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The Lower Cretaceous of Caravaca (Spain)

Berriasian Calcareous Nannoplankton of the Miravetes Section (Subbetic Zone, Prov. of Murcia) [1])

By WALTER GRÜN[2]) and FRANZ ALLEMANN[3])

SUMMARY

34 species of calcareous nannofossils from a Berriasian section west of Caravaca (Prov. of Murcia, S-Spain) are described and figured by stereoscan micrographs as well as schematic drawings. Short annotations are made concerning the stratigraphic distribution and preservation of the coccoliths. Six new species (*Ellipsagelosphaera keftalrempti*, *Diazomatolithus subbeticus*, *Stephanolithion caravacaensis*, *Miravetesina favula*, *Markalius ellipticus*, *Hemipodorhabdus niger*), two new genera (*Allemannites* and *Miravetesina*), a new subfamily (Helenoideae) and a new family (Retecapsaceae) are introduced.

The stratigraphic relationships of the studied section are briefly discussed in an introductory note.

ZUSAMMENFASSUNG

Aus einem Berriasien-Profil westlich von Caravaca (Prov. Murcia, S-Spanien) werden 34 Nannofossilarten beschrieben und durch Stereoscan Mikrographien sowie schematische Zeichnungen abgebildet. Kurze Anmerkungen über die stratigraphische Verbreitung und Erhaltung der Coccolithen werden gemacht. Sechs neue Arten (*Ellipsagelosphaera keftalrempti*, *Diazomatolithus subbeticus*, *Stephanolithion caravacaensis*, *Miravetesina favula*, *Markalius ellipticus*, *Hemipodorhabdus niger*), zwei neue Gattungen (*Allemannites* und *Miravetesina*), eine neue Subfamilie (Helenoideae) und eine neue Familie (Retecapsaceae) werden eingeführt.

Die stratigraphischen Beziehungen des untersuchten Profils werden in einer kurzen Einführung behandelt.

RÉSUMÉ

34 espèces de nannofossiles calcaires sont descrites d'une coupe à l'ouest de Caravaca (Prov. de Murcia, S-Espagne). Les espèces sont présentées par des micrographes du microscope à balayage et par des dessins schématiques. Des remarques sur les répartitions stratigraphiques sont donnés. Six nouvelles espèces (*Ellipsagelosphaera keftalrempti*, *Diazomatolithus subbeticus*, *Stephanolithion caravacaensis*, *Miravetesina favula*, *Markalius ellipticus*, *Hemipodorhabdus niger*), deux nouveaux genres (*Allemannites* et *Miravetesina*), une nouvelle sub-famille (Helenoideae) et une nouvelle famille (Retecapsaceae) sont introduits.

Les relations stratigraphiques sont discutées dans une courte note d'introduction.

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CONTENTS

GENERAL INTRODUCTION AND STRATIGRAPHY

by F. Allemann

The present study is part of a Swiss National Funds research project (F.A.) on problems of the Lower Cretaceous stratigraphy in the western Mediterranean area. In a first series of articles ,the Berriasian stratigraphy is dealt with. In one of the papers by F. ALLEMANN, J. WIEDMANN & W. GRÜN (in press), the stratigraphic ranges of calpionellids (F.A.), ammonites (J.W.) and calcareous nannoplankton (W.G.) are discussed.

The present article comprises the systematic paleontology of the calcareous nannoplankton (W.G.) from one of the Berriasian sections (Miravetes section). A short introduction to the general stratigraphic setting and to the calpionellid and ammonite zonation of the Miravetes section is given. The estimated bathymetry of the Miravetes sediments and correlation of faunal zones with Berriasian sections in SE-France are shown on Fig. 1 (F.A.). Additional geological data on the Caravaca region are given in VAN VEEN (1969).

The Miravetes section is composed of three parts (Fig. 1). The lower part (*A*) covers the Upper Tithonian – Lower Berriasian and was sampled in the Barranco de Tollo. The middle part (*B*) comprises the Middle – Upper Berriasian. It is well exposed in an unnamed gully some 300 m west of *A*. The upper part of the section (*C*), covering the Upper Berriasian – Lower Valanginian interval, crops out in a hilly region some 150 m west of the top of *B*.

The sections *B* and *C* are easily correlatable by a 17 m thick marl bed. Because of the lack of a marker bed, the correlation between *A* and *B* is based on dip measurements. Slight faulting near the samples All. 71139–71143, however, makes this correlation somewhat unreliable. When correlated faunistically and by lithological indications, there would be no overlap of *A* and *B*. The total thickness of the Berriasian section at Miravetes would then amount to about 260 m, instead of 220 m as drawn on Fig. 1.

Among the Berriasian sections in pelagic basinal carbonate facies of the Mediterranean area, the Miravetes section belongs to the thickest ones (for example the sections in Tunisia, Sicily, N-Italy, SE-France, Swiss Prealps are less than 100 m thick and only a few are up to 200 m).

The Miravetes Berriasian sediments consist of a regular alternation of 20–60 cm thick micritic limestones and marls (calcareous shales). The marls are of equal bedding in the lower part. They become thicker (mostly over 100 cm) in the upper half of the section. In the upper third part, a 17 m thick marl bed, mentioned above, serves as a marker in the otherwise hardly subdividable monotony. Within the Lower Valanginian, the thickness of the marls increases rapidly and the limestones become more marly.

On the whole the section represents a continuous sequence of low energy sediments. Both limestones and marls are chiefly composed of more or less recrystallized nannofossils and their fragments, mostly *Nannoconus colomi*.

The Berriasian sediments of the Miravetes section have been deposited in a quiet basinal pelagic environment (Fig. 1). With the exception of a single limestone bed showing slump phenomena, there is no other evidence for disturbance of the bedding. Throughout the section, no sharp lithological break occurs and no sand and silt-

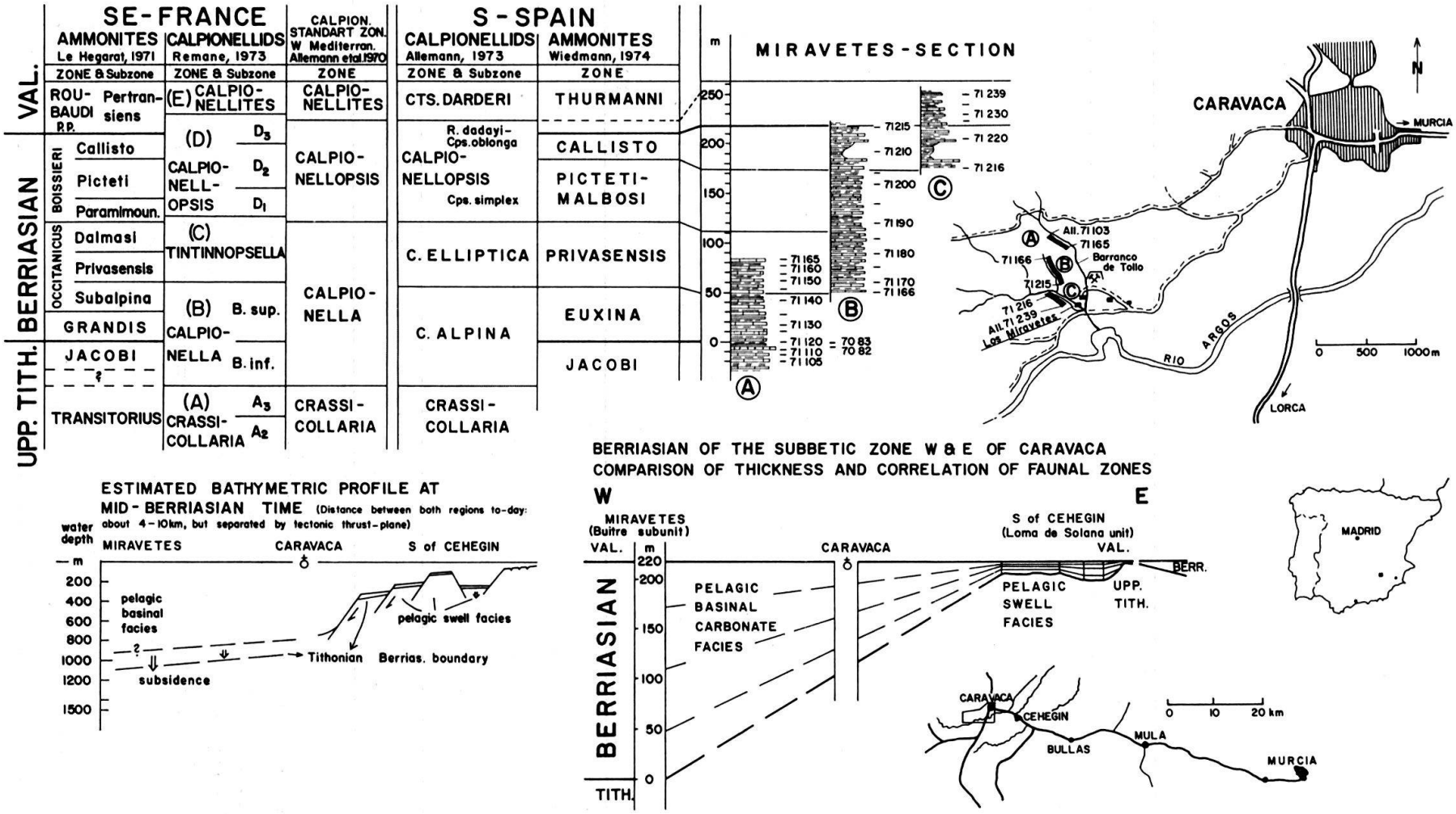

Fig. 1. Faunal and stratigraphic correlation, and bathymetric interpretation of the Miravetes section.

sized detrital material is found. The sediments are further characterized by the absence of nodular bedding and absence of chert.

The Miravetes section thus contrasts with the 0.5–20 m thick Berriasian sections in the area S of Cehegin (Fig. 1). These show many nodular beds, small stratigraphic gaps and disclose a reduced sedimentation rate. In cases, chert layers and nodules are present. In most instances, macrofossils are abundant (ammonites, belemnites, echinids, brachipods, lamellibranchs). The bathymetric interpretation of this swell facies as well as of the basinal facies at Miravetes is drawn schematically on Fig. 1. It will be discussed in a forthcoming paper.

Fauna and zonation of the Miravetes section: Ammonites are found abundantly throughout. A great number of specimens from stratigraphically unimportant species is found. Index ammonites are rare and frequently deformed. According to the results of J. Wiedmann (Tübingen), the zonal boundaries are, therefore, not very reliable. The ammonite zonation also differs from the one established by LE HÉGARAT (1973) in SE-France. The Berriasian of the two regions cannot be correlated directly with the help of ammonites only.

Determinable calpionellids, although rather rarely, occur in each thin-sectioned sample of the Miravetes section. This low frequency of calpionellids per thin-section contrasts with the extreme abundance and excellent preservation of calpionellids in the swell facies S of Cehegin. However, even in the Miravetes section, calpionellids are found consistently enough to place any sample in its proper zone. Considering the great thickness and monotonous facies of the Miravetes sequence, its calpionellid stratigraphy is of utmost importance for checking the zonation gained from the reduced sections of the swell facies. It is of equal importance for interregional zonal correlation. At present, the calpionellid zonation is apparently more reliable than the one based on ammonites or any orther fossil group for interregional correlation of Berriasian basinal sediments. This is especially true for the correlation with the well known sections in SE-France (Fig. 1).

On the basis of 220 m total thickness of the Berriasian section at Miravetes and a time span of approximately 6 m.y. for the Berriasian stage, an average sedimentation rate of 36 m/m.y. results. Considering a possible total thickness of 260 m, the rate would amount to 43 m/m.y.

SYSTEMATIC NANNOFOSSIL PALEONTOLOGY

by W. Grün

Introduction

One of the Berriasian sections SW of Caravaca has yielded a relatively rich Nannoflora. From the 220 meters of the Miravetes section (Fig. 2), 154 samples were collected. Nannofossils from these samples have been studied by light and electron microscopy. In addition to *Nannoconus colomi*, which is found throughout the section, 33 coccolithophorid species are recognised. 13 of these occur in strata older than those represented in this section. It is uncertain whether *Micrantholithus crenulatus* occurs as early as the Jurassic. THIERSTEIN in 1972, reported the first occurrence of *Micrantholithus hoschulzi* (= *M. crenulatus*) as upper Tithonian; in 1973 he gives it an upper

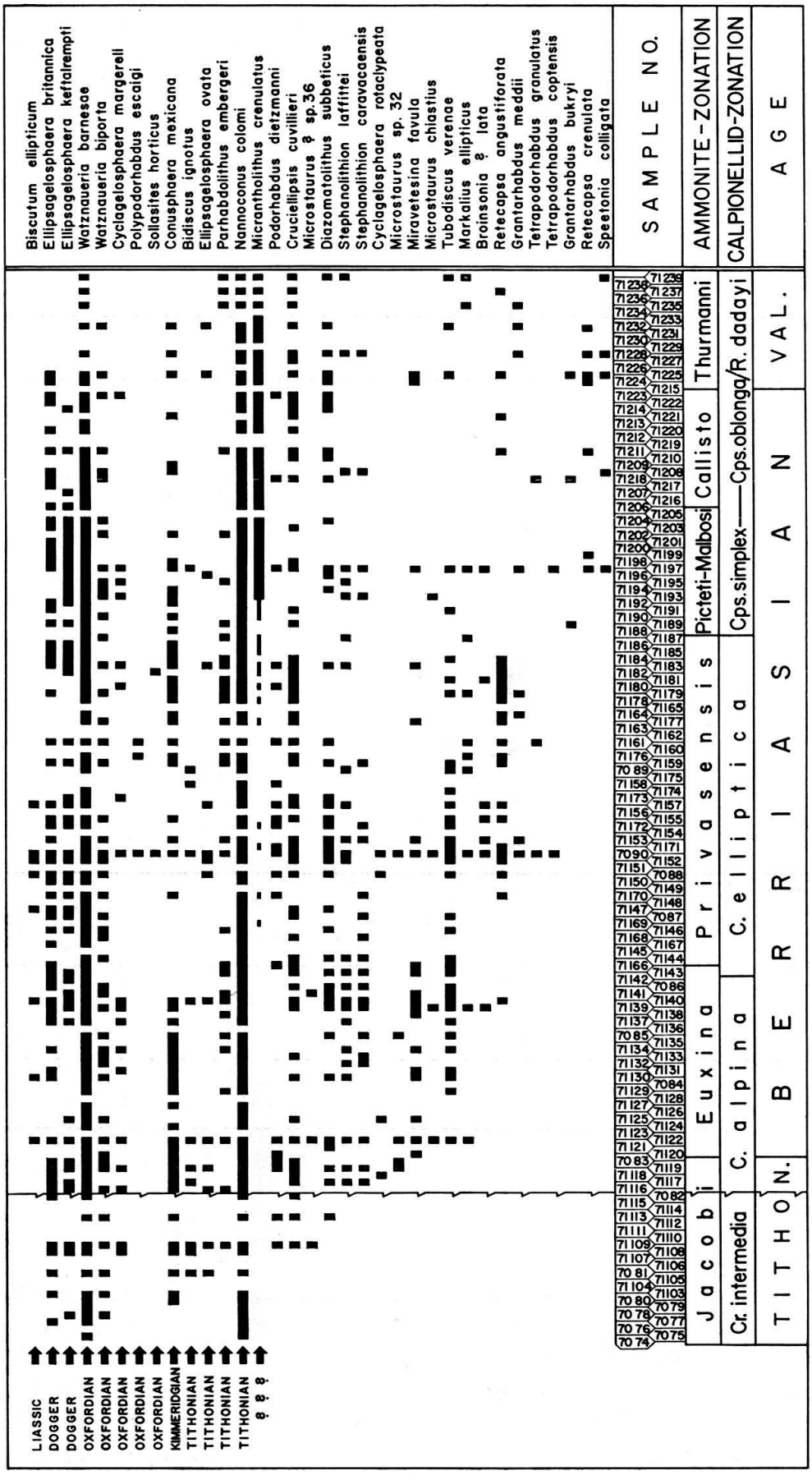

Fig. 2. Distribution of Nannofossil species in the Berriasian section of Miravetes.

Berriasian age in the text (p. 44) and as lower Berriasian in the Broyon section (p. 12). In the Miravetes section, delicate pentalith which I consider to be a precursor of *M. crenulatus*, appears for the first time in sample All 71.169 (*Privasensis*-zone, *C. elliptica*-subzone). These forms increase gradually in size until the typical larger dimensions of pentaliths of *M. crenulatus* are attained in sample All 71.193. Within the uppermost Tithonian a small disconformity interrupts the sequence. Near the Tithonian–Berriasian boundary 8 species appear for the first time, 4 in the uppermost Tithonian, and 4 on the lowest Berriasian. These species are *Stephanolithion laffittei*, *Stephanolithion caravacaensis*, *Cyclagelosphaera rotaclypeata*, *Microstaurus* sp. 32, *Miravetesina favula*, *Microstaurus chiastius*, *Tubodiscus verenae* and *Markalius ellipticus*. The remaining 8 species appear at intervals higher in the section. Special attention is called to the appearance of *Broinsonia* ? *lata* in the lower Berriasian.

The specimens are, in general, badly preserved. This is especially true for the upper part and for the very base of the section. Corrosion and overgrowth produce substantial morphological changes, which makes specific determinations very difficult. However, the section is of special interest due to its extreme thickness and constant facies. The average time interval between neighbouring samples is about 20.000 years.

Some differences are recognised between the nannofossil assemblages from the section at Miravetes and those of SE-France. Some species described by THIERSTEIN (1972, 1973) are not found at Miravetes, e.g. *Lithraphidites carniolensis* DEFLANDRE, 1963, and *Rucinolithus wisei* THIERSTEIN, 1972. On the other hand, some species occur earlier in Spain than in France.

Further comparisons with Lower Cretaceous material from N-Germany, the Netherlands and Great Britain reveal differences among the nannofossil assemblages which point to considerable provinciality.

To fully document the species described from Miravetes, I have illustrated additional material from several other localites. Dr. H. Stradner (Vienna) gave me two samples for comparison, from the Dutch NAM boreholes Nieuwerkerk 1 (Stradner-sample Nl 23 – Lower Aptian) and Tubbergen 4 (Stradner-sample Nl 33 – Upper Hauterivian). Prof. Dr. E. Michael (Hannover) gave another sample from the lower Barremian of the Konrad I mine (673 m depth), near Salzgitter, Germany.

Nearly all the coccoliths of the Miravetes section being poorly preserved, I have drawn schematic sketches to further illustrate the particular species. These drawings are based on all available pictures, including the project's material, and those in the literature. Thus I have not tried to represent any particular specimen, but rather to illustrate the general characters of the species.

Paleontology

With the rapid increase in the number of nannoplankton-publications, it has become necessary to state the exact date of issue (year, month and day – according to ICBN-recommendation 45B and 45C) with the synonyms and references.

With regard to the valuation of taxonomic features, I agree with the statement of PERCH-NIELSEN (1968, pp. 17–20). As far as possible, I have followed the rules of the ICBN (1972) and the recommandations of the Round Table on Calcareous Nannoplankton (Roma 1970).

Depository for all micrograph-negatives: Department of Scanning Electronmicroscopy University of Berne (Switzerland) at the Geological Institute, Sahlistrasse 5.

Family ***Arkhangelskiellaceae*** BUKRY, 1969–03–14

Subfamily ***Arkhangelskielloideae*** GARTNER, 1968–04–12

Genus *Broinsonia* BUKRY, 1969–03–14

Type species: *Broinsonia dentata* BUKRY, 1969–03–14.

Broinsonia ? lata (NOËL, 1969–03) NOËL, 1970–06

(Pl. I, Fig. 1–4)

1969–03 *Aspidolithus latus* n. sp. – NOËL, p. 196, Text-fig. 2; Pl. 2, Fig. 1, 2.
1970–06–15 *Aspidolithus latus* NOËL, 1969–03 – BLACK, p. 38; Pl. 3, Fig. 2.
1970–06 *Broinsonia lata* (NOËL, 1969–03) n. comb. – NOËL, p. 76; Pl. 23, Fig. 2,4.
1972–09 *Broinsonia lata* (NOËL, 1969–03) NOËL, 1970–06 – ROTH & THIERSTEIN, Pl. 14, Fig. 18–21.
1973–05–28 *Broinsonia lata* (NOËL, 1969–03) NOËL, 1970–06 – THIERSTEIN, p. 35; Pl. 6, Fig. 12–16.

Remarks: Although the characteristic "Arkhangelskiellaceae-sutures" are scarely visible, due to the bad preservation, there can be no doubt that the forms in question are specifically identical with Fig. 18, Pl. 14, of ROTH & THIERSTEIN (1972). This material could also be assigned to the genus *Broinsonia*, as presently defined. However, the status of this genus is problematical, and can only be clarified by a full revision of the family Arkhangelskiellaceae.

Major diameter: 6–8,5 μ; *minor diameter:* 5–6,5 μ.
First occurrence: Miravetes – All 71.139 – lower Berriasian (*Euxina*-zone; *C. alpina*-subzone).
Known range: Berriasian – upper Campanian.

Family ***Biscutaceae*** BLACK, 1971–07–02

Genus *Biscutum* BLACK, 1959–11–03

1965–09–30 *Palaeopontosphaera* n. gen. – NOËL, p. 76 (syn.).

Type species: *Biscutum ellipticum* (GÓRKA, 1957–03) n. comb. = *Biscutum testudinarium* BLACK, 1959–11–03.

Biscutum ellipticum (GÓRKA, 1957–03) n. comb.

(Text-fig. 3; Pl. I, Fig. 5–7)

1957–03 *Tremalithus ellipticus* n. sp. – GÓRKA, p. 245, 269; Pl. 1, Fig. 11.
1957–03 *Tremalithus melaniae* n. sp. – GÓRKA, p. 245, 270, Pl. 1, Fig. 12.
1957–03 *Tremalithus rhomboidalis* n. sp. – GÓRKA, p. 247, 271; Pl. 2, Fig. 3.
1957–03 *Tremalithus enodis* n. sp. – GÓRKA, p. 247, 271; Pl. 2, Fig. 8.
1957–03 *Discolithus constans* n. sp. – GÓRKA, p. 257, 279; Pl. 4, Fig. 7.
1957–03 *Discoaster floridus* n. sp. – GÓRKA (non SHAMRAY & LAZAREVA, 1956), p. 264, 283; Pl. 5, Fig. 11.
1959–11–03 *Biscutum testudinarium* n. sp. – BLACK, in BLACK & BARNES, p. 325; Pl. 10, Fig. 1.

1959–11–03 *Biscutum castrorum* n. sp. – BLACK, in BLACK & BARNES, p. 326; Pl. 10, Fig. 2.
1960–12–19 *Coccolithus* cf. *tenuis* KAMPTNER, 1937–12–01 – CARATINI, p. 42; Pl. 4, Fig. 71, 72.
1960–12–19 *Coccolithus* cf. *tenuis* KAMPTNER, 1937–12–01 – CARATINI, p. 42; Pl. 4, 71, 72.
1964 *Cribrosphaerella tectiforma* n. sp. – REINHARDT, p. 758; Pl. 2, Fig. 4.
1965–09–30 *Palaeopontosphaera dubia* n. sp. – NOËL, p. 4, Text-fig. 8.
1965 *Coccolithites polycingulatus* n. sp. – REINHARDT, p. 39; Pl. 3, Fig. 4.
1965–12 *Palaeopontosphaera dubia* n. sp. – NOËL, p. 76; Pl. 7, Fig. 1–13; Text-fig. 8.
non 1966–04–01 *Biscutum testudinarium* BLACK, 1959–11–03 – REINHARDT, p. 30; Pl. 19, Fig. 1.
1966–04–01 *Cribrosphaera* (al. *Cribrosphaerella*) *tectiforma* REINHARDT, 1964 – REINHARDT, p. 30; Pl. 5, Fig. 3; Pl. 12, Fig. 3, 4; Bild 12.
1967–05–31 *Biscutum constans* (GÓRKA, 1957–03) n. comb. – BLACK, p. 139.
1967–12–20 *Watznaueria melaniae* (GÓRKA, 1957–03) n. comb. – REINHARDT & GÓRKA, p. 241, 247; Pl. 31, Fig. 10, 14; Text-fig. 3.
non 1968–03–21 *Biscutum testudinarium* BLACK, 1959–11–03 – STRADNER, ADAMIKER & MARESCH, p. 29; Pl. 11; Pl. 12.
1968–05–06 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – PERCH-NIELSEN, p. 78, p. 78, Text-fig. 39; Pl. 27, Fig. 1–11.
1968–05–06 *Biscutum castrorum* BLACK, 1959–11–03 – PERCH-NIELSEN, p. 79, Text-fig. 40; Pl. 28, Fig. 1–5.
1968–07–02 *Maslovella blackii* n. sp. – PIENAAR (partim), p. 366; Pl. 69, Fig. 5 (non Fig. 1).
1968–07–02 *Maslovella pulchra* n. sp. – PIENAAR, p. 366; Pl. 69, Fig. 3.
1969–03–14 *Biscutum testudinarium* BLACK, 1959–11–03 – BUKRY, p. 28; Pl. 8, Fig. 7–12.
1969 *Coccolithus melaniae* (GÓRKA, 1957–03) n. comb. – LYULIEVA & LIPNIK, Pl. 3, Fig. 2.
1969 *Biscutum testudinarium* BLACK, 1959–11–03 – PIENAAR (partim), p. 85; Pl. 7, Fig. 2, 6, 7 (non Fig. 4).
1969 *Biscutum melaniae* (GÓRKA, 1957–03) n. comb. – REINHARDT, p. 936; Pl. 1, Fig. 5.
1970–06–15 *Biscutum testudinarium* BLACK, 1959–11–03 – BLACK, p. 39; Pl. 3, Fig. 3.
1970 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – HOFFMANN, p. 861; Pl. 5, Fig. 3; Pl. 6, Fig. 6.
1970–06 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – NOËL, p. 91; Pl. 33, Fig. 1–10; Pl. 34, Fig. 1a–g.
1970 *Biscutum melaniae* (GÓRKA, 1957–03) REINHARDT, 1969 – REINHARDT, p. 19, Text-fig. 32–34; Pl. 1, Fig. 7, 8.
1970 *Calyptrolithus tectiforma* (REINHARDT, 1964) n. comb. – SHUMENKO, p. 74; Pl. 2, Fig. 1.
1971–05–31 *Palaeopontosphaera dubia* NOËL, 1965–09–30 – MEDD (partim), p. 826; Pl. 4, Fig. 5 (non Fig. 6).
1971–06–07 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – SHAFIK & STRADNER, p. 81; Pl. 2, Fig. 1–4.
1971–07–02 *Biscutum gartneri* n. sp. – BLACK, p. 393; Pl. 30, Fig. 2.
1971–09–03 *Palaeopontosphaera dubia* NOËL, 1965–09–30 – ROOD, HAY & BARNARD, p. 265; Pl. 4, Fig. 9.
1971 *Biscutum testudinarium* BLACK, 1959–11–03 – MANIVIT, p. 113; Pl. 3, Fig. 8–12.
1972–01–12 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – LAUER, in GRÜN et al., p. 153; Pl. 23, Fig. 6–8.
1972–06 *Paleopontosphaera dubia* NOËL, 1965–09–30 – WILCOXON, Pl. 3, Fig. 6.
1972–09 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1959–11–03 – ROTH & THIERSTEIN, Pl. 8, Fig. 14.
1972–11–09 *Biscutum gartneri* BLACK, 1971–07–02 – BLACK, p. 27; Pl. 2, Fig. 1–4.
1972 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 « HOFFMANN, p. 66; Pl. 6, Fig. 5, 6; Pl. 8, Fig. 6; Pl. 10, Fig. 4; Pl. 18, Fig. 4–6.
1973–05–28 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – THIERHTEIN, p. 41.
1973–05–30 *Paleopontosphaera dubia* NOËL, 1965–09–30 emend. – NOËL, p. 117; Pl. 13, Fig. 1–5.
1973–11–28 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – PRIEWALDER, p. 15; Pl. 5, Fig. 1–3.
1973 *Biscutum constans* (GÓRKA, 1957–03) BLACK, 1967–05–31 – BARBIERI & TORELLI, Pl. 1, Fig. 5.

Description: Elliptical coccoliths with great differences in eccentricity (e = 1,1–1,45). The number of elements is extremely variable in both shields (distally and proximally 13–32). The elements are flat, wedge-shaped to rectangular, and show no imbrication. In distal and proximal view large elements occur at the ends of the ellipse. The elements along the long sides are narrow, with nearly parallel sutures. The central area is a distinct depression, surrounded by a cycle of nearly perpendicular, flat elements. Proximally the elements of the shield reach the center, where they are covered by many little elements (granules). The central area of the upper Cretaceous forms shows a simple, usually overgrown perforation. In the Jurassic forms this perforation is surrounded by a short tube, consisting of several fused elements. Both forms are represented in the Malm and Lower Cretaceous.

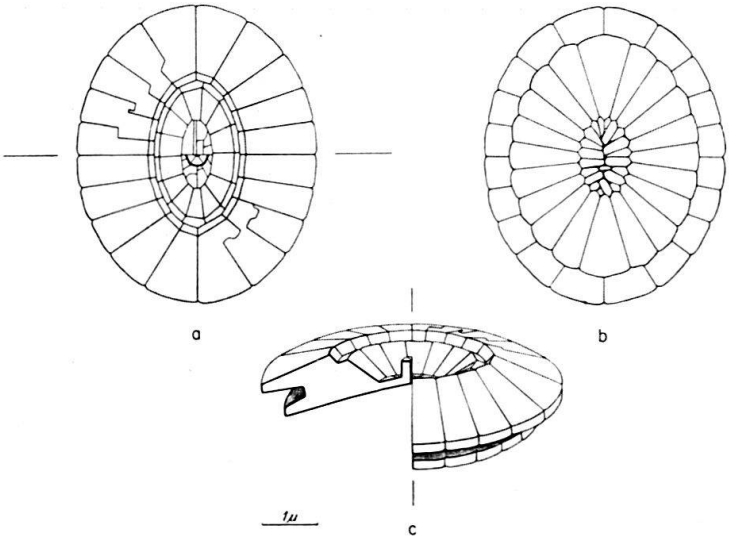

Fig. 3. Schematic drawings of *Biscutum ellipticum* (GÓRKA, 1957) GRÜN n. comb.
a) distal view – b) proximal view – c) oblique view on the distal side.

Coccospheres of *B. ellipticum* are of ellipsoidal to nearly cylindrical shape, consisting of 22–28 coccoliths. I consider the genus *Palaeopontosphaera* NOËL, 1965*a*, as amended by NOËL (1973) to be a junior synonym of *Biscutum* BLACK, 1959. The shapes of coccospheres and the numbers of coccospheres forming coccoliths are identical in the two genera. The presence or absence of the short, tubular central process may be a character on which species can be recognized.

Remarks: Among the synonymous species of GÓRKA (1957), *Tremalithus ellipticus* is the first in her publication. In contrast to *B. ellipticum*, *Biscutum blackii* GARTNER, 1968, has a nearly circular outline.

Major diameter of coccoliths: 2–10 µ; *minor diameter of coccoliths:* 1,3–8 µ; *major diameter of coccospheres:* 9–20 µ; *minor diameter of coccospheres:* 5,5–10 µ.
Known range: Lias delta – Maastrichtian.

Genus *Bidiscus* BUKRY, 1969–03–14

Type species: *Bidiscus cruciatus cruciatus* BUKRY, 1969–03–14.

Bidiscus ignotus (GÓRKA, 1957–03) HOFFMANN, 1970

(Text-fig. 4; Pl. I, Fig. 8–10)

1957–03 *Tremalithus ignotus* n. sp. – GÓRKA, p. 248, 272; Pl. 2, Fig. 9.
1965 *Biscutum tredenale* n. sp. – REINHARDT, p. 32, Text-fig. 2; Pl. 1, Fig. 3.
? 1965–12 "Embase de *Discorhabdus*" – NOËL, Pl. 23, Fig. 3, 5, 8–13.
1966–04–01 *Biscutum testudinarium* BLACK, 1959–11–03 – REINHARDT, p. 30; Pl. 19, Fig. 1.
1966–04–01 *Biscutum tredenale* REINHARDT, 1965 – REINHARDT, p. 31; Pl. 2, Fig. 3.
1967–12–20 *Biscutum ignotum* (GÓRKA, 1957–03) n. comb. et emend. – REINHARDT & GÓRKA, p. 245; Pl. 31, Fig. 9, 13.
1968–05–06 *Discorhabdus ignotus* (GÓRKA, 1957–03) n. comb. – PERCH-NIELSEN, p. 81, Text-fig. 41; Pl. 28, Fig. 6.
1968–08–30 *Biscutum testudinarium* BLACK, 1959–11–03 – STRADNER, ADAMIKER & MARESCH, p. 29; Pl. 11, Fig. 1, 2; Pl. 12, Fig. 1, 3–6.
1969–03–14 *Bidiscus rotatorius* n. sp. – BUKRY, p. 27; Pl. 7, Fig. 5–8.
1969 *Biscutum tredenale* REINHARDT, 1966–04–01 – PIENAAR, p. 86; Pl. 6, Fig. 4.
1970–05–06 *Coccolithus* sp. – BARTOLINI, Pl. 3, Fig. 5.
1970 *Bidiscus ignotus* (GÓRKA, 1957–03) n. comb. – HOFFMANN, p. 862; Pl. 7, Fig. 1.
1970–06 *Discorhabdus ignotus* (GÓRKA, 1957–03) PERCH-NIELSEN, 1968–05–06 – NOËL (partim), p. 87; Pl. 32, Fig. 4, 7, 10, 14, (non Text-fig. 21; Pl. 32, Fig. 1–3, 5, 6, 9, 15, 16).
1970–06 *Discorhabdus bellis* n. sp. – NOËL, p. 89; Pl. 32, Fig. 8, 11–13.
1970 *Biscutum ignotum* (GÓRKA, 1957–03) REINHARDT & GÓRKA, 1967–12–20 – REINHARDT, p. 18; Pl. 1, Fig. 1–4, 6.
1970 *Discorhabdus testudinarium* (BLACK, 1959–11–03) n. comb. – SHUMENKO, p. 72; Pl. 1, Fig. 3, 4.
1971–06–07 *Biscutum testudinarium* BLACK, 1959–11–03 – SHAFIK & STRADNER, p. 81; Pl. 3, Fig. 1, 2; Pl. 4, Fig. 1.
1971–07–02 *Bidiscus gorkae* n. sp. – BLACK, p. 392; Pl. 30, Fig. 1.
1971 *Bidiscus ignotus* (GÓRKA, 1957–03) HOFFMANN, 1970 – HOFFMANN & VETTER, p. 1182; Pl. 9, Fig. 6.
1971 *Discorhabdus ignotus* (GÓRKA, 1957–03) PERCH-NIELSEN, 1968–05–06 – MANIVIT, p. 112; Pl. 3, Fig. 1–7.

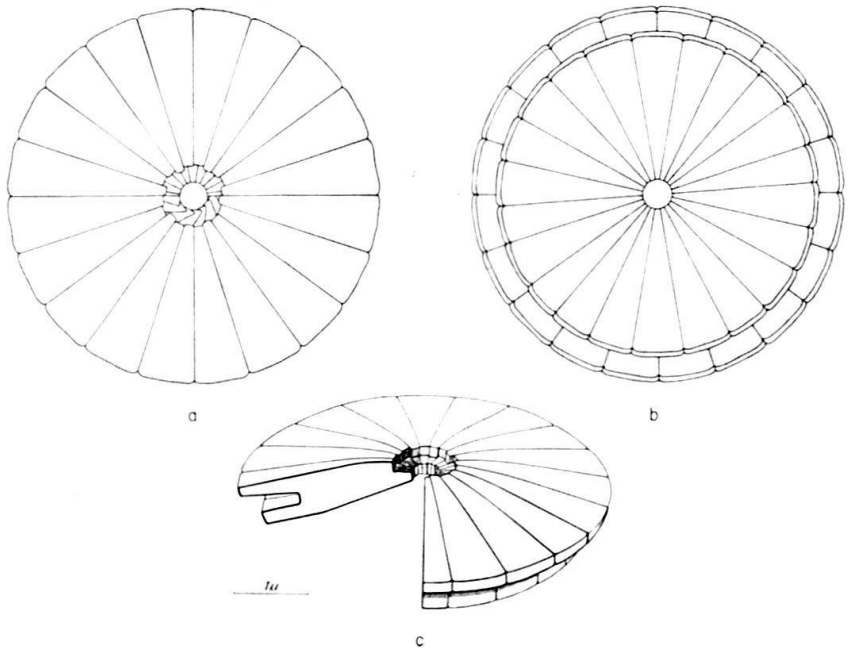

Fig. 4. Schematic drawings of *Bidiscus ignotus* (GÓRKA, 1957) HOFFMANN, 1970.
a) distal view – b) proximal view – c) oblique view on the distal side.

1972-01-12 *Bidiscus ignotus* GÓRKA, 1957-03) n. comb. – LAUER, in GRÜN et al., p. 152; Pl. 23, Fig. 5.
1972-06 *Biscutum testudinarium* BLACK, 1959-11-03 – WILCOXON, Pl. 8, Fig. 9.
1972-06 *Bidiscus rotatorius* BUKRY, 1969-03-14 – WILCOXON, Pl. 12, Fig. 5.
1972-09 *Bidiscus rotatorius* BUKRY 1969-03-14 – ROTH & THIERSTEIN, Pl. 15, Fig. 1-4.
1972-11-09 *Bidiscus rotatorius* BUKRY, 1969-03-14 – BLACK, p. 26; Pl. 1, Fig. 7-9.
1972-12 *Discorhabdus ignotus* (GÓRKA, 1957-03) PERCH-NIELSEN, 1968-05-06 – IACCARINO & RIO, p. 658; Pl. 72, Fig. 8.
1972 *Discorhabdus ignotus* (GÓRKA, 1957-03) PERCH-NIELSEN, 1968-05-06 – FORCHHEIMER, p. 34; Pl. 6, Fig. 8, 9.
1972 *Bidiscus ignotus* (GÓRKA, 1957-03) HOFFMANN, 1970 – HOFFMANN, p. 68; Pl. 12, Fig. 6; Pl. 19, Fig. 1, 2.
1972 *Bidiscus rotatorius* BUKRY, 1969-03-14 – HOFFMANN, p. 69; Pl. 19. Fig. 6.
1973-05-28 *Discorhabdus rotatorius* (BUKRY, 1969-03-14) n. comb. – THIERSTEIN, p. 42; Pl. 5, Fig. 13-16.
1973-11-28 *Biscutum ignotum* (GÓRKA, 1957-03) REINHARDT & GÓRKA, 1967-12-20 – PRIEWALDER, p. 16; Pl. 5, Fig. 4-6.
1973 *Discorhabdus ignotus* (GÓRKA, 1957-03) PERCH-NIELSEN, 1968-05-06 – BARBIERI & TORELLI, Pl. 1, Fig. 4.

Remarks: These circular coccoliths are composed of 2 mono-cycle shields. The elements of both shields are flat, wedge-shaped, and radially arranged. No imbrication occurs. The small central area is covered by cyclic or irregularly layered elements. No central process is present. Coccospheres of *B. ignotus* are of spherical to somewhat ellipsoidal shape, consisting of approximately 20 coccoliths.

Diameter of coccoliths: 2,5-5,5 μ; *diameter of coccospheres:* 8-13 μ.
First occurrence: Miravetes – All 70.81 – upper Tithonian (*Jacobi*-Zone; *Cr. intermedia*-subzone). Probably present in Oxfordian as "Embase de *Discorhabdus*".
Known range: (Oxfordian ?) upper Tithonian – Campanian.

Family ***Ellipsagelosphaeraceae*** NOËL, 1965-09-30

Subfamily ***Ellipsagelosphaeroideae*** NOËL, 1965-90-30

Type genus: *Ellipsagelosphaera* NOËL, 1965-09-30.

Genus *Ellipsagelosphaera* NOËL, 1965-09-30

Type species: *Ellipsagelosphaera britannica* (STRADNER, 1963-06-05) PERCH-NIELSEN, 1968-05-06, = *Ellipsagelosphaera frequens* NOËL, 1965-09-30 (partim).

Remarks: The elliptical coccoliths have 2 distinct shields. The distal shield is composed of a single cycle of flat elements with clockwise imbrication. The sutures show a strong counter-clockwise precession. Forms which seem to show a contrary precession are – in all probability – reversed copies produced in the making of elektron-micrographs. The wedge-shaped, unimbricated elements of the mono-cycle proximal shield precess in the opposite direction. When the coccoliths are turned over, they show – in proximal view – a counter-clockwise precession, too. Each of the proximal elements exhibits an angular, clockwise-oriented bend at the same point. At these bends both shields seem to be perforated by bar-shaped, in cross-section triangular, processes of flat, radially arranged elements which together form a wall on the distal

side. In cases of heavy corrosion, these nail-shaped elements will be dissolved first, leaving the typical shape of "*Calolithus martelae*". The wall on the distal side can either be depressed or elevated above the level of the distal shield. The variably extended central area is surrounded by an additional cycle of abcentrally sloping, unimbricated, flat elements. These form a tube which pierces the center of the proximal shield. The central area may remain free, or it may be covered up by a bridge or other combinations of elements.

Ellipsagelosphaera britannica (STRADNER, 1963–06–05) PERCH-NIELSEN, 1968–05–06
(Text-fig. 5; Pl. I, Fig. 11–12; Pl. II, Fig. 1–4)

1963–06–05 *Coccolithus britannicus* n. sp. – STRADNER, p. 10; Pl. 1, Fig. 7.
1964 *Watznaueria britannica* (STRADNER, 1963–06–05) n. comb. – REINHARDT, p. 753, Text-fig. 5; Pl. 2, Fig. 3.
1964 *Watznaueria communis* n. sp. – REINHARDT, p. 756; Pl. 2, Fig. 5; Text-fig. 6.
1965–09 *Coccolithus britannicus* STRADNER, 1963–06–05 – BLACK, p. 133, Fig. 6.
1965–09–30 *Ellipsagelosphaera frequens* n. sp. – NOËL (partim), p. 8, Fig. 38 (non Fig. 35–37, 39).
1965–09–30 *Ellipsagelosphaera lucasi* n. sp. – NOËL, p. 8, Fig. 40, 41.
1965–12 *Ellipsagelosphaera frequens* n. sp. – NOËL (partim), p. 119, Text-fig. 38; Pl. 11, Fig. 7; Pl. 12, Fig.1–7, 9, 10; Pl. 13, Fig. 5, 10 (non Text-fig. 35–37, 39, 40; Pl. 11, Fig. 8–10; Pl. 12, Fig. 8; Pl. 13, Fig. 1–4, 6–9; Pl. 16, Fig. 1–11; Pl. 19, Fig. 1, 4, 5; Pl. 20, Fig. 1, 6–8).
1965–12 *Ellipsagelosphaera lucasi* n. sp. – NOËL (partim), p. 126, Text-fig. 41, 42; Pl. 11, Fig. 1–3, 5 (non Pl. 11, Fig. 4, 6).
1966–04–01 *Watznaueria communis* REINHARDT, 1964 – REINHARDT (partim), p. 17; Pl. 4, Fig. 5, 6 (non Pl. 4, Fig. 3; Pl. 23, Fig. 5; Text-fig. 3).
1966–04–01 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – REINHARDT (partim), p. 17; Pl. 4, Fig. 7, (non Text-fig. 4).
1966–05–13 *Coccolithus britannicus* STRADNER, 1963–06–05 – STOVER, p. 139; Pl. 1, Fig. 12–14; Pl. 8, Fig. 6.
1966–09–30 *Coccolithus britannicus* STRADNER, 1963–06–05 – MARESCH (partim), Pl. 2, Fig. 1, 3 (non Pl. 2, Fig. 2.)
1967–06–23 *Coccolithus britannicus* STRADNER, 1963–06–05 – PANT, Pl. 1, Fig. 2.
1968–05–06 *Ellipsagelosphaera communis* (REINHARDT, 1964) n. comb. – PERCH-NIELSEN, p. 71.
1968–05–06 *Ellipsagelosphaera britannica* (STRADNER, 1963–06–05) n. comb. – PERCH-NIELSEN, p. 71.
1969–03–24 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – MICHAEL, p. 304, Text-fig. 2/3, 2/4.
1970–06–15 *Ellipsagelosphaera frequens* NOËL, 1965–09–30 – BLACK, Pl. 4, Fig. 2.
1971–06–24 *Ellipsagelosphaera lucasi* NOËL, 1965–09–30 – BLACK, Pl. 45.1, Fig. 10.
1971–07–02 *Ellipsagelosphaera gephyrocapsoides* n. sp. – BLACK, p. 399; Pl. 30, Fig. 7.
non 1971–09–03 *Watznaueria communis* REINHARDT, 1964 – ROOD, HAY & BARNARD, p. 268; Pl. 5, Fig. 1–4.
1971–09–03 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – ROOD, HAY & BARNARD, p. 269; Pl. 5, Fig. 5.
1971 *Ellipsagelosphaera frequens* NOËL, 1965–09–30 – NOCERA (partim), p. 429; Pl. 1, Fig.1–3 (non Pl. 1, Fig. 4, 5).
1971 *Ellipsagelosphaera* sp. – NOCERA, Pl. 1, Fig. 6.
1971 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – REINHARDT, p. 33, Fig. 34–36.
1971 *Watznaueria communis* REINHARDT, 1964 – REINHARDT, p. 34, Fig. 38.
1972–01–12 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – LAUER, in GRÜN et al., p. 155; Pl. 26, Fig. 10, 11.
1972–06 *Watznaueria britannica* (STRADNER, 1963–06–05) REINHARDT, 1964 – WILCOXON, Pl. 1, Fig. 1, 2.

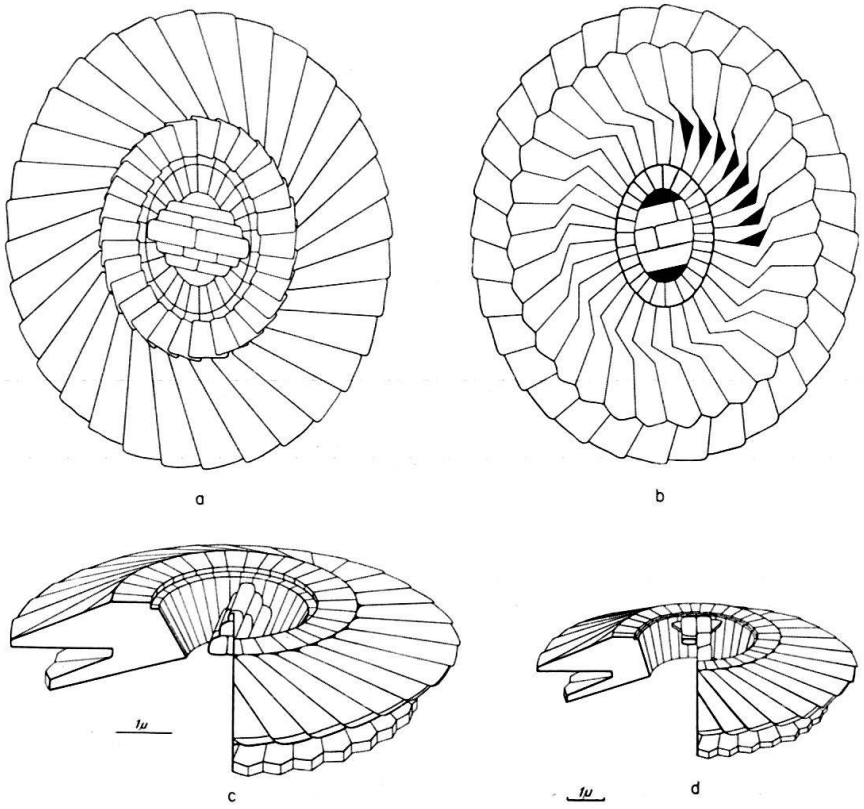

Fig. 5. Schematic drawings of *Ellipsagelosphaera britannica* (STRADNER, 1963) PERCH-NIELSEN, 1968. a) distal view – b) proximal view with "*Calolithus martelae*"-like dissolution pattern – c) oblique view on the distal side – d) oblique view on the distal side of a "*lucasi*"-type specimen.

1973–05–30 *Ellipsagelosphaera communis* (REINHARDT, 1964) PERCH-NIELSEN, 1968–05–06 – NOËL, p. 119; Pl. 14, Fig. 1–5.
1973–05–30 *Ellipsagelosphaera britannica* (STRADNER, 1963–06–05) PERCH-NIELSEN, 1968–05–06 – NOËL, p. 119, Pl. 14, Fig. 6, 7.

Remarks: Fig. 11, Pl. 1 shows clearly, that *E. britannica* and *E. communis* together build one coccosphere. *E. communis* is therefore a junior synomym of *E. britannica*. For the same reason forms with an oblique bridge must also be united with *E. britannica*.

Ellipsagelosphaera reinhardtii (ROOD, HAY & BARNARD, 1971) NOËL, 1973, has an extremly narrow bridge which bifurcates laterally. *Watznaueria biporta* also has 2 openings in the central area, formed by elements of the proximal shield, but here there is no tube or bridge.

Major diameter: 2–12 μ; *minor diameter:* 1,8–10 μ; *major diameter of central area in % of coccolith major diameter:* 18–60%; *minor diameter of central area in % of coccolith minor diameter:* 14–55%. *Known range:* Bathonian–Campanian.

Ellipsagelosphaera ovata (BUKRY, 1969–03–14) BLACK, 1973–11–15

(Text-fig. 6; Pl. II, Fig. 7–9)

1969–03–14 *Watznaueria ovata* n. sp. – BUKRY (partim), p. 33; Pl. 11, Fig. 11 (non Fig. 12).
1973–11–15 *Ellipsagelosphaera ovata* (BUKRY, 1969–03–14) n. comb. – BLACK, p. 71; Pl. 26, Fig. 10–12.

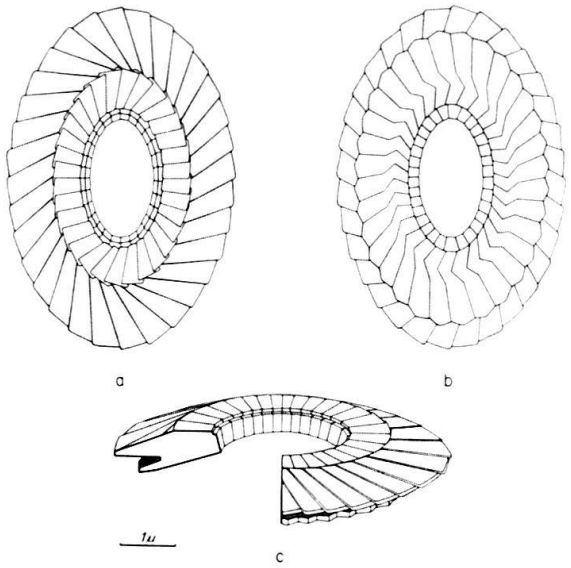

Fig. 6. Schematic drawings of *Ellipsagelosphaera ovata* (BUKRY, 1969) BLACK, 1973.
a) distal view – b) proximal view – c) oblique view on the distal side.

Remarks: This species has an oblong outline and a large, central opening. Fig. 12, Pl. 11 of BUKRY (1969) seems to have no central tube and must therefore be assigned to the genus *Watznaueria*.

Major diameter: 3,5–6,5 µ; *minor diameter:* 3–6 µ; *major diameter of central area in % of coccolith major diameter:* 35–55%; *minor diameter of central area in % of coccolith minor diameter:* 25–45%. *First occurrence:* Miravetes – All 70.81 – upper Tithonian (*Jacobi*-zone; *Cr. intermedia*-subzone). *Known range:* Upper Tithonian – Santonian.

Ellipsagelosphaera keftalrempti GRÜN, n. sp.

(Text-fig. 7; Pl. II, Fig. 5–6)

1965–12 *Ellipsagelosphaera frequens* n. sp. – NOËL (partim), p. 119; Pl. 12, Fig. 8; Pl. 19, Fig. 1 (non Text-fig. 35–40; Pl. 11, Fig. 7–10; Pl. 12, Fig. 1–7, 9, 10; Pl. 13, Fig. 1–10; Pl. 16, Fig. 1–11; Pl. 19, Fig. 4, 5; Pl. 20, Fig. 1, 6–8).
1966–04–01 *Watznaueria* sp. aff. *W. communis* REINHARDT, 1964 – REINHARDT, p. 19; Pl. 4, Fig. 1.
1966–09–30 *Coccolithus britannicus* STRADNER, 1963–06–05 – MARESCH (partim), Pl. 2, Fig. 2 (non Fig. 1, 3).
1968 *Ellipsagelosphaera frequens* NOËL, 1965–09–30 – LEZAUD, p. 16; Pl. 1, Fig. 12.
1969–12 *Ellipsagelosphaera* sp. – BARBIERI & MEDIOLI, p. 733; Pl. 48, Fig. 6a.
1971 *Ellipsagelosphaera frequens* NOËL, 1965–09–30 – NOCERA (partim), p. 429; Pl.1, Fig. 4, 5 (non Fig. 1–3).
1972–01–12 *Watznaueria barnesae* (BLACK, 1959–11–03) BURKY, 1969–03–14 – LAUER, in GRÜN et al. (partim), p. 154; Pl. 26, Fig. 5 (non Fig. 1–4).

Derivation of name: After Kef Talrempt, one of the two localities where this form was found by NOËL (1965*a*).
Holotype: Pl. 2, Fig. 6; Stereoscan micrograph 216/1.
Type level: Berriasian (*Privasensis*-zone; *C. elliptica*-subzone).
Type locality: Caravaca, Miravetes-section, All 71.159.
Depository: Department of Scanning Electronmicroscopy, Institute of Geology, University of Berne.

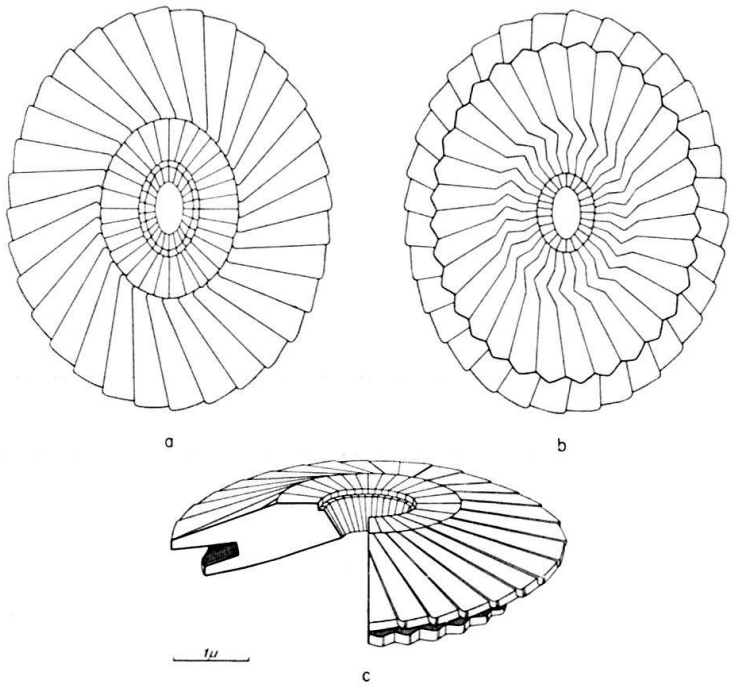

Fig. 7. Schematic drawings of *Ellipsagelosphaera keftalrempti* GRÜN n. sp.
a) distal view – b) proximal view – c) oblique view on the distal side.

Description: Relatively small, almost circular coccoliths of the genus *Ellipsagelosphaera*, with a very small central area, surrounded by a deep, narrow tube. No bridge or any other structure is developed in the central area.

Major diameter: 5–7 µ; *minor diameter:* 4,5–6 µ; *major diameter of central area in % of coccolith major diameter:* 15–25%; *minor diameter of central area in % of coccolith minor diameter:* 10–13%.
First occurrence: MARESCH (1966) – middle Callovian, France.
Known range: Middle Callovian – upper Hauterivian.

Genus *Watznaueria* REINHARDT, 1964

Type species: *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06.

Remarks: This genus is essentially constructed like *Ellipsagelosphaera*, but differs in the lack of any central tube. The central area is therefore partially or wholly blocked by the elements of the proximal shield, or by additional element-structures developed on the distal surface. Perforations and openings of different forms and arrangements can be present in the central area.

Watznaueria barnesae (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06

(Text-fig. 8; Pl. II, Fig. 10)

1959–11–03 *Tremalithus barnesae* n. sp. – BLACK, in BLACK & BARNES, p. 324; Pl. 9, Fig. 1, 2.
1964–07–21 *Colvillea barnesae* (BLACK, 1959–11–03) n. comb. – BLACK, p. 311.
1964–08–24 *Coccolithus* cf. *C. barnesae* (BLACK, 1959–11–03) n. comb. – BRAMLETTE & MARTINI, p. 298; Pl. 1, Fig. 13,14.
1964–11–25 *Colvillea barnesae* (BLACK, 1959–11–03) BLACK, 1964–07–21 – BLACK et al., Pl. 43, fig. *f*.

? 1964 *Tergestiella barnesae* (BLACK, 1959–11–03) n. comb. – REINHARDT, p. 753.
1964 *Watznaueria angustoralis* n. sp. – REINHARDT, p. 753, Fig. 4; Pl. 2, Fig. 2.
1965–09 *Colvillea barnesae* (BLACK, 1959–11–03) BLACK, 1964–07–21 – BLACK, p. 132, Fig. 2.
1965–12 *Ellipsagelosphaera frequens* n. sp. – NOËL (partim), p. 119; Pl. 16, Fig. 1–4; Pl. 19, Fig. 4 (non Text-fig. 35–40; Pl. 11, Fig. 7–10; Pl. 12, Fig. 1–10; Pl. 13, Fig. 1–10; Pl. 16, Fig. 5–11; Pl. 19, Fig. 1, 5; Pl. 20, Fig. 1, 6–8).
1966–01–27 *Maslovella barnesae* (BLACK 1959–11–03) n. comb. – TAPPAN & LOEBLICH, p. 43.
1966–04–01 *Tergestiella barnesae* (BLACK, 1959–11–03) REINHARDT, 1964 – REINHARDT (partim), p. 15; Pl. 2, Fig. 1; Pl. 12, Fig. 2 (non Text-fig. 2; Pl. 1, Fig. 1, 2; Pl. 23, Fig. 6).
1966–04–01 *Watznaueria angustoralis* REINHARDT, 1964 – REINHARDT, p. 16; Pl. 2, Fig. 2; Pl. 3, Fig. 1–3; Pl. 23, Fig. 4 (?); Text-fig. 5.
1966–05–13 *Coccolithus paenepelagicus* n. sp. – STOVER (partim), p. 139; Pl. 1, Fig. 10; Pl. 3, Fig. 22B; Pl. 8, Fig. 5 (non Pl. 1, Fig. 11).
1968–03–21 *Coccolithus barnesae* (BLACK, 1959–11–03) BRAMLETTE & MARTINI, 1964–08–24 – STRADNER, ADAMIKER & MARESCH (partim), p. 24, Text-fig. 8; Pl. 1; Pl. 2, Fig. 2–5 (non Pl. 2, Fig. 1).
1968–04–12 *Coccolithus barnesae* (BLACK, 1959–11–03) BRAMLETTE & MARTINI, 1964–08–24 – GARTNER (partim), p. 17; Pl. 1, Fig. 12; Pl. 8, Fig. 18–20; Pl. 11. Fig. 11; Pl. 14, Fig. 4, 5; Pl. 16, Fig. 15, 16; Pl. 19, Fig. 12; Pl. 20, Fig. 13; Pl. 22, Fig. 16, 17; Pl. 25, Fig. 1, 2 (non Pl. 4, Fig. 6, 7; Pl. 8, Fig. 21, 22; Pl. 15, Fig. 8; Pl. 20, Fig. 12; Pl. 24, Fig. 8).
1968–05–06 *Watznaueria barnesae* (BLACK, 1959–11–03) n. comb. – PERCH-NIELSEN (partim), p. 69 Text-fig. 32; Pl. 22, Fig. 1, 2, 4–7 (non Pl. 22, Fig. 3; Pl. 23, Fig. 1, 4, 5, 16).
1968 *Coccolithus hoellvikensis* n. sp. – FORCHHEIMER (partim), p. 28; SEM 6, 7, 8, 9 (non Pl. 1, Fig. 2, 5, 6; Fig. 2; Text-fig. 2, 6, 23).
non 1968 *Watznaueria* cf. *angustoralis* REINHARDT, 1964 – FORCHHEIMER, p. 30; Pl. 2, Fig. 7; Fig. 3; Text-fig. 6; SEM 10.
? 1968 *Watznaueria angustoralis* REINHARDT, 1964 – LOCKER, Pl. 2, Fig. 17
1969–03–14 *Watznaueria barnesae* (BLACK, 1959–11–03) n. comb. – BUKRY (partim), p. 31; Pl. 10, Fig. 1–6 (non Fig. 7).
1969 *Coccolithus barnesae* (BLACK, 1959–11–03) BRAMLETTE & MARTINI, 1964–08–24 – SHUMENKO, p. 68; Pl. 1, Fig. 1–2.
1970 *Coccolithus* cf. *barnesae* (BLACK, 1959–11–03) BRAMLETTE & MARTINI, 1964–08–24 – FORCHHEIMER, p. 17; Fig. 3, 4, 14–22, 42, 43.
1970–06 *Watznaueria* aff. *W. barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – NOËL (partim), p. 92; Pl. 35, Fig. 2–4, 6–8, 10, 11 (non Pl. 34, Fig. 2; Pl. 35, Fig. 1, 5, 9).
1971–06–07 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – SHAFIK & STRADNER (partim), p. 90; Pl. 1, Fig. 1, 3, 4; Pl. 4, Fig. 2 (non Pl. 1, Fig. 2, 5).
1971 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – HOFFMANN & VETTER, p. 1179, Text-fig. 2, 3; Pl. 5, Fig. 1–6; Pl. 6, Fig. 1–4.
1971 *Watznaueria barnesae* (BLACK, 1959–11–03) BUKRY, 1969–03–14 – MANIVIT, p. 113; Pl. 28, Fig. 1–4, 8, 9, 12, 13.
1971 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – REINHARDT, p. 32; Fig. 31–33.
1972–01–12 *Watznaueria barnesae* (BLACK, 1959–11–03) BUKRY, 1969–03–14 – LAUER, in GRÜN et al. (partim), p. 154; Pl. 26, Fig. 2 (non Fig. 1, 3–5).
1972–06 *Watznaueria barnesae* BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – WILCOXON, Pl. 1, Fig. 6, 7.
1972 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – HOFFMANN, p. 64, Text-fig. 28, 29; Pl. 11, Fig. 6; Pl. 18, Fig. 1–3.
1973–01 *Watznaueria barnesae* BLACK, 1959–11–03) PERCH- NIELSEN, 1968–05–06 – STRADNER (partim), Pl. 48, Fig. 9; Pl. 49, Fig. 2; Pl. 50, Fig. 1–3 (non Pl. 49, Fig. 1).
1973–11–15 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – BLACK, p. 82; Pl. 24, Fig. 7.
1973–11–28 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – PRIEWALDER (partim), p. 27; Pl. 14, Fig. 3–5 (non Fig. 6).

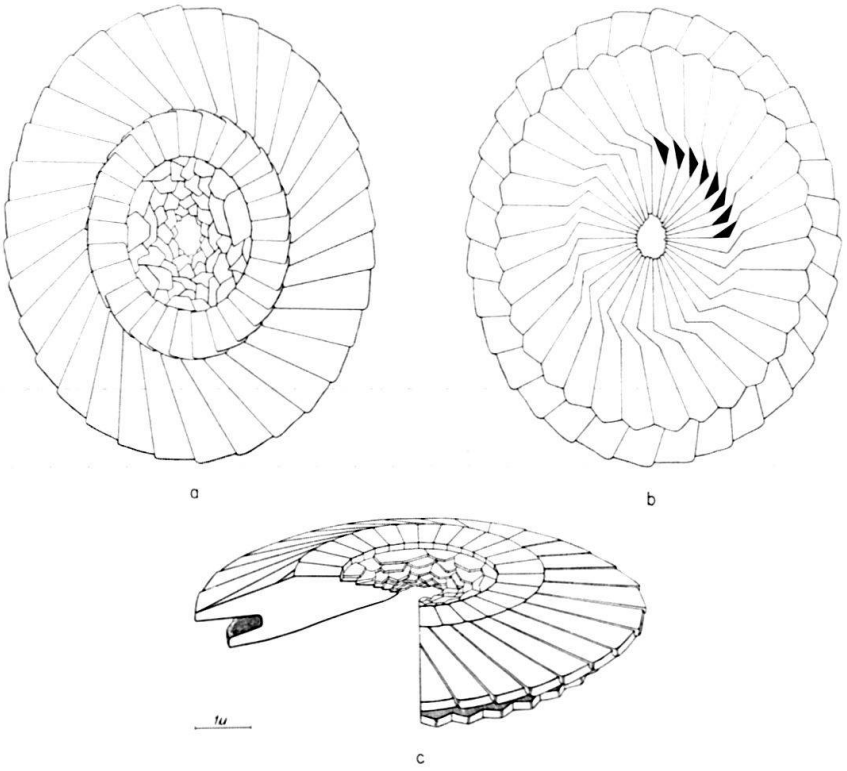

Fig. 8. Schematic drawings of *Watznaueria barnesae* (BLACK, 1959) PERCH-NIELSEN, 1968. a) distal view – b) proximal view with "*Calolithus martelae*"-like dissolution pattern – c) oblique view on the distal side.

Remarks: *Watznaueria barnesae* has only one perforation in the middle of the central area. Forms with two perforations, lying on the long axis of the ellipse, must be assigned to *Watznaueria biporta* BUKRY, 1969. *Watznaueria deflandrei* NOËL, 1965*a*) RHEINHARDT, 1971, is characterized by a narrow slit aligned with the long axis of the ellipse.

Major diameter: 2,5–8 μ; *minor diameter:* 2–7 μ.
Known range: Oxfordian – Danian.

Watznaueria biporta BUKRY, 1969–03–14

(Text-fig. 9; Pl. II, Fig. 11–12)

1965–09 *Coccolithus* sp. – BLACK, p. 133, Fig. 12.
1965–12 *Ellipsagelosphaera frequens* n. sp. – NOËL (partim), p. 119; Pl. 13, Fig. 1–3 (non Text-fig. 35–40; Pl. 11, Fig. 7–10; Pl. 12, Fig. 1–10; Pl. 13, Fig. 4–10; Pl. 16, Fig. 1–11; Pl. 19, Fig. 1, 4, 5; Pl. 20, Fig. 1, 6–8).
1968–05–06 *Watznaueria barnesae* (BLACK, 1959–11–03) n. comb. – PERCH-NIELSEN, (partim), p. 69; Pl. 23, Fig. 16 (non Text-fig. 32; Pl. 22, Fig. 1–7; Pl. 23, Fig. 1, 4, 5).
1969–03–14 *Watznaueria biporta* n. sp. – BUKRY, p. 32; Pl. 10, Fig. 8–10.
1970 *Coccolithus bornholmensis* n. sp. – FORCHHEIMER (partim), p. 12; Text-fig. 5, 6, 7, 12 (non Text-fig. 1, 2, 8–11, 13, 41).
1971–05–31 *Watznaueria cynthae* n. sp. – WORSLEY, p. 1314; Pl. 2, Fig. 23, 24, 25.
1971–09–03 *Watznaueria communis* REINHARDT, 1964 – ROOD, HAY & BARNARD (partim), p. 268 Pl. 5, Fig. 3, 4 (non Fig. 1, 2).
1972–01–12 *Watznaueria barnesae* (BLACK, 1959–11–03) BUKRY, 1969–03–14 – LAUER, in GRÜN et al. (partim), p. 154; Pl. 26, Fig. 3, 4 (non Fig. 1, 2, 5).

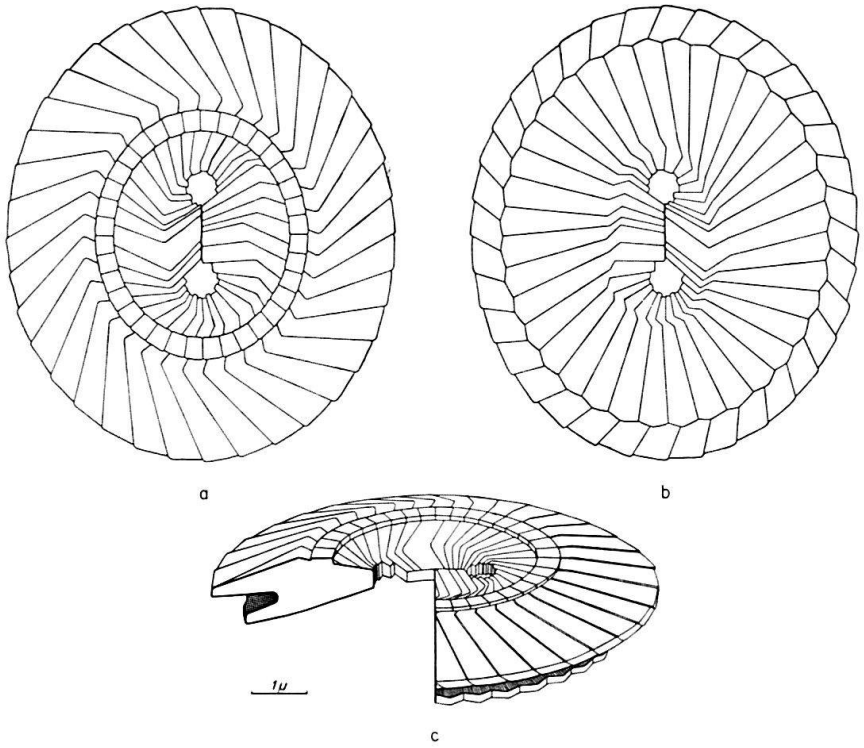

Fig. 9. Schematic drawings of *Watznaueria biporta* BUKRY, 1969.
a) distal view – b) proximal view – c) oblique view on the distal side.

1972–06 *Callolithus martelae* NOËL, 1965–09–30 – WILCOXON, Pl. 3, Fig. 7.
1973–05–28 *Watznaueria biporta* BUKRY, 1969–03–14 – THIERSTEIN, p. 43; Pl. 6, Fig. 6.
1973–11–15 *Margolatus bornholmensis* (FORCHHEIMER, 1970) n. comb. – BLACK, p. 81; Pl. 24, Fig. 6, 11, 12.
1973–11–28 *Watznaueria barnesae* (BLACK, 1959–11–03) PERCH-NIELSEN, 1968–05–06 – *Priewalder* (partim), p. 27; Pl. 14, Fig. 6 (non Fig. 3–5).

Remarks: *Watznaueria biporta* is distinguished from *W. barnesae* in that the former has two perforations in the central area, aligned with the long axis of the ellipse.

Major diameter: 4,5–9 µ; *minor diameter:* 4–8 µ.
Known range: Oxfordian – Campanien.

Genus *Cyclagelosphaera* NOËL, 1965–09–30

Type species: *Cyclagelosphaera margereli* NOËL, 1965–09–30.

Cyclagelosphaera margereli NOËL, 1965–09–30

(Text-fig. 10; Pl. III, Fig. 1–3)

1965–09 *Coccolithus* sp. – BLACK, p. 133, Fig. 7.
1965–09–30 *Cyclagelosphaera margereli* n. sp. – NOËL, p. 8; Fig. 45, 46, 48.
1965–12 *Cyclagelosphaera margereli* n. sp. – NOËL (partim), p. 130, Text-fig. 44–46; Pl. 17, Fig. 4, 5, 7–9; Pl. 18, Fig. 1, 2; Pl. 20, Fig. 2 (non Pl. 17, Fig. 6;. Pl. 20, Fig. 3, 4).
1966–04–01 *Tergestiella barnesae* (BLACK, 1959–11–03) REINHARDT, 1964 – REINHARDT, (partim), p.15, Text-fig. 2; Pl. 1, Fig. 1, 2 (non Pl. 2, Fig. 1; Pl. 12, Fig. 2; Pl. 23, Fig. 6).
1966–09–30 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – MARESCH, p. 380; Pl. 2, Fig. 5.

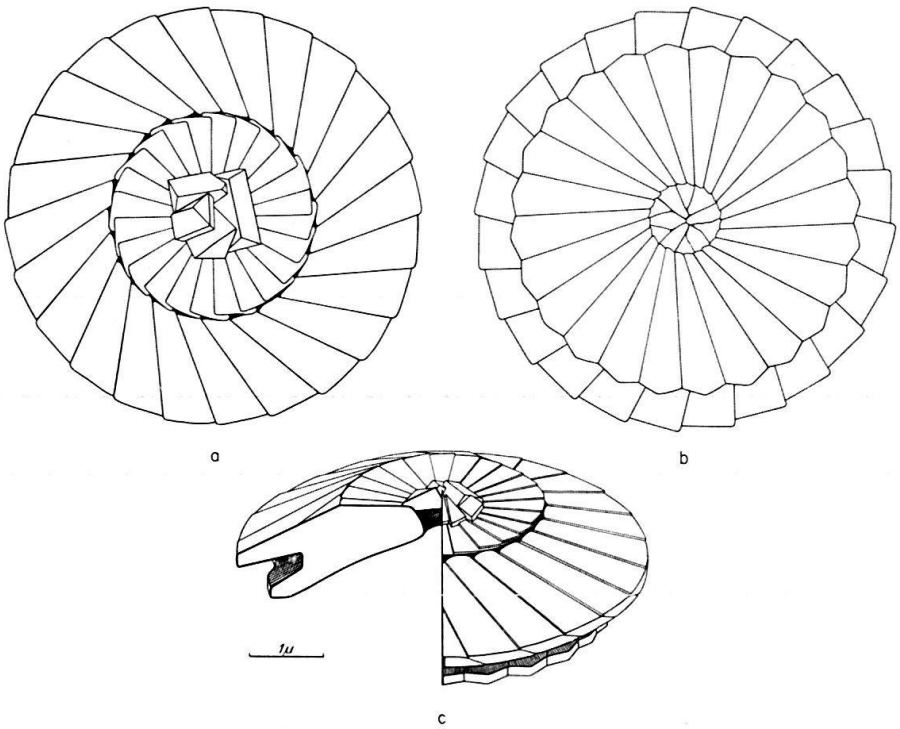

Fig. 10. Schematic drawings of *Cyclagelosphaera margereli* NOËL. 1965.
a) distal view – b) proximal view – c) oblique view on the distal side.

1968–05–06 *Markalius circumradiatus* (STOVER, 1966–05–13) n. comb. – PERCH-NIELSEN (partim), p. 73, Text-fig. 36; Pl. 25, Fig. 2–7 (non Text-fig. 37; Pl. 26, Fig. 1–7).
1968–12–20 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – BLACK, Pl. 144, Fig. 5.
1968 *Cyclagelosphaera margereli* ? NOËL, 1965–09–30 – LEZAUD, p. 15; Pl. 1, Fig. 23.
1969–03–14 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – BUKRY, p. 29; Pl. 9, Fig. 5, 6.
1969–03–24 *Tergestiella barnesae* (BLACK, 1959–11–03) REINHARDT, 1964 – MICHAEL, p. 304, Text-fig. 2/1, 2/2.
1969 *Tergestiella margereli* (NOËL, 1965–09–30 n. comb. – SHUMENKO, p. 69; Pl. 1, Fig. 3.
1970–06–15 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – BLACK, p. 39; Pl. 3, Fig. 5.
1971–06–24 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – BLACK, Pl. 45.1, Fig. 11.
1971–09–03 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – ROOD, HAY & BARNARD, p. 270; Pl. 5, Fig. 8, 9.
1971 *Tergestiella* ? *margeli* (NOËL, 1965–09–30) n. comb. – REINHARDT, p. 29, Text-fig. 23.
1971 *Tergestiella* ? *reinhardtii* (PERCH-NIELSEN, 1968–05–06) n. comb. – REINHARDT, p. 29, Text-fig. 24; Pl. 1, Fig. 6.
1972–06 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – WILCOXON, Pl. 1, Fig. 4.
1972–09 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – ROTH & THIERSTEIN, Pl. 16, Fig. 19–22.
1972 *Cyclagelosphaera margereli* NOËL, 1965–09–30 – FORCHHEIMER, p. 33; Pl. 8, Fig. 6; Pl. 13, Fig. 4; Pl. 14, Fig. 1, 2.
1973–11–15 *Cyclagelosphaera casarubrensis* n. sp. – BLACK, p. 76; Pl. 25, Fig. 1, 2, 3.
1973–11–15 *Cyclagelosphaera puncta* n. sp. – BLACK, p. 76; Pl. 25, Fig. 13.
1973–11–15 *Cyclagelosphaera shenleyensis* n. sp. – BLACK, p. 78; Pl. 25, Fig. 10; Text-fig. 39.
1973–11–28 *Markalius circumradiatus* (STOVER, 1966–05–13) PERCH-NIELSEN, 1968–05–06 – PRIEWALDER, p. 20; Pl. 14, Fig. 1, 2.

Remarks: A characteristic feature of this species is the central cone, built up by a few irregularly arranged elements. This central cone covers a deep and narrow hole. The spherical coccosphere consists of 12 coccoliths.

Diameter of coccoliths: 4–10 µ; *diameter of coccospheres:* 8–15 µ.
Known range: Oxfordian–Maastrichtian.

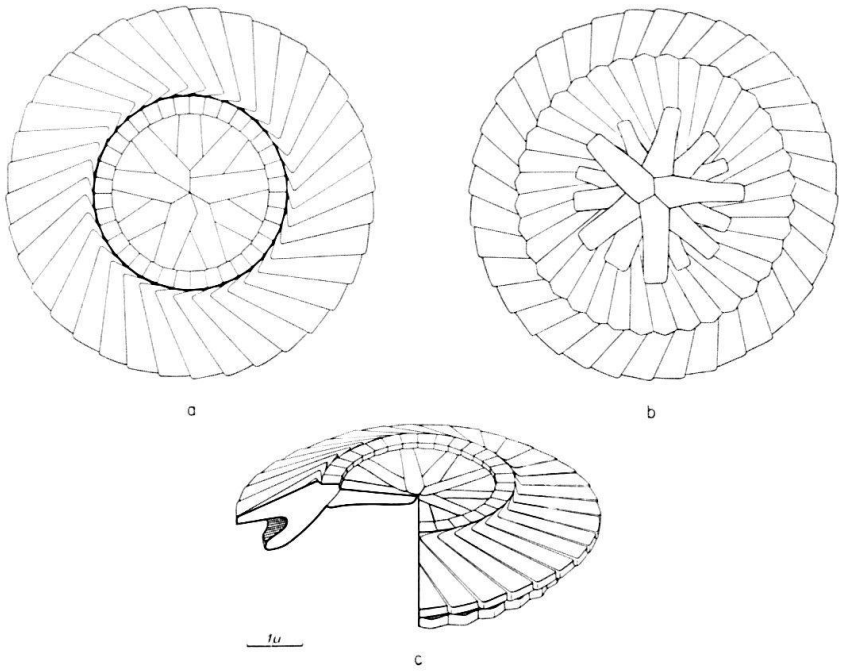

Fig. 11. Schematic drawings of *Cyclagelosphaera rotaclypeata* BUKRY, 1969.
a) distal view – b) proximal view – c) oblique view on the distal side.

Cyclagelosphaera rotaclypeata BUKRY, 1969–03–14

(Text-fig. 11; Pl. III, Fig. 4–6)

1965–12 *Cyclagelosphaera* aff. *margereli* n. sp. – NOËL, Pl. 18, Fig. 3.
1968–05–06 *Markalius circumradiatus* (STOVER, 1966–05–13) n. comb. – PERCH-NIELSEN (partim), p. 73, Text-fig. 37; Pl. 26, Fig. 3 (non Text-fig. 36; Pl. 2–7; Pl. 26, Fig. 1, 2, 4–7.)
1969–03–14 *Cyclagelosphaera rotaclypeata* n. sp. – BUKRY (partim), p. 30; Pl. 9, Fig. 8 (non Fig. 7).
1972–06 *Cyclagelosphaera rotaclypeata* BUKRY, 1969–03–14 – WILCOXON, Pl. 7, Fig. 5–7.
1972 *Markalius sulcatus* n. sp. – FORCHHEIMER, p. 36; Pl. 8, Fig. 5.
1973–11–15 *Cyclagelosphaera rotaclypeata* BUKRY, 1969–03–14 – BLACK, p. 76; Pl. 25, Fig. 4, 5.

Remarks: The distal shield of this nearly circular coccolith consists of a cycle of about 36 flat elements, showing left-handed imbrication and counter-clockwise precession. Inside this cycle is an additional cycle of flat elements, surrounding the central area. The elements of the central area are arranged radially and are also visible proximally.

Diameter: 4–9 μ; *diameter of the central area in % of coccolith diameter:* 32–45%.
First occurrence: NOËL (1965) – B. 13.358 – uppermost Portlandian, Kef Talrempt, Algeria. Miravetes – All 71.118 – upper Tithionian (*Jacobi*-zone; *C. alpina*-subzone).
Known range: Upper Tithonian – Campanian.

Family ***Podorhabdaceae*** NOËL, 1965–12

Type genus: *Podorhabdus* NOËL, 1965–12.

Remarks: Elliptical to nearly circular coccoliths with two shields. The distal shield consists of a single cycle of flat, straight, radially arranged elements, with only slight imbrication. The proximal shield is built up by two or more cycles of variously

shaped elements. The central area bears a crossbar. The single bars are almost always connected to the inner margin of the distal shield. Occasionally the normal linear elements of the central parts of the striated bars merge into granular elements which make the contact with the inner margin of the distal shield (*Perrissocyclus* BLACK, 1971; *Octocyclus* BLACK, 1972). The crossbar culminates in a hollow spine. The elements of this spine are arranged spirally. The quadrants between the bars may remain free, or they may be filled up by additional elements, giving rise to various patterns of openings and perforations. These openings are surrounded by individual cycles of elements. The elements of the central area are either connected directly with the inner margin of the distal shield or they are separated from it by an additional cycle of abcentrally sloping elements. The twofold symmetry axis of the central area, normally aligned with the axis of the ellipse, is occasionally disrupted (*Perissocyclus* BLACK, 1971).

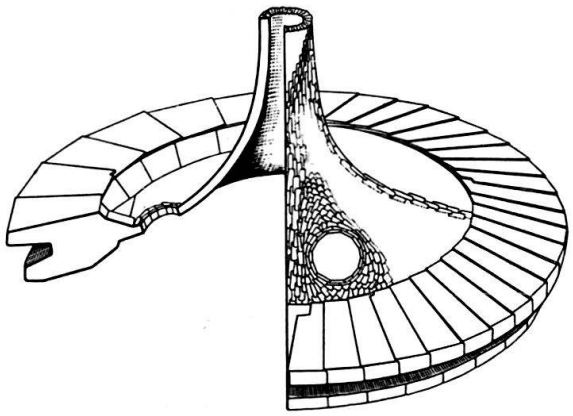

Fig. 12. Schematic drawings of the significant features of the family Podorhabdaceae NOËL, 1965.

Genus *Podorhabdus* NOËL, 1965–12

Type species: *Podorhabdus grassei* NOËL, 1965–12.

Remarks: According to NOËL (1965*b*) only forms with a crossbar aligned with the axes of the ellipse are included in this genus. BLACK (1972) has further restricted the genus to forms with only one opening in each quadrant between the bars. Coccoliths with more or less than 4 openings and an oblique crossbar must therefore be assigned to other genera. The distal shield consists of a single cycle of elements. The central process is a hollow spine.

Podorhabdus dietzmanni (REINHARDT, 1965) REINHARDT, 1967

(Pl. III, Fig. 7–9)

1965 *Ahmuellerella dietzmanni* n. sp. – REINHARDT, p. 30; Pl. 1, Fig. 1; Text-fig. 1.
1966–04–01 *Cretarhabdus dietzmanni* (REINHARDT, 1965) n. comb. – REINHARDT, p. 27; Pl. 22, Fig. 1.
1967 *Podorhabdus dietzmanni* (REINHARDT, 1965) n. comb. – REINHARDT, p. 169, Text-fig. 4.
1969–03–14 *Podorhabdus dietzmanni* (REINHARDT, 1965) n. comb. – BUKRY, p. 37; Pl. 16, Fig. 1–3.
1970 *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 – REINHARDT, p. 87, Text-fig. 107; Pl. 6, Fig. 4.
1971–06–24 *Podorhabdus* sp. indet. – BLACK, Pl. 45.4, Fig. 36.

1972–01–04 *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 – THIERSTEIN, p. 478; Pl. 8, Fig. 1–8.
1972–06 *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 – WILCOXON, Pl. 9, Fig. 7.
1972–11–09 *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 – BLACK, p. 33; Pl. 5, Fig. 1–5.
1972–11–09 *Podorhabdus* sp. cf. *P. septentrionalis* BLACK, 1971–07–02 – BLACK, p. 35; Pl. 6, Fig. 1–3.
1973–05–28 *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 – THIERSTEIN, p. 39; Pl. 3, Fig. 20.

Remarks: The first detailed description and documentation of this species was given by BUKRY (1969). REINHARDT (1970*b*) in his "Synopsis" accepts and repeats this account. According to BUKRY (1969), *P. dietzmanni* is distinguished from other species of this genus by two characteristic features. The outline of the coccolith is more elongated (e = 1,3–1,4). Between the distal shield and the central area an additional cycle of abcentrally sloped elements is inserted. It should be particularly noted that *P. dietzmanni* is distinguished from *P. albianus* BLACK, 1967, by these characters. Each shield in *P. dietzmanni* consists of a maximum of 48 elements in clockwise precession.

Major diameter: 10 μ.
First occurrence: Miravetes – All 71.109 – uppermost Tithonian (*Jacobi*-zone; *Cr. intermedia*-subzone).
Known range: Uppermost Tithonian – Campanian.

Podorhabdus albianus BLACK, 1967–05–31

1965–09 *Rhabdosphaera* sp. – BLACK, p. 132, Fig. 10.
1967–05–31 *Podorhabdus albianus* n. sp. – BLACK, p. 143 (Fig. 10, 1965–09).
1968–04–12 *Prediscosphaera ? orbiculofenestra* n. sp. – GARTNER, p. 21; Pl. 25, Fig. 23–25; Pl. 26, Fig. 8.
1972–01–04 *Podorhabdus orbiculofenestrus* (GARTNER, 1968–04–12) n. comb. – THIERSTEIN, p. 478; Pl. 8, Fig. 9–17.
1972–09 *Podorhabdus orbiculofenestrus* (GARTNER, 1968–04–12) THIERSTEIN, 1972–01–04) – RHOT & THIERSTEIN, Pl. 6, Fig. 1–7.
1972–11–09 *Podorhabdus albianus* BLACK, 1967–05–31 – BLACK, p. 33; Pl. 7, Fig. 1, 2, 4, 5; Text-fig 35.

Remarks: *P. albianus* differs from *P. dietzmanni* in that the former lacks an additional cycle of abcentrally sloping elements between the distal shield and the central area. *P. albianus* also has a lower eccentricity (e = 1,2–1,3).

Both BLACK and THIERSTEIN include *Rhabdosphaera* sp. of BLACK (1965) in the synonymy of forms here recognised as *P. albianus*. These forms are reported by BLACK and THIERSTEIN from the middle Albian for the first time.

Genus *Tetrapodorhabdus* BLACK, 1971–07–02

Type species: *Tetrapodorhabdus coptensis* BLACK, 1971–07–02.

Remarks: BLACK (1972) introduced this genus for Podorhabdaceae with an oblique crossbar in the central area, since the genus *Podorhabdus* is restricted to forms with a crossbar aligned with the axes of the ellipse. *Tetrapodorhabdus* also has only one opening in each quadrant of the central area.

Tetrapodorhabdus granulatus (REINHARDT, 1965) GRÜN, n. comb.

(Text-fig. 13; Pl. III, Fig. 10)

1965 *Ahmuellerella ? granulata* n. sp. – REINHARDT, p. 39; Pl. 1, Fig. 4.
1966–04–01 *Cretarhabdus ? granulatus* (REINHARDT, 1965) n. comb. – REINHARDT, p. 27; Pl. 8, Fig. 1.
1969–03–14 *Podorhabdus granulatus* (REINHARDT, 1965) n. comb. – BUKRY (partim), p. 37; Pl. 16, Fig. 4 (non Fig. 5, 6).
1970 *Podorhabdus granulatus* (REINHARDT, 1965) BUKRY, 1969–03–14 – REINHARDT, p. 88, Text-fig. 109.
1971–06–07 *Podorhabdus granulatus* (REINHARDT, 1965) BUKRY, 1969–03–14 – SHAFIK & STRADNER (partim), p. 85; Pl. 16, Fig. 1, 3 (non Fig. 2).
1972–09 *Podorhabdus decorus* (DEFLANDRE, 1955–03–08) n. comb. – THIERSTEIN, in ROTH & THIERSTEIN, p. 437; Pl. 4, Fig. 7, 8, 10–13.
1972–11–09 *Tetrapodorhabdus coptensis* BLACK, 1971–07–02 – BLACK (partim), p. 39; Pl. 9, Fig. 1, 3 (non Fig. 2, 4, 5).
1973–11–28 *Podorhabdus granulatus* (REINHARDT, 1965) BUKRY, 1969–03–14 – PRIEWALDER, p. 22; Pl. 15, Fig. 5, 6.

Remarks: There is a continuous transition from forms with a central cross consisting of two perpendicular bars, to forms with an X-shaped crossbar, and further to forms where the bars are united to form a single bridge aligned with the short axis of the ellipse. The following limits are proposed to distinguish among these forms (see Fig. 13). Forms with a ratio *a/b* less than 2 are assigned to *T. granulatus* (REINHARDT, 1965). If the ratio *a/b* is 2 or more, the forms belong to *T. coptensis* BLACK, 1971. If the bars are united to a single bridge aligned with the short axis of the ellipse, leaving only two openings in the central area, the conditions for the genus *Hemipodorhabdus* BLACK, 1971, are satisfied. *Grantarhabdus coronadventis* (REINHARDT, 1966) also has an oblique crossbar but it differs from *P. albianus* in having a bi-cycle distal shield. *G. coronadventis* and the synonymous species *Cretarhabdus unicornis* STOVER, 1966, therefore belong to the family Retecapsaceae. The coccolith in Fig. 4, Pl. 9, of BLACK (1972) shows a mono-cycle proximal shield ,which is a feature of the family Retecapsaceae and not of the family Podorhabdaceae.

Major diameter: 10 μ.
First occurrence: Miravetes – All 70.90 – middle Berriasian (*Privasensis*-zone; *C. elliptica*-subzone).
Known range: Middle Berriasian – Maastrichtian.

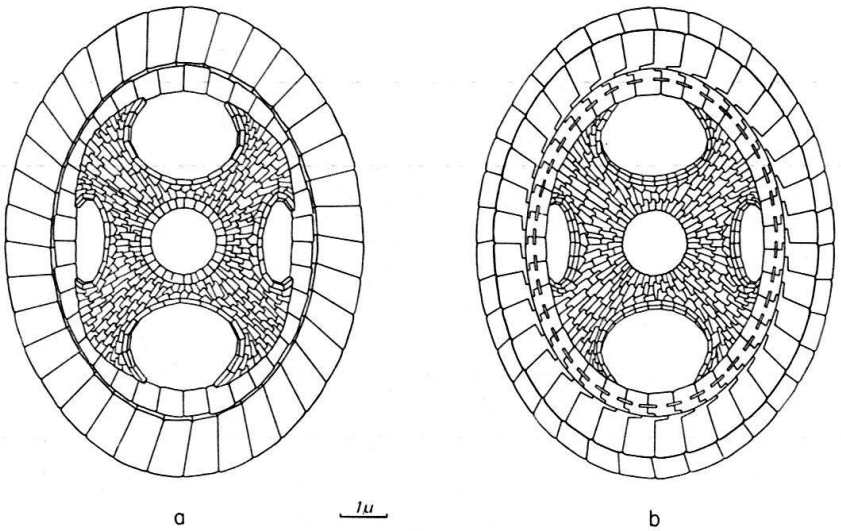

Fig. 13. Schematic drawings of *Tetrapodorhabdus granulatus* (REINHARDT, 1965) GRÜN n. comb. a) distal view – b) proximal view.

Tetrapodorhabdus coptensis BLACK, 1971–07–02

(Pl. III, Fig. 11, 12)

1969–03–14 *Podorhabdus granulatus* (RHEINHARDT, 1965) n. comb. – BUKRY (partim), p. 37; Pl. 16, Fig. 5, 6 (non Fig. 4).
non 1969 *Podorhabdus gorkae* n. sp. – REINHARDT, p. 933; Pl. 1, Fig. 1, 2.
1970 *Podorhabdus gorkae* REINHARDT, 1969 – REINHARDT (partim), p. 87, Text-fig. 108; Pl. 7, Fig. 8 (non Pl. 6, Fig. 7, 8).
1971–06–07 *Podorhabdus granulatus* (REINHARDT, 1965) BUKRY, 1969–03–14 – SHAFIK & STRADNER (partim), p. 85; Pl. 16, Fig. 2 (non Fig. 1, 3).
1971–07–02 *Tetrapodorhabdus coptensis* n. sp. – BLACK, p. 411; Pl. 31, Fig. 7.
1971–07–02 *Tetrapodorhabdus hunmanbiensis* n. sp. – BLACK, p.411; Pl. 31, Fig. 8.
1972–06 *Podorhabdus gorkae* REINHARDT, 1969 – WILCOXON, Pl. 6, Fig. 1, 2.
1972–11–09 *Hemipodorhabdus biforatus* n. sp. – BLACK (partim), p. 37; Pl. 10, Fig. 6, 9 (non Fig. 7, 8, 10).
1972–11–09 *Tetrapodorhabdus coptensis* BLACK, 1971–07–02 – BLACK (partim), p. 39; Pl. 9, Fig. 2, 5 (non Fig. 1, 3, 4).

Remarks: See Text-fig. 14 and remarks on *T. granulatus*. *Podorhabdus gorkae* REINHARDT, 1969, has only 2 large openings in the central area and must therefore be assigned to the genus *Hemipodorhabdus* BLACK, 1972. The holotype of *Hemipodorhabdus biforatus* BLACK, 1972, has 4 openings and all the other features of *T. coptensis* with which it is synonymous. I can not see any differences between *T. coptensis* BLACK, 1971, and *Tetrapodorhabdus hunmanbiensis* BLACK, 1971.

Major diameter: 8,5 μ.
First occurrence: Miravetes – All 70.90 – middle Berriasian (*Privasensis-zone*; *C. elliptica*-subzone).
Known range: Middle Berriasian.

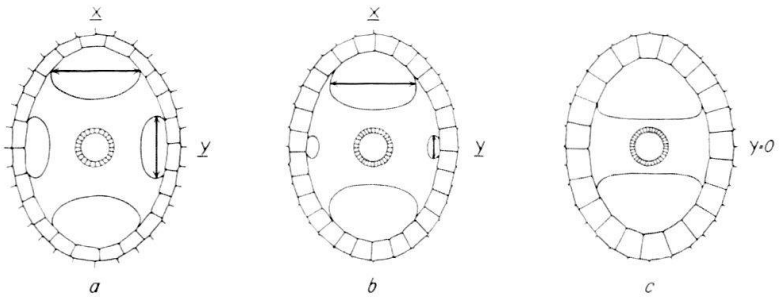

Fig. 14. Schematic drawings of the central area.
a) *Tetrapodorhabdus granulatus* x:y > 1, < 2; b) *Tetrapodorhabdus coptensis* x:y = 2 and more; c) Genus *Hemipodorhabdus* y = 0.

Genus *Hemipodorhabdus* BLACK, 1971–07–02

Type species: *Hemipodorhabdus gorkae* (REINHARDT, 1969) GRÜN, n. comb. = *Hemipodorhabdus latiforatus* BLACK, 1971–07–02.

Hemipodorhabdus gorkae (REINHARDT, 1969) GRÜN, n. comb.

1969 *Podorhabdus gorkae* n. sp. – REINHARDT, p. 933; Pl. 1, Fig. 1, 2.
1970 *Podorhabdus gorkae* REINHARDT, 1969 – REINHARDT (partim), p. 87; Pl. 6, Fig. 7, 8 (non Text-fig. 108; Pl. 7, Fig. 8).
1971–07–02 *Hemipodorhabdus latiforatus* n. sp. – BLACK, p. 404; Pl. 31, Fig. 6.
1972–11–09 *Hemipodorhabdus biforatus* n. sp. – BLACK (partim), p. 37, Pl. 10, Fig. 7 (non Fig. 6, 8–10).

Remarks: This species was not found in our samples.

Hemipodorhabdus niger GRÜN, n. sp.

1972–11–09 *Hemipodorhabdus biforatus* n. sp. – BLACK (partim), p. 37; Pl. 10, Fig. 8, 10 (non Fig. 6, 7, 9).

Derivation of name: Latin niger, black.
Holotype: BLACK, 1972–11–09, Pl. 10, Fig. 10; SM 27734.
Type level: Lower Gault, Bed VII.
Type locality: Folkstone (H. 1018).
Depository: The original negatives are by Mr. Derek Stubbings, the prints by Miss Judith Bragg (Mrs. Rolfe), Sedgwick Museum, Cambridge, CB2 3EQ, Great Britain.

Description: A species of the genus *Hemipodorhabdus* BLACK, 1972, with two circular openings lying on the long axis of the ellipse. The broad bridge, aligned with the short axis of the ellipse, is built up of relativelly large elements. This bridge bears no central process and it is not pierced by a central opening. *H. niger* differs in this respect from *Hemipodorhabdus gorkae* (REINHARDT, 1969) GRÜN, n. comb.

Remarks: Since the holotype of *Hemipodorhabdus biforatus* BLACK, 1972 (Fig. 6), is referred to *Tetrapodorhabdus coptensis*, *H. biforatus* is not a valid species. Two of the other specimens figured by BLACK (1972) cannot be assigned to any species so far described. *Hemipodorhabdus niger*, which could not be found in our material, is introduced for these specimens.

Family ***Retecapsaceae*** GRÜN, n. fam.

Describtion: A new family with the features of the two subfamilies Retecapsoideae BLACK, 1972, and Helenoideae GRÜN, n. subfam.

Subfamily ***Retecapsoideae*** BLACK, 1972–11–09

Type genus: *Retecapsa* BLACK, 1971–07–02, emend. GRÜN.

Description: Elliptical to almost circular coccoliths with two shields. The distal shield consists of two cycles of flat, straight, and slightly imbricated elements. The outer cycle often forms a very thin rim around the massive inner cycle. The suture are straight and often precess counter-clockwise, as seen from the distal side. The elements of the mono-cycle proximal shield precess – in proximal view – clockwise. The central area is covered by a striated bridge or crossbar. Sometimes these structures are hidden by flat, rhomboidal cover plates, The single bars are connected to the inner margin of the distal shield, overlapping it occasionally. The quadrants between the bars can remain free. Often, of course, the spaces are filled up by additional elements, leaving various patterns of openings and perforations. The openings are never surrounded by individual cycles of elements. The crossbar in the central area is surmounted of a solid spine, constructed of radially, but not spirally arranged elements of various lengths. Occasionally this solid spine is replaced by a knob or boss consisting of 4 relatively large elements. The central process can be absent (*Speetonia* BLACK, 1971; *Cruciellipsis* THIERSTEIN, 1972). In most species, the cocco-

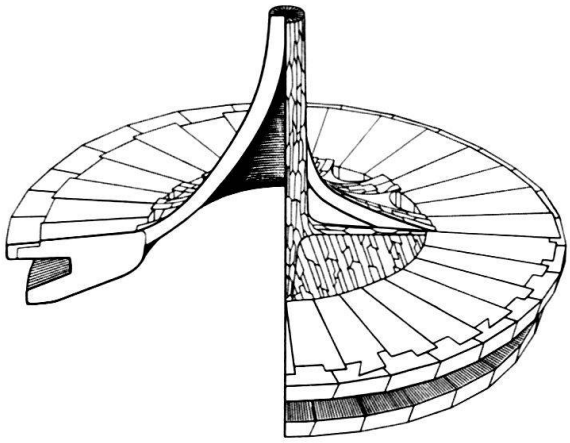

Fig. 15. Schematic drawings of the significant features of the family Retecapsaceae GRÜN n. fam.

liths are symmetrical, with the same numbers of openings in each of the four quadrants of the central area. However, in some cases, the numbers of openings in adjacent quadrants are dissimilar, but the numbers of opposite quadrants remain identical. Exceptionally the symmetry is disturbed by an eccentric position of the central process (*Cretarhabdella* BLACK, 1971).

Genus *Retecapsa* BLACK, 1971–07–02, emend. GRÜN

Type species: *Retecapsa brightoni* BLACK, 1971–07–02.

Description: According to BLACK (1971*b*) this genus is restricted to forms with 8 openings situated at the outher margin of the central are. The openings are separated by 4 massive striated principal bars, on the axes of the ellipse, and two pairs of unstriated lateral bars. I am here extending this diagnosis to forms with more than 8 openings lying in a cycle at the outer margin of the central area. In such cases the number of pairs of unstriated lateral bars increases to 4, 6, etc. This makes it possible to include species like *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964, and *Discolithus surirella* DEFLANDRE, 1955, in this genus. Otherwise, a new genus is necessary for these species.

Retecapsa angustiforata BLACK, 1971–07–02

(Text-fig. 16; Pl. IV, Fig. 1–3)

1968–04–12 *Cretarhabdus* sp. cf. *C. crenulatus* BRAMLETTE & MARTINI, 1964–08–24 – GARTNER (partim), Pl. 20, Fig. 10 (non Fig. 11).
1969–03–14 *Cretarhabdus crenulatus crenulatus* BRAMLETTE & MARTINI, 1964–08–24 n. ssp. – BUKRY, p. 35; Pl. 14, Fig. 4–6.
1969–06 *Cretarhabdus* sp. cf. *C. crenulatus* BRAMLETTE & MARTINI, 1964–08–24 – BUKRY & BRAMLETTE, Pl. 3, Fig. B.
1970 *Cretarhabdus schizobrachiatus* (GARTNER, 1968–04–12) n. comb. – REINHARDT (partim), p. 50; Pl. 1, Fig. 5 (non Text-fig. 21; Pl. 1, Fig. 4).
1971–06–07 *Polypodorhabdus schizobrachiatus* (GARTNER, 1968–04–12) n. comb. – SHAFIK & STRADNER (partim), p. 87; Pl. 15, Fig. 2 (non Fig. 1, 3).
1971–07–02 *Retecapsa angustiforata* n. sp. – BLACK, p. 409; Pl. 33, Fig. 4.
1971–07–02 *Retecapsa levis* n. sp. – BLACK, p. 410; Pl. 33, Fig. 1.

1971–07–02 *Retecapsa neocomiana* n. sp. – BLACK, p. 410; Pl. 33, Fig. 2.
1972–01–04 *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964–08–24, emend. – THIERSTEIN, p. 476; Pl. 5, Fig. 10–14.
1972–06 *Octopodorhabdus praevisus* NOËL, 1965–09–30 – WILCOXON, Pl. 5, Fig. 7.
1972–09 *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964–08–24, emend. THIERSTEIN, 1972–01–04 – ROTH & THIERSTEIN (partim), Pl. 5, Fig. 11, 12 (non Fig. 10).
1972 *Cretarhabdus octoperforatus* n. sp. – FORCHHEIMER, p. 51; Pl. 20, Fig. 1, 2.
1972 *Cretarhabdus ingens* (GÓRKA, 1957–03) REINHARDT & GÓRKA. 1967–12–20 – HOFFMANN, p. 49; Pl. 10, Fig. 3; Pl. 12. Fig. 3, 4.
1973–11–15 *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964–08—24 – BLACK, p. 52; Pl. 17, Fig. 7 (transition to *R. crenulata*), Pl. 19, Fig. 5, 7, 8.

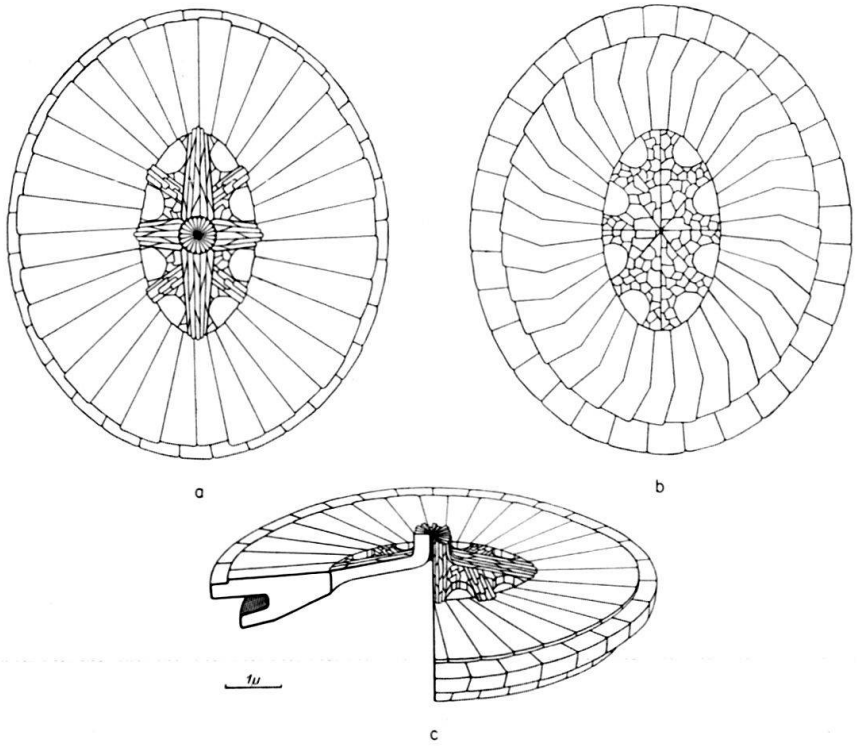

Fig. 16. Schematic drawings of *Retecapsa angustiforata* BLACK, 1971.
a) distal view – b) proximal view – c) oblique view on the distal side.

Remarks: The 8 openings, arranged in a cycle around the outer margin of the central area, are separated by four massive striated bars, aligned with the axes of the ellipse, and two pairs of unstriated lateral bars. The base of a solid spine is always present. The distal and the proximal shields each consist of 25 to 32 elements, which are – in distal view – in counter-clockwise precession.

There is a continuous transition from *R. angustiforata* BLACK, 1971, to *Retecapsa schizobrachiata* (GARTNER, 1968) For the limits which are set to separate these two species, see Text-fig. 17.

Major diameter: 5,5–9 µ; *minor diameter:* 4–7,5 µ; *major diameter of central area in % of coccolith major diameter:* 38–49%; *minor diameter of central area in % of coccolith minor diameter:* 30–40%.
First occurrence: Miravetes – All 71.140 – lower Berriasian (*Euxina*-zone; *C. alpina*-subzone).
Known range: Lower Berriasian – Maastrichtian.

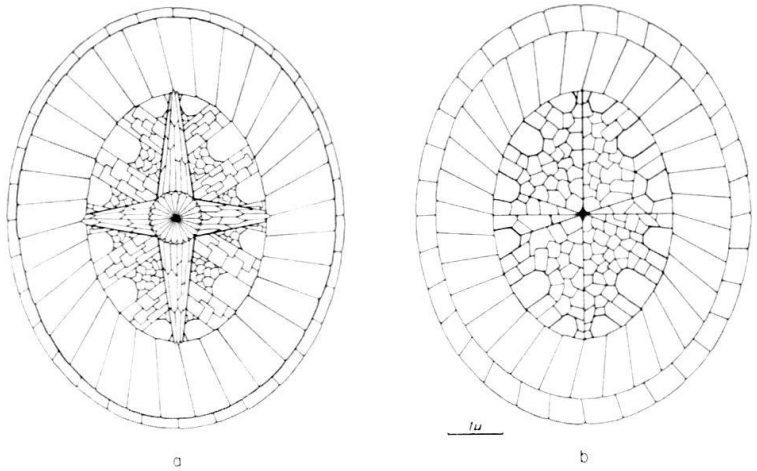

Fig. 17. Schematic drawings of the central area.
a) *Retecapsa angustiforata* x:y < 2; b) *Retecapsa schizobrachiata* x:y > 2.

Retecapsa schizobrachiata (GARTNER, 1968–04–12) GRÜN, n. comb.

1968–04–12 *Vekshinella schizobrachiata* n. sp. – GARTNER, p. 31; Pl. 13, Fig. 10, 11; Pl. 20, Fig. 5.
1969–03–14 *Cretarhabdus schizobrachiatus* (GARTNER, 1968–04–12) n. comb. – BUKRY, p. 36; Pl. 15, Fig. 4–6.
1970 *Cretarhabdus schizobrachiatus* (GARTNER, 1968–04–12) BUKRY, 1969–03–14 – REINHARDT (partim), p. 50, Text-fig. 21; Pl. 1, Fig. 4 (non Fig. 5.)
1971–06–07 *Polypodorhabdus schizobrachiatus* (GARTNER, 1968–04–12) n. comb. – SHAFIK & STRADNER (partim), p. 87; Pl. 15, Fig. 1–3 (non Fig. 2).
1971 *Cretarhabdus schizobrachiatus* (GARTNER, 1968–04–12) BUKRY, 1969–03—14 – MANIVIT, p. 97; Pl. 7, Fig. 15, 16.

Remarks: See Text-fig. 17 and the remarks on *R. angustiforata*. *R. schizobrachiata* was not found in our samples.

Retecapsa crenulata (BRAMLETTE & MARTINI, 1964–08–24) GRÜN, n. comb.

(Text-fig. 18; Pl. IV, Fig. 4–6)

1964–08–24 *Cretarhabdus crenulatus* n. sp. – BRAMLETTE & MARTINI, p. 300; Pl. 2, Fig. 21, 22–24.
1966–09–30 *Cretarhabdus romani* (GÓRKA, 1957–03) n. comb. – STRADNER, in MARESCH (partim), p. 378; Pl. 1, Fig. 4 (non Fig. 3).
1968–03–21 *Cretarhabdus romani* (GÓRKA, 1957–03) STRADNER, 1966–09–30 – STRADNER, ADAMIKER & MARESCH (partim), p. 30; Pl. 16, Fig. 1 (non Pl. 15, Fig. 1, 2; Pl. 16, Fig. 2–6; Pl. 17, Fig. 1–5).
1968–04–12 *Cretarhabdus conicus* BRAMLETTE & MARTINI, 1964–08–24 – GARTNER (partim), p. 21; Pl. 4, Fig. 9–11 (non Pl. 1, Fig. 10, 11; Pl. 3, Fig. 5, 6; Pl. 4, Fig. 12; Pl. 6, Fig. 3, 4; Pl. 11, Fig. 12; Pl. 14, Fig. 7–9; Pl. 15, Fig. 9; Pl. 16, Fig. 12, 14; Pl. 17, Fig. 10; Pl. 20, Fig. 8, 9; Pl. 22, Fig. 20, 12; Pl. 24, Fig. 11; Pl. 25, Fig. 3,4).
1968–05–06 *Polypodorhabdus crenulatus* (BRAMLETTE & MARTINI, 1964–08–24 n. comb. – PERCH-NIELSEN (partim), p. 48; Pl. 11, Fig. 2 (non Text-fig. 18; Pl. 11, Fig. 3–5).
1968–05–06 *Polypodorhabdus actinosus* (STOVER, 1966–05–13) n. comb. – PERCH-NIELSEN (partim), p. 50; Pl. 10, Fig. 1–3 (nonText-fig. 19; Pl. 10, Fig. 4–6).
1968–12–20 *Cretarhabdus* sp. – BLACK, pl. 150, Fig. 4.
1969–03–14 *Cretarhabdus crenulatus hansmanni* n. ssp. – BUKRY, p. 35; Pl. 14, Fig. 7, 8, 9.
1970–06 *Stradneria crenulata* (BRAMLETTE & MARTINI, 1964–08–24) n. comb. – NOËL (partim), p. 55; Pl. 13, Fig. 5 (non Pl. 17, Fig. 3).

1970 *Cretarhabdus surirellus* (DEFLANDRE & FERT, 1955–03–08) n. comb. – REINHARDT (partim), p. 50; Pl. 2, Fig. 2 (non Text-fig. 22; Pl. 1, Fig. 6–8; Pl. 2, Fig. 1, 3–6).

1971–06–07 *Polypodorhabdus crenulatus* (BRAMLETTE & MARTINI, 1964–08–24) PERCH-NIELSEN, 1968–05–06 – SHAFIK & STRADNER (partim), p. 85; Pl. 13, Fig. 3, 4 (non Pl. 12, Fig. 1, 2; Pl. 13, Fig. 1, 2).

1971–06–24 *Cretarhabdus* sp. indet. – BLACK, Pl. 45.4, Fig. 39.

1972 *Cretarhabdus actinosus* (STOVER, 1966–05–13) n. comb. – FORCHHEIMER, p. 49; Pl. 19, Fig. 4.

1972 *Cretarhabdus conicus* BRAMLETTE & MARTINI, 1964–08–24 – HOFFMANN (partim), p. 47; Pl. 11, Fig. 1, 2, 5 (non Fig. 3, 4).

1972 *Cretarhabdus romani* (GÓRKA, 1957–03) STRADNER, 1966–09–03 – HOFFMANN, p. 50; Pl. 12, Fig. 1, 2 (transition to *R. angustiforata*).

1973–11–15 *Cretarhabdus actinosus* (STOVER, 1966–05–13) FORCHHEIMER, 1972 – BLACK, p. 49; Pl. 18, Fig. 5, 6, 7 (transition to *R. angustiforata*), 8.

1973–11–15 *Cretarhabdus biseriatus* FORCHHEIMER, 1972 – BLACK, p. 50; Pl. 17, Fig. 8, 9.

1973–11–15 *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964–08–24 – BLACK (partim), p. 52; Pl. 17, Fig. 7 (transition to *R. angustiforata*) (non Pl. 19, Fig. 5, 7, 8).

1973–11–15 *Cretarhabdus leporarii* n. sp. – BLACK, p. 52; Pl. 18, Fig. 1(?), 2, 3 (transition to *R. surirella*), 4.

1973–11–28 *Cretarhabdus crenulatus* BRAMLETTE & MARTINI, 1964–08–24 – PRIEWALDER, p. 17; Pl. 6, Fig. 5, 6.

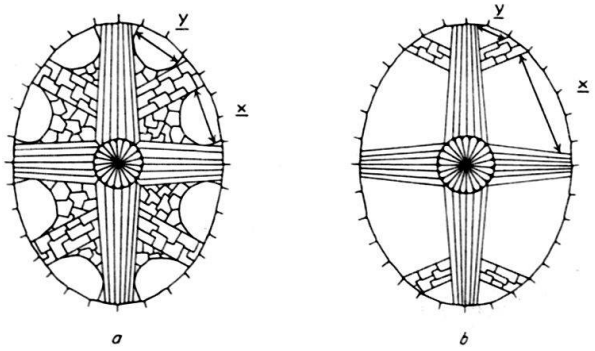

Fig. 18. Schematic drawings of *Retecapsa crenulata* (BRAMLETTE & MARTINI, 1964) GRÜN n. comb. a) distal view – b) proximal view.

Remarks: The 12 openings, arranged in a cycle around the outer margin of the central area, are separated by four massive striated bars, aligned with the axes of the ellipse, and 4 pairs of unstriated lateral bars.

There is a continuous transition from *R. crenulata* to *Allemannites romani* (GÓRKA, 1957) GRÜN, n. comb. and further to *Allemannites pienaari* (SHAFIK & STRADNER, 1971) GRÜN, n. comb. (see Text-fig. 19).

Major diameter: 4–7 μ; *minor diameter:* 3,5–5 μ; *major diameter of central area in % of coccolith major diameter:* 48–55%; *minor diameter of central area in % of coccolith minor diameter:* 40–52 %.
First occurrence: Miravetes – All 71.197 – upper Berriasian (*Picteti-malbosi*-zone; *Cps. simplex*-subzone).
Known range: Upper Berriasian – Maastrichtian.

Retecapsa surirella (DEFLANDRE & FERT, 1955–03–08) GRÜN, n. comb.

1955–03–08 *Discolithus surirella* n. sp. – DEFLANDRE & FERT, p. 144; Fig. 30, 31.

1970 *Cretarhabdus surirellus* (DEFLANDRE & FERT, 1955–03–08) n. comb. – REINHARDT (partim), p. 50; Pl. 2, Fig. 3 non Text-fig. 22; Pl. 1, Fig. 6–8; Pl. 2, Fig. 1, 2, 4–6).

1972–01–04 *Cretarhabdus surirellus* (DEFLANDRE & FERT, 1955–03–08) REINHARDT, 1970 – THIERSTEIN (partim), p. 477; Pl. 6, Fig. 2–6 (non Fig. 1).
1972 *Cretarhabdus biseriatus* n. sp. – FORCHHEIMER, p. 50 Pl. 19, Fig. 5, 6; Pl. 21, Fig. 6.
1973–11–15 *Cretarhabdus cantianus* n. sp. – BLACK, p. 51; Pl. 18, Fig. 12–14, 15.

Remarks: The 16 openings, arranged in a cycle around the outer margin of the central area, are separated by four massive striated bars, aligned with the axes of the ellipse, and 6 pairs of unstriated lateral bars.

R. surirella first occurs in the middle Valanginian of the "Middle-Ridge"-section.

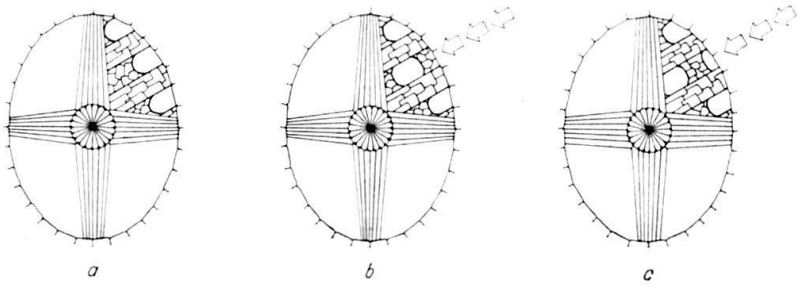

Fig. 19. Schematic drawings of the central area.
a) *Retecapsa crenulata*. All openings are situated at the margin of the central area.
b) *Allemannites romani*. The middle opening of each quadrant moves towards the center. The opening is separated from the margin by additional elements.
c) *Allemannites pienaari*. An additional opening appears at the margin of the central area.

Genus *Allemannites* GRÜN, n. gen.

Type species: *Allemannites striatus* (STRADNER, 1963–06–05) GRÜN, n. comb. = *Arkhangelskiella striata* STRADNER, 1963–06–05.

Description: A new genus of the subfamily Retecapsoideae with the following features: The central area has a striated crossbar aligned with the axes of the ellipse. In each of the resulting quadrants there is a grid of unstriated lateral bars, as in the genus *Polypodorhabdus*. The spaces between these lateral bars are subdivided by additional small elements. The resulting perforations lie close to a straight line which is generally perpendicular to the lateral bars. The perforations of the genus *Cretarhabdus* are situated in concentric rings around the central process. The base of a solid spine is always present.

Allemannites striatus (STRADNER, 1963–06–05) GRÜN, n. comb.

1963–06–05 *Arkhangelskiella striata* n. sp. – STRADNER, p. 176; Pl. 1, Fig. 1.
1966–05–13 *Arkhangelskiella striata* STRADNER, 1963–06–05 – STOVER, p. 137, Pl. 2, Fig. 3, 4.
1968–04–12 *Cretarhabdus loriei* n. sp. – GARTNER, p. 21; Pl. 24, Fig. 9, 10.
1969–03–14 *Cretarhabdus loriei* GARTNER, 1968–04–12 – BUKRY, p. 36; Pl. 15, Fig. 1–3.
1971 *Cretarhabdus loriei* GARTNER, 1968–04–12 – MANIVIT, p. 96; Pl. 16, Fig. 11–14.
1973–05–28 *Cretarhabdus loriei* GARTNER, 1968–04–12 – THIERSTEIN, p. 40; Pl. 4, Fig. 1–5.
1973–11–15 *Cretarhabdus striatus* (STRADNER, 1963–06–05) n. comb. – BLACK (partim), p. 53: Pl. 17, Fig. 3–6 (non Fig. 10, 11).
1973–11–28 *Cretarhabdus conicus* BRAMLETTE & MARTINI, 1964–08–24 – PRIEWALDER (partim), p. 17; Pl. 7, Fig. 4 (non Fig. 1–3).

Remarks: *A. striatus* first occurs in the upper Aptian.

Allemannites romani (GÓRKA, 1957–03) GRÜN, n. comb.

1957–03 *Tremalithus romani* n. sp. – GÓRKA, p. 246, 271; Pl. 2, Fig. 5.
1966–09–30 *Cretarhabdus romani* (GÓRKA, 1957–03) n. comb. – STRADNER, in MARESCH (partim), (p. 378; Pl. 1, Fig. 3 (non Fig. 4).
1968–03–21 *Cretarhabdus romani* (GÓRKA, 1957–03) STRADNER, 1966–09–30 – STRADNER, ADAMIKER & MARESCH (partim), p. 30; Pl. 15, Fig. 1, 2; Text-fig. 5/1 (non Pl. 16, fig. 1–6; Pl. 17, Fig. 1–5).
1973–11–15 *Cretarhabdus triforatus* n. sp. – BLACK, p. 55; Pl. 19, Fig. 1, 2–4, 9.

Remarks: *A. romani* first occurs in the middle Albian.

Allemannites pienaari (SHAFIK & STRADNER, 1971–06–07) GRÜN, n. comb.

1969 *Cretarhabdus decorus* (DEFLANDRE, in DEFLANDRE & FERT, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – PIENAAR (partim), p. 92; Pl. 8, Fig. 8 (non Pl. 2, Fig. 2, 4; Pl. 11, Fig. 8).
1971–06–07 *Polypodorhabdus pienaari* n. sp. – SHAFIK & STRADNER, p. 86, Text-fig. 4; Pl. 14, Fig. 1–4.

Remarks: *A. pienaari* is only known from the Maastrichtian.

Genus *Speetonia* BLACK, 1971–07–02

Type species: *Speetonia colligata* BLACK, 1971–07–02.

Remarks: The free central area is crossed by a single bridge, which is not surmounted by any kind of central process. The bridge is not necessarily aligned with the short axis of the ellipse in the genus *Speetonia*.

Speetonia colligata BLACK, 1971–07–02

(Text-fig. 20; Pl. IV, Fig. 7–8)

1966–04–01 *Zygodiscus pontilicus* (DEFLANDRE, in DEFLANDRE & FERT, 1955–03–08) n. comb. – REINHARDT, p. 40; Pl. 10, Fig. 3.
1971–07–02 *Speetonia colligata* n. sp. – BLACK, p. 413; Pl. 34, Fig. 10.
1971–07–02 *Speetonia nitida* n. sp. – BLACK, p. 414; Pl. 34, Fig. 11.
1962–01–04 *Bipodorhabdus roeglii* n. sp. – THIERSTEIN, p. 476; Pl. 1, Fig. 7, 8–11.
1972–06 *Zygodiscus acanthus* (REINHARDT, 1965) REINHARDT, 1966–04–01 – WILCOXON, Pl. 8, Fig. 4.
1973–05–28 *Bipodorhabdus roeglii* THIERSTEIN, 1972–01–04 – THIERSTEIN, p. 40.

Remarks: The central area is crossed by a bridge consisting of numerous elongate elements, which are covered by a small number of flat, rhomb-shaped plates. The striation of the bridge depends on the state of preservation. Since *Sp. nitida* differs from *Sp. colligata* only in that the former lacks this striation, and since *Sp. nitida* is based only on a single specimen, I unite both species under the name of the type species.

Major diameter: 8–12 μ; *minor diameter:* 6,5–9,5 μ; *major diameter of central area:* 5–7 μ; *minor diameter of central area:* 2,7–4,7 μ.
First occurrence: After BLACK (1971 b) – Berriasian – Speeton Clay, Great Britain. After THIERSTEIN (1972) – upper Valanginian – France. Miravetes – All 71.197 – upper Berriasian (*Picteti-malbosi*-zone; *Cps. simplex*-subzone).
Known range: Berriasian – Hauterivian.

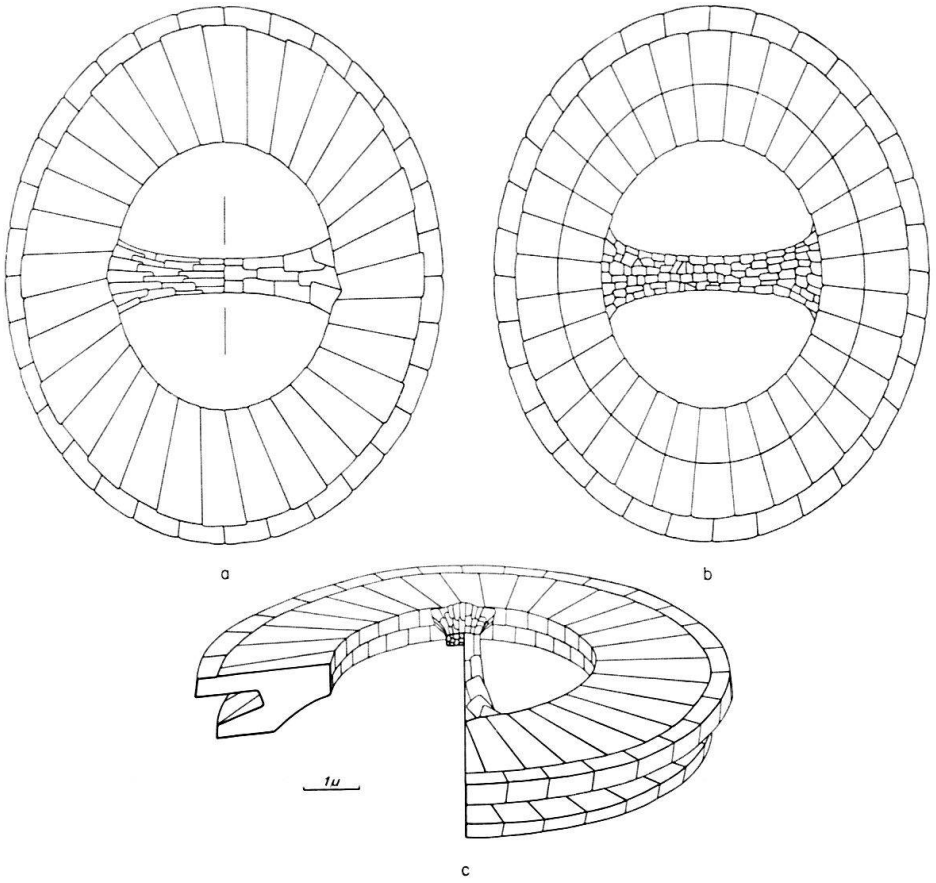

Fig. 20. Schematic drawings of *Speetonia colligata* BLACK, 1971.
a) distal view – b) proximal view – c) oblique view on the distal side.

Genus *Cruciellipsis* THIERSTEIN, 1972–01–04

Type species: *Cruciellipsis cuvillieri* (MANIVIT, 1966–06–20) THIERSTEIN, 1972–01–04, = *Coccolithus cuvillieri* MANIVIT, 1966–06–20.

Remarks: The central area has a massive crossbar aligned with the axes of the ellipse. This genus has no central process. Otherwise similar forms with a central process are assigned to the genus *Microstaurus* BLACK, 1971. The genus *Grantarhabdus* BLACK, 1971, has an oblique crossbar, while the genus *Helenea* WORSLEY, 1971, differs from *Cruciellipsis* in the complicated structure of its distal shield.

Cruciellipsis cuvillieri (MANIVIT, 1966–06–20) THIERSTEIN, 1972–01–04

(Text-fig. 21; Pl. IV, Fig. 9–12)

1966–06–20 *Coccolithus cuvillieri* n. sp. – MANIVIT, p. 268, Fig. 2, 3.
1969–06 ? *Cruciplacolithus* sp. – BUKRY & BRAMLETTE, Pl. 3, Fig. C, D; Pl. 5, Fig. C.
1971–07–02 *Cruciplacolithus pinnatus* n. sp. – BLACK, p. 397; Pl. 30, Fig. 5.
1972–01–04 *Cruciellipsis cuvillieri* (MANIVIT, 1966–06–20) n. comb. – THIERSTEIN, p. 478; Pl. 5, Fig. 4–8.
1972–01–12 *Crucidiscus andrusovi* n. sp. – LAUER, in GRÜN et al., p. 156; Pl. 25, Fig. 1, 2.
1972–06 *Cruciplacolithus cuvillieri* (MANIVIT, 1966–06–20) n. comb. – WILCOXON (partim), p. 431 Pl. 4, Fig. 4 (non Fig. 3).

1973–01 *Cruciellipsis cuvillieri* (MANIVIT, 1966–06–20) THIERSTEIN, 1972–01–04 – STRADNER (partim), Pl. 50, Fig. 4 (non Pl. 49, Fig. 3).

Remarks: The distal shield consists of two cycles of radially arranged or slightly counter-clockwise precessed elements. The outer cycle forms a very thin rim around the massive inner cycle. This outer cycle may be dissolved by corrosion or thickened by overgrowth. The central area bears a very massive crossbar, leaving four narrow openings. *C. cuvillieri* has no central process. Each cycle of elements, on both sides, consists of 26 to 32 elements. The elements of the proximal shield are – in proximal view – precessed counter-clockwise.

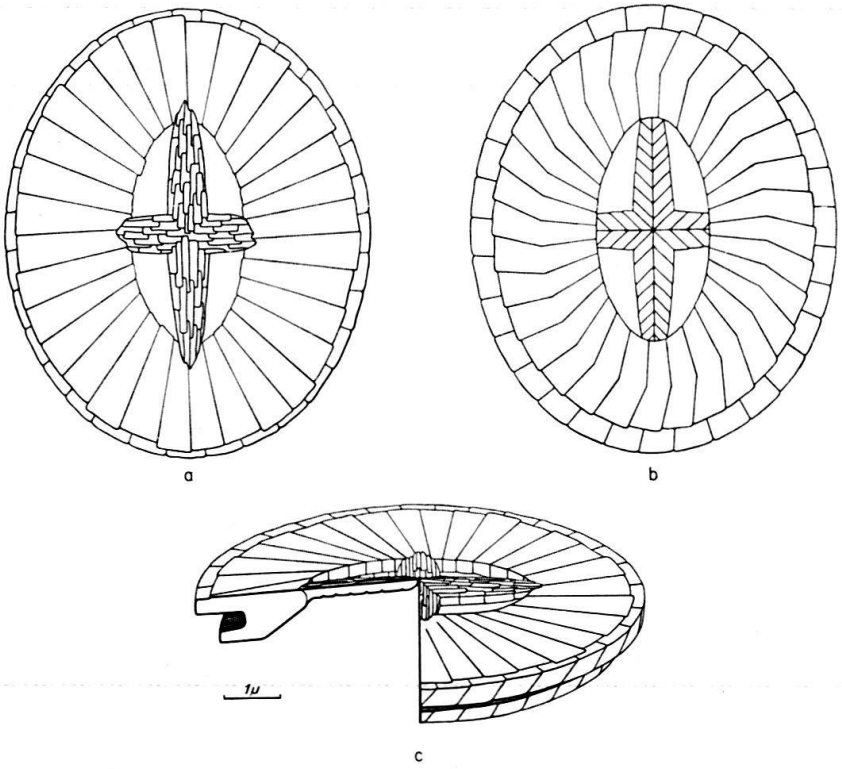

Fig. 21. Schematic drawings of *Cruciellipsis cuvillieri* (MANIVIT, 1966) THIERSTEIN, 1972.
a) distal view – b) proximal view – c) oblique view on the distal side.

Major diameter: 6–10,5 µ; *minor diameter:* 4,5–8 µ; *major diameter of central area:* 2,5–4,5 µ; *minor diameter of central area:* 1,2–2,5 µ.
First occurrence: Miravetes – All 71.109 – uppermost Tithonian (*Jacobi*-zone; *Cr. intermedia*-subzone).
Known range: Uppermost Tithonian – upper Hauterivian.

Genus *Microstaurus* BLACK, 1971–07–02

Type species: *Microstaurus chiastius* (WORSLEY, 1971–05–31) GRÜN, n. comb. = *Microstaurus quadratus* BLACK, 1971–07–02.

Remarks: The central area has a crossbar aligned with the axes of the ellipse. The central process is a short boss or solid spine. The genus *Helenea* WORSLEY, 1971, differs from the genus *Microstaurus* in the construction of its distal shield, which

looks misleadingly like that of the genus *Watznaueria* when they are seen only under the light microscope. The genus *Cruciellipsis* has no central process.

Microstaurus chiastius (WORSLEY, 1971–05–31) GRÜN, n. comb.

(Text-fig. 22; Pl. V, Fig. 1–4)

1971–05–31 *Helena chiastia* n. sp. – WORSLEY, p. 1310; Pl. 1, Fig. 42–44
1971–07–02 *Microstaurus quadratus* n. sp. – BLACK, p. 404; Pl. 32, Fig. 2.
1972–06 *Cruciplacolithus cuvillieri* (MANIVIT, 1966–06–20) n. comb. – WILCOXON (partim), p. 431; Pl. 4, Fig. 3 (non Fig. 4).

Remarks: The distal shield of these elliptical to almost circular coccoliths consists of two cycles of elements. The number of elements varies in each cycle of the distal shield and in the mono-cycle proximal shield from 28 to 32. The sutures of the proximal shield are radially arranged, while the sutures of the distal shield are – in distal view – precessed counter-clockwise. The relatively small central area bears a crossbar aligned with the axes of the ellipse. The bars widen laterally, leaving a circular opening in each of the quadrants. The central process is a short boss consisting of four elements.

Major diameter: 4,5–7,5 μ; *minor diameter:* 3,5–6,8 μ.
First occurrence: Miravetes – All 71.122 – lower Berriasian (*Euxina-zone*; *C. alpina*-subzone).
Known range: Berriasian–Hauterivian.

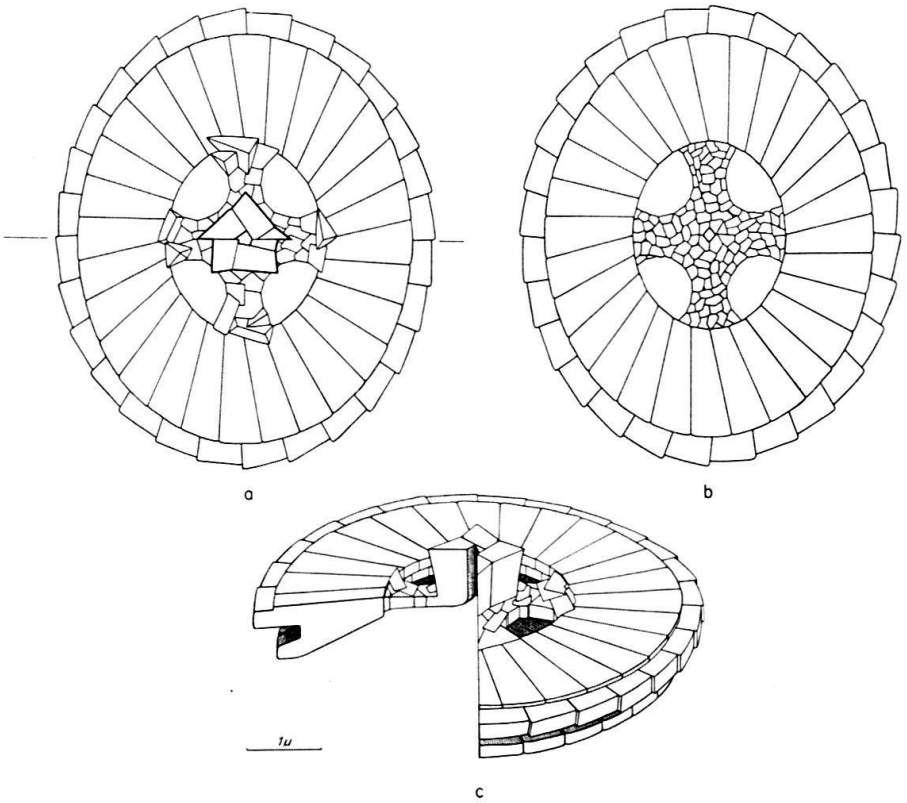

Fig. 22. Schematic drawings of *Microstaurus chiastius* (WORSLEY, 1971) GRÜN n. comb.
a) distal view – b) proximal view – c) oblique view on the distal side.

Microstaurus sp. 32

(Pl. V, Fig. 5–10)

Description: Coccoliths with an elliptical to almost circular outline. The bars of the central cross widen towards the inner margin of the distal shield, leaving a circular opening in each of the quadrants. The central process is a solid spine. The crossbar is aligned with the axes of the ellipse.

Remarks: The assignment to the subfamily Retecapsoideae is based on the relatively simple structure of the distal and proximal shields. The orientation of the crossbar and the presence of only four openings suggests the assignment of this material to the genus *Microstaurus*. However, *Microstaurus chiastius* does not have a solid spine on its central process. *Microstaurus* sp. 32 differs from *Microstaurus pusillus* BLACK, 1972, in size, and in the numbers of elements in both shields. In addition *Heterorhabdus sinuosus* NOËL, 1970, has four lateral bars and therefore 8 openings in the central area. Moreover, *H. sinuosus* seems to be a *Retecapsa angustiforata*, altered by overgrowth.

Major diameter: 7–9 μ; *minor diameter:* 6,5–8 μ.
First occurrence: Miravetes – All 71.119 – upper Tithonian (*Jacobi*-zone; *C. alpina*-subzone).
Known range: Upper Tithonian – Lower Berriasian.

Microstaurus ? sp. 36

(Pl. V, Fig. 11, 12; Pl. VI, Fig. 1–4)

Description: All the forms in question have been modified by overgrowth. The distal shield, which is not recognizeably bi-cycle, is covered by an additional cycle of flat and variously shaped elements around the center. This additional cycle also covers what could be a central area, leaving only an open space for the central process. This central process is a boss consisting of four elements, as in *Microstaurus chiastius* (WORSLEY, 1971).

Remarks: It is possible, that these coccoliths are overgrown forms of *Microstaurus chiastius*. In this case it is very doubtful from which elements the innermost distal cycle, the characteristic feature of these forms, arises.

Major diameter: 6,5–7 μ; *minor diameter:* 5,5–6 μ.
First occurrence: Miravetes – All 71.109 – upper Tithonian (*Jacobi*-zone; *Cr. intermedia*-subzone).
Known range: Upper Tithonian – middle Berriasian.

Genus *Grantarhabdus* BLACK, 1971–07–02

Type species: *Grantarhabdus meddii* BLACK, 1971–07–02.

Remarks: Retecapsaceae with an oblique crossbar. The angle between the single bars is variable.

Grantarhabdus meddii BLACK, 1971–07–02

(Text-fig. 23; Pl. VI, Fig. 5, 6)

1971–07–02 *Grantarhabdus meddii* n. sp. – BLACK, p. 403; Pl. 33, Fig. 7.

Remarks: The striated crossbar has an angle of 35–45° (145–135°). The central process is a solid spine. Each of the two cycles of the distal shield and the cycle of the proximal shield consist of 30 to 34 elements. The outer cycle of the distal shield can be extremely thin and may therefore be lost to corrosion.

Major diameter: 7–9 μ; *minor diameter:* 6–7,5 μ; *major diameter of central area:* 4,5–5,5 μ; *minor diameter of central area:* 3,5–4,5 μ.
First occurrence: BLACK (1971) – Berriasian – Great Britain. Miravetes – All 70.90 – middle Berriasian (*Privasensis*-zone; *C. elliptica*-subzone).
Known range: Berriasian–Hauterivian.

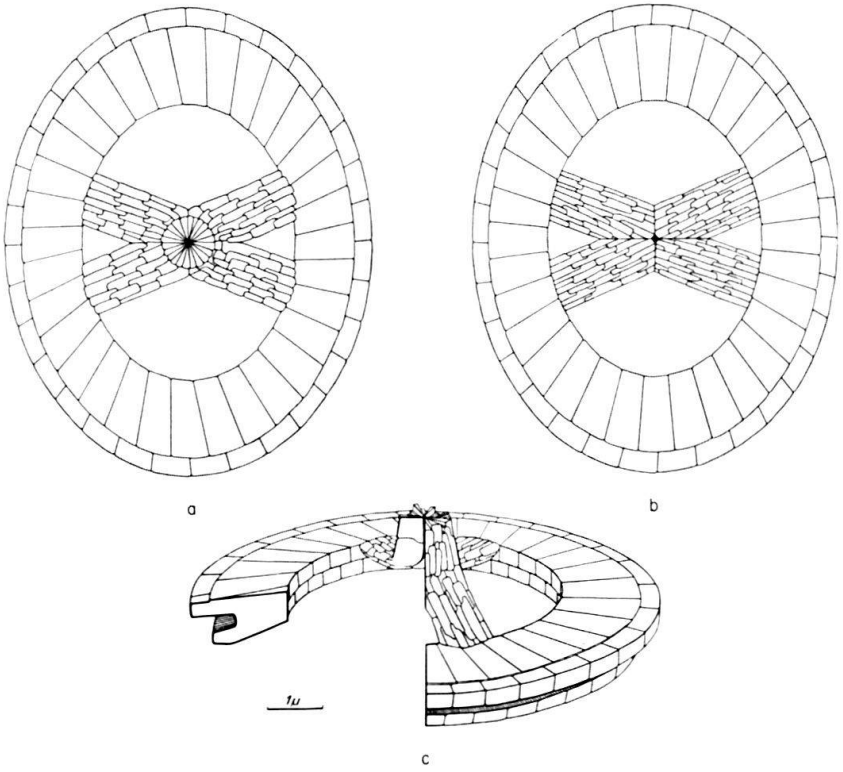

Fig. 23. Schematic drawings of *Grantarhabdus meddii* BLACK, 1971.
a) distal view – b) proximal view – c) oblique view on the distal side.

Grantarhabdus bukryi BLACK, 1972–11–09

(Text-fig. 24; Pl. VI, Fig. 7, 8)

1972–11–09 *Grantarhabdus bukryi* n. sp. – BLACK, p. 43; Pl. 11, Fig. 1–4.

Remarks: The perpendicular bars of the central cross bisect the axes of the ellipse. The single circular opening in each quadrant of the central area is surrounded by a separate cycle of about 10 elongated elements. The central process is a solid spine. The outer cycle of the bi-cycle distal shield can be extremely thin. The sutures of the distal shield are straight and – in distal view – slightly precessed counter-clockwise. *Grantarhabdus bukryi* differs from *Grantarhabdus meddii* in the angle between the bars and from *Grantarhabdus coronadventis* in the simple structure of its distal shield.

Major diameter: 5,4–7 μ; *minor diameter:* 4,1–5,8 μ; *major diameter of central area:* 2,9–3,8 μ; *minor diameter of central area:* 1,9–2,5 μ.

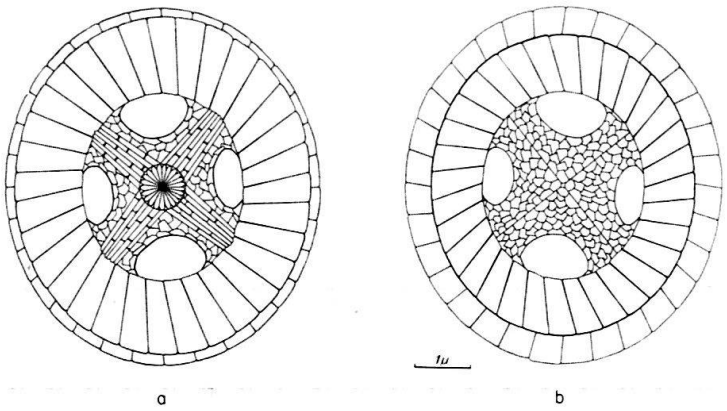

Fig. 24. Schematic drawings of *Grantarhabdus bukryi* BLACK, 1972.
a) distal view – b) proximal view.

First occurrence: Miravetes – All 71.189 – upper Berriasian (*Picteti-malbosi*-zone; *Cps. simplex*-subzone).
Known range: Upper Berriasian – upper Albian.

Grantarhabdus coronadventis (REINHARDT, 1966–04–01) GRÜN, n. comb.

1966–04–01 *Cretarhabdus coronadventis* n. sp. – REINHARDT, p. 26; Pl. 23, Fig. 29, 30.
1966–05–13 *Cretarhabdus unicornis* n. sp. – STOVER, p. 140; Pl. 5, Fig. 15, 16; Pl. 9, Fig. 15.
1969–03–14 *Cretarhabdus unicornis* STOVER, 1966–05–13 – BUKRY, p. 36; Pl. 15, Fig. 7–9.
1970–06 *Cretarhabdus unicornis* STOVER, 1966–05–13 – NOËL, Text-fig. 15; Pl. 18, Fig. 1–3.
1970 *Podorhabdus coronadventis* (REINHARDT, 1966–04–01) n. comb. – REINHARDT, p. 86; Text-fig. 16, 17.
1971 *Cretarhabdus unicornis* STOVER, 1966–05–13 – MANIVIT, p. 97; Pl. 9, Fig. 13–16.
1972–09 *Cretarhabdus coronadventis* REINHARDT, 1966–04–01 – ROTH & THIERSTEIN, Pl. 5, Fig. 1–9.
1972–11–09 *Grantarhabdus unicornis* (STOVER, 1966–05–13) n. comb. – BLACK, p. 44; Pl. 11, Fig. 5; Pl. 12, Fig. 1–4.

Remarks: The distal shield consists of two equally broad cycles of elements. The sutures of the distal shield are straight and precessed counter-clockwise; to a lesser extant in the inner cycle, but more in the outer cycle. The single opening in each quadrant of the central area is surrounded by an individual cycle of about 10 elements.

Gr. coronadventis differs from *Gr. bukryi* in the structure of its distal shield, which is more complicated and shows some similarities to the subfamily Helenoideae. *Gr. coronadventis* first occurs in the Albian.

Genus *Polypodorhabdus* NOËL, 1965–09–30
emend. BLACK, 1972–11–09

Type species: *Polypodorhabdus escaigi* NOËL, 1965–09–30.

Remarks: The original diagnosis was amended by BLACK (1972), who asserted that *Polypodorhabdus* has a solid spine rather than the hollow spine which NOËL (1965*b*) had presumed to be present. The structure of the bi-cycle distal and the mono-cycle proximal shields also suggest assignment to the subfamily Retecapsoideae BLACK, 1972.

Polypodorhabdus escaigi NOËL, 1965–09–30

1965–09–30 *Polypodorhabdus escaigi* n. sp. – NOËL, p. 6, Fig. 32.
1965–12 *Polypodorhabdus escaigi* n. sp. – NOËL, p. 109; Pl. 10, Fig. 6–8.
1972–11–09 *Polypodorhabdus hansmannii* (BUKRY, 1969–03–14) n. comb. – BLACK, p. 42, Text-fig. 37; Pl. 10, Fig. 5.

Remarks: Each of the parallel bars which form the oblique grille of the central area, is composed of more than two elements. Coccoliths with parallel bars composed of one or two elements should be assigned to *Polypodorhabdus madingleyensis* BLACK, 1968. Only two badly preserved specimens were found in our samples.

Polypodorhabdus madingleyensis BLACK, 1968–12–20

1968–12–20 *Polypodorhabdus madingleyensis* n. sp. – BLACK, p. 806; Pl. 150, Fig. 2.
1971–06–24 *Polypodorhabdus madingleyensis* BLACK, 1968–12–20 – BLACK, p. 619; Pl. 45.4, Fig. 37.
1971–09–03 *Polypodorhabdus escaigi* NOËL, 1965–09–30 – ROOD, HAY & BARNARD, p. 262; Pl. 3, Fig. 5, 6.
1972–11–09 *Polypodorhabdus madingleyensis* BLACK, 1968–12–20 – BLACK, p. 41; Pl. 10, Fig. 4.

Remarks: In contrast with *Polypodorhabdus escaigi*, the lateral bars of *P. madingleyensis* consist of only one or two elongated elements, As a result, the distinction between the bars and spaces in the quadrants of the central area is much clearer. It is not yet clear to what extent the pattern of the latteral bars can be of taxonomic or stratigraphic importance. *P. madingleyensis* was not found in our material.

Genus *Miravetesina* GRÜN, n. gen.

Type species: *Miravetesina favula* GRÜN, n. sp.

Derivation of name: After Miravetes, the locality near Caravaca (S. Spain) where these forms were found.

Description: A new genus of the subfamily Retecapsoideae BLACK, 1972, with the features of its only species, *Miravetesina favula* GRÜN, n. sp.

Remarks: *Miravetesina* is distinguished from *Cribrosphaerella* DEFLANDRE, 1952, emend. REINHARDT, 1964 (pro *Cribrosphaera* ARKHANGELSKY, 1912) in that the former has a striated crossbar and a bi-cycle distal shield. It differs from *Ethmorhabdus* in the structure of its distal and proximal shields, and in that *Miravetesina* lacks any kind of central process.

Miravetesina favula GRÜN, n. sp.

(Text-fig. 25; Pl. VI, Fig. 9–12)

? 1973–01 *Cruciellipsis cuvillieri* (MANIVIT, 1966–06–20) THIERSTEIN, 1972–01–04 – STRADNER, Pl. 49, Fig. 3.

Derivation of name: Latin favus, honeycomb.
Holotype: Pl. IV, Fig. 10, 11; Stereoscan micrographs 323/8, 323/7.
Type level: Upper Berriasian (*Picteti-malbosi*-zone; *Cps. simplex*-subzone).

Type locality: Caravaca, Miravetes-section, All 71.197.
Depository: Department of Scanning Electronmicroscopy, Institute of Geology, University of Berne.

Description: The almost circular coccoliths consist of two shields. The distal shield has two cycles of elements. The outer cycle is very thin and may be dissolved away. The sutures are straight and slightly precessed counter-clockwise. The monocycle proximal shield consists of straight elements which are – in proximal view – precessed clockwise. The number of elements in each shield varies between 28 and 34. The central area bears a striated crossbar aligned with the axes of the ellipse. The quadrants between the bars are filled in by granular elements like those of *Cribrosphaera*. The number of perforations varies between 20 and 40. *Miravetesina favula* has no central process.

Major diameter: 7–10 μ; *minor diameter:* 6–8 μ; *major diameter of central area:* 3,5–6 μ; *minor diameter of central area:* 2,5–4,5 μ.
First occurrence: Miravetes – All 71.120 – lower Berriasian (*Euxina*-zone; *C. alpina*-subzone).
Known range: Lower Berriasian – Hauterivian (Barremian ?).

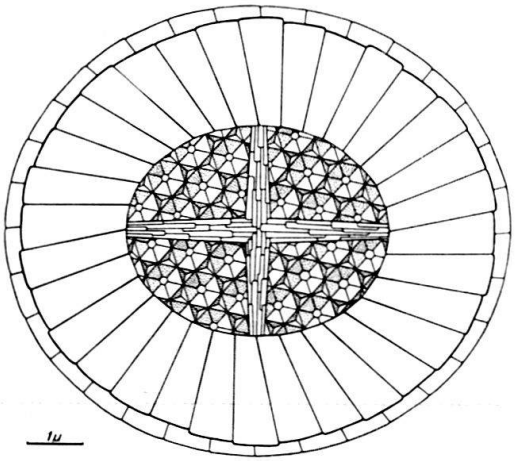

Fig. 25. Schematic drawing of *Miravetesina favula* GRÜN n. sp., distal view.

Subfamily ***Helenoideae*** GRÜN, n. subfam.

Type genus: *Helenea* WORSLEY, 1971–05–31.

Description: A new subfamily with the features of its single genus, *Helenea* WORSLEY, 1971.

Genus *Helenea* WORSLEY, 1971–05–31

Type species: *Helenea staurolithina* WORSLEY, 1971–05–31.

Description: The elliptical to almost circular coccoliths have two shields. The massive distal shield consists of two cycles of elements, which differ considerably in shape and arrangement. The straight elements of the inner cycle are radially arranged. The sickle-shaped elements of the outer cycle curve clockwise and precess counter-

clockwise. The central crossbar is aligned with the axes of the ellipse. The central process may be a boss or knob, consisting of four elements.

Helenea staurolithina WORSLEY, 1971–05–31

1971–05–31 *Helenea staurolithina* n. sp. – WORSLEY, p. 1310; Pl. 1, Fig. 45–47.
1971–07–02 *Microstaurus lindensis* n. sp. – BLACK, p. 405; Pl. 32, Fig. 1.
1972–09 *Cruciellipsis chiasta* (WORSLEY, 1971–05–31) n. comb. – THIERSTEIN, in ROTH & THIERSTEIN, p. 437; Pl. 6, Fig. 8–13.
1972–11–09 *Microstaurus lindensis* BLACK, 1971–07–02 – BLACK, p. 45; Text-fig. 38; Pl. 13, Fig. 1–3.
1973–01 *Cruciellipsis chiastia* (WORSLEY, 1971–05–31) THIERSTEIN, 1972–09 – STRADNER, Pl. 49, Fig. 4.
1973–05–28 *Cruciellipsis chiasta* (WORSLEY, 1971–05–31) THIERSTEIN, 1972–09 – THIERSTEIN, p. 40.

Remarks: The inner cycle of the distal shield consists of straight, radially arranged elements, which interlock irregularly with the elements of the outer cycle. The convex margins of the sickle-shaped elements of the broader outer cycle face counter-clockwise. They show a counter-clockwise precession, while the elements of the mono-cycle proximal shield – also in distal view – show clockwise precession. The small central area bears a crossbar aligned with the axes of the ellipse, which leaves only four small, almost circular openings. The central process is a boss consisting of four elements. This species was not found in our material.

Family ***Stephanolithiaceae*** BLACK, 1968–12–20

1969–03–14 Stephanolithionaceae – BUKRY, p. 40 (syn.).
1973–05–28 Stephanolithionaceae – THIERSTEIN, p. 43 (Err. cit. pro Stephanolithiaceae BLACK, 1968–12–20).

Type genus: *Stephanolithion* DEFLANDRE, 1939–04–24.

Genus *Stephanolithion* DEFLANDRE, 1939–04–24

Type species: *Stephanolithion bigoti* DEFLANDRE, 1939–04–24.

Stephanolithion laffittei NOËL, 1956

(Text-fig. 26; Pl. VII, Fig. 4)

1956 *Stephanolithion laffittei* n. sp. – NOËL (partim), p. 318; Pl. 2, Fig. 5 (non Fig. 6).
1958 *Stephanolithion laffittei* NOËL, 1956 – NOËL, p. 161; Pl. 1, Fig. 1, 2.
1963–b *Stephanolithion laffittei* NOËL, 1956 – STRADNER, p. 178; Pl. 1, Fig. 4.
1964–04–30 *Stephanolithion laffittei* NOËL, 1956 – STRADNER, p. 138; Fig. 47, 48.
1964–08–24 *Stephanolithion* sp. cf. *S. laffittei* NOËL, 1956 – BRAMLETTE & MARTINI, p. 320; pl. 6, Fig. 12–15.
1965–09–30 *Stephanolithion laffittei* NOËL, 1956 – NOËL, p. 4; Fig. 15, 16.
1965–09 *Stephanolithion* – BLACK, p. 133, Fig. 11.
1965–12 *Stephanolithion laffittei* NOËL, 1956 – NOËL, p. 83; Text-fig. 15, 16; Pl. 6, Fig. 3–5.
1965 *Stephanolithion laffittei* NOËL, 1956 – MANIVIT, p. 191; Pl. 2, Fig. 21.
non 1966–04–01 *Stephanolithion laffittei* NOËL, 1956 – REINHARDT, p. 41; Pl. 21, Fig. 19; Pl. 23, Fig. 23.
1966–05–13 *Stephanolithion crenulatum* n. sp. – STOVER, p. 160; Pl. 7, Fig. 25, 26, 27; Pl. 9, Fig. 25–27.

1966–09–30 *Stephanolithion laffittei* NOËL, 1956 – MARESCH, p. 383; Pl. 3, Fig. 5.
1967 *Stephanolithion crenulatum* STOVER, 1966–05–13 – LYUL'EVA, Pl. 4, Fig. 46.
1967 *Stephanolithion crenulatum* STOVER, 1966–05–13 – SALES, p. 305; Pl. 3, Fig. 23.
non 1968–04–12 *Stephanolithion* sp. aff. *Stephanolithion laffittei* NOËL, 1956 – GARTNER, p. 35; Pl. 5, Fig. 14; Pl. 22; Fig. 18.
1968–04–12 *Corollithion octoradiatum* n. sp. – GARTNER, p. 35; Pl. 6, Fig. 5; Pl. 10, Fig. 14, 15; Pl. 11, Fig. 7; Pl. 22, Fig. 19.
1968–12–20 *Stephanolithion laffittei* NOËL, 1956 – BLACK, p. 808; Pl. 152, Fig. 2.
1969–03–14 *Stephanolithion laffittei* NOËL, 1956 – BUKRY, p. 43; Pl. 21, Fig. 7–11.
1969 *Stephanolithion crenulatum* STOVER, 1966–05–13 – LYUL'EVA & LIPINK Pl. 3, Fig. 15.
1970–02–27 *Stephanolithion laffittei* NOËL, 1956 – ČEPEK, p. 246; Pl. 23, Fig. 9, 10.
1970–06 *Stephanolithion laffittei* NOËL, 1956 – NOËL (partim), p. 85; Pl. 29, Fig. 1–11 (non Pl. 31, Fig. 4).
1971–06–07 *Stephanolithion laffittei* NOËL, 1956 – SHAFIK & STRADNER, p. 89; Pl. 47, Fig. 2.
1971 *Stephanolithion laffittei* NOËL, 1956 – MANIVIT, p. 108; Pl. 23, Fig. 14–18.
1972–06 *Stephanolithion laffittei* NOËL, 1956 – WILCOXON (partim), Pl. 4, Fig. 5, 7 (non Fig. 8).
1972–09–18 *Stephanolithion laffittei* NOËL 1956 – ROOD & BARNARD p. 330; Pl. 1, Fig. 6, 12.
1972 *Stephanolithion laffittei* NOËL 1956 – HOFFMANN, p. 48; Pl. 3, Fig. 3–6; Pl. 4, Fig. 3, 4.

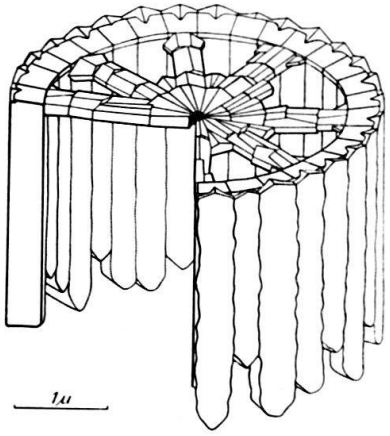

Fig. 26. Schematic drawing of *Stephanolithion laffittei* NOËL, 1956, oblique view on the proximal side.

Remarks: A short cylindrical form with 8 radially but slightly irregularly arranged bars in the central area. BUKRY (1969) confirmed that lateral processes, extending out from the periphery of the large central area, may or may not be present. In our material they are not present, presumably as a result of the preservation.

Diameter of the cylinder: 3,5–5 μ; *height of the cylinder:* 2,5–3,5 μ.
First occurrence: NOËL (1956) – uppermost Portlandian – Kef Talrempt, Algeria. Miravetes – All 71.117 – upper Tithonian (*Jacobi*-zone; *C. alpina*-subzone).
Known range: Upper Tithonian – Maastrichtian.

Stephanolithion caravacaensis GRÜN, n. sp.

(Text-fig. 27; Pl. VII, Fig. 1–3)

? 1972–06 *Stephanolithion laffittei* NOËL, 1956 – WILCOXON (partim), Pl. 4, Fig. 8 (non Fig. 5, 7).

Derivation of name: After Caravaca, a spanish town in the province of Murcia, the location of the Miravetes-section.

Holotype: Pl. VII, Fig. 1, 2; Stereoscan micrographs 162/1, 162/2.
Type level: Middle Berriasian (*Privasensis*-zone; *C. elliptica*-subzone).
Type locality: Caravaca, Miravetes-section, All 71.144.
Depository: Department of Scanning Electronmicroscopy, Institute of Geology, University of Berne.

Description: A new species of the genus *Stephanolithion* with a distinctive conical shape. The 8 radial bars of the central area are arranged as in *St. laffittei*.

St. caravacaensis differs from *St. laffittei* in its conical shape. The structure of the central area is the same in both species.

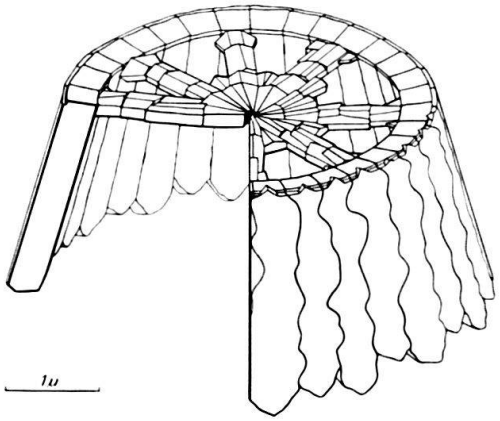

Fig. 27. Schematic drawing of *Stephanolithion caravacaensis* GRÜN n. sp., oblique view on the proximal side.

Diameter of the distal side: 5,5–6,5 μ; *diameter of the proximal side*: 3,5–4,5 μ; *height:* 3–5 μ.
First occurrence: Miravetes – All 71.117 – upper Tithonian (*Jacobi*-zone; *C. alpina*-subzone).
Known range: Upper Tithonian – lower Valanginian.

Family ***Syracosphaeraceae*** LEMMERMANN, 1908

Genus *Sollasites* BLACK, 1967–05–31

Type species: *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) BLACK, 1968–12–20, = *Sollasites barringtonensis* BLACK, 1967–05–31.

Sollasites horticus (STRADNER, ADAMIKER & MARESCH, 1966–08–30) BLACK, 1968–12–20

(Text-fig. 28; Pl. VII, Fig. 5, 6)

1966–08–30 *Coccolithus horticus* n. sp. – STRADNER, ADAMIKER & MARESCH, in STRADNER & ADAMIKER, p. 337; Fig. 1, 2; Pl. 2, Fig. 4.
1966–09–30 *Coccolithus horticus* STRADNER, ADAMIKER & MARESCH, 1966–08–30 – MARESCH, p. 378; Pl. 1, Fig. 2.
1967–05–31 *Sollasites barringtonensis* gen. et sp. nov. – BLACK, p. 144, Fig. 4.
1968–03–21 *Coccolithus horticus* STRADNER, ADAMIKER & MARESCH, 1966–08–30 – STRADNER, ADAMIKER & MARESCH, p. 25; Pl. 3; Pl. 4; Pl. 5, Fig. 1.
1968–04–12 *Coccolithus horticus* STRADNER, ADAMIKER & MARESCH, 1966–08–30 – GARTNER, p. 18; Pl. 10, Fig. 2; Pl. 25, Fig. 6–8; Pl. 26, Fig. 1.

1968–12–20 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) n. comb. – BLACK, Pl. 144, Fig. 1, 2.
1969–03–14 *Costacentrum horticum* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) n. comb. – BUKRY, p. 44; Pl. 21, Fig. 12; Pl. 22, Fig. 1–3.
1969 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) n. comb. – ČEPEK & HAY, p. 325, Text-fig. 2/8.
1969 *Coccolithus horticus* STRADNER & ADAMIKER, 1966–08–30 – PIENAAR (partim), p. 89; Pl. 1, Fig. 9; Pl. 8, Fig. 1 (non Pl. 1, Fig. 6).
1971–06–24 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) BLACK, 1968–12–20 – BLACK, Pl. 45.4, Fig. 40.
1971–09–30 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) BLACK, 1968–12–20 – ROOD, HAY & BARNARD, p. 264; Pl. 3, Fig. 9.
1971 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH 1966–08–30) ČEPEK & HAY, 1969 – MANIVIT, p. 117; Pl. 24, Fig. 1–5.
1971 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) n. comb. – REINHARDT, p. 26, Fig. 16.
1972 *Coccolithus horticus* STRADNER, ADAMIKER & MARESCH, 1966–08–30 – HOFFMANN, p. 62; Pl. 17, Fig. 4.
1973–05–28 *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966–08–30) BLACK, 1968–12–20 – THIERSTEIN, p. 42.
1973–11–15 *Sollasites barringtonensis* BLACK, 1967–05–31 – BLACK, p. 64; Pl. 22, Fig. 6–9

Remarks: The distal shield consists of 32 to 40 flat, straight elements which are slightly imbricated and precess clockwise. The central area is surrounded by an additional cycle of flat, abcentrally sloping elements which precess – also in distal view – counter-clockwise. The central area bears a bar consisting of many small elements. This bar is crossed by three additional bars, perpendicular to it. There is no reason to asign forms with straight outer bars and forms with slightly curved outer bars to different species. The proximal shield consists of 34 to 40 wedge-shaped elements, which show – in proximal view – clockwise precession.

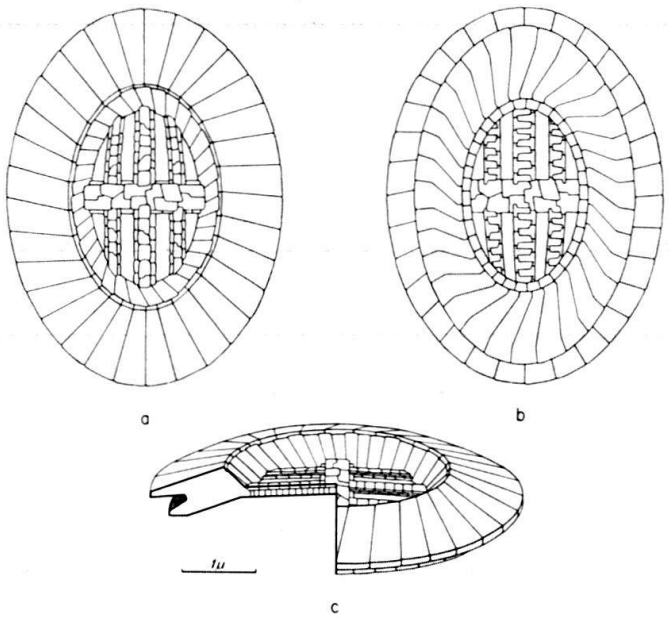

Fig. 28. Schematic drawings of *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966) BLACK, 1968, with straight and slightly curved outer bars.
a) distal view – b) proximal view – c) oblique view on the distal side.

This species has been independently assigned by various authors to the genus *Sollasites*.

Major diameter: 2,7–7 μ; *minor diameter:* 2–5,5 μ; *major diameter of central area in % of coccolith major diameter:* 45–67%; *minor diameter of central area in % of coccolith minor diameter:* 33–45%.
First occurrence: ROOD, HAY & BARNARD (1971) – lower Oxfordian (*Cordatum*-zone), Great Britain.
Known range: Lower Oxfordian – Campanian.

Family ***Zygolithaceae*** NOËL, 1965–09–30, ex BLACK, 1968–12–20 emend. GRÜN

Description: As electronmicrographs of well preserved specimens show (e.g. BUKRY 1969, Pl. 28, Fig. 7, 8; Pl. 32, Fig. 2; Pl. 34, Fig. 4, 8; Pl. 36, Fig. 6), the wall of the coccoliths in this family consists of several hundred flat, thin, straight elements. These elements are arranged spirally, so that there are two systems of sutures (see Text-fig. 29). One of these systems, which is only visible at the outer margin of the coccolith, slopes steeply counter-clockwise. The other system slopes at a low angle counter-clockwise and is often only visible as a series of layers around the inner margin of the wall. This second system is only occasionally visible at the outer margin of the coccolith, probably depending on the state of preservation.

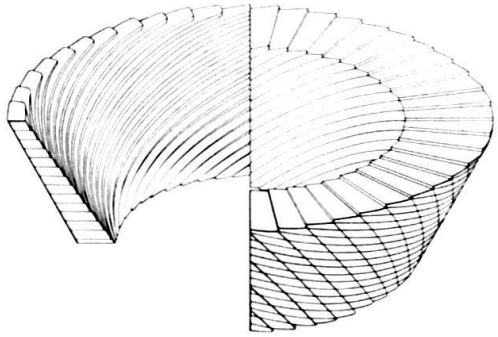

Fig. 29. Schematic drawing of the wall construction of the family Zygolithaceae NOËL, 1965, ex BLACK, 1968, emend. GRÜN.

I assign all forms with this characteristic arrangement of elements, regardless of the thickness of the wall and the structures of the proximal shield and the central area, to the family Zygolithaceae. A full revision of this family is very much needed.

Genus *Parhabdolithus* DEFLANDRE, 1952

Type species: *Parhabdolithus liasicus* DEFLANDRE, 1952.

Parhabdolithus embergeri (NOËL, 1958) STRADNER, 1963–06–05

(Pl. VII, Fig. 7–11)

1958 *Discolithus embergeri* n. sp. – NOËL, p. 164; Pl. 1, Fig. 5–8.
1961–03–30 *Discolithus embergeri* NOËL, 1958 – STRADNER, p. 80; Text-fig. 20–24.
1963–06–05 *Parhabdolithus embergeri* (NOËL, 1958) n. comb. – STRADNER, Pl. 4, Fig. 1.
1964 *Discolithus embergeri* NOËL, 1958 – BALDI-BEKE (partim), p. 135; Pl. 1, Fig. 3 (non Fig. 2).

1967–06–23 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – PANT, Pl. 1, Fig. 7.
1967–10–13 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – MOSHKOVITZ, p. 149; Pl. 1, Fig. 15, 16.
1967 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – LYUL'EVA, Pl. 2, Fig. 17.
1969–06 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – BUKRY & BRAMLETTE, Pl. 3, Fig. F.
1969 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – BILGÜTAY, JAFAR, STRADNER & SZÖTS, Pl. 1, Fig. 3, 4.
1971 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – MANIVIT, p. 88; Pl. 20, Fig. 1–6.
1972–01–12 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – LAUER, in GRÜN et al., p. 168; Pl. 30, Fig. 10–12.
1972–03–03 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – THIERSTEIN, FRANZ & ROTH, Text-fig. 2.
1972–09 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – ROTH & THIERSTEIN, Pl. 9, Fig. 1–6.
1973–05–28 *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963–06–05 – THIERSTEIN, p. 37.

Remarks: This species is easily distinguished from other species by its extremely large size and by its characteristic appearance under crossed nicols.

Major diameter: 9–16 μ; *minor diameter:* 6,5–11 μ; *height without spine:* 3–4,2 μ; *eccentricity:* 1,32–1,67.
Known range: Lower Tithonian – Maastrichtian.

Genus *Zygodiscus* BRAMLETTE & SULLIVAN, 1961–04–27

Type species: *Zygodiscus adamas* BRAMLETTE & SULLIVAN, 1961–04–27.

Zygodiscus sp. cf. *Z. compactus* BUKRY, 1969–03–14

(Pl. VII, Fig. 12; Pl. VIII, Fig. 1, 2)

? 1969–03–14 *Zygodiscus compactus* n. sp. – BUKRY, p. 59; Pl. 34, Fig. 1, 2.

Remarks: The relatively thin wall speaks against assignment of these specimens to *Zygodiscus compactus*, although this may be due to corrosion. The oblique transverse bar makes an angle of up to 15° with the short axis of the ellipse.

Major diameter: 7–8 μ; *minor diameter:* 5,4–6 μ.
Occurrence: Lower Berriasian.

Family ***Braarudosphaeraceae*** DEFLANDRE, 1947–09–08

Type genus: *Braarudosphaera* DEFLANDRE, 1947–09–08.

Genus *Micrantholithus* DEFLANDRE, 1950–11–20

Type species: *Micrantholithus flos* DEFLANDRE, 1950–11–20.

Micrantholithus crenulatus BRAMLETTE & SULLIVAN, 1961–04–27

(Pl. VIII, Fig. 3–5)

1954–09–24 *Braarudosphaera discula* n. sp. – BRAMLETTE & RIEDEL, p. 394; Pl. 38, Fig. 7.
1959–12–30 *Braarudosphaera undata* n. sp. – STRADNER, p. 487, Text-fig. 65.

1961–04–27 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BRAMLETTE & SULLIVAN, p. 153; Pl. 8, Fig. 6, 7.
1961–04–27 *Micrantholithus crenulatus* n. sp. – BRAMLETTE & SULLIVAN, p. 155; Pl. 9, Fig. 3, 4.
non 1961–10–18 *Braarudosphaera* cf. *discula* BRAMLETTE & RIEDEL, 1954–09–24 – STRADNER & PAPP, Pl. 37, Fig. 5.
1961–10–18 *Braarudosphaera undata* STRADNER, 1959–12–30 – STRADNER & PAPP, p. 119; Pl. 37, Fig. 6; Text-fig. 12/4.
1962–03 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BENEŠOVÁ & HANZLÍKOVÁ, Pl. 4, Fig. 6, 7.
1963–06–05 *Micrantholithus obtusus* n. sp. – STRADNER, p. (11); Pl. 6, Fig. 11.
1963–06–05 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – STRADNER, Pl. 6, Fig. 10.
1964–02–04 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – SULLIVAN, p. 188; Pl. 8, Fig. 2.
1964–02–04 *Micrantholithus crenulatus* BRAMLETTE & SULLIVAN, 1961–04–27 – SULLIVAN, p. 189; Pl. 8, Fig. 5–7.
1964–12 *Braarudosphaera* sp. – BALDI-BEKE (partim), p. 136; Pl. 1, Fig. 15, 16 (non Fig. 14, 17).
1964 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BÓNA, Pl. 14, Fig. 2.
1964 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BÓNA & KERNERNE, Pl. 5, Fig. 21.
1965–03–30 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – SULLIVAN, p. 39; Pl. 8, Fig. 1, 3.
1965–03–30 *Micrantholithus crenulatus* BRAMLETTE & SULLIVAN, 1961–04–27 – SULLIVAN, p. 39; Pl. 8, Fig. 6.
1966–04–01 *Micrantholithus obtusus* STRADNER, 1963–06–05 – REINHARDT, Text-fig. 10; Pl. 21, Fig. 1, 2, 4.
1966–04–01 *Braarudosphaera hoschulzi* n. sp. – REINHARDT, p. 42; Pl. 21, Fig. 3.
1967–06–23 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – PANT, Pl. 1, Fig. 18.
1967–11–17 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – HAY & MOHLER, p. 1535; Pl. 202, Fig. 13–15.
1969–03–14 *Braarudosphaera* sp. aff. *B. discula* BRAMLETTE & RIEDEL, 1954–09–24 – BUKRY, p. 62; Pl. 37, Fig. 4.
1969–06 *Micrantholithus obtusus* STRADNER, 1963–06–05 – BUKRY & BRAMLETTE, Pl. 5, Fig. D.
1969–06 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – PERCH-NIELSEN, p. 57; Pl. 7, Fig. 1, 2.
1969–07–24 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – PANT & MAMGAIN, p. 119; Pl. 21, Fig. 5.
1969–09 *Braarudosphaera perversus* SULLIVAN, 1965–03–30 – BOURDREAUX & HAY, p. 281; Pl. 8, Fig. 24–26.
1969 *Braarudosphaera* cf. *discula* BRAMLETTE & RIEDEL, 1954–09–24 – BILGÜTAY, JAFAR, STRADNER & SZÖTS, Pl. 3. Fig. 6.
1969 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BYSTRICKÁ, p. 231; Pl. 63, Fig. 13.
1971–03 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – BALDI-BEKE, Pl. 4, Fig. 2.
1971 *Micrantholithus fornicatus* MARTINI, 1961–04–17 – MANIVIT, p. 127; Pl. 17, Fig. 4–6.
1972–01–04 *Micrantholithus obtusus* STRADNER, 1963–06–05 – THIERSTEIN, p. 482; Pl. 5, Fig. 9.
1972–01–04 *Micrantholithus hoschulzi* (REINHARDT, 1966–04–01) n. comb. – THIERSTEIN, p. 482; Pl. 1, Fig. 12–15.
1972–01–12 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – LAUER, in GRÜN et al., p. 170; Pl. 32, Fig. 7, 8.
1972–06 *Micrantholithus obtusus* STRADNER, 1963–06–05 – WILCOXON, Pl. 9, Fig. 3, 4.
1972–07–20 *Braarudosphaera discula* BRAMLETTE & RIEDEL, 1954–09–24 – SADEK, p. 123; Pl. 2, Fig. 3.
1972 *Micrantholithus fornicatus* MARTINI, 1961–04–17 – LOCKER, p. 774; Pl. 12, Fig. 17–20.
1973–05–28 *Micrantholithus hoschulzi* (REINHARDT, 1966–04–01) THIERSTEIN, 1972–01–04 – THIERSTEIN, p. 44.
1973–05–28 *Micrantholithus obtusus* STRADNER, 1963–06–05 – THIERSTEIN, p. 44.

Remarks: The varying outlines of this regular pentalith, consisting of five elements, are surely produced by different modes of preservation. I assume, that the basic form of the pentalith, in the living coccospheres, was a regular pentagon with straight sides. The sutures run from the center of the pentagon to its corners. Under the light microscope a slight imbrication of the elements is seen.

As Fig. 5, Pl. VIII shows, "*discula*"-, "*obtusus*"- and "*hoschulzi*"- segments together build one pentalith. Furthermore, samples with better preservation contain more specimens of "*M. hoschulzi*" than badly preserved samples.

The first regular, unperforated pentalith with straight sides was described by BRAMLETTE & SULLIVAN (1961) under the name *Micrantholithus crenulatus*. Some representatives of the family Braarudosphaeraceae seem to have extremely long stratigraphic ranges (e.g. *B. bigelowi*).

Diameter: 4–18 μ.
First occurrence: THIERSTEIN 1972 ("*hoschulzi*") – upper Tithonian – France. THIERSTEIN 1972 ("*obtusus*") – upper Berriasian – France. THIERSTEIN 1973 ("*hoschulzi*", p. 44) – upper Berriasian – France. THIERSTEIN 1973 ("*hoschulzi*", Text-fig. p. 12) – lower Berriasian – France. THIERSTEIN 1973 ("*obtusus*") – upper Berriasian – France. Miravetes – All. 71.169 – middle Berriasian (*Privasensis*-zone; *C. elliptica*-subzone).
Known range: (Upper Tithonian?) middle Berriasian – Eocene.

Family ***Nannoconaceae*** REINHARDT, 1966–04–01

Type genus: *Nannoconus* KAMPTNER, 1931–12–24.

Genus *Nannoconus* KAMPTNER, 1931–12–24 emend. FARINACCI, 1964

1972–01–04 *Polycostella* n. gen. – THIERSTEIN, p. 483 (syn.).

Type species: *Nannoconus colomi* (DE LAPPARENT, 1931–11–16) KAMPTNER, 1938–07–15, = *Lagena colomi* DE LAPPARENT, 1931–11–16.

Nannoconus colomi (DE LAPPARENT, 1931–11–16) KAMPTNER, 1938–07–15

1925–03–30 "Embryons de *Lagena*" – DE LAPPARENT, p. 105, Text-fig. 1.
1931–11–16 *Lagena colomi* n. sp. – DE LAPPARENT, p. 223.
1931–12–24 *Nannoconus steinmanni* n. sp. – KAMPTNER, p. 289; Text-fig. 2, 3.
1938–07–15 *Nannoconus colomi* (DE LAPPARENT, 1931–11–16) n. comb. – KAMPTNER, p. 252.
1964 *Nannoconus colomi* (DE LAPPARENT, 1931–11–16) KAMPTNER, 1938–07–15 – FARINACCI, p. 174; Pl. 32, Fig. 1–4.
1972–01–04 *Nannoconus colomi* (DE LAPPARENT, 1931–11–16) KAMPTNER, 1938–07–15 – THIERSTEIN, p. 483; Pl. 3, Fig. 16.
1972–01–04 *Polycostella beckmannii* n. sp. – THIERSTEIN, p. 483; Pl. 2, Fig. 5–9, 10–16.
1972–01–04 *Polycostella senaria* n. sp. – THIERSTEIN, p. 484; Pl. 1, Fig. 1, 2–5, 6.
1973–05–28 *Polycostella beckmannii* THIERSTEIN, 1972–01–04 – THIERSTEIN, p. 45.
1973–05–28 *Polycostella senaria* THIERSTEIN, 1972–01–04 – THIERSTEIN, p. 45.
1973–05–28 *Nannoconus colomi* (DE LAPPARENT, 1931–11–16) KAMPTNER, 1938–07–15 – THIERSTEIN, p. 46.

Remarks: Only elongated forms with narrow axial canals were found in our samples. Occasionally forms which THIERSTEIN (1972, 1973) has described under the

names *Polycostella beckmannii* and *Polycostella senaria* were found. However, there is no doubt, that these forms are short or juvenile specimens of *N. colomi.*

Length: 4–18 μ; *diameter:* 3–8 μ.
Known range: Upper Tithonian – Barremian.

Genus *Conusphaera* TREJO, 1969

Type species: *Conusphaera mexicana* TREJO, 1969.

Conusphaera mexicana TREJO, 1969

(Text-fig. 30; Pl. VIII, Fig. 7–12)

1965–12 Particule calcaire – NOËL, Pl. 28, Fig. 4, 7, 9.
1969 *Conusphaera mexicana* n. sp. – TREJO, p. 6; Text-fig. 1–4; Pl. 1, Fig 1–7; Pl. 2, Fig. 1–8; Pl. 3, Fig. 1–6; Pl. 4, Fig. 1–6.
1972–01–04 *Cretaturbella rothii* n. sp. – THIERSTEIN, p. 483; Pl. 3, Fig. 1, 2–5.
1972–06 Genus ? species ? – WILCOXON, Pl. 12, Fig. 2–4.
1972–09 *Cretaturbella rothii* THIERSTEIN, 1972–01–04 – ROTH & THIERSTEIN, Pl. 3, Fig. 9, 12–14.
1973–05–28 *Cretaturbella rothii* THIERSTEIN, 1972–01–04 – THIERSTEIN, p. 46.

Remarks: Elongated, tapering cylinders with three cycles of elements. The innermost cycle consists of about 20 flat elements, arranged radially around an axial canal. The elements show – in distal view – a slight clockwise spiral twist around the axial canal. The middle cycle has 30 to 40 flat elements, which are also twisted clockwise. A third cycle of about 20 flat elements, forms an outer casing to the cylinder. TREJO (1969) has shown that the spheres of *Conusphaera* are very similar to the spheres of *Nannoconus*. However, the detailed structure of the single "cones" argues against a very close affilitation. The assignment to the family Nannoconaceae REINHARDT, 1966 (as proposed by B. Prins in a personal communication) seems reasonable.

Length: 5–10 μ; *distal diameter:* 4–5,5 μ; *proximal diameter:* 2–3 μ.
Known range: Kimmeridgian – lower Aptian.

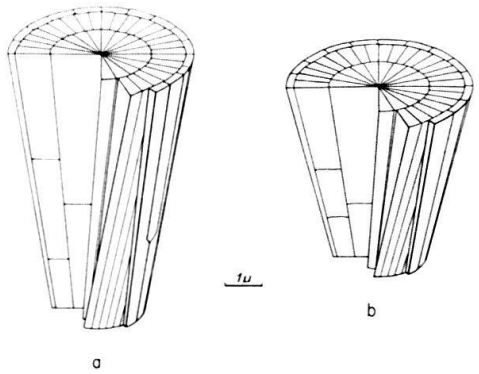

Fig. 30. Schematic drawings of *Conusphaera mexicana* TREJO, 1969, oblique view on the distal side. a) elongated form – b) small form.

Genera incertae sedis

Genus *Diazomatolithus* NOËL, 1965–09–30

Type species: *Diazomatolithus lehmani* NOËL, 1965–09–30.

Diazomatolithus subbeticus GRÜN, n. sp.
(Text-fig. 31; Pl. IX, Fig. 1–6)

Derivation of name: After the Subbeticum in Spain.
Holotype: Pl. IX, Fig. 3; Stereoscan micrograph 436/7.
Type level: Upper Berriasian (*Callisto*-zone; *R. dadayi–Cps. oblonga*-subzone).
Type locality: Caravaca, Miravetes-section, All 71.211.
Depository: Department of Scanning Electronmicroscopy, Institute of Geology, University of Berne.

Description: The almost circular coccolith consists of two shields. The distal shield has 24 to 32 serrate elements with slight clockwise precession. The 24 to 32 radially arranged elements of the proximal shield are flat and wedge-shaped. In lateral view this coccolith is almost rectangular. The angle between the distal and proximal shields varies from 0° to 20°. The free central area shows great variation in its diameter.

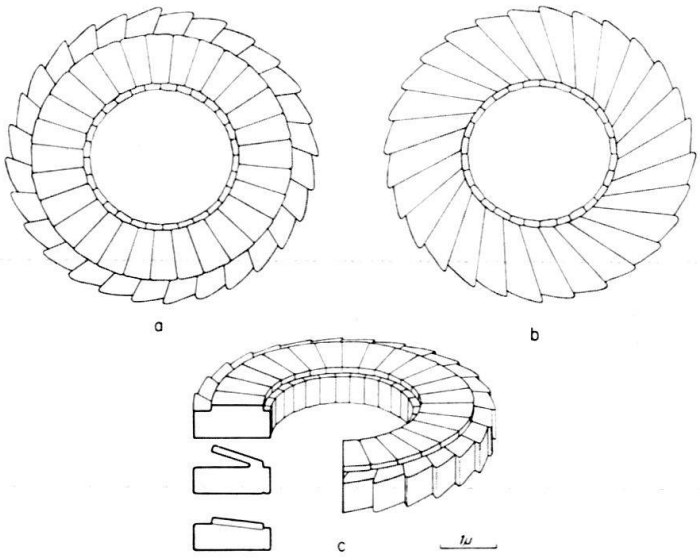

Fig. 31. Schematic drawings of *Diazomatolithus subbeticus* GRÜN n. sp.
a) distal view – b) proximal view – c) oblique view on the proximal side.

Remarks: There are some similarities to *Diazomatolithus lehmani* NOËL, 1965, but *D. subbeticus* differs from that species in the counter-clockwise precession of its distal (not proximal) shield. In cross-section *D. lehmani* is much higher and shows a clearly rounded shape.

Diameter of coccoliths: 4–6,5 µ; *diameter of central area:* 1,2–3,5 µ; *height:* 1–1,5 µ.
First occurrence: Miravetes – All 71.113 – upper Tithonian (*Jacobi*-zone; *Cr. intermedia*-subzone).
Known range: Upper Tithonian – Valanginian.

Form genus *Tubodiscus* THIERSTEIN, 1973–05–28 emend. GRÜN

Type species: *Tubodiscus verenae* THIERSTEIN, 1973–05–28, emend GRÜN.

Description: The monotypic genus *Tubodiscus* is here amended on the basis of its only species.

Tubodiscus verenae THIERSTEIN, 1973–05–28, emend. GRÜN

(Text-fig. 32; Pl. X, Fig. 1–12)

? 1965–09 *Cricolithus pemmatoideus* n. sp. – DEFLANDRE ex MANIVIT, p. 192; Pl. 2, Fig. 8.
1966–05–13 *Cyclolithus gronosus* n. sp. – STOVER (partim), p. 140; Pl. 1, Fig. 3 (non Fig. 1, 2).
non 1968–04–12 *Cyclolithus gronosus* STOVER, 1966–05–13 – GARTNER, p. 19; Pl. 22, Fig. 22.
1969–03–14 *Apertapetra gronosa* (STOVER, 1966–05–13) n. comb. – BUKRY (partim), p. 26; Pl. 6, Fig. 7–9 (non Fig. 6).
1971 *Cricolithus ? pemmatoideus* DEFLANDRE, 1965–09 – MANIVIT, p. 120; Pl. 9, Fig. 8, 9; Pl. 10, Fig. 1–5.
1972–01–04 *Manivitella pemmatoidea* (DEFLANDRE ex MANIVIT, 1965–09) n. comb. THIERSTEIN, p. 480; Pl. 5, Fig. 1–3.
1972–09 *Manivitella pemmatoidea* (DEFLANDRE ex MANIVIT, 1965–09) THIERSTEIN, 1972–01–04 – ROTH & THIERSTEIN (partim), Pl. 11 Fig. 10–13 (non Fig. 6–9).
1973–11–15 *Manivitella gronosa* STOVER 1966–05–13) n. comb. – BLACK, p. 79; Pl. 23, Fig. 4, 5.
1973–11–15 *Manivitella pecten* n. sp. – BLACK, p. 79; Pl. 23, Fig. 6, 7, 8.
1973–11–15 *Manivitella pemmatoidea* (DEFLANDRE ex MANIVIT, 1965–09) THIERSTEIN, 1972–01–04 – BLACK, p. 80; Pl. 23, Fig. 1–3.
1973–05–28 *Tubodiscus verenae* n. sp. – THIERSTEIN, p. 42; Pl. 2, Fig. 1, 2, 3, 4–7.

Description: These elliptical to almost circular coccoliths have 3 cycles of elements. Two cycles are visible distaly. The outer cycle, which forms the distal shield, consists of 42 to 48 straight, clockwise precessed elements, which are imbricated over half their widths. The inner cycle forms a large, proximally directed tube of about 48 elements. Each of these elements exhibits an angular, in distal view clockwise oriented, bend at the same point. Occasionally there is a second angular bend, perpendicular to the former one, which is clockwise oriented in proximal view. The third cycle, visible only on the proximal side, consists of about 48 very flat elements with an extreme, lefthanded imbrication.

Remarks: The arrangement of the elements is almost constant, but their shapes and especially their sizes are rather variable. This is particularly true of the elements of the inner cycle. These elements can be very small, forming only a low wall at the inner margin of the proximal shield (see Fig. 2, Pl. 5 of THIERSTEIN 1972). Alternatively this cycle of elements can grow very high, forming a large tube. These latter forms were assigned by THIERSTEIN (1973, Pl. 2, Fig. 1–7) to the new genus *Tubodiscus*. All intermediates between these two extreme forms occur. In the course of this transition, the distal shield turns up distally. Forms with a low wall or short tube have a distal shield which is distally convex, while forms with an elongated tube have a concave distal shield. THIERSTEIN assumed the large elongated tube to be a distal process, and so confused the distal shield with the proximal one.

The genus *Manivitella* THIERSTEIN, 1972, includes forms with two and three cycles of elements. I propose to restrict the genus *Manivitella* to coccoliths with only two

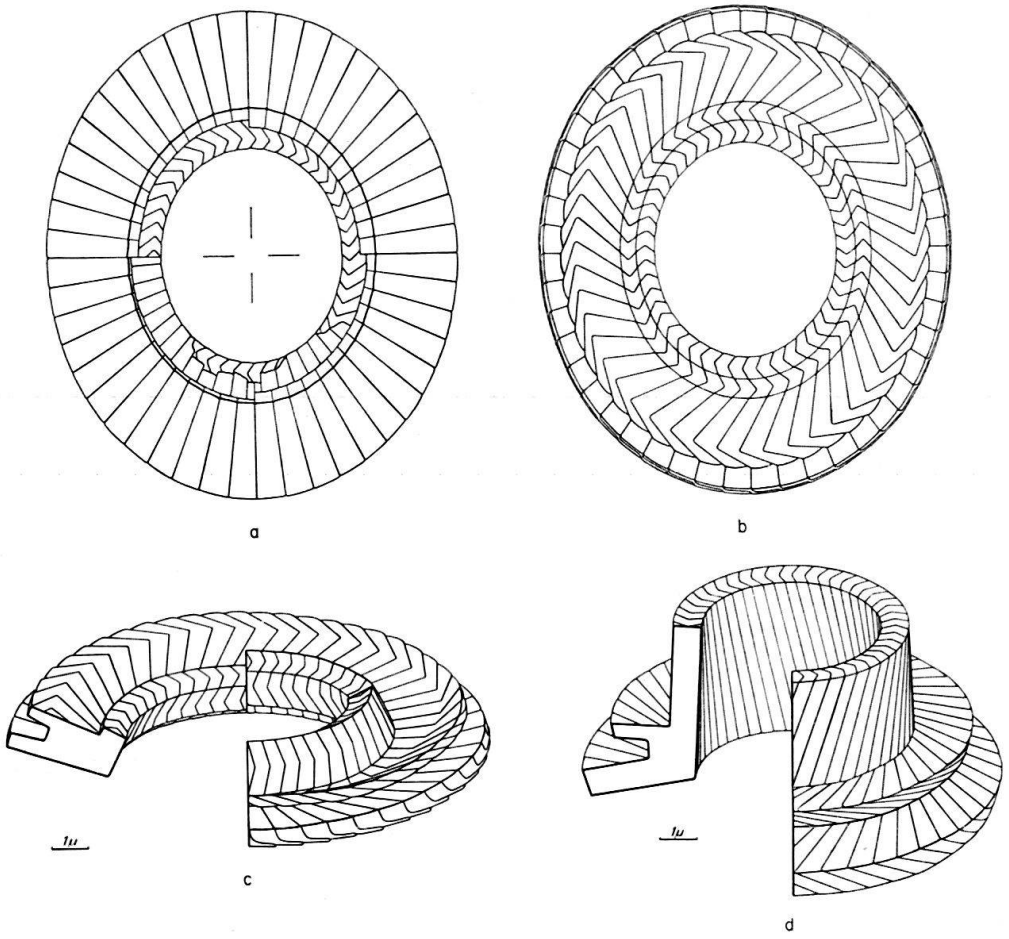

Fig. 32. Schematic drawings of *Tubodiscus verenae* THIERSTEIN, 1973, emend. GRÜN.
a) distal view – b) proximal view – c) oblique view on the proximal side – d) oblique view on the proximal side of a specimen with an elongated tube.

cycles of elements. Forms with three cycles of elements, as descriped above, are to be assigned to the genus *Tubodiscus*. The diagnosis of this genus is amended as follows: The large central tube extends proximally; the shield with the greater diameter is the distal one.

The great variability of the species *Tubodiscus verenae* suggests that these forms could be aperture-coccoliths. It may be that various species of coccolithophorids equip their apertures with individual, annular coccoliths. In such a case, *Tubodiscus* would be a form genus, including the aperture-coccoliths of different species and even genera.

Due to overgrowth the structure of these coccoliths is often superficially changed.

Major diameter: 6,5–15,5 µ; *minor diameter:* 5–13 µ; *eccentricity:* 1,05–1,4; *major diameter of central area in % of coccolith major diameter:* 45–60%; *minor diameter of central area in % of coccolith minor diameter:* 40–58%.
First occurrence: Miravetes – All 71.122 – lower Berriasian (*Euxina*-zone; *C. alpina*-subzone).
Known range: Lower Berriasian – Maastrichtian.

Genus *Markalius* BRAMLETTE & MARTINI, 1964–08–24

Type species: *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24, = *Cyclococcolithus leptoporus* MURRAY & BLACKMANN, 1898–11–03, var. *inversus* DEFLANDRE, 1955–03–08.

Markalius inversus (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24

(Text-fig. 33; Pl. VIII, Fig. 6)

1955–03–08 *Cyclococcolithus leptoporus* MURRAY & BLACKMANN, 1898–11–03 var. *inversus* n. var. – DEFLANDRE, in DEFLANDRE & FERT (partim), p. 150; Pl. 9, Fig. 4, 5 (non Fig. 6, 7).

non 1963c *Cyclococcolithus astroporus* n. sp. – STRADNER, in GOHRBANDT, p. 75; Pl. 9, Fig. 5–7; Text-fig. 3/2a–b.

1964–08–24 *Markalius inversus* (DEFLANDRE, 1955–03–08) n. comb. – BRAMLETTE & MARTINI, p. 302; Pl. 2, Fig. 4–9; Pl. 7 Fig. 2a–b.

1956–05–13 *Coccolithites circumradiatus* n. sp. – STOVER p. 138; Pl. 5, Fig. 2, 3, 4; Pl. 9, Fig. 10.

1966–07–18 *Cyclococcolithus inversus* DEFLANDRE, 1955–03–08 – HAY, MOHLER & WADE, p. 389; Pl. 7, Fig. 2.

1968–05–06 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – PERCH-NIELSEN (partim), p. 72, Text-fig. 35 (non Pl. 24, Fig. 1–8; Pl. 25, Fig. 1).

1968–05–06 *Markalius circumradiatus* (STOVER, 1966–05–13) n. comb. – PERCH-NIELSEN (partim), p. 73; Pl. 26, Fig. 1, 2 (non Text-fig. 36, 37; Pl. 25, Fig. 2–7; Pl. 26, Fig. 3–7).

1968–12–20 *Markalius* sp. cf. *M. inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – BLACK, Pl. 144, Fig. 6.

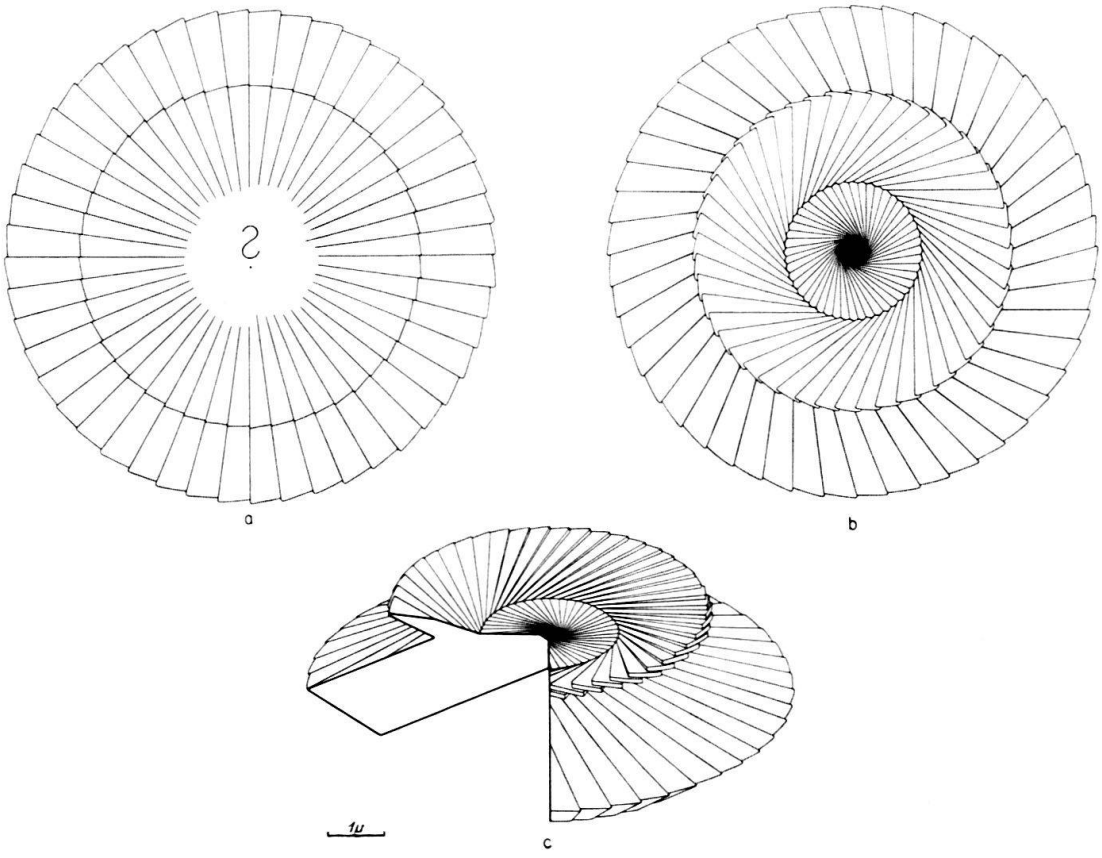

Fig. 33. Schematique drawings of *Markalius inversus* (DEFLANDRE, 1955) BRAMLETTE & MARTINI, 1964. a) distal view – b) proximal view – c) oblique view on the proximal side.

1969–03–14 *Cyclagelosphaera ? chronolitha* n. sp. – BUKRY, p. 29; Pl. 9, Fig. 2–4.
1969–06 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – PERCH-NIELSEN, p. 63; Pl. 3, Fig. 5, 6.
1971–05–31 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – MARTINI, p. 751; Pl. 1, Fig. 1, 2.
non 1971–06–07 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – SHAFIK & STRADNER, p. 84; Pl. 3, Fig. 3, 4.
1971–11–12 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – PERCH-NIELSEN, p. 24; Pl. 2, Fig. 6 (?), 7.
1972–01–04 *Markalius circumradiatus* (STOVER, 1966–05–13) PERCH-NIELSEN, 1969–05–06 – THIERSTEIN, p. 479; Pl. 4, Fig. 1–5.
non 1972–06 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – BYSTRICKÁ & GERTHOFFEROVA, p. 162; Pl. 6, Fig. 3; Pl. 7, Fig. 1–3.
1973–11–28 *Markalius inversus* (DEFLANDRE, 1955–03–08) BRAMLETTE & MARTINI, 1964–08–24 – PRIEWALDER, p. 20; Pl. 13, Fig. 3, 4.

Remarks: *M. inversus* first occurs in the middle Valanginian of the "Middle-Ridge"-section.

Markalius ellipticus GRÜN, n. sp.

(Text-fig. 34; Pl. IX, Fig. 7–12)

Derivation of name: From the elliptical outline.
Holotype: Pl. IX, Fig. 8, 9; Stereoscan micrographs 219/4, 219/5.
Type level: Middle Berriasian (*Privasensis*-zone; *C. elliptica*-subzone)
Type locality: Caravaca, Miravetes-section, All 70.90.

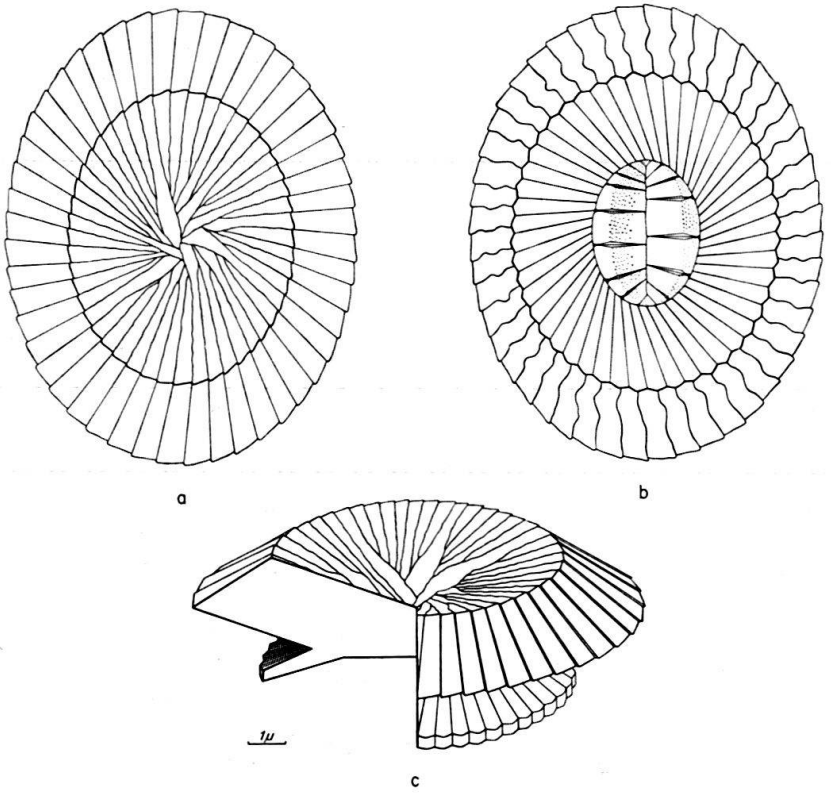

Fig. 34. Schematic drawings of *Markalius ellipticus* GRÜN n. sp.
a) distal view – b) proximal view – c) oblique view on the proximal side.

Depository: Department of Scanning Electronmicroscopy, Institute of Geology. University of Berne.

Description: The two elliptical shield, similar to watch-glasses, are connected at the centres of their convex sides. The distal shield consists of 40 to 46 flat elements which show – in distal view – a strong lefthanded imbrication. These elements extend to the centre, leaving no central area. The small, mono-cycle, proximal shield has 40 to 46 wedge-shaped elements, which are – in proximal view – precessed counter-clockwise. Within this proximal cycle is a space covered by a few coarse elements, arranged on both sides of a line along the major axis of the ellipse. The spherical coccosphere consists of about 10 coccoliths.

Remarks: *M. ellipticus* differs from *M. inversus* in its elliptical outline, in the structure of its proximal center, and in the precession of the elements of its proximal shield. Otherwise these two forms are very similar, so the assignment of this species to the genus *Markalius* seems to be justified.

Major diameter: 7–14 μ; *minor diameter:* 6,5–10,5 μ; *eccentricity:* 1,1–1,35; *major diameter of the proximal shield in % of the distal shield:* 68–75%; *minor diameter of the proximal shield in % of the distal shield:* 71–78%.
First occurrence: Miravetes – All 71.122 – lower Berriasian (*Euxina*-zone; *C. alpina*-subzone).
Known range: Lower Berriasian – lower Hauterivian.

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[Rejected names enclosed within square brackets]

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Plate I

Fig. 1–4 *Broinsonia ? lata* (NOËL, 1969) NOËL, 1970 . . . . . p. 154

1: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 220/1, 8,070 ×

2: Same specimen as Fig. 1; oblique side view
Stereoscan micrograph 220/2, 8,070 ×

3: Oblique view on the distal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.139
Stereoscan micrograph 178/3, 12,100 ×

4: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 312/9, 10,770 ×

Fig. 5–7 *Biscutum ellipticum* (GÓRKA, 1957) GRÜN, n. comb. . . . . p. 154

5: Coccosphere
Cehegin – Middle Ridge section; lower Barremian, All 68.47
Stereoscan micrograph 462/7, 8,070 ×

6: Distal view
Miravetes: *euxina*-zone, *C. alpina*-subzone, All 71.122
Stereoscan micrograph 291/2, 21,530 ×

7: Distal view
Cehegin–Middle Ridge section; Hauterivian, All 68.26
Transmission electronmicrograph 2002/69, 10,770 ×

Fig. 8–10 *Bidiscus ignotus* (GÓRKA, 1957) HOFFMANN, 1970 . . . . . p. 157

8: Coccosphere
Cehegin–Middle Ridge section; Hauterivian, All 68.25
Stereoscan micrograph 553/1, 6,500 ×

9: Distal view
Miravetes; *euxina*-zone, *C. elliptica*-subzone, All 71.166
Stereoscan micrograph 163/12, 16,100 ×

10: Proximal view
Miravetes: *euxina*-zone, *C. elliptica*-subzone, All 71.166
Stereoscan micrograph 164/12, 12,100 ×

Fig. 11, 12 *Ellipsagelosphaera britannica* (STRADNER, 1963) PERCH-NIELSEN, 1968 . . p. 159

11: Coccosphere
Deepwell Nieuwerkerk 1 (Netherlands); lower Aptian, Str. 23
Stereoscan micrograph 381/4, 8,070 ×

12: Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.87
Stereoscan micrograph 169/7, 8,070 ×

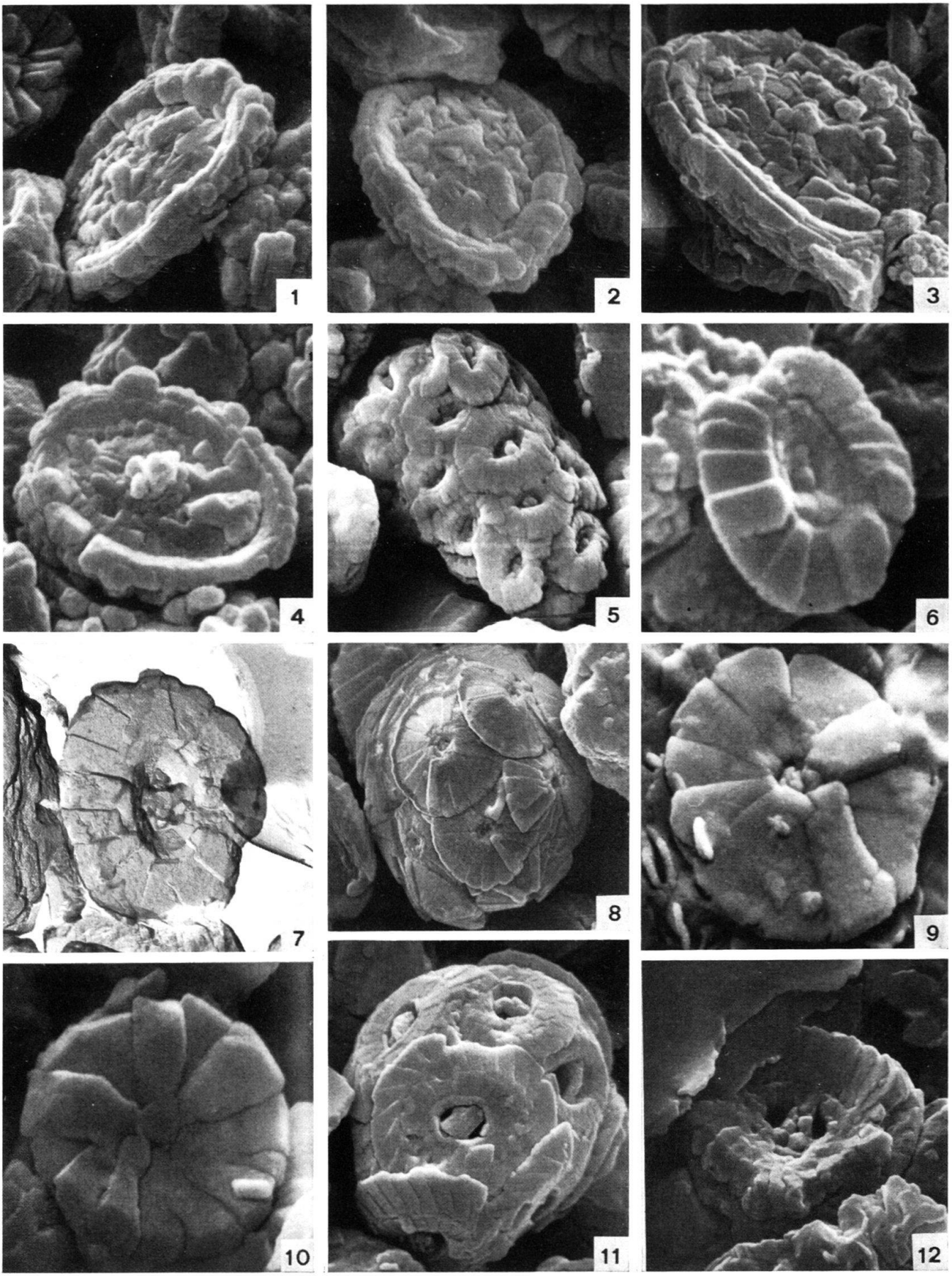
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Plate II

Fig. 1–4 — *Ellipsagelosphaera britannica* (STRADNER, 1963) PERCH-NIELSEN, 1968 . . p. 159

1: Distal view
Miravetes; *privatensis*-zone *C. elliptica*-subzone All 70.90
Stereoscan micrograph 314/3, 8,070 ×

2: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.159
Stereoscan micrograph, 215/12, 12,100 ×

3: Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161 ×
Stereoscan micrograph 217/5, 8,070 ×

4: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161
Stereoscan micrograph 218/7, 8,070 ×

Fig. 5, 6 — *Ellipsagelosphaera keftalrempti* GRÜN n. sp. . . . . p. 161

5: Distal side
Deepwell Tubbergen 4 (Netherlands); upper Hauterivian, Str. 26
Stereoscan micrograph 382/2, 9,700 ×

6: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.159
Holotype: Stereoscan micrograph 216/1, 12,100 ×

Fig. 7–9 — *Ellipsagelosphaera ovata* (BUKRY, 1969) BLACK, 1973 . . . . . p. 160

7: Distal view
Cehegin–Big Tree section; lower Barremian, All 69.23
Transmission electronmicrograph 2066/69, 9,400 ×

8: Oblique view on the distal side
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.109
Stereoscan micrograph *96*/2, 16,100 ×

9: Distal view
Cehegin–Middle Ridge section; Hauterivian, All 68.26
Transmission electronmicrograph 2794/69, 9,400 ×

Fig. 10 — *Watznaueria barnesae* (BLACK, 1959) PERCH-NIELSEN, 1968 . . . . . p. 162

Coccosphere
Miravetes; *euxina*-zone, *C. elliptica*-subzone, All 71.166
Stereoscan micrograph 223/5, 8,070 ×

Fig. 11, 12 — *Watznaueria biporta* BUKRY, 1969 . . . . . p. 164

11: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.152
Stereoscan micrograph 297/2, 8,070 ×

12: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.172
Stereoscan micrograph 428/12, 6,100 ×

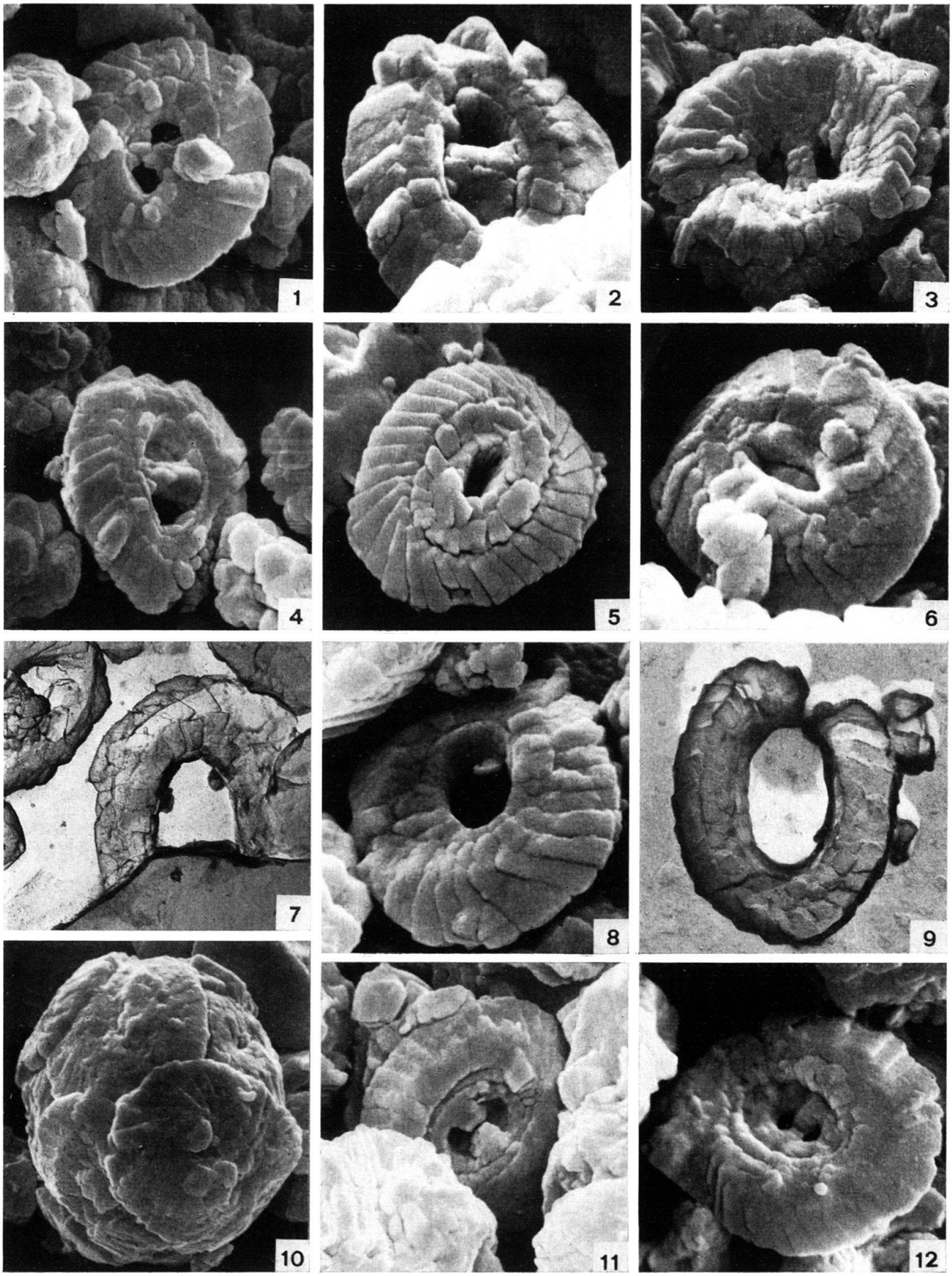
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Plate III

Fig. 1–3 — *Cyclagelosphaera margereli* NOËL, 1965 . . . . . p. 165

1: Coccosphere
Schacht Konrad I, 673 m, Salzgitter (Germany); lower Barremian.
Stereoscan micrograph 60/7, 8,070 ×

2: Coccosphere
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.180
Stereoscan micrograph 315/5, 8,070 ×

3: Oblique view on the distal side
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.103
Stereoscan micrograph 211/4, 12,100 ×

Fig. 4–6 — *Cyclagelosphaera rotaclypeata* BUKRY, 1969 . . . . . p. 167

4: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 219/11, 10,770 ×

5: Same specimen as Fig. 4; distal view
Stereoscan micrograph 219/10, 10,770 ×

6: Oblique view on the distal side
Miravetes; *jacobi*-zone, *C. alpina*-subzone, All 71.118
Stereoscan micrograph 118/7, 8,070 ×

Fig. 7–9 — *Podorhabdus dietzmanni* (REINHARDT, 1965) REINHARDT, 1967 . . . . . p. 168

7: Distal view
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71.197
Stereoscan micrograph 323/5, 10,770 ×

8: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.183
Stereoscan micrograph 181/2, 101,00 ×

9: Same specimen as Fig. 8; distal view
Stereoscan micrograph 181/3, 10,100 ×

Fig. 10 — *Tetrapodorhabdus granulatus* (REINHARDT, 1965) GRÜN n. comb.. . . . p. 170

Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 314/2, 8,070 ×

Fig. 12, 13 — *Tetrapodorhabdus coptensis* BLACK, 1971 . . . . . p. 169

12: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 220/3, 12,100 ×

13: Proximal view
Deepwell Nieuwerkerk 1 (Nederlands); lower Aptian, Str. 23
Stereoscan micrograph 381/9, 12,900 ×

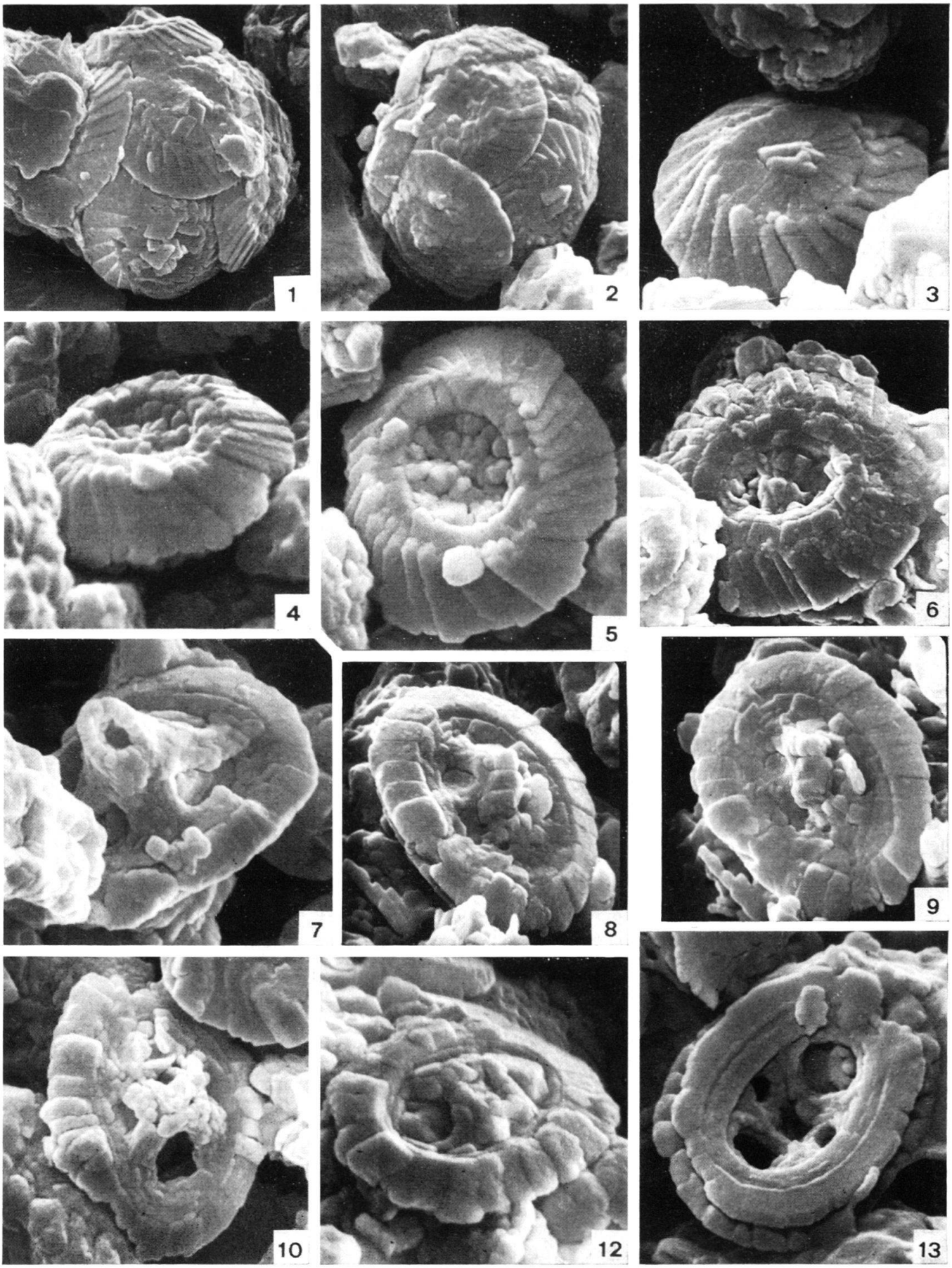
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Plate IV

Fig. 1–3 — *Retecapsa angustiforata* BLACK, 1971 . . . . . p. 173

1: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.182
Stereoscan micrograph 182/2, 8,070 ×

2: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161
Stereoscan micrograph 217/8, 8,070 ×

3: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.88
Steroscan micrograph 169/4, 8,070 ×

Fig. 4–6 — *Retecapsa crenulata* (BRAMLETTE & MARTINI, 1964) GRÜN, n. comb. . . p. 175

4: Oblique view on the distal side
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71. 197
Stereoscan micrograph 318/6, 10,770 ×

5: Oblique view on the distal side
Lower Chalk, Dunstable (GB); Cenomanian
Stereoscan micrograph 262/9, 8,070 ×

6: Proximal view
Deepwell Nieuwerkerk 1 (Netherlands); lower Aptian, Str. 23
Stereoscan micrograph 380/10, 9,700 ×

Fig. 7, 8 — *Speetonia colligata* BLACK, 1971 . . . . . p. 178

7: Proximal view
Cehegin–Middle Ridge section; lower Valanginian, All 69.69
Stereoscan micrograph 462/12, 8,070 ×

8. Distal view
Cehegin–Middle Ridge section; Valanginian, All 69.76
Stereoscan micrograph 468/2, 8,070 ×

Fig. 9–12 — *Cruciellipsis cuvillieri* (MANIVIT, 1966) THIERSTEIN, 1971. . . . . p. 179

9: Oblique view on the distal side
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71.203
Stereoscan micrograph 233/5, 8,070 ×

10: Same specimen as Fig. 9; oblique view on the distal side
Stereoscan micrograph 233/4, 8,070 ×

11: Distal view
Chegin–Middle Ridge section; upper Hauterivian, All 68.35
Stereoscan micrograph 459/10, 5,400 ×

12: Proximal view
Cehegin–Middle Ridge section; Hauterivian, All 68.25
Stereoscan micrograph 552/10, 8,070 ×

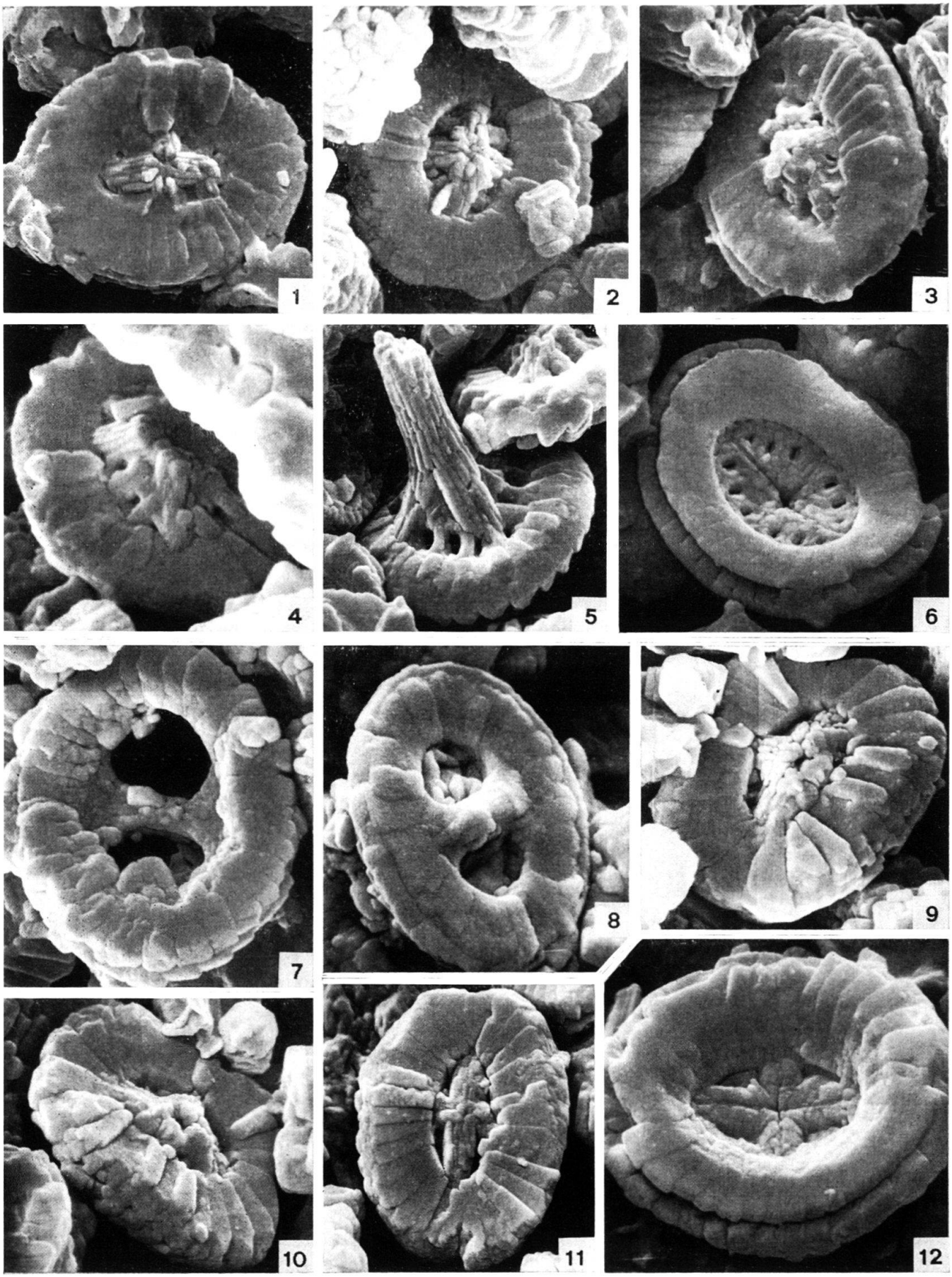
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Plate V

Fig. 1–4 — *Microstaurus chiastius* (WORSLEY, 1971) GRÜN, n. comb. . . . . p. 181

1: Coccosphere, slightly destroyed
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.88
Stereoscan micrograph 294/10, 8,070 ×

2: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.184
Stereoscan micrograph 317/7, 10,770 ×

3: Distal view
Miravetes; *euxina*-zone, *C. elliptica*-subzone, All 71.166
Stereoscan micrograph 167/7, 12,100 ×

4: Lateral view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.159
Stereoscan micrograph 216/8, 12,100 ×

Fig. 5–10 — *Microstaurus* sp 32 . . . . . p. 182

5: Distal view
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.122
Stereoscan micrograph 266/1, 8,070 ×

6: Same specimen as Fig. 5; lateral view
Stereoscan micrograph 265/12, 8,070 ×

7: Oblique view on the distal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.122
Stereoscan micrograph 291/7, 8,070 ×

8: Same specimen as Fig. 7; lateral view
Stereoscan micrograph 291/6, 8,070 ×

9: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.88
Stereoscan micrograph 294/12, 8,070 ×

10: Same specimen as Fig. 9; lateral view
Stereoscan micrograph 294/11, 8,070 ×

Fig. 11, 12 — *Microstaurus* ? sp. 36 . . . . . p. 182

11: Oblique view on the distal side
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.109
Stereoscan micrograph 212/2, 10,770 ×

12: Oblique view on the distal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.141
Stereoscan micrograph 178/11, 10,770 ×

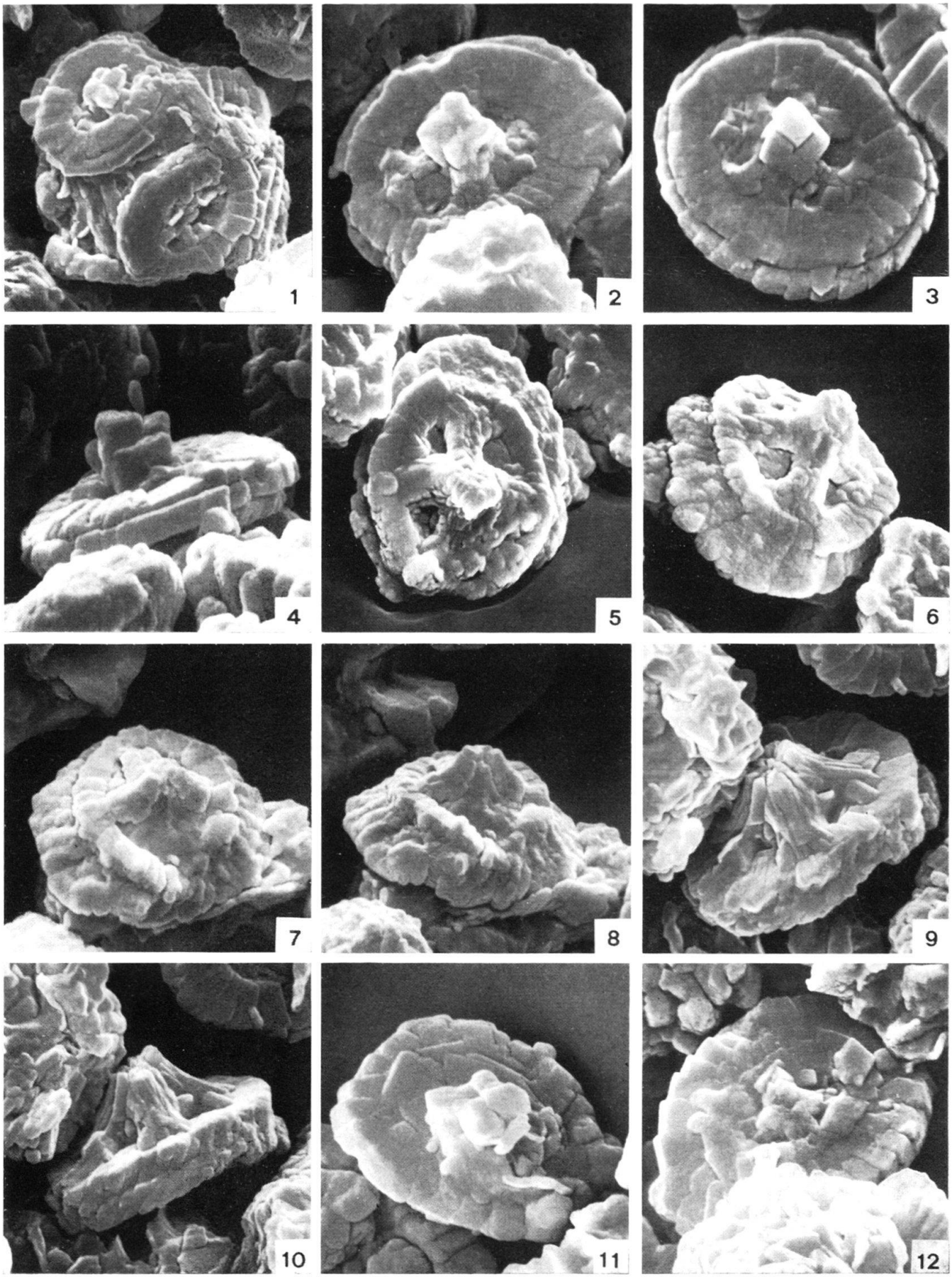
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Plate VI

Fig. 1–4 — *Microstaurus* ? sp. 36 . . . . . p. 182

1: Distal view
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.109
Stereoscan micrograph 211/11, 10,770 ×

2: Same specimen as Fig. 1: oblique view on the distal side
Stereoscan micrograph 211/12, 10,670 ×

3: Same specimen as Fig. 1; oblique view on the distal side
Stereoscan micrograph 212/1, 10,770 ×

4: Lateral view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.144
Stereoscan micrograph 162/10, 10,770 ×

Fig. 5, 6 — *Grantarhabdus meddii* BLACK, 1971 . . . . . p. 182

5: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 314/1, 8,070 ×

6: Same specimen as Fig. 5; oblique view on the distal side
Stereoscan micrograph 313/12, 8,070 ×

Fig. 7, 8 — *Grantarhabdus bukryi* BLACK, 1972 . . . . . p. 183

7: Distal view
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71.189
Stereoscan micrograph 317/12, 10770 ×

8. Same specimen as Fig. 7; oblique view on the distal side
Stereoscan micrograph 317/11, 10,770 ×

Fig. 9–12 — *Miravetesina favula* GRÜN, n. sp. . . . . p. 185

9: Oblique view on the distal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.131
Stereoscan micrograph 266/5, 8,070 ×

10: Oblique view on the distal side
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71.197
Holotype; Stereoscan micrograph 323/8, 10,770 ×

11: Same specimen as Fig. 10; distal view
Holotype; Stereoscan micrograph 323/7, 10,770 ×

12: Distal side, destroyed specimen
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.140
Stereoscan micrograph 263/9, 8,070 ×

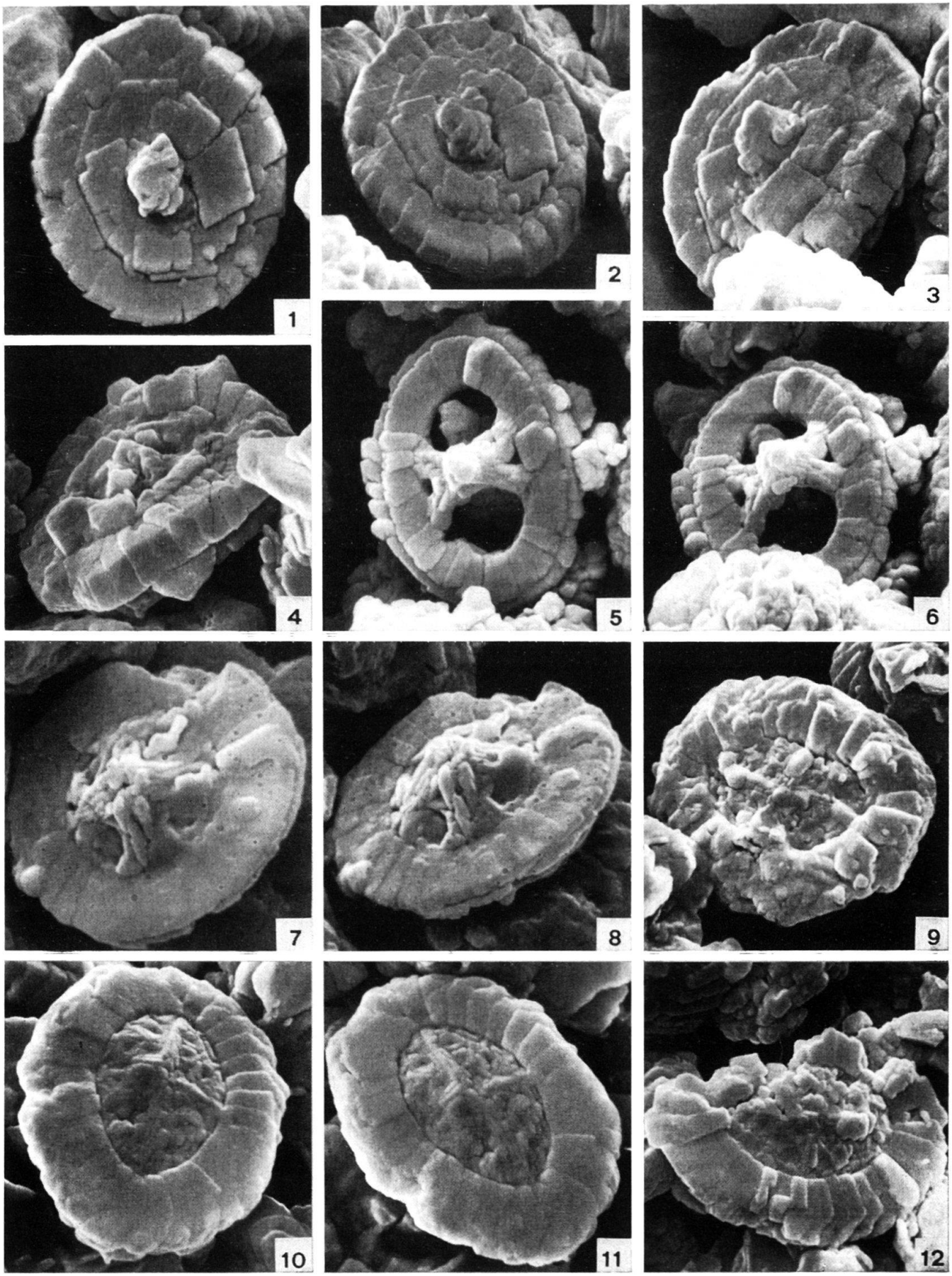
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Plate VII

Fig. 1–3 — *Stephanolithion caravacaensis* GRÜN, n. sp. . . . . p. 188

1: Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.144
Holotype: Stereoscan micrograph 162/1, 12,050×

2: Same specimen as Fig 1; lateral view
Holotype: Stereoscan micrograph 162/2, 12,050×

3: Proximal view
Miravetes; *euxina*-zone, *C. elliptica*-subzone, All 71.143
Stereoscan micrograph 292/1, 12,050×

Fig. 4 — *Stephanolithion laffittei* NOËL, 1956 . . . . . p. 187

Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.144
Stereoscan micrograph 162/11, 16,100×

Fig. 5, 6 — *Sollasites horticus* (STRADNER, ADAMIKER & MARESCH, 1966) BLACK, 1968 p. 189

5: Oblique view on the distal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.182
Stereoscan micrograph 182/3, 13,500×

6: Same specimen as Fig. 5; distal view
Stereoscan micrograph 182/5, 13,500×

Fig. 7–11 — *Parhabdolithus embergeri* (NOËL, 1958) STRADNER, 1963 . . . . . p. 191

7: Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161
Stereoscan micrograph 312/1, 5,400×

8: Same specimen as Fig. 7; lateral view
Stereoscan micrograph 312/2, 5,400×

9: Same specimen as Fig. 7; oblique view on the distal side
Stereoscan micrograph 312/3, 5,400×

10: Proximal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 221/8, 8,070×

11: Proximal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 220/12, 6,100×

Fig. 12 — *Zygodiscus* sp. cf. *Z. compactus* BUKRY, 1969 . . . . . p. 192

Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71. 181
Stereoscan micrograph 315/9, 10,770×

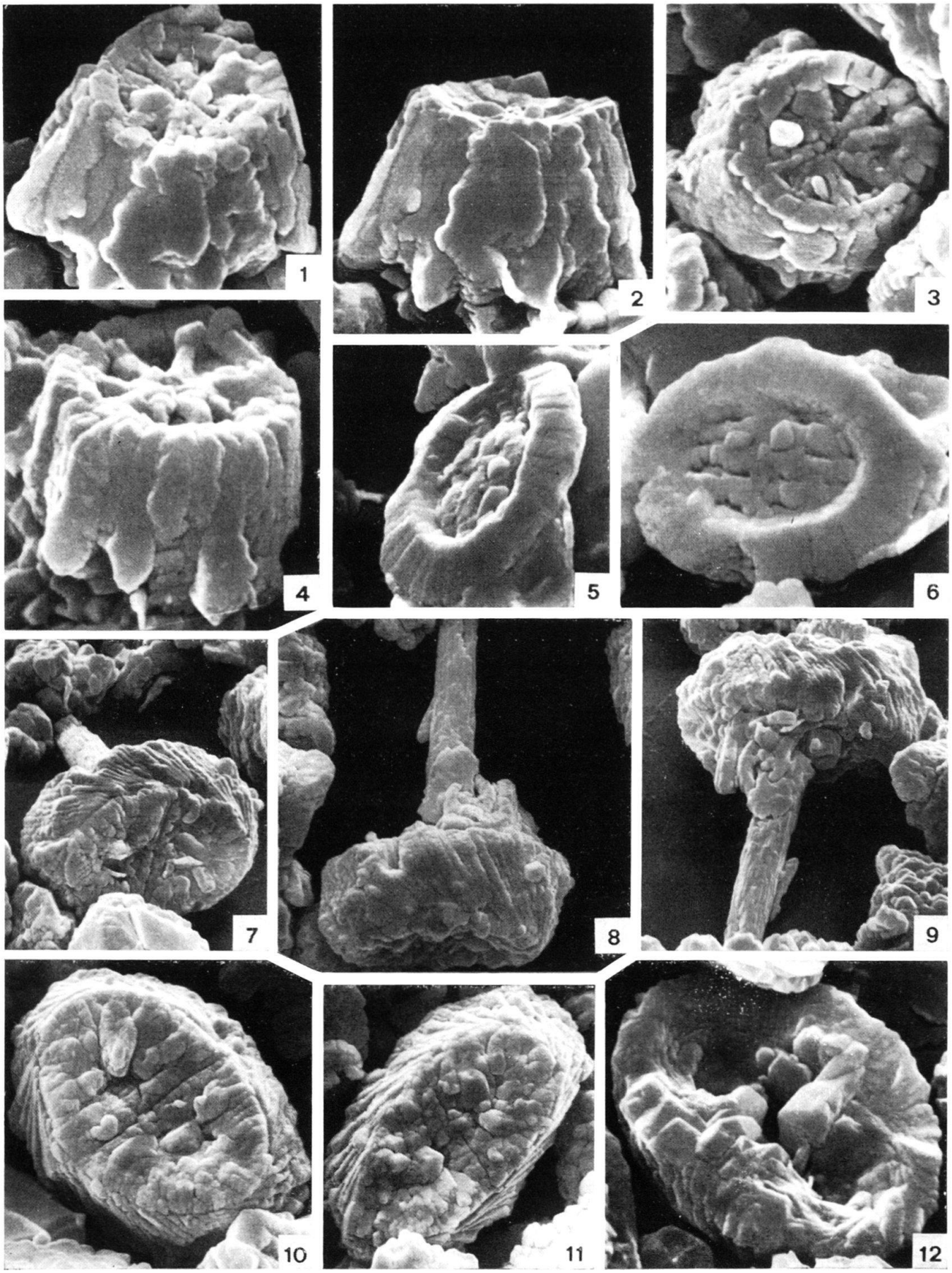
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Plate VIII

Fig. 1, 2 — *Zygodiscus* sp. cf. *Z. compactus* BUKRY, 1969 . . . . . p. 192

1: Distal view
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.141
Stereoscan micrograph 264/2, 10,770 ×

2: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 313/8, 10,770 ×

Fig. 3–5 — *Micrantholithus crenulatus* BRAMLETTE & SULLIVAN, 1961 . . . . . p. 192

3: Plan view
Cehegin–Big Tree section; lower Barremian, All 69.23
Transmission electronmicrograph 2385/69, 5,400 ×

4: Plan view
Cehegin–Middle Ridge section; upper Hauterivian, All 68.38
Stereoscan micrograph 459/3, 8,070 ×

5: Plan view
Cehegin–Middle Ridge section; lower Barremian, All 68.45
Stereoscan micrograph 553/7, 6,100 ×

Fig. 6 — *Markalius inversus* (DEFLANDRE, 1954) BRAMLETTE & MARTINI, 1964 . . p. 199

Oblique view on the proximal side
Cehegin–Middle Ridge section; Hauterivian, All 68.26
Stereoscan micrograph 552/1, 8,070 ×

Fig. 7–12 — *Conusphaera mexicana* TREJO, 1969 . . . . . p. 195

7: Lateral view
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.103
Stereoscan micrograph 211/5, 8,070 ×

8: Oblique view on the proximal side
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.103
Stereoscan micrograph 211/2, 8,070 ×

9: Same specimen as Fig. 8; proximal view
Stereoscan micrograph 211/3, 8,070 ×

10: Lateral view
Miravetes; *jacobi*-zone, *Cr. intermedia*-subzone, All 71.109
Stereoscan micrograph 212/4, 12,050 ×

11: Same specimen as Fig. 10; oblique view on the proximal side
Stereoscan micrograph 212/5, 12,050 ×

12: Oblique view on the distal side
Miravetes; *jacobi*-zone, *C. alpina*-subzone, All 71.119
Stereoscan micrograph 214/4, 12,050 ×

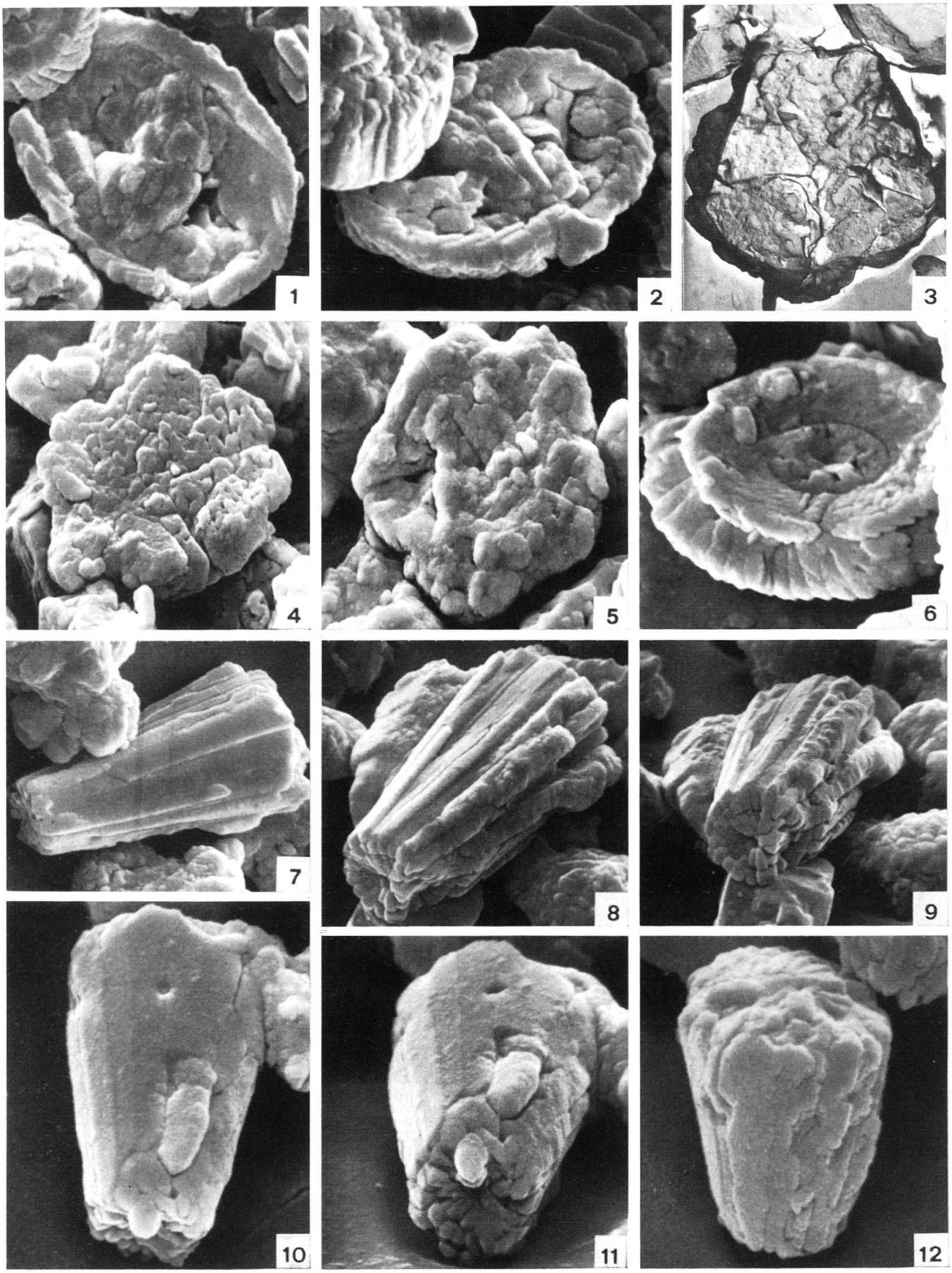
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Plate IX

Fig. 1–6 — *Diazomatolithus subbeticus* GRÜN, n. sp. . . . . p. 196

1: Coccosphere, heavily destroyed
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161
Stereoscan micrograph 217/4, 10,770 ×

2: Proximal view
Miravetes; *jacobi*-zone, *C. alpina*-subzone, All 71.119
Stereoscan micrograph 126/4, 16,100 ×

3: Oblique view on the proximal side
Miravetes; *callisto*-zone, *simplex–oblonga–dadayi*-subzone, All 71.211
Holotype; Stereoscan micrograph 436/7, 14,500 ×

4: Oblique view on the proximal side
Miravetes; *picteti–malbosi*-zone, *Cps. simplex*-subzone, All 71.197
Stereoscan micrograph 318/5, 13,500 ×

5: Oblique view on the proximal side
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 222/6, 12,100 ×

6: Oblique view on the proximal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.122
Stereoscan micrograph 171/3, 16,100 ×

Fig. 7–12 — *Markalius ellipticus* GRÜN, n. sp. . . . . p. 200

7: Coccosphere
Chegin–Middle Ridge section; Hauterivian, All 68.23
Stereoscan micrograph 551/3, 6,100 ×

8: Proximal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Holotype; Stereoscan micrograph 219/4, 6,100 ×

9: Same specimen as Fig. 8; oblique view on the proximal side
Holotype; Stereoscan micrograph 219/5, 6,100 ×

10: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.89
Stereoscan micrograph 68/3, 8,070 ×

11: Proximal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.161
Stereoscan micrograph 217/9, 8,070 ×

12: Oblique view on the proximal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.122
Stereoscan micrograph 265/11, 8,070 ×

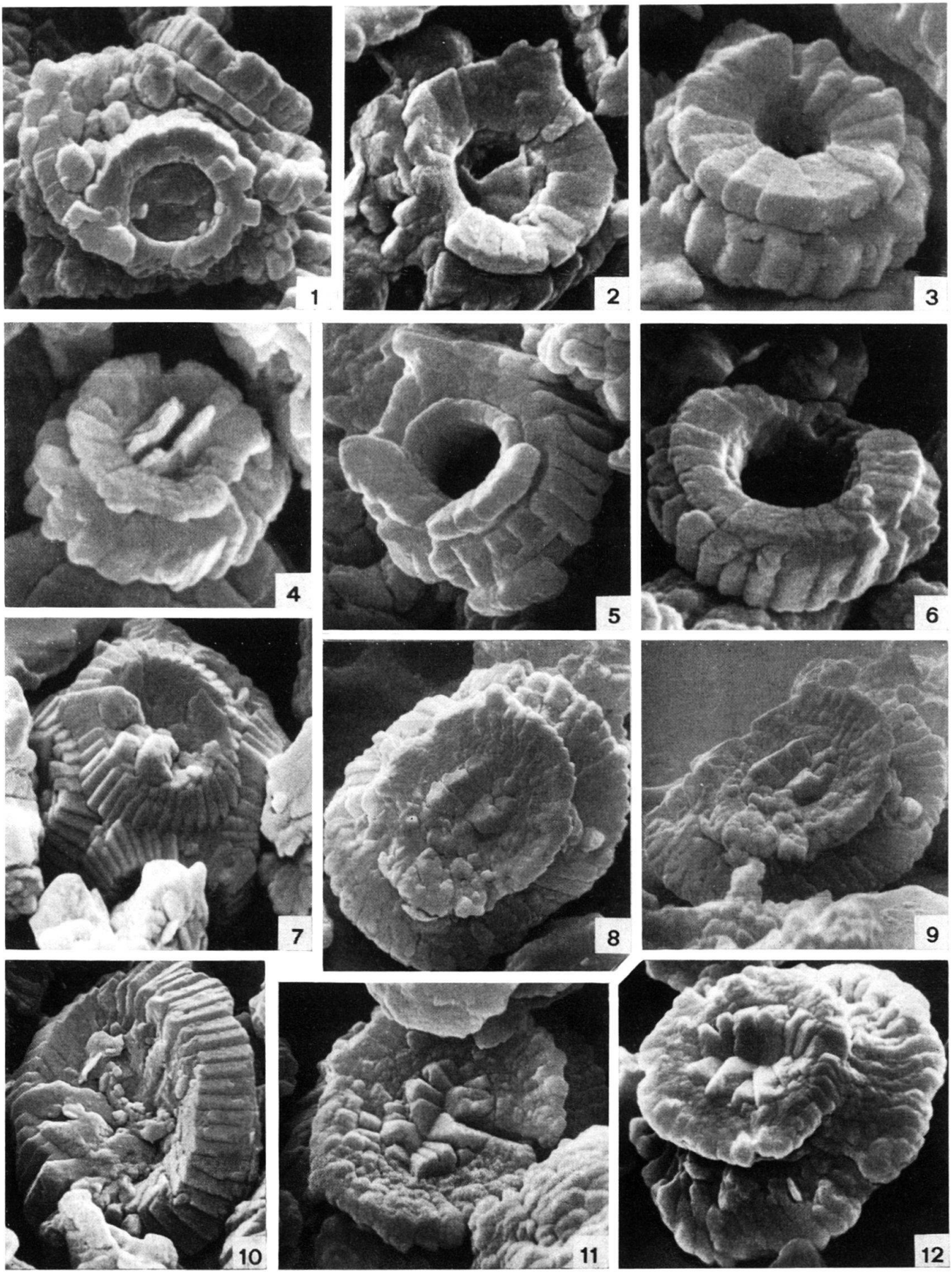
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Plate X

Fig. 1–12 *Tubodiscus verenae* THIERSTEIN, 1973, emend. GRÜN . . . . . p. 197

1: Proximal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 70.90
Stereoscan micrograph 319/10, 5,400 ×

2: Same specimen as Fig. 1; oblique view on the proximal side
Stereoscan micrograph 319/11, 6,700 ×

3: Oblique view on the proximal side
Miravetes; *euxina*-zone, *C. alpina*-subzone, All 71.139
Stereoscan micrograph 272/9, 8,070 ×

4: Lateral view
Deepwell Nieuwerkerk 1 (Netherlands); lower Aptian, Str. 23
Stereoscan micrograph 379/10, 12,900 ×

5: Distal view
Cehegin–Middle Ridge section; upper Valanginian, All 69.84
Stereoscan micrograph 471/5, 8,070 ×

6: Distal view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.144
Stereoscan micrograph 162/8, 6,100 ×

7: Lateral view
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.153
Stereoscan micrograph 297/3, 10,770 ×

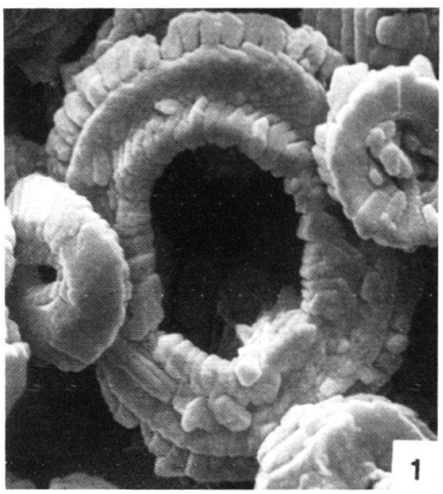
8: Same specimen as Fig. 6; oblique view on the distal side
Stereoscan micrograph 162/9, 6,100 ×

9: Proximal view
Deepwell Nieuwerkerk 1 (Netherlands); lower Aptian, Str. 23
Stereoscan micrograph 379/2, 9,700 ×

10: Distal view, broken specimen
Cehegin–Middle Ridge section; upper Valanginian, All 69.84
Stereoscan micrograph 472/1, 8,070 ×

11: Oblique view on the distal side of broken specimen
Miravetes; *privasensis*-zone, *C. elliptica*-subzone, All 71.172
Stereoscan micrograph 315/1, 10,770 ×

12: Same specimen as Fig. 11; lateral view
Stereoscan micrograph 315/2. 10,770 ×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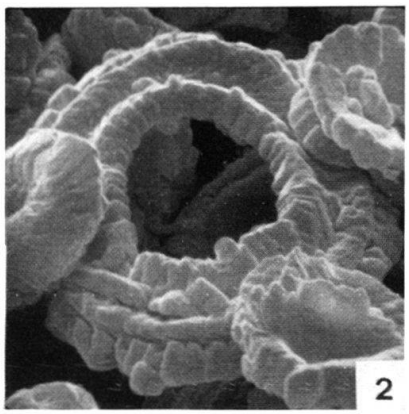
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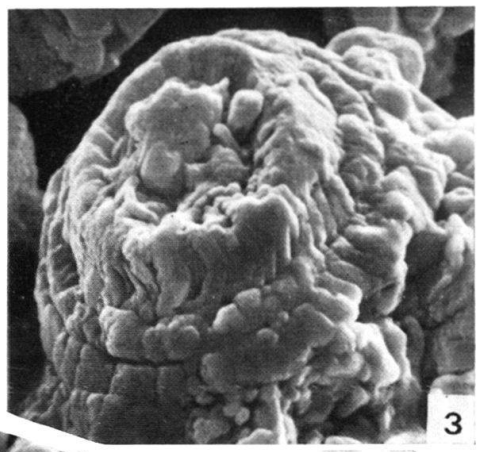
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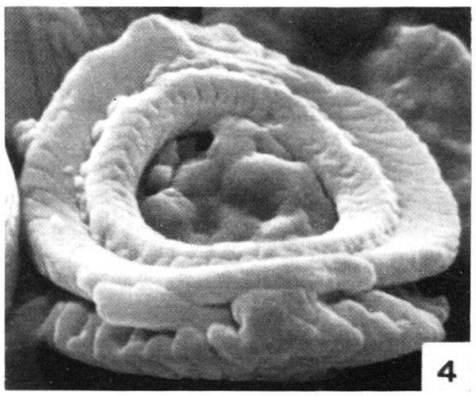
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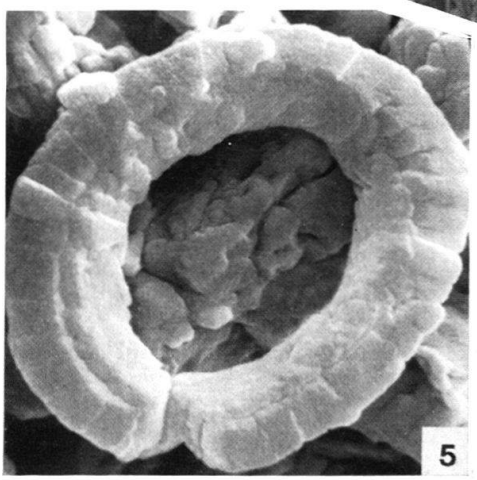
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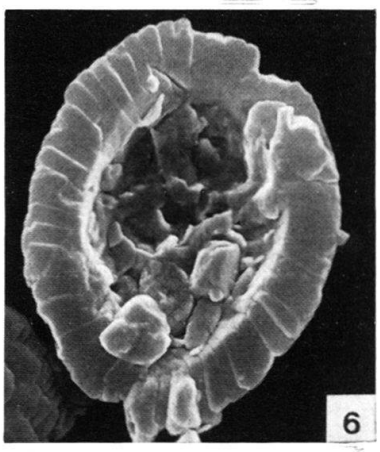
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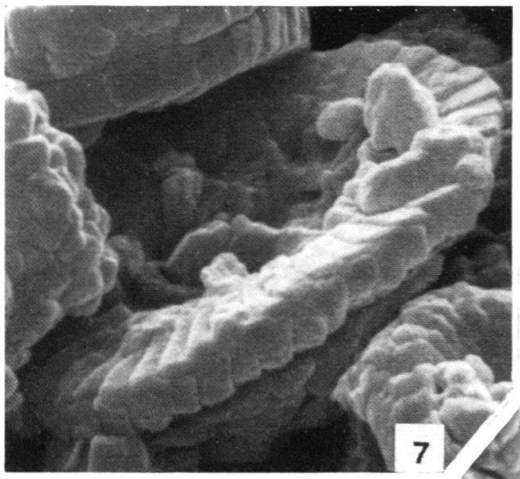
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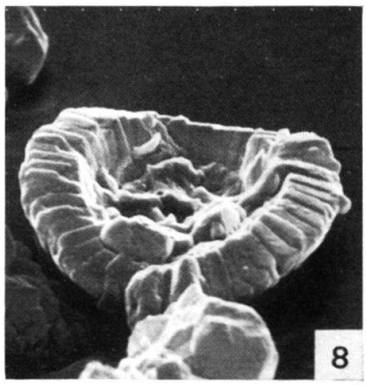
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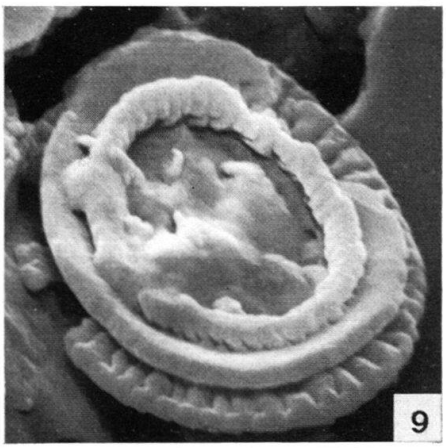
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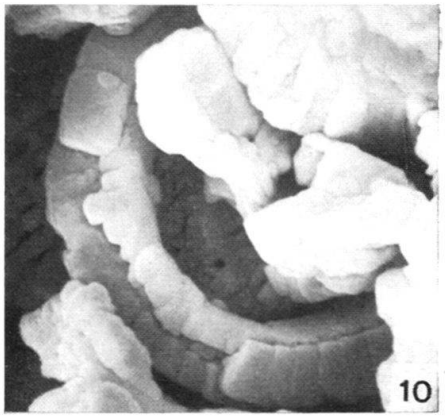
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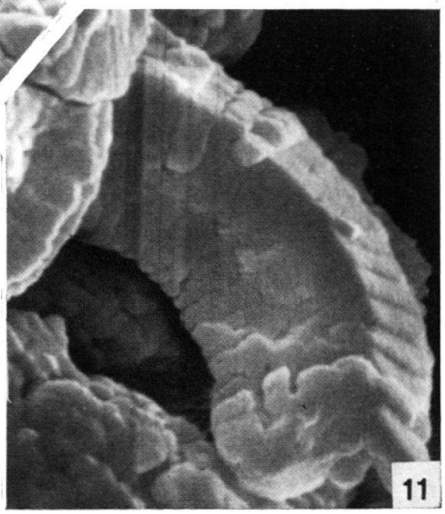
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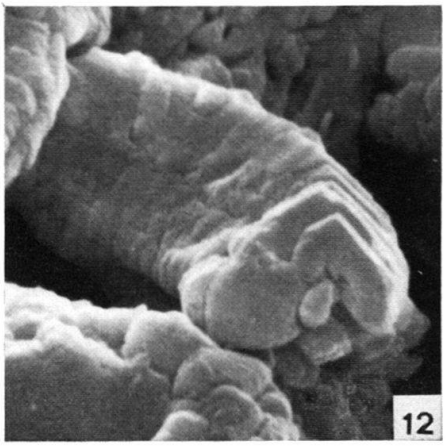
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