

A Study on the Fine Structure of the Marine Diatoms of Korean Coastal Waters-Genus *Thalassiosira* 1.

Jin Hwan Lee* and Kwang-Il Yoo**

* Dept. of Biology, Sangmyung Women's University, Seoul 110, Korea

** Dept. of Biology, Hanyang University, Seoul 133, Korea

한국 연안역의 부유성 규조류의 미세구조에 관한 연구 *Thalassiosira* 속 1.

이진환* · 유광일**

*상명여자대학 생물학과 **한양대학교 생물학과

Abstract

A study on the fine structure of the marine diatom has been carried out for taxonomical purpose during the period from Feb. 1982 to Feb. 1986 in Korean coastal waters. Fine structure of small *Thalassiosira* (Bacillariophyceae) was studied by means of light and scanning electron microscopy. Firstly, four species of *Thalassiosira* were identified and described. Of these *Thalassiosira weissflogii*, *T. minima* and *T. oestrupii* var. *venrickae* were new records for Korean coastal waters.

요약 : 1982년 2월부터 1986년 2월까지 한국 연안역에서 출현한 부유성 규조류중 *Thalassiosira* 속의 소형종에 대하여 주사전자현미경 등을 이용한 미세구조를 연구하였다. 이 결과 *Thalassiosira* 속 4종을 동정하여 기재하였으며, 그중에서 *Thalassiosira weissflogii*, *T. minima*, 및 *T. oestrupii* var. *venrickae* 등 3종을 한국산 미기록종으로 보고한다.

INTRODUCTION

In past the genus *Thalassiosira* has belonged to the Family Melosiraceae, but Simonsen (1972) pointed out that the Family Melosiraceae comprised several natural families. Hasle (1972) emphasized the presence of the structure called strutted tubulus in some of the genera which Simonsen previously placed in Melosiraceae, but not in all of them. Ross and Sims (1972) found evidence in the valve wall structure that some of the genera of Melosiraceae formed a natural group. Hasle (1973) has changed from this to a new family Thalassiosiraceae based on the morphological characteristics; presence of strutted processes involved in colony formation, presence of one

or a few labiate processes, external formation, and cribs.

The genus *Thalassiosira* now includes more than hundred taxa, and it shows considerable variations morphologically and ecologically (Fryxell, 1978). Lee and Cho (1985) have listed up a total of 538 taxa including 460 species, 65 varieties, and 13 forma of phytoplankton diatoms in the Korean coastal waters. Of these, the genus *Thalassiosira* was recognized 18 species. These species have been merely limited to the list of inventory, but fully description of the species has not made yet.

The main subject of this paper is to clarify the fine structure and morphology of *Thalassiosira* from Korean coastal waters. Firstly, the present study was focused to the fine

structures of the species by means of light and scanning electron microscope.

MATERIALS AND METHODS

Most of the materials used for the present study were mainly collected during the period from Feb. 1982 to Feb. 1986 from Korean coastal waters (Fig. 1).

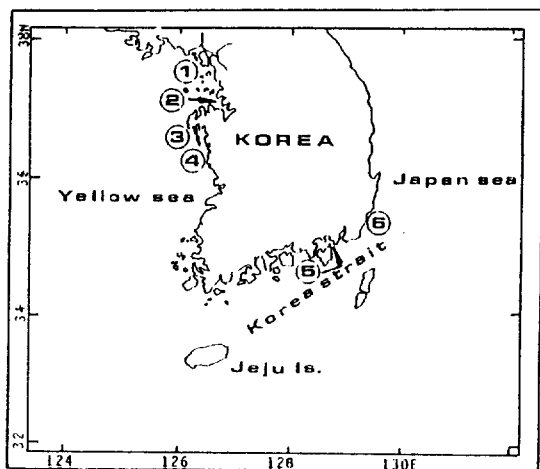


Fig. 1. Sampling areas of phytoplankton diatoms in Korean coastal waters. (1: Incheon Bay, 2: Asan Bay, 3: Chonsu Bay, 4: Daechon coast, 5: Chinhae Bay, 6: Ulsan Bay.)

Samples were observed in permanent mounts in LM and SEM after being cleaned the organic matter (Hasle and Fryxell, 1970; Hasle, 1983). Micrographs were taken with SEM (JSM-35CF), Department of Electron Microscope, Catholic Medical College of Korea.

The terms used were those recommended by the Working Party on Diatom Terminology, 3rd Symposium on Recent and Fossil Marine Diatoms, Kiel 1974 (Anonymous, 1975).

RESULTS AND DISCUSSION

A total of four species of the genus *Thalassiosira* has been identified during the present study; *Thalassiosira weissflogii*, *T. anguste-*

lineata, *T. minima* and *T. oestrupii* var. *venrickae*. Of these *Thalassiosira weissflogii*, *T. minima* and *T. oestrupii* var. *venrickae* were new records for Korean coastal waters.

Description of the species

Thalassiosira weissflogii (Grunow) Fryxell & Hasle Pl. 1(1-4).

Basinonym: *Micropodiscus weissflogii* Grunow (in Van Heurck 1880-1885, p. 210; 1896, p. 493, Fig. 231).

Type locality: Schleswig, Germany.

Synonyms: *Thalassiosira fluviatilis* Hustedt 1926, p. 565, Figs. 1-4, 1928, p. 329-330, Fig. 165, Hasle, 1962, p. 151-156, Pl. I-II, Figs. 1-9.

Thalassiosira hustedtii Poretzky & Anisimova 1933, p. 47, Pl. 9, Fig. 2.

Thalassiosira fluviatilis f. *mangrovii* Manguin (in Bourrelly & Manguin 1952, p. 35, Pl. 1, Figs. 6a-b).

Thalassiosira hustedt var. *vana* Makarova & Proschkina-Lavrenko 1964, p. 39, Fig. 5.

Thalassiosira weissflogii Fryxell & Hasle 1977, p. 68-72, Pl. 1-2, Figs. 1-15, Takano, 1979a, Sheet no. 8, Figs. A-F, Fryxell, Hebbard & Villareal 1981, p. 48, Pl. 6, Figs. 25-28.

Description: Cells disc-shaped in valve view, diameters 6.9-19.0 μm observed. Valve face almost flat or slight concave, valve mantle about 2.0 μm in height. The texture of the outside surface diagnostic; areolae poorly developed, often replaced by thickened radial ribs and some network of cross-venations. One labiate process conspicuous in the ring of the marginal strutted processes, usually closer to one of them. Marginal strutted processes opening pores 9-16 in 10 μm and 0.8-1.0 μm apart. Irregular ring of 4-7 strutted processes evident in SEM from both inside and outside in center of one valve. Central strutted processes opening.

Taxonomic note: The original description of the type species of the genus *Micropodiscus*, *M. weissflogii*, was based on ma-

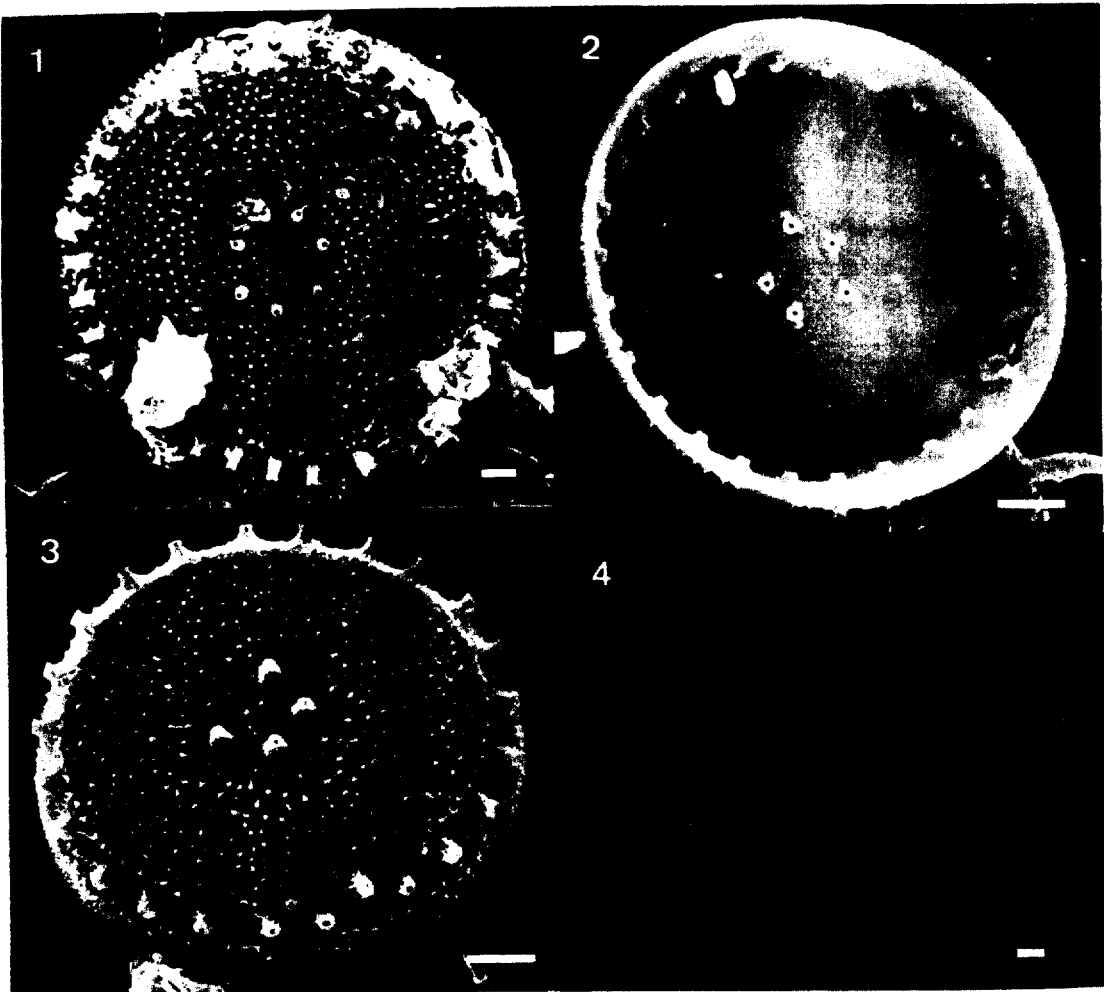


Plate I. *Thalassiosira weissflogii*. Scale = $1\mu\text{m}$, SEM. 1. Outside view of typical cell 2. Inside view of typical cell. Note labiate process at about 11:30 o'clock position. 3. Outside detail of valve showing more network of cross venations. 4. Focus showing valve mantle and valve surface concave.

terial in the Van Heurck Collection, Antwerp, Belgium. Hustedt (1926, 1928) described *Thalassiosira fluviatilis* from the Weser River in Germany. *Thalassiosira fluviatilis* f. *mangrovii* manguin was described in 1952 from Guadaloupe, Mangrove de Bouillante, west India. Poretsky and Anisimova (1933) described *Thalassiosira hustedtii*, remarking its similarity to *Thalassiosira fluviatilis*, especially the marginal strutted processes, the single large labiate process, and the circle of strutted processes around the center. Makarova and

Proschkina-Lavrenko (1964) described a variety, *Thalassiosira hustedtii* var. *vana*, differing from *T. fluviatilis* var. *hustedtii* by the marginal stripes and the inconspicuous structure of the valve on *T. hustedtii* var. *vana*. They illustrated and remarked on the presence of short chains in their material from the Caspian Sea in bay near Baku. Fryxell and Hasle (1977) gave this species then new combination of *Thalassiosira weissflogii* according to patterns of processes on valves, areals size and pattern, size and shape of valve, and

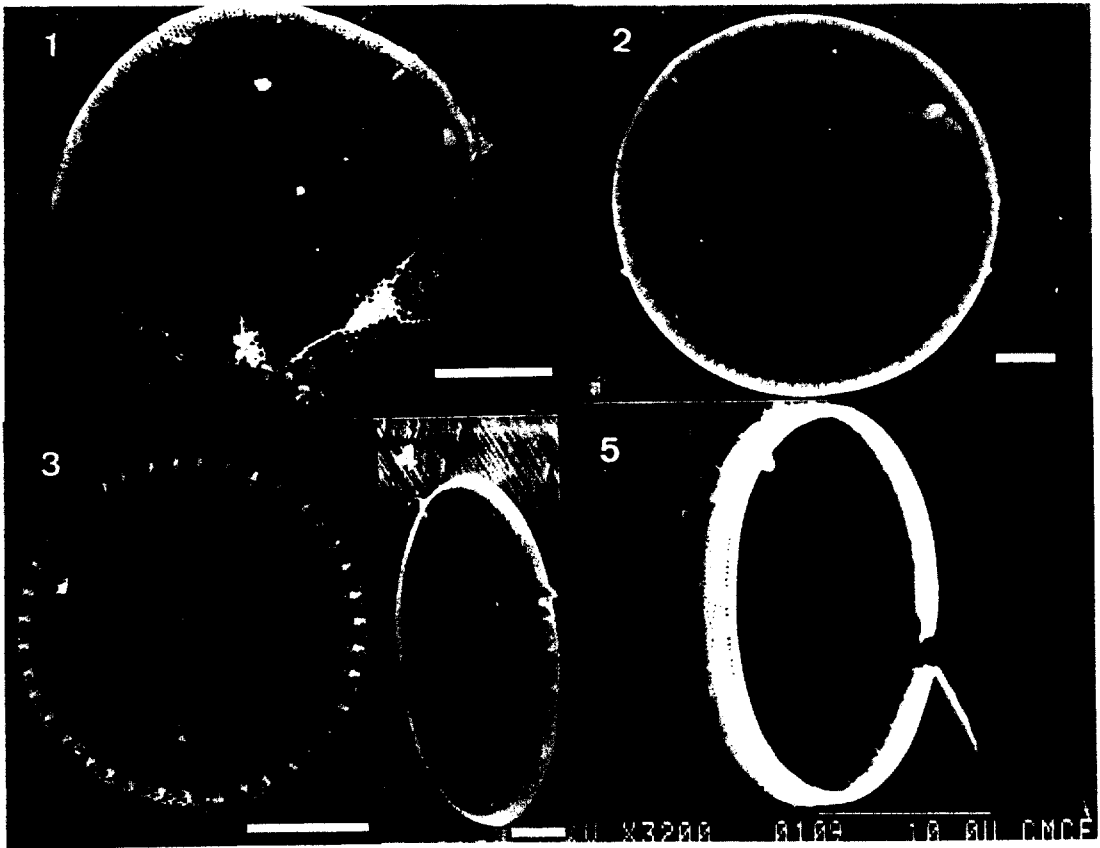


Plate II. *Thalassiosira anguste-lineata*. Scale = 10 μm . 1. Outside view of typical cell. Areolae only developed at marginal parts. 2. Areolae developed in whole valve surface and labiate process near 10:30 o'clock position. 3. Detail of marginal strutted processes showing flared bases and opening labiate process near 4:30 o'clock position. 4. Lateral view of internal cell. 5. External view of cingulum showing rows of coalesced pores.

ecological information.

Thalassiosira weissflogii was new record in Korean coastal waters; June and July 1983 in Chinhae Bay, Sept. 1985 in Incheon Bay.

Thalassiosira anguste-lineata (A. Schmidt) Fryxell & Hasle Pl. II (1-5).

Basionym; *Coscinodiscus anguste-lineatus* A. Schmidt 1878, Pl. 59, Fig. 34.

Type locality: Yokohama, Japan.

Synonyms; *Coscinodiscus polychorda* (Gran) 1897, p. 30, Pl. 2, Fig. 33; Pl. 4, Fig. 56.

Thalassiosira polychorda (Gran) Jørgensen 1899, p. 15.

Thalassiosira polychorda (Gran) 1900, p.

115; Hustedt, 1927-1930, p. 317, Fig. 154, Gran and Angst, 1931, p. 439, Fig. 16, Cupp, 1943, p. 44-45, Fig. 7a, b, Hendey, 1964, p. 89, Pl. 1. Fig. 11.

Coscinodiscus lineatus Ehrenberg f. *polychorda* (Gran) H. & M. Peragallo 1897-1980, p. 427.

Thalassiosira ornata Proshkina-Lavrenko 1959, p. 76, Figs. 1-8.

Thalassiosira anguste-lineata (A. Schmidt) Fryxell & Hasle 1977, p. 73-75, Pl. 4-5, Fig. 22-34, Takano, 1979b, Sheet no. 13, Figs. A-G.

Description: Cell narrowly rectangular in girdle view, with rounded corners. Cells united in chains by several gelatinous threads.

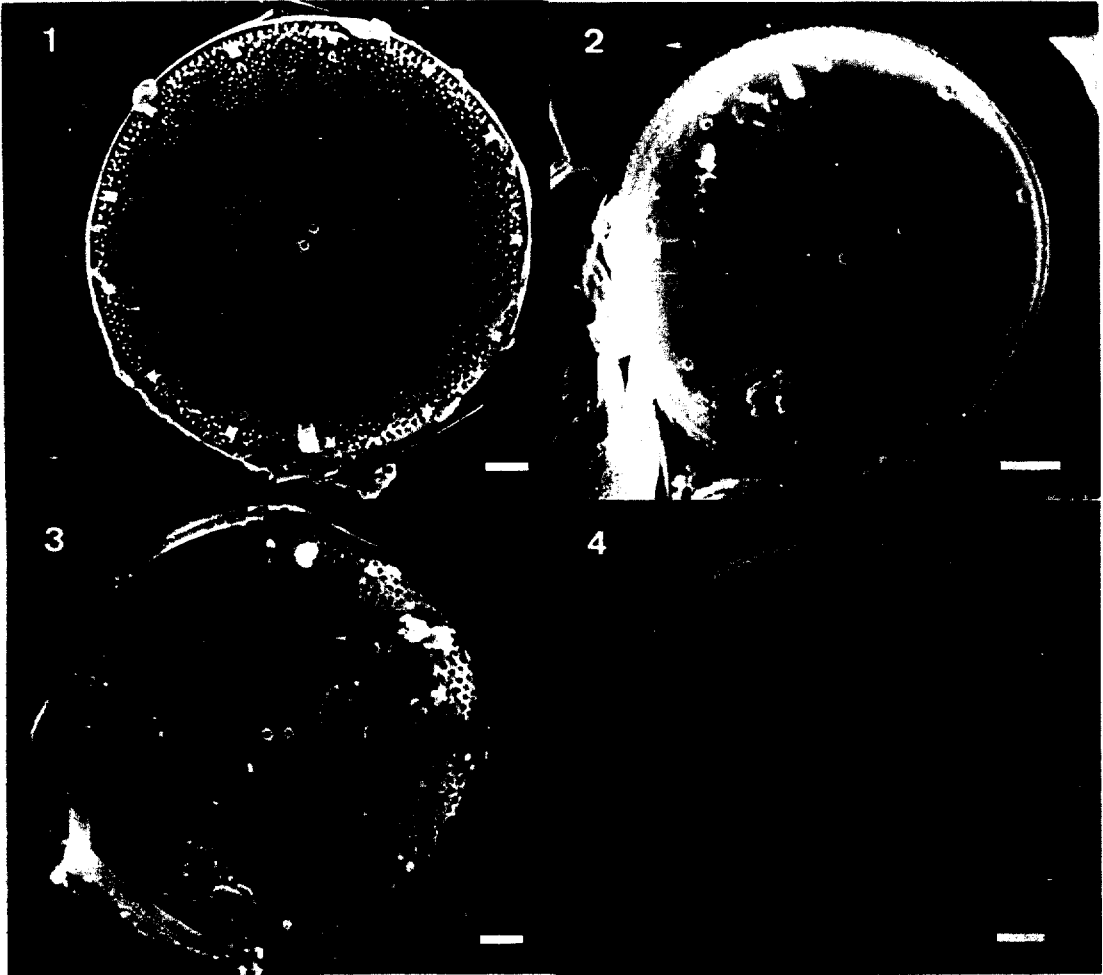


Plate III. *Thalassiosira minima*. Scale = $1\ \mu\text{m}$. 1. Outside view of typical cell. Areolae hexagonal in central parts and granules on the marginal parts. 2. Inside view of typical cell. Marginal strutted processes and central strutted process opening, labiate process near 11:30 o'clock position. 3. Valve center, two central strutted processes. 4. Internal view of labiate process, central strutted processes and marginal strutted processes.

Valve flat and disc-shaped, $30\text{--}66\ \mu\text{m}$ in diameter. Valve surface areolate or not, areolae arranged somewhat irregularly, seldom clearly radiate. A ring of strutted processes on the margin of the mantle, $5\text{--}7$ in $10\ \mu\text{m}$, which flared bases or cutted and ornately sculptured, their height less than $1\ \mu\text{m}$. Granules between marginal strutted processes sometimes developed into spines. One labiate process just on or in the ring of the marginal strutted processes and 3 times as high as marginal strutted processes. Usually no pro-

cess in the center of valve, but a modified ring of arcs, usually $5\text{--}8$, equidistant from the central areola. Each arcs made up of $1\text{--}6$ strutted processes, making a curved line around the center of the valve, curved either toward or always from the center.

Taxonomic note: *Coscinodiscus angustelineatus* was described by Schmidt (1878) from Yokohama of Japan. The problem of the variability of the areola pattern, from linear to fasciculated, was reflected throughout the taxonomic history of this species. Cleve (1897)

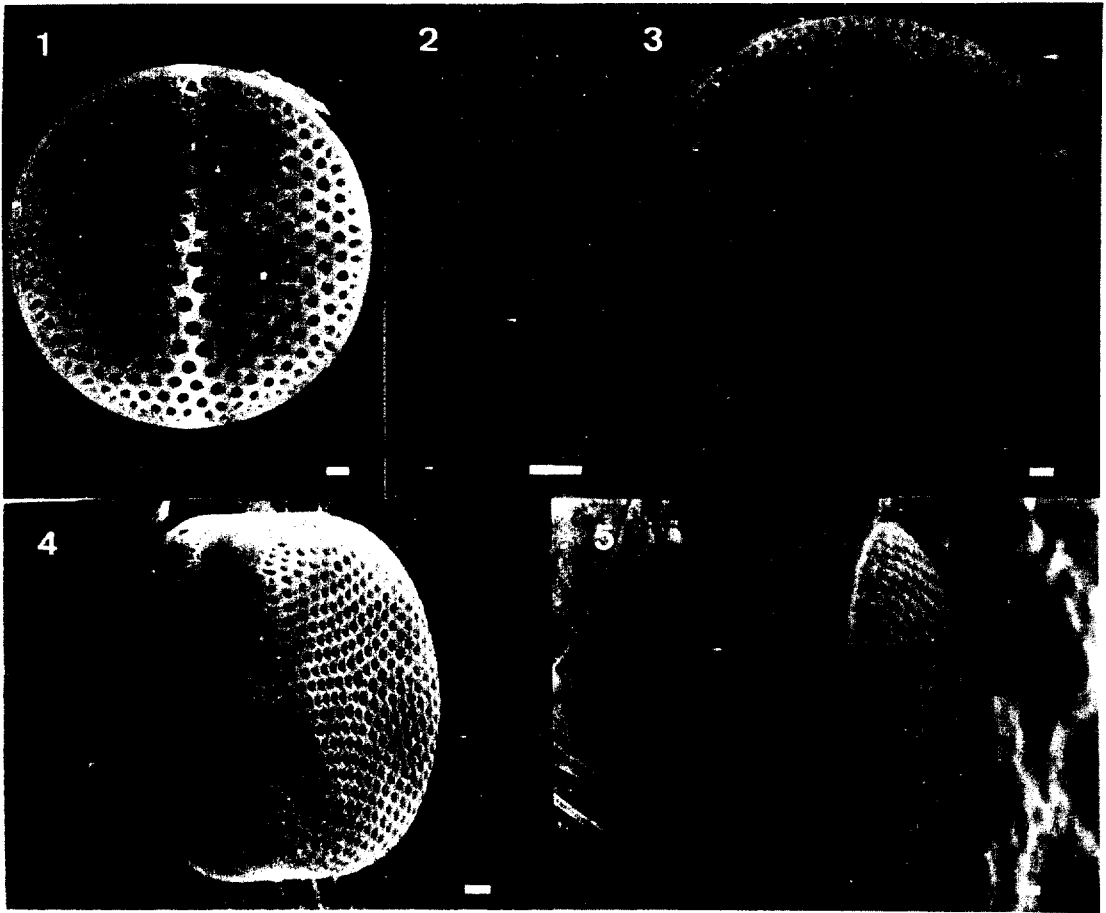


Plate IV. *Thalassiosira oestrupii* var. *venrickae*. Scale = $1\mu\text{m}$. 1. Outside view of typical cell. Large cell with valve having eccentric areola array and two small openings near the center of the valve. 2. Two small holes on face of valve separated by two large areolae. 3. Valve surface with having eccentric areolae. 4. Detail of margin of whole cell and large pores on copula. 5. Detail of girdle area with immature epitheca and hypotheca. Note small pores on copula, valvocopula and one pleurae.

noted that formerly he had considered this taxon a variety of *Coscinodiscus lineatus*, but he had become convinced that it was a distinct and separate species. Later, the basic linear pattern convinced Peragallo (1897-1908) that it should be considered *Coscinodiscus lineatus* f. *polychorda*. The fact that the cells in chains were connected by several threads rather than one thread from the center persuaded Gran (1900) to erect a new genus, *Coscosira*, later rejected by Hasle (1972). Fryxell and Hasle (1977) have reported the distribution of *Thalassiosira anguste-lineata*; the northern

Atlantic, off Plymouth of England, the Black Sea, the Canadian Arctic, Hudson Bay, Passamaquoddy Bay of Canada, off the west coast of the United States of America, the coast of Chile, the northwest Pacific, and off the coast of Japan.

Thalassiosira anguste-lineata was reported the wide distribution in the Korean coastal waters from 1969 to upto present by Lee and Cho (1985).

Thalassiosira minima Gaarder Pl. III (1-4).
Basionym: *Thalassiosira minima* Gaarder

1951, p. 31, Fig. 18.

Type locality: 'Michael Sars' Sts. 3 and 10, 49°32'N, 10°49'W, 10 April 1910 and 45°15'N, 09°20'W, 19 April 1910-North Europe

Synonyms; *Coscinoira floridana* Cooper 1958, p. 125, Figs. a,b,c, Pl. 3 Fig. d.

Thalassiosira floridana (Cooper) Hasle 1972, p. 544, Hasle 1976, Figs. 44, 45.

Thalassiosira minima Gaarder 1951, p. 31, Fig. 18, Hasle 1980, p. 167-170, Figs. 1-17, Takano 1981a, Sheet no. 62, Figs. A-F.

Description: Cells rectangular in girdle view, with rounded corners. Cells united in chains by a central, thin, fairly long thread, up to 15 μm long, usually 6-9 μm long. Valve face flattened, slightly depressed in center and round at margin, 7-12 μm in diameter. Areolae more or less regularly hexagonal to rectangular. Cribrum internal, consisting of fewer pores closer to valve center than in rest of the valve. Foramina external, circular, more or less constricted, sometimes raised above valve surface. Striae radial, shorter striae from valve margin usually terminating with a smaller areola. 3-4 areolae in 1 μm on the valve center, 4-5 areolae in 1 μm on the valve margin. One labiate process as like tongue just on the ring of the marginal strutted processes, usually closer to one of them than the others. One marginal ring of the strutted processes, 9-11, equidistant from the central areola. 2 (seldom 3) central strutted processes, closer together, no true areola between them. Central processes generally with 3 satellite pores, marginal one with 4.

Taxonomic note: Gaarder (1951) described *Thalassiosira minima* in the coast banks of North Europe from the "Michael Sars" North Atlantic Deep-sea Expedition 1910 for the first time. Cooper (1958) described *Coscinosira floridana* from the surface waters of the Gulf of Mexico off Fort Meyer, Florida. Hasle (1972) reported the inclusion of *Coscinosira* in *Thalassiosira*. Hasle (1980) studied that *Thalassiosira minima* and *Coscin-*

osira floridana were conspecific from LM and SEM. Hasle (1976) discussed the world-wide distribution of *Thalassiosira minima* under the name *Thalassiosira floridana*: the coast of Chile in the Pacific Ocean and from Oslofjord of Norway to the south coast of South Africa in the Atlantic Ocean. Takano (1981a) found this species in Tatibana-ura, Tokushima of Japan.

Thalassiosira minima was new to Korean coastal waters; July 1983 in Chinhae Bay and August 1985 in Asan Bay.

Thalassiosira oestrupii var. *venrickae* Fryxell & Hasle Pl. IV (1-5).

Fryxell & Hasle 1980, p. 810, Fig. 11-19, Takano 1981b, p. 47, Fig. 10-12, Takano 1982, Sheet no. 96, Fig. A-F.

Type locality: 29°32'N, 85°28'W, 13 Nov. 1974-Florida, U.S.A.

Description: Drum-shaped cells in girdle view. Cells 18-23 μm in diameter and valve surface convex. Valve with eccentric areola array, 9-12 in 10 μm in the center, 8-13 in 10 μm near the margin. Valve with extremely large areolae in the center of valve. No processes extruding on the outer surface of valves. A small pore opening of the labiate process located a few areolae apart from the center. Two small opening holes on face of valve separated by two large areolae. One strutted processes located nearly in center. Single labiate process 3 areolae distant. Marginal strutted processes 4.1 μm apart. Valvocopula with vertical rows of pores, with 1.8-3.6 μm in height. Copula with single row of pores, 15-19 in 10 μm . Pleurae visible, with no such large pores.

Taxonomic note: Fryxell and Hasle (1980) studied the species from the Atlantic Ocean, the Gulf of Mexico, the Indian Ocean and the Pacific Ocean. They also pointed out that this variety appeared in the tropical and subtropical continental shelf taxon. Takano (1981b) isolated the taxa in culture from the seawater taken in the Suhonada off Bungo-

takada, Oita Prefecture, in November 1980.

Thalassiosira oestrupii var. *venrickae* was new to Korean coastal waters; February 1982 in Chinhae Bay, May 1984 and January 1986 in Daechon coast, February 1986 in Chonsu Bay.

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