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## Algae of the Ehrenberg collection – 1. Typification of 32 names of diatom taxa described by C. G. Ehrenberg

### Abstract

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The present paper is the first in a series of papers typifying names of algae taxa, which Ehrenberg described as new, and illustrating the type specimens. In this paper, 32 diatom names from 18 genera in current use are typified, 58 infrageneric diatom names are evaluated. *Diploneis atmosphaerica* and *Odontella rhomboides* are validated as new names. Seven specimens are designated as the types for names of the genera *Brebissonia*, *Gomphonema*, *Microtabella*, *Petrodictyon*, *Raphoneis*, *Rhopalodia*, *Zygoceros*. Four names are attached to specimens that are either not available or not identifiable because of girdle band view or unrecognizable drawings. Three names are heterotypic synonyms of taxa described earlier. In addition, this paper presents an update on the organization of the Ehrenberg collection after it has been modernized through funds of the AlgaTerra project.

### Introduction

Christian Gottfried Ehrenberg (1795-1876) is one of the most important early pioneers in micro algal research, who was very prolific in finding and naming micro algae from many divers habitats. Even though he called them infusoria (“Infusionsthierchen”), in today’s understanding we would summarize them as microscopical uni-celled organisms including such divers groups as bacteria, protozoa and (micro)-algae including diatoms (on his concept of the diatoms see Jahn 1995b and of botany see Jahn 1998). Ehrenberg named about 1500 algal taxa (Jahn 2002-). One part of the AlgaTerra Project, “an information system for terrestrial algal biodiversity: a synthesis of taxonomic, molecular and ecological information”, is evaluating Ehrenberg’s names and assigning specimens to them (Jahn & al. 2004). The present paper is the first in a series of papers that publishes these lectotypifications before they go into the Internet to serve as calibrations of algal names. These papers focus mainly on names and their type specimens; a current taxonomic assessment is presented if possible. The purpose of this first paper is to demonstrate the complexity of assessing the enormous amount of material meticulously assembled by Ehrenberg. In respect to taxonomy, the selection of taxa is somewhat random, spanning 18 diatom genera and focusing on the first two decades of his work.

## The Ehrenberg collection

One of the most important items of reference and documentation in the Ehrenberg collection are his 3013 drawing sheets (pencil on paper, sometimes including water colour). These sheets had various functions. First of all, they served as documentation for his talks at the Academy of Sciences (Königliche Akademie der Wissenschaften zu Berlin), which were immediately published as the so called “Monatsberichte” or “Bericht über die zur Bekanntmachung geeigneten Verhandlungen der Königlich Preussischen Akademie der Wissenschaften zu Berlin”. These drawing sheets are documents of work in progress and were continuously supplemented by handwritten records, corrections and annotations. Their second function was to serve as the original for the copperplate engravings for his books (Ehrenberg 1838, 1854) and publications in the “Abhandlungen der Königlichen Akademie der Wissenschaften zu Berlin”, which were based on his talks but re-worked and more detailed. In the beginning of his research for the publication of his comprehensive and well illustrated book “Infusionsthierchen” (Ehrenberg 1838), Ehrenberg used one drawing sheet for one taxon, often including the date and place of sampling. Later, after 1838, Ehrenberg changed to one drawing sheet per sample to document what he had studied in the “Geographical preparations”, which served as originals for the illustrations in his papers (i.e. Ehrenberg 1843) and in his second well illustrated book “Mikrogeologie” (Ehrenberg 1854). Many specimens were documented on these drawings of samples; individual specimens were often named and their location in the voucher mica slides cross-referenced (i.e. 3 β bl). In addition to the normal heavy drawings sheets (size approximately 28 cm length and 22 cm high in landscape orientation) there are small pieces of paper, which apparently served for his sketches of individual taxa on his excursion to Russia and Siberia in 1829; these have been glued to later drawings on the regular sized paper. All drawings are consecutively numbered, starting with the taxonomic drawings in alphabetical order (taxonomy of the time of sorting; apparently by his daughter Clara for his “Mikrogeologie” 1854).

In order to be able to prove his findings, Ehrenberg was very meticulous in saving and depositing his preparations and samples (Ehrenberg 1837, etc.). Similar to the drawings, there are two different sets of mica preparations. One set is taxa oriented and was made as voucher for his book “Infusionsthierchen” (1838). He called this set “Trockenpräparate” (dry preparations); they are made up of dried algal suspension sandwiched between two small round mica slides, which are held together by a spring. Six of these are positioned into one wooden frame (“Schieberchen”). These preparations are alphabetical by genera and were numbered in Roman numerals (I-CCXI; originally they were deposited in the case no. 54) and have their own small taxonomic index. The second set of preparations is much larger and was made as voucher for his “Mikrogeologie”. These are small, round mica covered with dried algae suspension and Canada Balm (open-face, not sandwiched) plus coloured stitching rings for “circling” the position of the specimen (see also Jahn 1995a). Five round mica slides are glued onto one mica strip; they were numbered consecutively as  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$  by Ehrenberg. Sixteen mica strips are in one folder (“Buch”); several folders made up one case (“Kasten”). The cases and folders are organized by geography and numbered in Arabic numerals (1-50; 54 are the “Trockenpräparate”, see above; 51-53 and 55 are diverse microscopical slides etc., which are not in our focus). Each sample has one to several mica strips, which are consecutively numbered. The main taxonomic index and the geographical index refer to these preparations (for further details on the collection see Lazarus & Jahn 1998). In order not to confuse these two different mica preparations we have decided to call them “Taxonomic preparations” and “Geographical preparations” respectively. In addition, for easier use in databases we have converted the Roman numerals into Arabic and the Greek letters into Latin. Since the folders have been moved from the cases into trays, we indicate the former organisation with a 6 digit number: 2 digits for the original case, 2 for the folder and 2 for the mica strips. The mica strips are numbered consecutively within each tray, independent of how many strips belong to which sample. The 5 mica of each strip are individually numbered as a, b, c, d, e. For marking individual specimens there are coloured circles glued to the Canada Balm; the first initials of the colour (w = white, bl = blue, r = red, v = violet, g/y = yellow, gr = green) correspond to the label of names below the mica strips.

The Ehrenberg collection is deposited at the BHUPM (Institute of Paleontology, Museum für Naturkunde, the Humboldt Universität zu Berlin).

## Material and methods

The following material of Ehrenberg was studied in the Ehrenberg collection at BHUPM:

- Taxonomic preparations No. 540001-3, 540032-3, 540043-4, 540043-5, 540044-1, 540044-2, 540100-1, 540100-2, 540129-2, 540177-1, 540186-6, 540211-5.
- Geographical preparations No. 200701-a, 290702-b, 330802-a, 330803-e, 340810-b, 350704-b, 460412-b.
- Drawing sheets No. 5, 114, 167, 308, 312, 560a, 678, 681, 684, 688, 702, 766, 844, 1036, 1039, 1129, 1147, 1190, 1202, 1327, 2177, 2221, 2250, 2311. Extracts were made from digitized reproductions (see Jahn 2002-).

Original material in BHUPM was photographed with an Olympus DP 50 and BX 51, objectives: Olympus 80×: IC 80/0.75, 40× UPlan Fl 40/0.75, 20×: UPlan Fl 20/0.50; 10×: UPlan Fl 10/0.30.

Table 1. Original material of Ehrenberg in BHUPM.

	<b>Taxonomic preparations</b> (Kasten 54)	<b>Geographical preparations</b> (Kästen 1-50)
Title of handwritten index	“Trockenpräparate II Polygastrica”	Mikrogeologische Sammlung “Polygastrern I”
Order	alphabetic by genera (classification by Ehrenberg; after 1838 and before 1854)	geography (in German, according to the mid 19th century)
Units of the collection in descending order	wooden frame (“Schieberchen”) with 6 sandwiched mica slides, sometimes coloured circles	case “Kasten”, folder “Buch”, mica strip with 5 open-face mica slides, coloured circles correspond to written specimen name below
Numbering by Ehrenberg	Roman numbers for the “Schieberchen” plus Arabic numbers (1-6) for each mica slide	Roman numbers for each “Kasten”, Arabic numbers for each “Buch”; handwritten captions for each sample and consecutive numbering for the corresponding mica strips. Individual mica numbered in small Greek letters $\alpha$ , $\beta$ , $\gamma$ , $\delta$ , $\epsilon$
New numbering	Arabic 6-digits: 2 for “Kasten” No. 54, 4 for the “Schieberchen”	Arabic 6-digits: 2 each for case, folder, and mica strip
Numbering in this publication	6-digit-number for the “Kasten” and “Schieberchen”; “dash”; one digit (1-6) for the individual mica slide	6-digit-number plus a small letter (-a, -b, -c, -d, -e) for the individual mica slide; the letter of the coloured circle follows after a blank space (blue = bl; white = w; red = r; green = gr; orange = o; violet = v; yellow = g)
Marked specimens	scarcely marked but organized by taxon according to the taxonomic index	coloured rings by Ehrenberg correspond to the label of names of organisms beneath mica strip
Labels	no labels but corresponds to the taxonomic index	handwritten label of names beneath each mica strip and mica slide

The following sources were used for cross-checking: Silva (1997-) for algal names, Farr & al. (1979), Greuter & al. (1993, 1997), Round & al. (1990) and Fourtanier & Kociolek (1999, 2001) for genus information, and VanLandingham (1967, 1968, 1969, 1971, 1975, 1978a, 1978b, 1979) for the reconstruction of historical synonymy.

### List of taxa

***Amphora*** Ehrenb. ex Kütz., Kieselchal. Bacill.: 107. 1844.

– *Amphora* Ehrenb., Infusionsthierchen: 189. 1838, nom. inval. (Greuter & al. 2000a: Art. 34.1). Type: *Amphora ovalis* (Kütz.) Kütz., Kieselchal. Bacill.: 107. 1844 (*Frustulia ovalis* Kütz. in *Linnaea* 8: 539, t. 13, fig. 5. 1833) = *Navicula amphora* Ehrenb. in *Abh. Königl. Akad. Wiss. Berlin* 1831: 80. 1832.

***Amphora lineolata*** (Ehrenb.) Kütz., Kieselchal. Bacill.: 107. 1844 = *Navicula? lineolata* Ehrenb., Infusionsthierchen: 188-189, t. 14, fig. 4 (part 1). 1838.

Lectotype (designated here): [icon] Part “IV 27” of drawing sheet No. 114 in BHUPM (Fig. 1).

Lectotype locality: “Bei Berlin” [Berlin, Germany].

Comments: 1. Ehrenberg (1838: 189) gave 94-188 µm as the length of the valve, but according to the handwriting on the drawing sheet the type specimen was 226 µm long.

2. Ehrenberg (1838: 188-189, t. 14, fig. 4, part 2) mentioned another taxon, illustrated on drawing sheet No. 114 sub “IV 28 rimosa”, and published the provisional name *Navicula rimosa* Ehrenb., Infusionsthierchen: 188-189, t. 14, fig. 4 (part 2). 1838. This name was not formally introduced by Ehrenberg (1838: 188): “Man könnte die letztere *N. rimosa* nennen”, hence it is invalid (Greuter & al. 2000a: Art. 34.1).

3. It is clear from the protologue that Ehrenberg (1838: 188) studied valves, but no living cells. Since this taxon and other related species are known from brackish habitats and saline inland waters (Krammer & Lange-Bertalot 1986: 347), which can not be found in Berlin, it is here concluded that Ehrenberg had studied probably valves from (brackish or marine sediments) diatomaceous earth, so called “Kieselgur”.

4. The name *Amphora lineolata* is still in use but the current taxon concept differs from Ehrenberg’s drawing, designated here as lectotype (for comparison see Krammer & Lange-Bertalot 1986: t. 150, fig. 23-24). The historical synonymy, given by VanLandingham (1967: 233-234) is therefore questionable.

***Brebissonia*** Grunow in *Verh. K.K. Zool.-Bot. Ges. Wien* 10: 512. 1860, nom. cons.

Type: *Brebissonia boeckii* (Ehrenb.) O’Meara (*Cocconema boeckii* Ehrenb.) = *Brebissonia lanceolata* (C. Agardh) R. K. Mahoney & Reimer (*Gomphonema lanceolatum* C. Agardh).

***Brebissonia lanceolata*** (C. Agardh) R. K. Mahoney & Reimer in Ricard, *Proceedings Eighth International Diatom Symposium*: 184. 1986 = *Gomphonema lanceolatum* C. Agardh, *Consp. Crit. Diat.*: 34. 1831.

= *Brebissonia boeckii* (Ehrenb.) O’Meara in *Proc. Roy. Irish Acad.*, ser. 2, 2 (Sci.): 338. 1875 = *Cocconema boeckii* Ehrenb. in *Abh. Königl. Akad. Wiss. Berlin* 1833: 241. 1834.

Lectotype (designated here): Preparation No. 540044-1 in BHUPM (Fig. 5). The lectotype specimen corresponds to specimens on drawing sheet No. 308 in BHUPM (Fig. 2-3) which are from Wismar material. Fig. 4 is a complete cell from original material No. 540044-2 in BHUPM.

Lectotype locality: “Im August 1833 bei Wismar” [Baltic Sea, Germany].

Paralectotype locality: “Im August 1833 bei ... Kopenhagen auf *Monopyxis geniculata* im Seewasser. ... Handzeichnungen Dr. Boeck, ... Norwegen” [Copenhagen, Denmark; Norway].

Comment: In proposing the foregoing synonymy, Mahoney & Reimer (1986) compared Agardh’s original material with literature studies but did not consult Ehrenberg’s original material. In our study the conspecificity is confirmed on the basis of Ehrenberg’s lectotype specimen.

**Cocconeis** Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1835: 173. 1836.

Lectotype (designated by Boyer 1927: 242): *Cocconeis scutellum* Ehrenb., Infusionsthierchen: 194, t. 14, fig. 8. 1838 (Typification of *C. scutellum* by Huck & Jahn, in prep.)

**Cocconeis limbata** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 206. 1840.

Lectotype (designated here): Single specimen in red ring on preparation No. 540043-5 in BHUPM (Fig. 6).

Lectotype locality: “Ex aquis ad Salisburgum” [Salzburg, Austria].

Comment: This specimen was depicted on drawing sheet No. 2177 (see Fig. 7).

**Cymbella** C. Agardh, Consp. Diatom.: 1. 1830, nom. cons.

Type: *Cymbella cymbiformis* C. Agardh, Consp. Diatom.: 10. 1830, typ. cons.

**Cymbella mexicana** (Ehrenb.) Cleve in Kongl. Svenska Vetenskapsakad. Handl., ser. 4, 26(2): 177. 1894 ≡ *Cocconema mexicanum* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1844: 342. 1844.

Lectotype (designated here): Specimen on preparation No. 200701-a red in BHUPM (Fig. 11-12).

Lectotype locality: “Mexico”.

Comment: The selected specimen fits the original drawing on drawing sheet No. 312 in BHUPM (Fig. 10). Krammer (2002) cited later published illustrations (Ehrenberg 1854) as “iconotypes”; this is not a formal typification (Greuter & al. 2000a: Art. 7.11 & 9.21; Greuter & al. 2000b: 75-76) but can be misunderstood as such. The length of the valve is given as 1/18''' (= 125.3 µm), the valves in the original material differ very much in shape amongst each other (n = 6): 104.4-184.8 × 28.2-37.2 µm, length-width-ratio 3.7-4.9:1.

**Diatoma** Bory, Dict. Class. Hist. Nat. 5: 461. 1824, nom. cons.

Type: *Diatoma vulgaris* Bory, Dict. Class. Hist. Nat. 5: 461. 1824, typ. cons.

**Diatoma pectinalis** (Nitzsch) Kütz., Kieselschal. Bacill.: 47. 1844 ≡ *Bacillaria pectinalis* Nitzsch, Neue Schriften Naturf. Ges. Halle 3: 107, t. 6: fig. 7-10. 1817.

= *Bacillaria seriata* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1833: 232. 1834.

Lectotype (designated here): [icon] specimen on Ehrenberg’s drawing sheet No. 167 in BHUPM, (Fig. 13), original for the publication in Ehrenberg 1838: t. 15, fig. 8.

Lectotype locality: “Am 20. Juni 1832 bei Berlin zwischen Conferven des Thiergartens beobachtet” [Berlin, Germany].

Comments: 1. According to Kützing (1844: 47) *B. seriata* is a taxonomic synonym of *Diatoma pectinalis* (Nitzsch) Kütz.

2. Preparations in BHUPM are not available and the specimens on the drawing are in girdle view and do not permit a clear identification.

**Didymosphenia** M. Schmidt in A. W. F. Schmidt, Atlas Diatom.-Kunde: t. 214, fig. 1-12. 1899, nom. cons.

Type: *Didymosphenia geminata* (Lyngb.) M. Schmidt in A. W. F. Schmidt, Atlas Diatom.-Kunde: t. 214, fig. 1-12. 1899 (*Echinella geminata* Lyngb., Tent. Hydrophytol. Dan.: 210, t. 70, D. 1819, typ. cons.).

= *Diomphala* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1842: 336. 1843, nom. rej. (vs. *Didymosphenia* M. Schmidt).

Type (by monotypy): *Diomphala clava-herculus* Ehrenb.

**Didymosphenia clava-herculus** (Ehrenb.) Metzeltin & Lange-Bert. in Nova Hedwigia 60: 388. 1995 ≡ *Diomphala clava-herculus* [“*clava herculus*”] Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1842: 336, 338. 1843.

Lectotype (designated here): Geographical preparations No. 350704-b blue (Fig. 15-16). The

lectotype specimen corresponds to the specimen on drawing sheet No. 2221 in BHUPM (Fig. 14).

Lectotype locality: “Nördliches Irland, Mourne-Gebirge in Down, offenbar Süßwasserbildungen, Erdart A” [probably freshwater deposit, Ireland].

Comment: We follow Metzeltin & Lange-Bertalot (1995) in treating *Diomphala clava-herculus* as a clearly defined species not conspecific with *Echinella geminata*, the type of *Didymosphenia* (Fig. 17). Both taxa have been considered conspecific as well as congeneric for a long time (see VanLandingham 1969).

***Diploneis*** Ehrenb. ex Cleve in Kongl. Svenska Vetenskapsakad. Handl., ser. 2, 26(2): 76. 1894. Lectotype (designated by Boyer 1927: 345): *Diploneis didyma* (Ehrenb.) Cleve in Kongl. Svenska Vetenskapsakad. Handl., ser. 2, 26(2): 90. 1894 (*Pinnularia didyma* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1844: 85. 1844).

***Diploneis atmosphaerica*** (Ehrenb.) R. Jahn & Kusber, **comb. nova**  
 ≡ *Cocconeis atmosphaerica* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1847: 287, 455, t. 5 (part 2), fig. 45. 1849.

Lectotype (designated here): Specimen on preparation No. 460412-b white in BHUPM (Fig. 9).

Lectotype locality: “Scirocco-Staub von Lyon, 17. October 1846” [France].

Comments: 1. This specimen was depicted on drawing sheet No. 2177 (Fig. 8), labelled as “*Cocconeis*” on the drawing, but as “*Cocconeis lineata*” on the mica strip.

2. A similar taxon is *Diploneis ovalis* (Hilse) Cleve (Krammer & Lange-Bertalot 1986: t. 108, fig. 15). Because no original material of later described *Diploneis* taxa was consulted in this study, it can not be clarified here whether or not this new combination will replace any name in current use.

***Eunotia*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1837: 44. 1837. Lectotype (designated by Boyer 1927: 215): *Eunotia arcus* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1837: 45. 1837.

*Eunotia* sp.

= *Achnanthes? inaequalis* Ehrenb., Infusionsthierchen: 229. 1838.

Lectotype (designated here): Specimen on preparation No. 540001-3 (from Degernfors) marked with a red ring in BHUPM (Fig. 19). The lectotype specimen corresponds to the specimen on drawing sheet No. 2250 in BHUPM (Fig. 18).

Lectotype locality: “fossil im Bergmehl von Degernfors” [Sweden].

Paralectotype locality: “fossil im Bergmehl von Kymmene Gård” [Finland].

Comment: Ehrenberg (1838: 229) comments that this taxon is similar to *Eunotia faba* except for being bent in the middle part. Our observation on these specimens, drawing sheet No. 5 as well as Taxonomic preparations No. 540001-3, show that they are teratological forms of an *Eunotia* species.

***Gomphonema*** Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1831: 87. 1832, nom. cons.  
 Type: *Gomphonema acuminatum* Ehrenb., typ. cons.

***Gomphonema acuminatum*** Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1831: 88. 1832. Lectotype (designated here): [icon] specimen “b”, cell on drawing sheet No. 678 in BHUPM (Fig. 20), published by Ehrenberg (1838: t. 18, fig. 4 (part 3)).  
 Lectotype locality: “Berlin” [Germany].

Comment: The drawing published by Ehrenberg (1838: t. 18, fig. 4 (part 1)) is annotated as follows: “Berlin 11 Juli 1834, Januar 1835 Thiergarten”. The specimens from Taxonomic preparations No. 540100-1, here illustrated as Fig. 21, correspond to this illustration and fit to the description of *G. acuminatum*. It is possible, that this preparation was in Ehrenberg’s hand when describing the taxon and that the dates mentioned refer to later records.

= *Exilaria panduriformis* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1831: 86. 1832 = *Meridion? panduriforme* (Ehrenb.) Ehrenb., Infusionsthierchen: 208. 1838.

Lectotype (designated here): [icon] glued paper on the left hand side of drawing sheet No. 766 in BHUPM (Fig. 22).

Lectotype locality: “Sibirien”, “Catharinenburg” according to Ehrenberg (1830).

Comment: *Exilaria panduriforme* is a taxonomic synonym of *Gomphonema acuminatum* Ehrenb. Both taxa were validly described at the same time, but only *G. acuminatum* became accepted. Later, Ehrenberg exclusively used *G. acuminatum* and had doubts about the taxonomic value of *Exilaria panduriforme*; his comment in Ehrenberg (1838: 208) reads: “Die Form der Stäbchen erinnert an *Gomphonema acuminatum*”.

***Gomphonema augur*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 211. 1840.

Lectotype (designated here): Specimen on preparation No. 330803-e white in BHUPM (Fig. 25). Further original material on preparation No. 330802-a white in BHUPM.

Lectotype locality: “fossile ad Ceypam Galliae (Puy de Dome)” [France].

Paralectotype locality: “inter Confervas mexicanas vivum” [Mexico].

Comments: 1. Ehrenberg first published *G. augur* as a nomen nudum (Ehrenberg 1838, 1839). From the latter publication it is clear that he first saw Mexican material, but the validating publication (Ehrenberg 1840) includes also material from Puy de Dome (France). We studied the material of both provenances. Since the Mexican specimens (depicted on drawing sheet No. 681 sub “Mexicana” in BHUPM) belong to a different taxon than the Puy de Dome specimens (see also Ehrenberg 1843: 315), we selected that specimen from Puy de Dome for lectotypification that fits best the current taxonomic concept.

2. Krammer & Lange-Bertalot (1986) illustrated two cells probably from the same locality as Ehrenberg’s (t. 157, fig. 1, 2 “fossiles Material aus Ceysat, Syntypenhabitat”) as the ‘type’ variety. The lectotype specimen looks similar to the specimen illustrated in Krammer & Lange-Bertalot (1986: t. 157: fig. 1), this habitus was also illustrated by Ehrenberg on his drawing sheet No. 2311 sub “Fossilia Galliae 1/80” (i.e. 28.2 µm), see fig. 23-24.

3. After 1840 this species was found by Ehrenberg also alive in Berlin material (preparation No. 540100-2, see Fig. 26), this specimen was depicted on Ehrenberg’s drawing sheet No. 681 sub “Berolinensia” in BHUPM.

4. The variability of the valve of *Gomphonema augur* was first studied from a Berlin clone culture (Jahn 1986: fig. 7-8, 13-24).

***Gomphonema coronatum*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 211. 1840 = *Gomphonema acuminatum* var. *coronatum* (Ehrenb.) Rabenh., Fl. Eur. Alg. 1: 290. 1864 = *Gomphonema acuminatum* f. *coronatum* (Ehrenb.) Cleve in Kongl. Svenska Vetenskapsakad. Handl., ser. 4, 26 (2): 184. 1894.

Lectotype (designated here): Specimen on preparation No. 290702-b blue (the bigger one of the two blue rings) (Fig. 30). The lectotype specimens correspond to the specimens on drawing sheet No. 688 in BHUPM (Fig. 27-28).

Isolectotype (designated here): Specimen on preparation No. 290702-b blue (the bigger one of the two blue rings) (Fig. 29).

Lectotype locality: “Fossilis in farina silicea prope vicum Santaforam” [Italy].

Comment: In contrast to, e.g., Smith (1853) and VanLandingham (1971), who accepted this taxon as an infraspecific taxon of *G. acuminatum* Ehrenb., and others, who synonymized it with *G. acuminatum* (see Patrick & Reimer 1975), Reichardt (1999: 43) accepts Ehrenberg’s species with respect to outline and LM plus SEM characters of the valve.

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

Lectotype (designated here): [icon] glued paper on the right hand side of drawing sheet No. 684 in BHUPM (Fig. 31).



Lectotype locality: “Sibirien”, “Troizk” according to Ehrenberg (1830: 63) [Russia].

Comment: The identity of this taxon can not be clarified from Ehrenberg’s drawing. Because Ehrenberg did not use this name after 1838, we assess this taxon as a species inquirenda.

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

Lectotype (designated here): [icon] glued coloured paper in the middle part of drawing sheet No. 684 in BHUPM (Fig. 32).

Lectotype locality: “Russland”, “Saratof” according to Ehrenberg (1830: 63) [Russia].

Comment: The identity of this taxon can not be clarified from Ehrenberg’s drawing. The conspecificity with *G. abbreviatum* var. *longipes* Kütz., given in VanLandingham (1971) is not understandable, hence we assess this taxon as a species inquirenda.

*Grammatophora* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1839: 126. 1840.

Lectotype (designated by Boyer 1927: 154): *Grammatophora angulosa* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1839: 153. 1840.

*Grammatophora africana* (Ehrenb.) Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1839: 152. 1840 ≡ *Navicula africana* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1838: 130. 1839.

Lectotype (designated here): Specimen on Taxonomic preparations No. 540100-2 in BHUPM (Fig. 34). The lectotype specimen corresponds to the specimen on drawing sheet No. 702 in BHUPM (Fig. 33).

Lectotype locality: “Kreidemergel, Oran, Afrika” [Algeria].

*Hippodonta* Lange-Bert., Metzeltin & Witkowski in Iconogr. Diatomol. 4: 249. 1996.

Type: *Hippodonta lueneburgensis* (Grunow) Lange-Bert., Metzeltin & Witkowski in Iconogr. Diatomol. 4: 249. 1996 (*Navicula hungarica* var. *lueneburgensis* Grunow in Mojsisovics & Neumayr, Paläont. Österr.-Ung. Orient. 2 (4): 156, t. 30: fig. 43-44. 1882).

*Hippodonta capitata* (Ehrenb.) Lange-Bert., Metzeltin & Witkowski in Iconogr. Diatomol. 4: 254. 1996 ≡ *Navicula capitata* Ehrenb., Infusionsthierchen, 185, t. 13: fig. 20. 1838.

Lectotype (designated here): Taxonomic preparations No. 540129-2 in BHUPM (Fig. 37). The lectotype specimen corresponds to the specimen on drawing sheet No. 844 in BHUPM (Fig. 35), the drawn striae are more similar to the lectotype specimen than the published illustration in Ehrenberg (1838: t. 13, fig. 20, 1st cell) (Fig. 36).

Lectotype locality: “Berlin” [Germany].

*Microtabella* Round in Round & al., Diatoms: 434. 1990.

Type: *Microtabella interrupta* (Ehrenb.) Round in Round & al., Diatoms: 673. 1990 (*Tessella interrupta* Ehrenb.).

*Microtabella interrupta* (Ehrenb.) Round in Round & al., Diatoms: 673. 1990 ≡ *Hyalosira interrupta* (Ehrenb.) J. N. Navarro in Diatom Res. 6: 335. 1991 ≡ *Tessella interrupta* Ehrenb., Infusionsthierchen: 202. 1838.

Lectotype (designated here): Specimen on preparation No. 540186-6 in BHUPM (Fig. 39). The lectotype specimen corresponds to the specimen on drawing sheet No. 1202 in BHUPM (Fig. 38).

Lectotype locality: “Bei Hoffmannsgave auf Fühnen” [Fyn, Baltic Sea, Denmark].

*Odontella* C. Agardh, Consp. diatom.: 56. 1832.

Type (by monotypy): *Odontella aurita* (Lyngb.) C. Agardh, Consp. Diatom.: 56. 1832 (*Diatoma auritum* Lyngb., Tent. Hydrophytol. Dan.: 182, t. 62, D. 1819).

= *Zygoceros* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1839: 156. 1839.

Type: *Zygoceros rhombus* Ehrenb.

*Odontella rhomboides* R. Jahn & Kusber, **nom. nov.**

≡ *Zygoceros rhombus* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1839:

156. 1839 ≡ *Biddulphia rhombus* (Ehrenb.) W. Sm., Brit. Diat.: 49. 1856 [non *Odontella rhom-*

*bus* (Ehrenb.) Kütz., Sp. Alg.: 136. 1849 ≡ *Denticella rhombus* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1843: 79. 1844].

Lectotype (designated here): Specimen in red ring on preparation No. 540043-4 in BHUPM (Fig. 45).

Isolotype (designated here): Specimen on preparation No. 540211-5 in BHUPM (Fig. 44).

Lectotype locality: “Cuxhaven” [North Sea, Germany]. Both specimens are similar to the depicted valvar view on drawing sheet No. 1327 in BHUPM (Fig. 43), for girdle band view (Fig. 42).

Comment: Since *Zygoceros rhombus* is regarded as a species of *Odontella*, the genus name *Zygoceros* has become a heterotypic synonym of *Odontella*. The replacement name is necessary, because of *Odontella rhombus* (Ehrenb.) Kütz. based on *Denticella rhombus* Ehrenb. from Petersburg, Virginia. At the same time, Kützing (1849: 139) accepted the genus *Zygoceros* as well as *Z. rhombus* Ehrenb. Both species, regarded as distinct by Ehrenberg and Kützing, have been considered conspecific as well as congeneric for a long time (see VanLandingham 1978a). A recent study by E. Sar, I. Sunesen, R. Jahn, W.-H. Kusber & A. S. Lavigne (unpubl.) deals with this question in more detail.

***Petrodictyon*** D. G. Mann in Round & al., Diatoms: 638, 674. 1990.

Type: *Petrodictyon gemma* (Ehrenb.) D. G. Mann (*Navicula gemma* Ehrenb.).

***Petrodictyon gemma*** (Ehrenb.) D. G. Mann in Round & al., Diatoms: 674. 1990 ≡ *Navicula gemma* [“*Navicula (Surirella) gemma*”] Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1839: 156. 1840 ≡ *Surirella gemma* (Ehrenb.) Kütz., Kieselchal. Bacill.: 62. 1844.

Lectotype (designated here): Specimen of Taxonomic preparations No. 540032-3 in BHUPM (Fig. 41). The lectotype specimen corresponds to the valve on the left hand side of drawing sheet No. 1147 in BHUPM, except for the bacteria, which Ehrenberg might have interpreted as cilia (Fig. 40).

Lectotype locality: “An der Elbmündung bei Cuxhaven in der Nordsee” [North Sea, Germany].

Comment: *Navicula gemma* Ehrenb. was classified originally within *Surirella*, an unranked infrageneric name within *Navicula*. *Petrodictyon gemma* was based on *Navicula gemma* sub “*Surirella gemma* Ehrenb. 1839. Abh. Akad. Wiss. Berlin 1839: 156”. Although cited wrongly by Mann (in Round & al. 1990), the basionym is indicated by citing the protologue.

***Pinnularia*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1843: 45. 1843, nom. cons.

Type: *Pinnularia viridis* (Nitzsch) Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1841: 315. 1843 (*Bacillaria viridis* Nitzsch in Neue Schriften Naturf. Ges. Halle 3: 97, t. 6: fig. 1-3. 1816), typ. cons.

*Pinnularia* sp.

= *Navicula? constricta* Ehrenb., Infusionsthierchen: 188, t. 21, fig. 17. 1838 ≡ *Surirella constricta* (Ehrenb.) Ehrenb., Mikrogeologie, 19, t. 14: fig. 37. 1854, nom. illeg. (Greuter & al. 2000a: Art. 53.1) [non *Surirella constricta* W. Sm. in Ann. Mag. Nat. Hist. ser. 2, 7: 9. 1851].

Lectotype (designated here): Specimen of Taxonomic preparation No. 540177-1 in BHUPM.

Lectotype locality: “Bei Berlin” [Berlin, Germany].

Comment: From the handwriting on drawing sheet No. 1129, we can confirm that Ehrenberg regarded *Surirella constricta* Ehrenb. as the correct name for *Navicula constricta*, as Silva (1997-) summarized from different literature sources. However, the taxon represents neither a *Navicula* nor a *Surirella* but a *Pinnularia* species, which can not be identified due to girdle view.

***Rhaphoneis*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1844: 74. 1844.

Lectotype (designated by Boyer 1927: 190): *Rhaphoneis amphicerus* (Ehrenb.) Ehrenb. (*Cocconeis amphicerus* Ehrenb.).

***Rhaphoneis amphiceros*** (Ehrenb.) Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1844: 87. 1844 ≡ *Cocconeis amphiceros* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 206. 1840.

Lectotype (designated here): Specimen in blue ring on preparation No. 540043-4 in BHUPM (Fig. 47). The lectotype specimen corresponds to the specimen on drawing sheet No. 1036 in BHUPM (Fig. 46).

Lectotype locality: “Ad ostium Albis maritima” [North Sea, mouth of river Elbe in Cuxhaven, Germany].

Comments: 1. *Rhaphoneis amphiceros* is the type of the generic name *Raphoneis* Ehrenb.; also for *Doryphora* Kütz., nom. illeg. non *Doryphora* Endlicher.

2. The designated lectotype was the original for the drawn specimen from Cuxhaven on drawing sheet 1036 in BHUPM.

***Rhaphoneis rhombus*** (Ehrenb.) Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1844: 87. 1844 ≡ *Cocconeis rhombus* Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 206. 1840.

Lectotype (designated here): Specimen in yellow ring on preparation No. 540043-4 in BHUPM specimen in red ring (Fig. 50).

Lectotype locality: “Ad ostium Albis maritima” [North Sea, mouth of river Elbe in Cuxhaven, Germany].

The lectotype specimen corresponds to the specimens on drawing sheet No. 1039 in BHUPM (Fig. 48-49).

Comment: Ehrenberg differentiated *Rhaphoneis rhombus* from *R. amphiceros*; whether these two species are distinct from one another remains an unanswered question.

***Rhopalodia*** O. Müll. in Bot. Jahrb. Syst. 22: 57. 1895, nom. cons.

Lectotype (designated by Boyer 1927: 491): *Rhopalodia gibba* (Ehrenb.) O. Müll. (*Navicula gibba* Ehrenb.).

***Rhopalodia gibba*** (Ehrenb.) O. Müll. in Bot. Jahrb. Syst. 22: 65. 1895 ≡ *Navicula gibba* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1831: 80. 1832 ≡ *Epithemia gibba* (Ehrenb.) Kütz., Kiesel-schal. Bacill.: 35. 1844 ≡ *Eunotia gibba* (Ehrenb.) Ehrenb., Mikrogeologie: 62. 1954, nom. illeg. (Greuter & al. 2000a: Art. 53.1) [non *Eunotia gibba* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1841: 316. 1843].

Lectotype (designated here): [icon] cell on the upper row on the right hand side on the glued paper (upper row, center) “*Navicula gibba*, Orenburg 1/12-1/10” on drawing sheet No. 560a in BHUPM (see arrow in Fig. 51).

Lectotype locality: “Sibirien”, “bei Orenburg” according to Ehrenberg (1838) [Russia]. “Orenburg 1/12-1/10” (Ehrenberg 1830: 64); “Orenburg am Uralflusse” (Ehrenberg 1830: 68);

Paralectotype localities: “Tobolsk im nordwestlichen Sibirien am Irtytsch und Tobol” (Ehrenberg 1830). “Lebend bei Tobolsk in Asien (Sibirien) ... und Catharinenburg in Russland” according to Ehrenberg (1838) [Russia].

Comment: 1. Ehrenberg (1843: t. 3 (part 1) fig. 39 illustrated *Eunotia gibba*. Although *Eunotia gibba* is treated as newly described, from the picture it is clear, that Ehrenberg studied *Rhopalodia gibba*.

2. There are two specimens depicted on the paper sheet “*Navicula gibba*, Orenburg 1/12-1/10”, showing a striation, differing from that of the selected specimen. These differences are misinterpretations by Ehrenberg because of the form of the chloroplast (see Cox 1996: 103, t. 32: fig. f).

= *Eunotia gibba* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1841: 316, t. 3 (part 1) fig. 39. 1843.

= *Navicula uncinata* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1831: 80. 1832.

Lectotype (designated here): [icon] glued paper, median on the right hand side (“Orenburg 1/20”) on drawing sheet No. 560a in BHUPM (Fig. 52).

Lectotype locality: “Sibirien”, “Orenburg” according to Ehrenberg (1830).

Comment: Ehrenberg (1838: 184) synonymized *N. uncinata* with *N. gibba* as being a single valve of *N. gibba*, this interpretation is here confirmed.

***Tabellaria*** Kütz., Kieselschal. Bacill.: 127. 1844.

Lectotype (designated by Boyer 1927: 151): *Tabellaria fenestrata* (Lyngb.) Kütz., Kieselschal. Bacill.: 127. 1844 (*Diatoma fenestratum* Lyngb., Tent. Hydrophytol. Dan. 180, t. 61, E-3. 1819).

***Tabellaria flocculosa*** (A. W. Roth) Kütz., Kieselschal. Bacill.: 127. 1844.

= *Bacillaria tabellaris* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin 1833: 232. 1834.

Lectotype (designated here): [icon] fig. 32 on drawing sheet No. 1190 in BHUPM (Fig. 53), published in Ehrenberg (1838, t. 15, fig. 7, part 1).

Lectotype locality: “Am 16. April 1832 zwischen Conferven im Thiergarten bei Berlin beobachtet” [Berlin, Germany].

Comment: Already Ehrenberg (unpubl., handwriting on drawing sheet 1190) synonymized *Bacillaria tabellaris* with *Tabellaria flocculosa*.

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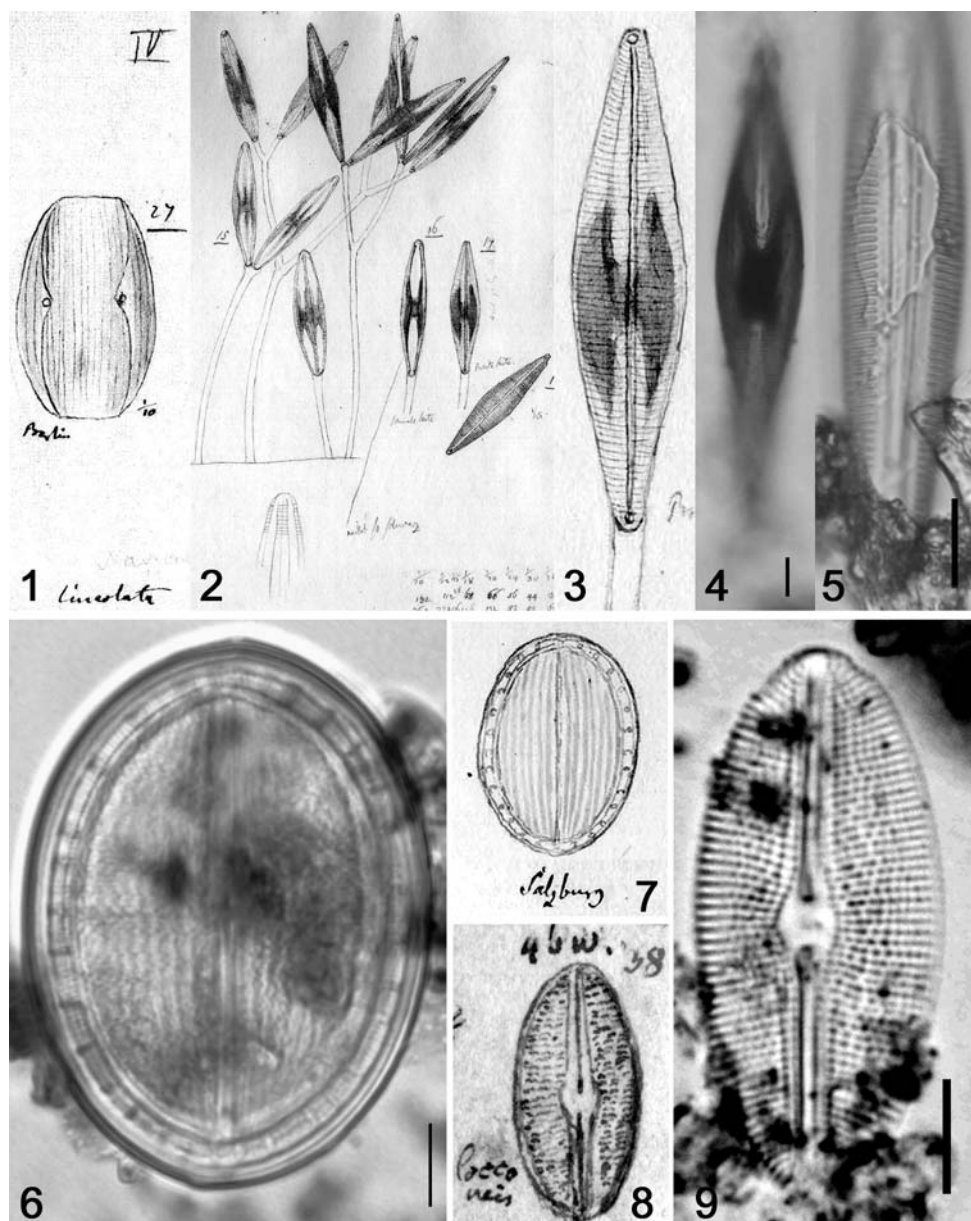


Fig. 1. *Amphora lineolata* (as *Navicula? lineolata*), part of drawing sheet No. 114 in BHUPM, lectotype. – 2-5: *Brebissonia lanceolata* (sub *Cocconeis boeckii*); 2-3: part of drawing sheet No. 308 in BHUPM; 3 is a cut-out of valve "17", showing chloroplasts; 4: cell from preparation No. 540044-2 in BHUPM, the valve ends are out of focus because the valve is convex; 5: valvar view, specimen on preparation 540044-1 in BHUPM, lectotype. – 6-7: *Cocconeis limbata*; 6: preparation No. 540043-5 in BHUPM, lectotype; 7: part of drawing sheet No. 2177 in BHUPM. – 8-9: *Diploneis atmosphaerica* (as *Cocconeis atmosphaerica*); 8: part of drawing sheet No. 2177 in BHUPM; 9: specimen on preparation No. 460412-b white in BHUPM, lectotype. – Scale bars = 10 µm.

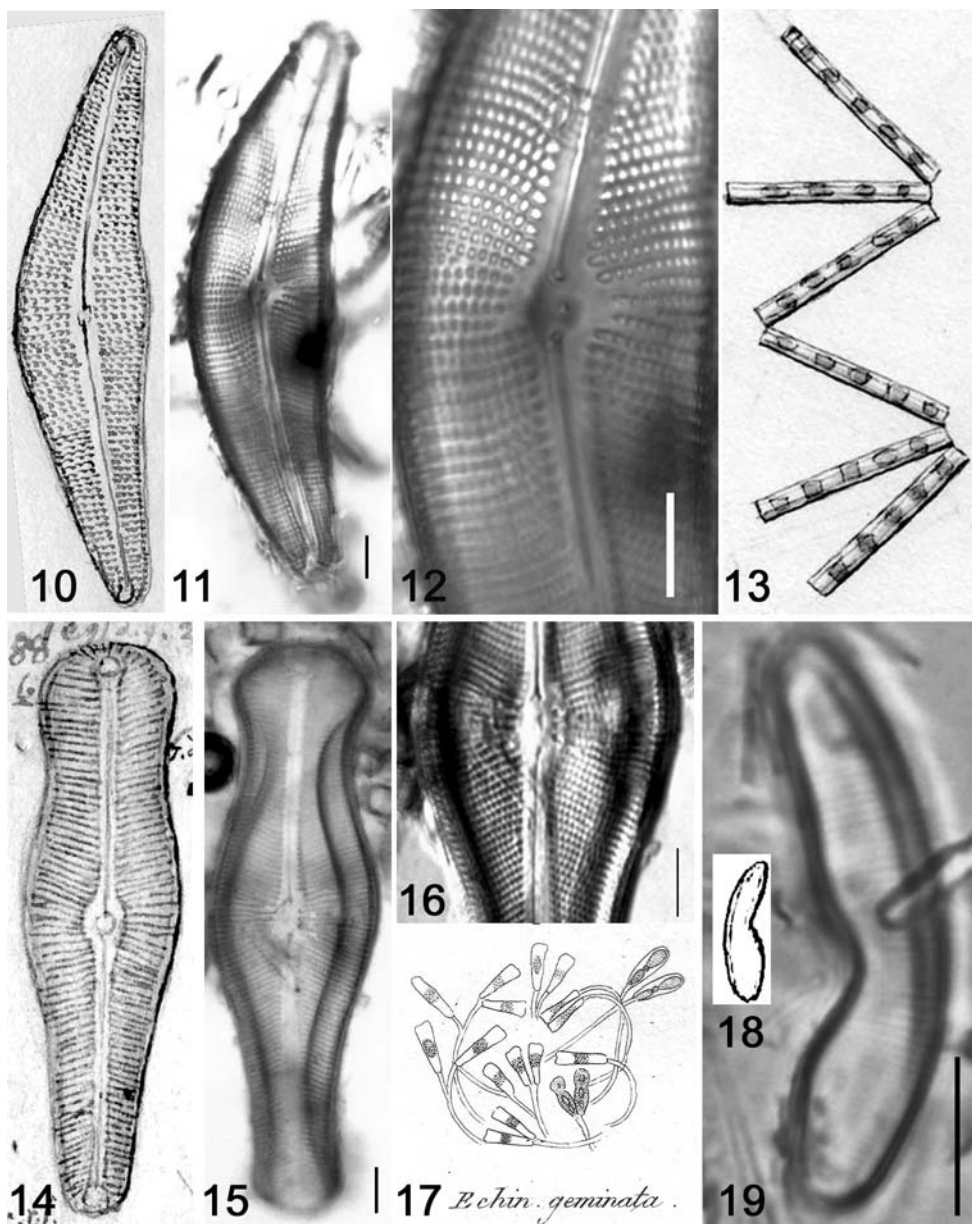


Fig. 10-12: *Cymbella mexicana* (as *Cocconema mexicanum*); Fig. 10: part of drawing sheet No. 312 in BHUPM. – 11-12: specimen on preparation No. 200701-a red in BHUPM at different magnifications, lectotype. – 13: *Diatoma pectinalis* (sub *Bacillaria seriata*), part of drawing sheet No. 167 in BHUPM, lectotype of *B. seriata*. – 14-16: *Didymosphenia clava-herculis* (as *Diomphala clava herculis*); 14: part of drawing sheet No. 2221 in BHUPM; 15-16: specimen on preparation No. 350704-b blue in BHUPM at different magnifications, lectotype. – 17: *Didymosphenia geminata* (as *Echinella geminata*) reproduced from Lyngbye (1819: t. 70, D). – 18-19: *Eunotia* sp. (as *Achnanthes? inaequalis*); 18: specimen on preparation No. 540001-3 in BHUPM, lectotype of *Achnanthes? inaequalis*; 19: part of drawing sheet No. 2250 in BHUPM. – Scale bars = 10  $\mu$ m.



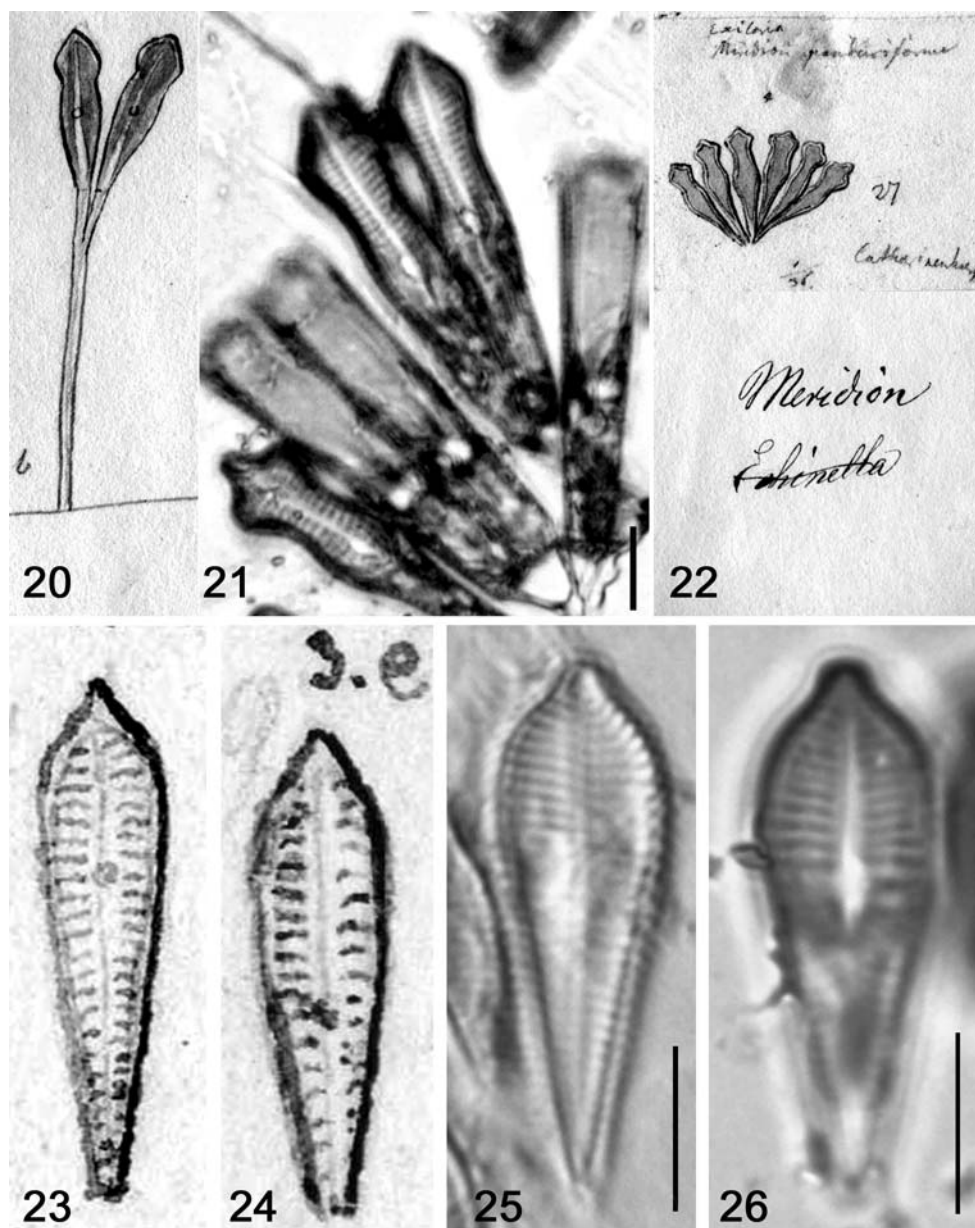


Fig. 20-21: *Gomphonema acuminatum*; Fig. 20: specimen "b" on drawing sheet No. 678 in BHUPM, lectotype; 21: specimens on preparation No. 540100-1, showing the morphological variability of the valve outline. – 22: *G. acuminatum* (sub *Exilaria panduriforme*), part of drawing sheet No. 766 in BHUPM, lectotype of *E. panduriforme*. – 23-26: *Gomphonema augur*; 23-24: part of drawing sheet No. 2311 in BHUPM; 24: is showing the lectotype specimen; 25: specimen on preparation No. 330803-e white in BHUPM, lectotype; 26: specimen from Berlin on preparation No. 540100-2 in BHUPM. – Scale bars = 10 µm.

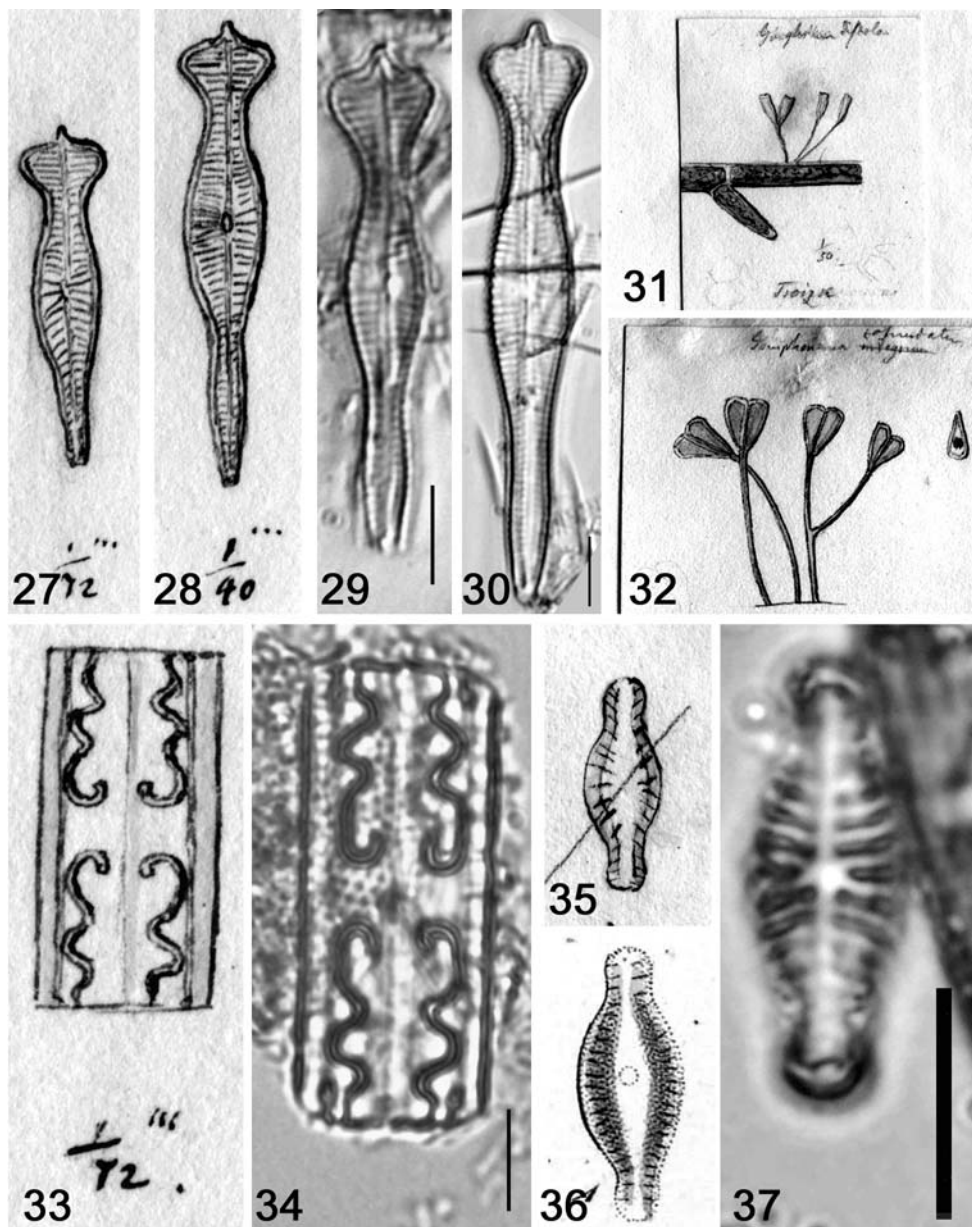


Fig. 27-30: *Gomphonema coronatum*; 27-28: parts of drawing sheet No. 688 in BHUPM; 29: specimen on preparation No. 290702-b blue, isolectotype; 30: specimen on preparation No. 290702-b blue, lectotype. – 31: *Gomphonema discolor*, part of drawing sheet No. 684 in BHUPM, lectotype. – 32: *Gomphonema rotundatum*, part of drawing sheet No. 684 in BHUPM, lectotype. – 33-34: *Grammatophora africana* (as *Navicula africana*); Fig. 33: part of drawing sheet No. 702 in BHUPM; 34: specimen on preparation No. 540100-2 in BHUPM, lectotype. – 35-37: *Hippodonta capitata* (as *Navicula capitata*); 35: part of drawing sheet No. 844 in BHUPM; 36: reproduction of the first depicted cell of Ehrenberg (1838: t. 13, fig. 20); 37: specimen on preparation No. 540129-2 in BHUPM, lectotype. – Scale bars = 10  $\mu$ m.

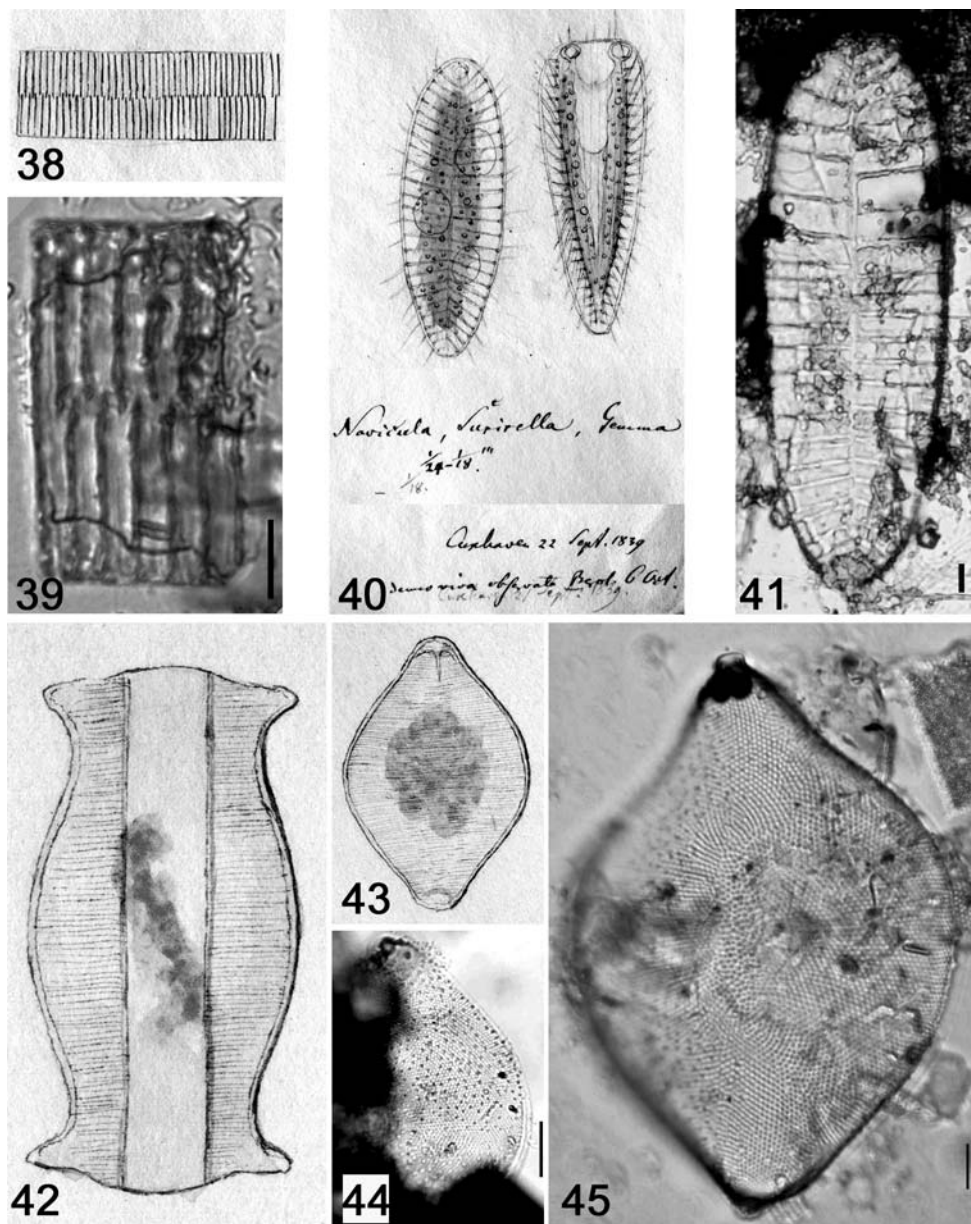


Fig. 38-39: *Microtabella interrupta* (as *Tessella interrupta*); 38: part of drawing sheet No. 1202 in BHUPM; Fig. 39: specimen on preparation No. 540186-6 in BHUPM, lectotype. – 40-41: *Petrodictyon gemma* (as *Navicula gemma*); 40: part of drawing sheet No. 1147 in BHUPM; 41: specimen on preparation No. 540032-3 in BHUPM, lectotype. – 42-45: *Odontella rhomboides* (as *Zygoceros rhombus*); 42-43: parts of drawing sheet No. 1327 in BHUPM; 42: girdle view of a living cell; 43: valvar view of a living cell; 44: specimen on preparation No. 540211-5 in BHUPM, isolectotype; 45: specimen on preparation No. 540043-4 in BHUPM, lectotype. – Scale bars = 10  $\mu$ m.

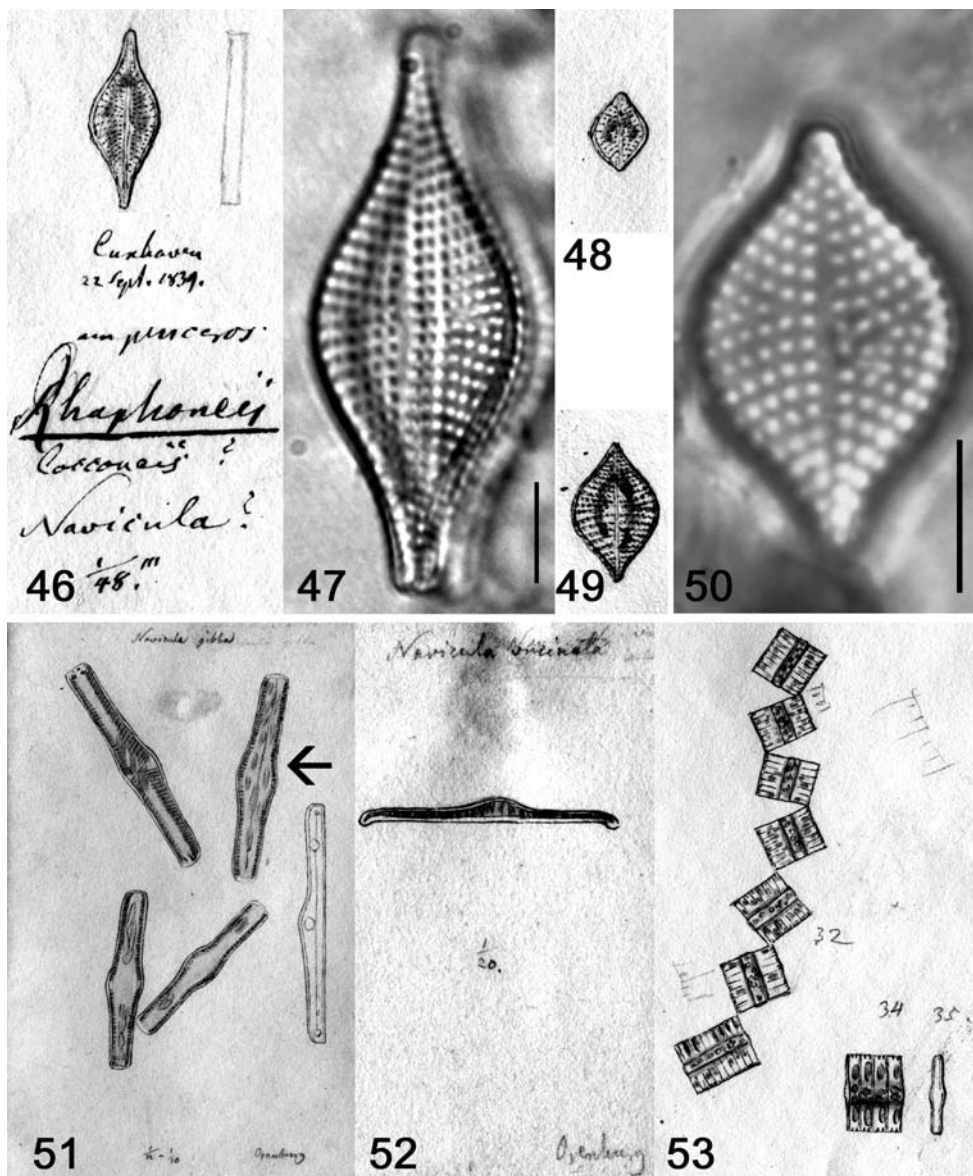


Fig. 46-47: *Rhaphoneis ampiceros*; 46: part of drawing sheet No. 1036 in BHUPM; 47: specimen on preparation No. 540043-4 in BHUPM, lectotype. – 48-50: *Rhaphoneis rhombus* (as *Cocconeis rhombus*); 48-49: parts of drawing sheets No. 1039 in BHUPM; 50: specimen on preparation No. 540043-4 in BHUPM, lectotype. – 51: *Rhopalodia gibba* (as *Navicula gibba*), part of drawing sheet No. 560a in BHUPM, arrow indicates the lectotype. – 52: *Rhopalodia gibba* (sub *Navicula uncinata*), part of drawing sheet No. 560a in BHUPM, lectotype of *N. uncinata*. – 53: *Tabellaria flocculosa* (sub *Bacillaria tabellaris*), part of drawing sheet No. 1190 in BHUPM, lectotype of *B. tabellaris*. – Scale bars = 10  $\mu$ m.