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MORE THAN MICROSCOPY

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SUPPORT

BASIC MICROSCOPY CONCEPTS

SOME IDEAS ABOUT STEREO MICROSCOPES

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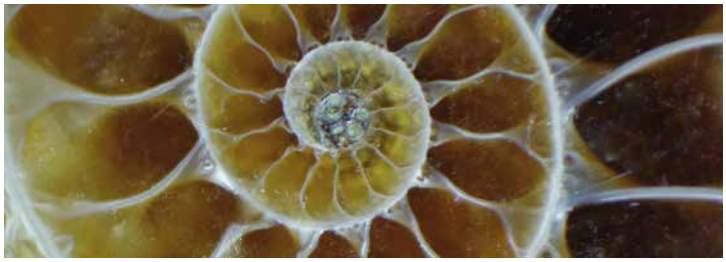
A stereo microscope certainly is the most widespread type of microscope. From industrial QS applications to the biomedical field, from professional environments to amateur usage: no other type of light microscope can claim to have a similar appreciation.

This success is based on its characteristics:

- Low magnification
- 3-D image
- True sided image
- No sample preparation needed

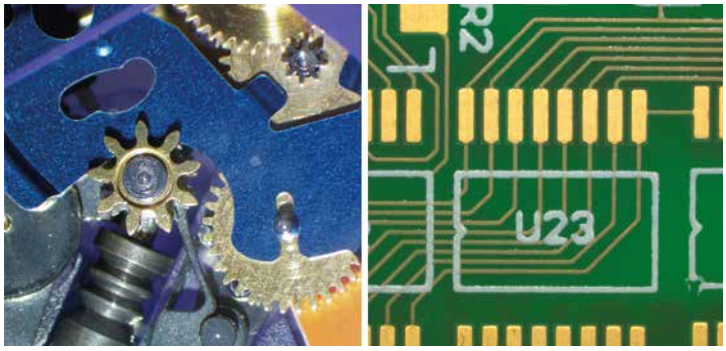
Especially in educational environments, there is no better instrument to take the first steps into the “world of small things”. Sample preparation for a regular transmitted light microscope is often associated with cutting and/or staining, time consuming and risky procedures which hardly should be expected in the hands of children. The preparation has a additional effect: the association between overall picture and detail information may get lost (cutting plane, high magnification): even grown-up students will have problems to understand the structure of wood when combining the aspects of a cross-radial and tangential section of a stem.

A stereo microscope allows simply to place a flower from the garden under the optics, and the young scientist can start working on plant identification. Give away a stereo microscope to your children, and the floor of your living room will be cleaned from any dead insect. The recommendation is quite clear: the best start into microscopy is assured with a stereo microscope.



With increasing experience, a question comes up which is popular in the world of compound microscopy: What is the resolution power of my microscope? The objectives of a transmitted light microscope indicate the necessary information as the Numerical Aperture (N.A.) value, following the magnification value, like: 40X/0.65. A widespread formula helps to calculate the minimum distance (d min) two structures may have to be resolved:

$$d\ min = 550nm/2\ N.A.$$



This formula is a pure theoretical approach, as it implies that illumination aperture and objective aperture are equal (resulting in 2 X N.A.). Most samples require the closure of the condenser diaphragm, means increasing the image contrast, but reducing resolution. The 550nm value may be achieved by using a green filter (like in the old times for b/w miniature film documentation). In our example of a 40X/0.65 Plan Achromat the minimum distance is calculated as follows:

d min = 550nm/2 x 0.65 = 423nm

Within the field of stereo microscopes, a second kind of resolution information is more popular, may be of historical reasons: line pairs per mm (LP/mm). We can find a helpful tool to measure the resolution limit actually, taking circumstances like production fluctuation or illumination quality into consideration.

The resolution test plate **(1)** carries a sequence of black bars on a transparent (="white") background. Each combination of 5 bars horizontally and vertically each is marked with a number, telling us how many line pairs (one black, one white) will fit into one millimeter distance. It is an easy task to find out the limit where the single bars can still be observed as separate structures. Once the bars merge to black block, we achieve the resolution limit.

A reasonable stereo microscope like Motic's SMZ171 with standard configuration achieves a resolution of about 250 LP/mm. Thus in this case the minimum distance to be resolved is 4 microns. We can upgrade the system with auxiliary objectives, increasing resolution power significantly.

Please note that these results are not based on a theoretical calculation, but on a practical test with the human eye. It is a great advantage that this evaluation can be done with a digital camera on top of the stereo microscope, showing to which amount the camera may act as a bottleneck of resolution information.

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