12. DIATOM STRATIGRAPHY OF THE SOUTHERN OCEAN

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INTRODUCTION

The Southern Ocean is today an area known for its abundant diatom flora. While the living planktonic diatoms of this region have been studied for a long period of time, studies of the paleontology and stratigraphy of diatoms have only recently begun (Abbott, 1972; Donahue, 1970a; Jousé et al., 1962; McCollum, 1972, 1973). Leg 28 of the Deep Sea Drilling Project provided a unique opportunity for the study of the diatom stratigraphy of this area of the world ocean.

Sites 264 through 269 recovered sediments of the pelagic areas of the Southern Ocean, while Sites 270 through 274 sampled the shallow Ross Sea environment. The diatom content and abundance vary with location and age and reflect differing sedimentological and environmental regimes through time. Site information is listed in Table 1.

Piston core material collected by the USNS *Eltanin* is used in conjunction with DSDP samples in order that the Quaternary/Pliocene aged material can be compared on the basis of paleomagnetic information. The combined data are used in the establishment of a high-latitude diatom stratigraphy.

METHODS AND MATERIALS

Shipboard Samples

Ten-cc samples were taken routinely from all sediments obtained by *Glomar Challenger*. Shipboard samples were treated in various ways depending on the sediment type and character as well as the abundance of diatoms.

In sediments composed primarily of calcium carbonate a portion was treated with 10% HCL and the undissolved residue centrifuged and decanted several times to concentrate the diatoms. This method was used on samples from Site 264 and the lower portions of Sites 265, 266, 267, and 268. In instances where diatoms were abundant, the sample was untreated, and a slide was made of the raw material (Sites 269, 274). In those samples in which diatom abundance was extremely low and the sediment was semilithified (270, 271, 272, 273), the sediment was treated with H_2O_2 (50%). The dissociated sediment was then separated through 25μ, 38μ, and 68μ sieves. A slide was made of each fraction, including the unsieved portion. All shipboard and shore-laboratory samples were mounted in Hyrax.

Shore-Laboratory Techniques

Approximately 1-cc of material was processed from each sample. Samples were placed in clean 200-ml beakers with 15 ml of H_2O_2 (30%), covered, and heated until the sediment dissociated and activity of the hydrogen peroxide was negligible. Fifteen ml of reagent grade HCL was added with continued heating until the activity of the acid was reduced. Treatment times for samples varied with the sediment type and degree of lithification. The samples were then diluted to 50 ml with distilled water and allowed to cool. Samples were then centrifuged at 2000 rpm for 3 min and decanted. Samples were then diluted to 50 ml with 0.5% sodium pyrophosphate and centrifuged again. This step was repeated five times. Following this, the samples were diluted to 50 ml with distilled water and centrifuged.

TABLE 1
Sequences Cored on Leg 28

Hole	Latitude	Longitude	Water Depth (m)	Penetration (m)	No. of Cores
264	34°58.13'S	112°02.68'E	2873	215.5	15
264A	34°58.13'S	112°02.68'E	2873	158.5	4
265	53°32.45'S	109°56.74'E	3582	462.0	18
266	56°24.13'S	110°06.70'E	4173	384.0	24
267	59°15.74'S	104°29.30'E	4564	219.5	7
267A	59°15.74'S	104°29.30'E	4564	70.5	3
267B	59°14.55'S	104°29.94'E	4539	323.0	10
268	63°56 99'S	105°09.34'E	3544	474.5	20
269	61°40.57'S	140°04.21'E	4285	397.5	11
269A	61°40.57'S	140°04.21'E	4285	958.0	13
270	77°26.48'S	178°30.19'W	634	422.5	49
271	76°43.27'S	175°02.86'W	554	265.0	24
272	77°07.62'S	176°45.61'W	629	443.0	48
273	74°32.29'S	174°37.57'E	495	76.0	9
273A	74°32.29'S	174°37.57'E	495	346.5	29
274	68°59.81'S	173°25.64'E	3326	421.0	45

This step was repeated twice. After the last centrifugation the samples were placed in clean labeled bottles for storage.

Microscope slides were made by withdrawing a portion with a disposable pipette from the center of the bottle immediately after it had been shaken. Two drops of the suspension were placed on a 22 mm × 22 mm cover slip and dried on a slide warmer. Two drops of Hyrax were added and heated until the volatile solvent evaporated. The cover slip and slide were then placed together and positioned with a clean toothpick and allowed to cool.

The recorded abundance of individual diatoms was ascertained by noting the relative abundance of the particular species in each of 100 fields of view. An individual diatom is defined as consisting of at least one half of a frustule, except for the genus *Rhizosolenia*. Each slide was first scanned at 400× in order to note the general abundance and condition. Abundance estimates were made at 1000×. Those diatoms not encountered at 1000×, that were noted at 400×, are recorded as occurring in trace amounts (T). Diatoms which occur in abundances of 45% or greater are listed as (A) abundant, 25%-44% (C) common, 10%-24% (F) few, 10% or less (R) rare. In some instances the total abundance was so low that only sieve samples could be used to identify the diatoms contained. In this case all occurrences are listed as rare.

DIATOM RANGE ZONES

The following diatom zones are defined as local range zones in accordance with the Code of Stratigraphic Nomenclature (1961). The general principles given by Riedel and Sanfillippo (1970) are used for zonal designations. The zones are discussed in sequence from oldest to youngest (Figure 1).

Pyxilla prolongata Partial-Range Zone

The local range (Site 274) of *Pyxilla prolongata* defines the boundaries of this zone. This zone is not subdivided.

Other diatoms occurring within this zone: *Trinarcria excavata, T. pileolus, Rhizosolenia barboi, Coscinodiscus marginatus, C. radiatus, Stephanopyxis appendiculata, S. grunowii, S. turris, Xanthiopyxis panderaformis, X. globosa, X. acrolophra, Asteromlampra vulgaris, A. affinis, Pterotheca carinifera, Pyrogodiscus* sp., *Pyxilla prolongata, P. reticulata, P. johnsoniana, Pseudopyxilla americana, Sticodiscus hardmanianus, Liradiscus ovalis, Triceratium inelegans*? *Rhizosolenia hebetata, Triceratium coscinoides, Hemiaulus polymorphus, Hemiaulus* sp.

Coscinodiscus sp. Zone

This zone is undefined; it represents that portion of sediment below the *Denticula nicobarica* Zone to the Miocene/Oligocene boundary and is characterized by *Coscinodiscus* sp. 1.

Other diatoms occurring within this zone: *Coscinodiscus vetutissimus, C. nodulifer, C. marginatus, Trinacria excavata, Actinocycus ellipticus, Synedra jouseana, Rhizosolenia barboi, Coscinodiscus* sp. 1.

Denticula nicobarica Partial-Range Zone

The base of this zone is defined by the earliest occurrence of *D. nicobarica*. The top of the zone is defined

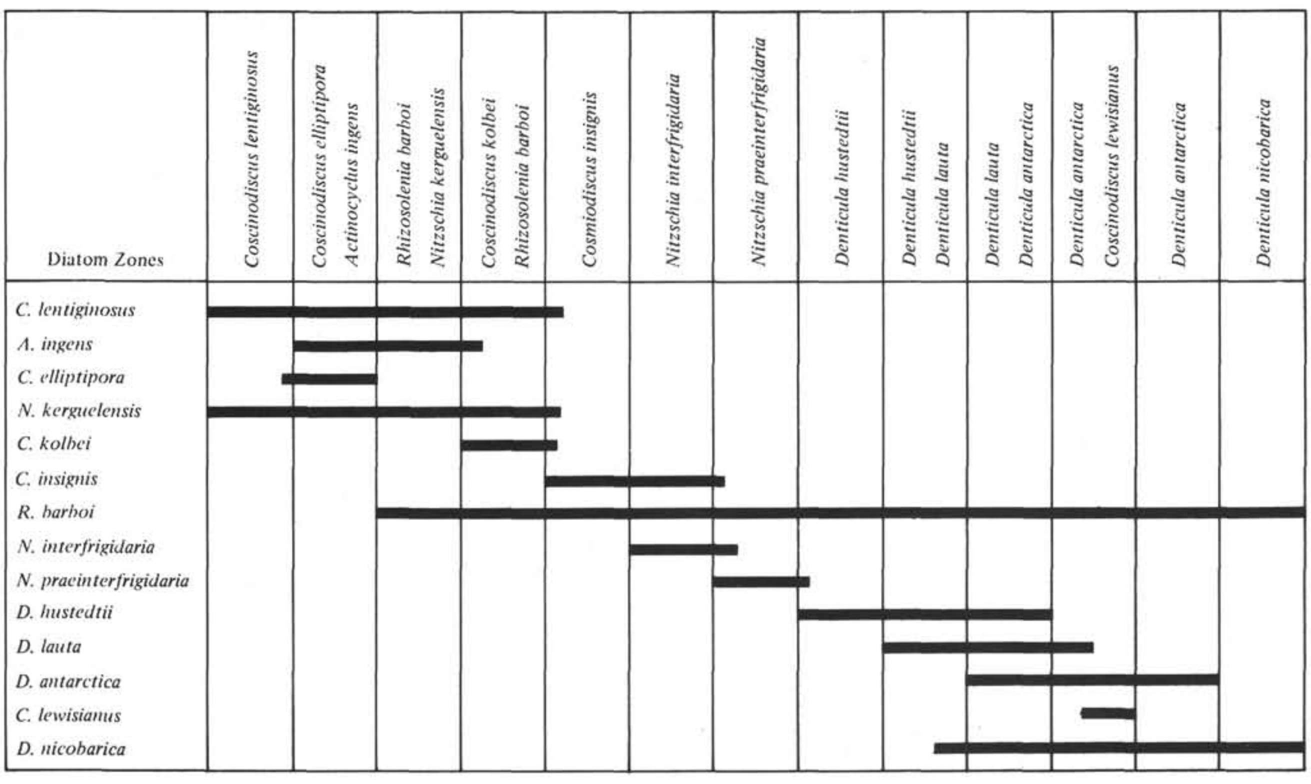

Figure 1. *Diatom zones used in this report, and range of zonal markers.*

by the earliest occurrence of *Denticula antarctica* and is coincident with the base of the *D. antarctica* Zone.

Other diatoms occurring within this zone: *Coscinodiscus vetutissimus*, *C. nodulifer*, *C. marginatus*, *Trinacria excavata*, *Synedra jouseana*, *Denticula nicobarica*, *Rhaponeis* sp., *Rhizosolenia barboi*.

Paleomagnetic correlation: No information available.

Correlation to other zonations: This zone correlates with the radiolarian *Spongomelissa brachythorax* Zone and the *Eucyrtidium punctatum* Zone (Chen, this volume). This zone also correlates in part with the *Corbisema triacantha* Zone (silicoflagellates) (Ciesielski, this volume).

Denticula antarctica Partial-Range Zone

The base of this zone is defined by the earliest occurrence of *D. antarctica*. The top of this zone is defined by the earliest occurrence of *Coscinodiscus lewisianus* and is coincident with the base of the *Denticula antarctica/Coscinodiscus lewisianus* Zone.

Other diatoms occurring within this zone: *Rhaphidodiscus marylandicus*, *Coscinodiscus nodulifer*, *C. marginatus*, *C. apiculatus*, *Denticula nicorbarica*, *D. antarctica*, *Trinacria excavata*, *T. pileolus*, *Synedra jouseana*, *Rhizosolenia barboi*, *Liradiscus ovalis*, *L.* sp., *Actinopthycus undulatus*.

Paleomagnetic correlation: No information available.

Correlation to other zonations: This zone includes the lower portion of the *Calocyclas polyporos* Zone (Radiolaria) (Chen, this volume) and the *Distephenas longispinus* Zone (silicoflagellates) (Ciesielski, this volume). The top of this zone correlates with the top of Zone XXV Schrader (1973) on the basis of the earliest occurrence of *Coscinodiscus lewisianus*. Schrader does not define the base of Zone XXV. The assemblage of this zone contains some diatoms that are common to Koizumi's (1973) *Denticula lanta* Zone. These are *Rhaphidodiscus marylandicus* and *Synedra jouseana*.

Denticula antarctica/Coscinodiscus lewisianus Zone

The base of this zone is defined by the earliest occurrence of *C. lewisianus*. The top is defined by the earliest occurrence of *Denticula hustedtii* and is coincident with the base of the *Denticula lauta/Denticula antarctica* Zone.

Other diatoms occurring within this zone: *Denticula antarctica*, *D. nicobarica*, *D. lauta*, *Coscinodiscus nodulifer*, *C. lewisianus*, *C. radiatus*, *C. endoi*, *C. marginatus* *C. apiculatus*, *Synedra jouseana*, *Trinacria excavata*, *T. pileolus* *Rhizosolenia barboi*, *Antinocyclus ingens*.

Paleomagnetic correlation: No information available.

Correlation to other zonations: This zone includes a portion of the *Calocyclas polyporos* Zone (Chen, this volume). It also includes the *Dictyocha mutabillis* Zone (Ciesielski, this volume). *Coscinodiscus lewisianus* is used to define the base of this zone and Schrader's (1973) Zone XXIV. The top of Zone XXIV is defined by the earliest occurrence of *Coscinodiscus endoi*; this diatom occurs within the *D. antarctica/C. lewisianus* Zone in the top of Core 14, Site 266, thereby making the interval between 14, CC to the top of Core 14 equivalent to Schrader's Zone XXIV. The top of this zone is equivalent to the top of Koizumi's (1973) *Denticula lauta* Zone, which is based on the first occurrence of *D. hustedtii*. The base of this zone could be within Koizumi's *D. lauta* Zone or below, since the base was not defined.

Denticula lauta/Denticula antarctica Partial-Range Zone

The base of this zone is defined by the earliest occurrence of *Denticula hustedtii*. The top of this zone is defined by the latest occurrence of *Denticula antarctica* and is coincident with the base of the *Denticula hustedtii/Denticula lauta* Zone.

Other diatoms occurring within this zone: *Actinocyclus ingens*, *Denticula hustedtii*, *D. lauta*, *D. antarctica*, *D. nicobarica*, *Trinacria excavata*, *T. pileolus*, *Coscinodiscus endoi*, *C. apiculatus*, *C. marginatus*, *Rhizosolenia barboi*, *Cestodiscus* sp., *Liradiscus* sp.

Paleomagnetic correlation: No information available.

Correlation to other zonations: This zone includes two radiolarian zones: *Antarctissa conradae* Zone and the *Actinomma tanyacantha* Zone (Chen, this volume). This zone also coincides with the nannofossil *Discoaster hamatus* Zone and *Catinaster coalitus* Zone (NN 8 and NN 9, respectively) (Burns, this volume). This correlation gives an approximate age for this diatom zone of 11 to 14 m.y.B.P. The base of this zone and Koizumi's (1973) *D. hustedtii/D. lauta* Zone is defined as the earliest occurrence of *D. hustedtii*.

Denticula hustedtii/Denticula lauta Partial-Range Zone

The base of this zone is defined by the latest occurrence of *Denticula antarctica*. The top of this zone is defined by the latest occurrence of *D. lauta* and is coincident with the base of the *Denticula hustedtii* Zone.

Other diatoms occurring within this zone: *Denticula nicobarica*, *D. lauta*, *D. hustedtii*, *Coscinodiscus radiatus*, *C. endoi*, *C. marginatus*, *C. flexosus*? *Cestodicus* sp., *Trinacria excavata*, *T. pileolus*, *Rhizosolenia barboi*, *R. hebetata* f. *hiemalus*, *Actinocyclus ingens*, *Rouxia californica*, *R. peragalli*, *Eucampia balaustium*.

Paleomagnetic correlation: No information available.

Correlation to other zonations: The silicoflagellate *Mesocena circulus* Zone (Ciesielski, this volume) is included within this zone. The radiolarian *Theocalyptra bicornis spongathorax* Zone includes all of this zone (Chen, this volume). Schrader's (1973) Zone XV and this zone are defined on the basis of the last occurrence of *Denticula lauta*. Using his time scale, the top of this zone would be placed in the "A" event of magnetic epoch 7. The last occurrence of *D. lauta* is common to this zone and Koizumi's (1973) *D. hustedtii/D. lauta* Zone. The base of Koizumi's *D. hustedtii/D. lauta* Zone is similar to the base of the *Denticula lauta/Denticula antarctica* Zone (this paper).

Denticula hustedtii Partial-Range Zone

The base of this zone is defined by the latest occurrence of *Denticula lauta*. The top of this zone is defined by the latest occurrence of *D. hustedtii* and is coincident with the base of the *Nitzschia praeinterfrigidaria* Zone.

Other diatoms occurring within this zone: *Actinocyclus ingens*, *Coscinodiscus marginatus*, *Rhizosolenia barboi*, *Nitzschia reinholdii*, *N. praeinterfrigidaria*, *Actinocyclus ellipticus* v. *javanica*, *Stephanogonia* sp., *Trinacria excavata*, *T. pileolus*, *Denticula hustedtii*.

Paleomagnetic correlation: The top of this zone is approximately 4.5 m.y.B.P. There are no paleomagnetic data available for the base, but it is probably greater than 5.5 m.y.B.P. (epoch 5).

Correlation to other zonations: The top of this zone is within Schrader's (1973) Zone XI and Burckle's (1972) *Thalassiosira convexa* Zone. The base of this zone probably falls below Schrader's Zone XI (5.5 m.y.B.P.). Schrader's (1973) Zone XV and the base of this zone are defined on the last occurrence of *Denticula lauta*. By Schrader's correlation to magnetics, the base of this zone is approximately equivalent to event "A" of magnetic epoch 7 and Burckle's *Thalassiosira convexa* Zone. This zone includes the lower portion of the *Mesocena diodon* Zone (Ciesielski, this volume). This zone includes the lower portion of the radiolarian *Helotholus vema* Zone and the upper portion of the *Theocalyptra bicornis spongothorax* Zone (Chen, this volume).

Nitzschia praeinterfrigidaria Partial-Range Zone

The base of this zone is defined by the latest occurrence of *Denticula hustedtii*. The top of this zone is defined by the latest occurrence of *N. praeinterfrigidaria* and is coincident with the base of the *Nitzschia interfrigidaria* zone.

Other diatoms occurring within this zone: *Nitzschia reinholdii*, *N. praeinterfrigidaria*, *N. interfrigidaria*, *Coscinodiscus marginatus*, *Rhizosolenia barboi*, *Rouxia diploneides*.

Paleomagnetic correlation: The top of this zone is approximately 3.65 m.y.B.P. and the base is approximately 4.5 m.y.B.P. (Gilbert epoch above the "A" event to "C" event).

Correlation to other zonations: This zone corresponds to Schrader's (1973) zone X and possibly with the lower portion of Zone IX. The base of this zone extends into Schrader's (1973) Zone XI and Burckle's (1972) *Thalassiosira convexa* Zone.

Nitzschia interfrigidaria Partial-Range Zone

The base of this zone is defined by the latest occurrence of *N. praeinterfrigidaria*. The top of this zone is defined by the latest occurrence of *N. interfrigidaria* and is coincident with the base of the *Cosmiodiscus insignis* Zone.

Other diatoms occurring within this zone: *Nitzschia angulata*, *N. interfrigidaria*, *N. reinholdii*, *Rouxia naviculoides*, *R. diploneides*, *Cosmiodiscus insignis*, *Coscinodiscus lentiginosus*, *C. obovatus*, *C. marginatus*, *Rhizosolenia barboi*.

Paleomagnetic correlation: The top of this zone is approximately 2.85 m.y.B.P. and the base is approximately 3.65 m.y.B.P. (Kaena event in the Gauss to the upper Gilbert above the "A" event).

Correlation to other zonations: This zone occurrs within the limits of Schrader's (1973) Zones VIII, IX, X. No closer correlation can be made because the boundaries between Schrader's VIII, IX, and X are not supplemented by paleomagnetic data. This zone spans the boundary of Burckle's (1972) *Rhizosolenia praebergonii* Zone and the *Nitzschia jouseae* Zone, and includes portions of both zones.

Cosmiodiscus insignis Partial-Range Zone

The base of this zone is defined by the latest occurrence of *N. interfrigidaria*. The top of this zone is defined by the latest occurrence of *Cosmiodiscus insignis* and is coincident with the base of the *Coscinodiscus kolbei/Rhizosolenia barboi* Zone.

Other diatoms occurring within this zone: *Nitzschia kerguelenis*, *N. angulata*, *Coscinodiscus lentiginosus*, *C. kolbei*, *C. obovatus*, *Rhizosolenia barboi*.

Paleomagnetic correlation: The top of this zone is approximately 2.5 m.y.B.P. The base of this zone is approximately 2.85 m.y.B.P. (upper Gauss to the Kaena event of the Gauss).

Correlation to other zonations: This zone is totally included within Schrader's (1973) Zone VIII and Burckle's (1972) *Rhizosolenia praebergonii* Zone.

Coscinodiscus kolbei/Rhizosolenia barboi Range Zone

The base of this zone is defined by the joint occurrence of *R. barboi* with *C. kolbei* immediately following the latest occurrence of *Cosmiodiscus insignis*. The top of this zone is defined by the latest occurrence of *Coscinodiscus kolbei* and is coincident with the base of the *Rhizosolenia barboi/Nitzschia kerguelensis* Zone.

Other diatoms occurring within this zone: *Nitzschia kerguelensis*, *N. angulata*, *Coscinodiscus lentiginosus*, *C. kolbei*, *Rhizosolenia barboi*.

Paleomagnetic correlation: The top of this zone is approximately 1.85 m.y. B.P., and the base is approximately 2.5 m.y. B.P. (Matuyama below the Olduvai event to the upper Gauss).

Correlation to other zonations: This zone includes Schrader's (1973) Zone V (lower portion) and all of VI and VII. This zone is totally included within Burckle's (1972) *Rhizosolenia praebergonii* Zone.

Rhizosolenia barboi/Nitzschia kerguelensis Partial-Range Zone

The base of this zone is defined by the joint occurrence of *R. barboi* and *N. kerguelensis* immediately following the latest occurrence of *Coscinodiscus kolbei*. The top of this zone is defined by the latest occurrence of *R. barboi* and is coincident with the base of the *Coscinodiscus elliptipora/Actinocyclus ingens* Zone.

Other diatoms occurring within this zone: *Eucampia balaustium*, *Thalassionema elegans*, *Thalassiosira gracillis*, *Charcotia actinochilus*, *Nitzschia curta*, *N. kerguelensis*, *N. angulata*, *Coscinodiscus lentiginosus*, *C. diviscus*, *Rhizosolenia barboi*.

Paleomagnetic correlation: The top of this zone is approximately 1.6 m.y.B.P., and the base is approximately 1.8 m.y.B.P. (upper Matuyama, below the Jaramillo event to the Olduvai event).

Correlation to other zonations: This zone includes the lower portion of Schrader's (1973) Zone IV and extends slightly into Zone V. Most of this zone is included within Burckle's (1972) *Pseudoeunotia doliolus* Zone but extends slightly into the *Rhizosolenia praebergonii* Zone (top at approximately 1.8 m.y. B.P.).

Coscinodiscus elliptipora/Actinocyclus ingens Concurrent-Range Zone

The base of this zone is defined by the earliest occurrence of *C. elliptipora*. The top of this zone is defined by the latest occurrence of *A. ingens* and is coincident with the base of the *Coscinodiscus lentiginosus* Zone.

Other diatoms occurring within this zone: *Coscinodiscus lentiginosus, C. diviscus, C. elliptipora, Nitzschia kerguelensis, N. angulata, N. curta, Eucampia balaustium, Thalassionema elegans, Thalassiosira gracilis, Charcotia actinochilus, Asteromphalus parvulus, A. hookerii, Actinocyclus ingens, Hemidiscus karstenii.*

Paleomagnetic correlation: The top of this zone is approximately 0.7 m.y.B.P., and the base is approximately 1.6 m.y.B.P. (upper Matuyama, including the Jaramillo event but younger than the Olduvai event).

Correlation to other zonations: This zone includes the lower portion of Schrader's (1973) Zone II, all of Zone III, and the upper portion of Zone IV. This zone is totally included within Burckle's (1972) *P. doliolus* Zone.

Coscinodiscus lentiginosus Partial-Range Zone

The base of this zone is defined by the latest occurrence of *Actinocyclus ingens*. The top of this zone is defined as recent sediment being formed in the Southern Ocean containing *C. lentiginosus*.

Other diatoms occurring within this zone: *Nitzschia kerguelenis, N. angulata, N. curta, N. ritscherii, Coscinodiscus lentiginosus, C. elliptipora, C. diviscus, C. tabularis, C. furcatus, Charcotia actinochilus, Hemidiscus karstenii, Eucampia balaustium, Thalassionema elegans, Thalassiosira gracilis, Asteromphalus parvulus, A. hookerii.*

Paleomagnetic correlation: The base of this zone approximately coincides with the base of the Bruhnes magnetic epoch (0.7 m.y.B.P.).

Correlation to other zonations: This zone includes all of Schrader's (1973) Zone I and most of Zone II. This zone is totally included within Burckle's (1972) *Pseudoeunotia doliolus* Zone.

DIATOM SUMMARIES

Site 264

Core-catcher samples were investigated for this site with all but Sample 2, CC being barren. The diatoms recovered are poorly preserved and extremely low in number. The diatoms identified in 2, CC are: *Melosira sulcata, Stephanopyxis turris, Triceratium partitum, Arachnoidiscus ehrenbergii, Hemiaulus polymorphus.*

Site 265 (Figure 2)

Core-catcher samples from Cores 1 through 17 were examined for diatoms. Diatom preservation is fairly good in Cores 1 through 14 and poor in Cores 15 through 17.

Sample \ Diatoms	*Actinocyclus ingens*	*Asteromphalus parvulus*	*Coscinodiscus elliptipora*	*C. endoi*	*C. kolbei*	*C. lentiginosus*	*C. marginatus*	*C. tabularis*	*C. flexosus*	*C.* sp. 2	*Cosmiodiscus insignis*	*Denticula hustedtii*	*D. lauta*	*Eucampia balaustium*	*Hemidiscus karstenii*	*Nitzschia kerguelensis*	*N. angulata*	*N. reinholdii*	*N. interfrigidaria*	*Rhaphoneis* sp.	*Rhizosolenia barboi*	*R. hebetata f. hiemalis*	*Rouxia R. naviculoides*	*Synedra jouseana*	Diatom Zones
1, CC						A		F						F		A	F								*C. lentiginosus*
2, CC						A		F						F		A	F								
3, CC						C		R								C									
4, CC	R		R			C								R		C									*C. elliptipora* *A. ingens*
5, CC	R	R				C								R	R	C									
6, CC	F	R				C								R		C									
7, CC	C					C										C	F								
8, CC	A					C										C	F								
9, CC	A					C										F	F								
10, CC	A					F										R	F						T		
11, CC	A					F											C								? ? ?
12, CC												R			F			F			R			F	
13, CC					F					C	F			R			F		C		R			F	*N. interfrigidaria*
14, CC							F								F		C	F	C		F				
15-1-00	C			F			F					C	C							R		F			*D. hustedtii* *D. lauta*
15, CC	C			C			C					C	C							R		C			
16, CC				F			R		R			F	C							R					
17-1-00																									

Figure 2. *Distribution of diatoms at Site 265.*

Although no zonal boundaries were detected, portions of zones were found throughout the site. A portion of the *Coscinodiscus lentiginosus* Zone is found in Cores 1 through 3. A portion of the *Coscinodiscus elliptipora/Actinocyclus ingens* Zone is found in Cores 4 through 10. Cores 11 and 12 are not zoned because of poor recovery. Cores 13 and 14 contain a portion of the *Nitzschia interfrigidaria* Zone. Cores 15 and 16 contain a portion of the *Denticula hustedtii/Denticulaa lauta* Zone.

Site 266 (Figure 3)

Diatom abundance and preservation are best in Cores 1 through 10. Below this point they worsen but are still sufficient for stratigraphic purposes.

Core 1 through Sample 2-3, 30 cm contain the *Coscinodiscus lentiginosus* Zone. Sample 2, CC through Core 4 contain a portion of the *Coscinodiscus elliptipora/Actinocyclus ingens* Zone. Cores 5 and 6 contain a portion of the *Nitzschia interfrigidaria* Zone. Core 7 contains a portion of the *Nitzschia praeinterfrigidaria* Zone. Samples 8-1, 55 cm through 10-1, 0 cm contain the *Denticula hustedtii* Zone. Samples 10-1, 90 cm through 12, CC contain the *Denticula hustedtii/Denticula lauta* Zone. Core 13 through Sample 15-3, 60 cm contain a portion of the *Denticula antarctica/Coscinodiscus lewisianus* Zone. Samples 16-1, 92 cm through 16, CC contain the *Denticula antarctica* Zone. Core 17 through Sample 18-2, 60 cm contain the *Denticula nicobarica* Zone. After Sample 18-3, 60 cm is the *Coscinodiscus* sp. Zone through to Core 24.

Holes 267 and 267A

Samples from this site contain diatoms in low abundance in a fair preservational condition. Only three cores could be zoned on the basis of diatoms. Sample 1, CC contains a portion of the *Rhizosolenia barboi/-Nitzschia kerguelensis* Zone. Sample 2, CC contains a portion of the *Denticula hustedtii* Zone. The remaining cores are barren. From Hole 267A Sample 1, CC contains a portion of the *Rhizosolensis barboi/Nitzschia kerguelensis* Zone. The remaining cores are barren.

Hole 267B (Figure 4)

Diatom abundance and preservation at this site are generally poor, but portions of three diatom zones can be recognized. Core 1 cannot be assigned to a zone and can only be described as having diatoms characteristic of a Miocene age. Cores 2, 3, and 4 contain a portion of the *Denticula hustedtii* Zone. Core 5 contains a portion of the *Denticula hustedtii/Denticula lauta* Zone. Cores 6 through 8 contain a portion of the *Denticula lauta/-Denticula antarctica* Zone. Below Core 8 the section is barren of diatoms.

Site 268

Diatoms are typically rare and poorly preserved. Very few entire frustules were found from Cores 1 through 12. Below Core 12 diatoms are absent.

Cores 1 through Sample 2, CC contain the *Coscinodiscus lentiginosus* Zone and a few reworked Oligocene diatoms. Only in Sample 2-1, 60 cm were there enough diatoms to give assurance to this assignment. In Cores 3 and 4 there were too few identifiable diatoms to make an assignment. Cores 5, 6, and 7 contain a portion of the *Denticula hustedtii* Zone. Cores 8 through 12 and below show such paucity of diatoms that these cores cannot be zoned.

Holes 269 and 269A (Figure 5)

Diatoms only occur in Cores 1 through 9 at Site 269. Cores 10 and 11 and all cores of Hole 269A are barren. The abundance of diatom frustules varies from common (Core 1) to poor (Cores 2-9). Preservation varies in a like manner.

Core 1 above 1-5, 130 cm contains the *Coscinodiscus lentiginosus* Zone. Below this point in Core 1 is a portion of the *Coscinodiscus elliptipora/Actinocyclus ingens* Zone. Core 2 contains a portion of the *Nitzschia interfrigidaria* Zone. Core 3 contains a portion of the *Denticula hustedtii* Zone. Cores 4, 5, and 6 through Sample 6-4, 140 cm contains a portion of the *Denticula hustedtii/Denticula lauta* Zone. The remainder of Core 6 and Cores 7 and 8 contain a portion of the *Denticula lauta/Denticula antarctica* Zone. Core 9 apparently contains a portion of the *Denticula antarctica/Coscinodiscus lewisianus* Zone.

Site 270

Site 270 is barren of diatom remains with the exception of Core 1. From the surface (1-1, 10 cm) through 1-2, 40 cm is an assemblage of diatoms suggestive of the *Coscinodiscus lentiginosus* Zone. Below this level no diatoms could be found.

Site 271

Samples from this site contain unidentifiable fragments or are barren except for the following instances. Sample 16, CC contains *Cosmiodiscus intersectus*, *Actinocyclus ehrenbergii*, and *Thalassiosira gracilis*, which suggest a lower Pliocene age. Sample 19, CC contains *C. intersectus*, *A. ehrenbergii*, and *Stephanopyxis turris* (lower Pliocene?). Sample 24, CC contains the same assemblage with rare occurrences of *Actinocyclus ingens*, indicating this sediment may be lower Pliocene/upper Miocene. The lower Pliocene age is more probable because of the lack of any other upper Miocene diatoms.

Site 272 (Figure 6)

Diatoms are in low abundance but are well preserved except for a barren section between Samples 1-1, 145 cm through 3, CC. Core 1 above 1-1, 130 cm contains the *Coscinodiscus lentiginosus* Zone. Below 1-1, 130 cm through 3, CC the sediment is essentially barren except for rare occurrences of *Actinocyclus ingens* in Core 3. No zonal assignment can be made on this diatom alone. Samples 4-1, 130 cm through 16-1, 113 cm contain a portion of the *Denticula lauta/Denticula antarctica* Zone. Below Sample 16-1, 113 cm through 17-3, a portion of the *Denticula antarctica/Coscinodiscus lewisianus* Zone is apparently present. The underlying interval through Core 38 is unzoned at present. The assemblage is characterized by *Coscinodiscus apiculatus* and *Aulacodiscus brownii* which are thought to extend into the early Miocene. Diatom abundance is drastically reduced below Core 18.

Holes 273 and 273A (Figure 7)

Diatom abundance and preservation are fair to good at this site. Cores 1 through 5 contain a mixture of diatoms comprising the *Coscinodiscus lentiginosus* and *Denticula antarctica* Zones. Cores 6 through 21A-1, 145 cm contain a portion of the *Denticula antarctica* Zone. Below this point the section is unzoned but is similar to Site 272 in that *Coscinodiscus apiculatus* is present.

Site 274 (Figure 8)

Sediments from this site contain diatoms in generally good abundance, with some localized areas of paucity. The preservational state of the diatoms ranges from fair and poor (Cores 1-19) to excellent (Cores 20-34). Cores 1 through 6 contain a reworked Miocene and Oligocene flora in an inverted sequence. This reworking apparently took place during the Gilbert/Gauss paleomagnetic epochs when Miocene and Oligocene sediments were eroded from the Ross Sea. Below a chert layer in Core 35, the sediments from this site are barren of diatoms.

Cores 1 through Sample 2-5, 30 cm contain a portion of the *Coscinodiscus lentiginosus* Zone. Samples 2-5, 90 cm through 4, CC contain a portion of the *Coscinodiscus elliptipora/Actinocyclus ingens* Zone. Cores 5 through Sample 8, CC contain a portion of the *Coscinodiscus kolbei/Rhizosolenia barboi* Zone. Samples 9-2, 90 cm through 10-1, 90 cm contain a portion of the *Nitzschia praeinterfrigidaria* Zone. Samples 10-5, 90 through 10, CC contain a portion of the *Denticula hustedtii* Zone. Evidence for the *Denticula hustedtii/Denticula lauta* Zone was found from 11-1, 140 cm through 12, CC. The *Denticula antarctica/Coscinodiscus lewisianus* Zone cannot be separated from the *Denticula antarctica* Zone because *Coscinodiscus lewisianus* was not found at this site. These two zones occur between 13-1, 90 cm through 15, CC. The *Pyxilla prolongata* Zone is contained in Cores 20 through 34.

Correlation of USNS *Eltanin* and *Glomar Challenger* Cores

Several USNS *Eltanin* piston cores, which have been dated by paleomagnetic methods (Hays and Opdyke, 1967; Bandy et al., 1971; Watkins and Kennett, 1972; Ciesielski and Weaver, 1973) and in which diatoms have been studied, have been used in conjunction with the core samples taken by *Glomar Challenger* on Leg 28 (see Table 2).

Studies using these cores have resulted in the establishment of a diatom stratigraphy for approximately the last 4.65 m.y.B.P. in the area of the Southern Ocean. The ranges shown in Figure 9 reflect the common to abundant occurrences of the species listed, thereby removing most minor range fluctuations for individual diatom species. The paleomagnetic boundaries assigned to zonal boundaries are therefore approximations. These differences are in some instances thought to represent time transgressive biofacies and the reworking of sediments. Because of this, not all species shown as occurring together will necessarily occur together for a specific period of time in a particular sample. Studies which incorporate biofacies problems are in progress but at this time are not refined sufficiently for regional conclusions.

CORRELATION OF VARIOUS AREAS OF THE PACIFIC BASED ON DIATOM STRATIGRAPHY

A preliminary effort to correlate distant areas of the Pacific Ocean is presented (Figure 12). For particular zonation correlations with respect to the present paper consult those portions of this paper.

Correlations are made using information from several sources. Correlation of this work to that of Schrader (1973) was made using the paleomagnetic data presented and diatom extinctions and first appearances where common diatoms exist. Donahue (1970b) used paleomagnetic data, and also correlated here work to that of Jousé (1962). This adaption is incorporated here. Schrader (1973) correlates his work to the foraminiferal zones of Blow (1969) as does Koizumi (1973). This combination was used to show the relative positions of some of Koizumi's zones to the others. Other zones of Koizumi (1973) are based on diatom first occurrences and extinctions. Donahue's (1970a) and Burckle's (1972) zonations are adapted from the correlation presented by Schrader (1973).

The accuracy of these correlations is, of course, questionable; as a consequence, these correlations are presented as a preliminary effort to coordinate previous work in the Pacific with that of the present study.

TABLE 2
Locations and Ages of *Eltanin* Cores

Core	Latitude	Longitude	Paleomagnetic Age
E 13-17	65°41.0'S	124°06.3'W	Recent–Gilbert "C"
E 14-7	58°03.1'S	160°09.0'W	Recent–Gilbert
E 14-8	59°40.0'S	160°17.4'W	Recent–Gilbert "B"
E 34-17	60°11.7'S	144°40.0'E	Mid Matuyama–Gilbert "A"
E 34-18	60°00.0'S	134°52.2'E	Lower Gauss–Gilbert "A"
E 36-8	58°05.5'S	139°54.6'E	Lower Gauss–Upper Gilbert
E 38-7	61°49.3'S	149°53.0'E	Lower Matuyama–Lower Gauss
E 38-8	61°48.6'S	149°54.2'E	Upper Gilbert–Gilbert "A"
E 50-20	62°54.2'S	150°41.2'E	Mid Gauss–Gilbert "A"

Sample (Interval in cm)	*Actinocyclus ellipticus*	*A.* var. *javanicus*	*A. ingens*	*Asteromphalus hookeri*	*A. parvulus*	*Charcotia actinochilus*	*Coscinodiscus endoi*	*C. kolbei*	*C. lentiginosus*	*C. lewisianus*	*C. marginatus*	*C. nodulifer*	*C. obovatus*	*C. radiatus*	*C. fabularis*
1-1, 110-112				F	F	F			C						F
1-2, 80-82				F	F				C						F
1-3, 70-72				F					C						F
1-4, 100-102					R				F						F
1, CC									F						
2-2, 120-122				R					F						
2-3, 30-32				R	R				F						
2, CC			F						F						
3, CC			F						F						
4-2, 60-62				R	R				F						
4-3, 100-102				R	R				F						
4-4, 120-122									F						
4, CC			F												
5-1, 120-122															
5-2, 130-132								F	R						
5-3, 130-132											R		C		
5-4, 130-132													C		
5-5, 130-132											R				
5-6, 120-122								R			R				
5, CC			F					F							
6-1, 120-122															
6-2, 110-112															
6-3, 120-122															
6-4, 120-122															
6-5, 110-112								F							
6-6, 120-122											R				
6, CC								R			R				
7-1, 125-127											R				
7-2, 45-47											R				
7-4, 120-122															
7-5, 45-47											R				
7-5, 117-119											R				
7, CC											C				
8-1, 55-57															
8-2, 45-47															
8-2, 120-122															
8-3, 45-47															

Sample (Interval in cm)	*C. vetutissimus*	*C.* sp. 2	*C.* sp. 3	*C.* sp. 1	*Cosmiodiscus insignis*	*Denticula antarctica*	*D. hustedtii*	*D. lauta*	*D. nicobarica*	*Eucampia balaustium*	*Hemidiscus karstenii*	*Liradiscus* sp.	*Nitzschia angulata*	*N. interfrigidaria*	*N. kerguelensis*
1-1, 110-112										F			F		A
1-2, 80-82													F		A
1-3, 70-72													F		C
1-4, 100-102													F		F
1, CC															F
2-2, 120-122															F
2-3, 30-32															F
2, CC															F
3, CC															F
4-2, 60-62															F
4-3, 100-102													F		F
4-4, 120-122															F
4, CC															
5-1, 120-122		F	F		F								F	F	
5-2, 130-132		F			F								F	F	
5-3, 130-132					C					R			F	F	
5-4, 130-132					C					R	F			F	
5-5, 130-132					C								F	F	
5-6, 120-122										R			F	F	
5, CC					F					F					
6-1, 120-122													C	C	
6-2, 110-112													C	A	
6-3, 120-122											R		C	A	
6-4, 120-122													C	A	
6-5, 110-112													C	C	
6-6, 120-122														C	
6, CC													C		
7-1, 125-127														C	
7-2, 45-47													F	C	
7-4, 120-122													R		
7-5, 45-47															
7-5, 117-119															
7, CC													C		
8-1, 55-57							R								
8-2, 45-47												R			
8-2, 120-122							R								
8-3, 45-47							R	R							

Sample (Interval in cm)	*N. reinholdii*	*N. praeinterfrigidaria*	*Rhaphidodiscus marylandicus*	*Rhaphoneis* sp.	*Rhizosolenia barboi*	*Rouxia diploneides*	*R. naviculoides*	*R. peragalli*	*Stephanogonia hanzawae*	*Stephanopyxis appendiculata*	*Synedra jouseana*	*Trinacria excavata*	*T. pileolus*	Diatom Zones
1-1, 110-112														*C. lentiginosus*
1-2, 80-82														
1-3, 70-72														
1-4, 100-102														
1, CC														
2-2, 120-122														
2-3, 30-32														
2, CC														*C. elliptipora* *A. ingens*
3, CC														
4-2, 60-62														
4-3, 100-102														
4-4, 120-122								R						
4, CC														
5-1, 120-122														*N. interfrigidaria*
5-2, 130-132														
5-3, 130-132														
5-4, 130-132														
5-5, 130-132							?							
5-6, 120-122					R		?							
5, CC								F						
6-1, 120-122							F							
6-2, 110-112						R	F							
6-3, 120-122							F			R				
6-4, 120-122	F					F	F							
6-5, 110-112						R	R	R						
6-6, 120-122							R							
6, CC					F					R				
7-1, 125-127	R	F					R							*N. praeinterfrigidaria*
7-2, 45-47	R	C								R				
7-4, 120-122	C	F												
7-5, 45-47	F	F												
7-5, 117-119	F	R												
7, CC	C				C									
8-1, 55-57	R	R												
8-2, 45-47								R	R					
8-2, 120-122	R	R							R					
8-3, 45-47	R													

Figure 3. *Distribution of diatoms at Site 266.*

8-4, 45-47	R				R					F				R	R							R			
8-5, 120-122					R					F				?	R				?						
8-6, 50-52	R									R				R					?		R				
8-6, 125-127										R				R	R										
8, CC					F								F	F											
9-1, 89-91	R				R					R				R	R			R		R		R			D. hustedtii
9-2, 30-32	R				R					R				R	R			R							
9-3, 30-32										R				R	R						R				
9-4, 99-101	R									R					R			R							
9, CC					F									F				R							
10-1-0																									
10-1, 90-92		C			C					F	F							C							
10-2, 40-42		C			C					F	F														
10-4, 40-42		C			C					C	C							C							
10-5, 30-32		C	A				R			C	C							C							
10-5, 90-92		C	A				R			C	C							C							
10-6, 80-82		C	A				R			F	A						F							R	
10, CC		R			C					R														R	
11-1, 60-62		C	C		C					R	F						F								
11-2, 60-62		C			F					R	F						F								D. hustedtii D. lauta
11-3, 90-92		C	F							R	R						F								
11-4, 40-42		A			F					R	R						F								
11-5, 30-32		C			F					F	F						F								
11-6, 70-72		C	F							C		F					F							R	
11, CC																		F							
12-1, 30-32										F		F													
12-2, 120-122		F			F					F		F													
12-3, 110-112		F			C					C														R	
12, CC					F													F							
13-1, 60-62		F		R	F				F									R						F	
13-2, 70-72			F						C		F							R					C		
13-3, 60-62					F				F		F														
13-4, 60-62		C	C	R	C	C			C		R														
13-5, 60-62		F		R	F	F			C		R							R							
13-6, 60-62		F	F	R	F				F		R	R						R						F	
13, CC		R							R																D. antarctica C. lewisianus
14-1, 80-82				C	C		F		C									R					C	F	
14-2, 60-62			R	C	C		F		C									R					C	F	
14-3, 60-62			R	C	F		F		A														C	R	
14-4, 60-62			R	C	C		C		A									R					F		
15-1, 60-62					F	R			C			F				C		R					R		
15-2, 60-62						C			C							C		R					C	R	
15-3, 60-62				R	F	C			C							C		R					C	R	
16-1, 92-94					F	F			C			F				C								R	
16-2, 60-62					R				R			R													D. antarctica
16, CC									F																
17-1, 140-142					R	R						R					R								
17-2, 60-62					F	C		R				C					C						F		
17-3, 60-62					F	R		F				F					F								

Figure 3. *(Continued).*

Sample (Interval in cm)	*Actinocyclus ellipticus*	*A.* var. *javanicus*	*A. ingens*	*Asteromphalus hookerii*	*A. parvulus*	*Charcotia actinochilus*	*Coscinodiscus endoi*	*C. kolbei*	*C. lentiginosus*	*C. lewisianus*	*C. marginatus*	*C. nodulifer*	*C. obovatus*	*C. radiatus*	*C. fabularis*	*C. vetutissimus*	*C.* sp. 2	*C.* sp. 3	*C.* sp. 1	*Cosmiodiscus insignis*	*Denticula antarctica*	*D. hustedtii*	*D. lauta*	*D. nicobarica*	*Eucampia balaustium*	*Hemidiscus karstenii*	*Liradiscus* sp.	*Nitzschia angulata*	*N. interfrigidaria*	*N. kerguelensis*	*N. reinholdii*	*N. praeinterfrigidaria*	*Rhaphidodiscus marylandicus*	*Rhaphoneis* sp.	*Rhizosolenia barboi*	*Rouxia diploneides*	*R. naviculoides*	*R. peragalli*	*Stephanogonia hanzawae*	*Stephanopyxis appendiculata*	*Synedra jouseana*	*Trinacria excavata*	*T. pileolus*	Diatom Zones
17-4, 60-62																R																												*D. nicobarica*
17-5, 63-65											F	F				F								F										F										
17, CC											F																																	
18-1, 63-65											R													R																				
18-2, 60-62											R	R												R																				
18-3, 60-62	R										R					R																									R	R		*Cos.* sp.
18-4, 60-62	R										R																															R		
18-5, 60-62	R										R					R			F																							R		
18, CC											F																								F									
19-1, 60-62	R										R	R							R																						R	R		
19-2, 60-62											R	R							R																R						R	R		
19-3, 60-62	R										F	F							F																									
19-4, 60-62											R	R							R																R							R		
19-5, 60-62	R										F	R							R																								R	
19-6, 60-62											R								R																							R		
19, CC											F																																	
20-1, 60-62											R	R							R																							R		
20, CC											R																															R		
21-4, 60-62	R										A								R														R								F	R		
21-5, 60-62	F										C	F							R																						C	R		
21-6, 60-62	R										R								R																						R	R		
21, CC											F																																	
22-1, 60-62											R	R																							R						R			
22-2, 60-62											R	R																							R									
22-3, 60-62	R										R	R																													R			
22-4, 60-62												R																							R									
23-1, 33-35			X								X										X			X																	X			Downhole slump material

Figure 3. *(Continued).*

Sample	*Actinocyclus ingens*	*Coscinodiscus lentiginosus*	*C. marginatus*	*C. radiatus*	*Cosmiodiscus insignis*	*Denticula antarctica*	*D. hustedtii*	*D. lauta*	*Nitzschia interfrigidaria*	*N. kerguelensis*	*Rhizosolenia barboi*	*Rouxia peragalli*	*Trinacria excavata*	*T. pileolus*	Diatom Zones
1, CC	F	F			R				R	F	F				*R. barboi/N. kerguelensis*
2, CC	C	C	C	C			C				R		F	R	*D. hustedtii*
3, CC													R		
4, CC															
5, CC	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
6, CC	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
1A, CC	C	F								F	R				*R. barboi/N. kerguelensis*
1B, CC			C								C	A		R	? ? ?
2B, CC							C						F	F	
3B, CC	F		F				C						R	R	*D. hustedtii*
4B, CC			A				A							R	
5B, CC	C		C				C	C			R		R		*D. hustedtii/D. lauta*
6B, CC	C		C			C		C							
7B, CC	F		F												*D. lauta/D. antarctica*
8B, CC	A		A			F	F	C			R				
9B, CC	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
10B, CC	–	–	–	–	–	–	–	–	–	–	–	–	–	–	

Figure 4. *Distribution of diatoms at Hole 267B.*

FLORAL REFERENCES

The genera and species are arranged alphabetically. Original descriptions are cited and were consulted when possible. Other citations, where good illustrations or comments can be found, are listed. In those instances where good illustrations and comments exist, the reader is referred to the same since it is felt by the writer that repetition of common data serves no useful purpose. In instances where the concept of the taxon was ambiguous or good illustrations were difficult to obtain, photographs or comments are included. Type material for new taxa is maintained by the author, and paratype material will be made available.

Actinocyclus diviscus (Grun.) Hustedt (1958)
(Plate 1, Figures 1, 2)

Description: Hustedt (1958), p. 129, pl. 8, fig. 81. Koizumi (1968), p. 207, pl. 32, fig. 3.

Actinocyclus ellipticus Grunow in Van Heurck (1881)

Description: Hustedt (1930), p. 533, fig. 303.

Actinocyclus ellipticus var. javanica Rheinhold (1937)

Description: Rheinhold (1937), p. 75, pl. 1, fig. 7, 8.

Actinocyclus ingens Rattray (1890)

Description: Kanaya (1971), p. 554, several figures. Koizumi (1968), p. 207-208, pl. 32, fig. 5, 6.

As has been mentioned by Koizumi (1973, p. 831), there is wide range of size and valve morphology noted for this taxon. In this material the large, undulated forms tend to be found in Pliocene material while the smaller, flat forms are found to a greater extent in Miocene sediments.

Actinopthycus undulatus (Bail) Ralfs in Pritchard (1861)
(Plate 1, Figures 3-6)

Description: Hustedt (1930), p. 475-478, fig. 264.

Specimens were noted with and without apiculi. Coarseness of the aerolation also varied.

Asterolampra affinis Greville (1862)
(Plate 2, Figures 1, 2)

Description: Greville (1862), p. 45, pl. 7, fig. 7-9

Asterolampra vulgaris Greville (1862)
(Plate 2, Figures 3, 4)

Description: Greville (1862), p. 47, pl. 7, 8, fig. 17-25.

Asteromphalus hookerii Ehrenberg (1854)

Description: Hustedt (1958), p. 127, pl. 8, fig. 88-90.

Asteromphalus parvulus Karsten (1905)

Description: Hustedt (1958), p. 128, pl. 8, fig. 91.

Aulacodiscus brownii Norman (?)
(Plate 2, Figures 5, 6)

Description: Long, Fuge, and Smith (1964) p. 97, pl. 14, fig. 12. Schmidt (1876), pl. 36, fig. 15, 16. (1886), pl. 105, fig. 6.

This identification is based solely on the illustrations cited because no reference could be found for the original description.

Biddulphia angulata? Schmidt (1889)
RPlate 3, Figures 3-5)

Description: Schmidt (1889), pl. 141, fig. 7, 8. Hanna (1932), p. 177, pl. 5, fig. 7, 8.

Charcotia actinochilus (Ehr.) Hustedt (1958)

Description: Hustedt (1958), p. 126, pl. 7, fig. 57-80.

Sample (Interval in cm)	Actinocyclus ingens	Coscinodiscus endoi	C. kolbei	C. lentiginosus	C. marginatus	C. tabularis	Cosmiodiscus insignis	C. intersectus	Charcotia actinochilus	Denticula antarctica	D. hustedtii	D. lauta	Eucampia balaustium	Nitzschia interfrigidaria	N. kerguelensis	N. angulata	Rhizosolenia barboi	Rouxia californica	R. diplonecides	R. peragalli	Trinacria excavata	T. pileolus	Hemidiscus karstenii	Diatom Zones
1-1, 90-92				A		C			R				R		A	C								
1-1, 145-147	R			A		F							R		A	F							R	
1-2, 20-22				A		F			R				R		A	F								
1-2, 90-92				C		F									C	F								
1-2, 140-142				C		R									C	R								
1-3, 30-32				C		F							F		C	R							R	
1-3, 80-82			R	C		F			R				F		C	R								C. lentiginosus
1-3, 133-135			R	C		F							R		C	R								
1-4, 30-32				C		F							F		C	R								
1-4, 78-80	R		R	C		R			R				R		C	R								
1-4, 130-132				C		F							F		C	F								
1-5, 20-22				C		F							F		C	F								
1-5, 80-82			R	C		C			R				C		C	R								
1-5, 130-132				A		F							F		A	R								
1-6, 20-22	F			A		R							F		A	R				?				
1-6, 70-72	C			C									R		C	R				?				C. elliptipora A. ingens
1-6, 120-122	C			C											C					?				
1, CC																R								
2-1, 123-125	C			R		C	R							A		A			F	C				
2-2, 30-32	R					F								C		C			F					
2-2, 80-82	R					F								C		F			R	C				
2-2, 130-132					R						R		R			R	R			R				
2-3, 20-22					A						F		F				F			R	C	R		N. interfrigidaria
2-3, 67-69													R			F	R							
2-3, 120-122					R						R	R				R	R		R	R	R			
2, CC					R												R			R				
3-1, 60-62					R			F			F	R							R		R	R		
3-1, 120-122								C			F								R		F	F		
3-2, 40-42								R			R	R						R	R		?			
3-2, 90-92											F													
3-2, 137-139							R	F			F								R		F			D. hustedtii
3-3, 30-32								F			C										F	F		
3-3, 80-82								C			A	F	R					R	R		C	R		
3-3, 130-132								C			C	F									C			
3, CC							R	R			R										R			
4-1, 0											C										R	R		
4-1, 80-82	F										A	F	F								F	F		
4-2, 130-132	F				C						C	R	F								F	F		
4, CC	R				R						C										F	F		
5-1, 131-133	F				F						A	C	F					R			C	R		
5, CC					?						A	F								R	C	C		
6-1, 0	R										F	F									R	R		
6-1, 90-92	R	?									C	C	R					R			C			
6-1, 140-142	R	?			R						C	C					R				C			D. hustedtii D. lauta
6-2, 51-53	R	F			R						C	C					R	R			C			
6-2, 140-142	R	?									C	C						R			C			
6-3, 40-42	R	?									C	C	R					R			C			
6-3, 90-92	C	R			R						C	C	R								C	R		
6-3, 140-142	R	?									C	C									R	R		
6-4, 40-42	R	?									C	C									F			
6-4, 90-92	R	?									C	C					R				R			
6-4, 140-142	R	?		?							F	F									C	R		
6, CC	R									R	C	C					R							
7-1, 80-82	R										R	R									F			
7-1, 130-132	F									R	R	R									C	R		
7-2, 30-32	F	?									?	F									C			
7-2, 80-82	F	?								R	R	R									C			
7-2, 130-132	R										T										F			D. lauta D. antarctica
7-3, 32-34	C									R	R	R					R				F	R		
7-3, 80-82	C									R	R	R					R				C			
7-3, 130-132	C									R	?	R									R			
7, CC	A									R	A	A									C	C		
8-1, 130-132	C									F	C	R									R			
8, CC	R									F	F	F									R	R		
9-1, 40-42	C											C					R				F			
9-1, 90-92	F										R	F					R				R			
9-1, 140-142	R									R		R									R	R		
9-2, 30-32	F											F												
9-2, 80-82	R											R									R			
9-2, 125-127	R											R												
9-3, 30-32	R											R									R			D. antarctica C. lewisianus ?
9-3, 80-82	C											R									C	F		
9-3, 130-132	C											F					R				F	R		
9-4, 30-32	C											R					F				R			
9-4, 75-77	C											F					R				F			
9-4, 130-132	R											R												
9-5, 30-32	R											R					R				R			
9-5, 130-132	C											R					R				F	R		
9, CC	C																				R	R		
10, CC																								
11, CC																								
1A-2, 95	R									R	R	R									R	R		Downhole slump
2A-1, 45																								
12A, CC																								

Figure 5. *Distribution of diatoms at Site 269.*

Sample (Interval in cm)	Actinocyclus ingens	Actinocyclus ehrenbergii	Actinoptychus undulatus	Asteromphalus parvulus	Aulacodiscus brownii	Charcotia actinochilus	Coscinodiscus apiculatus	C. lentiginosus	C. sp. 2	C. sp. 1	Cosmiodiscus intersectus	Denticula antarctica	D. hustedtii	D. lauta	Eucampia balaustium	Liradiscus sp.	Melosira sulcata	Nitzschia angulata	N. curta	N. kerguelensis	N. ritscherii	Rhizosolenia barboi	Stephanopyxis barbadensis	S. grunowii	S. turris	Trinacria excavata	T. pileolus	Diatom Zones
1-1, 0						C									C			R	C	R	L							
1-1, 80						C									F				C	R	C							
1-1, 85-87				R				R										F	C		C							C. lentiginous
1-1, 113															F													
1-1, 130-132		R																										
1-1, 145																												
1-2, 30-32																												
1-2, 80-82		R																										
1-2, 130-132																												
1-3, 30-32																												
1-4, 30-32																												
1-5, 70-72																												?
1, CC																												
2-1, 140-142																												
2-2, 140-142																												
2-3, 130-132									R																			
2-4, 130-132																												
2-5, 30-32																												
2, CC (25μ)																												
3-1, 38-40	R																											
3-1, 80-82																												
3-2, 27-29	R																											Miocene ?
3-3, 26-28																												
3-4, 30-32																												
3, CC (25μ)	R		R																									
4-1, 130-132	R									R		R	?	?			R									R		
4-2, 40-42												R	R	R												R		
4-3, 123-125	R											R	R				R									R	R	
4-4, 30-32												R	R	R												R		
4-5, 80-82												R	R	R												R		
4, CC (25μ)	R		R				R															R						
4, CC (38μ)	R																											
5-1, 77-79												R	R			R	R									R		
5-2, 30-32	R						R					R	R													R		
5-3, 30-32	R																									R		
6-1, 30-32	R											R	R	R												R		
6-2, 30-32							R						R			R										R		
6-3, 30-32																												
6-4, 30-32																												
7-1, 123-125																												
7-2, 80-82												R	R													R		
8-1, 30-32	R											R	R	R												R		
8-2, 30-32												R	R			R										R		
8-3, 25-27																												
8-4, 30-32	R											R	R	R												R		
9-1, 130-132																												
9-2, 10-12	R											R	R	R			R									R		
9-3, 67-69																												D. lauta D. antarctica
9-4, 111-113												R	R															
10-1, 9-11													R	R		R										R		
10-2, 0-2												R	R	R														
10-3, 108-110	R																									R		
10-4, 61-63	R											R														R		
10-5, 18-20																										R		
11-1, 15-17	R											F		R												R		
11-2, 65-67							R															R						
11-3, 74-76																												
11-4, 70-72												R														R		
11-5, 117-119												R														R		
12-1, 118-120														R												R		
12-2, 58-60	R											R																
13-1, 22-24	R											R	R													R		
13-2, 9-11	F											F	R			R	R									F		
13-3, 64-66												R																
14-1, 2-4	R						R					R	R				R									R		
14-2, 12-14	R											R	R													R		
14-3, 69-71	C											F	C													F	F	
14-4, 59-61	R												R	R												R		
14, CC (25μ)	R	R	R																						R			
15-1, 109-111													R													R	R	
15-2, 116-118	C											R	A	F														
16-1, 113-115	C											R	C	F												F	R	
16-2, 64-66	R																									R		D. antarctica D. lewisianus ?
16-3, 60-62																										R		
17-1, 96-98	R																									R		
17-2, 20-22												R														R		
17-3, 30-32												R														R		
18-1, 70-72					F		C																		R	R		
18-2, 20-22					F		C																			F		
18, CC (38μ)					R		R																			R	R	
18, CC (25μ)		R	R		R		R																			R	R	
18, CC (63μ)					R																					R		
18, CC					R																					R		
19-2, 35-37					R		R																			R		
19-3, 46-48																									R	R		
19-4, 30-32																										R		
19-5, 30-32																								R		R		
19-6, 130-132					R																	R		R		R		Early Miocene ?
21-1, 144-146					R					R														R		R		
21-2, 70-72										R														R		R		
21-3, 62-64							R																		R	R		
21-4, 116-118			R		R					R														R	R	R		
21-5, 30-32					R																		R	R		R		
22-1, 35-37																						R		R	R	R		
25, CC (38μ)							R										R											
25, CC (63μ)							R										R											
38-2, 120-122																								R		R		
38, CC (25μ)			R																						R	R		
39, CC (25μ)																												
40, CC (25μ)																												
40, CC (38μ)																												

Figure 6. *Distribution of diatoms at Site 272.*

Coscinodiscus apiculatus Ehrenberg (1844)
(Plate 4, Figures 1, 2)

Description: Hustedt (1930) p. 449-452, fig. 248. Hanna (1932) p. 178, 179, pl. 6, fig. 1.

Coscinodiscus bullatus Janisch (1891)
(Plate 16, Figure 1)

Description: Hustedt (1958), p. 112, pl. 4, fig. 26-28.

Coscinodiscus elliptipora Donahue (1970)
(Plate 16, Figure 10)

Description: Donahue (1970), p. 201, pl. 4, fig. e, i-m.

Sample (Interval in cm)	*Actinocyclus ingens*	*Actinopthycus undulatus*	*Asteromphalus parvulus*	*Charcotia actinochilus*	*Coscinodiscus apiculatus*	*C. furcatus*	*C. lentiginosus*	*C. marginatus*	*C. stellaris v. symbolophorus*	*Denticula antarctica*	*Eucampia balaustium*	*Liradiscus sp.*	*L. ovalis*	*Nitzschia curta*	*N. kerguelensis*	*Trinacria excavata*	*T. pileolus*	Diatom Zones
Hole 273																		
1-1, 71-73			C	C		C					C			C	C			
1-1, 80-82	R	R			R					R					R	R	R	
1, CC					R						R					R	R	
1-2, 10-12										R						R		
1-2, 60-62								R		R								
1-2, 110-112										R						R		
1-3, 10-12										R						R		
2-1, 110-112															R	R	R	
2-2, 15-17															R			
2-2, 60-62										R						R		
2-2, 110-112										R						R		Mixture of *C. lentiginosus* and *D. antarctica*
2-3, 10-12										R								
2-3, 63-65										R					R	R		
2-4, 10-12										R		R			R	R		
2, CC (25μ)	R	R		R					R	R	R					R	R	
3-1, 128-130										R					R	R		
4-1, 105-107										R						R		
4-2, 73-75								R		R	?				R	R		
5-1, 50-52	R	R			R										R	R		
5-1, 60-62	R			F											R			
5-1, 72-74	R	R														R		
5-1, 80-82				F							F							
5-1, 99-101	R			R												R		
5-1, 130-132					R					R		R				R		
5, CC (25μ)		R			R				R							R	R	
5, CC (38μ)					R				R									
6-1, 140-142										R		R				R		
6-2, 130-132										R						R		
6, CC (25μ)	R				R											R	R	
7-1, 110-112										R						R		*D. antarctica*
8-4, 18-20										R		R				R		
9-2, 127-129										R		R				R		
9, CC (25μ)		R			R											R	R	
Hole 273A																		
1-1, 58-60										R		R				R		
3-1, 128-130										R		R				R		
4-2, 30-32					R					R		R				R		
6-1, 104-106					F				F	C			R			C	C	
6-1, 120-122										C						C	C	
6, CC (25μ)		R			R											R	R	
6, CC (38μ)		R			R											R		
7-1, 36-38										R		R				R	R	
8-2, 35-37										R						F	F	
8-3, 117-119		R			F					F						C	C	
9-1, 79-82										R						R		*D. antarctica*
10-2, 30-32					R					R		R				R		
11-2, 38-40										R						R		
12-1, 137-139										R						R		
13-2, 140-142					R					R						R		
14-1, 134-136										R						R		
15-1, 104-106										R		R				R		
16-2, 130-132					R					R						R		
17-2, 30-32										R						R	R	
18-1, 123-125										R		R				R		
18, CC (25μ)		R			R											R	R	
18, CC										F						R	R	
21-1, 145-147										R						R		
22-1, 87-89																R		
22, CC (25μ)		R			R											R	R	
22, CC		R			R											R	R	
23-1, 132-134																R		Early Miocene ?
24-1, 144-146																R		
25-1, 125-127																R		
26-1, 109-111																R		
27-1, 139-141																R		
28, CC (25μ)		R			R													
28, CC (38μ)		R			R													
29,2, 145-147																R		

Figure 7. *Distribution of diatoms at Site 273.*

Coscinodiscus endoi Kanaya (1959)
(Plate 4, Figures 5, 6)

Description: Kanaya (1959), p. 76, 77, pl. 3, fig. 8-11. Koizumi (1968), p. 211, pl. 32, fig. 21, 22.

Coscinodiscus flexosus Brun (1895)
(Plate 4, Figures 3, 4)

Description: Kanaya (1959), p. 86, 87, pl. 5, fig. 6-9, (as *CC. yabei*) Kanaya (1971), p. 555.

Kanaya (1971) places in synonomy *Coscinodiscus yabei*, which is described in his 1959 work.

Coscinodiscus sp. 1
(Plate 8, Figure 3)

Coscinodiscus sp. 2
(Plate 8, Figures 1, 2)

Coscinodiscus ? sp. 3
(Plate 7, Figures 1-4)

Description: This diatom is tentatively placed within the genus *Coscinodiscus*. With further investigation this diatom may deserve a unique taxonomic position.

Cosmiodiscus insignis Jousé (1961)
(Plate 8, Figure 5)

Description: Shesrukova-Poretskaya (1967), p. 175, pl. 25, fig. 2. Koizumi (1973), p. 832, pl. 4, fig. 7-11. Jousé (1961), p. 67, pl. 2, fig. 8. Jousé (1959), pl. 4, fig. 9.

In many instances the presence of this diatom is evidenced only by the center hyaline area, the remainder of the valve being dissolved.

Cosmiodiscus intersectus (Brun) Jousé (1961)
(Plate 8, Figure 4)

Description: Sheshukova-Poretskaya (1967) p. 174, pl. 25, fig. 1. Koizumi (1973), p. 832, pl. 4, fig. 12, 13. Jousé (1961) p. 68, pl. 2, fig. 9, 10.

Denticula antarctica sp. nov.
(Plate 8, Figures 6-10)

Description: *Denticula antarctica* sp. nov.

Valves linear-elliptical with bluntly rounded ends. Raphe marginal. Septa strongly developed with crossbars connected by suture at both ends. Valves punctate only at margin with pseudosepta represented by thickenings of the valve surface. Punctae placed between each pseudoseptum. Length 18-47μ, width 4-7μ.

Coscinodiscus furcatus Karsten (1905)

Description: Hustedt (1958), p. 113, 114, pl. 3, fig. 18, 19, pl. 5, fig. 39.

Coscinodiscus kolbei Jousé (1962)
(Plate 4, Figures 7-9)

Description: Donahue (1970), p. 202, pl. 5, fig. A-C.

Coscinodiscus lentiginosus Janisch in Schmidt (1878)
(Plate 5, Figure 1)

Description: Hustedt (1958), p. 116, pl. 4, fig. 22-25.

Coscinodiscus lewisianus Greville (1866)
(Plate 5, Figures 2-4)

Description: Greville (1866), p. 78, pl. 8, fig. 8-10. Kanaya (1971), p. 555, pl. 40.5, fig. 4-6.

Coscinodiscus marginatus Ehrenberg (1841) [1843]
(Plate 16, Figures 2, 3)

Description: Hustedt (1930), p. 416-418, fig. 223. Koizumi (1968), p. 211, pl. 33, fig. 3a-b, 4a-b.

Coscinodiscus nodulifer Schmidt (1878)
(Plate 5, Figures 7, 8)

Description: Hustedt (1930), p. 426-427, fig. 229.

Sample (Interval in cm) \ Diatoms	*Actinocyclus ingens*	*A. ehrenbergii*	*Actinopthycus undulatus*	*Asteromlampra affinis*	*A. vulgaris*	*Biddulphia angulata ?*	*Charcotia actinochilus*	*Coscinodiscus apiculatus*	*C. diviscus*	*C. elliptipora*	*C. endoi*	*C. kolbei*	*C. lentiginosus*	*C. marginatus*	*C. praelineatus*	*C. radiatus*	*C. sp. 2*	*Cosmiodiscus insignis*	*C. intersectus*	*Denticula antarctica*	*D. hustedtii*	*D. lauta*	*Eucampia balaustium*	*Cestodiscus sp.*	*Hemiaulus polymorphus*	*H. sp. 1*	*Liradiscus sp.*	*L. ovalis*	*Melosira sulcata*	*Nitzschia angulata*	*N. curta*	*N. interfrigidaria*	*N. kerguelensis*	*N. praeinterfrigidaria*	*N. reinholdii*	*N. ritcherii*	*Odontotropis sp.*	*Pseudopyxilla americana*	*Pterotheca carinifera*	*P. sp. 1*	*P. sp. 2*	*Pyrogodiscus sp.*	*Pyxilla johnsoniana v. corniculum*	*P. prolungata*	*P. reticulata*	*Rhizosolenia barboi*	*R. hebetata f. hiemalus*	*Rouxia antarctica*	*R. californica*	*R. diploneides*	*R. peragalli*	*Stephanopyxis appendiculata*	*S. barbadensis*	*S. inermes*	*S. grunowii*	*S. turris*	*Sticopiscus hardmanianus*	*Thalassionema elegans*	*Thalassiosira gracilis*	*Triceratium coscinoides*	*T. inelegans*	*T. pulvinar*	*Trinacria excavata*	*T. pileolus*	*Xanthiopyxis acrolophra*	*X. globosa*	*X. panderaformis*	*Coscinodiscus sp. 6*	Diatom Zones
1-2, 0 (25µ)	R		R				R	R						R					R				R			R			R				R				R																						R				R	R				R	
1-2, 0							R																R			R							R													R																							
1-2, 60-62							R					R								R	R	R	F	R					C	R	R		F			F												F	R	R	F					R							?						
1-2, 95-97							R						R				R				R		F			R			C	R			F	R		F								R				F	R	R	R							R	F				?						
1-2, 130-132							R						R				R			R	R	R	F						C		R		F			F										R		R	R	R	F					R		R	R				?						
1-3, 30-32							R						R				R		?	R			C	R			R		F	R	R		F	R		C	R											R			R					R			R				R						
1-3, 70-72							R													R	R	R	R						C		R		F	R		C												R			R					R		R					?						
1-3, 130-132									R																				F		R		R	R		R													R	R													?						
1-4, 30-32							R													R			F					R	F	R	R		F	R		F	R												R	R	R					R		R	R				?						
1-4, 80-82							R						R				R				R		F	R			R		F	R	R		C			F											R				R					R		R	R				?						
1-4, 130-132							R						R				R			R	R	R	F						C	R	R		C			C																						R	R				R						*C. lentiginosus*
1-5, 30-32							R										R			R	R		C				R		F		R		C			C													R							R		R	R				R						
1-5, 80-82																					R								R				R			R												R											R				R						
1-5, 130-132							R													R			R				R		R				R			R															R																		
1-6, 30-32							R						R								R		C						R				R			F																				R		R											
1-6, 70-72							R										R			R			F						R	R			R			F																											R						
1-6, 130-132							R										R						R										R			R																																	
1, CC (25µ)							R						R										R																																														
1, CC							R						R										R																																														
2-2, 80-82																	R			R	R								R							R																											R						
2-2, 130-132																																																																					
2-3, 80-82																					R		R						R	R			R																																				
2-3, 130-132																				R							R		R				R																							R							?						
2-4, 30-32																																																																					
2-4, 80-82																																												R		R													R										
2-4, 135-137																																	R													R																	?						
2-5, 30-32		R															R			R	R		R						R	R																										R													
2-5, 90-92	R									R																							R											R																			?						
2-5, 130-132																			R	R										R						R																							R										
2-6, 30-32																			?														R													R																	?						
2-6, 77-79		R						R		R		R																					R													R													R				R						
2-6, 130-132	R							R					R								R		R				R		R																																		R						
2, CC (25µ)								R									R		?		R	R								R			R																														?						
3-1, 40-42																																																																					
3-1, 90-92																																																																					*C. elliptipora* *A. ingens*
3-1, 130-132																																																																					
3-2, 30-32																																	R																																				
3-2, 77-79										R													R																																														
3-2, 130-132																																																																					
3-3, 30-32																																																																					
3-3, 85-87										R																							R													R																							
3-3, 130-132										R																																																											
3-4, 30-32										R							R				R								R				R																										R				?						
3-4, 80-82																																																																					
3-4, 130-132																																														R																							
3-5, 30-32																																																																					
3-5, 75-77																																																																					
3-5, 130-132																																																																					
3-6, 30-32	R									?			R																				R													R																							
3-6, 89-91																																																																					
3-6, 130-132																	R																																														R						
3, CC (25µ)	R	R	R					R																																																							R	R					
3, CC																																																																					
4-1, 40-42										R																																																											
4-1, 90-92																																	R																																				
4-1, 130-132																																																																					
4-2, 30-32																																																																					
4-2, 70-72																																																																					
4, CC																																																																					

Figure 8. *Distribution of diatoms at Site 274.*

5-1, 120-122						C																																								
5-2, 90-92						C																												R												
5-3, 138-140																																		R												
5, CC																																														
6-1, 40-42						C				R																							A													
6-1, 90-92																																	R	R												
6-2, 40-42						F				?																			R				C													
6-2, 140-142																																														*C. kolbei*
6-3, 40-42						R																												R												*R. barboi*
6-3, 90-92						R																												R												
6-3, 140-142						R																												R												
6-4, 40-42						R																												R												
6-4, 90-92																																		R												
6-4, 140-142																																														
6-5, 40-42						R																											R	R												
6-5, 90-92																																		R												
6-6, 40-42						R																																								
6, CC (25μ)																																													C	
6, CC						R																																							C	
7-1, 40-42																																		R												
8, CC						R																																								
9-2, 90-92					R			R	R					F	R					R		R		R									C								R					
9-2, 140-142								R	R		?			R						R				R							?	R										R				
9-3, 110-112					R			R						R				R				F		R										R												*N. praeinterfrigidaria*
9-5, 90-92																																														
9-6, 140-142																					R	F												R							R					
10-1, 90-92																						F																								
10-2, 40-42							R																						R		R								F	R						
10-3, 40-42																																														
10-3, 140-142																													R																	
10-4, 40-42																													R			R								F						
10-5, 90-92									R			R																				R							R		F					
10-6, 40-42																							?									R		R						R						
10, CC (25μ)		R					R		R	R				R																												R				*D. hustedtii*
10, CC																																														
11-1, 140-142	R	R					F		?			R	R									R	R						R					R								R				
11-4, 140-142		R					F		C	F		F																	R					F								R	R			
11, CC (25μ)									R	R																																R				
11, CC							F																																							
12-1, 92-94												C																														F				*D. hustedtii*
12-6, 90-92												C																		R		R										R				*D. lauta*
12-6, 140-142												?																																		
12, CC (25μ)									R	R																			R													F	R			
12, CC	R	R		R			F					R																																		
13-1, 90-92											F	?																														R	R			
13-6, 40-42											C							F																								F	F			*D. antarctica*
13, CC (25μ)			R	R																																						R	R			*C. lewisianus*
14-1, 40-42											C							R																								R				
14-3, 140-142											C							F																								F	R			
14-6, 40-42											C							F	R																							F	F			- ? - ? - ? - ? - ? -
14, CC (25μ)			R	R							F								F																							F	F			
15-1, 90-92											F								F																							F	F			
15-4, 77-79											R							R																								R				
15-6, 75-77											C							R																					R			R				*D. antarctica*
15, CC (25μ)											?																															F				
16-1, 78-80																		R											R									R				R				
16-3, 130-132				R														R																				R				R				
16, CC (25μ)																																					R					F				Early Miocene ?
17-1, 140-142																																				F		F				F				
17-3, 80-82																																														
17, CC (25μ)			R																																							R				
18-1, 143-145																																						F				?				
18-2, 124-126																																										R				
18-5, 130-132																		F		?												R							R			R				Early Miocene ?
18, CC (25μ)			R																																				F			C	C			
19-1, 137-139																		F		C								T										F				R	R			
19-2, 30-32																																						R	R			R				
19-3, 84-86																																														
19-6, 130-132																		F		R								T				R										R	R			
19, CC (25μ)				R																								T														F	F			
20-1, 30-32																	F			F					R		F	F										C	C					C		
20-1, 145-147																										R																				
20-5, 30-32							C									C	C								R		F	F	F						C			C	C			F	F			

Figure 8. *(Continued).*

Sample (Interval in cm) \ Diatoms	Actinocyclus ingens	A. ehrenbergii	Actinopthycus undulatus	Asteromlampra affinis	A. vulgaris	Biddulphia angulata ?	Charcotia actinochilus	Coscinodiscus apiculatus	C. diviscus	C. elliptipora	C. endoi	C. kolbei	C. lentiginosus	C. marginatus	C. praelineatus	C. radiatus	C. sp. 2	Cosmiodiscus insignis	C. intersectus	Denticula antarctica	D. hustedtii	D. lauta	Eucampia balaustium
20, CC (25μ)				R		C																	
21-1, 30-32																							
21-1, 69																							
21-1, 132-134																							
21-5, 80-82																							
21-6, 74-76																							
22-1, 60-62				F	R										C								
22-4, 30-32																							
22-5, 30-32																							
22-5, 90-92				F										F	F	F							
23-1, 30-32				F							R			F		F							
23-6, 28-30																							
24-1, 58-60				F										F									
25-1, 30-32								F						F	R								
26-1, 30-32								F							R								
27-1, 80-82				F										F									
28-1, 30-32				F										F									
29-1, 90-92				F																			
30-1, 30-32																							
31-1, 30-32														R									
31, CC (25μ)																							
32-1, 30-32														F									
32, CC (25μ)																							
33-1, 30-32														F									
34-1, 30-32				R										F									
34, CC (25μ)																							
35, CC																							
36, CC																							
37, CC																							

Sample (Interval in cm) \ Diatoms	Centodiscus sp.	Hemialus polymorphus	H. sp. 1	Liradiscus sp.	L. ovalis	Melosira sulcata	Nitzschia angulata	N. curta	N. interfrigidaria	N. kerguelensis	N. praeinterfrigidaria	N. reinholdii	N. ritrcherii	Odontotropis sp.	Pseudopyxilla americana	Pterothéca carinifera	P. sp. 1	P. sp. 2	Pyrogodiscus sp.	Pyxilla johnsoniana v. Corniculum	P. prolungata	P. reticulata	Rhizosolenia barboi
20, CC (25μ)		C	C		R											R				C	C		R
21-1, 30-32																							
21-1, 69																							
21-1, 132-134		C	F																		C	?	
21-5, 80-82		C																			C		F
21-6, 74-76		F	C												R					C	C		
22-1, 60-62		C	C																	C	C	C	R
22-4, 30-32																				C	C		
22-5, 30-32		C	C																	C	C	C	
22-5, 90-92		C	C																	C	C	F	
23-1, 30-32		C	C		F															C	C	F	R
23-6, 28-30		F	F																	C	C	F	
24-1, 58-60		F																		C	C	F	R
25-1, 30-32		F	F																	C	C		
26-1, 30-32		F	F																	C	C		
27-1, 80-82		F	F													R				C	C	F	
28-1, 30-32		F	C												R						C		R
29-1, 90-92		F	F												R						C		
30-1, 30-32		F	F														R				C		
31-1, 30-32		F	C															R		C	C	R	R
31, CC (25μ)																							
32-1, 30-32		C	C																	C	C		
32, CC (25μ)																							
33-1, 30-32		F	C																	C	C		
34-1, 30-32		C	F												R					C	C	R	
34, CC (25μ)																							
35, CC																							
36, CC																							
37, CC																							

Sample (Interval in cm) \ Diatoms	R. hebetata f. hiemalus	Rouxia antarctica	R. californica	R. diploneides	R. peragalli	Stephanopyxis appendiculata	S. barbadensis	S. inermes	S. grunowii	S. turris	Sticopiscus hardmanianus	Thalassionema elegans	Thalassiosira gracilis	Triceratium coscinoides	T. inelegans	T. pulvinar	Trinacria excavata	T. pileolus	Xanthiopyxis acrolophra	X. globosa	X. panderaformis	Coscinodiscus sp. 6	Diatom Zones
20, CC (25μ)											R			R			F	F					
21-1, 30-32	R																						
21-1, 69																							
21-1, 132-134														R			F	F					
21-5, 80-82	F					F			C	F					R		F						
21-6, 74-76															R								
22-1, 60-62	F					C		C	C						R		C						Lower Oligocene
22-4, 30-32																							
22-5, 30-32	F								C	C													
22-5, 90-92						F		F	F						R		F						
23-1, 30-32						F			C		F			F	C		F						
23-6, 28-30	R					C			C	F				F	F			R					
24-1, 58-60	F					C			C					F	F	R	F		C				
25-1, 30-32								R	F		R			F	F		F	R	C				
26-1, 30-32	R					R		R		F				F		R	F		A				
27-1, 80-82	R								F	F					F		F	F	R				
28-1, 30-32	R										R			R	F		F		C				
29-1, 90-92	R					F			F								F		F				
30-1, 30-32						F	F		F						F		F						
31-1, 30-32	R								F								F						
31, CC (25μ)																				C			
32-1, 30-32	R					F			F					R			F						
32, CC (25μ)																							
33-1, 30-32						F			F					R			F						
34-1, 30-32						F			F					R			F						
34, CC (25μ)																							
35, CC																							
36, CC																							
37, CC																							

Figure 8. *(Continued).*

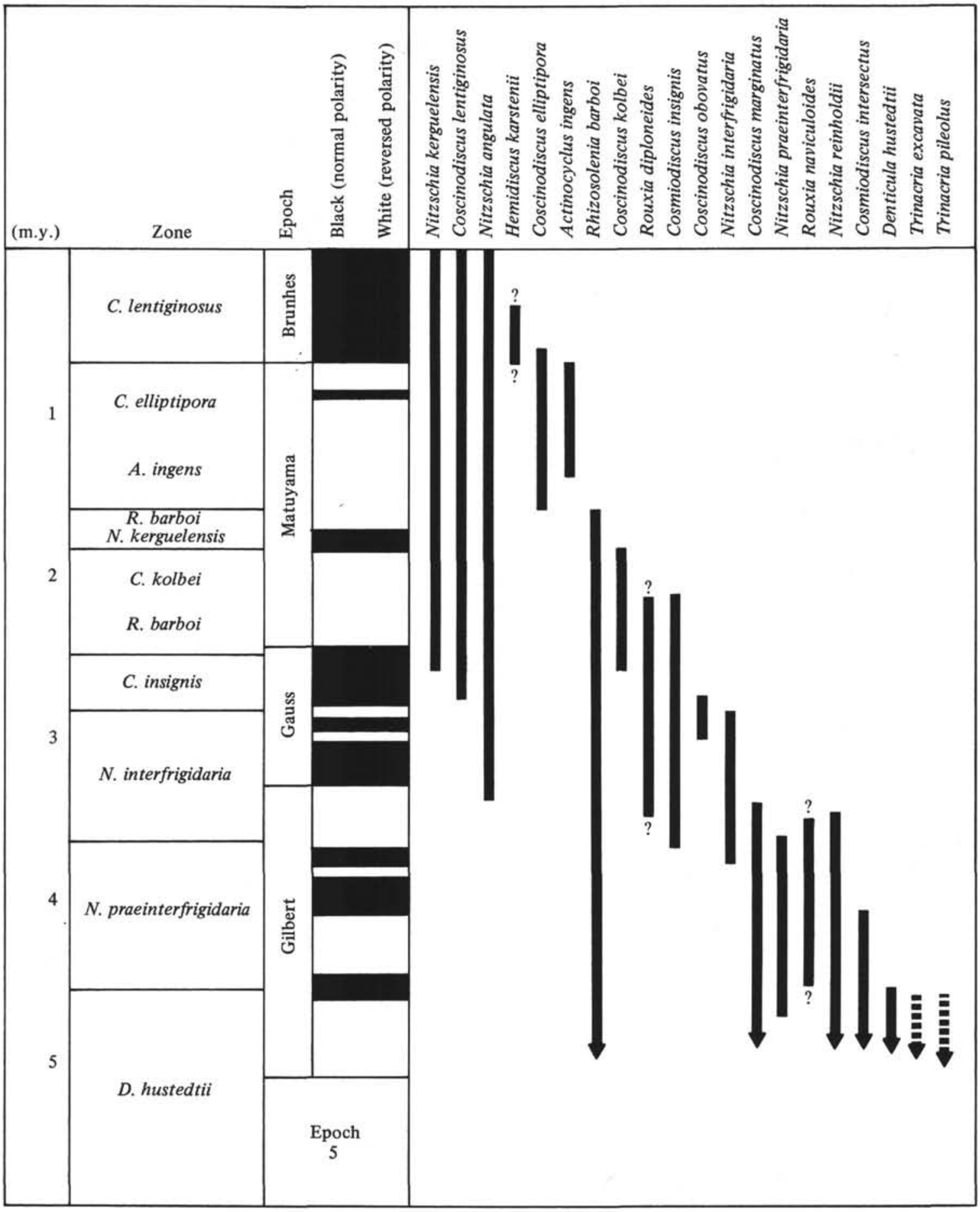

Figure 9. *Common to abundant occurrences of diatom species with respect to the zonation used in the present report and paleomagnetic stratigraphy as established in piston cores from the Southern Ocean.*

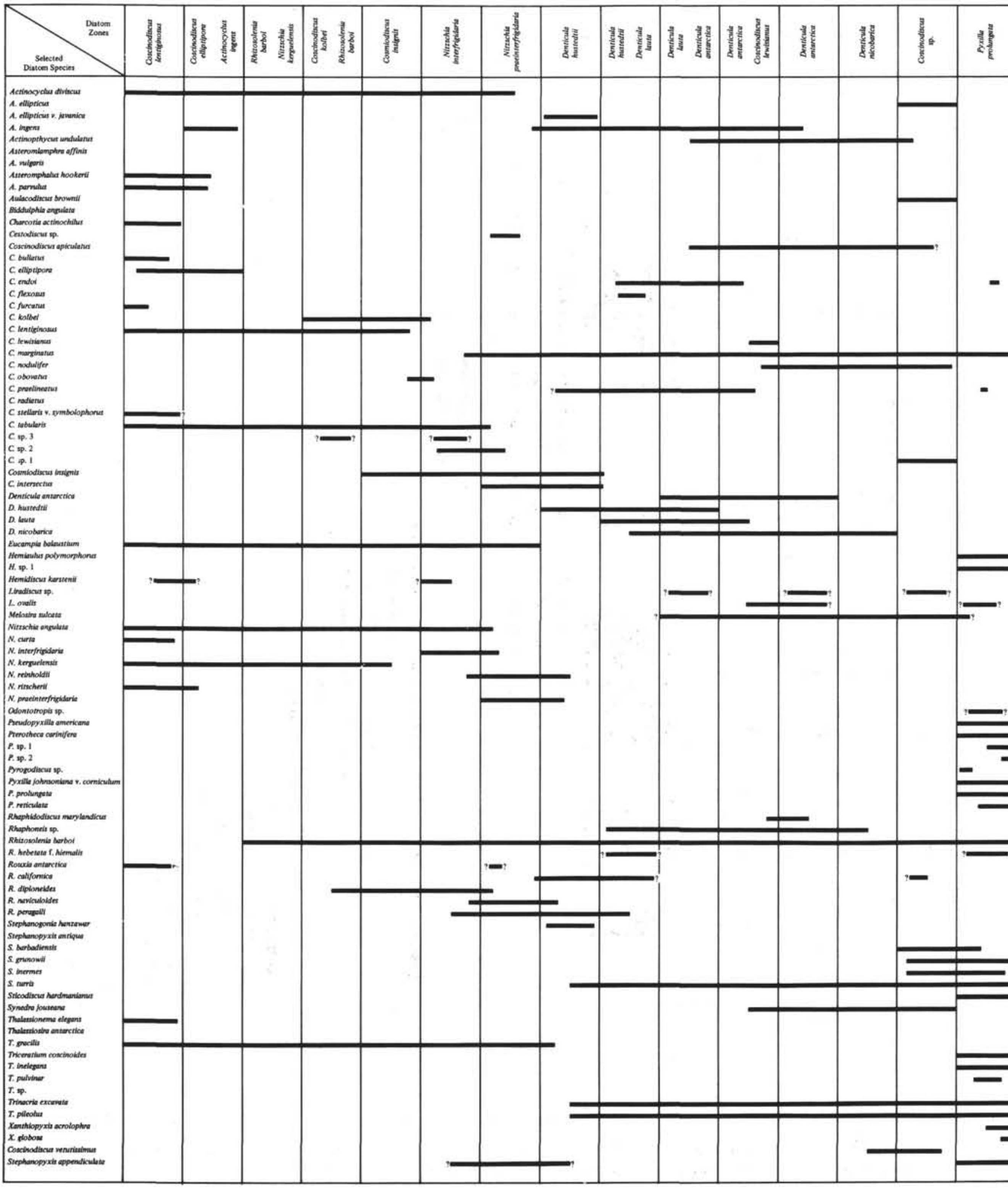

Figure 10. *Distribution of selected species of diatoms with respect to the zones used in the present paper.*

Zones	Sites										
	265	266	267, 267A	267B	268	269	270	271	272	273	274
Coscinodiscus lentiginosus	Core 1 2 3	Core 1 2-3-30			Core 1 2	Core 1 through 1-5, 130	Core 1 through 1-2, 40		Core 1 through 1-1, 145	Core 1 through 5, CC	Core 1 2-5, 30
Coscinodiscus elliptipora *Antinocyclus ingens*	Core 4 through 10	Core 2, CC 3 4				Core 1-6, 20 1, CC					2-5, 90 4, CC
Rhizosolenia baboi *Nitzcshia kergueiensis*			Core 1 Core 1A								
Coscinodisucs kolbei *Rhizosolenia baboi*											5-1, 120 8, CC
Cosmiodiscus insignis											
Nitzschia interfrigidaria	Core 13 14	Core 5 6				Core 2 2, CC					
Nitzschia pracinterfrigidaria		Core 7 7, CC									9-2, 90 9-6, 140
Denticula hustedtii		Core 8-1, 55 through 10-1, 0	Core 2	Core 2 3 4	Core 5 6 7	Core 3 3, CC					10-1, 40 10, CC
Denticula hustedtii *Denticula lauta*	Core 15 16	Core 10-1, 90 through 12, CC		Core 5 5, CC		Core 4 5 6-4, 140					11-1, 140 12, CC
Denticula lauta *Denticula antarctica*				Core 6 7 8		Core 6, CC 8, CC			Core 4 through 16-1, 113		
Denticula antarctica *Coscinodiscus lewisianus*		Core 13 14 15-3, 60				Core 9 9, CC			16-2, 64 17-3, 30		13-1, 90 ?
Denticula antarctica		Core 16-1, 90 16, CC								Core 6 through 21A-1, 145	? 15, CC
Denticula Nicobarica		Core 17 18-2, 60									
Coscinodiscus sp. 1	22-4, 60	Core 18-3, 60							18-1, 70 ? 38, CC		16-1, 78 ? 19, CC
Ryxilla prolungata											20-1, 30 34-1, 30

Figure 11. *Distribution of diatom zones at Leg 28 drill sites.*

Southern Ocean			North Pacific			Equatorial Pacific
This Paper	Donahue (1970 b)	Jouse (1962)	Schrader (1973)	Koizumi (1973)	Donahue (1970 a)	Burckle (1972)
C. lentiginosus	*N. kerguelensis* *B. californica*	I II	I		*D. seminae*	*Pseudoenoida doliolus*
C. elliptipora *A. ingenus*	*A. ingens*	III	II III		*R. curviostris*	
R. barboi *N. kerguelensis*	*R. barboi* [Base undefined]	IV ?	IV V ? ? ? ? ? ?	? ? ?	*A. oculatus*	
C. Kolbei *R. barboi*			VI VII	*D. seminae*		*Rhizosolenia praebergonii*
C. insignis			VIII ? ? ?	*D. seminae* *D. kamtschatica*	?	
N. interfrigidaria			IX			? ? ?
N. pracinterfrigidaria			? ? ? X	*D. kamtschatica*		*Nitzschia jouseana*
D. hustedtii			XI ? ? ? XII – XIV	*D. hustedtii*		*Thalassiosira convexa*
D. hustedtii *D. lauta*			XV – XVIII	*D. hustedtii* *D. lauta*		
D. lauta *D. antarctica*			XIX ? ? ?			
D. antarctica *C. lewisianus*			XX XXI – XXIV	*D. lauta*		
D. antarctica			XXV	[Base undefined]		
D. nicobarica			[Base undefined]			

Figure 12. *Correlation of various areas of the Pacific based on diatom stratigraphy.*

Coscinodiscus obovatus Castracane (1886)
(Plate 5, Figure 6)

Description: Castracane (1886), p. 160, pl. 22, fig. 9.

To this writer's knowledge this diatom has only been found in the Southern Ocean and only in Pliocene sediments.

Coscinodiscus praelineatus Jousé (1968)
(Plate 5, Figure 5)

Description: Jousé (1968), p. 15, pl. 2, fig. 1.

Coscinodiscus radiatus Ehrenberg (1839)

Description: Hustedt (1930), p. 420, fig. 225.

Coscinodiscus stellaris var. symbolophorus (Grun.) Jorgensen (1905)
(Plate 6, Figures 1-3)

Description: Hustedt (1930), p. 396, fig. 208.

Coscinodiscus tabularis Grunow (1884)

Description: Hustedt (1930), p. 427, fig. 230a. Hustedt (1958), p. 119, fig. 48-56.

Coscinodiscus vetutissimus Pantocsek (1903)
(Plate 6, Figures 4-7)

Description: Hustedt (1930), p. 412, fig. 220.

Denticula hustedtii Simonsen and Kanaya (1961)

Description: Simonsen and Kanaya (1961), p. 501, pl. 1, fig. 19-25.

Denticula lauta Baily (1854)

Description: Simonsen and Kanaya (1961), p. 500-501, pl. 1, fig. 1-10.

Denticula nicobarica Grunow (1868)

Description: Simonsen and Kanaya (1961), p. 503, pl. 1, fig. 11-13.

Eucampia balaustium Castracane (1886)
(Plate 16, Figure 8, 9)

Description: Hustedt (1958), p. 36, pl. 5, fig. 40-43.

Cestodiscus sp. Greville (1865)
(Plate 3, Figures 1, 2)

Hemiaulus polymorphus Grunow (1884)
(Plate 9, Figure 1)

Description: Hustedt (1930), p. 880-881, fig. 525, 526.

Hemiaulus sp. 1
(Plate 9, Figure 2)

Hemidiscus karstenii Jousé (1962)
(Plate 9, Figures 3, 4)

Description: Abbott (1972), p. 113-115, pl. 1, fig. D-F.

Liradiscus sp.
(Plate 9, Figures 5, 6)

Liradiscus ovalis Greville (1865)

Description: Greville (1865), p. 5, pl. 1, fig. 15, 16. Hanna (1927), p. 114, pl. 19, fig. 4-6.

Nitzschia curta (Van Heurck) Hasle (1972)

Description: Hustedt (1958), p. 160-161, pl. 11, fig. 140-144, pl. 12, fig. 159.

Nitzschia interfrigidaria sp. nov.
(Plate 9, Figures 7-9)

Description: *Nitzschia interfrigidaria* sp. nov.
Valves elliptical-linear, occasionally one side is slightly more curved than the other. Raphe marginal. Valve with large central hyaline area with scattered punctae. Valve margins strongly ribbed. Length 34-44μ, width 8-10μ.

Nitzschia kerguelensis (O'Meara) Hasle (1972)

Description: Hustedt (1958), p. 162-163, pl. 10, fig. 121-127. Hasle (1968), p. 205-208, fig. 1, 2, 7-9.

Nitzschia reinholdii Kanaya and Koizumi (1970)
(Plate 16, Figures 4, 5)

Description: Kanaya and Koizumi (1970), p. 58. Schrader (1973), p. 708, pl. 4, fig. 12-16; pl. 5, fig. 1-9.

Nitzschia angulata Hasle (1972)

Description: Hustedt (1958), p. 163-164, pl. 10, fig. 113-120 (as *N. rhombica*).

Nitzschia ritscherii (Hustedt) Hasle (1972)

Description: Hustedt (1958), p. 164, pl. 11, fig. 133-136; pl. 12, fig. 153.

Pyxilla johnsoniana Grev. var. corniculum Brun (1893-1896)
(Plate 11, Figures 1-3)

Description: Brun (1893-1896), p. 243, pl. 19, fig. 12, 13.

Pyxilla reticulata Grove and Strut (1887)
(Plate 11, Figure 7)

Description: Grove and Strut (1887), p. 145, pl. 13, fig. 50.
It is possible that this diatom is only a portion of *P. johnsoniana* and there should be synonomous with the same.

Pyxilla prolungata Brun (1890-1893)
(Plate 11, Figures 4-6)

Description: Brun (1890-1893), p. 176, pl. 24, fig. 7.

Rhaphidodiscus marylandicus Christian (1887)
(Plate 11, Figure 8)

Description: Hanna (1932), p. 208-210, pl. 14, fig. 3, 4.

Rhaphoneis sp.
(Plate 11, Figures 9, 10)

Rhizosolenia barboi Brun (1894)
(Plate 11, Figure 13)

Description: Donahue (1970b), p. 136, pl. 1, fig. B-C (as *R. curvirostris* v. *inermes*). Schrader (1973), p. 709, pl. 24, fig. 4-7.

Nitzschia praeinterfrigidaria sp. nov.
(Plate 10, Figure 1)

Description: *Nitzschia praeinterfrigidaria* sp. nov.
Valves elliptical-linear with Raphe marginal. Valve surface incompletely striated by punctae, but with punctae more linearly organized than those of *N. interfrigidaria*. Valve margin ribbed but not as strongly as *N. interfrigidaria*. Length 25-40μ, width 7-10μ.

Pseudopyxilla americana (Ehr.) Forti (1909)
(Plate 10, Figures 2, 3, 11)

Description: Sheshukova-Poretskaya (1967), p. 227, pl. 39, fig. 2. Schrader (1973), p. 708, pl. 10, fig. 22.

Pterotheca carinifera Grunow (1880-1881) in Van Heurck
(Plate 10, Figure 4)

Description: Hanna (1927), p. 119, pl. 20, fig. 9, 10.

Pterotheca sp. 1
(Plate 10, Figures 8, 9)

Pterotheca sp. 2
(Plate 10, Figure 10)

Pyrogodiscus sp.
(Plate 10, Figures 5-7)

Rhizosolenia hebeta (Bail) Gran forma hiemalis Gran (1904)

Description: Hustedt (1930), p. 590-592, fig. 337. Schrader (1973), p. 709, pl. 9, fig. 11, 13-17, 19-21, 24, 25.

Rouxia antarctica Heiden and Kolbei (1928)
(Plate 12, Figure 3)

Description: Heiden and Kolbei (1928), p. 632, pl. 4, fig. 90. Hanna (1930), p. 185, pl. 14, fig. 8.

Rouxia california Peragallo in Tempere and Peragallo (1910)

Description: Hanna (1930), p. 186-188, pl. 14, fig. 6, 7. Schrader (1973), p. 710, pl. 3, fig. 18-20, 26.

Rouxia diploneides Schrader (1973)
(Plate 11, Figures 11, 12)

Description: Schrader (1973), p. 710, pl. 3, fig. 24, 25.
This diatom is apprently the same as described by Schrader, with the exception that the apical ends of this diatom are not as sharp as those illustrated by Schrader (1973).

Rouxia naviculoides Schrader (1973)
(Plate 11, Figures 14, 15)

Description: Schrader (1973), p. 710, pl. 3, fig. 27-32.

Rouxia peragalli Brun and Heribaud in Heribaud (1893)
(Plate 12, Figures 1, 2)

Description: Hanna (1930), p. 180-184, pl. 14, fig. 1, 5.

Stephanogonia hanzawae Kanaya (1959)
(Plate 12, Figure 6)

Description: Kanaya (1959), p. 118, pl. 11, fig. 3-7.

Stephanopyxis grunowii Grove and Strut in Schmidt (1888)
(Plate 12, Figures 9, 10)

Description: Reinhold (1937), p. , pl. 25, fig. 12a, b. Schmidt (1888), pl. 130, fig. 1.

Stephanopyxis appendiculata Ehrenberg (1854)
(Plate 12, Figure 7)

Description: Wornardt (1967), p. 17, pl. 1, fig. 12, 13.

Stephanopyxis turris (Grev. and Arn.) Ralfs in Pritchard (1861)
(Plate 12, Figure 4)

Description: Hustedt (1930), p. 304-305, fig. 140.

Stephanopyxis antiqua Pantocsek (1883)
(Plate 12, Figure 8)

Description: Wornardt (1967), p. 17, pl. 1, fig. 8.

Stephanopyxis barbadiensis (Greville) Grunow (1884)
(Plate 12, Figures 11-14)

Description: Reinhold (1937), p. , pl. 15, fig. 14. Schmidt (1888), pl. 130, fig. 6, 7, 9, 10.

Stephanopyxis inermes Jousé (1961)
(Plate 12, Figure 5)

Description: Jousé (1961), p. 60, pl. 1, fig. 2. Jousé (1959), pl. 2, fig. 13, 14.

Sticodiscus hardmanianus Greville (1865)
(Plate 13, Figures 1-4)

Description: Hanna (1927), p. 121, pl. 21, fig. 1.

Synedra jouseana Scheshukova-Poretskaya (1962)
(Plate 13, Figure 5)

Description: Sheshukova-Poretskaya (1970), p. 245, pl. 42, fig. 4a, b. Koizumi (1973), p. 833, pl. 6, fig. 17.

Thalassionema elegans Hustedt (1958)
(Plate 13, Figure 6)

Description: Hustedt (1958), p. 140, pl. 9, fig. 93.

Thalassiosira antarctica ? Comber (?)
(Plate 14, Figures 1, 2)

Description: Hustedt (1958), p. 108, pl. 3, fig. 1-3.

Thalassiosira gracilis (Karsten) Hustedt (1958)
(Plate 14, Figure 3)

Description: Hustedt (1958), p. 109, pl. 3, fig. 4-7.

Triceratium sp. ?
(Plate 14, Figures 4, 5)

Triceratium coscinoides Grove and Strut (1886)
(Plate 14, Figures 6, 7)

Description: Grove and Strut (1886), p. 327, pl. 19, fig. 13.

Triceratium inelegans ? Greville (1866)
(Plate 14, Figures 8, 9)

Description: Greville (1866), p. 8, pl. 2, fig. 21. Hanna (1932), pl. 17, fig. 1, 3. (as *T. condecorum*) Forti (1913), p. (68) 1616, pl. 9, fig. 8. (as *T. exornatum* v. *typicum*).

Triceratium pulvinar Schmidt (1888)
(Plate 14, Figure 10)

Description: Schmidt (1888), pl. 126.

Trinacria excavata Heiberg (1863)
(Plate 13, Figure 6)

Description: Hustedt (1930), p. 887, 888, fig. 532.

Trinacria pileolus (Ehr.) Grunow (1884)
(Plate 15, Figure 3)

Description: Hustedt (1930), p. 885, 886. fig. 529.

Xanthiopyxis acrolophra Forti (1913)
(Plate 15, Figures 4, 5)

Description: Forti (1913), p. , pl. , fig. 30. Kanaya (1959), p. 121, pl. 11, fig. 8. Hanna (1927), p. 124, pl 21, fig. 10, 11.

Xanthiopyxis globosa Ehrenberg (1844)
(Plate 15, Figures 6-9)

Description: Hanna (1932), p. 224, pl. 18, fig. 3.

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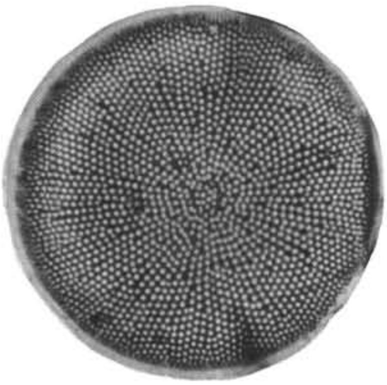
PLATE 1

Figures 1, 2	*Actinocyclus diviscus.* 1. Sample 266-2-2, 120-122 cm, diameter 67μ. 2. Sample 274-1-4, 80-82 cm, diameter 48μ.
Figures 3-6	*Actinopthycus undulatus* 3, 4. Sample 272-38, CC, diameter 43μ. 5, 6. Sample 274-20, CC, diameter 74μ.

PLATE 1



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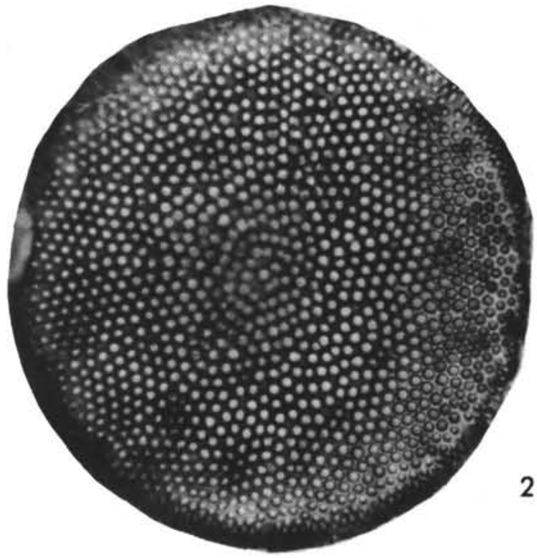

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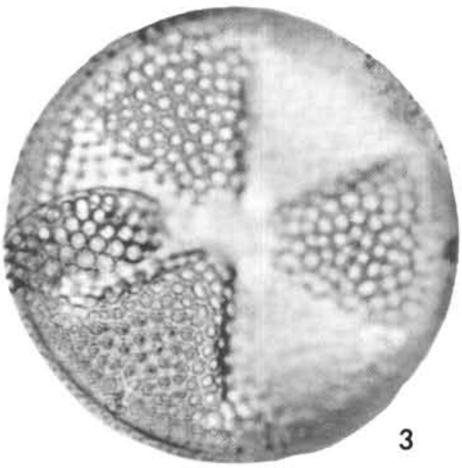

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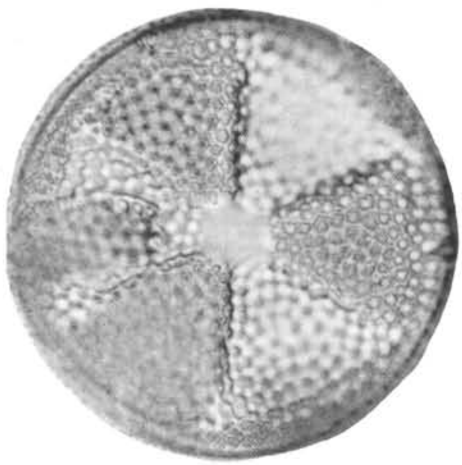

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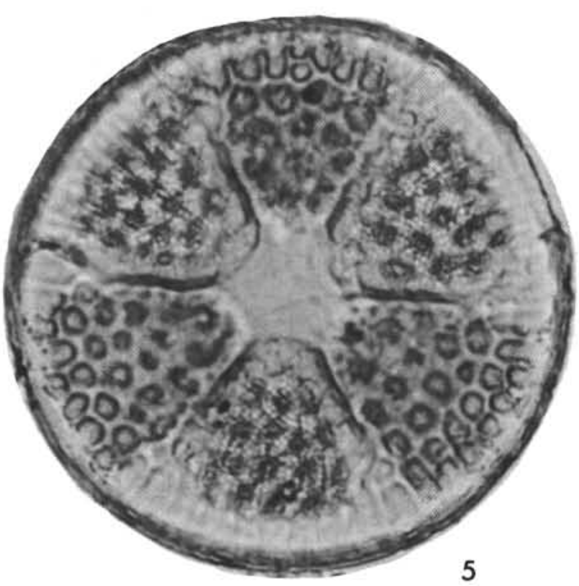

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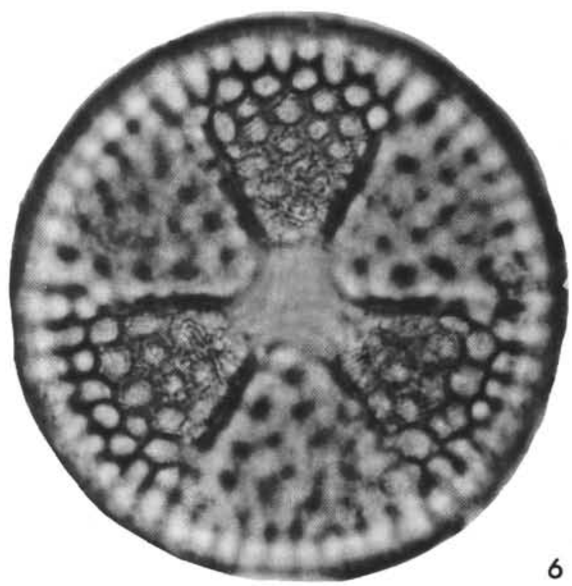

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PLATE 2

Figures 1, 2	*Asteromlampra affinis.* Sample 274-24-1, 58-60 cm, diameter 87μ.
Figures 3, 4	*Asteromlampra vulgaris.* Sample 274-22-1, 60-62 cm diameter 33μ.
Figures 5, 6	*Aulacodiscus brownii.* Sample 272-18, CC, diameter 89μ.

PLATE 2

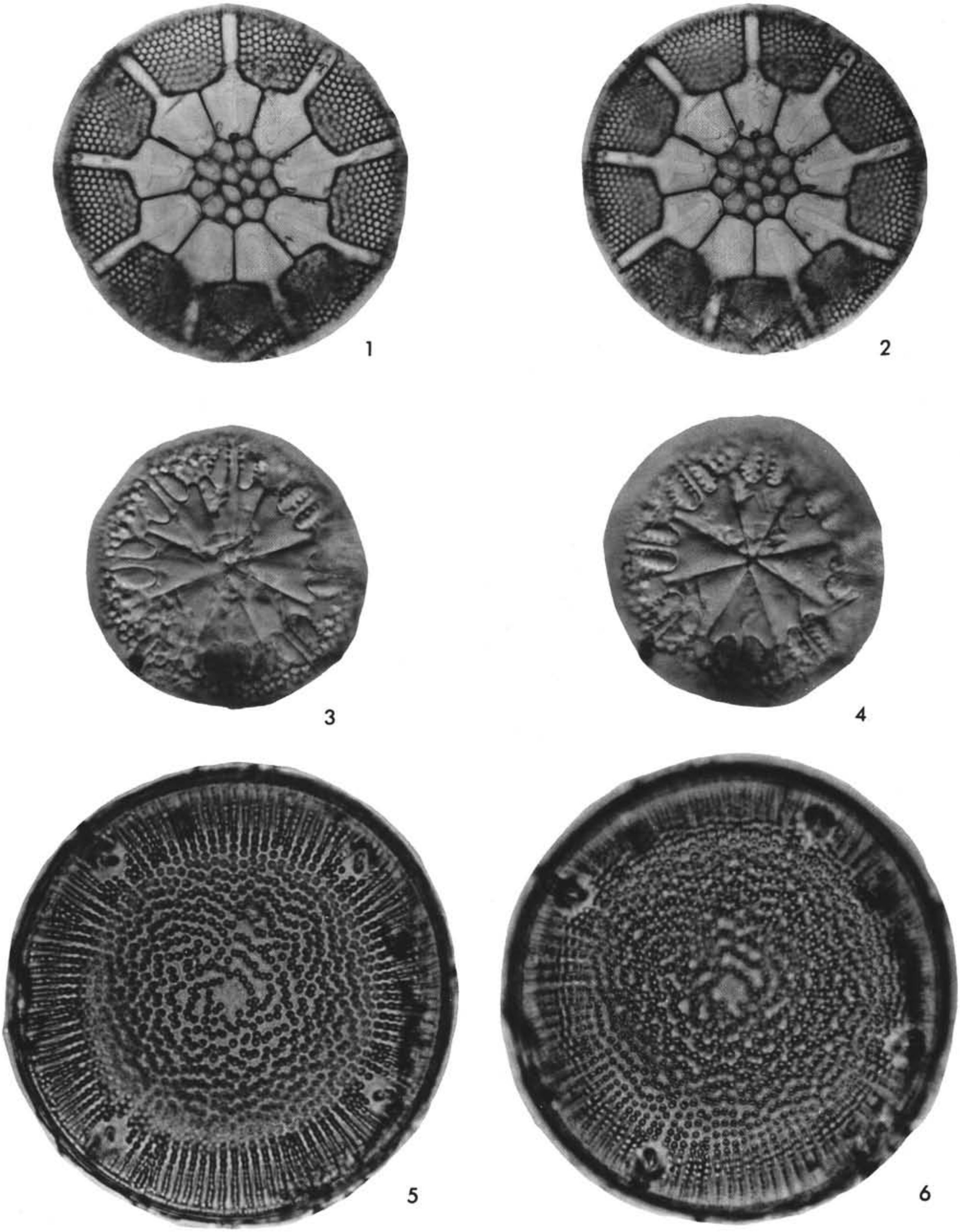


PLATE 3

Figures 1, 2	*Cestodiscus* sp. Sample 274-6, CC, diameter 50μ.
Figures 3-5	*Biddulphia angulata*?. Sample 274-20, CC, diameter 65μ.

PLATE 3

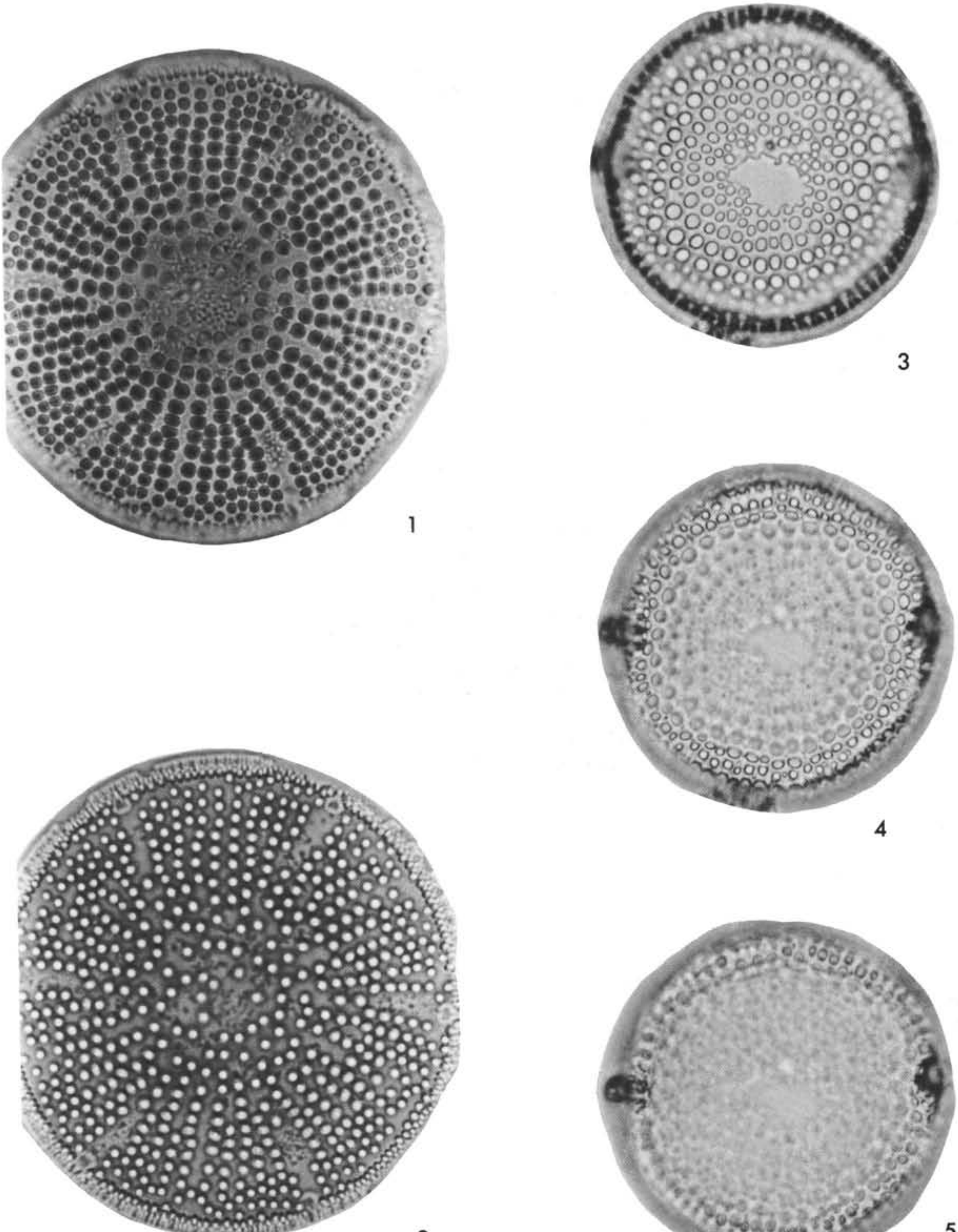


PLATE 4

Figures 1, 2	*Coscinodiscus apiculatus.* Sample 274-15, CC, diameter 89μ.
Figures 3, 4	*Coscinodiscus flexosus.* Sample 265-16, CC, diameter 22μ.
Figures 5, 6	*Coscinodiscus endoi.* Sample 265-16, CC, diameter 31μ.
Figures 7-9	*Coscinodiscus kolbei.* Sample 274-6, CC, diameter 77μ.

PLATE 4

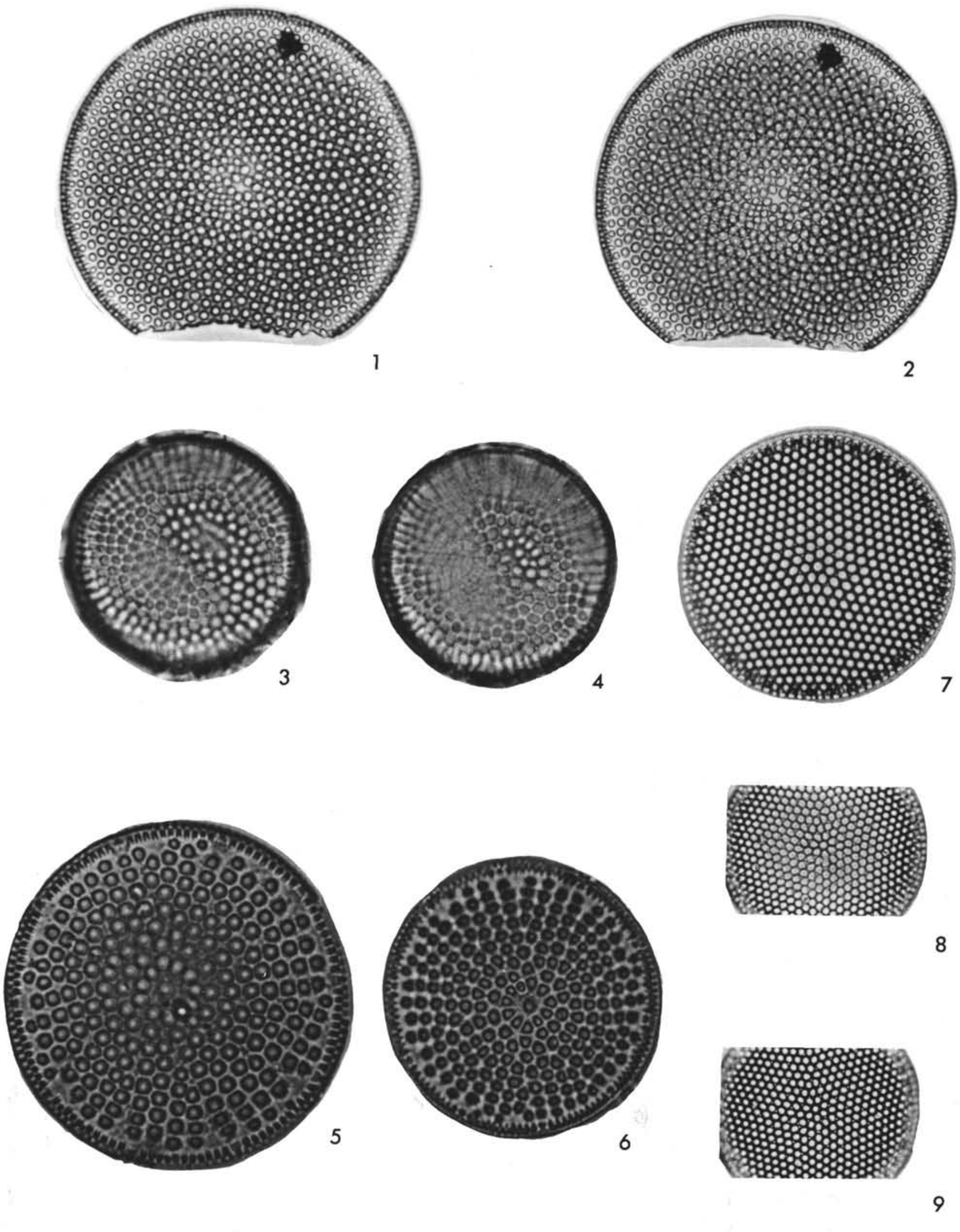


PLATE 5

Figure 1	*Coscinodiscus lentiginosus.* Sample 266-1-3, 70-72 cm, diameter 55μ.
Figures 2-4	*Coscinodiscus lewisianus.* 2, 3. Sample 266-14-2, 60-62 cm, diameter 58μ. 4. Sample 266-14-2, 60-62 cm, diameter 41μ.
Figure 5	*Coscinodiscus praelineatus.* Sample 274-22-1, 60-62 cm, diameter 50μ.
Figure 6	*Coscinodiscus obovatus.* Sample 266-5-4, 130-132 cm, length 67μ, width 48μ.
Figures 7, 8	*Coscinodiscus nodulifer.* Sample 274-23-1, 30-32 cm, diameter 37μ.

PLATE 5

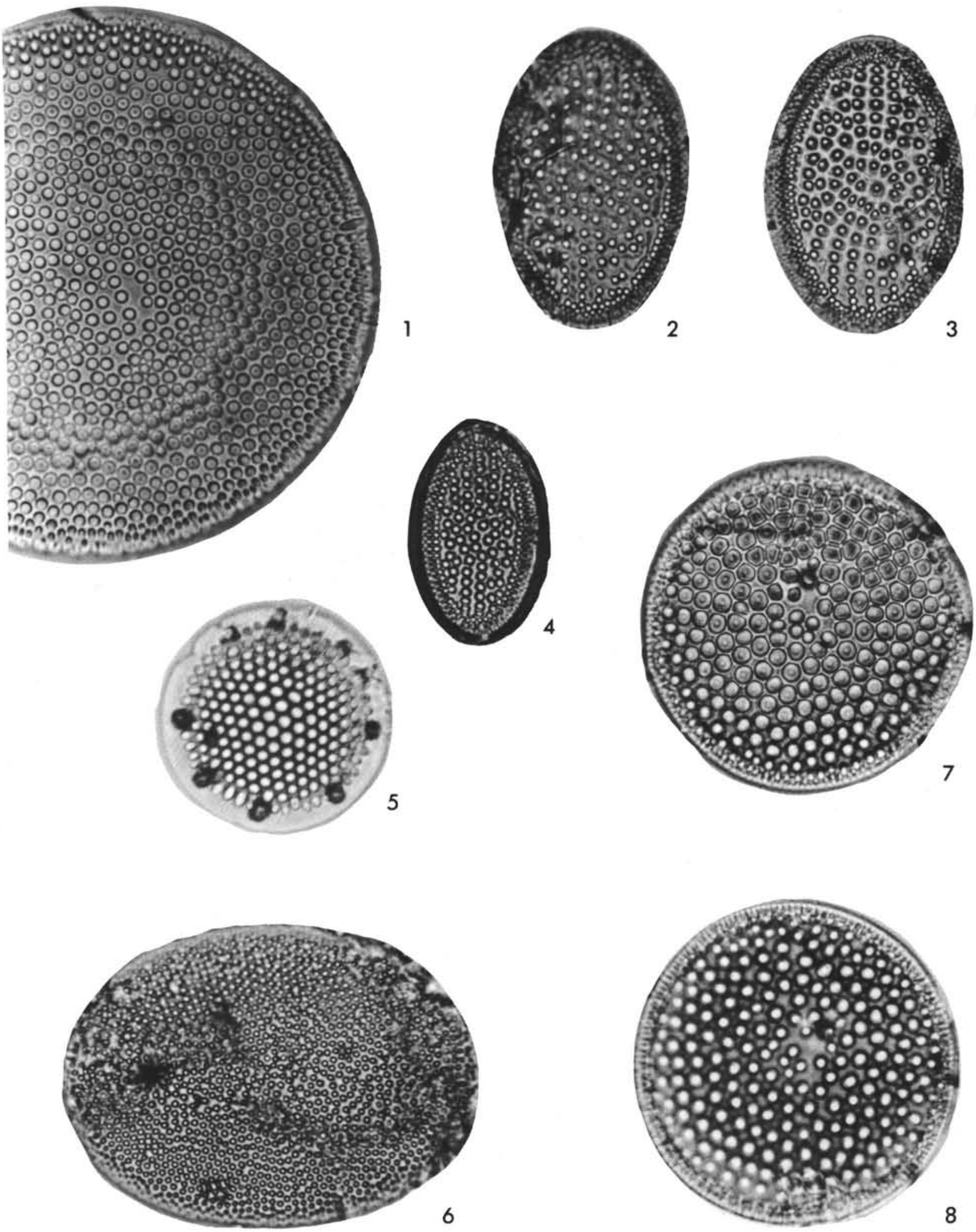
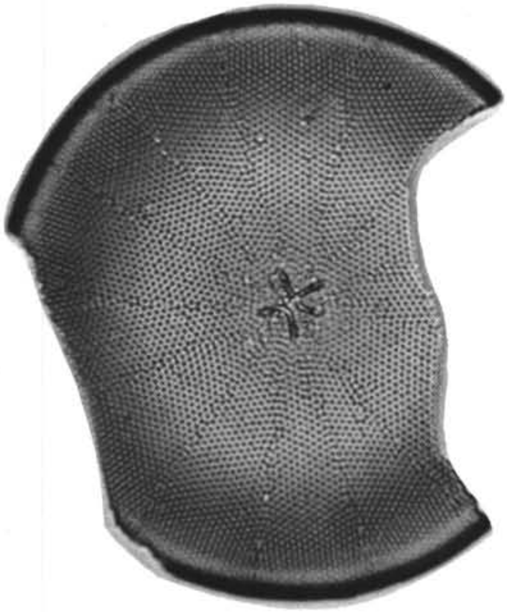


PLATE 6

Figures 1-3	*Coscinodiscus stellaris* v. *symbolophorus*. 1. Sample 274-19, CC, diameter 82μ. 2, 3. Sample 274-6, CC, diameter 50μ.
Figures 4-7	*Coscinodiscus vetutissimus*. Sample 266-17-5, 63-65 cm, diameter 70μ.

PLATE 6



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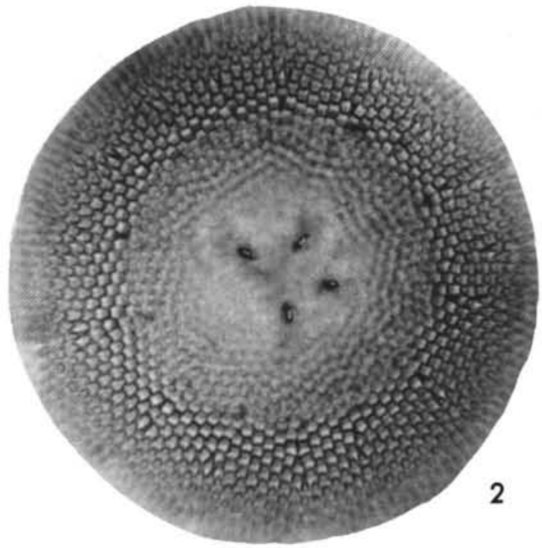

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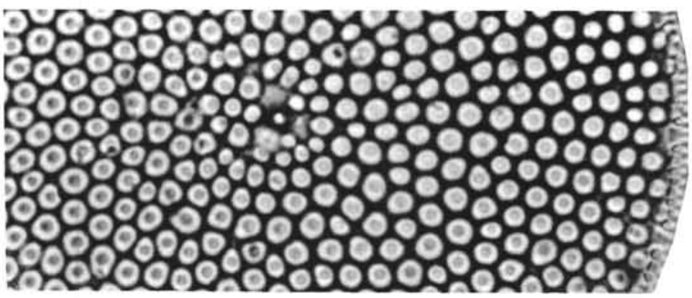

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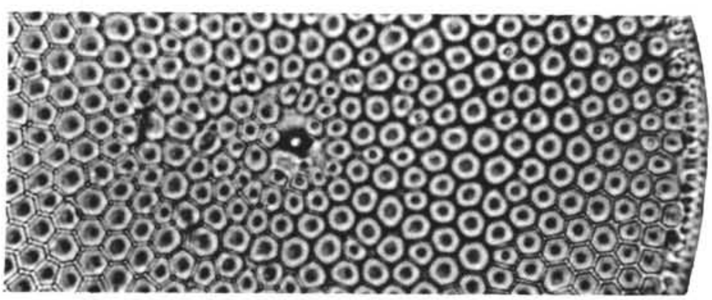

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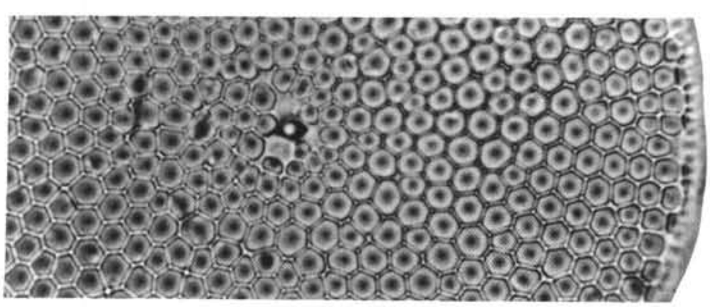

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PLATE 7

Figures 1-4 *Coscinodiscus* sp. 3.
Sample 274-6, CC, diameter 54μ.

PLATE 7

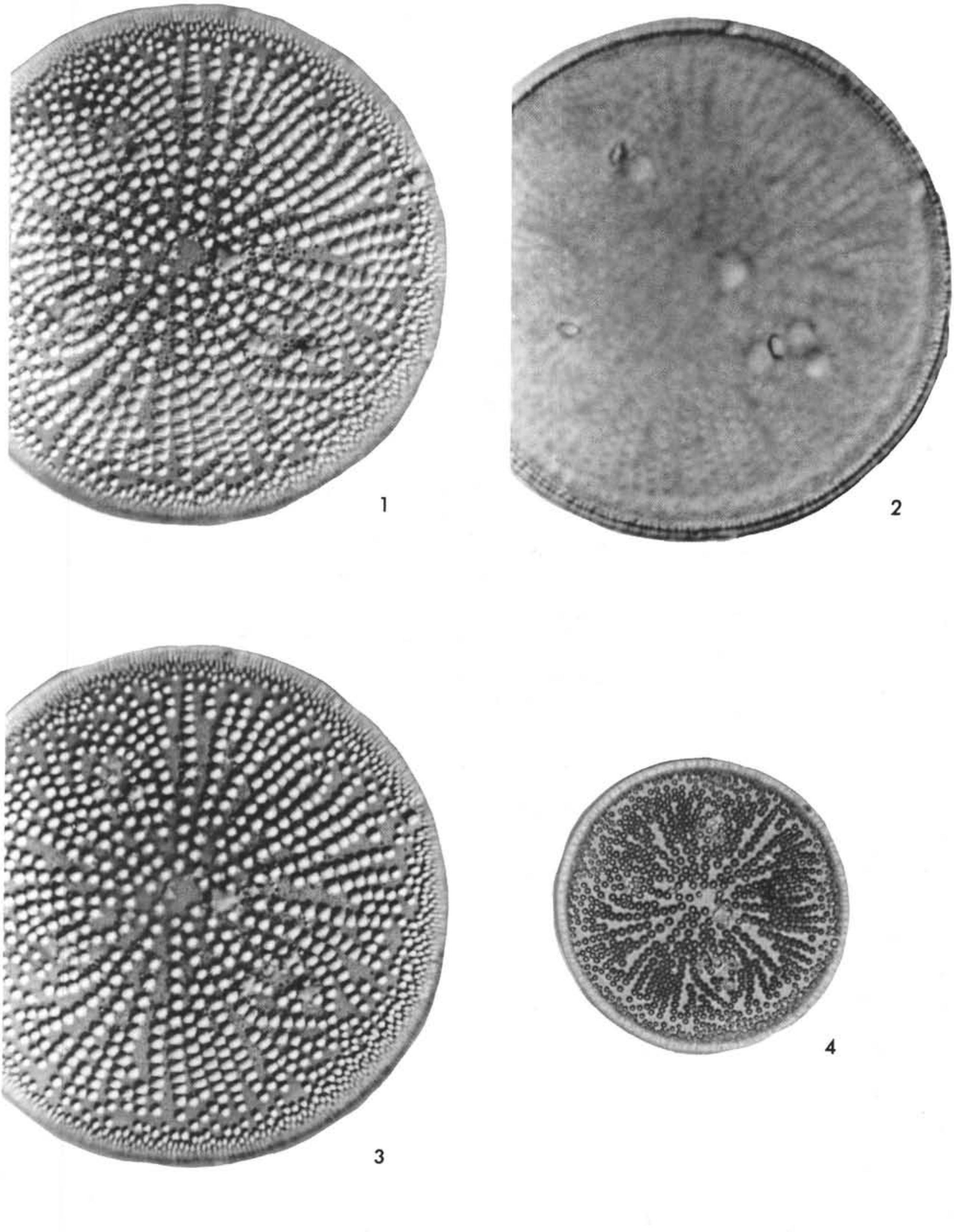

PLATE 8

Figures 1, 2	*Coscinodiscus* sp. 2. 1. Sample 274-6, CC, diameter 42μ. 2. Sample 274-6, CC, diameter 48μ.
Figure 3	*Coscinodiscus* sp. 1. Sample 266-19, CC, diameter 29μ.
Figure 4	*Cosmiodiscus intersectus.* Sample 271-16, CC, diameter 48μ.
Figure 5	*Cosmiodiscus insignis.* Sample 266-5-2, 130-132 cm, diameter 31μ.
Figures 6-10	*Denticula antarctica.* 6. Sample 274-15-1, 90-92 cm, length 45μ, width 7μ. 7, 8. Sample E 36-16, length 40μ, width 6μ. 9. Sample 274-15-1, 90-92 cm, length 47μ, width 7μ. 10. Sample E36-16, length 35μ.

PLATE 8

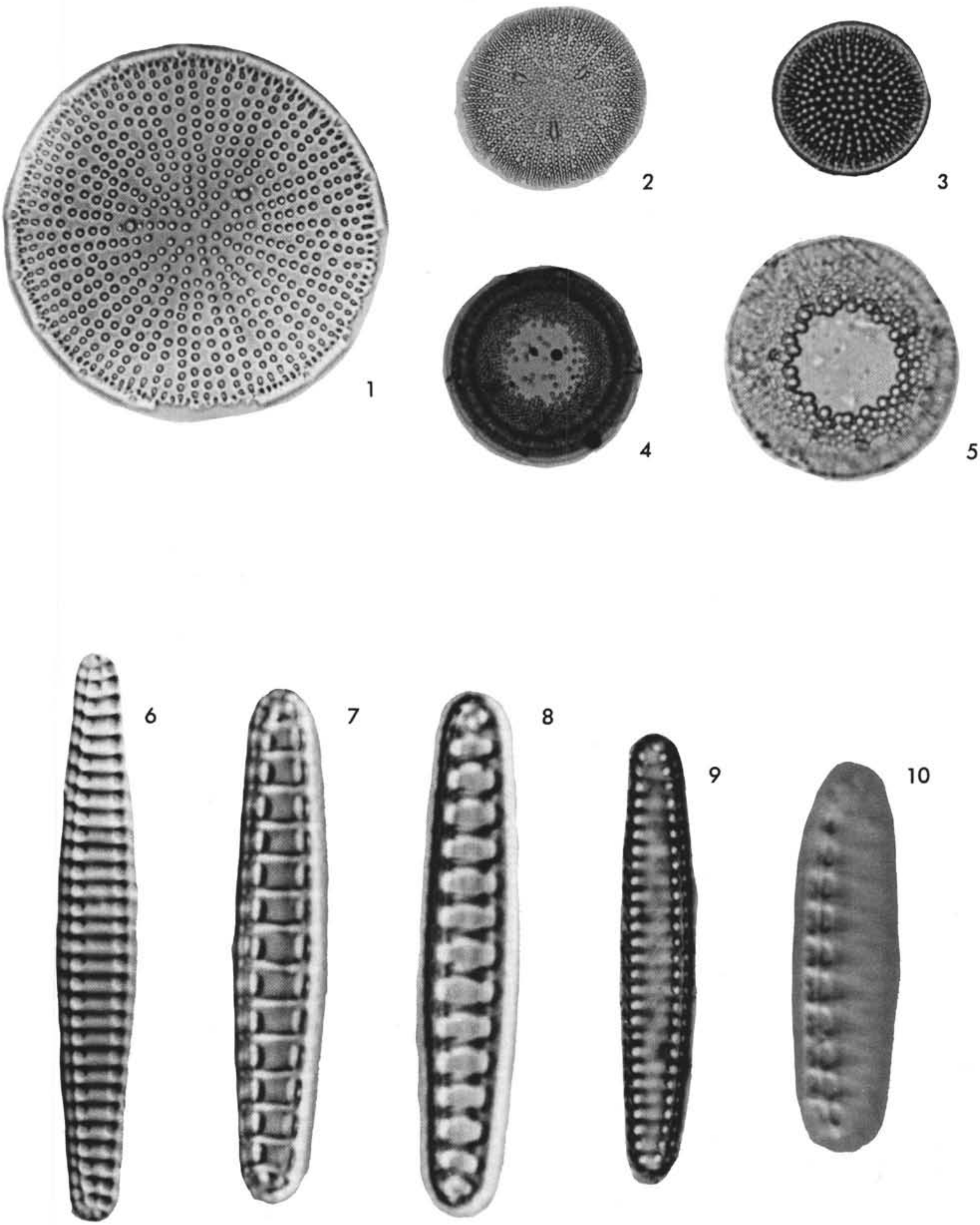

PLATE 9

Figure 1 — *Hemiaulus polymorphorus.*
Sample 274-20, CC, length 38μ, width 29μ.

Figure 2 — *Hemiaulus* sp.
Sample 274-20, CC, length 53μ, width 28μ.

Figures 3, 4 — *Hemidiscus karstenii.*
Sample 266-6-3, 120-122 cm, length 50μ, width 36μ.

Figures 5, 6 — *Liradiscus* sp.
5. Sample 274-9-3, 110-112 cm, length 19μ, width 9μ.
6. Sample 274-15-1, 90-92 cm, length 30μ, width 12μ.

Figures 7-9 — *Nitzschia interfrigidaria.*
7. Sample 266-6, 110-112 cm, length 34μ, width 8μ.
8. Sample 266-5, 120-122 cm, length 44μ, width 8μ.
9. Sample 266-5, 120-122 cm, length 47μ, width 7μ.

PLATE 9

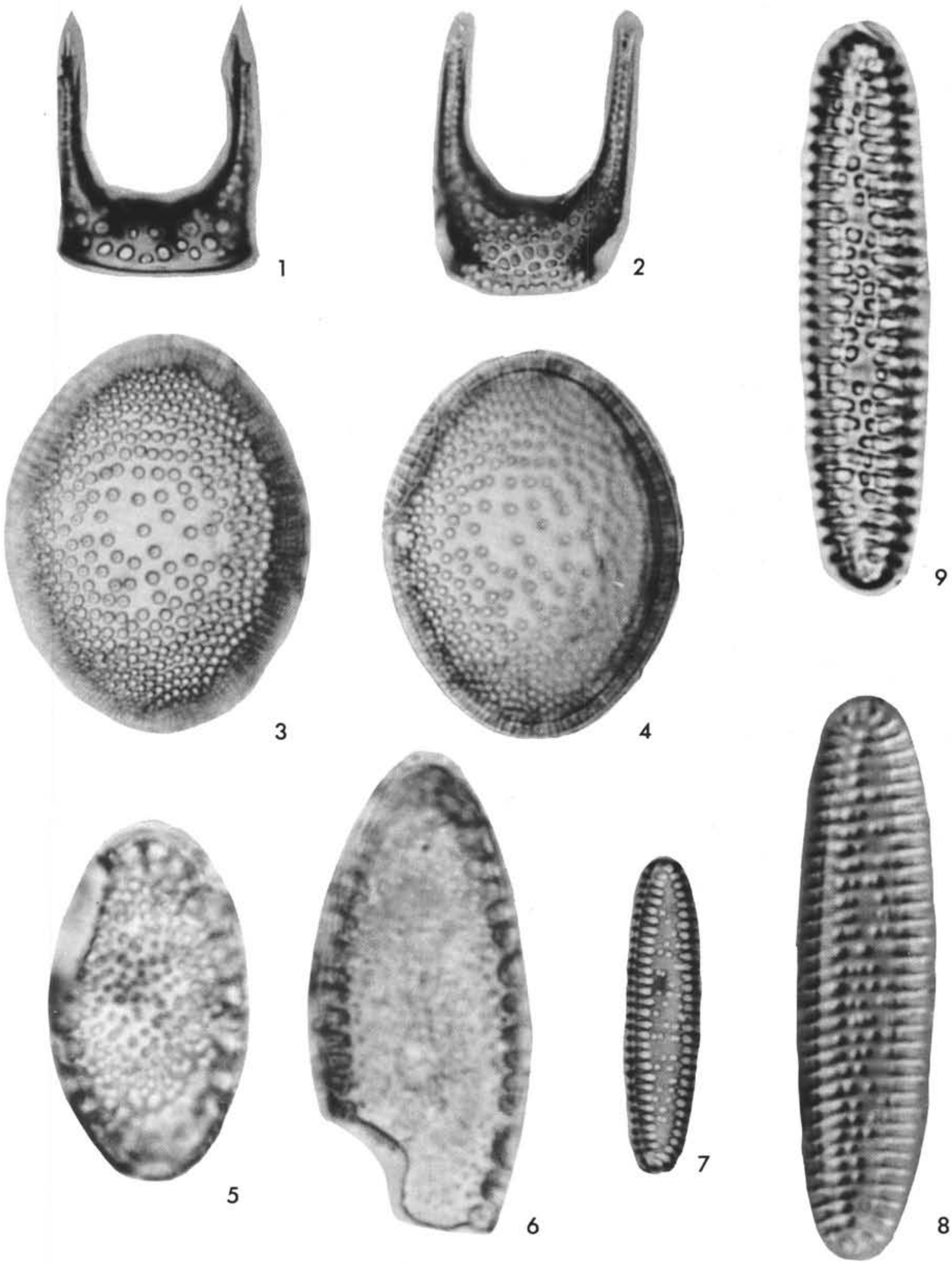

PLATE 10

Figure 1	*Nitzschia praeinterfrigidaria*. Sample 274-1, 130-132 cm, length 27μ, width 7μ.
Figures 2, 3, 11	*Pseudopyxilla americana*. 2, 3. Sample 274-20-6, 130-132 cm, length 53μ. 11. Sample 274-31, 30-32 cm, length 50μ.
Figure 4	*Pterotheca carinifera*. Sample 274-20-1, 145-147 cm, length 77μ.
Figures 5-7	*Pyrogodiscus* sp. Sample 274-20-1, 145-147 cm, diameter 36μ.
Figures 8, 9	*Pterotheca* sp. 1. Sample 274-30-1, 30-32 cm, length 80μ, width 11μ.
Figure 10	*Pterotheca* sp. 2. Sample 274-31-1, 30-32 cm, length 27μ, width 13μ.

PLATE 10

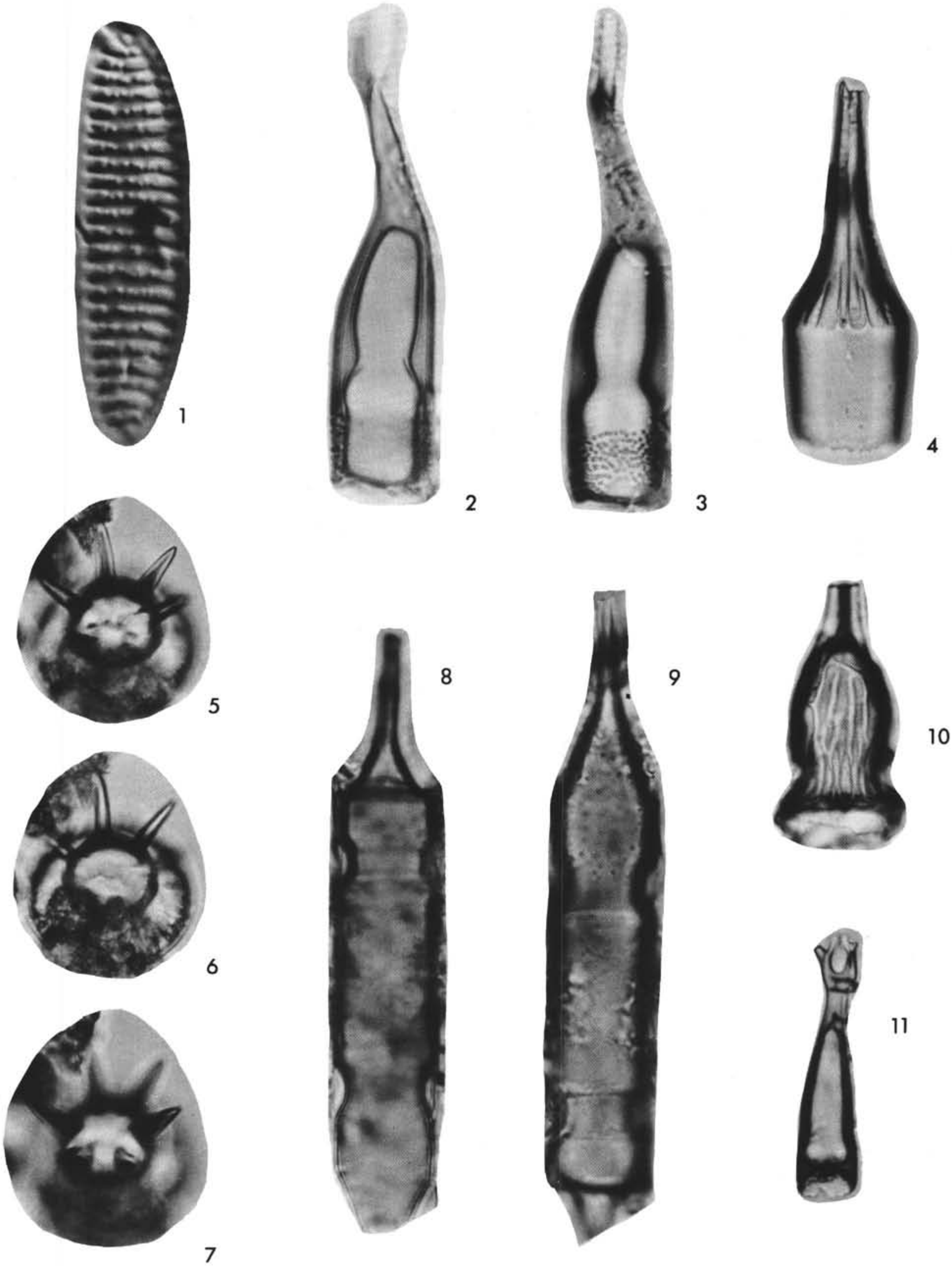

PLATE 11

Figures 1-3	*Pyxilla johnsoniana* v. corniculum. 1, 2. Sample 274-20, CC, length 79μ, width 22μ. 3. Sample 274-20-1, 145-147 cm, length 77μ, width 21μ.
Figures 4-6	*Pyxilla prolungata.* 4, 5. Sample 274-20, CC, length 65μ. 6. Sample 274-20, CC.
Figure 7	*Pyxilla reticulata.* Sample 274-22-1, 60-62 cm, length 16μ, width 15μ.
Figure 8	*Rhaphidodiscus marylandicus.* Sample 266-15-2, 60-62 cm, length 52μ, width 48μ.
Figures 9, 10	*Rhaphoneis* sp. 9. Sample 266-17-2, 60-62 cm, length 32μ. 10. Sample 266-17-2, 60-62 cm, length 28μ.
Figures 11, 12	*Rouxia diploneides.* Sample 274-6-2, 40-42 cm, length 67μ.
Figure 13	*Rhizosolenia barboi.* Sample 274-16-1, 78-80 cm, approximately 20μ.
Figures 14, 15	*Rouxia naviculoides.* Sample 266-6-4, 120-122 cm. 14. Length 21μ. 15. Length 20μ.

PLATE 11

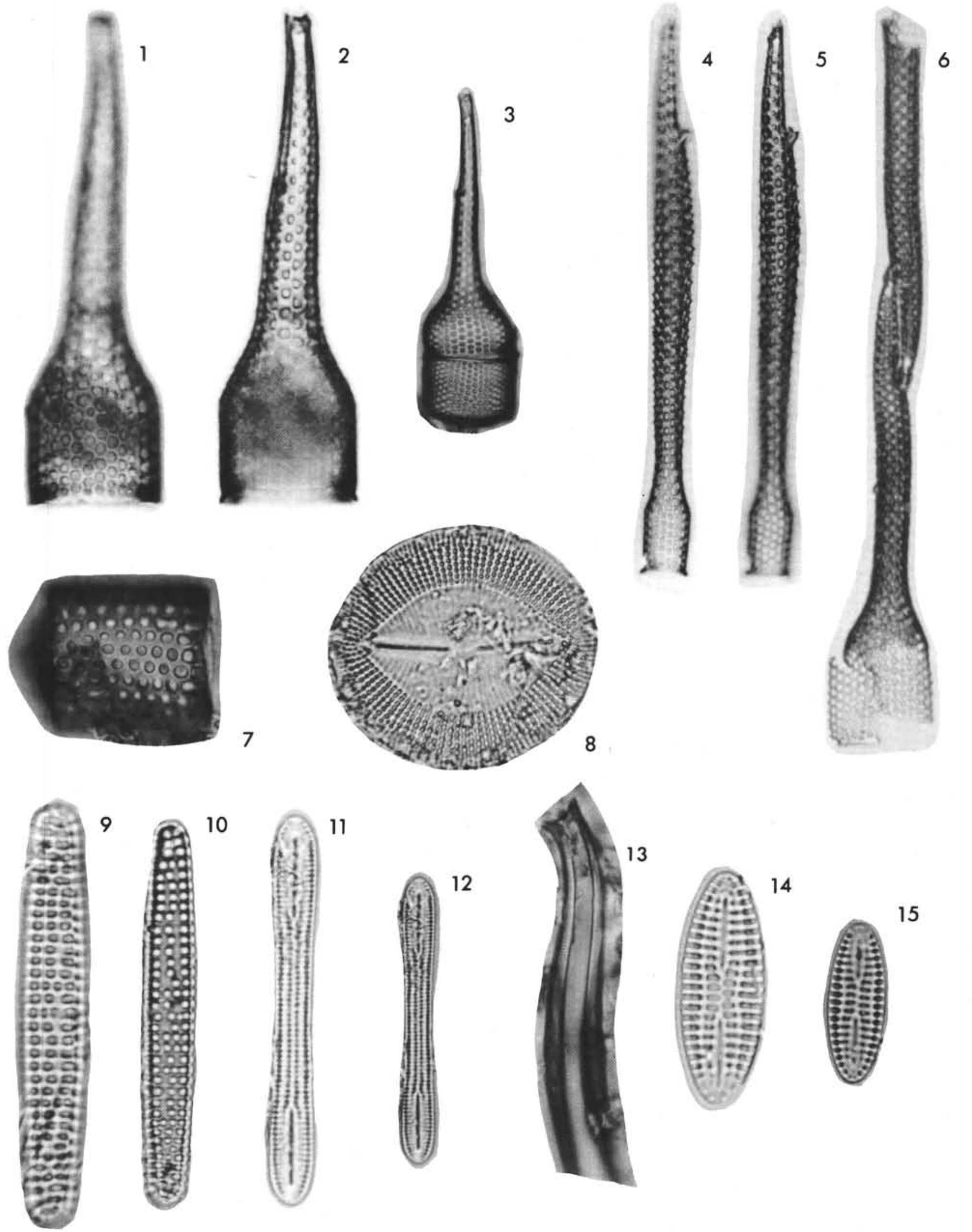

PLATE 12

Figures 1, 2	*Rouxia peragalli.* Sample 274-11-1, 140-142. 1. Length 32μ. 2. Length 50μ.
Figure 3	*Rouxia antarctia.* Sample 274-1-5, 80-82 cm, length 42μ.
Figure 4	*Stephanopyxis turris.* Sample 274-17, CC, length 29μ.
Figure 5	*Stephanopyxis inermes.* Sample 274-16, CC, length 38μ.
Figure 6	*Stephanogonia hanzawae.* Sample 274-10-6, 40-42 cm, diameter 15μ.
Figure 7	*Stephanopyxis appendiculata.* Sample 274-20, CC, diameter 48μ.
Figure 8	*Stephanopyxis antiqua.* Sample 274-20, CC, diameter 60μ.
Figures 9, 10	*Stephanopyxis grunowii.* Sample 274-20, CC, diameter 63μ.
Figures 11-14	*Stephanopyxis barbadiensis.* 11, 12. Sample 274-19, CC, length 38μ. 13, 14. Sample 274-18, CC, length 31μ.

PLATE 12

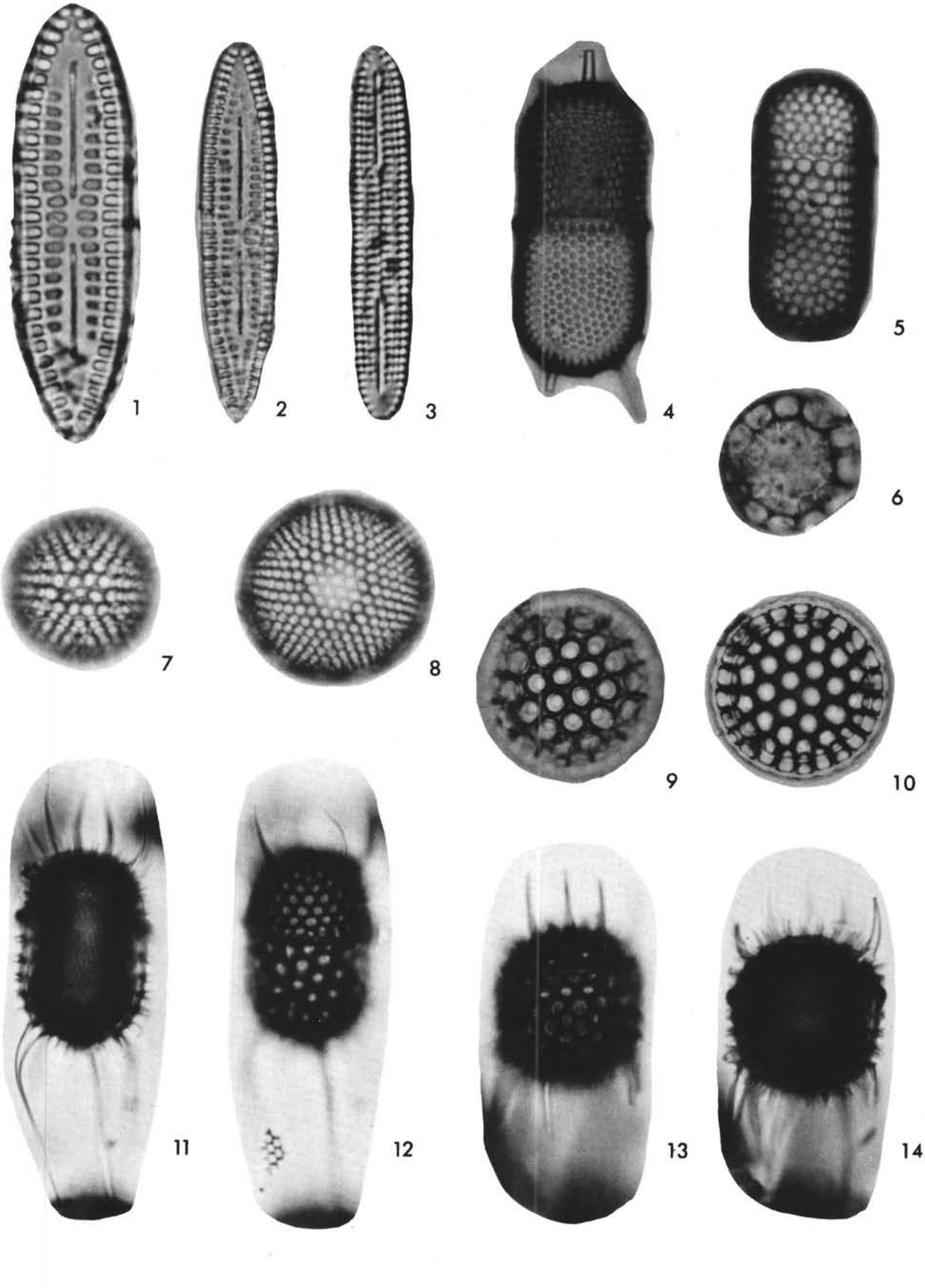

PLATE 13

Figures 1-4	*Sticodiscus hardmanianus.* Sample 274-26-1, 30-32 cm, diameter 55μ.
Figure 5	*Synedra jouseana.* Sample 266-14-2, 60-62 cm, length 77μ.
Figure 6	*Thalassionema elegans.* Sample 274-1-2, 95-97 cm, (broken specimen), length 63μ, width 5μ.

PLATE 13

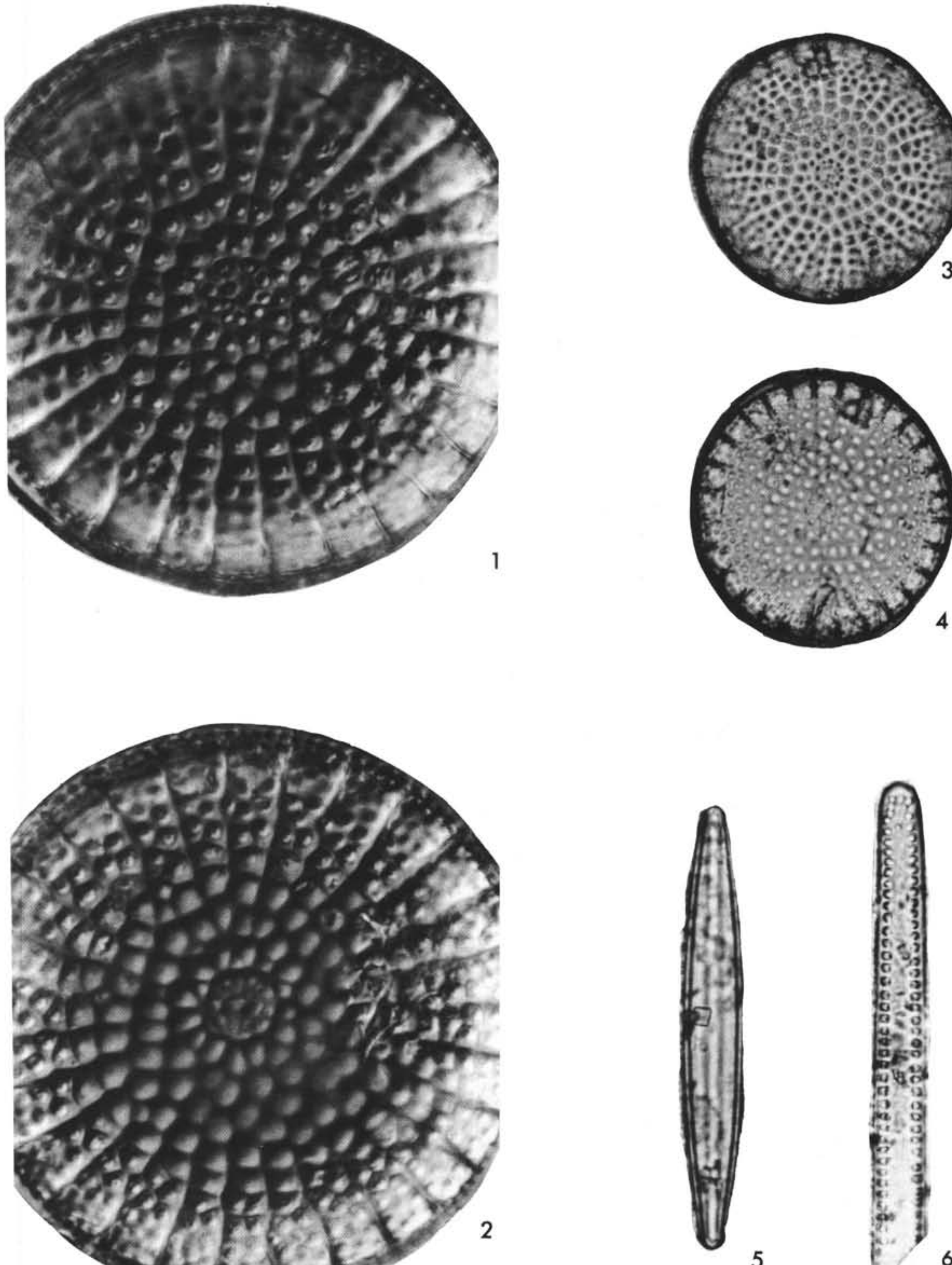

PLATE 14

Figures 1, 2	*Thalassiosira antarctica*?. Sample 274-1-2, 130-132 cm, diameter 91μ.
Figure 3	*Thalassiosira gracilis*. Sample 274-6, CC, diameter 53μ.
Figures 4, 5	*Triceratium* sp. Sample 274-28-1, 30-32 cm, length of side 53μ.
Figures 6, 7	*Triceratium coscinoides*. Sample 274-31, CC, length of side 72μ.
Figures 8, 9	*Triceratium inelegans*?. Sample 274-21-5, 80-82 cm. 8. Length of side 29μ. 9. Length of side 34μ.
Figure 10	*Triceratium pulvinar*. Sample 274-24-1, 58-60 cm, length of side 120μ.

PLATE 14

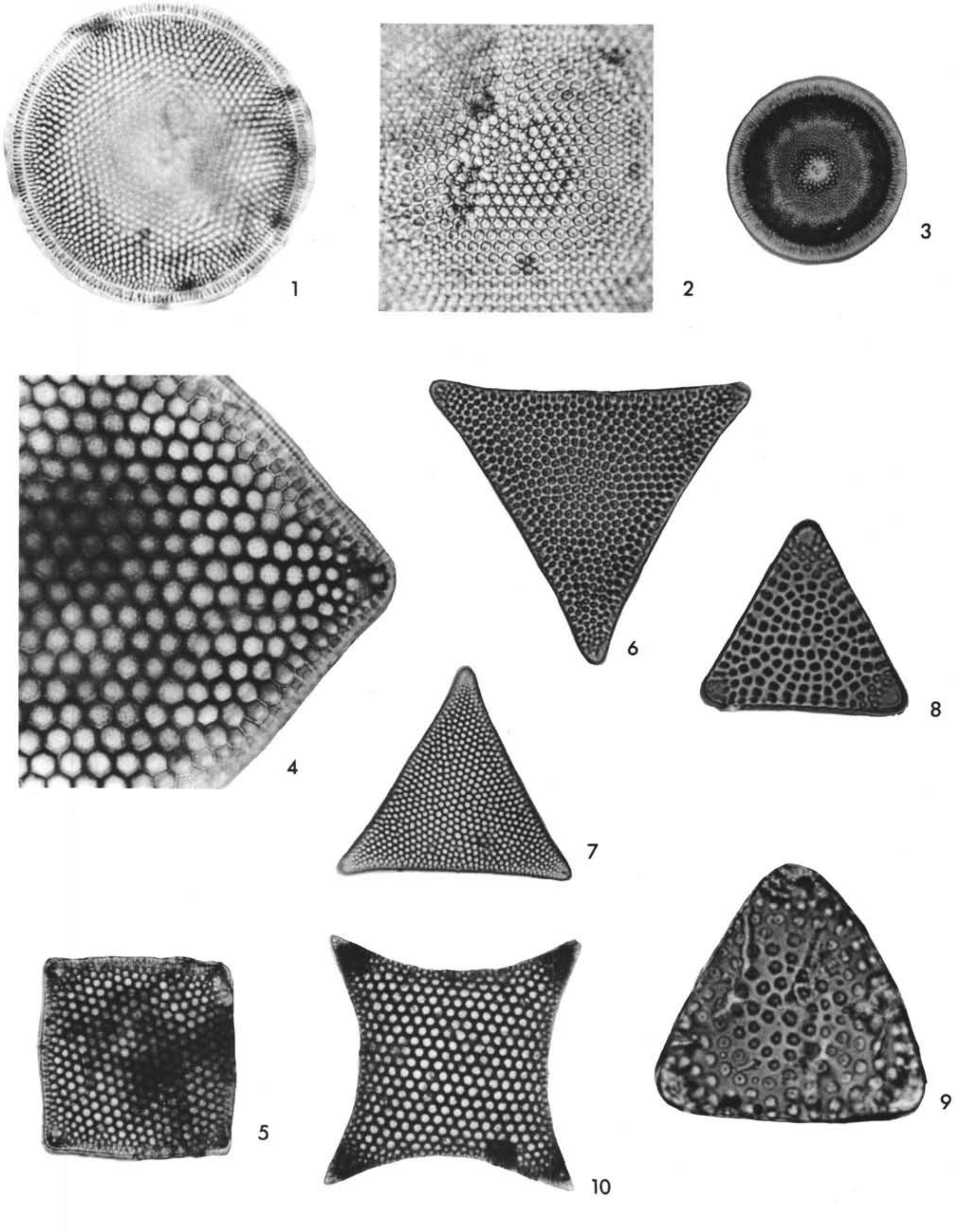

PLATE 15

Figures 1, 2	*Trinacria excavata.* 1. Sample 274-19, CC, length of side 72μ. 2. Sample 269-7, CC, length of side 90μ
Figure 3	*Trinacria pileolus.* Sample 274-19, CC, length of side 48μ.
Figures 4, 5	*Xanthiopyxis acrolophra.* Sample 274-20-1, 145-147 cm, length 43μ, width 21μ.
Figure 6-9	*Xanthiopyxis globosa.* Sample 274-31, CC. 7, 8. Length 31μ. 6, 9. Length 54μ.

PLATE 15

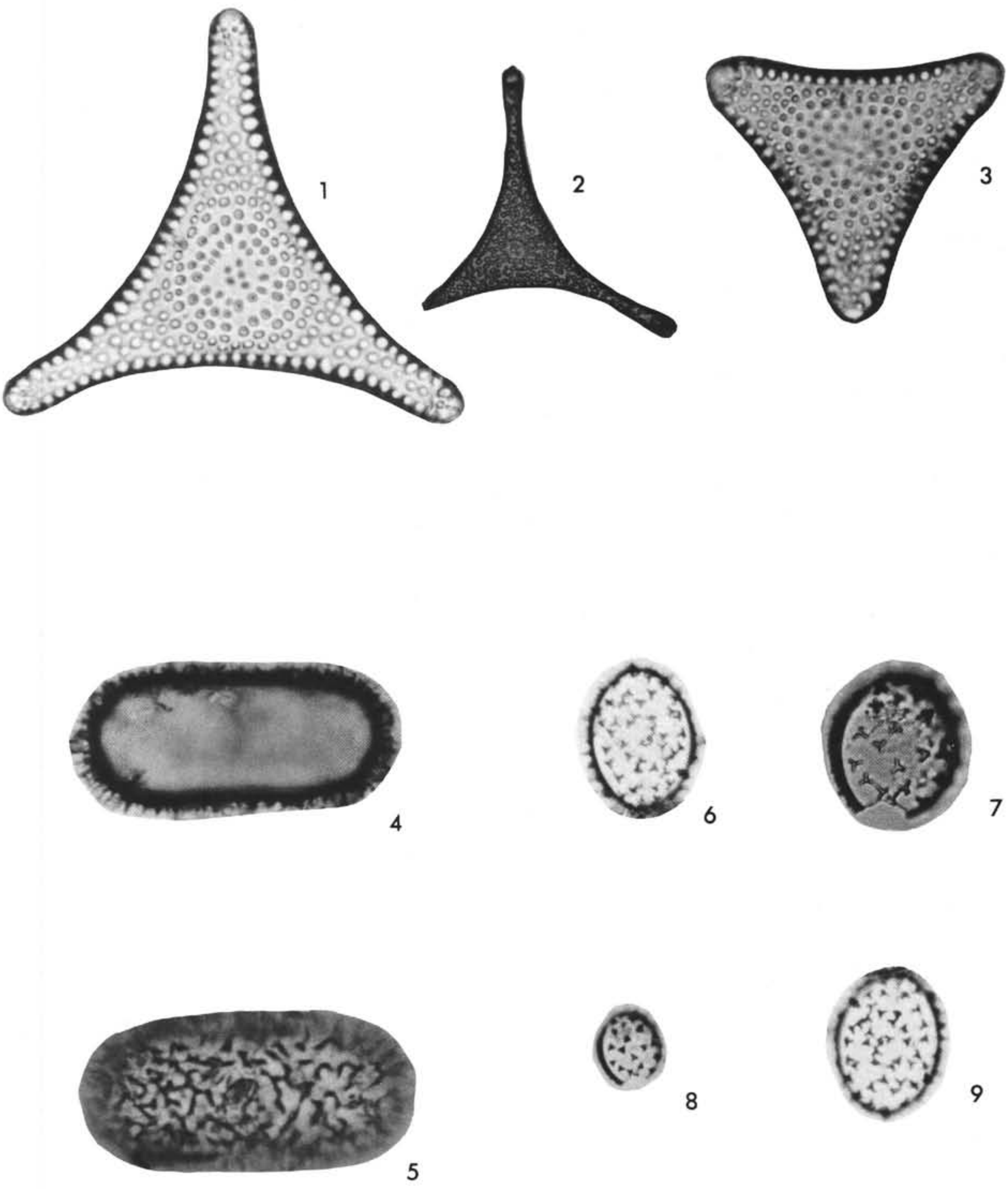

PLATE 16

Figure 1	*Coscinodiscus bullatus.* Sample 274-6, CC, diameter 83μ.
Figures 2, 3	*Coscinodiscus marginatus.* Sample E 13-17, 2050 cm., diameter 55μ.
Figures 4, 5	*Nitzschia reinholdii.* 4. Sample 266-7-3, 125-127 cm, length 50μ. 5. Sample 266-7-2, 120-122 cm, length 80μ.
Figures 6, 7	*Pterotheca carinifera.* Sample 274-20-1, 145-147 cm, length 77μ.
Figure 8, 9	*Eucampia balaustium.* 8. Sample 274-1-4, 130-132 cm, length 43, width 69μ. 9. Sample 274-1-2, 60-62 cm, length 19, width 23μ.
Figure 10	*Coscinodiscus elliptipora.* Sample E 14-8, 540 cm, diameter 55μ.

PLATE 16