

Observations and lectotypification of *Caloneis warmingii* Østrup (Naviculaceae, Bacillariophyceae)

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The collection of an oddly shaped *Caloneis* taxon in Lauwersoog (Prov. Groningen, The Netherlands) that initially could not be identified using the currently available literature, triggered an intensive search in the historic taxonomic literature, for which we present the results here. A first potentially conspecific taxon was found in the Grunow drawing collection, currently kept in the herbarium of the Naturhistorisches Museum Wien (**W, Vienna, Austria**) (Fig. 1). Grunow annotated his drawings with handwritten notes indicating relevant information (e.g. Grunow sample number, occasionally locality, collector, and collection number). This information is often necessary for locating the material from which the drawing was made, and which is, if still available, also kept in the Grunow collection at **W** (Schuster & al. 2022). The drawing, showing three valves, which were probably copied from an older publication, but the reference given by Grunow (“O. Schmid 68”, or perhaps “A. Schmidt 68”) could not be traced (Fig. 1). We think this is a reference to another illustration, because Grunow generally indicated his number for the sample he worked with, and which he assigned to any sample, even if he knew the collector’s number, but none is given here. This is also why we assume a reference to a citation, rather than a collection number (68). The identification as ‘*N.[avicula] gibberula* var. ?’, which cannot be considered a valid taxon name, was also questionable, as indicated by the question mark.

We eventually identified the Lauwersoog valves and Grunow’s drawing as *Caloneis warmingii* Østrup, a species described by Ernst Vilhelm Østrup (1845–1917) from material collected on the Danish island of Fanø (Østrup, 1910: 16). Østrup described the species as follows: “Long. 60 μ , Lat. 11 μ , Str. 18 in 10 μ , transverse lineatis. Valva elongata, biconstricta, apices truncatos versus magis inflata quam media in parte. Raphe

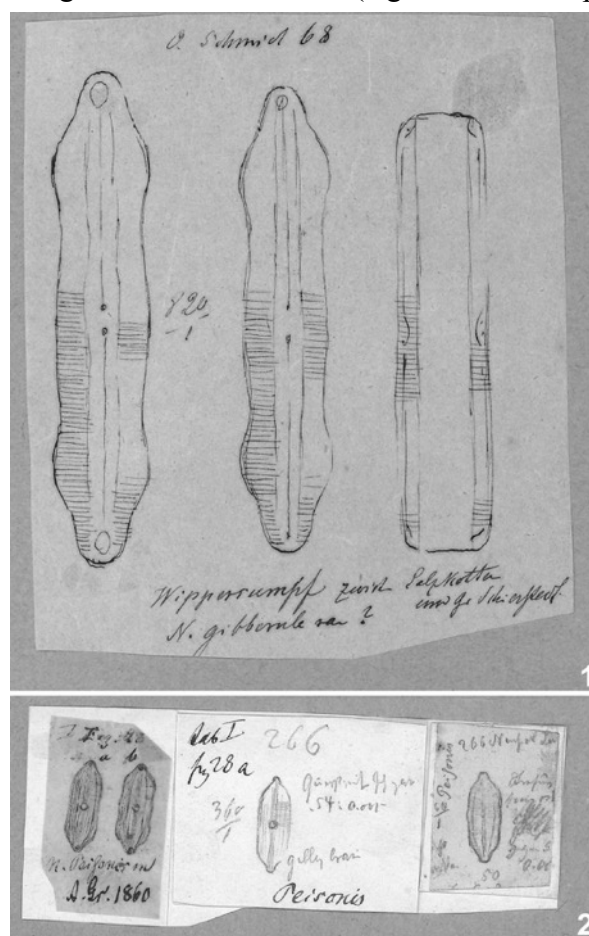


Fig. 1. Original Grunow drawing of a taxon identified as *N. gibberula* var. ?, most likely representing the first images of *Caloneis warmingii* Østrup. **Fig. 2.** Original drawing by Grunow of *Navicula peisonis* Grunow.

obliqua area hyalina lata cincta. Striis parallelis, sub apices Raphen attingentibus. Linea inframarginali conspicua.” [Length 60 µm, width 11 µm, striae 18 in 10 µm, transversely lined. Valve elongate, biconstricted, apices truncated [and] more inflated than in the valve middle. Raphe oblique, surrounded by a broad hyaline area. With parallel striae, reaching the raphe near the apices. Inframarginal line visible.] and illustrated his new species with one line drawing (Østrup 1910: pl. I, fig. 10; our Fig. 3). He named the species after Dr Johannes Eugenius Bülow Warming (1841–1924), former director of Copenhagen Botanic Garden, and collector of the material.

Other records of the species under the name *C. warmingii* are very scarce. At present, only Cleve-Euler (1955: 99) mentions the species as *Caloneis silicula* subsp. *limosa* τ *warmingii* (Østrup) A.Cleve, but it is unclear what taxonomic rank she gave to the taxon; perhaps she intended to give it a varietal rank, as many researcher of the late 19th century did when using Greek letters for infraspecific taxa. She illustrated the species with three line drawings (Cleve-Euler 1955, fig. 1143s–u), taken from three different sources: one drawing after Mayer (1941; Cleve-Euler’s fig. 1143s), a second one being an exact copy of Østrup (1910; Cleve-Euler’s fig. 1143t), and a third after Berg & Hessland (1949; Cleve-Euler’s fig. 1143u). Interestingly, Cleve-Euler (1955: 99) also added *Caloneis silicula* var. *peisonis* Hustedt (in Beck & Zahlbruckner 1928: 3045) as a synonym. *Caloneis silicula* var. *peisonis* was described in 1928 independently by Hustedt on the label of no. 3045 of the Beck & Zahlbruckner exsiccata set ‘*Kryptogamae exsiccatae, editae a Museo Palatino Vindebono*’ as a brackish-water species from a river near the the Neusiedler See, Austria (“*in rivulo aqua frigida repleto prope pagum Weiden am See*” [in a stream filled with cold water near the village of Weiden am See]. Hustedt (1930: 239) later reported it from the Mansfelder Seen, Germany. Simonsen (1987: 118) lectotypified the species and illustrated its variability with three LM pictures (Simonsen 1987, pl. 193: figs 7–9).

The taxonomic history of the taxon became even more complicated after the transfer of *Navicula peisonis* Grunow (1860: 544), described from the Neusiedler See (known as Lake Peiso or *Lacus Peisonis*), to the genus *Caloneis* as *C. silicula* f. *peisonis* (Grunow) Krammer (in Krammer & Lange-Bertalot 1985: 22). Krammer referred to Krammer & Lange-Bertalot (1986, pl. 172: fig. 8) showing a valve from the Neusiedler See, possibly observed in a slide from the Hustedt collection as Hustedt’s taxon and *C. silicula* var. *peisonis* was added as a synonym. *Navicula peisonis*, the basionym of *C. silicula* f. *peisonis*, however, was previously the basionym for *Neidium dubium* var. *peisonis* (Grunow) Mayer (1919: 200). Following the analysis of the original Grunow drawings of *N. peisonis* for Grunow sample 266 (Neusiedler See, Van de Vijver, pers. obs.; Fig. 2) it is clear that the taxon shows all the features of a species of *Neidium*, such as the typical longitudinal canals (visible as longitudinal lines) and lacks the typical characteristics of the genus *Caloneis*. Analysis of the LM images in Simonsen (1987) and Krammer & Lange-Bertalot (1986) indicates the conspecificity of *Caloneis warmingii* and *Caloneis silicula* var. *peisonis*, with priority of the former at the rank of species (ICN Art 11.2, Turland & al. 2018).

At C, original unmounted material of *C. warmingii* could not be found, and only a slide could be located. Analysis of the original drawing in Østrup (1910: pl. I: fig. 10; Fig. 3) shows such a high degree of similarity that conspecificity between the type of *C. warmingii* and the Lauwersoog population cannot be disputed. Furthermore, a forthcoming revision of the genera *Caloneis* and *Pinnularia* (N. Abarca, pers. comm.), will show that a better understanding of the ultrastructure of *C. warmingii* is necessary to place it there taxonomically.

Therefore, we here present observations on specimens of *C. warmingii* using LM and SEM, found in the Lauwersoog material, and Østrup sample 3918, slide 774.1, labelled *C. warmingii* at C is designated as lectotype. As unmounted material is no longer available, the Lauwersoog material is added as reference material to better illustrate the taxon named *C. warmingii* and to get first insight into its valve ultrastructure. The sample from Lauwersoog had a pH of 7.3 and a conductivity of more than 2800 µS.cm⁻¹.

Caloneis warmingii Østrup (Figs 3–17)

Original description: Østrup, *Danske Diatoméer med 5 tavler et Engelsk résumé*, p. 16, pl. 1: fig. 10, 1910.

Heterotypic synonym: *Caloneis silicula* var. *peisonis* Hustedt (in Beck & Zahlbruckner 1928: 3045)

Concept synonym: *Caloneis silicula* f. *peisonis sensu* Krammer & Lange-Bertalot (1986: 388, pl. 172: fig. 8)

Excluded from synonymy: *Caloneis silicula* f. *peisonis* (Grunow) Krammer (1985: 22), *nom. illeg. non Navicula peisonis* Grunow (1860: 544)

Lectotype (here designated): C-A-100639 (University of Copenhagen), Østrup sample 3918, slide 774.1, material kept in C.

Reference material: **BR**-4809, Lauwersoog, Prov. Groningen, The Netherlands, N 53.399211, E 6.222679. coll. date 14.viii.2023, leg. W. Leurs, slide, stub and dried material kept in **BR**.

Registration: <http://phycobank.org/104043>

Description: Frustules rectangular. Valves linear with clearly undulating, parallel margins and protracted, rostrate, cuneately rounded apices (Figs 3–11). Central valve part weakly convex, as wide as the apices. Valve dimensions (n=15): length 45–80 µm, width 10.0–12.65 µm. Axial area very broad, bordered near the striae by an irregular series of shallow depressions (Figs 12–14), lanceolate in outline. Depressions deeper near then central area (Fig. 14) compared to the apices (Fig. 15). Central area formed by a weakly widening axial area. Fascia not observed. Raphe lateral with curved outer branches (Fig. 13) and straight inner raphe branches. Near the central area and the apices raphe filiform (see LM figs). Central raphe endings simple to weakly expanded, straight. Terminal raphe fissures curved, halfway onto the mantle. Striae straight to slightly radiate throughout the entire valve, 15–16 in 10 µm, composed of one large alveolus, covered externally by porous hymenes (Figs 14–15). Longitudinal line crossing from apex to apex near the valve margins. Mantle very deep with short striae at the valve face/mantle junction and a large abvalvar hyaline edge, crossed by thin, transapical grooves (Fig. 12). Cingulum composed of at least two broad girdle bands with series of short, transapical, slit-like pores. Girdle bands covered with irregularly scattered siliceous papillae (Fig. 12). Internally, large hyaline plate covering the entire striae leaving only short opening at the margins (Fig. 16). Internal central raphe endings with intermission, shortly deflected (Fig. 16). Terminal raphe endings terminating onto small helictoglossae (Fig. 17).

We thank Christian Lange (Natural History Museum of Denmark, University of Copenhagen) for his help with the lectotype slide of *C. warmingii*. Dick Moe (*Index Nominum Algarum*) is thanked for his help in tracing the original description of *Caloneis silicula* var. *peisonis* Hustedt.

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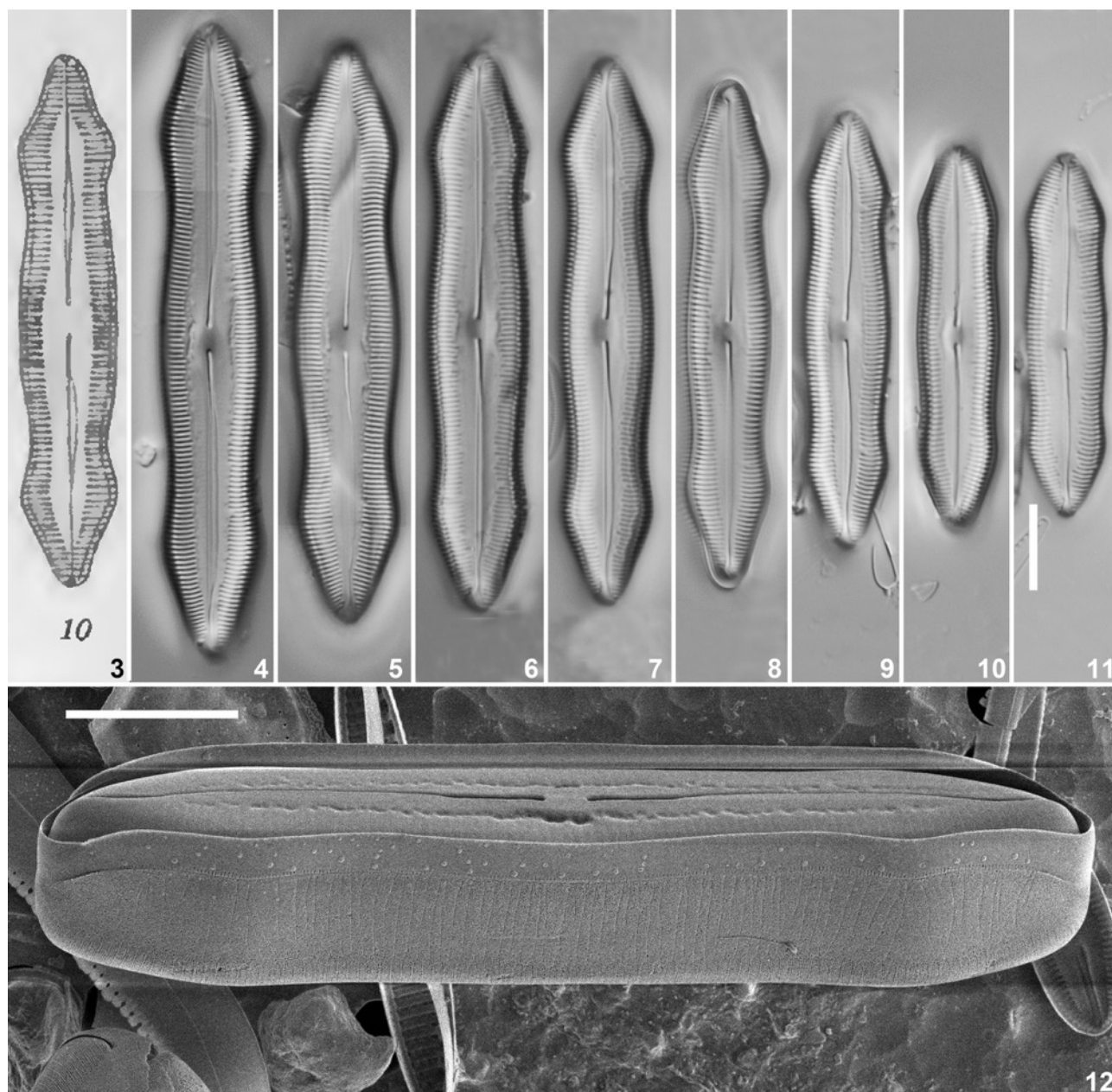
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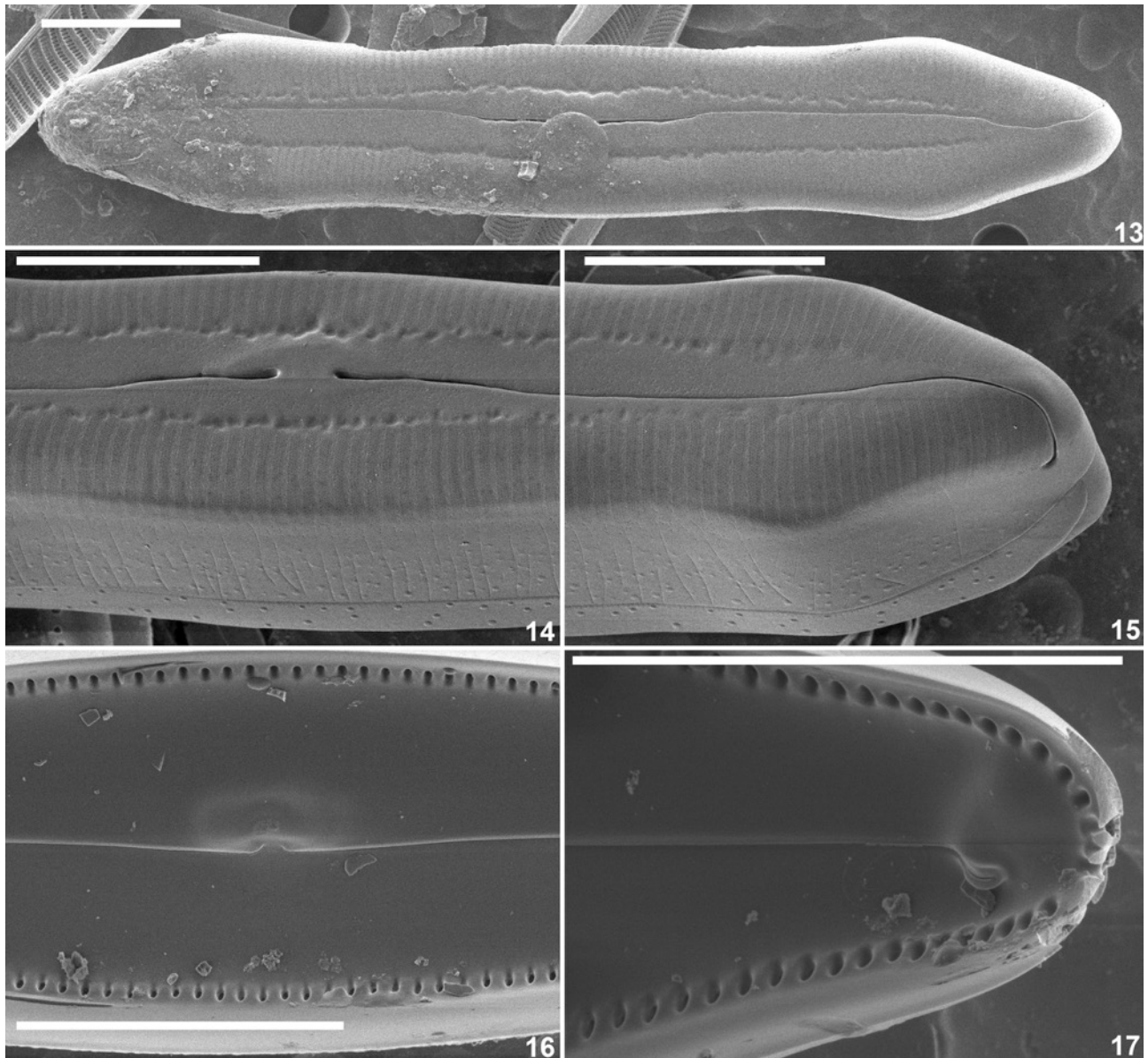
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Figs 1–12. *Caloneis warmingii* Østrup. LM and SEM pictures taken from the referenced material (BR-4809, Lauwersoog, The Netherlands, leg. W. Leurs). **Fig. 1.** Original drawing of *Caloneis warmingii* from Østrup (1910, plate 1, fig. 10). **Figs 2–11.** LM views of a size diminution series. **Fig. 12.** SEM external view of an entire frustule in oblique view. Scale bar = 10 µm.



Figs 13–17. *Caloneis warmingii* Østrup. SEM pictures taken from the referenced material (BR-4809, Lauwersoog, The Netherlands, leg. W. Leurs). **Fig. 13.** SEM external view of an entire valve. **Fig. 14.** SEM external detail of central area showing the central raphe endings, the shallow depressions bordering the axial area and the structure of the alveoli. **Fig. 15.** SEM external detail of the valve apex with the terminal raphe fissure. **Fig. 16.** SEM internal detail of the central area with the central raphe endings and the large hyaline plate covering the striae. **Fig. 17** SEM internal detail of the valve apex with the helictoglossa. Scale bar = 10 µm.