

Abh. Geol. B.-A.	ISSN 0378-0864 ISBN 3-900312-54-0	Band 39	S. 7–19	Wien, März 1987
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## Silicoflagellates from the Pliocene of Aitania (Crete), a Quantitative Inventory

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With 4 Figures and 3 Plates

Greece  
Crete  
Pliocene  
Silicoflagellates  
Stratigraphy

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### Zusammenfassung

Zweiundzwanzig Pliozänproben des Aitania-Profiles (Kreta) wurden auf ihren Gehalt an Silicoflagellaten und Ebridien untersucht. Dabei wurden 16 Arten von Silicoflagellaten und drei Ebridienarten gefunden. Die Artenverteilung in jeder Probe wurde durch Auszählen von 100 Exemplaren pro Probe quantifiziert. Die Florengesellschaften des Aitania-Profiles können in die *Dictyocha fibula*-Zone und die *Dictyocha stapedia stapedia*-Zone BUKRY's (1981) gestellt werden. Wie bei MANDRA & MANDRA (1972) beschrieben wurde auf Basis des *Dictyocha/Distephanus*-Verhältnisses eine Paläotemperaturkurve erstellt.

### Abstract

Twenty-two samples from the Pliocene of the Aitania section (Crete) were examined for their contents of silicoflagellates and ebridians. Sixteen silicoflagellate species were observed along with three ebridian species. The species distribution in each of the twenty-two samples was quantified by means of counts of 100 specimens per sample. The assemblages of the Aitania section can be assigned to the *Dictyocha fibula* Zone and the *Dictyocha stapedia stapedia* Zone of BUKRY (1981). A paleotemperature curve is constructed on the basis of the *Dictyocha/Distephanus* ratio as described by MANDRA & MANDRA (1972).

### 1. Introduction

Silicoflagellates were studied from the Pliocene Aitania section on Crete. The scope of this study was to

make an inventory of the species, to establish the position of the section in terms of silicoflagellate biostratigraphy and to develop a paleoenvironmental interpretation.

The sequence is exposed in a number of steep gullies west of the village of Aitania (for location see Fig. 1). In the lower part of the section, brown sapropelic laminites, up to 190 cm thick, are seen to alternate with homogeneous grey marls. In the upper part, the homogeneous marls are yellow to beige in colour; the laminites are white and diatomaceous and may be up to 3.5 m thick (see JONKERS, 1984). The total stratigraphic thickness of the sampled interval is 90 m. From this section 22 samples were studied for their contents of silicoflagellates. All 22 samples, except one, were taken from the laminites because we expected siliceous microfossils to be most abundant in sediments of this facies.

ZACHARIASSE (1975) and JONKERS (1984) assigned a Pliocene age to the Aitania section based on planktonic foraminiferal biostratigraphy. JONKERS found that the base of the Aitania section coincides approximately with the exit-level of *Globorotalia margaritae*. The top of the section is situated in between the exit-level of *Globorotalia puncticulata* and the entry-level of *Globorotalia bononiensis*.

SPAAR (1983) developed a regional zonation for the Mediterranean Pliocene based on planktonic foraminifera. According to his zonation the Aitania section covers the *Globorotalia puncticulata* Zone and the bottom part of the *Globorotalia crassaformis* Zone. This interval is the

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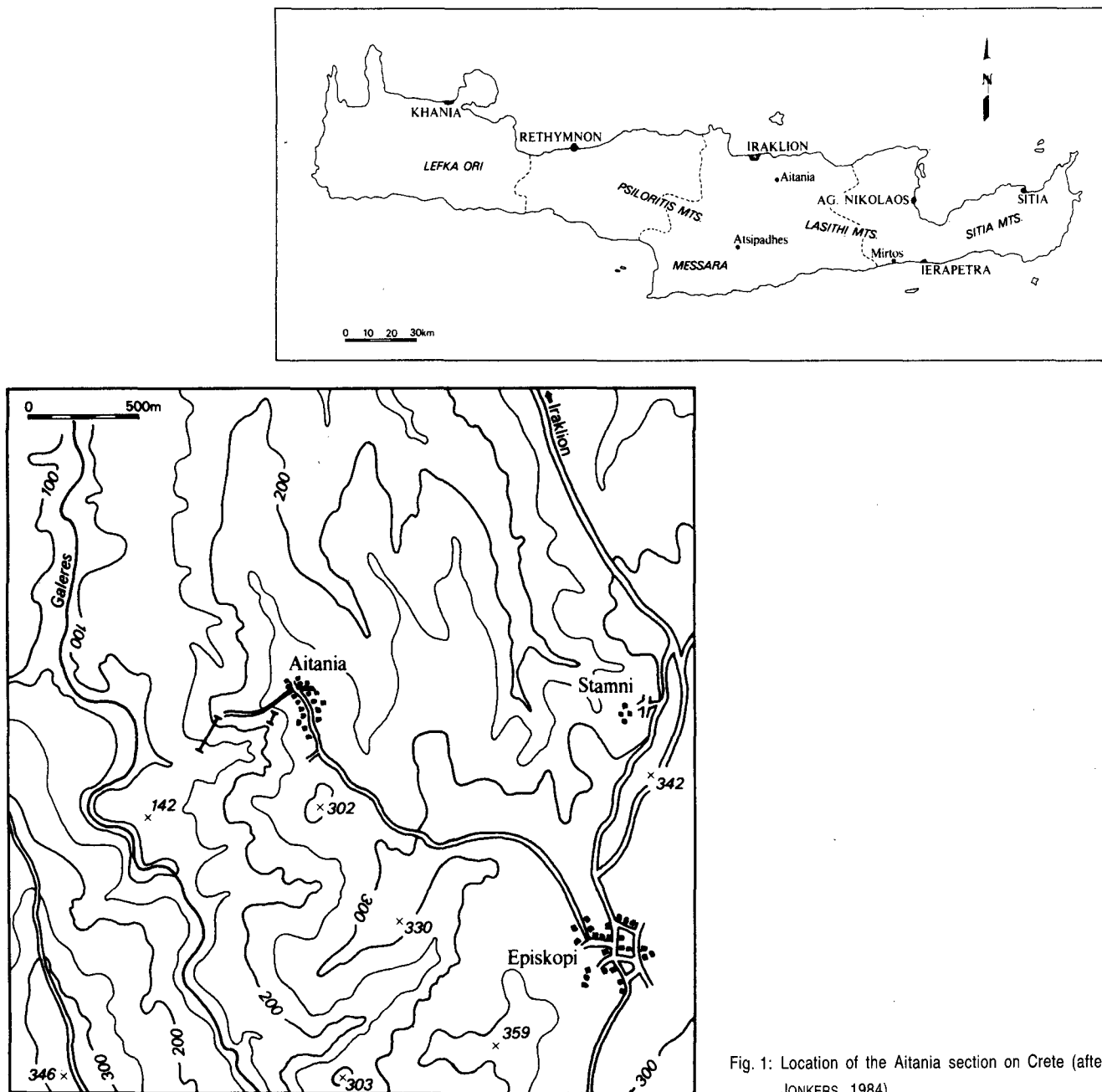


Fig. 1: Location of the Aitania section on Crete (after JONKERS, 1984).

same as the *G. puncticulata* Interval-zone of ZACHARIASSE (1975) and it correlates with the MPL-4 Zone of CITA (1975, cf. SPAK, 1983).

## 2. Previous Work

Previous work on Pliocene Mediterranean silicoflagellates was done by SCHRADER & GERSONDE (1978), by STRADNER & BACHMANN (1978) and by FRYDAS (1985). The Capo Rossello section on Sicily, studied by SCHRADER & GERSONDE (1978), is stratigraphically lower than the Aitania section. The DSDP material from site 378 in the Aegean basin which was studied by STRADNER & BACHMANN is younger (see Fig. 3). FRYDAS studied silicoflagellates from the Prassas section on Crete. This section is approximately of the same age as the Aitania section but, due to hiatuses caused by

faults, not fully comparable. No silicoflagellate study covers the Mediterranean Pliocene completely.

SCHRADER & GERSONDE (1978) assigned part of the lower Pliocene sequence of Capo Rossello on Sicily to the *Mesocena circulus* Zone of LING (1973) and the *Distephanus boliviensis* Zone of BUKRY & FOSTER (1973). STRADNER & BACHMANN (1978) recognized the *D. boliviensis* Zone of BUKRY (1976) in the older part of their material from DSDP site 378 and assigned it to the Upper Pliocene. The younger part of their material was assigned to the *D. octogonus* Zone of PERCH-NIELSEN (1975) which is of Early Pliocene age. Taking all this into consideration one could assign almost the entire Mediterranean Pliocene to one silicoflagellate zone: the *D. boliviensis* Zone of BUKRY (1976). Compared with calcareous nannofossils or planctonic foraminifera, silicoflagellates are of limited use for biostratigraphic correlations in the Mediterranean Pliocene.

### 3. Method

The following preparation procedure was used. After decalcification with 30 % HCl the samples were treated with hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) to oxidize the organic matter in the sediment. The material was then washed, the suspension was allowed to settle for 7 minutes and then decanted. This washing procedure was repeated until there was no material in suspension after 7 minutes of settling. In this way most clay particles will be washed out.

The silicoflagellates were counted in smear slides. Canada balsam was used as a mounting medium. The same slides were used for LM-photography. Some of the richest and best preserved samples were selected for SEM-photography.

gellate zonation for the Mediterranean Pliocene. However, we can apply various extra-Mediterranean zonations.

The Aitania section can be assigned to the *D. boliviensis* Zone of BUKRY (1976) which was established at DSDP site 157 in the Central Pacific.

The standard silicoflagellate zonation of BUKRY (1981) can be applied in the Mediterranean Pliocene as well (see Fig. 3). BUKRY defined his zones in assemblages from DSDP-cores from the mid-latitudes of the Atlantic. There was a good connection between the Atlantic Ocean and the Mediterranean Sea during the Pliocene. The Aitania flora can be placed in the *D. fibula* Zone and the *D. stapedia stapedia* Zone, the zonal boundary being between our samples CP 5361 and CP 5364. This boundary is based on the entry of *D. stapedia aspi-*

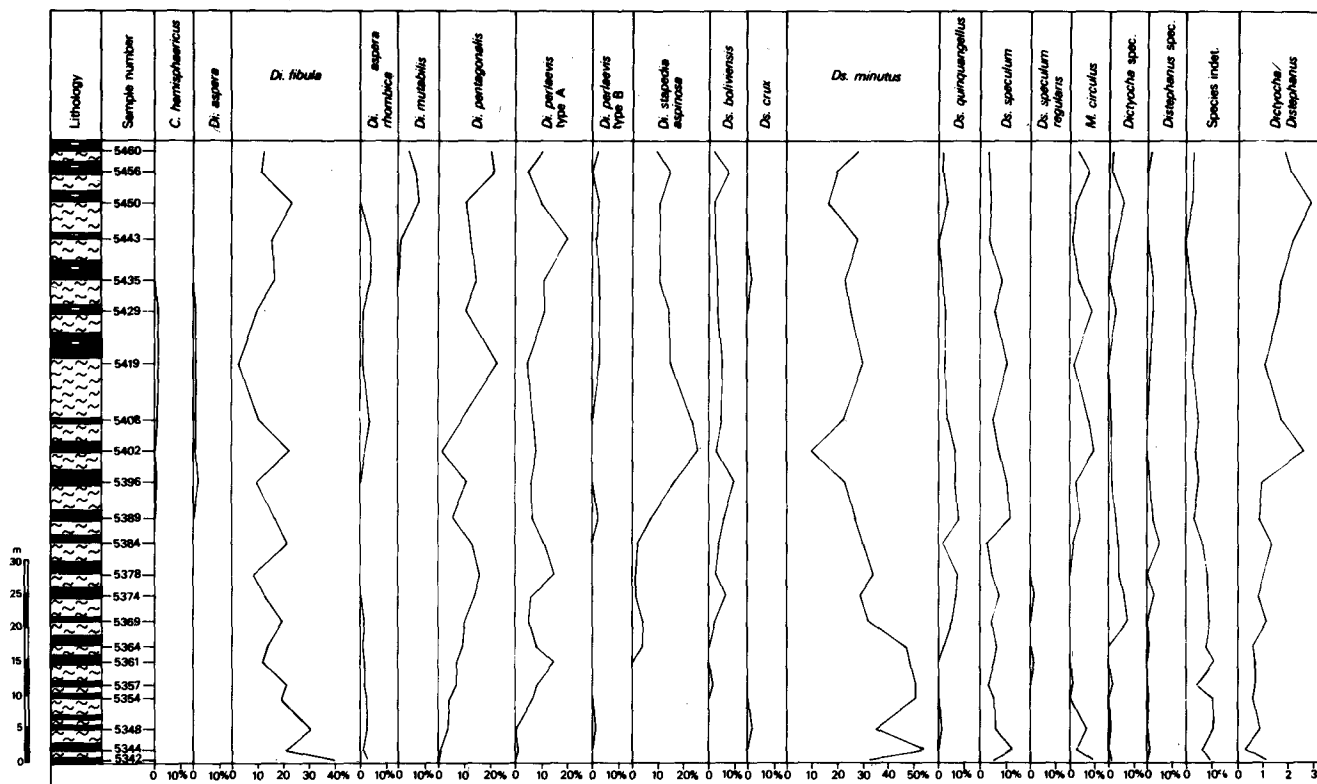


Fig. 2: Results of random counts of 100 silicoflagellate specimens per sample.

Countings were made of 100 specimens per slide using a mechanical stage traverse. This counting was done to get an idea of the species distribution in terms of number rather than in semi-quantitative terms like "rare", "common" or "abundant".

### 4. Counting Results and Biostratigraphy

The counting results are illustrated in Fig. 2. Fifteen silicoflagellate species together with three species of the Ebriopsidae were recognized. In *Dictyocha perlaevis* two types were distinguished.

We made an effort to fit our silicoflagellate flora into silicoflagellate zonations. There is no special silicofla-

nosa. The subzones described by BUKRY (1981) cannot be recognized in the Aitania section.

The zonal boundary is probably situated in the middle of the *Globorotalia puncticulata* Zone. On the basis of the planctonic foraminiferal biostratigraphy it is likely that the Aitania section covers only the upper part of the *D. fibula* Zone which is called the *D. aspera aspera* Subzone (PERCH-NIELSEN, 1985) and the lower part of the *D. stapedia stapedia* Zone which is called the *D. perlaevis ornata* Subzone (BUKRY, 1981).

### 5. Paleoenvironment

In the literature on silicoflagellates paleotemperatures are estimated on the basis of the relative abundances

		after Bukry, 1981			after Spaak, 1983		
		Coccoliths	Silicoflagellates		Planktonic foram.		
PLIOCENE	UPPER	<i>Discoaster brouweri</i> Zone	<i>Dictyocha stapedia stapedia</i> Zone	<i>Dictyocha perlaevis delicata</i> Subzone (Bukry,1981)	9	<i>Globorotalia inflata</i> Zone	DSDP-core 378-8
				<i>Dictyocha perlaevis ornata</i> Subzone (Bukry,1981)	8	<i>Globorotalia crassaformis</i> Zone	
					7		
					6		
					5		
					4		
	LOWER	<i>Reticulofenestra pseudumbilica</i> Zone	<i>Dictyocha fibula</i> Zone	<i>Dictyocha aspera aspera</i> Subzone (Perch-Nielsen,1985)	3	<i>G. margaritae</i> <i>G. puncticulata</i> Concurrent-range zone	
		<i>Amaurolithus tricorniculatus</i> Zone			2	<i>Globorotalia margaritae</i> Zone	
					1	<i>Sphaeroidinella</i> Acme-zone	
Aitania							
Capo Rossello							

Fig. 3: Silicoflagellate standard zonation of BUKRY (1981) compared with calcareous nannoplankton and planktonic foraminiferal biostratigraphy. The stratigraphic position of the Aitania interval on the basis of planktonic foraminiferal biostratigraphy is shown together with the position of the intervals studied by SCHRADER & GERSONDE (1978) and by STRADNER & BACHMANN (1978).

of *Dictyocha* which is considered to be a warm water indicator and of *Distephanus* which is considered to be an indicator of cold water. MANDRA & MANDRA (1972), SCHRADER & RICHERT (1974) and CIESIELSKY (1975) assigned various absolute watertemperatures to the scale of values of the *Dictyocha/Distephanus* ratio. In Fig. 4 the values of this ratio in our 22 samples are shown, together with the temperature interpretations given by the above authors. Although strong fluctuations in the *D./D.* ratio values can be seen, our curve shows a clear tendency towards higher values.

The water paleotemperature according to MANDRA & MANDRA would have increased with approximately 10

degrees from 15° to 25°C. The scheme of SCHRADER & RICHERT suggests a temperature increase of 2 degrees from 15°C to 17°C. When we use CIESIELSKY's interpretation, the temperature would have increased 5 degrees from 5°C to 10°C.

From the above it is clear that the *D./D.* ratio cannot be directly translated into absolute water temperatures. Furthermore, it is important to realize that our samples were derived from laminites. Such sediments were deposited under quite specific, short term paleoenvironmental conditions. The sedimentary facies indicates that the deep water was anoxic. The fossil content and the stable isotope record of foraminifera from mid-

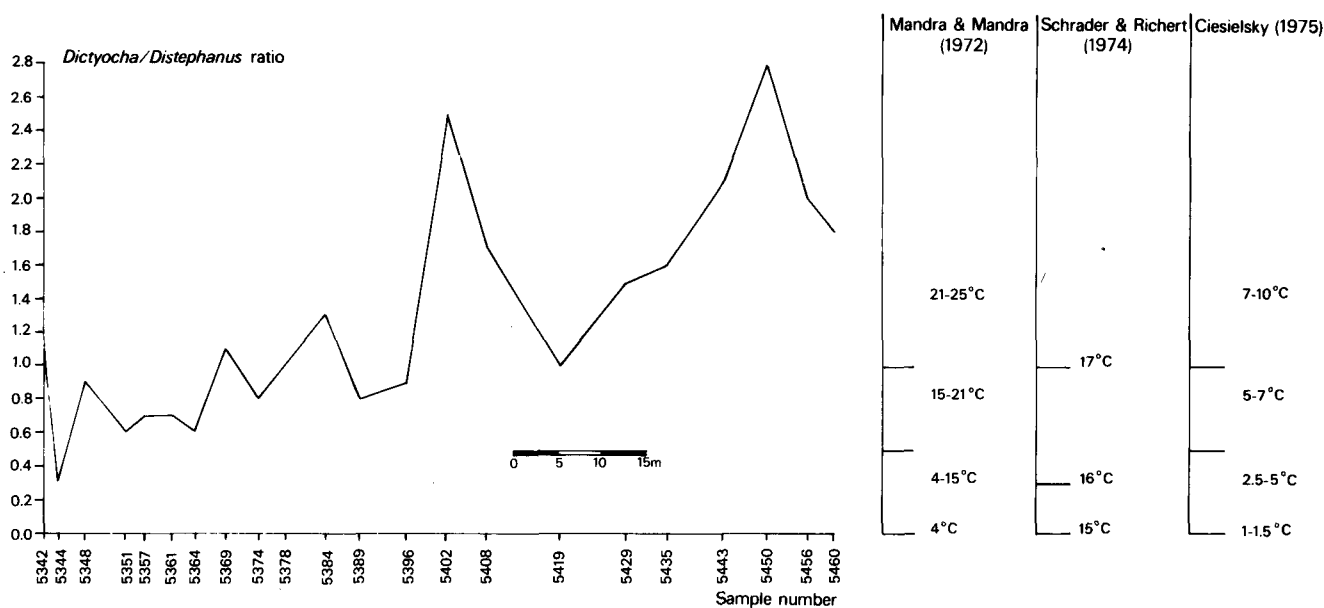


Fig. 4: *Dictyocha/Distephanus* ratio and three paleotemperature interpretations.

Pliocene laminites suggest that the levels of anoxia were associated with a salinity stratification of the water column, resulting from a periodical increase of river discharge (e.g. JONKERS, 1984). The increased river discharge probably led to an increase of nutrients in the basin. Locally this may have resulted in an increased fertility in the surface water as witnessed by the abundance of diatoms in the laminites in the higher part of the section. It seems reasonable to evaluate the composition of our silicoflagellate floras against the background of lowered paleosalinity and enhanced fertility. The increase of the *D./D.* ratio in an upward sense may indicate that *Dictyocha*, relative to *Distephanus*, flourished in highly fertile and/or low saline waters.

For a better evaluation of our paleoenvironmental results comparisons with stable isotope data from the same samples would be required.

## 6. Systematics

Phylum CHRYSOPHYCOPHYTA  
Class CHRYSOPHYCEAE  
Subclass SILICOFLAGELLATOPHYCIDAE  
Order SIPHONOTESTALES  
Family DICTYOCHIDAE

Genus *Cannopilus* HAECKEL 1887;  
emend. BACHMANN, 1967

*Cannopilus hemisphaericus* (EHRENBERG, 1844)  
HAECKEL, 1887

*Cannopilus hemisphaericus* (EHRENBERG, 1844) HAECKEL, 1887;  
DUMITRICA, 1973, p. 854, pl. 10, fig. 6;  
LING, 1970, p. 99, pl. 20, fig. 1-7.

Siliceous skeletons with hexagonal basal and apical rings. Along one axis the basal spines are longer. The

apical ring is subdivided by a cannopiloid structure forming four portals.

We follow LING (1970) in considering all specimens with a subdivided apical ring as representatives of the genus *Cannopilus*, and have therefore assigned this species to *C. hemisphaericus*. DUMITRICA (1973) considers this species as a cannopiloid form of *D. boliviensis*.

## Genus *Dictyocha* EHRENBERG, 1837

*Dictyocha aspera* (LEMMERMANN, 1901)  
BUKRY & FOSTER, 1973  
(Plate 2, figs. 1-3)

*Dictyocha aspera* (LEMMERMANN, 1901)

BUKRY & FOSTER, 1973, p. 826, pl. 2, fig. 4-6;  
PERCH-NIELSEN, 1975, p. 686, pl. 4, fig. 9,10,15;  
HAQ & RILEY, 1976, p. 681, pl. 1, figs. 7-9.

Siliceous skeletons consisting of a rhombic to lobed basal ring with radial spines at the ends of the major and minor axes. The asperoid apical bar is directed transverse to the major axis of the basal ring.

*D. aspera*, *D. aspera rhombica* and *D. mutabilis* are here described as separate taxa. Close examination of these three taxa shows an almost continuous range of morphotypes going from *D. aspera* to *D. mutabilis* (see Pl. 2, Fig. 1-7). Especially the two portals in the direction of the apical bar show a tendency of getting more and more reduced towards *D. mutabilis*.

*Dictyocha aspera* (LEMMERMANN, 1901)  
1973 fa. *rhombica* SCHULZ, 1928  
(Plate 2, fig. 4)

*Dictyocha fibula aspera* fa. *rhombica* SCHULZ, 1928, p. 253, fig. 37  
*Dictyocha fibula rhombica* SCHULZ, 1928;  
LING, 1970, p. 93, pl. 18, fig. 15.

*D. aspera rhombica* has a rhombic basal ring with an angular outline. The apical bar has an asperoid orientation. The two portals in the direction of the minor axis are distinctly smaller than the other two portals.

***Dictyocha fibula* EHRENBURG, 1839**

(Plate 2, figs. 8–11)

*Dictyocha fibula* EHRENBURG, 1839, p. 129;  
LING, 1972, p. 161, p. 25, fig. 11,12;  
BUKRY, 1973b, p. 826,827, pl. 3, fig. 12;  
PERCH-NIELSEN, 1975, p. 686, pl. 5, fig. 5.

Siliceous skeletons consisting of a rhombic to lobed basal ring with radial spines at the ends of the major and minor axes and a longitudinal (fibuloid) apical bar supported by four raised lateral struts. Sustaining pikes are inserted in the basal ring near the lateral struts. Although the surface of the skeleton is usually smooth, reticulate skeletons were also observed.

***Dictyocha mutabilis* DEFLANDRE, 1950**

(Plate 1, fig. 1; Plate 2, figs. 5–7)

*Dictyocha mutabilis* DEFLANDRE, 1950, p. 197, figs. 203–210.  
*Dictyocha ausonia* DEFLANDRE, 1950, p. 195, figs. 194–202.

*Dictyocha mutabilis* can be differentiated from *D. aspera rhombica* by the two portals in the direction of the minor axis which are much smaller. In some of the observed specimen one of the two small portals is very small, almost reduced completely or entirely missing. In the latter specimen only three portals remain.

***Dictyocha pentagonalis* (AUVRIILLIUS, 1898)**

**PERCH-NIELSEN, 1975**

(Plate 3, figs. 10,11)

*Dictyocha pentagonalis* (AUVRIILLIUS, 1898) PERCH-NIELSEN, 1975, p. 687, pl. 5, fig. 12.

*Dictyocha pentagonalis* has a five-sided basal ring with two long spines in the direction of the major axis. The apical part of the skeleton is formed by a network that seems to be derived from the apical structure of a fibuloid species.

***Dictyocha perlaevis* FRENGUELLI, 1951**

**type A**

(Plate 2, figs. 12,13)

*Dictyocha perlaevis* FRENGUELLI, 1951, p. 279, fig. 4b–c;  
DUMITRICA, 1973, p. 848, pl. 4, figs. 1,2;  
BUKRY, 1976a, p. 724, pl. 2, fig. 4.

*D. perlaevis* is distinguished from *D. fibula* by the pronounced four-lobed basal ring, the larger size and the relatively shorter basal spines. The surface of the basal ring is often reticulate.

Two types of *D. perlaevis* are here distinguished. Type A is characterised by having a basal ring which is not so distinctly reticulate than the basal ring of type B.

***Dictyocha perlaevis* FRENGUELLI 1951)**

**type B**

(Plate 1, fig. 3; Plate 3, fig. 1)

*D. perlaevis* type B differs from *D. perlaevis* type A in its more distinct reticulate surface.

***Dictyocha stapedia* (HAECKEL, 1887) ssp. *aspinosa***

**BUKRY, 1976**

(Plate 1, fig. 2; Plate 3, fig. 2)

*Dictyocha stapedia* (HAECKEL, 1887) ssp. *aspinosa* BUKRY 1976, p. 724, pl. 2, figs. 6–9;  
STRADNER & BACHMANN, 1978, p. 806, pl. 1, figs. 1,2 non 7,8.

*D. stapedia aspinosa* has a basal ring which is broadly rhombic, slightly lobed with four basal spines which can be of equal length and with four auxiliary pikes which are slightly off-set. The apical bar is fibuloid. The skeleton is relatively small and makes a massive impression.

**Genus *Distephanus* STOHR, 1880**

***Distephanus boliviensis* (FRENGUELLI, 1940)**

**BUKRY & FOSTER, 1973**

(Plate 1, fig. 4; Plate 3, fig. 3)

*Dictyocha boliviensis* FRENGUELLI, 1940, p. 44, fig. 4.  
*Dictyocha boliviensis major* FRENGUELLI, 1951, p. 227, fig. 3a–c.  
*Distephanus boliviensis* (FRENGUELLI, 1940) BUKRY & FOSTER, 1973, p. 827, pl. 4, figs. 1–3;

Skeletons with hexagonal basal and apical rings. Along one axis the basal spines are longer. *Distephanus boliviensis* differs from *D. speculum* by its larger overall dimensions and its relatively smaller apical ring which has a tendency to form cannopiloid forms. We only observed six-sided basal rings, other authors also reported five-sided and seven-sided basal rings. The basal spines along the main axis are longer than the other four.

***Distephanus crux* (EHRENBURG, 1840) HAECKEL, 1887**

(Plate 3, fig. 4A,B)

*Distephanus crux* (EHRENBURG, 1840) HAECKEL, 1887, p. 1563;  
BUKRY & FOSTER, 1973, p. 827, pl. 4, figs. 5,6;  
PERCH-NIELSEN, 1975, p. 687, pl. 6, figs. 2,3,5, pl. 7, figs. 1–5, 7–10, 13;  
HAQ & RILEY, 1976, p. 681, pl. 3, figs. 1–3.

*D. crux* has a quadrangular to rhombic basal ring with a spine on every corner. The spines along the major axis are longer than those along the minor axis. The quadrangular apical ring is supported by four straight lateral rods.

***Distephanus minutus* (BACHMANN, 1967)**

**BUKRY & FOSTER, 1973**

(Plate 1, figs. 5–7; Plate 3, figs. 5–7)

*Distephanus minutus* (BACHMANN, 1967) BUKRY & FOSTER, 1973, p. 828, pl. 4, figs. 10,11;  
HAQ & RILEY, 1976, p. 682, pl. 3, figs. 4,6.

Skeletons with hexagonal basal and apical rings. Along one axis the basal spines are longer. The relatively large apical ring can be either smooth or decorated with two apical pikes in the direction of the major axis.

*D. minutus* differs from *D. speculum* by its smaller overall dimensions. In plan view the apical ring practically covers the struts connecting the apical ring to the basal ring.

### ***Distephanus quinquangellus* BUKRY & FOSTER, 1973**

(Plate 3, figs. 8,9)

*Distephanus quinquangellus* BUKRY & FOSTER, 1973, p. 828, pl. 5, fig. 4;  
PERCH-NIELSEN, 1975, p. 688, pl. 6, figs. 8,9, pl. 7, figs. 11,14,15;  
HAQ & RILEY, 1976, p. 682, pl. 3, figs. 5,8.

*D. quinquangellus* has symmetric five sided basal and apical rings with equant spines at the apices of the basal ring.

### ***Distephanus speculum* (EHRENBERG, 1939)**

**HAECKEL, 1887**

(Plate 3, fig. 12)

*Distephanus speculum* (EHRENBERG, 1839) HAECKEL, 1887, p. 1565;  
LING, 1970, p. 78, pl. 3, figs. 7,8, pl. 4, figs. 3,4;  
BUKRY & FOSTER, 1973, p. 825, pl. 5, fig. 8;  
PERCH-NIELSEN, 1975, p. 688, pl. 7, figs. 16,23;  
STRADNER & BACHMANN, 1978, p. 808, pl. 2, figs. 1–4.

Skeletons with hexagonal basal and apical rings. Along one axis the basal spines are longer. The apical ring can be either smooth or decorated with six apical pikes.

### ***Distephanus speculum* (EHRENBERG) HAECKEL, 1887 var. *regularis* LEMMERMANN, 1901**

*Distephanus speculum* (EHRENBERG) HAECKEL, 1887 var. *regularis* LEMMERMANN, 1901, p. 263, pl. 11, figs. 12,13.

As *D. speculum* but with all basal spines of equal length, corresponding to the longest pair of *D. speculum*.

### **Genus *Mesocena* EHRENBERG, 1843**

#### ***Mesocena circulus* (EHRENBERG, 1844) EHRENBERG 1854**

(Plate 1, fig. 8)

*Mesocena circulus* (EHRENBERG, 1844) EHRENBERG 1854;  
EHRENBERG, 1844, p. 65;  
MARTINI, 1971, pl. 1, fig. 17.  
*Paradictyochoa circulus* (EHRENBERG, 1854) DUMITRICA, 1973, p. 853, pl. 9, figs. 7–10.

Subcircular to oval rings with 18 to 25 short irregularly spaced spines in centrifugal direction.

### **Order STEREOTESTALES Family EBRIOPSISIDA**

### **Genus *Ammodichium* HOVASSE 1932**

#### ***Ammodichium rectangulare* (SCHULZ, 1928)**

**DEFLANDRE, 1933**

(Plate 3, fig. 15)

*Ammodichium rectangulare* (SCHULZ, 1928) DEFLANDRE, 1933, p. 517, 518, figs. 5–7;  
PERCH-NIELSEN, 1975, p. 880, pl. 4, figs. 19–28, 30–32, pl. 5, figs. 23–26, pl. 9, fig. 22;  
STRADNER & BACHMANN, 1978, p. 808, fig. 2.

Siliceous skeletons consisting of three parallel proclades which are united in the centre by a triangular plate of three actines and at the apical and antapical ends by rings.

According to LING (1973) *A. rectangulare* has its last occurrence approximately at the Plio/Pleistocene boundary.

### **Genus *Ebriopsis* HOVASSE, 1932**

#### ***Ebriopsis antiqua* (SCHULZ, 1928) HOVASSE 1932**

*Ebriopsis antiqua* (SCHULZ, 1928) HOVASSE, 1932, p. 120, fig. 1;  
TSUMURA, 1963, p. 75, pl. 2, fig. 6;  
PERCH-NIELSEN, 1975, p. 880, pl. 4, fig. 15;  
STRADNER & BACHMANN, 1978, p. 808, fig. 2.

Siliceous skeletons with a central structure formed of six rods which are arranged in such a way as to form two alternating "Y"s.

The distal ends of these rods are bifurcated and combine to form a closed ring.

### **Genus *Hermesinum* ZACHARIAS, 1906**

#### ***Hermesinum adriaticum* ZACHARIAS, 1906**

(Plate 3, fig. 14)

*Hermesinum adriaticum* ZACHARIAS, 1906, p. 394, figs. a–d;  
STRADNER & BACHMANN, 1978, p. 808, fig. 2.

Siliceous asymmetrical skeletons similar to those which are illustrated by LOEBLICH et al. (1968) and by STRADNER & BACHMANN (1978).

### **Acknowledgements**

I would like to thank professor C. W. DROOGER, Miss SHIRLEY E. van HECK and BEN DRIEVER for their remarks on the manuscript, and TON ROMEIN for introducing me to the study of silicoflagellates. A. van DOORN and T. van HINTE made the drawings. W. den HARTOG took care of the SEM-micrographs.

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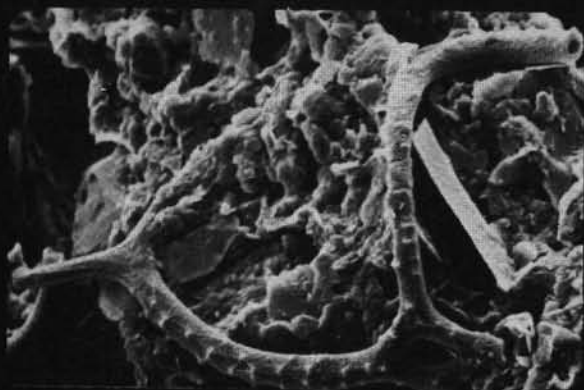
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## Plate 1

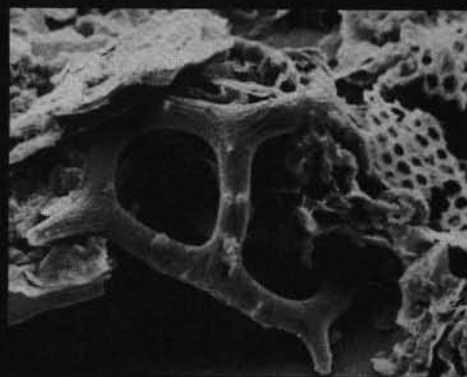
### S.E.M. photographs

- Fig. 1: *Dictyocha mutabilis*; × 2800.  
 Fig. 2: *Dictyocha stapedia aspinosa*; × 2800.  
 Fig. 3: *Dictyocha perlaevis*; × 1700.  
 Fig. 4: *Distephanus boliviensis*; × 1600.  
 Fig. 5: *Distephanus minutus*; × 1600.  
 Figs. 6,7: *Distephanus minutus*; × 3700.  
 Fig. 8: *Mesocena circulus*; × 1600.

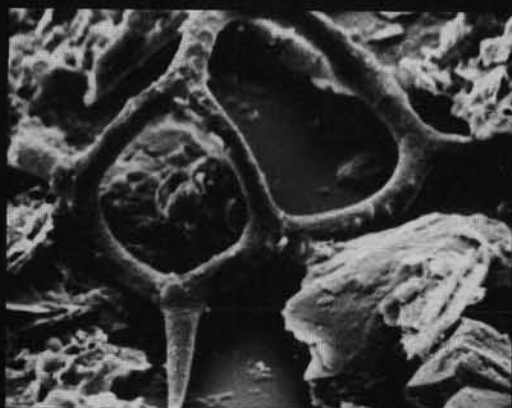




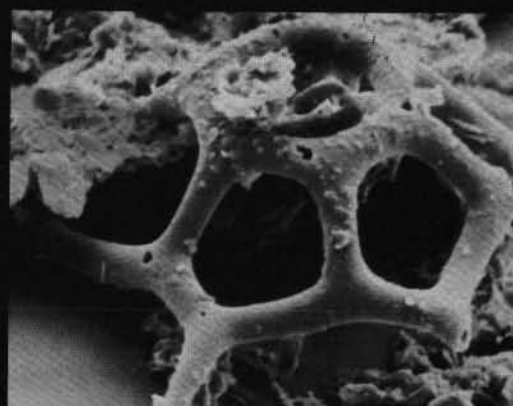
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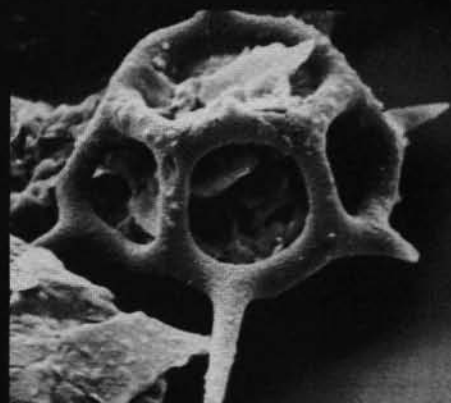
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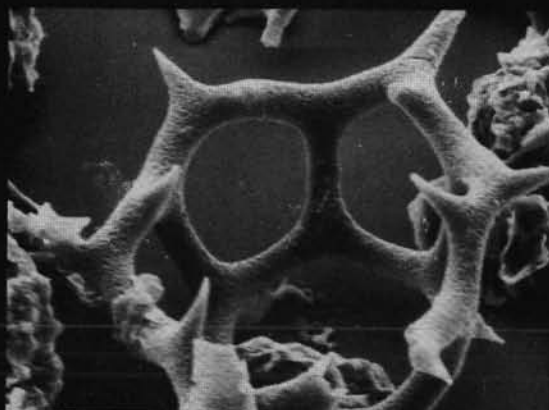
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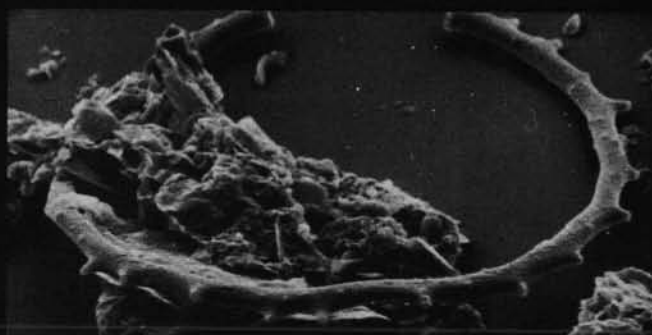
5



6



7



8

Plate 2

L.M. photographs (magnification  $\times 1250$ )

- Figs. 1–3: *Dictyocha aspera*  
Fig. 4: *Dictyocha aspera rhombica*  
Figs. 5–7: *Dictyocha mutabilis*  
Figs. 8–11: *Dictyocha fibula*  
Figs. 12,13: *Dictyocha perlaevis*

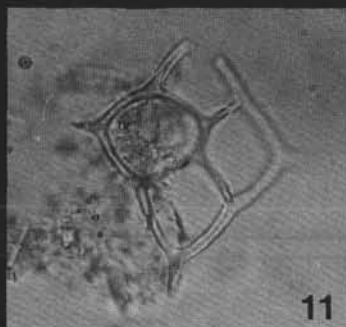
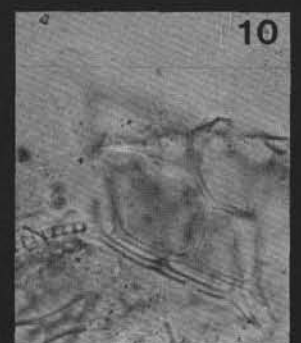
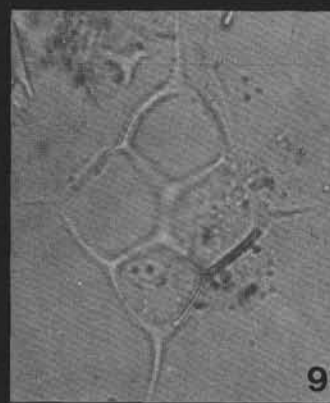
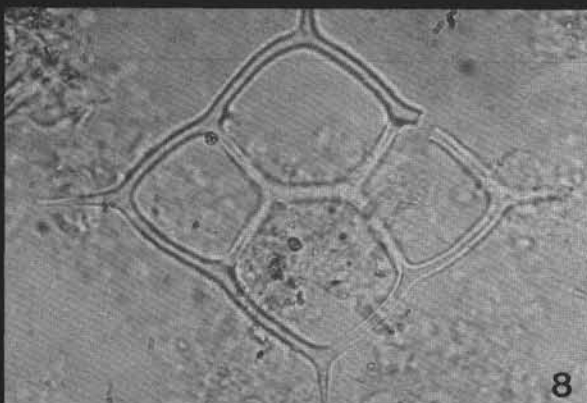
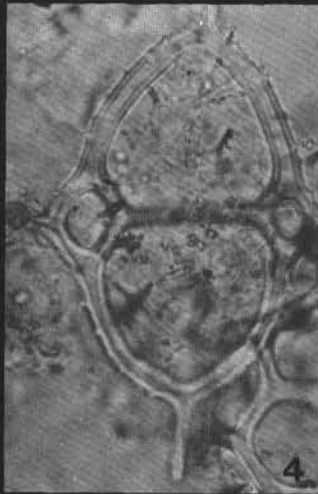
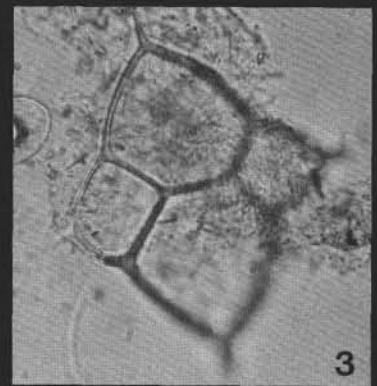
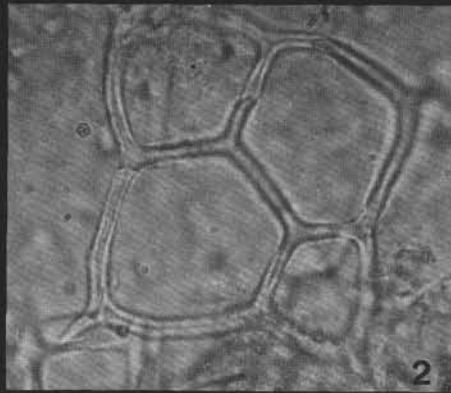
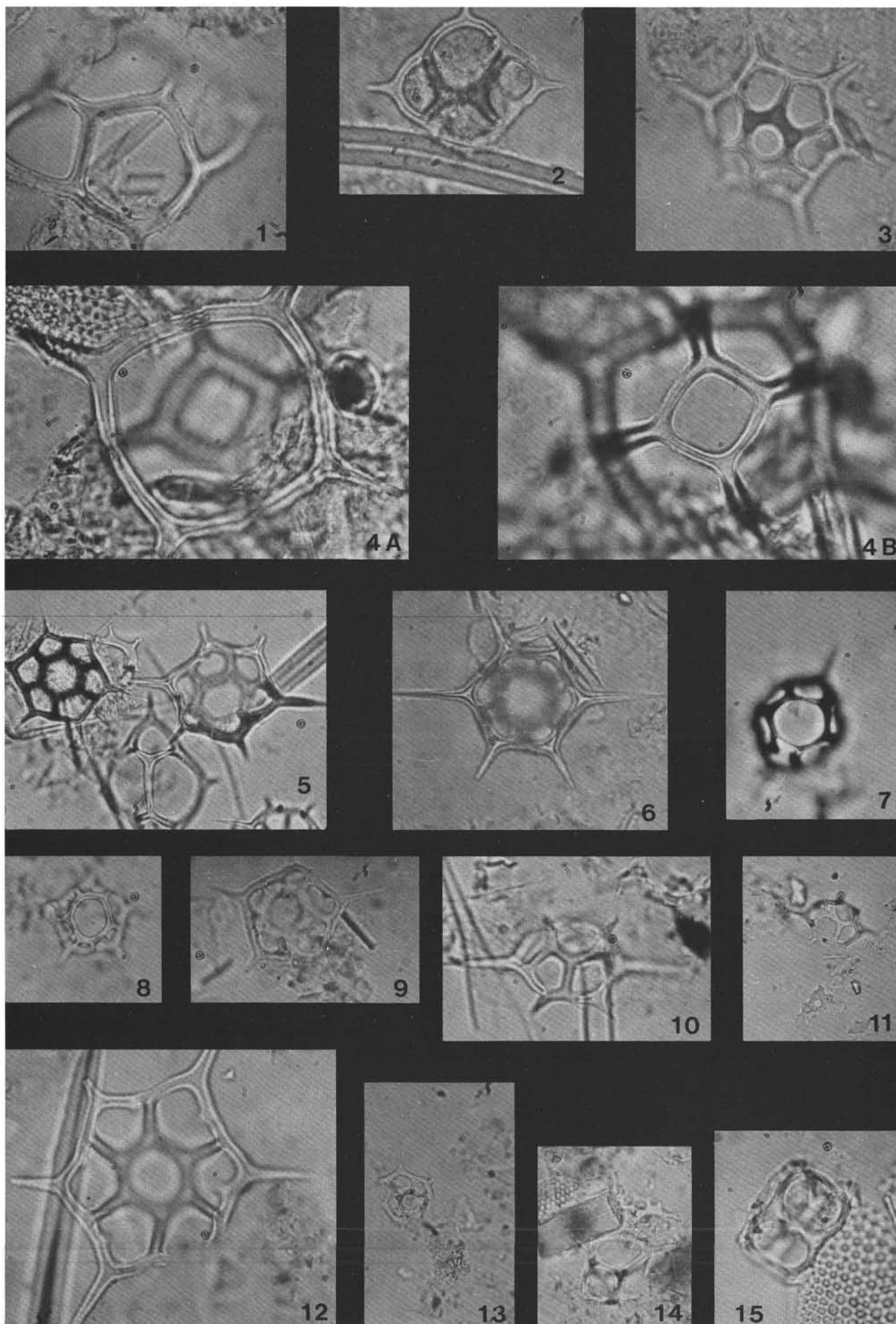


Plate 3

L.M. photographs (magnification  $\times 1250$ )

- Fig. 1: *Dictyocha perlaevis* type B  
Fig. 2: *Dictyocha stapedia aspinosa*  
Fig. 3: *Distephanus boliviensis*  
Fig. 4A,B: *Distephanus crux*  
Figs. 5–7: *Distephanus minutus*  
Figs. 8,9: *Distephanus quinquangellus*  
Figs. 10,11: *Dictyocha pentagonalis*  
Figs. 12: *Distephanus speculum*  
Fig. 13: spec. indet.  
Fig. 14: *Hermesinum adriaticum*  
Fig. 15: *Ammodichium rectangulare*



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