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ELŻBIETA GAŹDZICKA

Upper Maestrichtian coccoliths of the Lublin Upland

ABSTRACT: The Żyrzyn Beds (Upper Maestrichtian) of the Lublin Upland yield a rich and well-preserved assemblage of calcareous nannoplankton in which 54 coccolith species belonging to 34 genera were identified by the SEM method. The recognized assemblage is typical of the coccolith zone *Nephrolithus frequens* of the uppermost Maestrichtian.

INTRODUCTION

The Upper Maestrichtian of the Lublin Upland yields very rich and well-preserved calcareous nannoplankton (*vide* Górka 1957, 1963). This group of microfossils recently became the subject of remarkable interest due to the SEM analyses and due to recognition of the stratigraphic value of coccoliths. The author studied the sequence of the Żyrzyn borehole and, for comparative purposes, single samples of core material from the Zemborzyce and Podole boreholes (*cf.* Figs 1—2). Some coccoliths were previously described from the Żyrzyn borehole by Górka (1963) as *Cribrosphaera ehrenbergi, Kamptnerius magnificus, Nephrolithus frequens,* or under other names (*Chiastozygus litterarius, Loxolithus armilla, Prediscosphaera cretacea, Prediscosphaera spinosa* and *Staurolithites crux*).

The analysis of coccoliths was carried out with the use of optical microscope and scanning electron microscope *JEOL JSM-S1*. The material was prepared following the procedure proposed by Perch-Nielsen (1968) and involving ultrasonic and centrifuging treatments. In the identifications, all the recently published papers on Cretaceous coccoliths were taken into account (Bramlette & Martini 1964; Reinhardt 1965, 1970a, b, 1971; Stover 1966; Reinhardt & Górka 1967; Gartner 1968; Perch-Nielsen 1968, 1969, 1972; Bukry 1969; Farinacci 1969; Shumenko 1969; Noël 1969, 1970; Manivit 1971; Shafik & Stradner 1971; Priewalder 1973).

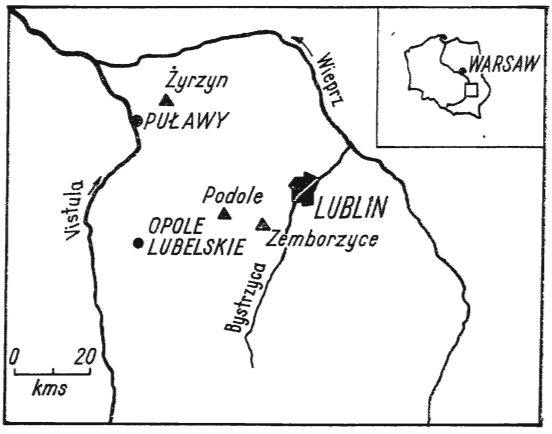

Fig. 1

Location of boreholes sampled for Upper Maestrichtian coccoliths in the Lublin Upland (the inset shows position of the area in Poland)

COCCOLITH ASSEMBLAGE

The material studied is very rich, both in number of species and individuals. It comprises 54 species representing 34 genera. According to the systematics proposed by Noël (1970), Upper Maestrichtian strata of the Lublin Upland yield representatives of the families:

Zygolithaceae Noël, 1965
Podorhabdaceae Noël, 1965
Arkhangelskiellaceae Bukry, 1969
Stephanolithionaceae Black, 1968
Coccolithaceae Kamptner, 1928
Microrhabdulaceae Deflandre, 1963

as well as of several *incertae-sedis* genera:

Lucianorhabdus Deflandre, 1959
Marthasterites Deflandre, 1959
Micula Vekshina, 1959
Rhomboaster Bramlette & Sullivan, 1961
Tetralithus Gardet, 1955.

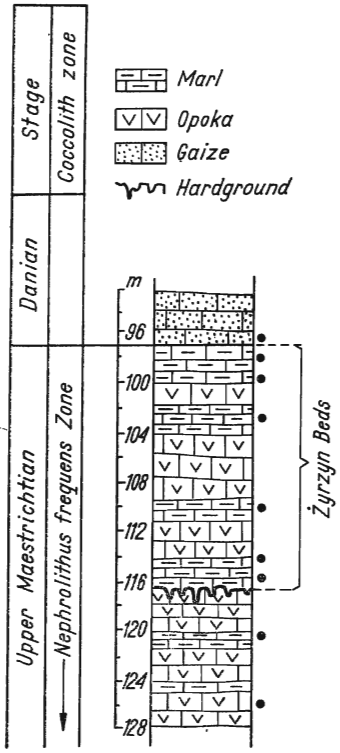

Fig. 2

Investigated interval of the borehole Żyrzyn, Lublin Upland, representing lithological sequence at the Upper Maestrichtian/Danian junction (sampling sites are marked by black dots)

All the species identified are adequately described in the literature, so only their list (Table 1) and some micrographs (Pls 1—8) are given here.

Table 1

Coccolith species of the uppermost Maestrichtian in the Lublin Upland

Ahmuellerella octoradiata (Górka) Reinhardt — Pl. 5, Figs 3a, 4a
Arkhangelskiella cymbiformis Vekshina — Pl. 6, Fig. 3
Arkhangelskiella distincta Shumenko — Pl. 7, Fig. 3b
Arkhangelskiella ethmopora Bukry — Pl. 6, Fig. 4
Arkhangelskiella specillata Vekshina — Pl. 1, Figs 3a, 4 and Pl. 6, Figs 1—2
Biscutum constans (Górka) Black
Biscutum testudinarium Black
Broinsonia bevieri Bukry
Chiastozygus amphipons (Bramlette & Martini) Gartner
Chiastozygus litterarius (Górka) Manivit — Pl. 4, Figs 3—4
Coccolithites dentatus Shumenko
Corollithion exiguum Stradner
Corollithion rhombicum (Stradner & al.) Bukry
Cretarhabdus conicus Bramlette & Martini
Cretarhabdus crenulatus Bramlette & Martini
Cribrosphaera ehrenbergi Arkhangelsky — Pl. 1, Fig. 1b and Pl. 5, Fig. 1
Eiffellithus regularis (Górka) Perch-Nielsen
Eiffellithus turriseiffeli (Deflandre) Reinhardt — Pl. 7, Fig. 2
Gartnerago obliquus (Reinhardt) Noël — Pl. 7, Fig. 4
Kamptnerius magnificus Deflandre
Kamptnerius perciivalii Bukry — Pl. 7, Fig. 1
Lithraphidites carniolensis Deflandre — Pl. 5, Fig. 4b
Lithraphidites grossopectinatus Bukry — Pl. 5, Fig. 3b
Lithraphidites quadratus Bramlette & Martini — Pl. 8, Fig. 3a
Loxolithus armilla (Black & Barnes) Noël
Lucianorhabdus cayeuxi Deflandre
Markalius inversus (Deflandre) Bramlette & Martini
Marthasterites furcatus Deflandre
Marthasterites inconspicuus Deflandre
Microrhabdulus attenuatus (Deflandre) Deflandre
Microrhabdulus belgicus Hay & Towe — Pl. 8, Fig. 4
Microrhabdulus decoratus Deflandre
Microrhabdulus stradneri Bramlette & Martini
Micula decussata Vekshina — Pl. 1, Fig. 3b and Pl. 8, Fig. 2
Nephrolithus frequens Górka — Pl. 1, Fig. 2 and Pl. 5, Fig. 2a
Parhabdolithus bispiralis Noël
Podorhabdus dietzmanni (Reinhardt) Reinhardt
Podorhabdus orbiculofenestrus (Gartner) Thierstein
Prediscosphaera cretacea (Arkhangelsky) — Pl. 1, Figs 1a, 3c; Pl. 3, Figs 3—6 and Pl. 5, Fig. 2b
Prediscosphaera spinosa (Bramlette & Martini) Gartner — Pl. 3, Figs 1—2 and Pl. 8, Fig 3b
Rhagodiscus plebeius Perch-Nielsen — Pl. 4, Fig. 1
Rhomboaster cuspis Bramlette & Martini
Staurolithites crux (Deflandre & Fert) Caratini — Pl. 2, Fig. 4
Stephanolithion laffitei Noël
Tetralithus obscurus Deflandre
Tetralithus pyramidus Gardet
Thoracosphaera operculata Bramlette & Martini
Tremalithus ignotus Górka
Vekshinella elliptica Gartner — Pl. 2, Figs 1—2
Vekshinella striata (Stradner) Priewalder — Pl. 4, Fig. 2
Watznaueria barnesae (Black) Bukry
Zygodiscus spiralis Bramlette & Martini — Pl. 2, Figs 5—6
Zygolithus bussoni Noël
Zygolithus crucifer Noël — Pl. 2, Fig. 3

The frequency of the species in the material studied is diverse. There is distinct predominance of the representatives of *Arkhangelskiella cymbiformis* Vekshina, *Chiastozygus amphipons* (Bramlette & Martini), *Cribrosphaera ehrenbergi* Arkhangelsky, *Eiffellithus turriseiffeli* (Deflandre), *Micula decussata* Vekshina, *Nephrolithus frequens* Górka, *Prediscosphaera cretacea* (Arkhangelsky), *P. spinosa* (Bramlette & Martini) and *Zygodiscus spiralis* Bramlette & Martini. The contribution of the remaining species is markedly subordinate.

STRATIGRAPHY

The highest Upper Maestrichtian strata of the Żyrzyn borehole were named by Pożaryska (1965) as the "Żyrzyn Beds" and dated on the basis of foraminifers as the uppermost Maestrichtian. This age assignment is supported by the result of the nannoplankton analysis. The coccolith assemblage appears typical of the Upper Maestrichtian coccolith zone *Nephrolithus frequens*, defined by Čepek & Hay (1969) as the interval between the first appearance of *N. frequens* and the time of extinction of the majority of Late Cretaceous species. The Żyrzyn profile displays the upper boundary of this zone. The boundary coincides with the upper boundary of the "Żyrzyn Beds" and, at the same time, with the Cretaceous/Tertiary boundary. The lower boundary of this zone was not recognized as the species *N. frequens* is present in the lowermost part of the profile, below the base of the "Żyrzyn Beds".

Some differences in the composition of the coccolith assemblage were found through the sequence. In its lower part, underlying the "Żyrzyn Beds" (depth 126.1—116.1 m), the assemblage appears to be most diversified, as it comprises the majority of Late Cretaceous species, including relic Campanian and older forms: *Broinsonia bevieri* Bukry, *Coccolithites dentatus* Shumenko, *Corollithion rhombicum* (Stradner), *Kamptnerius percivalii* Bukry, *Gartnerago obliquus* (Reinhardt) and *Vekshinella elliptica* Gartner. The "Żyrzyn Beds" display certain impoverishment of the Late Cretaceous forms (and primarily decrease in the number of species) and the first appearance of Paleocene species such as *Markalius inversus* (Deflandre) and *Thoracosphaera operculata* Bramlette & Martini.

Samples from the Zemborzyce and Podole boreholes (depths 74.85 and 53.75 m, respectively), also represent strata of the *Nephrolithus frequens* Zone, which is indicated by the composition of coccolith assemblages. The samples from the Zemborzyce and Podole boreholes may be correlated with the lowermost part of the Żyrzyn profile, older than the Żyrzyn Beds (*cf.* Fig. 2).

FINAL REMARKS

The coccolith assemblage that occurs in Upper Maestrichtian strata of the Lublin Upland appears identical to those known from Austria (Priewalder 1973) and New Zealand (Edwards 1971). On the basis of coccoliths, the strata may also be correlated with the Upper Maestrichtian of Denmark (*cf.* Perch-Nielsen 1968, 1969), West Germany (*cf.* Čepek 1970) and Dnepr-Donetz region of USSR (*cf.* Shafik & Stradner 1971).

The analysis of the nannoplankton makes it also possible to reconstruct the environment of deposition of Late Maestrichtian strata from the Lublin Upland. The assemblage is rich both in number of species and individuals, which suggests deposition in open marine basin of the oceanic type or with good seaway connections with the ocean, in warm waters of normal salinity, well oxidated and clear.

The distribution of Recent Coccolithophorida reveals a zone of maximum organic productivity, connected with the boundary of subtropical and moderate climatic belts (McIntyre & McIntyre 1971).

Regarding paleogeography, the existence of a province characterized by a specific, rich nannoplankton assemblage may be inferred. This province occupied Poland, southern parts of USSR, Austria, Denmark, West Germany, Netherlands and Belgium, being dependent on the distribution of oceanic basins and continents, as well as on climate. Its counterpart is also recognizable in the southern hemisphere, in New Zealand.

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Institute of Geology
of the Warsaw University
Al. Żwirki i Wigury 93, 02-089 Warszawa, Poland
Warsaw, March 1975

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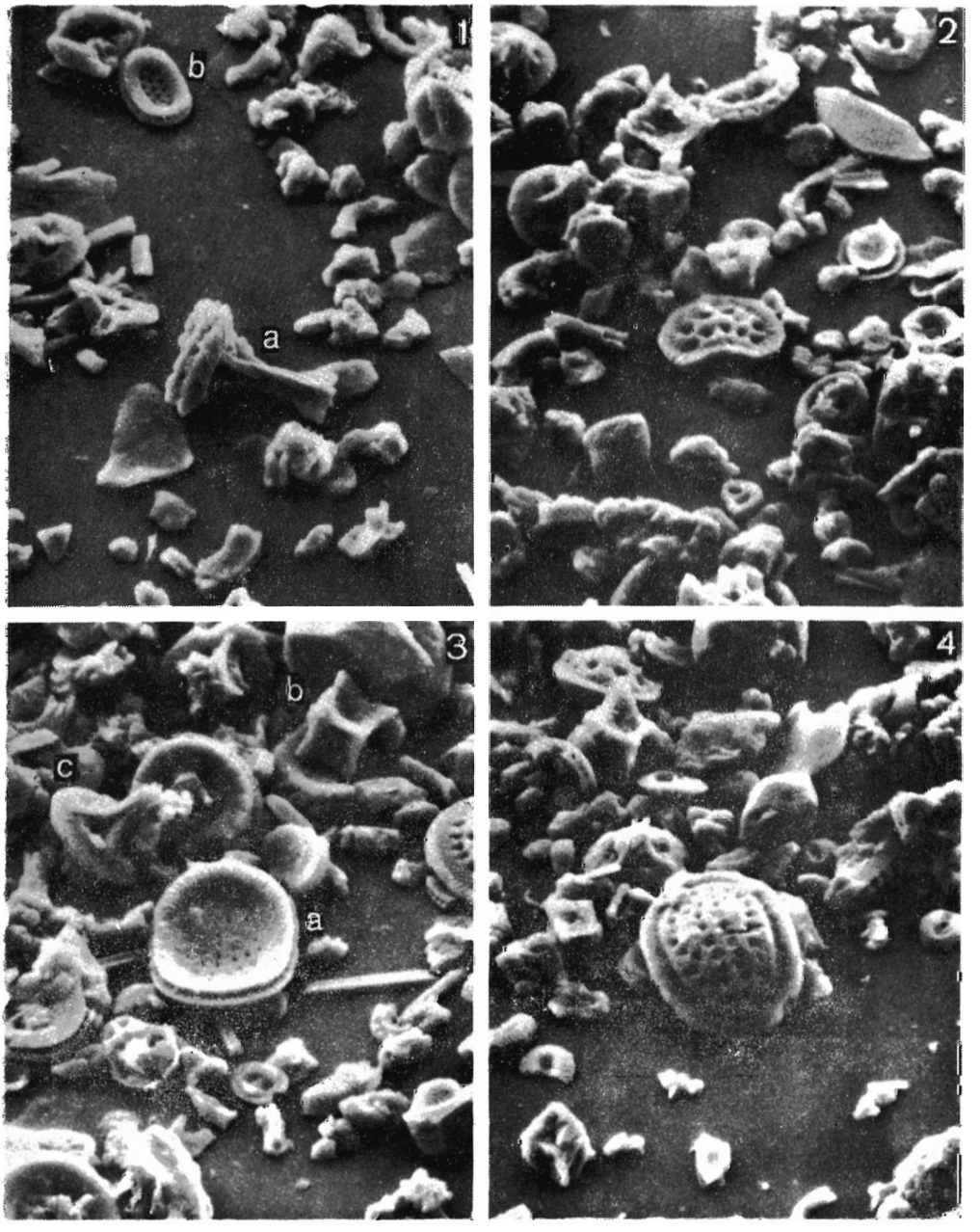
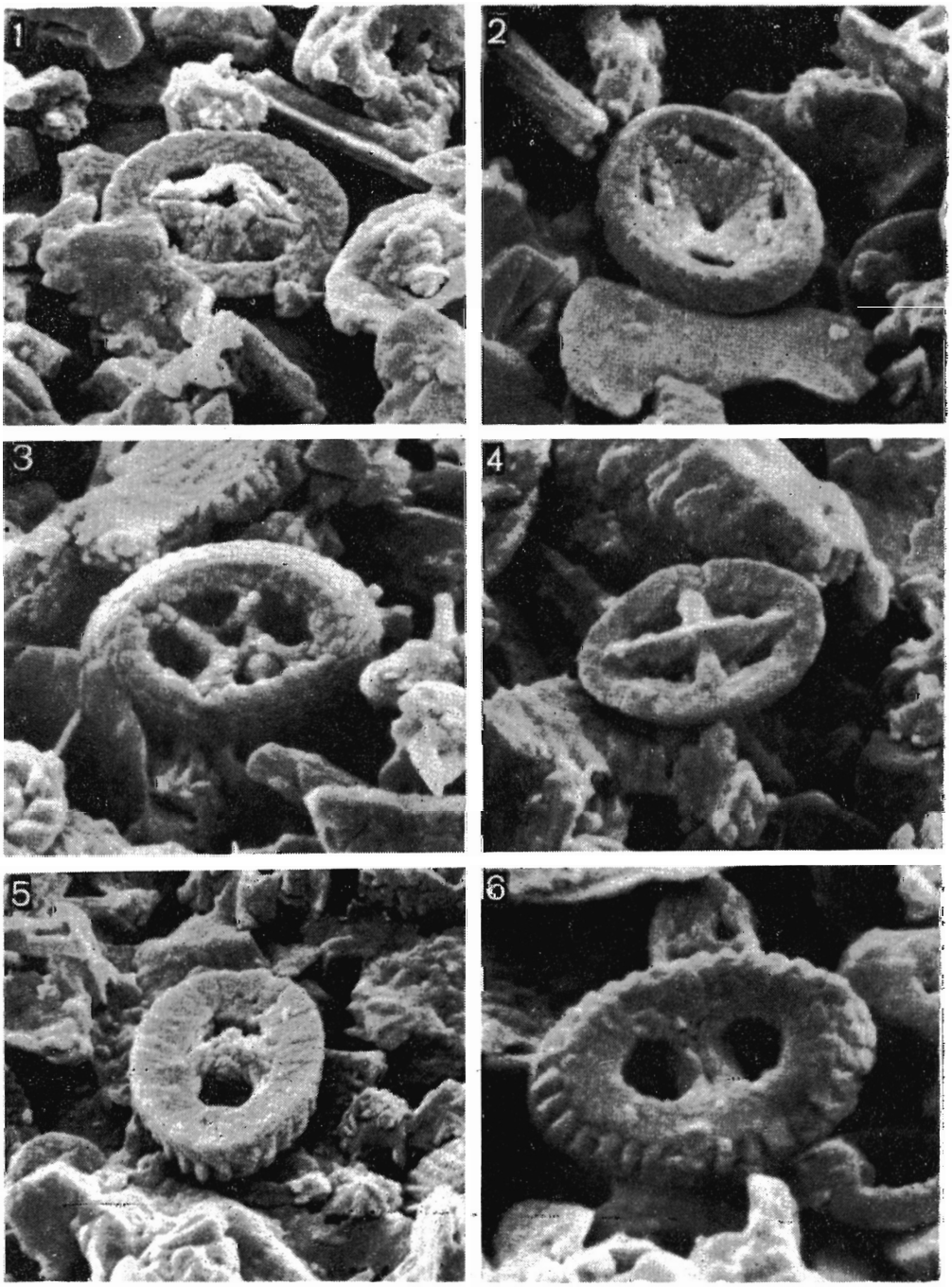
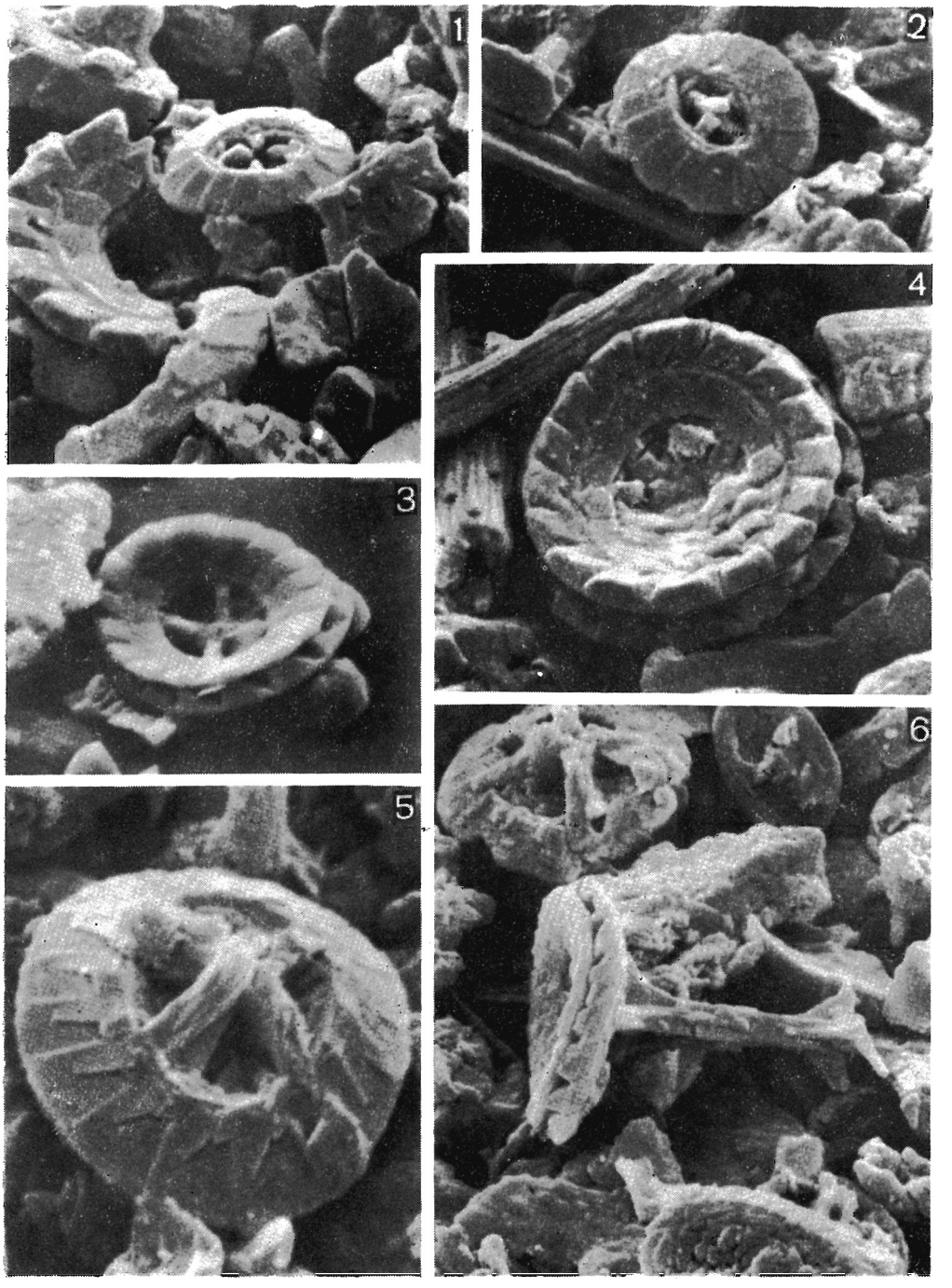


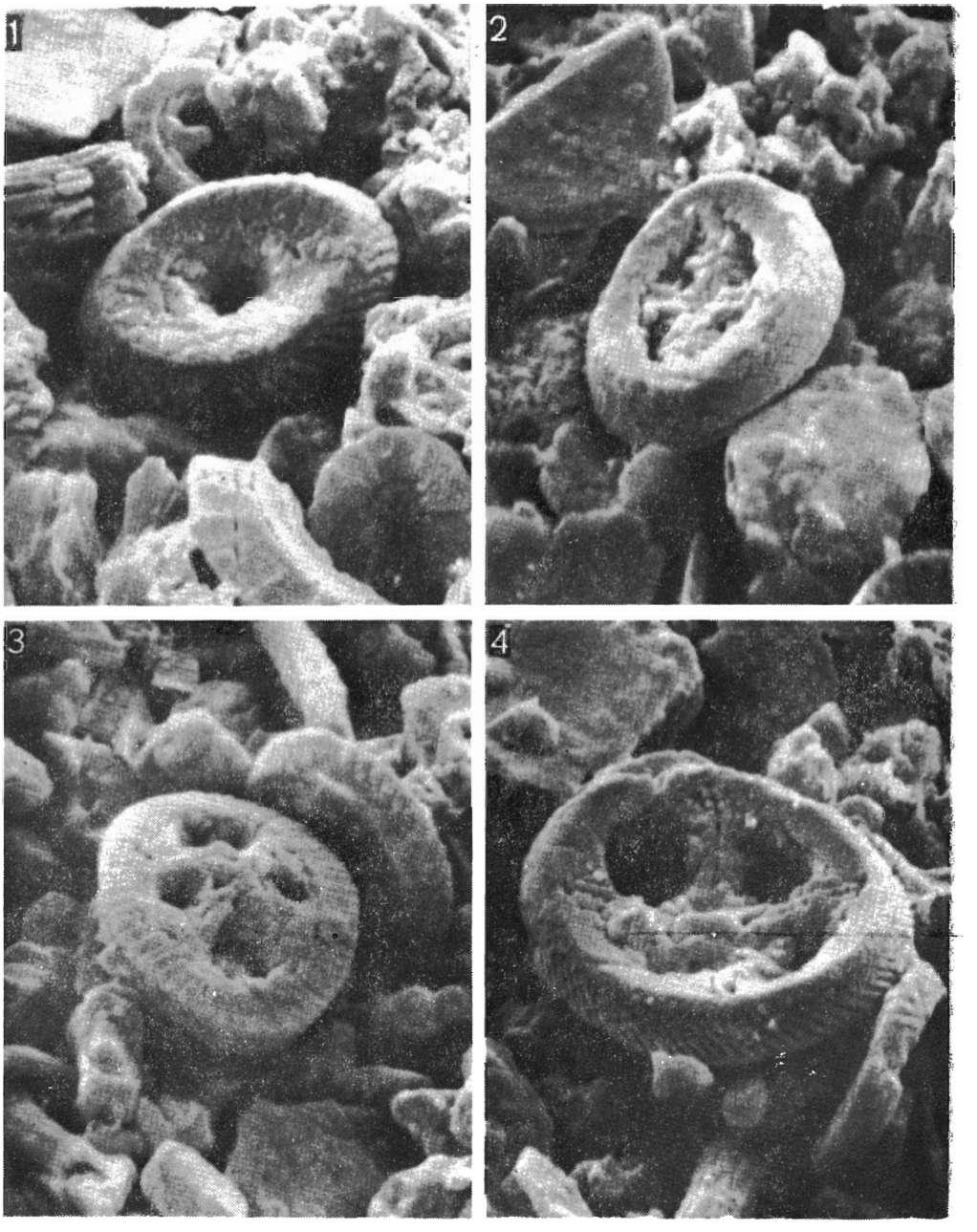
1 a — *Prediscosphaera cretacea* (Arkhangelsky), side view; b — *Cribrosphaera ehrenbergi* Arkhangelsky.
2 *Nephrolithus frequens* Górka; distal view (at center).
3 a — *Arkhangelskiella specillata* Vekshina, proximal view; b — *Micula decussata* Vekshina; c — *Prediscosphaera cretacea* (Arkhangelsky).
4 *Arkhangelskiella specillata* Vekshina, distal view (at center).
All specimens from the Upper Maestrichtian, Żyrzyn borehole; × 2700



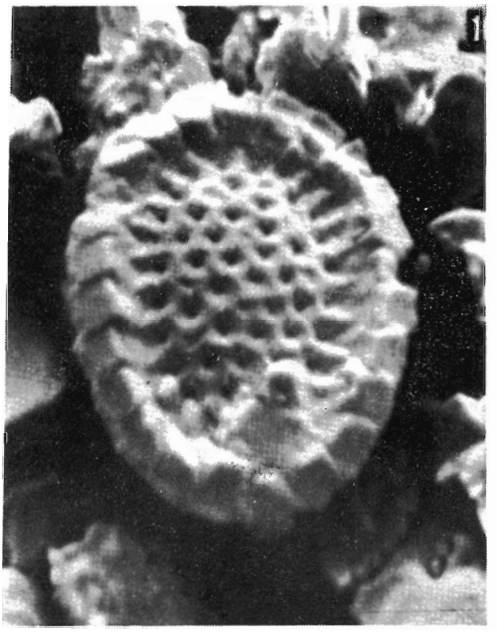
1–2 *Vekshinella elliptica* Gartner: *1* — distal view, *2* — proximal view of another specimen.
3 *Zygolithus crucifer* Noël, proximal view.
4 *Staurolithites crux* (Deflandre & Fert).
5–6 *Zygodiscus spiralis* Bramlette & Martini: *5* — distal view, *6* — proximal view of another specimen.
All specimens from the Upper Maestrichtian, Żyrzyn borehole; × 9000

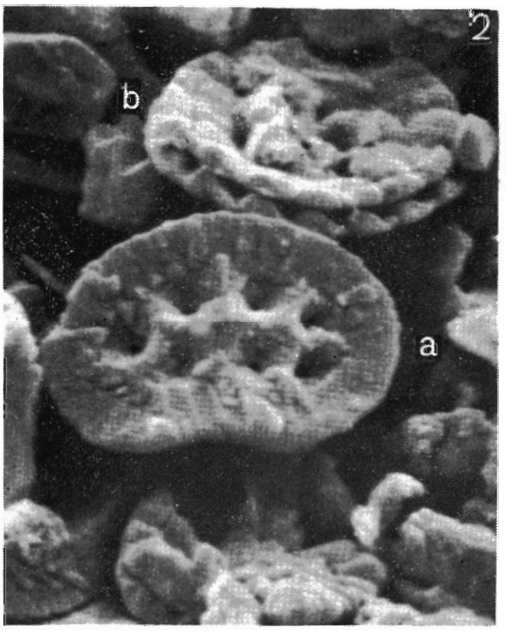


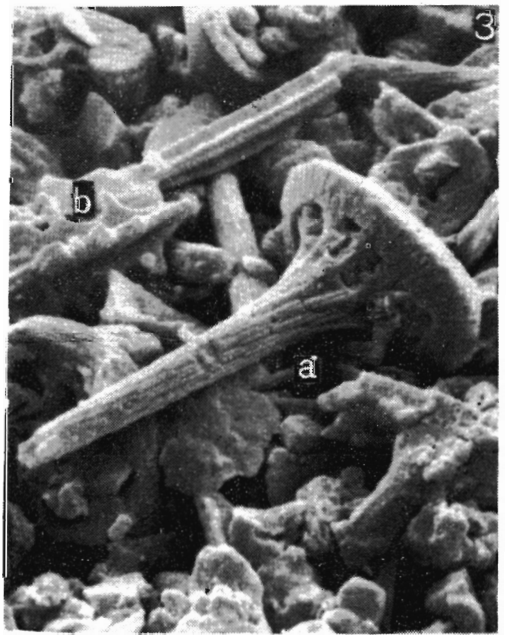
1–2 *Prediscosphaera spinosa* (Bramlette & Martini).
3–6 *Prediscosphaera cretacea* (Arkhangelsky), various specimens: *3* — proximal view (× 5400), *4* — proximal view, *5* — distal view, *6* — side view.
All specimens from the Maestrichtian, Żyrzyn borehole; × 9000 (except for Fig. 3)

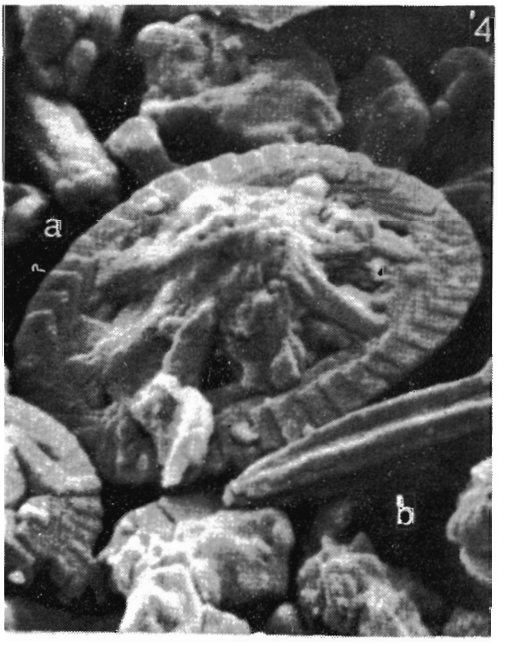


1 *Rhagodiscus plebeius* Perch-Nielsen, proximal view.
2 *Vekshinella striata* (Stradner), proximal view.
3–4 *Chiastozygus litterarius* (Górka): *3* — distal view, *4* — proximal view of another specimen.
All specimens from the Upper Maestrichtian, Żyrzyn borehole; × 9000

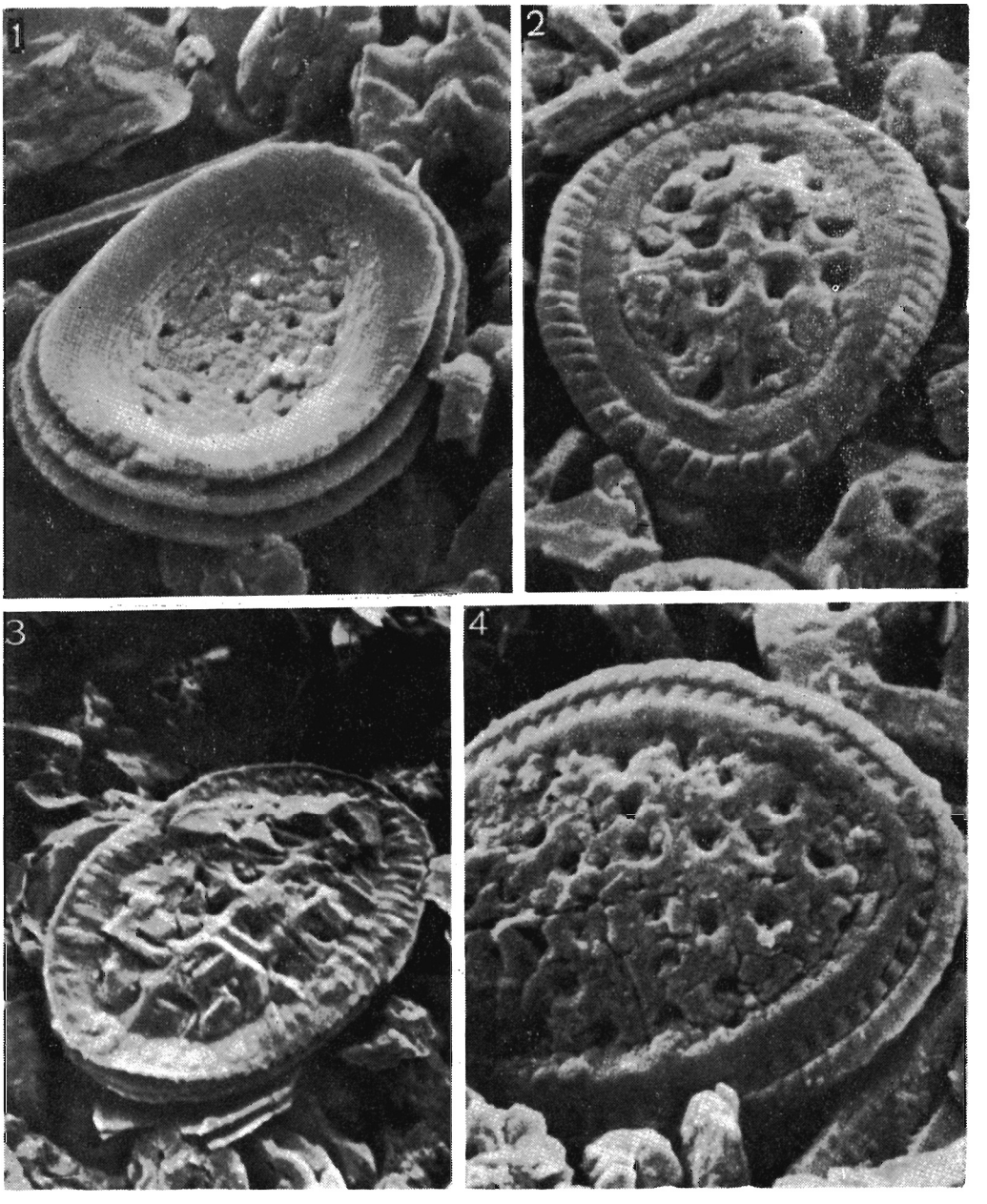




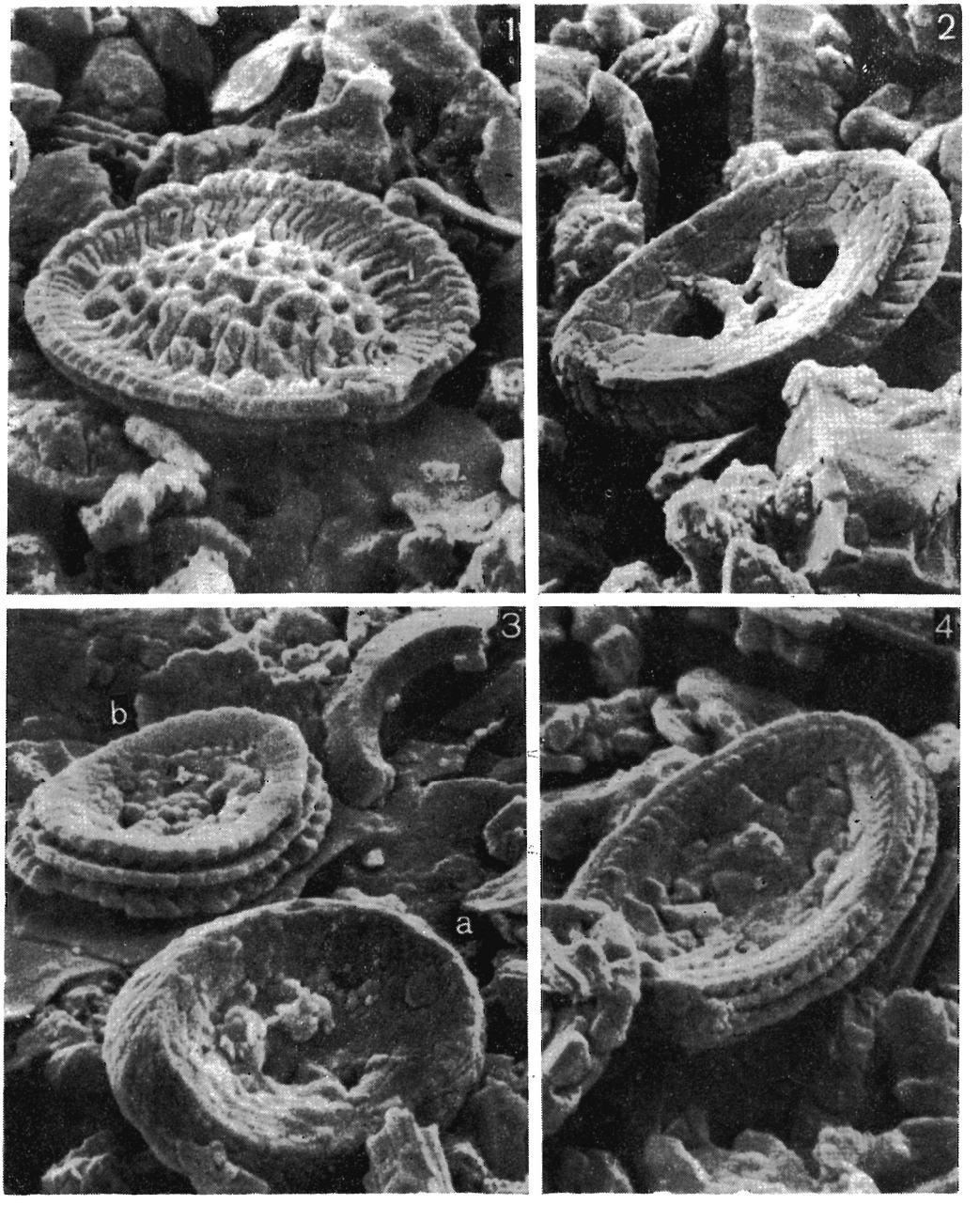




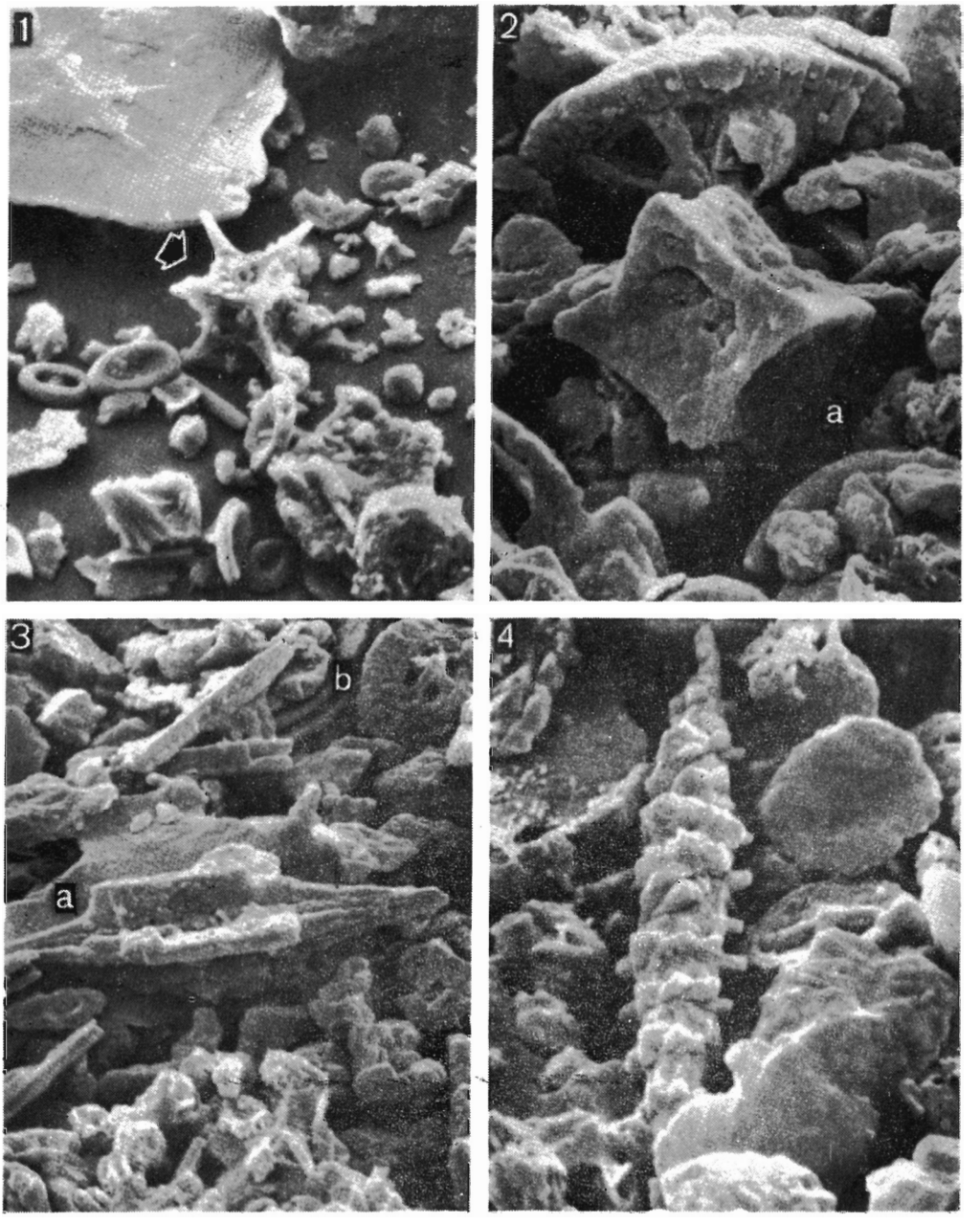
1 *Cribrosphaera ehrenbergi* Arkhangelsky; Upper Maestrichtian, Podole borehole; × 9000.
2 a — *Nephrolithus frequens* Górka; b — *Prediscosphaera cretacea* (Arkhangelsky); Upper Maestrichtian, Żyrzyn borehole; × 9000.
3 a — *Ahmuellerella octoradiata* (Górka), side view; b — *Lithraphidites grossopectinatus* Bukry; Upper Maestrichtian, Żyrzyn borehole; × 5400.
4 a — *Ahmuellerella octoradiata* (Górka), distal view; b — *Lithraphidites carniolensis* Deflandre; Upper Maestrichtian, Żyrzyn borehole; × 9000.



1–2 *Arkhangelskiella specillata* Vekshina: *1* — proximal view, *2* — distal view of another specimen; Upper Maestrichtian, Żyrzyn borehole; × 9000.
3 *Arkhangelskiella cymbiformis* Vekshina; Upper Maestrichtian, Podole borehole; × 5400.
4 *Arkhangelskiella ethmopora* Bukry; Upper Maestrichtian, Żyrzyn borehole; × 9000.



1 *Kamptnerius percivalii* Bukry, × 5400.
2 *Eiffellithus turriseiffeli* (Deflandre).
3 *a* — *Rhagodiscus* sp., proximal view; b — *Arkhangelskiella distincta* Shumenko, proximal view.
4 *Gartnerago obliquus* (Reinhardt).
All specimens from the Upper Maestrichtian, Żyrzyn borehole; × 9000 (except for Fig. 1)



1 *Micula* aff. *decussata* Vekshina, × 2700 (arrowed).
2 *Micula decussata* Vekshina, × 5400 (lettered *a*).
3 a — *Lithraphidites quadratus* Bramlette & Martini; b — *Prediscosphaera spinosa* (Bramlette & Martini); × 5400.
4 *Microrhabdulus belgicus* Hay & Towe, × 9000.
All specimens from the Upper Maestrichtian, Żyrzyn borehole

E. GAŹDZICKA

KOKKOLITY GÓRNEGO MASTRYCHTU WYŻYNY LUBELSKIEJ

(Streszczenie)

Przedmiotem pracy są kokkolity z utworów górnego mastrychtu Wyżyny Lubelskiej (*por.* fig. 1). Szczególnie liczny i dobrze zachowany nannoplankton wapienny znaleziono w materiale pochodzącym z wiercenia Żyrzyn (*por.* fig. 2), w którym rozpoznano 54 gatunki kokkolitów należące do 34 rodzajów (*por.* tab. 1 oraz pl. 1—8). Analiza zespołu kokkolitów pozwoliła na stwierdzenie przynależności badanych utworów do zony kokkolitowej *Nephrolithus frequens*, oraz na przeprowadzenie korelacji z równowiekowymi utworami Europy i niektórych obszarów pozaeuropejskich.