

Sexual reproduction of freshwater algae

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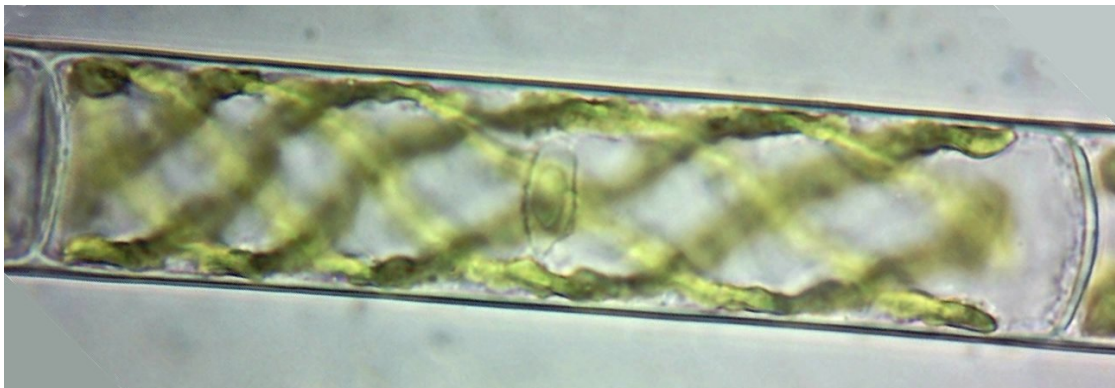
Although the topic has been covered several times in Micscape for *Spirogyra* species, let's look at two examples of sexual reproduction in two species of freshwater algae: *Spirogyra* and *Vaucheria*, to observe the differences in strategy in each case. Here is an illustration of the simple classification of algae (may be useful for other species !):

https://www.researchgate.net/figure/Classification-of-algae-explained-in-a-simple-way_fig1_325710331

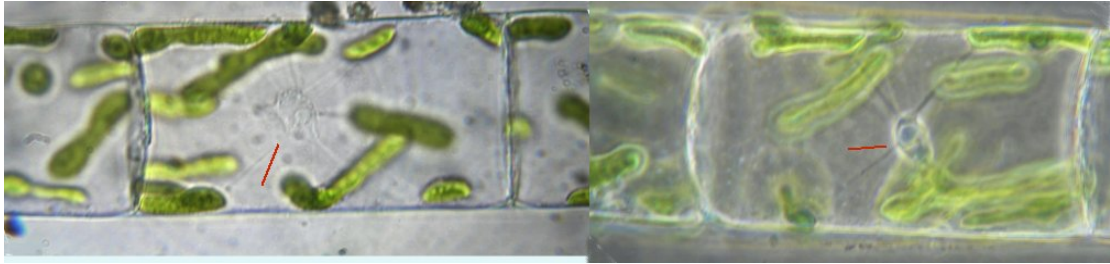
and to be more precise, this comparison between the two species extracted from the site Algaebase

Empire: Eukaryota	Empire: Eukaryota
Kingdom: Plantae	Kingdom: Chromista
Subkingdom: Viridiplantae	
Infrakingdom: Streptophyta infrakingdom	
Phylum: Charophyta	Phylum: Ochrophyta
Class: Zygnematophyceae	Class: Xanthophyceae
Subclass: Zygnematophycidae	
Order: Spirogyrales	Order: Vaucheriales
Family: Spirogyraceae	Family: Vaucheriaceae
Genus: Spirogyra	Genus: Vaucheria

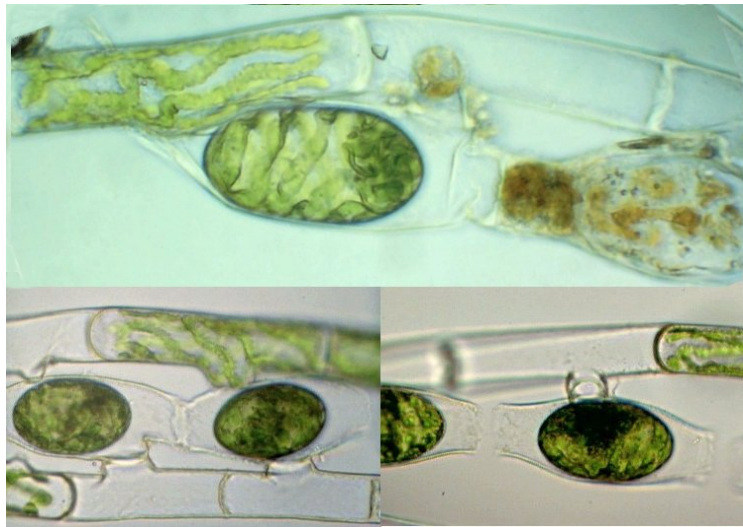
Spirogyra, of which there are 300 species, is easily recognized by the spiral shape of its chloroplasts. The cytoplasm forms a thin zone between the cell wall and a large central vacuole. The chloroplasts are contained in this cytoplasm and carry pyrenoids storing starch reserves. Each cell is separated from the others by a wall. *Spirogyra* seem to prefer fresh water from early spring. Here we see 4 chloroplasts and a nucleus in the center of the cell : (X 40 objective)



The nucleus in the center (red arrow) is difficult to see because it is often hidden by chlorophyll: here are two images of the nucleus, (best seen in phase contrast on the right picture) ; tracts connect it to the peripheral cytoplasm (X 40 objective)



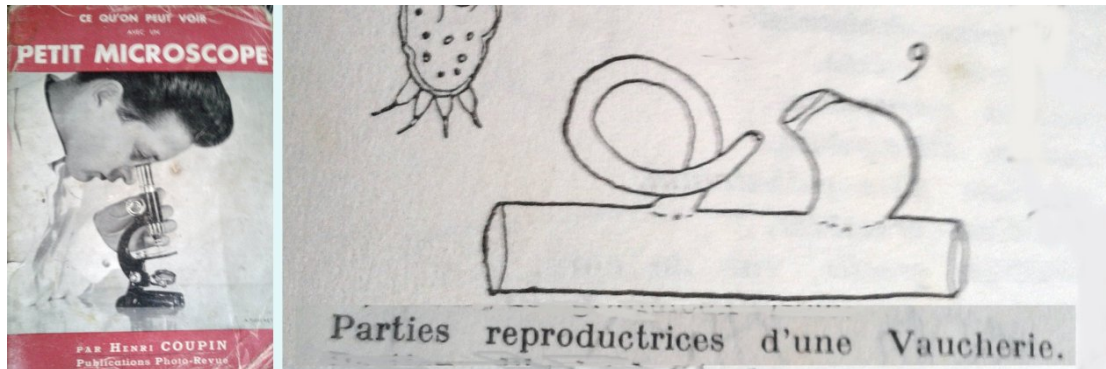
Spirogyra has male filaments and female filaments: under unfavorable environmental conditions, when the two types of filaments approach each other, tubular protrusions are formed from a male cell towards the female cell and vice versa. The tubes merge and open, there is then a migration of the cytoplasm of the male cells towards that of the female cells which merge to form a Zygospore: this is the phenomenon of conjugation (X 15 objective)



Another image of zygospores: the filament at the top of the image has only one chloroplast per cell : (X 15 objective)

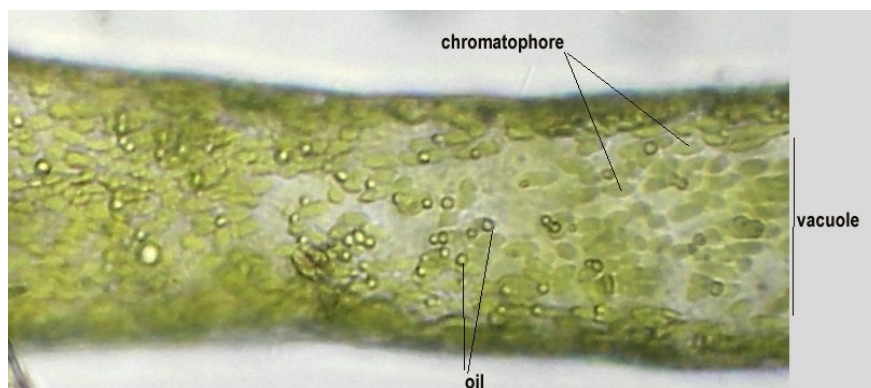


Second example from *Vaucheria*: but first a little anecdote: the description of the algae *Vaucheria* had intrigued me for a long time after reading the microscopy book offered with my first microscope! : here is a partial reproduction of the corresponding drawing in the book and the cover of the book (read and re-read!):



Reproduction occurred in a sample of algae left for more than a month in the light on a window sill, adding water from time to time. I had not identified the algae as being *Vaucheria* between to see the reproductive process!

I had collected this filamentous algae on the banks of a small stream with a slow flow, but it also grows in brackish environments. One of the characteristics is to present filaments without separation (septum) between cells unlike *Spirogyra*. The center of the filament is occupied by a large vacuole, the cytoplasm being located between the vacuole and the outer wall. Disc-shaped chloroplasts are peripheral, along with multiple nuclei. We also see food reserves in the form of small oil globules (X 40 objective)

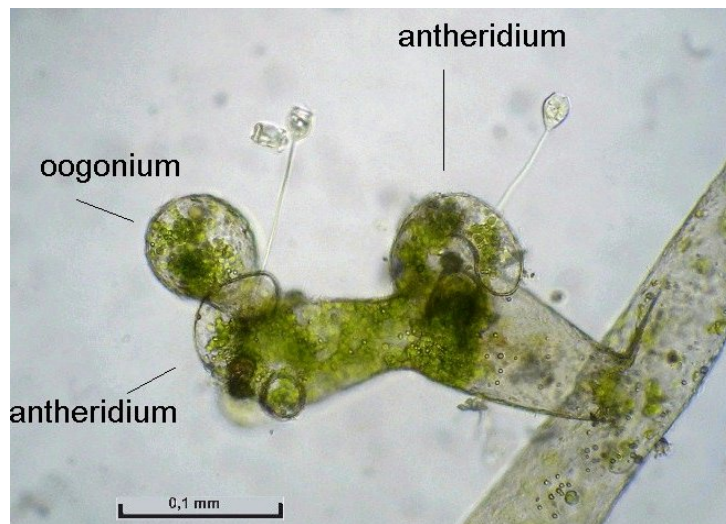


Vaucheria contains pigments like that of Xanthophyceae such as chlorophyll-a, β -carotene, xanthophylls, which give it a green-yellow color

When the environment becomes unfavorable, the filaments partition and side branches appear. On the branch develop both male organs: antheridium and female organs: oogonium

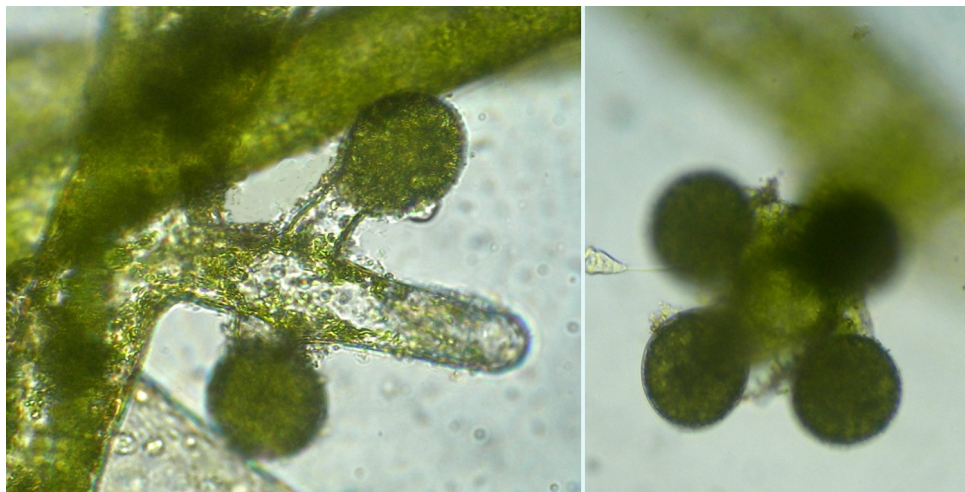
The position of the sex organs has two types: sessile and geminata.

- **Sessile type:** the sex organs are formed on the main filament. The male and female sex organs are produced close to each other,
- **Geminata type:** the sex organs are formed on special branches. These branches are short and bear the male sex organ : antheridium and one or lateral groups of oogonia (female sex organs),



The tip of the antheridium develops a septum that separates the area where the gametes will be produced. This zone curves towards the oogonium, and releases the gametes through a pore by which they join the pore of the oogonium. This then turns into an egg with a single nucleus. There may be an antheridium and several associated oogoniums

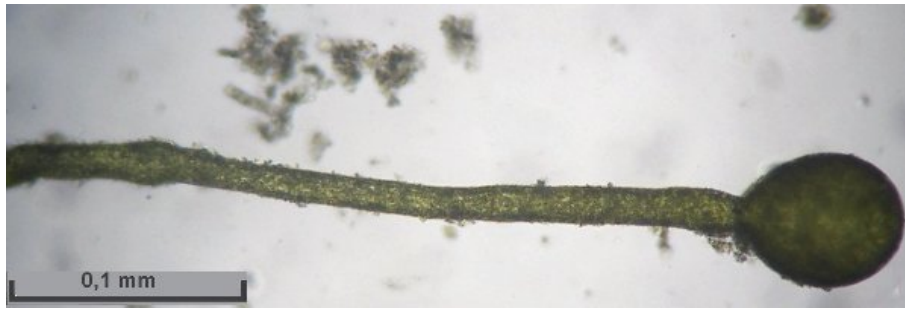
The vaucheria's taxonomy seems to be based on the morphology of antheridia and oogonia. Various configurations exist: Here *Vaucheria geminata*
 Left side picture with two eggs and four eggs into right picture (X 15 Objective)



Another form of branch with 3 antheridia and one oogonium



In the same sample one onogonium starting to germinate :



There are therefore two very different reproductive strategies on these two species of freshwater algae. However, the goal must probably be the same: One can imagine that this strategy contributes to a mixing of genetic material to give more resistant individuals for the next generation, which identical vegetative reproduction by cuttings for example does not allow.

We find also this strategy in animal species such as cladocerans or rotifers, for example, where males appear only for the formation of resting eggs to withstand adverse conditions temporarily.

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