38. CENOZOIC RADIOLARIANS FROM THE BLAKE PLATEAU AND THE BLAKE-BAHAMA BASIN, DSDP LEG 44

Fred M. Weaver[1] and Menno G. Dinkelman, Dept. of Geology, Florida State University, Tallahassee, Florida

INTRODUCTION

Radiolarians occur in four holes drilled at three sites during DSDP Leg 44. The hole locations are listed in Table 1.

The main objectives of this study were to examine the siliceous sediments recovered during DSDP Leg 44 and to identify and discuss the relative abundances of the radiolarian taxa contained within these sediments.

We present age and zonal assignments in the summary of occurrences section and provide a complete list of the species recognized, along with literature references to each species in the following section. The biostratigraphic framework utilized in this study is from Riedel and Sanfilippo (in press) and Nigrini (1971).

SUMMARY OF RADIOLARIAN OCCURRENCE

Site 388

Poor to moderately well preserved radiolarians were observed in Cores 1, 9, and 10 at Hole 388A. All remaining cores examined were totally barren of siliceous microfossils.

Core 388A-1, Core-Catcher, contains a moderate to well preserved, diverse assemblage of mixed middle to early Miocene and Eocene radiolarians. Since calcareous forminifers and nannoplankton diagnostic of a Pleistocene age were common throughout Core 1, the radiolarians present in Sample 388A-1, CC were obviously winnowed from submarine outcrops along the continental slope or rise and redeposited in ponded turbidites accumulating between the continental rise hills. The well-preserved nature of the radiolarians in Sample 388A-1, CC indicates they were not transported far by currents and thus the out-crop source was nearby.

Sample 388A-9-5, 102-104 cm, contains only a few fragments of *Orosphaerid* spines and undiagnostic spumellarians; however, Sample 388-9-6, 119-121 cm, contains a poorly preserved yet more diverse radiolarian assemblage diagnostic of a middle Miocene age. Most radiolarians found in Section 388A-9-6 were fragmented and indicate that they were reworked to some degree. The abundance of *Orosphaerid* and *Collosphaerid* radiolarians (tropical to subtropical forms) in Core 9 suggests that a warm climate prevailed at Site 388 during the middle Miocene.

Samples 388A-10-1 and 10, Core-Catcher contain only digitate spines of *Orosphaerid* radiolarians; consequently no age determination is possible.

[1]Present Address: Exxon Production Research Co., P.O. Box 2189, Houston, Texas.

Site 390

Two holes, 390 and 390A, were drilled on the Blake Nose. Hole 390 was cored to a subbottom depth of 206 meters and contains Maestrichtian to Barremian sediments. We found no radiolarian remains in any of the nine cores recovered from this hole. In Hole 390A, however, we recovered a continuously cored lower Tertiary and Upper Cretaceous section that contains abundant and well-preserved radiolarians within lower and middle Eocene intervals.

Figure 1 illustrates the relative abundances and ranges of the most common radiolarians from Hole 390A. The biostratigraphic zonation employed is from Riedel and Sanfilippo (in press).

The *Thyrsocyrtis triacantha* Zone is represented at Hole 390A in Core 2, Section 1 through Core 4, Section 5 (Figure 2). The base of this zone is recognized by the first morphotypic appearance of *Eusyringium legena*. Species frequently occurring within this interval include *T. mongolfieri*, *C. ampulla*, *L. ocellus gp.*, *P. striata striata*, *P. papalis*, *P. sinuosa*, *T. triacantha*, *L. biaurita*, *L. anoectum*, *T. rhizodon*, *T. amphora gp.*, *Lych. bellum*, *T. urceolus*, and *C. hispida*.

The *Theocampe mongolfieri* and *Theocotyle cryptocephala cryptocephala* zones are not recognized at Hole 390A.

Core 4, Section 6 and Core 5, Section 1 are barren of siliceous microfossils.

The *Phormocyrtis striata striata* Zone occurs in Core 5, Section 2 through Core 6, Section 5. The base of this zone is recognized by the first morphotypic occurrence of *Theocorys anaclasta*.

Core 6, Section 6 through Core 7, Section 4 is assigned to the *Buryella clinata* Zone (Figure 2). The base of this zone is identified by the evolutionary bottom of *Buryella clinata* (Figure 1).

The core-catcher sample of Core 7 falls within the *Bekoma bidartensis* Zone of Rieldel and Sanfilippo (in press). This zonal assignment is based upon the dominance of *B. tetradica* relative to *B. clinata* in this sample.

Hole 391A

Neogene radiolarians are present in varying abundance and preservation in the upper 20 cores. A single sample of

TABLE 1
Location of Leg 44 Holes From Which Radiolarians Were Recovered

Hole	Latitude	Longitude	Location	Water Depth (m)
388A	35° 31.33'N	69° 23.76'W	Continental Rise	4919
390, 390A	30° 08.54'N	76° 06.74'W	Blake Plateau	2670
391A	28° 13.70'N	75° 36.90'W	Blake-Bahama Basin	4963

Hole 390A Sample (Interval in cm)	Abundance	Preservation	Age	Radiolarian Zones	*Eusyringium fistuligerum*	*Lithapium plegmacantha*	*Podocyrtis dorus*	*Lithapium anoectum*	*Podocyrtis sinuosa*	*Theocorys anapographa*	*Theocampe mongolfieri*	*Thyrsocyrtis triacantha*	*Eusyringium lagena*	*Podocyrtis sinuosa ?*	*Theocotyl crypto. nigriniae*	*Heliostylus* sp. (p)	*Amphicraspedum prolixum*	*Dorcadospyris confluens*	*Calocycloma castum*	*Lamptonium fab. fabaeforme*	*Theocorys acroria*	*Lychnocanoma* sp.	*Stylotrochus q. quadribrachiatus*	*Periphaena tri. triangula*	*Theocorys anaclasta*	*Buryella clinata*	*Lithocyclia ocellus* gp.	*Dictyophimus craticula*	*Thyrsocyrtis rhizodon*	*Spongatractus pachystylus*	*Periphaena decora*	*Buryella tetradica*	*Bekoma* (?) sp.	*Thyrsocyrtis tarsipes*
2-1, 103-105	C	M	Middle Eocene	*Thyrsocyrtis triacantha*	R	R		C	F	+	C	F	+														F		F	R	R			
2-2, 107-109	C	G			R	F		C	R	F	C	F	R											+			F		F		F			
3-1, 144-146	C	G			R	R	+	F	C	R	C	F	R				+							R	+		F		F	R	F			
3-2, 135-137	C	G			+	R		F	F	+	C	F	R											R		+	F	+	F	R	F			
3-3, 40-42	C	G				F		C	F	R	C	F	R			+	+							R		+	F		F		F			
3-4, 131-133	C	G				F	+	F	C	+	C	F	R											R			F	+	F	R	F			
4-1, 10-12	C	G				R	R	F	F	R	C	F	R				+							+		+	F		F	R	F			
4-2, 101-103	C	M					R	C	R	+	C	F	R											+			F	+	F	R	F			
4-3, 107-109	C	G					R	C	F	R	C	F	R			+								R			F	R	F	R	F			
4-4, 29-31	C	M					R	F	R	R	C	F	R		+	+								+		+	F	R	F	R	F			
4-5, 28-30	C	G					R	C	C	R	C	F	R	R	F	R					+					+	F	R	F	R	F			
4-6, 133-135	B	B			BARREN																													
5-1, 132-134	B	B			BARREN																													
5-2, 123-125	C	G	Lower Eocene	*Phormocyrtis striata striata*										C	F	R	C	R	R	R	+		+	R			R		F	R	F			
5-3, 115-117	C	G												R	F	R	C	R	R	R	R	R	R	R		+	+	+	R	R	R			
5-4, 125-137	C	G												R	F	R	C	R	R	R	R	F	R	R	R	+		R	R	R	R			
6-1, 133-135	C	G												R	C	R	C	+	R	R	F	F	R		R	F		+		F	F			
6-2, 111-113	C	G												R	C	F	C	R	R	R	F	F	R		R	C	+	+	+	R	F			
6-3, 114-116	C	G												R	C	R	C	R	R	R	+	R	R		R	C			+	R	R			
6-4, 123-125	C	G												R	C	R	C	+	+	R	R	F	R		R	F				R	C			
6-5, 117-119	C	G												R	F	R	C	R	R	R	F	R	+		+	C				R	F	+		
6-6, 30-32	C	G		*Buryella clinata*											C	+	C	R	R	R	F	R	+			C				R	C			+
7-1, 87-89	C	G													F	F	R	R	R	+	F					F						R	R	R
7-2, 134-136	C	G													F	R	F	+	R	R	F					F						F	+	R
7-3, 47-49	C	G													C	F	F	R	F	R	F					F						R	R	R
7-4, 32-34	C	G													F	F	F	R	R	R	F					C						R		R
7, CC				*Bekoma bidartensis*											R	F	F		R	R	+					F						F		R

Figure 1. *Radiolarians at Hole 390A.*

Pleistocene sediment yielded a diverse assemblage of well-preserved radiolarians in which the most characteristic constituents are: *Amphirhopalum ypsilon* (three or four chambers before the bifurcation), *Euchitonia mulleri, Ommatartus tetrathalamus, Polysolenia murrayana, P. spinosa, Tetrapyle octacantha, Heliodiscus asteriscus, Druppatractus aquilonius, Lamprocyclas maritalis, Lithopera bacca, Eucyrtidium tumidulum, E. acuminatum, Anthocyrtidium ophirense,* and *Dictyophimus crisae*. The nature of the assemblage suggests it falls within the *Amphirhopalum ypsilon* Zone, which dates the sample as lower Pleistocene (Figure 3). The presence of *Stichocorys peregrina, S. delmontensis, Cyrtocapsella tetrapera, C. isopera, Thyrosocyrtis rhizodon,* and *Theocampe mongolfieri* provides evidence that the sample contains reworked Pliocene, Miocene, and Eocene age sediments. Collosphaerids occur in abundance and are well preserved in this sample (Plate 3, Figure 7).

The next few meters of sediment below this sample contain no siliceous microfossils. Siliceous microfossils are present again in sediments from the base of Core 5, Section 6, and, except for one sample (11-2, 20 cm) and one interval for which no samples were available (Cores 14 and 15), they occur continuously throughout Cores 5 through 20.

Cores 5, 6, 9, 10, 11, and 12 consist of displaced intraclastic carbonate oozes and chalks, the majority of which appear to have been displaced by debris flows and slumping from the Blake Plateau region. Many of the clasts contained within these cores are rich in siliceous microfossils. They were sampled and analyzed in an attempt to date the number of separate depositional events responsible for this large amount of carbonate deposition throughout the Blake-Bahama Basin. Radiolarian age assignments for these cores thus are the ages of the displaced siliceous clasts. Only those sediments from Core 7 and Core 8, Section 1 represent undisturbed normal pelagic deposition.

The *Dorcadospyris alata* Zone comprises the interval from the bottom of Core 5 to approximately halfway down Core 7. Tentatively, the base of this zone is placed between Samples 7-4, 70-72 cm, and 7-5, 74-76 cm. A short section of the *Calocycletta costata* Zone is present in Samples 7-5, 74-76 cm and 8-1, 30-40 cm. The rest of Core 8 contains assemblages characteristic of the *Cyrtocapsella tetrapera* Zone of the lowermost Miocene. Samples examined from Core 9, however, indicate the next two higher zones (*Stichocorys delmontensis* and *S. wolfi* zones) are present in that core. Cores 10 through 13 again contain assemblages of the *Calocycletta costata* Zone (Figure 3). No Samples were available from Cores 14 and 15 for which there was virtually no recovery. Since the top of Core 16 is placed in the *Stichocorys delmontensis* Zone and because it appears that

Theocoryl alpha	*Lamptonium fab. chaunothorax*	*Amphicraspedum murrayanum*	*Dendrospyris acuta*	*Giraffospyris lata*	*Spongomelissa cucmella*	*Calocyclas hispida*	*Thyrsocyrtis hir. hirsuta*	*Periphaena tri. tripyramis*	*Phormocyrtis striata striata*	*Phormocyrtis striata exquisita*	*Phormocyrtis turgida*	*Bekoma bidartensis*	*Ceratospyris articulata*	*Dorcadospyris platyacantha*	*Dendrospyris fragoides*	*Periphaena helioasteriscus*	*Stylosphaera cor. coronata*	*Axoprunum pierinae gp.*	*Podocyrtis papalis*	*Theocotyl ficus*	*Theocampe urceolus*	*Lychnocanoma bellum*	*Sethochytris babylonis gp.*	*Lophocyrtis biaurita*	*Calocycloma ampulla*	*Thyrosocyrtis hir. tensa*	*Rhopalocanium ornatum*	*Rhabdolithus pipa*	*Theocampe amphra gp.*	*Amphiternis clava*	*Podocyrtis diamesa*	*Theocotyl crypto cryptocephala*	*Lithochytris archaea*	*Lithochytris vespertilio*	*Periphaena delta*	*Theocotyl fimbria*	*Phormocyrtis cubensis*
						F		R	R				+	R	R	F	R	R	F	F	C	F	F	C	F		R	+	C	+			+	+			
						F		+	R				R	R	R	F	R	F	F	R	C	F	F	C	R	R	R		C	+			R				
						F	R	R	R				R	R	R	R	C	R	F	R	C	R	F	C	R	+	R	+	C					+			
						F	R	R	R				R	R	R	R	C	R	F		C	F	F	C	F		R	+	C								
						F	R	R	R				R	R	R	F	C	R	F	R	C	F	F	C	R		+	+	C								
						F	R	R	R				R	R	R	F	C	R	F	R	C	F	F	C	R			+	C					+			
						F	R	R	R				+	R	R	F	C	R	F	+	C	F	F	C	R	R	+	+	C					+			
						F	R	F	F				+	R	R	C	C	R	R	R	C	F	F	C	R	R			C	+	+						
						F	R	R	F				+	R	R	C	C	R	F	R	C	F	F	C	R	R	+	+	C								
						R	R	R	R				R	R	R	F	C	R	F	R	C	R	F	C	R	R	+	+	C	+							
						R	R	+	F				R	R	F	F	C	F	F	R	C	F	F	C	F	R		+	C	+	+	R					
																									BARREN												
						+	F	R	F				R	R	R	F	C	F	C	F	C	F	F	C	R	F			C		R		R	+			
							F	F	C				R	F	R	R	C	F	C	F	C	F	R	C	+	R			C		R		R	+			
							F	F	C				F	F	R	F	C	F	C	F	C	F	F	C	R	F	+		C		R	+	F				
						+	C	R	F				F	F	F	F	C	F	C	R	C	F	F	C	+	R			C	+	+		R				
						R	C	+	C				R	F	F	F	C	F	C	F	C	FF	F	C	R	R	R		C	+	+		F				
						+	F	R	F				F	F	R	C	C	F	C	R	C	R	F	C	R	R	+		C	+	+		R	+			
							F	R	F				R	F	R	F	C	R	C	F	C	R	F	C	R	F		+	C	+							
						R	F	+	F				R	F	R	C	C	R	C	R	C	R	F	C	+	R	+		C	+			+				
		+					F	R	F	+			R	F	R	C	C	F	C	R	C	R	F	C		R	R	+	C	+			R				
R	R	R	R	R	R		F	+	R	R			R	F	F	F	C	R	C	F	C	F	C	C	R	+		+	C				R				+
+	R	R	R	+	+	+	F	+	R	R			F	F	F	F	C	R	C	F	C	R	C	C	+	+		+		R			R			R	
R	R		R	R	R		F	+	R	R			R	F	F	C	C	R	C	F	C	R	C	C	+	+		+		+			+		+	R	R
R	R	R	R	+	+	+	R	+		R			F	F	C	F	C	F	C	R	C	R	F	C			+	+							+		
+		R	R	+						R	R	R	R	–		R	C	R	F	F	–	R	F	+	+										+		R

Key

Abundance

C – Common
F – Few
R – Rare
+ – Present
B – Barren

Preservation

G – Good
M – Medium
B – Barren

Figure 1. *Continued.*

the base of the *Calocycletta costata* Zone lies either at the bottom of Core 13 or just below it, we surmise that the *Stichocorys wolffii* Zone would be found in unsampled interval of cores 14 and 15. We could not properly ascertain the base of the *Stichocorys delmontensis* Zone. Although many radiolarians were found in Cores 17 through 19, they were generally poorly preserved making zone assignments in this interval difficult. A further problem is the presence of small amounts of reworked, predominantly middle Eocene radiolarians throughout most of the Miocene section. Detailed analyses of the radiolarians from this interval indicate that the base of the *S. delmontense* Zone could lie anywhere between Samples 17-3, 84-86 cm and 19-4, 34-37 cm. The base of the *Cyrtocapsella tetrapera* Zone is tentatively placed between Samples 20-3, 84-86 cm and 20-4, 83-85 cm. The remainder of Core 20 is placed within the *Lychnocanoma elongata* Zone.

The radiolarian biostratigraphy of Hole 391A is especially interesting in the interval represented by Cores 8 and 9, where several meters of older sediment are found on top of younger sediments. A reasonable explanation for this is that at the time the *C. costata* Zone sediments were being deposited several episodes of large downslope displacements occurred in the Blake-Bahama Basin. The first episode (event) deposited older material of the *S. delmontense* Zone on top of sediments of the *C. costata* Zone. Later events resulted in the deposition of sequentially older material, exposed upslope, on this sediment pile.

LIST OF SPECIES

The following list provides a bibliography of references to the radiolarian taxa identified in Leg 44 sediments. In most cases the original author is cited along with an additional reference(s) that contains the current concept of the limits of the species as applied to the identification of the radiolarians in Leg 44 sediments.

Amphicraspedum murrayanum Haeckel, 1887, p. 523, pl. 44, fig. 10; Sanfilippo and Riedel, 1973, p. 524, pl. 10; fig. 3-6; pl. 28, fig. 1 (Plate 11, Figure 2).

Amphicraspedum prolixum Sanfilippo and Riedel, 1973, p. 524, pl. 10, fig. 7-11.

Amphipternis clava (Ehrenberg), Foreman, 1973, p. 430, pl. 7, fig. 16, 17; pl. 9, fig. 2.

Amphirhopalum ypsilon Haeckel, 1887, p. 522; Nigrini, 1967, p. 35, pl. 3, fig. 3a-d.

Anthocyrtidium ehrenbergi (Stöhr, 1880), p. 100, pl. 3, fig. 21a, b; Riedel, 1957, p. 83-87, pl. 2, fig. 1-5 (Plate 1, Figure 1).

Anthocyrtoma sp. Nigrini, 1974, p. 1066, pl. 2c, fig. 1-5 (Plate 8, Figure 9).

Artophormis gracilis Riedel, 1959, p. 300, pl. 2, fig. 12, 13; Riedel and Sanfilippo, 1970, p. 532, pl. 13, fig. 6, 7.

Axoprunum pierinae group (Clark and Campbell), Sanfilippo and Riedel, 1973, p. 488, pl. 1, fig. 6-12; pl. 23, fig. 3.

Bekoma (?) sp. (Plate 10, Figures 1-6).

Bekoma bidartensis Riedel and Sanfilippo, Foreman, 1973, p. 432, pl. 3, fig. 20, 21; pl. 10, fig. 6; Riedel and Sanfilippo, in press, pl. 3, fig. 3.

Bekoma campechensis Foreman, 1973, p. 432, pl. 3, fig. 24; pl. 10, fig. 1, 2, 4 (Plate 10, Figure 7).

Buryella clinata Foreman, 1973, p. 433, pl. 8, fig. 1-3; pl. 9, fig. 19; Riedel and Sanfilippo, in press, pl. 3, fig. 4 (Plate 8, Figures 6, 7).

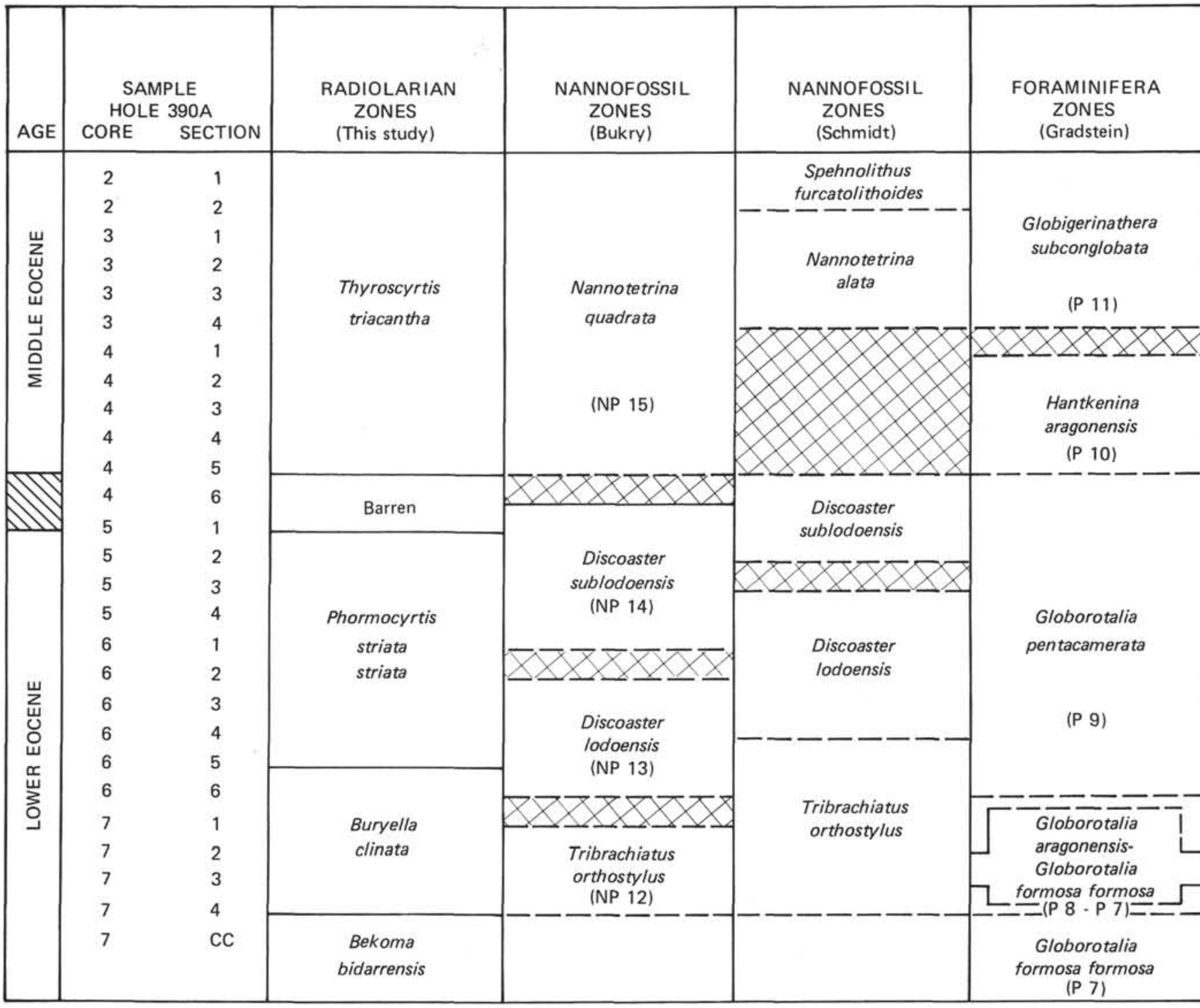

Figure 2. *Correlation of planktonic microfossil zones in radiolarianbearing sediments at Hole 390A.*

Buryella tetradica Foreman, 1973, p. 433, pl. 8, fig. 4, 5; pl. 9, fig. 13, 14; Riedel and Sanfilippo, in press, pl. 3, fig. 5.

Calocyclas hispida (Ehrenberg), Foreman, 1973, p. 434, pl. 1, fig. 12-15; Riedel and Sanfilippo, in press, pl. 3, fig. 6.

Calocycletta sp. Remarks: This form appears to be similar to the form illustrated by Ling, 1975, p. 731, pl. 12, fig. 13, 14. However, the forms reported by Ling occur only in the lower Oligocene and are thus considerably older than forms reported here. The presence of *Calocycletta* sp. in the Miocene section could be caused by admixing of older sediment into younger sediment, for which there is good evidence, or result from the fact that *Calocycletta* sp. had a longer range in the Blake-Bahama region. (Plate 2, Figure 9).

Calocycletta caepa Moore, 1972, p. 150, pl. 2, fig. 4-7.

Calocycletta costata (Riedel), Riedel and Sanfilippo, 1970, p. 535, pl. 14, fig. 12; in press, pl. 3, fig. 9.

Calocycletta robusta Moore, 1971, p. 743, pl. 10, fig. 5, 6; 1972, p. 48, pl. 1, fig. 6; Riedel and Sanfilippo, in press, pl. 3, fig. 10, 11.

Calocycletta serrata Moore, 1972, p. 148, pl. 2, fig. 1-3; Riedel and Sanfilippo, in press, pl. 3, fig. 12 (Plate 1, Figure 2).

Calocycletta virginis (Haeckel), Moore, 1972, p. 147, pl. 1, fig. 7; Riedel and Sanfilippo, in press, pl. 3, fig. 13, 14.

Calocycloma ampulla (Ehrenberg), Foreman, 1973, p. 434, pl. 1, fig. 1-5; pl. 9, fig. 20.

Calocycloma castum (Haeckel), Foreman, 1973, p. 434, pl. 1, fig. 7, 9, 10; Riedel and Sanfilippo, in press, pl. 1, fig. 9; pl. 3, fig. 15 (Plate 5, Figure 11).

Cannartus bassanii (Carnevale), Sanfilippo et al., 1973, p. 216, pl. 1, fig. 1-3.

Cannartus laticonus Riedel and Sanfilippo, 1971, pl. 1c, fig. 13, 14; Riedel and Sanfilippo, in press, pl. 4, fig. 1.

Cannartus mammiferus (Haeckel), Riedel, 1959, p. 291, pl. 1, fig. 4.

Cannartus prismaticus (Haeckel), Riedel and Sanfilippo, 1970, p. 520, pl. 15, fig. 1; 1971, p. 1588, pl. 2c, fig. 11-13.

Cannartus tubarius (Haeckel), Kling, 1971, pl. 3, fig. 3; Riedel and Sanfilippo, in press, pl. 4, fig. 3.

Cannartus violina Haeckel, 1887, p. 358; Riedel, 1959, p. 290, pl. 1, fig. 3; Moore, 1971, pl. 12, fig. 4; Riedel and Sanfilippo, in press, pl. 4, fig. 4.

Carpocanistrum sp. (p). Riedel and Sanfilipo, 1971, p. 1596, pl. 2f, fig. 5-16; Ling, 1975, p. 730, pl. 12, fig. 3-6.

Carpocanopsis bramlettei Riedel and Sanfilippo, 1971, p. 1597, pl. 2g, fig. 8-14; pl. 8, fig. 7; in press, pl. 4, fig. 6 (Plate 1, Figure 9).

Carpocanopsis cingulata Riedel and Sanfilippo, 1971, p. 1597, pl. 2g, fig. 17-21; pl. 8, fig. 8; in press, pl. 4, fig. 7.

Carpocanopsis cristatum (Carnevale) ?, Riedel and Sanfilipo, 1971, p. 1597, pl. 1g, fig. 16; pl. 2g. fig. 1-7.

Carpocanopsis favosa (Haeckel), Riedel and Sanfilippo, 1971, p. 1597, pl. 2g, fig. 15, 16; pl. 8, fig. 9-11 (Plate 1, Figure 8).

Centrobotrys petrushevskaya Sanfilippo and Riedel, 1973, p. 532, pl. 36, fig. 12, 13 (Plate 3, Figures 4, 5).

Ceratospyris articulata Ehrenberg, Sanfilippo and Riedel, 1973, p. 526, pl. 15, fig. 1-3; pl. 31, fig. 8, 9; Riedel and Sanfilippo, in press, pl. 4, fig. 9, 10.

Clathrocanium sphaerocephalum Haeckel, 1887, p. 1211, pl. 64, fig. 1; Sanfilippo et al., 1973, pl. 4, fig. 9 (Plate 1, Figures 6, 7).

Clathrocorona atreta Sanfilippo and Riedel, Sanfilippo et al., 1973, p. 219, pl. 4, fig. 5-8.

Clathrocorys sp. Ling, 1975, p. 727, pl. 8, fig. 15, 16.

Cyclampterium (?) *leptetrum* Sanfilippo and Riedel, 1970, p. 456, pl. 2, fig. 11, 12; Riedel and Sanfilippo, in press, pl. 4, fig. 12, 13.

Cyclampterium (?) *pegetrum* Sanfilippo and Riedel, 1970, p. 456, pl. 2, fig. 8-10; Riedel and Sanfilippo, 1971, pl. 2d, fig. 13, 14; pl. 3b, fig. 1, 2; in press, pl. 4, fig. 16.

Cyclampterium (?) *tanythorax* Sanfilippo and Riedel, 1970, p. 457, pl. 2, fig. 13, 14; Riedel and Sanfilippo, 1971, pl. 1e, fig. 8-10; pl. 2d, fig. 7, 8.

Cyrtocapsella sp. Holdsworth, 1975, pl. 2, fig. 17.

Cyrtocapsella cornuta Haeckel, Sanfilippo and Riedel, 1970, p. 453, pl. 1, fig. 19, 20; Sanfilippo et al., 1973, pl. 5, fig. 1, 2; Riedel and Sanfilippo, in press, pl. 4, fig. 17.

Cyrtocapsella elongata (Nakaseko), Sanfilippo and Riedel, 1970, p. 452, pl. 1, fig. 11, 12.

Cyrtocapsella japonica (Nkaseko), Sanfilippo and Riedel, 1970, p. 452, p. 1, fig. 13-15; Sanfilippo et al., 1973, pl. 5, fig. 3.

Cyrtocapsella tetrapera Haeckel, Sanfilippo et al., 1973, pl. 5, fig. 4-6; Riedel and Sanfilippo, in press, pl. 4, fig. 18.

Dendrospyris acuta Goll, Sanfilippo and Riedel, 1973, p. 526, pl. 15, fig. 5; pl. 31, fig. 11.

Dendrospyris bursa Sanfilippo and Riedel, Sanfilippo et al., 1973, p. 217, pl. 2, fig. 9-13 (Plate 3, Figure 2).

Dendrospyris damaecornis (Haeckel), Goll, 1968, p. 1420, pl. 173, fig. 1-4.

Dendrospyris fragoides Sanfilippo and Riedel, 1973, p. 526, pl. 15, fig. 8-13; pl. 31, fig. 13, 14.

Dendrospyris pododendros (Carnevale), Goll, 1968, p. 1422, pl. 174, fig. 1-4, test-fig. 8.

Dorcadospyris ateuchus (Ehrenberg), Riedel and Sanfilippo, 1970, pl. 15, fig. 4; 1971, p. 1590, pl. 2d, fig. 6; pl. 3a, fig. 9, 10; in press, pl. 5, fig. 3.

Dorcadospyris alata (Riedel), Riedel and Sanfilippo, 1970, pl. 14, fig. 5; 1971, pl. 2d, fig. 1; Moore, 1971, pl. 11, fig. 3, 4; Riedel and Sanfilippo, in press, pl. 5, fig. 2.

Dorcadospyris confluens (Ehrenberg), Ehrenberg, 1873, p. 246; Sanfilippo and Riedel, 1973, p. 528, pl. 17, fig. 6-10; pl. 33, fig. 1.

Dorcadospyris dentata (Haeckel), 1887, p. 1037; Riedel, 1957, p. 79, pl. 1, fig. 3; Riedel and Sanfilippo, in press pl. 5, fig. 4.

Dorcadospyris forcipata (Haeckel), Moore, 1971, p. 740, pl. 10, fig. 1, 2.

Dorcadospyris platyacantha (Ehrenberg), Sanfilippo and Riedel, 1973, p. 528, pl. 17, fig. 11-15; pl. 33, fig. 2.

Dorcadospyris simplex (Riedel), Riedel and Sanfilippo, 1970, pl. 15, fig. 6.

Dictyophimus craticula Ehrenberg, 1873, p. 223; Sanfilippo and Riedel, 1973, p. 529, pl. 19, fig. 1; pl. 33, fig. 11.

Euchitonia furcata Ehrenberg, Nigrini, 1970, p. 169, pl. 2, fig. 5.

Eucyritidium sp. A Ling, 1975, p. 731, pl. 12, fig. 20.

Eucyrtidium sp. B group (Plate 6, Figure 2).

Eucyritidium acuminatum (Ehrenberg), Nigrini, 1967, p. 81, pl. 8, fig. 3.

Eucyrtidium cienkowskii group Haeckel, 1887, p. 1493; Sanfilippo et al., 1973, p. 221, pl. 5, fig. 7-11.

Eucyrtidium diaphanes Sanfilippo and Riedel, Riedel and Sanfilippo, in press, pl. 5, fig. 5 (Plate 1, Figure 5).

Eucyrtidium punctatum group (Ehrenberg), 1847, p. 43; 1854, pl. 22, fig. 24; Sanfilippo et al., 1973, p. 221, pl. 5, fig. 15, 16.

Eusyringium fistuligerum (Ehrenberg), Foreman, 1973, p. 435, pl. 11, fig. 6; Riedel and Sanfilippo, in press, pl. 5, fig. 6, 7 (Plate 5, Figure 1).

Eusyringium lagena (Ehrenberg), Foreman, 1973, p. 435, pl. 11, Fig. 4, 5; Riedel and Sanfilippo, in press, pl. 5, fig. 8 (Plate 5, Figures 2, 3).

Giraffospyris sp. (Plate 4, Figures 1, 2); Remarks: The well-preserved specimens illustrated here are found only rarely. Usually the feet and crown structure have been broken off the specimens and it is difficult to distinguish this species from a number of *liriospyris* specimens (such as those illustrated by Ling, 1975, pl. 7, fig. 15-20).

Giraffospyris cyrillium Sanfilippo and Riedel, 1973, p. 528, pl. 18, fig. 1-3; pl. 33, fig. 3 (Plate 5, Figure 8).

Giraffospyris lata Goll, Sanfilippo and Riedel, 1973, p. 529, pl. 18, fig. 3-7; pl. 33, fig. 4 (Plate 5, Figure 7).

Gorgospyris sp. (Plate 1, Figure 10).

Gorgospyris perizostra Sanfilippo and Riedel, 1973, p. 213, pl. 3, fig. 4, 5.

Gorgospyris schizopodia Haeckel, 1887, p. 1071, pl. 87, fig. 4; Sanfilippo et al., 1973, p. 218, pl. 3, fig. 6, 7. (Plate 4, Figure 7).

Gorgospyris sp. cf. *G. schizopodia* (Plate 4, Figures 4, 11). Remarks: Specimens resemble those illustrated by Sanfilippo et al., 1973, pl. 3, fig. 8, 9.

Heliodiscus asteriscus Haeckel, 1887, p. 445, pl. 33, fig. 8; Nigrini, 1967, p. 32, pl. 3, fig. 1.

Heliostylus sp. Haeckel, Sanfilippo and Riedel, 1973, p. 522, pl. 8, fig. 1-7; pl. 26, fig. 10-12; pl. 27, fig. 1 (Plate 11, Figure 6).

Histiastrum martinianum Carnevale group, Sanfilippo et al., 1973, p. 217, pl. 2, fig. 7, 8.

Lamprocyclas sp. group Ling, 1975, p. 731, pl. 13, fig. 2 (Plate 2, Figures 7, 8).

Lamprocyclas maritalis Haeckel, Nigrini, 1967, p. 74-76, pl. 7, fig. 5.

Lamptonium fabaeforme chaunothorax Riedel and Sanfilippo, 1970, p. 524, pl. 5, fig. 8, 9; in press, pl. 5, fig. 11.

Lamptonium fabaeforme fabaeforme (Krasheninnikov) Foreman, 1973, p. 436, pl. 6, fig. 6-9; Riedel and Sanfilippo, in press, pl. 5, fig. 13 (Plate 6, Figures 7-10).

Lipmanella sp. group Petrushevskaya and Kozlova, 1972, pl. 37, fig. 2-5.

Liriospyris sp. (Plate 3, Figure 8). Remarks: Specimens of this larger species were a rare but easily recognizable constitutent in a number of samples from Hole 391A. From the illustrations, we suspect that *Eucoronis* sp. A (Petrushevskaya and Kozlova, 1972, p. 533, pl. 41, fig. 1, 2) is conspecific with this taxon.

Liriospyris parkerae Riedel and Sanfilippo, 1971, p. 1590, pl. 2c, fig. 15; pl. 5, fig. 4; in press, pl. 5, fig. 15.

Liriospyris stauropora (Haeckel), Goll, 1968, p. 1431, pl. 175, fig. 1-3, 7; Riedel and Sanfilippo, in press, pl. 5, fig. 16.

Lithapium anoectum Riedel and Sanfilippo, 1970, p. 520, pl. 4, fig. 4, 5; in press, pl. 5, fig. 17.

Lithapium plegmacantha Riedel and Sanfilippo, Sanfilippo and Riedel, 1973, p. 516, pl. 3, figs. 1, 2; pl. 24. fig. 8, 9.

Lithocampe sp. (Plate 7, Figures 8, 9).

Lithocampe subligata group Stöhr, 1880, p. 102, pl. 4, fig. 1; Petrushevskaya and Kozlova, 1972, p. 546, pl. 25, fig. 7-10 (Plate 2, Figures 1, 2).

Lithochytris archaea Riedel and Sanfilippo, Foreman, 1973, p. 436, pl. 2, fig. 4, 5; Riedel and Sanfilippo, in press, pl. 6, fig. 3 (Plate 5, Figures 5, 6).

Lithochytris vespertilio Ehrenberg, Riedel and Sanfilippo, 1970, p. 528, pl. 9, fig. 8, 9; in press, pl. 6, fig. 4.

Lithocyclia ocellus group Ehrenberg, Riedel and Sanfilippo, 1970, p. 522, pl. 5, fig. 1, 2; in press, pl. 6, fig. 8 (Plate 11, Figure 1).

Lithomelissa sp. aff. *L. mitra* Bütschli. Remarks: Similar to form illustrated by Chen, 1975, p. 458, pl. 8, fig. 4, 5 (Plate 1, Figure 11).

Lithopera bacca Ehrenberg, Nigrini, 1967, p. 54, pl. 6, fig. 2; Riedel and Sanfilippo, in press, pl. 6, fig. 9.

Lithopera renzae Sanfilippo and Riedel, 1970, p. 454, pl. 1, fig. 21-23, 27; Riedel and Sanfilippo, in press, pl. 6, fig. 11 (Plate 3, Figure 9).

Lophocyrtis biaurita (Ehrenberg), Riedel and Sanfilippo, in press, pl. 6, fig. 13.

Sample (Interval in cm)	Abundance Preservation	Age	Zone	*Anthocyrtidium ehrenbergi*	*Artophormis gracilis*	*Calocycletta caepa*	*Calocycletta costata*	*Calocycletta robusta*	*Calocycletta serrata*	*Calocycletta* sp.	*Calocycletta virginis*	*Cannartus bassanii*	*Cannartus laticonus*	*Cannartus mammiferus*	*Cannartus prismaticus*	*Cannartus tubarius*	*Cannartus violina*	*Carpocanistrum* sp. group	*Carpocanopsis bramlettei*	*Carpocanopsis cingulata*	*Carpocanopsis cristata*	*Carpocanopsis favosa*	*Centrobotrys petrushevskayae*	*Clathrocanium sphaerocephalum*	*Clathrocorona atreta*	*Clathrocorys* sp.
2, CC	A, G	Pleist.	A. upsilon																							
4-4, 10-12																										
5-3, 110-112																										
5-6, 26	F, M									R-F	R		+													
(olive)																										
5-6, 75	F, M			R			R			R	R		+	R-F			R	F			R					
(dark blue gray)																										
6-1, 86-88	R, P-M	Middle Miocene								+			+	+												
(dark green)																										
7-1, 94-96	C, G			R		+	R-F			R	F		R	+		R	R-F	F	R		R					
7-1, 148-150	R, P-M		Dorcadospyris alata				R				R			+			R									
7-2, 119-121	C, G			R		R	F/C			R	R	R		F			F	R	R							
7-3, 3-4	F, G			R						+	R	R		R/F			F	R/F	R							R
7-3, 84-86	C, G			+		R	F			+	F			R		R	F	F	+					R		
7-4, 70-72	C, G			+			F				F			R		R		F	R		R					
7-5, 74-76	C, M-G		C. costata				R/F				R	F				R	R	F	R/F			+		F		
8-1, 30-40	R, P			+			R				R							R	R		+					
8-1, 74-76	C, G							F	F		R				F	R		F		R						
8-1, 130-132	C, G							F	F		R	+			R/F	F		F		R/F						
(dark blue gray)																										
8, CC	A, G		C. tetrapera		+				C		F				F/C			F/C			F			+		
9-3, 78-80	F, M		Sidelmontensis to S. wolffii								F					+		R	R							
9-5, 27	R, P/M										+			+		+	+	R	R							
9-5, 88	F, M/G						R	+			F			R		R		R	R/F	+		R				
(dark gray)																										
10-2, 104	R, P/M			+			+											R								
(dark gray)																										
10-3, 97	R, P/M						R				R			+		R	R							R		R
(dark gray)																										
10-4,	C, M/G	Lower Miocene			+				F		R				R					+		+		R		
(green clast near base)																										
11-2, 20				Virtually barren of radiolarians																						
(dark olive)																										
12-1, 135-138	F, M		Calocycletta costata				+		R		F			+			R	R	+	R				+		
(dark gray)																										
12-1, 135-138	F, M			+			F				F					R	R	F	R					+		
(light gray)																										
12-3, 61-63	R, M						+				F	+						R						+		
(gray)																										
12-3, 60-62	R, M						R				R						+	R				+				
(light gray)																										
12-5, 55-60	C, G			+			F				F						R	F	R	+	R			+	R	R
(very light gray)																										
12-6, 50-52	F/C, M/G						F				F						R	R	R		R			+	+	+
(gray)																										
13-1, 51-53	C, G			R			F/C				F			R		R	R	F	+					R	+	R
13-2, 64-66	F, M			R			F				F						R	F	R		R			+	+	+
13-3, 59-61	F, M						F				F	+					R	R		R	R				+	
13-4, 18-20	C, M/G			+			F				F				R	+	F	R	R	+	R			+		
13-6, 51-53	F/C, M/G						F				R							F	R					+	R	
				Unsampled interval																						
16-1, 112-114	C, M										F	+			+			F		R	R		+	+	+	+
16-2, 102-104	C, M/G										F/C					+		F	R	R			+	F	I	R
17-1, 31-33	R, P/M										F					+		R/F	+							F
17-2, 55-57	R, M										R					+		+							+	F
17-3, 84-86	R, M		Cyrtocapsella tetrapera to Stichocorys delmontensis								R/F							R		+				R		+
17-4, 132-134	R, M										R							+		R						
18, CC	R, P/M										R				+			+		+						
19-2, 11-13	R, P/M								+		R							+		+		+				
19-3, 54-56	C, M								F		R				R			F	+	+	R		+	R		+
19-4, 37-39	C, M								F/C		R				R	+		F	+			+	+	+	R	+
19-4, 133-135	F, P								R		R							F		+		+				R/F
20-1, 88-90	R, P																	+							+	
20-3, 84-86	C, M				R			R			F				+			F		+						
20-4, 83-85	R, P										+							+								
20-5, 83-85	F, M		Lychnocanoma elongata		R			+			+				+			+		+						
20-6, 88-90	F, M				R				+		R/F									+	+					+

Note: Abundance; A – Abundant; C – Common; F – Few; R – Rare; + – Trace; Preservation; G – Good; M – Moderate; P – Poor.

Figure 3. *Radiolarians at Hole 391A.*

Cyclampterium? lepterum	*Cyclampterium? pegetrum*	*Cyclampterium? tanythorax*	*Cyrtocapsella cornuta*	*Cyrtocapsella elongata*	*Cyrtocapsella japonica*	*Cyrtocapsella tetrapera*	*Cyrtocapsella* sp.	*Dendrospyris bursa*	*Dendrospyris damaecornis*	*Dorcadospyris alata*	*Dorcadospyris ateuchus*	*Dorcadospyris dentata*	*Dorcadospyris forcipata*	*Dorcadospyris simplex*	*Eucyrtidium cienkowskii* group	*Eucyrtidium* sp. A	*Eucyrtidium* sp. B group	*Lithocampe subligata* group	*Eucyrtidium diaphanes*	*Eucyrtidium punctatum*	*Giraffospyris* sp.	*Gorgospyris perizostra*	*Gorgospyris schizopodia*	*Gorgospyris* sp. cf. *G. schizopodia*	*Histiastrum martinianum*	*Lamprocyclas* sp. group	*Lipmanella* sp. group	*Lithamelissa* sp. aff. *L. mofra*	*Lithopera renzae*	*Liriospyris parkerae*	*Liriospyris stauropora*	*Liriospyris* sp.	*Lychnocanoma elongata*	*Lynchnodictyum audax* (?)	*Phormostichoartus corona*	*Phormostichoartus* sp. aff. *P. corona*	*Rhodospyris* sp. cf. *R. anthocyrtis*	*Rhodospyris* sp. cf. de-1 group	*Saturnalis circularis*	*Stichocorys armata*	*Stichocorys delmontensis*
						F																							+													R	
			F					+	R							F												R													+	F
						+																					+															+
			C			R									R										R		F	R								+	R					F	F-C
			R																																									R
		R	F			F					R					F							R		R		F	R		+	+	+				+	R					F	F
			F			R/F					R						R		+	R			+		R						+				+	R					R	F/C
		+				R					+		+			R	R			+	R			+		R	+		R	+	+				+	R					F	F
		+	R		R						+							F						+	R	R	R		R	+		R			+			R					+	F
			R															F							R	R								+	R	+	F						+		R/F	F
			R		+	+												+																						+					+	R
			F			R	F	R			R				F				R	+				R	R		R								R/F	+								
			R			C		+			R			+	R	R			R					R			+		+					+								
			F			F		R			F			+	C				R									F		R					+			+					
			R		R	F		+	+					+	+										R												+					R/F			R
			R/F			R											+																										+	R
			+		F	F				R		R																	R					R	+								F	F
			+																									R																
			R																					+														R			R			R	R
			R			F					F				F		R		F									+	R								+		+						R
			F		R	R						+						+		R				+								+						+						+	R
+			R			F		+					R			R						+						+		+	+		+		+				+						R	F
			R			R							R			+				+		R												R											F
			R			R							+									+												+											R
			R			F		+				+			R					+	+					+		R	+		R		R	R		+	+					R	F
			F		+	K		R				+			R					+			R	R		R			+		R					+						R	F
			R		R	R/F		+				+			R				R						+		R	+								R	R					R/F	F
			R		+	R		R				F			R				R		R		R								+			+	R					R/F	F
			F			R		+				R/F					+		+	+	R															+								R	F
			F		+	R							R	+									R		+								+			+			+						F	F
			F	+	R	R							R	+		R	R			R								R							+	+			+						F
																																		Unsampled interval									
+			R			+	F			R			F		R		F	R	R			R/F					R		+	R			R						+			R			+	+	F
R			F		R	R			R			F		+		F		R			F					+		R	R								R/F			R					F
			R		R	F			+			F						R			F					+		+			+																R
			+			R			+			R									R					+		+																			+
			R		+	R			+			R									F					+		+			+									+							+
				+	+							+									F							+																					
						R/F	+				+				+			+		+																							
						R					R									+																								+
				R	F	+				R/F		+			+				R					+			R	+			R					R				+						R
						F		+			F				F	R	R/F		R	F					R			+				+									+	F	R			
	+			R			F		R			F				R	R	F		R	R				R			R																	R/F			
											+																															
	R					R	F				F/C				R	R	R										+															+	R	+		
											+				R																												
	+										R				+								+																				+	+			
											R/F															+											+					R			

Figure 3. *Continued.*

Sample (Interval in cm)	Abundance, Preservation	Age	Zone	*Stichocorys wolffii*	*Stylacontarium bispiculum*	*Tepka perforata*	*Tessarospyris pododendros*	*Theoconus spongoconum*	*Theocyrtis annosa*	*Theoperid* sp.	*Tholospyris cortinisca*	Reworking E = Eocene; M = Miocene O = Oligocene; P = Pliocene	Sponge Spicules	Sponge sterrasters
2, CC	A, G	Pleist.	A. upsilon									M, P	A	F
4-4, 10-12												–	R	+
5-3, 110-112												–	+	
5-6, 26 (olive)	F, M						R			F-C		O	R	
5-6, 75 (dark blue gray)	F, M	Middle Miocene		+			R			+		E	+	+
6-1, 86-88 (dark green)	R, P-M						+						A	F
7-1, 94-96	C, G			R	R		R			R			F	
7-1, 148-150	R, P-M		Dorcadospyris alata	+									C	C
7-2, 119-121	C, G			F	+		R			R	R	E	C	F
7-3, 3-4	F, G			F	R		R			R	+	E	F	F
7-3, 84-86	C, G			F	R		R			R	+	E	R	
7-4, 70-72	C, G			R/F		+						+	F/C	F
7-5, 74-76	C, M-G		C. costata	F									F	
8-1, 30-40	R, P			R									R	
8-1, 74-76	C, G						+	+	+	R		E	F	R
8-1, 130-132 (dark blue gray)	C, G							R/F					F	R
8, CC	A, G		C. tetrapera		R	+	R	F	R				F	R
9-3, 78-80	F, M		Sidelmontensis to S. wolffii										C	F
9-5, 27	R, P/M				+					+	+		F	F
9-5, 88 (dark gray)	F, M/G			R			+					E	A	F
10-2, 104 (dark gray)	R, P/M									+			R	+
10-3, 97 (dark gray)	R, P/M	Lower Miocene			R								R	+
10-4, (green clast near base)	C, M/G				R			R		+		E	F	R
11-2, 20 (dark olive)													R	+
12-1, 135-138 (dark gray)	F, M		Calocycletta costata					R	+			E	F/C	F
12-1, 135-138 (light gray)	F, M			R	R		R/F						A	F
12-3, 61-63 (gray)	R, M			R									R	
12-3, 60-62 (light gray)	R, M						+						F	R
12-5, 55-60 (very light gray)	C, G			R								E	C	R
12-6, 50-52 (gray)	F/C, M/G						R					E	A	R/F
13-1, 51-53	C, G			R								E	C	F
13-2, 64-66	F, M			F			R/F						A	R
13-3, 59-61	F, M			F								E/O	A	R
13-4, 18-20	C, M/G			F			R/F					E	A	R
13-6, 51-53	F/C, M/G			F									A	F
16-1, 112-114	C, M				R	+		R			+	E	A	F/C
16-2, 102-104	C, M/G				R	R	+	+			R		A	F/C
17-1, 31-33	R, P/M												A	F
17-2, 55-57	R, M						+						A	F
17-3, 84-86	R, M		Cyrtocapsella tetrapera to Stichocorys delmontensis					+					C	R
17-4, 132-134	R, M												R	R
18, CC	R, P/M					+		+					A	A
19-2, 11-13	R, P/M							F					A	F
19-3, 54-56	C, M						R	+				E, O	C	F
19-4, 37-39	C, M					+		R			R	E, O	C	C
19-4, 133-135	F, P					F		+					A	C
20-1, 88-90	R, P					+		+					F	R
20-3, 84-86	C, M							R	+			E	R	R
20-4, 83-85	R, P												R	R
20-5, 83-85	F, M		Lychnocanoma elongata			+							C	F/C
20-6, 88-90	F, M					R	+	+				E	A	C

Note: Abundance; A – Abundant; C – Common; F – Few; R – Rare; + – Trace; Preservation; G – Good; M – Moderate; P – Poor.

Figure 3. *Continued.*

Lychnocanoma sp. (Plate 10, Figures 8-10).

Lychnocanoma babylonis group (Clark and Campbell), Foreman, 1973, p. 437, pl. 2, fig. 1.

Lychnocanoma bellum (Clark and Campbell), Foreman, 1973, p. 437, pl. 1, fig. 17; pl. 11, fig. 9 (Plate 5, Figures 9, 10).

Lychnocanoma elongata (Vinassa), Sanfilippo et al., 1973, p. 221, pl. 5, fig. 19, 20; Riedel and Sanfilippo, in press, pl. 7, fig. 4.

Lychnodictyum audax (?) Riedel, 1953, p. 810, pl. 85, fig. 9; Riedel and Sanfilippo, in press, pl. 7, fig. 5 (Plate 3, Figure 1).

Ommatartus tetrathalamus (Haeckel), Riedel and Sanfilippo, 1971, p. 1588, pl. 1c, fig. 5-7.

Periphaena decora Ehrenberg, Sanfilippo and Riedel, 1973, pl. 8, fig. 8-10; pl. 27, fig. 2-5 (Plate 11, Figure 5).

Periphaena delta Sanfilippo and Riedel, 1973, p. 523, pl. 8, fig. 11, 12; pl. 27, fig. 6, 7; Riedel and Sanfilippo, in press, pl. 7, fig. 9.

Periphaena heliasteriscus (Clark and Campbell), Sanfilippo and Riedel, 1973, p. 523, pl. 9, fig. 1-6; pl. 27, fig. 8, 9.

Periphaena tripyramis triangula (Sutton), Sanfilippo and Riedel, 1973, p. 523, pl. 9, fig. 10, 11.

Periphaena tripyramis tripyramis (Haeckel), Sanfilippo and Riedel, 1973, p. 523, pl. 9, fig. 7-9.

Phormostichoartus corona (Haeckel, Riedel and Sanfilippo, 1971, p. 1600, pl. 1i, fig. 13-15; pl. 2j, fig. 1-5; in press, pl. 7, fig. 12.

Phromostichoartus sp. aff. *P. corona* (Plate 3, Figure 3).

Podocyrtis diamesa Riedel and Sanfilippo, Sanfilippo and Riedel, 1973, p. 531, pl. 20, fig. 9, 10; Riedel and Sanfilippo, in press, pl. 8, fig. 4.

Podocyrtis dorus Sanfilippo and Riedel, 1973, p. 531, pl. 35, fig. 12-14.

Podocyrtis papalis Ehrenberg, Sanfilippo and Riedel, 1973, pl. 20, fig. 11-14; pl. 36, fig. 2, 3.

Podocyrtis sinuosa Ehrenberg, Riedel, and Sanfilippo, 1970, p. 534, pl. 11, fig. 3, 4.

Podocyrtis sinuosa (?) Ehrenberg, Sanfilippo and Riedel, 1973, p. 532, pl. 21, fig. 4, 5.

Phormocyrtis sp. (Plate 8, Figures 1-4).

Phormocyrtis cubensis (Riedel and Sanfilippo), Foreman, 1973, p. 438, pl. 7, fig. 11, 12, 14 (Plate 9, Figures 1(?), 5, 6).

Phormocyrtis turgida (Krasheninnikov), Foreman, 1973, p. 438, pl. 7, fig. 10; pl. 12, fig. 6.

Phormocyrtis striata exquisita (Kozlova), Foreman, 1973, p. 438, pl. 7, fig. 1-4, 7, 8; pl. 12, fig. 5.

Phormocyrtis striata striata Brandt, Foreman, 1973, p. 438, pl. 7, fig. 5, 6, 9; Riedel and Sanfilippo, in press, pl. 7, fig. 11.

Polysolenia murrayana (Haeckel), Nigrini, 1967, pl. 1, fig. 1a-b.

Polysolenia spinosa (Haeckel), group, Nigrini, 1967, p. 14, pl. 1, fig. 1; Ling, 1975, p. 717, pl. 1, fig. 2, 3.

Rhabdolithis pipa Ehrenberg, Sanfilippo and Riedel, 1973, p. 529, pl. 18, fig. 12-16; pl. 33, fig. 9, 10.

Rhodospyris sp. cf. *R. anthocyrtis* Haeckel, Ling, 1975, p. 727, pl. 8, fig. 1, 2 (Plate 4, Figures 9, 10).

Rhodospyris sp. (?) cf. De 1 group Goll, 1968, p. 1417, text-fig. 8; Ling, 1975, p. 727, pl. 8, fig. 3, 4 (Plate 4, Figures 6, 12).

Rhoplocanium ornatum Ehrenberg, Foreman, 1973, p. 439, pl. 2, fig. 8-10; pl. 12, fig. 3.

Saturnalis circularis Haeckel, Nigrini, 1967, p. 25, pl. 1, fig. 9; Ling, 1975, p. 717, pl. 2, fig. 2.

Spongatractus pachystylus (Ehrenberg), Sanfilippo and Riedel, 1973, p. 519, pl. 2, fig. 4-6; pl. 25, fig. 3.

Spongodiscus sp. (Plate 11, Figure 4)

Spongodiscus rhabdostylus (Ehrenberg), Sanfilippo and Riedel, 1973, p. 525, pl. 13, fig. 1-3; pl. 30, fig. 1, 2 (Plate 11, Figure 3).

Spongomelissa cucumella Sanfilippo and Riedel, 1973, p. 530, pl. 19, fig. 6, 7; pl. 34, fig. 7-10.

Stichocorys wolffii Haeckel, Riedel and Sanfilippo, 1971, pl. 2e, fig. 8, 9; in press, pl. 9, fig. 12.

Stichocorys delmontensis (Campbell and Clark), Sanfilippo and Riedel, 1970, p. 451, pl. 1, fig. 9; Riedel and Sanfilippo, in press, pl. 9, fig. 10.

Stichocorys armata (Haeckel), Sanfilippo et al., 1973, p. 222, pl. 6, fig. 1, 2 (Plate 2, Figure 3).

Stylacontarium acquilonium (Hays), Kling, 1973, p. 634, pl. 1, fig. 17-20; pl. 14, fig. 1-4.

Stylacontarium sp. aff. *S. bisipiculum* Kling, 1973, p. 634, pl. 6, fig. 19-23; pl. 14, fig. 5-8.

Stylosphaera coronata coronata Ehrenberg, Sanfilippo and Riedel, 1973, p. 520, pl. 1, fig. 13-17; pl. 25, fig. 4.

Stylotrochus quadribrachiatus quadribrachiatus Sanfilippo and Riedel, 1973, p. 526, pl. 14, fig. 1, 2; pl. 31, fig. 1.

Tepka perforata Sanfilippo and Riedel, Sanfilippo et al., 1973, p. 228, pl. 6, fig. 18-20 (Plate 3, Figure 6).

Tetrapyle octacantha Müller, Benson, 1966, p. 245, pl. 15, fig. 3-10; pl. 16, fig. 1.

Theocampe urceolus group (Haeckel), Foreman, 1973, p. 432, pl. 8, fig. 14-17; pl. 9, fig. 6, 7.

Theocampe mongolfieri (Ehrenberg), Foreman, 1973, p. 432, pl. 9, fig. 6; pl. 9, fig. 17.

Theocorys acroria Foreman, 1973, p. 439, pl. 5, fig. 11-13; pl. 12, fig. 2 (Plate 7, Figures 6, 7).

Theocorys anaclasta Riedel and Sanfilippo, Foreman, 1973, p. 440, pl. 5, fig. 14, 15; Riedel and Sanfilippo, in press, pl. 1, fig. 6-8 (Plate 7, Figures 1-3)

Theocorys anapographa Riedel and Sanfilippo, Foreman, 1973, p. 440, pl. 5, fig. 9, 10; Riedel and Sanfilippo, in press, pl. 9, fig. 15 (Plate 7, Figures 4, 5).

Theocorys spongoconum Kling, 1971, p. 1087, pl. 5, fig. 6; Riedel and Sanfilippo, in press, pl. 9, fig. 16 (Plate 1, Figure 4).

Theocotyle alpha Foreman, 1973, p. 441, pl. 4, fig. 13-15; pl. 12, fig. 16.

Theocotyle cryptocephala cryptocephala (Ehrenberg), Foreman, 1973, p. 440, pl. 4, fig. 6, 7; pl. 12, fig. 18 (Plate 9, Figures 7, 8).

Theocotyle cryptocephala nigrinae Riedel and Sanfilippo, Foreman, 1973, p. 440, pl. 4, fig. 1, 3-5; pl. 12, fig. 17 (Plate 9, Figures 9-11).

Theocotyle ficus (Ehrenberg), Foreman, 1973, p. 441, pl. 4, fig. 16-20.

Theocotyle fimbria Foreman, 1973, p. 441, pl. 5, fig. 1, 2; pl. 12, fig. 21.

Theocyrtis annosa (Riedel), Riedel and Sanfilippo, 1970, p. 535, pl. 15, fig. 9; in press, pl. 10, fig. 3.

Theoperid sp. (Plate 2, Figure 5).

Tholospyris sp. (Plate 4, Figure 5).

Tholospyris cortinisca (Haeckel), Goll, 1969, p. 325-326, pl. 56, fig. 3, 5, 6, 8; Sanfilippo et al., 1973, p. 219, pl. 3, fig. 13-16 (Plate 4, Figure 8).

Thyrsocyrtis sp. (Plate 6, Figure 3, 5, 6).

Thyrsocyrtis hirsuta hirsuta (Krasheninnikov), Foreman, 1973, p. 441, pl. 3, fig. 3-8; pl. 12, fig. 15 (Plate 6, Figures 1, 2).

Thyrsocyrtis hirsuta tensa Foreman, 1973, p. 442, pl. 3, fig. 13-16; pl. 12, fig. 8.

Thyrsocyrtis rhizodon Ehrenberg, Foreman, 1973, p. 442, pl. 3, fig. 1, 2.

Thyrsocyrtis tarsipes Foreman, 1973, p. 442, pl. 3, fig. 9; pl. 12, fig. 14 (Plate 6, Figure 4).

Thyrsocyrtis triacantha (Ehrenberg), Foreman, 1973, p. 442, pl. 12, fig. 9-11.

Tricolocampe vitrea Krasheninnikov, 1960, p. 299, pl. 3, fig. 14; Foreman, 1973, p. 438, pl. 7, fig. 13 (Plate 9, Figure 4).

Velicucullus sp(p). Sanfilippo and Riedel, 1973, p. 530, pl. 20, fig. 2-6; pl. 34, fig. 14 (Plate 8, Figure 8).

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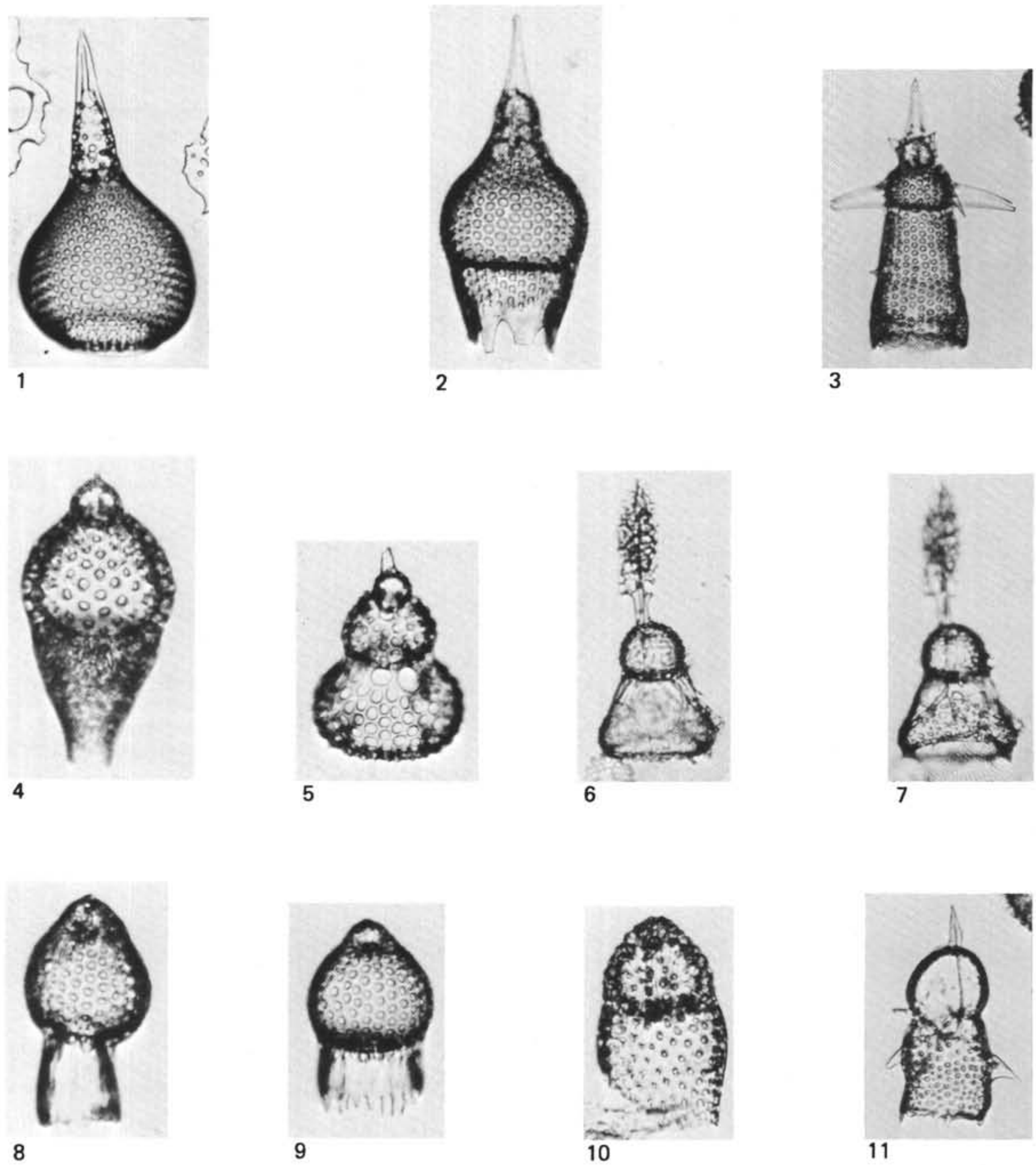

PLATE 1

Figure 1 *Anthocyrtidium ehrenbergi*. Såmple 391A-7-2, 119-121 cm; × 250.

Figure 2 *Calocycletta serrata*. Sample 391A-8-1, 130-132 cm; × 200.

Figure 3 Theoperid gen. et sp. indet. Sample 391A-7-1, 94-96 cm; × 220.

Figure 4 *Theocorys spongoconum*. Sample 391A-8-1, 130-132 cm; × 210.

Figure 5 *Eucyrtidium diaphanes*. Sample 391A-10-4, green clast near base of section; × 290.

Figure 6 *Clathrocanium sphaerocephalum*. Sample 391A-7-2, 119-121 cm; × 300.

Figure 7 *C. sphaerocephalum*. Sample 391A-7-2, 119-121 cm; × 270.

Figure 8 *Carpocanopsis favosa*. Sample 391A-19-4, 37-39 cm; × 270.

Figure 9 *Carpocanopsis bramlettei*. Sample 391A-7-1, 94-96 cm; × 240.

Figure 10 *Gorgospyris* sp. Sample 391A-7-5, 74-76 cm; × 260.

Figure 11 *Lithomelissa* sp. cf. *L. mitra*. Sample 391A-12-5, 55-57 cm; × 300.

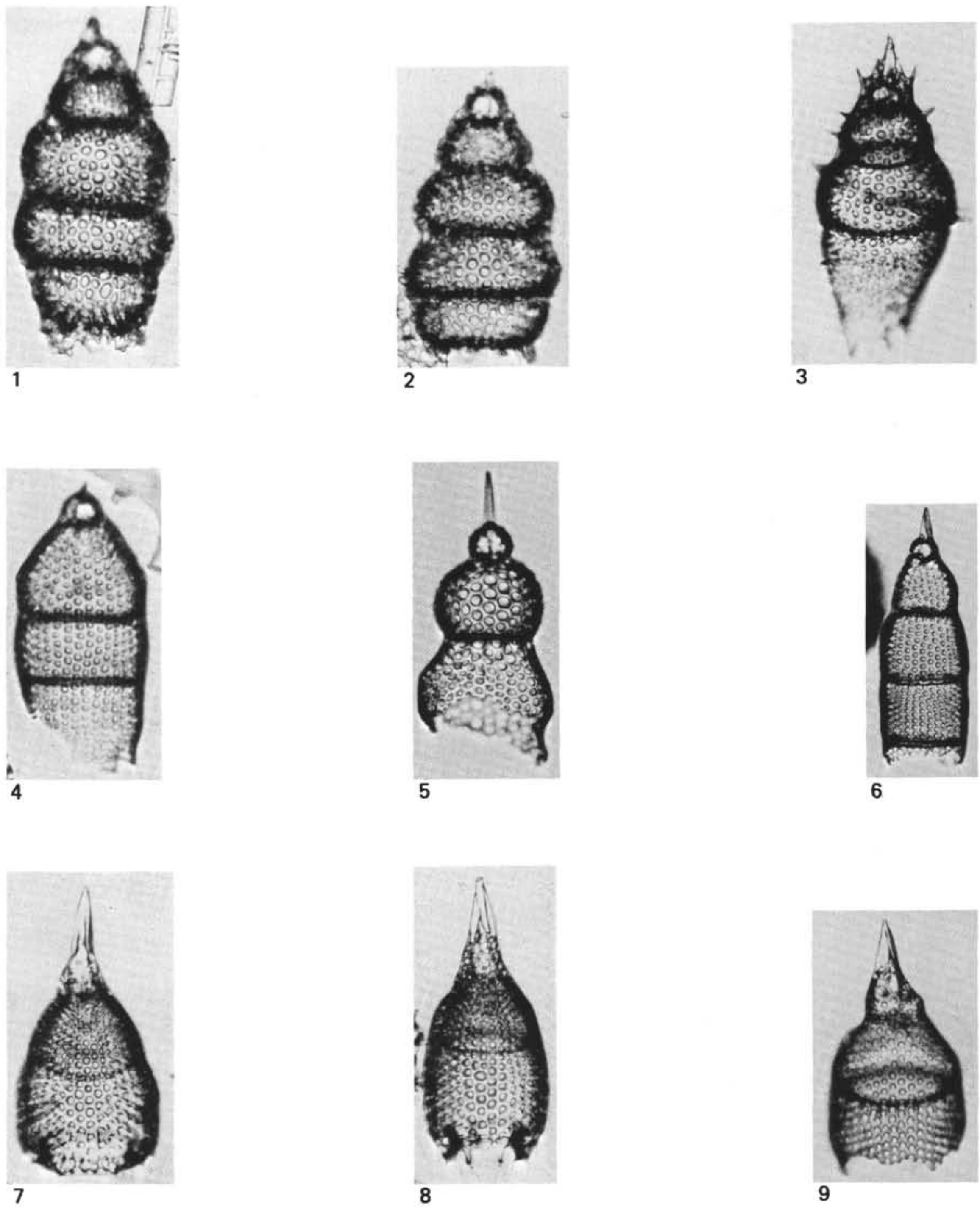

PLATE 2

Figures 1,2 *Lithocampe subligata* group. Sample 391A-20-3, 84-86 cm; × 260.

Figure 3 *Stichocorys armata*. Sample 391A-7-4, 94-96 cm; × 270.

Figure 4 *Eucyrtidium punctatum* group. Sample 391A-19-4, 37-39 cm; × 240.

Figure 5 Theoperid gen. et sp. indet. Sample 391A-5-6, 26-28 cm; × 320.

Figure 6 Theoperid gen. et sp. indet. Sample 391A-10-4, green clast near base of section; × 230.

Figure 7 *Lamprocyclas* sp. Sample 391A-7-4, 94-96 cm; × 250.

Figure 8 *Lamprocyclas* sp. Sample 391A-8, CC; × 230.

Figure 9 *Calocycletta* sp. Sample 391A-7-1, 94-94 cm; × 260.

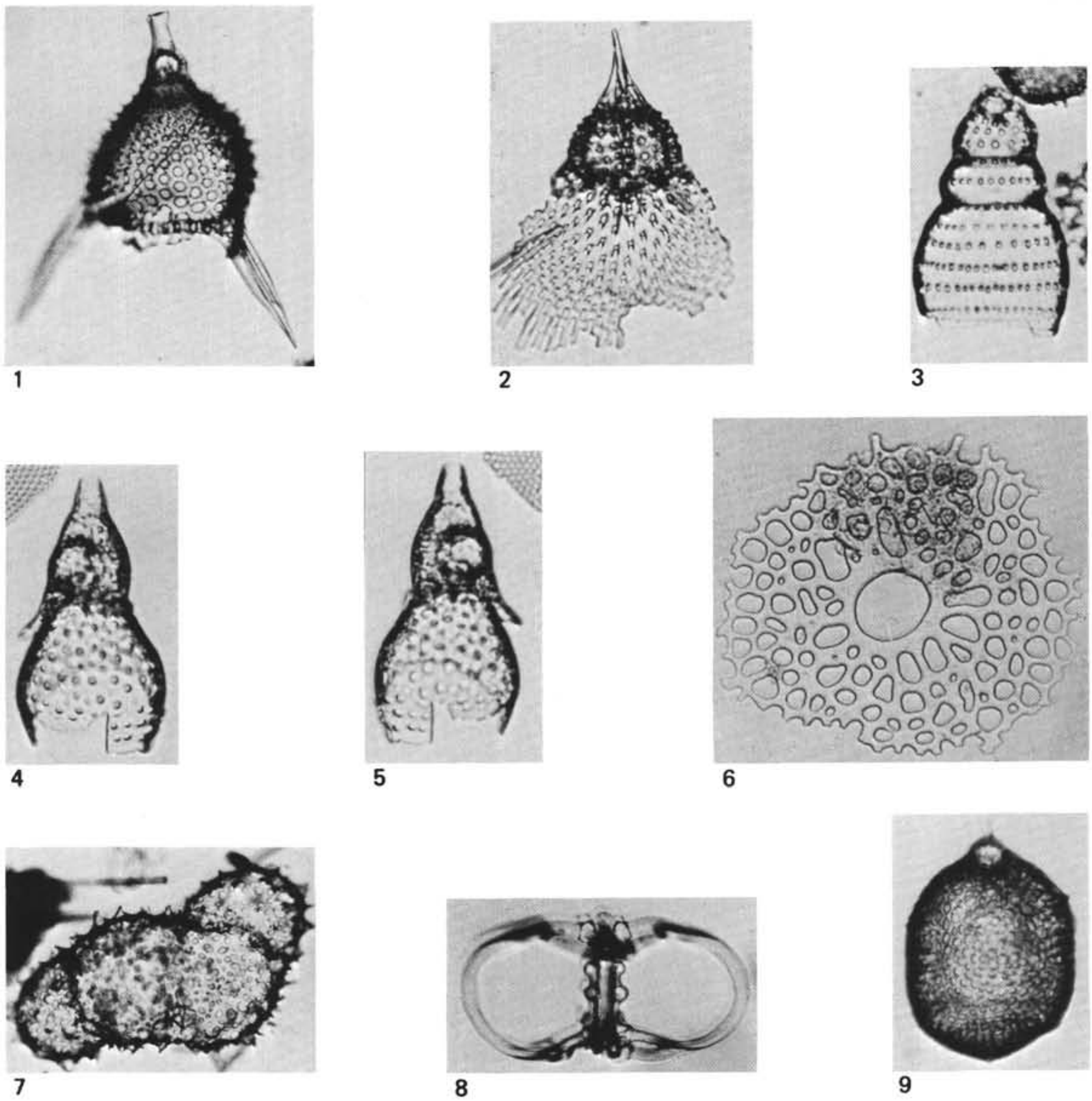

PLATE 3

Figure 1 *Lychnodictyum audax* (?). Sample 391A-7-1, 94-96 cm; × 200.

Figure 2 *Dendrospyris bursa*. Sample 391A-13-3, 59-61 cm; × 270.

Figure 3 *Phormostichoartus* sp. cf. *P. corona*. Sample 391A-8, CC; × 290.

Figures 4,5 *Centobotrys petrushevskayae*. Sample 391A-19-4, 37-39 cm; × 280.

Figure 6 *Tepka perforata*. Sample 391A-20-1, 88-89 cm; × 230.

Figure 7 Collosphaerid colony. Sample 391A-2, CC; × 150.

Figure 8 *Liriospyris* sp. Sample 391A-7-3, 84-86 cm; × 300.

Figure 9 *Lithopera renzae*. Sample 391A-7-2, 119-121 cm; × 220.

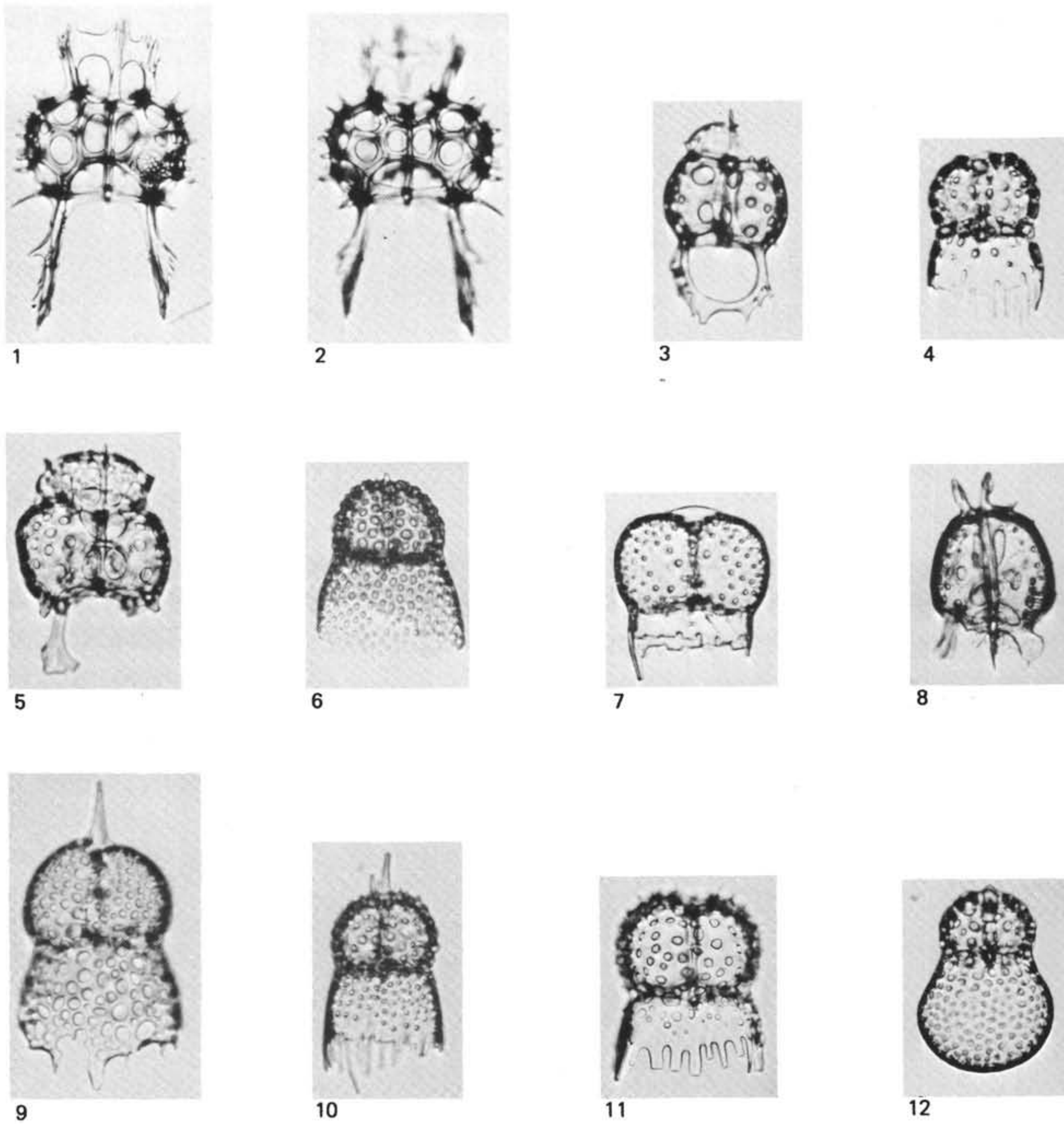

PLATE 4

Figures 1,2 *Giraffospyris* sp. Sample 391A-7-2, 119-121 cm; × 280.

Figure 3 *Tholospyris* sp. Sample 391A-7-2, 119-121 cm; × 240.

Figure 4 *Gorgospyris* sp. cf. *G. schizopodia*. Sample 391A-8-1, 130-132 cm; × 220.

Figure 5 *Tholospyris* (?) sp. Sample 391A-9-5, 27-29 cm; × 320.

Figure 6 *Rhodospyris* (?) sp. De 1 group. Sample 391A-19-4, 37-39 cm; × 210.

Figure 7 *Gorgospyris schizopodia*. Sample 391A-7-5, 74-76 cm; × 300.

Figure 8 *Tholospyris cortinisca*. Sample 391A-7-3, 34-36 cm; × 280.

Figure 9 *Rhodospyris* sp. cf. *R. anthocyrtis*. Sample 391A-19-4, 37-39 cm; × 300.

Figure 10 *Rhodospyris* sp. cf. *R. anthocyrtis*. Sample 391A-19-4, 37-39 cm; × 220.

Figure 11 *Gorgospyris* sp. cf. *G. schizopodia*. Sample 391A-7-1, 94-94 cm; × 200.

Figure 12 *Rhodospyris* (?) sp. De 1 group. Sample 391A-10-4, green clast near the bottom of section; × 210.

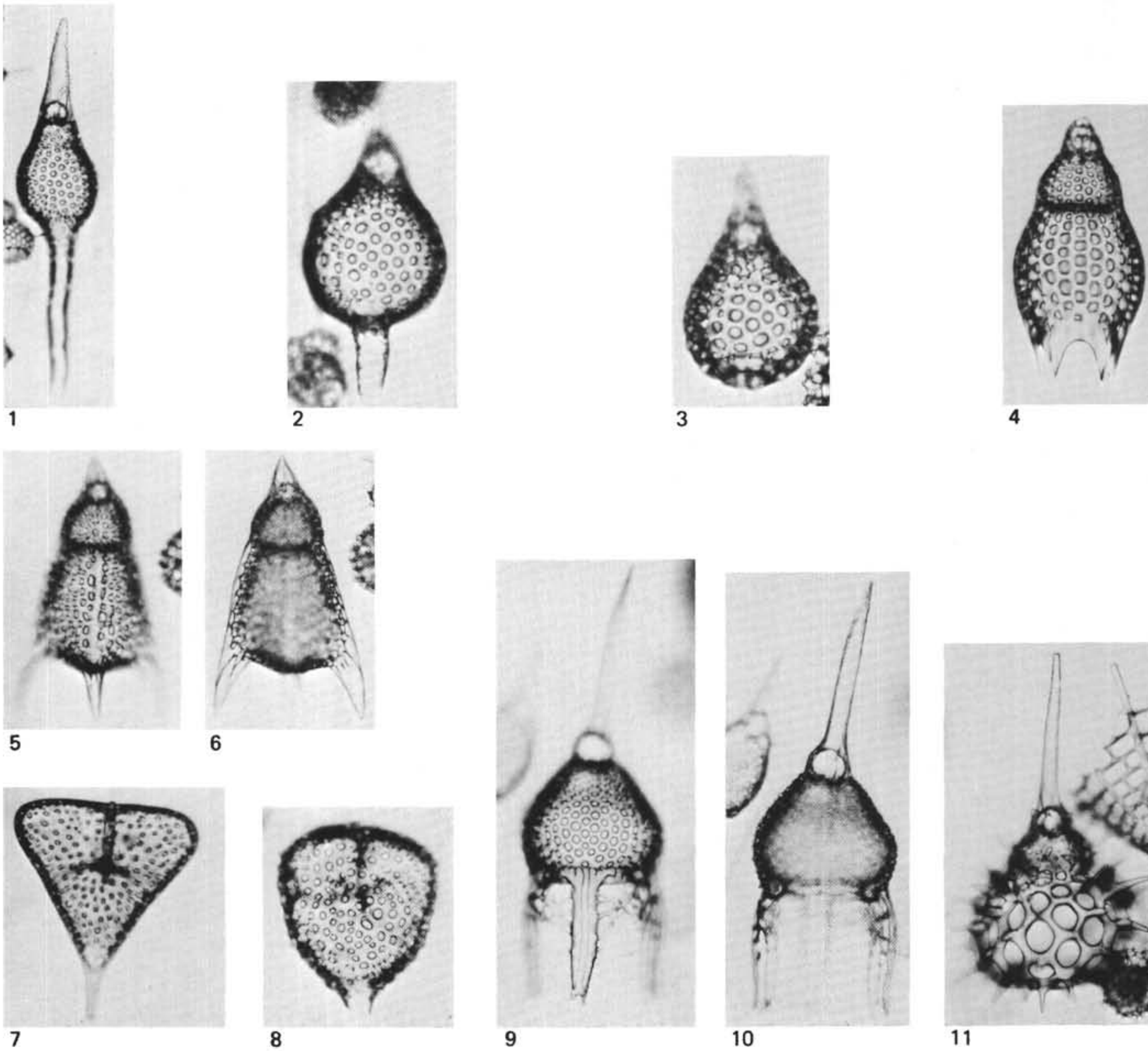

PLATE 5

Figure 1 *Eusyringium fistuligerum.* Sample 390A-2-2, 107-109 cm; × 170.

Figure 2 *Eusyringium lagena* (with tubule). Sample 390A-3-1, 144-146 cm; × 270.

Figure 3 *Eusyringium lagena.* Sample 390A-4-2, 101-103 cm; × 270.

Figure 4 *Podocyrtis sinuosa* (?). Sample 390A-3-3, 99-101 cm; × 160.

Figure 5 *Lithochytris archaea.* Sample 390A-6-2, 111-113 cm; × 160.

Figure 6 *Lithochytris archaea.* Sample 390A-6-2, 111-113 cm; × 180.

Figure 7 *Giraffospyris lata.* Sample 390A-7-2, 49-51 cm; × 200.

Figure 8 *Giraffospyris cyrillium.* Sample 390A-5-4, 125-127 cm; × 260.

Figures 9,10 *Lychnocanoma bellum.* Sample 390A-4-5, 28-30 cm; × 190.

Figure 11 *Calocycloma castum.* Sample 390A-6-6, 30-32 cm; × 150.

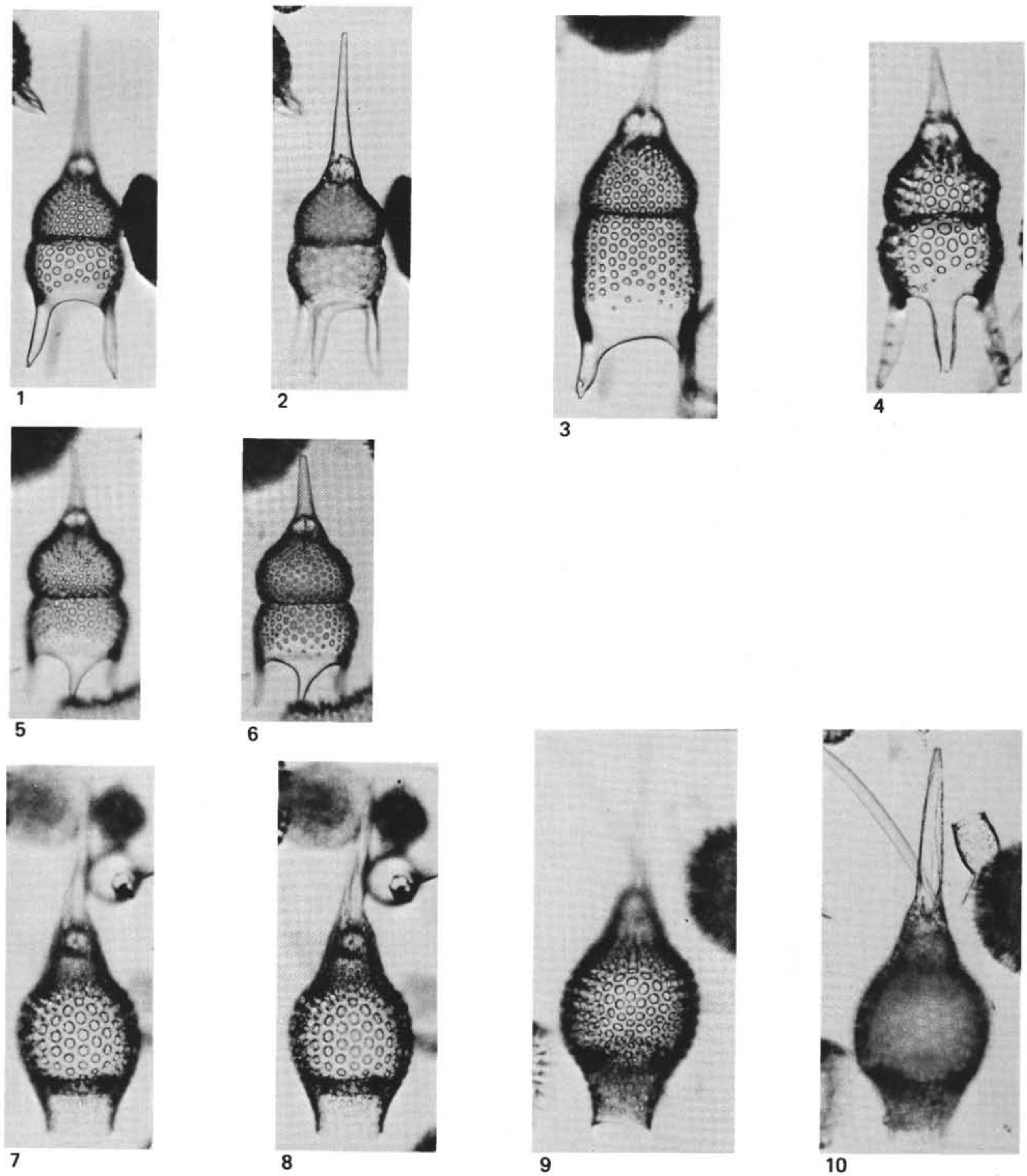

PLATE 6

Figures 1,2 — *Thyrsocyrtis hirsuta hirsuta*. Sample 390A-6-4, 123-125 cm; × 150.

Figure 3 — *Thyrsocyrtis* sp. Sample 390A-5-4, 125-127 cm; × 150.

Figure 4 — *Thyrsocyrtis tarsipes*. Sample 390A-7-2, 49-51 cm; × 200. (Pores in feet not in focus.)

Figures 5,6 — *Thyrsocyrtis* sp. Sample 390A-6-2, 111-113 cm; × 140.

Figures 7,8 — *Lamptonium fabaeforme fabaeforme*. Sample 390A-7-1, 87-89 cm; × 120.

Figures 9,10 — *Lamptonium fabaeforme fabaeforme*. Sample 390A-6-4, 112-114 cm; × 140.

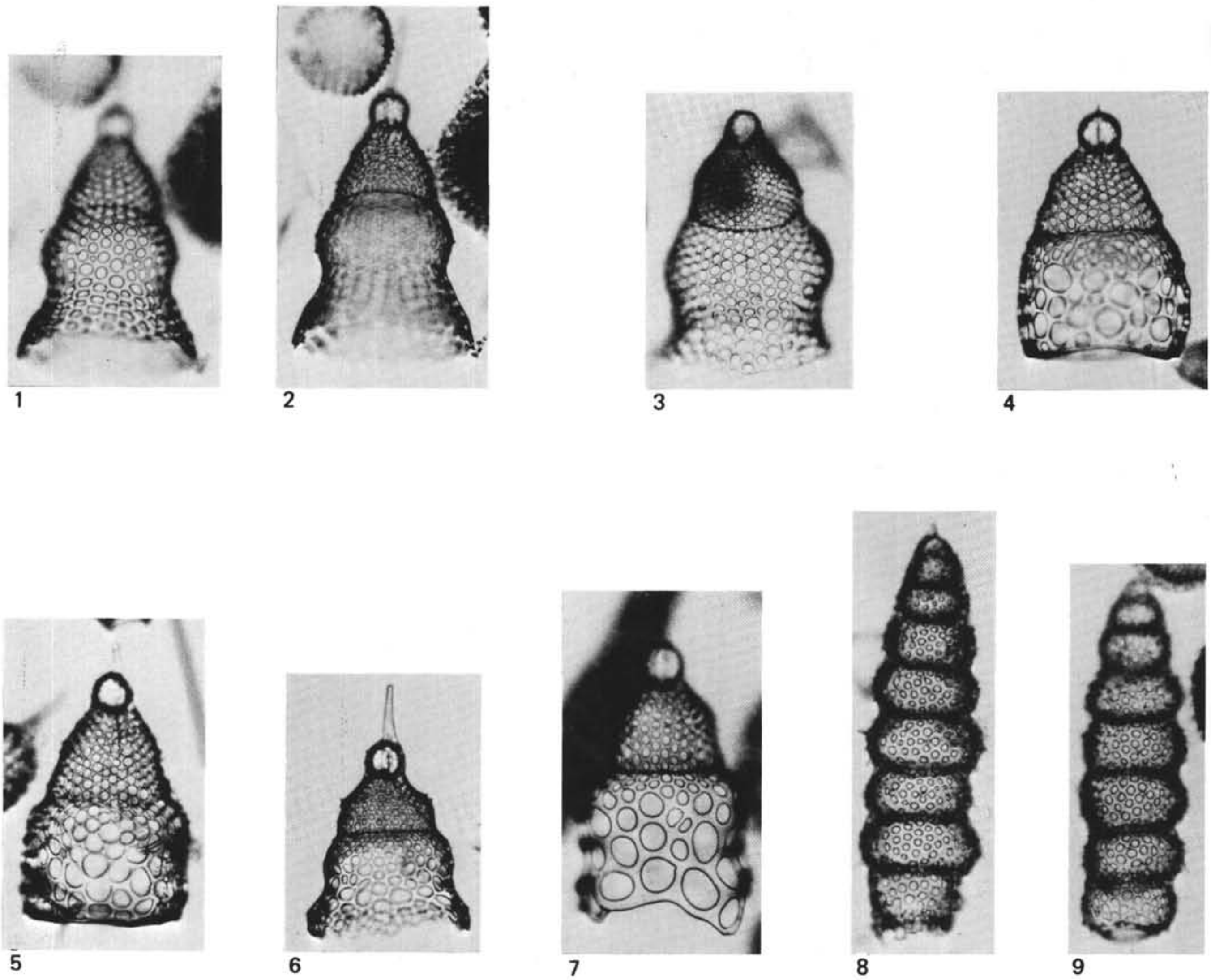

PLATE 7

Figures 1,2 — *Theocorys anaclasta*. Sample 390A-6-1, 36-38 cm; × 150.

Figure 3 — *Theocorys anaclasta*. Sample 390A-6-1, 36-38 cm; × 150.

Figure 4 — *Theocorys anapographa*. Sample 390A-4-3, 107-109 cm; × 160.

Figure 5 — *Theocorys anapographa*. Sample 390A-4-1, 103-105 cm; × 160.

Figure 6 — *Theocorys acroria*. Sample 390A-3-1, 141-143 cm; × 140.

Figure 7 — *Theocorys acroria*. Sample 390A-6-1, 36-38 cm; × 190.

Figure 8 — *Lithocampe* sp. Sample 390A-7-3, 47-49 cm; × 240.

Figure 9 — *Lithocampe* sp. Sample 390A-7-3, 47-49 cm; × 240.

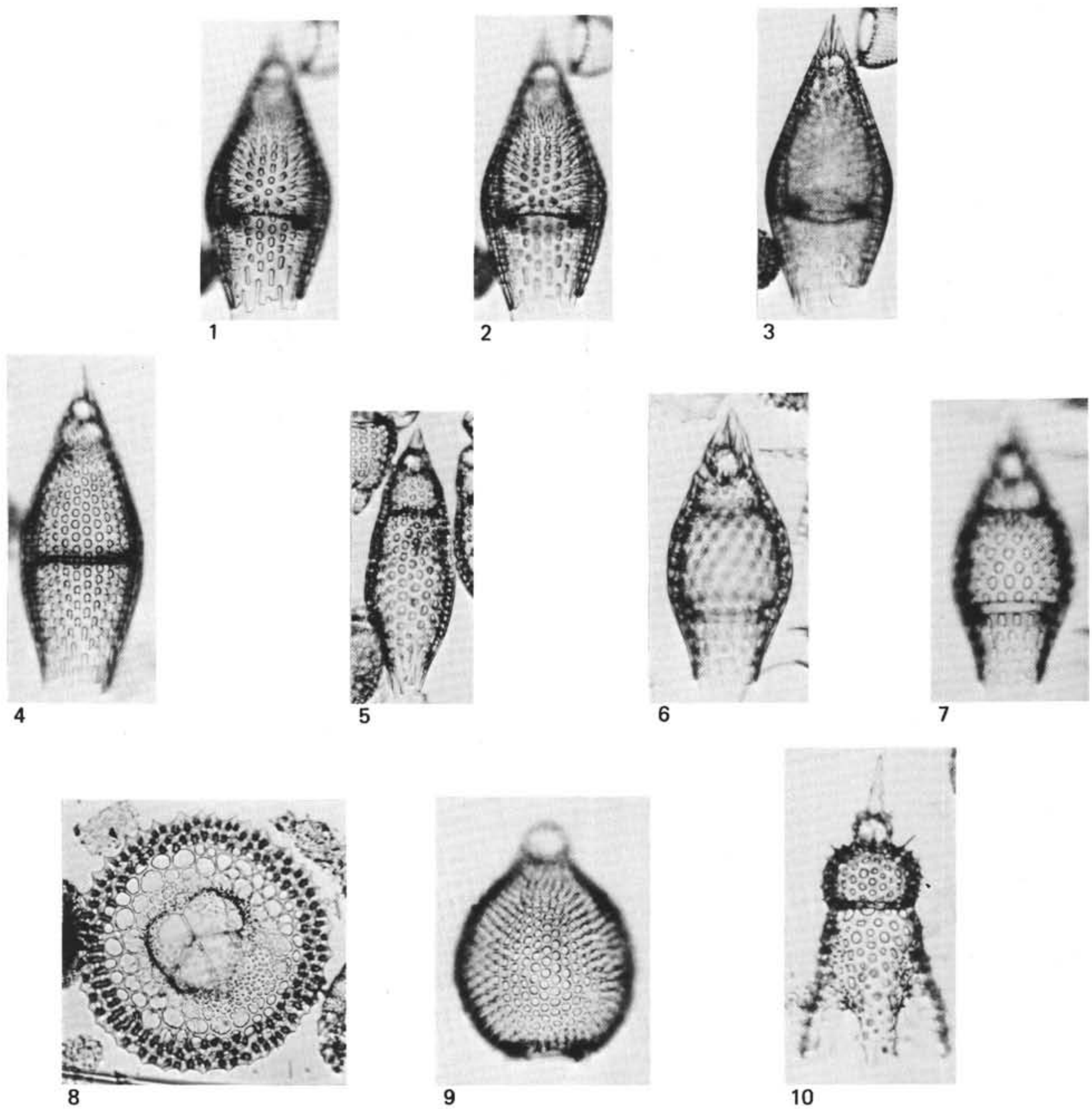

PLATE 8

Figures 1-3 *Phormocyrtis* sp. Sample 390A-7-2, 134-136 cm; × 250.

Figure 4 *Phormocyrtis* sp. Sample 390A-7-4, 32-34 cm; × 250.

Figure 5 *Phormocyrtis striata striata*. Sample 390A-4-1, 10-12 cm; × 250.

Figures 6,7 *Buryella clinata*. Sample 390A-6-6, 30-32 cm; × 250.

Figure 8 *Velicucullus* sp. Sample 390A-7-1, 87-89 cm; × 180.

Figure 9 *Anthocyrtoma* sp. Sample 390A-5-4, 125-127 cm; × 170.

Figure 10 Theoperid gen. et sp. indet. Sample 390A-4-1, 103-105 cm; × 200.

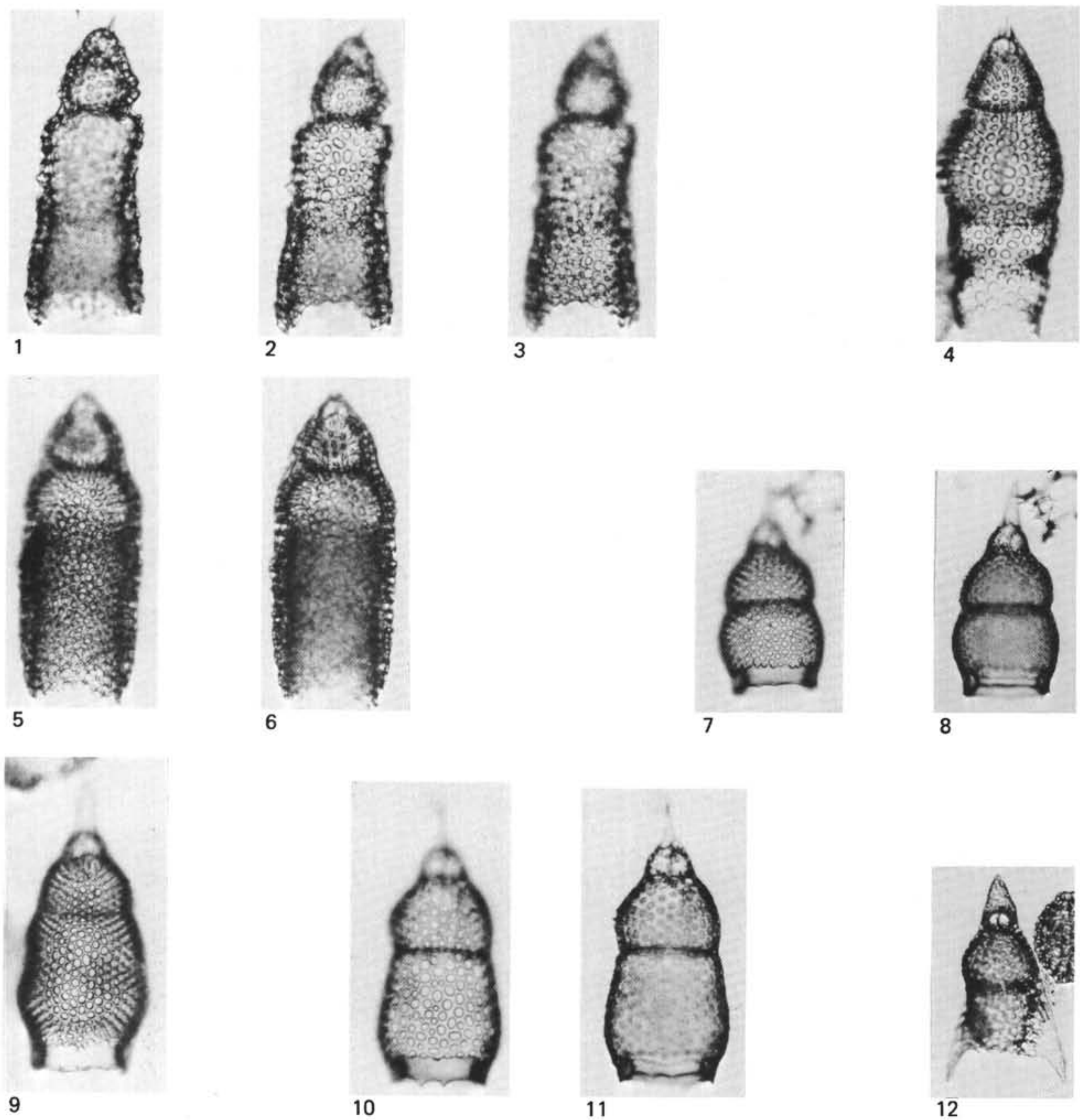

PLATE 9

Figures 1-3 *Phormocyrtis cubensis* (?). Sample 390A-7-1, 87-89 cm; × 150.

Figure 4 *Tricolcampe vitrea* (?). Sample 390A-7-3, 140-142 cm; × 170.

Figures 5,6 *Phormocyrtis cubensis*. Sample 390A-7-4, 32-34 cm; × 150.

Figures 7,8 *Theocotyle cryptocephala cryptocephala*. Sample 390A-6-3, 114-116 cm; × 150.

Figure 9 *Theocotyle cryptocephala nigriniae*. Sample 390A-6-3, 114-116 cm; × 240.

Figures 10,11 *Theocotyle cryptocephala nigriniae*. Sample 390A-7-1, 87-89 cm; × 240.

Figure 12 Theoperid gen. et sp. indet. Sample 390A-3-4, 131-133 cm; × 160.

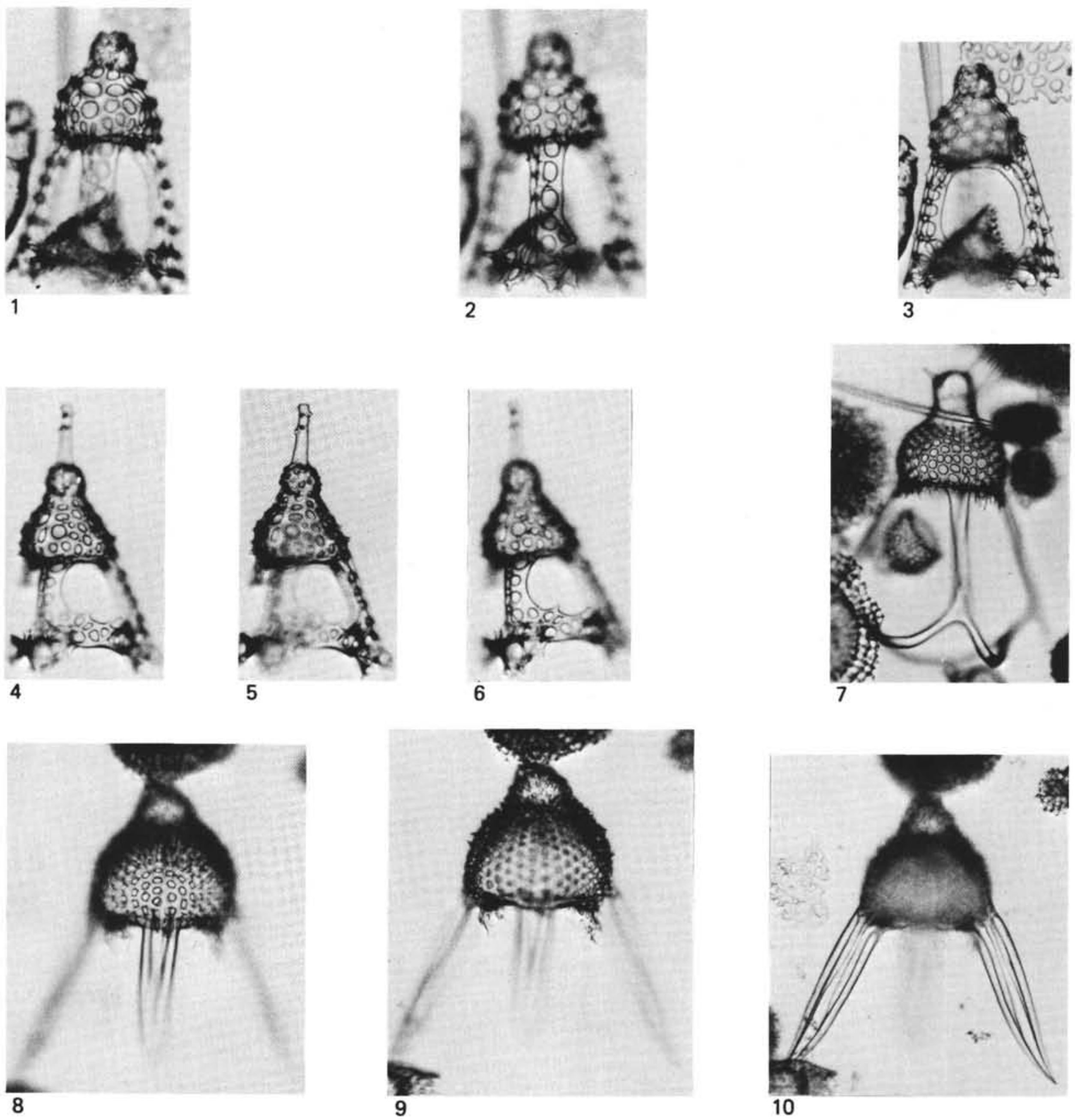

PLATE 10

Figures 1-3 *Bekoma* (?) sp. Sample 390A-7-3, 47-49 cm; × 150.

Figures 4-6 *Bekoma* (?) sp. Sample 390A-7-2, 49-51 cm; × 150.

Figure 7 *Bekoma campechensis*. Sample 390A-2-2, 107-109 cm; × 150.

Figures 8-10 *Lychnocanoma* sp. Sample 390A-6-2, 111-113 cm; × 160.

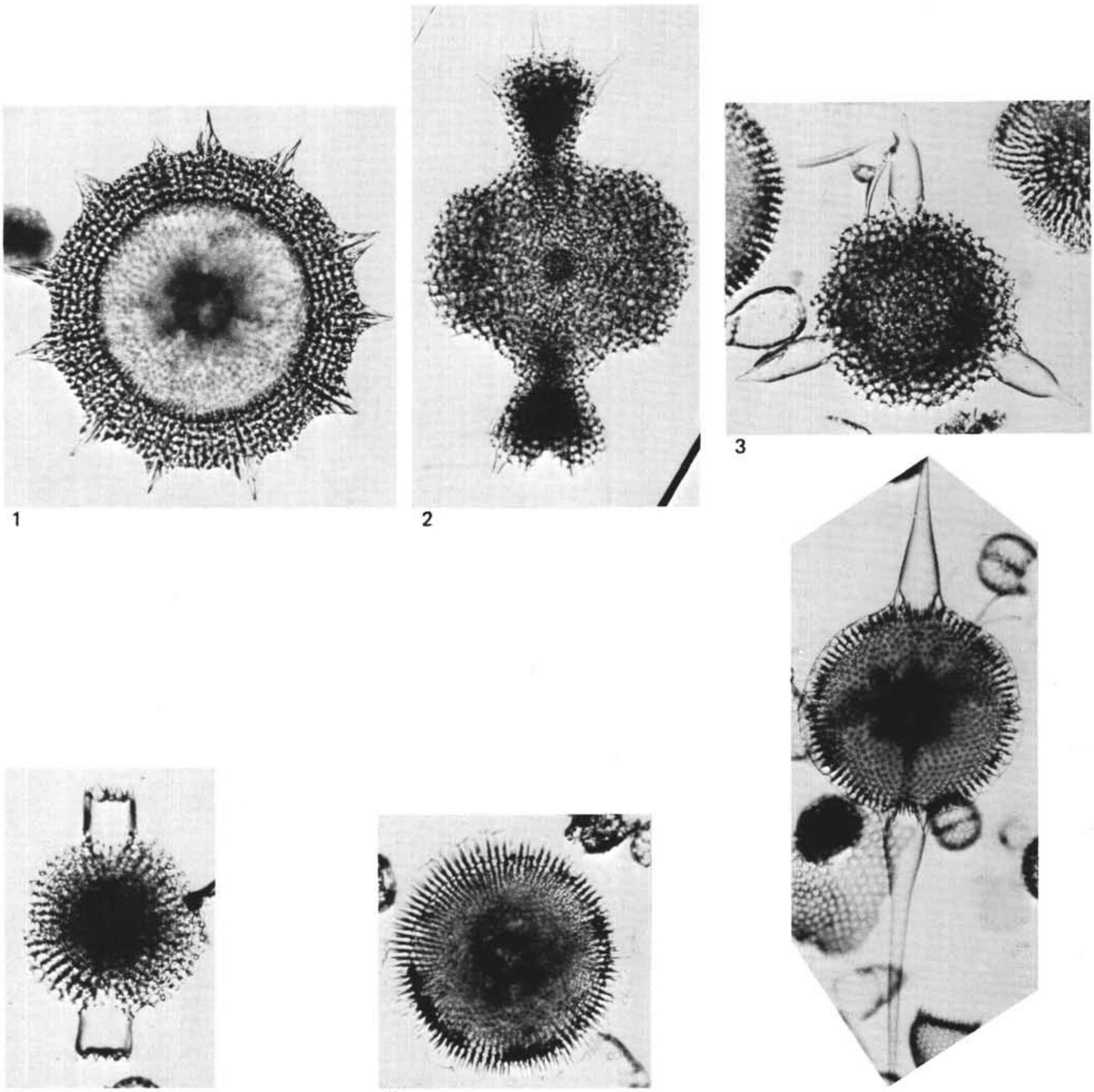

PLATE 11

Figure 1 — *Lithocyclia ocellus* group. Sample 390A-4-2, 103-105 cm; × 260.

Figure 2 — *Amphicraspedum murrayanum*. Sample 390A-7-1, 87-89 cm; × 150.

Figure 3 — *Spongodiscus rhabdostylus*. Sample 390A-4-1, 103-105 cm; × 170.

Figure 4 — *Spongodiscus* sp. Sample 390A-4-2, 101-103 cm; × 170.

Figure 5 — *Periphaena decora*. Sample 390A-3-4, 131-133 cm; × 200.

Figure 6 — *Heliostylus* sp. Sample 390A-7-2, 134-136 cm; × 190.