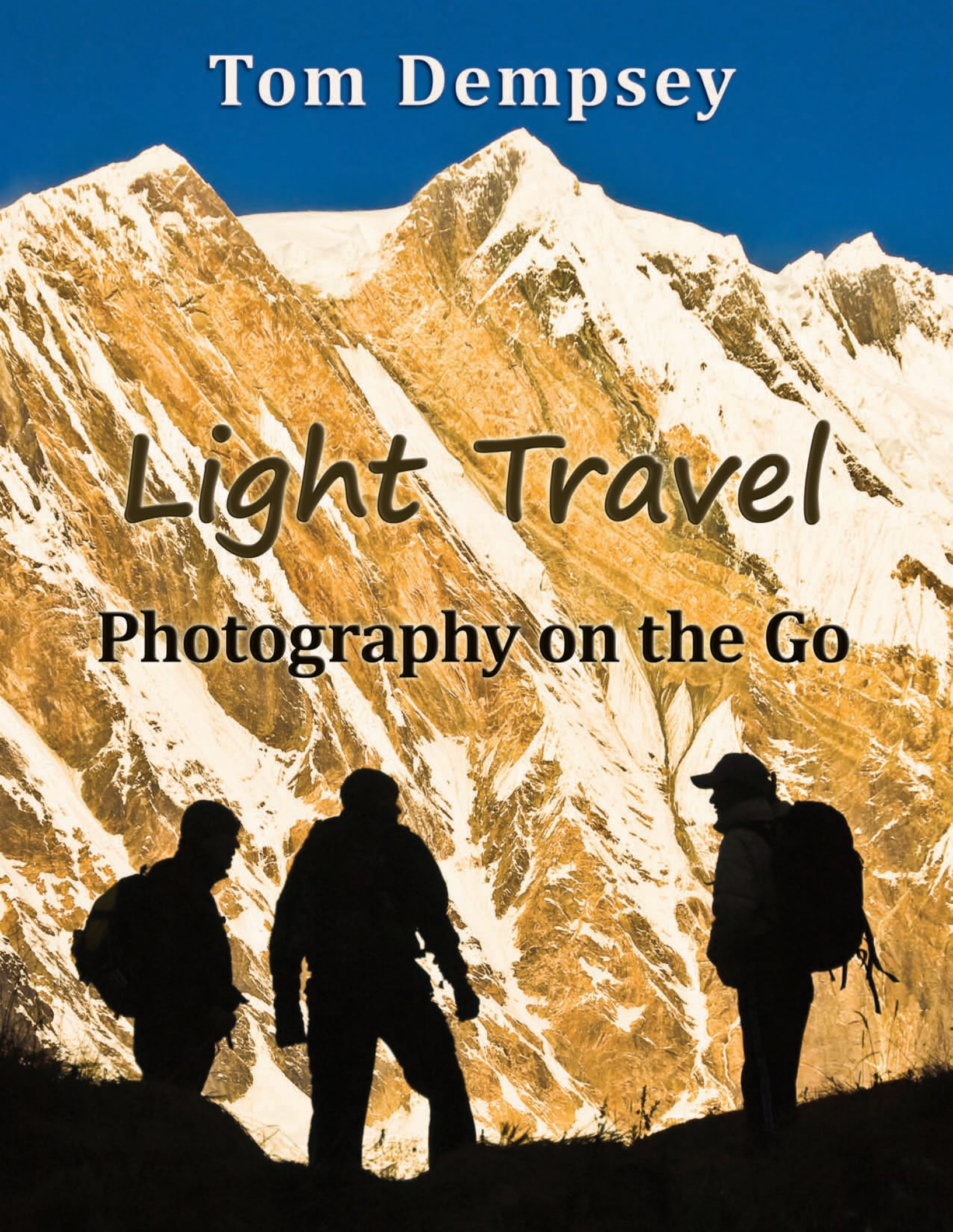
Tom Dempsey

Light Travel

Photography on the Go



Light Travel teaches and inspires on-the-go photography by revealing the magic of portable digital cameras.

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About Tom Dempsey

With 30 years of nature travel photography experience in over 20 countries, Tom has mastered the use of lightweight cameras for photography on the go. His images appear in travel publications by *Sierra*, *National Geographic*, *DK Publishing*, *Rough Guides*, *Moon Travel Guides*, and more.

He authors internet website ***www.PhotoSeek.com*** and teaches photography workshops in his home city of Seattle.

Email comments and order images/books:

tom@PhotoSeek.com

Above: Tom traveling in New Zealand, a favorite destination. Photo by Carol Dempsey. (2007)

"We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time."

— T. S. Eliot, *Little Gidding*

***Back cover**: Natural tannins released from decomposing vegetation stain Tidal River brown, in Wilson's Promontory National Park, Victoria, Australia. Captured with a* Canon PowerShot G5 *compact camera. (2004)*

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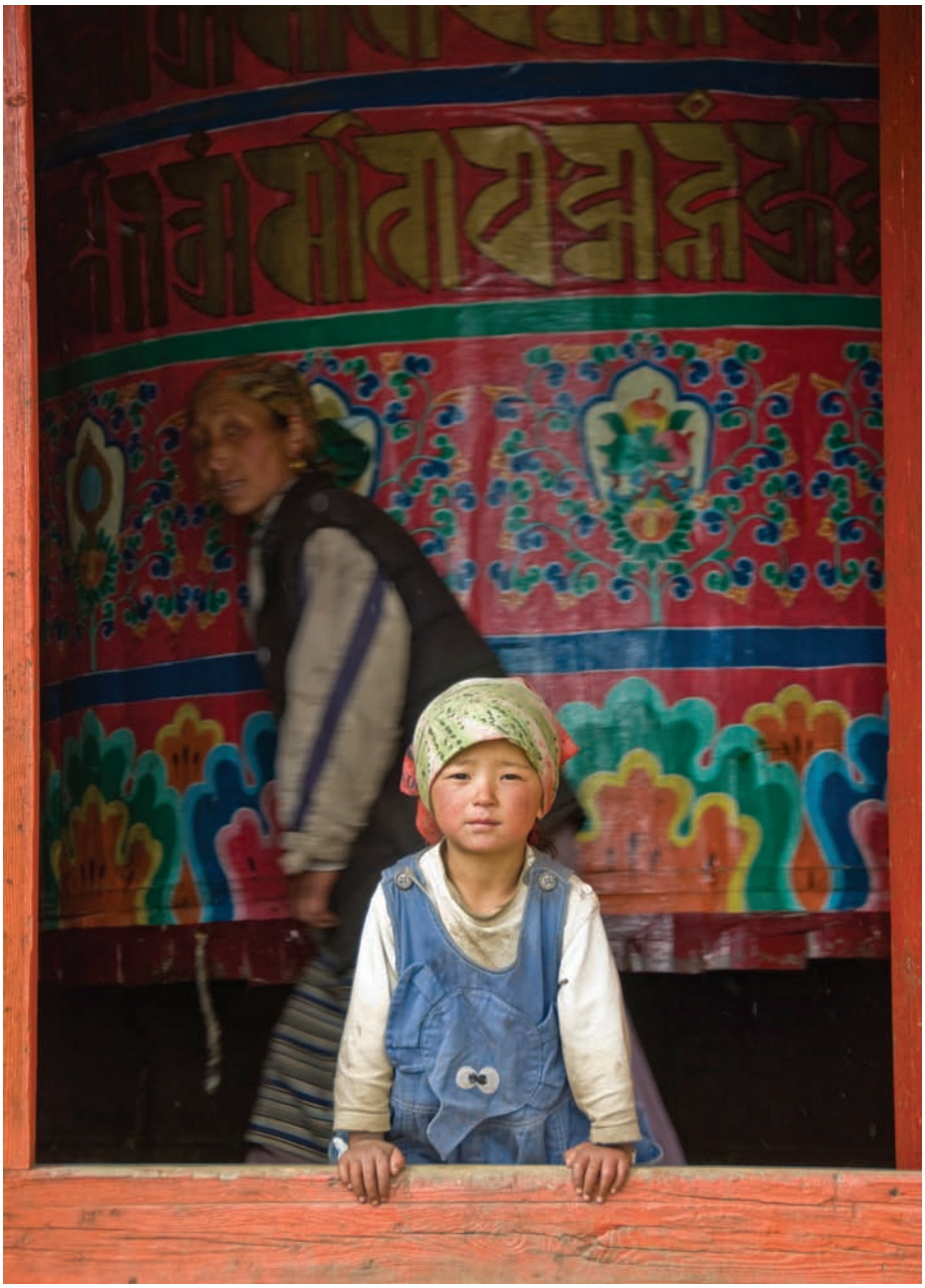
PhotoSeek Publishing ♦ Seattle, Washington



Right: *A Nepali woman turns a large prayer wheel at Pangboche Gompa, a Buddhist temple near Mount Everest in Sagarmatha National Park, a UNESCO World Heritage Site in Nepal. (2007)*

Previous pages: *The mountains of Eiger, Mönch, and Jungfrau (Ogre, Monk, and Virgin) reflect in a pond at Kleine Scheidegg train station in Switzerland. Six images were stitched to make this panorama—learn how on pages 44-45. Jungfrau-Aletsch is inscribed on the World Heritage List by UNESCO. (2005)*

Cover photo*: Trekkers pause at 13,000 feet/4000 meters elevation near the impressive mountain face of Fang (25,088 feet/7647 meters) in the Annapurna Sanctuary, Nepal. Photographed using a* Nikon D40X Digital SLR (DSLR) *camera. (2007)*

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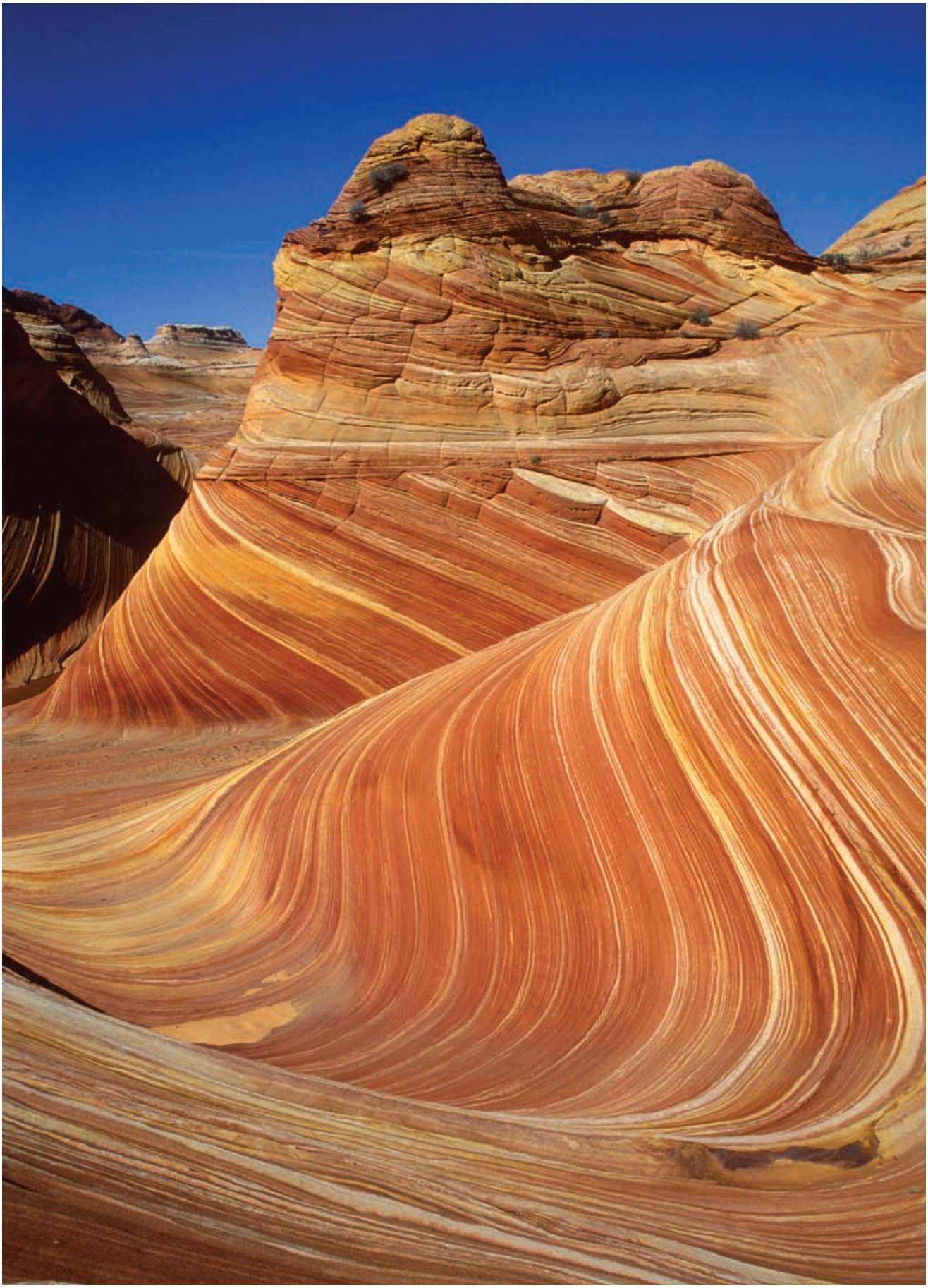


Erosion of fossilized sand dunes created The Wave, on the Arizona side of Paria Canyon-Vermilion Cliffs Wilderness Area. To help protect this section of the Coyote Buttes, a hiking permit is required from the US Bureau of Land Management. (2003)

Photographers catch sunrise on Mount Nimrod/Nemrut Dağı in the Republic of Turkey in 1999 before digital cameras bested the quality obtained from scanning 35mm color slide film. A decade later, the digital revolution empowers us with wonderfully lightweight cameras. Improved image stabilization and high-ISO quality free us from previous tripod constraints. But at dusk, night, and dawn we still require tripods to sharpen images recorded at shutter speeds too slow for hand holding a camera.

Introduction

Light Travel teaches and inspires on-the-go photography using minimal equipment.

I illustrate an active outdoor travel style for seeking evocative images:

Part I: ***How to Enliven Images*** teaches how to compose, focus, expose, and optimize photographs. Which camera is best—compact or DSLR? Are your skills more important than your camera choice?

Part II: ***Where to Seek the Light*** suggests exciting places to visit—a new state or another country. Revealing the beauty of our world can inspire environmental preservation and sustainable living.

If a topic seems too advanced, skip onwards and revisit later. Read the ***Glossary*** for definitions of photographic terms. Check the ***Index*** to find all occurrences of a term or place name.

Mesa Arch glows at sunrise in Canyonlands National Park, Utah. (2006)

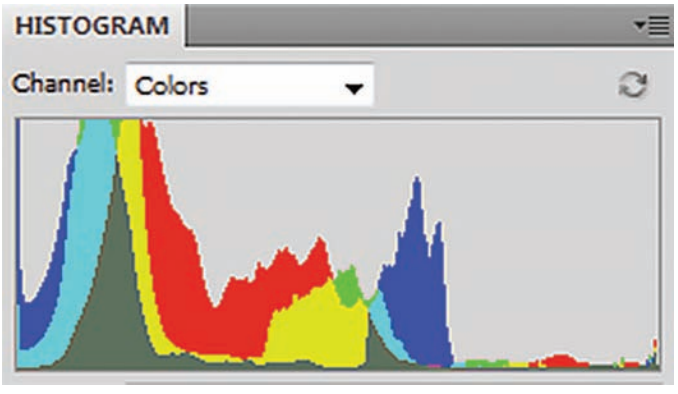
Part I: How to Enliven Images

- *Chapter 1: How to Compose Images*
- *Chapter 2: Focus, Expose, Edit, Create*
- *Chapter 3: Lightweight Cameras*

How can you create a charismatic photograph? Chapter 1 *explains how in mostly non-technical terms.* Chapter 2 *teaches basic camera skills, then reveals optional computer techniques such as the following:*

Most people shoot **JPEG files** *(with the default* **sRGB** *color space) which are compatible with all computers and retail printers. Dedicated professionals often prefer working with* **RAW files** *and* **Adobe RGB** *color space to preserve greater color depth and a broader range (gamut) of color data for improving prints.*

The above panorama was stitched from five RAW image files recorded on a Canon PowerShot Pro1 *compact digital camera using ISO 50, lens 7.8mm (31mm equivalent in terms of 35mm film), aperture f/8, and shutter speed 1/160th second.*



Using **Adobe Lightroom** *on a personal computer, for all five pictures as a batch, I adjusted the following:* Exposure *down -0.65 stops, white balance* WB Temp=*5850 Kelvin,* Tint *-5,* Blacks *4,* Brightness *+3,* Saturation *+63, and* Red/Cyan Chromatic Aberration *-55.* Lights *and* Darks *were brightened on the medium contrast* Tone Curve *by about 20%.*

The five separate overlapping vertical photographs were stitched into a seamless panorama in **Adobe Photoshop CS3/CS4** *software using the* File>Automate>Photomerge *menu. To the right is the* histogram *of brightness values shown in* Photoshop *for the resulting TIFF file image (which was optimized and saved in 16-bit* **Adobe RGB** *color space).*

Chapter 1. How to Compose Images

> *"Genuine poetry can communicate before it is understood."*
>
> — T. S. Eliot (1888 - 1965), critic, dramatist, and poet

All photographers, from beginning to advanced, can benefit from compositional exercises. Work through the exercises in this chapter:

- *A. Evoke Emotion*
- *B. Fill the Frame*
- *C. Create Contrast*
- *D. Fill with Flow*
- *E. Apply the "Rule of Thirds"*
- *F. Play with Perspectives*

Immediately after photographing each exercise, review image sequences in your LCD or EVF in *Playback mode*. Zoom into (magnify) each photo to check for sharp focus. Check for overexposure or underexposure using both the *highlight warning screen* and *histogram* for each photograph. Most importantly, ask yourself, "will this image maximize audience impact?" If not, shoot more as needed. When reviewing each picture on the LCD, your strongest instinctive reaction helps identify the best images.

Define it

Confused by camera lingo? See the *Glossary: Camera Terms Explained*.

Photography is communication. What do you want to say in each picture? What's the story? Who is your audience?

Most of us take pictures for our own enjoyment and that of an audience of family and friends. Evocative images by other photographers can inspire us to record vivid touchstones for our own personal memory as well as for sharing with an audience.

Ask or imagine how others may perceive the photograph. Other viewers later won't have your benefit of experiencing the smells, tastes, sounds, tactile sensations, or sequence of experiences that you felt when capturing the picture. Viewers will only experience what you present. Design your sensational image to stand alone, to complement a displayed sequence, or to gain impact with a well-written caption. Patient waiting or many shots may be required before recording a brief shining moment in a great photograph.

Are you serious about improving your photography? Don't leave home without your camera. Practice makes perfect. Cameras are great tools to record pictures of products and labels while shopping, or to photograph trailhead maps and signs for safety on a hike. Good quality subcompact cameras can handily fit a pocket/purse and make respectable prints. See *Chapter 3: Lightweight Cameras*.

Have fun with composition as you advance your skills and expand your creative portfolio.

A Steller Sea Lion plays with a firehose at the Alaska Sealife Center, Seward, Alaska. Photographed using a Canon PowerShot Pro1 *camera with flash turned off to prevent reflections on the aquarium glass. (2006)*

People pictures and fill flash

People often look best with candid or relaxed expressions of emotion. Be ready to capture the height of spontaneous laughter or excitement when people forget the presence of a camera. A ***photojournalist*** records events accurately without posing, as in the above Steller Sea Lion image. To engage the feelings of your audience or enhance the sense of scale, include local people at various distances from the camera.

Sometimes you can tell a story better by posing people or subjects. When arranging people outdoors, have them remove sunglasses and hats to reveal their expressive eyes. Record at least two shots to increase the likelihood of good expressions and open eyelids. Use ***fill flash***—*flash always on* mode—to fill harsh outdoor shadows on faces.

The fastest allowed ***flash synchronization*** on many cameras forces 1/200th second or slower shutter speed, which can *overexpose* flash photos in sunlit conditions outdoors. To compensate, use low *ISO* and *stop down* (increase the *f/number* for *aperture*). An advanced camera such as the compact *Canon PowerShot G11* can shoot 1/2000th second flash synchronization to improve fill flash and also freeze fast action. To prevent *motion blur*, most cameras also limit shutter speed to no slower than 1/60th second whenever using flash in most automatic exposure modes. To expose slower and pleasingly ***balance ambient light with flash***—such as indoors or at dusk, night, or dawn—use a tripod and dial your mode to *Night Scene*, *Shutter-preferred/S/Tv*, or *Manual/M* exposure mode. Or use *Slow Synchro* (or *Rear Curtain*) flash in *P/Program* or *Aperture-preferred/A/Av* mode.

Permission and legal issues

Ask *permission* before online internet posting of images with identifiable faces, and remove if later requested. On *public property* in the USA, you can legally take pictures of anyone or anything in any public place, where no expectation of *privacy* exists, though first asking permission is common courtesy. On *private property* or in other countries, follow their rules. When you record photos containing ***recognizable faces of people*** or ***copyright works***, a ***model release*** (a liability waiver) protects the *publisher* against legal claims by those people or owners. Photographers should have subjects sign a model release if the image will be sold to a *stock photo agency* or will be used commercially to promote a product or message in any media. *Editorial* or *news* usage usually doesn't require a model release. Tell publishers which of your photos are ***unreleased*** (having no model release), because *publishers* are legally culpable for unreleased images.

Exercise A: Evoke Emotion

Emotional impact outshines everything.

You don't need a big or expensive camera to capture a striking or touching image.

Research subjects in advance and open your heart in the presence of your photographic subject. When composing pictures, enter a state of emotional sensitivity, even vulnerability, while simultaneously applying technical and critical judgment. Trust your eyes, not the camera. Check the photo on the LCD after every shot to see if it catches the feeling of what you saw. Trust your instinctive reaction. Also seriously consider constructive feedback from your audience and peers.

If you know something emotionally crucial but not visible regarding the subject, imply it visually—zoom and play with lens perspectives, vary *shutter speeds*, follow the action (*pan*), or enhance impact with contrast or color saturation (adjusted in camera or on the computer) to match what you perceived.

Example A1: Keep sharp focus on an animal's ***eyes***, or else you risk disconnecting your audience. Little else need be in focus. We instinctively look to face and eyes for emotional cues. We project our human feelings upon (anthropomorphize) everything including other animals, plants, and inanimate nature. Morph your instinctive reactions into photographs.

A flip-out-and-twist LCD enabled viewing at arm's length low into the wombat's enclosure, with permission at Bonorong Wildlife Park, Tasmania, Australia. (2004)

Example A2: The terrifying mask contrasts with the two calm caretakers. The 1794 golden mask of Seto Bhairab (White Demon) glares in Durbar Square, Kathmandu, Nepal. Nepal Airlines proudly painted a winged version of this sculpture on their jets. (2007)

Example A3: Intense colors and a recognizable icon such as a lighthouse (at winter sunset at Heceta Head, Oregon) can evoke strong emotional responses. Use audience feedback to edit and improve what you show. Display only your best and leave your viewers wanting more. (2006)

Exercise B: Fill the Frame

Simplify your composition to make a clear statement. Exclude distracting or unrelated elements. Tell a visual **story** with emotion, motion, humor, contrast, color, tone, pattern, symmetry, asymmetry, texture, and/or detail.

Choose vertical or horizontal framing which best enhances the flow of the subject. If in doubt, record both versions and decide later.

To establish a greater sense of scale and depth when photographing an outdoor landscape, include identifiable subjects at three or more distinct distances away—near, middle, and far (as in *Example E2*, page 39).

Example B1 (two images on next page)

Question: Without changing the lens zoom or aperture, how was the second photo on the next page shot with a blurred background and enlarged subject?

Answer: The camera was **moved closer and focused closer**, sharply on the eye of the Galápagos Marine Iguana (2009).

In the upper image, a rock arch and sea lion offer background interest, but too many subjects compete for viewer attention. The lower image has stronger impact because an unusual reptile *fills the frame*. Both photographs were recorded with the same lens setting—zoomed at 90mm with an aperture of f/11 on a *Nikon D60 DSLR* camera. For a given angle of view, a *DSLR* camera lens can usually blur the background more than a *compact* camera, mainly due to larger *sensor size*.

Try this: Keep the zoom lens *angle of view* and *aperture* constant. Move your camera physically closer, which enlarges the subject in the frame. Now refocus at this closer distance, and the camera will reduce ***depth of field*** and blur background, as explained in the *Glossary*. Compare with pages 40-43, 53.

Example B2: All distracting elements are excluded, and enough water is included to establish pattern, space, and mood at Loutro Harbor, Crete, Greece. (2001)

Above, various subjects compete for attention...

Step in closer to fill the frame for stronger impact.

Example C1: A yellow sea nettle in the Oregon Coast Aquarium pops forward against a blue background. Yellow and blue are complements of the RGB and CMYK color models on page 34. (2008)

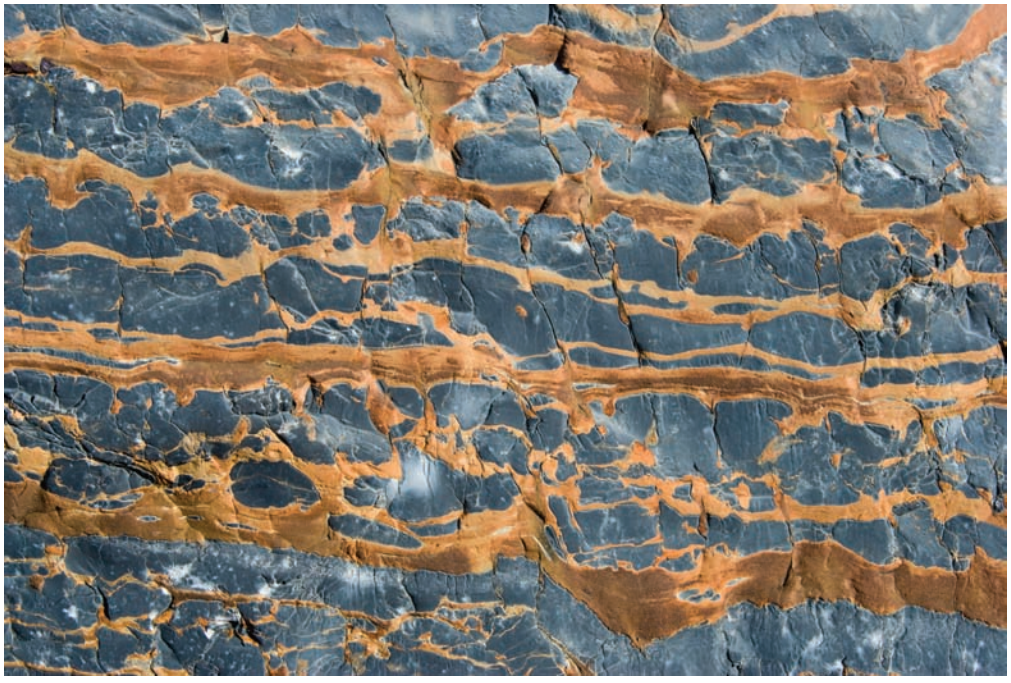
Exercise C: Create Contrast

- **Juxtapose** varying shapes, lines, textures, colors, and subjects to excite your audience and illustrate relationships.
- Frame a brightly-toned subject on a dark background, or darkly-toned subject on a bright background.
- Find a colorful subject on a background having a contrasting or *complementary color*. For example, **red** contrasts brightly with **green** or **cyan. Blue** complements **orange** or **yellow. Yellow** pops well against **purple** or **blue. Green** complements **magenta** or **red**. Read more about ***Color Theory*** on page 34.
  - Colors have an advancing or receding quality. Intense, warm colors (**red**, **orange**, **yellow**) and bright values come forward. Cool colors (**green**, **blue**, **purple**) and darker values seem to recede away from the viewer.
  - Darker, less intense colors invoke a somber atmosphere while brighter and lighter colors can create cheer. Play with mood.
- If the subject or pattern clearly stands out, then you have achieved good contrast.

Example C2: A Booted Racquet-tail hummingbird stands out against a lighter background in Bellavista Cloud Forest Reserve, near Quito, Ecuador. Red contrasts with green on the traditional RBY Artists' Color Wheel. (2009)

Example C3: Triangular blue feet contrast with the rounded eggs and white belly of a Blue-footed Booby. (2009)

Example C4: An orange layer of rock pops out against blue in the Canadian Rockies. Orange and blue are complements on the traditional RBY Artists' Color Wheel. (2008)



Creating contrast is the heart of photography.

Color Theory

Knowing how colors contrast and combine helps you compose images in your camera and later edit color tones on a computer. *Color Theory* is based on *spectral color*:

- A ***spectral color*** is identified by a fixed wavelength of light in the continuous visible spectrum, as seen in *rainbows* and *prisms*. Historically, Isaac Newton described seven *spectral colors* using the acronym **ROYGBIV** in the order of decreasing wavelength: **Red**, **Orange**, **Yellow**, **Green**, **Blue**, **Indigo**, and **Violet**. Humans cannot see wavelengths that are outside of ROYGBIV such as infrared, radio, x-ray, and ultraviolet.

  Visible ***non-spectral colors*** include **purple** and **magenta**, which are both mixtures of blue+red in the *RGB color model*. Mixing a *spectral color* with a *grayscale color* (white, silver, gray, or black) makes a *non-spectral color*, such as brown or pink. **Pink** is red+white in both *RGB* and *RBY color models*. **Brown** is actually a dark orange: a certain combination of red+green in the RGB model; or red+yellow+black in the RBY color model. The names of color gradations vary by language, culture, tradition, and perception.

The most common color models **RGB**, **CMYK**, and **RBY** are described below. Each model is based on three *primary colors*. Colors on opposite sides of a *model color wheel* are called *complementary*. When you place two *complementary colors* next to each other, they *pop aesthetically and look brighter in contrast*. Theoretically, mixing two complementary colors makes a neutral color (gray, white, or black, depending upon the color model).

- **RBY** is a historical set of *subtractive (pigmented) primary colors* **Red**, **Blue**, and **Yellow** (**RBY**). These colors, commonly available in early paints (plus green), became the basis of artistic color theory in the 1700s and 1800s. The *complement* of each primary color ink is roughly the color made by mixing the other two primary color inks. Blue ink plus Yellow ink makes *green* ink. Blue ink plus Red makes *purple*. Red ink plus Yellow makes *orange*. Mixing **R+B+Y** theoretically makes *black*, but looks muddy using real-world inks. RBY paints cannot be mixed to create cyan or magenta. RBY color wheel tints vary by artist.

  Mixing ink colors is called a *subtractive color* system, because inks selectively absorb and reflect different *spectral color* wavelengths and "subtract" brightness from white, non-inked paper. In the **RBY artistic model** using subtractive primary colors,

  1. **Red** primary complements (contrasts with) green.
  2. **Blue** primary complements orange.
  3. **Yellow** primary complements purple.

RBY paints

Above: A traditional Artists' Color Wheel *uses subtractive (pigmented) primary colors of Red, Blue, and Yellow—**RBY**.*

- **RGB** is an *additive (glowing light) primary color* model that is used by digital cameras (where each color is roughly a peak of *spectral color*):

  1. **Red** primary complements (contrasts with) cyan.
  2. **Green** primary complements magenta.
  3. **Blue** primary complements yellow.

  The **RGB** color model roughly relates to the three types of *cone cell* color receptors in the human eye. The light in an *additive color* model such as RGB emits directly from a source. The *complement* of each additive primary color is the color made by mixing the other two primary colors from light-projecting sources. A Red light source plus Green makes what we see as *yellow* light. Green light plus Blue makes *cyan*. Red light plus Blue makes *magenta*. The overlapping circular spotlights above show that R+G+B make *white* light.

RGB light

Above: The **RGB** Color Wheel *model uses additive (glowing light) primary colors of Red, Green, and Blue.*

- **CMYK** color printing technology uses a *subtractive/pigment color* model with three *primary colors* for *process inks*: **Cyan**, **Magenta**, and **Yellow** (**CMY**). Theoretically you would get *black* by mixing Cyan, Magenta, and Yellow, but real-world inks combine with a muddy non-black appearance, so printers add a **Black** ink (historically abbreviated **K**). Printing presses make a *rich black* by applying K ink onto a bedding of CMY *composite black*. In the CMYK model, *white* is defined as zero ink on the white paper or print media.

  The complementary color pairs for the **CMYK model** are the same as for RGB. As shown in the paint circles at right, mix two primary color inks to get *secondary colors*: Cyan ink plus Yellow makes *green*; Cyan ink plus Magenta makes *blue*; Magenta ink plus Yellow makes *red*.

CMYK inks

Example C5: The dark feathers of a Galápagos Dove stand out against a light background. (2009)

Example C6 above: On this aster flower, yellow brightly contrasts with purplish lavender. Flowers have naturally evolved highly contrasting colors to attract pollinators. Some flowers display *ultraviolet* color patterns which are invisible to humans but attractive to bees and certain other insects. On the long wavelength end of the visible spectrum, hummingbirds have co-evolved to suck nectar from red, orange, and pink flowers—colors which tend to be inconspicuous to insect eyes. (2008)

Example C7: A green beetle contrasts with a magenta thistle in Vikos-Aoos National Park, Zagoria, Greece. Green complements magenta in the RGB color wheel model, described on previous page. (2001)

Cut reflections with a polarizing filter

A *circular polarizing filter* for your lens cuts reflected light from water or shiny surfaces, as polarizing sunglasses do for your eyes. A *polarizer* is one of the few useful filters in digital photography, because the effect cannot be reproduced later using software.

Check the potential effect *before* taking the time to screw on a polarizing filter:

Hold the filter up to your eye and rotate it back and forth through a ninety degree (90^0) angle. If you like the effect, mount the filter using its threads, look through the viewfinder (or at the live LCD), then rotate the floating ring again to find the desired appearance.

If you see no change as you rotate the polarizing filter through 90^0, then the filter won't help, and will in fact hurt by reducing incoming light by 3 to 4 times (1.5 to 2 *stops*).

When finished cutting reflections or polarizing the blue sky, don't forget to remove the polarizing filter, and replace with your standard clear UV filter to protect the expensive lens.

Only apply a polarizing filter to your lens when the image will be improved as follows:

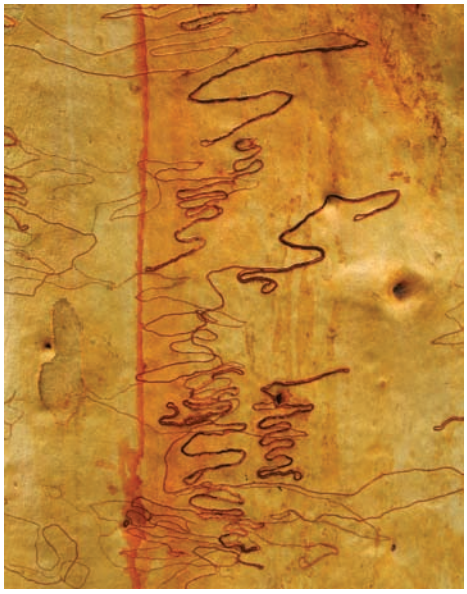
- **Remove bright reflections** from shiny surfaces such as water, glass, metal, or green vegetation. See beneath the reflective surface of lakes or streams.
- **Enhance or remove rainbows**, depending upon filter rotation between 0^0 and 90^0. **To find a rainbow**, look in a line from your eyes to the shadow of your head on the ground, then redirect your gaze by a 42 degree angle to an area where direct sunlight falls on water droplets from rain, waterfall, or garden hose.
- **Increase the contrast between clouds and blue sky**, with maximum effect at a 90^0 angle from the sun (and null effect looking near 0° into or 180° away from the sun). Clear blue sky is polarized, but not cloud. Don't overly darken an attractive blue sky unless you intend to communicate a more somber message. Skies are naturally darker at higher altitudes.

Polarized sunglasses will black out portions of LCDs and viewfinders of cameras, so wear non-polarized sunglasses for photography.

Part II: Where to Seek the Light

- *Chapter 4: Exciting Destinations*
- *Chapter 5: Nature Worship*
- *Chapter 6: Natural Patterns*

Annapurna South (left), also known as Annapurna Dakshin or Moditse, rises to 23,684 feet/7219 meters elevation. Prayer flags express compassion at a monument to fallen climbers, at Annapurna South Base Camp (ABC at 13,550 feet/4130 meters elevation), in Nepal. Annapurna is Sanskrit for "Goddess of the Harvests." Three images were stitched to make this sunset panorama.



For the viewer, photography is vicarious travel through time and place.

A Squiggly Bark Gum (eucalyptus tree) is marked by a worm which squirms under the bark. Ku-Ring-Gai Chase National Park, near Sydney, Australia. See Chapter 6 *and* Index *for more natural patterns. (2004)*

Wind blows prayer flags into an arch which frames Annapurna I, the world's 10th highest peak (26,545 feet/8091 meters, which appears shorter than the peak on the previous page only due to perspective). (2007)

Chapter 4. Exciting Destinations

Blue-footed Boobies do a sky pointing mating dance on the Galápagos Islands, Ecuador. Recorded with a Nikon D60 DSLR *camera using a* Nikkor 70-300mm VR f/4.5-5.6 *lens at focal length 185mm, ISO 800, aperture f/9, and shutter speed 1/160th second. (2009)*

Currently, my favorite places for outdoor photography and recreation are:

- ***New Zealand and Australia*** pages 80-93
- ***Nepal*** 72-73, 94-103
- ***The Alps: Switzerland & France*** 104-109
- ***South America: Ecuador, Peru, Chile, Argentina. Antarctica.*** 110-133
- ***Western Canada*** 134-139
- ***Western USA*** 140-161

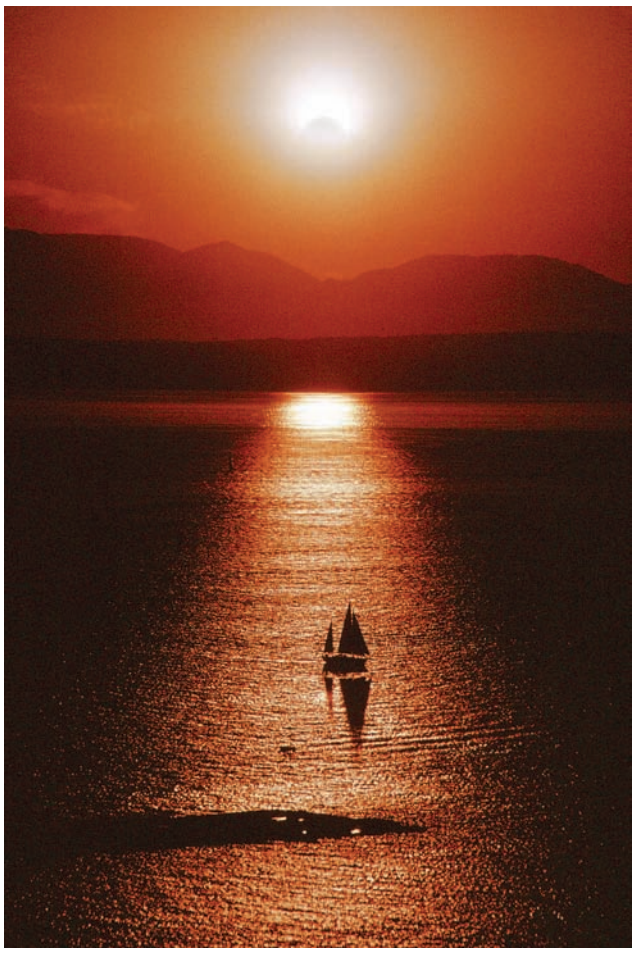
See the *Index* to find images throughout the book for each country or state.

This chapter may inspire your own unique adventures. Plan a trip or see more images on my nature travel photography website:

www.PhotoSeek.com

Above: Trekkers cross the outlet stream of Lake Carhuacocha (13,600 feet/4145 meters elevation) in the Cordillera Huayhuash, Peru. Photographed on Fujichrome Velvia 50 *color slide film using a* Nikon N70 SLR *camera. (2003)*

Right: A partial solar eclipse over Puget Sound, Seattle, Washington on July 11. Photographed on Kodachrome 64 *color slide film using an* Olympus OM-1N SLR *camera. (1991)*



The Romance of Difference

My home state of Washington packs incredible scenic variety into a small area, one of the most rewarding destinations on earth. Yet I hunger for experiences beyond my familiar home horizon.

Curiosity drives creative energy. Familiar surroundings are comfortably reassuring, but can eventually dull the senses. Humans naturally seek novelty and contrast. The joy of travel lies in the romance of difference.

Glossary

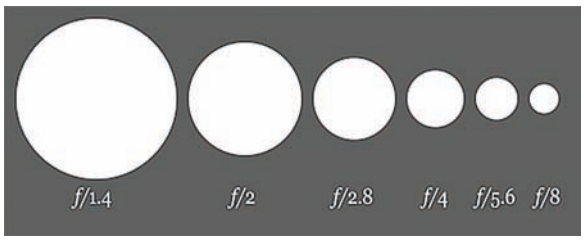
Camera Terms Explained

The Glossary *gives you a leg up on technical terms. A lava lizard perches on a Galápagos Marine Iguana, Ecuador. (2009)*

Below, words in **bold** are defined as glossary entries. Items in *italics* indicate other common photographic jargon, brands of camera gear, websites, and book sections.

Adobe Lightroom

a computer software program designed by Adobe Systems (*www.adobe.com)* specially for photographers to elegantly and quickly organize, edit, and output images. **Adobe Lightroom** cut my workflow time in half compared to using *Adobe Photoshop with Bridge*, or *Canon Zoombrowser*. The upgrade from version 1.4 to 2.x added important *Graduated Filter*, *Adjustment Brush* tools and a quicker interface to *Adobe Photoshop CS3/CS4* for features such as *Photomerge* (for stitching *panoramas*, described on pages 44-45). **Lightroom** smartly stores its *non-destructive* editing commands and labels in a powerful database (and in *XMP sidecar files* for **RAW**). **Lightroom** gives photographers total control over adjusting **exposure**, tone, **color**, **highlight** recovery, **shadow** fill, contrast curve, black and white clipping points, sharpness, **noise** reduction, lens chromatic aberrations (red, blue, or purple *fringing*), lens vignette correction, and more. **Lightroom** version 3 imports movies and improves copyright watermarking of export files.



aperture; aperture-preferred / A / Av

The **aperture** is the hole or pupil formed by the *lens diaphragm* (overlapping blades) in a camera. Each **relative aperture** size is expressed as an **f/number**—the ratio of the lens **focal length** to the pupil diameter. For example, an **aperture** of f/8 on an 18mm **focal length** lens makes the **aperture** diameter 2.25 millimeters (or 18mm divided by 8).

A **zoom lens** labelled *F3.5-5.6* or *1:3.5-5.6* means that as you zoom, f/3.5 is the widest (or brightest) **aperture** at *wide angle* and f/5.6 is the biggest opening at the *telephoto* end. **DSLR** and advanced **compact cameras** have an **Aperture-preferred** (or **Aperture-priority/A/Av**) auto **exposure** mode that lets you set the opening size (**f-stop**) while the camera meter automatically decides the **shutter speed** (at a given **ISO** setting).

color theory

See **Color Theory** on page 34 in *Chapter 1.*

compact camera, or point-and-shoot camera

a consumer camera designed for ease of use by a mass market, with a body smaller than a **DSLR** camera. In the hands of skillful photographers, *advanced* **compact cameras** (using up to **ISO** 200 or 400) can record image quality like low-end **DSLR** cameras. *Subcompact* cameras weigh up to 8 ounces and fit a shirt pocket.

depth of field, depth of focus, or DOF

the range of distance that remains *sharp* in front of and in back of where you *locked focus*. Foreground and background that are outside of the **depth of field** will appear *out of focus*, as in the keyboard example on page 53. Shallow **DOF**—where background and/or foreground blurs a short distance from the focus point—is most noticeable in **macro** close focus and *telephoto* photography. Increase **depth of focus** and sharpness from front to back by using a higher **f/number** (smaller pupil) for the **aperture** and by *locking focus one third of the distance between closest and furthest subjects*. Landscape images often employ deeper **DOF** than *portraits*. In portraiture, sharper emphasis can be drawn to the subject by *throwing the background out of focus*—by reducing the **f/number** value for the **aperture** (making a larger pupil size)—as in the Red-footed Booby photo on page 116. Focus on the eye of the person or animal being portrayed and little else need be sharp.

If you keep the **zoom lens** *angle of view* and **aperture** constant, then moving your camera closer to a subject and refocusing will enlarge the subject in the frame, reduce **depth of field**, and blur background (as for the second iguana on page 31). Moving away and then refocusing on the subject will increase **depth of field** and shrink the subject in the frame. If you keep the **aperture** constant and don't move the camera, then an 18mm lens shrinks the subject relative to the viewing frame and has a greater **depth of field** than a longer lens, such as 120mm telephoto.

For a given camera using a fixed **aperture**, wherever you stand or **zoom** (wide or telephoto), the **depth of field** will remain the same as long as you keep the focused subject appearing the same size in the frame (as in the tortoise example on page 41).

In bright light, many **compact cameras** let you conveniently record photos with closer, deeper focus than a camera with a larger sensor (unless you take the time to mount a special **macro** lens or diopter filter on a **DSLR** camera). For example, the *Canon PowerShot G9* compact camera can sharply magnify small objects by focusing to 1 cm (framing an area of 22 x 17 mm), which is much closer than the 50 cm closest focus on *Nikon's VR DX 18-200mm* travel lens (giving 93 x 62 mm macro coverage). To match the depth of field of the *Canon G9* with **aperture** f/8 zoomed to widest angle 7.4mm, the *Nikon D60* **DSLR** camera (mounting *Nikon DX* format lenses for APS-C **sensor**) would need a 24mm lens set to f/25, and 3.5 **stops** higher **ISO** to match the **shutter speed**. The **focal length** in this example uses an equivalent to a 35mm in terms of 35mm **film**.

Depth of field is determined by lens **aperture**, **focal length** (or *optical angle of view*), distance to the focus point, and size of **sensor** or **film**. Look up the **depth of field** and *hyperfocal distance* for most cameras on

- *www.dofmaster.com/dofjs.html*
- *www.dpreview.com/learn/?/Glossary*

f/8 is great

To optimize sharpness, use an **aperture stop** of **f/8** on **DSLR** cameras, or a middle **aperture** on **compact cameras**. Also use a **shutter speed** that is fast enough (with **image stabilization** turned on) to counteract blurring due to long telephoto or hand-held shake.

Most lenses capture sharpest images when using an **aperture** 1 to 2 **stops down** from the widest, brightest opening. The **depth of focus** increases with narrower **apertures** (higher **f/numbers**) but is counteracted by light diffraction through the smaller lens pupil, which softens or blurs *resolution*. **Zoom** lenses can be 5 to 25% blurrier than *prime lenses*.

To research how to optimize sharpness for a given lens, check camera reviews:

- *www.dpreview.com*
- *www.popphoto.com*
- *www.photozone.de*

For example, using *Nikon*'s versatile *Nikkor 18-200mm VR II f/3.5-5.6G DX AF-S IF ED* lens, you can sharpen images from 70mm to 200mm by using **apertures** between f/8 and f/16 (usually *f/8 is great*). This lens transmits images worst (blurriest) at 135mm, where as a workaround you can use an aperture between f/11 and f/16 for results much sharper than the other pupil sizes.

On a **DSLR** camera, **f/8** often nicely balances **depth of focus** with sufficient **shutter speed** while avoiding the fuzzier light which would diffract through a smaller opening such as f/22.

If your goal is to maximize **depth of field** while avoiding the softening effect of diffraction through the tiniest lens pupil, **f/16** is usually sharper than higher **f/numbers** for a **DSLR** camera lens (or use **f/8** for **compact cameras** in bright light). f/16 requires four times brighter light intensity (two full **stops**) compared to f/8 (for a given camera, **shutter speed**, and **ISO**).

DSLR, SLR cameras

an acronym for "**Digital Single Lens Reflex**," a style of **camera** that allows you to see from the **optical viewfinder** through the lens via a mirror. (*Reflex* means reflection.) When you press the **shutter release button**, the mirror must flip up, temporarily

blocking the viewfinder in order to expose the digital **sensor** to light shining through the lens. A **DSLR** camera is bigger and heavier than a **compact** or **point-and-shoot camera**. **Digital SLR** (**DSLR**) style cameras fit a digital **sensor** in place of the **film** found in older **SLR** cameras. Prior to the use of a mirror in **DSLR** and **SLR** designs, cameras with viewfinders had two optical light paths: one light path through the lens to the **film**, and another path through the viewfinder to the eye, either positioned above the lens (a *twin-lens reflex* or *TLR*) or to the side (a *rangefinder* camera).

dynamic range

the ratio of the brightest to darkest light value recorded by a camera or displayed by a device. "2048 to 1" means the brightest **highlight** is 2048 times brighter than the darkest **shadow**. 2048 is a range of 11 **stops**, 11 doublings, or 2 to the 11th power. To increase **dynamic range**, see **RAW** in *Glossary*, HDR on page 45, and Dynamize JPEG on page 62.

RAW files can record an extra one to three **stops** of **dynamic range** from a scene compared to **JPEG** files, using **DSLR** cameras with APS-C size **sensors** (see box at right). But on **compact cameras** (which have smaller **sensors**), **RAW** files record only about half of a **stop** of extra **dynamic range** compared to **JPEG**.

exposure

the amount of light received by the **sensor** or **film**, as determined by **aperture** and **shutter speed**. The resulting image brightness and **noise** depends on the **ISO** setting of the **sensor** or **film**. The **shutter speed** determines the amount of *motion blur*, and the **aperture** determines the **depth of field**. *Overexposure* can lose **highlight** detail by *clipping* data at the *white point* of the **histogram**. *Underexposure* can lose **shadow** detail by clipping data at the *black point* and can create extra **noise** if you brighten on the computer instead of shooting with *proper exposure*. Artistic judgment determines *proper exposure*. When shooting **RAW** or **JPEG**, to preserve the most detail (from **shadows** to **midtones** to **highlights)**, shoot **histograms** to far right without *clipping* (piling up) **highlights** at the white point, then adjust final appearance later on the computer. Or if you prefer to capture **JPEG** without later editing, expose more carefully at shooting time.

Below right: **Shutter speed** *and* **aperture** *are interlinked. For example, in* **Aperture-preferred** ***(Av** or **A)** auto exposure mode, each increase of the* **f/number** *in the table (a* **full aperture stop***) opens the* **shutter** *twice as long in order to let in the same amount of light. All columns transmit the same* **exposure value**, *or* **EV**.

f/number	f/1.4	f/2.0	f/2.8	f/4	f/5.6	f/8	f/11	f/16	f/22	f/32
shutter speed seconds	1/2000	1/1000	1/500	1/250	1/125	1/60	1/30	1/15	1/8	1/4

Dynamic range—the eyes have it

Human eyes can see a much wider **dynamic range** of light values (from brightest to darkest) compared to the range captured by cameras or portrayed by prints or display devices:

- 10 to 24 **stops** (16 million to 1) of dynamic range can be seen by human eyes when the pupil dilates or contracts like a camera's **aperture** (or 10 to 14 stops with a fixed pupil).
- 12 stops of dynamic range are recorded in **RAW** files (or 9 stops in **JPEG** files) of *Nikon D5000* and *Canon EOS 550D/ Rebel T2i* **DSLR** cameras (see *www.dpreview.com*).
- Up to 11 stops of dynamic range are recorded in RAW files of *Canon EOS 500D* (2009) and *EOS 40D* (2007) DSLR cameras, about 2000:1 ratio of brightest to darkest light. (9 stops JPEG.) RAW files from the *Canon EOS 450D/XSi* (2008) and *Nikon D60* record about 10 stops (JPEG 9 stops).
- 10 stops of dynamic range can be displayed by the *Canon Realis SX50 Multimedia Projector* with 1000:1 contrast ratio.
- 10 stops can be displayed by D*ell UltraSharp 2407WFP-HC 24-inch Widescreen Flat Panel LCD Computer Monitor* (2008) with 1000:1 contrast ratio and 1920x1200 **pixel** resolution.
- 8 stops are recorded in RAW files of a *Canon PowerShot Pro1* **compact camera** (2004) with *2/3" type* (8.8 x 6.6 mm) **sensor**.
- 6 to 7 stops of dynamic range can be recorded by JPEG files from the average compact digital camera made in 2007.
- 7 stops of dynamic range can be captured by *Kodak Gold 200 ASA* negative print **film**.
- 5 stops of range can be captured by *Fujichrome Velvia 50* color slide **film**.
- 4 to 7 stops of dynamic range can be displayed in photographs printed on paper.

EVF, Electronic Viewfinder, or LVF

an acronym for **Electronic Viewfinder**, also known as a **Live View Finder**, which is the miniaturized digital image display seen through an eye cup on some digital cameras. An **EVF** or **LVF** replaces an *optical viewfinder* (eliminating the need for the bulky mirror apparatus design of **DSLR** cameras). A digital

EVF or **LVF** helpfully shows the following: the live digital image recorded by the **sensor**, current camera settings, and in some models, a live **histogram** of light values. Note that a **DSLR** *optical viewfinder* consumes less power and may focus more clearly and quickly than an **EVF/LVF**.

film, 35mm film=135 film format

35mm **film** was introduced in 1892 by William Dickson and Thomas Edison, using **film** stock supplied by George Eastman, with a standard image size of 24 mm by 36 mm. **Film** is a sheet of plastic coated with an emulsion of light-sensitive gelatin-bonded silver halide salts, with variable crystal sizes that determine sensitivity (**ISO**, formerly *ASA* and *DIN*), contrast, and resolution. Chemical *film developing* is required to make a visible photograph. The small, high-quality *Leica* camera, designed in 1913 and mass produced starting in 1925, helped popularize the 35mm size film for professional photography. In 1934, *Kodak* introduced the 35mm-wide *135 film* in a handy metal cartridge, which surpassed the popularity of the physically larger *medium format 120 film* in the 1960s. *Large format film* is defined as 4 x 5 inches or larger.

f/number, f-number, F number, or f-stop

= (lens **focal length**) ÷ (**aperture** diameter)

If the lens **focal length** is 16 times the **aperture** diameter, then the **f/number** is f/16. The following standard **full stop** f/numbers are listed from widest to narrowest **aperture** (left to right), each admitting half the light of the previous **full stop**:

f/1.4 2 2.8 4 5.6 8 11 16 22 32 45

When you **stop down** to narrow the **aperture**, you are changing to a higher value of the **f-stop** or **f/number**. Cameras with **Aperture-preferred** or *Manual* exposure modes can let you adjust aperture by half or one-third stop increments between the above full stop values.

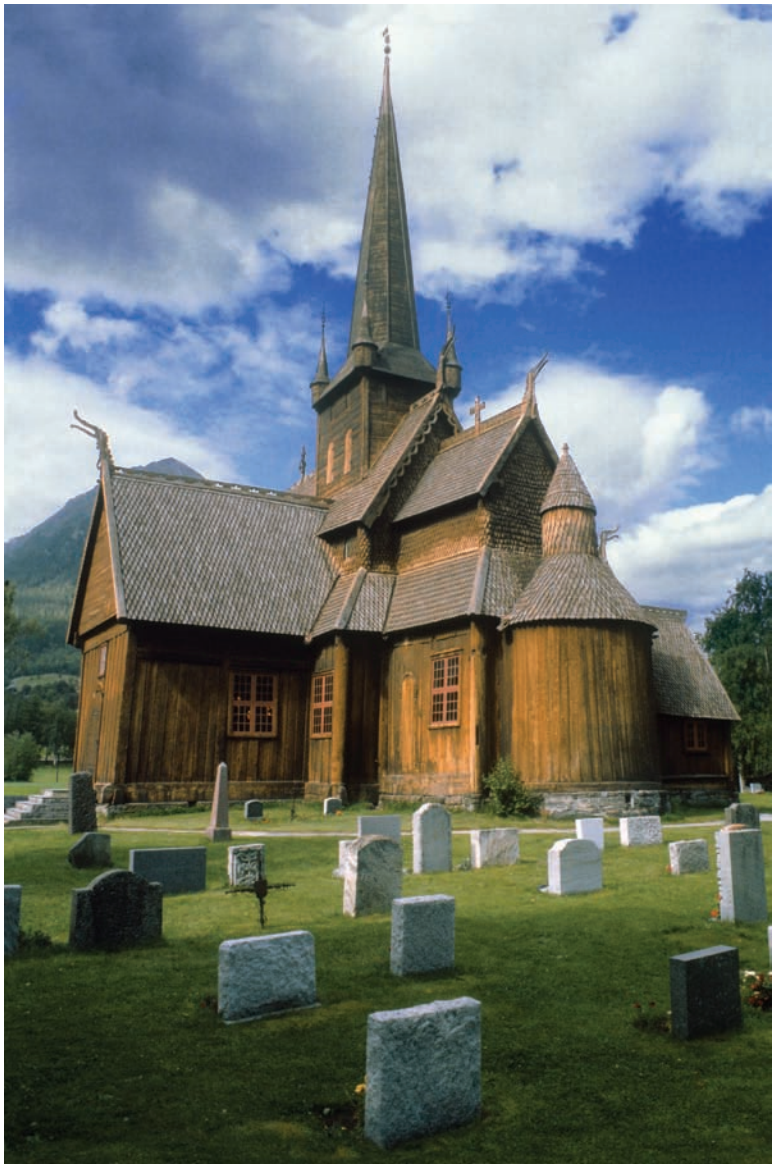
For a given camera, the brightest (widest) aperture of a *fast* lens such as f/2.8 has a larger diameter than that of a *slower* f/3.5 lens. *Faster* lenses gather more light and are usually larger, heavier, costlier, and can create better quality images than *slower* lenses. *Faster* and *slower* are terms reflecting the direct effect on **shutter speed**.

Most lenses are labeled on the barrel with their widest aperture. For example, *Nikon's 18-200mm VR* **zoom lens** marked "1:3.5-5.6" opens as brightly as f/3.5 at 18mm *wide angle* and f/5.6 at 200mm *telephoto*. The *Instruction Manual* says it can **stop down** to f/22 at *wide angle* and f/36 at *telephoto*.

Higher f/numbers decrease the **aperture** diameter (pupil) and admit less light while increasing depth of field. About two **stops** *down* from wide open is usually sharpest on typical modern lenses (thereby balancing the increased **depth of field** with the worsening diffraction of light through a smaller, darker opening).

On a given camera, a given f-stop transmits the same amount of light to the **sensor** no matter what lens you use. For example, the diameter of an f/5.6 pupil of a 200mm lens is 10 times larger than that of a 20mm lens, but both transmit the same amount of light to the sensor—at a given f-stop, a 20mm *wide-angle lens* gathers light from a wider area and stuffs it through a smaller hole than does a *telephoto lens*.

Each decreasing **full aperture stop** (measured by **f/number**) doubles the area of the pupil's circle. For each **full stop** change, the pupil's *diameter* (twice the radius size) changes by a factor of 1.414 (the square root of 2).



The Viking stave church at Lom, Norway was rebuilt in the year 1300. Photographed in 1981 on Kodak Ektachrome 200 *color slide film.*

focal length; and focal length multiplier or field of view crop factor

Focal length is the distance in millimeters (**mm**) from the optical center of the lens to the *focal point* located on the **sensor** or **film** when a subject at infinity is in focus. Lenses are defined by **focal length**, **zoom** range, brightest **aperture f/number**, closest focusing distance, and **macro** magnification. Good **zoom** lenses flexibly cover *wide* to *telephoto* angles of view, without the need for separate fixed-**focal-length** (*prime*) lenses.

The *equivalent focal length in terms of 35mm film* is the combination of camera lens and digital sensor size that captures the same *angle of view* (measured in *degrees of arc* diagonally in the frame, or sometimes horizontally) as does a 35mm **film** camera. On a 35mm film camera, 50mm is a *normal lens* with a 47° diagonal angle of view (roughly what humans perceive, about 40-60 degrees, not counting peripheral vision). With 35mm film, a 28mm lens is *wide-angle* and a 200mm lens is *telephoto*. Most **DSLR** and 35mm **film** cameras capture a width-to-height ratio of 3:2, while many **compact digital cameras** record an image with a 4:3 *aspect ratio*. For comparing cameras more accurately, check if your brand measures *35mm film equivalent angle of view* diagonally (most common) or horizontally.

A **focal length multiplier**, also known as **field of view crop factor** (such as 1.5 or 1.6 for **DSLR** cameras with APS-C size sensors), measures how many times smaller is the diagonal measurement of a **sensor** compared to the diagonal of a 35mm **film** frame. For example the *Nikon D5000*, *D80*, *D60*, and *D40/D40X* **DSLR** cameras have a 1.5 **field of view crop factor**, which makes the angle of view of the **sensor** through a 200mm lens to be the same as a 300mm lens recording onto 35mm **film**. (200mm multiplied by 1.5 equals 300mm.) Despite the sensor being 1.5 times smaller diagonally, these cameras can capture better quality images than digitizing (scanning) 35mm film. This *Nikon* factor of 1.5 makes an 18mm **focal length** lens capture the angle of view of a 27mm *lens equivalent in terms of 35mm film cameras*. The *Canon Digital Rebel* series **DSLR** cameras all have a **field of view crop factor** of 1.6 (including models *EOS 300D, 350D/XT, 400D/XTi, 450D/XSi, 1000D/XS, 500D/T1i, 550D/T2i)* due to an APS-C **sensor** slightly smaller than *Nikon*'s.

gigabyte, gb

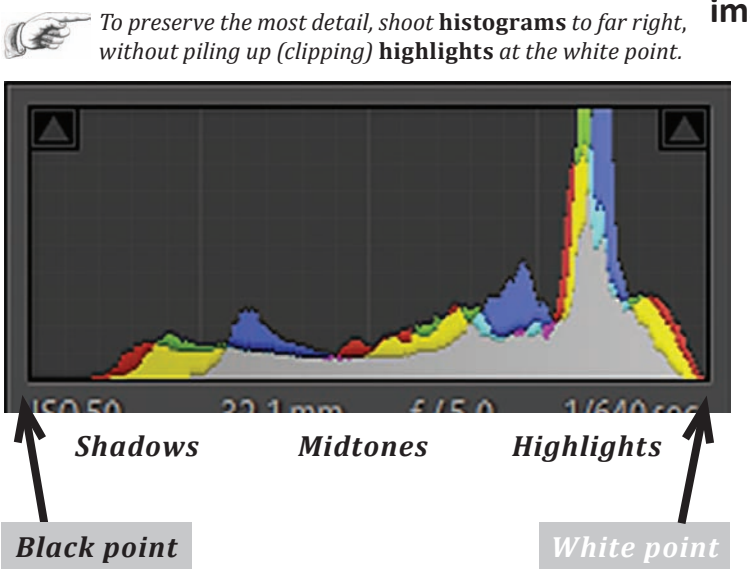
one billion (1,000,000,000) bytes in the context of disk or **memory card** storage capacity or data transmission. Exception: in the case of computer **RAM** (**Random Access Memory**), **gigabyte** traditionally means 1,073,741,824 bytes (or 1024 to the third power).

highlights

the brightest tones in a photograph, as tabulated on the far right side of the **histogram**.

histogram

a useful chart (below left) which collates the gradations of pixel brightness of a digital image. An *image* is a spatial distribution of pixels, and its **histogram** tabulates pixel brightness frequency from dark to bright, from left to right. A camera's **histogram** sorts every pixel in an image into 256 bins of brightness value, and displays each bin count as a vertical bar. The 256 vertical bars meld into a spiky or bell-shaped curve. **Shadows** (darks and blacks) rise on the left, **midtones** pile up in the middle, and **highlights** (brightest pixels) accumulate on the right. Many cameras display a monochrome *Combined RGB* **histogram**. Advanced cameras show three histograms for the separate red, green, and blue *channels* of *primary color*. **Adobe Lightroom** helpfully shows six-color **histograms**. Learn more about **histograms** in *Chapter 2: Focus, Expose, Edit, Create*.



To preserve the most detail, shoot **histograms** *to far right, without piling up (clipping)* **highlights** *at the white point.*

image stabilization: IS, VR, VC, OIS, OS

a desirable optical innovation to counteract the shake of hand-holding a camera, which can blur images when using a slow **shutter speed** and/or long telephoto lens. Turn off **IS** when using a *tripod*. Optical **image stabilization** can permit hand held shutter speeds 1 to 4 stops slower (2 to 16 times longer), depending on the camera model and lens. Each brand labels stabilization differently, as follows:

- *Canon* ***IS, Image Stabilization***
- *Nikon/Nikkor* ***VR, Vibration Reduction***
- *Tamron* ***VC, Vibration Compensation***
- *Panasonic* ***OIS, Optical Image Stabilizer***
- *Sigma* ***OS, Optical Stabilization***
- *Sony Alpha* ***Super SteadyShot CCD-shift*** *image stabilization in the camera body*
- *Pentax* ***body-based Shake Reduction***

ISO sensitivity rating (ASA & DIN for film)

can be set higher to shoot images in dimmer light without changing **shutter speed** or **aperture**, but at the cost of increased **noise** and contrast. **ISO** (formerly *ASA* & *DIN* for film) is a standard sensitivity to light defined for digital and **film** cameras by the *International Organization for Standardization (ISO)*. Most digital cameras have a lowest ISO setting of 50, 80, 100, or 200 and increase by steps:

ISO 100, 200, 400, 800, 1600, 3200…

Each doubling of **ISO** increases sensitivity by a **stop** of light, but can make the image **noisy** (grainy) at **ISO 800+** for **DSLR** cameras with APS-C size **sensors**. **Noise** is most noticeable in uniform areas such as **shadows** or blue skies at **ISO 1600** and higher. Compact cameras (having small **sensors** such as *type 1/1.6"* or *1/2.5"*) usually record significant noise at **ISO 400** and higher, with images very blotchy at **ISO 1600** and higher. **DSLR** cameras with APS-C size **sensors** can record images using at least a 4 to 6 times higher **ISO** number (2 to 2.5 **stops** better sensitivity) for a given **noise** level compared to **compact cameras** with a *1/2.5 inch type* sensor.

Shoot with ISO 200 for bright sunny subjects. ISO 100 is a **stop** slower and helps reduce **noise** for many **compact cameras** but doesn't improve quality for **DSLR** cameras. For dim daylight conditions, increase ISO sensitivity to 400. In darker light, when you choose not to mount the camera on a tripod to steady the image, you may need to set the camera to higher ISO such as 800, 1600, or 3200. Beware of ISO 400-800 or higher on compact cameras and ISO 1600 or higher on DSLR cameras, where blotchy **noise** impacts the *maximum effective print size* (discussed on page 68). But if too slow of a **shutter speed** blurs the hand-held shot, and you are already using the lens' brightest **aperture**, then choosing a higher **ISO** may be the only choice (aside from underexposing) to invoke a faster **shutter speed** and reduce the risk of blurring due to hand-held-shake. If no *tripod* is available, try steadying the camera against a wall, surface, or tree.

For tripod mounted exposures longer than 5 seconds at night, use **ISO 200** (and no higher), in order to avoid *random hotspots* created by **sensor** imperfections on all cameras including **DSLR** models. A black shot with lens cap on can be used to digitally subtract *hotspots* using a *Layer* in *Photoshop* with *Blend Mode=Difference*. The *Noise Reduction* feature in some cameras can automatically do the same thing, but may smear image appearance—test to find out.

Left: The sun sets near winter solstice at Three Arch Rocks, Oceanside, Oregon. (2006)

Metric conversions

1 meter (m) = 3.2808 feet = 39.37 inches (in)

1 meter = 100 centimeters = 1000 mm

1 centimeter (cm) = 0.3937 inches

1 millimeter (mm) = 0.1 centimeters

1 ounce (oz) = 28.35 grams (g)

El Capitan (9846 feet/ 3001 meters) is a granite tower of the 50-million-year-old Sawtooth batholith, in Sawtooth Wilderness Area, Idaho. (2007)

JPEG or .JPG file format

the default, compressed image file format most commonly recorded by digital cameras. Be sure to change your camera's default recording quality to the biggest and finest **JPEG** quality (*Low Compression*, which is virtually as good as an 8-bit **TIFF** file). Reliable, fast **memory cards** can inexpensively handle the extra volume. **JPEG** is compatible with all web browsers, image viewers, and editing software, and allows photographs to be compressed by a factor 10 to 20 with little loss in image quality compared to the camera's original **RAW** version. However if you later edit image tones, **RAW files** let you better optimize images. **JPEG** is an acronym for *Joint Photographic Experts Group*. See **Dynamize JPEG** on page 62 and **RAW** in *Glossary*.

How is a **JPEG** photograph recorded? The camera shapes the **RAW sensor** data into a medium *contrast curve*, gathers the **shadows**, **midtones**, and **highlights** between calculated *black* and *white points* on the **histogram**, and writes the image to an *8-bit* JPEG file with *lossy compression* on your **memory card**. By shooting JPEG files, you give up control of *RAW conversion* to the camera's defaults, which usually don't render the image as well as you could using a *RAW converter* program on a computer.

Each time you edit and resave a **JPEG** file on your computer, the *lossy JPEG compression* loses image quality. To uphold quality, always save your original/ master **JPEG** image to a **TIFF (.TIF)** file before editing. Better yet, instead of creating an extra **.TIF file**, use a *non-destructive* editor such as **Adobe Lightroom** which saves edits in a compact database instead of in a bulky new file.

LCD, Liquid Crystal Display

a screen that presents a live image or plays back photos recorded on a digital camera. An *articulated*, *flip-out-and-twist,* or *vari-angle* display is desirable for easier **macro** photography and better creative and candid shooting at arm's length. Look for new superior, thinner *AMOLED* displays such as by *Samsung*. LCD technology is common on televisions and computer monitors. Standard monitors, printers, and many **LCD** screens use *24-bit sRGB (Truecolor) color space*—with *8 bits*, or 256 shades of **color**, for each of the three channels of *primary color* (red, green, or blue), representing 16.7 million colors for each **pixel**.

macro, close focus

Compact digital cameras usually require a special close focus mode or **Macro** button (often marked with a flower symbol) to focus on objects nearer than about 50 centimeters or within 20 inches. Focus closely to enlarge a delightful unseen world—see *Magnify your world* on pages 46-47 in *Chapter 1*. A **DSLR** camera usually requires a screw-on *diopter filter* or special *macro lens* to focus closely.

megapixel, mp

1 million **pixels** or colored dots resolved by a camera **sensor**, stored on a **memory card**, or displayed on a glowing computer monitor. For example, the *Nikon D5000* **DSLR** camera records images 4288x2848 **pixels**, which equals 12.2 **megapixels**. Megapixels are commonly arranged in a *width:height aspect ratio* of *3:2* for **film** and **DSLR cameras**, *4:3* for **compact cameras** and television, and 16:9 for HD, High Definition TV. Image quality and actual *resolution* are more closely related to the physical size of the **sensor** than to a camera's total *effective megapixels*. Caution: In **compact cameras**, increasing the number of **megapixels** beyond about **8 mp** is a marketing device that consumes more **memory card** space but doesn't help image quality—see *Chapter 3* for recommendations.

memory card, flash memory

reliably stores recorded digital image files in your camera or other compatible device, even when power is shut off. For widest compatibility and economy, get a camera that uses *Secure Digital* (*SD* or *SDHC*) or *CompactFlash* memory card format. Note: *SDHC* (*SD High Capacity*) cards support 4 to 32 **gigabytes**, require an SD 2.0 card reader, and won't work in an SD 1.0 reader.

Memory cards handily carry large amounts of data from cameras to computers and other devices. To avoid compatibility problems, download and backup the card's data, then reformat the card in the camera before shooting, especially if writes or deletes were done from a different device.

Buy extra memory cards. After each photo shooting session or trip, put a removable label on the card(s) and rotate them through your *backup scheme* in coordination with your main image storage and backup on large *external hard drives*.

metering area

the portion of the *frame* (seen through a *viewfinder* or on a live **LCD**) where a camera reads light intensity to determine the **exposure** before capturing an image. *Matrix/Evaluative*—the default on most cameras—meters light based upon the whole frame and often improves flash photography. *Center Weighted* averages light intensity in the central area of the frame, giving the best control and predictability. Finicky *Spot meter* measures light from a tiny center area.

midtones

middle or medium brightness values of light falling between **shadows** and **highlights** on the **histogram**.

mm

an abbreviation for *millimeter*. One thousandth of a *meter* (1/1000 *m*) distance. See also **focal length**.

noise

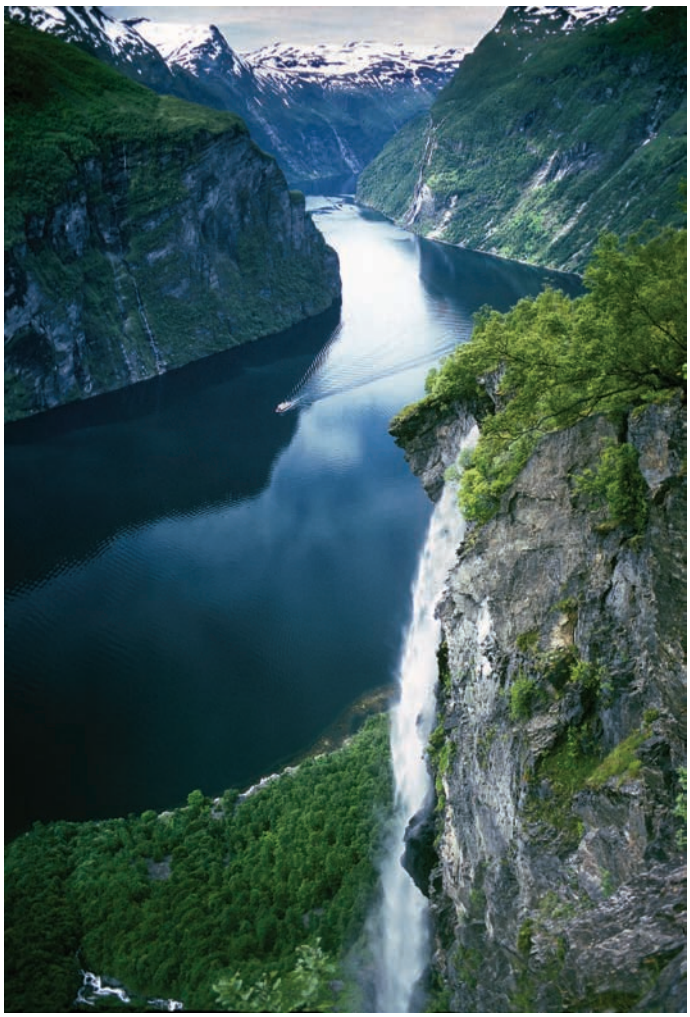
random mottling (appearing like **film** *grain*) in an image, especially noticeable in **shadows** or uniform areas such as blue skies. **Noise** usually comes from using a high **ISO** setting, such as **ISO**≥400 in **compact cameras** or **ISO**≥1600 in **DSLR cameras**. **Noise** affects maximum print enlargement size, discussed on page 68.

High-end **DSLR** cameras with APS-C size **sensors** such as the *Nikon D300* (2008), *Nikon D5000* and *Canon EOS 500D* (2009) introduced the ability to record good images at **ISO 3200** with less **noise** than any **film camera**—even their ISO 6400 can be useful.

For better night images, deactivate *Noise Reduction*, record **RAW** files, and use **ISO 200**. For tripod mounted exposures longer than 5 seconds at night, use **ISO 200** and no higher, in order to avoid random *hotspots* (created by **sensor** imperfections on all cameras including **DSLR** models). Also, a black shot with lens cap on can be used to digitally subtract *hotspots* using a *Layer* in *Adobe Photoshop* with *Blend Mode=Difference*. Your camera's *Noise Reduction* may do the same thing for long exposures but may smear pixel appearance—test it.

pixel

a dot whose **color** is determined by a combination of red, green, and blue values detected by a camera **sensor**. **Pixels** are stored in a grid of rows and columns (like an accounting *spreadsheet*), and can be displayed on a monitor or printed on paper at various resolutions expressed as *pixels per inch* (PPI) or *dots per inch* (DPI). A camera with bigger pixels (a larger **sensor** surface area per pixel) tends to capture higher quality **pixels**, which can make sharper/bigger *print enlargements* of better quality (as discussed on page 68). See also **LCD** in the *Glossary* and **Color Theory** on page 34.



Geirangerfjord, a World Heritage Site, is the epitome of Norwegian fjords. Photographed on Kodachrome 25 *color slide film. (1981)*

RAM, Random Access Memory

integrated circuit hardware used by a computer processor to load and run programs and store data (usually referring to the main volatile memory which is lost when the power is turned off). Computer **RAM** is traditionally measured in **gigabytes** defined as 1,073,741,824 bytes (or 1024 to the third power). But in the context of disk or **memory card** storage capacity or data transmission, a **gigabyte** means one billion (1,000,000,000) bytes.

RAW file or format

the native, unprocessed image format recorded directly from a camera's **sensor** (before the camera has built a **JPEG** file). Before **RAW** files can be printed or used, they must be converted to a standard format such as **JPEG** or **TIFF** on a computer, using special *RAW converter* software which also serves as an advanced editor (such as **Adobe Lightroom** or the freeware *FastStone Image Viewer*). The *filename extension* for a RAW file can be *.NEF* for *Nikon*, *.CRW* for *Canon*, *.RAW* for *Panasonic*, or other names unique by brand.

All consumer digital cameras can record images in **JPEG** files on a **memory card**, but only advanced cameras write images in their native **RAW** file format. If you want to later adjust the appearance of images with greatest flexibility, set your camera to record files as **RAW** instead of the default **JPEG**. But if you prefer not to spend much time editing images, and you prefer a simpler workflow with no RAW conversion step, then you may prefer shooting **JPEG.**

JPEG shooters must carefully set **exposure** and **white balance** at the risk losing **highlight** or **shadow** data, but **RAW** shooters can recover image data brighter than the camera's default *white point* and darker than default *black point*, to retrieve up to three **stops** of **dynamic range** better than **JPEG** on advanced cameras (page 186 box). **RAW** format better preserves **highlight** and **shadow** detail when editing, with 16 times more tonal leeway (4096 bits per *color channel* per **pixel** for *12-bit* **RAW files** compared to only 256 for **JPEG**, which is *8-bit*). When capturing **RAW file format**, the camera records unmodified *12-bit* **RAW sensor** data to a file (or *14-bit* overkill in advanced **DSLR** cameras).

sensor, or image sensor

measures photons of light like a bucket collecting rainwater, and allows a digital camera to record images sized in **megapixels** (**mp**). Generally, camera **sensors** with larger surface dimensions record better image quality, reduce **noise** recorded at sensitivities above **ISO 400**, and require larger diameter lenses:

A. ***Full frame* sensor** measures about 36 x 24 mm—the size of a 35mm **film** frame—requiring *Nikon FX* and *Canon EF* lens mounts.

B. ***APS-C*** size or ***1.8 inch type* sensor** measures about 24 x 16 mm. Balances good image quality with lightweight camera design, e.g. *Nikon DX format* and *Canon EF-S format* lens mounts.

C. ***4/3 inch type* sensor** measures about 18 x 13.5 mm. Instead of using a *4/3" type* camera model designed in a **DSLR** style with a mirror, consider the smaller, mirrorless *Panasonic Lumix DMC-G2/G10/GH1* camera designed for lighter weight *Micro Four Thirds System* lenses.

D. ***1/1.6 inch type* sensor** captures high quality for *subcompact* and **compact cameras**. Similar ***1/1.7 inch type*** is slightly smaller, 7.6 x 5.7 mm.

E. ***1/2.5 inch type* sensor** is tiny, 5.76 x 4.29 mm, and **noisy** above **ISO** 200. Best small travel **compact** super**zoom**: *Casio Exilim FH100* with 24-240mm lens. With similar ***1/2.3 inch type* sensor**: bigger *Canon PowerShot SX20; Panasonic FZ35*, *FZ28*, & small *ZS7; Samsung HZ35W*; and bargain *Kodak EasyShare Z950*.

shadows

the darkest tones in an image. **Shadows** are counted by brightness value and shown as vertical lines which make a curve on the far left side of the **histogram**.

shutter release button

Half-pressing then holding the **shutter release button** (*prefocusing*) can lock focus *and* **exposure**, take care of *shutter lag*, and allow you to recompose before *fully pressing* to record an image (except in *Continuous-Servo* or *AI-Servo autofocus* or *Sports/Action* scene mode, which all continuously hunt for focus, as on pages 48-52). Taking your time to prefocus with a half-press makes the subsequent full press of the **shutter button** *almost instant* on most cameras. Half-pressing on most **compact cameras** locks both **exposure** and focus, whereas more advanced cameras such as **DSLR**s can use a separate *Exposure Lock (EL) button*.

shutter speed, shutter-preferred / S / Tv

how long (in seconds) the camera's **sensor** or **film** is exposed to light when capturing a photograph. Each doubling or halving of **shutter speed** is a **stop** of light, such as from 1/15th to 1/30th second of **exposure**. Standard **shutter speeds** progress as follows in fractions of a second starting *slower* on left, to *faster*:

...1 second, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/250...

For simplicity, most cameras round off shutter speed fractions to the **full stops** shown above. **DSLR** and advanced **compact cameras** have a *Shutter-preferred* auto **exposure** mode (also known as *Shutter-priority*, S, or *Tv*) that lets you set the **shutter speed** while the camera meter automatically decides the **aperture** at your given **ISO** setting. Caution: Slow **shutter speeds** and long *telephoto* lenses worsen the risk of blurring caused by the unintentional shake when your hands hold a camera. Be sure to turn on **image stabilization** (if supported by your camera or lens) to counteract

hand-held shake. After capturing a photograph, in your camera's *Playback* mode, magnify the image on the **LCD** to check that details are sharply focused, by pressing the zoom controls (or *magnifying glass* symbols marked **+** plus and **-** minus). See **aperture**.

stop, full stop / Exposure Value, EV

Each **full stop**, or unit of light, halves or doubles the amount of light from the previous stop. One **EV** or **Exposure Value** commonly refers to one **stop**. ***Stop*** usually means **aperture stop** (**f-stop**), but can also refer to a doubling or halving of the amount of light controlled by **shutter speed** or **ISO**. See also **Exposure**.

TIFF or .TIF file

Tagged Image File Format (© *Adobe Systems*), trusted since 1992, is now universally edited. **TIFF files** retain every pixel value without lossy compression. To save space on computer hard drive storage, squeeze "**.TIF files**" smaller using non-lossy *LZW compression*. I convert my best **RAW** image files to 16-bit **TIFF** in *Adobe RGB color space* to fine tune in *Adobe Photoshop* before converting to an *sRGB color space* file for retail printing. To better preserve image integrity, convert original **JPEG** files to **TIFF** before extensive editing. Or, simply skip the intermediate **TIFF** by using a *nondestructive editor* such as **Adobe Lightroom**.

Most computers and cameras come with a basic free *image editor* which can adequately modify **JPEG** and **TIFF** image files. For an excellent free editor, try the freeware *FastStone Image Viewer* from *www.faststone.org* which also imports **RAW** image files from most cameras. For advanced editing required for publications and prints, use a combination of **Adobe Lightroom** and *Photoshop CS4/CS5*.

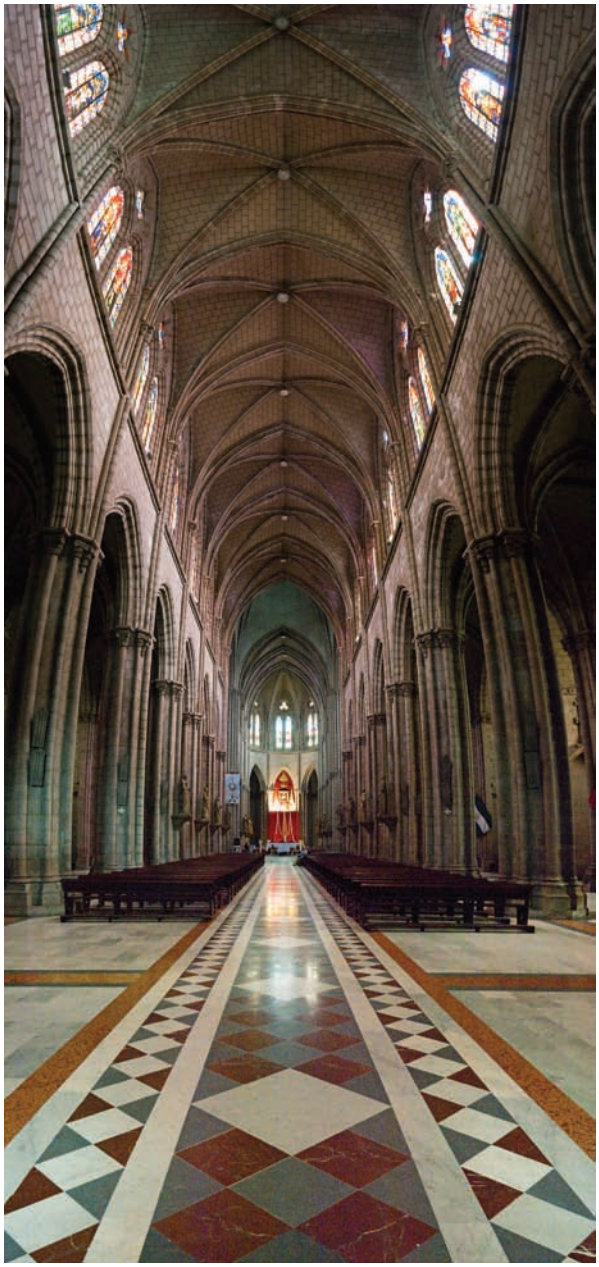
White Balance, WB, AWB

sets color balance, as explained on pages 51 and 58-59 in *Chapter 2*. Digital **Auto White Balance** (**AWB**) adapts (as our eyes/brain do) to compensate for off-color casts on the appearance of relatively "white" or "gray" subjects when lit by differently colored light sources, such as daylight, clouds, or light bulbs.

zoom lens (wide angle to telephoto)

has a sliding range of optical **focal lengths** to handily vary the *angle of view* of the *frame* recorded by the camera **sensor** or **film**. (A *prime lens* doesn't **zoom**.) Compact cameras by default start their **zoom lens** at widest angle when power is turned on, and a lever (or lens ring on **DSLR** cameras) lets you zoom towards telephoto to optically narrow the viewing angle. On a *10x optical zoom*, the *telephoto* end has ten times the **focal length** (**mm**) of the *wide angle* end, and ten times narrower *angle of view* (which is measured in *degrees of arc*, usually diagonally).

Nikon and *Canon* **DSLR**s boast an 18-200mm *11x* **zoom** with **image stabilization** great for travel. In contrast, **compact cameras** with *megazoom*, *superzoom*, or *ultrazoom* optical lens range (≥10x) physically require a smaller sensor, which often lowers image quality compared to *cropping* images from **compact cameras** with larger sensors. For better print enlargement quality, upgrade to a larger **sensor** surface area and lens with larger optical diameter.



Basílica del Voto Nacional in Quito, Ecuador was built starting in 1892. Eight stitched images make this panorama. (2009)

On a **compact camera**, turn *off* the *digital zoom* setting, which usually *crops* poorly and may be *on* by default. *Cropping* (which is best done later on the computer to simplify a composition) narrows the *angle of view* like a **telephoto lens**, but reduces **pixel** count (reducing effective print viewing size, discussed on page 68).

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Waterfalls plunge along the North Umpqua River in Oregon. Recorded with a compact Canon PowerShot Pro1 *camera using ISO 50, lens 7.2mm (28mm equivalent in terms of 35mm film), aperture f/8, and shutter speed 1 second on a tripod. (2004)*