Observations and lectotypification of *Gomphonema pulvinatum* A.Braun ex Rabenhorst (*Gomphonemataceae, Bacillariophyceae*)

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During a survey of the types of the *Gomphonema vibrio* group, valves that matched an illustration in Van Heurck (1880, plate XXIV [24]), but with a different taxon name, came to our attention. Grunow illustrated three valves (figs 32–34) of *Gomphonema intricatum* var. *pulvinatum* (as '*pulvinata'*) Grunow including the reference: "*G. pulvinatum* A.Braun!", a species he obviously had observed given the exclamation mark indicating that he had examined material.

Gomphonema pulvinatum was first described in Rabenhorst (1853: 58, pl. VIII: *Gomphonema*: fig. 16) based on material and a letter sent by Alexander Karl (Carl) Heinrich Braun (1805–1877) ("A. Braun *in litt. c. icone*" [in a letter with a drawing]) and a location "*Im Sihlwalde bei Zürich, im September 1850*" and this description "Bis 2/100 Mm. lang, nach oben wenig verbreitert, an der Basis schmäler als der sehr dicke, geschlängelte, hie und da zweitheilige Stiel. Bildet kleine, sehr dichte Polster, scheinbar glatte Hügelchen, in dem alle Köpfe gleich hoch sind. [Up to 2/100 mm. long, scarcely broadened towards the top, narrower at the base than the very thick, sinuous stem, which divides into two here and there. Forms small, very dense cushions, seemingly smooth mounds, in which all heads have the same height.]".

Rabenhorst (1864: 292) included the species in his *Flora Europaea* (Rabenhorst 1864: 292) and emended the description: "*G. pulvinato-aggregatum, stipitibus crassis simplicibus vel furcatis, flexuosis, fastigiatis et dense pulvinato-coacervatis; valvis obovato-subclavatis utroque fine rotundatis, nodulo centrali parvo rotundato, striis subradiantibus 36–38 in 0,001". v. s. Long. 1/87'" = 0,0010", lat. valvarum 0,00028–0,00034", lat. lateris 0,0004".* [*G.*[*omphonema*] living in cushions, on thick, simple or forked stipes, curved, ridged and densely cushioned; valves ovate-subclavate, rounded at both ends, small rounded central nodule, sub-radiating striae, 36–38 in 25 µm (i.e. 14–15 in 10 µm). Length ca 26 µm, width of the valve ca 6–9 µm, width of the frustule 10 µm.]". Note, that we have substituted conversions from inches to the metric system in the translation for ease of comparison with the modern literature. The letters v.s. indicated that the species was only seen in dry or fossil state (Smith 1853).

Grunow (in Van Heurck 1880) interpreted it as belonging to *G. intricatum* and transferred the species to the rank of variety (*G. intricatum* var. *pulvinatum* (A.Braun) Grunow). De Toni (1891, p. 427) considered it to be a variety of *G. dichotomum* as *G. dichotomum* var. *pulvinatum* (A.Braun) De Toni. Finally, Ross in Hartley (1986: 608) treated it as a variety of *Gomphonema vibrio* as *G. vibrio* var. *pulvinatum* (A.Braun) R.Ross.

This taxon has to date only been rarely reported. Mayer (1928) observed it in several Bavarian localities (Bad Reichenhall, Spessart), and Cleve-Euler (1932) reported it from the Tåkernsee (Lake Tåkern) in Sweden. Later, Cleve-Euler (1955) added that she could not find other records, but that the species was most likely more common, though often reported under different names. The fact

that later well-known and commonly used monographs such as Hustedt (1930) or Krammer & Lange-Bertalot (1986) did not include *G. pulvinatum* probably contributed to the lack of records.

In the Grunow collection, kept in **W** (herbarium of the Natural History Museum Vienna, Austria), a sample collected in "1848 by A. Braun from Sihlwald bei Zürich" is conserved as Grunow sample 637 (W0164935, W0164935 filed under "*Gomphonema dichotoma* var. *pulvinatum*"). The entry in Grunow's accession book (the catalogue of all his samples) reads "637 – *Gomphonema pulvinatum* A.Braun – Sihlwald bei Zürich – 1848 A.Br". It is likely this material is the same as that Rabenhorst listed as September 1850 (same locality, same collector, same period, Grunow's observations), which was the basis for the description of *G. pulvinatum* in Rabenhorst (1853), but there is the difficulty of the discrepancies in dates. Although only a tiny amount of material is available, we were able to make a preparation of the sample for analysis and illustrate the species using both LM and SEM observations. The drawing in Rabenhorst (1853, plate VIII: *Gomphonema* fig. 16) is here designated as lectotype. Grunow's sample 637 kept in **W**, is a good candidate for epitypification, as it most likely is the same material. However, Rabenhorst's (1853) description only mentions a very small species (< 25 µm), that, as he wrote "*bildet kleine, sehr dichte Polster*", i.e. forms small, very dense cushions. This could not be verified and Grunow's drawings (Fig. 1) also do not show this feature. As it seemed to be an important character for Rabenhorst, the chosen species name '*pulvinatum*' meaning 'cushion-forming', we decided not to formally designate Grunow's sample 637 as epitype for *G. pulvinatum*.

Gomphonema pulvinatum A.Braun ex Rabenhorst (1853: 58) Figs 1–34.
Type locality: "Sihlwalde bei Zürich [Switzerland], 1848, leg. A.Braun" (Rabenhorst 1853: 58)
Lectotype (here designated): original drawing in Rabenhorst 1853, plate VIII [8], *Gomphonema* fig. 16.
Registration: http://phycobank.org/104811
Homotypic synonyms: *Gomphonema intricatum* var. *pulvinatum* (A.Braun) Grunow (in Van Heurck 1880: pl. 30: figs 32–34); *G. dichotomum* var. *pulvinatum* (A.Braun) De Toni (1891: 427); *G. vibrio* var. *pulvinatum* (A.Braun) R.Ross (in Hartley 1986: 608)
Description: Frustules rectangular in girdle view, with almost parallel margins. Occasionally very weakly clavate. Mantle striae very short, marginal, composed of a few large, rounded areolae. Small more distantly spaced, areolae continuing the mantle striae near the mantle edge lacking. Two distinct longitudinal series of areolae clearly visible in LM on the girdle (Figs 3, 4, arrows). Cingulum composed of a broad open valvocopula and several narrower copulae. Series of rounded pores visible at the valvocopula edge. Valves linear to linear-lanceolate, slightly clavate. Valves occasionally asymmetrical with a slightly concave lower valve margin on one side (e.g. Figs 6, 12, 16 & 19). Headpole broadly rounded following a clear constriction of the valve in the upper half. Valve margins gradually tapering towards the narrower, broadly rounded footpole. Valve dimensions (n=25): length 15–55 µm, width 5.0–6.5 µm. Axial area very narrow, linear. Central area large, forming an almost complete fascia, except for one strongly shortened stria on each side. Small, rounded stigmoid present almost next to the central raphe endings. Central raphe endings straight, expanded in drop-like depressions. Terminal raphe fissures almost straight, bisecting the apical pore field in two almost equal parts. Apical pore field large, located on the mantle, extending onto the valve face, composed of a dense pattern of small, rounded pores. Striae slightly radiate throughout, 10–12 near the valve middle, becoming distinctly denser towards the apices, up to 20–25 in 10 µm. Striae uniseriate, composed of small, rounded areolae. Near the axial area in the lower halve of the valve, areolae often sunken in irregular straight to hemi-lunar depressions. Part of the population showing a different areola pattern with slit-like areolae in the upper part and clearly depressed areolae in the lower halve (Figs 32–34). Internally, pseudoseptum clearly visible at the footpole, less developed at the headpole. Central

raphe endings reverse-hooked. Striae sunken in long, shallow grooves. Silica struts between the areolae absent. Stigmoid elongated.

The variability in the areola shape and size is remarkable. As there are no other morphological differences (valve outline, dimensions, raphe structure, …), this should be considered as intraspecific variability rather than representing two different species.

Thanks to Ms Myriam de Haan for carefully preparing Grunow sample 637 allowing us to observe *G. pulvinatum* using LM and SEM techniques and for her help with the SEM observations.

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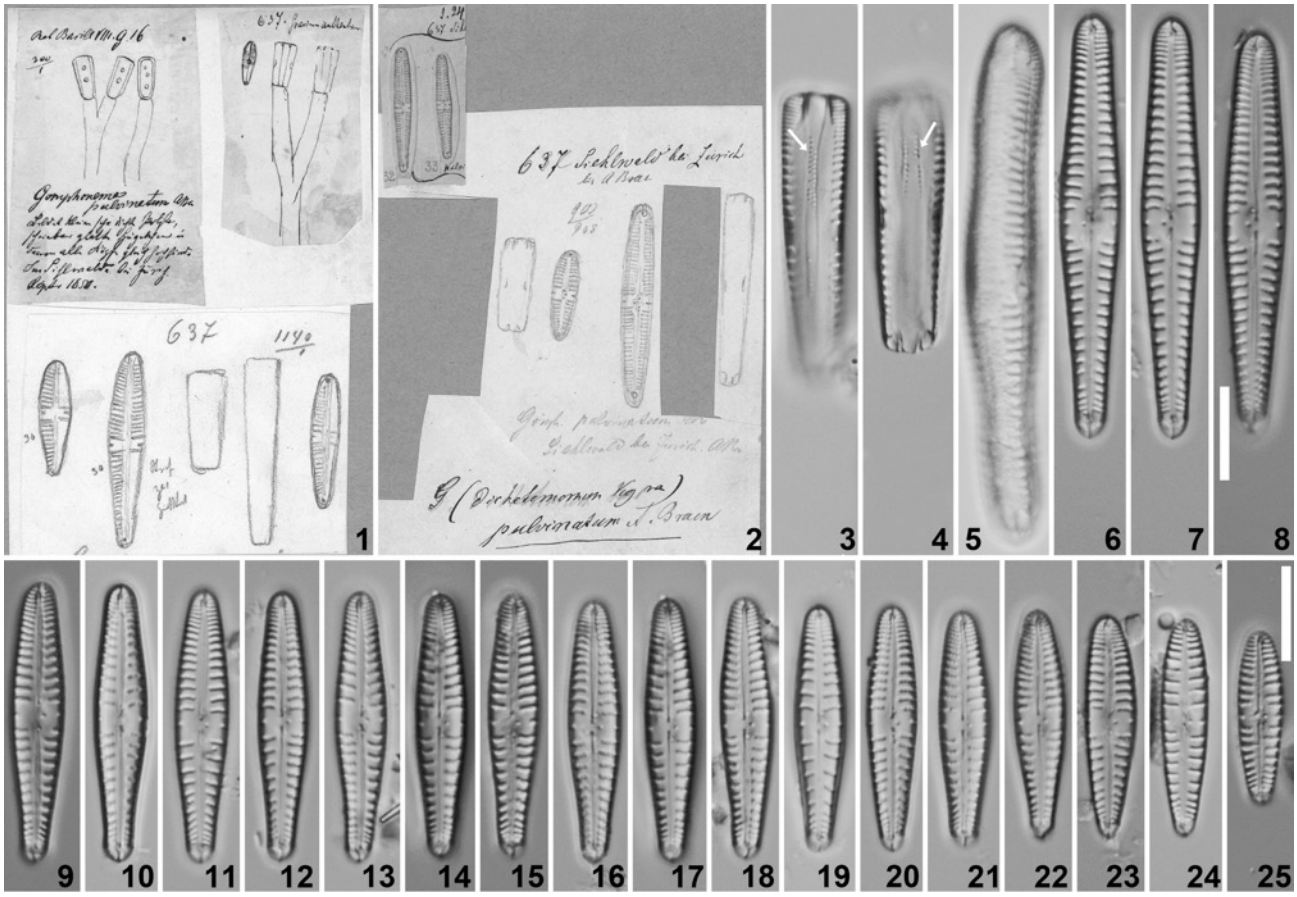
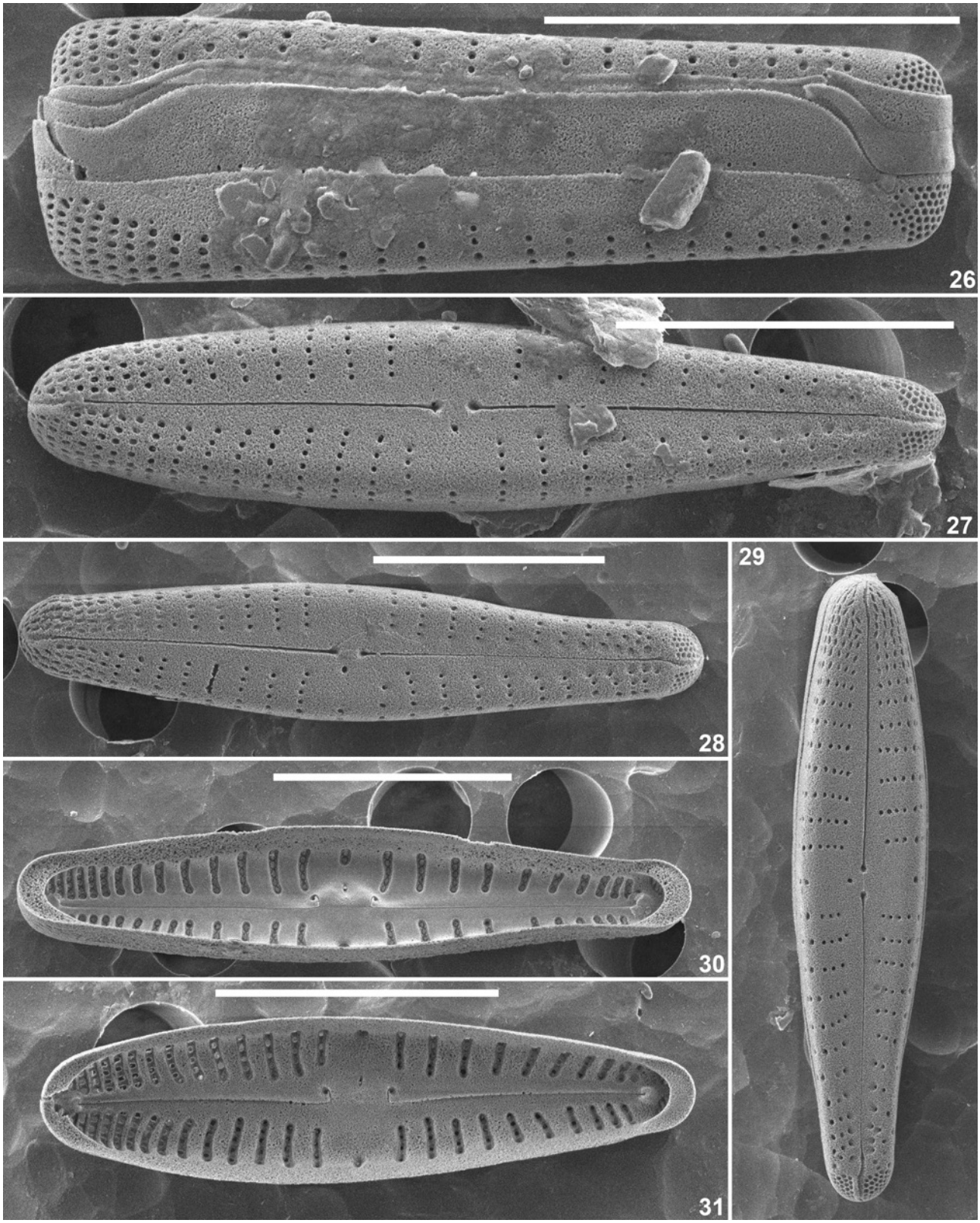
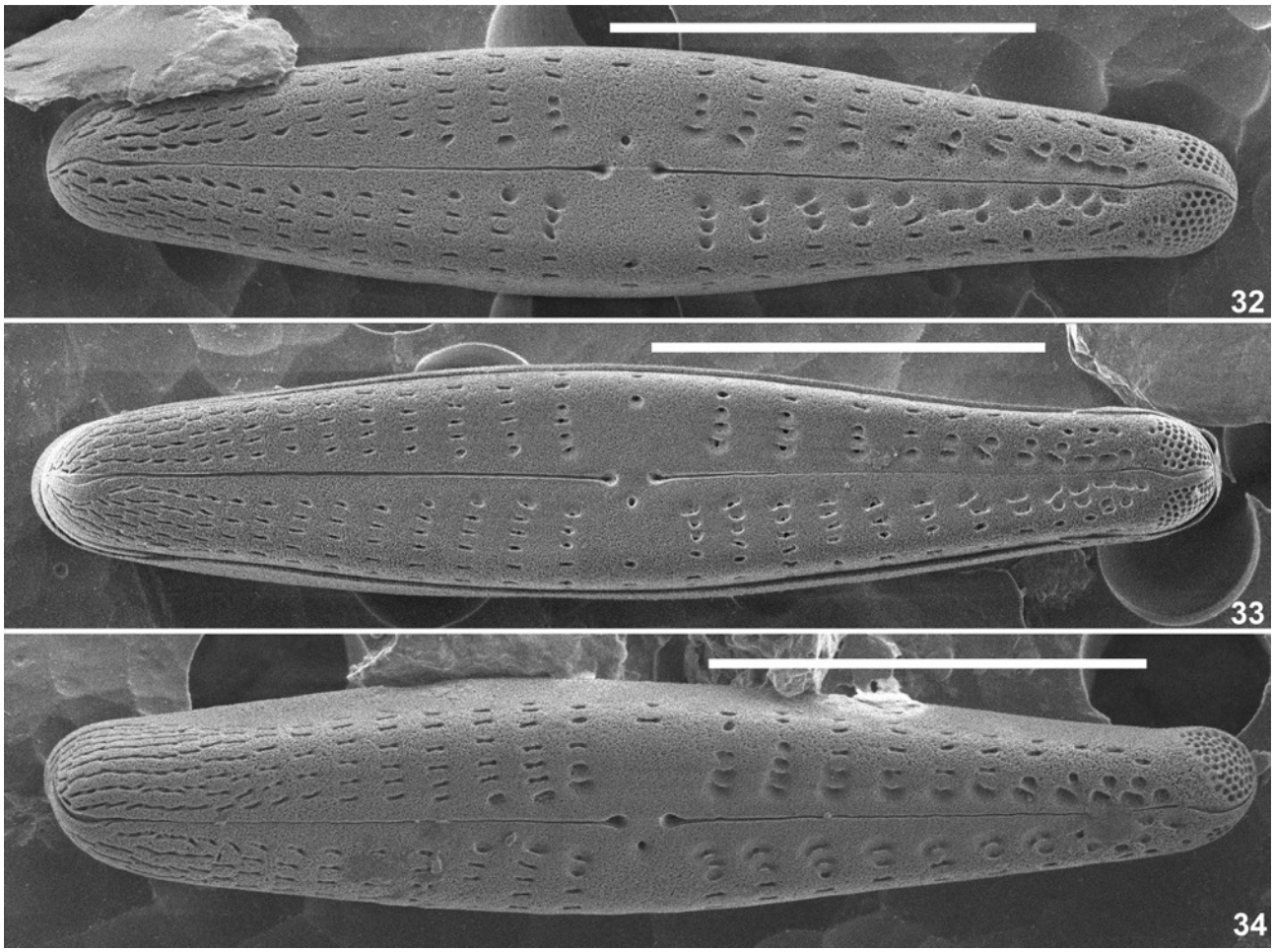


Figs 1–25. *Gomphonema pulvinatum* A.Braun ex Rabenhorst. LM pictures taken from Grunow sample 637 (W0164935), Sihlwald bei Zürich (Switzerland), 1848, leg. A. Braun. **Figs 1, 2.** Original drawings of *Gomphonema pulvinatum* made by Grunow based on his sample 637 conserved in **W**. The small drawing with the accompanying text in Fig. 1 is likely a copy of Rabenhorst's (1853) original information with notes added most likely by Grunow below the drawing. **Figs 3, 4.** LM views of two frustules in girdle view. Note the double series of pores in the middle of the frustule. **Fig. 5.** LM view of an initial valve. **Figs 6–25.** LM views of a size diminution series. Scale bar = 10 µm.



Figs 26–31. *Gomphonema pulvinatum* A.Braun ex Rabenhorst. SEM pictures taken from Grunow sample 637 (W0164935), Sihlwald bei Zürich (Switzerland), 1848, leg. A. Braun. **Fig. 26.** Frustule in girdle view showing the girdle bands and the apical pore fields. **Fig. 26–29.** SEM external views of an entire valve. Each valve has typical small, rounded areolae. Note the dense striation pattern in the apex, typical for the species. **Figs 30, 31.** SEM internal views of entire valve. Scale bar = 10 µm.



Figs 32–34. *Gomphonema pulvinatum* A.Braun ex Rabenhorst. SEM pictures taken from Grunow sample 637 (W0164935), Sihlwald bei Zürich (Switzerland), 1848, leg. A. Braun. All valves showing slit-like areolae in the upper half and depressed areolae in the lower halve. Scale bar = 10 µm.