35. ANTARCTIC RADIOLARIA FROM THE SOUTHEAST PACIFIC BASIN, DEEP SEA DRILLING PROJECT, LEG 35

Fred M. Weaver, Antarctic Marine Geology Research Facility,
Department of Geology, Florida State University, Tallahassee, Florida

INTRODUCTION

During Leg 35 of the Deep Sea Drilling Project, a total of four sites were occupied (Figure 1). All sites drilled are located in the southeast Pacific sector of the Southern Ocean. Two sites, 322 and 323, are situated in the Bellingshausen abyssal plain, while the other two, Sites 324 and 325, are located on the Antarctic continental rise. Fifty sediment cores were taken with a total recovered length of 193 meters.

Radiolarians occur at all sites drilled on DSDP Leg 35. Each site produced intermittent sequences of Neogene age sediments, and Hole 322 penetrated into Cretaceous material above its base. From the four sites, 237 samples were examined during this investigation; 137 were either totally barren of radiolarians or contained recrystallized assemblages. Radiolarians were commonly found in only 17 of the remaining samples which contained siliceous microfossils, and only 2 of these samples were pre-Pliocene in age. The general paucity and poor preservation of radiolarians examined from Leg 35 sediments is attributed to three factors: (1) high rates of sedimentation, (2) extreme water depths, and (3) significant diagenetic changes in pre-Pliocene sediment sequences.

Due to lack of any continuous coring during Leg 35, no detailed biostratigraphic analysis and interpretation of regional changes in paleooceanography was possible, utilizing radiolarians.

BIOSTRATIGRAPHIC FRAMEWORK

The Antarctic radiolarian zonation proposed for the Plio-Pleistocene by Hays (1965) and Hays and Opdyke (1967) was modified and extended by Chen (1975) to include the entire Neogene. This zonation is utilized almost exclusively in this investigation.

In contrast to the zonal scheme of Hays (1965) and Hays and Opdyke (1967), the major advantages of Chen's zonation is that it employs fewer index species and uses only their latest or earliest occurrence rather than their last occurrence in significant numbers in defining zonal boundaries (Figure 2). The abundance of individuals of a species is related to a specific combination of oceanographic parameters. Therefore, the last "common" occurrence of a species may define a time-transgressive event, as the oceanographic province migrates in response to regional climatic changes. The diachroneity of radiolarian zones based upon the last frequent occurrence of index species was demonstrated by Weaver (1973) for Pliocene age sediments from the Antarctic.

Pleistocene

The only Pleistocene sedimentary sequence recovered during Leg 35 is at Site 324. The *Antarctissa denticulata* (= Omega Zone), and the *Saturnalis circularis* (= Chi Zone) zones of Chen (1975) are recognized in Core 1. The *Stylatractus universus* zone, which spans the early Brunhes magnetic epoch and precedes the *Antarctissa denticulata* zone could not be recognized in Core 1. This may be the result of either a sedimentary hiatus in Core 1 or the sampling procedure. *Stylatractus universus* does occur in Core 1, but only within the range of *Saturnalis circularis.*

It is especially significant to note that the *A. denticulata* and *S. circularis* zones proposed by Chen (1975) are useful in the Southern Ocean as far south as 69°S latitude.

Pliocene

The *Helotholus vema* zone (≅ Upsilon Zone of Hays and Opdyke [1967]; see Figure 2) is identified in Pliocene sediments recovered at Sites 322, 323, and 325. The index species *H. vema* is rare and found sporadically at each site. Therefore, this zone is better recognized by the more consistent occurrence of *Desmospyris spongiosa* which has approximately the same stratigraphic range as *H. vema* in Southern Ocean sediments.

The Tau Zone of Hays and Opdyke (1967) is employed in Core 2 at Site 323. All samples examined from this interval lacked specimens of *H. vema* and *T. b. spongothorax*. However, they did contain numerous specimens of *Triceraspyris coronatus* (= *Triceraspyris sp.*) whose upper range limit tentatively defines the top of the Tau Zone.

The *Theocalyptra bicornis spongothorax* Zone defined by Chen (1975) is recognized in one sample from Leg 35 sediments, 325-5, CC. However, in spite of the absence of specimens of *T. b. spongothorax*, the radiolarian assemblage that characterizes this zone also occurs in Samples 325-4, CC and 325-6, CC.

Miocene

The only well preserved Miocene radiolarian sequence recovered during Leg 35 was at Site 323. The middle Miocene *Antarctissa conradae* Zone of Chen (1975) could be recognized in Sample 325-3, CC. A number of samples from below Core 3, contain a typical middle Miocene radiolarian assemblage as illustrated by Chen (1975), but because of the absence of the index species, *Calocyclas disparidens* and *Spongomelissa dilli*, no other zones could be recognized in this middle Miocene sequence.

RADIOLARIAN SITE SUMMARIES

Tables 1-4 illustrate the occurrences of radiolarians identified from material recovered during Leg 35. The following abbreviations are applied to species abundance and preservation: P (poorly preserved), M

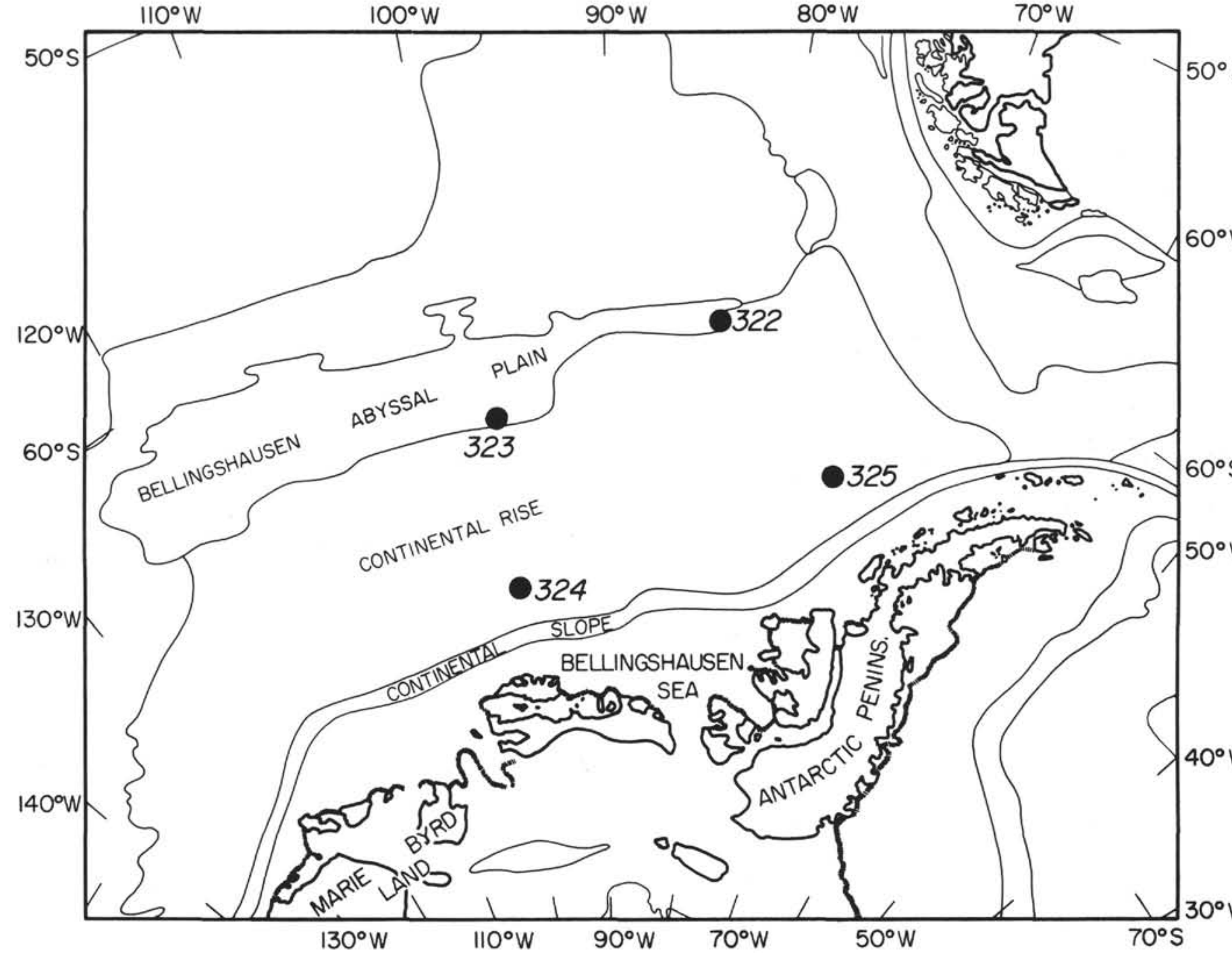

Figure 1. *Location of drilling sites, Leg 35, Deep Sea Drilling Project, Southeast Pacific Basin.*

(moderately well preserved), G (well preserved), A (abundant), C (common), F (few), R (rare), T (trace amounts—1 or 2 specimens per slide), and ? (questionable identification).

Site 322
(60°01.45′S, 79°25.49′W; water depth 5026 m)

Site 322 is located at the eastern end of the Bellingshausen abyssal plain (Figure 1). Eleven "spot" cores with a total length of 34.4 meters were recovered before basement was encountered at a subbottom depth of 514 meters.

Poor to moderately well preserved radiolarians of latest Paleogene (?) and Neogene age occur sporadically throughout Site 322 sediments. Cores 1, 2, 4, 6, 8, and 9 contain radiolarian assemblages with low abundances and species diversity. Other cores examined were either totally barren of radiolarians or contained specimens which were recrystallized.

Core 1, Section 1, 44-46 cm through Core 2, Section 2, 97-99 cm contains moderately well preserved specimens of *Desmospyris spongiosa*, *Helotholus vema*, *Eucyrtidium calvertense*, *Clathrocyclas bicornis*, *Prunopyle titan* (?), and *Lychnocanoma grande rugosum* which are diagnostic of a Pliocene age for this interval (latest Gilbert-Gauss), and places it within the Upsilon Zone of Hays and Opdyke (1967) and the *Helotholus vema* Zone of Chen (1975) (Figure 2).

Core 322-3 is totally barren of radiolarians, but the presence of poorly preserved specimens of *Dendrospyris haysi*, *Eucyrtidium* sp. aff. *E. inflatum*, *Prunopyle hayesi*, *Stichocorys peregrina* (?), *Eucyrtidium calvertense*, and *Actinomma tanyacantha* in Samples 322-2, CC and 4, CC is diagnostic of a late Miocene age. No biostratigraphic zonal definition of this interval was possible due to the absence of any of the nominate index species proposed by Chen (1975).

The only radiolarians identified between Cores 5 through 10 occur in three samples: 322-8, CC, 322-9-2, 75-82 cm, and 322-9, CC (top). These are dated as Miocene on the basis of the occurrence of *Dendrospyris haysi*, *Eucyrtidium calvertense*, and *E. cienkowskii* group. Cores 322-5, 7, and 10 are totally barren, but Core 322-6 does contain some recrystallized specimens of the *E. cienkowskii* group.

Site 323
(63°40.84′S, 97°59.69′W; water depth 4993 m)

Site 323 is located in the Bellingshausen abyssal plain just north of the Antarctic continental rise (Figure 1).

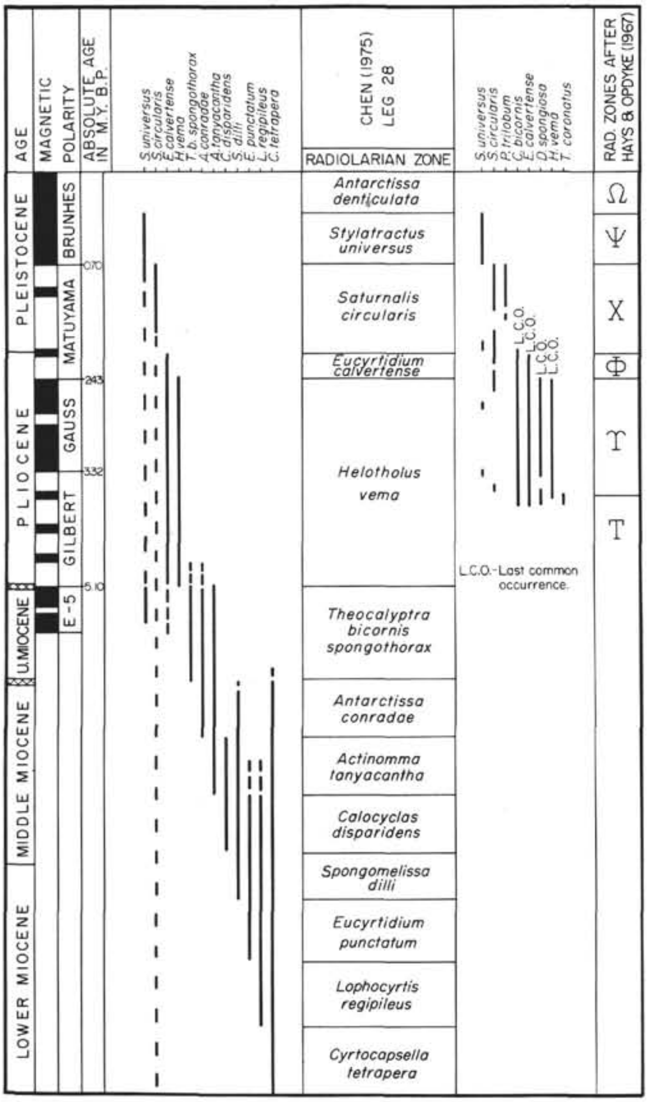

Figure 2. *Biostratigraphic framework utilized during this investigation (from Chen, 1975, and Hays and Opdyke, 1967).*

Eighteen sediment cores were taken at periodic intervals with a total recovered length of 76.4 meters. Basement was encountered at a subbottom depth of 701 meters.

Core 1, Section 1, 129-131 cm through Sample 2, CC contains a poor to moderately preserved Pliocene radiolarian assemblage. Although abundances of species fluctuate from common to rare, both the *Helotholus vema* Zone of Chen (1975) (Samples 323-1-2, 107-109 cm through 323-1, CC, and the Tau Zone of Hays and Opdyke (1967) (Samples 323-2-1, 65-67 cm through 323-2, CC) are recognized (Table 2).

Core 3, Section 1 and Core 3, Section 2 contain a few, moderately well preserved radiolarians which are long ranging and diagnostic of a Miocene age. Samples 323-3-2, 130-132 cm and 323-3, CC also contain numerous specimens of *Orosphaerid* (spines only) and *Collosphaerid* radiolarians.

A typical middle Miocene radiolarian assemblage which is well preserved occurs in Sample 3, CC. Common specimens representing the lower portion of the *Antarctissa conradae* Zone of Chen (1975) are present. Distinctive species represented are (in order of decreasing abundance) *Cyrtocapsella tetrapera* (30%-40% of the entire fauna), *Lychnocanoma sphaerothorax*, *Antarctissa conradae*, *Prunopyle hayesi*, *Eucyrtidium cienkowskii* group, *Actinomma tanyacantha*, *Dendrospyris megalocephalis*, *Cyrtocapsella cornuta* (?), *C. isopera* (rare), *Amphistylus angelinus*, and *Sethoconus* sp. (Table 2).

Sample 4, CC through Sample 6-1, 118-121 cm are essentially barren except for *Orosphaerids* and a few of the more resistant high-latitude Miocene radiolarians which include *C. tetrapera*, *P. hayesi*, *L. sphaerothorax*, and *A. angelinus*. None of the previously established radiolarian zones could be recognized within this interval.

The material recovered between Samples 323-6, CC and 323-8-1, 98-100 cm is middle Miocene in age. Preservation and abundance of specimens vary depending on the sediment lithologies. Based upon the cooccurrence and relatively high abundances of *Lophocyrtis golli*, *Lophocyrtis regipileus*, and *Eucyrtidium punctatum* group, the presence of *Cyrtocapsella isopera*, and the absence of *Actinomma tanyacantha*, this interval is assigned to the upper portion of the *Spongomelissa dilli* through the *Calocyclas disparidens* zones of Chen (1975) or early middle Miocene. Other species occurring within this interval include, *Prunopyle hayesi*, *Collosphaerids*, *Orosphaerids*, *Eucyrtidium cienkowskii* group, *Amphistylus angelinus*, *Dendrospyris haysi*, *Sethoconus* sp., *Cyrtocapsella tetrapera*, and *Stylacontarium bispiculum*.

Middle Miocene index species, *Spongomelissa dilli*, *Calocyclas disparidens*, and *Thyrsocyrtis clausa*, were not recognized in any of the 11 samples analyzed from Cores 6 through 8, suggesting that the middle Miocene zonal scheme proposed by Chen (1975) may need some revision or redefinition in order for it to be applicable throughout the entire Southern Ocean region.

Thirty-eight samples examined between Samples 323-8, CC and 323-18-2, 138-140 cm are entirely barren of radiolarians.

Commonly occurring but poorly preserved Cretaceous radiolarians were found in Sample 323-18-3, 63-65 cm through Section 323-18-6. The siliceous tests are completely recrystallized, and only limited morphological characteristics are preserved (test outline, number of segments, etc. A high percentage of the specimens examined belong to the genus *Dictyomitra* Zittel (1876), but species definition is impossible to establish due to the poor state of preservation.

Site 324
(69°03.21'S, 98°47.20'W; water depth, 4449 m)

Site 324 is located on the upper continental rise of Antarctica (Figure 1). Ten cores, with a total recovery of 48 meters, were taken before the site was abandoned at a subbottom depth of 199 meters.

Sixty-five samples were examined for radiolarians from the first nine cores. Forty-eight of these samples from between 324-1, CC and 324-9-1 are totally barren of any radiolarian remains.

TABLE 1
Radiolarians at Site 322

Sample (Interval in cm)	Abundance	Preservation	Age	Zone	*Antarctissa denticulata*	*A. strelkovi*	*A. conradae*	*A. antedenticulata*	*Spongotrochus glacialis*	*Spongodiscus osculosus*	*Lithelius nautiloides*	*Stylatractus neptunus*	*S. universus*	*Saccospyris antarctica*	*S. conithorax*	*Siphocampe aquilonaris*	*Lithomitra arachnea*	*Cornutella profunda*	*Cyrtopera languncula*	*Collosphaeridae*	*Prunopyle tetrapila*	*Pterocorys hirundo*	*Peripyramis circumtexta*	*Desmospyris spongiosa*	*Helotholus vema*	*Clathrocyclas bicornis*	*Eucyrtidium calvertense*	*E. cienknowskii* group	*E. inflatum* (?)	*Lychnocanoma grande rugosum*	*Prunopyle titan*	*Dendrospyris haysi*	*Prunopyle hayesi*	*Actinomma tanyacantha*	*Stichocorys peregrina* (?)	*Orosphaeridae*	*Theocorys redondoensis*
322-1-1, 44-46	C	M			C	F	–	–	C	F	R	F	–	R	–	R	R	R	–	–	R	–	–	C	–	R	C	–	–	–	R	–	–	–	–	–	R
322-1-2, 64-66	–	–																Barren																			
322-1-3, 19-21	F	M			R	R	–	R	F	F	–	–	–	R	R	R	–	–	–	–	–	–	–	R	R	R	C	–	–	R	–	–	–	–	–	–	–
322-1-4, 70-72	C	M	Pliocene	Upsilon	C	C	–	–	C	–	R	R	–	R	–	R	–	F	R	+	R	R	–	F	–	R	C	–	R	–	–	–	–	–	–	–	–
322-1, CC	F	M			F	R	–	F	F	R	–	–	–	R	–	–	–	R	–	+	–	–	R	R	–	–	F	–	R	R	R	–	–	–	–	–	–
322-2, 97-99	C	G			F	R	+	F	F	F	R	–	–	R	–	–	–	R	–	–	R	–	–	C	–	R	C	–	–	–	–	R	–	–	–	–	–
322-2, CC	F	M		—	–	–	–	+	–	+	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	R	–	–	R	–	+	+	–	–
322-3-1, 46-48	–	–																Barren																			
322-3, CC	–	–	?Late Miocene?															Barren																			
322-4-1, 73-75	R	P			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
322-4, CC	R	P		?	–	–	–	–	–	–	R	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	R	–	–	R	R	–	–	–	–
322-5-1, 98-100	–	–																Barren																			
322-5, CC	–	–																Barren																			
322-6-1, 84-86	–	–																Barren																			
322-6, CC	F	P																Silica Recrystallized										F									
322-7, CC	–	–	Miocene															Barren																			
322-8, CC	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	–
322-9-2, 75-82	F	P		?	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	F	–	–	–	F	–
322-9, CC (Top)	F	P			–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–
322-9, CC (Bottom)	–	–	—															Barren																			
322-10-2, 41-43	–	–																Barren																			
322-10-6, 130-132	–	–																Barren																			
322-10, CC	–	–																Barren																			

Only the core catchers of Core 9, and Core 1 contain any radiolarians.

Core 324, Section 1 is of Pleistocene age, and two biostratigraphic zones defined by Chen (1975) are recognized. Samples 324-1-1, 143-145 cm through 324-1-2, 53-55 cm fall within the *Antarctissa denticulata* Zone, while the *Saturnalis circularis* Zone extends from Samples 324-1-2, 138-140 cm through 324-1-6, 128-130 cm. Most samples from Core 1 contain the typical Quaternary Southern Ocean radiolarian assemblage which consists of *Antarctissa denticulata*, *A. strelkovi*, *Stylatractus neptunus*, *Lithelius nautiloides*, *Spongotrochus glacialis*, *Spongodiscus osculosus*, *Saccospyris antarctica*, *Triceraspyris antarctica*, *Stylodictya validispina*, *Spongoplegma antarcticum*, *Peripyramis circumtexta*, *Prunopyle antarctica*, *Cycladophora davisiana*, and *Spongurus pylomaticus*.

The *Stylatractus universus* Zone of Chen (1975) is not recognized in Core 324-1, although this species was found in the *Saturnalis circularis* Zone.

Sample 324-9, CC contains rare and moderately well preserved radiolarians diagnostic of an early Pliocene age (Table 3), but this age determination is quite uncertain because the hole was collapsing while Core 9 was being taken. Even with the barren nature of the sediments at Site 324, down-hole contamination from radiolarian-rich stringers between the coring gaps cannot be ruled out.

Site 325
(65°02.79'S, 73°40.40'W; water depth 3745 m)

Site 325 lies on the upper continental rise northwest of the central Antarctic peninsula. Ten "spot" cores were taken throughout the 718 meters of sediment penetrated, and 34.4 meters were recovered (Figure 1).

Radiolarians were found in all cored intervals at Site 325. Preservation is poor to moderate while species abundances and diversity are generally low. Cores 7, 8, 9, and 10 contain abundant radiolarians, but diagenetic effects within the claystones have resulted in partial or complete test recrystallization. Identification and age determinations within these intervals were therefore difficult and may be unreliable.

Core 1, Section 1, 18-20 cm through Core 3, CC contains a typical Pliocene radiolarian assemblage and can be assigned to the *Helotholus vema* Zone of Chen (1975) (Table 4). Species include *Antarctissa denticulata*, *A. strelkovi*, *Spongotrochus glacialis*, *Spongodiscus osculosus*, *Triceraspyris antarctica*, *Saccospyris antarctica*, *Prunopyle tetrapila*, *P. titan* (?), *Lithelius nautilioides*, *Cornutella profunda*, *Desmospyris spongiosa*, *Eucyrtidium calvertense*, and *Helotholus vema*.

Although the index species *H. vema* occurs only sporadically throughout this interval, *D. spongiosa*, which has approximately the same stratigraphic range as *H. vema*, does occur consistently through the entire interval, thus restricting it to the Pliocene.

Samples 325-4, CC, 325-5-1, 102-104 cm, 325-5, CC, and 325-6, CC are assigned to the *Theocalyptra bicornis spongothorax* Zone of Chen (1975). The top of this zone is placed between 325-3, CC and 325-4, CC at the first occurrence of *Helotholus vema*. Although *Theocalyptra bicornis spongothorax* only occurs in Sample 5, CC, the co-occurrence of the Pliocene form of *Stylatractus universus*, *Prunopyle hayesi*, *Stichocorys peregrina* (?), *Antarctissa conradae*, and *A. antedenticulata* (see Table 4), throughout the other samples examined within this interval, restricts them to the *T. b. spongothorax* Zone of Chen.

Radiolarian age determinations from material recovered from Cores 7 through 10 are difficult due to recrystallization of the specimens present. Two species could positively be identified within this interval, *Eucyrtidium cienkowskii* group and *Prunopyle hayesi* (Table 4). Cores 9 and 10 contain recrystallized specimens of what appears to be *Cannartus mammiferus*, based on their rough morphological appearance. Most details are obscured, but what may be remanent protuberances can be seen on the sides of the cortical shells of many specimens (Plate 5, Figure 8). Sample 10-1, 90-92 cm contains several specimens closely resembling *Cannartus prismaticus* (Plate 5, Figure 9; note the outline of the polar columns and cortical shell).

If these identifications are correct, Cores 9 and 10 could possibly range in age from upper Oligocene through the middle Miocene, based upon the defined ranges of *Cannartus mammiferus* and *C. prismaticus* in lower latitudes.

SYSTEMATIC DESCRIPTIONS

The classification proposed by Riedel (1967a, b; 1971) is followed wherever possible. Synonomies of taxa identified are not always complete and are often restricted to the original description and revised concept of the species.

Since the reports on Antarctic radiolarians from DSDP Legs 28 and 29 were completed independently, two completely different biostratigraphic zonations and illustrations of new taxa have emerged (Petrushevskaya, 1975; Chen, 1975). Numerous conflicting generic and species designations for pre-Pliocene Tertiary radiolarians from the Southern Ocean have added to the confusion created by inflated synonymies. In order to clarify these data for researchers dealing with Antarctic radiolarian taxa, Table 5 is included prior to the systematic descriptions in this report. This illustrates some important radiolarian taxa whose descriptions apparently have been duplicated.

Although the Leg 29 initial reports were published prior to Leg 28, the new taxonomy and biostratigraphy utilized in this report follow that presented by Chen in his Leg 28 studies. A preprint from the Leg 28 report was available at the time this investigation was being completed.

Plates 6-9 contain scanning electron micrographs taken on an International Scientific Instruments Super-Mini Scan. Wherever possible, both light micrographs and scanning electron micrographs of the same species, or species group, are illustrated in order to provide maximum morphological detail.

Subclass RADIOLARIA Müller, 1858

Order POLYCYSTINA Ehrenberg, 1838, emend. Riedel, 1967b

Suborder SPUMELLARIA Ehrenberg, 1875

Familty ACTINOMMIDAE Haeckel

Actinommidae Haeckel, 1862, emend. Riedel, 1967b

Genus ACANTHOSPHAERA Ehrenberg

Acanthosphaera Ehrenberg, 1858, p. 12.

Acanthosphaera sp.

Acanthosphaera sp. Hays, 1965, p. 169, pl. II, fig. 8; Chen, 1975, p. 509, pl. 22, fig. 5.

Abundance: Rare to few.

Occurrence: Pleistocene, *Saturnalis circularis* Zone (Site 324).

Genus ACTINOMMA Haeckel

Actinomma Haeckel, 1862, p. 440.

Actinomma tanyacantha Chen

Actinomma tanyacantha Chen, 1975, p. 487, pl. 11, fig. 5, 6.

Abundance: Rare to few.

Occurrence: Earliest Pliocene and middle Miocene (Site 323).

Actinomma yosii Nakaseko

(Plate 1, Figure 1)

Actinomma yosii Nakaseko, 1959, p. 10, pl. II, fig. 8a, b.

Abundance: Rare to few.

Occurrence: Pleistocene.

Genus AMPHISTYLUS Haeckel

Amphistylus Haeckel, 1881, p. 452.

Amphistylus angelinus (Campbell and Clark)

Stylosphaera angelina Campbell and Clark, 1944, p. 12, pl. 1, fig. 14-20.

Axoprunum angelinum (Campbell and Clark) Kling, 1973, p. 634, pl. 6, fig. 18.

Amphistylus angelinus (Campbell and Clark) Chen, 1975, p. 503, pl. 21, fig. 3, 4.

Abundance: Rare to few.

Occurrence: Middle Miocene (Site 323).

Genus DRUPPATRACTUS Haeckel

Druppatractus Haeckel, 1887, p. 324.

Druppatractus sp.

(Plate 5, Figures 1, 2; Plate 6, Figure 1)

Druppatractus sp. Chen, 1975, p. 505, pl. 20, fig. 11, 12.

Remarks: A few specimens of this species were observed in early Pliocene sediments at Site 323.

Genus ECHINOMMA Haeckel

Echinomma Haeckel, 1881, p. 453.

Echinomma leptodermum Jörgensen

Echinomma leptodermum Jörgensen, 1905, p. 116, pl. 8, fig. 33.

Abundance: Few to rare.

Occurrence: Pleistocene, *Saturnalis circularis* Zone (Site 324).

Echinomma popofskii Petrushevskaya

Echinomma popofskii Petrushevskaya, 1968, p. 20-22, fig. 12, I-III; Chen, 1975, p. 505, pl. 20, fig. 13.

Abundance: Rare.

Occurrence: Pleistocene (Site 324).

Genus PRUNOPYLE Dreyer

Prunopyle Dreyer, 1889, p. 3.

Prunopyle antarctica Dreyer

Prunopyle antarctica Dreyer, 1889, p. 24-25, fig. 75; Riedel, 1958, p. 225, pl. 1, fig. 7, 8; Chen, 1975, p. 511, pl. 23, fig. 5, 6.

Cromyechinus antarctica (Dreyer), Petrushevskaya, 1968, p. 22-27, fig. 13, I-VI; 14, I-VII.

Abundance: Rare to few.

Occurrence: Pleistocene and Pliocene.

TABLE 2
Radiolarians at Site 323

Sample (Interval in cm)	Abundance	Preservation	Age	Zone	*Antarctissa denticulata*	*A. strelkovi*	*A. conradae*	*A. antedenticulata*	*Stylatractus neptunus*	*Stylatractus universus*	*Stylodictya validispina*	*Lithelius nautiloides*	*Spongotrochus glacialis*	*Spongodiscus osculosus*	*Cornutella profunda*	*Saccospyris antarctica*	*S. conithorax*	*Theoclayptra bicornis*	*Prunopyle tetrapila*	*P. titan*	*P. hayesi*	*Peripyramis circumtexta*	*Collosphaeridae*	*Orosphaeridae*	*Eucyrtidium calvertense*	*E. cienkowskii* group	*E. punctatum* group	*Clathrocyclas bicornis*	*Desmospyris spongiosa*
323-1-1, 74-76	–	–																							Barren				
323-1-1, 129-131	R	M			R	–	–	–	F																				
323-1-2, 29-31	R	P			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R				
323-1-2, 57-59	R	P			–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-1-2, 107-109	C	M			C	C	–	+	R	–	R	R	C	F	R	R	–	–	–	+	–	–	–	–	F	–	–	R	C
323-1-2, 139-141	R	M			R	–	–	–	R	–	R	R	R	R	–	–	–	–	–	–	–	–	–	–	R	–	–	R	R
323-1-3, 14-16	F	M			F	R	–	–	–	–	–	R	F	R	R	R	–	R	–	+	–	–	–	–	R	–	–	–	R
323-1-3, 42-44	R	P			R	R	–	–	–	–	R	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–
323-1-3, 67-69	R	P			–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-1-3, 104-106	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–
323-1-4, 16-18	–	–																							Barren				
323-1-4, 71-73	R	M			–	–	–	–	R	–	–	–	R	–	–	–	–	–	R	–	–	–	–	–	R	–	–	–	R
323-1-4, 111-113	F	M			R	R	–	–	F	–	–	–	C	F	–	–	–	–	R	–	–	–	–	–	C	–	–	–	–
323-1-4, 142-144	C	M			R	R	–	–	F	R	–	R	F	F	–	–	–	–	R	+	–	–	–	–	C	–	–	R	F
323-1-5, 23-25	F	M			–	–	–	–	F	–	–	–	F	F	–	–	–	–	F	+	–	R	–	–	C	–	–	+	R
323-1-5, 65-67	R	M			–	–	–	–	–	–	–	–	F	F	–	–	–	–	–	–	–	–	–	–	C	–	–	–	R
323-1-5, 109-111	F	M			–	–	–	–	R	–	–	–	F	F	–	–	–	–	R	–	–	–	–	–	C	–	–	R	R
323-1-5, 125-127	F	M			–	R	–	–	F	–	–	–	F	F	–	–	–	–	–	–	–	R	–	–	C	–	–	–	R
323-1, CC	A	G			C	C	R	R	F	F	–	–	–	–	F	C	R	–	F	C	–	R	–	–	A	–	–	A	C
323-2-1, 65-67	F	P			–	–	–	–	–	–	–	–	F	–	–	–	–	–	–	R	–	–	–	–	F	–	–	–	–
323-2-1, 132-134	C	M			R	R	R	F	F	R	–	R	C	F	R	R	–	–	R	F	–	–	R	–	C	–	–	R	–
323-2, CC	C	G			R	F	F	F	–	R	–	R	F	–	R	R	–	R	R	–	R	R	R	–	R	–	–	–	–
323-3-1, 98-100	F	M			–	–	R	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–
323-3-1, 135-137	–	–																							Barren				
323-3-2, 33-35	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	R	–	–	–	–	–	–
323-3-2, 80-82	R	M			–		–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	–	–
323-3-2, 130-132	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	–	–	C	–	–	–	–	–
323-3, CC	C	G			–	–	C	–	–	–	–	–	–	–	F	–	–	R	–	–	C	–	F	C	–	F	–	–	–
323-4, CC	–	–																							Barren				
323-5-1, 134-137	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	–	–	–	–	–
323-5-1, 142-144	–	–																							Barren				
323-5, CC	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	C	–	–	–	–	–
323-6-1, 100-102	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	R	F	–	R	–	–	–
323-6-1, 118-121	–	–																							Barren				
323-6-1, 135-137	F	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	–	–
323-6, CC	C	G			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	–	C	C	–	C	F	–	–
323-7-1 (Gray)	R	P			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–
323-7-1 (Brown	F	G			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	–	–
323-7-1 (Green)	R	G			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–
323-7-1 (Dk. green)	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–

Sample (Interval in cm)	*Helotholus vema*	*Siphocampe aquilonaris*	*Acanthodesmiidae*	*Triceraspyris coronatus*	*Lychnocanoma grande rugosum*	*Lychnocanoma sphaerothorax*	*Amphistylus angelinus*	*Dendrospyris haysi*	*D. megalocephalis*	*Lophocyrtis golli*	*Lophocyrtis regipileus*	*Druppatractus* sp.	*Saturnalis circularis*	*Sethoconus* sp.	*Cyrtocapsella tetrapera*	*C. cornuta* (?)	*C. japonica*	*C. isopera*	*Eucyrtidium* sp. aff. *E. inflatum*	*Actinomma tanyacantha*	*Stylacontrarium bispiculum*	*Lithomelissa* sp. C.
323-1-1, 74-76																						
323-1-1, 129-131																						
323-1-2, 29-31																						
323-1-2, 57-59	–	–	–	–	–																	
323-1-2, 107-109	R	–	–	–	R																	
323-1-2, 139-141	R	–	–	–	–																	
323-1-3, 14-16	R	–	–	–	–																	
323-1-3, 42-44	+	–	–	–	–																	
323-1-3, 67-69	–	–	–	–	–																	
323-1-3, 104-106	–	–	–	–	–																	
323-1-4, 16-18																						
323-1-4, 71-73	–	–	–	–	–																	
323-1-4, 111-113	–	–	–	–	–																	
323-1-4, 142-144	–	–	–	–	–																	
323-1-5, 23-25	–	–	–	–	–																	
323-1-5, 65-67	–	–	–	–	–																	
323-1-5, 109-111	–	–	–	–	–																	
323-1-5, 125-127	–	–	–	–	–																	
323-1, CC	F	R	C	–	–																	
323-2-1, 65-67	–	–	–	R	F																	
323-2-1, 132-134	–	–	–	C	C	–	–	R	–	–	–	–	–	–	–	–	–	–	–	R	–	–
323-2, CC	–	–	–	R	C	–	–	–	–	–	–	F	R	–	–	–	–	–	R	–	–	–
323-3-1, 98-100	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–
323-3-1, 135-137																						
323-3-2, 33-35	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-3-2, 80-82	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-3-2, 130-132	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-3, CC	–	–	–	–	–	A	R	–	F	–	–		–	R	A	F	R	R	–	F	–	R
323-4, CC																						
323-5-1, 134-137	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-5-1, 142-144																						
323-5, CC	–	–	–	–	–	R	R	–	–	–	–	–	–	–	R	–	R	–	–	–	–	–
323-6-1, 100-102	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	R	–
323-6-1, 118-121																						
323-6-1, 135-137	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-6, CC	–	–	–	–	–	–	R	R	+	F	C	–	–	R	R	–	–	F	–	–	R	–
323-7-1 (Gray)	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–
323-7-1 (Brown	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-7-1 (Green)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-7-1 (Dk. green)	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

323-7-3, 19-21	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-7, CC	F	M	-?-	-?-	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	–	F	R	–	–	–	–	–	–	–	–	–	R	–	–	C	–	–		R	–	–	–	–	–	–	–
323-8-1, 34-36	F	P			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-8-1, 40-42	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–
323-8-1, 98-100	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
323-8, CC	–	–			Barren																																														
323-9, CC	–	–			Barren																																														
323-10-1, 96-98	–	–			Barren																																														
323-10-2, 103-104	–	–			Barren																																														
323-10-3, 67-68	–	–			Barren																																														
323-10, CC	–	–			Barren																																														
323-11-1, 36-38	–	–			Barren																																														
323-11-1, 130-132	–	–	?		Barren																																														
323-11-2, 66-68	–	–			Barren																																														
323-11, CC	–	–			Barren																																														
323-12-1, 129-131	–	–			Barren																																														
323-12-2, 14-16	–	–			Barren																																														
323-12-2, 74-76	–	–			Barren																																														
323-12, CC	–	–			Barren																																														
323-13-1, 104-106	–	–			Barren																																														
323-13-5, 83-84	–	–			Barren																																														
323-13-6, 31-32	–	–			Barren																																														
323-13-6, 108-110	–	–			Barren																																														
323-13, CC	–	–			Barren																																														
323-14-2, 69-71	–	–			Barren																																														
323-14-2, 122-124	–	–	?		Barren																																														
323-14, CC	–	–			Barren																																														
323-15-1, 110-112	–	–			Barren																																														
323-15-2, 105-107	–	–			Barren																																														
323-15-3, 116-118	–	–			Barren																																														
323-15-4, 24-26	–	–			Barren																																														
323-15-6, 18-20	–	–			Barren																																														
323-15, CC	–	–			Barren																																														
323-16-1, 37-39	–	–			Barren																																														
323-16-1, 94-96	–	–			Barren																																														
323-16-2, 40-42	–	–	?		Barren																																														
323-16-2, 90-92	–	–			Barren																																														
323-16-3, 90-92	–	–			Barren																																														
323-16-4, 57-59	–	–			Barren																																														
323-16, CC	–	–			Barren																																														
323-17-1, 81-83	–	–			Barren																																														
323-17, CC	–	–			Barren																																														
323-18-2, 138-140	–	–			Barren																																														
323-18-3, 63-65	C	P			Silica Recrystallized																																														
323-18-3, 127-129	A	P			Silica Recrystallized																																														
323-18-3, 143-145	C	P			Silica Recrystallized																																														
323-18-4, 58-60	C	P			Silica Recrystallized																																														
323-18-4, 85-87	C	P			Silica Recrystallized																																														
323-18-4, 105-107	–	–			Barren																																														
323-18-5, 0-2	–	–			Barren																																														
323-18-5, 47-49	F	P	Cretaceous		Silica Recrystallized																																														
323-18-5, 138-140	R	P			Silica Recrystallized																																														
323-18-6, (Basalt contact)	–	–			Barren																																														

TABLE 3
Radiolarians at Site 324

Species / Sample (Interval in cm)	Abundance	Preservation	Age	Zone	*Antarctissa denticulata*	*A. strelkovi*	*Stylatractus neptunus*	*Lithelius nautiloides*	*Cycladophora davisiana*	*Spongotrochus glacialis*	*Cyrtopera languncula*	*Saccospyris antarctica*	*S. conithorax*	*Cornutella profunda*	*Triceraspyris antarctica*	*Spongodiscus osculosus*	*Spongurus pylomaticus*	*Peripyramis circumtexta*	*Spongoplegma antarcticum*	*Theocalyptra bicornis*	*Pterocorys hirundo*	*Dictyophimus gracilipes*	*D. mawsoni*	*Stylodicta validispina*	*Prunopyle antarctica*	*Echinomma leptodermum*	*E. popofskii*	*Acanthosphaera* sp.	*Siphocampe aquilonaris*	*Stylatractus universus*	*Saturnalis circularis*	*Sethoconus* (?) *galea*	*Dendrospyris haysi*	*Eucyrtidium calvertense*	*Actinomma yosii*
324-1-1, 143-145	F	M	Pleistocene	*A. denticulata*	F	C	F	R	R	R	R	F	–	R	R	R	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
324-1-2, 53-55	C	G			C	C	R	R	F	F	–	C	–	R	R	C	R	R	F	R	R	F	–	F	R	–	–	–	–	–	+	R	–	–	–
324-1-2, 138-140	C	G			A	A	C	F	F	C	–	C	–	R	C	R	F	C	C	R	R	F	–	F	F	–	–	–	C	–	F	R	–	–	–
324-1-3, 30-32	C	G			A	A	C	R	F	C	–	C	R	–	C	R	R	R	C	–	R	F	–	F	F	–	R	–	F	R	–	R	–	–	R
324-1-3, 82-84	C	G			A	A	C	F	F	C	–	C	–	–	C	F	R	F	A	–	–	R	–	F	R	–	R	R	C	R	F	R	–	–	R
324-1-3, 134-136	F	M			C	C	F	F	R	F	–	F	–	R	F	F	–	R	F	–	–	–	–	R	R	–	–	R	R	–	R	–	–	–	–
324-1-4 34-36	R	P			F	F	R	–	R	–	–	R	–	–	R	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F
324-1-4, 68-70	C	G			C	C	C	F	F	C	–	C	–	R	C	C	F	F	C	R	–	–	R	F	R	F	–	F	R	R	R	–	–	–	R
324-1-4, 115-117	–	–			Barren																														
324-1-5, 28-30	–	–			Barren																														
324-1-5, 58-59	C	G			C	C	R	F	F	C	–	C	–	R	C	F	F	F	F	–	–	R	–	F	R	F	–	F	R	F	–	–	–	–	–
324 1-5, 86-88	R	M		*S. circularis*	R	R	R	R	R	R	–	R	–	–	R	–	R	–	–	–	–	–	–	R	–	R	–	–	–	R	–	–	–	–	–
324-1-5, 127-129	R	M			R	R	R	–	–	R	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–
324-1-6, 17-19	F	G			F	C	F	R	–	F	–	C	–	–	F	–	–	R	R	–	–	–	–	R	–	R	–	–	–	–	–	–	–	–	–
324-1-6, 53-55	R	M			R	R	–	R	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–
324-1-6, 128-130	R	M			R	R	R	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
324-1, CC	–	–			Barren																														
324-2-1 18-20	–	–			Barren																														
324-2-1, 78-80	–	–			Barren																														
324-2-2 74-78	–	–			Barren																														
324-2-2, 146-148	–	–			Barren																														
324-2-3, 75-77	–	–	?		Barren																														
324-2-3, 111-113	–	–			Barren																														
324-2-4, 77-79	–	–			Barren																														
324-2-5, 72-74	–	–			Barren																														
324-2-6, 112-114	–	–			Barren																														
324-2, CC	–	–			Barren																														
324-3-1, 19-21	–	–			Barren																														
324-3-2, 23-25	–	–			Barren																														
324-3-2, 111-113	–	–		?	Barren																														
324-3-3, 49-51	–	–			Barren																														
324-3-4, 44-46	–	–			Barren																														
324-3-5, 86-88	–	–			Barren																														
324-3-6, 119-121	–	–			Barren																														
324-3, CC	–	–			Barren																														
324-4-1, 141-143	–	–			Barren																														
324-4-2, 22-24	–	–			Barren																														
324-4-2, 68-70	–	–	?		Barren																														
324-4-2, 143-145	–	–			Barren																														
324-4-3, 50-52	–	–			Barren																														
324-4-3, 108-110	–	–			Barren																														
324-4-4, 57-59	–	–			Barren																														
324-4, CC	–	–		?	Barren																														
324-5-1, 96-98	–	–			Barren																														
324-5-2, 94-96	–	–			Barren																														
324-5-2, 122-123	–	–			Barren																														
324-5-3, 43-45	–	–			Barren																														
324-5-3, 89-91	–	–			Barren																														
324-5, CC	–	–			Barren																														
324-6-1, 100-102	–	–			Barren																														
324-6-2, 34-36	–	–			Barren																														
324-6-6, 133-135	–	–			Barren																														
324-6, CC	–	–			Barren																														
324-7-1, 83-85	–	–			Barren																														
324-7-2, 114-116	–	–			Barren																														
324-7-3, 129-131	–	–			Barren																														
324-7-4, 140-142	–	–			Barren																														
324-7-6, 141-143	–	–			Barren																														
324-7, CC	–	–			Barren																														
324-8-2, 129-131	–	–			Barren																														
324-8-3, 23-25	–	–			Barren																														
324-8-3, 103-105	–	–	E. Pliocene	?	Barren																														
324-8, CC	–	–			Barren																														
324-9-1, 117-119	–	–			Barren																														
324-9, CC	R	M			R	F	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	R	–

TABLE 4
Radiolarians at Site 325

Sample (Interval in cm) / Species	Abundance	Preservation	Age	Zone	*Antarctissa denticulata*	*A. strelkovi*	*A. conradae*	*A. antedenticulata*	*Spongotrochus glacialis*	*Spongodiscus osculosus*	*Prunopyle antarctica*	*Triceraspyris antarctica*	*Siphocampe aquilonaris*	*Saccospyris antarctica*	*Saccospyris conithorax*	*Stylatractus neptunus*	*Prunopyle tetrapila*	*Lithelius nautiloides*	*Stylodictya validispina*	*Lithomitra arachnea*	*Cornutella profunda*	*Stylatractus universus*	*Saturnalis circularis*	*Spongurus pylomaticus*	*Theocalyptra bicornis*	*Desmospyris spongiosa*	*Helotholus vema*	*Eucyrtidium calvertense*	*E.* sp. aff. *E. inflatum*	*E. cienkowskii* group	*Dendrospyris haysi*	*Stichocorys peregrina* (?)	*Theocalyptra bicornis spongothorax*	*Triceraspyris coronatus*	*Cannartus* sp. aff. *C. prismaticus*	*C.* sp. aff. *C. mammiferus*	*Prunopyle titan*	*Prunopyle hayesi*
325-1-1, 25-27																	Barren																					
325-1-1, 41-43																	Barren																					
325-1-1, 89-91																	Barren																					
325-1-1, 123-125																	Barren																					
325-1-2, 18-20	R	M			R	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-2, 49-51	F	M			R	R	–	R				R	–	–	–	F	–	F	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	R	–
325-1-2, 89-91	F	M			F	R	–	–	R	–	–	R	–	R	–	F	–	F	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–
325-1-2, 115-117	F	M			F	–	–	–	R	–	R	R	R	R	R	F	–	R	R	–	–	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–
325-1-2, 147-149	R	P			R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-3, 13-15	R	P			–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-3, 44-46	F	M			R	–	–	–	–	–	–	–	R	–	–	R	–	–	R	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–
325-1-3, 58-60				*Helotholus vema*													Barren																					
325-1-3, 104-106	R	P	Pliocene		R	R	–	–	–	–	–	R	R	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-3, 125-127	R	P			–	–	–	–	–	R	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–
325-1-4, 33-35	R	P			R	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-4, 96-98	R	P			–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-1-4, 136-138	R	M			–	R	–	R	R	–	–	–	R	–	–	–	–	R	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–
325-1-4, 144-146	C	M			C	F	–	R	F	C	–	–	R	R	–	–	–	R	R	–	–	–	–	–	–	C	R	R	–	–	–	–	–	–	–	–	R	–
325-1, CC	F	M			F	R	R	R	R	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C	–	R	–	–	–	–	–	–	–	–	–	–
325-2-1, 142-144	F	M			R	R	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	R	–	F	R	–	–	–	–	–	–	–	–	–	–	–
325-2-2, 76-78	R	P			R	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–
325-2-2, 112-114	F	M			F	R	–	–	F	–	–	–	–	R	–	–	–	R	–	–	–	–	–	–	–	R	R	R	–	–	–	–	–	–	–	–	R	–
325-2-2, 146-148	R	M			–	R	–	–	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
325-2, CC	R	M			R	R	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	R	R	–	–	–	–	–	–	–	–	–	–
325-3-1, 123-125	F	M			F	R	–	R	R	R	–	–	–	R	–	–	–	–	–	R	R	–	–	–	–	C	–	–	–	–	–	–	–	–	–	–	–	–
325-3-2, 43-45	R	P			R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	R	–	–	–	–	–	–	–	–	–	–
325-3-2, 105-107	F	M			F	–	–	–	R	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	R	R	–	–	–	–	–	–	–	–	–	–
325-3-3, 43-45	F	M			F	F	–	–	R	–	–	–	–	R	R	–	–	–	–	–	–	–	–	–		R	R	R	–	–	–	–	–	–	–	–	–	–
325-3-3, 103-105	F	M			C	F	–	–	–	R	R	–	–	R	–	–	–	–	–	R	R	–	–	–	–	F	R	R	–	–	–	–	–	–	–	–	–	–
325-3-4, 45-47	F	M			F	R	–	–	R	R	–	–	–	F	–	–	–	–	–	–	–	–	–	–	–	F	R	R	–	–	–	–	–	–	–	–	–	–
325-3-4, 106-108	F	M			F	R	–	–	R	–	–	–	–	R	–	–	–	–	–	R	–	–	–	–	–	C	R	R	–	–	–	–	–	–	–	–	–	–
325-3, CC	F	M			F	R	–	–	R	F	–	–	–	R	R	R	–	–	–	R	–	–	–	–	–	C	R	F	–	–	–	–	–	–	–	–	–	–
325-4, CC	F	M			F	–	R	R	–	R	–	–		–	–	–	–	–	–	–	R	–	–	–	–	R	–	R	R	–	–	R	–	–	–	–	–	–
325-5-1, 102-104	F	M			–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	R	–	R	–	–	–	–	–	–	–	–	–	F
325-5, CC	R	M			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	F	–	–	–	–	–	–	–	–	R	–	R	–	–	–	–	F
325-6, CC	R	M		*T. D. Spongothorax*	–	–	–	–	–	R	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	R	–	–	R	–	–	–	–	–	–	R
325-7-1, 105-140	C	P								Silica Recrystallized																				–					–	–		–
325-7-2, 51-53	C	P	L. Mio.							Silica Recrystallized																				–					–	–		–
325-7, CC	A	P								Silica Recrystallized																				–					–	–		–
325-8-1, 51-53	A	P								Silica Recrystallized																				F					–	–		–
325-8-1, 90-92	A	P								Silica Recrystallized																				F					–	–		–
325-8-2, 118-120	C	P								Silica Recrystallized																				–					–	–		–
325-8-3, 10-12	C	P								Silica Recrystallized																				F					–	–		C
325-8, CC	C	P								Silica Recrystallized																				–					–	–		–
325-9-1, 128-131	R	P	E.-M. Miocene							Silica Recrystallized																				F					–	R		–
325-9-2, 3-6	C	P								Silica Recrystallized																				–					–	–		–
325-9-2, 80-83	C	P								Silica Recrystallized																				F					–	F		–
325-9-2, 110-113	C	P								Silica Recrystallized																				F					–	F		–
325-9-3, 49-53	C	P								Silica Recrystallized																				–					–	–		–
325-9-3, 85-87	C	P								Silica Recrystallized																				–					–	R		–
325-9-3, 137-139	R	P								Silica Recrystallized																				–					–	–		–
325-9, CC	A	P								Silica Recrystallized																				–					–	–		–
325-10-1, 89-91	C	P	Olig. to E. Mio.							Silica Recrystallized																				–					R	F		–
325-10-2, 90-92	C	P								Silica Recrystallized																				F					–	–		–
325-10-3, 56-58	C	P								Silica Recrystallized																				–					–	–		–
325-10, CC	C	P								Silica Recrystallized																				–					–	R		–

TABLE 5
Taxonomic Designations as Given by Chen (1975), and Followed in this Report, and Equivalent Designations of Petrushevskaya (1975)

Chen, Leg 28	Petrushevskaya, Leg 29
Taxa	Equivalent Taxa
Amphistylus angelinus-Plate 21, fig. 3, 4.	*Stylosphaera hispida* group-Plate 2, fig. 4.
Prunopyle titan-Plate 23, fig. 1, 2.	*Lithocarpium titan*-Plate 4, fig. 3.
Prunopyle hayesi-Plate 9, fig. 3-5.	*Ommatodiscus haeckeli* group-Plate 3, fig. 12-16.
Cyrtocapsella isopera-Plate 11, fig. 7-9.	*Theocorys longithorax*-Plate 8, fig. 17, 18.
Dendrospyris haysi-Plate 15, fig. 3, 4.	*Desmospyris rhodospyroides*-Plate 10, fig. 31, 32.
Spongomelissa dilli-Plate 13, fig. 6, 7.	*Corythomelissa horrida*-Plate 11, fig. 14, 15.
Antarctissa denticulata-Plate 18, fig. 5, 6.	*Antarctissa cylindrica*-Plate 11, fig. 19, 20.
Antarctissa antedenticulata-Plate 18, fig. 1, 2.	*Antarctissa robusta*-Plate 11, fig. 21, 22.
Antarctissa antedenticulata-Plate 18, fig. 1, 2.	*Antarctissa capitata*-Plate 11, fig. 24.
Antarctissa conradae-Plate 17, fig. 1-5.	*Botryopera deflandrei*-Plate 11, fig. 30-32.
Theocalyptra bicornis spongothorax-Plate 12, fig. 1-3.	*Clathrocyclas cabrilloensis* group-Plate 15, fig. 27-29.
Lophocyrtis regipileus-Plate 12, fig. 6, 7.	*Clathrocyclas titanothericeraos*-Plate 23, fig. 1.
Cyclampterium (?) *longiventer*-Plate 10, fig. 7.	*Thyrsocyrtis* sp.-Plate 8, fig. 10.

Prunopyle hayesi Chen
(Plate 7, Figures 1-3)

Prunopyle hayesi Chen, 1975, p. 483, pl. 9, fig. 3-5.
Abundance: Few to common.
Occurrence: Miocene and early Pliocene.

Prunopyle tetrapila Hays

Prunopyle tetrapila Hays, 1965, p. 172, pl. II, fig. 5.
Cromyechinus tetrapila (Hays), Petrushevskaya, 1972, p. 575, pl. 9, fig. 11.
Abundance: Rare to few.
Occurrence: Pliocene (Sites 323 and 325).

Prunopyle titan (?) Campbell and Clark
(Plate 7, Figure 6)

Prunopyle titan Campbell and Clark, 1944, p. 20, pl. 3, fig. 1-3; Hays, 1965, p. 173, pl. II, fig. 4; Bandy et al., 1971, p. 9, pl. 1, fig. 6-10; Keany and Kennett, 1972, p. 539, fig. 4.
Abundance: Few to common.
Occurrence: Pliocene.
Remarks: The *Prunopyle titan* reported from Antarctic sediments by numerous authors is not believed to be the same species that was originally described by Campbell and Clark (1944) from Miocene sediments in California. Campbell and Clark (1944) clearly state that *P. titan* does not have any internal medullary shell. The Antarctic form referred to as *P. titan*, on the other hand, does have a loosely packed internal structure composed of at least four spirals. Although some of the Antarctic specimens do appear to be hollow, a preliminary SEM investigation indicates that this is a result of differential dissolution. The internal spirals are more easily dissolved with respect to the cortical prune-shaped outer shell. Specimens in all states of preservation have been observed and the preferential destruction of the internal spirals observed (Weaver, in preparation.)

Genus STYLATRACTUS Haeckel

Stylatractus Haeckel, 1887, p. 328.

Stylatractus neptunus Haeckel

Stylatractus neptunus Haeckel, 1887, p. 328, pl. 17, fig. 6.
Stylatractus neptunus Haeckel (?) Riedel, 1958, p. 226, pl. 1, fig. 9.
Stylatractus sp. Petrushevskaya, 1968, p. 27-28, fig. 15, I-IV; 32, III.
Abundance: Rare to few.
Occurrence: Pliocene and Pleistocene.

Stylatractus universus Hays
(Plate 5, Figures 3, 6; Plate 6, Figures 5-7)

Stylatractus sp. Hays, 1965, p. 167, pl. 1, fig. 6.
Stylatractus universus Hays, 1970, p. 215, pl. 1, fig. 1, 2; Kling, 1971, p. 1086, pl. 1, fig. 6; Chen, 1975, p. 507, pl. 21, fig. 5-9.
Abundance: Rare to few.
Occurrence: Pliocene ? and Pleistocene.
Remarks: The specimens identified as *S. universus* by Chen (1975) and in this study from early Pliocene sediments may be a totally different species. In contrast to the late Pleistocene form of *S. universus*, the "Pliocene form" has: (1) narrower polar spines, (2) a cortical shell that is less elliptical and elongated along the polar axis, (3) apparently only one inner medullary shell (this would place this species into the genus *Lithatractus*), and (4) no supporting spines that protrude from the cortical shell. The latest occurrence of this "Pliocene form" of *S. universus* is within the Gilbert magnetic epoch and is coincident with the top of the *T. b. spongothorax* Zone of Chen (1975).

Genus SPONGOPLEGMA Haeckel

Spongoplegma Haeckel, 1881, p. 455.

Spongoplegma antarcticum Haeckel

Spongoplegma antarcticum Haeckel, 1887, p. 90; Hays, 1965, p. 165-167, pl. 1, fig. 1; Chen, 1975, p. 509, pl. 22, fig. 3, 4.
Diploplegma banzare Riedel, 1958, p. 223, pl. 1, fig. 3, 4.
Cenosphaera antarctica Nakaseko, 1959, p. 5, pl. 1, fig. 3-6.
Diploplegma aquatica (Popofsky), Petrushevskaya, 1968, p. 14-18, fig. 9, I-III; 10, I-VI.
Abundance: Rare to common.
Occurrence: Pleistocene.

Genus SPONGURUS Haeckel

Spongurus Haeckel, 1860.

Spongurus pylomaticus Riedel

Spongurus pylomaticus Riedel, 1958, p. 226, pl. 1, fig. 10, 11; Petrushevskaya, 1968, p. 32, fig. 16, I-II.
Abundance: Rare to few.
Occurrence: Pliocene and Pleistocene (Sites 324 and 325).

Genus STYLACONTARIUM Popofsky

Stylacontarium Popofsky, 1912, p. 90.

Stylacontarium bispiculum Popofsky

Stylacontarium bispiculum Popofsky, 1912, p. 91, pl. 2, fig. 2; Chen, 1975, p. 507, pl. 21, fig. 1, 2.
Abundance: Rare.
Occurrence: Middle Miocene (Site 323).

Family COLLOSPHAERIDAE Müller, 1858

Members of this family were identified in early Pliocene and Miocene sediments. Specimens encountered are similar to those illustrated by Bandy et al., 1971, p. 11, pl. 2, fig. 8, 9; and Kennett and Brunner, 1973, p. 2045, fig. 2, A, B.

Family OROSPHAERIDAE Haeckel, 1887

Genus OROSCENA Haeckel

Oroscena Haeckel 1887, emend. Friend and Riedel, 1967.

Oroscena sp.
(Plate 3, Figure 11)

Oroscena sp. Bandy et al., 1971, p. 11, pl. 2, fig. 2, 3.
Abundance: Rare to common.
Occurrence: Miocene.
Remarks: Only digitate spines are illustrated. The orosphaerid spines are similar to those of *Oroscena* spp. Friend and Riedel, 1967, p. 229, pl. 2, fig. 5, an orosphaerid which occurs in assemblages from middle Miocene tropical Pacific sediments.

Family LITHELIIDAE Haeckel

Litheliidae Haeckel, 1862, p. 515.

Genus LITHELIUS Haeckel

Lithelius Haeckel, 1860, p. 843; Sanfilippo and Riedel, 1973, p. 522.

Lithelius nautiloides Popofsky

Lithelius nautiloides Popofsky, 1908, p. 230-231, pl. XXVII, fig. 4; Riedel, 1958, p. 228-229, pl. 2, fig. 3; Petrushevskaya, 1968, p. 50-52, fig. 27-28; Chen, 1975, p. 513, pl. 24, fig. 7.
Abundance: Few to rare.
Occurrence: Miocene to Pleistocene.

Family SPONGODISCIDAE Haeckel

Spongodiscidae Haeckel, 1862, emend. Riedel, 1967b, p. 295.

Genus SPONGODISCUS Ehrenberg

Spongodiscus Ehrenberg, 1854, p. 237; Sanfilippo and Riedel 1973, p. 524.

Spongodiscus osculosus (Dreyer)

Spongopyle osculosa Dreyer, 1889, p. 42-43, pl. VI, fig. 99, 100; Riedel, 1958, p. 226-227, pl. 1, fig. 12.
Spongodiscus osculosus (Dreyer), Petrushevskaya, 1968, p. 39-40, fig. 20, I, II; Chen, 1975, p. 513, pl. 24, fig. 4.
Abundance: Rare to common.
Occurrence: Miocene through Pleistocene.

Genus SPONGOTROCHUS Haeckel

Spongotrochus Haeckel, 1860, p. 844

Spongotrochus glacialis Popofsky

Spongotrochus glacialis Popofsky, 1908, p. 228-229, pl. 26, fig. 7, 8; pl. 27, fig. 1; Petrushevskaya, 1968, p. 40-50, fig. 21, I-VII; fig. 22, I-VII; fig. 26, II; Chen, 1975, p. 513, pl. 24, fig. 5, 6.
Spongotrochus (?) *glacialis* Popofsky, Riedel, 1958, p. 227-228, pl. 2, fig. 1, 2.
Abundance: Few to common.
Occurrence: Pliocene and Pleistocene.

Genus STYLODICTYA Ehrenberg

Stylodictya Ehrenberg 1847, emend. Kozlova, 1972, p. 525.

Stylodictya validispina Jörgensen

Stylodictya validispina Jörgensen, 1905, p. 119, pl. 10, fig. 40; Petrushevskaya, 1968, p. 30-31, fig. 17, IV, V.
Abundance: Rare to few.
Occurrence: Pliocene and Pleistocene.

Subfamily ARTISCINAE Haeckel 1881, emend. Riedel 1967b

Genus CANNARTUS Haeckel

Cannartus Haeckel, 1881, p. 462, emend. Riedel, 1971, p. 652.

Cannartus sp. aff. C. prismaticus (Haeckel)
(Plate 5, Figure 9)

Cannartus sp. aff. *C. prismaticus* (Haeckel), Chen, 1975, p. 505, pl. 20, fig. 7.
Abundance: Rare.
Occurrence: Oligocene (?) to early Miocene.

Cannartus sp. aff. C. mammiferus (Haeckel)
(Plate 5, Figures 7, 8)

Remarks: Rare to few specimens were found in Cores 9 and 10 at Site 325. All specimens were partially or totally recrystallized and vaguely resemble *C. mammiferus* on the basis of size, form, and the existence of remanent protuberances on the sides of the cortical shell (Plate 5, Figures 7, 8).

Subfamily SATURNALINAE Deflandre, 1953

Genus SATURNALIS Haeckel

Saturnalis Haeckel, 1881, p. 450, emend. Nigrini, 1967

Saturnalis circularis Haeckel
(Plate 1, Figure 4)

Saturnalis circularis Haeckel, 1887, p. 131; Nigrini, 1967, p. 25, pl. 1, fig. 9; Kling, 1973, p. 635, pl. 1, fig. 21-25; pl. 7, fig. 1-5; Chen, 1975, p. 513, pl. 24, fig. 2.
Saturnalis planetes Haeckel, 1887, p. 142, pl. 16, fig. 7; Hays, 1965, p. 167, pl. 1, fig. 5.
Abundance: Rare to few.
Occurrence: Pliocene and Pleistocene.

Suborder NASSELARIA Ehrenberg

Family ACANTHODESMIIDAE Haeckel

Acanthodesmiidae Haeckel, 1862; emend. Riedel, 1967b, p. 296.

Genus DENDROSPYRIS Haeckel

Dendrospyris Haeckel, 1881, p. 44; emend. Goll, 1968, p. 1417.

Dendrospyris haysi Chen
(Plate 2, Figures 7-9; Plate 7, Figure 4)

Dendrospyris haysi Chen, 1975, p. 495, pl. 15, fig. 3-5.
Abundance: Rare to few.
Occurrence: Miocene and early Pliocene.

Dendrospyris megalocephalis Chen
(Plate 3, Figures 9, 10)

Dendrospyris megalocephalis Chen, 1975, p. 493, pl. 14, fig. 3-5.
Abundance: Few.
Occurrence: Middle Miocene (Site 323).

Genus DESMOSPYRIS Haeckel

Desmospyris Haeckel, 1881, p. 443; 1887, p. 1089

Desmospyris spongiosa Hays
(Plate 1, Figure 12)

Desmospyris spongiosa Hays, 1965, p. 173-175, pl. 2, fig. 1; Keany and Kennett, 1972, p. 539, fig. 4, No. 12-13.
Abundance: Rare to common.
Occurrence: Pliocene.

Genus TRICERASPYRIS Haeckel

Triceraspyris Haeckel, 1881, p. 441.

Triceraspyris antarctica (Haecker)
(Plate 1, Figures 2, 3)

Phormospyris antarctica Haecker, 1907, p. 124, fig. 9.
Triceraspyris antarctica (Haecker), Haecker, 1908, p. 445-446, pl. 84, fig. 586; Riedel, 1958, p. 230, pl. 2, fig. 6, 7; Petrushevskaya, 1964, p. 1121-1123, fig. 1.
Abundance: Rare to common.
Occurrence: Pliocene and Pleistocene.

Triceraspyris coronatus Weaver n. sp.
(Plate 2, Figures 4, 5; Plate 6, Figures 8, 9)

Description: Shell, crown-shaped and heavily constructed. Sagittal ring D-shaped. Shell has deep-set circular to subcircular pores of uniform size arranged in longitudinal rows. Pores adjacent to the sagittal ring tend to be larger and elliptical in outline. Three basal feet slightly outwardly diverging, often bifurcated or trifurcated distally.

Discussion: A slight sagittal stricture is observed in some specimens. Well preserved specimens also have long, broad basal feet with a small amount of lattice-work between the proximal ends. Hays and Opdyke (1967, p. 9) have previously referred to *Triceraspyris coronatus* as *Triceraspyris* sp.

Measurements: Based on 25 specimens from Samples 323-2-1, 132-134 cm and E 34-5, 300 cm: Width of shell, 114-116 μm; length of shell, 84-96 μm; width of basal feet, 6-18 μm; length of basal feet, 25-50 μm; pore diameter 8-15 μm.

Abundance: Common.

Occurrence: Latest Miocene and Pliocene, Southern Ocean.

Type locality: DSDP Site 323, Core 2, Section 1, 132-134 cm.

Repository: Holotype deposited at the U.S. National Museum, Washington, D.C.

Family ARTOSTROBIIDAE Riedel

Artostrobiidae Riedel, 1967a, p. 149

Genus LITHOMITRA Bütschli

Lithomitra, Bütschli, 1882.

Lithomitra arachnea (Ehrenberg)

Eucyrtidium lineatum arachneum Ehrenberg, 1862, p. 299.
Lithomitra lineata (Ehrenberg) Haeckel, 1881, p. 1484.
Lithomitra arachnea (Ehrenberg) Riedel, 1958, p. 242-243, pl. 4, fig. 7, 8; Petrushevskaya, 1962, p. 339-340, fig. 9, 10; Ling et al., 1971, p. 716, pl. 2, fig. 13, 14.

Abundance: Rare.

Occurrence: Pliocene.

Genus SIPHOCAMPE Haeckel

Siphocampe Haeckel, 1887.

Siphocampe aquilonaris (Bailey)

Eucyrtidium aquilonaris Bailey, 1856, p. 4, pl. 1, fig. 9.
Lithocampe aquilonaris (Bailey), Haeckel, 1862, p. 317; 1887, p. 1504.
Lithocampe (?) *aquilonaris* (Bailey), Petrushevskaya, 1968, p. 140-141, fig. 79, 1, 11.
Siphocampe aquilonaris (Bailey), Ling et al., 1971, p. 716, pl. 2, fig. 12.

Abundance: Rare to common.

Occurrence: Pliocene and Pleistocene.

Family PLAGONIIDAE Haecekl

Plagoniidae Haeckel, 1881, emend. Riedel, 1967b

Genus ANTARCTISSA Petrushevskaya

Antarctissa Petrushevskaya, 1968, p. 83.

Antarctissa denticulata (Ehrenberg)

Lithobotrys denticulata Ehrenberg, 1844, p. 203.
Lithopera denticulata (Ehrenberg), Ehrenberg, 1873, pl. 12, fig. 7; Haeckel, 1887, p. 1083; Haecker, 1907, p. 123-124, fig. 8.
Permomelissa denticulata (Ehrenberg) Haecker, 1908, p. 448-452, pl. 84, fig. 582, 583, 591; Riedel, 1958, p. 236, pl. 3, fig. 9.
Helotholus histricosa var. *clausa* Popofsky, 1908, p. 281-282, pl. XXXIII, fig. 1.
Antarctissa denticulata (Ehrenberg) Petrushevskaya, 1968, p. 84-86, fig. 49, I-IV.

Abundance: Rare to common.

Occurrence: Pliocene and Pleistocene.

Antarctissa antedenticulata Chen

Antarctissa antedenticulata Chen, 1975, p. 501, pl. 18, fig. 1, 2.

Abundance: Rare to few.

Occurrence: Earliest Pliocene.

Antarctissa conradae Chen

Antarctissa conradae Chen, 1975, p. 499, pl. 17, fig. 1-5.

Abundance: Rare to common.

Occurrence: Middle Miocene and Pliocene.

Antarctissa strelkovi Petrushevskaya

Helotholus histricosa Jörgensen, 1905, p. 137, pl. 16, fig. 86-88; Popofsky, 1908, p. 279-281, pl. 32, fig. 1-5; pl. 36, fig. 2; Riedel, 1958, p. 234-235, pl. 3, fig. 8.
Helotholus longus Popofsky, 1908, p. 282-283, pl. 34, fig. 2.
Antarctissa strelkovi Petrushevskaya, 1968, p. 88-90, fig. 51, III-VI; Chen, 1975, p. 499, pl. 17, fig. 6-9.

Abundance: Rare to abundant.

Occurrence: Pliocene and Pleistocene.

Genus HELOTHOLUS Jörgensen

Helotholus Jörgensen, 1905, p. 137.

Helotholus vema Hays
(Plate 1, Figures 10, 11)

Helotholus vema Hays, 1965, p. 176, pl. 2, fig. 3; Chen, 1975, p. 497, pl. 16, fig. 1-4.
Pseudocubus vema (Hays), Keany and Kennett, 1972, p. 539, fig. 4, no. 10, 11.

Abundance: Rare to few.

Occurrence: Pliocene.

Genus LITHOMELISSA Ehrenberg

Lithomelissa Ehrenberg, 1847b, p. 54.

Lithomelissa sp. C Chen
(Plate 8, Figures 2, 3)

Lithomelissa sp. C Chen, 1975, p. 487, pl. 11, fig. 3, 4

Abundance: Rare.

Occurrence: Miocene.

Family PTEROCORYIDAE Haeckel

Pterocoryidae Haeckel, 1881, emend, Riedel, 1967b.

Genus PTEROCORYS Haeckel

Pterocorys Haeckel, 1881, p. 435.

Pterocorys hirundo Haeckel

Pterocorys hirundo Haeckel, 1887, p. 1318, pl. 71, fig. 4; Riedel, 1958, p. 238, pl. 4, fig. 1; Chen, 1975, p. 503, pl. 19, fig. 3.
Pterocorys ((?) *hirundo* Haeckel, Petrushevskaya, 1968, p. 114-116, fig. 67, I-V.

Abundance: Rare.

Occurrence: Pliocene and Pleistocene.

Family THEOPERIDAE Haeckel

Theoperidae Haeckel, 1881, emend. Riedel, 1967b, p. 296.

Genus CLATHROCYCLAS Haeckel

Clathrocyclas Haeckel, 1882, p. 434.

Clathrocyclas bicornis Hays

Clathrocyclas bicornis Hays, 1965, p. 179, pl. 3, fig. 3; Chen, 1975, p. 489, pl. 12, fig. 8, 9.

Abundance: Rare to abundant.

Occurrence: Pliocene.

Genus CORNUTELLA Ehrenberg

Cornutella Ehrenberg, 1838, p. 128.

Cornutella profunda Ehrenberg

Cornutella clathrata B. profunda Ehrenberg, 1858, pl. 35b., fig. 21; Bailey, 1856, p. 2, pl. 1, fig. 23.
Cornutella profunda Ehrenberg, 1858, p. 31; Riedel, 1958, p. 232, pl. 3, fig. 1, 2.
Cornutella hexagona Haeckel, 1887, p. 1180, pl. 54, fig. 9.

Abundance: Rare to few.
Occurrence: Pliocene and Pleistocene.

Genus CYCLADOPHORA Ehrenberg

Cycladophora Ehrenberg, 1847b, p. 54.

Cycladophora davisiana Ehrenberg
(Plate 1, Figure 7)

Cycladophora (?) *davisiana* Ehrenberg, 1862, p. 297; 1873, pl. 2, fig. 11.
Theocalpytra davisiana (Ehrenberg), Riedel, 1958, p. 239, pl. 4, fig. 2, 3.
Cycladophora davisiana Ehrenberg, Petrushevskaya, 1968, p. 120-122, fig. 69, I-VII; Chen, 1975, p. 491, pl. 13, fig. 3.
Abundance: Rare to few.
Occurrence: Pleistocene.

Genus CYRTOCAPSELLA Haeckel

Cyrtocapsella Haeckel, 1887; Sanfilippo and Riedel, 1970, p. 451; Riedel and Sanfilippo, 1970, p. 530.

Cyrtocapsella isopera Chen
(Plate 3, Figures 5, 6; Plate 9, Figures 4, 6)

Cyrtocapsella isopera Chen, 1975, p. 467, pl. 11, fig. 7-9.
Abundance: Rare to few.
Occurrence: Middle Miocene.

Cyrtocapsella tetrapera Haeckel
(Plate 3, Figures 1-3; Plate 9, Figures 1, 2, 3, 7)

Cyrtocapsa (*Cyrtocapsella*) *tetrapera* Haeckel, 1887, p. 1512, pl. 78, fig. 5.
Cyrtocapsella tetrapera Haeckel, Sanfilippo and Riedel, 1970, p. 453, pl. 1, fig. 16-18; Chen, 1975, p. 505, pl. 20, fig. 1.
Abundance: Rare to abundant.
Occurrence: Middle Miocene.

Cyrtocapsella cornuta (?) Haeckel
(Plate 3, Figure 8)

Cyrtocapsa (*Cyrtocapsella*) *cornuta* Haeckel, 1887, p. 1513, pl. 78, fig. 9.
Cyrtocapsella cornuta Haeckel, Sanfilippo and Riedel, 1970, p. 453, pl. 1, fig. 19-20; Kling, 1973, p. 636, pl. 11, fig. 16-18.
Abundance: Few.
Occurrence: Middle Miocene.

Cyrtocapsella japonica (?) (Nakaseko)
(Plate 3, Figure 7)

Eusyringium japonicum Nakaseko, 1963, p. 193, pl. 4, fig. 1-3.
Cyrtocapsella japonica (Nakaseko), Sanfilippo and Riedel, 1970, p. 452, pl. 1, fig. 13-15; Kling, 1973, p. 636, pl. 11, fig. 19, 20.
Abundance: Rare.
Occurrence: Middle Miocene.

Genus CYRTOPERA Haeckel

Cyrtopera Haeckel, 1881, p. 439

Cyrtopera languncula Haeckel

Stichopera pectinata Haeckel, 1887, p. 1449, pl. 75, fig. 11; Kling, 1973, p. 638, pl. 3, fig. 25-27, pl. 10, fig. 1-5.
Cyrtopera languncula Haeckel, 1887, p. 1451, pl. 75, fig. 10; Chen, 1975, p. 501, pl. 18, fig. 9.
Abundance: Rare.
Occurrence: Pliocene and Pleistocene.

Genus DICTYOPHIMUS Ehrenberg

Dictyophimus Ehrenberg, 1847b, p. 53.

Dictyophimus mawsoni Riedel

Dictyophimus mawsoni Riedel, 1958, p. 234, pl. 3, fig. 6, 7; Chen, 1975, p. 503, pl. 19, fig. 2
Dictyophimus (?) *mawsoni* Riedel, Petrushevskaya, 1968, p. 73-74, fig. 43
Abundance: Rare.
Occurrence: Pleistocene.

Dictyophimus gracilipes Bailey

Dictyophimus gracilipes Bailey, 1856, p. 4, pl. 1, fig. 8; Popofsky, 1908, p. 274-275, pl. 31, fig. 15 (in part); Riedel, 1958, p. 233-234, pl. 3, fig. 5; Petrushevskaya, 1968, p. 65-67, fig. 38, I-VII; fig. 39, I-III.
Abundance: Few.
Occurrence: Pleistocene.

Genus EUCYRTIDIUM Ehrenberg

Eucyrtidium Ehrenberg, 1847b, p. 43

Eucyrtidium calvertense Martin
(Plate 1, Figure 9)

Eucyrtidium calvertense Martin, 1904, p. 450, pl. 130, fig. 5; Hays, 1965, p. 181, pl. 3, fig. 4; 1970, p. 213, pl. 1, fig. 6; Kling, 1973, p. 636, pl. 4, figs. 16, 18, 19; Chen, 1975, p. 495, pl. 15, fig. 9.
Abundance: Rare to common.
Occurrence: Miocene and Pliocene.

Eucyrtidium cienkowskii Haeckel group
(Plate 4, Figures 3-5; Plate 8, Figures 7-9)

cf. *Eucyrtidium cienkowskii* Haeckel, 1887, p. 1493, pl. 80, fig. 9.
cf. *Eucyrtidium cienkowskii* Haeckel group, Sanfilippo et al., 1973, p. 221, pl. 5, fig. 7-11; Chen, 1975, p. 495, pl. 15, fig. 7.
Abundance: Rare to common.
Occurrence: Miocene.

Eucyrtidium sp. aff. E. inflatum Kling
(Plate 2, Figure 12)

Eucyrtidium inflatum Kling, 1973, p. 636, pl. 11, fig. 7, 8.
Abundance: Rare to few.
Occurrence: Latest Miocene and early Pliocene.

Eucyrtidium punctatum (Ehrenberg) group
(Plate 4, Figures 1, 2; Plate 8, Figures 4-6)

cf. *Lithocampe punctata* Ehrenberg, 1844, p. 84.
cf. *Eucyrtidium punctatum* (Ehrenberg)—Ehrenberg, 1847, p. 43; Ehrenberg, 1854, pl. 22, fig. 24.
cf. *Artostrobus zitteli* Vinassa de Regny, 1900, p. 586, pl. 3, fig. 19.
Eucyrtidium punctatum (Ehrenberg) group, Chen, 1975, p. 495, pl. 15, fig. 8; Sanfilippo et al., 1973, p. 221, pl. 5, fig 15, 16.
Abundance: Rare to few.
Occurrence: Middle Miocene.

Genus LOPHOCYRTIS Haeckel

Lophocyrtis Haeckel, 1887, p. 1410.

Lophocyrtis golli Chen
(Plate 4, Figures 9, 10; Plate 9, Figures 8, 9)

Lophocyrtis golli Chen, 1975, p. 489, pl. 12, fig. 4, 5.
Abundance: Rare to few.
Occurrence: Middle Miocene (Site 323).

Lophocyrtis regipileus Chen
(Plate 4, Figures 6-8; Plate 7, Figures 7-9)

Lophocyrtis regipileus Chen, 1975, p. 489, pl. 12, fig. 6, 7.
Abundance: Common.
Occurrence: Middle Miocene (Site 323).

Genus LYCHNOCANOMA Haeckel

Lychnocanoma Haeckel, 1887, p. 1229.

Lychnocanoma grande rugosum (Riedel)
(Plate 9, Figure 5)

Lychnocanium grande rugosum Riedel, 1952, p. 6, pl. 1, fig. 1; Hays, 1965, p. 175, pl. 3, fig. 5
Abundance: Rare to common.
Occurrence: Pliocene.

Lychnocanoma sphaerothorax Weaver n. sp.
(Plate 5, Figures 4, 5)

Description: Cephalis hemispherical, bearing a conical, apical horn, of approximately the same length, and a few small scattered pores. Separated from the thorax by a sharp collar stricture. Thorax truncate spherical with hexagonally framed subcircular to circular pores arranged in descussate rows. Three short, stout bladed feet, slightly diverted outward.

Measurements: Based on 25 specimens from Samples 323-3, CC and 323-5, CC: length of apical horn, 30-36 μm; cephalis, 28-32 μm; thorax, 90-102 μm; feet, 30-48μm; maximum diameter of the thorax, 96-120 μm; diameter of thoracic pores, 4-12 μm.

Abundance: Common.

Occurrence: Middle Miocene, Southern Ocean.

Range: Undetermined.

Type locality: DSDP Site 323, Core 3.

Repository: Holotype deposited at the U.S. National Museum, Washington D.C.

Genus PERIPYRAMIS Haeckel

Peripyramis Haeckel, 1881, p. 428.

Peripyramis circumtexta Haeckel
(Plate 1, Figure 5)

Peripyramis circumtexta Haeckel, 1887, p. 54, fig. 5; Riedel, 1958, p. 231, pl. 2, fig. 8, 9; Petrushevskaya, 1968, p. 111-112, fig. 64, 1, 11.

Abundance: Rare to common.

Occurrence: Pliocene and Pleistocene.

Genus SETHOCONUS Haeckel

Sethoconus Haeckel, 1887, p. 1399.

Sethoconus sp. Chen
(Plate 7, Figure 5)

Sethoconus sp. Chen, 1975, p. 485, pl. 10, fig. 5, 6.

Abundance: Rare.

Occurrence: Middle Miocene.

Sethoconus (?) dogeili Petrushevskaya
(Plate 1, Figure 8)

Sethoconus (?) *dogeili* Petrushevskaya, 1968, p. 94-95, fig. 53, 1, 11.

Abundance: Rare.

Occurrence: Pleistocene.

Genus STICHOCORYS Haeckel

Stichocorys Haeckel, 1881, p. 438; Riedel and Sanfilippo, 1970, p. 530.

Stichocorys peregrina (?) (Riedel)

Eucyrtidium elongatum peregrinum, Riedel, 1953, p. 812, pl. 85, fig. 2.
Stichocorys peregrina (Riedel), Riedel and Sanfilippo, 1970, p. 530; Sanfilippo et al., 1973, p. 224, pl. 6, fig. 4.

Abundance: Rare.

Occurrence: Latest Miocene.

Genus THEOCALYPTRA Haeckel

Theocalyptra Haeckel, 1881, p. 434.

Theocalyptra bicornis Popofsky

Pterocorys bicornis Popofsky, 1908, p. 228-229, pl. XXXIV, fig. 7, 8.
Theocalyptra bicornis (Popofsky), Riedel, 1958, p. 240, pl. 4, fig. 4; Chen, 1975, p. 491, pl. 13, fig. 1, 2.
Theocalyptra (?) *bicornis* (Popofsky), Petrushevskaya, 1968, p. 124-127, fig. 71, II-IX; 72, I-IV.

Abundance: Rare.

Occurrence: Miocene through Pleistocene.

Theocalyptra bicornis spongothroax Chen
(Plate 2, Figures 1-4; Plate 6, Figures 2-4)

Theocalyptra bicornis spongothorax Chen, 1975, p. 489, pl. 12, fig. 1-3.

Abundance: Rare.

Occurrence: Earliest Pliocene.

Genus THEOCORYS Haeckel

Theocorys Haeckel, 1881, p. 434; Riedel and Sanfilippo, 1970, p. 530.

Theocorys redondoensis (Campbell and Clark)
(Plate 2, Figure 11)

Theocyrtis redondoensis Campbell and Clark, 1944, p. 49, pl. 7, fig. 4; Casey et al., 1972, pl. 2, fig. 3.
Theocorys redondoensis (Campbell and Clark), Kling, 1973, p. 638, pl. 11, fig. 26-28; Chen, 1975, p. 505, pl. 20, fig. 2, 3.

Abundance: Rare.

Occurrence: Pliocene.

Family CANNOBOTRYIDAE Haeckel

Cannobotryidae Haeckel, 1881, emend. Riedel, 1967b

Genus SACCOSPYRIS Haecker

Saccospyris Haecker, 1907, emend. Petrushevskaya, 1965

Saccospyris conithorax Petrushevskaya

Saccospyris conithorax Petrushevskaya, 1965, p. 98-99, fig. 11, Petrushevskaya, 1968, p. 150, fig. 85, 1.

Abundance: Rare.

Occurrence: Pliocene and Pleistocene.

Saccospyris antarctica Haecker
(Plate 1, Figure 6)

Saccospyris antarctica Haecker, 1907, p. 124, fig. 10a, b; Haecker, 1908, p. 447-448, pl. 84, fig. 584, 589, 590; Petrushevskaya, 1965, p. 96-98, fig. 10; Petrushevskaya, 1968, p. 149-150, fig. 85, 11.
Botryopyle antarctica (Haecker), Riedel, 1958, p. 224-226, text-fig. 13, pl. 4, fig. 12 (in part).

Abundance: Rare to common.

Occurrence: Pliocene and Pleistocene.

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PLATES

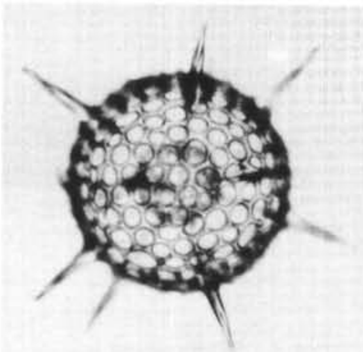
Plates 6-9 are scanning electron micrographs taken on an International Scientific Instruments, Super Mini Scan. Some illustrations on plates 2, 6, 7, and 8 were prepared from Samples of ELTANIN piston Core 34-5.

Preparations of type specimens of *Lychnocanoma sphaerothorax* and *Triceraspyris coronatus* are deposited at the United States National Museum, Washington, D.C.

PLATE 1

Figure 1	*Actinomma yosii* Nakaseko. Sample 324-1-5, 58-59 cm; ×225.
Figure 2	*Triceraspyris antarctica* (Haecker). Sample 324-1-4, 68-70 cm; ×240.
Figure 3	*Triceraspyris antarctica* (Haecker). Sample 324-1-5, 58-59 cm; ×225.
Figure 4	*Saturanlis circularis* Haeckel. Sample 324-1-3, 82-84 cm; ×160.
Figure 5	*Peripyramis circumtexta* Haeckel. Sample 324-1-2, 138-140 cm; ×192.
Figure 6	*Saccospyris antarctica* Haecker. Sample 324-1-1, 143-145 cm; ×280.
Figure 7	*Cycladophora davisiana* Ehrenberg. Sample 324-1-1, 143-145 cm; ×295.
Figure 8	*Sethoconus* (?) *dogeili* Petrushevskaya. Sample 324-1-3, 82-84 cm; ×225.
Figure 9	*Eucyrtidium calvertense* Martin. Sample 322-1-1, 44-46 cm; ×260.
Figure 10	*Helotholus vema* Hays. Sample 322-1-3, 19-21 cm; ×320.
Figure 11	*Helotholus vema* Hays. Sample 322-1-3, 19-21 cm; ×300.
Figure 12	*Desmospyris spongiosa* Hays. Sample 322-2-2, 97-99 cm; ×260.

PLATE 1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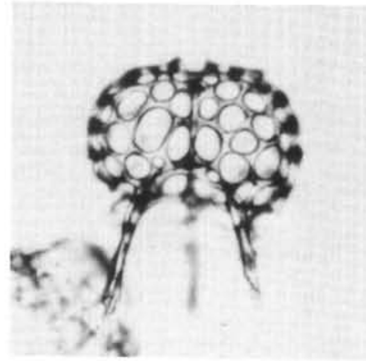
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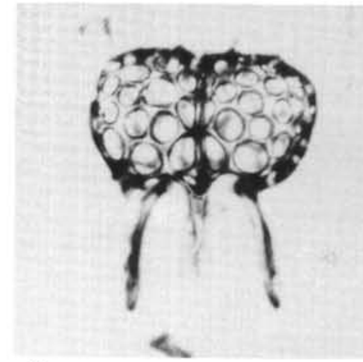
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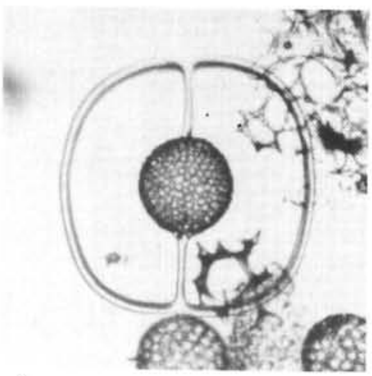
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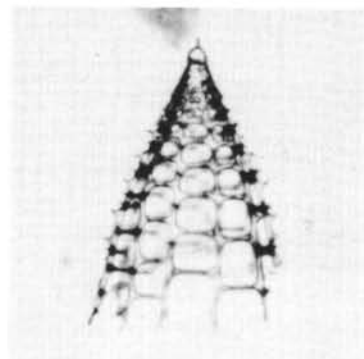
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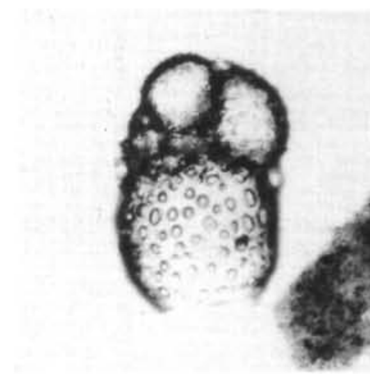
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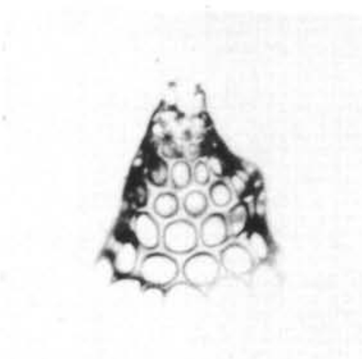
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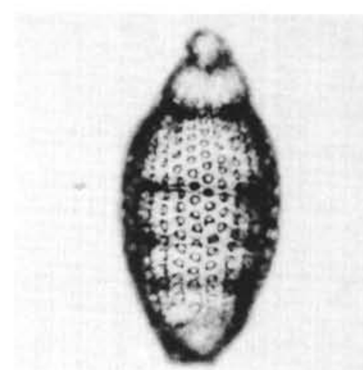
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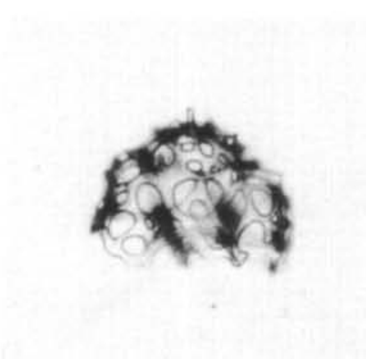
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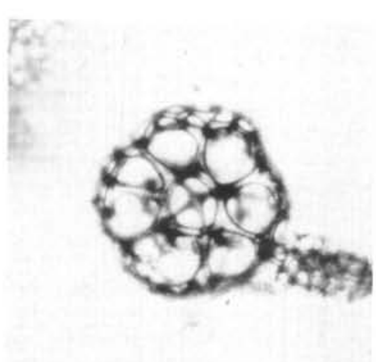
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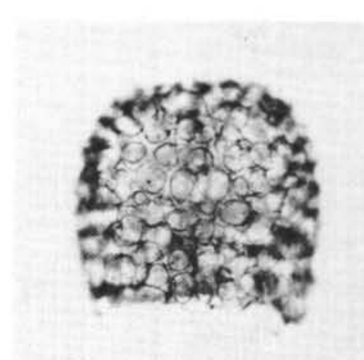
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PLATE 2

Figure 1 *Theocalyptra bicornis spongothorax* Chen.
ELTANIN 34-5, 360 cm; ×430.

Figure 2 *Theocalyptra bicornis spongothorax* Chen.
ELTANIN 34-5; 360 cm; ×350.

Figure 3 *Theocalyptra bicornis spongothorax* Chen.
Sample 325-5, CC; ×380.

Figure 4 *Theocalyptra bicornis spongothorax* Chen.
Sample 325-5, CC; ×380.

Figure 5 *Triceraspyris coronatus* n. sp.
Sample 323-2-1, 132-134 cm; ×270.

Figure 6 *Triceraspyris coronatus* n. sp.
Sample 323-2-1, 132-134 cm; ×245.

Figure 7 *Dendrospyris haysi* Chen.
Sample 323-2-1, 132-134 cm; ×375.

Figure 8 *Dendrospyris haysi* Chen.
Sample 322-2-2, 97-99 cm; ×360.

Figure 9 *Dendrospyris haysi* Chen.
ELTANIN 34-5, 380 cm; ×320.

Figure 10 *Lychnocanoma grande rugosum* (Riedel).
Sample 323-2-1, 132-134 cm; ×260.

Figure 11 *Theocorys redondoensis* (Campbell and Clark).
Sample 322-1-1, 44-46 cm; ×320.

Figure 12 *Eucyrtidium* sp. aff. *E. inflatum* Kling.
Sample 323-2, CC; ×250.

PLATE 2

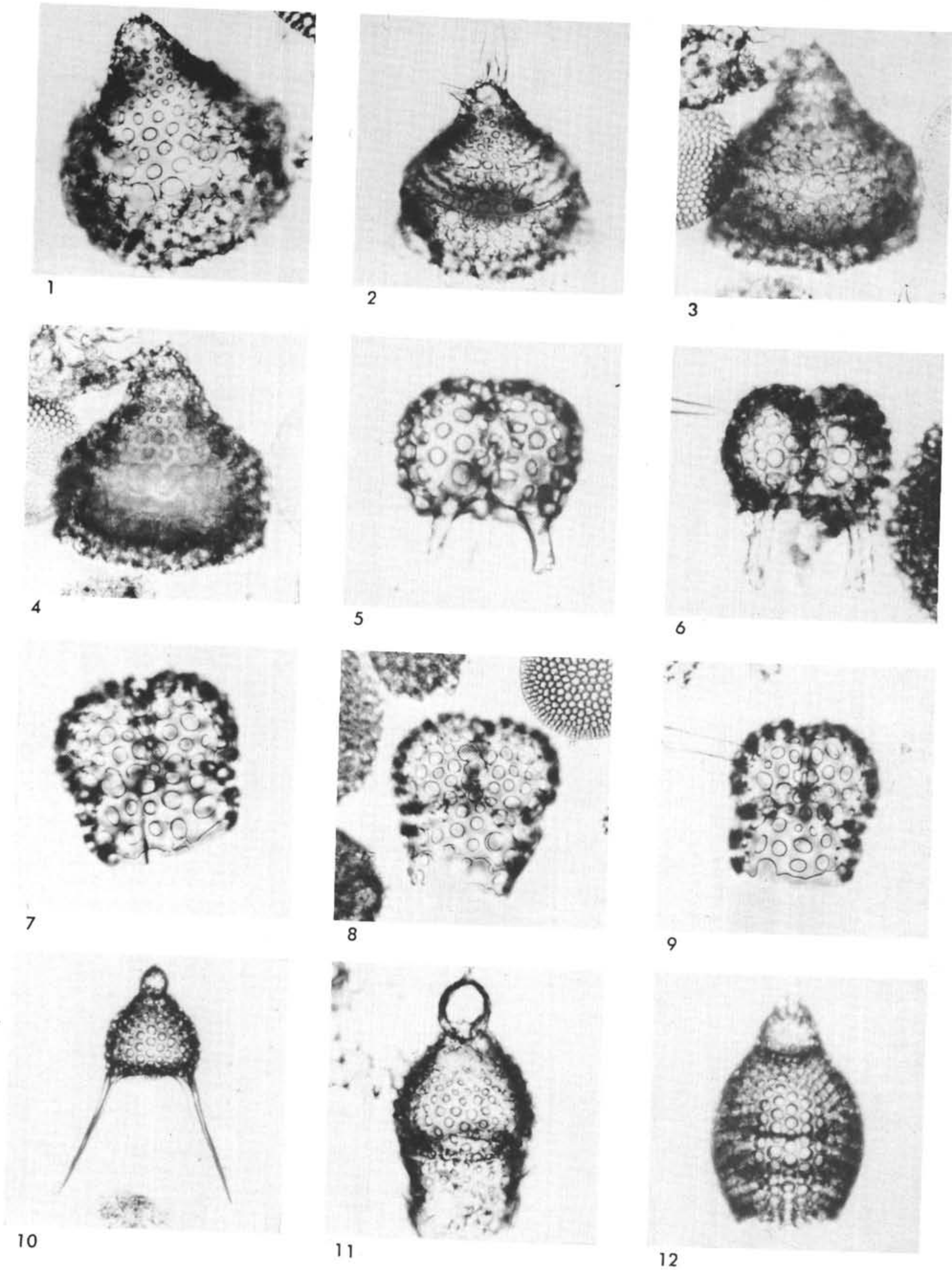


PLATE 3

Figure 1	*Cyrtocapsella tetrapera* Haeckel. Sample 323-3, CC; ×290.
Figure 2	*Cyrtocapsella tetrapera* (?) Haeckel. Sample 323-3, CC; ×260.
Figure 3	*Cyrtocapsella tetrapera* Haeckel. Sample 323-3, CC; ×330.
Figure 4	*Cyrtocapsella isopera* Chen. Sample 323-6, CC; ×360.
Figure 5	*Cyrtocapsella isopera* Chen. Sample 323-6, CC; ×390.
Figure 6	*Cyrtocapsella isopera* Chen. Sample 323-6, CC; ×420.
Figure 7	*Cyrtocapsella japonica* (?) (Nakaseko). Sample 323-3, CC; ×340.
Figure 8	*Cyrtocapsella cornuta* (?) Haeckel. Sample 323-3, CC; ×230.
Figure 9	*Dendrospyris megalocephalis* Chen. Sample 323-3, CC; ×260.
Figure 10	*Dendrospyris megalocephalis* Chen. Sample 323-3, CC; ×310.
Figure 11	*Oroscena* sp. Sample 323-3, CC; ×90 (spine).

PLATE 3

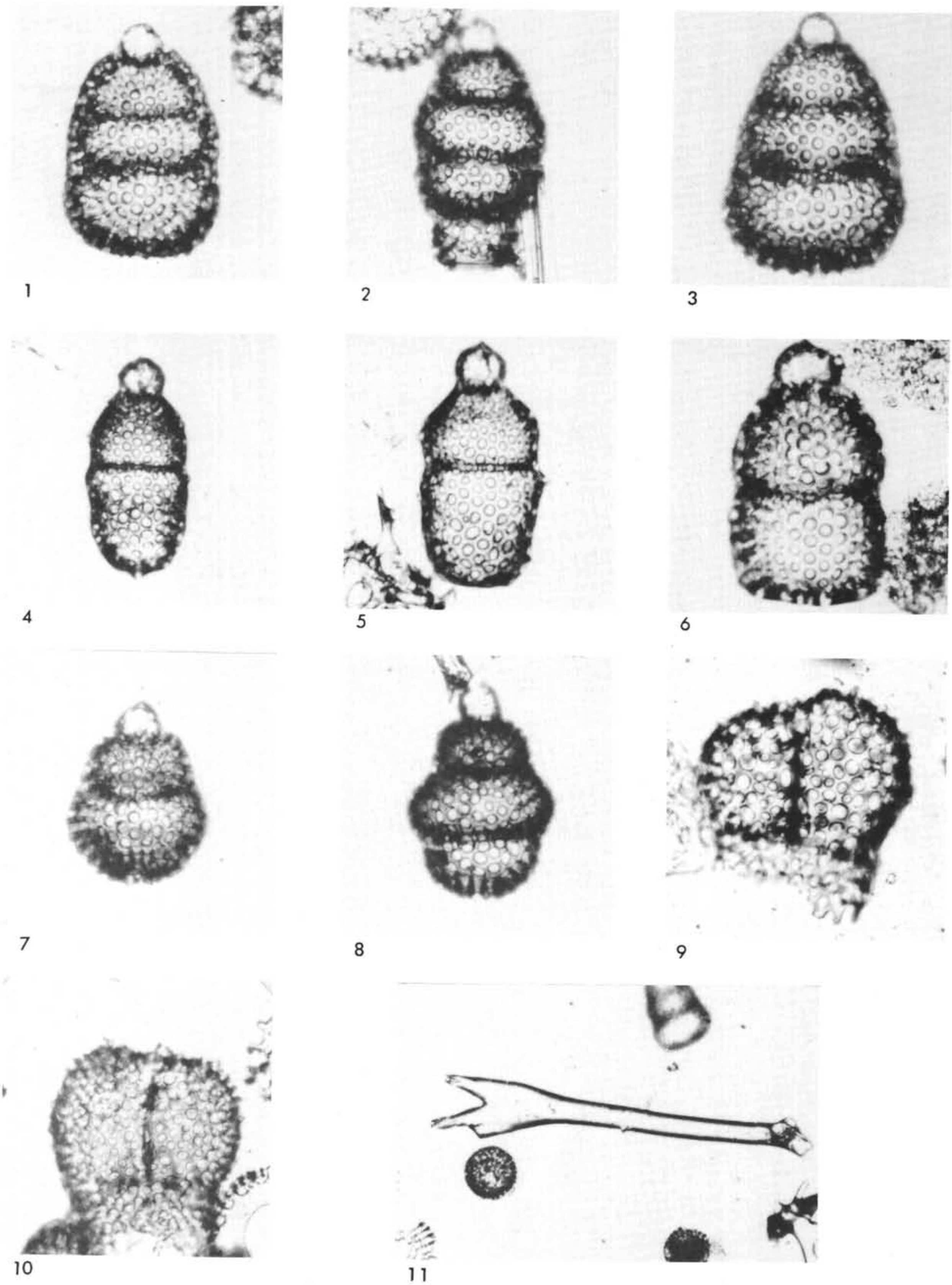
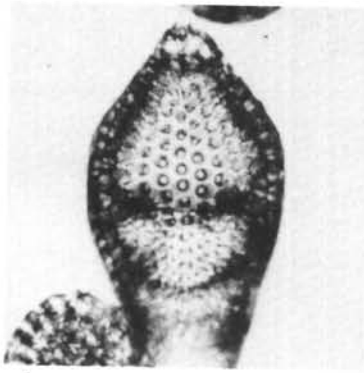


PLATE 4

Figure 1	*Eucrytidium punctatum* (Ehrenberg) group. Sample 323-6, CC; ×230.
Figure 2	*Eucrytidium punctatum* (Ehrenberg) group. Sample 323-6, CC; ×260.
Figure 3	*Eucrytidium cienkowskii* Haeckel group. Sample 323-6, CC; ×230.
Figure 4	*Eucrytidium cienkowskii* Haeckel group. Sample 323-6, CC; ×230.
Figure 5	*Eucyrtidium cienkowskii* Haeckel group. Sample 323-6, CC; ×350.
Figure 6	*Lophocyrtis regipileus* Chen. Sample 323-7, CC; ×280.
Figure 7	*Lophocyrtis regipileus* (?) Chen. Sample 323-6, CC; ×245.
Figure 8	*Lophocyrtis regipileus* (?) Chen. Sample 323-6, CC; ×330.
Figure 9	*Lophocyrtis golli* Chen. Sample 323-6, CC; ×310.
Figure 10	*Lophocyrtis golli* Chen. Sample 323-6, CC; ×300.
Figures 11, 12	Recrystallized Cretaceous radiolarians. Sample 323-18-3, 143-145 cm; ×150.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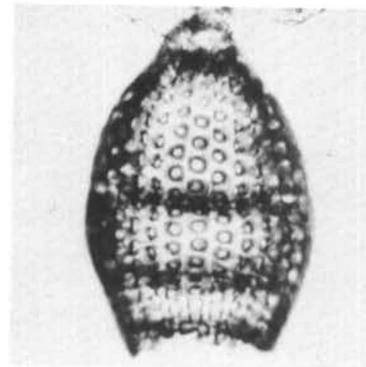
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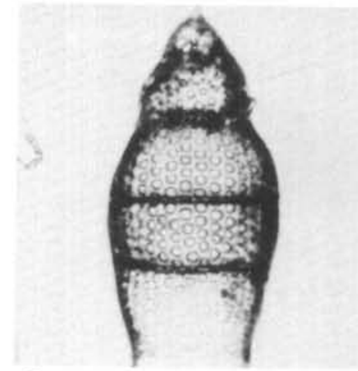
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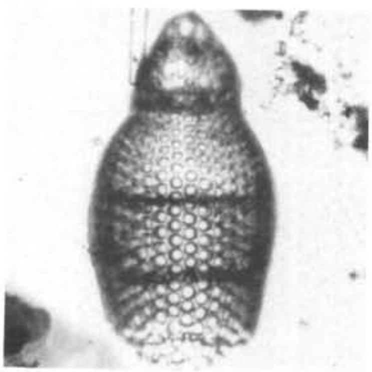
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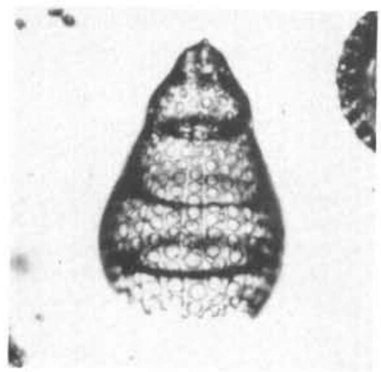
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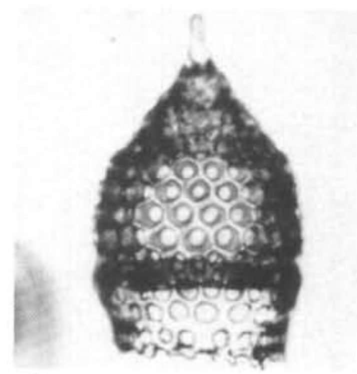
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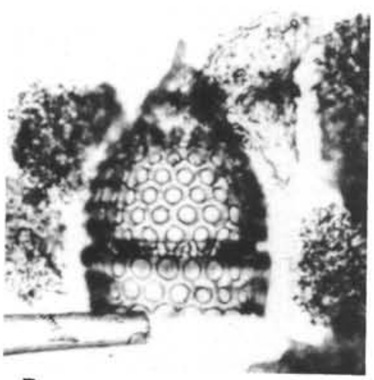
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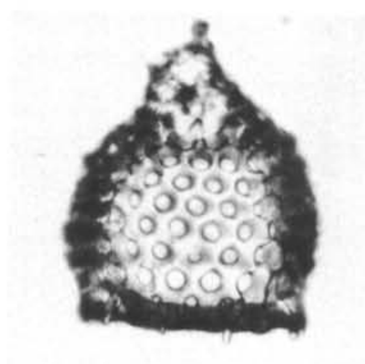
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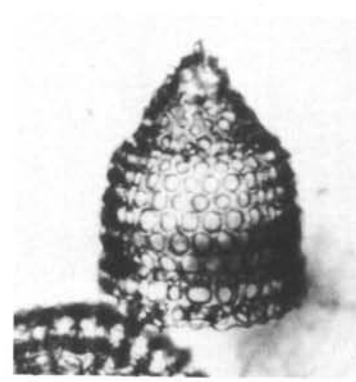
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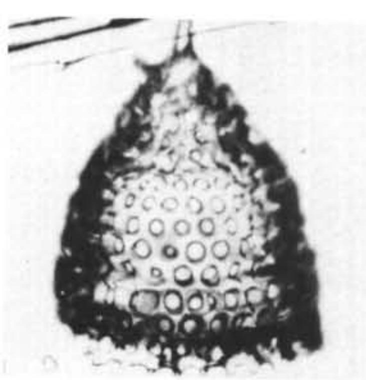
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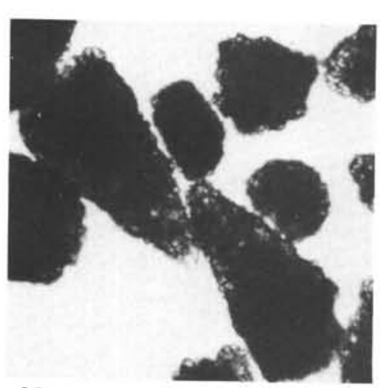
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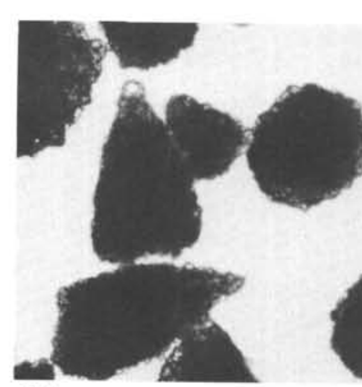
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PLATE 5

Figure 1	*Druppatractus* sp. Chen. Sample 323-2, CC; ×240.
Figure 2	*Druppatractus* sp. Chen. Sample 323-2, CC; ×240.
Figure 3	*Stylatractus universus* Hays. Sample 323-2, CC; ×280 (early Pliocene form).
Figure 4	*Lychnocanoma sphaerothorax* n. sp. Sample 323-3, CC; ×230.
Figure 5	*Lychnocanoma sphaerothorax* n. sp. Sample 323-3, CC; ×230.
Figure 6	*Stylatractus universus* Hays. Sample 323-2, CC; ×280 (early Pliocene form).
Figure 7	*Cannartus* sp. aff. *C. mammiferus* (Haeckel). Sample 325-9-2, 80-82 cm; ×260 (partially recrystallized specimen).
Figure 8	*Cannartus* sp. aff. *C. mammiferus* (Haeckel). Sample 325-9-2, 80-82 cm; ×260 (arrows point to protuberences).
Figure 9	*Cannartus* sp. aff. *C. prismaticus* (Haeckel). Sample 325-10-1, 89-91 cm; ×250.

PLATE 5

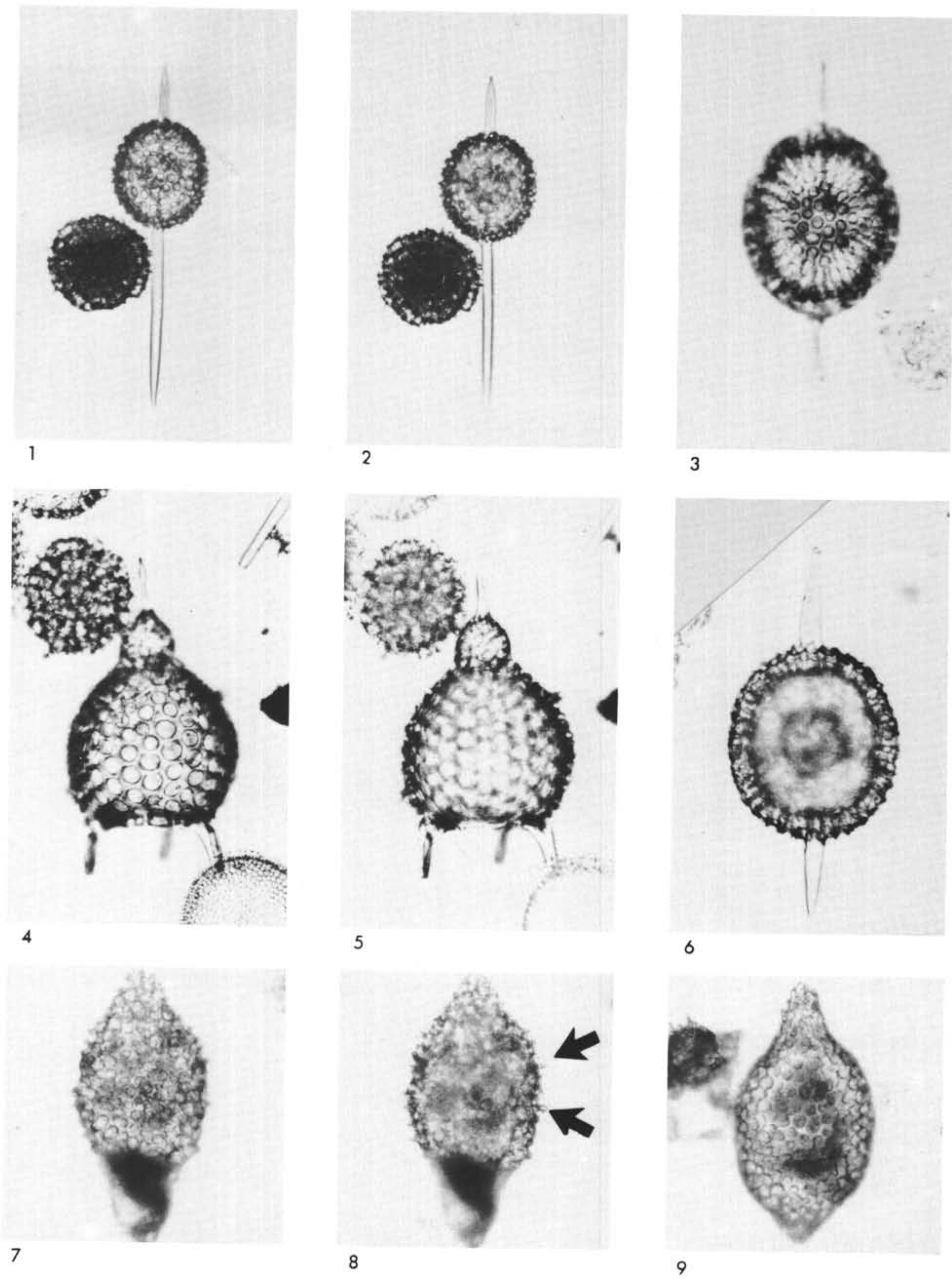

PLATE 6

Figure 1	*Druppatractus* sp. Chen. Sample 323-2, CC; ×270.
Figure 2	*Theocalyptra bicornis spongothorax* Chen. Sample 325-5, CC; ×340.
Figure 3	*Theocalyptra bicornis spongothorax* Chen. Sample 325-5, CC; ×310.
Figure 4	*Theocalyptra bicornis spongothorax* Chen. ELTANIN 34-5, 360 cm; ×350.
Figure 5	*Stylatractus universus* Hays. Sample 323-2, CC; ×310. (Early Pliocene form, specimen tilted along polar axis.)
Figure 6	*Stylatractus universus* Hays. Sample 323-2, CC; ×340 (early Pliocene form).
Figure 7	*Stylatractus universus* Hays. Sample 324-1-5, 58-59 cm; ×280 (Pleistocene form).
Figure 8	*Triceraspyris coronatus* n. sp. Sample 323-2-1, 132-134 cm; ×320.
Figure 9	*Triceraspyris coronatus* n. sp. Sample 323-2-1, 132-134 cm; ×320.

PLATE 6

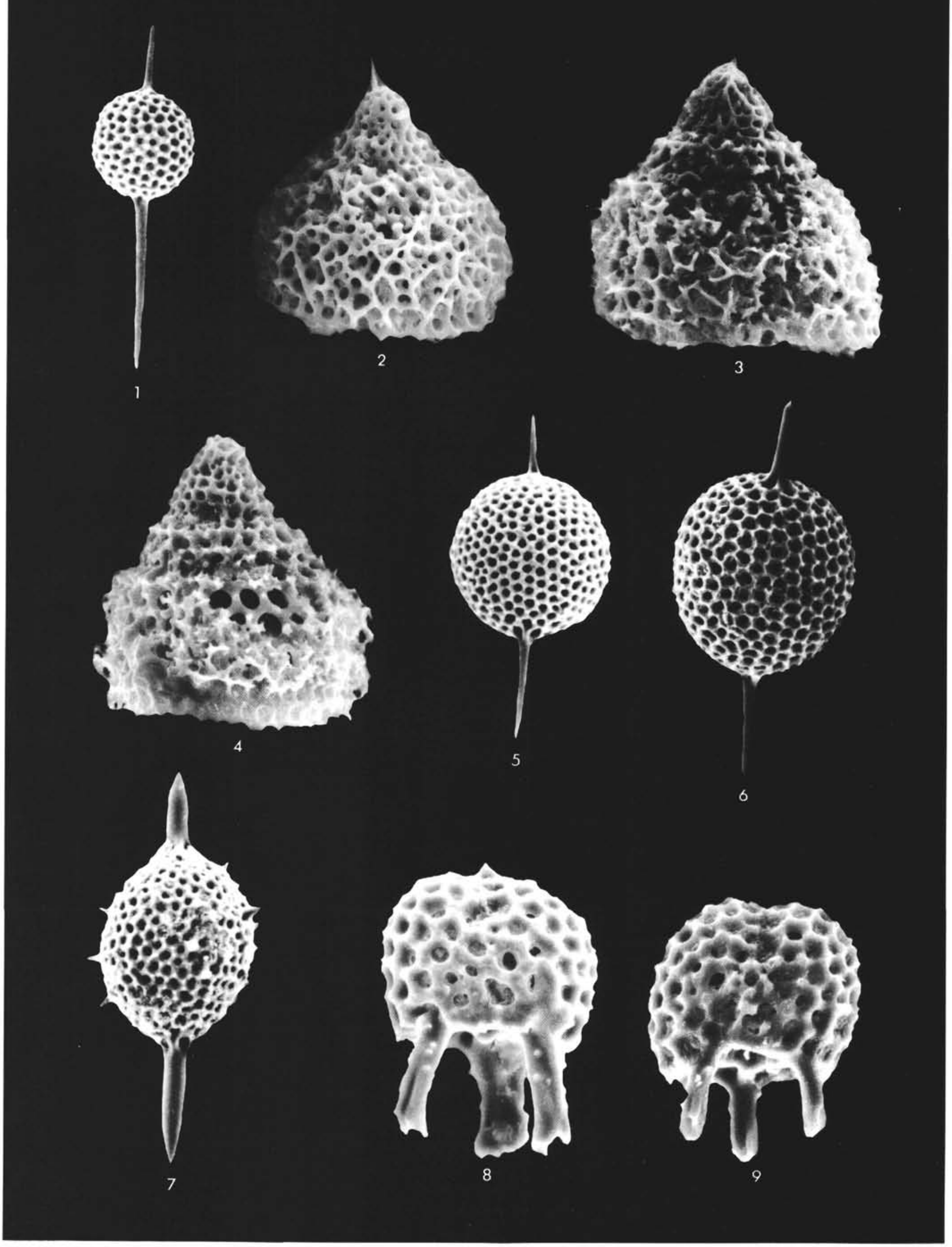

PLATE 7

Figure 1	*Prunopyle hayesi* Chen. ELTANIN 34-5, 440 cm; ×320.
Figure 2	*Prunopyle hayesi* Chen. ELTANIN 34-5, 440 cm; ×160.
Figure 3	*Prunopyle hayesi* Chen. ELTANIN 34-5, 440 cm; ×190.
Figure 4	*Dendrospyris haysi* Chen. Sample 323-2-1, 132-134 cm; ×340.
Figure 5	*Sethoconus* sp. Chen. Sample 323-3, CC; ×360.
Figure 6	*Prunopyle titan* (?) Campbell and Clark. Sample 323-1, CC; ×130.
Figure 7	*Lophocyrtis regipileus* Chen. Sample 323-6, CC; ×360.
Figure 8	*Lophocyrtis regipileus* Chen. Sample 323-6, CC; ×390.
Figure 9	*Lophocyrtis regipileus* (?) Chen. Sample 323-6, CC; ×340.

PLATE 7

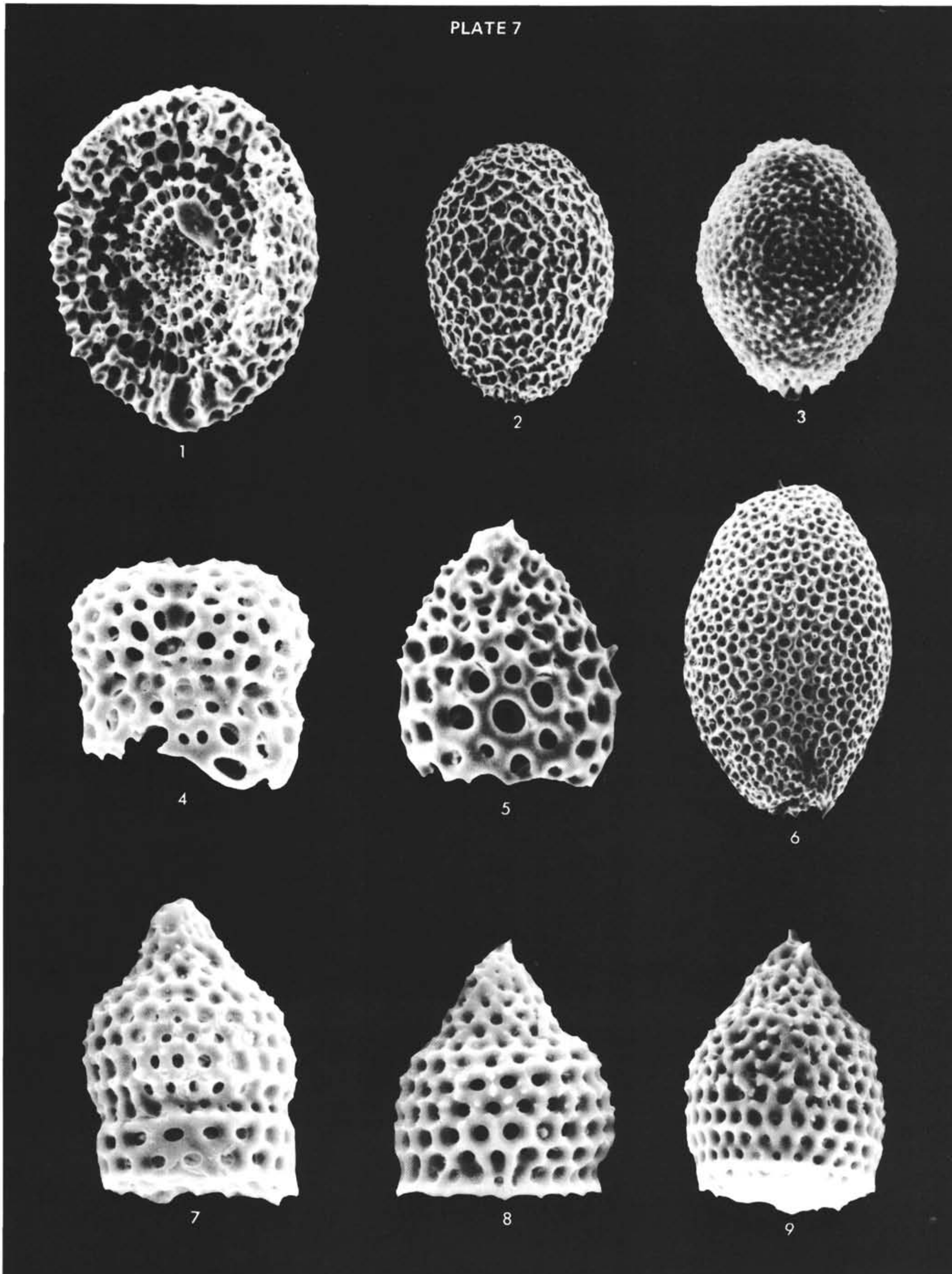

PLATE 8

Figure 1	*Eucyrtidium calvertense* Martin. Sample 323-1-4, 142-144 cm; ×290.
Figure 2	*Lithomelissa* sp. *C*. Chen. ELTANIN 34-5, 400 cm; ×380.
Figure 3	*Lithomelissa* sp. *C*. Chen. ELTANIN 34-5, 360 cm; ×480.
Figure 4	*Eucyrtidium punctatum* (Ehrenberg) group. Sample 323-6, CC; ×350.
Figure 5	*Eucyrtidium punctatum* (Ehrenberg) group. Sample 323-6, CC; ×330.
Figure 6	*Eucyrtidium punctatum* (Ehrenberg) group. Sample 323-6, CC; ×320.
Figure 7	*Eucyrtidium cienkowskii* Haeckel group. Sample 323-3, CC; ×320.
Figure 8	*Eucyrtidium cienkowskii* Haeckel group. Sample 323-6, CC; ×435.
Figure 9	*Eucyrtidium cienkowskii* Haeckel group. Sample 323-6, CC; ×425.

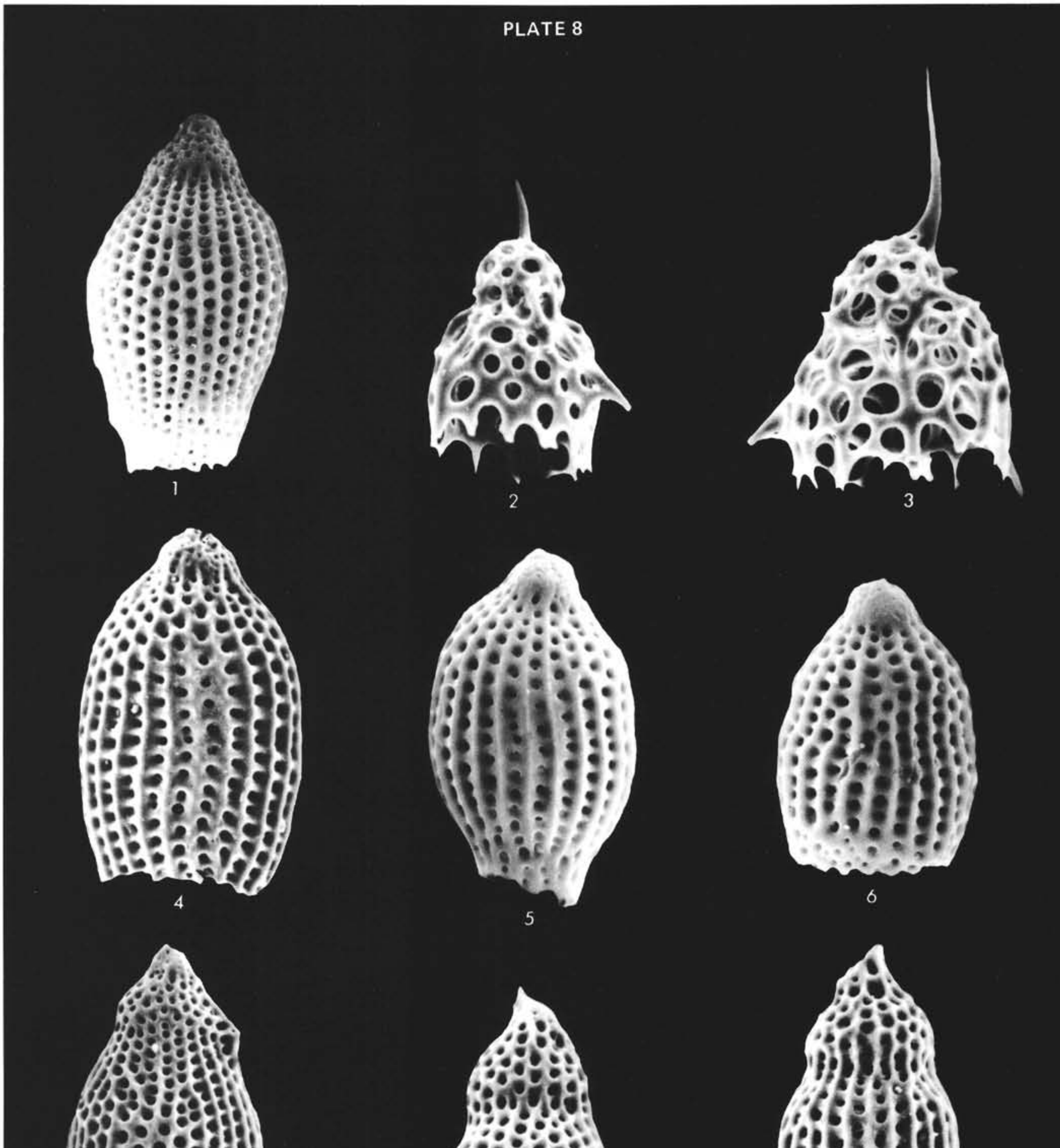
PLATE 8
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PLATE 9

Figure 1	*Cyrtocapsella tetrapera* Haeckel. Sample 323-3, CC; ×400.
Figure 2	*Cyrtocapsella tetrapera* Haeckel. Sample 323-6, CC; ×360.
Figure 3	*Cyrtocapsella tetrapera* Haeckel. Sample 323-5, CC; ×380.
Figure 4	*Cyrtocapsella isopera* Chen. Sample 323-6, CC; ×370.
Figure 5	*Lychnocanoma grande rugosum* (Riedel). Sample 323-2, CC; ×225.
Figure 6	*Cyrtocapsella isopera* Chen. Sample 323-3, CC; ×600.
Figure 7	*Cyrtocapsella tetrapera* Haeckel. Sample 323-3, CC; ×390.
Figure 8	*Lophocyrtis golli* Chen. Sample 323-6, CC; ×365.
Figure 9	*Lophocyrtis golli* Chen. Sample 323-6, CC; ×315.

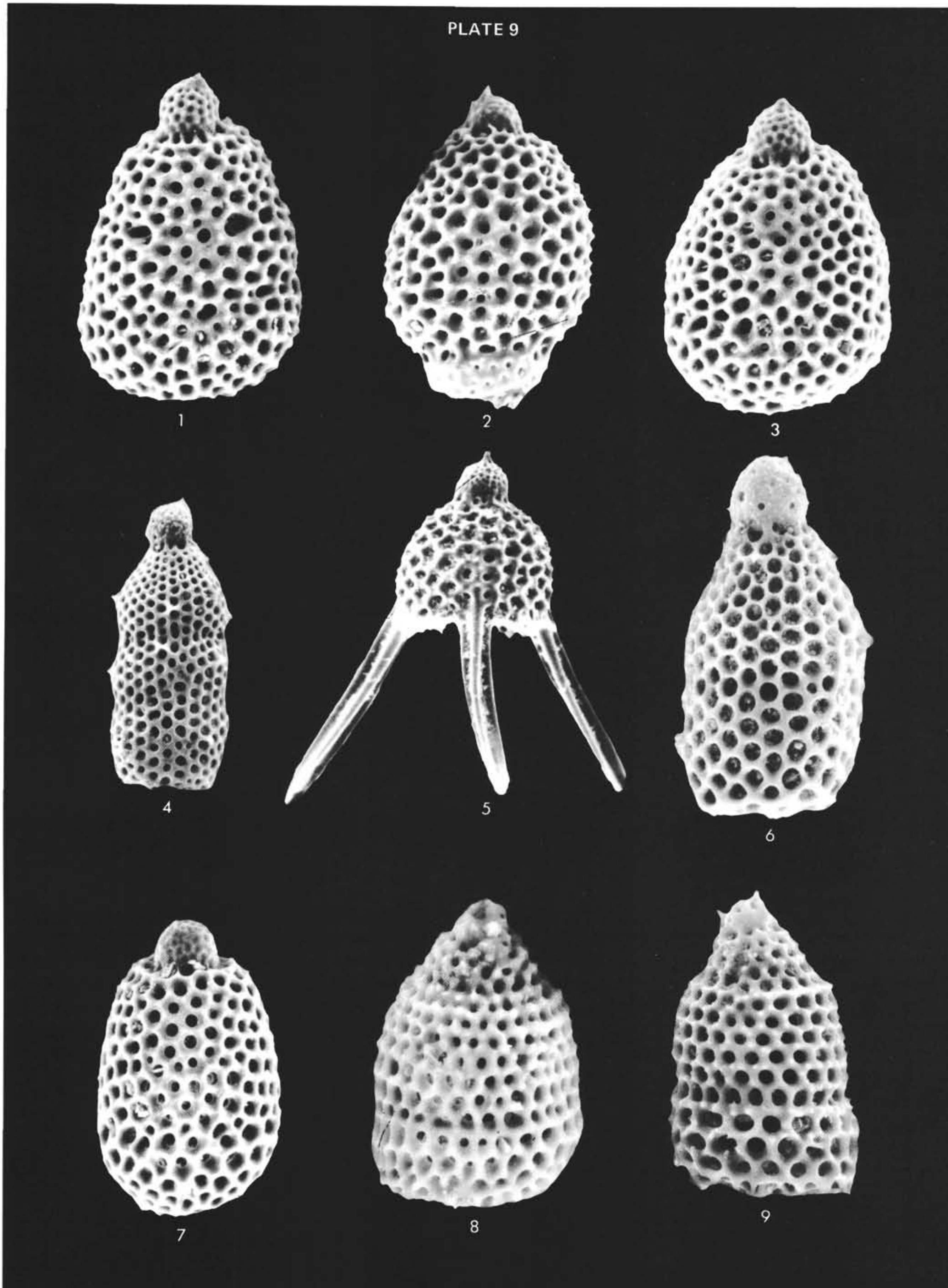
PLATE 9
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