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Digital Photography Essentials

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Glenn Rand, Christopher Broughton, Amanda Quintenz-Fiedler

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Dedicated to our past, present, and future students
and readers for sharing our passion
for photography.

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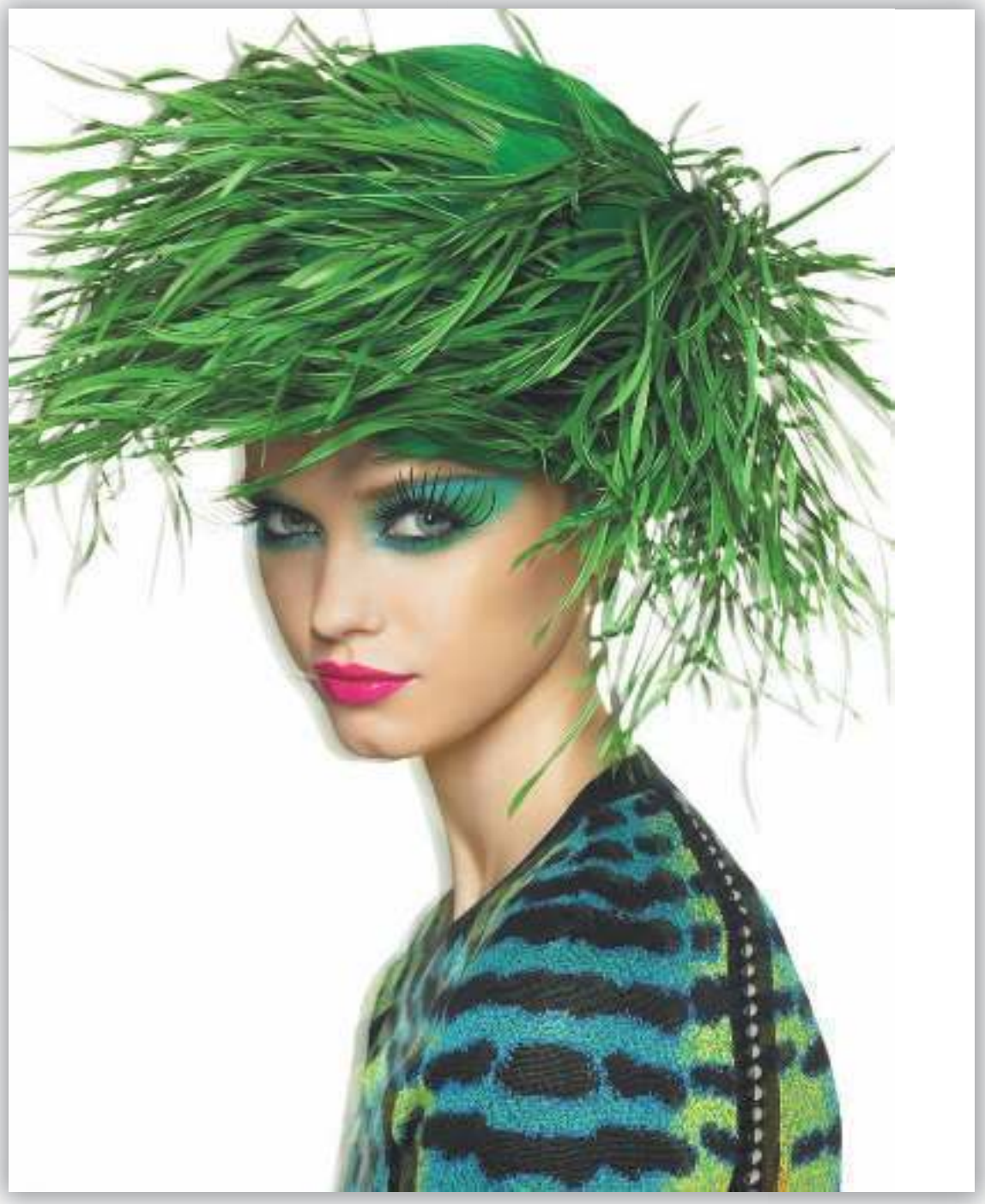
Introduction



© by Douglas Dubler. Courtesy of the artist.

Photography has changed. It seems that a few years ago photography underwent a major shift that replaced standard silver halide technology with new solid-state electronics technology. Although this has been called a *revolution*, it is really more of an *evolution*. The change was not drastic, nor was it sudden. The move from silver-based photography to digital imaging was a natural movement from one technology to another that did not alter the overall concept of photography—the act of capturing light coming from a scene with a camera. Therefore, when electronic capture devices replaced silver halide films, it was not so much a change in photography as an evolution in the basic capture and processing technology.

The most important underlying construct of photography is its ability to make permanent the vision of the photographer. Even the name of photography, light writing, is still valid with digital imaging. A photographer sees the desired image in his or her mind, or as it exists in the visual environment, and then goes about capturing and communicating this vision. The change from silver to electronics only deals with the technology, not the concept, of photography.

The desire to portray the elements of the environment preceded the invention of photography. Early in our history, artists and philosophers developed methods to discuss and represent the world around them. It was not until 1826 when Nicéphore Niépce made a permanent image from life that this goal had been realized. Niépce aimed his camera out the window, and during the next eight hours he captured the light intensities reflecting from the scene outside. This was not the first captured image; however, it is the oldest image in existence that demonstrates the artist's desire to replicate his vision of the world and then make it permanent.

From before the time of Niépce to today, the camera has been a tool that allows artists to capture the world. It was first used as an aid to painters to allow them to trace what the eye might see. With the invention of heliography, *sun writing* in Niépce's words, the camera became the vehicle that could capture the light of a scene so it could be made permanent. The basic operation of the camera has stayed consistent to the present. The initial experiments with lenses, light, and chemistry have made photography as we know it possible, and it has evolved over time into the digital cameras that we know today.

© by Elinor Carucci. Courtesy of the artist.

The importance of early photographic processes and cameras in relation to digital photography is that they set in motion a way of perceiving and memorializing our world. The concept of digital photography uses the same idea, that light emanating or reflecting from objects around us can be captured and made permanent through a physical process. It is very important to realize that over time, photography has always been based on this philosophical idea, whether it was accomplished with light-sensitive tar as used by Niépce or a metallic oxide semiconductor as used in today's digital sensors.

What we have learned since photography was introduced to the masses in the early 19th century holds true today. The invention of the charge-coupled device (CCD) in 1969 evolved the capture and processing technology, not the basic concept of photography. The process still involves light from a scene entering the camera through a lens that focuses it onto an imaging surface that then captures and holds the energy in place until a process can be used to make the image permanent.

When CCDs were introduced to most photographers, the prevalent method for making captured images permanent was through a chemical process that changed silver halide crystals from their manufactured state to an image structure made of metallic silver atoms. The change from this chemical process to an electronic process seemed radical at the time. Although the image capture techniques were new to photography, the controls to create an image and the basic relationship between light and the camera had not changed.

Before the introduction of the CCD to photographic capture, photography had already evolved through glass plate emulsions, film-based emulsions, color film, and Polaroid. Each approach altered how images were processed, but not the way light entered the camera and how it reached a photosensitive surface. Whether using film emulsions or a metallic oxide semiconductor, it makes little difference to the photons that enter the camera.

So why change? First, there is the natural tendency to make changes as new technologies emerge. Second, and more important, digital techniques bring advantages to the overall process of photography. These include everything from precapture to post-production. Within this book that deals with the capture of light, we can see various advantages of moving the photographic process from a silver-halide-based system to one that relies on solid-state electronics, including the ease of functions from exposure to output and the mobility of the captured images.

As we will see in the text, the electronic system allows an integration of processes that were separate in the silver-halide-based system. These include composition, metering, lens modification, exposure, soft proofing, and so forth. These activities are common to the photographic process. Beyond these considerations, ease of use and economic issues also encourage the use of digital photography.

It is our intent to help you master photography by understanding how to control the input factors. This has been the constant during the past two centuries. With good exposure that accommodates the capture medium comes the ability to communicate those things that attracted you to make the photograph in the first place.

In approaching this task we will present many concepts that will enable you to control how light is captured. For the most part, the control of the input to photography is critical for all steps that will follow. If the exposure does not create an image that is correct, then none of the subsequent steps can do more than save the technically poor image. On the other hand, if the exposure results in a proper image, then any steps applied to the image through processing can result in an image that meets our needs. Our approach is to master the input of reflected light from the scene to the sensor. This happens in the camera rather than tricks in a post-capture process.

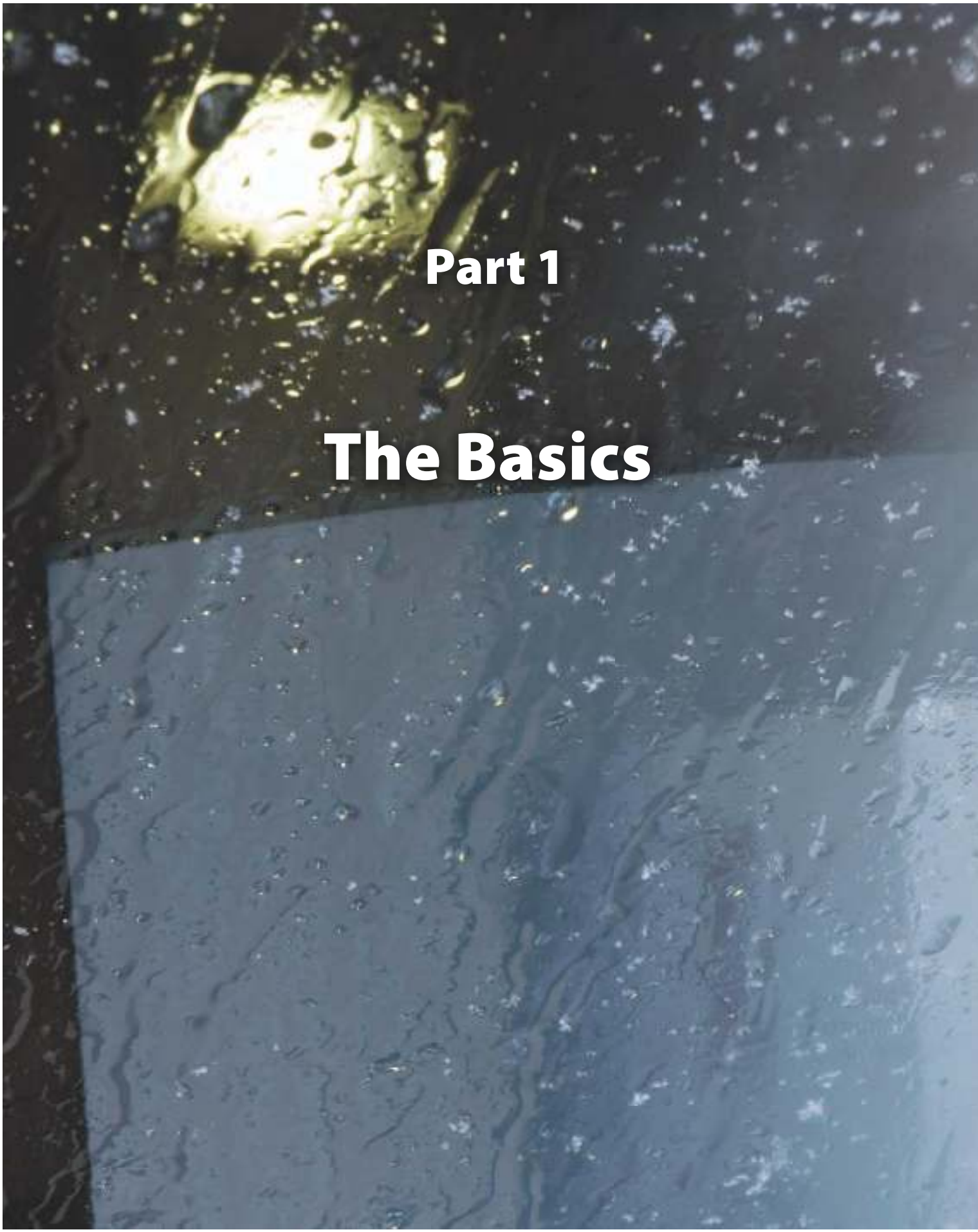
In helping you understand how digital photography works, and thus how you can make better images, we need to start by defining who you are in relation to the topic. We do not mean to rate who you are, but simply to put your history in context with digital imaging. We define two groups of people: digital natives and digital immigrants. Both groups successfully make photographs.

Digital natives are people who have always known and used digital imaging technologies. They started taking pictures after the movement to digital photography, and their first camera was a digital capture device. This may have been a phone camera, a point-and-shoot camera, or some other type of camera. The important thing about natives in terms of photography is that they learned their basics without a history in film-based photography.

Digital immigrants, on the other hand, learned photography using film and have come to digital imaging with this knowledge. In many cases their understanding of the technologies, methods, and outcomes have been colored by the successes they have had with film-based photography. This does not mean they need to discard their knowledge to successfully make digital photographs; it means they need to understand that digital photography and film-based photography have commonalities, but the differences may be profound.

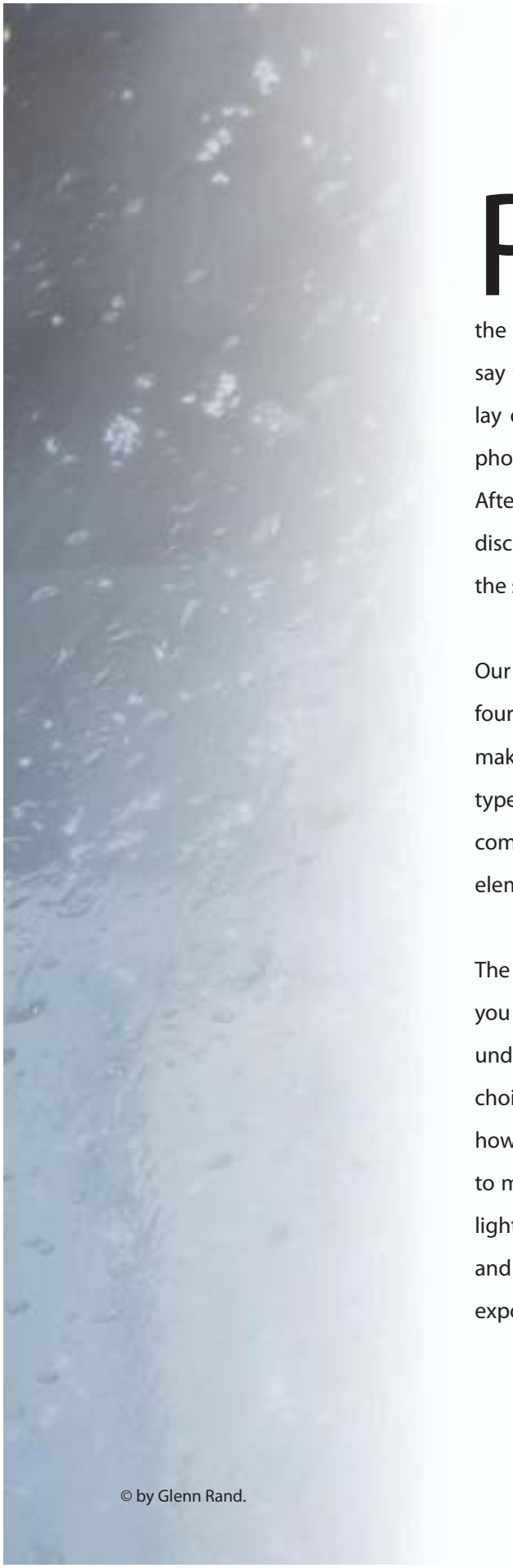
Therefore, as we endeavor to take you through this introduction to making photographs in the digital capture environment, we must be aware that in some cases we will make statements that are counterintuitive to people whose understanding of photography is based on film methods and processes. Many of these understandings will be valid, but they will need to be tempered with digital considerations and, in some cases, relegated to the evolutionary history of the art.

Ridi Pajliaccio © by Claudio Napolitano. Courtesy of the artist.



Part 1

The Basics



© by Glenn Rand.

Photography allows us to consciously act to capture something from life. As we enter this discussion of the medium, it is important that we lay the foundation for learning how to use the exceptional tools of digital photography to say what we want to say with a concise still image. The chapters in Part One of this book lay out the basic understanding and tools you will need for digital photography and will aid you in making choices about equipment. After you have gained this knowledge from Part One, we will go on to discuss its application and introduce advanced concepts that build on the solid fundamentals discussed here.

Our approach is to separate the portions of basic photography into four areas: cameras, sensors, lenses, and exposure. These elements make up the tenets of photography and will apply no matter what type of camera system you utilize to make your pictures. When you complete Part One, you will have a clear understanding of all of the elements that are necessary to create an image.

The camera is the most basic tool required for photography. Although you may have a camera as you start this book, it is our hope that understanding the various types of cameras will allow you to make choices as your digital photography progresses. We will then explain how sensors work and some of the concerns that must be addressed to make good photographs with a sensor. Because the way in which light gets to the sensor affects your images, we will also discuss lenses and shutters and how they function. Last, we will discuss the basics of exposure so that by the end of Part One you will be off and running.

1 Capture Devices

Denver to San Francisco, 2000 © by Julieanne Kost. Courtesy of the artist.

Get the Picture . . . Cameras

The concept of the camera is far older than the idea of photography. The Chinese philosopher Mozi, who lived 400 years before Christ, developed the concept that would become known as the camera obscura. Aristotle used the concept around 300 BC to devise an instrument with which he could view a solar eclipse. The term *camera obscura* comes from Latin and means a darkened room. It is a room that has no light entering except through a small opening in one wall. The light energy from outside the room passes through the small opening and creates a projected image on the wall opposite the opening. This is the basic construct of the pinhole camera and all cameras that followed.

In the 17th century it was found that lenses could be placed inside the opening in the wall, which increased the light-gathering power of the opening. With this discovery the camera obscura was made smaller and became portable, allowing artists to use the device to create sketches for their paintings. The famous painter Canaletto was renowned for his paintings of Venice in the 1720s. The sketches for these paintings were made with a camera obscura.

The inventors of photography used the camera obscura as a device to capture their images. The famous mousetrap cameras invented by William Henry Fox Talbot were very small camera obscurae that utilized large lenses with very short focal lengths to focus light energy on the very insensitive paper he bathed with sodium chloride and silver nitrate to use as his light-capturing surface.

Basics of Cameras

A camera obscura is the basis for all cameras in use today. The lens and the size of the imaging surface determine the size and shape of the dark space between the lens and the imaging surface. The lens determines the depth of the darkened chamber. If the lens has a long focal length, then the depth, in optical terms, needs to be greater. The area of the imaging surface determines the width and height of the darkened area of the camera.

When we talk about the size of the imaging surface in this context we mean its physical measurements, not its pixel dimensions. This is because the pixels range in size depending on the manufacturer of the sensor. For most cameras the sensors are quite small compared to the size of film. However, some systems utilize sensor or capture systems that are as large as film. The physical size of the sensor determines the height and width of the darkened chamber in the camera and the angles at which the lens sees the scene.

In today's digital cameras, regardless of the camera type, there are six common parts: the optical track that brings the light through the lens and focuses it on the imaging surface, the control unit, an image buffer, a viewing system, removable storage media, and the power supply.

For most cameras the optical track is constructed of a compound lens, either a fixed focal length or zoom lens, that is designed to focus the light from the scene onto the sensor to maximize the effectiveness of the light. For digital single lens reflex (DSLR) cameras, the optical track also includes a series of mirrors that are used in the viewing system. On some digital cameras, the optical track also includes a shutter to control exposure and possibly a protective device for the sensor. However, because they use electronic shutters, a mechanical shutter mechanism is not required in digital cameras.

The control unit is the computer that operates most functions of the camera. Today most digital cameras have more computing power than the small computer that was used on the Apollo spacecraft that took men to the Moon. The control unit for most cameras operates the automatic focus, exposure control, sequencing, liquid crystal display (LCD) viewing system, and memory for storing images. With many advanced cameras there are options that allow for manual operation to override the control unit.

An image buffer is most commonly found in higher-level, higher-priced cameras. The buffer allows images to be taken and held in short-term storage while the camera takes another image. Without an image buffer there is a delay between the time a picture is taken and when the camera is ready to take the next picture. This delay is the amount of time required to process and write the image to memory in the removable media.

There are several types of viewing systems used in digital cameras. They include LCD displays, viewfinders and rangefinders, and through-the-lens (TTL) systems. On many cameras the LCD display also serves as a reviewing system for captured pictures.

Removable media, or memory cards, are important parts of modern digital cameras. These memory devices can be used to record images until they are full, then they can be removed from the camera and replaced with another memory card to continue taking pictures.

The last part of the camera is the power supply. There are several types of battery systems, including standard batteries (such as AAA) and rechargeable battery units. The power supply is often overlooked, but it is important because all of the integrated systems within the camera use the electrical energy provided by the power supply. Although cameras and batteries are becoming more efficient, many aspects of taking digital images drain the batteries. The use of an LCD viewing system is one of the most taxing demands on the batteries.

Favino Piefrancesco © by Douglas Kirkland. Courtesy of the artist.