WINTER IS FOR MICROSCOPY

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As an entomologist I spend much of the warmer months photographing and collecting insects. When the weather is cold and insect activity ceases, late Fall to early Spring, it is time to take off the dust cover and get down to some microscopy. My favorite subjects are the aquatics. Locally there is a spring-fed lake with a small outflow that remains unfrozen for most of the Winter. The few aquatic plants, dead leaves, detritus and bottom sediment supply enough organisms to keep me busy. I normally collect a few samples and place them, in pond water, in an all-glass aquarium which I keep indoors next to a window. The extra warmth of the house and the light awakens any aquatics that had been 'sleeping'.

Equipment

An Olympus BH2-BHS with a trinocular head fitted with a 2.5x NFK projection eyepiece. A Nikon full-frame DSLR is mounted above the NFK on a separate stand so as to reduce/eliminate any vibration during exposure (Fig. 1). The Nikon camera is connected to a TV monitor via an HTML cable which allows me to get a critical focus on the camera's sensor (via Live View) and then to see the captured image on a large screen.

I also have Olympus accessories for phase contrast, polarization, and DIC.

I use the microscope's 100W halogen lamp for observation but turn it off and use a wireless remote-control flash to capture the image (Fig. 2). Care needed to use the lamp at low power and not to have the flash too close to the lamp; the 100W halogen gets very hot and will melt the plastic front cover of the flash.

For many of my subjects I photograph them alive in water on a slide. For the active ciliate protozoa, and some amoeboids, I add a drop or two of Protoslo. On rare occasions I will fix and stain a specimen using a mixture of formaldehyde and malachite green; such a formulation can be obtained from a tropical fish pet shop, it is sold as a cure for white-spot disease in fish.

Fig. 1. Olympus BH2-BHS and stand with camera

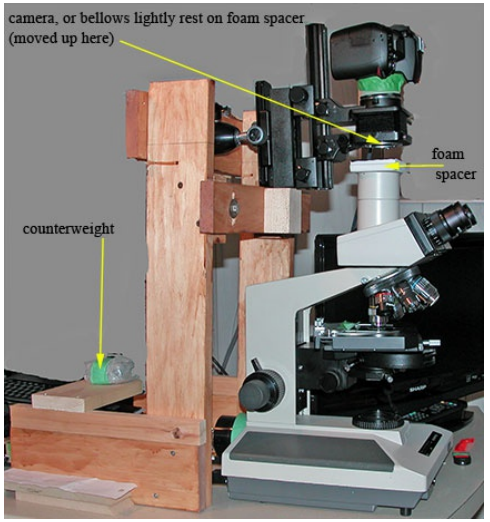
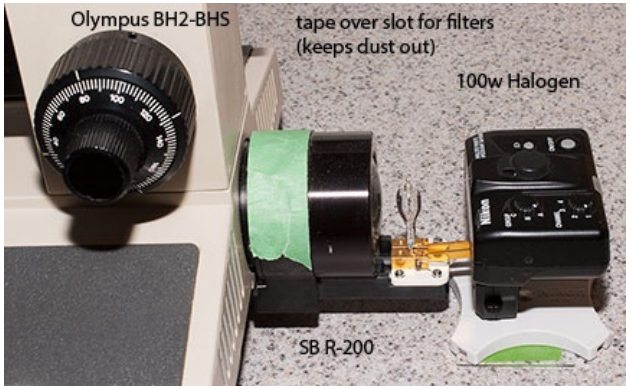


Fig. 2. Olympus lamp box removed, flash used to make the image



The Algae

Three basic types of algae occur in my samples, small unicellular, slightly larger multicellular or colonial species and filamentous species.

Among the unicellular species members of the genus:

Closterium are usually quite common. They are described as having crescent-shaped cells, rarely straight, with a conspicuous vacuole at each pole containing gypsum granules. Each cell contains two chloroplasts separated by a central area containing the cell's nucleus (Figs. 3, 5). The other spheres occurring in the chloroplasts, especially obvious in Fig. 5, top are pyrenoids. These are protein bodies around which starch collects and likely serve as food-storage structures. The cell wall may be smooth or grooved (Fig. 4.).

Fig. 3. Variously shaped *Closterium* spp.

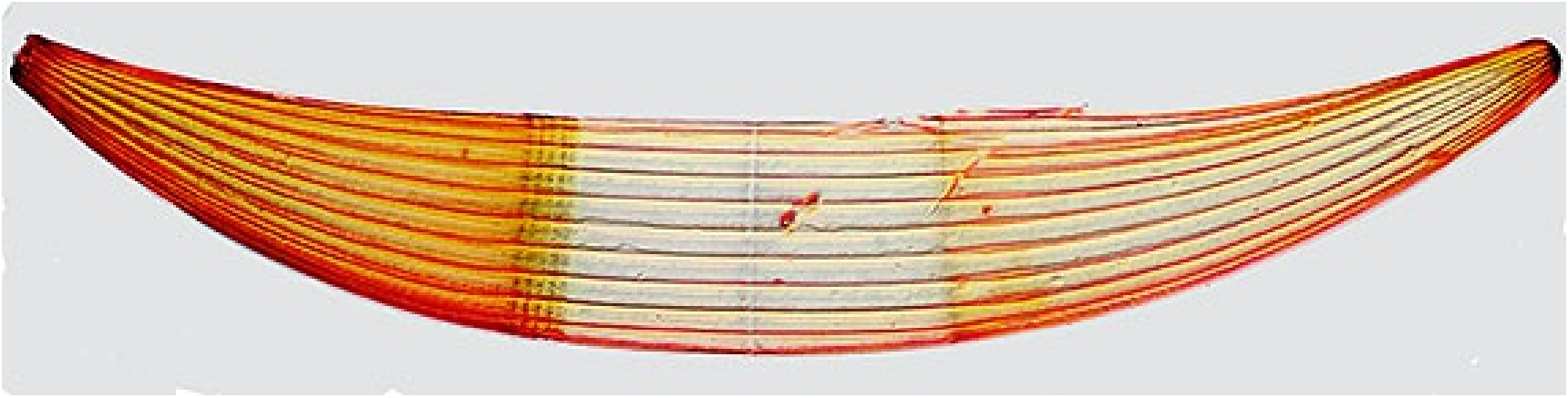


Fig. 4. *Closterium* showing grooved cell wall

Closterium navicula is boat-shaped and in this respect differs from most of the other species in the genus (Fig. 5, top).

Netrium spp. are described as 'cucumber-shaped' with two large chloroplasts each with finger-like margins (Fig. 5, bottom).

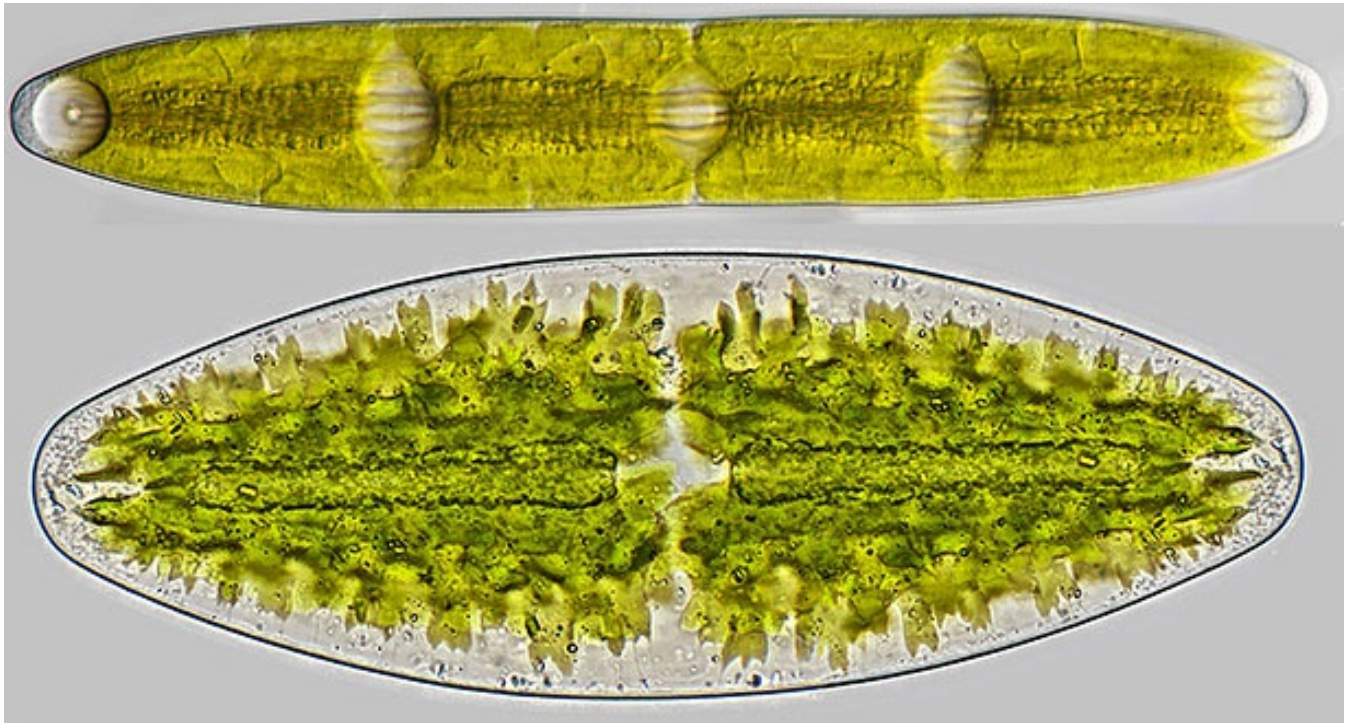


Fig.5. *Closterium navicula* (top), *Netrium* sp. (bottom)

Species in the genus ***Cosmarium*** vary considerably in shape, seemingly double-celled they actually consist of two semi-cells (Fig. 6). The semi-cells appear flat but when seen from the apex or side (difficult to see these aspects) they are oval or elliptical in outline. Various levels of focussing are necessary to see either the external cell wall which may be smooth, granular, or have short conical warts, as seen in the bottom left image of Fig. 6, or the internal structures. The cell nucleus is in the center between the two semi-cells.

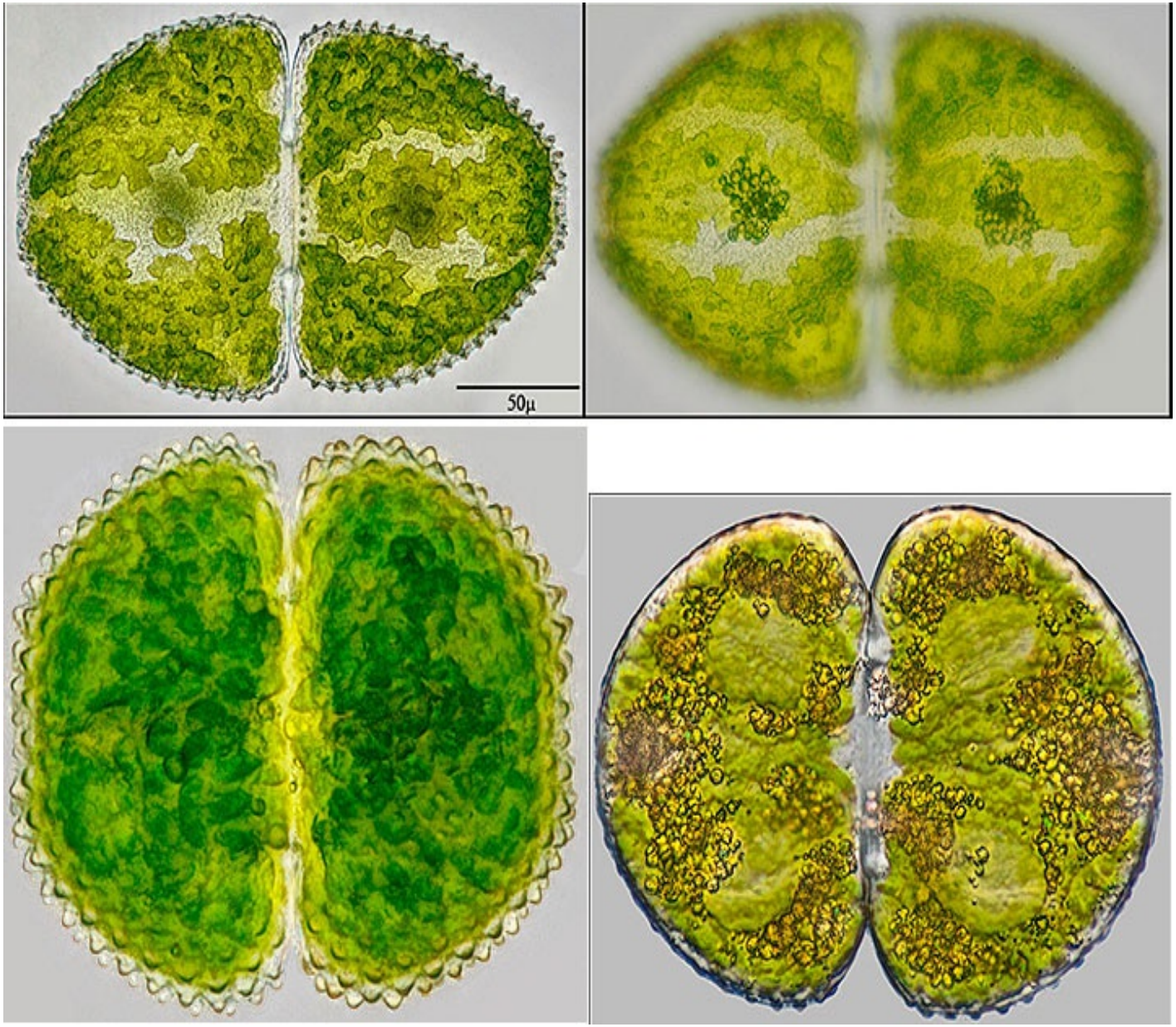


Fig. 6. *Cosmarium* spp. showing some of the variety of forms

Species in the genus ***Euastrum*** are somewhat similar to those in ***Cosmarium*** but have a more irregular outline and a small notch at each end (polar notch) (Fig. 7, top left). The out-of-focus central area of each semi-cell in Fig. 7 top left are characteristic swellings on the faces of the semi-cells.

The irregular cell border is even more extreme is species in the genus ***Micrasterias*** where each of the two semi-cells is deeply notched (Fig. 7)

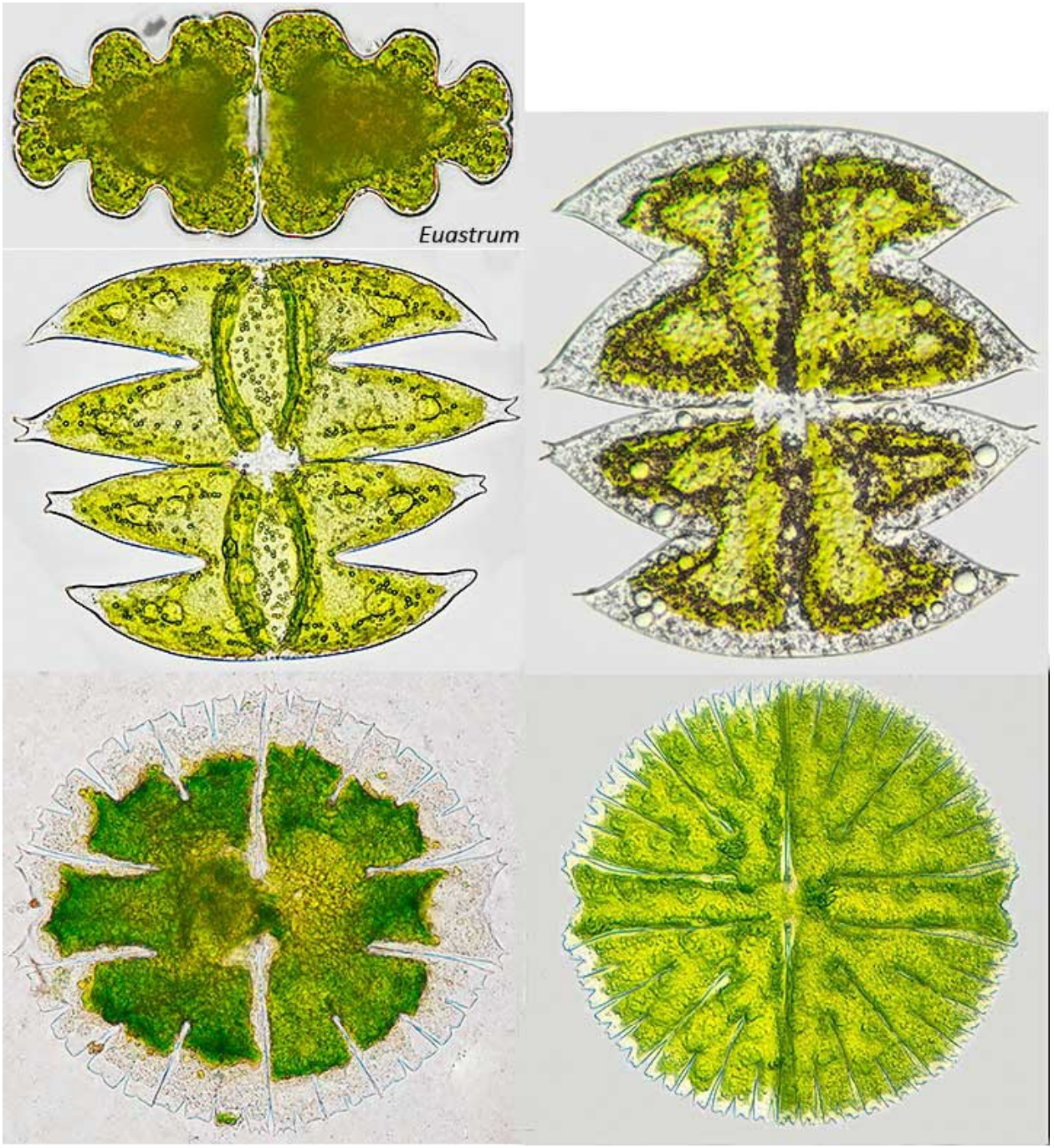


Fig. 7. *Euastrum* (top left), and 4 specimens of *Micrasterias*

Staurastrum is a genus of unicellular algae where each cell is divided into two semi-cells each of which bears arms in three or more planes. In the specimen shown the semi-cells have radiating arms in several planes which are smooth-sided and terminate in spiny tips (Fig. 8). I cannot imagine the function of such a structure, would appear very susceptible to damage.

All of the previous species of algae are mainly sedentary and found on surfaces. They can move slowly, not sure how! In contrast,

Euglena spp. are active swimmers using a long whip-like flagellum emerging from the front of the organism. When swimming the alga rotates along its longitudinal axis and moves along a spiral path. Structurally, *Euglena* species are complex. The outer body wall is a pellicle of microtubes (Fig. 9 pell) and a body filled with green photosynthetic chloroplasts (ch) which can synthesize a form of starch that is stored as paramylum bodies (pb). There is a central nucleus (nu) and several contractile vacuoles (cv) that discharge excess water. At the anterior end is a gullet (gu) with which the alga can ingest tiny food particles. Adjacent to the gullet is a red eyespot (ey) which is sensitive to light .

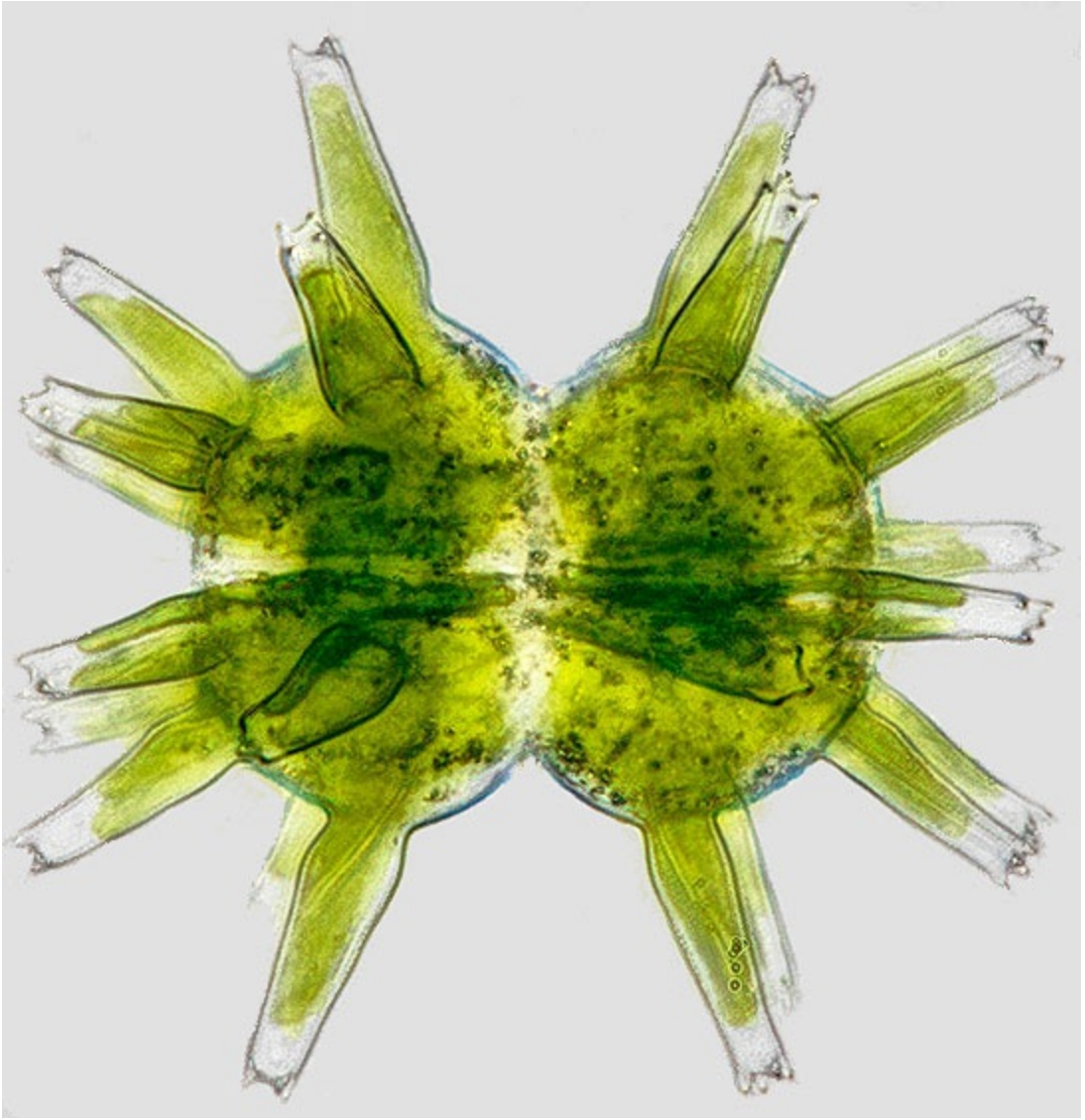


Fig. 8. *Staurastrum*

A simple way to concentrate pond water containing *Euglena* is to surround the container with dark paper and leave a small opening next to a bright light, within hours all the euglenoids, and often other single-celled algae, will congregate to that side of the container.

In short, *Euglena* behaves like a plant and an animal: it photosynthesizes, it moves, it ingests food.

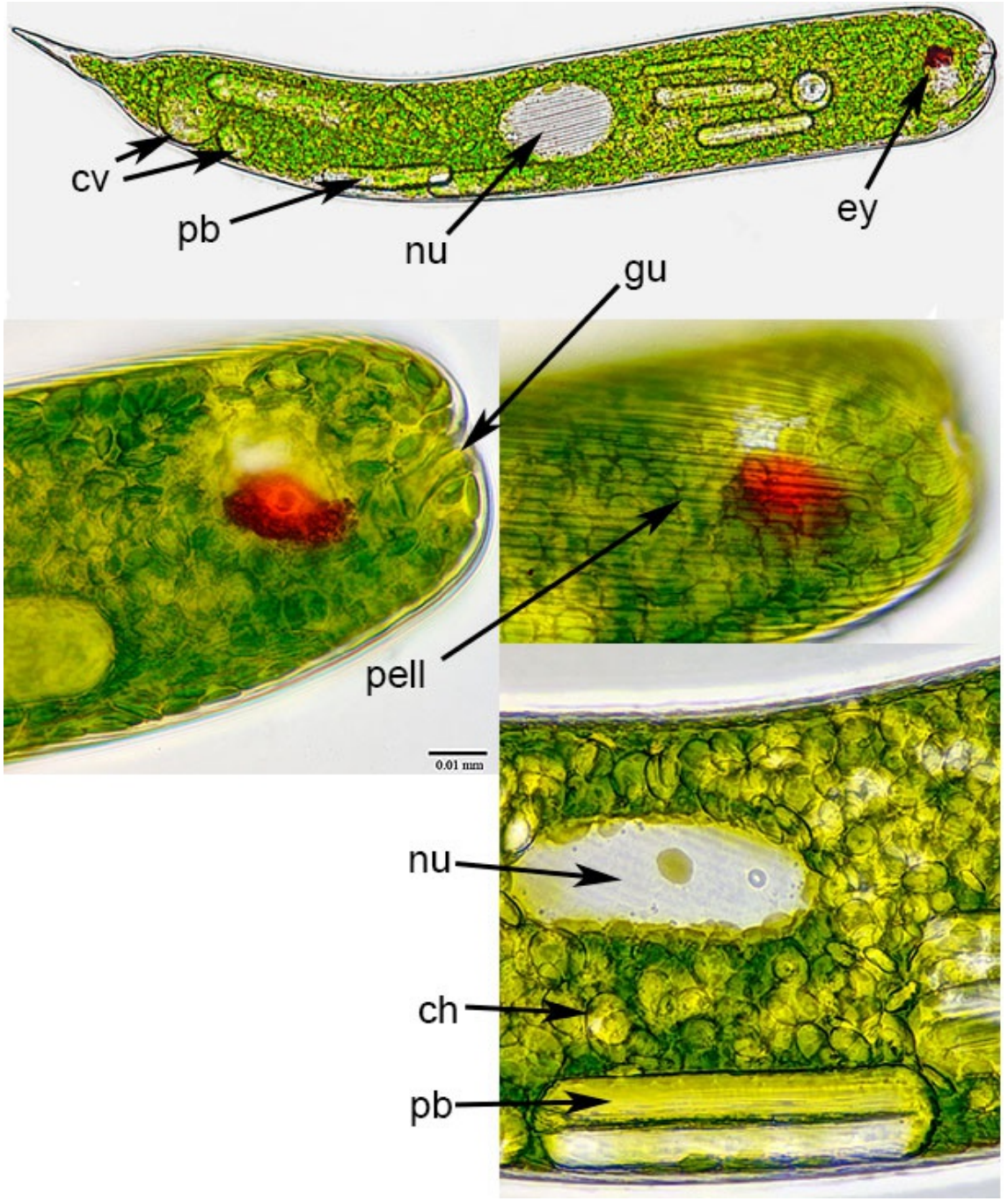


Fig. 9. *Euglena*
cv contractile vacuoles
pb paramylum body
nu nucleus
ey eye
gu gullet
pell pellicle
ch chloroplast

There are many other genera and species of these single-celled algae, often called Desmids, that can be found in all types of aquatic habitats including sphagnum bogs and wet moss.

It's now time to take a brief look at some of the multicellular algae, the filamentous algae, and the aquatic protozoa.....

to be continued.

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