1957), who were able to exclude Upper Danian age, based on some characteristic Paleocene Foraminifera, such as *Ceratobulimina perplexa* Plummer, *C. tuberculata* Brotzen, and *Lamarckina rugulosa* Plummer. From the spines of *Tylocidaris,* which generally are important for the stratigraphy of the Danian Kongiel (1958) gained no unambiguous result, although naturally he had no choice other than Upper Danian or Paleocene. At any rate, he leaves some possibilities for discussion: In Boryszew there is either Upper Danian and Montian or transitional beds, or it is Montian and the Cretaceous forms are relics surviving until Montian.

Therefore it would be very desirable if comparable faunas became known from the Lower Paleocene containing Bryozoa, such as have been identified in several deep borings in northern Germany. For example, single Bryozoa have been figured in micropalaeontological survey plates

Table 1

Stratigraphic occurrence of the bryozoan fauna from the Boryszew boring

Species	Maastrichtian	Baltic Danian	Dano-Montian of Curfs quarry near Berg (Maastricht)	Montian of Ciply near Mons	Paleocene, Vincentown limesand of New Jersey, USA
Cyclostomata					
Entalophora proboscidea (Milne-Edwards)	+	+	+	+	−
E. benedeniana (v. Hagenow)	+	+	+	+	−
Spiropora verticillata (Goldfuss)	+	+	+	+	−
Idmonea subgracilis d'Orbigny	+	+	+	+	−
I. filiformis d'Orbigny	+	+	+	+	−
Crisisina carinata (Roemer)	+	+	+	+	+
Heterocrisina communis (d'Orbigny)	+	+	+	+	+
Stigmatoechos punctatus Marsson	+	+	+	+	−
Meliceritella steenstrupi (Pergens & Meunier)	+	+	+	+	−
Cheilostomata					
Stamenocella pristis (Levinsen)	−	+	+	−	−
Pithodella cincta Marsson	+	+	+	−	−
Frurionella daniensis Berthelsen	−	+	−	−	−
Fr. polonica n.sp.	−	−	−	−	−
Coscinopleura angusta cf. *minor* Voigt	−	−	+	+	−
Lunulites saltholmensis Berthelsen	−	+	+	−	−
Lunulites sp.	−	−	−	−	−
Vibracella (Vibracella) pozaryskae n.sp.	−	+	+	−	−
V. (Discovibracella) oculata n.subg., n.sp.	−	+	+	+	−
Puncturiella cf. *sculpta* (d'Orbigny)	+	+	+	+	−
Taenioporina articulata Voigt	+	+	+	+	−
Pachythecella lundgreni Pergens & Meunier	−	+	+	−	−
Beisselinopsis cf. *hiltermanni* Voigt	+	+	+	−	−
Beisselina munita n.sp.	−	−	−	−	−
"*Beisselina*" *pauperata* n.sp.	−	−	−	−	−
"*B.*" *nobilis* (Levinsen)	+	+	−	−	−
Pavobeisselina oblita (Kade)	−	+	+	+	−
Porina sp.aff. *salebrosa* Marsson	−	+	−	−	−
Dysnoetocella aenigmatica n.gen., sp.	−	−	−	−	−

\+ present, − absent

without identifications by Staesche and Hiltermann (1940, Pl. 3) from the Nettgau boring, and by Krutzsch, Pchalek and Spiegler (1960) from western Brandenburg, but it is not possible to identify the fragments concerned with certainty from these figures. The fragments figured by the last-named authors are probably referable in part to *Crisisina carinata* (Roemer) and *Heterocrisina communis* (d' Orb.); these species occur in the Senonian-Danian as well as in the Montian.

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EHRHARD VOIGT

BRYOZOA Z DANU I MONTU BORYSZEWA I SOCHACZEWA

Streszczenie

Zbadane przez autora mszywioły pochodzą z danu i montu z wiercenia Boryszew koło Sochaczewa, głęb. 193—207 m. Zostały one uzupełnione materiałem tegoż wieku z sąsiedniego wiercenia Sochaczew, głęb. 193,5—265,2 m. Materiał przekazany został autorowi do opracowania przez Prof. dr K. Pożaryską i Prof. dr W. Pożaryskiego.

Mszywioły z pogranicza danu i paleocenu były dotychczas poznane niewystarczająco, a z Polski w ogóle nie były opracowywane, co bardzo podnosi znaczenie badanej fauny.

Opisano 28 gatunków. Ustanowiono 1 nowy podrodzaj: *Vibracella (Discovibracella),* 2 nowe rodzaje: *Dysnoetocella* i *Pavobeisselina,* i 6 nowych gatunków: *Vibracella (Vibracella) pozaryskae, V. (Discovibracella) oculata, Frurionella polonica, "Beisselina" pauperata, Beisselina munita* i *Dysnoetocella aenigmatica.*

Z uwagi na zły stan zachowania części materiału z wierceń, opisano dla porównania okazy pochodzące z innych miejsc występowania, a mianowicie: *Entalophora benediana* (v. Hag.), *Spiropora verticillata* (Goldf.), *Crisisina carinata* (Roem.) i *Heterocrisina communis* (d'Orb.); gatunki te nie były dotychczas znane, lub też poznane niewystarczająco. W przypadku dwóch ostatnich, zaliczenie ich do rodzajów *Crisisina* i *Heterocrisina* skorygowało błędne określenie rodzajowe dawniejszych autorów. Specjalnie interesujący jest gonozoid gatunku *Spiropora verticillata,* stanowiący nowy typ gonozoidu, odmienny od opisanych w pracy Canu i Basslera (1922) jako forma „*Mecynoecia*".

Zupełnie niejasne jest stanowisko systematyczne *Dysnoetocella aenigmatica* n.gen., n.sp., którego zoecja wykazują szczególny dymorfizm; polega on na tym, że w wewnętrznym, bilamellarnym stadium *"Eschara"* zooecja są o wiele większe, niż w stadium zewnętrznym, "kumulatywnym", oglądane zaś od strony frontalnej są one zupełnie różne.

Porina sp.aff. *salebrosa* różni się od *P. salebrosa* Marsson tym, że duże awikularia są u niej odmienne, a przy tym u typowej *P. salebrosa*, z kredy piszącej mastrychtu, istnieje 1 ząbek na poprzecznej listewce awikularium.

Na podstawie badania mszywiołów nie można odpowiedzieć z całą pewnością na pytanie, czy fauna ta jest wieku duńskiego, czy paleoceńskiego; niektóre dane jednak przemawiają za paleoceńskim (monckim) wiekiem osadów, które dostarczyły tę faunę.

Spośród 28 występujących gatunków, 22 są znane z danu Szwecji i Danii, jak również z bałtyckich kier duńskich z Niemiec północnych, co wskazywałoby ewentualnie na wiek duński. Brak jednak w Boryszewie wielu najpospolitszych duńskich gatunków, charakteryzujących dan bałtycki. Nadzwyczajna obfitość *Coscinopleura angusta* Voigt — jednej z częstszych form z "Tuffeau de Ciply" — oraz występowanie *Vibracella (Discovibracella) oculata* n.sp. przemawiałyby zarówno za wiekiem monckim, jak i górno-duńskim. Wskazywałyby na to również gatunki *Lunulites saltholmensis* Berth. i *Vibracella (Vibracella) pozaryskae* n.sp., które dotychczas spotykane były tylko w górnym danie. Znaleziona w Boryszewie (w 1 małym fragmencie) *Dysnoetocella aenigmatica* n.gen., n.sp. znana jest z Kanału Alberta z Vroenhoven (Belgia), z warstw, których fauna jest bardzo zbliżona do montu (Tuffeau de Ciply). Wiek osadów Tuffeau de Ciply jest jednak dyskusyjny i należy uwzględnić — na podstawie nowszych prac — możliwość ich przynależności do danu (Loeblich & Tappan, 1955, 1957; Marlière, 1955, 1957; Hofker, 1956, 1959). Ostateczne zajęcie stanowiska w tej sprawie nie jest możliwe przed opracowaniem bogatej fauny mszywiołów z belgijskiego montu. W każdym razie należy podkreślić, mimo pewnych podobieństw, odmienny od bałtyckiego danu charakter fauny mszywiołowej Tuffeau de Ciply i zaliczonych przez Hofkera do paleocenu warstw, leżących nad kredą tufową w okolicach m. Maastricht. Czy ta różnica faunistyczna związana jest z obecnością dwóch różnych prowincji faunistycznych, czy z odmiennym wiekiem warstw, nie można na razie rozstrzygnąć, bowiem paleocen w Skanii i Danii nie zawiera mszywiołów. Z drugiej strony, jest mało prawdopodobne, by tak bogata fauna mszywiołowa danu Szwecji i Danii całkowicie wymarła z końcem danu. Dopóki nie będzie poznana niewątpliwie paleoceńska fauna mszywiołowa w Europie i dopóki uważać się będzie za możliwe czasowe rozdzielenie danu i montu, — nie istnieje możliwość apriorycznego ustalenia charakteru fauny paleoceńskiej. Z tego powodu nie można wysnuć bezpośredniego wniosku o duńskim czy paleoceńskim wieku fauny z Boryszewa. Nie ma jednak wątpliwości, że fauna z Boryszewa i Sochaczewa odpowiadać może tylko najwyższemu danowi, lub jakiemuś niższemu poziomowi paleocenu.

Wnioski autora są bliskie wnioskom Brotzena i Pożaryskiej (1957) na podstawie otwornic, które wskazywały na paleoceński wiek omawianych warstw, oraz Różkowskiej (1955), która po zbadaniu fauny koralowców z tych warstw doszła również do przekonania, że reprezentują one wiek moncki.

ЭРГАРД ФОГТ

ДАТСКИЕ И МОНТСКИЕ МШАНКИ ИЗ БОРЫШЕВА И СОХАЧЕВА В ЦЕНТРАЛЬНОЙ ПОЛЬШЕ

Резюме

Изученные мшанки датского и монтского ярусов из скважины Борышев (около Сохачева) из глубины 193—207 м. были дополнены потом материалом этого самого века с соседней скважины Сохачев из глубины 193,5—265,2 м. Материал для изучения автору передали проф. др К. Пожарыска и проф. др В. Пожарыски.

Мшанки с пограничных датско-палеоценовых слоев до настоящего времени были изучены недостаточно, а в Польше вообще не исследованы, что конечно еще больше придает значения описываемой фауне.

Описано 28 видов. Установлено один новый подрод: *Vibracella (Discovibracella)*, два новых рода: *Dysnoetocella* и *Pavobeisselina*, и следующие новые виды: *Vibracella (Vibracella) pozaryskae*, *V. (Discovibracella) oculata*, *Frurionella polonica*, *„Beisselina" pauperata*, *Beisselina munita* и *Dysnoetocella aenigmatica*.

Принимая во внимание довольно плохую сохранность материала из скважин, для сравнения в работе представлено формы из других мест, принадлежащие к дату и маастрихту. Формы эти с овицеллами следующие: *Entalophora benedeniana* (v. Hag.), *Spiropora verticillata* (Goldf.), *Crisisina carinata* (Roem.), *Heterocrisina communis* (d'Orb.) — это виды до сих пор вовсе либо слабо изучены. Что касается двух последних видов, то причисление их к родам *Crisisina* и *Heterocrisina* исправило неправильные родовые определения предыдущих авторов. Особенно интересный гонозооид вида *Spiropora verticillata*, являющийся новым типом гонозооида, несходным с описанными в работе Каню и Басслера (Canu & Bassler, 1922) как форма *„Mecynoecia"*.

Совсем неясна систематическая позиция *Dysnoetocella aenigmatica* n. gen., n. sp. Зооэции этого вида обнаруживают свойственный диморфизм. Он проявляется в том, что во внутренней, биламелларной стадии *„Eschara"* зооеции не только много больше, чем в стадии внешней, „кумулятивной", но также от фронтальной стороны они совсем разные.

Porina sp. aff. *salebrosa* отличается от *Porina salebrosa* Marsson тем что у нее совсем разные большие авикулярии, при чем типичная *P. salebrosa* из осадков белого мела маастрихта имеет один зубчик на поперечной планке авикуляриума.

На основании мшанок трудно решить с целой уверенностью вопрос о том, есть-ли эта фауна датского или же палеоценового века; некоторые данные однако свидетельствуют о палеоценовом веке (монт) осадков, в которых обнаружена описываемая фауна.

Среди 28 видов — 22 известны из датских отложений Дании и Швеции, а также из балтийских дрифтовых пород этого же века северной Германии, что указывало бы на датский век. Однако в Борышеве отсутствуют найболее банальные

датские виды, характерные для этого яруса в балтийском районе. Необычайное обилие *Coscinopleura angusta* Voigt, частейшей формы из „Tuffeau de Ciply", и присутствие *Vibracella (Discovibracella) oculata* n. sp. может свидетельствовать так о монтском, как и о верхне-датском веке. На тот же век указывали бы *Lunulites saltholmensis* Berth. и *Vibracella (Vibracella) pozaryskae* n. sp., которые до сих пор встречались только в верхне-датских отложениях. В Борышеве найдено малый фрагмент *Dysnoetocella aenigmatica* n. gen., n. sp., формы известной в Канале Альберта из Vroenhoven (Бельгия) из слоев, которых фауна очень близка к монтской (Tuffeau de Ciply). Век осадков Tuffeau de Cipl'y спорный и надо принять во внимание их возможно датский век на основании новейших работ (Loeblich & Tappan, 1955, 1957; Marlière, 1955, 1957; Hofker, 1956, 1959). Решение этого вопроса невозможно до времени изучения богатой фауны мшанок из монтских осадков Бельгии. Надо подчеркнуть, что несмотря на некоторые сходства, характер балтийских мшанок датского яруса иной, чем мшанок Tuffeau de Ciply, которые Гофкер относит к слоям палеоценового века, лежащим над туфовыми осадками мела в окрестностях г. Маастрихта.

Есть-ли это различие по фауне связано с существованием двух различных фаунистических провинций, или же с иным веком отложений — пока трудно решить, так как в палеоцене Скании и Дании мшанки отсутствуют, Мало вероятно также, чтобы так обильная фауна мшанок датского века в Швеции и Дании в конце этого яруса целиком вымерла. Пока не будет изучена несомненно палеоценовая фауна мшанок в Европе и как долго будет приниматься возможность деления по времени датского и монтского ярусов — немыслемо априорное определение характера фауны палеоцена. По этому поводу автор не в состоянии делать выводы о датском или монтском веке фауны из Борышева

Во всяком случае нет сомнения, что век фауны из Борышева и Сохачева это самый верхний дат или нижний горизонт палеоцена.

Выводы автора близки выводам из работы Броцена и Пожарыской (Brotzen & Pożaryska, 1957) на основании фораминифер, которые указывают на палеоценовый век обсуждаемых осадков. Ружковска (Różkowska, 1955), которая изучала кораллы из этих слоев, век их определила тоже как монтский.

PLATES

Plate I

Entalophora bēnedeniana (v. Hagenow, 1851)

Figs. 1, 2. Fragments showing normal state of preservation with peristomes broken out, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/Nos. 1-2.

Fig. 3. Exceptionally well preserved specimen with peristomes, × 25; Upper Maastrichtian (Md), St. Pieter near Maastricht (Netherlands). Coll. Voigt, photo catalogue No. 3626.

Fig. 4. Badly preserved fragment, zooecial walls broken out, with gonozooid at bifurcation, × 25; Upper Maastrichtian (Md), St. Pieter near Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3666.

Fig. 5. Specimen with well preserved gonozooid seen in profile and with unciform oeciostome, × 25; Dano-Montian, Curfs quarry near Berg, Geul valley, near Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3628.

Fig. 6. Fragment in similar state of preservation, with two gonozooids, × 25; Upper Maastrichtian (Md), Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3625.

Fig. 7. Fragment with gonozooid and projecting oeciostome, × 25; Dano-Montian, Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3627.

Entalophora proboscidea (Milne-Edwards, 1838)

Fig. 8. Small curved fragment, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 3.

Fig. 9. Larger fragment, showing pseudopores on zoarial surface, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 4.


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4b

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6a

6b

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8a

8b

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Plate II

Spiropora verticillata (Goldfuss, 1827)

Figs. 1, 2. Narrow fragments of "*reussi*-form, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/Nos. 5-6.

Fig. 3. Worn fragment, showing cavity of tube-like gonozooid (it forms a furrow above the rows of peristomes), × 12; Upper Maastrichtian, Kunrade (southern Limburg, Netherlands). Coll. Voigt, photo catalogue No. 3635.

Figs. 4. *a-b*. Two views of a fragment with well preserved, still closed gonozooid (contours traced in ink), × 25; Santonian (Granulaten-Senon), Hannover. Coll. Voigt, photo cat. No. 3633.

Fig. 5. View of a transverse fracture of a specimen, showing circular course of opened gonozooid around periphery of zoarium, × 25; Dano-Montian, Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3634.

Meliceritella steenstrupi (Pergens & Meunier, 1886)

Dano-Montian of Boryszew boring; × 25

Fig. 6*a*. Badly preserved specimen in frontal view. Coll. Warszawa Br. II/No. 7.

Fig. 6*b*. Dorsal view of same specimen, showing hexagonal kenozooecia.

Fig. 7. Frontal view of larger fragment. Coll. Warszawa Br. II/No. 8.

Idmonea filiformis d'Orbigny, 1851

Dano-Montian of Boryszew boring; × 25

Fig. 8*a*. Frontal view of a fragment. Coll. Warszawa Br. II/No. 9.

Fig. 8*b*. Same specimen in obliquely lateral view.

Fig. 9. Bifurcating fragment, showing flat dorsal face. Coll. Warszawa Br. II/No. 10.

Plate III

Heterocrisina communis (d'Orbigny, 1852)

Fig. 1*a*. Branching, partly worn fragment, lateral view, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 11.

Fig. 1*b*. Same fragment in dorsal view, showing damaged dorsal face.

Fig. 2*a*. Fragment with frontal gonozooid, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 12.

Fig. 2*b*. Same in lateral view, × 25.

Fig. 3. Well preserved young specimen, longitudinal striation of dorsal face indicated, × 25; Danian of Sochaczew boring (193.5—195.7 m.). Coll. Warszawa Br. II/No. 63.

Fig. 4. Large gonozooid, frontal view, × 25; Upper Maastrichtian (Md), Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands). Coll. Voigt, photo catalogue No. 1542.

Fig. 5. Thin section of a fragment with gonozooid. To the right the nematopores of the dorsal face are visible, slanting upwards, × 25; Dano-Montian, Curfs quarry near Berg, Geul valley, close to Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3665.

Fig. 6*a*. Older fragment, lateral view, × 25; Paleocene Vincentown (New Jersey, U. S. A.). Coll. Voigt, photo cat. No. 3631.

Fig. 6*b*. Same fragment, frontal view, showing the apparent increase in size of peristomes frontally, × 25.

Fig. 6*c*. Same specimen viewed dorsally, showing irregular network of nematopores, × 25.

Idmonea subgracilis d'Orbigny, 1850

Fig. 7*a*. Badly preserved fragment, frontal view, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 13.

Fig. 7*b*. Same specimen, dorsal view.

Fig. 8. Fragment, frontal view, × 12; Danian, Sochaczew boring (250—254 m.). Coll. Warszawa Br. II/No. 14.

Fig. 9. Bifurcating fragment, frontal view, × 25; From a Danian drift boulder from Daerstorf near Hamburg. Coll. Voigt, photo cat. No. 3632.


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1b


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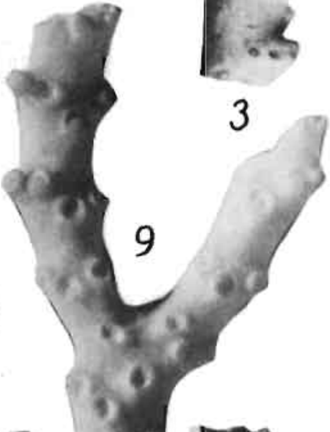
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6c


2a


2b


6b


7a


7b


6a

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1a

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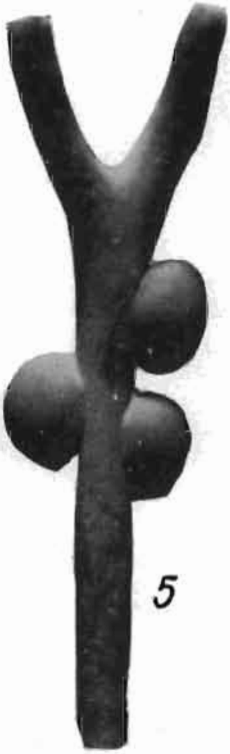

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1b

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Plate IV

Crisisina carinata (Roemer, 1840)

Fig. 1*a*. Badly preserved fragment, obliquely frontal view, × 25; Dano-Montian, Boryszew boring. Coll. Warszawa Br. II/No. 15.

Fig. 1*b*. Same specimen viewed laterally, at left convex dorsal face with striation caused by kenozooecia, × 25.

Fig. 2. Lateral view of a specimen, × 25. Paleocene of Vincentown (New Jersey, U. S. A.). Coll. Voigt, photo catalogue No. 3629.

Fig. 3. Fragment with open dorsal gonozooid at bifurcation, showing the kenozooecia opened by abrasion, × 25; *ibid.* Coll. Voigt, photo cat. No. 3630.

Fig. 4, 5. Young dichotomous branch with badly preserved frontal face (Fig. 4), but well preserved 3 gonozooids, in which the remnants of formerly longer peristomes are preserved, × 25; Upper Maastrichtian (Md), Curfs quarry, Geul valley near Maastricht (Netherlands). Coll. Voigt, photo cat. No. 2915.

Fig. 6. Thin section, at left showing the long, thin kenozooecia directed upwards, × 25; *ibid.* Coll. Voigt, photo cat. No. 3667.

Fig. 7. Thin section, at left showing the kenozooecia running parallel to the dorsal outer wall, × 12; *ibid.* Coll. Voigt, photo cat. No. 3668.

Stigmatoechos punctatus Marsson, 1887

Fig. 8*a*. Specimen in frontal view, × 25; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 16.

Fig. 8*b*. Same specimen, corroded dorsal face, × 25.

Plate V

Vibracella (Vibracella) pozaryskae n.sp.

Fig. 1. Complete zoarium, holotype, × 20; Dano-Montian, Boryszew boring. Coll. Warszawa Br. II/No. 17.

Fig. 2. Young zoarium, × 20; uppermost Danian, Hvallöse (Jutland, Denmark). Coll. Voigt, photo catalogue No. 3639.

Vibracella (Discovibracella) oculata n.subg., n.sp.

Fig. 3. Free zoarium in *Lunulites*-form, holotype, × 20; Montian. Tuffeau de Ciply near Mons (Belgium). Coll. Institut Royal des Sciences Naturelles de Belgique, Bruxelles.

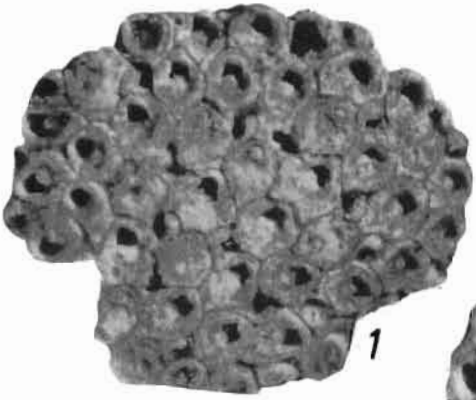
Fig. 4. Young specimen fixed to basis, × 20; Montian, Tuffeau de Ciply near Mons (Belgium). Coll. Voigt, photo cat. No. 3638.

Fig. 5. Much worn fragment, × 20; Dano-Montian, Boryszew boring. Coll. Warszawa Br. II/No. 18.

Fig. 6*a*. Fragment, × 20; *ibid.* Coll. Warszawa Br. II/No. 19.

Fig. 6*b*. Same specimen, from lower surface, × 20.

Fig. 7. Fragment, × 20; Montian, Ciply near Mons (Belgium). Coll. Voigt, photo cat. No. 3636.



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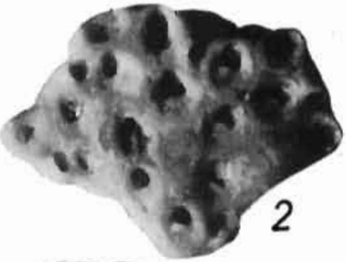

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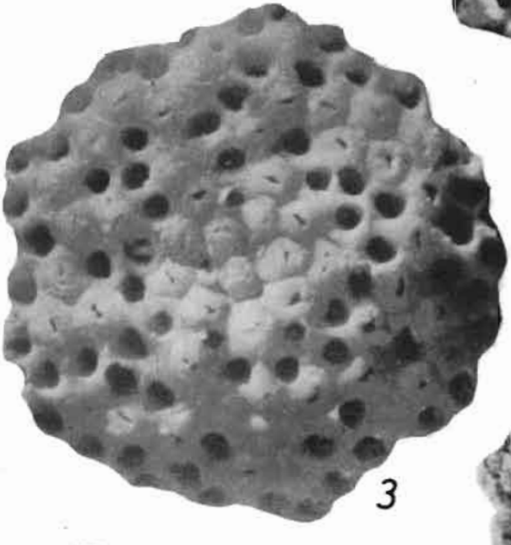

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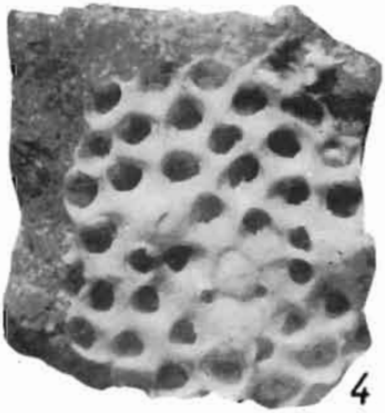

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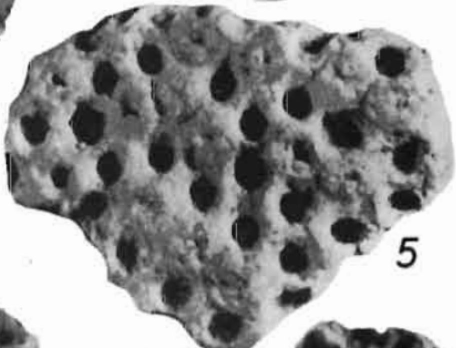

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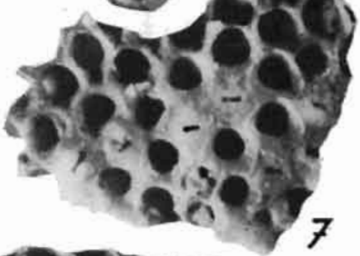

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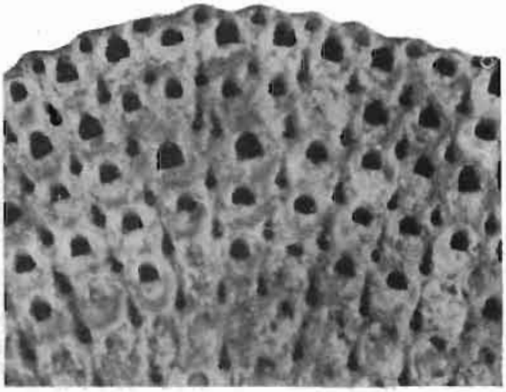
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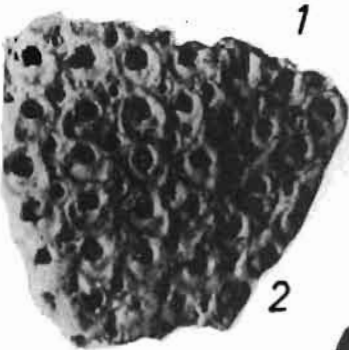
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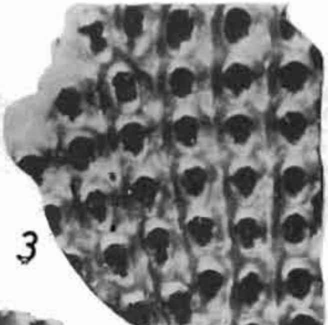
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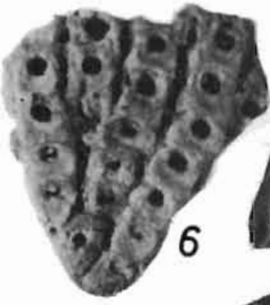
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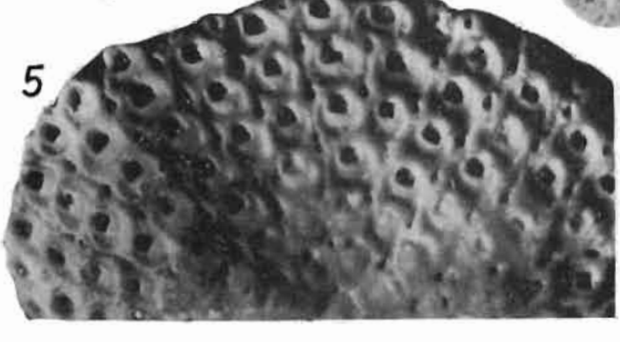
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Plate VI

Lunulites saltholmensis Berthelsen, 1962

Figs. 1, 2. Two fragments, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 20 and 62.

Fig. 3. Fragment, inner surface of zooecia, × 20; *ibid.* Coll. Warszawa Br. II/No. 21.

Fig. 4. Large fragment of zoarium, showing some fertile zooecia with larger opesia, × 20; Dano-Montian of Sochaczew boring (207.6—210.6 m.). Coll. Warszawa Br. II/No. 64.

Fig. 5. Partial view of complete zoarium, × 20; Upper Danian, Saltholmen (Denmark). Coll. Voigt, photo catalogue No. 3637.

Lunulites sp.

Fig. 6. Fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 22.

Fig. 7. Fragment, viewed from lower surface, × 20; *ibid.* Coll. Warszawa Br. II/No. 22*b*.

Fig. 8. Fragment, × 20; Dano-Montian of Sochaczew boring (207.6—210 m.) Coll. Warszawa Br. II/No. 65.

Stamenocella pristis (Levinsen, 1925)

Fig. 9. Fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 23.

Pithodella cincta Marsson, 1887

Fig. 10. Fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 24.

Plate VII

Coscinopleura angusta cf. *minor* Voigt, 1956
Dano-Montian of Boryszew boring

Fig. 1. Zoarium with the typical marginal vibracularia (Coscinozooecia), × 20. Coll. Warszawa Br. II/No. 25.

Fig. 2. Lateral view of another specimen, showing edge of zoarium with paired marginal vibracularia, × 20. Coll. Warszawa Br. II/ No. 58.

Fig. 3. Fragment with ooecia. The fertile zooecia show larger opesia, × 20. Coll. Warszawa Br. II/No. 26.

Frurionella daniensis Berthelsen, 1962

Fig. 4. Fragment with small avicularia, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 27.

Fig. 5. Bifurcated fragment, ×20; *ibid.* Coll. Warszawa, Br. II/No. 28.

Fig. 6. View of inner surface of zooecia, which possess no ascopore, × 20; Middle Danian, Voldum (Jutland, Denmark). Coll. Voigt, photo cat. No. 3651.

Puncturiella sculpta (d'Orbigny, 1851)

Fig. 7. Fragment, × 20; Upper Maastrichtian, Baculites Chalk of Chef du Pont (Cotentin, France). Coll. Voigt, photo cat. No. 3878.

Puncturiella cf. *sculpta* (d'Orbigny, 1851)

Fig. 8. Fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 29.

Pachythecella anhaltina (Voigt, 1930)

Fig. 9. Fragment, × 20; Danian of Sochaczew boring (262.2—263 m.). Coll. Warszawa Br. II/No. 30.


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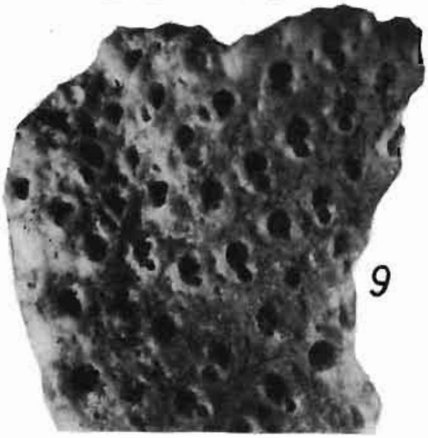
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Plate VIII

Frurionella polonica n.sp.
Dano-Montian of Boryszew boring (Figs. 1-5)

Fig. 1*a*. Much corroded fragment, showing denticle at base of most apertures, × 20. Coll. Warszawa Br. II/No. 31.

Fig. 1*b*. Same specimen viewed from the other side, × 20.

Fig. 2. Corroded fragment with some avicularia, × 20. Coll. Warszawa Br. II/No. 32.

Fig. 3. Fragment with irregularly distributed apertures and some avicularia, × 20. Coll. Warszawa Br. II/No. 33.

Fig. 4. Holotype, × 20. Coll. Warszawa Br. II/No. 34.

Fig. 5. Small fragment showing zooecia from inside, without ascopore, × 20. Coll. Warszawa Br. II/No. 35.

Fig. 6. Small fragment with large avicularia in center, × 20; Dano-Montian, Sochaczew boring (207,0—210.6 m.). Coll. Warszawa Br. II/No. 66.

Frurionella daniensis Berthelsen, 1962

Fig. 7. Small fragment showing the interior of some zooecia, × 20 (for comparison with Fig. 5); Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 36.

Pavobeisselina oblita (Kade, 1852)

Fig. 8. Small fragment, showing zooecia from inside, × 20 — *A* ascopore (compare Pl. XIV, figs. 1—3); Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 59.

Plate IX

Pachythecella lundgreni (Pergens & Meunier, 1886)
Dano-Montian of Boryszew boring (Figs. 1-3)

Fig. 1. Fragment with thickened peristome and small apertural avicularia, × 20. Coll. Warszawa Br. II/No. 37.

Fig. 2. Corroded fragment, × 20. Coll. Warszawa Br. II/No. 38.

Fig. 3. Fragment with thorn-like projections of apertural avicularia, × 20. Coll. Warszawa Br. II/No. 39.

Fig. 4. Siliceous cast of young branch, showing filling of apertural avicularia and lack of an ascopore, × 20; from a flint drift boulder of Danian age, Daerstorf near Hamburg. Coll. Voigt, photo catalogue No. 3672.

Taenioporina articulata Voigt, 1930

Fig. 5. Fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 40.

Fig. 6. Fragment, × 20; from a drift boulder of Danian age, Daerstorf near Hamburg. Coll. Voigt, photo cat. No. 3640.

"Beisselina" nobilis (Levinsen, 1925)

Fig. 7. Badly preserved fragment, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 41.

Fig. 8. Internal view of zooecia of the same or very closely related species, showing paired inner aperture of an ascopore, approx. × 28; Dano-Montian, Curfs quarry near Berg, Geul valley, Maastricht (Netherlands). Coll. Voigt, photo cat. No. 3655.

Beisselinopsis cf. *hiltermanni* Voigt, 1951

Fig. 9. Very badly preserved zoarium, × 20 (photographed under water); Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 60.

Fig. 10. Well preserved zoarium, × 20; uppermost Danian, Hvallöse (Jutland, Denmark), for comparison with Fig. 9. Coll. Voigt, photo cat. No. 3664.


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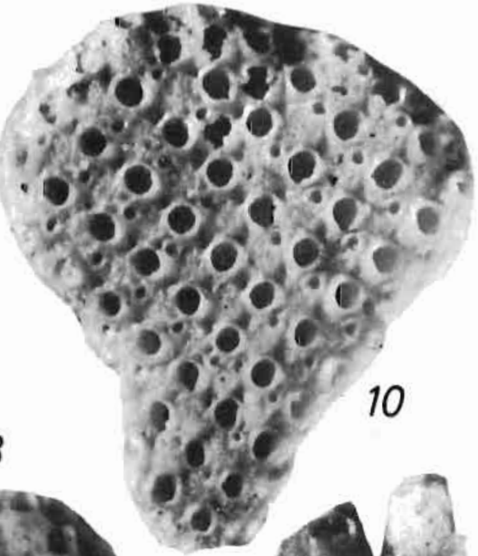
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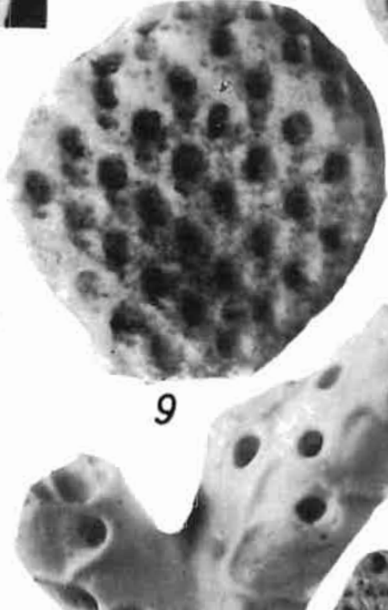
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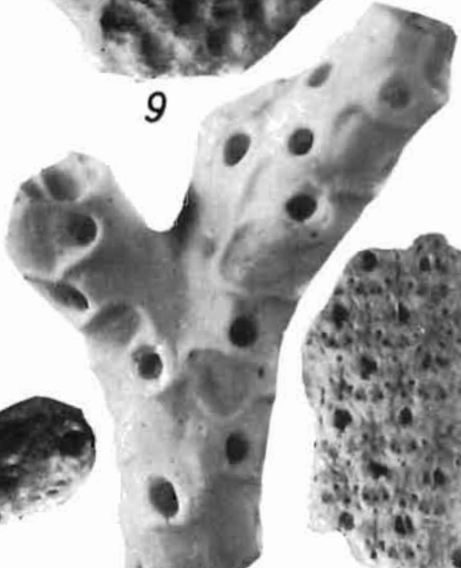
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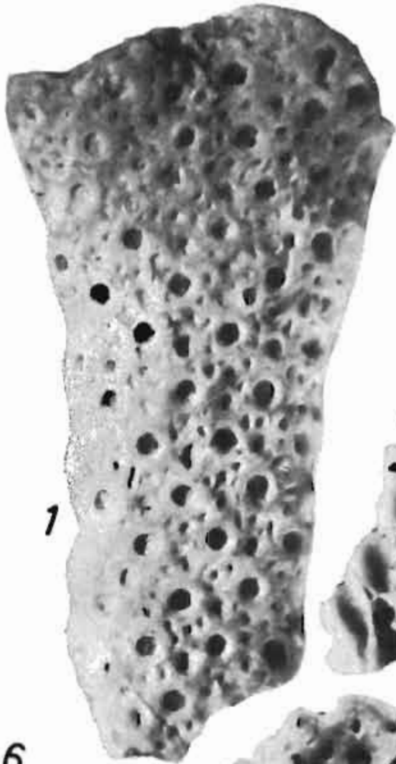

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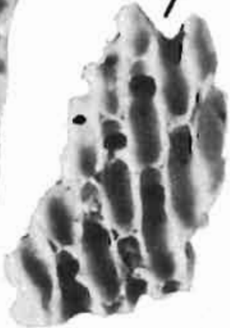

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Plate X

Beisselina munita n.sp.
Dano-Montian of Boryszew boring
All specimens in Coll. Warszawa Br. II/Nos. 42-48

Fig. 1. Moderately well preserved fragment without large avicularia, × 20. Br. II/No. 42.

Fig. 2. Fragment with some large avicularia, × 20. Br. II/No. 43.

Fig. 3. Holotype with numerous large avicularia, × 20. Br. II/No. 44.

Fig. 4. Young, well preserved fragment with regularly arranged zooecia and distinctly separated marginal zooecia without large avicularia, × 20. Br. II/No. 45.

Fig. 5. Small fragment with well preserved surface, which shows one large and many small avicularia, × 20. Br. II/No. 46.

Fig. 6. Small fragment with well preserved surface, some zooecia viewed from the inside, showing the ascopore, × 20 (for comparison with Pl. XI, fig. 4). Br. II/No. 47.

Fig. 7. Small fragment with internal view of zooecia, showing ascopore and ooecia, × 20. Br. II/No. 48.

Plate XI

Beisselina munita n.sp.

Fig. 1. Old, badly preserved fragment, in lower part showing some zooecia of cumulating stage, × 20; Dano-Montian of Boryszew boring. Coll. Warszawa Br. II/No. 49.

Fig. 2. Two avicularia at zoarial margin, × 40; *ibid.* Coll. Warszawa Br. II/No. 45 (same specimen as Pl. X, fig. 4).

Beisselina celleporoides Voigt, 1930
(for comparison with *B. munita* n.sp.)

Fig. 3. *a-b*. Avicularia at zoarial margin, × 40; Danian, Voldum (Jutland). Coll. Voigt, photo catalogue No. 3673.

Fig. 4. Internal view of zooecia, showing ascopore high up in the inner frontal wall, hereat inner exit of apertures is not visible, × 20 (for comparison with *B. munita* n.sp.); Danian, Voldum (Jutland). Coll. Voigt, photo cat. No. 3650.

"Beisselina" pauperata n.sp.
Dano-Montian of Boryszew boring

Fig. 5. Holotype, × 20. Coll. Warszawa Br. II/No. 52.

Fig. 6. Young fragment, × 20. Coll. Warszawa Br. II/No. 50.

Fig. 7. Fragment, × 20. Coll. Warszawa Br. II/No. 51.

Figs. 8-9. Two fragments with small avicularia on zoarial surface, × 20. Coll. Warszawa Br. II/No. 49 and 56.

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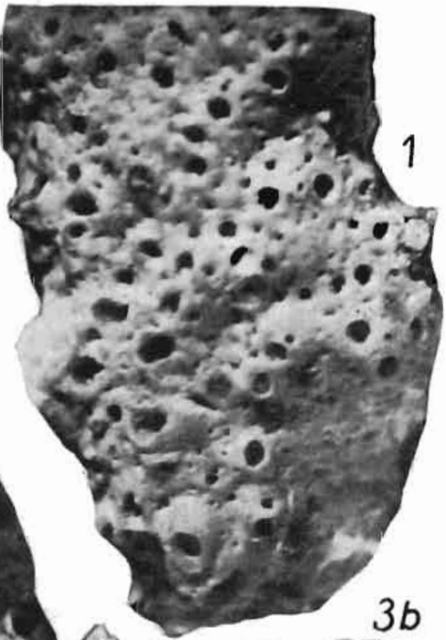

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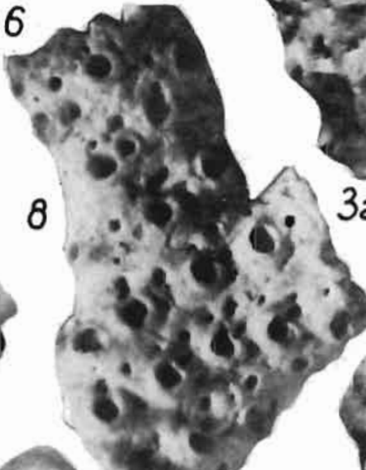

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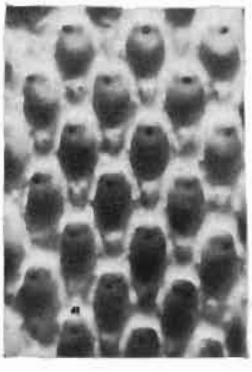

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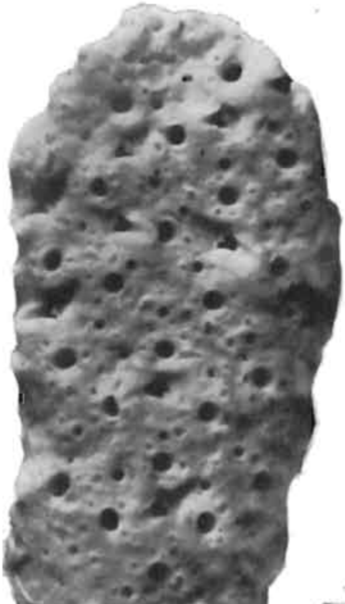

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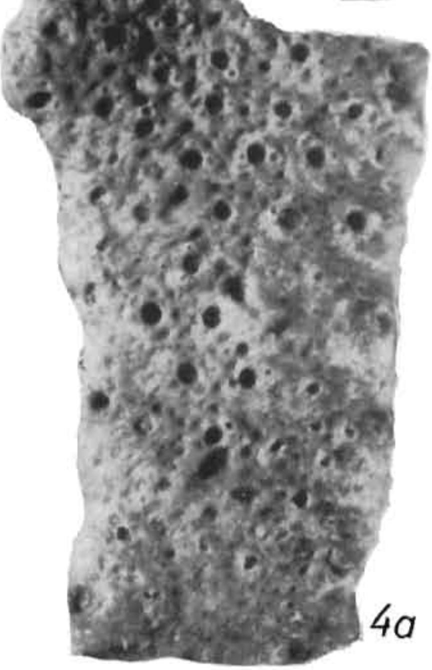

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Plate XII

Porina salebrosa Marsson, 1887

(for comparison with *Porina* sp. aff. *salebrosa* Marsson from Boryszew)

Fig. 1. Fragment with characteristic large avicularia, the bar (pivot) of which shows a denticle (compare Pl. XIII, fig. 1), × 20; Lower Maastrichtian, Rügen. Coll. Voigt, photo catalogue No. 3644.

Fig. 2. Small fragment, at right showing large avicularium with denticle, × 20; Lower Maastrichtian, Rügen. Coll. Voigt, photo cat. No. 3645.

Porina sp. aff. *salebrosa* Marsson, 1887

Fig. 3*a*. Fragment with 3 large avicularia, × 20; Middle Danian, Voldum (Jutland, Denmark). Coll. Voigt, photo cat. No. 3642.

Fig. 3*b*. Avicularia of same specimen, × 40.

Figs. 4. *a*-*b*. Moderately well preserved fragment, viewed from both sides, × 20; Dano-Montian of Boryszew boring, × 20. Coll. Warszawa Br. II/No. 53.

Plate XIII

Porina salebrosa Marsson, 1887

(for comparison with *Porina* sp. aff. *salebrosa* Marsson from Boryszew)

Figs. 1, 2. Large avicularia, × 40; Upper Maastrichtian, zone of *Belemnitella junior*, Hemmoor (Niedersachsen). Coll. Voigt, photo catalogue Nos. 3649 and 3702.

Fig. 3. View of internal structure of zooecia, showing paired radial ledge-like struts covering internal aperture of ascopore, × 40; *ibid.* Coll. Voigt, photo cat. No. 3645a.

Fig. 4. View of internal structure of zooecia, after removal of struts visible in Fig. 3, showing ascopore located below struts, × 40; *ibid.* Coll. Voigt, photo cat. No. 3647.

Porina sp. aff. *salebrosa* Marsson, 1887

Fig. 5. Internal view of zooecia with paired ledges covering internal ascopore, × 28; Middle Danian, Voldum (Jutland, Denmark). Coll. Voigt, photo cat. No. 3643.

"Beisselina" intermedia Canu & Bassler, 1933

Fig. 6. Fragment with some large avicularia, × 20 (for comparison with *Porina* sp. aff. *salebrosa* Marsson); Paleocene, Vincentown (New Jersey, U. S. A.). Coll. Voigt, photo cat. No. 3641.

Fig. 7. Marginal avicularium from lateral edges of zoarium, × 40; *ibid.* Coll. Voigt, photo cat. No. 3641a.

Dysnoetocella aenigmatica n.gen., n.sp.

Fig. 8. Polished transverse section of zoarium. Around central "*Eschara*"-axis smaller zooecia of cumulating stage, × 20; Montian, Albert Canal near Vroenhoven (Belgium). Coll. Voigt, photo cat. No. 3658.

Fig. 9. Same specimen in thin section, × 20; *ibid.* Coll. Voigt, photo cat. No. 3658a.

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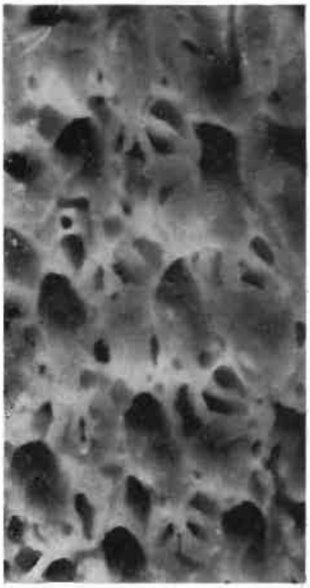

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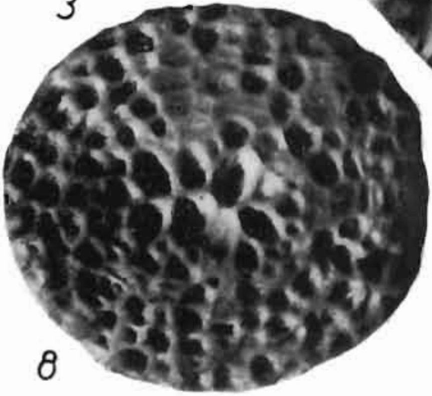

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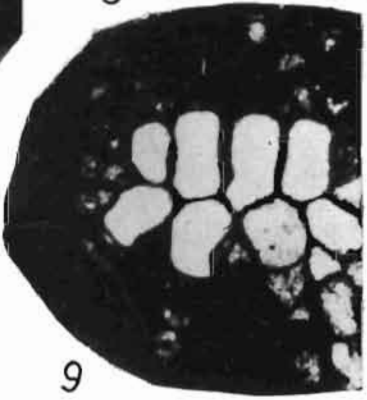

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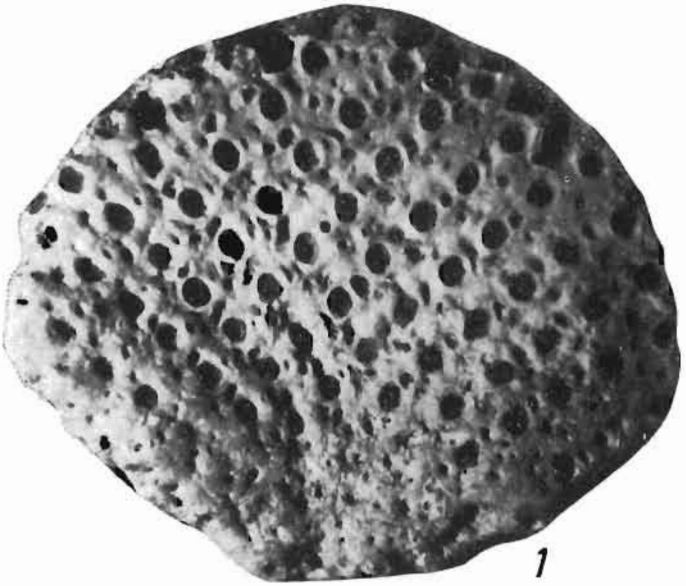

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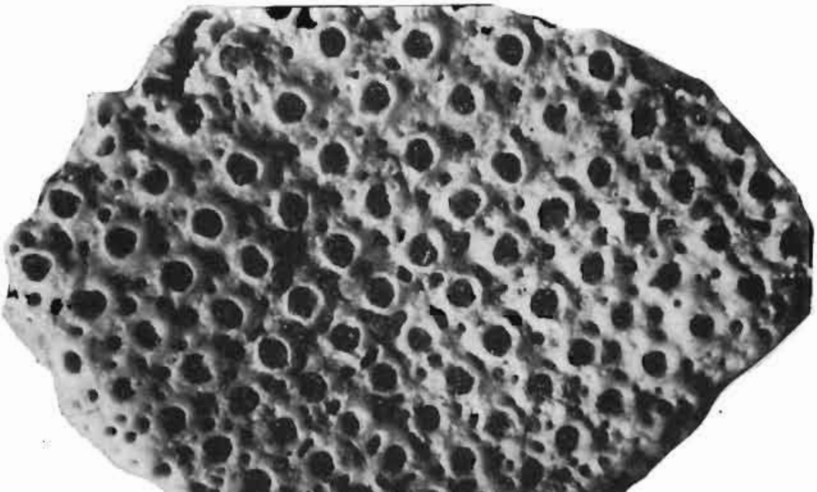

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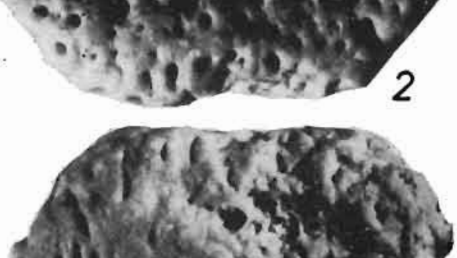

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Plate XIV

Pavobeisselina oblita (Kade, 1852)

Dano-Montian of Boryszew boring

Fig. 1. Complete zoarium, × 20. Coll. Warszawa Br. II/No. 54.

Fig. 2. Larger complete zoarium (upper margin damaged), × 20. Coll. Warszawa Br. II/No. 55.

Fig. 3. Fragment of proximal basal part, viewed from below, × 20. Visible are the slit-like pores of the radicells, by which the zoarium was fixed to the base. Coll. Warszawa Br. II/No. 61.

Plate XV

Dysnoetocella aenigmatica n.gen., n.sp.

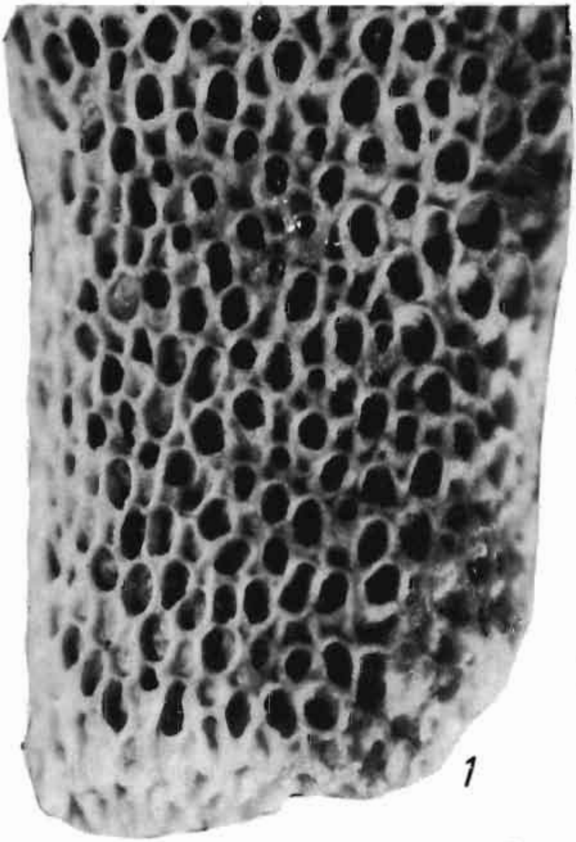
Fig. 1. Cylindrical fragment with outer layer of cumulating zooecia, holotype, × 20; Dano-Montian, Albert Canal near Vroenhoven (Belgium). Coll. Voigt, photo catalogue No. 3660.

Fig. 2. Small fragment with unusually numerous, widely opened cumulating zooecia, × 12; *ibid.* Coll. Voigt, photo cat. No. 2711.

Fig. 3. Section of surface of a specimen with relatively small cumulating zooecia, × 20; *ibid.* Coll. Voigt, photo cat. No. 3654.

Fig. 4. Specimen broken up in plane of axis, centrally large regular zooecia of bilamellar "*Eschara*"-stage, × 20 (for comparison with Fig. 5*a*); *ibid.* Coll. Voigt, photo cat. No. 3657.

Figs. 5. *a-b.* Irregularly bounded fragment from the Dano-Montian of Boryszew boring: *a* surface of transverse fracture with regular zooecia of axial bilamellar stage in lower part of picture, × 20; *b* surface of transverse fracture of same specimen, showing cumulating zooecia broken up, × 20. Coll. Warszawa Br. II/No. 57.



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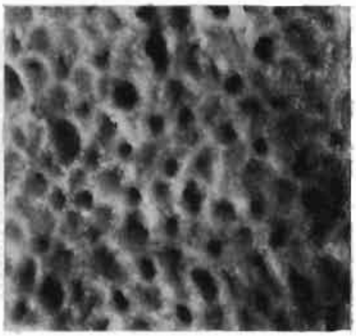

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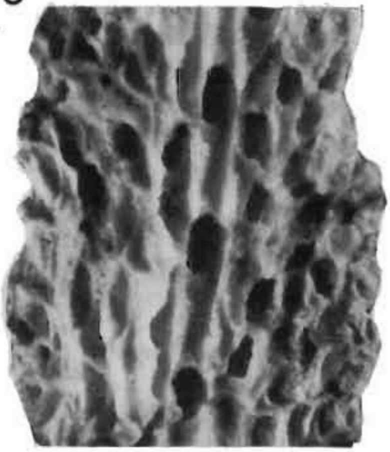

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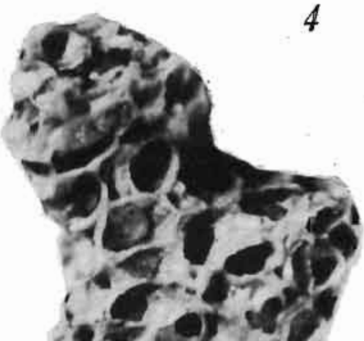

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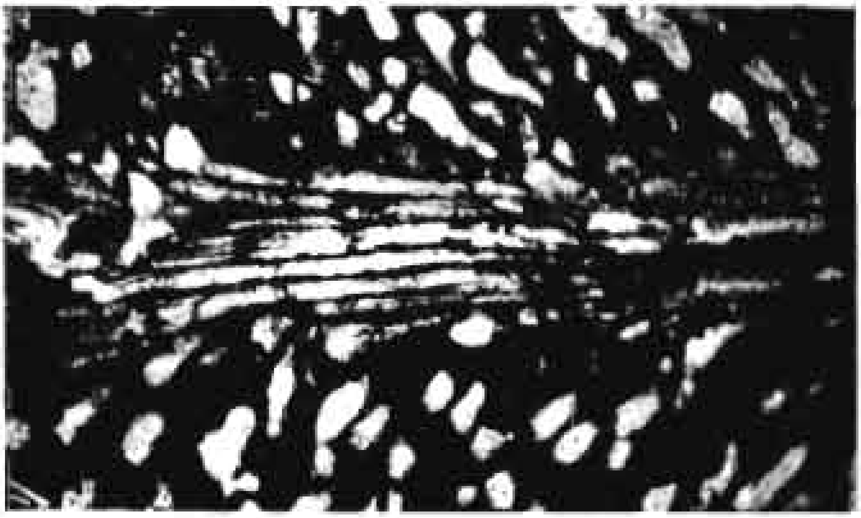

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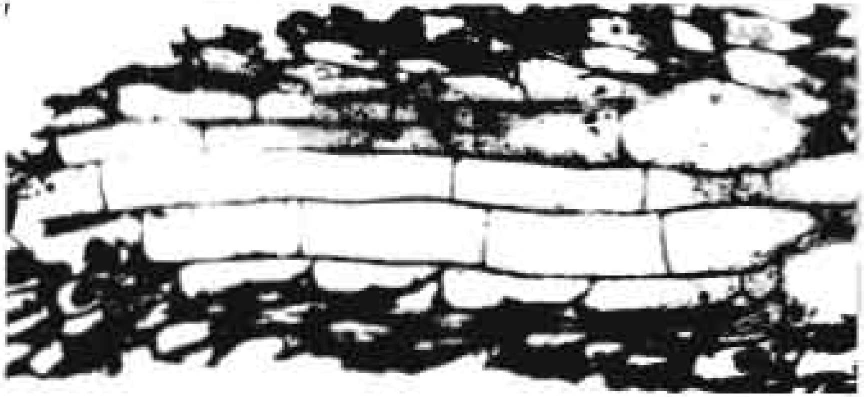

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Plate XVI

Dysnoetocella aenigmatica n.gen., n.sp.

Fig. 1. Longitudinal section, oriented transversely to bilamellar axis, showing stage with large primary zooecia and many smaller, irregular cumulating outer zooecia, × 25; Dano-Montian, Albert Canal near Vroenhoven (Belgium), Coll. Voigt, photo catalogue No. 3663.

Fig. 2. Longitudinal section, oriented diagonally to bilamellar axis, showing characteristic box-like shape of large inner zooecia, × 25; *ibid.* Coll. Voigt, photo cat. No. 3661.

Dysnoetopora celleporoides Canu & Bassler, 1926
(for comparison with *Dysnoetocella aenigmatica* n.gen., n.sp)

Fig. 3. Visible are: an axial bundle of long tube-like zooecia and an outer layer of "cumulating" zooecia, × 25 (for comparison with Figs. 1 and 2); Upper Maastrichtian, Bachtschissaraj (Crimea, U.S.S.R.). Coll. Voigt, photo cat. No. 3670.


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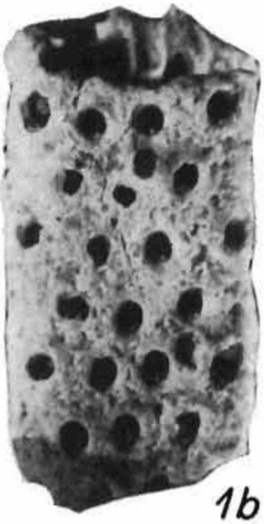
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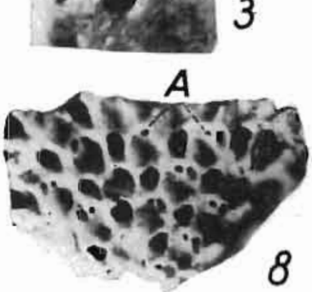

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