Three previously undescribed zygospores

Chris Johnson
CDN.Johnson@protonmail.com

Preamble

On 9 August, 2021 we collected water samples from Loch a' Chafain, Askernish, in South Uist, Outer Hebrides. In the samples was an unknown desmid, which was shown to several noted desmidiologists (it remains unidentified and is not featured in this account). A return visit was made on 23 May, 2022 to try and secure more specimens. It transpired that we were too early in the year as the aquatic flora was barely visible.

On our way back to the car, we noticed an interesting looking shallow pool with good vegetation. It was shelved, being deeper one end than the other, but deep enough to use the plankton net and several samples we secured. The pH at 6.3 was only slightly acidic. The flora included *Ranunculus flammula, Potamogeton polygonifolius* and *Eriophorum vaginatum*; some benthic debris was also collected (fig. 1).

Figure 1. Shallow pool by Loch a' Chafain, Askernish, South Uist, Grid. Ref. NF7463 2412. Photo © Christine Johnson.

The samples contained an abundance of desmids from a wide variety of species. Of particular note was the number of conjugating cells. Three of the zygospores were related to undescribed taxa. It is a known phenomenon (Coesel 1974; Coesel & Delfos 1986) that conjugation in one taxon can occur together with conjugation in other taxa.

Staurastrum boreale West & G.S.West 1905

A variable species and closely allied with *Staurastrum gracile* Ralfs ex Ralfs 1848. Coesel & Meesters (2013) in their footnote to *St. boreale* sums up the identification issues: "*St. boreale* sometimes is hardly to be distinguished from *St. gracile*. Mutual differences are such that the identity of *St. boreale* as a separate species may be questioned." Using their size data, *St. boreale* is smaller and appears to be 'stockier'.
Samples collected from sites it the Outer Hebrides suggest that keeping them separate is justified. Firstly, I rarely if ever find these two species in the same sample. On this occasion there was a healthy population of *St. boreale* but no identifiable *St. gracile*. This segregation has been noticed in other samples. Secondly, zygospores often reflect in size and protuberances (spines) the size of the species. There is little here for comparison: the only zygospore of *St. gracile* I can find reference to is the one in Coesel & Meesters (2013), reproduced from Homfeld (1929: p.75, fig. 96) (fig. 2).

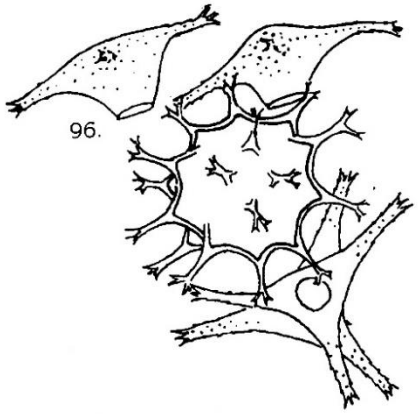

Figure 2. Homfeld 1929. *Staurastrum gracile* zygospore.

Homfeld notes: "Zygotes from Ahrensburg and from Prökel-Moor (localities 1, 3) were spherical, with slender, doubly forked spines on a conical base. Diameter 36–44, with spines 56–70 µ. Cells 43–50 µ long, with arms 65–72 µ wide, isthmus width 11 µ." (translated from German).

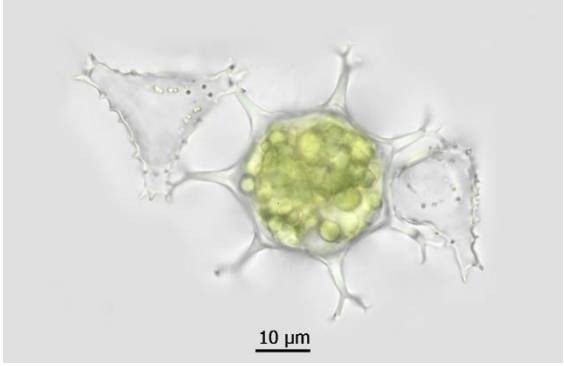

Figure 3. *Staurastrum boreale*. Zygospore. Photo © Chris Johnson.

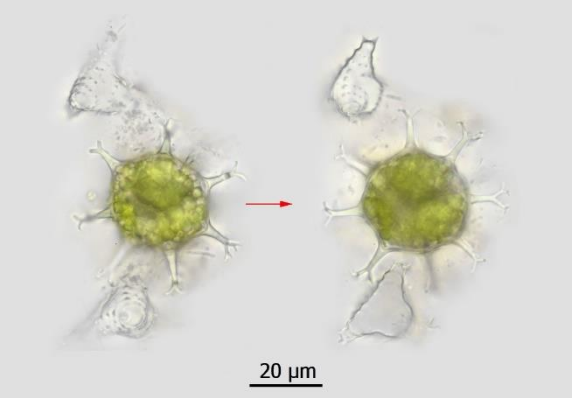

Figure 4. *Staurastrum boreale*. The same zygospore at different focal points. Photo © Chris Johnson.

Compare this with the zygotes the author found of *St. boreale* (figs. 3–4). Diameter minus spines: 22–29.8, with spines: 38–49.8 µm. Cells breadth 29–32 µm. Also of note is the number of spines in face view: 6–7 in *St. boreale*, 8–10 in *S. gracile*. Even with this small sample there is a clear size difference, but the overall shape and multifurcate spine-apices are similar.
Another similar species to consider is *Staurastrum crenulatum*. Referring to Coesel & Meesters (2013) again, they note for this species that the taxonomic concept is rather obscure and therefore have adopted West's (1899, pl. 11: 21–27) concept. There are differences between *St. boreale* and *St. crenulatum* which I note here: *boreale* first, *crenulatum* in brackets.

1. Semicells cup-shaped (semicell body subfusiform).
2. Processes tipped with short spines (processes tipped with minute spines).
3. A supraisthmial whorl of granules (no supraisthmial whorl of granules).

The first two items, I'm sure, will be variable but collectively the differences are quite persuasive. The supraisthmial whorl of granules is most important as it's a prominent feature on most *boreale* cells (fig. 5).

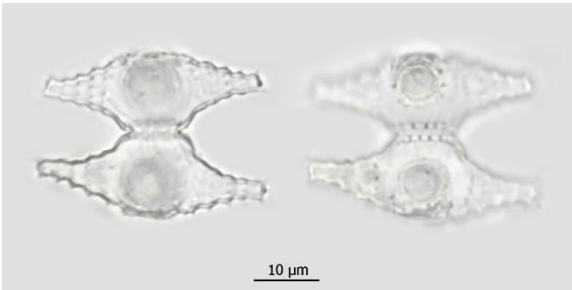

Figure 5. *Staurastrum boreale* showing the prominent supraisthmial granules. Photo © Chris Johnson.

Staurastrum bulbosum var. *bulbosum* (West) Coesel 1996

Once again, I have used Coesel & Meesters (2013) as the main work of reference. This taxon and the variety *cyathiforme*, were abundant in the sample. The main diagnostic characteristics given for the nominate variety are two spines at the tips of the processes and simple spines at the apices. For the variety *cyathiforme* there are three spines at the ends of the processes and bifurcate spines at the apices. The sample also included some puzzling atypical cells. These had two spines at the ends of the processes but short bifurcate spines at the apices. These I have tentatively associated with the nominate variety.

The zygospore shows ten spines in face view which have a broad base with a semi-circular hollow (resembling Eiffel Towers). The apices are doubly furcate. Dimensions: minus spines, 24–36 µm, overall, 50–66 µm (fig. 6).

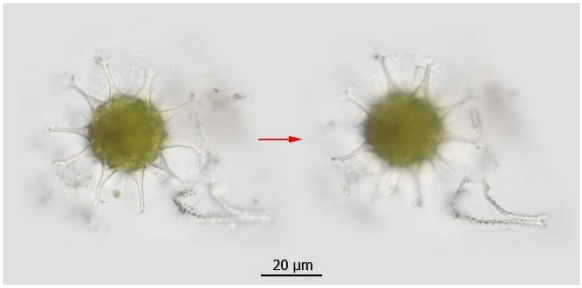

Figure 6. *Staurastrum bulbosum*. The same zygospore at different focal points. Photo © Chris Johnson.

A suggestion has been received that the pattern of ornamentation relates to *St. johnsonii.* However, there are distinct differences that exclude that species.
1. The processes are divergent rather than parallel.
2. They are tipped with three spines rather than two.
3. In apical view the semicell body rather abruptly passes into the processes.
In *St. bulbosum* the transition merges gradually into the processes. (Fig. 7–8).

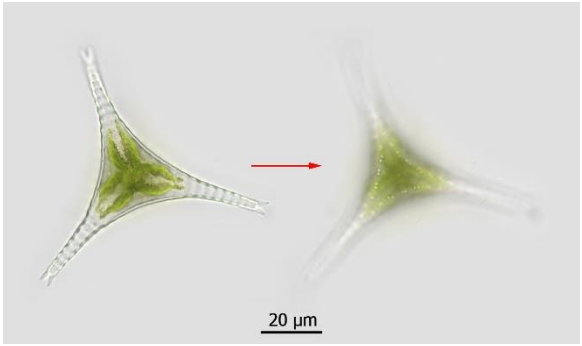

Figure 7. *Staurastrum bulbosum.* Apical view showing gradual transition into processes. Foto © Chris Johnson.

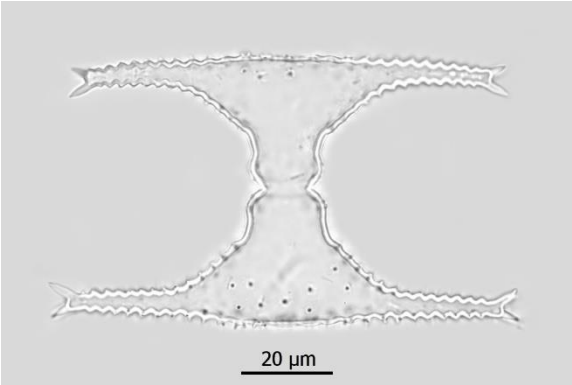

Figure 8. *Staurastrum bulbosum*. A dead cell. Photo © Chris Johnson.

Cosmarium sinostegos var. *ausseeanum* Lenzenweger 1984

The samples contained tychoplanktonic and benthic material, which is the habitat of this *Cosmarium*. It was unfamiliar to me and not easy to get good quality images. I examined the sample more closely with a x100 oil immersion objective and found several live cells and a dead semicell, which was useful for showing the configuration of the granules. Shortly after, I found the zygospore with gametangial cells attached. I took several images at different focal depths and have presented four on the accompanying image. I eventually identified it as *Cosmarium sinostegos* var. *ausseeanum.* The critical feature of this variety is the small, subapical median thorn. It doesn't show too clearly in figure 10 (except in apical view), but shows much better on the gametangial cells. In view of its perceived rarity (quite possibly overlooked due to its small size), I consulted Frans Kouwets, the recognised authority on this genus, for his opinion, and he confirmed my find.

The zygote has an irregular outline and is slightly longer than broad. It was embedded in detritus and consequently not possible to turn it; therefore, it may have a different profile in side view.

Length 10.1, breadth 7.7 µm. The projections were 4.0–5.5 µm long with inflated bases (figs. 9-11).

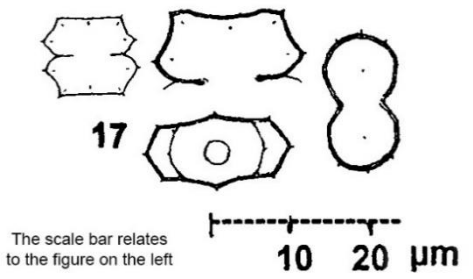

Figure 9. *Cosmarium sinostegos* var. *ausseeanum* (From Lenzenweger 1999).

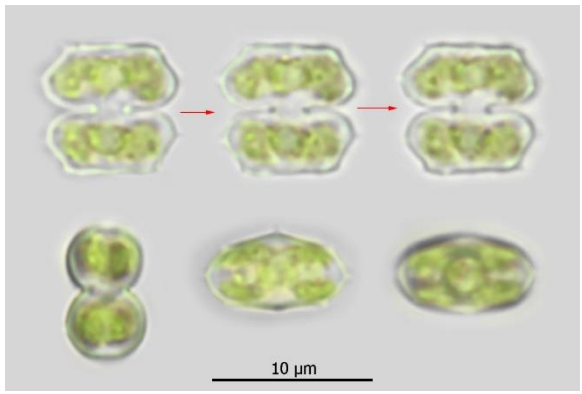

Figure 10. *Cosmarium sinostegos* var. *ausseeanum*. Photo © Chris Johnson.

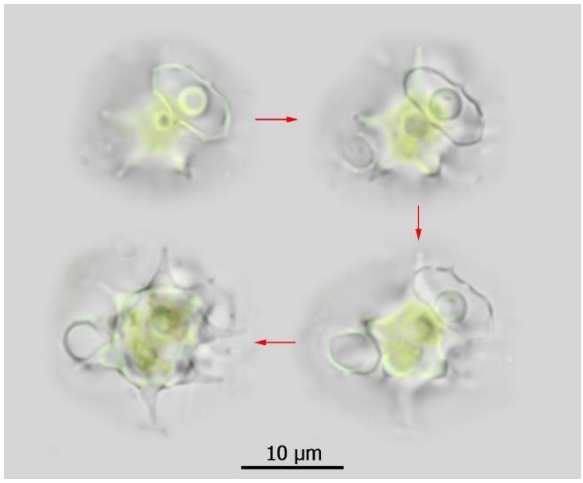

Figure 11. *Cosmarium sinostegos* var. *ausseeanum*. The same zygospore at different focal points. Photo © Chris Johnson.

References

Coesel, P. 1974. Notes on sexual reproduction in desmids. I. Zygospore formation in nature (with special reference to some unusual records of zygotes). Acta Bot. Neerl. 23(4), p. 361-368.

Coesel, P. & A. Delfos 1986. New and interesting cases of conjugating desmids from Lapland. [See Discussion, p.370]. Nord. J. Bot. 6: 363-371. Copenhagen.

Coesel, P.F.M. & K.L. Meesters 2013. European Flora of the Desmid Genera Staurastrum and Staurodesmus. KNNV Publishing, the Netherlands.

Homfeld, H. 1929. Beitrag zur Kenntnis der Desmidiaceen Nordwestdeutschlands besonders ihrer Zygoten. Pflanzenforschung, Heft 12.

Lenzenweger, R. 1999. Desmidiaceenflora von Österreich, Teil 3, tafel 52, fig.17.

West, G.S. 1899. On Variation in the Desmidieæ, and its Bearings on their Classification. Botanical Journal of the Linnean Society, Volume 34, Issue 238.

West, W. & G.S. West 1905. Freshwater algae from the Orkneys and Shetlands. Transactions and Proceedings of the Botanical Society of Edinburgh 23: p.27, fig. 25.