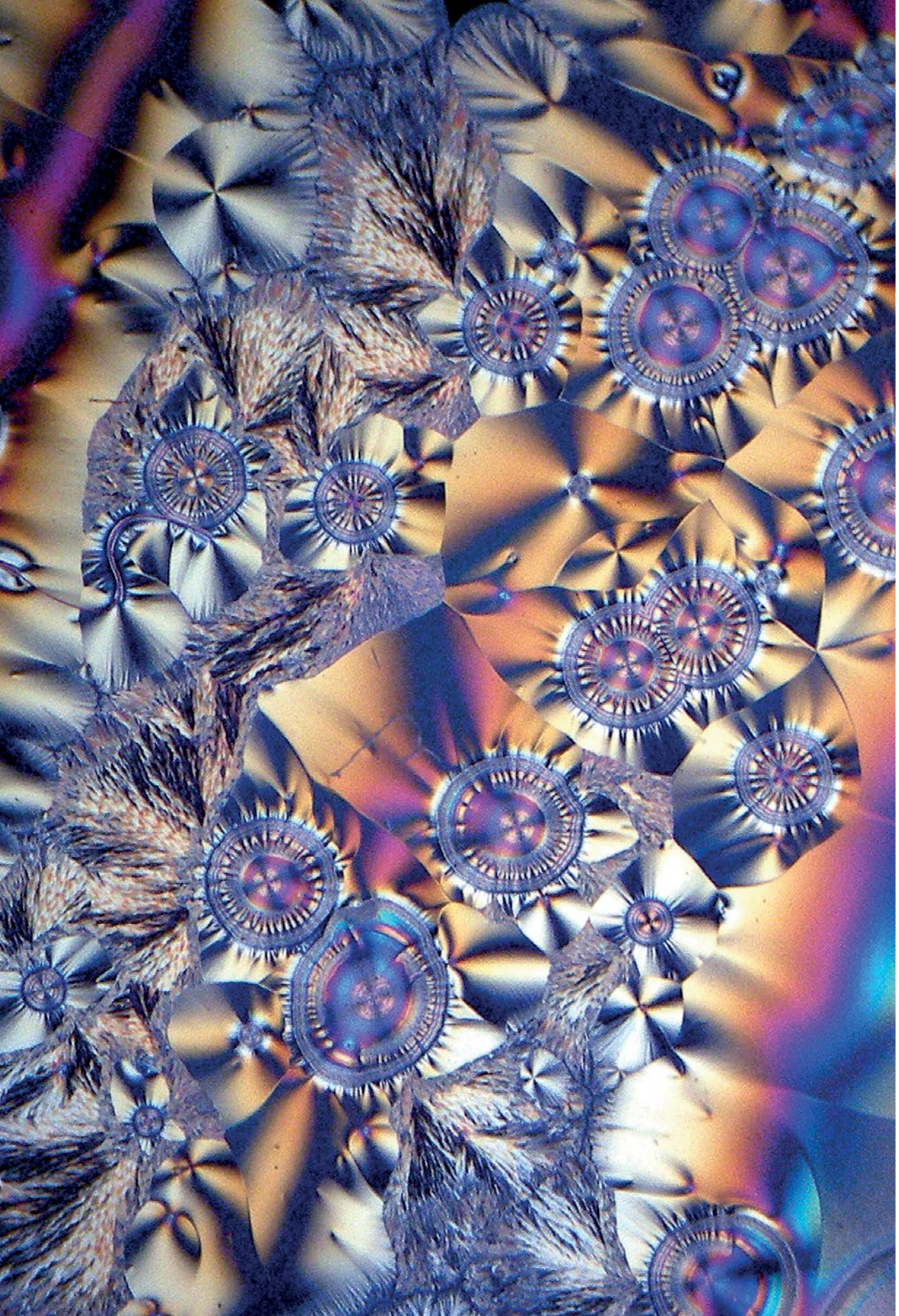
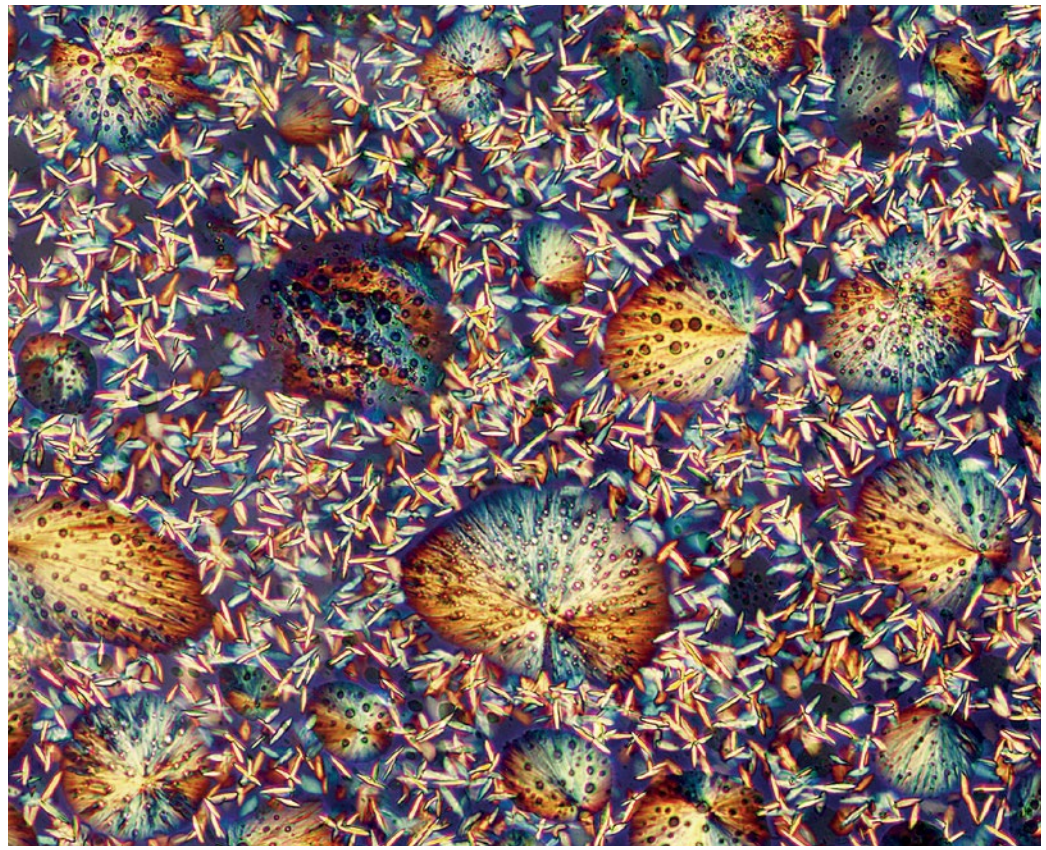
Medicine Show

Many pharmaceutical chemicals when properly prepared can evoke marvelous images of diverse patterns and colouration when cross-polarized under the microscope. In this article I will describe techniques for preparation of pharmaceuticals, photomicrographic techniques and a gallery of finished images.





Birefringence

Some crystals exhibit a property called *birefringence* or "double refraction." When light passes through birefringent crystals the light rays are split into two different polarizations. When these crystals are viewed using unpolarized light or singularly polarized light, their appearance is unremarkable. However, when crystals are viewed through crossed-polarizers, the difference between the polarizations created by the crystals is revealed as dynamic shapes, textures and colours. When fine crystals such as pharmaceutical chemicals are viewed through a microscope under cross-polarization, one enters a fascinating new world.

Specimen preparation

Not all pharmaceutical crystals are birefringent. In fact, some pharmaceuticals (insulin, for example) do not crystallize at all. Therefore, one has to rely on trial and error. For this article, I will only describe the methods I myself use for specimen preparation.

The first step is to dissolve the chemical in hot water. Since my purpose is fine art photography and not research, hot tap water rather than distilled water will do nicely.

I use 50 ml of water for each pill or capsule. The drug may dissolve quickly or, in the case of time-release medications, it may take an hour or more.

Since the inactive ingredients may remain in suspension in the solution, I then filter the solution through coffee filter paper. If the solution is still cloudy, I may centrifuge the solution for five minutes to settle any particulate matter. Then I can draw off the clear solution from the top of the centrifuge tube with a pipette so as to not disturb the pellet at the bottom of the tube.

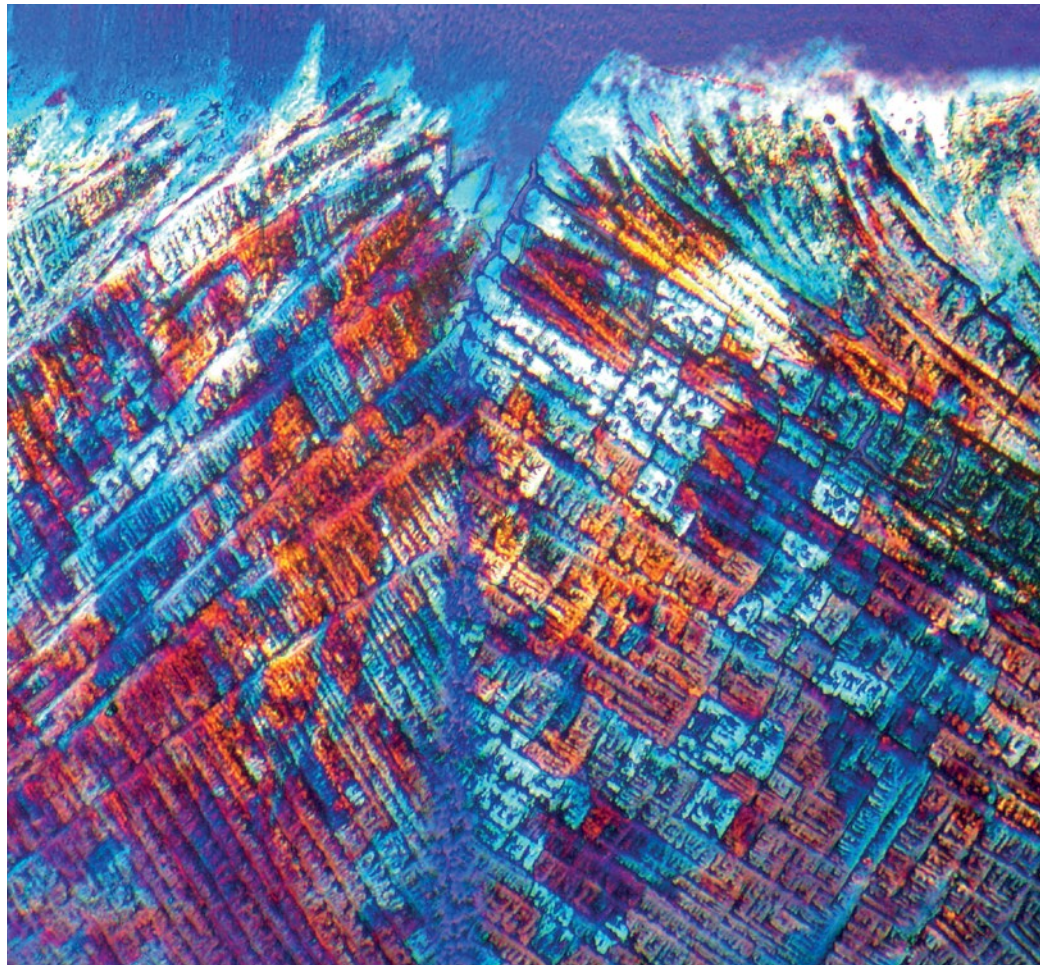
The specimen is then dried by evaporation. When I first started preparing chemicals for cross-polarization, I force dried them by placing the slides on an aluminum plate on a coffee-cup warmer. I was dissatisfied with the resultant crystals and suspected that in the case of some compounds, the molecules of trace chemicals didn't have time to "find" one another to form distinct crystals of their own. I then went to a slower evaporation technique by placing the slides on a black piece of cardboard on a sunny windowsill. I prepare three slides at a time with three separate drops on each slide, giving me nine specimens.

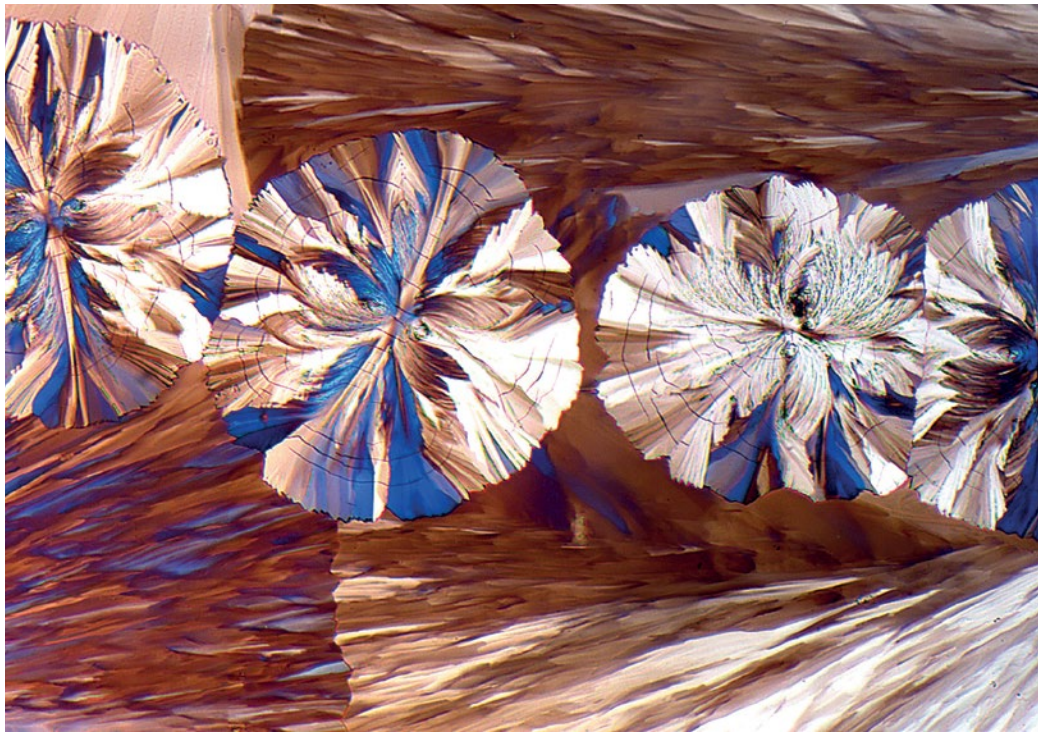
Some chemicals lend themselves to the "melt" technique of slide preparation. A "pinch" of the chemical is put on a slide and a cover glass is put over it. The slide is then held over an open flame (alcohol lamp or butane lighter) with forceps until the chemical starts to bubble as it melts. Suddenly it will flatten out into a thin sheet of the chemical between the slide and the cover glass, at which point the flame is removed. Not all chemicals will melt, so once again it is a matter of trial and error as to what will or will not melt. I have had success melting Ascorbic Acid, Resorcinol and Phenidone.

Be sure to have generous ventilation and be careful not to let the slide catch on fire.

Cross-polarized photomicroscopy

Specialized microscopes such as petrographic microscopes may already be set up for cross-polarization. However, it is very easy to set up a "hybrid" cross-polarization microscope. My setup





is based on a standard trinocular light microscope using photographic polarizing filters.

In cross-polarization, the *polarizer* is located at the light source below the stage. The *analyzer* is located anywhere in the light path above the objective. Linear or circular polarizers may be used, but I have found that the types should agree – either all linear or all circular. I have also found that the direction that the light passes through the polarizers must also agree. This adjustment is easily addressed by flipping the polarizer at the light source so that the polarizer/analyzer interface provides the most efficient polarization.

On my setup, the polarizer rests on the microscopes base illuminator, so it can be easily manipulated

There is a polarizer on the eyepiece that is kept in place so that while surveying the slide, I can rotate the polarizer on the light source to observe the birefringence.

There is another analyzer in the photo (camera) tube that rests on the photo eyepiece below the camera, in this case an Olympus NFK 2.5X photo eyepiece. This projects the image directly onto the sensor of an Olympus E-330 without the use of a relay lens. The Olympus E-330 has Live View, so I can rotate the polarizer at the light source and visually assess the polarized image being received by the camera.

Exposure is determined by testing, since the degree of birefringence of the chemical has a profound effect on how much light passes through the crossed-polarizers. The numerical aperture of the objective being used and the aperture opening on the substage condenser also come into play with regard to exposure time.

With some specimens, more coverage may be required to artistically express the chemical. In such cases I can shoot several shots to create a panorama or a photomosaic in the computer. The position of the specimen is shifted on the *x, y* or *x/y* axes with enough overlap to enable the stitching software to combine the images. I use a freeware called Microsoft Image Composite Editor (Microsoft ICE) to stitch images together into panoramas or mosaics.

Michael Reese Much FRMS

Michael Reese Much FRMS is an amateur microscopist recently retired from 40+ years in the photographic industries, which included positions with Kodak and Olympus in technical capacities.

He has exhibited his photography in solo and group installations, and has lectured on photography and developed an adult education course in photography which he taught for several years. He is a frequent contributor to the UK-based web magazine Micscape, for which he writes articles on microscopy technique and restoration of classic microscopes.

He has placed twice in the RMS Scientific Imaging Competition, and his winning image of cross-polarized Ascorbic Acid was featured on the cover of infocus in December 2010. He has also had an image featured on the RMS calendar every year from 2012-2015.

He and his wife Kathy live on a wooded mountain in Bethlehem, Pennsylvania, USA.

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