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The Magazine for the Enthusiast Microscopist

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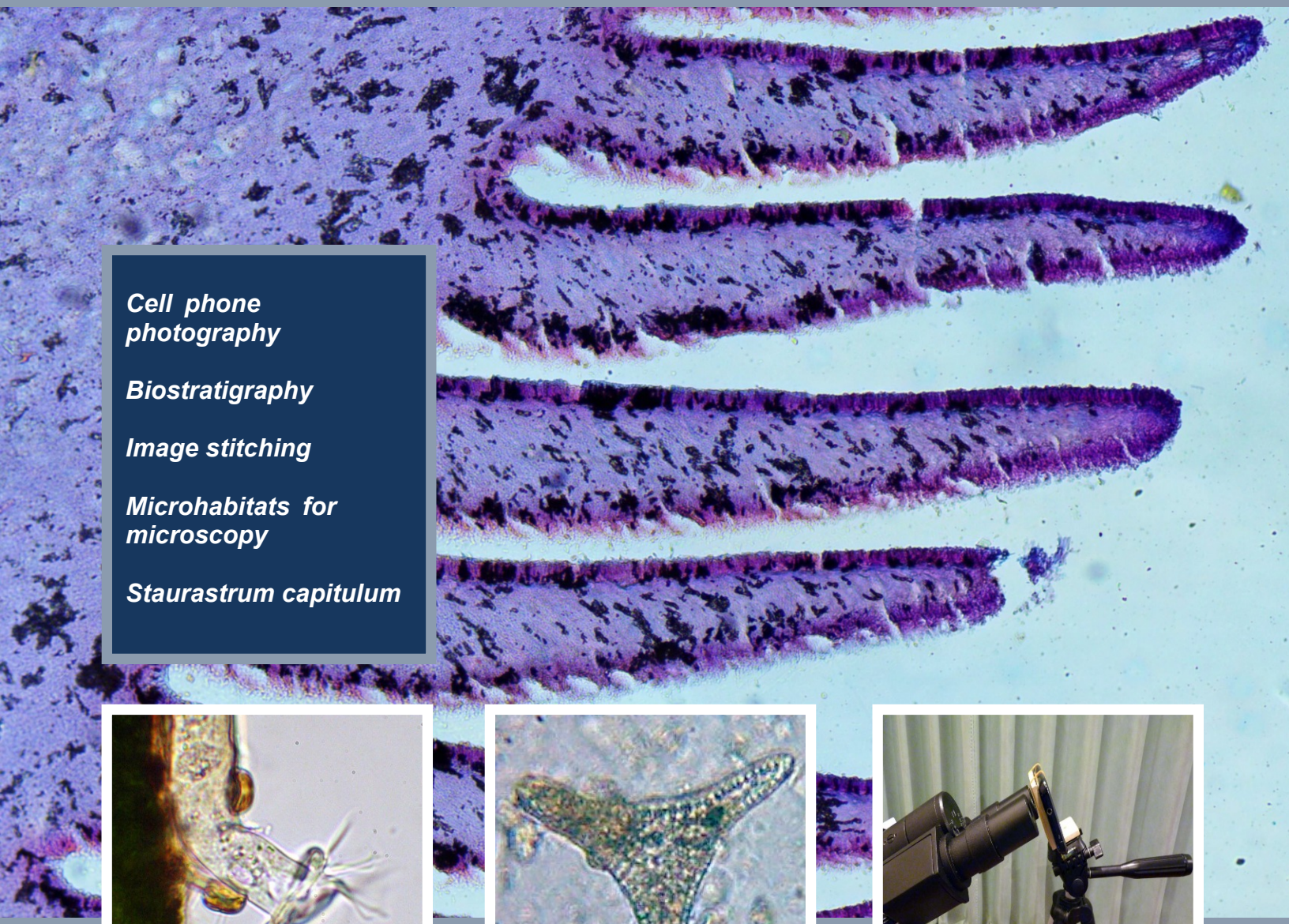

Cell phone photography

Biostratigraphy

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Staurastrum capitulum

Making a microhabitat

Micro fossils

Cell phone camera mount

ABOUT

Microbehunter Microscopy Magazine
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Front Cover:
Large image: Oliver Kim (mushroom fruiting body)
Left image: Charles Guevara
Middle image: Per Christensen
Right image: Suphot Punnachaiya

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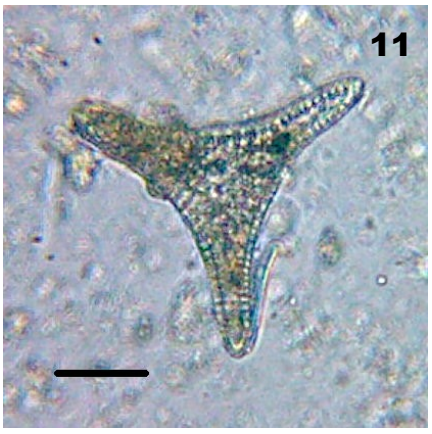
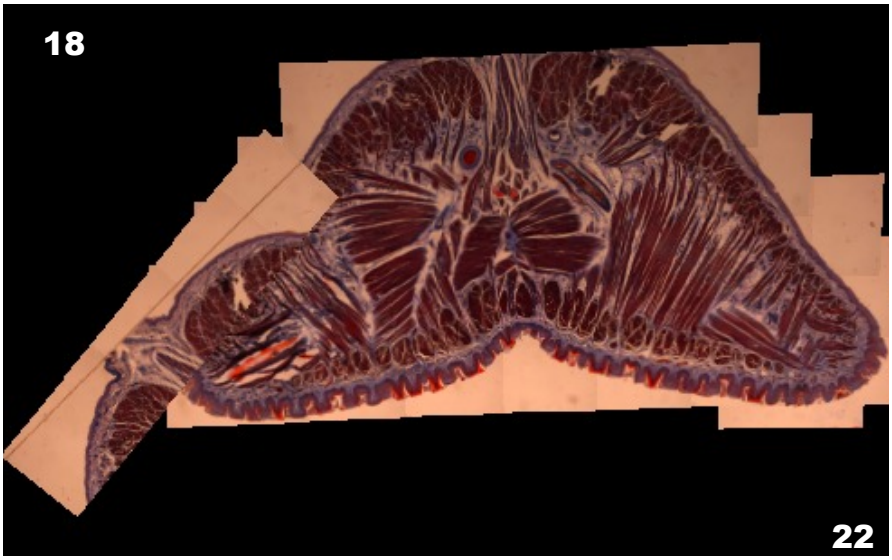




Answer to the puzzle (back cover):
Starch grains from Snowdrop bulb.

Using a cell phone for photomicrography

This DIY adapter will connect a cell phone to a tripod for afocal photography.

Suphot Punnachaiya

Today every cell phone has a built-in camera, often of a very good quality in terms of high resolution and sensitivity to low light. Cell phone cameras can be used to take photos and videos from a microscope by using the afocal technique. This is simple and one need not make any modifications to the microscope.

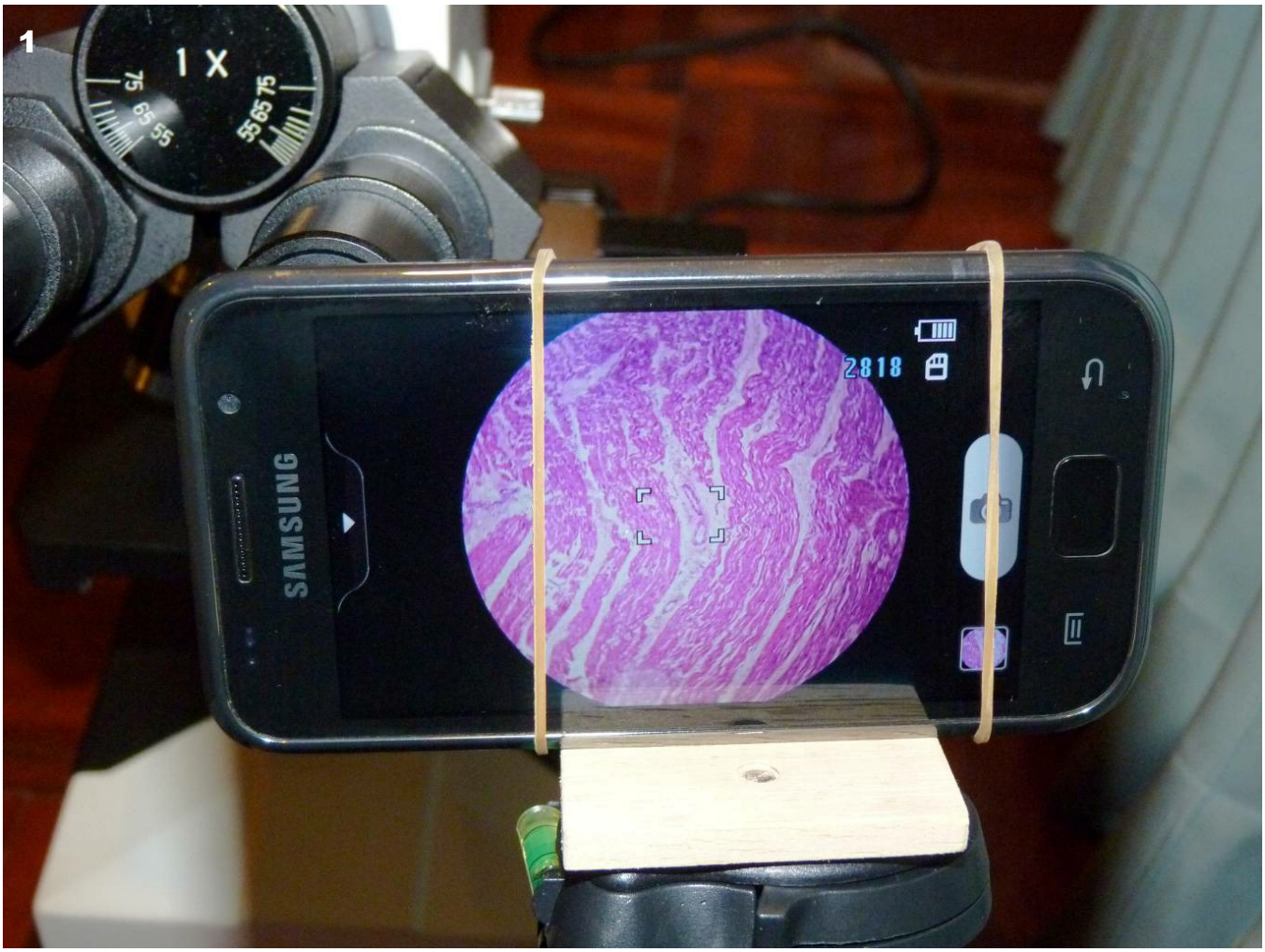
The camera on the cell phone will see through the eyepiece of the microscope in the same way as a human eye. All we have to do is position the cell phone camera in front of the microscope eyepiece. But hand-holding is very difficult and one does not get a good result.

By making a simple DIY adapter mounted on a small tripod, a cell phone camera can be used to take microphotographs and videos in a more convenient and easier way.

If we use a small digital camera, this is not a problem. We can mount the digital camera's body directly to the small tripod. But cell phones do not provide a tripod mount, so a DIY adapter is required to complete the job.

I made a cell phone adapter from two pieces of wood. The adapter was mounted to a small tripod and rubber bands were used to hold the cell phone in place.

Cut a 5 mm thick wood as a support piece. The size should be almost as wide as your cell phone and about 4 cm shorter in length. This way mounting your cell phone on this support piece will not block the camera.



Cut another piece of wood to be a tripod mount. This piece should be around 3.5 cm by 5 cm for small tripods. Drill the hole into this piece to accept the tripod mount screw. The hole should be a little bit smaller than tripod mount screw. When you tighten the tripod mount screw into this hole, it will be tight enough to hold the adapter in place (figure 2).

If you have no tool to drill the hole to make a tripod mount, then you can use a rubber band to hold the DIY adapter on the tripod. The whole DIY adapter, including the cell phone, is very light weight. Multiple rubber bands can be used for holding it.

Use wood glue to stick these two pieces together and leave it for a night. It will be strong enough to hold cell phone on the tripod. Now the cell phone adapter is ready for use (figure 3).

Mount the cell phone on this adapter by using a small rubber band. Place the cell phone more to the left hand side, as this will give the cell phone camera some room to align with microscope eyepiece. This DIY adapter can work with any cell phone. If you have a new cell phone in the future, this adapter is still usable.

You can see from the photo that rubber bands will wrap in front of the cell phone (figure 4). It will not interfere with the touch screen operation of the cell phone.

Mount the whole unit on the tripod by using tripod mounting screw. Then adjust the tripod height and align it left or right to match the microscope eyepiece. You can see the picture in the eyepiece on the cell phone LCD. The perfect alignment will show you a sharp circular field of view from the eyepiece and an even illumination of the picture.

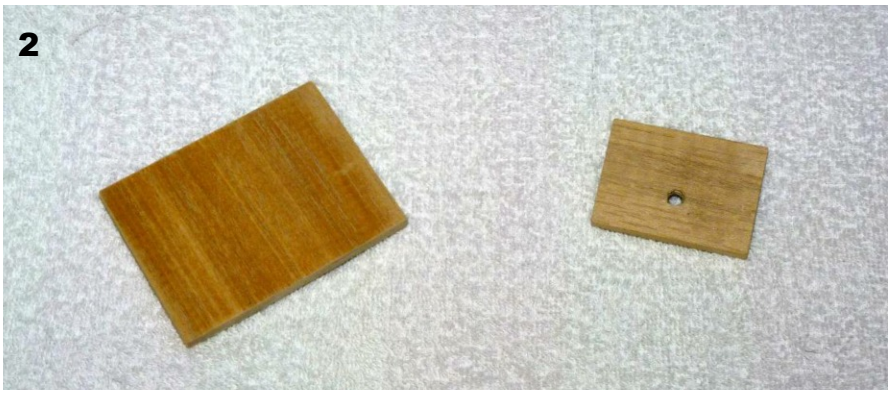
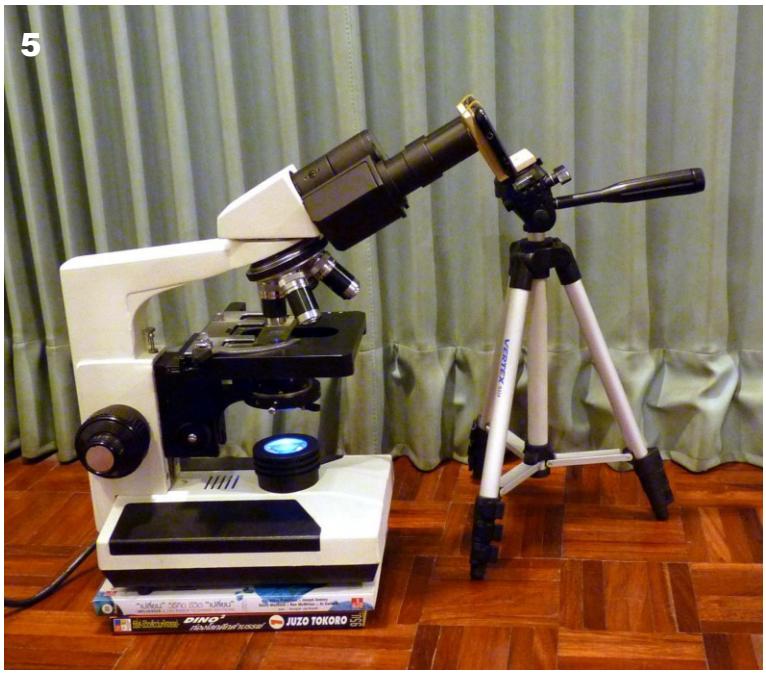
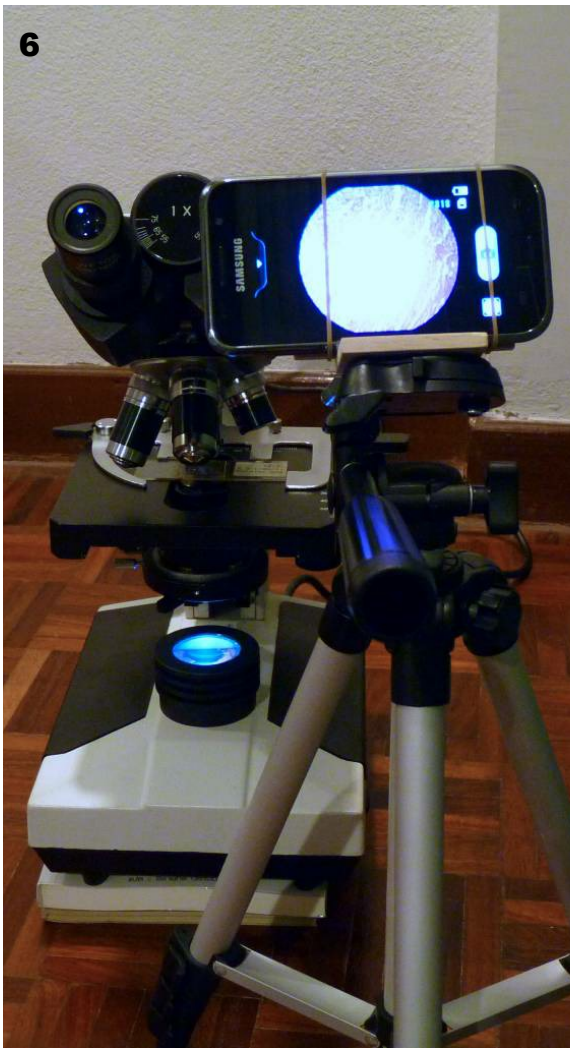


Figure 1: The cell phone is connected to the DIY adapter with rubber bands.

Figures 2-4: The parts of the adapter and the final assembly.





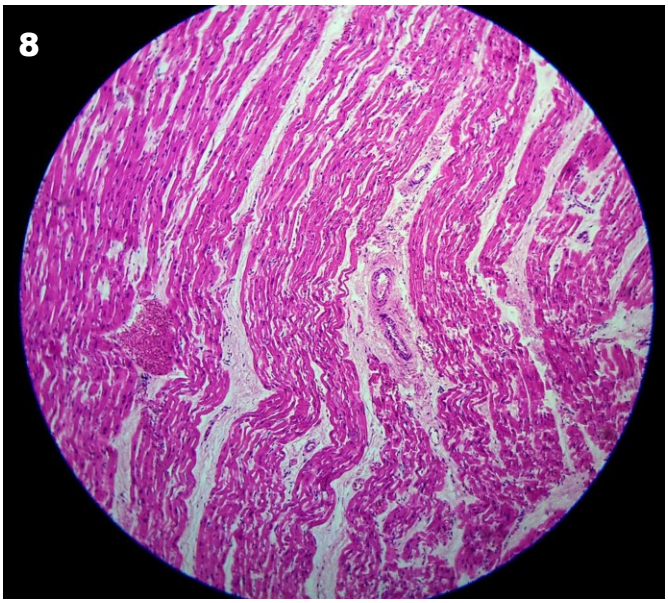
Figures 5-7: Set-up for afocal photography. The correct alignment of the cell phone camera with the eyepiece is important. If the camera to eyepiece distance is not correct, then it is not possible to see an evenly lit image.

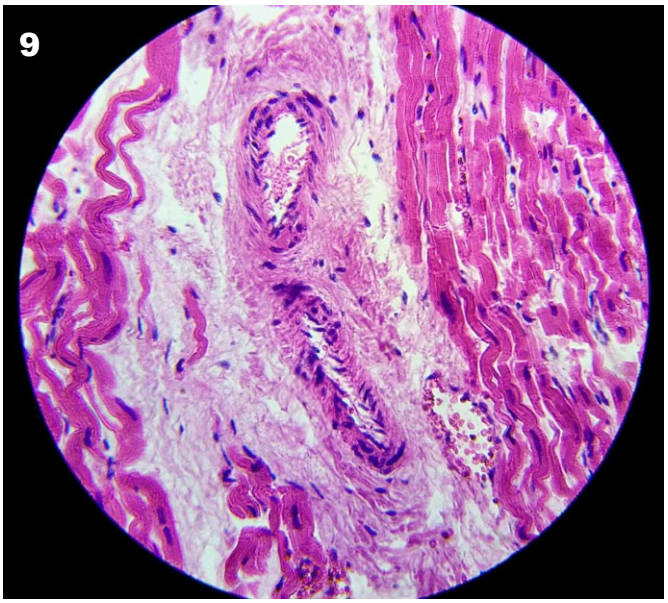
Cell phone camera alignment is the same afocal photography as with a small digital camera. If you put the cell phone camera too close to the eyepiece, most likely you will get a dark LCD on the cell phone. This is because the microscope eyepiece cannot properly project the final image into the cell phone camera lens.

If you put the cell phone camera too far from the eyepiece, you will get a small image circle on the LCD. The working distance should be around 7 mm between eyepiece and cell phone. You may try it by yourself and note it down for the next setup. Different microscope and cell phone combinations may need a different working distance.

Use the microscope's focus knob to find the sharpest picture on the cell phone LCD. With some cell phones you can zoom in to take the full screen micrograph. When you get the sharpest picture on the cell phone's LCD, you can start to take photo or video as needed. The autofocus on the cell phone will maintain a sharp photo. But if you did not focus a sharp picture on cell phone's LCD with the microscope's focusing knob first, then the autofocus on cell phone camera cannot correct it.

When you press the shutter release to take a photo or video from the cell phone, press very lightly to avoid camera shake and pushing the phone out of alignment. Because today's cell phones are using a touch screen to take a photo or video. So camera shake should not be a problem.





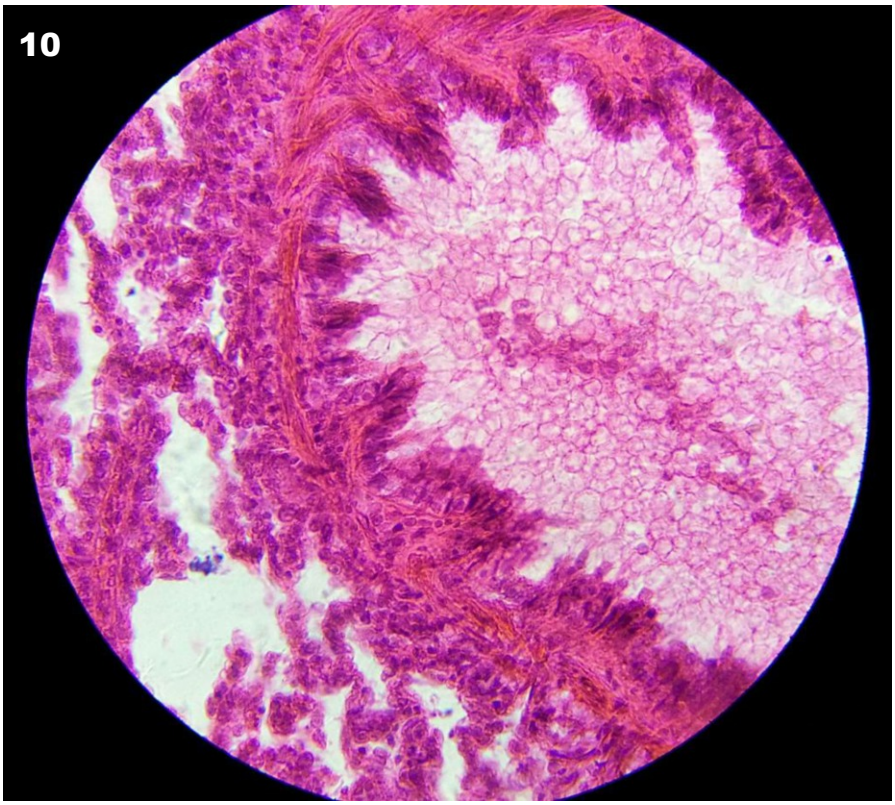


Figure 8: Cardiac muscle 100X, permanent slide

Figure 9: Cardiac Muscle 400X, permanent slide

Figure 10: Lung section 400X, permanent slide

You may need to adjust the microscope illumination lamp to 70% to 80% of its maximum brightness and you may need to stop down the condenser diaphragm for a good result. This setup does not need to be in a totally dark room. But if you set it up in very bright room, you may need to turn off some light sources to avoid light entering into the cell phone camera.

The result of taking photomicrographs with a cell phone camera is impressive. It is quite sharp and many details can be seen in the sample photos. It will be much better when we do some post processing by using photo editing software.

What I usually adjust in the post processing for cell phone microphotograph is:

1. Auto color correction: This step will adjust color balance of the photo.
2. Auto contrast adjustment: This step will adjust proper contrast.
3. Unsharp masking: Use this tool to adjust sharpness of the photo.

The advantages of using cell phones for microphotograph are:

1. If you have accessible to microscope (at school, lab or at home) and a

cell phone, it is low-cost method to start photomicrography. You may need to purchase a small tripod to make it work. But it will cost around US$ 10 from a local camera shop. That's all we need.

2. Simple setup, fast and easy. It is not necessary to make any modifications to the microscope or the cell phone. Just screw the adapter to the tripod and use a rubber band to mount the cell phone. Now you are ready to start taking the photo or video (including High Definition video). The alignment of the cell phone with the eyepiece is difficult for the first time. When you know the working distance and are used to it, you can make it done in a few minutes. If you take videos, I recommend you to zoom in to take a full LCD screen video. The result will be better than capturing the video with a black border. As for photos, you can crop it later.

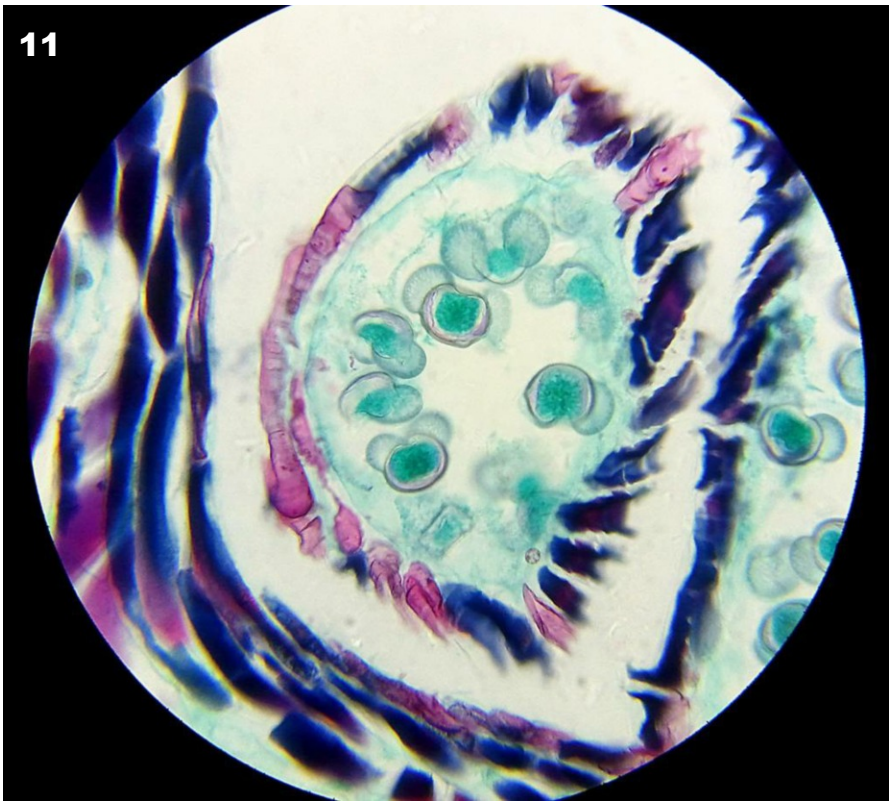
3. You don't need a computer like when using a USB camera. This is an all-in-one solution, there are no cables to connect, and there is no need for extra software to run.

4. After having taken the photo or video, you can send it by email or share it in the Internet directly from your cell phone. You do not need not to transfer the photo into computer to do it.

5. The end result from today's cell phone camera is very good, in my point of view. I compared the cell phone photo to what I saw in the eyepiece, it was very close. The view from the eyepiece shows a little bit more details. You can, of course, get a better photo quality by using better equipment, but this will cost a lot more.

This simple DIY adapter and a cell phone, hopefully opens up a low cost and easy way for every microscope user to try photomicrography. My cell phone was more than 3 years old but it can still provide good photos. Today's cell phones have much better built-in cameras compared to mine. They should deliver even better micrographs. Enjoy and have fun!

■



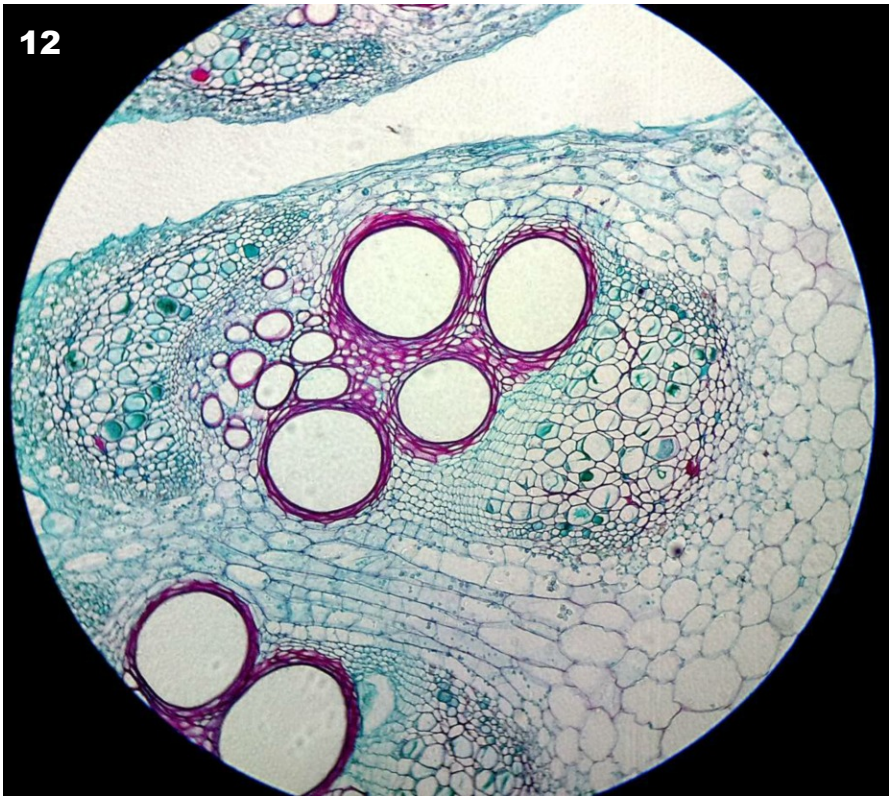
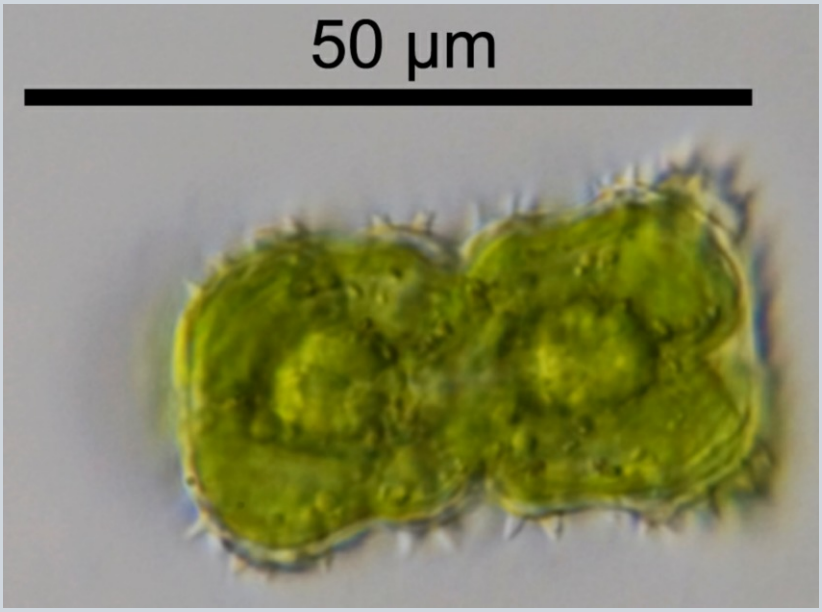


Figure 11: Pinus male strobile 400X, permanent slide

Figure 12: *Cucurbits* stem cross section 100X, permanent slide

Staurastrum capitulum

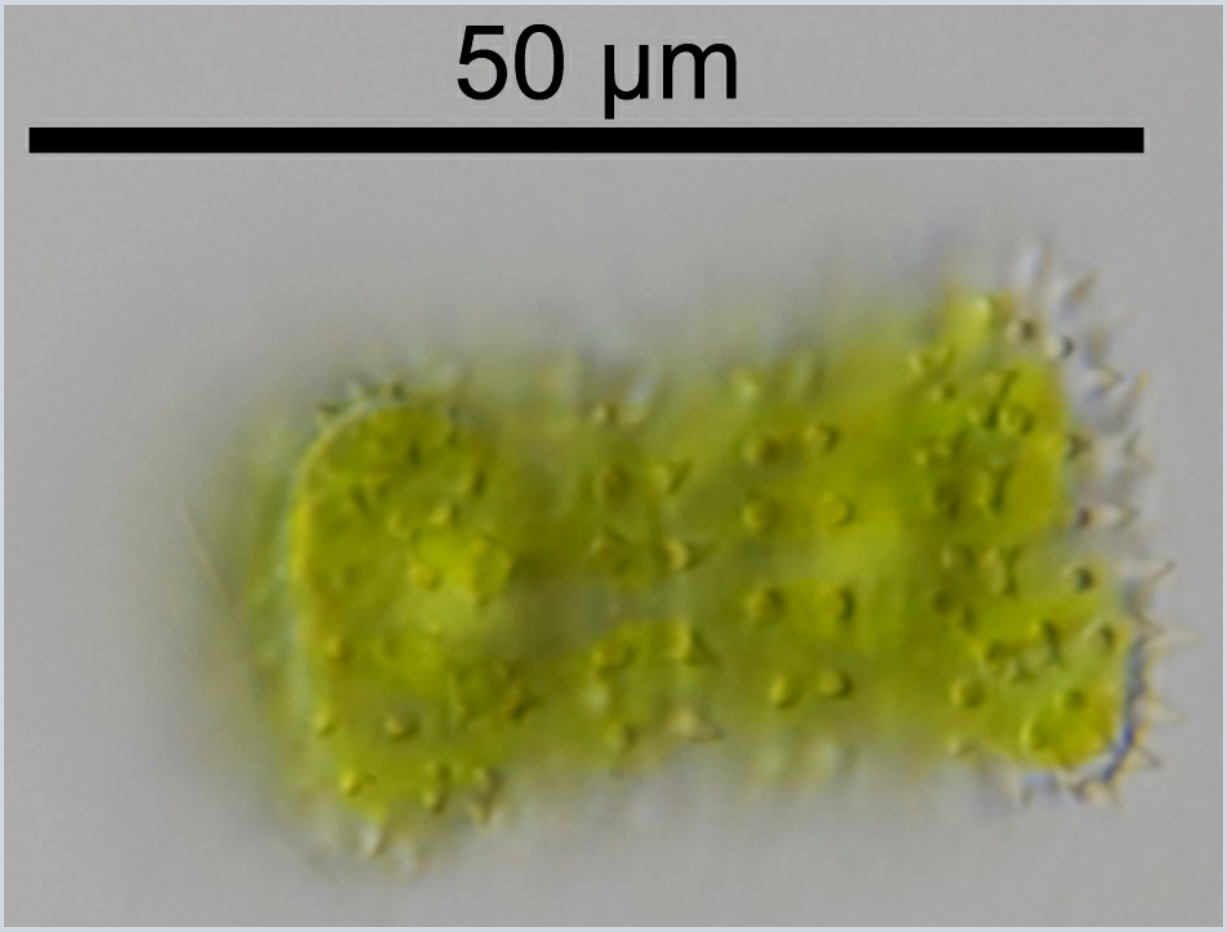
Mike Guwak

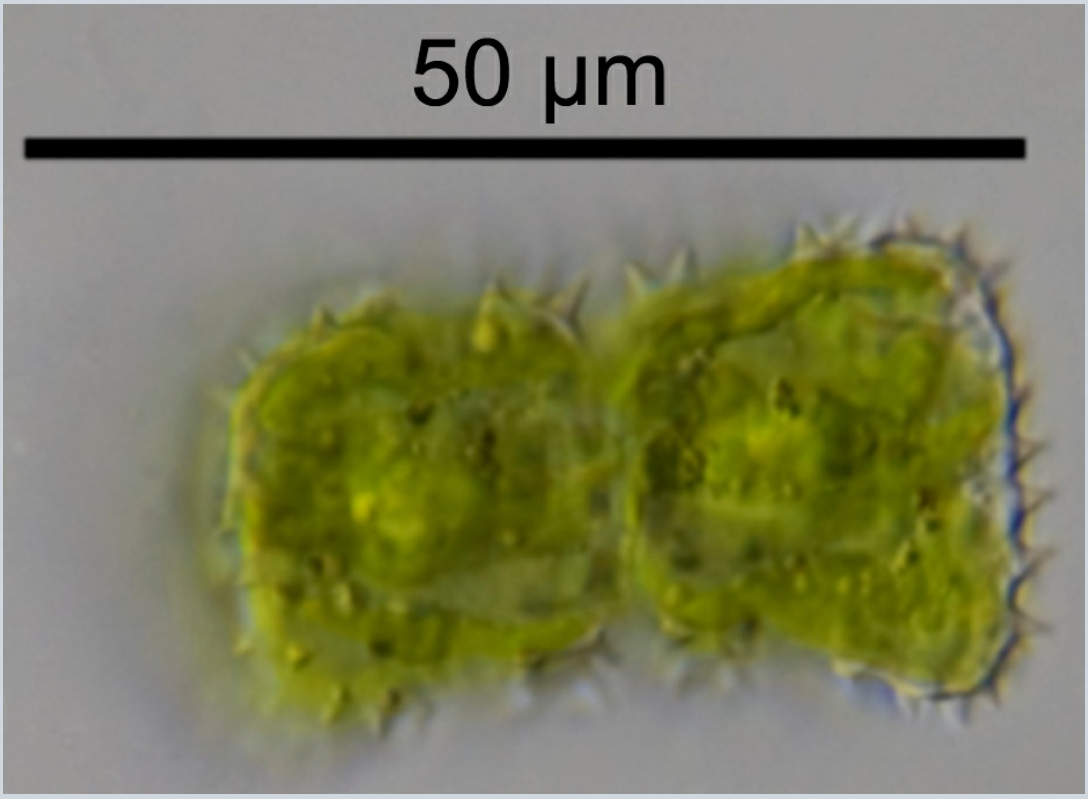


Full name:
S*taurastrum capitulum* BREB. ex RALFS var. *Capitulum*

Shape: The cells have an inverted bell-shape and are about 1.5 times longer than wide. The cell wall contains a ring with warts, arranged concentrically. The warts around the basis have multiple spikes, those at the vertex have 2 spikes. The cell wall has concentric rows of spiked granules.

Origin of name: from Greek
stauron: "cross"
astron: "star"





Description of the genus: Like many other desmids, Staurastrum is made of two semi-cells. In apical view, the cell has a radial symmetry. The semi cells have a large chloroplast. The nucleus is located where the two semi cells join each other (at the isthmus).

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Image Credit

The Paleocene - Eocene Thermal Maximum (PETM) on Mors, Denmark

Microfossils reveal much about the climate of earlier times.

Per Christensen

A lovely place to visit is the western part of the Limfjorden district on Jutland, Denmark. The landscape is mild, green and undulating with traces of settlement from the stone age onwards, like grave mounds, remnants of Viking fortifications and small monasteries and castles. Traditional coastal inns frequently serve eel with potato as the dish of the day.

In the fjord, nature has formed an archipelago. Nykøbing, the market town dating back to the 12th century, is located on Mors, the largest of the islands. The districts rolling landscapes are a result of unique geological processes. Millions of years ago, Denmark, North Germany, Holland and part of Southern England was under deep sea (figure 2), and somehow the seafloor from that time later has been squeezed up in the Limfjorden district. It is now covered with only a thin layer of mould in areas scattered around. The 55 million year old seabed also exposed alternating black and slightly coloured layers in many of the Limfjorden cliffs. These layers are rich in diatoms (empty algae silicate shells), making the seabed clay very light when dry, almost like foam. For many years the clay has been quarried and used to produce bricks for special insulation purposes as used for aluminum melting pots.

The approximately 60 meters of fine laminated clay is dated to the geologic early Eocene epoch. The clay resting on top is from the earlier Paleocene epoch. Laminated layers are determined as sediments from an oxygen depleted seabed. The black bands are ash layers from volcanic eruptions, which happened in the North Atlantic when Greenland parted from Norway. These ash layers form a bar-code like pattern which can also also seen in drilling cores from Bremen in Germany, Essex in England and the North Sea. Extremely well preserved fossils of insects, birds, fish, leaves, turtles and wood has been found in quarries and cliffs, many of these fossils now exhibited in two local museums.

Already many years ago experts studied the fossil insects. After comparing them with present tropical species, they proposed that they had lived in an environment far warmer than that of today. The more recently found sea turtle fossils support this assumption. On a global scale, similar fossils and other signs of high temperature are recorded in rock and clay from the very early Eocene. Currently many scientists pay special attention to this short warm timespan called the Paleocene-Eocene Thermal Maximum (PETM). After all,

Figure 1: Paleocene-Eocene sedimented seabed, "Svaleklit" seen in the background.

Figure 2: Suggested map of northern Europe in early Eocene.

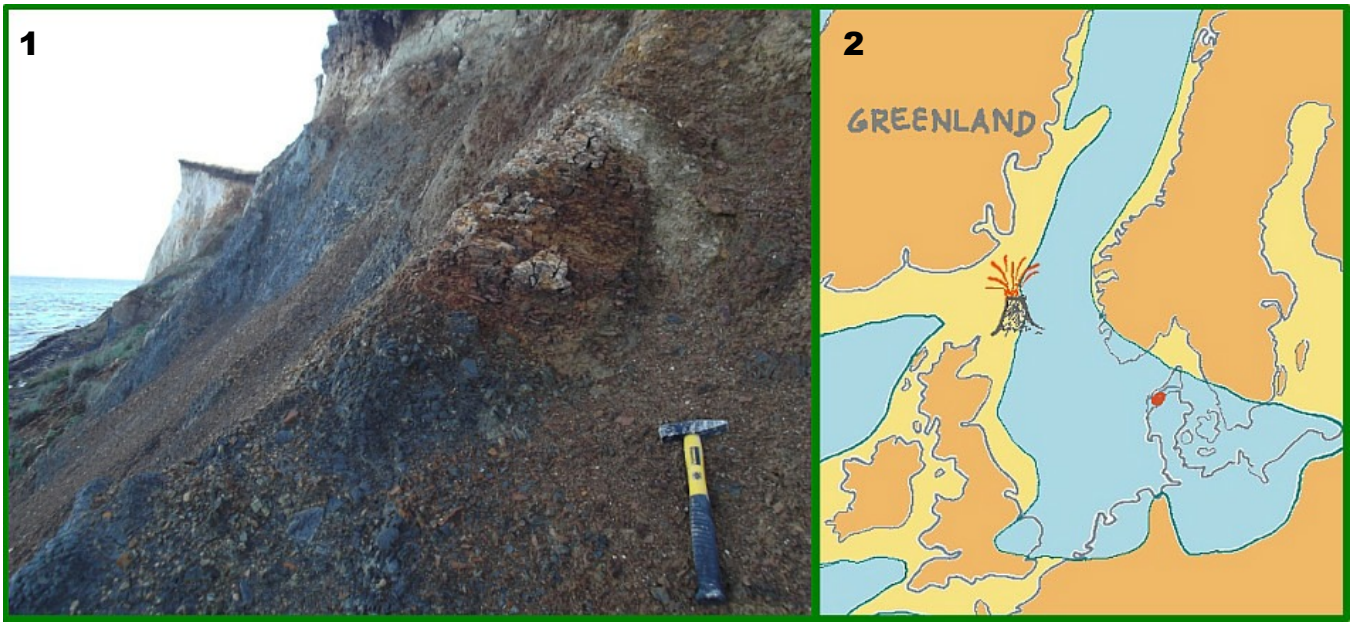


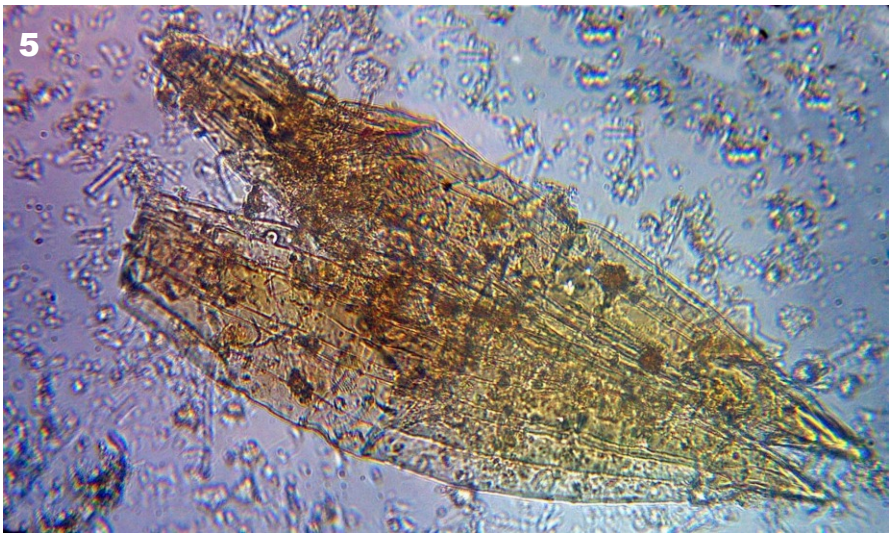
Figure 3: The coast north of Sundby.

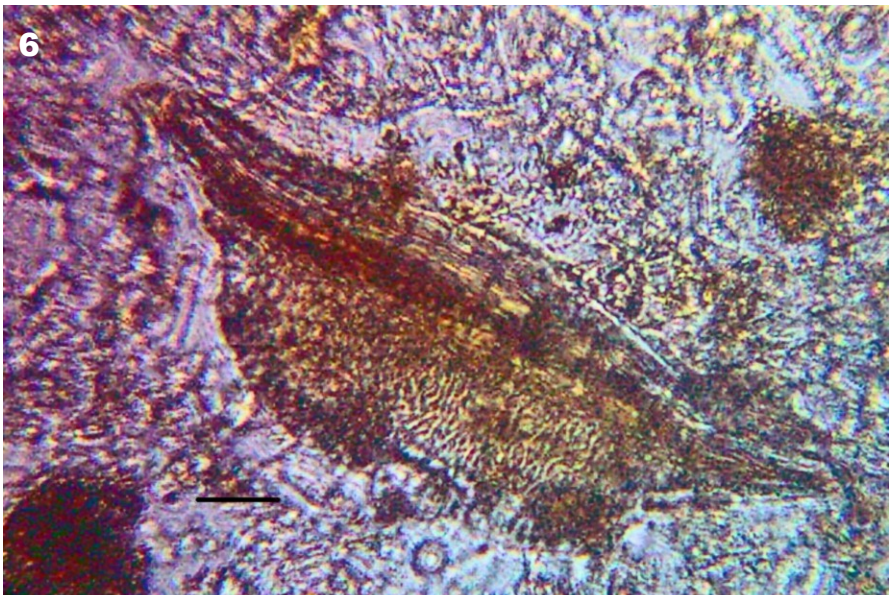
Figure 4: Abandoned quarry in Ejerslev

Figure 5: The protective glass in front of the camera sensor was cut off and a small tin (hobby paint) fitting the microscope ocular was glued onto the camera. The images were easily taken using the self timer. The Microscope was bought second hand many years ago, a LED torch was used as a lamp.

The clay sample can be seen in front. I found that the best sampling is possible when the clay (drying up fast) is soaked with drops of distilled water. The clay was scraped gently with a sharp knife, and the resulting suspension on the knife edge was flushed into an egg cup with drops of distilled water. Two drops were placed on the slide and a coverglass was placed on top. The sample were examined at 100x and 400x.

we might be heading towards a not unlike scenario. Just a few thousand years earlier, global temperatures were much lower and after determining ratios of carbon isotopes in rocks from this brief transition period, the rapid rise in temperature is believed to be a consequence of huge natural greenhouse gas emissions. Perhaps methane from sea floors, heated by underlying magma, or global firestorms resulted in a large volume of





Figures 5 and 6: Acritarchs. These are small organic fossils. They are an artificial group into which unidentified fossils are categorized. Any small organic structure which can not be identified is referred to as an Acritach.

released greenhouse gas. The amount was calculated to be equivalent to what humanity will emit if using up known fossil fuel reservoirs (4500 GtC).

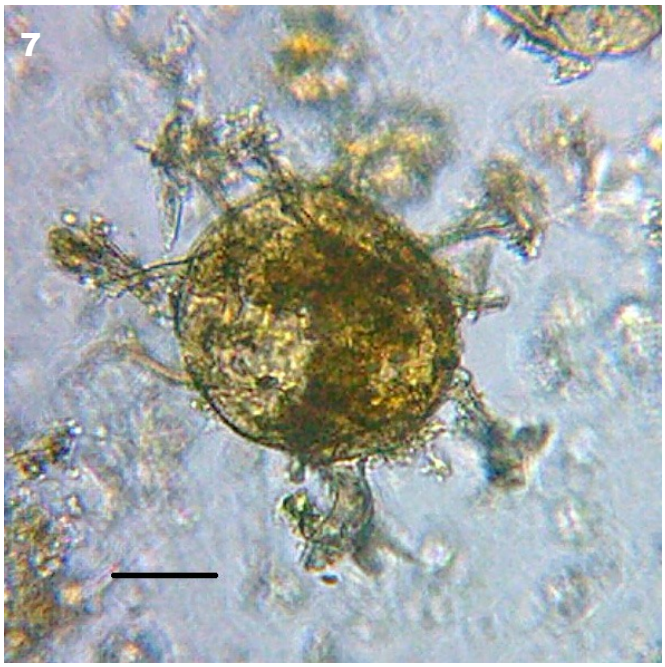
Determining atmospheric greenhouse gas contents

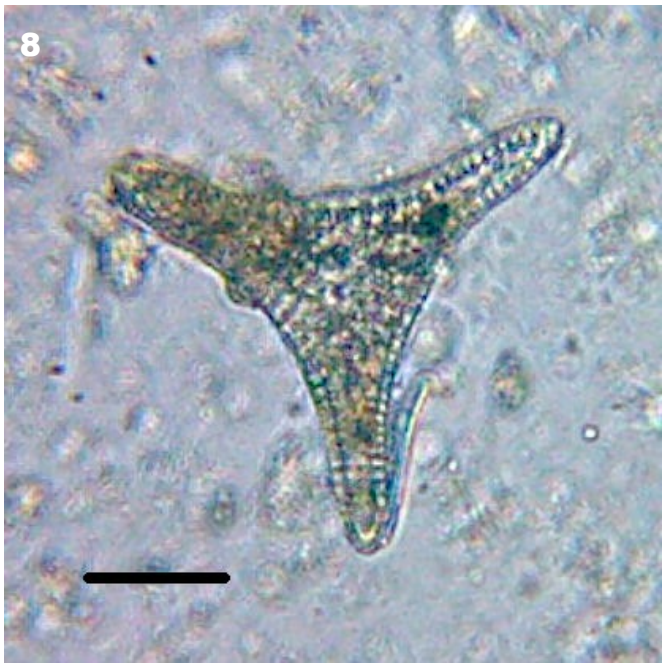
It is amazing that scientists are able to calculate atmospheric greenhouse gas contents for such distant times as of the Eocene era. An understanding of how this is done could be the following (must be taken with many grains of salt as I am only a hobbyist): assuming that living organisms prefer the light major "normal" C-12 carbon isotope over the heavier C-13 isotope as building blocks, then atmospheric gases of biological origin (methane and CO_2) will be sparse in heavy isotopes compared to CO_2 from volcanoes and other sources. We know methane in the atmosphere eventually is oxidised to CO_2 and water. High atmospheric CO_2 of biological origin will force its way into the sea, and then from the sea into seashells rich in carbon. Tis process dilutes the already sparse heavy isotope C-13 content in shells even more. In this way, elevated atmospheric carbon dioxide of biological origin will be mirrored as a lowered heavy C-13 content in shells. Past atmospheric CO_2 content csn be calculated by isotopic measurements on shell sediments when comparing with present day isotope figures from shells formed under a known atmospheric CO_2 pressure.

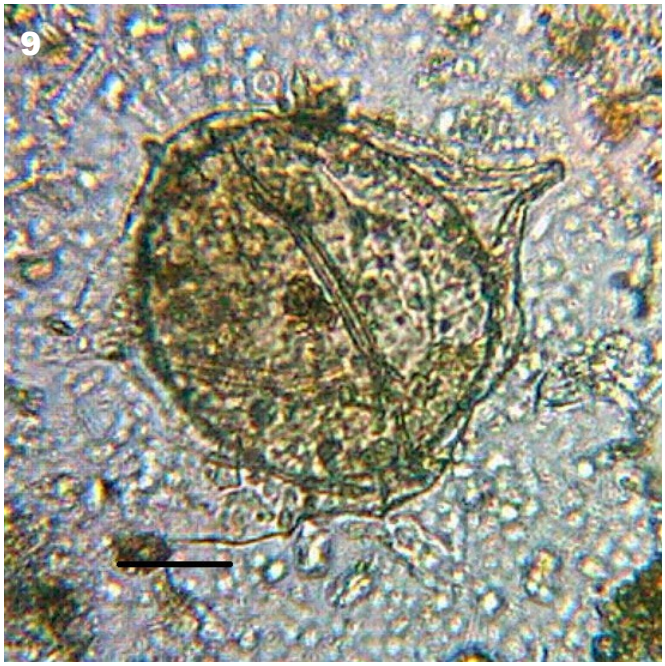
A characteristic abrupt lowering of C-13 content (called a negative CIE excursion) is found worldwide when comparing Paleocene and early Eocene rock sediments. Similarly, C-13 in modern seashells has been found to steadily decline for the last many decades. The rise of sea surface temperatures in the PETM are estimated to 5°C in the tropics and 9°C on high northern latitudes from base temperatures already a few degrees above today's. The rise was especially rapid for the first 1000 years, lasting for 10.000 years and finally returning to pre-PETM temperatures over the following 150.000 years. Also, after calculating pole to equator temperature gradients, researchers proposed that the poles were ice free in early Eocene. The existence of reflecting polar ice sheets would have resulted in other types of temperature gradients.

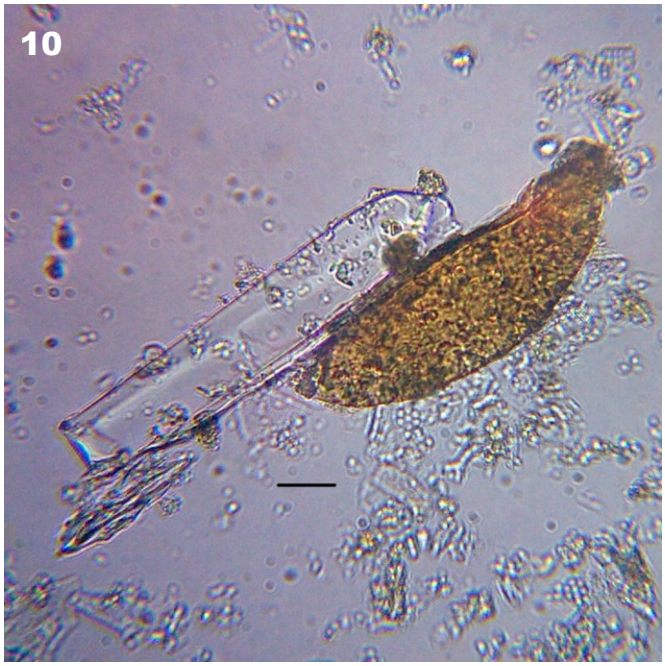
Fossil records reveal a quick decrease of biodiversity following this warming event, especially in the seas. On the other hand, mammals diverted and dwarf horses, deer and primates evolved from larger common ancestors, the dwarfing was proposed to be the result of less nutrients in plants growing in a high carbon dioxide environment.

In the early Eocene, England still was part of the European landmasses and much of northern Europe was under waters. A warm deep sea connected the great oceans only through a narrow northern channel, with the sea being encircled by subtropic lowlands with huge rivers returning high precipitations. Driftwood, birds, pollen and insects were blown out over the sea by northern winds before finding their graves in a dead sea floor depleted of oxygen. Decomposition of myriads of









dead marine microorganisms blooming in the upper sea layers are cause of the low oxygen content.

The very bottom of the Eocene layers are exposed in two places in the archipelago, on the island of Fur and near the village of Sundby on Mors. I was able to see these layers (figures 3 and 4) when visiting the coast two kilometers north east of Sundby.

Grabbing the black clay felt like grabbing very fine sand while the red laminated layers on top were much harder. This observation is consistent with the soft Paleocene oxygenated seafloor worked through by snails, shells and worms and overlaid by a more solid red clay from a lifeless sea bottom. I interpreted the dark clay not to be of volcanic origin but instead Paleocene seafloor, and the red clay to be sediments from the first 4000 years of Eocene. This is due to a sedimentation rate of 0.1 mm/year. The top grey band is a layer of volcanic ash.

Figure 7: Unknown dinoflaggelate

Figure 8: Diatom

Figure 9: *Deflandrea sp.* (dinoflaggelate)

Figure 10: Unknown dinoflaggelate next to what appears to be silicate glass.

Sampling and microscopy of microfossils

A couple of samples were wrapped in plastic and taken home. Grains from cleaved red sediments were stirred with distilled water in an eggcup and drops were examined under a school microscope. With an ordinary digital camera (figure 5), I was able to take the images of Eocene microfossils.

Silicate shells of diatoms are known for their geometry and the elaborate pattern of diatoms can be studied in detail (figures 8 and 11)

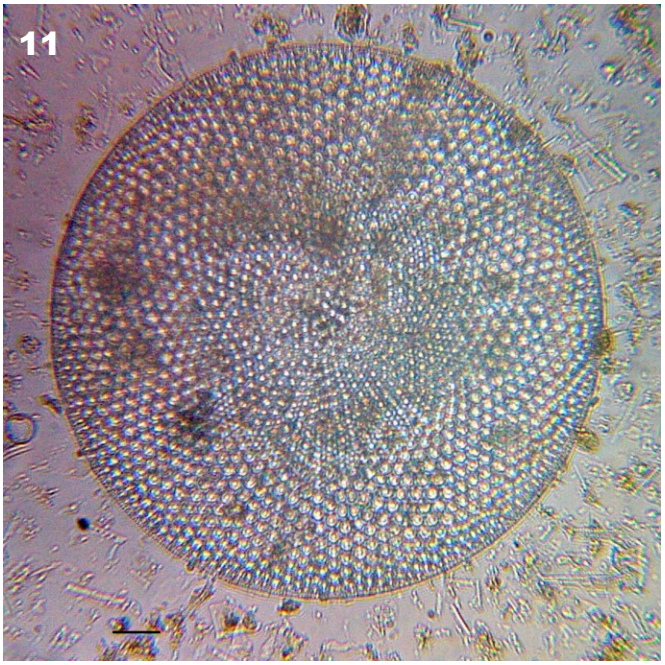
But back to the PETM: So far nuclear physicists have informed us on the composition of the atmosphere above Mors 55.9 million years ago (high CO_2) and entomologists on the the temperature (tropical). Algae experts (phycologysts) determined the salinity of the ancient sea to be low after demonstrating the presence of fossil diatoms which could only live in low saline waters. In general, diatoms exist only in environments rich in nutrients. Fossils of freshwater algae were also found. These facts suggest high precipitations and huge river mouths pouring out enriched freshwater at the coasts. Northern winds were dominant as grains of volcanic ash in the "bar code" become finer and finer the more to the south the ash layers are located. The sharp and edged volcanic glass (figures 15) is from a land-based volcanic eruption. The presence of water will result in more violent eruptions and will form different, often rounder shapes of volcanic glass. Experts on pollen (palynologists) have determined many types and families of pollen fossils, an admirable undertaking also as many of the species now are extinct. Pollen fossils of walnut, spores of ferns and in general from a tropical and subtropical vegetation could be found. Pollen of the extinct *Normapolles* family are witnesses of a land bridge between Europe and America as these pollen also are found in sediments in Northern America.

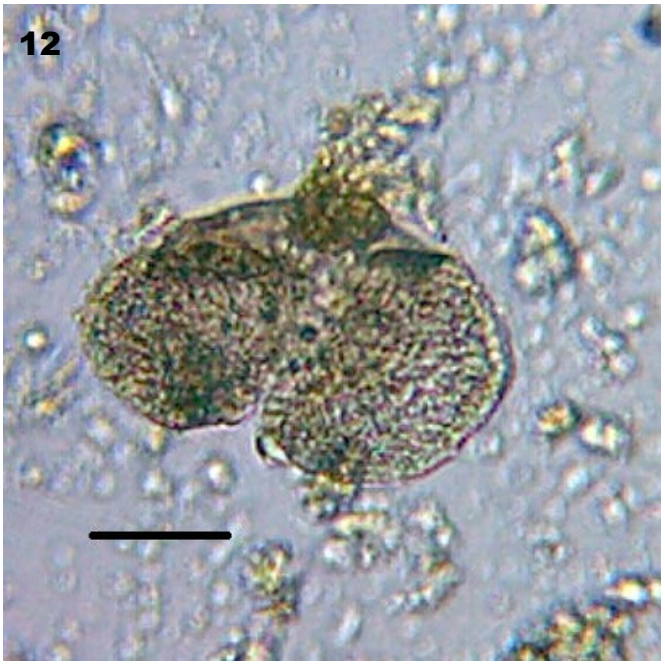
Dinoflaggelates are single-celled microorganisms of its own separate family. These organisms are huge compared to most other single celled organisms and are well known as they cause certain algal bloomings ("red tides") and their phosphorescence can sometimes be seen at night behind anchor ropes or the wake of a boat. Some types of dinoflaggelates are even equipped with a primitive eye while other types are capable of enclosing themselves in a hard resistant biological shell. They can sink to the bottom and hibernate as cysts for uptil 100 years before waking up again if stimulated by light or a change in salinity. Fossil dinoflaggelate cysts were identified in very old rock, and by experience the occurrence and extent of different types are found to correlate with (they are "proxys" of) contemporary factors as temperature, salinity and sea surface biological productivity. For this reason, the study of microfossils in clay layers is not only of interest to scientists collecting data to feed computer climate models, but also to companies drilling in search of hydrocarbons.

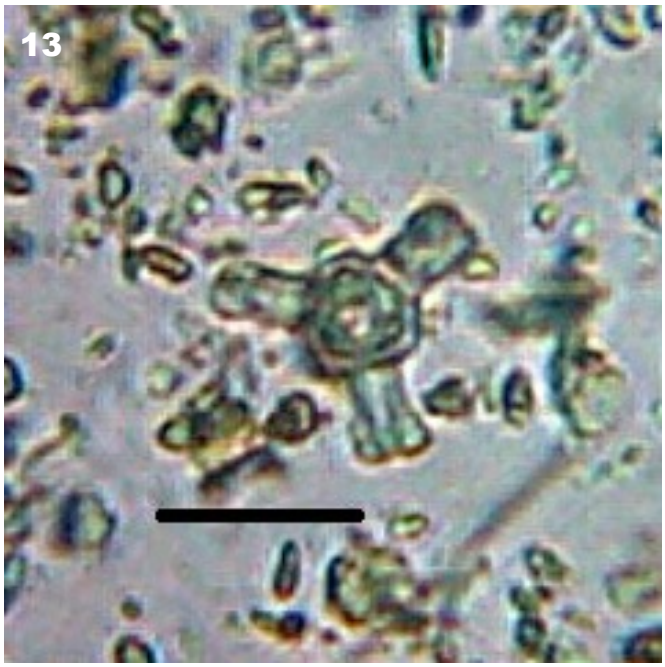
The species *Apectodinium sp.* (figure 19), I am quite sure, represents a proxy for early Eocene. The *Apectodinium* is seen together with transparent squares of glass and a chain of minute diatoms not observed by me elsewhere. One could guess that this *Apectodinium* lived in a luke-warm, mineral enriched sea surface, flourishing with diatoms and algae. The image shows that it recently engulfed a fellow dinoflaggelate and a chain of minute diatoms. Stuck to his sticky body are many square plates of crystallized silicate glass it used as an armor. Unfortunately, the load became to heavy, and it sank to the lifeless bottom of the sea - carrying along its armor and last meal.

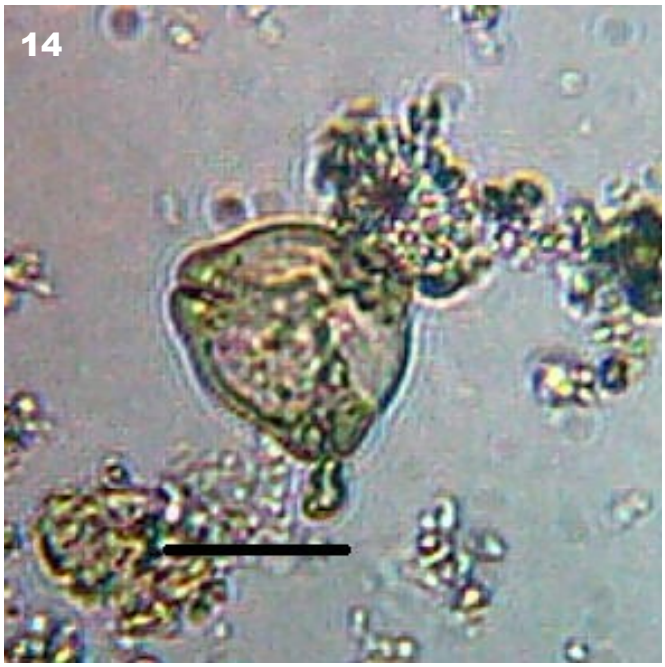
Figure 11: Diatom

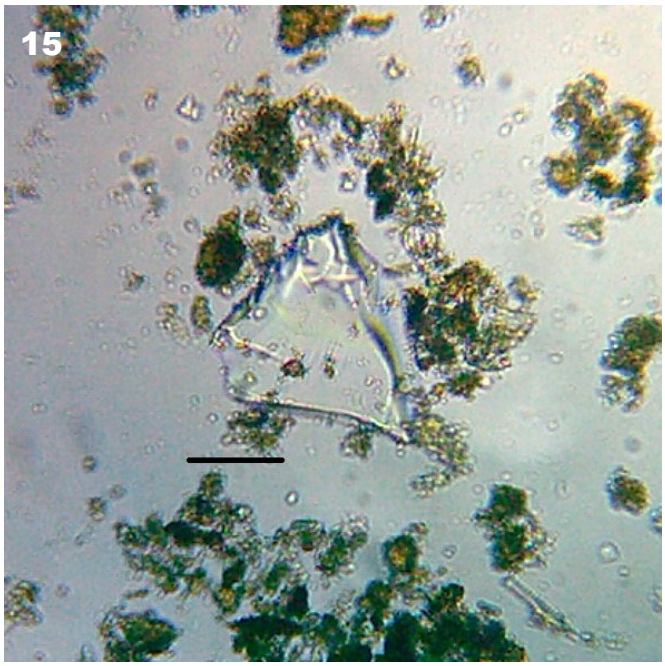
Figure 12: Foraminifera











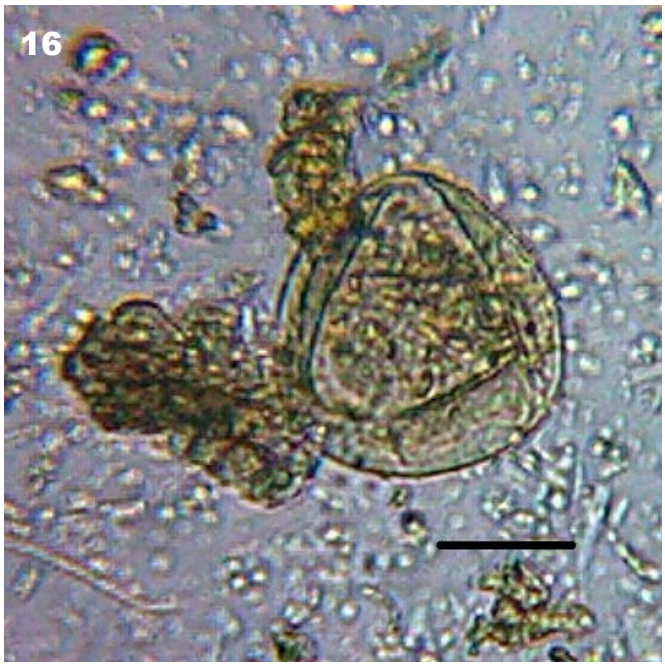


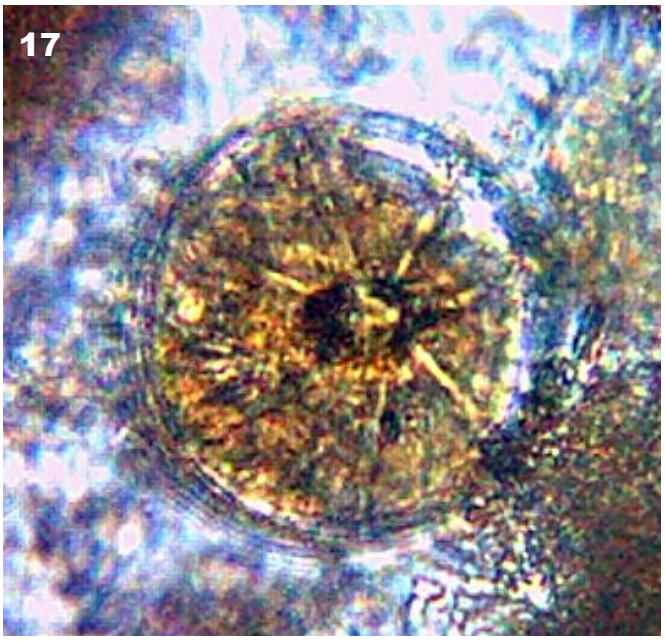
Figure 13: Normapolles (extinct pollen grain)

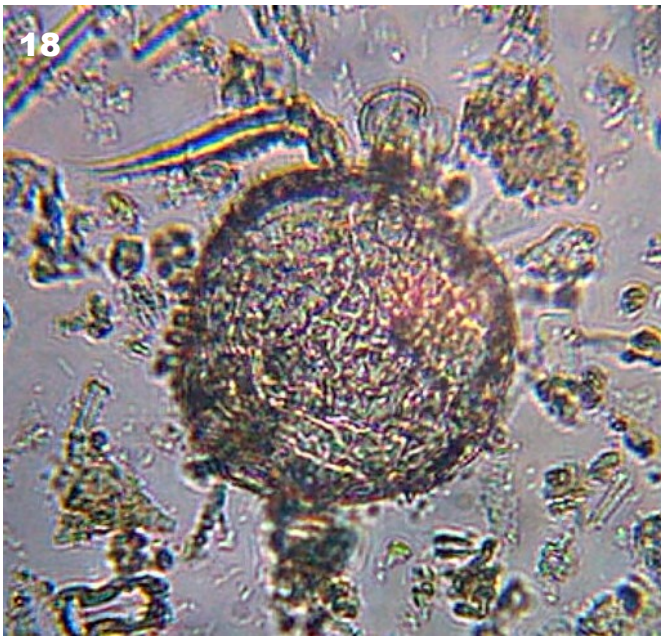
Figure 14: Pollen

Figure 15: Volcanic glass

Figure 16: Possibly walnut pollen

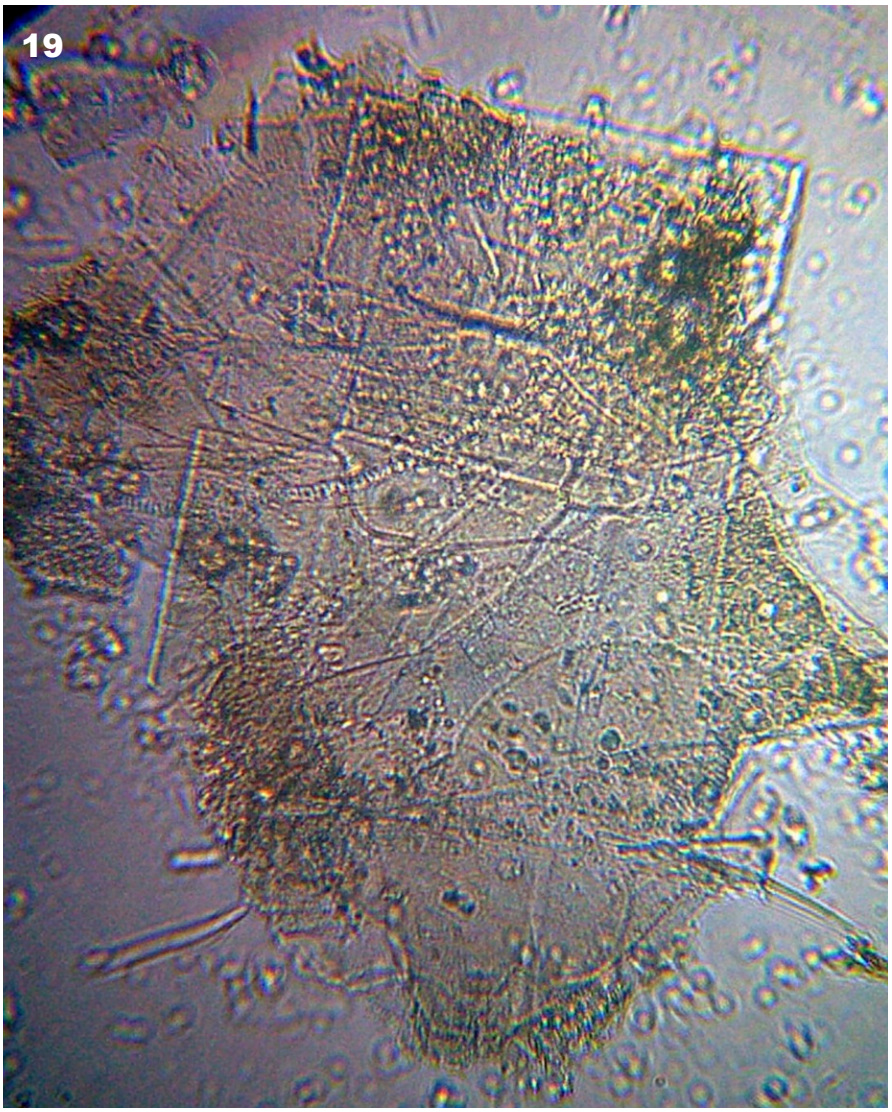
All these examples show that Geology (from Greek "the study of earth") is a discipline, which takes advantage of many other branches of science complementing each other. Also chemists help: with respect to the PETM, they present a problem to be considered carefully, namely the differences in rate of both greenhouse gas emission and acidification of oceans between then and now. Today's rate of acidification is much higher than during the PETM. Acidification of the oceans is moderate under only slowly increasing atmospheric CO_2 when an equlibrium will work among different forms of dissolved CO_2 and the solid carbonates in shells and reefs. An equlibrium (or buffering capacity) is already existing. It is when this buffering capacity is exhausted bad things unfortunately happen, damaging snails, reefs. The oceans will thus work as a "buffer" and inhibit negative effects like the extinction of many marine species in addition to allowing





Figures 17-18: Algae

Figure 19: *Apectodinium*



the seas to absorb substantial amounts of atmospheric CO_2. Under high rates of acidification, ocean chemistry works differently. In these conditions, the solid marine carbonates will decrease or disappear shifting the moderating equilibrium to one side, thereby distorting the buffering quality of the oceans. In journal publications, chemists express their concern over today's unprecedented rate of greenhouse gas emission making it difficult to draw parallels to the past, and raise the possibility that we are entering an unknown territory of ecosystem change.

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"Geologisk Tidsskrift" - Dansk Geologisk Forening December 2011 - Gunver Krarup Pedersen, Stig A. Schack Pedersen, Niels Bonde, Claus Heilmann-Clausen, Lotte Melchior Larsen, Bent Lindow, Henrik Madsen, Asger Ken Pedersen, Jes Rust, Bo Pagh Schultz, Michael Storey, Pi Suhr Willumsen

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Image stitching with MS-ICE, Hugin and Autostitch

Combining several overlapping micrographs into one final larger picture is often not an easy task.

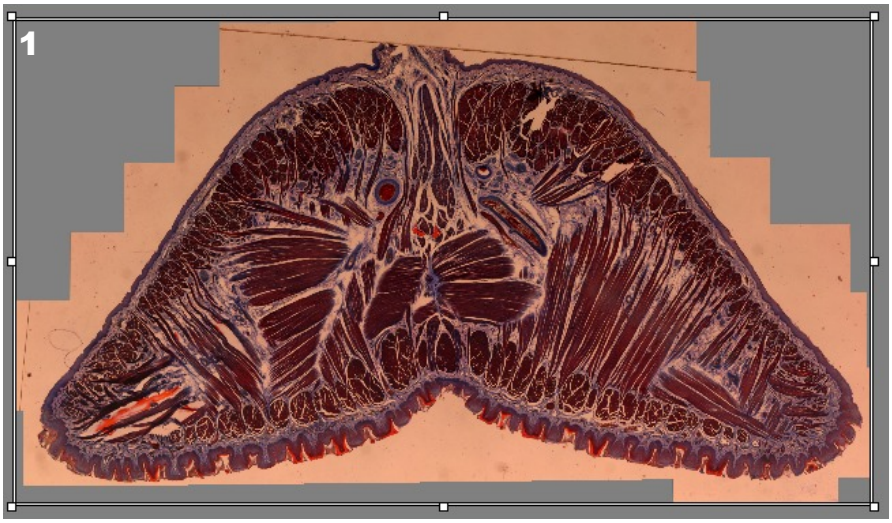
Oliver Kim

The combining of several overlapping images into a final larger image is referred to as stitching. Panorama software can be used for this, but not all programs are equally useful. The panorama software must fulfill several important criteria. First, it must be capable of creating a two dimensional panorama. During my research, I found out that several programs are capable of combining overlapping images in only one dimension. These programs assume that the pictures are taken in single row from left to right. Second, the software must allow for the stitching of flat images. Conventional panoramas are taken with a camera that rotates around a fixed point, usually a tripod on which the camera is mounted. The software then combines the overlapping images into a flat two dimensional picture. This process naturally introduces distortion. Micrographs, however, are made by horizontally shifting the specimen. If the panorama software now assumes that there is also a camera rotation involved, then the software might also introduce some distortion into the final image.

I found three free panorama programs: ICE from Microsoft Research the open source program Hugin and Autostitch. The programs differ greatly in terms of capability and user friendliness. I would suggest that you try out both in order to find the one that suits best.

Microsoft ICE

Microsoft ICE (Image Composite Editor) is an extremely fast and user friendly program. The program recognizes automatically that flat images are processed and the final panorama is computed within a matter of minutes. The error rate (i.e. wrongly stitched images) is also very low, as a matter of fact, during my tests, I have not encountered a single stitching error. If an error



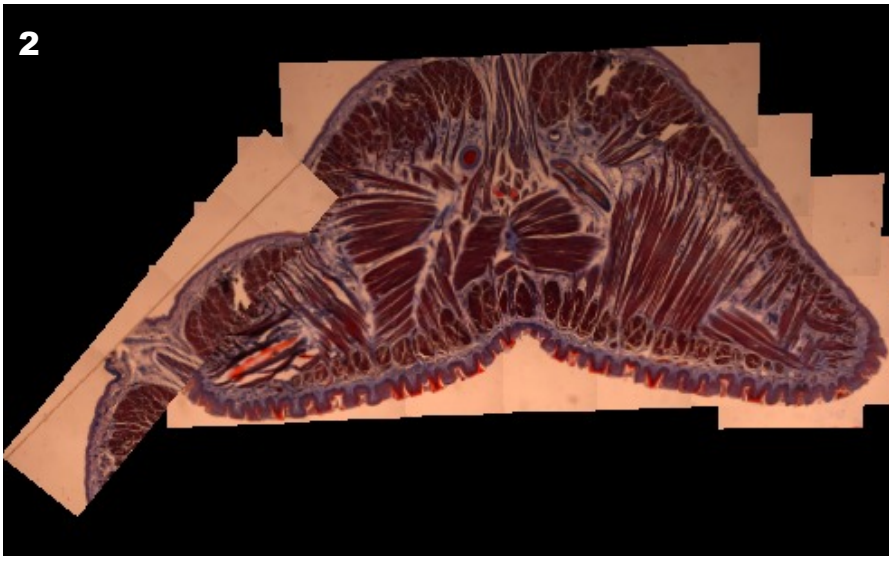


Figure 1: Image stitched with ICE (cross section of the tongue of a rabbit, commercial permanent slide)

Figure 2: Result produced by Hugin using automatic stitching. There was some misalignment. In Hugin, it is possible to manually correct the alignment. This is not possible using other programs.

did occur, there is no possibility to correct individual images, however.

ICE also allows you to stitch a panorama image from a video. This is a really practical solution. Simply set the camera to record a video and then systematically scan the sample. The program will extract the individual frames of the video and use these to assemble a final image. There is the problem of blurring if the sample moved too quickly, so I recommend to use a high frame rate. My Canon EOS 650 camera allows the filming with 50 frames per second and this is the setting that I used. Filming a video is simply more convenient than taking hundreds of individual pictures. Camera vibration is also not a problem when filming. Last, it is not even necessary to move the sample at a fixed speed. The program will extract the needed picture frames automatically. Figure 3 shows a specimen from a permanent slide, which was stitched using a video.

Unfortunately, the program suffers from a significant drawback (which also other people have observed). For whatever reason, the program introduces a disturbing color gradient. The stitched images all show that one side of the panorama is brighter than the other. This effect could be observed both in video stitching as well as image stitching mode. The change in background color is not due to different exposures of the originals, but is an artifact which was introduced by the program itself. The help forum of the program also mentioned this problem, but so far no solution has been proposed. This artifact, in my view, greatly reduces the usefulness of the program for microscopic work, and is a real pity. I could not find any manual control options in MS ICE and I therefore had no possibil-

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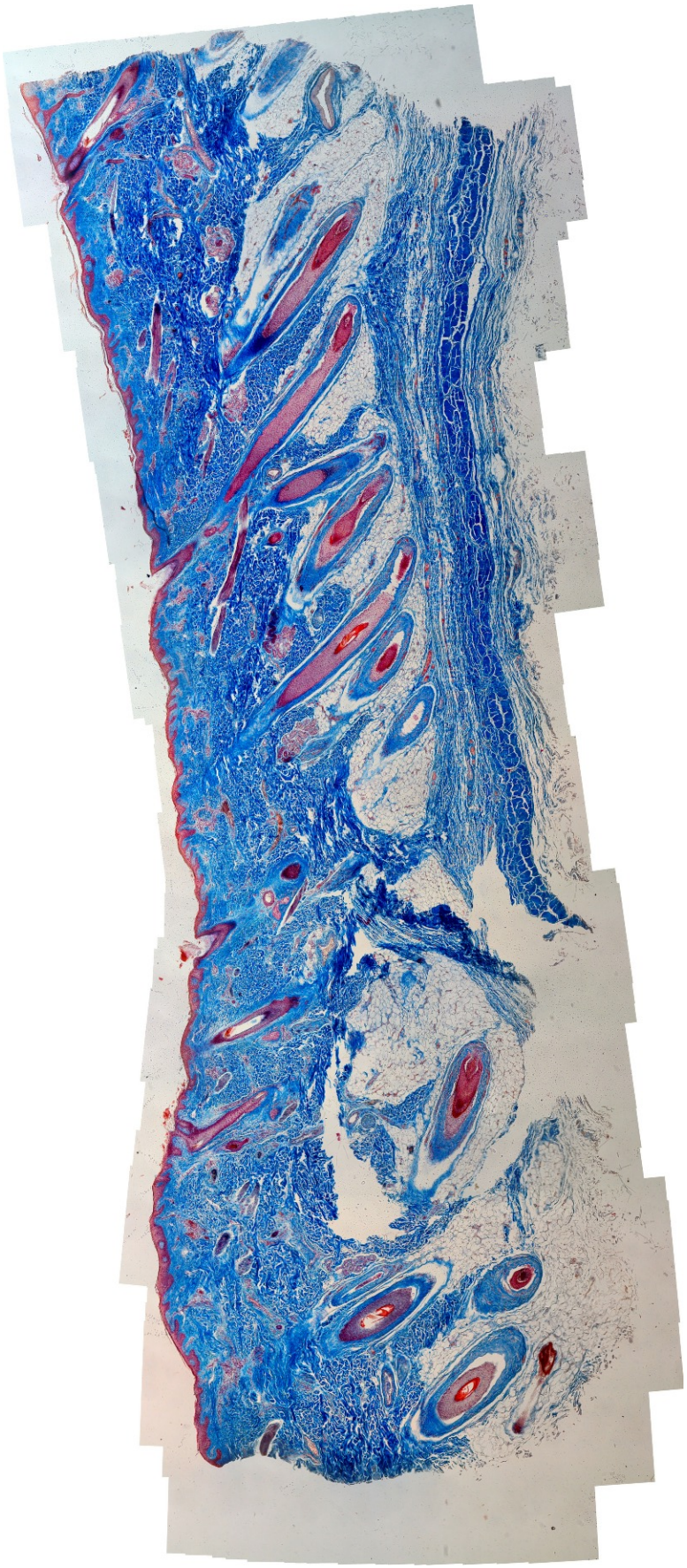
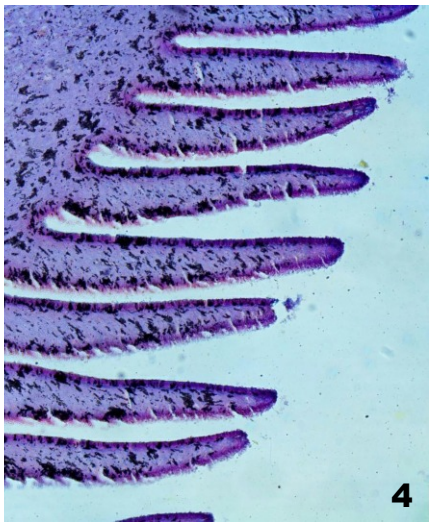
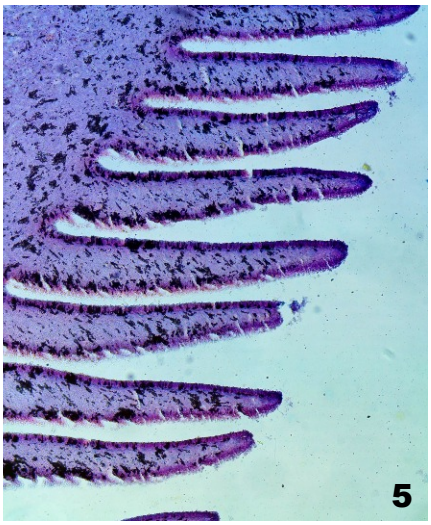


Figure 3: Cross section of the human scalp. The hair roots are visible, stained red. The micrograph was filmed using digital video an d then stitched with ICE. Some parts of the image are a little blurry, when enlarged because I moved the slide too quickly during the filming (motion blur).





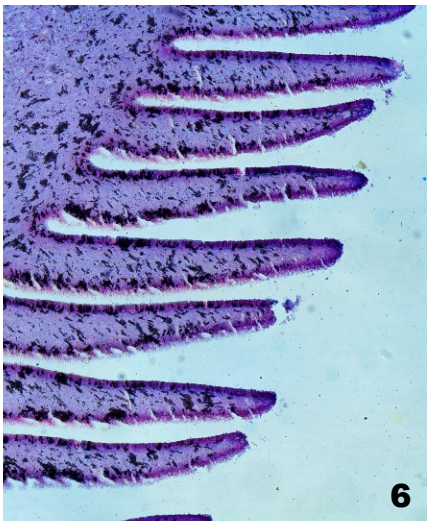


Figure 4: Fruiting body of a mushroom (*Psalliota*), 14 images stichted with Autostitch.

Figure 5: Same images processed with ICE

Figure 6: images processed with Hugin. For small images of this size, the results are nearly similar.

ities to adjust the stitching parameters. I can imagine that this background gradient is mainly visible when many individual images are stitched and that the effect is not noticeable for small panoramas. Image 5 was also stitched using ICE and the background color gradient is nearly not noticable (but still present).

Hugin

Hugin is on the other end of the complexity spectrum. It is a fairly comprehensive program and allows for much user control. The program worked much longer than ICE for the same original images. In one case it computed the panorama in a few hours, while ICE was finished in a matter of minutes. Not all results were acceptable, though. Some images were stitched wrongly and it was necessary to manually correct some of the control points, a time consuming undertaking. The advantage of Hugin is, however, that the program does not introduce a background gradient.

Hugin does have an integrated assistant, which is better than nothing, but of limited help when the final result is not as expected. The assistant requires the user to enter the focal length of the camera objective or the horizontal field of view (HFOV). The program needs these parameters in order to determine the degree of image distortion. Micrographs are, similar to scans, flat. The user has to enter a large focal length or small HFOV angles before being able to proceed. Small HFOV values represent flat images, but this is something that a beginner might not know. I therefore entered a HFOV angle of 2 degrees.

After loading the images over the assistant, Hugin automatically starts to process the images by adding control points and then by aligning the images. Depending on the number of images, this can take quite some time.

Autostitch

The use of this program is also straight forward. Stitching starts with the default parameters right after opening the original images. The final panorama is saved automatically. It is possible to adjust some parameters in an options dialog box, but I have not found any possibility to set and adjust individual control points.

One option in Autostitch allows the user to turn “Auto straighten” on or off. Turning this option off results in a more straight image, because the program does not attempt to flatten an already flat image. Autostitch allows for the adjustment of other parameters as well.

Conclusion

The three different programs have their individual strengths and weaknesses. For stitching a few images together, ICE is the most convenient program. For larger images, the background color drift can be disturbing, however.

Images that do not have much image overlap might be best stiched with Hugin, which allows also for manual correction of the control points.

Autostich also produces good results, but here image distortion becomes more evident for larger images (figure 7), at least when using the default options.

Downloads

You can download the programs from these websites:

www.autostitch.net

hugin.sourceforge.net

research.microsoft.com/en-us/um/redmond/groups/ivm/ice/

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Figure 8: Cross-section of an earth worm stitched with Hugin.

Figure 9: Stitched with ICE.

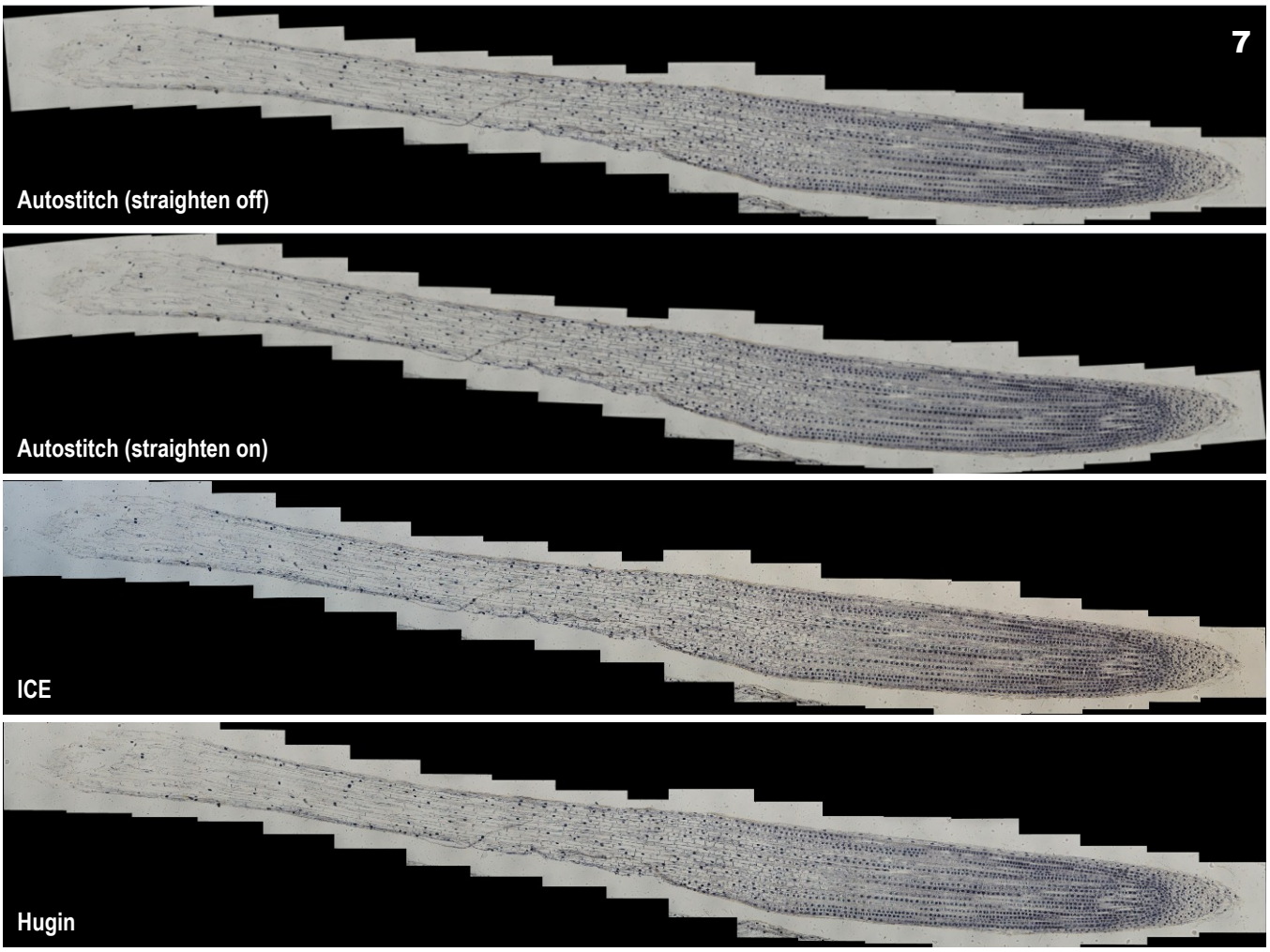
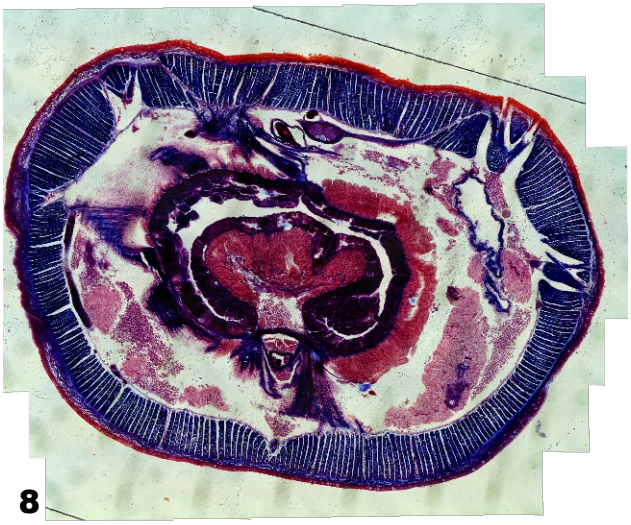
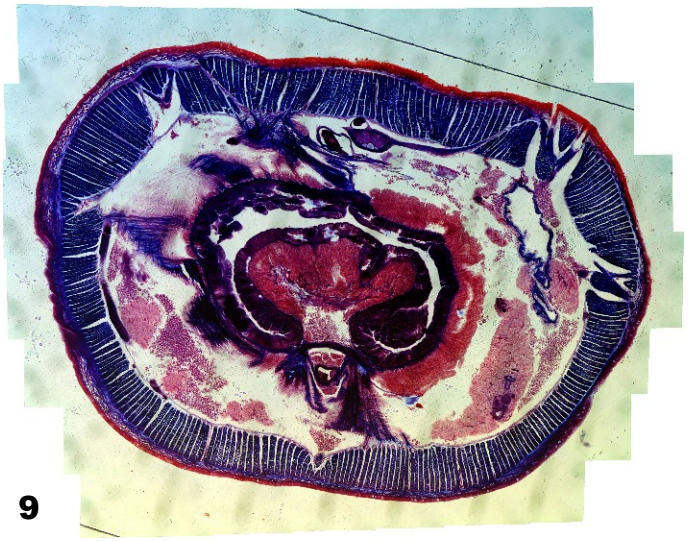


Figure 7: Root of an onion (43 separate images) stitched together with different programs. The "straighten" setting in Autostitch will attempt to remove image distortion of an already straight image. This results in the final image to be distorted. ICE produced a straight final image with the unexplainable color-gradient. The overall best results were obtained with Hugin, but this software was the least user friendly to use. It is important to say that in all cases the default options were used. It is well possible that after some fine-tuning of the parameters, better results can be obtained.





A Microcosm for Microscopy

Microhabitats provide an unlimited source of specimens for microscopic observations.

Charles E. Guevara

The collection of fresh specimens for microscopy is a satisfying aspect of any outdoor hike. When work or chores control my schedule, my collected field samples sit idle to the point where changes of all the assemblages in the freshly collected sample occurs. It's not exactly spoilage that occurs here. It is the communities of biota in the small volume containers seeking rapid use of resources in a suddenly isolated confinement. There is no climax community of biota in a small jar. There are only rather predictable shifts in active populations, as the chemistry changes in the collection container. I understand that sample containers always maintain living biota. So I guess that some terrific microscopy of a small container is always possible and rewarding. But I fancy microscopy observations of naturally occurring assemblages of the locale they thrive in. I enjoy freshly collected specimens, observed promptly at the bench, rather than microscopy of all the subsequent communities of which an idle collection container transitions through.

An outdoor balanced microcosm with a variety of microhabitats offers a stable environment to keep collected specimens fresh and unaltered for days. Located outdoors, the balanced set up is exposed to the seasonal cycles of weather and natural lighting.

The starter components of my balanced aquarium and its over-tank wetland-biofilter are aquatic plants from the littoral zone of a river where a tributary creek enters. Native fish, crustaceans, and snails, and wetland plants from my locale's wetland areas are also included.

The over-tank biofilter is configured as a wetland. Therefore wetland plants from my area have been placed into this niche of the microcosm. Bamboo sticks attached to bottle corks comprise surface floating racks upon which aquatic littoral zone plants are draped. Styrofoam islands can be wire-braced to remain under the biofilter drainage outflow stream of water. All these spe-

Figure 1: Wetland habitat, fall season setting in

Figures 2-3: Sector of the wetland niche

Figure 4: A surface floating rack

cific microhabitats offer locations to place freshly collected field samples. I fancy the 'seep wall' of the biofilter container, and the Styrofoam islands for placement of field specimens from similar outdoor microhabitats.

Robert Warington in London, experimented with a 12-13 gallon glass aquarium set up as a balanced ecosystem. On March 4, 1850, Robert Warington read a paper on his work with the balanced aquarium before the Chemical Society of London. In 1857, Robert Warington wrote a second paper regarding his balanced aquarium system. His starter components were goldfish, snails, eelgrass, and attendant microorganisms. "Thus was established that wondrous and admirable balance between the animal and vegetable kingdoms..", wrote Robert Warington in 1857.

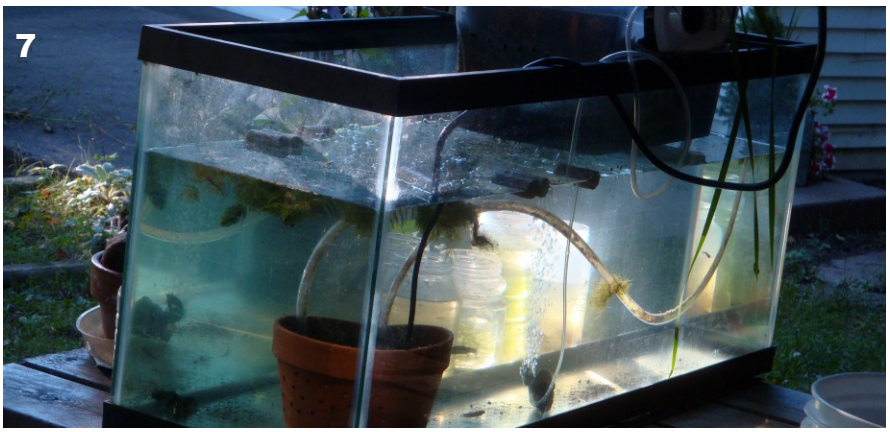
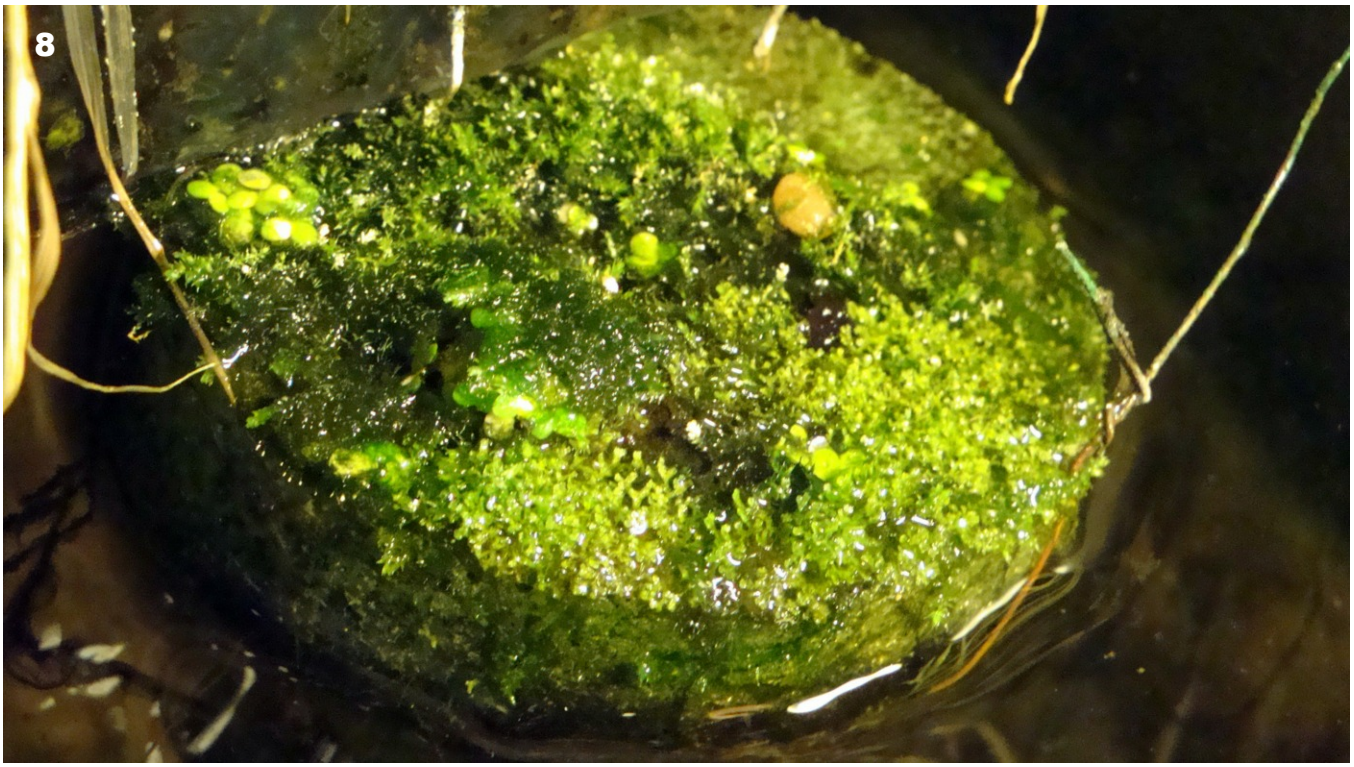


Figure 5: Sector of the wetland niche

Figure 6: The microcosm biota, when balanced, maintain the system through the seasons

Figure 7: Low cost, easy to configure system



Anticipating latter studies on food webs, population and community ecology, and the ecosystem concept, Stephen A. Forbes delivered his paper: "The Lake as Microcosm" (2/25/1887).

Reading into the Peoria Scientific Association, Peoria, Illinois, US: "Nowhere can one see more clearly illustrated what may be called the sensibility of such an organic complex,--expressed by the fact that whatever affects any species belonging to it [the lake, ed.], must speedily have its influence of some sort upon the whole assemblage." And: "It forms a little world within itself,--a microcosm within which all the elemental forces are at work and the play of life goes on in full, but on so small a scale as to bring it easily within the mental grasp." (Forbes, 1887).

Please consider these low cost outdoor setups for microscopy of their assemblages, irrespective of how frequently you add native fish, macroinvertibrates, meiofauna, or protists to the variety of microhabitats you configure in your balanced microcosm.

Figure 8: Styrofoam island habitat

Figure 9: Start-up components of the system's biota are a pleasure to visit daily - but they are not pets!

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Robert J. Beyers, "the Microcosm Approach to Ecosystem Biology", The American Biology Teacher, Vol. 26, No. 7 (Nov., 1964), pp. 491-498.

Stephen A. Forbes,"The Lake As Microcosm", Bull. of the Scientific Association (Peoria, IL), 1887: 77-87. Accessed online 10/28/12 http://people.wku.edu/charles.smith/biogeog/FORB1887.htm

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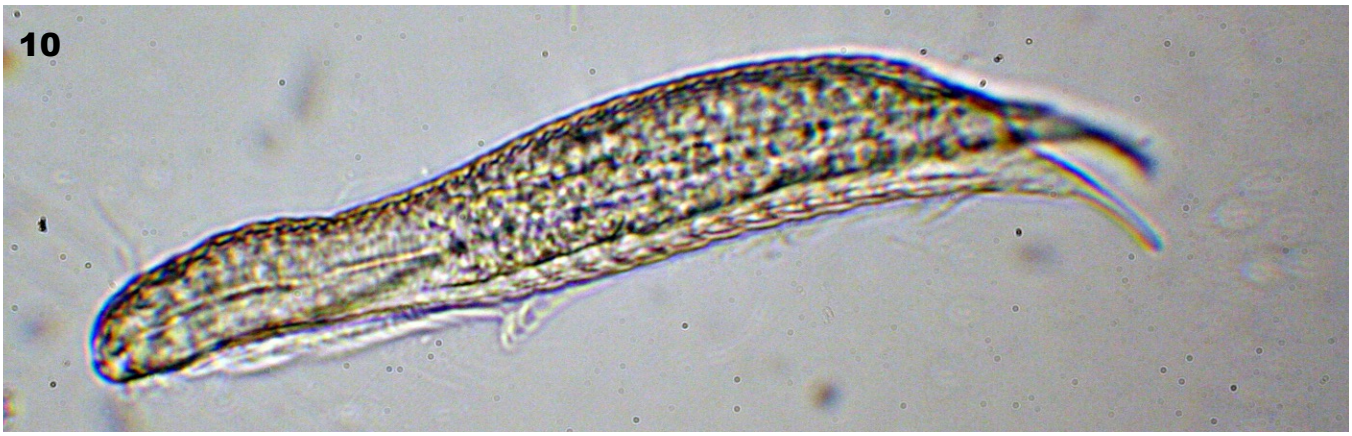
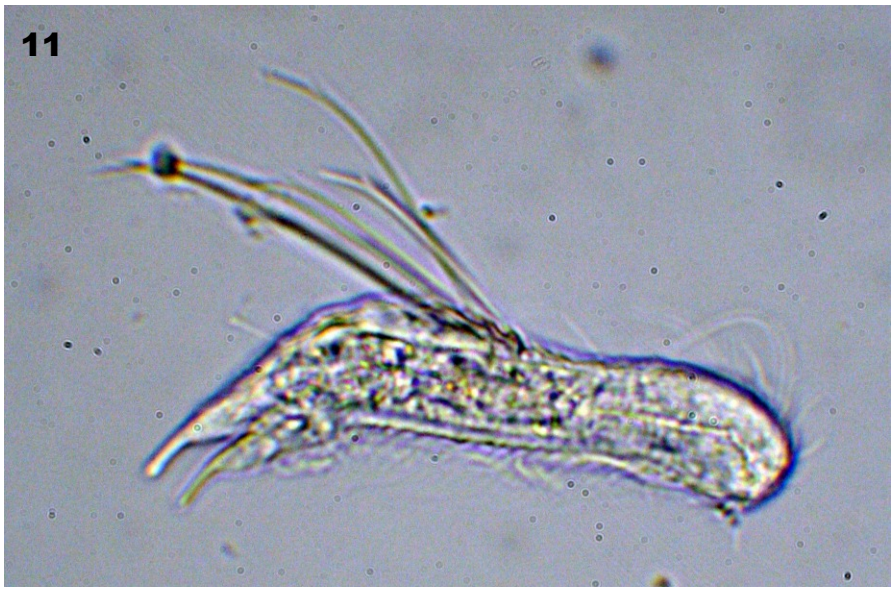
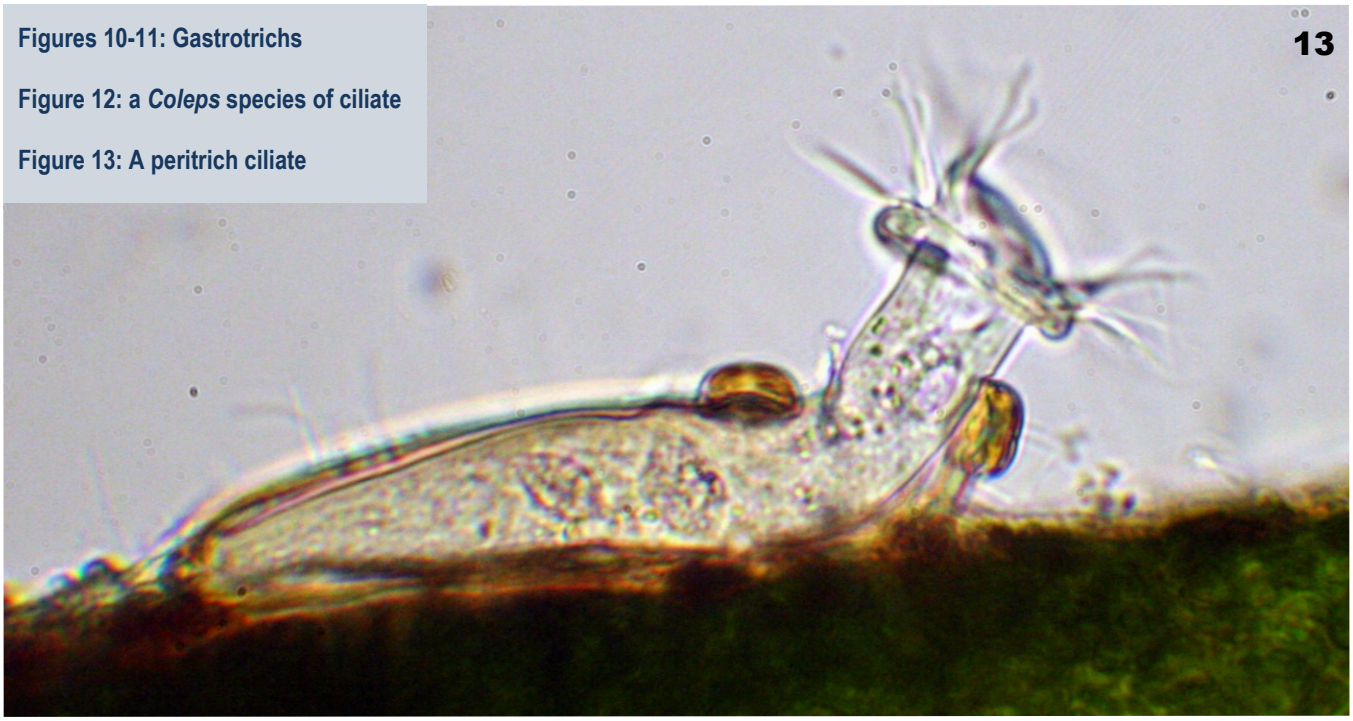




Figures 10-11: Gastrotrichs

Figure 12: a *Coleps* species of ciliate

Figure 13: A peritrich ciliate



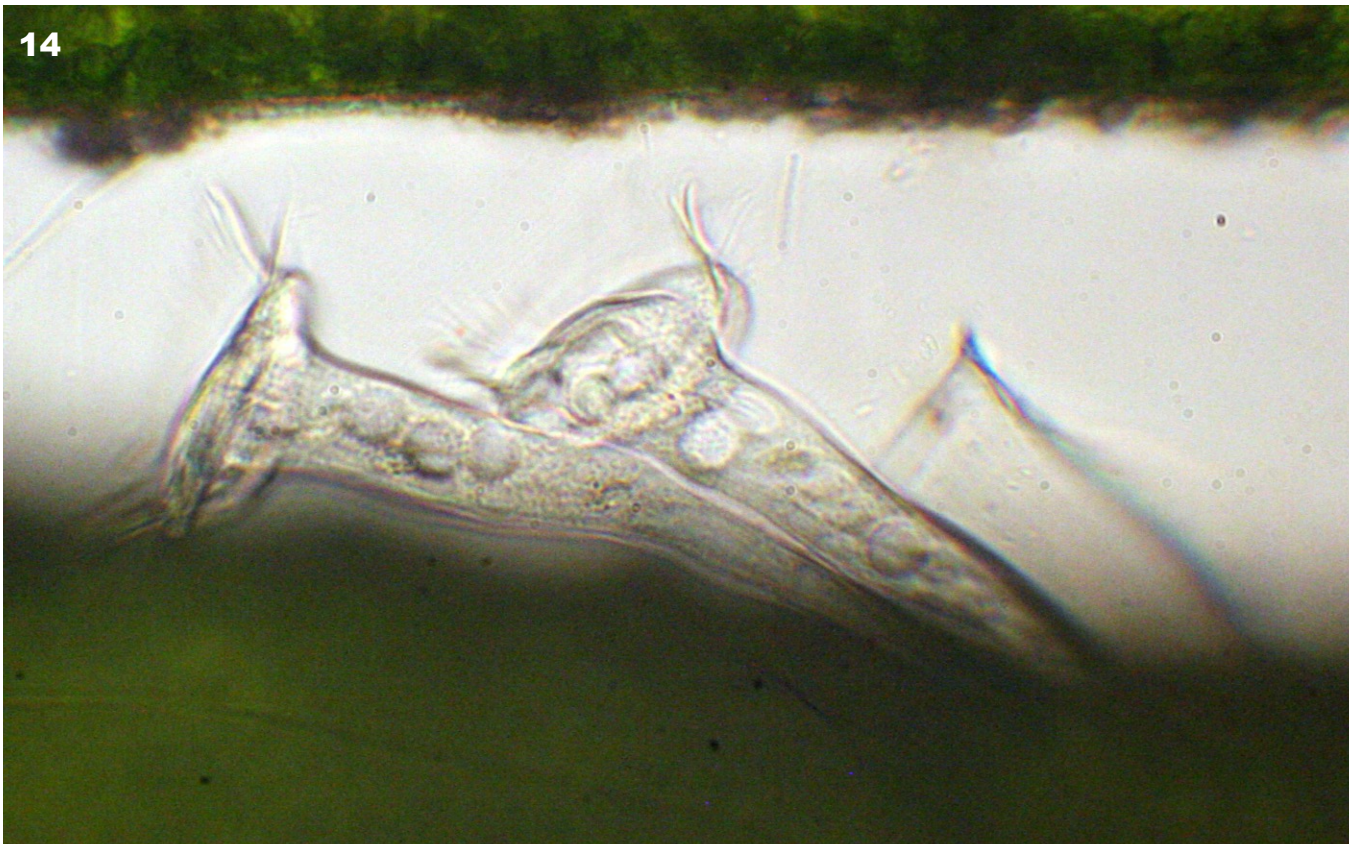
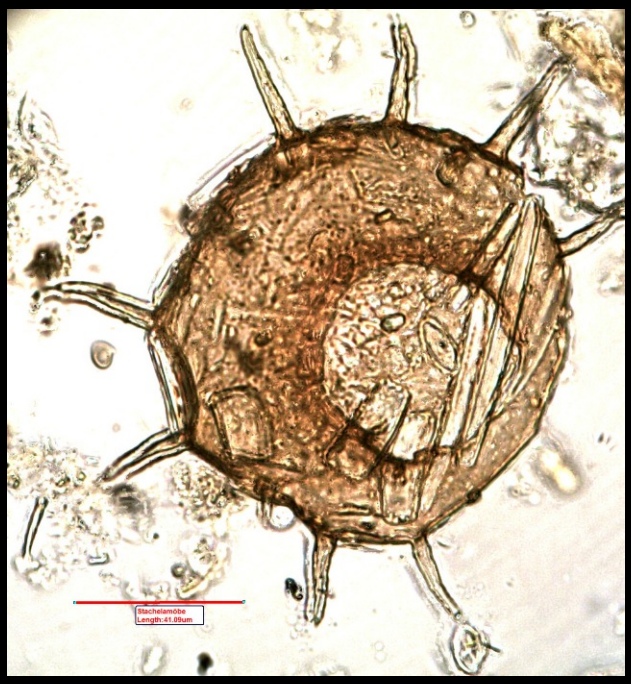
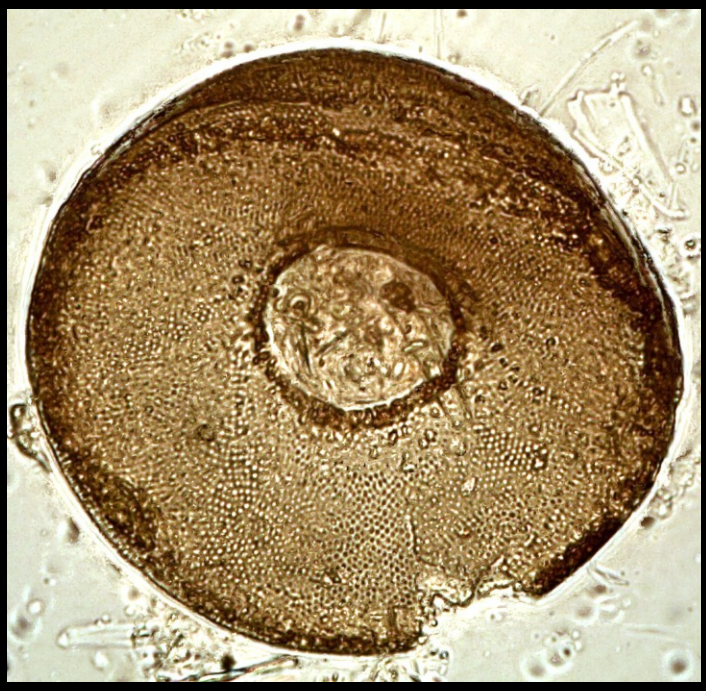


Figure 14: a group of peritrich ciliates

Figure 15: DL-phase contrast of these peritrich ciliates

Thecamoeba





Thecamoeba are great objects for the microscopy newby:

- They are rather slow movers
- There is a nearly endless number of species
- Like diatoms some of them are nicely patterned and quite colourful (even if dead)
- They are the perfect stacking-objects, being the only method to illustrate their three- dimensional shapes. I use Picolay.

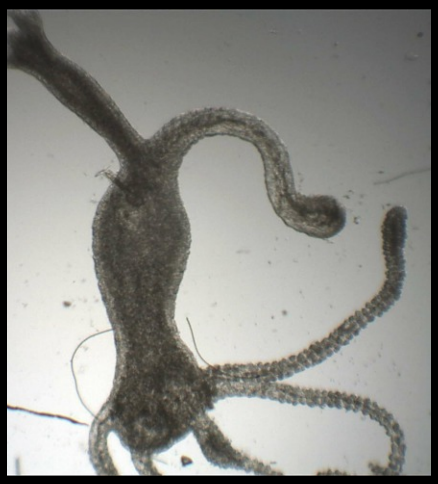
Top left: *Centropyxis*. all spines are in focus, 100 µm diameter.

Top right: *Artocrea* (?) with a distinct rim.

Bottom: *Arcella*. This picture hows the umbrella-shape of the Arcella sp, a shell which otherwise is difficult to figure. 140 µm diameter.

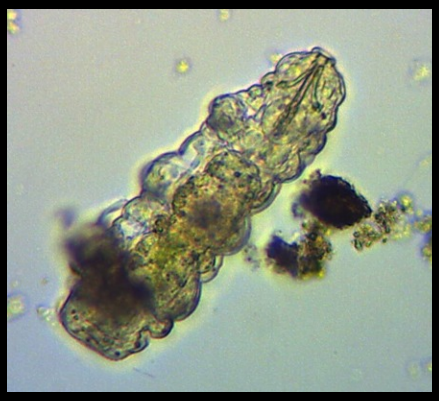
By Hans Rothauscher

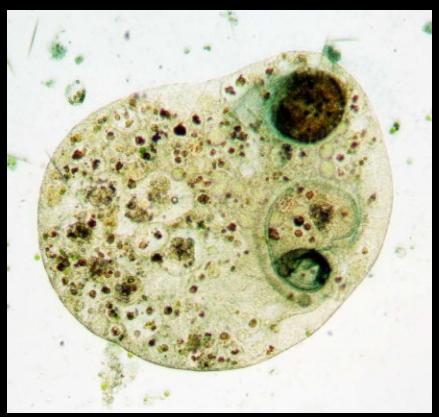
Hydra, Tardigades and *Stentor*

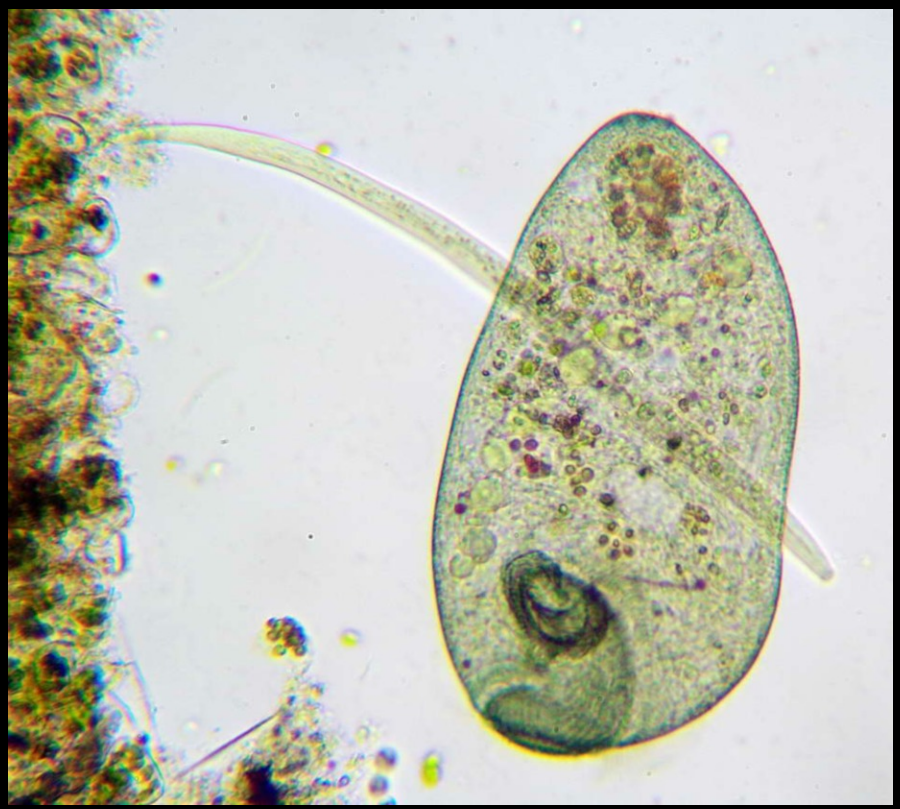


Hydra. 4x and 10x achromat objective - bright and dark field. Camera: Optikam B1 at 1,3 MP (1280x1024)

By Luca Monzo

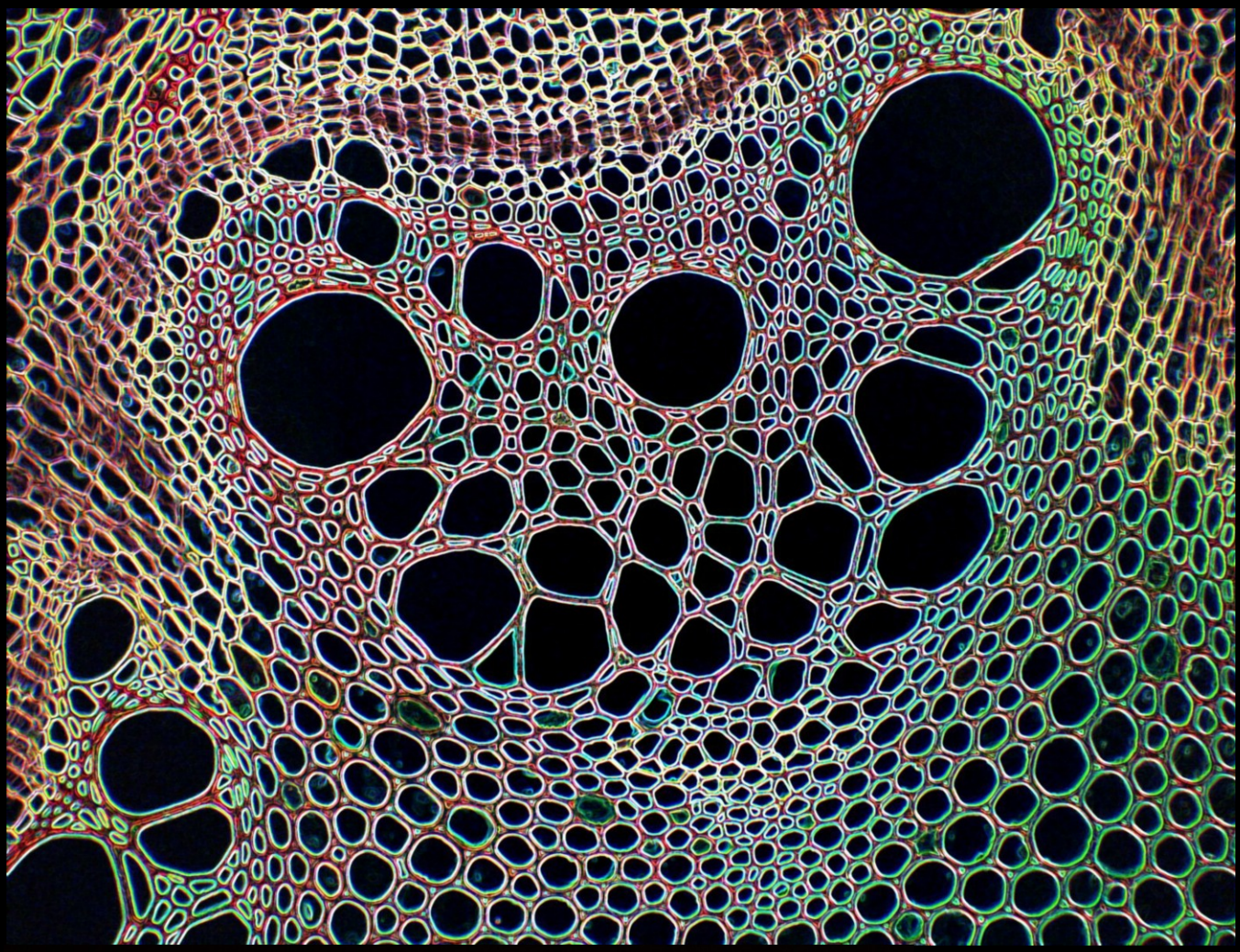


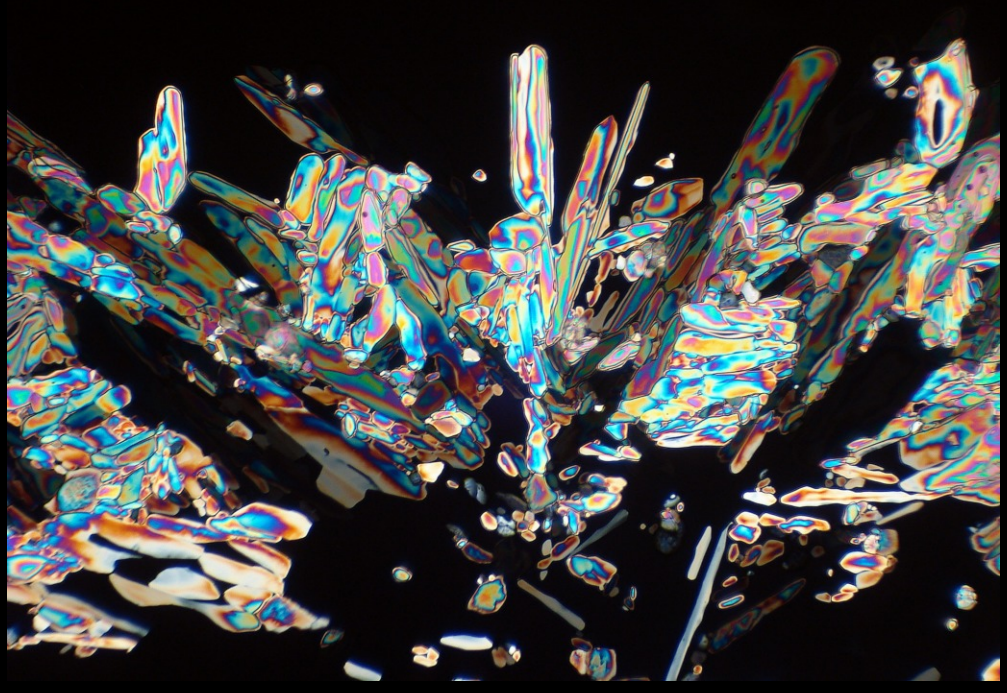




Tardigrade (left) and Stentor (bottom left and right).

Clematis vitalba and urea crystals





Top: *Clematis vitalba*

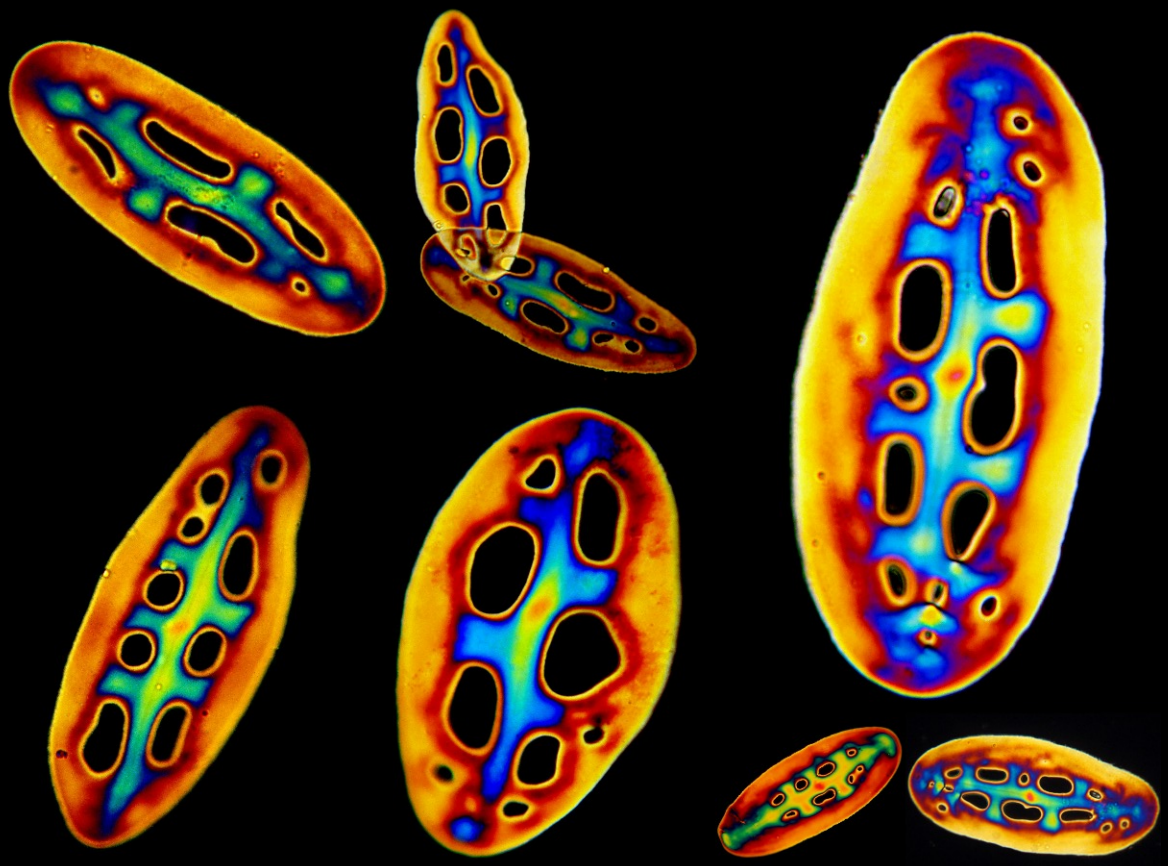
Bottom: Urea crystals in polarized light

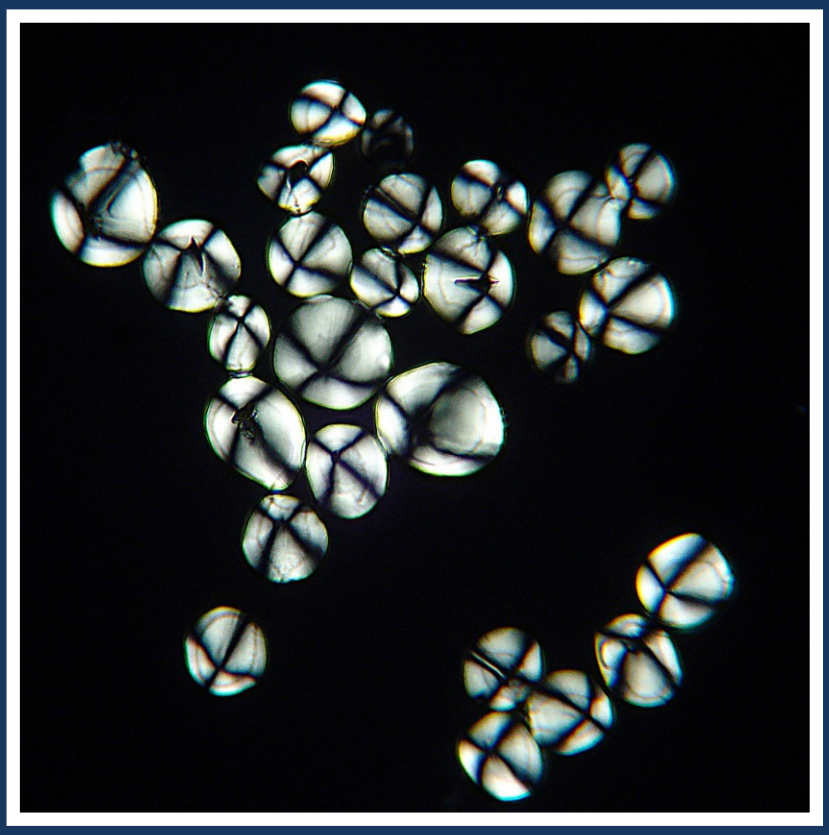
Facing page top: Ossicles from a sea cumber

Facing page bottom: Cetirizine

By Mike Gibson

Sea cucumber ossicles and Cetrizine





What's this? Answer on page 3. Image by Mike Gibson.