

WOLF-HENNING KUSBER, MALTE ELBRÄCHTER & REGINE JAHN

## Algae of the Ehrenberg collection – 2. The type specimens of two dinoflagellate names published by C. G. Ehrenberg

### Abstract

Kusber, W.-H., Elbrächter, M. & Jahn, R.: Algae of the Ehrenberg collection – 2. The type specimens of two dinoflagellate names published by C. G. Ehrenberg. – Willdenowia 35: 205-210. – ISSN 0511-9618; © 2005 BGBM Berlin-Dahlem.

The genus *Prorocentrum* was published by C. G. Ehrenberg in 1834 from the Baltic Sea. *P. micans*, the type of the name of the genus by monotypy, and the scarcely known *P. viride* are illustrated and lectotypified.

### Introduction

Ehrenberg (1834) based his new genus *Prorocentrum* Ehrenb. (*Dinophyceae*), on a single species, *P. micans* Ehrenb. Later, Ehrenberg (1840) added a second species, *P. viride* Ehrenb. Another dinoflagellate, described by Ehrenberg (1860) as *Cryptomonas lima* Ehrenb., was transferred to *Prorocentrum* by F. Stein (1883). Typification of the latter species will be addressed in a separate paper. In its current circumscription, the genus *Prorocentrum* (*Dinophyceae*) comprises many species and is widely distributed in marine, especially coastal waters. Some species are toxic and/or causing red-tide discolorations (Taylor & al. 2003).

*Prorocentrum micans* is a morphologically variable species, causing non-toxic red tides. Early monographs (e.g., Schiller 1933, Dodge 1975) used only morphological characters to describe the species. Ultrastructural characters were added by Dodge & Bibby (1973) and molecular characters were included by Zardoya & al. (1995) and Grzebyk & al. (1998). Recent studies have shown an infraspecific genetic variability even within one mass development of *P. micans* and the ecological implications are not well understood (Shankle & al. 2004).

In contrast to the well known and often reported *P. micans*, *P. viride* was published by Ehrenberg without an illustration and has neither been adequately assessed in the literature nor reported from the field since.

### Material and methods

The following material of Ehrenberg was studied at the Ehrenberg collection (BHUPM): Taxonomic preparations No. 540164-1 [CLXIV 1] and No. 540164-2 [CLXIV 2]; drawing sheets No. 1026 and 1028 (for further details see Jahn & Kusber 2004.). The measurements were carried out by using an Olympus 80x: IC 80/0.75. Because the material was air dried without pressure, the cells are not in one plane, so that the measurements do not give the exact dimensions.

### Observations and discussion

*Prorocentrum* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin, Phys. Kl. 1833: 307. 1834.

Type: *Prorocentrum micans* Ehrenb.

*Prorocentrum micans* Ehrenb. in Abh. Königl. Akad. Wiss. Berlin, Phys. Kl. 1833: 307. 1834.

Lectotype (designated here): Preparation No. 540164-1 (BHUPM). The cell in the lower ring is illustrated here as Fig. 2-4; the cell on the right hand side beside the upper ring at 2 o'clock position is Fig. 5. The later published figure "Ehrenberg (1835, [t. 2] fig. VI, 6a-h)", illustrated by McLachlan & al. (1997: 39, fig. 1) is not eligible as lectotype and hence erroneously cited as such.

*Further original material.* – Drawing sheet No. 1026 "*Prorocentrum micans*, 25 Nov. 1832" (BHUPM), see Fig. 1.

*Locus typicus.* – "Ostseewasser aus Kiel" [Germany]. Further information in Ehrenberg (1834: 307) reads: "Am 25. November 1832 im Ostseewasser aus Kiel in Berlin von mir lebend beobachtet". In 1830 and 1832 Ehrenberg performed experiments in Berlin with water samples from the Baltic Sea, sent by Dr Michaelis (Ehrenberg 1835: 536-537). The samples of September 1832, studied until November 1832 by C. G. Ehrenberg were the basis for his description of *P. micans*.

*Original description.* – "P. flavum, testa compressa, apice mucronata. Proboscis filiformis, cilia nulla", "Länge 1/36" [= 62.7 µm]".

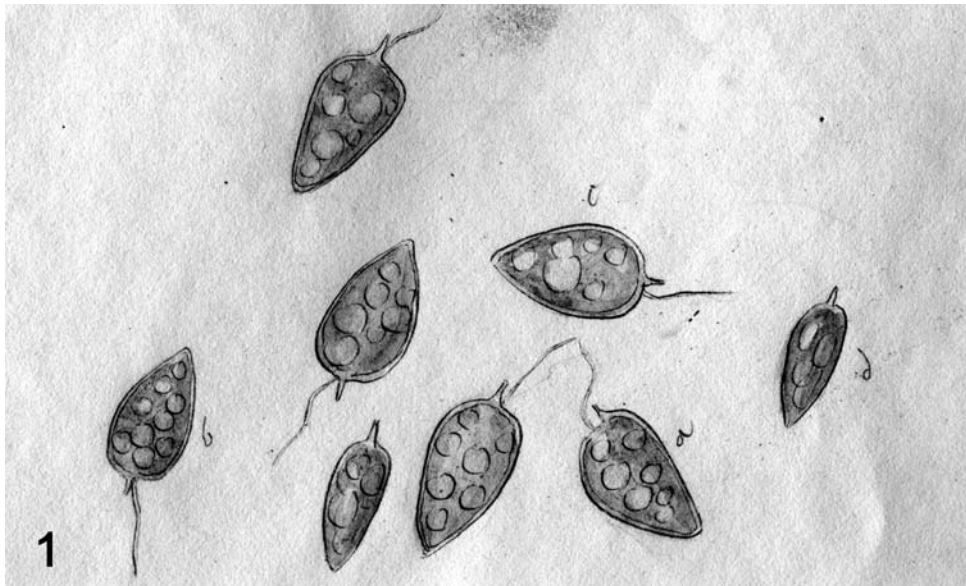


Fig. 1. *Prorocentrum micans*, part of drawing sheet No. 1026 in BHUPM, the specimen "c" is marked with an exclamation mark.

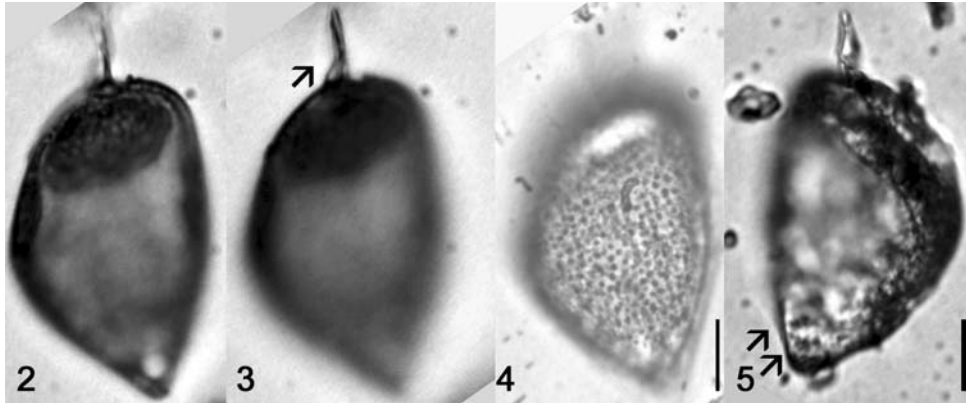


Fig. 2-5. *Prorocentrum micans*, preparation No. 540164-1 in BHUPM, lectotype – 2-4: cell, representing the lectotype; 2: outline; 3: apical spine (arrow); 4: poroids of the cell surface; 5: second cell on preparation No. 540164-1 in BHUPM, two rows with three trichocyst pores visible (arrows). – Scale bars = 10  $\mu$ m.

**Observation.** – Drawing sheet No. 1026 (Fig. 1) shows eight cells, which were published in Ehrenberg (1835: t. 2, fig. 6a-h). The copper plate engraving by Wiencker is more schematic than the original drawings of C. G. Ehrenberg. The taxon was again illustrated in Ehrenberg (1838: t. 2, fig. 23) by a different engraver (C. E. Weber). The four cells were depicted according to a master copy (original drawing or copper plate engraving of the original publication), hence they are a later interpretation of original material. On preparation No. 540164-1 there are two small rings, marking some cells. The cell depicted as Fig. 2-4 has a total length of 55.8  $\mu$ m, including an apical spine of 10.8  $\mu$ m (0.19  $\times$  the total length) and is 28.2  $\mu$ m wide. The basis of the apical spine has a diameter of 2.8  $\mu$ m. The length : width ratio of the cell is 1.98 : 1 (respectively 1.60 : 1, without the apical spine). The poroids of the cell on the lectotype slide have a diameter of about 0.7 to 0.8  $\mu$ m (see Fig. 4). The length of a second cell in the same ring can not be measured, the width is 30  $\mu$ m. In the upper ring there is one cell of 46.8  $\mu$ m (excluding an oblique apical spine of about 10  $\mu$ m length) in lateral view. Outside the rings there is a 54  $\mu$ m long cell including an apical spine of 7.2  $\mu$ m. Besides *P. micans* the preparation includes the brackish marine dinophyte *Dinophysis* sp. and the diatom *Cocconeis scutellum* Ehrenb.

**Comments.** – Although there are only a few taxonomic preparations prior to 1835 in the Ehrenberg collection, we assume that preparation No. 540164-1 was in Ehrenberg's hand when describing *P. micans*. "Meeresleuchten", i.e. bioluminescence, was a major topic at that time, hence he deposited a voucher of his 1832 findings.

***Prorocentrum viride*** Ehrenb. in Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin 1840: 201. 1840.

Lectotype (designated here): Preparation No. 540164-2 (BHUPM); the taxon is represented by a marked cell, illustrated in Fig. 8-9.

**Further original material.** – Drawing sheet No. 1028 (BHUPM), see Fig. 6-7.

**Locus typicus.** – "In mari baltico" [Germany]. The complete information is given on drawing sheet No. 1028, it reads: "e mari baltico. Wismar 5 Sept. 1840, observata etiam Berolini in aqua mari baltici 20 Sept. 1840".

**Original description.** – "P: corpore minore ovato suborbiculari turgido, postico fine rotundato, aculeo frontis brevioris interno colore viridi. Magn. 1/96" [= 24.5  $\mu$ m]".

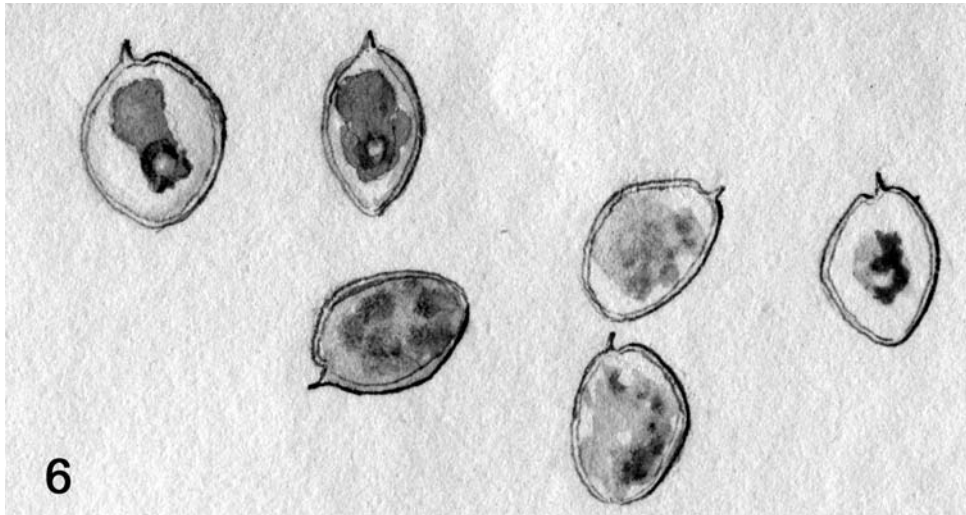


Fig. 6: *Prorocentrum viride*, part of drawing sheet No. 1028 in BHUPM.

*Observation.* – On drawing sheet No. 1028 there are six cells of the same size from a living sample (see Fig. 6). On preparation No. 540164-2 (“*Prorocentrum viride*, Wismar”, according to the unpublished taxonomic index in BHUPM), there is one cell, marked with a ring. The cell has a  $\pm$  symmetrical shape and a total length of 40.2  $\mu\text{m}$  including the apical spine of 4.8  $\mu\text{m}$  length ( $0.12 \times$  the total length). The width is 36.6  $\mu\text{m}$  and the L : W-ratio 1.23 : 1 (respectively 1.10 : 1, without spine). The cell dimension differs remarkably from the published data, an inconsistency that cannot be explained. The poroids of the cell have a diameter of less than 1  $\mu\text{m}$  (see Fig. 9) and no trichocyst pores are visible. Ehrenberg documented a ring-like structure, which is visible in the centre of the cell. It resembles a stalked pyrenoid with a starch sheath but from the dried preparation this interpretation cannot be verified.

*Comments.* – *Prorocentrum viride* was regarded by Stein (1883) as a taxonomic synonym of or a species closely related to *P. micans*. The legend in Stein (1883: ad t. 1) reads: “*Prorocentrum*

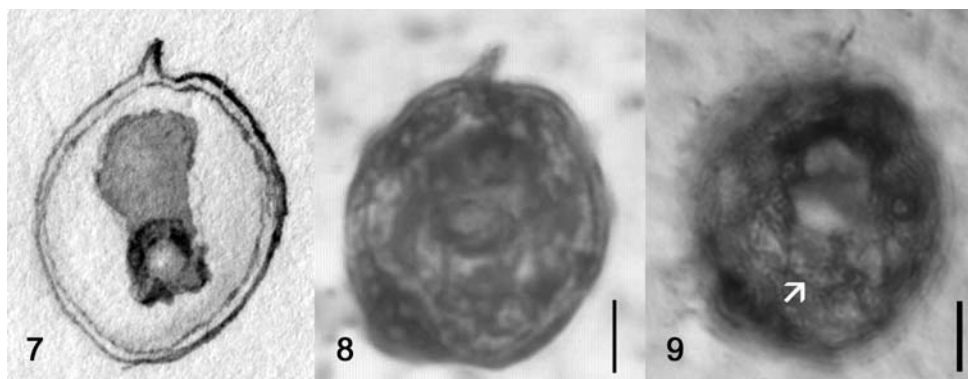


Fig. 7-9: *Prorocentrum viride* – 7: part of drawing sheet No. 1028 in BHUPM for comparison; 8-9: same cell in different focus on preparation No. 540164-2 in BHUPM, representing the lectotype, arrow indicates poroids on the cell surface. – Scale bars = 10  $\mu\text{m}$ .

*micans* Ehrbg. (und *Pror. viride* Ehrbg.)". *P. viride* was neglected by many authors. Dodge (1975) did not mention the name in his revision, whereas Schiller (1933: 35) mentioned it as a doubtful synonym of *P. micans* ("vix *P. micans*"). This may be due mainly to the lack of a published illustration by Ehrenberg (1840).

The cell on the lectotype slide differs clearly from *Prorocentrum micans* by its outline and the internal ring-like structure. The outline differs from all *Prorocentrum* species depicted in Schiller (1933) or Dodge (1975) by its more symmetrical shape with a short and robust apical spine. If *P. viride* has a stalked pyrenoid with starch sheath, this would be the best diagnostic feature. To our knowledge, until now Ehrenberg's taxon had not been investigated or documented.

### Acknowledgements

The work in and for the Ehrenberg collection, curated by David Lazarus, was financed by the German Federal Ministry of Education and Research, BMBF (AlgaTerra project, grant 01 LC 0026) within the BIOLOG program. The manuscript benefited from comments by Paul C. Silva and Werner Greuter.

### References

- Dodge, J. D. 1975: The *Prorocentrales* (*Dinophyceae*). II. Revision of the taxonomy within the genus *Prorocentrum*. – Bot. J. Linn. Soc. **71**: 103-125.
- & Bibby, B. T. 1973: The *Prorocentrales* (*Dinophyceae*). I. A comparative account of fine structure in the genera *Prorocentrum* and *Exuviaella*. – Bot. J. Linn. Soc. **67**: 175-187.
- Ehrenberg, C. G. 1834: Dritter Beitrag zur Erkenntnis großer Organisation in der Richtung des kleinsten Raumes. – Abh. Königl. Akad. Wiss. Berlin **1833**: 145-336.
- 1835: Das Leuchten des Meeres. Neue Beobachtungen nebst Übersicht der Hauptmomente der geschichtlichen Entwicklung dieses merkwürdigen Phänomens. – Abh. Königl. Akad. Wiss. Berlin **1834**: 411-575.
- Ehrenberg, C. G. 1838: Die Infusionsthierchen als vollkommene Organismen. – Leipzig.
- 1840: Charakteristik von 274 neuen Arten von Infusorien – Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin **1840**: 197-219.
- 1860: Verzeichniss der Leuchtthierchen. – Ber. Bekanntm. Verh. Königl. Preuss. Akad. Wiss. Berlin **1859**: 791-793.
- Grzebyk, D., Sako, Y. & Berland, B. 1998: Phylogenetic analysis of nine species of *Prorocentrum* (*Dinophyceae*) inferred from 18S ribosomal DNA sequences, morphological comparisons, and description of *Prorocentrum panamensis*, sp. nov. – J. Phycol. **34**: 1055-1068.
- Jahn, R. & Kusber, W.-H. 2004: Algae of the Ehrenberg collection. 1. Typification of 32 diatom taxa described by C. G. Ehrenberg. – Willdenowia **34**: 577-595.
- McLachlan, J. L., Boalch, G. T. & Jahn, R. 1997: Reinstatement of the genus *Exuviaella* (*Dinophyceae*, *Prorocentrophycidae*) and assessment of *Prorocentrum lima*. – Phycologia **36**: 38-46.
- Schiller, J. 1933: *Dinoflagellatae* (*Peridineae*) in monographischer Behandlung. Teil 1. – In: Kolkwitz, R. (ed.), Dr. L. Rabenhorst's Kryptogamen-Flora von Deutschland, Österreich und der Schweiz **10**. – Leipzig.
- Shankle, A. M., Mayali, X. & Franks, P. J. S. 2004: Temporal patterns in population genetic diversity of *Prorocentrum micans* (*Dinophyceae*). – J. Phycol. **40**: 239-247.
- Stein, F. 1883: Der Organismus der Infusionsthierchen. **3(2)**. – Leipzig.
- Taylor, F. J. R., Fukuyo, Y., Larsen, J. & Hallegraeff, G. M. 2003: Taxonomy of harmful dinoflagellates. – Pp. 389-432 in: Hallegraeff, G. M., Anderson, D. M. & Cembella, A. D. (ed.), Manual on harmful marine microalgae. – Paris.

Zardoya, R., Costas, E., López-Rodas, V., Garrido-Pertierra, A. & Bautista, J. M. 1995: Revised dinoflagellate phylogeny inferred from molecular analysis of large-subunit ribosomal RNA gene sequences. – *J. Molec. Evol.* **41**: 637-645.

Addresses of the authors:

Wolf-Henning Kusber and Dr Regine Jahn, Botanischer Garten und Botanisches Museum Berlin-Dahlem, Freie Universität Berlin, Königin-Luise-Str. 6-8, 14191 Berlin, Germany; e-mails: w.h.kusber@bgbm.org, r.jahn@bgbm.org

Dr Malte Elbrächter, Deutsches Zentrum für Biodiversitätsforschung, Forschungsinstitut Senckenberg; Wattenmeerstation Sylt, Hafenstr. 43, 25992 List/Sylt, Germany; e-mail: melbraechter@awi-bremerhaven.de