

NOMENCLATURE

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Typification of *Conferva pectinalis* O. F. Müll. (*Bacillariophyceae*) and the identity of the type of an alleged synonym, *Fragilaria capucina* Desm.

Akihiro Tuji^{1,2} & David M. Williams²

¹ Department of Botany, National Science Museum, Tokyo, Amakubo 4-1-1, Tsukuba, 305-0005, Japan. tuji@kahaku.go.jp (author for correspondence)

² Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, U.K.

The application of the generic name *Fragilaria* has remained uncertain because the identity of the lectotype, *Conferva pectinalis* O. F. Müll., is unknown. Traditionally *Fragilaria capucina* Desm. has been considered a synonym of *F. pectinalis*, although this synonymy has not been confirmed. Application of the generic name *Fragilaria* can best be fixed by designating an epitype for *C. pectinalis* that fits the current circumscription of the genus (sensu Williams & Round). As epitype for *C. pectinalis*, we designate a specimen that Dillwyn thought to be representative of that species. We also examined the type material of *F. capucina*. Specimens from this material have a rimoportula at each pole and open girdle bands. Although the first character was not part of the revised definition proposed by Williams & Round, *F. capucina* can be placed in *Fragilaria* on account of the structure of its striae and the general appearance of the basal siliceous layer. *Fragilaria capucina* is, however, clearly not a synonym of *F. pectinalis*.

KEYWORDS: *Conferva pectinalis*, *Fragilaria pectinalis*, *Fragilaria capucina*, epitype, epitypification.

INTRODUCTION

Conferva pectinalis O. F. Müll. has been a problematic species for some time, its identity remaining unknown. It was included by Lyngbye (1819: 184) in his new genus *Fragilaria*, as *F. pectinalis* (O. F. Müll.) Lyngb. Boyer (1927: 183) designated “*Fragilaria pectinalis* Lyngb.” as the type of the generic name, but type material for *C. pectinalis* has never been found and consequently its taxonomy has remained obscure. Boyer treated *F. pectinalis* as a synonym of *F. capucina* Desm. (1825: no. 453), thus accepting the synonymy proposed by Kützinger (1844: 45). *Index Nominum Genericorum* (Farr & al., 1979: 441, and <http://ravenel.si.edu/botany/ing/ingForm.cfm>, consulted 30 November 2005) and Fourtanier & Kociolek (1999: 65) cite *F. pectinalis* (O. F. Müll.) Lyngb. as the type of *Fragilaria* (see also Hasle & Syvertsen, 1981: 117; Silva & Hasle, 2006). The identity of *Fragilaria capucina* Desm. is also relevant, as some have mistakenly treated it as generitype. Williams & Round (1988: 268), considering that *F. capucina* was probably synonymous with *C. pectinalis*, suggested that the Desmazières name would be a better choice for the type of *Fragilaria* than *F. pectinalis*. Nevertheless, as Fourtanier & Kociolek (1999: 65) rightly noted, “They [Williams & Round, 1988] were not justified, however,

in giving *F. capucina* as the type of *Fragilaria*, and conservation may be necessary to preserve current usage”. A solution to the problem of the identity of *C. pectinalis* requires typification of this name with appropriate substitute material. In this study we examine relevant material and designate an epitype for *C. pectinalis*. We also describe the ultrastructure of the type material of *F. capucina* based on scanning electron microscopy (SEM).

MATERIALS AND METHODS

Material ascribed to *Conferva pectinalis*. —

The following material has been used to study *C. pectinalis* (≡ *Fragilaria pectinalis*).

1. The illustrations in Müller (1788, figs. 4–7) (Fig. 1A).
2. The illustrations in Dillwyn (1803 in 1802–1809, Pl. 24, figs. A, B) (Fig. 1B).
3. The illustrations in Lyngbye (1819, Tab. 63, Fig. D1, 2) (Fig. 1C).
4. Dillwyn’s original packet labelled “New river near Hornsey, Mar 5 1802” (BM 101152-3). In the BM diatom herbarium there are seven “ex herb. Dillwyn” packets of material labelled as “*Himantidium pectinalis*”. Dillwyn’s material contains samples that were dried onto

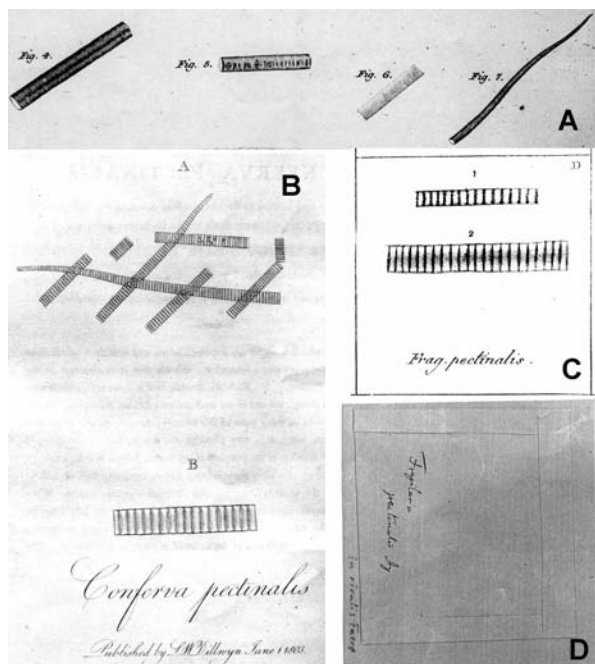


Fig. 1. A, *Conferva pectinalis*, reproduced from Müller (1788, figs. 4–7). B, *Conferva pectinalis*, reproduced from Dillwyn (1802 in 1802–1809, Pl. 24, figs. A, B). C, *Fragilaria pectinalis*, reproduced from Lyngbye (1819, Tab. 63, Fig. D1, 2). D, The envelope labelled “*Fragilaria pectinalis* Ag.” housed in C.

pieces of glass, stored in packets and mounted on standard herbarium sheets. The material was placed in the BM on “permanent loan” from K following reorganisation of the cryptogamic collections from both institutions (Ross & Brenan, 1970). Dillwyn’s herbarium was scattered, with specimens ultimately housed in several different herbaria, e.g., BM, K, LINN (Dixon, 1966). The authenticity of the seven packets in the BM diatom collection was confirmed by identifying Dillwyn’s handwriting, as suggested by Dixon (1966). Six packets bear the name “*Conferva pectinalis*” on the original label, the seventh being labelled “*Conferva bronchialis*” Roth. Of the six packets labelled “*Conferva pectinalis*”, only one can be considered to come from the “neighbourhood of London...” (Dillwyn, 1803 in 1802–1809) and to predate Dillwyn’s publication.

5. A slide in BRM numbered “16/4” and labelled “*Fragilaria pectinalis* Lyngb.” which was made from Jürgens exsiccatae “*Algae Aquaticae*” decade 16, no. 4 (Jürgens, 1822 in 1816–1824).

6. Raw material labelled “*Fragilaria pectinalis* Ag.” in C (Fig. 1D).

Material representing *Fragilaria capucina*. —

Desmazières described *F. capucina* on the label to no. 453 of his exsiccatae “*Plantes cryptogames du Nord de la France*” (Desmazières, 1825–1851). Fascicle 10, which

includes no. 453, was published in 1830 (Sayre, 1969: 12). The label provides a lengthy account of the nomenclature of *Fragilaria* and related genera. The packet contains syntype material. The dates of issue for the *Plantes cryptogames du Nord de la France* are given in Sayre (1969: 12) and Stafleu & Cowan (1986: 631). Fascicle 10, which includes the material for no. 453, was issued in 1830; hence this is the correct date for publication rather than the oft-quoted 1825, the date the series began. The set was known as *Plantes cryptogames du France* only after fascicle 17 was issued in 1836. Many sets exist in various herbaria around the world (see listing in Stafleu & Cowan, 1986: 631), thus all the extant packets of no. 453 are syntype material.

BM 81302 was made from cleaned and prepared material from the BM’s copy of Desmazières’ exsiccatae set (fascicle 10, no. 453). In addition to BM 81302, another slide has since been made from the BM Desmazières’ material and is now housed in TNS (TNS-AL-53974).

RESULTS AND DISCUSSION

History of *Conferva pectinalis* and the genus *Fragilaria*. —

Conferva pectinalis O. F. Müll. was first described by Otto Friedrich Müller (1788) who illustrated the species with four very simple figures (Fig. 1). The figures were drawn to represent colonial specimens that are arranged in either circular or ellipsoid cylinders. These four figures may represent different species. Dillwyn (1803 in 1802–1809) described *C. pectinalis* from the British Isles (“In rivers and stagnant waters, adhering to wood and vegetables ... neighbourhood of London...”) using just two simple figures (fig. 1B). Lyngbye (1819) created the genus *Fragilaria* for eight species, which included *Fragilaria pectinalis*. He cited *C. pectinalis* O. F. Müll. as a synonym, but also had living material upon which to base his description of *F. pectinalis*. However, he did not designate a type for the generic name *Fragilaria* and many years later Boyer (1927: 183) chose *F. pectinalis* as its type. Boyer, like Kützing (1844: 45), see below, considered *F. pectinalis* a synonym of *F. capucina*. The figures Lyngbye (1819) offered of *F. pectinalis* are simple drawings of cylindrical colonies (Fig. 1C) similar to those of O. F. Müller. None of the early drawings (Müller, Dillwyn, Lyngbye) can be easily identified.

Kützing (1844: 45) treated *C. pectinalis* as a synonym of *F. capucina*—a decision that began the long association of synonymy between the names *F. pectinalis* and *F. capucina*. Kützing (1844: 39) also described as a new species, in the genus *Himantidium* Ehrenb., *H. pectinalis* Kütz., in which he included *C. pectinalis* sensu Dillwyn,

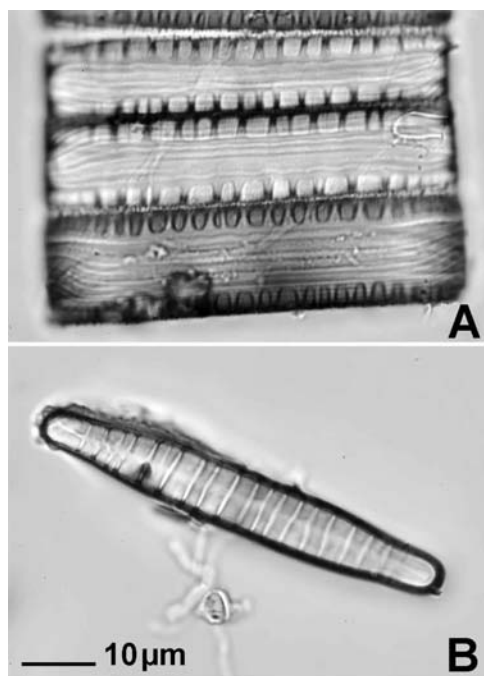


Fig. 2. Specimen of *Diatoma hiemale* observed from the material in the envelope labelled “*Fragilaria pectinalis* Ag.” (Fig. 4) housed in C. A, girdle view; B, valve view.

referring to Dillwyn’s 1803 description. Later, Rabenhorst (1864:73) transferred *Himantidium pectinale* to the genus *Eunotia* Ehrenb. referring to Kützinger’s description. Clearly Kützinger recognised that *C. pectinalis* O. F. Müll. was not the same species as that which Dillwyn had called *C. pectinalis*. Having treated the former as a synonym of *F. capucina*, he proceeded to adopt the same epithet for Dillwyn’s species; *H. pectinale* should, therefore, be considered a new species described by Kützinger (1844), who excluded *C. pectinalis*.

Specimens suitable for fixing identity of *Conferva pectinalis*. — Because O. F. Müller’s material has never been found, it may be that genuine specimens of *C. pectinalis* are lost forever. Hence an alternative is required to fix the identity of *C. pectinalis*. Without original material, the next best method for clarifying the identity of *C. pectinalis*, and hence the genus *Fragilaria*, would be to use Lyngbye’s material (housed in C and LD). A search of these herbaria did not yield any relevant material. In C no material was found labelled for this taxon with Lyngbye’s name attached—only a packet labelled as “*Fragilaria pectinalis* Ag.” (Fig. 1D). However, there was no information on the collector or the date of collection for this packet of material and it is thus

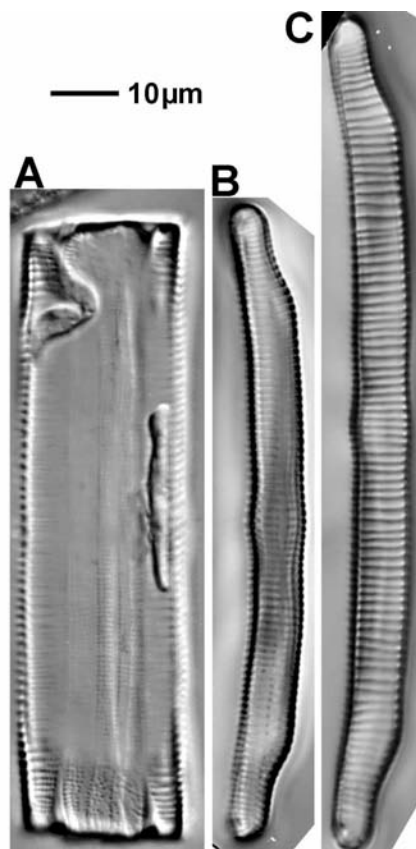


Fig. 3. *Eunotia pectinalis* (Kütz.) Rabenh., specimen from Jürgens Algae aquatica (Slide BRM 16/4, “*Fragilaria pectinalis* Lyngb.”). A, girdle view; B–C, valve view.

difficult to explain how—or even if—Lyngbye used this material¹. Examination of this material reveals only specimens belonging to *Diatoma hiemale* (Kütz.) Heib. (Fig. 2); no specimens belonging to *Fragilaria* Lyngb. emend. D. M. Williams & Round were found.

Examination of Dillwyn’s original material (BM 101152-3) yielded one group of specimens belonging to *Eunotia* (Fig. 5) and another belonging to *Fragilaria* (Fig. 4). Species from these genera usually form filamentous colonies (figs. 4D, 5A, B). Dillwyn’s sample also contained specimens from the genera *Gomphonema* and *Synedra* but neither of these genera have species that form filamentous colonies. The specimens of *Fragilaria* possess characters consistent with the current concept of the genus *Fragilaria* (sensu Williams & Round, 1988), whereas the specimens of *Eunotia* are not those usually identified as *Eunotia pectinalis* (Krammer & Lange-Bertalot, 1991, 2000).

As noted above, a slide from BRM (BRM 16/4)

¹Interestingly, the specimens from this particular packet were coated on to a piece of paper that has been cut in half. Therefore, the possibility exists that the other half may be located in another herbarium.

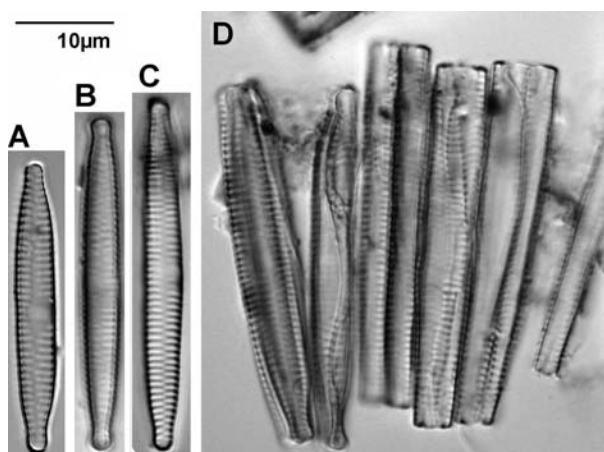


Fig. 4. *Conferva pectinalis*; B, epitype specimen (designated here). A–C, other valves; D, sibling frustules in girdle view, possibly dissociated from a colony. Specimens from original Dillwyn material, BM 101152.

labelled “*Fragilaria pectinalis*” was examined. Only specimens of *Eunotia* were found on this slide (fig. 3); none belonged to *Fragilaria*. The specimens of *Eunotia* can be identified as *Eunotia pectinalis*.

In the absence of relevant Lyngbye material, the best candidate to serve as epitype for *C. pectinalis* is a specimen from Dillwyn’s original material, which contains specimens that would today be placed in the genus *Fragilaria*.

The illustrations provided by Dillwyn are similar to those provided by Müller, both representing more than one species. Nevertheless, Dillwyn has been widely cited in the context of *C. pectinalis* and it seems appropriate to designate the epitype of that name from his original material. Specimens agreeing with the traditional concept of *Fragilaria pectinalis* have been mounted on slide BM 101152.

Taxonomy of *Fragilaria capucina*. — Three different morphologies were found in the type material of *F. capucina*. The same three morphologies were documented by Lange-Bertalot (Krammer & Lange-Bertalot, 1991, see Taf. 108–9). The first has lanceolate valves but lacks marginal spines (Figs. 6, E, F); the second has valves that are linear to lanceolate but relatively shorter than those of first kind above (Figs. 6, A–D). Both the first and second morphologies have only one rimoportula per valve (Figs. 6, D, E), strongly rostrate valve apices and a unilateral central area. The third morphology has linear valves, with a rectangular to rhombic central area and weakly rostrate valve apices (Figs. 6, G–R). These valves have linking spines and form ribbon like colonies (Figs. 7, D–F), as well as two small rimoportulae, one at each pole (Figs. 7, D, E, G, H). The rimoportulae have an elliptical opening and are situated within the polar striae

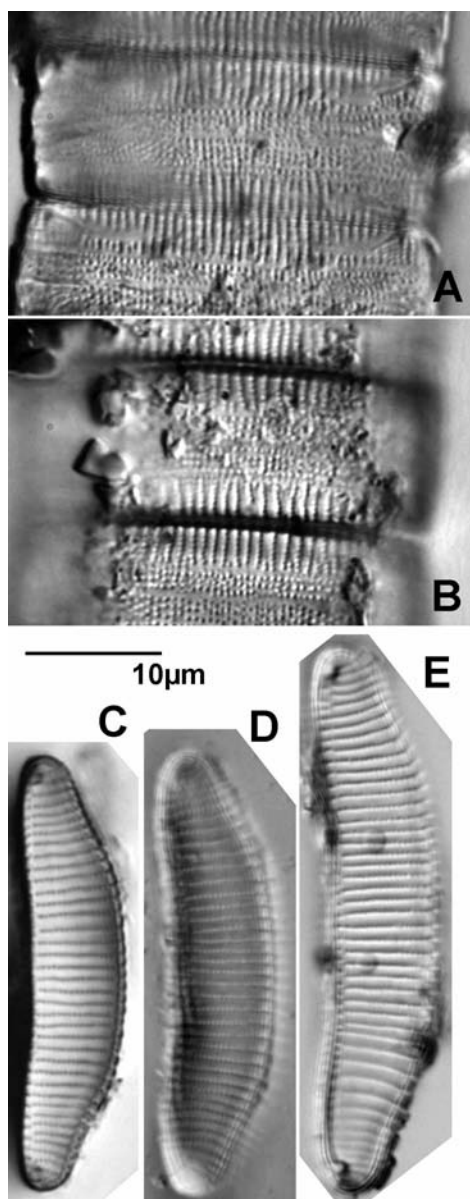


Fig. 5. Specimens of a species of *Eunotia*. A–B, girdle view showing the colony; C–E, valve view.

that extend either side of the sternum (Figs. 7, D, E, G, H). Each valve apex has a pore field, which is less well developed than those seen in *F. pectinalis*, for example (Figs. 7, I). There is also a series of open bands each with a single row of small punctae (Figs. 7, A–C).

Only the third morphology described above—with linking spines—agrees with the original description of *F. capucina*. Hence an individual specimen from this group is designated herein as lectotype of *F. capucina*. Whereas Lange-Bertalot (Krammer & Lange-Bertalot, 1991, 2000) considered the morphological variation of this species to be extensive, it appears more reasonable to understand the variation as due to three different species,

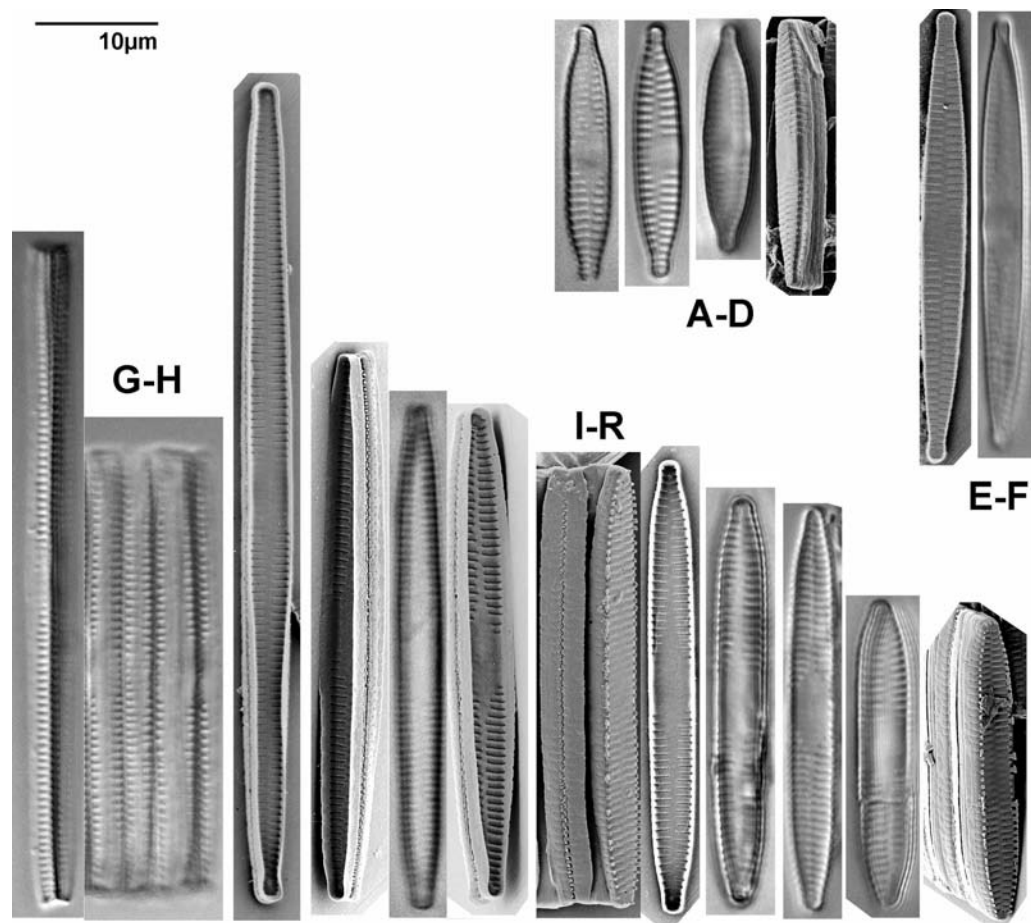


Fig. 6. *Fragilaria* specimens found in Desmazières's material, BM 81302. A-D. *Fragilaria* sp.; G-R, *Fragilaria capucina* Desm. A-C, F, G, H, K, O-Q, LM. D, E, I, J, L-N, R, SEM. O, lectotype (England finder Q33-1).

all present in the same gathering; the morphological variation of *Fragilaria capucina* s.s. is therefore not so diverse (Figs 6, G–R).

Definition of the genus *Fragilaria*. — *Fragilaria capucina* has features typical of *Fragilaria*—valves with striae not opposite each other relative to the sternum, linking spines and open girdle bands (Williams & Round, 1988). However, the presence of a rimoportula at each apex was not part of the revised definition of this genus. Nevertheless, such an arrangement—the presence of a rimoportula at each apex of the valve—while unusual for a species of *Fragilaria* s.s. (but see Le Cohu, 1999 and Morales, 2003), is observed in a number of other freshwater genera (species of *Diatoma* Bory, for example; Williams, 1985). Many specimens from both the United States and Japan, previously identified as *F. capucina*, possess only one rimoportula per valve (Tuji, 2004 and Tuji, pers. obs.). Considering the data given, these specimens cannot now be considered members of *F. capucina*. Given the results presented here, *F. capucina* cannot be identified just by noting its valve shape. It

is necessary to examine the number of rimoportulae and the structure of the valve itself, both of which can be observed in the LM (Figs. 6, O, P).

Williams & Round (1988) modified the definition of *Fragilaria* so as to include only taxa that have simple rows of areolae and one apical rimoportula. Our studies on the type specimens of *F. capucina* suggest that the description of the genus requires expansion with its defining characters remaining the same. The characters that distinguish *Fragilaria* from *Synedra* sensu D. M. Williams & Round (= *Ulnaria* Compère in Lange-Bertalot & Compère, 2001), such as the number of rimoportulae and the structure of the girdle bands (complete, closed hoops in *Synedra*), casts the morphology of *F. capucina* in a different light; with respect to characters of *Synedra* and *Fragilaria*, and *F. capucina* might be considered “intermediate”. However, as noted above, the number of rimoportulae is a variable character common to many other freshwater “araphid” diatoms, hence while the structure of the girdle band is definitive in the case of *Synedra*, the definition of *Fragilaria* is less so. Neverthe-

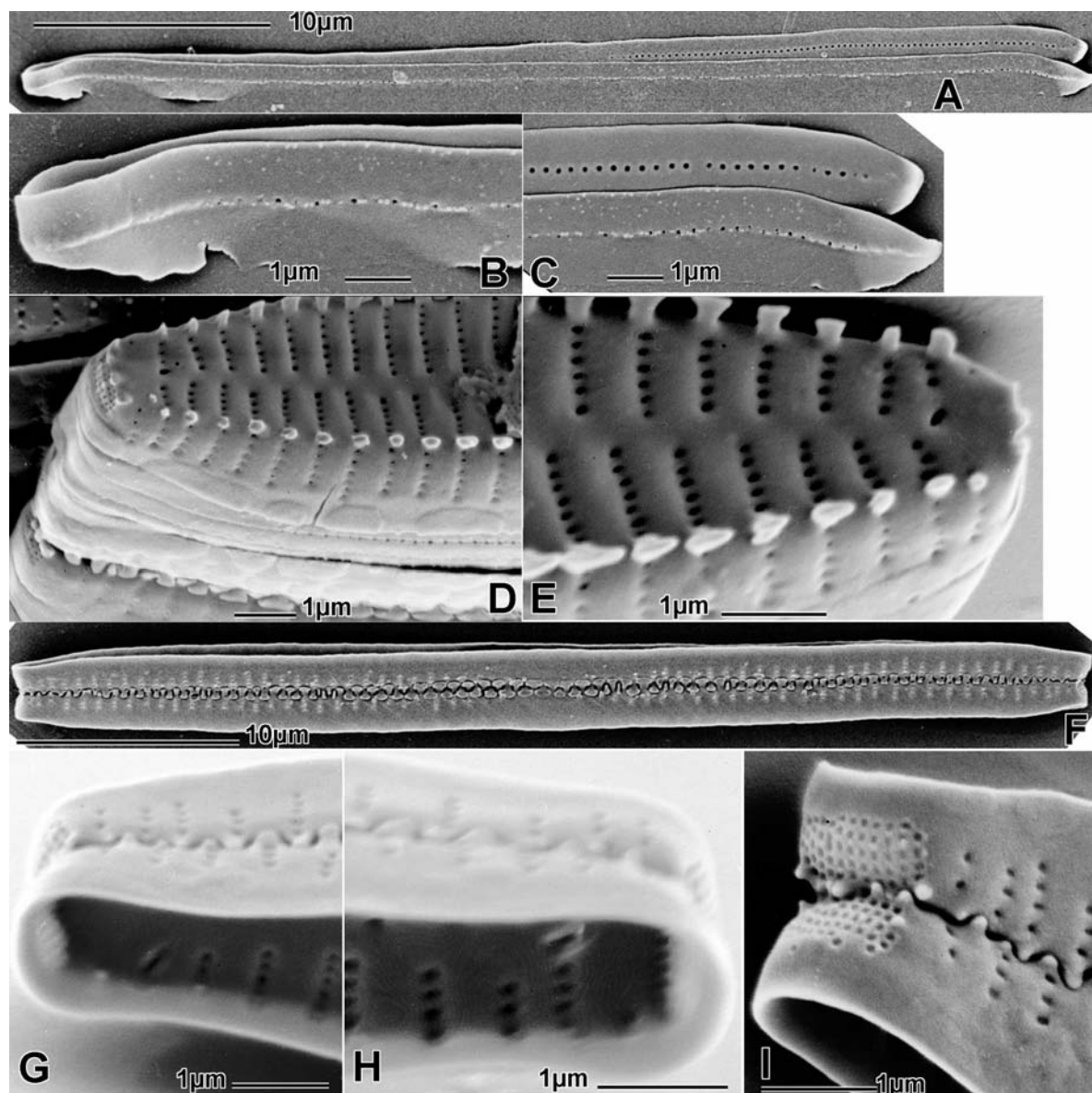


Fig. 7. *Fragilaria capucina* Desm. A–I, SEM. A–C, open girdle bands with single row of small punctae; D–E, linking spines and elliptical opening of rimoportulae. F, linking spines; G–H, two small rimoportulae, one at each pole; I, pore field at each valve apex.

less, our current state of knowledge would place *F. capucina* in the genus *Fragilaria*. Of significance, *F. capucina* is not synonymous with *F. pectinalis*.

TAXONOMIC CONCLUSION

Fragilaria Lyngb., Tent. Hydrophytol. Dan.: 182. 1819, emend. D. M. Williams & Round, Diat. Res. 2: 268. 1988. – Lectotype (designated by Boyer. Proc. Acad. Nat. Sci. Philad. 78: 183. 1927): *Fragilaria pectinalis* (O. F. Müll.) Lyngb. 1819.

Fragilaria pectinalis (O. F. Müll.) Lyngb., Tent. Hydrophytol. Dan.: 184–185. 1819 ≡ *Conferva pectinalis* O. F. Müll., Nov. Acta Acad. Sci. Imp. Petropol. 3: 91. f. 4–7. 1788. – Lectotype (designated here): figure 4 in O. F. Müller Nov. Acta Acad. Sci. Imp. Petropol. 3: 91. 1788. – Epitype (designated here): an individual from slide BM 101152 in BM! (located at England finder L33-3: Fig. 4B), “New river near Hornsey, March 5, 1802”. – isoepitype TNS!

Fragilaria capucina Desm., Pl. Crypt. N. France. Fasc. 10, no. 453, 1830. – Lectotype (designated here): an

individual from BM 81302 in BM! (located at England finder Q33-1: Fig. 6O). – Isolectotype TNS!

Eunotia pectinalis (Kütz.) Rabenh., Fl. Eur. Alg. 1: 73. 1864 = *Himantidium pectinale* Kütz., Kieselschal. Bacill. 39: pl. 16. f. XI. 1844. – Holotype: “Jever unter No. 28.” Kützing packet 28 in AWH. – Isotype: slide BM17856 in BM! (photographs in Tuji & Williams, 2006), non *Conferva pectinalis* O. F. Müll.

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