Observations on the type material of *Gomphonema ventricosum* Gregory (*Gomphonemataceae, Bacillariophyceae*)

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The taxonomy and systematics of the genus *Gomphonema* Ehrenberg, 1832, *nom. cons.* are currently being revised using a combination of morphological and molecular data resulting in the transfer or reinstatement of several, often entire, groupings of former *Gomphonema* taxa to the other genera such as *Gomphonella* Rabenhorst, 1853 (e.g. Jahn & al. 2018, Abarca & al. 2020). Several other such groupings still await to be split off from the core genus *Gomphonema*, which is based on a conserved type, *G. acuminatum* Ehrenberg (1832: 88) (Abarca & al. unpubl.). Despite the relatively extensive literature that exists on the genus, including several monographs such as Levkov & al. (2016), and the detailed studies of Erwin Reichardt (e.g. Reichardt 1999, 2001, 2005, 2015), the original material of several widely reported species often remains only poorly studied. Analyses are frequently limited to light microscopical observations of type slides combined with scanning electron microscopy data of populations presumed to be similar, but not topotype material. A good knowledge of the morphology in both LM and SEM is, however, of critical importance to be able to make an appropriate transfer of taxa to a new genus. A good example of the importance of type material analysis before making a taxonomic transfer, is *Anomoeoneis minor* Krasske (1939: 377), a Chilean species transferred by Lange-Bertalot in Lange-Bertalot & Moser (1994: 47) to the genus *Brachysira* Kützing, 1844 as *B. minor* (Krasske) Lange-Bertalot, based solely on LM observations of syntype material (Lange-Bertalot & Moser 1994). SEM analysis of the type material, however, shows that based on its morphology, the species does not belong to the genus *Brachysira* but should be transferred to the genus *Diadesmis* Kützing (1844) (Van de Vijver, unpubl.). Therefore, a thorough analysis of the type material should always be carried out before making any taxonomical or nomenclatural changes.

One of the *Gomphonema* species whose morphology was not examined using SEM is *Gomphonema ventricosum* W.Gregory (1856: 12, pl. 1: fig. 40). The species was originally described from "a gathering from the banks of the Spey near Elchies" [Scotland], probably collected on 26.vii.1854 according to Smith (1856: 99) and Hoover (1976: 49). Gregory described the species as having a much-expanded central part, obtuse and rounded extremities, with the longer part of the valve being a little expanded at the apex. He added that the species is short and broad in proportion and very uniform in its characters. Length about 0.0014 inch (approx. 35 µm) and striae 30–32 in 10 µm. The new species was illustrated with a single line drawing (Gregory 1856, pl. 1: fig. 40, our Fig. 1). Gregory (1856: 12) also mentioned in his protologue a collection of the species by R.K. Greville in April 1855 at the Bridge of Allen [Stirling, Scotland]. Later authors, such as Smith (1856: 99), Van Heurck (1880, pl. 24: fig. 13), Hustedt (1930, p. 377), Patrick & Reimer (1975: 137, pl. 19: fig. 2) and Krammer & Lange-Bertalot (1986: 373, pl. 162: figs 4, 5) illustrated the species but apart from Smith, none of these records implied type specimens and the species appears not to be formally lectotypified.

Kociolek & Stoermer (1987) studied the distribution and variability of *G. ventricosum*. They analysed slide BM 673 (currently listed as BM0000673 on the NHM data portal) labelled '*Gomphonema ventricosum* Spey (E 4/5) Gregory' from the Greville collection in the Natural History Museum, London, UK as possible type material for the species, naming it "Holotype" in their table 1. E4/5 refers to samples E4 and E5 in the Gregory sample collection. According to the original Gregory notes (*Localities & Gatherings with notes I*), both samples were collected from Spey and for E4, Gregory even wrote down '*G. geminatum ventricosum* n. sp. *E. triodon E. tridentata* n. sp. *Synedra arcus* ? n. sp. *T. lacustris St ovalis* ? n. sp.' Four valves from the original slide were photographed but unfortunately no SEM analysis was made.

Together with the type material, Kociolek & Stoermer (1987) also studied many reports of *G. ventricosum* in Europe, Asia and North America. Additionally, Yoshitake & al. (2009) analysed the valve outline of several populations of what they identified as *G. ventricosum* from a handful of Asian lakes such as Lake Baikal. They distinguished at least five different morphotypes, without making any further taxonomic separations. Several years later, and despite the lack of SEM analysis of the original material, Kociolek & al. (2018) described several species from the Lake Baikal region separating them from *G. ventricosum* based on features that could only be seen in SEM (areola occlusions, presence of septa and pseudosepta) (Kociolek & al. 2018). Although we do not question whether the species are truly different from *G. ventricosum*, SEM data of the original material would have been preferable to justify the separation of these taxa.

William Smith (1808–1857) gathered, in preparation of his *Synopsis of the British Diatoms* (Smith 1853, 1856), many samples from Britain and Ireland, often collected by contemporary diatom scientists such as William Gregory (1803–1858). Most of the William Smith type collection is conserved in the Van Heurck diatom collection in Meise Botanic Garden (**BR**, Belgium) with a minor part also present in the Natural History Museum (**BM**, London, UK) (Smith 1859). Hoover (1976) compiled a complete inventory of all unmounted material in the Smith collection in **BR**. One sample, labelled in W. Smith's handwriting, was collected from the River Spey sample collected by Dr Gregory on 26.VII.1854 (Hoover 1976, p. 49).

We consider this material as original material and are using it for detailed observations on specimens of *G. ventricosum* using LM and SEM. Kociolek & Stoermer (1987) mentioned the slide with the original Gregory material at **BM** as a 'possible holotype' but this cannot be considered a formal lectotypification. Thus. we designate here the slide labelled **BM** 0000673 as lectotype and the River Spey sample kept in **BR**, is here designated as isolectotype for *G. ventricosum*.

Gomphonema ventricosum W.Gregory (Figs 1–15)
Original description: Gregory, *Quarterly Journal of Microscopical Science, New Series* 4, 12, pl. 1: fig. 40, 1856
Homotypic synonyms
Gomphonema capitatum var. *ventricosum* (W.Gregory) Rabenhorst (1864: 288)
Gomphonema constrictum f. *ventricosum* (W.Gregory) Mayer (1928: 93, pl. 1: fig. 13 *'ventricosa'*)
Gomphonema constrictum var. *ventricosum* (W.Gregory) Z.X.Shi (2014: 28), *nom. inval.* (ICN, Art. 41.5)
Lectotype (here designated): **BM** 0000673 (Natural History Museum, London, UK)
Isolectotype (here designated): **BR**-4808 (Meise Botanic Garden, Belgium).
Lectotype locality: River Spey near Elchies [Scotland], coll. date 26.vii.1854, leg. Dr W. Gregory
Registration: https://phycobank.org/104054
Description: Frustules distinctly clavate with broad head pole and narrower foot pole (Figs 2–3). Presence of pseudosepta clearly discernible at head poles (Fig. 2). Valves rhombic-lanceolate, clavate with broadly convex margins. Head pole broadly rounded. Largest valve width at the center, very abruptly strongly tapering towards the protracted, capitate foot pole. Pseudosepta present at foot and head pole. Valve dimensions (n=10): length 28–43 µm, width 10–12 µm.

Axial area narrow, widening towards the central area. Raphe lateral with curved raphe branches. Central raphe endings simple to weakly inflated, deflected (Figs 11, 13). Terminal raphe fissures long, unilaterally bent continuing onto the valve mantle. Internally central raphe endings hooked and recurved (Fig. 14). Terminal raphe endings terminating onto well-developed helictoglossae (Fig. 15). Bilobed apical pore field evident at the foot pole, bisected by the terminal raphe fissure (Fig. 12). Central area irregular elliptic, bordered by several shortened, radiating striae. Small isolated pore present in the central area with rounded external opening (Fig. 13) and slit-like, transapically elongated internal opening (Fig. 14). Striae distinctly punctate, uniseriate, curved in the central area, radiate throughout the entire valve, 12–14 in 10 µm. Striae composed of relatively large areolae with complex, irregular external foramina. Internally, areola openings irregularly shaped, located in shallow grooves. Silica struts separating the areolae absent (Figs 14, 15). Mantle striae composed of up to 3 areolae bordered by a large hyaline mantle edge (Figs 10, 12). Cingulum composed of at least 3 open, perforated girdle bands (Fig. 10).

We thank Wolf-Henning Kusber for nomenclatural advice.

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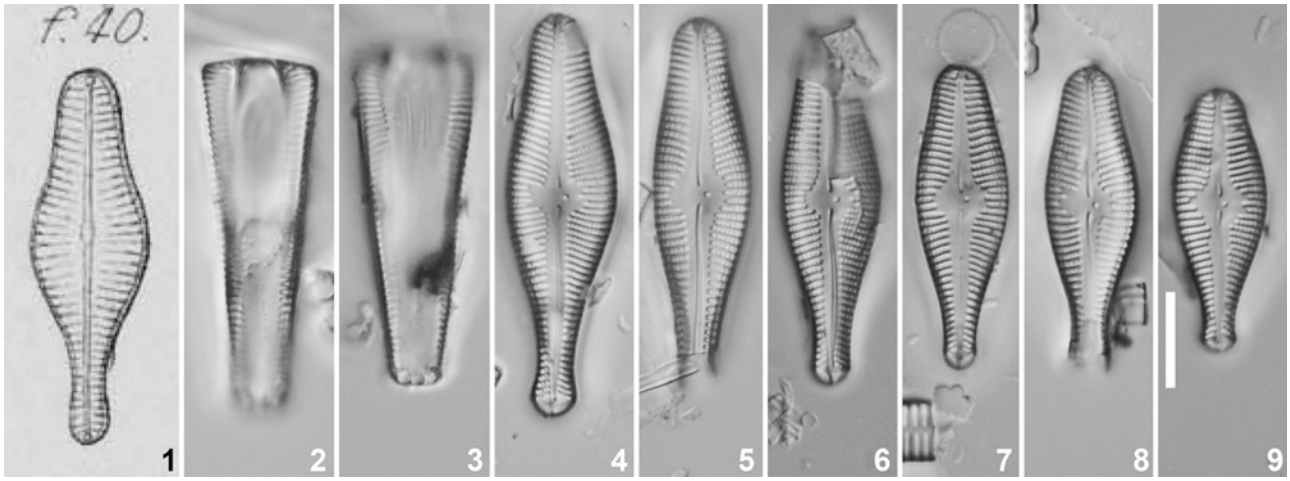
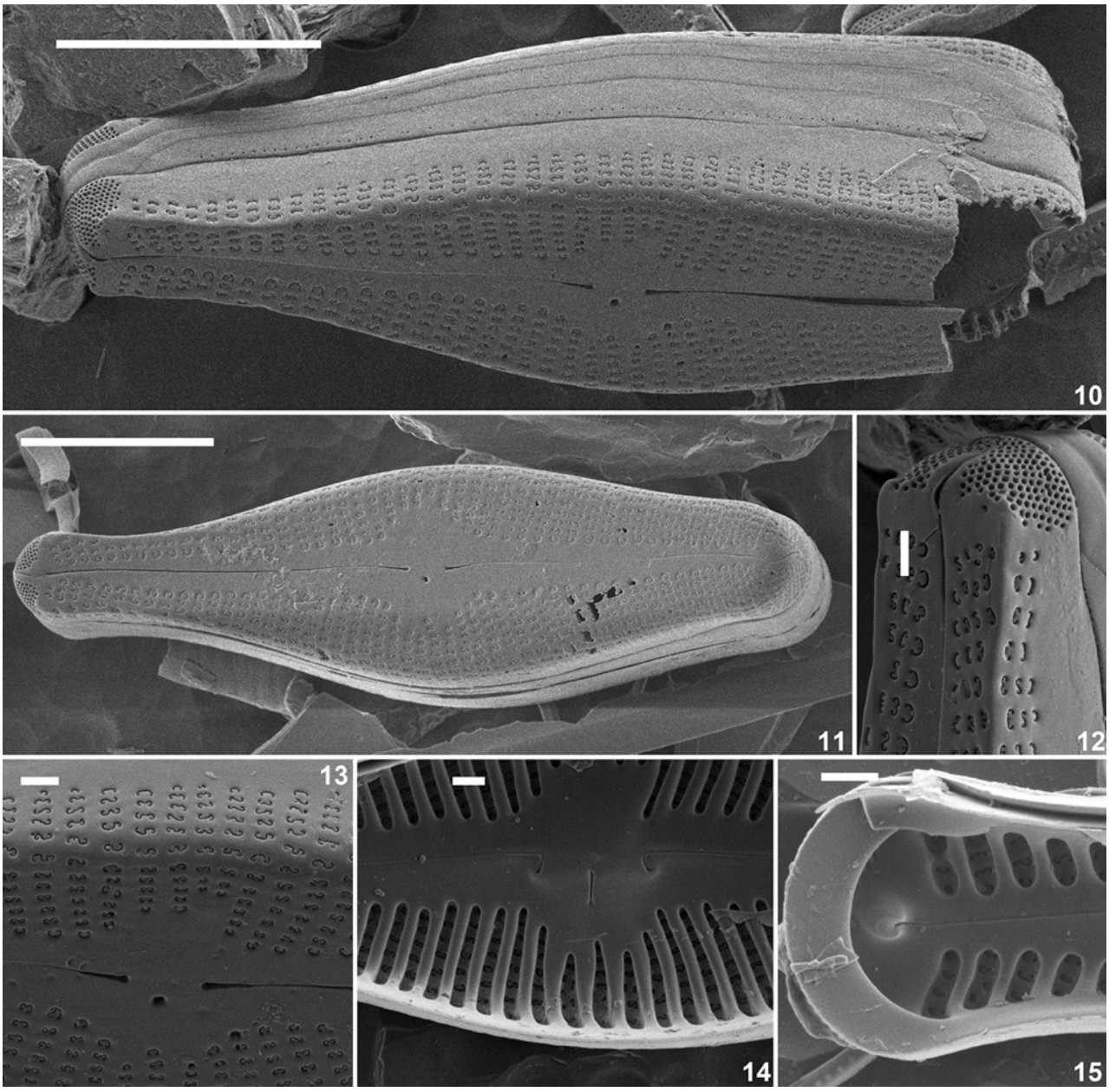


Figs 1–9. *Gomphonema ventricosum* W.Gregory. LM pictures taken from the isolectotype material (BR-4808, River Spey near Elchies {Scotland], coll. date 26.vii.1854, leg. Dr Gregory). **Fig. 1.** Original drawing of *G. ventricosum* from Gregory (1856, plate 1, fig. 40). **Figs 2 & 3.** LM pictures of 2 frustules in girdle view showing the distinct clavate outline. **Figs 4–9.** LM views of a size diminution series. Scale bar = 10 µm.



Figs 10–14. *Gomphonema ventricosum* W.Gregory. SEM pictures taken from the isolectotype material (**BR**-4808, River Spey near Elchies [Scotland], coll. date 26.vii.1854, leg. Dr Gregory). **Fig. 10.** SEM external view of an entire (partly broken) frustule in girdle view. **Fig. 11.** SEM external view of an entire valve. **Fig. 12.** SEM external detail of the footpole with the apical pore field bisected by the terminal raphe fissure. **Fig. 13.** SEM external detail of central area in oblique view showing the central raphe endings, the structure of the areolae and the isolated pore opening. **Fig. 14.** SEM internal detail of the central area with the central raphe endings and the slit-like internal opening of the isolated pore. Note the absence of siliceous struts between the areolae. **Fig. 15** SEM internal detail of the foot pole with the distinct pseudoseptum, and the well-developed helictoglossa. Scale bar = 10 µm (Figs 10 & 11) and 1 µm (Figs 12–15).