

WIESŁAWA PRZYBYŁOWSKA-LANGE

ULTRASTRUCTURE AND MORPHOLOGICAL VARIABILITY OF FOSSIL CYCLOTELLA DISTINGUENDA HUST. (*BACILLARIOPHYCEAE*) FROM FERDYNANDÓW (EASTERN POLAND)

Ultrastruktura i morfologiczna zmienność kopalnej *Cyclotella distinguenda* Hust. (*Bacillariophyceae*) z Ferdynandowa (południowo-wschodnia Polska)

ABSTRACT. Light and scanning electron microscope studies of *Cyclotella distinguenda* Hust. of Pleistocene sediment from Ferdynandów revealed the characteristic structural pattern of the external and internal valve face. The valves are flat or tangentially undulated. The central area is well defined and almost structurless. There are no central fultoportulae. The radial striae are of equal length. The marginal fultoportulae with three struts occur at every second or third hyaline costa. The marginal alveoli are simple and partially occluded. A single rimoportula is located on the valve mantle. This taxon reveals two morphological types which differ in the range of the size of the valves, density and arrangement of structural pattern of striae. Based on the similarities between morphological structures of *C. distinguenda* and *C. plivicensis* author suggest to regard *C. plivicensis* as synonym of *C. distinguenda*.

INTRODUCTION

A profile of Pleistocene sediments from Ferdynandów, was taken by the members of the staff of the Geological Institute in Warsaw and was kindly given to me by Dr. J. Rzechowski for the diatom study.

On the basis of complex geological and palaeobotanical study, as well as thermoluminescence (TL) dated, the stratigraphical position of this sediments was defined as a new interglacial in Poland, called the Ferdynandów Interglacial (Janczyk-Kopikowa et al. 1981, Rzechowski 1986). It is older than the Mazovian (Likhvin, Holstein) Interglacial.

An abundant occurrence of *Cyclotella* species (up to 56% of diatom specimens) was observed in the lower part of the profile. One of them was *C. distinguenda*. In the studied materials this taxon occurs more frequently (up to 8%) only in the first diatom zone (pollen phases- forest tundra and mixed wood, according to Janczyk-Kopikowa 1975), whereas in the upper diatom zones it occurs in single specimens or disappears almost completely.

A similar distribution has been noted in other profiles in which *C. distinguenda* was found in Interglacial and Lateglacial sediments (as well as in contemporary materials), but it is generally found in single specimens or occurs in small amount (e.g. Hustedt 1948, Simonsen 1957, Foged 1980, Khursevich 1976, Kaczmarska 1976, Marciniak 1973, 1984). Hustedt (1948) regarded this taxon (together with *C. antiqua* and *Gomphocymbella ancyli*) as the most characteristic for Interglacial sediments. The mode of occurrence of *C. distinguenda* in the Ferdynadów profile endorses the great stratigraphical value of this taxon.

C. distinguenda has been previously illustrated mostly in the light microscope. The present paper intends to give more complementary information on the morphological features of internal and external valve face of them and to show the polymorphism of *C. distinguenda* in the studied material.

MATERIAL AND METHODS

The samples for diatom analysis were cleaned of organic matter by treatment with H_2O_2 and rinsed in distilled water and decanted. Material for light microscope study was mounted in the Elyaashev aniline-formaldehyde medium ($d_n = 1,67$) and observed in Zeiss Jena Amplival microscope. For scanning electron microscope (SEM) diatoms were coated with gold and examined with a SEM Jeol-35C.

OBSERVATIONS

Cyclotella distinguenda Hustedt (in Gams 1927, p. 329, Pl. 3 figs 4,7)

Cyclotella plitvicensis Hustedt (Hustedt 1945, p. 899, Taf. 38, Fig. 5,6).

Most of the specimens of *C. distinguenda* occurred in Ferdynadów profile agree well with the original description of this species (Hustedt in Gams 1927), however some of specimens differ from them by having more finer striae and they have been difficult to identify using light microscope.

The frustules are short cylindrical. The valves are flat or tangentially undulated (Pl. I, figs 6-7) 10.1-24.4 μm in diameter.

External view of the valve. The central area is well defined, circular, usually smooth or with very fine isolated punctae (Pls. II-IV, V, figs 21-22). No central fultoportula was found. The marginal zone extends 1/3 to 1/2 of the valve radius, and consists of radial striae of equal length. The striae increase in width towards the margin of the valve. A great variability of striae structural pattern are observed. Radial punctate rows (2-7) grouped into fascicles are visible. The striae are separated by hyaline interfascicles (10-15 in 10 μm) which increase in width more visibly where external apertures of marginal fultoportulae occur (Pls II, III).

Interior view of the valve. The central area is smooth. The marginal alveoli are partially occluded and have simple structure (Pls IV, V, figs 21-22). The alveolar openings are short in relationship to the length of the striae, and are situated below the striae depressions. Marginal fultoportulae with three satellite pores are located at the base of

every second, third or occasionally fourth costae (Pls IV, V). A single, well developed rimoportula with slit-like opening occur on the mantle, between two alveolar openings. External expression of rimoportula is very difficult to distinguish because of its location on the mantle; it appears as a enlarged pore (Pl. V, figs 22.24).

As it is mentioned above *C. distinguenda* is very polymorphic taxon in examined material. Two morphotypes (A and B) may be distinguished (Table 1).

Table 1. Chief features of the two morphotypes of *C. distinguenda* from Ferdynandów and *C. plivicensis* according to Heustedt, Jercovič and Agošton descriptions

Taxon	<i>C. distinguenda</i>		<i>C. plivicensis</i>	
	Morphotype A	Morphotype B	Hustedt in Gams 1945	Jarcovič and Agošton 1976
Valve diameter/ μm	14.0-25.4	10.1-18.0	12-40	17-34
Centre diameter/ μm (externally)	5.2-13.2	4.2-6.9		
Centre pattern	smooth or with isolated punctae		smooth or with isolated punctae	
Undulation	flat or tangentially undulated		flat	
No. of striae/10 μm	12-15	10-12	8-10	10-16
Structure of striae, no. of radial punctate rows	(1) 2-4	(2) 3-7		(1) 2-3
No. of pores on striae/1 μm	6-7(10)	6-7(12)		
Central fuloportulae	none	none		none
No. of costae in between the costa bearing the fuloportulae	2, 3, (4)	(1), 2, 3, (4)		2, 3
No. of rimoportulae	1	1	no information	

The specimens of the morphotype A have larger valve diameter (14.0-25.4 μm), noticeable larger central area (5.2-13.2 μm) and proportionally shorter marginal zone than it is observed in specimens of morphotype B (Pl. I, figs 6, 7: Pl. II). The radial striae (12-15 in 10 μm) are biseriate except the margin where they are triseriate or quadriseriate. At the end of each stria (near the valve margin) edge rows of pores are shorter to about half of the normal rows length (Pl. II, fig. 13: Pl. III). The pores of striae increases in size from the margin (to 12 in 1 μm) to the central area (6-7 in 1 μm).

The specimens of morphotype B differs from morphotype A by smaller valve size (10.1-18.0 mm), smaller central area (4-7 mm in diameter), and by relatively longer marginal zone. The most striking differences is the striae pattern. In specimens of morphotype B the radial fasciculate striae (10-12 in 10 mm) increase in width towards the margin more distinct. They have biseriate pattern only very close to the central area, and become quadri- to multiseriate at the margin of the valve. The pores of striae are not of the same size. Usually the pores are larger in the edge rows, while between them there are smaller ones, which may be irregular or arranged in parallel rows. The pores on the mantle are usually much finer (Pl. III, figs. 15-17).

DISCUSSION

The two morphotypes of *C. distinguenda* from Ferdynandów profile have in common: flat or tangentially undulated valves, with well-defined and almost structureless central area, the marginal zone consisting of radial striae of equal length, lack of central fultoportula, marginal fultoportulae with three satellite pores, a single rimoportula located on the valve mantle, and simple alveolate structure. The differences occur in valve diameter, in size of central area and in density and arrangement of striae pattern.

Because of the same basic ornamentation of both morphotypes of *C. distinguenda* and the same time and place of the occurrence, mainly in the lower section of profile (the first diatom zone), suggest that there is no reason to distinguish them as a separate new taxa.

The presented SEM pictures of *C. distinguenda* of morphotype A are very similar to recent specimens of *C. plitvicensis* Hust. presented by Jercović and Agošton (1976) from the Plitvice Lakes in Yugoslavia (Table 1). The differences occur in size of the flat valves and in form of alveoli chambers. As illustrated in LM pictures by Hustedt (1945) and Jercović and Agošton in LM, SEM (1976), *C. plitvicensis* has very distinct „shadow line”. It is caused by different degree of alveoli occlusion (internal marginal lamina). The comparison discussed above suggests that *C. distinguenda* and *C. plitvicensis* should be considered as one species, highly variable taxa.

Concerning the morphological groups of the genus *Cyclotella* proposed by Lowe (1975) and expanded by McFarland and Collins (1978), Serieyssol (1981, 1984) and Theriot et al. (1985), it should be noted that *C. distinguenda* observed in this study has many features in common with *C. adancensis* group (Serieyssol 1981). This group is characterized by the presence of simple alveolate chambers, marginal strutted processes (fultoportulae), and a single labiate process (rimoportula). Central strutted processes and marginal spines are absent. The same features were observed in *C. distinguenda* in the studied material. On the other hand there are clear differences between them. The most striking one is the form of central area and marginal zone. *C. adancensis* has a little eccentric and reduced central area with numerous randomly distributed pore-like depressions. The striae (14-16 in 10 μm) are of unequal length and slightly indulate towards the centre and extend 4/5 of the valve radius (Serieyssol 1981). In *C. distinguenda* central area is larger, well-defined and almost structureless. The striae are of equal length, less dense, they extend from 1/2 to 1/3 of the valve radius. It seems that those differences may be sufficient to separate a new subgroup of *C. distinguenda*.

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PLATES

PLATE I

Cyclotella distinguenda Hust.

1-5. LM x 1500

6-7. SEM. Scale bars = 1 μ m. External view of valves of morphotype A

6. Valve with flat central area, and with pore-like depressions (arrow)

7. Valve with undulate central area

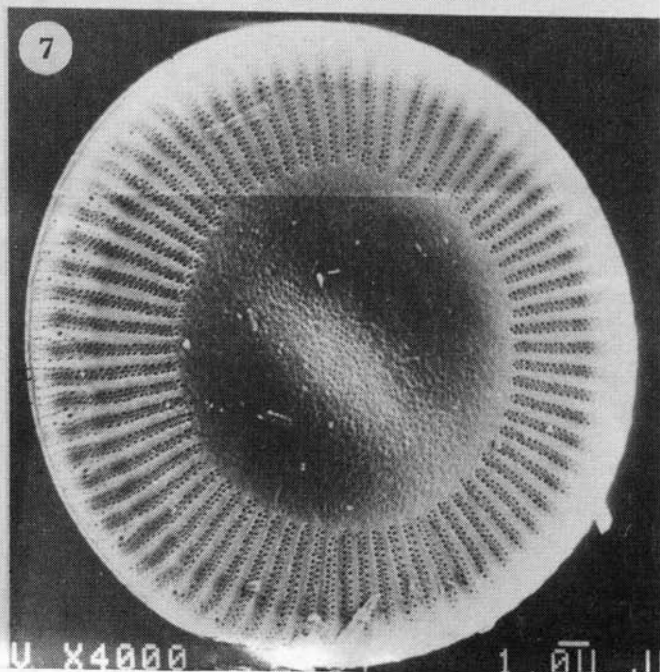
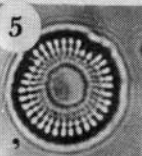
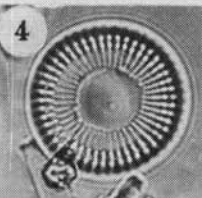
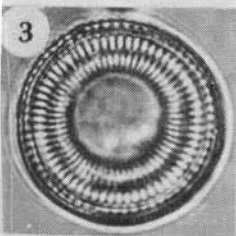
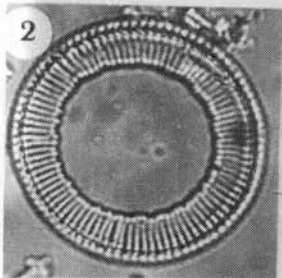
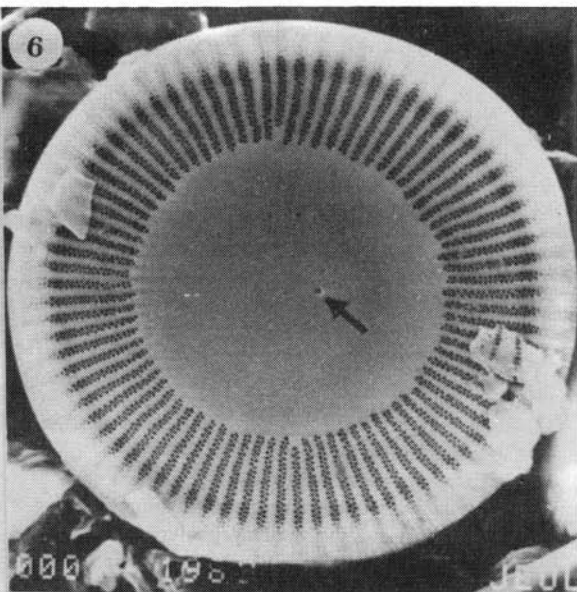
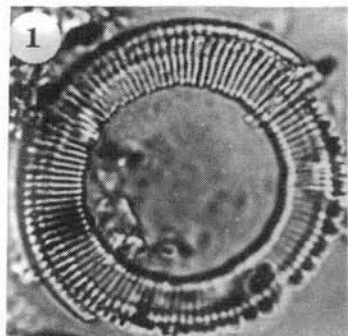


PLATE II

Cyclotella distinguenda Hust.

8-13. EM. Scale bars = 1 μ m

8-9, 11-12. External view of valves of morphotype B

9. Partially corroded valve showing external opening of rimoportula (arrow R)

10. External view of valve of morphotype A

12. Central area with pore-like depressions (arrow)

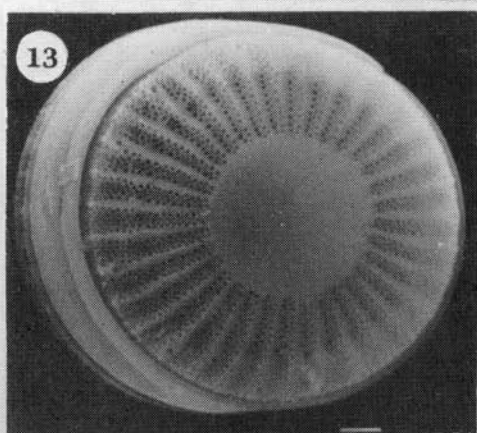
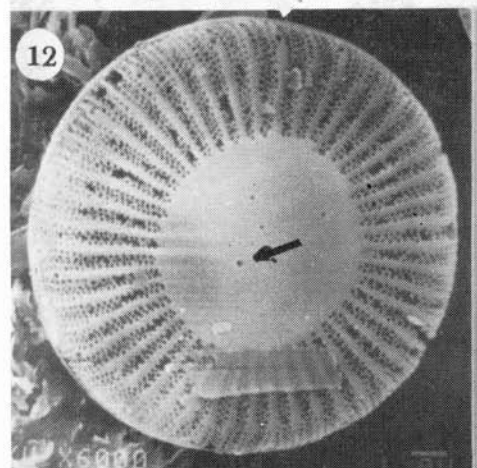
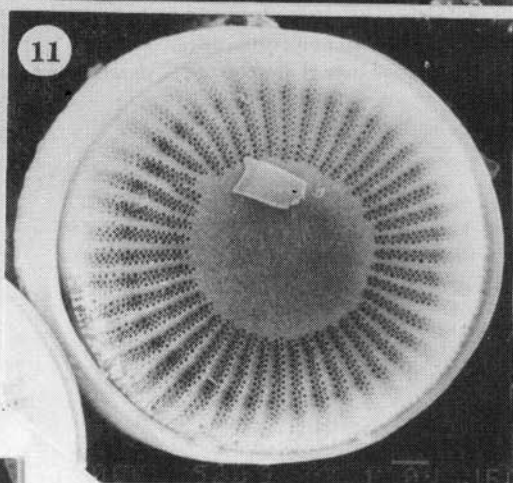
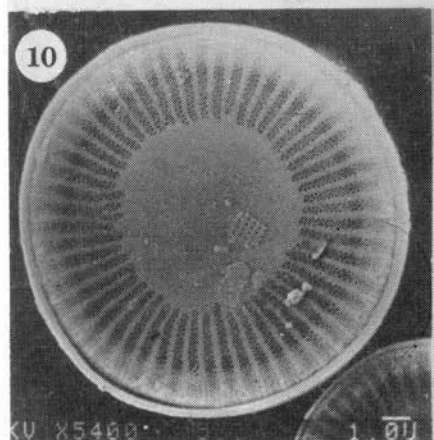
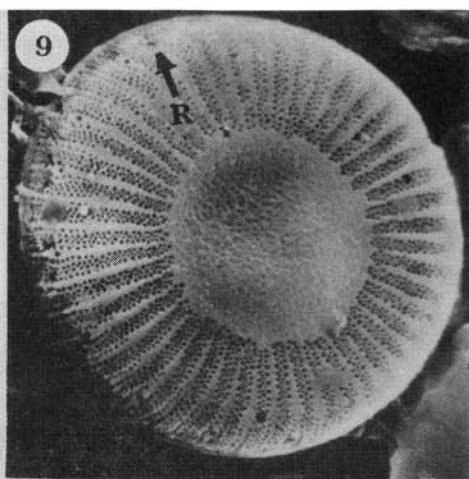
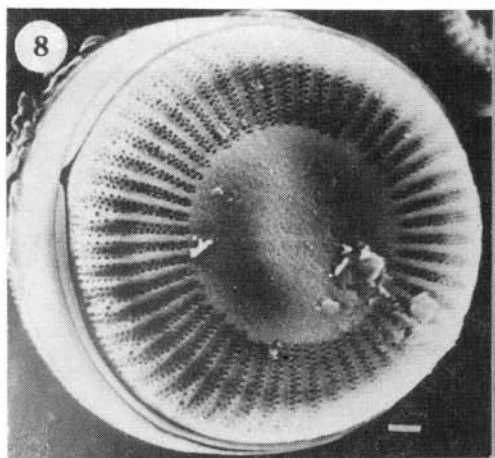


PLATE III

Cyclotella distinguenda Hust.

14-17. SEM. Scale bars = 1 μ m

14. External view of whole frustule of morphotype B, showing the opening of rimopurtula (arrow R), and position of marginal fultoportulae (arrow F)

15. Detail of marginal zone of morphotype B, showing the position of rimopurtula (arrow R), and fultoportulae (arrow F)

16-17. Detail of marginal zone of morphotype A

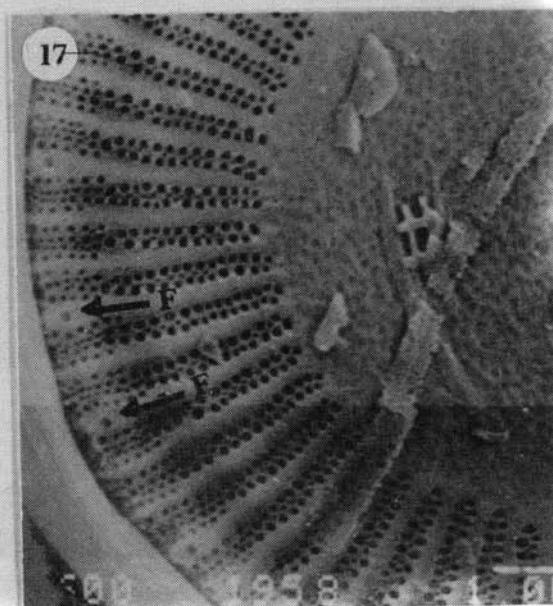
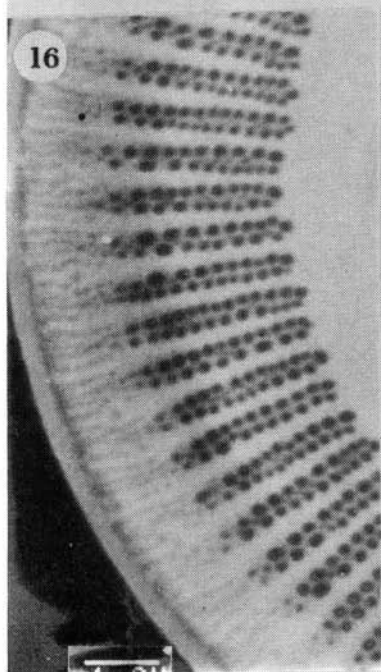
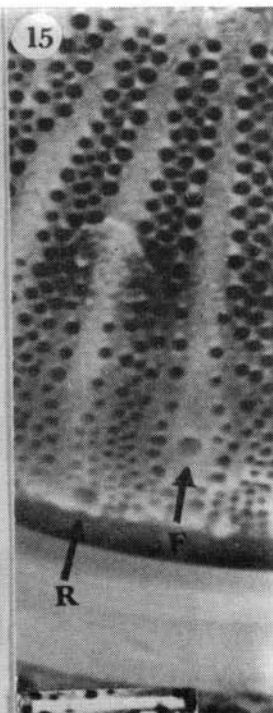
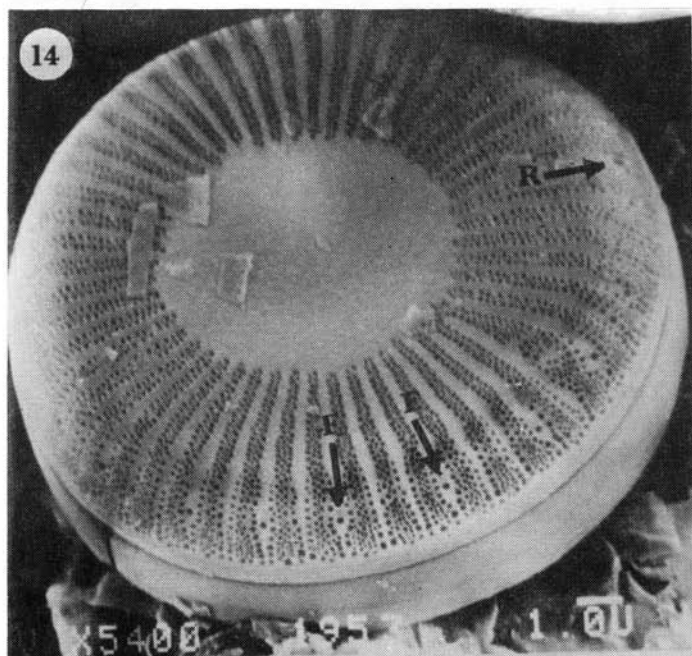


PLATE IV

Cyclotella distinguenda Hust.

18-20. SEM. Figs 18-19 scale bars = $1\mu\text{m}$, fig. 20 scale bar = $10\mu\text{m}$. Internal view of whole valves showing smooth central area, marginal alveoli, position of rimoportula (arrow R) and fultoportulae (arrow F)

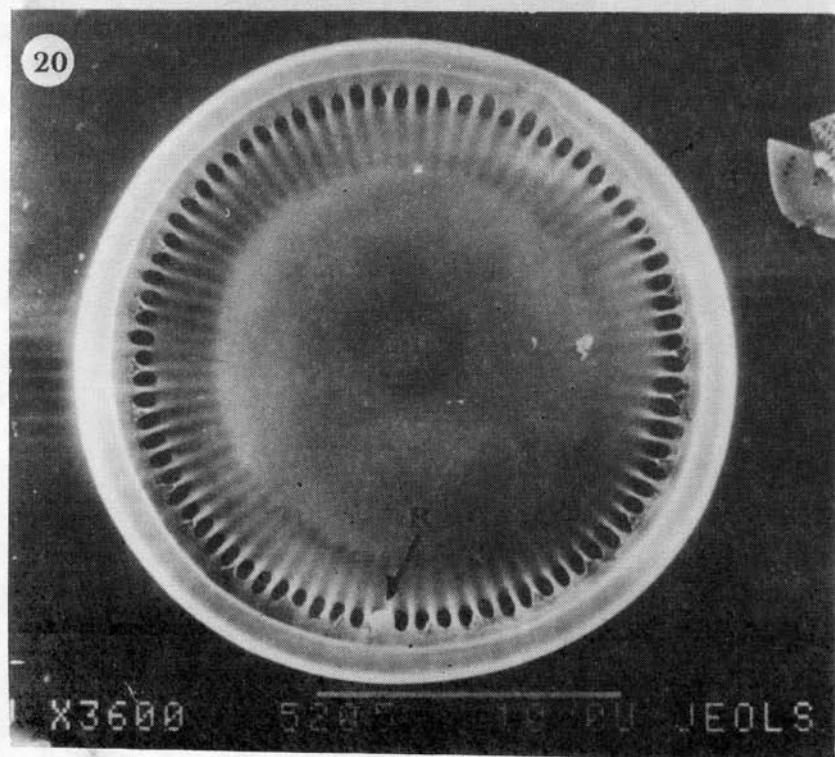
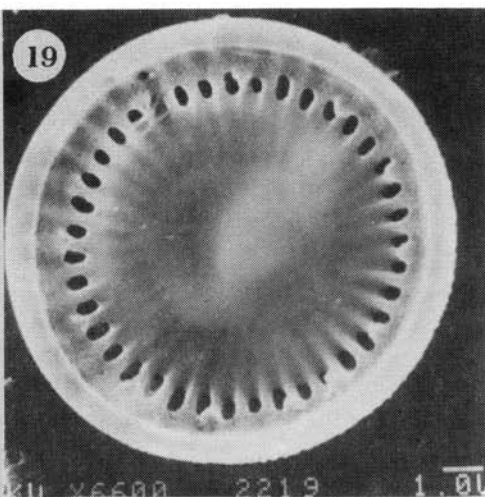
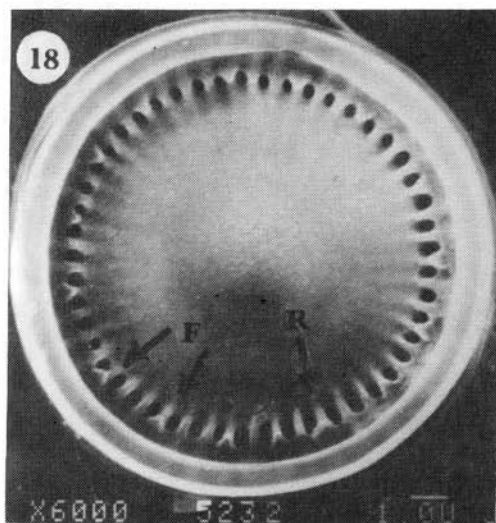


PLATE V

Cyclotella distinguenda Hust.

21-24. SEM. Scale bars = 1 μ m

21.23. Internal view of the same valve showing smooth central area, partially occluded alveoli, position of fultoportulae (arrow F) and rimoportula (arrow R)

22-24. Detail of external marginal zone showing the position and form of fultoportulae (arrow F) and rimoportula (arrow R)

