ELECTRON MICROSCOPIC STUDIES ON NEPHROLITHUS (COCCOLITHOPHORIDAE)

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INTRODUCTION AND METHODS

*Nephrolithus* Görka (1957, p. 263) is easily recognizable by its characteristic kidney-like shape. The original description by Görka runs as follows: "Kidney-shaped with smooth marginal zone. The center is occupied by a slightly bent bar, which is crossed by other bars" (translated from French).

The diagnosis by Görka is based on observations made by means of a light microscope (Zeiss Lumipan X 1350). In the present investigation the author has studied *Nephrolithus* in an electron microscope and this has brought out new details which seem to make the original description in need of a revision.

The chalk in which the coccoliths occur was disintegrated in an ultrasonic vibrator. A frequency of 40 kcps was used and a working time of 1½ minutes proved to be the most suitable. Shorter treatment resulted in the coccoliths not being quite "clean", while a longer period destroyed the more fragile ones.

The following method for preparing the carbon replicas necessary for electron microscope studies was used. A slide was covered with a thin film of formvar in dioxane. The film was floated off on distilled water; 200 mesh copper grids were placed on the film, the whole of which was then lifted out by means of a filter paper. After drying, a drop of the coccolith suspension was poured on each grid, which after renewed drying was covered with a thin layer of evaporated carbon. The formvar was removed by transferring the filter paper with the grids to a bath of chloroform. The calcite of the coccoliths on the grids was dissolved by digestion in 5% acetic acid for 12 hours. After washing in distilled water and drying, the replicas were ready for viewing. In the present investigation a microscope of type Zeiss EM 9 was used.
TERMINOLOGY

Previous authors have used the terms proximal and distal in the sense of the concave respectively the convex side of the coccolith. This implies knowledge of how the coccoliths were placed on the cocsphere. As this is seldom the case with fossil coccoliths, the present author prefers to use the unambiguous terms concave and convex.

TYPOIFICATION

In the preparation of a carbon replica the specimen itself is destroyed. Hence the holotype of a new species is a photographic plate, identified by the serial number of the type collection. This is in accordance with the practice of several previous authors.

SYSTEMATIC DESCRIPTION

Form genus *Nephrolithus* GóRKA

1957 *Nephrolithus* n. gen. — GÓRKA, p. 263
1964 Genus *Nephrolithus* GóRKA, 1957 — BRAMLette and MARTINI, p. 302

EMENDED DIAGNOSIS. — Coccolith convexo-concave. Outline generally kidney-shaped. Rim consisting of two rows of crystals, the inner row elevated above central area and situated on the concave side, the outer row in same plane as central area. Central area constituted by ring-shaped structures, each consisting of crystals of mutually equal shape and size encircling a small pore.

TYPE SPECIES. — *Nephrolithus frequens* GóRKA.

OTHER SPECIES. — *N. furcatus* GóRKA; *N. barbara* GóRKA; *N. trietus* GóRKA.

DISTRIBUTION. — Coccoliths referable to the genus *Nephrolithus* GóRKA have been reported from Maestrichtian deposits of several parts of the world: Poland (GóRKA, 1957, pp. 263—264), USSR (ARCHANGELSKY, 1912, pl. 7, fig. 17), Denmark, western Siberia, USA, New Zealand (BRAMLette and MARTINI, 1964, p. 302). *Nephrolithus gorkae* n. sp. occurs abundantly in the Maestrichtian of Scania, Sweden.

REMARKS. — The generic diagnosis proposed above is in accordance with the
diagnosis published by GÓRKA as regards the general shape of the coccoliths and the presence of pores in the central area. The examinations in the electron microscope show that the central area consists of ring-shaped structures. Examination under a light microscope (Zeiss Photomicroscope, magnification $\times 1600$, and Leitz Ortholux, magnification $\times 2000$) of Nephrolithus specimens from the type material kindly provided by Dr. GÓRKA, has not confirmed the presence of the bar-like structures mentioned in her diagnosis.

Furthermore, the micrographs clearly show that the rim consists of two rows of crystals. GÓRKA mentions this fact only for the species N. barbarae, the occurrence of which is said to be rare. In all the specimens of the type material examined, two rows of crystals form the rim, so in the present author's opinion this must be considered a generic character.

The genus Nephrolithus was first figured by ARCHANGELSKY (1912), although mentioned by him as "coccoliths of unidentifiable family". His drawing gives a surprisingly accurate idea of how the coccolith really looks: two rows of marginal crystals around the annulate area.

The relationship of Nephrolithus to other forms is as yet unexplored. Several modern coccolithophorids belonging to different genera are characterized by coccoliths with central areas perforated by pores, which under the light microscope are reminiscent of the pores of Nephrolithus. They have, however, not been studied under the electron microscope, and their finer structure is not known. Of more interest is the similarity between Nephrolithus and Favocentrum BLACK. Species of this genus are distributed throughout the Maestrichtian chalks of Denmark, East Anglia (England), and Scania (Sweden). Pl. III: 6 shows a specimen of Favocentrum matthesi BLACK taken from the same beds as Nephrolithus. It may be noted that the two layers of marginal crystals surround a large central area, consisting of a system of equidimensional crystals. These seem to be fitted closer together, although with minute pores left between them. Also, the shape of the marginal crystals is different from that of Nephrolithus. But despite these differences, the general appearance is strikingly reminiscent of Nephrolithus and may be due to a certain relationship.

Nephrolithus gorkae n. sp.

Pl. I; pl. II, figs. 1—6; pl. III, figs. 1—6; text-fig. 1.

DERIVATION OF NAME. — The species is named for Dr. HANNA GÓRKA, Warsaw.

DIAGNOSIS. — Coccolith generally kidney-shaped. The two rows of rim crystals interlaced in regular alternation. The ring-shaped structures of central area compo-
Nephrolitus gorkae n.sp. Reconstruction of holotype: view of concave side. Approximately \( \times 15,500 \).

Fig. 1.

sed of seven to nine imbricately arranged crystals orientated clockwise. Each ring has one or more crystals in common with neighbouring rings.

**Holotype.** — Pl. I. Negative no. Y 1, type collection of Geol. Inst., Stockholm Univ.

**Size of Holotype.** — Maximum breadth 4.6 microns, minimum breadth 3.3 microns.

**Paratypes.** — Negatives nos. Y 2—Y 18.

**Repository.** — Geologiska institutionen, University of Stockholm.

**Material.** — Total material studied under electron microscope = 18 specimens. In addition further specimens were studied under the light microscope.

**Type Locality.** — Södra Sallerup, Scania, Sweden.

**Type Stratum.** — Maestrichtian.

**Distribution.** — Maestrichtian of Södra Sallerup and Limhamn, Scania, Sweden.

**Remarks.** — The crystals of the rim are interlaced in regular alternation so as to give a stable structure.
The kidney-like shape seems to result from the bending outwards of the rim crystals of the longer side towards the convex side. In pl. I, five crystals, seen more or less from the side, display this condition. Some specimens do not have the typical kidney-shape, but the shape and general arrangement of the crystals justify their inclusion in *Nephrolithus gorkae* n.sp. Perhaps the typical kidney-shaped coccoliths were placed round some kind of opening in the coccosphere. Such differences in shape of the coccoliths is well known from many modern genera.

The rings of the central area constitute part of the neighbouring rings, the part in common consisting of one or more crystals. The rings may hold together even if the rim is broken. An example of such a separate ring is shown in pl. II, fig. 3.

The size range of the coccoliths for greatest breadth is 4.6—7.7 microns and for smallest breadth 2.6—5.1 microns. The measurements were made on micrographs. The separate rings and the individual crystals show remarkably little variation in size.

**REFERENCES**


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PLATES

All pictures except pl. II, figs. 1 a—b, are electron micrographs. The electron microscope magnification is in all cases ×7,000; the cited magnifications are photographic enlargements of the electron microscope negatives.
Approximately $\times 26.500$

*Fig. 1. View of convex side. Holotype no. Y I.*

*Plate 1*
PLATE II

*Nephrolithus gorkae* n.sp.

Figs. 1 a—b. Specimen seen in light microscope. — a. High level. — b. Low level. — Approximately × 6,500 (magnification of photographic negative × 1,600).

- Fig. 2. View of concave side. Approximately × 14,000.
- Fig. 3. Separate ring. Approximately × 17,000.
- Fig. 4. View of convex side. Approximately × 14,000.
- Fig. 5. View of concave side. Approximately × 14,000.
PLATE III

*Nephrolithus gorkae* n.sp.

Fig. 1. View of concave side. Part of central area missing. Approximately $\times 11,000$.

Fig. 2. Detail of rim. Note interlacing of crystals. Approximately $\times 14,000$.

Fig. 3. View of convex side. Approximately $\times 14,000$.

Fig. 4. View of concave side. Approximately $\times 14,000$.

Fig. 5. Broken specimen, showing part of the rim and one ring in central area. Approximately $\times 14,000$.

Fig. 6. *Favocentrum mattheusi* Black. View of concave side. Approximately $\times 11,000$. 