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COCCOLITHS AND RELATED CALCAREOUS NANNOFOSSILS FROM THE UPPER CRETACEOUS FENCEPOST LIMESTONE OF NORTHWESTERN KANSAS

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ABSTRACT—Electron microscope studies of samples of the Fencepost Limestone, Upper Cretaceous (Turonian) from outcrops in Russell County, northwestern Kansas, have revealed abundant coccoliths. The typical Cretaceous coccolith *Watznaueria coronata* (Gartner) occurs predominantly along with appreciable numbers of *Braarudosphaera bigelowi imbricata* Bukry and *Prediscosphaera germanica* Bukry.

Two new species, *Biscutum concavum* and *Cyclococcolithus clockiradialis,* are described. Under low magnification, these nannoplanktonic fossils appear as part of the matrix of the Fencepost Limestone, which is a foraminiferous calcarenite with some mud matrix.

INTRODUCTION

COCCOLITHS are the skeletal plates produced by golden-brown unicellular planktonic marine algae of the class Coccolithophyceae. The organisms are less than 50 microns in diameter and their skeletal plates are 1 to 20 microns in diameter. With the advent of electron microscopy, coccoliths have become valuable time-stratigraphic markers.

This paper reports the occurrence of coccoliths in the Fencepost Limestone, Upper Cretaceous (Turonian) of northwestern Kansas, describes, and illustrates them with electron micrographs.

The Fencepost Limestone is the uppermost bed of the Greenhorn Limestone, Colorado Group. This bed is about nine inches thick and crops out extensively in the northwestern part of Kansas. It is a rather hard, slightly sandy, chalky calcarenite which is overlain by the Fairport Chalk Member. Because of its hardness, uniform thickness, and extensive outcrop, the Fencepost has been used as a stratigraphic marker bed for many years in western Kansas. The name was acquired because the bed is widely used as material for fenceposts, building stone, and bridge masonry throughout the Greenhorn Limestone outcrop area in western Kansas. Coccoliths appear to occur more abundantly in the lower half of the Fencepost Limestone than in the upper half, but detailed quantitative work was not done.

A positive replication method (Bradley, 1956) was applied to make carbon replicas from the surface of polished and etched samples. Electron micrographs were taken from the Jeolco electron microscope at The University of Michigan and Hitachi electron microscope at the Bowling Green State University.

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Type specimens are represented by materials deposited in the United States National Museum. Mrs. Beverly B. Tate and Mr. Frederick J. Collier kindly made arrangements for the deposition and cataloguing.

DISCOVERY AND SCIENTIFIC INTEREST IN COCCOLITHS

The first recorded illustration of coccoliths was made by Ehrenberg from study of chalk samples in 1840 but he called them "elliptical granular platelets" and considered them to be inorganic. In 1858, T. H. Huxley discovered minute calcareous bodies in deep-sea sediment samples gathered from the North Atlantic and named them "coccoliths" for their resemblance to small seeds.

Wallich (1860) found spherical bodies, which seemingly were formed of a number of

coccoliths, from North Atlantic floor sediments. He named these spherical bodies "coccospheres" and suggested that all coccoliths originated from the disintegration of such coccospheres. Sorby (1861) stated that what he had termed "crystalloids" in chalk were identical to Huxley's coccoliths and he suggested that coccoliths were not inorganically precipitated but had an organic origin.

In 1868, Huxley restudied the North Atlantic sediment samples and divided the coccoliths into two groups: *Discolithus,* oval discoidal bodies with a thick, strongly refracting rim, a thinner central portion, slightly convex on one side, and *Cyatholithus,* convex on one side and flat or concave on the other side with an oval contour. He also stated that coccoliths were skeletal elements or spicules of a primitive organism. Schmidt (1870) studied samples from the Adriatic sea-floor and found large numbers of rods, some of uniform thickness, others club-shaped and tapered, and many having a disc at one end. He named these "rhabdoliths."

Dawson (1875) described coccoliths and rhabdoliths from Cretaceous rocks of Manitoba. Williston (1890) described coccoliths and rhabdoliths from the Kansas chalk, in which W. S. Bunn had discovered them in 1882 (see Williston, 1890). Murray & Renard (1891) reported coccospheres as part of living pelagic algae. Lohmann (1902) extensively studied the taxonomy of living forms in the early 1900's but interest in coccoliths declined thereafter.

After decades of being almost ignored, coccoliths and related fossils again started to be intensively studied because of the development of better equipment, such as the electron microscope, and applicability to biostratigraphic work.

Deflandre & Fert (1952, 1954) developed the application of electron microscopy to the study of coccoliths and Bramlette & Riedel (1954) emphasized the great significance of coccoliths in biostratigraphic work. Deflandre & Durrieu (1957) made carbon replicas of the surface of the coccoliths successfully. Black & Barnes (1959) and Hay & Towe (1962) developed excellent separation and replication techniques for electron microscopy of coccoliths. Bramlette & Sullivan (1961) described a significant zonation for the lower Tertiary of California based on the coccolithophyceae content. Many new taxa and stratigraphic distributions of coccoliths and related nannofossils have been made by Bramlette & Martini (1964) in Germany; Stover (1966) in France and the Netherlands; Fischer, Honjo, & Garrison (1967) in the United States; Gartner (1967, 1968) in Texas, Jamaica, and the Gulf of Mexico; and Bukry (1969) in Texas and Europe.

LOCALITIES OF FENCEPOST LIMESTONE SAMPLES

Sample F–1–1. East side road cut at NW¼ SW¼ sec. 18, T 13 S, R 12 W, Russell Co., Kansas.

Sample F–1–2. Approximately 100 feet south of sample F–1–1.

Sample F–1–3. Approximately 100 feet south of sample F–1–2.

Sample F–1–4. East side road cut at SW¼ SW¼ sec. 19, T 13 S, R 12 W, Russell Co., Kansas.

Sample F–1–5. Approximately 150 feet south of sample F–1–4.

Sample F–1–6. Approximately 100 feet south of sample F–1–5.

SYSTEMATIC DESCRIPTIONS

Family COCCOLITHOPHORACEAE Kamptner, 1928

Genus WATZNAUERIA Reinhardt, 1964

WATZNAUERIA CORONATA (Gartner), 1968, emend. Bukry, 1969

Pl. 1, figs. 1–3; pl. 2, figs. 1, 2

Coccolithus coronatus Gartner, 1968, p. 17, pl. 23, figs. 26–28.

Watznaueria coronata Bukry, 1969, p. 32, pl. 10, figs. 11, 12.

Remarks.—A semi-elliptical coccolith with smooth margin of the distal shield and sutures slightly inclined to clockwise. Rim counts of 27 to 32 observed, about 30 most common. In proximal view, a short element is imbricated on top of a large element at the innermost area. Intercardinal large outer elements are segmented but imbricated to each other (pl. 2, fig. 2). Average size: 8 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

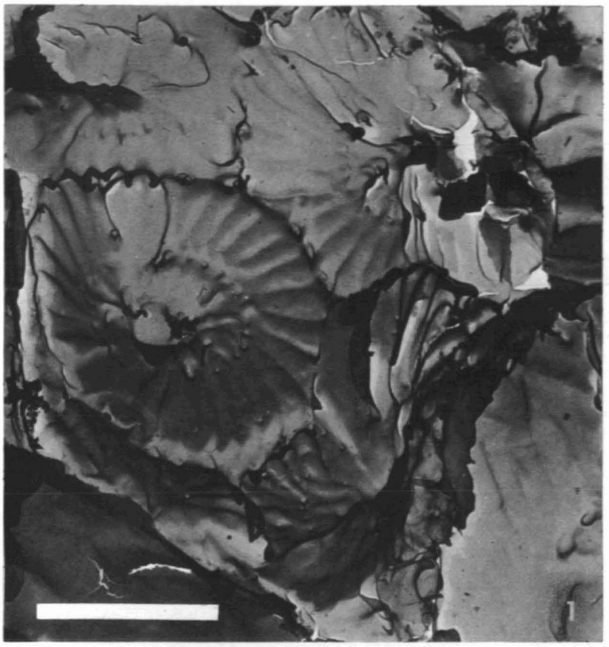
WATZNAUERIA MARTELAE (Noël), Bukry, 1969

Pl. 2, fig. 3

Calolithus martelae Noël, 1965, p. 135, text-figs. 50–52, pl. 14, figs. 1–10; pl. 15, figs. 1–6.

EXPLANATION OF PLATE 1

FIGS. *1–3* — *Watznaueria coronata* Bukry. Proximal views; 3, the enlarged electron micrograph of a coccolith in figure 1. Bar indicates 5 microns.



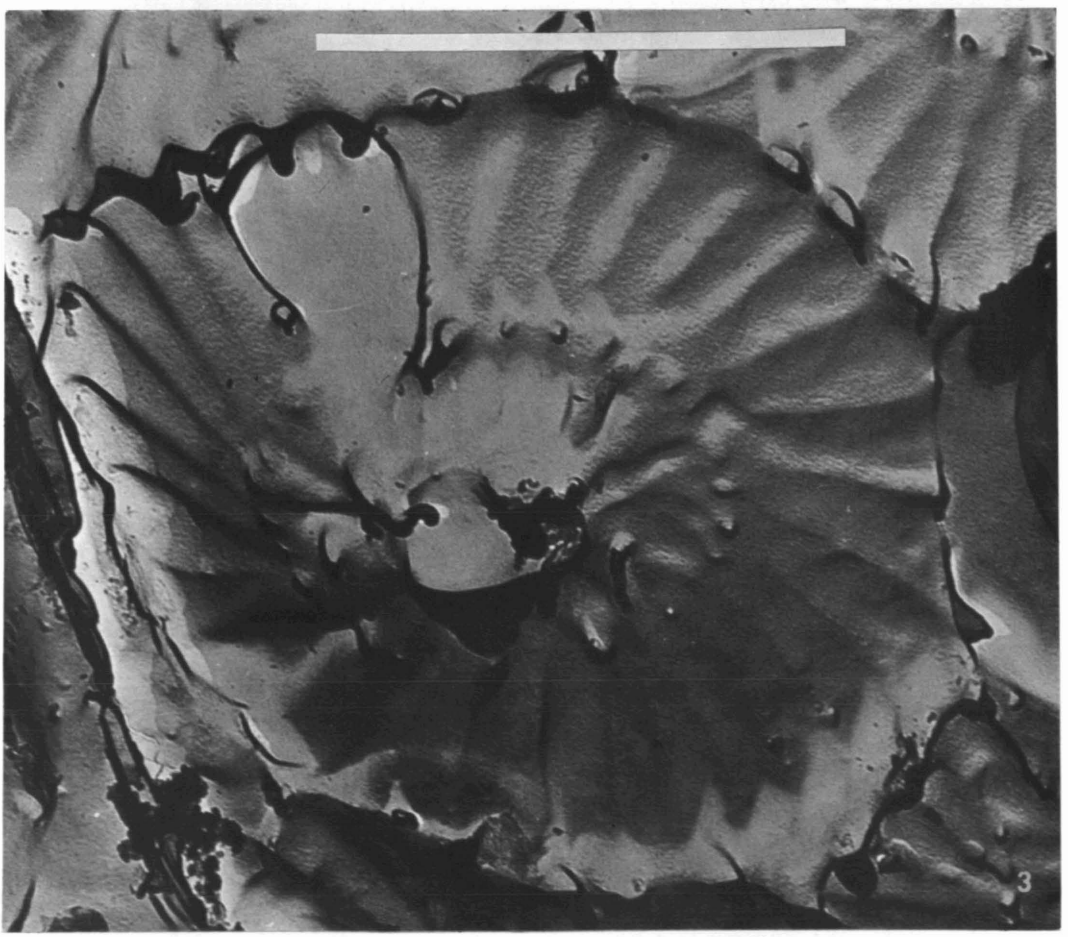


PLATE 1

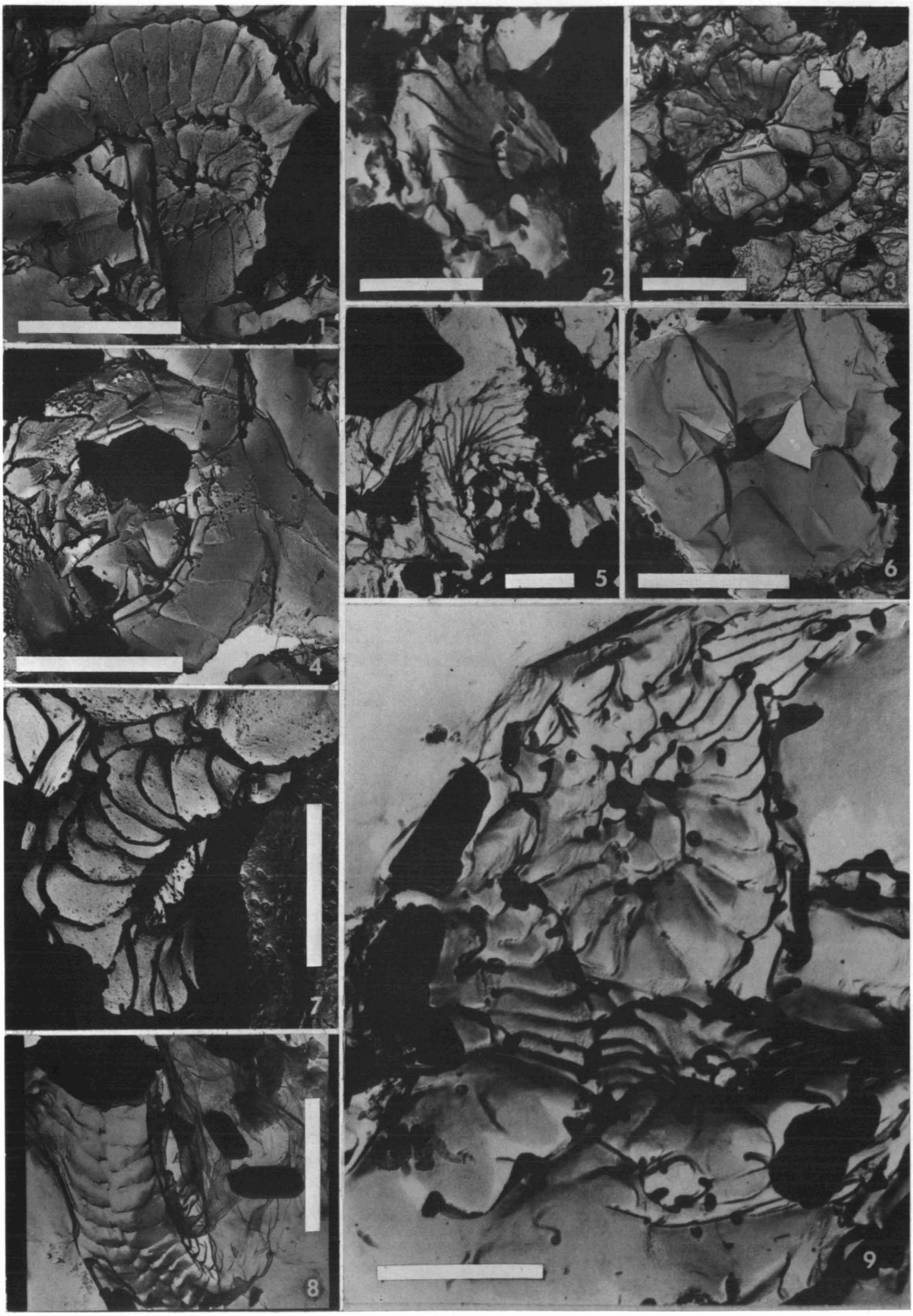


PLATE 2

Watznaueria martelae Bukry, 1969, p. 32, pl. 11, figs. 6, 7.

Remarks.—A distinctive side notching of elements produces a circle of depression at the central area margin. Average size: 9 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

Genus BISCUTUM Black, 1959

BISCUTUM CONCAVUM Huh, n. sp.

Pl. 2, fig. 9

Description.—Semi-elliptical coccolith, concave in proximal view, consisting of 17 to 22 radially oriented elements. A wedge-shaped element, wider at the cardinal area and narrow at the proximal, is the diagnostic feature of the genus *Biscutum*. Average size: 11 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

Holotype.—USNM 170556.

Genus CYCLOCOCCOLITHUS Kamptner, 1958

CYCLOCOCCOLITHUS CLOCKIRADIALIS Huh, n. sp.

Pl. 2, fig. 5

Description.—Circular coccolith with dextrally inclined and imbricated elements. Central area filled with spore-type elements. Average size: 13 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

Holotype.—USNM 170555.

Family BRAARUDOSPHAERACEAE Deflandre, 1947

Genus BRAARUDOSPHAERA Deflandre, 1947

BRAARUDOSPHAERA BIGELOWI IMBRICATA Bukry, 1969

Pl. 2, fig. 6

"Pentaliths of uncertain affinities," Hay & Towe, 1962, p. 426–28, fig. 2.

Braarudosphaera bigelowi (Gran & Braarud), Gartner, 1968, p. 45, pl. 19, fig. 7a-c.

Remarks.—This coccolith is distinguished from *Braarudosphaera bigelowi bigelowi* (Gran & Braarud) by the imbrication of its elements which results in an irregular central depression. Average size: 12 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

Family RHABDOSPHAERACEAE Lemmermann, 1903

Genus PREDISCOSPHAERA Vekshina, 1959

PREDISCOSPHAERA GERMANICA Bukry, 1969

Pl. 2, fig. 4

Description.—Elliptical coccolith with sinistrally imbricated 16 outer elements. Distinctive inner circle of 10 to 15 elements extending from under the outer elements. Distal side of each inner element with a long extension that apparently imbricates dextrally, producing a serrate pattern strongly inclined clockwise. A crossbar aligned with the long and short axis of the coccolith, supporting a slender 4-element central stem (as can be seen after dilute acid treatment). Average size: about 9 microns in diameter.

Occurrence.—Samples F–1–1 through F–1–6.

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EXPLANATION OF PLATE 2

FIGS. *1, 2* — *Watznaueria coronata* Bukry. Proximal and side views. Bar indicates 5 microns.

3 — *Watznaueria martelae* (Noël) Bukry. Proximal view. Bar indicates 5 microns.

4 — *Prediscosphaera germanica* Bukry. Bar indicates 5 microns.

5 — *Cyclococcolithus clockiradialis* Huh, n. sp. USNM 170555. Bar indicates 5 microns.

6 — *Braarudosphaera bigelowi imbricata* Bukry. Whitish triangle at the center-right is broken part of carbon film. Bar indicates 5 microns.

7 — Unnamed species.

8 — Unnamed species.

9 — *Biscutum concavum* Huh, n. sp. Small black dots are made from unresolved replicas. USNM 170556. Bar indicates 5 microns.

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