

ABSTRACT

Some doubtful foraminiferal "brown bodies" in Bryozoa, "egglike" microfossils, dinoflagellates, hystrichospherids, Radiolaria, echinoderm sclerites, scolecodont assemblages, and miscellaneous Problematica in Baltic Cretaceous flintstones are described, with taxonomic comments.

New microfossils from Baltic Cretaceous flintstones

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PRIMITIVE OR DOUBTFUL FORAMINIFERA

The Baltic Cretaceous flintstones frequently contain many foraminifera of different species, but sometimes only a single specimen of a rare species is found during the examination of numerous samples of flint chips, and its preservation is generally too poor to permit exact determination of the species, genus, or even family. The following examples illustrate the occurrence of somewhat primitive or doubtful foraminifera, supplementing my earlier reports on these objects.

SUPPOSED FORAMINIFERA

Family REOPHACIDAE?

Gen. et sp. indet.

Plate 1, figures 1-2

Brown membranous bodies, increasing in size, compose the chamber molds in a more or less closed row. See O. Wetzel (1953b, pl. 83, figs. 1-2) for similar fossils, illustrated less clearly.

Subfamily RHIZAMMININAE?

Gen. et sp. indet.

Plate 1, figure 5

A brown membranous branching tube bears a pair of round dark bodies, supposed molds of two chambers, which still retain some shreds of their covering. See O. Wetzel (1953b, pl. 83, figs. 3-4).

DOUBTFUL FORAMINIFERA

Genus CHITINODENDRON Eisenack, 1937

Chitinodendron spp. indet.

Plate 1, figures 3-4

Filament-bearing blastulae, dark brown; apparently compressed hollow "chitinous" membranes. They were at first interpreted by the author as "horny" (keratinous) Bryozoa (e.g., *Hippothoa* sp.?) or hydrozoan polyps (see O. Wetzel, 1933, pl. 1, figs. 7-10; 1953b, pl. 83, fig. 7). On the other hand, they resemble the Silurian species of *Chitinodendron* established by Eisenack in 1937 and classified doubtfully as foraminifera. More recently, Sigal (in Piveteau, 1952, p. 152) mentioned such primitive tests, i.e., a Cambrian *Chitinodendron* species, in discussing the ancestry of the foraminifera.

SYSTEMATIC POSITION OF PSEUDASTRORRHIZULA

MICROFOSSILS INCERTAE SEDIS

Genus *Pseudastrorhizula* O. Wetzel, 1940

Description (based on the 1940 diagnosis): Somewhat starlike round bodies with several more or less thick branches extending nearly radially from an indistinct central region. Color yellowish brown, often darker at the center.

Type species: *Pseudastrorhizula eisenacki* O. Wetzel, 1940.

Pseudastrorhizula eisenacki O. Wetzel

Plate 1, figures 6-7

Pseudastrorhizula eisenacki O. WETZEL, 1940, Zeitschr. Geschief., vol. 16, no. 2, p. 122, pl. 1, figs. 3-4.

Holotype: Collection of O. Wetzel, Eutin; slide no. A 1022 (pl. 1, fig. 6).

Paratype (typoid): Same collection; slide no. A 2160 (pl. 1, fig. 7).

Age and occurrence: Sporadic in Baltic Cretaceous flintstones; found mostly in an isolated condition, but recently within the chambers of fragments apparently belonging to the skeletons of bryozoan colonies.

Description: See that of the genus.

Dimensions: Diameter about 120-160 μ .

Comments: My original classification of these flintstone microfossils as foraminifera was intended only as provisional but was justified by their external form, which is obviously similar to *Pseudastrorhiza silurica* Eisenack (1932, p. 259, pl. 11, figs. 1-6). They also resemble *Astrorhiza* Sandahl of Issler (1908, p. 39, pl. 1, figs. 1-3), and Perruche (1936, pp. 23-25, pl. 1, figs. 4-5) recorded a Jurassic form found by him as an internal mold of a foraminifera, probably of the *Astrorhizidae*.

However, in a later publication (O. Wetzel, 1950, p. 166), I emphasized the fact that some features of the so-called "brown bodies" occurring in fossil Bryozoa seem to coincide with those of *Pseudastrorhizula eisenacki* (compare pl. 1, figs. 8-10, especially the central part of fig. 8). The chemical substance of these "ovoid bodies" (also somewhat problematical) is similar, but *Pseudastrorhizula* has a more hyaline surface, without the

concentric pile lines that are often visible in the "ovoids" (now called "brown bodies"). Because of these two differences, *Pseudastrorhizula eisenacki* may perhaps be regarded as only morphologically convergent with the "brown bodies," having descended from another organism, which is assumed to have been some symbiont of the Bryozoa.

In any case, it seems improbable, in spite of a certain morphological resemblance, that *Pseudastrorhizula eisenacki* has any real affinity with the "euasters," i.e., calcified spicules of Silicispongia described by M. Deflandre-Rigaud (1949, p. 159, text-figs. 22-26). On the whole, the systematic position of *Pseudastrorhizula* is still uncertain, and for the moment these problematic objects should not be included among the foraminifera.

"EGGLIKE" MICROFOSSILS OF UNCERTAIN SYSTEMATIC POSITION

This category includes rare microfossil types of rather ambiguous form, having the general appearance of a very small egg or an aggregate of such bodies.

MICROFOSSILS INCERTAE SEDIS

Genus *Palambages* O. Wetzel, new genus

"Morulosae" O. WETZEL, 1933, *Palaeontographica*, vol. 78 pp. 23-24.

Derivatio nominis: Lat. *ambages* = uncertainty in two different directions.

Description (based on O. Wetzel, 1933): Spheroidal bodies, composed of many (8-18?) oval membranous cells, sometimes with a flat peripheral portion (with aperture?).

Type species: *Palambages morulosa* O. Wetzel, 1961.

Palambages morulosa O. Wetzel, new species Plate 1, figure 11

"Morulose" O. WETZEL, 1933, *Palaeontographica*, vol. 78, pp. 23-24, pl. 4, figs. 1-5.

Derivatio nominis: Lat. *morula* = diminutive of *morum*, a mulberry.

Holotype: Collection of O. Wetzel, Eutin; slide no. A 350 (pl. 1, fig. 11).

Paratypes (typoids): Same collection; slide nos. A 173/509 (figured in 1933).

Age and occurrence: Sporadic in Baltic Cretaceous flintstones, and frequent in the Baltic Senonian and Danian chalk and flint, in place.

Description: See that of the genus.

Dimensions: Assemblages about 80-120 μ ; single cells about 30-50 μ in diameter.

Comments: These microfossils are identical with the objects recorded previously as "Morulosae" (O. Wetzel, 1933, pp. 23-24, pl. 4, figs. 1-5). A detailed discussion of their possible systematic relations with

extant microorganisms was given in that paper. From a purely morphologic point of view, they stand between the egg-balls of planktonic crustaceans (e.g., those of *Clausocalanus*) and the coenobia of the alga *Coelastrum*. Perhaps these fossil forms may be provisionally classified in the form-group Hystrichosphaeridea s.l. In any case, to conform to correct taxonomic procedure, I have here assigned them Linnean nomenclature in place of the group name "Morulosae" O. Wetzel (1933).

Remark: There are, perhaps, other smaller species with fewer cells; an aberrant form, not certainly known, was reported by the author (O. Wetzel, 1953a, p. 41, pl. 2, fig. 11).

Form genus *Palaeobion* O. Wetzel, new genus

Description: Spiny spheroidal microfossils, somewhat resembling normal fossil hystrichospherids, as well as some of the extant planktonic "cysts" or eggs described by H. Lohmann (1904).

Type species: *Palaeobion catenatum* O. Wetzel, 1961:

Palaeobion catenatum O. Wetzel, new species Plate 1, figures 12-13

Holotype: Collection of O. Wetzel, Eutin; slide no. Jt. 75a (pl. 1, figs. 12-13).

Age and occurrence: Found once, in a Cretaceous flintstone from Moens Klint, Denmark.

Description: Spheroidal bodies of brown color. Their relatively thick covering bears sparse, small, conical spines, a few of which are somewhat curved, obliquely arranged, or indistinctly formed. The shells are filled with a pyritized granular substance. The individuals are closely united in a double chain. At the points of contact they have a discoidal surface always bearing short, peg-shaped protuberances. Note the point of breakage at the top of figures 12-13.

Dimensions: Illustrated fragment, 450 \times 160 μ ; single cells 80-85 μ in diameter.

Comments: This microfossil, remarkable for the unusual arrangement of egglike bodies, has its counterparts among the extant marine plankton, e.g., *Ovum hispidum capense* H. Lohmann (1904, p. 30, pl. 4, fig. 5, 5a). However, the fossil cells have a thicker cover and not so many or such distinct spines. The fact that no trace of either the mucous envelope or the tubiform membrane that holds the long double chains of living "*Ova hispida*" together is visible in the surrounding flintstone is perhaps not surprising in the case of a fossil body. In any case, it seems more likely that this fossil belongs to the "*Ova hispida*" than to the ordinary hystrichospheres, which are more membranous. In fact, it appears to be identical with one of the planktonic types which Lohmann distinguished separately, a spiny spheroid with a thick shell and many compact spines (total diameter variable, about 15-45 μ). That body, found only in an isolated state in the ocean, was regarded as an indepen-

dent organism *incertae sedis* and therefore designated as "*Bion multispinosum* (Möbius) Lohmann." I have derived the name for the form-genus of my new fossil in accordance with this nomenclature.

Eisenack was in a comparable position with regard to the taxonomy of the Silurian "cysts" before the morphologic group Hystrichosphaeridea was introduced. I hesitate to say, even provisionally, that my unusual but interesting microfossil, found only once as an assemblage, is really a representative of the Hystrichosphaeridea worthy of recognition.

Remark: The object illustrated in figures 12–13 is only a fragment of the original assemblage of 15–16 cells; the flint chip must be cut into smaller pieces for good observation.

Genus *Pleurozonaria* O. Wetzel, 1933

Description (based on the 1933 diagnosis): Spheroidal body of light brown color. Wall thick but perforated by numerous channels, which are generally first apparent under the microscope in the transparent "border."

Type species: *Pleurozonaria globulus* O. Wetzel, 1933.

Pleurozonaria globulus O. Wetzel

Plate 1, figures 14–15

Holotype: Collection of O. Wetzel, Eutin; slide no. A 405 (pl. 1, figs. 14–15).

Age and occurrence: One specimen in a glacial erratic flintstone of probable Cretaceous (or Jurassic?) age at Krywonogi, Poland.

Description: According to the optical plane of observation, the bright "ribbed border" of the wall is first seen, then (on the "disc" inside the "border") portions of oblique punctate lines, and finally a layer of pores are seen from above. Some of the lines seem (at least in the present state of my single object) to converge in two flattened polar points; the whole body has the appearance of a small globe with meridional lines.

Dimensions: Diameter (total) 40–48 μ ; "border" (wall) thickness 5–6 μ .

Comments: This fossil was previously described in the author's first detailed discussion of the Hystrichosphaeridea (1933, p. 29, pl. 4, fig. 12), where it was distinguished from his species of *Cymatiosphaera*. Recently Eisenack (1957) denoted a thick-walled species of the latter as *Cymatiosphaera pachytheca*, regarding it as related to his species of *Tasmanites*, *Tytthodiscus*, and *Leiosphaeridia*. He combined all these "micromorphs" in the Hystrichosphaeridea, since Sommer (1956) had introduced the new family Tasmanaceae (Algae) for the Paleozoic species of *Tasmanites*. It is undoubtedly possible that these microfossils, striking in their very thick perforated walls, are closely affiliated with each other; at least, it should not be too difficult to establish a common generic name for the forms called *Tasmanites*

Newton, 1875 (or Sommer, 1956), *Pleurozonaria* O. Wetzel, 1933, and *Tytthodiscus* Norem, 1955, with more or less slight differences between their species. But even if this is true, what were these microfossils during their lifetime – Algae, Protozoa, spores, or eggs? According to the most recent studies, they represent "crustacean eggs" (Bitterli, 1960, pp. 42, 45) or, at any rate, animal bodies, since they show strong luminescence under ultraviolet light (W. Wetzel, 1959, pp. 264–265, pl. 24, figs. 1–3; Maier, 1959, pp. 298–299).

INTERMEDIATE TRIPARTITE MICROFOSSILS

The Hystrichosphaeridea undoubtedly represent a morphological grouping of very different forms. Besides those resembling plants such as Algae and spores, many others show morphological resemblances to Protista. These forms are of major importance because of the possibility of their relationship to the Radiolaria and, perhaps even more, to the Dinoflagellata. The following examples illustrate some of the microfossils that are intermediate between the Hystrichosphaeridea and the Dinoflagellata, having a tripartite shell and only very incomplete equatorial lines and other wall structures instead of the girdle-furrow and normal plates of the typical dinoflagellates.

MICROFOSSILS INCERTAE SEDIS

HYSTRICHOSPHAERIDEA? OR DINOFLAGELLATA? FAMILIAE INCERTAE

Genus *Triblastula* O. Wetzel, 1933

Description (based on the 1933 diagnosis): Shells tripartite in the axial direction. A spheroidal central body bears two hemispherical or cylindrical segments at each end of the equatorial surface. Usually the two "pole-caps" differ in the form and ornamentation of their ends (apical and antapical). The central portion may be covered with a more or less spiny surface, but the naked ones show the pylomes more clearly when they are present.

Type species: *Triblastula utinensis* O. Wetzel, 1933.

Triblastula utinensis O. Wetzel

Plate 2, figure 1

Triblastula utinensis O. WETZEL, 1932, Zeitschr. Geschiebef., vol. 8, no. 3, p. 136, pl. 2, fig. 11; 1933, Palaontographica, vol. 78, pp. 54–55, pl. 6, figs. 5–6.

Neotype: Collection of O. Wetzel, Eutin; slide no. 2109b.

Age and occurrence: Sporadic in Baltic Cretaceous flintstones and chalk samples.

Description (based on the 1933 diagnosis): Central portion covered with bristles, which are sometimes furcate and extending over the other segments. One of the two "pole-caps" is especially strongly formed and may resemble a round box, having a large terminal point with circular rows of small protuberances. Pylome-like openings occur.

Dimensions: 130 × 50μ; 105 × 60μ.

Remark: Since the holotype has been lost, a neotype is substituted for it.

Triblastula nuda O. Wetzel, new species

Plate 2, figure 2

"Dreiteilige Hülle (stachellose *Triblastula*?)" O. WETZEL, 1932, Zeitschr. Geschief., vol. 8, no. 3, p. 136, pl. 2, fig. 14.

"Dreiteilige Hüllen (stachellose *Triblastulac*?)" O. WETZEL, 1933, Palaeontographica, vol. 78, p. 21, pl. 3, fig. 23.

Holotype: Collection of O. Wetzel, Eutin; slide no. A 2360.

Age and occurrence: Common in Baltic Cretaceous flintstones.

Description (based on the 1933 diagnosis): Central portion spheroidal, smooth, without spines. Usually only one of the "pole-caps" has a terminal point (apex); the other is more cuboidal or cylindrical, narrowing somewhat at the end. The caps often have four longitudinal striations, which may indicate the corners of the broad areas or fields of the shell. The circular bases of the two caps together appear as a narrow pair of parallel lines, and may represent the equatorial "girdle" of a true dinoflagellate. "Pylomes" are apparently not rare.

Dimensions: 96 × 48μ; 100 × 45μ.

Comments: With regard to their *Scriniodinium galeatum*, Cookson and Eisenack (1960) stated that they were "aware that it differs in shape very considerably from that of the genotype, *Scriniodinium crystallinum* (Deflandre)," which the same authors in 1957 had called *Gymnodinium crystallinum* Deflandre. The type species of the genus *Scriniodinium* Klement, 1957, mentioned by Cookson and Eisenack (1960, p. 3) in discussing their new species, is otherwise unknown to me, but I assume that, at all events, my *Triblastula* forms do not belong to *Scriniodinium* and that *Scriniodinium galeatum* Cookson and Eisenack would be more suitably included in the genus *Triblastula* because of its resemblance to *Triblastula nuda*.

Remark: This fossil was previously described and illustrated in 1933. In that first discussion of the "Stachel-eier-Problem," I had to content myself with including the spiny membranous microfossils in the new family "Hystrichosphaeridae," but I emphasized the close relationship of the "naked" tripartite forms to the typical species by using the designation "spineless *Triblastulac*(?)."

Triblastula tubulata O. Wetzel, new species

Plate 2, figure 4

Holotype: Collection of O. Wetzel, Eutin; slide no. A 2360.

Age and occurrence: Rare in Baltic Cretaceous flintstones.

Description: Overall appearance slender, the tripartition less abrupt than in *Triblastula nuda* O. Wetzel; like that form, it also lacks bristles. The two "pole-caps" narrowly embrace the equatorial circle of the central sphere and are drawn out with somewhat concave outlines in opposite directions; one (the "epitheca") ends in a short, humplike "apex," but the other remains cylindrical, like a truncated tube. A pylome appears to be present below the "apex"; in other respects the fossil is not sufficiently transparent to permit further observations.

Dimensions: 80 × 45μ.

Triblastula quasicribrata O. Wetzel, new species

Plate 2, figure 3

Holotype: Collection of O. Wetzel, Eutin; slide no. A 2375.

Age and occurrence: Rare in Baltic Cretaceous flintstones and chalk.

Description: Central body spheroidal and spineless. Both "caps" are cylindrical-cuboidal, narrower toward the ends, especially the one ("epitheca") having a more projecting field of pore-meshes with terminal edges protruding. "Pylomes" are common.

Dimensions: ca. 100 × 50μ.

Comment: *Amphidiadema denticulata* Cookson and Eisenack (1960) appears closely similar to this species of *Triblastula*, but it differs in the terminal portions, which are smaller and more open but not "quasicribrate" (i.e., perforated like a sieve). The authors themselves regarded their new species as closely related to another of their new forms, *Deflandrea tripartita* Cookson and Eisenack (1960) (see my remarks under *Bulbodinium* O. Wetzel, 1960, below).

Triblastula sp. indet.

Plate 2, figure 5

Figured specimen: Collection of O. Wetzel, Eutin; slide no. A 2421.

Age and occurrence: One specimen in a Baltic Cretaceous flintstone.

Description: Central body spheroidal, without spines but partly covered with a network of lines. The "pole-caps" have a flattened terminal region and differ somewhat in size and outline.

Remark: The figured specimen is a special case, as the "epitheca" has been shifted upward and lies obliquely; it prevents a dark disk from escaping, which is undoubtedly the round lid and has the appropriate form for the "pylomar" opening at the upper end of the central body.

CRETACEOUS BALTIC MICROFOSSILS

DINOFLAGELLATA
INCERTAE FAMILIAE
(NON DEFLANDREIDAE?)

Genus *Bulbodinium* O. Wetzel, 1960

Type species: Bulbodinium seitzi O. Wetzel, 1960.

Remark: My German paper on these microfossils was in press and publication in 1960 was anticipated as the present paper was submitted for publication. Because of their resemblance to some microfossils from the Australian Cretaceous recently described by Cookson and Eisenack (1960), it appears desirable to describe them here in English as well.

Description (based on the 1960 German diagnosis): In contrast to all other fossil and extant microorganisms (so far as I am aware) that have been described to date (i.e., through 1959) and referred to the Dinoflagellata, this form has the body clearly divided into three rather than two segments. However, when some of my specimens were isolated chemically from the flintstone matrix, the very flat "girdle" of the equatorial region became distinct, or at least some parts of it. This structure seems to replace the transverse furrow characteristic of the typical dinoflagellates (peridiniids), separating their epitheca and hypotheca from one another. Instead of a regular arrangement of plates, the wall of the typical *Bulbodinium* shell is more or less granular or areolar and has, at most, some wide fields with indistinct borders. The central portion of the body, which may be a highly inflated, block-shaped "capsule," extends outward, and the epitheca may also extend outward, but less so, below the "apical" point, which is often blunted. The hypotheca has a square outline and may be prolonged into a "horn" at one of the terminal edges.

Comments: The type species of *Bulbodinium* appears to be closely similar to *Deflandrea tripartita* Cookson and Eisenack (1960), but it differs in the distinct transverse delimitation of the central portion from both external segments, which are longer than the corresponding ones in the new Australian form and all previously described species of *Deflandrea* that I have seen. In addition, there are other species of *Bulbodinium* with forms that are even more slender than the type species and do not resemble the true *Deflandrea* species.

Bulbodinium seitzi O. Wetzel
Plate 2, figures 6 (upper) and 7-8

Holotype: Collection of O. Wetzel, Eutin; slide no. A 1269.

Age and occurrence: Nearly 20 specimens in one Baltic Cretaceous flintstone; one, possibly identical, in an English Cretaceous flint.

Description: See that of the genus above and my German paper (1960).

Dimensions: 128 × 65μ; 112 × 64μ.

Bulbodinium altipetax O. Wetzel
Plate 2, figures 6 (lower) and 9

Holotype: Collection of O. Wetzel, Eutin; slide no. A 1266.

Age and occurrence: A few specimens in the same Baltic Cretaceous flintstone as above.

Description (based on the German diagnosis of 1960): Shell more slender, more concave in outline, and more pointed terminally than in *Bulbodinium seitzi*.

Dimensions: 135 × 60μ.

Bulbodinium oistoides O. Wetzel
Plate 2, figure 10

Holotype: Collection of O. Wetzel, Eutin; slide no. A 1267.

Age and occurrence: Only two specimens, rather similar to each other, in the same Baltic Cretaceous flintstone as above.

Description (based on the German diagnosis of 1960): Overall appearance very slender. The equatorial region of the central body extends outward with two small protuberances situated obliquely opposite each other. One of the terminal segments has a more or less pointed "apex" resembling a beak. The other one ("hypotheca") is nearly tubiform and ends bluntly. Because of its opacity, the individual structures of the shell are almost imperceptible.

Dimensions: 120 × 50μ.

TAXONOMY OF TRIBLASTULA AND BULBODINIUM

The species of *Triblastula* and *Bulbodinium* described above may all belong to the same family or superfamily and be united across the taxonomic boundary between the Hystrichosphaeridea and Dinoflagellata, but they can not be assigned to the family Deflandreidae Eisenack (1954, p. 52), which was intended to include more compact and less elongate forms than the present objects. As for the few points of similarity between my *Bulbodinium* species and the extant form *Heterodinium* Kofoid, 1906, mentioned in my German paper of 1960, it is likewise impossible to place my tripartite microfossils taxonomically in the vicinity of that genus. In any case, this is not the first time that some fluctuation has persisted in the taxonomic assignment of new microfossils of intermediate form. For example, even today I am not entirely certain that *Peridinium illustrans* O. Wetzel (1932-33), which was originally assigned to a separate division of fossil Peridiniidae, i.e., to the Dinoflagellata, was correctly classified. As its general appearance is like certain sparsely spined hystrichosphaerids, I chose the specific name to indicate that it illustrates the close relationship between such hystrichosphaerids and the dinoflagellates. Unfortunately, the type specimen, the only well-preserved representative of this form, has been lost, but figure 11 of plate 2 here shows the resemblances mentioned (total dimensions 34 × 28μ).

RADIOLARIA AND HYSTRICHOSPHAERIDEA OF SIMILAR FORM

In general, the siliceous shells of diatoms, being very delicate, are easily dissolved, and they are totally lacking in the Baltic Cretaceous flintstones, except for the unusual case of "*Trinacria* sp.," a chain of "horned" diatom shells preserved in a non-siliceous substance in an erratic flintstone (slide no. A 1873, collection of O. Wetzel, Eutin). Radiolaria, however, have rarely been found in the flintstones, preserved only by pseudomorphic replacement of their skeletons, which are mainly in fragments. As a rule, specific identification of the specimens is impossible, and not all of the forms figured in earlier publications are true Radiolaria as understood today; some of them may preferably be assigned to the Hystrichosphaeridea (see below).

I recently found two delicate pyritized skeletons, the fragments of which lay almost on top of one another in the flint matrix. One of them, which is figured here in plate 3, figure 1, is $130 \times 40\mu$ in size, and may be another species of *Dictyomitra*, different from the one previously figured (O. Wetzel, 1932-33, pl. 3, fig. 1). The other specimen may be recorded here as follows:

Class RADIOLARIA
Order SPUMELLARIA
Suborder COLLODARIA
Family THALASSOTHAMNIDAE Haecker
Genus CYTOCLADUS Schröder

Cytocladus tricladius Haecker
Plate 3, figure 2

Cf. *Cytocladus tricladius* Haecker. — TREGOUBOFF, 1953, in GRASSÉ, *Traité de Zool.*, vol. 1 (Protozoaires), pt. 2, pp. 335-340, text-fig. 224.

Figured specimen (fragment): Collection of O. Wetzel, Eutin; slide no. A 2340.

Age and occurrence: The present fragment, found in a Baltic Cretaceous flintstone, is the first and only fossil specimen.

Description: A long thin shaft is based on a short trunk, then divides into two branches, each of which is trifurcated at the end. The surfaces of the terminal portions may have been somewhat rough (or this effect may merely be an irregularity due to preservation).

Dimensions: Fossil fragment (total) $180 \times 130\mu$; trunk $30 \times 20\mu$.

Comments: This microfossil closely resembles a single ray of the simple stellate skeleton of the extant radiolarian *Cytocladus tricladius* Haecker, which has a highly ramified central capsule. The discovery of this microfossil, which undoubtedly belongs to the family Thalassothamnidae, so far as I can judge, supports the classification of a form previously found in a flintstone (see pl. 3, fig. 3), the pyritized fragment described by O. Wetzel (1933, p. 5, pl. 3, fig. 8). I believed that it was not a bristle or spine of a plant but a fragment of the skeleton of a radiolarian related to *Orosclena regalis* Borgert or

belonging to *Thalassothamnus*; the size of the former is 4-5 mm. and of the latter ca. 14 mm. for the diameter of the total living sphere.

RADIOLARIA OR HYSTRICHOSPHAERIDEA?

A new microfossil, hitherto published only as figure 19 on plate 1 in O. Wetzel (1957), is worthy of fuller notice here. In addition, I have recently become aware that another microfossil found in the Tertiary of South America, which is still problematical and may be a radiolarian, resembles my new fossil to some degree. The latter is therefore formally described as follows:

UNCERTAIN RADIOLARIAN
Order NASSELLARIA?

Suborder PLECTOIDEA (Haeckel) Popovsky?
FAMILIA INCERTA

Genus *Rhizoplectopsis* O. Wetzel, new genus

Description: Skeleton rounded polygonal, with a radiolarian-like lattice structure. Meshes with thick borders and of different sizes. More or less elongate spines originate at some of the outer corners. The arrangement of the protuberances seems to be similar to that in typical species of the suborder Plectoidea.

Type species: *Rhizoplectopsis baltica* O. Wetzel, 1961.

Rhizoplectopsis baltica O. Wetzel, new species
Plate 3, figure 4

Holotype: Collection of O. Wetzel, Eutin; slide no. Jt. 105a.

Age and occurrence: One specimen in a Cretaceous flintstone from Moens Klint, Denmark.

Description: See that of the genus, above.

Dimensions: Diameter 140-180 μ .

Remarks: The central portion of this fossil is dark due to pyritization, and it is impossible to observe the internal structure of the skeleton; in addition, the lattice seems to be partly broken away on the exterior and to have lost one or more spines (note the isolated one near the body).

Comments: The other microfossil mentioned above as comparable to the present form is *Rhizoplecta trithyris* Frenguelli (1940), which was cited by Deflandre (1953, p. 423, text-fig. 320 A); it appears to have a "spicule triaxone" in its juvenile condition (see Deflandre's text-fig. 320 B).

SYSTEMATIC POSITION OF CANNOSPHAEROPSIS

The Hystrichosphaeridea not only show relationship to the Dinoflagellata, but also frequently resemble typical Radiolaria to some extent. Indeed, at the start of his systematic studies of the hystrichospherids, the author of the genus *Cannosphaeropsis* O. Wetzel (1933) classified it in the taxonomic unit Tripylea R. Hertwig (= Phaeodaria Haeckel), specifically in the family

Cannosphaeridae Haeckel, because the species *C. utinensis* O. Wetzel (see pl. 2, fig. 12) very closely resembles *Cannosphaera geometrica* Borgert, of the extant marine plankton. But even then some limitations were apparent in this classification (see O. Wetzel, 1933, p. 9), among other things, with respect to its organic substance, as I then pointed out. Later, Deflandre stated that my microfossil should be united with his genus *Hystrichosphaeridium* Deflandre, 1937. Other species showing transitional forms between *Cannosphaeropsis* and *Hystrichosphaeridium* were recorded by Deflandre (1947a) as new species of *Cannosphaeropsis* O. Wetzel, 1933, the latter being included in the *Hystrichosphaeridea*.

In spite of the changed opinions of Deflandre and the present author, a few modern textbooks still report that *Cannosphaeropsis* indicates the geologic longevity of the radiolarian order Phaeodaria (= Tripylea), as its only fossil representative. Aside from this failure to correct an early provisional opinion, it is still possible, nevertheless, that some *Hystrichosphaeridea* were in a general manner connected with the Radiolaria as well as with the Dinoflagellata. In this regard, *Hystrichosphaera furcata* (Ehrenberg) of O. Wetzel (1932-33) (figured here in pl. 2, fig. 15) may be a conspicuous example, with its one additionally prolonged "apical" protuberance. Such an abnormal structural development was first described by O. Wetzel (1932-33, pl. 5, fig. 4), and similar "aberrations" occur rather frequently in the skeletons of radiolarians. In addition, there are modern optical and chemical methods which permit views of the animal's molecular structure as well as some probable primary siliceous substance in the fossil skeletons of *Cannosphaeropsis* species and other radiolaria-like *Hystrichosphaeridea*.

OCCURRENCE OF OTHER SPECIES OF CANNOSPHEROPSIS

Cannosphaeropsis is apparently represented in the Baltic Cretaceous first by the rather common species *C. utinensis* O. Wetzel, which has been isolated not only from the flintstone but also from the Senonian chalk (see pl. 2, fig. 12). Two other specimens found later in flintstones do not belong to the type species. The first one is *Cannosphaeropsis (Hystrichosphaeridium) aemula* Deflandre, 1938 (1947) (see pl. 2, fig. 13); the flintstone enclosing it was collected near the southern limit of the Baltic glacial area and may possibly have come from pre-Senonian or pre-Cretaceous sediments. The other specimen has a strange appearance due to the protuberances (8-12?), terminally bearing an indistinct group of round meshes or irregular points (see pl. 2, fig. 14). It may be additionally deformed or merely a variety of a previously described species, e.g., *Cannosphaeropsis reticulensis* A. Pastsels, 1948, or *Cannosphaeropsis aemula* (see O. Wetzel, 1953b, pl. 83, fig. 20).

A NEW INDETERMINATE MICROFOSSIL

The present form does not appear to be related to any other known species, but is best included provisionally in the morphologic group *Hystrichosphaeridea*.

MICROFOSSIL INCERTAE SEDIS (HYSTRICHOSPHERIDEA?)

Genus *Coronopsis* O. Wetzel, new genus

Description: The main portion of the microfossil is a thick "wreath" (see remarks below). Upon it, several (about six) long, spoon- or finger-shaped prominences are set in a somewhat irregular arrangement; they seem to be attached by some very small rootlike ramifications. Terminally, the thin "handle" becomes broader and flatter and forms a bifurcated oval top with a few round openings in the "bowl."

Type species: *Coronopsis digitata* O. Wetzel, 1961.

Coronopsis digitata O. Wetzel, new species Plate 3, figure 11

Holotype: Collection of O. Wetzel, Eutin; slide no. A 2350 (pl. 3, fig. 11).

Age and occurrence: One specimen, from a Baltic Cretaceous flintstone.

Description: See that of the genus, above.

Dimensions: Diameter (total) 50 μ ; corner of the "wreath" 15 μ thick; top of the "finger" 5 μ broad.

Remarks: The fossil may be somewhat compressed and cracked; as its position within the flint chip shows only the corner of the "wreath," it is possible that there is a membrane connecting the corner with the center of the circular portion, to form a disc.

Comments: The overall appearance of this microfossil somewhat resembles (although only superficially) the shape of some Suctorina, i.e., Ciliata, such as *Dendrocometes paradoxus* Stein, which have lost their cilia and live as parasites. However, it is possible that some sort of parasite is actually present here.

REMAINS OF ECHINODERMS AND SIMILAR MICROFOSSILS

In the course of my studies of flintstone chips, the number of observed sclerites of Holothuroidea has gradually increased. I recently found a large wheel-shaped specimen (see pl. 3, fig. 5), 240 μ in diameter. It probably belongs to the form-genus ("manipulus") *Myriotrochites* Deflandre-Rigaud, 1948, being similar to *Myriotrochites elegans* (Schlumberger) Deflandre-Rigaud, which was first taken for a disciform diatom by F. Hustedt (see pl. 3, fig. 6, and O. Wetzel, 1950, pp. 174-176, 190; 1951, pp. 102-103). In 1953 (1953a, p. 42, pl. 2, figs. 20-21), I published descriptions to two other radiolarian-like specimens from the flintstone, which were identified as *Chiridotites* cf. *ingens* and *Chiridotites atavus* by Deflandre-Rigaud. In addition, it is barely possible that another of my problematic microfossils of 1953 (1953a, pp. 39-40, pl. 1, fig. 14), reported there as "*Gymnodinium* cf. *Actiniscus elegans* Ehrenberg" (pl. 3, fig. 7), is also a sclerite, similar to *Mortensenites sievertsi* Deflandre-Rigaud (1953, p. 954, text-fig. 17).

With regard to pedicellariae (peculiar organs from the surface of fossil echinoids), M. F. Glaessner cited some publications by Geis and Mortensen and figured one set of a type which was called "ophiocephalous" (Glaessner, 1947, p. 24, pl. 4, fig. a-d). Still other forms were described by W. Wetzel (1953, p. 175, text-figs. 4-6), who disintegrated flintstone chips (mostly from the Danian) in dilute hydrofluoric acid and observed a few very small arrow-shaped specimens in a pseudomorphous condition among the residues. I too have recently found occasional pedicellariae of almost the same form and size, which may have belonged to an echinoid related to the extant genus *Saleniocidarid*, possibly to a dwarf form of it (see pl. 3, figs. 8-9).

SCOLECODONT ASSEMBLAGES

Since the publication of my paper of 1932-33, showing the variations in the forms of scolecodonts, I have consistently found single specimens or pairs in the Baltic Cretaceous flintstones. In two cases, however, I have observed an assemblage (more than two) of specimens very similar to each other (see pl. 3, fig. 10). These forms may represent a variety of "Kammzahn a" or of a form such as that figured in 1932-33 (pl. 6, fig. 23). The dimensions of the total assemblage are about $270 \times 65\mu$; one is $110 \times 70\mu$ (slide no. A 2165). In purely morphological respects, they resemble an assemblage of conodonts figured in Pokorný's recent textbook of micropaleontology (1958, vol. 2, p. 62, text-fig. 610). The other assemblage found in the flintstones contains some (four?) handlike "mandibles," which are brown and partly marked with small spots. The dimensions of a long specimen are $175 \times 65\mu$ (slide no. A 2141).

WORMLIKE AND TUBIFORM FRAGMENTS

A few microfossils may be united under this heading which at first appeared to be insignificant and of very uncertain origin. However, in my opinion they may be worthy of some notice in connection with later observations of additional, more complete specimens. One of the present fragments can be recorded at the present time and classified with some assurance in a taxonomic division that is of particular biological interest:

Division STOMOCHORDA Davydoff, 1948?
Class PTEROBRANCHIA Ray Lankester, 1878?
Order RHABDOPLEURIDA?
Genus RHABDOPLEURA Allmann?

Rhabdopleura? sp. cf. *R. normanni* Allmann
Plate 3, figure 12

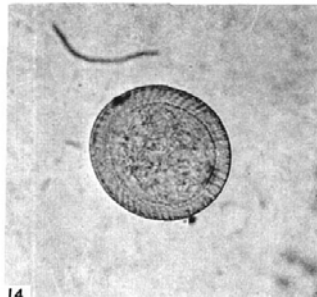
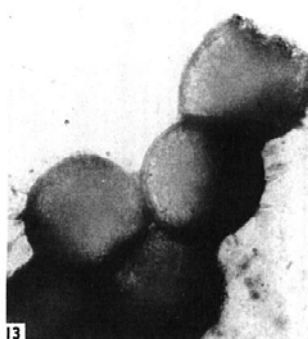
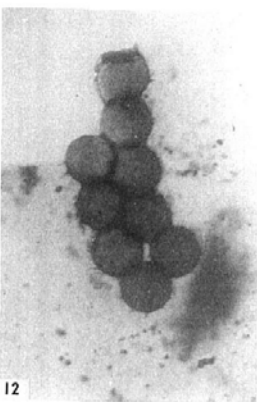
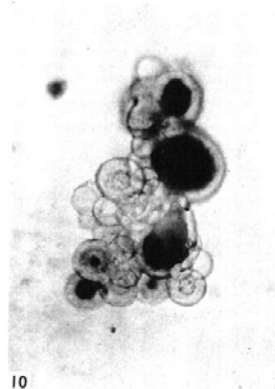
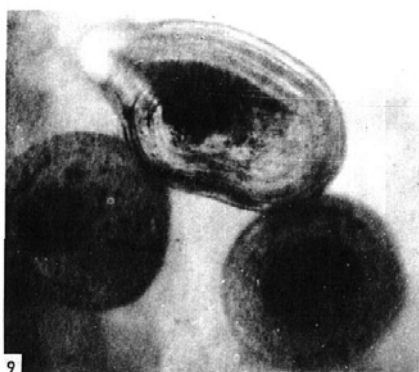
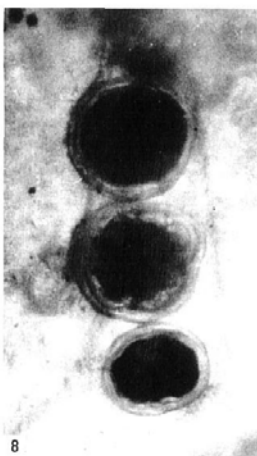
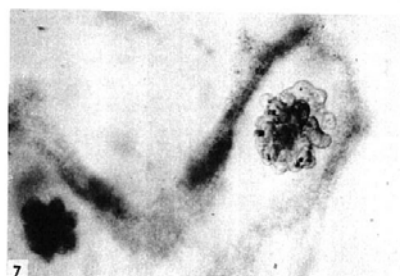
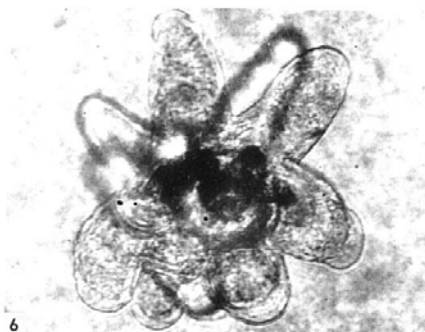
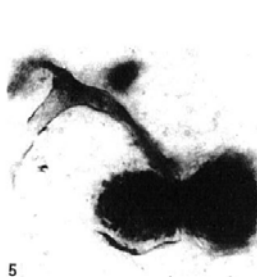
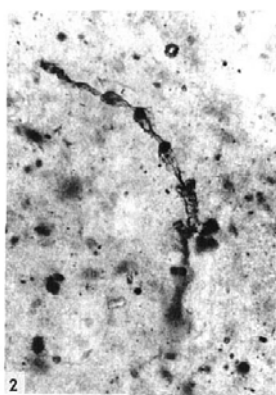
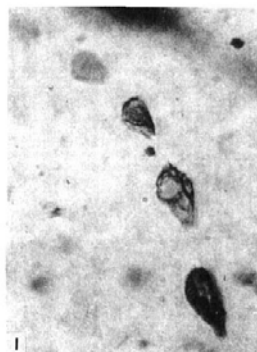
Figured specimen: Collection of O. Wetzel, Eutin; slide no. A 2463.

Age and occurrence: One specimen, from a Baltic Cretaceous flintstone.

Description: Body long, cylindrical, and coiled in a wormlike manner. At one end it tapers to a somewhat conical form; at the other end it is broken away. In the central region it is broken nearly into two pieces, and there is a smaller cleft near the conical end. In these places, an axial cord ("stolon"?) is still preserved and clearly visible, which evidently runs longitudinally, but perhaps not quite centrally, through the entire fragment. The body wall is divided into numerous small transverse segments, apparently covered with scaly plates or meshes. Color brownish. Substance probably chitinous.

PLATE 1

- 1-2 Two different spp. indet. ex aff. *Reophacidae*?
Erratic flints; slide nos. A 2178, A 2454; \times ca. 250 and ca. 100.
- 3-4 Two different spp. indet. ex aff. *Chitinodendron*
Eisenack, 1937
Senonian flint from Stevns Klint, Denmark, or erratic flint; slide nos. A 350, A 124; \times ca. 50 and ca. 100.
- 5 Foraminifera gen. et sp. indet. ex aff. *Rhizammininae*?
Erratic flint; slide no. A 2327; \times ca. 175.
- 6-7 *Pseudastrophorhizula eisenacki* O. Wetzel
Erratic flints; slide nos. A 1022, A 2160. 6, free in flintstone, \times ca. 300; 7, within the chambers of a bryozoan colony, \times ca. 15.
- 8-10 "Brown bodies" of fossil Bryozoa ("ovoids" of O. Wetzel, 1950)
Erratic flints; slide nos. A 1583, A 1580, A 2159. 8, a set of three bodies, with a radial "blastula"-like structure in the middle one, \times ca. 110; 9, another set, with concentric layers and excrescences in the largest one, \times ca. 175; 10, probably a close association of egglike "brown bodies," free in the flint chip, \times ca. 125.
- 11 *Palambages morulosa* O. Wetzel, n. sp. (= "Morulosae" of O. Wetzel, 1933)
Cretaceous flintstone from Stevns Klint, Denmark; slide no. A 350; \times ca. 250.
- 12-13 *Palaeobion catenatum* O. Wetzel, n. sp.
Erratic flint; slide no. Jt. 75a. Two different views, \times ca. 10 and ca. 170.
- 14-15 *Pleurozonaria globulus* O. Wetzel
Erratic flintstone (Cretaceous or Jurassic?) from Krywonogi, Poland; slide no. A 405. Two different views, both \times ca. 400.



Dimensions (fragment): $180 \times 15\mu$.

Comments: Although this microfossil has the general form of an annelid worm, it also resembles the structure of other organisms in fragments to some extent. Having attempted to exhaust the possibilities for satisfactorily identifying my "problematicum" by comparison with the forms most recently described in the literature, I came to the conclusion that the classification given above is the best provisional one (see Waterlot, 1953, "Pterobranchs," in Piveteau, pp. 963-966, text-figs. 1-6). In the latter publication there are descriptions not only of the external and internal organization of the living organism (colonies), but also of some rare fossil fragments recently found by R. Kozłowski in the Upper Cretaceous (Maestrichtian) of Poland. In my fossil specimen the buds for additional growth are lacking, as well as the "blastoïde inachevé," but the fragment, with its conical termination, may have been a young portion belonging to a minute species.

MICROFOSSILS INCERTAE SEDIS

"Form B" (fragment) Plate 3, figure 13

Figured specimen: Collection of O. Wetzel, Eutin; slide no. A 2416.

Age and occurrence: One specimen, from a Baltic Cretaceous flintstone.

Description: Body elongate-cylindrical, coiled in a worm-like manner; ends indistinct (broken away?). At least part of the specimen seems to be divided more or less regularly into segments, which differ in size and transparency. On the whole, the fragment has a granular structure and vague color, but it is probably of organic origin.

Dimensions: About $400 \times 40\mu$.

Comments: The structure (or the preservation) is different from that of the preceding form, and it is difficult to decide whether or not the object was produced by a true worm (annelid?).

Remark: Under the central portion of the elongate fossil there is another microfossil, which is probably a hystriospherid in a delicate, transparent condition. Its radial protuberances are curved and end in furcate tips; a round dark plate lies in the interior (the lid of a "pylome"?).

"Form C" (fragment) Plate 3, figure 14

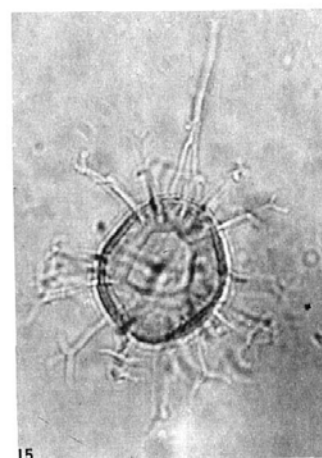
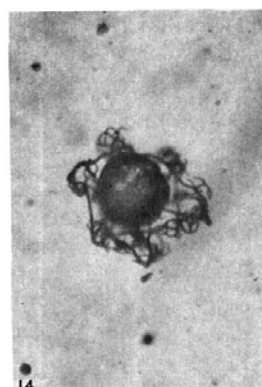
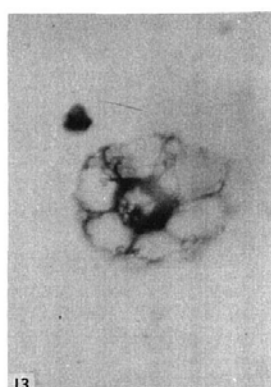
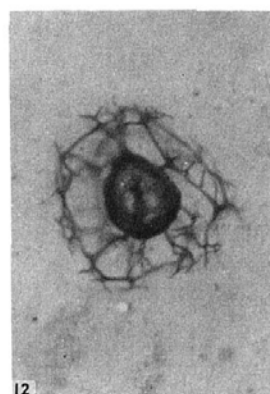
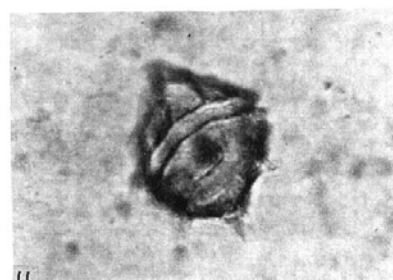
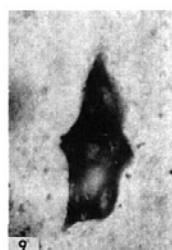
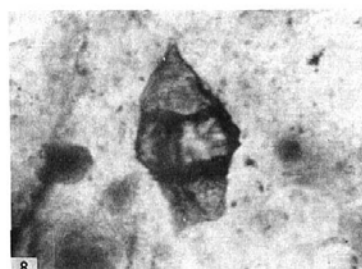
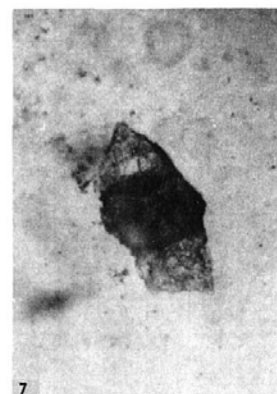
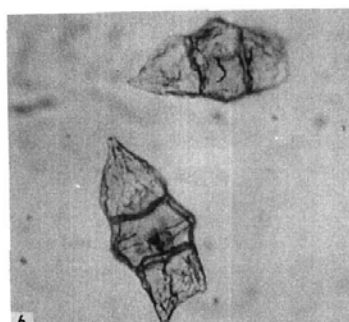
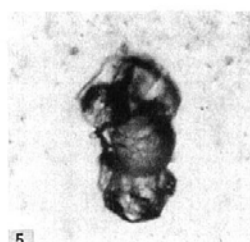
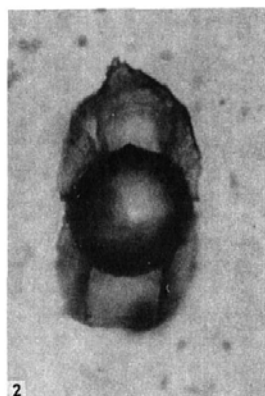
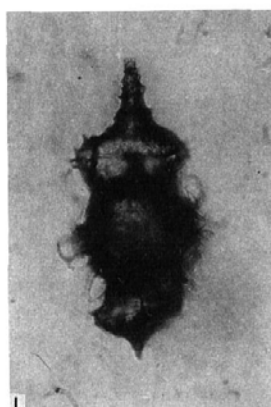
Figured specimen: Collection of O. Wetzel, Eutin; slide no. A 2406.

Description: Fragment tubular, enlarged at intervals and truncated at the ends. Wall finely granular and bearing numerous annular transverse lines. Color brownish.

Dimensions: $240 \times 65\mu$.

PLATE 2

- 1 *Triblastula utinensis* O. Wetzel
Erratic flint; slide no. 2109b; \times ca. 220.
- 2 *Triblastula nuda* O. Wetzel, n. sp.
Erratic flint; slide no. A 2360; \times ca. 325.
- 3 *Triblastula quasricibrata* O. Wetzel, n. sp.
Erratic flint; slide no. A 2375; \times ca. 200.
- 4 *Triblastula tubulata* O. Wetzel, n. sp.
Erratic flint; slide no. A 2360; \times ca. 250.
- 5 *Triblastula* sp. indet.
Erratic flint; slide no. A 2421; \times ca. 205.
- 6 Upper: *Bulbodinium* cf. *seitzi* O. Wetzel; lower: *Bulbodinium* cf. *altipetax* O. Wetzel
Residues from chips of an erratic flint disintegrated with hydrofluoric acid; specimens figured together but lost in further preparation. \times ca. 175.
- 7-8 *Bulbodinium seitzi* O. Wetzel
Two typical specimens, tripartite with an inflated central portion; form seen as enclosed in an erratic flintstone (compare fig. 6). Slide nos. A 1269, A 1264; \times ca. 185 and ca. 205.
- 9 *Bulbodinium altipetax* O. Wetzel
Erratic flint; slide no. A 1266; \times ca. 155.
- 10 *Bulbodinium oistoides* O. Wetzel
Erratic flint; slide no. A 1267; \times ca. 170.
- 11 *Peridinium illustrans* O. Wetzel
A very small microfossil resembling both the peridinians and the hystriospheres. Erratic flint; slide no. A 700 (slide lost); \times ca. 150.
- 12 *Cannosphaeropsis utinensis* O. Wetzel
Erratic flint; slide no. A 612; \times ca. 195.
- 13 *Cannosphaeropsis* (*Hystriosphera*) *aemula* Deflandre
Erratic flint; slide no. Mü. 8; \times ca. 160.
- 14 *Cannosphaeropsis* sp.
Erratic flint; slide no. A 1738; \times ca. 175.
- 15 *Hystriosphera furcata* (Ehrenberg) of O. Wetzel
Aberrant, with one additional prolonged "apical" protuberance. Senonian chalk residue from Stevns Klint, Denmark; slide no. A 1104; \times ca. 440.



Comments: The present fragment is very similar to the tubiform portions of problematica that I isolated at an earlier date from some Liassic samples. At the 1957 annual meeting of the German Paleontological Society in Freiburg i. Br., I reported my observations of these Liassic residues, which were assumed to be fossil remains. I proposed to establish provisionally an independent morphologic group of organisms to include these problematic microfossils, to be called Anellotubulata ("ring-tubers"). For, in spite of having some resemblance in shape and size to certain extant organisms, especially coelenterates (the tubes of polyps), they are nevertheless different and cannot be included in any systematic unit known to date. If further specimens are found, exact identification will, perhaps, be possible, and the nature of my present fragment may become determinable. In any case, I have appended here (pl. 3, fig. 15) an illustration of one of these Liassic supposed anellotubulates. I have not previously published any illustrations or detailed descriptions of these "ring-tubers," merely some notes in a paper read by title (O. Wetzel, 1959).

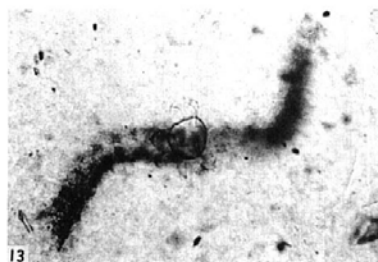
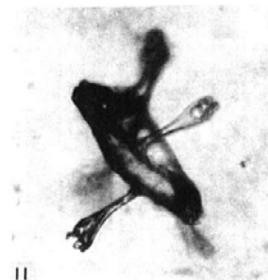
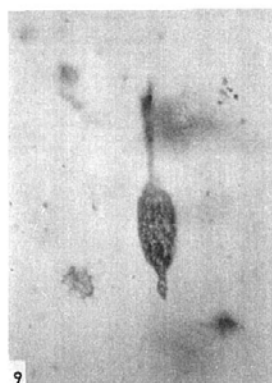
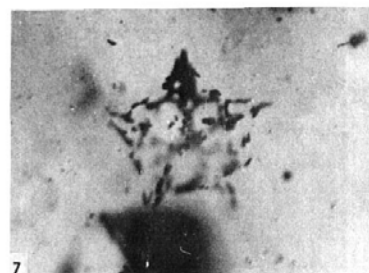
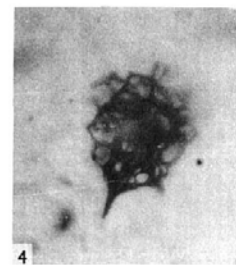
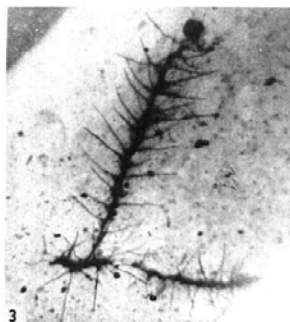
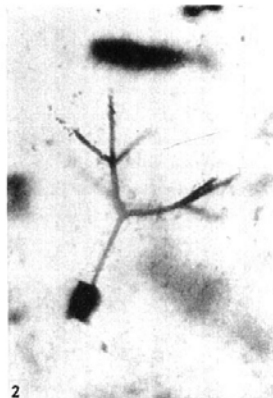
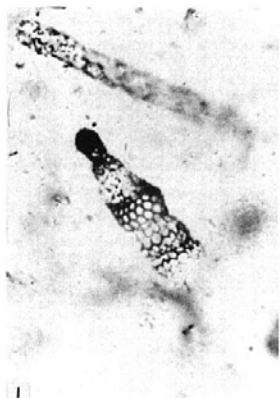
REMARKS ON THE "FLAGELLA" OF FOSSIL OPHIOBOLUS

The occurrence of "flagella" on fossil *Ophiobolus* specimens in the Baltic Cretaceous flintstones is most unusual, as the flagella of extant organisms are ordinarily very transitory in preparations made from living specimens. Perhaps it can be assumed that these so-called

"flagella" actually had some special function as cellular organelles on the body of the *Ophiobolus* during its life in the Cretaceous ocean. The same is true of species of *Dimastigobolus* Deflandre, another genus of the Ophiobolidae. The "flagellum" could have been a kind of thread which served to attach the living organism to some other object, e.g., another organism to be eaten. There are many extant flagellates of the genus *Chrysochromulina* which, in addition to their true flagellum, also have a so-called "haptonema," which is often attached to some support during a brief resting period (see the extensive studies on such marine flagellates by Mary Parke at the Plymouth Laboratory, 1956-1958). Miss Parke has had the kindness to grow some samples for me from cultures of individual species of algae. As for the microfossils in the flintstones, I am aware that the special mechanisms at the terminal end of the "haptonema" of living flagellates is apparently lacking in the Ophiobolidae and that it would be too difficult to study the microscopic structure in transverse thin sections of a fossil thread in a flintstone chip, which is very hard and brittle. Nevertheless, the "flagella" or cellular organs of the Ophiobolidae may have been composed of a special substance, appropriate to its function and differing from what is usual in most flagellates. Thus, the unusual composition of that organic material may have been more resistant to chemical destruction in the course of long geologic time, especially if the body was rapidly buried in the siliceous material that was to become the flintstone matrix.

PLATE 3

- 1 *Dictyomitra* sp. indet.
Erratic flint; slide no. A 2340; \times ca. 175.
- 2 *Cytocladus tricladius* Haecker
A single radial spicule. Erratic flint; slide no. A 2340; \times ca. 175.
- 3 *Oroslena* cf. *regalis* Borgert var. *oroplegmoides* Haecker or *Thalassothamnus* cf. *pinetum* Popofsky
A branched spicule. Erratic flint; slide no. A 33; \times ca. 12/5.
- 4 *Rhizoplectopsis baltica* O. Wetzel, n. sp.
Erratic flint; slide no. Jt. 105a; \times ca. 105.
- 5 *Myriotrochites* sp. indet.
A holothurian sclerite. Erratic flint; slide no. A 2450; \times ca. 90.
- 6 *Myriotrochites elegans* (Schlumberger) Deflandre-Rigaud
A sclerite. Erratic flint; slide no. Ds. 2; \times ca. 120.
- 7 *Gymnodinium* cf. *Actiniscus elegans* Ehrenberg or the sclerite *Mortensenites sievertsi* Deflandre-Rigaud
Erratic flint; slide no. A 1922; \times ca. 155.
- 8-9 Pedicellariae (pseudomorphs) of an echinoid (dwarf form?) ex aff. *Saleniocidaris*
Erratic flint; slide nos. Mü. 3 and Mü. 5; both \times ca. 120.
- 10 Assemblage of scolecodonts, perhaps of the same species
Erratic flint; slide no. A 2165; \times ca. 155.
- 11 *Coronopsis digitata* O. Wetzel, n. sp.
A problematic microfossil. Erratic flint; slide no. A 2350; \times ca. 375.
- 12 *Rhabdopleura?* cf. *normanni* Allmann
A wormlike tubiform fragment, probably from a colony of this pterobranch. Erratic flint; slide no. A 2463; \times ca. 120.
- 13 Wormlike tubiform fragment "Form B," incertae sedis
Another microfossil (hystriochospherid?) lies near it. Erratic flint; slide no. A 2416; \times ca. 120.
- 14 Wormlike tubiform fragment "Form C," incertae sedis
Erratic flint; slide no. A 2406; \times ca. 100. Compare with fig. 15.
- 15 A simple tubiform representative of the problematic forms designated "Anellotubulata" ("ring-tubers") by O. Wetzel (1959)
Residue from a Liassic sample; slide no. Dea 10; \times ca. 90.



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