MAKING CASTS

Among my many interests is paleontology. I have been collecting fossils since my teenage years (quite a few years ago…), and I have been contributing photographs for three books on the fossils of southern Quebec as well as two books (so far) on the fossils of the Molteno formation of South Africa. There are still two more South African books in the work, so I will have to sacrifice some of my time and make a few more trips to visit my friend Dr. John Anderson in Pretoria. Life can be so tough sometime…

The author with his Titanites

On one of those trips I also purchase a few casts of fossils from Witwatersrand University: Lystrosaurus and Cynognatus skulls, as well as a reproduction of the Taung Child a historical discovery made in 1924 and described by Raymond Dart. I also have a Titanites ammonite from England; it's fortunate that this one is not an original as I would not be able to lift it and it would probably damage my floor… More casts came from Miguasha, an important fossil site in the southern part of the Gaspé Peninsula, in Québec. Such casts are very common in paleontology. Some fossils are extremely rare and those we see in museums are often casts made from the originals. On top of it, many countries, including South Africa, restrict the exportation of their fossil heritage. A good cast is just as interesting as the original, and those I have acquired from various sources share an important place in my personal collection.

Cast of the Taung Child

Cynognatus

Lystrosaurus

Eusthenopteron fordii from Miguasha

Bothriolepis canadensis

Silicone rubber mold in two parts. Above it, another ammonite cast was made with a single side rubber mold.

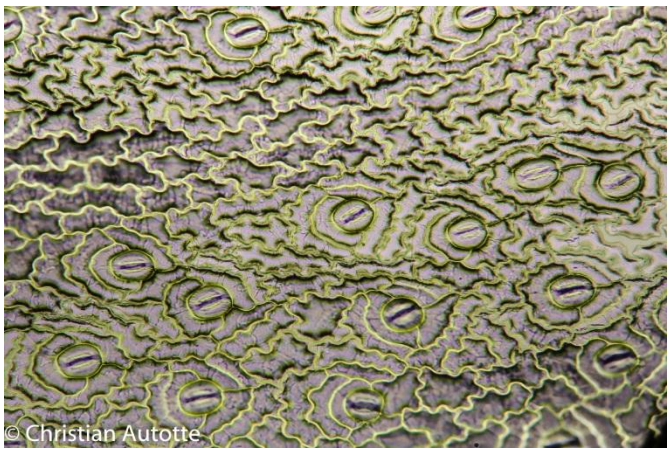
I have also learned to make some fossil casts of my own. First, a mold is made, often with silicone rubber. The simpler mold are one sided; you simply place the original fossil in a container and pour liquid rubber over it. The resulting cast shows the fossil on one side and a flat surface on the other. For tridimensional subjects a mold of at least two parts must be made. Plaster or resin is then injected through an opening in the mold. A bit of work to clean up the inevitable defects along the seam, a dab of paint and the copy looks just as good as the original.

The finished cast. With a bit of paint it looks just like the real thing.

The original with the plaster cast. The "snake head" was sculpted by people who once thought that ammonites were snakes petrified by a Christian saint, Hilda of Whitby. But someone remarked that the snakes never had a head. So people started to sculpt heads on fossils of *Dactylioceras commune* , a species commonly found on England's Jurassic Coast.

But what does all of it have to do with microscopy? Well, if fossils can be cast to keep copies of them, maybe some microscopic subjects could be cast as well. The answer is yes, and they are much easier to make than some three dimensional fossils. I got the idea from a short article by Anne Bruce in Micscape (a link is at the end of this article).

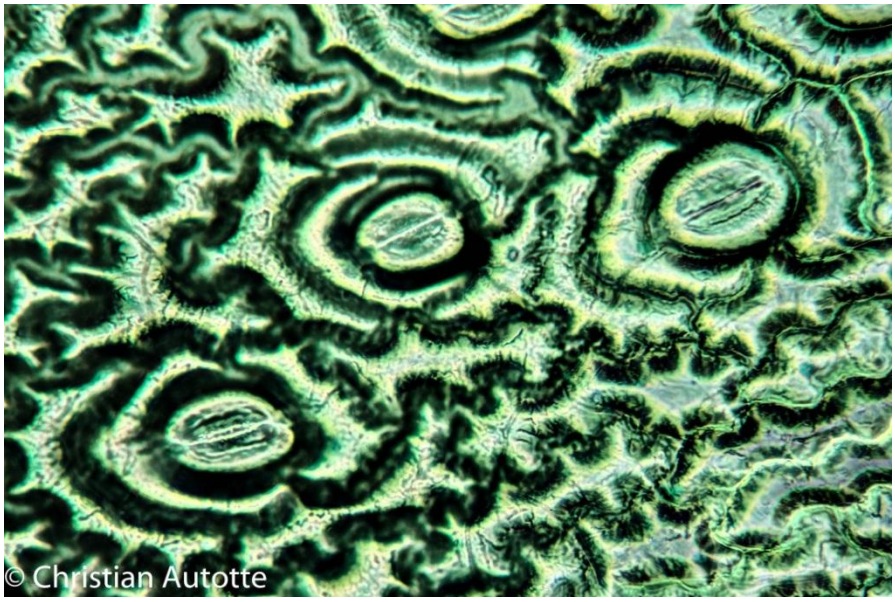
Contrary to fossils, there is no need to make a mold. You simply paint a thin layer of clear nail polish over the chosen subject; usually that will be a leaf, but we will see later on that it's possible to make casts of a lot more than leaves. My first try was with the leaflet of a common fern. It came out very well. Of course, it's impossible to see internal structures of the cells, like the nucleus, but the amount of details reproduced in the cast is surprising. The under part of the leaf (any leaf) is more interesting than the top part. It is filled with the stomata, the mouth-shaped cells that handle the gas exchange during photosynthesis.



Polypodium fern cast, stomata at 200x

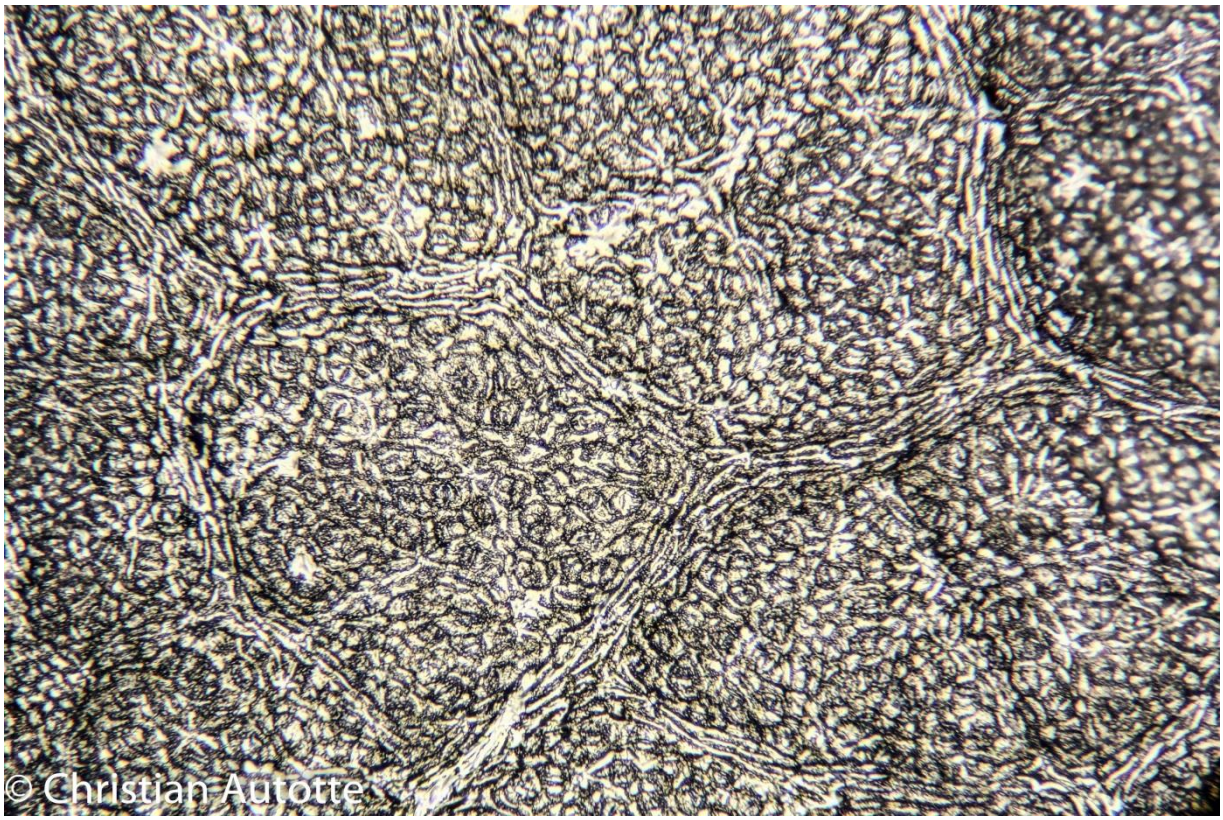
The first picture I took was with a standard bright field set-up. While interesting, I thought that I could do better with a little work. After trying a few filters, I settled on a green filter with a clear center. The result is very interesting, and the details hold up even at 400x magnification.

Polypodium Fern cast, 200x with a green filter

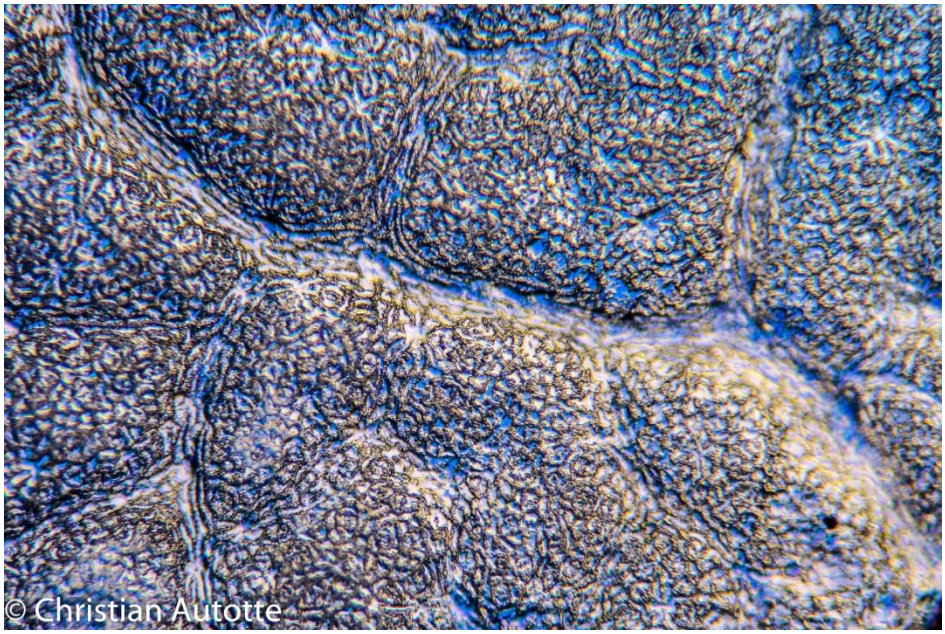


Polypodium Fern cast, 400x with a green filter

It’s the beginning of winter, so the next leaves I tried to cast were dried. I had both beech and aspen leaves set aside. The aspen was particularly interesting. The small veins look almost like 3D illustrations of mountain ridges.



Aspen leaf cast, 100x. Stack of 5 images.

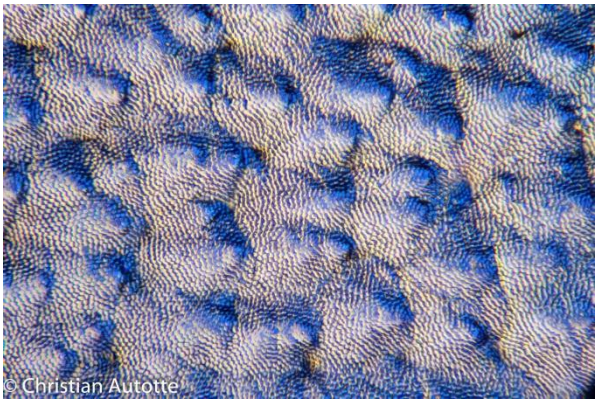


Aspen leaf cast, 100x, with blue/oblique filter

With the right combination of filter and lighting, some pictures even take on a brushed metal aspect. Very interesting.

I was on a roll and kept on experimenting. A few casts were made with a second coat of nail polish; while it does make the cast more resistant, it makes it a bit thick and does not add any more details. Then, I went on looking for other specimens that could be interesting as casts. The first one was the elytra of a ground beetle. Those elytra are too thick to be viewed by a standard microscope, unless they are left in potassium hydroxide for weeks to make them more transparent. The results were surprising. The surface appears full bumps that look like scales. But to really make the image stand out I had to play with filters again. I tried oblique lighting, which was pretty good but still too black and white for my taste. So I switched to a filter with a blue center dot and a clear crescent, which create a kind of oblique lighting with blue highlight. Another filter that gave good results is half green half yellow.

Ground Beetle elytra cast, 100x, green/yellow filter



Ground Beetle elytra cast, 100x, blue/oblique filter

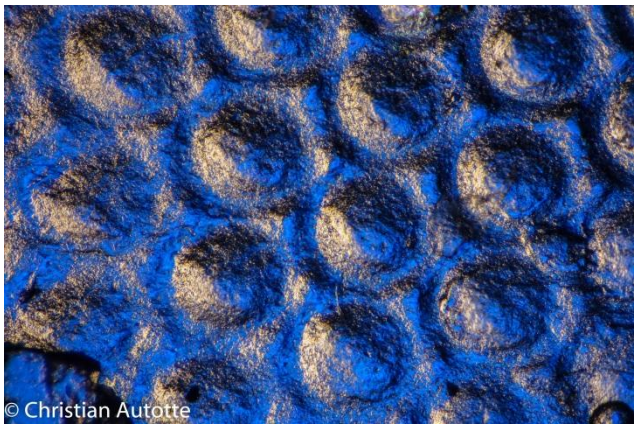
Working with a different beetle, I was surprised to see fragile details such as spines being reproduced faithfully. The details hold up to scrutiny even at 400x.

Beetle elytra cast, 400x, stack of 7 pictures

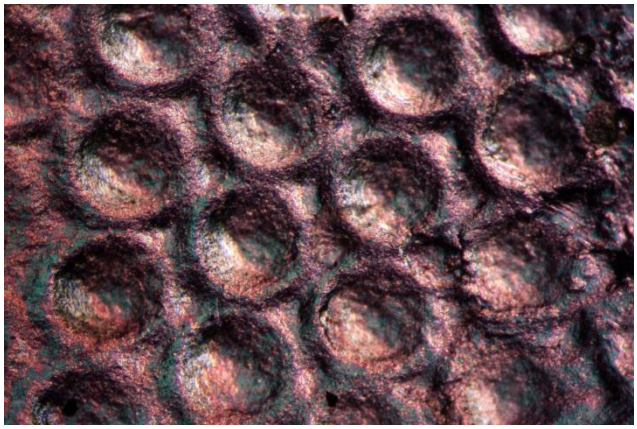
I tried something else: gently painting some nail polish on a butterfly wing. While the result was not exactly a cast, it remains interesting. When I peeled off the nail polish, it pulled most of the scales from the wing surface. So in effect, I ended up with a single layer of scales. When we look directly at the wing with bright field illumination light must pass through two layers, above and below the wing. Looking at a single layer makes the image somewhat clearer. We can see how the scales are laid out on the wing, as well as their individual point of attachment. It's not necessarily better than the traditional picture of butterfly wings, but it adds another point of view.

Nail polish peel with butterfly wing scales, 400x, stack of 8 pictures

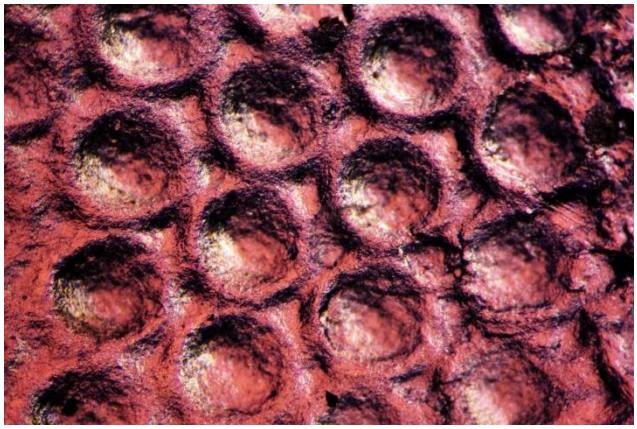
I even tried the technique with one of my fossils. I painted a thin coat of varnish on a trilobite eye to see what would come out. The plain result is interesting. Since it's a cast everything is reversed, so that what looks like "bumps" are actually "dips" made by the individual omatidium of the eye.



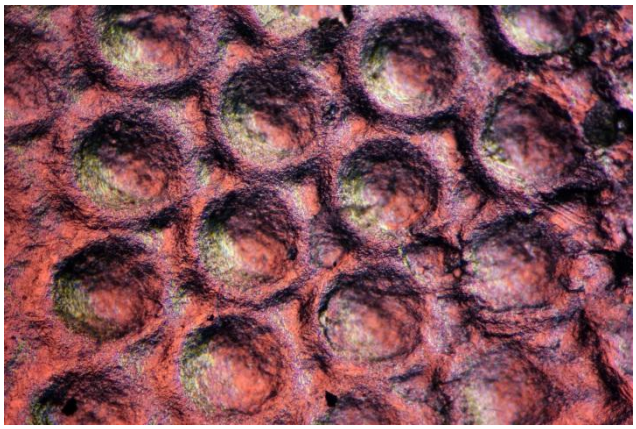
Blue/oblique filter



RGB images combined as “Darken” mode



RGB images combined as “Hard Light”



RGB images combined as “luminosity”

Then I pulled out the filters again. The first one was the blue center spot with a crescent for oblique lighting; that made the relief really stand out. I also tried different colors for the central disk. Eventually, I tried something else entirely: one red, one green, one blue, which were then combined as layers in Photoshop. With all the layers selected, I chose various blending mode to come up with different effects.

Other experiments did not work out so well. Other fossil did not have enough texture to make interesting casts. Trying to duplicate my butterfly success with a different species, a Luna Moth, very few of the long hairy scales would lift up, so the cast was left with very little details of interest. Trying a cast of a dragonfly wing also turned out to be useless, as these wings are quite transparent to start with. Egg shell was also disappointing; there was just not enough texture to make things interesting.

With many subjects, peeling off the cast is the most difficult part. With those that can bend, like leaves and butterfly wings, it is usually easier to gently bend the subject at the very edge of the nail polish. Once the cast starts to peel off just pick it up with a pair of fine tweezers and pull slowly; it should come off easily. Sometimes, it may also be necessary to paint more than one coat of varnish to make the cast more resistant and less prone to tear apart. Things can also get a bit more difficult with hard subjects, like the beetle elytra. In that case I found that by using a fine needle, or the tip of a scalpel, it is possible

to pick at the edge of the cast to slip between subject and nail polish. The moment you can lift a small corner of it with the needle keep applying pressure gently and evenly, the cast eventually come off. Surprisingly, I could not peel off the cast from a crow's feather; it just stayed tightly bonded to the feather and broke up in little pieces.

Another problem that creeps up every now and then is nasty bubbles that may reduce the usable surface of the cast. Keeping the nail polish thin enough with the addition of some acetone seems to help. After adding the acetone, shake the nail polish bottle to mix it up properly. You will see the formation of hundreds of tiny bubbles; give them plenty of time to rise or dissipate before using that nail polish again.

The results of my casting experiments were not discarded. I decided to mount them dry under a cover glass glued in place with epoxy glue (see my article in the June 2019 issue). DO NOT try to mount such casts with any kind of mounting medium, be it nail polish, Canada balsam, or PVA based glue; remember that these casts are nothing more than bumps and pits on a translucent film, any liquid medium would fill those pits and render them invisible. Using a clamp to hold the cover slide in place prior to gluing it also makes the cast lay as flat as possible, which makes viewing and photography easier. The cast must also be mounted *dull side up*, that's the side that was in contact with the subject, the side that has all the information we want to see.

This is the article that got me started on microscopic casts:

(http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/art97b/epider.html)

The color/oblique filter was made with the help of the following article:

http://www.google-mic.net/mag/indexmag.html?http://www.google-mic.net/mag/artnov02/diydic.html

Comments to the author Christian Autotte welcomed, email: cautotte.9001 AT videotron DOT ca

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