BOB FOSBURY

Marsh Marigold flowers (*calthra palustris*) photographed on type 667 Polaroid film in visible light (above) and ultraviolet (below). The UV image shows the dark central guidemarks seen and used by pollinating bees.

Although relatively new to photography and Hasselblad, I have always been interested in observing nature. As a professional astronomer, I can sometimes indulge this interest as part of my job.

With a Flexbody, an 80mm Planar and a 56mm extension-tube, I find that I can obtain more spectacular images of flowers than would normally be seen with the naked eye. The process of growth, maturity and decay, the structure in three dimensions and the appearance in light beyond the visible spectrum can be studied by taking sequences in time, by imaging in stereo and by using ultraviolet lamps and filters for illumination.

For the closeups of the Protea flower shown here, I used three high-intensity, low voltage quartz-halogen lamps feeding bundles of optical fibres which can be positioned within a few cm of the subject. These fibre lamps, commonly used for stereo microscope illumination, have a colour temperature at full voltage of between 3100 and 3600K and are quite satisfactory when used unfiltered with daylight film. For the ultraviolet image of Marsh Marigolds, I used a 400 watt mercury arc lamp with a coloured glass envelope which transmits the 365 nanometer group of mercury emission lines. This somewhat frightening device, which emits copious noise and heat as well as 'black light', causes lots of things, including dust particles, to fluoresce. To avoid this fluorescent light entering the camera, I use a second UV-transmitting filter - 2mm of Schott UG2 - over the lens. Even using a condensing lens to focus the arc onto the flowers, the exposure times are quite long. With type 667 Polaroid film (3000 ASA), an exposure of about a minute is required at $f/37$ (the effective aperture of an 80mm Planar set to $f/22$ with 56mm extension).

When photographing objects like flowers, the most appropriate plane of best focus is not usually the one perpendicular to the optical axis and so the ability to tilt the film plane in the camera is an asset. Setting the best tilt angle by eye through the viewfinder is not very easy in practice and I find it is better to actually measure the angle of the required object focal plane with a protractor and then calculate the required film plane tilt using the lens equation. To do this, I have a simple spreadsheet program on a laptop computer which allows me to enter the lens focal length, the extension and the film tilt from which it calculates the position of the object focal plane and its tangent angle on the optical axis. With the very limited depth of focus in closeup photography, even using the slowest possible focal ratio, this ability to control the focal plane is a huge advantage. As I use an external lightmeter, I have to correct the exposure value for the lens extension. The spreadsheet calculates this correction in stops across the tilted focal plane since, with extreme tilts, the difference from one side to the other (or top to bottom) can be significant.

Obtaining these images in stereo is not difficult to do although it is hard to reproduce the results in a magazine! I use two exposures with a single camera mounted on an optical bench at right angles to the optical axis. The camera is moved by just a few mm parallel to itself between exposures. This means that the fields of view of the pair of images (taken on slide film) have a large region of overlap where the stereo image, viewed with two identical loupes or a simple stereo viewer, is quite stunning.

Two images of a Protea separated in time by several weeks. Taken with a Flexbody, the focal plane was tilted to coincide with a tangent across the top of the flower. Both of these images are members of stereo pairs.