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CHRISTINE COCQUYT & REGINE JAHN

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Abstract

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East African original material from which Otto Müller had described more than 100 new diatom taxa at the beginning of the 20th century was re-evaluated. In this paper nine of his names of *Surirella* taxa have been assigned lectotypes. For three taxa specimens were chosen from the original samples, for six taxa Müller's drawings have to serve as type, for three of these also an epitype is designated. Three taxa are elevated to species rank (*S. tumida*, *S. likomensis*, *S. africani-orientalis*), for the latter two species substitute names are validated. One taxon is synonymized. The distribution of the eight accepted taxa in East Africa is summarized from literature. Although rare, all but one have been recorded after Müller's first description. In addition to the above mentioned, these are *S. brevicostata*, *S. linearis* var. *elliptica*, *S. margaritacea*, *S. turbo*; only *S. panganensis* seems to be so rare that it has never been recorded since its first description.

Introduction

Algae material of the German "Nyassa-See- und Kinga-Gebirgs-Expedition" was discovered in the Botanical Museum Berlin-Dahlem (Jahn 1996). The samples belong to the material from which Otto Müller described over 100 new East African diatom taxa, of which 25 belong to the genus *Surirella* (Müller 1903, 1904, 1905, 1910, Müller in Schmidt 1904, Jahn 2002). Müller published good drawings and wrote detailed descriptions in German but in a journal that is not well accessible today. Recently, the diatom flora of East Africa has received renewed attention (i.e. Cocquyt 1998) and it became evident that Müller's taxa have to be reinvestigated to evaluate possible new or endemic species. Moreover, taxonomic problems need to be solved since many of the early described taxa of central East Africa by, amongst others, Müller had been sunk into synonymy by later researchers who believed in cosmopolitanism of these diatoms.

With the advance of scanning electron microscopy (SEM) and molecular methods we are now beginning to understand that diatoms do have a tropical, regional or local distribution and many more species exist than had been expected. Therefore, it is essential to see and understand the species described by Müller to have a better idea of species variability and support for the description of new taxa from Lake Tanganyika and other lakes in the East African Great Rift area.

The present paper deals with nine rare *Surirella* taxa, described by Müller. In order to make his taxa available worldwide we translated his descriptions, lectotypified each taxon, and included modern light microscopy (LM) photographs of specimens from the original material. Distributions since Müller's first findings are added as well as taxonomic comments and nomenclatural changes. In addition to this publication, the data will be made available via the AlgaTerra Information System (Jahn & Kusber 2005).

Material and methods

Since the original slides by Müller are lost, the original samples, mostly dried material, available in the Botanical Museum Berlin-Dahlem (B) were used for lectotypification. The following samples were studied in this paper (text translated from German into English and as on the label of each sample; in most cases this text is in accord with Müller's list and his last two numbers (Müller 1903); current names of localities are in square brackets):

- B 2.0025: Lake Nyassa [Lake Malawi], near the island of Likoma [Malawi]. Sediment from 333 m depth. Collected by Fülleborn on 31 January 1900.
- B 2.0028: Swamp near Wiedhafen at Lake Nyassa [Lake Malawi, Tanzania]. From the top of the water. Collected by Fülleborn on 31 January 1899.
- B 2.0032: River Baka, Konde-Land [Tanzania]. Plankton. Collected by Fülleborn in December 1898.
- B 2.0035: River Mbasi, near the inflow in Lake Nyassa [Lake Malawi, Tanzania]. In a quiet bay, which was covered with water chestnut (*Trapa natans* L.). Collected by Fülleborn on 27 April 1899.
- B 2.0036: River Songwe, about 1 hour from discharge into Lake Nyassa [Lake Malawi, Tanzania]. From the bank at lowest water level. Collected by Fülleborn on 2 November 1898.
- B 2.0038: Lake Malombe after discharge of Lake Nyassa [Lake Malawi], Malawi. Marshy pond, water 1-2 m deep, flowed through by the River Shire. Collected by Fülleborn on 3 February 1900.
- B 2.0039: As B 2.0038 but collected on 7 February 1900. Label has extra word "Diatoms".
- B 2.0040: As B 2.0038. Label has extra words "Polycystis, Aphanothece".
- B 2.0041: As B 2.0038. Label has extra word "Plankton".
- B 2.0042: Lake Rukwa not far from the left bank of the River Songwe [Tanzania]. From marshy bank, shallow water has firm sediment. Collected by Fülleborn on 26 June 1899. Label has extra words (translated) "thick cover of algae and other water plants".
- B 2.0053: In a watercourse near the hot springs of Utengule [Tanzania]. Collected by Fülleborn on 6 November 1899.
- B. 2.0059: Doubtful sample. Even Müller (1903) was not sure about the origin of this sample (from Ruaha-plankton. Iringa, or Nyassa [Malawi]-plankton near Langenburg) and about the collecting date (7 December 1898?).

The following material from Lake Tanganyika was used and is deposited at the Botanical Garden in Meise, Belgium (BR):

- ACBUA 645: Plankton sample taken in the littoral zone of Lake Tanganyika near Resha, 52 km south of Bujumbura, Burundi, collected on 9 May 1986 by A. Caljon. Rocky coast interspersed with a few sandy beaches.

The samples were oxidized with peroxide and embedded in Naphrax to obtain new microscopic slides. Investigations were done both at the Botanic Garden and Botanical Museum Berlin-Dahlem

(Germany) and at the laboratory of Protistology and Aquatic Ecology, Ghent University (Belgium), with a Zeiss and a Leitz Diaplan microscope, respectively. Most of the micrographs were taken with Nomarski differential interference contrast (DIC) at a magnification of 20×, 40×, 63× (oil immersion) and 100× for the smallest specimens.

Results and discussion

Surirella tumida (O. Müll.) Cocquyt & R. Jahn, **comb. nov.**

≡ *Surirella bifrons* var. *tumida* O. Müll. in Bot. Jahrb. Syst. 34: 27, t. 1, fig. 2. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 245, fig. 9. 1904.

Lectotype (designated here): [icon] Müller 1903: t. 1, fig. 2; here reproduced as Fig. 1. Type locality: Lake Malombe after discharge of Lake Nyassa [Lake Malawi, Malawi]. – Epitype (designated here): slide B 400 040 179 (the valve representing the epitype is here illustrated in different foci as Fig. 2-3). Locality of the epitype: Lake Malombe after discharge of Lake Malawi, Malawi (sample B 2.0038).

– *Surirella biseriata* var. *bifrons* (Ehrenb.) Hustedt sec. Hustedt (in Schmidt 1911) pro parte.

Translated into English, Müller's description reads (1903: 27-28): "Valves broad lanceolate with acute poles, costae not very distinct, sometimes stronger, 1.7 in 10 µm, divergent from the middle of the valve towards the poles, reaching the pseudoraphe. Strong alae near the margins with distinct wing projection. Pseudoraphe a continuous line. Length: 102-127 µm, width: 58-70 µm. Width-to-length ratio 1:1.6-2. – Lives in Lake Nyassa [Lake Malawi] near Likoma on the bottom at 333 m depth (25), in Lake Malombe and its plankton (40-41), in Lake Rukwa not far from the river Songwe (42), in a watercourse near the hot springs of Utengule (53)."

Typification. – As no specimens in samples B 2.0025, 2.0040-41, 2.0042 and 2.0053 fitted the description and drawing of Müller, where he indicated the presence of *Surirella tumida*, we designate the epitype specimen from another sample of Lake Malombe where this taxon was present. The valve is somewhat smaller than the dimensions given by Müller: length about 100 µm, width: 55 µm, width-to-length ratio 1: 1.8 and 2 costae in 10 µm.

Taxonomy. – Hustedt (in Schmidt 1911) and many later authors did not recognize Müller's African taxon but sunk it into synonymy with the European *Surirella biseriata* var. *bifrons*. Later, Hustedt (1942) distinguished even two formae in *S. biseriata* [var. *bifrons*], i.e. f. *punctata* F. Meister and f. *amphioxys* (W. Sm.) Hustedt, the first with many tiny spines on its valve face, but gave no information on the distribution of these taxa. The confusion already started with Hustedt's classification of *S. bifrons* Ehrenb. as a variety of *S. biseriata* Bréb. The difference between *S. bifrons* and *S. biseriata* is not so obvious in the LM as valve contour and the presence or absence of spines are no reliable characters. SEM investigations, however, show distinct characteristics: *S. bifrons* has a coarser valve structure and the striation is half as dense (see Krammer & Lange-Bertalot 1988). No SEM information is available for *S. tumida*, but the comparison of length and width between *S. tumida*, *S. bifrons* and *S. biseriata* shows a distinct difference between these three taxa (Table 1). Since *S. tumida* does not fit with and therefore cannot be a variety of *S. bifrons* (own observation of the type material in the Ehrenberg collection, unpubl. data) we decided to elevate Müller's taxon to species rank.

Distribution. – Originally reported from Lake Malawi, Lake Malombe, Lake Rukwa and near a hot spring in Utengule (Tanzania) (Müller 1903), this taxon was reported subsequently from Lake Malawi (West 1907, Van Meel 1954) and Lake Victoria (West 1907, Wołoszyńska 1914, Van Meel 1954).

Surirella likomensis Cocquyt & R. Jahn, **nom. nov.**

≡ *Surirella bifrons* [var. *tumida*] f. *minor* O. Müll. in Bot. Jahrb. Syst. 34: 28, t. 1, fig. 3. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 245, fig. 10. 1904.

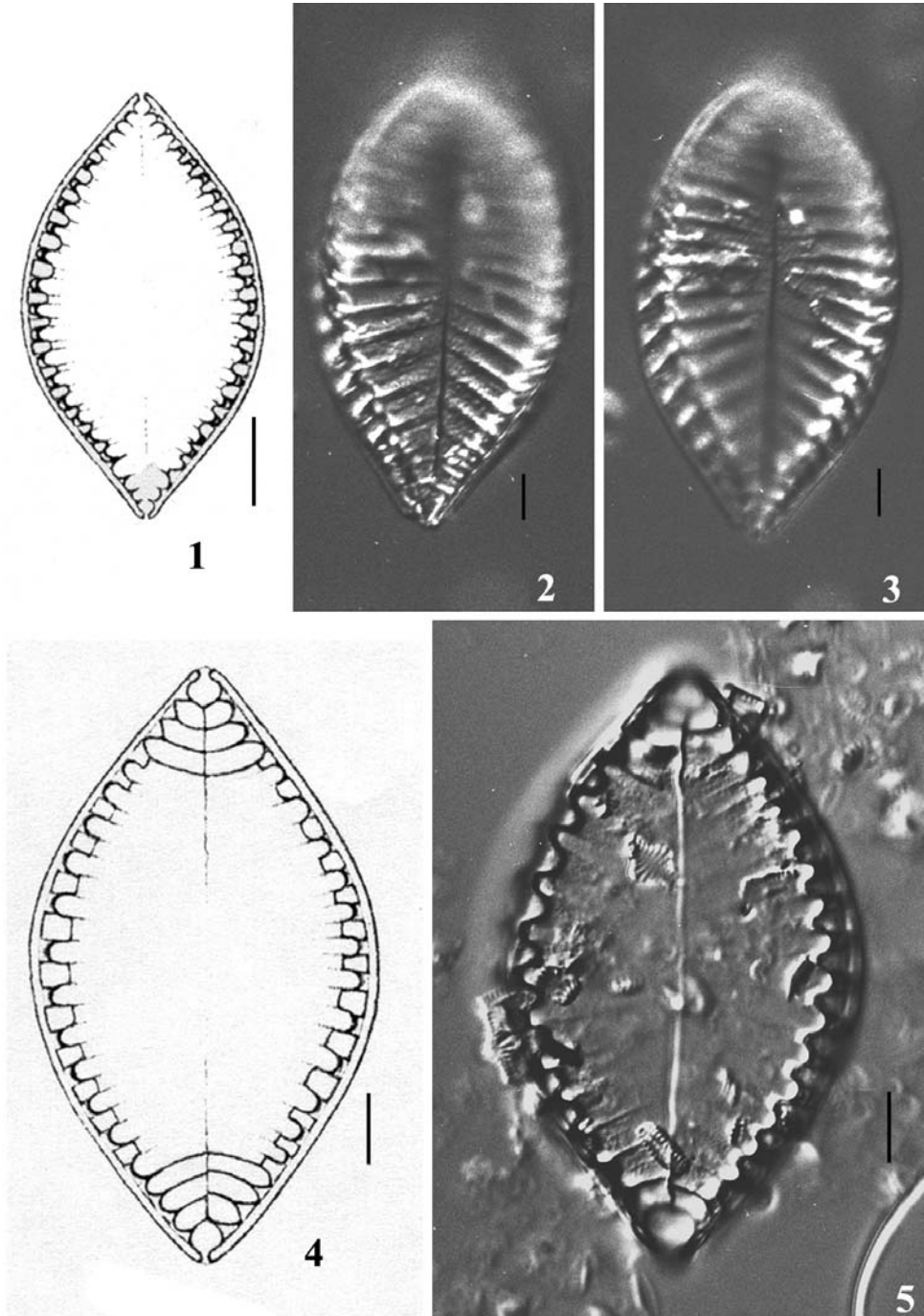


Fig. 1-3: *Surirella tumida*, lectotype [Müller's published drawing (1903: t. 1, fig. 2) of *S. bifrons* var. *tumida*] (1); different foci of the epitaxial valve [slide B 400 040 179] (2-3); 4-5: *S. likomensis*, lectotype [Müller's published drawing (1903: t. 1, fig. 3) of *S. bifrons* f. *minor*] (4), and epitaxial valve [slide B 400 040 180] (5). – Scale bars = 10 μ m.

Lectotype (designated here): [icon] Müller 1903: t. 1, fig. 3; here reproduced as Fig. 4. Type locality: Lake Nyassa [Lake Malawi] near Likoma on the bottom. – Epitype (designated here): slide B 400 040 180 (the valve representing the epitype is here illustrated as Fig. 5). Locality of the epitype: Lake Malombe after discharge of Lake Malawi, Malawi (sample B 2.0039). – *Surirella biseriata* var. *bifrons* (Ehrenb.) Hustedt sec. Hustedt (in Schmidt 1911) pro parte.

Translated into English, Müller's description reads (1903: 28): "Valves like var. *tumida*; the costae form closed fields near the poles; distinct wing projection; 2 costae in 10 µm. Length: 85-95 µm, width: 49-60 µm. Width-to-length ratio 1:1.6-1.7. – Lives in Lake Nyassa [Lake Malawi] near Likoma on the bottom (25), in a watercourse near the hot springs of Utengule (53)."

Typification. – Since no specimen was found, the lectotype is Müller's illustration. The epitype of this taxon was chosen from a sample of Lake Malombe, a small lake in connection with Lake Malawi (= Lake Nyassa) forming the outlet of it, which was not mentioned by Müller. The epitype specimen fits well the description given by Müller, length: 84 µm, width: 54 µm, width-to-length ratio 1: 1.6. Only the number of costae with 1.8 in 10 µm is somewhat higher. Müller's observation that the costae form a closed field near the poles is distinctly visible on this epitype.

Etymology. – The species is named after Likoma, one of the two localities from which O. Müller described this taxon.

Taxonomy. – Hustedt (in Schmidt 1911) and many later authors did not recognize Müller's African taxon but sunk it into synonymy with the European *Surirella biseriata* var. *bifrons*. But the confusion already started with making *S. bifrons* a variety of *S. biseriata* (see above discussion under *S. tumida*). In the check-list of the East African Great Lakes (Cocquyt & al. 1993) *S. biseriata* [var. *tumida*] f. *minor* was put into synonymy with *S. biseriata* var. *tumida*. However, after observation of more material we are convinced that this synonymy is not correct and that *S. biseriata* [var. *tumida*] f. *minor* is a separate species, because no specimens were observed in the slides studied showing a gradually transition from *S. tumida* to *S. likomensis* and because, in addition, it cannot be a variety of *S. bifrons* (see under *S. tumida*, above). Moreover, the number of costae in 100 µm is higher in *S. likomensis* than in *S. tumida* (Table 1).

Distribution. – Besides Lake Malawi and in a watercourse near a hot spring in Utengule (Tanzania) (Müller 1903) this taxon was also reported from Sierre Leone (Woodhead & Tweed 1960) under the name of *S. bifrons* f. *minor* O. Müll.

Surirella brevicostata O. Müll. in Bot. Jahrb. Syst. 34: 34-35, t. 2, fig. 9. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 246, fig. 11. 1904.

Lectotype (designated here): slide B 400 040 181 (the valve representing the lectotype is here illustrated as Fig. 11) (see also Cocquyt 2000, fig. 1E). Type locality: Lake Malombe after discharge of Lake Nyassa [Lake Malawi, Malawi] (sample B 2.0039). = *Surirella tanganicae* G. S. West 1907: 166, t. 8, fig. 6 (depicted also in Hustedt 1942).

Translated into English, Müller's description reads (1903: 34): "Valve long linear with rounded or acute poles, margins sometimes faintly constricted. Costae short, 1.3 in 10 µm, marginal, forming right angles, with distinct wing projection, not reaching the pseudoraphe. Pseudoraphe a continuous line. The part of the valve face, not taken in by the costae, is punctuated or wrinkled by short, thin lines. Girdle linear with bluntly rounded poles, fenestrae broader than their supports. Length 118-150 µm, width 24-27 µm. Width-to-length ratio 1: 4.9-6.8. – Lives in the river Mbasi near the inflow in Lake Nyassa [Lake Malawi] (35), in a swamp near Wiedhafen at Lake Nyassa [Lake Malawi] (28), in Lake Malombe (39), in a watercourse near Utengule [Tanzania] (53)."

Typification. – The valve on the lectotype slide fits the description by Müller, length: 132 µm, width: 25 µm, width-to-length ratio 1:5.3. The number of costae of 1.5 in 10 µm is somewhat higher.

Table 1. Morphometric measurements of four *Surirella* species as cited by different authors and our own observations on Müller's original material (this publication). The figures in italics are our measurements or calculations based on the figures and/or text in the cited literature.

	Length	Width	L/W Ratio	Costae in 100 µm
<i>S. tumida</i>				
Müller 1903	102-107	58-70	1.6-2	1.7
Van Meel 1954	98-160	46-53	<i>2.1-3</i>	
Cocquyt & Jahn, this study	100	55	1.8	2
<i>S. likomensis</i>				
Müller 1903	85-95	49-60	1.6-1.7	2
Cocquyt & Jahn, this study	84	54	1.6	1.8
<i>S. bifrons</i>				
Krammer & Lange-Bertalot 1988	76-150	30-60	2.5	1.2-2.2
<i>S. biseriata</i>				
Krammer & Lange-Bertalot 1988	80-400	30-90	<i>2.6-4.4</i>	0.8-2.0
Gasse 1986	220	66	3.3	1.4

Taxonomy. – Müller (1903: 35) notes that “the valve shape resembles *Surirella linearis* and *S. engleri* var. *angustior* but differs in the short wrinkled lines and the absence of punctuation on the wing”. The valve margins are linear or only very faintly constricted. The range of dimensions for *S. brevicostata* is: length: 58-164.5 µm, width: 23-32 µm, 13-18 costae in 100 µm.

Distinctly constricted specimens, described by Hustedt as *Surirella brevicostata* var. *constricta* (Hustedt in Schmidt 1914: t. 309, fig. 2, Simonsen 1987: 50, t. 57, fig. 1-2, Cocquyt 1998: t. 34, fig. 5), were observed in Lake Tanganyika, Burundi and Sierra Leone (Cocquyt 1998) but were not reported from Lake Malawi and Lake Malombe. More elliptical forms, as observed in Lake Tanganyika by Cocquyt (1998, t. 34, fig. 6), were not found in Müller's material. Somewhat smaller valves up to a length of 112.5 µm were observed in Lake Malombe (B 2.0039) (Cocquyt 2000). Specimens corresponding to *S. brevicostata* var. *elongata* Hustedt (in Schmidt 1914: t. 309, fig. 1, Simonsen 1987: 50, t. 56, fig. 1-5) with a valve length: 230 µm, width: 25 µm; width-to-length-ratio: 8.6 and 14-15 alae in 100 µm were only observed in Lake Tanganyika by Hustedt himself and one specimen by Cocquyt (2000). Further investigation is necessary to prove if *S. brevicostata* var. *elongata* is a separate taxon.

Distribution. – Originally reported from Lake Malombe, Lake Malawi, River Mbasi and near a hot spring at Utengule (Tanzania) by Müller (1903), this taxon was reported subsequently from Lake Malawi (Ross 1983), Lake Victoria (Ross 1983), Lake Tanganyika (West 1907, Van Meel 1954, Ross 1983, Mpawenayo 1996, Caljon & Cocquyt 1992, Cocquyt 1998), Burundi (Mpawenayo 1996) Congo (Zaire) (Zanon 1938, Woodhead & Tweed 1958), Tanzania (Zanon 1938).

***Surirella africana-orientalis* Cocquyt & R. Jahn, nom. nov.**

≡ *Surirella constricta* var. *africana* O. Müll. in Bot. Jahrb. Syst. 34: 32, t. 2, fig. 1. 1903 ≡ *Surirella muelleri* Hustedt in Schmidt, Atlas Diatomaceenkunde: t. 355. 1922, nom. illeg. [non Forti 1910].

Lectotype (designated here): [icon] Müller 1903, t. 2, fig. 1; here reproduced as Fig. 8. Type locality: plankton of Lake Malombe [Malawi]. – Epitype (designated here): slide ACBUA 645; the valve representing the epitype is here illustrated as Fig. 14 (see also Cocquyt 1998, t. 36 fig. 6), deposited at the National Botanic Garden of Belgium, Meise (BR). Locality of the epitype: littoral phytoplankton of Lake Tanganyika at Resha, 52 km south of Bujumbura (Burundi), rocky coast interspersed with a few sandy beaches (the sample was collected on 9 May 1986 by A. Caljon).

= *Surirella constricta* var. *maxima* O. Müll. in Bot. Jahrb. Syst. 34: 32-33, t. 2, fig. 2. 1903. – Lectotype (designated here): [icon] Müller 1903, t. 2, fig. 2; here reproduced as Fig. 7. Type locality: plankton of Lake Malawi, northern part, Tanzania.

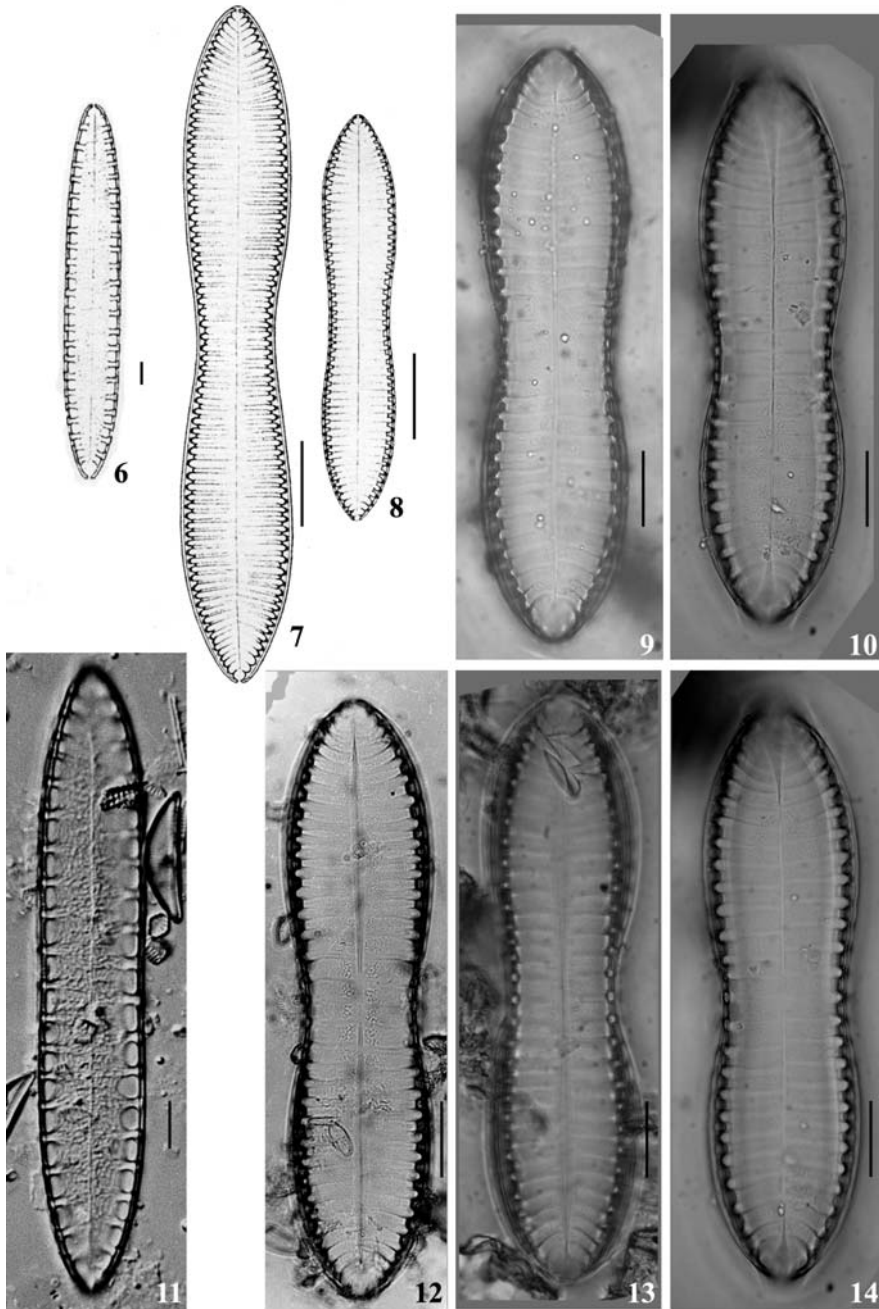


Fig. 6, 11: *Surirella brevicostata*, Müller's published drawing (1903: t. 2, fig. 9) (6), lectotype of *S. brevicostata* [slide B 400 040 181] (11); 7-10, 12-14: *S. africana-orientalis*, lectotype of the synonym *S. constricta* var. *maxima* [Müller's published drawing (1903, pl. 2, fig. 2)] (7), lectotype of *S. africana-orientalis* [Müller's published drawing (1903: t. 2, fig. 1) of the synonym *S. constricta* var. *africana*] (8), specimens from Lake Tanganyika (9-10, 13), epitype of *S. africana-orientalis* [slide ACBUA 645, BR] (14). – Scale bars = 10 μ m.

Note. – Because *Surirella africana* Leud.-Fortm. has been validated for a marine diatom from the Cape Verde Islands (Silva 1997-) and because Hustedt's substitute name is a later homonym of *S. muelleri* Forti (1910), a new name had to be chosen for *S. constricta* var. *africana* at species rank.

Translated into English, Müller's description of *Surirella constricta* var. *africana* reads (1903: 32): "Valves sole-shaped with rounded, cuneate poles, margins strongly constricted in the middle. Costae 2 in 10 µm, very finely punctuated, in the middle straight, becoming divergent near the poles, small alae near the margins without distinct wing projection. Pseudoraphe a continuous line. Length 200-272 µm, width smallest 32-33 µm, largest 40-43 µm. Width-to-length ratio 1:6.1-8. – Lives in the plankton of Lake Malombe (40-41)."

Emended species description (Fig. 8-10, 12-14): Valves isopolar with rounded, cuneate poles. Margins strongly constricted in the middle. Costae very finely punctuated, straight in the middle and becoming divergent near the poles. Small alae near the margins without distinct wing projection. Pseudoraphe distinct as a continuous line. Length: 135-413 µm, 30-50 µm width in the constricted part, 35-66 µm in the broadest part of the valve.

Typification. – Since no specimen was found, the lectotype is Müller's illustration.

Taxonomy. – Müller (1903: 32) mentions the resemblance with *Surirella rattrayi* A. W. F. Schmidt, but *S. africana-orientalis* differs from *S. rattrayi* in its weakly developed costae, which are wider spaced, and in its more distinct wing projection. Noteworthy is that the dimensions of the specimens observed in Lake Tanganyika (Cocquyt 1998) are smaller than the dimensions given by Müller: length: 135-190 µm; width: 30-45 µm, 35-37 µm in the constricted part; 18-21 alae in 100 µm.

Surirella constricta var. *maxima* is here treated as a heterotypic synonym. Translated into English, Müller's description reads (1903: 32-33): "Valves as var. *africana*. Costae 1.8 in 10 µm, medium strong, finely punctuated, with strong alae without distinct wing projection. Length 413 µm, width smallest 50 µm, largest 66 µm. Width-to-length ratio 1: 8.2. – Lives in the plankton of Lake Nyassa [Lake Malawi] (18)." This taxon was only reported from one sample by Müller, which is missing in the samples from East Africa at Berlin. No specimens of this taxon were observed in any other material. The only illustration existing of this taxon is the drawing given by Müller (1903). In our view, Müller's var. *maxima* represents just a large cell within the range of his var. *africana*.

Distribution. – Besides Lake Malombe (Müller 1903) *Surirella africana-orientalis* was reported (under the name *S. constricta* var. *africana*) from Lake Malawi (Van Meel 1954), Lake Victoria (Wołoszyńska 1914, Van Meel 1954), Lake Tanganyika (West 1907, Van Meel 1954) and Tanzania (Zanon 1938). Woodhead & Tweed (1958) reported this taxon (as *S. constricta* var. *africana*) from Congo, but two years later (Woodhead & Tweed 1960) they stated that this report is erroneous. Under the name *S. constricta* var. *maxima* it was only mentioned from Lake Malawi (Müller 1903, Van Meel 1954). It was reported under the name *S. muelleri* Hustedt (non Forti) in Lake Malawi and Lake Tanganyika (Hustedt in Schmidt 1922, Hustedt 1942, Van Meel 1954, Cocquyt 1991, 1998, Cocquyt & al. 1991).

Surirella linearis var. *elliptica* O. Müll. in Bot. Jahrb. Syst. 34: 30, t. 1, fig.10. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 245, fig. 11-12. 1904.

Lectotype (designated here): slide B 400 040 182 (here illustrated as Fig. 16). Type locality: Lake Malombe after discharge of Lake Malawi, Malawi (sample 2.0039).

Translated into English, Müller's description reads (1903: 30): "As *S. linearis* (2.2-2.5 costae in 10 µm, not reaching the pseudoraphe, without wing projection) but broader elliptic with cuneate poles. Length 60-103 µm, width 20-27 µm. Width-to-length ratio 1:3.8-4.8. – Lives in the plankton of Lake Nyassa [Lake Malawi] near Langenburg (7-8), in the plankton of the river Baka, Konde-Land (32), in the Uluguru mountains, on gneiss washed with water at an altitude of 1000 m (50); in Lake Malombe (37, 39)."

Typification. – The valve in Fig. 16 fits the description given by Müller: length; 92.5 µm, width: 24 µm, width-to-length ratio: 1:3.9, 2.5 costae in 10 µm. Müller observed one frustule with double valve construction.

Taxonomy. – Since the type of *Surirella linearis* W. Sm. was not studied, we are not certain if this taxon actually is a variety of *S. linearis*.

Distribution. – This taxon was also reported from Congo (Zaire) (Zanon 1938, Woodhead & Tweed 1958), Kenya (Bachmann 1938, D'Hollander 1976), Lake Malawi (Van Meel 1954) and Lake Malombe (Van Meel 1954).

Surirella margaritacea O. Müll. in Bot. Jahrb. Syst. 34: 37, t. 2, fig. 12. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 245, fig. 7. 1904.

Lectotype (designated here): slide B 400 040 183 (the valve representing the lectotype is here illustrated as Fig. 21). Type locality: River Songwe [Tanzania] (sample B 2.0036).

Translated into English, Müller's description reads (1903: 37): "Valves ovoid, with rounded apical pole, cuneate terminal pole. Costae composed of two rows of regularly placed spines (pearls), not reaching the pseudoraphe, building up short furrows near the margins. Pseudoraphe narrow, lanceolate. Length 46-55 µm, width 26 µm. – Lives in the river Songwe (36), in the plankton of Lake Nyassa [Lake Malawi] near Langenburg (59)."

Typification. – The dimensions of the valve in Fig. 21 are somewhat smaller than the range given by Müller, length 44 µm, width 24 µm; the number of costae is somewhat higher, 4.1 in 10 µm than in Müller's drawing (3.7 in 10 µm). Therefore the new range for the species should be: length: 44-55 µm; width: 21-26 µm; 3.4-4.1 alae in 10 µm.

Distribution. – Rarely observed in the samples from River Songwe and Lake Malawi (Müller 1903, Hustedt 1942, Ross 1983). In Lake Tanganyika it was observed only twice (Cocquyt 1998: t. 56, fig. 5), another report is from Lake Victoria (Ross 1983).

Surirella panganiensis O. Müll. in Bot. Jahrb. Syst. 34: 257-258, fig. 3-4. 1904.

Lectotype (designated here): [icon] Müller 1904, fig. 3; here reproduced as Fig. 22; see also Fig. 23 (Müller's fig. 4) in girdle view. Type locality: Rufidji (Usambara-USagara region) Pangani rapids.

Translated into English, Müller's description reads (1904: 257-258): "Valves sole-shaped, with bluntly rounded poles, margins strongly constricted in the middle. Costae 1-1.2 in 10 µm, faint, not reaching the pseudoraphe, divergent near the poles. Near the margins alae, without distinct wing projection. In between two costae 1-3 points near the margin. Pseudoraphe indistinct, somewhat widened, straight. Girdle view broad linear with straight poles and rounded angles, strongly constricted in the middle. Wings medium high, very constricted, fenestrae broad, 1-3 smaller ones in between two long tubes. Valve length 90-107 µm, broadest width 24-28 µm, smallest 17-21 µm. Girdle view largest width 41-45 µm, smallest 34-38 µm. – Lives in the river Rufidji (Usambara -Usagara region) Pangani rapids, 250 m above sea level (51)."

Typification. – Since the sample 51 (Müller 1903) with the date: "9 November 1898" and the text "Usambara-USagara region, leg. W. Goetze. Rufidji, Pangani-rapids, water near the border of the river, 250 m asl" is missing, Müller's illustration has to serve as lectotype. No epitype can be designated here as no valves were found in any other sample.

Taxonomy. – Müller remarks: "This *Surirella* species is related to *S. ratrayi* A. Schmidt (1875, Tafel 23, 18-21), but differs in its particular structure of the wings, which I did not observe in any other species. 1-3 irregular shorter and narrower tubes are inserted between two long and proportional broader tubes. In valvar view these shorter tubes look like points near the margin and in between the costae. These tubes as well as the longer ones are connected with the canal raphe on the girdle side. This taxon is rare".

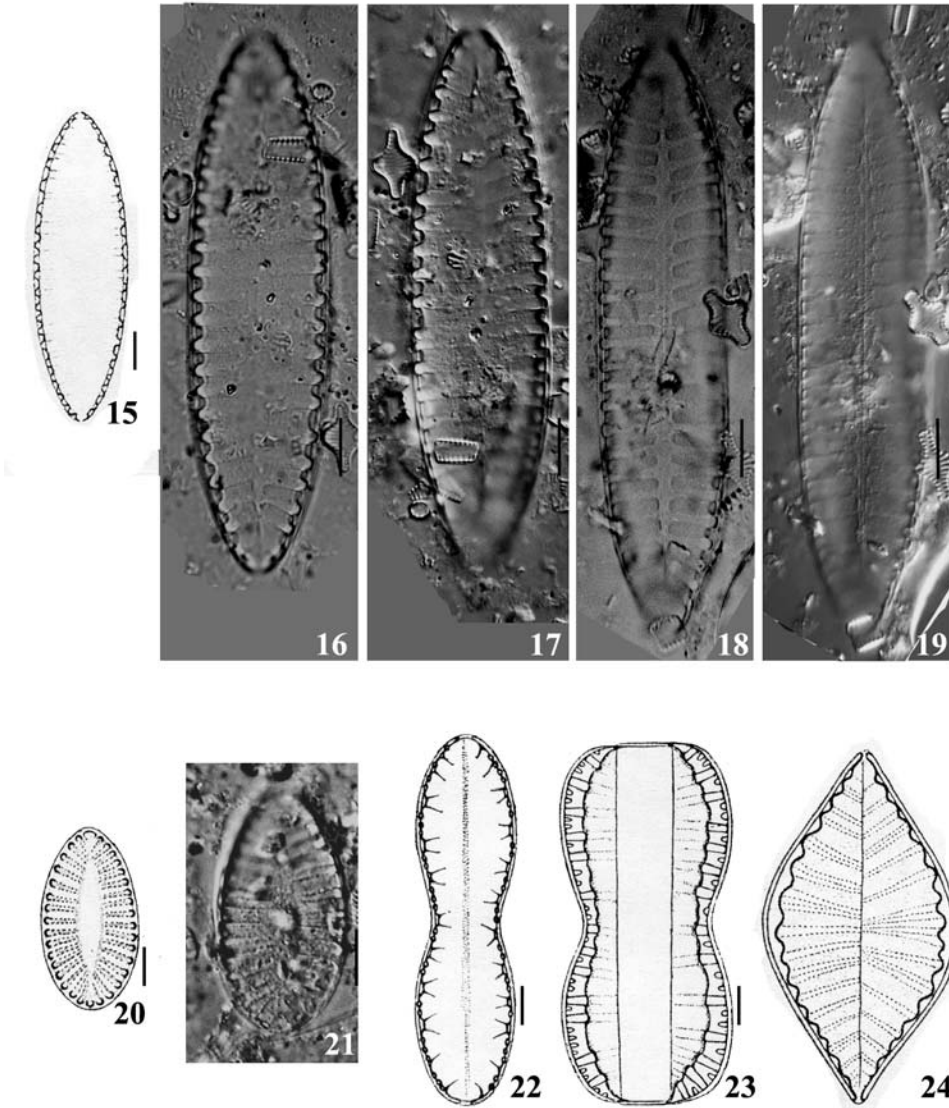


Fig. 15-19: *Surirella linearis* var. *elliptica*, Müller's published drawing (1903: t. 1, fig. 10) (15), lectotype [slide B 400 040 182] (16), other specimens from Lake Malombe (17-19); 20-21: *S. margaritacea*, Müller's published drawing (1903: fig. 12) (20), lectotype [slide B 400 040 183] (21); 22-23: *S. panganiensis*, lectotype [Müller's published drawing (1904: fig. 3)] (22), Müller's published drawing (1904: fig. 4) (23); 24: *S. turbo*, lectotype [Müller's published drawing (1903: t. 2, fig. 8)]. – Scale bars = 10 µm.

Van Landingham (1978: 3859) put this taxon in synonymy with *Surirella rattrayi* A. W. F. Schmidt, described from the river Demerara, America (Schmidt 1875). The specimens referred to as *S. rattrayi* by Wolle (1890: t. 69, fig. 10), De Toni (1892: 5) and Boyer (1927: 543) therefore should be checked.

Distribution. – No other reports from Africa.

Surirella turbo O. Müll. in Bot. Jahrb. Syst. 34: 34, t. 2, fig. 8. 1903; additional figure in Schmidt, Atlas Diatomaceenkunde: t. 246, fig. 9. 1904.

Lectotype (designated here): [icon] Müller 1903, t. 2, fig. 8; here reproduced as Fig. 24. Type locality: Lake Malawi, near Island of Likoma (sample B 2.0025).

Translated into English, Müller's description reads (1903: 34): "Valves broadly lanceolate with strongly widened, acute poles. Costae in star-shaped bundles composed of 2-5 punctuated lines, arising from the pseudoraphe, strongly divergent towards the poles. Stronger punctuated, undulated alae near the margins, which are not reaching the margin in the middle. Pseudoraphe a continuous line. Length 93 µm, width 51 µm. Width-to-length ratio 1: 1.82. – Lives in Nyassa [Lake Malawi] near Likoma at 333 m depth (25)."

Taxonomy. – This elegant taxon appears to be rare. Müller observed it only once in a sample from 333 m depth near Likoma. It differs in the construction of the costae and alae from all other *Surirella* taxa described by Müller. In the middle part of the valve the costae are not reaching the margin.

Distribution. – *Surirella turbo* was further reported from Lake Malawi (Van Meel 1954, Ross 1983) and Lake Victoria (Wołoszyńska 1914, Ross 1983).

Conclusion

The eight taxa discussed above are all rare endemics of East and perhaps Central Africa. *Surirella panganiensis* has even only been found at its type locality in 1898 (Table 2), a case similar to *S. capensis* Ehrenb. ex Cocquyt & R. Jahn, which so far has only been reported from the time of its finding in 1843 (Ehrenberg 1854) at its type locality in South Africa (Cocquyt & Jahn 2005). Although there has been renewed taxonomic interest in the diatoms starting in the 1980's, after the survey by Van Meel (1954), who had summarized all algal reports for Central and East Africa up to then, only few re-findings were made. Even in the intensively studied Lake Tanganyika (e.g. Cocquyt 1998) only *S. brevicostata* was regularly observed in the northern basin (Cocquyt 2000), whereas *S. africana-orientalis* and *S. margaritacea* were only sporadically reported (Cocquyt 1998). For Lake Victoria *S. margaritacea* and *S. turbo* were reported (Ross 1983). In contrast, the presence of *S. likomensis* in Sierra Leone (Woodhead & Tweed 1960) as

Table 2. Geographic distribution of the discussed eight *Surirella* taxa based on literature data (Bachmann 1938, Caljon & Cocquyt 1992, Cocquyt 1991, 1998, Cocquyt & al. 1991, D'Hollander 1976, Hustedt in Schmidt 1922, Hustedt 1942, Mpawenayo 1996, Müller 1903, 1904, Ross 1983, Van Meel 1954, West 1907, Wołoszyńska 1914, Woodhead & Tweed 1958, 1960, Zanon 1938)

	Lake Malawi	Lake Tanganyika	Lake Victoria	Lake Malomba	Tanzania	Kenya	Burundi	Congo	Sierra Leone
<i>S. tumida</i>	x		x	x	x				
<i>S. likomensis</i>	x			x					x?
<i>S. brevicostata</i>	x	x	x	x	x		x	x	
<i>S. africana-orientalis</i>	x	x	x	x	x				
<i>S. linearis</i> var. <i>elliptica</i>	x			x	x	x?		x?	
<i>S. margaritacea</i>	x	x	x		x				
<i>S. panganiensis</i>					x				
<i>S. turbo</i>	x		x						

well of *S. linearis* var. *elliptica* in Congo (Zanon 1938) and on Mt Kenya (D'Hollander 1976) is doubtful and must be re-investigated. This is, however an almost impossible task as the material is not available anymore and the current habitat probably has changed too much to harbour these rare *Surirella* taxa.

It is fortunate that Müller's historical material is still available and enables us to lectotypify his names and re-evaluate his taxa, many of which had been sunk into synonymy by contemporary and later researchers. In this, our first paper on Müller's species described from central East Africa, we have found that Müller's taxon concept was similar to our current concept as his varieties are separate taxonomic entities, which we today would define as species. The formae, on the other hand, are often only illustrating the extreme ends of the variability within a taxon.

In addition, these historical samples of lakes and rivers of East Africa, which are some of the earliest from this region, can also serve as a baseline for an evaluation of biogeography and biodiversity changes and contribute to our understanding of diatom endemism.

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References

- Bachmann, H. 1938: Beiträge zur Kenntnis des Phytoplanktons ostafrikanischer Seen. Mission Scientifique l'OMO. – *Hydrobiologia* **8**: 119-140.
- Boyer, C. S. 1927: Synopsis of North American Diatomaceae. – *Proc. Acad. Nat. Sci. Philadelphia* **79**: 229-583.
- Caljon, A. G. & Cocquyt, C. 1992: Diatoms from surface sediments of the northern part of Lake Tanganyika. – *Hydrobiologia* **230**: 135-156. [[CrossRef](#)]
- Cocquyt, C. 1991: Epilithic diatoms from thrombolitic reefs of Lake Tanganyika. – *Belg. J. Bot.* **124**: 102-108.
- 1998: Diatoms from the Northern Basin of Lake Tanganyika. – *Biblioth. Diatomol.* **39**.
- 2000: A light and scanning electron microscopic investigation of *Surirella brevicostata* O. Müller (*Bacillariophyceae*) an endemic tropical African diatom. – *Syst. Biogeogr. Pl.* **70**: 245-254.
- , Caljon, A. & Vyverman, W. 1991: Seasonal and spatial aspects of phytoplankton along the north-eastern coast of Lake Tanganyika. – *Ann. Limnol.* **27**: 215-225.
- & Jahn, R. 2005: *Surirella capensis* Ehrenberg ex Cocquyt et R. Jahn a rare diatom species from South Africa. – *Cyptog. Algol.* **26**: 149-153.
- , Vyverman, W. & Compère, P. 1993: A checklist of the algal flora of the East African Great Lakes: Lake Malawi, Lake Tanganyika and Lake Victoria. – *Scripta Bot. Belg.* **8**: 1-56.
- De Toni, G. B. 1892: Sylloge algarum omnium hucusque cognitarum. 2. *Bacillarieae*. Sectio II, *Pseudoraphideae*. – Patavii.
- D'Hollander, E. 1976: Algologische studie van enkele hooggebergtemeren op Mount Kenya. – Thesis, Ghent University.
- Ehrenberg, C. G. 1854: Mikrogeologie. Das Erden und Felsen schaffende Wirken des unsichtbar kleinen selbstständigen Lebens auf der Erde. – Leipzig.
- Forti, A. 1910: Contribuzioni diatomologiche. 11. Elenchi preventive delle specie contenute in alcune depositi terziari italiana. – *Atti Reale Inst. Veneto Sci., Lett. Arti* **69**: 1303-1318.

- Gasse, F. 1986: East African diatoms. Taxonomy, ecological distribution – *Biblioth. Diatomol.* **11**.
- Hustedt, F. 1942: Diatomeen. – In: Huber-Pestalozzi, G. (ed.), *Das Phytoplankton des Süßwassers. Die Binnengewässer* **16(2/2)**. – Stuttgart.
- Jahn, R. 1996: The historical East African freshwater algae collection at the Botanical Museum Berlin-Dahlem (B). – *Willdenowia* **26**: 333-340.
- 2002: Otto Müller's names of diatoms (*Bacillariophyceae*) and extant original material at the Botanical Museum Berlin-Dahlem (B). – *Willdenowia* **32**: 155-173.
- & Kusber, W.-H. 2005 (ed.): *AlgaTerra Information System*. – Botanic Garden and Botanical Museum Berlin-Dahlem, FU Berlin. – Published on the Internet <http://www.algaterra.org> [accessed 16 October 2005].
- Krammer, K. & Lange-Bertalot, H. 1988: *Bacillariophyceae. 2. Bacillariaceae, Epithemiaceae, Surirellaceae*. – In: Ettl, H., Gerloff, J., Heynig, H. & Mollenhauer, D. (ed.), *Süßwasserflora von Mitteleuropa* **2/2**. – Stuttgart.
- Mpawenayo, B. 1996: Les eaux de la plaine de la Rusizi (Burundi): Les milieux, la flore et la végétation algales. – *Mém. Acad. Roy. Sci. Outre-Mer., Cl. Sci. Nat. Méd., Collect.* 8vo. **23(2)**.
- Müller, O. 1903, 1904, 1905: Bacillariaceen aus dem Nyassalande und einigen benachbarten Gebieten 1-4. – *Bot. Jahrb. Syst.* **34**: 9-38, **35**: 256-301, **36**: 137-205, **45**: 69-122.
- Ross, R. 1983: Endemism and cosmopolitanism in the diatom flora of the East African Great Lakes. – Pp. 157-177 in: Sims, R. W., Price, J. H. & Whalley, P. E. S. (ed.), *Evolution, time and space*. – *Syst. Assoc. Special* **23**.
- Schmidt, A. (ed.) 1874-1959: *Atlas der Diatomaceenkunde*. – Leipzig.
- Silva, P. C. 1997-: *Index nominum algarum*, University Herbarium, University of California, Berkeley. – Published on the Internet <http://ucjeps.berkeley.edu/INA.html> [accessed 28 July 2004].
- Simonsen, R. 1987: *Atlas and catalogue of the diatom types of Friedrich Hustedt* **1-3**. – Berlin.
- VanLandingham, S. L. 1978: *Catalogue of the fossil and recent genera and species of diatoms and their synonyms* **7**. – Lehre & Vaduz.
- Van Meel, L. 1954: Le phytoplankton. – In: *Résultats scientifiques de l'exploration hydrobiologique du lac Tanganika (1946-1947)* **4(1)**. – Bruxelles.
- West, G. S. 1907: Report on the freshwater algae, including phytoplankton, of the Third Tanganyika Expedition conducted by Dr. W. A. Cunningham, 1901-1905. – *J. Linn. Soc. Bot.* **38**: 81-197.
- Wolle, F. 1890: *Diatomaceae of North America*. – Bethlehem, Pa.
- Wołoszyńska, J. 1914: Studien über das Phytoplankton des Viktoriasees [In: Schröder, B. (ed.), *5: Zellpflanzen Ostafrikas*]. – *Hedwigia* **55**: 184-223.
- Woodhead, N. & Tweed, R. D. 1958: A check list of tropical West African algae. – *Hydrobiologia* **11**: 299-395. [[CrossRef](#)]
- & — 1960: A second check-list of tropical West African algae. – *Hydrobiologia* **15**: 225-286.
- Zanon, V. 1938: Diatomee della regione del Kivu (Congo Belga). – *Commentat. Pont. Acad. Sci.* **2**: 535-668.

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