*Cryptogamie, Algol., 2008, 29 (1): 5-11*


# Morphology of *Rhoicosigma arcticum* (Bacillariophyta)

*Geraldine REID*[*]

*Department of Botany, The Natural History Museum, Cromwell Rd., London, UK*

*(Received 16 January 2007, accepted 6 August 2007)*

**Abstract** – The morphology of *Rhoicosigma arcticum* is investigated using light and scanning electron microscopy. Based on specimens in Cleve's collection, a type slide is designated.

***Rhoicosigma* / diatom / typification / arctic**

**Résumé** – Morphologie de *Rhoicosigma arcticum* (Bacillariophyta). La morphologie de *Rhoicosigma arcticum* a été étudiée en utilisant le microscope photonique et le microscope électronique à balayage. Une lame type a été choisie au sein de la collection de Cleve.

***Rhoicosigma* / diatomée / typification / arctique**

## INTRODUCTION

*Rhoicosigma* Grunow is a small marine diatom genus, whose species are found mostly living in isolated populations on coarse-grained sandy marine sediments within the littoral to sub-littoral zones (Reid, 2008). Thirty-two taxa have been described under the name *Rhoicosigma*. *Rhoicosigma* belongs to the family Pleurosigmataceae Mereschkowsky, which has been the subject of a recent revision (Reid, 2008).

Grunow (1867: 19) established the genus *Rhoicosigma* and included two taxa: *R. falcatum* (Donkin) Grunow and *R. reichardtianum* Grunow. Grunow (1867) recognised the difference between *Pleurosigma* (which, at that time, also included species of *Gyrosigma*) and *Rhoicosigma,* in that the latter had an achnanthioid frustule (i.e. dissimilar valves). He discussed the relative merits of his new genus, suggesting that it was very similar to *Pleurosigma* but because of its achnanthioid form he maintained it as a separate entity: "This genus is perhaps not sufficiently distinct from *Pleurosigma*, but the species belonging to it are of a very peculiar habit, in front view resembling *Achnanthes*." (Grunow, 1877: 181). A translation of the 1867 paper contained the original text plus some further details (Grunow, 1877). Here Grunow now included six species in the genus *Rhoicosigma: R. reichardtii* Grunow*, R. reichardtii* var. *constrictum* Grunow, *R. compactum* (Greville) Grunow, *R. arcticum* Cleve, *R. mediterraneum* Cleve and

* Correspondence and reprints: gr@nhm.ac.uk
Communicating editor: Pierre Compère

*R. falcatum*. In the earlier paper Grunow (1867) considered *R. compactum* to be a species of *Donkinia*. The nomenclatural and taxonomic history of *Rhoicosigma* and the subsequently added taxa are confusing, the genus has had a varied history over the years, including not being recognised by many workers (see Reid, 2008: fig. 1). Apart from the achnanthioid nature of the frustules, the genus can easily be separated from other members of the family by the twisting of the valve (valves will rarely lie flat, so that specimens observed on glass slides are never completely in focus) and its longitudinal and transverse striae arrangement (Reid, 2008).

*Rhoicosigma arcticum* was described by Cleve (1873: 18 plate 3 fig. 16) from "*Spetsbergen* Hackluyts. Brandwyns Bay (10-15 fths), Kings Bay (160 fths), *Greenland rare*" (Fig. 5). In his later paper (Cleve, 1894: 119) he transfers it to the genus *Gyrosigma* and modifies its striae densities from transverse "37-44 in 0,025m.m" (13-18 per 10 μm) to transverse 21-23 per 10 μm and longitudinal 28-30 per 10 μm and included a number of additional localities "Greenland! Spitsbergen! Sea of Kara! Finmark! Grip in Norway! Firth of Tay! Barbados! Kerguelens Land!". Cardinal *et al.* (1986; 1989), when studying material from Quebec, did not recognise *Rhoicosigma,* listing *R. arcticum* as a species of *Gyrosigma* when dealing with the Pleurosigmataceae.

## MATERIALS & METHODS

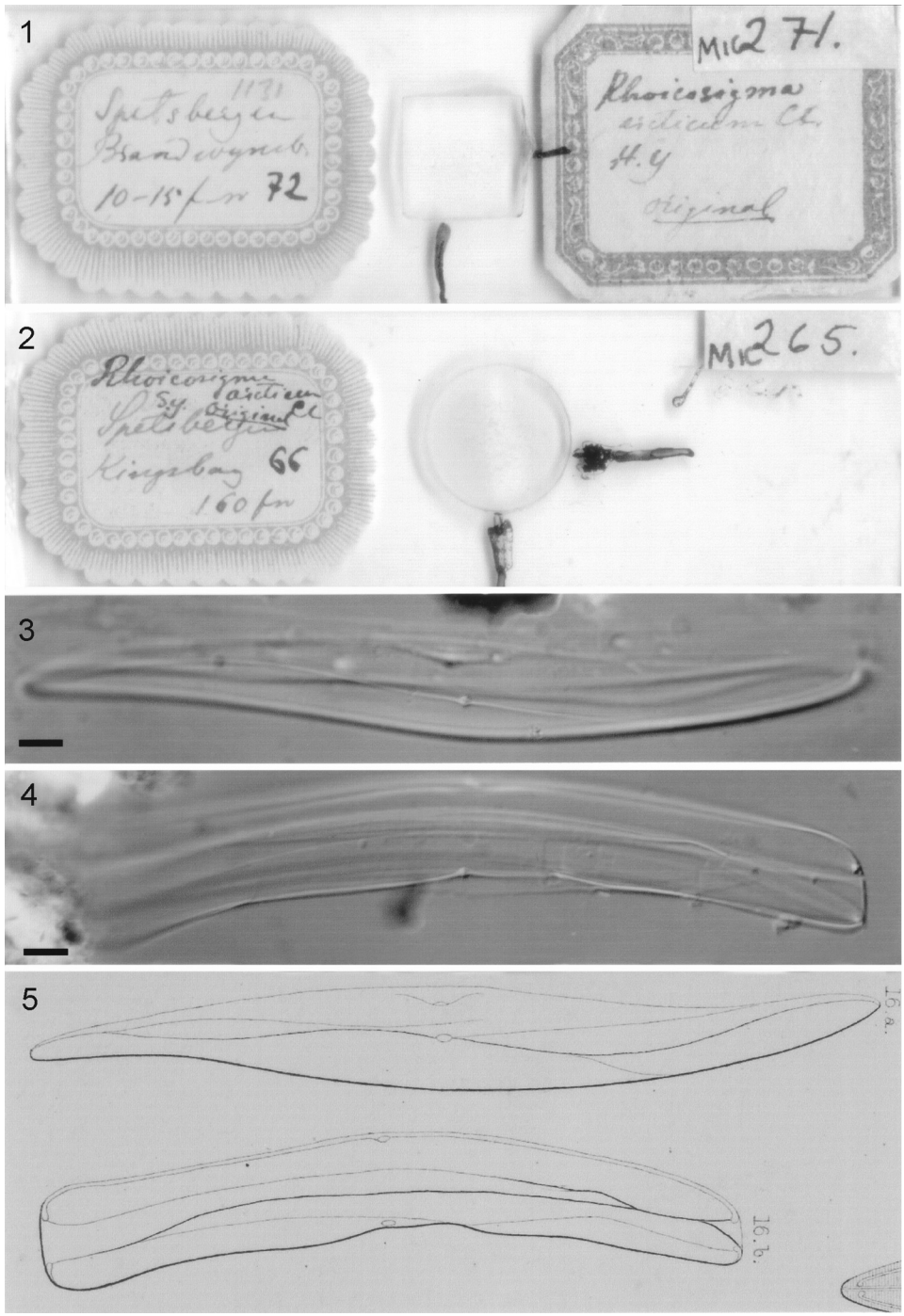
Slides were examined using a Reichert microscope. For photomicroscopy, specimens were examined on a Carl Zeiss microscope, with differential interference contrast, using plan apochromat objectives and tri colour green filter. Cleaned specimens were strewn on aluminium stubs for SEM examination. The specimens were sputter coated with gold-palladium and observed using a Hitachi S800 field electron microscope. Slide locations are indicated by their *Index Herbariorum* acronym (Holmgren & Holmgren 1998): Natural History Museum, London (BM), Swedish Museum of Natural History, Stockholm (S), Naturhistorisches Museum, Wien (W).

**Material Studied:** Spitsbergen, Svalbard: S MIC 271, S MIC 265; Norway: Finmark Maasö (Kjellman): BM 13071, BM 13072, W 1843f, W 1843, Grundstat: BM 68512; Scotland: BM 101315. SEM studies: BM-Scotland; BM-Cleve & Möller 313 Finmark.

### Diatom morphology

Terminology for the siliceous parts of the diatom frustule follows Anonymous (1975) and Ross *et al.* (1979).

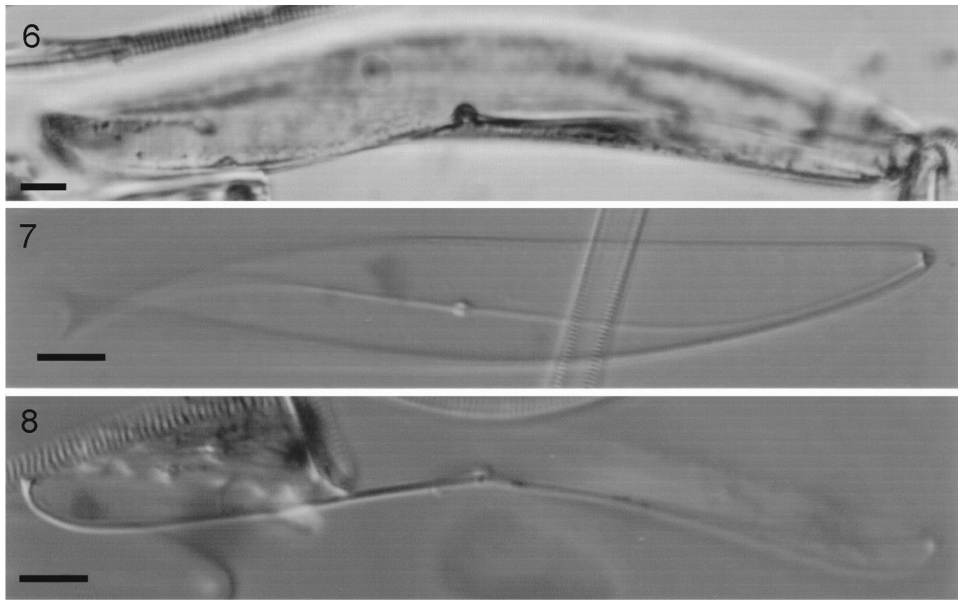
Figs 1-5. Figs 1-2. Cleve Type slides. **1.** S MIC 271: Spetsbergen Brandwyn b 10-15 fn 72, Rhoicosigma arcticum Cl. H. Y original. (Spitsbergen, Svalbard). **2.** S MIC 265: Rhoicosigma arcticum Cl. S. y. original Spetsbergen Kingsbay 160 fn, 66. (Spitsbergen, Svalbard). Figs 3-4 Light micrographs of *Rhoicosigma arcticum*. **3.** Lectotype specimen from S MIC 271, specimen marked; this specimen relates to the illustration in Cleve 1873: fig. 16a. **4.** Type specimen S MIC 265 showing girdle view, specimen marked; this specimen relates to the illustration in Cleve 1873: fig. 16b. **5.** Reproduction of Cleve 1873: fig. 16. (Scale Bars: Figs 3-4 = 10 μm).


1
MIC 271.
Rhoicosigma
arcticum Cl.
H.Y
Original
2
MIC 265.
3
4
5
16.a.
16.b.

## OBSERVATIONS AND DISCUSSION

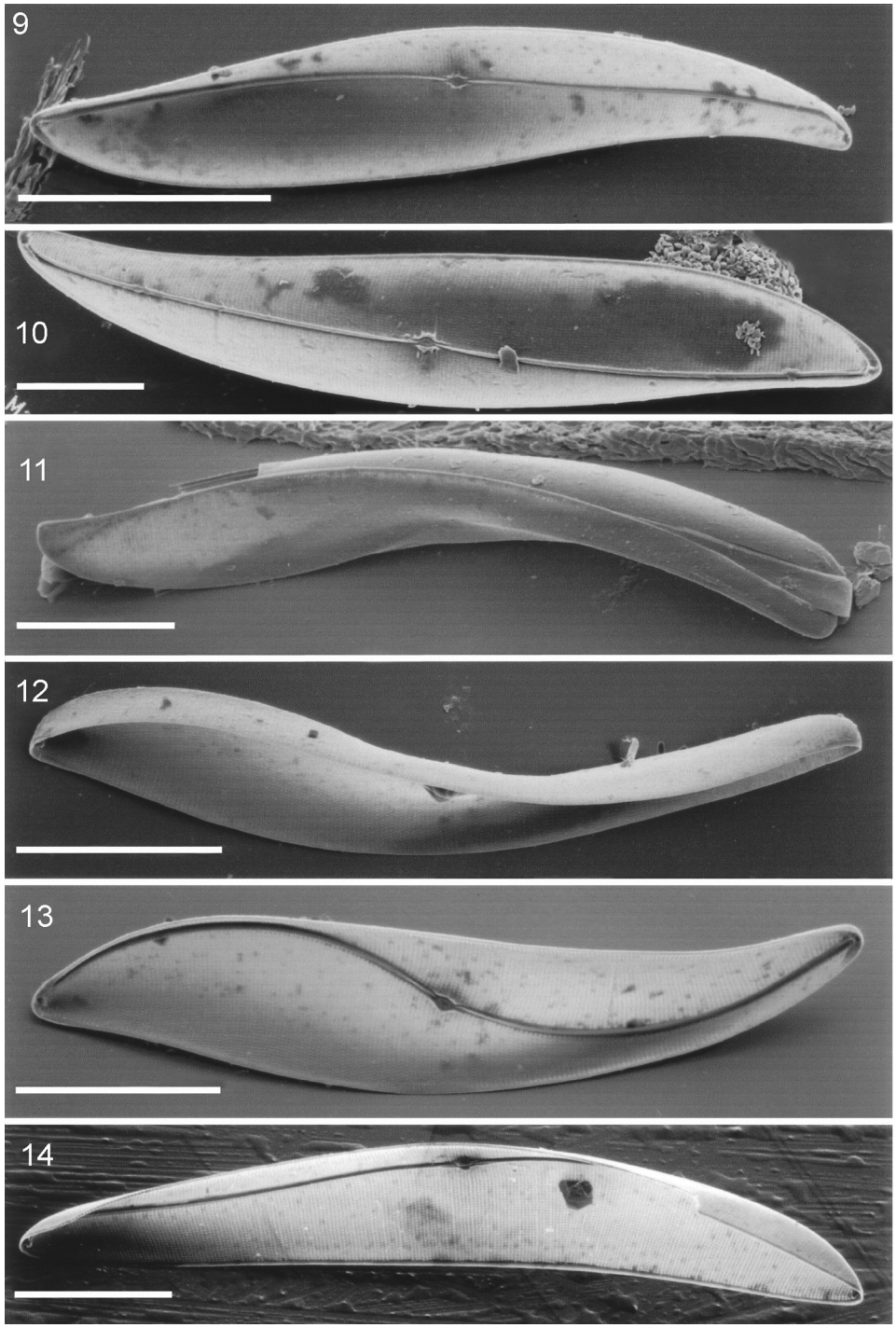
***Rhoicosigma arcticum*** Cleve, 1873: 18 plate 3 fig. 16
**Synonym:** *Gyrosigma arcticum* (Cleve) Cleve, 1894: 119
**Type locality:** "*Spetsbergen* Hackluyts. Brandwyns Bay (10-15 fths), Kings Bay (160 fths), *Greenland rare.*"
**Type slides:** Lectotype (designated here). S MIC 271: 72 Spetsbergen Brandwyn B 10-15 fn Rhoicosigma arcticum Cl. H. Y. original. (Spitsbergen, Svalbard). (Figs 1, 3). S MIC 265: 66 Rhoicosigma arcticum Cl. S. y. original Spetsbergen Kingsbay 160 fn. (Figs 2, 4).

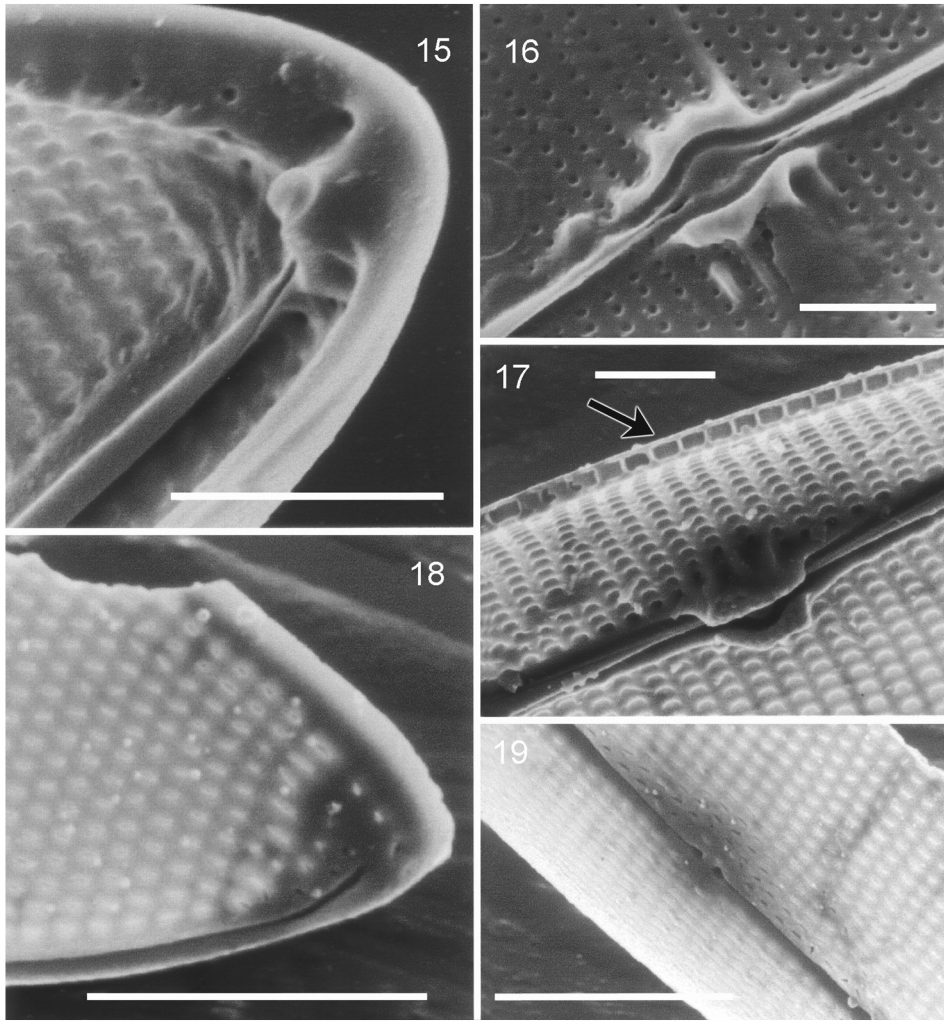
Frustule heterovalvate, achnanthioid, with spatulate appearance in girdle view (Figs 4, 6, 8, 11). Valves dissimilar, linear-lanceolate, sigmoid, hypo-valve concave, with a weakly sigmoid raphe (Figs 9-10), epi-valve convex, with a strongly sigmoid raphe (Fig. 13), 63-210 µm long, 16-20 µm wide. Apices variable tending towards sub-acute. Transverse striae 21-24 per 10 µm; longitudinal striae 30-34 per 10 µm. Valve loculate, with areolae opening to outside by an apically elongate slit (Figs 18-19); to inside by a poroid occluded with a hymene




Figs 6-8. Light micrographs of *Rhoicosigma arcticum*. **6.** Girdle view W 1843. **7.** Valve view BM 13071. **8.** Girdle view BM 13071. (Scale Bars: 10 µm).

Figs 9-14. SEMs of *Rhoicosigma arcticum*. Figs 9-13 Scotland. Fig. 14 Finmark. **9-10**. Internal view of hypo-valve with a weakly sigmoid raphe that bisects the valve unequally. **11.** Frustule in girdle view. **12.** General view of epi-valve in girdle view. **13.** Internal epi-valve with strongly sigmoid raphe. **14.** General view hypo-valve. (Scale Bars: 20 µm).


9
10
11
12
13
14




Figs 15-19. SEMs of *Rhoicosigma arcticum*. Figs 15-16 Scotland. Figs 17-19 Finmark. **15**. Internal polar region. **16.** Internal central region, showing central bars with lateral extensions into inter striae. **17.** Fracture in valve revealing loculate structure (arrow). **18.** External polar region. **19.** External central region with central raphe fissure almost straight. (Scale Bars: Figs 15, 16, 17 = 2 µm; Figs 18, 19 = 5 µm).

(Figs 15-17). Areolae form a lattice in the locular walls forming a continuous space in valve matrix (Fig. 17, arrow). Raphe sigmoid, situated on a keel. The central internal raphe endings within the central nodule, flanked either side by central bars (Figs 16-17). The central bars with lateral extensions, extending into interstriae (Fig. 16). Raphe sternum internally thickened, thickening stronger on primary side, continuous with central bar. External central raphe fissures straight,

with expanded ends (Fig. 19). Terminal raphe endings deflected in opposite directions. Chloroplasts deeply incised, plate-like (pers. obs.).

In the protologue, Cleve (1873: plate 3, fig. 16) provided illustrations of two specimens (Fig. 5). These match those found on Cleve's slides, MIC 271 and MIC 265 (compare Figs 3-5). Both slides are labelled by Cleve as "*Rhoicosigma arcticum* Cleve Original", with marks on the slides to locate the specimens (see Figs 1-2). As Cleve (1873: pl. 3, fig. 16) did not specify a holotype, and the illustrations are from two different slides, a lectotype needs to be designated. Thus, S MIC 271 from Brandwyns Bay, Spitsbergen, Svalbard is designated here.

Cleve (1894) lists Kerguelens Land and Barbados as localities, I have been unable to track down any specimens of *R. arcticum* in samples from either locality. Cleve (1894: 119) stated "Specimens from Kerguelens Land, named by Grunow *Donkinia subflexuosa* (Icon. N. Part II Pl. 1 g. 3, 4), are straight, so also are specimens from Barbados, but otherwise they differ in nothing of importance". Examination of Grunow's Kerguelens slides has not revealed any specimens of *D. subflexuosa*. Cleve (1895: pl. 1 fig. 4) illustrated specimens from Kerguelens as linear, rather than curved, in girdle view which leads to the conclusion that *D. subflexuosa* is not synonymous with *R. arcticum*, as the latter is curved in girdle view. Thus, *R. arcticum* occurs only in the Northern Hemisphere. From the data available *R. arcticum* appears to be geographically restricted, being found in the Arctic Ocean extending down into the Northern Atlantic Ocean and Northern North Sea.

*R. arcticum* differs from *R. compactum* and *R. robustum* Grunow by having denser longitudinal striae 30-34 per 10 µm, compared to 19-23 per 10 µm and 12-13 per 10 µm, respectively.

**Acknowledgements.** I would like to thank David Williams for his comments on this manuscript.

## REFERENCES

ANONYMOUS, 1975 — Proposals for a standardization of diatom terminology and diagnoses. *Beihefte zur nova Hedwigia* 53: 323–354.

CARDINAL A.C., POULIN M. & BÉRARD-THERRIAULT L., 1986 — Les diatomées benthiques de substrats durs des eaux marines et saumâtres du Quebec. 5. Naviculales, Naviculaceae; les genres *Donkinia, Gyrosigma,* et *Pleurosigma*. *Le naturaliste Canadien (Revue d'Ecologie Systématique)* 113: 167-190.

CARDINAL A.C., POULIN M. & BÉRARD-THERRIAULT L., 1989 — New criteria for species characterization in the genera *Donkinia, Gyrosigma,* and *Pleurosigma* (Naviculaceae, Bacillariophyceae). *Phycologia* 28: 15-27.

CLEVE P.T., 1873 — On Diatoms from the Arctic Sea. *Bihang till kongliga Svenska vetenskaps-akademiens handlingar* 1: 1-28.

CLEVE P.T., 1894-1895 — Synopsis of the Naviculoid Diatoms. *Kongliga Svenska vetenskaps-akademiens handlingar* 26 (2): 1-194 (1894), 27 (3): 1-219 (1895).

GRUNOW A., 1867 — Algae. Reise seiner Majestat Fregatte Novara um die Erde. *Botanischer Theil* 1: 1-104.

GRUNOW A., 1877 — New Diatoms from Honduras, with notes by F.Kitton. *Monthly microscopic journal* 18: 165-186, pl. 193-196.

HOLMGREN P.K. & HOLMGREN N. H. — 1998 onwards (continuously updated) - *Index Herbariorum,* New York Botanical Garden. http://sciweb.nybg.org/science2/IndexHerbariorum.asp

REID G., 2008 — A revision of the family Pleurosigmataceae (Bacillariophyta). *Diatom monographs* 10: in press.

ROSS R., COX E.J., KARAYEVA N.I., MANN D.G., PADDOCK T.B.B., SIMONSEN R. & SIMS P.A., 1979 — An amended terminology for the siliceous components of the diatom cell. *Beihefte zur nova Hedwigia* 64: 513-533.