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Navicula pseudacceptata sp. nov. and Validation of *Stauroneis japonica* H. Kob.

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新種 *Navicula pseudacceptata* と *Stauroneis japonica* H. Kob. の正当化

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Abstract

Two diatoms previously reported by H. Kobayasi from the Ara-kawa (Ara River), Japan, were re-examined in detail using scanning electron microscopy. A new species, *Navicula pseudacceptata,* is proposed for the diatom that was identified as *N. acceptata* Hust. The generic position of the second, *Stauroneis japonica* H. Kob., is confirmed and a type is designated, thereby validating this previously invalid name.

Key index words

diatom ; fine structure ; *Navicula pseudacceptata* ; new species ; *Stauroneis japonica.*

The identity of two diatoms previously reported from the Ara-kawa (Ara River), Japan, namely *Navicula acceptata* Hust. (Kobayasi 1962, 1964) and *Stauroneis japonica* H. Kob. (Kobayasi 1965), was sufficiently uncertain that a re-examination seemed advisable. Specimens identified as *N. acceptata* appeared to differ from the original illustrations of Hustedt (1950) in the pattern of striation, while an examination by scanning electron microscopy of the original specimens of *S. japonica,* previously observed only by light microscopy, seemed advisable. In the present paper we propose a new species, *Navicula pseudacceptata,* to accommodate Ara-kawa specimens formerly identified as *N. acceptata,* confirm the generic placement of *Stauroneis japonica,* and designate a type for the latter, thereby validating this previously invalid name.

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Materials and Methods

The samples were collected from the Ishima-gawa (Ishima River) (St. 93 in Kobayasi 1962; on 18 Nov. 1959, wt. 12℃, pH 7.8, K-5385), Kawaura-gawa (Kawaura River) (St. 91 in Kobayasi 1962; on 18 Nov. 1959, wt. 10℃, pH 7.5, K-5382), and Aono-gawa (Aono River) (St. 1 in Mayama & Kobayasi 1982; on 5 Dec. 1977, wt. 13.3 ℃, pH 8.2, E. Cond. 116 $\mu S \cdot cm^{-1}$, K-372). Methods of cleaning, washing and preparing objects for light and electron microscopy are given in Mayama & Kobayasi (1984) and Kobayasi *et al.* (1985).

The type of *Navicula acceptata* Hust. (from Salemer See, Germany) was photographed at the Institut für Meeresforschung, Bremerhaven (BRM 392/2) and that of *Navicula dulcis* Patr. (a later homonym applied to a diatom from Texas, U. S. A., renamed *N. mendotia* VanLand. 1975) was photographed at the Academy of Natural Sciences, Philadelphia (PH-G. C. 8035).

Results and Discussion

Navicula pseudacceptata **H. KOB.** sp. nov.

Comparison of the specimens found in Ara-kawa with the type specimen of *Navicula acceptata* HUST. shows superficial similarities but also distinct differences. Both have a pair of short central striae. From the original description and illustration of *N. acceptata* (HUSTEDT 1950, p.398, pl.38: figs. 66, 67), the impression is gained that the transapical striae are parallel or slightly radiate at the valve ends. A photomicrograph of the type slide (Fig. 6), however, reveals that the striae are radiate throughout the valve, strongly so at the ends. By contrast, the striae of the Ara-kawa diatom are slightly convergent at the ends, although slightly radiate at the center. The Ara-kawa specimens further differ from *N. acceptata* in having polar hyaline areas, which are absent in the latter. A second species with which the Ara-kawa specimens should be compared is *Navicula dulcis* PATR. (PATRICK & REIMER 1966), which also has short central striae. An examination by one of us (S. MAYAMA) of the holotype, however, shows that the transapical striae are more strongly radiate at the center and more convergent near the ends (Fig. 5). The puncta forming the striae are barely visible by LM (Fig. 5). Furthermore this species can be clearly distinguished by SEM because it has fishhook-shaped terminal raphe fissures (MAYAMA & KOBAYASI 1982, using the substitute name *N. mendotia* VANLAND.) as contrasted with the straight raphe fissures of the Ara-kawa specimens. KRAMMER & LANGE-BERTALOT (1985) have referred this species to *N. perminuta* GRUNOW. When Ara-kawa specimens are viewed with SEM, the valve face appears to be almost flat (Fig. 7). Externally the raphe branches are simple slits. The central and polar raphe endings are somewhat dilated externally and curve slightly toward the side bearing a Voigt fault (Figs. 7, 9, 11). Voigt faults are irregularities in the arrangement of striae. In the Ara-kawa diatom the second areola from the raphe in certain striae is consistently missing (Fig. 7, arrows), although this irregularity is often difficult to discern with LM (Figs. 1-4). Internally the raphe slit lies within narrow, raised axial ridges that lack additional thickening such as that seen in *N. tripunctata* (O. F. MÜLL.) BORY, the type of the genus (COX 1979). The central raphe endings are straight and close to the central nodule. The raphe fissures terminate in small helictoglossae (Figs. 8, 10).

The striae are composed of linear areolae arranged with their long axis perpendicular to the alignment of the striae (Figs. 7-12). The central pair of striae are shorter than the surrounding striae so that the central area is transversely rectangular (Fig. 7). The slit-like foramen of the areolae is external and occluded internally by a rica or hymen with perforations arranged hexagonally (Figs. 10, 12). As is true of most Pennales (COX & ROSS 1981), striae in the new species consist of a row of areolae lying in a trough-like depression on the inner side of the valve and run from the axial area to the margin. A single row of 8-10 pores curves around each pole. The long axis of these pores, which are occluded internally by a hymen (Fig. 10), is perpendicular to the valve margin (Figs. 7, 9).

The terminal hyaline areas, which are clearly visible at black focus in LM (Figs. 1, 4, arrows), are laterally expanded terminal nodules from which the helictoglossae protrude internally (Figs. 8, 10). Although expanded terminal nodules have been reported in other species of *Navicula*, e. g., *Navicula pupula* KÜTZ. (SCHOEMAN & ARCHIBALD 1979), *N. bacillum* EHR. (GERLOFF & HELMCKE 1977, T. 963, 964), *N. retrocurvata* J. R. CARTER (ROSS & SIMS 1978; COX & ROSS 1981), they are a distinctive feature of the new species.

We conclude that the Ara-kawa specimens formerly identified as *N. acceptata* represent a new species.

Navicula pseudacceptata H. KOB. sp. nov.

Valvae lineari-ellipticae, marginibus leviter inflatis, apicibus late rotundatis, area hyalina in quoque apice, 6-15 μm longae, 4-5 μm latae. Raphe recta. Area axialis angusta et area centralis rectangulata et transapicaliter dilatata. Striae transapicales leviter radiantes, 16 in 10 μm in apicibus ad lineam mediam perpendiculares vel leviter convergentes, usque ad 18 in 10 μm. Striae centrales breves binatim.

Valves linear-elliptic with slightly convex margins, broadly rounded ends, and a hyaline area at each end, 6-15 μm long, 4-5 μm broad. Raphe straight. Axial area narrow, and central area transapically dilated, rectangular. Transapical striae slightly radiate at the center, 16 in 10 μm, but perpendicular to the axial line and slightly convergent at the ends, up to 18 in 10 μm. A pair of short striae at each margin of the central area.

Holotype : H. K. T-79 in coll. H. KOBAYASI, will be housed in the Nat. Sci. Mus. Tokyo.

Type material : K-5385, on 18 November 1959.

Type locality : Ishima-gawa, a tributary stream of Akahira-gawa, a tributary river of Ara-kawa, Saitama Prefecture, central Japan.

Stauroneis japonica **H. KOB.**

This species was described from three mountain streams that are tributaries of the Ara-kawa (KOBAYASI 1965). A nomenclatural type was not indicated, so that the publication of the name was invalid. Since the original description, it has been reported from mosses collected from Nakatsu Gorge, Arima Valley and Nippara-gawa (KOBAYASI & ANDO 1978) and from Aono-gawa (MAYAMA & KOBAYASI 1982). In the present study, only material from one of the original sites (station 93, Ishima-gawa) has been used (K-5385), and a specimen from that collection is herewith designated as the holotype (Fig. 13).

Valves of *S. japonica* are 15-25 μm long and 5-6 μm broad. They are lanceolate to elliptic-lanceolate with broadly rostrate ends and subapical constrictions. Transapical striae are strongly radiate throughout, numbering about 24 in 10 μm near the center and 28 in 10 μm near the ends (Figs. 13-16).

The valve face is flat (Fig. 17) with a conspicuous hyaline marginal rim between the face and the mantle. The valve mantle is perpendicular to the valve face. The raphe, which is a curved slit, has central pores that form somewhat expanded depressions in the outer surface of the valve. The terminal fissures are narrow slits that are deflected to the same side of the valve and extend some distance down the mantle, terminating at one of the elongated poroids that form a row around the mantle (Figs. 17, 19).

The axial area is smooth and hyaline externally. It is markedly raised internally (Figs. 18, 20, 21). It is about one fourth the width of the valve at the central pores and tapers gradually towards the poles (Figs. 17, 19). The central area is a broad and transapically rectangular hyaline region with the shape of a bow-tie externally. Internally, the central nodule is laterally expanded and reaches the valve margin. As defined in Ross *et al.* (1979), a stauros is a central nodule that is transapically expanded and almost reaches or reaches the valve margin. Although short striae are inserted marginally in the central area, we are interpreting the expanded central nodule as a stauros. The stauros is thicker than the interstriae, including those of the short central striae (Figs. 18, 21).

Each transapical stria consists of a single row of poroids lying in a trough-like depression (in internal view; cf. Cox & Ross 1981) (Figs. 20, 21). The poroids are approximately circular, except adjacent to the axial area, where they are elongated transapically (Figs. 17, 19). They are occluded internally by a rica or hymen. The mantle bears a row of poroids that correspond in number to the transapical striae (Figs. 17, 19). These poroids are elongated parallel to the pervalvar axis and are also occluded internally by a hymen (Fig. 20,

arrow).

One of the most distinctive features of this species is a cavity at the apex of each pole (Figs. 14, 16, 18-20, arrow heads). Although the wall thickness is reduced, the cavity does not have an external aperture. A similar cavity has been reported in *Navicula clarensiana* Schoem. & Archib. (1977), a species which also has a laterally expanded central nodule and which may be related to ***S. japonica.***

Stauroneis japonica H. Kob.

Latin description : H. Kobayasi 1965, J. Jap. Bot. **40**:348, 349.

Holotype : H. K. T-80 in coll. H. Kobayasi, will be housed in the Nat. Sci. Mus. Tokyo. (Fig. 13).

Type material : K-5385, on 18 November 1959.

Type locality : Ishima-gawa, a tributary stream of Akahira-gawa, a tributary river of Ara-kawa, Saitama Prefecture, central Japan.

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摘　　要

今回の著者の一人である小林 (1962) が、荒川水係から報告した 2 種類のケイソウについて、電顕を用いて詳細な観察を行なった。

その 1 つは *Navicula acceptata* Hust. と同定して報告されたものであるが、西ドイツ、ブレーメルハーフェンの海洋調査研究所にある Hustedt のタイプ標本と比較したところ、この種類は殻端で収れんする条線と、明瞭な極域をもつことで、タイプとは異っていた。そのため新種 *Navicula pseudacceptata* として報告した。

他の 1 つは新種 *Stauroneis japonica* として報告されたものであるが、殻内側中央部に明瞭な十文結節 (stauros) が見られた。しかし原記載では、国際植物命名規約に規定されているタイプの指定を欠いていたため、今回正当出版に必要な条件を付加した。

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Explanation of Plates

Plate 1

Figs. 1-4, 7-12. *Navicula pseudacceptata* sp. nov. Ishima-gawa, Sample no. K-5385. —Figs. 1, 2. Holotype specimen, taken in different planes of focus, Slide no. H. K. T-79. Terminal enlarged, from outside. ×50,000. —Fig. 12. Pore occlusions with perforations in a hexanal hyaline areas are visible in Fig. 1 (arrow). ×2,000. —Figs. 3, 4. Isotype specimens, Slide no. H. K. 1931. Terminal hyaline areas are visible in Fig. 4 (arrow). ×2,000. —Fig. 7. External view of epitheca with Voigt faults (arrows). ×10,000. —Fig. 8. Internal view of valve. ×10,000. —Fig. 9. Exterior view of valve end. ×20,000. —Fig. 10. Interior view of valve end. ×20,000. —Fig. 11. Valve center gonal array. ×70,000. Fig. 5. *Navicula dulcis* Patr. (=*Navicula mendotia* VanLand.). Holotype specimen, PH-G. C. 8035, Sabine River, Texas. —Fig. 6. *Navicula acceptata* Hust. Isotype specimen, BRM 392/2, Salemer See, Germany. ×2,000. Figs. 1-12. Black scale bar for LM =10μm, black scale bars for SEM =1μm, and white scale bars for SEM and TEM =0.2μm.

Plate 2

Figs. 13-21. *Stauroneis japonica* H. Kob. Ishima-gawa, K-5385. —Figs. 13-16. Figs. 13, Holotype specimen and 14-16, Isotype specimens, taken in different planes of focus showing a cavity which is visible as a white dot at each pole (arrow heads). Slide no. H. K. T-80. ×2,000. Fig. 17. External view of valve with valvocopula broken partially. ×4,000. —Fig. 18. Internal view of valve with valvocopula broken partially. Note a cavity at the pole (arrow head). ×4,000. —Fig. 19. The location of the cavity visible under the thin siliceous wall, from outside (arrow head). ×8,500. —Fig. 20. Valve end showing the cavity (arrow head) and occluded poroids on the mantle (arrow), from inside. ×17,000. —Fig. 21. Stauros enlarged, from inside. ×8,500. Figs. 13-21. Black scale bar for LM =10μm, black scale bars for SEM =1μm.

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Plate 1

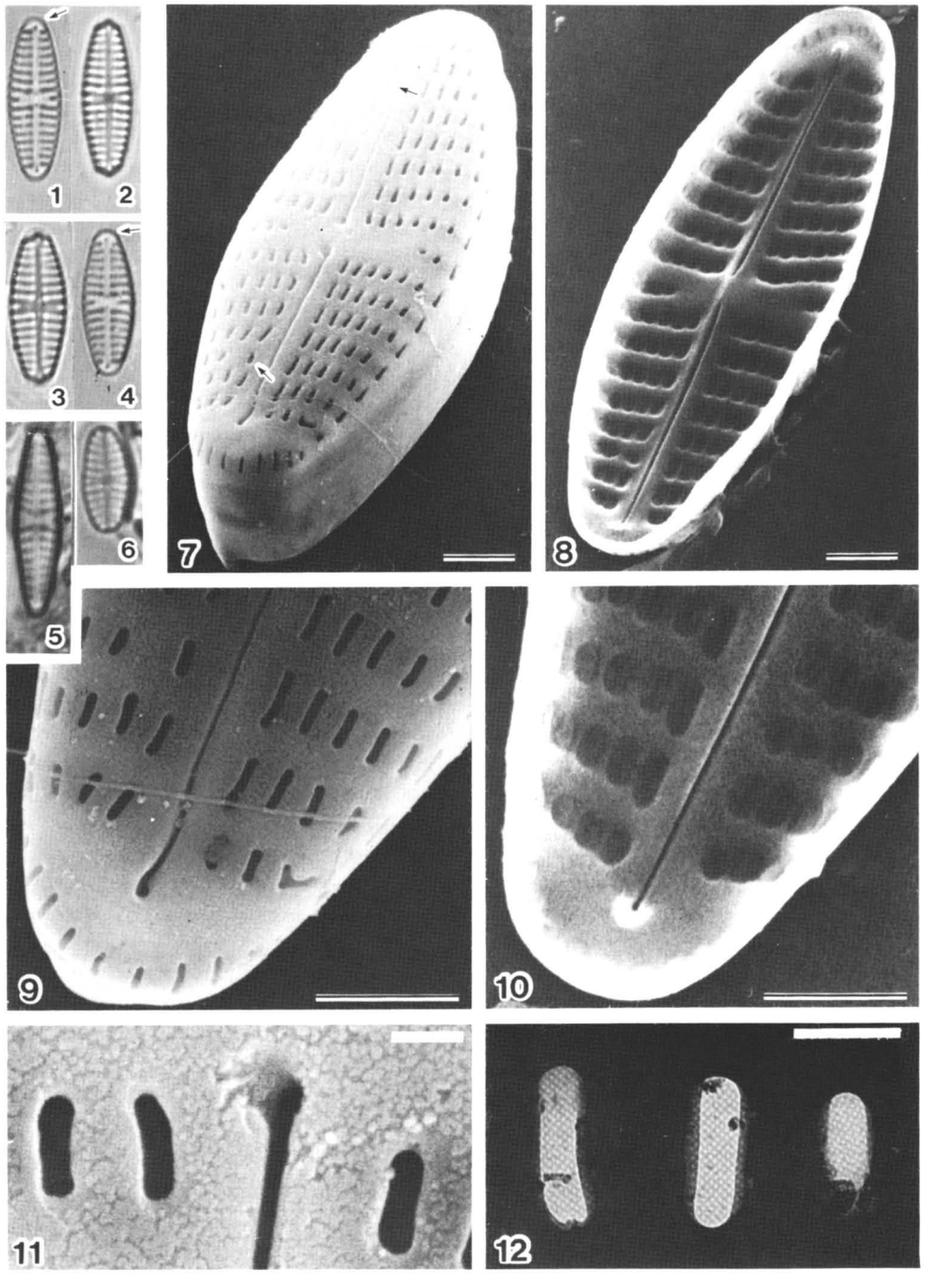

Plate 2