THE UNIVERSITY OF KANSAS

PALEONTOLOGICAL CONTRIBUTIONS

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CALCAREOUS NANNOFOSSILS FROM NEOGENE OF TRINIDAD, JAMAICA, AND GULF OF MEXICO

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ABSTRACT

Previous studies of Neogene calcareous nannofossils commonly have been restricted either to a limited interval of the Neogene or to particular groups among the calcareous nannofossils. Consequently, a number of species have not yet been described. Among these are 14 new species and 1 new subspecies described here from Trinidad, Jamaica, and the Gulf of Mexico.

INTRODUCTION

During the past decade considerable attention has been given to coccoliths, discoasters, and other related calcareous nannofossils. At the same time, however, Neogene (Miocene-Pliocene) calcareous nannofossils are discussed in only a few significant publications, and in all cases either a limited interval of the Neogene was considered (e.g., middle Miocene to lower Pliocene by MARTINI & BRAMLETTE, 1963; upper Oligocene to lower Miocene by MARTINI, 1965), or studies were confined to particular calcareous nannofossils (e.g., discoasters, STRADNER & PAPP, 1961; coccolith- and discolith-like forms, KAMPTNER, 1963). As a result, a brief survey of Neogene calcareous nannofossils reveals a number of forms that have not been described or illustrated previously. Several of the more common forms, including 14 new species and 1 new subspecies, are described and illustrated here.

The materials used in this study include several samples from type localities of planktonic foraminiferal zonal markers in the Miocene of Trinidad collected by N. K. BROWN, JR., of Esso Production Research Company. The sample from the San San clay of Jamaica was collected by A. H. COOGAN, also of Esso Production Research Company. Samples from core 64-A-9-5E were obtained through the courtesy of T. E. PYLE and W. R. BRYANT of the Department of Oceanography of Texas A. & M. University, who have given a general description, as well as a detailed analysis of the core (BRYANT & PYLE, 1965; PYLE, 1966).

LOCALITIES

C887AA.—Type locality of ***Catapsydrax dissimilis*** zone in Trinidad (BOLLI, 1957).

C887AC.—Type locality of ***Globorotalia fohsi barisanensis*** zone in Trinidad (BOLLI, 1957).

C887AG.—Type locality of ***Globorotalia fohsi lobata*** zone in Trinidad (BOLLI, 1957).

C887AH.—Type locality of ***Globorotalia fohsi robusta*** zone in Trinidad (BOLLI, 1957).

C887M.—Cotype locality of ***Globorotalia menardii*** zone in Trinidad. Near dairy of Texaco compound, Pointe-a-Pierre, in proximity of stop 4, excursion 3, 4th Caribbean Geol. Conf., March-April, 1965.

C730C.—From top of San San clay, exposure along coastal highway, 2 to 3 miles southeast of Port Antonio, at San San Bay, Portland County, Jamaica.

Core 64-A-9-5E.—Collected on June 5, 1964, by Texas A. & M. University research Vessel ***Alaminos*** at depth of 3,536 m. at lat. 23°50′ N., long. 92°24.5′ W. near crest of one of the Sigsbee knolls at an elevation of 152 m. above the abyssal plain.

SYSTEMATIC PALEONTOLOGY

[Type species of genera and type specimens of species marked by asterisk (*).]

Genus DISCOASTER Tan Sin Hok, 1926

*Type Species.—Discoaster *pentaradiatus* TAN SIN HOK.

DISCOASTER AULAKOS Gartner, new species

?Discoaster brouweri var. β TAN SIN HOK, 1926, p. 120, fig. II-6.

Asterolith, generally with 6 rays; rays thickened toward tip, slightly tapered, and terminated flat or with broad, shallow notch at tip of ray; between rays furrows extend to center.

Discussion.—Asteroliths of this species may resemble specimens of *Discoaster deflandrei* BRAMLETTE & RIEDEL (1954) in termination of the rays, but in *D. aulakos* the notch at the tip of the rays is broad and shallow. In *D. deflandrei* the area between adjacent rays is smoothly rounded, whereas in *D. aulakos* this interarea is sharply pointed and continues as a furrow to the center of the asterolith.

Type Specimen.—Plate 4, figure *4; from *Globorotalia fohsi barisanensis* Zone, Cipero Formation, Trinidad.

Occurrence.—Catapsydrax stainforthi and *Globorotalia fohsi barisanensis* Zones, Cipero Formation, low. Mio.-mid. Mio., Trinidad.

Illustrations.—Plate 4, figures *4-5; light micrographs, ×2,500; *4a, 5a, phase contrast; *4b, 5b, bright field.

DISCOASTER BROUWERI Tan Sin Hok RUTELLUS Gartner, new subspecies

Asterolith with 6, rarely 5, long, slender, and gently curved rays; rays sharply bent near end and extending like broad blades in direction of concave side; these blades may slant laterally from rays of asterolith.

Discussion.—The bladelike wedge on the concave side of the tip of each ray generally is not symmetrical with respect to the median line of the ray but is more strongly developed on one side. This feature is constant on all rays of the same specimen; that is, the bladelike wedge is to the left of the median on every ray of one specimen, but on another specimen this wedge may be on the right side of the median on every ray. Occasionally, the tip of the ray is seen to be highly asymmetrical. From the center of the asterolith, ridges may extend a short way along the median of each ray, and the interareas may be marked by furrows.

This subspecies probably has been assigned to *Discoaster brouweri* TAN SIN HOK (1926) in the past but differs from that species in having a flat wedge at the tip of each ray, whereas *D. brouweri* has the tips terminated in a point. With the light microscope *D. brouweri rutellus* may resemble *D. perforatus* STRADNER (in STRADNER & PAPP, 1961), but the latter species has a minute perforation near the tip of each ray.

Type Specimen.—Plate 1, figure *2; from the *Globorotalia menardii* Zone, Lengua Formation, Trinidad.

Occurrence.—Globorotalia menardii Zone of the Lengua Formation, M. Neogene, of Trinidad.

Illustrations.—Plate 1, figures 1-*2.—1. Electron micrograph, ×8,000, oblique view of concave side.—*2. Light micrographs, ×2,500; *2a, phase contrast, concave side; *2b, bright field, concave side; *2c, bright field, side view.

DISCOASTER CALCARIS Gartner, new species

Asterolith, usually with 6 rays, bifurcating asymmetrically at tip; longer branch of bifurcation curved sharply proximally but extending only slightly laterally beyond tip of ray; smaller branch of bifurcation making angle of about 60° with ray of asterolith and resembling spur on tip of ray.

Discussion.—The unusual termination of the rays differentiates this species from similar forms. *Discoaster hamatus* MARTINI & BRAMLETTE (1963) differs in that the tip of the ray has a long spine extending to the side and proximally, and in some a short, straight spur, the reverse arrangement of *D. calcaris*. *D. brouweri rutellus* is about the same size but does not have bifurcate rays and *D. surculus* MARTINI & BRAMLETTE (1963) has symmetrically trifurcate rays.

Type Specimen.—Plate 2, figure *3; from the *Globorotalia menardii* Zone, Lengua Formation, mid. Mio., Trinidad.

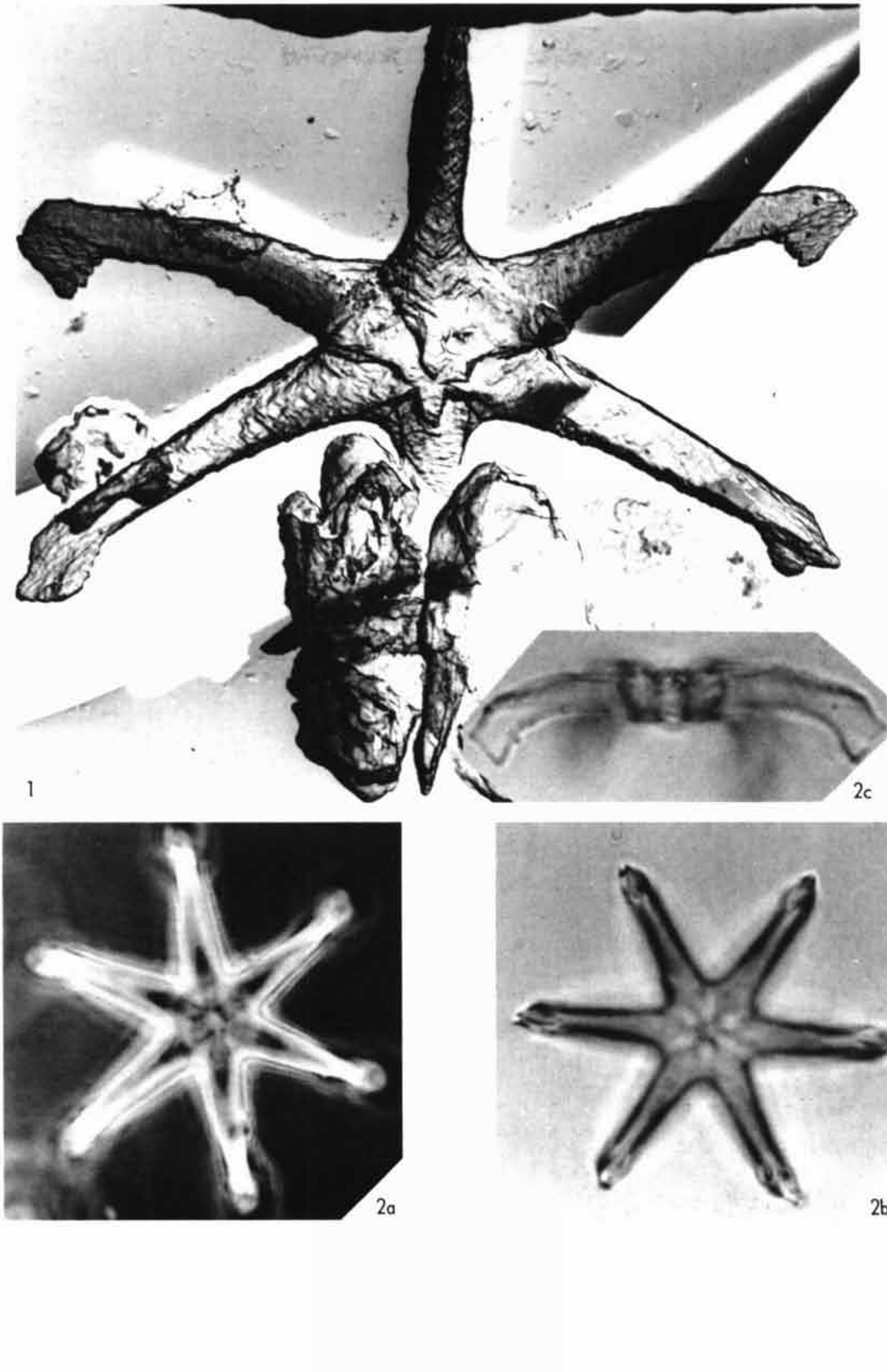
Occurrence.—Rare in *Globorotalia menardii* Zone, Lengua Formation, mid. Mio., Trinidad.

Illustrations.—Plate 2, figures 1-*3.—1. Electron micrograph, ×8,000, concave side.——2-*3. Light micrographs, ×2,500, concave side; 2a, *3a, phase contrast; 2b, *3b, bright field.

DISCOASTER OBTUSUS, Gartner, new species

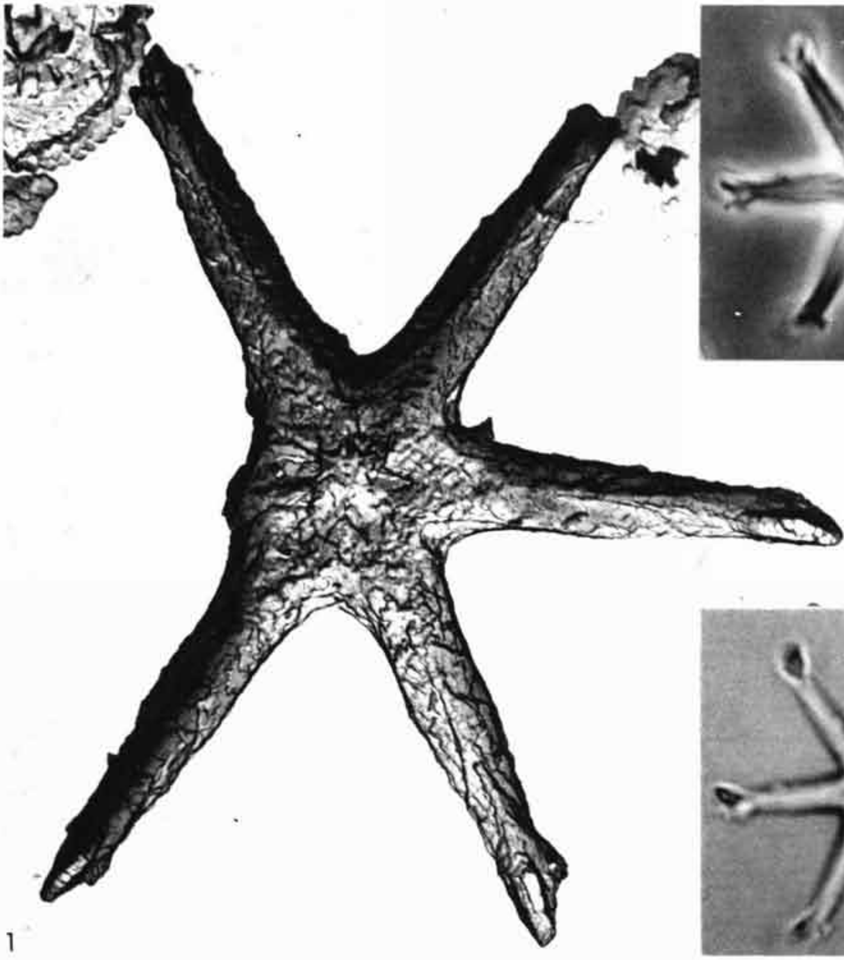
Discoaster sp. I. MARTINI, 1965, p. 405, pl. 36, figs. 11, 12.

Asterolith with 6 rays; hexagonal or slightly notched between adjacent rays; rays stubby and



1 2c

2a 2b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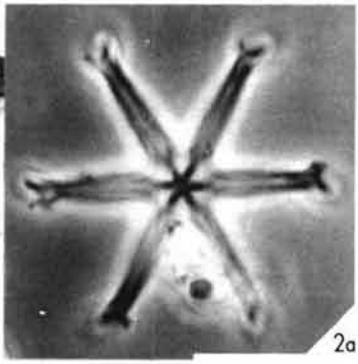
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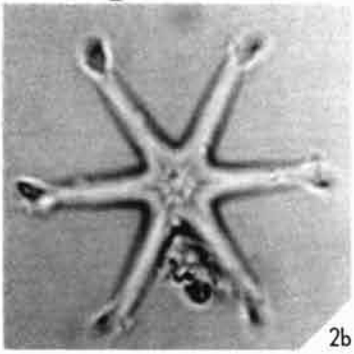
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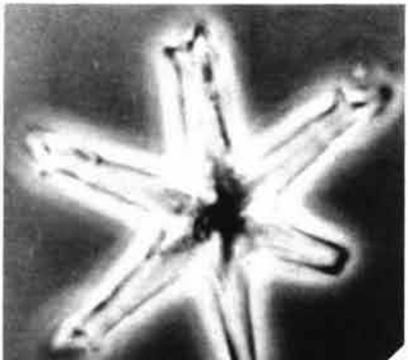
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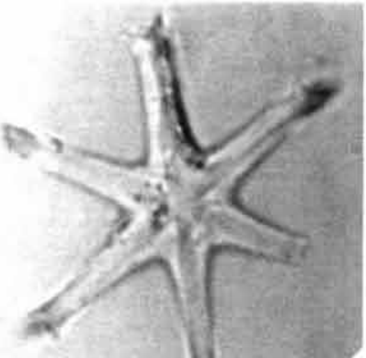
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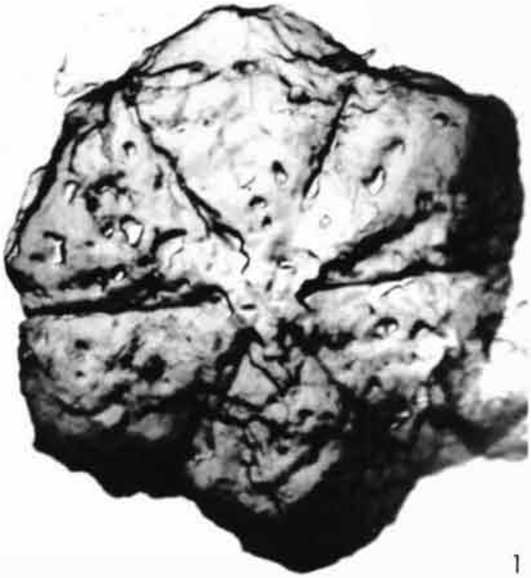

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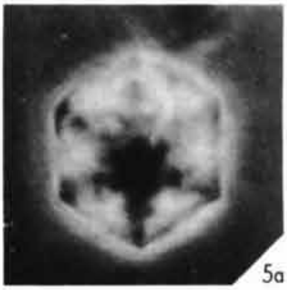

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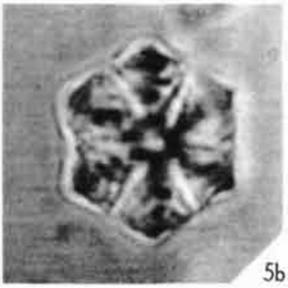
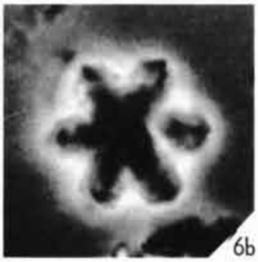
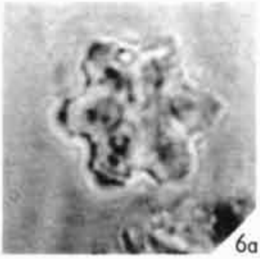


5b

2



6b



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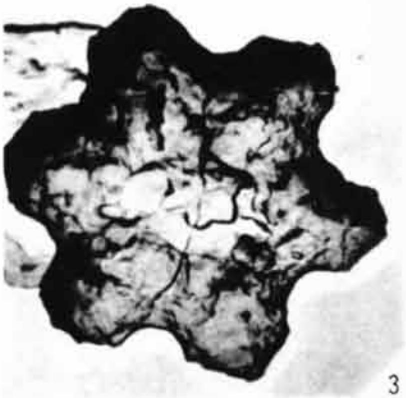

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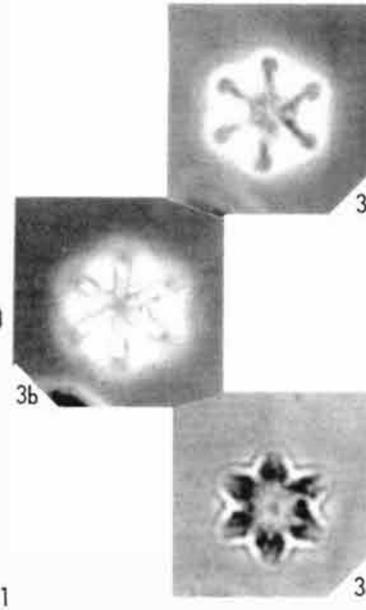
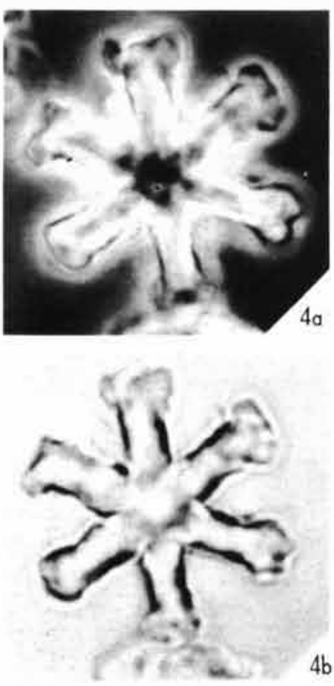
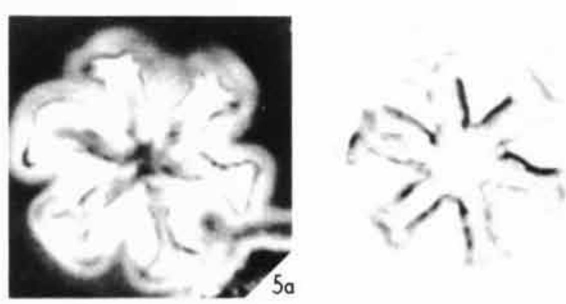


3a 3b 3c

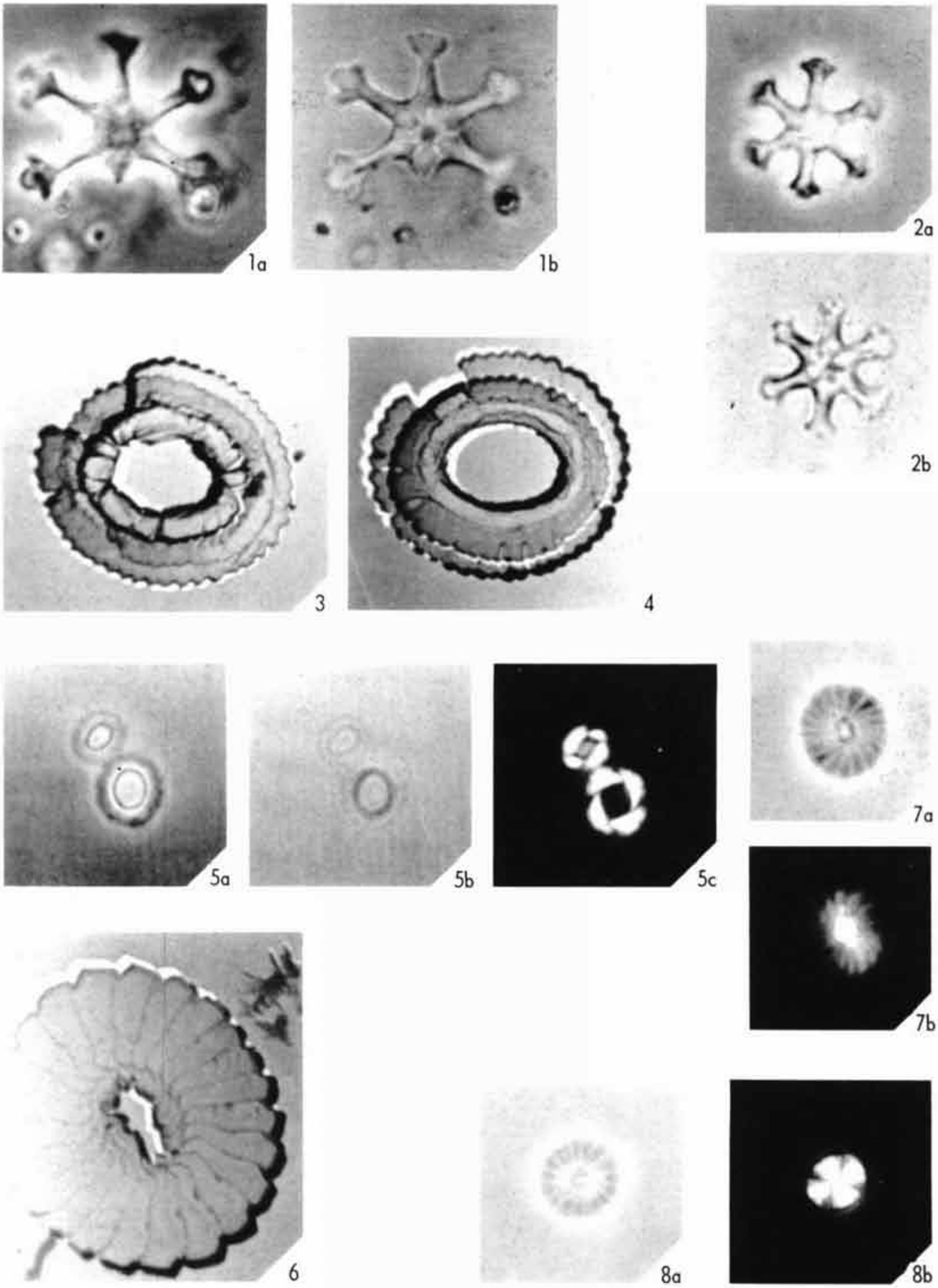
2



4a 4b



5a 5b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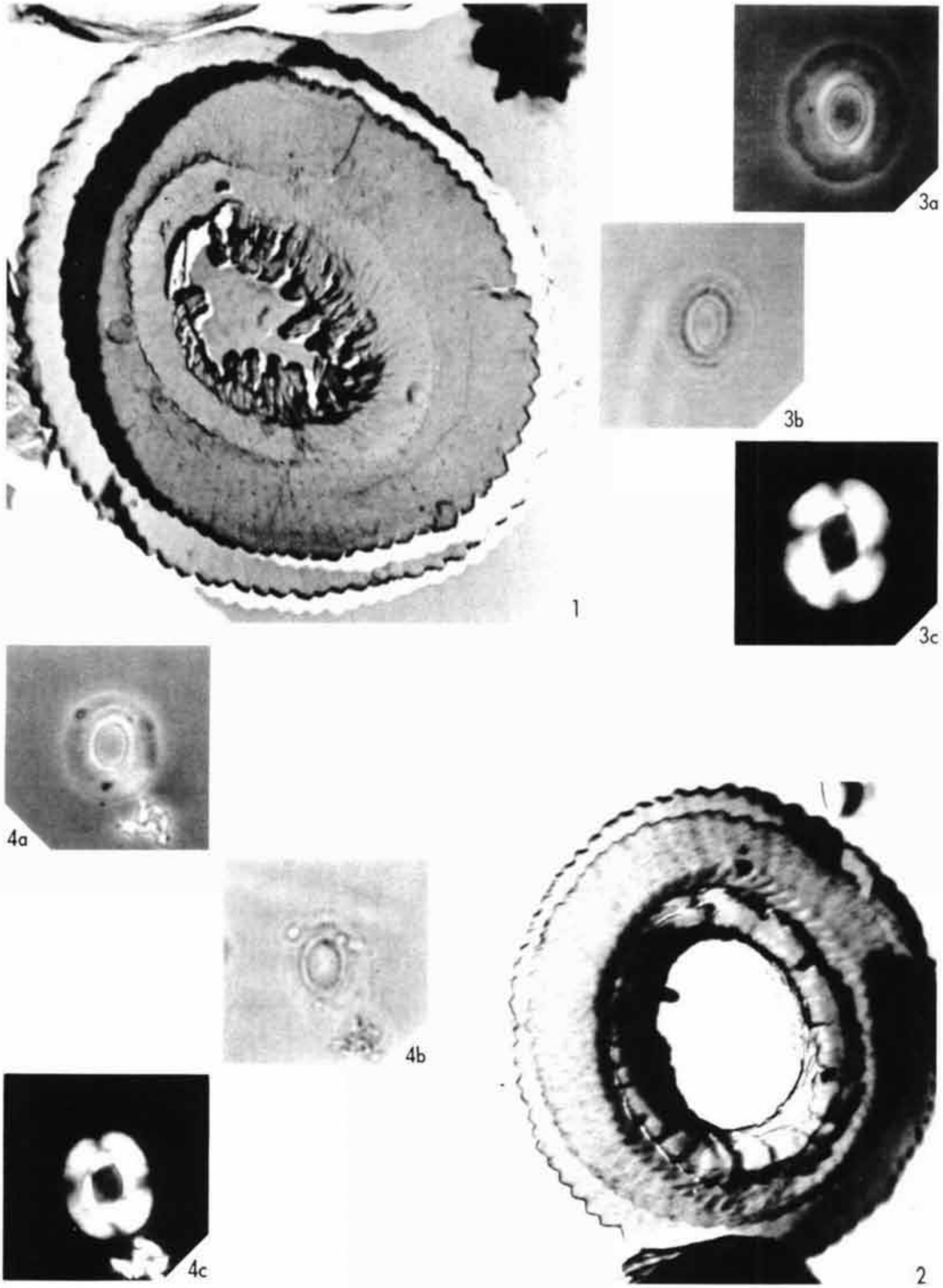
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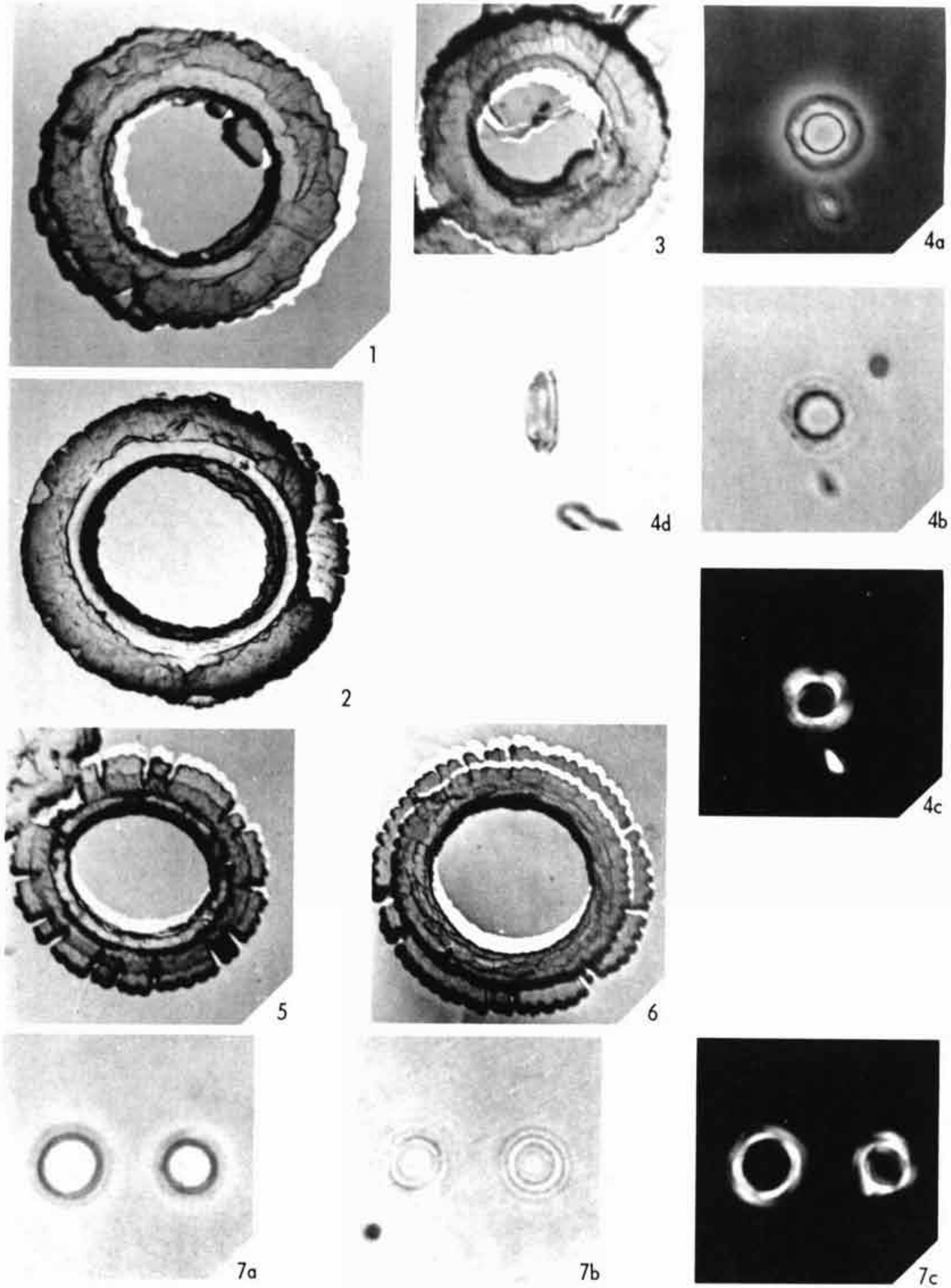
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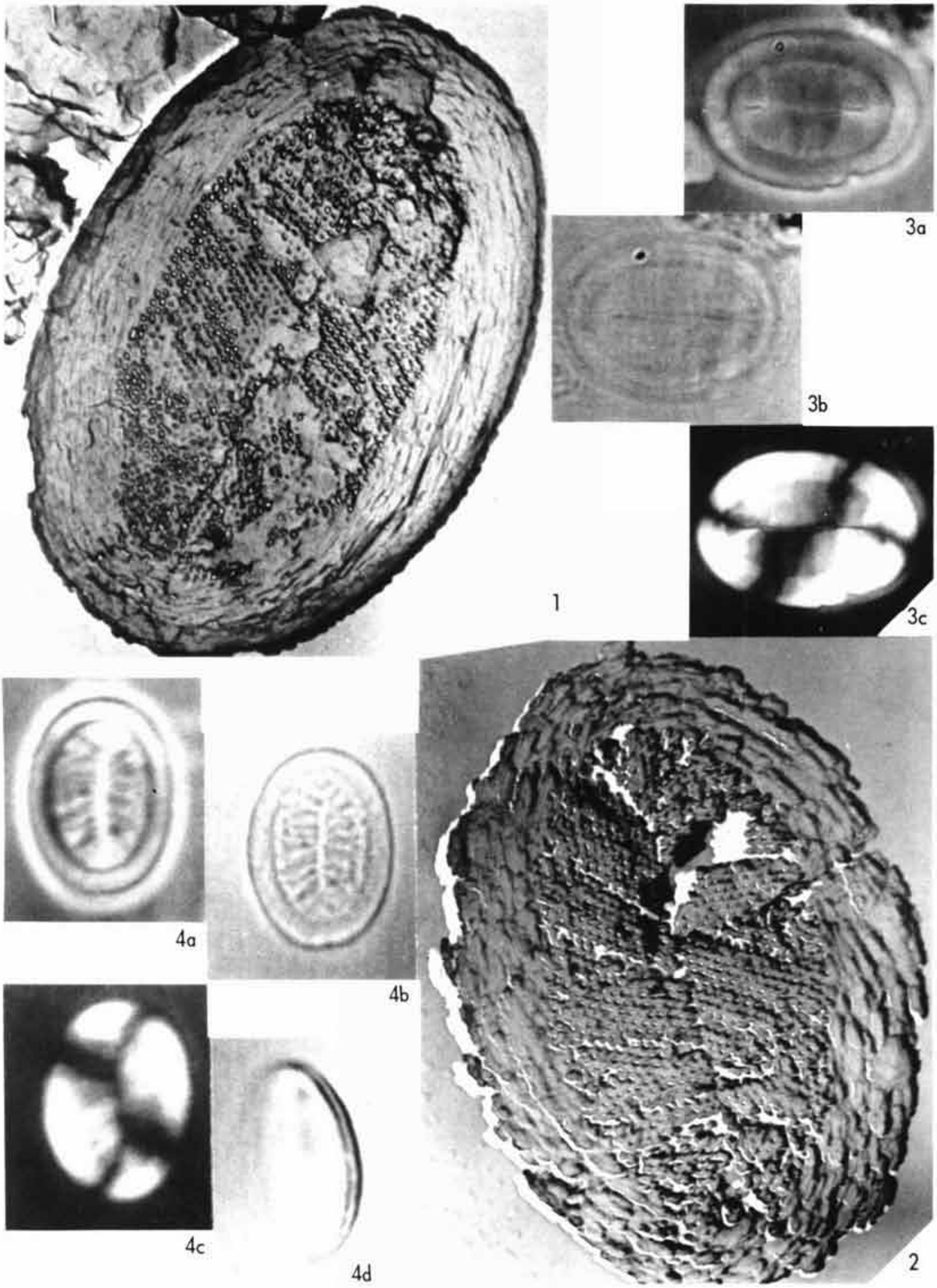
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3c
4a
4b
4c
4d

tapered to blunt point; radial furrows extend from center between rays; small, stellate knob in center on one side.

Discussion.—The short, bluntly pointed rays make this species easily recognizable. In outline, specimens may be hexagonal with almost no notch between adjacent rays, or a distinct but shallow notch may be developed. *Discoaster obtusus* differs from *D. stellulus* GARTNER, n. sp., in that the latter has conspicuous parallel-sided ridges developed on the surface of the rays, whereas in the former a single line marks the ridge in the center of each ray. The presence of a "pore" indicated by MARTINI was not confirmed.

Type Specimen.—Plate 3, figure *5; from *Catapsydrax dissimilis* Zone, of Cipero Formation, low. Mio., Trinidad.

Occurrence.—MARTINI (1965) recorded the species from the *Globorotalia kugleri* and *G. ciperoensis* Zones of Trinidad and equivalent deep-sea assemblages from the Pacific Ocean. The specimens figured here are from the *Catapsydrax dissimilis* Zone of the Cipero Formation.

Illustrations.—Plate 3, figures 1-6.——1-4. Electron micrographs, $\times$10,000.——*5-6. Light micrographs, $\times$2,500; *5a, 6a, phase contrast; *5b, 6b, bright field.

DISCOASTER STELLULUS, Gartner, new species

Asterolith, usually with 6 short rays; prominent parallel-sided ridges radiate from center to near tip of each ray.

Discussion.—*Discoaster stellulus* is similar to *D. obtusus* GARTNER, n. sp., but differs from that species in having sharply terminated rays and in having a prominent parallel-sided ridge on the surface of each ray. This ridge can be seen very well with a light microscope by varying the focus on the specimen.

Type Specimen.—Plate 4, figure *3; from the *Globorotalia menardii* Zone, Lengua Formation, mid. Mio., Trinidad.

Occurrence.—*Globorotalia menardii* Zone, Lengua Formation, of Trinidad.

Illustrations.—Plate 4, figures 1-*3.——1-2. Electron micrographs, $\times$10,000; 1, oblique view; 2, plan view.——*3. Light micrographs, $\times$2,500; *3a, phase contrast, median focus; *3b, phase contrast, high focus; *3c, bright field, median focus.

DISCOASTER SUBSURCULUS Gartner, new species

Asterolith with 5 or 6 slender rays with nearly parallel sides; tips of rays broadly bifurcated with large, knoblike protrusion between 2 lateral branches of ray; from small knob in the center lines or furrows radiate to areas between rays.

Discussion.—*Discoaster subsurculus* resembles *D. exilis,* MARTINI & BRAMLETTE (1963) but differs from that species in having broadly bifurcated rays and in having a knob in the bifurcation. In *D. surculus* MARTINI & BRAMLETTE (1963) the two lateral protrusions are not so prominent as in *D. subsurculus,* and the median knob is bent at a sharp angle to the ray.

Type Specimen.—Plate 5, figure *1; from *Globorotalia fohsi lobata* Zone, Cipero Formation, mid. Mio., Trinidad.

Occurrence.—*Globorotalia fohsi lobata* and *Globorotalia fohsi robusta* Zones, Cipero Formation, Trinidad.

Illustrations.—Plate 5, figures *1-2, light micrographs, $\times$2,500; *1a, 2a, phase contrast; *1b, 2b, bright field.

Genus COCCOLITHUS Schwarz, 1894

Type Species.—*Coccosphaera *pelagica* WALLICH, 1877.[1]

COCCOLITHUS MINUTULUS Gartner, new species

Small, elliptical placolith with collar protruding distally; central area open; shields constructed of about 45 imbricate elements with subradial sutures.

Discussion.—This diminutive placolith has an unusually coarse collar that protrudes distally. As in most elliptical placoliths, the collar is continuous with the proximal shield. The elements that make up the shields are about 0.1 μ across and therefore are not distinguishable with a light microscope. Its minute size distinguishes this species from associated forms in the light microscope and electron microscope. It differs from *Coccolithus huxleyi* (LOHMANN, 1902) in not having a gap between adjacent elements of the shield.

Type Specimen.—Plate 5, figure *5; from the 200-cm. depth of core 64-A-9-5E, Sigsbee knolls, Gulf of Mexico.

Occurrence.—This species was found in core 64-A-9-5E from Sigsbee knolls, Gulf of Mexico.

Illustrations.—Plate 5, figures 3-*5.——3-4. Electron micrographs, $\times$10,000; 3, distal view, 4, proximal view.——*5. Light micrographs, $\times$2,500; *5a, phase contrast; *5b, bright field; *5c, cross-polarized light.

[1] In an earlier publication (GARTNER & SMITH, Univ. of Kansas Paleont. Contrib., Paper 20, p. 2-3, 1967) the specific names *pelagicus* and *eopelagicus* were misspelled as *palagicus* and *eopalagicus*. Also in the same publication (p. 3) the type specimen of *Coccolithus falcatus* should be indicated as pl. 1, fig. 5 instead of pl. 1, fig. 3.

COCCOLITHUS PATAECUS Gartner, new species

Small, slightly elliptical placolith with about 20 elements in distal shield; between crossed nicols proximal shield yields distinctive interference figure; distal shield yields poorly defined interference figure.

Discussion.—This species is easily overlooked because of its small size. The 2 shields often are broken apart, and when the distal shield is found isolated, it resembles very much a small distal shield of *Cyclococcolithus leptoporus* (MURRAY & BLACKMAN, 1898) [=*Calcidiscus medusoides* (KAMPTNER, 1950)] in that it does not have a distinctive interference figure in cross-polarized light. The proximal shield of this species, like the proximal shield of *C. leptoporus,* has a distinct interference figure in cross-polarized light, and when an entire specimen is seen, the interference figure is a combination of them. This species differs from *C. leptoporus* in that it is elliptical, smaller, and has much fewer elements per shield.

Type Specimen.—Plate 5, figure *7; from the 200-cm. depth of core 64-A-9-5E, Sigsbee knolls, Gulf of Mexico.

Occurrence.—This species was found intermittently in core 64-A-9-5E from the Sigsbee knolls.

Illustrations.—Plate 5, figures 6-*7-8.——6. Electron micrograph, ×10,000, distal shield.——*7-8. Light micrographs, ×2,500; *7, complete specimen; 8, distal shield only; *7a, 8a, phase contrast; *7b, 8b, cross-polarized light.

COCCOLITHUS PSEUDOUMBILICUS Gartner, new species

Elliptical placolith with shields made of about 70 elements; the elliptical central area differs in size within the species and in well-preserved specimens is covered with a lacy network of bars that join along a longitudinal fissure at the center of the placolith; distally the collar may be decorated by large, coarse crystallites.

Discussion.—This species resembles somewhat the Eocene species *Coccolithus umbilicus* LEVIN (1965); it differs from that species in being smaller, having correspondingly fewer elements per shield, and having a relatively larger central area. Because of its delicate nature, the lacy network in the center generally is destroyed and, in any case, is visible only with the electron microscope.

Type Specimen.—Plate 6, figure *3; from the 250-cm. depth of core 64-A-9-5E, Sigsbee knolls, Gulf of Mexico.

Occurrence.—This species is found throughout most of core 64-A-9-5E from the Sigsbee knolls (figs. 1-*3) and in the *Globorotalia menardii* Zone, Lengua Formation, mid. Mio., Trinidad (Fig. 4).

Illustrations.—Plate 6, figures 1-*3-4.——1-2. Electron micrographs, ×10,000; 1, oblique proximal view; 2, distal view.——*3-4. Light micrographs, ×2,500, proximal view; *3a-4a, phase contrast; *3b-4b, bright field; *3c-4c, cross-polarized light.

Genus CYCLOCOCCOLITHUS Kamptner, 1954

Type Species.—*Coccosphaera *leptopora* MURRAY & BLACKMAN, 1898.

CYCLOCOCCOLITHUS AEQUISCUTUM, Gartner, new species

Cyclococcolithus rotula (Kamptner), STRADNER, 1963, p. 158 (in part), fig. 4.

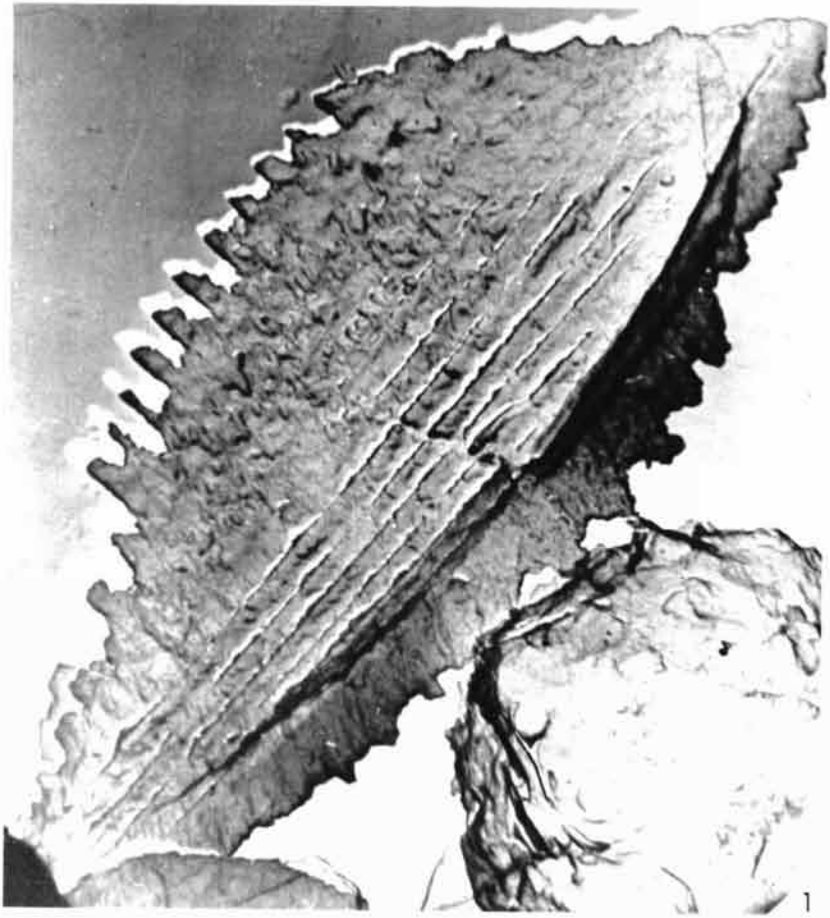
Small, circular placolith with large central opening; the proximal and distal shields are approximately equal in size and constructed of elements 0.1-0.2 μ in diameter.

Discussion.—With the electron microscope this species can be distinguished readily from other similar species. With a light microscope identification is considerably more difficult unless a viscous mount is used so that the specimen can be turned on edge and viewed from the side. In a plan view, it is impossible in some specimens to determine whether the two shields are equal or unequal, even by very careful focusing, because the difference in size of the shields generally is less than 0.5 μ, as, for example, in *Cyclococcolithus cricotus* GARTNER, n. sp. It should be noted that the collar in *C. aequiscutum* is never as prominent as in the former species. Because of difficulty in identifying this species, it is of limited stratigraphic value where only light microscopy can be used.

Type Specimen.—Plate 7, figure *4; from the 200-cm. depth of the Sigsbee knolls core, Gulf of Mexico.

Occurrence.—This species was found in the San San clay of Jamaica (Fig. 3) and intermittently in core 64-A-9-5E from the Sigsbee knolls (fig. 1-2, *4).

Illustrations.—Plate 7, figures 1-*4.——1-3. Electron micrographs, ×10,000.——*4. Light micrographs, ×2,500; *4a, phase contrast; *4b,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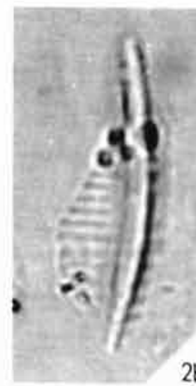
2a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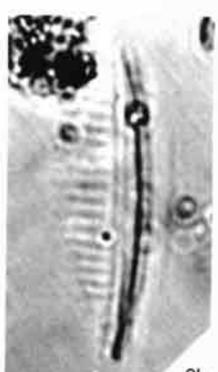
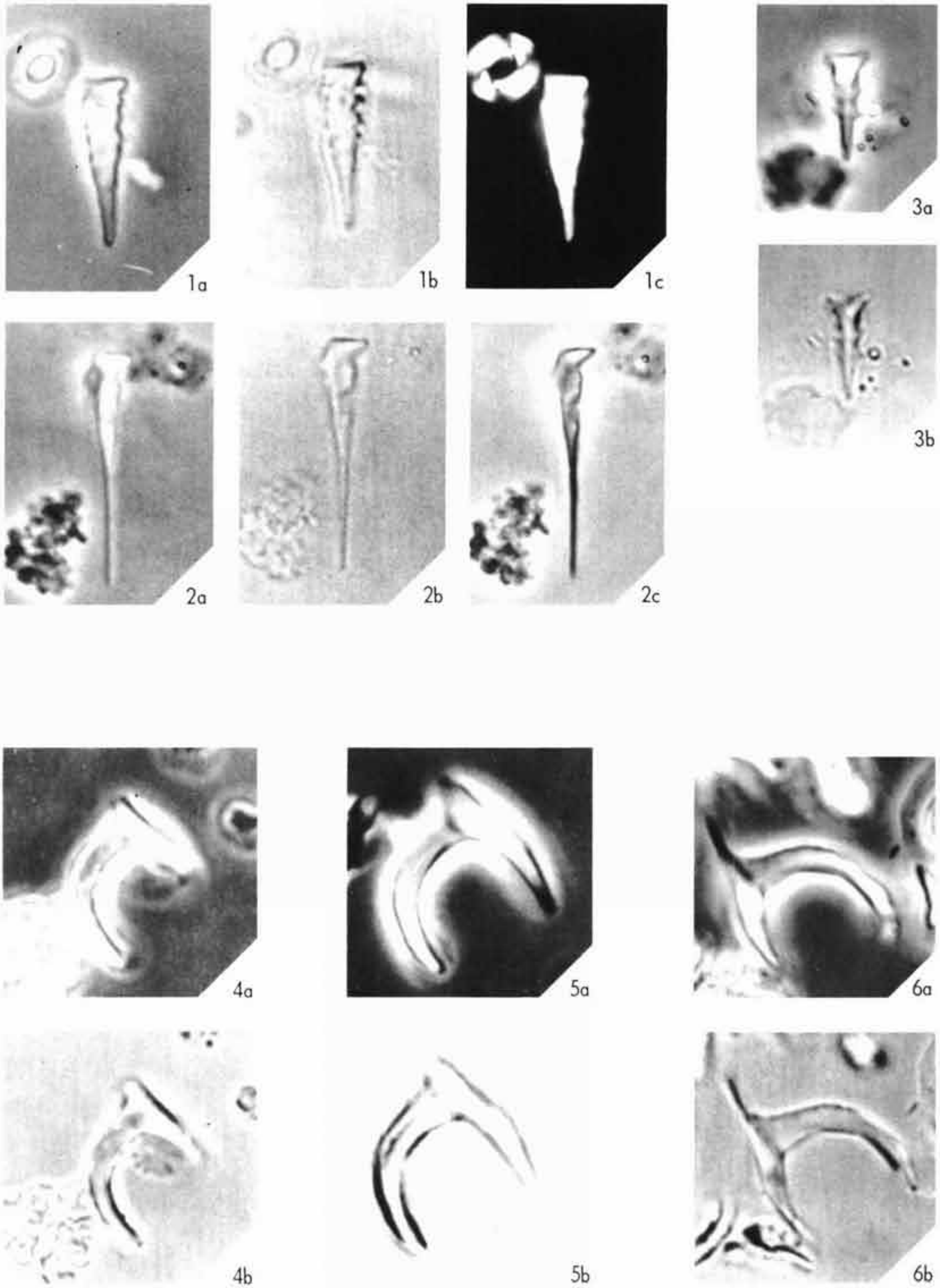

3b


4a


4b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bright field; *4c, cross-polarized light; *4d, bright field, side view.

CYCLOCOCCOLITHUS CRICOTUS, Gartner, new species

Circular to slightly elliptical placolith with large central opening; shields narrow, constructed of up to 70 elements joined along radial sutures.

Discussion.—This small, circular placolith has very narrow shields and a relatively large, open central area. The smaller proximal shield is 0.5 to 0.7 the width of the distal shield, and the collar connecting the 2 shields is continuous with the proximal shield. Each shield is constructed of up to 70 radially arranged elements. These elements measure 0.1 μ or less in diameter and consequently cannot be resolved with a light microscope.

Cyclococcolithus cricotus resembles *Umbilicosphaera nitescens* KAMPTNER (1963) but is less than half the size of that species and has a much greater number of elements per shield.

Type Specimen.—Plate 7, figure *7; from the 200-cm. depth of core 64-A-9-5E, Sigsbee knolls, Gulf of Mexico.

Occurrence.—This species was found throughout core 64-A-9-5E from the Sigsbee knolls.

Illustrations.—Plate 7, figures 5-*7.——5-6. Electron micrographs, ×10,000; 5, distal view; 6, proximal view.——*7. Light micrographs, ×2,500; *7a, phase contrast; *7b, bright field; *7c, cross-polarized light.

Genus DISCOLITHINA Loeblich & Tappan, 1963

*Type Species.—Discolithus *vigintiforatus* KAMPTER, 1948.

DISCOLITHINA MILLEPUNCTA, Gartner, new species

Elliptical disc with distinct, flat rim and longitudinal central fissure; area within rim perforated by numerous minute holes.

Discussion.—The numerous perforations in this disc are less than 0.1 μ in diameter and consequently can be seen only with the electron microscope. Viewed from the side the disc is relatively thin (about 1 μ). The unperforated rim is distinct in the light microscope, and the enclosed area appears to consist of irregular, radially or diagonally arranged elements. In electron micrographs the perforations appear to be aligned diagonally with respect to the axis of the disc, and their distribution does not seem to be influenced by the crystallographic orientation of the elements. In cross-polarized light the interference figure is identical with that of other discoliths.

Type Specimen.—Plate 8, figure *4; from the San San clay, up. Mio., Jamaica (sample C730C).

Occurrence.—This species was found in the San San clay of Jamaica (Fig. 1) and core 64-A-9-5E from the Sigsbee knolls, Gulf of Mexico (Fig. 2-*4).

Illustrations.—Plate 8, figures 1-*4.——1-2. Electron micrographs, ×10,000.——3-*4. Light micrographs, ×2,500; 3a-*4a, phase contrast, distal view, 3b-*4b, bright field, distal view, 3c-*4c, cross-polarized light, distal view; *4d, bright field, side view.

Genus CERATOLITHUS Kamptner, 1950

*Type Species.—Ceratolithus *cristatus* KAMPTNER, 1950.

CERATOLITHUS TRICORNICULATUS Gartner, new species

Ceratolith with one long, regularly curved horn and one short horn; a short third horn projects on the convex side of the curvature in line with the short horn; one or both of the normal horns may be split near the tip.

Discussion.—This species of *Ceratolithus* is smaller than the modern representatives of *Ceratolithus *cristatus* KAMPTNER (1954). It differs further from that species in that it has a third "horn" projecting on the convex side of the curved back. This third "horn" is generally not more than 1 to 2 μ long and is in line with the shorter of the primary horns. Some specimens have the primary horns split or bifurcated, but this often is overlooked when the specimen is resting on its side.

Type Specimen.—Plate 10, figure *4; from the 375-cm. depth of core 64-A-9-5E, Sigsbee knolls, Gulf of Mexico.

Occurrence.—Ceratolithus tricorniculatus was recorded from the San San clay, up. Mio. (Fig. *4), of Jamaica and from core 64-A-9-5E from the Sigsbee knolls (Fig. 5-6).

Illustrations.—Plate 10, figures *4-6. Light micrographs, ×2,500; *4a, 5a, 6a, phase contrast; *4b, 5b, 6b, bright field.

CERATOLITHUS? FARNSWORTHII, Gartner, new species

Flat, calcareous object consisting of spine, generally tapered and pointed at both ends; unequal lateral planes project on each side of spine, generally extending full length of spine; planes appear to be constructed of parallel laths that are at about 90° to the spine.

Discussion.—In the light microscope this species has roughly the appearance of a feather or crow quill. It is similar to half of a specimen of *Ceratolithus cristatus* KAMPTNER, on which laths are well developed, but this resemblance is largely superficial. This form may be ancestral to *C. cristatus*, but cannot be so demonstrated clearly because the ranges of the two species do not appear to overlap. Furthermore, it is the younger (Pleistocene) representatives of *C. cristatus* that resemble this species most closely. Early representatives of *C.? farnsworthii* have smooth lateral planes and do not show the serrate margin or the parallel-lath construction developed in later forms. Also, the spine in earlier forms is straight, whereas in later forms it commonly is slightly curved. Thus, early forms of *C.? farnsworthii* are suggestive of *Triquetrorhabdulus carinatus* MARTINI (1965), but the latter species disappears at the level of the *Catapsydrax dissimilis* Zone in Trinidad, long before the first occurrence of *C.? farnsworthii*.

Type Specimen.—Plate 9, figure *2; from the *Globorotalia menardii* Zone, Lengua Formation, mid. Mio., Trinidad.

Occurrence.—This species was found in the *Globorotalia fohsi robusta* Zone of the Cipero Formation and *Globorotalia menardii* Zone of the Lengua Formation of Trinidad.

Illustrations.—Plate 9, figures 1-4, *Ceratolithus? farnsworthii* GARTNER, from the *Globorotalia menardii* Zone, Lengua Formation, Trinidad (Fig. 1-3) and from the *Globorotalia fohsi robusta* zone, Cipero Formation, Trinidad (Fig. 4).——1. Electron micrograph, $\times$10,000.——*2-4. Light micrographs, $\times$2,500; *2a, 3a, 4a, phase contrast, *2b, 3b, 4b, bright field.

Genus TRIQUETRORHABDULUS Martini, 1965

Type Species.—*Triquetrorhabdulus* **carinatus* MARTINI, 1965.

TRIQUETRORHABDULUS MARTINII, Gartner, new species

Triquetrorhabdulus sp. MARTINI, 1965, p. 408, pl. 36, fig. 6.

Calcite rod, tapered at one end and terminated flat at other end; tapered portion of rod relatively smooth, and opposite end irregularly knobby; cross section of rod more or less triangular at knobby end and more nearly circular at pointed end.

Discussion.—Size and shape of these objects vary considerably. The tapered end may be relatively long and thin, or it may be very short and stout. On some specimens the laterally protruding knobs are long and thin; on others they are large but do not protrude so much and, therefore, are less conspicuous. The cross section is not very constant, but the knobs are arranged to form 3 keels or carinae; this gives the rod a pronounced triangular cross section in some specimens.

Type Specimen.—Plate 10, figure *1; from the *Catapsydrax dissimilis* Zone, low. Mio., Trinidad.

Occurrence.—MARTINI recorded this form only from the *Catapsydrax dissimilis* Zone of the Cipero Formation of Trinidad. In the present study it was found also at that level.

Illustrations.—Plate 10, figures *1-3.

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