13. CALCAREOUS NANNOFOSSILS FROM THE SOUTHERN SOUTHWEST PACIFIC, DEEP SEA DRILLING PROJECT, LEG 29

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ABSTRACT

Calcareous nannofossils were obtained from all sites drilled in the southern southwest Pacific on Leg 29 (Figure 1). They occur in mid Paleocene to late Pleistocene sediments and show highly variable states of preservation. Diversity is generally low, as might be expected from the high southern latitudes of the sites drilled. Consequently the biostratigraphic resolution is much lower than that in subtropical and tropical areas, especially the mid Oligocene to early Pliocene part of the column. Great similarity was found between the high southern and high northern latitude assemblages of the same age, although a number of species seem to occur only in the north whereas only very few seem to be restricted to the south. Observations on the fine structure of coccoliths and nannoliths, and comparison with their northern high latitude equivalents, showed a surprisingly high degree of morphological agreement. Three new species, *Ericsonia tasmaniae, Helicopontosphaera*? *subantarctica*, and *Hornibrookina australis* are described.

INTRODUCTION

The calcareous nannofossils (coccoliths and nannoliths) of DSDP Leg 29 were studied from several points of view for this report:

1) Age determinations were deduced from the biostratigraphic studies and the results of these studies are summarized in the appropriate site report chapter.

2) Species distribution of most species observed (using the light microscope) is listed in tables with an outline of the biostratigraphic framework employed in this high latitude region (Tables 1-12).

3) Some paleoecological observations have been made.

4) Nannofossil structure is discussed emphasizing the fine structure of some of the nannofossils in order to compare them with the structure of the same species in the equivalent northern hemisphere environment (Plates 1-21).

Calcareous Nannofossil Biostratigraphy

The low-diversity nannofloras found in the Neogene and Oligocene do not allow a high-resolution biostratigraphy to be used in this subantarctic region. However, somewhat more diverse assemblages do occur in parts of the Eocene and Paleocene. The biostratigraphic events used for age assignment on Leg 29 are summarized in

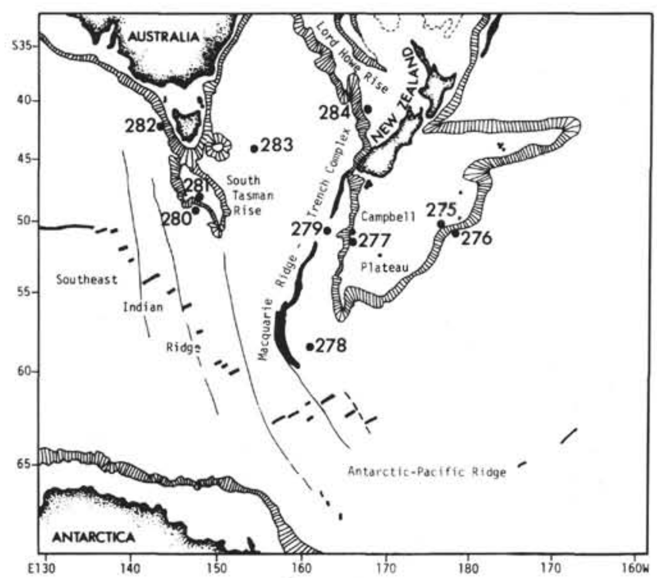

Figure 1. *DSDP Leg 29 site locations.*

Table 1. Table 2 includes the definition of the calcareous nannofossil biostratigraphic units used on Leg 29, their correlation with New Zealand stages, and their adopted age. The age distribution of the cores and sections, according to their coccolith and nannolith content, is summarized in Table 3. In Tables 4 to 12, the species distribution in all samples studied is given.

Species identification in many samples was often difficult due to heavy overgrowth on the coccoliths and nannoliths. Also the authors each having their own

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TABLE 1
Biostratigraphic Events Used for Age Assignment in DSDP Leg 29 Sites[a]

Foraminifera and Radiolarians	Series Epoch	Calcareous Nannofossils
T. *Saturnalus circularis* (Site 278, subantarctic)	Late Pleistocene	
		T. *Pseudoemiliania lacunosa* (not Site 278)
	Early Pleistocene	
B. *Globorotalia truncatulinoides* (Site 284, temperate)		
T. *Eucyrtidium calvertense* (Site 278, subantarctic)	1.8 m.y.	
	Late Pliocene	
		T. *Reticulofenestra pseudoumbilica*
	Early Pliocene	
B. *Globorotalia puncticulata* (temperate)		
T. *Triceraspyris* sp. (Site 278, subantarctic)	4.3 m.y.	
	Late Miocene	
T. *Globorotalia mayeri mayeri*		
	Mid Miocene	
B. *Praeorbulina glomerosa curva*		T. *Discoaster deflandrei*
	Early Miocene 22.5 m.y.	T. *Reticulofenestra bisecta*
	Late / Mid Oligocene	
		T. *Reticulofenestra placomorpha*
	Early Oligocene	
T. *Globigerapsis index*		
	Late Eocene	
		B. *Reticulofenestra bisecta*
	Mid / Early Eocene	
		T. *Discoaster multiradiatus*
	Late Paleocene	
		B. *Discoaster multiradiatus*
	Mid Paleocene	
		T. *Hornibrookina teuriensis*
	Early Paleocene	
	Late Cretaceous	

Note: B = first occurrence of a species; T = last occurrence.

[a]Different events define the Plio/Pleistocene and Miocene/Pliocene boundaries in temperate and subantarctic sites. Late Cenozonic radiometric ages based on paleomagnetic dating of New Zealand marine sediments (Kennett et al., 1972; Kennett and Watkins, 1972). Older ages according to Berggren (1972).

"tradition" and opinion about species names and generic assignments often had to adopt a mutual compromise on the names to be used in this report. Selected species are illustrated on Plates 1-21.

PALEOECOLOGY

Several paleoenvironmental factors can be reconstructed with reasonable confidence if well-preserved nannofloras from samples dated by at least one other fossil group are available. In the material examined here, coccoliths older than late Pleistocene are usually only moderately or poorly preserved. Furthermore, coccoliths were often the main basis for determining the age. Thus conditions for paleoecological studies were far from ideal.

The factors influencing a coccolith assemblage from its living state to the sample which is studied are numerous and include:

1) Solution during sinking. This is documented by the fact that only about one third of the living species are found in Recent sediments. Solution at this stage evidently affects different species differently.

2) Sorting of the assemblage according to size by currents (winnowing), both during sinking and in the young sediment.

3) Solution of some species and overgrowth on others as a result of diagenesis. Solution removes part of the assemblage, while overgrowth renders another part nearly or wholly indeterminable. Generally small species are dissolved so the resulting assemblage might be taken for a residual assemblage after winnowing, if the state of preservation of the remaining assemblage is not taken into consideration. Diagenesis, however, affects coccoliths differently at comparable depths (i.e., in a 9-m core) depending on the lithology of the sample (i.e., the presence of clay, zeolites, siliceous organisms, and organic material). Thus, in interbedded lithologies, the presence of different coccolith assemblages or differences in diversity need not indicate major differences in climate, but might result from different

TABLE 2
Calcareous Nannofossil Biostratigraphic Events and Zones, DSDP Leg 29

Adopted Age	New Zealand Stages	Nannofossil Zones	Biostratigraphic Events (Regional reliability in brackets)
Pleistocene, Late	Castlecliffian	*Coccolithus pelagicus*	
			T. *Pseudoemiliania lacunosa* (high)
Pleistocene, Early	Nukumaruan	*P. lacunosa*: *P. lacunosa*	B. *Gephyrocapsa oceanica* (moderate to low)
		P. lacunosa: *D. brouweri*	T. *Discoaster brouweri* (low to very low)
Pliocene, Late	Waitotaran	*P. lacunosa*: *D. surculus*	T. *Discoaster surculus* (low to very low)
			T. *Reticulofenestra pseudoumbilica* (high)
Pliocene, Early	Opoitian	*Reticulofenestra pseudoumbilica*	B. *Ceratolithus amplificus* (very low)
Miocene, Late	Kapitean	*Reticulofenestra pseudoumbilica*	T. *Triquetrorhabdulus rugosus* (low to very low)
Miocene, Late	Tongaporutuan	*Reticulofenestra pseudoumbilica*	
Miocene, Mid	Waiauan, Lillburnian, Clifdenian		T. *Cyclicargolithus neogammation* (high)
Miocene, Mid		*Cyclicargolithus neogammation*	T. *Discoaster deflandrei* (moderate)
Miocene, Early	Altonian, Otaian	*Discoaster deflandrei*	
Oligocene, Late	Waitakian		T. *"Reticulofenestra" bisecta* (high)
Oligocene, Late	Duntroonian	*"Reticulofenestra" bisecta*	
Oligocene, Mid	Whaingaroan: Late	*"Reticulofenestra" bisecta*	
Oligocene, Early	Whaingaroan: Early		T. *Reticulofenestra placomorpha* (moderate)
Oligocene, Early	Whaingaroan: Early	*R. placomorpha*	T. *Isthmolithus recurvus* (moderate to low)
Oligocene, Early	Whaingaroan: Early	*Blackites rectus*	B. *Discoaster deflandrei* (low)
			T. *Discoaster saipanensis* (low to very low)
Eocene, Late	Runangan	*R. oamaruensis*	B. *Reticulofenestra oamaruensis* (moderate)
Eocene, Late	Runangan / Kaiatan	*Discoaster saipanensis* and *I. recurvus*	T. *Cyclicargolithus reticulatus* (high)
			T. *Zygolithus* (low?)
			B. *Isthmolithus recurvus* (high)
Eocene, Late	Kaiatan	*C. oamaruensis*	B. *Chiasmolithus oamaruensis* (high)
Eocene, Late	Kaiatan	*"R." bisecta*	B. *"Reticulofenestra" bisecta* (high?)
Eocene, Mid	Bortonian	*D. tani nodifer*	B. *Cyclicargolithus reticulatus* (high)
Eocene, Mid	Bortonian	*D. distinctus* & *R. hampdenensis*	B. *Reticulofenestra hampdenensis* (moderate)
Eocene, Mid	Porangan	*C. cristatus* and *D. elegans*	B. *Reticulofenestra placomorpha* (moderate)
Eocene, Mid	Heretaungan		T. *Discoasteroides kuepperi* (moderate)
Eocene, Early	Mangaorapan	*Reticulofenestra dictyoda*	B. *Reticulofenestra dictyoda* (high)
Eocene, Early	Mangaorapan	*D. lodoensis*	B. *Discoaster lodoensis* (low-very?)
Eocene, Early	Waipawan: Late, Mid	*C. grandis* and *M. tribrachiatus*	B. *Discoasteroides kuepperi* (high)
			T. *Discoaster multiradiatus* (moderate) (also base *Discoaster diastypus*) (high?)
Paleocene, Late	Waipawan: Early; Teurian: Late	*R. cuspis, D. mediosus* and *D. multiradiatus*	
			B. *Discoaster multiradiatus* (high)
Paleocene, Mid (part)	Teurian: Mid (part)	Unnamed	
			T. *Heliolithus kleinpelli* (high?)
		H. kleinpelli	

Note: B = first occurrence of a species; T = last occurrence.

TABLE 3
Calcareous Nannofossil Correlations DSDP Leg 29

Adopted Age		Site Hole 275	276	277	278	278A	279	279A	280
Pleistocene	Late	"1-2 to 2,CC" (downhole)	1, CC	1-1 to 1-2	1-1 to 1-4	1, CC and 2, CC	1-1	1-1 to 1-3	1-1
	Early			1-2, 110 cm to 1-3, 110 cm	2-1 to 8, CC (top)		1-1, 100 cm	1-3, 110 cm	
Pliocene	Late								"Barren"
	Early								
Miocene	Late				8, CC to 15, CC				Maximum Range 1-4 to 1, CC
	Mid				16-1 to 25-3		1-1 to 1, CC	1-3 to 1-4; 1-4, 110 cm to 3-6, 30 cm	
	Early				25-4 to 30, CC			3-6, 110 cm to 11, CC	
Oligocene	Late			Maximum Range 1-4, 10 cm to 15-4	31-1 to 34 CC			BASALT	
	Mid		(ranges of selected species)						
	Early			15-5 to 21-2	BASALT				
Eocene	Late			21-3 to 21, CC; 22-1 to 22-3; 22, CC to 26-3; 26-4 to 28, CC; 29-1 to 30, CC					
	Mid			31-1 to 35 CC; 36-1 to 37-2; 37-3 to 35, CC					
	Early			38-1 to 40, CC; 41-1 to 42, CC; 43-1 to 43, CC; 44-1 to 44-2					
Paleocene	Late			Bit Sample: 44-2, 120 cm to 45, CC					
	Mid			46-2 to 46-4; 46, CC					

Note: Crosshatched areas indicate unconformities. B = first occurrence of a species; T = last occurrence.

TABLE 3 – *Continued*

280A	281	281A	282	283	283A	284	284A	Nannofossil Events
	1, CC to 2-2	1-1	1-1 to 1-4			1-1 to 1, CC	1-1 and 1-2	T. *P. lacunosa*
				1, CC	1, CC	2, CC and 3-1	1-5 to 1, CC	B. *G. oceanica*
	2-3 to 3-5	1-2 to 1, CC				3-2 to 5-4	2, CC	T. *D. brouweri*
					2-1, 40 cm	5-5 to 6-3		T. *D. surculus*
						6-4 to 8, CC	3, CC	T. *R. pseudoumbilica*
	3-6 to 5, CC	2, CC and 3, CC		Barren	Barren	9-1 to		B. *C. amplificus*
						21, CC		T. *T. rugosus*
	6-2 to 9, CC		1-5, 18 cm to 1 CC			22-1 to 22, CC		T. *C. neogammation*
	10-3 to 12-3							T. *D. deflandrei*
Unconformity or highly condensed sequence	12-4 to 13-3, 106 cm		2 CC to 5-1, 136 cm	Unconformity or highly condensed sequence				T. "*R.*" *bisecta*
Maximum Range 3-2, 30 cm to 4-5, 30 cm	13-3, 130 cm to 13 CC		5-1, 148 cm to 13-5, 110 cm	Barren				T. *R. placomorpha*
	13, CC (base)		13, CC to 14, CC					T. *I. recurvus*
			15-1 and 15-2	Max. Range 5-2 to 5, CC				B. *D. deflandrei*
								T. *D. saipanensis*
4-5, 110 cm to 9-1, 127 cm	Unconformity or highly condensed		15-2 and 15-3					B. *R. oamaruensis*
			15-3, 20 cm to 15, CC					T. *C. reticulatus*
								T. *Zygolithus*
								B. *I. recurvus*
	14-1 to 17-3, 6 cm			6-1 to 7, CC				B. *C. oamaruensis*
9, CC to 11, CC	"Barren"		16-1 to 18-1, 115 cm	Barren				B. "*R.*" *bisecta*
			BASALT					B. *C. reticulatus*
								B. *R. hampdenensis*
								B. *R. placomorpha*
Maximum Range 17, CC to 20, CC								T. *D. kuepperi*
								B. *R. dictyoda*
								B. *D. lodoensis*
								B. *D. kuepperi*
Barren								T. *D. multiradiatus* (= B. *D. diastypus*)
BASALT	SCHIST			BASALT				B. *D. multiradiatus*
								T. *H. kleinpelli*

TABLE 4A
Calcareous Nannofossil Distribution, Site 277

Adopted Age	Late Pleistocene					Mid Pleistocene to Late Pliocene					Late to Mid Oligocene																																								
Zone	*C. pelagicus*					*P. lacunosa*					*Reticulofenestra bisecta*																																								
Lithology	Foram ooze		Foram-rich Nanno ooze			Foram ooze		Foram-rich Nanno ooze			Foram-rich Nanno ooze																																								
Depth Below Sea Floor (m)	0.0-7.0																7.0-16.5							16.5-26.0							26.0-35.5							35.5-45.0							45.0-54.5						
Sample (Interval in cm)	1-1, 31	1-1, 92	1-1, 131	1-2, 10	1-2, 50	1-2, 110	1-2, 110	1-3, 10	1-3, 53	1-3, 110	1-4, 10	1-4, 50	1-4, 110	1-5, 13	1-5, 52	1, CC	2-1, 50	2-2, 50	2-3, 50	2-4, 50	2-5, 50	2-6, 50	2, CC	3-1, 110	3-2, 110	3-3, 110	3-4, 110	3-5, 110	3-6, 110	3, CC	4-1, 110	4-2, 110	4-3, 110	4-4, 110	4-5, 110	4-6, 110	4, CC	5-1, 110	5-2, 110	5-3, 110	5-4, 110	5-5, 110	5-6, 110	5, CC	6-1, 110	6-2, 110	6-3, 110	6-4, 110	6-5, 110	6-6, 110	6, CC
Overall Abundance	A	A	A	A	A	C	A	C	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	G	G	P	M	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Chiasmolithus altus		R					f				X	R	R	F	R	R	F	?	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C
C. eopelagicus							f					F			R		R			R	F	R			R		R	R	R	R	R		R	R	R		R	R		R	R	R	R	R					R		
"Coccolithus" minutulus						F		X																																											
C. pelagicus	C	C	C	C	C	A		C	C	X		C																																							
Cyclicargolithus neogammation							c				A		A	A	C	C	C	C	F	F	F	F	F	C	C	C	C	C	F	F	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C
Cyclococcolithina leptopora	F	F	F	F	R	F		R	C	F								x						1																											
C. macintyrei						R		C		C	x	F																																							
Discoaster deflandrei s.l.							r				X		X	X	R		R		1		R	R	R	1		F				1		R												1						1	
Discoaster brouweri s.l.												R																																							
Emiliania huxleyi	R	F			F																																														
Ericsonia alternans																																																			
E. ovalis s.l.							c				A		C	A	C	C	C	C	F	C	C	C	C	C	C	C	F	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C
E. fenestrata s.l.																																																			
Gephyrocapsa operta		F			C																																														
G. caribbeanica	C	C			A																																														
Helicopontosphaera kamptneri	R	F	F	X	R	X		X		X																																									
Helicopontosphaera sp.																																																			
Isthmolithus recurvus													x								r																														
Neococcolithes dubius															1						1												1											R		1					
Pontosphaera sp.						X		X	C	X		R		X	1	R	R	R		1			1	1		R	R	1				R			1											1					
Prinsiaceae, small	A	A	A	A	A	C		A	A	C	A	A	A	A																																					
Pseudoemiliania lacunosa						R		R	R	A		F																																							
Reticulofenestra bisecta				x			f				F		F	C	C	F	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	F
R. placomorpha											x			x			F													R	1											1									
Reticulofenestra sp.							r								C	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	?	F	F	F	F	F	F	F	F	R	R	R	R	F	F	F
Rhabdothorax regale	1	R	X						R			R											1			1																									
Sphenolithus moriformis							r				X		R	R	F	R	R	R	R	R	R	R	R	R	R	F		R	R	R	R	R	R	F			R	R	R	R	R	R		R	R	R	R	R	R	R	R
Syracosphaera hystrica	R	1	R	F	R	X			R	X		R																																							
Thoracosphaera sp.		R										R							R												R	R						R	R												
Zygrhablithus bijugatus							f				R	R	F	R	F	R	F	F	F	R	R	C	C	F	F	R	R	R	F	F	R	R	R	F	R	F	R	R	R	R	F	R	R	F	R	R	R	R	R	F	R

Note: A=abundant; C=common; F=few; R=rare; X=1-5 specimens; 1=1 specimen; +=present trace; and –=absent. These symbols are in lower case when specimens are thought to be reworked or contaminated. G=good; M=moderate; and P=poor preservation.

TABLE 4A – *Continued*

Adopted Age	Late to Mid Oligocene																																														
Zone	*Reticulofenestra bisecta*																																														
Lithology	Foram-rich Nanno ooze																																														
Depth Below Sea Floor (m)	54.5-64.0						64.0-73.5							73.5-83.0							83.0-92.5							92.5-102.0							102.0-111.5							115.5-121.0						
Sample (Interval in cm)	7-2, 110	7-3, 110	7-4, 110	7-5, 110	7-6, 110	7, CC	8-1, 110	8-2, 110	8-3, 110	8-4, 110	8-5, 110	8-6, 110	8, CC	9-1, 110	9-2, 112	9-3, 110	9-4, 110	9-5, 110	9-6, 110	9, CC	10-1, 110	10-2, 110	10-3, 110	10-4, 110	10-5, 110	10-6, 110	10, CC	11-1, 110	11-2, 110	11-3, 110	11-4, 110	11-5, 110	11-6, 110	11, CC	12-1, 140	12-2, 110	12-3, 110	12-4, 110	12-5, 110	12-6, 110	12, CC	13-1, 110	13-2, 110	13-3, 110	13-4, 110	13-5, 110	13-6, 110	13, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Chiasmolithus altus	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	F	C	C	F	C	C	C	C	C	F	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C
C. eopelagicus				R	R	R				R	R	R	R		R	R	R	R	R	R		R			R	R					R	R	R			R	R	R		R					R	R	R	R
"Coccolithus" minutulus																																																
C. pelagicus																																																
Cyclicargolithus neogammation	C	C	C	C	A	A	C	F	C	A	A	A	A	C	C	C	C	C	C	C	C	F	C	F	C	C	A	C	C	C	F	C	F	R	C	C	C	C	C	C	C	F	C	C	C	C	F	C
Cyclococcolithina leptopora																																																
C. macintyrei																																																
Discoaster deflandrei s.l.						1																																										
Discoaster brouweri s.l.																																																
Emiliania huxleyi																																																
Ericsonia alternans											1								1																													
E. ovalis s.l.	F	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
E. fenestrata s.l.																																																
Gephyrocapsa operta																																																
G. caribbeanica																																																
Helicopontosphaera kamptneri																																																
Helicopontosphaera sp.						1				1	R																		1																			
Isthmolithus recurvus																													1										1									
Neococcolithes dubius											1																		1									1										
Pontosphaera sp.								1					1							1						1																				1		
Prinsiaceae, small																																																
Pseudoemiliania lacunosa																																																
Reticulofenestra bisecta	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	F	C	C	C	C	C	F	C	F	C	F	C	C	C	C	C	F	F	C	C	F	C	F	R	C
R. placomorpha																																							1		1							
Reticulofenestra sp.	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	R	R	F	F	R	R	F	F	R	F	F	F	F	R	F	F	R	F	F	F	R	R	F	F	F	F	F	F	F	F	F
Rhabdothorax regale																							1																					1				
Sphenolithus moriformis	R	R	F	R	R	R	F	R	R		F	R	R	F	R	R	R	R	F	F	R	R	R	R	F	F	R	R	F	R	R	R		R	R	R	R	R		R	R	R	R	R	R	R	R	R
Syracosphaera hystrica																																																
Thoracosphaera sp.																																R									R	R				R	R	
Zygrhablithus bijugatus	R	R	R	R	R	R	R	R	R	R	F	F	F	F	F	F	F	R	R	F	F	R	R	F	F	R	F	F	F	F	R	F	F	R	R	R		R		R	R	R	R	R	R	R	R	R

TABLE 4B
Calcareous Nannofossil Distribution, Site 277

Adopted Age	Late to Mid Oligocene											Early Oligocene																							Late Eocene		
Zone	*Reticulofenestra bisecta*											top *Reticulofenestra placomorpha* to base *Reticulofenestra oamaruensis*																									
Lithology	Nanno ooze																																				
Depth Below Sea Floor (m)	121.0-130.5						130.5-140.0					140.0-149.5						149.5-159.0						159.0-168.5				168.5-178.0		178.0-187.5					187.5-197.0		
Sample (Interval in cm)	14-2, 114	14-3, 110	14-4, 110	14-5, 110	14-6, 110	14, CC	15-2, 110	15-3, 110	15-4, 110	15-5, 110	15, CC	16-1, 110	16-2, 110	16-3, 124	16-4, 110	16-5, 110	16, CC	17-2, 110	17-3, 115	17-4, 110	17-5, 110	17-6, 110	17, CC	18-1, 135	18-2, 110	18-3, 110	18, CC	19-2, 111	19, CC	20-3, 110	20-4, 144	20-5, 143	20-6, 110	20, CC	21-2, 110	21-3, 110	21 CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	P	M	M	M	M	M	M	M
Chiasmolithus altus	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C								
C. expansus																																					
C. grandis																																					
C. oamaruensis																C	C		R				C	R	F	F	R	F	C	R	F	F	F	C	C	C	C
Chiasmolithus sp.																		F	R		F	F															
Cyclicargolithus neogammation	C	C	F	F	C	C	F	F	F																												
C. reticulatus																																					
Cyclococcolithina leptopora					R			R	R																												
Discoaster barbadiensis				1												1																					
D. deflandrei						1	1		1		R												1														
D. saipanensis								1																												R	
D. tani s.l.																																R				R	
Discoaster sp.			1																																		
Ericsonia eopelagica	R	R	R	R	R	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		F	R	R	R	R	R	R	R	R	R	R
E. fenestrata s.l.			R				R			R	R	R	R	R	R	R	R	R	R	F	R	R	C	C	C	C	F	F	F	R		R		R	R	R	R
E. ovalis	C	C	C	A	A	C	C	C	C	F	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C
Helicopontosphaera salebrasa																																		1			
Isthmolithus recurvus					1				R					R	F	F	R				R		R	R	R	F	F	F	C	F	F	F	R	F			
Markalius inversus																					R										R						
Neococcolithes dubius			R	R			R																		R				x								
Pontosphaera ? sp.																																					
Reticulofenestra bisecta	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C
R. hampdenensis	F	F	C	F	F	F	F	F	C	F	F	F	F	R	R	F	F	F	R	F	F	C	C	C	C	F	F	F	F	F	F	C	F	F	R		
R. oamaruensis																															R	R	R	R	R	F	R
R. placomorpha			1	R		X				F	F	C	C	C	C	C	C	F	F	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
R. cf. *R. bisecta*																																					
R. cf. *R. dictyoda*																																					
Rhabdolithus sp.			R		R	R	F	F	F	F	F	F	F	F	F	F	F	F	R	F	F	F	F	R	R	R	F	R	F		R	R	F	F	F	R	F
Rhabdothorax regale							R		R									1																			
Sphenolithus moriformis	F	R	R	R	F	R	R		R	R	R	R	R	R	R	R	R	F	F	R	R		R	R	R	R	R		R				R	R			
S. radians																																					
Thoracosphaera sp.				R	R	R		R									R																		R	R	
Zygrhablithus bijugatus	C	C	F	R	F	R	F	R	R	R	R	F	C	F	F	F	F	C	F	C	C	C	C	C	C	F	F	F	F	F	R	R	R	R	R	F	F

Note: See Table 4A for explanation of symbols.

lithologically controlled diagenetic effects. It is then necessary to attempt to determine the reason for the deposition of different lithologies.

4) Drilling and coring, especially in the usually soupy or very soft uppermost layers, can produce mixed coccolith assemblages. These are sometimes not recognized as such, resulting in incorrect conclusions.

5) The preparation of smear slides varies from scientist to scientist. A certain amount of sorting during drying of the sample often cannot be avoided. Thus a slide may have a "residual" winnowed assemblage with mainly large forms in the central part, surrounded by a more or less normal, "true" assemblage, with an assemblage consisting mainly of smaller forms towards the edges of the slide.

Some of the ecological factors which affect the vertical and horizontal distribution of living calcareous nannoplankton are well known. Certainly others are still unknown. However, most species occurring in sediments older than Pliocene are extinct. Our conclusions about the paleoecological significance of these species are, of necessity, based on analogy with the results of previous investigations in areas where certain ecological conditions were assumed to be present.

The presence of more or less common *Zygrhablithus bijugatus* is considered to indicate deposition in water depths well above the lysocline, as this species seems to dissolve easily. Edwards (1973c) came to similar conclusions regarding DSDP Leg 21 material. However, the writers cannot yet explain why the possibly related Late Cretaceous species *Lucianorhabdus cayeuxi* is among the species most resistant to diagenesis in the Baltic chalk. *Z. bijugatus* was found to be consistently present and often common in the late Paleocene to Oligocene sediments of Site 277 on the Campbell Plateau (present depth, 1222 m). It is very rare in a very few Eocene-Oligocene samples at Site 280 south of Tasmania (present depth, 4181 m), and rare to few *Z. bijugatus* occur in the Oligocene of Site 281, just north of Site 280 (present depth, 1591 m). The presence of few to common *Z. bijugatus* in selected samples only of Oligocene and Eocene age at Site 282 (present depth, 4207 m) is at-

TABLE 4B – *Continued*

Adopted Age	Late Eocene																																	Mid Eocene					
Zone	base *R.O.* to top *c.r.*				top *Cyclicargolithus reticulatus* to base *Reticulofenestra bisecta*															base *R. bisecta* to base *C. oamaruensis*					base *C. oamaruensis* to base *C. reticulata*									base *C. reticulata* to base *R. hampdenensis*					
Lithology	Nanno ooze																			Nanno chalk																			
Depth Below Sea Floor (m)	197.0-206.5				206.5-216.0				216.0-225.5			225.5-235.0			235.0-244.5					244.5-254.0		254.0-263.4			263.5-273.0				273.0-282.5					282.5-292.0			292.0-301.5		
Sample (Interval in cm)	22-1, 138	22-2, 110	22-3, 110	22, CC	23-1, 110	23-2, 110	23-3, 110	23, CC	24-2, 110	24 3, 110	24, CC	25-1, 108	25-2, 110	25, CC	26-1, 144	26-2, 110	26-3, 110	26-4, 110	26, CC	27-1, 101	27, CC	28-1, 110	28-2, 110	28, CC	29-1, 110	29-2, 110	29-3, 110	29, CC	30-2, 110	30-3, 110	30-4, 110	30-5, 110	30, CC	31-1, 110	31-2, 110	31, CC	32-1, 110	32-3, 137	32, CC
Overall Abundance	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	A	A	A	A	A	A	C
Overall Preservation	M	M	M	M	M	M	P	M	M	M	M	M	M	M	M	P	M	P	M	M	M	M	M	M	M	M	M	M	M	M	P	M	M	M	M	M	M	M	M
Chiasmolithus altus																																							
C. expansus															F	F			R	R	R	F	F	F	R	R	F	F		F	R	F	R	R	R	R	R	F	R
C. grandis																												R											
C. oamaruensis	F		F	F	R	F	F	F	F	F	F	F	C	F	F	F	C	C	F	F	F	F	F	F															
Chiasmolithus sp.											R				R	F	R		R	F	R	R	R	R	F	F	F	R	R	F	F	F	F	F	F	R	F	F	R
Cyclicargolithus neogammation																																							
C. reticulatus				R	R	F	F	C	C	C	C	F	F	C	C	C	C	C	C	F	C	C	C	F	C	C	C	C	C	C	C	F	F						
Cyclococcolithina leptopora																																							
Discoaster barbadiensis															R	R	R						R							R							R	R	R
D. deflandrei																																							
D. saipanensis					R			R		1					R	R		1						1			R			R	R	R					1		
D. tani s.l.								R			R	R			R	R				R			R		R		R				R	R							
Discoaster sp.																	1				R			R				R	R	F			R	R	F				
Ericsonia eopelagica	R	F	F	R	F		R	F	F	F	F	F	F	F	R	R	R	F	R	F	R	F	F	R	F	R	R	R	R	R	R	F	F	R	R	R	R	R	R
E. fenestrata s.l.		R				R				R			F	R	R			R	R	R	R	R	R	F	R	R	R	R	R		F	R	R	F	F		R	R	
E. ovalis	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Helicopontosphaera salebrasa																	1			1				R			R					R	R	R	R		R	R	R
Isthmolithus recurvus	R	R	R	F	F	R	R	R	R	R	R					1	R																						
Markalius inversus		R		R	R	R			R	R		R			R	R		R	R			R	R		R	R		R		R		R	R	R	R		R	R	
Neococcolithes dubius			R			R						R	R	R	R	F	R	R		R	R	F	F	F	F	F	F	F	R	R	F	F	F	F	F	R	F	F	R
Pontosphaera ? sp.																			R						R		R	R		R	R	R	R	R					
Reticulofenestra bisecta	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	R																						1
R. hampdenensis		F	F	F	F	F	F	F		F				F	F		R	F	R	C	C	C	C	C	C	C	C	C				F	C	C	C		F		
R. oamaruensis				X																																			
R. placomorpha	F	F	C	C	F	F	F	R	F	C	C	C	C	C	F	C	C	C	F	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
R. cf. *R. bisecta*																																							
R. cf. *R. dictyoda*																				C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Rhabdolithus sp.	R	R		R	R	F	F	R	R	F	C	F	F	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	
Rhabdothorax regale																																							
Sphenolithus moriformis	R	R	R		F	R	R	R		R	R	R	R	R	R	R		R	R		R		R	R	R	R	R	R			F	F	F	F	F	F	R	F	F
S. radians																					1											1							
Thoracosphaera sp.	R	F	F	F	R	F	F	R		F		F	F	R	F	F	F	C	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F		F	R	R
Zygrhablithus bijugatus	F	F	F	F	F	F	F	F		F	F	F	F	F	F	F	R	F	C	F	C	C	C	F	F	F	C	C	F	F	F	F	C	F	F	C	F	F	C

tributed to occasional rapid transport and burial of coccoliths and nannoliths from the nearby shelf of Tasmania and southern Australia. *Z. bijugatus* is missing at Site 283 (4746 m, present depth), although coccolith-bearing Eocene sediments were found.

At most sites of Leg 29, representatives of the Pontosphaeraceae (except *Helicopontosphaera*) are rare or absent. This is also true of the Braarudosphaeraceae. Both are well known for their preference for nearshore environments. These conclusions are consistent with New Zealand and DSDP Leg 21 experience (Edwards, 1968; 1973b). Pontosphaerids often occur as few to common in samples containing common Braarudosphaeraceae, as well as when the latter are rare.

The ratio between discoasters, considered to be warm water forms because of their abundance in sediments deposited in tropical seas, and *Chiasmolithus*, representative of cooler conditions, has been used as an indication of changing climates (Bukry, 1973). *Chiasmolithus* occurs from the Paleocene through to the Oligocene whereas discoasters last until the end of the Pliocene (by definition) in warm areas, but are absent earlier in cool water areas. No counts were made of discoasters and *Chiasmolithus* in Leg 29 samples. Some trends, however, can be extracted from the observations made so far and are tabulated in Tables 4-12.

In the late Paleocene of Site 277, discoasters are initially more frequent than *Chiasmolithus* but a reversal occurs near the top. Above this *Chiasmolithus* dominates over discoasters until both groups reach similar frequencies in the late early Eocene to early mid Eocene interval. Discoasters are rare or usually absent throughout the remainder of the Eocene and the Oligocene, whereas various species of *Chiasmolithus* flourish. This pattern is considered to indicate a temporary cooling of the climate across the late Paleocene-early Eocene boundary, relatively warmer conditions again in the late early Eocene and early mid Eocene, and finally cooler conditions for the remainder of the Eocene and most of the Oligocene. These conclusions are consistent with the distribution of warm water nannoliths excluding discoasters and the cosmopolitan *Sphenolithus moriformis* group. In the entire Paleogene sequence of Site 277 these nannoliths are only represented by *Fasciculithus tympaniformis* (common in the late mid Paleocene to mid late Paleocene interval), and *Sphenolithus radians* (rare in the early to mid early Eocene and rare to few in the late early Eocene and early mid Eocene). A similar

TABLE 4C
Calcareous Nannofossil Distribution, Site 277

Adopted Age	Mid Eocene																				Early Eocene																						Late Paleocene													Mid Paleocene			
Zone	base *C. reticulata* to base *R. hampdenensis*									base *R. hampdenensis* to base *R. placomorpha*				base *R.p.* to top *D.K.*			top *D. kuepperi* to base *R. dictyoda*										base *R. dictyoda* to base *D. kuepperi*										base *D. kuepperi* to top *D. multiradiatus*						*Discoaster multiradiatus*													base *D.m.* to top *H.k.*			*H.k.*
Lithology	Nanno chalk																																																										
Depth Below Sea Floor (m)	311.0-320.5			330.0-339.5			349.0-358.5			368.0-377.5				377.5-387.0			387.0-396.5				396.5-406.0			406.0-415.5			415.5-425.0			425.0-434.5			434.0-444.0				444.0-453.5												453.5-463.0							463.0-472.5			
Sample (Interval in cm)	33-1, 120	33-2, 110	33, CC	34-1, 104	34-2, 110	34, CC	35-1, 105	35-2, 104	35, CC	36-1, 126	36-2, 108	36-3, 108	36, CC	37-2, 102	37-3, 112	37, CC	38-1, 120	38-2, 110	38-3, 112	38, CC	39-2, 110	39-3, 120	39, CC	40-2, 110	40-3, 117	40, CC	41-1, 113	41-2, 111	41, CC	42-2, 119	42-3, 114	42, CC	43-1, 112	43-2, 126	43-3, 121	43, CC	44-1, 101	44-2, 20	44-2, 60	44-2, 90	44-2, 107	44-2, 120	44-2, 130	44-2, 140	44-3, 18	44-3, 80	44-3, 112	44, CC	45-1, 102	45-2, 118	45-3, 127	45-4, 126	45-5, 111	45-6, 122	45, CC	46-2, 118	46-3, 114	46-4, 111	46, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	C	A	A	A	A		A	C	A	A	A	A	A	A	A	A	C	C	A	A	C	C	C	C	C	C	C	A	C	C	C	C	C	C	C	C	C	C	C
Overall Preservation	M	M	P	P	M	M	M	M	M	P	M	M	P	P	P	P	M	M	M	M	P	M	M	M	M	M	M	M	P	M	M	P	P	M	M	P	M	M	M	M	P	M	M	M	M	M	M	P	M	M	M	M	P	M	P	P	P	P	P
Biscutum panis																								1			1		R	R	R	R	R											R	R	R	R	R	C		1						1		
Chiasmolithus eograndis																		f		F							R	F	F	F	F	F	F	C	C	R	C	F	C	C	F	F	F	R	C	C	C	F	F	R	R	R	R		R		R		
C. expansus	F	R	R	R	F	F	F	F	R	F	F	R	R	R			R	R																																									
C. grandis	R							R				R	R	R	F	F	R	R	R	R	R	R	R	R				F																															
C. solitus + *C.* sp.	C	C	F	F	C	C	C	C	C	S	C	C	C	C	C	C	C	C	F	F	F	F	C	C	F	F	F	F	F	F	F	F																1											
Conococcolithus? sp.																																R	F	R	R	R	R	R	R	R	R																		
Cruciplacolithus staurion					R	R	R														1		1																																				
Cruciplacolithus sp.										1				1																				R	R			R	R																				
Discoaster barbadiensis	?		?														R	R			1	1	1		F	C	F	C	F	F	F	R																											
D. diastypus																																				R	R	R	R	R																			
D. kuepperi			1				1										R	R	F	R	R	R	F	F	R	F	F	F	F	F	R	R	R	R	R	F																							
D. lodoensis																	R	C		F	R	1	R	R	R	F	R	R	R	1		R																											
D. multiradiatus																																						R	R			X	R	R	R	R		R	F	C	C	F	F	R	R				
D. sublodoensis-?														R			?	F?			?		?			?	1																																
D. wemmelensis							F	R	F		F		1	1		R		1		1																																							
Discoaster sp.	R		R	F		F	R	F	R				R		F	R	F	C	F	F	F	F	F	F	F	C	C	F							R			1																					
Ellipsolithus macellus															R	1	1		1			1															R	R	R	R	R	R		R			R	1		R	R								
Ericsonia alternanus	R		R	R	R	R	F	R	R		R		R		R	R	R	F	F	F	F	F	F	R	R	R	F	R																															
E. copelagica	R	F	R	R	F	F	R	R	R	R	R	R	R																																														
E. fenestrata s.l.	F	R		R	R	R	F	R	F		F	R				R	R	R	F	R	F	F	F	F		F	R	R	R	F	F	F							R																				
E. ovalis	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	F	F	F	F	R	F		R	C
Fasciculithus tympaniformis																													1							1							1		1	1	R	R	F	C	C	C	C	C	C	C	C	C	
Heliolithus kleinpellii				1												1			1								1				1	1					sp.	sp.	sp.	sp.																sp.			F
Hornibrookiana australis																																							R		F	R		F	F	C	F	R	F	C	R					1		1	
Markalius astroporus	R		R			R	R				R	R	R		R	R	R	R					1	R	R	R	R	R	R	R	F	F	F	F	R	R	R	R	F	F		R	R	R	F	R	R	R	F	F	F				R	R			R
Neochiastozygus concinnus																																																			R				R	F	R		R
N. distentus																																							1			R		R		R	F				F	R			R				
Neococcolithes dubius s.l.	F	R	R	R	F	F	F	F	F	C	C	C	F	F	C	C	C	C	C	C	F	F	F	F	F	F	F	R	F	R	F	F	F	F	R		R	R	R	R	R			F	F	F	R	F	F	C									
Pontosphaera sp.																			1														R		R		R				R	R							R										
Marthasterites tribrachiatus																																				R		1			1																		
Reticulofenestra cf. *R. bisecta*	F	F	F	F	R	R	F	F	R	R	F	F	F	F	F	F	F																																										
R. cf. *R. dictyoda*	A	C	F	C	C	F	A	A	C	A	A	A	A	C	C	C	C	C	C	C	C	C	C	C	F	C																																	
R. hampdenensis	R	R	R	R	R	F	F	F	R																																																		
R. placomorpha	C	C	C	C	F	F	F	F	F	R	F	R	R	R																																													
Rhabdolithus sp.	F	R		R	F	R	R	R	R	R	R	R	R																																														
Sphenolithus moriformis	F		F	R	R	F	F	R		R	R	R	F	R	R	R	F	F	R	R	F	F	F	F	F	F	R	F	R	C	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	C	C	C	C	F	F	F	R	F	F	F			
S. radians														R	R	R	R	F	F	R	R	F	F	F	R	F	R	R	R	R	F	F	R	R	R	R	R	X	R																				
Thoracosphaera sp.			R	R	F	F	R					R	R	R			R	R	R	R	C	F	F	F	F	F	F	F	F	F	F	F	F	F	R			R	R	R	R	R	R	R	F	R	F	F	C	C	F	F	F	R	F			R	
Toweius? sp., large																	1				1		1	1	F	R	R	R						R				R	C	C	F	F	C	R	C	C	C	C	C		R	C	C	F	F	F	R		
Zygrhablithus bijugatus s.l.	F		R	F	F	F	R	F	C	F	F	R	F	F	F	F	C	C	C	C	C	C	C	C	C	A	A	C	A	C	C	A	C	A	A	A	A	C	C	C	A	F	C	F	F	F	C	C	C	C	1								

Note: See Table 4A for explanation of symbols.

TABLE 5A
Calcareous Nannofossil Distribution, Site 278

Adopted Age	Late Pleistocene									
Zone	*Coccolithus pelagicus*									
Lithology										
Depth Below Sea Floor (m)	0.0-6.0								~17	~31
Sample (Interval in cm)	1-1, 120	1-1, 131	1-2, 30	1-2, 110	1-3, 20	1-3, 118	1-4, 150	1-4, 150	1A, CC	2A, CC
Overall Abundance	R	R	C	C	C	F	R	R	R	R
Overall Preservation	P	M	M	M	M	M	M	P	M	M
Coccolithus minutulus										
C. pelagicus	F	X	X	F	X	F	X	C	R	
Cruciplacolithus cf. *C. neohelis*										
Cyclococcolithina leptopora	F	R	A	C	A	C	X	F	F	
C. macintyrei										
Emiliana huxleyi ?	F	F	A	C	F	F	F			
Gephyrocapsa spp., small		X	R		R		X		X	X
G. cf. *G. oceanica*			X	F	X	F			X	
Helicopontosphaera kamptneri		X	R	F	F	F			X	X
Pontosphaera spp.								R		
Prinsiaceae, small	F			C		C		C	R	F
Pseudoemiliania lacunosa										

Adopted Age	Mid Pleistocene to Late Pliocene												
Zone	*Pseudoemiliania lacunosa*												
Lithology	Diatom ooze												
Depth Below Sea Floor (m)	101.0-110.5												
Sample (Interval in cm)	2-1, 30	2-1, 110	2-2, 30	2-2, 110	2-3, 30	2-3, 110	2-4, 30	2-4, 110	2-5, 30	2-5, 110	2-6, 30	2-6, 110	2, CC
Overall Abundance	C	C	C	C	C	F	F	F	C	C	C	F	F
Overall Preservation	M	P	M	M	M	P	P	P	P	P	P	M	P
Coccolithus minutulus	R	F	C	F	C	R	R	R	R		R	R	R
C. pelagicus	C	C	C	C	F	R	C	F	C	F	C	R	R
Cruciplacolithus cf. *C. neohelis*							X						
Cyclococcolithina leptopora	F	C	C	F	C	F	F	C	F	C	F	C	C
C. macintyrei													
Emiliana huxleyi ?													
Gephyrocapsa spp., small	X		X		C						X		
G. cf. *G. oceanica*							X						
Helicopontosphaera kamptneri					X		X		X		X	R	
Pontosphaera spp.					X								
Prinsiaceae, small	R	F	A	A	A	C	C	C	A	C	A	C	F
Pseudoemiliania lacunosa	C	C	A	F	R	F	R	C	X	F	X	C	R

Adopted Age	Mid Pleistocene to Late Pliocene																		
Zone	*Pseudoemiliania lacunosa*																		
Lithology	Diatom ooze																		
Depth Below Sea Floor (m)	110.5-120.0							120.0-129.0			129.5-139.0							139.0	
Sample (Interval in cm)	3-1, 110	2-2, 110	3-3, 110	3-4, 110	3-5, 110	3-6, 110	3 CC	4-1, 110	4-2, 110	4, CC	5-1, 110	5-2, 110	5-3, 110	5-4, 110	5-5, 110	5-6, 110	5, CC	6-1, 110	6-2, 56
Overall Abundance	F	C	F	C	C	C	C	C	C	F	C	F	C	F	F	F	R	C	C
Overall Preservation	P	P	P	P	P	P	P	M	P	P	P	P	P	P	P	P	P	M	M
Coccolithus minutulus	R	R		R	R		R			X									
C. pelagicus	F	F	R	R	F	F	F	F	F	R	F	F	F	F	R	F		F	F
Cruciplacolithus cf. *C. neohelis*		R						R											
Cyclococcolithina leptopora	C	C	F	F	C	C	C	C	C	F	C	F	C	F	F	R	X	F	F
C. macintyrei					R	R	R			F									R
Emiliana huxleyi ?																			
Gephyrocapsa spp., small											F		F					R	
G. cf. *G. oceanica*	R																		
Helicopontosphaera kamptneri								X	R	R	F	R							R
Pontosphaera spp.		R																	
Prinsiaceae, small	C	C	C	C	A	C	C	C	C	C	C	C	A	C	C	C	C	A	A
Pseudoemiliania lacunosa	F	F	C	C	C	F	C	C	C	F	F	R	R	F	R	R		F	F

Note: See Table 4A for explanation of symbols.

pattern has been observed in New Zealand and southern DSDP Leg 21 samples.

At Site 278, *Chiasmolithus* is common to abundant in the mid and late Oligocene; discoasters are usually absent. Very rare specimens (visitors) occur in a few samples in the latter part of the Oligocene. This site at present underlies the Antarctic Convergence.

In the poorly dated Oligocene and Eocene at Site 280, *Chiasmolithus* is absent or occasionally rare to common. Discoasters are absent. Here, the absence of *Chiasmolithus* is probably due to deposition just above the calcite compensation depth. As discoasters are known to be more resistant to dissolution than coccoliths, it can reasonably be concluded that the absence of discoasters is a primary feature, probably resulting from adverse climatic conditions.

At Site 281, *Chiasmolithus* is common in the early late Eocene, early Oligocene, and late Oligocene whereas discoasters only occur in low numbers in a short late Oligocene interval which follows a hiatus.

At Site 282, *Chiasmolithus* is as rare as the discoasters in the late Eocene but they become more frequent through the Oligocene where chiasmoliths dominate over the discoasters which are rare or, more usually, absent.

Where Paleogene calcareous nannofossils are present in reasonable numbers at Site 283 (early late Eocene) *Chiasmolithus* dominates over the very rare discoasters.

These observations on the frequency relationships of discoasters and *Chiasmolithus* strongly support the use of this ratio as a tool to detect changes in paleoconditions, possibly in terms of paleotemperatures.

Observations on the Neogene Leg 29 occurrences of discoasters show the following. (1) Discoasters are conspicuously common in the early Miocene sediments of Sites 279, 281, and 282, but much rarer in the underlying and overlying assemblages (see Site Reports, Chapters 6, 8, and 9, this volume). This pattern is so pronounced at these sites that the simple observation that a sample of unknown age contains common discoasters is sufficient to date it as early Miocene! A similar but less pronounced pattern occurs in equivalent age sediments in New Zealand, and at the southern DSDP Leg 21 sites. This pattern coincides with the strongest indications for warm climate in New Zealand (Hornibrook, 1971). (2) This pattern does not extend as far south as Site 278. At this site, which at present underlies the Antarctic Convergence, discoasters are very rare and sporadic throughout the entire sequence. Even the cosmopolitan *Sphenolithus moriformis* group *s.l.* is rare and sporadic in its Neogene occurrences. At this site it would seem advisable to consider all discoasters as "visitors." (3) In Leg 29 sediments the last appearance of discoasters, which in warm water areas is considered to coincide with the Plio-Pleistocene boundary, is clearly climatically controlled. For example, at Site 284 (40°S) their last appearance appears to approximate their extinction in warm water areas, but at Site 281 (48°S) their last occurrence (more than one specimen observed) occurs in the basal Pliocene, and at Site 278 (56°S) their last occurrence probably occurs in the early mid Miocene. A similar but less extreme pattern has been observed in both the North Atlantic (Perch-Nielsen, 1972), and New Zealand.

Southern and Northern High-Latitude Calcareous Nannofossils in the Cenozoic

Calcareous nannofossils are currently widely used for intercontinental and interoceanic correlations of marine sediments. Several zonal schemes have been proposed for different areas and a "standard Tertiary and Quaternary calcareous nannoplankton zonation" was

TABLE 5B
Calcareous Nannofossil Distribution, Site 278

Adopted Age	Mid Pleistocene to Late Pliocene																																	
Zone	*Pseudoemiliania lacunosa*																																	
Lithology	Diatom ooze																																	
Depth Below Sea Floor (m)	139.0-148.5						148.5-158.0							158.0-167.5								167.5-177.0								177.0-186.5				
Sample (Interval in cm)	6-2, 135	6-3, 126	6-4, 120	6-5, 110	6-6, 110	6, 110, CC	7-1, 110	7-2, 110	7-3, 110	7-4, 110	7-5, 110	7-6, 110	7, CC	8-1, 143	8-2 110	8-3, 110	8-4, 106	8-5, 110	8-6, 30	8, CC	8, CC	9-1, 30	9-1, 110	9-2, 110	9-3, 110	9-4, 110	9-5, 110	9-6, 110	9, CC	10-1, 110	10-2, 110	10-3, 110	10-4, 110	10-5, 110
Overall Abundance	C	C	F	R	F	F	F	F	F	F	F	F	R	-	-	R	-	-	C	R	C	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	P	P	P	P	P	P	P	P	P	P	-	-	P	-	-	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Coccolithus eopelagicus s.l.																								R	R							R		
C. pelagicus group	F	F	F	R	F	R	F	F	F	R	R	F	R						C	R	C	R	F	C	R	R	F	R	C	R		F	R	R
Cyclicargolithus neogammation																																		
Cyclococcolithina leptopora	R	F	F	R	R	R	R	R			R	F	R						R		R		R				R							
C. macintyrei	R			R						R		R	X									R	R	F	R	F	R	R	R	R				
Discoaster pentaradiatus																				X		X												
Discoaster sp.									R											X	X			R				X						
Prinsiaceae, small	A	A	C	F	C	C	C	C	C	C	F	F	F			R				R	C	A	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa	R	R	R	R	F	F																												
Reticulofenestra pseudoumbilica																				X	C	A	A	A	A	A	A	A	A	A	A	A	A	A
Sphenolithus abies																																		
S. neoabies																							R	R					X					
Thoracosphaera sp.								R																R	R			R						

Note: See Table 4A for explanation of symbols.

suggested by Martini (1971). The degree of biostratigraphic resolution obtainable using calcareous nannofossils is highest in the lower latitudes where diversity is high, and gradually decreases to the north and south with the decrease in diversity. The association of two authors having different experiences with southern and northern high-latitude calcareous nannofossils provided a valuable opportunity to consider the following:

1) How far south and north can the "tropical" zonations be used? It was noted by Perch-Nielsen (1972) that in the north Atlantic, the "tropical" zones were generally useful to almost 60°N in the Paleogene, while similar correlations in the Neogene became increasingly more difficult as the sediments became younger. Although the index species were usually present, they were often extremely rare. Biostratigraphy could be based mainly on nannoliths such as discoasters, sphenoliths, and ceratoliths. In the southern high-latitude sites drilled on Leg 29, the "tropical" zones could hardly be used in the Paleocene and early Eocene. By mid Eocene the marker species of families other than Coccolithaceae and Prinsiaceae began to disappear south of about 50°S. Only a few low-ranging discoasters are present, and the Prinsiaceae (*Reticulofenestra, Dictyococcites, Cyclicargolithus, Pseudoemiliania, Gephyrocapsa,* and finally *Emiliania*) constitute the greatest part of the assemblage. This assemblage also includes *Coccolithus pelagicus s.l.,* and occasional occurrences of warmer species as "visitors." Thus the "tropical" zones can be recognized farther north than south. This situation is easily explained by the effect of the warm Gulf Stream on that portion of the northern Atlantic in which the sequences studied have been recovered.

2) Is there a difference in the relative levels of the first and/or last occurrences of different species in northern and southern high latitudes? Some examples of reversed events were observed. For example, the first occurrences of *Reticulofenestra bisecta* and *Chiasmolithus oamaruensis* change their relationship to each other. In Denmark and at Site 277, *C. oamaruensis* occurs before *R. bisecta* whereas in New Zealand *R. bisecta* appears before *C. oamaruensis* (Edwards, 1971). Details of this and eventual other "reversed" first occurrences will, however, have to await further, more detailed, investigation before they are understood. It is well known that, for example, *Isthmolithus recurvus* is not a "reliable" taxon in low latitudes. Also, *Discoaster saipanensis,* the last occurrence of which marks the Eocene-Oligocene boundary in low latitudes, is unreliable in high southern and northern latitudes. Such examples illustrate the uncertainties involved in the age assignments. They also demonstrate the idealistic nature of the assumption that first and last occurrences occur at the same time all over the world. Diachronous first and last appearances are far more frequent in the high southern and northern latitudes than in the "tropical" regions.

3) Are there species in one region that do not occur in other high latitude regions? No detailed survey has yet been attempted to find the complete assemblages of southern high latitudes for different stratigraphic levels. Such studies need well-preserved material and sufficient time to study it extensively under the electron micro-

TABLE 5B – *Continued*

Early Pliocene to late Mid Miocene																																				Early mid Miocene					
Reticulofenestra pseudoumbilica																																				*Cyclicargolithus neogammation*					
Siliceous nanno ooze																																				Siliceous ooze					
		186.5-196.0							196.0-205.5							205.5-215.0						215.0-224.5							224.5-234.0							234.0-243.5					
10-6, 110	10, CC	11-1, 110	11-2, 110	11-3, 110	11-4, 110	11-5, 110	11-6, 110	11, CC	12-1, 110	12-2, 110	12-3, 110	12-4, 110	12-5, 110	12-6, 140	12 CC	13-2, 110	13-3, 110	13-4, 110	13-5, 110	13-6, 108	13, CC	14-1, 110	14-2, 70	14-4, 118	14-5, 84	14-5, 110	14-6, 110	14, CC	15-1, 140	15-2, 110	15-3, 110	15-4, 110	15-5, 110	15-6, 110	15, CC	16-1, 30	16-1, 110	16-2, 110	16-3, 115	16-4, 110	16-5, 110
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	A	F	A	C	R	-	-	F	R	C	A	C	-	A	C	R	-
P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	-	-	P	P	P	P	P	-	P	P	P	-
R					R												R						R			R	R	R													
	R	R	R	R	F	F	R	F				R		R							X		R		R	R	R	R	R					R	R	X		F	F		
																																				R		F	F	F	
							R																																		
	F					R		X						R		R							R	R	R			R								X					
	X							X																				X							X						
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C	C	C	F	F		F			R	R	C	C			A	C	R	
A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A	A	A			R		A	A	A	A		A	A		
	X																																		X						

scope in order to find and examine the rare and very rare species. Generally it can be said that truly oceanic assemblages have, in both the southern and northern high latitudes, a lower diversity than assemblages known from shelf regions.

While many species seem to be common to both northern and southern high latitudes, some seem to be restricted to the northern latitudes and a very few to the southern latitudes. This certainly is partly due to the fact that far less studies have been made from the southern high latitudes and thus fewer species have been found. Selected species found only in the southern high latitudes are therefore of more interest here as if they occurred in the north they should have been found and described by now. In the Paleocene, we note the presence of the genus *Hornibrookina* in New Zealand and at DSDP Sites 206, 207, 208, and 277. Only one of the two species of this distinctive genus has so far been found in the north (*H. australis*, in the Crimea, U.S.S.R.). In the Eocene we note the presence of *Reticulofenestra hampdenensis* from New Zealand and the Eocene of different sites of Legs 21 and 29. This species is very closely related to, and perhaps identical with, *Dictyococcites onustus* Perch-Nielsen, and *Cribrocentrum foveolatum* (Reinhardt). The new species described in this paper from the Oligocene of Site 277, *Helicopontosphaera*? *subantarctica*, is so large and easily recognizable in the light microscope that it should have been found earlier in the northern hemisphere, if it existed there. Apart from *Hornibrookina teuriensis* it might be the only really southern taxon found so far. The occurrence of the *Ilselithina* sp. in the Miocene is also noteworthy, and might be another indication of a coccolith with a restricted southern distribution. However, this small and delicate form might have been overlooked in other samples.

4) Is the fine structure of species the same in northern and southern high latitudes, or are there differences that exceed the usual species concept, but which cannot be distinguished using the light microscope? The fine structure of a limited number of species, mainly of the Paleocene to Oligocene of Site 277, has been studied with the scanning electron microscope (SEM) for comparison with the fine structure of calcareous nannofossils studied from DSDP Leg 12 (Perch-Nielsen, 1971a, b, and 1972) in the North Atlantic and from Denmark (Perch-Nielsen, 1971b, c). So far the differences observed in the fine structure found in the same species from the northern and southern high latitudes can readily be attributed to differences in preservation. Solution and/or overgrowth have affected the fossils beyond recognition of possible differences in their structure if they ever existed.

SYSTEMATIC PALEONTOLOGY

No attempt has been made in this report to update the names of calcareous nannofossils listed on the tables or plates. From this study it was evident that the members of the Prinsiaceae family will have to be studied very closely with both the light microscope and the SEM if a reliable and relatively finely subdivided high-latitude zonation is to be established. In the following, three new species from the late Paleocene, early Oligocene, and early Miocene, respectively, are described.

Genus ERICSONIA Black 1964

Ericsonia tasmaniae n.sp.
(Plate 20, Figures 5-12)

Holotype: Plate 20, Figure 5; distal view.
Paratype: Plate 20, Figure 11; proximal view.

TABLE 5C
Calcareous Nannofossil Distribution, Site 278

Adopted Age	Early mid Miocene																								
Zone	*Cyclicargolithus neogammation*																								
Lithology	Siliceous ooze		Nanno ooze, siliceous nanno ooze, and siliceous ooze															Radiolarian-Diatom and Siliceous oozes							
Depth Below Sea Floor (m)	243.5		243.5-253.0					235.0-262.5							262.5-272.0					272.0-281.5					
Sample (Interval in cm)	16-6, 110	16, CC	17-2, 110	17-4, 110	17-5, 110	17-6, 110	17, CC	18-1, 110	18-2, 110	18-3, 110	18-4, 110	18-5, 110	18-6, 110	18, CC	19-2, 60	19-2, 110	19-3, 13	19-3, 54	19, CC	20-1, 125	20-3, 126	20-5, 110	20-6, 25	20-6, 110	20, CC
Overall Abundance	C	C	R	F	-	C	C	C	C	C	C	C	C	C	F	F	C	C	C	C	-	A	A	C	R
Overall Preservation	P	P	P	P	-	P	P	P	P	P	P	P	P	P	P	P	P	M	P	P	-	P	P	P	P
Chiasmolithus altus																	X								
Coccolithus eopelagicus						R	R			R			R				R		R						
Cyclicargolithus neogammation	F	F		F		C	C	F	C	C	C	C	C	A	F	F	C	F	F	F		C	C	C	R
Cyclococcolithina macintyrei		X												X											
Discoaster adamanteus																									X
D. cf. *D. aulakos*																						1		1	R
D. cf. *D. bollii*							1		1											1					1
D. challengeri						1			R		1			1										1	1
D. deflandrei																									
D. druggi?																									
D. exilis	1	1					1	1			1		R	X											
D. variabilis						R	R	R	R		R	R		X				R		R		R		R	X
Discoaster sp. indet.	R			R		R	X	R	F			R	R	X		R	R	R	X	R		R	R	R	
Ericsonia ovalis group		R	R	F		C	A	C	F	F	F	C	C	C	F	F	C	C	C	F		R	F	C	F
Prinsiaceae, small	A		R	R		C	C	C	C	C	C	C	A	C	F	F	R	R	A	C		C	A		
Reticulofenestra bisecta																									
R. pseudoumbilica		A																	R						
Reticulofenestra sp.																	F					A	A		
Sphenolithus moriformis																	R	R							
Thoracosphaera sp.																									

Adopted Age	Early mid Miocene																						
Zone	*Cyclicargolithus neogammation*																						
Lithology	Radiolarian-Diatom and Siliceous oozes																						
Depth Below Sea Floor (m)	281.5-291.0						291.0-300.5				300.5-310.5												
Sample (Interval in cm)	21-2, 125	21-3, 110	21-4, 140	21-5, 110	21-6, 110	21, CC	22-1, 110	22-2, 110	22-4, 110	22, CC	23-1, 10	23-1, 110	23-2, 25	23-2, 140	23-3, 53	23-3, 110	23-4, 10	23-4, 65	23-5, 30	23-5, 110	23-6, 30	23-6, 110	23, CC
Overall Abundance	A	A	A	A	A	A	A	R	C	C	C	C	F	C	F	R	F	R	C	F	C	C	C
Overall Preservation	P	P	P	P	P	P	M	P	M	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Chiasmolithus altus	X								X														
Coccolithus eopelagicus						X			R	F			X		X						X		F
Cyclicargolithus neogammation	C	C	C	C	C	F				X	C	F	C	R	F	R	R		F		R	F	X
Cyclococcolithina macintyrei																							
Discoaster adamanteus											X		X						X				X
D. cf. *D. aulakos*																							
D. cf. *D. bollii*																							
D. challengeri																							
D. deflandrei							cfX			cfX		cfX		cfX		cfX							cfX
D. druggi?										X	X		X		X		X		X		R		X
D. exilis																							
D. variabilis																							
Discoaster sp. indet.			R			X	R			X		R	X		X				R	R	R	R	X
Ericsonia ovalis group	F	R	R	R	C	C	A		A	A	R	C	R	C	X	R	F	R	A	F	C	C	A
Prinsiaceae, small	C	C	C	C	C	A	C	R	C	F	A	A	C	A	C	F	C	R	C	A		A	C
Reticulofenestra bisecta	C	C	C	F	F		1								X								
R. pseudoumbilica						A							F				?R		?C		?F		?F
Reticulofenestra sp.																							
Sphenolithus moriformis			R			R			R						X						X	R	R
Thoracosphaera sp.		R																					

Note: See Table 4A for explanation of symbols.

TABLE 5C – *Continued*

Adopted Age	Early mid Miocene																							
Zone	*Cyclicargolithus neogammation*																							
Lithology																								
Depth Below Sea Floor (m)	310.5-319.5													319.5-329.0										
Sample (Interval in cm)	24-1, 6	24-1, 46	24-2, 39	24-2, 110	24-3, 30	24-3, 110	24-4, 25	24-4, 110	24-5, 35	24-5, 110	24-6, 35	24-6, 110	24, CC	25-1, 97	25-1, 140	25-2, 30	25-2, 110	25-3, 30	25-3, 110	25-4, 30	25-4, 110	25-5, 35	25-5, 110	25, CC
Overall Abundance	C	C	C	C	C	C	C	C	C	F	R	F	R	C	F	F	C	F	R	C	F	R	F	C
Overall Preservation	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Chiasmolithus altus								X																
Coccolithus eopelagicus	R	R	R	R		R		F					R	R	R	X	R	R	R	F	R		R	X
Cyclicargolithus neogammation	X	F	X	F	R	F		R		R		R	X	R	R	R	R	X	R	R	F		F	R
Cyclococcolithina macintyrei																								
Discoaster adamanteus			X											X		X								X
D. cf. *D. aulakos*																								
D. cf. *D. bollii*																								
D. challengeri																								
D. deflandrei	–	cfX	–		–		–		–	cfX	–	cfX	–	–		–		?		X	R			
D. druggi?	R		X		R				X															
D. exilis																								
D. variabilis																								
Discoaster sp. indet.			X		R		X		X		X		X	R		X		X					R	R
Ericsonia ovalis group	C	C	C	A	C	C	A	A	A	R	X	F	R	C	R	R	F	C	F	A	C	R	C	F
Prinsiaceae, small	A	A	A	A	C	A	F	C	F	F	R	C	F	A	C	C	A	F	A	C	C	X	C	C
Reticulofenestra bisecta																								
R. pseudoumbilica	?X												x											
Reticulofenestra sp.																								
Sphenolithus moriformis		R	X		X		X	R	X					X			R			X			R	X
Thoracosphaera sp.																								

Adopted Age	Early Miocene																		
Zone	*Discoaster deflandrei*																		
Lithology	Radiolarian-Diatom and Siliceous oozes																		
Depth Below Sea Floor (m)	329.0-338.5											338.5-348.0							
Sample (Interval in cm)	26-2, 26	26-2, 94	26-3, 38	26-3, 114	26-4, 74	26-4, 135	26-5, 28	26-5, 111	26-6, 30	26-6, 110	26, CC	27-3, 100	27-4, 68	27-4, 110	27-5, 28	27-5, 118	27-6, 76	27-6, 125	27, CC
Overall Abundance	C	F	C	C	F	R	C	F	C	R	C	R	+	-	+	-	+	-	R
Overall Preservation	P	P	P	P	P	P	P	P	P	P	P	P	P		P		P		P
Chiasmolithus altus																			
Coccolithus eopelagicus																			
Cyclicargolithus neogammation	C	F	F	F	F	R	C		C		C	C					X		
Cyclococcolithina macintyrei																			
Discoaster adamanteus																			
D. cf. *D. aulakos*																			
D. cf. *D. bollii*																			
D. challengeri																			
D. deflandrei	X		X		X		X		X		X								
D. druggi?											X								
D. exilis																			
D. variabilis																			
Discoaster sp. indet.					X														
Ericsonia ovalis group	C	F	C	C	F	R	C	C	C	R	C	R							R
Prinsiaceae, small	C	C	C	C	C	R	A	A	A	R	A	C							R
Reticulofenestra bisecta																			R
R. pseudoumbilica							x												
Reticulofenestra sp.												R	R		R		X		
Sphenolithus moriformis									X										
Thoracosphaera sp.																			

Depth Below Sea Floor (m)	348.0-357.5												
Sample (Interval in cm)	28-1, 60	28-1, 110	18-2, 32	28-2, 110	28-3, 28	28-3, 110	28-4, 30	28-4, 110	28-5, 30	28-5, 110	28-6, 30	28-6, 110	28, CC
Overall Abundance	+	+	+	-	-	+	+	-	-	-	-	+	+
Overall Preservation	P	P	P			P	P					P	P
Chiasmolithus altus													
Coccolithus eopelagicus													
Cyclicargolithus neogammation													X
Cyclococcolithina macintyrei													
Discoaster adamanteus													
D. cf. *D. aulakos*													
D. cf. *D. bollii*													
D. challengeri													
D. deflandrei													
D. druggi?													
D. exilis													
D. variabilis													
Discoaster sp. indet.													
Ericsonia ovalis group					X								
Prinsiaceae, small		R										R	
Reticulofenestra bisecta													
R. pseudoumbilica													
Reticulofenestra sp.	R										X		R
Sphenolithus moriformis													
Thoracosphaera sp.													

Diagnosis: *Ericsonia* with a perforated central area surrounded directly by the distal shield in distal view.

Description: The distal shield, which is larger than the proximal shield, consists of about 30 to 40 elements lying side by side. No other elements are inserted between them, and the elements spanning the central area. These are platey on the distal side, and perforated by few to common small, more or less well defined holes. The proximal shield consists, as usual of *Ericsonia*, of two cycles of elements.

Remarks: *E. tasmaniae* is very similar to the mainly late Eocene and Oligocene *Ericsonia fenestrata* group. However, *E. fenestrata* is usually larger and shows an additional ring of elements (in distal view) between the distal shield, and the central area.

Occurrence: The holotype and paratype of *E. tasmaniae* were obtained from the early Miocene of Site 282, west of Tasmania. This species seems to be quite common in the high-latitude Pacific Miocene. *E. tasmaniae* is the youngest perforate *Ericsonia* known to date. Due to its minute size, the perforations are difficult to distinguish in the light microscope, where it more closely resembles a very small *Chiasmolithus* or *Cruciplacolithus* than a perforate *Ericsonia*.

Genus HELICOPONTOSPHAERA Hay and Mohler 1967

Helicopontosphaera? subantarctica n. sp.
(Plate 14, Figures 1-7; Plate 15, Figures 1-3, 7, 8)

Holotype: Plate 15, Figures 3 and 8; distal view.

Paratype: Plate 15, Figure 7; proximal view.

Diagnosis: An essentially elliptical proximal shield is connected by a "tubus" to a usually very asymmetrical distal shield forming a flange. Central area elliptical and (?) open.

Description: By far the most conspicuous feature of this new species is its (often) enormous flange on the distal side of the coccolith. It consists of elements which are oriented almost radially but which converge towards each other where the flange is largest. The flange includes one length of the coccolith, while the opposite side is built by a

TABLE 5D
Calcareous Nannofossil Distribution, Site 278

Sample (Interval in cm)	29-1, 30	29-1, 88	29-2, 46	29-2, 110	29-3, 17	29-3, 110	29-4, 10	29-4, 130	29-6, 32	29-6, 110	29, CC	30-1, 103	30-1, 130	30-2, 30	30-2, 110	30, CC
Adopted Age	Early Miocene															
Zone	*Discoaster deflandrei*															
Lithology	Radiolarian-diatom ooze														Nanno ooze	
Depth Below Sea Floor (m)	357.0-367.0											367.0-386.0				
Overall Abundance	-	+	-	-	-	+	-	-	-	+	C	C	C	C	C	C
Overall Preservation	-	P	-	-	-	P	-	-	-	P	P	P	P	P	P	P
Chiasmolithus altus															F	R
C. sp. (*altus?*)														X		
Coccolithus eopelagicus sp.																
Cyclicargolithus neogammation											X	R		C	R	F
Discoaster adamanteus											X					
D. deflandrei											X	X				
D. deflandrei sp. indet.																
Ericsonia ovalis group											C	F		C	F	R
Helicopontosphaera recta																
Prinsiaceae, small		X				X				X	R					
Reticulofenestra bisecta																
R. sp.											A	A		A	A	A
Sphenolithus moriformis												X				X
Thoracosphaera sp.																
Triquetrorhabdulus carinatus																X
Zygrhablithus bijugatus																

Sample (Interval in cm)	31-1, 20	31-1, 134	31-2, 17	31-2, 110	31-3, 30	31-3, 110	31, CC	32-1, 30	32-1, 99	32-2, 110	32-3, 30	32-3, 110	32-4, 110	32-5, 30	32-5, 110	32-6, 110	32, CC
Adopted Age	Late to Mid Oligocene																
Zone	*Reticulofenestra bisecta*																
Lithology	Siliceous nanno Chalk																
Depth Below Sea Floor (m)	395.5-405.5							405.5-414.5									
Overall Abundance	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	P	P	P	P	M	P	P	P	P	P	P	P	P	P	P	P
Chiasmolithus altus	F	R	R	C	C	C	A	A	C	C	C	C	A	A	C	C	A
C. sp. (*altus?*)					A												
Coccolithus eopelagicus sp.										R							X
Cyclicargolithus neogammation	A	R	A	R	F	R	R	C	F	F	F	R	F	R	F	F	R
Discoaster adamanteus								X									
D. deflandrei	X		X		X												X
D. deflandrei sp. indet.														X			
Ericsonia ovalis group	F	C	R	F	X	F	F	X	C	C	R	C	C	R	C	C	X
Helicopontosphaera recta																	
Prinsiaceae, small																	
Reticulofenestra bisecta	R	R	F	R	R	F	F	R	R	R	R	R	R	R	R	R	R
R. sp.		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sphenolithus moriformis	X	F	X	R		R		X				R	R	X	R		X
Thoracosphaera sp.						R											
Triquetrorhabdulus carinatus	X																
Zygrhablithus bijugatus			X														

Sample (Interval in cm)	33-1, 30	33-1, 110	33-5, 30	33-5, 110	33-6, 25	33-6, 110	33, CC	34-1, 12	34-1, 134	34-2, 15	34-2, 125	34-3, 25	34-3, 110	34, CC
Depth Below Sea Floor (m)	415.5-424.0							424.0-429.0						
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Chiasmolithus altus	A	C		C	A	C		A	C	A	C	C	C	
C. sp. (*altus?*)			A				C							C
Coccolithus eopelagicus sp.														
Cyclicargolithus neogammation	F	F	R	F	F	F	R	R	C	R	F	F	R	X
Discoaster adamanteus														
D. deflandrei														
D. deflandrei sp. indet.														
Ericsonia ovalis group	C	C	C	C	F	C	C	F	C	F	C	C	C	F
Helicopontosphaera recta								X						
Prinsiaceae, small														
Reticulofenestra bisecta	R	R	F	R	F	F	C	R	C	F	C	F	F	R
R. sp.	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Sphenolithus moriformis	X		X		X	R	X	X	R	X	R	X	R	X
Thoracosphaera sp.			X					X			R			
Triquetrorhabdulus carinatus														
Zygrhablithus bijugatus														

Note: See Table 4A for explanation of symbols.

TABLE 6
Calcareous Nannofossil Distribution, Site 279

Sample (Interval in cm)	1-1, 60	1-1, 80	1-1, 90	1-1, 100	1-1, 105	1-1, 110	1-1, 120	1, CC	1-1, 25	1-1, 60	1-1, 75	1-1, 97	1-1, 120	1-1, 147	1-2, 108	1-2, 146	1-3, 35	1-3, 110	1-3, 130	1-3, 145	1-4, 30	1-4, 110	1-4, 135	1-4, 150	1, CC
Hole	279								279A																
Adopted Age	L. Pleist.			M.P. to L. Plio	late Mid Miocene				Late Pleistocene									M. Plei to L. Plio	late Mid Miocene			early Mid Miocene			
Zone	*C. pelagicus*			*P.l.*	*Reticulofenestra pseudo-umbilica*				*Coccolithus pelagicus*									*P.l.*	*Ret. pseudo-umbilica*			*Cyclicargolithus neogammation*			
Lithology	Nanno-Foram ooze				Nanno ooze				Foram and Nanno oozes								Nanno ooze								
Depth Below Sea Floor (m)	0.0-1.0								13.0-20.0																
Overall Abundance	A	C	A	C	A	A	A	A	A	C	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	P	M	M	M	M	P	M
Coronocyclus prionion					R		R	X							r				R						
Coccolithus eopelagicus	X		X	R	F	R	R	R	R	R					R							R			
C. pelagicus group	R	C	R	A	X	C	C	C	C	R	C	C	F	F	A	R	R	F	C	C	C	F	C	C	C
Cruciplacolithus cf. *C. neohelis*		R		R	R				R		R	R		R	R			R	R			R			
Cruciplacolithus sp.																									
Cyclicargolithus neogammation	x														r						x	R	R		R
Cyclococcolithina leptopora	R	C	F	R	F	F	F	R	R	F	X	R	R	R		X			R						
C. macintyrei	x		x	x	R	F	F	F	r	x			r		r				C	F	F	F	F	R	F
Discoaster adamanteus																									
D. aulakos																								?	
D. brouweri								X															X		
D. challengeri																									
D. deflandrei group																									
D. divaricatus																									
Discoaster druggi s.l.																									
D. variabilis						X	X	X												X	X		X		X
Discoaster spp. indet.							X																		
Discolithina segmenta et aff.	x			x	R	R	R	R											R	R	X	R	X		X
Gyphyrocapsa spp., small	A	A	A	C				A	A	A	A	A	A	R	A	A	R	A	A						
G. oceanica		R	X	X				R	C	R	R	R	R		R										
Helicopontosphaera euphratis																									
H. kamptneri	X	F	R	X	R	X	X	R	F		R	R	X		X	X	R	R R	R		R	R	R		R
H. sellii						R			R											R	X				
H. wallichi		R	R			R		R				R	R					R							
Pontosphaera spp.		X		X																					
Prinsiaceae, small	A	A	A	F	C	C	C	A	C	A	A	A	A	A	C	A	A	A	A			A		C	C
Pseudoemiliania lacunosa				R					-	-	-	-	-	-	-	-	-	R							
Reticulofenestra abisecta																									
Reticulofenestra pseudoumbilica		x	r	r	A	A	A	A	r	x	x	x	r	r	r	r	x	r	A	A	A	A	A	A	A
Rhabdolithus sp.																									
Sphenolithus abies							R																		
S. cf. *S. belemnos*																									
S. heteromorphus (?)																									
S. moriformis						R	R																		
S. neoabies	x				R	F	X	R											C	R	R	R	R	F	R
Sphenolithus sp.																									
Thoracosphaera sp.														R										R	X
Triquetrorhabdulus rugosus							X	X																	

Sample (Interval in cm)	2-1, 65	2-1, 103	2-2, 30	2-2, 110	2-2, 118	2, CC	3-1, 103	3-1, 140	3-2, 110	3-3, 56	3-3, 142	3-4, 30	3-4, 110	3-5, 30	3-5, 110	3-6, 30	3-6, 125	3-6, 140	3, CC	4-1, 113	4-2, 92	4, CC
Adopted Age																	Early Miocene					
Depth Below Sea Floor (m)	99.0-108.5						108.5-118.0													118.0-127.5		
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	P	P	P	M	M	P	M	P	P	P	M	M	M	M	M	M	M	M
Coronocyclus prionion	X	R	X					R	F		F		F		F	X	F		R	R	R	F
Coccolithus eopelagicus			X		R	X												F	X			
C. pelagicus group	C	C	C	C	C	C	A	C	C	A	C	A	C	A	C	A	C	C	C	C	C	C
Cruciplacolithus cf. *C. neohelis*																						
Cruciplacolithus sp.																				R	R	
Cyclicargolithus neogammation	C	C	A	C	A	A	C	C	C	C	C	C	C	C	C	C	A	A	A	C	C	C
Cyclococcolithina leptopora													R				R			R		
C. macintyrei	R	R	X		R	X	F	R	C	R	F	R	F	R	F	F	F	R	F	F	F	C
Discoaster adamanteus													R		R	X	R	X	R	R	R	R
D. aulakos																	?					
D. brouweri																						
D. challengeri									R				R		R							
D. deflandrei group				x		x			r		r				x	x	F	R	R	F	C	F
D. divaricatus		?				R		R			R		R		R						R	
Discoaster druggi s.l.						x														?	R	
D. variabilis	R		R		F	R	X			X		X		R		X						
Discoaster spp. indet.			X			X	X					X				X		X				
Discolithina segmenta et aff.		R	X			X		R	R	X	R		R	X	R		R	X	X	C	C	F
Gyphyrocapsa spp., small																						
G. oceanica																						
Helicopontosphaera euphratis																						
H. kamptneri	X	R	R	X	R		F	R	F	F	R	X	F		R	X	X		R	F		
H. sellii																						
H. wallichi																						
Pontosphaera spp.																						
Prinsiaceae, small		C	C	C	A	C		A	C		C		C		C		C			C	C	C
Pseudoemiliania lacunosa																						
Reticulofenestra abisecta				R																		C
Reticulofenestra pseudoumbilica	A																					
Rhabdolithus sp.													R							R		
Sphenolithus abies											R		R									
S. cf. *S. belemnos*		?															?				?	
S. heteromorphus (?)								R	R	X	?		R							R	R	
S. moriformis			X			X	R	R	R	X	R	X	R	X	R		R	X	R	R	R	F
S. neoabies				R				R	R		R		R		R		R			R	R	
Sphenolithus sp.				R				?														
Thoracosphaera sp.	X	R		R					R		R				R						R	
Triquetrorhabdulus rugosus																						

Note: See Table 4A for explanation of symbols.

TABLE 6 – *Continued*

Hole	279A																
Adopted Age	Early Miocene																
Zone	*Discoaster deflandrei*																
Lithology	Nanno ooze																
Depth Below Sea Floor (m)	127.5-137.0				137.0-146.5						146.5-156.0						
Sample (Interval in cm)	5-2, 141	5-3, 110	5-4, 110	5, CC	6-1, 110	6-2, 125	6-3, 127	6-4, 56	6-5, 137	6, CC	7-1, 109	7-2, 128	7-3, 130	7-4, 135	7-5, 110	7-6, 110	7, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	P	M	M	M	M	M	M	P	M	M	P	M	M	M	P	M
Coronocyclus prionion	R	R	R	R	R	R	R	R		F			R	R	R	R	
Coccolithus eopelagicus																	
C. pelagicus group	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	F
Cruciplacolithus cf. *C. neohelis*																	
Cruciplacolithus sp.																	
Cyclicargolithus neogammation	C	C	C	C	C	C	C	C	C	C	C	C	C	F	F	C	C
Cyclococcolithina leptopora	R	R	R		R										R		
C. macintyrei	R	R	F	F	R	R	R	R		C	R		R	R	F		R
Discoaster adamanteus	F	R	F	F	R			F		R		R			?		
D. aulakos			R					R				R					
D. brouweri																	
D. challengeri																	
D. deflandrei group	C	C	C	C	C	F	C	C	F	F	R	F	R			R	
D. divaricatus		R	R		R			R	R				R				
Discoaster druggi s.l.		R	R		R		R	R	R				R				
D. variabilis																	
Discoaster spp. indet.																	
Discolithina segmenta et aff.	F	R		R	R	R		R	R	F	R	R			R	R	R
Gephyrocapsa spp., small																	
G. oceanica																	
Helicopontosphaera euphratis	?										R						
H. kamptneri	R		R	F						F	F			R	F	R	R
H. sellii																	
H. wallichi																	
Pontosphaera spp.																	
Prinsiaceae, small	C	C	C	A	C	F	C	C	C	C	C	C	C	C	C		A
Pseudoemiliania lacunosa																	
Reticulofenestra abisecta				F				R	C	C	C	F	F	R	R		C
Reticulofenestra pseudoumbilica																	
Rhabdolithus sp.							R										
Sphenolithus abies											R						
S. cf. *S. belemnos*							?										
S. heteromorphus (?)	R	R	R	R			R	R	R								
S. moriformis	R		R	F	R	R	F	F		F	R	R	R		R	R	F
S. neoabies	R	R			R	R	F	R			R		R		R	R	
Sphenolithus sp.	?				R		?	?								?	
Thoracosphaera sp.			R	R	R	R		R				R			R		
Triquetrorhabdulus rugosus																	

Hole	279A																	
Adopted Age	Early Miocene																	
Zone	*Discoaster deflandrei*																	
Lithology	Nanno ooze																	
Depth Below Sea Floor (m)	156.0-165.5				165.5-175.0							175.0-184.5						
Sample (Interval in cm)	8-1, 114	8-4, 110	8-5, 109	8-5, 150	9-1, 109	9-2, 132	9-3, 110	9-4, 116	9-5, 113	9-6, 110	9, CC	10-1, 130	10-2, 110	10-3, 110	10-4, 114	10-5, 115	10-6, 110	10, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Coronocyclus prionion	R	R	R	R	R	R	F	R	R	R	R		R	R	R	R	F	R
Coccolithus eopelagicus																		
C. pelagicus group	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A
Cruciplacolithus cf. *C. neohelis*																		
Cruciplacolithus sp.						R	R					R				R	R	
Cyclicargolithus neogammation	C	C	C	A	C	C	F	F	C	C	F	F	C	C	C	C	C	A
Cyclococcolithina leptopora	R	R	R	R				R				R	R		R		R	R
C. macintyrei	R	R	R	R		R		R										
Discoaster adamanteus	F	R	R	F	R	R	R	R	F	F	R	R	R	F	R	F	F	R
D. aulakos				R									R		R	R		
D. brouweri																		
D. challengeri																		
D. deflandrei group	C	C	R	C	F	F	F	C	F	C	C	F	F	C	F	C	C	C
D. divaricatus			R	R														
Discoaster druggi s.l.			R	R	R							R			R			
D. variabilis																		
Discoaster spp. indet.																		
Discolithina segmenta et aff.	R	R	R	R	R	R	R	R	R	R	R	F	R		R	R	R	R
Gephyrocapsa spp., small																		
G. oceanica																		
Helicopontosphaera euphratis				R								?						R
H. kamptneri			R	X	R			R	R	R		R				R	R	R
H. sellii																		
H. wallichi																		
Pontosphaera spp.																		
Prinsiaceae, small	C	C	C	C	C	C	C	C	C	C	A	C	C	C	C	C	C	C
Pseudoemiliania lacunosa																		
Reticulofenestra abisecta		R		F				R							F	R	R	
Reticulofenestra pseudoumbilica																		
Rhabdolithus sp.												R						
Sphenolithus abies												?						
S. cf. *S. belemnos*				?							R							
S. heteromorphus (?)	R	R	R	R								?F	?C					
S. moriformis	R	R	R	R	F	R	F	R	R	R	C	C	R	C	F	F	F	F
S. neoabies		R	R	R	R	R	F	R	R	R		R		F	F	F	F	
Sphenolithus sp.			?				R	R	R	R			R			F		
Thoracosphaera sp.									R		R							R
Triquetrorhabdulus rugosus																		

Hole	279A																		
Adopted Age	Early Miocene																		
Zone	*Discoaster deflandrei*																		
Lithology	Nanno ooze																		
Depth Below Sea Floor (m)	184.5-194.0																		
Sample (Interval in cm)	11-1, 49	11-1, 74	11-1, 137	11-2, 25	11-2, 130	11-2, 140	11-3, 23	11-3, 110	11-3, 119	11-4, 75	11-4, 112	11-4, 137	11-5, 50	11-5, 110	11-5, 130	11-6, 30	11-6, 110	11-6, 140	11, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	M	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Coronocyclus prionion		R		X	F	X	X	F	X		R			R			R		X
Coccolithus eopelagicus																			
C. pelagicus group	C	C	C	R	C	F	C	C	C	F	C	C	C	C	C	C	C	A	A
Cruciplacolithus cf. *C. neohelis*																			
Cruciplacolithus sp.																			
Cyclicargolithus neogammation	R	C	F	F	C	R	F	C	F	F	C	F	C	C	F	F	A	F	A
Cyclococcolithina leptopora																			
C. macintyrei										X?									X?
Discoaster adamanteus	C	F	R	R	C	R	R	F	R	F	C	C	F	C		C	F	C	C
D. aulakos								R											
D. brouweri																			
D. challengeri																			
D. deflandrei group	C	C	C	C	C	C	A	C	A	A	C	C	C	C	C	C	C	C	C
D. divaricatus																			
Discoaster druggi s.l.																			
D. variabilis																			
Discoaster spp. indet.																			
Discolithina segmenta et aff.		R	X	X	R			R		X				R			R		
Gephyrocapsa spp., small																			
G. oceanica																			
Helicopontosphaera euphratis																			
H. kamptneri				X						X					X		R		
H. sellii																			
H. wallichi																			
Pontosphaera spp.																			
Prinsiaceae, small	A	C	A	A	C	A	A	C	A	A	C	A	A	C	A	A		A	C
Pseudoemiliania lacunosa																			
Reticulofenestra abisecta											R			R					
Reticulofenestra pseudoumbilica																			
Rhabdolithus sp.																			
Sphenolithus abies		R																	
S. cf. *S. belemnos*																			
S. heteromorphus (?)																			
S. moriformis	X	F	R	R	F	X	X	R	X	R	R	X	X	R	X	X	R	X	X
S. neoabies		F			R			R			F			F			F		
Sphenolithus sp.								R			R			F					
Thoracosphaera sp.		R												R					
Triquetrorhabdulus rugosus																			X

normal distal shield. A layer of nearly vertical elements forms a wall between the distal shield and the central area on the distal side of the coccolith. The proximal shield consists of radial oriented elements. A suture is visible where the proximal shield ends and the bend to the vertical "tubus" begins. The latter is built by a continuation of the elements of the proximal shield towards the central area. Thus the pattern known from the forms of *Discolithina/Pontosphaera* and *Helicopontosphaera*, with a proximal side consisting of radial elements and a distal side with concentric elements, seems to be repeated in *H*? *subantarctica*. In this form the distal side of the central area, when present, also is found to consist of concentric elements. In none of the many specimens found of the new species was the central area completely covered or spanned by a bridge.

Remarks: Some doubts exist as to the generic position of this new species. It seems most likely, however, that it evolved from a *Helicopontosphaera* and is therefore tentatively placed in this genus. Apart from the asymmetrical flange, this species has nothing in common with the Late Cretaceous genus *Kamptnerius*. The species of *Pontosphaera* and *Discolithina* have walls with an elliptical outline and do not develop a proximal shield or comparable structure.

Occurrence: *H*? *subantarctica* was found in the early Oligocene of Site 277 on the Campbell Plateau, where it is common. The finding of such an easily recognizable and large new species in the early Oligocene, which has been closely studied in many widely separated parts of the world, is surprising. It is concluded that the species probably has a rather restricted distribution.

Genus HORNIBROOKINA Edwards 1973

Hornibrookina australis n. sp.

(Plate 2, Figures 1-3, 6, 9, 12; Plate 5, Figures 6, 9, 12)

Hornibrookina sp., in Edwards, 1973a, p. 77, fig. 82.
Hornibrookina n. sp., in Edwards, 1973b, pl. 9, fig. 1-3.

Holotype: Plate 2, Figure 9; distal view.

Paratype: Plate 2, Figure 6; proximal view.

Diagnosis: *Hornibrookina* with a slightly elongate to rhomboedrical outline and relatively narrow proximal and distal shields forming a convexly arched coccolith.

Description: The body has a somewhat asymmetrical outline (elongate to rhomboedrical) and is convexly arched. The distal shield consists of about 20 elements lying side by side and continuing into the large central area as parallel, elongate bars. The proximal shield is much smaller than the distal shield and very narrow. Its elements continue to the distal side, where they form the wall around the central area, overlapping each other considerably.

Remarks: *H. australis* differs from *H. teuriensis* Edwards by its more irregular outline, smaller size, and narrower shields. *H. australis* is remarkably well preserved in samples where most of the other coccoliths show signs of solution and/or overgrowth.

Occurrence: *H. australis* was first found in the Late Paleocene of New Zealand and subsequently in the late Paleocene of DSDP 207A on Lord Howe Rise (Edwards, 1973a, b). During Leg 29 this species was observed in the late Paleocene of DSDP Site 277 on the Campbell Plateau, where it is "few to common". It has also been found in the late Paleocene of the Crimea, U.S.S.R. (Perch-Nielsen, unpublished).

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TABLE 7
Calcareous Nannofossil Distribution, Site 280

Hole	280											280A													
Adopted Age	Late Pleist.	?Pliocene?								?Late Miocene		?Oligocene?													
Zone or Interval	*Coccolithus pelagicus*	Indeterminate								*Reticulofenestra pseudoumbilica*		Indeterminate													
Lithology	Nanno ooze	Detrital Silty Clay								Nanno ooze		Silty to Clayey Silt Diatom Ooze													
Depth Below Sea Floor (m)	0.0-6.0											38.0-44.0						53.5-63.0							
Sample (Interval in cm)	0.00, 000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.00, 000	38.0, 000	0.0	0.0	0.0	0.0	44.0, 000	53.5, 000	0.0	0.0	0.0	0.0	0.0	0.0	63.0, 000
Overall Abundance	A	A	+	R	R	–	R	A	A	A	A	–	–	–	–	–	+	–	–	+	+	–	+	+	+
Overall Preservation	M	M	P	P	P		P	P	P	P	P						P			P	P		P	P	P
Chiasmolithus altus																									
C. oamaruensis																									
C. solitus																									
Coccolithus eopelagicus	R										X											x			
C. pelagicus group	C	C		r				X	F	F	R						x								
Cruciplacolithus cf. *C. mechelis*	R																								
Cyclicargolithus cf. *C. meohelis*																									
Cyclococcolithina leptopora	F	C		x																					
C. macintyrei								C	R	R	F														
Discoaster variabilis pansus								X	X																
Discoaster spp. indet.											X														
G. oceanica	R																								
Helicopontosphaera kamptneri	F	X		x																					
Prinsiaceae, small	A	A	x	x	R		R	A	A	A	C						x			x	x			x	X
Reticulofenestra bisecta																				?					?
R. placomorpha (small center)																									
R. pseudoumbilica	r		x	x			R	A	A	A	A						x			x	x		x		
Sephyrocapsa spp., small	F	A		x																					
Sphenolithus neoabies		x							X		X														
Syracosphaera hystrica	R																								
Transversopontis obliquiporis																									
Zygrhablithus bijugatus																									

Hole																		
Adopted Age	Oligocene or Late Eocene																	
Zone or Interval	Interval with *R. bisecta*																	
Lithology																		
Depth Below Sea Floor (m)	72.5-82.0									82.0-91.5								
Sample (Interval in cm)	72.5, 000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	82.0, 000	82.0, 000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	91.5, 000
Overall Abundance	–	+	+	–	+	+	+	+	R	+	+	+	+	R	+	R	R	–
Overall Preservation		P	P		P	P	P	P	P	P	P	P	P	P	P	P	P	
Chiasmolithus altus		?							?					?		X		
C. oamaruensis																X		
C. solitus																		
Coccolithus eopelagicus																		
C. pelagicus group		X				X			X					X		X		
Cruciplacolithus cf. *C. mechelis*																		
Cyclicargolithus cf. *C. meohelis*		X				X			?					X				
Cyclococcolithina leptopora																		
C. macintyrei																		
Discoaster variabilis pansus																		
Discoaster spp. indet.																		
G. oceanica																		
Helicopontosphaera kamptneri																		
Prinsiaceae, small		X			X		X	X	F		X	X	X	R	X	R	R	
Reticulofenestra bisecta			X			X	X		R	X				X		X		
R. placomorpha (small center)																	R	
R. pseudoumbilica															x		x	
Sephyrocapsa spp., small																		
Sphenolithus neoabies																		
Syracosphaera hystrica																		
Transversopontis obliquiporis																		
Zygrhablithus bijugatus							X											

Hole																						
Adopted Age	Early Oligocene or Late Eocene																					
Zone or Interval	Interval with *Reticulofenestra bisecta* and *R. placomorpha*																					
Lithology																						
Depth Below Sea Floor (m)	91.5-101.0						101.0-110.5							120.0-129.5								
Sample (Interval in cm)	91.5, 000	0.0	0.0	0.0	0.0	101.0, 00	101.0, 00	0.0	0.0	0.0	0.0	0.0	110.5, 00	120.0, 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	129.5, 00
Overall Abundance	R	R	+	F	F	+	F	R	R	+	R	R	+	+	R	+	+	–	R	R	R	R
Overall Preservation	M	P	P	M	P	P	P	P	P	P	P	P	P	P	P	P	P		P	P	P	P
Chiasmolithus altus	F			F	C		R					R					R		R			F
C. oamaruensis		X			X			X		X										X		X
C. solitus																						
Coccolithus eopelagicus																						
C. pelagicus group	F	X	X	F	F		F	X											R	X	R	F
Cruciplacolithus cf. *C. mechelis*																						
Cyclicargolithus cf. *C. meohelis*		X						X												X		
Cyclococcolithina leptopora																						
C. macintyrei																						
Discoaster variabilis pansus																						
Discoaster spp. indet.																						
G. oceanica																						
Helicopontosphaera kamptneri																						
Prinsiaceae, small	C	R	X	C	C	X	F	R	F	X	F	C		X	R	X	F		F	R	F	F
Reticulofenestra bisecta	R	X			R		R	X								X				X		
R. placomorpha (small center)	R											R	X	X		X				X	R	
R. pseudoumbilica																						
Sephyrocapsa spp., small																						
Sphenolithus neoabies																						
Syracosphaera hystrica																						
Transversopontis obliquiporis					X																	
Zygrhablithus bijugatus					X															X		

Note: See Table 4A for explanation of symbols.

TABLE 7 – *Continued*

Hole	280A																														
Adopted Age	Early Oligocene or Late Eocene							?Early Oligocene or Late Eocene?																							
Zone or Interval	Interval with *Reticulo-fenestra bisecta* and *R. placomorpha*							Interval with *R. bisecta*											Indeterminate												?
Lithology	Clayey Siltstone and Silty Claystone																		Green Sand			Clayey Siltstone and Silty Claystone										
Depth Below Sea Floor (m)	139.0-148.5					167-177			196.0-205.5					215.0-224.5					234-243			262.5-272.0				291.0-200.5				319-329		
Sample (Interval in cm)	139.0, 00	0.0	0.0	0.0	148.5, 00	167.0, 00	0.0	177.0, 00	196.0, 00	0.0	0.0	0.0	205.5, 00	215.0, 00	0.0	0.0	0.0	224.5, 00	234.0, 00	0.0	243.0, 00	262.5, 00	0.0	0.0	272.0, 00	241.0, 00	0.0	0.0	300.5, 00	319.0, 00	0.0	329.0, 00
Overall Abundance	R	R	R	R	+	+	+	+	+	+	+	+	+	+	+	+	R	R	+	+	–	–	–	+	+	–	+	–	+	+	+	R
Overall Preservation	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P		P	P	P					P	P		P		P	P	P	P
Chiasmolithus altus	X	R		R			R	?							R																	
C. oamaruensis	X		X		?																											X
C. solitus																																
Coccolithus eopelagicus																																
C. pelagicus group	X	R	X	R	X		R						X	X				X							X				X			X
Cruciplacolithus cf. *C. meohelis*																																
Cyclicargolithus cf. *C. meohelis*		R					R		?	?					R			?						?	?							
Cyclococcolithina leptopora																																
C. macintyrei																																
Discoaster variabilis pansus																																
Discoaster spp. indet.									X																							
G. oceanica																																
Helicopontosphaera kamptneri																																
Prinsiaeae, small	R	F	X	F	X		R	X	X	X	R		X	X	R	X	R	X	X	R				X	X		R		X	X	X	R
Reticulofenestra bisecta			X		X	X		X				?	?		?			X														X
R. placomorpha (small center)	X	R	X	R			R																									X
R. pseudoumbilica																																
Sephyrocapsa spp., small																																
Sphenolithus neoabies																																
Syracosphaera hystrica																																
Transversopontis obliquiporis																																
Zygrhablithus bijugatus																																

Hole																															
Adopted Age	?Eocene?									Mid to Early Eocene																					
Zone or Interval	Indeterminate									Interval with *Chiasmolithus solithus*																Indeterminate					
Lithology	Clayey Siltstone and Silty Claystone																														
Depth Below Sea Floor (m)	348-357			376.5-386.0							405-414			443.0-452.5								481.0-490.5				509.5-512.5				512.5-519.0		
Sample (Interval in cm)	348.0, 00	0.0	357.0, 00	376.5, 00	0.0	0.0	0.0	0.0	0.0	386.0, 00	405.0, 00	0.0	414.0, 00	443.0, 00	0.0	0.0	0.0	0.0	0.0	0.0	452.0, 00	481.0, 00	0.0	0.0	490.5 00	509.5, 00	0.0	0.0	512.5, 00	512.5, 00	0.0	519.0. 00
Overall Abundance	–	+	–	–	+	–	–	–	–	R	R	R	+	–	+	+	+	–	–			–	–	–	R	+	+		+	–		
Overall Preservation		P			P					P	P	P	P		P	P	P								P	P	P		P			P
Chiasmolithus altus																															
C. oamaruensis																															
C. solitus										R	X														X						
Coccolithus eopelagicus																															
C. pelagicus group										X	X		X			X					R										
Cruciplacolithus cf. *C. meohelis*																															
Cyclicargolithus cf. *C. meohelis*																									?	X	X		X			
Cyclococcolithina leptopora																															
C. macintyrei																															
Discoaster variabilis pansus																															
Discoaster spp. indet.																															
G. oceanica																															
Helicopontosphaera kamptneri										x																					
Prinsiaeae, small		R			X					R	X		X		X		X			R	R				R			R	X		R	X
Reticulofenestra bisecta																													?			
R. placomorpha (small center)																					R											
R. pseudoumbilica																															
Sephyrocapsa spp., small																															
Sphenolithus neoabies																															
Syracosphaera hystrica																															
Transversopontis obliquiporis																															
Zygrhablithus bijugatus																															

TABLE 8A
Calcareous Nannofossil Distribution, Site 281

Adopted Age	Late Pleistocene	Mid Pleistocene to Late Pliocene														Late Pleistocene				Mid Pleistocene to Late Pliocene													Early Pliocene							
Zone	*Coccolithus pelagicus*	*Pseudoemiliania lacunosa*														*Coccolithus pelagicus*				*Pseudoemiliania lacunosa*													*Reticulofenestra pseudoumbilica*							
Lithology	Foram ooze and Foram-nanno ooze																																							
Depth Below Sea Floor (m)	~0	0.0-9.5														7.5-17.0										17.0-26.5										~27	~27	36.0-45.5		
Sample (Interval in cm)	1, CC	1A-1, 40	1A-1, 145	1A-2, 130	1A-2, 145	1A-3, 110	1A-4, 13	1A-4, 33	1A-4, 50	1A-4, 70	1A-4, 90	1A-4, 110	1A-4, 131	1A-4, 145	1A, CC	2-1, 30	2-1, 110	2-2, 110	2-2, 130	2-3, 30	2-3, 110	2-4, 110	2-5, 110	2-6, 110	2, CC	3-1, 110	3-2, 110	3-3, 30	3-3, 110	3-4, 110	3-5, 110	3-5 130	3-6, 30	3-6, 110	3, CC	4, CC	2A, CC	5-1, 110	5-2, 110	5, CC
Overall Abundance	A	A	A	A	C	A	C	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C	A	C	A	A	A	C
Overall Preservation	M	M	M	M	M	M	M	P	P	P	P	P	M	M	M	P	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	P	M	M	M	M	M	M
Ceratolithus amplificus																																								
Ceratolithus sp.																								1						1								1		X
Coccolithus cf. *abisectus*																																								
C. eopelagicus		R	R			R	R	R	R	R			R				1																			1				
C. pelagicus group	C	F	F	F	F	F	F	F	C	F	F	F	F	F	F	C	C	C	F	F	C	C	C	C	C	C	C	F	C	C	C	F	C	C	C	C	C	F	F	F
Coronocyclus prionion																																						1	1	R
Cruciplacolithus cf. *C. neohelis*			R			R	R	R		R							F				R		R	R	R		R		R	R	R			R					R	
Cyclicargolithus neogammation																																					x			
Cyclococcolithina leptopora	C	F	F	R		C	C	C	C	C	C	C	C	C	F	R	F	F	R	R	C	C	C	C	F	C	F		F	F	C	R	R	C	F	R	X	C	C	C
C. macintyrei		R			F	F	R	R	F	F	F	F	R	R	F	r			x	x					1			R		R	R	F		F	R	R	1	C	F	R
Discoaster adamanteus																																								
D. brouweri																										1			1	1				1						
D. deflandrei																																								
D. surculus																																		1		1	1	1		
D. variabilis																																							1	1
Discoaster sp.																																			1				1	R
Emiliania huxleyi ?	C															F?	?																							
Gephyrocapsa spp., small	C	F	F		A		A	F	F	R		F	F	F	F	C	F	C	C	C	C	C	C	F	R												F			
G. oceanica	R		R				R		R	R	R	R		1	1		F	F		X	R		R	R																
Helicopontosphaera kamptneri	C	R	R	F	F	R	F	F	F	F	F	F	R	F	R	C	R	C	X	X	C	C	C	F	F	R	F		R	R	R		X	C	R	R		R	R	R
H. sellii																					R			R	R		F	R	F	R	R				R		R			
Pontosphaera sp.	R						R	R	R	R	R	R			X			R		X		R	R		R	R	R		R	R	C			C	F	R				
Prinsiaceae, small	A	A	A	A		A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C
Pseudoemiliania lacunosa		R		R	R	F	R	R	F	R	R	R	R	R	F?					R	R	C	C	F	F	F	F	R	F	R	C	X		R		1				
Reticulofenestra pseudoumbilica					x			1						R	R					x			x					x		R		x	F	F	F	A	R	A	C	A
Rhabdosphaera claviger	R		R					R							R			F	X										R		R	R	R	R	R					
R. stylifera																		R																R	R				?	
Scyphosphaera sp.																															R	F		R	R					R
Sphenolithus heteromorphus																																								
S. moriformis																																								
S. neoabies																x																			1					
Syracosphaera hystrica	R	R	F			F	R	R	R	R		R	R		R		R	F	R		R	R	R	R	F	R	F	R	R		R	R	X	R	R	X				
S. pulchra			F		X																					R	F			R	R	F	R		R	X				
Thoracosphaera sp.														R											1					1	R				1					
Triquetrorhabdulus rugosus																																								
Umbilicosphaera ? sp.								R	R						R						1										1									

Note: See Table 4A for explanation of symbols.

TABLE 8A – *Continued*

Adopted Age	Early Pliocene			Late and late Mid Miocene																			early Mid Miocene															Early Miocene			
Zone	*Reticulofenestra pseudoumbilica*																						*Cyclicargolithus neogammation*															*Discoaster deflandrei*			
Lithology	Foram ooze and Foram-nanno ooze												Foram-nanno ooze																												
Depth Below Sea Floor (m)	36.0-45.0			45.5-55.0							55.0-64.5				65.0	74.0-83.5							83.5-93.0						93.0-102.5							102.5-112.0						
Sample (Interval in cm)	3A-1, 110	3A-2, 110	3A, CC	6-2, 30	6-2, 110	6-3, 110	6-4, 110	6-5, 110	6-6, 110	6, CC	7-2, 131	7-3, 110	7-4, 110	7, CC	8, CC	9-1, 96	9-2, 110	9-3, 110	9-4, 110	9-5, 110	9-6, 110	9, CC	10-3, 63	10-3, 110	10-4, 110	10-5, 89	10-6, 114	10, CC	11-1, 110	11-2, 110	11-3, 110	11-4, 111	11-5, 110	11-6, 110	11, CC	12-1, 110	12-3, 110	12-4, 30	12-4, 110	12-4, 130	12-6, 110	12, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	P	M	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	P	M	M
Ceratolithus amplificus			1																																							
Ceratolithus sp.																																										
Coccolithus cf. *abisectus*					C	F	F	C	F	F	F	F	F	F	C	F	F	R		R	R	R			R	R																
C. eopelagicus				1								1	1		1	C	F	F		R									R	R	R		R	R								
C. pelagicus group	F	C	R	C	F	F	C	C	C	F	F	C	C	C	C	F	C	C	C	F	C	C	A	A	C	C	C	C	C	F	C	C	C	C	C	C	C	A	C	C	C	A
Coronocyclus prionion					R			R				R						F	R		R	R		F	R	R	R	R	R	R	R	R	R	R	R	R		1			F	
Cruciplacolithus cf. *C. neohelis*																				1																						
Cyclicargolithus neogammation		R																		1	1		C	C	F	F	R	R	C	C	C	C	C	C	C	F	F	A	C	C	C	C
Cyclococcolithina leptopora	C	C	C		F	F	R	R	R	R	R	R	R	R	R	F	F	F	R	F	R	R		C	C	C	C						1			1						
C. macintyrei	C	F	F	R	R	R	R	F	R	R	R	F	R	R	F	R	C	C	F	F	F	F	R	F	F	F	F	F	R	R	R	R	F	R	R	R	R				R	
Discoaster adamanteus																														1		R		R	R	F	F	R	F	R	C	C
D. brouweri				1																								?														
D. deflandrei																																				cf	cf	cf	R	C	F	C
D. surculus			1																																							
D. variabilis			1	1			1	R	1	R			1															?														
Discoaster sp.						1		1		R	1				1	1		1	R	1		1		1	R	F	1	R	1	1	R	R	1	R		1		X				
Emiliania huxleyi ?																																										
Gephyrocapsa spp., small																																										
G. oceanica																																										
Helicopontosphaera kamptneri	R?	F?	R	X	R		R		R	R	R							R		R	R	R		F	R	R		R	R		R	R	R	R	R	R			R			
H. sellii																																										
Pontosphaera sp.		R	R				R	1														1								1	1		1		1							
Prinsiaceae, small	A	A			A	C	C	A	C	C	C	C	C	C	C	C	C	C	C	C	A	A	C	A	A	A	A	A	A	A	A	A	C	C	C	C	C		C		C	C
Pseudoemiliania lacunosa																																										
Reticulofenestra pseudoumbilica	A	C	A	A	A	A	C	A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	C	C	A	A	A	C	C	C	C	C	C	A	A	A	A	A	A	A	A
Rhabdosphaera claviger	R	R	X																																							
R. stylifera																																										
Scyphosphaera sp.			X																		1												1									
Sphenolithus heteromorphus																																	1			1	1		1			1
S. moriformis											1	F	F	F	R	R		R	R	R	F	R	R	F	R	R	R	R	R	R	R	R		R	R	R		X	F	F	F	R
S. neoabies				1													F	C	F	C	C	F			F	F		F	R	R	R	R		R	R		F		F	F	F	
Syracosphaera hystrica																																										
S. pulchra																																										
Thoracosphaera sp.	R								R		1									1		1		1	1	1				R		R		1								
Triquetrorhabdulus rugosus					?		?	?	?	?				R	?		cf1	cf1				cf1																				
Umbilicosphaera ? sp.																																										

TABLE 8B
Calcareous Nannofossil Distribution, Site 281

Sample (Interval in cm)	13-2, 110	13-3, 57	13-3, 106	13-3, 130	13-4, 110	13-4, 130	13-5, 30	13-5, 40	13-5, 127	13, CC (top)	13, CC (base)
Adopted Age	Early Miocene		Late or mid Oligocene								
Zone	*Discoaster deflandrei*		*Reticulofenestra bisecta*								
Lithology	Foram Nanno ooze Glauconite-rich detrital sand										
Depth Below Sea Floor (m)	112.0-121.5										
Overall Abundance	A	A	A	A	A	A	A	A	C	F	C
Overall Preservation	M	M	M	M	M	M	P	M	P	M	M
Chiasmolithus altus				F	F	F	A	C	C	F	
C. expansus											
C. oamaruensis											C
Coccolithus abisectus			F					R	F	R	
C. eopelagicus	F	X	F		F		1	F		R	R
Coronocyclus prionion			R		R			1			
Cyclicargolithus neogammation	C	X	F	C	F	C	C	C	F	C	R
C. reticulatus											
Cyclococcolithina leptopora											
Discoaster adamanteus	F				F	X		F		R	
D. deflandrei	R	F		X		X	X	cfF			X
Discoaster sp.			1					F		F	
Ericsonia ovalis group	A	C	C	F	C	C	C	C	C	C	F
Isthmolithus recurvus											R
Markalius inversus											
Neococcolithes dubius											
Prinsiaceae, small	C	A	A	A	A			C	F	C	A
Reticulofenestra bisecta		x		F	R	R	F			X	F
R. hampdenensis											
R. oamaruensis										x	F
R. placomorpha											C
Rhabdolithus sp.			F		F						
Sphenolithus moriformis	F	R		R		X	X			1	X
S. neoabies			F		F			?	?		
Thoracosphaera sp.			R					R	R		X
Transversopontis pulcher											
T. pulcheroides											
Triquetrorhabdulus milowi?			R		R			R			
Zygrhablithus bijugatus								R		R	

Sample (Interval in cm)	14-1, 42	14-1, 110	14-2, 68	14-2, 120	14-3, 14	14-3, 110	14-4, 15	14-4, 110	14-5, 25	14-5, 112	14-6, 40	14-6, 107	14, CC
Adopted Age	← Early Oligocene												
Zone	← *Blackites rectus*												
Lithology	Sandy silts and silty clays with varying amounts of siliceous and calcareous microfossils												
Depth Below Sea Floor (m)	121.5-131.0												
Overall Abundance	F	C	C	C	F	C	A	A	A	A	A	A	C
Overall Preservation	P	P	P	P	P	P	P	P	P	P	M	M	M
Chiasmolithus altus											cfR		
C. expansus		X	F		F						cfR		
C. oamaruensis	R		R		R	R	R	R	R	R	R	R	R
Coccolithus abisectus													
C. eopelagicus	R	F	R		R	F	R	F	F	F	C	F	R
Coronocyclus prionion													
Cyclicargolithus neogammation						1							
C. reticulatus	F	C	F	F	F	C	F	F	F	C	C	C	C
Cyclococcolithina leptopora													
Discoaster adamanteus													
D. deflandrei													
Discoaster sp.													
Ericsonia ovalis group	F	R	F	R	R	F	F	F	F	F	R	F	F
Isthmolithus recurvus													
Markalius inversus													
Neococcolithes dubius													
Prinsiaceae, small	A	A	A	C		C	C	A	A	A	A	A	A
Reticulofenestra bisecta	R	R	R	R	R	R	F	F	F	F	F	F	R
R. hampdenensis	C	C	F	R	F	C	F	C	C	C	C	C	A
R. oamaruensis						R?					F?		R?
R. placomorpha	C	F	R	R	R	C	F	R	F	F	F	F	R
Rhabdolithus sp.													
Sphenolithus moriformis													
S. neoabies													
Thoracosphaera sp.		R	R	R			R	R	F	R	F	R	
Transversopontis pulcher													
T. pulcheroides											R		R
Triquetrorhabdulus milowi?													
Zygrhablithus bijugatus	R												

Sample (Interval in cm)	15-2, 40	15-2, 114	15-3, 40	15-3, 110	16-1, 40	16-1, 112	16-2, 35	16-2, 110	16-3, 40	16-3, 107	16-4, 40	16-4, 110	16-5, 40	16-5, 107	16-6, 40	16-6, 114	16, CC	17-1, 20	17-1, 29	17-3, 6	17-6, 22	17-6, 36	17-6, 85
Adopted Age	Early late Eocene																				?		
Zone	*Chiasmolithus oamaruensis*																				downhole?		
Lithology																		Lithified clastics			Schist breccia		
Depth Below Sea Floor (m)	131.0-140.5				140.5-150.0													150.0-c.153					
Overall Abundance	A	A	A	A	A	A	A	A	A	A	C	A	A	A	A	A	A	F	F	R	R	R	+
Overall Preservation	P	P	M	M	M	M	M	M	M	M	M	M	M	M	M	M	P	P	P	P	P	M	P
Chiasmolithus altus																							
C. expansus																							
C. oamaruensis	F	R	R	F	C	F	F	F	C	C	C	F	C	C	C	C	F		1	1		1	
Coccolithus abisectus																							
C. eopelagicus	R	R	R		R		R								R		R		1				
Coronocyclus prionion																							
Cyclicargolithus neogammation																							
C. reticulatus	C	C	C	C	C	C	A	A	A	C	C	C	C	C	C	C	C	R	C	R		R	
Cyclococcolithina leptopora																							
Discoaster adamanteus																							
D. deflandrei																							
Discoaster sp.																							
Ericsonia ovalis group	F	R	R	R	R	R	R	R	R			R	R	R	R	R	R	R	1				1
Isthmolithus recurvus																							
Markalius inversus															R	R							
Neococcolithes dubius											R				R								
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	R	C	F	R	C	
Reticulofenestra bisecta	C	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F		1			X	
R. hampdenensis	C	C	F	C	C	C	C	C	C	C	F	C	C	C	C	C	A		C	1		F	
R. oamaruensis																							
R. placomorpha	C	F	F	C	C	R	R	R	F	F	R	R	F	F	F	F	F		X	1		1	
Rhabdolithus sp.					R								R		R								
Sphenolithus moriformis											R			R		R							
S. neoabies																							
Thoracosphaera sp.	R			R	R		R	R	R		R	R	R	R	F	R		R	1	1			
Transversopontis pulcher											R						F					1	
T. pulcheroides		R				R			R			R	R		R	F	R					X	
Triquetrorhabdulus milowi?																							
Zygrhablithus bijugatus	R					R	R	R			R	R	R	R	F	R	R						

Note: See Table 4A for explanation of symbols.

TABLE 9A
Calcareous Nannofossil Distribution, Site 282

Adopted Age	Late Pleistocene														?Late Miocene								
Zone	*Coccolithus pelagicus*													?	*R. pseudoumbilica*								
Lithology	Nanno, foram, micarb and bryozoa-foram oozes														Nanno ooze								
Depth Below Sea Floor (m)	0.0-9.0																						
Sample (Interval in cm)	1-1, 75	1-1, 101	1-1, 140	1-1, 29	1-2, 83	1-2, 141	1-3, 8	1-3, 37	1-3, 80	1-3, 145	1-3, 15	1-4, 26	1-4, 125	1-4, 130	1-5, 18	1-5, 20	1-5, 50	1-5, 80	1-5, 120	1-6, 152	1-6, 54	1-6, 108	1, CC
Overall Abundance	A	A	A	A	A	A	F	A	A	A	F	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	P	P	P	P	M	M	P	M	M	M	P	P	P	P	P	P	P	P	P
Chiasmolithus altus				x								x											
C. oamaruensis																							
Coccolithus eopelagicus	R	F			R					R				F	X	R	R						
C. pelagicus group	C	C	C	C	C	C	A	C	C	F	R	C	F	F	R	R	R	R	R	R	F	F	R
Coronocyclus nitescens																							
C. prionion																							
Cruciplacolithus cf. *C. neobelis*			R			R	R		R	R		R											
Cyclicargolithus neogammation			x	x			x			R	x	x		x									
Cyclococcolithina leptopora	C	A	A	F	A	A	F	A	C	C	F	C	C	C		F	F	R	R		R	R	
C. macintyrei	x		x	x								x		R	R	F	C	F	C	F	C	C	F
Discoaster adamanteus																							
D. deflandrei			x																				
D. druggi ?																							
D. saundersi																							
D. formosus																							
D. tani																							
D. variabilis														X	X	X	X	X		X		R	X
Discoaster sp. indet.			r			r						r		F	X					X	R	F	X
Emiliania huxleyi	A	?		A			A				A		A										
Ericsonia tasmaniae																							
Gephyrocapsa sp. small	A	C	C	A	F	F	A	F	C	C	A	F	C	F									
G. oceanica	R	F	R	X	R			F	R	R		F	X	F									
Helicopontosphaera ampliaperta																							
H. euphiatis																							
H. kamptneri	C	C	C	R	C	F	X	C	F	F	R	F	F	F									
H. obliqua																							
H. recta																							
Isthmolithus recurves																							
Orthozygus aureus																							
Pontosphaeria sp.	X		R																				
Prinsiaceae, small	A	A	A		A	A	C	A	A	A		A		C		F	F	C	C		C	C	C
Reticulofenestra bisecta																							
R. placomorpha																							x
R. pseudoumbilica	x		r		r	r	r	r	f	c	x	f	c	A	A	A	A	A	A	A	A	A	A
Reticulofenestra sp.																							
Rhabdolithus sp.																							
Rhabdosphaera claviger	R	F	F	X								X											
Sphenolithus abies																							
S. cf. *conicus* n. sp.																							
S. heteromorphus				x																			
S. moriformis	r		r		r	r		r		r		f	x							X			X
S. predistentus																							
Sphenolithus sp.	x			x																			
Syracosphaera hystrica	R	F	F		R	R				R		F	X	R									
S. predistentus																							
Thoracosphaera sp.	X					R																	
Transversopontis obliquipons																							
Triquetrorhabdulus carinatus																							
Zygrhablithus bijugaths						x				x													

Adopted Age	Early early Miocene										Mid to Late Oligocene						
Zone	*Discoaster deflandrei*										*Reticulofenestra bisecta*						
Lithology	Detrital silty clay Nanno ooze										Nanno detrital silty clay						
Depth Below Sea Floor (m)	~9	~19	28.0-34.0						53.5-56.5								
Sample (Interval in cm)	2, CC	3, CC	4-1, 30	4-1, 110	4-2, 50	4-3, 80	4-4, 7	4, CC	5-1, 127	5-1, 136	5-1, 148	5-2, 40	5-2, 81	5-2, 110	5-2, 140	5, CC (T)	5, CC (B)
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	G	M	M	M	M	M	G	M	M	M	M	M	G	M
Chiasmolithus altus											C	C	C	C		R	C
C. oamaruensis																	cf
Coccolithus eopelagicus	R	R		R	X			R	F					R	R	R	
C. pelagicus group	C	R	F	C	C	C	C	F	C	C	F	F	F	F	F	R	F
Coronocyclus nitescens	X	R	X	R	X	X	X	X	R	X	X	X	R		R	X	
C. prionion	R			R					C								
Cruciplacolithus cf. *C. neobelis*																	
Cyclicargolithus neogammation	A	A	A	C	A	A	A	A	C	A	A	C	C	C	C	A	C
Cyclococcolithina leptopora																	
C. macintyrei	X	X		R													
Discoaster adamanteus	X	X	X	X	X	X	R	R	F	X							
D. deflandrei	X	X						–	C	–		F					F
D. druggi ?				F				R	F								
D. saundersi	R	F	R		F	C	F	C	C	F	X	F		R		R	
D. formosus		F															
D. tani																	
D. variabilis																	
Discoaster sp. indet.	X																
Emiliania huxleyi																	
Ericsonia tasmaniae		R		C				F		F							
Gephyrocapsa sp. small																	
G. oceanica																	
Helicopontosphaera ampliaperta	X	X		F	X			R		X							
H. euphiatis	R	R	X	F	X	R	X	X		R	R		R	R	R	R	
H. kamptneri	R	R		X	X	F	F	X		R							
H. obliqua		R						X		R	X						
H. recta	X	X		F						X	R	F	R	R	R	X	
Isthmolithus recurves																	
Orthozygus aureus											R			F	F	X	
Pontosphaeria sp.	R	R	X	R	X		X	X	R	R	R	R	F	F	R	X	
Prinsiaceae, small	A	A	A	C	A	A	A	A	C	C	A	A	A	A	A	A	A
Reticulofenestra bisecta											F	F	F	F	F	C	C
R. placomorpha																	
R. pseudoumbilica																	
Reticulofenestra sp.									C	C	C	C	C	C	C	A	A
Rhabdolithus sp.																	
Rhabdosphaera claviger																R	
Sphenolithus abies																	
S. cf. *conicus* n. sp.	R	R	F		X	F	F	X		X						X	
S. heteromorphus																	
S. moriformis	R	F	F	C	R	R	C	R	F	F	R	C	F	C	C	R	F
S. predistentus																	
Sphenolithus sp.	F			C				F	C								R
Syracosphaera hystrica																	
S. predistentus																	
Thoracosphaera sp.										R			R		R		
Transversopontis obliquipons												R		R	R	C	
Triquetrorhabdulus carinatus				X				R				I		R		R	
Zygrhablithus bijugaths											R	R	F	F	C	C	

Adopted Age	Mid to Late Oligocene																					
Zone	*Reticulofenestra bisecta*																					
Lithology	Nanno detrital silty clay																					
Depth Below Sea Floor (m)	~57	66.0-75.5			75.5-85.0					85.0-94.5				95	104.0-113.5					113.5-123		
Sample (Interval in cm)	6, CC	7-1, 110	7-2, 110	7, CC	8-1, 140	8-2, 110	8-3, 110	8-4, 130	8, CC	9-1, 140	9-2, 110	9-3, 110	9, CC	10, CC	11-1, 136	11-2, 110	11-3, 110	11-4, 110	11, CC	12-1, 140	12-2, 115	12-3, 132
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	C	C	C	C	A	A	A
Overall Preservation	G	M	M	P	M	M	P	M	P	M	M	M	M	M	M	M	M	M	M	M	M	M
Chiasmolithus altus	A	C	C	A	C	C	C	C	C	C	C		C	A	C	C	C		R	C	C	C
C. oamaruensis				cf		cf					cf			R	E	X			R	F	F	F
Coccolithus eopelagicus														F		R	R					
C. pelagicus group	F	C	C	C	F	C	F	F	C	C	F		C	C	F	F	C		C	F	C	C
Coronocyclus nitescens	R	R				R								R			R		R			
C. prionion																						
Cruciplacolithus cf. *C. neobelis*																						
Cyclicargolithus neogammation	C	C	C	F	F	F	F	F	F	F	F		F	F	F					C	C	C
Cyclococcolithina leptopora																						
C. macintyrei																						
Discoaster adamanteus																						
D. deflandrei	R					R									R	R	F					
D. druggi ?										X												
D. saundersi																						
D. formosus																						
D. tani				X							R		R	R		R						R
D. variabilis																						
Discoaster sp. indet.	R					R		R	R	R			R	R		X						
Emiliania huxleyi																						
Ericsonia tasmaniae														F								
Gephyrocapsa sp. small																						
G. oceanica																						
Helicopontosphaera ampliaperta																						
H. euphiatis																						
H. kamptneri																						
H. obliqua																						
H. recta																						
Isthmolithus recurves																r	r		c			
Orthozygus aureus															R	R						
Pontosphaeria sp.	F					R			R		R			R	R	R	R		F	R	C	
Prinsiaceae, small	A	A		A	A	A	A	A	A	A	A		A	A	A	A	A		C	A	A	A
Reticulofenestra bisecta	F	C	C	C	C	C	C	C	C	F	C		C	C	C	C	C		C	C	A	A
R. placomorpha													r			f			f			
R. pseudoumbilica																						
Reticulofenestra sp.	A	A	A	A	A	A	A	A	A	C	A	R	R	R	A	A	A					
Rhabdolithus sp.															F	F	R	R	F			
Rhabdosphaera claviger	R			I		I			I					I	F							
Sphenolithus abies																						
S. cf. *conicus* n. sp.																						
S. heteromorphus																						
S. moriformis	F			F										R	F	F						
S. predistentus											R			R	R							R
Sphenolithus sp.		R		R	F	F			F	F	F		F	F					F			
Syracosphaera hystrica																						
S. predistentus																						
Thoracosphaera sp.										R												
Transversopontis obliquipons						R								R	R	C	F		C			
Triquetrorhabdulus carinatus									I													
Zygrhablithus bijugaths	C				R										F	C	C		C			

Note: See Table 4A for explanation of symbols.

TABLE 9B
Calcareous Nannofossil Distribution, Site 282

Adopted Age	Mid to late Oligocene										Early Oligocene								Late Eocene						Early late Eocene						
Zone or Interval	*R. bisecta*										*R. placomorpha*			top *I. recuruus* to top *C. reticulata*						top *C. reticulata* to base *I. recurvus*					*R. bisecta*						
Lithology	Nanno detrital silty clay																Silty clay and clayey silt														
Depth Below Sea Floor (m)	132.5-142.0										161.0-170.0			189.5-199.0											~218		256.0-265.0				~294	
Sample (Interval in cm)	13-1, 130	13-2, 110	13-3, 110	13-4, 23	13-4, 31	13-4, 34	13-4, 44	13-4, 110	13-5, 110	13, CC	14-2, 110	14-3, 107	14, CC	15-1, 132	15-2, 63	15-2, 66	15-2, 70	15-2, 95	15-3, 5	15-3, 10	15-3, 20	15-3, 110	15, CC	16-1, 110	16, CC	17-2, 115	17-3, 110	17-4, 110	17, CC	18-1, 82	18-1, 115
Overall Abundance	A	A	C	A	A	+	F	A	C	A	A	A	A	A	A	A	A	A	+	A	A	C	F	F	R	C	A	A	C	C	F
Overall Preservation	M	M	P	M	M	P	P	M	M	M	M	M	M	M	M	M	M	M	P	M	M	P	M	P	P	P	M	M	P	P	P
Braarudosphaera bigelowi						R									R					R	R				R						
Chiasmolithus altus	C	C			C		F	C	F	C	C	F	A	C	F	F	F														
C. cf. *C. expansus*																								R	R	I	R	R	R	X	X
C. oamaruensis								F						F	F	C	C	F		C	F	R	R								
Chiasmolithus sp.				F	F						R								R							R					
Coccolithus eopelagicus	R	R		R				R	R	F		R										R	R			R			R		
Cyclicargolithus neogammation	C	F	R	C	C	R	R	C	C	F	F	F	C	F	F	C	F	F		F	F	F							F	R	
C. reticulatus																					F	F	F	F	F	F	F	C	C	C	R
Daktylethia punctulata																										R	F	R	R	R	
Discoaster cf. *D. barbadiensis*																										R		I	I	R	
D. saipanensis																		I		I	I	R	R		R	R	R	R	R	X	X
D. tani													R			R					R	R			R			R		X	
Discoaster sp.		R		R							R	R		R												R		R	R	R	F
Ericsonia fenestriata														C	F	F	F	C		C	R	R	I	I			R	R	I		
E. fenestrata, small				F	F				R			F				F							R								
E. formosa										R				R	R	R	R	R		F	R	R	R	R	R		R		R	X	
E. ovalis	C	F	F	C	C	R	F	C	C	F	F	C	C	C	C	F	F	F		C	C	R	R	F	R		F	F	C	C	R
Isthmolithus recurvus														F	F	C	C	C		C	R	F	R								
Lanternithus minutus															R		F	R		F		R	R					R	R		
Markalius inveirsus																					I		R	R		R	R	R		X	
Pontosphaera sp.	R			R				F	R	R		R		F	R	R	F	F		F	R	R	R	R	R	R	R	R	F	R	
Prinsiaceae, small	A	A	C	A	A	R	C	A	C	A	A	A	A	A	A	A	A	A	R	A	C	C	C	C	F	C		A	A	A	F
Reticulofenestra bisecta	C	C	F	C	C		F	C	C	C	C	C	C	C	F	C	C	F	R	F	C	C	C	R	R	F	F	R	R	R	R
R. daviesi																											C	C	F	F	
R. cf. *R. dictyoda*																							R		R		F	F			
R. hampdenensis llaevis	F			F				F	F	F		R		C	C	C	C	C		C	R	R	F		R	F	F	F	F	C	
R. placomorpha								1	1	R			F	C	C	C	C	C	R	C	C	C	F	F	R	C	F	F	C	C	R
C. reticulatus																					F	F	F	F	F	F	F	C	C	C	R
Sphenolithus moriformis	F	F		F	F	R	R	F	F	F	F	R	F	F	F	F	F	F		F	R	R	R	F		R		F	F	R	R
S. predistentus	R			R	R							R																R			
Thoracosphaera sp.				R				R	R			R		R	R		R	R		R		R	R	R		R	R	F		R	R
Transversopontis obliguipons	R			R				R		F	R	R		R	R		F	F	R	R		R	R	R		R		R	R		
T. pulcher																								F		R	R	R	R	R	
T. pulcheroides														R	R		R			R					R				F		
Zygrhablithus bijugatus				R				R		R		R		R	R	R	F	R		C	F	F	R		R		R	R	F		

Note: See Table 4A for explanation of symbols.

TABLE 10
Calcareous Nannofossil Distribution, Site 283

Sample (Interval in cm)	1A, CC	1, CC	2A-40, 1	2A-30, 2	2A-115, 3	2A-40, 4	2A, CC
Adopted Age	Mid to early Pleistocene		← Late Pliocene				
Zone	*Pseudoemiliania lacunosa*		Indeterminate				
Lithology	← Manganese Nodules	Zeolitic clay (Unit 1A)					
Depth Below Sea Floor (m)	1.5	0.5*	11.0-20.5				
Overall Abundance	C	C	A	-	-	+	+
Overall Preservation	P	P	P			P	P
Chiasmolithus altus							
C. oamaruensis							
Coccolithus pelagicus	X	F	C			x	x
Cyclicargolithus reticulatus	x						
Cycloccolithina leptopora	C	C	C				r
C. macintyrei			F				
Dactylethra punctulata							
Discoaster asymmetricus			X				
D. pentaradiatus			X				
D. saipanensis							
D. tani nodifer							
Discolithina multipora							
D. pulcheroides							
Ericsonia ovalis							
Gephyrocapsa spp., small	A	R	–				x
G. oceanica	R	X	–				
Helicopontosphaera kamptneri		X	R				
Markalius inversus							
Neococcolithes dubius							
N. minutus							
Pontosphaera multipora							
Prinsiaceae, small	A	A	A				r
Pseudoemiliania lacunosa	R	X	R				x
Reticulofenestra bisecta	x						x
R. daviesi							
Reticulofenestra hampdenensis							
Reticulofenestra sp. cf. *minutulus*	A	C	C				
R. placomorpha							x
Reticulofenestra, small							
Rhabdolithus sp.							
Sphenolithus sp.							
Thoracosphaera sp.							

Sample (Interval in cm)	2-14, 1	2-31, 1	2-53, 1	2-90, 1	2-98	2-146	2-45, 2	2-3, 30	2-3, 110	4-4, 30	2-4, 110	2, CC	2, CC	3-1	3, CC	4, CC
Adopted Age	?Late Neogene															
Zone	Indeterminate															
Lithology	Zeolitic clay (Unit 1A)								Silty zeolitic clay (Unit 1B)					Diatom ooze (Unit 2)		
Depth Below Sea Floor (m)	10.0-19.5													29.0		57.5
Overall Abundance	-	-	-	-	+	-	-	-	-	-	-	+	+	-	-	+
Overall Preservation					P							P	P			P
Chiasmolithus altus																
C. oamaruensis																
Coccolithus pelagicus					x								x			
Cyclicargolithus reticulatus																
Cycloccolithina leptopora																
C. macintyrei																
Dactylethra punctulata																
Discoaster asymmetricus																
D. pentaradiatus																
D. saipanensis																
D. tani nodifer																
Discolithina multipora																
D. pulcheroides																
Ericsonia ovalis												x				x
Gephyrocapsa spp., small																
G. oceanica																
Helicopontosphaera kamptneri																
Markalius inversus																
Neococcolithes dubius																
N. minutus																
Pontosphaera multipora																
Prinsiaceae, small													x			
Pseudoemiliania lacunosa																
Reticulofenestra bisecta												x				x
R. daviesi																
Reticulofenestra hampdenensis																
Reticulofenestra sp. cf. *minutulus*																
R. placomorpha																
Reticulofenestra, small												x				x
Rhabdolithus sp.					x											
Sphenolithus sp.																
Thoracosphaera sp.																

Sample (Interval in cm)	5-1, 14	5-1, 90	5-2, 30	5-2, 117	5, CC	6-1, 100	6-1, 145	6-2, 35	6-2, 117	6, CC
Adopted Age	?Late Eocene?					Early late Eocene				
Zone	Indeterminate					*Chiasmolithus oamaruensis*				
Lithology	Diatom ooze (Unit 2)									
Depth Below Sea Floor (m)	86.0-95.5					124.0-133.5				
Overall Abundance	-	-	-	+	+	C	C	C	C	C
Overall Preservation				P	P	P	P	P	P	P
Chiasmolithus altus										
C. oamaruensis						F	F	R	F	R
Coccolithus pelagicus										
Cyclicargolithus reticulatus						A	C	C	C	C
Cycloccolithina leptopora										
C. macintyrei										
Dactylethra punctulata						X				
Discoaster asymmetricus										
D. pentaradiatus										
D. saipanensis								X		X
D. tani nodifer										
Discolithina multipora										
D. pulcheroides										
Ericsonia ovalis						R	R		F	X
Gephyrocapsa spp., small										
G. oceanica										
Helicopontosphaera kamptneri										
Markalius inversus										
Neococcolithes dubius										X
N. minutus						X				
Pontosphaera multipora										
Prinsiaceae, small										
Pseudoemiliania lacunosa										
Reticulofenestra bisecta				R	X	C	C	F	C	C
R. daviesi							R		F	
Reticulofenestra hampdenensis						A		X		R
Reticulofenestra sp. cf. *minutulus*										
R. placomorpha				R	R	C	C	F	C	C
Reticulofenestra, small				F	F	A	A	A	A	A
Rhabdolithus sp.						X	X		X	X
Sphenolithus sp.						X		X		X
Thoracosphaera sp.										

Sample (Interval in cm)	7-1, 4	7-1, 135	7-2, 125	7-3, 49	7-3, 148	7-5, 92	7-5, 147	7-6, 40	7-6, 145	7, CC
Adopted Age	Early late Eocene									
Zone	*Chiasmolithus oamaruensis*									
Lithology	Diatom ooze (Unit 2)									
Depth Below Sea Floor (m)	152.5-162.0									
Overall Abundance	C	A	C	C	C	C	C	C	C	C
Overall Preservation	P	N	P	P	P	P	P	P	P	P
Chiasmolithus altus										
C. oamaruensis	R	F	R	X	F	F	F	R	R	F
Coccolithus pelagicus										
Cyclicargolithus reticulatus	C	F	A	C	F	A	F	C	F	X
Cycloccolithina leptopora										
C. macintyrei										
Dactylethra punctulata										
Discoaster asymmetricus										
D. pentaradiatus										
D. saipanensis	X	X	X	X	X	X				X
D. tani nodifer	X	X	X	X	X		X	X		
Discolithina multipora				X						X
D. pulcheroides	X		X	X		X				
Ericsonia ovalis	R	F	F	F	C	R	C	R	C	
Gephyrocapsa spp., small										
G. oceanica										
Helicopontosphaera kamptneri										
Markalius inversus										
Neococcolithes dubius							X			X
N. minutus						X				X
Pontosphaera multipora										
Prinsiaceae, small										
Pseudoemiliania lacunosa										
Reticulofenestra bisecta	C	C	C	C	C	A	C	C	C	C
R. daviesi		F			F		F		F	
Reticulofenestra hampdenensis	R		R	F		C		C		F
Reticulofenestra sp. cf. *minutulus*										
R. placomorpha	C	A	C	F	A	F	A	F	A	C
Reticulofenestra, small	A	A	A	A	A	A	A	A	A	A
Rhabdolithus sp.	X	X		X	F	X	X	X	X	X
Sphenolithus sp.	X		X	X		X	X	X		X
Thoracosphaera sp.		R								

Sample (Interval in cm)	8-1, 36	8-2, 30	8-3, 30	8-3, 55	8, CC	9-1, 64	9-2, 10	9-30, 3	9-30, 4	9-5, 30	9, CC
Adopted Age	Eocene or older										
Zone	Indeterminate										
Lithology	Silty clay (Unit 3)										
Depth Below Sea Floor (m)	190.5-200.0					219.0-228.5					
Overall Abundance	-	-	-	-	X	-	-	-	-	-	X
Overall Preservation					P						P
Chiasmolithus altus											
C. oamaruensis											
Coccolithus pelagicus											
Cyclicargolithus reticulatus					x						
Cycloccolithina leptopora											
C. macintyrei											
Dactylethra punctulata											
Discoaster asymmetricus											
D. pentaradiatus											
D. saipanensis											
D. tani nodifer											
Discolithina multipora											
D. pulcheroides											
Ericsonia ovalis					x						x
Gephyrocapsa spp., small											
G. oceanica											
Helicopontosphaera kamptneri											
Markalius inversus											
Neococcolithes dubius											
N. minutus											
Pontosphaera multipora											
Prinsiaceae, small											
Pseudoemiliania lacunosa											
Reticulofenestra bisecta					x						
R. daviesi											
Reticulofenestra hampdenensis											
Reticulofenestra sp. cf. *minutulus*											
R. placomorpha					x						
Reticulofenestra, small					r						
Rhabdolithus sp.											
Sphenolithus sp.											
Thoracosphaera sp.											

Note: See Table 4A for explanation of symbols.

TABLE 11
Calcareous Nannofossil Distribution, Site 284

Adopted Age	Pleistocene																			
Zone	*Coccolithus pelagicus*							*Pseudoemiliania lacunosa*												
Lithology	Foram and Nanno oozes																			
Depth Below Sea Floor (m)	0.0-8.5							8.5-18.0						18.0-27.5						~35
Sample (Interval in cm)	1-1, 35	1-2, 135	1-2, 110	1-3, 110	1-4, 110	1-5, 110	1, CC	1A-1, 56	1A-2, 47	1A-5, 43	1A-6, 16	1A, CC	1A-2, CC	3-1, 110	3-2, 110	3-3, 110	3-4, 110	3-5, 110	3, CC	2A-CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Ceratolithus spp.																				
Coccolithus eopelagicus												X				R			R	
C. pelagicus	F	F	F	F	F	F	F					C	C	C	F	F	F	F	C	C
Cruciplacolithus cf. *neohelis*					R		R					R		R						X
Cyclicargolithus cf. *neogammation*																				
Cyclococcolithina leptopora	C	C	C	C	C	F	C					C	C	C	C	C	C	C	C	C
C. macintyrei, >15μ																				C
Discoaster asymmetricum																				
D. brouweri																				
D. challengeri																				
D. pentaradiatus																				
D. surculus																				
D. tamalis																				
D. variabilis																				
Discoaster sp.																				
Gephyrocapsa oceanica	C	C	C	C	C	C	C					F	X	C						
Helicopontosphaera euphratis																				
H. kamptneri group	F	C	F	F	C	F	F					C	C	C	C	R	F	C	C	F
H. sellii					R	R	F													R
Pontosphaera discopora					R		R					X	X		F	F	R	F	F	C
P. japonica	R	R		R			X					R			R	R	R	F	X	
Pontosphaera sp.	R	R				R								R						X
Prinsiaceae, small	A	A	A	A	A	A	A					A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa							-	-	-	C	C	C	C		F	C	C	C	C	C
Reticulofenestra bisecta																			x	
R. pseudoumbilica																				
Rhabdolithus sp.																				
Rhabdosphaera claviger	R	R	F	F	R	F	C					F	R	R		R	R*	F	R	F
Rhabdothorax regale																				
Scapholithus sp.	R	R	R	R		R	R							R	R	R				
Scyphosphaera sp.							X					R		R	R			F	X	
Sphenolithus abies																				
S. neoabies																				
Syracosphaera hystrica group	C	R		F	R	F	F					F	X	F	C	F	F	F	X	F
Thoracosphaera sp.	R	R	R	R										R						R
Triquetrorhabdulus rugosus																				
Trochoaster sp.																				

Adopted Age	Late Pliocene																			
Zone	*Discoaster brouweri*												*Discoaster surculus*							
Lithology	Foram and Nanno oozes																			
Depth Below Sea Floor (m)	37.0-46.5							46.5-56.0					56.0-65.5						65.0-70.0	
Sample (Interval in cm)	5-1, 110	5-2, 110	5-3, 114	5-4, 110	5-5, 110	5-6, 110	5, CC	6-1, 110	6-2, 110	6-3, 110	6-4, 85	6, CC	7-1, 110	7-2, 110	7-3, 110	7-4, 110	7-5, 110	7, CC	3A, CC	8, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	P	M	P	P	M	P	M	M	M	M	M	M	M	M	M	M	M	M
Ceratolithus spp.																				
Coccolithus eopelagicus	R	R		R																
C. pelagicus	F	C	F	A	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Cruciplacolithus cf. *neohelis*						R					X			X			X			X
Cyclicargolithus cf. *neogammation*																				
Cyclococcolithina leptopora	C	C	C	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	C	C
C. macintyrei, >15μ			R	F	R	F	X	F	F	F	F	F	C	C	C	F	C	F	C	C
Discoaster asymmetricum																		cf		
D. brouweri					R	R	R	R	R	X	R	R		R	R		R	R	F	F
D. challengeri																				
D. pentaradiatus											R		R		R	R	R	R		R
D. surculus											R	R	R	R	R	R	R	R	R	F
D. tamalis													R			R	R	R		R
D. variabilis																	cf.	cf		
Discoaster sp.											R	F	R	R	R	F	R	F		
Gephyrocapsa oceanica																				
Helicopontosphaera euphratis																				
H. kamptneri group	F	F	C	R	F		X	F	F	F	F	R	F	F	F	F	F	R	F	F
H. sellii	R	R	F	R	R	C	C	R	F	R	R	X		R	F	R	R	F		R
Pontosphaera discopora							R					X						R	F	F
P. japonica							X											X		F
Pontosphaera sp.	F	C	F	C	F	F		R	R	F	F	F	F		F	F	F		F	F
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa	C	C	C	C	C	C	C	C	C	C	F	C	F	F	R	F	F	F	F	R
Reticulofenestra bisecta																				
R. pseudoumbilica													?						-	?
Rhabdolithus sp.																	R			R
Rhabdosphaera claviger		F	F	F	C	R	F	R	R	R	R	X	F	F	F	R		X	F	F
Rhabdothorax regale															R					
Scapholithus sp.	R		R		R			R					R	R						F
Scyphosphaera sp.	R	R		R			R		R	R	R	R	R		R		R	X	F	F
Sphenolithus abies										x										
S. neoabies														?				x		
Syracosphaera hystrica group		F	F	F	C	C	A	F	F		F	X	F	F	F	F	F	F	C	F
Thoracosphaera sp.			R					R	R	R	R	R	R		R	R	R			R
Triquetrorhabdulus rugosus																				
Trochoaster sp.											X									

Adopted Age	Early Pliocene																				
Zone	*Reticulofenestra pseudoumbilica*																				
Lithology																					
Depth Below Sea Floor (m)	75.0-84.5							84.5-94.0							94.0-103.5						
Sample (Interval in cm)	9-1, 110	9-2, 110	9-3, 110	9-4, 110	9-5, 110	9-6, 110	9, CC	10-1, 135	10-2, 135	10-3, 110	10-4, 110	10-5, 110	10-6, 90	10, CC	11-1, 110	11-2, 110	11-3, 110	11-4, 110	11-5, 110	11-6, 110	11, CC
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	M	M	M	M	P	M	M	M	M	M	M	M	G	P	M	M	M	M	M	M
Ceratolithus spp.							X	X	R		R	R		R	R	R	R	R	R	R	F
Coccolithus eopelagicus																					
C. pelagicus	F	C	F	F	F	F	F	F	F	F	F	F	F	F	F	C	C	C	C	C	C
Cruciplacolithus cf. *neohelis*				X																	
Cyclicargolithus cf. *neogammation*																					
Cyclococcolithina leptopora	C	C	C	C	C	C	C	C	C	C	C	C	C	C	F	C	C	C	C	C	C
C. macintyrei, >15μ	F	F	F	F	F	F	F	F	F	F	C	C	F	F	F	F	F	F	C	C	C
Discoaster asymmetricum	R	R												X							
D. brouweri	R	R				R	R		R		R				R			R			R
D. challengeri										R	R		R	R	X						
D. pentaradiatus	R	R	X					R	R		F	R	R	R					R		R
D. surculus	R	X	X		R	R	R			R		R	X	R	X	X		X	R	R	R
D. tamalis		R																			
D. variabilis										R		R		R							
Discoaster sp.	R				R	R	R	R	F	F	F	F	F	F	F	R	R	R	R		
Gephyrocapsa oceanica																					
Helicopontosphaera euphratis																					
H. kamptneri group	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	C	F
H. sellii		R			R																
Pontosphaera discopora							F			R		R		F							F
P. japonica																					
Pontosphaera sp.	C	C	F	F	C	F		F	F	F	F	F	C	R	C	F	F	F	F	F	F
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa	R	R	R	R	R																
Reticulofenestra bisecta																					
R. pseudoumbilica	R	R	F	F	C	C	C	C	C	C	C	C	C	C	C	C	C	C	A	C	C
Rhabdolithus sp.		R	R		R								R		R	R					
Rhabdosphaera claviger	F	C	F	R	F	F	F	R	F	R	R	R	F	F	F	F	R	R	F	F	F
Rhabdothorax regale	R	R	R									R				R					
Scapholithus sp.	R		R	R	R	R			R									R			
Scyphosphaera sp.	F	C	F		F	F	F	F	R	F	F	F	C	F	F	F	F	F	F	R	F
Sphenolithus abies		R	R	R			F	R	R	R	F	F	F	F		F	R	R			
S. neoabies			R		R		F	F	F	F	F	F	F	F	F	F	F	F	F	F	F
Syracosphaera hystrica group	F	F	C	C	F	F	F	F	R	R	R	F	R	F	F	C	C	F	F	F	F
Thoracosphaera sp.	R	R	R	R	R	R	X	R	R	F	R	R	F		F	R	R	R	R		
Triquetrorhabdulus rugosus																					
Trochoaster sp.		X										R	R								

TABLE 11 – *Continued*

Sample (Interval in cm)	12-1, 110	12-2, 98	12-3, 110	12-4, 110	12-5, 110	12-6, 110	12, CC	13-1, 110	13-2, 110	13-3, 110	13-4, 110	13-5, 110	13-6, 110	13, CC	14-1, 110	14-2, 110	14-3, 110	14-4, 110	14-5, 110	14-6, 110	14, CC
Adopted Age	Early Pliocene														Undifferentiated early Pliocene to late Miocene						
Zone	*Reticulofenestra pseudoumbilica*																				
Lithology	Foram and Nanno oozes																				
Depth Below Sea Floor (m)	103.5-113.0							113.0-122.5							122.5-132.0						
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	M	M	M	M	M	M	P	M	M	P	M	M	M	M	M	M	M
Ceratolithus spp.	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R			
Coccolithus eopelagicus							R														
C. pelagicus	F	C	C	F	F	C	C	C	C	F	F	C	C	C	F	C	C	C	C	F	C
Cruciplacolithus cf. *neohelis*																					
Cyclicargolithus cf. *neogammation*																					
Cyclococcolithina leptopora	C	C	F	C	C	C	F	C	C	C	C	C	C	C	C	C	C	C	F	C	C
C. macintyrei, >15μ	F	F	R	F	F	F	F	F	C	F	F	C	C	C	C	C	C	C	C	F	C
Discoaster asymmetricum											R			R	R						
D. brouweri	R	R				R		R	R	R	R		R	F		R	R				
D. challengeri																		R			
D. pentaradiatus	R	R	R		R	R	X	R	F	F	R	R	R	F		R	R	F	R		R
D. surculus	R	X			X				R	R	R			X				R	R	R	
D. tamalis																					
D. variabilis		R				R									R	R	R	R			R
Discoaster sp.					R	R	R	R	F	F	R	R	R	F	R	R	F	F	R	R	F
Gephyrocapsa oceanica																					
Helicopontosphaera euphratis				R									R				R	R			
H. kamptneri group	F	F	F	F	R	F	R	F	C	F	F	F	F	F	F	F	F	F	F	F	F
H. sellii																					
Pontosphaera discopora							F						R	F						R	R
P. japonica																					
Pontosphaera sp.	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F	R
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	C	A
Pseudoemiliania lacunosa																					
Reticulofenestra bisecta																r					x
R. pseudoumbilica	C	A	C	C	C	C	C	C	F	F	F	F	R	F	F	F	F	C	C	C	C
Rhabdolithus sp.				R						R	R			X							
Rhabdosphaera claviger	F	R	F	F	R	F	F	F	R	F	R	F	F	F	R	R	R	R	R	R	F
Rhabdothorax regale		R													R						
Scapholithus sp.	R				R	R	R		R	R	R			R				R			R
Scyphosphaera sp.	F	R	F	R	R	F	R	F	F	F	F	F	F	F	F	F	F	R	R	F	F
Sphenolithus abies			R		R		R	R	R	R	R	R	F	R	R	R	R	F	R	F	F
S. neoabies	F	R	R	F	R	R	R	F	F	R	F	F	F	F	F	F	C	C	F	F	F
Syracosphaera hystrica group	F	R	F	F	F	F	F	F	R	F	F	F			R						
Thoracosphaera sp.		R		R		R							R			R		R	R		X
Triquetrorhabdulus rugosus																					
Trochoaster sp.																					

Sample (Interval in cm)	15-1, 110	15-2, 110	15-3, 110	15-4, 110	15-5, 110	15-6, 110	15, CC	16-2, 110	16-3, 110	16-4, 110	16-5, 110	16-6, 133	16, CC	17-1, 135	17-2, 110	17-3, 110	17-4, 110	17-5, 110	17-6, 110	17, CC
Adopted Age	Undifferentiated early Pliocene to late Miocene																			
Zone	*Reticulofenestra pseudoumbilica*																			
Lithology	Foram and Nanno oozes																			
Depth Below Sea Floor (m)	132.0-141.5							141.5-151.0						151.0-160.5						
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Ceratolithus spp.									R	X					X	X	R			X
Coccolithus eopelagicus																				
C. pelagicus	F	F	F	F	C	C	C	F	F	F	F	F	F	C	C	F	C	F	F	F
Cruciplacolithus cf. *neohelis*																				
Cyclicargolithus cf. *neogammation*																				
Cyclococcolithina leptopora	F	F	F	F	F	F	F	F	F	F	C	C	C	C	C	C	C	C	C	C
C. macintyrei, >15μ	F	F	C	F	F	F	C	F	F	F	F	R	R	C	F	C	F	F	F	F
Discoaster asymmetricum														R						
D. brouweri							R				R								R	
D. challengeri											X									
D. pentaradiatus	R	R	X			R	X													
D. surculus						R	R									R		R	R	R
D. tamalis																				
D. variabilis							R			X			R	R	R	R		R	R	R
Discoaster sp.	R		R	R	F	F	R	R	R	R	R	R		F	F	F	R	F	F	C
Gephyrocapsa oceanica																				
Helicopontosphaera euphratis	R					X	X		R				X	F	F	R		R		
H. kamptneri group	F	F	F	F	C	F	F	F	F	F	R	R	R	F	F	F	F	F	F	F
H. sellii																				
Pontosphaera discopora							R						X							
P. japonica																				
Pontosphaera sp.	F	F	F	R	R	R	F	R	F	R	R	R	R	F	R	F	R	R		
Prinsiaceae, small	A	A	A	A	A	A	A	C	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa																				
Reticulofenestra bisecta										x			r	x						
R. pseudoumbilica	A	A	A	A	A	A	C	A	C	C	C	A	A	A	C	A	A	A	A	A
Rhabdolithus sp.																				X
Rhabdosphaera claviger	F	R		R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	X
Rhabdothorax regale																				
Scapholithus sp.																				
Scyphosphaera sp.	F	F	R	R	F	F	R	R	R	R	R	F	R	F	R	F	R	R	F	R
Sphenolithus abies	R	R		R		R	F	R	R	R	R	R	R	R	R	R	R	F	R	F
S. neoabies	F	F	F	F	R	F	F	R	R	R	F	F	R	R	F	F	C	F	F	F
Syracosphaera hystrica group																				
Thoracosphaera sp.	R								R		R		R		R	R	R			X
Triquetrorhabdulus rugosus																				
Trochoaster sp.																				

Sample (Interval in cm)	18-2, 110	18-3, 110	18-4, 110	18-5, 110	18-6, 110	18, CC	19-1, 140	19-2, 110	19-3, 110	19-4, 110	19-5, 110	19-6, 110	19, CC	20-1, 120	20-2, 100	20-3, 110	20-4, 110	20-5, 110	20-6, 110	20, CC
Adopted Age	Undifferentiated early Pliocene to late Miocene																			
Zone	*Reticulofenestra pseudoumbilica*																			
Lithology	Foram and Nanno oozes																			
Depth Below Sea Floor (m)	160.5-170.0						170.0-179.5							179.5-189.0						
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	M	M	M	M	P	M	P	P	P	P	M	P	M	P	P	P	P	P	P	P
Ceratolithus spp.		R	F	R	R	F	R	R	F	R	F	R	R		R	X	X			X
Coccolithus eopelagicus																				
C. pelagicus	F	F	F	F	C	F	C	C	C	C	C	C	C	C	C	F	F	F	F	F
Cruciplacolithus cf. *neohelis*																				
Cyclicargolithus cf. *neogammation*							x	x												
Cyclococcolithina leptopora	F	R	F	F	F	F	C	F	C	F	F	F	C	F	C	C	C	F	F	F
C. macintyrei, >15μ	R	R	R	R	F	R	F	F	F	R	F	F	C	R	F	F	F	F	R	R
Discoaster asymmetricum															R					
D. brouweri	R						X					R		R		R	R			
D. challengeri																			X	R
D. pentaradiatus				X																
D. surculus	R		R	R	F	F			R	R			F	R			R	X		
D. tamalis																				
D. variabilis	R			R	R	X	R	R	R	R	R	R	R	R	R	R	F	R	R	F
Discoaster sp.	F	R	R	F	R	R	F	F	F	R	F	F	R	R	R	R	R	R	R	
Gephyrocapsa oceanica																				
Helicopontosphaera euphratis			R			R	R	R	R		F	R	R							
H. kamptneri group	R	R	R	F	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F
H. sellii																				
Pontosphaera discopora																				
P. japonica																				
Pontosphaera sp.			R					R	R	R	F	R		R		R			X	
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa																				
Reticulofenestra bisecta																				
R. pseudoumbilica	A	A	A	A	A	C	A	A	A	A	A	A	A	C	A	A	A	A	A	A
Rhabdolithus sp.																				
Rhabdosphaera claviger				R			R	R	R	R	F	R	F							R
Rhabdothorax regale			R																	
Scapholithus sp.																			X	
Scyphosphaera sp.	R		R		R	R	R	R	R	R	F	R	R		R	R	R		R	R
Sphenolithus abies	R	R	R	R	R	R	R	R	R	R	R	F	F		X	X				R
S. neoabies		R	R	F	F	F	F	C	F	F	C	F	F		R	X				R
Syracosphaera hystrica group																				
Thoracosphaera sp.	R	R	F	R	R	F	R	F	R	R	R	R	R	R	R	R	R			R
Triquetrorhabdulus rugosus																				
Trochoaster sp.																				

Sample (Interval in cm)	21-1, 140	21-2, 110	21-3, 110	21-4, 110	21-5, 110	21-6, 110	21, CC	22-1, 135	22-2, 110	22-3, 110	22-4, 110	22-5, 110	22-6, 110	22, CC
Adopted Age	Undifferentiated early Pliocene to late Miocene							Late Miocene						
Zone	*Reticulofenestra pseudoumbilica*													
Lithology	Foram and Nanno oozes													
Depth Below Sea Floor (m)	189.0-198.5							198.5-208.0						
Overall Abundance	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Overall Preservation	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Ceratolithus spp.				X		R	X	R	R		X		X	
Coccolithus eopelagicus														
C. pelagicus	F	F	F	F	F	F	F	C	F	F	F	C	C	R
Cruciplacolithus cf. *neohelis*							X	X					X	
Cyclicargolithus cf. *neogammation*		x			x			x		x				
Cyclococcolithina leptopora	F	F	F	F	R	R	F	F	F	C	F	C	C	C
C. macintyrei, >15μ	R	R	R	R	R	R	R	R	F	R	R	R	R	R
Discoaster asymmetricum					X									
D. brouweri	X													X
D. challengeri	X													
D. pentaradiatus					X				X					
D. surculus	R				X							X		
D. tamalis														
D. variabilis	R	R	R	R	R	R	R	R	R				R	R
Discoaster sp.	R	R	F	F	F	R	R	F	F	R	R	R	X	
Gephyrocapsa oceanica														
Helicopontosphaera euphratis														
H. kamptneri group	R	R	F	F	F	R	F	R	R	R	R	R	R	R
H. sellii														
Pontosphaera discopora														X
P. japonica														
Pontosphaera sp.	R	R	R	R	R	R	R	R	R		R	R	R	
Prinsiaceae, small	A	A	A	A	A	A	A	A	A	A	A	A	A	A
Pseudoemiliania lacunosa														
Reticulofenestra bisecta														
R. pseudoumbilica	A	A	A	A	C	A	A	A	A	A	C	C	C	A
Rhabdolithus sp.														
Rhabdosphaera claviger									X		X			
Rhabdothorax regale										R				
Scapholithus sp.														
Scyphosphaera sp.	X		X	R	R	R	R	R	F	R	R	R	R	R
Sphenolithus abies	R	R	R		R	R	R	F	R	F	R	F	F	F
S. neoabies	F	F	F	R	R	R	F	C	C	F	F	F	F	F
Syracosphaera hystrica group														
Thoracosphaera sp.	R	R		R	R	R	R			R	X	X		
Triquetrorhabdulus rugosus								R	R	R	R	R	R	R
Trochoaster sp.														

TABLE 12
Additional Species Observed but not Listed in Tables 4-11

Site 277 (see Table 4)

Braarudorphaera bigelowi-R in Samples 40, CC; 41-2, 111 cm; 43, CC.
Camphylosphaera dala-R in Sample 43-3, 121 cm.
Cruciplacolithus mustahus-R in Sample 36-2, 108 cm.
Discoaster mecliosus-R in Samples 44-1, 101 cm; 44-2, 130 cm; 44-3, 127 cm.
D. taris-R in Samples 34-2, 110 cm; 34, CC.
Helicopontosphaera salebrosa-R in Sample 33-1, 120 cm.
H. seimnulum-R in Samples 38-2, 110 cm; 39, CC; 40-2, 110 cm; 40-3, 117 cm.
Lophodolithus mochloporus-R in Samples 40-3, 117 cm; 40, CC; 41-1, 113 cm.
L. nascens-R in Samples 42-3, 114 cm; 42, CC.
Markalius reinhardtii-R in Samples 44-2, 20 cm; 45-5, 111 cm.
Micrantholithus sp.-R in Sample 40-3, 117 cm.
Nannotetrina cristata-R in Samples 35-1, 105 cm; 35-2, 104 cm; 36, CC.
Neochiastogugus junctus-R in Samples 44-2, 20 cm; 44-2, 90 cm.
N. perfectus-R in Sample 46-2, 118 cm.
Neococcolithes minubus-R in Samples 44, CC; 43-1, 117 cm.
N. protenus-R in Samples 45-3, 127 cm; 46-2, 118 cm.
Rhabdolithus tenuis?-R in Samples 38-3, 122 cm; 39-2, 110 cm; 39-3, 120 cm.
Transvesophonhis puleheroides-R in Sample 40-3, 177 cm.
Zygodiscus plectopons-R in Sample 41-2, 111 cm.
Z. sigmoides-R in Sample 45-3, 127 cm.

Site 278 (see Table 5)

Discoaster brouweri-1 in Sample 18-2, 110 cm; R in Sample 18-1, 110 cm.
D. cf. *D. calcaris*-1 in Sample 18-2, 110 cm; R in Sample 17, CC.
D. druggi-kugleri group-1 in Samples 26, CC; 23, CC; 23-5; 110 cm. 23-1, 110 cm.
D. lodoensis-1 in Sample 17, CC.
Ericsonia tenestrata s.l.-1 in Sample 32-3, 110 cm.
Helicopontosphaera kamptneri-1 in Samples 20, CC; 16-6, 110 cm.

Site 279 (see Table 6)

Chiasmolithus alhus-1 in Samples 279A-6-4, 56 cm; 279A-3-6, 125 cm; 279A-9, CC.
Helicopontosphaera ampliaperta-R in Sample 279A-5, CC.
Hornibrookina australis-1 in Sample 279A-8-1, 114 cm.
Micrantholithus sp.-1 in Sample 279A-6-4, 56 cm.
Rhabdosphaera skylifer-1 in Sample 279-1-1, 80 cm.
Rhabdothorax regale-1 in Sample 279-1-1, 80 cm.
Sphenolibluis cf. *S. capricornutus* 279A-6-4, 56 cm.
Triquetrorhabdulus milowii-1 in Sample 279A-3-1, 140 cm.
Zygrhablithus bijugatus-1 in Sample 279A-3-4, 110 cm.

Site 282/I (see Table 9)

Blackites rectus?-1 in Sample 11-1, 136 cm; 11-3, 110 cm; F in Sample 11, CC.
D. divaricatus-F in Sample 2, CC; 3, CC; 4, CC.
Helicopontosphaera compacta-1 in Sample 12-2, 115 cm.
H. obliqua-F in Sample 5, CC.
Lanternithus minutus-R in Samples 11-1, 130 cm; 11-2, 110 cm.
Reticulofenestra abisecta-C in Sample 5, CC.
R. oamaruensis?-1 in Sample 11-2, 110 cm.
Rhabdosphaera skylifer-F in Sample 1-1, 75 cm; R in Sample 1-1, 101 cm.
Scapholithus sp.-R in Sample 1-1, 75 cm.
Sphenolithus abies-F in Samples 2, CC; 5-1, 127 cm; 5-2, 40 cm.
S. heteromorphus-1 in Sample 1-4, 130 cm.
Transversopontis sp.-R in Samples 11-1, 136 cm; 11-2, 110 cm.
Trachoaster sp.-1 in Sample 11, CC.
Umbilicosphaera mirabilis-R in Sample 1-1, 75 cm.

Site 282/II (see Table 9)

Chiasmolithus solitus-F in Sample 17, CC; R? in Core 18 (top).
Coramulus germaincus?-Sample 16, CC.
Coronocyclus uifescens-R in Samples 13-5, 110 cm; 14-3, 107 cm.
Cruciplacolithus sp.-1 in Samples 15-2, 66 cm; 15-3, 30 cm; 15, CC.
Discoaster binodosus binodosus-R in Core 18 (top).
Helicopontosphaera dinesenii-1 in Samples 17-3, 110 cm; 17-4, 110 cm.
H. lophota-1 in Samples 17-3, 110 cm; 15-2, 63 cm.
H. cf. *H. salebrosa*-1 in Sample 17-4, 110 cm; R in Sample 17, CC.
Helicopontosphaera sp.-F in Sample 13-4, 23; 1 in Sample 14-2, 110 cm.
Neococcolithites dubius-R in Samples 17-3, 110 cm; 17-4, 110 cm.
N. minutus-1 in Samples 17-3, 110 cm; 17-4, 110 cm; R in Sample 17, CC.
Orthozygus aurcus-R? in Sample 13-1, 130 cm; 1 in Sample 16-1, 110 cm.
Reticulofenestra oamaruensis-F? in Sample 15-2, 66 cm.
Rhabdolitus vitrea-R in Sample 13-4, 23 cm.
Sphenolithus sp.-R in Samples 15, CC; 17-3, 110 cm.
Trausversopontis sp.-1 in Samples 16-1, 110 cm; 17-3, 110 cm; 17, CC.
Holococcolith-1 in Sample 17-3, 110 cm.

Site 283 (see Table 10)

Table 10 includes all coccoliths and nannoliths observed down to Sample 9, CC. At least one sample per section was searched for calcareous nannofossils down to Sample 17, CC. While most samples proved to be barren, the following included very rare and poorly preserved small *Reticulofenestra*, and occasionally *Ericsonia ovalis:* Samples 10, CC; 11-2, 117 cm; 13-2, 111 cm; 13-5, 104 cm; 14-2 114 cm; 14, CC; 15-31, 114 cm; and 17-5, 35 cm.

Note: See Table 4A for explanation of symbols.

PLATE 1

Calcareous nannofossils from Sample 277-46-2, 118 cm; Paleocene.
(Figures 1-9, 11 ×5700; Figures 10, 12-15, ×11,500)

Figure 1	*Sphenolithus* sp. Side view of specimen reminiscent of *S. primus* Perch-Nielsen; heavy overgrowth.
Figures 2-8	*Fasciculithus tympaniformis* Hay and Mohler. Varying degrees of solution and overgrowth. 2, 3. Distal views. 4, 5, 7, 8. Side views. 6. Proximal view.
Figure 9	*Neochiastozygus junctus* (Bramlette and Sullivan). Proximal view; damaged specimen.
Figure 10	*Neochiastozygus* sp. 1. Distal view; some selective overgrowth.
Figure 11	*Neococcolithes protenus* (Bramlette and Sullivan). Distal view; heavy overgrowth in center.
Figure 12	*Neochiastozygus* sp. 2. Distal view; overgrowth in center.
Figures 13-15	*Neochiastozygus* cf. *N. modestus* Perch-Nielsen. 13, 14. Distal views; some overgrowth in center. 15. Proximal view; some overgrowth in center.

PLATE 1

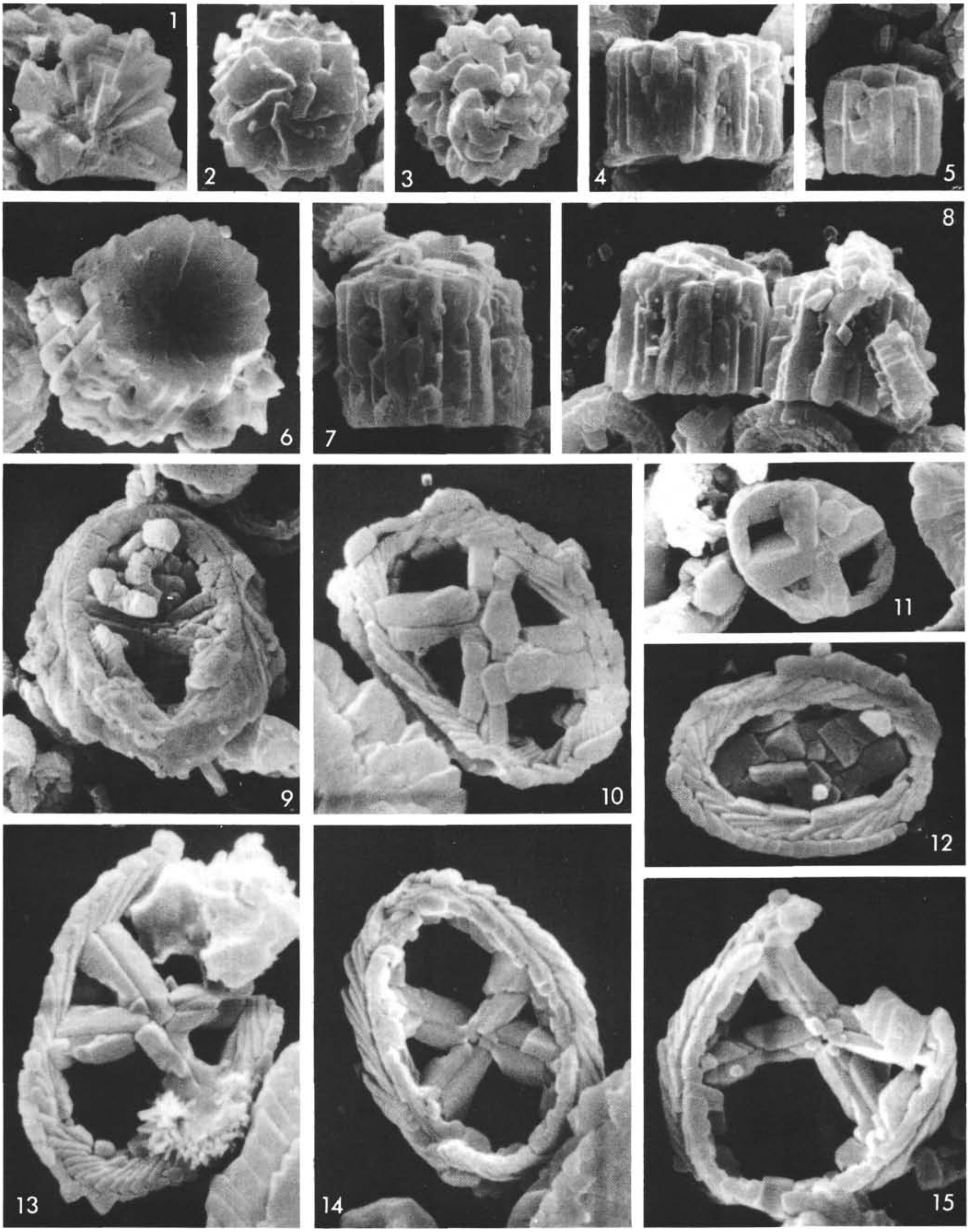


PLATE 2

Calcareous nannofossils from Sample 277-45-2, 118 cm; Paleocene.

Figures 1-3, 6, 9, 12	*Hornibrookina australis* n. sp. ×11,200. 1-3, 12. Distal views. 6. Paratype; proximal view. 9. Holotype; distal view.
Figures 4, 7, 11	*Chiasmolithus danicus* (Brotzen). ×11,500. 4, 11. Distal views; little overgrowth 7. Heavy selective overgrowth.
Figure 5	*Ericsonia*? sp. Distal view; ×11,500.
Figure 8	*Chiasmolithus bidens* (Bramlette and Sullivan). Distal view; diffuse overgrowth; ×5700.
Figure 10	*Chiasmolithus* cf. *C. eograndis* Perch-Nielsen. Distal view, some overgrowth; ×5700.

PLATE 2

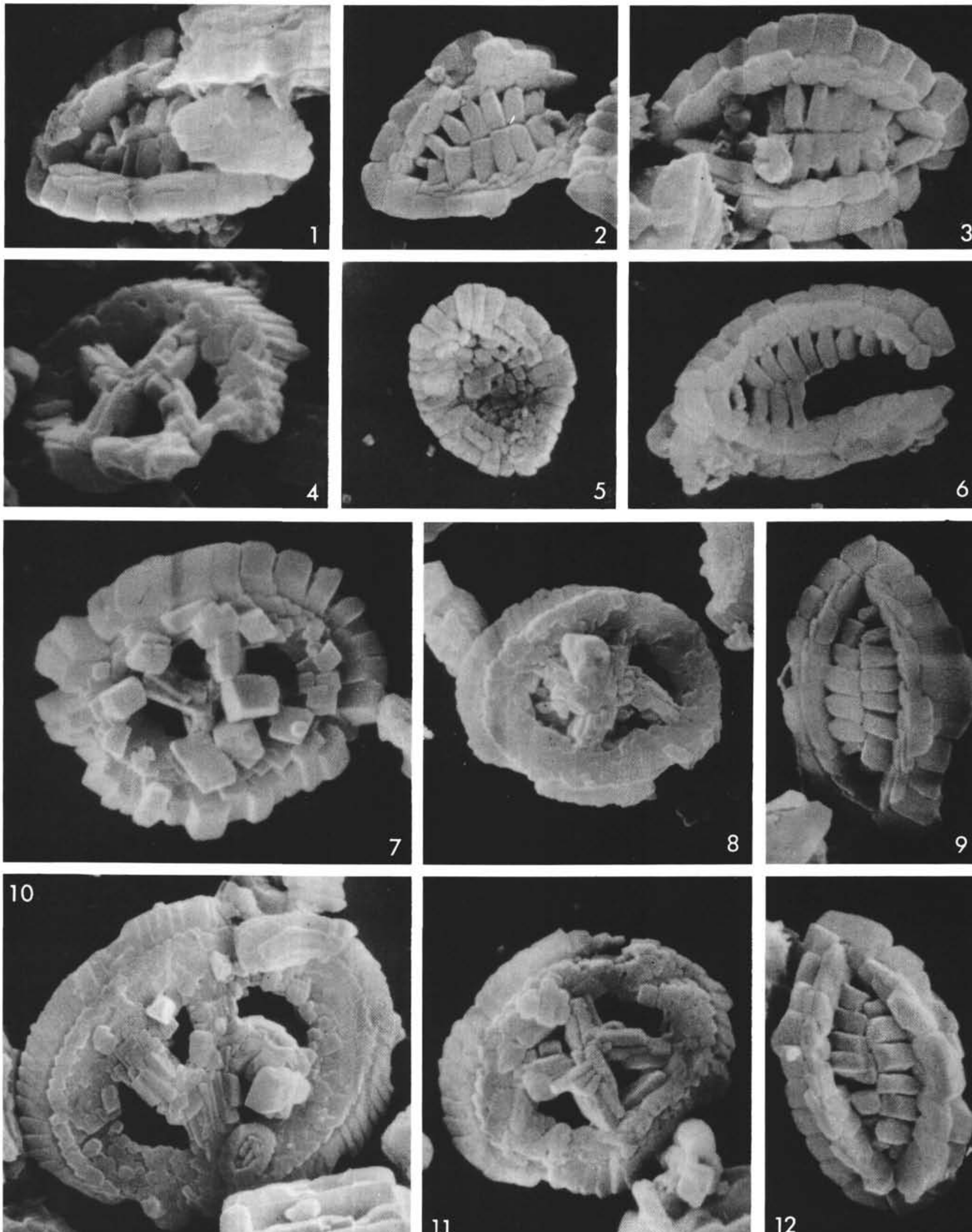


PLATE 3

Calcareous nannofossils from Sample 277-45-3, 127 cm; Paleocene.
(Figures 1-11, ×11,400; Figures 12, 13, ×5700)

Figures 1, 2, 4, 5, 7, 10	*Neochiastozygus distentus* (Bramlette and Sullivan). 1. Proximal view. 2, 4, 5, 7. Distal views; overgrowth. 10. Distal view; first wall visible.
Figures 3, 6, 8, 9	*Toweius craticulus* Hay and Mohler. 3, 6. Proximal views; etching and overgrowth. 8, 9. Distal views.
Figure 11	*Neococcolithes protenus* (Bramlette and Sullivan). Distal view; center heavily overgrown.
Figure 12	*Toweius callosus* Perch-Nielsen. Distal view; some overgrowth.
Figure 13	*Toweius* cf. *T. occultatus* (Locker). Distal view of specimen which could be either *T. occultatus* with an additional central net, or *T. craticulus* with an additional set of radial elements (due to overgrowth only?).

PLATE 3

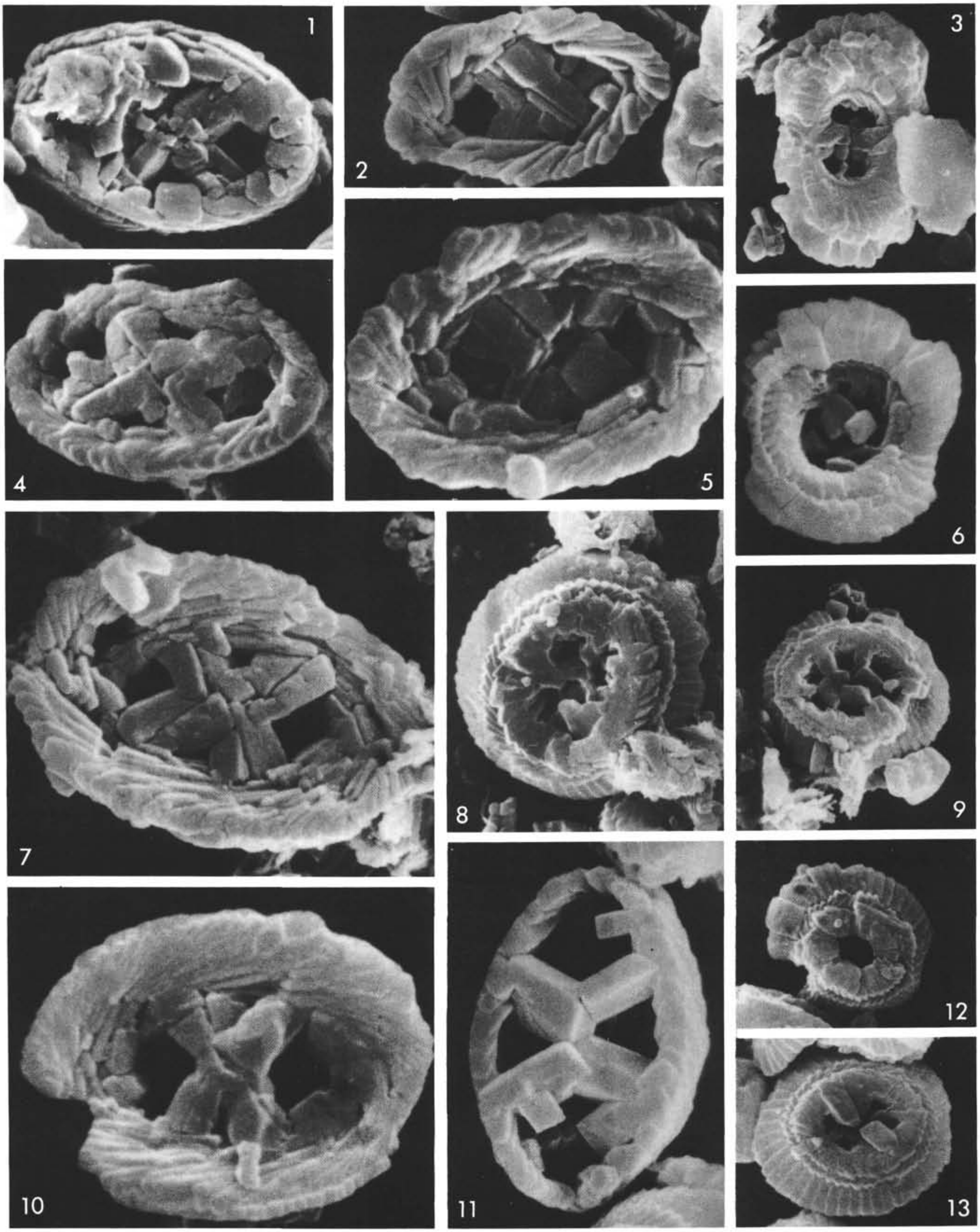


PLATE 4

Calcareous nannofossils from Sample 277-45-3, 127 cm; Paleocene
(All figures ×12,000)

Figures 1, 2	*Neochiastozygus distentus* (Bramlette and Sullivan). Distal views; some overgrowth.
Figure 3	*Discoaster*? sp. 1.
Figure 4	*Toweius eminens* (Bramlette and Sullivan). Distal view; specimen badly damaged.
Figure 5	*Discoaster multiradiatus* Bramlette and Riedel. Distal view; selective overgrowth.
Figure 6	*Toweius craticulus* Hay and Mohler. Distal view; some overgrowth in center.
Figure 7	*Zygodiscus sigmoides* Bramlette and Sullivan. Proximal view.

PLATE 4

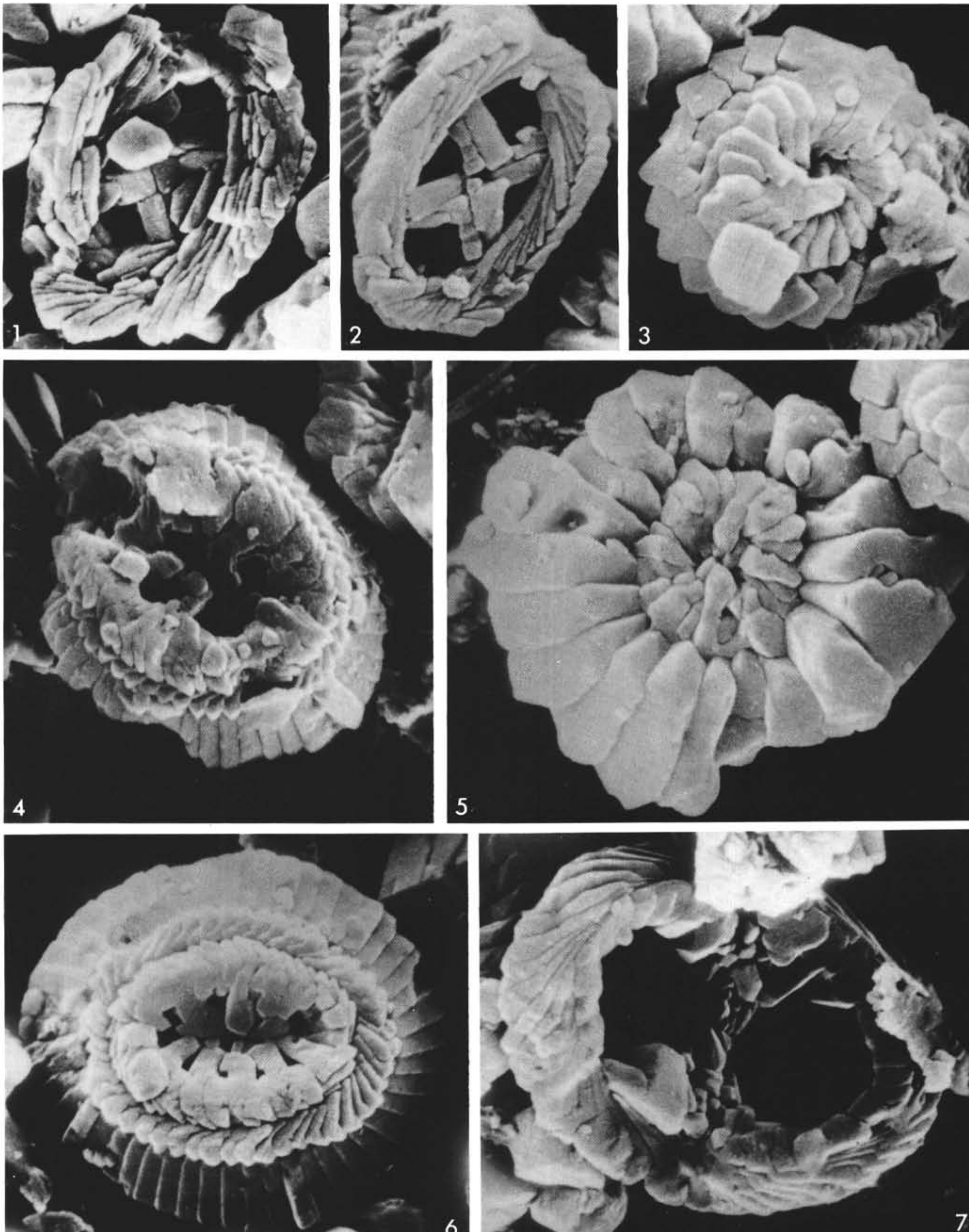


PLATE 5

Paleocene calcareous nannofossils.
(Figures 1-8, 10-12, Sample 277-45-3, 127 cm;
Figure 9, Sample 277-45-2, 118 cm)

Figures 1-3	*Fasciculithus tympaniformis* Hay and Mohler. ×5700. Some overgrowth.
Figures 4, 7, 10	*Discoaster multiradiatus* Bramlette and Riedel. ×5700. 4. Distal view; heavily overgrown. 7, 10. Proximal views.
Figure 5	*Chiasmolithus danicus* (Brotzen). ×5700. Distal view; overgrowth in center.
Figures 6, 9, 12	*Hornibrookina australis* n. sp. ×11,400. 6. Proximal view. 9, 12. Distal views.
Figures 8, 11	*Chiasmolithus eograndis* Perch-Nielsen. ×5700. Distal and proximal views; diffuse overgrowth.

PLATE 5

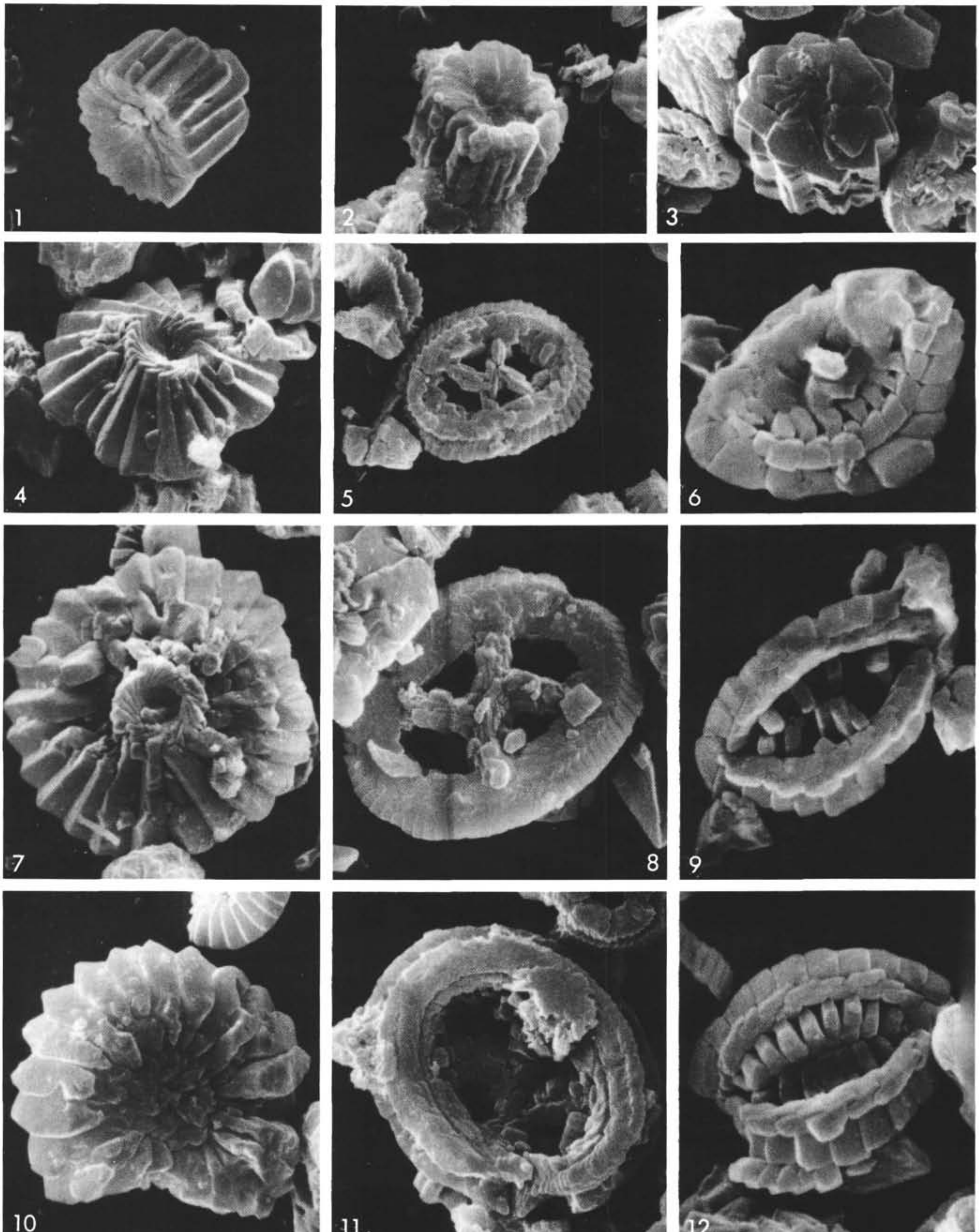


PLATE 6

Calcareous nannofossils from Sample 277-44-2, 20 cm; early Eocene.

Figures 1, 4	*Neochiastozygus* sp. 3. ×5200. Distal and proximal views; overgrowth.
Figure 2	*Sphenolithus* sp. 2. ×5200. Distal view; overgrowth.
Figure 3	*Chiasmolithus* cf. *C. danicus* (Brotzen). ×5500. Distal view; diffuse overgrowth in center.
Figure 5	*Ericsonia robusta* (Bramlette and Sullivan). ×5200. Proximal view; diffuse overgrowth.
Figures 6, 10, 14, 15	*Chiasmolithus eograndis* Perch-Nielsen. ×5200. 6, 10, 15. Distal views; varying overgrowth. 14. Proximal view.
Figures 7, 8	*Neococcolithes protenus* (Bramlette and Sullivan). ×5500. Distal views; center heavily overgrown.
Figure 9	*Toweius callosus* Perch-Nielsen. ×5200. Distal view; some overgrowth on second wall.
Figures 11, 13	*Discoaster robustus* Haq. ×5200. Proximal views.
Figure 12	*"Chiasmolithus" consuetus* (Bramlette and Sullivan). ×5200. Distal view; selective overgrowth.

PLATE 6

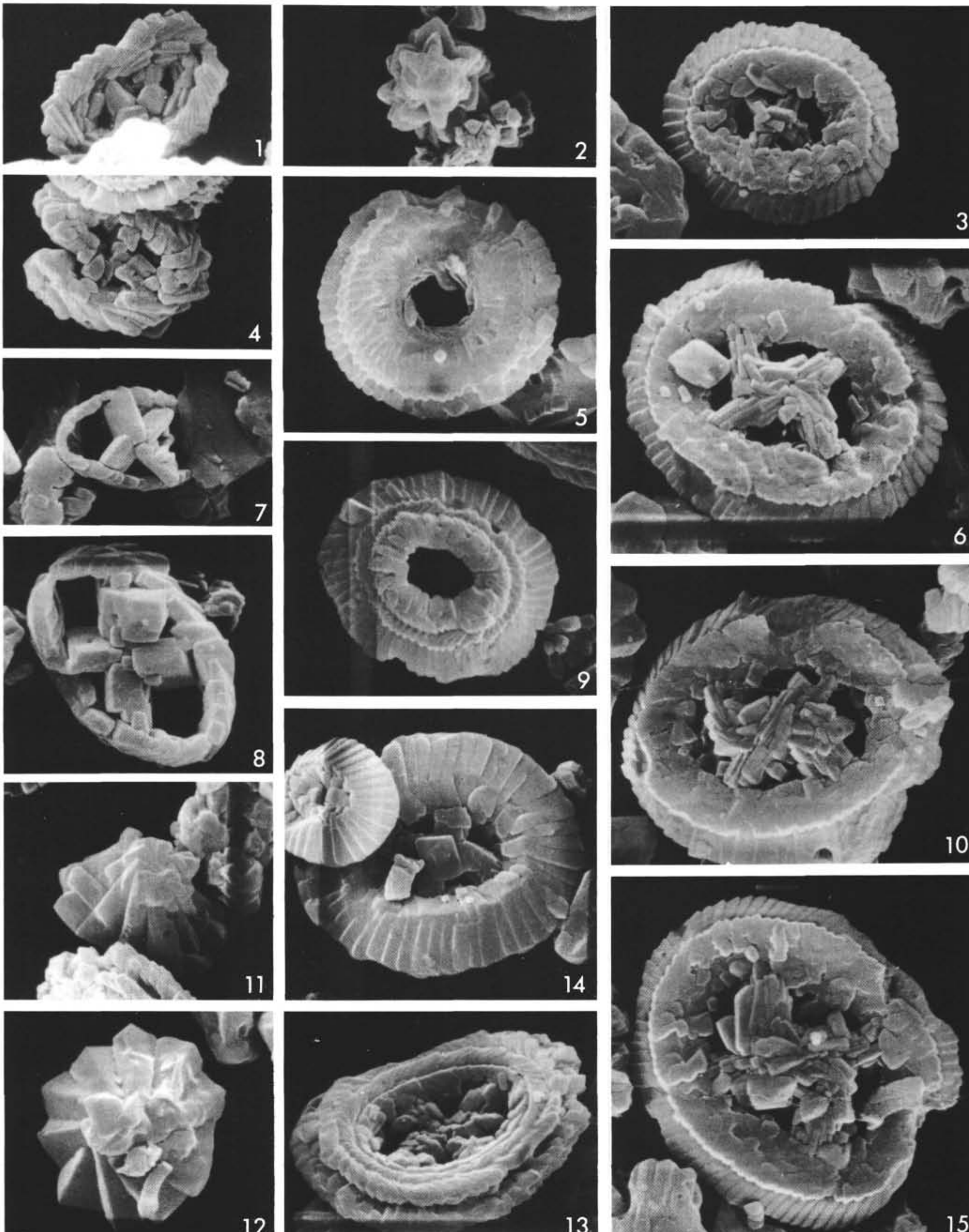


PLATE 7

Calcareous nannofossils.
(Figure 1, Sample 277-45-3, 127 cm; Paleocene.
Figures 2-9, Sample 277-43-3, 121 cm; early Eocene)

Figure 1	*Chiasmolithus* sp. ×12,000. Distal view; dissolution.
Figure 2	*Discolithina* sp. 1. ×6000. Distal view.
Figure 3	*Sphenolithus radians* Deflandre. ×12,000. Side view; overgrowth.
Figures 4, 7	*Chiasmolithus eograndis* Perch-Nielsen. ×6000. Proximal and distal views; specimens damaged.
Figure 5	*Markalius astroporus* (Stradner). ×12,000. Proximal view; overgrowth in center.
Figure 6	*Sphenolithus* sp. 3 (*moriformis* group). ×12,000. Side view, overgrowth.
Figure 8	*Toweius callosus* Perch-Nielsen. ×12,000. Distal view; damaged specimen.
Figure 9	*Zygrhablithus bijugatus* Deflandre. ×6000. Heavily overgrown.

PLATE 7

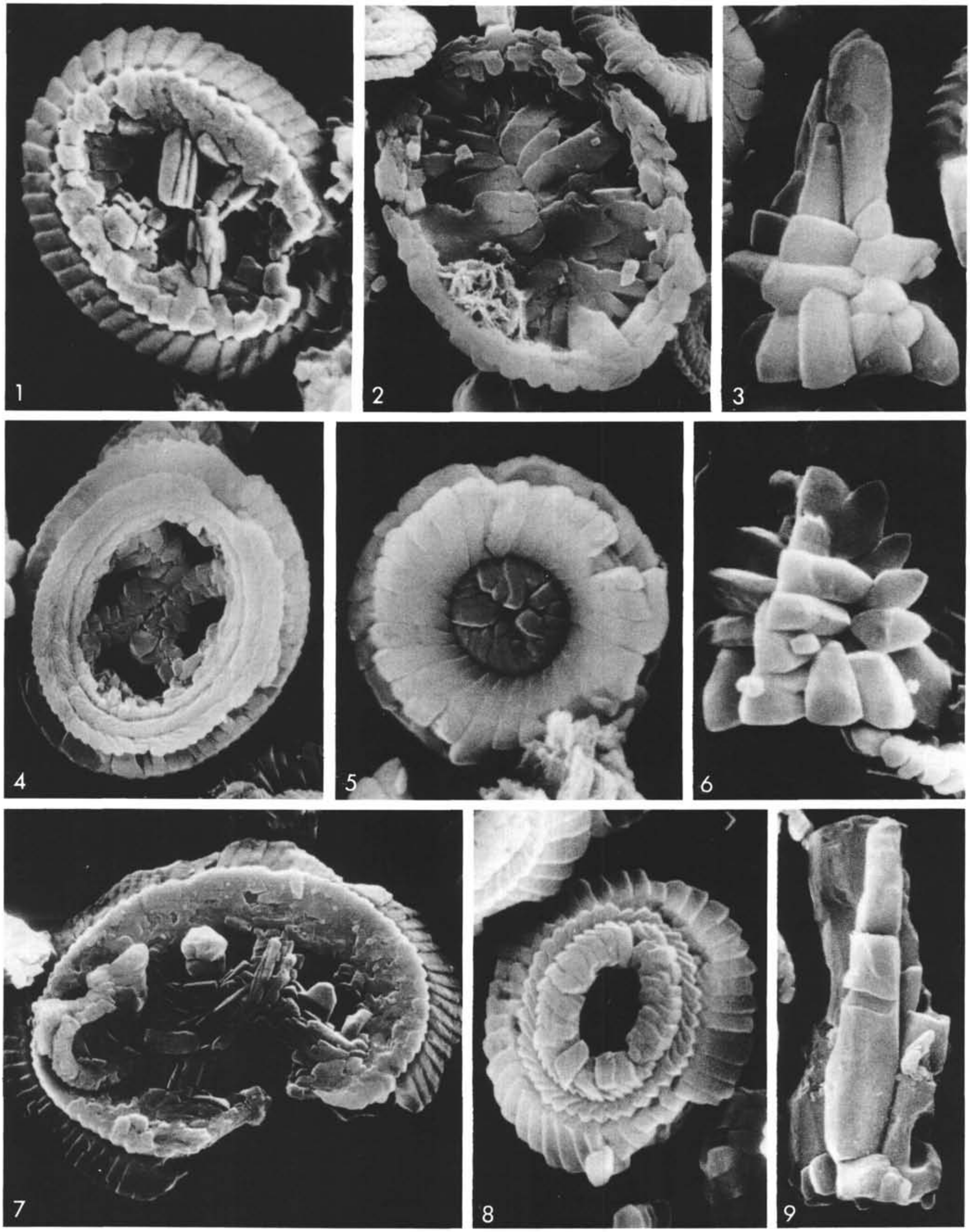


PLATE 8

Calcareous nannofossils.
(Figures 1, 3, 4, 6-9, 11, Sample 277-45-2, 118 cm; Paleocene.
Figures 2, 5, 10, Sample 277-40, CC; Eocene)

Figure 1	*Ellipsolithus distichus* (Bramlette and Sullivan). ×5700. Distal view; damaged specimen.
Figure 2	*Toweius craticulus* Hay and Mohler. ×11,500. Proximal view; damaged specimen.
Figure 3	*Biscutum panis* (Edwards) n. comb. (Basionym: *Conococcolithus panis* Edwards 1973, p. 73, fig. 2-21.) ×11,200. Damaged specimen.
Figure 4	*Discoaster multiradiatus* Bram-lette and Riedel. ×5700. Oblique distal view; damaged specimen.
Figures 5, 10, 11	*Zygrhablithus bijugatus* Deflandre. ×5700. Heavy overgrowth.
Figure 6	*Neococcolithes protenus* (Bramlette and Sullivan). ×11,200. Distal view; selective overgrowth.
Figure 7	*Fasciculithus* ? sp. 1. Note internal structure not previously observed in fasciculiths. ×11,500.
Figure 8	*Markalius astroporus* (Stradner). ×5700. Distal view; minor overgrowth in center.
Figure 9	Nannolith. (Possibly stem of *Discoaster multiradiatus*?); ×5600.

PLATE 8

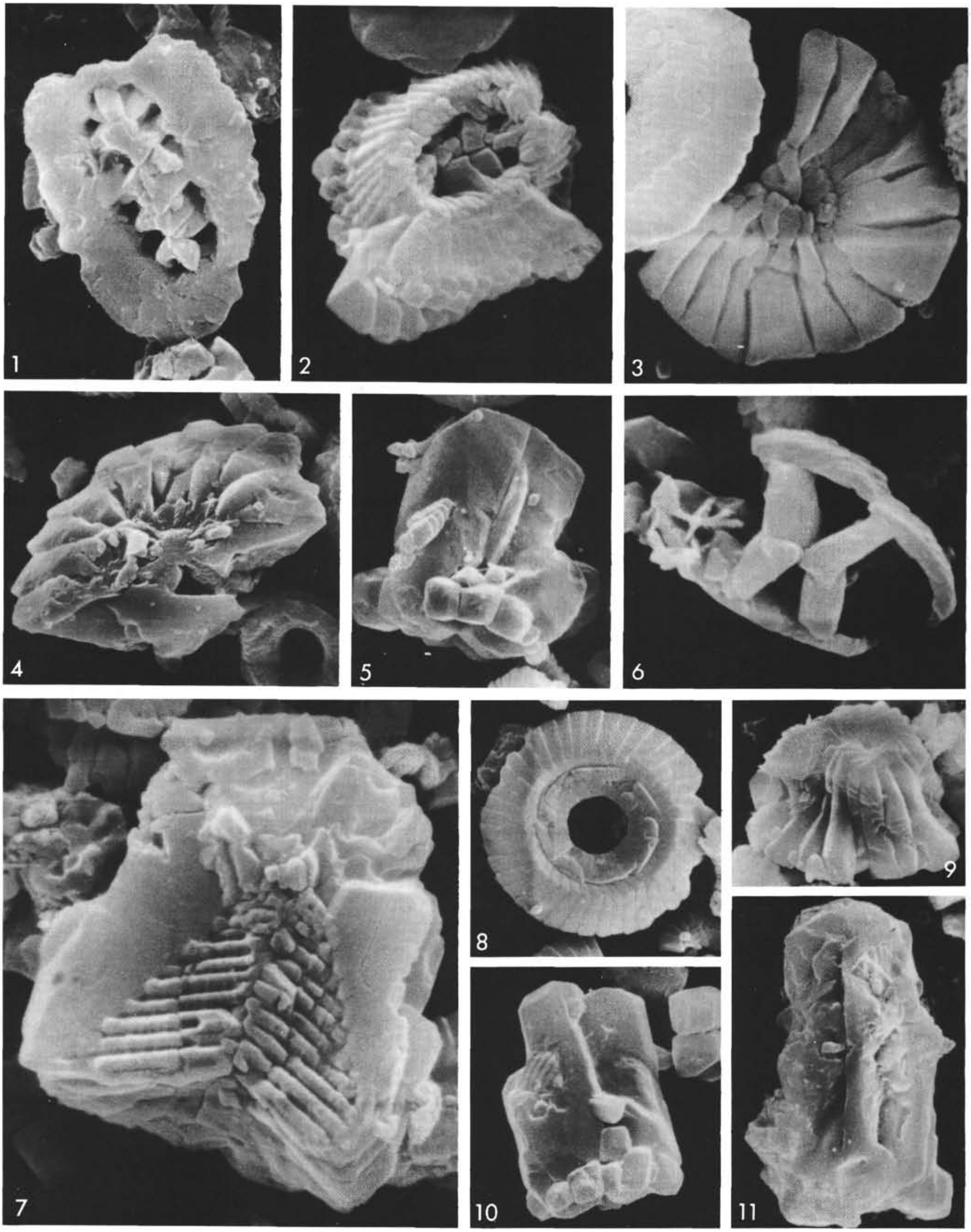


PLATE 9

Calcareous nannofossils; Sample 277-40, CC; Eocene.
(Figures 1-4, 7, 8, 13, ×5700; Figures 5, 6, 9-12, ×11,400)

Figures 1-3	*Helicopontosphaera seminulum* (Bramlette and Sullivan). Distal and proximal views.
Figure 4	*Neococcolithes protenus* (Bramlette and Sullivan). Distal view; center heavily overgrown.
Figure 5	*Reticulofenestra dictyoda* (Deflandre and Fert). Distal view; damaged specimen; selective overgrowth.
Figure 6	*Toweius callosus* ? Perch-Nielsen. Distal view; some overgrowth.
Figures 7, 8	*Discoasteroides kuepperi* (Stradner). Proximal and distal views; partly overgrown.
Figure 9	*Markalius astroporus* (Stradner). Relatively wide central area has suffered more under recrystallization than the shield. Distal view.
Figure 10	*Sphenolithus radians* Deflandre. Heavy overgrowth.
Figure 11	*Markalius?* sp. 1. Proximal view of distal shield?
Figure 12	Ring of elements of a broken coccolith or whole coccolith(?); ×11,400.
Figure 13	*Coronocyclus prionion* (Deflandre and Fert). Distal view.

PLATE 9

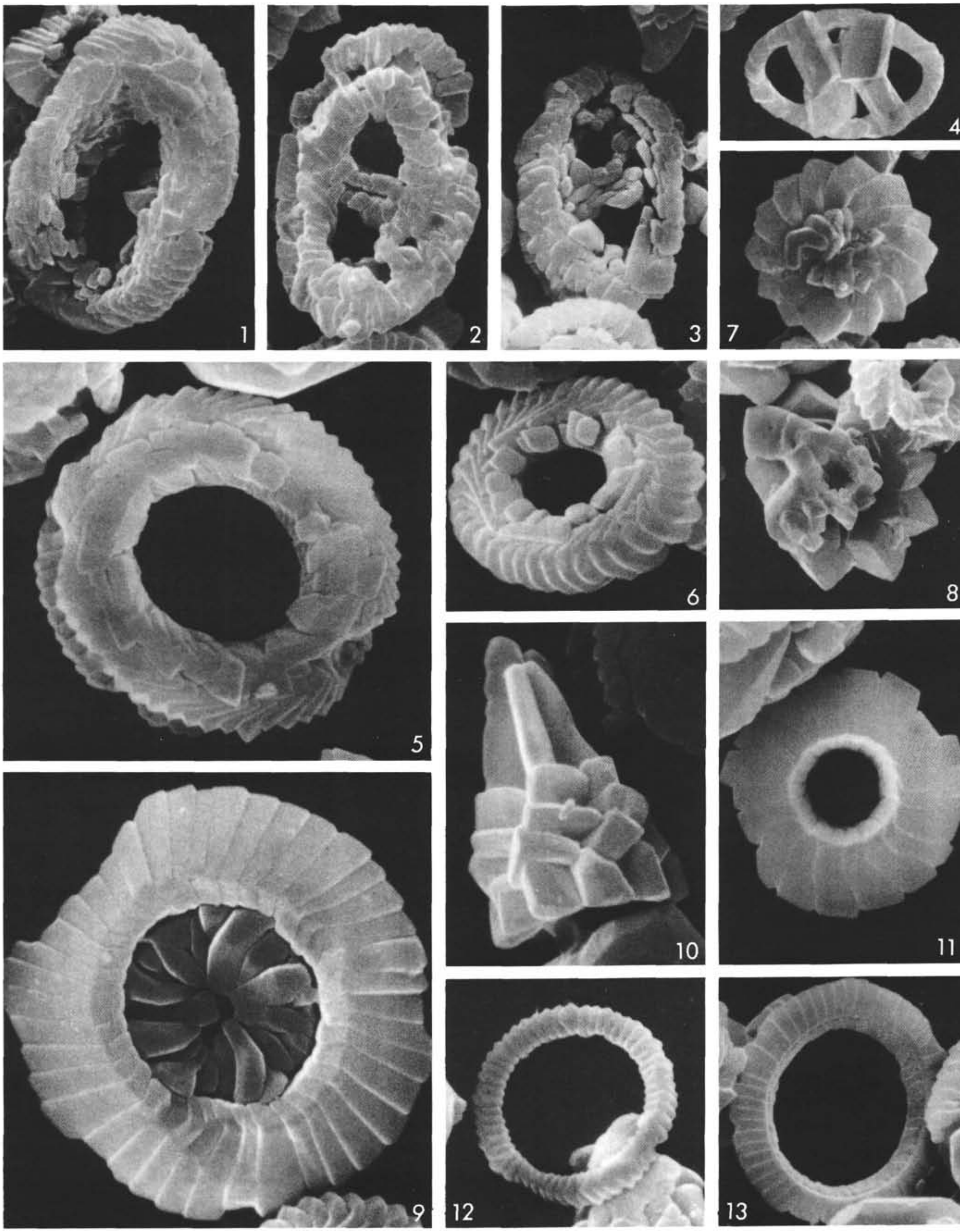


PLATE 10

Calcareous nannofossils; Sample 277-33-1, 120 cm; Eocene.

Figures 1, 5, 11	*Chiasmolithus solitus* (Bramlette and Sullivan). ×6000. Distal views.
Figures 2-4	*Neococcolithes dubius* (Deflandre). ×9000. Distal views; heavy overgrowth in centers.
Figure 6	*Sphenolithus radians s.l.* Deflandre. ×12,000. Side view; some overgrowth.
Figure 7	*Helicopontosphaera* sp. 1. ×6000. Distal view; damaged specimen.
Figure 8	*Chiasmolithus expansus* (Bramlette and Sullivan). ×6000. Proximal view.
Figure 9	*Sphenolithus moriformis s.l.* (Brönnimann and Stradner). ×12,000. Side view; heavy overgrowth.
Figures 10, 12	*Helicopontosphaera salebrasa* Perch-Nielsen. ×6000. Distal and proximal views.

PLATE 10

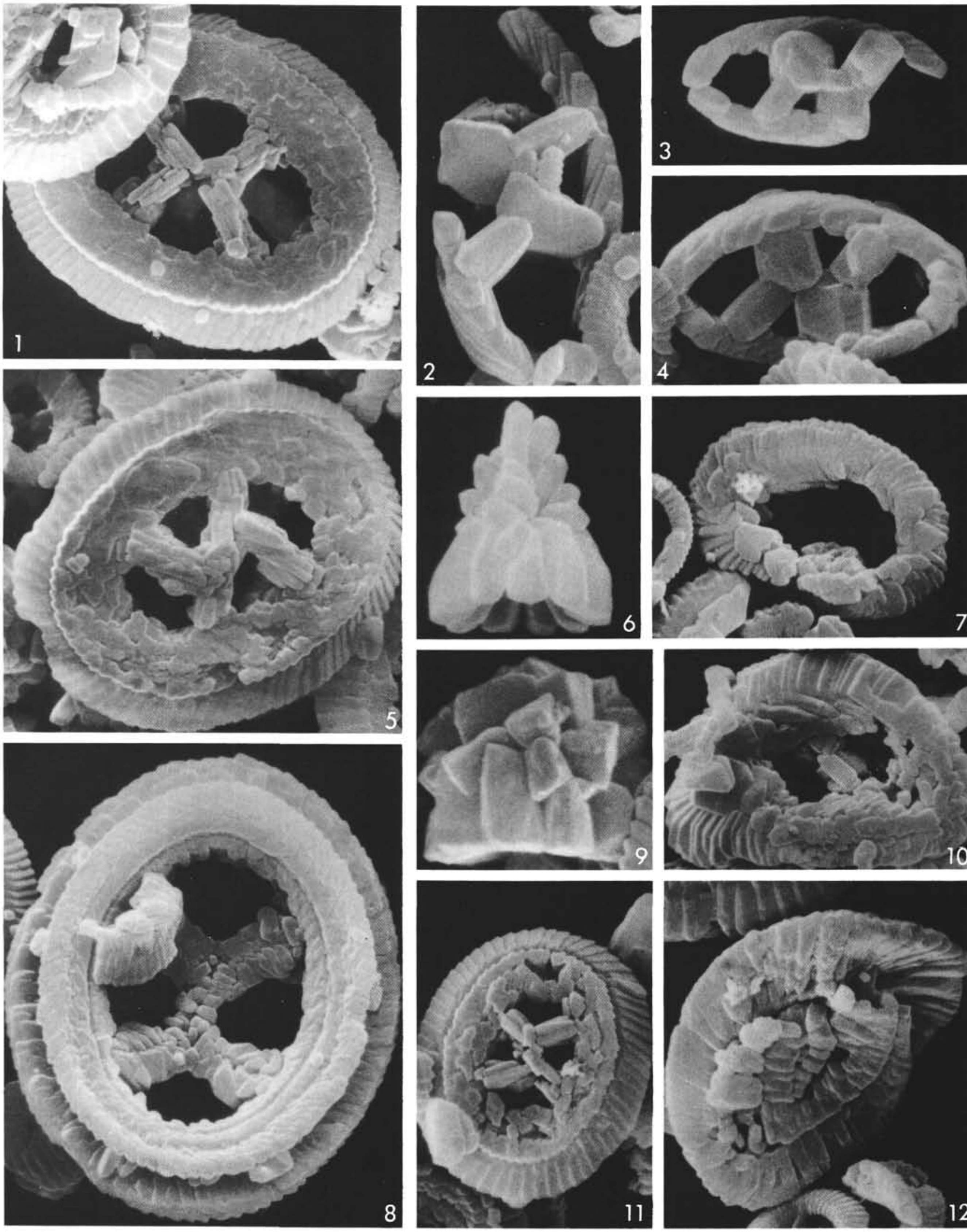


PLATE 11

Calcareous nannofossils; Sample 277-33-1, 120 cm; Eocene.

Figure 1	Rhabdolith. ×6100. Broken stem.
Figure 2	*Discoaster* sp. 2. ×6000. Heavy overgrowth.
Figures 3, 8	*Cyclicargolithus* cf. *C. neogammation* (Bramlette and Wilcoxon). ×12,000. Distal views.
Figures 4, 7	*Ericsonia obruta* Perch-Nielsen. ×12,000. Distal views; some overgrowth in center.
Figure 5	*Discoaster barbadiensis* Tan Sin Hok. ×6000. Distal view; overgrowth on arms.
Figures 6, 12, 13	*Dictyococcotes daviesi* (Haq). 6, 13. ×6000. Distal views. 12. ×9000. Proximal views.
Figure 9	*Toweius occultatus* (Locker). ×12,000. Distal view; selective overgrowth.
Figure 10	*Reticulofenestra placomorpha* (Kamptner). ×6000. Distal view; shields missing?
Figure 11	*Ericsonia alternans* Black. ×6000. Proximal view; some overgrowth.

PLATE 11

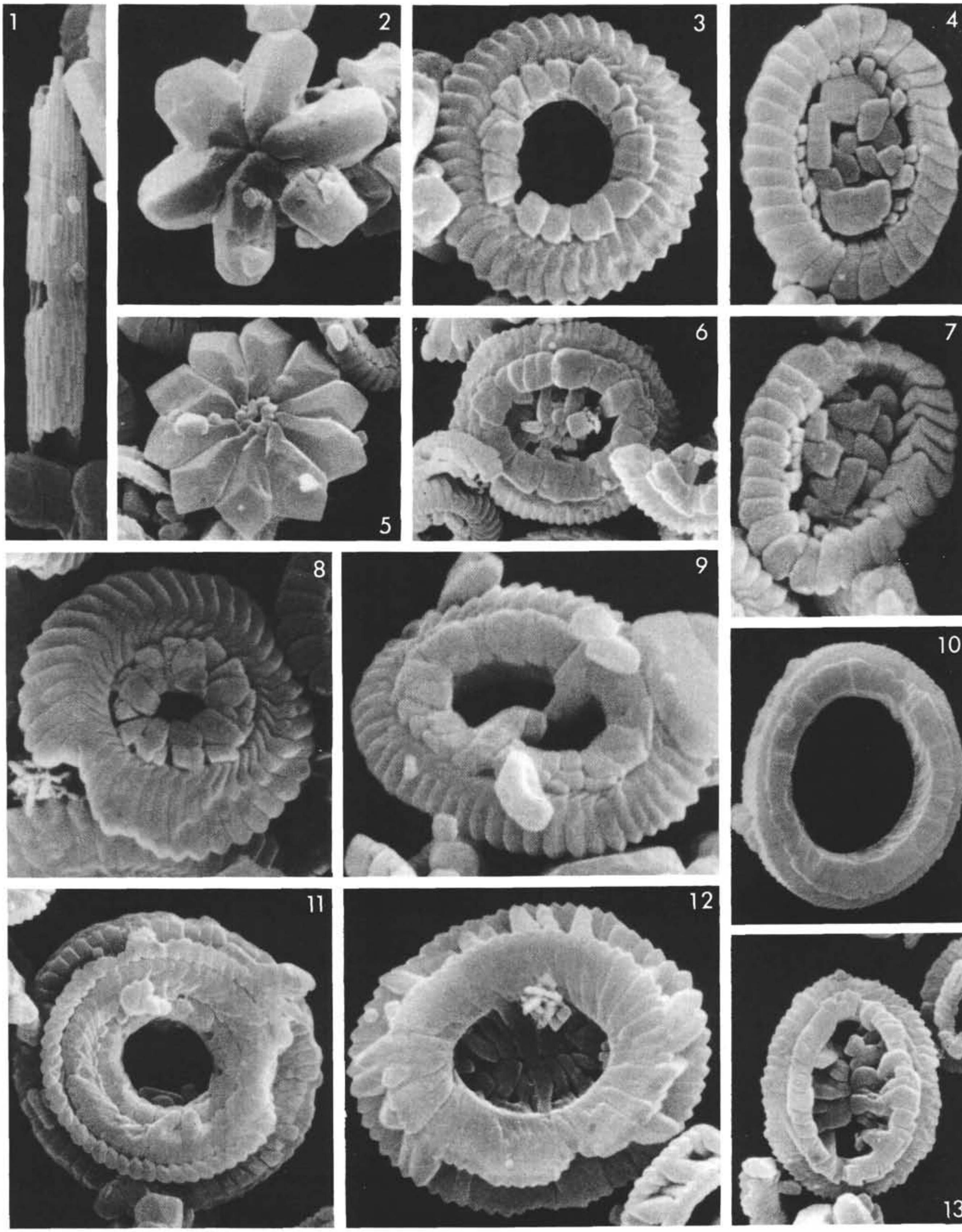


PLATE 12

Calcareous nannofossils.
(Figures 1, 2, 4, 8 from Sample 277-29, CC; Eocene; Figures 3, 5-7, 9-11 from Sample 277-19; late Eocene to early Oligocene)

Figure 1	*Reticulofenestra* sp. Small coccosphere; ×5700.
Figures 2, 4, 7	*Dictyococcites onustus* Perch-Nielsen. 2. ×5700. Distal view. 4. ×9000. Distal view. 7. ×11,400. Distal view.
Figures 3, 6, 9, 11	*Dictyococcites* ? sp. 1. ×11,400. 3, 6. Proximal views. 9, 11. Distal views.
Figure 5	*Dictyococcites callidus* Perch-Nielsen. ×5700. Distal view; etching and overgrowth.
Figures 8, 10	*Cribrocentrum coenurym* (Reinhardt). ×11,400. Proximal views; etching and overgrowth.

PLATE 12

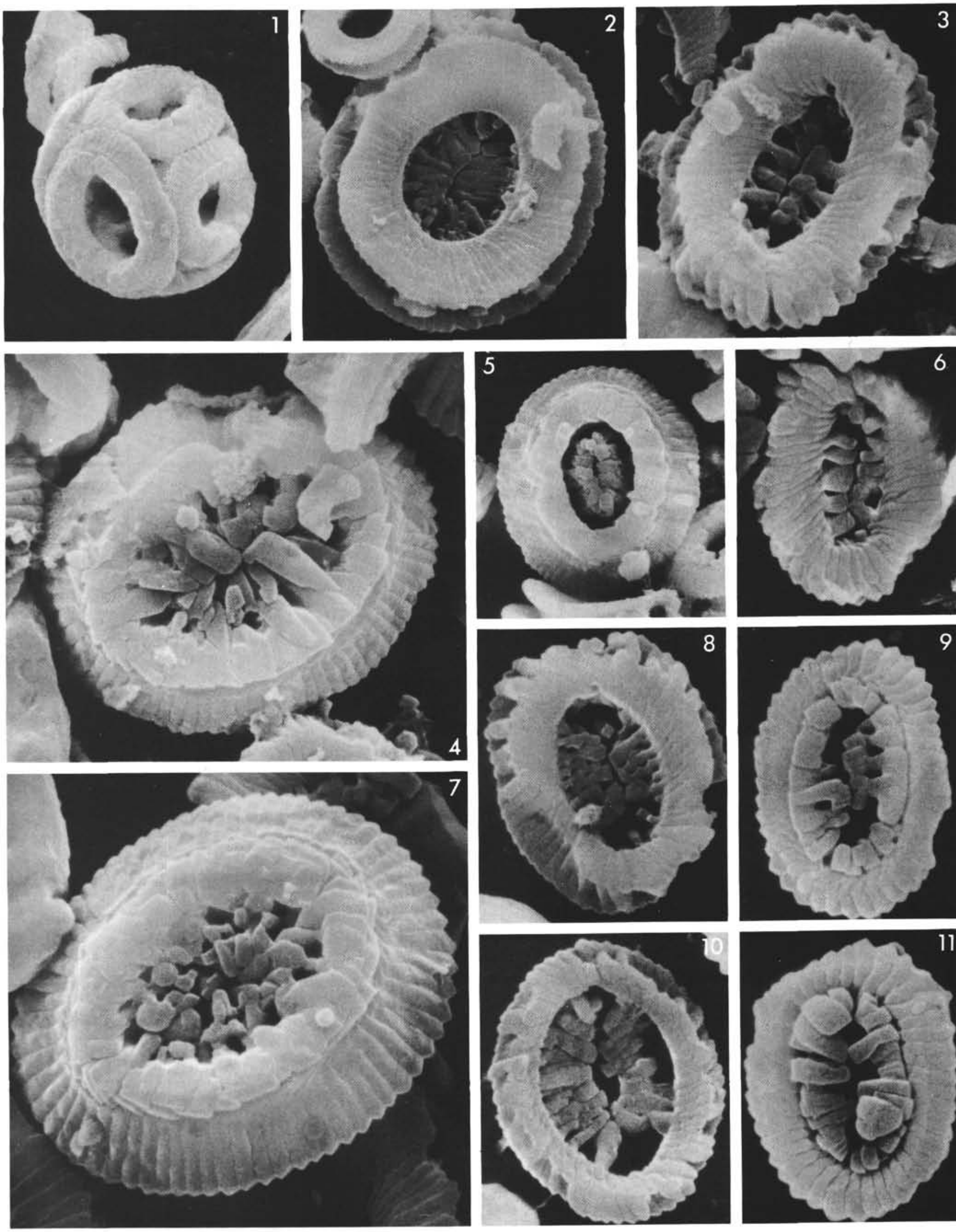


PLATE 13

Calcareous nannofossils.
(Figures 1-3, 5, 7, 10, 11 from Sample 277-29, CC; Eocene:
Figures 4, 6, 8, 9, 12 from Sample 277-19, CC; late Eocene to early Oligocene)

Figures 1, 2	Rhabdolith stems with heavy overgrowth of selected elements while others are well preserved. Overgrowth results in forms similar to the Late Cretaceous *Microrhabdulus belgicus*; ×5700.
Figures 3, 4	*Ericsonia obruta* Perch-Nielsen. Proximal views of specimens without proximal shields; ×11,400.
Figure 5	*Neococcolithes dubius* (Deflan-dre). ×9000. Minor overgrowth of central structure.
Figure 6	*Transversopontis prava* Locker. ×5700. Distal view; etching and overgrowth.
Figure 7	*Chiasmolithus expansus* (Bramlette and Sullivan). ×5700. Distal view; diffuse etching and overgrowth.
Figure 8	*Chiasmolithus* cf. *C. oamaruensis* (Deflandre). ×5700. Distal view; diffuse overgrowth in wall.
Figures 9, 12	*Isthmolithus recurvus* Deflandre. ×9000. Heavy overgrowth.
Figure 10	*Ericsonia ovalis* Black. ×11,400. Distal view; selective overgrowth.
Figure 11	*Markalius*? sp. 2. ×11,400. Proximal view; heavy overgrowth.

PLATE 13

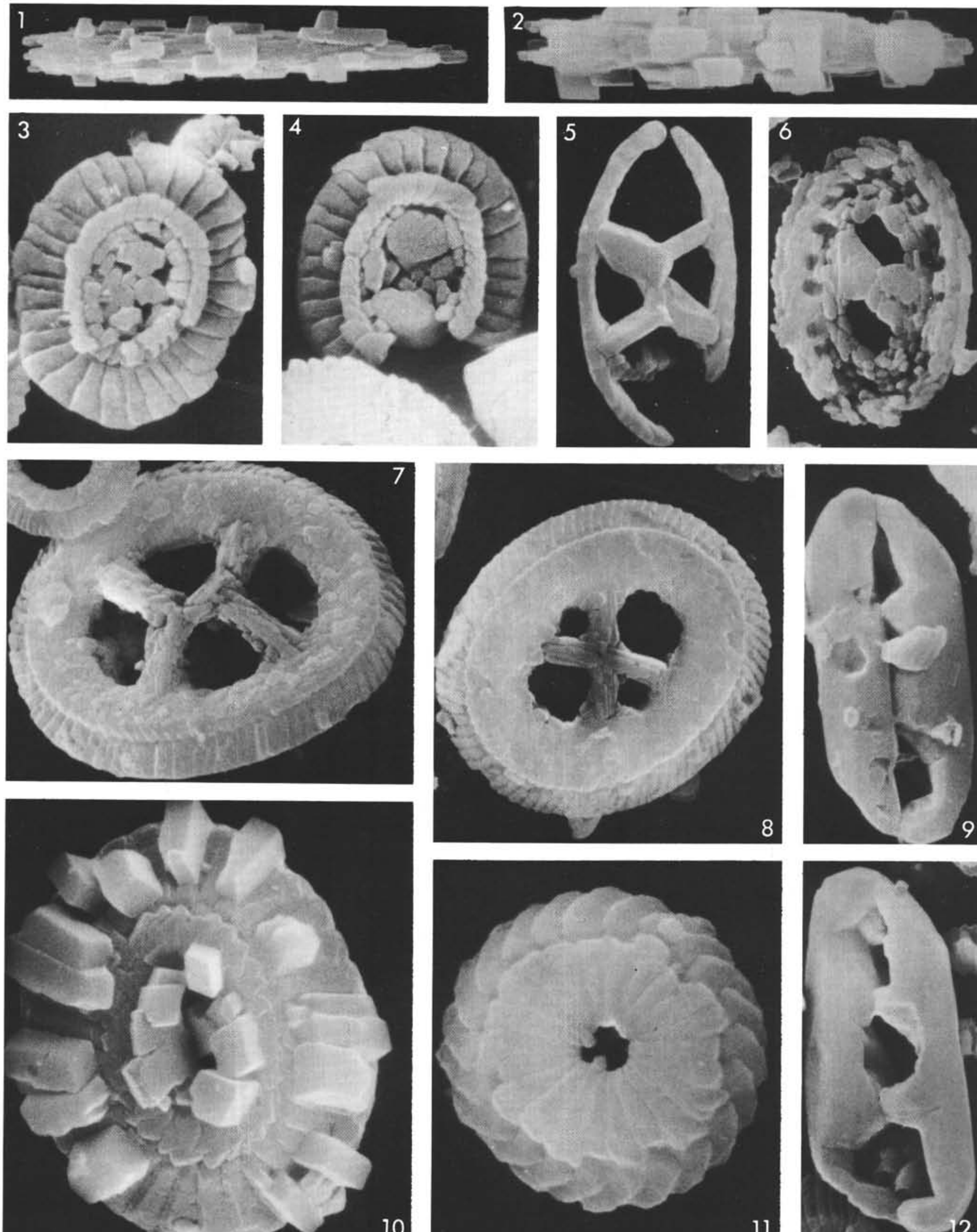


PLATE 14

Calcareous nannofossils from Sample 277-16-5, 110 cm; early Oligocene

Figures 1-7 *Helicopontosphaera* ? *subantarctica* n. sp.
1-5, 7. ×6100. Distal views.
6. ×12,200. Proximal views.

PLATE 14

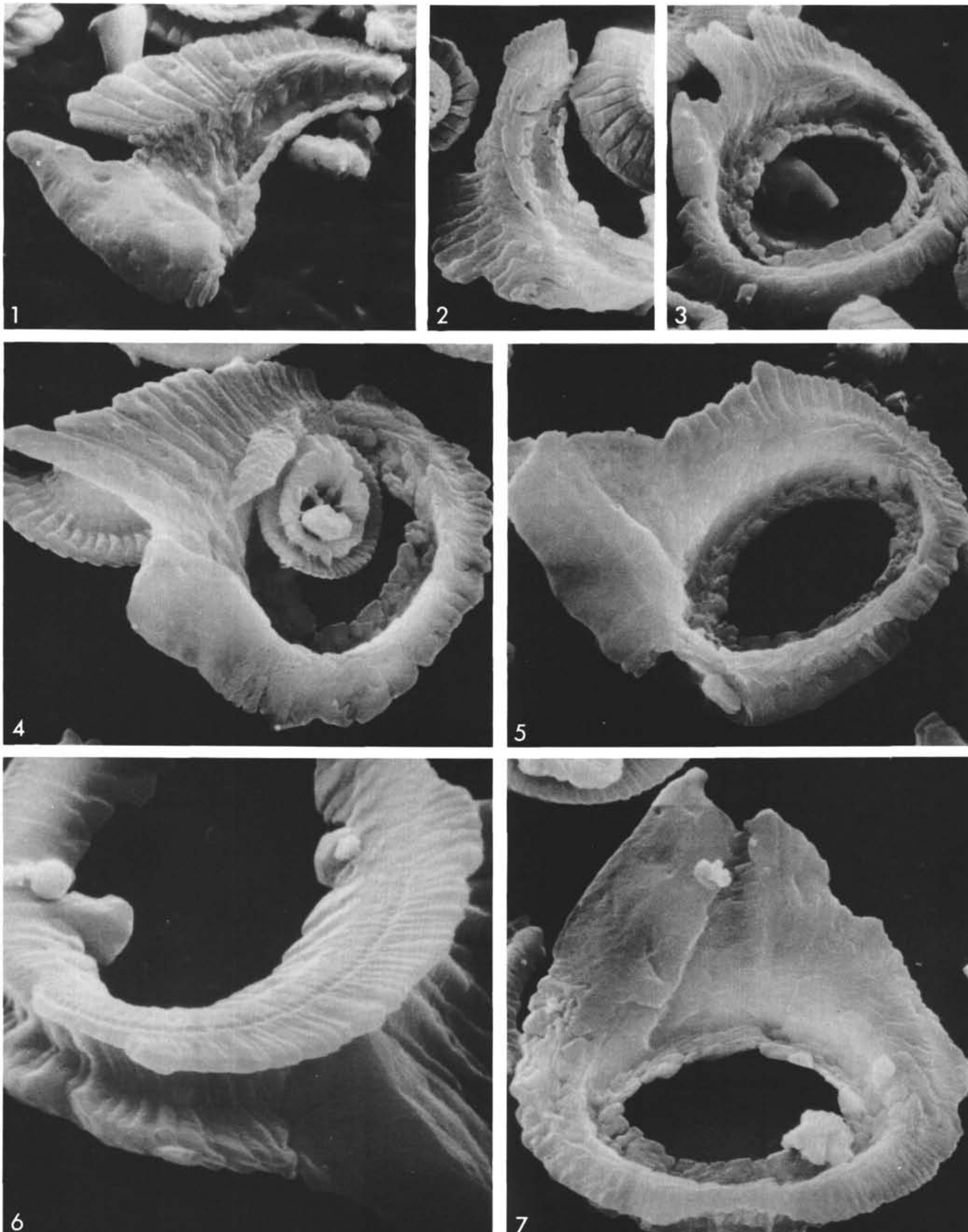


PLATE 15
Oligocene calcareous nannofossils.

Figures 1-3, 7, 8	*Helicopontosphaera*? *subantarctica* n. sp. Sample 277-16-5, 110 cm; early Oligocene; ×6000. 3, 8. Holotype. Distal views. 7. Proximal view.
Figures 4, 5, 9, 10	*Chiasmolithus altus* Bukry and Percival. 4. Sample 277-3-3, 110 cm; mid-late Oligocene; ×5700. Distal view. 5. Sample 277-6-4, 110 cm; mid-late Oligocene; ×5700. Distal view. 9. Sample 277-16-5, 110 cm; early Oligocene; ×6000. Distal view. 10. Sample 277-13-2, 110 cm; mid-late Oligocene; ×5700. Distal view.
Figure 6	*Isthmolithus recurvus* Deflandre. Sample 277-16-5, 110 cm; early Oligocene; ×9000.
Figure 11	*Syracosphaera*? sp. Sample 277-16-5, 110 cm; early Oligocene; ×11,800. Distal view.

PLATE 15

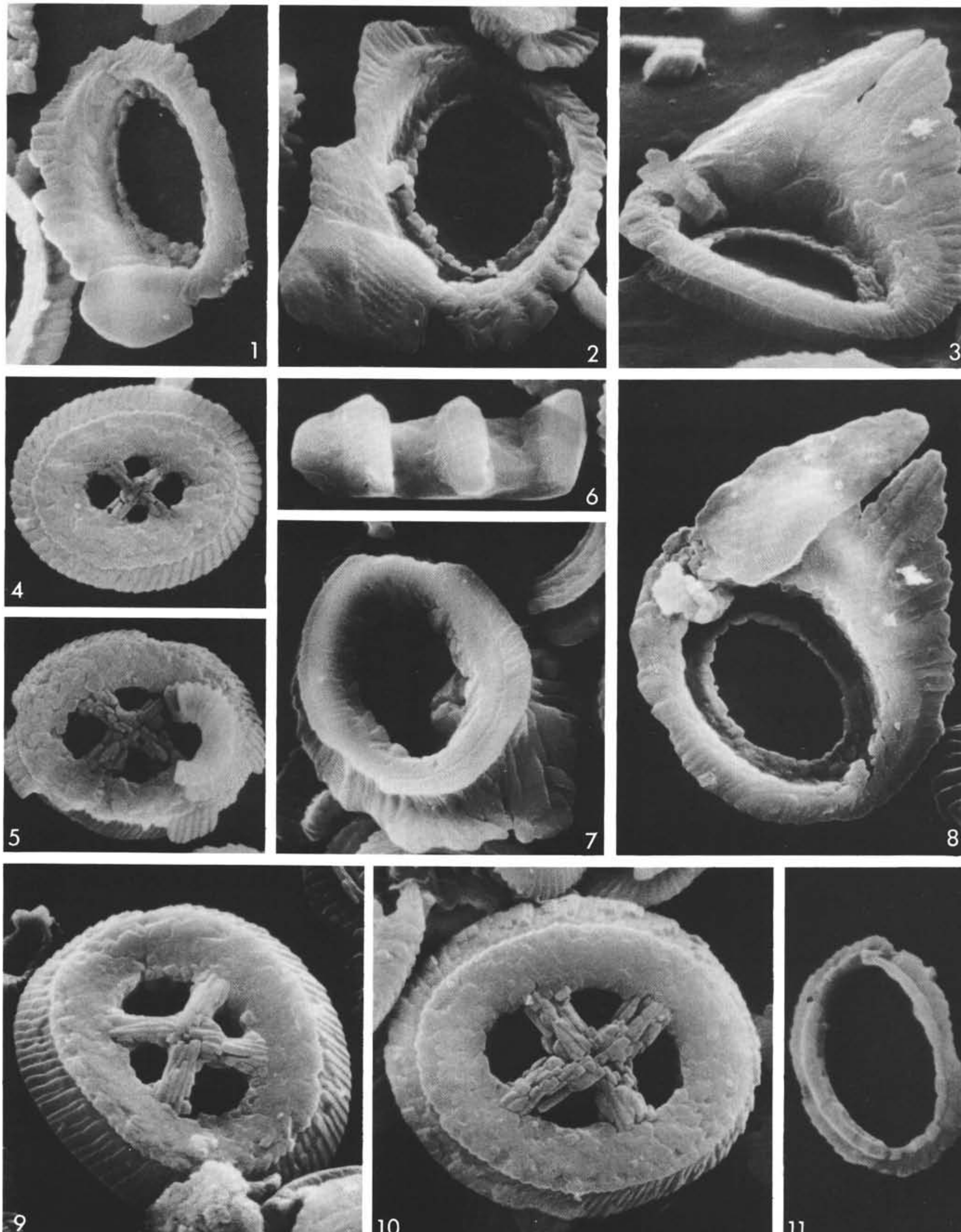


PLATE 16

Calcareous nannofossils.
(Figures 6, 7, 14 from Sample 277-16-5, 110 cm; early Oligocene. Figures 11, 13 from Sample 277-13-3, 110 cm; mid-late Oligocene. Figures 3, 5, 9, 10, 16 from Sample 277-6-4, 110 cm; mid to late Oligocene. Figures 1, 2, 4, 8, 12, 15 DSDP 277-3-3, 110 cm; mid to late Oligocene.)

Figure 1	*Discoaster deflandrei* ? Bramlette and Riedel. ×5800. Heavy overgrowth.
Figures 2-7, 11, 12	*"Reticulofenestra"* cf. *R. alabamensis* Roth. 2-5, 11, 12. ×5800. 6, 7. ×5900.
Figure 8	*Discolithina segmenta* Bukry and Percival. ×11,600. Distal view; etching and overgrowth.
Figures 9, 10	*Reticulofenestra* cf. *R. pseudoumbilica* (Gartner). ×5800. Proximal and distal views.
Figure 13	*Cyclicargolithus neogammation* (Bramlette and Wilcoxon). ×5700. Proximal view, small specimen.
Figures 14, 15	*"Reticulofenestra" bisecta* (Hay et al.) 14. ×6000. Distal view. 15. ×5800. Proximal view.
Figure 16	*"Reticulofenestra" abisecta* (Müller). ×5800. Distal view.

PLATE 16

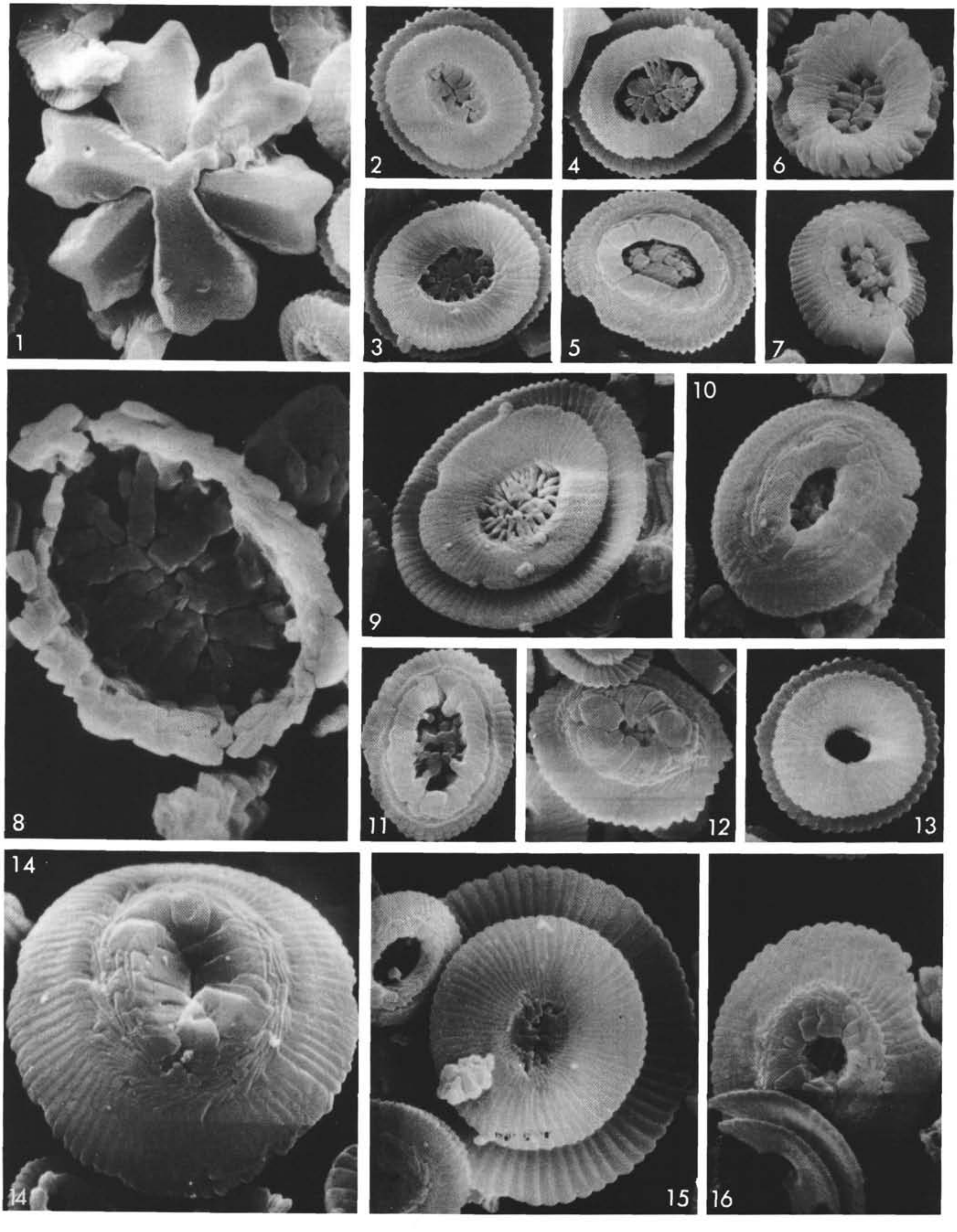


PLATE 17

Calcareous nannofossils from Sample 279A-5-4, 110 cm; early Miocene.

Figures 1, 3, 4	*Reticulofenestra* sp. ×5700. Proximal and distal views; overgrowth in walls.
Figure 2	*Cyclicargolithus neogammation* (Bramlette and Wilcoxon). ×4500. Proximal view.
Figure 5	*Cyclococcolithus macintyrei* Bramlette and Bukry. ×2900. Distal view; slight etching and overgrowth.
Figure 6	*Discoaster adamanteus* Bramlette and Wilcoxon. ×5700. Some overgrowth.
Figures 7, 8	*Discoaster deflandrei* Bramlette and Riedel. ×5700. Distal views; overgrowth.
Figures 9, 10	*Helicopontosphaera granulata* Bukry and Percival. ×5700. Distal and proximal views.
Figure 11	*Helicopontosphaera sellii* Bukry and Bramlette. ×5700. Distal view.
Figures 12-14, 17, 18	*Sphenolithus heteromorphus* Deflandre. ×11,400. Variable overgrowth.
Figures 15, 16	*Sphenolithus* cf. *S. moriformis* (Brönnimann and Stradner). ×11,400. Etching?

PLATE 17

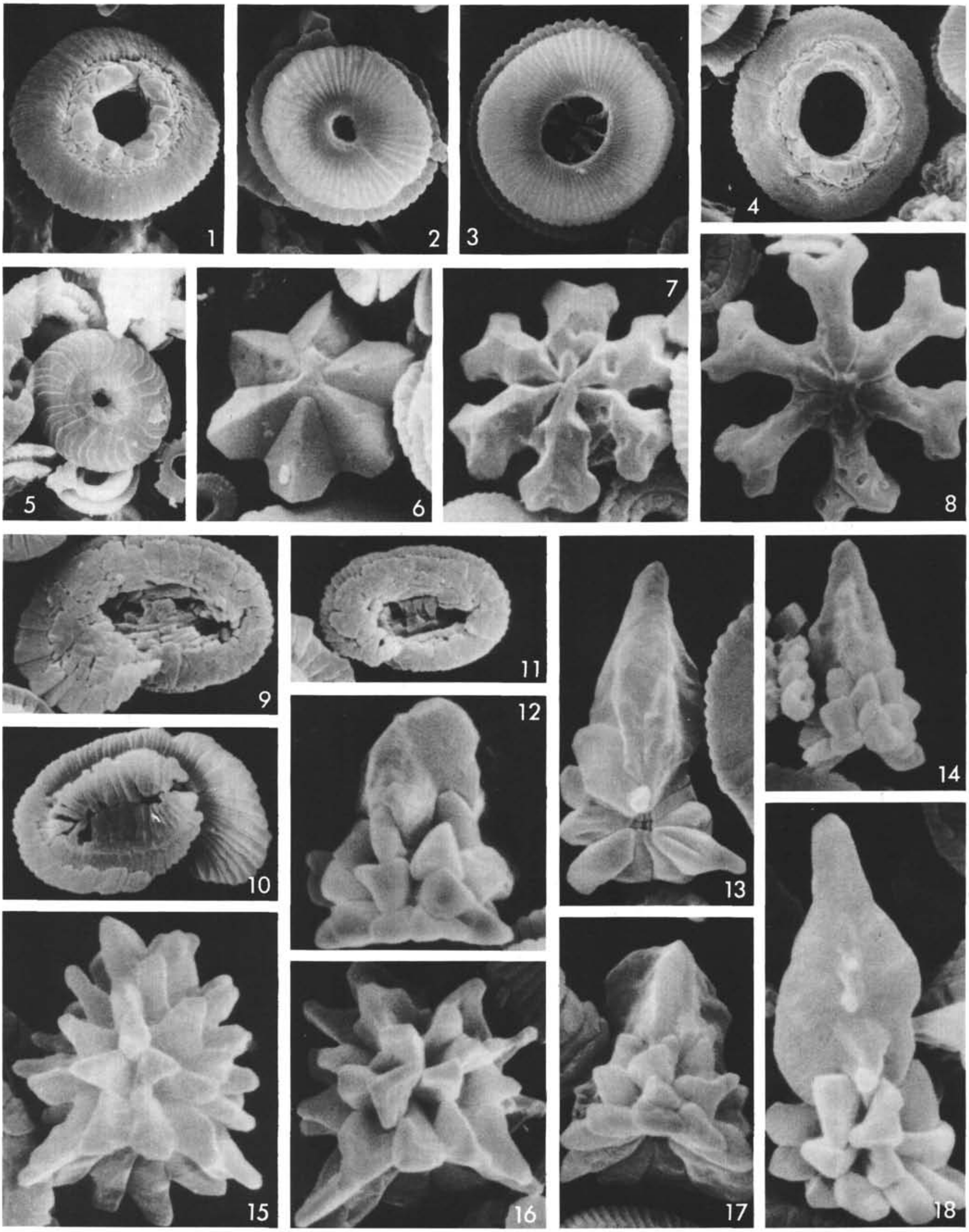


PLATE 18

Calcareous nannofossils from Sample 279A-5-2, 141 cm; early Miocene.

Figures 1-5	*Sphenolithus heteromorphus* Deflandre. 1-4. ×11,400. Side views; some overgrowth. 5. Could be mistaken as an overgrown specimen of *Triquetrorhabdulus rugosus* Bramlette and Wilcoxon. ×5700.
Figure 6	*Sphenolithus moriformis* (Brönnimann and Stradner). ×11,400. Side view.
Figures 7, 8	*Discoaster deflandrei* Bramlette and Riedel. ×5700. Etching and overgrowth.
Figure 8	*Ericsonia ovalis* Black. ×5700. Distal view; selective heavy overgrowth.
Figure 9	*Helicopontosphaera intermedia* (Martini). ×5700. Proximal view; some etching.
Figures 10-12	*Helicopontosphaera granulata* Bukry and Bramlette. ×5700. Distal and proximal views.
Figure 13	*Chiasmolithus altus* Bukry and Percival. ×5800. (Reworked?) Distal view.
Figure 14	(?)*Cyclococcolithus* sp. 1. ×11,400. Proximal view of distal shield?
Figure 15	*Helicopontosphaera euphratis* (Haq). ×5700. Proximal view; damaged and etched specimen.

PLATE 18

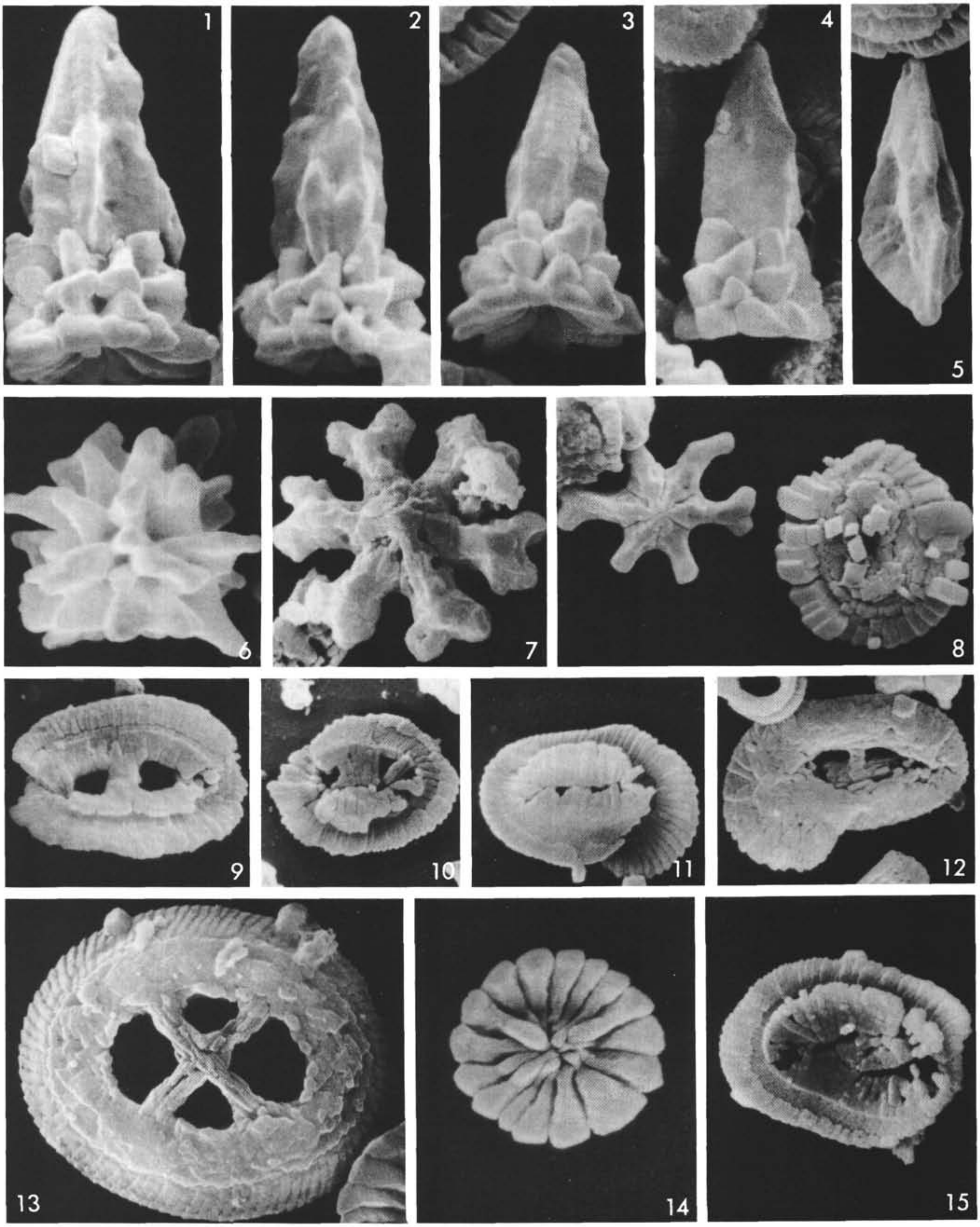


PLATE 19

Calcareous nannofossils from Sample 282-5-1, 136 cm; early Miocene.

Figures 1, 6-10	*Sphenolithus* cf. *S. conicus* Bukry. ×11,600.
Figure 2	*Coronocyclus nitescens* (Kamptner). ×5800. Distal view; selective overgrowth.
Figure 3	*Discoaster* cf. *D. saundersi* Hay. ×5800. Proximal view; etching and overgrowth.
Figure 4	*Pontosphaera* cf. *P. multipora* (Kamptner). ×5800. Proximal view; slight etching.
Figure 5	?*Sphenolithus* sp. 4. ×11,600.
Figure 11	*Sphenolithus moriformis* (Brönnimann and Stradner). ×11,600. Etching.

PLATE 19

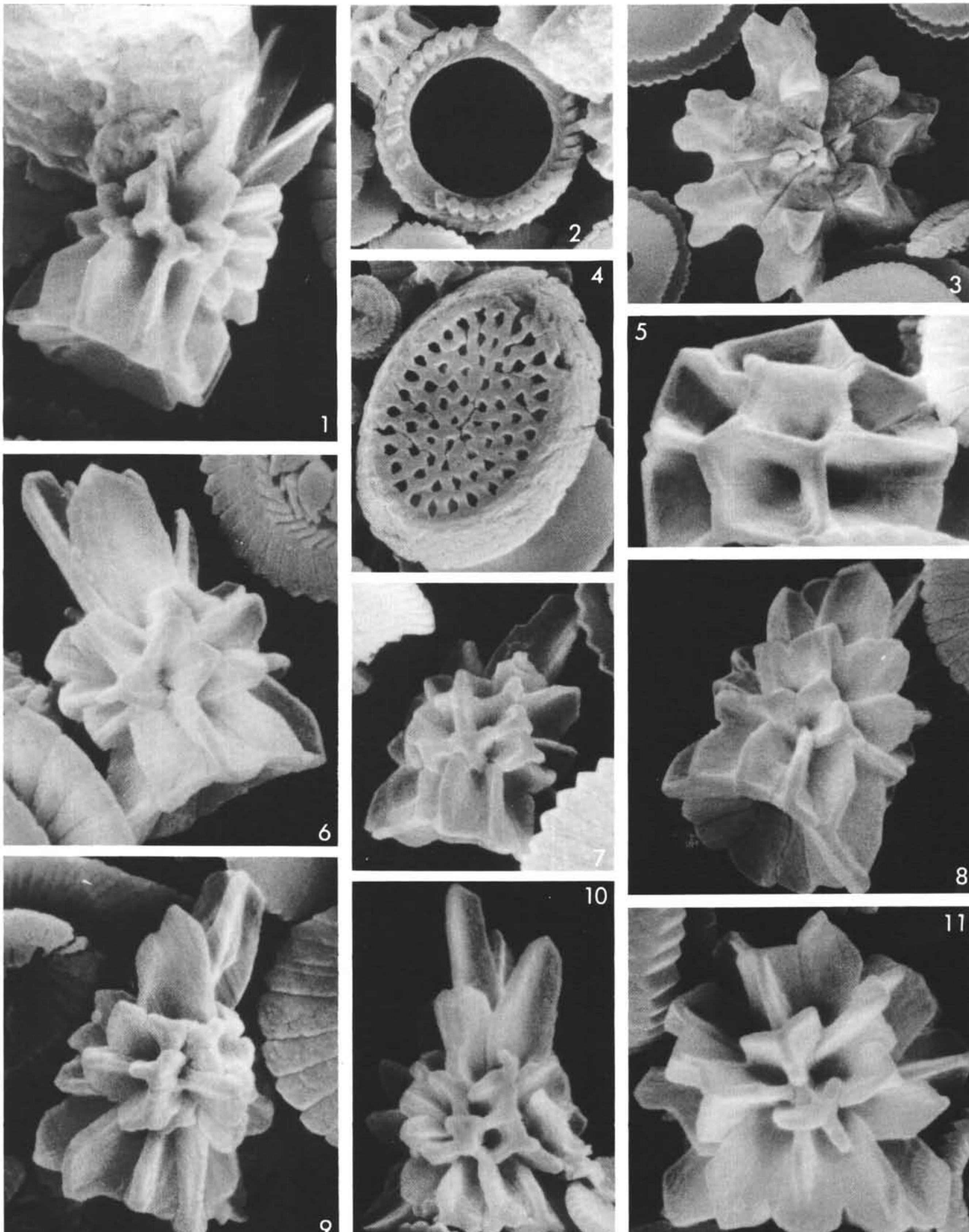


PLATE 20

Calcareous nannofossils.
(Figures 3, 5, 9-11, Sample 282-4-1, 110 cm; early Miocene,
Figures 1, 2, 4, 6-8, 12, Sample 282-4, CC; early Miocene)

Figure 1 — *Sphenolithus abies* Deflandre. ×12,100. Side view.

Figure 2 — *Sphenolithus moriformis* group (Brönnimann and Stradner). ×12,000. Side view.

Figure 3 — *Ilselithina* sp. 1. ×12,000. Youngest known to date of this late Paleogene genus. Side view; damaged specimen.

Figure 4 — *Coronocyclus nitescens* (Kamptner). ×9600. Distal view.

Figures 5-12 — *Ericsonia tasmaniae* n. sp. ×12,000.
5. Holotype.
5-8. Distal views.
11. Paratype.
9-12. Proximal views.

PLATE 20

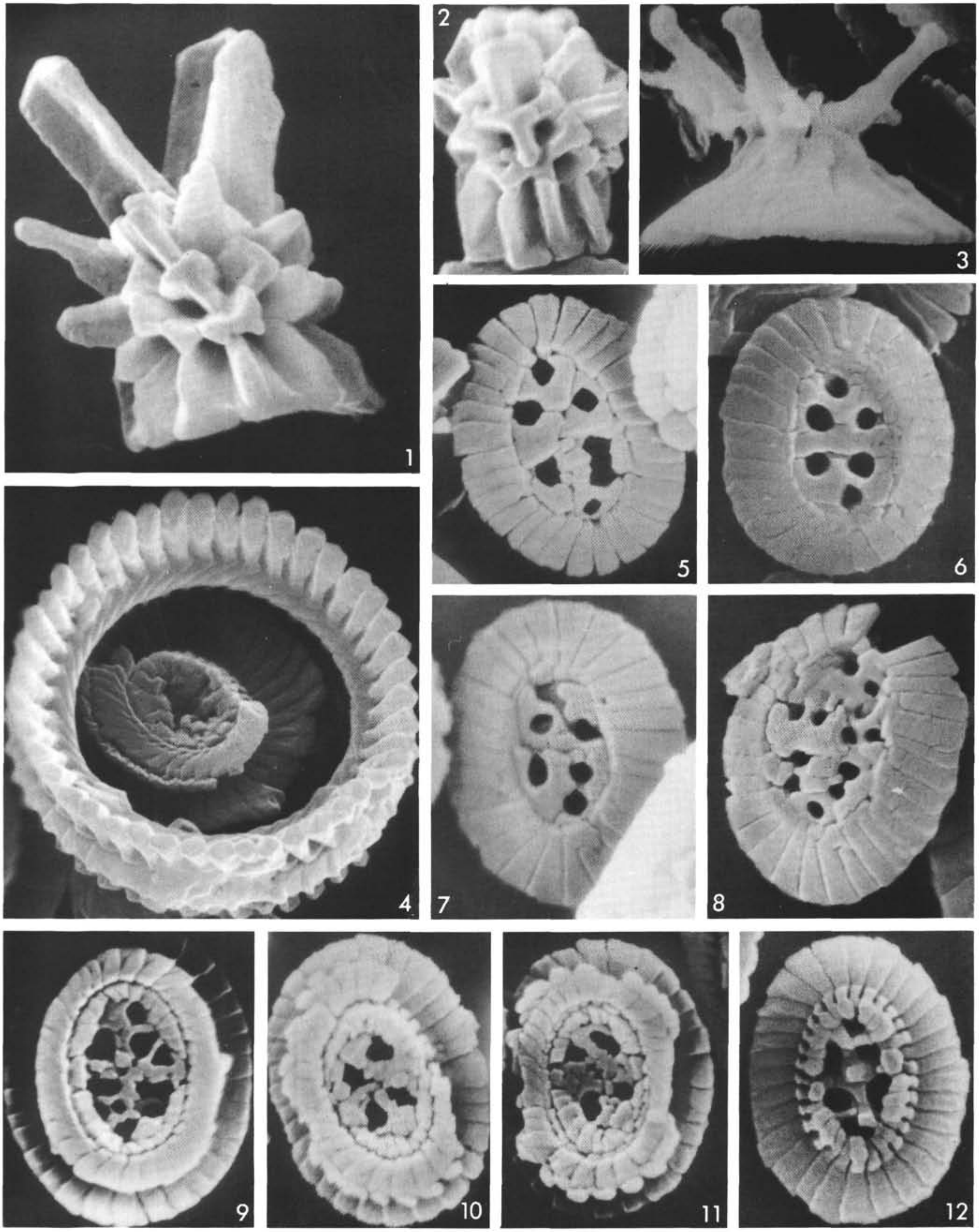
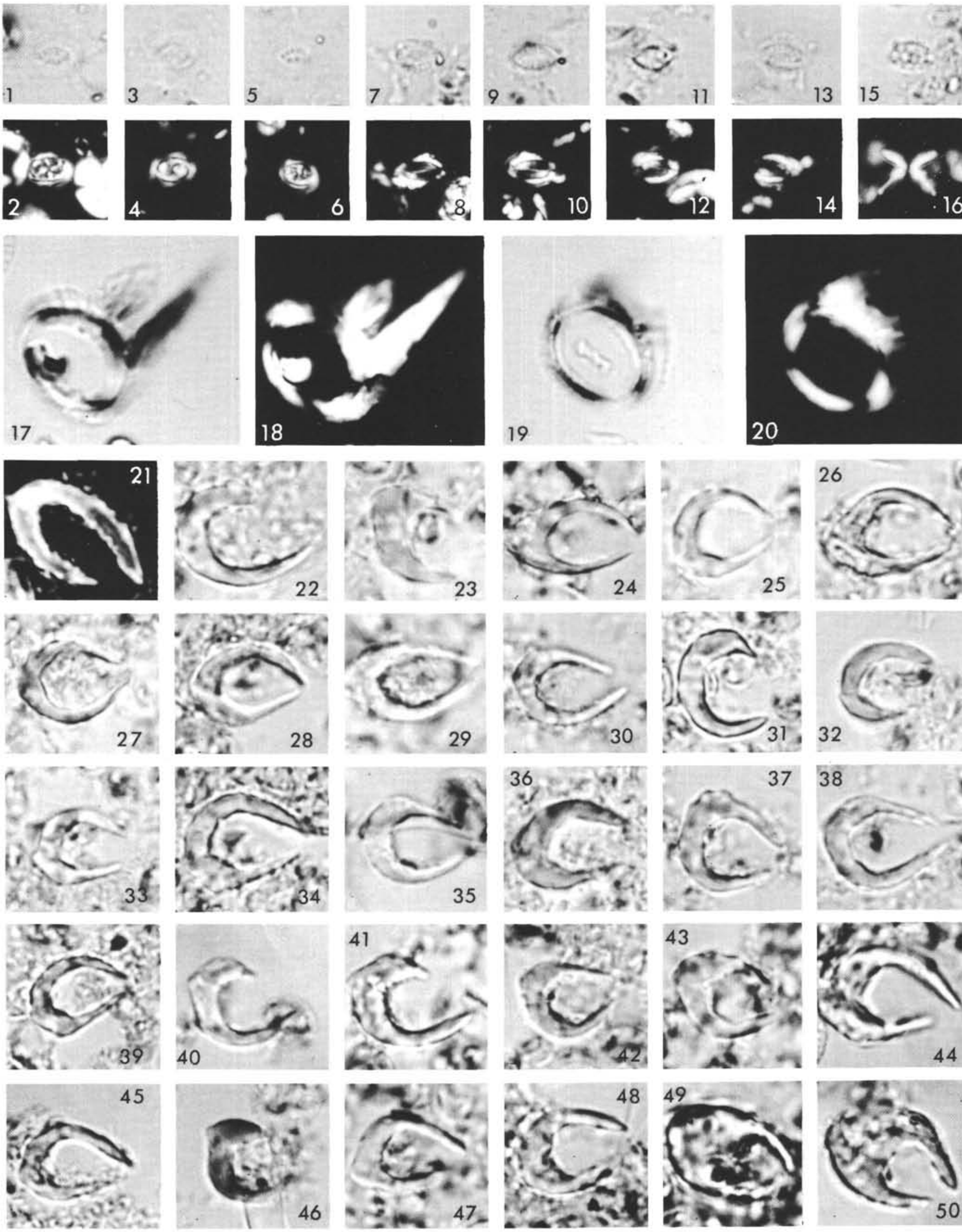


PLATE 21

Neogene calcareous nannofossils at Site 284.
(All figures ×2000)

Figures 1-6	*Ericsonia tasmaniae* n. sp. Sample 282-4-1, 110 cm; early Miocene.
Figures 7-14	*Hornibrookina australis* n. sp. 7-10. Sample 277-45-2, 118 cm; late Paleocene. 11, 12. Sample 277-46-4, 111 cm; late Paleocene. 13, 14. Sample 277-45-3, 127 cm; late Paleocene.
Figure 15	Holococcolith. Sample 284-10-5, 110 cm; early Miocene.
Figure 16	*Ilselithinia* sp. Sample 282-4-1, 110 cm; early Miocene.
Figures 17-20	*Helicopontosphaera*? *subantarctica* n. sp. Sample 277-16-5, 110 cm; early Oligocene.
Figure 21	*Ceratolithus rugosus* Bukry and Bramlette. Sample 284-10-5, 110 cm; early Pliocene.
Figures 22-48	*Ceratolithus triconiculatus* group Gartner. No birefringence shown. 22. Sample 284-10-2, 135 cm; early Pliocene. 23. Sample 284-10-5, 110 cm; early Pliocene. 24. Sample 284-10, CC; early Pliocene. 25. Sample 284-12-1, 110 cm; early Pliocene. 26. Sample 284-11-4, 110 cm; early Pliocene. 27, 29. Sample 284-13-4, 110 cm; early Pliocene. 28, 30, 32. Sample 284-14-4, 110 cm; early Pliocene. 31. Sample 284-14-1, 110 cm; early Pliocene. 33, 34. Sample 284-16-3, 110 cm; late Miocene. 35, 36. Sample 284-17-4, 110 cm; late Miocene. 37, 38. Sample 284-18-6, 110 cm; late Miocene. 39, 41. Sample 284-19-2, 110 cm; late Miocene. 40, 42. Sample 284-19-3, 110 cm; late Miocene. 43. Sample 284-19-1, 140 cm; late Miocene. 44. Sample 284-29-4, 110 cm; late Miocene. 45-47. Sample 284-22-2, 110 cm; late Miocene. 48. Sample 284-22-4, 110 cm; late Miocene.
Figures 49, 50	*Ceratolithus primus* Bukry and Percival. 49. Sample 284-22-1, 135 cm; late Miocene. 50. Sample 284-22-6, 110 cm; late Miocene; slight birefringence.

PLATE 21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