

# A refined morphological circumscription of *Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round (*Bacillariophyceae*, *Achnanthidiaceae*) based upon original material

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*Achnanthes marginulata* Grunow from "Memerutungen (Norwegen) O. Nordstedt." was introduced with only a short description and lacked an illustration (Cleve & Grunow 1880: 21): "Sehr klein, wenig gebogen. Schalen oval oder fast stumpf lanzettlich. Die Querstreifen der Oberschale kurz, randständig, die der Unterschale radial, die Mittellinie erreichend, in der Mitte beim breiten Pseudostauros aber nur sehr kurz, randständig, 24–25 in 0,01 mm. Länge 0,011–0,014 mm, Breite 0,005 mm. [Very small, weakly curved. Valves elliptical or almost bluntly lanceolate. Striae of the upper valve (=rapheless valve) are short and marginal, those of the lower valve (=raphe bearing valve) are radial, reaching the midline. Striae are very short and marginal only in the centre by the broad pseudostauros, 24–25 in 10 µm. Length 11–14 µm, width 5 µm]". Van Heurck (1880, pl. XXVII [27]: figs. 45, 46) illustrated two valves based on drawings made by Grunow. Although the drawings, which Van Heurck clipped from Grunow's original sketches to make the plates, are kept in the Van Heurck collection in **BR** (Meise Botanic Garden, Belgium), the remaining piece of paper from these clippings (Fig. 1) and additional drawings are conserved in the Grunow collection in **W** (Naturhistorisches Museum Wien, Austria). The information on these cut-out remainders in **W** is valuable, in that it provides data about the sample on which the drawing was based. According to the information on the drawings pieced together with the remaining drawing and Grunow's accession books (a handwritten catalogue of his sample collection), the population is from Grunow sample 2024 collected by the Swedish botanist Carl Fredrik Otto Nordstedt (1838–1924) on 3.viii.1868 at Memerutungen (Fig. 2). This placename is a mystery. Grunow (in Cleve & Grunow 1880: 21) indicates that it is in Norway. But Hustedt (in the Schmidt *Atlas* plate 409, figs 20–23) places Memerutungen in Sweden. A search for such a locality only revealed a possible locality in the Svalbard archipelago (Norway) but, more likely, a misspelling of the Norwegian mountain chain Memurutindene in the Memurutind massif in Norway.

Grunow most likely obtained the sample when he was analysing material from the Cleve collection in Stockholm, as the sample was also listed as Cleve 113. One of the species Grunow listed in his *Accession Books* for this sample was *Achnanthes marginulata*. Until now, the type material has not been analysed and instead other populations from different localities were used to illustrate the species. For example, Lange-Bertalot & Krammer (1989: 98–99) indicated that "Das im Protolog angegebene Material aus Norwegen ließ sich in der Coll. Grunow bisher nicht finden [The material from Norway cited in the protologue could not yet be located in the Grunow collection]". Later, a slide from the original material surfaced, although unmounted material was no longer available (note that none of Cleve's (sub)samples used by Grunow are kept at **W** and there are only microscope slides in the collection for this material, Van de Vijver, pers. obs.). Two other slides, presumably from the same Cleve material, might be in the Van Heurck collection (part of the **BR** herbarium, Meise, Belgium). Both are labelled "Memerutungen" and were prepared by Eugène Weissflog (1822–1898). Analysis of the diatoms in the sample, revealed that the same Nordstedt material may have been used, since the observed diatom flora is almost identical to the one listed in

Grunow's accession book for sample 2024 (Fig. 2): *Eunotia triodon*, *E. denticulata*, *Brachysira confusa* (as *Navicula serians* f. *minuta* nom. inval.), *Tabellaria flocculosa*, *Pinnularia* sp. (as *Navicula rupestris*). However, there is no indication on the slides, nor in the handwritten catalogue of the Weissflog collection Van Heurck added, that Weissflog used the same Cleve 113 material that Grunow prepared for his slide of *A. marginulata*. Thus, since there is still doubt about the identity of these slides, we prefer not to lectotypify with the slide. Hasty lectotypifications in the past have led to mistakes in the designation of the correct type material. Nevertheless, the slides can still be used to document and illustrate *A. marginulata*, providing a good morphological characterisation of the species so that the identification of the species will be less problematic.

*Psammothidium marginulata* was designated by Bukhtiyarova & Round (1996: 3) as the type of the newly erected genus *Psammothidium* Bukhtiyarova & Round, although the authors did not study original (type) material of *Achnanthes marginulata* Grunow. Moreover, they mistakenly claimed (Bukhtiyarova & Round (1996: 5) that several of the illustrations in Lange-Bertalot & Krammer (1989, pl. 26: figs 1–6) were made from “type mater.”. These pictures were from specimens found on slide Cleve & Möller 324, collected in Atanek (Ataneq, west coast of Greenland) by the Swedish geologist Nils Olof Holst (1846–1918). *Achnanthes marginulata* is among the numerous species listed for this sample but analysis of slide 324 conserved in **BR**, revealed that only very few valves of *A. marginulata* could be found.

Moreover, light microscopical analysis of the *A. marginulata* population in the Memerutungen slides prepared by Weissflog (Figs 3–44) and in Cleve & Möller slide 324 (Figs 45–63), presents two diatom taxa with distinctly different valve outlines. In the Weissflog slides, almost all valves have a lanceolate valve outline with broadly protracted apices whereas in slide 324 all valves present a strictly elliptical outline throughout the entire cell division cycle and lack protracted apices. Lange-Bertalot & Krammer (1989: 99) commented on this outline stating that the species has a quite constant valve outline, questioning the identity of some valves they photographed from a Norwegian sample showing a lanceolate outline with broadly protracted apices (Lange-Bertalot & Krammer 1989, pl. 27: figs 39–42). A few years later, Krammer & Lange-Bertalot (1991, pl. 13: figs 11–20) show similar lanceolate valves (some pictures are identical to those published in 1989) originating from Norway.

To illustrate *P. marginulatum*, Bukhtiyarova & Round (1996, figs 2–11) used the type material of *Achnanthes marginulata* f. *major* Flower & V.J. Jones, a taxon described in 1989 from An Lochan Uaine [The Green Loch], Cairngorm Mountains, Scotland, an acid lake. This forma has typically broadly rounded, elliptical valves lacking the protracted apices. As such, this forma can be considered similar to the population in Cleve & Möller slide 324, although Flower & Jones (1989) separated their f. *major* from the presumed *A. marginulata* population they observed in Cleve & Möller slide 324 (using slide **BM** 13083 = Cleve & Möller 324) based on larger valve dimensions and the more distinct axial area in the f. *major*. Bukhtiyarova & Round (1996: 27) stated that the f. *major* is simply a synonym of the nominate form based on comparison of this form with the illustrations in Lange-Bertalot & Krammer (1989) as the drawings in Hustedt (1933) may represent a different taxon.

To separate these non-protracted valves from *A. marginulata* sensu stricto., Lange-Bertalot & Metzeltin (1996, p. 22) described the new species *Achnanthes acidoclinata* Lange-Bertalot [now *Psammothidium acidoclinatum* (Lange-Bertalot) Lange-Bertalot] and discussed the differences and similarities with *P. marginulatum*. They also mentioned for the first time that the type material of *A. marginulata* is from Norway. The main difference between both species is the valve outline with *P. acidoclinatum* having an elliptical outline with broadly rounded, non-protracted apices and *P. marginulatum* having a lanceolate outline with protracted apices. Lange-Bertalot & Metzeltin (1996: 22) clearly excluded the drawings Grunow made from Memerutungen from synonymy with *P. acidoclinatum*. Also, the identity of *A. marginulatum* f. *major*, considered a synonym of *P.*

*marginulatum* by Bukhtiyarova & Round (1996), was questioned, concluding that conspecificity with *P. acidoclinatum* was not to be excluded (“Vermutlich aber gehört diese var. *major* zu *A. acidoclinata*”, Lange-Bertalot & Metzeltin 1996: 23). The Atanek population in Cleve & Möller 324 was not discussed but it is clear that it should be identified as *P. acidoclinatum* and not as *P. marginulatum*.

With the current contribution, we wish to establish the morphological identity of *P. marginulatum* solely using light microscopy, clearly pointing out that almost none of the observed valves presents the broadly elliptical outline and that most of these strictly elliptical valves should be identified as *P. acidoclinatum*, correcting in this way numerous erroneous identifications in the literature. Bukhtiyarova & Round (1996: 22) described a new species, *P. bristolicum* Bukhtiyarova, that according to Lange-Bertalot & al. (2017) was occasionally misidentified as *P. marginulatum*. They separated this new species from *P. marginulatum* on the basis of the shape of the sternum of the raphe-less valve and the absence of a ribbed raphe slit, although one should keep in mind that it is now clear that they based their comparison on the incorrect species, *P. acidoclinatum*. Nevertheless, valve outline and shape of the axial and central area can be used to separate these species, providing the correct populations are used in the analysis. Because of all this confusion, a lot of the illustrations of *P. marginulatum* in widely used literature may contain multiple species and thus a refined morphological circumscription based on the Memerutungen material was very desirable.

*Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round (1996: 5)

Basionym: *Achnanthes marginulata* Grunow, in Cleve & Grunow, *Kongliga Svenska Vetenskaps-Akademiens Handlingar* 17(2): 21, 1880. Valves illustrated in Van Heurck (1880) plate XXVII [27], figs 45 & 46.

Slides used: **BR** VIII-31-A5 and A6, E. Weissflog slides.

Slide locality: “Memerutungen”, Norway (leg. O. Nordstedt, 3.viii.1868)

Description: Valves lanceolate (larger valves) with convex margins and broadly protracted apices.

Smaller valves more elliptical in outline with broadly rounded, only very weakly protracted apices. Valve dimensions (n=40): length 10–15 µm, width 4.0–4.5 µm. Raphe valve: Axial area narrow to very narrow, slightly thickened. Central area forming a broad, rectangular pseudofascia, bordered by several shortened striae at the margins. Raphe straight with indistinct central pores. Striae radiate throughout the entire valve length, 27–29 in 10 µm. Rapheless valve: axial area very large, distinctly widening to the elliptical central area. Striae marginal, short, radiate throughout, 24–27 in 10 µm.

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**Figs 1–2.** Historic materials relating to *Psammothidium marginulatum*. **Fig. 1** Original cut-out remainder of Grunow's drawing used to describe *Achnanthes marginulata* kept in **W** (the cut-out was used in Van Heurck's *Atlas* and remained in his collection, now at **BR**). **Fig. 2.** Grunow's notes in his catalogue for his sample 2024 citing Cleve's sample 113 and the locality Memerutungen. **Figs 3–44.** Analysed population of *Psammothidium marginulatum* (Grunow) Bukhtiyarova & Round photographed from **BR** VIII-31-A5 and A6, two Weissflog slides prepared from material collected at Memerutungen. **Figs 3–23.** LM views of a size diminution series of the raphe valve. **Figs 24–44.** LM views of a size diminution series of the rapheless valve. **Figs 45–63.** *Psammothidium acidoclinatum* (Lange-Bertalot) Lange-Bertalot, population from Cleve & Möller slide 324 (Atanek, Greenland). **Figs 45–55.** LM views of a size diminution series of the rapheless valve. **Figs 56–63.** LM views of a size diminution series of the raphe valve. Scale bar = 10  $\mu$ m.