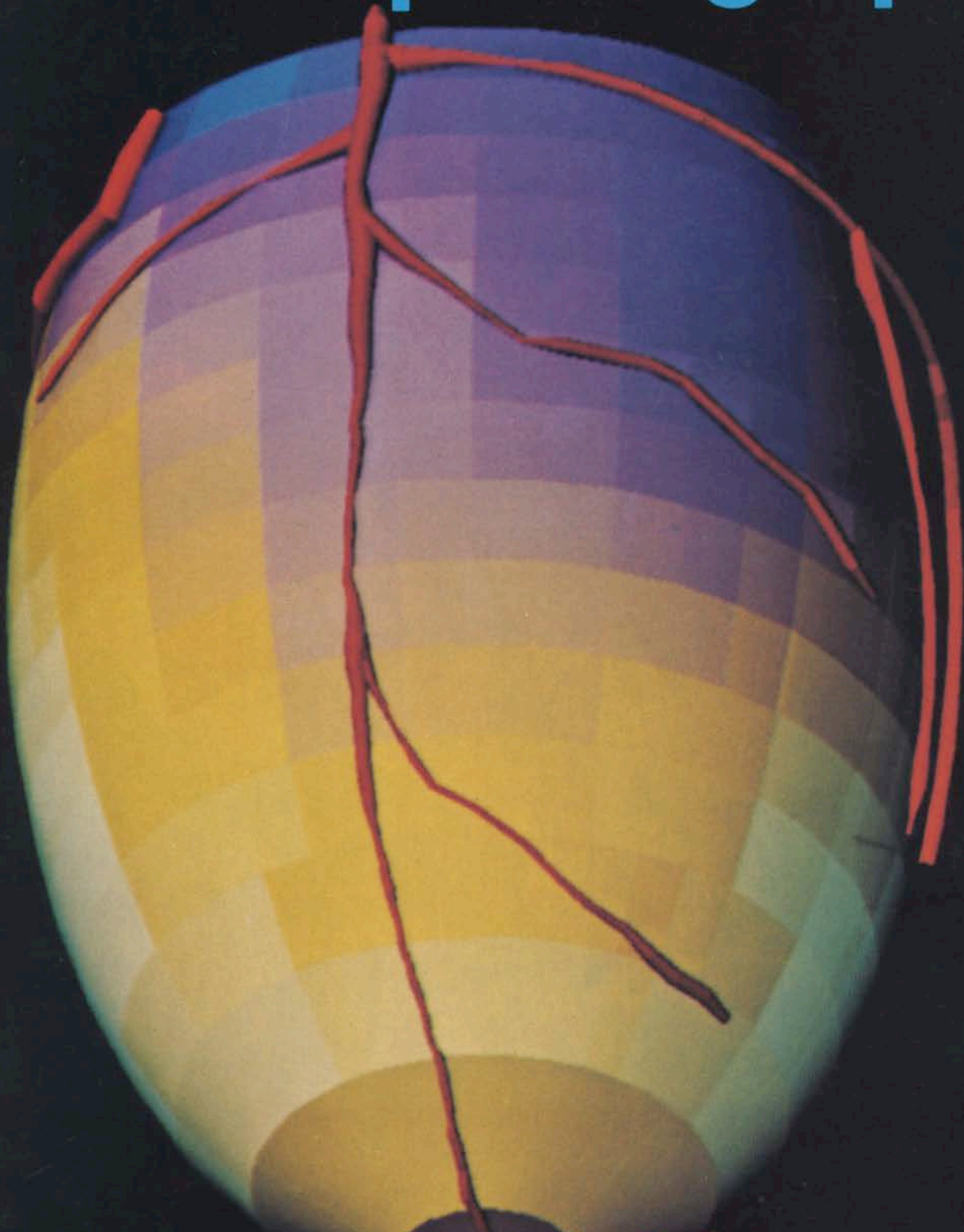
MARCH 1988

industrial photography



Capturing the computer image

Making the most of metering

Documenting a construction project

Photographing a river ecology

Zero perspective imaging

Scanning photomacrography yields optimum sharpness with unlimited depth of field.

For anyone who has dabbled in photomacrography, it often seems impossible to optimize sharpness while maintaining depth of field. To further complicate the process, increasing magnification leads to a proportionate increase in other problems associated with photomacrography.

Generally, achieving maximum depth of field requires you to stop your lens down to minimum aperture, such as f/22, or smaller. This approach, however, usually necessitates long exposure times, which often lead to reciprocity failure and color shift. At the same time, in photomacrography, the smaller the aperture, the further one deviates from optimum results. It would be impossible to expand upon diffraction theory here, but the end result of stopping your lens down too far is *total breakdown* of image sharpness—not a desirable effect.

One solution to the problem is through the use of scanning photomacrography, a way to create sharp pictures by passing the subject through a thin sheet of light at optimum aperture. The technique uses a thin (one millimeter or smaller) beam of light, which is projected onto the subject at a perfect 90 degree angle to the lens axis, exactly parallel to the film plane. The camera lens focuses only on the part of the subject illuminated by the light beam. The shutter remains open as the subject is slowly moved up or down on a stage, passing through the scanning beam one portion at a time.

The primary advantage of this technique is that the resulting image will exhibit practically unlimited depth-of-field, since the width of the scanning beam never exceeds the plane of sharpest focus through which the subject passes. Images created with this technique also exhibit an isometric, or zero, perspective. Unlike conventional rectilinear perspective, all points are equidistant from the lens. There are no vanishing points, and every part of the subject is rendered in exactly 1:1 proportion to the whole. The result is a sharp, clear, *flat* image.

Basic requirements for this relatively simple technique include a solid camera stand, a camera with macro capabilities (any format and/or system) and proper scanning equipment, which is the key. The only commercially available system is the DynaPhot, manufactured by Irvine Optical Corp. of Burbank, California, and costing approximately $12,000. This compact, finely-tooled device simplifies the process because it was designed specifically for scanning photomacrography and features built-in alignment and exposure controls. It puts the "creative" back into the process by enabling you to concentrate on your pictures instead of the equipment. It is also possible to building your own set-up (which would probably cost less), but this requires patience and mechanical know-how.

Regardless of the system you use, the stage must be "smooth" in its movements to eliminate vibration (hence image movement) as it travels up or down during exposure. The direction of scanning (either up or down) makes no difference and is a matter of personal preference. Stage speed dictates exposure time by allowing longer or shorter periods of illumination over each scanned portion of the subject. A stage with a wide range of speeds is necessary to provide a useful choice of exposure possibilities. Exposure can be further adjusted on the DynaPhot with a rheostat connected to the light sources.

A stepped motor is the best type of driver for the stage because it alters speeds by a factor of two, conforming to exposure rules familiar to all photographers. Although driving the stage with a variable voltage supply is possible, low power levels may cause the motor to stall.

The illumination system is an equally important component. Scanning requires a sheet of light with adjustable thickness. The thinner the sheet of light, the greater the sharpness of the image. Obviously, the thickness of the beam should never exceed the depth of field created by the lens at a particular magnification, since the accumulation of out-of-focus portions of the scanned subject will contribute to

Vespid wasp shot at f/6.7 on tungsten-balanced Ektachrome with a 5mm/min. scan speed.

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an image lacking in sharpness.

The system must be critically adjusted so that all lights are aligned with each other and with the plane of focus. Scanning speed is set according to light intensity, subject reflectance, film speed, and magnification extension factor. Polaroid film is a wonderful aid in determining exposure for this type of work.

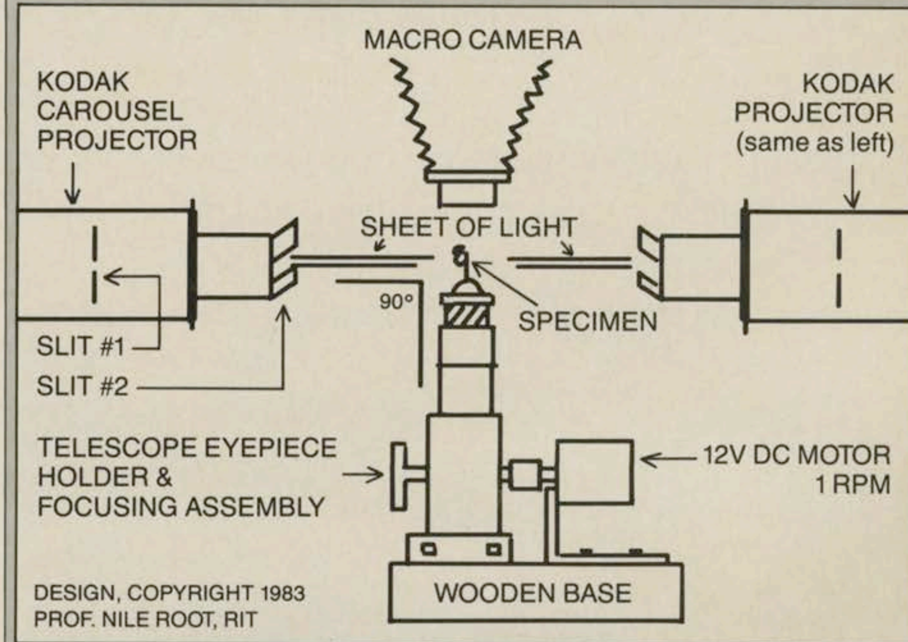
Subject preparation, while a major consideration, is often overlooked. Because of the great degree of enlargement, any flaws exhibited by the subject, as well as any focusing errors, will become obvious in the final image. You should be judicious in preparing your specimen to avoid having the flaws detract from evaluation of the subject itself. The better your initial preparation, the more dramatic the final presentation will be.

Our example here is a Vespid wasp that was killed using ethyl acetate and positioned prior to the onset of rigor mortis. This photograph was shot on tungsten-balanced Ektachrome sheet film at f/6.7. The scan speed (determined by trial and error) was approximately 5mm/minute. Since the subject was two centimeters long, the exposure took four minutes. Consequently, our work area required complete isolation from vibration and air currents, as well as total darkness. Any movement of the subject would have resulted in distortion and lack of image sharpness.

The ability of scanning photomacrography to produce completely sharp images of small objects is an enormous asset to botanists, entymologists, and industrial, medical and forensic photographers, among others. We are currently working on new methods of exposure determination while pushing the technique, and our DynaPhot, to its limits. If you have questions regarding this process, please feel free to drop us a note any time. If you are interested in gaining some hands-on experience, contact the T&E Center, Rochester Institute of Technology, Rochester, New York 14623 for more information on photomacrography workshops. (IP)

Build your own scanning photomacrography system

By David E. Anderson



A scanning photomacrography system can be easily set up using equipment you already own. Such a system will be somewhat less precise than the DynaPhot, but effective all the same. You will need a conventional 4x5 camera equipped with a medium focal length (75-80mm) enlarging lens, two carousel-type slide projectors, a movable stage for the specimen, a few razor blades and some tape.

To convert the projectors into effective light sources, install a horizontal slit in their 2x2 slide stages. Make the slits by taping two razor blades together, leaving a very small gap between them. Use a short focal length lens (3-inch) to allow the slit to come into focus under the camera lens. Place a second horizontal slit on the outside of each lens to serve as a diaphragm.

For the moving stage, use a precision rack-and-pinion worm gear focusing assembly from a telescope, or purchase Assembly R640 from Meade Instruments Corp. Attach the gear assembly to a small multi-voltage motor (offered by Edmund Scientific or your local Radio Shack); it should have high torque and a variable speed capacity. Lastly, use a variable voltage transformer to control exposure by varying scan speed. Avoid confusion by keeping your aperture constant.

If, however, you decide to switch film types, it is easier to adjust the lens opening than the scanning speed. This will eliminate the need to run exposure tests every time you change ASA/ISO. Personally, I have found that using Tri-X at f/8 gives me the best results. Of course, scanning time will vary with the length and size of the subject. Once you have obtained a correct exposure, record it as a base measurement for future shots. (IP)

Photo at left taken with normal photomacrography setup exhibits narrow depth-of-field. Photo at right produced with scanning photomacrography system is sharp throughout. Both photographs were shot at f/11 by Kerri Hopkins.