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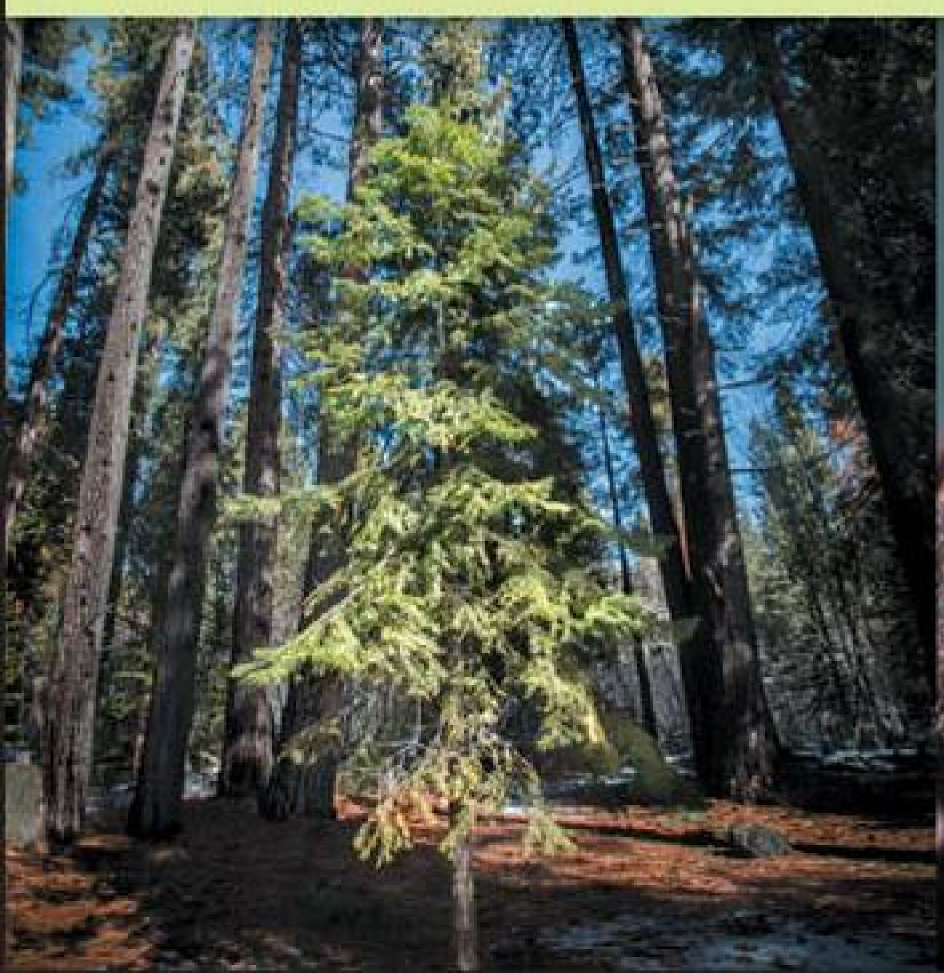
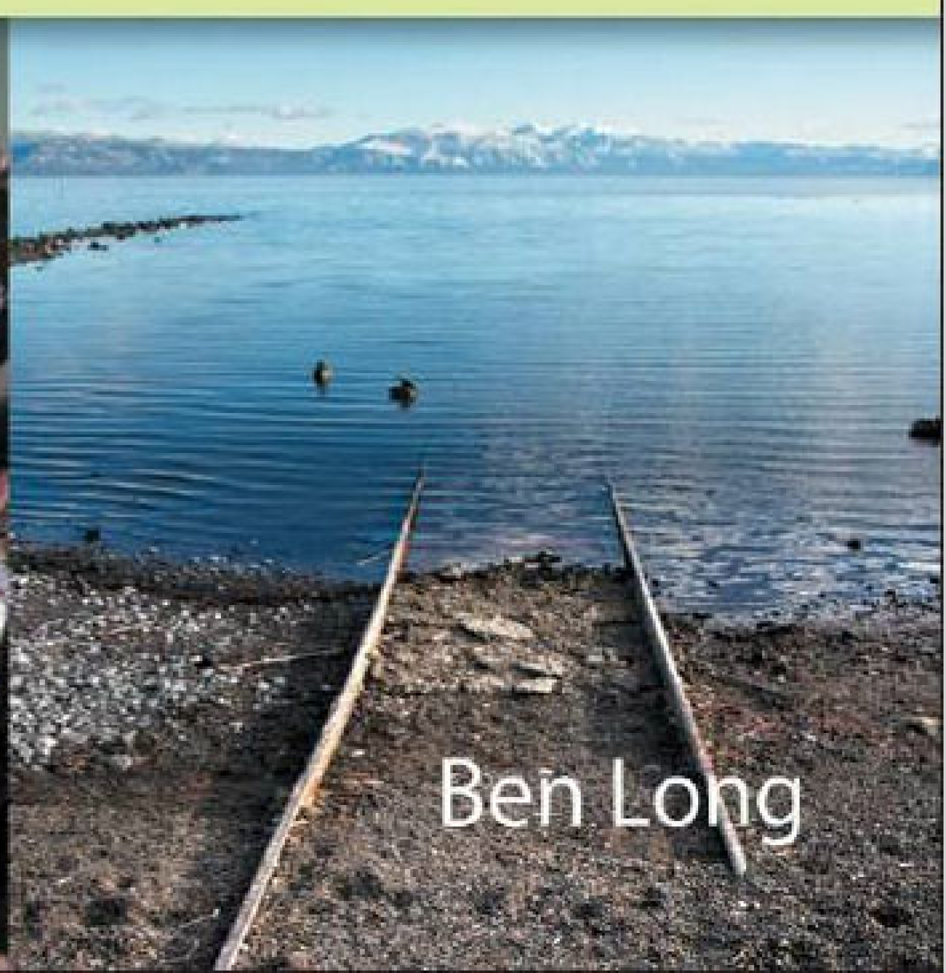
COMPLETE Digital Photography

Eighth Edition





Ben Long

Complete Digital Photography
Eighth Edition

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Cengage Learning PTR

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Complete Digital Photography
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Ben Long

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Proofreader: Sue Boshers

Library of Congress Control Number: 2014945696

ISBN-13: 978-1-305-25872-3

ISBN-10: 1-305-25872-X
eISBN-10:1-305-25873-8
Cengage Learning PTR
20 Channel Center Street
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Printed in Canada
1 2 3 4 5 6 7 16 15 14

Acknowledgments

There are a lot of changes and additions in this revision of *Complete Digital Photography, Eighth Edition* and many of them are there because, once again, my dad, Jim Long, did such a thorough job of technical editing.

I was also thrilled to have the production team of Marta Justak and Jill Flores again, who applied their considerable talent and care to making this such a nice book. Finally, thanks to Stacy Hiquet for giving us the go-ahead to move this book forward ahead of schedule.

About the Author

Ben Long is a San Francisco-based photographer and writer. The author of over a dozen books on digital photography and digital video, he has been a longtime contributor to many magazines, including *MacWeek*, *MacUser*, *Macworld UK*, and more. He is currently a senior contributing editor for *Macworld* magazine, a senior editor at CreativePro.com, and has created many best-selling photography instruction courses for Lynda.com. His photography clients have included 20th Century Fox, Blue Note Records, Global Business Network, the San Francisco Jazz Festival, the Pickle Family Circus, and Grammy-nominated jazz musicians Don Byron and Dafnis Prieto. Long has taught and lectured on photography around the world. He also dabbles in computer programming, and has written image editing utilities that are in use in the Smithsonian, the British Museum, and the White House.

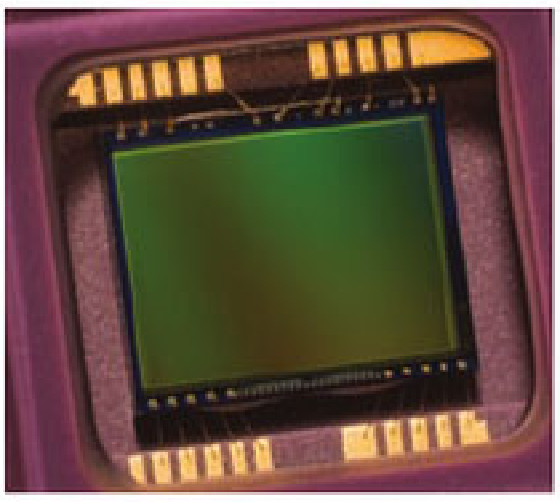
Contents

3 Camera Anatomy 36

Holding and Controlling Your Camera

4 Image Transfer . . . 74

Building a Workstation and Transferring from Your Camera



5 Image Sensors . . . 98

How a Silicon Chip Captures an Image

6

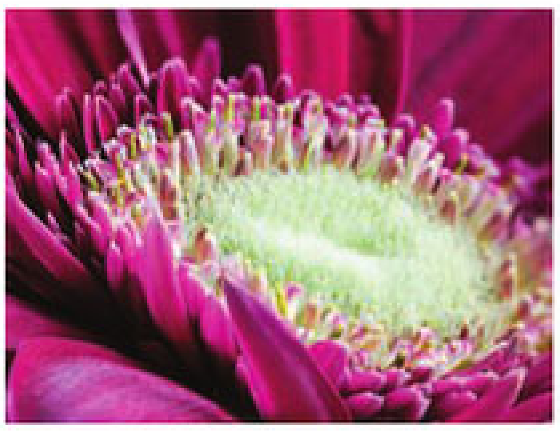
Exposure Basics... 112

The Fundamental Theory of Exposure

7

Program Mode... 128

Taking Control of Exposure, Focus, and More



17 Selective Editing and Masks.... 438

Making Edits to Specific Parts of an Image

18 Photoshop Adjustment Layers 468

Advanced Tools for Adjustments and Corrections

19 Black-and-White Conversion 484

Turning Your Color Images into Black-and-White Images

Introduction

In 1990, I began using version 1 of a new piece of software called Photoshop. Adobe, at that time, was best-known for PostScript—the page description language that was used in most laser printers. It would be nice to write about how using that first version was a startling experience that instantly changed my ideas about photography and image editing, but there had already been image editing programs around, most notably Silicon Beach's Digital Darkroom. Adobe did not create the digital image editing market, but over the next 10 years they absolutely defined and ultimately dominated it.

During those years, I enjoyed working through the addition of layers, Adjustment Layers, Camera Raw, and many more features. Through all those features, though, Photoshop remained built around the document-centric Open/Save paradigm of late 1980s software. As processing power, memory, and storage increased, Adobe kept pace as best they could, but ultimately it was not possible to change Photoshop's basic design. And so they created Lightroom, which eschewed the old-fashioned architecture of Photoshop for one that is much speedier and more flexible.

In the previous seven editions of this book, I have used Photoshop as the basis for all of the postproduction tutorials. With this edition, that has all changed. In the latter chapters of this book, you will find that I now offer Lightroom as the basis for postproduction workflow and editing. Photoshop is far from obsolete, though, and it's still the perfect tool of choice for many image editing options—it still touches the majority of the images that I print—and so a lot of Photoshop training remains.

The good news is that Lightroom is an ideal workflow tool, so if you follow the examples and practices set forth in this book, you'll find yourself with a robust, comprehensive, and very capable postproduction workflow.

On Learning Photography

In the 1980s, the graphic design world went through an enormous change. Aldus, Incorporated released PageMaker 1.0, and Adobe Systems, Inc. unveiled the first PostScript laser printer. The result was "desktop publishing." And with desktop publishing came a lot of really bad, ugly designs.

What desktop publishing technology did was to give anyone instant craft ability. Whereas graphic design had traditionally required a lot of skill with a lot of manual tools, tools that required years of practice to use well, desktop publishing gave everyone the ability to instantly draw a straight line. Suddenly, people who had never had any interest in graphic design thought "I know how to use these new, digital tools, therefore I'm a graphic designer." Mostly, what they did was reveal that graphic design requires much more than simply knowing the craft.

The advent of digital cameras and Photoshop had the same effect on photography. With their automatic features and instant feedback, digital cameras didn't require the extensive theoretical understanding that you had to have to use a film camera. And with Photoshop, the complex chemistries and tricky practices of the darkroom were reduced to push-button simplicity. Suddenly, everyone was buying a camera and a computer and proclaiming themselves "photographers."

I've been writing about and teaching photography since the beginning of the digital era, and for many years, I found that students were focused on learning Photoshop or some other image editing program. But over the last few years, I've been noticing a change. Just as graphic designers eventually reclaimed their profession from the "desktop publishing revolution," now more people seem to understand that learning to use an image editor is not the same thing as learning photography.

As the novelty of the ease of digital technology has worn off, people are getting back to the essential questions of making a good photo: How do I recognize interesting subject matter? How do I translate that into an interesting image? What do I need to do to capture that translation?

Because of that, this book is far more than a book about theory and button-pushing. In these pages, you'll find a lot of instruction on the "softer" more "artistic" concepts that you need to understand to be a good photographer.

One of the best ways to improve as a photographer is to cast a learned eye on other photos. There are more people shooting now than ever, and as more people recognize that it takes something besides good button pushing to get a good image, the number of nice photos in the world only increases.

It's a good time to be a photographer, and the changes in this latest edition will help you go as deep as you want to go into the art and craft of the photographic discipline.

How This Book Is Organized

This book is aimed at photographers of all levels. Photographic technology, whether digital or film, sees the world very differently from your eyes, and it's important to understand how your camera's results will differ from your visual experience at the scene. Therefore, Chapter 1, "Eyes, Brains, Lights, and Images," leads you through an exploration of your visual sense and how it differs from your camera. Many of the concepts in this chapter will become critical when you learn more about exposure.

Chapters 2 and 3, "Getting to Know Your Camera" and "Camera Anatomy," serve to familiarize you with your camera. Like any tool, you'll get better results from your camera if you know how to use it well, and these chapters should get you up to speed with all those buttons and dials.

To assess the results of the exercises in Chapters 2 and 3, you'll need to move your images into your computer. Chapter 4, "Image Transfer," will walk you through the process of importing images from your camera.

The great film photographers of the past didn't just understand composition and exposure theory, they also had detailed understanding of the chemistry of their film and darkroom technologies. It was this understanding that provided them with such fine control over their final result. Digital photographers similarly benefit from an understanding of digital image capture, so Chapter 5, "Image Sensors" walks you through the basics of how the guts of your digital camera work.

Chapters 6, 7, and 8—"Exposure Basics," "Program Mode," and "Advanced Exposure"—provide a thorough, detailed series of lessons in exposure theory. Starting with the most basic concerns and controls, you'll progress steadily up to the most advanced exposure features of your camera and learn how these tools can be used to broaden your expressive palette.

Chapter 9, "Finding and Composing a Photo," gives you a break from the technical concerns of shooting, and offers a lengthy discussion of how you go about finding a potential subject, and how to craft that subject into a final image. Photography is a discipline that rewards constant practice and experimentation, and this chapter will provide you with an understanding of the nontechnical subjects that you will explore for the rest of your photographic life.

Just about any digital camera you buy these days will have a built-in flash unit, and learning to use it can be tricky. Chapter 10, "Lighting," will walk you through the process of modifying light using flashes and reflectors.

All SLRs and many point-and-shoot cameras offer the ability to shoot in raw format, which provides several advantages over the JPEG shooting that your camera defaults to. Chapter 11, "Raw Shooting," discusses the particular advantages of raw shooting and addresses specific concerns that you'll face when shooting in raw mode.

Chapter 12, "Special Shooting," takes the detailed understanding of shooting that you glean from the first 11 chapters, and applies it to specific situations. In this chapter, you'll learn to shoot sporting events, theatrical events, how to shoot in low light, and much more.

With Chapters 13 and 14, "Workflow" and "Editing Workflows and First Steps," your post-production education will begin, starting with a discussion of what workflow is and why it matters.

As you'll learn in the workflow chapters, one of your first image editing tasks is to correct tone, so Chapter 15, "Correcting Tone," will walk you through basic tonal adjustments. This is followed by Chapter 16, "Correcting Color."

Chapter 17, "Selective Editing and Masks," presents some of the most important tools that you'll add to your editing arsenal. With masks, you can make localized edits and adjustments, and good masking skills can be crucial to getting the results you want.

Adjustment Layers give Photoshop users a very simple way to work with masks. Chapter 18, "Photoshop Adjustment Layers," will show you the ins and outs of Adjustment Layers, as well as introduce you to other techniques for applying edits and adjustments to specific parts of an image. These tools augment Lightroom's built-in masking and provide valuable localized editing controls.

Black-and-white processing is given a detailed discussion in Chapter 19, "Black-and-White Conversion," while layers and other special effects and retouching tools are covered in Chapter 20, "Layers, Retouching, and Special Effects."

Panoramic stitching and HDR (high dynamic range) merging are covered in Chapter 21, "Panoramic Stitching and HDR Merging." These lessons build on the panoramic and HDR shooting discussions that are introduced in Chapter 12.

Finally, the last stage of your workflow is covered in Chapter 22, "Output," where you'll learn how to turn your finished images into files for email, Web pages, or archival prints.

However, this book offers you much more than what's printed on these pages. Throughout the book, you'll find Web links to movies and additional PDF documents that you can download. These resources will provide you with further discussions, examples, and tutorials on a wide variety of topics.

What You Need

Obviously, to take pictures you need a camera, and this book assumes that you already have one. The postproduction chapters of this book are built around Adobe Photoshop and Lightroom, and you can download demos of each from *www.adobe.com/downloads*. However, most image editing programs use similar interfaces, so you should find that the editing lessons herein translate very easily to many other image editing programs.

The Photoshop tutorials are built around the latest version of Photoshop (as of this writing), which is Photoshop CC. Most of the tutorials will work on earlier versions, and Photoshop Elements can easily be used for the book's tutorial sections. Because of the changes introduced in Photoshop CS6, some tutorials won't work well with previous versions. For those, you can download compatible tutorials from the companion website.

Finally, you need to have some curiosity about photography and the world in general. As with any art form, photography is a process of exploration. There's no recipe for a good photo, and while I recommend some specific ways of doing things, it's very rare that my recommendations are the best for everybody. Don't ever stop exploring on your own and trying to find the methods that work best for you.

There are many more tutorials, reviews, essays, and articles at the book's companion website *www.completedigitalphotography.com*. You can also email me through the site by clicking on the Contact Us link.

Glossary

Photography has always involved a lot of jargon and technical terms, and to help you with those I've built a glossary on the companion website. You can find it at *www.completedigitalphotography.com/glossary*.

Companion Website Downloads

You may download the companion website files from *www.completedigitalphotography.com/CDP8*.

1

EYES, BRAINS, LIGHTS, AND IMAGES

Understanding How You See

Consider, for a moment, a piece of film.

To make a piece of film, a thin strip of translucent celluloid is covered with a gelatin emulsion that includes crystals of silver halide. Silver halide is light sensitive, and when light strikes silver halide crystals, the crystals undergo a chemical change. As more light strikes a particular area of the silver halide–covered film, that area goes through more changes. When the film is developed, those chemically changed silver halide crystals turn into grains of silver. Where more silver halide is exposed to light, more metallic silver grains appear. The silver crystals, though, are dark, so areas that are exposed to more light get darker and darker—in other words, lighter areas of the original scene are represented as darker concentrations of silver. Thus, a negative image is created, as shown in Figure 1.1.

Figure 1.1 After a piece of film is developed, it contains a negative image.

If you project that negative image onto a photographic paper that is coated with silver halide crystals, the same chemical process occurs. A latent image is captured by the silver halide crystals on the paper, and when developed, the photon-activated crystals are turned into black metallic silver. But because the image is a negative, this time the original lighter areas collect fewer silver halide crystals. The practical upshot is that a positive image is produced.

One of the things that is amazing about this technology is that a single piece of film is both an imaging medium and a storage device. What's more, the negatives and prints that are produced can be very durable.

The image sensor that you'll find inside a digital camera also exploits the light sensitivity of certain elements. Instead of silver, though, a digital image sensor uses a special type of electronic circuit. For each pixel on the sensor's surface, there is a capacitor attached to a photodiode. A capacitor is simply a device that can store an electric charge, while a photodiode is a device that conducts or allows current to flow when it is exposed to light. Before capturing an image, the capacitor is given an electrical charge. When the photodiode is struck by light, the photodiode drains some of the charge from its attached capacitor. Just as silver halide crystals clump together in proportion to the amount of light that strikes them, a photodiode will reduce the charge on the capacitor in direct proportion to the number of photons that it was exposed to.

Your camera's image sensor is covered with these circuits—one for each pixel in your final image. By measuring the voltages across the surface of the image sensor, your camera can find out how much light struck each location. Your camera then passes this information to an on-board computer, which analyzes and interprets it to yield a full-color digital image, which is then stored on a memory card. All of this (and more) happens so quickly that your camera can capture multiple images in a single second.

Digital image sensors are incredibly sensitive to light. To understand how sensitive they are, just look at images from the Hubble telescope. The digital image sensors in this giant, orbiting telescope can yield images by capturing photons that have traveled through space for billions of years.

Both film and digital image sensors are amazing technologies, and they have improved dramatically over the years, thanks to the work of untold numbers of brilliant engineers. Both technologies allow for the capture and creation of striking, finely detailed, color-rich images.

And both pale in comparison to the imaging properties of the human eye.

The fact is, as amazing as our current imaging technologies are, there are many things that the human eye does much better, and a few things that the eye can do that analog and digital imaging technology can't do at all.

How Your Eyes See

Like a piece of film, or a digital image sensor, your eye has a light-sensitive area called the *retina* (see Figure 1.2).

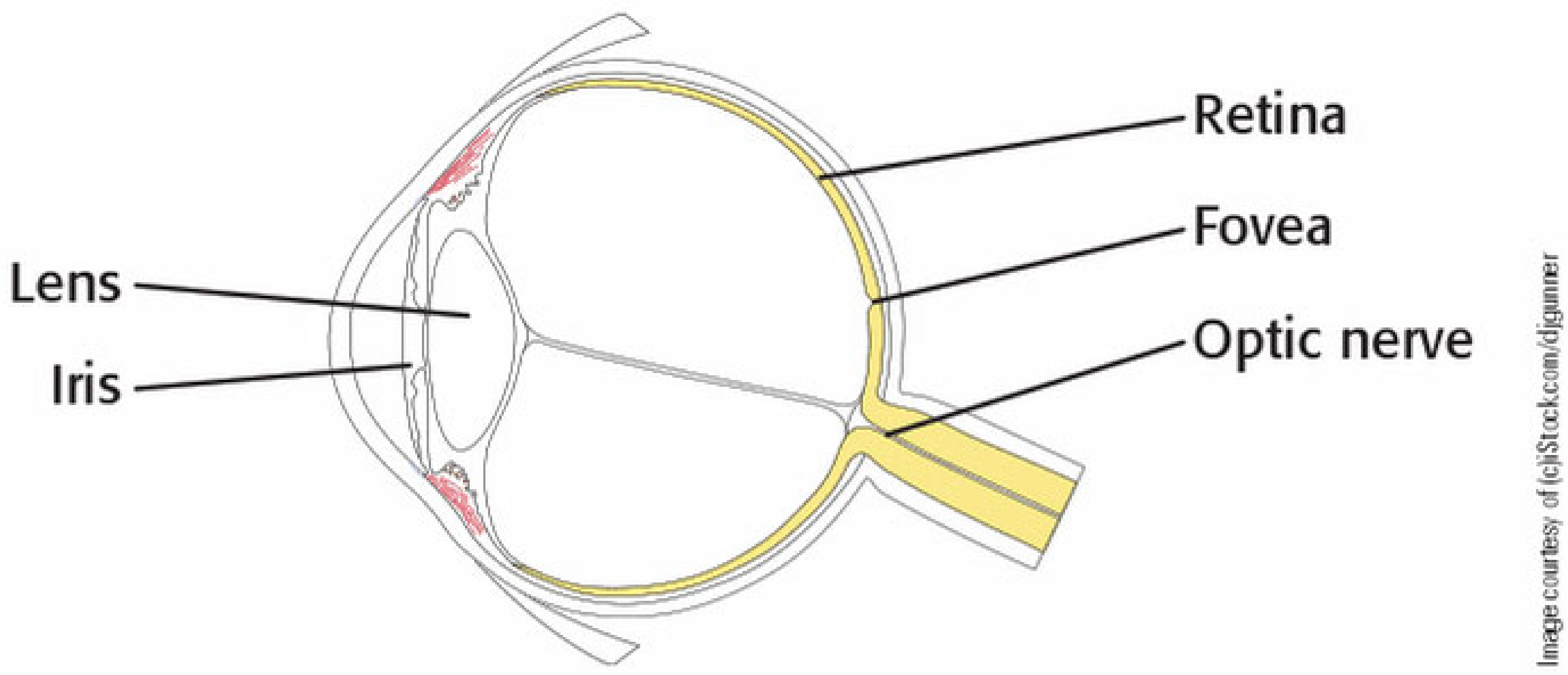


Figure 1.2

The eye is a lot like a camera. It focuses light with a lens, controls exposure with an iris, and has an imaging medium, the retina.

Located at the back of the eye, the retina contains four different kinds of light-sensitive cells: rods and three different types of cones. Cones are the color-sensitive cells, and most of them are found in a tiny region called the *fovea*. Less than one millimeter in diameter, the fovea is responsible not only for color, but also for sharpness and almost all of your spatial sensitivity. Cones can only detect light that strikes them straight on, which means that only well-focused light will activate them.

The fovea is very small yet contains all of the cells that generate your focused vision. Consequently, only a tiny bit of your field of view is in focus at any given time. This may come as a bit of a surprise, but of your whole field of view, only an area about the size of your thumbnail is actually in focus.

To test this, try an experiment. With this book held at arm's length, place your thumb on the page in the middle of a paragraph. Without moving your eyes, pay attention to the text around your thumb. While the area right next to your thumb might be in focus (it might not, depending on the size of your thumb), you probably can't read the text that's just a little farther away. Without moving your eyes, take your thumb off the page and note that the text where your thumb was is now in focus.

That thumb-sized focused area is the extent of your foveal vision. However, you perceive a full field of view of focused color vision because you subconsciously move your eyes around to sample your entire field of view. Your brain then assembles all of these samples into what you perceive as a fully focused, full-color visual sense.

Because they only respond to light coming from a single angle, cones (the light sensitive cells in the fovea) are not very light-sensitive, and as light levels decrease, colors become muted, and the rods in your eyes take over.

Rods cover the rest of the retina—about 98 to 99 percent of it—and they see only in monochrome. However, they can be triggered by light coming from just about any direction, which makes them incredibly sensitive to light. A rod that has been given time to adapt to the dark can detect a single photon of light—this means that, in good conditions, you could see the light of a candle from 17 miles away. But because rods are not located in the fovea, they don't yield as focused an image as what you see when your foveal vision is active.

Your rods are what we consider *peripheral vision*, and while your peripheral vision is not super sharp, it is great for seeing dim objects in low light. If you've ever spent any time making astronomical observations through a telescope, then you might already know that, often, the only way to see a very dim object is to avert your eyes from it. When you point your peripheral, rod-based vision at a very dim subject, you often see the object better—not necessarily sharper, but brighter. In fact, you may not be able to see the object at all unless you look away from it.

Your rod vision can also come in handy when walking in the dark. Next time you're out in the country, away from bright lights, take a walk outside. If possible, get off the pavement and put your feet on some less even terrain. If you keep your eyes focused directly ahead of you and don't move them while you walk, you'll probably find that your peripheral vision reveals a tremendous amount of detail on the path in front of you. Some of the things you see might disappear if you look directly at them, because your rod vision does a much better job in the dark than your foveal vision. If you practice this technique, you'll probably find that it's easier to walk in the dark using your peripheral vision than it is to use a flashlight, which completely wipes out your low-light vision and confines what you see to only the area lit up by the light.

Understanding the light sensitivity of your own eyes, and how to exploit that sensitivity, can be handy in low-light shooting situations when it can be difficult to identify subject matter and composition.

Of course, these days we spend most of our time in well-lit areas, moving through a full-color world.

Transmitting Color to the Brain

Earlier, I mentioned that there are three types of cones. Each type is sensitive to a different wavelength of color. One type is sensitive to red, another to green, and the third to blue. These colors are the additive primaries of light. As they are mixed together, they create other colors (see Figure 1.3).

If you mix equal amounts of red, green, and blue, the result is white. Varying amounts of each of these primaries allow you to create all of the other colors that the human eye can perceive.

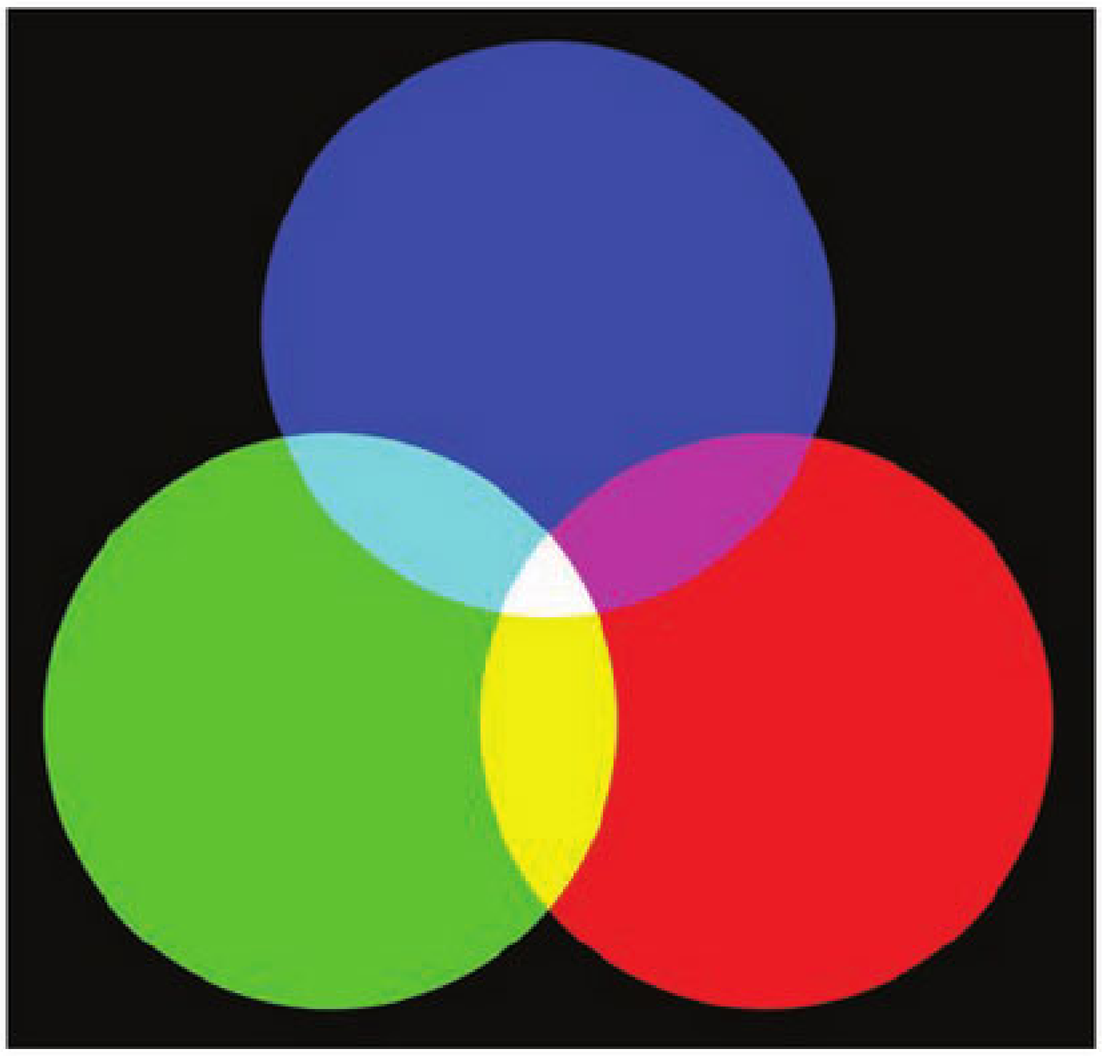


Figure 1.3

Red, green, and blue—the three additive primary colors of light—can be mixed together to create other colors. As you combine them, the resulting color gets lighter, eventually becoming white. Note also that where the colors overlap, they create the secondary primary colors—cyan, magenta, and yellow. These are the primary colors of ink.

The Different Primary Sets

In grade school, you might have learned some different primary colors, such as yellow. Yellow, cyan, and magenta are the primary colors of pigment, which are different from the light primaries. Unlike the primary colors of light, if you mix equal amounts of the primary colors of pigment, you get black. Because of this, we say that pigment colors are subtractive, while the colors of light are additive.

The total number of colors that the eye can perceive is not known for certain. Current research suggests a number from 2.3 million to 10 million different colors.

Like a digital camera, rods and cones generate electrical impulses when exposed to light. These signals are separated into two channels, one for brightness, and one for color, and both are transmitted to the brain via the optic nerve. The brightness channel contains far more information than the color channel, which might be one reason that black-and-white images are so compelling—they're composed exclusively of the type of information that the human visual system is the most sensitive to.

Once these signals get to the visual cortex in the brain, they get processed in many different ways. You can see one result of this processing by looking at something white.

If you've replaced any of the incandescent light bulbs in your house with compact fluorescents, you might have noticed how the compact fluorescents have a different color. They are what we call a "cooler" light, because they cast a light that's bluer than the warmer red light created by a tungsten bulb. Different types of light have different inherent colors, but your brain is able to compensate for this by automatically adapting so that color looks correct in any type of light, no matter what its color is.

For example, you might read this book under tungsten lighting and see the pages as white. However, if you carry it into your fluorescently lit kitchen, it will still look white, even though fluorescent light is much bluer than tungsten light. It will continue to appear white if you take it out into bright sun, into shade, or look at it under sodium vapor lights at night.

The brain is able to correct color in this way because it understands that a piece of paper is supposed to be white. In other words, you don't see these pages as white because of a purely optical process. While your eyes are incredibly sensitive to light and collect a good amount of visual data, a full 80 percent of what you perceive with your eyes is generated by your brain!

Based on your experience, memory, and expectations, your brain imposes a model of the world onto the visual signals that it receives from your eyes. At the simplest level, this model allows your brain to correct color, but it can also dramatically change your perception of objects in the world.

You can immediately feel how much the brain is involved in your visual sense simply by looking at an optical illusion. Optical illusions occur when your brain's model, or expectation, doesn't quite match the data coming from your eyes. The brain gets confused, and your sense of what you're seeing becomes more ambiguous.

One of the simplest examples is shown in Figure 1.4.

Your brain recognizes some lines that seem to indicate a particular thing, a cube, and so it tells you "Oh yeah, I know what that is, that's a cube." Except that it's not a cube, it's merely some lines on the page, even though those lines are describing a shape very similar to a cube. So, at some point in the process of trying to reconcile "cube" with the set of lines that you're seeing, the brain gets tripped up, and your perception of the object becomes less certain. The cube appears to change orientation as the brain tries to sort out what it's seeing. Ultimately, of course, your brain is simply wrong—the image is merely flat lines on paper.

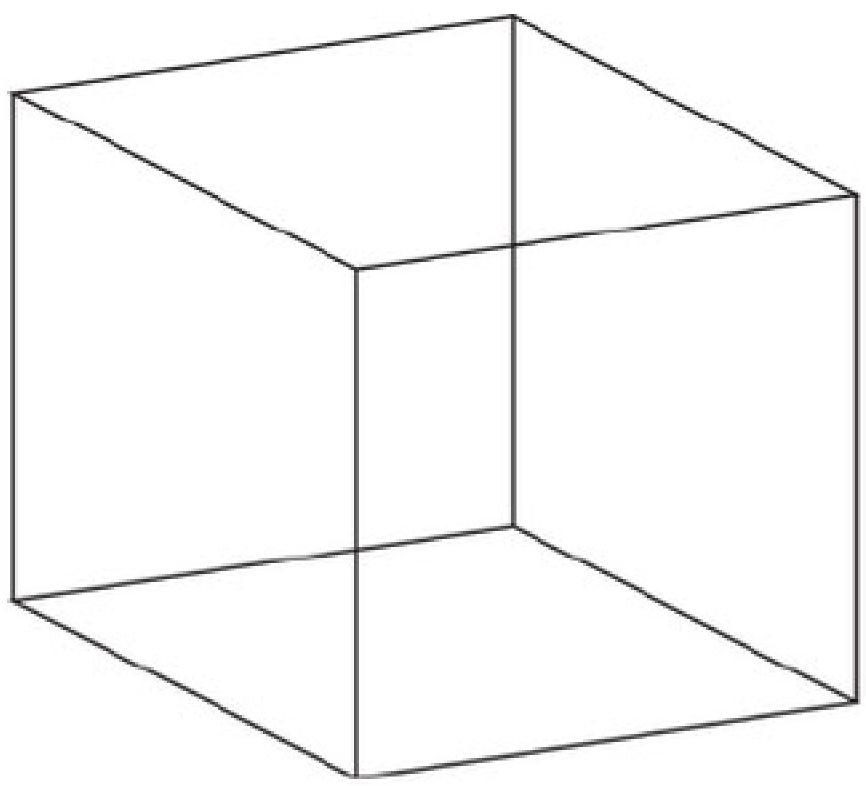


Figure 1.4

Your brain knows enough about the overall shape of these two-dimensional lines to assume that they represent a three-dimensional object—a cube. Of course, your brain is wrong. This isn't actually a 3D object, so there's not really enough information for your brain to correctly render a fully realized cube. As it struggles to reconcile what it's seeing with what it *thinks* the object is, the cube appears to flip back and forth.

Figure 1.5 shows another example, an optical illusion created by MIT researcher Edward H. Adelson.

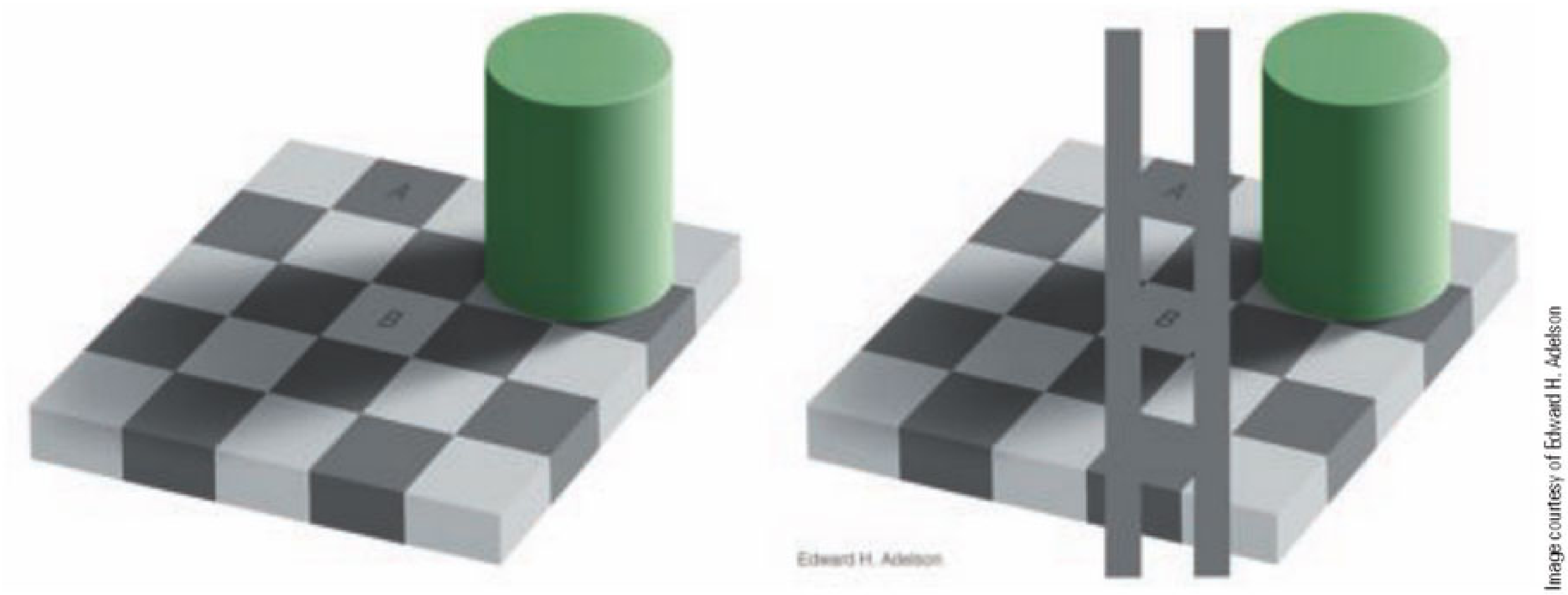


Figure 1.5 While the checkered squares appear to be alternating colors, squares A and B are actually the same color. In fact, your brain "corrects" the B square to make it fit an expectation that isn't true. The right figure shows that the two squares are actually the same color.

Light and Dark

Camera makers have yet to devise any kind of technology that can perform the type of sophisticated color adaptation that your eyes pull off. When you throw in the fact that the eye also provides extremely fast, silent autofocus with a range from a few centimeters all the way to infinity, it becomes obvious that current camera technology lags far behind the capability of the human eye.

The good news is that none of these facts mean that you can't take beautiful, compelling images. However, it is important to understand that your eyes see a world that your camera can't necessarily capture. Understanding the differences between what your eyes can see and what your camera can capture is an essential step for taking better pictures.

The most significant difference between the eye and any camera is the range of brightness that your eye can perceive. Just as your camera can alter the amount of light that strikes its image sensor by changing the size of its aperture, your eye can alter the amount of light that strikes its retina by closing the iris. Your eye controls brightness, or exposure, by opening and closing its iris, or pupil, to limit the amount of light that strikes the retina. It does this automatically as you look at brighter and darker things, and as the light in a scene changes.

Dynamic range is the measure of the darkest to lightest tones that can be captured by a device. Your eye can manage in very dark, moonless nights guided only by starlight, as well as in harsh, glaring sunlight. If you express this difference as a ratio, then the total dynamic range of the human eye is about a billion to one—the brightest thing you can perceive is about a billion times brighter than the darkest thing.

Photographers use a different way to measure light. Every time the amount of light in a scene doubles, photographers say that the scene has brightened by one *stop*, or *f-stop*. Conversely, if you cut the amount of light in a scene in half, then the scene has darkened by one stop. *Every doubling or halving of light is measured as one stop.* Using this measure, the human eye can perceive a total dynamic range of about 30 stops. However, you can't perceive this entire range at once. As you know, your eyes have to adjust to darkness and to emerging from darkness into bright light. So, while your eyes have the ability to perceive 30 stops of light, at any given time, they can only discern a dynamic range of about 15 stops. That is, the darkest thing and brightest thing in the scene can be about 15 stops apart. By comparison, a digital camera has a total dynamic range of 10 to 12 f-stops, and in any particular scene, you can expect to capture a range of about 5 to 9 stops.

Because the eye can see so much more dynamic range than your camera can, you will often have to make decisions about what part of the range you want to capture in a scene.

For example, consider Figure 1.6. In real life, the bottom of the canyon and the blue of the sky were visible to the eye. However, because the camera has a smaller dynamic range than the eye, it could capture only some of the range of light. It was not possible to shoot a single exposure that would properly expose both the depths of the canyon and the bright sky above. Although we can see detail in the sky in the first image, we see no detail in the canyon. In the second image, we have the exact opposite problem.

Figure 1.6 Because of the huge range of light to dark in this canyon, it was not possible to take a single exposure that captured both the bottom of the canyon and the sky above.

Learning to recognize when your camera will see things differently than your eye is an essential skill that will come with practice. In this book, you'll learn how to compensate for your camera's dynamic range deficiencies so that you can get images that are closer to how you actually see a scene. But to use these skills effectively, you first have to be able to recognize when dynamic range is a problem.

Summing Up

Offering continuous autofocus from a few centimeters to infinity, real-time color adaptation for different types of lights, a tremendous dynamic range, silent operation, and easy portability, your eyes trump modern camera technology in a number of ways. But, by understanding what we've discussed here, you'll be better able to work around the limitations of your camera.

However, there are a few ways that your camera outperforms the human eye. First, you can change the lens on it. Sure, modern surgical techniques allow lens replacement in the eye, but it's not the sort of thing you want to do every day, and you can't swap your eye's lens out for one with more magnification or a wider field of view.