



Taxonomic notes on desmids from the Netherlands V, with a description of seven new taxa

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Abstract

From the Netherlands and a nearby Flemish region, seven more desmid taxa giving rise to taxonomic confusion are described as new to science: *Actinotaenium coronisporum*, *A. silvae-nigrae* var. *cucurbitiniforme*, *Cosmarium gietenense*, *C. meestersii*, *C. pseudotrachypleurum*, *Cylindrocystis subjenniferi* and *Staurastrum lutsii*. The affinity with similarly looking taxa is discussed.

keywords: algae, desmids, taxonomy, new taxa, *Actinotaenium*, *Cosmarium*, *Cylindrocystis*, *Staurastrum*.

Introduction

In the material collected during their excursions members of the Dutch and Flemish desmid working groups encountered a number of species that could not be identified with the available literature. We herewith describe them as new taxa.

Material & Methods

For way of collecting and preparing of the samples, see Van Westen & Coesel (2018).

Taxonomic account

Actinotaenium coronisporum Van Westen & Coesel spec. nov. (figs. 1a–e)

Description: Cells 2.1–2.5 times as long as broad with a very slight median constriction. Semicells semi-elliptic to almost cylindrical with broadly rounded apex. Cell wall with scattered, fine pores. Chloroplast stelloid with a single, central pyrenoid. Zygosporae globose, furnished with 3-spinate, corona-shaped protuberances. Dimensions: cell length 26–34 µm, breadth 11.5–14.5 µm. Diameter zygosporae 20–27 µm without spines, 30–40 µm with spines.

Type: —THE NETHERLANDS. Province of Drenthe in estate Eexterveld near Eext, 53.015653° N, 6.698512° E. Van Westen, 25 February 2021 (holotype L! Hugo de Vries Lab 2022.01, preserved as a fixed natural sample and represented by our fig. 1b).

Etymology: The 3-spinate protuberances show some resemblance with a crown (corona in Latin).

Differential diagnosis: — Vegetative cells of our newly described species may be easily confused with a number of similarly shaped and equally sized other *Actinotaenium* species with fine pores, in particular *A. didymocarpum* (P.Lundell) Coesel & Delfos, *A.*

phymatosporum (Nordstedt) Kouwets & Coesel and *A. spinospermum* (Joshua) Kouwets & Coesel. However, those species differ essentially in the shape of their zygosporae. Whereas *A. didymocarpum* is marked by more or less quadrate twin zygosporae, *A. phymatosporum* and *A. spinospermum* are characterized by globose spores furnished with

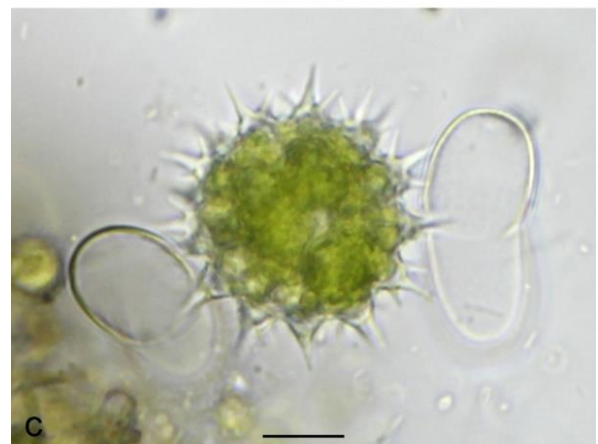
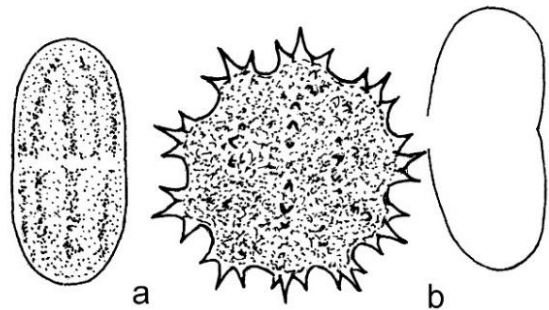


Figure 1. Vegetative cells of *Actinotaenium coronisporum* and zygosporae with adhering gametangia. Scale bar = 10 µm.



conically rounded processes. Also the pore pattern (longitudinal rows of pores) in the latter two species is different. As far as could be traced, the peculiar ornamentation in the zygospore of *A. coronisporum*, viz. protuberances that are crowned with a series of three equal spines in line, within the genus *Actinotaenium*, represents a unique feature. Occasionally, zygospores were found where one or two of the spines in the triplet were reduced, but never absent. *A. coronisporum* was found between mosses on a cattle track on the type location, but also in a rain puddle on bare ground in an urban area. Some accompanying species: *Closterium pusillum*, *Cosmarium hexalobum* var. *minus*, *C. microsphinctum*, *Cylindrocystis* spp., *Roya obtusa* var. *montana*.

Actinotaenium silvae-nigrae* var. *cucurbitiniforme

Van Westen & Coesel var. nov. (figs. 2a–2d, 3a–3d)
Description: Cells 2.0–2.6 times as long as broad with a very slight median constriction, Semicells semi-elliptic to almost cylindrical. Apex more or less truncate with broadly rounded angles. Cell wall with longitudinal series of closely spaced pores. Chloroplast asteroid-lobostelloid with a single, central pyrenoid. Zygospores elliptic-tetragonal, the angles broadly bulging into the empty semicells. Dimensions: cell length 47–66 μm , breadth 20–28 μm . Zygospore 45–57 x 40–50 μm .

Type: — THE NETHERLANDS. Province of Drenthe in estate Hijkerveld near Hijken, 52.924867° N, 6.490157° E. Van Westen, 5 February 2016 (holotype L! Hugo de Vries Lab 2022.02, preserved as a fixed natural sample and represented by our fig. 2d).

Differential diagnosis: — *Actinotaenium silvae-nigrae* (Rabanus) Kouwets & Coesel (1984) originally was described as *Penium silvae-nigrae* by Rabanus (1923: 229, pl. 2: 4–6). Rabanus (l.c.) described its cell outline as cylindrical to elliptic, but in later published floras the extremes in this range of forms were made separate varieties. Krieger (1935: 240) distinguished *Penium silvae-nigrae* var. *parallellum*, characterized by perfectly cylindrical cells, and characterized the cells of the nominate variety as being elliptic in outline. This view was adopted in the authoritative flora by Růžička (1981). Actually, those two varieties as represented in the above-mentioned floras are such different in cell shape that one might consider them as separate species as well. Yet, it appears that they are interconnected by an intermediate form, herewith being described as var. *cucurbitiniforme* because of its resemblance in cell outline to *Actinotaenium cucurbitinum* (Bisset) Teiling.

As compared to the nominate variety of *A. silvae-nigrae* our newly described variety differs by more or less truncate cell apices (versus broadly rounded ones); as compared to *A. silvae-nigrae* var. *parallellum*

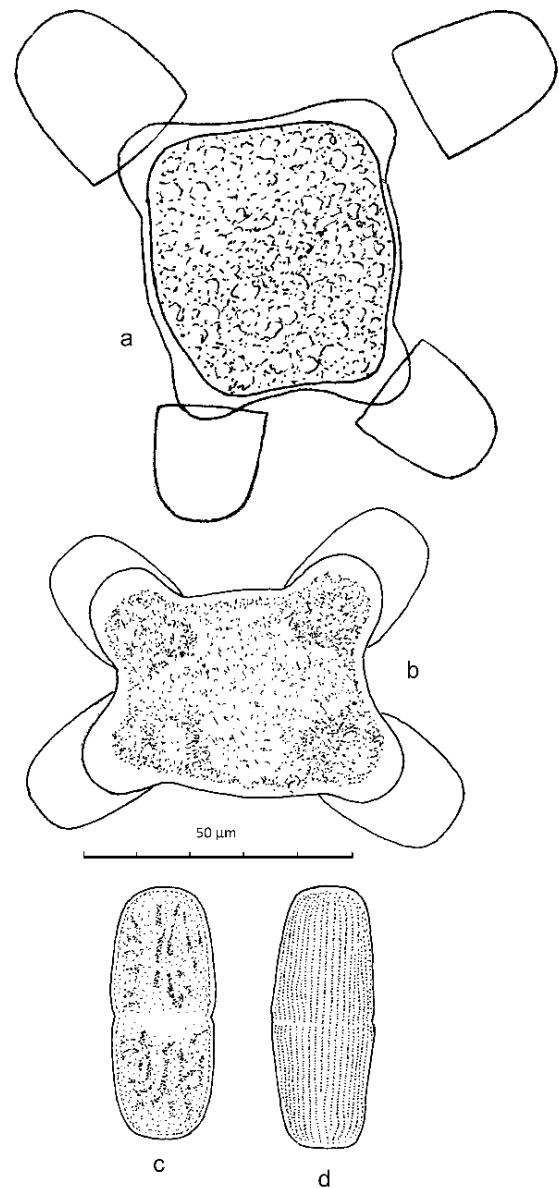


Figure 2. Vegetative cells of *Actinotaenium silvae-nigrae* var. *cucurbitiniforme* and zygospores with adhering gametangia.

it differs by semicells tapering from base to apex (instead of being cylindrical) as well as by an in average smaller cell length to breadth ratio, viz. 2.0–2.6 versus 2.9–3.6 in var. *parallellum*.

In 2016 and 2021 also zygospores of this taxon were encountered in rain puddles on a public footpath in the nature conservation area Hijkerveld. They agree with those described for the nominate variety of *A. silvae-nigrae* by Krieger (1935: 239, pl. 11: 2, sub *Penium*) and are characterized by their outbulging angles getting stuck in the empty gametangial semicells for quite some time. Interestingly, our above-described taxon, including its zygospore, was recorded by Sampaio (1949: 106, figs. 1–18) from



Portugal but he did not describe it under any infraspecific label. In the Dutch province of Drenthe *A. silvae-nigrae* var. *cucurbitiniforme* was found a few times in rain puddles in early spring and late autumn in nature conservation areas. At the type location, only a few accompanying species were found in the sample collected: *Actinotaenium phymatosporum*, *Cosmarium decedens*, *C. taticum*, *Cylindrocystis* spp. and *Mesotaenium* spp.

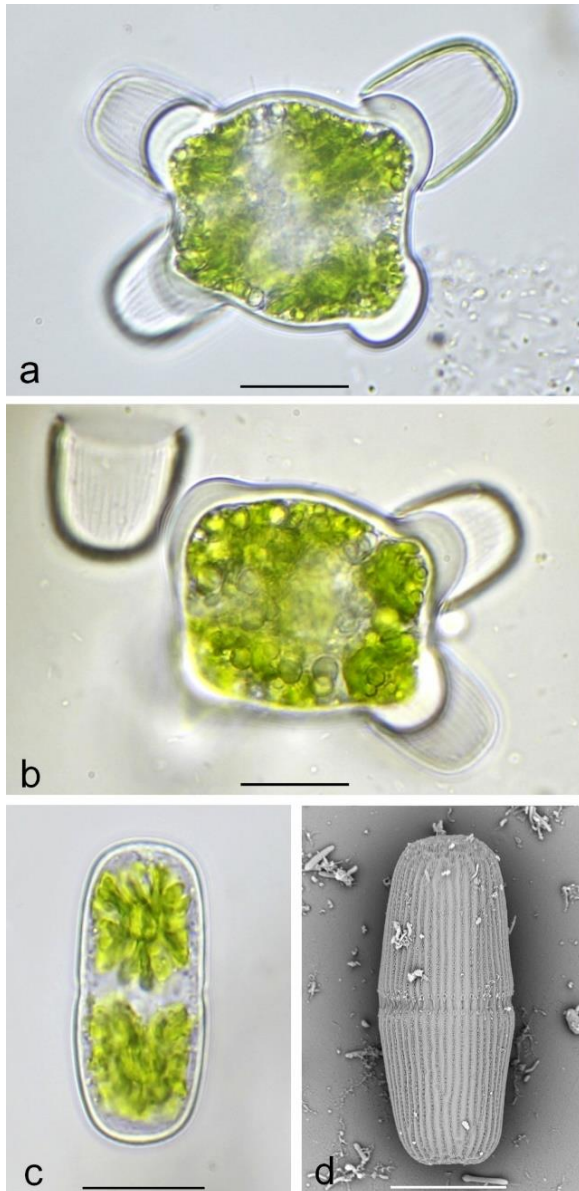


Figure 3. Vegetative cells of *Actinotaenium silvae-nigrae* var. *cucurbitiniforme* and zygospores with adhering gametangia. 3a–3c LM photographs. 3d. SEM photograph. Scale bar = 10 μ m.

Cosmarium gietenense Van Westen & Coesel spec. nov. (figs. 4a–4e)

Description: Cells about as long as broad, deeply constricted. Sinus widely open from a U-shaped apex. Semicells in frontal view oblong with convex lateral sides. Cell wall at each of the lateral sides furnished with two blunt, submarginal granules: the lower one somewhat closer to the lateral margin than the upper one. Semicells in lateral view globose, in apical view oblong with convex poles, the median part a little bit inflated and furnished with a marginal granule near each of the four rounded angles.

Chloroplast with a single, central pyrenoid.

Dimensions: cell length 7.0–8.5 μ m, breadth 7.5–9.5 μ m, isthmus 2.5–3.5 μ m, thickness about 4 μ m.

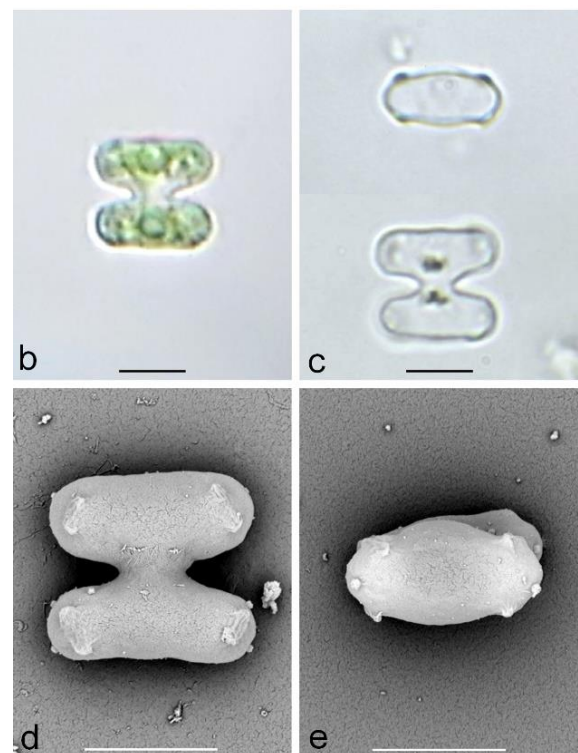
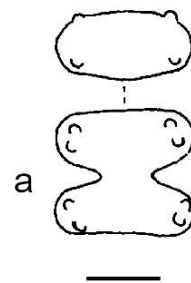


Figure 4. Vegetative cells of *Cosmarium gietenense*. 4b, 4c. LM photographs. 4d, 4e. SEM photographs. Scale bar = 5 μ m.



Type: — THE NETHERLANDS. Province of Drenthe in a fish pond near Gieten, 53.020739° N, 6.757895° E. Van Westen, 26 June 2010 (holotype L! Hugo de Vries Lab 2022.03, preserved as a fixed natural sample and represented by our fig. 4a).

Differential diagnosis: — In their cell outline, cells of *Cosmarium gietenense* resemble those of the much larger *C. bioculatum* var. *hians* West & G.S.West (1897: 486, pl. 6: 24) and particularly those of *C. calculus* Coesel (2007: 6, fig. 7) a taxon, moreover, with similar cell dimensions. However, whereas those latter taxa are characterized by a fully smooth cell wall, *C. gietenense* is distinctly marked by a pair of granules located near the margin of each of the lateral lobes. Our species could also be compared with *C. lutetianum* Kouwets (1998: 132, figs 24, 25), but the semicells in that species are trapeziform with only one granule at each lateral side, whereas our species has more oblong semicells and two granules and is also slightly larger. Our newly described species is only known from a mesotrophic fish pond near the village of Gieten, hence its name. Due to the small size it may easily be overlooked. The main accompanying species were: *Cosmarium contractum*, *C. dilatatum*, *C. subprotumidum*, *Staurostrum chaetoceras* and *St. levanderi* var. *hollandicum*.

Cosmarium meestersii Coesel & Van Westen spec. nov. (figs. 5a–5d).

Description: Cells 1.1–1.3 times as long as broad with a deep, linear, largely closed sinus. Semicells in frontal view near the base widening upwards, then subsemicircular, margin with 10 undulations. Semicells both in apical and lateral view elliptic with a distinct protuberance on each side. Cell wall smooth. Chloroplast with a single, central pyrenoid. Dimensions: cell length 24–27 µm, breadth 19–21 µm, thickness 13–14 µm, breadth of isthmus 6–8 µm.

Type: — THE NETHERLANDS. Mesotrophic pool on sandy soil in 'Groeve Oostermeent' at Blaricum, 52.28039 N, 5.25690 E. Meesters, 30 March 2004 (holotype L! Hugo de Vries Lab 2022.05, preserved as a fixed natural sample and represented by our fig. 5a).

Etymology: named for our colleague Koos Meesters who collected this species and brought it to our attention.

Differential diagnosis: — *Cosmarium meestersii* resembles *C. suborthogonum* Raciborski (1889: 85, pl. 1: 29) suggested by West & West (1908: 88) to be a mere forma ('*suborthogona*') of *C. impressulum* Elfving, only differing from Elfving's original description by the presence of a slight protuberance in the middle of the semicell.

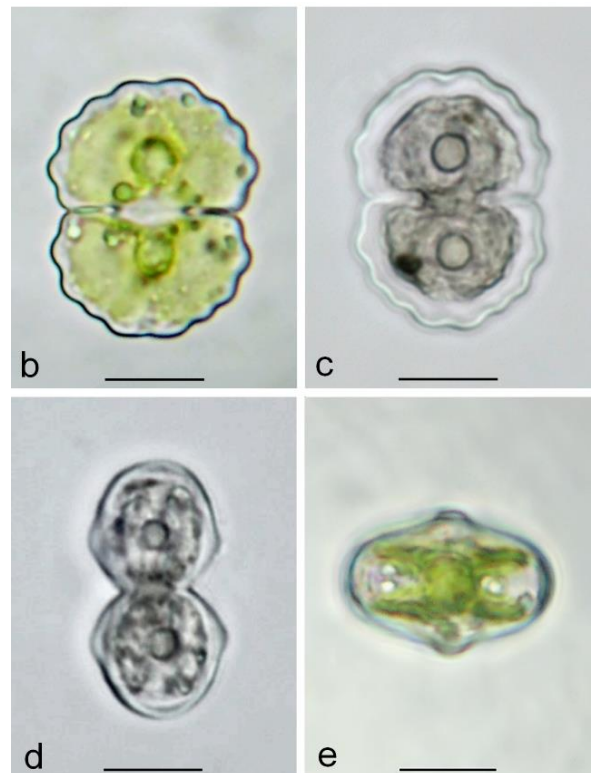
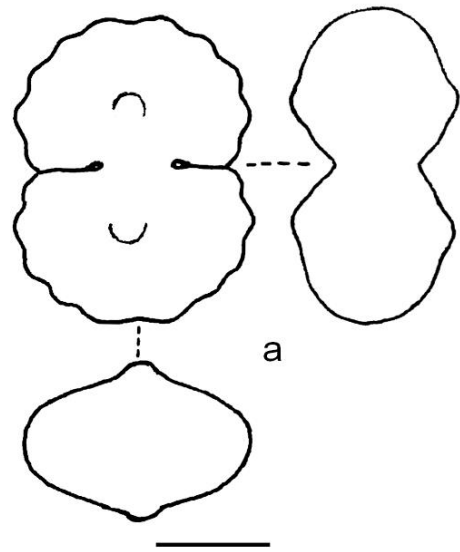


Figure 5. Vegetative cells of *Cosmarium meestersii*. Scale bar = 10 µm.

However, this taxon, in taxonomic status raised to var. *suborthogonum* by Taft (1945: 195) differs by having but 8 undulations per semicell. As for the number of marginal undulations, *C. meestersii* rather agrees with *C. undulatum* Corda sensu West & G.S. West (1905, pl. 59: 4), but that latter taxon is in want of the central protuberance characteristic of our newly described species.



In the Netherlands, *C. meestersii* was found a number of times, in different regions, but always in pools and puddles on sandy soil. At its type locality it was mainly accompanied by other *Cosmarium* species (among which *C. speciosum* and *C. holmiense* var. *integrum*) and also some common species of the genera *Closterium*, *Pleurotaenium*, *Staurastrum* and *Staurodesmus* characteristic of circumneutral environmental conditions.

Cosmarium pseudotrachypleurum Van Westen & Coesel spec. nov. (figs. 6a–6e)

Description: Cells about as long as broad with a deep, linear sinus closed for the greater part. Semicells in frontal view subreniform to almost oblong with broadly rounded angles. Semicells in lateral view about circular, in apical view elliptic with a prominent central inflation. Cell wall at and just within the margin ornamented with small, conical granules. In the semicell centre a big, usually subdivided wart, at the isthmus side surrounded by a semicircular series of smaller granules. Chloroplast with a single, central pyrenoid. Dimensions: cell length 29–34 μm , breadth 28–33 μm , thickness 19–21 μm , breadth of isthmus 10–13 μm . L/B 0.99–1.1.

Type: —THE NETHERLANDS. Province of Drenthe in estate Hijkerveld near Hijken, 52.917215° N, 6.475898° E. Van Westen, 4 June 2021 (holotype L! Hugo de Vries Lab 2022.04, preserved as a fixed natural sample and represented by our fig. 6a).

Differential diagnosis: — In rough cell outline, dimensions and ornamentation in the form of conical (sub)marginal granules the above-described species resembles *C. trachypleurum* var. *minus* Raciborski (1885: 11, pl. 1: 5). An essential difference, however, is in the central ornamentation of the semicell: a closed circle of granules enclosing a central one in *C. trachypleurum* var. *minus* versus an isthmus orientated semicircular series of granules enclosing a bigger, usually subdivided wart in *C.*

pseudotrachypleurum. Yet, it is likely that *C. pseudotrachypleurum* in earlier literature has been overlooked as a separate species; compare, e.g. *C. trachypleurum* var. *minus* in Coesel (1979: 393, pl. 18: 11) and in Kouwets (1987: 235, pl. 14: 26). *C. pseudotrachypleurum* was found in several weakly buffered, shallow moorland pools in the province of Drenthe between submerged mosses. Main accompanying species: *Euastrum neogutwinskij*, *Eu. ansatum*, *Hyalotheca dissiliens*, *Pleurotaenium ehrenbergii*, *Staurastrum borgeanum* and *Staurodesmus extensus*.

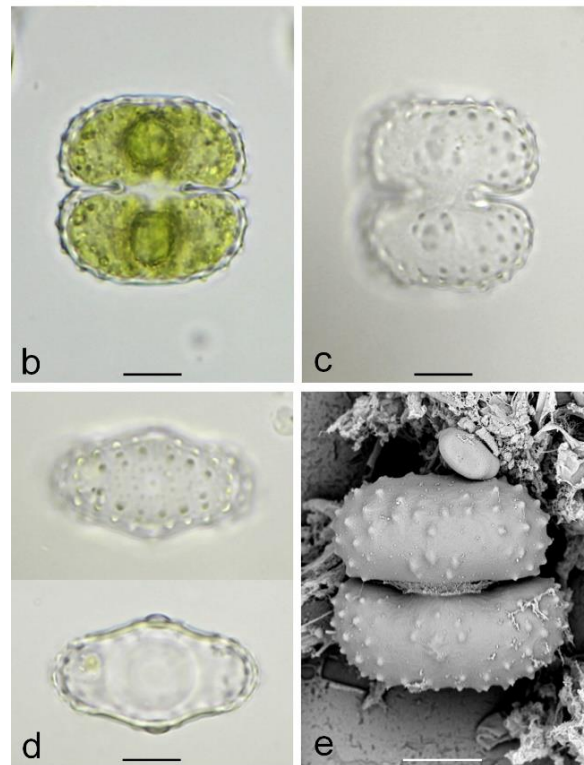
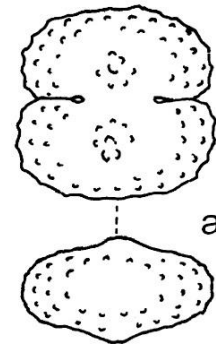


Figure 6. Vegetative cells of *Cosmarium pseudotrachypleurum*. 4b–4d. LM photographs 4e. SEM photograph. Scale bar = 10 μm .



Cylindrocystis subjeneri Van Westen & Coesel spec. nov. (figs. 7a–7i).

Description: Cells cylindrical, 2–3 times longer than broad. Chloroplasts (two per cell) asteroid in configuration, with a central pyrenoid. Zygospores more or less globose and smooth-walled; gametes released through a circular hole in the gametangial cells. Dimensions: cell length 19–38 μm , breadth 8.5–9.5 μm . Diameter zygospore 18–22 μm .

Type: —THE NETHERLANDS. Province of Drenthe in a rain puddle in estate Dwingelderveld near Dwingeloo, 52.822529° N, 6.448646° E. Van Westen, 30 March 2021 (holotype L! Hugo de Vries Lab 2022.06, preserved as a fixed natural sample and represented by our fig. 7c).

Differential diagnosis: — *Cylindrocystis subjeneri* much resembles *Cylindrocystis jeneri* (Ralfs) West & G.S. West, e.g., in Brook & Williamson (2010: 34). An essential feature of this taxon is the globose 'free' zygospore between the conjugating cells in which it differs from the enclosed zygospore characteristic of the common and widely distributed species *Cylindrocystis brebissonii* (Ralfs) De Bary. According to Brook & Williamson (2010), *Cylindrocystis jeneri* is an incompletely known species. Actually, as for the vegetative cell there is no certainty about the configuration of the chloroplast. This has to do with the very few observations of its zygospores, a necessary condition for a reliable identification. Ralfs, who described this species originally as *Penium jeneri* reports that the endochrome of the vegetative cells in arrangement is similar to that in *Penium brebissonii* but in his illustrations the chloroplast is undifferentiated (Ralfs 1848: 153, pl. 33: 2). Brook & Williamson (2010) refer to Förster (1965, pl. 1) depicting *Cylindrocystis brebissonii* var. *jeneri* f. *curvata* with a stelloid chloroplast but, by want of a zygospore, correct identification of that taxon is highly questionable. The only reliable illustration — viz. a zygospore with adherent gametangial cells in combination with a chloroplast-containing vegetative cell — published by Suxena (1984: 49, pl. 2: 16) under the name of *Cylindrocystis brebissonii* var. *jeneri* (Ralfs) Hansgirg shows an asteroid chloroplast.

Apart from a possible difference in chloroplast structure, our above-diagnosed new taxon differs from *Cylindrocystis jeneri* as originally described as *Penium jeneri* in Ralfs (l.c.) by distinctly smaller cell dimensions. Whereas Ralfs mentions a cell length between 30 and 60 μm , a cell breadth between 14 and 16 μm , and a zygospore diameter of a good 25 μm , those values in our *Cylindrocystis subjeneri* are 19–38 μm , 8.5–9.5 μm and 18–22 μm , respectively. Suxena (l.c.) described his form from India with cell length 20–21



Figure 7. 7a–7g. *Cylindrocystis subjeneri* vegetative cells and zygospores with gametangia, from type location. 7h, 7i. Zygospores and adhering gametangia from location Assen. Scale bar = 10 μm .



μm , breadth 11–12 μm and a zygospore diameter of 27–29 μm , so also distinct from our species. At the type location, *Cyl. subjenneri* was very abundant and no more than a few cells of *Cylindrocystis brebissonii* (cell width of about 15 μm) were found in our sample. This enabled us to study the chloroplast structure. In the shorter cells, the asteroid, somewhat coarsely lobed, chloroplast is clearly visible (figs 7d, 7e). The longer ones are in the process of cell division and the pyrenoid already started to divide (figs 7f, 7g). Apart from the zygospores with gametangia, many free globose zygospores and empty cells with a round hole were found, indicating that fig. 4c shows a late stage in zygospore formation, but not the final state. More recently (April 2022), in a sample from an almost dried up rain puddle on sand in the town of Assen, we found another sporulating population of *Cyl. subjenneri*. In this sample, the gametangia were already a bit detached from the rounded zygospores (figs 7h, 7i). Unfortunately, the chloroplasts of the cells were obscured by oil drops and dark particles in the cytoplasm. In this sample we also found (in low numbers): *Actinotaenium curtum*, *A. riethii*, *Closterium pusillum*, *Cosmarium crenatoides*, *C. microsphinctum*, *C. parvulum* and *C. pericymatium*.

Staurastrum lutsii Van Westen & Coesel spec. nov. (figs. 8a–8g)

Diagnosis: Cells somewhat longer than broad, deeply constricted. Sinus acuminately angled for a very short distance, then abruptly opening very widely. Semicells in frontal view anvil-shaped with a rather abrupt transition between a columnar basal part and a flattened upper part with broadly rounded angles. Semicells in apical view 4(-5) angular with concave sides and produced, broadly rounded angles. Cell wall finely granulate. Granules arranged in concentric circles around the arm-like processes and from there extending over the semicell body towards the base where two supraisthmial rings may be distinguished. Dimensions: cell length 32–37 μm , breadth 24–31 μm . Breadth of isthmus ca 12 μm .

Type: —FLANDERS (Belgium). Pool near Engsbergen, 51.016867° N, 5.040726° E. Luts, 20 June 2020 (holotype L! Hugo de Vries Lab 2022.07, preserved as a fixed natural sample and represented by our fig. 8a).

Etymology: named for Roland Luts who collected this species for the first time from Flanders and brought it to our attention.

Differential diagnosis: — Based on Coesel & Meesters 2013), the above newly described species was previously identified by Luts (2021: 6, figs 1-6) as *St. sinense* Lütke Müller. Indeed, the rough resemblance to that species is remarkable. Yet, there are some essential differences with *St. sinense* as

described by Lütke Müller (1900: 124, pl. 6: 39, 40) from China. In *St. sinense* cell dimensions are smaller and cell length to breadth ratio is lower than in *St. lutsii*. Next to that, in *St. sinense*, cell processes in

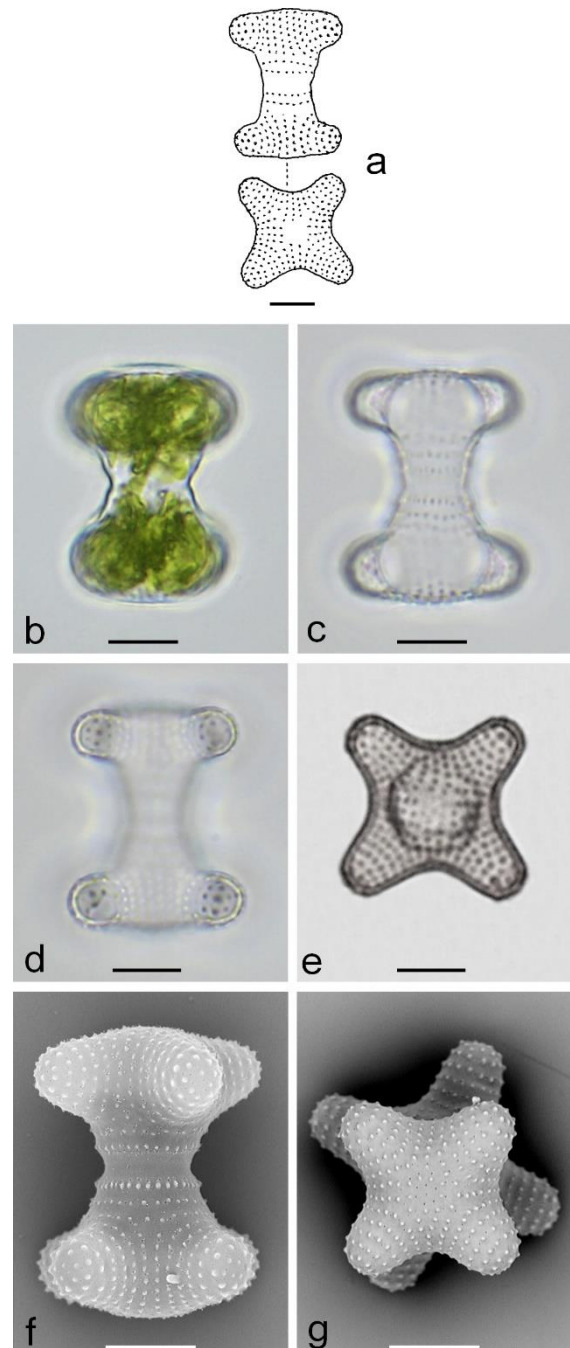


Figure 8. Vegetative cells of *Staurastrum lutsii*. 8b–8e LM photographs. 8f, 8g SEM-photographs. Scale bar = 10 μm .

apical view somewhat dilate towards their truncate ends whereas in *St. lutsii* they are tapering and broadly rounded. The most important difference, however, is in the cell wall granulation: in *St. sinense* strictly confined to the processes, in *St. lutsii* extending over almost the complete semicell surface



with two distinct whorls at the base. In that respect it differs also from *St. dilatatum* var. *extensum* Borge (1906: 46, pl. 3: 37), a taxon that superficially resembles *St. lutsii* as well.

St. lutsii abundantly occurred in a shallow, mesotrophic pool on loamy soil near the Flemish village of Engsborgen, together with species such as *Euastrum verrucosum*, *Micrasterias papillifera*, *Cosmarium porteanum*, *Xanthidium antilopaenum*, *Staurodesmus convergens* and *Staurastrum cristatum*.

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Literature

- Borge, O., 1906.** Beiträge zur Algenflora von Schweden. Arkiv för Botanik 6 (1): 1-88.
- Brook, A.J. & D.B. Williamson, 2010.** A Monograph on some British Desmids. Ray Society, London.
- Coesel, P. F. M., 1979.** Desmids of the broads area of NW-Overijssel (The Netherlands) II. Acta Botanica Neerlandica, 28(6), 385-423. doi: 10.1111/j.1438-8677.1979.tb01167.x
- Coesel, P.F.M., 2007.** Taxonomic notes on Dutch desmids IV: new species, new names, new combinations. Systematics and Geography of Plants 77: 5-14. doi: 10.2307/20649728.
- Coesel, P.F.M. & K.(J.) Meesters, 2013.** European flora of the desmid genera *Staurastrum* and *Staurodesmus*. KNNV Publishing, Zeist.
- Förster, K., 1965.** Beitrag zur Desmidiaceen-Flora der Torne-Lappmark in Schwedisch-Lappland. Archiv für die Botanik, Ser. 2, Band 6, nr 3: 109-161.
- Kouwets, F.A.C. & P.F.M. Coesel, 1984.** Taxonomic revision of the conjugatophycean family Peniaceae on the basis of cell wall ultrastructure. Journal of Phycology 20: 555-562. doi: 10.1111/j.0022-3646.1984.00555.x
- Kouwets, F.A.C., 1987.** Desmids from the Auvergne (France). Hydrobiologia, 146(3), 193-263. doi: 10.1007/bf00016347.
- Kouwets, F.A.C., 1998.** Contributions to the knowledge of the French desmid flora. 2. Rare and remarkable taxa from the regions of Sologne and Brenne. Cryptogamie, Algologie. 1998, 19 (1-2): 121-147.
- Krieger, W., 1935.** Die Desmidiaceen Europas mit Berücksichtigung der aussereuropäischen Arten. Rabenhorst's Kryptogam.-Fl. Deutschl., Öst., Schweiz. Band 13, Abt. 1, Teil 1, Lief. 2 (1935) p. 225-376, pl. 9-36. Akademische Verlagsgesellschaft, Leipzig.
- Luts, R., 2021.** On the existence of 5-radiate *Staurastrum sinense*. Desmidiological Communications 7: 6-7.
- Lütkemüller, J., 1900.** Desmidiaceen aus den Ningpo-Mountains in Centralchina. Annalen des K.K. Naturhistorischen Hofmuseums 15: 115-126.
- Rabanus, A., 1923.** Beitrag zur Kenntnis der Desmidiaceen des Schwarzwaldes. Hedwigia 64: 228-230.
- Raciborski, M., 1885.** Desmidyje okolic Krakowa. Sprawozdanie Komisji Fizyograficznej Akademija Umiejetnosci W Krakowie, Czesc II, 19 (1884): 3-24.
- Raciborski, M., 1889.** Nowe Desmidyje. Pamietnik Akademii Umiejetnosci W Krakowie — Wydziaie Matematyczno-Przyrodniczy 17: 73-113.
- Ralfs, J., 1848.** The British Desmidieae. Reeve, Benham & Reeve, London. doi:10.5962/bhl.title.14791.
- Růžička, J., 1981.** Die Desmidiaceen Mitteleuropas. Band 1, Lief. 2. E. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.
- Sampaio, J., 1949.** Desmidias novas para a flora Portuguesa. Boletim da Ciedade Broteriana 23 (2. Série): 105-117.
- Suxena, M.R., 1984.** Algae from Kodaikanal Hill, South India., p. 43-99 in: Algae of the Indian Subcontinent, A Collection of Papers. Bibliotheca Phycologica 66, J. Cramer, Vaduz.
- Taft, C.E., 1945.** The desmids of the west end of Lake Erie. The Ohio Journal of Science 45: 180-205.
- Van Westen, M.C. & P.F.M. Coesel, 2018.** Taxonomic notes on desmids from the Netherlands II, with a description of six new species. Phytotaxa 385: 1-9. doi: 10.11646/phytotaxa.385.1.9.
- West, W. & G.S. West, 1897.** A contribution to the freshwater algae of the south of England. Journal of the Royal Microscopical Society 1897: 467-511. doi: 10.1111/j.1365-2818.1897.tb00946.x.
- West, W. & G.S. West, 1904.** A Monograph of the British Desmidiaceae. Vol. I. Ray Society, London. doi: 10.5962/bhl.title.1619.
- West, W. & G.S. West, 1905.** A Monograph of the British Desmidiaceae. Vol. II. Ray Society, London. doi: 10.5962/bhl.title.1619.
- West, W. & G.S. West, 1908.** A Monograph of the British Desmidiaceae. Vol. III. Ray Society, London. doi: 10.5962/bhl.title.1619.