Harmful Blooming of Minute Cells of *Thalassiosira decipiens* in Coastal Water in Tokyo Bay

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In September, 1951, a great number of bivalves cultured in the coastal water of Chiba City (facing Tokyo Bay) were damaged by discolored water caused by vigorous multiplication of a minute phytoplankter. The event was reported in a paper read by Mr. Kaneo Sugawara (Chiba Prefectural Fisheries Experiment Station) at the annual meeting of the Japanese Society of Scientific Fisheries held in Tokyo on April 5, 1953. He identified the plant, with some doubts, as *Thalassiosira subtilis*† or an unknown species of *Phaeocystis*.†† The present writer received the material tow-netted in the discolored water from Mr. Sugawara, by favour of Mr. Micrinori Tamakawa (then at the Tokai Regional Fisheries Research Laboratory), and noticed at once that the predominant was a minute form belonging to the genus *Thalassiosira*. The purpose of the present paper is to clarify the taxonomic position of the plant.

The diatom bloomed in the discolored water has following characteristics under light-microscope:— Cells disc-shaped or box-like, 4-10 μ in diameter, embedded densely in formless gelatinous masses. Valves flat, with an apiculus on rounded margins. Areolae, not visible in water, arranged in eccentric system as same as *Th. decipiens*. Marginal punctae extremely minute, difficult to see. Chromatophores 2-4, more or less lobed.

As areolae of the present form were not visible in water mounts, the writer thought at first sight it had a resemblance in size or in cell form to several small species in *Thalassiosira*, such as *Th. nana* LOHMANN (1908), *Th. marginata* VENKATARAMAN (1939), *Th. minuscula* KRASSKE (1941), etc. However, by a more detailed examination, he could find in burned specimens the areolae arranged in eccentric system and a row of small marginal punctae (probably bases of marginal spines), which are evidently seen in electron-microphotographs (Plate I, Figs. 5-7). So the questionable species stands clearly with *Th. decipiens* (GRUN.) JÜNG. except considerable differences in size and in clearness of sculpturing.

In some authors' monographs (HUSTEDT, 1930; CUPP, 1943 etc.), Gen. *Thalassiosira* is placed in Sceletoneminae. CLEVE-EULER (1942, 1951) believes its close affinity with *Coscinodiscus* and claims to put the genus in *Coscinodiscus* as a subgenus. It is well known that some species of *Coscinodiscus* make their small individuals in mother cells or in packets held together by a fine membrane. MURRAY (1896) found such form dividing in 2, 4, 8, 16 small cells on *Coscinodiscus concentris*, and KARSTEN (1907) also on *Coscinodiscus* sp. Murray states that the individual membranes of the young packet *Coscinodiscus* are either not silicified or are incompletely so, and they are therefore capable of superficial growth. Gran (1902, 1904) describes as if the phenomenon may be found on more or less morbid cells tending to death. KARSTEN supposes that the diatoms are driven to form small cells when the microspore-formation is prevented by unknown factors in or out of cells. Moreover, he claims the phenomenon to be the normal growing procedure of microspores of *Coscinodiscus* (cf. Karsten, 1929, p. 174. "Apogamie bei den Centrales"). Here it is accordingly conceivable that the present form may be the small cells of *Th. decipiens* grown from the microspores.
or in process of the microspore-formation. In fact, the blooming of the minute form in the coastal water of Chiba City must have broken out in unusual circumstance, and small cells are divided in irregular size varying 4-10 μ in diameter in a colony (see Plate I, Fig. 4) making to remind the Gran’s statement. However, the writer has commonly found in materials collected from waters in Sagami Bay in winter small individuals, quite identical with the cells appeared in the discolored water, which are wholly uniform in size in a mass.

On the other hand, the present form is closely alike to Th. Levanderi Van Goor (1924) which has been known from Finnish water. In Th. Levanderi cells are 8-13 μ in diameter and have similar sculptures of valves to Th. decipiens, which were observed with great difficulty by Van Goor.

Van Goor (1924, p. 322) describes as follows:—

Als ich in den frisch angefertigten Styroporpräparaten keine Schalenstruktur auffinden konnte, dachte ich an eine Verwandtschaft mit den beiden von LOHMANN aus der Kieler Bucht beschriebenen Arten, Th. nana und Th. Saturni. Als die Präparate jedoch gründlich eingetrocknet waren und dadurch vielleicht der Brechungsindex sich ein wenig geändert hatte, fand ich im Lichte kürzester Wellenlänge mit der 2-mm Apochromat-Ölimmersion N.A. 1,4 von Zeiss eine sehr zarte aber unverkenntliche Porenstruktur, die ich nach einer ganz reinen Schale in der Fig. 11 so genau wie nur möglich abgebildet habe.

Th. Levanderi has no apiculus on valve margins whereas the present form has it. But the presence of a marginal apiculus seems not a decided character for separating them. As for Th. decipiens, some author gives actually no description on it (Hustedt, 1930) but another describes as it is present (Cuff, 1943). Th. Levanderi has also no marginal puncta notwithstanding the present form has them. Though marginal punctae of the present form are clearly seen in large cells in electron-microphotographs, the writer made considerable efforts for finding them under light-microscope. If treatments of the specimens have not been carried out well, it is probable that one cannot notice them whereas they are present. Van Goor observed as the colony of Th. Levanderi only several cells connected in chains by a central mucilage thread. In the form here dealt with, numerous cells are involved in irregular gelatinous masses, and sometimes the marginal apiculus connects cell to cell. However, the writer has commonly observed the present form in materials from Sagami Bay in winter, cells of which are mostly embedded in gelatinous masses but sometimes several cells are connected in chains by a fine mucilage thread without surrounding gelatinous substance. Thus the writer regards as Th. Levanderi does not differ from the present form although Van Goor did not find the marginal punctae and also he did not refer enough to the colony formation.

As the result of observations and considerations mentioned above, the writer regards that the present form is not a species out of Th. decipiens but a form in process of reproduction of the species. And for distinguishing it from the type it is better to place it as a forma of Th. decipiens emending the former description by Van Goor as Th. Levanderi.

Thalassiosira decipiens (GRUN.) Jørg.
(Syn. Coscinodiscus decipiens GRUN.)
Form Levanderi (Van Goor) forma emend.
(Fig. 1 a-d; Plate I, Figs. 1-7)
1924. Thalassiosira Levanderi VAN GooR, Rec. d. trav. bot. néerland., vol. 21, p. 322, fig. 11.


Cells smaller than the type, 4-13 μ in diameter, disc-shaped or box-like, embedded in formless gelatinous masses or connected in
chains by a mucilage thread. Valves flat, generally with an apiculus on rounded margins. Marginal punctae very minute, 4-5 in 10μ, difficult to see. Areolae arranged in eccentric system as same as the type, not visible in water. By diagnosis in electron-microphotographs, areolae ca. 20-21 in 10μ in center, 23-24 near margin. A small mucous pore near valve center. Chromatophor's 2-4, more or less lobed.

Marine. Neritic, temperate form.

It is well known that some minute species of *Thalassiosira* were often found in enormous numbers in blackish water. *Th. fluviatilis* Hustedt (1926) was the cause of the 'Wasserblüte' in the river Werra, Germany. *Th. marginata* Venkataraman occurred abundantly also in the lower Werra (*Thalassiosira* sp. in Kolbe and Tieg, 1929) and in the river Cooum, Madras (Venkataraman, 1939). Gran and Braarud (1935) made mention of small cells of *Thalassiosira* with quite thin cell walls observed at the stations in the Bay of Fundy, in the Gulf of Maine, where a rich *Scolethonema*-plankton was growing, and the specimens were difficult to classify because of the thin cell walls but some of them were certainly small specimens of *Th. Nordensioldii* Cl.

Discolored waters caused by diatoms give mostly no distinct injuries to aquatic productions. But in the present case, *Th. decipiens* forma *Levanderi* has been regarded as the cause of the harmful discolored water at the coast of Chiba City. The water temperature was comparatively high, arranged from 22.7°C to 24°C, and the salinity from 29.56‰ to 31.60‰ in the area (recorded by Sugawara). Though many diatom species appeared with it in water, they were far less in quantity than it. The other main constituents were as follows:—

*Stephanopyxis palmeriana* (Grev.) Grun.  
*Scolethonema costatum* (Grev.) Cl.  
*Coccinodiscus gigas* Ehr.  
*Corethron pelagicum* Brun.  
*Bacteriovorum varians* Laud.  
*Chaetoceros decipiens* Cl.  
*Dityum Brightwellii* (West) Grun.  
*Biddulphia sinensis* Grev.  

*B. longicurvis* Grev.  
*Thalassionema nitzschoides* Grun.

So far as we know, there is no example of such injuries to aquatic animals caused by blooming of a single diatom plankter. Many individuals of bivalves might be put to death not only by degeneration of water but also by mechanical closing of respiration by gelatinous substance densely attached to gills of them. According to Sugawara, fishermen suffered a great loss at the time and the damages amounted about ¥57,958,000.00.

Of the accompanying photographs, those
taken by electron-microscope were prepared by Mr. Sigco Sakata (Department of Radiology, School of Medicine, University of Tokyo), by favour of Mr. Takahisa Nemoto (Whales Research Institute, Tokyo). The other microphotographs were taken assisted by Mr. Yoshio Takemura (Tokai Regional Fisheries Research Laboratory). The writer expresses his sincere thanks to all gentlemen who supplied generous assistance in the course of the present study.

References


, 1928: "Abteilung Bacillariophyta (Diatomeae)." In ENGLER and PRANTL, Die Natürlichen Pflanzenfamilien, 2, 105-303, 332 figs.


Plate I. Th. decipiens f. Levanderi (VAN GOOR) TAKANO

Figs. 1-4. Sights under light-microscope.

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\begin{align*}
&\text{Figs. 1-2. Material in formalin solution.} \\
&\text{Figs. 3-4. Material washed by water.} \\
&\times (\text{in Fig. 3): } \text{typical form of Th. decipiens (GRUN.) JöRG. appeared in the same mass.}
\end{align*}
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Figs. 5-7. Sights under electron-microscope.

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\begin{align*}
&\text{ap: marginal apiculus, } \\
&\text{mp: marginal punctae, } \\
&\text{pa: mucous pore}
\end{align*}
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