chapter six

All About Film & Exposure

Text and photos by Jack and Sue Drafahl

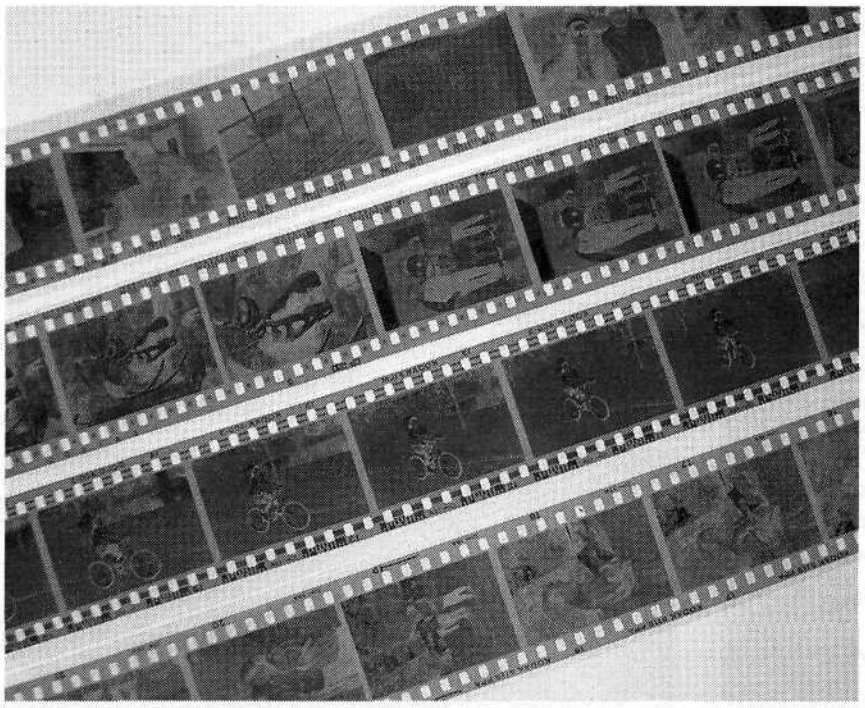
Your basic tools...and how to use them

As the 21st century brings us closer to a digital new world, the battle between film and digital has taken a new twist. Instead of fighting change, most film users are now looking at film as a chemical data-capture method. You might say that film is "silver pixels." Film still has many advantages besides its optimum capture capability since it can go through the complete traditional process of processing, printing, and photographic enlargement, or be converted into the digital process via film and flatbed scanners. Film gives you the best of both worlds, by giving more options than ever before. The best part is that film and cameras have become even more high-tech at capturing that moment in time. Even so, it still takes a photographic brain behind the eyepiece to completely understand how to get the best exposure on film emulsions. Let's start at the beginning with the construction of film itself.

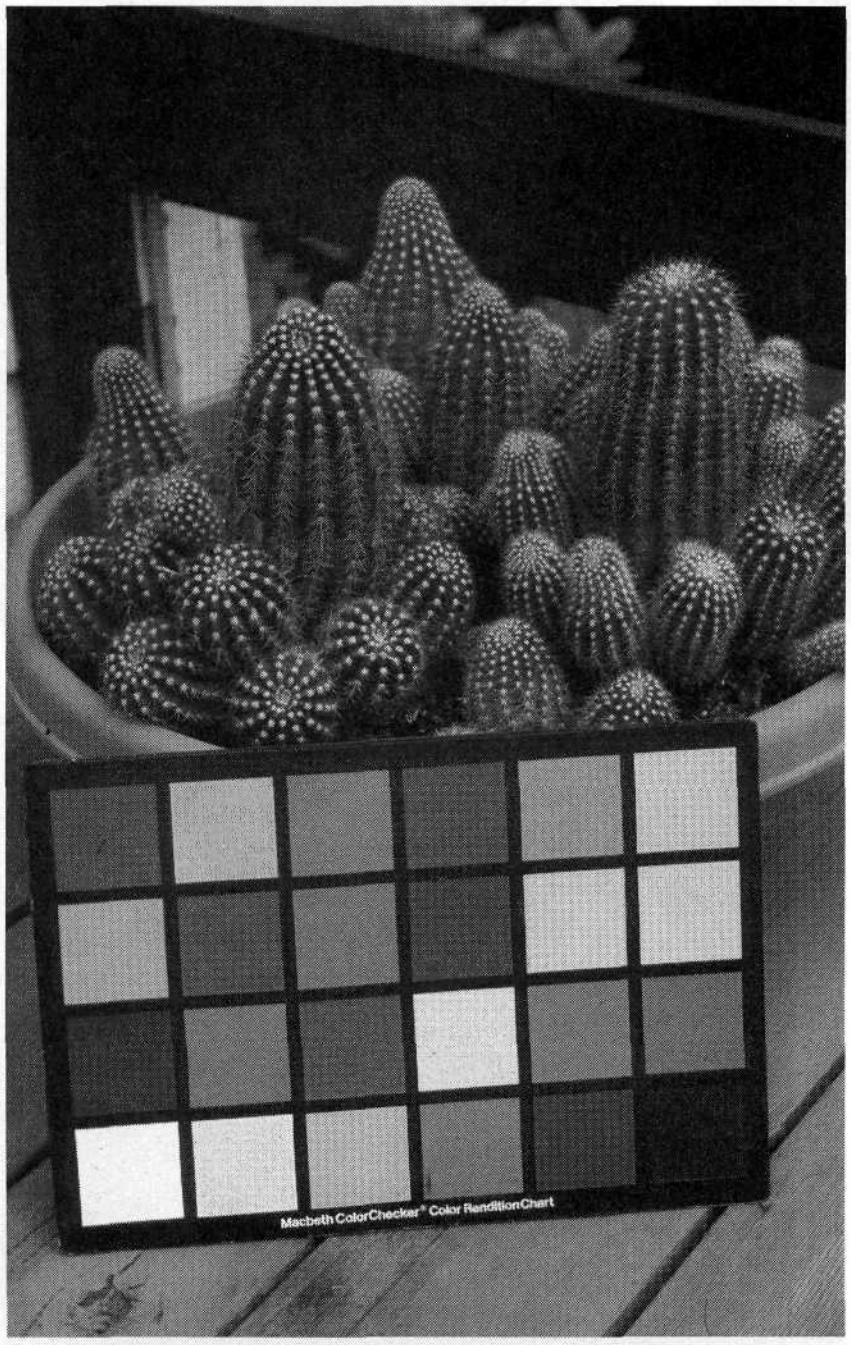
What Is Film?

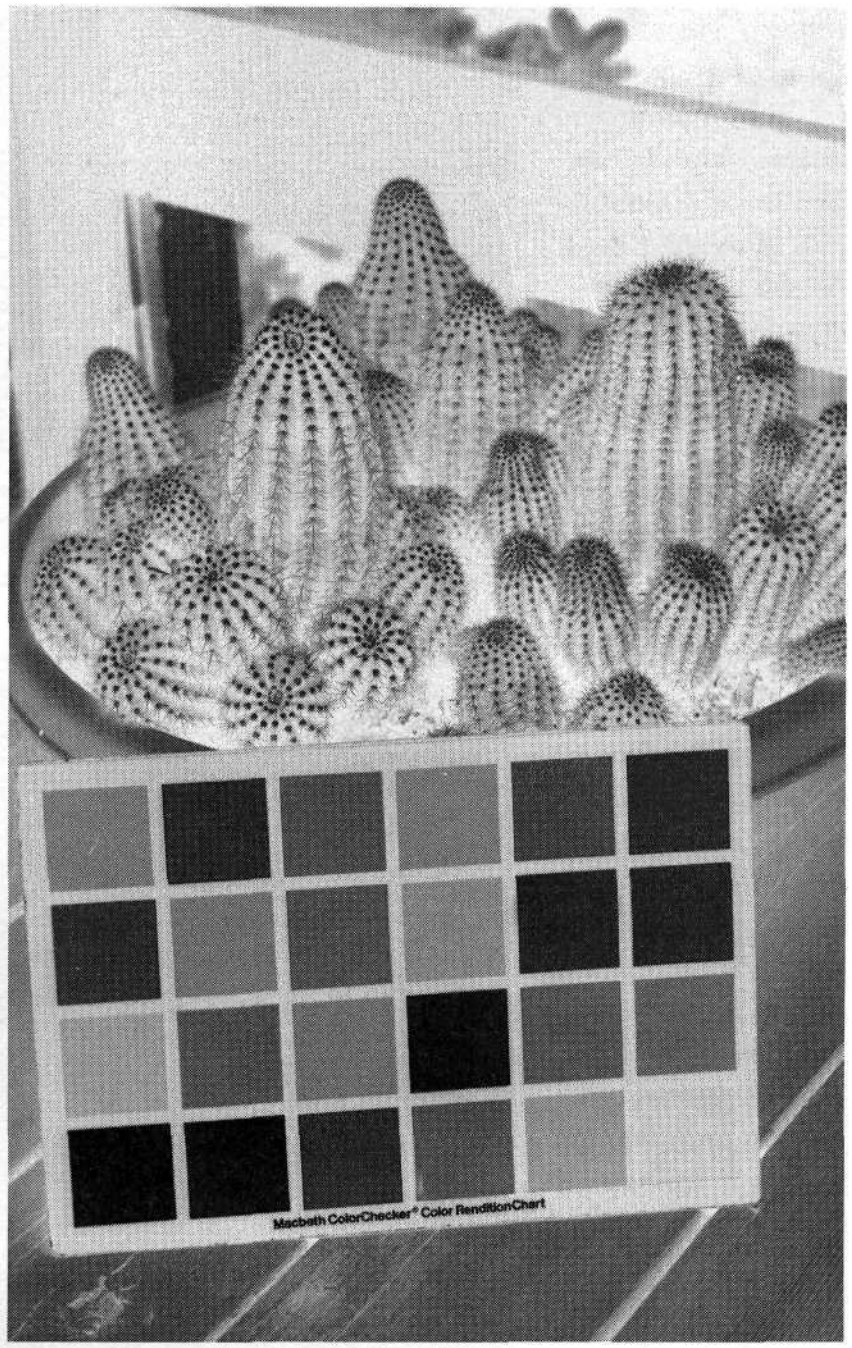
Simply put, film is a flexible transparent base coated with a light-sensitive emulsion containing silver-halide crystals in a variety of shapes and sizes. When a black-and-white roll of film is processed, exposed crystals form a

Choosing the right film and exposing it correctly are keys to good photos. When using a long lens, you need a fast film or a fast lens (a tripod helps, too!). Here, a slow film and a fast lens did the trick.



When black-and-white film is developed, it produces negative images of the subjects you photographed. With color-negative films, the colors are reversed, too.





The original scene (left) appears reversed—as a negative—on processed negative film (above).

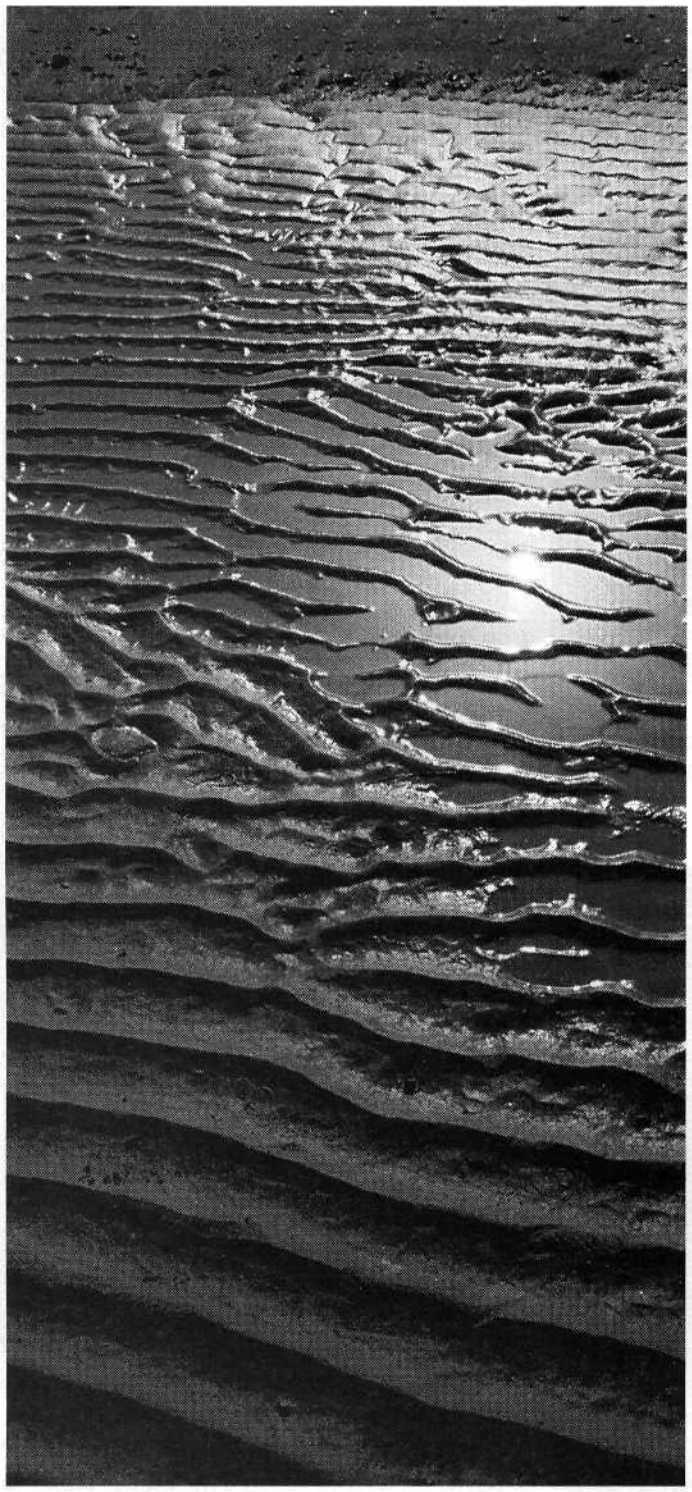
permanent negative image. The unexposed crystals are then removed at the end of the process, and the film is dried. The final processed image is no longer light sensitive, and can be printed onto black-and-white paper with a darkroom enlarger, or scanned into your computer system and for digital use. When the negative is printed, the densest areas print as white, and the clear areas as black. All other densities print as shades of gray.

Color film, on the other hand, needs additional layers to transfer the images to color dye, selectively filtering light as it passes through the layers, plus a final layer that protects the emulsion itself. Many of these super-high-tech emulsion may have more than a dozen layers, but are still very thin compared to films from a few years back. Since film is light sensitive, it is manufactured in a light-free manufacturing facility that finally packages the film into a cassette, 120 paper-protected roll, or in sheet film boxes.

Color negative film has the same silver crystal exposed, but transfers the color component data to various color dye levels in the processing. At the end of the process all silver and the unused dyes are removed during a bleach and fixer process. The final negative has cyan, magenta, and yellow layers with an additional orange mask built in. The processed image is then safe in room light and can be printed on a color enlarger. As the image is printed, all the colors print as reversed colors on the paper—cyan prints as red, magenta as green, and yellow as blue.

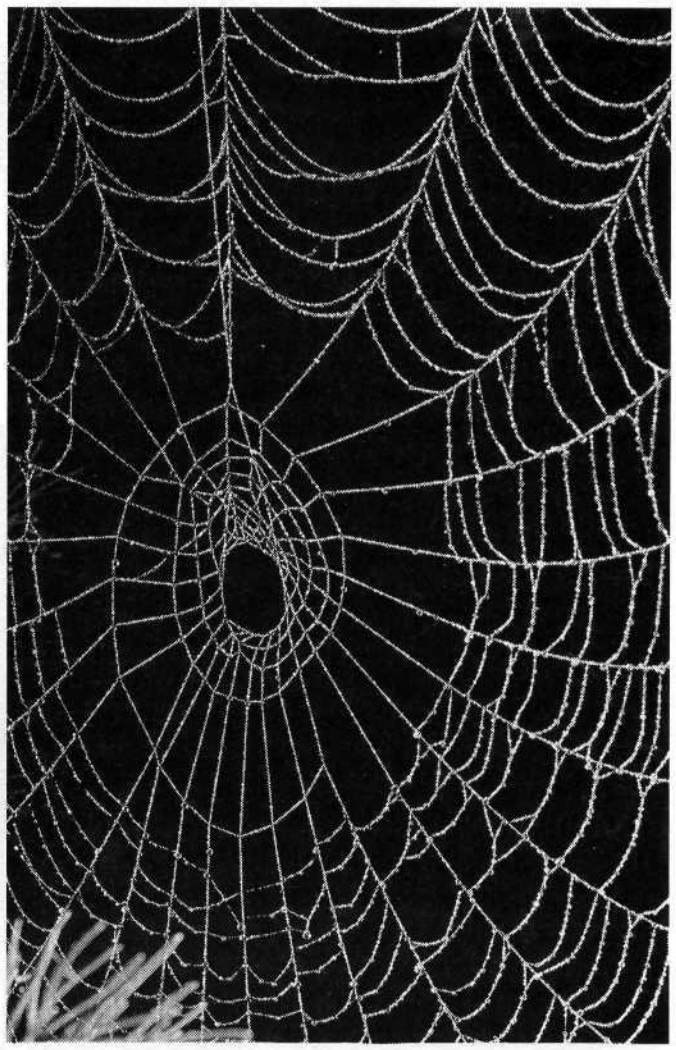
Color slide film takes the process even one step further. During the processing, the black-and-white images are reversed before they are linked to the color dyes. These

reversed dye images are then combined to give a positive transparent image, which can be inserted in a mount to produce a color slide. All the silver-halide crystals and the unused color dyes are removed during the bleaching and fixing process before the film is dried.



Left: Exposed and processed properly, today's films can reproduce a wide range of tones, whether color or black-and-white.

Below: Today's films are capable of recording fine detail (this was shot on ISO 100 color-slide film) if you use a good lens and keep the camera steady (it's a good idea to use a tripod for maximum sharpness).



How Is the Film Exposed?

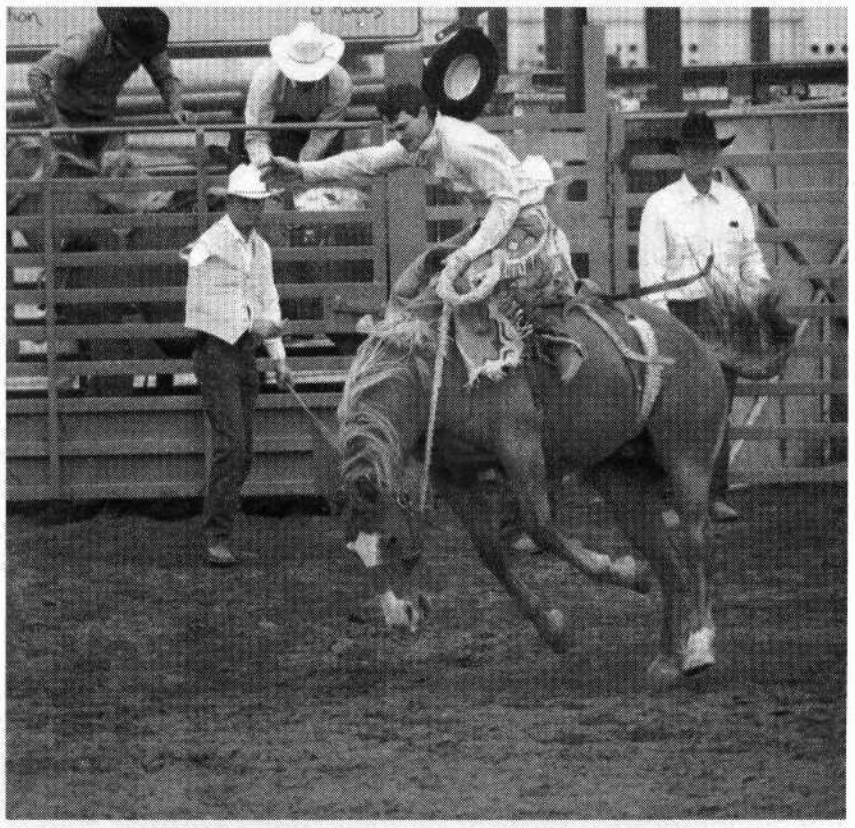
When any film is to be used, it is loaded into a camera, and a single frame sits behind a shutter device. When the shutter is opened for a short period of time, light passes through the lens aperture, and focuses as an inverted latent image on the film emulsion. This data is stored in the exposed silver-halide crystals of the film, and will be enhanced in the developing process at a later time.

Correct exposure is based on letting the right amount of light reach these crystals. The crystals come in different sizes depending on the speed of the film. A film with a low ISO rating is called a slow film and will have small crystals, which require a lot of light to capture an image. A film with a high ISO rating will have crystals that have a larger surface area and thus require less light to capture an image. The size of these crystals is proportional to the amount of grain you will see in a photograph.

Which Film to Use?

This is the most-asked question we get from readers, and it doesn't have a simple answer. First, there are more than a 100 different types of films to pick from, and there are always new contenders in the making. If your goal is black-and-white prints, then there is a wide assortment of black-and-white films to select from. Keep in mind that not all labs today will process or print black-and-white. It is usually used by fine-art photographers and the more-serious advanced amateur photographer who has easy access to a darkroom.

If you are looking for color prints or enlargements, then your choice should be color print film (also known as color



Fast films let you use a fast shutter speed to freeze action and a small lens aperture for enough depth of field to keep subject and background sharp, but are grainier than slower films, and not as sharp. But today's fast films are *very* good.

It's a good idea to bracket exposures when shooting slide film in tricky lighting situations like backlighting.

Black-and-white infrared film produces an eerie effect, with flare around hot spots, very dark skies, and light foliage. It's best used with a red No. 25 filter for pictorial work.

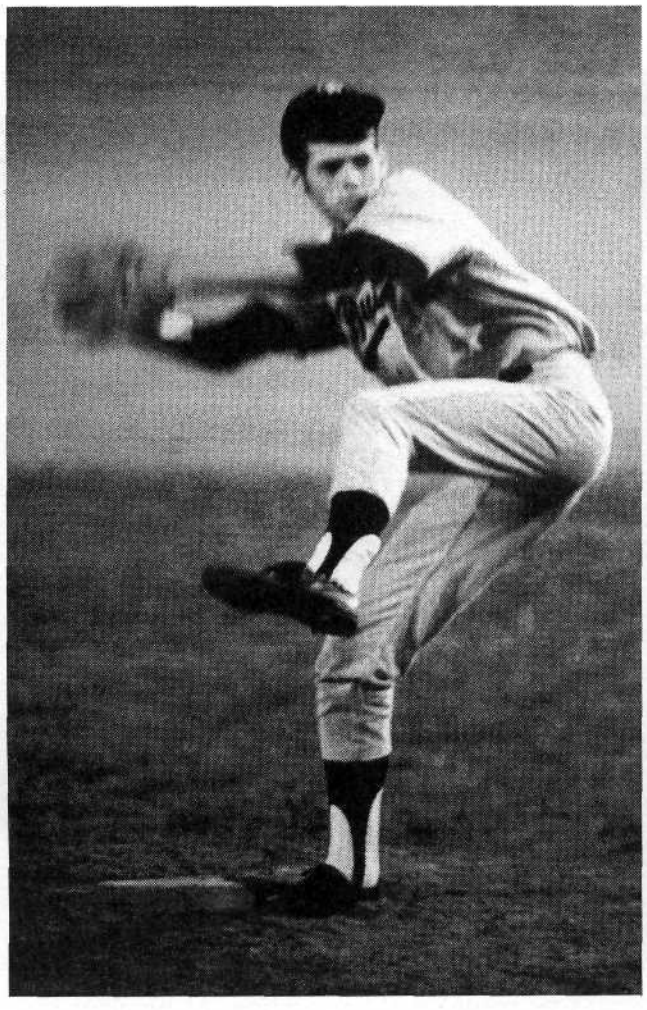
negative film). These films offer great advantages as films can range in speed from a very slow ISO 50 to a super-high-speed ISO 3200. The exposure latitude of these films can be as great as seven stops (more on this later) and it is difficult to get a bad exposure. Ninety-five percent of the images exposed by amateur photographers today are taken on color negative films.

Color slide film is targeted towards photographers producing slide shows, images destined for color separations, or professional assignments. In past years, slide film was necessary for stock, magazine submissions, and most color publications. This trend is slowly changing as more magazine printers are accepting scans made from both slides and color negatives. The quality of slide film is generally better than color negative, but the versatility of color negative eventually outweighs those benefits. At present the numbers indicate that less than four percent of the images taken by amateurs are on slide film.

When selecting a film, remember that if you want color prints, use color print film. You can make prints from slides, but they won't be as good as prints made from color negatives. On the flip side, if you want slides, use color slide film. You can make slides from color negative film, but they won't be as good as original slides.

Film Speed

Film speeds are given ISO (International Standards Organization) values to measure the film's sensitivity to light. The higher the ISO number, the more sensitive the film. The ISO setting is what tells the exposure meter inside your camera how sensitive to light the film that you are using is. This communication is absolutely necessary



Fast films (left) are great for low-light shooting, but grainy. Slow films (right) produce great detail, but require good light or use of a tripod. Choose your film to suit your shooting needs.

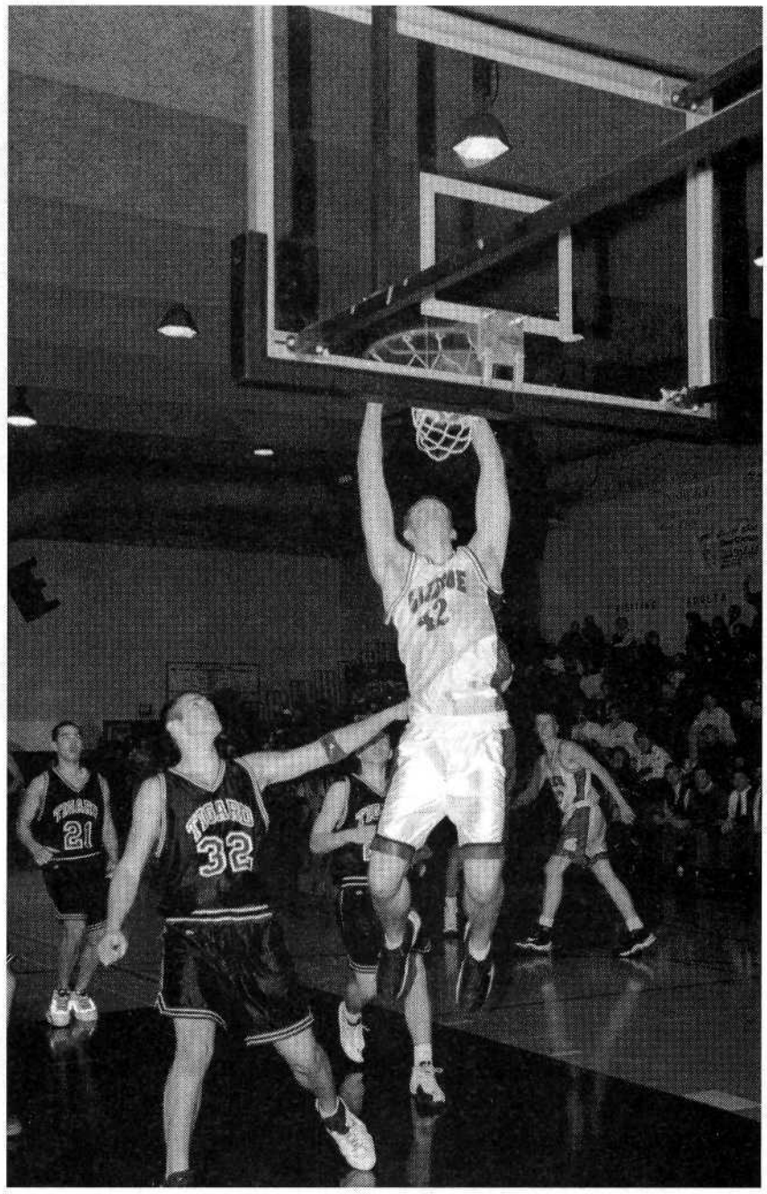
to obtain good exposures.

Most of today's cameras have DX coding on the film canister that automatically tells the camera the film speed. This works great because then you can't forget to set the ISO as you might with non-DX cameras.

The key to understanding film speed is deciding what is most important to you. The slower films offer superfine grain, but the higher-speed films allow you to stop the action and keep the subjects sharp. It is all a trade-off, and you have to decide. Not to worry though, because the new technologies in the high-speed films make it possible to optimize the way the silver halide crystals react to the light striking them. The results is finer grain, sharper images, and better color reproductions. Many of these higher-speed films resemble the quality of ISO 100 films of a few years past, so there is hope.

Image Characteristics

Photo images are made up of tiny particles called grain. In black-and-white film, grain is caused when exposed grains of silver halides clump together during development. In color film, these silver-halide crystals are removed from the film during processing, leaving behind color dye clouds to form grain. Most film manufacturers provide a guide to film granularity with RMS figures. The lower the figure, the finer the grain. For example, Fuji Superia 100 has a RMS value of 4. Fuji's Velvia has a RMS of 9 and it is one of the finest-grain slide films on the market today. So, what gives? The RMS values for color negative film and color slide film are not directly comparable. You must multiply the color negative film's RMS number by 2.5 to get an approximation of its grain compared to a slide film's RMS rating. When you take Superia 100 at RMS 4 and multiply it by 2.5, you will see that it matches Astia at RMS 10 and closely resembles the fine-grain Velvia. Kodak uses its own method of measuring granularity, and its Print Grain Index numbers cannot be related to RMS ratings, and so are useful only for comparing granularity of one Kodak film to that of another Kodak film.)



Fast color-negative press films are great for low-light action, as they provide the speed to stop action, the ability to be pushed to higher speeds, and lots of exposure latitude.

Exposure Control in the Camera

Two mechanical devices in the camera control the amount of exposure the film receives. When they are properly balanced, you will get a good exposure on your film. The shutter speed controls how long the film is exposed to the light (and thus, the degree of action-freezing or blurring in the picture), and the aperture controls the amount of light that reaches the film (and also the depth of field, or zone of acceptable focus

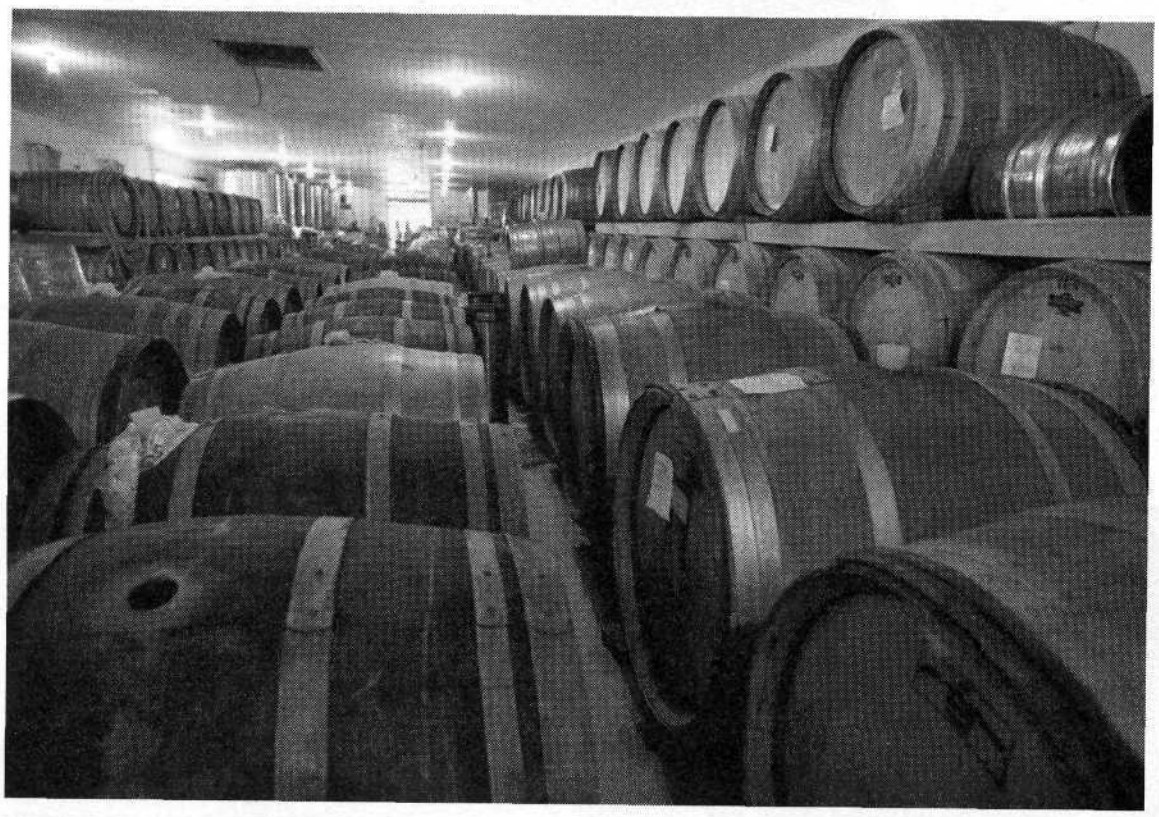
Photographic images are made up of tiny particles of metallic silver (black-and-white films) or tiny clouds of dye (color films). These particles are called "grain." Slower films have finer grain; faster films have larger grain. This is a highly magnified portion of an image to show the grain.

in a scene). A high shutter speed reduces the exposure while a slow shutter speed allows the light to reach the film for a longer time, thus producing more exposure. The advantage of high shutter speeds is that they will stop subject (and camera) motion better than the lower speeds. If you use a shorter the shutter speed to stop the action, the aperture should be opened to compensate for the reduced exposure time. If you need a smaller aperture to increase the depth of field, the shutter speed will need to be longer to compensate for the reduced amount of light that reaches the film. As you can see, this critical balance of exposure between the shutter speed and aperture involves trade-offs, especially when you are using slow films. You may need both a fast shutter speed and a small aperture, and a slow ISO may not do the job. This is why we recommend that you try films at all levels of speed. If you're still not sure, just ask yourself, "Would I rather have a blurred picture with extremely fine grain, or a sharp picture with slightly larger grain?"

Push- and Pull-Processing

Pushing a film in processing means that you purposely underexpose your film by a specific amount, and then compensate by increasing the developing time (or by using a special "speed-increasing" developer). Pull-processing is the opposite of pushing and involves overexposing the film and underdeveloping it. Pushing film usually increases grain, decreases exposure latitude, and increases contrast in the final image. Pulling reduces grain slightly, expands the exposure latitude, and reduces the amount of color saturation. If you push or pull a roll, remember that all the images on the roll will be affected. You can't rate part of the roll at one speed and then change to a new speed for the rest of the roll. (That's why fine-art photographers use sheet-film cameras, where each image can be processed individually.)

Why would you want to push or pull a film in processing? Perhaps you made a mistake in exposing the entire roll and want to correct the mistake in processing. Perhaps you need the extra film speed and don't have a fast enough film to get a good exposure (push-processing will let you expose the film you have at the needed speed—albeit with a loss of image quality). Or perhaps the scenic brightness range is extreme, and you want to record detail throughout the scene (pull-processing can help in this situation). We don't recommend push-processing unless you have no other options—we'd rather see you keep various levels of ISO films in your camera bag for just those situations, because you'll get better image quality from a faster film at its rated speed than from a slower film pushed to that speed.



Top: Push-processing increases contrast and grain. These characteristics enhanced the feeling of starkness in this photo.
Above: For available-light work in mixed lighting, fast color-negative films are a great choice, for their great exposure latitude and ability to be color-corrected when prints are made.

ISO Choices

Thanks to technological advances, you now have so many film speed choices, you probably won't know which one to choose. We would like to say that one film is better than another, but as soon as we did, another manufacturer would come out with one better. As we see it today, you can't go wrong with any film from the top brand-name manufacturers. They all make good films, and the differences between them will not be readily apparent on small prints for your photo album.

Different film manufacturers often offer films with different biases. Some films will provide highly saturated colors, while others offer soft subtle tones. The

best way to determine which brand of film you like is to experiment. When you find one you like, stay within that brand because many of the films today come in film family groups. This means that a variety of film speeds in a group are matched in color, saturation, and color balance so that when you switch from one ISO to the next there will be little change in the way the images look.

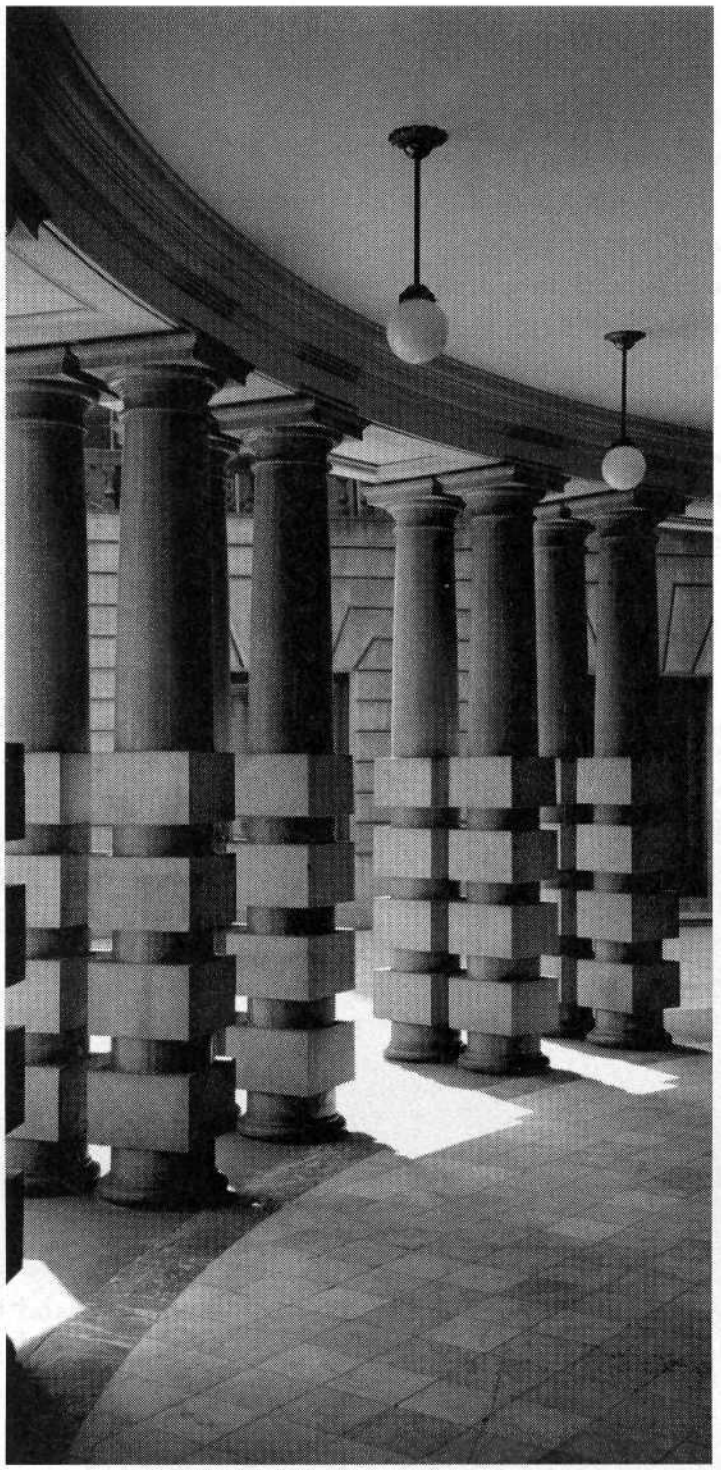
Once you move in with a family you like, you should test all the ISO speeds in that film group. It's true that the slowest ISO will have the best image quality (i.e., the finest grain, the greatest sharpness and the richest color), but you may find a higher speed more desirable. This is because not all photo situations in the world are perfect. The lighting may be poor, the subjects may be far apart, or may be moving faster than a slow shutter speed can capture. When you need a higher shutter speed to stop the action, or a smaller aperture to maintain sufficient depth of field—or both—a faster film will be necessary.

Film Latitude

Film latitude is the amount the film can be over- or underexposed and still deliver acceptable images. Color slide films usually have a narrow exposure latitude of ±⅔ stop. This means that you have to be very careful when lighting situations are difficult. It's true that exposure meters can be very accurate, but they are only as good as the person using them. Keep in mind that a scene might have a brightness range from highlight to shadow or 10 stops (or more).

Black-and-white and color negative films are a different story. Most have very wide exposure latitudes, and it is not uncommon to see some with a –3 to +4-stop range in exposure. Even so it is critical that you still try to get as close to the correct exposure as possible. Remember that some scene ranges are so extreme that they may be too much for even even the seven-stop latitude of the most forgiving negative films.

If we had to suggest a direction to lean with negative films, we recommend towards overexposure. Most negative films can handle it better. When negative films



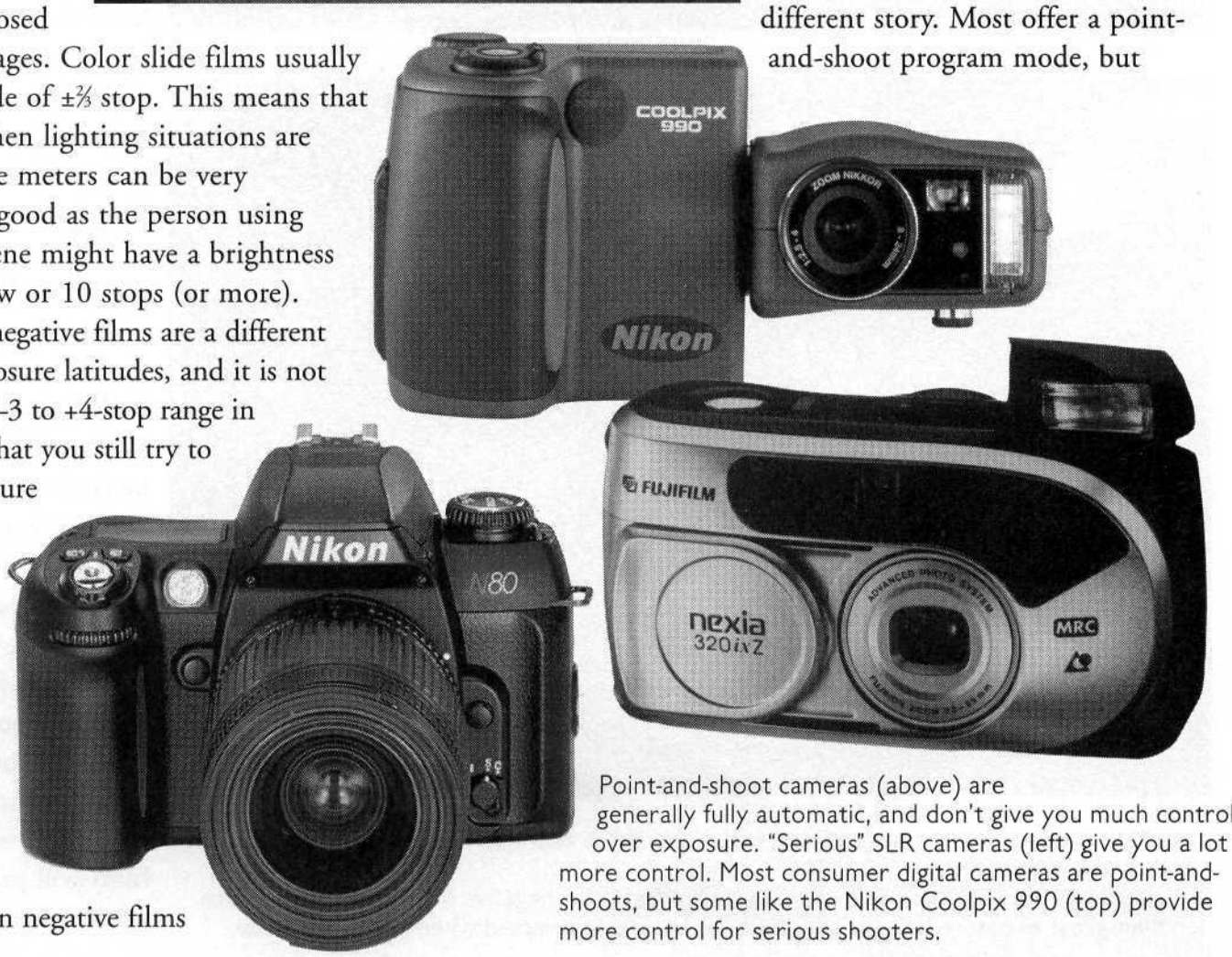
If a scene exceeds the brightness range the film can record, detail will be lost in the highlights and/or shadows. Pull-processing can help retain detail throughout.

are underexposed, the contrast decreases and the grain starts to increase in size. The overexposed direction increases slightly in contrast, and the grain pattern pretty much remains the same.

Exposure Control

Most point-and-shoot cameras today make exposure decisions easy. They use an exposure system found in most of the advanced SLR cameras called a program mode. In this mode, the point-and-shoot camera evaluates the amount of light in a scene, and sets the best combination of shutter speed and aperture. Almost all recommend the use of color negative film, so that helps a lot, but we will have to admit that these cameras have come a long way in the last few years. We have even used them for several professional travel assignments as a back-up system. In some cases those images were used over the professional-camera images.

Exposure control in the more advanced SLR cameras is a different story. Most offer a point-and-shoot program mode, but



Point-and-shoot cameras (above) are generally fully automatic, and don't give you much control over exposure. "Serious" SLR cameras (left) give you a lot more control. Most consumer digital cameras are point-and-shoots, but some like the Nikon Coolpix 990 (top) provide more control for serious shooters.

they also have a variety of exposure control systems to provide the photographer complete control over the camera exposure. Unfortunately, they also give the photographer more chances to get incorrect exposures. If you do move up to one of these more sophisticated cameras, make sure you understand how the controls work and which one best suits your needs in getting the best exposure. You could set these cameras to work the same as a point-and-shoot, but that somewhat defeats the purpose of getting a sophisticated camera. When you boil it down to the one area that gives photographers the most trouble with any level of camera, it is exposure control. To fully understand how to obtain good exposures, we need to step back to the basics of exposure, and then work up to the fancy stuff.

Manual Exposure Calculations

Believe it not, before exposure meters, photographers had a couple of tricks up their sleeves for calculating exposure. The first and most basic was called the Magic 16 rule. In full sunlight, the correct exposure is f/16 using 1/ISO as the shutter speed. For example, for an ISO 125 film in sunlight the correct exposure would be f/16 at 1/125 second. If we needed a different shutter speed or f-stop, we used the halving and doubling principle for making adjustments in exposure. If we increased the shutter speed from 1/125 to 1/250, we would then change the aperture from f/16 to f/11 to compensate for the change in exposure. Eventually, we would remember the various combinations in our head and our brain actually became the exposure meter. Wow!

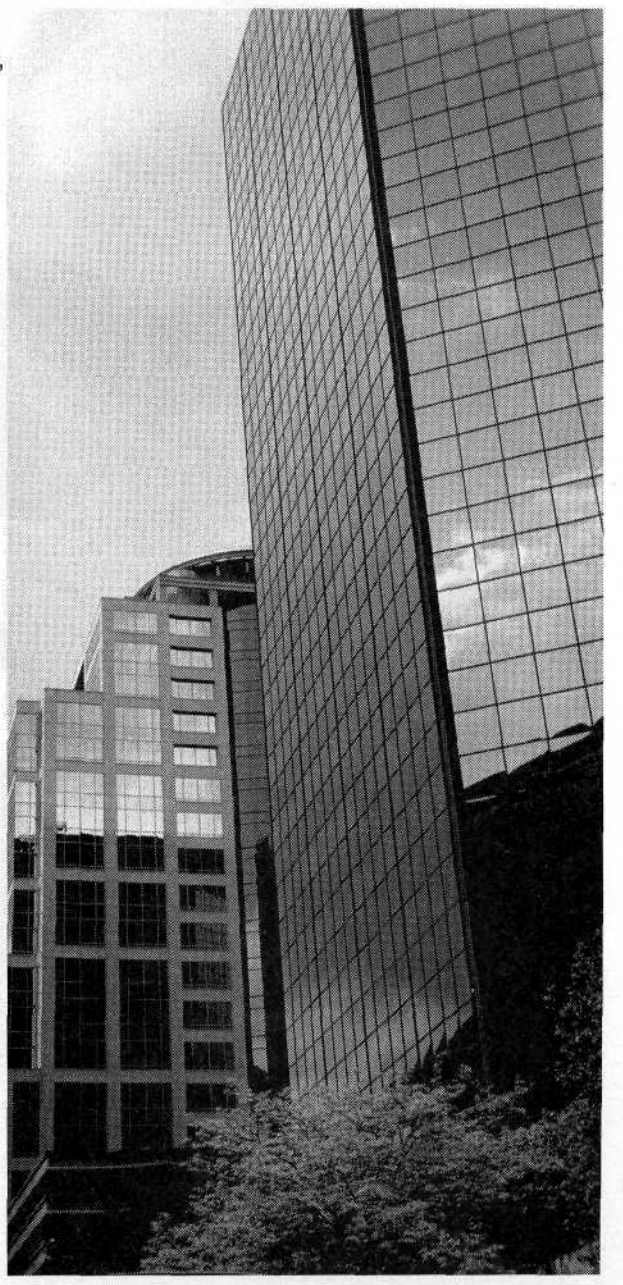
Using this as a starting point we would open the lens aperture or decrease the shutter speed as it became overcast or shady. To make it even easier, film manufacturers placed a Magic 16 exposure chart on the inside of most film boxes. It listed exposure values for situations on sand, in sunlight, cloudy bright and heavy overcast. These charts worked very well for cameras with manual controls, but it also gave us the heads up when our camera wasn't working correctly. For example, if we were shooting in full sunlight, and the meter setting inside the viewfinder indicated an exposure of 1/30 second at f/5.6 for ISO 100, we knew we needed to check our system. We may have set the ISO incorrectly, have set the camera incorrectly on manual exposure, or the battery may be dead.

Camera Meters

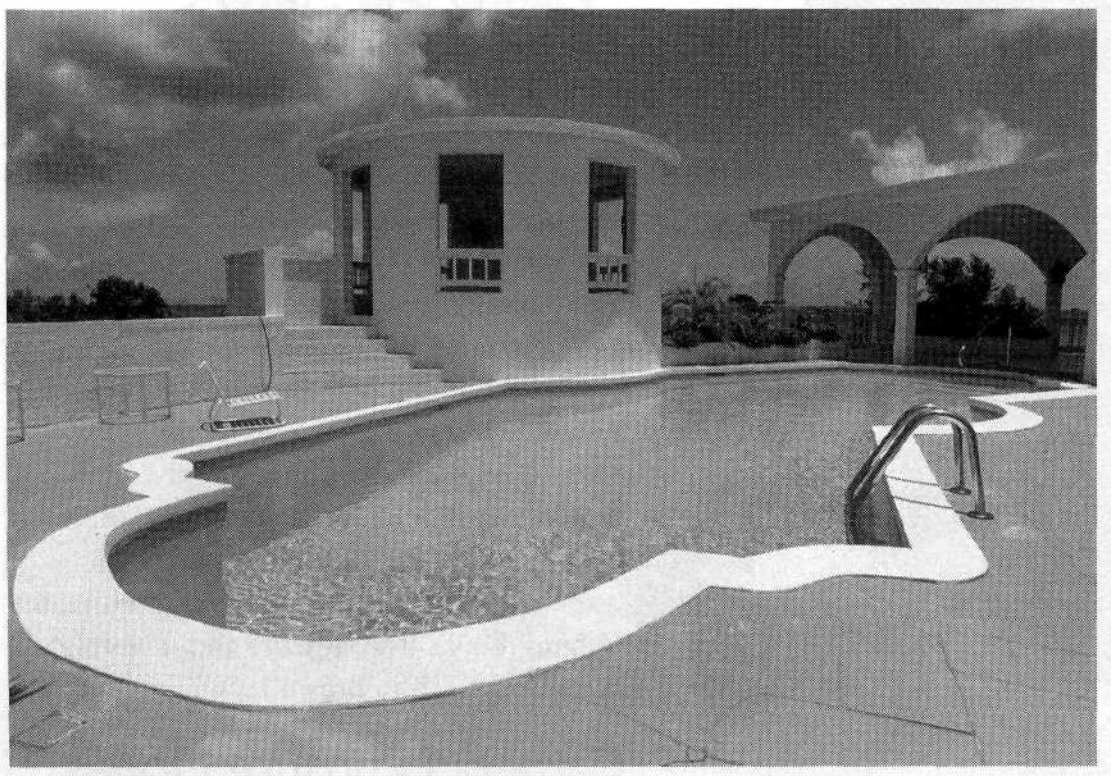
Most point-and-shoot cameras are simplified and offer no meter choices. You merely point the camera, and it does the rest. Some of the more expensive point-and-shoot cameras do have special settings for portraits, action and landscapes. These settings use the program mode in the camera, and force it to conform to special situations. For example, if you set your point-and-shoot camera to action, the program control will use higher shutter speeds to achieve maximum action-stopping capability. A landscape setting would force the program mode to use a small aperture for maximum depth of field so subjects in the foreground and background are both in focus.

SLR cameras today are very sophisticated, generally offering several metering systems and a variety of exposure modes. Many are programmed to recognize thousands of lighting situations and provide exposures accurate to 1/10 stop. The light strikes the subject and is reflected into the metering system in the camera, hence the term reflected meter system.

The center-weighted meter concentrates most of its



When shooting in overcast conditions, open the lens one or two stops from the Magic 16 rule's f/16: Shoot at f/11 or f/8. And whenever you're in doubt about the exposure, bracket!



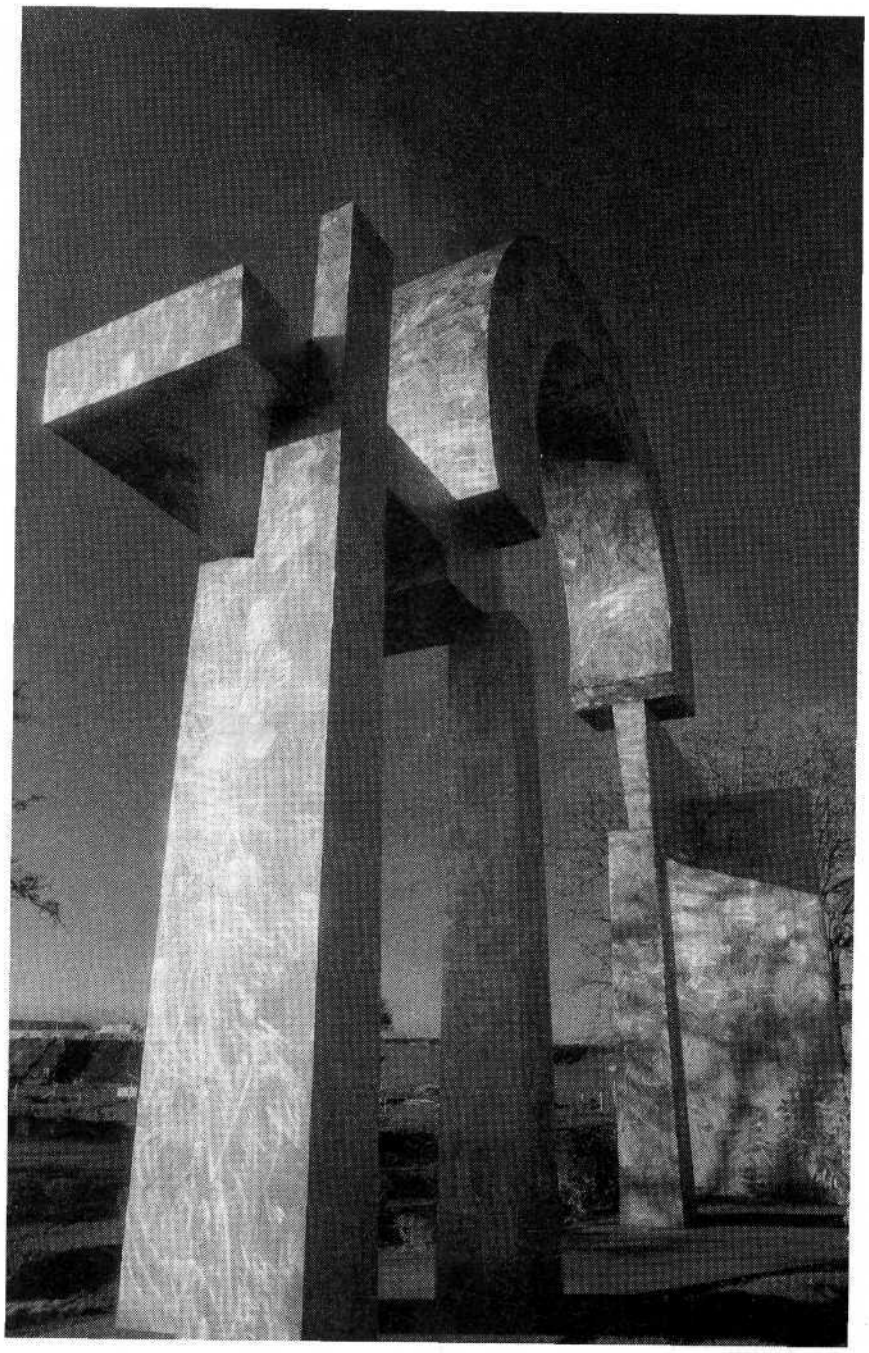
Today's multi-segment metering can handle 'most anything. But when in doubt, consider the old Magic 16 rule: When shooting a front-lit subject in full sunlight, the exposure should be f/16 at a shutter speed equal to the reciprocal of the film's ISO speed.

sensors on a circle that covers about 60 percent of the photo's center. Most of the original cameras with TTL metering used the center-weighted system. It actually worked pretty well for most situations. When photographers recognized that the scene could not be metered correctly, they would switch to manual and use their basic knowledge of exposure control.

Eventually cameras came out with exposure locks, which allowed photographers to point the camera at a spot outside the scene, lock the exposure, and point it back at the shooting scene. The center-weighted control is still part of most SLR cameras on the market today, and can be a great control of exposure if used properly.

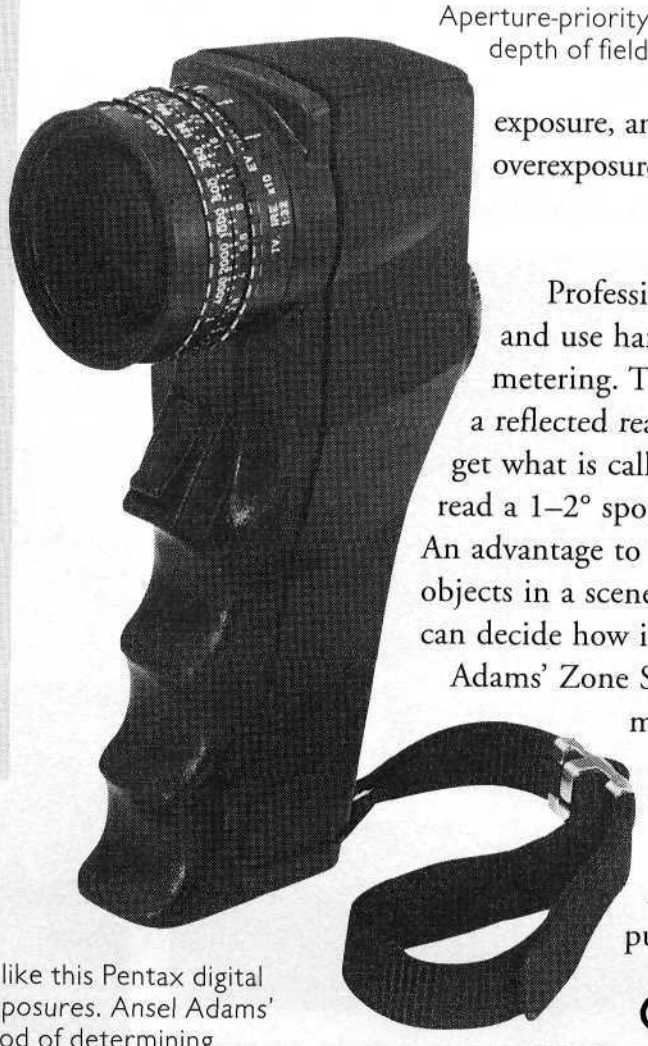
A multi-segment meter should be considered the most intelligent of the three systems as it stores different types of lighting situations, and uses that data to calculate a proper exposure. For example, if the sun is in the upper left ⅓ portion of a scene, the multi-segment will recognize the sun and compensate so that the image will not be underexposed, as it would be with the other two systems. If you run into a very difficult exposure situation and you have a multi-segment meter system, you definitely want to give it a try.

The spot meter is for those photographers who have a firm understanding of film exposure. Spot meters are set to look and compensate for areas that are 18% gray. If you point the spot meter at blue sky 90° from the sun, green grass, or in some cases the back of your hand, you will obtain good exposures. Knowing just what reflects 18% gray is critical to using a spot meter. If you point it at the sun, you will get a drastic under exposure, and it you point it at a dark shadow, a gross overexposure will result.



Aperture-priority AE mode lets you set the aperture to control depth of field, with the speed and convenience of automation.

Above: A hand-held incident meter is a very useful accessory. This Sekonic L-508 measures flash and ambient light, incident and reflected.



Used knowledgeably, a 1° spot meter like this Pentax digital unit can produce the most accurate exposures. Ansel Adams' Zone System is a highly effective method of determining exposures, but it requires a good knowledge of how reflected readings work, and of what you want your photo to look like.

Hand-Held Meters

Professional photographers go even one step further, and use hand-held meters that use center or spot metering. These meters can be pointed at the subject for a reflected reading or read from the subject's position to get what is called incident metering. Hand-held spot meters read a 1–2° spot, allowing you to meter a very small area. An advantage to these meters is that you can meter various objects in a scene to determine the brightness range so you can decide how it will best be exposed on your film. (Ansel Adams' Zone System is a very precise way to use a spot meter to produce exposures that give you exactly what you want in your photos. If you're really serious about accurate exposures, and shoot in black-and-white, see Adams' books *The Negative* and *The Print*, published by Little, Brown.)

Camera Exposure Modes

The basic exposure modes on most SLRs usually include shutter-priority autoexposure (AE), aperture-priority

Top: Shutter-priority AE lets you set the shutter speed to freeze or blur action, while the camera instantly sets the corresponding aperture for proper exposure.

Above: Program AE mode is great for everyday shooting, because the camera sets everything, leaving you free to concentrate on expressions and composition.

AE, program AE, and manual mode. Every photographer tends to have a preference towards one of the modes based on the type of subjects they photograph. If you're into nature photography and take macro images, you will probably use the aperture-priority AE, which allows you to set the aperture so that you have the maximum depth of field. Since most of these images include flash, the shutter speed would automatically lock at flash sync. A sports photographer, on the other hand, would want shutter-priority AE, which allows you to set the shutter speed to freeze action.

The photographer who shoots general shots requiring limited action and no need for maximum depth of field might use the program mode. The difference is that the camera makes all the decisions. The only way you will know what is going on, is to look at the readings as the camera makes the exposure in this mode. If you're happy with the combination of shutter speed and aperture in program mode, then stay with it. If not, switch and try one of the other exposure modes.

The big advantages of the AE modes are speed and convenience. In program AE, the camera sets both shutter speed and aperture, so you're always ready to shoot. Aperture-priority give you control over the aperture, and the camera automatically and instantly sets the corresponding shutter speed for correct exposure. In shutter-priority AE, you set the shutter speed you want to use, and the camera automatically and instantly sets the corresponding aperture for proper exposure.

As we stated earlier some of the point and shoot cameras have special program modes. This is also the case with a few SLR cameras. Some will have a macro mode that provides small apertures, a sports setting that uses high shutter speeds, and a portrait setting that keeps the aperture wide enough to blur the background. In each case these program modes are calculating the best exposure by juggling the shutter speed and aperture to best fit the situation.

Bracket, Bracket, Bracket

When all else fails, and you absolutely must have a good exposure, the best method is to bracket your exposure. The old adage that film is cheap, is absolutely true when you have a once-in-a-lifetime event you can't afford to miss on exposure. If you are shooting color negative film, setting your camera to ±1 stop usually covers just about every situation. Slide films are another story, as you need to know, or test, their exposure latitude before making bracketed exposures. It doesn't do any good to make a ±⅓ exposure bracket when the film only has a ±½-stop exposure latitude. In that case you would probably miss all the acceptable exposures.

Build an Exposure Knowledge Base

Everyone has a different way of storing photographic data that they need later. Whether you store it in data files or in your head, it is important to build on information gained from both good and bad exposures of the past. There is no better teacher of photographic exposure than experience in the field. If you don't store this data somewhere, every time you go out to take a picture, you will be starting over. ■