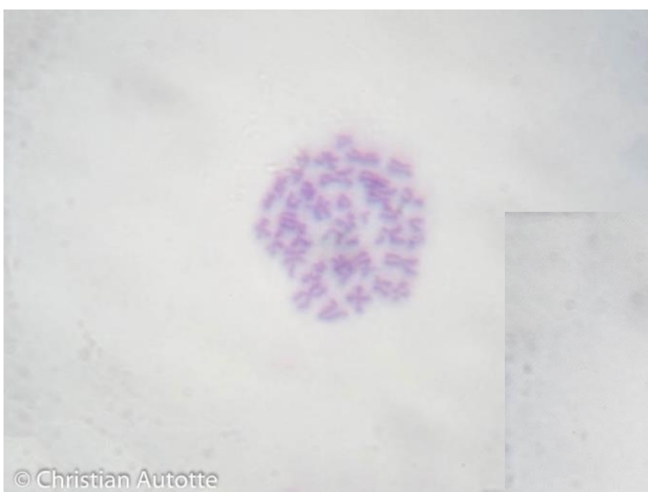
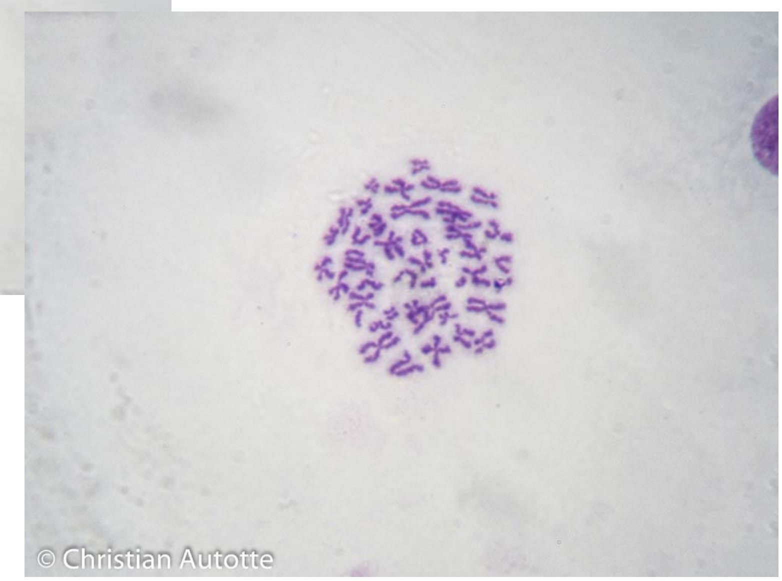
GOING TO 1000…

Ever seen those publicities for so called “microscopes” that promise 2000x magnification? Just take a look on the Web with the key words “microscope 2000x” and you will find plenty. Problem is, that’s about 1000x too much! The maximum magnification of an optical microscope is around 1000x because of the limited resolving power of visible light. Any further enlargement will not show more details and is typically referred to as “empty magnification”, a term that can be applied both to microscopy and to astronomy. To magnify more with meaningful results one need to get his hands on an SEM, a Scanning Electron Microscope… And in case you’re wondering, there are “so called telescopes” that promise magnifications that could not even be achieved by space telescopes worth billions of dollars!

Most amateur microscopy is done in the 40 to 400x range. That’s enough to see details of insects or most microorganisms found in ponds or seashores. But move on to bacteria or try to see details inside a single cell and more magnification is likely to be needed. The amateur who first try to swing that 100x lens under his microscope might end up with fuzzy pictures that are no better than those of toy microscopes with their 2000x magnification. It’s because they failed to take in consideration those three little letters usually engraved on 100x microscope lenses: OIL… This means that to get acceptable results one needs to immerse the lens in the proper kind of oil. But that begs the question: Why? It’s all liked to refraction. The oil has a refractive index similar to glass. A drop of oil fills the gap between the lens and the cover slide, which prevents light from being scattered by the air, which results in a fuzzy picture.



Human chromosome, 1000x, with no immersion oil



Human chromosome, 1000x, with immersion oil

This business of oil immersion has stopped me from trying 1000x for some time, but eventually I went beyond my hang-ups, bought some oil, and went to work…

First thing to do is find a likely subject to be observed at high magnification. Once the subject has been located and centered with the shorter lenses, a drop of oil is placed on the slide and the 100x lens lowered until it makes contact with the oil. To do that, you look at the lens from the side. *Do not lower the lens while looking through the microscope or you might break the slide and damage the lens!* That's because the subject gets in and out of focus so quickly that you may not notice when it appears!

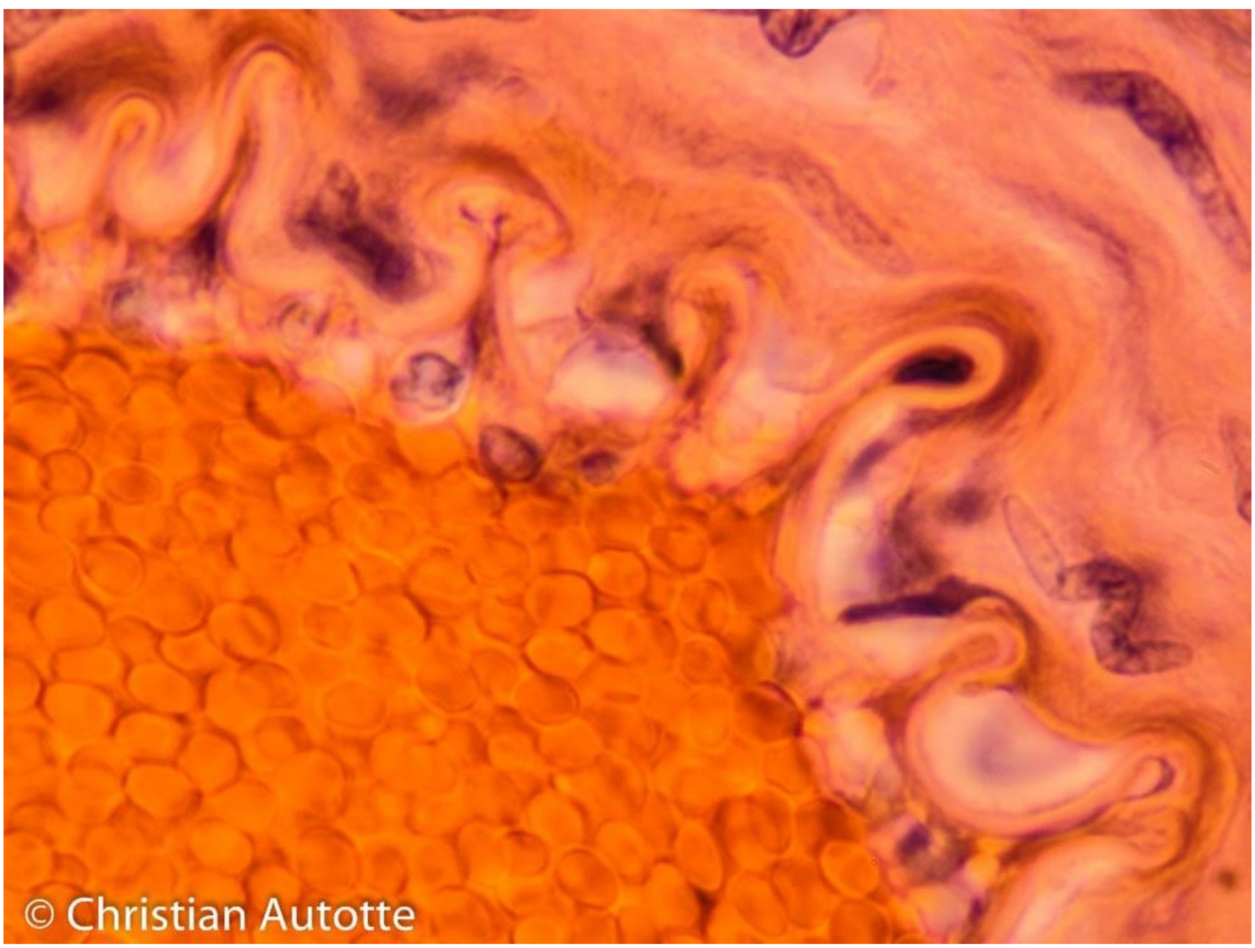
Under the stage, the condenser normally has a group of lenses that can be swung in position when working at 1000x. It may also be necessary to place a drop of oil on that lens and raise it until it couches the bottom of the slide. With or without oil, it should be raised until it nearly touches the bottom of the slide.

This is the tedious part of working at 1000x; it does slow down the proceedings, but it is a necessary evil. The other part that is very important will be to clean all the oil, especially from the optical surfaces. Lens paper is usually the way to do it, and it must be done quickly once the observing session is completed otherwise the oil may dry up and be almost impossible to clean without the use of xylene or other chemical agent that could potentially be damaging to the optics.

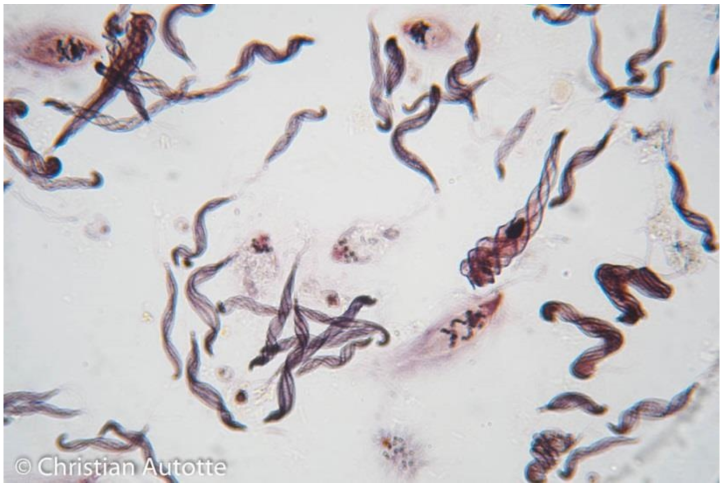
Artery at 100x

Swing the condenser in position and raise it. Find the subject at 400x (or less). Move the 100x lens in position. Put some oil on the slide. Lower the lens until it touches the oil. Focus (slowly!)… Then clean up the lens and slide. Once the mechanics of going to 1000x has been mastered through several repetitions, the fun can begin…

At 100x, the cross section of an artery looks just like what we can imagine it should look like. But pushed to 1000x it takes on a totally different appearance and becomes more abstract.



Artery at 1000x



Termite flagellates, 400x

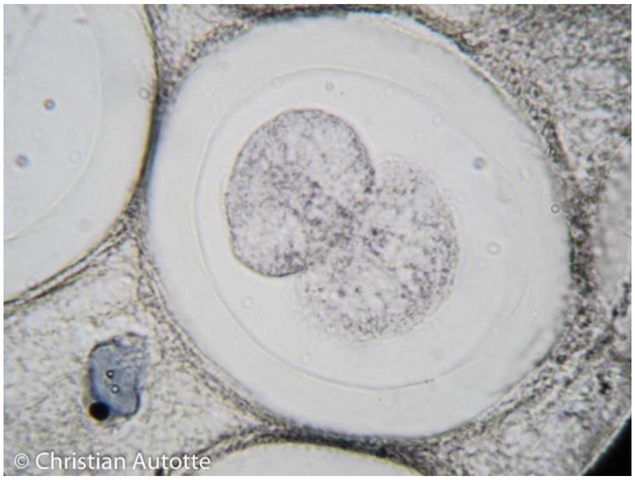
These flagellates are found in the gut of termites, it's what gives termites the ability to digest wood. At 400x we can see groups of flagellates but the fine details of individuals is difficult to see.

Termite flagellates, 1000x, with no oil

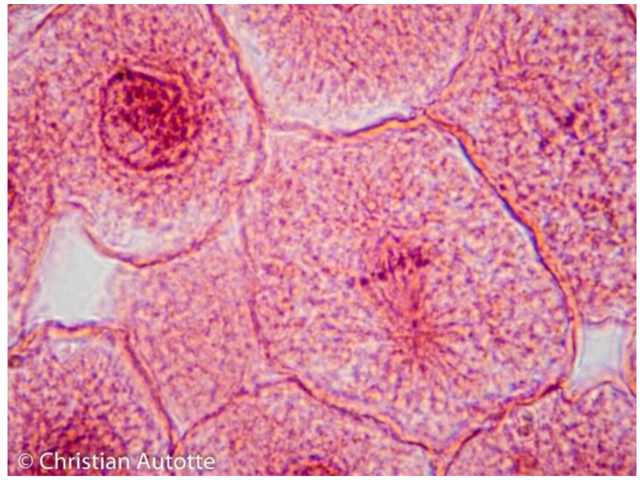
With the 100x lens magnification now reaches 1000x, but without the use of immersion oil resolution is not very good and the image looks blurry.

Termite flagellate, 1000x, with oil, stack of two images

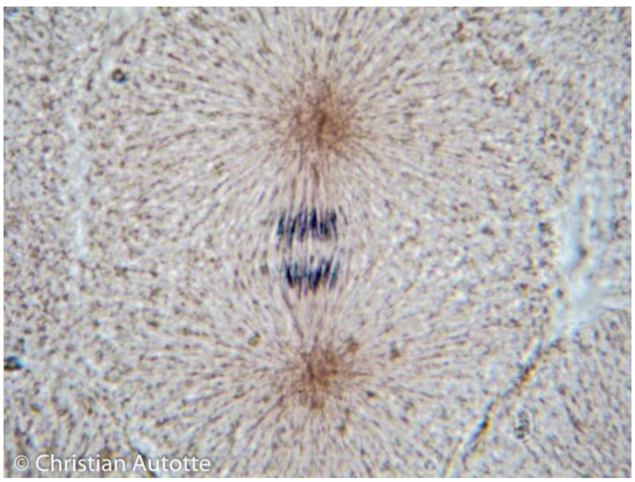
With a drop of oil on the slide and the condenser properly adjusted the sharpness increase tenfold. To increase it some more, the image was made by stacking two individual pictures made with slightly different focus. The resulting picture is simply fascinating.



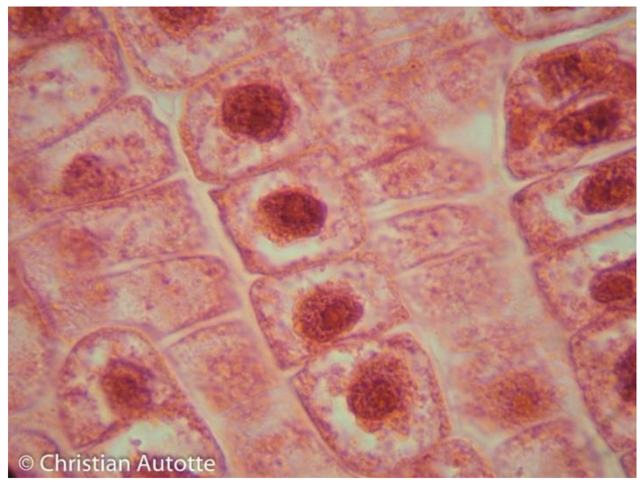
Ascaris mitosis,



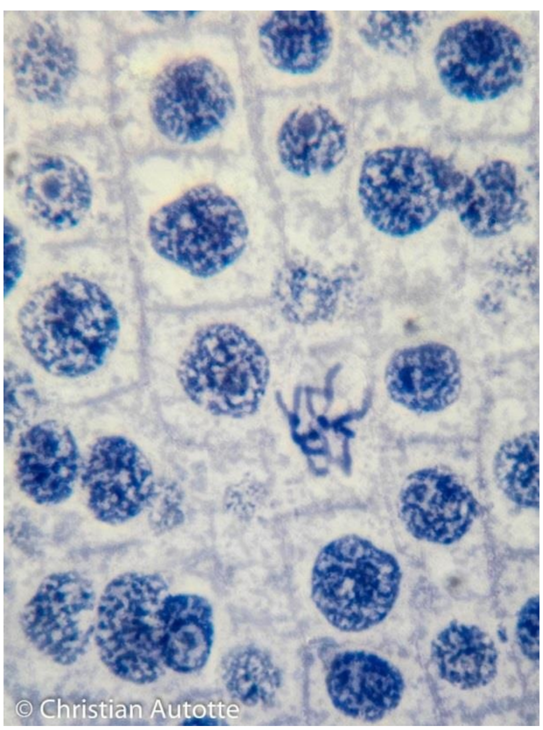
Whitefish mitosis



Mitosis



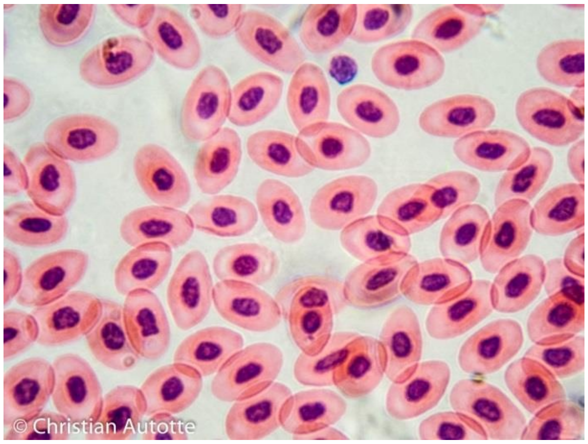
Vicia root



Onion root mitosis

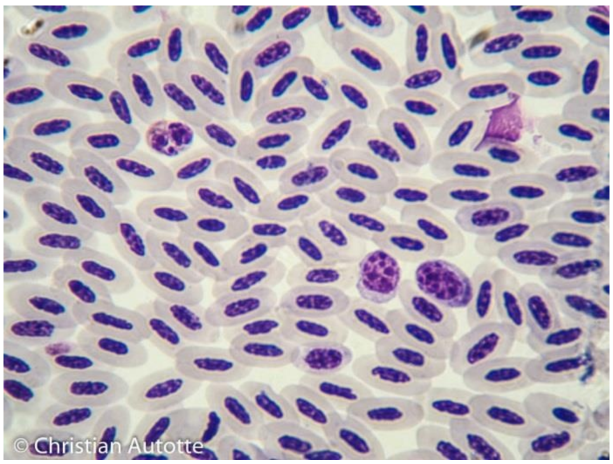
One of the targets of 1000x microscopy has to be mitosis. It’s fascinating to see cells splitting in two and see the chromosomes migrating between two cells.

That’s something I have never tried to make; fortunately, my collection of prepared slides has several examples that were made by professionals with advanced staining techniques.

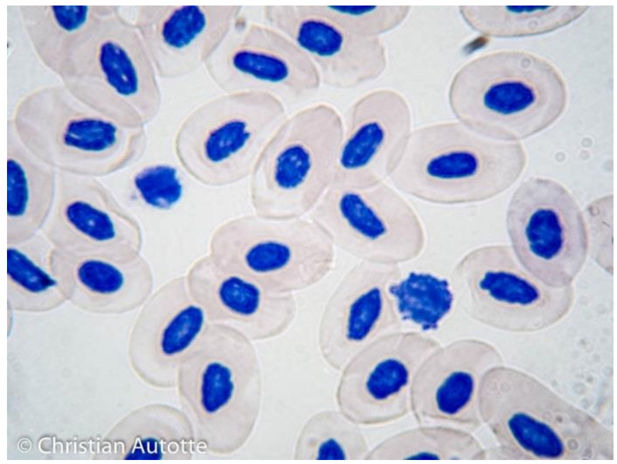


Chicken blood smear, 1000x

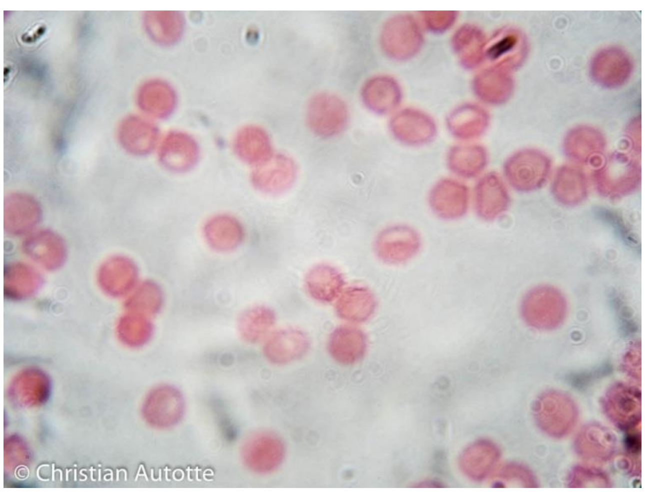
Fish blood smear, 1000X



Pigeon blood smear, 1000x



Frog blood smear, 1000x



Human blood smear, 1000x

Once you get started, it's hard to resist… I soon found myself looking through my slides collection for potential subjects to study at 1000x, like these various blood samples.

The last one shows one of the drawbacks of high magnification: a poor quality slide sees all its defects revealed. I was unable to get a better picture of this human blood smear; I guess I'll have to shed some of my own blood to make my own…

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