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Examination of the type material of *Diploneis boldtiana* Cl. (Bacillariophyceae)

Masahiko Idei* and Hiromu Kobayasi**

*Institute of Biological Sciences, University of Tsukuba, Tsukuba-shi, Ibaraki, 305 Japan
**Department of Biology, Tokyo Gakugei University, Koganei-shi, Tokyo, 184 Japan

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The type material of *Diploneis boldtiana* Cl. in the P. T. Cleve Collection was examined by LM and SEM together with recent material from Finnish lakes. *D. boldtiana* has following features; the outer wall of the alveolus is composed of double rows of areolae, but near the margin it has three rows of areolae; the last two alveoli are wide, and form a triangular shape; a small round opening is present at the margin of each alveolus.

Key Index Words: *Diatom*—Diploneis—Diploneis boldtiana—*fine structure*—*type material.*

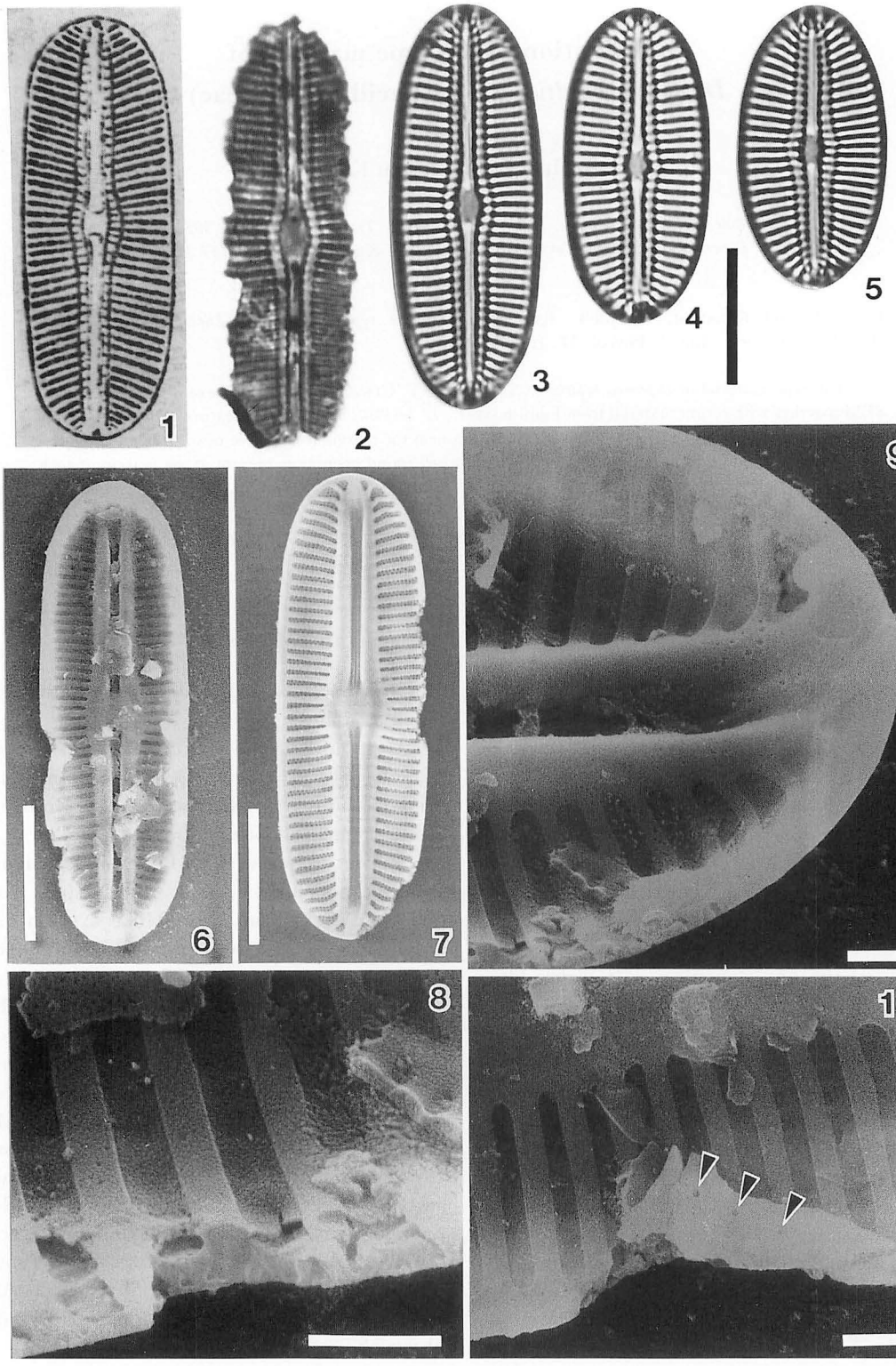
The first total systematic treatment of the genus *Diploneis* was accomplished by Cleve (1894) who described many new species and transferred many taxa to this genus, mainly from *Navicula*. The name *Diploneis* was first given by Ehrenberg (1844). *Diploneis boldtiana* was also described by Cleve (1891) from Finnish material (northern Savolaks) collected by R. Boldt. Since these early reports, information about *D. boldtiana* has come mostly from Finland (Hustedt 1937, Mölder and Tynni 1973, Krammer and Lange-Bertalot 1986). We have already reported the fine structure of *D. parma* Cl., which was described at the same time with *D. boldtiana* in Cleve's paper of 1891, based on the type material (Idei & Kobayasi 1988a). Cleve (1891) examined only a few specimens for his original description. We also examined a part of the same sample, but unfortunately found only one valve. However, we were able to get some valuable information in characterizing this taxon from this specimen. We have also found many specimens from three Finnish lakes and have been able to carry out more detailed investigations.

Material and Methods

The material used in this observation is listed as follows:
(1) Unmounted type material from Lake Viando (Sb. 4, No. 12:4, Savonia borealis, Viando) housed in the Swedish Museum of Natural History, Stockholm.
(2) Recent material from Finland: sediment from Lake Pääjärvi on 11 August 1986, K-6331; sediment from Lake Mekrijärvi on 12 August 1986, K-6338; sediment from Lake Isolampi on 12 August 1986, K-6345.

These specimens were treated with sulphuric acid and potassium nitrate to remove organic matter, and then washed in distilled water. For LM, the cleaned valves were embedded in Pleurax. Valves for SEM were prepared by air drying on glass coverslips which were then fixed to metal stubs. They were coated with gold-palladium using a Fine Coat JFC-1100 and observed with a JEOL-F15 field emission type SEM. The specimens for TEM were placed on formvar-coated 50-mesh copper grids and observed using a JEOL-100C.

The terminology follows Anonymous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(1975), Ross *et al.* (1979), von Stosch (1975) and Mann (1981).

Observations and Discussion

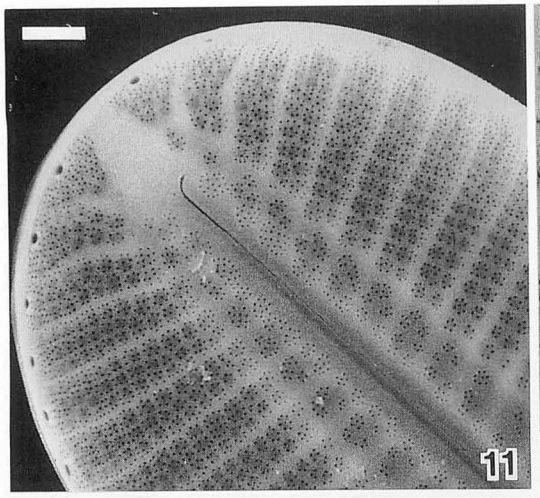
The type material of *D. boldtiana* in the Swedish Museum was very scarce and we were able to examine only a small part of it. Only one valve specimen was found (Figs. 2, 6, 8–10). It is linear-elliptic, 30 μm long and 11 μm wide. The longitudinal canals are narrow and almost straight except at the central area. The transapical striae are 14 in 10 μm. These values are fully consistent with the original description and figure (Fig. 1). Valves in the recent material from Finnish lakes are 20–30 μm long and 11–12 μm wide (Figs. 3–5). There is a small range of variation of the valve width. Valve shape is linear-elliptic in large specimens and elliptic in small ones. The striae are constantly 13 or 14 in 10 μm. They are parallel near the center and gradually radiate toward the apices, though in the original figure they are radiate throughout the valve. The last stria is parallel to the apical axis. We regard this feature as one of the criteria for this taxon. According to Hustedt (1937) the striae are composed of two rows of areolae (27–30 in 10 μm), but they are not visible by LM. However, TEM and SEM observations showed that the striae are basically two rows of areolae, as mentioned by Hustedt (1937), but the number of the areolae is denser (35–38 in 10 μm) than that of the Hustedt's description. This density is beyond the resolving power of LM.

The specimen obtained from type material was observed without acid treatment, so it was covered with a lot of inorganic and organic material, and the external surface was almost entirely covered with organic material. However, it gave us some important information for taxonomy (Figs. 2, 6, 8–10). The longitudinal canals are constantly narrow over their length as seen by LM, and do not have openings on their inner walls (Figs. 6, 7). In *Diploneis* generally, transapical costae are straight and slightly curved near the poles. In *D. boldtiana* the second costa from the last is strongly curved. As a result the last two alveoli are apparently wide, and form a triangular shape (Figs. 9, 12).

The external raphe fissure is narrow and straight. The central and terminal fissures are short and curved at nearly right angles in the same direction (Figs. 11, 13). In *Diploneis* curved central and terminal raphe endings have not been reported except marine species *D. crabro* (Sims and Paddock 1979, Navarro 1982). *D. oculata, D. minuta* (Idei and Kobayasi 1986) and *D. marginestriata* (Idei and Kobayasi 1988b) have straight fissures at both ends. *D. papula* (Gerloff and Helmcke 1975) and *D. finnica* have a straight central fissure and a curved terminal one. The internal raphe fissure is narrow straight slits which terminate simply at both central and terminal ends (Fig. 12).

The outer wall of the alveolus is composed of double rows of areolae (Figs. 12, 15, 17, 18), but near the margin it has three rows of areolae (Fig. 12). Moreover, the second alveolus from the last has several rows of areolae (Fig. 12). The outside of each areola is occluded by a cribrum (Figs. 11, 13, 14). The perforations of the cribra are densely and regularly scattered, but those of the central region surrounding the central nodule are scarce due to the small areolae (Figs. 13, 14, 18). Externally the hyaline lines showing the boundaries of alveolus are present, even though they are not apparent at the margin (Figs. 11, 14), as seen in *D. parma* (Idei and

Fig. 1. P. T. Cleve's original figure of *Diploneis boldtiana*. Fig. 2. Light micrograph of the isotype specimen coated with gold-palladium used for SEM observation. Sb. 4. Fig. 3. The large linear-elliptic valve. K-6345. Fig. 4. The medium sized valve. K-6331. Fig. 5. The small elliptic valve. K-6345. Fig. 6. Internal view of the valve which is the same as Fig. 2. Fig. 7. Internal view of the valve. K-6345. Fig. 8. Enlargement of Fig. 6 showing the broken edge of the alveoli and transapical costae. Fig. 9. Enlargement of Fig. 6 showing the internal valve end. Fig. 10. Enlargement of Fig. 6 showing the openings of alveoli at the valve margin (arrowheads). Bar in Figs. 6, 7=10 μm, in Figs. 9, 10=1 μm. Figs. 6–10. SEM.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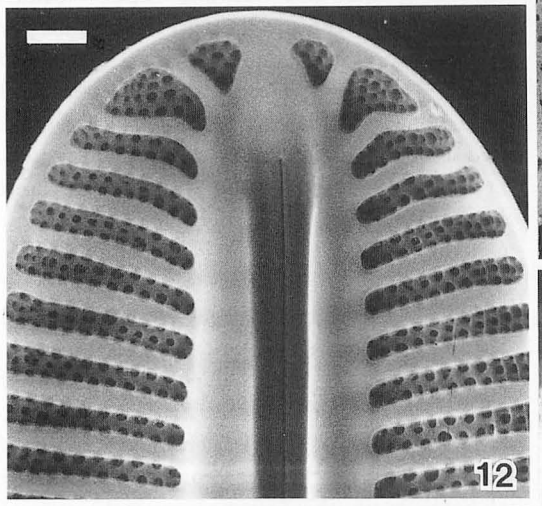
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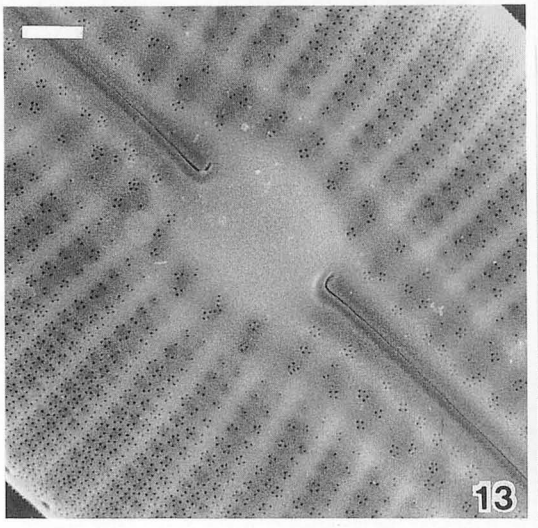
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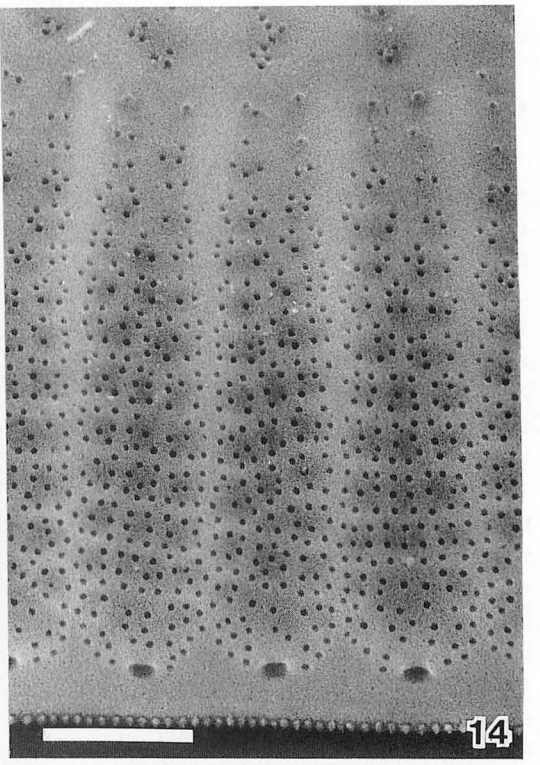
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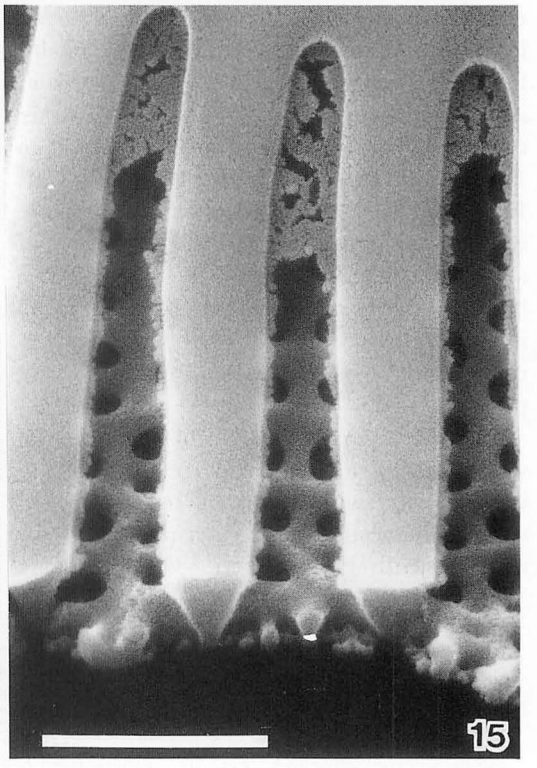
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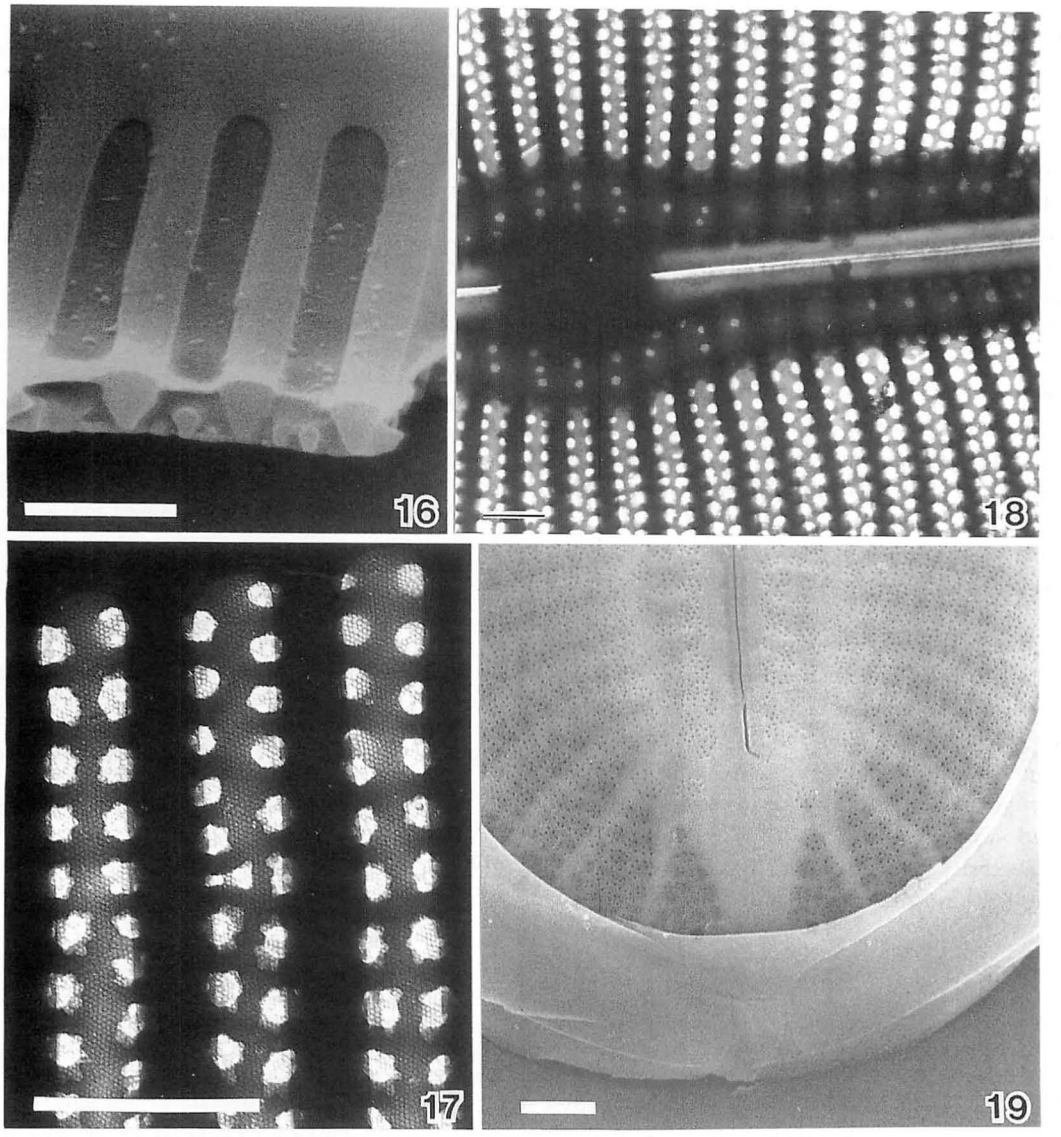

Fig. 16. Internal broken valve showing the inner occlusion of the alveoli. K-6345. Fig. 17. The inner occlusions with perforations arranged in an hexagonal array. TEM. K-6345. Fig. 18. Smaller areolae of the alveoli surround the central nodule. TEM. K-6345. Fig. 19. External valve end showing the open ends of the valvocopula and the ligula of the pleura. K-6331. Bars=1 μm.

KOBAYASI 1988a).

A small round opening is present externally at the margin of each alveolus (Fig. 10 arrowhead, Figs. 11, 14). We regard this feature as one of the important taxonomic criteria for this species. The same feature,

Fig. 11. External valve end showing the curved terminal raphe fissure. K-6331. Fig. 12. Internal valve end showing the alveoli lacking inner occlusions, and the two sets of triangular-shaped alveoli at the valve pole. K-6345. Fig. 13. External central valve showing the curved central raphe fissures. K-6331. Fig. 14. Detail of the valve showing the areolae occluded by cribra and the opening at the end of each alveolus. K-6331. Fig. 15. Internal valve showing the detail of a broken edge of the transapical costae, and the two rows of areolae and the eroded innner occlusions of the alveoli. K-6345. Bars=1 μm.

but different in shape, is present in *D. finnica* (manuscript under review).

Marginal granules are also present at the valve margin (Fig. 14). There are 12 or 13 granules in 1 μm as in *D. parma* (IDEI and KOBAYASI 1988a). The shape of the transapical costa in cross-section is obovate, being narrow externally and broadly rounded internally (Figs. 8, 15, 16). Internally each alveolus is occluded by a thin siliceous layer with perforations arranged in a hexagonal array (Figs. 10, 16, 17). This inne occlusion of the alveolus is attached to the widest portions of the transapical costae. The cingulum is composed of two bands, one valvocopula and one pleura (Fig. 19), but their details were not observed.

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出井雅彦*・小林　弘**：*Diploneis boldtiana* Cl. のタイプ材料の調査

スウェーデンの自然史博物館所蔵の P. T. Cleve のコレクションの中の *Diploneis boldtiana* のタイプ材料を光顕及び走査電顕を用いて調査した。また同時にこの種の原産国であるフィンランドの現生の試料についても調査した。その結果以下のような特徴がみられた。長胞条線の外壁は 2 列の胞紋からなるが，殻縁近くでは 3 列となる。殻端の 2 つの長胞条線は特に広く三角形となる。各長胞の外側の殻縁側末端には 1 個の開口がある。(*305 茨城県つくば市天王台1-1-1　筑波大学生物科学系　**184 東京都小金井市貫井北町4-1-1　東京学芸大学生物学教室)