Understanding and Using the Stereomicroscope. By Lewis Woolnough.
Quekett Microscopical Society. ISBN 978-0-9564591-0-7. £6 from **sales@quekett.org**

Review by *Alan Cooper*

Queketts is an amateur microscopy society (memorably named after the early microscopist John Thomas Quekett) and this is one of their publications. It is an introduction to the use of a stereomicroscope, starts by assuming no experience at all with microscopes, and is only 90 pages long, clearly set out and illustrated, not a difficult read. He does not cover photography as such (except for two paragraphs), but all the background he gives is equally important for both viewing and imaging.

Standard camera macro lenses give 1:1 and the specialised macro lens Canon MPE 65 goes from 1:1 to 5:1. Stereomicroscopes start with about that level of magnification, but different combinations of objectives and eyepieces will give up to about 50:1, which is still low compared with a standard microscope. One type may cover the range smoothly with a zoom objective.

This range is suitable for large numbers of natural subjects, from small flowers and insects down to pollen, normally barely visible to the unaided eye, and it will reveal them in their full beauty. Or if you prefer, a spider can appear like something from a horror movie.

Pages 25-50 give simple explanations of the various components of a microscope in adequate detail for practical use. There are two standard types of stereo microscope, Greenough and CMO (Common Main Objective), clearly illustrated in the book. Both have two light beams which pass through Porro prisms so that the image is the right way round, which makes it easier when handling the object, especially for dissection. Both have eyepiece tubes which can be varied in separation, and which are often angled inwards at about 2 degrees. It sounds perfect for stereo, but there is a little more to it.

In both systems the two light paths leave the object with an opening angle of about 15 degrees. This sounds like far too much for a stereo image, since the norm for an everyday shot is of course a degree or two. However the range of distances in this type of stereo shot is always tiny – a few percent of the focal length. There is therefore magnification in the z direction, which would look silly in a beach scene but works well here. However the slightly oblique view, together with the shallow depth of field can also result in slight fuzziness at the two sides, which is not a problem in everyday shots.

Stereo microscopes are not high resolution, a few µm is typical, so if you want, say, 1000 pixel resolution, objects should not be much smaller than 3mm. (eg 3mm = 3µm x 1000). That is why stereo microscopes and standard monocular microscopes are different, you want one or the other according to what you are doing, you can't have both in one instrument. At least you couldn't until recently. Leica now has a range of stereo microscopes with 'fusion' optics, which have one high resolution path, and one low resolution path. The two views 'fuse' in the eye-brain, giving stereo with high resolution and double the depth of field of conventional stereo microscopes. Of course this is very expensive, whereas ordinary stereo microscopes, which are made in large quantities for educational purposes, are rather low cost, typically about £150 upwards, and even less secondhand.

In all photography it is the understanding of lighting that can turn a casual record into a striking and revealing image, and this is especially true in microscopy, and the next 20 pages are about light. Besides the filters and polarisers that we are familiar with in ordinary photography, there are many masks and interference filters that can vastly improve the clarity of images. That is another story, and Quekett is the place to hear it.

The Quekett meeting April 10th (last week as I write) was called 'Objects for the stereomicroscope' and was led by the author, Lewis Woolnough. For monocular microscopes, which often have much higher magnification, it is common to prepare slides, a technique which needs some skill. But a slide is flat, so there is little point in viewing it in stereo. Objects for a stereo microscope are usually just placed

under the objective, it is not even necessary to have a stage. If they are semi-transparent they may be better seen if they are on a small light box, the type used for viewing 35mm or 5 x 4 transparencies.

Lewis Woolnough had brought along some galls, which look much more attractive when seen well lit and in natural depth under a stereo microscope. (A copy of *Plant Galls* by Darlington, ISBN 0713704713 happened to be lying on the bench, I found later it is readily available secondhand for less than £5). In some cases a measurement of thickness may even help in identification. The underneath of leaves is usually more interesting than the top, and at the right time of year there will be fascinating arrays of eggs. There were, as usual, many microscopes – for this event nearly all stereo – available on the benches round the room showing off the attractions of radiolarians and diatoms and tiny shells, and insects in the most intimate detail. *Collins Guide to Insects*, by Michael Chinery, also on the bench, is a standard practical reference.

It is easy to take a still 2D photograph with a camera looking straight into one of the microscope eyepieces – even a handheld compact can work, because at low magnification there can be adequate light. But taking 3D video of live insects, in air or water, would be more exciting. The interocular separation of the two microscope eyepieces is usually variable up to 75mm, which should nicely match a Fuji W3. In practice I have found it very difficult to get both left and right images simultaneously. I suspect there is a subtle difference between Greenough and CMO systems which I don't understand – can anyone help? There was a Russian microscope (Lomo MBC-10, Russian optics are good value) at the meeting which I found rather easier to line up with the W3.

I have a Brunel microscope, (Greenough type) as shown in the photograph below, which is similar to (but simpler than) the one illustrated on page 55 of the book. The advantage of the design is an unusually large amount of working space and great flexibility. It can be used 'in the field'. A strong LED light on a gooseneck is built in, and is much preferable to incandescent lights, which are liable to overheat the object. I find a rather even illumination is best, and I often use a 5 x 4 lightbox - but proper transmitted light systems, and stages, are available.