

NEW TAXA FROM THE NIOBRARA FORMATION (UPPER CRETACEOUS) OF KANSAS, USA

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Introduction

Intervals with well preserved nannofossils were studied from the Upper Turonian - Lower Campanian Niobrara Formation of northwestern Kansas, USA. Extensive scanning electron microscopy of the samples yielded several new taxa, clusters of monospecific coccoliths which represent collapsed coccospheres, and the first truly cylindrical 'coccosphere' published from the fossil record. Covington (1985) provides discussion on the study area, clusters, and cylindrical forms. The purpose of this paper is to describe the new species observed in the study. New taxa described here include one genus, *Watkinsia*, and four species, *Watkinsia pedalion*, *Biscutum dekaenelii*, *Biscutum zulloi*, and *Rotelapillus applegatei*.

All type material is deposited at the Department of Geology, Florida State University, Tallahassee, Florida, U.S.A.

Acknowledgments

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Systematic palaeontology

Biscutum zulloi, new species
(Plate 1, figures 1-5)

Derivation of name: In honour of the late Dr. Victor Zullo, University of North Carolina at Wilmington.

Diagnosis: A species of *Biscutum* distinguished by a double row of obliquely oriented overlapping laths bordering the central area margin, and by its long cylindrical coccosphere.

Description: The distal rim is of typical *Biscutum* type with about 30 petaloid elements. The central area is relatively wide accounting for approximately 52% of the width and 67% of the length.

The outermost cycle of central area elements is a double row of obliquely oriented overlapping elements which forms a distinct ridge around the perimeter of the large central area. This "collar" is distinct in both phase contrast and cross-polarized light. Inside this collar is an irregular cycle of blocky elements. The specimens in Plate 1, figures 1 & 3, illustrate wide variation in this cycle of blocky elements; this variation is probably a function of preservation. On well preserved specimens, a small knob occurs in the centre of the central area.

Biscutum zulloi is the only species of *Palaeopontosphaera* or *Biscutum* observed to form a truly cylindrical coccosphere (further discussion in Covington, 1985). Other non-spherical coccospheres have been ovoid to subcylindrical in shape (Plate 1, figures 6 & 7).

Remarks: de Kaenel & Bergen (1993) present a revised classification of the Jurassic Biscutaceae based on ultrastructural characteristics, in particular the nature of cycles around the central area/rim margin. Following them species with a discrete birefringent inner wall cycle should be placed in *Palaeopontosphaera*. *B. zulloi* falls within their concept of *Palaeopontosphaera*, however, applying their scheme to the Late Cretaceous would require a wide-ranging revision of the taxonomy of the Biscutaceae, which is beyond the scope of this paper.

Size: The coccoliths of the holotype measure approximately 4.4 by 5.5 μm along the short and long axes respectively of the distal shield. Including the collar, the central area is 2.3 by 3.7 μm . Cylindrical coccospheres that are known to be complete (closed at the ends) have not been observed. The longest specimen found in this study was approximately 35 μm .

Occurrence: Rare to common throughout the Niobrara Formation (Upper Turonian - Lower Campanian).

Holotype: Plate 1, figures 1-3.

Paratype: Plate 1, figures 4-5.

Type locality: Location 18 (Hattin, 1982), sample 18/11-B27, Smoky Hill Member of the Niobrara Formation, northwestern Kansas, Western Interior, U.S.A.

Biscutum dekaenelii, new species
(Plate 2, figures 5-6)

Genus and species indet., Wise & Wind, 1977; Plate 28, figure 6.

Derivation of name: In honour of Dr. Eric de Kaenel.

Diagnosis: A species of *Biscutum* with a central area spanned by a hollow granular cross.

Description: The distal rim of the holotype is composed of 20 petaloid elements. The elements form a steep wall around the central area, which is bordered by a narrow ledge of laths that imbricate clockwise and are roughly equal in number to the rim elements. The central area accounts for approximately 50% of the total width of the coccolith, and 60% of the length. The coarsely granular bars of the cross originate from below the ledge of laths and

gradually rise distally, forming a hollow knob. The bars are aligned with the long and short axes of the coccolith.

Remarks: On two occasions, these rare coccoliths were found in association with clusters of *Boletuvelum* (Plate 2, figures 1-6), which is also rare. Though further documentation is necessary, this association raises the possibility that the two coccolith types may have originally belonged to the same cell. Wise and Wind (1977; Plate 28, figure 6) illustrate a specimen of *B. dekaenelii* which they list as "Genus and species indet.", from a Maastrichtian DSDP Sample from the Falkland Plateau. On their range chart, the same sample contained rare specimens of *Boletuvelum candens*.

Size: Holotype: Approximately 5 μm long and 3.3 μm wide.

Occurrence: Rare in the upper Coniacian - lower Santonian of the Smoky Hill Member of the Niobrara Formation, Western Interior, North America.

Holotype: Plate 2, figure 5. Same specimen is viewed at lower magnification in Plate 2, figures 3 and 6 in the lower right of the photograph.

Type locality: Location 12, Marker Unit 5 (Hattin, 1982), Smoky Hill Member of the Niobrara Formation, north-western Kansas, Western Interior, U.S.A.

Rotelapillus applegatei new species
Plate 3, figures 2-9

Diagnosis: A species of *Rotelapillus* distinguished by its robust radial bars and stem.

Differentiation: The outer rim of *R. ellipticum* and *R. applegatei* are nearly identical, but the radial bars of *R. applegatei* fill, or nearly fill, the entire central area to the point that the bars are sometimes barely discernible. Where the stem of *R. ellipticum* is fragile to the point that it is rarely preserved intact, the stem of *R. applegatei* is very robust and often 80% as wide as the basket-shaped rim. The distal end of the stem is terminated by a rosette of 8 imbricate petals, resembling specimens of *Rucinolithus*. Because of its robust stem, *R. applegatei* is usually observed in side view in the light microscope, whereas *C. ellipticum* and other members of *Rotelapillus* are nearly always seen in proximal or distal view. In side view, *C. applegatei* resembles a flat-topped mushroom, and often the distal rosette and the sutures between rim elements may be distinguished.

Remarks: The specimens are somewhat overgrown and it is conceivable that the differences between the species may be an artifact of overgrowth. Plate 3, figure 2, however, illustrates a cluster of *C. applegatei* with several specimens of *C. ellipticum* (upper right). The micrograph is of a fractured surface of chalk broken parallel to bedding, and the coccoliths have presumably experienced the same diagenetic history. The association of both subspecies on

a bedding plane would seemingly rule out overgrowth as the cause of their basic differences. Other species illustrated show no significant signs of intense overgrowth.

Derivation of name. This subspecies is named in honour of Joseph Applegate, Florida State University Nannofossil Laboratory, Tallahassee, Florida.

Occurrence. Few to common in a very short interval within the Santonian of the Niobrara Formation of Kansas, Western Interior, North America.

Size. Holotype: Approximately 2.7 μm across the proximal base, and 3 μm across the widest, most distal part of the rim. Distal ends of stems (rosettes) of two paratypes (Plate 3, figure 7, bottom left) measured 1.6 μm across.

Holotype. Plate 3, figure 7 (middle).

Paratypes. Similar specimens in Plate 3, figures 2-8.

Type locality. Location 12, Marker Unit 5 (Hattin, 1982), Smoky Hill Member of the Niobrara Formation, North-western Kansas, Western Interior, North America.

Watkinsia, new genus

Type species: *Watkinsia pedalion* new species

Derivation of name. In honour of Dr. David K. Watkins, Department of Geology, University of Nebraska, Lincoln, Nebraska.

Diagnosis: A large, flat nannofossil that resembles the rudder or centreboard of a sailboat. The assumed proximal end is thickened in a plane perpendicular to the flat "fin". In cross-polarized light, the entire specimen goes into extinction as one unit.

Remarks: This oddly shaped nannofossil has no discernible elements and is somewhat irregular in outline. It seems highly susceptible to overgrowth and is difficult to distinguish in the light microscope; it appears to be a flat simple piece of calcite. At present, this is a monospecific genus. It is possible that these are holococcoliths, with overgrowth having destroyed the original crystallite ultrastructure.

Watkinsia pedalion new species
Plate 4, figures 1-4

Derivation of name. From $\pi\epsilon\delta\alpha\lambda\iota\omicron\nu$ (Greek)- rudder.

Description: In side view, this taxon resembles the centreboard or rudder of a sailboat. In assumed proximal view, it exhibits an elliptical base. The base has a convex central area, surrounded by a flat rim, the width of which is approximately 22% of the total width of the short axis of the base. There are no discernible elements forming the

base. The "rudder" projects perpendicularly from the plane of the base. It flattens and thins distally and exhibits an irregular outline when viewed in a plane parallel to the base.

Remarks: When observed in side view under the light microscope, the irregular outline and lack of a distinguishing interference pattern make this species appear as a flat piece of calcite (Plate 4, figure 4) and hence, difficult to identify. It goes extinct as a unit in cross-polarized light.

Occurrence: Rare to few in the Santonian of the Niobrara Formation of northwestern Kansas, Western Interior, U.S.A..

Size: Holotype: 15 μm across the base, 21 μm along the axis perpendicular to the base, and 10 μm (mean) across the flat "rudder".

Holotype: Plate 4, figures 1-2.

Paratypes: Plate 4, figure 3.

Type locality: Location 18 (Hattin, 1982), 11 meters below Bed 27 (Sample 18/11-B27), Smoky Hill Member of the Niobrara Formation, northwestern Kansas, Western Interior, North America.

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PLATE 1

Fig.1 Scale bar = 10 μm ; Figs. 2-3, 6-7, Scale bar = 1 μm

- 1-5:** *Biscutum zulloi*, n. sp.; (1) cylindrical coccosphere; note orderly, spiral arrangement of coccoliths; Sample 18/11-B27. (2) same specimen tilted 60°, end view. (3) same specimen, close up. (4) cylindrical coccosphere; phase contrast; Sample 20/8-M15; X2300. (5) same specimen; cross-polarized light.
- 6-7:** *Biscutum constans* (Górka); (6) subcylindrical form; Sample 24/16-B59. (7) same specimen tilted 45°; arrows point to smaller, simpler end-forming coccoliths.

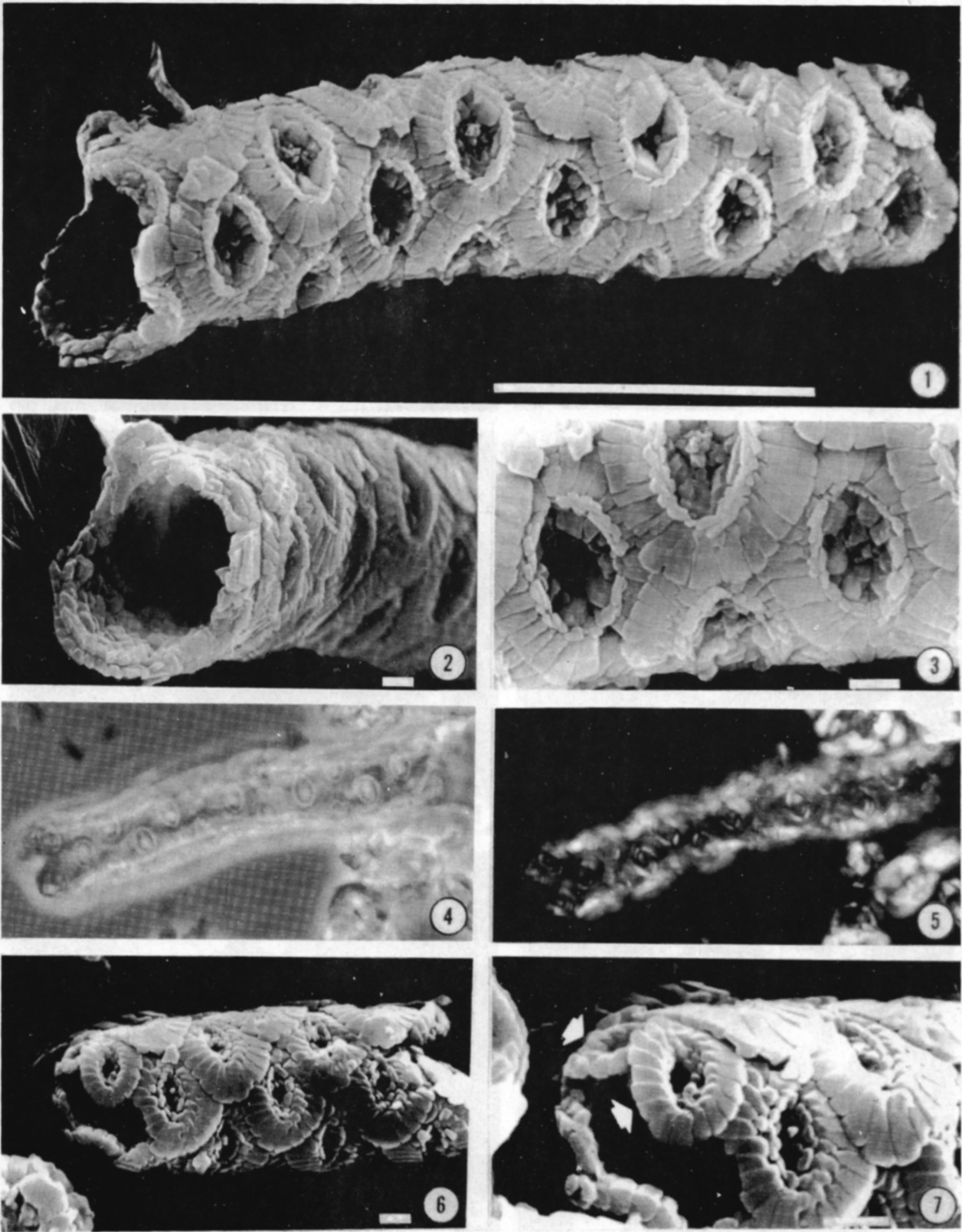


PLATE 2

Fig. 1, Scale bar = 10 μm ; Figs. 2-6, Scale bar = 1 μm

1-4: *Boletuvelum candens* Wind and Wise; (1) distal views; Sample 21/25-TSH. (2) side view; Sample 21/25-TSH. (3) side view; Sample 12/M5. (4) side view showing interior of the spine and distal view of coccolith (with spine broken away?).

5-6: *Biscutum dekaenelii*, n. sp., (5) distal view; Sample 12/M5. (6) same specimen in lower right with additional specimen in upper left, associated with *Boletuvelum* specimens.

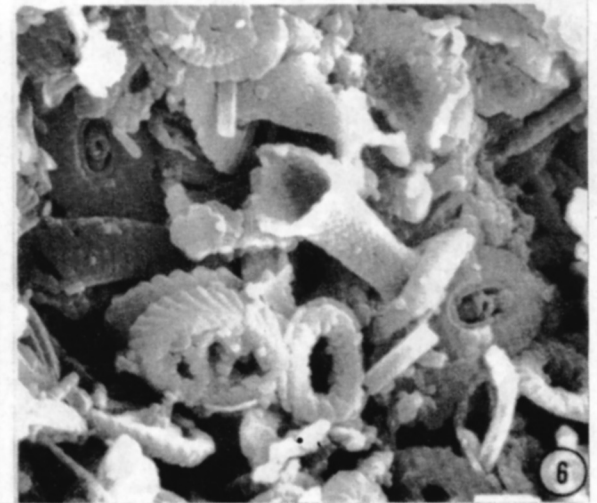
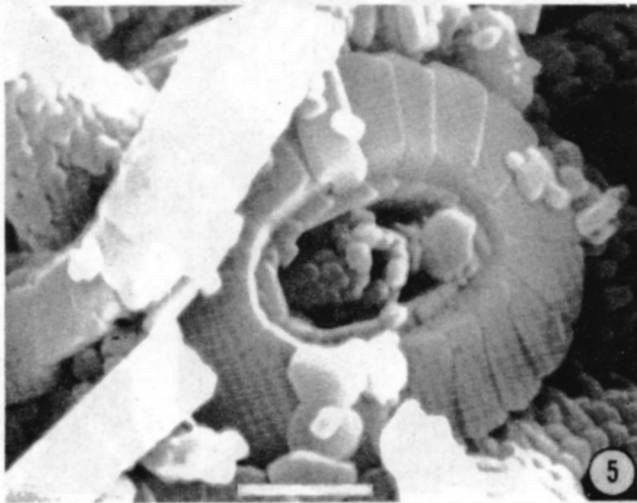
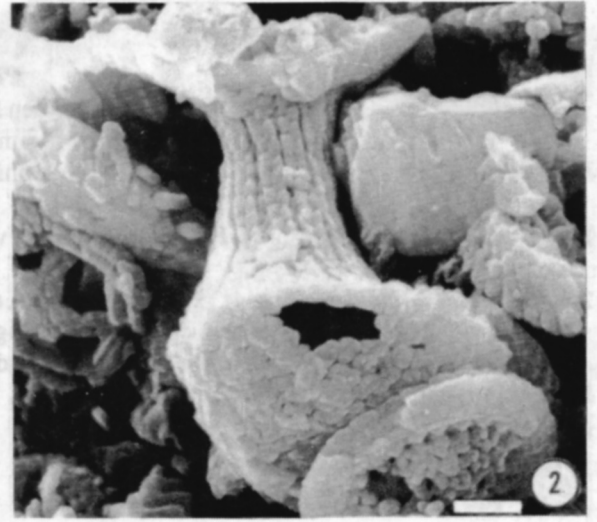
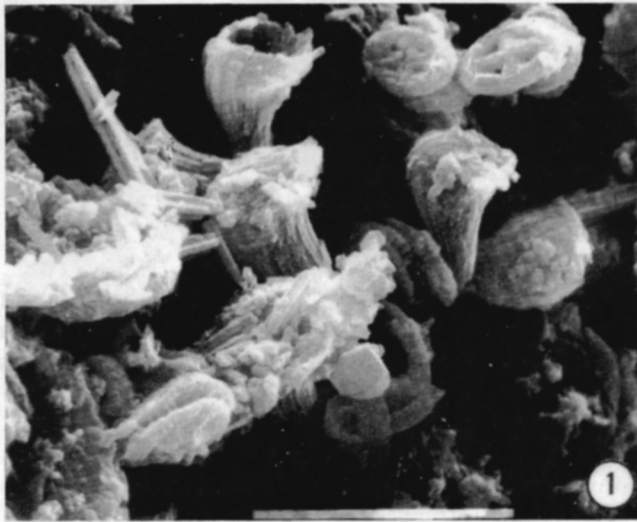


PLATE 3

All specimen from Sample 12/M5

Fig. 2, Scale bar = 10 μm ; Figs. 1, 8-9, Scale bar = 1 μm

All light micrographs $\times 2200$

1: *Rotelapillus ellipticum* Bukry, Proximal and distal views.

2-9: *Rotelapillus applegatei*, n. sp., (2) proximal, distal, and side views; arrow points to *R. ellipticum*. (3) phase contrast; side view. (4) same specimen; cross-polarized light. (6) different specimen; cross-polarized light. (7) proximal and distal views; note *Rucinolithus*-like stem ends (arrows). (8) side views. (9) proximal, distal, and side views.

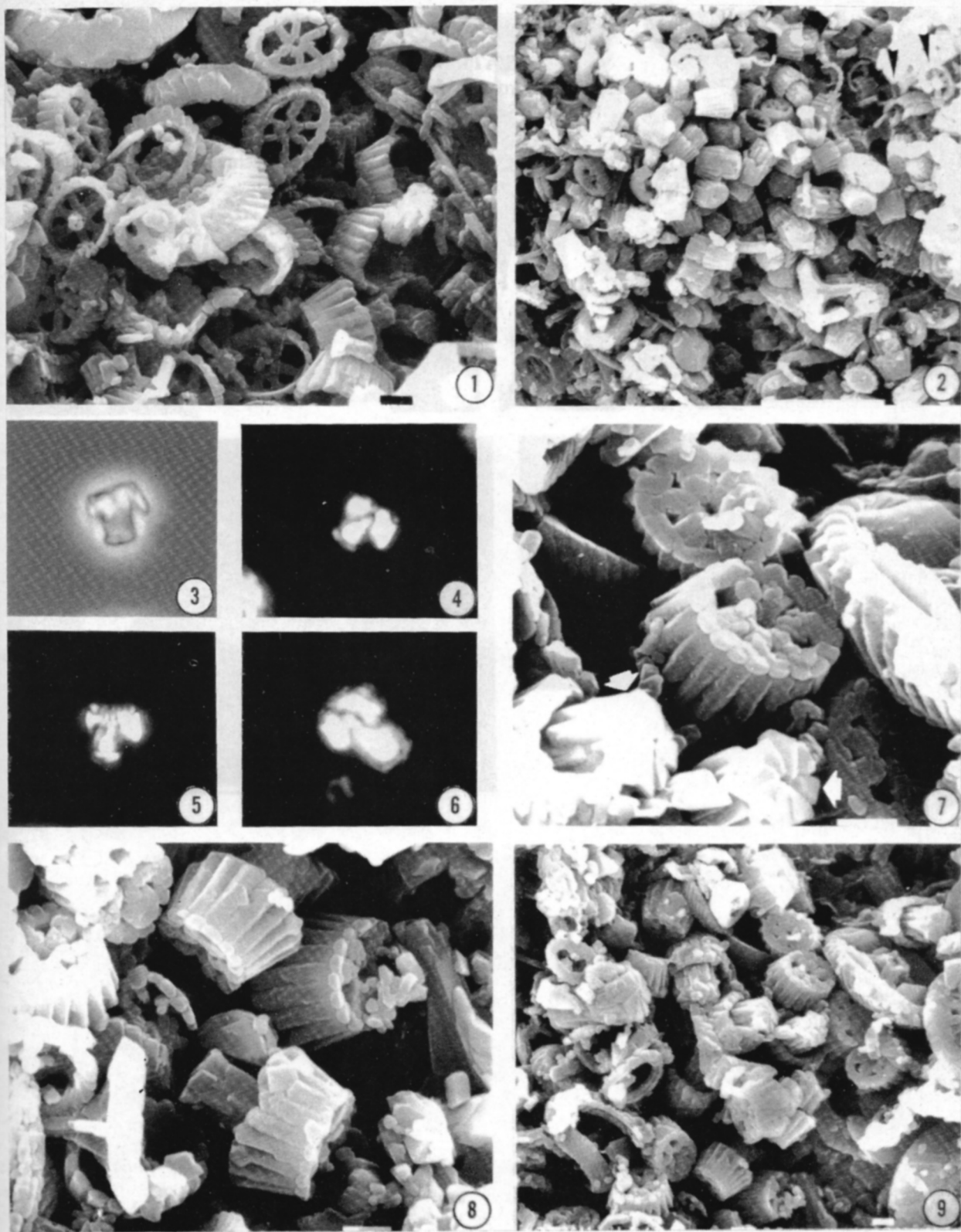


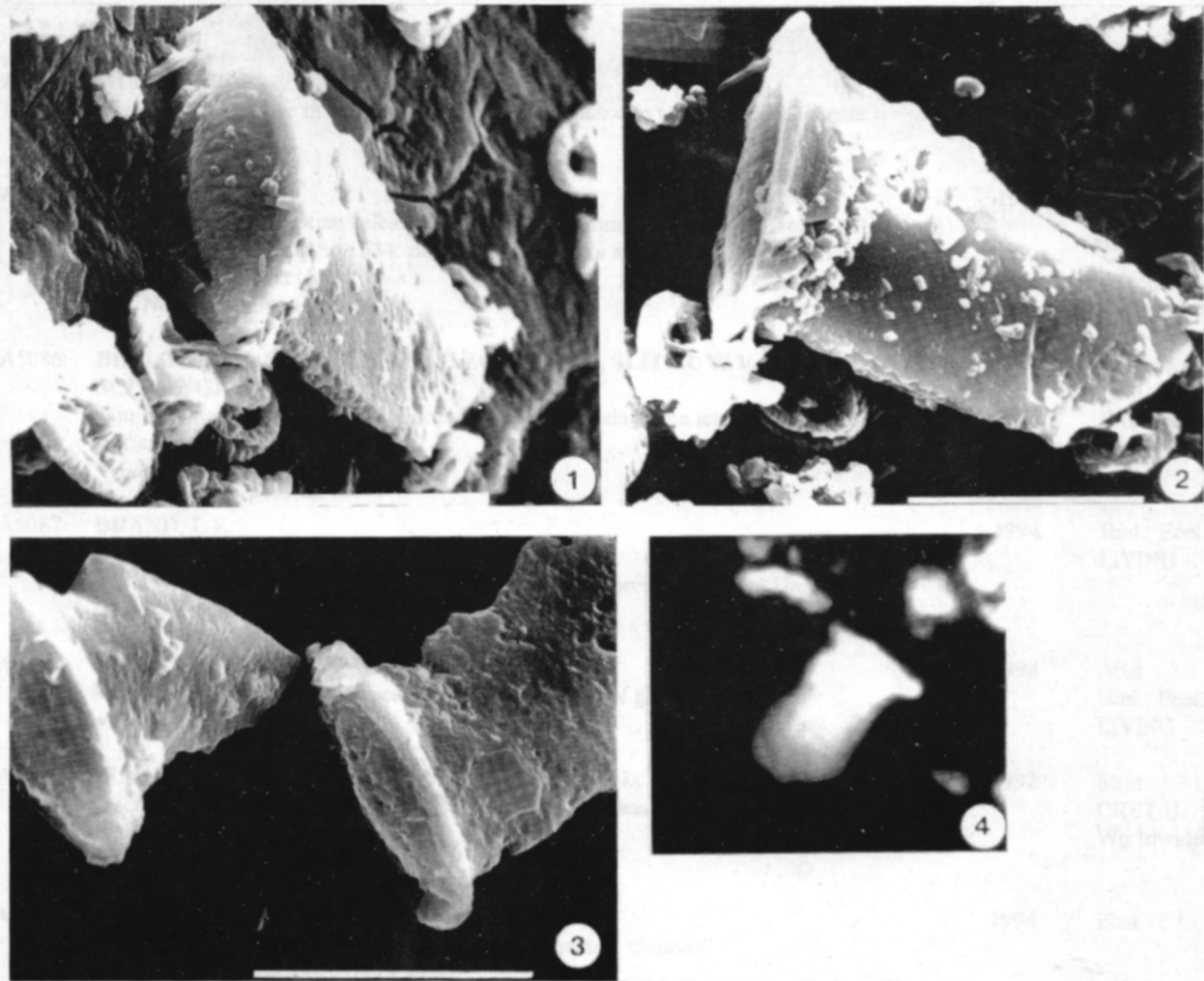
PLATE 4

All specimens from Sample 18/11-B27

Figs. 1-3, Scale bar = 10 μm

1-4: *Watkinsia pedalion*, n. gen., (1) holotype, proximal(?) view, tilted 60°; (2) same specimen, side view; (3) Side view of two paratypes; (4) cross-polarized light.

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