

1 **An electron microscope study and re-description of the type specimens of *Synedra*** 2 ***subula* and its transfer to *Ctenophora* (Bacillariophyta)**

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13 14 **Abstract**

15 *Synedra subula* Sande Lac. & Suringar is rarely encountered today. Although a reasonable
16 description was provided, the species has never been illustrated. Having discovered the type
17 specimens in the diatom collection of the Naturalis Biodiversity Center in Leiden (the
18 Netherlands), this short account presents details of some specimens using only scanning
19 electron microscopy as no light microscope slides exist or have been prepared.

20
21 Key-words: *Synedra*, *Ctenophora*, Herbarium types in L

22 23 **Introduction**

24 The name, and species, *Synedra subula* Sande Lac. & Suringar (in van der Sande Lacoste &
25 Suringar 1861a: 289) is rarely, if ever, encountered, except in compilation papers published
26 some time ago (e.g. Beijerinck 1927, this is a PhD thesis, <https://edepot.wur.nl/158644>) and
27 online data aggregating websites (e.g. GBIF, <https://www.gbif.org/species/3192737>). A
28 reasonably detailed description of *Synedra subula* was provided (Figure 1, and see below) but
29 no illustrations were offered, nor have any ever been provided, which may explain the lack of
30 many records. *Synedra subula* was first found on ‘*Cladophora Sandii*, Zwindersche Diep’
31 (Drenthe, the Netherlands), a species of *Cladophora* described by Suringar (in van der Sande
32 Lacoste & Suringar 1861a: 269).

33 This short account presents some details of the type specimens using only scanning
34 electron microscopy as no slides exist or have ever been prepared.

35 36 **Material & Methods**

37 *Place of Publication*

38 *Synedra subula* was first published in volume 5 of *Nederlandsch Kruidkundig Archief*.

39 Volume 5 was published in two parts: ‘vijfde deel, eerste stuk’ and ‘vijfde deel, tweede stuk’,
40 the first published in 1860, the second in 1861. The paper in question occupies pages 262–
41 296 (van der Sande Lacoste & Suringar 1861a). Sometimes reference is made to different
42 page numbers (e.g. p. 51 is referred to in Mills 1935: 1580, and VanLandingham 1978:

43 3944). This alternative pagination refers to a reprint in a collection of several papers from the
44 *Nederlandsch Kruidkundig Archief*, ‘vijfde deel, tweede stuk’ [5 (2)] with the title
45 ‘*Phanerogamen en Vaatkryptogamen, in het oostelijk zuidelijk deel van Drenthe*

46 *waargenomen nieuw beschrevene en voor onze Flora nieuwe Zoetwater-Wieren, verzameld*
47 *in Drenthe [...] 1859*’, dated 1861 (van der Sande Lacoste & Suringar 1861b). The reprint has

48 ‘Overgedrukt uit het Verslag van de Vergadering der Vereeniging voor de Flora v. Nederl.

49 enz., den 20 Julij 1860’ on its final page (p. 52), indicating the date of the meeting rather than
50 the date of publication, but it followed after publication in volume five of *Nederlandsch*

51 *Kruidkundig Archief*. In this collection, van der Sande Lacoste & Suringar's paper describing
52 *Synedra subula* is found on pages 24–52, and with one plate under the separate title of
53 'Nieuw Beschrevene en voor onze Flora nieuwe Zoetwater-wieren. verzameld in Drenthe, 9–
54 20, Julij, 1859'. There are no differences in the text, the plate or the sequence of pages.

55 A description of *Synedra subula* was also reported in the *Journal de botanique*
56 *néerlandaise* (Anonymous 1861: 378) as part of the 'Rapport sur la 15^{ème} Assemblée, etc.,
57 tenue à Leyde, le 20 Juill. 1860. (Extrait du *Nederlandsch Kruidkundig Archief* V. p. 186–
58 241' [the page numbers cited in the title are erroneous and should be 186-296). This summary
59 omits the discussions that follow each species in the fuller accounts. All three publications
60 are dated 1861, but circumstantial evidence suggest that the original (first) article is that in
61 volume five of *Nederlandsch Kruidkundig Archief* (van der Sande Lacoste & Suringar
62 1861a).

63 Notable, too, is that *Synedra bilunaris* var. *elongata* Sande Lac. & Suringar (in van
64 der Sande Lacoste & Suringar 1861a: 287, 1861b: 49) and *Gomphonema naviculoides* var.
65 *navicella* Sande Lac. & Suringar (in van der Sande Lacoste & Suringar 1861a: 285, 1861b:
66 47) were published first in van der Sande Lacoste & Suringar (1861a). Both of these names
67 appear in Rabenhorst (1864), which is sometimes assumed to be the first place of publication:
68 *Synedra bilunaris* var. *elongata* in Rabenhorst (1864: 129, attributed to 'Suringar.') and
69 *Gomphonema naviculoides* var. *navicella* in Rabenhorst (1864: 285, attributed to 'Lacoste et
70 Sur. '), each having a reasonable description but still neither with any illustrations. Rabenhorst
71 also attributed the name '*Synedra acus* f. *curvula*' to 'Suringar' (Rabenhorst 1864: 136) and
72 refers to 'l.c. [=van der Sande Lacoste & Suringar 1861b] p. 50', yet no reference is made to
73 this name on that page or elsewhere in the monograph, with the exception of a comment in
74 the description of *Synedra acus*: 'angustissima, a latere primario interdum curvula [...]' (van
75 der Sande Lacoste & Suringar 1861a: 288 = van der Sande Lacoste & Suringar 1861b: 50).
76 Type specimens for the names *Synedra bilunaris* var. *elongata* and *Gomphonema*
77 *naviculoides* var. *navicella* have not yet been traced but may also be in L (Naturalis
78 Biodiversity Center, Leiden, the Netherlands).

79

80 *Abbreviations, terminology, and material*

81 The specimens have been studied in SEM only as no light microscope slides are, as yet,
82 available.

83

84 *Abbreviations*: SEM = scanning electron microscope; the valvocopula is abbreviated as
85 valvocopula (VC); herbarium acronyms follow *Index Herbariorum*
86 (<http://sweetgum.nybg.org/science/ih/>); author names follow *International Plant Names*
87 *Index* (<https://www.ipni.org/>).

88

89 *Terminology*: For the most part, the three standard terminology papers have been followed
90 (Anonymous 1975, its updated version Ross *et al.* 1979, and the recent Russian language
91 version Gogorev *et al.*, 2018).

92

93 *Material*: For the type specimens of *Synedra subula*, there is only one herbarium sheet. This
94 has a packet attached to it. Enclosed are two pieces of glass with dried specimens (L4111638,
95 <https://data.biodiversitydata.nl/naturalis/specimen/L.4111638>, Figure 2). One piece of glass
96 has unprepared ('raw') material, the other has prepared material. The latter was glued to a
97 large sized aluminium stub and examined using SEM (stub L1 = Leiden 1), which was
98 examined in BM, but will be retained in L.

99

100 **Taxonomy**

101 *Ctenophora subula* (Sande Lac. & Suringar) D.M.Williams & Van de Vijver *nov. comb.*

102 Registration: <http://phycobank.org/103733>

103 Basionym:—*Synedra subula* Sande Lac. & Suringar 1861a: 289.

104 TYPE:—THE NETHERLANDS, Zwindersche Veld, Drenthe (“Op *Cladophora Sandii*,

105 Zwindersche Diep. D. 34”), L4111638,

106 <https://data.biodiversitydata.nl/naturalis/specimen/L.4111638>, Figure 2 =

107 lectotype designated here.

108 Valves lanceolate, but gently tapering towards both poles; length ca. 65–80µm, width ca. 2–
109 5µm (Figure 3, measurements taken from pole and centre, n = 8). Sternum relatively narrow,
110 linear, regular, slightly narrowing towards poles, becoming slightly irregular towards each
111 pole (Figures 5, 7, 8, 10). Sternum meeting square to oblong shaped ‘central area’, heavily
112 buttressed both sides of valve (Figures 4, 7); buttressing composed of modified virgae
113 enclosing clear hyaline area (= ‘central area’), ‘ghost striae’ faint (Figures 4, 7). Sternum
114 meeting and coalescing with virgae, both ca. same size, vimines reduced in size relative to
115 virgae (Figures 4, 5, 7–9, 10), appearing as mesh-work with ca. 8–12 strutted closing plate.
116 Striae (= virgae + vimines) 13–14 (?) in 10µm, areolae ca. 20 (?) in 10µm, regularly spaced,
117 parallel (Figures 5, 7, 8), extending onto mantle, in 2–4 ‘rows’ (Figure 7). Apical pore field
118 as ocellulimbus (sunken pore field), composed of ca. 6 rows/columns of pores, situated
119 entirely on valve mantle (Figure 6). Spines absent, rimoportulae at both poles, simple,
120 composed of (internally) paired lips situated on or adjacent to virgae, externally occurring
121 between virgae, one at each pole (Figures 3, 8, 10). Girdle composed of at least one open
122 band, VC (Figure 11), with series of areolae similar to those on valve, occurring just below
123 surface of valve mantle, crenulated edge to fit virgae.

124

125 Discussion

126 The diatom genus *Ctenophora* (Grunow) D.M.Williams & Round is usually thought of as
127 monotypic, with *C. pulchella* being its only species. *Ctenophora sinensis* Lui &
128 D.M.Williams (in Lui *et al.* 2020: 119, ‘China, Lake Quinhai’) was recently described, but it
129 is clear a number of others require either the necessary revival of old names or formal
130 description as new species (Williams pers. obs.). The genus *Ctenophora* is distinguished by
131 the unique central area of the valves: a robust structure usually occupying the entire width of
132 the valve face and mantle (as in Lui *et al.* 2020) rather than just an area in the middle of the
133 valve lacking any appreciable structure (Figure 4). Other taxa have a similar structure to this
134 kind of central area – similar in the sense that the central area is enclosed with what appear to
135 be buttressed ‘ribs’ (e.g. *Hannaea*, Bixby *et al.*, 2005, Liu *et al.* 2020).

136 Significantly, van der Sande Lacoste & Suringar compared this species to *Synedra*
137 *pulchella* Kützing (= *Ctenophora puchella*): “Deze soort komt het naast bij *S. pulchella* Kg.,
138 waarvan zij zich door hare groeiwijze, door den slankeren, van uit het midden en in regte
139 rigting spits toeloopenden vorm der cellen en door de fijnere, digter bijeen geplaatste strepen
140 onderscheidt” [This species relates most closely to *S. pulchella* Kg., from which it is
141 distinguished by its mode of growth, by the more slender shape of its cells, which taper
142 straight from the centre, and by the finer, more closely spaced striations. (Translation by
143 Ronald Jenner, NHM)]. *Ctenophora pulchella* and *Synedra subula* share a number of features
144 most of which are relevant to either the genus or its higher level taxon. The one notable
145 feature is that *C. subula* has a series of areolae on the VC similar to those on valve, occurring
146 just below surface of valve mantle. Some specimens of other species in *Ctenophora* suggest
147 the VC is plain (Liu *et al.* 2020).

148 It is clear that *Synedra subula* should be in the genus *Ctenophora*, but less clear that it
149 should be recognised as a distinct species, given that there are numerous species of
150 *Ctenophora* yet to be described. The name *subula* is retained for the moment, with the

151 possibility that this species is synonymous with one or another currently recognised species
152 of *Ctenophora*.

153

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157 Ronald Jenner (Life Sciences, NHM) deftly translated part of the *Synedra subula* species
158 description and Innes Clatsworthy (Core Research Labs, NHM) made a number of useful
159 suggestions how to examine this material.

160

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196

197 **Figures 1, 2**

198 Figure 1, reproduction of the description for *Synedra subula* Sande Lac. & Suringar (in van
199 der Sande Lacoste & Suringar 1861a: 289).

200 Figure 2, type specimens of *Synedra subula*, herbarium sheet with packet, enclosed within are
201 two pieces of glass with specimens dried attached (L4111638,
202 <https://data.biodiversitydata.nl/naturalis/specimen/L.4111638>).

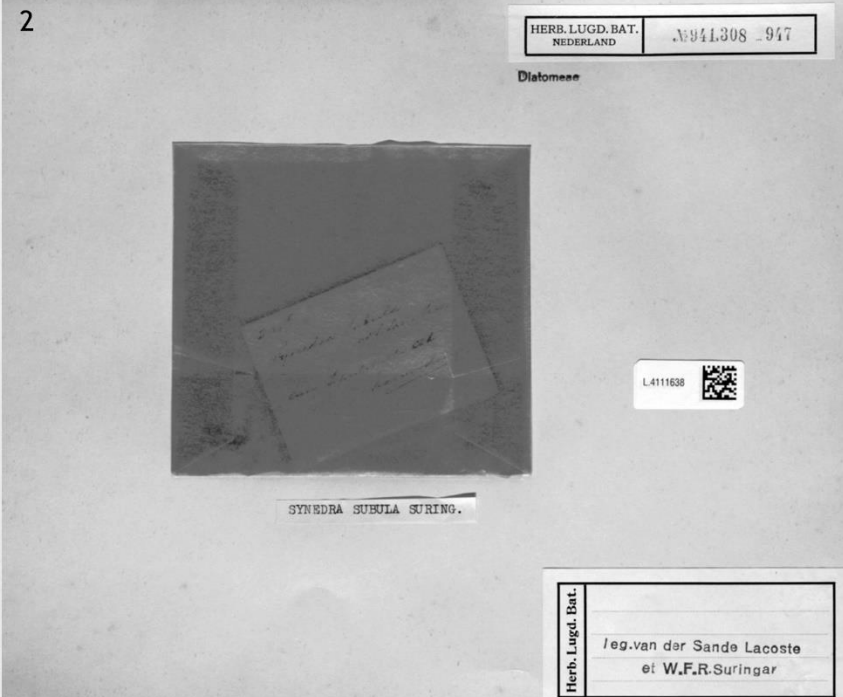
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204 **Figures 3–11, *Ctenophora subula* SEM images**

205 Figure 3, entire valve; Figure 4, ‘central area’, heavily buttressed both sides of valve; Figure
206 5, detail of external valve surface; Figure 6, ocellulimbus, composed of ca. 6

207 rows/columns of pores, situated on valve mantle; Figure 7, detail of external valve
 208 surface with view of 'central area'; Figure 8, ocellulimbus, with rimoportula, arrow;
 209 Figure 9, broken internal view of valve, arrows indicate position of external closing
 210 plate; Figure 10, internal view of pole, with rimoportulae, arrow; Figure 11, girdle
 211 with VC, series of areolae similar to those on valve (arrows), just below surface of
 212 valve mantle, crenulated edge fitting virgae. Scale bars 1µm (Figures 5–11), 2µm
 213 (Figure 4), 10µm (Figure 3).
 214
 215

1 2516—2517. *Synedra subula*.
S. a latere primario attenuata truncata, a latere secundario angusta, marginibus rectissimis e medio conniventibus acuta, cavitate interna in apicibus angustissima denique saepius inflata sive producta, striis transversis subtilibus, pseudonodulo distincto primo adpectu subquadrato-orbiculari, bacillis in pede satis crasso horizontali radiatis (interdum binis s. quaternis flabellatim s. tabellatim cohaerentibus). Longit. 90—107 µ = $\frac{3}{8}$ — $\frac{1}{2}$ ''', latit. in medio lat. sec. 4—6 µ = $\frac{1}{10}$ — $\frac{1}{8}$ ''', prim. 5,5—7 (8,5) µ = $\frac{1}{15}$ — $\frac{1}{10}$ ($\frac{1}{8}$ '''). Striae 50—50 in 25 µ.
 Op *Cladophora Sandii*, Zwindersche Diep. D. 54.
 Deze soort komt het naast bij *S. pulchella* Kg., waarvan zij zich door hare groeiwijze, door den slankeren, van uit het midden en in regte rigting spits toeloopenden vorm der cellen en door de fijnere, digter bijeen geplaatste strepen onderscheidt. Ook de grootte levert een duidelijk verschil op met betrekking tot de opgaaf van KÜTZING en de daarmede overeenstemmende, geciteerde exemplaren. SMITH
 daarentegen geeft de grootte voor *S. pulchella* op als 0,0017—0,0046 E. d. (= 46—145 µ), en zijne figuur op tab. XI stelt een exemplaar van de niterste grens dier grootte voor. Deze vorm, ofschoon nog altijd betrekkelijk breeder, komt zeer nabij aan dien van onze *S. subula*.



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