11. UPPER JURASSIC – LOWER CRETACEOUS CALCAREOUS NANNOPLANKTON FROM THE WESTERN NORTH ATLANTIC BASIN

J. A. Wilcoxon, Chevron Oil Field Research Company

INTRODUCTION

At present, the early Cretaceous and Jurassic represent the most significant gap in our knowledge of calcareous nannoplankton biostratigraphy. To date most of the work that has been published is taxonomic, providing a very good base for biostratigraphic research.

This report is the result of the study of 50 core-catcher samples recovered from the early Cretaceous and late Jurassic at four different sites of Leg 11 of the Deep Sea Drilling Project. In addition, an analysis of six samples of known geologic age from Europe is included in the report (Table 1). These samples were kindly supplied by Dr. D. Bernoulli of the Geologic-Paleontologic Institute of the University of Basel and Dr. F. Allemann of the Geological Institute of the University of Berne.

While on board the *Glomar Challenger* each sample was studied using a light microscope, but only the transmission electron microscope was utilized during the shore lab study. All electron micrographs were made by L. Hancock, Jr. of the Chevron Oil Field Research Company Laboratory.

CRETACEOUS – JURASSIC SITES

The late Jurassic early Cretaceous intervals from the following DSDP sites were used in this report (Figure 1):

Site 99, Hole A
(lat 23° 41.14′ N.; long 73° 50.99′ W., depth 4914 meters)

The principal objective at Site 99, approximately 40 miles southeast of San Salvador Island, was to sample strata in what has been considered to be the oldest part of the Atlantic Basin. The section at this site is mostly pre-Tertiary; late Jurassic Oxfordian-Kimmeridgian sediments were penetrated. Fourteen cores were recovered and all but two were Cretaceous or Jurassic in age. Cores 3 through 7 are considered to be early Cretaceous (Neocomian); Cores 8 through 12 are assigned to the late Jurassic Tithonian; and Cores 13 and 14 are placed in the late Jurassic Oxfordian-Kimmeridgian.

Site 100
(lat 24° 41.28′ N.; long 73° 47.95′ W., depth 3225 meters)

The principal objective at Site 100, located between the Hatteras Abyssal Plain and the Bahama Platform, also was to sample old sediments from the oldest part of the Atlantic. Two hundred meters were drilled before the first core was taken in sediments of Cretaceous Valanginian age. Cores 2 through 11 are of late Jurassic Oxfordian-Kimmeridgian age. These sediments rest on basalt.

Site 101, Hole A
(lat 25° 11.93′ N.; long 74° 26.31′ W., depth 4868 meters)

This site was chosen on the southern extremity of the Blake-Bahama Outer Ridge approximately 80 miles east of the central portion of the Blake-Bahama Platform. The primary objective was to obtain information relating to the origin of the ridge. Ten cores were recovered, seven of which are assignable to the Cretaceous and four of which are rich in nannoplankton.

Site 105
(lat 34° 54′ N.; long 60° 10′ W., depth 5251 meters)

This site was located near the northern end of the Hatteras Abyssal Plain. The objective was to determine the age and nature of the oldest sediments. Beginning with Core 11, which is assignable to the Albian Stage, the early Cretaceous and late Jurassic are well represented. Coring from this point was continuous through Core 40, which revealed sediment in contact with basalt. All but two of these cores contain rich nannoplankton assemblages.

SURFACE OUTCROP SAMPLES

The following samples, supplied by F. Allemann, are from a section in Spain and are dated by ammonites: 6831, 6952, and 69140.

The following samples, supplied by D. Bernoulli, are from the Scisti ad Aptici Formation of the Central Apennines: DB 1849, DB 2393, and DB 1848.

TABLE 1
Upper Jurassic – Lower Cretaceous Calcareous Nannoplankton from the Western North Atlantic Basin

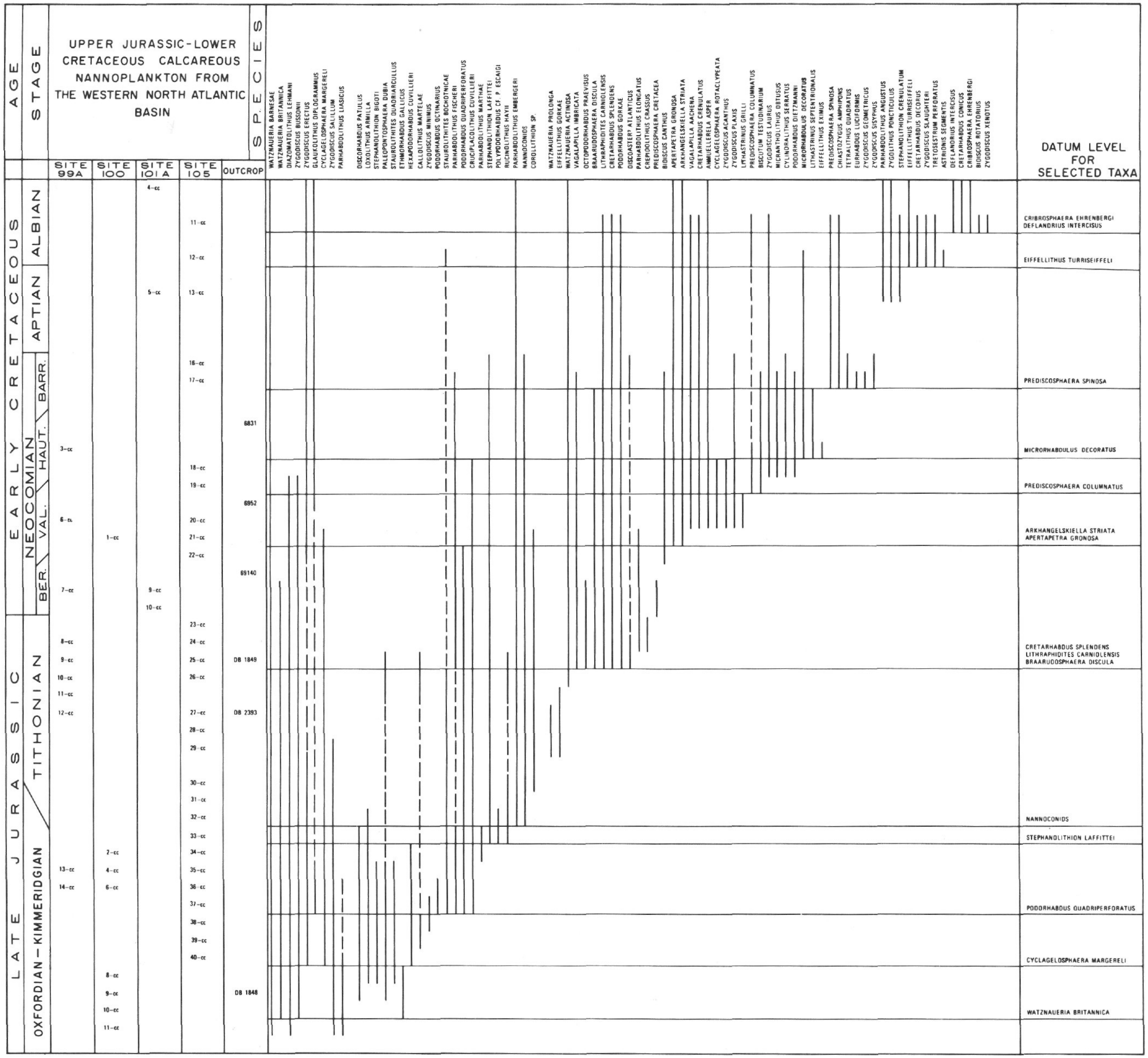

Figure 1. *Site locations, Leg 11.*

The paleontological analyses of these samples, and their biostratigraphic correlation are shown on Table 1.

GENERAL

No attempt has been made in this study to erect zones for the late Jurassic-early Cretaceous interval. Any zonation based on a limited number of sections from a small geographic area may or may not be applicable on an interregional or world-wide basis. Table 1 illustrates the range of 82 species in addition to the overall observed range of the Nannoconid group. These ranges are probably applicable to only a limited area of the western North Atlantic Basin, and may not be identical elsewhere.

The stratigraphic assignment of samples within the stages of the Neocomian has not been made with the accuracy that will be feasible after further investigation of this part of the section. For this reason, the exact definition of the stage boundaries was not attempted. More study of type section material and material from areas where there is good biostratigraphic control by means of other fossils is necessary before the exact definition of stages will be possible. However, the relative placement of the cores with respect to each other in the adjoining sites in Table 1 is considered to be accurate.

At Sites 99, 101 and 105 a hiatus separates the Oligocene-Miocene from the early Cretaceous. The presence or absence of this hiatus at Site 100 could not be determined, since the first core taken (212 meters) was already of Valanginian age.

NEW TAXA AND COMBINATIONS

Astrionis Wilcoxon, n. gen.

These forms are characterized by their stellate outline, which resembles the outline of some species of *Discoaster* and *Micrantholithus.* Unlike the genus *Discoaster,* however, each ray of *Astrionis* is a separate unit of calcite and not in optical continuity with the adjacent one. Unlike *Micrantholithus, Astrionis* has six rays instead of five pentaliths.

Type Species: *Astrionis segmentis,* new species.

Astrionis segmentis Wilcoxon, n. sp.
(Plate 11, Figures 1 and 2)

Description: This species is characterized by 6 pointed rays joined for approximately one third to one half their length. Each ray, plus the basal portion of it which extends into the central area, is a single unit of calcite. Suture lines where the units of calcite join each other can be observed on most specimens. These suture lines can be followed into the central portion where they terminate at an angular hole. The hole, or central opening, is present in every specimen observed. Near their base the rays are broad, but taper to a rather sharp point at their distal end. Size: 4 to 7 microns.

Distribution: Present only in Core 105-12 which is of early Albian age (early Cretaceous).

Tretosestrum Wilcoxon, n. gen.

Elliptical coccolith characterized by two cycles of elements and composed of two shields. The proximal shield is one half to two thirds as large as the distal shield. Central area filled by elements which meet in the center, and an axial line which ends at a large opening at both ends.

Type Species: *Tretosestrum perforatus,* new species.

Tretosestrum perforatus Wilcoxon, n. sp.
(Plate 11, Figures 5-7)

Description: Species composed of 17 to 22 tabular elements, strongly imbricated in a clockwise direction as viewed distally, with truncated ends. Border of central area uniformly perforated by a single series of holes situated at the inner edge of each suture line of the outer cycle of elements. Two large axial openings are present at each end of the central area. These openings terminate the line formed by the meeting in the center of the elements of the central area. The above features are obvious in both the electron and light microscopes. Size: 4 to 6 microns.

Remarks: This species may be mistaken for *Callolithus martelae* or *Watznaueria barnesae* but both of these species have more elements and the elements are not so tabular nor so imbricated.

Distribution: Observed only in the Albian Stage.

Bidiscus canthus Wilcoxon, n. sp.
(Plate 6, Figures 5 and 6)

Description: This double-shield circular coccolith is composed of a single cycle of elements with a well-developed central opening through both shields. One shield (distal?) has 9 to 11 large wedge-shaped elements with truncated distal ends, positioned with no overlap. The other shield is stellate and composed of eight blunt-tipped "rays" which overlap near their inner margins.

Remarks: A first impression that the stellate form of one shield is the result of solution effects appears to be false since other species in the same samples do not show the same effects. Also, other species of *Bidiscus* do not reveal the same overlap of elements near their inner margins. This species resembles *B. monocavus* but has fewer and larger elements than latter.

Distribution: This species occurs commonly at Sites 99 and 105 in the Valanginian-Barremian interval of the Neocomian.

Discoaster? atlanticus Wilcoxon, n. sp.
(Plate 6, Figures 3 and 4)

Description: Rather large form (12 microns) composed of eight narrow and roughly parallel-sided rays with sub-angular to lobate tips. Prominent on one side is a stellate knob which occupies most of the central area. The other side is plain and the suture lines can be traced to a point in the center.

Remarks: This species shows the optical character of the ortholithid discoasters. In the DSDP cores it always occurs alone and is never attached to another form.

Distribution: Rare occurrences observed in early Cretaceous Barremian, Hauterivian, Valangian, and late Jurassic Tithonian cores (Site 105-16, 17, 18, 20, 24, 25).

Podorhabdus octinarius Wilcoxon, n. sp.
(Plate 3, Figures 8 and 9)

Description: Small elliptical coccolith with a narrow outer cycle of elements and an inner structure of cross bars which occupy most of the individual. The central structure is composed of large elements forming a cross at 45° to the long and short axis of the individual. Superimposed on this is another cross aligned with the long and short axis. A central stem may or may not be present.

Distribution: Rare occurrences in the Oxfordian-Kimmeridgian Cores 105-36 and 105-37.

Zygodiscus plaxis Wilcoxon, n. sp.
(Plate 8, Figures 1-3)

Description: Elliptical form with a very narrow rim of small tabulate elements which are strongly imbricated in a clockwise direction when viewed from the distal side. The broad open area enclosed by the rim cycle is spanned by two very large separate elements which meet in the center and occupy approximately one-half of the total central area. Except for the direction of rotation of the rim elements as viewed from opposite sides, both sides are identical. Size: 4 to 6 microns.

Distribution: Occurs with low frequency in the Neocomian, from Valanginian to Barremian.

Cruciplacolithus cuvillieri (Manivit) Wilcoxon, n. comb.
(Plate 4, Figures 3 and 4)

Coccolithus cuvillieri Manivit, 1966, C.R. Soc. Géol. France, p. 268, text-figs. 2a-3b.

Discolithus cuvillieri Manivit, 1969, Proc. First International Conference on Planktonic Microfossils, Geneva, v. 2, pl. 2, figs. 11a-b.

Coccolithus cuvillieri Manivit, 1969, Proc. First International Conference on Planktonic Microfossils, Geneva, v. 2, pl. 1, figs. 8a-b, pl. 3, figs. 2a-c.

Cruciplacolithus cretaceous Reinhardt, 1969, Monatsberichte Deutschen Aka. Wissenschaften Zu Berlin, v. 11, p. 933, pl. 1, fig. 4.

?Cruciplacolithus sp. Bukry and Bramlette, 1969, Deep Sea Drilling Project Initial Reports, Leg 1, pl. 3, figs. C-D.

Staurolithites quadriarcullus (Noël) Wilcoxon, n. comb.
(Plate 3, Figures 3 and 4)

Discolithus quadriarcullus Noël, 1965, Cahiers Micropaleont., ser. 1, no. 1, p. 4, fig. 7.

Zygodiscus bussonii (Noël) Wilcoxon, n. comb.
(Plate 1, Figure 3)

Zygolithus bussoni Noël, 1957, Publ. Serv. Carte Géol. Algerie, ser. 2, Bull 8, p. 321, pl. 2, figs. 13-14.

Zygodiscus salillum (Noël) Wilcoxon, n. comb.
(Plate 2, Figures 6 and 7)

Discolithus salillum Noël, 1965, Cahiers Micropaleont., ser. 1, no. 1, p. 4, figs. 5-6.

SPECIES LIST

Ahmuellerela asper (Stradner) Reinhardt, 1965

Apertaperta gronosa (Strover) Bukry, 1969

Arkhangelskiella striata Stradner, 1963

Astrionis segmentis n. gen., n. sp.

Bidiscus canthus n. sp.

Bidiscus rotatorius Bukry, 1969

Biscutum testudinarium Black in Black and Barnes, 1959

Braarudosphaera discula Bramlette and Riedel, 1954

Callolithus martelae Noël, 1965

Chiastozygus amphipons (Bramlette and Martini) Gartner, 1968

Corollithion sp.

Crepidolithus crassus (Deflandre) Noël, 1965

Cribrosphaera ehrenbergi Arkhangel' skii, 1912

Cretarhabdus conicus Bramlette and Martini, 1964

Cretarhabdus crenulatus Bramlette and Martini, 1964

Cretarhabdus decorus (Deflandre) Bramlette and Martini, 1964

Cretarhabdus splendens (Deflandre) Bramlette and Martini, 1964

Cyclagelosphaera margereli Noël, 1965

Cyclagelosphaera rotaclypeata Bukry, 1969

Cruciplacolithus cuvillieri (Manivit) Wilcoxon, n. comb.

Cylindralithus serratus Bramlette and Martini, 1964

Deflandrius intercisus (Deflandre) Bramlette and Martini, 1964

Diazomatolithus lehmani Noël, 1965

Discoaster? atlanticus n. sp.

Discorhabdus patulus (Deflandre) Noël, 1965

Eiffellithus eximius (Stover) Perch-Nielsen, 1968

Eiffellithus gorkae Reinhardt, 1965

Eiffellithus turriseiffeli (Deflandre) Reinhardt, 1965

Ethmorhabdus gallicus Noël, 1965

Eurhabdus luciformis Reinhardt, 1965

Glaukolithus diplogrammus (Deflandre) Reinhardt, 1964

Hexapodorhabdus cuvillieri Noël, 1965

Lithastrinus grilli Stradner, 1962

Lithastrinus septentrionalis Stradner, 1963

Lithraphidites carniolensis Deflandre, 1963

Loxolithus armilla (Black) Noël, 1965

Micrantholithus obtusus Stradner, 1963

Microrhabdus decoratus Deflandre, 1959

Nannoconus spp.

Octopodorhabdus praevisus Noël, 1965

Paleopontosphaera dubia Noël, 1965

Parhabdolithus augustus (Stradner) Stradner, 1968

Parhabdolithus elongatus Stover, 1966

Parhabdolithus embergeri (Noël) Stradner, 1963

Parhabdolithus fischeri Bukry, 1969

Parhabdolithus liasicus Deflandre in Grassé, 1952

Parhabdolithus marthae Deflandre in Deflandre & Fert, 1954

Podorhabdus dietzmanni (Reinhardt) Reinhardt, 1967

Podorhabdus gorkae Reinhardt, 1969

Podorhabdus octinarius n. sp.

Podorhabdus quadriperforatus Bukry, 1969

Polypodorhabdus cf. P. escaigi Noël, 1965

Prediscosphaera columnatus (Stover) Bukry and Bramlette, 1969

Prediscosphaera cretacea (Arkhangel' skii) Gartner, 1968

Rucinolithus hayii Stover, 1966

Staurolithites bochotnicae (Gorka) Reinhardt, 1965

Staurolithites quadriarcullus (Noël) Wilcoxon, n. comb.

Stephanolithion bigoti Deflandre, 1939

Stephanolithion crenulatum Stover, 1966

Stephanolithion laffittei Noël, 1957

Tetralithus quadratus Stradner, 1961

Tretosestrum perforatus n. gen., n. sp.

Vagalapilla aachena Bukry, 1969

Vagalapilla imbricata (Gartner) Bukry, 1969

Watznaueria actinosa (Stover) Bukry, 1969

Watznaueria barnesae (Black) Perch-Nielsen, 1968

Watznaueria britannica (Stradner) Reinhardt, 1964

Watznaueria prolonga Bukry, 1969

Zygodiscus acanthus (Reinhardt) Reinhardt, 1966

Zygodiscus bussonii (Noël) Wilcoxon, n. comb.

Zygodiscus erectus (Deflandre) Bukry and Bramlette, 1969

Zygodiscus laurus Gartner, 1968

Zygodiscus minimus Bukry, 1969

Zygodiscus plaxis n. sp.

Zygodiscus salillum (Noël) Wilcoxon, n. comb.

Zygodiscus sisyphus Gartner, 1968

Zygodiscus slaughteri Bukry, 1969

Zygodiscus xenotus (Stover) Bukry and Bramlette, 1969

Zygolithus geometricus (Gorka) Stradner, Adamiker and Maresch, 1968

Zygolithus ponticulus (Deflandre) in Deflandre and Fert, 1954

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Stradner, H., 1963. New contributions to Mesozoic stratigraphy by means of nannofossils. *Proc. Sixth World Petrol. Congr. [Frankfurt am Main, 1963].* Sect. 1, paper 4, 16 p., 6 pls.

PLATE 1

Figures 1, 2	*Watznaueria britannica* (Stradner) Reinhardt. Both specimens from 11-99A-14. (1) Distal view, 750X; (2) Distal view, 7500X.
Figure 3	*Zygodiscus bussonii* (Noël) Wilcoxon, n. comb. Distal view, 17,000X. Specimen from 11-105-25.
Figure 4	*Cyclagelosphaera margereli* Noël. Distal view, 19,800X. Specimen from 11-105-35.
Figure 5	*Diazomatolithus lehmani* Noël. Distal view, 15,000X. Specimen from 11-105-25.
Figures 6, 7	*Watznaueria barnesae* (Black) Perch-Nielsen. (6) Distal view, 8000X, specimen from 11-105-19-CC. (7) Proximal view, 10,000X, specimen from 11-105-19-CC.

PLATE 1

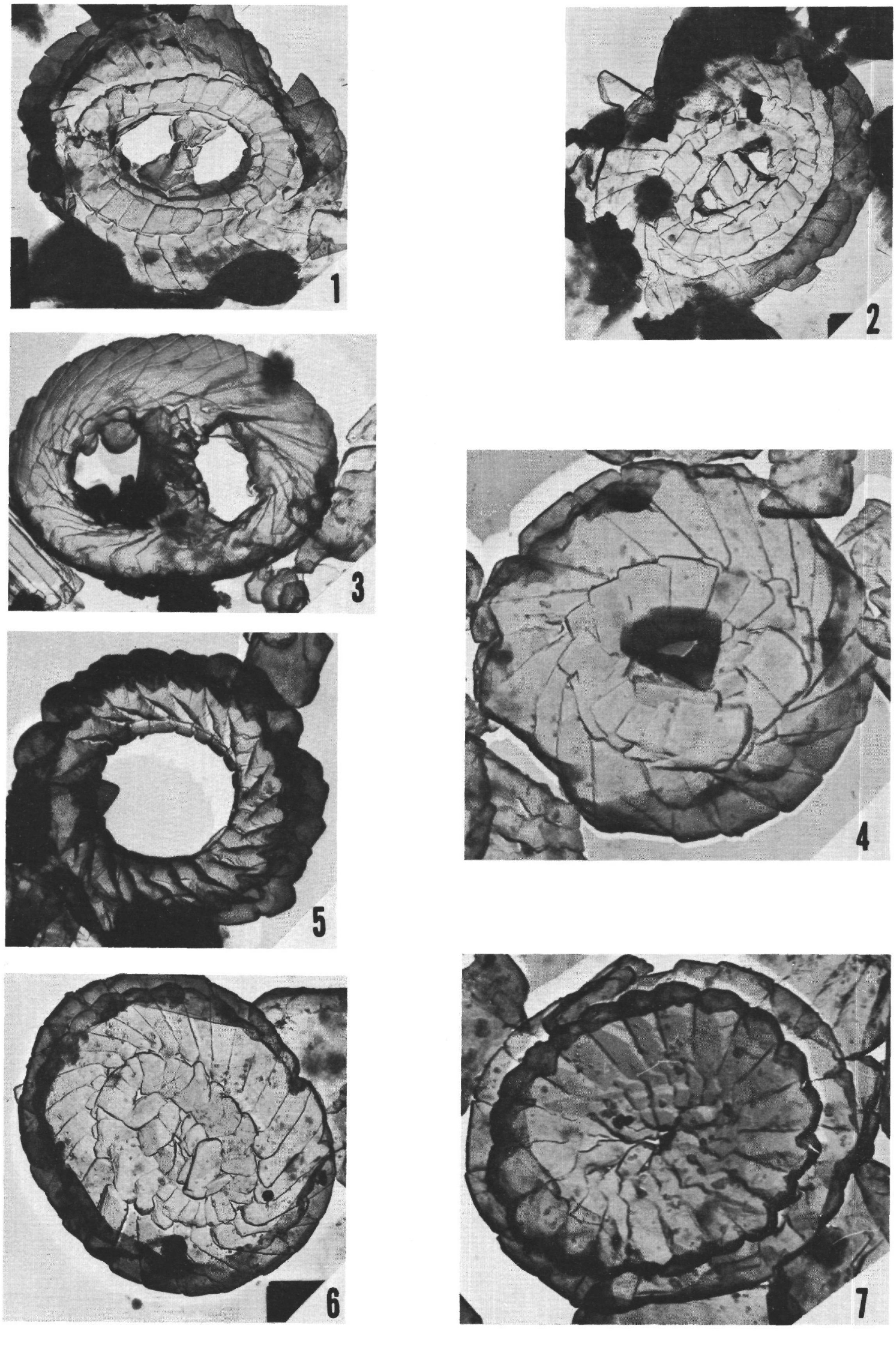

PLATE 2

Figures 1, 2	*Glaukolithus diplogrammus* (Deflandre) Reinhardt. (1) Distal? view, 11,500X. Specimen from 11-105-11. (2) Of Noël, 1965, pl. 1, figs. 5-6, Proximal? view, 16,900X, Specimen from 11-100-9.
Figure 3	*Zygodiscus erectus* (Deflandre) Wilcoxon, n. comb. Distal view, 16,000X. Specimen from 11-105-18.
Figures 4, 5	*Discorhabdus patulus* (Deflandre) Noël. (4) Stem, 17,000X, (5) Distal view, 16,000X. Specimens from 11-105-37.
Figures 6, 7	*Zygodiscus salillum* (Noël) Wilcoxon, n. comb. (6) Distal view, 7000X. Specimen from 11-105-29. (7) Proximal view, 16,000X. Specimen from 11-100-9.
Figures 8, 9	*Loxolithus armilla* (Black) Noël. (8) Distal(?) view, 18,000X. Specimen from 11-100-9. (9) Proximal(?) view, 22,000X. Specimen from 11-105-33.

PLATE 2

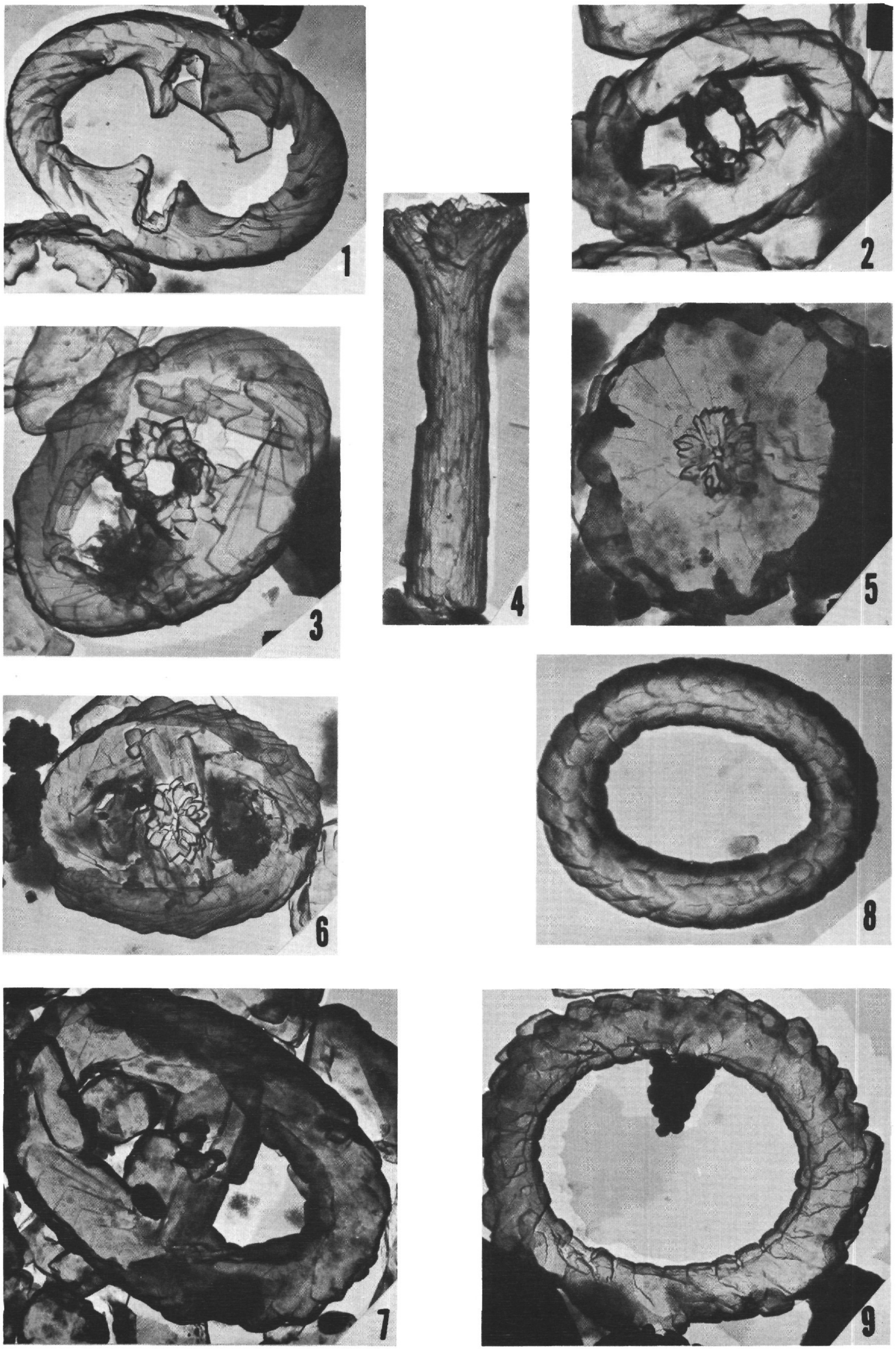

PLATE 3

Figure 1	*Staurolithites bochotnicae* (Gorka) Reinhardt. Distal view, 11,200X. Specimen from 11-101A-9.
Figure 2.	*Stephanolithion bigoti* Deflandre. 7000X. Specimen from 11-105-37.
Figures 3, 4	*Staurolithites quadriarcullus* (Noël) Wilcoxon, n. comb. (3) Distal view, 11,000X. Specimen from 11-105-37. (4) Distal view, 12,000X. Specimen from 11-105-37.
Figure 5	*Zygodiscus minimus* Bukry. Distal view, 23,300X. Specimen from 11-105-37.
Figure 6	*Paleopontosphaera dubia* Noël. Distal view, 23,300X. Specimen from 11-105-38.
Figure 7	*Callolithus martelae* Noël. Proximal view, 15,000X. Specimen from 11-99A-14.
Figures 8, 9	*Podorhabdus octinarius* Wilcoxon, n. sp. (8) Holotype. Distal(?) view, 22,500X. Specimen from 11-105-37.

PLATE 3

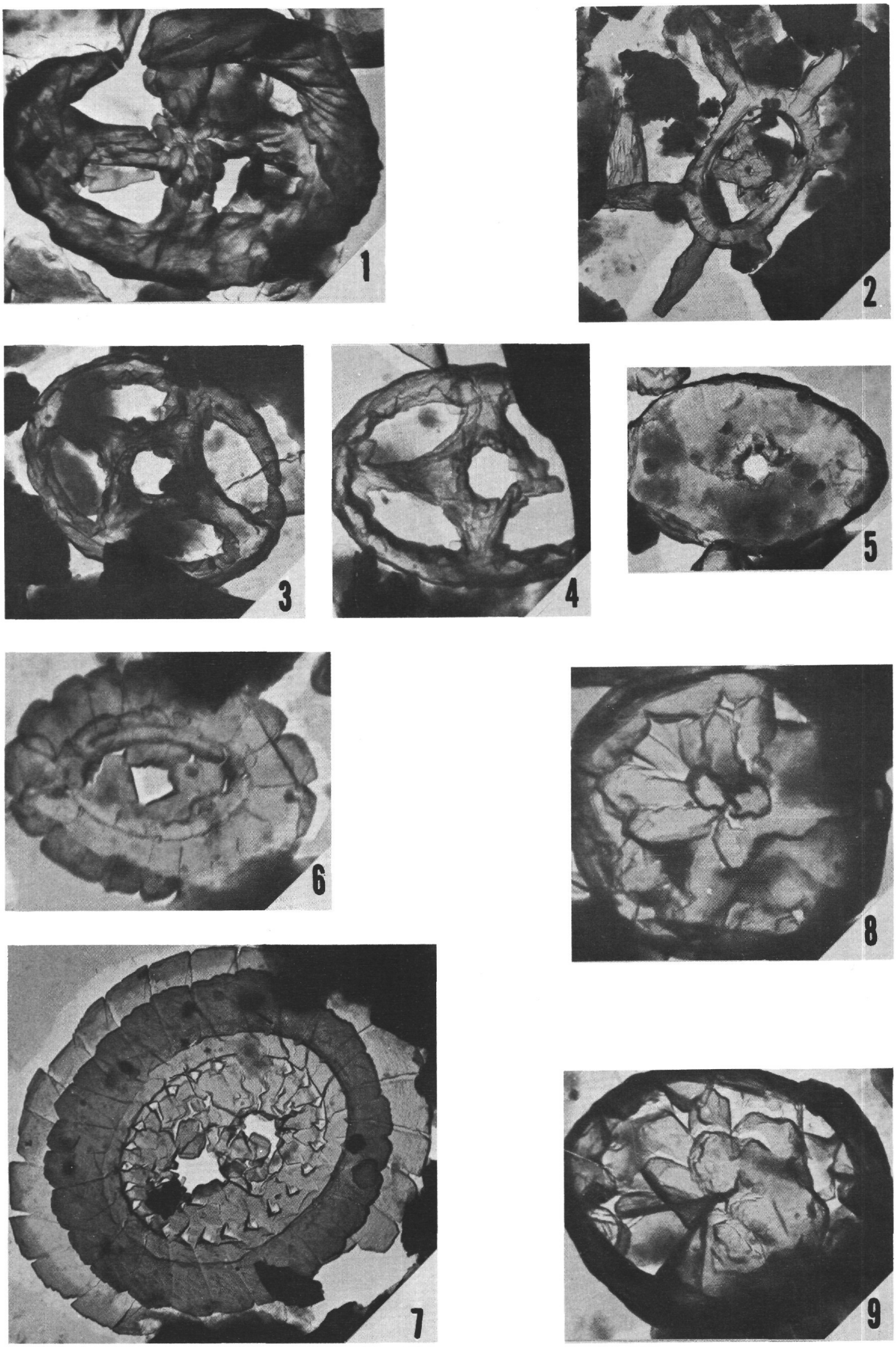

PLATE 4

Figures 1, 2	*Parhabdolithus fischeri* Bukry. (1) Proximal view, 10,000X. Specimen from 11-105-18. (2) Proximal view, 12,000X. Specimen from 11-105-18.
Figures 3, 4	*Cruciplacolithus curvillieri* (Manivit) Wilcoxon, n. comb. (3) Proximal view, 8000X. Specimen from 11-105-18. (4) Proximal view, 6000X. Specimen from 11-105-22.
Figures 5, 7, 8	*Stephanolithion laffittei* Noël. (5) Side view, 11,500X. Specimen from 11-105-22. (7) Proximal view, 13,000X. Specimen from 11-105-19-CC. (8) Proximal view, 12,000X. Specimen from 11-105-17. 11-105-17.
Figure 6	*Rucinolithus hayii* Stover. 13,500X. Specimen from 11-105-33.

PLATE 4

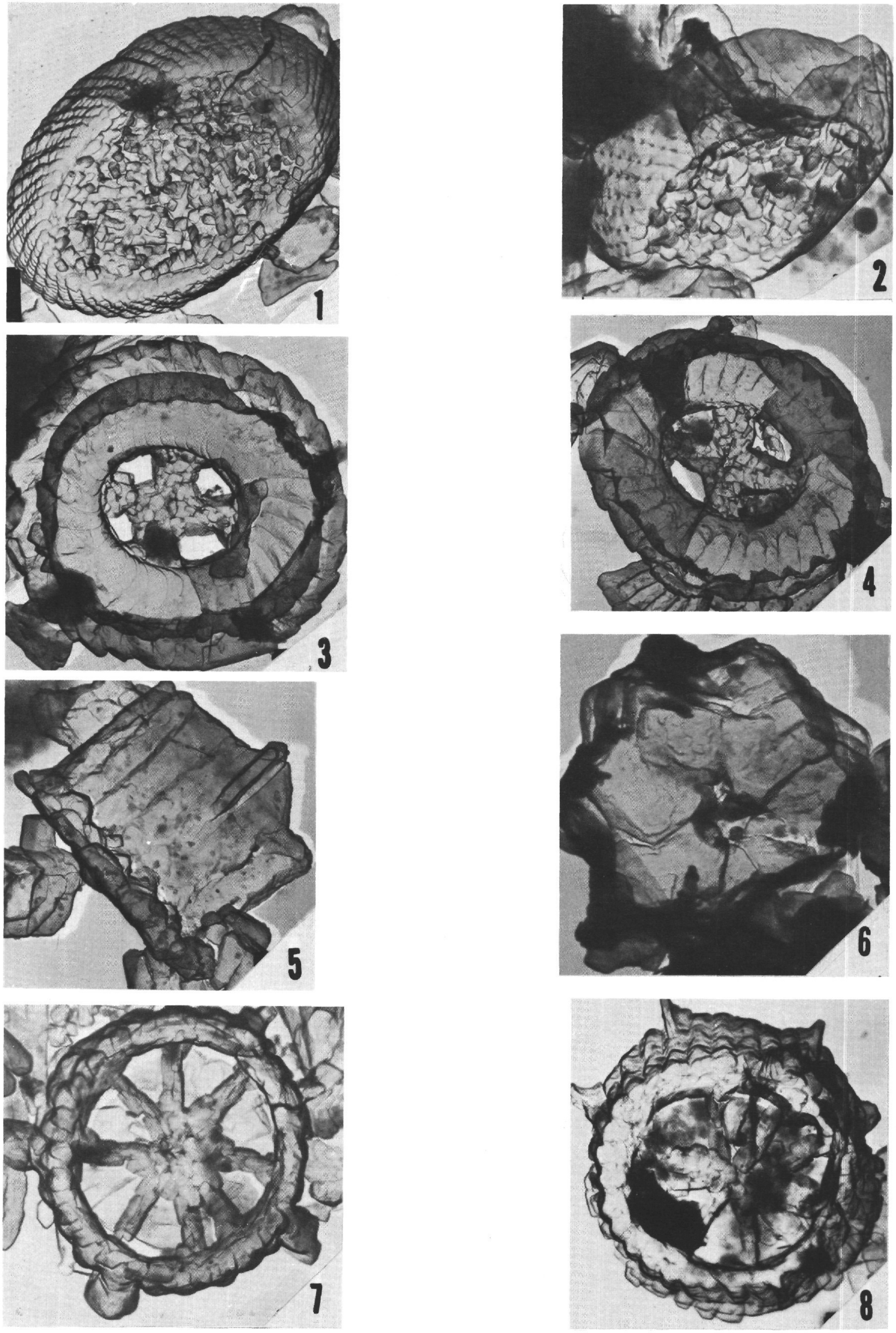

PLATE 5

Figures 1, 2	*Parhabdolithus embergeri* (Noël) Stradner. (1) Proximal view, 12,500X. Specimen from 11-105-20. (2) Proximal view, 13,500X. Specimen from 11-105-20.
Figures 3, 4	*Vagalopilla imbricata* (Garnter) Bukry. (3) Proximal view, 13,500X. Specimen from 11-105-17. (4) Distal view, 12,000X. Specimen from 11-105-17.
Figures 5, 6	*Lithraphidites carniolensis* Deflandre. (5) 2800X. Specimen from 11-105-17. (6) 3500X. Specimen from 11-105-17.
Figure 7	*Octopodorhabdus praevisus* Noël. Distal view, 9800X. Specimen from 11-105-25.
Figure 8	*Watznaueria prolonga* Bukry. Proximal view, 9500X. Specimen from 11-105-29.
Figures 9, 10	*Cretarhabdus splendens* (Deflandre) Bramlette and Martini. (9) Distal view, 11,500X. Specimen from 11-105-11. (10) Distal view, 13,000X. Specimen from 11-105-11.

PLATE 5

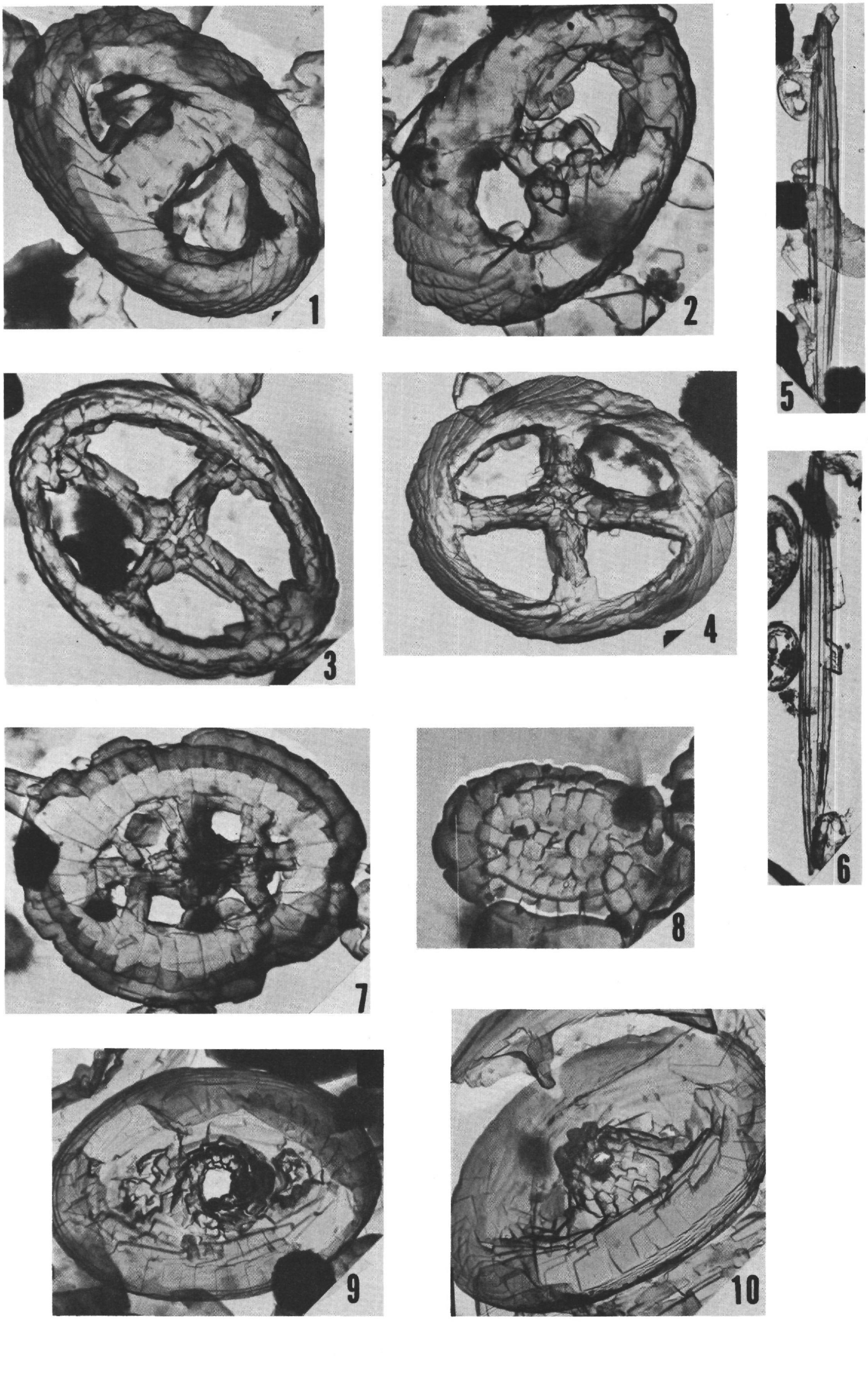

PLATE 6

Figures 1, 2	*Podorhabdus gorkae* Reinhardt. (1) Distal view, 9500X. Specimen from 11-105-11. (2) Distal view, 9500X. Specimen from 11-105-11.
Figures 3, 4	*Discoaster* ? *atlanticus* Wilcoxon, n. sp. (3) Holotype. Distal view, 9000X. Specimen from 11-105-17. (4) Paratype. Proximal view, 11,000X. Specimen from 11-105-17.
Figures 5, 6	*Bidiscus canthus* Wilcoxon, n. sp. (5) Holotype. 15,500X. Specimen from 11-105-18. (6) Paratype 17,500X. Specimen from 11-105-20.
Figure 7	*Prediscosphaera cretacea* (Arkhangelśkii) Gartner. Proximal view, 13,500X. Specimen from 11-101A-9.
Figure 8	*Eiffellithus gorkae* Reinhardt. Proximal view, 17,500X. Specimen from 11-105-29.

PLATE 6

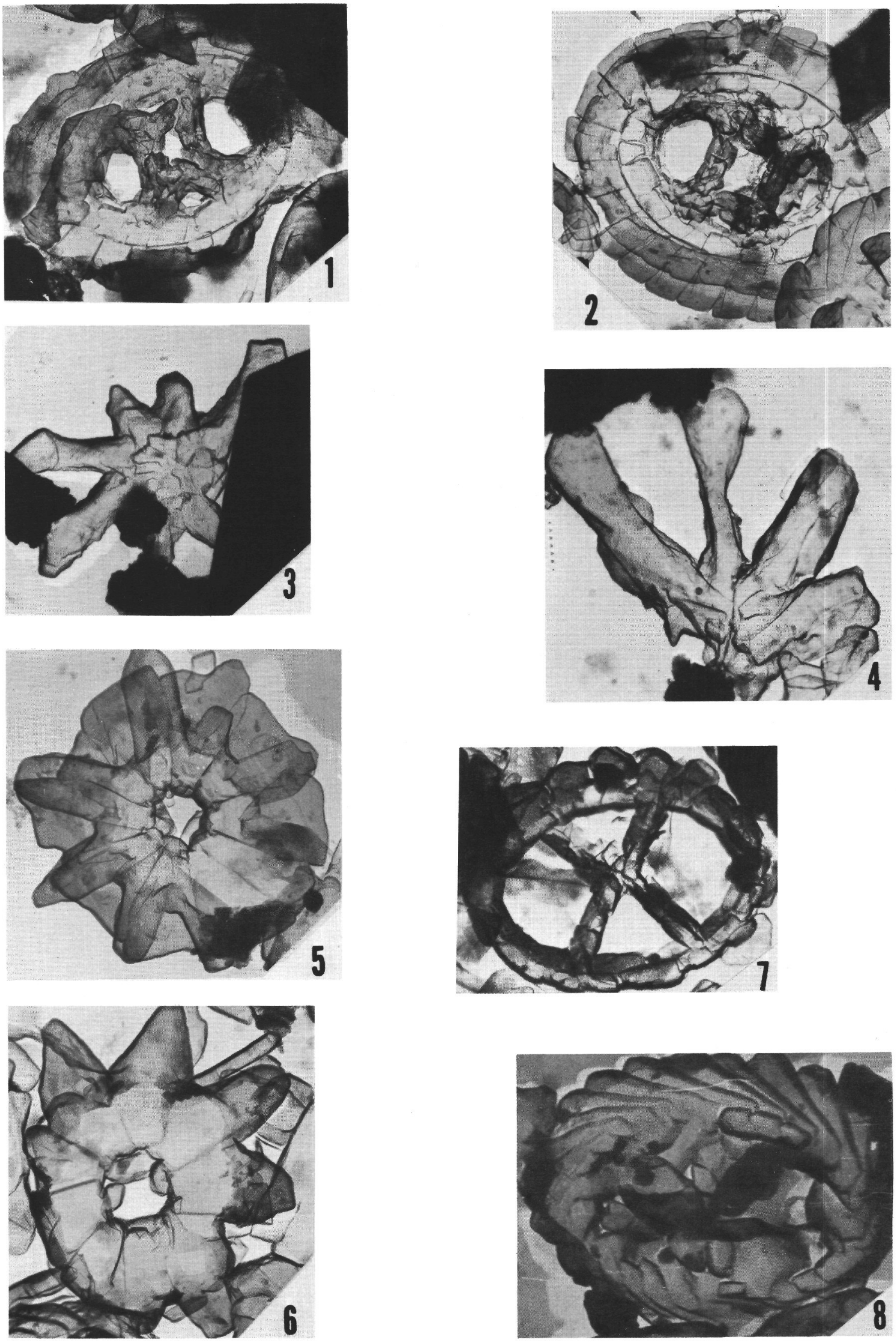

PLATE 7

Figures 1, 2	*Cretarhabdus crenulatus* Bramlette and Martini. (1) Proximal view, 9000X. Specimen from 11-105-17. (2) Distal view, 10,000X. Specimen from 11-105-11.
Figures 3, 4	*Vagalapilla aachena* Bukry. (3) Proximal view, 9500X. Specimen 11-105-10. (4) Distal view, 10,500X. Specimen from 11-105-18.
Figures 5-7	*Cycagelosphaera rotaclypeata* Bukry. (5) Proximal view, 14,000X. Specimen from 11-105-20. (6) Side view, 14,000X. Specimen from 11-105-18, (7) Proximal view, 14,000X. Specimen from 11-105-18.
Figure 8	*Apertapetra gronosa* (Stover) Bukry. Distal view 17,000X. Specimen 11-105-12.

PLATE 7

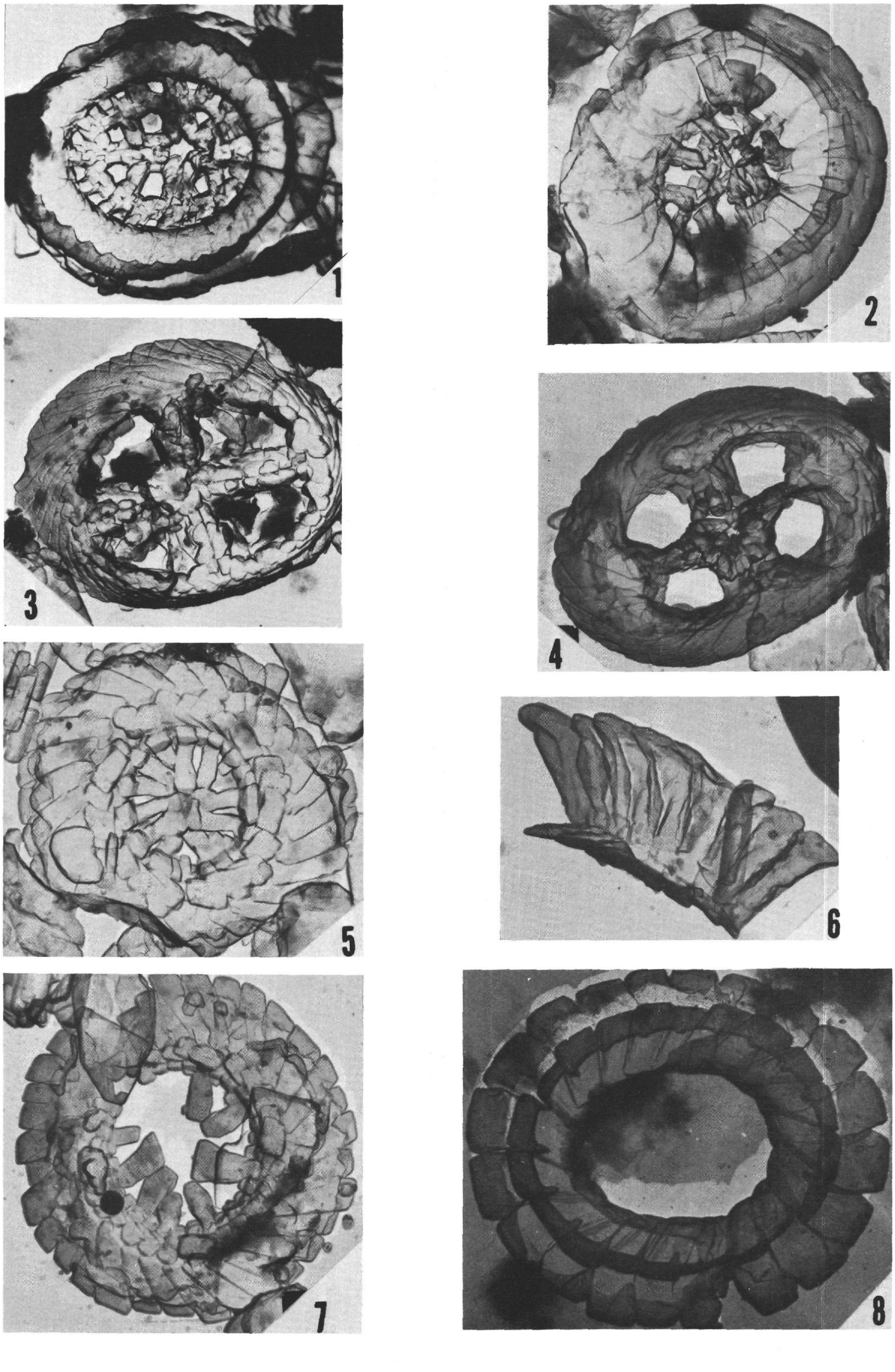

PLATE 8

Figures 1–3	*Zygodiscus plaxis* Wilcoxon, n. sp. (1) Holotype. Distal view, 13,500X. Specimen from 11-105-20-CC. (2) Paratype. Distal view 12,500X. Specimen from 11-105-18. (3) Paratype. Proximal view, 13,000X. Specimen from 11-105-17.
Figure 4	*Zygodiscus acanthus* (Reinhardt) Reinhardt. Distal view, 7500X. Specimen from 11-105-18.
Figures 5, 6	*Lithastrinus grilli* Stradner. (5) 8000X. Specimen from 11-105-20. (6) Side view, 11,000X. Specimen from 11-105-20.
Figures 7, 8	*Prediscosphaera columnatus* (Stover) Bukry and Bramlette. (7) 10,000X. Specimen from 11-105-11. (8) 10,500X. Specimen from 11-105-11.
Figure 9	*Biscutum testudinarium* Black in Black and Barnes. Distal view, 12,500X. Specimen from 11-105-18.

PLATE 8

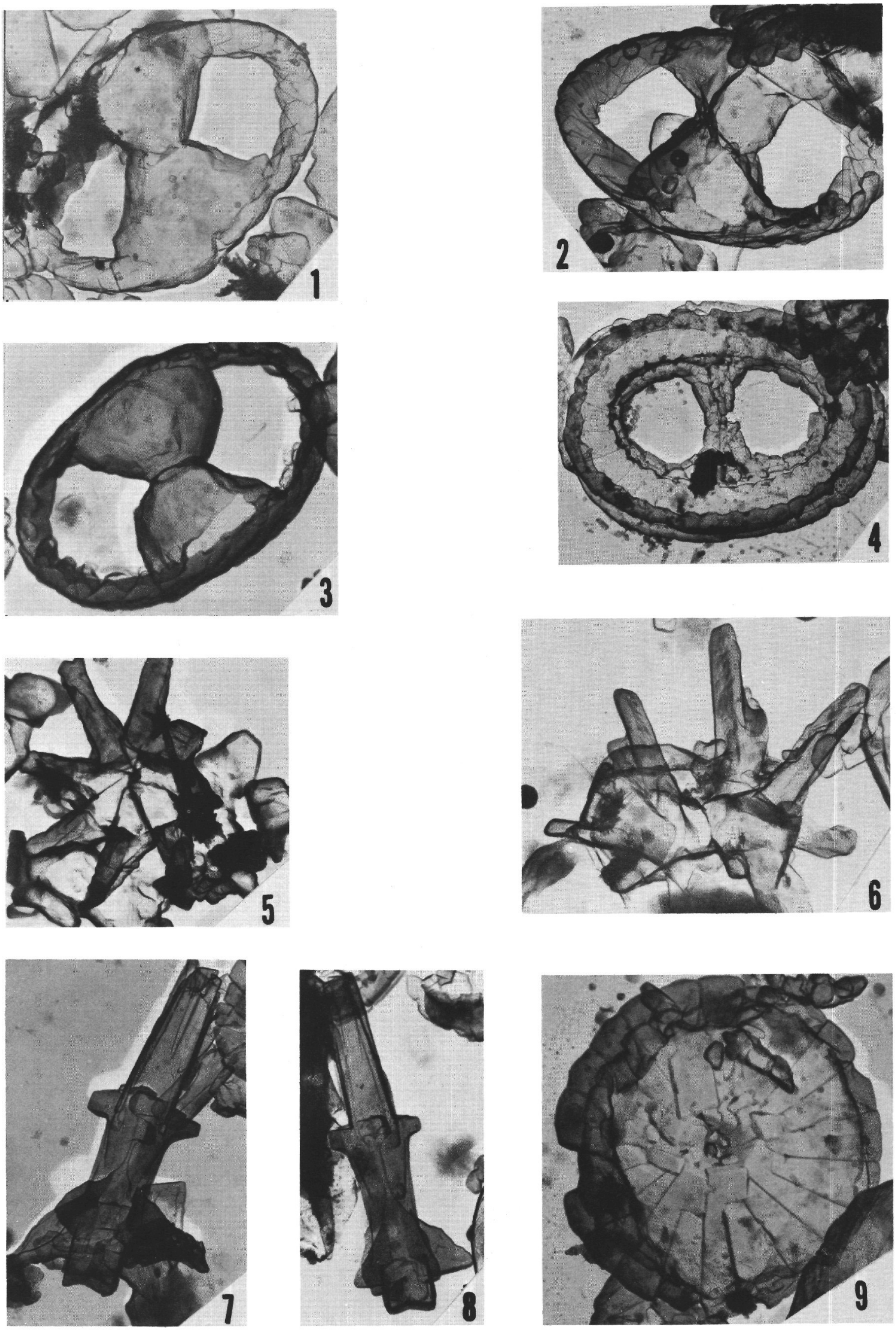

PLATE 9

Figures 1, 2	*Zygodiscus laurus* Gartner. (1) Proximal view, 15,500X. Specimen from 11-105-17. (2) Proximal view, 17,000X. Specimen from 11-105-19.
Figures 3, 4	*Micrantholithus obtusus* Stradner. Both specimens 14,000X. Specimens from 11-105-18.
Figures 5, 6	*Prediscosphaera spinosa* (Bramlette and Martini) Gartner. (5) Proximal view, 14,500X. Specimen from 11-105-11. (6) Oblique view, 12,000X. Specimen from 11-105-11.
Figure 7	*Podorhabdus dietzmanni* (Reinhardt) Reinhardt. Distal view, 7,000X. Specimen from 11-105-17.
Figure 8	*Cylindralithus serratus* Bramlette and Martini. Side view, 12,500X. Specimen from 11-105-18.

PLATE 9

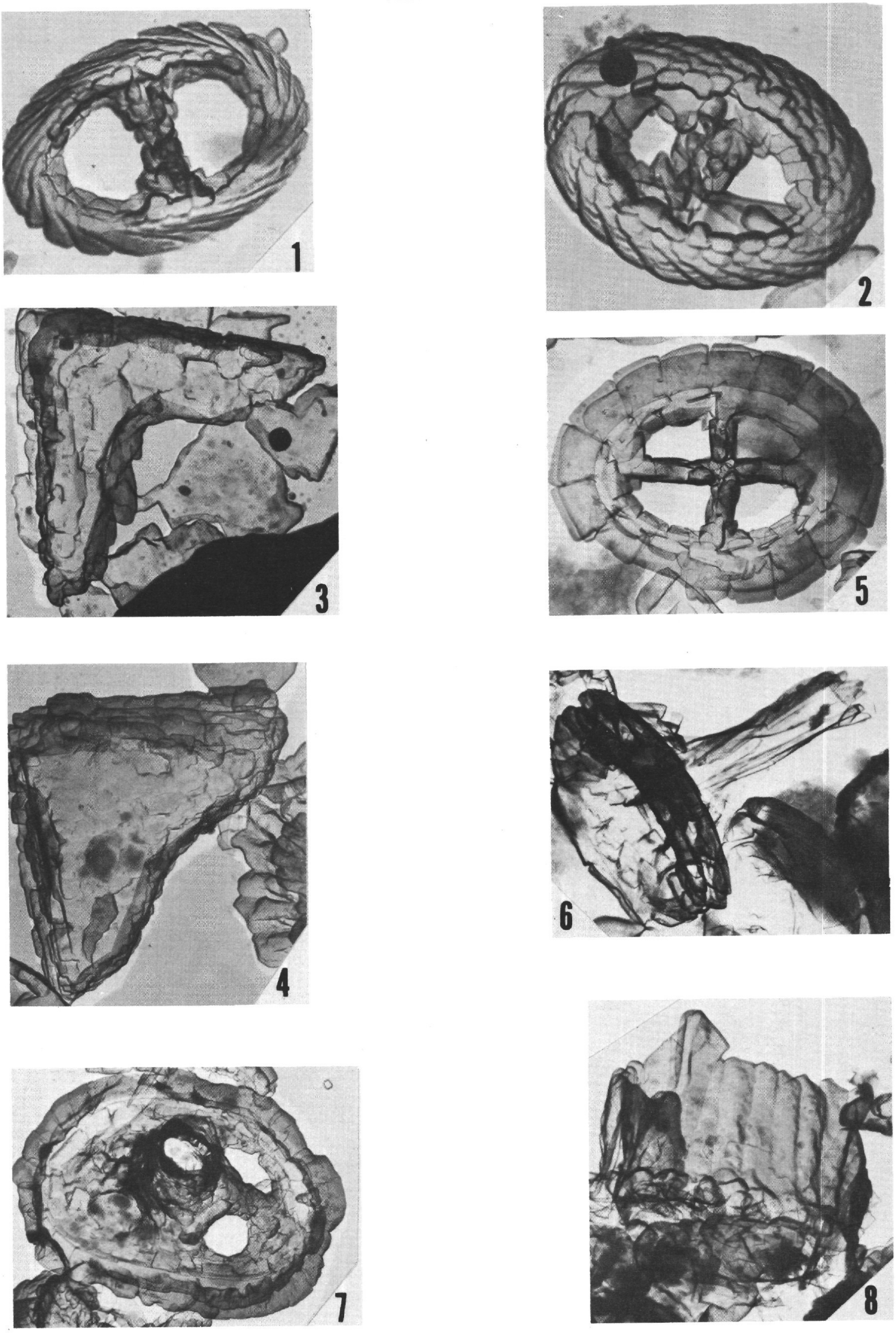

PLATE 10

Figures 1, 2	*Zygodiscus slaughteri* Bukry. (1) Proximal view, 11,000X. Specimen from 11-105-11. (2) Distal view, 11,000X. Specimen from 11-105-11.
Figure 3	*Zygodiscus sisyphus* Gartner. Proximal view, 18,500X. Specimen from 11-105-17.
Figure 4	*Eurhabdus luciformis* Reinhardt. 6000X. Specimen from 11-105-17.
Figures 5, 6	*Zygolithus geometricus* (Gorka) Stradner. (5) Distal(?) view, 18,000X. Specimen from 11-105-17. (6) Distal view, 16,000X. Specimen from 11-105-17.
Figures 7, 8	*Chiastozygus amphipons* (Bramlette and Martini) Gartner. (7) Distal view, 8000X. Specimen from 11-105-17. (8) Distal view, 11,500X. Specimen from 11-105-11.
Figure 9	*Tetralithus quadratus* Stradner. 26,000X. Specimen from 11-105-17.

PLATE 10

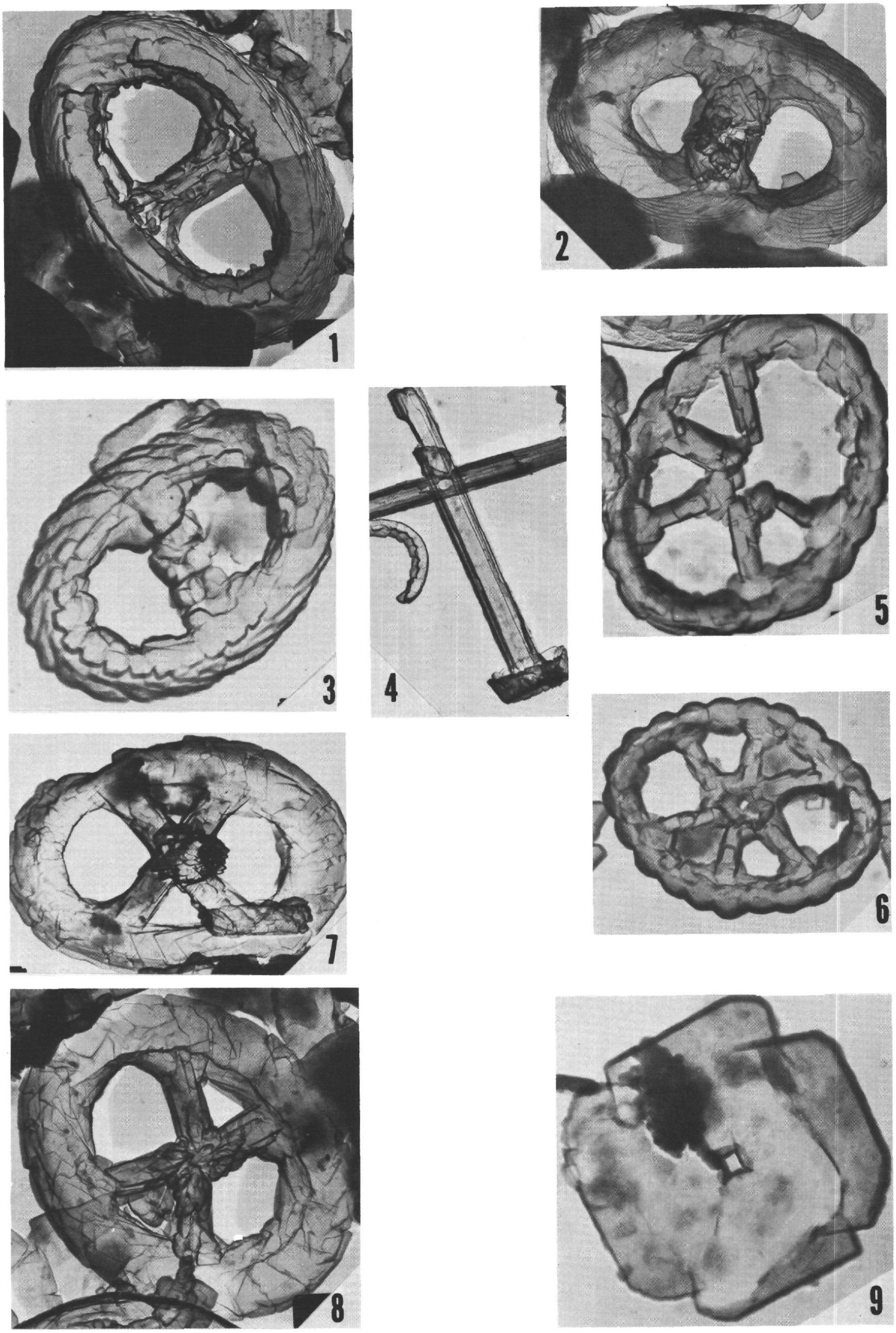

PLATE 11

Figures 1, 2	*Astrionis segmentis* Wilcoxon, n. gen., n. sp. (1) Paratype. 14,500X. Specimen from 11-105-12. (2) Holotype. 16,000X. Specimen from 11-105-12.
Figures 3, 4	*Cribrosphaera ehrenbergi* Arkhangelskii. (3) Distal view, 13,500X. Specimen from 11-105-11. (4) Proximal view, 12,000X. Specimen from 11-105-11.
Figures 5-7	*Tretosestrum perforatus* Wilcoxon, n. gen., n. sp. (5) Paratype. Distal view, 15,600X. Specimen from 11-105-12. (6) Holotype. Distal view, 25,700X. Specimen from 11-105-12. (7) Paratype. Distal view, 18,800X. Specimen from 11-105-12.

PLATE 11

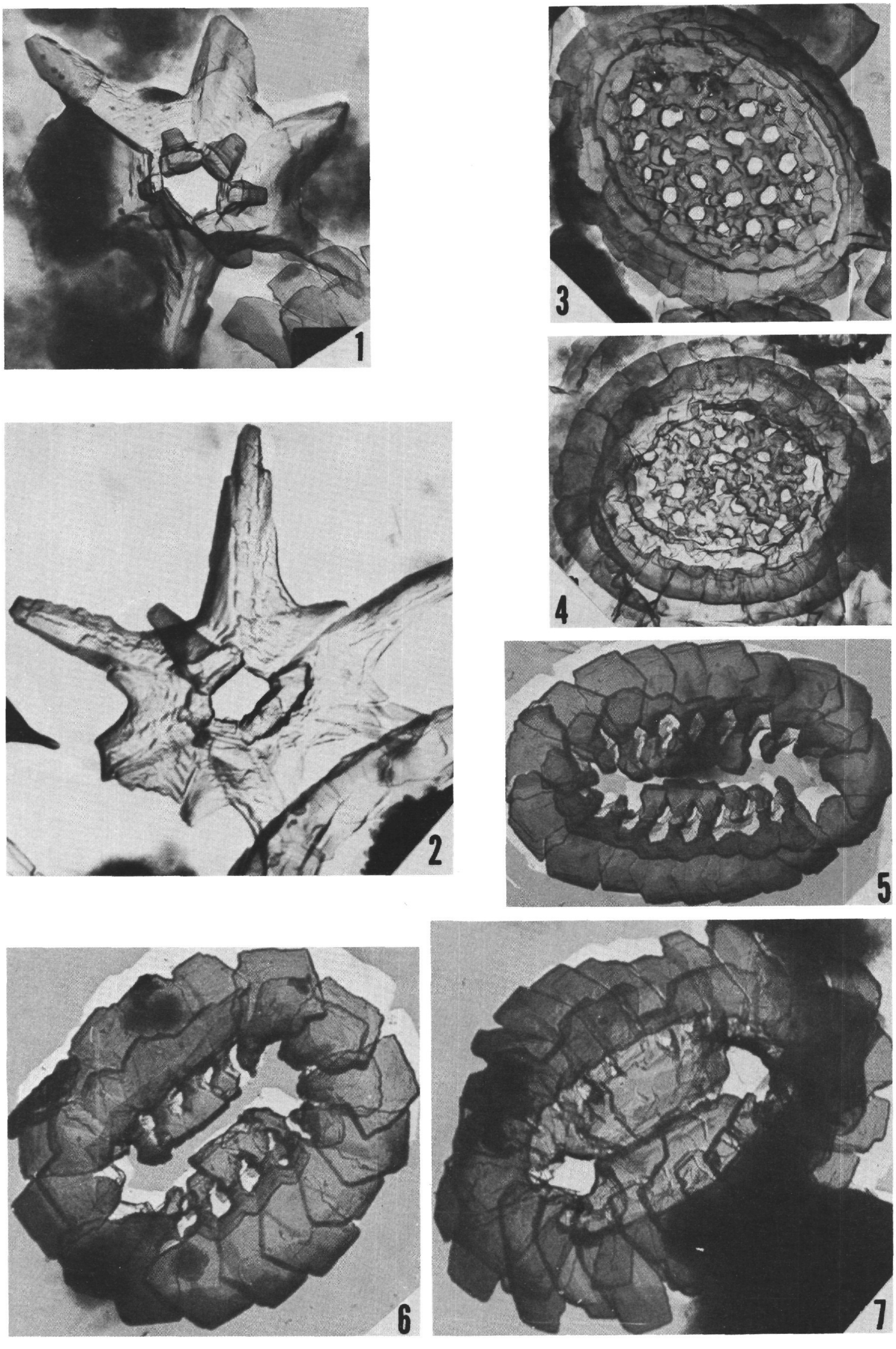

PLATE 12

Figure 1	*Corollithion sp.* 20,500X. Specimen from 11-105-37.
Figures 2-4	GENUS ? SPECIES ? (2) 6900X. Specimen from 11-105-33. (3) 8800X. Specimen from 11-105-33. (4) 10,800X. Specimen from 11-105-33.
Figure 5	*Bidiscus rotatarius* Bukry. Distal view, 21,000X. Specimen from 11-105-11.
Figures 6, 7	*Nannoconus sp.* (6) 16,200X. Specimen from 11-105-33. (7) 16,300X. Specimen from 11-105-33.

PLATE 12