

The diatom flora of Berlin (Germany): A spotlight on some documented taxa as a case study on historical biodiversity

Ursula Geissler¹, Wolf-Henning Kusber² & Regine Jahn^{* 2}

¹ *Institut für Biologie – Systematische Botanik und Pflanzengeographie,
Freie Universität Berlin, Altensteinstr. 6, 14195 Berlin, Germany*

² *Botanischer Garten und Botanisches Museum Berlin–Dahlem, Freie Universität Berlin,
Königin-Luise-Str. 6–8, 14191 Berlin, Germany*

Abstract

This study focusses on diatoms which were described from Berlin (as *Gomphonema acuminatum*, *Navicula diabolica*, *Naviculadicta geisslerae*, *Navicula monile*, *Stephanodiscus berlinensis*, *Stephanosira europaea*, and *Synedra berlinensis*), or which were found in Ehrenberg samples from the mid-19th century. Four species are newly typified and one species is recombined (*Orthoseira europaea*). For nine diatoms the pattern of records for the last 170 years is discussed.

Introduction

Berlin (today 3.4 million inhabitants) is one of the best studied cities concerning algae since the 19th century. Its area (883 km²) contains urban and suburban parts with parks, woods and water bodies. The landscape of Berlin (Pleistocene North-German lowland) with its glacial valley is drained by the rivers Spree and Havel (catchment area of the river Elbe which meets the North Sea).

Geissler & Kies (2003) presented a literature baseline of all available recorded algae findings in Berlin (e.g. theses, experts' reports, personal communications). This checklist spans a time of 210 years from 1787 to 1997. It reports 383 algal genera with 1638 species. Each entry consists of the scientific name, its synonymy, the references of the records and all habitats, where the taxon was found. A taxonomical and nomenclatural basis for the Bacillariophyceae, mainly the "*Süßwasserflora von Mitteleuropa*" (Krammer & Lange-Bertalot 1986, 1988, 1991a,b) was chosen. The checklist by Geissler & Kies (2003) of fossil and recent diatoms includes 67 genera (some of them historical names). 627 fully determined infrageneric taxa were recorded as accepted names: 493 species, 5 subspecies, 122 varieties and 7 formae. The aim of the algal checklist for Berlin (Geissler & Kies 2003) was not only the documentation of all records, but the analysis of the data set under different aspects. In Geissler & Kies (2003) records of 104 habitats in Berlin were analysed. The best documented areas by number of diatom dataset entries are the lake Tegeler See (541 records), the air of Berlin (267 records), the river Spree which is in the city mostly canal-like (248 records), a canal, connected with the river Spree "Charlottenburger Verbindungskanal" (216 records), the partially lake-like river Havel (209 records), and the shallow lake Müggelsee through which

* Corresponding author: e-mail r.jahn@bgbm.org

the river “Spree flows” (199 records). Although the data set is big enough for detailed analyses, it is also evident that our knowledge of the Berlin diatom flora is far from being complete.

In this paper we are focussing on algae findings in samples, therefore extending the literature listings of Geissler & Kies (2003) into real diatom findings. This implies looking at historical samples with modern methods/microscopes (as far as possible) and identifying them with current concepts and names. The materials of C.G. Ehrenberg (123 published records in Geissler & Kies 2003) are of special interest because they were taken before the main urbanization of Berlin took place. The drawings and preparations are extremely valuable, because they have been kept, are available, dated and well documented. Ehrenberg’s specimens and new species are being studied in detail within the *AlgaTerra* project by Jahn and Kusber (see also Jahn 2004, Jahn *et al.* 2004, Jahn & Kusber 2004, 2005), who are continuing to record the Berlin algal flora and its changes (Kusber *et al.* 2003).

Material & methods

From the Ehrenberg Collection at Museum für Naturkunde, Humboldt Universität zu Berlin (BHUPM) the following material was studied:

1. Ehrenberg’s drawings No. 678, 993, 1104, in BHUPM
2. Taxonomical Preparations “Trockenpräparate II Polygastrica”
 - No. 540100–1 “*Gomphonema acuminatum*, Berlin”;
 - No. 540117–3 “*Micrasterias tetras*” according to Ehrenberg (1838: 156) August 1834;
 - No. 540133–3 “*Pinnularia monile*, Berlin”;
 - No. 540180–2 “*Stephanodiscus berolinensis* α”; No. 540180–3 “*Stephanodiscus berolinensis* β”.
3. The following Geographical Preparations in BHUPM were studied (numbers according to the numbering schema of mica strips, consisting of mostly 5 mica slides (see Jahn & Kusber 2004) plus the label information; additional information by Ehrenberg (1848b) in square brackets. Preparations from mosses on trees:
 - 390301, 390302, 390304 “Auf Hainbuche, Moos im Thiergarten” [in mehr als Mannshöhe (8–10 Fuss) entnommen, in der Gegend von Kempershof, nach Bellevue zu, Aug. 1848] (*Carpinus betulus*);
 - 390305, 390306, 390307, 390308 “Auf Eichenmoos im Thiergarten, Aug. 1848” [in mehr als Mannshöhe (8–10 Fuss) entnommen, in der Gegend der Rousseau’schen Insel, im geschlossenen Walde ebenda] (*Quercus*);
 - 390115 “Berlin Krautgasse, Apfelbaummoos, Aug. 1848” [in mehr als Mannshöhe (8–10 Fuss) entnommen, mitten in der sehr ausgedehnten freien Garten-Anlage des Bouchéschen Kunstgartens] (*Malus*);
 - 390201 “Potsdam, Brauhausberg, Baummoos, Aug. 1848” [in mehr als Mannshöhe (8–10 Fuss) entnommen, aus dem geschlossenen Walde des Brauhausberges zu Potsdam in der obersten Höhe, von einer Eiche];
 - 390202 “Potsdam, Allee, Pappelmoos, Aug. 1848” (*Populus*);
 - 390107, 390108 “Berlin, Baummoos d. oberen Stämme, 9 Febr. 1849”;

- 390101, 390102 “Baummoos aus der Höhe über 6', Berlin Thiergarten, 16 Januar 1849”;
- 390103 “Berlin Thiergarten, Baummoos, Fichte, 29 Januar 1849” (*Picea*);
- 390507, 390508 “Berlin Baummoos, 28 Febr. 1849, Thiergarten Erle” (*Alnus glutinosa*);
- 390509, 390510 “Berlin Baummoos, 27 Maerz 1849, Thiergarten Erle”;

4. Modern preparations in B:

- B 2004/075 Moss (mainly *Hypnum cupressiforme*) on *Quercus robur* (oak) height 30 cm, near the isle “Rousseau-Insel”; Berlin-Tiergarten, 04. July 2004;
- B 2004/076 Moss on *Acer platanoides* (maple) height 2.0 m; Berlin-Tiergarten, 04 July 2004;
- B 2004/077 Moss on *Alnus glutinosa* (alder) 15 cm above the water level of the shallow lake “Neuer See”; Berlin-Tiergarten, 04 July 2004;
- B 2004/078 Moss (*Hypnum cupressiforme*) on *Catalpa bignonioides*, crotch at a height of 1.0 m ; Berlin-Tiergarten, 04 July 2004.

Photographs at the Ehrenberg Collection were taken with an Olympus DP 50 and BX 51, Objective: Olympus SPlan 80x/N.A.0.75.

Results

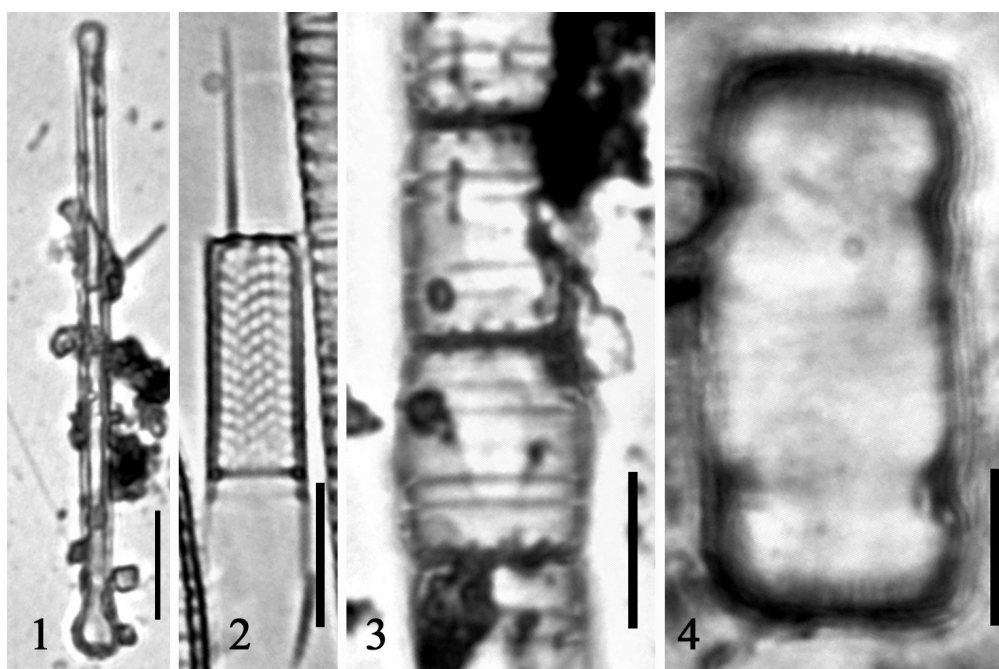
We present a documentation on the first dated historical records for the river Spree (Figs 1–3, 14–18) as well as on the first studies on aero-terrestrial algae by C.G. Ehrenberg which were reinvestigated (Figs 9–13, Table 1). We provide further habitat information in an annotated species list on three scarcely known species, described in the 19th century by C.G. Ehrenberg: *Orthoseira europaea* (Fig. 4), *Pinnularia monile* (Figs 7, 8), and *Stephanodiscus berolinensis* (Figs 14–18), and on three species described in the 20th century, *Naviculadicta geisslerae*, *Navicula diabolica* (Fig. 6), and *Staurosira berolinensis*. In Figs 19, 20 we present different patterns of documented findings on eleven diatom species as a key to interpret historical biodiversity; these taxa are also included in the annotated taxon list.

Actinocyclus normanii f. *subsalsus* (Juhl.-Dannf.) Hust. in Abh. Naturwiss. Vereine Bremen 34: 219. 1957.

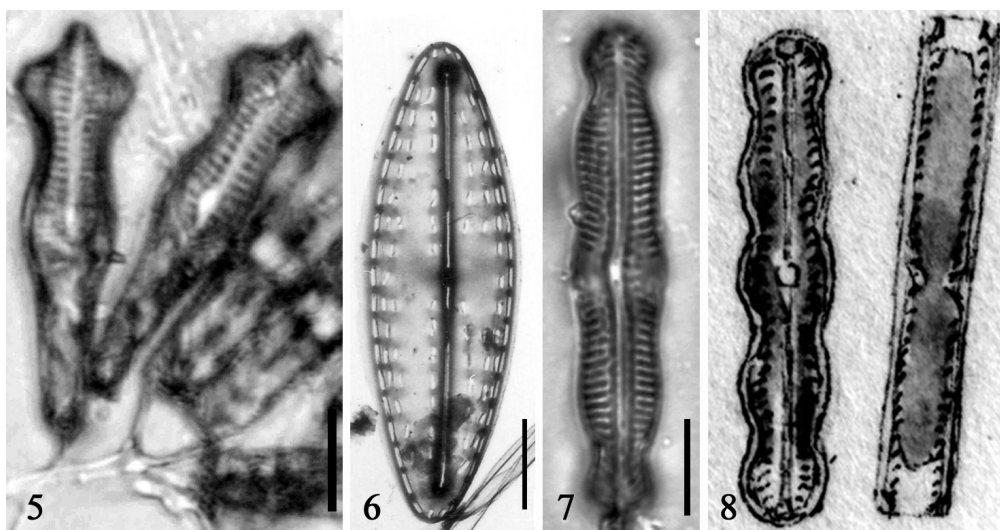
Basionym: *Coscinodiscus subsalsus* Juhl.-Dannf. in Bih. Kongl. Svenska Vetensk.-Akad. Handl. 6 (21): 47. 1882.

Actinocyclus normanii (W. Greg. ex Grev.) Hust. morphotype *subsalsus* sec. Krammer & Lange-Bertalot (1991a).

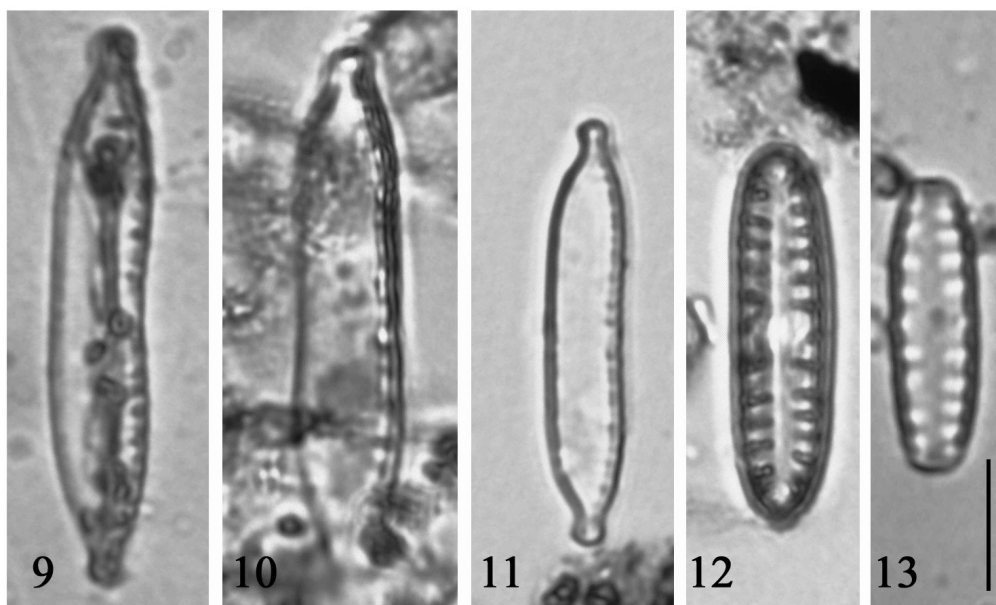
Distribution in Berlin: According to Geissler & Kies (2003) this taxon (sub *A. normanii* (W. Greg. ex Grev.) Hust. and *A. normanii* morphotype *subsalsus* and their synonyms) was not found in Berlin before 1911; since the 1970s it was found in rivers, channels, lakes, and air (Fig. 19a). In a comparison of samples from the river Spree (September 1924, 1978 and 1979) *Actinocyclus normanii* f. *subsalsus* was not found in 1924, but in the 1970s with an abundance of 5.0%, and respectively, 0.2% of the diatom valves (Jahn & Geissler 1993); in the holotype preparation of *Naviculadicta geisslerae* (R. Jahn) R. Jahn, it was co-dominant, reaching 11.8% of the diatom valves (Jahn 1990, 1992). The taxon occurs in waters with an increased conductivity (627–826 $\mu\text{S cm}^{-1}$).



Figs 1–4. Historical diatom records from Berlin. **Fig. 1.** *Asterionella formosa* Hassall, first record, Spree 1845. **Fig. 2.** *Aulacoseira granulata* (Ehrenb.) Simonsen, Spree 1856. **Fig. 3.** *Stephanodiscus binderanus* (Kütz.) Willi Krieger, Spree 1845. **Fig. 4.** *Orthoseira europaea* (Ehrenb.) R. Jahn & Kusber, in moss in the Tiergarten 1848, lectotype (Figs 1–5: Ehrenberg Collection at BHUPM). Scale bars = 10 μm .



Figs 5–8. Historical diatom records from Berlin. **Fig. 5.** *Gomphonema acuminatum* Ehrenb., first available preparation by C.G. Ehrenberg. **Fig. 6.** *Navicula diabolica* Geissler & Gerloff, Teufelsbruch 1959, type. **Figs 7–8.** *Pinnularia monile* (Ehrenb.) Ehrenb. **Fig. 7.** 1840, lectotype. **Fig. 8.** Drawing by C.G. Ehrenberg. Scale bars: Figs 5, 7 = 10 μm . Fig. 6 = 1 μm .



Figs 9–13. Historical diatom records from Berlin. **Figs 9–11.** *Hantzschia amphioxys* (Ehrenb.) Grunow. **Figs 12–13.** *Pinnularia borealis* Ehrenb. Scale bar = 10 μm .

Asterionella formosa Hassall, *Microscop. Exam. Water*: 10. 1855.

Neotype, designated by Körner (1970): B 25634, leg. H. Körner, 26 March 1966, documented also as figs 15–26 by Pappas & Stoermer (2003).

Neotype locality: Lake Gross–Glienicke See in Berlin, Germany.

Distribution in Berlin: The first dated record is of 1845 from the river Spree (see Fig. 1). After 1910 *A. formosa* (Fig. 19b) was found in a wide range of water bodies such as rivers, channels, lakes, ponds, swamps and a sewage treatment plant (Geissler & Kies 2003).

Aulacoseira granulata (Ehrenb.) Simonsen in *Bacillaria* 2: 58. 1979.

Basionym: *Gallionella granulata* Ehrenb. in *Abh. Königl. Akad. Wiss. Berlin* 1841: 415. 1843.

Distribution: According to Geissler & Kies (2003) this taxon was found in rivers, channels, lakes, ponds, swamps and a sewage treatment plant. The first documented record is of 1856 from the river Spree (see Fig. 2). This taxon occurs frequently in eutrophic waters (compare Fig. 19c). In the river Spree *A. granulata* was the most abundant diatom in September 1924, 1978, and 1979 with 48.6, 56.0 respectively 77.6% of the counted cells (Jahn & Geissler 1993). In the summer plankton of the shallow lake Nikolassee in 1987 it was the most abundant diatom with nearly 100% of the counted diatom cells and a biovolume of up to $2 \text{ mm}^3 \text{ l}^{-1}$; replaced in autumn by solitary centric taxa (Kusber 1999).

Gomphonema acuminatum Ehrenb. in *Abh. Königl. Akad. Wiss. Berlin* 1831: 88. 1832.

Lectotype according to Jahn & Kusber (2004): [icon] specimen “b”, right cell on Ehrenberg’s drawing sheet No. 678 at BHUPM, published in Ehrenberg (1838) as pl. 18, fig. 4 (part 3).

Type locality: Berlin, Germany.

Further material: Taxonomic Preparations 540100–1; 540117–3 at BHUPM (see our Fig. 5).

Habitat: Ehrenberg (1838: 217) writes “lebend bei Berlin ... im Frühjahre bei Berlin in zahlloser Menge als filzartiger gelbbrauner Schleim auf den Wasserpflanzen, welche keinen Zweifel übrig lassen, dass die fossilen und jetzt lebenden Infusorien identisch sind.” The living material is referred to spring samples as a felt-like yellow-brownish mucilage on water plants. Ehrenberg (1840) later separated the fossil *G. coronata* Ehrenb. (see Jahn & Kusber 2004).

Distribution: According to Geissler & Kies (2003) this taxon was found in running waters, lake-like rivers, and swamps. Further records, not listed in Geissler & Kies (2003): Berlin, August 1834; Spree, November 1844; valve found on moss on a tree 29 January 1849; Schlachtensee, August 1856; Grunewaldsee, August 1856; records in dated samples 1998–2004 (Fig. 19d).

Hantzschia amphioxys (Ehrenb.) Grunow in Cleve & Grunow, Kongl. Svenska Vetenskapsakad. Handl. 17: 103. 1880.

Basionym: *Eunotia amphioxys* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1841: 413. 1843.

Distribution: According to Geissler & Kies (2003) this taxon was found in rivers, channels, lakes, swamps, a sewage treatment plant, sewage fields, and in air (Fig. 20a). The first dated documented records from Ehrenberg’s studies are shown in Figs 9–11. The microhabitats of Ehrenberg (1848b) are listed in Table 1; recently *H. amphioxys* was also found on mud and in puddles (unpubl. data).

Navicula diabolica Geissler & Gerloff in Geissler *et al.*, Diatomeenschalen im elektronenmikroskopischen Bild 4: 30, pl. 388, fig. 30, 31. 1963.

Holotype: pl. 388, fig. 30, 31 in Geissler *et al.* (1963) (see our Fig. 6).

Type locality: Teufelsbruch in Berlin, Germany.

Original material: Sample No. 9a, 1. May 1959, leg. W. Krüger in B; pl. 388: fig. 30, 31 in Geissler *et al.* (1963).

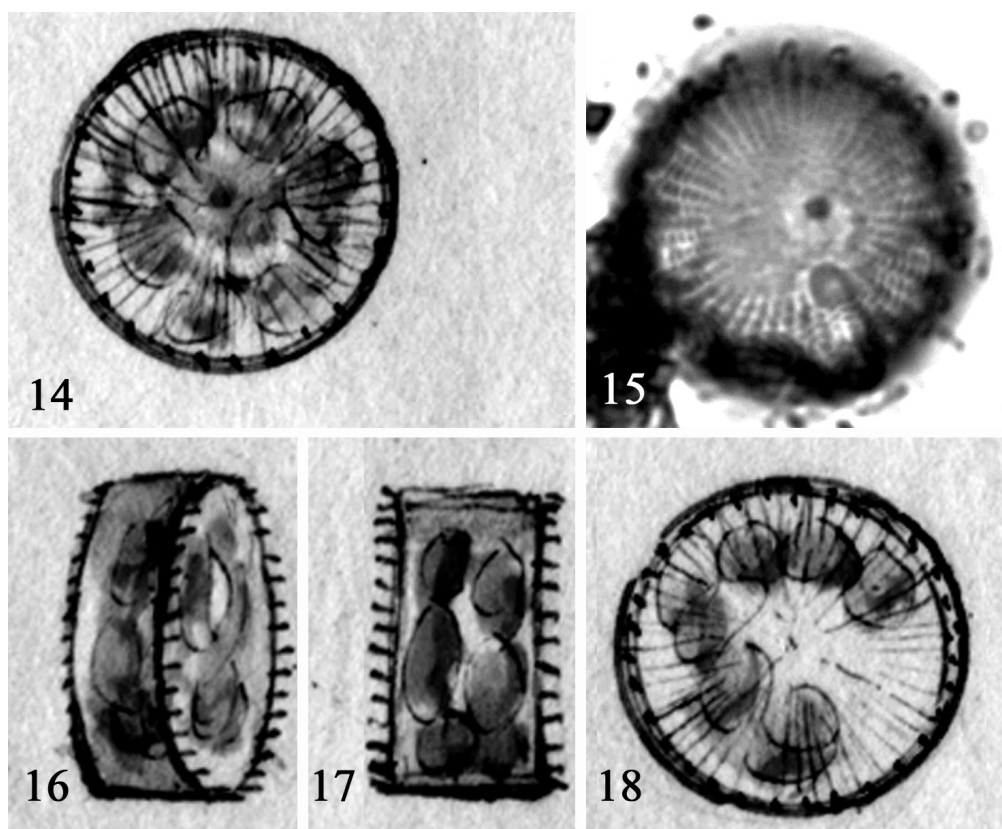
Habitat: Teufelsbruch in Berlin, Germany. Habitat information was not given by Geissler *et al.* (1963). According to Krüger (1962) this species was found in his sample 9a of 1 May 1959. Small water body (“Schlenke”) in a peat bog near a flooded alder woodland. The sample was taken among *Utricularia intermedia* (a species, probably now extinct in Berlin; see Prasse *et al.* 2001). The water was clear with 22°C and pH 6.2. Krüger (1962) listed 73 diatom taxa, which co-occurred. Since a detailed list of the type locality was published and the records by Krüger (1962) were checked for current taxon names (Geissler & Kies 2003), only those taxa are listed here that are included in Red List taxa for Germany (Lange-Bertalot 1996; categories, see Schnittler & Ludwig 1996): *Caloneis tenuis* (W. Greg.) Krammer (G=Gefährdung anzunehmen ≈ conservation dependent/o=oligotraphentic), *Cymbella amphioxys* (Kütz.) Cleve (2 = stark gefährdet, i.e. endangered/od=oligotraphentic predominantly in acidic waters), *Cymbella reinhardtii* Grunow (R=extrem selten, i.e. rare/o), *Cymbella turgida* Pant. (2/od), *Eunotia arcubus* Nörpel & Lange-Bert. (G/od), *Eunotia bilunaris* var. *mucophila* Lange-Bert. & Nörpel (G/od), *Eunotia faba* Ehrenb. (1=vom Aussterben bedroht, i.e. critical/od), *Eunotia glacialis* F. Meister (G/od), *Navicula semen* Ehrenb. (1/o), *Pinnularia gigas* Ehrenb. (G/od), *Pinnularia gentilis* (Donkin) Cleve (G/od), *Pinnularia nobilis* (Ehrenb.) Ehrenb. (G/o).

Distribution: No further records in Berlin (Fig. 20b).

Table 1. Diatoms from mosses on trees in Berlin and Postdam.

Habitat	Taxa according to Ehrenberg's label	Taxa (revisited) in Ehrenberg's samples	Abundance
Moss on <i>Carpinus betulus</i> (hornbeam), height 2.5–3.1 m; Berlin–Tiergarten; 08.1848 (390301, 390302, 390304)	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+
	<i>Meridion?!?</i>	[not found]	–
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Stephanosira europaea</i>	<i>Orthoseira europaea</i>	+
Moss on <i>Quercus</i> (oak), height 2.5–3.1 m; Berlin–Tiergarten; 08.1848 (390305, 390306, 390307, 390308)	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+
	<i>Cocconema?</i>	[Teratology, unidentifiable]	+
	<i>Gallionella?</i>	[not found]	?
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Stauroneis semen</i>	[unidentifiable]	+
Moss on <i>Malus</i> (apple tree), height 2.5–3.1 m; Berlin–Friedrichshain; 08.1848 (390115)	<i>Stephanosira europaea</i>	<i>Orthoseira europaea</i>	+
	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+
Moss on <i>Quercus</i> (oak), 3.1 m; Potsdam; 08.1848 (390201)	<i>Eunotia amphioxys</i>	[not found]	?
	[not found]	<i>Pinnularia borealis</i>	+
Moss on <i>Populus</i> (poplar), Potsdam; 08.1848 (390202)	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Synedra ulna</i> ??!	[unidentifiable]	+
Moss on a tree; Berlin; 09.02.1849 (390107, 390108)	<i>Navicula semen</i>	[unidentifiable]	+++
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+++
	<i>Stephanosira europaea</i>	<i>Orthoseira europaea</i>	+
Moss on a tree; 1.9 m; Berlin–Tiergarten; 16.01.1849 (390101, 390102)	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+
	<i>Gallionella</i>	<i>Aulacoseira</i> sp.	+
	<i>Himantidium arcus</i>	<i>Eunotia arcus</i>	+
	<i>Navicula semen</i>	[unidentifiable]	+
	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Stauroneis semen</i>	[unidentifiable]	+
Moss on <i>Picea</i> (spruce); Berlin–Tiergarten; 29.01.1849 (390103)	<i>Stephanosira europaea</i>	[not found]	?
	<i>Gomphonema acuminatum</i>	<i>Gomphonema acuminatum</i>	+
Moss on <i>Alnus glutinosa</i> (alder); Berlin–Tiergarten, 28.02.1849 (390507, 390508)	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Eunotia amphioxys</i>	<i>Hantzschia amphioxys</i>	+, alive*
Moss on <i>Alnus glutinosa</i> (alder); Berlin–Tiergarten, 27.03.1849 (390509, 390510)	<i>Pinnularia borealis</i>	<i>Pinnularia borealis</i>	+
	<i>Gallionella?</i>	<i>Aulacoseira</i> sp.	+

Legend: + occurrence confirmed, +++ occurrence with many specimens, ? = identity unclear, – = not found, *alive = cell with chloroplasts, having been alive when dried onto the mica slide.



Figs 14–18. *Stephanodiscus berolinensis* Ehrenb. **Figs 14, 16–18.** Cells on drawing sheet No. 1104 in BHUPM. **Fig. 15.** Lectotype in BHUPM. Scale bar = 10 μm .

Naviculadicta geisslerae (R. Jahn) R. Jahn in Biblioth. Diatomol. 29: 86. 1994.

\equiv *Navicula geisslerae* R. Jahn in Diatom Research 7: 69–70, figs 1–14. 1992.

Holotype: B 400036200.

Type locality: River Spree in Berlin, Germany.

Habitat: River Spree in urban Berlin, Germany. 20 October 1982, water temperature 12°C, c. 1.2 mg l⁻¹ ortho-phosphate and 4 mg l⁻¹ ammonium-nitrate (according to Jahn 1990, 1992). The sample was taken at a shallow part of the river on slanted stones.

In October 1982 *N. geisslerae* had a relative abundance of 1.2%; the main taxa of this sample were: *Melosira varians* C. Agardh (13.3%), *Actinocyclus normanii* f. *subsalsus* (Juhl.-Dannf.) Hust. (11.8%), *Achnantheidium minutissimum* (Kütz.) Czarnecki (7.3%), *Luticola goeppertiana* (Bleisch) D.G. Mann (6.9%), *Cocconeis pediculus* Ehrenb. (5.0%), and *Nitzschia amphibia* Grunow (5.0%). In November 1982, *N. geisslerae* had a relative abundance of 1.0%; the main taxa of this sample were: *Melosira varians* (8.8%), *Nitzschia amphibia* (8.2%), *Navicula reichardtiana* Lange-Bert. (7.6%), *Luticola goeppertiana* (6.7%), and *Fragilaria capucina* var. *vaucheriae* (Kütz.) Lange-Bert. (5.7%).

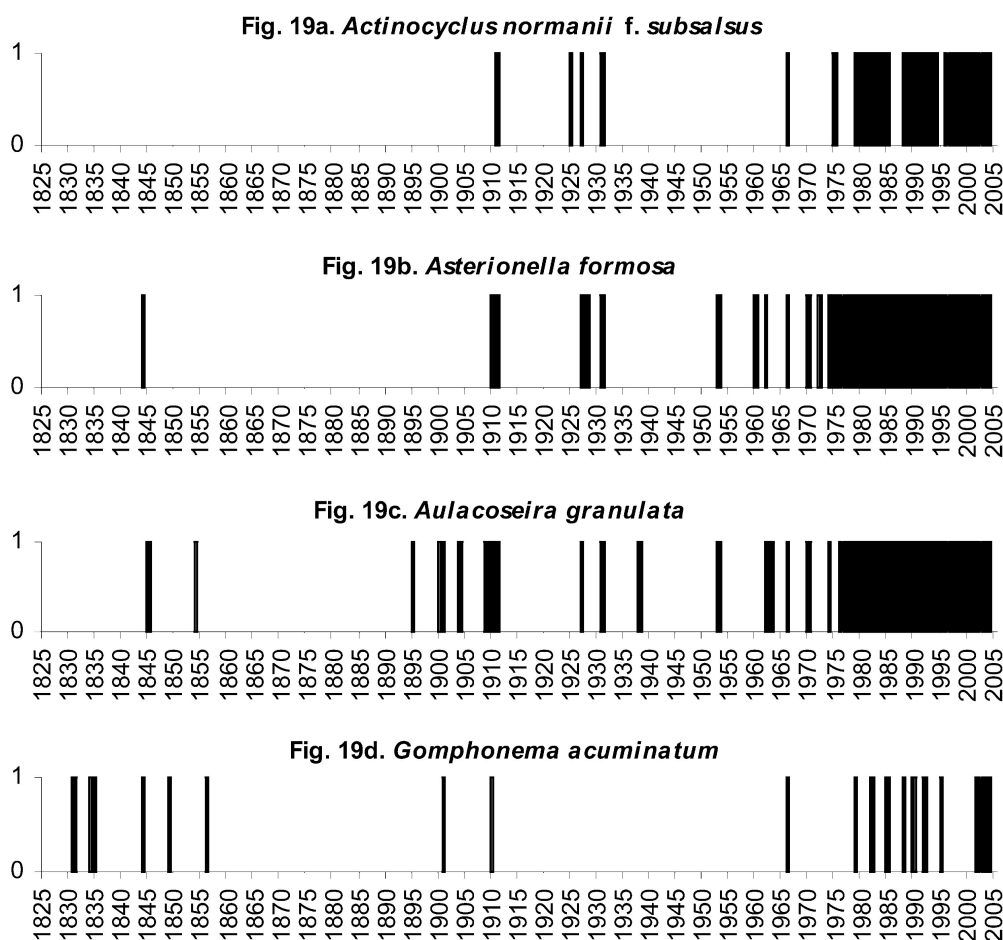


Fig. 19. Documented records of diatoms in Berlin (according to Geissler & Kies 2003, plus additional data pre-1860 and post-1997 from this study; 0 = taxon not recorded, 1 = taxon recorded). **Fig. 19a.** *Actinocyclus normanii* f. *subsalsus* (Juhl.-Dannf.) Hust. **Fig. 19b.** *Asterionella formosa* Hassall. **Fig. 19c.** *Aulacoseira granulata* (Ehrenb.) Simonsen. **Fig. 19d.** *Gomphonema acuminatum* Ehrenb.

Orthoseira europaea (Ehrenb.) R. Jahn & Kusber, comb. nov.

Basionym: *Stephanosira europaea* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1848: 341, 379. 1848.

? = *Orthoseira roeseana* (Rabenh.) Pfitzer in Bot. Abh. (Bonn) 1 (2): 134, 159, 165. 1871.

? = *Melosira roeseana* Rabenh., Süsw.-Diat.: 13, pl. 10, suppl.: fig. 5. 1853.

Lectotype (designated here): preparation 390308-c, marked with a blue ring in BHUPM (see our Fig. 4).

Type locality: Tiergarten in Berlin, Germany.

Habitat: Tiergarten in Berlin, Germany (see Table 1).

Distribution: Because no further records of this taxon were given for Berlin (Fig. 20c, cf. Geissler & Kies 2003), we studied all available historical samples from mosses on trees in Berlin and also checked recent samples from the type locality for the occurrence of this taxon (see Table 1). In recent samples *Pinnularia borealis* Ehrenb. was found on *Acer*, *Catalpa*, and *Quercus*. On *Alnus*, a diatom flora similar to the water of lake “Neuer See”, Tiergarten was found.

Pinnularia monile (Ehrenb.) Ehrenb., Mikrogeologie, Atlas: 18. 1854.

Basionym: *Navicula monile* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 214. 1840.

Lectotype (designated here): Taxonomic Preparation No. 540133–3, documented on Fig. 7.

Type locality: Berlin, Germany.

Original material: Drawing sheet No. 993 in BHUPM “5. April 1840”.

Habitat: Habitat information was not given by Ehrenberg (1840). Indirect habitat information is available through the co-occurring algae identified in the original material: *Cymatopleura librile* (Ehrenb.) Pant., *Diatoma tenuis* C. Agardh, *Gomphonema acuminatum* Ehrenb., *Hippodonta capitata* (Ehrenb.) Lange-Bert., Metzeltin & Witkowski, *Navicula rhyndotella* Lange-Bert., *Pinnularia stomatophora* (Grunow) Cleve, *Planothidium lanceolatum* (Bréb. ex Kütz.) Lange-Bert., *Sellaphora pupula* (Kütz.) Mereschk., deme 4 sensu Mann (2001), *Stauroneis gracilior* E. Reichardt, *Stauroneis phoenicenteron* (Nitzsch) Ehrenb.; *Lepocinclis ovalis* (Ehrenb.) Minkew. (Euglenophyta).

Distribution: According to Ehrenberg (1854) this taxon also occurred in diatomite under Berlin.

Stausosira berolinensis (Lemmerm.) Lange-Bert. in Krammer & Lange-Bertalot, Süßwasserfl. Mitteleur. 2(3), 2. ed., 587. 2000.

Basionym: *Synedra berolinensis* Lemmerm. in Ber. Deutsch. Bot. Ges. 18: 31. 1900.

≡ *Fragilaria berolinensis* (Lemmerm.) Lange-Bert. in Biblioth. Diatomol. 27: 43. 1993.

Type: not indicated.

Type locality: Grunewaldsee in Berlin, Germany.

Original material: not seen; sample and unpublished illustration are mentioned in Lemmermann (1900).

Habitat: Lake Grunewaldsee is the type locality; further habitat information was not given by Lemmermann (1900).

Ecological information: Planktonic species with star-like aggregates. Lake Grunewaldsee is a glacial lake of 14.5 ha; at the turn of the century, the swamp areas surrounding the lake were degraded due to beginning urbanization. The waterbody was probably already eutrophic at that time.

Distribution: According to Geissler & Kies (2003) this taxon was scarcely found (Fig. 20d) in rivers, channels, and in other lakes.

Stephanodiscus berolinensis Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1845: 80.1845.

Lectotype (designated here): preparation 540180–2 in BHUPM (see our Fig. 3).

Type locality: Spree in Berlin, November 1844, Germany. According to Ehrenberg (1845): "vivam Berolini"; the habitat, the river Spree was given first in Ehrenberg (1848a: 217); the date is according to drawing sheet No. 1104 in BHUPM.

Further original material: Taxonomical Preparations 540180–3 in BHUPM.

Habitat: No habitat information was given by Ehrenberg (1845). Indirect habitat information is available through the co-occurring algae. In the original material the following algae were identified: *Amphora copulata* Kütz. [= *Amphora libyca* Ehrenb. sensu Krammer & Lange-Bertalot (1986)], *Amphora ovalis* (Kütz.) Kütz., *Asterionella formosa* Hassall (Fig. 1), *Aulacoseira granulata* (Ehrenb.) Simonsen, *Craticula cuspidata* (Kütz.) D.G. Mann, *Cymatopleura librile* (Ehrenb.) Pant., *Encyonema minutum* (Hilse) D.G. Mann, *Fragilaria crotonensis* Kitton, *Gomphonema acuminatum* Ehrenb., *Hippodonta capitata* (Ehrenb.) Lange-Bert., Metzeltin & Witkowski, *Neidium ampliatum* (Ehrenb.) Cleve, *Nitzschia acicularis* (Kütz.) W. Sm., *Nitzschia palea* (Kütz.) W. Sm., *Placoneis placentula* (Ehrenb.) Mereschk., *Planothidium delicatulum* (Kütz.) Round & L. Bukhtiyarova, *Stephanodiscus binderanus* (Kütz.) Willi Krieger (Fig. 3). Non-diatoms (documentation and discussion in Jahn & Kusber 2005, Geissler *et al.* 2005): *Desmodesmus armatus* (Chodat) E.H. Hegew., *Pediastrum boryanum* (Turpin) Menegh. var. *boryanum* (Chlorophyta), and *Microcystis wesenbergii* (Komárek) Komárek (Cyanoprokaryota).

Stephanodiscus binderanus (Kütz.) Willi Krieger in Pflanzenforsch. 10: 21. 1927.

Basionym: *Melosira binderana* Kütz., Kieselschal. Bacill.: 55, pl. 2, fig. 1. 1844.

Type (cons. prop. by Håkansson & Ross 2002, also cited in Håkansson 2002): B 6169 "Spree bei Berlin" (Krieger), not recommended by the Nomenclature Committee for Algae because of the availability of Kützing's published pictures as part of the original material (Compère 2004).

Lectotype (designated here by R. Jahn & H. Håkansson): [icon!] pl. 2, fig. I:1 (upper chain) in Kützing (1844).

Lectotype locality: "Moorgräben bei Hamburg", leg. F. Binder (Germany).

Epitype (designated here by R. Jahn & H. Håkansson): B 400040219 (ex "Krieger 6169"; material documented in Håkansson (2002) as fig. 162, 163, 165–167).

Epitype locality: "Spree bei Berlin" (Germany), September 1924.

The first dated record is of 1845 (Fig. 3) from the river Spree. Later, *St. binderanus* was also found in channels and lakes (Geissler & Kies 2003). The maximum abundance (28.8% of the counted valves) was measured in a Krieger sample from the river Spree, September 1924 (Jahn & Geissler 1993). Since the 1950s, this taxon was scarcely recorded for Berlin (Fig. 20e).

Discussion

The dynamics in the occurrence of 9 single taxa, shown in Figs 19, 20 is difficult to interpret. In all graphs gaps can be found. Different reasons are responsible for this; certainly some important reasons are that many observations were never published; a lot of water bodies were not examined at all or not regularly.

Species with hardly visible characters were not detected by Ehrenberg; e.g., *Asterionella formosa* was not distinguished from *Diatoma* species although we found it in a dated historical preparation. This shows that *Asterionella formosa* has a different pattern of

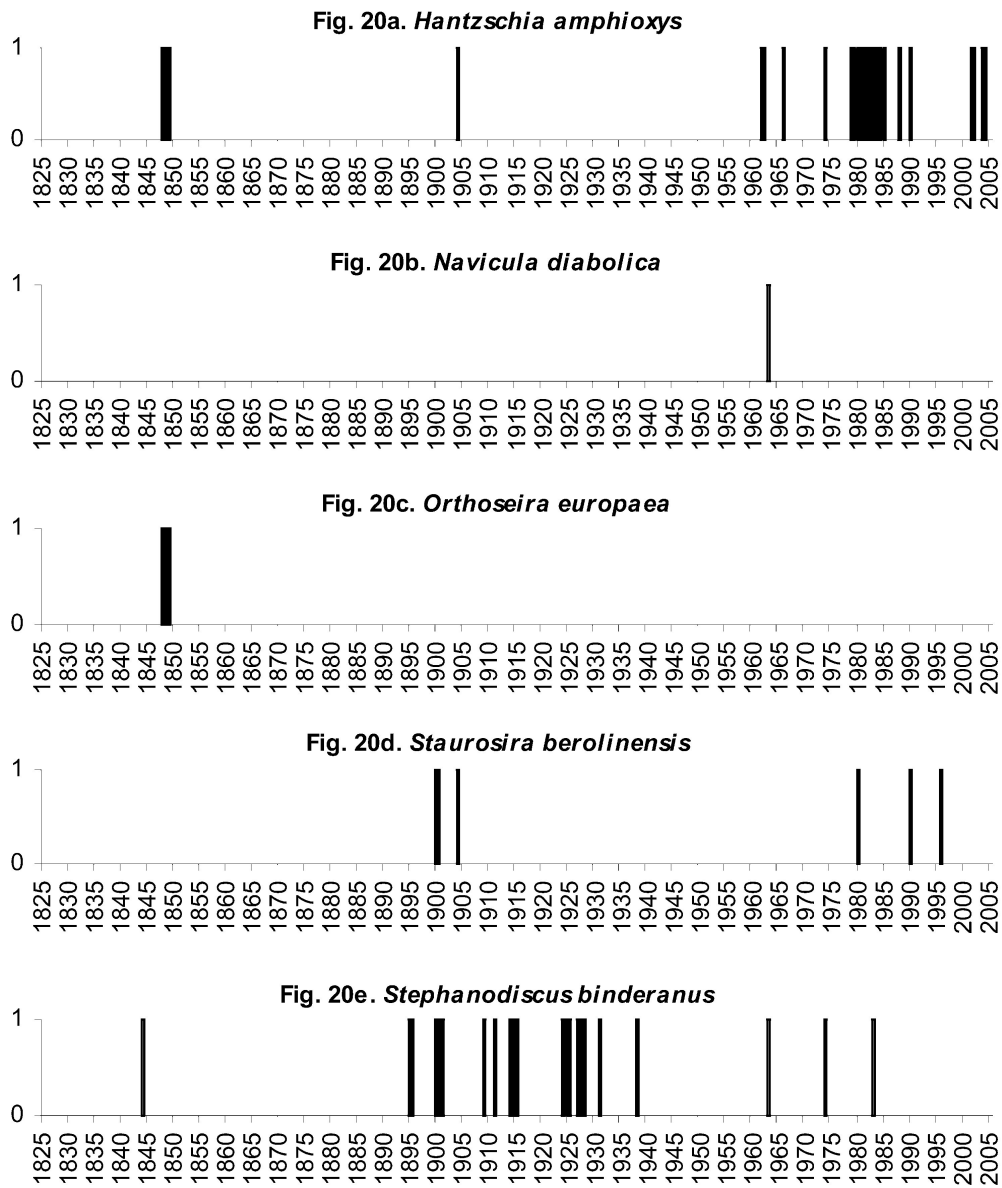


Fig. 20. Documented records of diatoms in Berlin (according to Geissler & Kies 2003, plus additional data pre-1860 and post-1997 from this study; 0 = taxon not recorded, 1 = taxon recorded). **Fig. 20a.** *Hantzschia amphioxys* (Ehrenb.) Grunow. **Fig. 20b.** *Navicula diabolica* Geissler & Gerloff. **Fig. 20c.** *Orthoseira europaea* (Ehrenb.) R.Jahn & Kusber; **Fig. 20d.** *Staurosira berlinensis* (Lemmerm.) Lange-Bert. **Fig. 20e.** *Stephanodiscus binderanus* (Kütz.) Willi Krieger.

occurrence than *Actinocyclus normanii* f. *subsalsus*, a neophyte recorded for the first time in 1911 for Berlin (Geissler & Kies 2003) which we have not found yet in the Ehrenberg material. In contrast *Aulacoseira granulata* and *Gomphonema acuminatum* were identified early in Berlin diatom research, gaps in the occurrence pattern are due to uneven

documentation. In *Stephanodiscus binderanus* the pattern of occurrence is again different, because there are only a few recent records in the last decades. As discussed in Jahn & Geissler (1993) and Geissler & Kies (2003) the taxon became rare although it is assessed as eutrathentic by Lange-Bertalot (1996). In this study, it is shown that the taxon was already part of the Berlin diatom flora at Ehrenberg's time.

Orthoseira europaea was not found in Berlin after 1849. One reason is that the habitats (mosses on trees) were not studied in Berlin. In his broadly based study on algae in Berlin air, Baumann (1979) did not find any *Orthoseira*. To check whether or not this species still occurs in Berlin, we reinvestigated its type locality. Mosses on trees were found and also the diatom *Hantzschia amphioxys* but not *Orthoseira europaea*. This is possibly due to anthropogenic changes of the environment. The main changes were sinking ground water levels because of urban building, nutrient enrichment, air pollution, and changes in the species composition of the vegetation. In addition, after World War II almost all old trees in the park Tiergarten were gone. Hence, now the microclimate in the Tiergarten is much dryer than at the time of Ehrenberg and many mosses are only able to survive close to the soil and/or water.

Environmental changes are probably also the reason why *Navicula diabolica* was not found in Berlin again after its first description. Since no habitat information was given in Geissler *et al.* (1963), we have to rely on the species inventory of the original material given by Krüger (1962) with updated synonymy by Geissler & Kies (2003). It shows that this habitat was rich in threatened species of oligotrathentic waters. Further investigations of similar habitats can give evidence if the species is also an endangered oligotrathentic species, or if it was only accompanying these threatened species. A halophilous taxon, identified as *N. diabolica* by Karayeva (1976), with similar valve shape but different terminal raphe ends, was recorded from the Caspian Sea.

This paper shows that even the comprehensive checklist of diatoms in Geissler & Kies (2003) is far from being complete. During the times of intensive studies of the diatom flora (ca 1970–1995), when many masters and doctoral theses were done at the Freie Universität Berlin, numerous taxa from all algal groups were newly found for Berlin. For example, in the river Spree 8 out of ca. 180 diatom species were reported for the first time for Berlin (Jahn 1990). Our results underline the fact that it is worth to take detailed notice of the diatoms at your feet!

Acknowledgements

The work in the Ehrenberg Collection, curated by David Lazarus, was financed by the German Federal Ministry of Education and Research, BMBF (AlgaTerra project, grant 01 LC 0026) within the BIOLOG program. We acknowledge the contribution of H. Håkansson to the typification of *Stephanodiscus binderanus*.

References

- BAUMANN, L.-H. (1979). *Verbreitung von Algen durch Luftströmungen*. 169 pp., 43 Tafeln. Dissertation am Fachbereich Biologie der Freien Universität Berlin.
- COMPÈRE, P. (2004). Report of the Committee for Algae: 8. *Taxon*, **53**, 1065–1067.
- EHRENBERG, C. G. (1838). *Die Infusionsthierchen als vollkommene Organismen*. 548 pp. Voss, Leipzig.
- EHRENBERG, C. G. (1840). Charakteristik von 274 neuen Arten von Infusorien. *Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, **1840**, 197–219.

- EHRENBERG, C. G. (1845). Neuere Untersuchungen über das kleinste Leben als geologisches Moment. *Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, **1845**, 53–87.
- EHRENBERG, C. G. (1848a). Über eigenthümliche auf den Bäumen des Urwaldes in Süd-Amerika zahlreich lebende mikroskopische oft kieselschalige Organismen. *Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, **1848**, 213–220.
- EHRENBERG, C. G. (1848b). Mittheilung neuer Beobachtungen über das gewöhnlich in der Atmosphäre unsichtbar getragene formenreiche Leben. *Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin*, **1848**, 325–345.
- EHRENBERG, C. G. (1854). *Mikrogeologie. Das Erden und Felsen schaffende Wirken des unsichtbar kleinen selbstständigen Lebens auf der Erde*. Atlas. T. 1–40. Leipzig
- GEISSLER, U. & KIES, L. (2003). Artendiversität und Veränderungen in der Algenflora zweier städtischer Ballungsgebiete Deutschlands: Berlin und Hamburg (Diversity and dynamics of the freshwater algal flora in two urban areas of Germany: Berlin and Hamburg). *Nova Hedwigia, Beiheft*, **126**, 1–777.
- GEISSLER, U., GERLOFF, J., HELMCKE, J.-G., KRIEGER, W. & REIMANN, B. (1963). In: *Diatomeenschalen im elektronenmikroskopischen Bild* (J.-G. Helmcke & W. Krieger, eds), Teil 4, Tafel 301–413. J. Cramer, Weinheim.
- GEISSLER, U., KUSBER, W.-H. & JAHN, R. (2005). Die Algenflora Berlins: Datenlage und Praxisrelevanz. In: *Tagungsbericht 2004* (Deutsche Gesellschaft für Limnologie, ed.), 447–451. Weißensee Verlag, Berlin.
- HÅKANSSON, H. (2002). A compilation and evaluation of species in the genera *Stephanodiscus*, *Cyclostephanos* and *Cyclotella* with a new genus in the family Stephanodiscaceae. *Diatom Research*, **17**, 1–139.
- HÅKANSSON, H. & ROSS, R. (2002). Proposals to conserve the names *Cyclotella kuetzingiana* and *Melosira binderana* with conserved types, and to conserve the name *Stephanodiscus novaezeelandiae* against *Cyclotella bella* (Bacillariophyta). *Taxon*, **51**, 800–801.
- JAHN, R. (1990). *Untersuchungen zur benthischen Diatomeenflora und -vegetation der Spree und angrenzender Kanäle im innerstädtischen Gebiet von Berlin (West)*. 257 pp. Dissertation am Fachbereich Biologie der Freien Universität Berlin.
- JAHN, R. (1992). *Navicula geisslerae* sp. nov. – a small species from the river Spree (Berlin, Germany). *Diatom Research*, **7**, 69–75.
- JAHN, R. (2004). Discovery of the type specimen of *Pinnularia gastrum* Ehrenberg, the type species of the genus *Placoneis* Mereschkowsky. *Diatom Research*, **19**, 229–234.
- JAHN, R. & GEISSLER, U. (1993). Zur Bedeutung von Proben-Sammlungen mikroskopischer Organismen anhand von Diatomeen-Beispielen. In: *Pflanzen der geologischen Vergangenheit, Festschrift W. Krutzsch*, 19–26. Museum für Naturkunde Berlin, Berlin.
- JAHN, R. & KUSBER, W.-H. (2004). Algae of the Ehrenberg collection I. Typification of 32 names of diatom taxa described by C.G. Ehrenberg. *Willdenowia*, **34**, 577–595.
- JAHN, R. & KUSBER, W.-H. (eds) (2005). AlgaTerra Information System [online]. *Botanic Garden and Botanical Museum. Berlin–Dahlem, FU–Berlin*. [31 March 2005]. Available from <<http://www.algaterra.org>>.
- JAHN, R., KUSBER, W.-H., MEDLIN, L. K., CRAWFORD, R. M., LAZARUS, D., FRIEDL, T., HEPPELLE, D., BESZTERI, B., HAMANN, K., HINZ, F., STRIEBEN, S., HUCK, V., KASTEN, J., JOBST, A. & GLÜCK, K. (2004). Taxonomic, molecular and ecological information on diatoms: The information system AlgaTerra. In: *Proceedings of the Seventeenth International Diatom Symposium 2002* (M. Poulin, ed.), 121–128. Biopress, Bristol.
- KARAYEVA, N. I. (1976). Novitates ad Cognitionem Bacillariophytorum e Mari Caspico II. *Novosti sistematiki nizshikh rastenii*, **13**, 14–18.
- KÖRNER, H. (1970). Morphologie und Taxonomie der Diatomeengattung *Asterionella*. *Nova Hedwigia*, **20** (3–4), 557–724.
- KRAMMER, K. & LANGE-BERTALOT, H. (1986). Bacillariophyceae, 1. Teil: Naviculaceae. In: *Süßwasserflora von Mitteleuropa* (H. Ettl, J. Gerloff, H. Heynig & D. Mollenhauer, eds), Band 2/1, 876 pp. Gustav Fischer Verlag, Stuttgart, New York.

- KRAMMER, K. & LANGE-BERTALOT, H. (1988). Bacillariophyceae, 2. Teil: Bacillariaceae, Epithemiaceae, Surirellaceae. In: *Süßwasserflora von Mitteleuropa* (H. Ettl, J. Gerloff, H. Heynig & D. Mollenhauer, eds), Band 2/2, 596 pp. Gustav Fischer Verlag, Stuttgart, New York.
- KRAMMER, K. & LANGE-BERTALOT, H. (1991a). Bacillariophyceae, 3. Teil: Centrales, Fragilariaceae, Eunotiaceae. In: *Süßwasserflora von Mitteleuropa* (H. Ettl, J. Gerloff, H. Heynig & D. Mollenhauer, eds), Band 2/3, 576 pp. Gustav Fischer Verlag, Stuttgart, New York.
- KRAMMER, K. & LANGE-BERTALOT, H. (1991b). Bacillariophyceae, 4. Teil: Achnanthaceae, Kritische Ergänzungen zu *Navicula* (Lineolatae) und *Gomphonema*, Gesamtliteraturverzeichnis Teil 1–4. In: *Süßwasserflora von Mitteleuropa* (H. Ettl, G. Gärtner, J. Gerloff, H. Heynig & D. Mollenhauer, eds), Band 2/4, 437 pp. Gustav Fischer Verlag, Stuttgart, New York.
- KRAMMER, K. & LANGE-BERTALOT, H. (2000). Bacillariophyceae, 3. Teil: Centrales, Fragilariaceae, Eunotiaceae. In: *Süßwasserflora von Mitteleuropa* (H. Ettl, J. Gerloff, H. Heynig & D. Mollenhauer, eds), Band 2/3 (2nd edition), 599 pp. Spektrum Akademischer Verlag, Heidelberg.
- KRÜGER, W. (1962). Das Naturschutzgebiet Teufelsbruch in Berlin–Spandau. II. Die Diatomeenflora einiger ausgewählter Standorte. *Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin*, N.F. 2, 120–134.
- KÜTZING, F. T. (1844). *Die kieselschaligen Bacillarien oder Diatomeen*. 152 pp. F. Förstemann, Nordhausen.
- KUSBER, W.-H. (1999). Phytoplanktondynamik von Algen mit silifizierten Zellhüllen in einem von Flagellaten dominierten eutrophen Flachwassersee. *Berichte des Instituts für Gewässerökologie und Binnenfischerei (IGB)*, 7 (Sonderheft 2), 69–72.
- KUSBER, W.-H., JAHN, R. & GEISSLER, U. (2003). Datensammlung für eine Rote Liste und Florenliste der Zieralgen und Diatomeen Berlins. In: *Tagungsbericht 2002* (Deutsche Gesellschaft für Limnologie, ed.), 796–800. Werder.
- LANGE-BERTALOT, H. (1996). Rote Liste der limnischen Kieselalgen (Bacillariophyceae) Deutschlands. *Schriftenreihe für Vegetationskunde*, 28, 633–677. Bundesamt Naturschutz, Bonn–Bad Godesberg.
- LEMMERMANN, E. (1900). Beiträge zur Kenntnis der Planktonalgen. *Berichte der Deutschen Botanischen Gesellschaft*, 18, 24–32.
- MANN, D. G. (2001). The systematics of the *Sellaphora pupula* complex: typification of *S. pupula*. In: *Lange-Bertalot-Festschrift* (R. Jahn, J.P. Kociolek, A. Witkowski & P. Compère, eds), 225–241. Gantner, Ruggell.
- PAPPAS, J. L. & STOERMER, E. F. (2003). Morphometric comparison of the neotype of *Asterionella formosa* Hassall (Heterokontophyta, Bacillariophyceae) with *Asterionella edlundii*, sp. nov. *Diatom*, 19, 55–65.
- PRASSE, R., RISTOW, M., KLEMM, G., MACHATZI, B., RAUS, T., SCHOLZ, H., STOHR, G., SUKOPP, H. & ZIMMERMANN, F. (2001). Liste der wildwachsenden Gefäßpflanzen des Landes Berlin mit Roter Liste. 85 pp. Kulturbuch Verlag, Berlin.
- SCHNITTLER, M. & LUDWIG, G. (1996). Zur Methodik der Erstellung Roter Listen. *Schriftenreihe für Vegetationskunde*, 28, 709–739. Bundesamt Naturschutz, Bonn–Bad Godesberg.