

Revision of some spathidiid genera
(Alveolata, Ciliophora, Spathidiida)

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Cover: *Epispathidium papilliferum* (front; see Fig. 6.11h–j in Chapter 6); *Neospathidium longinucleatum* (back; see Fig. 12.9j–l in Chapter 12)

In memory of Wilhelm Foissner (1948–2020)

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Preface, authorship, acknowledgements, and funding

The spathidiids have been one of several favorite ciliate groups of Wilhelm Foissner. In 2001, W. Foissner started a revision of this large group of haptorids. During processing his huge archive after his sudden death in 2020, I found a well-advanced manuscript dealing with several spathidiid genera. In order to prevent this manuscript from being forgotten, I have decided to publish it in my monographic series on ciliates.

W. Foissner collected most samples, made the in vivo observations, the preparations, many morphometries, and wrote text. K. Xu made morphometries and illustrations, compiled the plates, and wrote text. I updated the text of the raw manuscript, organized the deposition of the slides in the Biology Centre of the Upper Austrian Museum in Linz, wrote the front matter, the general introduction, the material and method section including the summary of taxa (Chapter 1), the brief introduction to the spathidiids (Chapter 2), the chapter on *Neocultellothrix* Foissner nov. gen. (Chapter 13), and the back matter (index). Further, I made the layout and produced the final PDF.

The help of the following persons must be acknowledged: Sabine Agatha, Remigius Geiser, Eva Herzog, Wolf-Dietrich Krautgartner, Brigitte Moser, Birgit Peukert, Fritz Seyrl, and Andreas Zankl. Colleagues who provided samples are acknowledged in the individual species descriptions. I also want to thank Magdalini Christodoulou and Alexandra Aberham at the Biology Centre of the Upper Austrian Museum in Linz for help with the transfer of the Foissner archive from Salzburg to Linz.

Wilhelm Foissner, Kuidong Xu, and co-workers involved in this project got financial support by the Austrian Science Fund FWF (Project P15017-B06, “Monographie der Familie Spathidiidae (Ciliophora)”). I wish to thank Ilse Foissner who generously privately financed my work on this book.

Salzburg
January 2025

Helmut Berger (Publisher)
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Abstract

Foissner W., Xu K. & Berger H. (Eds) (2025): Revision of some spathidiid genera (Alveolata, Ciliophora, Spathidiida). – Ser. Monogr. Cilioph. 6: i–xv, 1–465.

This book deals with some spathidiid taxa. The following genera are treated and established, respectively: *Apospathidium* Foissner et al., 2002; *Centrospathidium* nov. gen.; *Epispathidium* Foissner, 1984; *Latispathidium* Foissner et al., 2005; *Schmidingerophrya* nov. gen.; *Semibryophyllum* nov. gen.; *Semispathidium* Foissner et al., 2002; *Supraspathidium* Foissner & Didier, 1981; *Pharyngospathidium* nov. gen. (type genus of Pharyngospathidiidae nov. fam.); *Neospathidium* nov. gen.; *Neocultellothrix* Foissner nov. gen. The latter genus “replaces” *Cultellothrix* Foissner, 2003, an unavailable genus because no holotype was fixed for the type species in the original description. In addition, 12 *Spathidium* species are reviewed, and three new species assigned to this genus are described. In total, four new subspecies, 19 new species, six new genera, and one new family are described, 13 species are transferred to other genera, and 41 known species and two subspecies are reviewed. Further, three “*Spathidium* groups” are discussed. The type slides of the new species and voucher slides of the redescribed species are documented.

Key words: Alveolata; biogeography; Ciliophora; cyst; diversity; Haptoria; monograph; morphogenesis; nomenclature; Protista; revision; soil biology; systematics; taxonomy

Chapter 5

***Centrospathidium* nov. gen. (Ciliophora, Spathidiidae), a new genus whose type species was discovered in an Australian floodplain¹**

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Abstract

Centrospathidium nov. gen. is based on the type species *Centrospathidium verrucosum* nov. spec., which was discovered in soil from the floodplain of the Murray River, Australia. A main feature of *Centrospathidium* nov. gen. is the short oral bulge which only partially occupies the anterior body end. *Centrospathidium faurei* (Kahl, 1930) nov. comb. and *Centrospathidium minutum* (Kahl, 1926) nov. comb. are provisionally assigned.

***Centrospathidium* nov. gen.**

Nomenclature: *Centrospathidium* is a composite of the Latin noun *centrum* (centre; Werner 1972, p. 128) and the genus-group name *Spathidium* (small spatula; see also nomenclature of genus *Spathidium* in Chapter 2, that is, Berger et al. 2025b), referring to both the central location of the oral apparatus and the similarity with the members of the genus *Spathidium*. Like *Spathidium* of neuter gender (Aescht 2001, p. 300).

Diagnosis: Obovate Spathidiidae(?) with slightly oblique and concave anterior body end only partially occupied by the oblong oral bulge. Dorsal brush row 1 partially covered by a cortical ridge.

Type species: *Centrospathidium verrucosum* nov. spec.

¹ This chapter should be referenced as follows: Foissner W., Xu K. & Berger H. (2025): *Centrospathidium* nov. gen. (Ciliophora, Spathidiidae), a new genus whose type species is from Australia. – Ser. Monogr. Cilioph. 6: 127–140. For notes on “Material and methods”, see Chapter 1 (Berger et al. 2025a).

Species assigned: *Centrospathidium verrucosum* nov. spec (type species); *Centrospathidium faurei* (Kahl, 1930) nov. comb. (original combination *Spathidium faurei*); *Centrospathidium minutum* (Kahl, 1926) nov. comb. (original combination *Spathidium minutum*).

ZooBank registration: urn:lsid:zoobank.org:act:937A51B7-7537-48C8-A2E7-B40110817875

Remarks: *Spathidium faurei* and *Spathidium minutum*, both described by Kahl, have the same type of oral apparatus as *Centrospathidium verrucosum* and a very similar body shape (Kahl 1926, 1930b). Thus, they are transferred to the new genus. *Spathidium lieberkuehnii*, Bütschli, 1889, which Kahl (1930b, p. 150) erroneously furnished with a centrospathidid oral apparatus, belongs to *Spathidium* Dujardin, 1841 or *Supraspathidium* Foissner & Didier, 1981.

The three species assigned to this new genus have a unique oral apparatus/bulge. In contrast to all other spathidiids, the oral bulge is rather distinctly concave and does not extend over the whole anterior body end but is slightly shortened ventrally and dorsally. The second generic feature, viz., the peculiar dorsal brush, is not known in *Centrospathidium faurei* and *Centrospathidium minutum*; if these species have an ordinary brush, they should be separated from *Centrospathidium verrucosum* at subgenus level.

Unfortunately, *Centrospathidium verrucosum* was rare and impregnated poorly. Thus, the ciliary pattern could not be revealed unequivocally. Likely, it is a *Spathidium* pattern. Considering the unique oral bulge, we even cannot exclude that such species belong to the Enchelyodontidae Foissner et al., 2002.

Key to species

- 1 Body length > 50 μm ; extrusomes long ($\sim 10 \mu\text{m}$) 2
- Body length about 40 μm ; extrusomes short ($\leq 5 \mu\text{m}$)
..... *Centrospathidium minutum* (p. 138)
- 2 With many cortex warts containing bundles of extrusomes; terrestrial; without symbiotic green algae *Centrospathidium verrucosum* nov. spec. (p. 128)
- Without cortex warts; planktonic; with symbiotic green algae
..... *Centrospathidium faurei* (p. 136)

Centrospathidium verrucosum nov. spec.

(Fig. 5.1a–s, 5.2a–q, Table 5.1)

Nomenclature: The species-group name *verrucosu-us*, *-a*, *-um* (Latin adjective [m, f, n], rich in warts, covered with wart-like outgrowths; Hentschel & Wagner 1996, p. 606) refers to a main feature of the species, viz., the warts caused by the extrusome bundles.

Diagnosis: Body size about $65 \times 40 \mu\text{m}$ in vivo. Obovate with narrowly oblong oral bulge occupying about 60% of widest trunk region. Macronucleus reniform. Two types of extrusomes: oral toxicysts form single row in right half of oral bulge, rod-shaped and slightly curved, about 7 μm long; somatic extrusomes form bundles and cortex warts between ciliary

Table 5.1 Morphometric data on *Centrospathidium verrucosum* nov. spec.^a

Characteristic	Mean	M	SD	SE	CV	Min	Max	n
Body, length	58.4	60.0	8.0	1.7	13.7	44.0	75.0	21
Body, width	39.2	40.0	4.7	1.0	12.1	31.0	49.0	21
Body length:width, ratio	1.5	1.5	0.2	-	11.9	1.3	2.1	21
Oral bulge, length	22.8	22.0	4.4	1.0	19.2	14.0	30.0	21
Oral bulge, width	3.2	3.0	0.8	0.3	26.4	2.0	5.0	8
Oral bulge, height	1.7	1.5	-	-	-	1.0	2.0	17
Oral bulge length:body width, ratio	0.6	0.6	0.1	0.1	14.5	0.4	0.7	21
Dorsal brush ridge, height	1.8	2.0	-	-	-	1.5	2.0	5
CK to last dikinetid of brush row 1, distance	15.4	14.0	2.8	1.2	18.1	13.0	20.0	5
CK to last dikinetid of brush row 2, distance	16.2	16.0	1.8	0.8	11.0	14.0	19.0	5
CK to last dikinetid of brush row 3, distance	7.3	6.5	1.9	0.9	26.1	6.0	10.0	4
Anterior body end to macronucleus, distance	22.0	21.0	6.6	1.4	29.9	10.0	41.0	21
Macronucleus, length	20.9	22.0	4.5	1.0	21.6	13.0	32.0	21
Macronucleus, width	8.3	8.0	1.2	0.3	14.4	6.0	10.0	21
Macronucleus, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	21
Micronucleus, diameter	2.9	3.0	-	-	-	2.5	3.0	9
Micronucleus, number	1.0	1.0	0.0	0.0	0.0	1.0	1.0	9
Somatic kineties, number	30.7	30.0	-	-	-	30.0	32.0	3
Dorsal brush rows, number	3.0	3.0	0.0	0.0	0.0	3.0	3.0	9
Dikinetids in brush row 1, number	17.8	17.0	3.1	1.5	17.4	15.0	22.0	4
Dikinetids in brush row 2, number	16.6	17.0	2.1	0.9	12.5	14.0	19.0	5
Dikinetids in brush row 3, number	10.7	9.0	-	-	-	9.0	14.0	3

^a Data based on mounted, protargol-prepared (Foissner's method), and randomly selected specimens from a non-flooded Petri dish culture. Measurements in μm . CK – circumoral kinety, CV – coefficient of variation in %, M – median, Max – maximum, Mean – arithmetic mean, Min – minimum, n – number of individuals investigated, SD – standard deviation, SE – standard error of arithmetic mean.

rows, rod-shaped and ca. 10 μm long. About 30 ciliary rows. Dorsal brush inconspicuous, row 3 about half as long as rows 1 and 2.

Type locality: Soil from Murray River floodplain near the town of Albury at the land-side of Ryans Road (36.1126°S 146.9730°E), Australia.

Type material: The slide (Fig. 5.2k, l; accession number 2002/708) containing the holotype (Fig. 5.1m–o) and three paratype slides (Fig. 5.2m–q; 2024/236, 237, 238) have been deposited in the Biology Centre of the Upper Austrian Museum in Lin (LI).²

ZooBank registration: urn:lsid:zoobank.org:act:B62D4767-6AF7-4A31-A284-81C C5E8BC713

continued on p.134

² Note by H. Berger: The name of *Centrospathidium verrucosum* nov. spec. on the type slides is "*Centrospathidium verruculosum*" (see Fig. 5.2k–q; this incorrect name is disclaimed for nomenclatural purposes, ICZN 1999, Article 8.3). The slides were labelled before the final species-group name of this species was fixed. The slide (Fig. 5.2k, l) containing the holotype of *Centrospathidium verrucosum* nov. spec. also contains the holotype of *Bilamellophrya australiensis* Foissner et al., 2002 and paratypes of *Enchelydium blattereri* Foissner et al., 2002. A paratype slide (Fig. 5.2m, n) also contains an Australian voucher specimen of *Neospathidium longinucleatum* Foissner et al., 2025 (see Chapter 12, that is, Foissner et al. 2025).

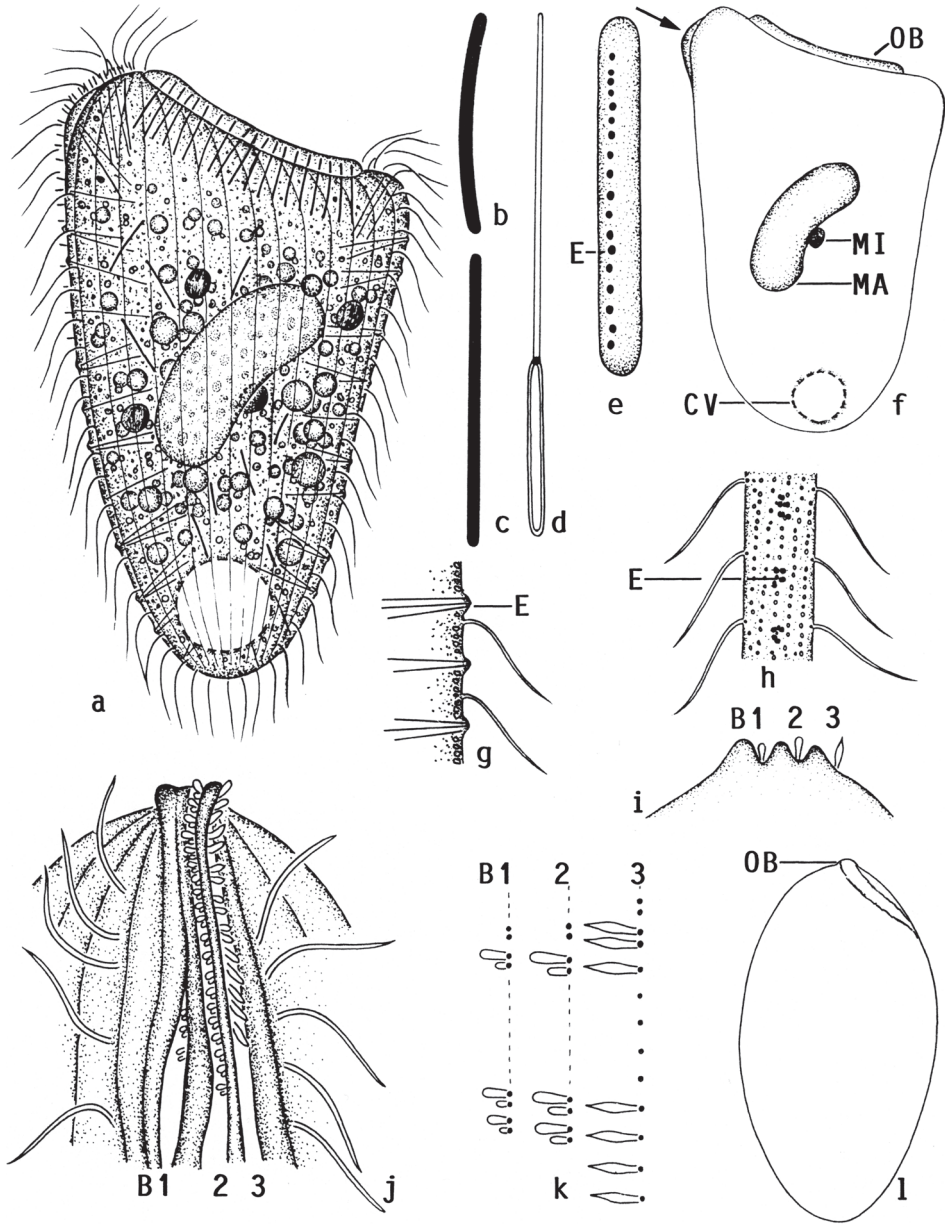


Fig. 5.1a-l *Centrospathidium verrucosum* nov. spec. (originals. From life). **a, f:** Right side view of representative specimens, 70 µm. Arrow in (f) marks dorsal brush ridge. **b, c:** Oral (7 µm) and somatic (10 µm) extrusomes. **d:** Exploded somatic extrusome, 30 µm. **e:** Frontal view of oral bulge. **g, h:** Optical section and surface view showing body extrusomes and cortical granulation. **i-k:** Dorsal brush as seen in transverse view (i), in the scanning electron microscope (j), and in surface view (k). Note that most of brush row 1 is covered by a cortical ridge. **l:** Ventrolateral view. B1-3 – dorsal brush rows, CV – contractile vacuole, E – extrusomes, MA – macronucleus, MI – micronucleus, OB – oral bulge.

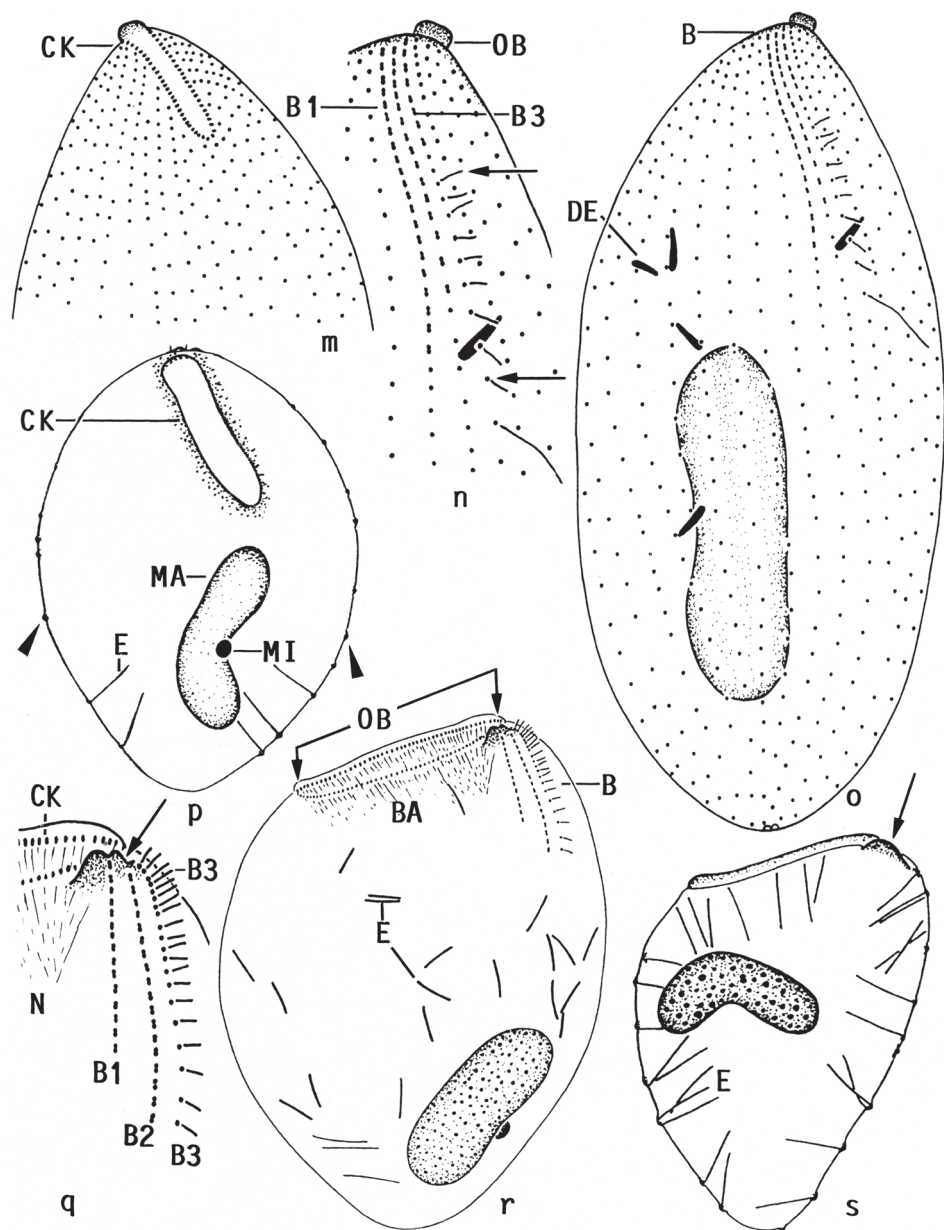


Fig. 5.1m–s *Centrospathidium verrucosum* nov. spec. (originals. Protargol preparation). Somatic and oral ciliary pattern and nuclear apparatus. **m–o**: Ventral and dorsal view of holotype specimen showing, inter alia, ciliature and macronuclear apparatus, 75 μ m. Arrows in (n) mark bristle tail of brush row 3. **p**: Ventral view, 66 μ m. Arrowheads mark extrusome warts. **q–s**: Left side views showing details of the oral apparatus and dorsal brush, 68 μ m, 60 μ m. Arrows in (q, s) mark cortical ridge covering brush row 1. B – dorsal brush, B1–3 – dorsal brush rows, BA – oral basket, CK – circumoral kinety, DE – developing extrusome, E – body extrusomes, MA – macronucleus, MI – micronucleus, N – nematodesmata, OB – oral bulge.

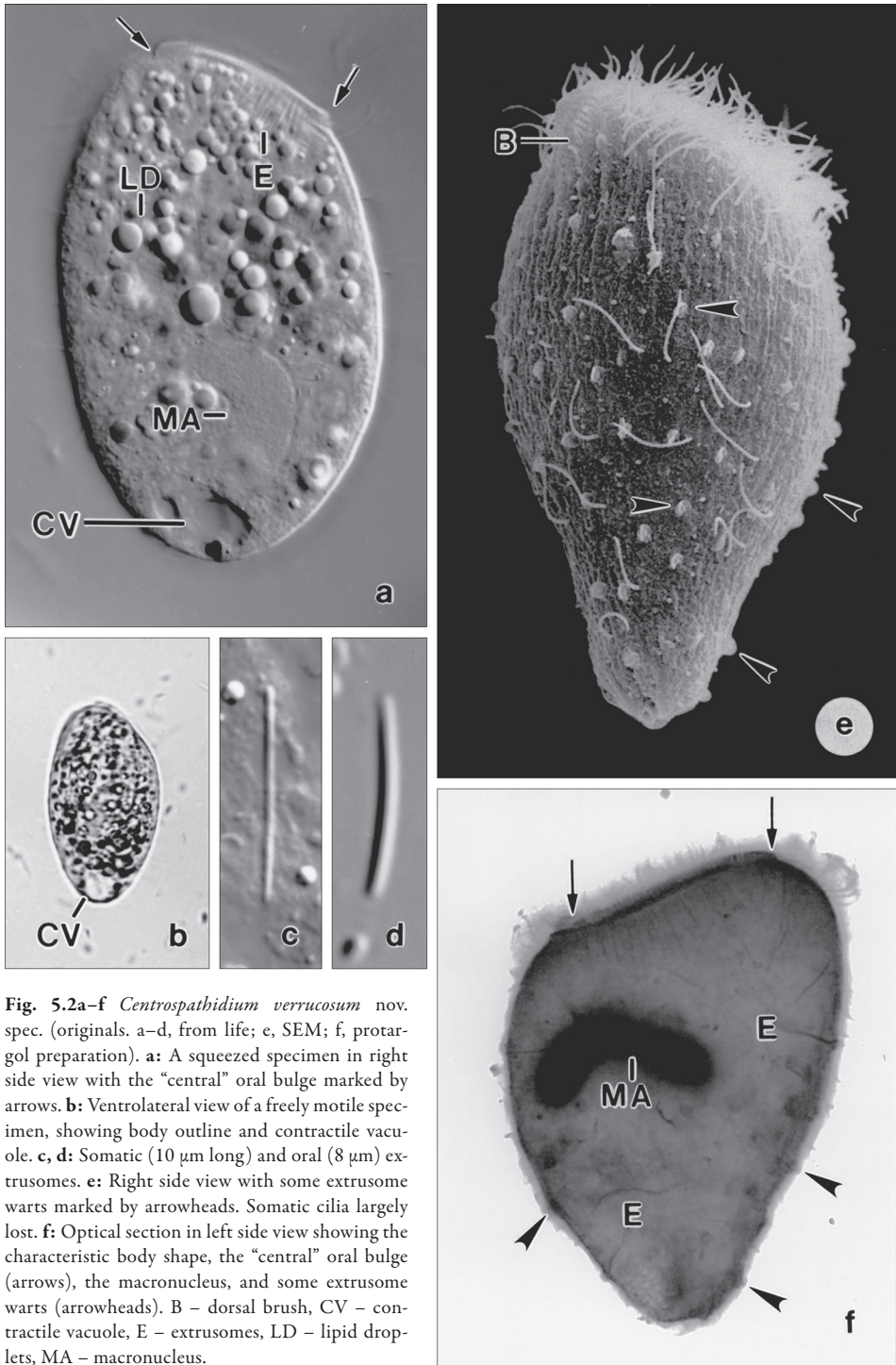


Fig. 5.2a–f *Centrospathidium verrucosum* nov. spec. (originals. a–d, from life; e, SEM; f, protargol preparation). **a:** A squeezed specimen in right side view with the “central” oral bulge marked by arrows. **b:** Ventrolateral view of a freely motile specimen, showing body outline and contractile vacuole. **c, d:** Somatic (10 µm long) and oral (8 µm) extrusomes. **e:** Right side view with some extrusome warts marked by arrowheads. Somatic cilia largely lost. **f:** Optical section in left side view showing the characteristic body shape, the “central” oral bulge (arrows), the macronucleus, and some extrusome warts (arrowheads). B – dorsal brush, CV – contractile vacuole, E – extrusomes, LD – lipid droplets, MA – macronucleus.

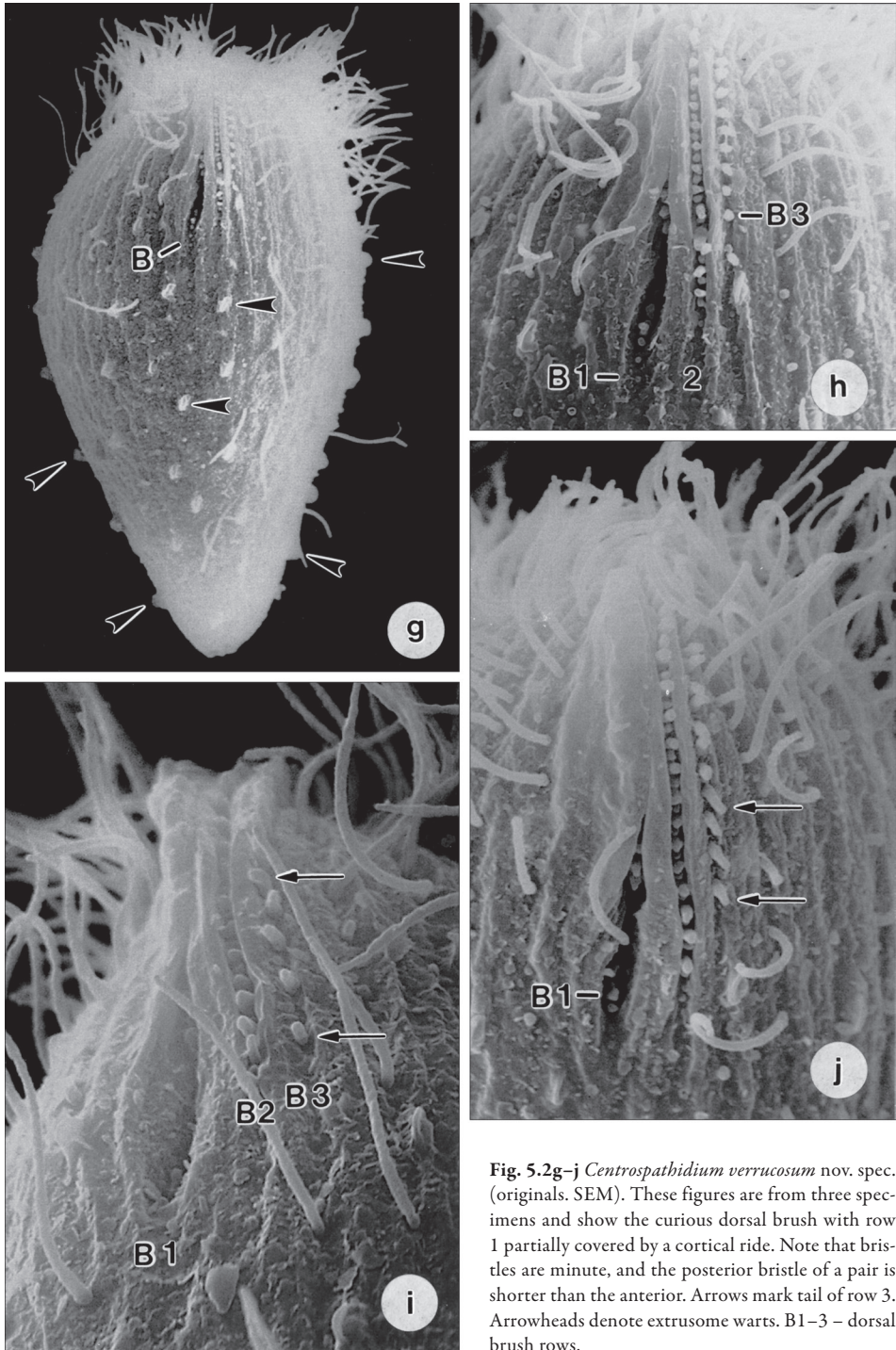


Fig. 5.2g–j *Centrospathidium verrucosum* nov. spec. (originals. SEM). These figures are from three specimens and show the curious dorsal brush with row 1 partially covered by a cortical ridge. Note that bristles are minute, and the posterior bristle of a pair is shorter than the anterior. Arrows mark tail of row 3. Arrowheads denote extrusome warts. B1–3 – dorsal brush rows.

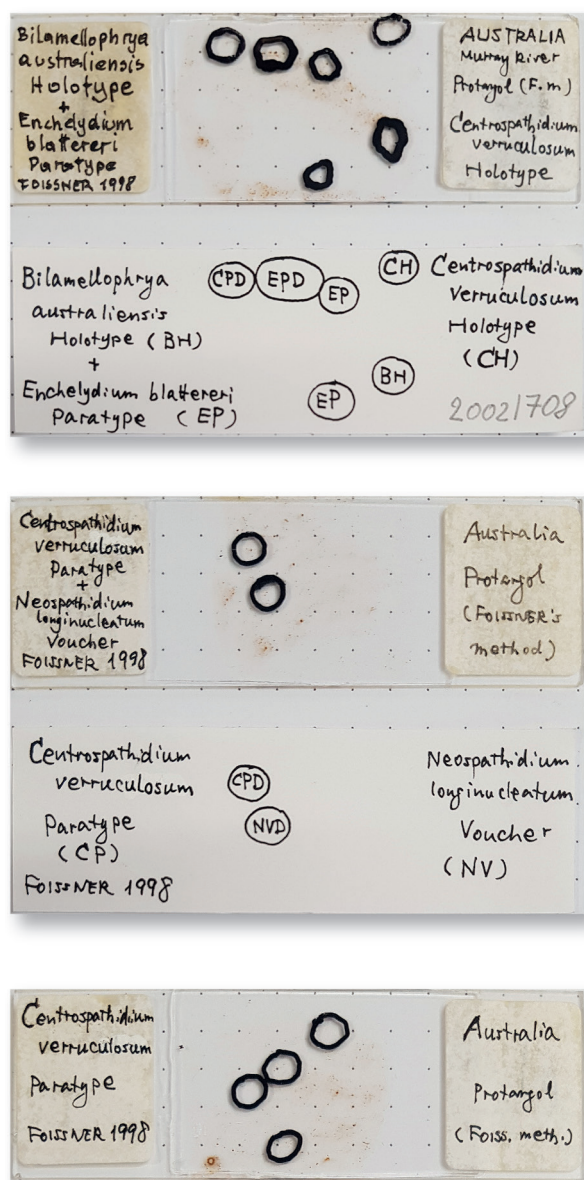


Fig. 5.2k–o *Centropathidium verrucosum* nov. spec. (originals. Protargol slides). **k, l**: Slide (k) and protocol (l) containing the holotype (CH) and a paratype drawn (CPD). Accession number (LI): 2002/708. Note that this slide is also the holotype slide of *Bilamellophrya australiensis* Foissner et al., 2002 (BH) and a paratype slide of *Enchelydium blattereri* Foissner et al., 2002 (EP, EPD). **m, n**: Slide (m) and protocol (n) containing a paratype drawn (CPD). Accession number (LI): 2024/236. Note that this slide also contains an Australian voucher specimen of *Neospathidium longinucleatum* Foissner et al., 2025. **o**: Slide containing paratypes of *Centropathidium verrucosum*. Accession number: 2024/237. The name “*Centropathidium verrucosum*” is an incorrect name of *Centropathidium verrucosum* which is disclaimed for nomenclatural purposes (ICZN 1999, Article 8.3).

Remarks: This new species is clearly defined by the unique dorsal brush and the somatic extrusome warts. The general appearance and size are very similar to *Centropathidium faurei* (p. 136).

Description: The preparations are of poor quality. Thus, the data on the ciliary pattern are incomplete. Despite, we describe this species because we have detailed in vivo observations

and some good scanning electron micrographs perfectly supplementing the protargol data.

Body size 50–85 × 30–50 μm, usually about 65 × 40 μm in vivo, as calculated from some in vivo measurements and the morphometric data; length:width ratio 1.3–2.1:1 in protargol-prepared specimens, on average near 1.5:1 both in vivo and in preparations (Table 5.1). About 1.5:1 flattened laterally, thus ellipsoidal in dorsal and ventral view, while obovate to bursiform and widest subapically when viewed laterally, broad anterior (oral) body

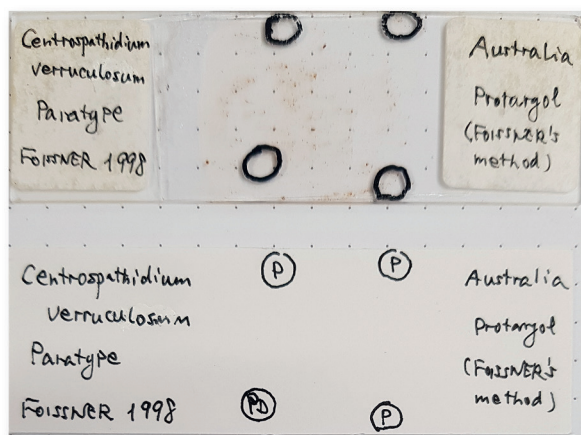


Fig. 5.2p, q *Centrospathidium verruculosum* nov. spec. (originals. Protargol slide). p, q: Slide (p) and protocol (q) of a slide containing paratypes (P) and a paratype drawn (PD). Accession number (LI): 2024/238. The name “*Centrospathidium verruculosum*” is an incorrect name of *Centrospathidium verrucosum* which is disclaimed for nomenclatural purposes (ICZN 1999, Article 8.3).

margin distinctly rounded at ends and slightly oblique and concave, gradually narrowed posteriorly with rear end narrowly to broadly rounded; rarely broadly clavate (Fig. 5.1a, f, l, o, p, r, s, 5.2b, e–g; Table 5.1). Nuclear apparatus usually in middle body third, rarely near body ends. Macronucleus slightly to distinctly reniform, contains many nucleoli up to 2 μm across. Micronucleus globular, attached to mid-region of macronucleus, usually faintly impregnated (Fig. 5.1a, f, o, p, r, s, 5.2a, f; Table 5.1). Contractile vacuole in rear body end, some excretory pores in pole area. Oral and body extrusomes rod-shaped, both about 30 μm long and of typical toxicyst structure after explosion; rarely faintly impregnated with the protargol method used. Oral extrusomes form single row in right half of bulge, a rare pattern checked in several specimens; slightly curved and about $7.0\text{--}8.0 \times 0.5 \mu\text{m}$ in size. Body extrusomes between ciliary rows, form small, serially arranged bundles attached to about 1 μm high cortex warts difficult to discern in vivo, but usually clearly recognizable in protargol preparations and SEM; straight and about $10.0 \times 0.4 \mu\text{m}$ in size, that is, slightly longer and thinner than oral toxicysts; warts possibly contain a further extrusome type, viz., about 1.5 μm long rods faintly impregnating with protargol (Fig. 5.1a–e, g, h, o, r, s, 5.2a, c–g). Cortex flexible, distinctly furrowed in dorsal brush area, contains about five rows of colourless, minute ($\leq 0.3 \mu\text{m}$) granules between two ciliary rows each; granules impregnate intensely and cover the ciliary pattern. Cytoplasm colourless, usually packed with lipid droplets 1–5 μm across and some food vacuoles containing green and colourless protists, specimens thus refractive and dark at low magnification ($\leq 100\times$). Swims moderately rapid rotating about main body axis.

Somatic cilia about 11 μm long in vivo, arranged in about 30 ordinarily spaced and ciliated rows likely abutting to circumoral kinety in *Spathidium* pattern (Fig. 5.1a, m, o; Table 5.1). Brush located exactly dorsally, dikinetidal and three-rowed, occupies about 28% of body length, individual rows continue posteriorly as ordinary somatic kineties, inconspicuous in vivo because bristles only about 2 μm high, but distinct in the scanning electron microscope where three specimens show the same, curious pattern (Fig. 5.2g–j). Individual rows in deep furrows, anterior two thirds of row 1 covered by an about 2.0–2.5 μm high

ridge recognizable also in vivo as a hyaline convexity; posterior third of row 1 in deep, ellipsoidal concavity not covered by the cortical ridge. Brush rows 1 and 2 of similar length each composed of about 17 dikinetids with posterior bristle shorter than anterior; row 3 about half as long as rows 1 and 2, composed of about nine dikinetids and followed by a monokinetidal bristle tail extending to mid-body (Fig. 5.1a, f, j, k, n, o, q–s, 5.2e, g–j; Table 5.1).

Oral apparatus occupies about 60% of the slightly oblique ($\leq 30^\circ$) and concave anterior body end, inconspicuous because bulge only about 2 μm high and thus indistinctly set off from body proper. Oral bulge narrowly oblong in frontal view and slightly concave (Fig. 5.1a, e, f, r, s, 5.2a, f; Table 5.1). Circumoral kinety of same shape as oral bulge, continuous and separate from ciliary rows, composed of ordinarily spaced dikinetids each associated with a cilium and a short, faintly impregnated nematodesma; oral basket thus indistinct (Fig. 5.1m, p, r).

Occurrence and ecology: As yet found only at the type locality (see above), where it was rare in the non-flooded Petri dish culture. The habitat is floodplain litter (mainly leaves from red gum trees and dry *Myriophyllum*) and light brown soil with pH 5.2. Thus, it is not known whether *Centrospathidium verrucosum* is a limnetic or soil species.

Centrospathidium faurei (Kahl, 1930) nov. comb.

(Fig. 5.3a–e)

- 1924 *Spathidium lieberkühni* Bütschli – Fauré-Fremiet, Bull. biol. Fr. Belg. Suppl. 6: 120, Fig. 37 (Fig. 5.3a; misidentification; no permanent preparations available).
 1930 *Spathidium faurei* spec. n. – Kahl, Arch. Protistenk. 70: 363, Fig. 4e (Fig. 5.3b; original description, based on the description of Fauré-Fremiet 1924; no type material available).
 1930 *Spathidium faurei* Kahl, 1930 – Kahl, Tierwelt Dtl. 18: 150, Fig. 22₅ (Fig. 5.3c; revision).
 1936 *Spathidium faurei* Kahl – Krüger, Zoologica 34: 22 (misidentification?; Fig. 5.3e).
 1943 *Spathidium faurei* Kahl – Kahl, Infusorien, p. 25, Tafel 5 Fig. 3 (redrawing of Fig. 5.3c; brief review).
 1972 *Spathidium faurei* Kahl 1930 – Bick, Binnengewässer 26: 64, Abb. 34 (Fig. 5.3d; review on planktonic ciliates).

Nomenclature: Named in honour of Prof. Dr. Fauré-Fremiet who described but misidentified the species. The original spelling of the species-group name is “*faurëi*” (Kahl 1930a, p. 363). The mark at the letter “ë” must be deleted according to ICZN (1999, Article 32.5.2.1).

Remarks: For a justification for the transfer from *Spathidium* to *Centrospathidium*, see remarks at genus section. All solid morphological data are from Fauré-Fremiet (1924) because the notes by Krüger (1936) suggest that he dealt with a different species with ellipsoidal macronucleus, stout extrusomes, and without symbiotic green algae. Bick (1972) added only data on food and conjugation. Thus, redescription is needed to reveal details of the extrusomes, ciliary pattern and, especially, the dorsal brush. At the present state of knowledge, *Centrospathidium faurei* differs from the congeners by the bursiform shape, the distinctly concave anterior end, and the symbiotic green algae.

Description (based on the original data of Fauré-Fremiet 1924 if not stated otherwise): Body length about 70 μm in vivo. Body shape bursiform, rear body half hemispherical, anterior region flattened laterally; anterior margin obliquely truncate and distinctly concave causing hump-shaped dorsal end. Macronucleus in mid-body, spherical. Contractile vacuole in posterior body end. Extrusomes 10–20 μm long and fine, according to the illustration of

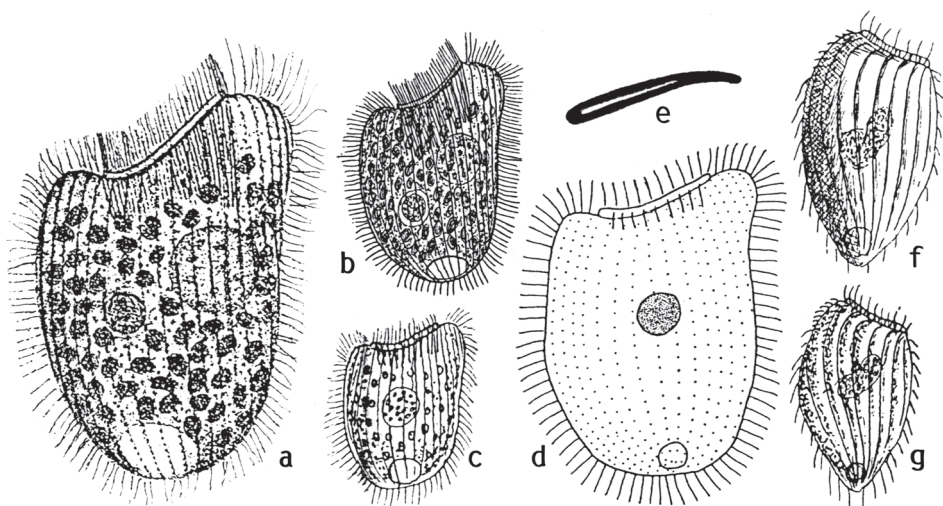


Fig. 5.3a–e *Centrospathidium faurei* (Kahl, 1930) nov. comb. (from life. a, from Fauré-Fremiet 1924; b, c, from Kahl 1930a, b, based on Fauré-Fremiet 1924; d, from Bick 1972, based on Kahl 1930b, the figure is not based on silver impregnation though it looks like this; e, from Krüger 1936, likely a misidentification). **a–d**: Left side views, about 70 μm . **e**: Extrusome, length 9–12 μm .

Fig. 5.3f, g *Centrospathidium minutum*, (Kahl, 1926) nov. comb. (from life. f, from Kahl 1926; g, from Kahl 1930b). Right side view, 30 μm (f), 40 μm (g).

Fauré-Fremiet (1924), who interpreted it as “trichites”; according to Krüger (1936), who likely misidentified the species, extrusomes very narrowly ovate, slightly curved, 9–12 μm long when resting and about 30 μm when exploded (Fig. 5.3e). Cytoplasm packed with zoochlorellae. Swims slowly in surface water. About 40 meridionally extending ciliary rows, according to figure by Fauré-Fremiet (1924); dorsal brush not mentioned. Oral opening marked by a minute ridge and a layer of extrusomes, occupies about 70% of widest trunk region.

Conjugation: Conjugating specimens unite with the anterior dorsal and ventral end (Bick 1972).

Occurrence and ecology: Fairly frequent in the type locality, that is, in the surface plankton of clear ponds in the surroundings of Paris (48°N 2°E), France (Fauré-Fremiet 1924). The following records lack illustrations, but most are likely correct because *Centrospathidium faurei* is a very characteristic species: castle moat in the city of Münster, Germany, where great numbers occurred during a bloom of sulphur bacteria (Krüger 1936; see remarks above for supposed misidentification); in a small lake (Plußsee) in northern Germany, where Reck (1987, p. 63) observed up to 544 ind./l in the April surface plankton at a temperature of about 8.5°C, pH 8.6, and 13.9 mg/l O_2 (118% saturation); in fish aquaria (Günkel 1997, p. 221, a review); in the upper 5 mm mud layer of a Polish fishpond which received sugar factory wastes (Grabacka 1977, p. 380); in putrid waters of the city of Hakodate, Japan (Muramatsu 1957, p. 467). Feeds on other protists and is probably only facultative planktonic (Bick 1972).

***Centrospathidium minutum* (Kahl, 1926) nov. comb.**

(Fig. 5.3f, g)

1926 *Spathidium minutum* spec. nov.³ – Kahl, Arch. Protistenk. 55: 269, Textfig. B_{1a} (Fig. 5.3f; no type material available; for note on figure, see remarks).

1930 *Spathidium minutum* Kahl, 1926 – Kahl, Tierwelt Dtl. 18: 156, Fig. 22₂₀ (Fig. 5.3g; revision of ciliates).

1943 *Spathidium minutum* Kahl – Kahl, Infusorien, p. 25, Tafel V, Fig. 48 (a redrawing of Fig. 5.3g; update of Kahl 1930b).

Nomenclature: No etymology has been provided in the original description or in a later work. The species-group name *minut-us*, -a, -um (Latin adjective [m; f; n]; very small, tiny; Hentschel & Wagner 1996, p. 400) refers to the small body length of 30 µm (Kahl 1926). Since *Centrospathidium* is neuter (see above), *minutum* is correct (ICZN 1999, Article 31.2).

Diagnosis (by data of Kahl 1926, 1930b): Body size about 40 × 30 µm. Obovate with oral bulge occupying about 70% of widest trunk region. Macronucleus reniform. Extrusomes short. About 20 deeply furrowed ciliary rows. Dorsal brush distinct.

Remarks: For a justification of the transfer from *Spathidium* to *Centrospathidium*, see remarks at genus section. Since the original description is based only on in vivo observations, a detailed redescription is needed. The small size and the short extrusomes indicate that it is different from *Centrospathidium verrucosum* and *Centrospathidium faurei*. “(Textfig. A_{1a})” in the heading of Kahl (1926) is incorrect; correct is “Textfig. B_{1a}”.

Description: The following data are based on the brief descriptions by Kahl (1926, 1930b) and the corresponding illustrations (Fig. 5.3f, g). Body length 30 µm (40 µm according to Kahl 1930b, 1943); body obovoid, narrowed posteriorly; asymmetrically ventricose, slightly flattened laterally. Macronucleus reniform. Contractile vacuole in posterior body portion. Cilia short and loosely spaced, arranged in about 20 (calculated from figures) ordinarily spaced rows deeply furrowing the cortex. Dorsal brush distinct. Oral bulge low and long, but does not reach ventral and dorsal margin.

Occurrence and ecology: As yet found only at the type locality, namely in a shallow ditch filled with leaves in the Eppendorfer Moor (about 53.61°N 9.99°E), a bog near the city of Hamburg, Germany. This is also the type locality of *Spathidium vermiculus* Kahl, 1926 (p. 269). Once abundant in April (Kahl 1926); a few times with low abundance on other sapropelic sites (likely in the same area; Kahl 1930b).

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³ Kahl (1926) provided the following description: “Nur 30 µ lang, unsymmetrisch bauchig. Mundsaum niedrig und breit, Rückenborsten deutlich, lateral etwas abgeplattet tief und eng gerillt.”

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Index

Systematic index

The index contains all ciliate names mentioned in the book, including vernacular names for example, haptorids. Designations as, for example, “haptorid ciliates” are mentioned under the corresponding vernacular name, that is, “haptorids” in present example. Names in singular (e.g., haptorid) are mentioned under the plural version (e.g., haptorids). The index is two-sided, that is, species appear both with the genus-group name first (for example, *Apospathidium atypicum*) and with the species-group name first (*atypicum*, *Apospathidium*). Valid (mainly in W. Foissner’s judgement) species and genera treated in detail are in boldface italics print. Valid taxa not treated in detail in the present book, invalid taxa, junior homonyms, synonyms, outdated combinations, incorrect spellings, and nomina nuda are not in bold. Suprageneric taxa are represented in normal type, valid ones treated in detail in the present work in boldface. A boldface page number indicates the beginning of the description of a valid taxon. “T” indicates the location of the table with the morphometric characterisation; “K” marks a key (e.g., of the genus *Apospathidium*) and the page where a taxon is mentioned in a key. The names on the slide figures and the names of the subchapter “Summary of nomenclatural acts and taxa described in Chapters 1–13” (see Chapter 1, pp. 18–20) are not included.

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