VARIATIONS FROM OCULARS

It all began when I started looking for a new 5x ocular to take pictures with a wider field of view than with a standard 10x. I did have a 5x that gave me reasonable results, but with a certain amount of distortions at the edges. A search on eBay produced a likely candidate: an Olympus 5x that was actually recommended for photography.

When it arrived I immediately made some tests, comparing my old 5x with the new arrival. I was somewhat taken aback, not by the image quality but by the resulting magnification. Used in conjunction with the 4x objective, its theoretical field of view should be double that of the field seen with the 10x ocular. The 10x gives me a field of view of 2.8 mm; a 5x ocular should give me 5.6 mm, but the Olympus gave me a 3.2 mm, or a mere 1.15x wider field that the 10x. In other words, the magnification went from 40x to 34.78x, a far cry from the anticipated 20x… So I was left to ponder and investigate.

Images produced by various oculars used on a given microscope can vary greatly not only in the intrinsic quality of the images but also in final magnification. To get the purported magnification, one should ideally use oculars and lenses of the same brand as the microscope. Photographers should also use camera adapter designed for a given microscope. Any variations can cause slight (or not so slight!) variations of the magnification. Microscope optical tubes can be of various lengths; most are of 160mm, a length that can be found engraved on microscope lenses. More recent microscopes may also be “infinity corrected”, and their lenses bear an infinity symbol (∞); those lenses must be used with the right microscope. Lenses screw on the turret and have a standard thread. Oculars may have a standard diameter, but as far as I can tell, they don’t necessarily fit the same way on top of the optical tube, especially those of the trinocular tubes used for photography. That is why we should be very circumspect when precise magnifications must be included with the pictures being made. This can be a problem with amateurs such as myself, who work with different microscopes equipped with parts of mixed origins.

In the following pages we can see the effects produced by four oculars used on the same Zeiss Standard microscope. Both the oculars and lenses are from different brands. All pictures were shot with the same objective and the same camera adapter, so all variations come from the oculars themselves.

You may notice some differences in tints between those pictures, even though they were all shot with exactly the same color balance settings. As with photographic lenses (in fact, with any optical instruments) the lens elements chosen by the optical engineer will have an effect on the color rendition. Photographers will often refer to some lenses as being “warm” or “cold”, a reference to their color cast. In our examples, the two 5x show an image that is “warmer”, or more yellowish. As for the very last image, it has a bit more chromatic aberrations. These defects can be corrected in post-production.

But why should oculars give different magnifications? Below we see four oculars, first the 10x I normally use for photography, followed by three 5x. Their "lips", the part that will sit against the camera adapter, are not all at the same height. That is already one reason why not all 5x oculars will provide identical magnifications on a microscope tube designed for a different set of optics. And we don't even see their internal design, which may add to the problem. So my 5x Olympus ocular mounted on the trinocular head of my Zeiss Standard gives an image that is much bigger than its theoretical magnification. On top of it, different camera adapters can also influence the resulting magnification, depending on the length and design on the adapter itself. That's a subject I covered in a past Micscape article (http://www.microscopy-uk.org.uk/mag/artjul20/ca-magnify.pdf).

I may be wrong in my assumptions, but after much research and testing, I can see no other reasons for the discrepancies. If anyone has other explanations I would appreciate their input.

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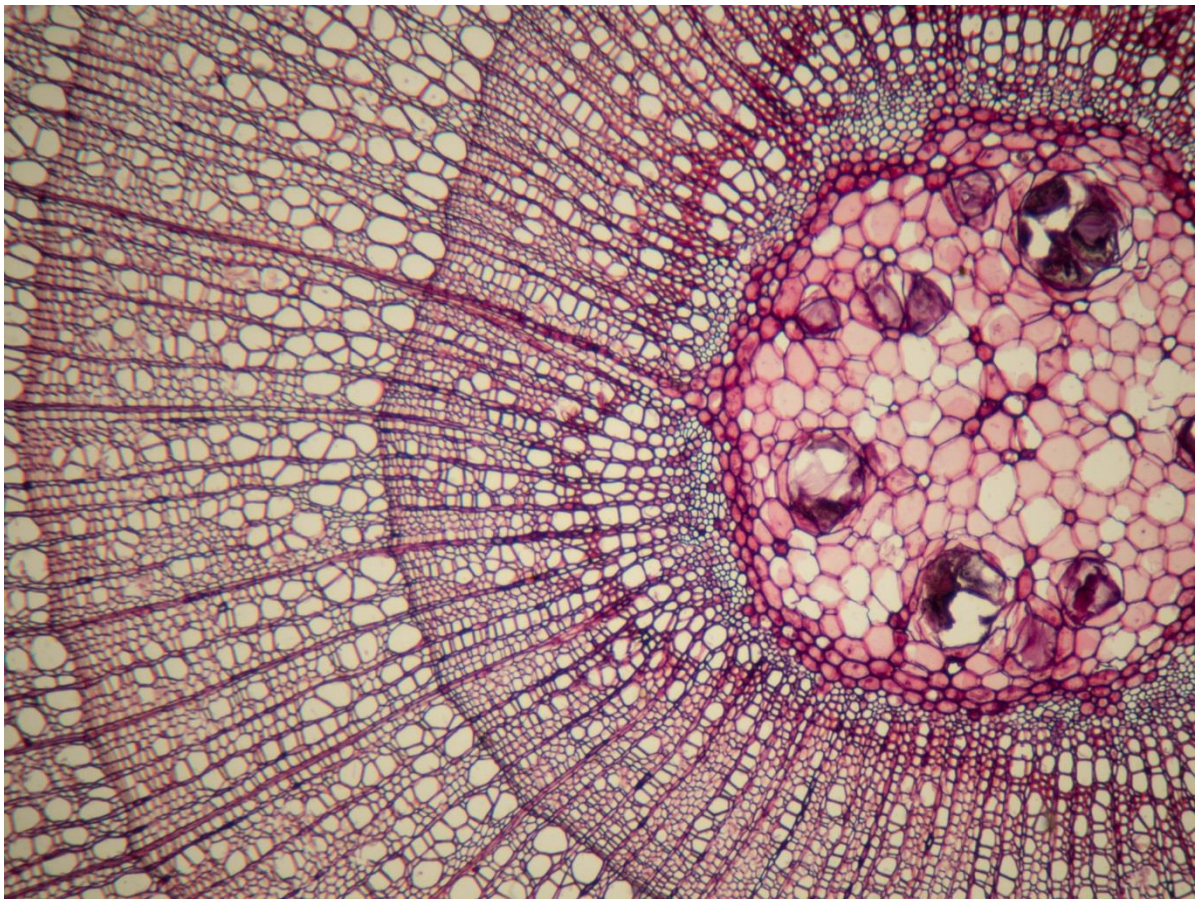
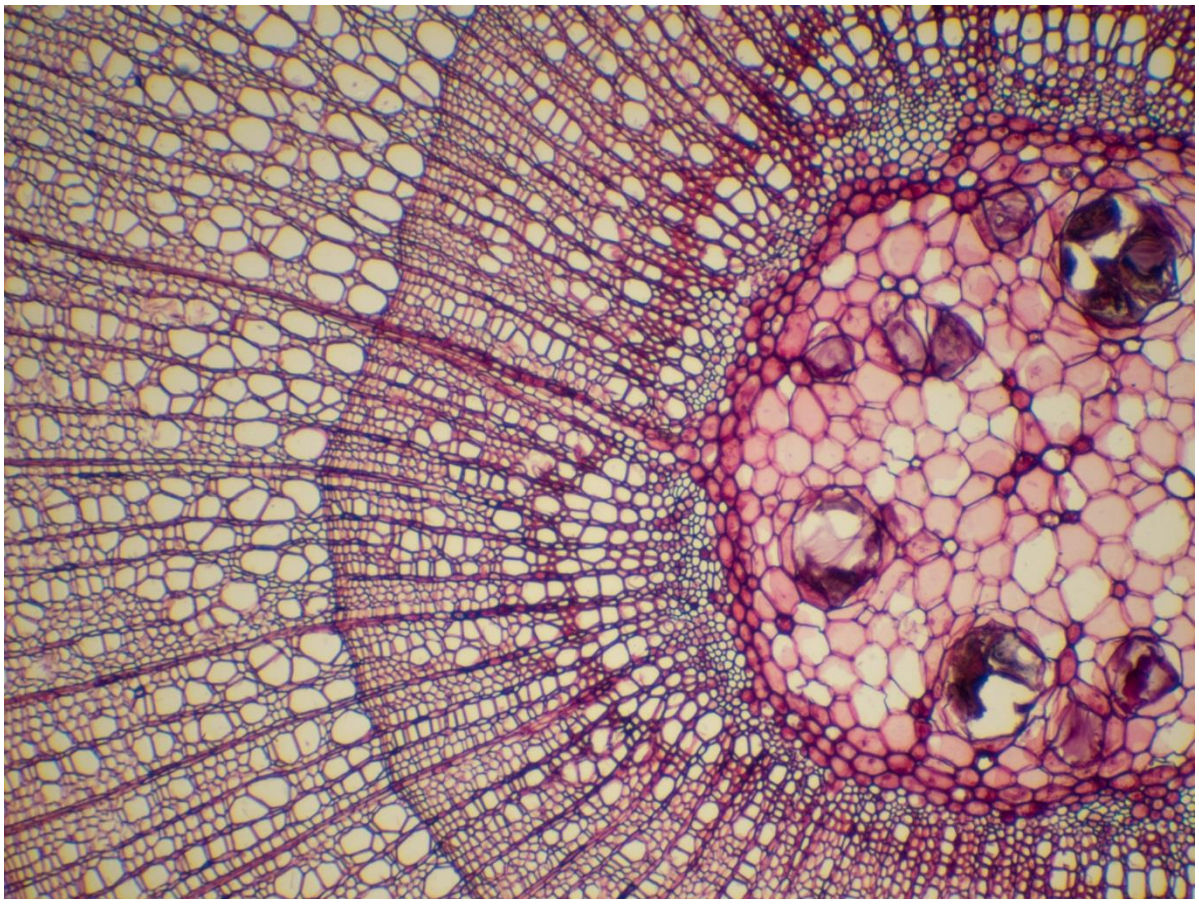
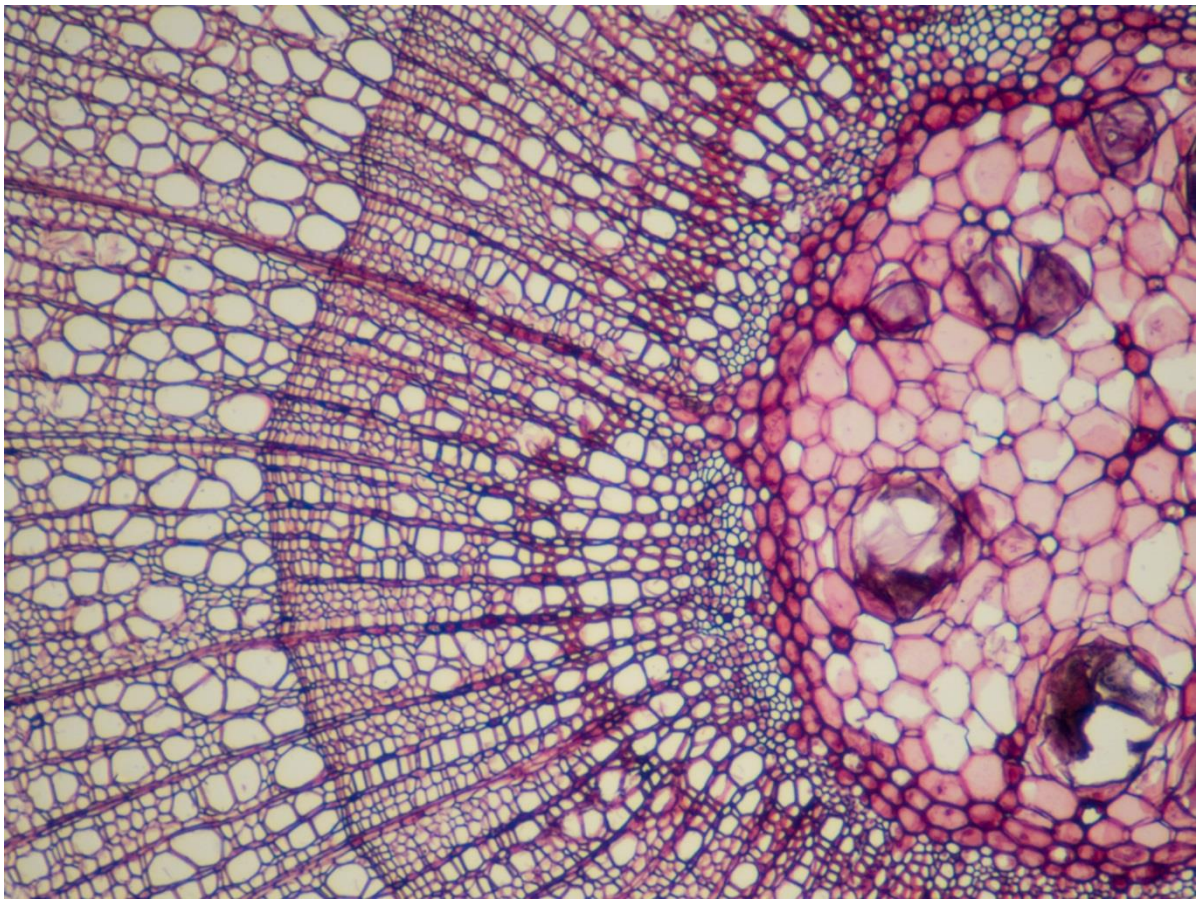
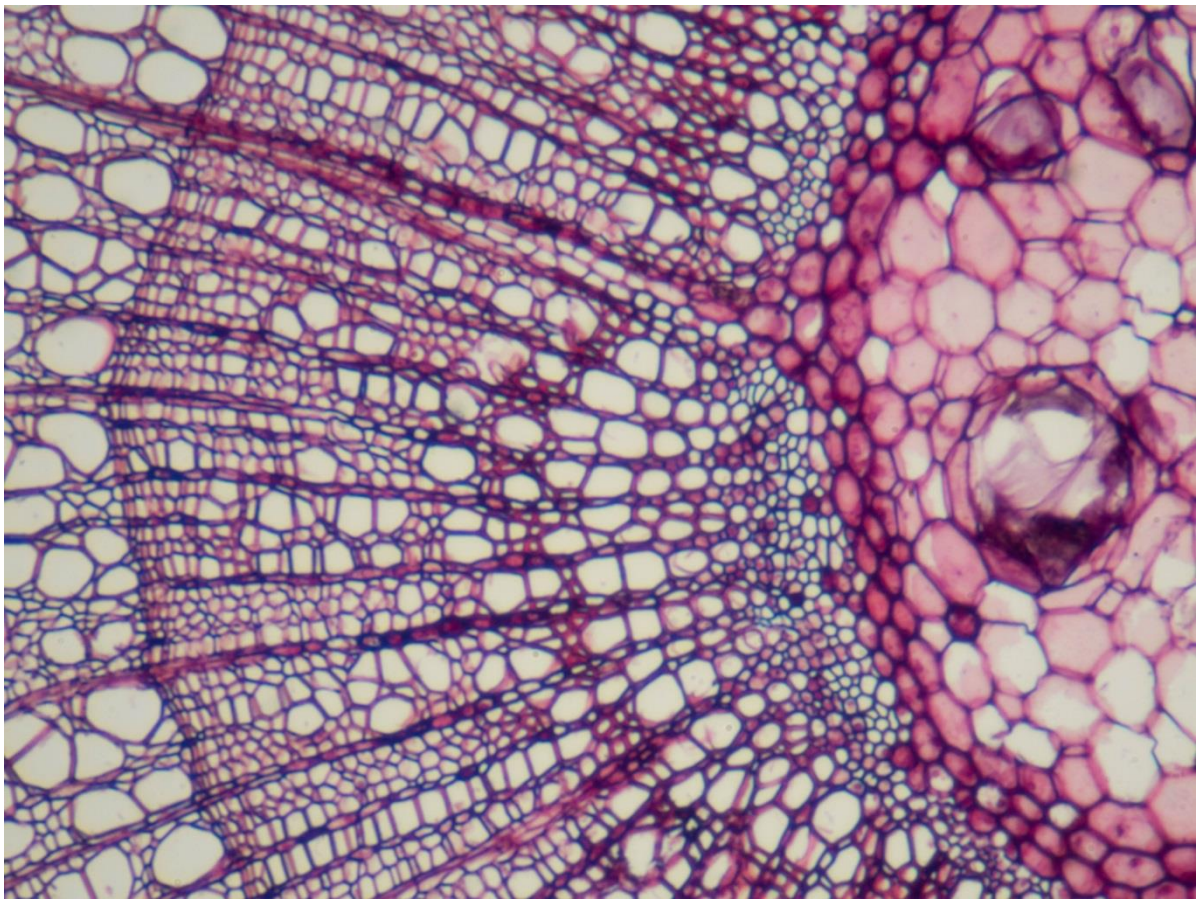




Two shots made with 5x oculars





Similarly, these two examples were shot with 10x oculars. As with the previous pair, one of the oculars shows more magnification than the other. Note also the chromatic aberrations of the bottom image.