SHOT CRAFT by Jay Holben

On a cloudy day, the sun illuminates the clouds, which become the source of light for the Earth. Being a significantly larger source — relative to the planet — than just the bare sun, clouds produce a significantly softer light. Effectively, they are diffusion for the sun.

Light Quality 101

The primary characteristics of light that a cinematographer must learn to master are intensity, color and quality. This month we'll take a look at the fundamentals of quality.

Light quality, which is generally described as "hard" or "soft," is defined in terms of the breadth and nature of the transition between light and shadow — i.e., the "shadow edge transfer." Does it transition from light to shadow in a sharp, well-defined manner, or is the transition more gradual?

The shadow edge transfer, or the overall quality of light, is determined by the size of the light source relative to its distance from the subject. This essentially means that once

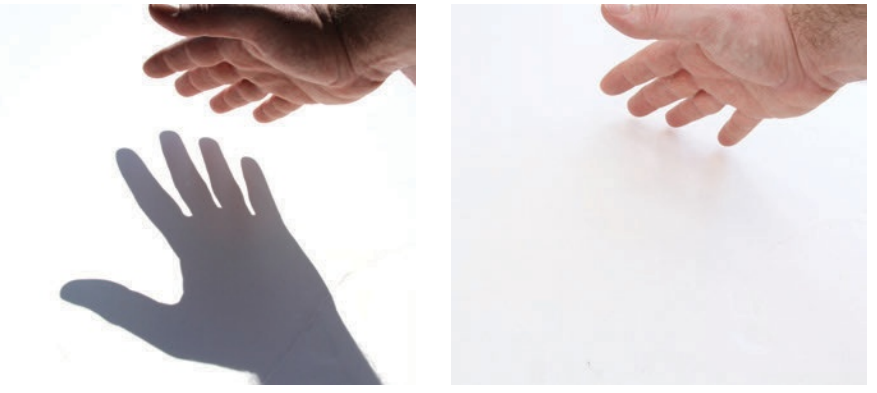
the physical size of the source is selected, controlling the quality of light then becomes all about controlling the source's size *relative* to the subject. (See "Relative Size" sidebar, page 18.)

Soft and Hard Light

The closer the source is to your subject, the softer the light will be. As light becomes softer, the shadow transition becomes longer and more gradual. Soft light is, by its nature, very low in contrast. It can be non-directional and even feel "sourceless," meaning that it's hard to determine what direction the light is coming from. It can hide the texture of an object, even at extreme angles. Extremely soft light can create a nearly shadowless environment.

If you're looking for a hard light, you need a small source as far away as possible. The smaller the source — physically or relatively, or both — the harder the light. Hard light has a very sharp, well-defined transfer from light to shadow. With hard light, we get very defined shadow shapes, and as it is high in contrast, it can create bright highlights and deep shadows. Depending on the direction of the light, it can reveal the texture of an object. If you *rake* (or sidelight) a hard light against a textured object, the light and shadows will distinctly define that texture.

Hard light is also very directional. Spotlights, for example, are hard sources — their beams are distinctly defined, and they can be focused to a very small area without spilling light onto other areas.



The author's hand under direct hard sunlight with a very sharp, well-defined shadow — and under heavy clouds, creating extremely soft, nearly shadowless light.

Controlling Light

The cinematographer's job is just as much about what *not* to light as it is about what to light. Controlling unwanted light is crucial.

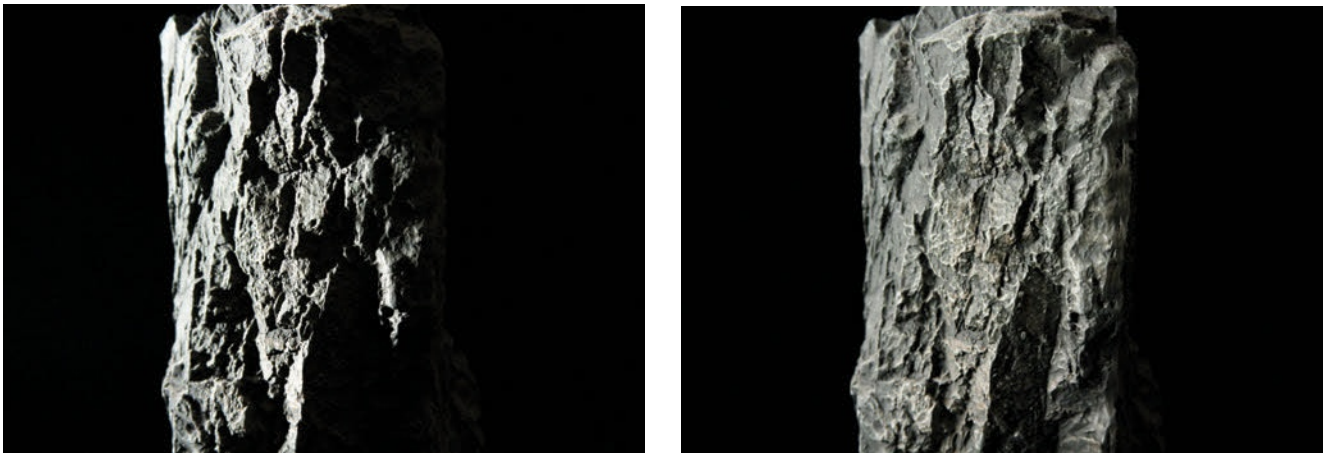
Hard light is easily controlled. Because of the sharp, well-defined shadows it creates, it's fairly simple to place objects — such as flags — into its path to cut light off of areas you don't want it to hit. The farther away the flag or cutter is from the light source, the sharper and more defined the cut will be. Just remember that even with a very hard light source, as you move the flag closer to the light, you're allowing more light rays to scatter around the edge of the flag and soften the definition of the cut, which may or may not be the effect you're looking for.

Understanding that, you should be able to visualize the effectiveness of barn doors on hard sources. Although they can be handy, they will not necessarily provide as sharp and defined a cut as a flag positioned away from the light. Barn doors are most often used for basic adjustments, whereas flags are best for fine ones.

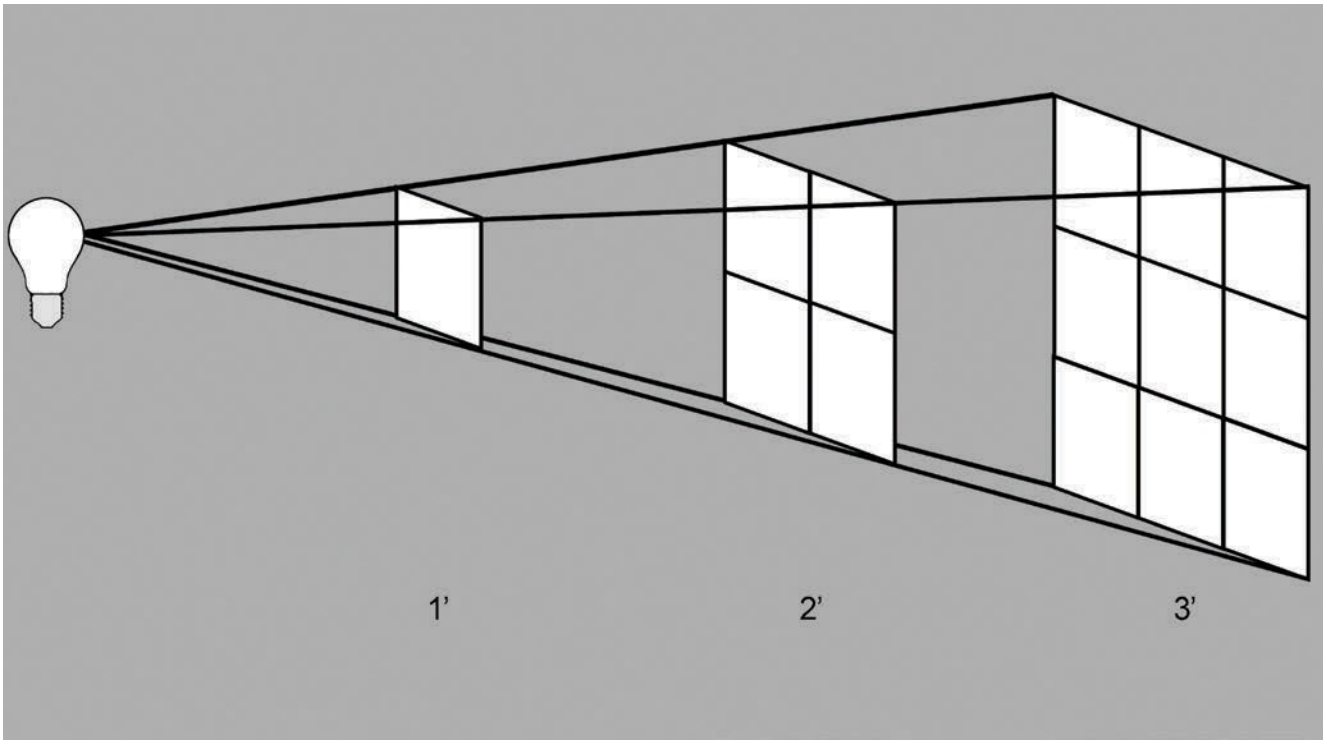
Putting flags in front of a soft source, however, can be a lot like trying to stop an ocean wave with a 2x4. Because light is scattering in all directions, getting a clean, sharp cut from a soft source ranges from difficult to impossible. Controlling soft sources requires much larger flags, which can take up a lot of space. All said, once a soft source is placed, further control can be challenging to achieve.

Diffusion and Source Size

Perhaps surprisingly, the ability of diffusion materials to soften light is directly related to the principle that, all else the same, a larger source creates softer light. Placing in front of a light source a piece of diffusion *that is larger*



Examples of hard light and soft light from the same raking side angle on a stone with a heavily textured face. Note that the hard light accentuates the appearance of the texture while the soft light greatly reduces it.



Above and opposite: Illustrations of the inverse-square law. Light diminishes by the square of the distance traveled.

Relative Size

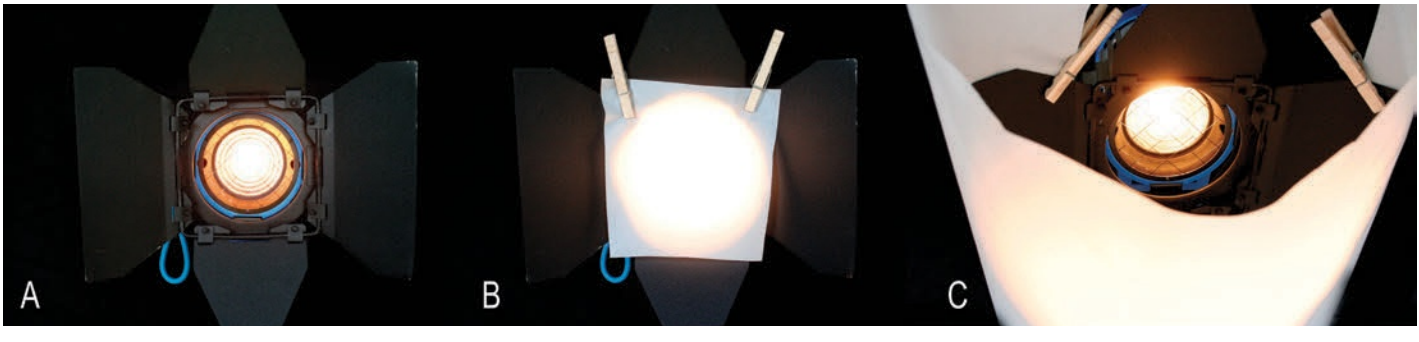
When bringing the source closer to the subject — and thus softening the light — you are increasing the source's size relative to the subject. To think about it another way, you could achieve a roughly equivalent softening of the light by keeping the same distance between the source and the subject, but replacing the source with a physically larger one of a similar type.

than the source itself spreads the light over a larger area and increases the size of the source. In effect, the diffusion, like a cloudy sky, becomes the source. (See "Sun and Sky" sidebar, page 20.) This is what softens the light.

Some young cinematographers make the mistake of thinking it's diffusion on its own that does the softening; I've seen many clip a piece of diffusion to the face of a fixture in an attempt to soften the source. This might spread the light a bit, but it does not significantly change the light quality, because the size of the source — and its distance from the subject — remain the same. If the lens of the light is, say, 6" in diameter and the diffusion covers only that lens, you're not increasing the size of the source. However, if the diffusion is a larger piece that is moved away from the light, you *will* change the size of the source and the quality of light. Even clipping the diffusion to the barn doors 6"-8" away can change light quality by increasing the size of the source. But if you want a truly soft light that fills the frame, you must place a larger piece of diffusion farther from your source.

A 20'x20' diffusion frame would seem to be an exceptionally large light source. Again,

Examples of diffusion clipped to a 650-watt Arri Fresnel. The diffusion against the lens does very little to increase the size of the source or change the quality. However, a larger piece of diffusion clipped to the barn doors away from the lens starts to alter the quality of the light by increasing its size.

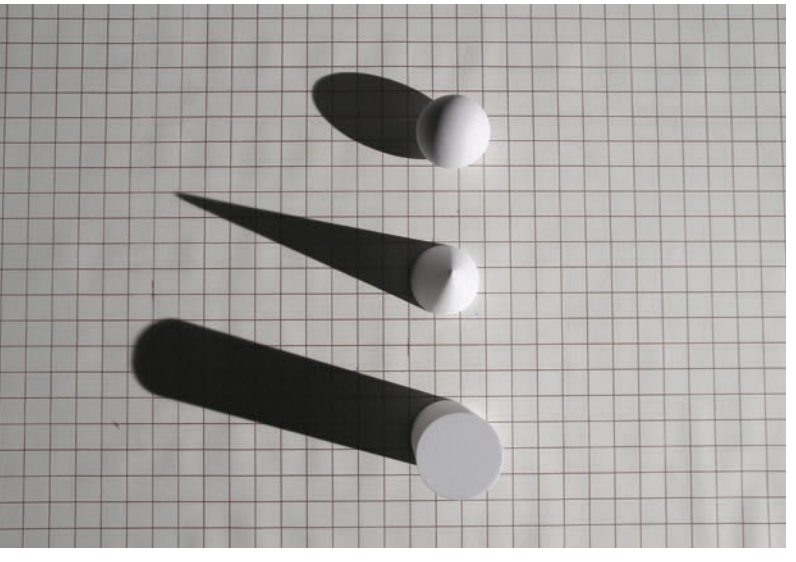


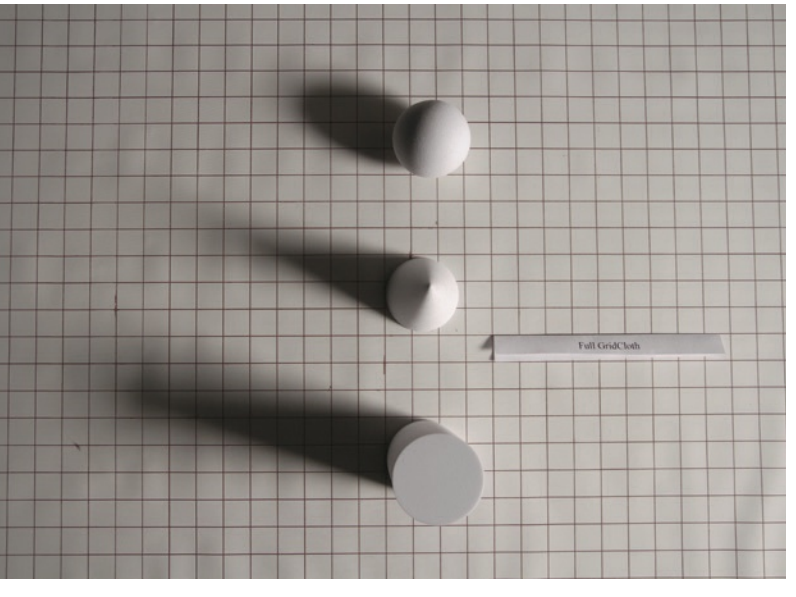
Sun and Sky

The sun is a gigantic source — a huge ball of burning gas 864,600 miles in diameter — however, it is also, on average, 92.96 million miles from Earth, which makes it a small point source in the sky. The sky encompasses a 180-degree hemisphere of our vision, and the sun makes up only .5 degrees. Light from direct sunlight is the hardest light we know.

When it's an overcast day, however, clouds encompass the 180-degree hemisphere of the sky, and the sun illuminates the full sky fairly evenly. In this case, clouds become the light source, which means the source is now 180 degrees rather than .5 degrees. The effect of this extreme example of soft light can be nearly shadowless.

For a discussion of sunlight vs. ambient skylight, see Shot Craft in AC *June '18.*





however, it needs to be large relative to the distance from the subject. If that same 20'x20' diffusion is 100' from your subject, it becomes a very small source and the quality of light becomes significantly harder.

Increasing the size of a source also happens anytime you *bounce* light off of material, as the bounce material itself effectively becomes the source. If you bounce a small, open-face fixture into a white ceiling, it becomes a soft overhead source.

For a look at the different ways that specific diffusion materials affect the light, see Shot Craft in AC *Oct. and Dec. '18.*

The Inverse-Square Law & Photometrics

As there is a direct relationship between quality of light and distance to the source, we start to touch upon a law of physics called the *inverse-square law*, which states that the energy (of light, in this case) will diminish by the square of the distance traveled. For most lighting professionals, this is a rule used to determine falloff of a fixture at a specific distance. It is a great formula for determining the intensity you'll get out of a fixture in your particular circumstance.

But this concept has other applications. In the simplest case, when you have a fixed distance between your fixture and your subject, using photometrics and inverse-square can help you determine the size of the fixture necessary to light your subject to a specific stop. Also, if you have a fixture that is providing too much intensity, knowing inverse-square can help you quickly determine how much light you can reduce by simply increasing the distance to the subject to obtain the intensity you want. For the mathematically inclined:

Intensity = $1/d^2$

The formula and physics technically only apply to point sources; these are sources without lenses to focus the light, without diffusion, and that derive from a single point — like tungsten or HMI lamps, as opposed to fluorescent (a large light source that is not one point) or LED (a multiple-point source). The formula can, however, be applied to broader, softer sources as well, but the math will never be as clean. Softer sources will have a greater falloff than just the inverse square.

Looking at some photometrics for lamps, a typical 1K open-face fixture has an intensity of 1,000 footcandles of light at 4'. If we increase that distance to 8', our intensity drops to 250 fc. We have doubled our distance, but our intensity is now $^1/_4$ (or the inverse-square the distance traveled) of the output.

If we look at the diagrams on pages 18 and 19, we see that as light rays diverge from a point source, they travel outward in all directions, and the farther they are from the source, the more they diverge and cover a larger physical area. So, at 1', what might cover a

Hard-Light Tech Tip

Open-face light sources with clear bulbs can create very hard light. A Fresnel fixture can create sharp shadows and, depending on its size, relatively hard light, but the nature of the lens itself diffuses the light to a degree, so if you want a really sharp shadow, you should remove the lens.

1'-square area will at 2' cover a 4'-square area. At 3', that same light is spread over a 9'-square area. If we continued to 4', we'd see the light spreading over 16 square feet of area. So, from 1' to 4' the light has diminished in intensity 1/16 of its initial power because it is spread over that much more area.

When you're dealing with a fixed subject — for instance, an actor sitting at a desk — the relationship of that subject to the light source doesn't change. But if the actor becomes animated and leans forward in their chair, their relationship to the light source can change substantially. This is where understanding inverse-square can help you alleviate problems before they arise. If you're lighting that actor with a fixture from 4' away and they lean forward, moving 1' closer to the fixture, they have changed their relationship to that light by 25 percent. Or, in inverse-square terms, there's about a 50-percent increase in light intensity on the actor — definitely a noticeable brightness. However, if you move the fixture to 8' from the actor (and increase its brightness), then their movement of 1' is now only 1/8 or 12.5-percent increase.

This is also a situation where bigger is better. A 4' soft source at 4' has the same quality of light as a 16' source 8' away, but the spatial relationship to the subject is substantially different. (The intensity of the source behind the diffusion will need to increase to keep everything equivalent, but that's a subject for another day.)

This also works for lighting groups of people: The farther away and larger the source is, the more evenly the light will spread on subjects — who, of course, will likely be at different distances from the source. Moving from 1' to 2' away from a fixture, there's a fall-off of 75-percent light intensity, but moving from 11' to 12' from that same fixture creates a fall-off of less than 20-percent. Therefore, if you have the ability to create a 20' source and place it 20' away, then the intensity difference would be negligible between subjects at different distances, and the actors can move around within a substantial area without necessitating a change to light-intensity and exposure.

The practical lesson is that the larger and farther away the source is, the larger the area you can cover with relatively equal illumination from a single source. This is what I like to call the lighting inverse-square "dance."

For more on photometrics and the inverse-square law, see Shot Craft in AC *Dec. '19.*

Soft Light Everywhere

Look around and you'll see myriad examples of soft lighting in architectural situations. Interior designers are always looking for ways to soften light in rooms, making them more ambient and "sourceless." This starts with lampshades, which are nothing more than decorative diffusers for standard light bulbs. There are also torchiere lamps, which direct hard light *up* to bounce off the ceiling and give the room a soft glow. Architectural designers often hide lights in recessed areas, bouncing them off walls to create a soft glow from a seemingly invisible source.

Not every light can easily be made into a hard source, but any light can be made into a soft — or at least a soft*er* — source by adding diffusion material or by bouncing.

The Resurgence of Vintage Optics and Why Rehousing Them Is a Good Thing

By Christopher Probst, ASC

Over the past decade, new lens series for motion-picture photography have been created at an unprecedented pace. As the industry has transitioned from mostly film-based capture to digital-recording media, imager sizes have increased, and there has been a push for increasingly higher-resolution capture, mastering and exhibition formats. All of this has spurred optical manufacturers to respond with ever more lens offerings.

A set of Canon FD Aspherical lenses from the 1970s, rehoused by Zero Optik of Los Angeles.

In terms of achieving a creative intent, the characteristics inherent in lenses have become increasingly important to cinematographers. The roles that lighting, production design, wardrobe, color and atmosphere play in the final look continue to be significant, but with today's digital cameras rendering often hyper-clean, rock-steady and potentially *grainless* images, the idiosyncratic nuances of individual lenses and lens families are scrutinized as never before.

Many cinematographers find it hard to define exactly *what* they look for in a lens. Lately, lots of attention has been placed on "flares" as a trick to pull out of one's toolkit, and "bokeh" has seemingly become an obsession for those trying to achieve a sumptuous background blur in their images. But regardless of trends, a lot of what we associate with a given lens or lens manufacturer has been ingrained in us through our own biases and beliefs (shaped in part by manufacturers' claims) and generalizations handed down over the years.

With the push into higher-resolution cameras and exhibition specifications, it might seem counterintuitive that some cinematographers look *backward*, to vintage optics, to give "character" to their work. What advantages might older lenses provide over (arguably)

In comparison to the Zero Optik lenses, these Canon K-35 lenses were rehoused by True Lens Services from England. Both companies offer cam-style movement, new irises and PL mount. Zero Optik is 95mm front diameter, while TLS' housings have 110mm fronts.

superior modern optics? Should we not want our images to be rendered sharp, in-focus, and with good contrast — all hallmarks of a well-corrected, optimally designed, modern cine lens?

Most of today's cinematographers work with a handful of prominent digital-imaging platforms supplied by just a few camera manufacturers, and the look created by these "digital stocks" is more homogenized than the looks cinematographers traditionally achieved in analog, film-based work. With film, the characteristics of the image were shaped by emulsions (historically created by more than one manufacturer) of varying sensitivities, color and contrast, as well as by the processing/printing options at labs (of which there were also many).

In the digital realm, this playing field has been greatly whittled down.

Lenses employed to create motion-picture images have evolved tremendously over the last century-plus of filmmaking, and lens manufacturers have endeavored to eliminate as many imperfections in their products as possible. However, some aberrations that would make an optical designer cringe while examining the lens' image on a projector can have interesting qualities in regard to the photographed image. A subtle degree of spherical aberration, for example, can work wonders in smoothing out the transition between the foreground focus and the background image. (Yay, bokeh!) A little bit of geometric distortion can heighten a dimensional feeling at the center of the frame, popping the talent out amid their environment — and some fall-off/optical vignetting toward the edges of the frame can similarly help direct the audience's eye. These are all attributes that an *imperfect* lens can give to a scene.

In support of this idea, manufacturers such as Panavision have, over the last decade, cracked open their storage rooms and dusted off "retired" lenses. For example, cinematographer Robert Richardson, ASC had Panavision's Dan Sasaki — an ASC associate — resurrect long-dormant Ultra Panavision 70 anamorphic lenses (used on such films as 1959's *Ben-Hur*) for *The Hateful Eight* (*AC* Dec. '15). Panavision has also been refurbishing and rehousing many of its other legacy lenses for contemporary use; the PVintage line, for instance, is a modern repackaging of their popular Ultra Speed lenses of the mid-to-late 1970s.

In 2014, in tandem with its move into larger-format sensors, Arri created the Prime 65 lenses, essentially updating and rehousing the legacy medium-format Hasselblad optics from the late 1980s that were used with the Arri 765. Demand for other optical "flavors" covering larger sensors prompted Arri to tap into various full-frame and medium-format optics (rehoused by IB/E Optics) to create the Prime DNA lenses in 2017, which have since worked on dozens of films.

In addition, several third-party rehousing companies have been working overtime to place vintage glass (from still-lens families as well as actual legacy cine series) into modern housings with updated mechanics. The 70-plus-year-old Cooke Speed Panchros, for example, have been recommissioned to shoot television's *The Crown* (Adriano Goldman, ASC, ABC, BSC; *AC* June '20) and *Penny Dreadful: City of Angels* (John Conroy, ISC; *AC* June '20). Prominent rehousing companies such as True Lens Services (England), P+S Technik (Germany), Zero Optik (U.S.) and GL Optics (China) all offer a wide range of lens series for rehousing.

Rehousing a stills or vintage lens can make a dramatic difference in its functionality, essentially transforming it from something not easily used into something ready to withstand the rigors of film production. Rehousers typically discard the old barrels and retain the original glass elements and (often) the sealed lens groups. Taking this "lens head" back to its barest form, rehousers can provide entirely new focusing transports (such as cam-style movements), which facilitate much smoother operation, and can possibly also redistribute the spread of focus distances engraved, offering more usable degrees of rotation to the AC. As well, new barrels can be standardized to today's ergonomics and common front diameters, making their use on contemporary camera setups effortless. Finally, new irises can occasionally be used, increasing the number of blades — which creates a more circular aperture, which is then exhibited in the bokeh of the image — and also possibly reversing its rotation direction to match cine-lens standards.

Regardless of which option one chooses — modern lenses or rehoused vintage glass — there have never been more optical options than now. And having such a wide range of lenses spanning the gamut of performance and character is never a bad thing. ◆

THIS MONTH'S CONTRIBUTORS

Ernest R. Dickerson, ASC is a director, cinematographer, producer and Society member ("Creation Is a Patient Search," p. 56).

Samantha Dillard is *AC*'s digital-content creator ("Otherworldly Talent," p. 30).

Michael Goi, ASC, ISC is a cinematographer, screenwriter, director and Society member ("Directing and Visual Storytelling," p. 54).

Dana Gonzales, ASC is a cinematographer, director and Society member ("It's All About Perspective," p. 58).

Jay Holben is a filmmaker and an associate member of the ASC (Shot Craft, p. 16).

Jean Oppenheimer is a Los Angeles correspondent for the magazine ("Across Nations," p. 42; "Cinematographers Sharing Knowledge," p. 44).

Stephen Pizzello is *AC*'s editor-in-chief ("A New Millennium of Screen Artistry," p. 46; Global Village, p. 64).

Patricia Thomson is a New York correspondent for the magazine (Short Takes, p. 26; "Shifting Tones," p. 60).

David E. Williams is *AC*'s web director and associate publisher ("Long Legacy," p. 57).

EDITOR'S NOTE

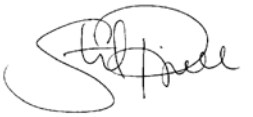
The late, great Allen Daviau, ASC was the embodiment of what the Society seeks from its members. In addition to his world-class talent, Allen's commitment to the ASC was remarkable. He always made himself available as an educational resource, and his incredible knowledge of cinema history made him a walking encyclopedia (and I mean the "walking" part literally, because Allen famously did not drive). For years, he served as chair of the ASC's Membership Committee, devoting countless hours to the duty of finding and assessing promising candidates who would enrich the Society's roster.

But beyond the service, his helpful and humble nature, and his innate joy and enthusiasm for cinematography and movies, there is the work itself, which will outlive all of us. Allen was there to help Steven Spielberg establish his name with the 1968 short *Amblin'*, whose title was incorporated into the name of Spielberg's production company, Amblin Entertainment. He captured the magic of a lovable alien's bike ride past the moon with a young boy for *E.T. the Extra-Terrestrial*, an iconic shot that became the Amblin logo and helped make the movie a beloved touchstone for millions around the world. He contributed his skills to a long list of other classic films that certify his versatility, including Spielberg's *The Color Purple* and *Empire of the Sun*; John Schlesinger's acclaimed espionage thriller *The Falcon and the Snowman*; Barry Levinson's period feature *Avalon* and handsome gangster film *Bugsy*; the Albert Brooks comedy *Defending Your Life*; and Peter Weir's existential drama *Fearless*.

Along the way, Allen earned a string of industry honors from his admiring peers, including the ASC's Lifetime Achievement Award; two ASC Awards (for *Bugsy* and *Empire of the Sun*) and another nomination (*Avalon*); and five Academy Award nominations.

Allen was always a good friend to this magazine, and it's our honor to present a heartfelt tribute in the form of a career overview by staffer Samantha Dillard, who gathered warm and insightful testimonials from friends and collaborators ("Otherworldly Talent," page 30).

In addition, this month's issue presents a piece on Ellen Kuras, ASC and producer Anna Hashmi's project *Chronicle*, for which dozens of filmmakers across the world captured the early days of the Covid-19 pandemic ("Across Nations," page 42). Also featured are an *AC* Archive historical revisiting the magazine's coverage of cinematography during the 2000s ("A New Millennium of Visual Artistry," page 46); an article showcasing ASC members who have shifted to the director's chair ("Directing and Visual Storytelling," page 54); a profile of cinematographer Quyen Tran, whose recent projects include the television mini-series *Unbelievable* and the feature *Palm Springs* ("Shifting Tones," page 60); a Short Takes column detailing the remote-production techniques that helped cinematographer Nicola Daley, ACS shoot the playful dance project *Swan Lake Bath Ballet* during lockdown (page 26); the return of our periodic Global Village department, which this month details the international production *Giri/Haji*, a critically lauded crime drama set in London and Tokyo (page 64); an In Memoriam tribute to industry stalwart and ASC associate Denny Clairmont of Clairmont Camera (page 78); and the revival of Wrap Shot, a back-page slice of cinematography history (page 80) that will occasionally alternate with our ASC Close-Up Q&As with Society members.



Stephen Pizzello
Editor-in-Chief