ADVANCED LIGHTING TECHNIQUES
For
MINERAL PHOTOGRAPHY

Wendell E. Wilson
The Mineralogical Record
4631 Paseo Tubutama
Tucson, AZ 85750
minrec@earthlink.net

Mineral photography at the master level requires, among other things, a complete understanding and command of the way light interacts with opaque, translucent and transparent specimens and their surrounding environment. The photographer must take control of every aspect of this interaction, carefully, patiently and intelligently manipulating each one to serve his artistic vision and scientific sensibilities.

INTRODUCTION

Mineral photography at its highest level is an exact science in service of both art and nature. On the one hand, the requirements of good scientific illustration must be met—that is, the specimen must be depicted fully and accurately, without any distortion or compromise in scientific integrity. On the other hand, an expertly crafted photograph is more than a mere depiction of data; it comes alive with sparkle, drama, depth, and a fine-art feeling of aesthetic quality. We must exclude from our discussion the contribution of innate artistic talent on the part of the photographer because, necessary though this is, it cannot be taught. That said, master mineral photographers all utilize an arsenal of techniques and thought processes which can indeed be learned and can be adapted to each photographer's own style and ability. Mastery of these intellectual tools is generally the last skill to be developed along the learning curve from novice to expert.

Following is an edited transcript of a slide-lecture I presented on this subject at the 16th annual Rochester Mineralogical Symposium in 1989. That year there was a special one-day seminar on mineral photography technique which was held before the start of the main symposium program. The Rochester audience was attentive and quick to ask questions whenever clarification was needed (those questions, and the answers, are included here). This is, as far as I know, the first published description of many of these photographic concepts.

THE SET-UP

I'm going to pick up here where Eric Offermann left off in the preceding lecture, and go into detail on a few aspects of lighting. You may, as photographers, have considered some of these aspects on a subconscious level but may not have quantized them in your mind yet.

My basic set-up is very simple: I use a sheet of translucent white Plexiglas as a background. Two Tensor lamps with acetate diffusers and black paper baffles are positioned above the specimen to be photographed, casting a soft pool of light around the specimen. The specimen is secured in position by a wad of silicone-based clay, and folded pieces of aluminum foil and black paper are positioned around the specimen as needed to reflect or block light from various directions. [See *Suggestions for Photographers* on this website for more information on the basics of specimen photography.] I sometimes tell people that 50% of good mineral photography consists of clay squashing and foil folding—getting the specimen positioned the way you want it, and getting the reflectors to sit where you want them so as to provide the reflections you're looking for.

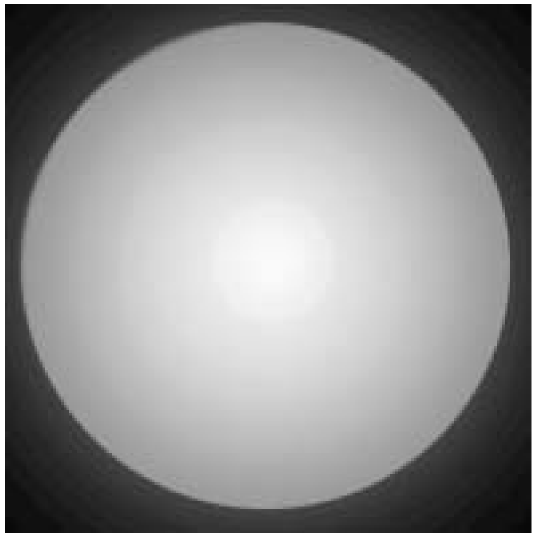
OLIVINE, Burma, 4.7 cm, Edward Tripp collection.

THE PILE OF BROKEN MIRRORS

Taking a photo of a lustrous, multi-faced crystal, as Joel Arem has said, can be compared to taking a picture of a pile of broken mirrors. The crystal is going to show you, in little bits and pieces, what it is seeing around the room. If the window is open, one of the little faces is sure to show you a little blue reflection from the sky. If you've got a brass base on your lamp, one of them is going to show a little yellow reflection that bounced off the brass base. So first of all you have to isolate your specimen from all of the possible light sources in the room except the ones *you* control. What remains after the extraneous sources have been removed, of course, is black and gives no reflection. You must then engineer your controlled light sources to do all that is necessary to yield a fully realized photo that doesn't look overly artificial or awkward.

The specimen shown here is one of the world's largest faceted olivines, from Burma. Like all faceted stones and many crystals, it demonstrates the "pile of broken mirrors" concept and how difficult it is to pick out just a few faces to define the whole shape. In this photo nine different facets have been highlighted to some degree and yet major portions of the stone's forward surface, to say nothing of the rearward-facing facets, are concealed in darkness.

The special techniques needed for effectively photographing faceted stones are beyond the scope of this talk, but suffice it to say that gemstone photography involves overcoming many of the same problems facing the photographer of natural mineral specimens, especially lustrous, transparent, colored crystals of any kind.



Specimen's-eye-view of a photographer's lamp.

Shown here is a specimen's-eye-view of the Tensor light bulb and its surrounding hood, covered by a diffuser. What you are going to see on a face [positioned so as to reflect the light to the camera] is some cut-out portion of this view, its size and shape depending on the size and shape of the face. The bright center part, near the filament, is what you want to avoid because it will give a reflection that is too bright—called a "burn-out." The softer light from the surrounding hood will be more useful for placing subtle reflections.

THE GRADATIONAL REFLECTION

Selecting an area of the light source that grades from brighter to dimmer will produce an essential tool of the mineral photographer: *the gradational reflection*. This is basically an uneven reflection which is fairly bright at one end or edge of the crystal face but then trails off gradually to being very dim or dark at the other end. Gradational reflections lend depth and aesthetic sensitivity to a face, and often show up very subtle surface features along the way. The gradation can be linear (the intensity decreasing in equal increments along the way) or asymptotic (decreasing rapidly at first and then more gradually). It seems like a simple thing, and it is, but mastering the control of this type of reflection is essential to good mineral photography, and is one skill which sets the expert apart from the amateur. Many, if not most, of the photos I'll be showing contain gradational reflections.

THE ARTISTIC COMPROMISE

The challenge for the photographer involves a fundamental trade-off. You have two aspects of the specimen to depict, the surface shape and the interior. When you put a reflection on one of the little faces, you're blocking out something of the interior *but* you are helping to show the shape of the surface. If neither of two adjacent faces has a reflection on it, you will be able to see the interior clearly through them both, but you might not be able to make out the edge where they meet. What you want to do is to *define the overall shape of the entire crystal* using the minimum number and intensity of reflections.

When you set about defining a crystal, as a photographer you really begin to enter the realm of the artist. You're painting with light. You're looking at the different shapes and you're saying, "I want to put a little reflection here, I want to put a little one there, I want to leave this one open because the view through this particular window to the interior is particularly nice and I want to save that" …you're picking and choosing what you want to show. There is no way to show everything all at once; you have to make a selection.

COPPER, Houghton County, Michigan, 5.5 cm, Richard Kosnar collection.

COLORED REFLECTORS

This photo of some copper crystals from Michigan illustrates a fact that still-life painters learn early on: that reflected light from opaque objects is colored whereas reflected light from translucent to transparent objects is uncolored. You can see here that the reflected light from the copper is copper-colored. If you try to paint a still life that includes a copper bowl, and you make the reflected highlights white instead of copper-colored, it will look like a glazed copper-colored ceramic bowl instead. It's good to keep this in mind in mineral photography because it reminds you not to let your reflections get so bright that they turn completely white.

GOLD, Eureka mine, California, 5.1 cm, Keith Proctor collection

It's possible to fiddle with these colored reflections for photographic purposes, for example, by using a yellow reflector to deepen the yellow color of a gold specimen (as shown here). However, the results are usually not totally successful because you can't get every part of the gold specimen to reflect the artificial color. I don't particularly like this technique because it is untrue to the specimen, showing a color intensity that isn't really there. It really shouldn't be done. To take another example, people have attempted to boost the dark green color of minerals like dioptase by using green reflectors. But this doesn't work, because it's confusing: the mind knows that the reflections come from *outside* of the specimen. The color doesn't represent what I would call the "body color" of the crystal.

REALGAR, Getchell mine, Nevada, 1.4-cm crystals, F. Cureton collection

LOW-INTENSITY REFLECTIONS

This photo of a realgar from Washington illustrates the value of keeping the reflections as reduced and subtle as possible. Probably the last thing that a good photographer learns in his career of refinement is to get to the subtle stage, to learn subtlety in these reflections, and it may be especially hard if the photographer is also a collector, because mineral collectors love the drama of mineral specimens. They are so *beautiful* that you just want to show the sparkle and the flash, and enjoy the most spectacular view through the viewfinder. The fly in the ointment is that the human eye sees much more than the film can record. Your eyes can see a range of darks and lights which is significantly wider than film can respond to. A bright reflection which appears through the viewfinder, to your eyes, *not* to be burned out, will prove to be burned out on film. Your eyes may look at a dark area and still see some nice detail, but when you get the slides back it will have gone totally black because the film did not have the exposure latitude that your eyes have. Therefore one must learn to be *more* subtle than is apparently necessary, judging by what is seen through the viewfinder.

QUESTION from the audience: What is the background there?

ANSWER: The background here is my standard white, translucent Plexiglas. I mount black paper on the back to soften the brightness of the white. One can modulate the color a little bit by mounting colored paper on the back, and a little faint color will show through, but I prefer the gray, partially because you don't want the reflections which come from the foreground to be colored. We run into problems with photos to be published in *The Mineralogical Record* when the photographer has used some god-awful orange background and we decide to remove it and substitute a more subtle color. *But* if there are little orange reflections on some of the crystal faces, and their source has been removed, it then appears that the specimen itself must actually be orange.

Q: Do you have trouble with reflections off that white Plexiglas?
A: It's not a problem; it's actually useful in some cases, and if you don't want it you can just lay a little piece of black paper on the part that's reflecting.
Q: You have a good range of light and dark there in the background, from top to bottom. Is that a property of the Plexiglas?
A: The Plexiglas background goes off into the distance back here, because the lights are arranged to shine mostly on the specimen and the foreground. The diffusing screen causes a soft gradation from light to dark rather than a sharp dividing line.

What you want to do in mineral photography is to get control of every possible aspect of the physics of the situation. You want to identify everything that the light is doing, and why, and then use that knowledge to your benefit. Low-intensity reflections, the kind that are just bright enough to delineate the shape and no brighter, are important because *the fainter a reflection is, the more it lets you see through it into the interior,* and the less of a compromise you have to make in choosing between showing the surface and the interior. With a faint reflection you can also get very subtle surface features to reveal themselves, which would be overwhelmed and obliterated by a brighter reflection.

STURMANITE, N'Chwaning mine, South Africa, 3.8 cm, Ken Roberts specimen.

Here is a sturmanite from South Africa. Note that it is not necessary to put a reflection on the *entire* face. You can use a gradational reflection and just sort of skinny around the edge of the face on one side while leaving the rest of the face dark.

Q: Do you do that by adjusting your foil reflector?
A: By adjusting the foil, by adjusting the lamp overhead, by adjusting the distance between the lamp and the specimen, the distance between the foil and the specimen. With a white paper reflector you can adjust its darkness and reflective impact by turning it at different angles to the light—as you rotate it to more extreme angles to your lamp it will gradually darken.

WULFENITE, Red Cloud mine, Arizona, 5.7 cm, Harvard collection.

I ‘m going to show a lot of problem species in this talk, the ones that seem to give mineral photographers the most trouble. Red Cloud wulfenite is one, and it’s because the faces are so brilliant and the color is so gorgeous. I think that by not making the reflections subtle enough I’ve ruined more photos of Red Cloud wulfenite than of any other species I’ve ever photographed, partially because the darn things are so exciting. You look at them and you just sort of go out of gear—they glow and they blaze, and you start forgetting the little things you should be remembering about subtlety and the limits of film. Altogether there is very little that is subtle about Red Cloud wulfenite.

This particular photo utilizes every trick I could come up with. It has gradational reflections, and utilizes very soft and subtle reflections. It also has foreground reflections, mixed-intensity reflections, apex reflections and skimmed reflections, plus a little backlighting, each of which I will get to in a bit. The point is simply that some specimens will dazzle and thrill you, as a collector, into forgetting about many of the technical niceties and refinements needed to create a professional-looking photo. It is a difficult challenge to suppress one’s enthusiasm while remaining creative and open-minded to possibilities and alternatives that might be employed or combined. But it’s essential to maintain your cool, especially when photographing borrowed specimens or specimens on location that will not be readily available later for a second try.

ELBAITE, Madagascar, 9 cm, Harvard collection.

This is a Madagascar tourmaline crystal. At the termination (the big face in the center) you can see another one of those gradational reflections—it doesn't cover the whole face brightly but grades off dimly to the right. The termination face on the left shows very much the same thing—brighter on the outside margin to give contrast against the dark background, and then darker again before meeting the highlighted central face.

The gradational reflections on the termination also allow the surface texture to be revealed better, while showing the maximum view of the interior. This property is a bonus with gradational reflections, and the mathematical curve of the gradation can be adjusted so as to maximize the effect over as much of the face as possible.

Along the prism face are just a few very weak reflections, just enough to define some shape while revealing as much as possible of the interior—particularly nice in this crystal, which is almost entirely gem-grade and therefore extremely valuable. In retrospect, however, I should have used some internal reflections along the prism to better bring out the internal color—we'll get to that technique in a bit.

EMERALD, Muzo mine, Colombia, 3.5 cm, Wallace Mann collection.

This is an emerald crystal from Colombia. It has all sorts of interesting little surface etch features, which, if you're not careful, you can lose by putting too bright a reflection on that surface.

Q: How close is your Plexiglas background to your specimens?
A: They sit right on it.
Q: When you say "sit on it" do you mean lying down on it?
A: No, the Plexiglas is horizontal, on the table-top, and the crystal is standing up at 90 degrees to it, more or less. This is the only way that I can have the background receding into darkness at the top to give a sense of depth in the environment
Q: You've said that getting the green of emerald was a problem—how do you cope with that?
A: Actually no one has ever photographed emerald-green accurately. The reason, apparently, is—well, in the case of a mineral that is, let's say, red, it is not a pure single-frequency red like a laser beam. If you were to pass a beam of white light through it and then use a prism to fan out the outgoing "red" light into its spectrum you wouldn't see the red portion of the rainbow. You would see narrow bands of color at various places (wavelengths) in the spectrum. This collection of different colors, like a recipe, adds up to an impression of red when you view it. When you photograph a red mineral onto film, the red-colored emulsion is not made of the same chemicals as the mineral, and will therefore produce red light having a *different* recipe of frequency bands. It will still look red, but it won't be exactly the *same* red. In cases where the differences in the two spectra are too severe, they will become noticeably different in appearance. The situation is made even worse when the picture is published because red printing ink is, again, chemically different and has a *third* set of bands in its spectrum of frequency components. The true, original color is degraded at each step. The chromium-green color of emerald cannot be reproduced by any known film emulsion or combination of printing inks. The situation is better now than it used to be because film emulsion technology has improved, but probably no emerald photo will ever be perfect.

THE FOUR KINDS OF LIGHT

What you have to deal with, as a photographer, is really four different categories of light. And you have to separate these in your mind, so that you understand what is going on and can play with each one as you wish. (1) The first category is light reflected off the surface. (2) The second would be what I call the "body color" of the crystal—light that is reflected from the internal goings on, the little cracks and fissures and translucencies that are inside the crystal. (3) The third category is light that is actually introduced from the back. (4) And the fourth is light reflected off the *inside-back faces* of the (transparent) crystal—light that entered more or less through the front of the crystal, bounced off an inside back face and then emerged again through the front. You need to balance all of these against each other—that's the challenge, the artistic part and also the scientific part. All of these different light paths sort of blend together as you make the choice of what you want to show about the surface and what you want to show about the interior.

WULFENITE, Empire mine, Arizona, 4-mm crystal, W. Wilson collection.

HIGHLIGHT THE SMALL FACES

This next series of photos (beginning with a Tombstone, Arizona wulfenite) illustrates the notion that, if you're going to have to use reflections on faces to identify or to define the shape, and if those reflections are therefore going to block out views of the interior, then it makes the most sense to use the *little* faces to put the reflections on, and use the *big* faces to see the interior. All you're trying to do is define those little edges where the faces meet, and to do that it doesn't matter which side of that edge the reflection is on.

Wulfenite is a good example because, as shown here, the crystals usually have one big central face and a number of little narrow pyramid faces all around the edge. The big face serves as a window showing almost all of the interior of the crystal. In this case there is an interesting phantom inside composed of a layer of red vanadinite microcrystals covering an early growth phase of the wulfenite crystal.

WULFENITE, Los Lamentos, Mexico, 3 cm, Arizona-Sonora Desert Museum collection

This is another example, from Los Lamentos, Mexico—note the gradational reflection at upper-right. The two reflections on the lower edges come from the foreground Plexiglas.

NEPTUNITE, Dallas Gem mine, California, 4.1-cm crystals, Denver Museum of Natural History collection.

One of the classic problems for mineral photographers is neptunite. I remember that once years ago when I was thinking about learning to play the guitar, I went with a friend of mine to a music store and I said, "Oh, why don't we get this?" It was *The Beatles Songbook*. He said "You don't start out with *The Beatles Songbook*, you *end up* with *The Beatles Songbook*." Likewise, as a mineral photographer you don't start out with neptunite, you end up with neptunite. The problem is that it is so lustrous and inky black, and yet it has such complicated morphology and surface features, that to really define the complex neptunite crystals is probably the highest challenge there is in mineral photography. And if you do make it, perfectly defined, it will often look a little strange and overdone with that much detail. The trick, once again, is to keep the reflections very subtle, use brighter ones only for small highlights here and there, and really work with the reflectors to get a lot of little reflections going at different angles because the two main lights are just not going to make it. You're going to need to put foil and reflective paper all over the place.

Remember, for example, that barite photo that Steve Chamberlain showed you earlier, that I took with a large-format camera. The set-up around the specimen (not visible in the actual photo, of course) looked like an explosion in a foil factory. I had little pieces hanging off the lights, I had them sitting on pop cans, there must have been a dozen pieces positioned all about. I had to keep my wife entirely out of that room, because if anyone even walked by, it caused this little sea of foil pieces to wave in the wind. And I had to let it sit that way for a day until I got my Ektachrome back to make sure I had the photo I wanted, because if I didn't, I might want to adjust a couple of foil pieces and try again, so I practically had to tape the door shut that night.

RUTILE (red), Graves Mtn., Georgia, 2.8-cm crystal, J. Fowler collection.

MAINTAINING THE SPECIMEN MARGIN

This is a Graves Mountain rutile showing nice, red interior color, and with the thinnest faces used for reflections to define the shape. The side face on the right—you aren't going to see much through that face anyway because you're seeing it at such a high angle. So a reflection has been placed there to set off the crystal from the dark background. If you have a face that is roughly the same darkness as the background it sort off runs off and gets lost. Not only do you lose an edge, which is bad enough, but you also lose part of the margin of the specimen as a whole.

Maintaining the integrity of the specimen margin is very important. The eye doesn't like it when a specimen fails to stand out against the background, so—and this is an important point—you want to have *contrast all the way around*, against the light portions of the background as well as the dark. This means that where the background is bright the specimen, at least the part of it near the margin there, must be dark, and vice versa. This technique was sometimes used by the Old Masters in portrait painting. If you look at old portraits you will sometimes see that the light is coming through a window out of view— softly diffused light from the northern part of the sky was used because they didn't have acetate diffusers in those days. It usually comes from one side or upper corner (usually from the left for a right-handed artist) and illuminates the sitter's face. But it may not shine on the wall directly *behind* the sitter's face…that part of the wall is often left dark, so as to provide good contrast with the well-lit face. The light shines instead on the wall *behind* the back of the sitter's head (which is in shadow) to provide contrast on the back as well. (An example by the Dutch painter Jan Vermeer is shown on the following page.) So it's like a typical mineral photo turned sideways. In the mineral photo the light generally comes from above, brightly illuminating the top portion of the specimen, but the upper part of the background is left dark for best contrast. In the bottom half of the photo the specimen is more shaded but the background is brightly lit, once again providing contrast. This also helps to give a sense of up and down in the mineral photo, providing a sort of visual stability and lack of ambiguity.

"Girl Reading a Letter," 1657, by Jan Vermeer

SULFUR, Cianciana, Sicity, 12 cm, Harvard collection.

SKIMMED REFLECTIONS

What I call "skimmed" reflections, for lack of a better word, are those which don't really cover a whole face but instead cover little tiny parts of the whole face. Often, as is the case with the Sicilian sulfur crystal shown here, there will be little oscillations of some kind going on, or most of the face is one crystal form but actually there are also little ins and outs scattered across the surface that represent indents or little extensions made up of other crystal faces. If you can skim the light along, like skipping a stone over water, and just pick *those* up instead of the whole face, then you're doing better in your compromise. You're seeing through that face to the crystal interior, to the body color, and yet you're defining it with reflections.

PYRITE ON CALCITE, Idarado mine, Colorado, 15.5 cm, M. & G. Miller collection.

VIRTUAL FACES

Here's another knotty problem that photographers sometimes face. Some specimens are particularly problematic to light because they appear to have faces which don't actually exist. Sometimes they are coated by a flat druse of some other mineral having its own set of faces, as in the case of this pyrite-coated calcite cluster from Colorado. Or the "virtual face" may be composed of a roughly planar set of oscillating forms that only approximate a larger face. In such cases you can try all night long and you are not going to get your light to reflect off one of those faces, because those faces don't exist. The best you can achieve (with opaque minerals especially) is a light and dark shadow effect as shown here. Transparent minerals such as fluorite can be even more difficult in this regard because the crystal form cannot be shadowed as easily.

WULFENITE, Los Lamentos, Mexico, 2.2-cm crystal, W. Wilson collection.

COLORED BACKGROUNDS

This Los Lamentos wulfenite crystal was fairly easy to define. Skimming the light down the bumpy surface features of this virtual face along the edge here delineated it quite well while leaving the big face open. This photo was taken many years ago when I was experimenting with the use of matte-finish colored papers as backgrounds. I switched to the white/gray Plexiglas because, first of all, it doesn't introduce any extraneous color through the back of the crystal, as is happening a bit here, and, secondly, it doesn't reflect strange colors onto the front of the crystal.

Thirdly, I decided that for my purposes (that is, for publication in *The Mineralogical Record*) I needed uniformity. The reason was that I might take large numbers of pictures over the course of several years, and then I might go back into this file and pick and choose a few to be published together in some article. I didn't want the jarring effect of variously colored backgrounds appearing beside each other in the same layout. Besides that, I was weary of trying to select colors that would harmonize well with each individual specimen, of carrying around sheaves of background paper in an array of colors, and having to discard each sheet after only a few uses because they became scratched so easily. I have been using the same sheet of white Plexiglas for 15 years, and although it is covered with small scratches, they don't show up on film. I have no idea why.

That said, I don't want to imply that colored backgrounds are intrinsically bad. Photographers such as Jeff Scovil and Harold and Erica Van Pelt utilize them to magnificent effect. They have learned, through years of experience, to avoid the little pitfalls, and they generally use relatively muted colors so that if random photos are selected from their stock to publish together there will not be a serious clash of backgrounds. One should never try to make up for the lack of bright color in a specimen by using a brightly colored background. As with reflections, subtlety in the choice of background colors is essential.

PYRITE, Nanisivik mine, Canada, 6.5 cm, Fred Bailey collection.

VARY THE REFLECTIONS

Another one of the banes of the mineral photographer, together with neptunite, azurite and a few others, is pyrite. Here again you have to remember that because you are dealing with an opaque metallic mineral you have to allow the color of the pyrite to show in all of the reflections. That's rule number one. Secondly, the darn things are so highly reflective that you have to be extremely judicious in the intensity of the reflections. In fact, you sometimes have to resort to using gray paper for reflectors because white paper would be too bright, to say nothing of foil.

For the most aesthetic and least distracting overall effect you should try to *vary* the intensity of the reflections on different faces, rather than just to show faces that are either reflected or not reflected. You want them to be gently different from each other in some way as your eye roams over the specimen. This looks more natural because in the real world, with its myriad of different, uncontrolled light sources, reflections are rarely uniform.

SPESSARTINE, Gilgit, Pakistan, 2.4-cm crystal, Gene Schlepp collection.

Like the pyrite, this Pakistan garnet is complex and highly lustrous, presenting the same kind of problem. But this photo works because you can see just about every edge where two faces meet, and almost every face has something going on in terms of some type of reflection. Every one of those reflections, from fairly intense to very faint, had to be put there on purpose and fine-tuned for brightness. Most of the time it doesn't just happen by itself. Once in a great while you might get a mineral that takes its own picture as soon as it hits the plastic—you don't have to touch it, you don't have to mess with it, you just look through the viewfinder and say "Wow!" Snap the shutter and move on to the next one. But most of them, especially if they have some complexity like this one, are going to take a lot of fiddling if you're going to take maximum advantage of the situation and modulate all of the variables at your command for best effect.

This photo probably took around 20 to 30 minutes to set up. I began by solidly mounting the specimen with clay. Then I positioned my two overhead lights so as to create the bright reflections while illuminating enough of the background behind to show up as a soft, gradational gray visible behind on the left and right. You'll notice that the bright face on the right-hand crystal has a skimmed reflection which shows the striated surface as well as some color behind it. Then, because the foreground plastic wasn't reflecting very brightly, I positioned some foil reflectors flat on the plastic in front of the specimen and they provided some soft fill-in light from below. Then I carefully placed a reflector on the left and one on the right to provide a couple of additional reflections which completed the delineation of the overall shape of the big crystals. After a depth-of-field check, the photo was taken.

Q: What kind of exposure method do you use—through-the-lens metering? Averaging?

A: Through-the-lens metering, weighted toward the center. And I bracket an *awful* lot, unlike Erich [Offermann] here, who has mastered his exposure times better than I. I have to make sure, because most of the specimens I shoot are borrowed and I'm not going to get a second shot at them. So I have to be certain not only that I have the perfect exposure but that I have several in that close vicinity in case I should ever need a second one. So I'll pick what the meter says, then bracket with several shots below that and about twice as many above, and I'll end up with five or six slides that are pretty good and one or two that are perfect. If one later gets damaged or scratched I'm still in business.

Q: What about f-stops and depth of field? How do you bracket down—do you change the f-stop?

A: I bracket strictly with exposure time.

Q: What f-stop do you normally shoot at?

A: It depends on the depth of the specimen. You want to use the smallest f-stop number (i.e. largest aperture) that you can get away with, that will still encompass the whole specimen in the sharp focus zone. This is because you will supposedly suffer slightly in overall sharpness at the smallest apertures because of diffraction around the iris blades. Usually f-16 isn't going to be a problem, though, and I've shot down to f-32 without really noticing any obvious deterioration in sharpness. I don't use f-32 unless I have to, but when I do the photos still seem to come out pretty well. Modern high-quality lenses operate very well at small f-stops. The problem with an f-32 shot on a small specimen with the lights I'm using is that I sometimes have to do two or three-minute exposures. But my time is cheap compared to film and opportunities so I do what I have to do.

Q: Do you use Ektachrome-50 or the 160?

A: Ektachrome-50. The slowest speed always has the highest resolution, even though it requires longer exposure times.

RUTILE TWIN, Graves Mtn., Georgia, 3.2-cm crystal, David Crawford specimen.

Here's another rutile from Graves Mountain, Georgia—these, as I said, are one of those minerals that are very difficult to photograph, and the worst of the lot are the cyclic twins because they have so much going on morphologically that it's very difficult to delineate every single edge where two faces meet. So it really puts you to the test, and sometimes it just can't be done as well as you would like. For example, the large lower face shown here is really too large, in my opinion, to bear a full reflection, but the light was coming from the foreground and was too hard to modify.

MANGANITE, Ilfeld, Harz, Germany, 7.9 cm, Kristalle specimen.

Another problem mineral: manganite from Ilfeld, Harz, Germany. Like neptunite it's very black and lustrous. Clusters like this, because of their geometry and complexity, can act rather like those sound-deadening rooms that have the cones all over the walls, except that in this case it's light rather than sound which goes in but doesn't come out. So it's very difficult to light properly for good definition—the terminations show brightly at the right angle, and the prisms reflect brightly when facing you, and the rest of the faces turn black as night and disappear amongst each other. This example required an awful lot of different lights and reflectors to generate enough reflections to halfway define the shape, because the little terminations are all at different angles. One light or one reflector could show up only a few at a time, so many were needed.

SMOKY QUARTZ TWIN, El Capitan Mtn., New Mexico, 7 cm, Thomas McKee collection.

THE APEX REFLECTION

Next I want to talk about a stylistic point which I use from time to time and which I think is useful—I call it the "apex reflection." It's a fairly bright reflection off some face up near the top of the specimen. The smoky quartz twin shown here is a perfect example. The apex reflection lends a nice bit of artistic drama and gives the composition something to hang on in a comfortable sort of way. You can't make it very big; it should be fairly small, but a nice bright gradational reflection near the top, if small enough, works very well.

An apex reflection is particularly useful in maintaining the integrity of the specimen margin for proper contrast with the background. Because the top of my backgrounds tends to be very dark, almost any crystal near the top of a specimen, but most especially a dark crystal such as this smoky quartz, needs an apex reflection to help make it stand out from the background, and to hold down the composition.

This also aids in providing a sense of up and down. It is possible to picture a specimen floating in a gravity-free environment, illuminated primarily from the front, but it's very difficult to do so effectively, without the specimen having a vaguely uncomfortable feel. The eye wants a sense of stability. Furthermore, front-lighting eliminates any feeling of depth in the specimen. Light coming from fairly high angles to the lens axis and from a roughly upward direction—usually 10 o'clock to 2 o'clock—creates the best impression of relief in the specimen and a comfortable feeling of up and down.

RHODOCHROSITE, N'Chwaning mine, South Africa, 4.7-cm crystal, Bill Larson collection.

I love these three big rhodochrosite crystals from South Africa, all owned by Bill Larson. The two on the left each have an apex reflection and look quite nice, whereas the crystal on the right does not have that reflection and looks kind of like the poor sister to the other two. It sort of fades away compared to these other two which look more elegant.

AZURITE, Tsumeb, Namibia, 6-cm crystal, Harvard collection.

This is a Tsumeb azurite, and there is the gradational apex reflection right at the top. You can imagine that if that reflection were taken out, the photo would suffer considerably. The reflection adds something valuable in terms of style as well as surface definition. Below it, incidentally, is probably the biggest and best gradational reflection that I've ever managed to produce on a face. The light is coming from the foreground, fortunately, because the face is so large that getting such a perfect reflection from foil would be very difficult.

Notice also the shadow that the crystal casts on the matrix, and how important this shadow is in showing the depth and shape of the specimen. Such a shadow comes from high-angle lighting, and is the natural complement to the apex reflection. It should not be obliterated by fill-in light.

RHODOCHROSITE, N'Chwaning mine, South Africa, 7.8 cm, Bill Larson collection.

Even on a specimen that doesn't really have any good apex crystals you can still capitalize on the effect by lighting the upper edge really well, as shown here with "The Snail" rhodochrosite. The reflection helps the specimen stand out from the dark background at the top and helps to define the rounded shape and give it depth.

POWELLITE, Nasik, India, 3.5-cm crystal, Smithsonian collection.

This is a big powellite from India, and there is the apex reflection at the top. The problem with photographing this piece is that this is the only angle from which it looks good, and there is an enormous bash front-and-center on the crystal. Really a shame. So you wouldn't want to show that, and yet there it is right smack in the middle. So to de-emphasize it the lights must be adjusted so as not to cause any reflections at all from the broken portion. A slight movement of the upper light and this photo would have shown a zillion little reflections off the fracture surface, and it would have drawn attention. By avoiding highlights on damaged areas you're not really *concealing* the damage; you're just not drawing attention to something which is not an intrinsic characteristic of the mineral unless you happen to be a student of fracture patterns.

VESZELYITE, Black Pine mine, Montana, 1.2 cm, Herb Obodda specimen.

This is a veszelyite thumbnail from Montana. And there's the gradational apex reflection at the top. Note that it's a very subtle reflection, and it's also an example of a "skimmed" reflection in that it kind of skitters down the face, hitting only the high spots so as to show the interesting surface features. And we get a bonus because here next to it is a little transparent body color showing through at the top—two interest points right up there at the top of the crystal, which I think is elegant.

FOREGROUND REFLECTIONS

This next group of shots illustrates foreground reflections. Light coming from the foreground, as you recall, is one of the four types of light that I mentioned. If you are suspending your specimen on a sheet of transparent glass well above the background, as Jeff Scovil does, or if you perch the specimen on the leading edge of the Plexiglas, this kind of "fill-in" light can be supplied from below by another lamp. The main thing about it is that it comes from below in front and should be very soft and diffused so as not to cause any sharp little reflections. And it should never, under any circumstances, be brighter than the overhead light, as this may confuse the sense of up and down.

In my case, since I use a white background/foreground material, the foreground reflections are white. If you are *not* using a white material to set the crystals on, and you want to utilize foreground reflections, then you'll have to slip a piece of white or gray paper under the front of the specimen (outside the field of view) so the reflection will be uncolored.

Foreground reflections are nice because, first of all, they come from a direction which can be difficult to supply directly with lamps (unless you use Jeff's technique). Also they tend to be more subtle and don't cause burn-outs the way direct lamplight can. I should mention that, no matter how much we might say that you should never have burn-outs, there isn't a photographer on the planet who doesn't sometimes have burn-outs. They just happen with certain specimens, you're not going to get away from it, and you just have to try to make them as small as possible so that they will not hurt your eyes to look at and so that they will not obscure large amounts of information.

SILVER on Copper, Osceola mine, Michigan, 2.5 cm, Seaman Museum collection.

Here is a big composite crystal of silver on copper from Michigan. All of the faces on the upper half are being illuminated directly by the lamps overhead, while the lower half is being nicely illuminated by the foreground.

SPESSARTINE, Topaz Mtn., Utah, 5 cm, Mike Sprunger specimen.

Here on this Utah garnet you can see that the brighter reflections on the top, including a nice apex reflection, are coming from the lamp overhead, and all of the other, softer reflections on the lower half are coming from the foreground.

AZURITE, Chessy, France, 6.4 cm, Bill Larson collection.

Here again is a classic problem for mineral photographers: azurite (this one from Chessy, France), and the better the specimen is the more of a problem it is because the crystals are so dark and lustrous. They do have a little body color but, as with dioptase, getting any of it to show up can be a real challenge. In this photo almost all of the reflections except the small bright ones on top are from the foreground, and that helped to make them a little softer. Unfortunately the white matrix here prevented a significant over-exposure to bring out the blue better because the white rock would then have burned out. Nevertheless it's the soft foreground reflections that really make this photo work.

DIOPTASE, Tsumeb, Namibia, 8.9 cm, Bill Larson collection.

BRINGING OUT BODY COLOR

Dioptase from Tsumeb, like this extraordinary example (possibly the best known) from Bill Larson's collection, is another of those classic dark-but-lustrous problem minerals. Dioptase presents a problem in that it has a wonderful deep green color, which you'd really like to show. But if you increase the exposure enough to get that dark green color to show up, then all of the reflections get brighter too and turn into burn-outs. One way to help that situation is to use a lot of soft foreground reflections, as shown here.

Something to remember in this regard, and it's an elusive concept at first: when you look through the viewfinder you naturally want to make it look right *while* you're looking at it, but you forget that the camera has greater latitude than the eye in one important way, and that is time-exposure. If something is too dark, you just give it a little more exposure time and it comes out fine. Our eyes don't have that option. So in cases like this dioptase, where you have a problem showing the dark body color without burning out the reflections, you have to remember that it doesn't need to look bright enough when you're looking through the viewfinder. So you set one light up in such a way as to cause no reflections if possible, just to illuminate the body color, even though it may still look too dark. Then you pull *way* back on the other lights and reflectors that are causing the reflections, so that the reflections get so dim that you can hardly see them. Through the viewfinder, both the crystal body color and the reflections are going to look too dark. But when you then take a longer exposure you will bring up the body color nicely to just where you want it, and the extremely faint reflections will then come up to the proper brightness instead of being burned out. You could take a series of shots in which, at each successive stage, you lower the reflection intensity and increase the exposure time. When you look at the resulting slides, the reflection intensity will appear identical on all of them but the body color will be getting brighter and brighter. It all hinges on controlling the *ratio* of body color brightness to reflection brightness, and then selecting an exposure time that works.

PYRITE, Pasto Bueno, Peru, 17 cm, Gene Schlepp specimen.

SHADOWS

Pyrite, as I said before, is a big problem. This is a cabinet piece and really stretched my system (designed for smaller specimens) to the limit. The brighter reflections, including some nice apex reflections, are from the overhead lamps, and the softer reflections are all from the foreground. And notice the soft, diffused shadow under the specimen.

The thing I like about Plexiglas as a background material—and Erich Offermann alluded to this problem—is that it eliminates sharply defined shadows, which can be very distracting. You should not see sharp shadows on a mineral photo. If you've ever seen an old cowboy movie or TV series that was shot in a studio and wondered why it looks so unnatural, well, look on the ground: the guy has two shadows! Are there two suns?? Plexiglas has the wonderful property of melding and blurring multiple shadows into one, as shown here.

POLYBASITE, Arizpe, Mexico, 3 cm, Terry Wallace collection.

FOCUSING SURPRISES

This is a polybasite from Arizpe, Mexico. I have to explain that this is a concave specimen, shaped like a flower, with the surrounding petals coming out toward you; the little "stamen with the pollen" right in the middle is chalcopyrite. It's a very aesthetic piece. In this particular case the reflections are reversed. The softer reflections in the top half are coming from the foreground and the brighter reflections in the bottom half are coming from the overhead lamp. At least I did get one essential apex reflection at the top.

The little dark stump at the top of the polybasite specimen, which actually projects backward some distance, caused an embarrassing problem. When you look through the viewfinder without stopping down, this little thing is totally out of focus. The first time I shot the specimen I did not bother to stop down to check the focus, and when I got the slides back I was surprised to see very clearly a catalog number painted on that little stump! You could read it very plainly once it had come into sharp focus, and it ruined the whole photo. I had to paint the little thing black so it wouldn't show, and then shoot it again. It's an example of a whole category of problems that can happen when unwanted things accidentally come into focus as you stop down for the shot.

To cite a second example, I once photographed a beautiful, mirror-bright, hexagonal hematite plate from Arizona, about 2 inches across. It stood straight up on the matrix, so I took a dramatic head-on shot. Through the viewfinder it looked great. But when I got the slides back there was a peculiar circular image in the middle of the big main face. Close examination showed that it was the image of my camera lens reflected in the crystal face—thanks to the depth of field gained by stopping down, my camera had taken a picture of itself.

MIMETITE, Tsumeb, Namibia, 2-cm crystal, Gene Schlepp specimen.

A third example is shown by this beautiful Tsumeb mimetite thumbnail. Notice that there is a variegated look to the reflection on the upper right prism face. Through the viewfinder it looks great, and the face has a smooth and even reflection. There is not, in fact, any variegated aspect to the surface of that crystal. What happened is that, as I stopped down, the wrinkles in the foil reflector started to become discernible in the reflection. When that starts to happen you need to take a new foil or a flat piece of paper, anything without wrinkles, and substitute it, or perhaps see if you can get by with a larger aperture and less depth of field. In any case, the moral here is to check carefully through the viewfinder first, using the depth-of-field preview button to stop down to the setting that will be used, even though it will be dark and difficult to see.

SMOKY QUARTZ, El Capital Mtn., New Mexico, 4.8 cm, R. DeMark collection.

BACKIGHTING

Method #1

Now to backlighting—another of those four types of light that I mentioned. The first method of backlighting is simplicity itself: Some specimens are so transparent that you don't have to do anything special to backlight them other than to let the background show through, as in the case of this New Mexico smoky quartz. My own opinion is that if a background shows through at all, it shouldn't be any color other than white or gray. If it is, you are adding color to the body of the crystal which the viewer's mind is going to have to sort out. And that isn't always a simple matter, especially if there are changes in color zones along the crystal, or if the body color happens to be opposite from the background color on the color wheel, in which case it will turn black. And then how do you know whether it's really black or whether its color has just been cancelled by the background color? There could be very subtle color variations going on which you won't see if there is any color coming through from the background. This is another reason why, for documentary purposes, I never use anything but white or gray backgrounds anymore.

UVITE, Brumado mine, Brazil, 2 cm, Don Olson specimen.

You can accentuate backlighting by pumping light into small areas of the background behind the specimen. If you simultaneously increase the exposure to maximize the effect, be sure to also draw back on the reflections because they will increase proportionately to the increase in exposure time. In the case of this uvite thumbnail from the Brumado mine in Bahia, you can see that I have softened the reflections so that I could bring out the backlighting.

CUPRITE, Onganja, Namibia, 5.8 cm, Gene Schlepp specimen.

Method #2

This is a big cuprite crystal from Onganja, Namibia, which has had the malachite layer removed. For this one I used a second backlighting technique: I positioned a narrow beam of bright light from a microscope lamp so as to strike the back side and bring out some of this nice gemmy red internal color. Had I not done that, the whole crystal would have appeared black. I personally don't see anything wrong with strongly backlighting some specimens—within reason. The color that shows up is indeed the real color of the mineral, and no one can say what the ideal amount of light is for viewing a specimen. Anything, in my opinion, that shows up a genuine characteristic of the mineral, without pumping in false information, is acceptable within aesthetic limits. Of course if you were to pump enough wattage in to make this thing glow like a stoplight it would look grossly overdone. As I said, subtlety is what you want to evolve into.

NADORITE, Touissit, Morocco, 2.7 cm, Victor Yount specimen.

This happens to be the world's best specimen of nadorite, which Victor Yount brought back from Morocco. Backlighting with a narrow beam of light from a microscope lamp has revealed the internal color at lower left. Particularly in cases involving extremely rare species such as this, there is mineralogical value to backlighting them enough to show what the internal color is. That gives more data about the piece, an extraordinary piece in this case, which people might never learn if there wasn't a photo available showing it. Everybody knows that cuprite is red inside, but how many of you knew that nadorite is butterscotch brown in transmitted light?

SPESSARTINE, Urucum mine, Brazil, 6.3 cm, R. Gaines collection.

Here is a gem mineral, a big spessartine garnet from Brazil, and I've likewise pumped a little extra light into the back to bring out the red color. A specimen of gem rough like this may have great gem value, but the bigger and thicker it is the darker it appears unless you boost the backlighting. Ultimately faceting will show off its color and transparency best, of course, but backlighting will help to show its potential.

CINNABAR, Guizhou, China, 2.5-cm crystal.

CINNABAR, Guizhou, China, 2.5-cm crystal.

On the left is an untwinned Chinese cinnabar crystal, rather large and dark, without any backlighting. On the right is shown the same crystal judiciously backlit with the microscope lamp. You can take your choice as to which one you like better.

EPIDOTE, Knappenwand, Austria, 7 cm, Gene Schlepp specimen.

Method #3

Now we come to a third technique for backlighting. You can't see it here, but two or three inches behind this crystal (an epidote crystal from Austria) is a strip of foil, stood up at about a 45-degree angle and cut to match the outline of the crystal all around, from the angle that the camera sees it. It's hiding just under the edge all the way around. Then you shine a light on the foil and it bounces the light through the crystal from an angle that would have been impossible to achieve with the actual lamp. If you use a frost foil you can get a broad, diffused light without bright spots. But you have to be careful not to overdo it, or someone with a discerning eye will notice that something is peculiar about the lighting.

ELBAITE, Minas Gerais, Brazil, 2.6 cm, Gene Schlepp specimen.

This is a very dark indicolite. It did not want to show its color at all, though it had a very beautiful color. The crystal was scheduled to be cut and faceted shortly, so I felt that to show the color it really behooved me to place a foil behind it and shine a microscope light on that reflector to really pound in some good light from the back to make that blue show up.

SPODUMENE (Hiddenite), Hiddenite, North Carolina, 7 cm, Harvard collection.

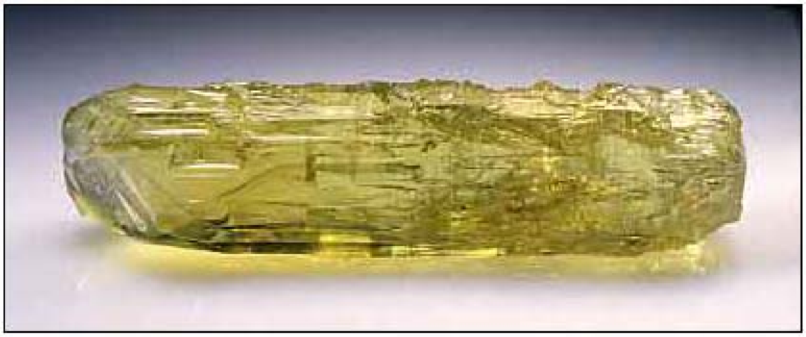
Here again there is a foil reflector back there, a couple of inches away and out of sight, but still putting light through this lovely hiddenite crystal. Without it, the top half of the crystal would have gone mostly black and failed to show the deep green color of the termination area. The effect is not entirely natural-looking but it's still a relatively pleasing photo, and it serves the purpose better than any other method except laying the crystal down horizontally on the plastic.

The choice of whether to stand a crystal like this straight up or lay it down is simply one of style and the necessities of the ultimate layout for publication. Sometimes the wisest course is simply to shoot it both ways, and then you have both options covered. Where there is no special layout requirement for vertical or horizontal you can just pick the one that looks best.

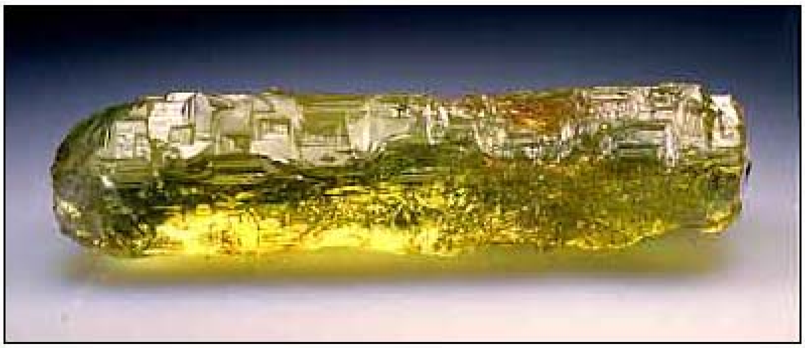
Method #4

A fourth way to do backlighting, instead of shining the light in directly from the back, is to bounce the light off the inside back face. This is the fourth kind of light that I mentioned earlier: light from internal reflections. It has one advantage, or at least one difference, from pumping light in directly from the back is that it doubles the body color.

There is no such effect on the first of the two shots shown here (a Ukrainian beryl)—the light is simply hitting the Plexiglas behind the crystal and them coming on through to the camera, passing once through the crystal. But if the light were to come in through the front, hit the back,



BERYL, Volodarsk-Volynsk, Ukraine, 13 cm, John Barlow collection.



BERYL, Volodarsk-Volynsk, Ukraine, 13 cm, John Barlow collection.

and then bounce out through the front again, it will have passed *twice* through the crystal, and the color will then look as if the crystal is twice as thick as it really is. The above shot of the same specimen shows this effect. Remember that light will reflect off any interface between two mediums of differing refractive index, and it doesn't matter which side of the interface the light strikes.

ELBAITE, Little Three mine, California, 5.4 cm, Cal Graeber specimen.

This is a tourmaline crystal from the Little Three mine in California. Here light is being introduced from the right side, and the pink reflection on the left side of the crystal is an internal reflection picking up the nice internal color. The light came in from the opposite side, marked by a white surface reflection.

VANADINITE, J. C. Holmes claim, AZ, 3.5-mm xls, Mark Hay.

GRAPES, Severin Roesen, 1858.

This is a vanadinite from the J. C. Holmes claim in Arizona. The crystals are small but they demonstrate what I call the "grape effect." If you look carefully at Old Master still-life paintings of fruit and piles of grapes you will see this phenomenon consistently. As with the crystal here, the light enters on one side of the "grape," marked by a white reflection surrounded by a relatively dark area. It then reflects off of the opposite inside surface of the grape, showing the bright internal color. This is a rule of thumb that any artist can use to realistically depict a lustrous, transparent, colored body of any kind.

BERYL, Teofilo Otoni, Brazil, 13.8 cm, Keith Proctor collection.

This is Keith Proctor's big Brazilian aquamarine. These blue faces here on the left are all internal reflections whereas the white highlights on the opposite side are the external reflections. In this case light is also entering through the termination faces (note the small apex reflection), passing the long way through the crystal, and then reflecting off of the interior side of the broken base. Really gemmy minerals are sometimes a problem because they don't always want to show their best color, and the best way to make it visible is to use internal reflections.

RHODONITE, Broken Hill mine, Australia, 2.9 cm, Robert Noble collection.

Method #5

Now to a fifth technique for backlighting which doesn't always work really well. Shown above is one of the world's finest single crystals of rhodonite, from Australia. What I have done here is to cut a piece of white paper the exact size of the crystal and stick it directly on the back of the crystal. The light goes through the crystal, hits the paper and comes right back out, just like a reflection from an inside back face. Unfortunately this method can easily produce an unnatural effect because you are trying to fool the eye rather blatantly.

DIAMONDS to 1 cm from No. Carolina, California, Kentucky, Smithsonian collection.

The technique of plastering something white directly against the back of the crystal can work better if you place the crystals on a flat white surface and then shoot downward at them at a steep angle to the background. It works beautifully here with these three American diamonds, showing the lovely yellow color of the two on the right. It works better in this case because there is no attempt to fool the eye—people can clearly see that something white is backing the crystals, so the technique is legitimized.

SAPPHIRE, Ceylon, 3.2 cm; PHOSPHOPHYLLITE, Bolivia, 3.3 cm; RUBY, Mogok, Burma, 2.6 cm; Bill Larson collection.

MULTIPLE SUBJECTS

If you want to make extra headaches for yourself, compound your problems by putting two or three specimens in the same photo and trying to get the lights right on all of them at the same time. It's particularly difficult if the specimens are grossly different in color brightness—if you have a very dark one and a very light one you're going to have problems. Sometimes you'll need a reflection to come from a direction that is being blocked by the other specimen. Or perhaps a lighting angle that yields an essential reflection on one will cause a burn-out on the other. You also want to make sure that colors don't reflect from one specimen onto the other.

FLUORAPATITE, Pulsifer quarry, Maine, 1.2-cm crystals, Harvard collection.

Here are two Pulsifer apatite thumbnails, which are at least the same species and color. But generally speaking you can't get the quality of the reflections refined as much on a double shot or a multiple shot as you can on a single-subject shot, so you have to decide if it's worthwhile to try.

ELBAITE, Dunton mine, Maine, 6.2-cm slab, Harvard collection.

This collection of Newry tourmalines is probably the largest group of specimens that I've successfully shot, and it took hours to set up. The crystal edges are not all defined as well as I would like, and there are various non-ideal reflections here and there, but overall it came out passably well. Just count on a lot of frustrating fiddling, and a lack of perfection in the end.

DIAMONDS, Finsch mine, South Africa, crystals to 6 mm, Philip Rust collection.

These are colored diamonds, and the nice thing about them in terms of a group shot is that each one individually looks pretty good from any angle. So I set up my lights *first*, then piled the diamonds up, putting the big ones in the back, and adjusted the position of each one delicately using a very small, thin paintbrush, until the reflections looked good. If you can arrange the specimens to fit the lights instead of arranging the lights to fit the specimens it will be much easier to create a good group shot.

That's all I have. Any questions?

Q: I use a Plexiglas background like you do, and I carefully check the viewfinder with the shutter stopped down, but I still have a problem with a line showing up separating the light foreground and middle ground from the dark back area of the background. Is there anything you can suggest?

A: Yes. Be sure that you have a thick enough diffuser, several layers thick, and roll it around the lower edge of your lamp hood. This will diffuse the dividing line between light and dark and give you a smooth transition. You can then modulate the transition zone by adjusting the lens axis relative to the background. The closer your shooting angle is to horizontal, the more abrupt the transition between light foreground and dark background will be. But as you raise the camera up to look down on the specimen at higher angles you will spread out the transition zone and make it more gradual.

Q: Is that a black sheet of some kind on the wall behind your set-up?

A: Yes, that's just a sheet of black cloth I've tacked to the wall. The first time I tried using Plexiglas as a background I was photographing in the Smithsonian, and I ran out of unblemished colored paper backgrounds. I asked John White whether any other photographers had been in there lately and whether they'd left behind any background materials. He said yes, another fellow had been in there, a Smithsonian photographer, and he used a plastic sheet which was still there. I asked if I could borrow it and he said "Sure." So I put the plastic down on the desk in his office, where I had been working, and I set up a nice little alexandrite crystal and a faceted stone. I put my lights on it, everything looked great, and I took the picture. I got the slide back the next day and there was an upside-down set of *The American Mineralogist* suspended behind the specimen! I couldn't see it through the viewfinder with the aperture open, but when I stopped down, his bookcase above the desk came into focus, reflected in the plastic background sheet. So ever since then I have been careful to cover the wall behind my set-up with a black sheet. If you don't you are at least going to get a trace of the white wall reflected and that's going to poison your nice black background.