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An introduction to the catalogue of Albert Grunow's 19th century diatom collection at W including a palaeographic aid

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Abstract

The diatom collection of Albert Grunow (1826–1914) is rich in taxonomic types and important, not only for Grunow's own material (slides, samples) and species, but because it also contains a great deal of historical material collected by early phycologists (e. g. de Brébisson, Kützing, William Smith). The collection is housed at the Department of Botany of the Natural History Museum in Vienna (herbarium W). Grunow's collection is accompanied by a catalogue listing all samples Grunow studied and is organised by ascending sample numbers. The information contained in the catalogue includes species lists, collection localities, the origin of the material (such as marine or fossil), collectors and their collection numbers, cross-references to exsiccata containing the same material, preparation types, or the coordinates of particular valves on his slides, and is therefore important to access for current taxonomists. However, one hurdle is deciphering Grunow's handwriting in German cursive script ('Kurrent').

Hence, the goals of this paper are twofold: 1) to provide insights into Grunow's curation methods and available materials, as laid out in eleven pages of instructions (in German) written by Grunow about the collection and the catalogue and 2) to function as a palaeographic aid, which is provided as an electronic supplement, in order to facilitate reading the instructions and catalogue. The latter is done by pairing Grunow's instructions with their transcription and by providing handwriting samples for each letter of the alphabet. The first is achieved by giving an English translation of the instructions and some comments on the materials and methods he used. We also include two tables listing historical measurement units and their conversions to the metric system, as well as abbreviations used by selected authors.

Key words: Bacillariophyta, cryptogams, curation, historical collections, microalgae, orthography.

Zusammenfassung

Die Diatomeensammlung von Albert Grunow (1826–1914) ist reich an Typusbelegen und auch deshalb wichtig, weil sie nicht nur seine eigenen Proben (Objektträger, Aufsammlungen) und von ihm beschriebene Arten enthält, sondern auch viel historisches Material umfasst das von frühen Phykologen (zum Beispiel de Brébisson, Kützing, William Smith) gesammelt wurde. Die Sammlung ist in der botanischen Abteilung des Naturhistorischen Museums Wien (Herbarium W) untergebracht. Grunows Sammlung beinhaltet auch einen Katalog der alle Aufsammlungen mit denen Grunow gearbeitet hat auflistet und nach aufsteigenden Nummern organisiert ist. Die Erschließung der im Katalog enthaltenen Information ist für heutige Taxonomen daher wichtig, weil sie Artenlisten, Fundorte, Ursprung des Materials, wie marin oder fossil, Sammler und deren Sammelnummern, Querverweise zu exsiccata die dasselbe Material enthalten, Präparationsart,

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oder Koordinaten einzelner Diatomeen auf den Objektträgern enthält. Allerdings stellt das Entziffern von Grunows Handschrift in Kurrent hier eine Hürde dar.

Das Ziel dieser Publikation ist daher ein zweifaches: 1) Einblicke in Grunows Verfahren und verfügbare Präparate zu geben, basierend auf seinen elfseitigen Anweisungen (in Deutsch) zur Sammlung und dem Katalog und 2) die Erstellung einer palaeographischen Hilfe, als elektronischen Anhang, die das Lesen der Anleitung und des Kataloges erleichtern soll. Letzteres durch die Gegenüberstellung von Grunows Anleitung und deren Transkription und dem Bereitstellen von Schriftbeispielen für jeden Buchstaben des Alphabets. Ersteres durch eine englische Übersetzung der Anleitung mit einigen Kommentaren zu den Materialien und Methoden Grunows. Zusätzlich führen wir in zwei Tabellen historische Längenmaße und deren Umwandlung ins metrische System sowie die von ausgewählten Autoren verwendeten Abkürzungen auf.

Introduction

Albert Grunow (1826–1914) was a renowned phycologist, who specialised in diatoms. His extensive collection, including a great deal of type material, is archived at The Department of Botany (herbarium W, institutional acronyms follow Index Herbariorum, http://sweetgum.nybg.org/science/ih/; see THIERS 2022) at the Natural History Museum Vienna (NHMW). Grunow's diatom collection comprises several sub-collections including thousands of drawings made by him, his slide collection documenting many types, as well as exsiccata by others, such as CLEVE & MÖLLER's 'Diatoms' (1877–1882), DELOGNE's 'Diatomées de Belgique' (1880–1881), EULENSTEIN's 'Diatomacearum Species Typicae' (1867–1869), MÖLLER's 'Probe- und andere Platten' (1868), and MÖLLER's 'Preisverzeichnis mikroskopischer Präparate' (1868) (see SCHUSTER et al. 2022 for more details). Grunow documented the samples he worked with in a handwritten catalogue (also termed accession books); i. e. an itemised list of the original material forming the basis for his taxonomic work.

The availability of catalogues usually facilitates interpretation of an historical collection by increasing its accessibility; it helps to get one's arms around a researcher's body of work based on the specimens they studied and any additional information given. These documents show which material from which localities the researcher had access to, including information relevant for pinpointing type material, sometimes cross linking these samples with other collections and collectors (via the respective numbering systems and localities), and generally give a framework and reference points for a collection. Due to the lack of knowledge about their underlying organisation and other information, historical collections lacking such a catalogue are challenging to work with.

Grunow was diligent in maintaining his catalogue, which benefits subsequent researchers, who need to interpret his work, in particular for assessing original slides, material, and other taxonomic issues. Grunow's catalogue includes five accession books listing his samples 1–3,278 in ruled or blank composition notebooks of varying dimensions (Table 1). The samples are listed on altogether 737 bound pages plus additional glued in or loosely inserted notes, the latter especially in the last book. The first entry in book I is from the 1st of September 1856. It is unclear when entry 3,278 was made, but Grunow continued to work on diatoms even after donating his collection to the NHMW in 1899 (ANONYMOUS 1899), as book IV contains his instructions on how to deal with the collection, but there is a book V. The instructions were possibly addressed to Karl von Keissler (1872–1965), who curated Grunow's diatom collection when it was given to the museum (STEINDACHNER 1901, 1902, SCHUSTER et al. 2022), but as there is no salutation given in the instructions, we cannot be sure.

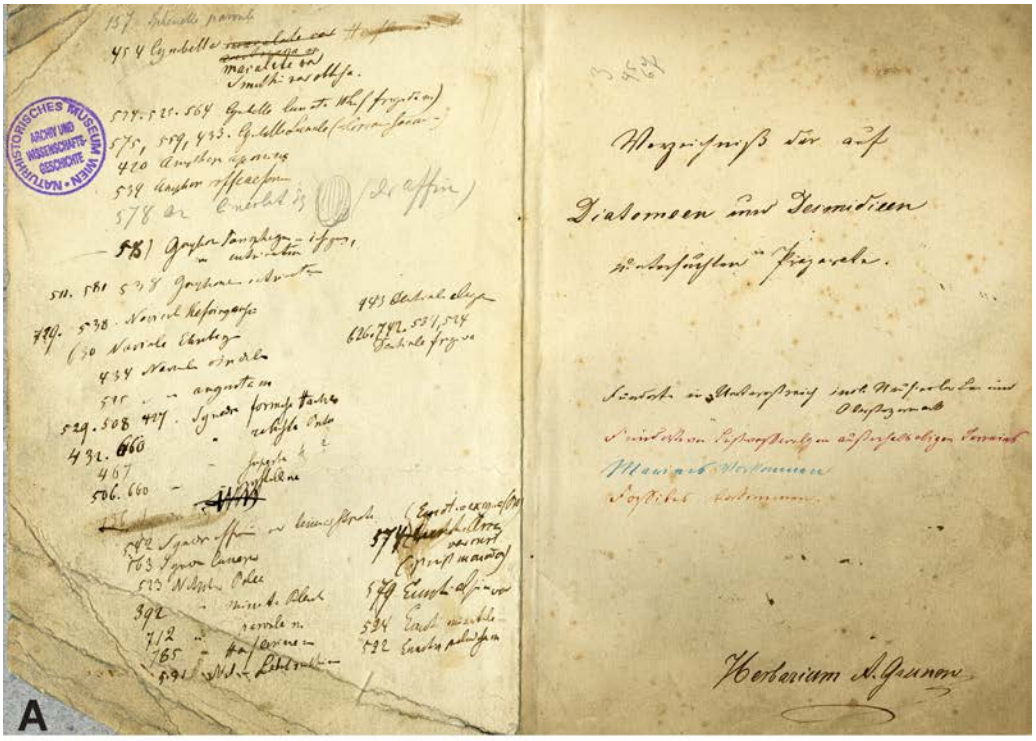
Table 1: Sample numbers included in Grunow's five accession books.

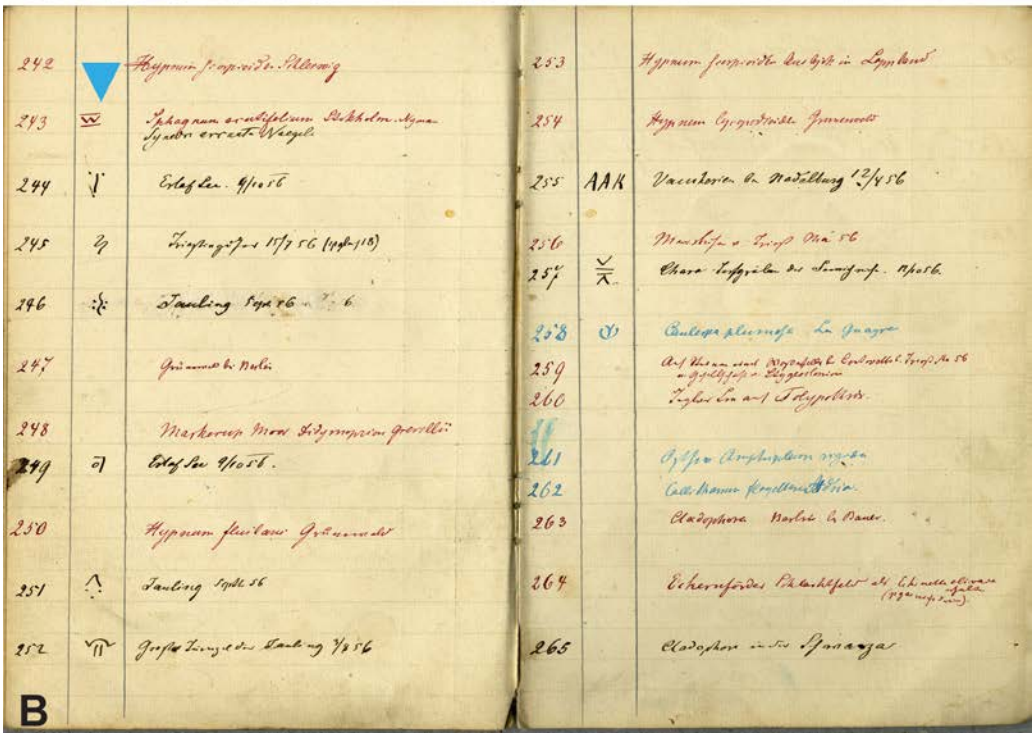
Book	Samples	Book dimensions	Pages (bound, excluding blank pages and glued in or loose notes)
I	1 – 1235	222 × 177 mm	244
II	1236 – 2056	248 × 177 mm	168
III	2057 – 2521	248 × 192 mm	80
IV	2522 – 3135	195 × 125 mm	199
V	3136 – 3278	195 × 125 mm	46

There is also one additional notebook (49 pages) listing localities and/or the host organisms of diatom epiphytes (phorophytes) for the first 386 samples (Figs 1A & 1B). As the stamp reading 'Naturhistorisches Museum Wien: Archiv und Wissenschaftsgeschichte' shows (Fig. 1A), these records belong to the NHMW Department Archive and History of Science and are generously on permanent loan to the Department of Botany.

The catalogue (and in consequence Grunow's unmounted material, of which a fair amount still exists at W) is organised according to a consecutive numbering system assigning a number to each sample in turn. Usually this is formatted as a block of species listed under a brief header prefixed by the sample number (Fig. 2). For the first few hundred samples Grunow also maintained a table organised by sample number where he assigned symbols corresponding to collection localities, phorophyte, and sometimes collection date (Fig. 1B). He discontinued usage of symbols after sample 258, and the table altogether with sample 386. As the title page of the locality table notebook shows (Fig. 1A), Grunow initially indicated the fossil, fresh water, or marine origin of samples with differently coloured ink (Figs 1 & 2), with black referring to localities in "Lower Austria" including Neusiedlersee [now part of the province Burgenland rather than that of Lower Austria] and Upper Styria ["Fundorte in Unteroestreich incl. Neusiedler See und Obersteyermark"]. Purple ink indicated fresh water algae excluding the previously mentioned terrain ["Fundorte von Süßwasseralgen außerhalb obigen Terrains"], blue were marine in origin ["Marines Vorkommen"], and samples shown in brown were from fossil deposits ["Fossiles Vorkommen"]; Grunow discontinued this notation after sample 508 in the catalogue.

In the accession books, each sample number entry is mainly composed of a list of taxa Grunow observed in that particular gathering, usually headed by a brief indication of collection locality. Occasionally, the collector, their collection number and date, at least month and year, are shown too. Corresponding numbers in other exsiccata for the same sample (e. g. exsiccata of Cleve, Cleve and Möller, Kützing, Möller, Rabenhorst, William Smith, etc.) may also be noted. Publication citations where mainly Grunow's illustrations were included (e. g. in VAN HEURCK (1880–1885, 1882–1885)) are sometimes given. Judging by some slides checked (e. g. Grunow samples 36, 522, 552, 1854), underlined taxon names (Fig. 2) were either dominant or those Grunow felt like noting for other reasons, such as particularly nice valves or rare taxa found in the sample. The notations /, or /., but most likely a long s (ſ) (see Fig. 2, and transcription and translation of instruction page 1, Fig. S1) and probably an abbreviation for siehe [see] (Christof N. Schröder, pers. comm.), likely refer to where the material was filed in Grunow's herbarium organised by taxon name, which is now the general diatom collection at W. Roman numerals in green wax pencil denote how many slides were prepared, and which may


A
Diatomeen und Desmidieen
Herbarium A. Grunow

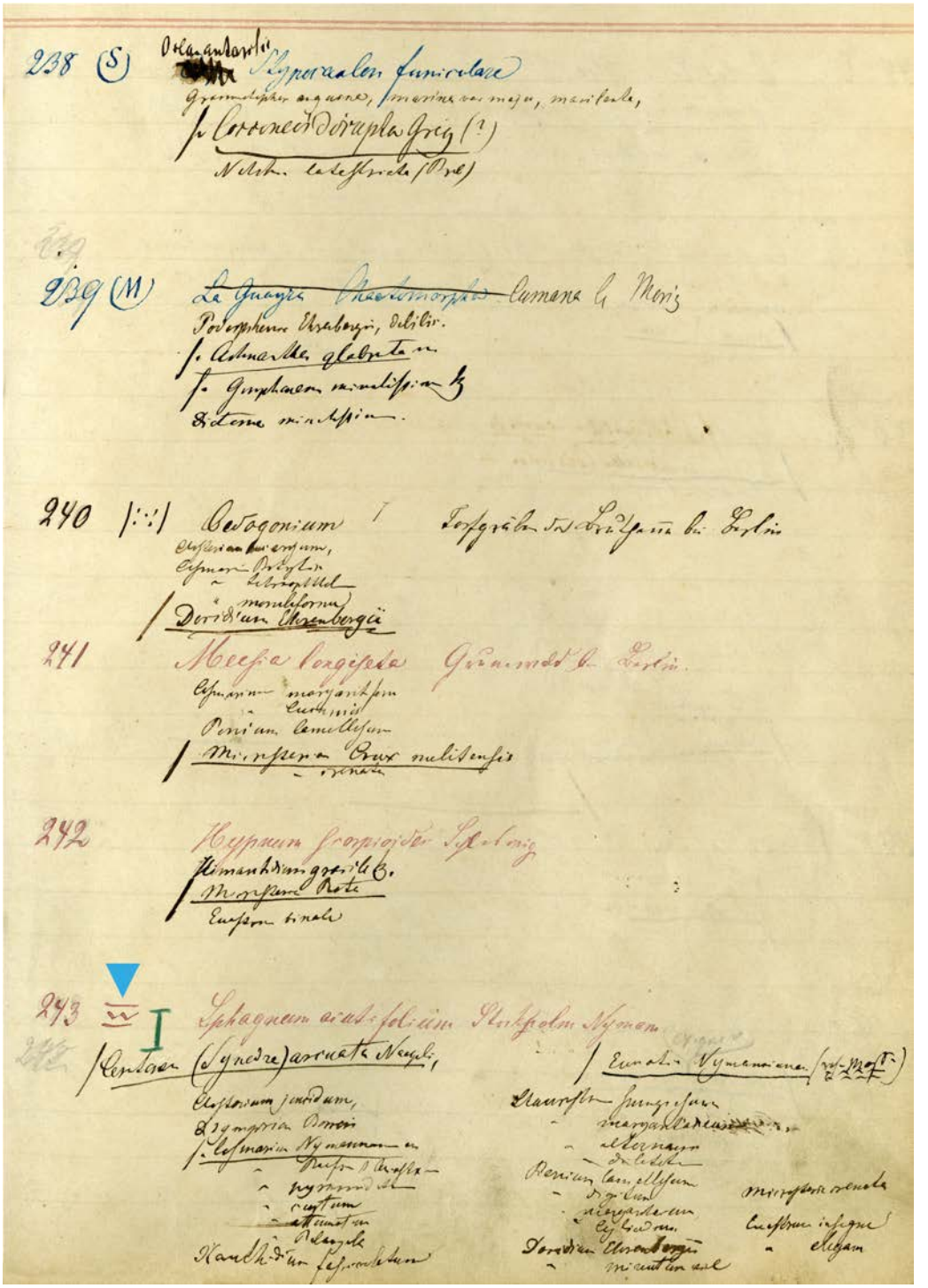

B

still be present in the extant slide collection, though some no longer exist for various reasons. As mentioned above, accession book IV includes eleven pages of instructions (electronic supplementary material, Figs S1–S11,) for interpreting the catalogue and working with the collection. An English translation is provided here (see below). The German transcription is also provided as a further reading aid for Grunow's handwriting and is included in the electronic supplement.

Beyond a description of the catalogue, this paper is intended as a palaeographic aid for those needing to read it and Grunow's other writings by giving handwriting samples according to the alphabet (electronic supplementary material, Figs S12–S16, as part of the electronic supplement). To summarise, the entire palaeographic aid is provided as an electronic supplement that includes Figs S1–S16. Although the catalogue is invaluable for pinpointing Grunow's material, interpreting his taxonomic decisions, and learning something about the ecological setting (based on their species composition), deciphering this handwritten document can be challenging. Grunow wrote in the older German cursive script ('Kurrent') and changes in the representation of letters across his long period of activity can be difficult to decipher. It is even possible to find different representations of one letter on a single page, as Grunow mostly used modern script for scientific and other names, such as the Novara expedition (see Fig. S2), words in languages other than German, and publication citations (Figs S6–S8). To capture the range in characters used and different representations of letters, we scanned the catalogue for at least three examples of each upper- and lower-case letter, ligatures, umlauts, and other special characters. These examples are shown in Figs S12–S16.

As Grunow's samples are being digitised and made available online through the W database JACQ (2022), the corresponding accession book page for that Grunow sample number is being added as an image as well as a transcription of that information (e. g. https://w.jacq.org/W0164808). Transcription and publication of the entire catalogue awaits the commitment of dedicated volunteers, years of work by the collection curator, or major advances in Optical Character Recognition (OCR) techniques for handwritten texts. Meanwhile, high resolution scans of selected pages can be made available by the corresponding author to facilitate taxonomic work of diatomists. Eventual full-scale digitisation will be part of a larger goal, which aims to integrate and make accessible information about historical diatom collections from several institutions. For example, regarding Kützing's samples at the BM (main repository), BR (as part of the Van Heurck collection), and W (as part of the Grunow collection), it is unclear what is held at each institution and how each holding complements those at the other institutions. Aside from digitising the various collections in their entirety, an epic undertaking due to their size and complexity, a first step to achieve information integration is to digitise and extract these data from various catalogues. In addition to their scientific value, the richness of information about cultural events and developments also captured through these historical specimens warrants these efforts. Linking information about the voyages on which the specimens were acquired, their purpose, "in short, the who was where, why, and

◀ Fig. 1: Grunow's catalogue: (A) locality notebook title page. Note use of differently coloured ink for samples from different origins (various localities, fossil, or marine); (B) a page in that notebook showing table and locality symbols using Grunow sample 243 as example (blue arrow) in this case, also indicating a phorophyte (*Sphagnum acutifolium*).



when" enriches our knowledge of the associated cultural history, which, for the most part, is an overlooked and underrated dimension of collections. Making the metadata available to a broader audience will also make it accessible for cultural historians and other researchers (David M. Williams, pers. comm.).

English translation of Albert Grunow's catalogue instructions

Note that the translation from German to English is faithful in meaning. To facilitate readability, it is not an exact word for word conversion and we paraphrase a little. Short comments or additions are given in square brackets to clarify some terms used by Grunow. To make them relatable for current users, the citations Grunow gives in abbreviated form on his pages 6–8 are included in the references section with links to full text resources, such as Biodiversity Heritage Library (https://www.biodiversitylibrary.org/). These citations are marked with an asterisk (*).

Page 1 (Fig. S1). Comments on using A. Grunow's diatom collection and the associated drawings

1) The oldest samples are in part only located in the herbarium [currently, general diatom collection W. With 'in part' Grunow likely refers to the oldest samples not being available as raw or cleaned material in bottles or otherwise, see below]. In the catalogue, this is indicated in the following way: e. g. No. 285. Schneeberg s. *Cymbella alpina* Grun. When there is also a slide, this is indicated by s. Glaspräparat [slide] and mostly one or more green lines I, II, III, depending whether one or more slides are available. When a sample is also available as acid treated material, this is indicated by s. Fl. e. g. No. 274. Jauling [at Berndorf] s. *Navicula ambigua* forma *Craticula*. In addition, ~~one~~ two slides and bottled material are available here. In case bottled material has dried up, then it should be boiled with a bit of nitric acid, the acid removed by multiple decantations with distilled water, and then spread onto cover slips (not too thick, let dry slowly with the water etc., etc.). Larger and smaller

Page 2 (Fig. S2). forms [valves] can be separated via simple or centrifugal elutriation [a particle separation process; washing], and I here point to publications about diatom preparation. The liquid preparations of fossil deposits were often produced via rather modified treatments through boiling with acids, alkalis, hydrofluoric acid etc., etc. The original material from the Novara Expedition, Franz Josefsland etc., etc. are located, as can be seen in the catalogue, partially in the herbarium, and in part with the slides. The designations from above mostly stop later, where mostly only slides are available.

◀ Fig. 2: Grunow's catalogue: Corresponding entry for Grunow sample 243 in accession book I with matching symbol (blue arrow), nonetheless repeating locality and phorophyte information, and citing species included in the sample. The green Roman numeral I indicates that one slide was made; this is still extant in the Grunow slide collection at W. The /, /., or s (ſ) notations plus an underlined taxon name show under which names samples of the original material were filed in Grunow's herbarium (currently the general diatom collection at W) and presumably also indicate particularly nice valves for these taxa.

2) Location of particular forms [valves] on the slides. Small scales are sometimes glued onto the older slides [see Fig. S2 for drawing]. The centre of the small circle in the middle has to align with the microscope focus, when

e. g. a = 15

b = 12

c = 15 is indicated.

Some trials will clarify this

Page 3 (Fig. S3). When searching, it is advisable to initially always use low magnification. It is possible, that in preparations made with balsam [Canada balsam, balsam of fir] individual forms moved elsewhere, and have to be searched for close to the given reference point. For all later preparations, the location of the diatom in question is fixed through the upper left corner point of the glass slide. To this belongs a millimetre grid, either affixed directly to the stage, or on a plate, which is affixed to the stage, as the sketch below shows, of which the origin exactly aligns with the focus of the microscope [see Fig. S3 for drawing]. The vertical lines in the portion below 0 can also be omitted.

Page 4 (Fig. S4). When for example, on a drawing of *Mastogloia Braunii* 1363. b (Cagliari) 12.9/32.9 is noted, then this means that the upper glass edge has to align with horizontal line 12.9 (so, nearly 13), and the upper left corner point of the plate has to align with vertical line 32.9 (so, nearly 33). There are several slides available of No. 1363, of which the second is labelled **b** [see Fig. S4 for drawing]. Assuming that the sketch above shows said preparation, **a** would be the point where the drawn diatom is located.

3) Additional remarks about the drawings. For the drawing above, there is the notation 900/P.0.1. This means that here magnification 900 ×, a prism and objective 1 were used for drawing (900/P.ÖI. means 900 × with prism and oil immersion etc.). Next to the same drawing, part of the horizontal lines [stria] are shown with 1540 × magnification, also drawn with a prism. In other cases, stria density is given in numbers, which refers to 0.01 mm in all (except the oldest drawings).

Page 5 (Fig. S5). Examples

[see Fig. S5 for drawings]

25 = 25 horizontal lines in 0.01 mm

20 = 20 longitudinal lines in 0.01 mm

15, 20 = 15 longitudinal lines [and] 20 horizontal lines in 0.01 mm

20, 20, 20 = 20 oblique lines [and] 20 horizontal lines in 0.01 mm

20, 20, 16 = 20 oblique lines [and] 16 horizontal lines in 0.01 mm

16, 16, 20 = 16 oblique lines [and] 20 horizontal lines in 0.01 mm etc.

4) Original specimens for the drawings in Van Heurck's

Synopsis. For this publication solely citing Van Heurck, I made all identifications and most of the drawings. Van Heurck cut the drawings out, glued them together on

sheets, photographed them, and then reduced the magnification mostly from 900 to 600 ×. In the drawing collection, there are many blue photocopied drawings, which all stem from this, but which is not always noted. In addition, there are many cut-out remainders (see Fig. 3, black double arrow), where the drawing is missing (or was glued somewhere [else]), but which all contain notes about the sample number, diatom location, striation specifications, etc. These must be retained,

Page 6 (Fig. S6). because they enable comparison of the original specimen to any illustration in Van Heurck.

5) Listing of diatom localities. These lists are more or less complete, in some cases already assembled, in others, the cut up strips of [taxon] lists including the various [sample] numbers are kept in corresponding envelopes.

e. g. 2832 China *Homoeocladia Martiana* [see Fig. S6 for clipping]

Following their entry, these strips can of course be discarded. However, it is unlikely that someone will be able to continue this work, as not nearly all [sample] numbers in the collection have been treated thus, continuously only until ca 2500, from then on individual [samples]. Mostly, the names listed as such are marked by a vertical line across the whole length of the species list [see Fig. 3, blue arrow]. Here and there, there are some lists in the catalogue that have not yet been cut up: 2024–2328.

6) Some of the more common abbreviations for the drawings copied from others

K. B, Kg Bac, = Kützing Bacillarien

(those marked as 300/1 are copies of Ehrenberg Americ, etc.)

W. Sm. br. Diat. – W. Smith british Diatoms

~~(A. Gr. Diat. = A. Grunow Oesterreich. Diatoms, etc.)~~

F. J. L. D – A. Grunow, Franz Josefs Land Diatoms – 1884

Nord See Exp – by A. Schmidt

Ehg Micr – Ehrenberg Microgeologie

Rab. Bac – Rabenhorst Bacillarien

Pritchard – Diatoms

Page 7 (Fig. S7).

M. J. – Microscopical Journal

Cleve – Nord. Diatom

Cleve et Grunow – Arctische Diatomeen 1880 Kongl. Svensk. Vet Ak. Hand.

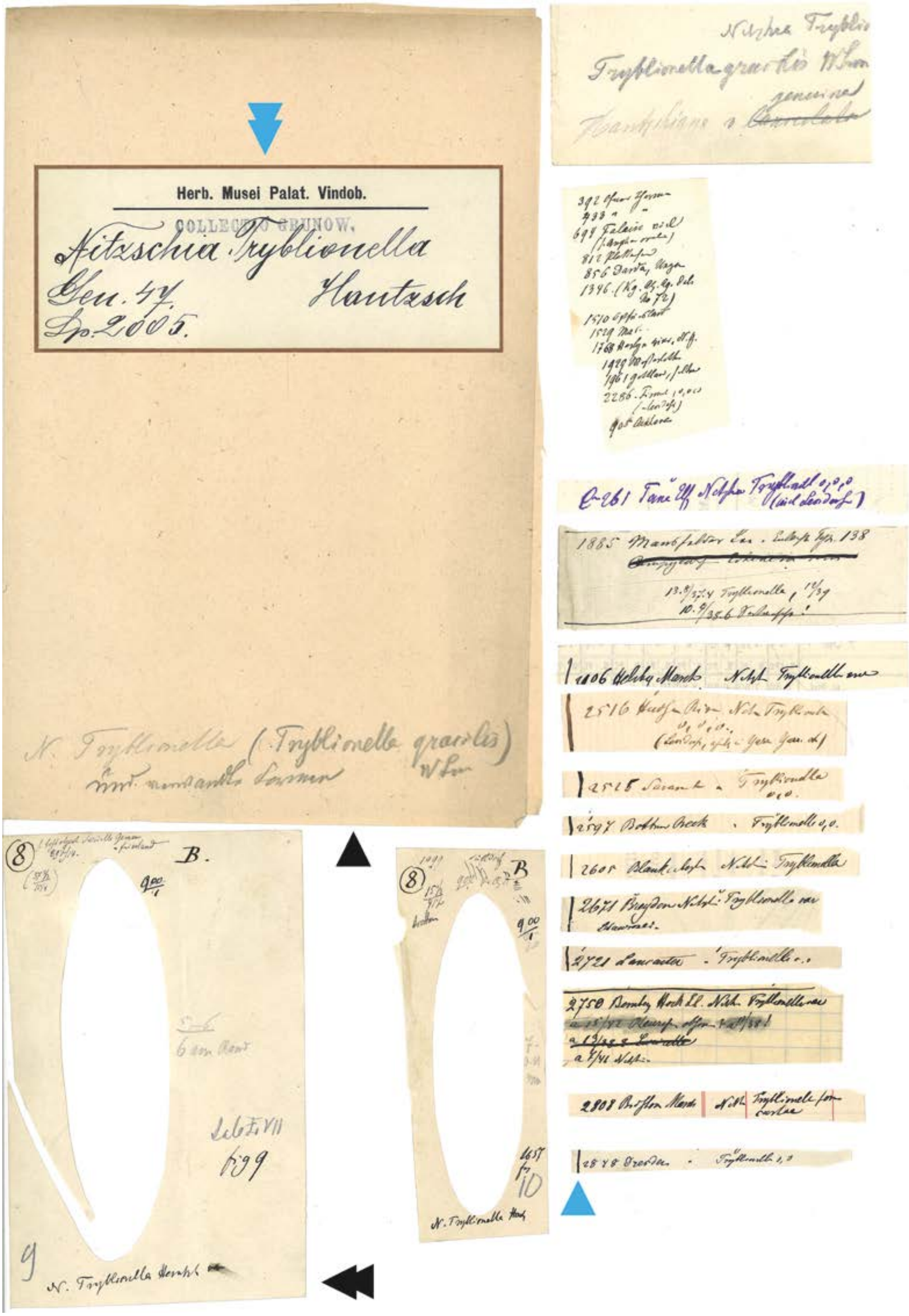
A. Grun. ~~Oesterr. Diat. 1862 Familie Nitzschiae tab 12 (18)~~

A. Grun. fossile ~~Ungar.~~ Diatom von Oesterreich u. Ungarn 1882.

A. Grun. Caspi See Algen und Diatomaceen / published in Isis

A. Grun. Honduras, and subsequent measurements (on *Sargassum* leg. Lindig)

A. Gr. 1860 – neue u. ungenügend bekannte Algen. I. Diat. fam Naviculaceae 1860. tab III – VII (1–5 in the publication)


Herb. Musei Palat. Vindob.
COLLECTIO GRUNOW.
Nitzschia Tryblionella
Gen. 47 Hantzsch
Sp. 2005.
N. Tryblionella Hantzsch

A. Gr. 1862.1. Österreichische Diatomeen etc. 1te. Folge Epithemieae, Meridioneae, Diatomeae, Entopyleae, Surirelleae, Amphipleureae tab III – VII und tab XIII (6–11 in the publication)

A. Gr. 1862.2. Österreichische Diatomeae 2te. Folge Nitzschieae tab 18 (12 I.H. [in the publication ?])

A. Gr. 1863. Neue u. ungenügend bekannte Diatoma. tab IV, V. (13. 14)

Micros. Journ. Grunow, New Diatoms from Honduras tab 193–196

A. Grun. Novara Exp. 1868

A. Grun. Banca. In Rabenhorst Beiträge. Diatom. et Desm. von Banka (lg Gerstenberger)

A. Grun. Caspi See Algen u. Diatomeen, expanded English treatment

in Micros. Journ. 1879

A. Grun. Beitrag zur Kenntniß der *Schizonema* u. *Berkeleya*. Hedwigia 1868

A. Grun. Systematische Anordnung von *Schizonema* u. *Berkeleya* in Bezug auf Van Heurck Tafel 15. 16. 17. botan. Centralblatt 1880

A. Grun. On some species of *Nitzschia*. Journ. Of. Microsc. Society 1880

A. Grun. Bemerkungen zu Brun's Diatom. Fl. d. Alpen. Botanisches Centralblatt

Cleve et Grun. Diatomii from the West Indian Archipel in Bihang till K. Svenska Vet. Akad. Handl. 1878

Page 8 (Fig. S8).

Pantoczek [Pantocsek]. fossile Ungarische Diatomeen (clipped illustrations)

A.S.D.A. A. Schmidt. Diatomeen Atlas (clipped illustrations) etc., etc., etc.

Castracane Challenger Exp. (clipped illustrations)

C. Janisch. Guano.

Leuduger Fortmorel, Diatomeen von Ceylon (collotypes of the illustrations)

7) Original samples of the diatoms from Franz Josefs Land and Austro-Hungarian fossils

◀ Fig. 3: Grunow's drawing collection: the loose contents of the map of drawings (the latter not shown) for *Nitzschia tryblionella* Hantzsch showing the map label as inset (blue double arrow). The loose contents are usually inserted in an envelope or a folder (black arrow). These may contain cut up locality listings for the relevant taxon organised by Grunow sample number, note the vertical line to the left of this in most snippets indicating that locality listings were completed (blue arrow). The flimsies may also contain cut-out remainders of drawings clipped for use as illustrations in publications (black double arrow), and various other bits and pieces not glued to sheets, as were the drawings.

As with the Van Heurck illustrations, these include the cut-out remainders of the drawings used for the photographs, and are almost always right next to the drawing itself, with the necessary sample numbers, coordinates, distances between striations etc. Due to the rarity of the diatoms in the samples from Franz Josefsland, the cut-out remainders are particularly important for that material. It might be best to glue the drawings to somewhat larger sheets and to copy the notes from the cut-out remainders.

8) Observations begun for later samples

For these, there is much scope for many studies. The samples have been looked at in part, and in the catalogue, coordinates are shown for the most notable valves. For example, No. 3071, 3072, 3073, 3074 (all Hungarian fossil deposits) *Navicula gemmata* fragment [?] 3073. b 18/ 45.8, etc., etc. When the

Page 9 (Fig. S9). coordinates are circled, this means that this particular diatom has already been drawn [see Fig. S9].

E. g. *Actinoptychus Moronensis* (nice) 3073. (b 13.8/42.1)

Navicula n. sp ? 3073. (b 8.3/44.3) etc.

9) Magnifications

My oldest drawings are mostly drawn at 400/1, then mostly 650/1 or 910/1 [and] without a prism. Recently, mostly 900/1 or 450/1 up to 1540/1 using a prism, which is always indicated by a P. Kützing's drawings are supposedly 420/1, but actually are 260/1 – 280/1. Ehrenberg's drawings are almost always 300/1, and are therefore not really discernible if one is unable to compare them with the original material. In my older drawings, striation distances refer to 0.01 ligne [Paris line], the same for Kützing, for all of my later drawings to 0.01 mm, for W. Smith to 0.001 Engl. inch. Where possible, in my drawings, the striations are almost always drawn using a prism and only the thinnest were measured, often with great difficulty. Where ribs and lines (lines of dots) occur together, the thickness is either noted or drawn exactly for both.

Page 10 (Fig. S10). 10) Diatom materials in bottles

Some of this part of the collection may have to be discarded, however, there is much that could be used for exchanges etc. Some of it, in particular in the smallest bottles, is dried up. For valuable samples nothing can be done, but to boil them in a small amount of nitric acid, after removing paper, cork, etc., to dilute them amply with (distilled) water using very small glassware, to let them settle, and to remove the liquid with small, slowly running pipettes, [see Fig. S10 for drawing, blue double arrow], which can be easily fashioned from any thin glass pipe, if necessary by repeated dilutions and pipetting, and to finally make the slides by spreading [the material] onto very thin, circular cover slips, which are heated slightly on a sheet of platinum, in order to destroy any still remaining organic parts, and is then mounted dry or in Canada balsam. Some of the bottles are marked with HgCl somewhere, which means that some mercury chloride has been added to prevent fungal growth. Some contain alcohol for the same reason. However, it is always necessary to clean the material again through careful elutriation and pipetting before slide preparation ~~and~~ if one is

to obtain slides of good quality. If the material contains a lot of sand, it is advisable to use small porcelain crucibles [see Fig. S10 for drawing, blue arrow] for rotating elutriation, where the sand remains in the crucible after careful elutriation that requires some practice

Page 11 (Fig. S11). and where the diatom-enriched liquid is decanted and can be processed further. At some point, I can potentially show you this in more detail. In the catalogue samples, which have been bottled, are marked with the symbol: s. Flaschen or s. Fl. When this is not underlined or underlined only once, then that bottle no longer exists, has been used up, or has been discarded because the label was lost.

P. 5

Some samples have been selected, are either unordered (with a locality sketch) or are ordered in rows. These are marked as sample No. … 0 or Ω.

Summary comments on Grunow's catalogue instructions, including the materials and methods described therein

1. General comments about the collection in reference to the catalogue instructions: At this point, only 87 of the bottles Grunow mentions are still available (including 35 larger and 18 smaller bottles or vials, and 34 bottles that contain HgCl). However, some of the smaller vials and bottles were put into capsules and filed in the collection when they were incorporated into the collections. The order Grunow refers to has therefore been lost and so are the situation sketches. Grunow's suggestion about gluing his drawings onto larger sheets was completed, and the sheets were put into maps and organised according to de Toni's numbering system in his *Sylloge Algarum* (DE TONI 1891, 1892, 1894). The drawings are available at W (as the Grunow drawing collection, see SCHUSTER et al. 2022 for more detail about this collection and its organisation). However, occasionally, the portion of a drawing with the specimen information around a removed line drawing (termed cut-out remainder here and elsewhere) (Fig. 3, black double arrow) remained loose, presumably when it was unclear to which line drawing copy (see below) it belonged or when this was missing. Most cut-out drawings were used to assemble the original plates for VAN HEURCK's (1880–1885) Atlas of the *Synopsis des Diatomées de Belgique*, and only copies were returned to Grunow. The original plates of the Atlas, and hence, the original drawings used for it, can only be seen in the Van Heurck collection (BR). Interestingly, the shape of the cut out line drawings can be matched to the drawings on the original plates in that publication. The cut up locality lists including Grunow's sample numbers largely also remained loose (Fig. 3, blue arrow) and are in the original paper folders (often scraps of (news)paper, Fig. 3, black arrow) or envelopes and were inserted with the maps of drawings for each taxon (see Fig. 3 inset, blue double arrow).
2. Comments about the materials mentioned in the catalogue instructions: Canada balsam with a refractive index (RI) of 1.54–1.55 is still in use as a mounting medium today. However, its lower refractive index that is close to diatom silica results in a lesser contrast between the valve and the mountant, and it is now often replaced by synthetic resins such as Naphrax (RI = 1.65). Regarding the use of platinum, we surmise that Grunow used it for preparing his slides, because it does not oxidise upon heating and is acid-resistant.

3. Comments about the methods mentioned in the catalogue instructions:

   Elutriation: This is a physical process by which small particles are separated based on size and density, usually into two particle groups, large and small. With respect to this, it is interesting that some of Grunow's slides for the same sample number are labelled gross [large] or klein [small]. Elutriation involves an apparatus where liquids or gas are flowing in the opposite direction of the treated sediment, by which mechanism lighter particles flow to the top of the mixture. As Grunow was a chemist, he likely had access to such an apparatus and was skilled with such methods. However, the drawing of a crucible in Fig. S10 (blue arrow), which Grunow suggests for rotating elutriation, implies that he may have accomplished separation by agitating the sample by hand, rather than using an apparatus. We cannot be sure of this though, as he does not go into detail about his methods for this process other than saying that it requires some skill.

   Slide preparation: Grunow sometimes made both air mounts (mostly using shellac to affix the coverslip) and resin mounts (Canada balsam is mentioned, but he may have also used other types of resin), where the latter can still yield valuable observations, whereas air mounts mostly do not.

   The merits of brightfield optical illumination versus phase alterations not detectable to the human eye: Grunow explored the use of prisms to enhance the resolution of valves. Microscopy using prisms (Differential interference contrast (DIC) for example), creates gradients in optical path lengths (changes in wavefront shear) with steep gradient changes creating a pseudo three-dimensional relief from a two-dimensional structure (Murphy et al. 2022). In addition, using a prism was a form of *camera lucida*, allowing specimens to be traced rather than drawn freehand (David G. Mann, pers. comm.).

   Magnifications: Grunow initially used a unit other than mm for his measurements, which is Paris line (‴). It is as yet unclear when exactly he made the switch, as he does not explicitly mention a specific sample number in his instructions. The drawing collection is not organised chronologically, so it is not possible to search for this. There are convenient online conversion programmes and the 0.01 ligne Grunow refers to equates to 22.6 µm. The conversion value for 1.0 ligne is 2.2558291 mm and 1.0 mm is 0.443296 ligne. Grunow also refers to Engl. inch (″) regarding W. Smith's drawings. As 1.0 inch equals 25.4 mm, the 0.001 inch referred to by Grunow equals 25.4 µm. See Table 2 for further measurement units used in historical literature. Table 3 lists abbreviations and units used by selected historical phycologists.

Table 2: Some historical measurement units used for diatoms and their metric equivalents. Adapted from a list compiled and supplied with compliments by Charles W. Reimer, Academy of Natural Sciences Philadelphia (undated); later transcribed by Norman A. Andresen, University of Michigan (1990s).

Historical Unit	Metric equivalent	
c.d.m. (Belgian)	centièmes de millimetre	0.01 mm
inch (″) (British & U.S.)	1/12 foot (′)	25.4 mm
ligne (‴) (French)	Paris ligne, 1/12 pouce	2.256 mm
line (British & U.S.)	1/12 inch, 0.0833 inch	2.12 mm
Linie (Austrian)	1/144 Fuß, 0.087 inch	2.20 mm
Linie (Bavarian)	1/144 Fuß, 0.080 inch	2.03 mm
Linie (Swiss)	ligne, 0.08202 inch	2.0833 mm
liniya (Russian)	ligne, 0.10 inch	2.54 mm
linje (Swedish)	1/144 Fot, 0.117 inch	2.97 mm
linje (Danish)	1/144 Fod, 0.0858 inch	2.18 mm
mm	0.03937 inch	
Paris inch	same as Pariser Zoll & pouce	27.07 mm
Paris line	Paris ligne, 1/12 pouce	2.256 mm
Pariser Linie (German)	Paris ligne, 1/12 pouce	2.256 mm
Pariser Zoll (″) (German)	Paris inch, same as pouce	27.07 mm
pouce (French)	1/72 toise, 12 lignes, same as Pariser Zoll & Paris inch	27.07 mm
R (of Schumann)	1/100 of a Paris line	0.02256 mm
T (of Schumann)	1/1000 of a Paris line	0.002256 mm
toll (Estonian)	1.0 inch	25.4 mm
tomme (Danish)	1/12 Fod, 1.03 inch	26.15 mm
totchka (Russian)	ligne, 0.01 inch	0.254 mm
tum (Swedish)	1/10 Fot, 1.17 inch	29.7 mm
µ	micron or micrometre	0.001 mm
uncia (ancient Rome)	1/12 pes, 0.97 inch	24.6 mm
uncia	may be Latin for 1/12 Paris inch, or 1/12 pouce	2.25 mm
Zoll (British & U.S.)	1.0 inch	25.4 mm
Zoll (British, pre-1959 standardisation)	1.03 inch (see DEVRIES 1946)	26.16 mm
Zoll (old Prussian)	1/12 Fuß, 1.03 inch	26.16 mm
Zoll (Swiss)	1.181 inch	30.00 mm

Table 3: Some abbreviations used by selected historical phycologists. Adapted from a list compiled and supplied with compliments by Charles W. Reimer, Academy of Natural Sciences Philadelphia (undated); later transcribed by Norman A. Andresen, University of Michigan (1990s).

Author	**Abbreviations or units used**
Boyer	µ
Cleve P.T. (ca 1893)	mm
Cleve & Grunow	mm
de Toni	µ
	white space separates width from length measurements; e. g. "42–60 10–12" means 42–60 µm long &10–12 µm wide
Ehrenberg	1/1000 of a Paris line for length measurements; 2.265 µm
	1/100 of a Paris line for striae measurements; 22.56 µm
Fricke (Schmidt's *Atlas*: A.S.A.[1])	only plate magnifications
Grunow	striae distances: initially 0.01 Paris line, then 0.01 mm (time of switch unknown)
Hustedt (Schmidt's *Atlas*: A.S.A.[1])	only plate magnifications
Kützing F.T. (ca 1850)	1‴ = *linea parisiens*, Paris line
	1″ = *pollex*, 1.0 uncia, which could be either 1/12 inch, Zoll, or pouce
	1′ = *pes,* foot
	C.V. = *cum vagina*: with sheath [mucilaginous layer around algae]
	S.V. = *sine vagina*: without sheath [mucilaginous layer around algae]
	V.S. = *vidi siccam* (*speciem*): (species) seen dried
	V.V. = *vidi vivam* (*speciem*): (species) seen living
	N.V. = *non vidi*: not seen
Müller, Otto Friedrich	none, Latin descriptions only
Müller O. (1890, 1909)	µ
Pantocsek J. (1903 [2nd ed. of 1886])	µ
Peragallo	mm
Pritchard A. (ca 1861)	white space in measurements is fractional: e. g. L–1 598″: length of frond 1/598th of an inch (British & U.S.)
	f.v. = front view
	s.v. = side view
	e.v. = end view
	tr.v. = transverse view
	e.f. = empty frond
	L. = length
	B. = breadth
Rabenhorst	‴ = Paris line
	″ = British inch
Schönfeldt H. von (ca 1907)	mm

Author	Abbreviations or units used
SCHMIDT A. (1874 – 1959, *Atlas*: A.S.A.[1])	only plate magnifications
Schuman(n)	‴ or R = 1/l00 of a Paris line; 22.56 µm
	T = 1/1000 of a Paris line; 2.256 µm
	Neb, Nebenseite = upper (pseudoraphe) valve
	Bauch, Bauchseite = ventral valve (raphe valve)
	Haupt, Hauptseite = girdle or side view
	Imagines = rim 'image' sections from centric diatoms
Smith, Hamilton Lanphere	″ = (very likely) British & U.S. inch; 25.4 mm
Smith, William	″ = inch (British & U.S.); 25.4 mm
	F = frustule
	F.V. = front view of frustule
	S.V. = side view of frustule
	v = valve
	vv. = living specimen examined
	vs.= fossil or dry specimen examined
	letters used in plates: a = side, b = front, c = front of single valve, d = self division
Van Heurck	c.d.m. = centièmes de millimetre; 0.01 mm, 10 µm

[1]A.S.A.: SCHMIDT A., 1874–1959: Atlas der Diatomaceen-Kunde. Taf. 1–212 (A. Schmidt), Taf. 213–216 (M. Schmidt), Taf. 217–240 (F. Fricke), Taf. 241–244 (H. Heiden), Taf. 245–246 (O. Müller), Taf. 247–256 (F. Fricke), Taf. 257–264 (H. Heiden), Taf. 265–268 (F. Fricke), Taf. 269–472 (F. Hustedt). – Leipzig: O.R. Reisland.

When A.S.A. plates are at 660× multiply image size in mm by 1.516 to get size in µm.
When A.S.A. plates are at 900× multiply image size in mm by 1.111 to get size in µm.
To convert striae from (#) in 25.4 µm to (#) in 10 µm; multiply striae # in 25.4 µm by 0.3937.
To convert striae from (#) in 0.001″ to (#) in l0 µm; multiply striae # in 0.001″ by 0.3937.

In summary, this contribution is aimed at researchers, who have to deal with deciphering German cursive script ('Kurrent') for their taxonomic work, and in particular those phycologists, who need to read Grunow's handwriting, as featured in his catalogue or notes on the drawings. These often contain salient information for making taxonomic decisions or can provide an idea about 19th century diatom flora. We also supply a compilation of obsolete units of measurement used by historical phycologists and give their conversions to the metric system (Table 2). In addition, we explain some abbreviations used by selected historical authors (Table 3).

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