

Chlorophyceae and Zygnematophyceae from the Turvo State Forest Park, state of Rio Grande do Sul, Brazil

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ABSTRACT – This paper presents the results of the taxonomic study of Chlorophyceae and Zygnematophyceae from lotic and lentic environments in the Turvo State Forest Park, in Rio Grande do Sul, Brazil. Thirty-five samples were gathered during November and December 1995 and February 1996. Fifty taxa were identified, which were assigned to Chlorophyceae (11) and Zygnematophyceae (39) belonging to the five orders: Chaetophorales (3), Desmidiaceae (33), Oedogoniales (6), Ulotrichales (2), and Zygnematales (6). Zygnematophyceae was the richest class (77.5% of species). *Closterium* and *Cosmarium* with ten and nine taxa, respectively, were the best represented genus on the material studied. Twenty-two of these taxa are new records for the State of Rio Grande do Sul and one of them for Brazil.

Key words: Chlorophyta, metaphyton, periphyton, plankton, taxonomy.

RESUMO – **Chlorophyceae e Zygnematophyceae do Parque Florestal Estadual de Turvo, Rio Grande do Sul, Brasil.** São apresentados os resultados do estudo taxonômico de Chlorophyceae e Zygnematophyceae de alguns ambientes lóticos e lênticos do Parque Florestal Estadual do Turvo, Rio Grande do Sul, Brasil. Foram analisadas 35 amostras coletadas durante os meses de novembro e dezembro de 1995 e fevereiro de 1996. Cinquenta táxons foram identificados como representantes das classes Chlorophyceae (11) e Zygnematophyceae (39) pertencentes às seguintes cinco ordens: Chaetophorales (3), Desmidiaceae (33), Oedogoniales (6), Ulotrichales (2) e Zygnematales (6). A classe mais bem representada foi Zygnematophyceae com 77,5% dos táxons identificados. Os gêneros *Closterium* e *Cosmarium* respectivamente com dez e nove táxons foram os mais bem representados nos ambientes estudados. Vinte e dois táxons constituem primeiras citações para o Rio Grande do Sul, sendo um destes também para o Brasil.

Palavras-chave: Chlorophyta, metafiton, perifiton, plâncton, taxonomia.

INTRODUCTION

Phycology in Brazil has a relatively recent scientific history, with just over 50 years of actual and continued studies. The ample dimensions of the country and its diversity of continental environments caused gaps in knowledge about algal flora from several geographic areas. The Turvo State Forest Park comprises a good example. Fifty-four years after its establishment, the algal inventory is restricted to a single article (Callegaro *et al.*, 1993) on diatoms.

The Turvo State Forest Park (27°-27°20'S and 53°40'-54°10'W) was the first park established in the State of Rio Grande do Sul, in March 1947, in the

municipality of Derrubadas, being called Turvo State Reserve. It occupies an area 17, 491.40 ha and has a total perimeter of 90 km, a reduced anthropic action and about 80% of original fauna and flora. The park comprises a subtropical rainforest, with grassy marshes, rivers, streams, and lagoons. Also notable is the Yucumã Falls (Salto do Yucumã) on the border of Brazil and Argentina, the longest longitudinal waterfall in the world.

The present study, based on the qualitative analysis of samples collected in some lotic and lentic environments in the park, comprises a pioneering taxonomic inventory for green algae. Short descriptions, photomicrographs and information on the geographic distribution of the identified taxa are given.

MATERIALS AND METHODS

The thirty-five samples analyzed were collected in November and December 1995; and February 1996, in lotic (streams and rivers) and lentic (occasional pools and lagoons) environments, in the Turvo State Forest Park (Map 1).

The sampling methodology allowed the study of different communities, as follows: a) manual collection of algal mass (metaphytic and periphytic community); b) flask skimming on the water surface (planktonic community) and, c) collection and scraping of varied substrata (periphytic community).

Measurements of some abiotic water variables were taken in the field only in some samples: pH measurements were taken by means of an Analion pHmeter, model PM603; water electric conductivity ($\mu\text{S}\cdot\text{cm}^{-1}$) was measured with a Digimed portable field conductivimeter, model CD-2P; water temperature ($^{\circ}\text{C}$) was measured with an Elidi digital thermometer, model TH-1200C.

The samples were immediately fixed and preserved with Transeau's solution. Study of material was carried out with an OLYMPUS, model BH-2,

binocular microscope with camera-lucida and phase contrast condenser, micrometer and equipped for the taking of photomicrographs and image analysis kit (Image-pro Plus 4.5), Media Cybernetics software model.

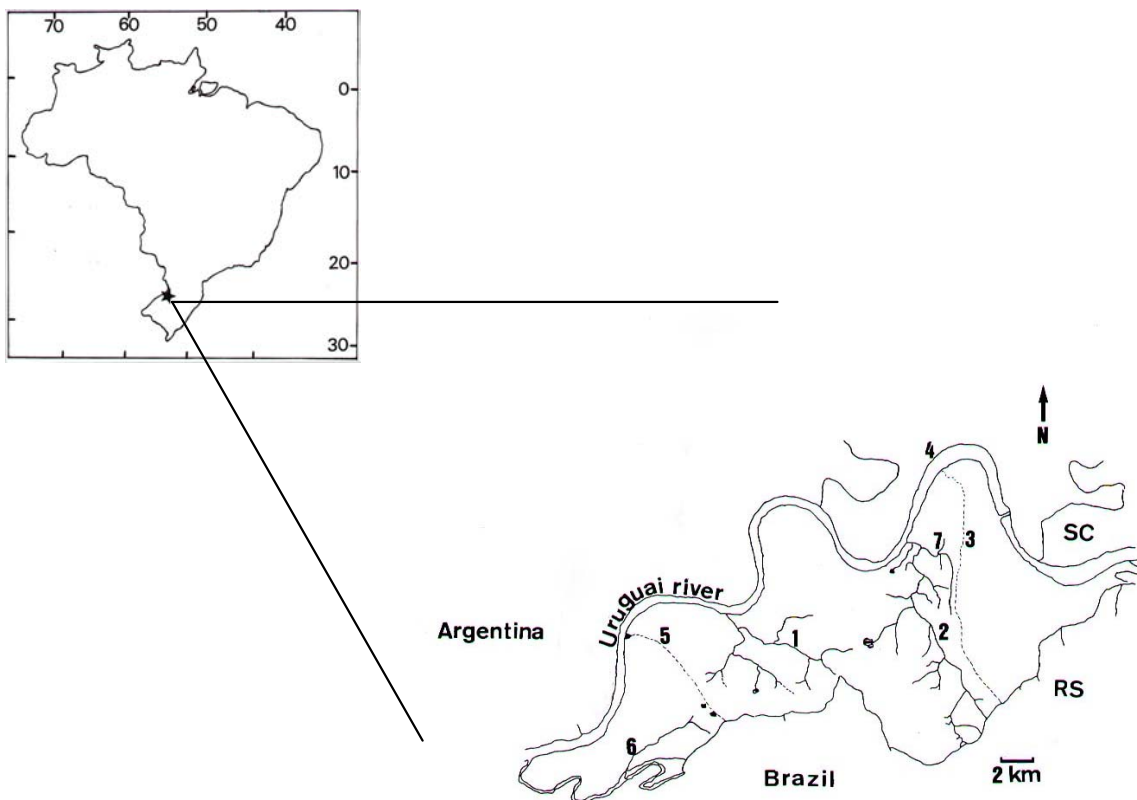
Geographic distribution was based the published and available literature for Brazil. Desmids were based only on the Torgan *et al.* (2001). The continental distribution was based on Prescott *et al.* (1972, 1975, 1977), Prescott *et al.* (1981), Prescott *et al.* (1982), Croasdale *et al.* (1983), Kadlubowska (1984), Mrozinska (1985) among others.

The presentation of classes and orders follows the alphabetic order within Hoek *et al.* (1997), except for *Microspora*, for wich Ramanathan (1964) was adopted.

For Desmidiatales the measures shows length \times width and for the others orders the inverse, as usual in the specific papers for each algal group.

After fixation, all samples were stored at the National Museum Herbarium (R) of the "Universidade Federal do Rio de Janeiro" (UFRJ).

The samples studied are described in Table 1.



Map 1. Rio Grande do Sul, Brazil. 1. Calixto river; 2. Mairoza river; 3. Yucumã waterfall road; 4. Yucumã waterfall; 5. Porto Garcia road; 6. Fabio stream; 7. Meio rivulet (modified from Affonso, 1998).

TABLE 1 – List of the samples studied from lotic and lentic environments of Turvo State Forest Park, Derrubadas, Rio Grande do Sul State, Brazil, gathered during November and December 1995 and February 1996, including number (R), place, date and gatherer.

R	Place	Date	Gatherer
201815-201821	Mairosa river (Stuary), occasional pool.	18/XI/1995	R.O. Affonso
201822	stream close to Yucumã waterfall.	19/XI/1995	R.O. Affonso
201823, 201824	Uruguai river, border, close to Yucumã waterfall.	19/XI/1995	R.O. Affonso
201825	Yucumã waterfall, occasional pool.	19/XI/1995	R.O. Affonso
201826	Golden lake, Porto Garcia road, occasional pool.	30/XI/1995	R.O. Affonso
201827	Calixto, small stream, next to farming.	22/XI/1995	R.O. Affonso
201828-201831	Fabio's stream.	06/XII/1995	R.O. Affonso
201832-201834	Meio rivulet.	11/XII/1995	R.O. Affonso
201835	Ouro lake, Porto Garcia road, km 2.	16/II/1996	R.O. Affonso/L.H.S. Silva
201836	Porto Garcia road, km 3, occasional pool.	16/II/1996	R.O. Affonso/L.H.S. Silva
201837	Porto Garcia road, occasional pool.	16/II/1996	R.O. Affonso/L.H.S. Silva
201838	Calixto road, lagoon 1.	17/II/1996	R.O. Affonso/L.H.S. Silva
201839	Calixto road, lagoon 2.	17/II/1996	R.O. Affonso/L.H.S. Silva
201840	Calixto road, occasional pool.	17/II/1996	R.O. Affonso/L.H.S. Silva
201841	Derrubadas road, lagoon, near to new downtown.	17/II/1996	R.O. Affonso/L.H.S. Silva
201842	Porto Garcia road, km 2,8, lagoon 3.	21/II/1996	R.O. Affonso/L.H.S. Silva
201843	Porto Garcia road, occasional pool.	21/II/1996	R.O. Affonso/L.H.S. Silva
201844	Porto Garcia road, km 5,9, lagoon	21/II/1996	R.O. Affonso/L.H.S. Silva
201845	Bacurau lagoon, Porto Garcia road, km 5,9, lagoon	21/II/1996	R.O. Affonso/L.H.S. Silva
201846-201847	Yucumã waterfall, stream	22/II/1996	R.O. Affonso/L.H.S. Silva
201848	Yucumã waterfall road, km 1, lagoon 2	22/II/1996	R.O. Affonso/L.H.S. Silva
201849	Yucumã waterfall road, lagoon 1, near the gate	22/II/1996	R.O. Affonso/L.H.S. Silva

RESULTS

Chlorophyceae

Chaetophorales

Aphanochaete repens A. Braun, **Betrachtungen über ... in der Natur**, p. 196. 1851.

(Fig. 1)

Filaments creeping on *Oedogonium* sp., vegetative cells subcylindric, 7.5-10.5 µm diameter; setae long and slender, 3-4 µm wide at the bulbous base; 1 chloroplast parietal.

Studied material: R 201818.

Distribution: cosmopolitan; BRAZIL: Dias (1990); Franceschini (1992).

Habitat: metaphyton; filaments associated with Chlorococcales *sensu lato*, diatoms, desmids, euglenoids, filamentous green algae.

Schizomeris leibleinii Kützing, **Phycol. Gener.**, p. 247. 1843.

(Figs. 13, 14)

Filaments slightly constricted at regular intervals; basal part with fixation disc, uniseriate, 25-35 µm in diameter; median and distal portions multiseriate

40-72 µm in diameter; chloroplast parietal, laminate at the uniseriate portion, perforate at the multiseriate portion, 1-3 pyrenoids.

Studied material: R 201816 and 201824.

Distribution: cosmopolitan; BRAZIL: Dias (1985, 1989); Franceschini (1992); Necchi & Moreira (1995); Necchi & Pascoaloto (1993); Necchi *et al.* (1994, 1995).

Habitat: metaphyton, periphyton; filaments associated with cyanobacteria, Chlorococcales *sensu lato*, diatoms, desmids, filamentous green algae, flagellates.

Uronema gigas Vischer, **Beih. Bot. Zbl.**, v. 51 (A), p. 74-77. 1933.

(Fig. 2)

Filaments isolated, attached to substratum, constriction at cross walls of some cells; vegetative cells 10-12 (-13.5) × 19.5-22 µm; apical cell gradually tapered to the apex, acute, straight or apex slightly curved; chloroplast parietal, laminate, occupying about 3/4 of cell length, 1-4 pyrenoids.

Studied material: R 201816.

Distribution: Europe, South America; BRAZIL: Fermio (1997), Dias & Bicudo (2001).

Habitat: metaphyton, periphyton; filaments associated with cyanobacteria, diatoms, desmids, filamentous green algae.

Oedogoniales

Bulbochaete sp.

(Fig. 6)

Vegetative cells doliformis 9-12 × 9-15 µm, filaments sterile.

Studied material: R 201818.

Oedogonium borisianum (Le Clerc) Wittrock var. *borisianum* f. *borisianum*, **Öfvers. K. VetenskAkad. Förh.**, v. 3, p. 132. 1870 (1871)

(Fig. 5)

Dioecious, nannandrous; vegetative cells 15-17 × 57-66.5 µm; suffultory cells 28.5-32.5 × 57-63 µm; oogonium single, obovoid or quadrangular-ellipsoid, pore superior, 38-41 × 41.5-44 µm; oospore ovoid to quadrangular-ovoid, 35-39 × 38-42 µm; spore wall smooth; dwarf male on suffultory cell 11.5 × 28.5-34.5 µm.

Studied material: R 201837.

Distribution: Africa, Asia, North America, South America; BRAZIL: Hirn (1900); Dias (1995).

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, water temperature 22°C, conductivity 10 µS.cm⁻¹.

Oedogonium lageniforme Hirn var. *lageniforme* f. *lageniforme* **Acta Soc. Sci. Fenn.**; v. 27, p. 291. 1900.

(Fig. 10)

Dioecious, macrandrous; female vegetative cells 13-13.5 × 38-57.5 µm; oogonium single obpyriform, pore superior, 30-34.5 × 47.5 µm; oospore globose to ellipsoid 28.5 × 29.5 × 26-35.5 µm; spore wall smooth; antheridium 12 × 6-8.5 µm.

Studied material: R 201837.

Distribution: Africa, Asia, Europe, North America, Oceania, South America; BRAZIL: Hirn (1900); Borge (1925); first citation for the state of Rio Grande do Sul.

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, desmids,

diatoms, dinoflagellates, filamentous green algae; pH 5.0, water temperature 22°C, conductivity 10 µS.cm⁻¹.

Oedogonium sociale Wittrock in Wittrock & Nordstedt ex Hirn var. *sociale* f. *sociale*, **Acta Soc. Sci. Fenn.**, v. 27, p. 79. 1900.

(Fig. 4)

Dioiceous, macrandrous; female and male vegetative cells 13-14 (-16) × 43-58 µm; oogonium single globose to subglobose, pore median, 30-38 × 32-40 µm; oospore globose 34-35 × 35-36 µm; spore wall smooth; antheridium 10-14 × 9-12 µm.

Studied material: R 201818.

Distribution: Africa, Asia, Europe, North America, South America; BRAZIL: Dias, 1992; first citation for the state of Rio Grande do Sul.

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Oedogonium subdissimile Jao **Sci. Press.**, p. 536. 1979.

(Figs. 8, 9)

Dioecious, macrandrous; female vegetative cells (7-)10-12 × 30-45 µm, male 8-10 × 30-55 µm; oospore globose-subglobose, pore superior, (21-)25-30 × (24-)26-32 µm; oospore globose-subglobose 20-23 × 20-24 µm; antheridium 9-12 × 15-28 µm.

Studied material: R 201837.

Distribution: Asia; BRAZIL: first citation of occurrence of this species.

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 µS.cm⁻¹.

Comments: This species was known until now only by original diagnose.

Oedogonium subplagiostomum Ley var. *subplagiostomum* f. *subplagiostomum*, **Bot. Bull. Acad. Sin.**, v. 3, p. 103. 1949.

(Figs. 11, 12)

Dioecious, macrandrous; female vegetative cells 11-12 × 35-40 µm, male 8-9 × 30-45 µm; oogonium 1-2

ovoid to globose, pore superior, $28.5-32 \times 32-36 \mu\text{m}$; oospore globose $26-30 \mu\text{m}$; spore wall smooth; antheridium 3-5, sperms 2, $8.5-9 \times 5.5-9.5 \mu\text{m}$.

Studied material: R 201816, 201818, 201825 and 201837.

Distribution: Asia, South America; BRAZIL: Dias (1992); first citation for the state of Rio Grande do Sul.

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, diatoms, euglenoids, dinoflagellates, desmids, Chlorococcales *sensu lato*, filamentous green algae; pH 5.0, temperature 22°C , conductivity $10 \mu\text{S}\cdot\text{cm}^{-1}$.

Ulotrichales

Microspora quadrata Hazen, **Mem. Torrey bot. Club.**, v. 11, p. 178. 1902.

(Fig. 3)

Vegetative cells short cylindrical or quadratic $6.5-7(-9.5) \times 7.5-9.5(-11.5) \mu\text{m}$; cell wall thin, H – piece moderately distinct; chloroplast plate-like partially covering the cell.

Studied material: R 201824 and 201845.

Distribution: Africa, Asia, North America, South America; BRAZIL: Necchi *et al.* (1994, 1995, 1997 – as *M. stagnorum*); Necchi *et al.* (2000 – as *M. stagnorum*); Necchi *et al.* (2002); first citation for the state of Rio Grande do Sul.

Habitat and abiotic variables: metaphyton, periphyton; filaments associated with cyanobacteria, diatoms, desmids, flagellates, green algae; pH 6.3, water temperature 22°C , conductivity $50 \mu\text{S}\cdot\text{cm}^{-1}$.

Microspora willeana Lagerheim, **Ber. dt. bot. ges.**, v. 5, p. 514. 1887.

(Fig. 7)

Vegetative cells cylindrical or quadratic $(10.5-) 12-14 \times 12-16(-18) \mu\text{m}$; cell wall thin; H – pieces scarcely distinct in vegetative cell; chloroplast a perforated plate covering only the side walls.

Studied material: R 201816.

Distribution: Asia, Europe, North America, South America; BRAZIL: Dias (1989); Prescott (1957); first citation for the state of Rio Grande do Sul.

Habitat: metaphyton, periphyton; filaments associated with cyanobacteria, diatoms, desmids, filamentous green algae.

Zygnematophyceae

Desmidiaceae

Closterium ehrenbergii Meneghini ex Ralfs var. *ehrenbergii*, **Brit. Desm.**, p. 166, pl. 28. 1848.

(Fig. 28)

Cells strongly curved, 130° of arc, 5-6 times longer than broad, $500-600 \times 90-100 \mu\text{m}$; ventral margin concave, tumid middle portion, poles obtusely rounded; wall smooth, chloroplast with many scattered pyrenoids, with terminal vacuoles.

Studied material: R 201832.

Distribution: Asia, Europe, North America, Oceania, South America; BRAZIL (state of Rio Grande do Sul): Borge (1903); Ungaretti (1981a, b); Rosa *et al.* (1987); Rosa *et al.* (1988); Franceschini (1992).

Habitat: metaphyton; associated with cyanobacteria, diatoms, Chlorococcales *sensu lato*, filamentous green algae.

Closterium exiguum West; West G.S., **Trans. Linn. Soc. Lond.**, v. 6, p. 141. 1902.

(Fig. 44)

Cells strongly curved, 160° of arc, 18-19 times longer than broad, $54-60 \times 2-3 \mu\text{m}$, w. at apex $0.7-0.8 \mu\text{m}$; ventral and dorsal margin concave; large cells in the midregion, attenuated to strongly acutely poles; walls smooth.

Studied material: R 201818.

Distribution: Asia, Europe, North America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat: metaphyton; associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Comments: *Closterium exiguum* differs from *Cl. parvulum* Nägeli var. *angustum* West; West for displaying, the former taxon acute poles, whereas the latter, rounded poles. It also differs from *Cl. acutum* Brébisson var. *variabile* (Lemmermann) Kriger, for the latter displays narrower cells in its longer extension, as well as for showing a large variety of forms, changing the cell curvature, a feature not observed in the studied material which always presented itself in a constant form.

Closterium gracile Brébisson ex Ralfs var. *gracile*, **Brit. Desm.**, p. 221. 1848.

(Fig. 45)

Cells almost straight, 40-42 times longer than broad, $200-210 \times 5-6 \mu\text{m}$, w. apex $1-2 \mu\text{m}$; dorsal and margins parallel, gradually narrowed curved toward the apical region; apices obliquely truncate.

Studied material: R 201818 and 201837.

Distribution: widespread; BRAZIL (state of Rio Grande do Sul): Borge (1903); Bicudo & Ungaretti (1986); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, Chlorococcales *sensu lato*, diatoms, desmids, dinoflagellates, euglenoids, filamentous green algae; pH 5.0, temperature 22°C , conductivity $10 \mu\text{S}\cdot\text{cm}^{-1}$.

Closterium incurvum Brébisson, **Mem Soc. Imp. Sci. Nat. Cherbourg**, v. 4, p. 150, pl. 2 fig. 47. 1856.

(Fig. 52)

Cells strongly curved, 170° of arc, 5-6 times longer than broad, $40-51 \times 7-9 \mu\text{m}$, w. apex $1-2 \mu\text{m}$; ventral margin not inflated; poles acutely pointed; wall smooth.

Studied material: R 201818.

Distribution: Africa, Artic, Asia, Australia, Europe, North America, South America: BRAZIL (state of Rio Grande do Sul): first citation.

Habitat: metaphyton; associated with Chlorococcales *sensu lato*, diatoms, desmids, euglenoids, filamentous green algae.

Closterium jenneri Ralfs var. *jenneri*, **Brit. Desm.**, p. 167, pl. 28, fig. 6. 1848.

(Fig. 34)

Cells strongly curved, $110-130^\circ$ of arc, 7-8 times longer than broad, $60-90 \times 10-12 \mu\text{m}$, w. apex $3-4 \mu\text{m}$, ventral margins not inflated; rounded poles; wall finely punctated.

Studied material: R 201836.

Distribution: Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1976); Bicudo & Ungaretti (1986).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, eugle-

noids, dinoflagellates, filamentous green algae; pH 5.5, temperature 30°C , conductivity $10 \mu\text{S}\cdot\text{cm}^{-1}$.

Closterium kuetzingii Brébisson var. *kuetzingii*, **Mem. Soc. Imp. Sci. nat. Cherbourg**, v. 4, p. 156, pl. 2, fig. 40. 1856.

(Fig. 46)

Cells almost straight, 20-22 times longer than broad, $320-325 \times 14-16 \mu\text{m}$, w. at apex $3-4 \mu\text{m}$, middle portion fusiform, ventral and dorsal margins almost equally convex, tapering into long cylindrical processes incurved, apices obliquely rounded, wall apparently smooth.

Studied material: R 201818.

Distribution: Africa, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981a); Rosa *et al.* (1987); Franceschini (1992); Garcia & Vélez (1995).

Habitat: metaphyton; associated with Chlorococcales *sensu lato*, diatoms, desmids, euglenoids, filamentous green algae.

Comments: It was not possible to observe striae on the cell wall. Thus, the taxon was initially identified as *Closterium kuetzingii* Brébisson var. *laeve* Krieger (1937) but, according to Ruzicka (1977), this variety is synonymous to the typical species.

Closterium leibleinii Kützing ex Ralfs var. *leibleinii*, **Brit. Desm.**, p. 167 pl. 28: 4c-h, k-l. 1848.

(Fig. 53)

Cells strongly curved, $150^\circ-160^\circ$ of arc, 5-6 times longer than broad, $80-90 \times 15-16 \mu\text{m}$, w. at apex $2-3 \mu\text{m}$; ventral margin concave, tumid median part; acutely rounded apices; wall smooth.

Studied material: R 201818.

Distribution: cosmopolitan; BRAZIL (state of Rio Grande do Sul): Borge (1903); Ungaretti (1981a); Franceschini (1992).

Habitat: metaphyton; associated with Chlorococcales *sensu lato*, diatoms, desmids, euglenoids, filamentous green algae.

Closterium lineatum Ehrenberg ex Ralfs var. *lineatum*, **Brit. Desm.**, p. 173, pl. 30, fig. 1. 1848.

(Fig. 47)

Cells 30-32 times longer than broad, slender, $470-490 \times 15-18 \mu\text{m}$, w. at apex $5-8 \mu\text{m}$; midregion

straight, parallel margins, the apical region curved and gradually attenuated rounded-truncate poles; wall brown, with 8-10 striae in 10 μm .

Studied material: R 201837.

Distribution: Africa, Asia, Europe, North America, Oceania, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Closterium navicula (Brébisson) Lutkemüller var. *navicula*, **Beitr. Biol. Pfl. Breslau**, v. 8, n. 3, p. 395. 1902.

(Figs. 35, 36)

Cells straight, broadly fusiform, 3-4 times longer than broad, 35-44 \times 10-14 μm , w. at apex 6-7 μm ; ventral and dorsal margins almost convex, apices broadly rounded; wall smooth; zygospore quadrate, rounded angles, 25-34 \times 25-34 μm .

Studied material: R 201837.

Distribution: Africa, Asia, Artic, Europe, North America do Norte, Oceania, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981a).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Closterium toxon West, **Jour. Soc. Bot. London**, v. 29, p. 121, pl. 19, fig. 14. 1892.

(Fig. 48)

Cells almost straight, 14-15 times longer than broad, 130-135 \times 8-10 μm , w. at apex 5-6 μm ; straight in the midregion, parallel margins, apical region slightly curved; poles broadly truncate; wall smooth.

Studied material: R 201818.

Distribution: Artic, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat: metaphyton; associated with Chlorococcales *sensu lato*, diatoms, desmids, euglenoids, filamentous green algae.

Cosmarium botrytis Meneghini ex Ralfs var. *botrytis*, **Brit. Desm.**, p. 99, pl. 16, fig. 1. 1848.

(Fig. 15)

Cells 1.3-1.4 times longer than broad, 60-70 \times 45-50 μm , at isthmus 13-17 μm ; deeply constricted, sinus narrow linear, opening outwardly; apex narrowly truncate; semicells oval-pyramidal from a broad flat base; apex narrowly truncate; cell wall uniformly granulate; vertical view elliptic.

Studied material: R 201837.

Distribution: Africa, Asia, Artic, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Rosa *et al.* (1988).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium formosulum Hoff in Nordstedt, **Vidensk Meddr. dansk naturh. Foren.**, p. 194, pl. 6, fig. 6, 7. 1888.

(Fig. 55)

Cells 1.2-1.3 times as long as broad, 63-65 \times 47-49 μm , at isthmus 12-14 μm , very deeply constricted; semicells trapeziform-subsemicircular, sides convex and crenate; apex truncate and crenulate; vertical view elliptic, median tumor granulate.

Studied material: R 201837.

Distribution: Africa, Asia, Artic, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium galeritum Nordstedt var. *subtumidum* Borge, **Ark. Bot.**, v. 1 p. 95, fig. 14. 1903.

(Fig. 49)

Cells 1.8-2 times longer than broad, 70-75 \times 55-59 μm , at isthmus 18-21 μm , deeply constricted, sinus linear; semicells pyramidal-trapeziform; basal and upper angles rounded; side view subcircular; vertical view widely elliptic; cell wall punctate.

Studied material: R 201837.

Distribution: North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981a); Bicudo & Ungaretti (1986); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium granatum Brébisson ex Ralfs var. *concauum* Lagerheim, **An. Univ. Quito**, v. 4, n. 27, p. 287. 1890.

(Fig. 60)

Cells 1.2-1.3 times longer than broad, 40-44 \times 32-36 μm , at isthmus 8-10 μm ; deeply constricted; semicells pyramidate; basal angles rounded; lateral margins concave; rounded apex; wall smooth.

Studied material: R 201836.

Distribution: North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.5, temperature 30°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Comments: Prescott *et al.* (1981) and Förster (1972) have carried out an extensive discussion on this variety which, according to them, needs to be better investigated. The concavity on the lateral wall of the semicell may be a variability into the species.

West & West (1905) included the studied variety within the typical species. As this species was rarely observed in the Turvo State Forest Park, and in the taxon examined presents the lateral margin is always concave, the *concauum* variety of the typical species was kept.

Cosmarium montrealense Croasdale in Prescott *et al.*, **A synopsis of North American Desmids**, v. 2, n. 3, p. 195, pl. 171, fig. 13-14. 1981.

(Fig. 50)

Cells 1.2-1.3 times longer than broad, 17-23 \times 16-18 μm , at isthmus 5-7 μm ; semicells transversely elliptic; sinus closed; lateral margins and apex rounded; wall smooth.

Studied material: R 201837.

Distribution: North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; filaments associated with desmids, diatoms, dinoflagellates, cyanobacteria; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Comments: *Cosmarium montrealense* was described from an unnamed form of *Co. bioculatum* Brébisson (Prescott *et al.*, 1981). However, Krieger & Gerloff (1962) named the Brébisson taxon as *Co. bioculatum* var. *canadense*.

According to Prescott *et al.* (1981), this species does not belong to the *bioculatum* group, because the latter displays an open isthmus. Croasdale in Prescott *et al.* (1981) proposes a new name: *Cosmarium montrealense* Croasdale.

Cosmarium pseudopyramidatum Lundell var. *pseudopyramidatum* f. *pseudopyramidatum*, **Nova Acta R. Soc. Scient. upsal.**, ser. III, v. 8, n. 2, p. 41, pl. 2, fig. 18. 1871.

(Fig. 57)

Cells 1.7-1.8 times longer than broad, 65-75 \times 35-42 μm , at isthmus 10-14 μm ; semicells pyramidate, deeply constricted, sinus linear, sides evenly converging to a narrow truncate apex, wall punctuate.

Studied material: R 201837.

Distribution: widespread; BRAZIL (state of Rio Grande do Sul): Borge (1903), Ungaretti (1981a), Rosa *et al.* (1987); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium simplicius (West & West) Grönblad, **Soc. Sci. Fennica, Commen. Biol.**, v. 3, n. 17, p. 7. 1931.

(Fig. 16)

Cells 1.8-2 times longer than broad, 40-45 \times 21-24 μm , at isthmus 17-20 μm , semicells oblong; median constriction very shallow; apex widely rounded; cell wall with rounded to somewhat elongated granules, about 15 granules visible on the margin of the semicell.

Studied material: R 201837.

Distribution: Artic, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium subtumidum Nordstedt var. *circulare* Borge, **Ark. Bot.**, v. 1, p. 97, pl. 3, fig. 22. 1903.

(Fig. 69)

Cells as long as broad, almost straight, 27-28 \times 27-28 μm , at isthmus 7-8 μm , deeply constricted, sinus linear; semicells subsemicircular; basal angles bluntly rounded, apex truncate; wall finely punctate; side view circular; vertical view elliptic.

Studied material: R 201837.

Distribution: South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Cosmarium vexatum West; West var. *vexatum*, **Jl. R. microsc. Soc.**, n. 1892, p. 9, fig. 33. 1892.

(Figs. 51, 54)

Cells 1.2-1.3 times longer than broad, 31-35 \times 24-27 μm , at isthmus 7-12 μm , deeply constricted, sinus linear; semicells pyramidal-truncate; lateral margins convex, undulate; apex truncate, slightly subundulate, semicells with central area smooth; vertical view oblong-elliptic, with a tumor in the midregion on either side; zygospore large, with many conical-based spines, about 16 around the margin, 62 μm diameter (without spines).

Studied material: R 201837.

Distribution: Africa, Artic, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Franceschini (1992).

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Comments: As discussed by Sophia (1991), for the material from state of Rio de Janeiro, the samples

from the Turvo State Forest Park presented individuals of a smaller size than those mentioned by West & West (1908) and Prescott *et al.* (1981) for the individuals studied in Europe and in North America, respectively. The zygospore is described for the first time in the current work.

Desmidium graciliceps (Nordstedt) Lagerheim var. *graciliceps*, **Öfvers. K. VetenskAkad. Förh.**, v. 42, n. 7, p. 228. 1885.

(Figs. 19, 20)

Filaments twisted; cells about as long as broad, 17-20 \times 17-21 μm , at isthmus 14-15; semicells pyramidal-truncate, median constriction moderate, sinus open; lateral margins biondulate, basal angles acutely rounded; apex truncate; vertical view elliptical, with 2 opposite mammillae.

Studied material: R 201837.

Distribution: Africa, Asia, Europe, North America, Oceania, South America; BRAZIL (state of Rio Grande do Sul): Borge (1903).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Euastrum ansatum Ehrenberg ex Ralfs var. *ansatum*, **Brit. Desm.**, p. 85, pl. 14, fig. 2 a-f. 1848.

(Figs. 21, 58)

Cells 2-2.2 μm times longer than broad, 90-95 \times 40-45 μm , at isthmus 9-11 μm , w. at apex 15-17 μm , semicells with broadly rounded basal angles and retuse sides, narrow apex, with fairly deep, close notch, truncate with rounded angles; wall punctuate.

Studied material: R 201837.

Distribution: cosmopolitan; BRAZIL (state of Rio Grande do Sul): Borge (1903); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Comments: It was not possible to observe, in the examined material, the five protuberances on the face of the semicell as mentioned in literature, although Prescott *et al.* (1977, pl. 58, fig. 6) supply an illustration of this species with a smooth wall. According to Ruzicka (1981), it is common to find dicotypical forms in this species, as observed in the

material from the Turvo State Forest Park, in which a semicell could be identified as belonging to the typical variety, while the other as variety *concovum* of the same species (Fig. 58). In this work, the *concovum* variety is thought a synonym of the typical species, until new studies prove otherwise.

Haplotaenium minutum (Ralfs) Bando var. *minutum*, **J. Jap. Bot.**, v. 63, p. 176. 1988.

(Figs. 26-27)

Cells cylindrical, 9-12 times longer than broad, $170-132 \times 17-19 \mu\text{m}$, w. at apex 13-18 μm , slight median constriction; lateral margin very gradually attenuated towards the apex; rounded-truncate apices; cell wall minutely punctate.

Studied material: R 201836.

Distribution: Africa, Asia, Europe, North America, Oceania, South America; BRAZIL (state of Rio Grande do Sul): Borge (1903 – as *Penium minutum*).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Comments: Bando (1988) proposes the genus *Haplotaenium* based on the axial chloroplast, with pyrenoids in a longitudinal series and absence of terminal vacuoles. The material collected at the Turvo State Forest Park showed some variability regarding the median breadth of the cells, presenting measurements a little smaller than those found in literature.

Haplotaenium minutum (Ralfs) Bando var. *gracile* (Wille) Bando, **J. Jap. Bot.**, v. 63, n. 5, p. 176. 1988.

(Fig. 66)

Cells 12 times longer than broad, semicells cylindrical $170-180 \times 11-13 \mu\text{m}$, w. at apex 9-10 μm ; margins parallel; apex rounded-truncate, basal inflation very slight; cell wall minutely punctate.

Studied material: R 201836.

Distribution: Africa, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Hyalotheca dissiliens (Smith) Brébisson ex Ralfs var. *dissiliens*, **Brith. Desm.**, v. 51, pl. 1, fig. 1. 1848.

(Figs. 17, 18)

Filaments not twisted; cells 1.1-1.2 times as broad as long, $23-25 \times 26-27 \mu\text{m}$; semicells transversely oblong, constriction extremely small, lateral margins slightly convex; apices broadly truncate; vertical view circular; zygospore spherical to rounded-oblong, 15-25 μm in diameter, smooth wall.

Studied material: R 201837.

Distribution: cosmopolitan; BRAZIL (state of Rio Grande do Sul): Rosa *et al.* (1987); Rosa *et al.* (1988); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, desmids, diatoms, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Micrasterias abrupta West; West, **Trans. Linn. Soc. Lond.**, Bot. II, v. 5, n. 5. p. 242, pl. 14, fig. 13-16. 1896.

(Fig. 22)

Cells about as broad as long, $63-65 \times 58-60 \mu\text{m}$, at isthmus 8-10 μm , w. at apex 28-30 μm ; polar lobe flat with short, diverging bidentate lateral extensions; lateral lobes twice divided; sinus narrow, closed for the inner half of its length; wall finely punctate.

Studied material: R 201836.

Distribution: Africa, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.5, temperature 30°C, conductivity 10 $\mu\text{S}\cdot\text{cm}^{-1}$.

Micrasterias truncata (Corda) Brébisson ex Ralfs var. *truncata* f. *truncata*, **Brit. Desm.** 75, pl. 8, fig. 4, pl. 10, fig. 5. 1848.

(Fig. 56)

Cells approximately circular, $135-137 \times 135-136 \mu\text{m}$, at isthmus 26-29 μm , w. at apex 99-101 μm ; semicells with five lobes; polar lobe broad, lateral lobes once or twice shallowly divided; sinus narrow,

closed for the inner half of its length; wall finely punctuate.

Studied material: R 201818.

Distribution: Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Borge (1903).

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Micrasterias truncata (Corda) Brébisson *ex* Ralfs var. *pusilla* G. West. **Mem. Soc. Neuchât. Sci. nat.**, v. 5, p. 1035, pl. 22, fig. 42-43. 1914.

(Fig. 61)

Cells 57-59 × 55-59 μm, at isthmus 10-12 μm, w. at apex 41-43 μm; a variety differing in small size and in having a subcircular semicell form.

Studied material: R 201836.

Distribution: Asia, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungareti (1981b); Bicudo & Ungareti (1986); Rosa *et al.* (1987); Rosa *et al.* (1988); Franceschini (1992).

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Penium margaritaceum (Ehrenberg) Brébisson *ex* Ralfs var. *margaritaceum* f. *margaritaceum*, **Brit. Desm.**, p.149, pl. 25, fig. 1 a-c, e-h; pl. 33, fig. 3. 1848.

(Figs. 37, 40)

Cells cylindric, 5-11 times longer than broad, 60-210 × 12-19 μm, slightly constricted in the midregion, margins parallel, slightly attenuated to the rounded poles; wall with granules irregularly arranged; chloroplasts 2 in each semicell; zygospore round, wall smooth, 27-30 μm in diameter.

Studied material: R 201837.

Distribution: widespread; BRAZIL (state of Rio Grande do Sul): Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with desmids, diatoms, dinoflagellates, cyanobacteria; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Comments: Most of the populational sample examined showed the individuals in sexual reproduction. The identification on the studied material was based on the measurements of vegetative cells as well as in the behavior of the cells in sexual reproduction. *Penium margaritaceum* do not fully “break” the cells during the fusion of their contents. *Penium cylindrus* “break” the cells by the isthmus, four semicells are perfectly visible around the zygospore. West & West (1904), Croasdale & Flint (1986) and Ruzicka (1977) illustrated this fact. Only with sexual reproduction is difficult the separation between *P. margaritaceum* and *P. cylindrus* because the identification is based on the vegetative cells length and the behavior of the reproductive cells. *P. margaritaceum* reduces cells length under sexual reproduction, reaching the proportions presented for *P. cylindrus*.

Pleurotaenium ehrenbergii (Brébisson) De Bary var. *ehrenbergii*, **Conjugatae**, p.75. 1858.

(Figs. 23, 24, 67)

Cells cylindrical, 9-12 times longer than broad, 170-132 × 17-19 μm, w. at apex 13-18 μm, slight median constriction; lateral margin very gradually attenuated towards the apex; rounded-truncate apices; cell wall minutely punctuate; zygospore ellipsoid with crenated wall, 70 × 60 μm.

Studied material: R 201837.

Distribution: Africa, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981b), Rosa *et al.* (1987), Rosa *et al.* (1988).

Habitat and abiotic variables: metaphyton; filaments associated with cyanobacteria, desmids, diatoms, dinoflagellates; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Comments: Prescott *et al.* (1975) describe the zygospore as having a smooth cell wall. The material observed here differs only in the morphology of the zygospore, which showed a crenated cell wall while in the literature specialized the zygospore is described as having a smooth cell wall.

Pleurotaenium ehrenbergii (Brébisson) De Bary var. *undulatum* Schaarsmidit, **Mag. Tudom. Akad. Math. S. Term. Közlem.**, v. 18, p. 238. 1883.

(Figs. 25, 68)

Cells 12-15 times longer than broad; 600-610 × 40-49 μm, w. at apex 30-34 μm; margins of semicells

undulate; apex truncate, 4 visible tubercles; wall cell punctate; zygospore globose, wall smooth, $92 \times 105 \mu\text{m}$.

Studied material: R 201837.

Distribution: Asia, Africa, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981a).

Habitat and abiotic variables: metaphyton; filaments associated with desmids, diatoms, dinoflagellates, cyanobacteria; pH 5.0, temperature 22°C , conductivity $10 \mu\text{S}\cdot\text{cm}^{-1}$.

Staurastrum gladiusum Turner var. *gladiusum*, **Jl. R. microsc. Soc.**, ser. II, v. 5, n. 6, p. 938, pl. 16, fig. 21. 1885.

(Figs. 32, 33)

Cells 1.2-1.3 times longer than broad, $48-50 \times 36-38 \mu\text{m}$ (with spines); $37-39 \times 30-32 \mu\text{m}$ (without spines), at isthmus $12-14 \mu\text{m}$; median constriction deep; semicells transversely oval; cell wall uniformly covered with stout spines; vertical view triangular with spines in the wall; zygospore circular with long stout spines.

Studied material: R 201837.

Distribution: Africa, Asia, Artic, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat and abiotic variables: metaphyton; filaments associated with desmids, diatoms, dinoflagellates, cyanobacteria; pH 5.0, temperature 22°C , conductivity $10 \mu\text{S}\cdot\text{cm}^{-1}$.

Comments: *Staurastrum gladiusum* var. *gladiusum* is quite similar to *St. teliferum* Ralfs. The difference between them fact that *St. gladiusum* var. *gladiusum* has its spines equally distributed on the semicell wall, whereas in *St. teliferum* the spines are more numerous in the semicell angles. The zygospore of *St. gladiusum* var. *gladiusum* is cited for the first time in this work, a fact which has also contributed to the distinction between the two species: *St. teliferum* presents a circular zygospore with furcated spines, whereas *S. gladiusum* var. *gladiusum* has displayed a circular zygospore with straight, pointed spines (Fig. 33).

Staurastrum orbiculare (Ehrenberg) Ralfs var. *depressum* Roy; Bisset, **J. Bot.**, v. 24, p. 237, pl. 268, fig. 14. 1886.

(Figs. 29, 30)

Cells about as broad as long, $25-30 \times 25-29 \mu\text{m}$, at isthmus $6-8 \mu\text{m}$; median constriction deep; semicells depressed-semicircular; apex and basal angles rounded; wall smooth; vertical view triangular.

Studied material: R 201818.

Distribution: Africa, Artic, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Staurodesmus dickiei (Ralfs) Lillieroth var. *dickiei*, **Acta Limnol.**, v. 3, p. 264. 1950.

(Figs. 62, 63)

Cells 1.2-1.3 times as broad as long (without spines); $24-27 \times 20-26 \mu\text{m}$ (without spines), $24-32 \mu\text{m}$ w. (with spines), at isthmus $6-8 \mu\text{m}$; semicells elliptic, median constriction deep, open; lateral and apical margins equally convex; lateral angles bearing a stout, downward-projecting spine; smooth cell wall; vertical view triangular, corners bearing one short spine.

Studied material: R 201818.

Distribution: North America, South America; BRAZIL (state of Rio Grande do Sul): Franceschini (1992).

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Staurodesmus spetsbergensis (Nordstedt) Teiling var. *spetsbergensis* f. *evoluae* Teiling, **Ark. Bot.**, v. 6, n. 1, p. 496, pl. 2, fig. 11. 1967.

(Figs. 64, 65)

Cells 1.2 times longer than broad (without spines); $20-22 \times 15-19 \mu\text{m}$ (without spines), $16-20 \mu\text{m}$ w. (with spines), at isthmus $4-5 \mu\text{m}$; semicells broadly cup-shaped; median constriction deep, open; lateral and apical margins convex, angles acute, often incrassate, like a mucron; vertical view triangular.

Studied material: R 201818.

Distribution: Artic, Europe, North America; BRAZIL (state of Rio Grande do Sul): first citation.

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Comments: Teiling (1967) admits two forms for the typical variety: f. *evolutae* and f. *reductae*. The former bears acute, thickened angles, sometimes similar to a mucron (Teiling, 1967, pl. 2, fig. 11), and the second has rounded angles without thickening. The material from the Turvo Park is quite similar to f. *evolutae*.

Teilingia granulata (Roy & Bissett) Bourrelly, **Revue algol.: nov. ser.**, v. 7, n. 2, p. 190. 1964.

(Fig. 59)

Filaments not twisted; cells about as broad as long, 10-13 × 10-12 μm, at isthmus 4-6 μm; semicells oblong, constriction deeply, sinus open; lateral margins rounded, bearing 3 marginal small granules; apices truncate with 2 pairs of connecting projections; vertical view oblong.

Studied material: R 201818.

Distribution: Asia, Europe, North America, Oceania, South America, BRAZIL (state of Rio Grande do Sul): Rosa *et al.* (1987); Franceschini (1992).

Habitat: metaphyton; filaments associated with diatoms, euglenoids, desmids, Chlorococcales *sensu lato*, filamentous green algae.

Tetmemorus laevis (Kützing) ex Ralfs var. *minutus* (De Bary) Krieger, **Rabenhorst's Kryptogamen-Flora**, v. 13, p. 457, pl. 55, figs. 8, 9. 1937

(Fig. 31)

Cells 2.8-4 times longer than broad, 42-77 × 15-20 μm, at isthmus 14-17 μm, w. at apex 11-12 μm; median constriction slight; semicells very gradually attenuated to the apices; apex broad and rounded, with a deep median incision; cell wall minutely punctate.

Studied material: R 201836.

Distribution: Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Borge (1903).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Zygnematales

Netrium digitus (Ehrenberg) Itzigsohn; Rothe var. *lamellosum* (Bréb.) Grönblad, **Acta Soc. Fauna Flora fenn.**, v. 47, n. 4, p. 13. 1920.

(Fig. 38)

Cells oblong-elliptic, 4-5 times longer than broad, 150-193 × 31-45 μm, w. at apex 16-22 μm, lateral margins convex, gradually attenuated to truncate-rounded.

Studied material: R 201836.

Distribution: Africa, Asia, Europe, North America, South America; BRAZIL (state of Rio Grande do Sul): Ungaretti (1981a); Franceschini (1992).

Habitat and abiotic variables: metaphyton; associated with cyanobacteria, diatoms, desmids, euglenoids, dinoflagellates, filamentous green algae; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Comments: According to Croasdale & Flint (1986), the variety studied could be included in the typical variety of this species. It was not very frequent in the examined samples. The individuals studied always present retuse cells in the median region, and have thus been identified as the *lamellosum* variety of *Netrium digitus*.

Spirogyra inflata (Vaucher) Kützing, **Phycol. gener.**; p. 247. 1843.

(Figs. 41, 43)

Vegetative cells 17-19 × 85-140 μm, with replicate end wall, 1 chloroplast; conjugation lateral and scalariform, tubes formed by both gametangia, fertile cell inflated to 32-33 μm; zygospore ellipsoid 24-28 × 38-42 μm, median spore wall yellow, smooth.

Studied material: R 201837.

Distribution: Africa, Asia, Europe, North America, Oceania, South America; BRAZIL: Borge (1903); first citation for the state of Rio Grande do Sul.

Habitat and abiotic variables: metaphyton; filaments associated with desmids, diatoms, dinoflagellates, cyanobacteria; pH 5.0, temperature 22°C, conductivity 10 μS.cm⁻¹.

Zygnema sp.

(Fig. 39)

Vegetative cells 9-11 × 12-14 µm; filaments sterile.

Studied material: R 201816.

CONCLUSION

Fifty taxa (two genera and forty-eight infra-generic taxa) were identified and classified in two classes (Chlorophyceae and Zygnematophyceae) and five orders: Chaetophorales (3), Desmiales (33), Oedogoniales (6), Ulotrichales (2) and Zygnematales (6). *Bulbochaete* sp. and *Zygnema* sp. were identified at genera level based only on vegetative cells. These taxa were registered in eight of the 35 samples collected and examined.

Zygnematophyceae was the richest class, with 77.5% of the total of species. *Closterium* and *Cosmarium*, respectively, with ten and nine taxa were the best represented genera in the studied samples.

Twenty-two taxa are mentioned for the first time for the State of Rio Grande do Sul, one of them for Brazil, supplementing Torgan *et al.* (2001). *Oedogonium subdissimile* was known until now only by its original diagnose.

The studied environments feature slightly acidic waters (pH 5-7.4), low conductivity (10-50 µS. cm⁻¹) and water temperature between 19 and 34°C.

These conditions, especially acidic pH, low conductivity, and shallow environments are favourable for the development of the desmids species (Brook, 1981; Graham & Wilcox, 2000) as verified for the Turvo State Forest Park.

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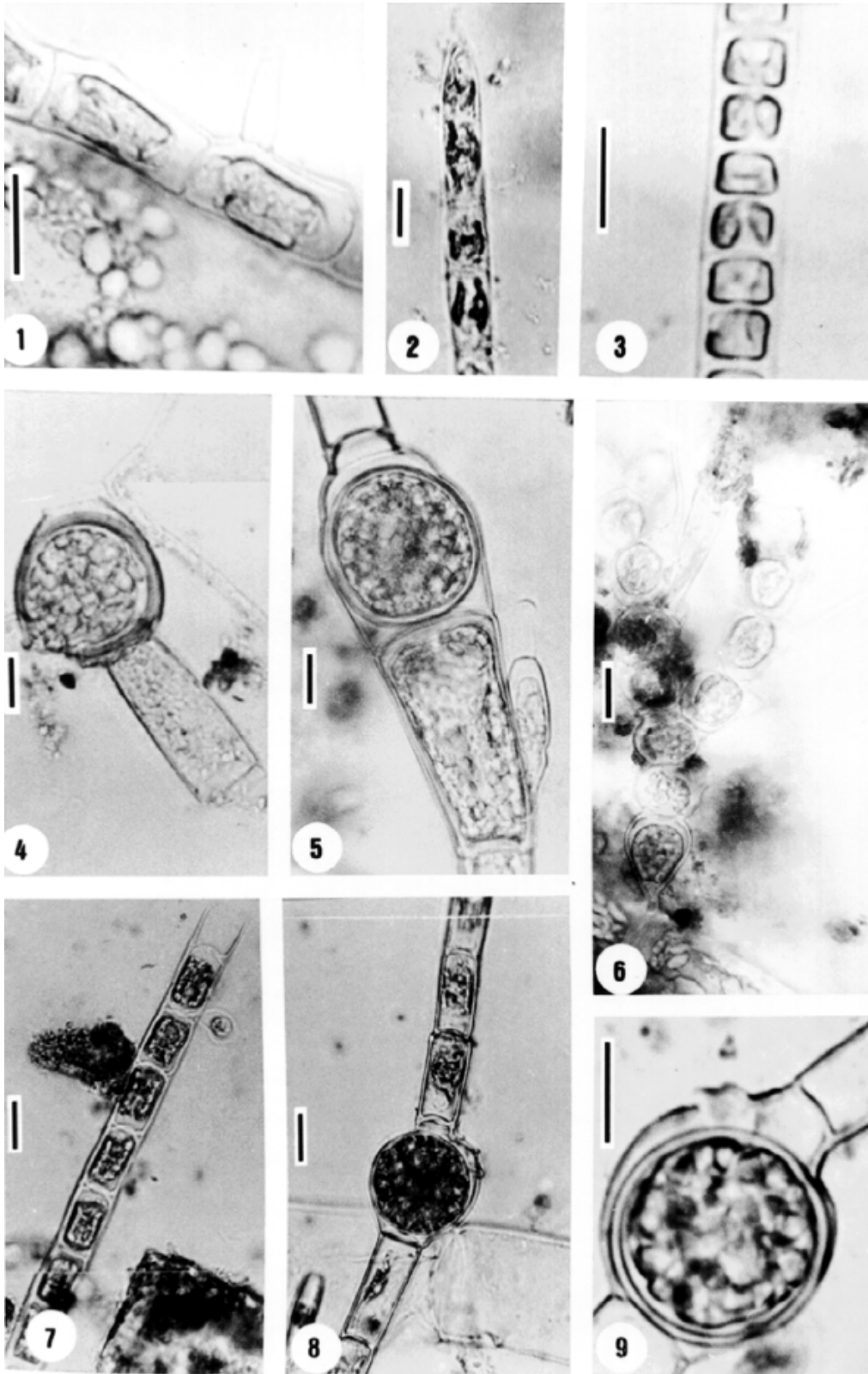
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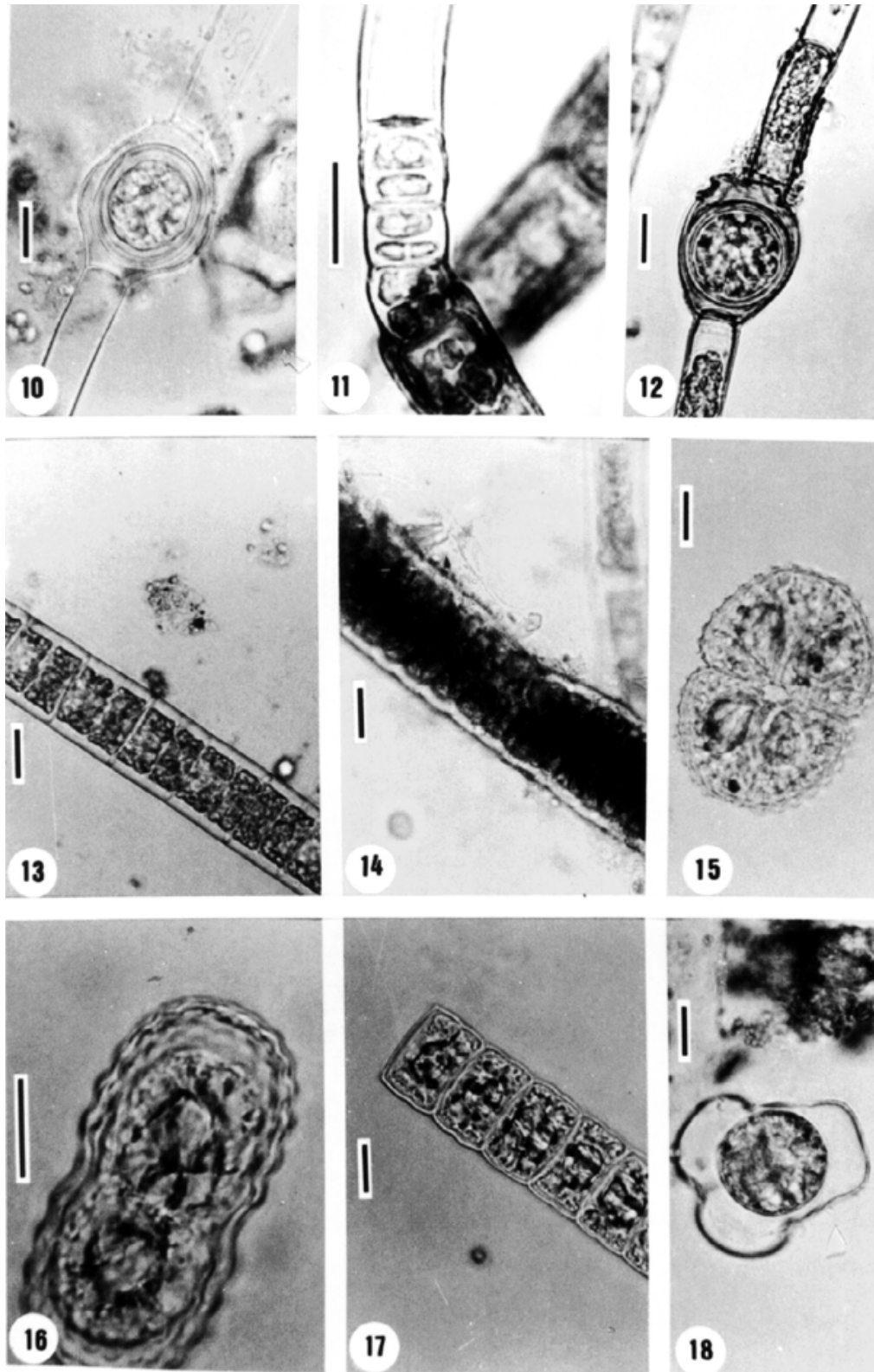
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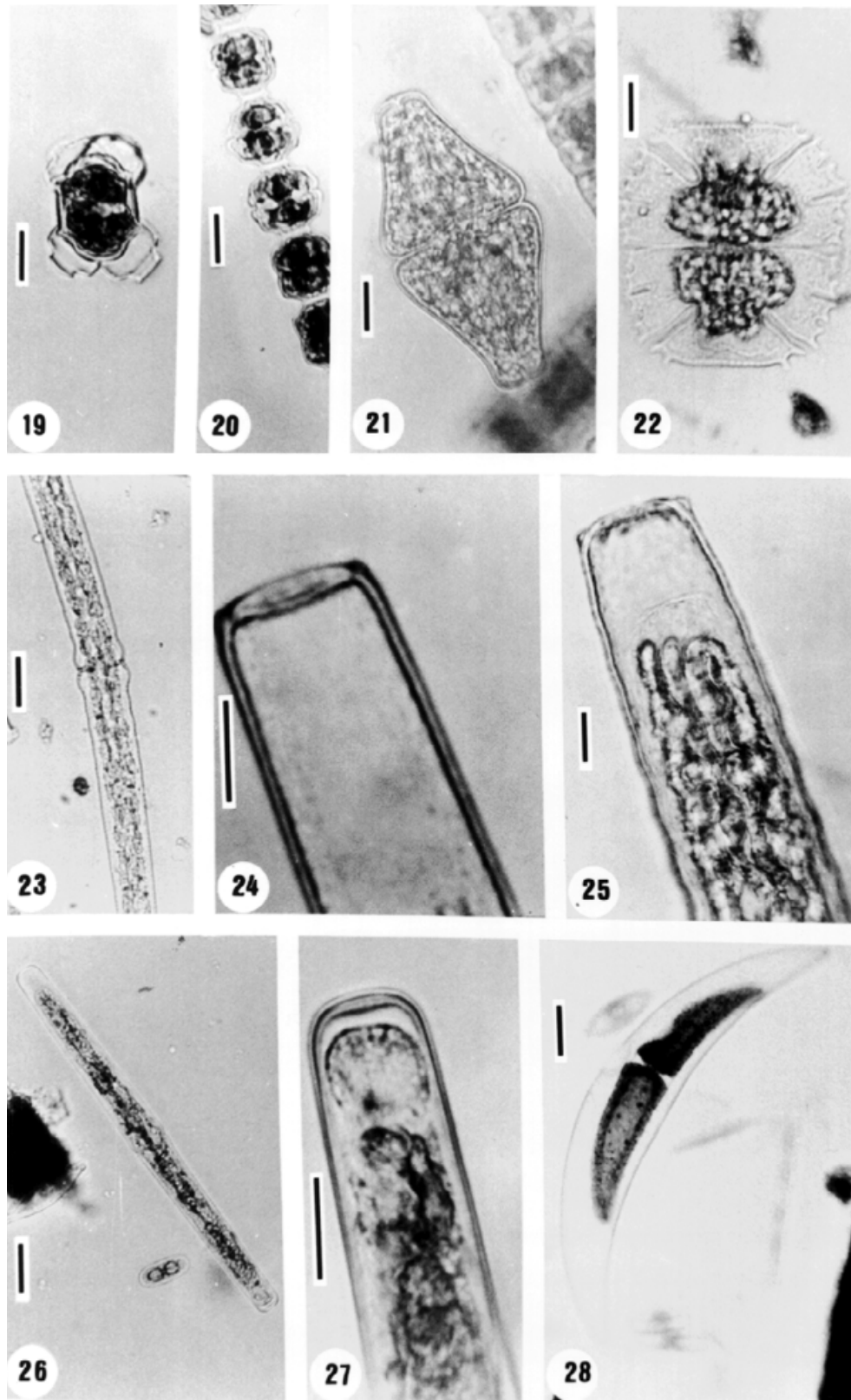
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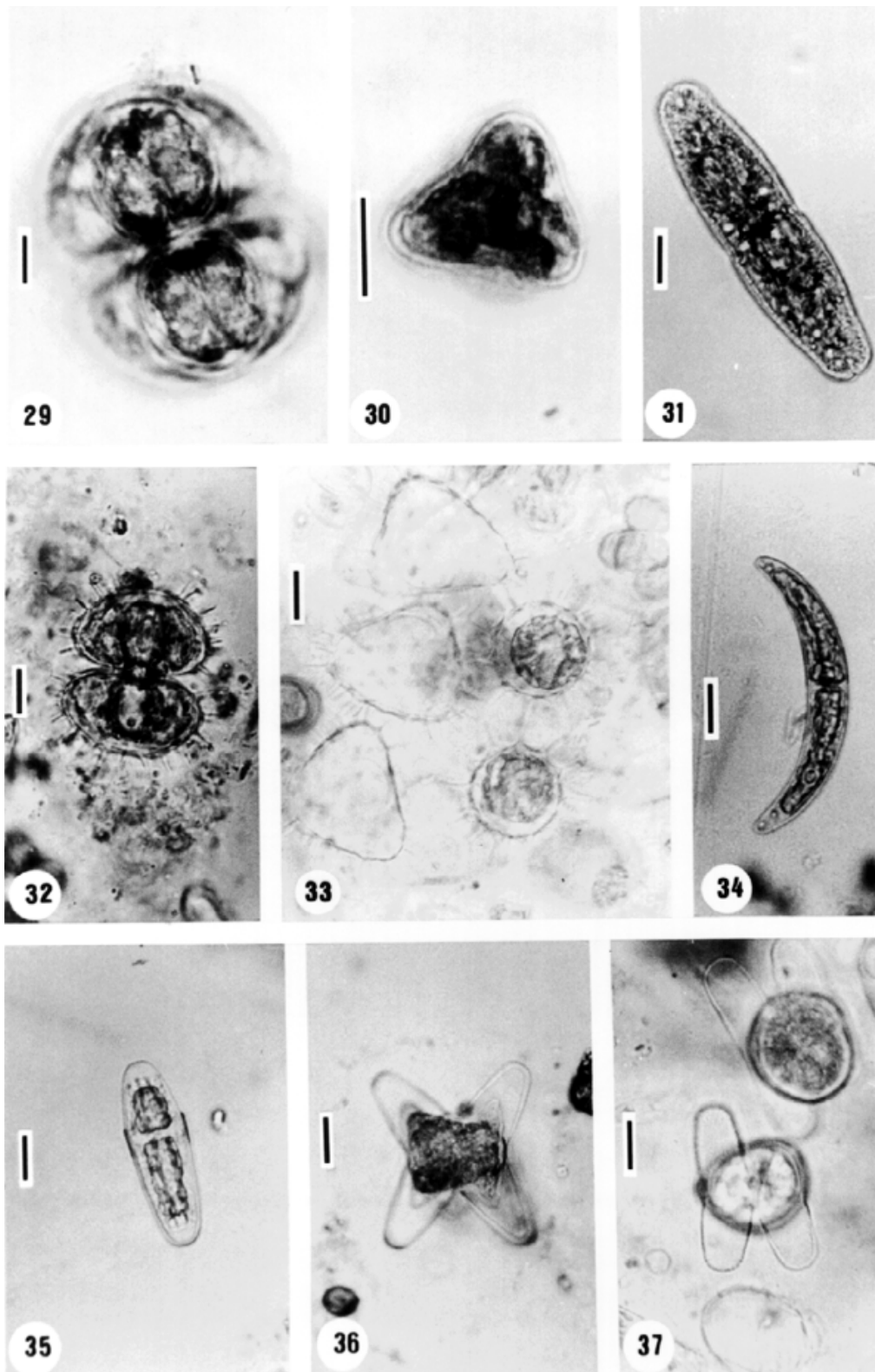
Figs. 1-9. 1. *Aphanochaete repens*; 2. *Uronema gigas*; 3. *Microspora quadrata*; 4. *Oedogonium sociale* var. *sociale* f. *sociale* (oogonium); 5. *Oedogonium borisianum* var. *borisianum* f. *borisianum* (oogonium, dwarf male); 6. *Bulbochaete* sp.; 7. *Microspora willeana*; 8, 9. *Oedogonium subdissimile* (oogonium with pore superior). Bars: 10 μ m.



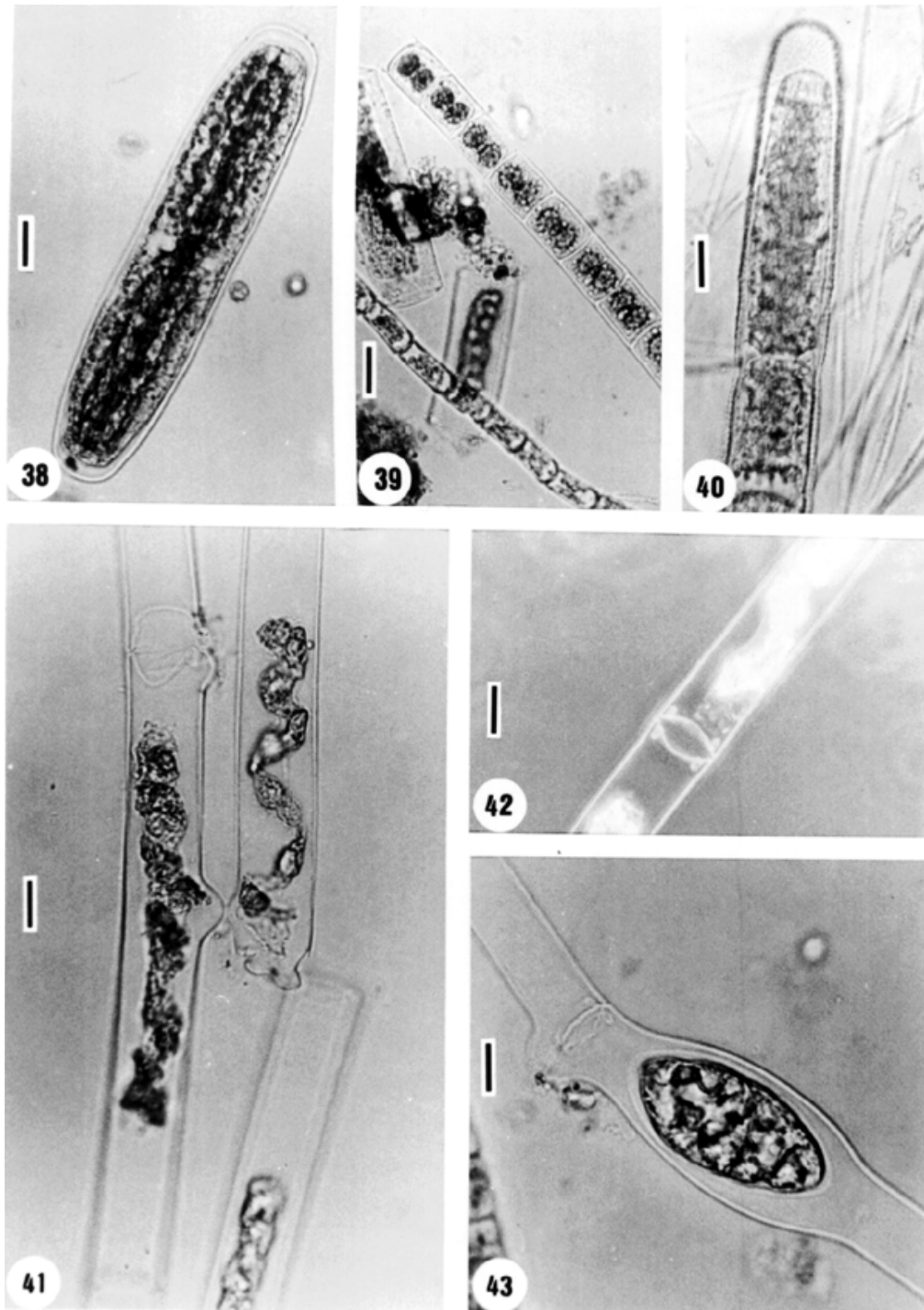
Figs. 10-18. 10. *Oedogonium lageniforme* var. *lageniforme* f. *lageniforme* (oogonium); 11, 12. *Oedogonium subplagiostomum* var. *subplagiostomum* f. *subplagiostomum*. 11. antheridium, 12. oogonium; 13, 14. *Schizomeris leibleinii*. 13. uniserial portion, 14. multiseriate portion; 15. *Cosmarium botrytis* var. *botrytis*; 16. *Cosmarium simplicius*; 17, 18. *Hyalotheca dissiliens* var. *dissiliens*. 18. sexual reproduction/zygospore. Bars: 10 μ m.



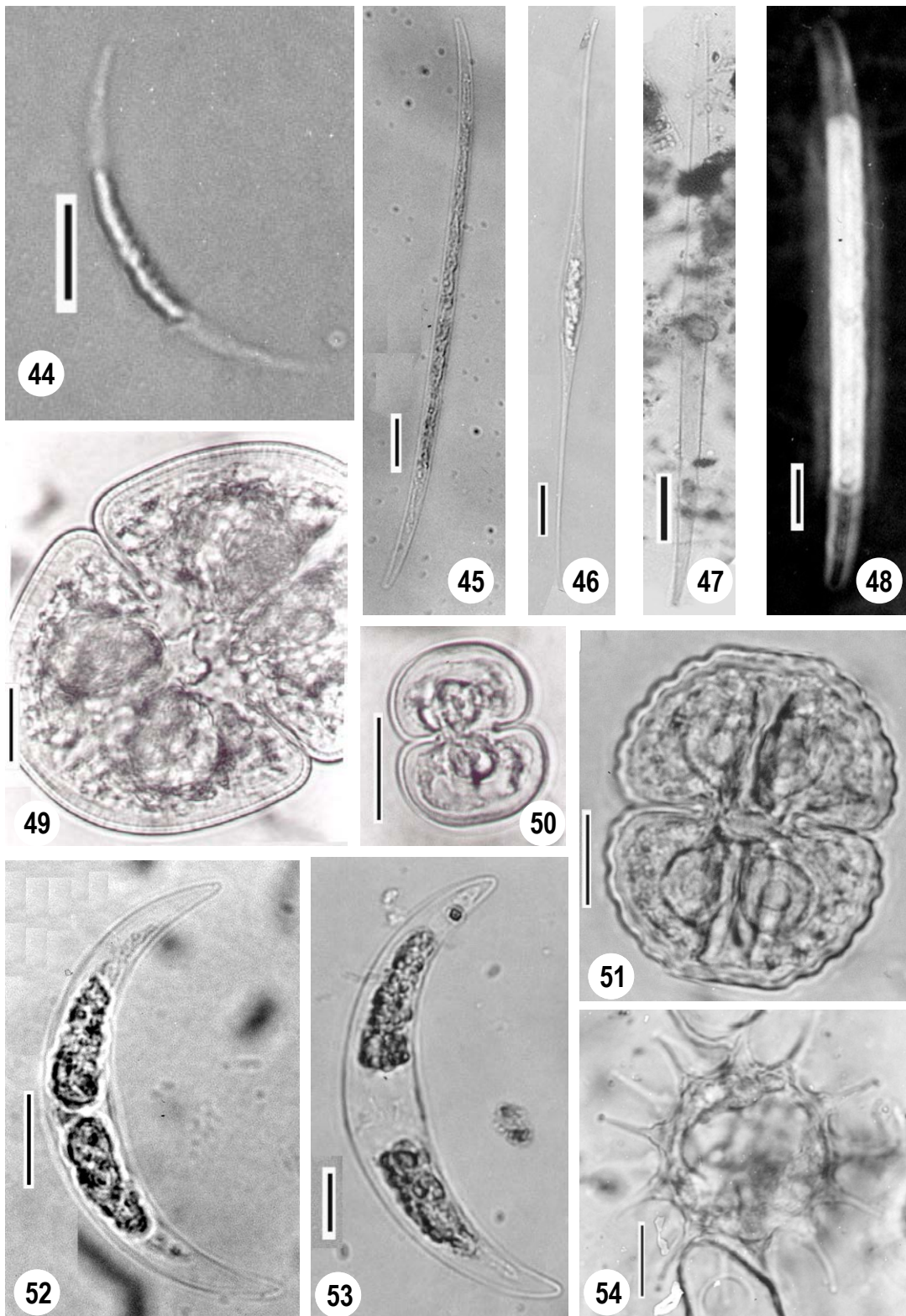
Figs. 19-28. 19, 20. *Desmidium graciliceps* var. *graciliceps*. 19. sexual reproduction/zygospore; 21. *Euastrum ansatum* var. *ansatum*; 22. *Micrasterias abrupta*; 23, 24. *Pleurotaenium ehrenbergii* var. *ehrenbergii*; 25. *Pleurotaenium ehrenbergii* var. *undulatum*; 26, 27. *Haplotaenium minutum* var. *minutum*; 28. *Closterium ehrenbergii*. Bars: **Fig. 26** = 30 μ m; **Fig. 28** = 60 μ m; **others** = 10 μ m.



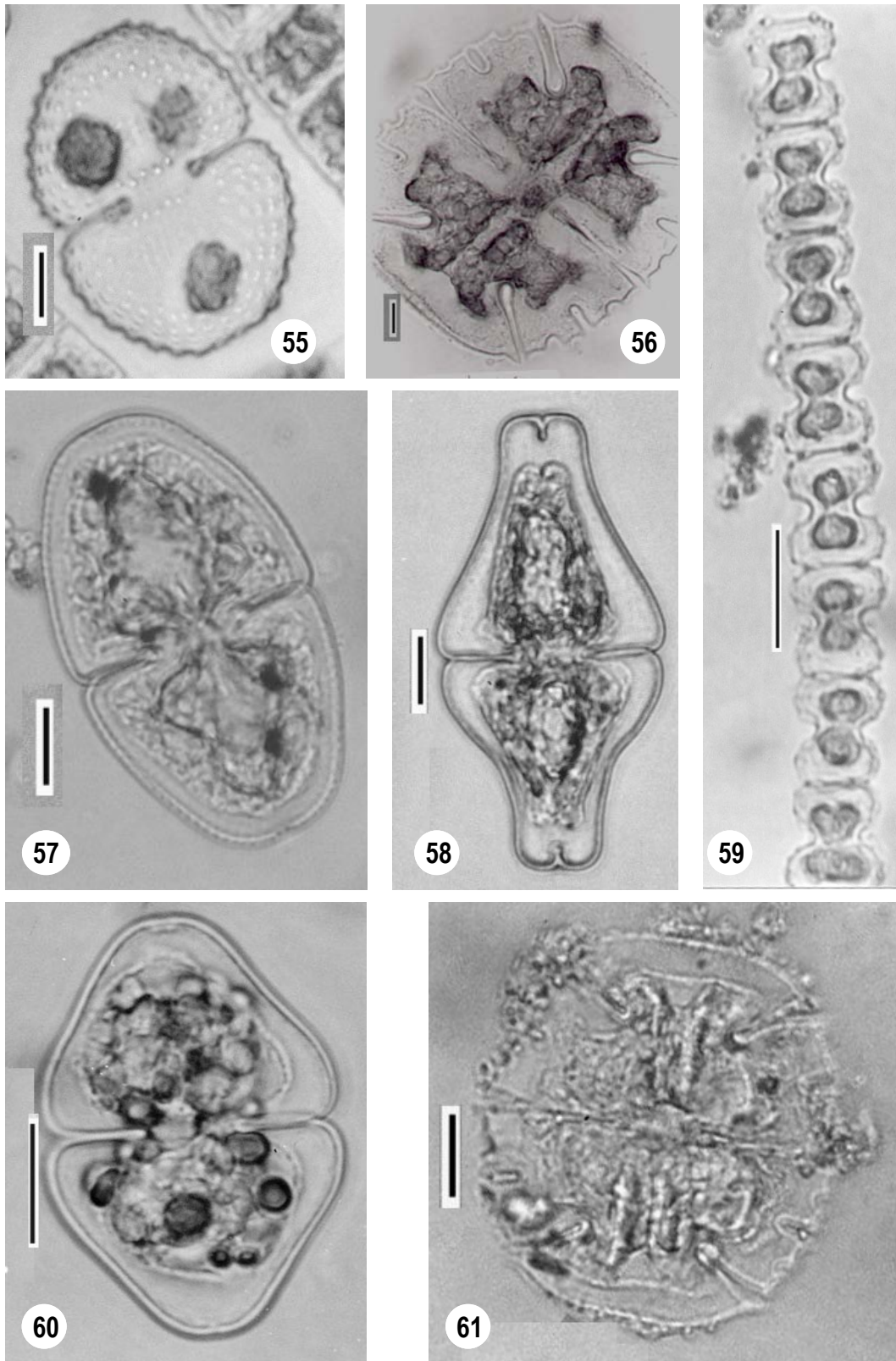
Figs. 29-37. 29, 30. *Staurastrum orbiculare* var. *depressum*. 30. apical view; 31. *Tetmemorus laevis* var. *minutus*; 32, 33. *Staurastrum gladiusum* var. *gladiusum*. 33. sexual reproduction/zygospore; 34. *Closterium jenneri*; 35, 36. *Closterium navicula*. 36. sexual reproduction/zygospore; 37. *Penium margaritaceum* var. *margaritaceum* f. *margaritaceum* (sexual reproduction/zygospore). Bars: 10 μ m.



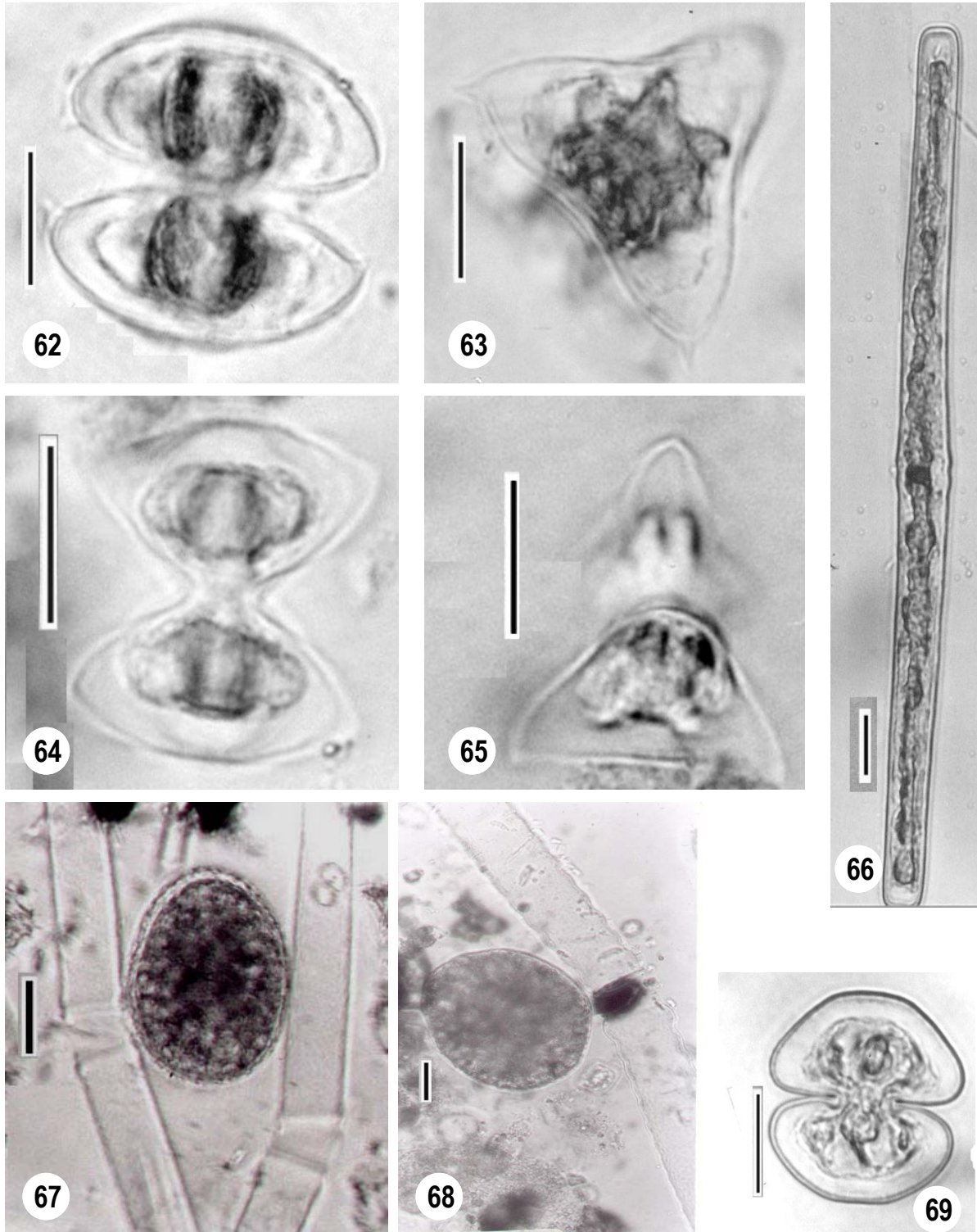
Figs. 38-43. 38. *Netrium digitus* var. *lamellosum*; 39. *Zygnema* sp.; 40. *Penium margaritaceum* var. *margaritaceum* f. *margaritaceum*; 41-43. *Spirogyra inflata*. 42. replicate end wall, 43. lateral conjugation/zygospore. Bars = 10 μ m.



Figs. 44-54. 44. *Closterium exiguum*; 45. *Closterium gracile* var. *gracile*; 46. *Closterium kuetzingii* var. *kuetzingii*; 47. *Closterium lineatum* var. *lineatum*; 48. *Closterium toxon*; 49. *Cosmarium galeritum* var. *subtumidum*; 50. *Cosmarium montrealense*; 51, 54. *Cosmarium vexatum* var. *vexatum*, 54. zygospore; 52. *Closterium incurvum*; 53. *Closterium leibleinii* var. *leibleinii*. Bars: Fig. 46 = 30 μ m; Fig. 47 = 60 μ m; others = 10 μ m.



Figs. 55-61. **55.** *Cosmarium formosulum*; **56.** *Micrasterias truncata* var. *truncata* f. *truncata*; **57.** *Cosmarium pseudopyramidatum* var. *pseudopyramidatum* f. *pseudopyramidatum*; **58.** *Euastrum ansatum* var. *ansatum* (dicotypical cell); **59.** *Teilingia granulata*; **60.** *Cosmarium granatum* var. *concauum*; **61.** *Micrasterias truncata* var. *pusilla*. Bars = 10 μ m.



Figs. 62-69. 62, 63. *Staurodesmus dickiei* var. *dickiei*; 63. apical view; 64, 65. *Staurodesmus spetsbergensis* var. *spetsbergensis* f. *evolutae*. 65. apical view; 66. *Haplotaenium minutum* var. *gracile*; 67. *Pleurotaenium ehrenbergii* var. *ehrenbergii* (sexual reproduction and zygospore); 68. *Pleurotaenium ehrenbergii* var. *undulatum* (sexual reproduction and zygospore); 69. *Cosmarium subtumidum* var. *circularae*. Bars: Figs. 67, 68 = 30 μ m; others = 10 μ m.