

Cosmarium charnainense C.D.N. Johnson 2023

Taxonomic Account

(Figs. 1-4)

Description: Cells small, about as long as broad to marginally broader than long. Sinus slightly open with a rounded apex and parallel sides for half the length, then opening widely to broadly rounded basal angles. Semicells trapezoid-hexagonal with the lower lateral angles divergent and more or less straight. The broadest part is just above the median point. Upper lateral angles acutely convergent and retuse. Apex truncate or slightly retuse. Each semicell has two small granules disposed asymmetrically: in front view the left granule is placed near the left lateral angle whereas the right granule is placed near the right apical angle. In apical view the asymmetry is clearly seen. Side view is orbicular. The cell-wall is smooth with numerous mucilage pores. Chloroplast axile with a single pyrenoid per semicell.

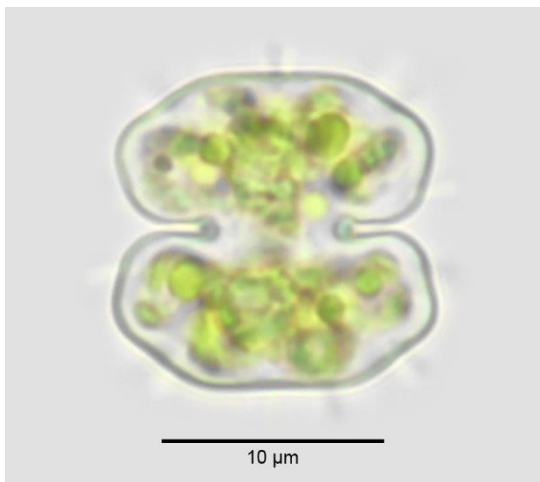


Figure 1. Vegetative cell of *C. charnainense* from the type material. Note the radiating strands of mucus along its outline, associated with cell wall pores. Photograph © Chris Johnson.

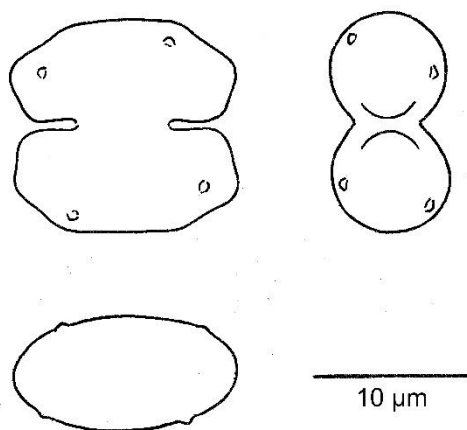


Figure 2. Drawing of frontal, lateral and apical views of a single cell. Drawing © Frans Kouwets.

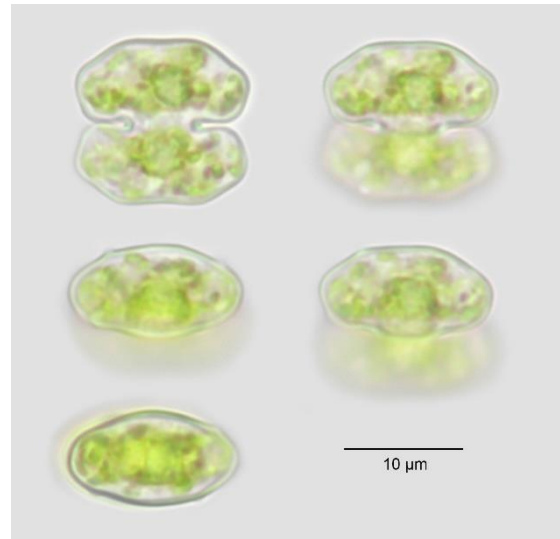


Figure 3. Vegetative cells of *C. charnainense*. Note the small granules in oblique and apical views. Photograph © Chris Johnson.

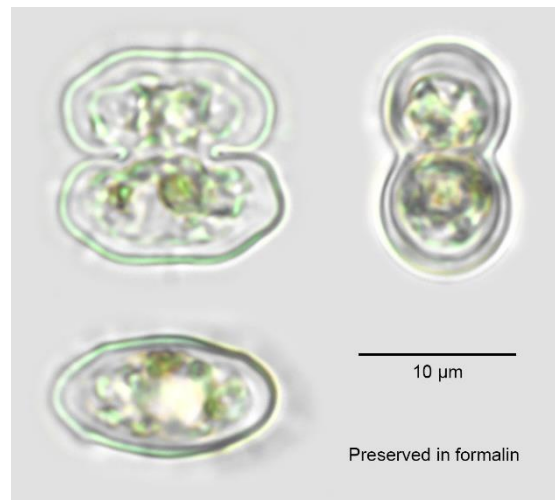


Figure 4. Vegetative cells of *C. charnainense* in formalin. Photograph © Chris Johnson.

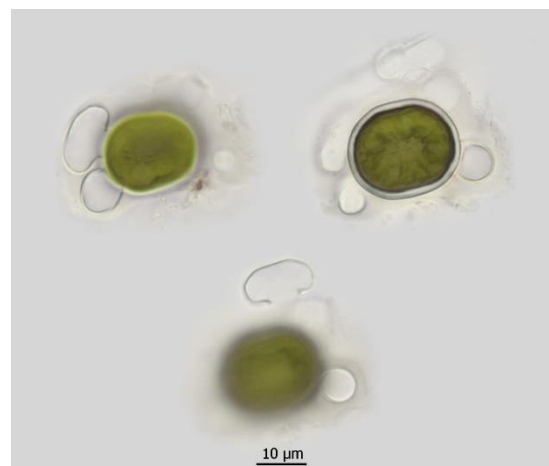


Figure 5. Zygospore of *C. charnainense* at three focal points. Photograph © Chris Johnson.

The zygospore is subglobose with dark olive-green mesospore and almost black edge, the transparent exospore has the gametangial cells embedded. Dimensions: L: 14.0–14.7 μm . B: 14.4–15.4 μm . Is: 6.2–6.9 μm . Th: 8.1–8.3 μm . L/B: 0.95–1.01. Zygospore: 22.3 x 18.7 μm .

Type: Fixed natural sample (plankton net through a shallow boggy pool), collected by C.D.N. Johnson, 8 May 2021, deposited at the Natural History Museum, London, Accession No. BM013788933. (Holotype represented by fig. 2).

Type locality: UNITED KINGDOM. By Wind Farm, near Loch a' Charnain, South Uist, Outer Hebrides. Lat: 57.358016N Long: 7.293079W.

Etymology: named after the nearby scattered settlement of Loch a' Charnain, South Uist, Outer Hebrides.



Figure 6. Sample site, near Loch a' Charnain, South Uist. Photograph © Christine Johnson.

Occurrence: *Cosmarium charnainense* is currently only known from a shallow moorland pool, near Loch a' Charnain, South Uist (fig. 6). Samples were taken using a plankton net through marginal vegetation comprising: *Nymphaea alba*, *Potamogeton natans* & *Ranunculus flammula*. The substratum is peaty and acidic with a pH 5.3. conductivity: 88 $\mu\text{S}/\text{cm}$.

Discussion

There are other taxa with small granules that are asymmetrically disposed in a similar manner. First, we need to consider *Cosmarium sphagnicola* [as *sphagnicolum*] W. & G.S. West 1897. They presented a clear description with detailed figures (W. & G.S. West l.c., p. 486, pl. 6: 13-14; see fig. 7). These drawings are replicated in their flora (W. & G.S. West 1908, p. 71, pl. 71: 11–14). As dimensions they gave L: 10.5–11.5, B: 11–13.5, Is: 5–5.5, Th: 6.5 μm . Interestingly, the granules are placed symmetrically within each truncate apical angle as if unaware of their true disposition. This taxon and later varieties are all markedly smaller than *C. charnainense* and have a broader isthmus relative to size. Also, the nominate variety in face view is broadest near the

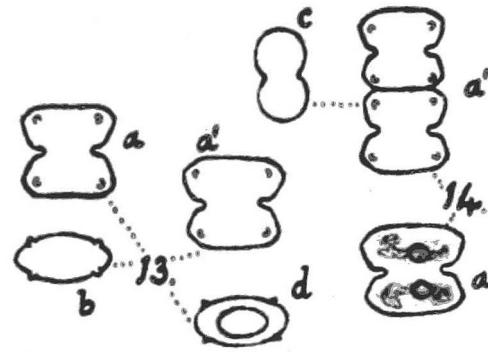


Figure 7. Image of *C. sphagnicola* [as *sphagnicolum*] from West & West (1897).

apex. They are acidophiles, usually associated with *Sphagnum*. Compare the recently described *Cosmarium sphagnicoliforme* M.C. van Westen & P.F.M. Coesel 2021 which has a rather similar morphology but still smaller dimensions: L: 6.5–9.5,

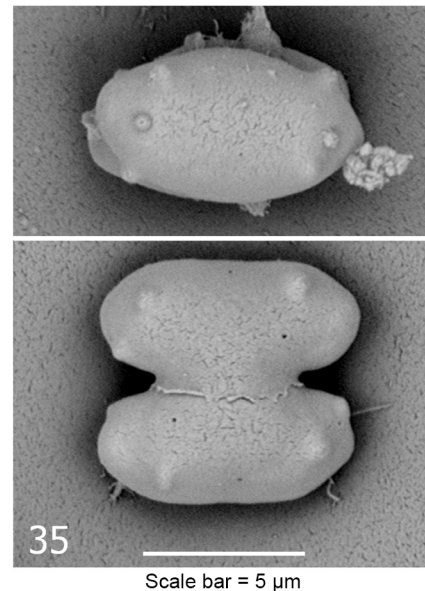


Figure 8. SEM Image of *C. sphagnicoliforme* from Van Westen & Coesel (2021).

B: 6.5–10, Is: 4.5–5.5, Th. about 5 μm (van Westen & Coesel 2021, p. 247, figs 7, 27-29, 35; see our fig. 8). *Cosmarium pygmaeum* W. Archer 1864 also displays the same granular pattern but in addition has a central papilla (Archer 1864, pl. 6: 45-49). The taxonomy of this species is complicated and only mentioned here in having a similar granular configuration. Even at its largest (L: 7–13, B: 7–13 μm .) it is smaller than the taxon under discussion with which it most interestingly co-occurred in the sample studied.

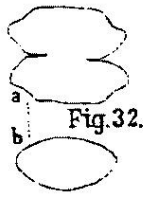
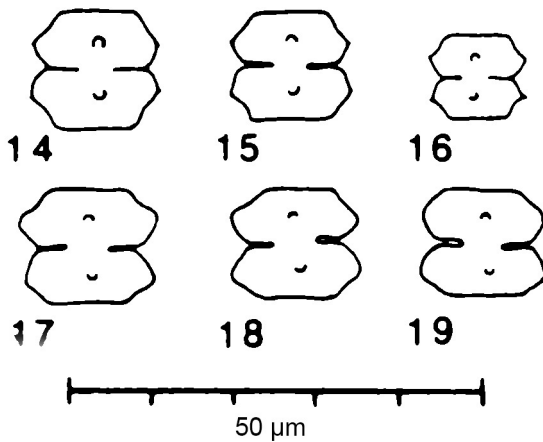


Figure 9. Image of *C. abbreviatum* f. *germanicum* from Raciborski (1889).

A taxon with similar morphology is *Cosmarium abbreviatum* f. *germanicum* M. Raciborski 1889 (Raciborski l.c., p. 79, pl. 5: 32; as *germanica*). Dimensions: L: 15, B: 16, ls: 6.6, Th: 7.5 μ m. Krieger & Gerloff (1969) raised it to variety and presented a copy of Raciborski's drawings (Krieger & Gerloff l.c., p. 242, pl. 42: 16; see fig. 9). This taxon differs from the Charnain desmid in having a closed sinus for half its length, broadly rounded basal angles, the broadest point on the median line, and lacking granules. It is also smaller on average. *Cosmarium polygonum* (C.W. von Nageli) W. Archer [in A. Pritchard 1861] is another problematic species as the original diagnosis lacked clarity. *C. polygonum* var. *depressum* E.A. Messikommer 1942 was first



14-16. *C. polygonum* var. *acutius*
17-19. *C. polygonum* var. *depressum*

Figure 10. Images of *C. polygonum* var. *acutius* and var. *depressum* from Coesel (1991).

found in the Swiss Alps. A small taxon (its dimensions have been approximated from the fractions given: L: 8–8.9, B: 9.2–10, ls: 3 μ m.) with narrowly open sinus, strongly produced lateral angles on the median line and a central protuberance (Messikommer l.c., p. 147, pl. 5: 8). He also noted granular asymmetry similar to the Charnain desmid but stated that the apical granules frequently are almost invisible. See Coesel (1991, p. 45, pl. 9: 17-19) for an expanded size-range of this taxon (fig. 10). The figures show a central

protuberance but no granulation. Another variety: *C. polygonum* var. *acutius* E.A. Messikommer 1942 is compared by the author with *C. sinostegos* J.G. Schaarschmidt 1883 (Messikommer l.c., p. 148, pl. 9: 17–19). These taxa are slightly smaller than var. *depressum* and have a spicule at the widest lateral point, plus a small protuberance. This is also recorded and illustrated by Coesel (1991, p. 45, pl. 9: 14-16) on the same plate for comparison (fig. 22). The taxonomical complexity of this group of small *Cosmarium* forms is demonstrated by the fact that in a later publication *C. polygonum* var. *depressum* and var. *acutius* were both considered identical to the equally problematic *Cosmarium polygonatum* M. Halász 1940 (Coesel & Meesters 2007, p. 132, pl. 69: 3-9).

Note: A consistent asymmetrical granular pattern displayed in a limited number of species, such as the first two species mentioned in the discussion, is very unusual and suggests a common heritage, perhaps going back millennia. This characteristic granular pattern has also been noted on *C. polygonum* var. *depressum* as a transient feature. As these indistinct granules are very difficult to observe in a light microscope, they are easily overlooked. Consideration of this phenomenon is perhaps deserving of more attention.

Conclusion

C. sphagnicola and *C. pygmaeum*, with their similar granular configuration, such as the first two species mentioned have the closest affinity to the Charnain taxon but the differences and problems noted above preclude associating it with *C. charnainense* as it would cause confusion. The other taxa mentioned are largely smooth-walled with the possible exception of a central protuberance, which is a feature of many. They differ morphologically as discussed with the main differences being generally smaller size with a narrower isthmus: the L/B ratio is lower (0.7–0.9). The author feels this desmid is sufficiently distinct to warrant species rank.

Acknowledgements

The author would like to thank Frans Kouwets for enormous help especially with his innate knowledge of the relevant literature and comparative diagnoses skills, resulting in a much-improved manuscript. Also, for providing the excellent drawings. To Marien van Westen for the generous sharing of his comprehensive reference repository.

Literature

- Archer, W. (1864) Description of two new species of *Cosmarium* (Corda) of Penium (Bréb.) and of *Arthrodesmus* (Ehr.). *Quarterly journal of microscopical science*, new series 4: 174-182.
- Archer, A. [in Pritchard, A.] (1861) *A history of infusoria, including the Desmidiaceae and Diatomaceae, British and foreign*. Whittaker and Co., London.
- Coesel, P.F.M. (1991) *De Desmidiaceeën van Nederland. Deel 4. Fam. Desmidiaceae (2)*. Stichting Uitgeverij Koninklijke Nederlandse Natuurhistorische Vereniging, Utrecht.
- Coesel, P.F.M. & K. Meesters (2007) *Desmids of the Lowlands. Mesotaeniaceae and Desmidiaceae of the European Lowlands*. KNNV Publishing, Zeist
- Krieger, W. & J.H. Gerloff (1962–1969) *Die Gattung Cosmarium*. J. Cramer Verlag, Weinheim
- Messikommer, E. (1942) Beitrag zur Kenntnis der Algenflora und Algenvegetation des Hochgebirges um Davos. *Beiträge zur geobotanischen Landesaufnahme der Schweiz*. 24: 1–452.
- Raciborski, M. (1889) Nowe desmidyje. *Pamiętnik Akademii Umiejetnosci w Krakowie, Wydział Matematyczno-Przyrodniczy*. 17: 73–113.
- Van Westen, M.C. & P.F.M. Coesel (2021) Taxonomic notes on desmids from the Netherlands IV, with a description of another five new species. *Phytotaxa* 522 (3): 240–248
- West, W. & G.S. West (1897) A contribution to the freshwater algae of the south of England. *Journal of the Royal Microscopical Society* 1867: 467–511.
- West, W. & G.S. West (1908) *A Monograph of the British Desmidiaceae*, Vol. 3. The Ray Society, London.