INTRODUCTION

Leg 55 of the Deep Sea Drilling Project (DSDP) was proposed to drill a few holes on the Emperor Seamounts of the North Pacific Ocean. The plan had a special appeal to the author because deep-sea sediments recovered from this part of the North Pacific could be the "missing link" bridging the biostratigraphic zonation of silicoflagellates and ebridians previously recognized from high- and low- to middle-latitude areas (Ling, 1973, 1975). At the same time, such zonation in the eastern North Pacific region had been documented (Ling, 1977), and a similar study in the western counterparts was being concluded. Furthermore, biostratigraphic succession of these siliceous microplanktonic remains observed from submarine sequence had already been successfully applied to, and/or compared with, those on the land outcrops of the circum-North Pacific regions (Ling, 1977; Ling and McPherson, 1976). Leg 55 was significant further because no further drilling has been scheduled in this corner of the Pacific by the project until 1981, at the earliest.

With these considerations and the progress in this field as background, the D/V Glomar Challenger left Honolulu, Hawaii on 22 July 1977, and after having drilled 11 holes at four sites (Figure 1, Table 1), ended the cruise at Yokohama, Japan on 6 September 1977.

Methods involving laboratory preparation of these deep-sea sediments, such as the manner of recording the illustrated specimens in the strewn slides by using an England Finder, and reporting their relative abundances (A, abundant; C, common; F, few; R, rare) and states of preservation (G, good; F, fair; P, poor) are essentially the same as those of previous reports (Ling, 1973, 1975).

All the slides examined and described in this report will be deposited permanently in the Micropaleontological Collection, Department of Oceanography, University of Washington.

CENOZOIC SILICOFLAGELLATE AND EBRIDIAN BIOSTRATIGRAPHY OF THE WESTERN NORTH PACIFIC

As it has in almost all the other microplankton groups, our knowledge of temporal and spatial distribution of silicoflagellates and ebridians throughout the Cenozoic has been greatly advanced during the last decade. At the beginning of this decade, many earth scientists held doubts about the biostratigraphic potential for this group of siliceous microfossils. In sharp contrast, today there is a chapter dealing with silicoflagellates and ebridians, either singularly or jointly with other microfossils, in each volume of the Initial Reports.

Figure 1. Index map of the northwestern Pacific, showing sites drilled during Leg 55 of the Deep Sea Drilling Project.

In the North Pacific, biostratigraphic zonation of silicoflagellates and ebridians has been proposed, a more comprehensive treatment for the eastern part presented (Ling, 1977), and the westward extension of a similar study almost completed. The combination of these studies provides the working framework (Table 2) for analysis of submarine sediments from each drilled site during the cruise. Analyses of individual sites will be discussed later.

The locations of drilled sites in the western Pacific until Leg 33 are shown in Figure 2. The oldest silicoflagellate-bearing sediments from this part of the Pacific are upper Eocene. These sediments from Holes 165A and 166, are characterized by the occurrence of Corbisema bimucronata together with Corbisema hastata minor (Table 3). This assemblage is probably Dictyocha bimucronata Zone of Martini (1974), which is defined as "the interval from the last occurrence of Dictyocha spinosa (Deflandre) to the first occurrence of Mesocena apiculata (Schulz)," with DSDP Sample 65-1-8, CC of the equatorial Pacific as the reference locality. Martini further listed Dictyocha triacantha Ehrenberg, Pseudorocella barbadiensis Deflandre, and Phyllodictyocha schulzi Deflandre as common species for the zone. This
### TABLE 1
Coordinates of Drilling Sites and Coring Summary of DSDP Leg 55

<table>
<thead>
<tr>
<th>Hole</th>
<th>Latitude (N)</th>
<th>Longitude (E)</th>
<th>Water Depth (m)</th>
<th>Penetration (m)</th>
<th>Total Cored (m)</th>
<th>Meters Recovered</th>
<th>Recovery (%)</th>
<th>Cores</th>
<th>Meters Recovered</th>
<th>Recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>430</td>
<td>37°58.88'</td>
<td>170°35.45'</td>
<td>1464.0</td>
<td>14.0</td>
<td>3</td>
<td>14.0</td>
<td>7.90</td>
<td>56.4</td>
<td>3</td>
<td>14.0</td>
</tr>
<tr>
<td>430A</td>
<td>37°59.29'</td>
<td>170°35.86'</td>
<td>1485.5</td>
<td>118.0</td>
<td>11</td>
<td>85.5</td>
<td>16.83</td>
<td>19.7</td>
<td>4</td>
<td>34.0</td>
</tr>
<tr>
<td>430B</td>
<td>37°59.52'</td>
<td>170°36.12'</td>
<td>1492.0</td>
<td>3.0</td>
<td>1</td>
<td>3.0</td>
<td>0.10</td>
<td>3.3</td>
<td>1</td>
<td>3.0</td>
</tr>
<tr>
<td>431</td>
<td>42°25.44'</td>
<td>170°32.68'</td>
<td>1714.5</td>
<td>9.5</td>
<td>2</td>
<td>9.5</td>
<td>3.33</td>
<td>35.1</td>
<td>2</td>
<td>19.0</td>
</tr>
<tr>
<td>431A</td>
<td>42°25.39'</td>
<td>170°32.60'</td>
<td>1713.5</td>
<td>17.0</td>
<td>2</td>
<td>17.0</td>
<td>4.35</td>
<td>25.6</td>
<td>2</td>
<td>17.0</td>
</tr>
<tr>
<td>432</td>
<td>41°20.03'</td>
<td>170°22.74'</td>
<td>1320.0</td>
<td>74.0</td>
<td>5</td>
<td>38.0</td>
<td>15.92</td>
<td>42.4</td>
<td>2</td>
<td>19.0</td>
</tr>
<tr>
<td>432A</td>
<td>41°20.03'</td>
<td>170°22.74'</td>
<td>1320.0</td>
<td>74.0</td>
<td>5</td>
<td>38.0</td>
<td>15.92</td>
<td>42.4</td>
<td>2</td>
<td>19.0</td>
</tr>
<tr>
<td>433</td>
<td>44°46.60'</td>
<td>170°01.26'</td>
<td>1874.0</td>
<td>45.0</td>
<td>1</td>
<td>5.5</td>
<td>5.50</td>
<td>100.0</td>
<td>1</td>
<td>5.5</td>
</tr>
<tr>
<td>433A</td>
<td>44°46.60'</td>
<td>170°01.26'</td>
<td>1874.0</td>
<td>45.0</td>
<td>1</td>
<td>5.5</td>
<td>5.50</td>
<td>100.0</td>
<td>1</td>
<td>5.5</td>
</tr>
<tr>
<td>433B</td>
<td>44°46.63'</td>
<td>170°01.23'</td>
<td>1874.0</td>
<td>195.0</td>
<td>7</td>
<td>58.0</td>
<td>10.72</td>
<td>18.5</td>
<td>7</td>
<td>58.0</td>
</tr>
<tr>
<td>433C</td>
<td>44°46.63'</td>
<td>170°01.23'</td>
<td>1874.0</td>
<td>195.0</td>
<td>7</td>
<td>58.0</td>
<td>10.72</td>
<td>18.5</td>
<td>7</td>
<td>58.0</td>
</tr>
</tbody>
</table>

Total: 1209.0

### Soft Sediments

- Reef carbonate sands sandwiched between the flows.

### TABLE 2
Biostratigraphic Framework for Silicoflagellates in the North Pacific Region

<table>
<thead>
<tr>
<th>Chronostratigraphy</th>
<th>High Latitude (Ling, 1973, this paper)</th>
<th>Middle Latitude</th>
<th>Low Latitude (Ling, 1977, this paper)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>East North Pacific (Ling, 1977)</td>
<td>Japan Sea</td>
<td></td>
</tr>
</tbody>
</table>

- *Distephanus octangulatus*
- *Dictyocha suberecta*
- *Distephanus octocorallus*
- *Dictyocha suberecta*
- *Mesocena quadangula*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Distephanus limingii*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha brevispina*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha aspera aspera*

- *Mesocena circularis apiculata*
- *Dictyocha pseudobulla*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha brevispina*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha aspera aspera*

- *Corbisema triacanthus*
- *Dictyocha pseudobulla*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha brevispina*

- *Ammadiacum rectangular *
- *Etricotheca antiqua antiqua*
- *Dictyocha aspera aspera*

**Note:** Symbols are those used in Figures 3–12.

---

**Figure 2.** Locations of drilled sites during DSDP Leg 55 in the western North Pacific. Solid circles indicate where cured sediments were examined for silicoflagellates and ebridians; number of samples analyzed from site during investigation shown in parentheses and italicized.
TABLE 3
Silicoflagellates and Ebridians from Sediments Bearing Corbisema bimucronata in the Western North Pacific, Holes 165A and 166

<table>
<thead>
<tr>
<th>Hole</th>
<th>Sample (Interval in cm)</th>
<th>Corbisema bimucronata</th>
<th>Corbisema triacantha</th>
<th>Ebridia antiqua</th>
<th>Ebidia antennata</th>
<th>Corbisema bimucronata</th>
</tr>
</thead>
<tbody>
<tr>
<td>165A</td>
<td>7-2, 120-121</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>7-4, 120-121</td>
<td>R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>7-6, 119-120</td>
<td>R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>8-2, 119-120</td>
<td>F</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>8-4, 119-120</td>
<td>R + R + C</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>8-6, 120-121</td>
<td>R + R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>9-1, 50-51</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>166</td>
<td>10-5, 120-121</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12-1, 30-31</td>
<td>+ C</td>
<td>C</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12-4, 120-121</td>
<td>R + C</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>12-6, 120-121</td>
<td>R R F</td>
<td>F</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>13-2, 120-121</td>
<td>R R R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>13-4, 120-121</td>
<td>R R R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>13-6, 120-121</td>
<td>+ + R R</td>
<td>R</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>14-2, 120-121</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Note: R = rare; F = few; C = common, + = present.

zone is correlated with the lower part of the NP 20 (Sphenolithus pseudoradians) Zone. Later, the Dictyocha bimucronata Zone, on the basis of results of the Leg 38 investigation (Norwegian Sea), was amended to include "...from the first occurrence of Dictyocha quadria (Mandra) to the first occurrence of Mesocena apiculatae." The zone included Corbisema apiculata (Lemmermann), Mesocena oamaruensis (Schulz), Navi- culopsis pontica (Perch-Nielsen), and Corbisema flexuosa (Stradner) as the common species (Martini and Müller, 1976). The zone was then correlated with NP 17 (Discoaster saipanensis) and NP 18 (Chiasmolithus oamaruensis) (calcareous nannoplankton) zones. It should be noted here that, besides the occurrences of Corbisema bimucronata and Corbisema triacantha (=Dictyocha triacantha), the western North Pacific assemblage lacks all of the above common species. Furthermore, no such silicoflagellate assemblage was recognized from the eastern Pacific submarine deposits.

The Oligocene through lower Miocene section can be regarded for practical purposes as barren of this group of microfossils.

The combined Neogene biostratigraphic zonation is presented here (see Table 2), and the definition of the zones has been presented in previous articles. The occurrence of each zone, or its coeval section recognized from the examined site, is shown in ascending order in Figures 3 through 12. As in the previous eastern Pacific study, the latitudinal orientation for their distribution is apparent.

Silicoflagellate and Ebridian Occurrence at Each Site

Although a total of 11 holes was drilled in four seamounts during the cruise, the recovery of soft sediments was disappointingly low (see Table 1) apparently because all the drilling was attempted on top of the seamounts.

Site 430

Among the three holes drilled into what appeared to be a lagoonal sediment pond of Ojin Seamount, only surface samples from Hole 430B (Sample 1-1, 0-3 cm) contained well-preserved and abundant silicoflagellates of a modern assemblage of the middle latitude region.
Site 431

Although two holes were drilled into a faulted terrace on the east side of the newly proposed Yōmei Seamount (Dalrymple, personal communication), this group of siliceous microplanktonic remains was completely absent from the cored deep-sea sediments.

Site 432

Among the sediments cored from two holes of the presumed perched terrace deposits on the top of Nintoku Seamount, well-preserved but rare Dictyocha mes-sanensis specimens were recovered.

Site 433

It was only at this re-entry site that well-preserved and generally common to abundant silicoflagellates and ebridians were finally encountered. The drill holes were located in a complexly deformed marginal structural basin associated with a fairly extensive lagoonal complex on the top of Suiko Seamount.

Hole 433

One sample, 1-1, 75–77 cm (0.7 m), was barren of this group of siliceous microfossils, but Sample 1-2, 10–13 cm (1.6 m) belongs to the Distephanus octonarius Zone, and Sample 1-2, 113–115 cm (2.6 m) is recognized as belonging to the Ebriopsis antiqua antiqua Zone. Thus, the lower Pleistocene Dictyocha subarctios and upper Pliocene Ammodochium rectangulare zones were apparently not encountered. From Sample 1-3, 94–97 cm (3.9 m) down to 1, CC, the bottom of this hole belongs to the lower Pliocene Distephanus jimlingii Zone (Table 4).
Hole 433A

Although Samples 1-1, 4-13 cm (about 0.1 m) and 1-1, 23-25 cm (0.2 m) failed to yield either silicoflagellates or ebridians, the sediments are considered to be upper Pleistocene, on the basis of co-occurring radiolarians (Ling, this volume) and diatoms (Koizumi, this volume). One sample, 1-1, 70-73 cm (0.7 m), is identified as belonging to the Ebriopsis antiqua antiqua Zone, and is characterized by the occurrence of nominated species. This would suggest an unconformity encompassing an interval from lower Pleistocene to at least upper Pliocene.

The uppermost occurrence of Distephanus quinquangellus, in Sample 4-1, 13-15 cm (24 m) marks the top of the Miocene as observed in high latitude areas of the North Pacific (Ling, 1973) and the Japan Sea (Ling, 1975).

Although rare, the presence of Corbisema triacantha below Sample 6-6, 140-142 cm (51.9 m), through Core 7 (62 m), probably suggests the middle Miocene Corbisema triacantha Zone (Table 5). Neither silicoflagellates nor ebridians were found in sediments below Core 8 (62 m).

Hole 433B and 433C

Both silicoflagellates and ebridians were completely absent from drilled sediments of these two holes.

TAXONOMIC REFERENCE LIST

Silicoflagellates and ebridians from the sediment samples of the western North Pacific region have recent-
TABLE 4
Silicoflagellate and Ebridian Species Distribution, Abundance, and Preservation, Hole 433

<table>
<thead>
<tr>
<th>Sample (Interval in cm)</th>
<th>Abundance</th>
<th>Preservation</th>
<th>Distephanus octangularis</th>
<th>Ebriopsis antiqua antiqua</th>
<th>E. b. rectangulare</th>
<th>Ebriopsis antiqua cornuta</th>
<th>Distephanus jimlingii</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1, 75-77</td>
<td>-</td>
<td>-</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td></td>
<td></td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
</tr>
<tr>
<td>1-2, 10-13</td>
<td>R</td>
<td>M</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td></td>
<td></td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
</tr>
<tr>
<td>1-3, 94-97</td>
<td>R</td>
<td>M</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td></td>
<td></td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
</tr>
<tr>
<td>1-4, 10-12</td>
<td>F</td>
<td>M</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td></td>
<td></td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
</tr>
<tr>
<td>1,CC</td>
<td>R</td>
<td>M</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
<td></td>
<td></td>
<td>Diictyocha (Schulz), Bukry, 1975, p. 854, pl. 1, fig. 10.</td>
</tr>
</tbody>
</table>

Note: R = rare; F = few; + = present; M = moderate.

Acknowledgments

I was pleased to have the opportunity to participate in the three cruises of the North Pacific Ocean, and sincere appreciation is extended to the Deep Sea Drilling Project for inviting me to be a shipboard scientist. The operation of the project was funded by the National Science Foundation and a part of the research was supported through an NSF grant (OCE75-2043).

Special thanks are due to my wife Su Yu Lee and children, Dorothy and Richard, for their utmost understanding and cheerful endurance of three long summer sessions.

REFERENCES


### TABLE 5
Silicoflagellate and Ebridian Species Distribution, Abundance, and Preservation, Hole 433A

| Sample (Interval in cm) | Abundance | *Distephanus fimbriatus* | *Diseroparia antiqua antiqua* | *Ehriopsis triacantha* | *Ehriopsis antiqua antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua rectangula* | *Ehriopsis antiqua comata* | *Ehriopsis antiqua jinglingi* | *Ehriopsis antiqua* | *Ehriopsis antiqua supera* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriopsis antiqua* | *Ehriops
H. Y. LING

PLATE 1
(Magnification 500× unless otherwise indicated.)

Figures 1-3  *Corbisema bimucronata*
1. 2. 165A-8-4, 119-120 cm, L-2 (H36/0)
3. 165A-8-4, 119-120 cm, L-2 (S9/4)

Figures 4-6  *Corbisema hastata minor*
4. 165A-8-4, 119-120 cm, L-2 (E12/1)
5, 6. 165A-8-4, 119-120 cm, L-2 (U33/0)

Figure 7  *Dictyocha brevispina* 65-13, 120-121 cm, L-2 (N18/0)

Figures 8, 9  *Dictyocha* sp. ct. *D. calida*
8, 9. 310-3-2, 118-119 cm, L-2 (Y15/0)

Figure 10  *Dictyocha mandrai* 303-1-1, 100-101 cm, L-2 (L38/2)

Figure 11  *Dictyocha subarctios* 310-3-2, 118-119 cm, L-2 (F15/2)

Figures 12, 13  *Distephanus* sp. cf. *D. quinquangularis.*
12, 13. 303-4-6, 120-121 cm, L-2 (O10/4)

Figure 14  *Mesocena circulus* 303-2-6, 100-101 cm, L-2 (U10/1)

Figure 15  *Mesocena quadrangula* 303-3-2, 52-53 cm, L-2 (H12/3)

Figure 16  *Naviculopsis iberica* 303-4-6, 120-121 cm, L-2 (T8/1)

Figures 17-19  *Ebriopsis crenulata*
17, 18. 165A-8-4, 119-120 cm, L-2 (H36/0), ×800
19. 166-12-1, 30-31 cm, L-2 (R29/3), ×800
PLATE 1
PLATE 2
(Magnification 500 × unless otherwise indicated.)

Figure 1  *Dictyocha aspera aspera* 433A-31, 13–15 cm, L-2 (U39/3)

Figure 2  *Dictyocha rhombica*

Figure 3  *Dictyocha ausonia* 433A-4-5, 10–12 cm, L-2 (Q7/0)

Figure 4  *Dictyocha aspera clinata* 433A-4-2, 5–7 cm, L-2 (F9/3)

Figure 5  *Dictyocha fibula* 433A-6-5, 90–92 cm, L-2 (U5/0)

Figures 6, 7  *Distephanus jimlingii*

6. 433A, 1 CC, L-2 (X33/0)

7. 433A, 3-3, 13–15, L-2 (Y9/2)

Figure 8  *Distephanus crux* 433A-7-1, 80–82 cm, L-2 (S7/0)

Figure 9  *Distephanus octangulatus* 303-1-1, 100–101 cm, L-2 (R21/0)

Figure 10  *Distephanus quinquangellus* 433A-4, CC, L-2 (T3/0)

Figure 11  *Distephanus speculum* 433A-3-2, 13–15 cm, L-2 (Q20/4)

Figure 12  *Mesocena circulus* 433A-3-1, L-2 (M31/4)

Figure 13  *Mesocena diodon* 433A-3-5, 13–15 cm, L-2 (U22/3)

Figure 14  *Mesocena elliptica* 433A-3-4, 23–25 cm, L-2 (K16/0)

Figure 15  *Ammochochium rectangular* 433A-4-1, 13–15 cm, L-2 (O40/0) × 800

Figure 16  *Ebriopsis antiqua antiqua* 433A-3-1, 13–15 cm, R-1 (K25/4) × 800

Figure 17  *Ebriopsis antiqua cornua* 433-1-4, 10–12 cm, L-2 (U5/0) × 800
PLATE 2

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17