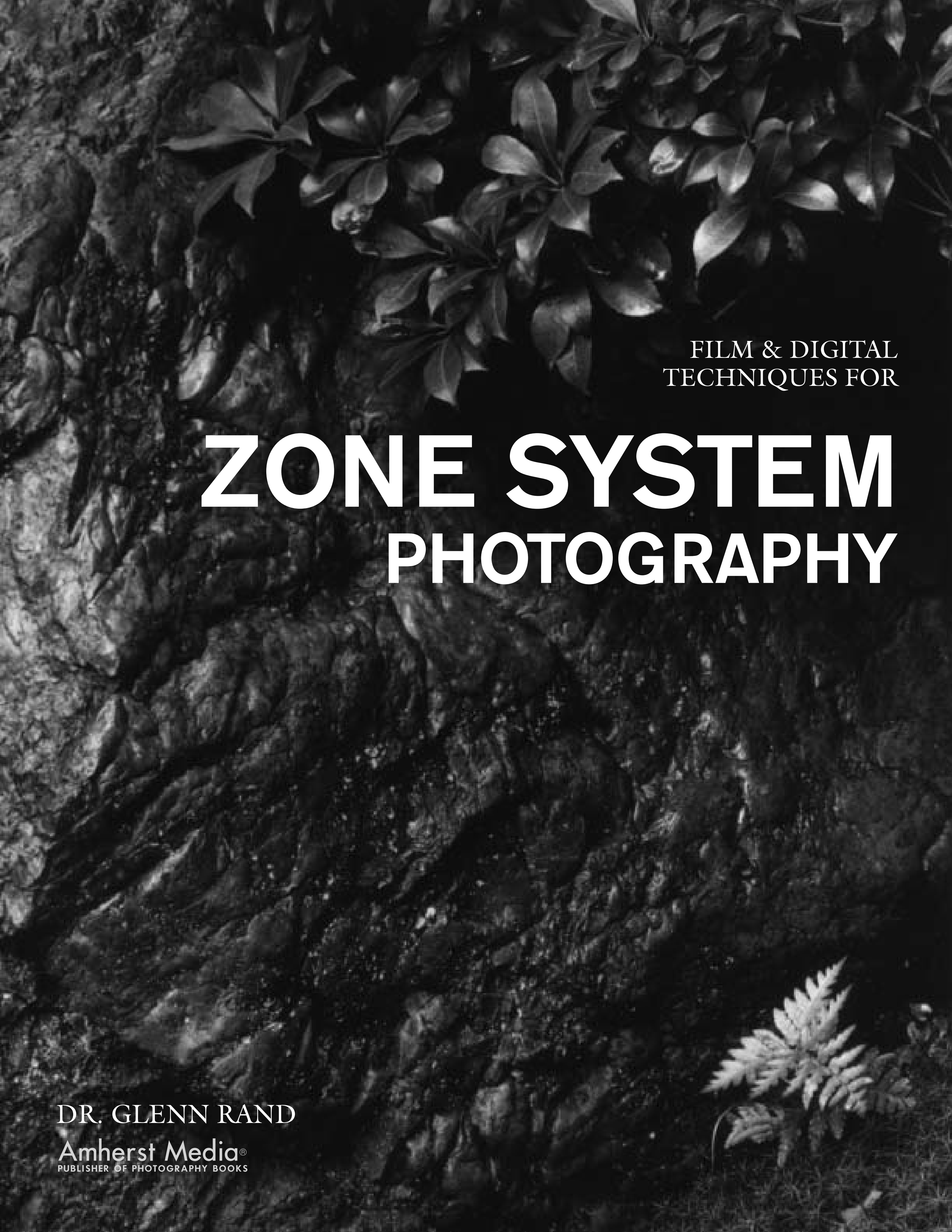

FILM & DIGITAL TECHNIQUES FOR

ZONE SYSTEM PHOTOGRAPHY

DR. GLENN RAND

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All photographs by the author unless otherwise noted.

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Photo by David Ruderman.

ABOUT THE AUTHOR

Dr. Glenn Rand has taught and administered in public education, community colleges, and universities since 1996. Since 2001 he has taught in the graduate program at Brooks Institute in Santa Barbara, CA, where he serves as acting graduate program chairman. In conjunction with these academic roles and consulting he has developed and reorganized several curricula for fine art photography, commercial photography, digital imaging, and allied curricula. His teaching has included courses in lighting, as well as commercial and fine art photography.

He received his bachelors degree and master of arts from Purdue University. He earned a doctorate from the University of Cincinnati, centering on the psychology of educational spaces, and did post-doctoral research as a visiting scholar at the University of Michigan. Since the early 1980s, his extra-academic research has included computer-based imaging.

As a consultant, Rand's clients have included the Ford Motor Company, Photo Marketing Association International, the Ministry of Education of Finland, and many other businesses and several colleges. As part of his consulting for the Eastman Kodak Company, he traveled and lectured on how to maximize Tmax films when they were first released.

Black & white photographs by Glenn Rand are held in the collections of thirty public museums in the United States, Europe, and Japan and are widely exhibited. His photographs have also been published in editorial, illustrative, and advertising functions.

He has published and lectured extensively about photography and digital imaging, covering topics ranging from commercial aesthetics to the technical fine points of lighting. He is the author of numerous books and contributes regularly to various periodicals, such as *Rangefinder* magazine, of which he is a contributing editor.

ABOUT THE CONTRIBUTORS

CHRISTOPHER BROUGHTON—Christopher Broughton earned his BS and MS in professional photography from Brooks Institute in Santa Barbara, CA, where he served as Director of Laboratory Operations while completing his Masters of Science degree. Prior to becoming a full-time faculty member at the Brooks Institute in 1996, Broughton also served as faculty for University of Pittsburgh's "Semester at Sea" program. He has authored articles in *Petersen's Photographic, Outdoor Photographer, PC Photo,* and *Studio Photography & Design Magazines,* and has been a featured lecturer for Hasselblad USA, and Eastman Kodak. Broughton's black & white photography is exhibited and represented by Art Matters in Long Beach, CA; Robin Fold of The Golden Orb, CA; The Griffin Gallery in Venice Beach, CA; and the Silver Light Gallery in Carmel, CA.

DAVID RUDERMAN—David Ruderman has been making photographs for many years and has studied with well-known photographers, such as John Sexton, through short courses and workshops. David works in Sacramento, CA, where he exhibits and has his work published. While transitioning to digital photography, David's photographic experiences are heavily weighted with his black & white photography.

ROBERT SMITH —Robert Smith (BA, MS) is a long-time faculty member at Brooks Institute in Santa Barbara, CA, who taught full time for more than twenty years and remains a part-time faculty member. Before coming to Brooks, Smith's career included celebrity portraiture and advertising photography. His personal work seeks to capture the play of light and design on the natural landscape, and in the unexpected abstraction found in abandoned, man-made objects. His photographs are included in private, corporate, and museum collections, and exhibited in many one-man and group exhibitions.

INTRODUCTION

As photographers, we see the effects of light falling on our subjects and are drawn to create images so we can share the visual excitement. However, in order to best communicate our vision to viewers of our photographs, we must rely on some tools and processes that allow us to effectively convey our impressions. The Zone System is one of these tools. It allows us to precisely record our visual impression of the world and tell someone else what we saw in the most beautiful of visual languages: the language of black & white photography.

Facing page—Photo by Glenn Rand.
Below—Photo by Christopher Broughton.

THE CONCEPT

The Zone System looks at the photographic process with the finished product in mind. Putting consideration of the print at the beginning of the creative process means that the end of the process is as important as finding the subject for the photograph. This idea is known as *previsualization*.

To present viewers with a print that matches our creative vision, we must have a clear idea of the way that light affects the scene and the way the visual information in the scene will be recorded on the negative. We must be able to control exposure to ensure the widest range of tones, from black to white (measured in zones in this system) and capture detail within all important areas of the scene. When we capture these qualities on the negative, we must maximize the development process to ensure that we can print an image that matches our creative vision.

THE ZONE SYSTEM LOOKS AT THE PHOTOGRAPHIC PROCESS WITH THE FINISHED PRODUCT IN MIND.

Though the Zone System may seem complicated, following the steps the method requires will allow you to become consistent in the way you work and lead to better results. As you become more and more consistent, you become free to say more with your photographs. When consistency replaces "happy accidents," your vision will emerge.

Though using the Zone System can ensure that the image you produce is technically excellent, following the approach alone does not make a picture *art*. After all, what does it matter how elegantly you speak if you have nothing to say? So while the main emphasis of this book is the technical approach to making excellent black & white photographs, it will be your vision and interpretation of the world around you and how you communicate this through black & white photography that determines your success as an artist.

Photo by David Ruderman.

CHAPTER ONE

GETTING STARTED

Using the Zone System requires a scientific approach to creating art. To produce images that match our creative vision, we must fully understand and anticipate the way the existing light affects the scene, how to best capture detail, and how to refine the development process so that the final print sings. When photographers master the steps outlined in the Zone System, they can easily predict (previsualize) the outcome of their prints. With the technical success of the image assured, we have more mental energy that can be put toward seeing and composing our photographs.

VARIABLES AND CONSTANTS

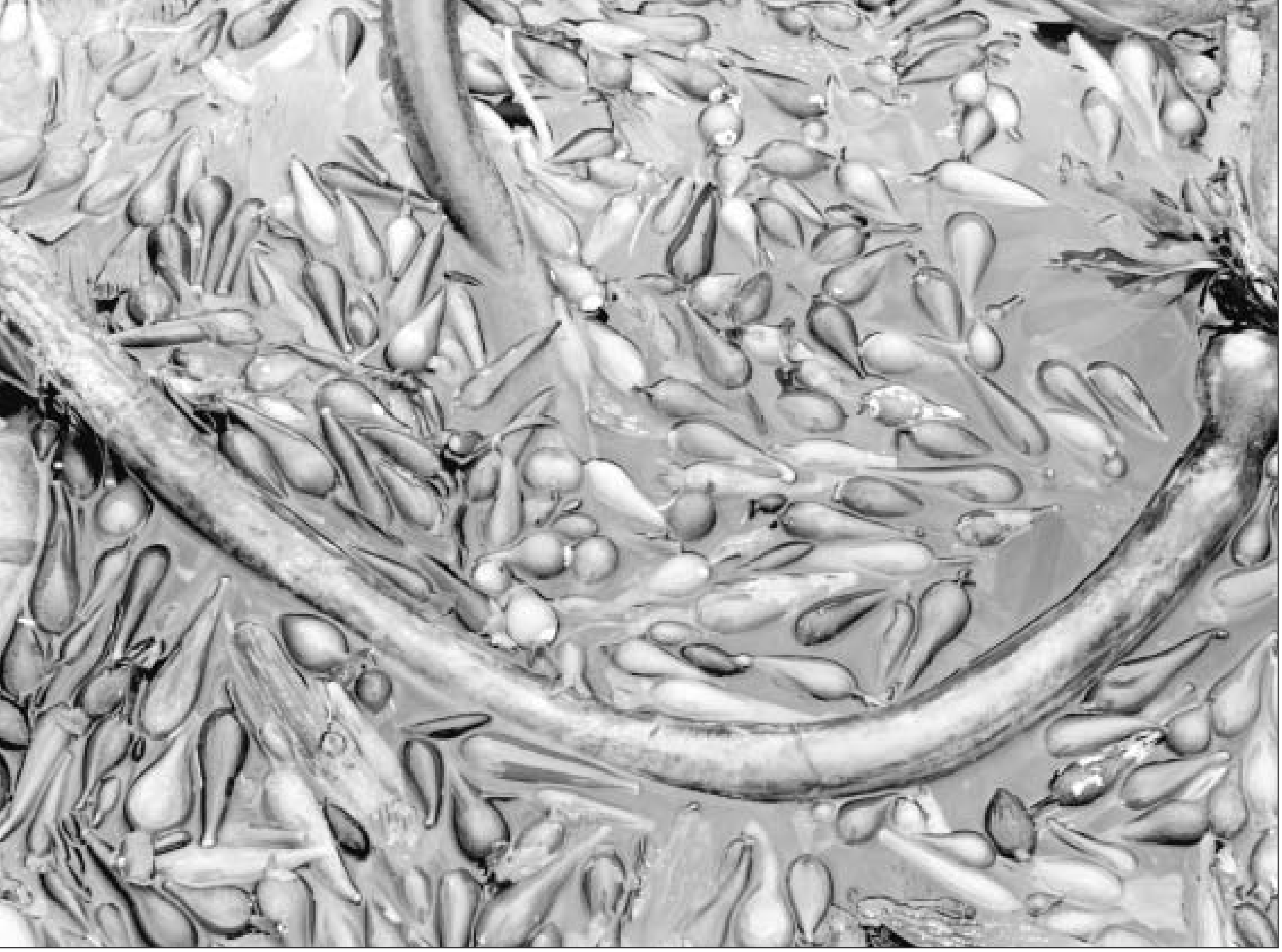
Over five-thousand variables (or, more specifically, combinations of factors) are at play when creating images—not including the effects of filtration and advanced printing techniques. The light in the scene, the exposure, the film type and ISO, the shutter speeds and aperture, the variables at play in developing the film, and the options we are faced with in printing our images all affect the outcome of our images.

With so much variability, the odds that we will not achieve our goal in conveying our artistic vision are high. For this reason, one of the most important tasks we must undertake when beginning to use the Zone System is to control and eliminate some of the variables and their overall effect on our work. This process of standardization is the key to achieving good results. Without it, you cannot predict the outcome of your efforts.

USING THE ZONE SYSTEM REQUIRES A SCIENTIFIC APPROACH TO CREATING ART.

Of the many variables, the only factor that lies outside our control (unless we're working in the studio) is the light. For this reason, it is considered an independent variable—meaning we can't control how it changes. The other aspects of the photographic process (development and printing), however, are either dependent variables (we can control how they change) or constants (they don't change).

By controlling the dependent variables in the photographic system, we can compensate for the effect of the constants and the independent variables.



Above—Photo by David Ruderman.
Facing page—Photo by Robert Smith.

CONTROLLING VARIABLES

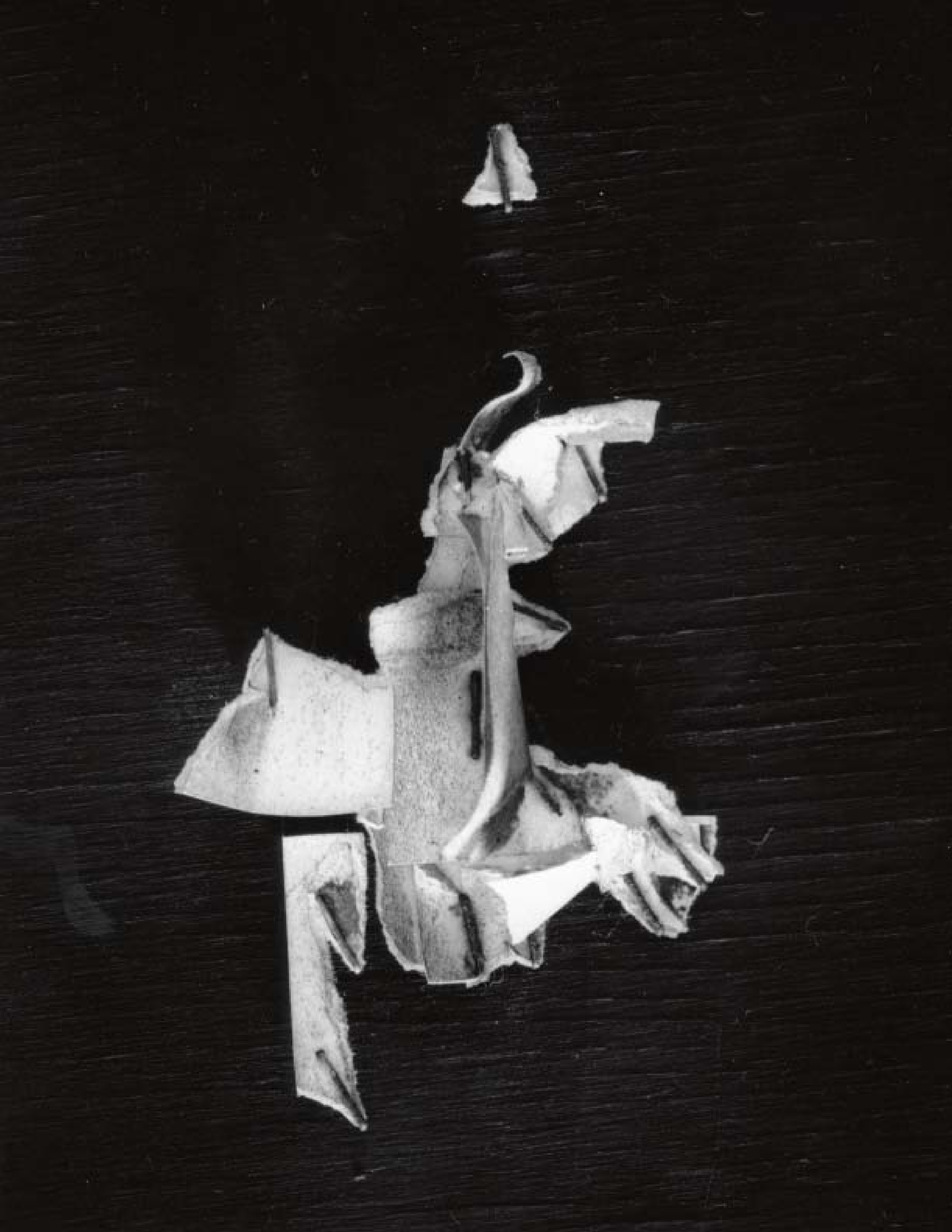
Aperture and Shutter Speed Calibration. Shutter speed calibration is the first step in standardizing our photographic process. If a spring mechanism creates the shutter speeds, the speeds may vary based on the strength, age, and reliability of the spring—and this introduces an unwanted variable into our imaging. Use a shutter speed tester or go to a camera repair shop to have the lens tested. Unless the shutter speeds are far out of line (more than a factor of ⅓ stop), the known variation can be added into the exposure calculation. If there is a significant or inconsistent difference between the marked and actual speeds, the lens or shutter system should be repaired.

The aperture settings on most cameras click into position to ensure that the manufacturer's setting is maintained. If this is "sloppy," have your lens checked at a camera repair shop.

SHUTTER SPEED CALIBRATION IS THE FIRST STEP IN STANDARDIZING OUR PHOTOGRAPHIC PROCESS.

Film Speed Test. Another important step in preparing to use the Zone System is the film speed test. Conducting the test will allow you to ensure that the ISO setting on your camera is matched to the published ISO rating of your selected film. The testing process involves a few simple steps:

Metering. Taking a light meter reading allows us to understand the way the light in our scene will affect our exposure. It is a critical step in creating a



negative that will allow us to produce a print that matches our previsualization of the subject or scene.

Light meters can measure incident light (light falling on the subject) or reflected light (light that bounces off of a subject or element in a scene). For our purposes, using a reflective meter is the best bet.

There are three types of reflective meters. The most common type is the TTL (through-the-lens) meter, which is built into a camera. When using the Zone System, such meters can be useful as measuring tools, not automatic ex-

Photo by Christopher Broughton.

Photo by Christopher Broughton.

posure controls. To use a TTL meter, set it to spot mode or place it close to the reflective subject rather than taking a reading from distance. Handheld averaging meters are yet another option. The downside to using them is that you must be able to stand close to the subject you are metering so that you can focus the meter on the tonal area you want to meter. A third type of meter, a handheld spot meter, is a narrow-angle light meter used to take accurate reflected-light readings from a small area of the subject. Such a meter allows you to stand farther away from subject or tonal area. A spot meter is your best choice when using the Zone System.

BEING AWARE OF THE SUBTLETY OF THE LIGHT IS WHERE THE ZONE SYSTEM COMES ALIVE.

Today, most meters provide a digital readout. This can cause small problems in converting from a world of smooth transitions of light (analog) to a measure of specific numbers (digital). If you are using a digital meter, remember that there may actually be important tonal shifts that fall *between* the values on your meter's readouts. Though this will not affect most pictures, it *can* have a visible effect in some cases. Being aware of the subtlety of the light is where the Zone System comes alive.

The Target. To run the film speed test, you will need to photograph an evenly lit target. It is best to use one comprised of a white board with a large black rectangle at the center (i.e., the target should be predominately black with a white border). This type of target takes into account the effect of scenic light when testing your film. Because the target has a white border reflecting toward the camera lens, a small amount of flare is created that affects the exposure. Since flare is a normal part of all photography, including it in the target design provides a more naturally occurring light situation. However, if need be, you can use a single-toned target. Because we need to produce a thin (i.e., low-density) negative, you will want to use a darker-toned target like a gray card or a dark-colored piece of matboard. Whatever your choice, make sure that the target is large enough to fill the frame (at least 8x10 inches). The lens should be set to infinity. Focus is not an issue. Meter the center and the four corners of the dark target before starting the test. They should all read the same. If they read differently, then the target is not evenly lit.

Below—Photo by Christopher Broughton.
Facing page—Photo by Glenn Rand.

Photo by Christopher Broughton.

Location. Photograph your target on the shaded side of a building or under a cloudy sky. Do not conduct the test on a day when the sun is intermittently blocked by cloud cover. If you use artificial lights, note that tungsten lights will yield different results than sunlight. You can compensate for the difference in the color of the tungsten light by using an 80A filter for the test.

DO NOT CONDUCT THE TEST ON A DAY WHEN THE SUN IS INTERMITTENTLY BLOCKED BY CLOUD COVER.

Tripod. Setting your camera on a tripod will allow you to keep the camera steady and eliminate the need to reframe the shot when creating a series of exposures.

Technical note: Some cameras allow you to change the aperture setting in ⅓ stops, some change in ½ stops, and some change in whole stops. It is important to understand how your camera's settings work before starting this test. If you are unsure, consult the user's manual.

Here are the specific steps for conducting the film speed test:

1. With your camera in manual mode and the lens focused at infinity, expose two frames with the lens cap on.
2. Next, remove the lens cap and prepare to photograph the target.
3. Set your meter's or camera's ISO to ¼ the ISO rating of the film. (For example, if you're using ISO 100 film, set your camera or meter to ISO 25; if you're using 400-speed film, set it to ISO 100.)

RESET YOUR CAMERA'S ISO SETTING TO MATCH THE FILM'S PRINTED ISO RATING AND FINISH THE ROLL. . . .

4. Meter the dark part of the target you have set up. (*Note:* There is no need to re-meter before capturing subsequent frames.)
5. Stop down four full stops from your metered reading. (In other words, if your meter reading was f/5.6 at 1⁄15 second, your new exposure would be f/5.6 at 1⁄250 second or an equivalent exposure.) Use the largest aperture (smallest f-stop number) as your starting lens setting. Focus at infinity and fill the frame with the target. The card need not be in focus. Make an exposure of the target.
6. Stop down your aperture using the smallest increment (e.g., 1⁄3 or 1⁄2 stop) available and capture another shot.
7. If your camera allows adjusting the aperture setting in 1⁄2 stops, you will repeat steps 5 and 6 until you expose seven frames (nine including the two taken with the lens cap on). If your camera allows for 1⁄3- stop adjustments, repeat steps 5 and 6 until you expose ten frames (twelve including the two taken with the lens cap on).
8. Reset your camera's ISO setting to match the film's printed ISO rating and finish the roll with normal exposures. This is important. If you fail to finish the roll, the developer will have fewer frames to work on, and overdevelopment may occur on the tested frames.

Photo by Glenn Rand.

We have made a roll of film with a series of exposures at different exposure indices. We are establishing the exposure index that is accurate for the film. (Readers will a basic understanding of the Zone System will note that stopping down four stops in step 5 and making the incremental changes, we produced all Zone I exposures. This zone concept will be covered in chapter 3.)

Develop the film using your standard development method and time. The resulting strip of film will have two blank frames at the beginning, then a series of frames starting relatively thin and fading to no density.

Once the film has dried, read the negatives with a densitometer. (The following instructions will assume you're using ISO 100 film. If you're using some other ISO, your results will be similar but the ISO numbers listed will differ.) Here's how it's done:

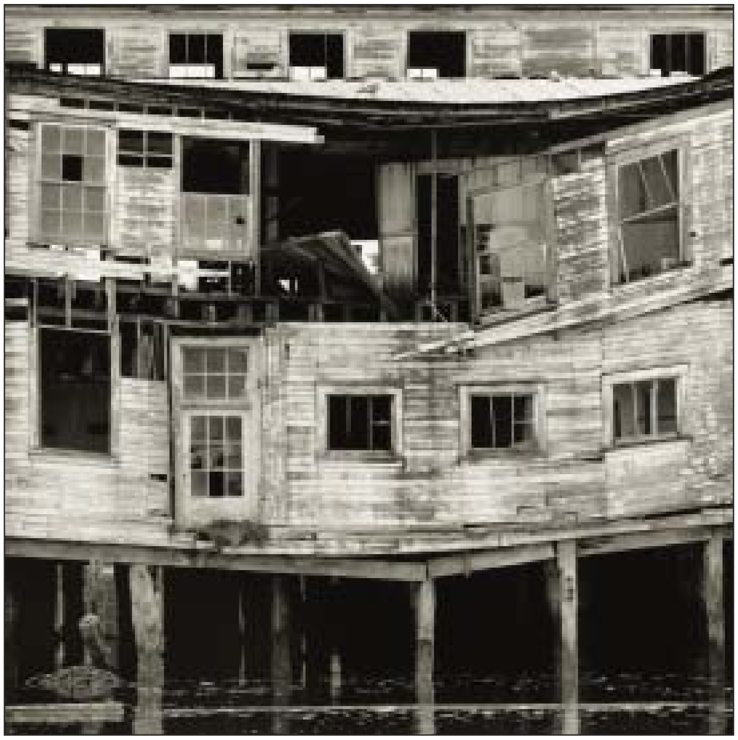


Photo by Christopher Broughton.

1. Use the densitometer to take a reading of the two blank frames at the beginning of the roll (the ones created with the lens cap on). The resulting number is your film base plus fog (FB+F) reading.
2. Read each subsequent frame and record the readings on the appropriate line below. The darkest frame should be the first one after FB+F, lightest to the farthest right.

If your camera's ISO setting was adjusted in ⅓ stops in the film speed test, use the following chart:

FB+F =	25 =	32 =	40 =	50 =	64 =
80 =	100 =	125 =	160 =	200 =	

If your camera's ISO setting was adjusted in ½ stops in the film speed test, use this chart:

FB+F =	25 =	32/40 =	50 =
64/80 =	100	125/160 =	200 =

Your optimal film speed setting with the tested film will be the ISO closest to FB+F+.10. If FB+F+.10 lies equally between two frames, choose the lower ISO setting.

CHAPTER TWO

UNDERSTANDING LIGHT

To use the Zone System, you must understand how light affects your subject or scene. You must also learn how light will be translated into a range of tones, from pure black to pure white, when the scene is captured in black & white. (These tones are called zones. The concept will be covered in detail in chapter 3.) By cultivating an understanding of light, you will be able to

Photo by David Ruderman.

"read" your photographic subject and make creative exposure and development decisions that will allow you to create a print that expresses your creative interpretation.

COLOR AND TONALITY

Light is an energy source that makes vision possible and allows photographic capture to happen. Some light is invisible. Some light, the kind that concerns us as we make images, can be perceived by the human eye. This is termed visible light. All light is comprised of waves, which are described in terms of their length. Each of the wavelengths that comprise the visible spectrum can be perceived as a particular color. This concept governs our visual perception of the world around us. Though it is essential to our perception of the world as we experience it with our eyes, we must learn how to "translate" that perception if we are to visualize a scene in black & white.

IMAGES WITH A GREATER NUMBER OF TONES CAN DEPICT SCENES WITH MORE DETAIL.

To previsualize a color scene as a black & white image, you will need to understand how various scenes will appear when devoid of color. To approximate monochromatic vision (seeing in black & white) and to aid in diminishing the effect of color, some photographers use an amber-colored filter (e.g., Wratten #80) to view their scenes. This renders the scene in a sepia tone. Squinting is often thought to be a way to reduce color, but it only produces a change in intensity, not a change in color or tonal range.

In a black & white image, the range of light values present in the scene are depicted as tones. Images with a greater number of tones can depict scenes with more detail. Imagine an image comprised of only pure black and pure white tones. Now, imagine an image comprised of a wide range of tones, from pure black, to dark gray tones, to medium-dark tones, moving all of

Facing page—Photo by David Ruderman.
Below—Photo by Christopher Broughton.

Photo by Christopher Broughton.

the way to light gray and pure white. When an image incorporates a wide range of tones, we can perceive the soft shadow of a dark tree cast on freshly fallen snow. We can perceive that the skin tones of a particular subject are lighter than her hair color but darker than her sweater. We can also see the pattern and texture of the subject's clothing, depicted by varying tones (highlights and shadows).

"SEEING" THE SCENE: HUMAN VISION VS. PHOTOGRAPHY

Learning to anticipate the way a color subject or scene will appear when rendered in black & white is critical to producing a quality image. However, before we can predict the way the scene will be depicted, we must investigate the differences between human perception and the capabilities of photographic capture.

Humans can perceive a wider range of tones than can be captured on film or reproduced in the print. The human perceptual system has the ability to see a 1,000,000:1 dynamic range. This range would include being able to see black print on white paper under starlight at the low end and the sun at the high end. While we can see the sun, the light is so intense that it will

Photo by Christopher Broughton.

Photo by David Ruderman.

damage the retina of our eyes. This means that we can see light throughout a twenty-stop range. Film, on the other hand, can only capture a 1,000:1 dynamic range without manipulated development. This is equivalent to about a ten-stop range. Because we can see a wider range of tones than we can capture, we need to learn how to modify the way we look at a light range as we attempt to photograph a scene. This is one of the main concepts of the Zone System.

Human vision has another advantage over photographic capture—chromatic adaptation. This means we can look at the side of a white building, in shade, and process it as white. Unfortunately, film cannot adapt. It holds a constant dynamic range. This means that our film will record the shadow side of the building not as white, but as gray. Fortunately, through exposure control we can manipulate the limits of the film. However, it is important to realize that as we make exposure adjustments, we are not impacting the dynamic range of changing the film's exposure latitude. Rather, you are using the Zone System to finesse your capture and development and make the scene appear in the print as it did in the scene.

THROUGH EXPOSURE CONTROL WE CAN MANIPULATE THE LIMITS OF THE FILM.

QUALITIES OF LIGHT

Reflected Light. To optimize our black & white photography, we must understand the way the quality of light will affect the scene and, ultimately, the photograph. In outdoor scenes, most of the light that you will use to make photographs is reflected light.

Several things affect the reflected light that we see and capture when photographing our subject. The qualities of the subject—for instance, whether it is light and smooth or dark and textured—affect the way it will be recorded on film. Dark objects reflect less light than light objects. The angle of incidence of the light and the direction in which the light is reflected from an object's surfaces also impacts the way the scene is recorded. For instance, a mirrored surface will reflect almost all light striking it, but if the reflection is pointed away from the camera, then little light will be recorded. Reflective subjects also affect the appearance of nearby scenic elements. For instance, when light is reflected off of a white wall, it can strike another scenic element, opening up the shadows and softening the overall contrast in the scene. Conversely, a nearby dark row of trees can increase the dynamic range in the

IN OUTDOOR SCENES, MOST OF THE LIGHT THAT YOU WILL USE TO MAKE PHOTOGRAPHS IS REFLECTED LIGHT.

Photo by Glenn Rand.

Facing page—Photo by Glenn Rand.
Right—Photo by Robert Smith.

scene by absorbing more of the ambient light and keeping it from lightening up the shadows.

LIGHT NORMALLY HAS A COLOR BIAS THAT CAN AFFECT THE INTENSITY OF REFLECTED LIGHT.

Even though we are capturing black & white images, the color of light in our scene can affect the final print. Light normally has a color bias that can affect the intensity of reflected light. At sunrise or sunset, for instance, light takes on a reddish cast that will not reflect as well from green objects as it will from neutral tones. Similarly, open shade, without direct sunlight, is very blue and reduces the reflectivity from yellow or reddish subjects. (Remember, our eyes can adapt to changes in light, allowing us to perceive colors as we expect them to be rendered. Film cannot process this information in this way. It simply records what is there.)

Specular vs. Diffuse Light. Light is often described as being specular (hard) or diffuse (soft). Specular light is produced when a light source is positioned far from a subject or is small in relation to the subject. This type of light is characterized by a high contrast range. In other words, direct light produces bright highlights and sharp, dark shadows. In the studio, specular light may result, for example, when lighting your subject with a single light; with little ambient light filling in the shadow areas, there is a high dynamic range. In outdoor work, specular light results on a clear day when the sun's light hits the earth in parallel rays. To envision specular light, think of the tiny hot spots you might see on a car's chrome bumper on a sunny day.

Diffuse light is soft in nature and is characterized by softer shadows (which, in some cases, may even disappear). In studio work, diffuse light is often achieved by passing light through a large, transparent material, placed close to the subject. A softbox is a popular diffuser; however, its proximity to the subject is key in determining the quality of light that will result. Even a softbox can produce harsh light on the subject if it is positioned far away. Soft light may also be created by using a series of lights to illuminate the subject. When working outdoors, cloud cover, humidity, direction of the light, altitude, and particles in the air affect the quality of the light. Humidity, fog, and rain, for instance, can affect the path of direct light, softening the effects of the sun and reflected light in the scene and lowering the contrast range in the image. On an overcast day, for instance, the sun lights up the clouds and they transmit the light to the earth's surface from all across the sky, creating many angles of light. In the natural landscape, light commonly becomes more diffuse when sunlight reflects off light-toned surfaces, such as snowfields, sand, light-colored rock walls, or even light-colored trees. These surfaces not only reflect the light into the shadows but also diffuse the reflected light because they are textured and often change the color of the light.


Photo by Glenn Rand.

The specular/diffuse nature of the light should not be confused with the intensity of the light. Intensity of the light deals with how much light is illuminating the scene, not its specular or diffuse nature. While intensity affects how exposure is made it does not affect the quality of the light.

DIFFUSE LIGHT IS SOFT IN NATURE AND IS CHARACTERIZED BY SOFTER SHADOWS. . . .

We must also be careful not to confuse the subject contrast range with specular/diffuse light. The difference in reflectivity of various parts of the scene creates the subject contrast range. If there is a large subject contrast range, then specular light will only expand those differences while diffuse light can only reduce the apparent differences depending on how each tone was created.

Sweet Light. Another type of light that is very interesting to many photographers is what is called "sweet light." On clear days, this light exists from about one half to one hour before sunrise to sunrise and also from about a half hour to an hour following sunset. This is dependent on the sky conditions, time of year, and the landscape. This light is very long in contrast range even though the light is diffused. The brightest portion of the sky is around the horizon, and the light lacks strong directionality. Because the light is highly diffuse and not strongly directional, the light penetrates into shadows, opening them up and allowing exposure of large areas of the scene that might otherwise be overlooked as potential picture areas.

Now that we understand the basics of light, we can begin to analyze how light is recorded in the negative and how we can manipulate exposure and development to create the visual effects we desire in our prints.

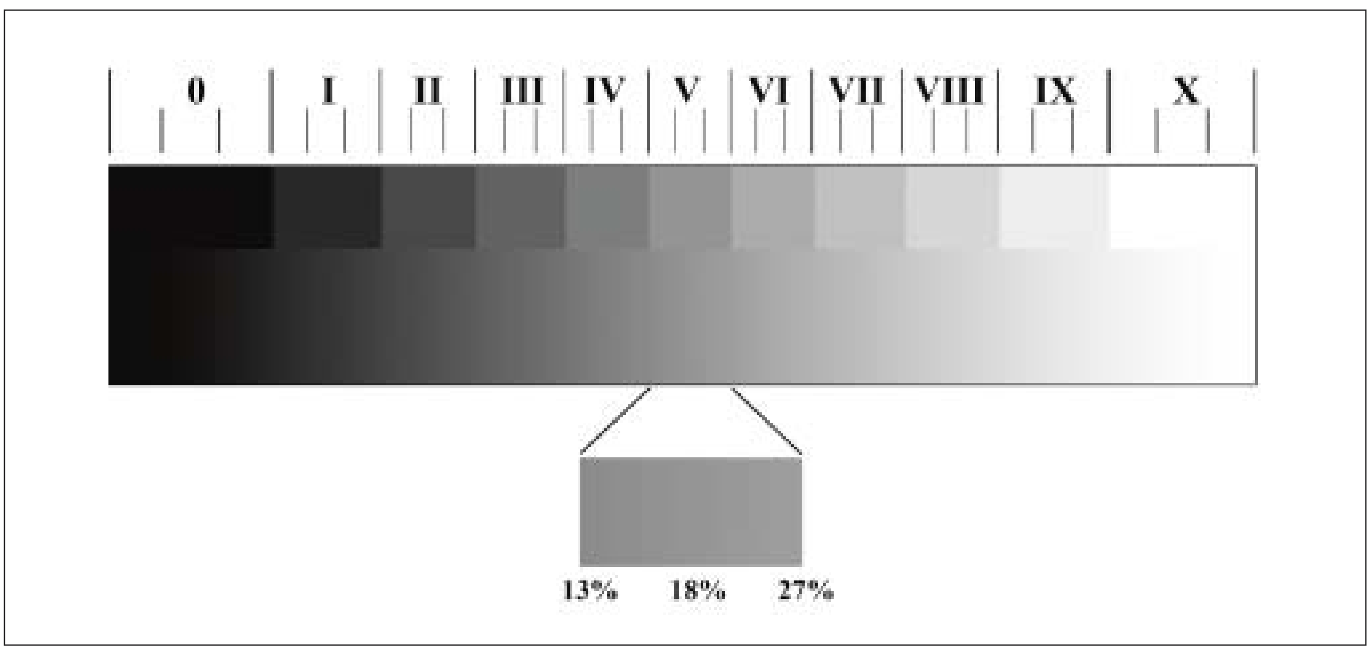
CHAPTER THREE

THE ZONE SCALE

The zone scale (also called the grayscale or zone ruler) is perhaps the most recognizable component of the Zone System. It is a visual tool comprised of a series of eleven tones, labeled Zone 0 through Zone X, ranging from pure black to pure white. Once we've metered key areas of our subject, we can use this tool to previsualize the tones in the scene as various print densities. (*Note:* Some Zone System practitioners use a ten-zone scale [labeled Zone 0 through Zone IX]. Either scale can be used to achieve good photographs.)

In the following pages you will read descriptions of the eleven zones. The scale can be thought of as being comprised of three separate areas: the dark zones, detail zones, and highlight zones. The dark zones add richness to the print. They do not support detail but do provide dark patterns. The detail zones are the information carriers for the picture. The highlight zones provide sparkle and life to the picture. The way the dark zones and highlight zones interact determines the tonal range and dynamism of the print.

This illustration shows the way a black–white gradient is divided into zones. Film and human perception compress the high and low responses to tones in the scene, and thus the zones will enlarge as they move toward either end of the gradient of black-to-white tones.



You will also find a discussion of the qualities the various tones add to the image. These are: (1) pattern—observable tonal shifts without image information; (2) soft detail—image information at a low level of communication; (3) texture—a repetitive change in image tone with reasonable sharpness; and (4) sharp detail—a quality that provides strong image information allowing easier reading of the subject.

While we talk about the way the zones look or are previsualized we will also discuss how they relate to the measurement of density in the print or negative where appropriate.

DARK ZONES (ZONES 0, I, AND II)

Zone 0 (Black). Zone 0 is black. Think of this as the richest black tone you can achieve on a piece of photographic paper. True black is the absence of reflection, but this is very hard to accomplish. In terms of the negative there is no usable density.

The black in a photograph can give richness or can absorb all the energy in the image. There are no hard and fast rules about the amount of Zone 0 that will work in a photograph. The black establishes the bottom of the print's dynamic range and creates pattern, texture, and detail in dark-toned areas of the image. Too much black can be detrimental to the quality of the photograph because no detail will be visible in such areas, and detail is critical to communicate your vision to the viewer. Lacking detail, large areas of Zone 0 density can be thought of as black holes that absorb energy from the photo as the eye moves across the area.

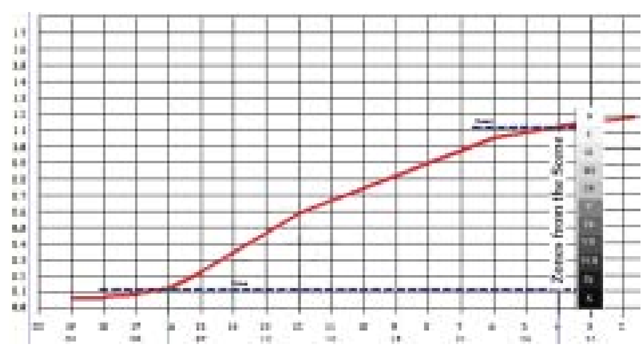
DENSITOMETRIC TERMS

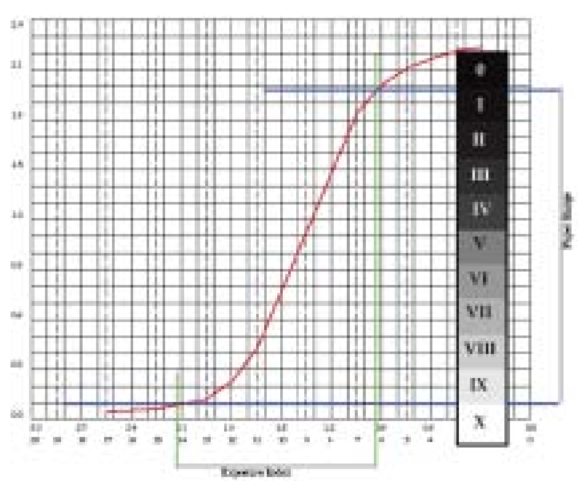
In the following sections, densitometric terms are used to discuss some of the zones. These are stated in both how they can be used and in American National Standards Institute (ANSI) measurements. The terms important to the Zone System are Dmin, the least useable density on a negative that is defined by ANSI as film base plus fog plus 0.04 (FB+F+0.04) and Dmax, the highest density that will be useable or as an ANSI standard of 0.9 times the maximum density in a negative. These two represent the toe (the lowest density or where the film curve turns upward) and the shoulder (rounding off at the top or the highest density) of the negative. All densities in the negative below Dmin will reproduce in a print as black, and all tones above Dmax will reproduce as white.

The point where the toe ends and the curve becomes a straight line is known as the "speed point." This represents a value used to establish our exposure index and has a value of FB+F+0.10.

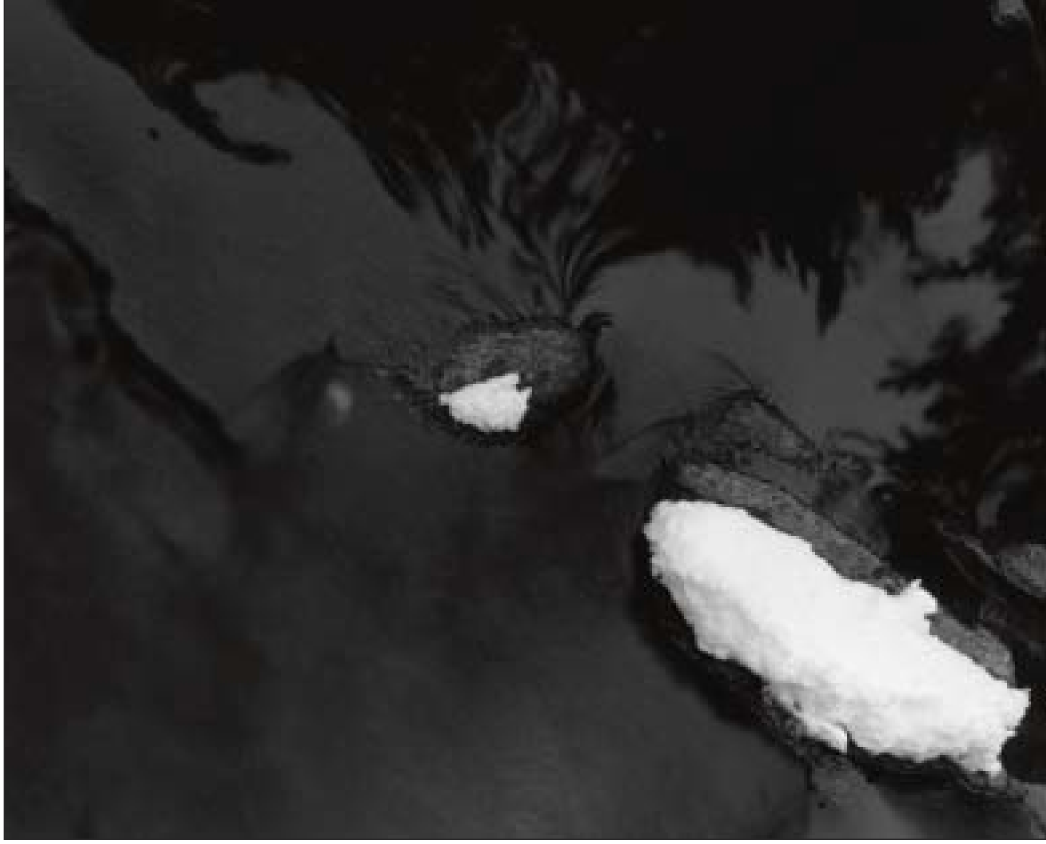
In the film curve chart below, the red line indicates the densities of the negative, the horizontal dashed line at the bottom represents Dmin, the horizontal dashed line at the top represents Dmax, and the zone scale indicates which zones will be created by various densities in the negatives. The densities shown as the portion below the Dmin line represents the end of the tone and black in the print; the density portion above Dmax will reproduce as white.

The photographic printing paper curve has the same components as the film curve though we do not use a measure of speed point. Thus, the ANSI standard for Dmin represents white or paper base (B)+F+0.04, and Dmax is 0.9X the maximum black that is seen as black.





Above—Film curve with zones. **Left**—Paper curve with zones.



Because the sky reflected as dark middle gray in the smooth water, the dark zones (0, I, and II) formed the patterns. These zones will only be seen when compared to lighter zones. Photo by Glenn Rand.

Zone I (Near Black). This tone is visually discernable from Zone 0, but without black to compare it with, it might be wrongly assumed to be Zone 0. In the previous chapter's film speed test section, you learned about the significance of a densitometer reading of FB+F+0.10. Here, it is useful to note that this value is equivalent to Zone I.

As discussed on page 30, the densitometric value of FB+F+0.10 establishes the starting point of the straight-line portion of the film's curve. This is the point where we see the predictable change in density with increased units of exposure. On a perceptual basis, this means that above this point, each one-stop increase in exposure will increase the density one zone. Thus, Zone I becomes the point where the Zone System becomes most predictable. This concept of predictability is what the Law of Reciprocity is all about. (*Note:* the Law of Reciprocity and characteristic curves are discussed in greater detail in the next chapter.)

ZONE II IS THE DARKEST TONE THAT SUPPORTS ANY PICTURE INFORMATION BEYOND TONE.

Finally, since Zone I is close to black, it has similar qualities to Zone 0; it too creates pattern, texture, and detail in dark areas of the image. It also creates subtleties in an image. Beginning photographers often eliminate Zone I by using higher printing filters or higher grades of paper. This will flatten the picture and can enlarge black holes. When we look at a scene this is the zone that is normally seen as the darkest area.

Zone II (Patterned Darkness). Zone II is the darkest tone that supports any picture information beyond tone. In the print it will be about 5 percent reflective, which is just above the upper limit of what we normally call black. Soft detail and pattern can be perceived within these dark areas because Zone II is not the darkest possible tone. However, it cannot display as much texture or pattern as Zone III.

Because Zone II is located directly on the straight-line portion of the film's characteristic curve it is the first zone that can be consistently placed. This is done by taking a reflected light meter reading and underexposing by three stops. The concept of "placing" zones will be covered in detail in the next chapter.

Facing page—Because it is centered in the middle Zones (III–VII), the image shows smooth tonal changes and soft, curved surfaces. Both highlights and shadows accent against the broad middle tones. Photo by Robert Smith.

DETAIL ZONES (ZONES III, IV, V, VI, AND VII)

Zone III (Shadow Detail). In many ways Zone III is the most important zone. It is the darkest area of the scene where we can see sharp detail with full texture. Zone III sets the information flow in the image in much the same way as the underlying melody sets the structure of a song.

If you choose to have the majority of the information in Zone III, then the photograph can easily take on a mysterious feel. In low key images Zone III will carry the majority of the information since the higher zones in the detail area will function more as highlight or accent areas than detail carriers.

Regardless of the use you select for Zone III, it is a conscious zone. In good photography it seldom just happens. You determine what scenic elements must contain detail in the shadows and place that area in Zone III.

Zone III is used as the base level for considering proper exposure. This is because, no matter how you finesse the development, if you have not exposed to record the shadow detail it will not appear in the negative. For this reason we commonly use Zone III as the metering zone for dark-tone metering and as one of the end points of average value metering (see page 43). This is difficult for beginning photographers, who often meter the darkest area in a scene rather than a dark area with sharp detail.

FOR SOME PHOTOGRAPHERS THIS ZONE IS A CHOICE FOR DARK-TONE METERING.

Zone IV (Dark Middle Gray). Zone IV is a transitional zone that is full of detail. The tonal change from shadow to lightness starts at Zone IV. The progression through the two transitional zones, IV and VI, are very important in determining the contrast feeling of the photograph. If the transitional zones are minimized, the image will look contrasty. Though we must attend to how Zone IV functions, it is not an issue of the amount of Zone IV in the picture but how the zone helps transition from the shadows to lighter tones.

Some photographers use this zone for dark-tone metering. By choosing a tone only one stop below middle gray, the photographer shifts the detail consideration to highlight separation as opposed to concern for shadow detail.

Zone V (Middle Gray). Zone V is often referred to as middle gray. It is in the center of the tonal range and is within the reciprocity range (Zone II–Zone VIII). Zone V reflects about 18 percent of the light falling on it. Because meters are calibrated to this value, we can make both technical and aesthetic judgments in relation to positioning against Zone V. (*Note:* The concepts of reciprocity range and zone placement will be covered in the following chapter. Reread this section once you've worked through chapter 4 if these concepts are not yet clear to you.)

While many people interpret Zone V as darker than middle gray, it is both in the center of the system and perceptually the midpoint of the grayscale. When seen in comparison to the lower zones its centrality becomes clear. At the center of the zones, Zone V acts a visual pivotal point for the system.

Zone VI (Light Middle Gray). Zone VI is full of detail. The tonal change from middle tones to highlights begins at this zone. Once again in this transitional zone we need to attend to how this zone functions within the image more than the amount of the zone in the picture.

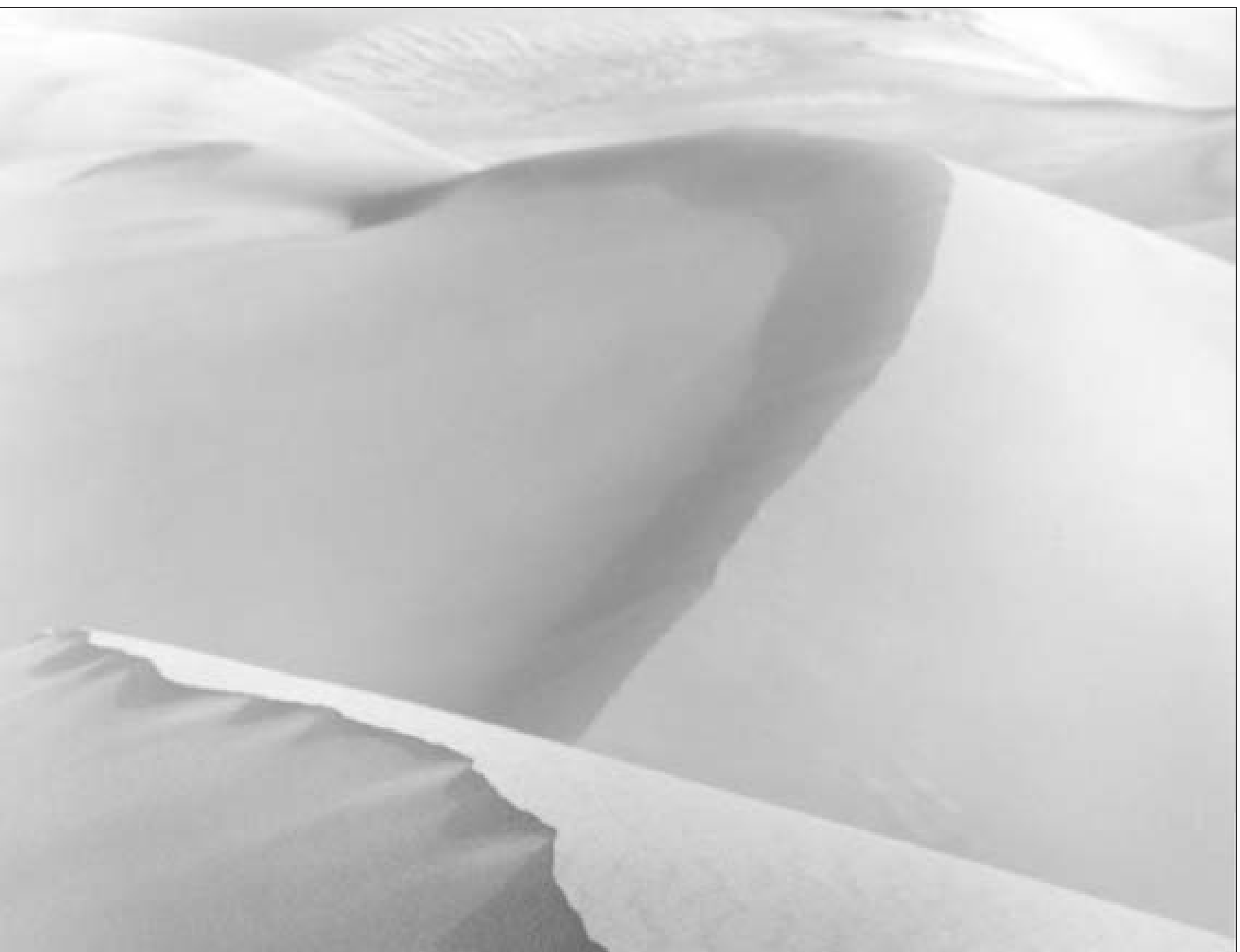
Since bright areas appear to advance in a print, the highlight and accent areas in this zone are very attractive to the eye. Note that Zone VI serves as the base of high key imagery.

This zone is also used in substitution metering. When photographing Caucasian portrait subjects, you can meter the palm of the hand instead of a gray card and open up one stop to create an effective image.

Zone VII (Highlight Detail). At the light end of the detail area is Zone VII. With a reflectivity of approximately 72 percent, this is the last zone in which sharp detail will be visible. Just as in Zone III, for the image to function, the detail in Zone VII is critical. If the majority of detail falls in this zone, the image will take on a soft, light, and airy feel. This is why we often use higher key images to convey a romantic feel.

LITTLE-KNOWN FACT

We typically think of zones as consisting of a single tonal value, because this makes it easier for us to quickly conceptualize the final print. For example, we think of Zone V as 18 percent gray. However, within each zone there is actually a range of reflectance values. For instance, Zone V actually spans reflected values from about 13 to 27 percent.



Seldom do we find naturally occurring high key images such as this one, previsualized by David Ruderman. Ruderman produced an image that uses only the highlight zones (VIII, IX, and X). The shadow detail in this image is found in Zones VI and VII.

Photo by David Ruderman.

As we move to higher zones the lack of tonal separation will not allow us to interpret the information within the lighter zones. With the sharp detail and full texture available in Zone VII, it is used as the high end for average value metering.

THE ZONES ABOVE ZONE VII WILL BE DIFFICULT TO DEFINE AS SIMPLE CHANGES IN UNITS OF EXPOSURE.

Within the printing process, Zone VII is a target for establishing proper print densities. This is because, as discussed above, the density changes in the higher zones are affected by printing from the shoulder portion of the film's curve, thus showing larger tonal areas than previous zones. The zones above Zone VII will be difficult to define as simple changes in units of exposure.

HIGHLIGHT ZONES (ZONES VIII, IX, AND X)

Zone VIII (Patterned Highlight). Zone VIII is the lightest information zone beyond highlight tone. In the print it will be the lower limit of what we normally call white. Because there are two zones lighter than Zone VIII, we can see pattern and soft detail in this light area. Though there is no strong detail in Zone VIII, it is a visually active area of the picture.

Located at the point at which the shoulder of the paper curve rounds off, Zone VIII is the last zone that matches a change in exposure with a predictable change in tone. (*Note:* This concept is covered in detail in the following chapter.) You should expect some soft detail on the negative before you achieve white. At higher zones the relationship between steps will not

translate directly from exposure to print. It can be accurately placed at three stops of overexposure from the meter reading.

Zone IX (Near White). This zone can be seen as different from white but only through a side-by-side comparison. Like Zone I at the dark end of the gradient, Zone IX correlates to a point that can be defined densitometrically. Zone IX is at the place where the shoulder rounds off. If a print is measured at Zone IX, its density will meet an ANSI standard for Dmin (B+F+0.04). (This should not be confused with the measurement of film [FB+F+0.04], that is Dmin.)

Because Zone IX is close to white, it provides highlight accents within the image. Along with white it will create pattern in Zone VIII.

Zone X (White). White is any value that reflects more light than the Dmin of the paper. Though the paper will gain some chemical fog during development, this is not perceptible. In most situations the whiteness of the paper base determines the way Zone X will appear. Depending on the base materials, coatings, and processing, the reflectance of the paper base will change.

CREATING A ZONE SCALE

To create your own zone scale, you can make a series exposures of a textured material, then print each exposure and arrange the frames from darkest to lightest. Here's how it's done:

1. Make a target by taking a piece moderate-toned, matte, textured material (e.g., a towel) and affixing it to a board so it stays flat.
2. Position the material in sunlight or under a single light source so that its texture is apparent.
3. With the camera on a tripod, focus on the surface. No shadows should fall on the target other than those created by the material itself. The frame should be completely filled with the target.
4. Take a meter reading from the material assuring that the only reading comes from the target.
5. Make a series of eleven exposures from five stops underexposure to five stops overexposure.
6. Process the film normally.
7. Contact print the negatives being careful to use a low paper grade or filter number to give separation between steps from black to white. If you have use of a reflection densitometer, control the print time so that your middle tone has a reflectance of approximately 0.74. If you are making this zone ruler without a densitometer, then print the middle tone to visually match an 18 percent gray card. All negatives should print at the same time or be printed simultaneously.
8. Cut the small prints and paste them to a card, arranging them from darkest to lightest.

The accent ability of Zone X is the important concern in the picture. Like black, too much white can harm the effectiveness of an image. When there is a great deal of white a void will be formed and/or the photo will have a hot look. If borders are important to the function of the photo, white at the edge of the image will break up or diminish the structural concept of the border.

Pure base white is easy to lose as you produce and finish your prints. Safelights can fog the paper slightly, overwashing can reduce the baryta coating, and chemical staining, incomplete fixing, and dry-down of fiber papers will all contribute to a loss of the dynamic range from the white part of the print.

Facing page and below—
Photos by Christopher Broughton.

CHAPTER FOUR

ZONE PLACEMENT

Imagine for a moment that you wish to photograph a light-skinned woman. You meter her skin and get a recommended exposure of f/8 at 1⁄30 second. However, this exposure will render your subject's skin tones as Zone V—middle gray. Obviously, this would be too dark for your fair-skinned subject. Fortunately, there is a remedy for this situation. For now, simply note that increasing the exposure will get you closer to your goal of creating a more realistic rendering of your subject. Note, too, that in order to do this you'll need to practice a technique referred to as zone placement. This concept depends on some other important concepts though, so before we turn our attention to zone placement, we'll need to understand a few other fundamental concepts.

THE LAW OF RECIPROCITY

The law of reciprocity is a key consideration when using the Zone System. In a nutshell, the law states that as one part of the system is increased another part of the system is decreased to keep the system in balance. At the center of the photographic system is a 2:1 ratio. For instance, the amount of light striking the film is either doubled or halved when a one-stop exposure change is made. Changing the aperture setting from f/8 to f/5.6 doubles the exposure and stopping down from f/8 to f/11 halves the exposure. A shutter speed of one second gives two times the exposure as 1⁄2 second. The film speeds are also based on a 2:1 ratio. An ISO rating of 200 is twice as fast as ISO 100.

THE IDEA OF EQUIVALENT EXPOSURES ONLY WORKS BECAUSE OF RECIPROCITY.

The law of reciprocity allows us to produce a series of equivalent exposures by opening up or stopping down and changing the shutter speed setting accordingly. For example, an exposure setting of f/8 at 1⁄125 second is equivalent to a setting of f/11 at 1⁄60. The idea of equivalent exposures only works because of reciprocity.

Many photographers think of reciprocity as the change in exposure effectiveness because of long exposure. That is actually reciprocity failure. We will deal with reciprocity failure later in the book.

Facing page—Photo by David Ruderman.

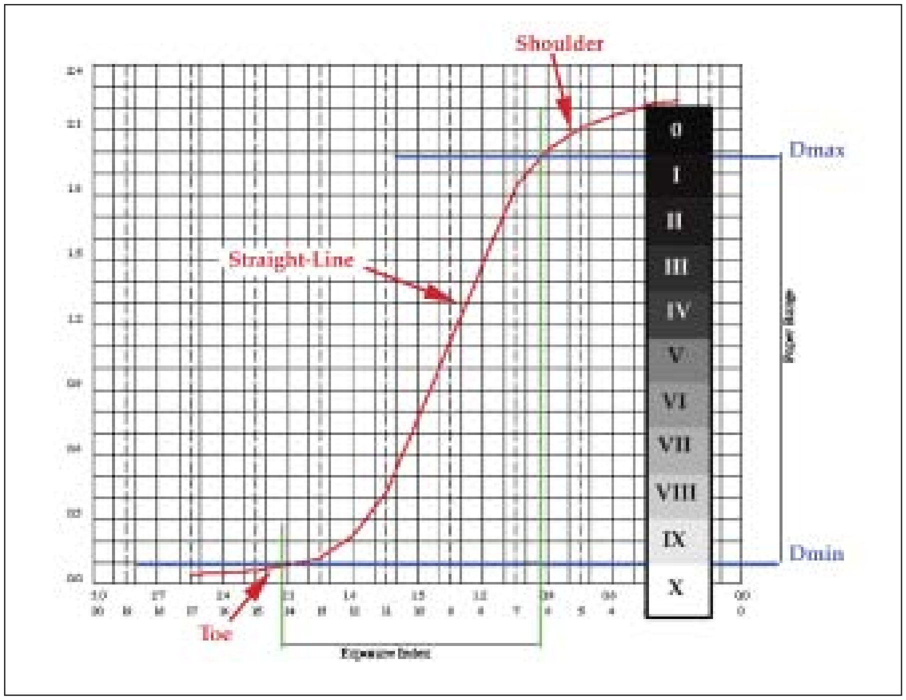
THE CHARACTERISTIC CURVE

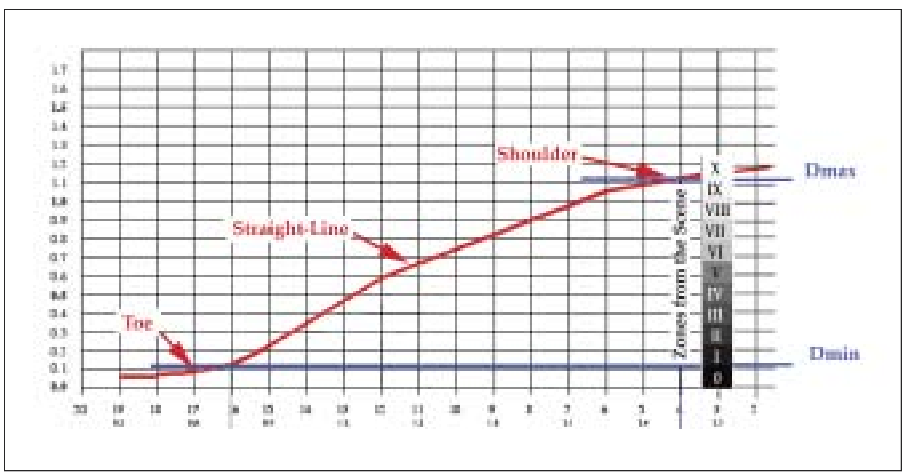
A characteristic curve is a graphical representation of the way various photosensitive materials respond to a light source. The curve shows the way in which density (plotted on the vertical axis) is affected by an increase in exposure (plotted on the horizontal axis). (*Note:* The actual characteristic curves and the zone relationships are not this equally spaced; they have been simplified for ease of discussion.)

The Paper Curve. The paper curve has three distinctive parts—the toe, the shoulder, and the straight line. The toe is the lower portion of the curve and includes Zones X and IX. Zone X falls below Dmin and Zone IX is located on the curved portion. Zones 0 and I are represented in a similar area at the shoulder of the curve. The curved part of the toe and shoulder show the tonal compression of Zones I, II, VIII, and IX in the print. Zones II through VIII appear on the straight-line portion of the curve.

In "Placing the Zones" on pages 41–42, you will learn how reading the curve will allow you to perfect your printing techniques to ensure an excellent print.

The Film Curve. The film curve is comprised of the same parts as the paper curve—the toe, shoulder, and straight-line areas. However, in the film curve, the shoulder is not as pronounced, and the slope of the curve is shallow compared to the paper curve. The slope of the curve is referred to as the contrast index, average gradient, or gamma depending on the shape of the curve and measurement method. Note that Zone 0 from the scene will fall at and below Dmin of the film. As discussed earlier, Zone I falls at the speed point, or the beginning of the straight line. This means Zone 0 and Zone I will not work well





Top—The paper curve is steep with a pronounced toe and shoulder. The red line is the curve representing the densities measured from a series of tones printed on the paper. The top blue line represents Dmax and the lower blue line is Dmin. The zone scale at the right shows where the various zones will print in relation to the curve. **Above**—The film curve is not as steep as the paper curve with a less pronounced toe and shoulder. The red line is the curve representing the densities measured from a series of tones produced on film. The top blue line represents Dmax, and the lower blue line is Dmin. The zone scale at the right shows where the various zones will be captured in relation to the curve. The zones are shown as they represent the scene and the print.

Photo by Christopher Broughton.

within a predictable linear relationship. While the areas are not as predictable with a relationship between exposure and tonal change, we use the toe area for Zones 0 and I to produce a negative with predictable and thus controllable zones (II through VIII) on the straight-line portion of the curve. Since the film's shoulder is not as pronounced as a paper curve, the function of our zones extends to include Zone IX. Zone X from the scene will be above our Dmax and is beyond the linear relationship we are creating.

PLACING THE ZONES

In the above section, we looked at a paper curve and a film curve. We noted the various parts of the curve: the toe, the shoulder, and the straight-line portion. By reviewing the curves, we can learn how manipulating the exposure will impact our final image.

AS THE EXPOSURE INCREASES, A CORRESPONDING CHANGE IN DENSITY OCCURS.

To get an idea of the way this works, let's look at the paper curve. Note that Zones II through VIII fall into the straight-line portion of the curve. The straight-line portion of the curve represents a direct relationship between exposure and density. In other words, as the exposure increases, a corresponding change in density occurs. For every stop of exposure you add to the initial print exposure, you will move up the zone scale by one zone. For every exposure stop you subtract from the initial print exposure, you will move down the scale by one zone. We know that a light meter reads Zone V. Therefore, on film, an area of the image that falls into Zone V will be rendered as Zone VI when the exposure is increased by one stop. Note that the effects of changing the print exposure will be most noticeable and controllable in the center of the zone scale, Zones III through Zone VII. Also, because we want to ensure repeatability in our results, the paper grade should remain a con-

Photo by Christopher Broughton.

stant. In this case, we used a grade 2 paper. We could also use a #2 filter with multi-contrast paper.

To summarize, then, you can use the following steps to ensure that the tones in your image will match the previsualized photograph:

1. Previsualize the zone you wish to have appear in the final print.
2. Meter the area of the scene that you wish to have in the final print. (The reflective light meter reading will give an exposure to make Zone V.)
3. Count the number of zones between the previsualized zone and Zone V.
4. If the zone previsualized is lower than Zone V (e.g., Zone II, III, or IV), then stop down the aperture or increase the shutter speed one stop for each zone you wish to change. If the zone previsualized is higher (e.g., Zone VI, VII, VIII, or IX), then open up the aperture or decrease the shutter speed one stop for each zone you wish to change.
5. Develop the film normally.

ZONE PLACEMENT GIVES YOU CONTROL OF ONLY ONE TONAL AREA IN THE SCENE.

Zone placement gives you control of only one tonal area in the scene. As you move the chosen tonal area up or down, the rest of the tones in the image will move proportionally in the same direction.

ALTERNATIVE METERING METHODS

There are three metering methods that are based on zone placement. These are commonly used methods that require no change beyond the metering/ exposure process. While these methods affect exposure for digital and film photography differently, they can help you achieve good exposure.

Dark-Tone Metering. Perhaps the most useful and nontechnical approach to film exposure based on the Zone System is dark-tone metering. This exposure method commonly uses Zone III as the metering point for proper exposure. It is a specific application of zone placement. Because image sensors do not tolerate overexposure, dark-tone metering is a very poor method for digital photography.

Many photographers have heard the phrase, "Expose for the shadows and develop for the highlights." Shadow detail is less affected by development than highlights, which are very susceptible to and controlled by changes in development. Therefore, you need to expose for the shadow detail or it will not be in the negative.

THIS EXPOSURE METHOD COMMONLY USES ZONE III AS THE METERING POINT FOR PROPER EXPOSURE.

You determine what part of the scene you want to be Zone III, shadow detail, and take a reflective light meter reading in that tonal area. Then stop down two stops from the meter reading for a correct exposure. When using this method, be sure to choose the area of the scene containing detail (Zone III) that is important to your photograph. Some photographers choose the darkest area in the scene as their dark tone. When they do this, they overexpose by two or three stops. This is a very common mistake.

Highlight Detail Metering. While not as common as dark-tone metering, some photographers prefer to meter highlight details. In this method, you meter the area in which you want to show highlight detail and adjust the ex-

Photo by Christopher Broughton.

posure by opening up by two stops. This is a preferred method for digital photography.

Average Value Metering. Some scenes we encounter will be predominantly comprised of light tones or dark tones. In such a case, we can use average value metering to make good negatives. In the previous chapter, we learned that Zone III is the darkest area of the scene where we can see sharp detail with full texture. Zone VIII is the lightest area of the scene where we can see sharp detail and full texture. Therefore, if we can control these areas, we will create an exposure that contains both highlight and shadow detail.

Prior to metering and exposing for the image, we must previsualize the way the important highlight and shadow areas of the image should appear in the final print. These areas of the scene will become Zone III and Zone VII in our final print.

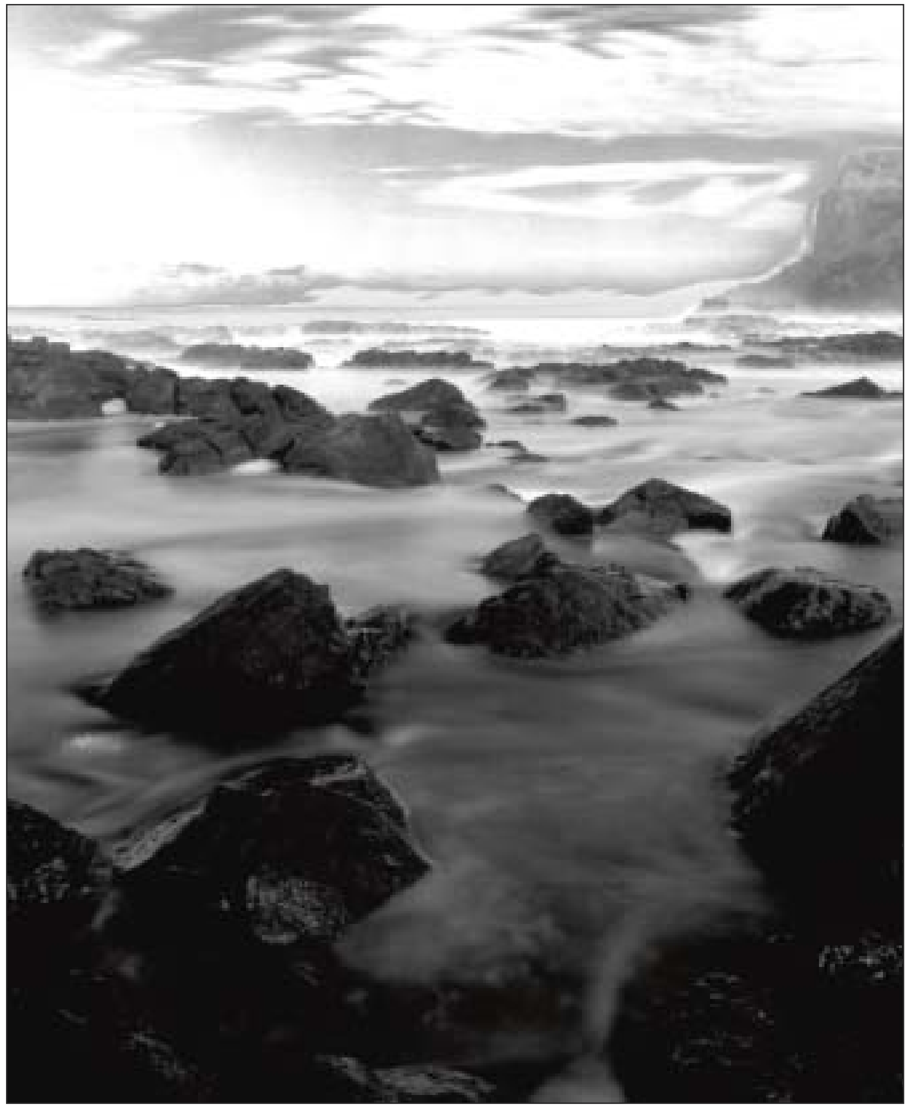


Photo by Glenn Rand.

Note that in order to use this exposure method, the light's dynamic range must not be too long or too short. The method will only work in scenes where there is more than an 8:1 and less than a 32:1 tonal difference. That provides a window to use this method if there are between three and five stops difference in the metered values of Zone III and Zone VII. To determine this variation simply count the stops between the meter readings of the chosen Zone III and Zone VII. There are three stops of exposure difference with 8:1 and six stops difference with 32:1 tonal variation.

We know that Zone III and Zone VII are four stops apart. If the scene we will be photographing has a four-stop difference between Zone III and Zone VII, then the light fits our expectation for a normal scene. In this case we would expose for Zone V—that is, two stops above Zone III and two stops below Zone VII. This is the same logic that we use if there are three to five stops difference between what we previsualize as shadow and highlight detail. Within this range, averaging the exposure values from Zone III and Zone VII will produce a negative meeting our need for detail without being biased by brightness or darkness in the scene.

CHAPTER FIVE

VISUALIZING THE SYSTEM

As mentioned in chapter 2, light makes photography and vision possible. Beyond understanding how light affects the scene we need to be concerned with how light is related to the film's sensitivity, exposure, and processing.

FLARE

Camera System Flare. Camera system flare is an unavoidable but somewhat controllable part of photographic capture. As light enters the camera the lens not only focuses light from the scene but also captures light from areas not

Photo by Christopher Broughton.

included in our viewfinder. This might be the sun shining on the lens from just outside the captured image, an overcast sky, or other environmental elements with high luminance or reflectance.

Some of the light that enters the lens reflects off of the lens elements, filters, or interior surfaces of the camera and, finally, exposes the film. When this light comes from a strong point source, polygons of light in the shape of the iris opening appear in the print. This can even occur when the sun is not directly in the image, if its light strikes the lens.

Scenic Flare. Glare, scenic brightness, overcast conditions, and bright skies can create a less noticeable type of flare. When the light is diffuse or broad, flare creates a broad pattern of light that spreads over a larger part of the negative or image sensor. Since it is diffuse, we do not recognize it in our negatives or digital files. It is not as blatant as those polygons of light—however, it is there.

With film, the effect of this added light to the negative is not just additional density that we will need to print through, it also alters the contrast range of the negative. Because we are adding light to areas of the negative that would be unexposed or lightly exposed we raise the Dmin or the speed point of the film. It takes only a little increase in density to change the dark areas of a picture. When we looked at the density of the negative we found that we were adding only 0.10 to black to achieve Zone I. Moving up the straight-line portion of the curve we needed additional density to move each successive zone. Therefore, adding an overall fogging created by flare to the film will have a greater effect in the areas with the least density. These are the dark areas of the picture.

Adding density to the shadow detail and toe areas of the negative and digital capture flattens the contrast. It also affects the highlight areas of the negative, filling in detail or eliminating detail in the highlights. This makes it difficult to obtain a discernable difference between Zones VIII and IX. This often compounds the problem you have in making your photographs in overcast or diffuse light situations. Because this light is diffuse to start with it will give you a flatter image.

Good technique, processing controls, and use of multicoated lenses and filters can reduce some ambient light flare, but nothing can totally remove the effect. Your best defense in reducing the flare is to use a lens hood or shade. The black interior surfaces of the shade or hood will absorb some of the diffuse light and stop it from reaching the lens surface, thereby reducing flare. This is as important in diffuse lighting conditions as in direct sunlight.

While not part of the picture taking process, you can produce flare when printing in the darkroom. It can be generated from fingerprints, old enlarging lenses, the use of white burning boards, or a white wall directly behind the enlarger and will reduce contrast in the final print.

If we think of the relationship between the parts of the capture-to-print process we can think of the continuum of light as "scenic flare." The light in

EXPOSURE LATITUDE

The negative effect of flare is exceptionally pronounced in digital images, because digital capture is highly intolerant of overexposure. Film, in contrast, is more forgiving of overexposure.

IT TAKES ONLY A LITTLE INCREASE IN DENSITY TO CHANGE THE DARK AREAS OF A PICTURE.

Photo by Christopher Broughton.

the scene varies greatly and our eyes, through adaptation and other physiological functions, can see a great deal of that light. However, film and image sensors do not have the same dynamic range and can record only a portion of the total light that might be in the scene. Through exposure we can select a contiguous portion of the light in the scene. This light might be in the deep shadows or the bright highlights, but the recording of the light has thresholds and maximum limits based on the exposure given.

Realizing that we see a different dynamic range than the film or image sensor records helps us greatly. This ability to transition from perceiving the world as it appears before our eyes to visualizing it in terms of how the film or image sensor will record it is one of the most important yet difficult parts of the Zone System. We need to look at our scenes in terms of the tonal qualities that can be reproduced in our photographic process rather than just marveling at the glories of the scene. This is previsualization.

When looking at a scene we will try to "normalize" the tonal range. This means that our perceptual system holds things to what we know as well as the reality of the tonality that is actually there. In this way we tend to see light in most scenes as normal. But in the photographic process there are several other concepts that can be seen as normal: There are the standards set by the ISO (International Standards Organization) and the manufacturers. These define the slope of the straight-line portion of the film, establishing sensor or film speeds and establishing specific values for the outcome of the process. The process of exposing and processing the film is controlled, and this is the concept that is used to establish the film speed. We will use this later to establish working speeds for the Zone System.

There is a limit to the range of tones the film can record and reproduce within the exposure and processing system. While we may like the light on a sunny day, this light may be beyond the "normal" expectations of the film. Depending on the humidity of the atmosphere, the light will exceed the dynamic range of the film by as many as three stops. In this case, with normal development, we could not reproduce either the highlight or shadows or parts of both.

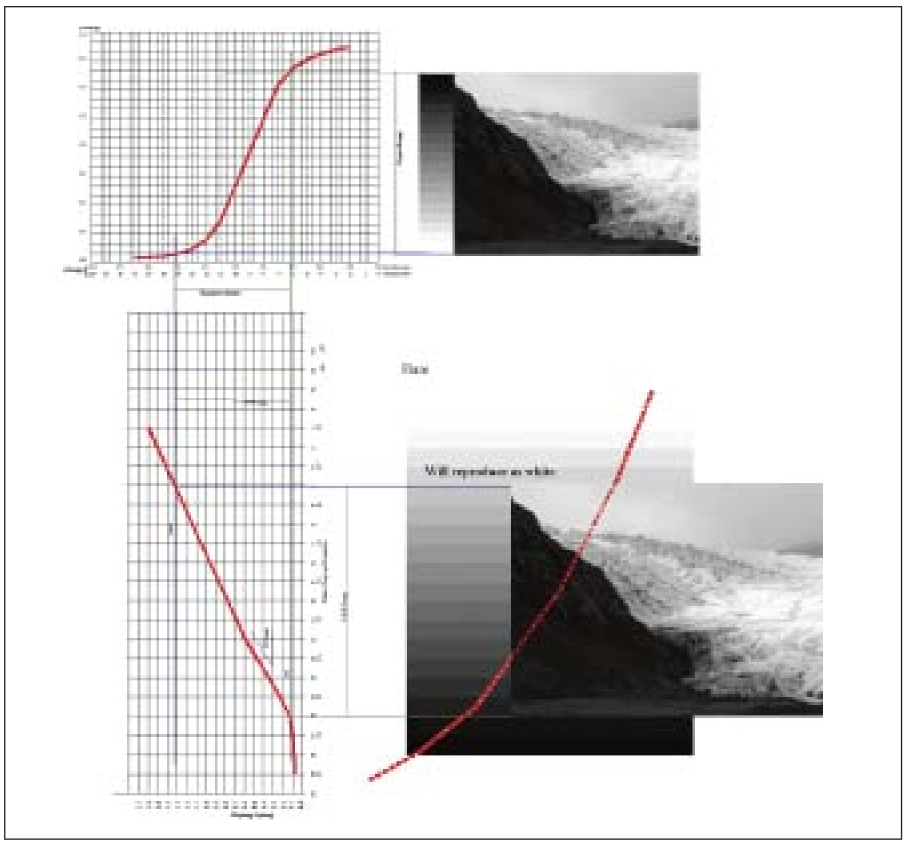
For film, normal light is flatter, slightly diffuse light that will closely match the film's ability to render the scene, giving you a negative that will print well. If the light is not normal for the dynamic range, development can be manipulated to allow the negative to print acceptably.

TONAL RELATIONSHIPS

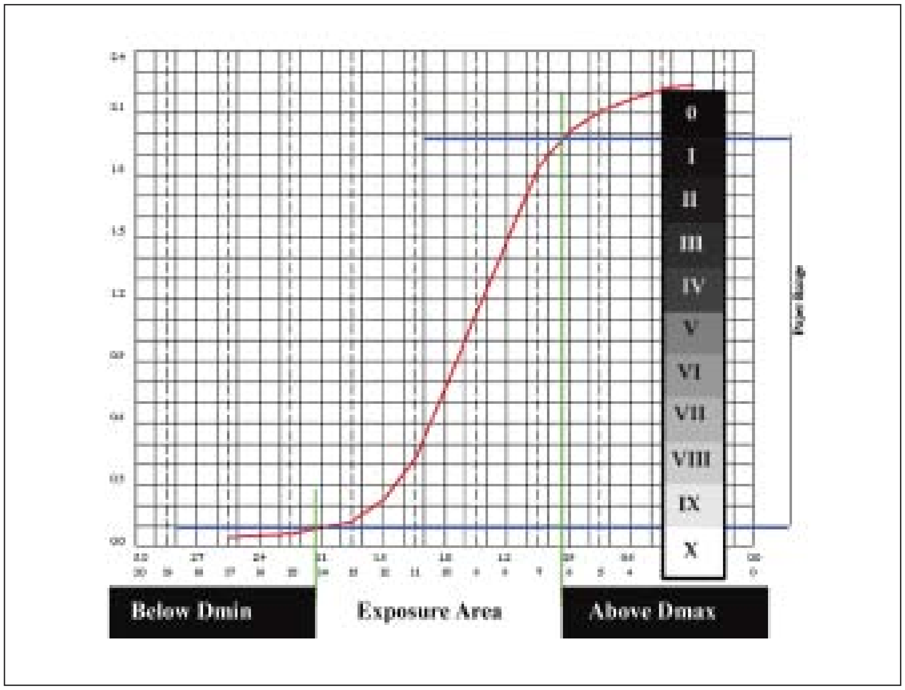
To see how we can make the film conform to the light without extensive use of calculations, let us examine the interrelationship of flare (the light in the scene), the film curve, and the print curve.

As mentioned above, not all light makes its way through the process and is represented in the print. Looking at the diagram we see that some light represented in the flare curve is below the threshold of exposure for the film; it will be located on the toe of the curve with a value less than Dmin. This light will have no exposure value in the negative and will not be seen in the final print.

At the other end of the useable portion of the light shown in the flare



This diagram depicts the interrelationship of the flare curve, film curve, and paper curve. We can see how light from the scene is translated by the film and reproduced in the print. At first glance, it is obvious that the film curve is turned 90∞degrees counterclockwise. Following any tone horizontally from the flare curve to the film curve shows the effect of the light during exposure. The point at which the tonal value intersects the film curve represents the effect of development on the tone. Moving vertically from the intersection on the film curve we arrive at the paper curve. The vertical line represents the light coming through the negative used to expose the paper. The point where the vertical line from the film curve intersects the paper curve represents the exposure effect of the paper in the enlarger. From the intersection on the paper curve, we again move horizontally to find the tone reproduced in the print.



The printing of the paper can only happen within specific limits. In the diagram above the characteristic curve is shown in red, and the blue lines show Dmax and Dmin. The green vertical lines define the limits of the light that will show tonal variations in the print from the negative. While the negative may provide tonal variation above and below the limits, in this diagram, as shown by the black rectangles, light variations to the left of the green line from Dmin will reproduce as white, and light variations to the right of the green line from Dmax will show as black.

curve is the tone that will reproduce as white. This may not be the brightest light in the environment, but because of the way the film develops and the limits of exposure of the paper it will be reproduced as white. Though the film has greater latitude to capture and develop tone than does the paper, it is the exposure limits of the paper that will determine the tones that appear when the image is printed.

The tonal exposure range of the paper is the controlling factor for the system. This is the amount of exposure the paper will accept from the negative; any value variations below Dmin or above Dmax will not be seen in the final print. If the negative lets in less light than is needed to expose the paper for Dmin, then that will be indistinguishable from other areas of white. Also, if the negative passes more light than is needed to achieve Dmax, it will be black regardless of the detail that might be present in that thin portion of the negative.

Our goal then is to make negatives that include information from the scene that won't exceed the paper's exposure range. At the least technical level this means we must know how the light in the scene compares to normal light.

If we can determine that the light for our photograph uses more of the flare curve and has a long tonal range, then we can make a simple adjustment to the development time that will produce a negative that is closer to our need for the paper. Likewise, if we determine that the light from the scene has less tonal range than the paper requires, we can make another simple adjustment to develop the negative to match the paper's ability to accurately represent the scene.

EXPANSION/COMPACTION

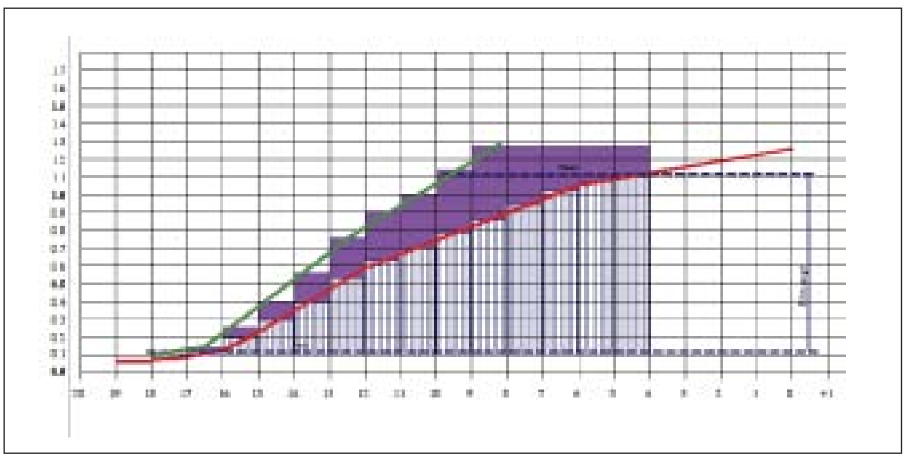
As we just saw, when all the parts—flare, film, and paper—are in sync, the negative will provide what is needed to represent our previsualized tones. But as just mentioned, the exposure needs to be within the limits for "normal" for the system to work. We can make small adjustments in development to control the negative's contrast if the light is not normal.

The idea is to over- or underdevelop to make the negatives meet the needs of the paper. Understanding the development of silver halide emulsions is key to being able to change the development to create negatives that "fit" the paper's exposure range.

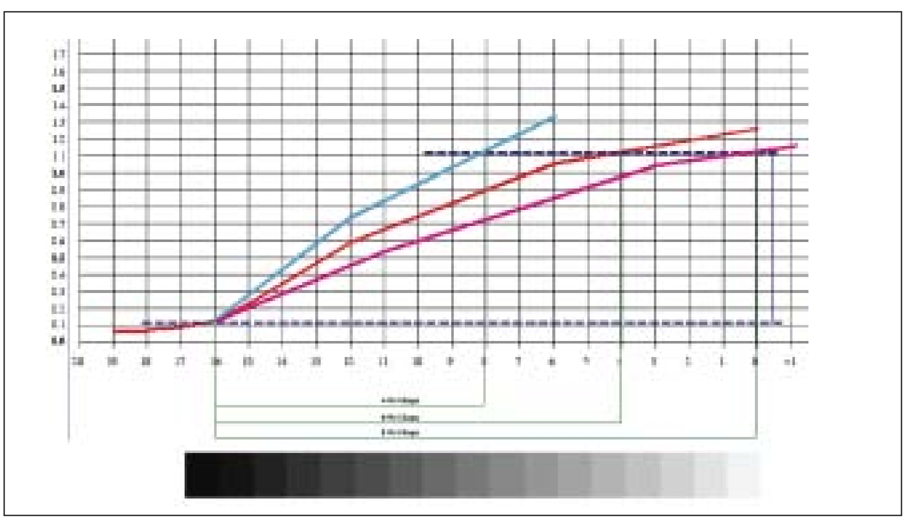
Development has a greater effect on highlights than on shadows. As we increase development there is a buildup in density, with more density in areas of greater exposure. As the film curve shows, as you give more development there is an increasing spread of the two curves as you get farther from the toe. The opposite is also true; with controlled underdevelopment the negative loses density more toward the shoulder.

When the development changes beyond the increase or decrease in density compared to exposure, there is also a change in the amount of useable light from the scene. Changes in development make the film function better if there is a "non-normal" light situation.

To see this in the interrelated graphs we start at the paper curve and follow down vertically from both Dmin and Dmax. These are the limits for the amount of light from the film that will fit within the range of the paper. If we then change the angle (slope) of the film curve, we can see that less or more of the scenic flare curve is useable as we move horizontally from the intersection points of the vertical lines from the paper and the new film curve.



This diagram shows how the increase in development affects the characteristic curve. The red line indicates the normal development and the shaded area under the curve represents the densities created. Since development is proportional, the more normal density, the larger the amount of increased development density. The violet color shows the effect of the overdevelopment density increases, and the green line shows the characteristic curve coming from this overdevelopment.



The black–white scale at the bottom shows the potential light that might reach the film. The green lines down from each line show how much of the grayscale is captured at a given development. The orange line indicates normal development, the cyan line shows overdevelopment, and the red line shows the effect of underdevelopment. Because Dmin and Dmax stay the same, this diagram shows that overdevelopment gathers the least light represented by the grayscale, and the underdevelopment captures the most.

Rotating just the film curve 90∞degrees clockwise to have the horizontal axis represent exposure, we have the usual presentation of the film curve. In this view we can see that the steeper curve relates to the smaller scenic tonal range. On the other hand, if we underdevelop and get a shallower curve with more tonal variation from the scene, we will make the negative meet the exposure range of the paper.

When we overdevelop or underdevelop to make the film record the non-normal light, we call it expansion or compaction (also known as contraction). Expansion is used for processing photos taken in light that does not have as much tonal variation as normal. Overdevelopment "expands" tones that the negative will provide. Where there are more tones available than normal light provides, we need to "compact" or compress the negative to reduce the tones so they will fit within the exposure range of the paper. Underdevelopment is used for compaction.

OVERDEVELOPMENT "EXPANDS" TONES THAT THE NEGATIVE WILL PROVIDE.

If we determine that the light produces more or less tone than normal light, we can decide what kind of development to use to ensure the negative has the tonal range needed to produce a good print. Two "non-normal" lighting conditions are very common: The first is overcast skies. Overcast skies diffuse the light and shorten the range of tones in the scene by putting light into the shadows and not providing a specular light source to give bright highlights. Generally for overcast situations expansion (overdevelopment) aids in making negatives that encompass full tonal range. The second non-normal lighting condition is bright sun. In this scenario, you need to compress the long tonal range through compaction (underdevelopment).

Time, temp, agitation, and developer dilution or concentration affect the rate.

Though you should test the development to get accurate development times and chemical dilutions (strengths) for both expansion and compaction, you can use the following guidelines as a starting point:

Expansion—120 percent of normal development (+20 percent)
Compaction—88 percent of normal development (–12 percent)

Sometimes it is very difficult to control development-through time when your times are very short because of the possibility of uneven development. On the other hand, when your development times are extremely long, there is a possibility of a large temperature drift or death by boredom. It is very easy to keep your processing wet time exactly the same and vary development with different developer dilutions. With all concentrated developers, T-Max, HC110, etc., you can do this.

CHAPTER SIX

DEVELOPMENT

In looking at the technical side of the Zone System, we see three distinct parts of the process of moving from the scene to the print that we previsualized. These are the print, the light in the scene, and the negative's development. If the process were an algebraic formula, one part would be a constant, one part would be an independent variable, and one part would be a dependent variable.

Let us define how these might function in an abstract mathematical structure to simplify and show how the Zone System works. In our algebraic formula, the constant is the goal, and the dependent variable controls the effects of the independent variable. If we have the equation:

Print = Light x Development

we can see how simple the Zone System is at its base.

In this equation the print is the constant. The paper has a limited exposure range. Though the paper functions as a constant, in nature the light is beyond our control (i.e., it is an independent variable). Since the film's development changes its slope and thus its ability to capture varying dynamic ranges, this controls the amount of light that can be passed to paper. The film's development functions as a dependent variable. In the Zone System we are striving for the great print by adapting to the changing light of the scene.

THOUGH THE PAPER FUNCTIONS AS A CONSTANT, IN NATURE THE LIGHT IS BEYOND OUR CONTROL.

To make the system work we need information about what the paper's range requires and how to make the film produce that range. This means we must test the paper and film beyond the levels we have discussed to this point. We will use densitometric information to define our paper's constant value and the effects of the film's development to adapt to changes in the light environment.

THE PAPER

Because the Zone System is based on a group of interrelated standards, we need to stick with our chosen or tested standard. To find the paper's standard

Facing page—Photo by Glenn Rand.

for exposure we will either need to create characteristic curves for our paper or use the ANSI standards for the paper (with filtration for multigrade paper). If we choose to use ANSI standards, we will need to select a specific value for the paper's exposure range from the range given by ANSI.

ANSI GRADES		EXPOSURE RANGES	
Print Filter #	Description	Cold Light	Condenser
0	Very Soft	1.41 >	1.09 >
1	Soft	1.15 – 1.4	.86 – 1.08
2	Medium	.95 – 1.14	.71 – .85
3	Hard	.80 – .94	.60 – .70
4	Very Hard	.65 – .79	.49 – .59
5	Extra Hard	< .64	< .48

To be as accurate as possible, we will want to find our exposure range for the paper by analyzing its characteristic curve. For this purpose we will need to make the curve. This requires a reflection densitometer and a step wedge.

A step wedge is a printed series of density increases, in regular steps from transparent to opaque. Step wedges come in divisions of 0.10 or 0.15 density changes. The density range of the step wedge is ten stops of exposure. Density is measured in log units.

Log 2 = 0.30

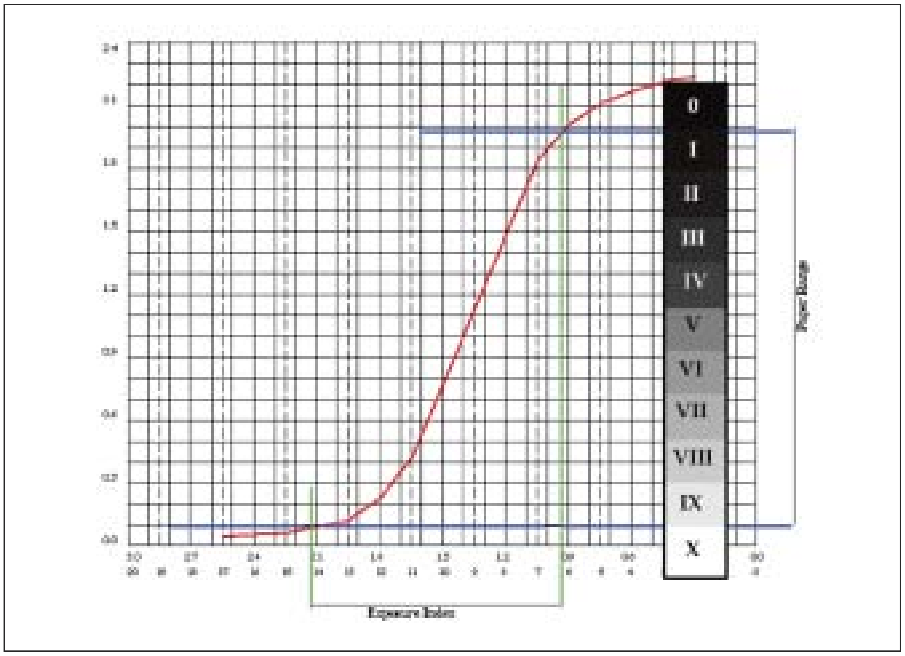
Since our photographic system works on a 2:1 basis, 0.30 equals one stop. This means that a ten-stop wedge ranges from a clear area (0.0 on the densitometer) to the most dense area (3.0 on the densitometer). The 0.10 density step wedge is divided in $\frac{1}{3}$ stops, and the 0.15 is made up of $\frac{1}{2}$ stops. Either will serve our purposes.

Making a characteristic curve for paper requires us to print the step wedge on the paper in the manner we will use for our final printing. Most will use an enlarger, so the step wedge will be used as a negative and a print will be made. Exposure of the print needs to achieve at three steps that are maximum black and three that are paper white. We will use the print of the center portion of the step wedge while ensuring pure black and pure white.

THE 0.10 DENSITY STEP WEDGE IS DIVIDED IN $\frac{1}{3}$ STOPS, AND THE 0.15 IS MADE UP OF $\frac{1}{2}$ STOPS.

Once we have printed, processed, and dried the paper in a normal and standard way, we will use a densitometer to read the reflective differences in the printed step wedge. The numbers represent the density of the print. These numbers are then graphed to create the characteristic curve. The number of steps on the wedge is plotted on the horizontal axis of the graph, and the corresponding density measurements are graphed on the vertical axis.

The enlarger type—condenser, diffusion, or cold-light—along with paper grade or filtration for multi-contrast paper will affect the exposure range. Since we want to hold the paper as a constant, these variables need to be kept constant; we must not change the paper grade, filtration, or enlarger type.



The paper characteristic curve shows the graphing of the densities from the printed step wedge and how they relate to the zones.

We are interested most in one piece of information that we will get from the curve: the exposure range of the paper. To find this we first need to establish the Dmin and Dmax. To find these points on the curve we will first work vertically.

We use the dense area of the step wedge that printed as a paper white reading (you should use at least three steps that print as white). This is the paper's base plus any fog created in the processing. This will be used to determine Dmin. Dmin is calculated by taking the density value of the white base plus fog (B+F) and adding the ANSI standard constant of 0.04. If we take the value just calculated and plot a horizontal line on our graph at the value of Dmin, we will establish the point we need for finding the exposure range (i.e., exposure index) of the paper.

. . . YOU SHOULD HAVE A NUMBER THAT IS IN THE ANSI RANGE FOR YOUR GRADE OR FILTER.

Using the highest density reading (you should have at least three steps at this value), we calculate Dmax. The highest reading is known as maximum black. To find Dmax you multiply maximum black by 0.90. Again we draw a horizontal line, this time using the value of Dmax, and where it crosses our curve we establish the point we will need for finding the exposure range of the paper.

From these two points on the curve we then draw vertical lines down through the base of the graph. These lines represent the limits of the paper's exposure range. The exposure range (exposure index) is determined by counting the number of step-wedge steps between the vertical line from Dmin and the vertical line from Dmax. (If your step wedge has thirty or thirty-one steps, the value is 0.10; if it has twenty or twenty-one steps, then the value is 0.15.) Depending on the paper's grade or filter used to print on multi-contrast paper you should have a number that is in the ANSI range for your grade or filter. This will be the constant we will be developing the film to achieve.

There is also a visual approach you can take to establish your paper's exposure range. By making the test print with the step wedge as explained above, you can use a visual determination of where there is a change from black to white to define the extremes of the paper's exposure. Once you have printed your step wedge look carefully and determine where there is a visible difference between the blacks at one end of the series of steps. You need the number of this step. Then do the same thing for the lighter end of the printed step wedge. At the lighter end, select the step with the first hint of tone darker than paper white and note the number of that step.

At this point in the visual process you have the numbers for the steps that approximate Dmin and Dmax for the paper. For this information we will need to convert the step numbers to an exposure range for the paper. This is done by taking the difference between the two steps just identified and multiplying by 0.15 (if you used a twenty-one-step wedge) or by 0.10 (if you used a thirty-one-step wedge). Though not as accurate as using a densitometer and working through the sensitometry of the paper, this method will give you a good approximation of the paper's exposure range.

THE FILM

As we saw in the last chapter different developing times for the film allow us to adapt to various lighting situations. But we dealt only with general conditions of expansion (overdevelopment) and compaction (underdevelopment). However, there are many more potentials. If we use a similar idea of what we just did for paper we can determine the range of light that will work with a specific development.

PLOTTING FILM CURVES

Instead of plotting one curve we need to generate a family of curves that depict a variety of developing times. You can expose with a sensitometer, enlarger, or camera.

You can use the same step wedge that was used for the paper, but this time it will be exposed onto film. Because of the small size of the film it is best to contact print the step wedge directly on the film. You will need to test the exposure if your lighting source is an enlarger.

You will need to expose at least five separate pieces of film. While they are all exposed for the same effective ISO, their developing times will vary. A sensitometer will give the most consistent results, but an enlarger is a good

The film curves below show the effects of development times from five minutes to twelve minutes. The six-minute development curve (yellow) is shallow and shows the effect of capturing light over three stops more light than is normal (N–3 development). The cyan lines show the effect of a near normal development time of nine minutes (N). The twelve-minute curve (blue lines) shows the effects of a development to deal with two stops less light than normal (N+2).

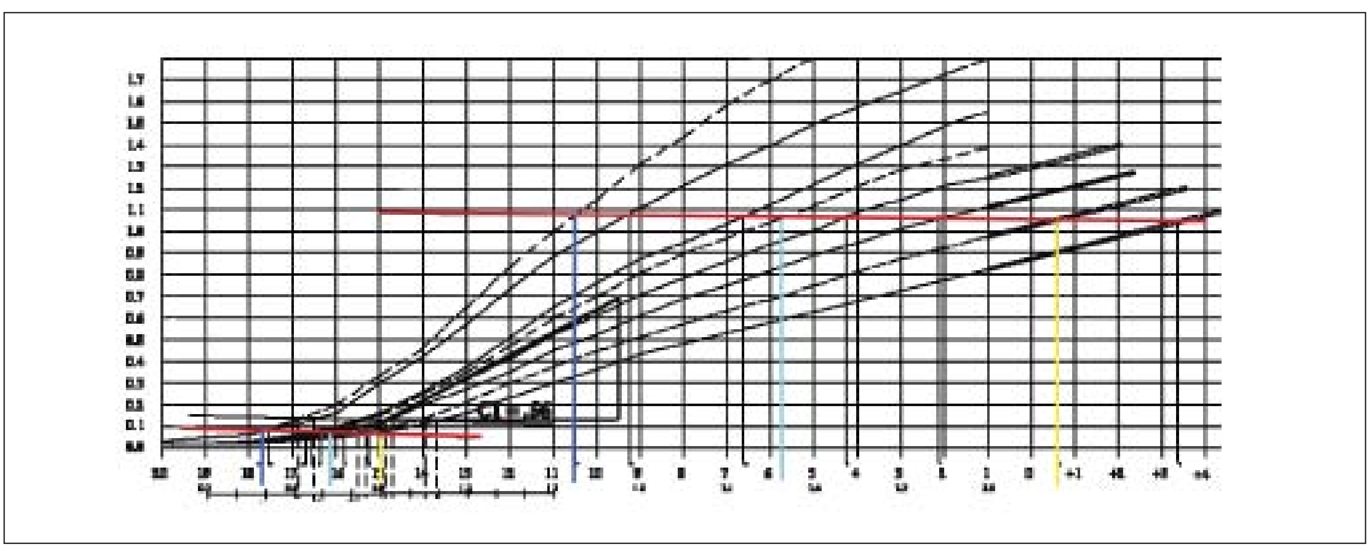


Photo by Christopher Broughton.

second choice. A camera can also be used. By photographing an evenly toned board and adjusting the exposure of each frame a series of tonal steps can be created. The range of tones needed to plot the characteristic curves must include tonal values from five stops under the meter reading for the board to at least seven stops over the meter reading. This will give you a twelve-stop brightness range.

If you are using sheet film, the same process can be used, but it will require a lot of film. To save film and simplify the processing you can create dark slides, and only part of the film will be exposed during any exposure. A dark slide with a hole cut in one quadrant will allow two exposures by turning the slide over between exposures. If another dark slide is modified with the hole cut in the other end of the slide, you will have the ability to accomplish four exposures on each sheet of film.

TO SAVE FILM AND SIMPLIFY THE PROCESSING YOU CAN CREATE DARK SLIDES. . . .

While it might be attractive to use the dark slide to move small increments in or out, this is not recommended because of the intermittency effect created by making multiple exposures. This will change the zone concept of the exposure needed in the film.

To determine developing times for the Zone System start with the manufacturer's normal developing time. Then develop four pieces of film with an additional 10 percent and 20 percent more time with two other developments at 7 percent and 14 percent less time. This will give you five pieces of film, providing a good spread in your curves.

Photo by Glenn Rand.

Once you have processed the five pieces of film at the different times you must read them on a transmission densitometer. In this case you read and record each step on the film. Some may be only B+F, but you need to read all steps. You will have a series of density numbers. Plot all the film on the same graph, but plot each film separately. It is suggested that you use various colors for each curve. Once again, we use the vertical axis to plot the density value from your densitometer readings, and the horizontal axis is used to plot the steps of the step wedge.

Find Dmin on the steepest and shallowest curve. Just as in paper, Dmin is FB+F+0.04. Next, connect these two points to form a line that represents Dmin on all curves. This line might be at an angle sloping slightly downward or may be horizontal.

To establish Dmax you will add the exposure range for the paper to the value of Dmin. This is called "fit." Since the Zone System works by using the development of the film to control the amount of light reaching the paper, we will want to use the paper's exposure range value as the difference between Dmin and Dmax. This means that the light from the scene that represents white for the negative will be Dmax in the negative.

Once again you define your limits on the extremes by finding Dmax on only the steepest and shallowest curve. If the shallowest curve does not rise

Photo by Christopher Broughton.

to a density level high enough to add the exposure range of the paper to its Dmin and be on the line, then extend the line on the angle suggested by the curve. This shows that the film requires much more exposure to achieve Dmax than was available in your test. (This situation is not unusual for short development times.) As with Dmin, you connect the two extremes with a straight line. This will cross the other curves and define their Dmaxes.

Working with each curve separately, draw vertical lines down from where the Dmin and Dmax lines cross each curve. This establishes the exposure range for the film for the amount of development expressed in that curve. Count the number of steps between the two vertical lines you created, then divide by two (if you used a 0.15 step wedge) or by three (if you used a 0.10 step wedge) to make the test negatives. The result is the number of stops of light from the darkest part of the scene to the lightest that will produce a negative that fits the paper at the development time for that curve.

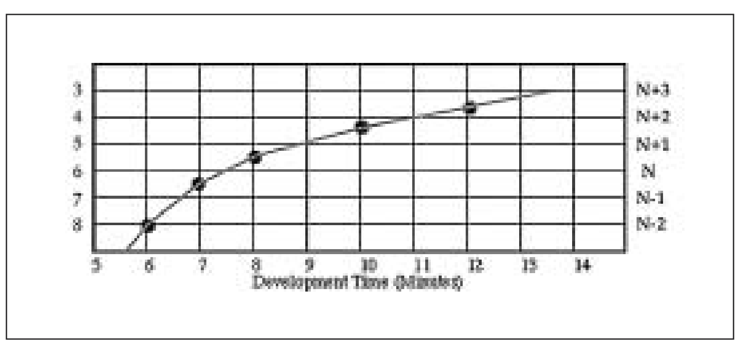
With the information generated from each curve we now have a set of development times and the subject brightness range (SBR) from the scene that each development works best with. This is the foundation of our exposure system. In Zone System terminology, these developing times are referred to as N (normal), N+ (normal plus, or expansion), and N– (normal minus, or compaction) development.

WITH THE INFORMATION GENERATED FROM EACH CURVE WE NOW HAVE A SET OF DEVELOPMENT TIMES. . . .

But how do we define N, N+, or N–? First we need to define normal development in relation to the light in the scene. As was discussed earlier, we know that reciprocity functions between Zones II and VIII. Because of the compression of the tonal difference at both ends of the zone scale, we need to discount the light potentials of the outlying zones (0, I, IX, and X). That is a difference of six stops between the zones and seven stops inclusive of the end stops. Either a six-stop or seven-stop approach can work if they are used constantly. The use of six stops employs the center tonal values; the seven-stop approach assumes the use of the limits of tonal potentials for Zones II and VIII. We will use the six-stop range for our calculations.

To find our N values, we need to make another graph that plots development times against light rendering capability from our testing. On the horizontal axis, evenly space out developing times to include more time variation on each end than you used in your testing. (For example, if your longest developing time was twelve minutes and your shortest was six minutes, you should include development times from five to fourteen minutes.) On the vertical axis, arrange—from bottom to top—the stops of light (SBR) from one stop more than the greatest number of stops gained in the testing to one stop less than the least number of stops gained in testing.

This graph will allow you to adjust your development to the scenic light, the subject brightness range (SBR). Seeing how the graph's line for a point representing light is different than normal light and translating that to the time scale gives you the development time for the measured light.



By arranging the graph this way we have created a listing of development times given in terms of N values. In our example, 6 min. = 8 stops, 7 min. =

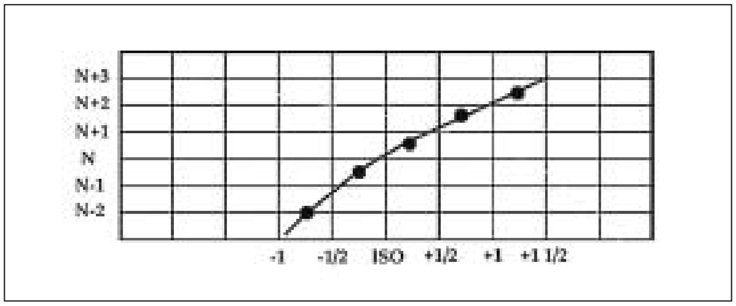
Photo by Glenn Rand.

IN ADAPTING THE FILM FOR DIFFERENT SBRS WE NEED TO OVERDEVELOP OR UNDERDEVELOP.

6.5 stops, 8 min. = 5.5 stops, 10 min. = 4.5 stops, and 12 min. = 3.7 stops. When we draw the graph we can find the development times for the N values by seeing where the curve crosses the lines labeled N+3 through N–2. In this way we see that a six-minute developing time is N–2 development, 6.67 minutes is N–1, 7.5 minutes is N, 9 minutes is N+1, and 11 minutes is N+2. Extending the line beyond our last point we can approximate that 13.5 minutes will equal N+3. (The numbers and times are examples only.)

The last bit of information we need to generate from the testing is the effective ISO. The logic is simple: in adapting the film for different SBRs we need to overdevelop or underdevelop. We are manipulating development to control the highlight detail in the negative. Exposure controls the shadow details. Remember, we want to expose for the shadows and develop for the highlights. Therefore, we need to be sure that the shadow will receive the correct amount of exposure based on development. With underdevelopment there will be less shadow detail than with normal development, and the opposite is true with overdevelopment. For this reason we need to establish a method for adjusting the exposure, and using different ISO settings in the metering system depending on the SBR is an excellent approach.

Calculating effective ISOs for various developments can be done with the same testing materials and on the same set of characteristic curves already produced. While the method of calculating effective film speed is dependent on which measure of slope you use, the slope of the characteristic curve of the film is key in determining an effective ISO. These slope ratings may be referred to as contrast index, gamma, or average gradient. Rather than deal with the densitometry for all calculations of slope, we will use contrast index (CI) for our discussion.



The graph shows the relationship between the exposure index (adjusted ISO) and the dynamic range of the light. The vertical scale is in relation to N, which is normal light having five stops between Zone III and Zone VII. On the horizontal axis are the proportional adjusted ISOs compared to the published ISO.

The process requires that we find the curve in the set that has the same slope as the standard CI set by the film's manufacturer. You can find the slope of the straight-line portion of each curve. To do this we will first want to establish the speed points on all the curves. Since reciprocity kicks in at this point you should start your slope measurement at this point. To find all of the speed points, find the point on the steepest and shallowest curves. The speed point's value is equal to FB+F+0.10. By finding the speed points at both ends of the curve you can draw a straight line between these points. This line will cross the other curves at their speed points.

TO FIND ALL OF THE SPEED POINTS, FIND THE POINT ON THE STEEPEST AND SHALLOWEST CURVES.

If none of the curves have the same slope as the manufacturer's CI, then interpolate the value between existing slopes. Whether you find a curve's slope that matches the manufacturer's CI or interpolate one, the point on the line through the speed points locates the published ISO. This becomes the development time that will result in the film functioning at its published speed.

Once the development time is established for the published ISO, the ISOs for the other development times can be determined by measuring horizontally to where the other curves cross the speed line. If the intersection of a curve and the speed line is one stop toward the toe of the curves, the ISO for that curve would be twice that of the published ISO and if it was one stop toward the shoulder then it will be half the published ISO. A stop measurement will be two steps on a twenty-two step wedge and three steps on a thirty-three step wedge. To make a usable tool you can create a graph similar to the one used to establish the N developments.

On this graph the horizontal axis will be the ISOs, with the published ISO in the center of the graph. If your step wedge was made up of 0.15 steps, then the steps on the graph will be in ½ units. In this case the first step to the right would be ½ stop more than the published ISO, and two steps would be double the ISO. To the left the ISO diminishes by ½ stops. With a 0.10 step wedge, the steps on the graph will be in ⅓ stops. Once again we are interested in the N values and not necessarily our actual points from the characteristic curves. In the graph of ISOs compared to the N values for light, if the published ISO is 100, then N is slightly left of the published ISO. In this

Photo by Glenn Rand.

case we would use ISO 80 (err toward slight overexposure). The N–1 level is crossed about 1⅓ of the way from the –½ mark, making it function as ISO 80. The N–2 is about halfway to the –1 mark, and should use ISO 50. On the other side of N, N+1 is not quite to the +½ mark, and this indicates that we would use ISO 125. N+2 is at the +1 mark, indicating the use of ISO 200 with the extension of the curve for N+3 at +1½ indicating ISO 250. In this way we can compensate exposure: raising the ISO decreases exposure, and lowering the ISO increases exposure.

Photo by Glenn Rand.

EXACTNESS OF DEVELOPMENT

We have now found the three densitometric values that make the Zone System work. These are the exposure range of the paper, the amount of light from the scene that will fit the paper based on the film's development time, and the exposure compensation needed to make the light properly record the shadow detail. To ensure proper results, there must be consistency in the developing process. Below are two charts that show the tested times for Kodak Tmax 100 and Ilford Delta 100. The third chart shows the developer dilution recommendations for Kodak Tmax at a consistent developing time.

With this in mind we can take our information about the relationship of light, development, and the paper into the field to make the Zone System work. When in the field you need only two parts of the equation: the N values and effective ISOs. However, you will also need to remember what light condition or for what N development each roll or sheet of film has been exposed. You might consider taking minimal notes on the exposed roll or cut-sheet film holder for reference when you return to the darkroom.

KODAK TMAX 100/400
SELECTED DENSITY RANGE: 1.0
DEVELOPER: D-76/1:1 AT 70ºF

N# Dev.	Dev. Time	Effective ISO
N+3	15	200/800
N+2	12½	125/250
N+1	10	100/400
N	8¾	80/320
N–1	8	80/320
N–2	7½	64/250
N–3	6¾	50/200
N–4	6	50/200

ILFORD DELTA 100
SELECTED DENSITY RANGE: 1.0
DEVELOPER: D-76/1:1 AT 70ºF

N# Dev.	Dev. Time	Effective ISO
N+3	17 (est.)	160
N+2	12	125
N+1	8	100
N	6½	80
N–1	5¾	64
N–2	5	64
N–3	4½	50
N–4	3¾ (NR)	50

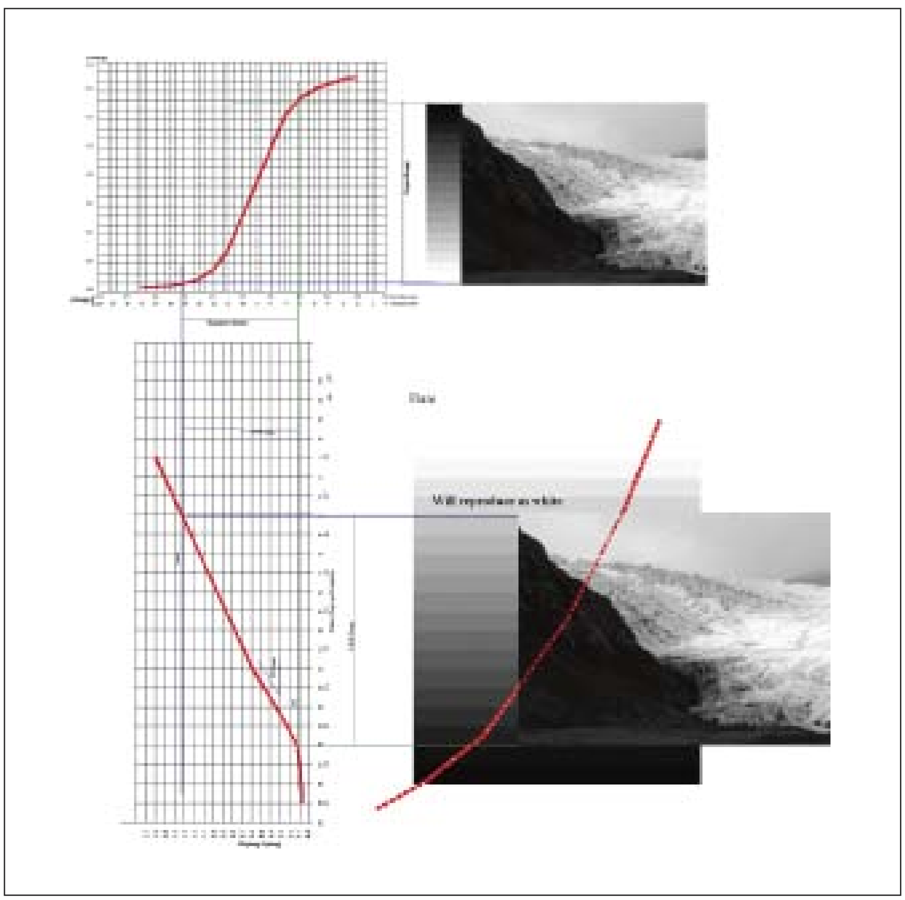
KODAK TMAX 100/400
SELECTED DENSITY RANGE: 1.0
DEVELOPER: HC 110 70ºF FOR X MINUTES

N = 1:7
N+1 = 2:7
N+2 = 4:7
N+3 = 8:7

CHAPTER SEVEN

MAKING PHOTOGRAPHS

Having generated the information required for the Zone System, you can go into the field to make photographs. You can previsualize your prints while observing the scene. Also, now that you are armed with the knowledge you need to make negatives that will "fit" your paper, you will make better prints. It may not be possible to make perfect negatives, but the closer your negatives are to fitting the paper, the fewer problems you will encounter when you print your photographs.



These graphs show the relationship between the scenic light (flare), the film, and the paper.

In the diagram on the left you can see the fit that the Zone System provides. When we select the tones in the scene and assign them to zones that represent the way we want to see them in the print, we choose a development time that will provide the same range in the film (the density difference between Dmin and Dmax) as the exposure range of the paper. We are using our formula and balancing. We convert the formula for the system and come up with a new formula that equals zero. Because the paper is a constant, we find that the light and the development must be the inverse of each other. Our equation changes from:

Print = Light x Development

to (simplified)

Light + Development = 0.

Facing page—Photo by Glenn Rand.

There are two distinct methods for using the Zone System: an overall approach and a tonal specific approach. Within the overall approach we use a light meter and read the dark area of what will be our picture, then pick the brightest highlight and measure that area. The difference should be seven stops. The tonal separation method is another way to measure the light. We can pick any two zones between II and VIII, and these should have the same separation in number of stops as our previsualized image. Regardless of the method we use to define the light, it will be the act of estimating the zone of the light and measuring it that will have the greatest impact on the photographs we make.

With the preparations we have made through the testing and our previsualization, we find that the Zone System is not complicated. With the information generated we need only five procedural steps in the field to make photographs with the Zone System. A key consideration is that we need to find a way to compare the light of the scene to the information we generated about development for various light conditions. When we see the scene we wish to capture, we start to visualize how the light in the scene will be represented as tones in the final print. We might use a zone ruler or rely on our memory of the print zones.

. . . WE START TO VISUALIZE HOW THE LIGHT WILL BE REPRESENTED AS TONES IN THE FINAL PRINT.

Prior to the first procedure comes previsualization of the image. This crucial portion of the process relates the scene in front of our eyes to the print that we will produce. The rest of the steps are as follows:

1. Determine the light within the entire scene. Measure the extremes of the light. This is done through average value metering. In other words, we will measure an area with the darkest shadow detail in the scene and an area with highlight detail. We then count the stops between these two readings. In this case we end up with two numbers: the first is the number of stops representing normal light; the second is the light's tonal range, which is determined with a light meter.
2. Next, we need to find the normal (N) development. You will take this information back to your darkroom after the photograph is taken. When we calculate the development we will subtract the metered range (stop range between meter readings) from the light's normal range. The normal light is seven stops including Zone II and Zone VIII. If our metering in step 1 was six stops, our calculation would be N (seven) minus measured (six in this example). Because 7 – 6 = +1, development will be N+1.
3. We must adjust the exposure to ensure shadow detail. We do this by adjusting the ISO in relation to the N value we determined in the second step. This ISO needs to be put into the light metering system before going on to step 4.
4. With the new ISO setting put into the meter, take a light meter measurement of the area of the picture that will be Zone III in the final

Photo by Glenn Rand.

image. We need to be sure to expose for the shadows and develop for the highlights.
5. Finally, we must set the exposure. This is done by "stopping down" two stops from the light meter reading just taken for Zone III. After stopping down, an exposure is made.

With these five steps you have made an exposure with the development of the film in mind. Based on the testing, the development will be at the calculated time (N±) determined in step 2. Using this system it should be quite simple.

When metering you should always isolate the tonal areas that will become the overall or chosen zones of your photograph. Without a spot meter we often find that we cannot get sufficiently close to the actual subject of the scene to meter the zones. In this case, you can meter a nearby object that is similar in tone to your intended subject. If you use this approach, be sure the light meter is positioned at an angle to the surrogate tone that approximates the angle of the camera to the scene. Also realize that like the exposure itself, metering is subject to flare. If your meter is pointed at or near a bright object or light source, the flare in the metering will increase.

ALSO, REALIZE THAT, LIKE THE EXPOSURE ITSELF, METERING IS SUBJECT TO FLARE.

Let us look at the two methods you turn to when using the Zone System to make exposures.

ZONE CONTROL AS AN OVERALL CONCEPT

Particularly when using roll film and in very consistent light, such as clear skies in the desert, we can use an overall approach to the Zone System. This method holds the light as unchanging during the photography session. The assumption for an overall consistent lighting means that the development for all exposures will be considered to be the same. This is because the independent variable of the light remains at the same measured values.

In the overall approach we will meter the extremes of the light and use that reading to determine what development will be needed. We look at the scene and meter the darkest area, Zone II, below detail. We select this zone because it can be tough to differentiate between Zone 0 and Zone 1 in the scene. Also we want Zone 0 to fall below Dmin on the film. For similar reasons we select the lightest area of our scene and assume it to be Zone VIII. Therefore, we can compare our meter readings of our darkest and lightest against our normal light range of seven stops.

THIS METHOD HOLDS THE LIGHT AS UNCHANGING DURING THE PHOTOGRAPHY SESSION.

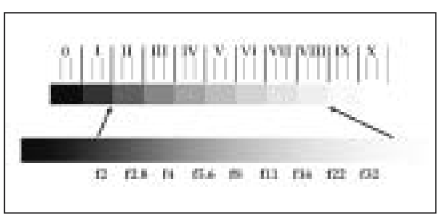
Let us look at two examples that will show how the overall method works. (*Note:* For all examples, we used Tmax 100 developed in D-76 1:1 at 70°F.)

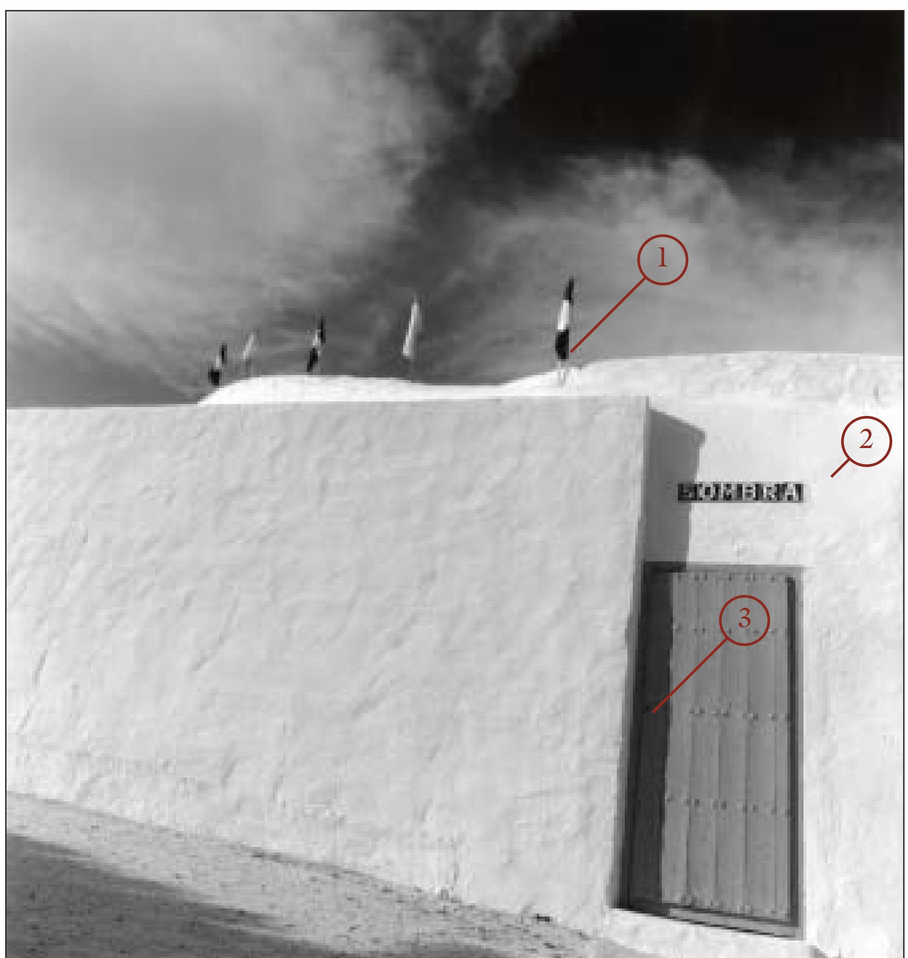
Example 1

Conditions of the scene are a bright sun and dry atmosphere with the whitewashed buildings as the subject.

To create this image, I looked at the overall scene and chose as the darkest point the dark part of the flag. When I metered that area with a spot meter I got a reading of f/2. The highlight reading was f/32. This meant that the darkest and lightest areas were eight stops apart, and there was more dynamic

Right—Mijas, Spain, 1992. (1) Darkest tone meter reading = f/2. (2) Brightest tone meter reading = f/32. (3) Area metered for exposure as Zone III. Photo by Glenn Rand. **Below**—This image shows the effect of the N–2 development on the scene's tones.





range in the scene than the film would deem "normal." Therefore, the development was compacted to bring the highlights into the paper's exposure range. Here's how it was done:

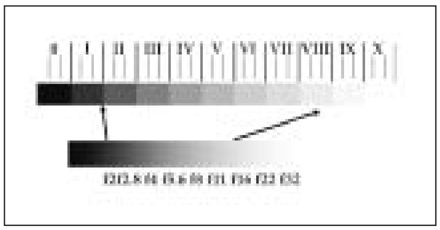
1. *Determine the light*. Normal light has a seven-stop range. The metered light in the scene ranged from f/2 to f/32, or nine stops.
2. *Calculate the development*. Normal Light – Metered Light = Development. 7 – 9 = –2. Therefore, the development was N–2.
3. *Adjust the ISO*. ISO 64 was entered into the light meter.
4. *Expose for the shadow detail*. I took a meter reading at the area I wanted to represent as Zone III in the print.
5. *Set the exposure*. I stopped down two stops from the exposure reading obtained in step 4 and made the exposure.

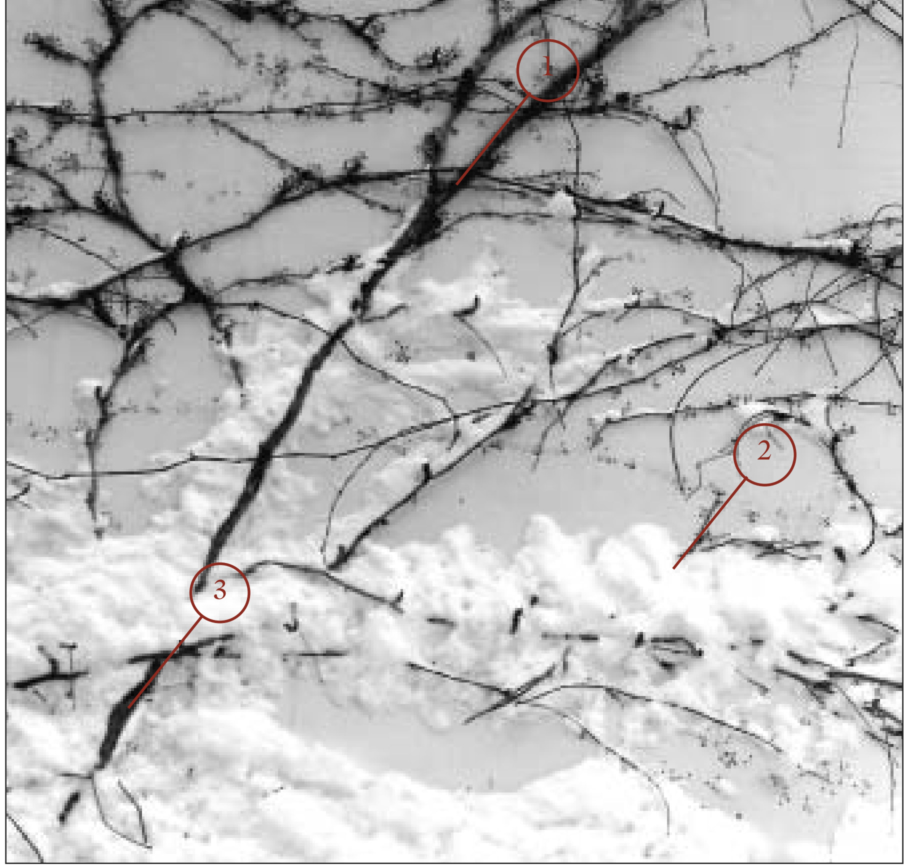
Processing the film upon return to the darkroom, I used D-76 1:1 for 7½ minutes at 70°F.

This exposure and processing allowed me to adjust the tonalities of the scene by compaction. This brought the highlights down to a density range in the negative that was printable, meaning no burning or flashing was necessary. In metering, I found there was two more stops of dynamic range in the scene than the film would normally handle. Note that this exposure/development relationship could be used for the rest of the roll of film or throughout the day as long as the light and subject stayed the same.

Photo by Christopher Broughton.

Right—Garmisch, Germany, 1996. (1) Darkest tone meter reading = f/2. (2) Brightest tone meter reading = f/11. (3) Area metered for exposure as Zone III. Photo by Glenn Rand. **Below**—This image shows the effect of the N+2 development on the scene's tone.





Example 2

This scene was photographed after sunset and included an east-facing wall.

To begin, I looked at the overall light and chose as the darkest point the dark part of the vine. I metered that area with a spot meter and got a reading of f/2. The highlight reading was f/11. Therefore, the highlights and shadows were five stops apart. This meant there was less dynamic range in the scene than the film was capable of presenting. Therefore, the development needed to be expanded to bring the highlights to fill the paper's exposure range. Here's how it was done:

THERE WAS LESS DYNAMIC RANGE IN THE SCENE THAN THE FILM WAS CAPABLE OF PRESENTING.

1. *Determine the light.* Normal light has a seven-stop range. The metered light in the scene ranged from f/2 to f/11, or six stops.
2. *Calculate the development.* Normal Light – Metered Light = Development. 7 – 6 = +1. Therefore, the development was N+1.
3. *Adjust the ISO.* ISO 100 was entered into the light meter.
4. *Expose for the shadow detail.* I took a meter reading at the area I wanted to represent as Zone III in the print.
5. *Set the exposure.* I stopped down two stops from the exposure reading obtained in step 4 and made the exposure.

Processing the film upon return to the darkroom, I used D-76 1:1 for 10 minutes at 70°F.

This exposure and processing allowed me to adjust the tonalities of the scene by expanding the tonal values. That developed the highlights with more density to fit the exposure range of the paper. This negative was now printable without becoming muddy. In metering, I learned there was one stop less dynamic range in the scene than the film would normally handle. (Note that having determined this exposure/development relationship, it could be used for the rest of the roll as long as the light and subject's openness to the sky stayed the same.)

ZONE CONTROL AS A TONAL SEPARATION CONCEPT

When you are using sheet film or can work with one exposure at a time, using a tonal separation concept provides the ultimate control of black & white photography. Tonal separation exposure with zone placement is what most photographers call the Zone System. The method works with scene-specific situations. The tonal separation method approaches each exposure as unique.

Photo by Robert Smith.

In this approach we meter any two tones within the Zone II–VIII range and use their tonal separation along with the previsualization of the final print to determine what development will be needed. In doing this, we tend to use the center value of each zone as opposed to the extremes of the range of each zone. However, you can use the extremes or any portion of the zones by using fractions of the zones in your calculations.

WE USE THE CENTER VALUE OF EACH ZONE AS OPPOSED TO THE EXTREMES OF THE RANGE OF EACH ZONE.

Instead of using a set number as normal, we use the previsualized zones for our two tonal areas. We say that the numerical difference between previsualized zones is normal. Unlike the overall approach, we do not expand or compact development for the effect on the whole negative. Rather, we use development to achieve a desired difference between our previsualized areas of the image that will be translated into specific zones.

Let us look at two examples that can show how the tonal separation method can work. (*Note:* Both examples use Tmax 100 developed in D-76 1:1 at 70°F.)

Example 1

The image was captured before dawn. I previsualized the clouds in this scene as Zone VI and the dark rocks as Zone II. This meant that the tonal separation in the scene was four zones and the metered light had a six-stop range. Even though the light was low in intensity and diffuse, it required underdevelopment because the tonal separation was larger than the zone spread. Here's how the situation was handled:

Right—Kauai, Hawaii, 1997. (1) Zone VI reading = f/16. (2) Zone II meter reading = f/2. (3) Area metered for exposure as Zone III. Photo by Glenn Rand. **Below**—Here we see the effect of the N–2 development on the scene's tone.

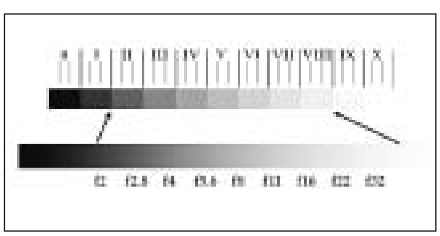


Photo by Glenn Rand.

1. *Determine the light.* There was a four-stop range (Zone VI – Zone II) in the previsualized image. The metered light read f/2 to f/16, or six stops.
2. *Calculate the development.* Determined Zone Difference – Metered Zones = Development. 4 – 6 = –2. Therefore, the development was N–2.
3. *Adjust the ISO.* ISO 64 was entered into the light meter.
4. *Expose for the shadow detail.* I took a meter reading at the area I wanted to represent as Zone III in the print.
5. *Set the exposure.* I stopped down two stops from the exposure reading obtained in step 4 and made the exposure.

Processing the film upon return to the darkroom, I used D-76 1:1 for 7½ minutes at 70°F.

This exposure and processing allowed me to adjust the tonalities of the scene to produce a density range in the negative with only four stops between the previsualized tonal areas of the scene. Though the bright areas of the sky moved to Zone X, the shadow detail was maintained.

Example 2

The scene was characterized by bright sun on red rocks with medium green bush.

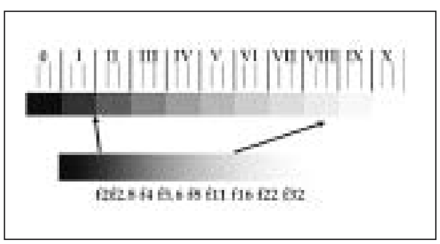
I previsualized the picture as having a bright bush against dark rocks. However, when I metered the bright highlight that I wanted to present as Zone VIII, I found there was just three stops difference from the area of the scene I wanted to be Zone III. Even with bright specular light I found I needed to overdevelop to spread the density in the negative to represent these areas as Zone VIII and Zone III in the print. This is because the tonal separation was smaller than the zone spread desired. Here's how it was done:

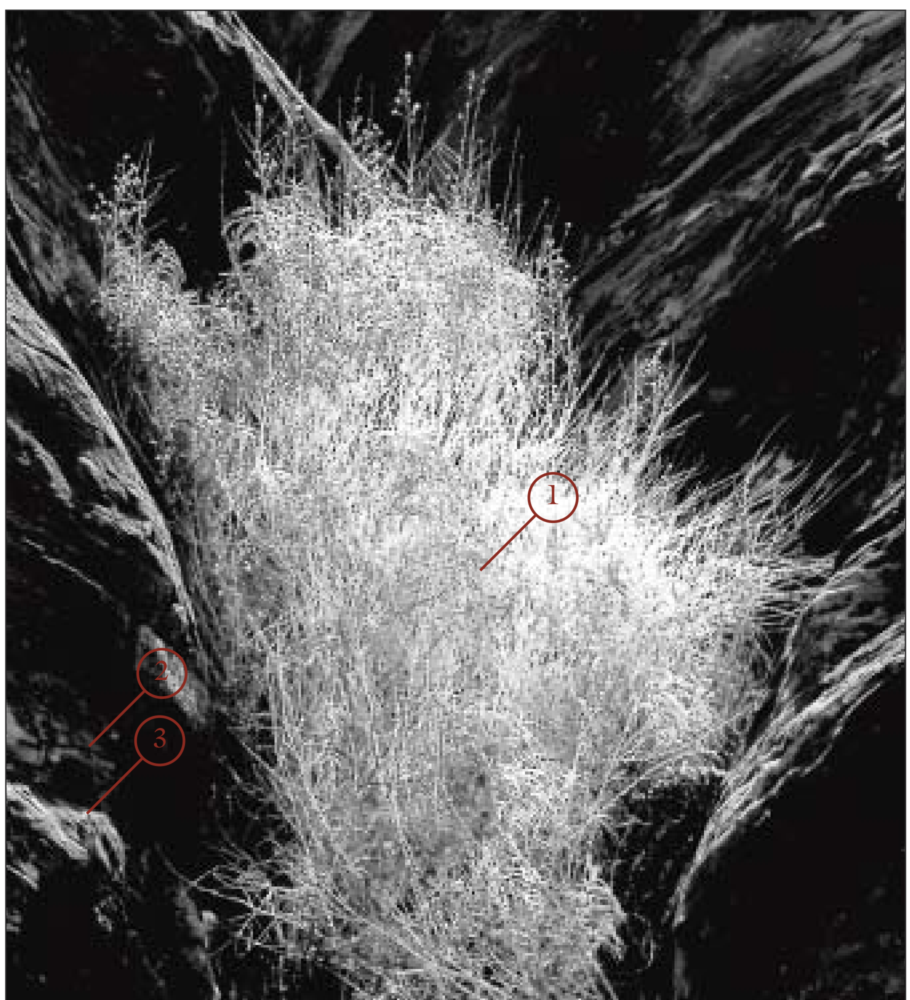
I PREVISUALIZED THE PICTURE AS HAVING A BRIGHT BUSH AGAINST DARK ROCKS.

1. *Determine the light.* There was a five-stop range in the image I previsualized (Zone VIII – Zone III). However, the reading (f/4 and f/11) showed a three-stop difference between the highlights and shadows.
2. *Calculate the development.* Determined Zone Difference – Metered Zones = Development. 5 – 3 = +2. Therefore, the development was N+2.
3. *Adjust the ISO.* ISO 125 was entered into the light meter.
4. *Expose for the shadow detail.* I took a meter reading at the area I wanted to represent as Zone III in the print.
5. *Set the exposure.* I stopped down two stops from the exposure reading obtained in step 4 and made the exposure.

Processing the film upon return to the darkroom, I used D-76 1:1 for 12½ minutes at 70°F.

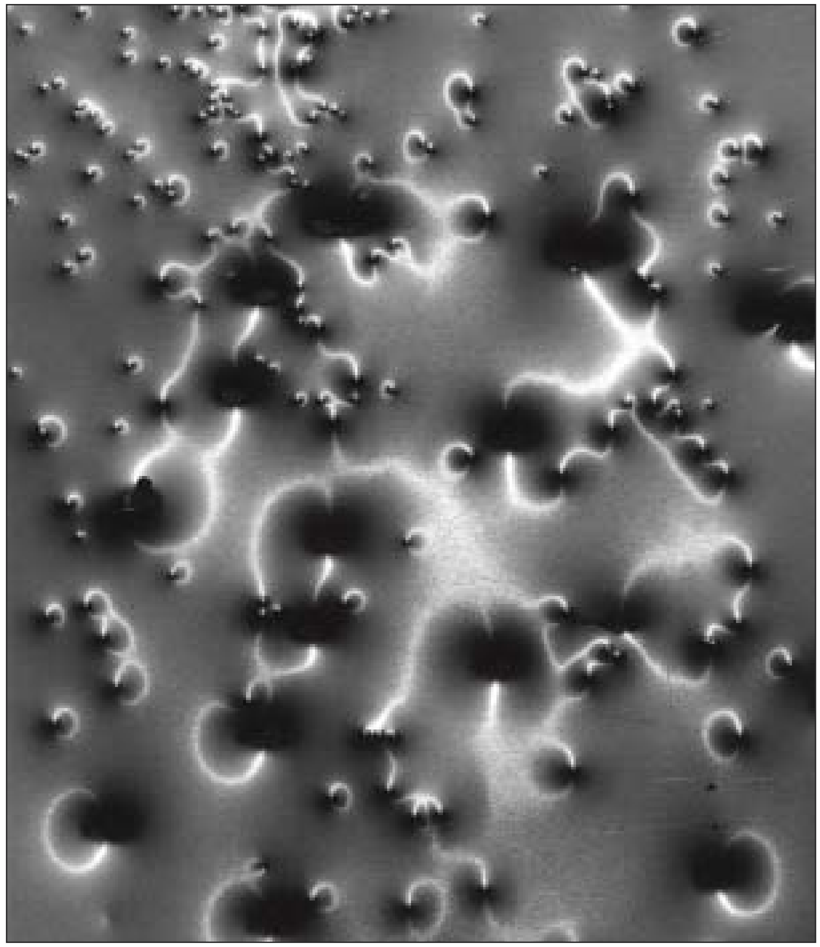
Right—Canyonlands, N.P., 1996. (1) Zone VIII meter reading = f/11. (2) Zone III reading = f/4. (3) Area metered for exposure as Zone III. Photo by Glenn Rand. **Below**—This image shows the effect of the N+2 development on the scene's tone.





This exposure and processing allowed me to adjust the tonalities of the scene to produce a negative with a five-stop density range between the previsualized tonal areas of the scene. Since there were no very bright areas in the scene, the overdevelopment moved the light middle tones up to become highlight detail areas of the print.

As was shown in the last two examples, we can determine the way the print will look based on the way we expose and process our images. The system will allow us to move the zones in brightness, including the amount of tonal separation, however, the Zone System does not allow a brighter tone to be made darker than an existing dark tone. Also, the system works better if there are at least two zones between our previsualized areas. Note that compacting two adjacent zones will be exceptionally difficult.



Above—Photo by Robert Smith. **Facing page**—Using a field chart like the one shown here will allow you to ensure accuracy and continuity throughout the Zone System process.

INCIDENT METERING

Though using a reflected light meter is our best bet in most Zone System applications, an incident meter can be used for the overall approach (see pages 69–72) and in studio situations. For an overall approach, an incident reading with the light falling on the meter's dome provides a value for Zone V, and using the meter within the shadow without light falling on the dome provides a value for Zone III. This means that you can read these two areas for normal, with two stops in between.

For studio work, photographers often rely on an incident-type flash meter. Though we control the light in the studio, we can still use the Zone System. Reading the light ratio, which describes the relationship between the main light and fill light, can allow us to employ the overall approach to the Zone System. We point the dome of the meter at the main light to obtain our first reading, then point it at the fill light to establish its value. If the desired lighting ratio in the print is 4:1, your readings represent a two-stop variation.

THE ZONE SYSTEM REQUIRES ACCURACY AND CONTINUITY OF THE PROCESS FROM ITS INCEPTION.

FIELD CHARTS

The Zone System requires accuracy and continuity of the process from its inception. Note-taking will aid you in this process. Whether you use a note pad or field charts, you will want to follow directions for development (N) in the darkroom and keep track of your previsualization. Use the field chart shown on the facing page to take notes and calculate N development.

ZONE SYSTEM FIELD CHART

FILM:	FILM TYPE:
DATE:	LOCATION:

PREVISUALIZED:

METER READING:		DESIRED ZONE:
	VIII	
	VII	
	VI	
	V	
	IV	
	III	
	II	
	I	

LIGHT CONDITION:

DEVELOPMENT TIME (MINUTES OR N): ______

	F-STOP	TIME
EFFECTIVE BASE EXPOSURE METER AT ZONE III STOPPED DOWN 2 OR CRITICAL ZONE ______/______ ± ______		
LENS FOCAL LENGTH: ______ BELLOWS DRAW FACTOR: ______ + ______ STOPS		
FILTER COLOR (TYPE) ______		
RECIPROCITY CALCULATION: + ______ STOPS		
FINAL EXPOSURE:		

COMMENTS: ______

______

FINAL DEVELOPMENT TIME BASED ON RECIPROCITY: ______

CHAPTER EIGHT

IN-CAMERA CONTRAST CORRECTION

As we move beyond the Zone System we find that there are many parts of the black & white photographic process that will enhance our ability to communicate our visual ideas. These expand our vision beyond the literal interpretation of the scenes we choose to photograph. There are two concepts we can use on the negative to allow for expanded potentials. In the camera we can modify the way light affects the film. Beyond this is the positive and negative effect created by failure in reciprocity. Because most digital cameras capture in color, some methods discussed here may not seem appropriate, but many are. In some cases, these are handled exactly as they are for film, and in some cases they are applied using other equipment or software.

BEYOND THIS IS THE POSITIVE AND NEGATIVE EFFECT CREATED BY FAILURE IN RECIPROCITY.

FILTERS

Filters provide the easiest opportunity to change the overall or local contrast of a photograph during exposure. Two main types of filters, absorption and interference filters, are used to increase or decrease the contrast that will be created during exposure. This can change contrast relationships between varying subjects within a single image. (Note that another group of filters, special effects filters, do not affect image contrast.)

First are absorption filters. These reduce the amount of light that is transmitted to the film by absorbing part of the light reflecting from the scene. The simplest type to understand are the neutral density filters, which are very useful for digital capture. These reduce all the light from the scene by the same factor regardless of the color of the light.

Filters are described in terms of density. Using a 0.30 filter will reduce exposure by one stop. These filters allow for the use of larger f-stops or slower shutter speeds. These filters will affect contrast if they make the exposure fall outside the reciprocity for the film.

Contrast filters are a type of absorption filter commonly used for black & white photography. These are colored and reduce the effect of the light that is complementary to the color of the filter. In this way a red filter will shift the contrast in a picture to make reddish objects record lighter in compari-

Facing page—Photo by Glenn Rand.

Three separate color (contrast) filters were used in converting from the raw file to black & white. The sky was approached as though it was captured using a deep-yellow filter (darkening the blue), the yellowish hill was adjusted as though a light-blue filter was used (adding tone to the shadow areas of the grass), and the stop sign was approached as though a green filter was used (darkening the red portions while leaving the white in the sign brighter). Photo by Glenn Rand.

son to greenish ones. The red filter absorbs more of the green spectrum but has a lesser impact on the red portions of the spectrum. The filter reduces all the light entering the lens but has a greater effect on colors that are not in its makeup.

Because digital cameras capture color, "hardware" (i.e., traditional) contrast filters become color changing devices. Therefore, we use software to accomplish contrast filtering as we change the image from color to grayscale (black & white). This can be accomplished as an adjustment or adjustment layer. The major advantage of working with black & white images through digital capture and image manipulation software is that contrast filtering can be added to specific areas of the image without applying the filter to the entire image.

Color theory shows us that all colors in light are made up of three primaries—red, green, and blue. Mixing all three primaries at full strength creates white light. If we mix in any other combination we will get other colors. The filter works because it is absorbing color that is not in its makeup. A red filter is in a primary color and will reduce the portion of the other primaries, blue and green. Since yellow is made up of red and green light, a yellow filter will have less effect on reddish or greenish colors while reducing the effect of blue light on the film.

In this way we can reorder the contrast of a scene by using contrast filters. The filters do not change the overall dynamic range but make areas of the scene increase or decrease in brightness without necessarily changing the dynamic range of other parts of the photograph. Most common of the contrast filters are red, yellow, orange, and green.

Red is useful for darkening green and blue comparatively. It increases contrast in landscapes by darkening foliage while creating dramatic sky effects by greatly increasing tonal separation of clouds or subjects against blue sky. It also helps in haze penetration. On the downside, it greatly reduces shadow exposure.

The yellow filter is often used to increase the contrast between the blue sky and the clouds. While yellow darkens the sky it tends to lighten light green or "May" leaves. Because the light in open shade is very blue, the yellow filter will also increase the difference between lightness of areas in the sun and in shadow.

Orange filters also darken blue water and blue sky. These increases in contrast and darkening of shadows are stronger than those produced with a yellow filter but weaker than those created with a red filter. This filter has the most effect for blue and blue-green absorption.

THERE ARE ALSO SOME FILTERS THAT ARE PARTIALLY COLORED AND PARTIALLY CLEAR.

The green filter is often used to increase the tonality of people with lighter skin in order to enhance shape or make the subject look healthier. Green or yellow-green can also be used to comparatively lighten leaves while darkening both earth tones and the clear sky.

There are also some filters that are partially colored and partially clear. These are gradient filters, and they exhibit a density that gradually changes to clear, allowing photographers to alter the contrast in only a portion of the scene. These balance large areas of different exposures. A neutral density or red gradient could be used to darken the sky while leaving other portions of the scene unaffected. However, the graduation on mass manufactured grad-

The freshly whitewashed wall had two sets of handprints applied. These were made by dipping the hands in a light ochre (yellow-brown) mud and pressing against the wall. While the larger handprints were very visible, the smaller and lower handprints were very faint and yellow. To increase contrast between the yellowish color of the mud and the white wall a blue filter was used. This darkened the handprints in relation to the wall. Photo by Glenn Rand.

Photo by Glenn Rand.

uated filters have straight or regular split fields and do not always fit the desired contour of an image.

Another type of filter that is used in black & white photography is the interference filter. There are both diffusion filters and polarizing filters. Diffusion filters put material in front of the lens that breaks up and softens the light. A polarizing filter allows light to more easily travel through the filter if its wave-form is parallel to the micrometallic lines on the filter. This allows for the elimination of or increase in the brightness of light coming from reflective surfaces. The polarizer darkens blue sky and increases cloud separation at some angles. It will also eliminate reflections from reflective surfaces. This filter allows light to penetrate some haze by reducing reflections from atmospheric particles, thereby resulting in images with higher contrast. When a polarizer is combined with a yellow filter it increases cloud separation without extreme reduction of shadow exposure.

THE POLARIZER DARKENS BLUE SKY AND INCREASES CLOUD SEPARATION AT SOME ANGLES.

Any time we put a filter between the scene and the film we need to increase exposure. This is known as a filter factor. You should refer to the information that comes with your filters for those factor numbers. Another way to arrive at the factor is to use a spot meter to read a gray card and then meter the same gray card through the filter.

DODGING EXPOSURE

Most of us became familiar with dodging and burning prints when we began to learn black & white printing. However, what many photographers fail to realize is that many of the techniques used in printing can also be used during exposure. Dodging exposure, for instance, can be done in two ways—through long exposure or multiple exposure. In either situation you will need a tripod and black matboard.

MANY OF THE TECHNIQUES USED IN PRINTING CAN ALSO BE USED DURING EXPOSURE.

For long exposure dodging, the matboard card is positioned, prior to exposure, with the black surface toward the camera so that it will block the area of the scene that is too bright. The card should be as close to the lens or lens shade as possible. As you start your exposure, begin moving the card out of the way. Move the card in and out of the frame (much like vibrating to repeatedly expose and block the light over an area of the image). Ensure that this movement is smooth, as your skill in dodging will be evident in the final image. Due to the limits of our hand speed and the optics in our camera, we will not be as accurate in dodging exposure with fast shutter speeds. Therefore, longer exposures will allow us to perform dodging exposure more ac-

Photo by Glenn Rand.

curately (shutter speeds of ½ second or longer will work well). This method of dodging is particularly helpful for scenes that have bright skies.

The second way to dodge exposure is to repeat the exposure with and without the black card in place. The amount of exposure used for the multiples needs to be the same as a normal exposure. Though this method can work in bright light it is better in more subdued light with need to only reduce areas outside the overall dynamic range of the scene.

THIS METHOD OF DODGING IS PARTICULARLY HELPFUL FOR SCENES THAT HAVE BRIGHT SKIES.

Two notes of caution if you choose to use this method of dodging: First, the card will need to create a soft border image on the negative to success-

While the exposure was in progress, a black card was brought down through the top of the lens's view. Photo by Glenn Rand.

Above—The left image is the underexposed bracket, and the right image is the overexposed bracket. The light image was placed in the background with the darker image layered on top with the opacity reduced. A mask was applied to the foreground of the darker layer. **Right**—The final image shows the use of the lighter image to allow good detail in the shadow areas, while the darker image compensates for the overexposure of the foreground and the areas through the windows in the background. This creates the previsualized image. Photos by Glenn Rand.

fully blend into the tones of the picture. The closer to the lens the card is and the larger the aperture, the softer the image on the negative. Even if the card is only an inch or two from the lens the line created by the card will destroy the image. If the exposure is suitably long, then vibration or movement will soften the edge. Second, with this technique or multiple long exposures you may have problems with intermittency effect or reciprocity failure.

USING MULTIPLE EXPOSURES HAS A NICE APPLICATION IN THE DIGITAL REALM.

Both approaches work for digital photography. With the camera on a tripod, using multiple exposures has a nice application in the digital realm. By using the bracketing option on many DSLR cameras the normal exposure can be set as an underexposure by the amount of exposure equivalent to half the previsualized dodge. This means that the "on" exposure will actually be underexposed and the lower bracket will be two brackets underexposed. This allows for layering of the top bracket (the proper exposure) and the underexposure bracket (the dodged exposure). A more robust but similar process is used for high dynamic range imaging (HDRI). See page 124 for more information on this process.

PREEXPOSURE

The dynamic range of the film can be expanded by preexposure (also known as flashing or presensitizing the film). Flashing is a common process in printing but can also be used in the capture stage. This process presensitizes the film up to its threshold. The purpose of preexposure is to expand the sensitivity of the film to better record deep shadow details. Preexposure is not suited for digital photography since it may result in overexposure or create unwanted noise.

A closer look at the toe of the characteristic curve of film shows that there is density change below Dmin. Adding a small amount of exposure before or after taking the photograph will shift Dmin to open up shadow details. The extra exposure will have a noticeable effect on the shadow detail but will not impact the highlights.

The process is to use an even tone and underexpose the film just below the threshold of the film. This exposure added to low levels of exposure provides enough density to be printed. In the field or with roll film, a gray card or a piece of translucent white Plexiglas can be used to provide the even tone. The gray card needs to be positioned in front of the lens so that it completely

Photo by Christopher Broughton.

Photo by Christopher Broughton.

covers the frame. It should be out of focus and in even light. A meter reading of the gray card is taken, and then the camera is stopped down four stops before flashing the film. When using the Plexiglas over your lens, take a TTL meter reading, then stop down the lens as needed. If you are using sheet film, you can use artificial lighting when returning to your studio or darkroom.

RECIPROCITY FAILURE COMPENSATION

Reciprocity is a key component of the Zone System. As we saw earlier, reciprocity functions in the straight-line portion of the film's characteristic curve. When the exposure of the film does not reach the level of the straight-line

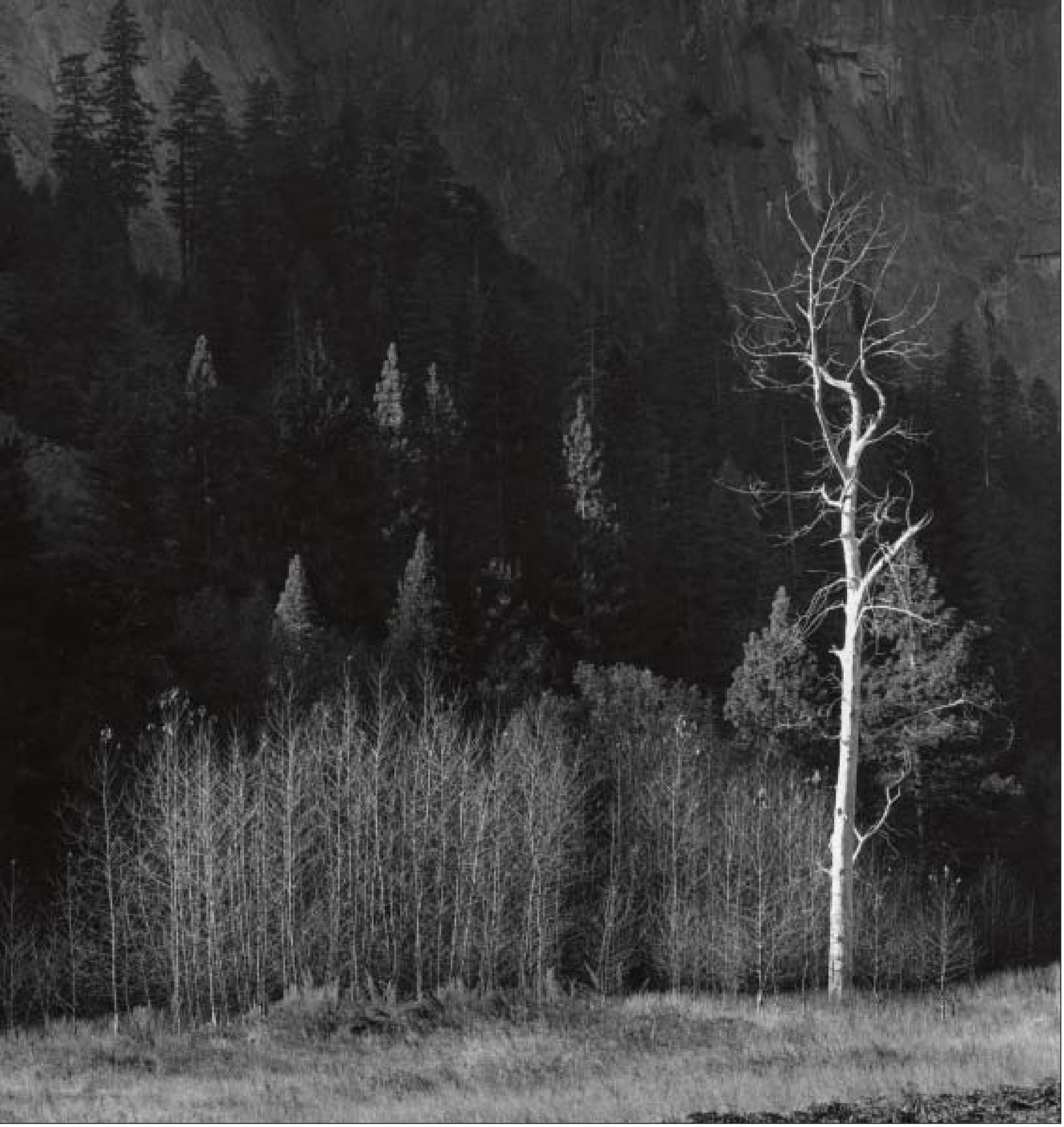


Photo by Robert Smith.

then a consistent change in the amount of exposure does not achieve a consistent change in density. This is referred to as "reciprocity failure."

With reciprocity failure, we cannot expect that correct exposure will occur. This happens in very long and exceptionally short exposures. Most commonly, reciprocity failure happens with very long exposure times. Since short exposure reciprocity failure happens at extremely short times, such as high-speed/strobe, that situation will not be covered in this book.

KODAK TMAX 100		
Metered Time	Exposure Time	Development Comp.
1 sec.	1 sec.	N
2 sec.	2 sec.	N
4 sec.	5 sec.	N
8 sec.	12 sec.	N
15 sec.	25 sec.	N–1/2
30 sec.	55 sec.	N–1/2
1 min.	2 min.	N–1
2 min.	5 min.	N-1
4 min.	12 min.	N–1 1/2
8 min.	30 min.	N–2
15 min.	1 hour	N–2

In long exposure time situations, there will need to be added exposure in order to achieve proper exposure in the shadow. In long exposures the film's ability to capture and hold the latent image (the image not visible on the film until development) is less effective and decreases as exposure time increases. However, the highlights are not affected in the same way. This creates different exposure requirements for the various portions of SBR.

Once again we use the concept of exposing for the shadows and developing for the highlights. To create a negative that will print well we will increase the exposure for the shadows and thereby boost the highlights. This will raise the contrast of the scene. To develop the negative to fit our paper's exposure range we will use N– development.

RECIPROCITY FAILURE OCCURS DIFFERENTLY FROM ONE FILM TYPE TO THE NEXT.

Reciprocity failure occurs differently from one film type to the next. For conventional grain films (Ilford HP5 and Kodak TriX), the rule of thumb is to double the exposure one stop for exposure times between one and nine seconds, two stops for exposures of ten to ninety-nine seconds, and three stops for exposures over one hundred seconds. This is a generally accepted practice, and the actual changes are not in steps but are gradual. This is evident in the chart above. You will also note the development compensation required to shift the highlights to a useable level for the paper's exposure range. Tabular grain film such as Tmax shows reciprocity failure differently. The tables on page 90 show the exposure and development changes required by reciprocity failure. To accurately determine the way reciprocity failure affects any particular film you will need to do extensive testing.

USING RECIPROCITY FAILURE FOR EXPANSION

Because we need to change exposure and development with reciprocity failure, we can use this knowledge to make N+ exposures. If the film is developed normally when it requires decreased development because of reciprocity, it will perform as though it is photographed in normal light ranges with N+ development. The following chart provides information on using reciprocity failure for expansion photography.

To take advantage of reciprocity failure for N+ zone exposures, you will want to force your system into long exposures. This can be done with small f-stops on the camera and/or filters. Be aware that with these long exposure times motion effects can be a problem.

KODAK TMAX 100

Meter Reading	Exposure Comp.	Contrast Effect
30 sec.	55 sec.	N+.5
1 min.	2 min.	N+1
2 min.	5 min.	N+2
4 min.	12 min.	N+3
8 min.	30 min.	N+3.5
15 min.	1 hour	N+4

CONVENTIONAL GRAIN FILMS

Meter Reading	Exposure Comp.	Contrast Effect
4 sec.	8 sec.	N+.5
15 sec.	1 min.	N+1
1 min.	5 min.	N+2
4 min.	24 min.	N+3

Left—Photo by Glenn Rand. **Facing page**—With the use of eight stops of neutral density filtration and a small aperture, the exposure time calculation was long. When including the failure of reciprocity, the exposure time was five minutes. The film had to be underdeveloped to control the highlight contrast. Photo by Glenn Rand.

CHAPTER NINE

ADVANCED PRINTING TECHNIQUES

It is as Ansel Adams said, "The negative is the score, the print is the performance." The advanced film and printing techniques presented in this chapter will allow you to accent ideas in your photographs and to strengthen what you communicate to your audience.

GLOBAL CONTROLS

Control can be used to affect the overall image or in local situations. Of the overall or global controls, the selection of the correct contrast is the first and most important consideration. Too often we select a high contrast paper or filter because the image appears crisper, even though it loses both highlight and shadow details. To avoid this, you should start by using a lower grade paper or lower number filter. Once you have made your print with the lower contrast you can make adjustments by adding more contrast to the print.

DEVELOPMENT CONTROL

We often think of graded paper as offering no flexibility in contrast. Though the paper is more rigid than a multi-contrast paper, it does allow for some flexibility. The amount of development will change the contrast function of the paper.

Photographic paper develops to completion. Completion means that the density of the paper increases to a certain level and no amount of development will make it darker. Therefore, if we change the development we still can reach completion and maintain our black density. Since we are trying to reach a point of completion we can change the time, temperature, or strength of the chemistry and still achieve total development.

IF WE CHANGE THE DEVELOPMENT WE STILL CAN REACH COMPLETION AND MAINTAIN OUR BLACK DENSITY.

As with film, overdevelopment changes the angle of the straight-line portion of the paper curve. As you overdevelop you compact the exposure range of the paper. This is the same as increasing the grade or number of the filter. While high strength developers will create this difference so will the increase of development time. Unlike film there is not as much latitude in developing paper and we can gain only ⅓ to ½ grade through overdevelopment. This

Facing page—Photo by Glenn Rand.

Photo by Christopher Broughton.

means that through simply overdeveloping your paper you can make a grade 2 paper print like a 2½. It also means that if you are using multigrade fiber-based paper, with printing filters and tray processing you can increase your developing time slightly and have continuous variability in the contrast of the paper.

Like increasing the development time of the paper, weakening the development process will change the angle of the characteristic curve. In this case the change indicates that the reduced strength of development of the paper will expand the exposure range of the paper. One of the easiest ways to accomplish this weakening of the development is through a water bath process. In the water bath processing of paper you allow the paper to develop in still water between developer refreshing. This development process is capable of reducing the contrast more than a full grade or filter. An increase in exposure may be required to maintain Dmax.

Since times will vary depending on the variables pertaining to the water and developer, it is strongly recommended that you test your paper before

using this technique on your fine prints. However, the following steps will serve as a general guide:

1. Expose the paper normally.
2. Start the development process by immersing the paper in the developer with adequate agitation.
3. After thirty seconds remove the print from the developer and place it in a tray of water.
4. Allow the paper to sit in the water without agitation for thirty seconds.
5. Place the paper back in the developer for five seconds with vigorous agitation.
6. Remove the paper from the developer and place it in the still water for fifty-five seconds.
7. Repeat steps 5 and 6 two more times.
8. Finish the print process with stop bath and fixer as normal.

Beers and Pseudo-Beers developers can also be used to control the development speed by the strength of the developer and the makeup of the chemical. In these cases higher-contrast and lower-contrast developers are proportionally mixed to change the developer's effect on the paper. With these developer combinations as well as with split bath developing (using the two different types of developers separately) you can also change the effective exposure range of the paper.

MULTI-CONTRAST PRINTING

Using combination printing of multi-contrast paper can give even more control of the way various tonal areas of the print are exposed. In this situation you print the negative twice without moving the paper or easel. The only change in the two successive exposures is in the printing filtration. If one of the filters is a low contrast number (0–2) and the other is high contrast (4–5), then the resultant print will have the highlight characteristic of the low contrast filter with the dark shadow areas looking like the printing from the higher contrast filter. This technique will give the print sharpened shadow and highlight details.

Facing page—Multi-contrast printing allowed the highlight areas of the print, the trees outside the window, to gain tones because they reacted to the #0 filter, while the dark areas in the burned bricks inside the building gained detail because of the use of the #4 filter. Because of the complexity of the image, dodging or burning the image would be very difficult. Photo by Glenn Rand. **Below**—Photo by Glenn Rand.

LOCAL CONTROL

Very early in our photographic education we learned to dodge and burn in the printing process. However, it is difficult to know how much dodging or burning to apply at various areas in one print. This is particularly true when the print requires both dodging and burning. To best make these determinations, you can create mini prints of areas that require dodging or burning,

Facing page—Photo by Glenn Rand.
Right—Photo by Glenn Rand.

then lay them on the working print to show the amount of dodge or burn that will be applied in those areas. Because the mini prints can be changed and compared directly to the working print, there is no need to reprint the working print with each change.

START BY MAKING A PRINT WITH A BASE EXPOSURE TIME AND NO DODGING OR BURNING.

Start by making a print with a base exposure time and no dodging or burning. This print should show the proper overall contrast. If you are tray printing, then after at least half the time needed for total fixing, the print should be squeegeed on a viewing board. Next, you make judgments on the test prints to determine how much dodging or burning may be needed in which areas.

At this point you cut the paper into pieces that will cover the areas you have determined need adjustment. Next, you will place the cut pieces of paper in the printing easel in the areas where you will adjust the exposure with either dodging or burning. If you will be burning the area, after giving the pieces of paper the base exposure, give the added exposure you expect to use. Repeat this process with more and less time than you estimated for the burn.

After processing the paper the same as the base exposure print, you can place the various pieces of paper on the print to see the effect that will be created without using an entire piece of paper for each test.

For dodging, you subtract exposure from the pieces of paper that cover the areas that need to be lightened. In this situation, you can use your dodging tool and count the dodge or you can subtract the time differential from the base exposure and expose the pieces of paper. After processing the paper you use the same method discussed above for determining the amount of exposure to reduce the exposure of the print.

USING A FILTER ALLOWS YOU TO SEE THE AREA YOU ARE DODGING, NOT JUST A MOVING SHADOW.

Of course, consistency is one of the keys in creating great prints. With dodging and burning there are several tools we can use. The first is a metronome. Some enlarger timers have an audible tone that can be turned on to assist counting. If your timer does not have this capability, you can purchase a metronome from a musical instrument store.

FILTER DODGING AND BURNING

To dodge and burn your prints, you can use multi-contrast printing filters instead of solid tools. Using a filter allows you to see the area you are dodging, not just a moving shadow. You also have the option to change the contrast in the dodged area if you are using multigrade paper. This method is the simplest and easiest way to change contrast within an image. By using a magenta filter (#4–5) as you dodge you also increase the contrast in the area that is

Selective contrast dodging increased the contrast of the waterfall compared to the rocks. A piece of #4 multi-contrast filter was cut to create a custom-shaped dodging tool. This not only reduced the light reaching the waterfall area of the print but raised its contrast within, making it sparkle. Photo by Glenn Rand.

Photo by Christopher Broughton.

dodged. This adds more brilliance to lighter tones in the dodged area. You can also use a neutral density filter if only lightening is desired without a change in contrast.

If you wish to use a contrast filter when burning a highlight area of the print, select a yellow filter (#0–1) for use in combination with your burning tool. The lower contrast filter used for burning adds subtle tonality to the highlight areas when working on lighter areas of the print. If the burning is used to darken an already dark area, a magenta filter (#4–5) will maintain more of the shadow detail rather than block the dark areas up with the added exposure.

THIS PREEXPOSURE PROCESS IS MORE COMMON IN PRINTING AND IS KNOWN AS "FLASHING."

FLASHING

As discussed in the previous chapter, we can change the way low light exposures affect film by giving an extra exposure to an even tone under the level that will expose Dmin. This preexposure process is more common in printing and is known as flashing. The preexposure of film works on shadow detail, but in the print it affects the highlights. By adding a small amount of light (just below the tonal threshold [Dmin]) to the paper we move the effective exposure point of Dmin (white level) to a lower amount of exposure. This expands the exposure range of the paper only in the area of Dmin. Flashing has no noticeable effect on the detail or dark zones in the print. Flashing can be used either for overall or local control.

To determine the amount of flashing that will be needed to bring out added highlight detail you will need to do a test strip with only flashing exposures. To do this, take the negative from the enlarger so that you are printing with white or filtered light. While flashing can work with any filter, flashing acts contrary to the higher filters (#4–5). To increase the effect of flashing, a lower number filter (#0–1) can be used. Very small amounts of light are used to make the test strip. It is important to know how many exposures are made. This is important since you are trying to build up exposure that does not gray the paper. Once the paper is processed, you determine the flashing exposure by taking the last exposure time that does not show on the test strip. If all your steps show a gray difference compared to the paper base you will need to repeat the process at a lower exposure level by shortening your base time or stopping down.

TO INCREASE THE EFFECT OF FLASHING, A LOWER NUMBER FILTER (#0–1) CAN BE USED.

BLEACHING

Bleaching photographs is not the same as whitening clothes. In the photographic process, development changes exposed silver halide crystals into black metallic silver. Potassium ferricyanide, the active agent in photographic

Photo by David Ruderman.

Photo by Glenn Rand.

bleaching, changes developed metallic silvers back to a silver halide form. Normally potassium bromide is added to the solution. Bringing the developed silver back to a form similar to silver halide means that fixer will dissolve bleached areas of a print. Bleaching can be done in a two-step process, using potassium ferricyanide followed by fixer, or by using Farmer's Reducer, which has both the bleach and fixer in one solution.

Because bleaching is done after fixing, the bleach can only act on areas of the picture that were blackened silver. The reduction happens evenly across all tones of the image. Reducing the image's density evenly throughout the print affects Dmin more than Dmax. With the reduction of silvers in the print, Dmin will be moved to the exposure value that created a light gray in the original print.

While Dmin shifts by reducing the total amount, the effect on Dmax is hardly changed. Dmax is 90 percent of maximum black, and the effect of bleach reduction is only a 10 percent change. With proportionally larger reductions in the exposure value of Dmin than Dmax the bleaching increases the highlight difference from other portions of the print. The visual effect of bleaching is to increase the contrast.

BLEACHING CAN BE USED ON THE IMAGE GLOBALLY OR AS A LOCAL CONTROL.

Bleaching can be used on the image globally or as a local control. When bleaching is used on a print locally it acts like dodging for lighter areas. To bleach a small area of the print you will want to work in a sink with a small hose or tube able to bring water to the area you are using to work on the print. Whether using bleach followed by fixer or Farmer's Reducer, you will need running water to control the area being affected by the bleach. Place the print on a flat, steeply inclined surface holding the flowing water from the tube just below the area to be bleached. Then using a cotton swab or watercolor brush apply the bleaching solution to the area to be lightened. Slowly lighten the area with repeated applications of solution. If you are using the bleach/fix process, you will not see the effect of the bleach until after fixing the bleached area.

Photo by Christopher Broughton.

INTENSIFYING/TONING NEGATIVES

Like bleaching, intensifying can be used for local or global control. Intensifiers not only darken the negative, in doing this they raise the contrast of the negative. They work by molecularly bonding to the silver in the negative and producing more density. Most intensifiers increase density proportionally to the amount of silver present in the negative. This means that the darker areas of the negative take on more density than thin areas. This gives a similar effect to overdeveloping without increasing apparent grain. Selenium toner can also be used for this purpose.

If you wish to intensify a small part of the negative, this can be done with a fine-tipped brush, a light table, and a selenium toner solution. To make the selenium toner solution, mix one part Rapid Selenium toner with one part working strength hypo-clearing agent. The hypo-clearing agent is used instead of water because it penetrates the negative more effectively. With the dry negative on a horizontal light table the solution is applied to the areas of the negative that you wish to intensify. Be careful, because once the selenium reaches the negative it changes the density permanently. By using this technique you will accomplish a similar effect to dodging with a magenta filter.

THE DARKER AREAS OF THE NEGATIVE TAKE ON MORE DENSITY THAN THIN AREAS.

CHAPTER TEN

THE ZONE SYSTEM FOR DIGITAL PHOTOGRAPHY

Digital photography is very seductive. It allows the photographer to do things that were not possible before. In digital photography, just because you can expose and erase many times does not mean that you should. Nor does it mean that you can ignore correct exposure for a post-capture fix.

How can the Zone System benefit digital photographers? Perhaps most important is the thinking process we must employ in using the system. We must consider the output of the process as, or before, we make the exposure calculations and before we press the shutter release. The Zone System is valu-

Photo by Glenn Rand.

Photo by Christopher Broughton.

able in digital photography because it can lead us to a system approach resulting in better communicated portrayal of the scene.

At the heart of the Zone System is previsualization. As discussed earlier in the book, previsualization is based on your assumptions of how the scene will look in the final print. In digital photography there are no rules that say that you must jettison this type of thinking. Whether with film or digital photography, previsualization is a prime element for success in image making.

To accurately previsualize the image and create a print that meets our needs, we need to understand how the various parts of the digital capture and output process can be manipulated and controlled.

ISSUES FOR DIGITAL PHOTOGRAPHY IN A ZONE SYSTEM APPROACH

What are the constraints within today's digital photography that we must consider? First and most important is the white level capture limit for digital sensors. Whether a charged-coupled device (CCD) or a complimentary metallic oxide semiconductor (CMOS), the sensors have a firm maximum range of light that they can record. When the top level is reached the sensor stops accepting light at the maximum or the light energy spreads to adjacent pixels (this is called "blooming"). Once the limit is reached no difference between a fully exposed pixel and an overexposed pixel can be determined. With the white limit reached all pixels at and above this limit will record white with no detail. Though some photographers believe that using the raw file format

Photo by Christopher Broughton.

allows this to be corrected in post-capture, the problem of overexposure cannot be corrected in digital photography.

The second consideration is the dynamic range the sensor can capture. The dynamic range can be defined as the difference between the brightest white that is not overexposed and the darkest tone above the noise level that the sensor can capture. Though film can be developed to alter the range of

Photo by Glenn Rand.

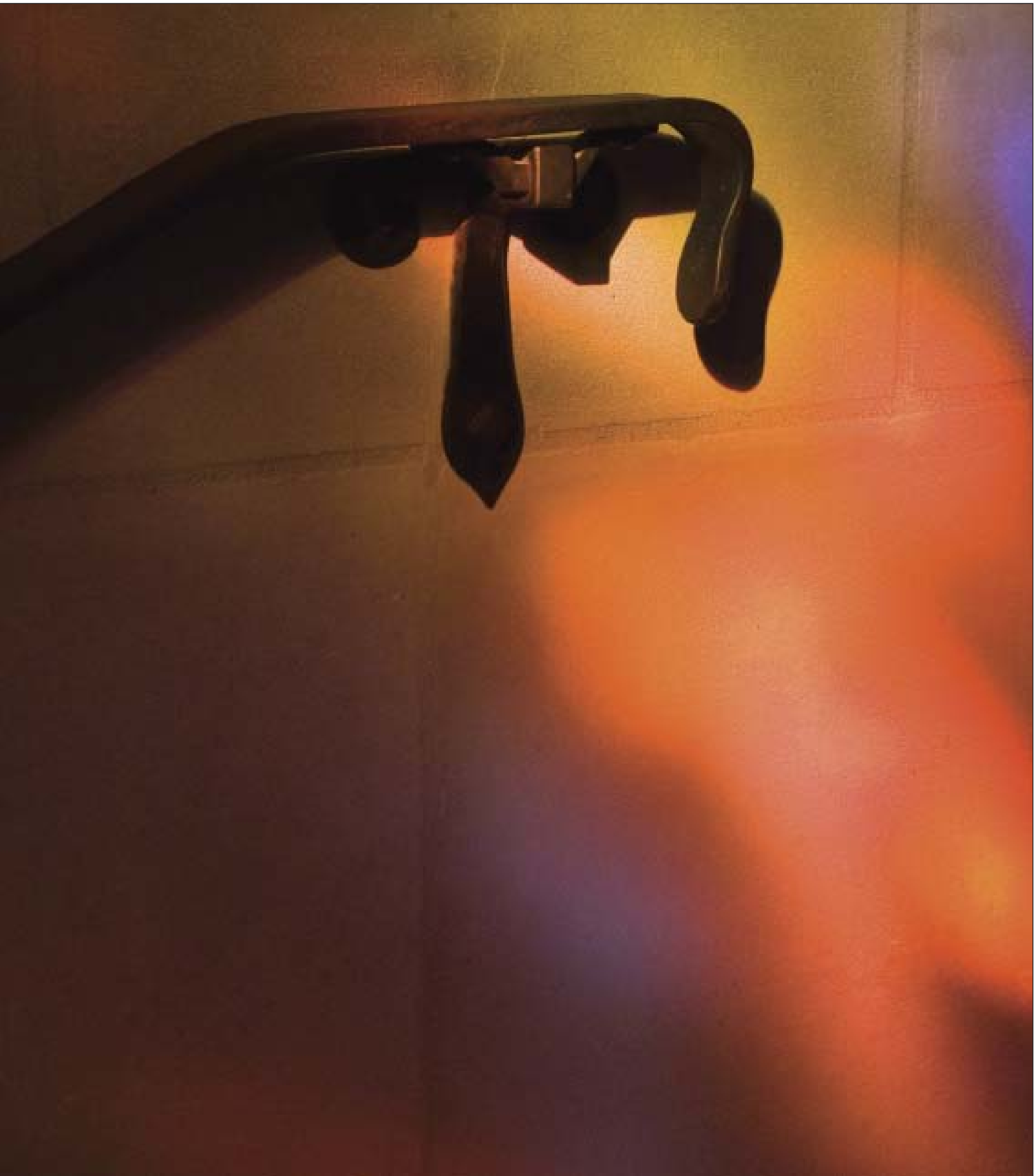


Photo by Glenn Rand.

light that can be effectively captured, digital sensors have a maximum fixed dynamic range. We can work on the values defined within the dynamic range but cannot expand the range when processing the file in the computer.

A misconception by some using digital photography is that if you work in 16-bits per channel raw mode you have a sixteen-stop dynamic range. As and analogy, if we consider a meterstick (a ruler one meter long) as the dynamic range, we can divide it into 100 centimeters or into 39.37 inches. Regardless, the dynamic range does not change—only the number of divisions changes. The same is true of the way a sensor captures light. If the sensor captures light at twelve stops in dynamic range, then that is the length of our "meterstick." If we divide the dynamic range into 8-bit channels, there will be 256 divisions between maximum white and black. However, if we use 16-bit channels, we are dividing the white-to-black range into 65,536 parts. While it is better for post-capture use to have the file in 16-bit channels, using this setting does not provide a greater dynamic range capture than the same sensor providing 8 bits per channel.

NOISE SHOWS AS RANDOM SPECKS OF VALUE CHANGES WITHIN A TONAL AREA.

Another issue that must be addressed when thinking about how an image will be output is that noise is required. Noise shows as random specks of value changes within a tonal area. Unless the noise is exceptionally contrasty it will be unnoticeable or not objectionable. Digital printers need some noise to keep from posterizing prints (producing flat, blocky tones). While a small amount of noise is required in all areas it is most noticeable in very dark areas.

To prevent highlight blocking and allow for the required noise, it is better to use a range of 12–242 than the full range (0–255) of tones available for the image. If the minimum value is 12, there will be enough dark tones to permit noise. Using 242 as a maximum you guard against blocking up the highlight details. This smaller range provides about 7.5 stops of output range, which matches the potentials of "photo-inkjet" printers.

There are two major differences between using film and digital capture that we need to consider. First, film has a much greater dynamic range than digital capture. Black & white film that has been discussed previously in this

Photo by Christopher Broughton.

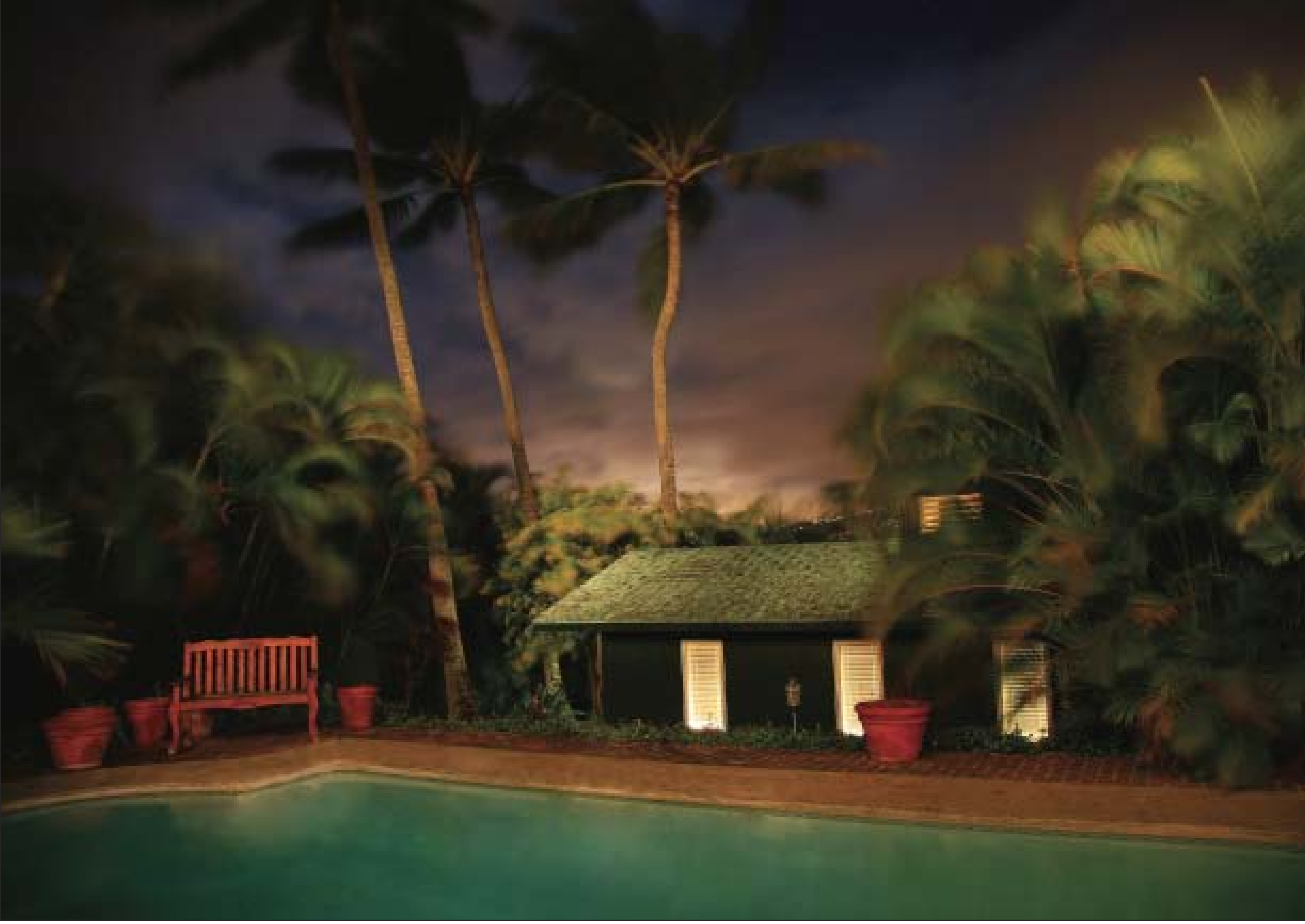


Photo by David Ruderman.

book can be controlled to produce a dynamic range up to seventeen stops. With digital sensors the dynamic range is fixed and ranges between eleven and fourteen stops depending on the type of sensor and manufacturer. This means that film can be used in light conditions that are beyond the capture capabilities of digital photography.

Another major difference between using the film-based and digital Zone System is that a digital approach can capture color images. When working with film, on the other hand, the Zone System can only be applied to black & white capture, because color film, when overdeveloped or underdeveloped, changes color balance. This restricts our ability to control contrast.

FILM HAS A MUCH GREATER DYNAMIC RANGE THAN DIGITAL CAPTURE.

In digital imaging colors that fall outside of capture or output limits are called "clipped." The clipping or cutoff point in capture occurs when (1) the light in the scene is too low to be recorded as anything other than noise or (2) the brightness level at the high end was too great for the sensor to fully capture. In output, the clipping points are where the printer can no longer differentiate tones near black or white. For example, if you are printing your image using an inkjet printer that can only reproduce a seven-stop range, then image detail beyond the printable range will be lost.

Photo by Glenn Rand.

DEFINING THE PARTS OF A DIGITAL ZONE SYSTEM

Earlier in the chapter, we learned that previsualization is key to a successful digital image, just as it is when using film. There are several other aspects of the Zone System that can be used with digital capture as well. These parts include the relationship between reflective intensities, the zones, exposure regulators, and the importance of output considerations.

The zones represent one-stop exposure separations across the tonal range from pure white to pure black. There is no difference between film and digital, and we can consider the zones to have this relationship across their functional dynamic ranges. For most situations, the dynamic range of a digital sensor is adequate to cover the range of light in the scene. Therefore, zone placement in exposure is possible. With digital as with film capture, opening up one stop will lighten the metered area one zone, and closing down one stop will darken the metered area one zone. This applies to color digital images as well. As with film, middle zones provide image information, dark zones provide richness and saturation of color, and the highlight zones add sparkle to the image.

PREVISUALIZATION IS KEY TO A SUCCESSFUL DIGITAL IMAGE, JUST AS IT IS WHEN USING FILM.

TESTING

With digital capture, we need to concern ourselves with highlight exposure instead of using dark-tone metering as the basis of exposure. When working with film, we ran a film-speed test to optimize our capture. When working with digital capture, we need to test our sensor's exposure index (EI). Film is more tolerant of some overexposure than is the image sensor, so we will test the sensor's ability to tolerate overexposure.

The test for finding your image sensor's optimal EI is not very different from the film-speed test used to find the optimal ISO setting. To run the test, you will need the following:

1. A meter designed to meter the light in the scene (e.g., an incident light meter; or you can take a reflective meter reading of an 18 percent gray card).
2. A test target that consists of a white, 18 percent gray, and black area that will be large enough on the image to measure in imaging software. These can be overlapped separate cards.
3. A model. The model should be wearing a textured white shirt or sweater. If need be, a piece of white material with heavy texture, ribs, or cabling can be draped over the subject's shoulder.
4. The camera must be in manual mode so that you can adjust the shutter speed and aperture and set it to capture raw files.

To ensure the test is properly conducted, complete the following steps.

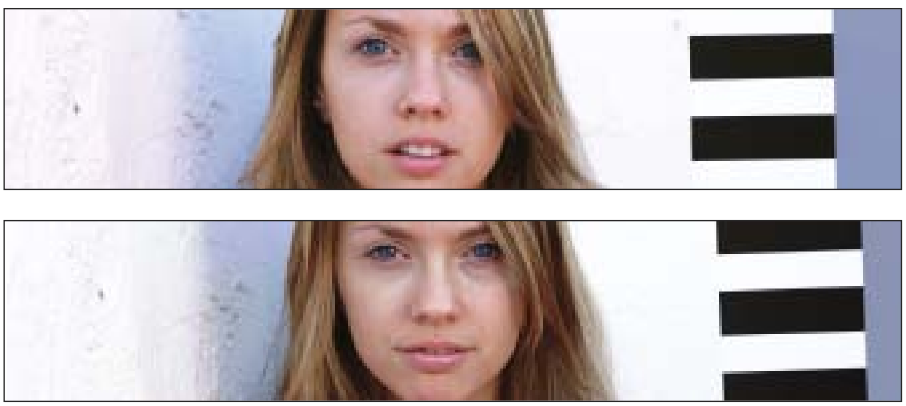
1. Find or create an evenly illuminated scene with an even, solid, dark background. If there is a bright background or backlighting the test will be inaccurate.
2. Place the card(s) on a stand near the model's face. Accuracy will only happen when the gray, black, and white cards are parallel to the sensor's plane (the back of the camera). Also ensure that you can see part of the white fabric with detail.
3. Check to see that the light is non-directional (i.e., diffuse) on the model and card(s). Do not conduct the test under specular light.
4. The ISO for the light meter must be the same as the selected ISO for the camera. (Because of noise considerations it is recommended that you use ISO 100 or the lowest available ISO for baseline testing.)
5. Take an incident meter reading and write down the f-stop and shutter speed.
6. Take a reflective meter reading of the white test patch. Subtract the incident reading (step 5) from the reflected white reading. The resulting value will be used when determining the optimal exposure.
7. Make an exposure with the aperture opened up two stops from the reading obtained in step 5.
8. Close down the lens $\frac{1}{3}$ stop and take your second exposure. If your lens has $\frac{1}{2}$ stops, do the test in $\frac{1}{2}$ stops. Record the information obtained for each successive frame.

Test setup. Photo by Tim Meyer.

9. Close down another ⅓ stop (or ½ stop if appropriate) and take another exposure. Repeat until you have a complete four-stop range.

To determine your camera's true ISO, read the white card with the color sampler tool in your image-editing software. Neutralize the file, then take a series of readings across the white card. The neutralizing should not include adjusting the white point. The correct exposure will be the frame where your white card value is approximately 245 with no exposure adjustment.

If you organize the shooting and corresponding white point data in order of exposure, from most exposure to least exposure, you can see which exposure's white point is closest to 245. That is the exposure closest to the ISO set in the meter. The optimal ISO setting (EI) is the number of stops (⅓ or ½) away from the camera's set ISO. If the EI is below the meter setting, you must reduce your exposure. Conversely, if the EI is greater than the meter setting, you must increase the exposure. Obviously, this is only viable if the camera is used in manual mode using the light meter used for testing. It is also important to record the light meter readings for the white card and the textured white area of the test scene.



The two examples show a normal exposure (top) and a two-stop overexposure test (bottom). Our task is to find the highest level of exposure in which detail is maintained in the white textured area of the image. Photos by Tim Meyer.

When determining the highest amount of overexposure that your camera will allow while still recording detail in white/highlight areas, start by setting the new EI as your ISO for metering and view successively overexposed frames. To avoid clipping, you can use your image-editing software to adjust the exposure, setting the white card to a value of about 242. With this accomplished, magnify and view the white textured material and look for the loss of detail, color shifts, blooming, and color fringing. You can observe the highest amount of overexposure that your camera will allow without loss of detail in white/highlights or significant degradation of the image. This finding is accurate for the camera being used in manual or any automatic mode.

The white target measurement establishes the number of stops you should open up by when using highlight metering. If the meter reading for the white target was 2⅓ stops beyond the exposure for the EI and the overexposure acceptability is one stop, then the correct exposure for highlight metering is obtained by measuring the brightest point in the image and opening up 3⅓

Photo by Glenn Rand.

stops. The number of stops varied from the meter reading that established the EI is the highlight exposure adjustment. This will place the highlight measured below the "clipping" threshold.

DIGITAL ZONE EXPOSURE

Though we discussed the ways the Zone System can be used for both film and digital capture, some of the considerations differ from one approach to the other. These are the exposure point and image processing. With film we expose for shadow detail and thus use dark-tone metering to set our exposure. Because of digital's comparative intolerance to overexposure we must concern ourselves with highlight-based exposure. Another difference is that with digital, development times do not come into play.

Of these considerations, exposing for the highlights has the most profound effect on our thinking and working. Image-editing software allows us to ma-

A GOOD BET

The Sekonic L-758DR light meter creates exposure profiles, including EI, overexposure information, and the dynamic range for the camera, providing a convenient reference that contains all of the information you need to use the Zone System when working digitally.

nipulate captured data in the image file and lighten or darken specific parts of the image. But it must be noted that if there is overexposure, there is no difference between white and any light source that is brighter than white. Darkening an overexposed area does not add detail, it only grays the tone.

DARKENING AN OVEREXPOSED AREA DOES NOT ADD DETAIL, IT ONLY GRAYS THE TONE.

The approach to working within the environment is comparable whether digital capture or film is used. We can certainly use zone placement to establish the relationship of any critical zone within the image. As discussed previously, the change of one f-stop is equivalent to change of one zone. In a digital Zone System while working with selected zones we must consider the effect on the highlight areas of the image. If moving a specific tone will force

Photo by Glenn Rand.

Photo by Glenn Rand.

the highlights into an overexposed situation it would be better to deal with the tonal placement in the processing software. Unlike film, digital capture holds this f-stop/zone relationship across its entire capture range. This is because the way film exposes and is processed creates an S-shaped characteristic curve while digital produces a straight line throughout its image range.

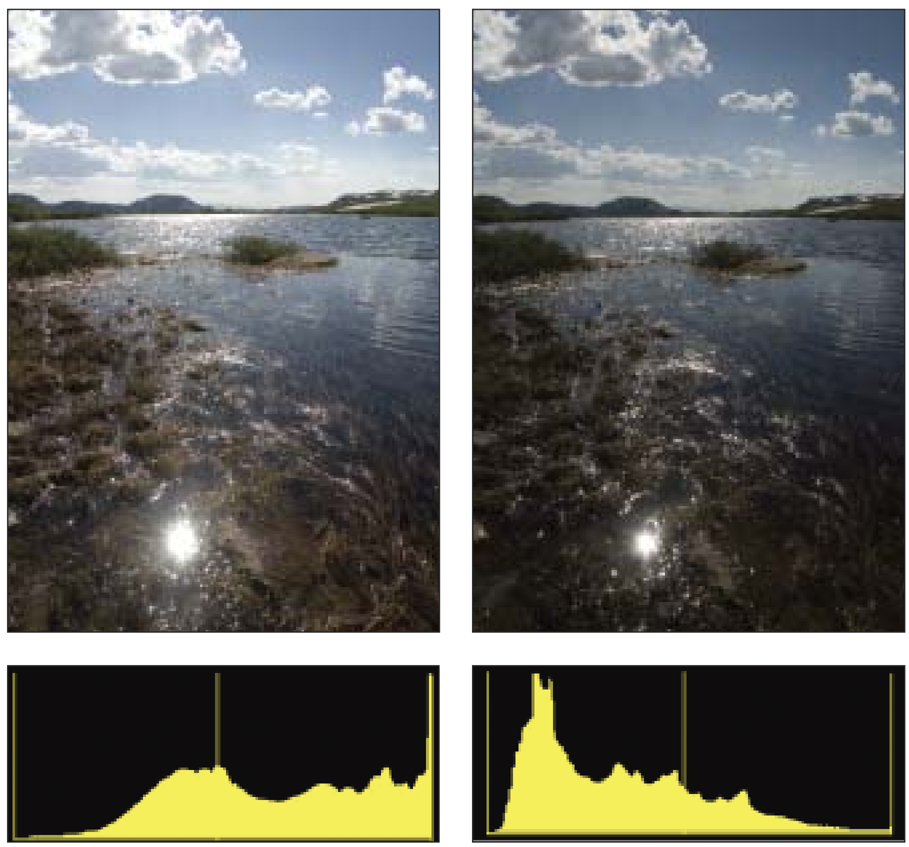
However, digital capture ends abruptly at its white and noise limits while film continues beyond the f-stop/zone relationship.

Our second consideration is the predetermination of development for the negative based on light conditions within the scene. When working with a film-based system the development becomes our N value. Within a digital-based system we only need to determine how we wish to move the exposure with our consideration of not overexposing the highlights.

USING THE DIGITAL SYSTEM

When applying the Zone System in digital photography we must use an overall approach adapting the light environment to the capture potentials. We will have the ability to move zones within the capture and imaging software, but for exposure an overall approach performs best. Because we will need to deal with highlights and do not have the ability to use overexposed areas in our final output, we will adjust the high end of the image in exposure and use imaging software to adjust other areas within the image.

1. Enter the EI into the meter. Use the EI determined for the sensor and enter it into the meter or camera's metering system.
2. Determine the highlight. Read the brightest point in the image that you will want to have detail. This will be the last tone below white (Zone IX). Your image-editing software will allow you to open up darker tones but cannot open up overexposed areas. For this reason, exposing for the highlights is critical.
3. Determine the shadow point. Meter the darkest point in the image, that below which it is acceptable to lose shadow detail.
4. Determine the capture dynamic range. Calculate the difference between steps 2 and 3.
5. Place the exposure. If the dynamic range is twelve stops or less, the exposure is within the capture capabilities of the sensor. Under these conditions the high-



The image on the left was taken using an incident meter reading (f/11 @ 1/125), and the image on the right was exposed using highlight exposure adjustment (f/22 @ 1/125). The histogram for the left image shows a large amount of pixels at or above the maximum exposure with little in the dark areas of the image. The image on the right has a histogram that shows all but a few pixels falling between the extremes of the exposure, a small white spike caused by the reflection of the sun. This means that the image on the right has the ability to be processed to give tones throughout its captured dynamic range. While neither image matches the previsualized image, the right image contains data that can be adjusted in post-capture to match the previsualized photo. Photo by Glenn Rand.

light exposure metering is used to set the exposure. Even if the dynamic range is within the capture range of the sensor, it is the highlights that are critical.

6. Out-of-dynamic-range exposure. If the dynamic range is beyond the capacity of the sensor, normally beyond twelve stops, you need choose what you will sacrifice, the highlight or shadow detail. (This situation normally occurs when shooting on a bright sunlit day on sand or snow with deep shadows.) If the shadow detail is more important, you will need to open up additional stops to include the dark-tone detail. This operation will block up the highlights. If the highlights are more important, use the highlight exposure adjustment.

CAPTURE YOUR IMAGES IN THE RAW MODE TO MAXIMIZE THE POTENTIAL OF THIS APPROACH.

It is important that you capture your images in the raw mode to maximize the potential of this approach. Other file formats, particularly JPEG, compress the images, and this can result in a loss of image data when the images are opened. Furthermore, raw images are stored with the captured dynamic range intact. Though the raw file converter in your image-editing software will spread the captured dynamic range across all 16 bits as seen on the computer screen, a raw file provides the best representation of the captured light.

POST-CAPTURE PROCESSING

When the image is captured without overexposing the white level, image-editing software can be used to open up the shadows and create a photograph that matches the previsualized image. (*Note:* Both CS2 and CS3 feature raw file conversion capabilities. In the paragraphs that follow, we will look at how Photoshop CS2 is used to make post-capture enhancements and will then outline the way the process differs when using CS3.)

The process is straightforward. The image should be processed in 16 bits per channel. (In Camera Raw, use the pull-down menu to the right of the

The yellow highlighted portion shows where the selection for depth is found in Camera Raw.

Depth field to set this preference. In Photoshop CS2, go to Image>Mode>16 Bits/Channel.) Selecting this setting does not expand the dynamic range of the image but prevents the loss of image detail because the image has been compressed into 8 bits per channel when opened from the captured dynamic range.

When the image is open in Camera Raw the light resembles that captured in the scene. Regardless of the exposure control applied, it will be spread as near as possible across the 16-bit range. This means the histogram for the image will appear as a file with a total 16-bit capture. As explained above, this is not the case and actually is a division of the light captured and transferred to the converter in 16 bits per channel.

In the Camera Raw dialog box you'll find sliders that can be used to adjust the exposure, shadows, brightness, contrast, and saturation. These controls will help you finesse the light levels in the image and produce your previsualized image. Note that the adjustments should be made with the auto box above each slider deselected.

The Exposure slider can be used to adjust the dynamic range in the image. Moving the slider to the left increases the number of darker tones in the image, and moving it to the right edge increases the overall image brightness.

The Shadows control anchors the highlight point but allows you to manipulate the dark tones in the image. Since digital files are ideally exposed for the highlights, this will be a very effective control.

The Brightness slider anchors the shadow point but allows you to manipulate the brightness in the image.

The Contrast slider adjusts the overall distribution of the light captured in the image file and allows us to maximize the output tones.

The Saturation slider has little effect on the light captured in the image. Moving the slider toward the left end (–100) will produce a grayscale image. Moving the slider to the right end will gradually boost saturation.

You will need to experiment to find the best controls for your exposure preferences. The following list outlines one of the general steps required to maximize the image:

1. Set the Exposure slider to 0 so that the image exposure appears close to the way it was captured. Note that if the majority of the histogram data is located predominantly on the right (highlight) side of the histogram or on the left (shadow) side of the histogram, the image will be too light or too dark and an exposure adjustment will be required.
2. Adjust the Shadow slider until the data is close to but not at the extreme left edge of the histogram. Because the right end point of the tonal range shown in the histogram is anchored, moving the slider will only allow you to adjust the shadows.
3. Adjust the Brightness slider to achieve the desired results in critical areas. Because the left end point of the tonal range shown in the histogram is

INCREASED CONTROL

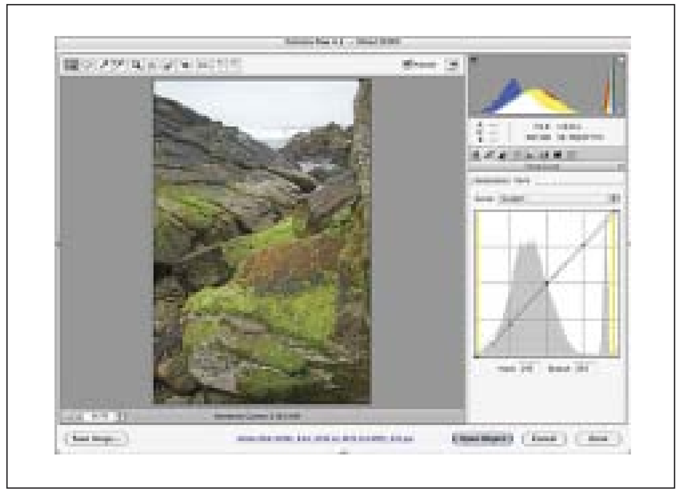
The Shadows, Brightness, and Exposure sliders are particularly handy for opening up detail that has been "underexposed" to reduce the chances of overexposing the image highlights.

THE SATURATION SLIDER HAS LITTLE EFFECT ON THE LIGHT CAPTURED IN THE IMAGE.

anchored, moving the slider will adjust only the highlights. Move the slider until the data is close to but not at the extreme right edge of the histogram.

4. Adjust the Contrast slider to increase or decrease the tonal difference between the darkest and lightest parts of the image. When the slider is moved toward the right (produces a positive number), a contrastier image results. When the slider is moved toward the left (produces a negative number) the tonal range is wider and contrast is diminished. This wider tonal range allows for a more optimal output.
5. Moving the Saturation slider to the right can boost the intensity of the colors in the scene, but it should be used sparingly, as it can also produce an unrealistic portrayal of the scene. By moving the slider to the extreme left edge, you can create a grayscale image from a color original. Though this is a simple approach, one of the many other available color conversion methods will produce a better result.
6. Once the preview image appears as desired, rename and save the file. The raw file converter will then process the image and save it as an inter-

The image matches the previsualization. There is detail in all areas of the image including the star created by the sun's reflection diffracted by the iris in the lens. While the sun's orb is beyond the sensor's sensitivity, there is detail in the clouds as well as in the shadow details. Photo by Glenn Rand.



polated file. Renaming the file ensures that your original, unedited raw image is preserved and unaffected by any image editing. Safeguarding the original raw file ensures that you can work with and reinterpret the image at a future date.

The following paragraphs explain how Photoshop CS3 can be used to process your image. Though the interface and names of some of the controls differ from those used in CS2 processing, we will follow the same basic steps to process our images.

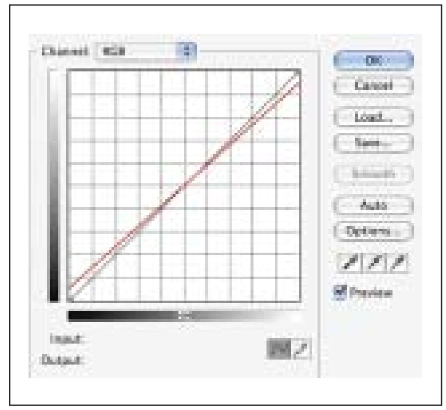
CS3 allows for more advanced Curves control—in fact, all of the functions discussed previously (with the exception of saturation) can be controlled by manipulating the curve. When the Curves feature is activated, the curves adjustment appears superimposed over the histogram of the image. To edit the curve, click on "edit points to modify curve" icon at the top left of the dialog box, then click and drag the curve itself to adjust the highlight, midtone, and shadow areas of the image as well as the contrast.

With the default settings in place (and working on an image in the RGB mode), pulling the center of the curve down darkens the image; pulling it up lightens the image. If the top-right end of the curve is pushed up and the bottom-left end is pushed down (creating an S curve), the shadow details will darken and the highlight details will compress and become brighter. This will produce a more contrasty image. As needed, you can remove the anchor points by clicking on them and dragging them off of the curve.

At the shadow and highlight ends of the curve, the endpoints can also be adjusted to change the highlight (top-right point) and shadow (bottom-left point) limits and tonal compression of the image.

OUTPUT

There are two basic options for outputting your digital images. The first is an online presentation (e.g., on a website or e-mail attachment) or archiving your images on CD or DVD. When sharing digital image files or on-screen



Top left—In CS3 the Exposure control works as it does in CS2. The Fill Light control replaces CS2's Shadow control; it also holds constant the highlight point, allowing you to adjust the shadows in the image. The Brightness, Contrast, and Saturation controls in CS3 function the same as they did in CS2. **Top right**—The yellow lines have been drawn in to indicate where the ends of the curve are moved to maximize the use of the curve. When the point on the $^3/_4$ position is moved up to about the $^7/_8$ level and the point at the $^1/_8$ position is moved downward the image is changed to the final product. **Above**—To adjust the curve to maximize the output of an inkjet printer, move the end points +5 percent as shown by the red line. **Facing page**—The final image after proper exposure and image adjustment for the previsualized image. There is detail in the surf, and rich, deep tones are visible in the rocks. Photo by Glenn Rand.

Photo by Glenn Rand.

images with your clients, your files will be usable as produced (so long as it is at a web resolution if required). However, most professional photographers will need to produce prints—and this presents us with a new challenge.

There is an unfavorable discrepancy between the capture capabilities of a digital image sensor and the printer used to output your image. For instance, your sensor may be able to capture an eleven-stop exposure range, but inkjet printers will only be able to reproduce about 7.5 stops, and offset printers can only reproduce 3.8 stops of capacity. This discrepancy means that some of the detail you endeavored to capture and print in your image will be clipped. Fortunately, this can be remedied by using Photoshop's Curves feature. To do this, move the curve down 5 percent from the top and up 5 percent from the bottom.

HIGH DYNAMIC RANGE IMAGING

When the light is beyond a twelve-stop range, high dynamic range imaging (HDRI) can be used. Newer image-editing programs support this process, layering a series of exposures, made with the camera on a tripod. This discussion is beyond the scope of this book, but informative discussions can be found in books that cater to using image-editing software or by entering the relevant terms in your Internet browser's search field.

CONCLUSION

A PERSONAL APPROACH TO THE VISUAL LANGUAGE

Sharing the visual world intrigues visual artists. In creating photographs, we can communicate those things that engage and enlighten us to our viewers. We can create a visual narrative that exceeds the reach of our spoken language.

We are all capable of seeing something interesting and unique, but it is the effectiveness with which we communicate our vision that makes our work important. An effective image should do more than present a likeness of the subject or scene. Your images must have content. Even the most carefully crafted communication is meaningless if the content has no real value. Mastery of the Zone System, then, should enhance your communication; it is not the end all and be all of that communication.

Photo by Glenn Rand.

As you learned in reading this book, there are four distinct aspects of the photographic process. First and foremost is visualization of the image, followed by the capture of images, the processes required to create the print, and finally, the presentation. The methods I use enhance visualization in the photographic process but do not replace it.

Because I have tested and "own" my processes and the tools used to carry out my vision, my creativity is not hampered by concerns as to whether or not the image I previsualize can be made into a print. By owning and trusting the processes described in this book, I am free to use my eyes and interpret the world for my audience. The strategies involved in the image capture have become a seamless part of the capture-to-print process. This allows me to expend my mental energy for the purpose of perceiving and interpreting the world I encounter and communicate through my photographs.

INDEX

TAKE CONTROL OF YOUR PHOTOGRAPHY AND
LEARN HOW TO ACHIEVE CONSISTENTLY EXCELLENT RESULTS

As a photographer, the Zone System offers you a way to capture your impression of the world and tell someone else what you saw in the most beautiful visual language: the language of black & white photography. Based on the techniques of legendary photographer Ansel Adams and presented by Dr. Glenn Rand of the Brooks Institute, this book offers a systematic approach that integrates a knowledge of light, exposure, development, and printmaking. By implementing these step-by-step instructions for each phase in a film or digital workflow you can become consistent in the way you work and achieve overall better results in your images

FEATURES:

- Tips for getting started quickly with the Zone System
- Identifying the many variables in your workflow and learning how to control them or compensate for them
- Understanding the zones and how to place them in your images
- Tips for accurate previsualization
- Metering techniques for more precise exposures
- Development techniques for exacting contrast control
- Printing to bring out the most in each image
- Implementing the Zone System principles in a digital workflow
- Images by Glenn Rand, Christopher Broughton, David Ruderman, and Robert Smith

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