

SCANNING ELECTRON MICROSCOPE STUDIES  
ON SOME SPECIES  
OF THE CENTRIC DIATOM GENERA  
*THALASSIOSIRA* AND *COSCINODISCUS*

by

Daniël SOMERS

RÉSUMÉ.— La structure submicroscopique de quatre espèces de *Thalassiosira* et de deux espèces de *Coscinodiscus* a été étudiée au moyen du microscope électronique à balayage. Cinq d'entr'eux sont plus ou moins semblables dans la disposition des aréoles. Outre la description de chaque espèce et de la structure submicroscopique de l'auxospore de *Thalassiosira nordenskiöldii*, la classification des taxa étudiées, est donnée.

INTRODUCTION

The genus *Thalassiosira* described by CLEVE (1873), is characterized by fine central mucus threads linking the cells into loose chains ; in a few cases the cells are embedded in a mucus mass (CLEVE, 1873 ; HUSTEDT, 1930 : 319).

It is sometimes difficult to distinguish the species, because the chains break easily and the cells are very similar in morphology (HASLE, 1968 : 193). In pure cultures we have observed that the formation of mucus can fail to develop, so that confusion with other genera is possible.

Of the species studied all except one have more or less distinct tangentially arranged areole rows. The number of these tangential areole systems appears to vary greatly at least for *Thalassiosira* aff. *baltica* in pure cultures. For *Coscinodiscus eccentricus*, HUSTEDT (1930 : 389) also mentions a certain variability in the number of tangential areole systems.

Many *Thalassiosira* species were diagnosed more accurately by HASLE (1968), by means of the processes of the valves. "The arrangement of these elements often seems to characterize the species in a better way than the valve structure proper, the areolation" (HASLE, 1968 : 193).

## MATERIAL AND METHODS

The diatoms observed were gathered in the sluice dock of the port of Ostend (Belgium) at different times during 1971. Following species were obtained : *Thalassiosira nordenskiöldii* CLEVE, *T. decipiens* (GRUN.) JORGENSEN, *T. affinis baltica* (GRUN.) OSTENFELD, *T. hyalina* (GRUN.) GRAN, *Coscinodiscus eccentricus* EHRENBERG, *C. kützingi* A. SCHMIDT.

*Thalassiosira nordenskiöldii* and *T. aff. baltica* were isolated and brought into culture. The culture media used were respectively : ES medium of PROVASOLI et al. (1957) with solution C of the medium described by LOOSANOFF (1951) and the medium of VON STOSCH and DREBES (1964). The unialgal cultures were grown in Petri-dishes at a temperature of 21 C ( $\pm 1$ ) and a light intensity of approximately 1400 lux. The light-dark cycle amounts to 16 : 8 hours.

The diatoms have been studied with a Cambridge scanning electron microscope of the Electron Microscopic Service of the Ghent State University.

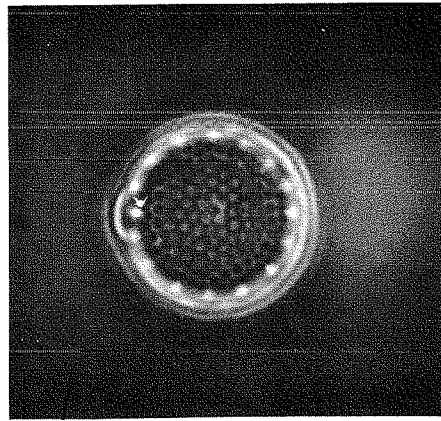
The electron microscopic slides were made according to the methods described by ECHLIN (1969 : 408-415), the diatoms, however, were mounted on the slides without gluten.

## RESULTS

The *Thalassiosira* species were characterized by central mucus pores, most often by a single apiculus (HENDEY, 1959 ; HASLE, 1968 : 197) and tubular spinae. The two *Coscinodiscus* spp. studied did not possess these structures.

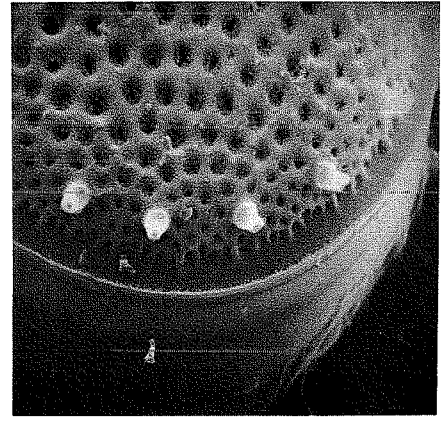
***Thalassiosira nordenskiöldii*** CLEVE-HUSTEDT (1930), Fig. 157, p. 321 ; CLEVE-EULER (1951), Fig. 115.

The valves have a marked reticulation ; the loculi are closed by an irregularly broken cribriform membrane on the outside (Fig. 2 and 3). There was one central mucus pore (Fig. 3), also observed by HASLE (1968 : 196). At the loose end, the spinae often widen calyx-like and are hollow (Fig. 2 and 6). The cells with a maximae diameter developed from auxospores, possessed an analogous structure. The reticulation of the surface was somewhat less marked and the marginal spines were more distinctly calyx-like (Fig. 4). It was, however, remarkable that the loculi of the young cells developed from the zygote do not possess a cribriform membrane ; some loculi were closed by a membrane with a central foramen (Fig. 7). The loculi on the edge of the valves of young cells had an irregularly perforated sieve membrane. Intermediate cases,



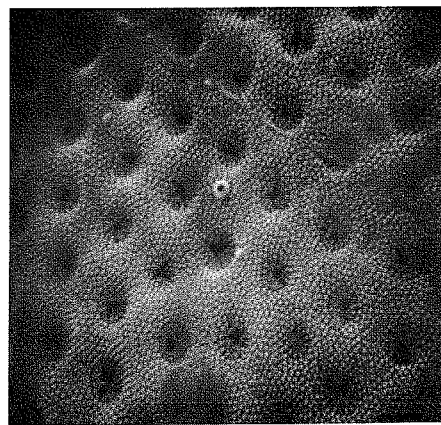
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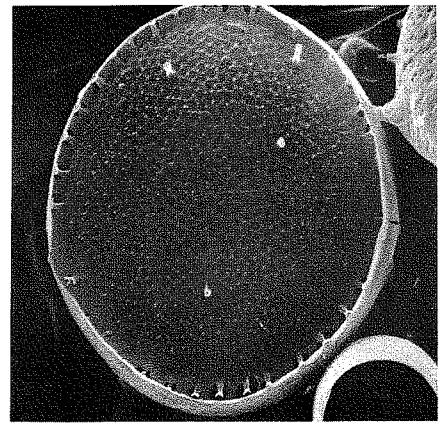
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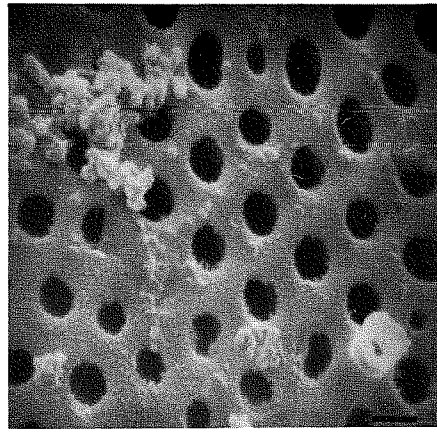


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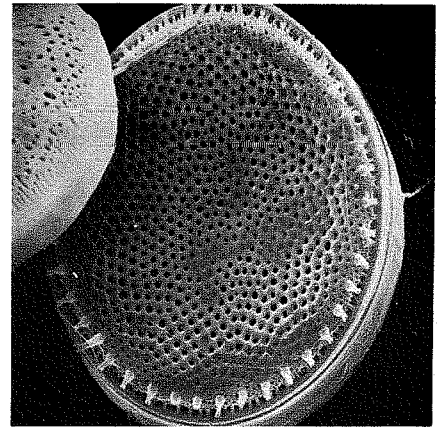
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FIG. 1. — Micrograph (LM = Light micrographs, SEM = scanning electron micrographs) of *Thalassiosira nordenskiöldii*.

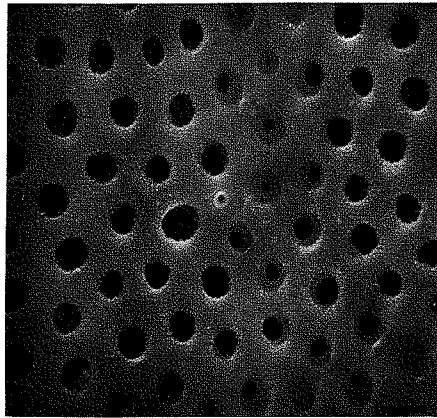
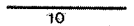
FIG. 2-4. — (SEM) Valve structure of *T. nordenskiöldii* with the central mucus pore (3). Auxopore with some apiculi scattered over the valve (4).



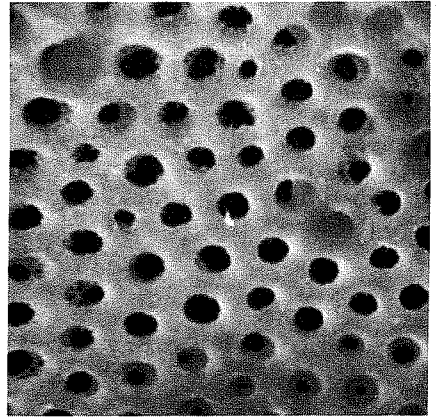
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FIG. 5-8. — (SEM) Detail of an apiculi of an auxospore of *T. nordenskiöldii* (5). Structure of the valves of cells with maximum diameter ; in (7) loculi with a membrane with a central foramen, in (8) several stages in the development of the sieve membrane.

where the membrane show even more small perforations next to the central foramen occurred (Fig. 8). With *Planktoniella sol* (WALLICH) SCHUTT, GERLOFF (1970 : 206) also found different types of membranes in the pores. It is quite possible that there are different developmental stages in the formation of the sieve membranes. With the formation of new silicious valves, the loculi are formed without membranes. Only in older specimens have we found a membrane with a foramen in the loculi, of which a sieve membrane develops.

The zygote itself is distinguished by the absence of a central mucus pore ; there are 3 to 6 apiculi (mucus pores ?) scattered over the valves (Fig. 5 and 6). In the zygote the marginal spines are pressed against a marginal silicious wing with big perforations opposite to the spines.

***Thalassiosira decipiens*** (GRUN.) JORGENSEN-HUSTEDT (1930), (Fig. 158, p. 322) ; CLEVE-EULER (1951), Fig. 116.

Loculi with fine spinae externally on the marginal walls, directed to the centre of the loculi. The central loculi are oviform in contrast with the others up to the edge which are circular (Fig. 9). There is one central mucus pore (Fig. 9) (HASLE, 1968 : 196). The marginal spines are tubular and consist of an exterior tube, which at the loose end widens calyx-like, and a second interior tube which is slightly longer.

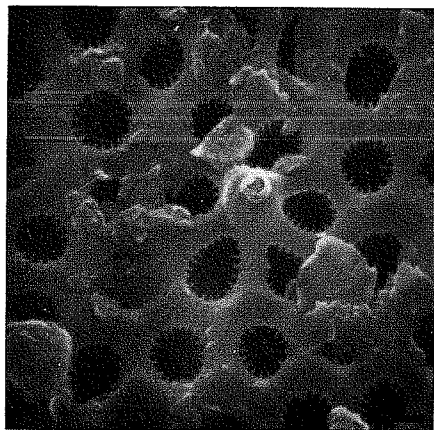
***Thalassiosira affinis baltica*** (GRUN.) OSTENFELD.

The observed organism differs from the description given by HUSTEDT (1930 : 328) in the radiating of the areole rows. The arrangement of the areole rows is, as mentioned above, very variable and cannot be considered as an accurate identification mark (Fig. 11 and 12).

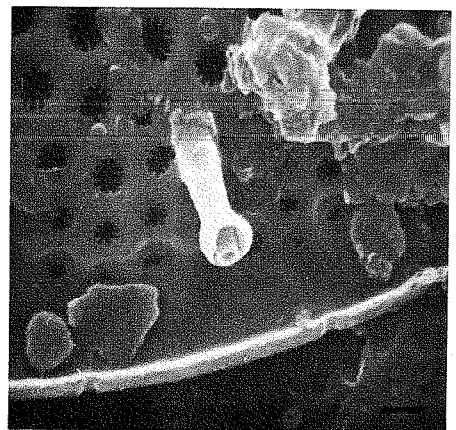
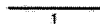
Circular loculi without a sieve membrane are located external and the surface has very fine dots. There is one central (slightly eccentric) mucus pore which arise only slightly above the valve surface (Fig. 15). The marginal spines are arranged in three rows, one of these rows consists of larger spines. Each valve bears one large single apiculus. A part of the copulae protrudes marginally and extends to the valve. Each theca shows a similar structure situated under the single apiculus (Fig. 14).

***Thalassiosira hyalina*** (GRUN.) GRAN-HUSTEDT (1930), Fig. 159 p. 325 ; CLEVE-EULER (1951), Fig. 122 ; HASLE (1968) Fig. 4 (Electron microsc.).

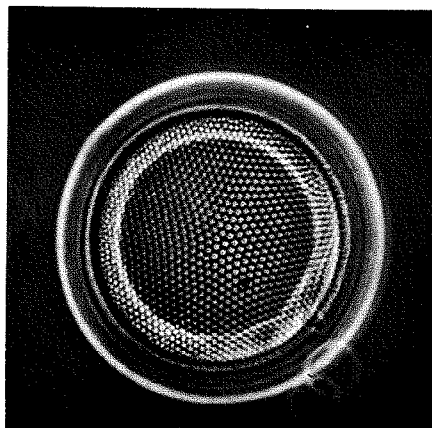
There are no loculi proper ; the structure of the valves consists of small radial silicious beams branching dichotomously ; at the edge,



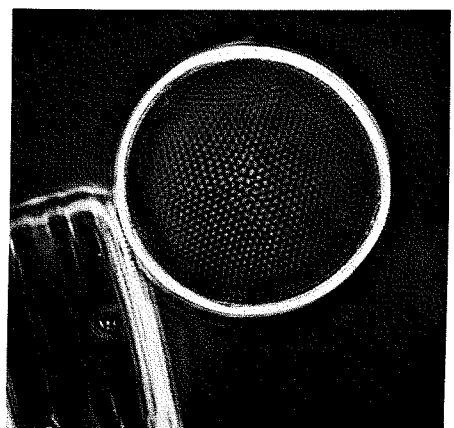
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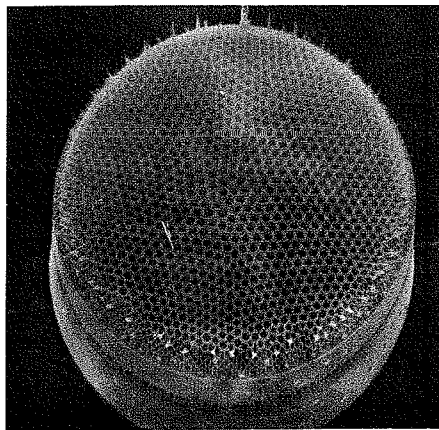


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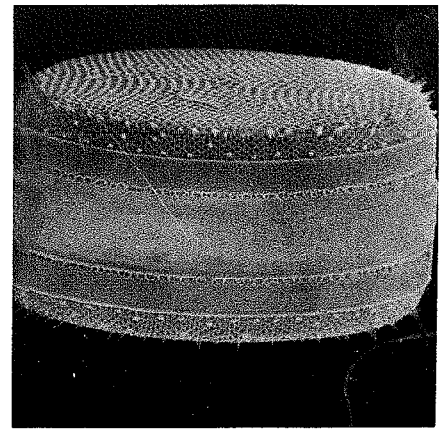
FIG. 9-10. — (SEM) Valve structure with the central pore and a marginal spine of *Thalassiosira decipiens*.

FIG. 11-12. — (LM) Variability in the areolation of *Thalassiosira aff. baltica*.



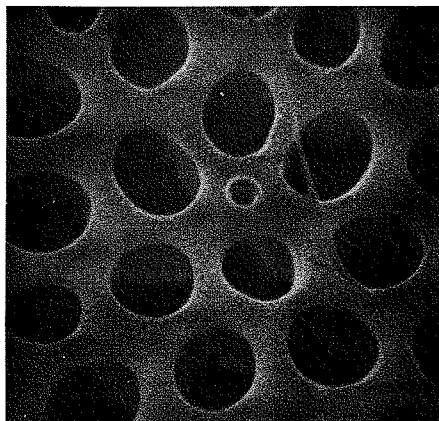
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FIG. 13-15. — (SEM) Valve structure of *Thalassiosira* aff. *baltica*: the marginal spines, the solitary apiculus (10) and the central pore.  
FIG. 16. — (SEM) *Thalassiosira* *hyalina*.

however, areoles are formed (Fig. 16). In the centre there are several mucus pores, each forming a mucus thread (Fig. 17). These threads fuse and build up the mucus thread linking the cells in a chain (Fig. 18). Besides these, there are numerous single mucus pores scattered over the valves from which emerge mucus threads (Fig. 19). There is one single apiculus and one row of marginal spines (HASLE 1968).

**Coscinodiscus eccentricus** EHRENBERG-HUSTEDT (1930), Fig. 201, p. 389 ; CLEVE-EULER (1951), Fig. 118 ; OKUNO (1970), pl. 621 (Electron microsc.).

Loculi are circular, lacking microstructures externally ; the lateral walls are devoid of a special structure (Fig. 21). The spinae are arranged in one marginal row ; they have a broad base and end in a closed point (Fig. 22). Under this row of spines, two other rows of protuberances occur which may perhaps be considered as spines.

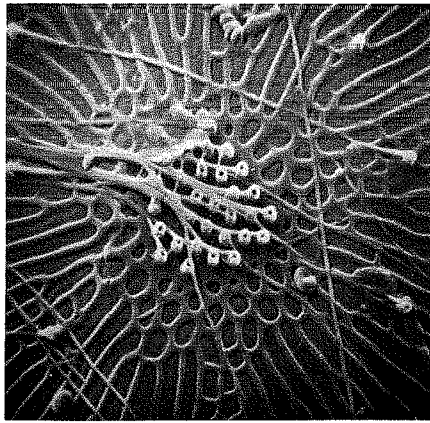
**Coscinodiscus kützingi** A. SCHMIDT-HUSTEDT (1930), Fig. 209, p. 399 ; CLEVE-EULER (1951), Fig. 77.

Loculi are circular ; the lateral walls lack any special structure. The marginal zone of the valves, which has a finer areolation, shows numerous protuberances between the loculi. These protuberances are arranged in radial rows. The spines are located on the edge of the these zone (Fig. 23).

#### CONCLUSIONS

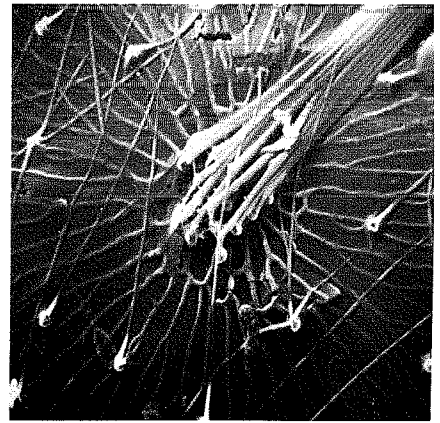
Observations show that there is a distinct difference in the sub-microscopic structure of the thecae of *Coscinodiscus* spp. and *Thalassiosira* spp. studied. The genus *Thalassiosira* is characterized by three types of processes : the central pores, and either a solitary apiculus or with some species an additional apiculus (HASLE, 1968 : 197). *Thalassiosira* aff. *baltica* has these characteristics, but never forms chains as is to be expected from a *Thalassiosira* sp. In *Coscinodiscus eccentricus* and *C. kützingi* none of these structures have been observed. The studied taxa can be distinguished according to the valve processes. CLEVE-EULER (1951 : 390) places *Coscinodiscus eccentricus* with the subgenus *Thalassiosira* ; HUSTEDT (1930 : 390) mentions the presence of "einzelner grösserer Fortsatz" between the other spines in *C. eccentricus*, which corresponds with a single apiculus. From the present study it appears that *C. eccentricus* (s. tr.) lacks this structure. Nevertheless confusion may arise easily with loose *Thalassiosira* sp.-cells that possess a similar areole structure. *T.* aff. *baltica* which in cultures is always found as solitary





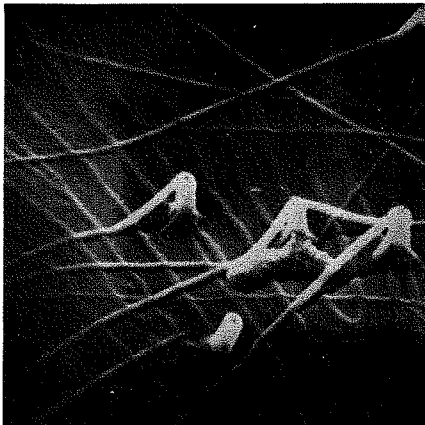
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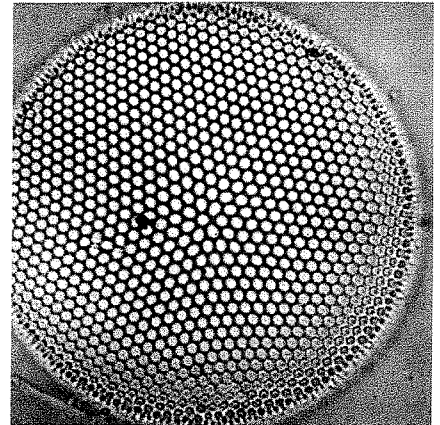
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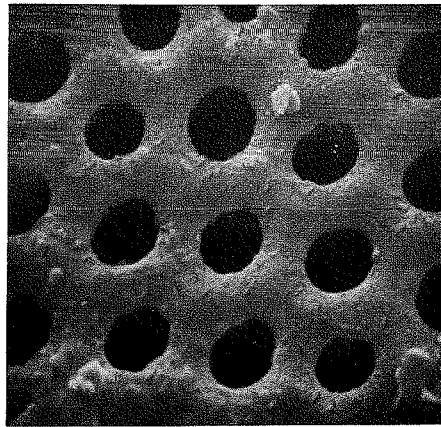


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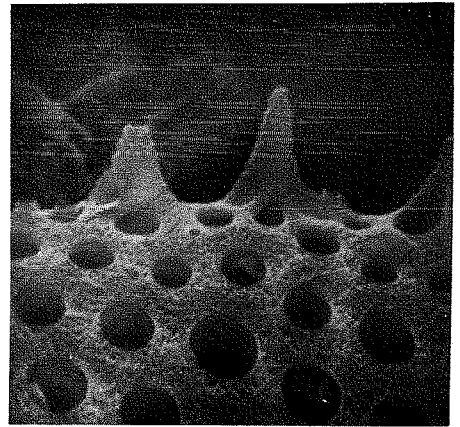
FIG. 17-19. — (SEM) *Thalassiosira hyalina* : the central mucus pores and the mucus thread build up by several fine threads ; in (19) some solitary pores who are scattered over the valve with a mucus thread.

FIG. 20. — (LM) *Coscinodiscus eccentricus*.



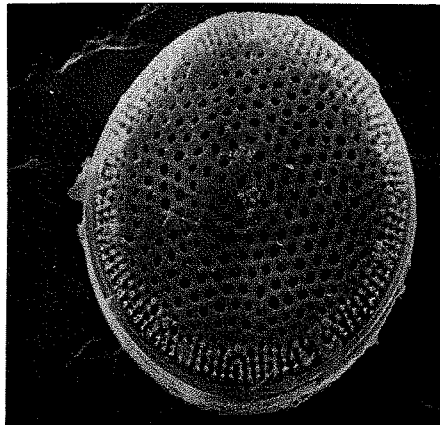
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FIG. 21-22. — (SEM) *Coscinodiscus eccentricus* : structure of the valve and the marginal spines.  
FIG. 23. — (SEM) *Coscinodiscus kützingi*.

## Classification table

	<i>Thalassiosira nordenskiöldii</i>	<i>Thalassiosira nordenskiöldii</i> : auxospores	<i>Thalassiosira decipiens</i>	<i>Thalassiosira aff. baltica</i>	<i>Thalassiosira hyalina</i>	<i>Coscinodiscus eccentricus</i>	<i>Coscinodiscus kützingeri</i>
Number of central pores	1	0	1	1	many (20-30)	0	0
Single apiculus	+	+	+	+	+	—	—
Number of rows of marginal spines	1	1 (+ 3 to 6 apiculi scattered over the valve)	1	3	1 (+ many apiculi scattered over the valve)	1	0
Shape of the spines tubulous	+	+	+	+	+	—	—
Surface of the valves	reticulate	reticulate	smooth	slightly reticulate	no loculi	smooth	smooth
Structure of the lateral wall of the loculi (external)	interrupted sieve membrane	none	fine spines	none	—	none	none

(1) + : structure present, — : structure absent.

cells, has an areolation often resembling that of *Coscinodiscus eccentricus*. The taxon *C. eccentricus* is sometimes taken too broadly, and then includes all solitary cells with tangential areole systems. Numerous intermediate forms, however, may exist which make the distinction of the taxon difficult.

The auxospores of *Thalassiosira nordenskiöldii*, resemble in structure vegetative cells. They lack a central mucus pore, which is found with all *Thalassiosira* species. The spores can be recognized as such and can be distinguished from *Coscinodiscus* sp. by the apiculi scattered over the valves. The reticulation surface of the valves of *Thalassiosira nordenskiöldii* and *T. aff. baltica* and the structures on the lateral walls of the loculi of *T. nordenskiöldii* and *T. decipiens* enable to distinguish these organisms from *Coscinodiscus eccentricus* and *C. kützingi* which lack any of these characteristics. Among several specimens of a same taxon the ultrastructure of the valve surface appears to vary little and can be considered a taxonomically valid identification characteristic. The microstructure of the loculi seems to show a greater variability (GERLOFF, 1970 : 206). It is possible that these variations are due to the development of the sieve membranes of the loculi, which passes through several stages.

The submicroscopic structures of the valves permit a classification of the six taxa studied ; a survey of these structures is given in a table. A classification of the genus *Thalassiosira* was already made by HASLE (1968) according to the valve processes.

#### SUMMARY

By means of a scanning electron microscope, the submicroscopic structure of four *Thalassiosira* species and two *Coscinodiscus* species is studied. Five of these taxa are more or less similar in the arrangement of the areoles ; the sixth one is aberrant. Besides the description of each species and the description of the submicroscopic structure of the auxospore of *Thalassiosira nordenskiöldii*, a classification is given of the six taxa studied.

#### ACKNOWLEDGEMENT

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Laboratory of Morphology, Systematics  
and Ecology of the Plants.  
Dir. Prof. Dr. P. VAN DER VEKEN,  
Ghent State University,  
Ledeganckstraat 35, B-9000 Ghent (Belgium).