acta
geologica
polonica

Vol. 28, No. 3 Warszawa 1978

ELŻBIETA GAŹDZICKA

Calcareous nannoplankton from the uppermost Cretaceous and Paleogene deposits of the Lublin Upland

ABSTRACT: Abundant and well-preserved calcareous nannoplankton found in the Campanian and Maastrichtian deposits of the western part of the Lublin Upland, Central Poland, was studied under both light and scanning electron microscopes. The overlying Paleocene deposits comprise very scarce and taxonomically poor calcareous nannoplanktic assemblage. Totally, 83 species are described, 3 new species including, viz. *Eiffellithus multicostatus* sp. n., *Broinsonia cribrata* sp. n., and *Thoracosphaera longiuscula* sp. n. Four calcareous nannoplanktic biostratigraphic zones are recognized in the uppermost Cretaceous, and two zones in the Paleocene.

INTRODUCTION

The uppermost Cretaceous deposits of the western part of the Lublin Upland comprise abundant and well-preserved calcareous nannoplankton. The mass occurrence of those microfossils was recorded by Sujkowski (1931) but the Upper Maastrichtian coccoliths were for the first time investigated by Górka (1957) in the environs of Kazimierz-upon-Vistula.

The use of *SEM* technique to studies on and the recognition of stratigraphic importance of calcareous nannoplankton induced a renewed interest in this fossil group.

The investigated material has been derived mostly from boreholes pierced and made available by the Geological Survey of Poland. The remaining part was offered by Docent H. Górka or collected by the present author herself in the field in 1974—1975.

Acknowledgements. The author is greatly indebted to Professor A. Urbanek for his continuous care and helpful remarks in the course of the present study; to Docent H. Górka for making available the material and paleontological literature and introducing into the problems involved in the present work; and to Docent A. Radwański for valuable suggestions and critical comments on the manuscript. Dr. R. Marcinowski and Dr. B. A. Matyja are gratefully acknowledged for their help in micro-

facies work on the Cretaceous and Tertiary lithologies. Thanks are also due to Dr. A. Gaździcki for the assistance in the field and taking photomicrographs of thin sections.

GEOLOGICAL SETTING

The investigated calcareous nannoplankton comes from the uppermost Cretaceous (Campanian and Maastrichtian) to lowermost Tertiary strata of the western part of the Lublin Upland, Central Poland (*cf.* Text-fig. 1). The Upper Cretaceous (Albian to Maastrichtian) and Paleocene deposits are exposed along the Vistula valley, between Annopol and Puławy (*cf.* Pożaryski 1938). The investigated material has been derived

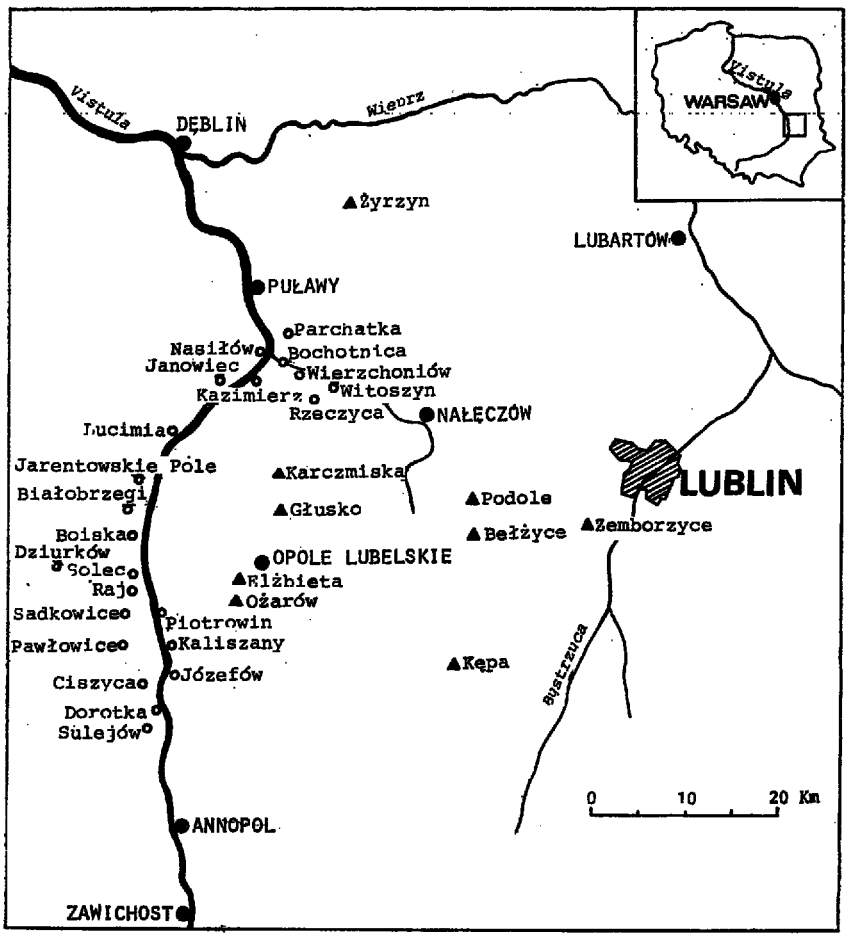
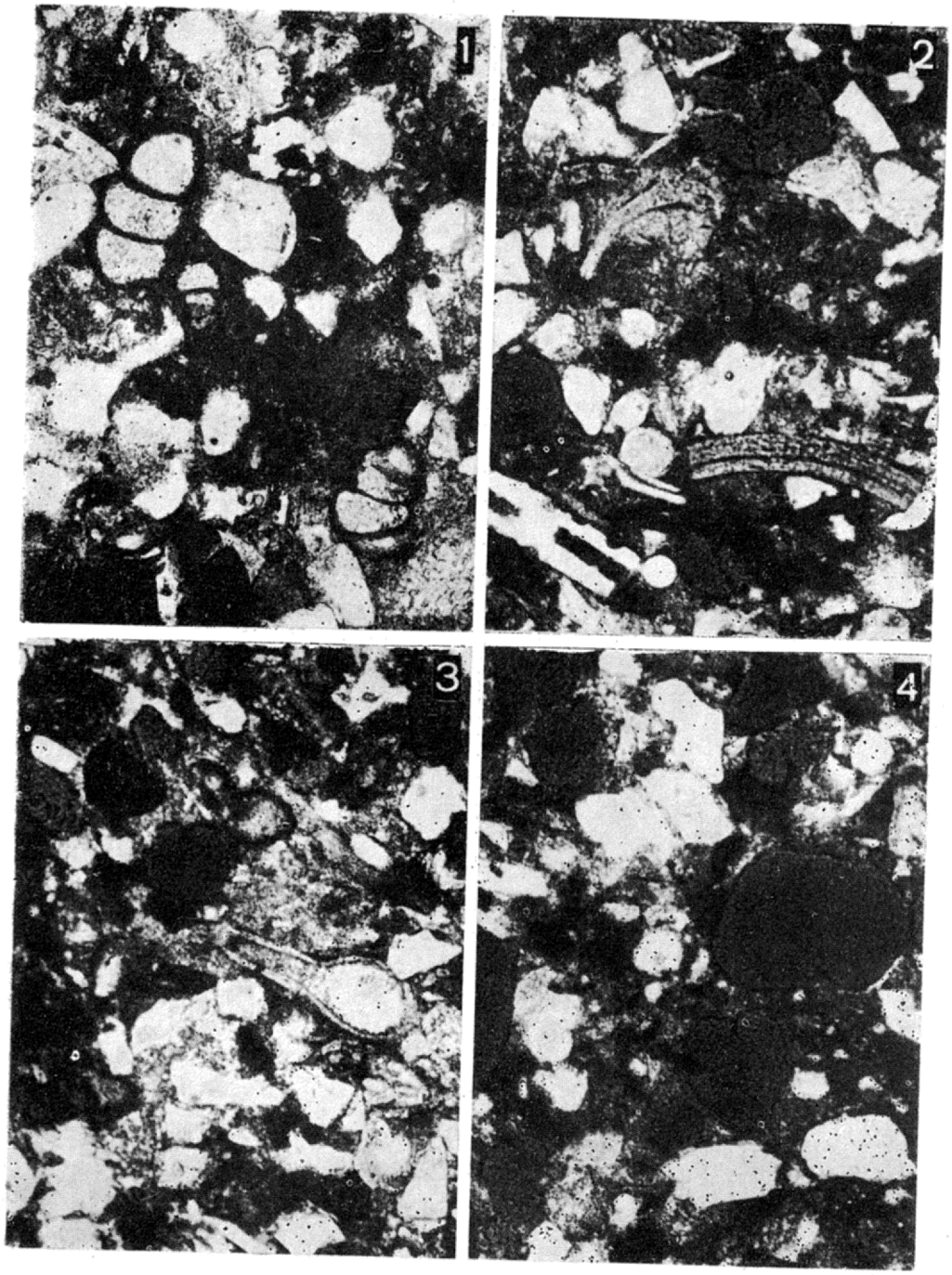


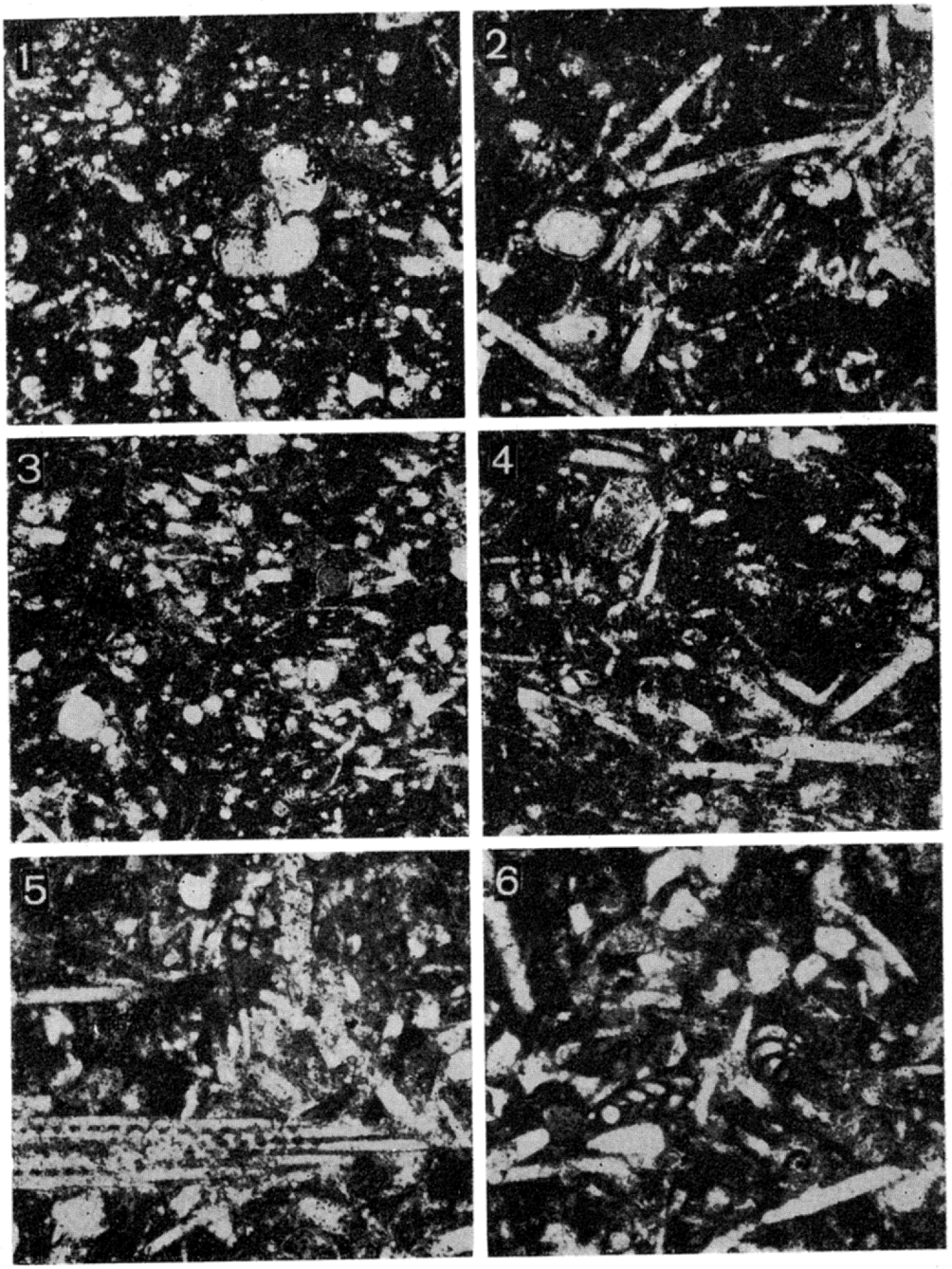
Fig. 1. Location of outcrops (*circles*) and boreholes (*black triangles*) in the western part of the Lublin Upland yielding Campanian, Maastrichtian and Paleogene deposits sampled for calcareous nannoplankton; inset shows position of the investigated area in Poland



Maastrichtian lithology; all figures × 80

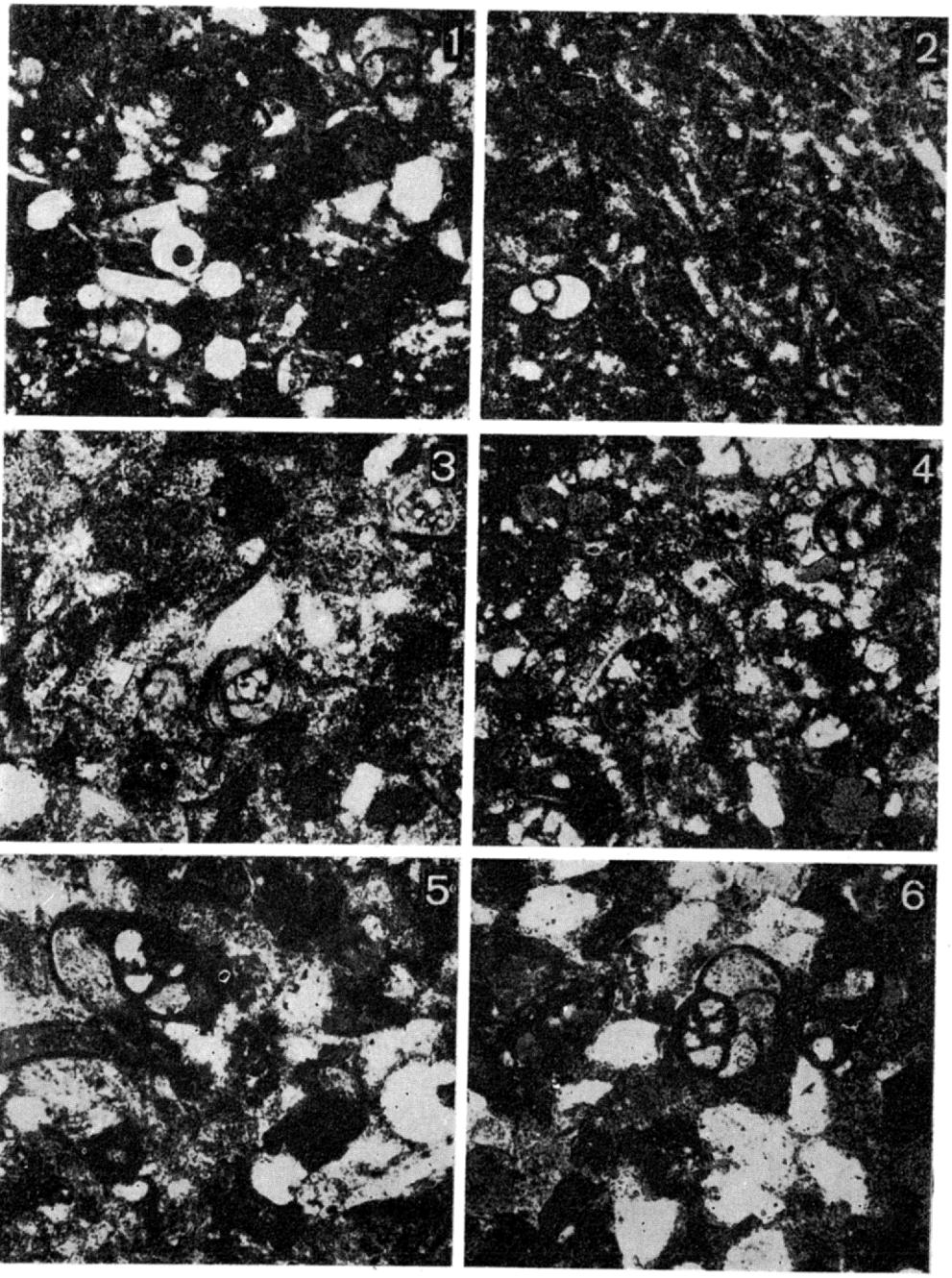
1 and 2 — Quartz-glauconitic calcareous sandstone with foraminifer (**1**) and bivalve detritus (**2**); Upper Maastrichtian, Bochotnica

3 and 4 — Glauconitic gaize with organic remains (**3**); Upper Maastrichtian, Nasiłow



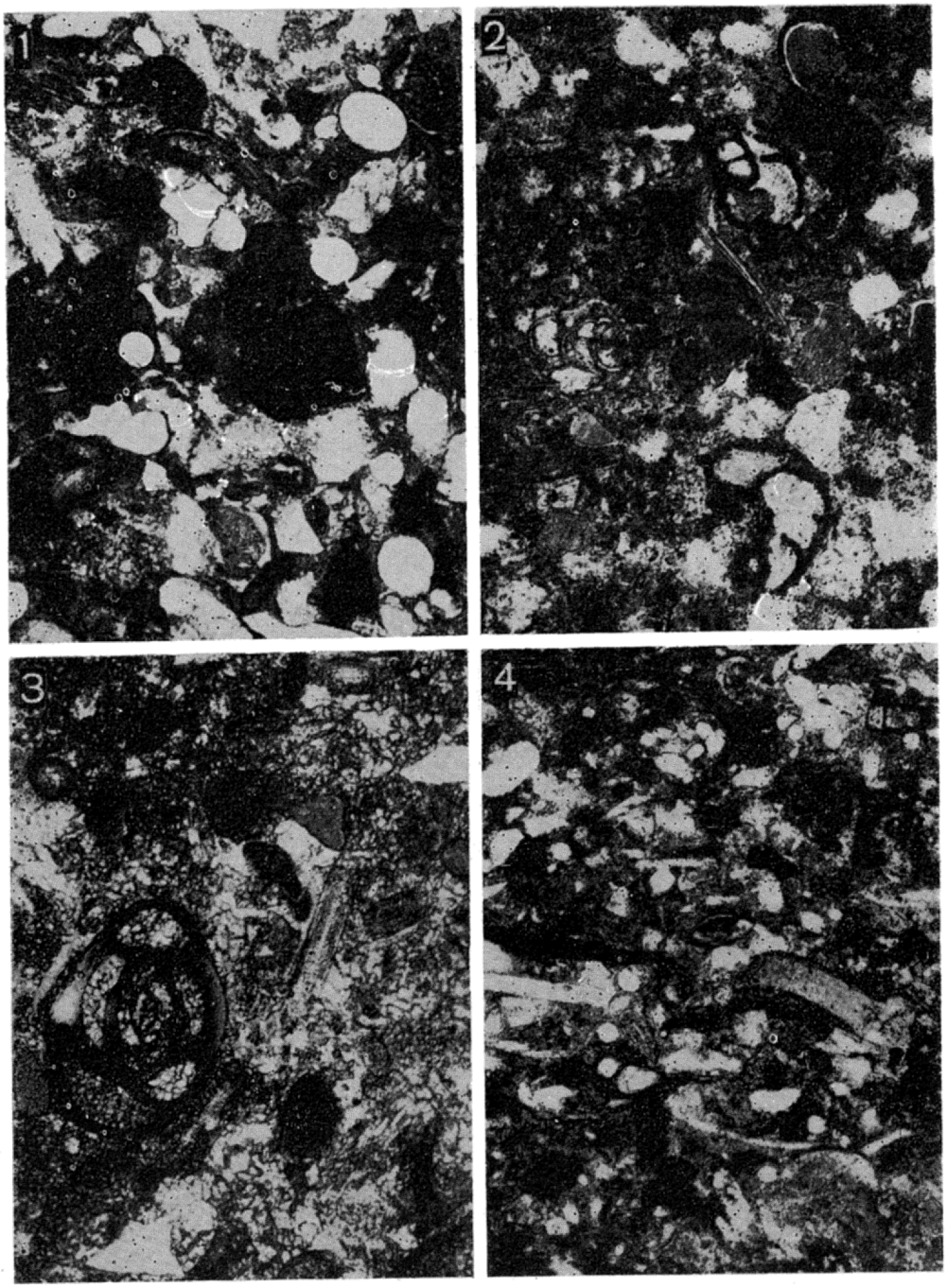
Campanian and Maastrichtian siliceous marls

1 — abundant sponge spicules and planktic forams; Upper Campanian, Pawłowice; × 80
2 — abundant sponge spicules, foraminifer and echinoderm fragments; Lower Maastrichtian, Piotrowin; × 50
3 — silt-sized quartz and foraminifer fragments; Upper Maastrichtian, Kazimierz; × 50
4 — abundant sponge spicules; Upper Campanian, Józefów; × 50
5 — abundant sponge spicules, foraminifer fragments, and an echinoid spine; Upper Maastrichtian, Nasiłów; × 80
6 — silt-sized quartz, abundant sponge spicules, and foraminifer fragments; Upper Maastrichtin, Nasiłów; × 80



Paleocene lithology

1 and 2 — silty gaize with organic remains (foraminifers, sponge spicules, bryozoan fragments); Paleocene, borehole Żyrzyn (depth 90 m); × 50
3 — glauconitic gaize with foraminifer and bivalve detritus; Paleocene, Wierzchoniów; × 50
4 — silty gaize with foraminifer fragments; Paleocene, borehole Żyrzyn (depth 90 m); × 50
5 — glauconitic gaize with foraminifer and bivalve detritus; Paleocene, Rzeczyca; × 80
6 — sandy gaize with foraminifer fragments; Paleocene („siwak"), Nasiłów; × 80 (with nicols crossed)



Paleocene lithology; all figures × 80

1 and 2 — glauconitic sandy gaize with bryozoan (**1**) and foraminifer detritus (2); Paleocene ("siwak"), Nasiłów; Fig. 1 with nicols crossed

3 — glauconitic silty gaize with foraminifer fragments; Paleocene, Rzeczyca

4 — gaize with silt-sized quartz and organic remains (bivalve fragments, foraminifers, and sponge spicules); Paleocene, Witoszyn

from those exposures as well as from the boreholes located near Lublin (Zemborzyce, Podole, Bełżyce, Kępa), Opole Lubelskie (Ożarów, Elżbieta, Głusko, Karczmiska), and north to Puławy (Żyrzyn). In addition, the Paleocene deposits were also sampled in some small natural and artificial exposures in the Bystra valley at Bochotnica.

In the western part of the Lublin Upland, the Campanian and Maastrichtian deposits are represented by a monotonous carbonate and carbonate-siliceous complex over 500 m thick (Pożaryski 1938, Cieśliński 1973). Siliceous marls, so-called *opoka* (Pls 1—2), appear dominant in the lithology, whereas limestones, marls, and chalk appear but in minor amounts.

In the north of the study area (Żyrzyn borehole), the Upper Maastrichtian siliceous marls are overlaid by interbedding marls and gaizes separated from the former deposits by a hardground. That overlying set of strata has been called as the Żyrzyn Beds and attributed to the uppermost Upper Maastrichtian (Pożaryska 1965).

The Żyrzyn Beds are lacking at Nasiłów and Bochotnica where the Upper Maastrichtian limestones end with a hardground overlaid directly by the Paleocene grey gaizes, so-called *siwak* (Pls 3—4), intercalated with marls and limestones.

The chalk and marls appear as the most suitable lithologies for studying calcareous nannoplankton in the investigated area. In fact, they comprise an abundance of those microfossils and are sufficiently loose as to permit the isolation of the latter without any damage to the fossil structure. The coccoliths occur commonly also in the gaizes and limestones but they are rather poorly-preserved therein and hardly extractable from the rock.

METHODS OF INVESTIGATION

The calcareous nannoplankton was studied by means of both light and scanning electron microscopes. The electron microscopes used were *JEOL JSM-S1* (at Nencki Institute of Experimental Biology, Warsaw) and *JEOL IXA-50A* (at "Wizamet", Łódź). The material was prepared by the method of Perch-Nielsen (1968) with some necessary modifications. The samples ranged in weight from 1 g in the case of chalk, marls, and limestones, up to 5 g in the case of compact gaizes.

SYSTEMATIC DESCRIPTION

The following description comprises synonymies, dimensions, morphological remarks and occurrence data for all the species or forms recognized in the investigated samples. Illustrated are most of the species (Pls 5—44)

except of a few ones having been investigated only under the light microscope.

Family Eiffellithaceae Reinhardt, 1965 emend. Perch-Nielsen, 1968

Genus *LOXOLITHUS* Noël, 1965

Type species: *Loxolithus armilla* (Black 1959) Noël, 1965

Loxolithus armilla (Black 1959) Noël, 1965

(Pl. 6, Fig. 2)

1959. *Cycrolithus armilla* sp. nov.; M. Black *in* M. Black & B. Barnes, p. 327, Pl. 12, Fig. 2.
1965. *Loxolithus armilla* (Black & Barnes) nov. comb.; D. Noël, p. 67, Text-fig. 3.
1968. *Cycrolithella inflexa* (Kamptner ex Deflandre) Loeblich & Tappan; H. Stradner & *al.*, p. 28, Pl. 10.
1971. *Loxolithus armilla* Noël; H. Manivit, p. 77, Pl. 17, Figs 7—10.
1972. *Loxolithus armilla* (Black & Barnes, 1959) Noël, 1965; S. Forchheimer, p. 59, Pl. 18, Figs 5—6.
Dimensions: length 6—8 μ; width 5—6.5 μ.

Remarks. — When erecting the species, Black (1959) found a rudimentary internal structure supposed to be a thin membrane. No similar structures have been recorded in the investigated material.

Occurrence. — Oxfordian of Paris Basin (Noël 1965); Albian of Netherlands (Stradner & *al.* 1968); Cenomanian of England (Black & Barnes 1959) and Sweden (Forchheimer 1972); and Maastrichtian of France (Manivit 1971).

In the study area, some specimens have been found in the Campanian and Maastrichtian in Vistula valley, and the Maastrichtian of the borehole Żyrzyn.

Genus *ZYGODISCUS* Bramlette & Sullivan, 1961, emend. Gartner, 1968

Type species: *Zygodiscus adamas* Bramlette & Sullivan, 1961

Zygodiscus acanthus (Reinhardt, 1965) Reinhardt, 1966

1965. *Zeugrhabdotus acanthus* n. sp.; P. Reinhardt, p. 37, Pl. 3, Fig. 1.
1966. *Zygodiscus acanthus* (Reinhardt, 1965); P. Reinhardt, p. 40, Pl. 15, Fig. 5 and Pl. 23, Fig. 8
1971. *Zygodiscus acanthus* (Reinhardt); H. Manivit, p. 77, Pl. 13, Figs 8—11.
1976. *Zygodiscus acanthus* (Reinhardt, 1965) Reinhardt, 1966; S. Shumenko, p. 42, Pl. 11, Figs 4—5.
Dimensions: length 7—8 μ; width 5—6 μ.

Remarks. — The investigated specimens were observed exclusively under a light microscope. The species differs from its congeners in the wide wall with a distinct groove parallel to its edge. There are two openings in the central area, located in the ellipse focuses.

Occurrence. — Albian to Maastrichtian of Europe (Reinhardt 1966, Manivit 1971, Shumenko 1976).

In the study area, very few specimens have been found in the Maastrichtian of the borehole Żyrzyn.

Zygodiscus bussoni (Noël, 1956) Manivit, 1971

(Pl. 6, Figs 3—4)

1956. *Zygolithus bussoni* sp. n.; D. Noël, p. 321, Pl. 2, Figs 13—14.
1957. *Zygolithus fibulus* (Lecal-Schl.); H. Górka, p. 242, Pl. 1, Fig. 4.
1971. *Zygodiscus bussoni* (Noël) nov. comb.; H. Manivit, p. 73, Pl. 13, Fig. 1 and Pl. 29, Figs 4, 15, 16.
1976. *Zygodiscus bussoni* (Noël, 1965) Manivit, 1971; S. Shumenko, p. 42, Pl. 11, Figs 6—7.
Dimensions: length 5—7 μ; width 4—5 μ.

Remarks. — The species has been precisely described and illustrated by Noël (1965, 1970). The *SEM* studies have recently demonstrated that the old generic names *Zygolithus* and *Zygodiscus* are synonymous. The present author agrees with Manivit (1971) and Thierstein (1973) in considering the name *Zygodiscus* Bramlette & Sullivan, 1961, emend. Gartner, 1968, as the more precisely defined one. Hence, the investigated species is here assigned to the genus *Zygodiscus*.

Occurrence. — Kimmeridgian of Algeria (Noël 1956); Aptian to Maastrichtian of Europe (Perch-Nielsen 1968, Noël 1970, Manivit 1971, Shumenko 1976); Danian of Denmark (Perch-Nielsen 1968).

In the study area, the species has been found in most samples of Campanian and Maastrichtian age.

Zygodiscus compactus Bukry, 1969
(Pl. 7, Figs 1, 3, 5*a*)

1969. *Zygodiscus compactus Bukry*, n. sp.; D. Bukry, p. 59, Pl. 34, Figs 1—2.
1970. *Zygolithus compactus* (Bukry) nov. comb.; D. Noël, p. 26, Text-figs 2—3, Pl. 2, Figs 2—8 and Pl. 3, Figs 1—3.
Dimensions: length 4—6 μ; width 2.8—4.5 μ.

Remarks. — A massive, rather irregular bar composed of some rhomboedric crystals step-like or disorderly arranged, appears typical of the species. In the investigated area, *Z. compactus* occurs in younger strata than it has been insofar recorded.

Occurrence. — Coniacian to Campanian of North America (Bukry 1969); Campanian of Germany and France (Bukry 1969, Noël 1970).

In the study area, the species has been found in the Upper Maastrichtian of the borehole Podole, and the Paleocene at Rzeczyca.

Zygodiscus diplogrammus (Deflandre & Fert, 1954) Gartner, 1968

1954. *Zygolithus diplogrammus* cent. nov.; G. Deflandre & C. Fert, p. 148, Pl. 10, Fig. 7.
1970. *Zygolithus ?diplogrammus* Deflandre 1954; D. Noël, p. 28, Pl. 3, Figs 4—5 [*cum syn.*].
1971. *Glaukolithus diplogrammus* (Deflandre) Reinhardt; H. Manivit, p. 81, Pl. 13, Figs 2—7, 12—14.
1973. *Zygodiscus diplogrammus* (Deflandre & Fert, 1954) Gartner, 1968; H. Thierstein, p. 36, Pl. 3, Fig. 19.
1976. *Zygodiscus diplogramimus* (Deflandre, 1951) Gartner, 1968; S. Shumenko, p. 43, Pl. 11, Figs 9—10 and Pl. 12, Figs 1—2.
Dimensions: length 6—9 μ; width 3—4 μ.

Remarks. — Generic attribution of the investigated species was discussed several times (Perch-Nielsen 1968, Noël 1970) and ultimately, the species was usually assigned to the genus *Glaukolithus* Reinhardt. However, the nature of both the wall and central structure appears typical of the genus *Zygodiscus* Bramlette & Sullivan, 1961, emend. Gartner, 1968, and hence, the present author is of the opinion that the name *Glaukolithus* is to be considered as a junior synonym of *Zygodiscus*.

Occurrence. — Valanginian to Maastrichtian of Europe (Reinhardt 1964, Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Thierstein 1973, Shumenko 1976); Cenomanian to Campanian of North America (Gartner 1968); Miocene of Algeria, presumably redeposited from the Cretaceous (Deflandre & Fert 1954).

In the study area, the species has been found in the Campanian at Sulejów, Dorotka, Ciszyca, Kaliszany, and Pawłowice, and the Lower Maastrichtian of the borehole Ożarów.

Zygodiscus sigmoides Bramlette & Sullivan, 1961
(Pl. 7, Figs 2, 4)

1961. *Zygodiscus sigmoides* n. sp.; M. Bramlette & F. Sullivan, p. 149, Pl. 4, Fig. 11*a-e*.
1969a. *Zygodiscus sigmoides* Bramlette & Sullivan, 1961; K. Perch-Nielsen, p. 65, Pl. 5, Figs 1—3 [*cum syn.*].
1971. *Zygodiscus sigmoides* Bramlette & Sullivan; H. Manivit, p. 80, Pl. 26, Figs 19—23.
1976. *Zygodiscus sigmoides* Bramlette et Sullivan, 1961; H. Bystricka, p. 53, Pl. 53, Fig. 2.
Dimensions: length 6—8 μ; width 4—6 μ.

Remarks. — The bar is distinctly widened at the contact with the wall which results in the openings at both sides of the bar being close to circular in outline.

Occurrence. — Paleocene of Denmark, Germany, and France (Bramlette & Sullivan 1961; Bramlette & Martini 1964; Perch-Nielsen 1969*a*, 1969*b*; Hay & Mohler 1967), Western Carpathians (Bystricka 1975), Tunisia, and the United States (Bramlette & Martini 1964).

In the study area, the species has been found in the Paleocene at Nasiłów and Rzeczyca and in the boreholes Żyrzyn and Zemborzyce.

Zygodiscus spiralis Bramlette & Martini, 1964
(Pl. 7, Fig. 5b and Pl. 8, Figs 1—4)

1964. *Zygodiscus spiralis* n. sp.; M. Bramlette & E. Martini, p. 303, Pl. 4, Figs 6—8.
1971. *Zygodiscus spiralis* Bramlette & Martini; H. Manivit, p. 80, Pl. 29, Figs 13—14.
1973. *Zygodiscus spiralis* Bramlette & Martini; H. Priewalder, p. 27, Pl. 22, Figs 3—6.
1976. *Zygodiscus spiralis* Bramlette et Martini, 1964; S. Shumenko, p. 44, Pl. 13, Fig. 3.
Dimensions: length 5—6 μ; width 4—6 μ.

Remarks. — The investigated specimens display a wide wall composed of radial elements, reduced central area, and bar with a distinct groove; thus, they are entirely consistent with the description given by Gartner (1968) and hence, their recognition was quite easy.

Occurrence. — Maastrichtian of Denmark, France, and Tunisia (Bramlette & Martini 1964), Egypt (Shafik & Stradner 1971), the United States (Gartner 1968), and the Soviet Union (Shumenko 1976).

In the study area, the species has been found in all the samples of Late Maastrichtian age.

Genus *VEKSHINELLA* Loeblich & Tappan, 1963, emend. Gartner, 1968
Type species: *Vekshinella acutifera* (Vekshina, 1959)
Vekshinella aachena (Bukry, 1969) Shafik & Stradner, 1971
(Pl. 10, Fig. 1)

1969. *Vagalapilla aachena* Bukry, n. sp.; D. Bukry, p. 55, Pl. 31, Figs 6—9.
1971. *Vekshinella aachena* (Bukry).; S. Shafik & H. Stradner, p. 89, Pl. 40, Figs 2—3.
Dimensions: length 5—6 μ; width 4—5 μ.

Remarks: — Species of the genus *Vekshinella* differ one from another in their central structure. The investigated species is characterized by a platy nature of the cross arms and their considerable widening at the ends, which results in the central area filled to a much larger degree than in other species.

Occurrence. — Santonian to Lower Campanian of Texas, Middle Campanian of Germany and France (Bukry 1969); Upper Maastrichtian of the Soviet Union (Shafik & Stradner 1971).

In the study area, some specimens have been found in the Upper Maastrichtian of the borehole Żyrzyn.

Vekshinella crux (Deflandre & Fert, 1954) Shafik & Stradner, 1971
(Pl. 9, Figs 1—5 and Pl. 20, Fig. 1b)

1954. *Discolithus crux* Deflandre & Fert; G. Deflandre & C. Fert, p. 143, Text-fig. 55, Pl. 14, Fig. 4.
1961. *Zygolithus crux* (Deflandre & Fert); M. Bramlette & F. Sullivan, p. 149, Pl. 6, Figs 8—10.
1963. *Staurolithites crux* (Deflandre & Fert); C. Caratini, p. 25.
1971. *Vekshinella crux* (Deflandre & Fert) nov. comb.; S. Shafik & H. Stradner, p. 89, Pl. 39, Figs 1—4.
1973. *Vekshinella crux* (Deflandre & Fert) Shafik & Stradner; H. Priewalder, p. 26, Pl. 20, Figs 1—6.
1973. *Vagalapilla stradneri* (Rood, Hay & Barnard, 1971) n. comb.; H. Thierstein, p. 38.
1976. *Staurolithites crux* (Deflandre et Fert, 1954) Caratini, 1963; S. Shumenko, p. 50, Pl. 16, Fig. 1.
Dimensions: length 4—6 μ; width 2.5—3 μ.

Remarks. — The central structure is in the form of a cross with straight and narrow arms concordant with the ellipse axes.

Occurrence. — Cretaceous (Valanginian to Maastrichtian) of Europe (Caratini 1963, Bramlette & Martini 1964, Stradner & al. 1968, Manivit 1971, Thierstein 1973, Shumenko 1976); Maastrichtian of North America (Bramlette & Martini 1964).

In the study area, the species has been found abundantly in all the samples of Campanian and Maastrichtian age.

Vekshinella crucifer (Noël, 1970) n. comb.
(Pl. 10, Fig. 2)

1970. *Zygolithus crucifer* n. sp.; D. Noël, p. 30, Text-fig. 4, Pl. 3, Figs 11—15 and Pl. 4, Figs 1—6
1975. *Zygolithus crucifer* Noël; E. Gaździcka, Pl. 2, Fig. 3.
Dimensions: length 4.5—5 μ; width 3 μ.

Remarks. — The nature of wall and central structure of the investigated species appears entirely consistent with that typical of the genus *Vekshinella* Loeblich & Tappan. The specific feature of *V. crucifer* is a clockwise displacement of the cross arms relative to the ellipse axes.

Occurrence. — Campanian of Paris Basin (Noël 1970).

In the study area, the species has been found in the Upper Maastrichtian of the borehole Żyrzyn.

Vekshinella elliptica Gartner, 1968
(Pl. 10, Figs 3—4)

1968. *Vekshinella elliptica* n. sp.; S. Gartner, p. 30, Pl. 17, Fig. 5, Pl. 25, Figs 26—27, and Pl. 26, Fig. 7
1969. *Vagalapilla elliptica* (Gartner), Bukry, n. comb.; D. Bukry, p. 57, Pl. 32, Figs 9—12.
1971. *Vekshinella elliptica* Gartner; S. Shafik & H. Stradner, p. 90, Pl. 38, Figs 1—4.
1973. *Vekshinella elliptica* Gartner; H. Priewalder, p. 25, Pl. 21, Figs 1—2.
Dimensions: length 4—5 μ; average width 3—3.5 μ.

Remarks. — The specific feature of this species is its rhomboidal central structure with diagonals parallel to the ellipse axes.

Occurrence. — Upper Cenomanian to Campanian of the United States (Gartner 1968, Bukry 1969); Maastrichtian of Austria (Priewalder 1973) and Egypt (Shafik & Stradner 1971).

In the study area, a few specimens have been found in the Upper Maastrichtian at Nasiłów and in the borehole Żyrzyn.

Vekshinella striata (Stradner, 1963) Priewalder, 1973
(Pl. 10, Figs 5—6)

1968. *Zygolithus striatus* (Stradner) n. comb.; H. Stradner & *al.* (partim), p. 38, Pl. 32, Figs 1—2, non Pl. 33, Figs 1—2.
1969. *Vagalapilla dentata dentata* Bukry, n. sp., n. ssp.; D. Bukry, p. 56, Pl. 32, Figs 1—3.
1969. *Vagalapilla dentata aperta* Bukry, n. sp., n. ssp.; D. Bukry, p. 57, Pl. 32, Figs 4—6.
1970b. *Pontilithus dentatus* (Bukry 1969) n. comb.; P. Reinhardt, p. 90, Text-fig. 115.
1973. *Vekshinella striata* (Stradner) n. comb.; H. Priewalder, p. 26, Pl. 22, Figs 1—2.
Dimensions: length 3.8—5.2 μ; average width 2.5—3.5 μ.

Remarks. — The central structure is in the form of a cross concordant with the ellipse axes. The edges of cross arms display processes pointing the coccolith wall. The processes vary in number.

Such a structural characteristics was assigned by Stradner & *al.* (1968) exclusively to juveniles of the investigated species, whereas the adult central area was claimed to fill with additional crystals producing something like a lattice. However, the adult specimen illustrated by Stradner & *al.* (1968) is rather attributable to the species *Arkhangelskiella ethmopora* Bukry, since its wall consists of more numerous cycles and its size (8 μ) is larger than in the genus *Vekshinella*.

Occurrence. — Albian of the Netherlands (Stradner & *al.* 1968); Campanian of Texas (Bukry 1969); Maastrichtian of Austria (Priewalder 1973).

In the study area, the species has been found in samples of the Campanian and Maastrichtian age.

Genus *CHIASTOZYGUS* Gartner, 1968
Type species: *Chiastozygus litterarius* (Górka, 1957) Manivit, 1971

When erecting the genus *Chiastozygus*, Gartner (1968) cited *?Zygodiscus amphipons* Bramlette & Martini, 1964, as the type species. The latter form is, however, a junior synonym of the species *Discolithus litterarius* Górka, 1957, which is therefore to be recognized for the type species.

Chiastozygus litterarius (Górka, 1957) Manivit, 1971
(Pl. 14, Figs 1—4)

1957. *Discolithus litterarius* n. sp.; H. Górka, p. 251, Pl. 3, Fig. 3.
1964. *?Zygodiscus amphipons* n. sp.; M. Bramlette & E. Martini, p. 302, Pl. 4, Figs 9—10.

1967. *Zygolithus litterarius* (Górka) n. comb.; P. Reinhardt & H. Górka, p. 149, Text-fig. 4, Pl. 31, Figs 18, 22 and Pl. 33, Fig. 7.
1968. *Chiastozygus amphipons* (Bramlette & Martini); S. Gartner, p. 26, Pl. 8, Figs 11—14, Pl. 11, Fig. 9, and Pl. 22, Figs 10—11.
1968. *Zygolithus litterarius* (Górka) n. comb.; H. Stradner & *al.*, p. 39, Pl. 34.
1969. *Chiastozygus amphipons* (Bramlette & Martini) Gartner; D. Bukry, p. 49, Pl. 26, Figs 8—9.
1971. *Chiastozygus litterarius* (Górka) n. comb.; H. Manivit, p. 92, Pl. 4, Figs 1—5.
1971. *Zygolithus litterarius* (Górka) Reinhardt & Górka; S. Shafik & H. Stradner, p. 92, Pl. 41, Figs 1—4.
1971. *Chiastozygus litterarius* (Górka 1957) Manivit 1971; H. Thierstein, p. 476, Pl. 2, Figs 17—21.
1972. *Chiastozygus litterarius* (Górka, 1957) Manivit, 1971; P. Roth & H. Thierstein, Pl. 1, Figs 1—6.
1973. *Zygolithus litterarius* (Górka) Reinhardt & Górka; H. Priewalder, p. 28, Pl. 23, Figs 3—6.
1975. *Chiastozygus amphipons* (Bramlette & Martini) Gartner; E. Gaździcka, p. 409.
1975. *Chiastozygus litterarius* (Górka) Manivit; E. Gaździcka, p. 409, Pl. 4, Figs 3—4.
Dimensions: length 4—12 μ; width 2.5—8.5 μ.

Remarks. — The species *amphipons* Bramlette & Martini, 1964, appears as a junior synonym of the species *litterarius* Górka, 1975, The latter species was described from the Upper Maastrichtian strata of Kazimierz. Following a revision, it was attributed by Reinhardt & Górka (1967) to *Zygolithus*. The genus *Zygolithus* has been in its turn split into several distinct genera depending upon the nature of central structure. Then, the species *litterarius* is to be assigned to the genus *Chiastozygus* comprising forms with X-shaped central structure.

Occurrence. — Aptian to Maastrichtian of Europe (Górka 1957, Bramlette & Martini 1964, Stradner & *al.* 1968, Manivit 1971, Thierstein 1971, Priewalder 1973); Upper Cretaceous of North America (Gartner 1968, Bukry 1969) and Africa (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found abundantly in all the samples of Campanian and Maastrichtian age.

Genus *AHMUELLERELLA* Reinhardt, 1964
Type species: *Ahmuellerella octoradiata* (Górka, 1957) Reinhardt, 1966
Ahmuellerella octoradiata (Górka, 1957) Reinhardt, 1966
(Pl. 15, Figs 1—4 and Pl. 18, Figs 1*a*, 2*a*)

1970. *Ahmuellerella octoradiata* (Górka) Reinhardt 1967; D. Noël, p. 36, Text-fig. 5, Pl. 4, Figs 8—10 and Pl. 5, Figs 1—9 [*cum syn.*].
1970*a*. *Ahmuellerella octoradiata* (Górka 1957) Reinhardt 1966; P. Reinhardt, p. 11, Text-figs 12—13, Pl. 1, Figs 9—10.
1971. *Ahmuellerella octoradiata* (Górka) Reinhardt; H. Manivit, p. 93, Pl. 1, Figs 1—5.
1971. *Ahmuellerella octoradiata* (Górka) Reinhardt; S. Shafik & H. Stradner, p. 80, Pl. 23, Figs 1—4.
1972. *Ahmuellerella octoradiata* (Górka 1957) Reinhardt 1966; N. Hoffmann, p. 35, Text-figs 17—18, Pl. 4, Fig. 5 and Pl. 5, Figs 1—3.
1975. *Ahmuellerella octoradiata* (Górka) Reinhardt; E. Gaździcka, p. 409, Pl. 5, Figs 3*a*, 4*a*.
1976. *Ahmuellerella octoradiata* (Górka, 1957) Reinhardt, 1966; S. Shumenko, p. 56, Pl. 19, Figs 4—5.
Dimensions: length 6.5—8 μ; width 4—6 μ.

Remarks. — Elements of the central structure are often considerably displaced relative to the ellipse axes. Some specimens have been found with a central process built up by small elongate crystals arranged in a spiral (Pl. 18, Figs 1*a*, 2 *a*). The process comprises an internal channel, as evidenced by the opening located in the center of central structure in specimens lacking central process.

Occurrence. — Cenomanian to Maastrichtian of Europe (Górka 1957, Reinhardt 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Hoffmann 1972, Priewalder 1973, Shumenko 1976); Turonian to Maastrichtian of North America (Čepek & Hay 1969); Maastrichtian of Africa (Bramlette & Martini 1964).

In the study area, the species has been found in most samples of Campanian and Maastrichtian age.

Genus *HELICOLITHUS* Noël, 1970
Type species: *Helicolithus anceps* (Górka, 1957) Noël, 1970
Helicolithus anceps (Górka, 1957) Noël, 1970
(Pl. 16, Figs 3—4)

1970. *Helicolithus anceps* (Górka) nov. comb.; D. Noël, p. 41, Text-fig. 6, Pl. 8, Figs 1—5 and Pl. 9, Figs 1—2 [*cum syn.*].

1970b. *Eiffellithus anceps* (Górka 1957) Reinhardt & Górka 1967; P. Reinhardt, p. 59, Text-figs 42—44, Pl. 3, Figs 5—7.
1971. *Eiffellithus anceps* (Górka) Reinhardt & Górka; H. Manivit, p. 91, Pl. 11, Figs 7—9.
1971. *Eiffellithus anceps* (Górka) Reinhardt & Górka; S. Shafik & H. Stradner, p. 32, Pl. 44, Figs 1—4.
1976. *Chiastozygus anceps* (Górka, 1957) comb. nov.; S. Shumenko, p. 46, Pl. 14, Figs 1—3.
Dimensions: length 5.8—6 μ; width 4.1—5.2 μ.

Remarks. — The specific feature of *H. anceps* is the presence of 8 large, irregular crystals in the central area. They occur at the internal edge of the wall and they display stripes pointing outwards and participate in the wall formation.

Occurrence. — Albian(?) to Maastrichtian of Europe (Górka 1957, Reinhardt 1966, Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Shumenko 1976).

In the study area, a few specimens have been found in the Upper Maastrichtian at Kazimierz and Nasiłów and in the borehole Podole.

Genus *EIFFELLITHUS* Reinhardt, 1965

Type species: *Eiffellithus turriseiffeli* (Deflandre, 1954) Reinhardt, 1965

Eiffellithus eximius (Stover, 1966) Perch-Nielsen, 1968

(Pl. 11, Fig. 1)

1970. *Eiffellithus eximus* (Stover) Perch-Nielsen 1968; D. Noël, p. 40, Pl. 6, Figs 4—5, 7 and Pl. 7, Figs 1—7 [*cum syn.*].
1970. *Eiffellithus eximus* (Stover 1966) Perch-Nielsen, 1968; P. Reinhardt, p. 61, Text-fig. 46.
1971. *Eiffellithus eximius* (Stover) Perch-Nielsen; H. Manivit, p. 91, Pl. 11, Figs 10—11.
1976. *Eiffellithus eximius* (Stover, 1966) Perch-Nielsen, 1968; S. Shumenko, p. 46, Pl. 15, Figs 3—4.
Dimensions: length 9—11 μ; width 6—8 μ.

Remarks. — The investigated species differs from *E. regularis* and *E. turriseiffeli* in its ribs at the base of central process, concordant with the ellipse axes.

Occurrence. — Cenomanian to Maastrichtian of Europe (Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Shumenko 1976); Coniacian to Campanian of North America (Gartner 1968).

In the study area, the species has been found exclusively in the Campanian at Sulejów.

Eiffellithus regularis (Górka, 1957) Perch-Nielsen, 1968

(Pl. 11, Figs 2—3, 4*a*)

1957. *Tremalithus regularis* n. sp.; H. Górka, p. 246, Pl. 2, Fig. 4.
1968. *Eiffellithus turriseiffeli* (Deflandre); S. Gartner (partim), p. 26, Pl. 2, Fig. 22, Pl. 9, Fig. 6—7, Pl. 18, Fig. 11, Pl. 23, Fig. 7, and Pl. 25, Figs 15—16.
1968. *Eiffellithus regularis* (Górka 1957) n. comb.; K. Perch-Nielsen, p. 30, Pl. 32, Figs 8—9.
1973. *Eiffellithus regularis* (Górka) Perch-Nielsen; H. Priewalder, p. 18, Pl. 9, Fig. 5.
Dimensions: length 7—8 μ; width 5—6 μ.

Remarks. — Under a light microscope, the investigated species appears much more regular in structure than its congeners. When studied in polarized light, the central area is cut by four darkened zones concordant to the ellipse axes. The central structure is always symmetric relative to those darkened zones reflecting interplate "sutures".

Occurrence. — Upper Maastrichtian of Denmark (Perch-Nielsen 1968) and Austria (Priewalder 1973).

In the study area, the species has been found in the Upper Campanian at Dorotka, the Lower Maastrichtian at Lipsko and Solec, and the Upper Maastrichtian at Lucimia and Męćmierz and in the borehole Żyrzyn.

Eiffellithus turriseiffeli (Deflandre, 1954) Reinhardt, 1965

(Pl. 12, Figs 1—4)

1970. *Eiffellithus turriseiffeli* (Deflandre) Reinhardt 1965; D. Noël, p. 38, Pl. 6, Figs 1*a-c*, 6 [*cum syn.*]
1970b. *Eiffellithus turriseiffeli* (Deflandre *in* Deflandre & Fert 1954) Reinhardt 1965; P. Reinhardt, p. 62, Text-figs 47—48, Pl. 4, Figs 6—7 and Pl. 5, Figs 1—2.
1971. *Eiffellithus turriseiffeli* (Deflandre) Reinhardt; H. Manivit, p. 90, Pl. 11, Figs 1—4, 12—13.
1971. *Eiffellithus turriseiffeli* (Deflandre 1954) Reinhardt 1965; H. Thierstein, p. 475, Pl. 7, Figs 9—11.

1973. *Eiffellithus turriseiffeli* (Deflandre) Reinhardt; H. Priewalder, p. 19, Pl. 9, Figs 1—4.
1976. *Eiffellithus turriseiffeli* (Deflandre, 1954) Reinhardt, 1965; S. Shumenko, p. 49, Pl. 15, Figs. 5—7.
Dimensions: length 7—12 μ; width 5—8 μ.

Remarks. — The central structure is less regular than in congeneric species. It forms usually an angle of less than 45° with the shorter ellipse axis. Central process has not been observed in the investigated material.

Occurrence. — Aptian to Maastrichtian of Europe (Górka 1957, Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Priewalder 1973, Shumenko 1976); Albian to Cenomanian of Western Atlantic and Venezuela (Thierstein 1973); Cenomanian to Maastrichtian of North America (Gartner 1968, Bukry 1969).

In the study area, the species has been found very abundantly in all the samples of Campanian and Maastrichtian age.

Eiffellithus multicostatus sp. n.
(Pl. 13, Figs 1—4)

Holotypus: Pl. 13, Fig. 4.
Paratypus: Pl. 13, Fig. 1.
Stratum typicum: Upper Maastrichtian.
Locus typicus: Nasiłów, Vistula valley, western part of the Lublin Upland, Central Poland.
Derivatio nominis: Latin *multicostatus* — multicostate; after a large number of ribs at the base of central process.
Diagnosis: Central structure in form of circular base of central process, with at least 8 ribs pointing outwards; ribs clustered into doublets or triplets.
Dimensions: length 5.5—7 μ; width 3.5—5.5 μ.

Description. — The outline is elliptic. The wall is formed by a single cycle of thin calcite plates arranged obliquely and strongly overlapping. The central area is filled up with crystals variable in both size and shape. The central structure is in the form of a base of central process, strengthened by numerous radial ribs. It consists of small densely packed grains. The central process is probably tube-like but it has not been preserved.

Remarks. — The new species resembles *E. eximius* in the nature of central area but the latter species displays less numerous ribs (namely 4, while there are at least 8 in *E. multicostatus*). The ribs resemble also in number and distribution the species *Ahmuellerella octoradiata* but in the latter species, the central area remains unfilled.

Occurrence. — Upper Maastrichtian at Nasiłów (beds below hardground in the quarry) and in the boreholes Żyrzyn, Podole, and Zemborzyce.

Genus *TRANOLITHUS* Stover, 1966
Type species: *Tranolithus manifestus* Stover, 1966
Tranolithus exiguus Stover, 1966
(Pl. 16, Fig. 2)

1966. *Tranolithus exiguus* Stover, n. sp.; L. Stover, p. 146, Pl. 4, Figs 19—21 and Pl. 9, Figs 3—4.
1968. *Zygolithus exiguus* (Stover, n. comb.; H. Manivit, p. 279, Pl. 1, Fig. 11*a-c*.
1970. *Tranolithus* cf. *manifestus* (Stover 1966; D. Noël, p. 44, Pl. 9, Figs 3, 5, 7 and Pl. 10, Figs 1—4.
1971. *Tranolithus exiguus* Stover; H. Manivit, p. 85, Pl. 26, Figs 10—12, 16.
1972. *Tranolithus exiguus* Stover, 1966 emend.; S. Forchheimer (partim), p. 60, Pl. 9, Fig. 6, Pl. 16, Figs 2, 14, and Pl. 17, Figs 3—4, non Figs 1—2.
1976. *Tranolithus exiguus* Stover; D. Burns, p. 238, Pl. 4, Fig. 12.
Dimensions: length 5.5—7 μ; width 3.5—5 μ.

Remarks. — The central structure is in the form of 4 triangular crystals situated in couples at the internal edge of wall, at both sides of the longer ellipse axis.

Occurrence. — Hauterivian to Campanian of Europe (Stover 1966, Noël 1970, Manivit 1971, Forchheimer 1972, Thierstein 1973, Burns 1976).

In the study area, the species has been found very rarely in the Upper Maastrichtian at Kazimierz.

Tranolithus manifestus Stover, 1966
(Pl. 16, Fig. 1)

1966. *Tranolithus manifestus* Stover, n. sp.; L. Stover, p. 146, Pl. 4, Figs 26—27 and Pl. 9, Fig. 6.
1968. *Zygolithus diplogrammus* Deflandre; H. Stradner & *al.* (partim), p. 35, Pl. 26, Figs 3—7 and Pl. 27, Fig. 1, non Fig. 2.
1970*a*. ?*Zygostephanos diplogrammus* (Deflandre 1954) n. comb.; N. Hoffmann, p. 169, Pl. 2, Figs 1—2, Pl. 3, Fig. 4, and Pl. 6, Fig. 4*A*.
Dimensions: length 6—8 μ; width 4—5 μ.

Remarks. — The species differs from *T. exiguus* in the nature of its central structure consisting of 4 narrow crystals fusing in the middle to form 2 bars.

Occurrence. — Albian of the Netherlands (Stradner & *al.* 1968); presumably, Albian to Lower Maastrichtian of northern Germany (Hoffmann 1970*a*); Turonian to Campanian of Paris Basin (Stover 1966).

In the study area, the species has been found uncommonly in the Campanian at Sulejów, and the Paleocene at Parchatka (the latter specimens are probably redeposited from the Cretaceous).

Genus *PARHABDOLITHUS* Deflandre, 1952
Type species: *Parhabdolithus liasicus* Deflandre, 1952
Parhabdolithus angustus (Stradner, 1963) Stradner & *al.*, 1968
(Pl. 18, Fig. 5)

1973. *Parhabdolithus angustus* (Stradner, 1963) Stradner, Adamiker & Maresch, 1968; H. Thierstein, p. 36 [*cum syn.*].
1973. *Parhabdolithus angustus* (Stradner) Stradner; H. Priewalder, p. 22, Pl. 16, Figs 1—2.
1976. *Parhabdolithus angustus* (Stradner); D. Burns, p. 280, Pl. 4, Fig. 1.
1976. *Parhabdolithus angustus* (Stradner, 1963) Stradner, Adamiker & Maresch, 1968; S. Shumenko, p. 53, Pl. 17, Figs 1—2.
Dimensions: length 4—5.5 μ; width 2.5—3.5 μ.

Remarks. — The specific features of *P. angustus* are its elongate elliptic shape and massive structure at the base of central process.

Occurrence. — Aptian to Maastrichtian of Europe (Reinhardt 1966, Stradner & *al.* 1968, Manivit 1971, Priewalder 1973, Thierstein 1973, Shumenko 1976); Aptian to Campanian of America (Bukry 1969, Roth & Thierstein 1972).

In the study area, the species has been found very rarely in the Upper Maastrichtian at Lucimia and in the borehole Żyrzyn.

Genus *REINHARDTITES* Perch-Nielsen, 1968
Type species: *Reinhardtites anthophorus* (Deflandre, 1959) Perch-Nielsen, 1968
Reinhardtites anthophorus (Deflandre, 1959) Perch-Nielsen, 1968
(Pl. 18, Fig. 4)

1968. *Reinhardtites anthophorus* (Deflandre 1959) n. comb.; K. Perch-Nielsen, p. 38, Text-figs 13—14, Pl. 5, Figs 1—8 [*cum syn.*].
1968. *Chiastozygus anthophorus* (Deflandre); S. Gartner (partim), p. 27, Pl. 14, Fig. 6 and 15, Figs 5—7, non Pl. 11, Figs 5—6.
1971. *Reinhardtites ?anthophorus* (Deflandre) Perch-Nielsen; H. Manivit, p. 19, Pl. 20, Figs 1—10, 12—14.
1971. *Reinhardtites anthophorus* (Deflandre 1959) Perch-Nielsen 1968; P. Reinhardt, p. 20, Text-figs 3—4.
1976. *Reinhardtites anthophorus* (Deflandre, 1959) Perch-Nielsen, 1968; S. Shumenko, p. 45, Pl. 13, Fig. 9.
Dimensions: length 10—12 μ; width 8—10 μ.

Remarks. — Deflandre (1959) illustrated the holotype in lateral view (Pl. 1, Fig. 22) without showing or describing its proximal side or distal basal plate. However, Perch-Nielsen (1968) found her Lower Maastrichtian specimens from Denmark to be identical to those investigated by Deflandre. Therefore, the specimens derived from the Lublin Upland consistent with the description given by Perch-Nielsen (1968) are here attributed to the species *R. anthophorus*.

Occurrence. — Turonian to Maastrichtian of Europe (Deflandre 1959, Stover 1966, Perch-Nielsen 1968, Manivit 1971, Shumenko 1976); Campanian to Maastrichtian of North America (Bramlette & Martini 1964, Gartner 1968).

In the study area, the species has been found in the Campanian at Sulejów and Dorotka, and the Lower Maastrichtian at Dziurków, Lipsko, Raj, and Kaliszany and in the borehole Ożarów.

Genus *ANGULOFENESTRELLITHUS* Bukry, 1969
Type species: *Angulofenestrellithus snyderi* Bukry, 1969
Angulofenestrellithus snyderi Bukry, 1969

1969. *Angulofenestrellithus snyderi* Bukry, n. sp.; D. Bukry, p. 48, Pl. 26, Figs 1—3.
1970a. *Angulofenestrellithus snyderi* Bukry, 1969; P. Reinhardt, p. 13, Text-fig. 15.
1973. *Angulofenestrellithus snyderi* Bukry; H. Priewalder, p. 12, Pl. 2, Figs 1—3.
1976. *Angulofenestrellithus numerosus* (Górka, 1957) comb. nov.; S. Shumenko, p. 52, Pl. 16, Figs 11—12.
Dimensions: length 9—10 μ; width 7—8 μ.

Remarks. — One cannot follow Shumenko (1976) in considering *A. snyderi* as a junior synonym of the species *Discolithus numerosus* Górka, 1957. In fact, the latter species has been recently ascribed (Reinhardt & Górka 1967) to the genus *Cribrosphaerella* Deflandre.

Occurrence. — Campanian to Maastrichtian of Europe (Bukry 1969, Priewalder 1973, Shumenko 1976).

In the study area, a few specimens have been found in the Upper Campanian at Dorotka and Ciszyca, and the Maastrichtian of the boreholes Żyrzyn and Podole.

Genus *RHAGODISCUS* Reinhardt, 1967
Type species: *Rhagodiscus asper* (Stradner, 1963) Reinhardt, 1967
Rhagodiscus plebeius Perch-Nielsen, 1968
(Pl. 17, Figs 1—4)

1968. *Rhagodiscus plebeius* n. sp.; K. Perch-Nielsen, p. 44, Pl. 7, Figs 2—6.
1971. *Rhagodiscus plebeius* Perch-Nielsen 1968; P. Reinhardt, p. 34, Text-fig. 12, Pl. 2, Fig. 3.
1971. *Rhagodiscus plebeius* (Perch-Nielsen; S. Shafik & H. Stradner, p. 88, Pl. 26, Figs 2—4 and Pl. 27, Figs 1—2, 4.
1973. *Rhagodiscus plebejus* (Perch-Nielsen; H. Priewalder, p. 25, Pl. 12, Fig. 5.
Dimensions: length 5.5—6.5 μ; width 4—5 μ.

Remarks. — The wall consists of a single cycle of calcite crystals arranged obliquely and strongly overlapping counterclockwise (in proximal view). Such a wall structure is typical of the family Eiffellithaceae Reinhardt, 1965, emend. Perch-Nielsen, 1968. Furthermore, that family may also include coccoliths with central area filled up with small grains. Therefore, the genus *Rhagodiscus* is here assigned to Eiffellithaceae rather than to Podorhabdaceae Noël, 1965, in contrast to the attribution by Perch-Nielsen (1968).

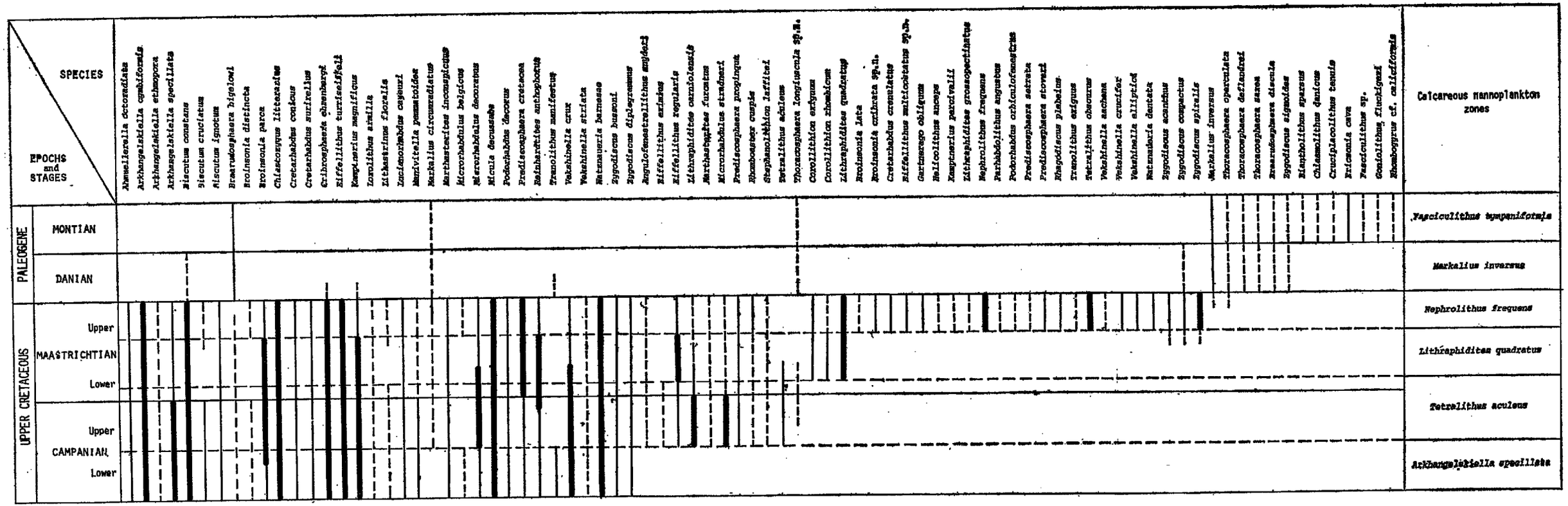
Occurrence. — Lower Maastrichtian of Denmark (Perch-Nielsen 1968); Upper Maastrichtian of Austria (Priewalder 1973), Egypt and the Soviet Union (Shafik & Stradner 1971).

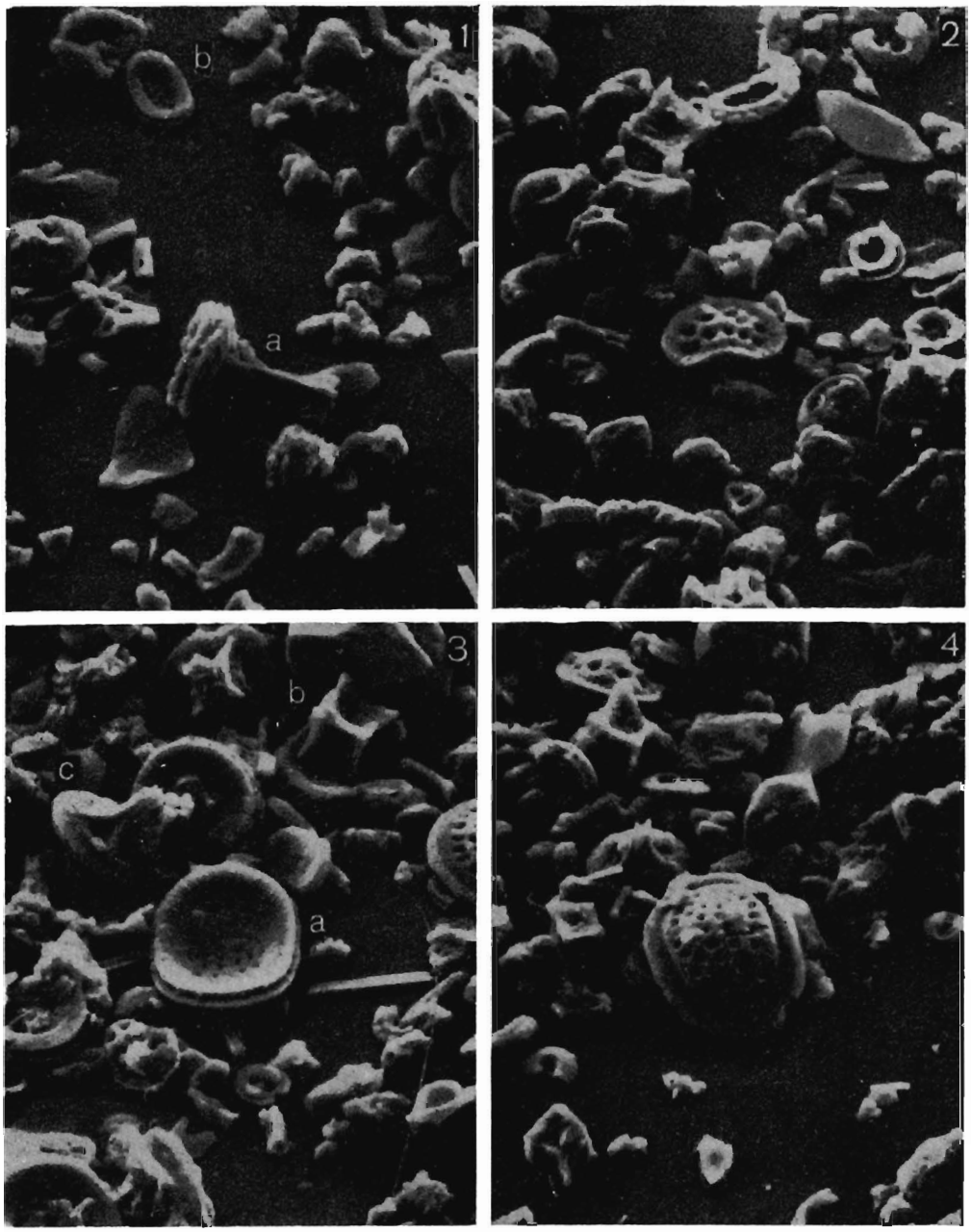
In the study area, the species has been found exclusively in the Upper Maastrichtian at Nasiłów and in the boreholes Żyrzyn and Podole.

Family **Podorhabdaceae** Noël, 1965
Genus *PODORHABDUS* Noël, 1965
Type species: *Podorhabdus grassei* Noël, 1965
Podorhabdus decorus (Deflandre, 1954) Thierstein, 1972
(Pl. 19, Fig. 1)

1972. *Podorhabdus decorus* (Deflandre, 1954) Thierstein n. comb.; P. Roth & H. Thierstein, p. 437, Pl. 4, Figs 7, 9, 10—13 [*cum syn.*].

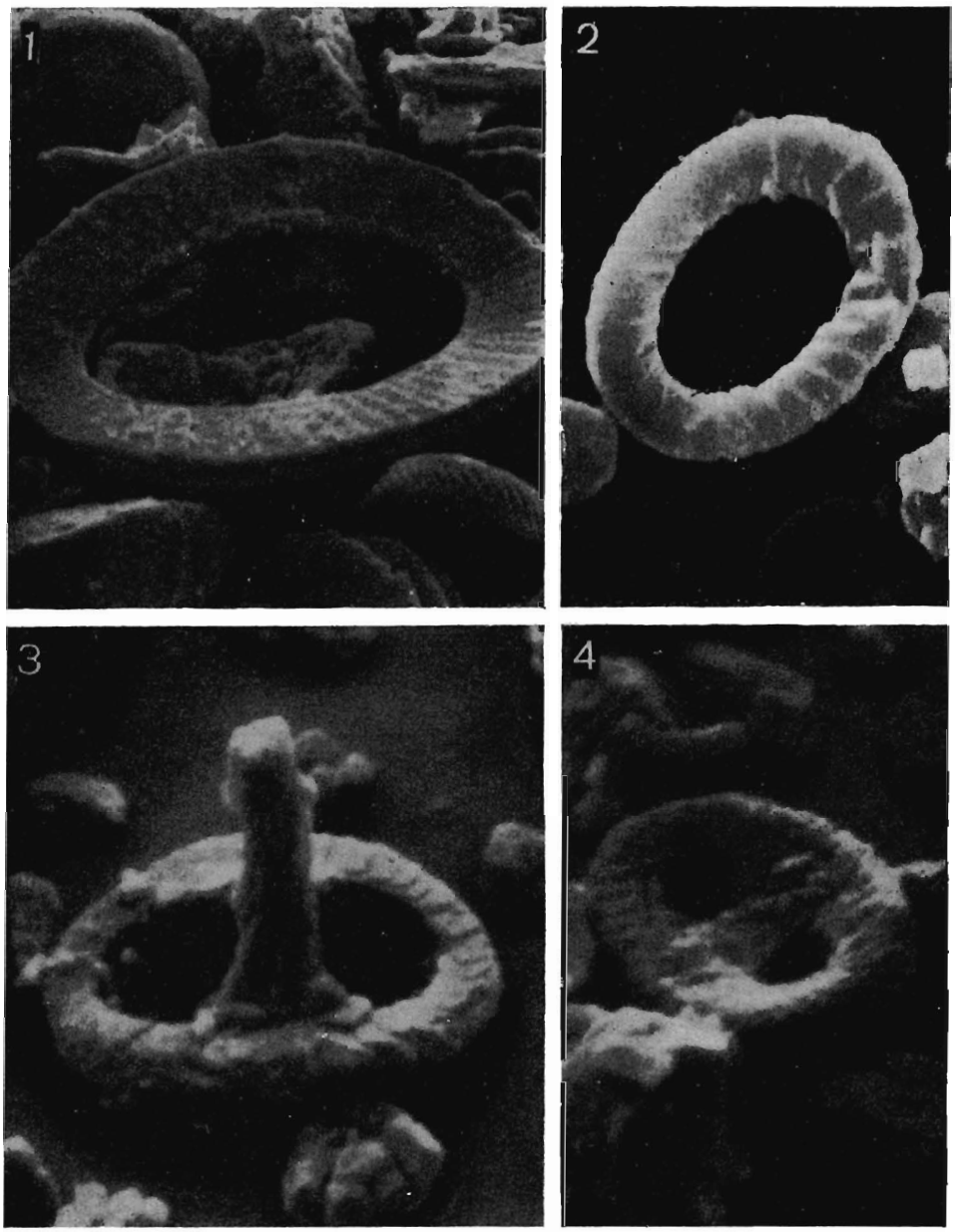
Stratigraphic ranges of the calcareous nannoplankton species in the Campanian, Maastrichtian and Paleogene deposits of the western part of the Lublin Upland



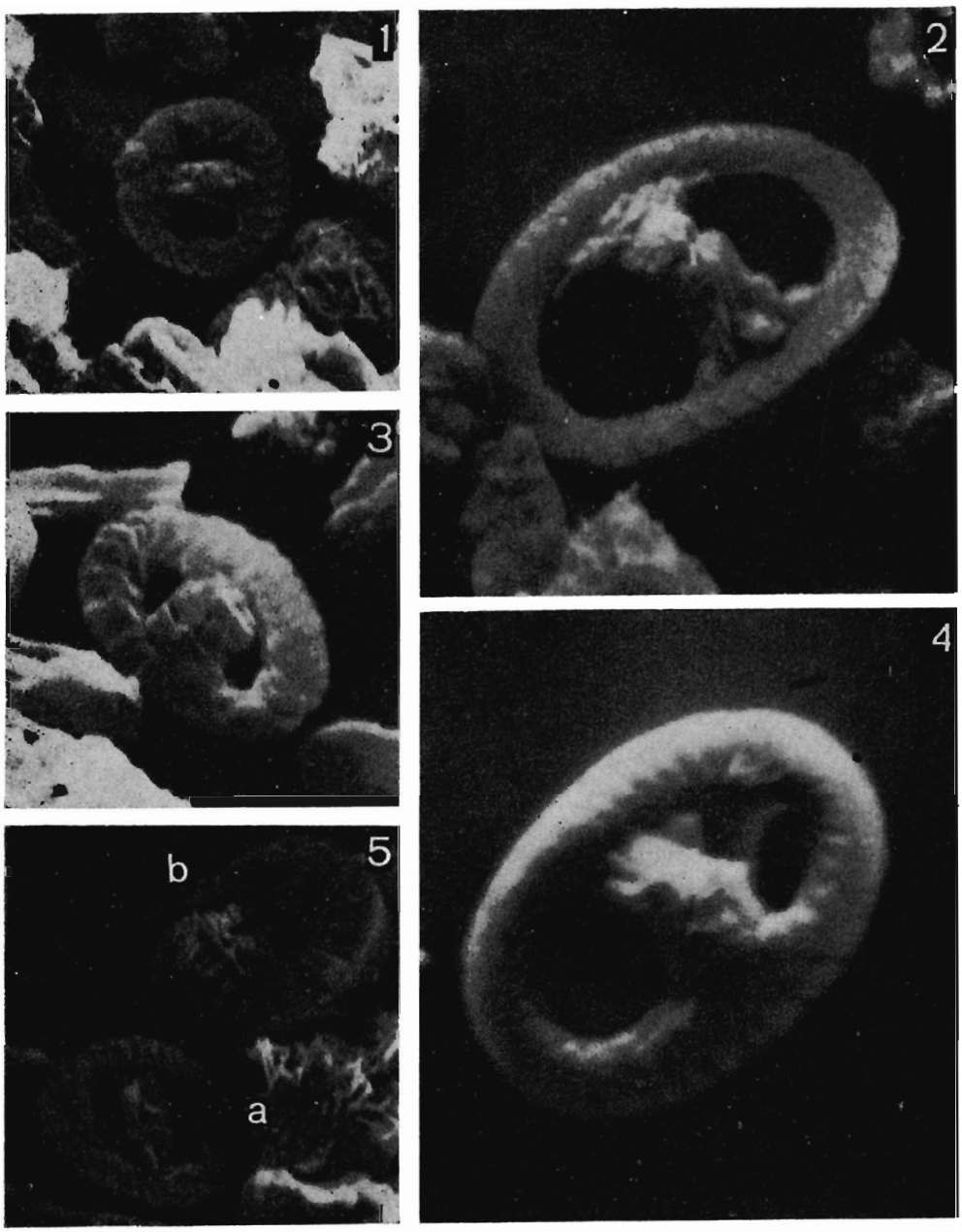


Upper Maastrichtian calcareous nannoplankton of the borehole Żyrzyn (depth 115.4 m); all specimens × 2,700

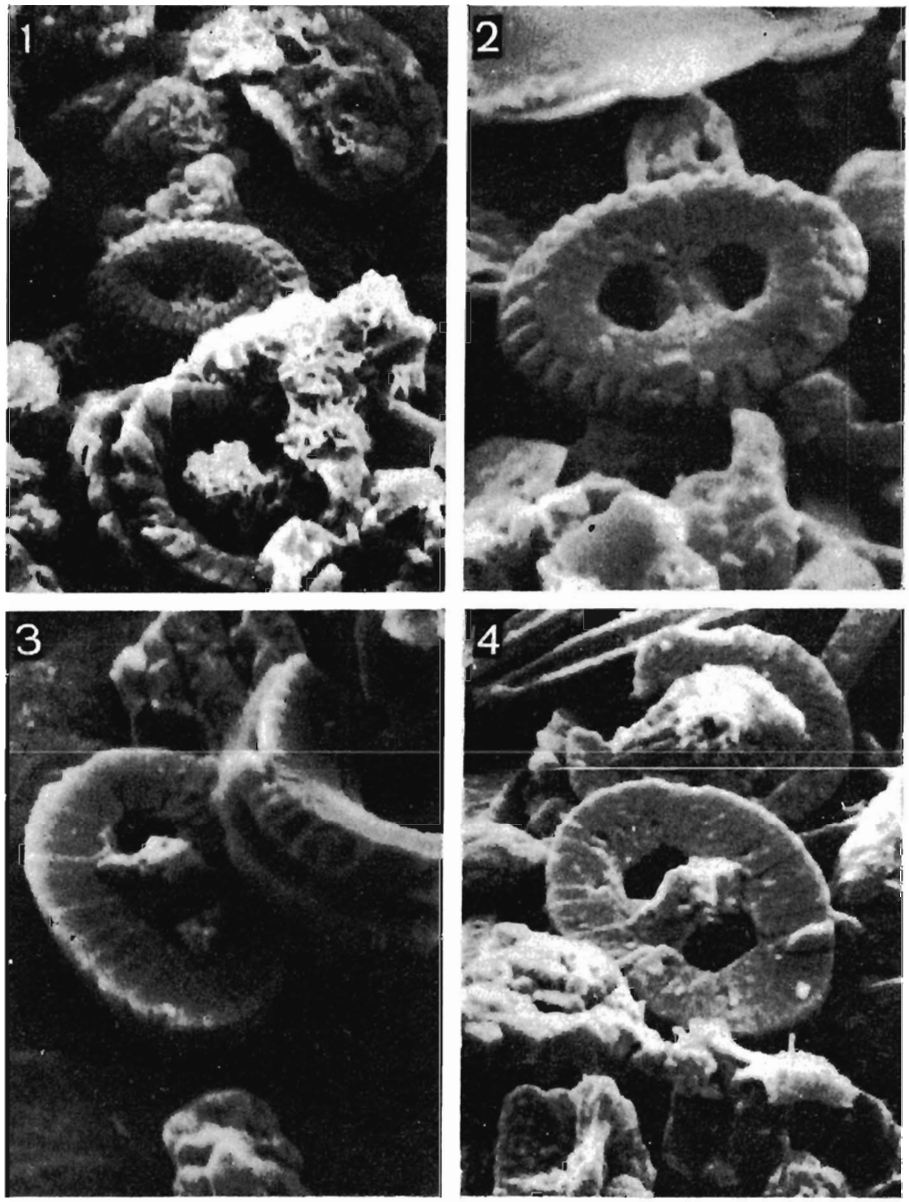
1 — **a** *Prediscosphaera cretacea* (Arkhangelsky), lateral view
b *Cribrosphaera ehrenbergi* Arkhangelsky, proximal view
2 — *Nephrolithus frequens* Górka, distal view
3 — **a** *Arkhangelskiella specillata* Vekshina, proximal view
b *Micula decussata* Vekshina
c *Prediscosphaera cretacea* (Arkhangelsky), distal view
4 — *Arkhangelskiella specillata* Vekshina, distal view



1 — *Manivitella* sp.; Upper Maastrichtian, borehole Żyrzyn (depth 126.1 m); × 9,000
2 — *Loxolithus armilla* (Black); Upper Maastrichtian, Lucimia; × 8,000
3 — *Zygodiscus bussoni* (Noël), distal view; Upper Campanian, Sulejów; × 6,000
4 — *Zygodiscus bussoni* (Noël), proximal view; Upper Campanian, Sulejów; × 5,400

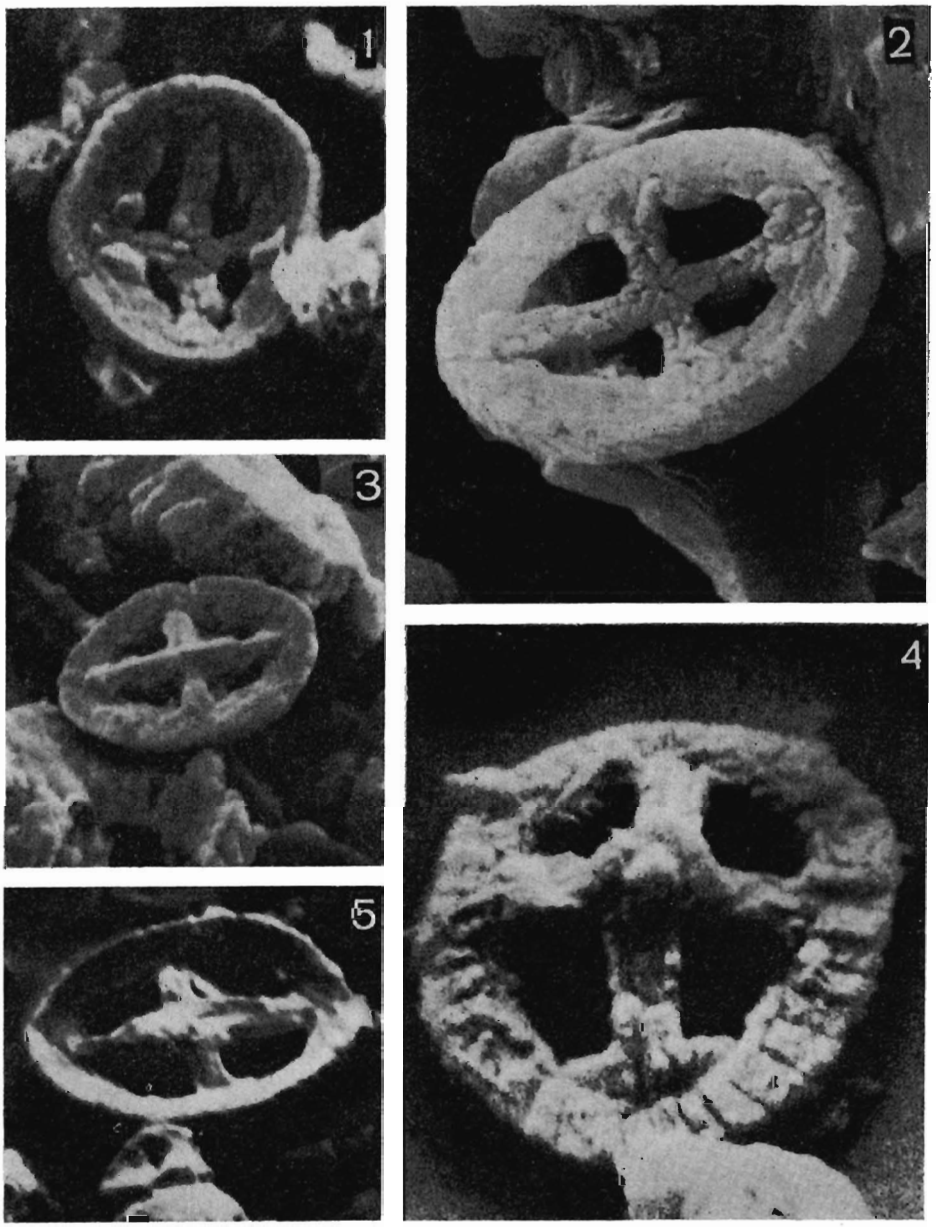


1 — *Zygodiscus compactus* Bukry, distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 5,400
2 — *Zygodiscus sigmoides* (Bramlette & Sullivan), distal view; Paleocene ("siwak"), Nasiłów; × 10,000
3 — *Zygodiscus compactus* Bukry, distal view; Paleocene, Rzeczyca; × 8,000
4 — *Zygodiscus sigmoides* (Bramlette & Sullivan), distal view; Paleocene, Rzeczyca; × 15,000
5 — a *Zygodiscus compactus* Bukry, distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 5,400
b *Zygodiscus spiralis* Bramlette & Martini, distal view



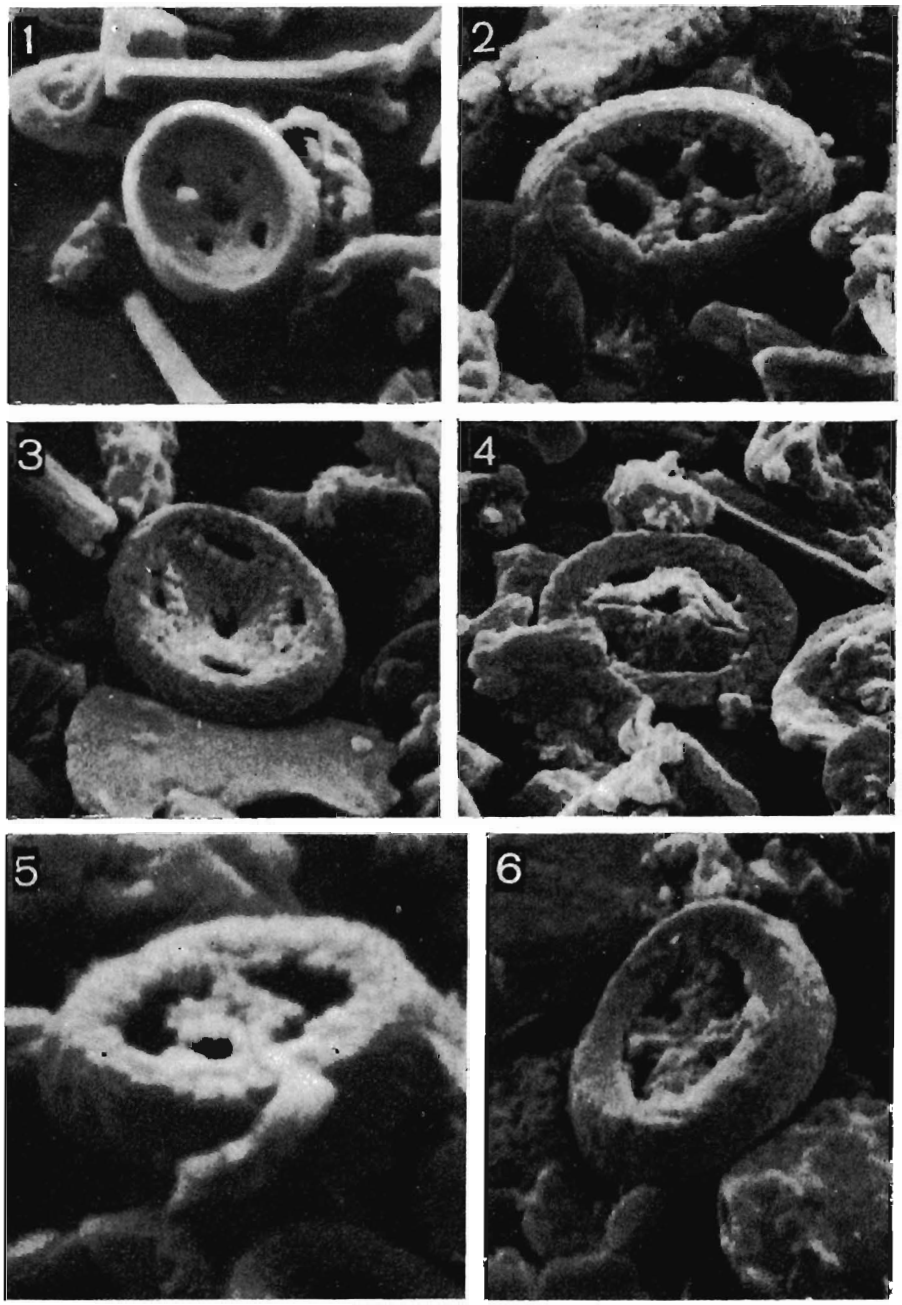
Upper Maastrichtian *Zygodiscus spiralis* Bramlette & Martini

1 — proximal view, borehole Podole (depth 53.7 m), × 5,400
2 — proximal view, Żyrzyn (depth 126.1 m), × 9,000
3 — distal view, Zemborzyce (depth 101 m), × 9,000
4 — distal view, Żyrzyn (depth 126.1 m), × 9,000



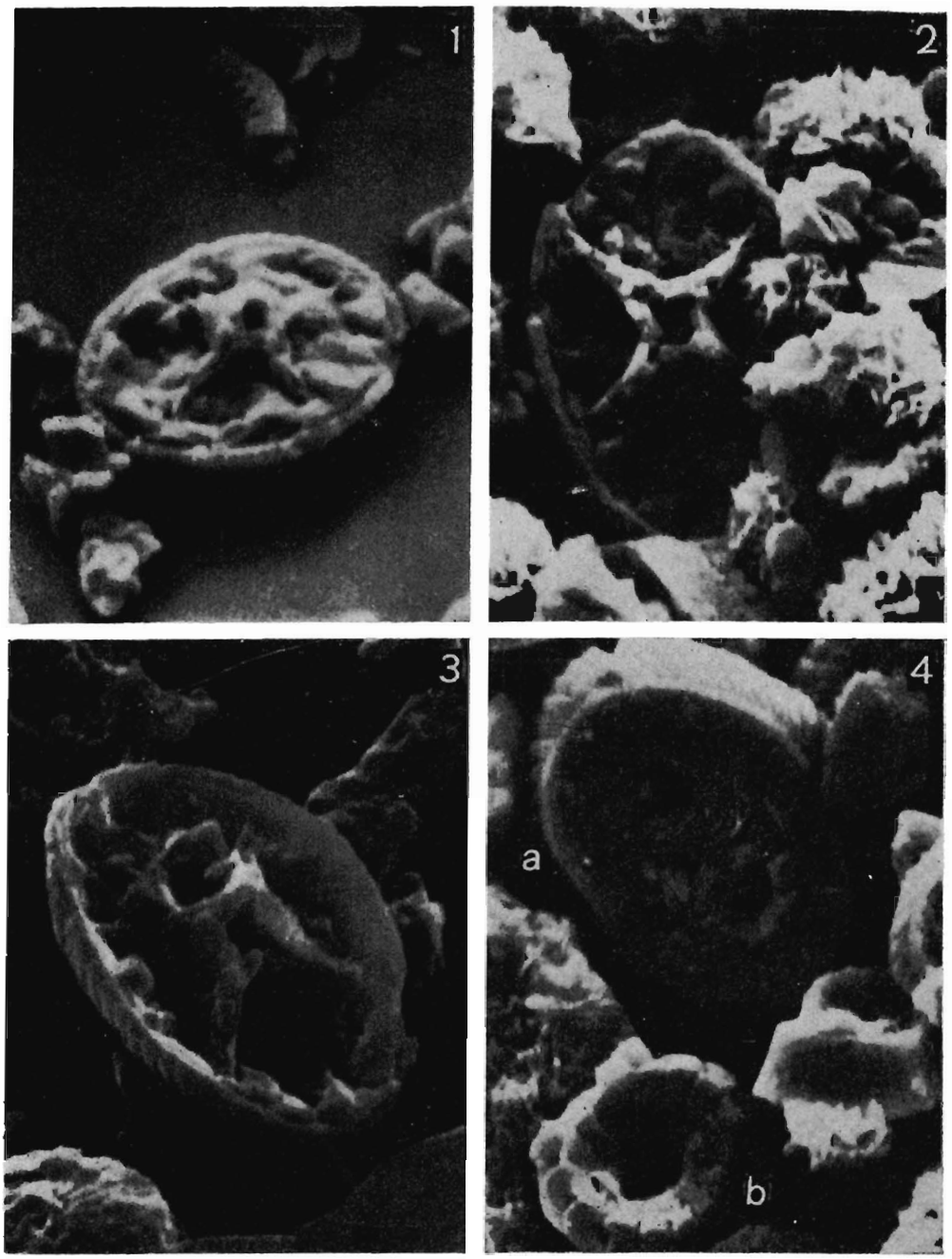
Vekshinella crux (Deflandre & Fert)

1 — proximal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 9,000
2 — proximal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 11,000
3 — distal view; Upper Maastrichtian, Żyrzyn (depth 126.1 m); × 5,400
4 — distal view; Upper Campanian, Ciszyca; × 15,000
5 — proximal view; Upper Maastrichtian, Zemborzyce (depth 74.8 m); × 6,300

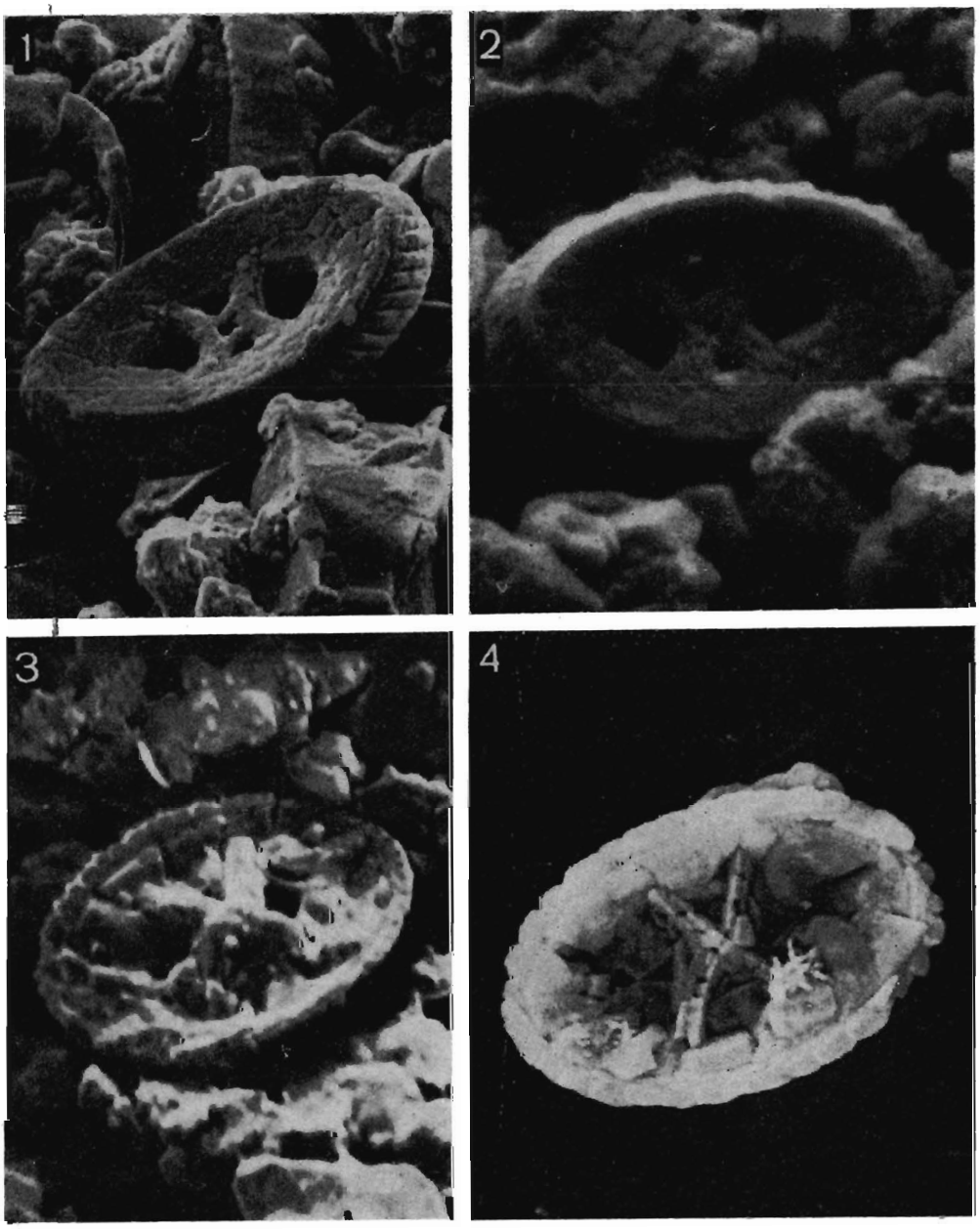


Upper Maastrichtian species of *Vekshinella*

1 — *Vekshinella aachena* Bukry, proximal view; borehole Żyrzyn (depth 110.2 m); × 5,400
2 — *Vekshinella crucifer* (Noël), proximal view; Żyrzyn (depth 126.1 m); × 8,000
3 — *Vekshinella elliptica* Gartner, proximal view; Żyrzyn (depth 126.1 m); × 9,000
4 — *Vekshinella elliptica* Gartner, distal view; Żyrzyn (depth 115.4 m); × 9,000
5 — *Vekshinella striata* (Stradner), proximal view; Nasiłów; × 12,000
6 — *Vekshinella striata* (Stradner), proximal view; Żyrzyn (depth 126.1 m); × 9,000

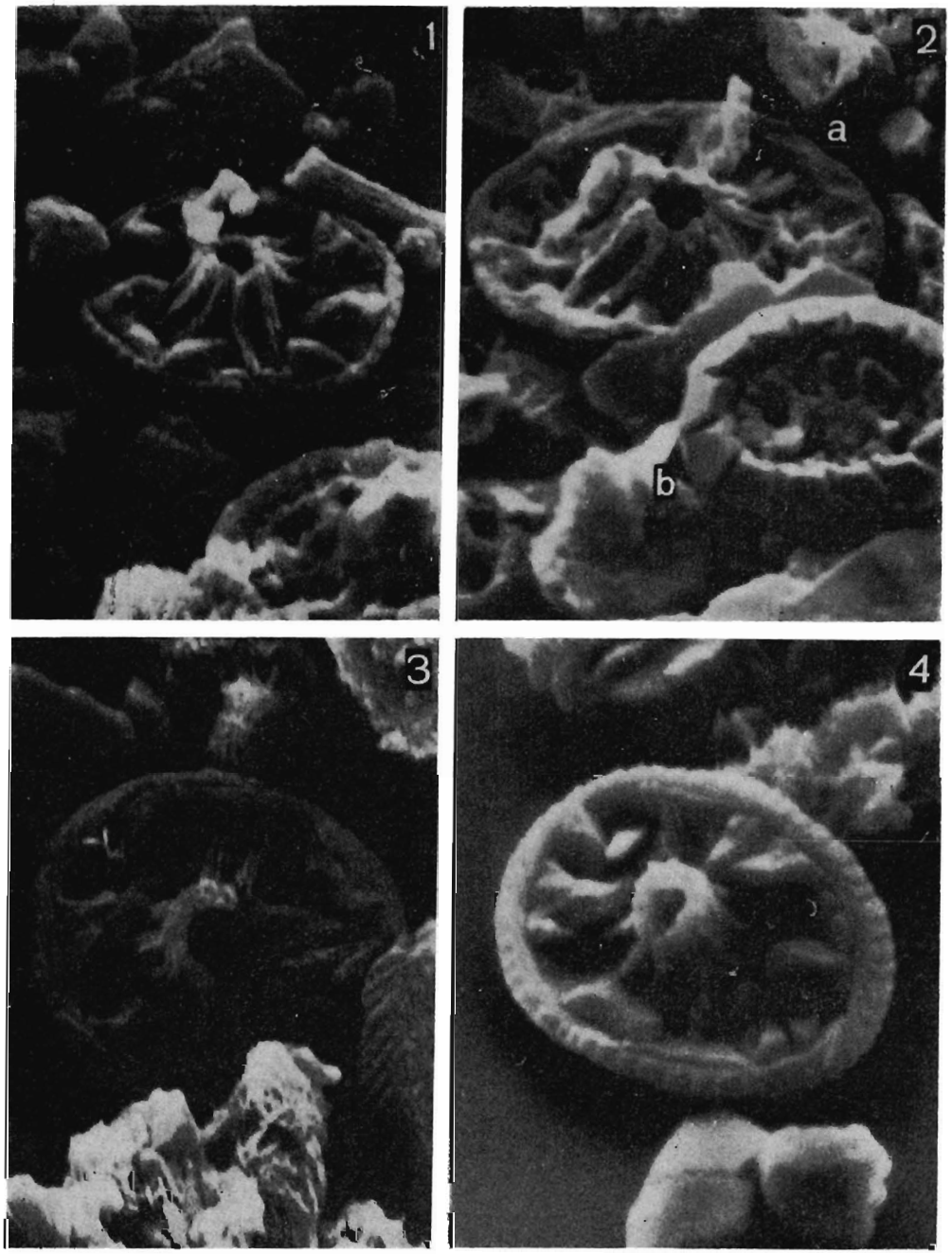


1 — *Eiffellithus eximius* (Stover), distal view; Upper Campanian, Sulejów; × 5,200
2 — *Eiffellithus regularis* (Górka), distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 9,000
3 — *Eiffellithus regularis* (Górka), distal view; Upper Maastrichtian, Lucimia; × 8,000
4 — **a** *Eiffellithus regularis* (Górka), proximal view; Upper Maastrichtian, Podole (depth 53.7 m); × 9,000
b *Prediscosphaera cretacea* (Arkhangelsky), proximal view



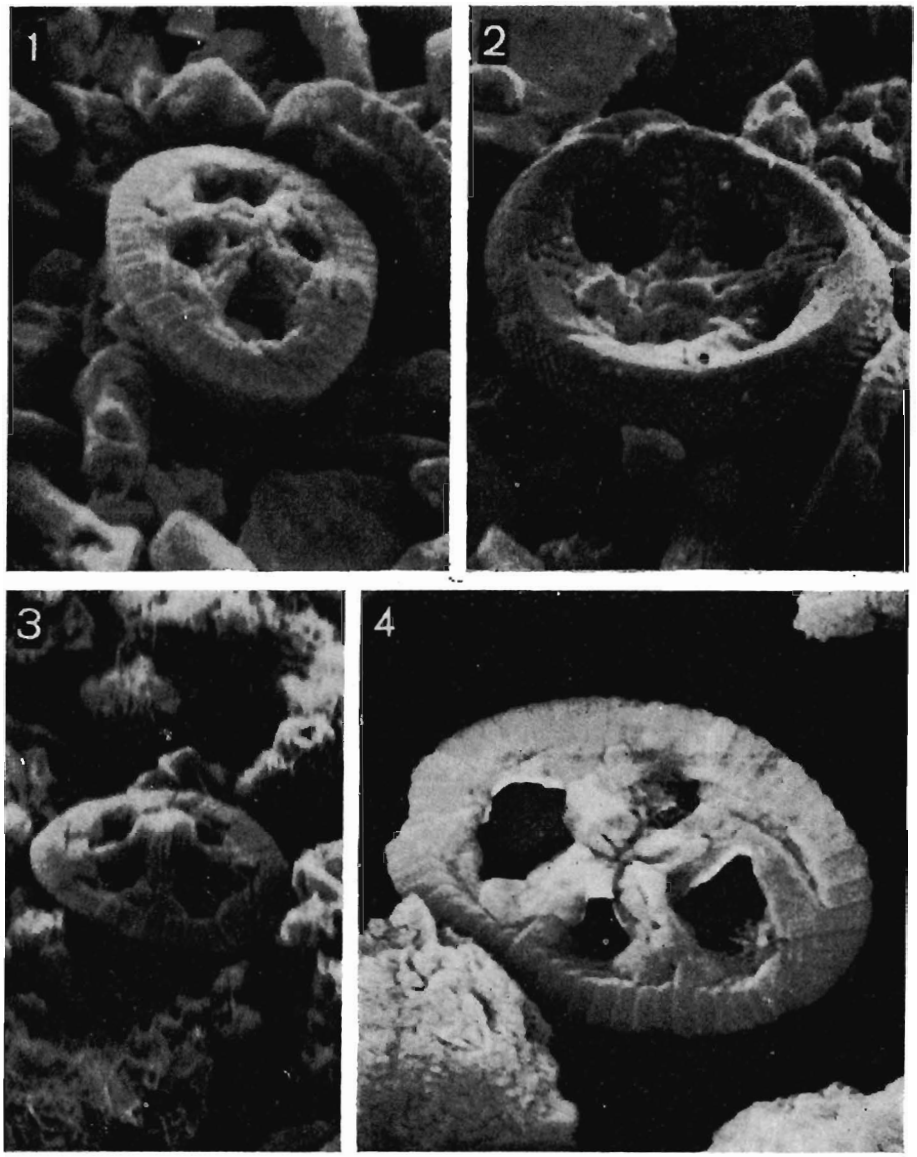
Eiffellithus turriseiffeli (Deflandre)

1 — proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 115.4 m); × 9,000
2 — proximal view; Upper Maastrichtian, Nasiłów; × 8,000
3 — distal view; Upper Maastrichtian, Zemborzyce (depth 74.8 m); × 6,300
4 — distal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 13,000



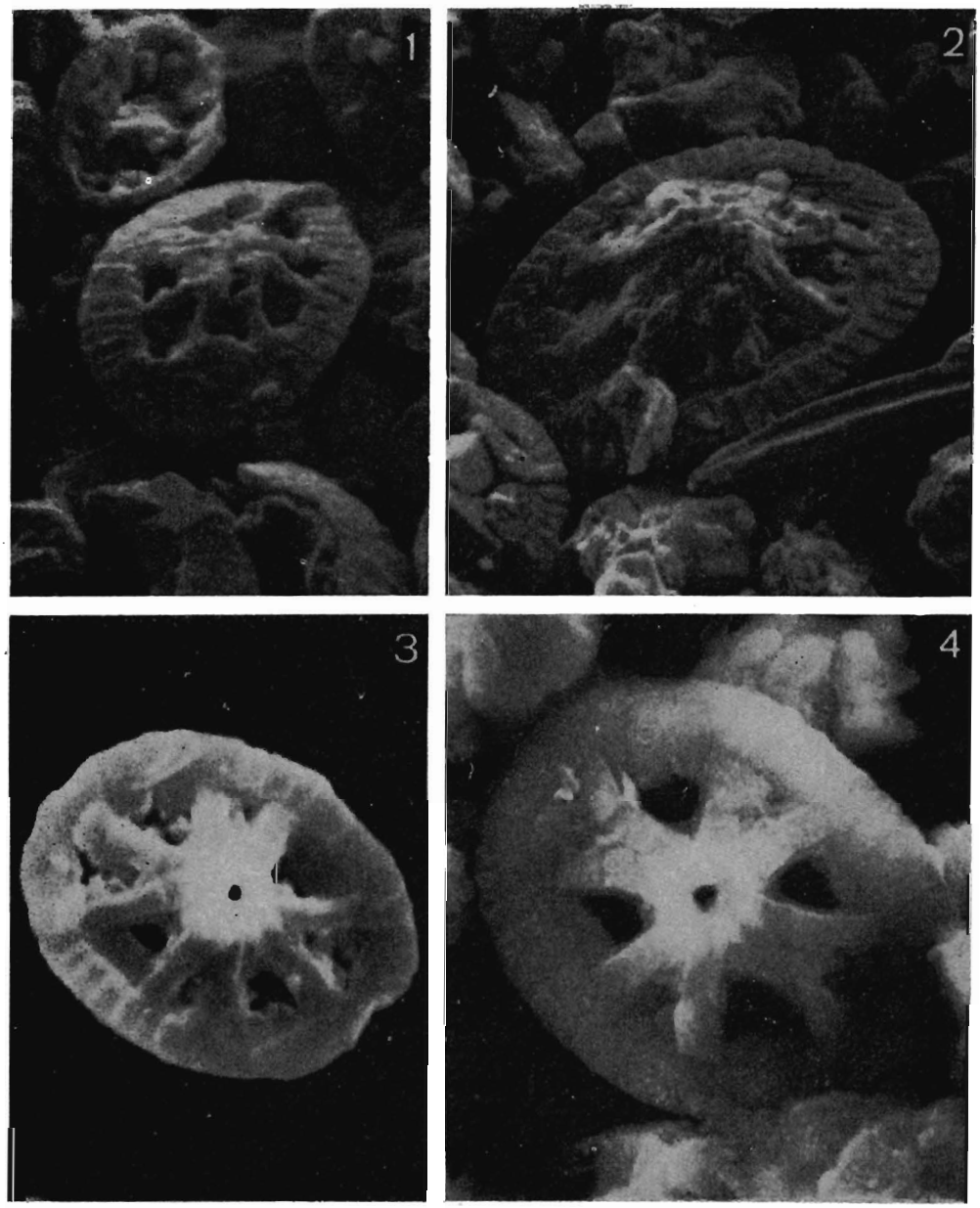
Upper Maastrichtian *Eiffellithus multicostatus* sp.n.

1 — paratype, distal view; borehole Podole (depth 53.7 m); × 9,000
2 — **a** distal view; Żyrzyn (depth 126.1 m); × 9,000
b *Cribrosphaera ehrenbergi* Arkhangelsky, distal view
3 — distal view; Podole (depth 53.7 m); × 9,000
4 — holotype, distal view; Nasiłów; × 10,000

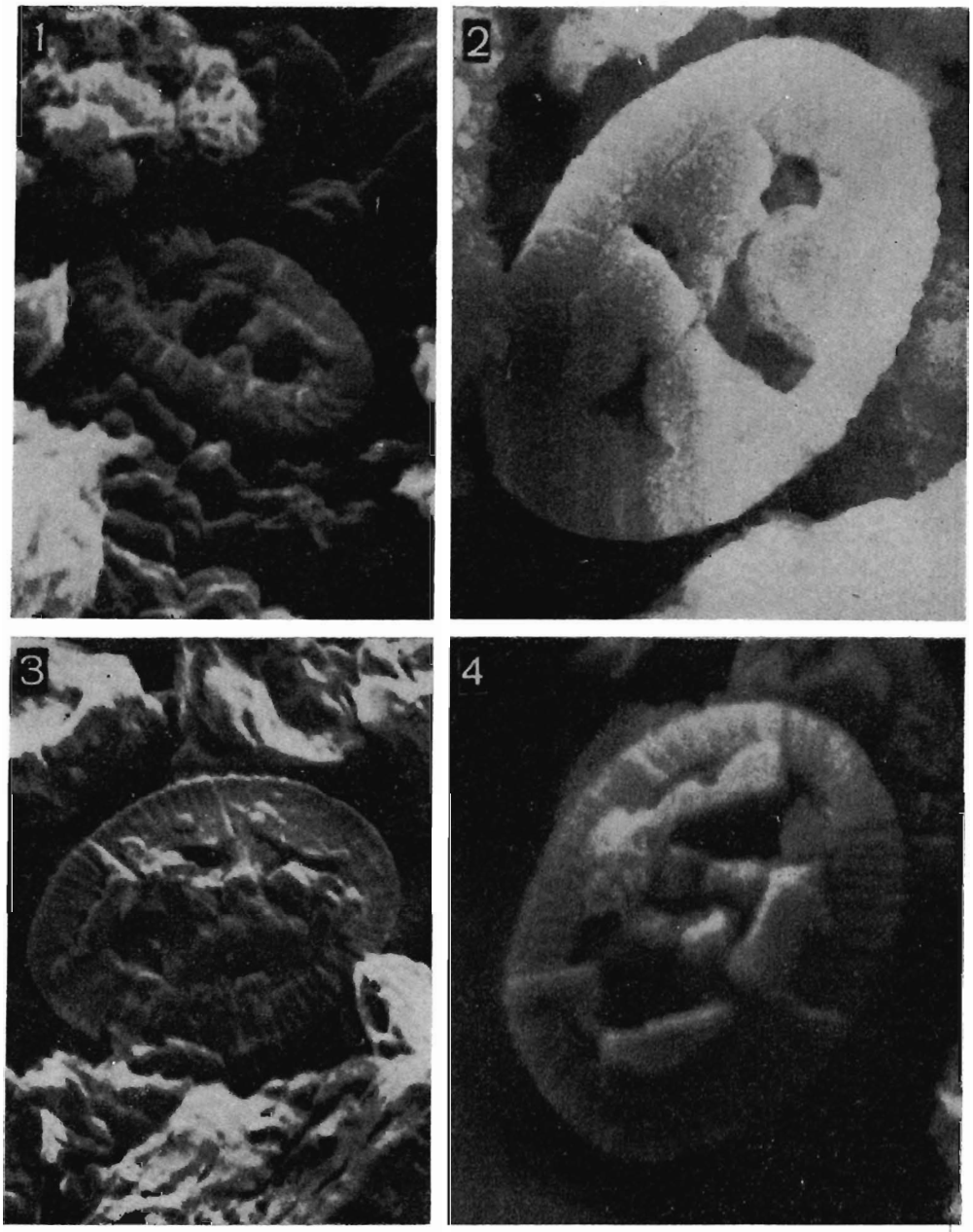


Chiastozygus litterarius (Górka)

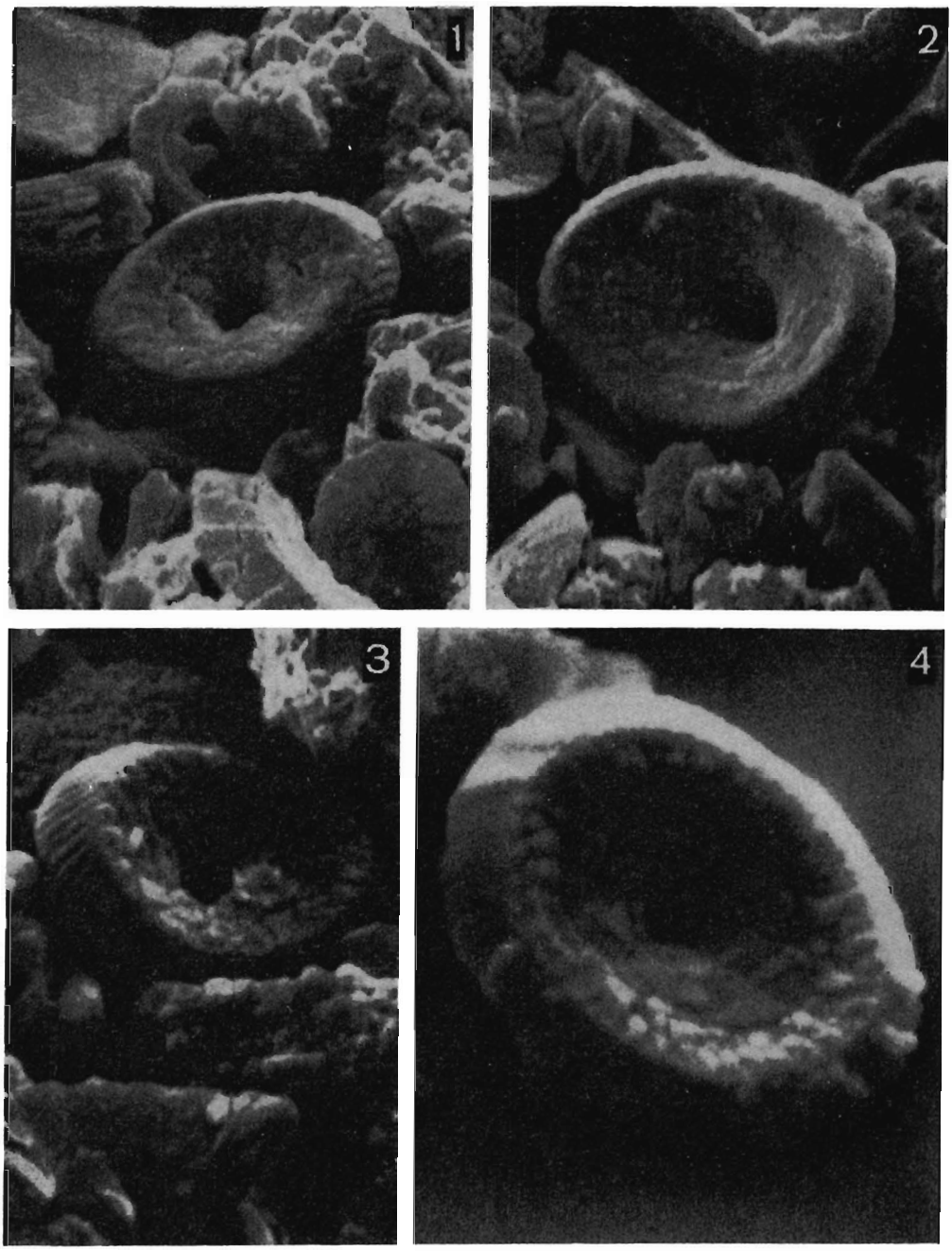
1 — distal view; Upper Maastrichtian, borehole Żyrzyn (depth 126.1 m); × 9,000
2 — proximal view; Upper Maastrichtian, Żyrzyn (depth 115.4 m); × 9,000
3 — distal view; Upper Maastrichtian, Podole (depth 53.7 m); × 6,300
4 — distal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 13,000



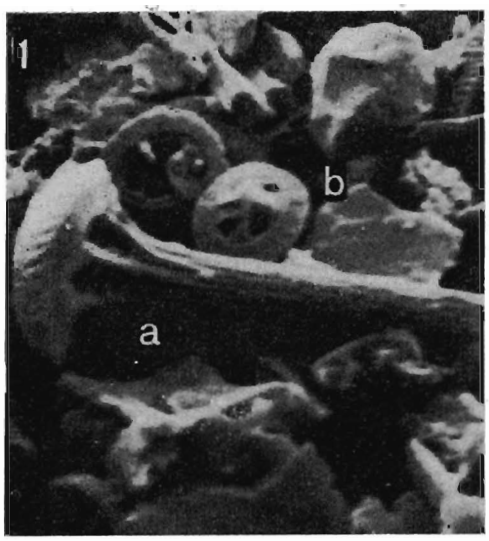
Upper Maastrichtian *Ahmuellerella octoradiata* (Górka) in distal view
1 and 2 — borehole Żyrzyn (depth 126.1 m); 1 × 6,300, 2 × 9,000
3 — Lucimia; × 8,000
4 — Kazimierz, × 13,000

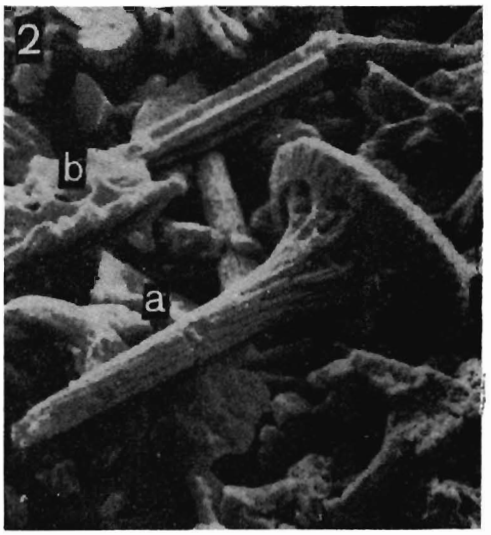


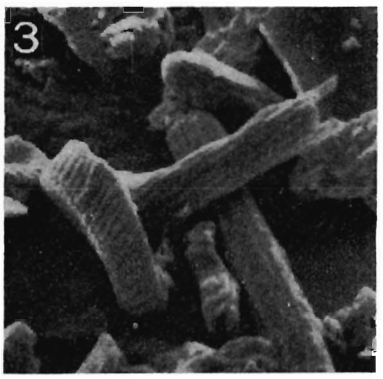
1 — *Tranolithus manifestus* Stover, distal view; Paleocene, Parchatka; × 8,000
2 — *Tranolithus exiguus* Stover, distal view; Upper Maastrichtian, Kazimierz; × 15,000
3 — *Helicolithus anceps* (Górka), distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 7,200
4 — *Helicolithus anceps* (Górka), distal view; Upper Maastrichtian, Nasiłów; × 10,000



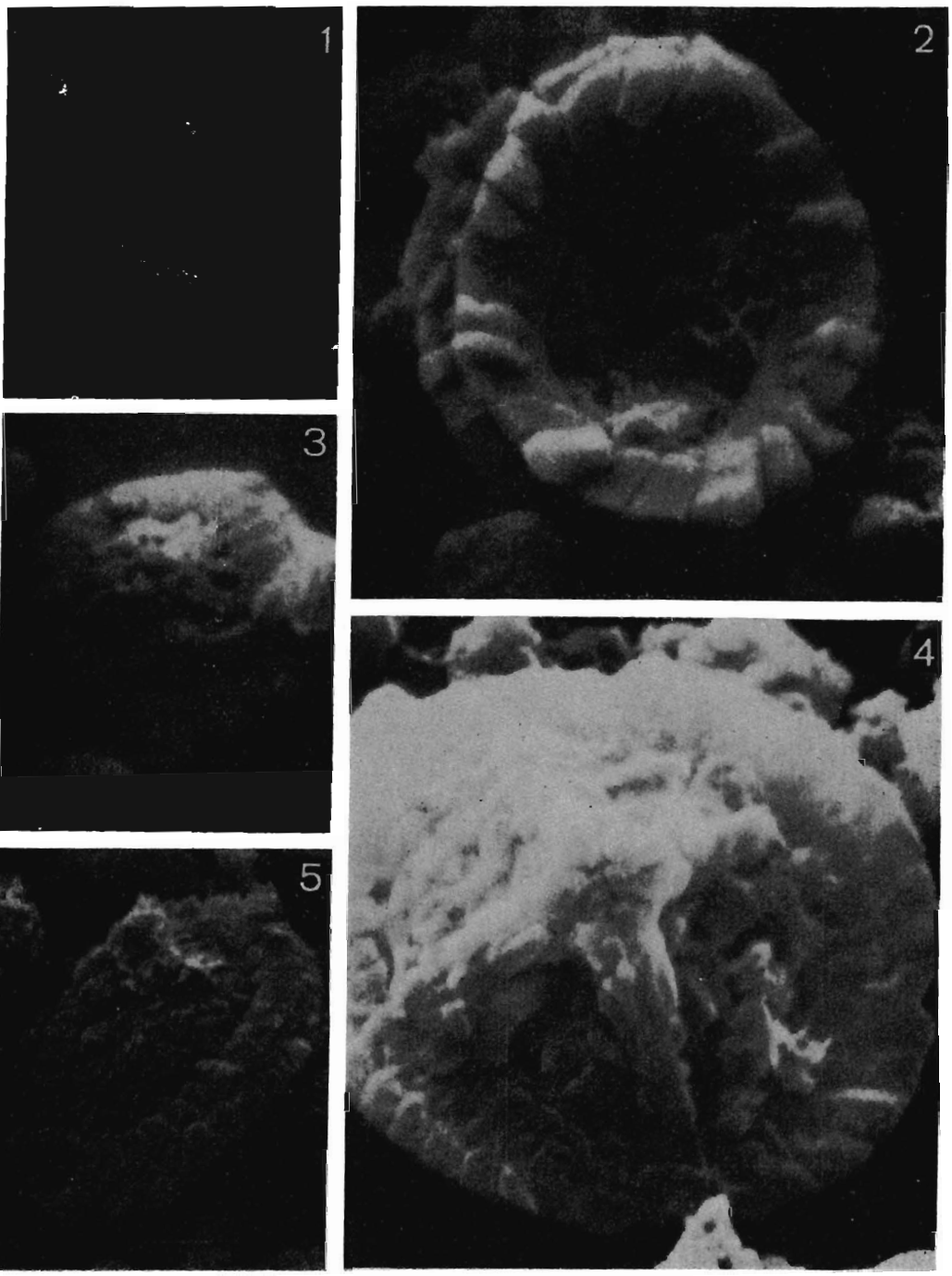
Upper Maastrichtian *Rhagodiscus plebeius* Perch-Nielsen in proximal view
1 and 2 — borehole Żyrzyn (depth 126.1 m), × 9,000
3 — Zemborzyce (depth 101 m); × 9,000
4 — Nasiłów, × 12,000



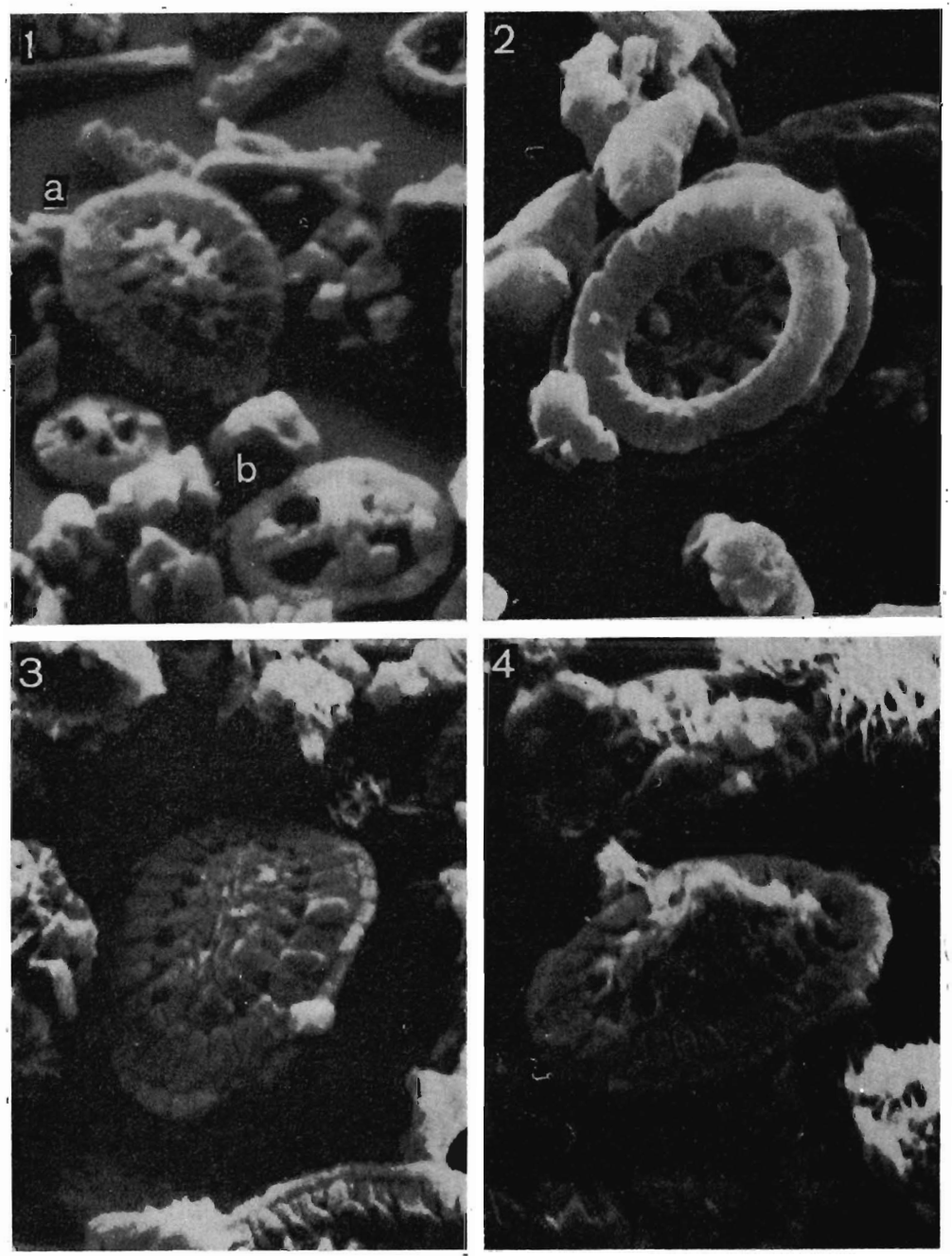




1 — a *Ahmuellerella octoradiata* (Górka), lateral view; Upper Maastrichtian, borehole Żyrzyn (depth 126.1 m); × 5,400
b *Prediscosphaera cretacea* (Arkhangelsky), distal view
2 — a *Ahmuellerella octoradiata* (Górka), lateral view; Upper Maastrichtian, Żyrzyn (depth 119.2 m); × 5,400
b *Lithraphidites grossopectinatus* Bukry
3 — *Parhabdolithus* sp., lateral view; Upper Maastrichtian, Żyrzyn (depth 115.4 m); × 6,300
4 — *Reinhardtites anthophorus* (Deflandre), distal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 13,000
5 — *Parhabdolithus angustus* (Stradner), distal view; Upper Maastrichtian, Lucimia; × 8,000



1 — *Podorhabdus* sp., proximal view; Upper Maastrichtian, borehole Zemborzyce (depth 101 m); × 8,300
2 — *Cretarhabdus crenulatus* Bramlette & Martini, proximal view; Upper Maastrichtian, Nasiłów; × 12,000
3 — *Cretarhabdus surirellus* (Deflandre), distal view; Upper Maastrichtian, Nasiłów; × 8,000
4 — *Cretarhabdus conicus* Bramlette & Martini, distal view; Paleocene, Rzeczyca; × 10,000
5 — *Cretarhabdus surirellus* (Deflandre), distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); × 6,000



Cretarhabdus surirellus (Deflandre)

1 — **a** distal view; Upper Campanian, Sulejów; × 5,200
b *Vekshinella crux* (Deflandre & Fert), distal view

2 — proximal view; Upper Maastrichtian, Lucimia; × 8,000

3 and 4 — distal view; Upper Maastrichtian, borehole Zemborzyce (depth 101 m); × 6,000

1973. *Podorhabdus granulatus* (Reinhardt) Bukry; H. Priewalder, p. 22, Pl. 15, Figs 5—6.
1976. *Podorhabdus granulatus* (Reinhardt, 1965) Bukry, 1969; S. Shumenko, p. 60, Pl. 21, Fig. 7.
Dimensions: length 7—9 μ; width 6—8 μ.

Remarks. — The present author follows Thierstein (*in* Roth & Thierstein 1972) in assigning *P. decorus* (Deflandre) and *P. granulatus* (Reinhardt) to a single species.

Occurrence. — Barremian to Aptian of Crimea (Shumenko 1976); Aptian to Maastrichtian of Europe (Bramlette & Martini 1964, Reinhardt 1966, Manivit 1971, Priewalder 1973, Thierstein 1973); Santonian to Maastrichtian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Africa (Bramlette & Martini 1964).

In the study area, the species has been found in most samples of Campanian and Maastrichtian age.

Podorhabdus orbiculofenestrus (Gartner, 1968) Thierstein, 1971

1968. *Prediscosphaera? orbiculofenestra* Gartner, n. sp.; S. Gartner, p. 21, Pl. 25, Figs 23—25 and Pl. 26, Fig. 8.
1970b. *Podorhabdus dietzmanni* (Reinhardt 1965) Reinhardt 1967; P. Reinhardt (partim), p. 87, Text-fig. 107b, Pl. 6, Fig. 4.
1971. *Podorhabdus orbiculofenestrus* (Gartner 1968) n. comb.; H. Thierstein, p. 478, Pl. 8, Figs 8—17.
1972. *Podorhabdus orbiculofenestrus* (Gartner, 1968) Thierstein, 1971; P. Roth & H. Thierstein, Pl. 6, Figs 1—7.
Dimensions: length 7—8 μ; width 5.5—6.5 μ.

Remarks. — There are 4 circular openings in the central area, surrounded by a rim of small grains; the openings are symmetric relative to the ellipse axes.

Occurrence. — Albian to Cenomanian of France, England, and Western Atlantic (Thierstein 1973); Cenomanian of Texas (Gartner 1968).

In the study area, a few specimens have been found in the Upper Maastrichtian at Lucimia and in the borehole Żyrzyn.

Genus *CRETARHABDUS* Bramlette & Martini, 1964
Type species: *Cretarhabdus conicus* Bramlette & Martini, 1964
Cretarhabdus conicus Bramlette & Martini, 1964
(Pl. 19, Fig. 4)

1970. *Cretarhabdus conicus* Bramlette et Martini 1964; D. Noël, p. 88, Text-fig. 14, Pl. 17, Figs 2, 4 [*cum syn.*].
1970b. *Cretarhabdus conicus* Bramlette & Martini 1964; P. Reinhardt, p. 48, Text-figs 13—15.
1971. *Cretarhabdus conicus* Bramlette & Martini; H. Manivit, p. 95, Pl. 2, Figs 13—18.
1971. *Cretarhabdus conicus* Bramlette and Martini 1964; H. Thierstein, p. 477, Pl. 6, Figs 7—12.
1973. *Cretarhabdus conicus* Bramlette & Martini; H. Priewalder, p. 17, Pl. 7, Figs 1—4.
1976. *Cretarhabdus conicus* Bramlette et Martini, 1964; S. Shumenko, p. 57, Pl. 19, Figs 8—9.
Dimensions: length 8—13 μ; width 6.6—11 μ.

Remarks. — The investigated species includes forms with central structure in form of a cone displaying some rows of perforations, overlaid by a cross with arms concordant or almost concordant to the ellipse axes; the cross makes base of central process.

Occurrence. — Berriasian to Maastrichtian of Europe (Bramlette & Martini 1964, Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Thierstein 1971, Priewalder 1973, Shumenko 1976); Cenomanian to Maastrichtian of North America (Gartner 1968); Maastrichtian of Tunisia (Bramlette & Martini 1964).

In the study area, the species has been found uncommonly in the Campanian at Sulejów, the Maastrichtian of the boreholes Żyrzyn and Podole, and the Paleocene at Rzeczyca (the latter specimens are probably redeposited).

Cretarhabdus crenulatus Bramlette & Martini, 1964, emend. Thierstein, 1971
(Pl. 19, Fig. 2)

1971. *Cretarhabdus crenulatus* Bramlette and Martini 1964 emend.; H. Thierstein, p. 476, Pl. 5, Figs 10—14 [*cum syn.*].
1972. *Cretarhabdus crenulatus* Bramlette & Martini, 1964 emend. Thierstein, 1971; P. Roth & H. Thierstein, p. 424, Pl. 5, Figs 10—13.

1976. *Cretarhabdus crenulatus* Bramlette et Martini, 1964; S. Shumenko, p. 57, Pl. 20, Figs 1—2.
Dimensions: length 7—10 μ; width 5—6 μ.

Remarks. — Following Thierstein (1971), the present author assigns to the investigated species only those specimens with 8 openings in the central area.

Occurrence. — Berriasian to Maastrichtian of Europe (Bramlette & Martini 1964, Thierstein 1971, Shumenko 1976); Aptian to Cenomanian of Eastern Atlantic (Roth & Thierstein 1972); Coniacian to Maastrichtian of North America (Gartner 1968, Bukry 1969).

In the study area, the species has been found only in the Upper Maastrichtian at Nasiłów.

Cretarhabdus surirellus (Deflandre, 1954) Reinhardt, 1970
(Pl. 19, Figs 3, 5 and Pl. 20, Figs 1—4)

1971. *Cretarhabdus surirellus* (Deflandre 1954) Reinhardt 1970; H. Thierstein, p. 477, Pl. 6, Figs 1—8 [*cum syn.*].
1973. *Cretarhabdus crenulatus* Bramlette & Martini; H. Priewalder, p. 17, Pl. 6, Figs 5—6.
1976. *Cretarhabdus surirellus* (Deflandre et Fert, 1954) Reinhardt, 1970; S. Shumenko, p. 56, Pl. 20, Figs 8—9 and Pl. 21, Fig. 1.
Dimensions: length 6.5—11 μ; width 3.8—6.5 μ.

Remarks. — Following Thierstein (1971), the present author assigns to the investigated species all those specimens with more than 8 openings in the central area forming a single row at the edge of wall.

Occurrence. — Berriasian to Maastrichtian of Europe (Deflandre & Fert 1954, Reinhardt 1966, Stover 1966, Perch-Nielsen 1968, Noël 1970, Thierstein 1971, Priewalder 1973, Shumenko 1976); Coniacian to Santonian of North America (Bukry 1969).

In the study area, the species has been found in the Campanian at Sulejów, and the Maastrichtian at Lucimia and Nasiłów and in the boreholes Żyrzyn and Podole.

Genus *PREDISCOSPHAERA* Vekshina, 1959

Type species: *Prediscosphaera cretacea* (Arkhangelsky, 1912) Gartner, 1963
Prediscosphaera cretacea (Arkhangelsky, 1912) Gartner, 1968
(Pl. 5, Figs 1*a*, 3c Pl. 11, Fig. 4*b*, Pl. 18, Fig. 1*b*, Pl. 21, Figs 1—7, and Pl. 22, Fig. 4)

1970. *Prediscosphaera cretacea* (Arkhangelsky) Gartner 1968; D. Noël, p. 64, Text-fig. 16, Pl. 15, Figs 3—6, 9, 11 and Pl. 16, Figs 2—3, 7—8 [*cum syn.*].
1970b. *Prediscosphaera cretacea* (Arkhangelsky 1912) Gartner 1968; P. Reinhardt, p. 91, Text-fig. 118.
1971. *Prediscosphaera cretacea* (Arkhangelsky) Gartner; H. Manivit, p. 99, Pl. 22, Figs 1—14.
1971. *Prediscosphaera cretacea* (Arkhangelsky) Gartner; S. Shafik & H. Stradner, p. 87, Pls 18—19.
1971. *Prediscosphaera cretacea* (Arkhangelsky 1912) Gartner 1968; H. Thierstein, p. 479, Pl. 7, Fig. 7.
1973. *Prediscosphaera cretacea cretacea* (Arkhangelsky) Gartner; H. Priewalder, p. 23, Pl. 17, Figs 1—4.
1975. *Prediscosphaera cretacea* (Arkhangelsky); E. Gaździcka, p. 409, Pl. 1, Figs 1*a*, 3c, Pl. 3, Figs 3—6, and Pl. 5, Fig. 2b.
1976. *Prediscosphaera cretacea cretacea* (Arkhangelsky) Gartner; D. Burns, p. 293, Pl. 4, Fig. 5.
1976. *Prediscosphaera cretacea* (Arkhangelsky, 1912) Gartner, 1968; S. Shumenko, p. 61, Pl. 22, Figs 5—6.
1976. *Prediscosphaera intercisa* (Deflandre, 1954) comb. nov.; S. Shumenko, p. 62, Pl. 22, Figs 7—9 and Pl. 23, Fig. 1.
Dimensions: total length, central process including 8—14 μ; width of basal plate 6—10 μ.

Remarks. — Slight differences in shape of the crystals building coccolith wall, size of central process, or form details of bars fall into the range of intraspecific variability.

Occurrence. — Albian to Maastrichtian of Europe (Deflandre 1959, Bramlette & Martini 1964, Reinhardt 1966, Stover 1966, Perch-Nielsen 1968, Manivit 1971, Thierstein 1971, Shumenko 1976); Cenomanian to Maastrichtian of North America (Gartner 1968, Bukry 1969).

In the study area, the species has been found abundantly in all the samples of Campanian and Maastrichtian age.

Prediscosphaera propinqua (Górka, 1957) Reinhardt, 1970
(Pl. 22, Figs 1—3)

1957. *Discolithus propinquus* n. sp.; H. Górka, p. 250, Pl. 2, Fig. 13.
1970. *Prediscosphaera spinosa* (Bramlette et Martini) Gartner 1968; D. Noël, p. 66, Pl. 16, Figs 4—6, 9—10 [*cum. syn.*].
1970b. *Prediscosphaera propinqua* (Górka, 1957) n. comb.; P. Reinhardt, p. 93, Text-fig. 120.
1971. *Prediscosphaera spinosa* (Bramlette & Martini) Gartner; S. Shafik & H. Stradner, p. 88, Pl. 20, Figs 1—4.
1971. *Prediscosphaera spinosa* (Bramlette & Martini) Gartner; H. Manivit, p. 101, Pl. 21, Figs 4—6.
1972. *Deflandrius spinosus* Bramlette & Martini, 1964; S. Forchheimer, p. 44, Pl. 6, Figs 1—2, 4, 6—7.
1973. *Prediscosphaera spinosa* (Bramlette & Martini) Gartner; H. Priewalder, p. 24, Pl. 18, Figs 3—4.
1975. *Prediscosphaera spinosa* (Bramlette & Martini) Gartner; E. Gaździcka, p. 409 (partim), Pl. 3, Fig. 1 [*non Fig. 2*], Pl. 6, Fig. 3b.
1976. *Prediscosphaera propinqua* (Górka, 1957) Reinhardt, 1970; S. Shumenko, p. 62, Pl. 23, Figs 2—4.
Dimensions: length 4—8 μ; width 3.5—7 μ.

Remarks. — The *SEM* studies on the material investigated originally by Górka (1957) permit its identification with the species *Deflandrius spinosus* Bramlette & Martini, 1964. Then, the commonly used name *Prediscosphaera spinosa* (Bramlette & Martini) is to be considered as a junior synonym of *P. propinqua* (Górka). The investigated species differs from *P. cretacea* in the arrangement of central-structure bars and also in the form of central process.

Occurrence. — Hauterivian to Cenomanian of Sweden (Forchheimer 1972); Albian to Maastrichtian of other European countries (Górka 1957, Bramlette & Martini 1964, Reinhardt 1966, Stover 1966, Perch-Nielsen 1969, Manivit 1971, Thierstein 1971, Priewalder 1973, Shumenko 1976); Coniacian to Maastrichtian of North America (Gartner 1968, Bukry 1969).

In the study area, the species has been found in all the samples of Campanian and Maastrichtian age.

Prediscosphaera serrata Noël, 1970
(Pl. 23, Figs 2, 4)

1970. *Prediscosphaera serrata* n. sp.; D. Noël, p. 66, Pl. 15, Fig. 2 and Pl. 16, Fig. 11.
Dimensions: diameter 6—7 μ.

Remarks. — The species differs from *P. cretacea* in its denticulate external edge of the wall, the denticulation resulting from acute ends of crystals building the wall. No specimens with central process have been recorded in the investigated material.

Occurrence. — Lower Campanian of France (Noël 1970).

In the study area, some specimens have been found in the Upper Maastrichtian at Nasiłów.

Prediscosphaera stoveri (Perch-Nielsen, 1968) Shumenko, 1974
(Pl. 23, Figs 1, 3, 5)

1968. *Deflandrius stoveri* n. sp.; K. Perch-Nielsen, p. 66, Pl. 16, Figs 11—13.
1969. *Prediscosphaera germanica* Bukry, n. sp.; D. Bukry, p. 39, Pl. 18, Figs 1—3.
1970b. *Prediscosphaera quadripunctata* (Górka 1957) n. comb.; P. Reinhardt, p. 92, Text-fig. 119, Pl. 8, Figs 4—8.
1976. *Prediscosphaera stoveri* (Perch-Nielsen, 1968) Shumenko, 1974; S. Shumenko, p. 62, Pl. 23, Figs 6—8.
Dimensions: length 3.8—5 μ; width 3.2—5 μ.

Remarks. — The species differs from *P. propinqua* in its smaller central area and an additional cycle of minute elongate elements arranged obliquely and overlapping with elements of the main cycle. Furthermore, no central process has been ever recorded in *P. stoveri*.

Occurrence. — Campanian of Germany (Bukry 1969); Campanian to Maastrichtian of the Soviet Union (Shumenko 1976); Maastrichtian of Denmark (Perch-Nielsen 1968).

In the study area, the species has been found in the Upper Maastrichtian of the boreholes Żyrzyn, Zemborzyce, and Podole.

Genus *CRIBROSPHAERA* Arkhangelsky, 1912, emend. Reinhardt, 1964
Type species: *Cribrosphaera ehrenbergi* Arkhangelsky, 1912

Deflandre (1952) proposed to replace the name *Cribrosphaera* Arkhangelsky with the new name *Cribrosphaerella*, as the former one had previously been used for a radiolarian taxon (Popofsky 1906). Since that time, both the names have been commonly used to designate that genus. The present author is of the opinion that the name *Cribrosphaera* appears valid in botanical nomenclature and hence, it may be recommended for further use.

Cribrosphaera ehrenbergi Arkhangelsky, 1912
(Pl. 5, Fig. 1*b*, Pl. 13, Fig. 2*b*, Pl. 24, Figs 1—4, and Pl. 25, Figs 1—4)

1970. *Cribrosphaera ehrenbergi* Arkhangelsky 1912; D. Noël, p. 70, Pl. 18, Figs 4—7, Pl. 19, Figs 1—4, and Pl. 20,, Figs 1—4 [*cum syn.*].
1970b. *Cribrosphaerella ehrenbergi* (Arkhangelsky 1912) Deflandre in Piveteau 1952; P. Reinhardt, p. 52, Text-fig. 24, Pl. 3, Fig. 4.
1971. *Cribrosphaera ehrenbergi* Arkhangelsky; H. Manivit, p. 101, Pl. 8, Figs 1—13.
1971. *Cribrosphaera numerosa* (Górka) Reinhardt & Górka; S. Shafik & H. Stradner, p. 82, Pl. 32, Figs 1—2.
1972. *Cribrosphaera ehrenbergi* Arkhangelsky, 1912; S. Forchheimer, p. 60, Pl. 9, Figs 1, 3—4.
1972. *Cribrosphaera ehrenbergi* Arkhangelsky 1912; N. Hoffmann, p. 64, Pl. 15, Figs 1—2.
1973. *Cribrosphaerella ehrenbergi* (Arkhangelsky) Deflandre; H. Priewalder, p. 16, Pl. 6, Figs 3, 5.
1975. *Cribrosphaera ehrenbergi* Arkhangelsky; E. Gaździcka, p. 409, Pl. 1, Fig. 1b and Pl. 5, Fig. 1.
1976. *Cribrosphaera ehrenbergi* Arkhangelsky; D. Burns, p. 285, Pl. 3, Fig. 4.
1976. *Cribrosphaerella ehrenbergi* (Arkhangelsky, 1912) Deflandre, 1952; S. Shumenko, p. 40, Pl. 10, Figs 8—9 and Pl. 11, Fig. 1.
Dimensions: length 6.5—11 μ; width 4.5—6.5 μ.

Remarks. — Apart from typical *C. ehrenbergi* with wall consisting of two cycles of crystals, there are also in the investigated material some specimens with a three-cyclic wall. The latter specimens cannot, however, be attributed to the species *C. pelta* Gartner, since they are almost circular in outline and display a large central area with numerous concentrically arranged pores (*cf.* Pl. 25, Fig. 3).

Occurrence. — Hauterivian to Barremian of Sweden (Forchheimer 1972); Albian to Maastrichtian of other European countries (Deflandre 1954, Górka 1957, Bramlette & Martini 1964, Reinhardt 1966, Stover 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Thierstein 1971, Priewalder 1973, Burns 1976, Shumenko 1976); Coniacian to Maastrichtian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Africa (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found abundantly in all the samples of Campanian and Maastrichtian age.

Genus *NEPHROLITHUS* Górka, 1957, emend. Aberg, 1966
Type species: *Nephrolithus frequens* Górka, 1957

Nephrolithus frequens Górka, 1957
(Pl. 5, Fig. 2 and Pl. 26, Figs 1—5)

1969. *Nephrolithus gorkae* Aberg; D. Bukry, p. 47, Pl. 24, Figs 11—12.
1970b. *Nephrolithus frequens* Górka 1957; P. Reinhardt, p. 61, Text-figs 95—96, Pl. 7, Figs 1—6 [*cum syn.*].
1971. *Nephrolithus frequens* Górka; H Manivit, p. 102, Pl. 17, Figs 16—18.
1971. *Nephrolithus frequens* Górka; S. Shafik & H. Stradner, p. 85, Pls 28—29.
1973. *Nephrolithus frequens* Górka; H. Priewalder, p. 21, Pl. 15, Figs 1—4.
1975. *Nephrolithus frequens* Górka; E. Gaździcka, p. 409, Pl. 1, Fig. 2 and Pl. 5, Fig. 2*a*.
Dimensions: length 6—8 μ; width ca 4 μ.

Remarks. — Pore number ranges from 3 up to a dozen or so depending upon the coccolith size. Hence, it cannot be regarded as a specific diagnostic feature but rather as a reflection of intraspecific variability (Perch-Nielsen 1968). This opinion is strongly supported by the co-occurrence of morphotypes differing in pore number as well as their simultaneous appearance and subsequent extinction.

Occurrence. — Upper Maastrichtian of Europe (Bramlette & Martini 1964, Aberg 1966, Perch-Nielsen 1968, Manivit 1971, Shafik & Stradner 1971, Priewalder 1973), the United States (Bramlette & Martini 1964), and New Zealand (Edwards 1966).

In the study area, the species has been found abundantly in all the samples of Late Maastrichtian age.

Nephrolithus aff. *frequens* Górka, 1957
(Pl. 27, Figs 1—3)

Dimensions: length 5.5—6 μ; width ca 3.5 μ.

Remarks. — In some specimens, the wall consists of elongate, key-shaped crystals arranged obliquely relative to the coccolith plane. Any additional proximal cycle of crystals is invisible; or it is considerably reduced and situated within the main cycle. The specimens are considerably concave at the proximal side. The crystals filling up the central area are much smaller than those in the wall. The pores are numerous (usually ca 10).

In contrast, Aberg (1966) and Perch-Nielsen (1968) illustrated quite different specimens assigned to *N. frequens*. Furthermore, the specimen derived from Mędmierz (Perch-Nielsen 1968, Pl. 18, Fig. 1) differs in the wall structure from the specimens from Kjöliby Gard, Denmark (Perch-Nielsen 1968, Pl. 18, Figs 2—6).

Further studies are needed to determine whether specimens displaying those differential wall types are to be assigned to a single species or not.

Occurrence. — Upper Maastrichtian at Kazimierz and in the borehole Żyrzyn.

Family **Arkhangelskiellaceae** Bukry, 1969
Genus *Arkhangelskiella* Vekshina, 1959, emend. Reinhardt, 1964
Type species: *Arkhangelskiella cymbiformis* Vekshina, 1959
Arkhangelskiella cymbiformis Vekshina, 1959
(Pl. 28, Figs 1—2 and Pl. 29, Fig. 3)

1970a. *Arkhangelskiella cymbiformis* Vekšina 1959; P. Reinhardt, p. 14, Text-figs 17—20 [*cum syn.*].
1971. *Arkhangelskiella cymbiformis* Vekshina; H. Manivit, p. 103, Pl. 1, Figs 6—11.
1971. *Arkhangelskiella cymbiformis* Vekshina; S. Shafik & H. Stradner, p. 80, Pls 5—7.
1973. *Arkhangelskiella cymbiformis* Vekshina; H. Priewalder, p. 12, Pl. 3, Figs 1—4.
1975. *Arkhangelskiella cymbiformis* Vekshina; E. Gaździcka, p. 409, Pl. 6, Fig. 3.
1976. *Arkhangelskiella cymbiformis* Vekschina, 1959; S. Shumenko, p. 35, Pl. 7, Figs 6—8.
Dimensions: length 8—12 μ; width 6—6.5 μ.

Remarks. — Sutures in the central area form a characteristic cross concordant with the ellipse axes.

Occurrence. — Campanian to Maastrichtian of Europe (Bramlette & Martini 1964, Reinhardt 1966, Perch-Nielsen 1968, Noël 1969, Manivit 1971, Priewalder 1973, Shumenko 1976); Maastrichtian of North America (Bramlette & Martini 1964, Gartner 1968) and Africa (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found in most samples of Campanian and Maastrichtian age, especially of Late Maastrichtian age.

Arkhangelskiella ethmopora Bukry, 1969
(Pl. 30, Fig. 2)

1969. *Arkhangelskiella specillata ethmopora* Bukry, n. ssp.; D. Bukry, p. 21, Pl. 4, Figs 4—7.
1971. *Arkhangelskiella ethmopora* Bukry; H. Manivit, p. 103, Pl. 1, Figs 12—14.
1975. *Arkhangelskiella ethmopora* Bukry; E. Gaździcka, p. 409, Pl. 6, Fig. 4.
Dimensions: length 11—12 μ; width 7.5—9.5 μ.

Remarks. — The specific feature of *A. ethmopora* is its perforated central area. There are several openings distributed regularly in rows parallel to the longer ellipse axis and along the border of wall. Every opening is subdivided by minute processes.

Occurrence. — Coniacian to Campanian of France (Bukry 1969, Manivit 1971); Campanian of North America (Čepek & Hay 1969).

In the study area, the species has been found rarely in the Campanian at Sulejów and Chmyca, and the Upper Maastrichtian at Lucimia and in the borehole Żyrzyn.

Arkhangelskiella specillata Vekshina, 1959
(Pl. 5, Figs 3*a*, 4 and Pl. 30, Fig. 3)

1968. *Arkhangelskiella specillata* Vekshina; S. Gartner, p. 39, Pl. 8, Figs 6—7 and Pl. 11, Fig. 4.
1971. *Arkhangelskiella specillata* Vekshina; H. Manivit, p. 104, Pl. 1, Figs 16—17.
1973. *Arkhangelskiella specillata* Vekshina; H. Priewalder, p. 13, Pl. 4, Figs 1—4.
1975. *Arkhangelskiella specillata* Vekshina; E. Gaździcka, p. 409, Pl. 1, Figs 3*a*, 4 [*non* Pl. 6, Figs 1—2].
1976. *Arkhangelskiella specillata* Vekschina, 1959; S. Shumenko, p. 35, Pl. 7, Figs 9—10.
Dimensions: length 8—11 μ; width 6—8 μ.

Remarks. — According to Gartner (1968), *A. specillata* differs from *A. cymbiformis* in its thinner wall ad hence, larger central area with perforations around the external edge of central area. One may, however, suspect that particular species of the genus *Arkhangelskiella* Vekshina (and also *Broinsonia* Bukry) are variously interpreted in paleontological literature.

Occurrence. — Campanian of North America (Gartner 1968); Campanian to Maastrichtian of Europe (Manivit 1971, Priewalder 1973, Shumenko 1976).

In the study area, the species has been found in all the samples of Campanian age, and most samples of Maastrichtian age.

Genus *BROINSONIA* Bukry, 1969
Type species: *Broinsonia dentata* Bukry, 1969
Broinsonia distincta (Shumenko, 1968) Reinhardt, 1970
(Pl. 30, Fig. 1*a*)

1968. *Arkhangelskiella distincta* Shumenko, sp. nov.; S. Shumenko, p. 34, Pl. 1, Figs 4—6.
1969. *Aspidolithus signatus* n. sp.; D. Noël, p. 197, Pl. 2, Figs 3—4.
1970. *Broinsonia signata* (Noël) nov. comb.; D. Noël, p. 78, Pl. 25, Figs 4—6.
1970*a*. *Broinsonia distincta* (Sumenko 1968) n. comb.; P. Reinhardt, p. 23, Text-fig. 42.
1972. *Broinsonia signata* (Noël, 1969) Noël, 1970; P. Roth & H. Thierstein, Pl. 13, Figs 12—20 and Pl. 14, Figs 1—5.
1974. *Arkhangelskiella distincta* Shumenko; A. Grigorovitsch, Pl. 1, Fig. 6.
1975. *Arkhangelskiella distincta* Shumenko; E. Gaździcka, p. 409, Pl. 7, Fig. 3*b*.
1976. *Broinsonia distincta* (Shumenko, 1968) Reinhardt, 1970; S. Shumenko, p. 36, Pl. 8, Figs 5—7.
Dimensions: length 4—5 μ; width 2.8—3.2 μ.

Remarks. — The wall consists of two or three shields, each one composed of two cycles of radially arranged crystals. In the central area, there is a cross with arms concordant with the ellipse axes; each arm consists of two rows of small grains.

According to Shumenko (1968), this is an early developmental stage. Later on, additional elements appear in the central area to fill up free space between the central cross and wall. No specimens of the latter structural type have been found in the investigated area. However, the relatively small size of the specimens studied may support the opinion of Shumenko (1968). One may also claim that *B. bevieri* Bukry represents actually a mature stage of *B. distincta*, as the elements of its central area do also form a cross concordant with the ellipse axes.

Occurrence. — Cenomanian to Santonian of both Eastern and Western Atlantic (Roth & Thierstein 1972); Turonian to Coniacian of the Soviet Union (Grigorovitsch 1974, Shumenko 1976); Campanian of France (Noël 1969).

In the study area, the species has been found very rarely in the Campanian at Sulejów and Ciszyca, and the Upper Maastrichtian of the borehole Żyrzyn.

Broinsonia lata (Noël, 1969) Noël, 1970
(Pl. 32, Figs 1, 3)

1969. *Aspidolithus latus* n. sp.; D. Noël, p. 196, Text-fig. 2*a-b*, Pl. 2, Figs 1—2.
1970. *Broinsonia lata* (Noël) nov. comb.; D. Noël, p. 76, Pl. 23, Fig. 2*a-b*.
1970*a*. *Arkhangelskiella lata* (Noël 1969) n. comb.; P Reinhardt, p. 16, Text-fig. 23.
1972. *Broinsonia lata* (Noël, 1969) Noël, 1970; P. Roth & H. Thierstein, Pl. 14, Figs 18—21.
1973. *Broinsonia lata* (Noël, 1969) Noël, 1970; H. Thierstein, p. 35, Pl. 6, Figs 12—16.
Dimensions: length 6.5—8.5 μ; width 4.8—6 μ.

Remarks. — The specific features of *B. lata* are its large central area, thin wall, lack of cross structure and perforations in the central area.

Occurrence. — Upper Albian to Upper Campanian of both Eastern and Western Atlantic (Roth & Thierstein 1972); Campanian of France (Noël 1969).

In the study area, the species has been found in the Upper Maastrichtian of the borehole Podole.

Broinsonia parca (Stradner, 1963) Bukry, 1969
(Pl. 29, Figs 1—2, 4, Pl. 30, Fig. 4, and Pl. 32, Figs 2, 4—5)

1970. *Broinsonia parca* (Stradner 1963) Bukry 1969; D. Noël, p. 77, Text-fig. 18, Pl. 23, Fig. 3 [*cum syn.*].
1970a. *Arkhangelskiella parca* Stradner 1963; P. Reinhardt, p. 16, Text-figs 24—26.
1971. *Broinsonia parca* (Stradner) Bukry; H. Manivit, p. 106, Pl. 2, Figs 1—6.
1976. *Broinsonia parca* (Stradner, 1963) Bukry, 1969; S. Shumenko, p. 37, Pl. 9, Fig. 4.
Dimensions: length 10—12 μ; width 8.5—9 μ.

Remarks. — Specimens with large central area and numerous pores assigned by Bukry to the species *B. parca* (cf. Bukry 1969, Pl. 3, Figs 8—10) seem to be quite different from the type material. In fact, similar forms have been found in the investigated material and are here regarded as a new species *B. cribrata*.

Occurrence. — Campanian to Maastrichtian of Europe (Bramlette & Martini 1964, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Shumenko 1976) and North America (Bramlette & Martini 1964, Gartner 1968, Bukry 1969).

In the study area, the species has been found abundantly in all the samples of Campanian and Early Maastrichtian age, and rarely in samples of Late Maastrichtian age.

Broinsonia cribrata sp. n.
(Pl. 33, Figs 1—6)

Holotypus: Pl. 33, Fig. 2.
Paratypus: Pl. 33, Fig. 5.
Stratum typicum: Upper Maastrichtian.
Locus typicus: Żyrzyn, western part of Lublin Upland, Central Poland.
Derivatio nominis: Latin *cribrum* — sieve; after a large number of pores in the central area.
Diagnosis: Central area vast, filled with irregular crystals; numerous pores in rows along the longer ellipse axis and around the central area at the contact with wall.
Dimensions: length 6—9 μ, width 5—7 μ.

Description. — The outline is elliptic. The wall appears typical of *Broinsonia*, as it consists of three overlapping plates, each one built up by two cycles of identical crystals. The crystals are slightly inclined clockwise. The central area is convex at the distal side and filled with irregular crystals. There are numerous pores among the latter crystals.

Remarks. — The new species differs from *B. lata* in its perforated central area. From *B. parca*, it differs in its much larger central area and thinner wall. Some specimens assigned by Bukry (1969, Pl. 3, Figs 8—10) to *B. parca* resemble closely the newly erected species.

Occurrence. — Upper Maastrichtian at Lucimia and Nasiłów and in the boreholes Żyrzyn and Podole.

Genus *GARTNERAGO* Bukry, 1969

Type species: *Gartnerago concavum* (Gartner, 1968) Bukry, 1969
Gartnerago obliquum (Stradner, 1963) Reinhardt, 1970
(Pl. 28, Figs 3—5 and Pl. 31, Fig. 1)

1963. *Arkhangelskiella obliqua* nov. spec.; H. Stradner, p. 176, Pl. 1, Fig. 2a-b.
1969. *Laffittius confossus* n. sp.; D. Noël, p. 198, Pl. 2, Fig. 5 and Pl. 3, Fig. 6.
1970b. *Gartnerago obliquum* (Stradner 1963) n. comb.; P. Reinhardt, p. 66, Text-figs 58—59.
1972. *Gartnerago obliquum* (Stradner, 1963) n. comb.; S. Forchheimer, p. 28, Pl. 4, Figs 5—6.
1973. *Gartnerago obliquum* (Stradner) Reinhardt; H. Priewalder, p. 19, Pl. 10, Figs 1—4.
1975. *Gartnerago obliquus* (Reinhardt) Noël; E. Gaździcka, p. 409, Pl. 7, Fig. 4.
Dimensions: length 6—10 μ; width 4.5—7 μ.

Remarks. — In the original diagnosis, Stradner (1963) cited a perforation of the central area among other characteristics of the investigated species. Therefore, one cannot agree with Noël (1970) considering *Arkhangelskiella concava* Gartner as a junior synonym of *G. obliquum*, since the former species displays an imperforated central area. Furthermore, imperforated forms described by Noël (1970) from the Campanian of France and assigned to *Laffittius obliquus* and *Gartnerago obliquus* are also to be attributed to another species.

Occurrence. — Hauterivian to Cenomanian of Sweden (Forchheimer 1972); Turonian to Maastrichtian of Austria (Stradner 1963, Priewalder 1973); Coniacian of France (Noël 1969).

In the study area, the species has been found uncommonly in the Upper Maastrichtian at Lucimia and Nasiłów and in the borehole Żyrzyn.

Genus *KAMPTNERIUS* Deflandre, 1959
Type species: *Kamptnerius magnificus* Deflandre, 1959
Kamptnerius magnificus Deflandre, 1959
(Pl. 29, Fig. 5 and Pl. 31, Figs 3—4)

1969. *Kamptnerius magnificus magnificus* Deflandre; D. Bukry, p. 25, Pl. 5, Figs 7—9.
1969. *Kamptnerius magnificus sculptus* Bukry, n. ssp.; D. Bukry, p. 25, Pl. 5, Figs 10—12.
1970. *Kamptnerius magnificus* Deflandre 1959; P. Čepek, p. 242, Pl. 24, Figs 5—6 and Pl. 26, Fig. 5
1970b. *Kamptnerius magnificus* Deflandre 1959; N. Hoffmann, p. 859, Pl. 7, Fig. 2.
1970. *Kamptnerius magnificus* Deflandre 1959; D. Noël, p. 82, Pl. 27, Figs 1—5 and Pl. 28, Figs 1—5 [*cum syn.*].
1970b. *Kamptnerius magnificus* Deflandre 1959; P. Reinhardt, p. 68, Text-figs 64—65, Pl. 5, Fig. 5
1971. *Kamptnerius magnificus* Deflandre; H. Manivit, p. 107, Pl. 14, Figs 10—14 and Pl. 20, Fig. 11
1971. *Kamptnerius magnificus* Deflandre; S. Shafik & H. Stradner, p. 83, Pl. 8, Figs 1—2, Pl. 9, Figs 1—2, Pl. 10, Figs 1—2, and Pl. 11, Fig. 1.
1976. *Kamptnerius magnificus* Deflandre, 1959; S. Shumenko, p. 36, Pl. 10, Figs 1—2.
Dimensions: total length up to 20 μ; elliptic-part length 10—13 μ; elliptic part width 7—10 μ.

Remarks. — The species is very easily identifiable and cosmopolitanic. Nevertheless, its biostratigraphic usefulness may be questioned. In fact, the Kamptnerius magnificus Zone recognized in North America (Čepek & Hay 1969) represents the Lower Campanian. In France, the Kamptnerius magnificus Zone (Manivit 1971) makes part of the Santonian. Moreover, the species has also been recorded in the Turonian (Reinhardt 1966, Stover 1966) and even Cenomanian (Shumenko 1976).

Occurrence. — Cenomanian to Maastrichtian of the Soviet Union (Shumenko 1976); Turonian to Maastrichtian of Europe (Deflandre 1959, Górka 1963, Bramlette & Martini 1964, Reinhardt 1966, Stover 1966, Perch-Nielsen 1966, Čepek 1970, Hoffmann 1970b, Noël 1970, Manivit 1971); Coniacian to Maastrichtian of North America (Gartner 1968, Bukry 1969, Čepek & Hay 1969); Maastrichtian of Africa (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found fairly commonly in the Campanian at Sulejów and Dorotka, and the Maastrichtian at Sadkowice, Boiska, and Lucimia and in the borehole Żyrzyn.

Kamptnerius percivalii Bukry, 1969
(Pl. 31, Fig. 2)

1969. *Kamptnerius percivalii* Bukry, n. sp.; D. Bukry, p. 25, Pl. 6, Figs 1—3.
1970b. *Kamptnerius percivalii* Bukry 1969; P. Reinhardt, p. 69, Text-fig. 66.
1971. *Kamptnerius percivalii* Bukry; S. Shafik & H. Stradner, p. 83, Pl. 11, Fig. 2.
1973. *Kamptnerius percivalii* Bukry; H. Priewalder, p. 19, Pl. 11, Figs 3, 5—6.
1975. *Kamptnerius percivalii* Bukry; E. Gaździcka, p. 409, Pl. 7, Fig. 1.
Dimensions: length 11.5—13 μ; width 7.5—9 μ.

Remarks. — The species differs from *K. magnificus* in its perforated central area and somewhat thicker wall. In its turn, *K. punctatus* Stradner exhibits more numerous and smaller pores irregularly distributed.

Occurrence. — Campanian of Texas (Bukry 1969); Upper Maastrichtian of Austria (Priewalder 1973) and Egypt (Shafik & Stradner 1971).

In the study area, a few specimens have been found in the Upper Maastrichtian of the borehole Żyrzyn

Family Stephanolithionaceae Black, 1968
Genus *STEPHANOLITHION* Deflandre, 1939
Type species: *Stephanolithion bigoti* Deflandre, 1939
Stephanolithion laffittei Noël, 1956

1970. *Stephanolithion laffittei* Noël 1956; D. Noël, p. 85, Pl. 29, Figs 1—11 and Pl. 31, Fig. 4 [*cum syn.*].
1971. *Stephanolithion laffittei* Noël: H. Manivit, p. 108, Pl. 23, Figs 14—18.
1971. *Stephanolithion laffittei* Noël 1957; P. Reinhardt, p. 28, Text-figs 20—21.
1972. *Stephanolithion laffittei* Noël, 1957; P. Roth & H. Thierstein, Pl. 16, Figs 6—11.
1973. *Stephanolithion laffittei* Noël; H. Priewalder, p. 25, Pl. 6, Fig. 2.
1976. *Stephanolithion laffittei* Noël, 1957; S. Shumenko, p. 67, Pl. 25, Figs 7—9.
Dimensions: diameter 4.5—5.5 μ.

Remarks. — The specific features of *S. laffittei* are its cylindric wall with some short processes pointing outwards, and 8 radial bars in the central area.

Occurrence. — Portlandian of Algeria (Noël 1965); Berriasian to Maastrichtian of Europe (Bramlette & Martini 1964, Reinhardt 1966, Noël 1970, Manivit 1971, Priewalder 1973, Thierstein 1973, Shumenko 1976); Aptian to Campanian of the Atlantic (Roth & Thierstein 1972); Coniacian to Maastrichtian of North America (Gartner 1968, Bukry 1969).

In the study area, some specimens have been found in the Campanian at Sulejów, and the Upper Maastrichtian of the borehole Żyrzyn.

Genus *COROLLITHION* Stradner, 1961
Type species: *Corollithion exiguum* Stradner, 1961
Corollithion exiguum Stradner, 1961
(Pl. 34, Figs 1—2)

1969. *Corollithion exiguum* Stradner; D. Bukry, p. 40, Pl. 16, Fig. 12 and Pl. 19, Fig. 1 [*cum syn.*].
1970*b*. *Corollithion exiguum* Stradner 1961; P. Reinhardt, p. 44, Text-fig. 3.
1971. *Corollithion exiguum* Stradner; H. Manivit, p. 109, Pl. 5, Figs 1—3.
1971. *Corollithion exiguum* Stradner; S. Shafik & H. Stradner, p. 81, Pl. 46, Figs 1—4 and Pl. 47, Fig. 1.
1973. *Corollithion exiguum* Stradner; H. Priewalder, p. 16, Pl. 6, Fig. 1.
1976. *Corollithion exiguum* Stradner, 1961; S. Shumenko, p. 68, Pl. 26, Fig. 8.
Dimensions: diameter 4—6 μ.

Remarks. — The specific feature of *C. exiguum* is its hexagonal outline.

Occurrence. — Turonian to Maastrichtian of Europe (Reinhardt 1966, Manivit 1971, Priewalder 1973, Shumenko 1976); Coniacian to Maastrichtian of North America (Bramlette & Martini 1964, Gartner 1968, Bukry 1969); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found in the Maastrichtian at Sadkowice, Lucimia, and Nasiłów and in the borehole Żyrzyn.

Corollithion rhombicum (Stradner & Adamiker, 1966) Bukry, 1969
(Pl. 34, Fig. 3)

1966. *Zygolithus rhombicus* Stradner & Adamiker; Stradner & *al.*, p. 40, Pl. 37, Figs 5—7 and Pl. 38.
1969. *Corollithion rhombicum* (Stradner & Adamiker) Bukry, n. comb.; D. Bukry, p. 41, Pl. 19, Figs 2—4.
1973. *Corollithion rhombicum* (Stradner & Adamiker, 1966) Bukry, 1969; H. Thierstein, p. 43, Pl. 4, Fig. 3.
1976. *Corollithion rhombicum* (Stradner & Adamiker) Bukry; D. Burns, p. 283, Pl. 2, Fig. 5.
1976. *Corollithion rhombicum* (Stradner & Adamiker, 1966) Bukry, 1969; S. Shumenko, p. 69, Pl. 26, Fig. 9.
Dimensions: length 3—4 μ; width 2—3μ.

Remarks. — The specific feature of *C. rhombicum* is its elongate rhomboidal outline.

Occurrence. — Aptian to Maastrichtian of Europe (Stradner & *al.* 1966, Manivit 1971, Priewalder 1973, Thierstein 1973, Burns 1976, Shumenko 1976); Coniacian to Campanian of North America (Bukry 1969); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, a few specimens have been found in the Lower Maastrichtian at Solec, and the Upper Maastrichtian at Lucimia and in the borehole Żyrzyn.

Family Coccolithaceae Kamptner, 1928
Genus *BISCUTUM* Black, 1959
Type species: *Biscutum constans* (Górka, 1957) Black, 1967
Biscutum constans (Górka, 1957) Black, 1967
(Pl. 38, Figs 1—5)

1970. *Biscutum constans* (Górka 1957) Black 1959; D. Noël, p. 91, Pl. 24, Fig. 1 and Pl. 32, Figs 1—10 [*cum syn.*].
1970a. *Biscutum melaniae* (Górka 1957) Reinhardt 1969; P. Reinhardt, p. 19, Text-figs 32—34, Pl. 1, Figs 7—8.
1971. *Biscutum testudinarium* Black; H. Manivit, p. 113, Pl. 3, Figs 6—12.
1971. *Biscutum constans* (Górka) Black; S. Shafik & H. Stradner, p. 81, Pl. 2.
1973. *Biscutum constans* (Górka) Black; H. Priewalder, p. 15 Pl. 5, Figs 1—3.
1976. *Biscutum constans;* D. Burns, p. 281, Pl. 1, Figs 3—4.
1976. *Biscutum constans* (Górka, 1957) Black, 1967; S. Shumenko, p. 33, Pl. 6, Fig. 8.
Dimensions: length 6—9 μ; width 5—7 μ.

Remarks. — The specific feature of *B. constans* is a radial arrangement of lamellae contributing to the shields, with larger elements occurring at the ellipse ends. The present author follows Perch-Nielsen (1968) and Noël (1970) in regarding *B. testudinarium* Black as a junior synonym of *B. constans*. *B. castrorum* Black is also assigned to the same species (*cf.* Bukry 1969), as there are specimens (Pl. 38, Fig. 2) intermediate in element number between those typical of *B. castrorum* and *B. constans*.

Occurrence. — Aptian to Cenomanian of the Eastern Atlantic (Roth & Thierstein 1972); Aptian to Maastrichtian of Europe (Górka 1957, Black 1959, Reinhardt 1964, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Priewalder 1973, Burns 1976, Shumenko 1976); Coniacian to Campanian of North America (Bukry 1969); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found in all the samples of Campanian and Maastrichtian age, and in most samples of Paleocene age.

Biscutum ignotum (Górka, 1957) Reinhardt & Górka, 1967
(Pl. 34, Figs 4, 6)

1957. *Tremalithus ignotus* n. sp.; H. Górka, p. 248, Pl. 2, Fig. 9.
1957. *Tremalithus postremus* n. sp.; H. Górka, p. 248, Pl. 2, Fig. 10.
1965. *Biscutum tredenale* n. sp.; P. Reinhardt, p. 32, Pl. 1, Fig. 3.
1966. *Biscutum tredenale* Reinhardt 1965; P. Reinhardt, p. 31, Text-fig. 13, Pl. 2, Fig. 3*a-b*.
1967. *Biscutum ignotum* (Górka 1957)) n. comb. et emend.; P. Reinhardt & H. Górka, p. 245, Pl. 31, Figs 9, 13.
1968. *Discorhabdus ignotus* (Górka 1957) n. comb.; K. Perch-Nielsen (partim), p. 81, Text-figs 41—42, Pl. 28, Figs 6, 9, non Figs 7—8.
1969. *Bidiscus rotatorius* Bukry, n. sp.; D. Bukry, p. 27, Pl. 7, Figs 5—9.
1970a. *Biscutum ignotum* (Górka 1957) Reinhardt & Górka 1967; P. Reinhardt, p. 18, Text-figs 30—31, Pl. 1, Figs 1—4, 6.
1971. *Discorhabdus ignotus* (Górka) Perch-Nielsen; H. Manivit, p. 112, Pl. 3, Figs 1—7.
1971. *Biscutum testudinarium* Black; S. Shafik & H. Stradner, p. 81, Pl. 3, Figs 1—2 and Pl. 4, Fig. 1.
1973. *Biscutum ignotum* (Górka) Reinhardt & Górka; H. Priewalder, p. 16, Pl. 5, Figs 4—8.
1976. *Bidiscus gorkae;* D. Burns, p. 280, Pl. 1, Fig. 2.
1976. *Discorhabdus ignotus* (Górka, 1957) Perch-Nielsen, 1968; S. Shumenko, p. 77, Pl. 20, Figs 6—8
Dimensions: diameter 4.5—6 μ

Remarks. — The genus *Biscutum* Black, as originally diagnosed, includes coccoliths elliptic and circular in outline as well; the generic diagnostic feature is structural similarity of all the shields of a specimen. Hence, there is no reason to accept the genus *Bidiscus* Bukry erected for circular coccoliths.

The investigated species cannot be assigned to the genus *Discorhabdus* Noël including Jurassic coccoliths with a tube-like central process and a central opening; whereas some authors did so (Perch-Nielsen 1968, Manivit 1971, Shumenko 1976). In fact, most Upper Cretaceous specimens are imperforated, and no central process has been ever recorded.

The species *Bidiscus gorkae* described by Burns (1976) is here considered as a junior synonym of *Biscutum constans*, since that author did not give any diagnosis or even description of the species, while the only illustration given appears identical to the latter species.

Occurrence. — Aptian to Maastrichtian of Europe (Górka 1957, Reinhardt 1966, Perch-Nielsen 1968, Manivit 1971, Priewalder 1973, Burns 1976, Shumenko 1976); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found uncommonly in the Campanian at Sulejów and Dorotka, and the Maastrichtian at Lipsko, Dziurków, Lucimia, and Kazimierz, and in the borehole Żyrzyn.

Biscutum cruciatum (Bukry, 1969) Reinhardt, 1970

1969. *Bidiscus cruciatus cruciatus* Bukry, n. sp., n, ssp.; D. Bukry, p. 27, Pl. 6, Figs 10—11.
1969. *Bidiscus cruciatus multicruciatus* Bukry, n. sp., n. ssp.; D. Bukry, p. 27, Pl. 6, Fig. 12 and Pl. 7, Figs 1—2.
1970. *Discorhabdus ignotus* (Górka 1957) Perch-Nielsen 1968; D. Noël, p. 87, Text-fig. 21, Pl. 32. Figs 1—7, 9—10, 14—16.
1970a. *Biscutum cruciatum* (Bukry 1969) n. comb.; P. Reinhardt, p. 18, Text-fig. 29.
1976. *Discorhabdus cruciatus* (Bukry, 1969) Shumenko, 1971; S. Shumenko, p. 76, Pl. 29, Figs 3—5.
Dimensions: diameter 3.5—5 μ.

Remarks. — The species differs from *B. ignotum* in its cross-like structure situated in the center of distal shield, composed of four small crystals. The Campanian specimens from France described by Noël (1970) display this specific feature.

Occurrence. — Turonian to Maastrichtian of the Soviet Union (Shumenko 1976); Santonian to Campanian of Texas (Bukry 1969); Campanian of France (Noël 1970).

In the study area, some specimens have been found in the Campanian at Sulejów and Dorotka, and the Upper Maastrichtian at Lucimia.

Genus *WATZNAUERIA* Reinhardt, 1964
Type species: *Watznaueria barnesae* (Black, 1959) Perch-Nielsen, 1968
Watznaueria barnesae (Black, 1959) Perch-Nielsen, 1968
(Pl. 35, Figs 3—6)

1959. *Tremalithus barnesae* sp. nov.; M. Black in M. Black & B. Barnes, p. 325, Pl. 9, Figs 1—2.
1964. *Watznaueria angustoralis* n. sp.; P. Reinhardt, p. 753, Text-fig. 4, Pl. 2, Fig. 2.
1968. *Coccolithus barnesae* (Black); S. Gartner, p. 17, Pl. 1, Fig. 12, Pl. 4, Figs 6—7, Pl. 8, Figs 18—22, Pl. 11, Fig. 11, Pl. 14, Figs 4—5, Pl. 15, Fig. 8, Pl. 16, Figs 15—16, Pl. 19, Fig. 12, Pl. 20, Figs 12—13, Pl. 22, Figs 16—17, Pl. 24, Fig. 8, and Pl. 25, Figs 1—2.
1968. *Watznaueria barnesae* (Black 1959) n. comb.; K. Perch-Nielsen, p. 69, Text-fig. 32, Pl. 22, Figs 1—7 and Pl. 23, Figs 1, 4—5, 16.
1968. *Coccolithus barnesae* (Black) Bramlette & Martini; H. Stradner & *al.*, p. 24, Text-fig. 8, Pl. 1 and Pl. 2, Figs 1—5.
1973. *Watznaueria barnesae* (Black) Perch-Nielsen; H. Priewalder, p. 27, Pl. 14, Figs 3—6.
1976. *Watznaueria barnesae* (Black) Bukry; D. Burns, p. 298, Pl. 5, Figs 4—8.
1976. *Watznaueria barnesae* (Black, 1959) Perch-Nielsen, 1968; S. Shumenko, p. 24, Pl. 1, Figs 1—6 and Pl. 2, Figs 1—2.
Dimensions: length 5—7 μ; width 4.5—6.5 μ.

Remarks: — There is an intraspecific variability in the form of central area in the investigated species, since a cycle of small grains may occur at the level of the main cycle or a little below the latter; in the latter case, the central area forms a depression (Pl. 35, Fig. 4).

Occurrence. — Hauterivian to Maastrichtian of Europe (Black 1959, Reinhardt 1964, Perch-Nielsen 1968, Stradner & *al.* 1968, Noël 1970, Macivit 1971, Priewalder 1973, Burns 1976, Shumenko 1976); Cenomanian to Maastrichtian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found in all the samples of Campanian and Maastrichtian age.

Watznaueria dentata (Shumenko, 1969) Shumenko, 1976
(Pl. 35, Fig. 1)

1969. *Coccolithites dentatus* Shumenko, sp. nov.; S. Shumenko, p. 12, Pl. 2, Fig. 10.
1976. *Watznaueria dentata* (Shumenko, 1969) comb. nov.; S. Shumenko, p. 26, Pl. 4, Fig. 1.
Dimensions: length 3—4 μ; width 2.5—3 μ.

Remarks. — The investigated species is quite different from all the other representatives of the genus. In fact, it appears unique among all other calcareous nannoplanktic genera. Nevertheless, the present author follows Shumenko (1976) in generic assignment of the species, since the investigated material is too small to permit more detailed studies.

Occurrence. — Turonian of Donets Basin, Soviet Union (Shumenko 1969, 1976).

In the study area, a few specimens have been found in the Maastrichtian of the borehole Żyrzyn.

Genus *MARKALIUS* Bramlette & Martini, 1964, emend. Perch-Nielsen, 1968

Type species: *Markalius inversus* (Deflandre, 1954) Bramlette & Martini, 1964

Markalius circumradiatus (Stover, 1966) Perch-Nielsen, 1968
(Pl. 36, Figs 1—4)

1966. *Coccolithites circumradiatus* Stover, n. sp.; L. Stover, p. 138, Pl. 5, Figs 2—4 and Pl. 9, Fig. 10.
1968. *Markalius circumradiatus* (Stover 1966) n. comb.; K. Perch-Nielsen, p. 73, Text-figs 36—37, Pl. 25, Figs 2—7 and Pl. 28, Figs 1—7.
1970. *Markalius circumradiatus* (Stover 1966) Perch-Nielsen 1968; D. Noël, p. 93, Pl. 36, Figs 1—7.
1971. *Markalius circumradiatus* (Stover) Perch-Nielsen; H. Manivit, p. 116, Pl. 26, Figs 1—5.
1973. *Markalius circumradiatus* (Stover) Perch-Nielsen; H. Priewalder, p. 20, Pl. 14, Figs 1—2.
Dimensions: diameter 5.5—6 μ.

Remarks. — The present author follows Perch-Nielsen (1968) and Noël (1970) in assigning coccoliths composed of two circular and closely attached shields, each one consisting of ca 30 elongate crystals inclined counterclockwise, and displaying a small central area filled up with small radially arranged crystals, to the species *M. circumradiatus*. Nevertheless, the identification of those forms studied under electron microscope with the holotype described by Stover (1966) after light-microscope studies may appear but tentative.

Occurrence. — Albian to Campanian of France (Stover 1966, Noël 1970); Maastrichtian of Denmark (Perch-Nielsen 1968) and Austria (Priewalder 1973).

In the study area, the species has been found in the Campanian at Cieszyca, the Maastrichtian at Ożarów, Kazimierz, Nasiłów, and Żyrzyn, and the Paleocene at Rzeczyca.

Markalius inversus (Deflandre, 1954) Bramlette & Martini, 1964
(Pl. 37, Figs 1—4)

1964. *Markalius inversus* (Deflandre); M. Bramlette & E. Martini, p. 302, Pl. 2, Figs 4—9 and Pl. 7, Fig. 2a-b.
1967. *Markalius astroporus* (Stradner); W. Hay & H. Mohler, p. 1528, Pl. 196, Figs 32—35 and Pl. 198, Figs 2, 6.
1968. *Markalius inversus* (Deflandre 1954) Bramlette & Martini 1964; K. Perch-Nielsen, p. 72, Text-fig. 35, Pl. 24, Figs 1—6 and Pl. 25, Fig. 1.
1969a. *Markalius inversus* (Deflandre, 1954) Bramlette & Martini 1964; K. Perch-Nielsen, p. 63, Pl. 3, Figs 5—6.
1969b. *Markalius inversus* (Deflandre 1954) Bramlette & Martini 1964; K. Perch-Nielsen, p. 326, Text-fig. 5.
1970b. *Markalius rotaclypeatus* (Bukry 1969) n. comb.; P. Reinhardt, p. 76, Text-fig. 83.
1971. *Markalius astroporus* (Stradner) Hay & Mohler; H. Manivit, p. 116, Pl. 16, Figs 1—4.
1971. *Markalius inversus* (Deflandre) Bramlette & Martini; S. Shafik & H. Stradner, p. 84, Pl. 3, Figs 3—4.
1973. *Markalius inversus* (Deflandre) Bramlette & Martini; H. Priewalder, p. 20, Pl. 13, Figs 3—4.
1977. *Markalius inversus* (Deflandre) Bramlette & Martini; S. Jafar, Figs 2—3a-d, 3—1a-d, 3—3a-d
Dimensions: diameter 4.8—7 μ.

Remarks. — The proximal and distal shields consist each of three cycles of calcite elements, two internal cycles forming a wide central area. The external-cycle elements are oblique relative to the coccolith plane and inclined clockwise. The crystals are differentially oriented optically among the cycles.

Occurrence. — Upper Maastrichtian of Europe (Perch-Nielsen 1968, Manivit 1971, Shafik & Stradner 1971, Priewalder 1973); Paleocene of Europe, Africa, and North America (Bramlette & Martini 1964; Hay & Mohler 1967; Perch-Nielsen 1969a, b; Manivit 1971; Jafar 1977); Eocene of Caucasus (Hay & al. 1966).

In the study area, the species has been found in the Upper Maastrichtian at Kazimierz and Nasiłów and in the borehole Żyrzyn, and in the Paleocene at Nasiłów, Parchatka, Rzeczyca, and Witoszyn, and in the borehole Zemborzyce.

Genus *MANIVITELLA* Thierstein, 1971

Type species: *Manivitella pemmatoidea* (Deflandre *ex* Manivit, 1965) Thierstein, 1971

Manivitella pemmatoidea (Deflandre *ex* Manivit, 1965) Thierstein, 1971 (Pl. 6, Fig. 1)

1971. *Cricolithus? pemmatoideus* Deflandre; H. Manivit, p. 120, Pl. 9, Figs 8—9 and Pl. 10, Figs 1—5.
1971. *Manivitella pemmatoidea* (Deflandre ex Manivit 1965) n. comb.; H. Thierstein, p. 490, Pl. 5, Figs 1—3.
1972. *Manivitella pemmatoidea* (Deflandre ex Manivit, 1965) Thierstein, 1971; P. Roth & H. Thierstein, Pl. 11, Figs 6—13.
Dimensions: length 9—12 μ; width 7—10 μ.

Occurrence. — Berriasian to Maastrichtian of France (Manivit 1971, Thierstein 1971); Valanginian to Cenomanian of the Western Atlantic (Roth & Thierstein 1972).

In the study area, the species has been found in all the samples of Campanian age, and in the Maastrichtian of the borehole Żyrzyn.

Genus *CHIASMOLITHUS* Hay, Mohler & Wade, 1966

Type species: *Chiasmolithus camaruensis* (Deflandre, 1954) Hay, Mohler & Wade, 1966

Chiasmolithus danicus (Brotzen, 1959) Hay & Mohler, 1967

1964. *Coccolithus danicus* (Brotzen); M. Bramlette & E. Martini, p. 298, Pl. 1, Figs 15—16.
1967. *Chiasmolithus danicus* (Brotzen); W. Hay & H. Mohler, p. 1526, Pl. 196, Figs 16, 21—22 and Pl. 198, Figs 8, 12—13.
1969a. *Chiasmolithus danicus* (Brotzen, 1959) Hay et *al.*, 1966; K. Perch-Nielsen, p. 58, Pl. 1, Figs 1—4 and Pl. 7, Figs 11—12.
1969b. *Chiasmolithus danicus* (Brotzen 1959) Hay et *al.* 1966; K. Perch-Nielsen, p. 321, Pl. 33, Figs 1—2.
1971. *Chiasmolithus danicus* (Brotzen) Hay & Mohler; H. Manivit, p. 118, Pl. 12, Figs 3—4.
Dimensions: length 7—9 μ; width 5.5—7.5 μ.

Remarks. — The central structure resembles that of the Upper Cretaceous genus *Chiastozygus* Gartner but the wall structure appears quite different.

Occurrence. — Danian of Europe (Hay & Mohler 1967; Perch-Nielsen 1969*a*, *b*; Manivit 1971), New Zealand (Edwards 1966), Tunisia, and the United States (Bramlette & Martini 1964).

In the study area, some specimens have been found in the Paleocene at Nasiłów and Rzeczyca.

Genus *CRUCIPLACOLITHUS* Hay & Mohler, 1967

Type species: *Cruciplacolithus tenuis* (Stradner, 1961) Hay & Mohler, 1967

Cruciplacolithus tenuis (Stradner, 1961) Hay & Mohler, 1967

1964. *Coccolithus helis* Stradner; M. Bramlette & E. Martini, p. 298, Pl. 1, Figs 10—12 and Pl. 7, Figs 5—6.
1967. *Cruciplacolithus tenuis* (Stradner); W. Hay & H. Mohler, p. 1527, Pl. 196, Figs 29—31 and Pl. 198, Figs 1, 17.
1969a. *Cruciplacolithus tenuis* (Stradner, 1961) Hay et Mohler 1967; K. Perch-Nielsen, p. 59, Pl. 1, Figs 7—8.
1969b. *Cruciplacolithus tenuis* (Stradner 1961) Hay et Mohler 1967; K. Perch-Nielsen, p. 323, Pl. 34, Figs 1—7.
1971. *Cruciplacolithus tenuis* (Stradner) Hay & Mohler; H. Manivit, p. 118, Pl. 12, Figs 1—2.
Dimensions: length 7—10 μ; width 6—8 μ.

Occurrence. — Danian of Europe (Hay & Mohler 1967; Perch-Nielsen 1969*a*, *b*; Manivit 1971), New Zealand (Edwards 1966), North America, and Africa (Bramlette & Martini 1964).

In the study area, a few specimens have been found in the Paleocene at Nasiłów and Rzeczyca.

Family **Prinsiaceae** Hay & Mohler, 1967
Genus *ERICSONIA* Black, 1964
Type species: *Ericsonia occidentalis* Black, 1964
Ericsonia cava (Hay & Mohler, 1967) Perch-Nielsen, 1969
(Pl. 39, Figs 1—2, 4)

1967. *Coccolithus cavus* n. sp.; W. Hay & H. Mohler, p. 1524, Pl. 196, Figs 1—3 and Pl. 197, Figs 5, 7, 10, 12.
1969*a*. *Ericsonia cava* Hay & Mohler, 1967; K. Perch-Nielsen, p. 61, Pl. 2, Figs 7—8.
1971. *Ericsonia cava* (Hay & Mohler) Perch-Nielsen; H. Manivit, p. 121, Pl. 12, Figs 10—11.
1975. *Ericsonia cava* (Hay et Mohler 1967) Perch-Nielsen 1970; H. Bystricka, p. 45, Pl. 43, Figs 1—2, Pl. 44, Fig. 1, and Pl. 45, Fig. 3.
Dimensions: length 6—9 μ; width 4.5—7μ.

Remarks. — The central area of distal shield forms a vast depression filled up with calcitic lamellae or irregular grains. There is a small elliptic opening in the center of the shield.

Occurrence. — Paleocene of Europe (Hay & Mohler 1967, Perch-Nielsen 1969*a*, Manivit 1971, Bystricka 1975).

In the study area, the species has been found in the Paleocene at Rzeczyca and Parchatka.

Family **Eprolithaceae** Black, 1973
Genus *RHOMBOGYRUS* Black, 1973
Type species: *Rhombogyrus caliciformis* Black, 1973
Rhombogyrus cf. *caliciformis* Black, 1973
(Pl. 34, Fig. 5)

Dimensions: diameter 11 μ; height 2 μ.

Description. — The shape is of a shallow calyx with nonagonal base. The wall consists of 9 closely attached elements. The basal plate consists of 9 rhomboedric elements radially arranged and overlapping counterclockwise. There is a small opening in the center of the basal plate.

Remarks. — The investigated specimens are twice as large as the holotype. Furthermore, the wall appears somewhat more massive than in the original material described by Black (1973).

Occurrence. — The species itself has been recorded in the Albian to Cenomanian of England (Black 1973).

A few investigated specimens have been found in the Paleocene of the borehole Zemborzyce (possibly, they are redeposited).

Genus *LITHASTRINUS* Stradner, 1962
Type species: *Lithastrinus grilli* Stradner, 1962
Lithastrinus floralis Stradner, 1962

1968. *Lithastrinus floralis* Stradner; S. Gartner, p. 47, Pl. 21, Fig. 13, Pl. 22, Figs 28—29, and Pl. 24, Fig. 12.
1968. *Lithastrinus floralis* Stradner; H. Stradner & *al.*, p. 42, Pl. 42.
1969. *Lithastrinus floralis* Stradner; D. Bukry, p. 43, Pl. 21, Figs 1—3.
1970*b*. *Lithastrinus floralis* Stradner 1962*b*; P. Reinhardt, p. 71, Text-figs 69—70.
1971. *Lithastrinus floralis* Stradner; H. Manivit, p. 139, Pl. 15, Figs 3, 7, 7—11, 15—16.
1971. *Lithastrinus floralis* Stradner 1962; H. Thierstein, p. 481, Pl. 7, Figs 1—5.
1976. *Lithastrinus floralis* Stradner, 1962; S. Shumenko, p. 67, Pl. 26, Figs 2—4.
Dimensions: diameter 5—6 μ.

Remarks. — The specific feature of *L. floralis* is its *H*-shaped outline in lateral view.

Occurrence. — Aptian to Maastrichtian of Europe (Stover 1966, Stradner & *al.* 1968, Manivit 1971, Thierstein 1971, Shumenko 1976); Turonian to Campanian of North America (Gartner 1968, Bukry 1969).

In the study area, some specimens have been found in the Campanian at Sulejow and Dorotka, and the Maastrichtian of the borehole Żyrzyn.

Family **Thoracosphaeraceae** Schiller, 1930
Genus *THORACOSPHAERA* Kamptner, 1927
Type species: *Thoracosphaera pelagica* Kamptner, 1927
Thoracosphaera deflandrei Kamptner, 1956
(Pl. 41, Fig. 3)

1956. *Thoracosphaera Deflandrei* nov. spec.; E. Kamptner, p. 448, Figs 1—4.
1961. *Thoracosphaera deflandrei* Kamptner; H. Stradner, p. 84, Text-fig. 74.
1967. *Thoracosphaera deflandrei* Kamptner; W. Hay & H. Mohler, p. 1534, Pl. 203, Fig. 8.
1968. *Thoracosphaera deflandrei* Kamptner; A. Radomski, p. 577, Pl. 43, Fig. 22.
1971. *Thoracosphaera deflandrei* Kamptner; H. Manivit, p. 122, Pl. 30, Figs 6—7.
Dimensions: diameter 9—18 μ.

Remarks. — The wall elements are fairly regular and densely packed.

Occurrence. — Aptian to Albian and Paleocene to Eocene of France (Kamptner 1956, Hay & Mohler 1967, Manivit 1971); Paleocene to Eocene of Polish West Carpathians (Radomski 1968).

In the study area, the species has been found in the Paleocene of the boreholes Podole and Zemborzyce.

Thoracosphaera operculata Bramlette & Martini, 1964
(Pl. 41, Figs 2, 4)

1964. *Thoracosphaera operculata* Bramlette & Martini, n. sp.; M. Bramlette & E. Martini, p. 305, Pl. 5, Figs 3—7.
1969b. *Thoracosphaera operculata* Bramlette & Martini 1964; K. Perch-Nielsen, p. 330, Pl. 34, Fig. 9.
1977. *Thoracosphaera operculata* Bramlette & Martini; S. Jafar, Fig. 2—1a-d.
Dimensions: diameter 12—20 μ.

Remarks. — The wall is built up by numerous, circular perforated elements closely attached one to another; the aperture is encircled by an imperforate rim consisting of small irregular elements.

Occurrence. — Danian of Denmark, France, Tunisia, the United States (Bramlette & Martini 1964), and Germany (Perch-Nielsen 1969b).

In the study area, the species has been found in the uppermost Maastrichtian (Żyrzyn Beds) and Paleocene of the boreholes Żyrzyn and Zemborzyce.

Thoracosphaera saxea Stradner, 1961
(Pl. 40, Figs 1—2)

1961. *Thoracosphaera saxea* nov. spec.; H. Stradner, p. 84, Text-fig. 71.
1967. *Thoracosphaera saxea* Stradner; W. Hay & H. Mohler, p. 1534, Pl. 203, Fig. 5.
1968. *Thoracosphaera saxea* Stradner; A. Radomski, p. 577, Pl. 43, Fig. 21.
1977. *Thoracosphaera saxea* Stradner; S. Jafar, Fig. 2—2a-d.
Dimensions: diameter 25—80 μ.

Remarks. — Spherical form composed of numerous, irregular, densely packed elements. The sutures among structural elements are zigzak-like, and the wall surface is rough. No aperture has been ever observed.

Occurrence. — Paleocene of Austria (Stradner 1961), France (Hay & Mohler 1967), and North America (Jafar 1977); Paleocene to Eocene of Polish West Carpathians (Radomski 1968).

In the study area, the species has been found in the Paleocene at Rzeczyca.

Thoracosphaera longiuscula sp. n.
(Pl. 40, Figs 3—4 and Pl. 41, Fig. 1)

Holotypus: Pl. 41, Fig. 1.
Paratypus: Pl. 40, Fig. 4.
Stratum typicum: Paleocene.
Locus typicus: Zemborzyce, western part of the Lublin Upland, Central Poland.

Derivatio nominis: Latin *longiusculus* — fairly long; after elongate outline.
Diagnosis: Cylindric shape with rounded ends; wall consisting of numerous, densely packed polygonal elements.
Dimensions: length 12—16 μ; width 4—6 μ.

Description. — The shape is cylindric with rounded ends. The wall consists of numerous, polygonal, densely packed elements ca 0.5 μ in diameter. No aperture has been observed.

Remarks. — The new species resembles *T. deflandrei* in both the shape and arrangement of structural elements but the general shape of specimens appears quite differential.

Occurrence. — Campanian at Sulejów, Lower Maastrichtian of the borehole Ożarów, Paleocene of the borehole Zemborzyce.

Family **Braarudosphaeraceae** Deflandre, 1947
Genus *BRAARUDOSPHAERA* Deflandre, 1947
Type species: *Braarudosphaera biegelowi* (Gran & Braarud, 1935) Deflandre, 1947
Braarudosphaera bigelowi (Gran & Braarud, 1935) Deflandre, 1947
(Pl. 44, Figs 1—3)

1954. *Braarudosphaera bigelowi* (Gran et Braarud) Defl.; G. Deflandre & C. Fert, p. 51, Pl. 10, Figs 8—13 and Pl. 13, Figs 7—9.
1968. *Braarudosphaera bigelowi* (Gran & Braarud); S. Gartner, p. 45, Pl. 4, Fig. 5, Pl. 15, Fig. 3, Pl. 16, Fig. 9, Pl. 19, Fig. 7, Pl. 20, Fig. 4, and Pl. 21, Fig. 8.
1968. *Braarudosphaera bigelowi* (Gran & Braarud 1935) Deflandre 1947; K. Perch-Nielsen, p. 85, Pl. 32, Figs 1—8.
1969. *Braarudosphaera bigelowi bigelowi* (Gran & Braarud) Deflandre; D. Bukry, p. 62, Pl. 36, Figs 11—12.
1971. *Braarudosphaera bigelowi* (Gran & Braarud) Deflandre; H. Manivit, p. 125, Pl. 3, Figs 13—14, 16.
1976. *Braarudosphaera bigelowi* (Gran et Braarud, 1935) Deflandre, 1947; S. Shumenko, p. 70, Pl. 27, Fig. 2.
Dimensions: diameter 7—15 μ.

Remarks. — The investigated species is regular pentagonal in outline, built up by 5 identical rhomboidal plates closely attached one to another. The sutures are straight and distinct at both sides of a coccolith.

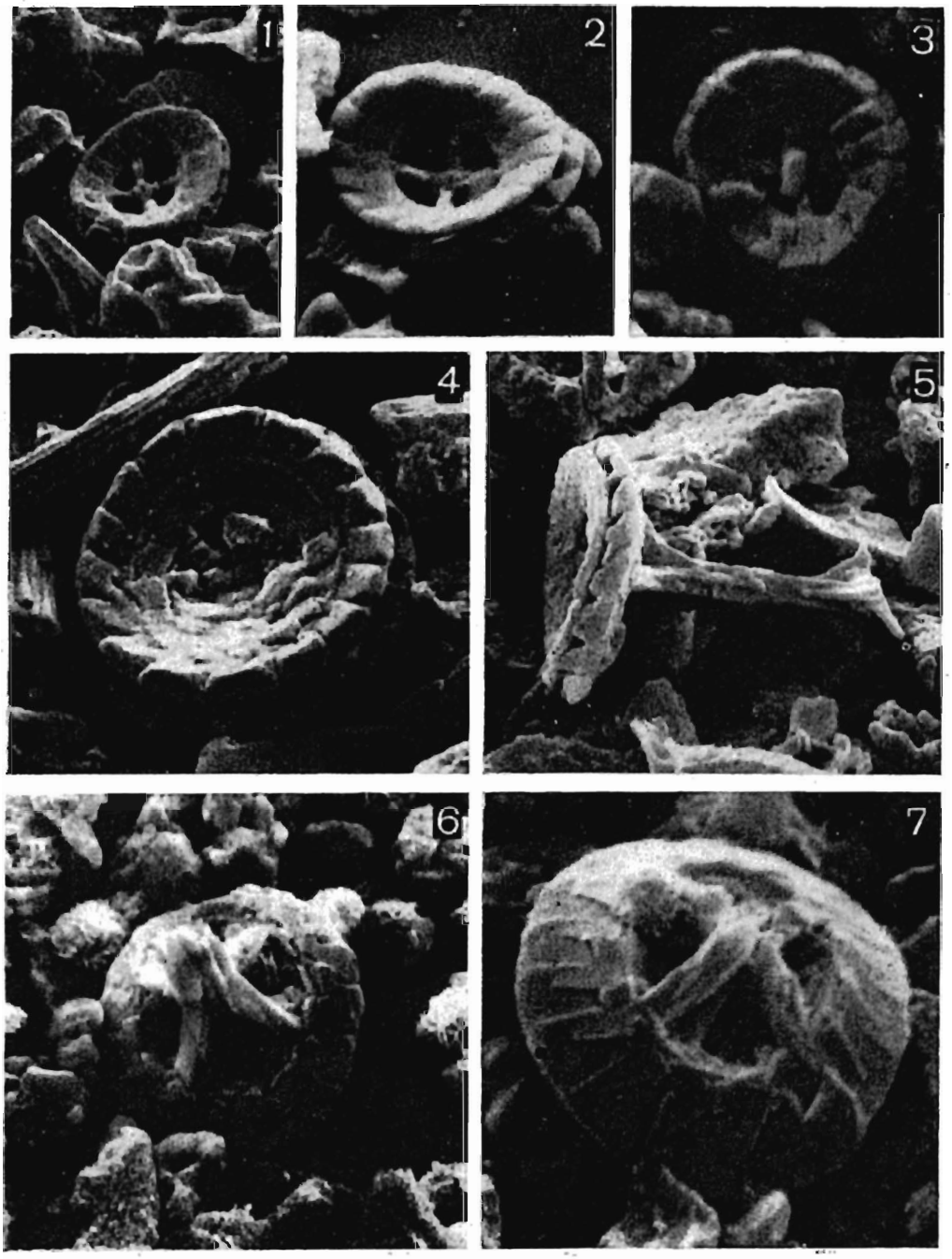
Occurrence. — Cretaceous (Górka 1963, Perch-Nielsen 1968, Manivit 1971, Thierstein 1973, Shumenko 1976) and Tertiary of Europe (Deflandre & Fert 1954, Hay & Mohler 1967, Radomski 1968, Perch-Nielsen 1969b); Santonian to Maastrichtian (Gartner 1968, Bukry 1969) and Paleogene of North America (Bramlette & Sullivan 1961, Sullivan 1964).

In the study area, the species has been found rarely in the Campanian and Maastrichtian at Dorotka, Pawłowice, Kaliszany, and Nasiłów, and commonly in all the samples of Paleocene age.

Genus *BIANTHOLITHUS* Bramlette & Martini, 1964
Type species: *Biantholithus sparsus* Bramlette & Martini, 1964
Biantholithus sparsus Bramlette & Martini, 1964

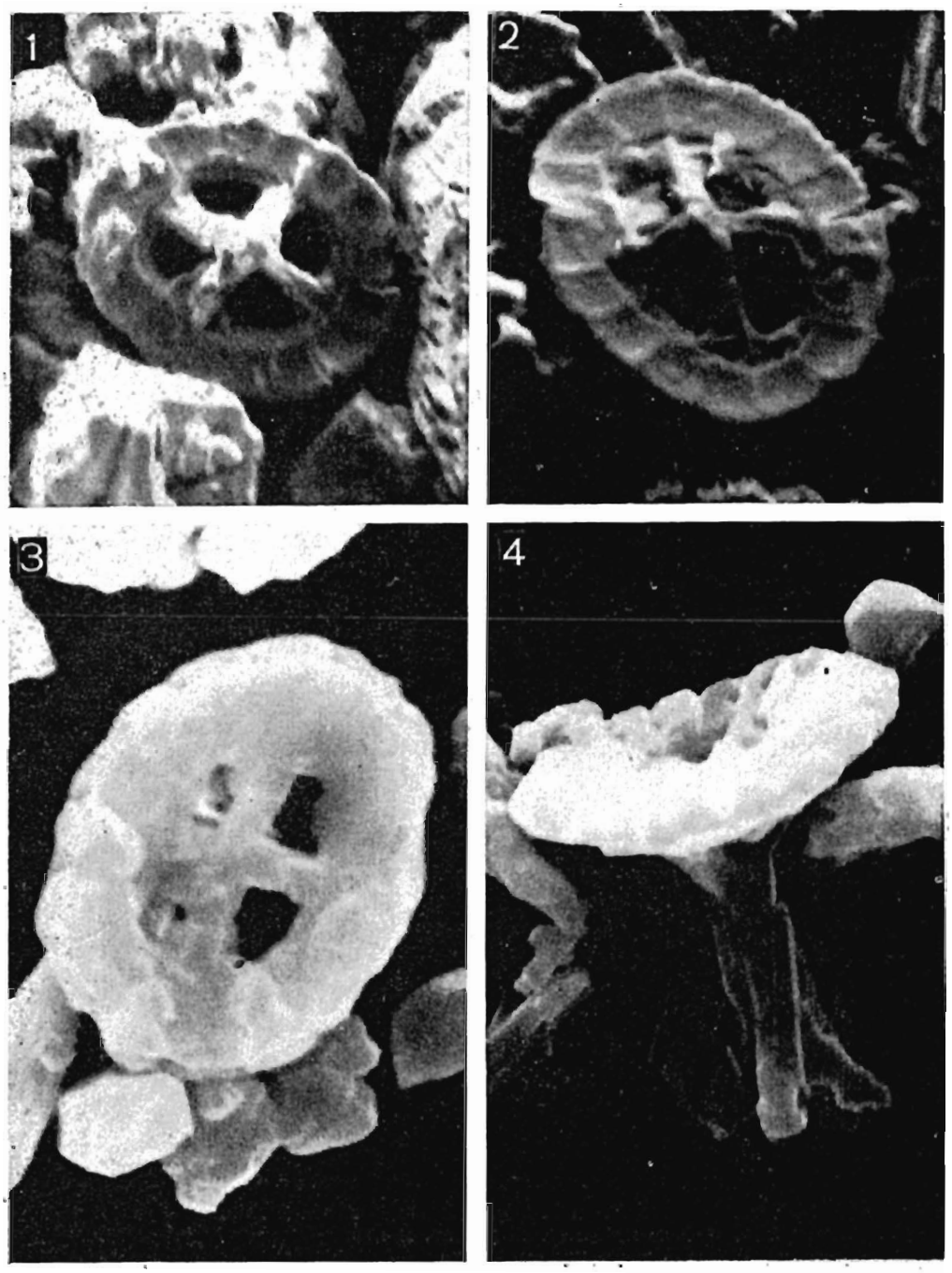
1964. *Biantholithus sparsus* Bramlette & Martini, n. sp.; M. Bramlette & E. Martini, p. 205, Pl. 4, Figs 21—24.
1969a. *Biantholithus sparsus* Bramlette & Martini, 1964; K. Perch-Nielsen, p. 56, Pl. 6, Figs 1—3, 10 and Pl. 7, Figs 3—10.
1971. *Biantholithus sparsus* Bramlette & Martini; H. Manivit, p. 127, Pl. 12, Figs 5—6.
1976. *Biantholithus sparsus* Bramlette et Martini, 1964; S. Shumenko, p. 71, Pl. 27, Fig. 4.
Dimensions: diameter 8—12 μ.

Remarks. — The specific features of *B. sparsus* are its circular outline with denticulated edge due to the radial arrangement of 8 constituent segments, and a clockwise distortion of the structural elements.



Upper Maastrichtian *Prediscosphaera cretacea* (Arkhangelsky)

1 — proximal view, borehole Żyrzyn (depth 115.4 m), × 4,500
2 — proximal view, Żyrzyn (depth 110.2 m), × 5,400
3 — proximal view, Podole (depth 53.7 m), × 6,000
4 — proximal view, Żyrzyn (depth 126.1 m), × 9,000
5 — lateral view, Żyrzyn (depth 126.1 m), × 6,300
6 — distal view, Zemborzyce (depth 101 m), × 6,300
7 — distal view, Żyrzyn (depth 115.4 m), × 9,000

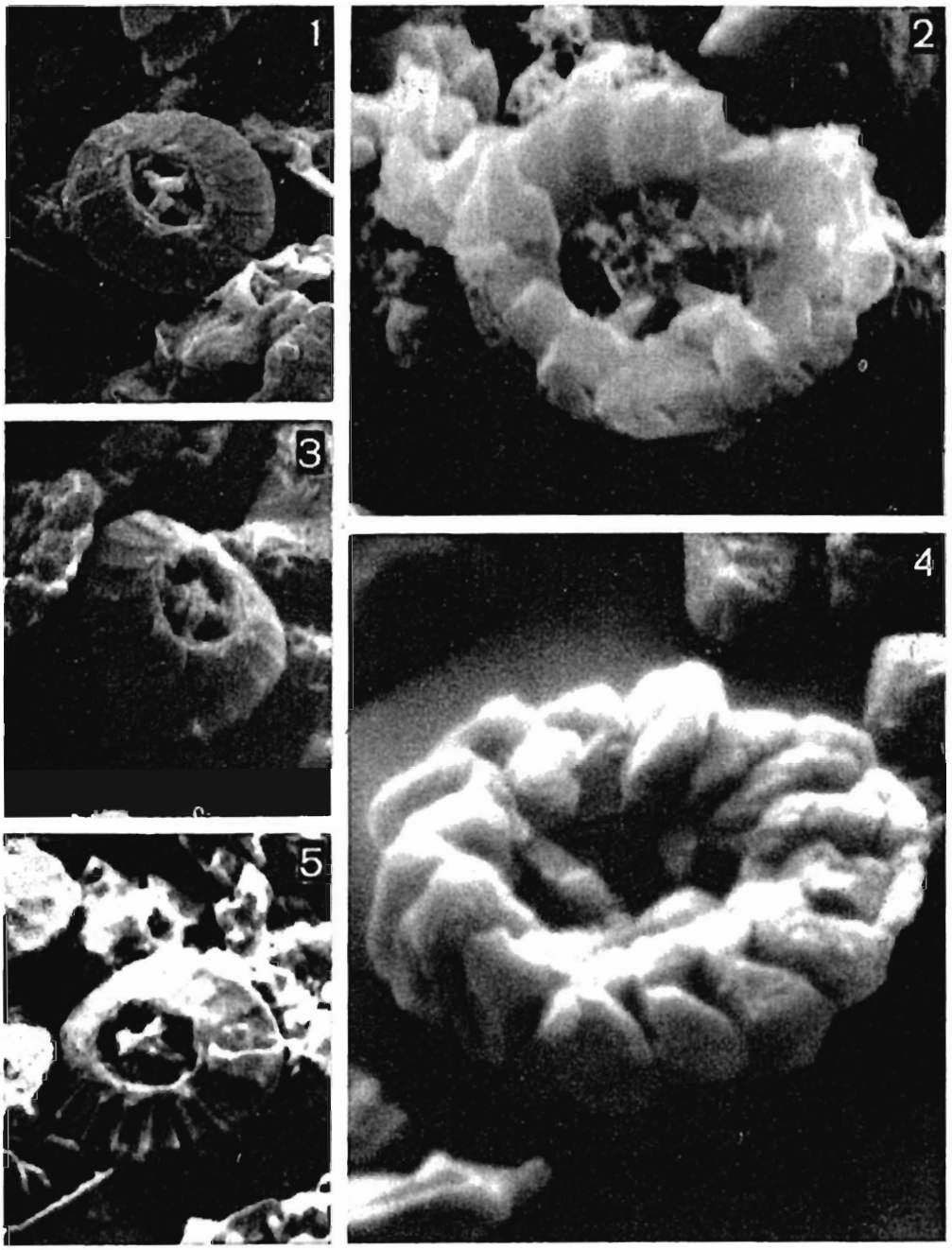


Upper Maastnichtian species of *Prediscosphaera*

1 and 2 — *Prediscosphaera propinqua* (Górka), distal view; borehole Zemborzyce (depth 74.8 m); × 9,000

3 — *Prediscosphaera propinqua* (Górka), proximal view; Lucimia; × 8,000

4 — *Prediscosphaera cretacea* (Arkhangelsky), lateral view; Lucimia; × 8,000



Upper Maastrichtian species of *Prediscosphaera*

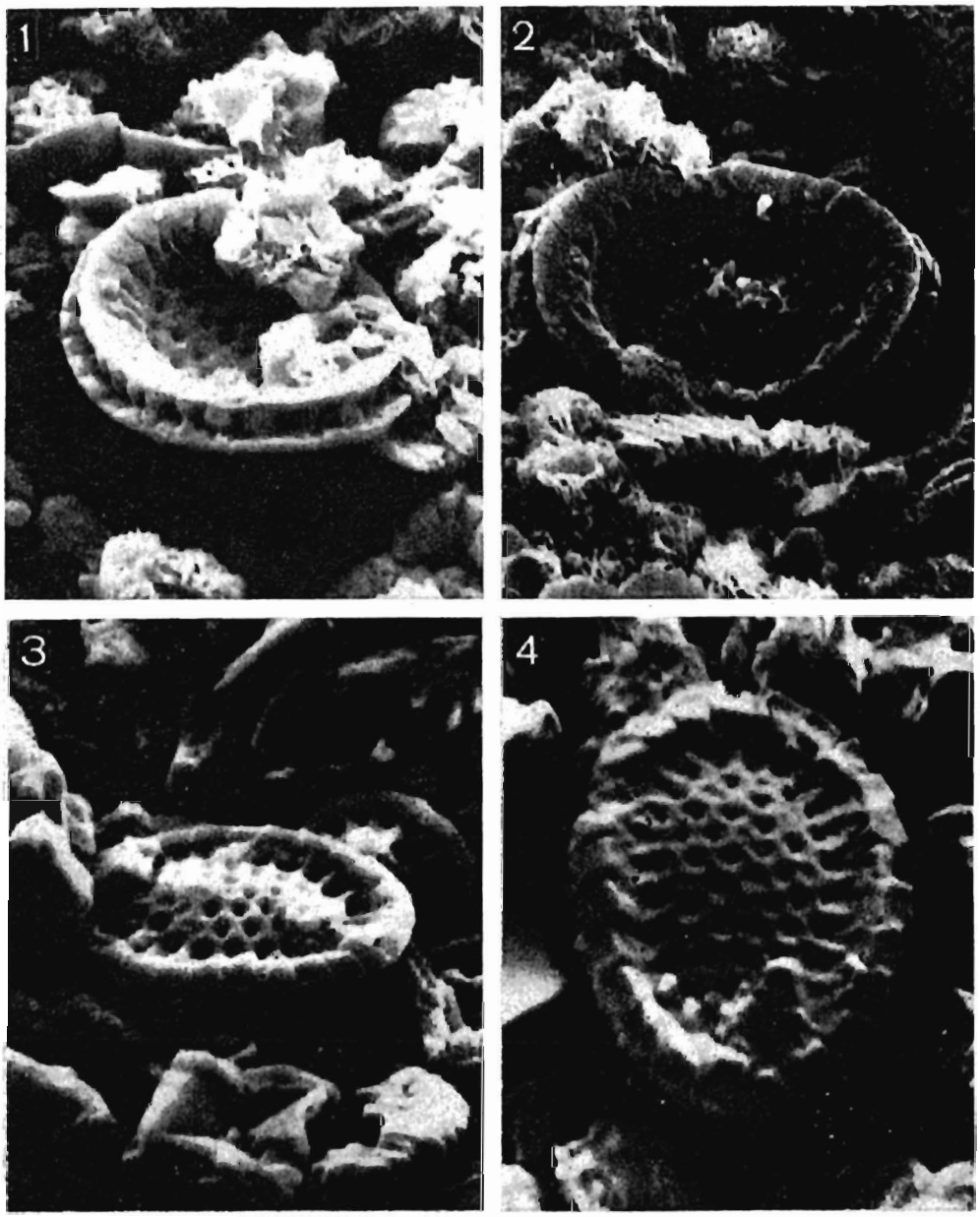
1 — *Prediscosphaera stoveri* (Perch-Nielsen), distal view; borehole Żyrzyn (depth 115.4 m); × 9,000

2 — *Prediscosphaera serrata* Noël, proximal view; Nasiłów; × 8,000

3 — *Prediscosphaera stoveri* (Perch-Nielsen), distal view; Podole (depth 53.7 m); × 9,000

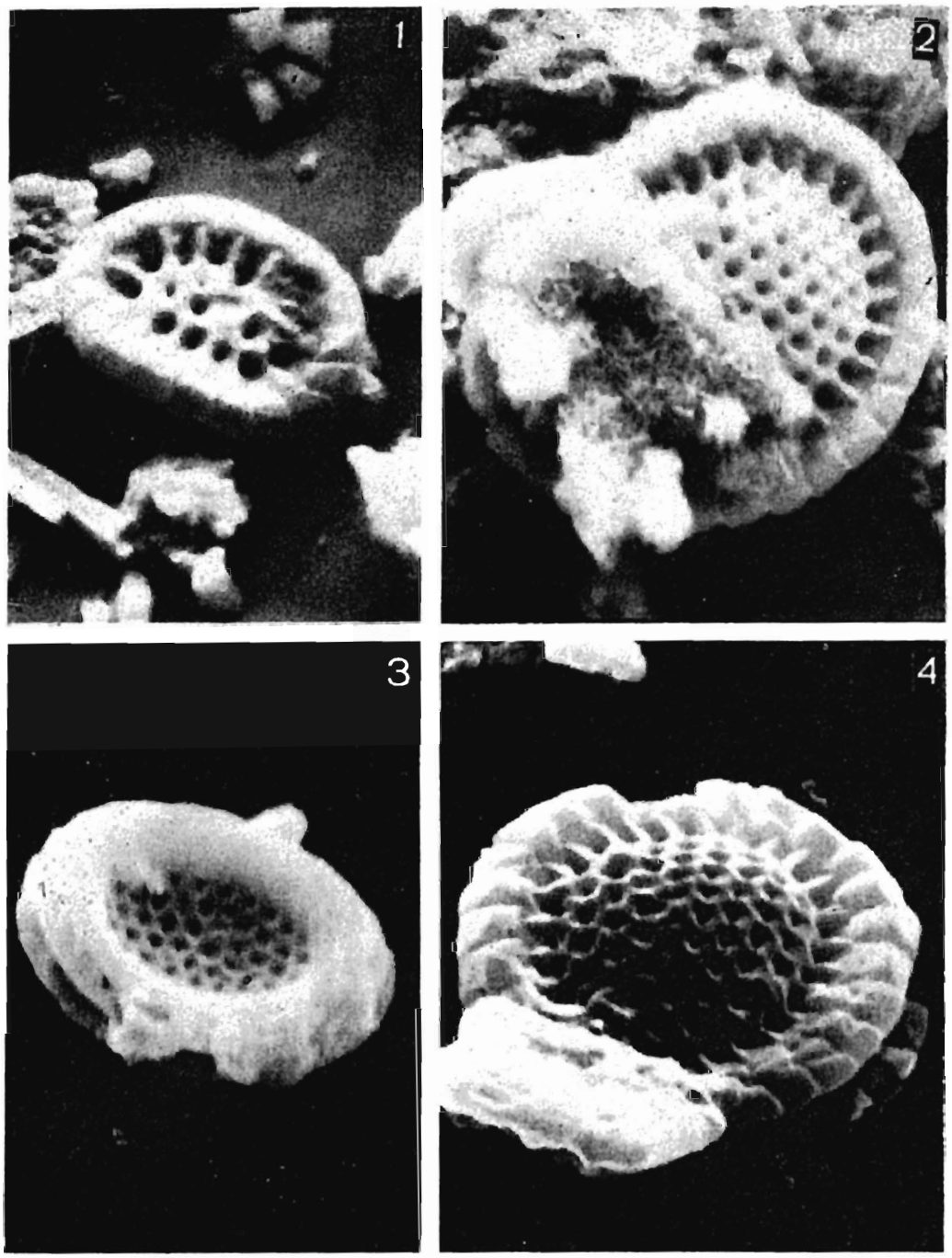
4 — *Prediscosphaera serrata* Noël, proximal view; Nasiłów; × 12,500

5 — *Prediscosphaera stoveri* (Perch-Nielsen), distal view; Zemborzyce (depth 74.8 m); × 9,000



Upper Maastrichtian *Cribrosphaera ehrenbergi* Arkhangelsky

1 and 2 — proximal view, borehole Podole (depth 45 m), × 6,000
3 — distal view, Żyrzyn (depth 110.2 m), × 5,400
4 — distal view, Podole (depth 53.7 m), × 9,000

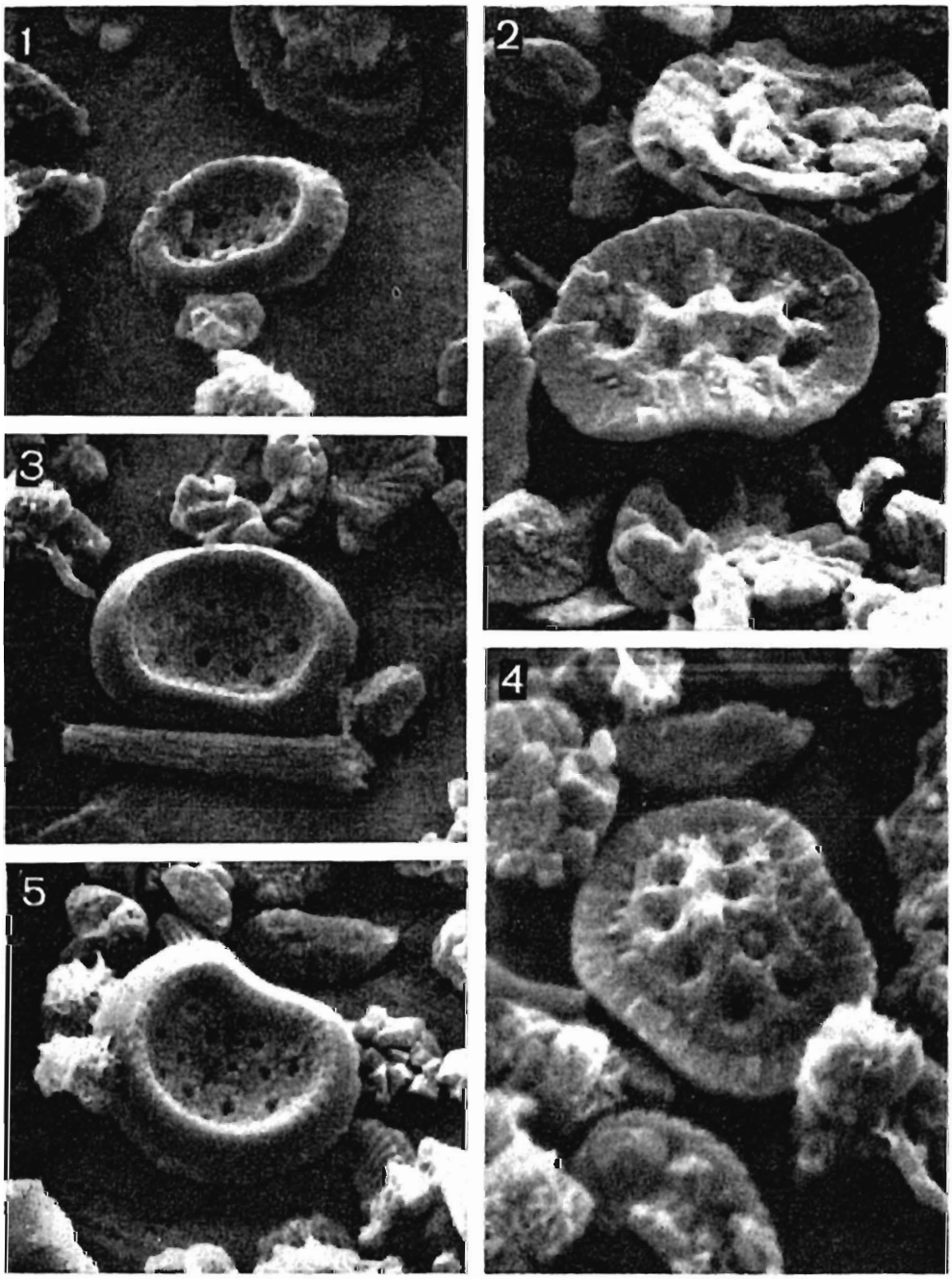


Cribrosphaera ehrenbergi Arkhangelsky

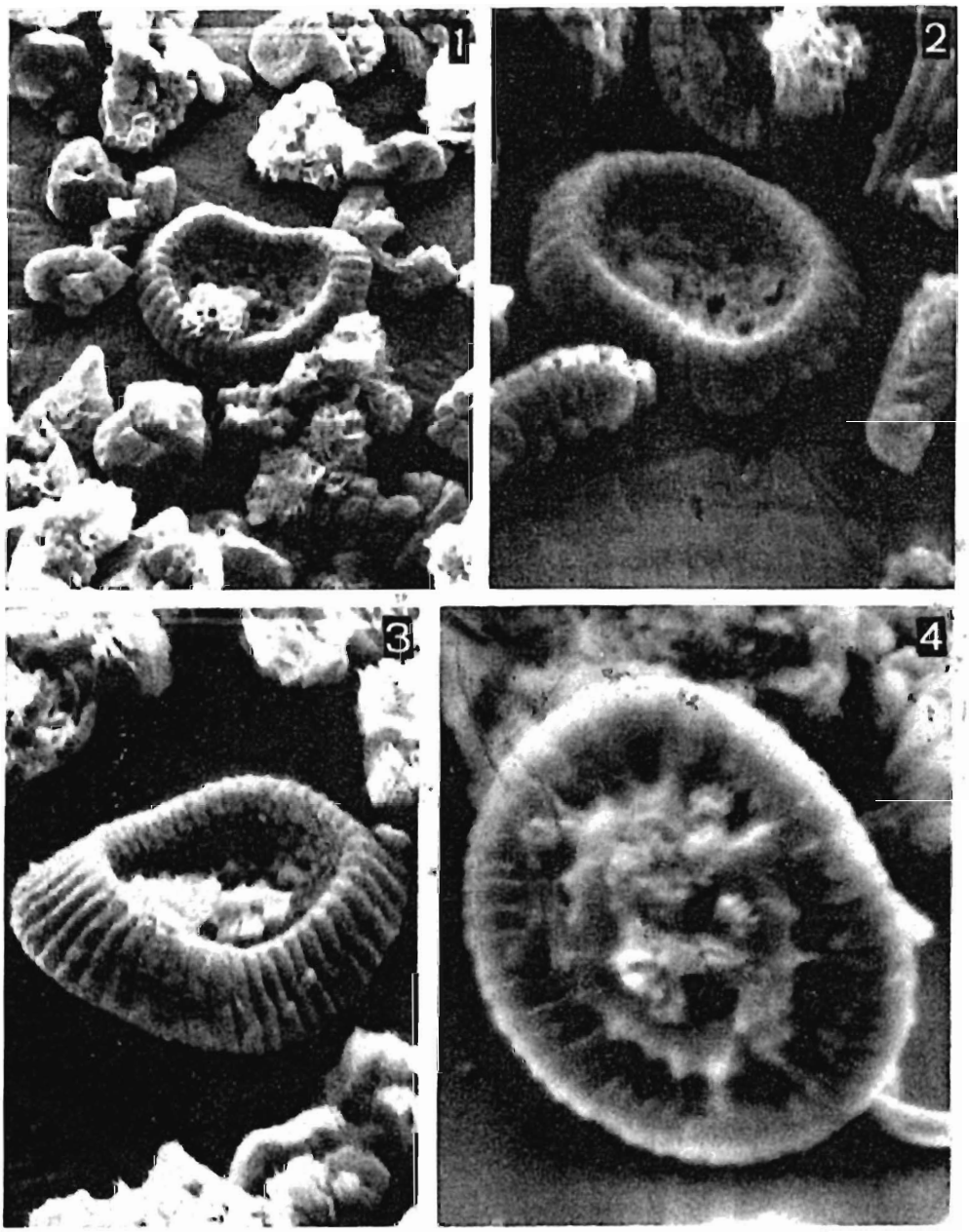
1 and 2 — distal view; Lower Maastrichtian, borehole Ożarów (depth 71.7 m); × 3,200

3 — proximal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 8,000

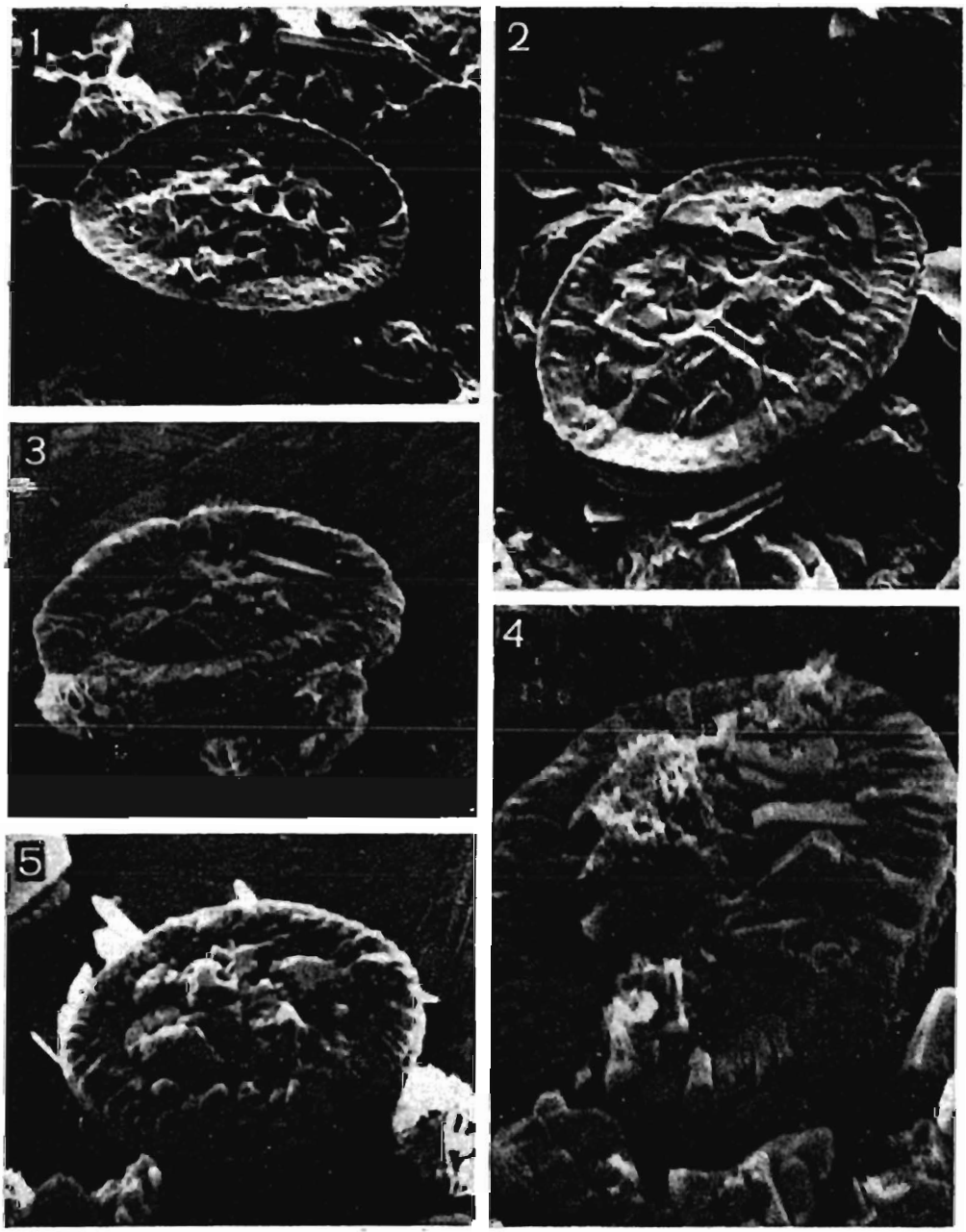
4 — distal view; Upper Maastrichtian, Lucimia; × 8,000



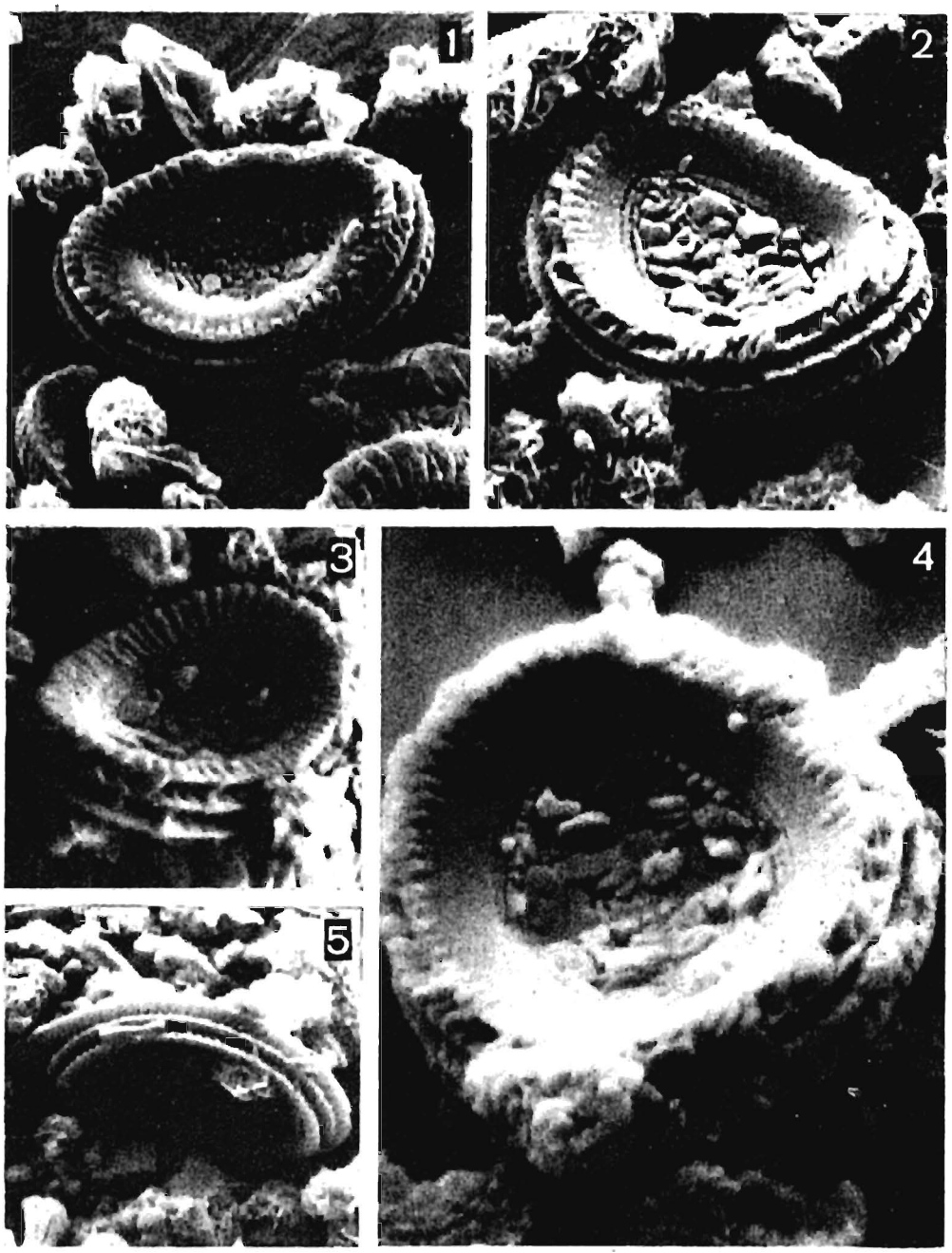
Upper Maastrichtian *Nephrolithus frequens* Górka
1 — proximal view, borehole Podole (depth 45 m), × 3,600
2 — distal view, Żyrzyn (depth 128.1 m), × 9,000
3 — proximal view, Podole (depth 45 m), × 6,000
4 — distal view, Nasiłów, × 6,000
5 — proximal view, Podole (depth 53.7 m), × 6,000



1 — *Nephrolithus* sp., proximal view; Upper Maastrichtian, Kazimierz; × 6,000
2 and 3 — *Nephrolithus* sp., proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 115.4 m); × 9,000
4 — *Cretarhabdus* cf. *surirellus* (Deflandre), distal view, Lower Maastrichtian, Ożarów (depth 71.3 m), × 7,000



1 and 2 — *Arkhangelskiella cymbiformis* Vekshina, distal view; Upper Maastrichtian, borehole Podole (depth 53.7 m); *1* × 4,500, *2* × 5,400
3, 4, and 5 — *Gartnerago obliquum* (Stradner), distal view; Upper Maastrichtian, Zemborzyce (depth 101 m); *3* and *5* × 6,000, *4* × 9,000



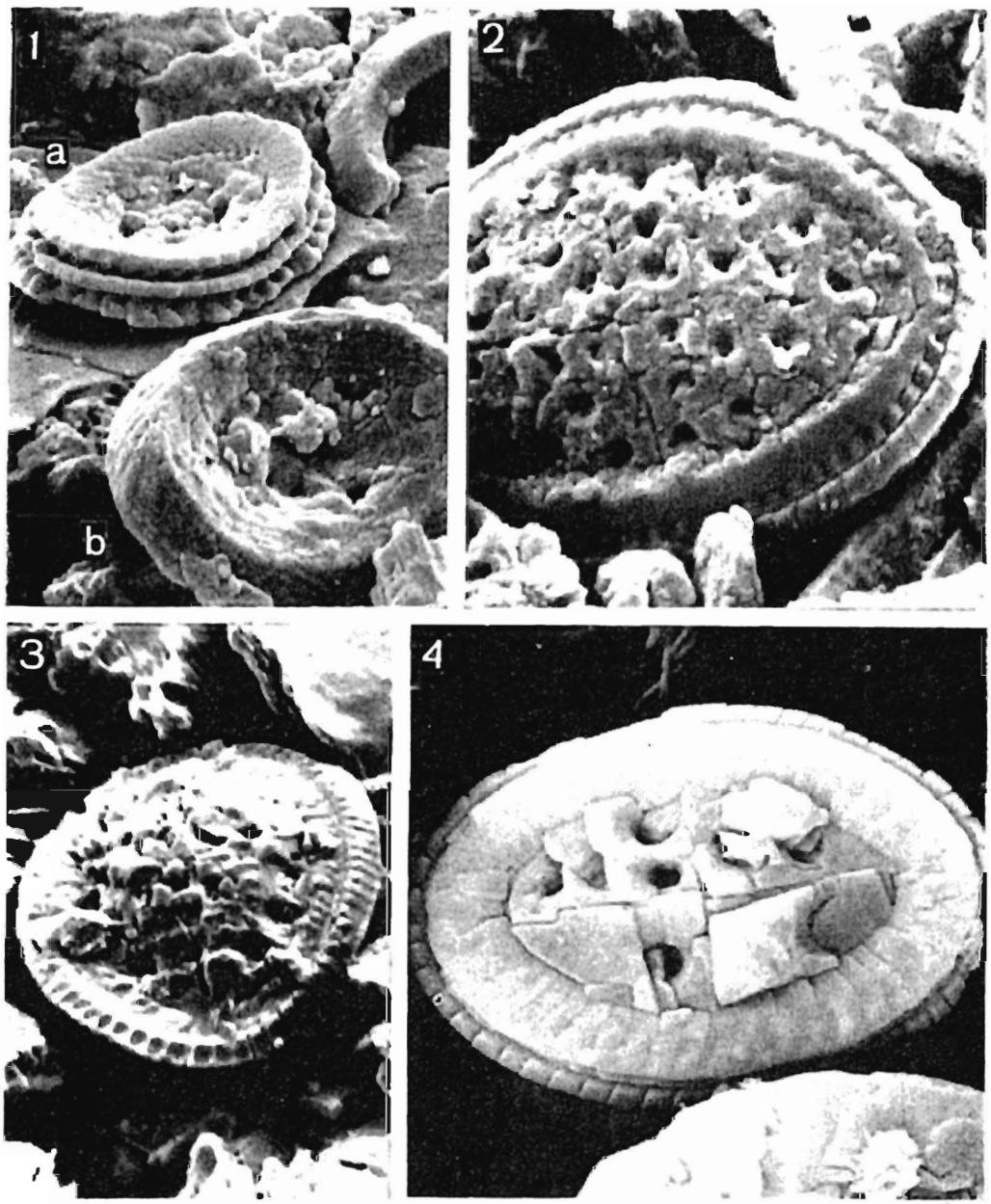
Upper Maastrichtian calcareous nannoplankton

1 and 2 — *Broinsonia parca* (Stradner), proximal view; borehole Zemborzyce (depth 101 m); × 5,400

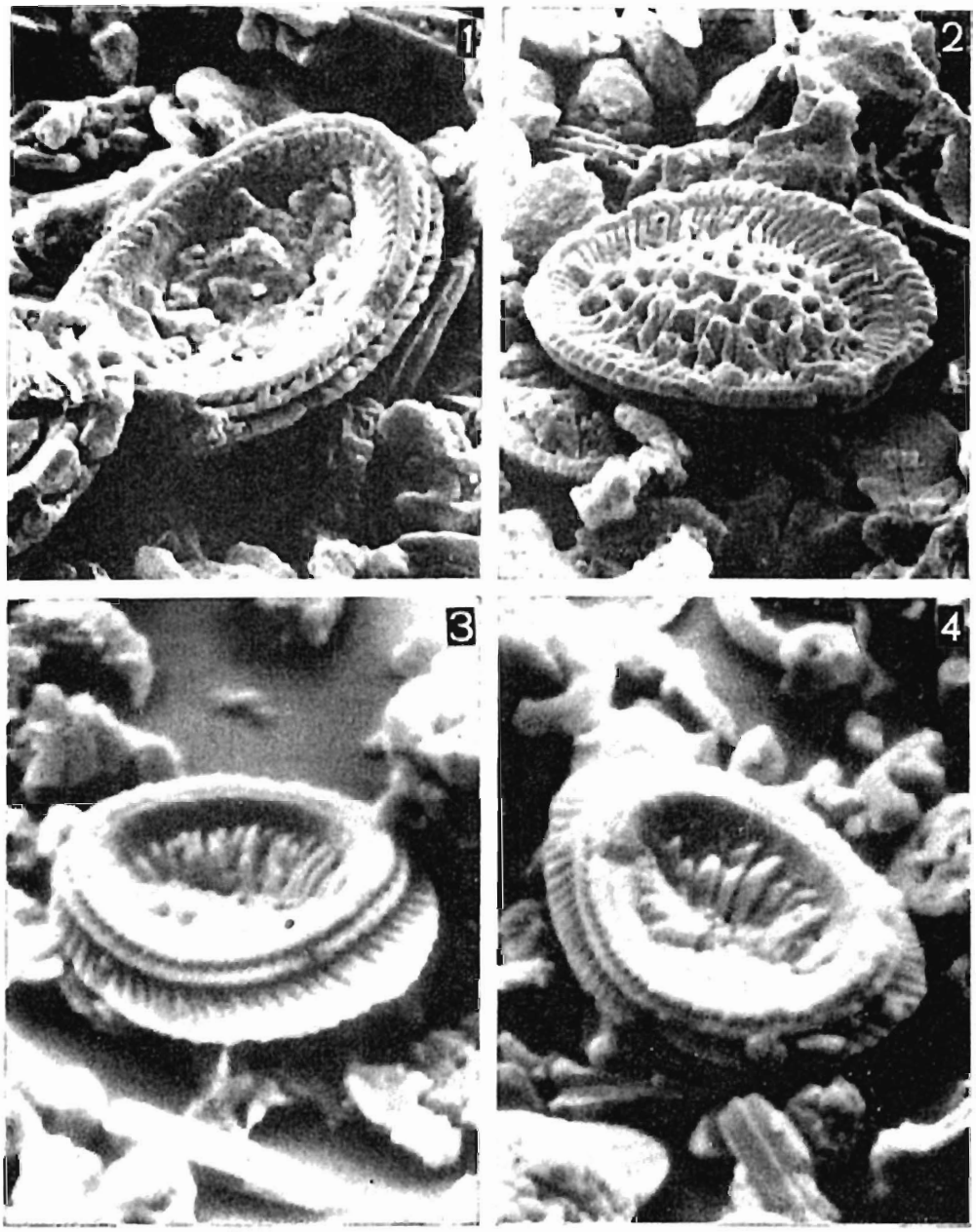
3 — *Arkhangelskiella cymbiformis* Vekshina, proximal view; Podole (depth 45 m); × 5,000

4 — *Broinsonia parca* (Stradner), proximal view; Nasiłów; × 8,000

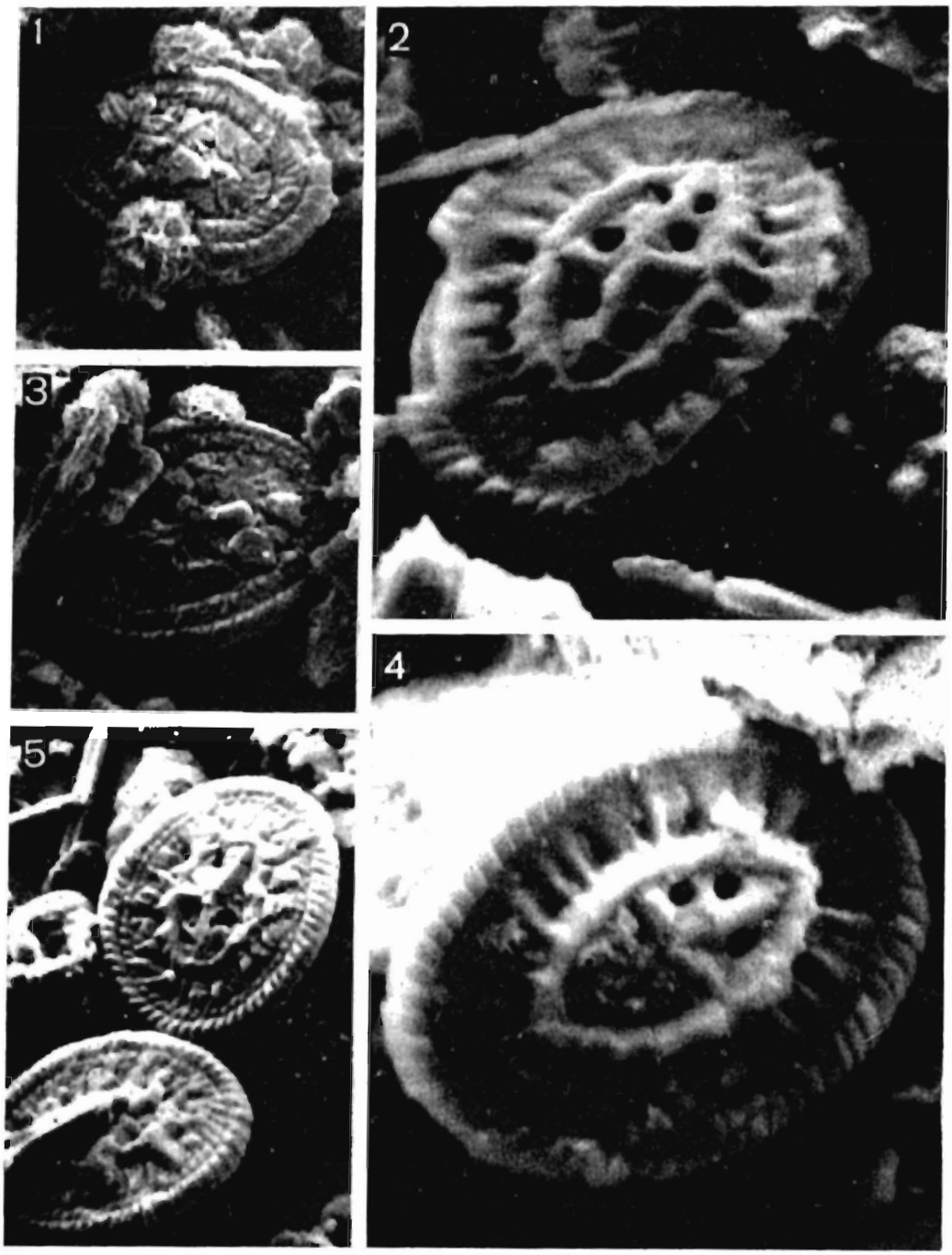
5 — *Kamptnerius magnificus* Deflandre, lateral view; Zemborzyce (depth 101 m); × 4,500



1 — a *Broinsonia distincta* (Shumenko), proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 126.1 m); × 9,000
b *Rhagodiscus* sp., proximal view
2 — *Arkhangelskiella ethmopora* Bukry, distal view; Upper Maastrichtian, Żyrzyn (depth 126.9 m); × 9,000
3 — *Arkhangelskiella specillata* Vekshina, distal view; Upper Maastrichtian, Podole (depth 53.7 m); × 5,400
4 — *Broinsonia parca* (Stradner), distal view; Lower Maastrichtian, Ożarów (depth 2.4 m); × 13,000



1 — *Gartnerago obliquum* (Stradner), proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 115.4 m), × 9,000
2 — *Kamptnerius percivalii* Bukry, distal view; Upper Maastrichtian, Żyrzyn (depth 126.1 m); × 5,400
3 and 4 — *Kamptnerius magnificus* Deflandre, proximal view; Upper Campanian, Sulejów; × 5,400

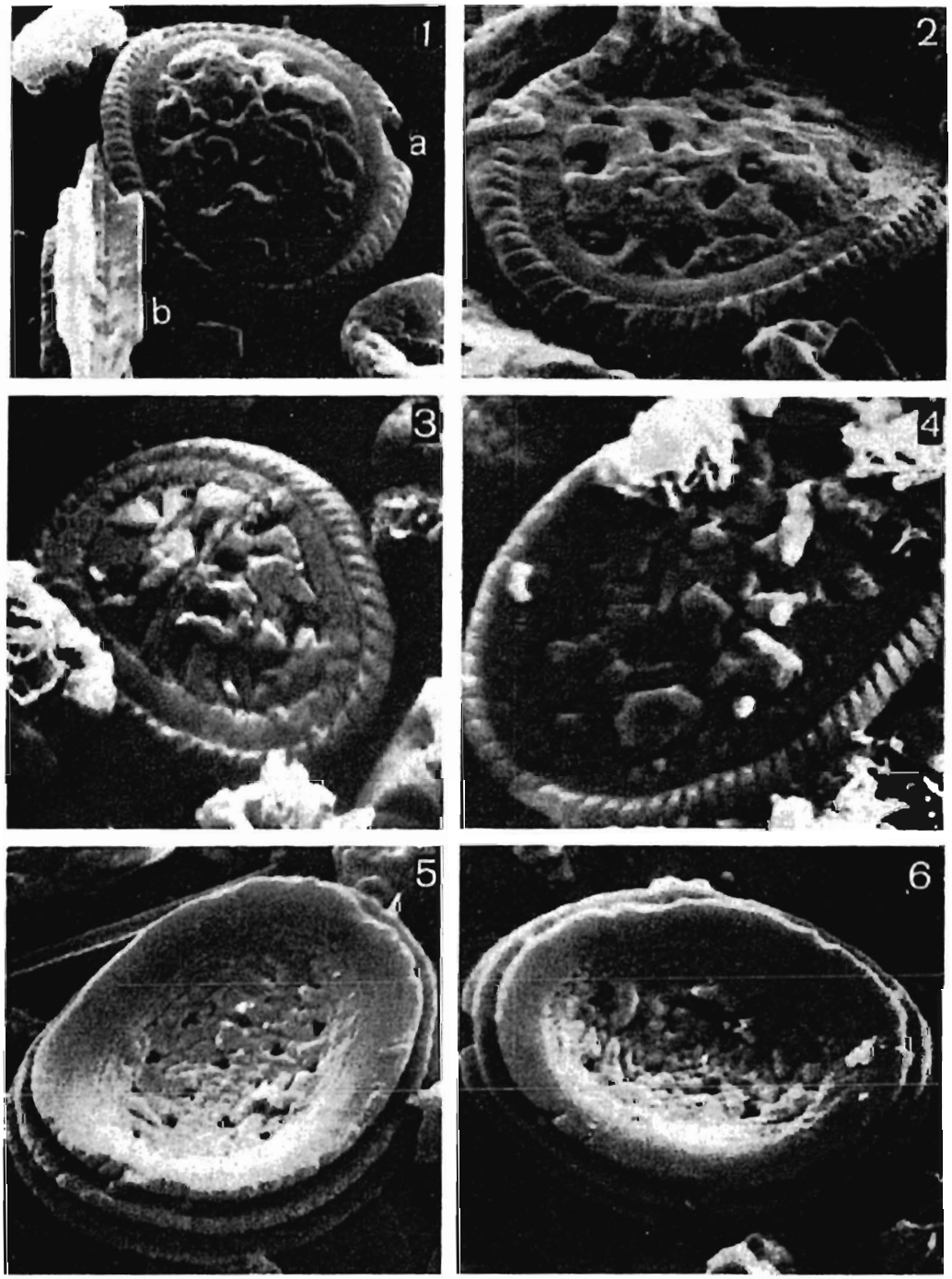


Species of *Broinsonia*, in distal view

1 and 3 — *Broinsonia lata* (Noël); Upper Maastrichtian, borehole Podole (depth 45 m); × 4,500

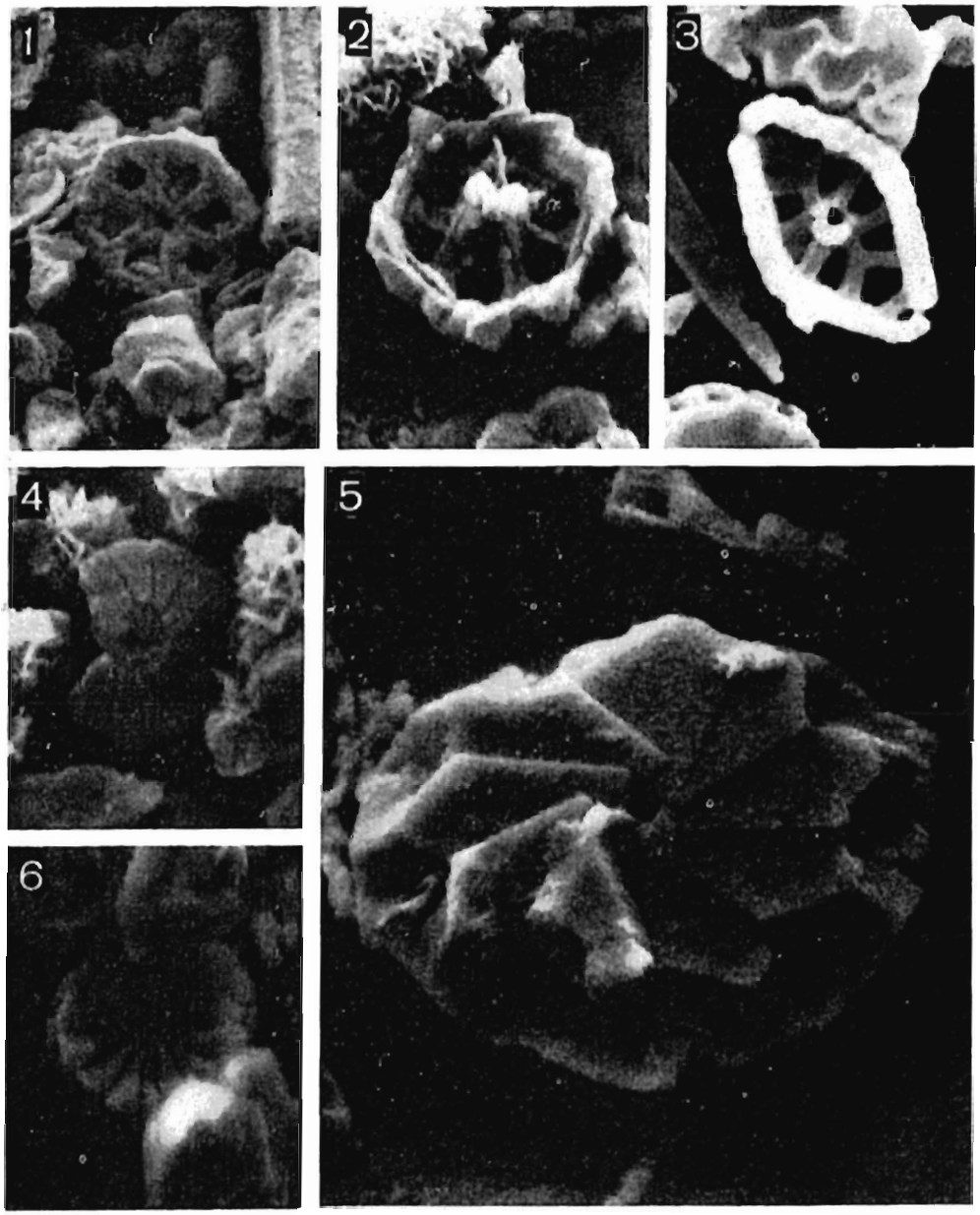
2 and 4 — *Broinsonia parca* (Stradner); Lower Maastrichtian, Ożarów (depth 71.7 m); × 8,000

5 — *Broinsonia parca* (Stradner); Upper Campanian, Sulejów; × 3,800

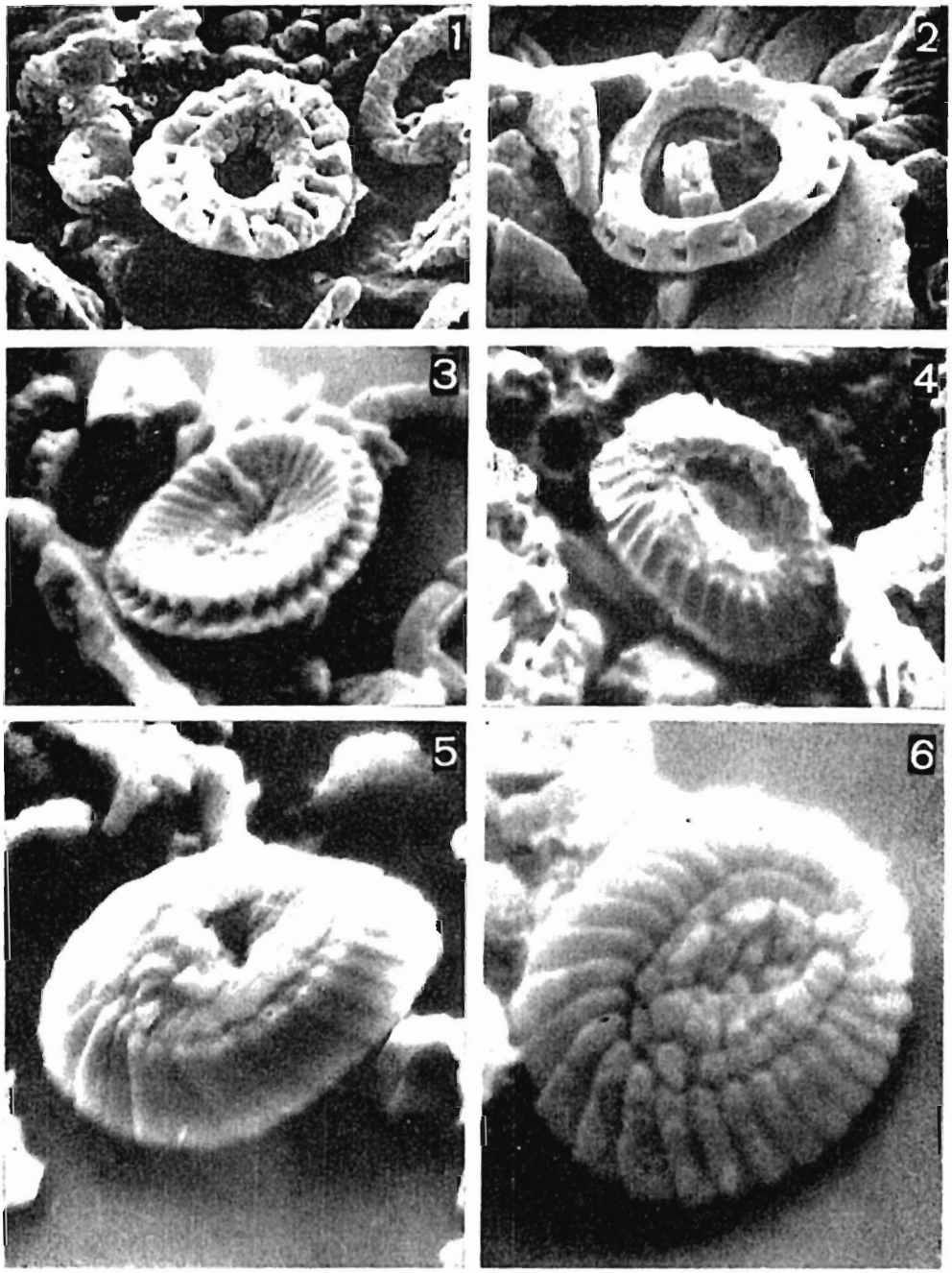


Upper Maastrichtian *Broinsonia cribrata* sp. n.

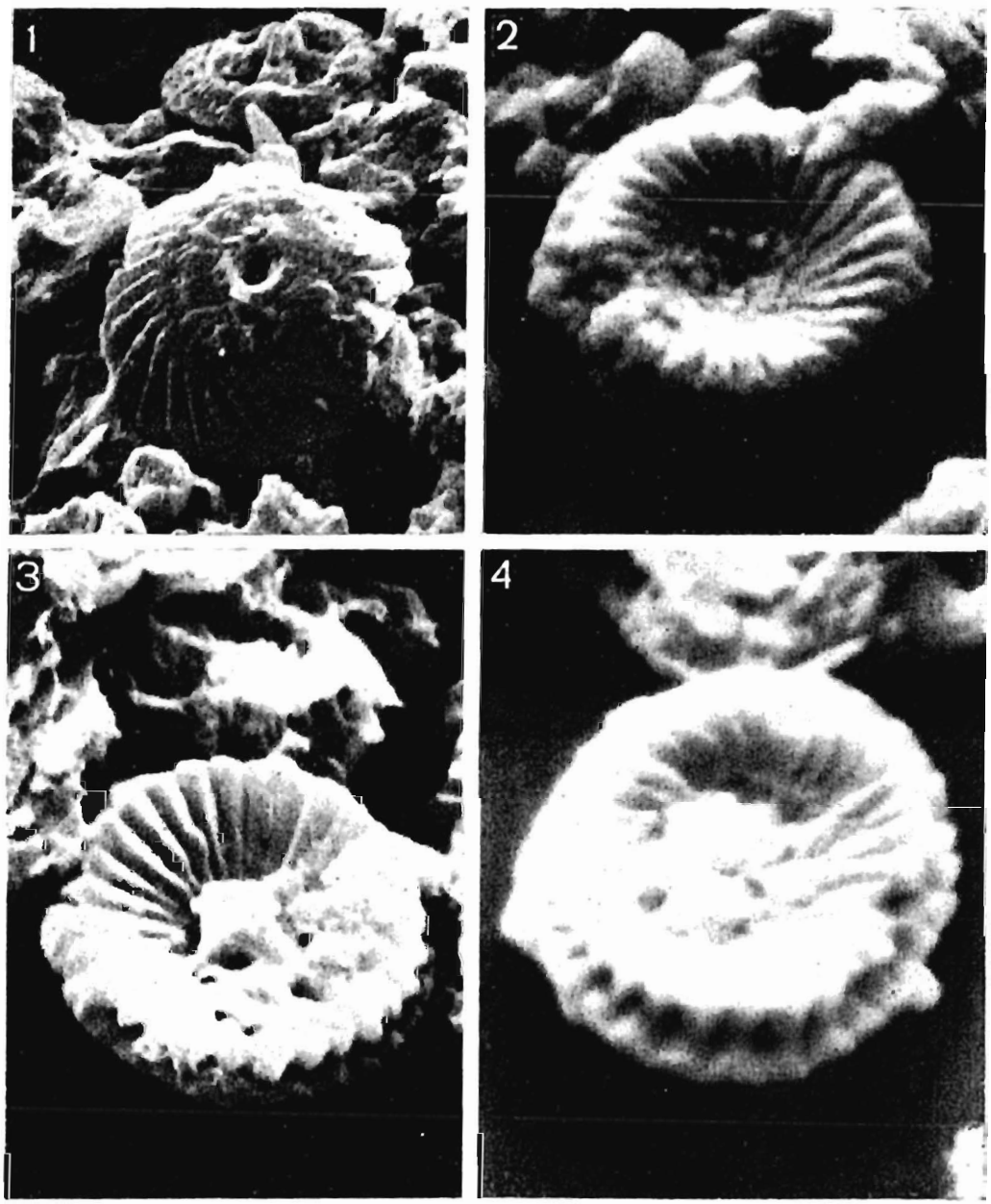
1 — **a** distal view; Lucimia; × 8,000
b *Lithraphidites quadratus* Bramlette & Martini
2 — *holotype*, distal view; borehole Żyrzyn (depth 126.1 m); × 9,000
3 and 4 — distal view; Podole (depth 53.7 m); × 9,000
5 — paratype, proximal view; Żyrzyn (depth 115.4 m); × 9,000
6 — proximal view; Żyrzyn (depth 126.1 m); × 9,000



1 — *Corollithion exiguum* (Stradner); Upper Maastrichtian, borehole Żyrzyn (depth 128.1 m); × 9,000
2 — *Corollithion exiguum* (Stradner); Lower Maastrichtian, Ożarów (depth 71.7 m); × 9,000
3 — *Corollithion rhombicum* (Stradner & Adamiker); Upper Maastrichtian, Lucimia; × 8,900
4 — *Biscutum ignotum* (Górka), distal view; Upper Maastrichtian, Podole (depth 45 m); × 6,900
5 — *Rhombogyrus* cf. *caliciformis* Black, distal view; Paleocene, Zemborzyce (depth 49 m); × 6,000
6 — *Biscutum ignotum* (Górka), proximal view; Upper Maastrichtian, Zemborzyce (depth 101 m); × 6,000

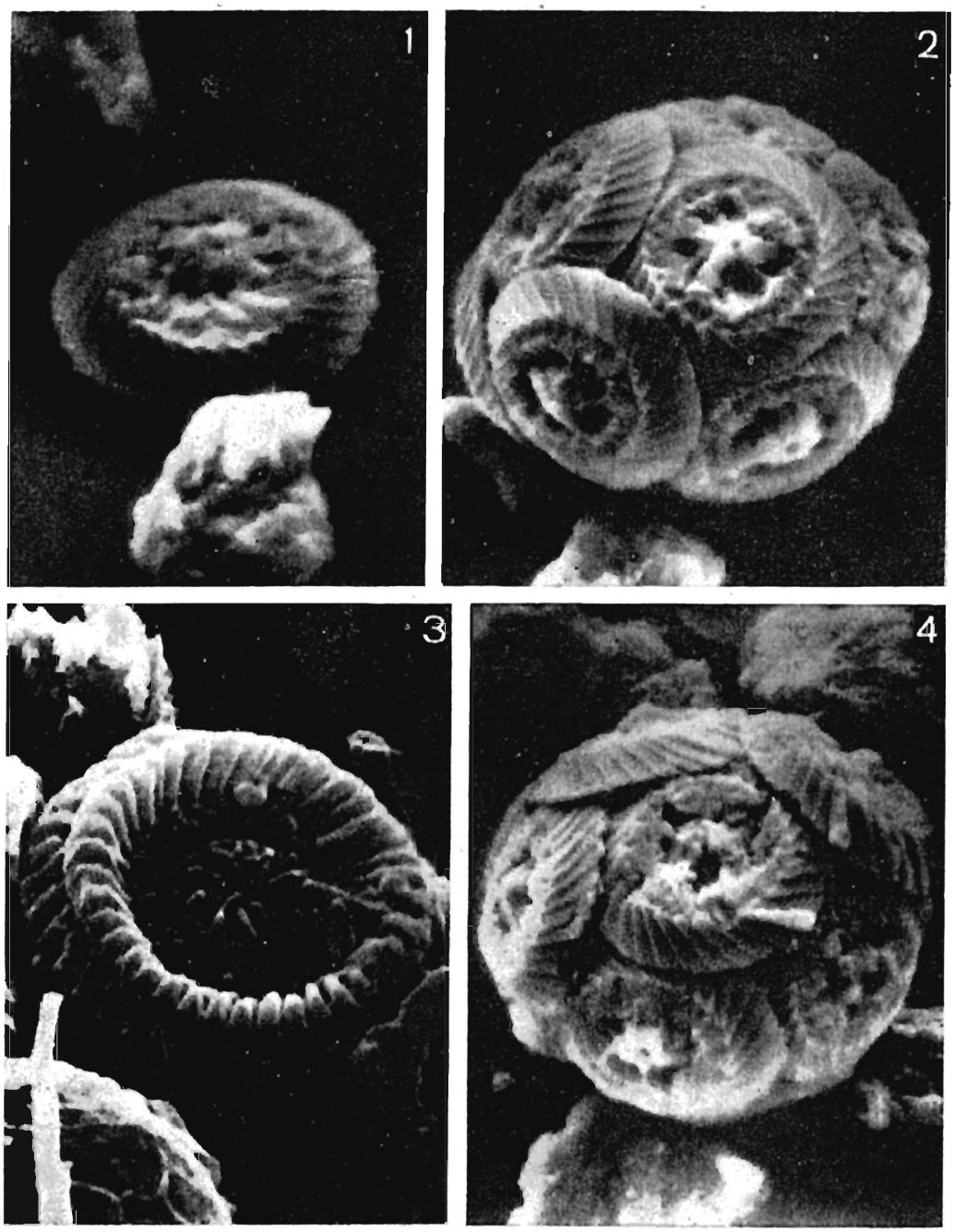


1 — *Watznaueria dentata* (Shumenko), proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 115.4 m); × 9,000
2 — *?Prediscosphaera* sp.; Upper Maastrichtian, Żyrzyn (depth 126.1 m); × 9,000
3 — *Watznaueria barnesae* (Black), proximal view; Upper Campanian, Sułejów; × 5,500
4 — *Watznaueria barnesae* (Black), distal view; Upper Maastrichtian, Podole (depth 53.7 m); × 9,000
5 — *Watznaueria barnesae* (Black), distal view; Upper Maastrichtian, Żyrzyn (depth 110.2 m); × 9,000
6 — *Watznaueria barnesae* (Black), distal view; Upper Maastrichtian, Nasiłów; × 12,000



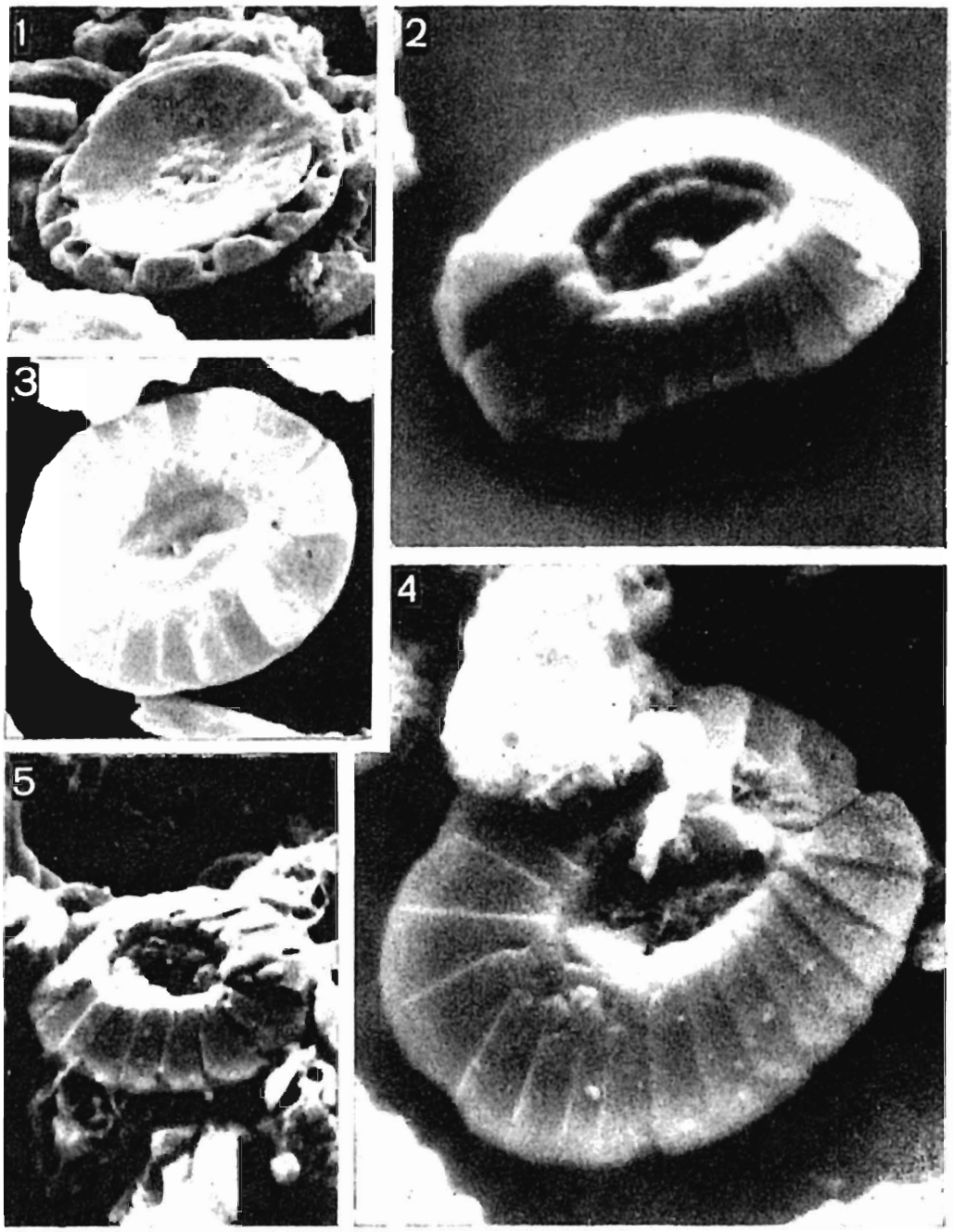
Markalius circumradiatus (Stover)

1 — distal view; Upper Maastrichtian, borehole Żyrzyn (depth 115.4 m); × 9,000
2 — proximal view; Upper Maastrichtian, Nasiłów; × 12,000
3 — proximal view; Paleocene, Rzeczyca; × 8,000
4 — proximal view; Paleocene, Rzeczyca; × 10,000



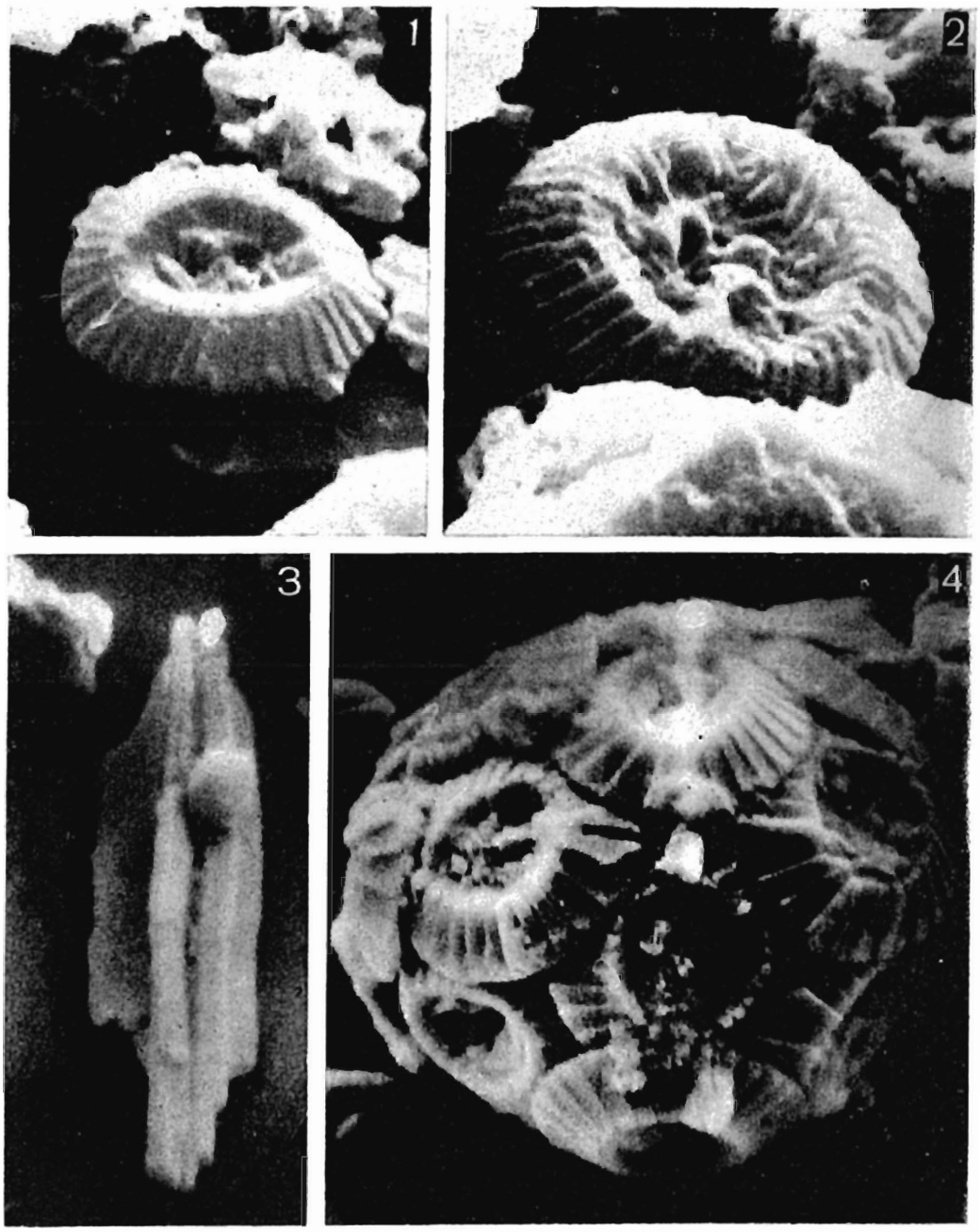
Paleocene *Markalius inversus* (Deflandre)

1 — distal view, Rzeczyca, × 7,000
2 — coccosphere, Rzeczyca, × 6,000
3 — proximal view, Parchatka, × 8,000
4 — coccosphere, Rzeczyca, × 6,000

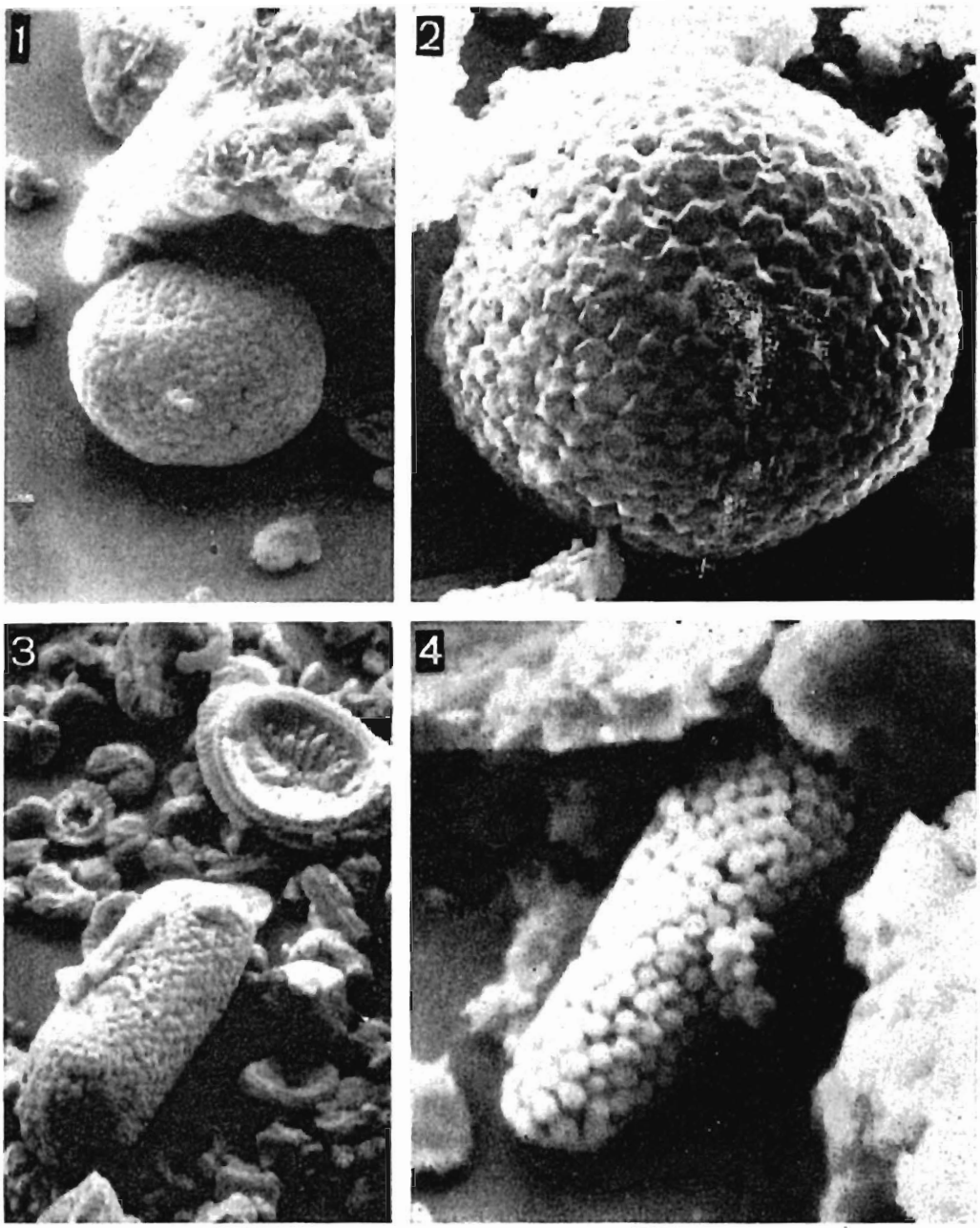


Biscutum constans (Górka)

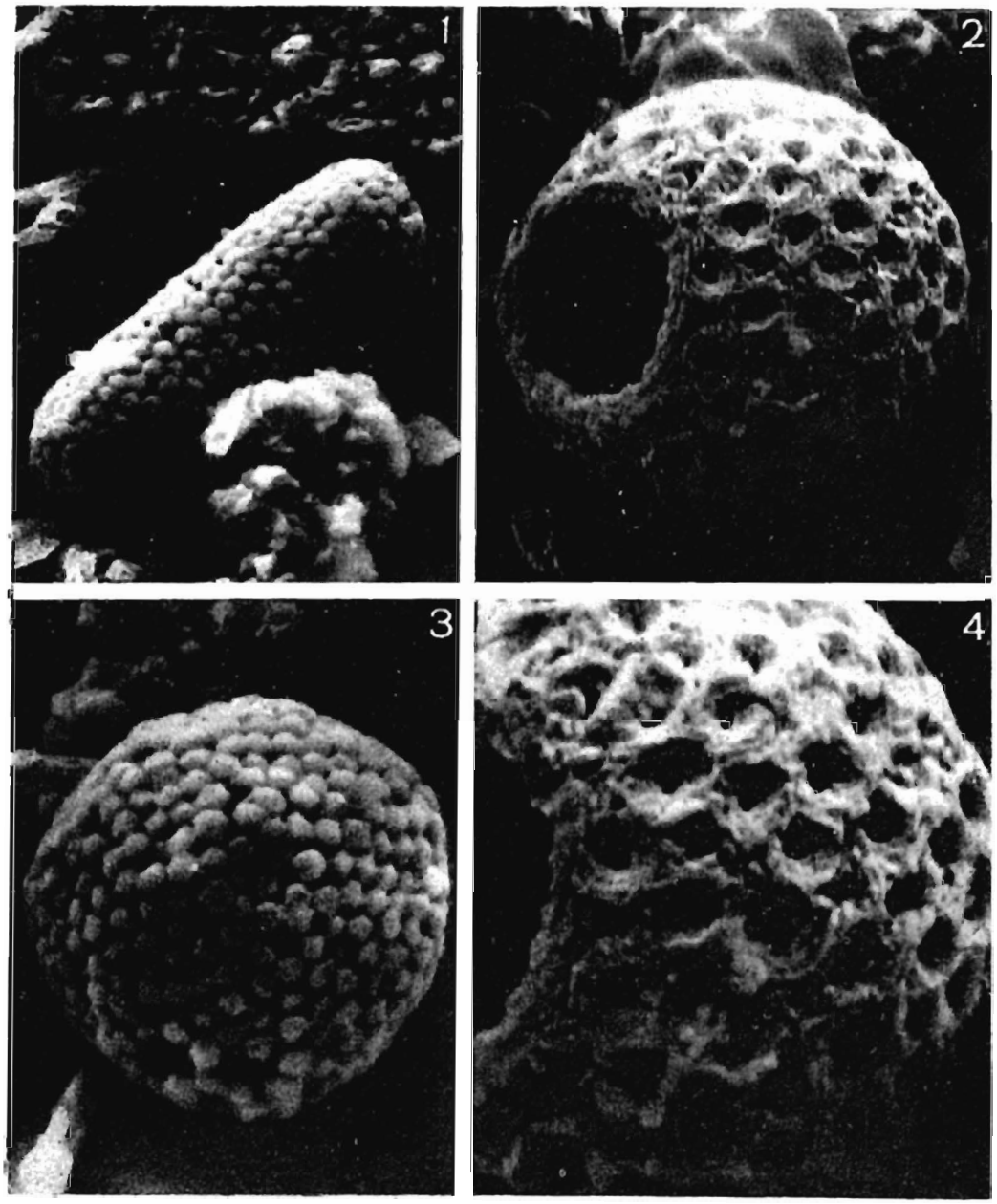
1 — proximal view; Upper Maastrichtian, borehole Żyrzyn (depth 126.1 m); × 9,000
2 — distal view; Upper Maastrichtian, Nasiłów; × 11,000
3 — distal view; Upper Maastrichtian;, Lucimia; × 8,000
4 — distal view; Paleocene, Zemborzyce (depth 49 m); × 12,000
5 — distal view; Upper Maastrichtian, Podole (depth 53.7 m); × 7,000



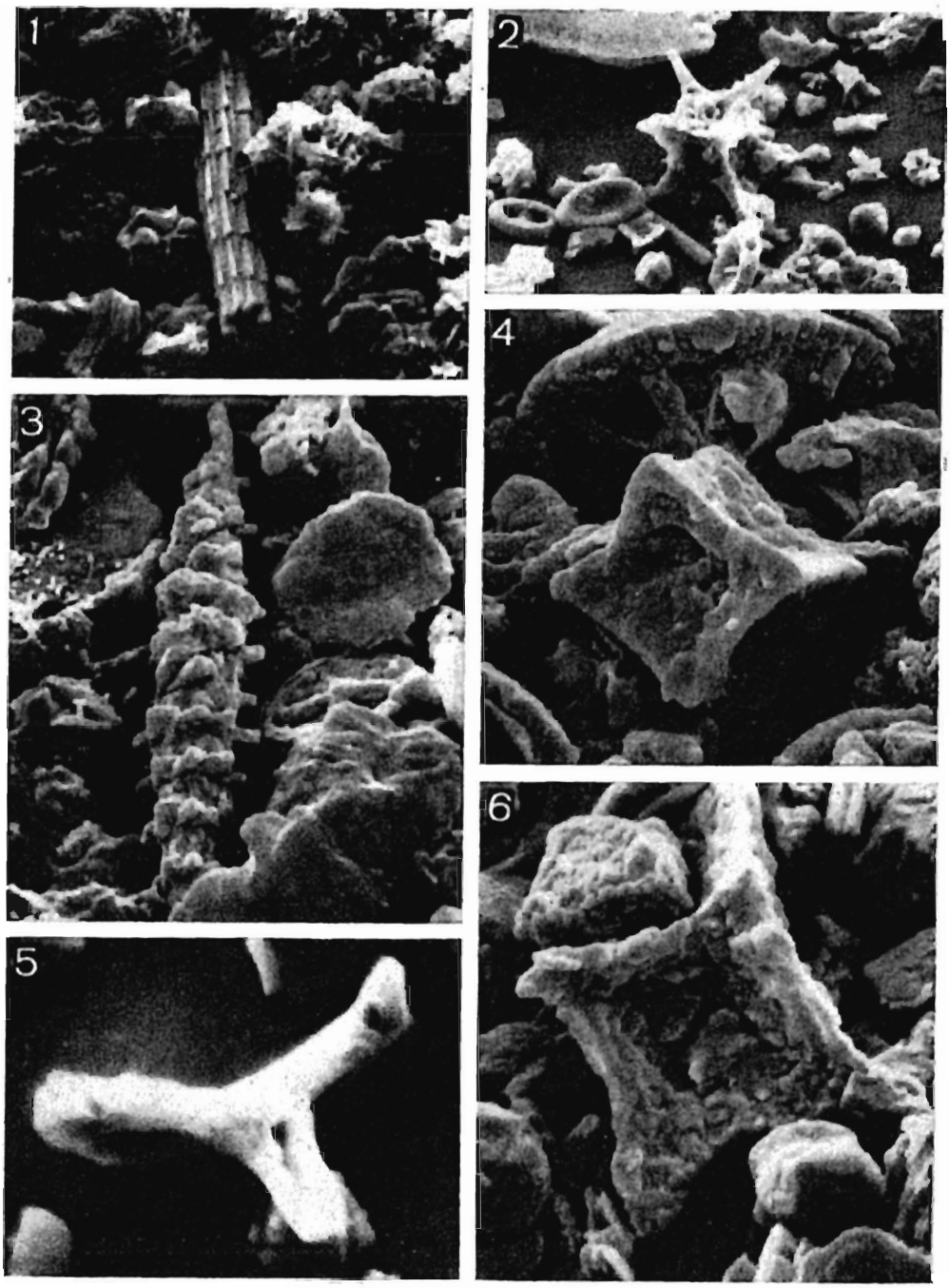
1 — *Ericsonia cava* (Hay & Mohler), distal view; Paleocene, Rzeczyca; × 8,000
2 — *Ericsonia cava* (Hay & Mohler), distal view; Paleocene, Parchatka; × 8,000
3 — *Lithraphidites quadratus* Bramlette & Martini; Upper Maastrichtian, Nasiłów; × 11,500
4 — *Ericsonia cava* (Hay & Mohler), coccosphere; Paleocene, Rzeczyca; × 6,000



1 — *Thoracosphaera saxea* Stradner; Paleocene, borehole Podole (depth 29 m); × 3,000
2 — *Thoracosphaera saxea* Stradner; Paleocene, Rzeczyca; × 6,000
3 — *Thoracosphaera longiuscula* sp. n.; Campanian, Sulejów; × 3,000
4 — *Thoracosphaera longiuscula* sp. n. paratype; Paleocene, Podole (depth 29 m); × 5,500

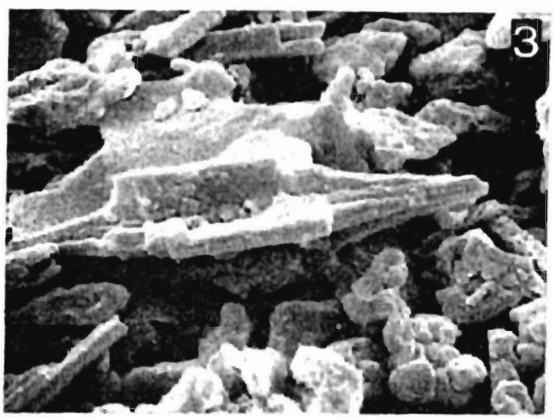


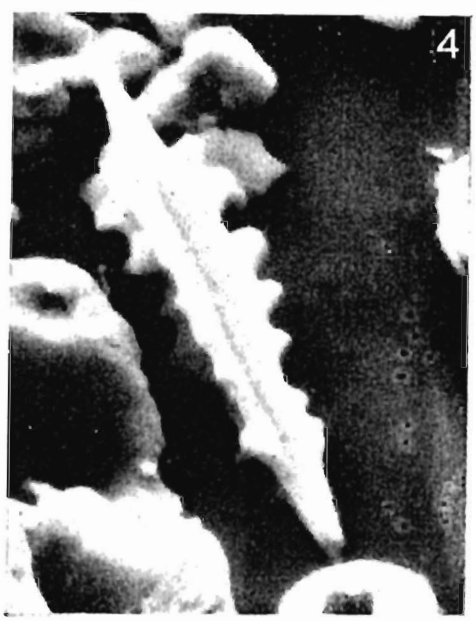
1 — *Thoracosphaera longiuscula* sp. n., holotype; Paleocene, borehole Zemborzyce (depth 49 m); × 5,500
2 and 4 — *Thoracosphaera operculata* Bramlette & Martini; Upper Maastrichtian, Żyrzyn (depth 97 m); 2 × 5,400, 4 × 9,000
3 — *Thoracosphaera deflandrei* Kamptner; Paleocene, Zemborzyce (depth 49 m); × 7,000

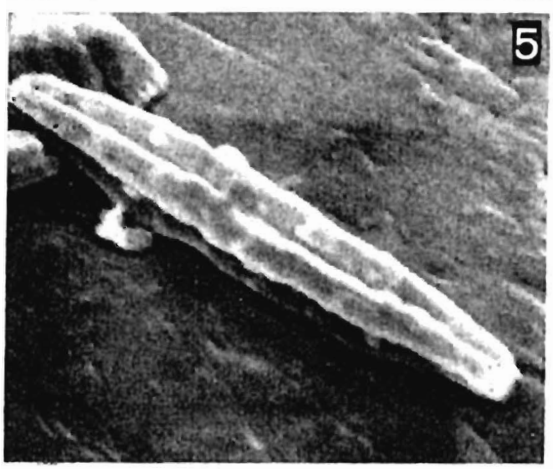


Upper Maastrichtian calcareous nannoplankton

1 — *Microrhabdulus decoratus* Deflandre; borehole Podole (depth 53.7 m), × 6,000
2 — *Micula* aff. *decussata* Vekshina, Żyrzyn (depth 110.2 m), × 2,700
3 — *Microrhabdulus belgicus* Hay & Towe, Żyrzyn (depth 115.4 m), × 9,000
4 and 6 — *Micula decussata* Vekshina; Żyrzyn (depth 126.1 m); *4* × 6,000, *6* × 9,000
5 — *Marthasterites furcatus* Deflandre, Żyrzyn (depth 110.2 m), × 9,000

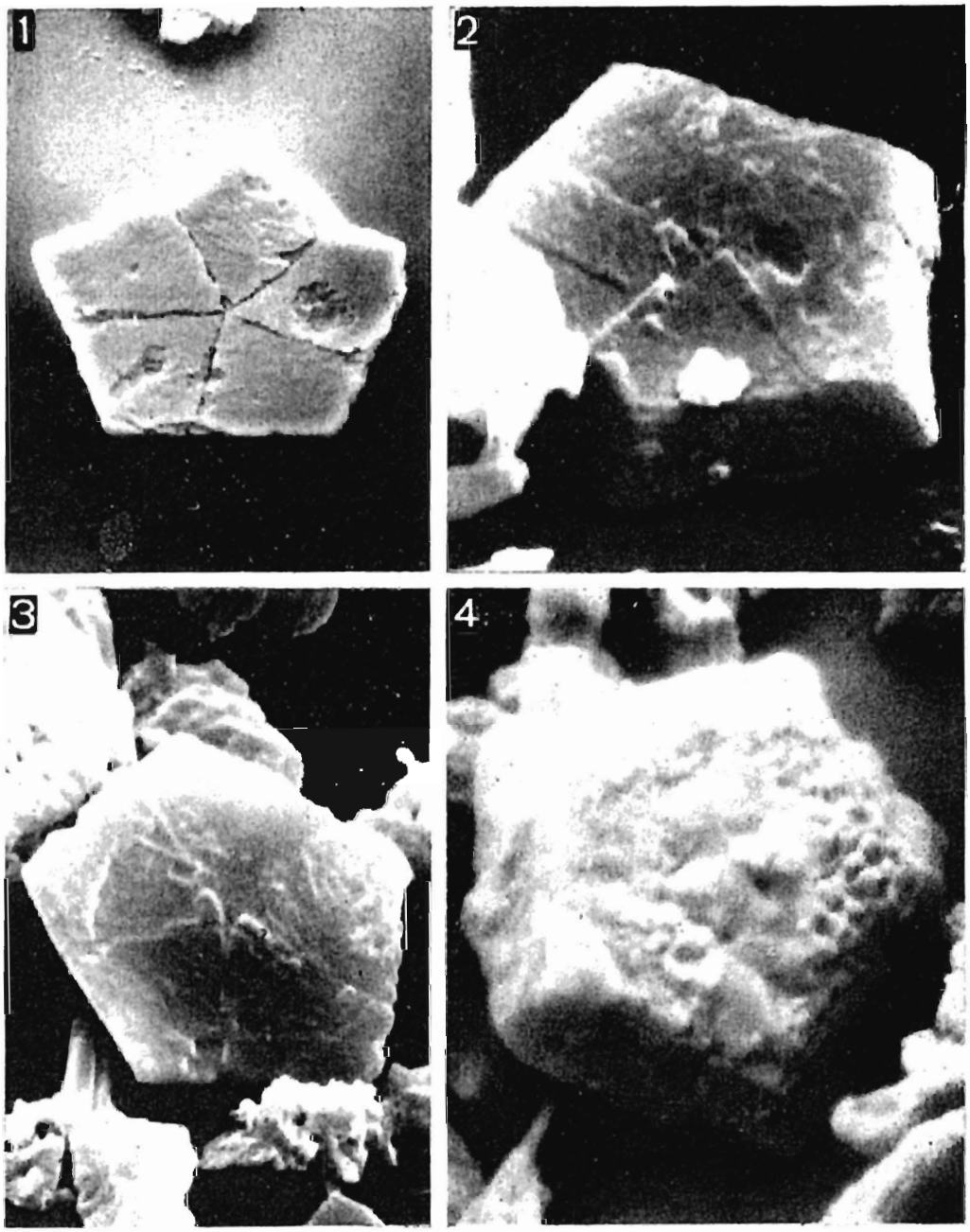






Upper Maastrichtian species of *Lithraphidites*

1 and 2 — *Lithraphidites quadratus* Bramlette & Martini, Lucimia, × 8,000
3 — *Lithraphidites quadratus* Bramlette & Martini, borehole Żyrzyn (depth 115.4 m), × 5,400
4 — *Lithraphidites grossopectinatus* Bukry, Żyrzyn (depth 110.2 m), × 9,000
5 — *Lithraphidites carniolensis* Deflandre, Żyrzyn (depth 115.4 m), × 13,500



Paleocene calcareous nannoplankton

1 and 2 — *Braarudosphaera bigelowi* (Gran & Braarud); Rzeczyca; *1* × 4,000, *2* × 8,000

3 — *Braarudosphaera bigelowi* (Gran & Braarud), Parchatka, × 8,000

4 — *Goniolithus fluckigeri* Deflandre, Nasiłów, × 10,000

Occurrence. — Danian of Denmark, France, the United States (Bramlette & Martini 1964, Hay & Mohler 1967, Perch-Nielsen 1969*a*, Manivit 1971), and Crimea (Shumenko 1976).

In the study area, a few specimens have been found in the Paleocene at Nasiłów.

Family **Goniolithaceae** Deflandre, 1957
Genus *GONIOLITHUS* Deflandre, 1957
Type species: *Goniolithus fluckigeri* Deflandre, 1957
Goniolithus fluckigeri Deflandre, 1957
(Pl. 44, Fig. 4)

1967. *Goniolithus* cf. *G. fluckigeri* Deflandre; W. Hay & H. Mohler, p. 1536, Pl. 202, Figs 4—5.
1969*a*. *Goniolithus fluckigeri* Deflandre, 1957; K. Perch-Nielsen, p. 62, Pl. 6, Figs 7—8.
Dimensions: diameter 7—9 μ.

Remarks. — The wall consists of rectangular crystals, while the central area is filled with small grains.

Occurrence. — Danian of France (Hay & Mohler 1967) and Denmark (Perch-Nielsen 1969*a*).

In the study area, the species has been found in the Paleocene at Nasiłów and Rzeczyca.

Family **Fasciculithaceae** Hay & Mohler, 1967
Genus *FASCICULITHUS* Bramlette & Sullivan, 1961
Type species: *Fasciculithus involutus* Bramlette & Sullivan, 1961
Fasciculithus sp.

Dimensions: diameter 5—6 μ; height 4.5—6 μ.

Remarks. — The investigated specimens were studied exclusively under a light microscope. The short proximal column with concavo-convex ends appears typical of the species *F. tympaniformis*. However, the present author could hardly determine whether the column surface is smooth, or ornamented as in *F. involutus*.

Occurrence. — A few specimens have been found in the Paleocene of Nasiłów and Parchatka.

Family **Microhabdulaceae** Deflandre, 1963
Genus *MICRORHABDULUS* Deflandre, 1959
Type species: *Microrhabdulus decoratus* Deflandre, 1959
Microrhabdulus belgicus Hay & Towe, 1963
(Pl. 42, Fig. 3)

1963. *Microrhabdulus belgicus* Hay & Towe, n. sp.; W. Hay & K. Towe, p. 95, Pl. 1, Fig. 1.
1971. *Microrhabdulus belgicus* Hay; S. Shafik & H. Stradner, p. 84, Text-fig. 3.
1975. *Microrhabdulus belgicus* Hay & Towe; E. Gaździcka, p. 409, Pl. 8, Fig. 4.
1976. *Microrhabdulus belgicus* Hay et Towe, 1963; S. Shumenko, p. 64, Pl. 24, Fig. 1.
Dimensions: length 8—10 μ; width ca 1.5 μ.

Remarks. — There are elongate indistinct grooves at the surface. The specific feature of *M. belgicus* are equidistant rims, each one composed of 8 rhomboidal crystals.

Occurrence. — Turonian to Maastrichtian of Europe (Hay & Towe 1963, Reinhardt 1966, Noël 1970, Shumenko 1976); Coniacian to Campanian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found uncommonly in the Campanian at Sulejów and Ciszyca, and the Maastrichtian at Sadkowice and in the borehole Żyrzyn.

Microrhabdulus decoratus Deflandre, 1959
(Pl. 42, Fig. 1)

1970. *Microrhabdulus decoratus* Deflandre 1959; D. Noël, p. 96, Pl. 36, Figs 7, 12—13 [*cum syn.*].

1971. *Microrhabdulus decoratus* Deflandre; H. Manivit, p. 128, Pl. 18, Figs 1—5.
1976. *Microrhabdulus decoratus* Deflandre, 1959; S. Shumenko, p. 64, Pl. 24, Fig. 2.
Dimensions: length 12—22 μ; width c 1.5 μ.

Remarks. — The specific length of *M. decoratus* appears hardly recognizeable since most specimens are probably broken.

Occurrence. — Cenomanian to Maastrichtian of Europe (Deflandre 1959, Górka 1963, Bramlette & Martini 1964, Reinhardt 1966, Perch-Nielsen 1968, Noël 1970, Manivit 1971, Shumenko 1976); Campanian to Maastrichtian of North America (Gartner 1968); Maastrichtian of Africa (Bramlette & Martini 1964) and Australia (Deflandre 1959).

In the study area, the species has been found in most samples of Campanian and Maastrichtian age.

Microrhabdulus stradneri Bramlette & Martini, 1964

1964. *Microrhabdulus stradneri* Bramlette & Martini, n. sp.; M. Bramlette & E. Martini, p. 316, Pl. 6, Figs 3—4.
1971. *Microrhabdulus stradneri* Bramlette & Martini; H. Manivit, p. 129, Pl. 18, Figs 6—8.
1976. *Microrhabdulus stradneri* Bramlette et Martini, 1964; S. Shumenko, p. 64, Pl. 24, Fig. 5.
Dimensions: length up to 30 μ; width 1.5—2 μ.

Remarks. — Under polarized light, *M. stradneri* differs from *M. decoratus* in triangular shape of the light segments symmetric relative a distinct dark groove concordant with the coccolith axis. Furthermore, *M. stradneri* is somewhat larger than the latter species.

Occurrence. — Campanian to Maastrichtian of Europe (Bramlette & Martini 1964, Manivit 1971, Shumenko 1976); Maastrichtian of North America and Africa (Bramlette & Martini 1964).

In the study area, the species has been found rarely in the Campanian at Dorotka, Ciszyca, and Kaliszany, and commonly in the Maastrichtian at Lucimia and Bochotnica and in the boreholes Żyrzyn and Ożarów.

Genus *LITHRAPHIDITES* Deflandre, 1963
Type species: *Lithraphidites carniolensis* Deflandre, 1963
Lithraphidites carniolensis Deflandre, 1963
(Pl. 43, Fig. 5)

1971. *Lithraphidites carniolensis* Deflandre; H. Manivit, p. 130, Pl. 16, Figs 13—15.
1973. *Lithraphidites carniolensis* Deflandre; H. Priewalder, p. 20, Pl. 12, Fig. 6.
1975. *Lithraphidites carniolensis* Deflandre; E. Gaździcka, p. 409, Pl. 5, Fig. 4b.
1976. *Lithraphidites carniolensis* Deflandre, 1963, S. Shumenko, p. 65, Pl. 24, Figs 8—9.
Dimensions: length 8—18 μ; width 1.5—2.5 μ.

Remarks. — Most investigated specimens are c 10 μ long, while their acute ends indicate their completeness. Conspecific individuals of comparable length were reported by Gartner (1968) from the Campanian and Maastrichtian of the United States. This indicates a considerable decrease in length relative to the older representatives of the species; in fact, the Upper Aptian holotype is 26 μ long and the Albian hypotype (Stradner & *al.* 1968) is 29 μ long.

Occurrence. — Berriasian to Maastrichtian of Europe (Stradner & *al.* 1968, Manivit 1971, Priewalder 1973, Thierstein 1973, Shumenko 1976); Coniacian to Maastrichtian of North America (Gartner 1968).

In the study area, the species has been found uncommonly in the Campanian at Dorotka, and the Maastrichtian at Nasiłów and in the borehole Żyrzyn.

Lithraphidites grossopectinatus Bukry, 1969
(Pl. 18, Fig. 2b, Pl. 43, Fig. 4)

1969. *Lithraphidites grossopectinatus* Bukry, n. sp.; D. Bukry, p. 66, Pl. 40, Fig. 3.
1971. *Lithraphidites grossopectinatus* Bukry; H. Manivit, p. 130, Pl. 16, Fig. 12.
1973. *Lithraphidites grossopectinatus* Bukry; H. Priewalder, p. 20, Pl. 12, Fig. 5.
1975. *Lithraphidites grossopectinatus* Bukry; E. Gaździcka, p. 409, Pl. 5, Fig. 3b.
Demensions: length 7—9 μ; width 2—3 μ.

Remarks. — The specific feature of *L. grossopectinatus* is the occurrence of numerous processes on lists forming a specimen.

Occurrence. — Upper Maastrichtian of Denmark (Bukry 1969), France (Manivit 1971), and Austria (Priewalder 1973).

In the study area, the species has been found in the Upper Maastrichtian at Nasiłów and in the boreholes Żyrzyn and Zemborzyce.

Lithraphidites quadratus Bramlette & Martini, 1964
(Pl. 33, Fig. 1b, Pl. 39, Fig. 3, and Pl. 43, Figs 1—3)

1964. *Lithraphidites quadratus* Bramlette & Martini, n. sp.; M. Bramlette & E. Martini, p. 310, Pl. 6, Figs 16—17 and Pl. 7, Fig. 8.
1973. *Lithraphidites quadratus* Bramlette & Martini; H. Priewalder, p. 20, Pl. 13, Figs 1—2.
1975. *Lithraphidites quadratus* Bramlette & Martini; E. Gaździcka, p. 409, Pl. 8, Fig. 3a.
1976. *Lithraphidites quadratus* Bramlette et Martini, 1964; S. Shumenko, p. 65, Pl. 24, Fig. 10.
Dimensions: length 7—12 μ; width 2.5—4 μ

Remarks. — In the study area, forms intermediate from *L. carniolensis* to *L. quadratus* occur in the Upper Campanian and lowermost Maastrichtian. Their laminae are narrower and longer than in *L. quadratus* but their ends appear typical of that species. They occur exclusively in the Upper Campanian and lowermost Maastrichtian where true *L. quadratus* is still lacking. Thus, they may represent an intermediate stage of the phyletic line.

Occurrence. — Maastrichtian of Europe (Bramlette & Martini 1964, Perch-Nielsen 1968, Manivit 1971, Priewalder 1973, Shumenko 1976), North America (Gartner 1968), and Africa (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found in all the samples of Maastrichtian age.

Genera *incertae sedes*
Genus *LUCIANORHABDUS* Deflandre, 1959
Type species: *Lucianorhabdus cayeuxi* Deflandre, 1959
Lucianorhabdus cayeuxi Deflandre, 1959

1959. *Lucianorhabdus cayeuxi* n. sp.; G. Deflandre, p. 142, Pl. 4, Figs 11—25.
1970b. *Lucianorhabdus cayeuxi* Deflandre 1959; P. Reinhardt, p. 74, Text-fig. 78.
1971. *Lucianorhabdus cayeuxi* Deflandre; H. Manivit, p. 139, Pl. 15, Figs 1—2 and Pl. 16, Figs 5—6.
1976. *Lucianorhabdus cayeuxi* Deflandre, 1959; S. Shumenko, p. 76, Pl. 30, Fig. 3.
Dimensions: length 10—25 μ; width 4—6 μ.

Remarks. — The shape is irregular, often [illegible]

Occurrence. — Cenomanian to Maastrichtian of Europe (Deflandre 1959, Stradner 1961, Górka 1963, Bramlette & Martini 1964, Stover 1966, Manivit 1971, Shumenko 1976); Santonian to Campanian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Africa (Bramlette & Martini 1964).

In the study area, the species has been found in all the samples of Campanian and Maastrichtian age.

Genus *MARTHASTERITES* Deflandre, 1959
Type species: *Marthasterites furcatus* (Deflandre, 1954) Deflandre, 1959
Marthasterites furcatus (Deflandre, 1954) Deflandre, 1959
(Pl. 42, Fig. 5)

1954. *Discoaster(?) furcatus* Defl., cent. nov.; G. Deflandre & C. Fert, p. 168, Pl. 13, Fig. 14.
1959. *Marthasterites furcatus* (Defl.); G. Deflandre, p. 139, Pl. 2, Figs 3—12 and Pl. 3, Figs 1, 5.
1971. *Marthasterites furcatus* Deflandre; H. Manivit, p. 140, Pl. 16, Figs 7—8.
1976. *Marthasterites furcatus* (Deflandre, 1954) Deflandre, 1959; S. Shumenko, p. 74, Pl. 28, Fig. 3.
Dimensions: 5—10 μ.

Remarks. — Fairly narrow and long arms somewhat expanded at the end make the specific feature of *M. furcatus*.

Occurrence. — Turonian to Maastrichtian of Europe (Manivit 1971, Shumenko 1976); Coniacian to Campanian of North America (Gartner 1968, Bukry 1969).

In the study area, the species has been found in the Campanian at Dorotka, and the Maastrichtian of the borehole Żyrzyn.

Marthasterites inconspicuus Deflandre, 1959

1959. *Marthasterites inconspicuus* n. sp.; G. Deflandre, p. 140, Pl. 3, Figs 6—14.
1971. *Marthasterites inconspicuus* Deflandre, 1959; H. Manivit, p. 141, Pl. 16, Figs 8—10.
1976. *Marthasterites inconspicuus* Deflandre, 1959; S. Shumenko, p. 74, Pl. 28, Figs 4—5.
Dimensions: 3—5 μ.

Remarks. — The arms are more or less distinct but always acute at the end.

Occurrence. — Cenomanian to Maastrichtian of the Soviet Union (Shumenko 1976); Santonian to Maastrichtian of North America (Deflandre 1959, Gartner 1968); Maastrichtian of Europe (Deflandre 1959, Perch-Nielsen 1968, Manivit 1971) and Africa (Bramlette & Martini 1964).

In the study area, the species has been found fairly abundantly in most samples of Campanian and Maastrichtian age.

Genus *MICULA* Vekshina, 1959
Type species: *Micula decussata* Vekshina, 1959
Micula decussata Vekshina, 1959
(Pl. 5, Fig. 3*b* and Pl. 42, Figs 4, 6)

1961. *Nannotetraster staurophorus* (Gardet) Martini & Stradner; H. Stradner, p. 83, Text-figs 68—69
1964. *Micula staurophora* (Gardet); M. Bramlette & E. Martini, p. 318, Pl. 6, Figs 7—11.
1968. *Micula decussata* Vekshina; S. Gartner, p. 47, Pl. 2, Figs 5—6, Pl. 4, Fig. 18, Pl. 9, Figs 18—20, Pl. 14, Figs 13—14, Pl. 18, Fig. 7, and Pl. 20, Fig. 15.
1969. *Micula decussata decussata* Vekshina; D. Bukry, p. 67, Pl. 40, Figs 5—6.
1970. *Micula staurophora decussata* (Vekshina) nov. comb.; D. Noël, p. 98, Pl. 37, Figs 1—8 and Pl. 38, Figs 1—2.
1972. *Micula cubiformis* n. sp.; S. Forchheimer, p. 54, Pl. 25, Figs 1, 3—5.
1976. *Micula staurophora* (Gardet, 1955) Stradner, 1963; S. Shumenko, p. 73, Pl. 28, Figs 1—2.
Dimensions: 4—8 μ.

Remarks. — The specific name *staurophora* was originally given to coccoliths derived from the Neogene strata (Gardet 1955). The present author follows the opinion of Gartner (1968) that that name cannot be accepted since nobody knows insofar whether those coccoliths were redeposited from the Cretaceous or not.

Occurrence. — Hauterivian to Cenomanian of Sweden (Forchheimer 1972); Turonian to Maastrichtian of other European countries (Bramlette & Martini 1964, Perch-Nielsen 1968, Manivit 1971, Shumenko 1976); Coniacian to Campanian of North America (Gartner 1968, Bukry 1969); Maastrichtian of Africa, Australia, and New Zealand (Bramlette & Martini 1964, Shafik & Stradner 1971).

In the study area, the species has been found abundantly in all the samples of Campanian and Maastrichtian age.

Micula aff. *decussata* Vekshina, 1959
(Pl. 42, Fig. 2)

Dimensions: up to 10 μ.

Remarks. — Specimens resembling generally *M. decussata* but displaying unusually long and pointed spine-like corners are assigned herein.

Occurrence. — Upper Maastrichtian of the borehole Żyrzyn.

Genus *RHOMBOASTER* Bramlette & Sullivan, 1961
Type species: *Rhomboaster cuspis* Bramlette & Sullivan, 1961
Rhomboaster cuspis Bramlette & Sullivan, 1961

1961. *Rhomboaster cuspis* Bramlette & Sullivan, n. sp.; M. Bramlette & F. Sullivan, p. 166, Pl. 14, Figs 17—19.
1971. *Rhomboaster cuspis* Bramlette & Sullivan; H. Manivit, p. 142, Pl. 23, Figs 8—9.
?1971. *Marthasterites spineus* nov. spec.; S. Shafik & H. Stradner, p. 93, Text-figs 6—7*a*-d.
Dimensions: 9—11 μ.

Remarks. — The specimens from the Paleocene of Egypt described by Shafik & Stradner (1971) as *Marthasterites spineus* differ from *Rhomboaster cuspis* from the Paleocene of California (Bramlette & Sullivan 1971) only in their size.

Occurrence. — Maastrichtian of France (Manivit 1971); Paleocene to Eocene of California (Bramlette & Sullivan 1961); presumably, Paleocene of Egypt (Shafik & Stradner 1971).

In the study area, the species has been found in several samples of Campanian and Maastrichtian age.

Genus *TETRALITHUS* Gardet, 1955

Type species: *Tetralithus pyramidus* Gardet, 1955

Tetralithus aculeus (Stradner, 1961) Gartner, 1968

1961. *Zygrhablithus aculeus* nov. spec.; H. Stradner, p. 61, Text-figs 53—57.
1968. *Tetralithus* sp. aff. *Tetralithus aculeus* (Stradner); S. Gartner, p. 43, Pl. 9, Fig. 5 and Pl. 13, Fig. 5.
1971. *Tetralithus aculeus* (Stradner) Gartner; H. Manivit, p. 143, Pl. 25, Figs 13—15.
1976. *Tetralithus? aculeus* (Stradner, 1961) Manivit, 1971; S. Shumenko, p. 71.
Dimensions: 7—10 μ.

Remarks. — Stradner (1961) claimed that the investigated coccoliths consist of 4 rhomboedric elements situated around a symmetry axis, and supposed that the elements represent ends of central processes of the species *Prediscosphaera cretacea* (= *Zygrhablithus intercisus*). However, this hypothesis has not been supported by further studies. The coccoliths appear to consist of two triangular elements with a symmetry plane inbetween (Gartner 1968). If so, their attribution to the genus *Tetralithus* may be questioned.

Occurrence. — Upper Campanian to Maastrichtian of Europe and North America (Stradner 1961), Gartner 1968, Cita & Gartner 1971, Manivit 1971, Shumenko 1976).

In the study area, the species has been found in the Upper Campanian and Lower Maastrichtian at Dorotka, Ciszyca, Kaliszany, Pawłowice, Sadkowice, Dziurków, Lipsko and Solec.

Tetralithus obscurus Deflandre, 1959

1959. *Tetralithus obscurus* n. sp.; G. Deflandre, p. 138, Pl. 3, Figs 26—29.
1971. *Tetralithus obscurus* Deflandre; H. Manivit, p. 144, Pl. 25, Figs 2—5.
1976. *Tetralithus obscurus* Deflandre, 1959; S. Shumenko, p. 72, Pl. 27, Fig. 10.
Dimension: 5—7 μ.

Occurrence. — Upper Campanian to Maastrichtian of Europe and North America (Stradastrichtian at Dorotka, Ciszyca, Kaliszany, Pawłowice, Sadkowice, Dziurków, Lipsko and Solec. lette & Martini 1964).

In the study area, the species has been found in the Upper Maastrichtian at Nasiłów and in the borehole Żyrzyn.

BIOSTRATIGRAPHY

Some distinct zonation patterns have been proposed recently based upon the Upper Cretaceous calcareous nannoplankton (Bukry 1969, Čepek & Hay 1969, Manivit 1971, Perch-Nielsen 1972, Thierstein 1976, Sissingh 1977). There are large inconsistencies among the biostratigraphic schemes due both to the climatic and facies influences upon calcareous nannoplanktic assemblages. Furthermore, the inconsistencies result also in part from differential taxonomic assignment of particular forms by diverse authors and much ambiguity in usage of many specific and generic names; this is probably caused by methodological dualism in studies on calcareous nannoplankton (the use of both light and electron microscopes).

The succession of Campanian to Maastrichtian calcareous nannoplanktic zones found in the Lublin Upland, Central Poland (Text-fig. 2), appears consistent with that recognized by Manivit (1971) in France. The Pa-

leogene zonation as recognized in the present study follows that proposed by Martini (1970) for the standard pattern. All the calcareous nannoplanktic zones are here meant as coenozones.

ARKHANGELSKIELLA SPECILLATA ZONE

Definition: Interval from the first occurrence of *Arkhangelskiella speciallata* Vekshina to the first occurrence of *Tetralithus aculeus* (Stradner).
Author: Manivit (1971).

Remarks. — Species unknown in older zones appear in the calcareous nannoplanktic assemblage, viz. *Arkhangelskiella specillata* Vekshina, *Broinsonia parca* (Stradner), and *Reinhardtites anthophorus* (Deflandre). In turn, *Arkhangelskiella cymbiformis* Vekshina, *Biscutum constans* (Górka), *Chiastozygus litterarius* (Górka), *Cribrosphaera ehrenbergi* Arkhangelsky, *Kamptnerius magnificus* Deflandre, *Micula decussata* Vekshina, *Vekshinella crux* (Deflandre & Fert), and *Watznaueria barnesae* (Black) are among the most common species. The base of *Arkhangelskiella specillata* Zone has not been recognized in the study area because of the lack of adequate paleontological material.

Locality: Sulejów.
Age: Early Campanian.

TETRALITHUS ACULEUS ZONE

Definition: Interval from the first occurrence of *Tetralithus aculeus* (Stradner) to the first occurrence of *Lithraphidites quadratus* Bramlette & Martini.
Authors: Cepek & Hay (1969), modified by Manivit (1971).

Remarks. — In this zone, *Angulofenestrellithus snyderi* Bukry, *Eiffellithus regularis* (Górka), *Microrhabdulus stradneri* Bramlette & Martini, *Rhomboaster cuspis* Bramlette & Martini, and *Tetralithus aculeus* (Stradner) appear for the first time. In addition to those species common already in the underlying zone, *Broinsonia parca* (Stradner), *Lithraphidites carniolensis* Deflandre, *Microrhabdulus decoratus* Deflandre, and *Prediscosphaera propinqua* (Górka) do also appear abundantly.

Localities: Vistula Valley (between Dorotka and Solec at the left side; Józefów, Kaliszany, and Piotrowin at the right side); borehole Ożarów I (depth 77—10 m).
Age: Late Campanian to earliest Maastrichtian.

LITHRAPHIDITES QUADRATUS ZONE

Definition: Interval from the first occurrence of *Lithraphidites quadratus* Bramlette & Martini to the first occurrence of *Nephrolithus frequens* Górka.
Authors: Cepek & Hay (1969).

Remarks. — The species *Lithraphidites quadratus* Bramlette & Martini appears abundantly in this zone, while *Zygodiscus acanthus* (Reinhardt), *Zygodiscus compactus* Bukry, and *Zygodiscus spiralis* Bramlette & Martini appear but in its higher part. The calcareous nannoplanktic assemblage is dominated by most species recorded in the older zones, accompanied by *Prediscosphaera cretacea* (Arkhangelsky), and *Lithraphidites quadratus* Bramlette & Martini. The genus *Microrhabdulus* is much less abundant than in the older zones, whereas the species *Tetralithus aculeus* (Stradner) is absent. *Lithraphidites grossopectinatus* Bukry recorded by Manivit (1971) in this zone appears in the study area but in the next successive zone.

Localities: Bolska, Białobrzegi, and Jarentowskie Pole; boreholes Ożarów *I* (depth 10—2 m), Elżbieta *II* (depth 61—3 m), Głusko *III* (depth 110—9 m), Karczmiska *IV* (depth 102—82 m), and Kępa *V* (depth 98—15 m).
Age: Early Maastrichtian.

NEPHROLITHUS FREQUENS ZONE

Definition: Interval from the first occurrence of *Nephrolithus frequens* Górka to the extinction of most Upper Cretaceous species.
Authors: Cepek & Hay (1969).

Remarks. — The species *Nephrolithus frequens* Górka appears in this zone. The appearance of many other species in this zone in the study area is but an artifact of more intense sampling; in fact, those species have been recorded in older strata abroad. The calcareous nannoplanktic assemblage is dominated by those species dominant in *Lithraphidites quadratus* Zone, accompanied by *Nephrolithus frequens* Górka, *Tetralithus obscurus* Deflandre, and *Zygodiscus spiralis* Bramlette & Martini. The genus *Broinsonia* and the species *Kamptnerius magnificus* Deflandre, *Eiffellithus regularis* (Górka), *Reinhardtites anthophorus* (Deflandre), and *Vekshinella crux* (Deflandre & Fert) are much less common than in the older zones.

Moreover, the calcareous nannoplanktic assemblage decreases gradually in diversity through the investigated zone. In the uppermost part of the zone, equivalent to the Żyrzyn Beds of Pożaryska (1965), some species disappear that attained their maximum development in the Campanian or earlier but persisted also in the lower part of *Nephrolithus frequens* Zone. In turn, the Paleogene species *Markalius inversus* (Deflandre) and *Thoracosphaera operculata* Bramlette & Martini appear in those strata representing therefore a horizon intermediate from the Upper Maastrichtian to Paleocene. The assemblages of this type have been found not only in the borehole Żyrzyn but also in the boreholes Zemborzyce and Podole.

Localities: Lucimia, Nasiłów, Mećmierz, Kazimierz, and Bochotnica; boreholes Karczmiska *IV* (depth 80—14 m), Bełżyce *VII* (depth 97—6 m), Zemborzyce *IX* (depth 101—69 m), Podole *X* (depth 86—29 m), and Żyrzyn *1* (depth 126—97 m).
Age: Late Maastrichtian.

MARKALIUS INVERSUS ZONE

Definition: Interval from the last occurrence of *Arkhangelskiella cymbiformis* Vekshina to the first occurrence of *Cruciplacolithus tenuis* (Stradner).
Authors: Hay & Mohler (1967), modified by Martini (1970).

Remarks. — The calcareous nannoplanktic assemblage is poor in both species and individuals. The index species *Markalius inversus* (Deflandre) occurs already in the uppermost Maastrichtian. Most Upper Cretaceous species are lacking in the study area, except of singular specimens of *Biscutum constans* (Górka), *Cribrosphaera ehrenbergi* Arkhangelsky, *Kamptnerius magnificus* Deflandre, *Tranolithus manifestus* Stover, and *Zygodiscus compactus* Bukry. However, all the above-mentioned specimens are probably redeposited, as suggested by their preservation state.

Locality: Borehole Żyrzyn 1 (depth 97—89 m).
Age: Danian.

FASCICULITHUS TYMPANIFORMIS ZONE

Definition: Interval from the first occurrence of *Fasciculithus tympaniformis* Hay & Mohler to the first occurrence of *Heliolithus kleinpelli* Sullivan.
Authors: Hay & Mohler (1967).

Remarks. — The calcareous nannoplanktic assemblage found in the study area is less diverse than its time equivalents from abroad. This is probably due to the local ecological conditions. The simultaneous appearance of *Cruciplacolithus tenuis* (Stradner), *Chiasmolithus danicus* (Brotzen), *Ericsonia cava* (Hay & Mohler), and the genus *Fasciculithus* indicates a stratigraphic hiatus in the Paleocene in the study area.

The investigated calcareous nannoplanktic assemblage is dominated by *Markalius inversus* (Deflandre) and *Ericsonia cava* (Hay & Mohler). There are also some Upper Cretaceous species, probably redeposited from the older strata.

The top of *Fasciculithus tympaniformis* Zone has not been recognized in the study area, as the investigated section ends with an erosional boundary.

Localities: Bochotnica, Nasiłów, Parchatka, Rzeczyca, Wierzchoniów, and Witoszyn.
Age: Danian to Montian.

FINAL REMARKS

The very rich and diverse calcareous nannoplanktic assemblages in the Campanian through Maastrichtian of the western part of Lublin Upland, Central Poland, comprise 73 species of 37 genera. The nannoplankton abundance indicates a warm- and clear-water normal-marine sedimentary environment for the investigated deposits. This was probably a pelagic realm, as evidenced by the occurrence of planktic foraminifers and radiolarians. On the other hand, the commonness of echinoids, gastropods, bivalves, bryozoans, and corals may indicate that the water depth did not exceed 100—300 m.

The investigated calcareous nannoplanktic assemblages appear closely related to their time equivalents reported from e.g. Denmark, the Netherlands, northern France, and the European part of the Soviet Union. The analogies in taxonomic composition of nannoplankton evidence the existence of connections among the considered Upper Cretaceous marine basins. In contrast, the investigated assemblage is largely different from the Tethyan ones (Egypt, Tunisia, southern France). In fact, the Upper Maastrichtian assemblage of Egypt (*cf.* Shafik & Stradner 1971) lacks the species *Nephrolithus frequens* Górka common in higher latitudes, while it comprises many species absent from the Maastrichtian of Central Europe.

The Lower Paleogene deposits present in the north of the study area comprise but very poor calcareous nannoplanktic assemblages or even lack those fossils at all. There are but a dozen species in the investigated Paleogene strata, while just above the Maastrichtian boundary there are only a few species. Furthermore, most Paleogene species represent new phyletic lineages, that is unknown from the Mesozoic. The genus *Braarudosphaera* (ranging Jurassic through Recent) and the species *Markalius inversus* (Deflandre) and *Thoracosphaera operculata* Bramlette & Martini (both the species known since the uppermost Maastrichtian) are the only exceptions. This sharp difference in composition of the calcareous nannoplanktic assemblages reflects a crisis underwent by those organisms at the Cretaceous/Tertiary boundary (*cf.* Bramlette & Martini 1964, Hay & Mohler 1967). No statisfactory causal explanation for the phenomenon

has been insofar given. One may but note that submarine-erosion traces in the uppermost Maastrichtian and glauconite-content increase in the Lower Paleogene observed in both Europe and North America (Hay & Mohler 1967) can also be recognized in the Lublin Upland (*cf.* Pożaryski 1938, Pożaryska 1952). The species *Braarudosphaera bigelowi* (Gran & Braarud) occurs sporadically in the Campanian and Maastrichtian in the study area, while it becomes fairly common in the Paleocene. The Paleocene lithology may suggest a more shallow-water sedimentary environment (coarse-grained fraction, sharp-edged detrital quartz). At present, the considered species occurs exclusively in nearshore areas; its distribution in the study area may then suggest that the species can be regarded as indicative of such geological environments.

The uniqueness of the investigated Paleogene calcareous nannoplanktic assemblage is in its gradually decreasing diversity starting with the *Fasciculithus tympaniformis* Zone, which contrasts with the general trend displayed by those organisms. This gradual fall and ultimate disappearance of calcareous nannoplankton found in the study area resulted probably from a change in facies and ecological conditions related to the emersion of the Middle-Polish Anticlinorium (Kutek & Głazek 1972), the latter being a tectonic unit extending over the western part of the Lublin Upland.

Institute of Geology
of the Warsaw University,
Al. Żwirki i Wigury 93,
02-089 Warszawa, Poland

REFERENCES

ABERG M. 1966. Electron microscopic studies on *Nephrolithus* (Coccolithophoridae). *Stockholm Contr. Geol.*, **13** (6), 63—67. Stockholm.

ARKHANGELSKY A. D. 1912. Kreidezonen im Distrikt Saratow im östlichen europäischen Russland. *Mater. Geol. Russl.*, **25**, 1—631. St. Petersburg — Moscau.

BLACK M. 1959. *In:* BLACK M. & BARNES B., The structure of coccoliths from the English Chalk. *Geol. Mag.*, **96**, 321—328. Hertford.

— 1964. Cretaceous and Tertiary coccoliths from Atlantic seamounts. *Palaeontology*, **7** (2), 300—316. Oxford — London.

— 1967. New names for some coccolith taxa. *Geol. Soc. London, Proc.*, **1640**, 139—145. London.

— 1968. Taxonomic problems in the study of coccoliths. *Palaeontology*, **11** (5), 793—813. Oxford — London.

— 1973. British Lower Cretaceous coccoliths. I. Gault clay. Part 2. *Palaeont. Soc. Monographs*, **127**, 49—112. London.

BRAMLETTE M. N. & MARTINI E. 1964. The great change in calcareous nannoplankton fossils between the Maestrichtian and Danian. *Micropaleontology*, **10** (3), 291—322. New York.

— & SULLIVAN F. R. 1961. Coccolithophorids and related nannoplankton of the Tertiary in California. *Micropaleontology*, **7** (2), 129—188. New York.

BUKRY D. 1969. Upper Cretaceous coccoliths from Texas and Europe. *Univ. Kansas Paleont. Contr.*, **51** (Protista 2), 1—79. Lawrence.

BURNS D. A. 1976. Nannofossils from the Lower and Upper Cretaceous chalk deposits, Nettleton Lincolnshire, England. *Rev. Espan. Micropaleont.*, **8** (2), 279—300. Madrid.

BYSTRICKA H. 1975. Middle Paleocene coccoliths of the West Carpathians. *Západné Karpaty, Sér. Paleontológia* (1), 41—57. Bratislava.

CARATINI C. 1963. Contribution à l'etude des coccolithes du Cénomanien supérieur et du Turonien de la région de Rouen. *Publ. Lab. Géol. Appl. Univ. Alger*, 1—61. Paris.

ČEPEK P. 1970. Zur Verticalverbreitung von Coccolithen-Arten in der Oberkreide NW-Deutschlands. *Geol. Jb.*, **88**, 235—264. Hannover.

— & HAY W. W. 1969. Calcareous nannoplankton and biostratigraphic subdivision of the Upper Cretaceous. *Trans. Gulf Coast Assoc. Geol. Soc.*, **19**, 323—336.

CIEŚLIŃSKI S. 1973. *In:* Geology of Poland, Vol. 1, Stratigraphy, Part 2. *Wydawnictwa Geologiczne*, Warsaw.

CITA M. B. & GARTNER S. 1971. Deep sea Upper Cretaceous from the Western North Atlantic. *In:* FARINACCI A. (*Ed.*), Proceedings of the II Planktonic Conference, Roma 1970, 287—319. Roma.

DEFLANDRE G. 1952. Classe des Coccolithophoridés. *In*: PIVETEAU J., Traité de Paléontologie, **1**, 107—115. Paris.

— 1959. Sur les Nannofossiles calcaires et leur systématique. *Rev. Micropaléont.*, **2** (3), 127—152. Paris.

— 1963. Sur les Microrhabdulidés, famille nouvelle de nannofossiles calcaires. *C. R. Acad. Sci. Paris*, **256**, 3484—3486. Paris.

— & FERT C. 1954. Observations sur les Coccolithophoridés actuels et fossiles en microscopie ordinaire et électronique. *Ann. Paléont.*, **40**, 115—176. Paris.

EDWARDS A. 1966. Calcareous nannoplankton from the Uppermost Cretaceous and Lowermost Tertiary of the Mid-Waipara section, South Island, New Zealand. *N. Z. J. Geol. Geophys.*, **9** (4), 481—490. Wellington.

FORCHHEIMER S. 1972. Scanning electron microscope studies of Cretaceous coccoliths from the Köpingsberg borehole No. 1, SE Sweden. *Sver. Geol. Undersök., Ser. C.* No. 668, Arsb. 65, No. 14, 1—87. Stockholm.

GARTNER S. 1968. Coccoliths and related calcareous nannofossils from Upper Cretaceous deposits of Texas and Arkansas. *Univ. Kansas Paleont. Contr.*, **48** (Protista 1), 1—56, Lawrence.

GAŻDZICKA E. 1975. Upper Maestrichtian coccoliths of the Lublin Upland. *Acta Geol. Pol.*, **25** (3), 407—412. Warszawa.

GÓRKA H. 1957. Les Coccolithophoridés du Maestrichtien supérieur de Pologne. *Acta Palaeont. Pol.*, **2** (2—3), 235—284. Warszawa.

— 1963. Coccolithophoridés, Dinoflagellés, Hystrichosphaeridés et microfossiles incertae sedis du Crétacé supérieur de Pologne. *Acta Palaeont. Pol.*, **8** (1), 3—90. Warszawa.

GRIGOROVITSCH A. S. 1974. The coccolith assemblages from the Upper Cretaceous deposits of Volyno-Podolian Platform. *Paleont. Sborn.*, **10** (2), 71—77. Lvov.

HAY W. W. & MOHLER H. P. 1967. Calcareous nannoplankton from Early Tertiary rocks at Pont Labau, France, and Paleocene — Early Eocene correlations. *J. Paleont.*, **41** (6), 1505—1541. Menasha.

—, — & WADE M. E. 1966. Calcareous nannofossils from Nal'chik (Northwest Caucasus). *Eclogae Geol. Helv.*, **59** (1), 379—399. Basel.

— & TOWE K. M. 1963. *Microrhabdulus belgicus*, a new species of nannofossils. *Micropaleontology*, 9 (1), 95—96. New York.

HOFFMANN N. 1970*a*. Taxonomische Untersuchungen an Coccolithineen aus der Kreide Norddeutschlands anhand elektronen-mikroskopischer Aufnahmen. *Hercynia*, 7 (1—3), 169—198. Leipzig.

— 1970*b*. Coccolithineen aus der weissen Schreibkreide (Unter-Maastricht) von Jasmund auf Rügen. *Geologie*, 19 (7), 846—879. Berlin.

— 1972. Coccolithen aus der Kreide und dem Paläogen des nördlichen Mitteleuropas. *Geologie*, 21 (73), 1—121. Berlin.

JAFAR S. A. 1977. A device for variable observation of the same nannoplankton specimen, with remarks on Paleocene coccoliths from Alabama. *N. Jb. Geol. Paläont. Mh.*, 2, 103—111. Stuttgart.

KAMPTNER E. 1956. *Thoracosphaera Deflandrei* nov. spec., ein bemerkenswertes Kalkflagellaten-Gehäuse aus dem Eocän von Donzacq (Dep. Landes, Frankreich). *Zt. Österr. Botan.*, 103 (4), 448—456. Wien.

KUTEK J. & GŁAZEK J. 1972. The Holy Cross Area, Central Poland, in the Alpine Cycle. *Acta Geol. Pol.*, 22 (4), 603—652. Warszawa.

LOEBLICH A. R. & TAPPAN H. 1963. Type fixation and validation of certain calcareous nannoplankton genera. *Biol. Soc. Washington Proc.*, 76, 191—196. Washington.

MANIVIT H. 1971. Nannofossiles calcaires du Crétacé Français (Aptien — Maestrichtien). Essai de Biozonation appuyée sur les Stratotypes. Thése. 1—187. Orsay.

MARTINI E. 1970. Standard Palaeogene calcareous nannoplankton zonation. *Nature*, 226 (5245), 560—561. London.

NOËL D. 1956. Coccolithes des terrains jurassiques de l'Algérie. *Publ. Serv. Carte Géol. Algérie*, 2 (8), 303—345. Alger.

— 1965. Sur les Coccolithes du Jurassique Européen et d'Afrique du Nord. Essai de classification des coccolithes fossiles. *Centre Nat. Rech. Sci.*, Paris.

— 1969. *Arkhangelskiella* (Coccolithes crétacés) et formes affines du Bassin de Paris. *Rev. Micropaléont.*, 11 (4), 191—204. Paris.

— 1970. Coccolithes crétacés. La craie campanienne du Bassin de Paris. *Centre Nat. Rech. Sci.*, Paris.

PERCH-NIELSEN K. 1968. Der Feinbau und die Klassifikation der Coccolithen aus dem Maastrichtien von Dänemark. *Kong. Danske Vidensk. Selsk., Biol. Skr.* 16 (1), 1—96. København.

— 1969*a*. Die Coccolithen einiger Dänischer Maastrichtien- und Danienlokalitäten. *Medd. Dansk Geol. Foren.*, 19 (1), 51—68. København.

— 1969*b*. Elektronenmikroskopische Untersuchungen der Coccolithophoriden der Dan-Scholle von Katharinenhof (Fehmarn). *N. Jb. Geol. Paläont. Abh.*, 132 (3), 317—332. Stuttgart.

— 1972. Remarks on Late Cretaceous to Pleistocene coccoliths from the North Atlantic. *In:* LAUGHTON A. S., BERGGREN W. A., & *al.*, Initial Reports of the Deep Sea Drilling Project, 12, 1003—1069. Washington.

POŻARYSKA K. 1952. The sedimentological problems of Upper Maestrichtian and Danian of the Puławy environment (middle Vistula). *Inst. Geol. Pol., Bull.*, 81, 1—104. Warszawa.

— 1965. Foraminifera and biostratigraphy of the Danian and Montian in Poland. *Palaeont. Pol.*, 14, 1—154. Warszawa.

POŻARYSKI W. 1938. Senonsstratigraphie im Durchbruch der Weichsel zwischen Rachów und Puławy in Mittelpolen. *Inst. Geol. Pol., Bull.*, 6, 1—94. Warszawa.

PRIEWALDER H. 1973. Die Coccolithophoridenflora des Locus typicus von *Pseudotextularia elegans* (Rzehak), Reingrüberhöhe, Niederösterreich; (Maastricht). *Jb. Geol. B.-A.*, **116**, 9—34. Wien.

RADOMSKI A. 1968. Calcareous nannoplankton zones in Palaeogene of the Western Polish Carpathians. *Ann. Soc. Géol. Pol.*, **38** (4), 545—605. Kraków.

REINHARDT P. 1964. Einige Kalkflagellaten-Gattungen (Coccolithophoriden, Coccolithineen) aus dem Mesozoikum Deutschlands. *Monatsber. Dt. Akad. Wiss. Berlin*, **6** (10), 749—759. Berlin.

— 1965. Neue Familien für fossile Kalkflagellaten (Coccolithophoriden, Coccolithineen). *Monatsber. Dt. Akad. Wiss. Berlin*, **7** (1), 30—40. Berlin.

— 1966. Zur Taxonomie und Biostratigraphie des fossilen Nannoplanktons aus dem Malm, der Kreide und dem Alttertiär Mitteleuropas. *Freiberger Forsch.-H.* **C 196**, 5—63. Leipzig.

— 1967. Fossile Coccolithen mit rhagoidem Zentralfeld (Fam. Ahmuellerellaceae, Subord. Coccolithineae). *N. Jb. Geol. Paläont. Mh.*, **3**, 163—178. Stuttgart.

— 1970*a*. Synopsis der Gattungen und Arten der mesozoischen Coccolithen und anderer kalkiger Nannofossilien, Teil 1. *Freiberger Forsch.-H.*, **C 260**, 5—30. Leipzig.

— 1970*b*. Synopsis der Gattungen und Arten der mesozoischen Coccolithen und anderer kalkiger Nannofossilien, Teil. 2. *Freiberger Forsch.-H.*, **C 265**, 43—94. Leipzig.

— 1971. Synopsis der Gattungen und Arten der mesozoischen Coccolithen und anderer kalkiger Nannofossilien, Teil 3. *Freiberger Forsch.-H.*, **C 267**, 19—41. Leipzig.

— & GÓRKA H. 1967. Revision of some Upper Cretaceous coccoliths from Poland and Germany. *N. Jb. Geol. Paläont. Abh.*, **129** (3), 240—256. Stuttgart.

ROTH P. H. & THIERSTEIN H. 1972. Calcareous nannoplankton: Leg 14 of the Deep Sea Drilling Project: *In:* HAYES D. E., PIMM A. C., & *al.*, Initial Reports of the Deep Sea Drilling Project, **14**, 421—485. Washington.

SHAFIK S. & STRADNER H. 1971. Nannofossils from the Eastern Desert, Egypt with reference to Maastrichtian Nannofossils from the USSR. *Jahrb. Geol. B. A.*, **17**, 69—104. Wien.

SHUMENKO S. I. 1968. Nekotorye momenty ontogeneza, izmenchivosti i sistematiki iskopaemykh kokkolitoforid na osnove elektronomikroskopicheskikh issledovanij. *Paleont. Zh.*, **4**, 32—37. Moskva.

— 1976. Mesozoic calcareous nannoplankton of the European part of the USSR., *Nauka*, Moskva.

SISSINGH W. 1977. Biostratigraphy of Cretaceous calcareous nannoplankton. *Geol. Mijnbouw*, **56** (1), 37—65. Den Haag.

STOVER L. E. 1966. Cretaceous coccoliths and associated nannofossils from France and Netherlands. *Micropaleontology*, **12** (2), 133—167. New York.

STRADNER H. 1961. Vorkommen von Nannofossilien im Mesozoikum. *Erdoel-Zt.*, **3**, 77—88. Wien.

— 1962. Uber neue und wenig bekannte Nannofossilien aus Kreide und Alttertiär. *Verh. Geol. B.-A.*, **2**, 363—377. Wien.

— 1963. New contributions to Mesozoic stratigraphy by means of nannofossils. *Proc. VI World Petrol. Congr., Frankfurt am Main 1963*, Sect. **1** (4), 1—16. Frankfurt a. M.

— & ADAMIKER D. 1966. Nannofossilien aus Bohrkernen und ihre elektronenmikroskopische Bearbeitung. *Erdöl-Erdgas-Zt.*, **82** (8), 330—341. Hamburg.

— , — & MARESCH O. 1968. Electron Microscope Studies on Albian Calcareous Nannoplankton from the Delft 2 and Leidschendam 1 Deepwells, Holand. *Verh Nederl. Akad. Wetensch., Afd. Natuurk., Eerste Reeks,* **24** (4), 1—107. Amsterdam.

SUJKOWSKI Z. 1931. Étude pétrographique du Crétacé de Pologne. La série de Lublin et sa comparaison avec la craie blanche. *Trav. Inst. Géol. Pol.,* **6** (3), 485—628. Warszawa.

SULLIVAN F. R. 1964. Lower Tertiary nannoplankton from the California Coast Ranges. *I* Paleocene. *Univ. Calif. Publ. Geol. Sci.,* **44** (3), 163—227. Berkeley.

THIERSTEIN H. R. 1971. Tentative Lower Cretaceous nannoplankton zonation. *Eclogae Geol. Helv.,* **64** (3), 459—488. Basel.

— 1973. Lower Cretaceous calcareous nannoplankton biostratigraphy. *Abh. Geol. B.-A.,* **29**, 1—61. Wien.

— 1967. Mesozoic calcareous nannoplankton biostratigraphy of marine sediments. *Marine Micropaleontology,* **1** (4), 325—362. Amsterdam.

E. GAŻDZICKA

NANNOPLANKTON WAPIENNY Z NAJWYŻSZEJ KREDY I PALEOCENU WYŻYNY LUBELSKIEJ

(Streszczenie)

Przedmiotem pracy jest analiza nannoplanktonu wapiennego z utworów kampanu i mastrychtu oraz paleocenu zachodniej części Wyżyny Lubelskiej (*por.* fig. 1). W oparciu o badania w mikroskopie optycznym i elektronowym, opisano z rozmaitych osadów tego obszaru (*por.* pl. 1—4) 83 gatunki kokkolitów reprezentujące 44 rodzaje (*por.* fig. 2 oraz pl. 5—44). Wśród nich 3 gatunki uznano za nowe: *Eiffellithus multicostatus* sp. n., *Broinsonia cribrata* sp. n. i *Thoracosphaera longiuscula* sp. n., a jeden przeniesiono do innego rodzaju: *Vekshinella crucifer* (Noël 1970) n. comb.

Zmiany w zespołach kokkolitów badanego obszaru pozwoliły na wyróżnienie następujących poziomów biostratygraficznych w utworach najwyższej kredy: Arkhangelskiella specillata, Tetralithus aculeus, Lithraphidites quadratus i Nephrolithus frequens, oraz poziomów Markalius inversus (*NP 1*) i Fasciculithus tympaniformis (*NP 5*) w paleocenie (*por.* fig. 2). Następstwo poziomów kokkolitowych w kampanie i mastrychcie jest zgodne ze stwierdzonym w profilach stratotypowych (*por.* Manivit 1971), natomiast następstwo poziomów paleoceńskich świadczy o istnieniu luki sedymentacyjnej obejmującej trzy poziomy w obrębie danu (od *NP 2* do *NP 4*).