Microscopy Automation for Art and Design

Microscopy can be an artistic as well as a scientific pursuit, using the increased magnification to inspire art as well as generate knowledge. In this article, we examine the work of Richard Weston, who has enhanced the capability of his stereo microscope with a motorised stage and focus motor and uses his system as an artistic, rather than a scientific, instrument. Whilst these devices are usually thought of as something that only research scientists have a need of, this equipment helps Richard obtain the best images he can. Both his work, and some of the techniques he uses to obtain his images, are described here.

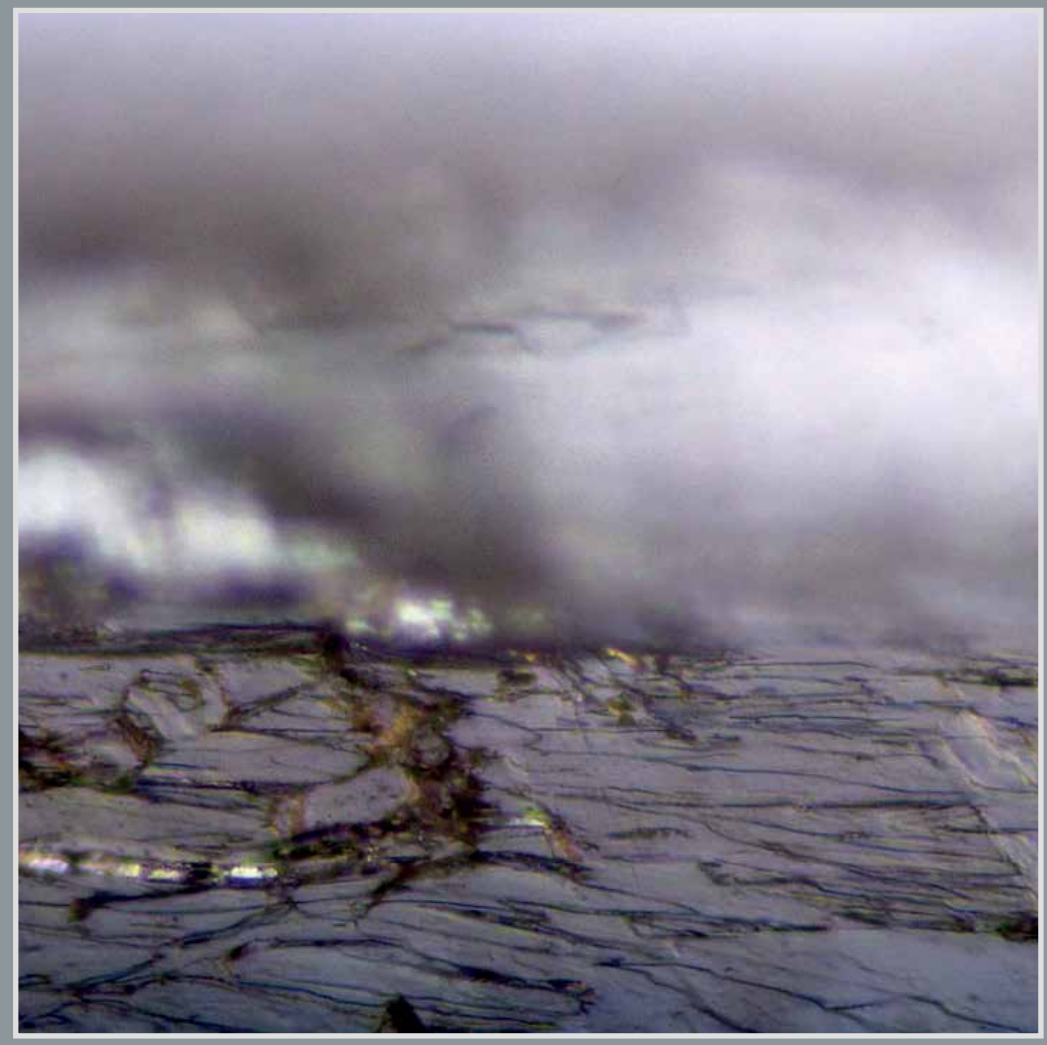
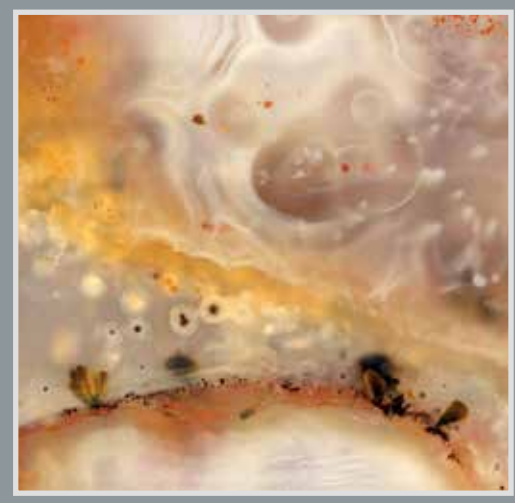
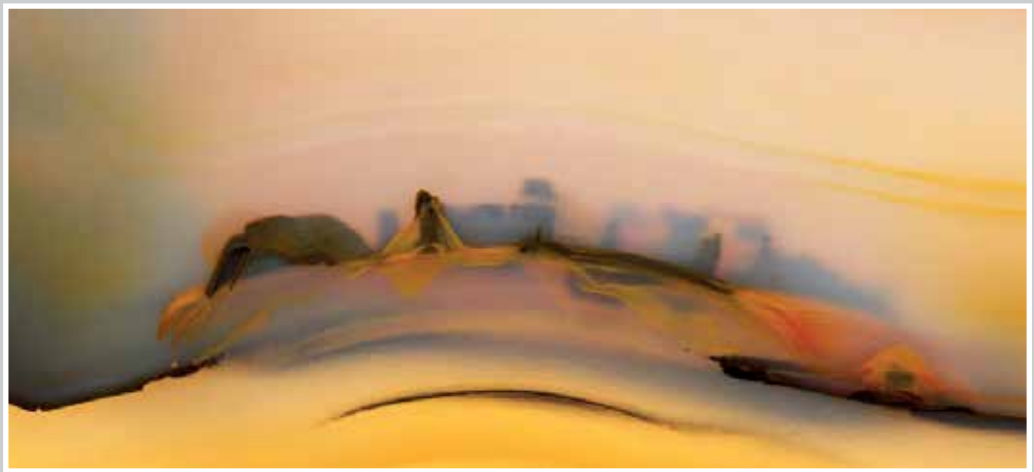


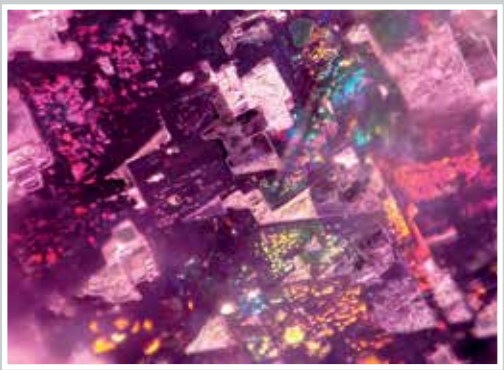
Fig 1: *View down the face of a calcite mineral, obtained via Z-stacking.*



Figs 2 & 3: *Surreal patterns found in agate. Figure 3 also shows the extreme regularity which can be seen within such crystals.*



Figs 4,5,6,7 *were obtained within agate, whilst figure 5 was obtained from calcite. All show the incredible variety of images that can be found within these rocks.*



Figs 8, 9: *These fluorite crystals have a purple tinge but, like calcite and agate, form a huge variety of patterns.*

In 2003, Richard Weston digitally scanned an ammonite using a large flatbed scanner and was immediately captivated by the intricate structures he found, which were barely visible with the naked eye. The fine detail found within seemingly normal rocks and minerals fascinates him as much now as it did when he started.

Richard was Professor of Architecture at Cardiff University and has always been inspired by the natural world and now spends much of his time observing the stunning images he sees inside highly magnified minerals. Richard uses a wide variety of samples in his work, but most commonly he uses thin, translucent slices of calcite or agate. These two minerals are the ones he has most intensively examined under the microscope so far, although he is eager to move onto other sample types – for example, fossilised remains. Even the dullest looking sample can harbour amazing, unsuspected images that would never be seen without the aid of microscopy.

The scanner has been replaced with a Nikon SMZ 1270 stereomicroscope so Richard can magnify his samples by up to 200 times. Although this level of magnification is not always needed (with some samples the rock grain becomes intrusive at such high magnifications) it allows Richard to focus on tiny areas of the sample, and find surprising and often eerie patterns that he would otherwise be unable to see. In particular, he finds agate a source of almost infinite motifs and colours; sometimes exhibiting extreme regularity and symmetry, sometimes forming almost organic seeming patterns, and other times showing random swirls of colour, unlike anything normally seen in nature. Other minerals, such as calcite and fluorite, can also produce surprising, unique and attractive images, and he is always on the lookout for new materials to examine.

Illumination for the microscope is provided by a Schott LED lighting ring, allowing him to choose in which direction(s) the illumination will strike the sample. Varying the illumination conditions highlights different aspects of the mineral, creating vastly different images from the same field of view much as, using Richard's analogy, the same landscape can appear very different depending upon the prevailing weather.

Richard finds that the ES111 motorised stage from Prior Scientific is a vital component of his system, allowing him to obtain his stunning images. Such a stage allows far smaller and more precise movement than would be attainable using a manual stage, meaning that he can precisely frame the image to create the best possible composition. Additionally, the ease at which image stitching and tiling can be performed with a motorised stage, allows him to create a large image at high magnification – ideal for his larger art works. Richard says that controlling his stage via computer is easier for him and lets him perform the entire imaging process from one point. Not only does this make imaging more efficient, it

also greatly reduces the risks of repetitive strain injury, which can be a concern for microscopists who spend many hours over a microscope, manually adjusting a stage and focus.

Another vital part of the imaging process is performed by his H122 focus motor, also from Prior Scientific, which controls the focussing in uniform steps which are too small to be managed manually. This is required for accurate z-stacks which are combined to produce an extended focussed image, a technique that Richard uses to achieve most of his final images. This is particularly useful for thicker samples of agate and other translucent minerals, which do not have a single optimum focus point, as well as when taking images of an opaque, irregular surface. Another technique is to take a series of images – as many as 150 – down the face of a mineral slice. A refinement to this is to stop the sequence, creating an area which is deliberately out of focus and contrasting with the detail of the mineral. The final effect, as shown in Figure 1, is startling, and creates a vertiginous viewpoint reminiscent of staring down from atop a high cliff into a cloud layer – all by stopping the Z- stack at a specific place.

Fig 10: *Richard's system, which includes the microscope, LED lighting, a motorised stage and a focus motor is an example of how a microscope can be automated for relatively little outlay.*

Such effects would simply not be possible without the fine control over focus provided by the H122 focus motor. Both the stage and the focus motor are controlled via the OptiScan® system, which allows their control via either joystick or an imaging software package – in Richard's case, NIS- Elements. This compatibility ensures that the entire image capture process can be handled from one place. According to Richard the system has performed perfectly.

The images Richard has captured are truly startling. Some, such as those shown in Figures 2 and 3, appear as surreal visions, unrelated to anything we see in our day to day lives. Figure 3 also exhibits the repeating and regular patterns often found within agate, and minerals more generally.

However, other images appear to suggest landscapes, such as deserts (Figure 4) or a rocky, wet shore (Figure 5) or even organic forms, such as corals or leaves (Figures 6 and 7).

Agate and calcite are not the only materials used by Richard. He also uses fluorite (Figures 8 and 9), which when examined this closely has a purple tinge. Just as with agate, fluorite can form a huge variety of patterns, from angular, blocky structures to almost liquid-seeming forms.

Obtaining these amazing images would not be possible without the accurate movement offered by the motorised stage, and the precise focussing given by the focus motor. Automating the microscopy stage and focus motor is not for every microscopist, however such a purchase can substantially increase the quality of your microscopy as well as open up the potential to try new techniques, such as Z-stacking, which are almost impossible without some degree of automation. Therefore, even for the amateur, automation may prove to be an investment well worth making. Richard's system (fig 10) is an example of an extremely powerful system built for relatively little outlay.

Richard intends to keep observing his mineral collection and increase his collection of images. He

Fig 11.

is interested in using these images to inspire rich, complex designs for a wide variety of products. So far, he is perhaps best known for designing scarves for Liberty, printed with the images he found in rocks, which became Liberty's best-selling range (fig 11). Furthermore, he has added these images onto floor tiles. He has also experimented with using these images to design greetings cards, fabrics, glass panels, wall coverings and, in one case, a silk in glass facade (fig 12) for a three story house in Camden (which won the Sunday Times Small House of the Year 2013 prize.)

However, his main motivation for collecting these images remains, as it always has been, an appreciation of the almost infinite variety of patterns nature can provide.

Richard Weston's website is www.richardwestonstudio.com and he can be contacted by email at richard@richardwestonstudio.com. He is always happy to discuss his work, ideas, and commissions.

NIS-Elements is a registered trademark of Nikon Corporation, Tokyo.

Prior Scientific has been making precision equipment for microscopy since 1919 and can be contacted at uksales@prior.com or visited on the web at www.prior.com. For more information on this article, please contact James Wilson at jwilson@prior.com

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Fig 12 *shows the silk glass facade Richard designed, whilst Figure 11 shows a range of clothing Richard designed using patterns he obtained from mineral.*