Hand-Assembling Lenses for the View Camera

Photography and Text by John Siskin

Can lens: Two +3 diopters are mounted in a can of Green Giant beans. The lenses are optical blanks available from the supply houses used by optometrists. Also shown is the lens cap and waterhouse stop-style aperture, made from dog food lids.

I HEARD A STORY ABOUT GALILEO GALILEI: HE SENT HIS ASSISTANT down the street to the lens grinder's shop. When the assistant brought back lenses from the shop, Galileo made a telescope and changed the place of earth in the heavens. Antony van Leeuwenhoek made lenses for his own microscopes and found new life with them. Lenses predated photography by millennia. When Louis Daguerre & William Henry Fox Talbot first recorded light with silver compounds, they were using lenses made by others. Galileo and Leeuwenhoek were working with one of the most magic properties of glass. This magic has captivated me for years—the idea that a simple curved piece of glass can affect the way we see! I can seem to be closer to a distant object, see more of a landscape, or view an incredibly small object, all because light travels slower in glass than in air, causing light to bend at a curved glass surface.

I have long searched for more opportunities to manipulate images with lenses. This is why I love the large-format experience so well: I can put almost any lens onto a view camera. Over my many years in photography, I've acquired about 25 view camera lenses, from 30mm to 620mm—it's something of an obsession. In the last several years, I've become interested in the soft-focus lenses. These lenses produce a more poetic translation of reality onto film. When I use a Symar or an Angulon or a Dagor, I'm looking for a perfect recording of the external view onto film. When I use my Bausch & Lomb Plastigmat, my Fujinon Soft Focus, or a lens of my own design, I'm trying to manipulate the final image as it moves through the glass. Now I can do something like this with a filter, but the look is different, often just fuzzy everywhere, while a soft-focus lens usually differentiates the high values from the low values.

Soft-focus lenses were very popular early in this century, but as the aesthetic changed, fewer and fewer were made. I believe the Rodenstock Imagon is the only soft-focus lens for a large format camera currently imported to the U.S. The older lenses were interesting not only because of their way of seeing, but also because of the many designs used in their optical construction. Some were sim-

***Glass In Funnel*: Fuji RTP 4x5 in. Subject +3 diopter< +3 diopter> shutter -1 diopter> film, *f*/12 with 3 light sources. Push 2/3 stop. Toyo C. *Note*: On captions for all photos, the symbols < > after the lens description define the direction of the lens; thus a +2 diopter> has the convex side facing away from the subject.**

ple, one-element systems, while others were quite complex. Several lenses were made with moving elements! Because the goal for a soft-focus lens is a more poetic image, any evaluation of the results is entirely subjective. Because so few new soft focus lenses are made, simple lenses are now selling for rather a lot of money.

My goal became to return to Galileo's day and assemble my own lenses. While I can't send someone down to the lens grinder's shop, I can run over to the camera store and pick up some close-up filters. My original insight into this came when I happened to check the focal length of a plus-3 diopter lens I purchased for my digital system. Perhaps you know the trick of focusing a light source onto a convenient surface and measuring the distance from the middle of the lens to the image. In this case it was about 15 inches! I had somehow acquired the idea that a #1 diopter was very short, 4 or 5 inches. I thought I would have needed fractional diopter lenses to build anything that would work with a large-format camera. The longer focal lengths are less critical regarding element spacing and give greater coverage, so they're more possible to build. I have since discovered that a #1 diopter is defined as having a focal length of one meter—yes it's a metric measurement. When I discovered this simple piece of informa-

***Roses*: Kodak EPY, 4x5 in. Subject +3 diopter< -1 diopter< shutter +3 diopter> film. *f/8.5* with 2 light sources. Normal processing. Toyo C.**

tion, I realized how easy it would be to make soft-focus designs. You can easily make a version of the Plastigmat by putting two #2 diopters on either side of a tin can.

In order to create your own lenses, some more information is useful. Please note that I found the following values through experimentation (I put lenses on a camera and measured the bellows at infinity). I point this out because there was a lot of variation between the two sets of diopters I tested. The focal length of a #1 diopter is about 40 inches or one meter (my tests revealed more than 10% variance). The focal length of a #2 is 20 inches, or 1/2 of a #1.The focal length of a #3 is 12.5 inches, and a #4 is 10 inches or 1/2 of a #2. A #5 has a focal length of 8.5 inches, and a #6 is 7 inches. I measured the #7 at 6 inches. So we see that each time we double the diopter number, we halve the focal length. I should point out that the focal length of two #1s does equal the focal length of a #2. Clearly we could go on to extrapolate these values or find them experimentally for some time. I would also like to mention that a modern set of close-up filters, #4, #2, and #1, will provide focal lengths of 40, 20, 12.5, 10, 8.5, 7, and 6 inches! Rather like a Plasmat set, but much cheaper. Now let's not get too excited; these are going to be soft-focus lenses.

Several things enable us to improve the sharpness of these lenses. First is an adjustable diaphragm. When I began my experiments, I had an old Prontor #1 press shutter. This was a happy accident because I was easily able to adapt it to the old Series 6 filters. The diaphragm is about an inch wide open, so even the worst designs are usably sharp. If you work with a wider diaphragm, your lenses will start out softer than mine. Please note that what's important is diaphragm size or f-stop, not lens element size. If you mount a 52mm filter on a 1-inch shutter, you'll get results similar to mine. I have seen images made with 52mm filters on a #3 shutter; they're way soft. You can also build a diaphragm. For my tin can lens, I used resealable dog food caps. As I often use soft-focus lenses at two apertures in a single image, thus blending different levels of sharpness, an adjustable diaphragm is very helpful, though a cap with a hole will do the job. I would call these waterhouse stops; they have a long history in lens construction. It is helpful if the diaphragm is in the middle of the lens; this position maximizes lens coverage, while a behind-the-lens position minimizes coverage. If the diaphragm opening is closer to a perfect circle, the transition from soft to softer will be smoother. Obviously a standard shutter and diaphragm combination would be most flexible.

Another significant improvement in sharpness is possible with the choice of lens design; just using a two-element lens will be better than a single piece of glass. Thus a #2 diopter and two #1 diopters should have the same focal length, but as you will see, just on the ground

glass, two #1s are sharper. This brings us to perhaps the most fascinating and rewarding part of lens creation: design. Our choices will be dictated first by the availability of lens elements. There are several sources for lens elements. You may already have close-up lenses. I have checked out optical supply houses, but unfortunately they haven't proven particularly useful. Costs seem high and actual availability isn't great. I am still looking for a good supplier in this class. Optical surplus suppliers such as Surplus Shed at surplusshed.com or Anchor Optical at anchoroptical.com are a hit-or-miss option. Optical labs, the places that fit the lenses for eyeglasses, are another source. I've used R.P.M. Optical Inc., 626-813-1070. They were able to sell me 70mm elements in both positive & negative diopters for only a few dollars a pair. Camera swap meets can be a good source, and if your local camera store has a junk pile, you'll want to check it out. You may want to check out these last two sources for shutters too.

Shutter & Lens Elements: Prontor Press Shutter with the Series 6 lens elements. Please note the spacer, which allows multiple filters to be used or changes the distance between elements. A large group of elements fits in a box for 35mm slides.

The most difficult items to find from photographic sources are negative diopters. A positive lens acts as a magnifier, while a negative element reduces an image. Although many useful designs can be created without negative elements, they do greatly increase your options. I was lucky enough to find a set of Kodak Telek filters (negative 1, 2, and 3 diopters). These were made to increase the width of view of fixed-lens cameras, somewhat the same way close-up filters were used at the same time. By the way, Kodak close-up filters used to be called Portra filters. My most useful lenses are built with two positive elements and one negative element. Not surprisingly this is related to the old Cooke Triplet formulas.

Close-up of the shutter showing the adapter used to mount series 6 elements to the shutter.

I have now assembled a set of Series 6 filters that mount onto that old Prontor Press shutter. I attached two old adapter rings directly to the shutter, sealing the edges with silver Mylar tape. I used these things for several reasons: first, when I made this system it was a prototype—I didn't know it would work! Second, these were the only adapters I could find that would fit into the shutter, so the shutter was recoverable if this didn't work. Lastly, I have a substantial junk pile; I had seven Series 6 close-up filters hanging around. This turned out to be an even better choice when I found the Telek filters in Series 6. Including the contrast filters and retaining rings, the whole thing fits into two boxes for 35mm slides. It's not really as nice as the velvet-lined casket case made for a Plasmat set, but it works great. I eventually mounted the shutter onto a Speed Graphic board, as I also have an adapter for these boards to Toyo; this fits both my 4x5 systems and my 8x10. I can literally design a lens for a specific image in the studio or in the field.

I've already mentioned the existence of many classic designs. Some information on these lenses is available from Jay Allen in his book *Pictorial Soft Focus And Portrait Lenses from the Past*. Unfortunately, this is mostly a collection of manufacturers' original promotional material; it has little design data and no modern user reports or comparisons. A variety of other books on lens design have been published over the years; however, few have much information on soft-focus lenses. I am interested in these lenses first because of their way of seeing, and second because I can ignore some of the fine points of design and construction, which are beyond my capability. There is no way I could acquire the materials and construction equipment to make a Schneider Apo-Symar. I can really only use a 1, 2, or 3 element lens; more elements seems too soft for my tastes. I have discovered that spacing is not very critical between either positive elements or groups of positive elements, but placement of a negative element has a visible effect. I have not seen my results change based on centering the elements. Either I am incredibly lucky and every time I assemble the same elements in the same configuration, my centering is the same (unlikely with drop-in series filters), or this is not very critical in soft-focus applications. I think that without access to better-prepared glass and more precise mounting equipment, many of the minor points of construction can be ignored. If you want a sharper image from these lenses, stop down. I've found that at a diaphragm opening of about 15mm, most anything you assemble is reasonably sharp.

In describing results from my experiments here, I am limited by language and photomechanical reproduction.

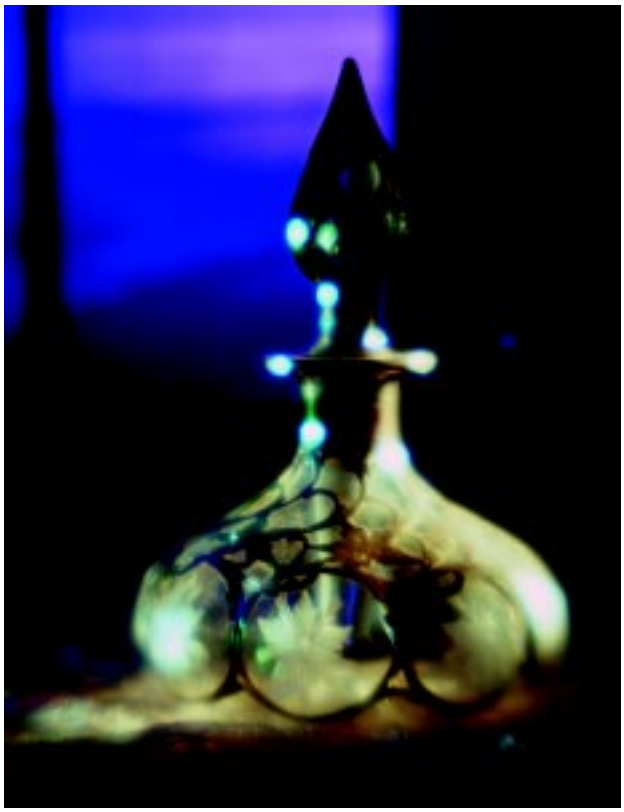
Projector test: The set-up for lens testing with a projector. A test slide is mounted in the projector and a diopter lens is mounted in the camera. This gives some information on sharpness, aberrations, and focus shift. I found it particularly useful in testing focus shift.

The differences in my many test transparencies are often very subtle. I would like to encourage you to use this information as a starting point; you'll need to evaluate your own results. These lenses affect different parts of the image differently: highlights are often haloed (sometimes with color fringing), while other values may just be diffused or lacking in contrast. As I've already mentioned, a single element is very soft. It also exhibits more color fringing (chromatic aberration). The symmetrical design is much better; try a plus-2 convex side toward the film, then the shutter, then another plus 2 facing away from the film. When I tried two positive, but unmatched, elements, putting the stronger one toward the subject was sharper—that is, the combination film, plus 2, shutter, plus 3, subject is sharper than the combination film, plus 3, shutter, plus 2, subject. All of these lenses display considerable color fringing; those built with only positive elements display somewhat more than those built with a negative element. The single element tests I did displayed a lot of color fringing. The sharpest design I've found is a subject, plus 3, minus 1, shutter, plus 3, film. One of the most interesting designs is the plus 3, plus 3, shutter, minus 1. It has extraordinary highlights. All of these lenses have diffused highlights; this particular design exhibits an oddly diamond-shaped highlight with more crisply defined color fringing. The overall images are softer than the other designs. All these designs are much sharper two stops from wide open in my tests. Please remember my lens has a one-inch diaphragm wide open. So with the 7-inch lenses I've been describing, that's *f*/7 wide open and *f*/14 stopped down two stops. These results are from testing with transparency film. In the captions for the sample images accompanying this article, I've used the < symbol to mean that the convex side of the lens faces toward the subject and the > symbol to mean the convex side faces the film.

Another method I have used to examine my lenses is to project a test pattern through them. I set up a Kodak projector behind my front standard, with a test pattern negative in the slide holder. The projector lens was removed for these tests. The practical information from the test concerned both sharpness and focus shift. In all the lenses I tested, focus shifted considerably upon being stopped down. Clearly, focusing stopped down would be indicated. I tried the same experiment on my manufactured lenses: a Fujinon 180 *f*/5.6 soft focus lens and a Bausch & Lomb 12 inch *f*/5.6 Plastigmat. They both show considerable focus shift.

There are other practical difficulties in using these lenses. As I've mentioned, the aperture has a significant affect on sharpness. This is normal for a soft-focus lens. Figuring out your working aperture is a normal problem with multi-element lens sets such as a Plasmat or even a triple convertible such as the Protarlinse. We will need to do this the old fashioned way: with division. Focal length, in inches, divided by diaphragm opening equals f-stop. So for my one-inch diaphragm opening, it's easy: 7-inch focal length divided by one-inch shutter equals *f*/7. By using another shutter with marked apertures, I was able to find and mark the full stop points on the lens. So I can find *f*/14 easily, but I have to extrapolate for *f*/16. If my lens is *f*/7 wide open, one stop down is 7 multiplied by 1.4 or f/9.8 (I'm calling it *f*/10). There is no question that this is somewhat annoying; further it is easy to make a

***Watches*: Fuji RTP. 4x5 in. Subject +3 diopter< +3 diopter shutter -1 diopter> film. *f*/12 with 2 light sources. Push 2/3 stop. Toyo C.**



***Perfume bottle*: Kodak EPY. 4x5 in. Subject +3 diopter< shutter -1 diopter> +2 diopter> film. Bottle exposed at *f*/10 with 2 lights, background and projection at *f*/22 with 3 additional lights. Normal development. Toyo C.**

mistake in the field. I recommend you use Polaroid to confirm your exposure. The practice of using Polaroid proofing has the added benefit of providing information about actual shutter speeds; mine are slightly off.

In discussing aperture, I should mention the accessory apertures available for many of the more modern soft-focus lenses. My tests lead me to believe certain things about these apertures: first, they mostly function as neutral-density filters; they don't make lenses softer. However, they do change the highlights a lot. I haven't been able to determine if there is an increase in depth of field; this is difficult to determine precisely in a soft-focus lens. A point source of light will reproduce the pattern of the aperture; this can be really attractive or really annoying. Leitz made a different sort of filter for their Thambar soft-focus lens: a clear filter with a black dot in the middle. This works very well to increase softness in any lens, but particularly for a soft-focus lens. The appropriate size for the dot seems to be related to the size of the diaphragm. I've been using a dot about 1/3 the size of my aperture.

I have found the practice of making multiple exposures at different apertures to be particularly satisfying. This allows me to have a basically sharp image surrounding a diffused subject with glowing highlights. This is easiest in the studio, where I can have two different sorts of lighting on the same subject. Thus I would expose one part of the image several stops closed down, then close the shutter and open the diaphragm. It enables me to choose to make a part of an image more magic. A self-cocking shutter is a real asset here. When I work outdoors, the most helpful aspect of these lenses is the variable focal length. In a small space I can have choices from about 6 inches to 40 inches! Further, I can choose the degree of sharpness I want by adjusting the aperture.

I am still experimenting. I want to build one of these designs onto a Mamiya twin-lens shutter. I think this might be a wonderful portrait combination. I have used my lenses on people, with a Speed Graphic and a roll film back, but I am happier shooting people with a better viewing system. I want to continue to experiment with the optometric blanks. My current tests are too soft for my tastes. I believe that if I found the right shutter diaphragm combination, I might be inspired to find a better formula for these blanks. ▲

John Siskin is a commercial photographer with a studio in Los Angeles. His client list includes General Motors, Walt Disney, UCLA/Hammer Museum and Aids Walk. The portraiture he has done for the Aids Walk: Faces *campaign has been extensively used in Los Angeles, New York, Atlanta, and San Francisco. He teaches privately at the Learning Tree University in Chatsworth, California. He is represented by ROMA Stock in Pasadena. More of his work can be viewed at siskinphoto.com.*