The genus *Fallacia*, established by Stickle and Mann (Round et al. 1990), includes many small species that previously belonged to the genus *Navicula* Bory sensu lato. The genus *Fallacia* is characterized by a single H-shaped plastid, lateral sterna interrupting striae and finely porous conopeum completely and partly covering striae. The lateral depressed sterna exhibit lateral hyaline areas on the valve face, when observed by light microscope. Those lateral hyaline areas also present in *Lyrella* species, however, they lack the finely porous conopeum. Now there are over 100 species in the genus *Fallacia* (Guiry M. D. in Guiry M. D. and Guiry G. M. 2013). Recently a new genus *Pseudofallacia* was proposed (Liu et al. 2012). The genus *Pseudofallacia* shares some features with *Fallacia*, such as lateral longitudinal canals on either side of raphe, and finely porous conopea covers those canals. In contrast, the canals in *Pseudofallacia* were not composed by a depressed sternum interrupting striae, but a depressed part of the primary silica layer of valve along the raphe. The striae in *Pseudofallacia* are one large round to elongate areola per striae rather than several tiny areolae. Since the depressed lateral sterna, areolae and conopeum could only be observed by using electron microscopy is needed to review taxa in detail in order to identify them properly.

*Navicula hodgeana* Patrick & Freese (1961) was first described based on the material from Rogers-Post Monument, Barrow, Alaska second judicial division. The species lives in fresh to brackish water environment. The holotype specimen was collected from scrapings of
small rock submerged at edge of lagoon. It also could be found in tundra pools, scrapings from pebbles in stream and algae in lake overflow or plankton, according to the original description. However, there were few reports from other locations. Recently, the photograph of the holotype of *N. hodgeana* was exhibited at the website Diatom of the United States, contributed by Hamilton and Manoylov (2012). They considered this species could belong to *Fallacia* or *Pseudofallacia*. Because there were only two specimens observed in the type material, more detailed morphological study is required to know the exact taxonomic position. Our samples were collected from Edogawa River, Japan. The morphology of this species was observed using light microscopy, scanning and transmission electron microscopes. We propose to transfer this species to the genus *Fallacia*, based on our observations.

**Materials and Methods**

Surface sediments with benthic diatoms were collected from Edogawa River, Tokyo, Japan, about two kilometers from the river mouth (35°41'45.87"N, 139° 55' 53.01"E) by using glass tube as described by Round (1953). Epipelic diatoms were harvested on a cover slip according to Round et al. (1990). Cells of *N. hodgeana* were isolated from cover slips and transferred to F/2 medium (20 psu). Cultures were maintained at 20–23ºC, with 20–30 µmol photons·m⁻²·S⁻¹ from cool-white fluorescent tubes; The photoperiod was 14 : 10 light : dark (L : D).

Living cells were observed by the method mentioned by Poulíčková et al. (2007). Cleaned frustules were prepared by the bleach solution (Nagumo and Kobayasi 1990). For LM observation, cleaned frustules were mounted on a glass slide with Mountmedia (Wako, Osaka, Japan). Nikon Optiphot-2 light microscope, with differential interference contrast (DIC) was used (Nikon, Tokyo). For TEM observation, cleaned frustules were placed on formvar-coated copper mesh grids and view with JEOL-2000EX (JEOL, Tokyo).

Diatoms were prepared for scanning electron microscopy (SEM) by the method described by Mann and Poulíčková (2009), fixing with 2.5% glutaraldehyde and oxidizing with 70% nitric acid. Cleaned samples were dried in air, coated with osmium and observed by Hitachi S-4000 Field Emission SEM (Hitachi High-Technologies, Tokyo).

Terminology follows Anonymous (1975), Ross et al. (1979), Sims and Paddock (1979), Round et al. (1990) and Cox (2012).

**Results**

*LM observation*

Vegetative cell was solitary and contained a single H-shaped plastid (Fig. 7). Valves were naviculoid with bluntly round poles (Figs. 1–6), 11–18 µm in length and 4–6 µm in width. Raphe was slightly arched. Terminal fissures curved towards the same direction. Central endings were close to each other. Extremely narrowed axial area was hardly recognizable in LM. Longitudinal hyaline lateral areas connected with the narrow bar-like central area. The lateral areas constricted near the central area, resulting in an H-shaped hyaline area on the valve face. Striae were parallel, becoming radical near two poles, 19–24 in 10 µm. Striae were interrupted by the hyaline lateral area near the proximal end, giving rise to a single longitudinal row of areolae between raphe and hyaline lateral area (Fig. 1, arrow). The longitudinal row of areolae near the valve margin spaced from others. A solid vimen could be found in TEM photograph (Fig. 6). The two longitudinal rows of areolae adjacent to a raphe on either side were asymmetric, and areolae in the row on convex side were lesser and smaller.

*SEM observation*

Raphe slightly curved. In external view, the distal terminal fissures were sickle-like and deflect in the same direction, extending on to the
The central raphe endings were slightly curved slits and appeared elevated from the general plane of the valve (Fig. 15). In internal view, striae were interrupted by lateral sterna (Figs. 9, 11, arrows) at the proximal end, resulting in one longitudinal row of areolae between lateral sterna and raphe (Figs. 9, 11, 13, 15). The areolae on the margin curved up and directly connect to the exterior on the mantle (Figs. 12, 20, arrows). On the outer surface, the finely porous conopeum (Figs. 16, 18, 19, arrows) extend outward from the outer edge of raphe sterna, running through the surface, and connected with proximal edge of mantle. Along the proximal edge of mantle, a number of “peg” projections could be observed (Figs 14, 16, arrowheads), which were inlaid into the nonporous margin of conopeum. The porous conopeum concealed the whole canal system of valve. The depressions of longitudinal lateral sterna on the primary layer of the valve gave rise to two main canals on either side of raphe, which connected to each other at the central area, between two central raphe endings, composing an H-shaped space between primary layer and conopeum (Figs. 19, 21). This space or main canals connected to the exterior directly at slit openings (Figs. 12, 20, arrowheads) located on both sides of the terminal fissure and through the small pores of conopeum. Each stria was flanked by two thick virgae (Figs. 19, 21, arrowheads).
Figs. 10–15. *Fallacia hodgeana*. SEM images of valves. Scale bars = 1 µm, except Figs. 10, 11 (5 µm). Figs. 10, 11. Views of external and internal valve faces at 20° tilt, showing the lateral sterna in internal view (Fig. 11, arrow). Fig. 12. The detail of a terminal of valve in external view, showing the finely porous conopeum (double arrowheads), slit opening of canal (arrowhead) and elongate areola on the mantle of valve (arrow). Fig. 13. Internal view of terminal of valve, showing the small helictoglossa at the distal end of raphe (arrow). Figs. 14, 15. External and internal views of the proximal ends of raphe branches. Note the “peg” structure (arrowhead) was inlaid into the nonporous margin of conopeum (arrow).
which projected from and were perpendicular to the primary layer of the valve, forming several branch canals. The branch canals were also covered by finely porous conopeum, composing an elongated chamber running from the distal edge of lateral depressed canal to the proximal
edge of the valve mantle. All of those transapical chambers connected to the main canal at the proximal end. Consequently, the protoplasm is commutate with the exterior directly via the areolae on the mantle or indirectly via the canal system between conopeum and primary layer of valve. The cingulum was composed of two bands, a broad valvocopula and an extremely linear pleura with a ligula (Figs. 22, 23).

Discussion

The morphological features of the specimen in our study agree with the photograph of the holotype of *Navicula hodgeana* presented by Hamilton and Manoylov (2012), although our specimens possess slightly higher striae density, 19–24 in 10 µm comparing with 16–20 in 10 µm given by them and more or less acute terminals in some specimens. The weak valve structures, slightly curved H-shaped lateral areas and a single longitudinal row of areolae adjacent the raphe and one on the outer edge of valve are identical with our specimen. Thus, we identify the specimen found in Japan as *N. hodgeana*. It has to be mentioned that the fine hyaline line by the outer longitudinal row of areolae is not easy to observe by using LM, particularly at a focus on the surface of epitheca. And this feature was not in the original description given by Patrick and Freese (1961).

Hamilton and Manoylov (2012) pointed that this species should belong to *Fallacia* or *Pseudofallacia*. Since only two specimens were observed in the type material, further morphological study was needed. According to our observation using SEM and TEM, this species has the following unique combination of morphological features found in the genus *Fallacia*.

1. A single H-shaped plastid. This feature presents in the family *Sellaphoraceae* including *Sellaphora, Fallacia, Rossia* (Mann and Stickle 2009) and *Pseudofallacia* (Liu et al. 2012), whereas *Navicula* species have two plate-like plastids, along each side of the girdle (Round et al. 1990).

2. The lateral sterna interrupt striae, and they are depressed from the general surface of primary silica layer of valve, resulting in the main canal on both sides of raphe. This is the key feature for distinguishing *Fallacia* and *Pseudofallacia*. In the genus *Pseudofallacia*, the lateral canals were not composed by depressed lateral sterna below the plane of primary silica layer, but curving down or depression of part of primary silica layer next to the raphe. *Fallacia* species could be recognized by the feature that the lateral sterna is flanked by areolae on the same plane (the general surface of primary silica layer). In the description of *Pseudofallacia*, the
striae are interrupted by a “longitudinal rib” on either side of the axial area internally (Liu et al. 2012). The “longitudinal rib” is a strengthened vimen located on the curving edge of a valve. In fact, the virgae also strength or thinken here to strengthen of a valve. Thus, the areolae surrounded by virgae and vimes appear sinking in and not on the surface of an internal valve face. As the result, the curve of valve face, the vimes or intervening gap between longitudinal rows of areolae appear much wider than others. This also occurs in *Navicula hodgeana*. The larger intervening gap between areolae on the valve mantle and outer margin areolae on the valve surface.

3. The canal system between primary silica layer and conopeum. Both *Fallacia* and *Pseudofallacia* possess the lateral longitudinal canals, although the construction is different as mentioned above. In addition, *Fallacia* species also possess transapical branch canals connected to the main longitudinal canal. It could be recognized by upgrowth or thickening of lateral virgae outward, forming a trough-like depression in which areolae are located. In most pennate diatom, the trough-like depression is commonly on the inner surface (Cox and Ross 1981). This was not exhibited in *Pseudofallacia occulta*, the type species of the genus (Liu et al. 2012).

4. Finely porous conopeum outgrowth from raphe sternum covering the whole valve surface. Conopeum presents in a number of genera such as *Sellaphora*, *Fallacia*, *Pseudofallacia*, *Amphora* and *Nitzschia* etc. (Cox 2012). However, such well-developed perforated conopeum which covers the whole valve surface is fairly unique in the genus *Fallacia*.

5. Striae are uniseriate containing round areolae closed by hymen. A number of *Navicula* species also have uniseriate striae. However, the areolae is apically elongate or linear. In addition, the striae in *Pseudofallacia* are also uniseriate, but one stria only contains one elongate areola (Liu et al. 2012).

By all those features suggested, this species does not belong to the genus *Navicula*. It should be transferred to the genus *Fallacia* rather than *Pseudofallacia*.

**Fallaica hodgeana** (Patrick & Freese) Yu H. Li & Hide. Suzuki, **comb. nov.**


**TYPE:** Slide No. ANSP_GC8249a (PH).

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李 宇航 a, 鈴木秀和 a, 南雲 保 b, 田中次郎 a : 底生珪藻 *Fallacia hodgeana* の形態学研究

東京湾江戸川河口から得られた *Navicula hodgeana* Patrick & Freese の形態を光学および電子顕微鏡により観察し、葉緑体の形と殻の微細構造を初めて明らかにした。本種は H 字形葉緑体を 1 個もつ。条線は 1 列の円形の胞紋からなる。横枝は殻外面にわずかに肥厚し、条線は浅い溝になる。多孔の天幕が縦溝中肋から殻套の縁まで広がる。縦溝の両側の多孔の天幕の下には無紋の浅い溝があり、これにより条線は分断される。この溝はほぼ全殻に伸長し、極裂の両側にある裂け目を経て、外部に開口する。殻套には 1 列の胞紋をもつ。本種は *Navicula hodgeana* Patrick & Freese と記載されたが、以上の形質は *Navicula* 属にはなく *Fallacia* 属の特徵と一致するため、新組み合わせ *Fallacia hodgeana* (Patrick & Freese) Yu H. Li & Hide. Suzuki を提案する。

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