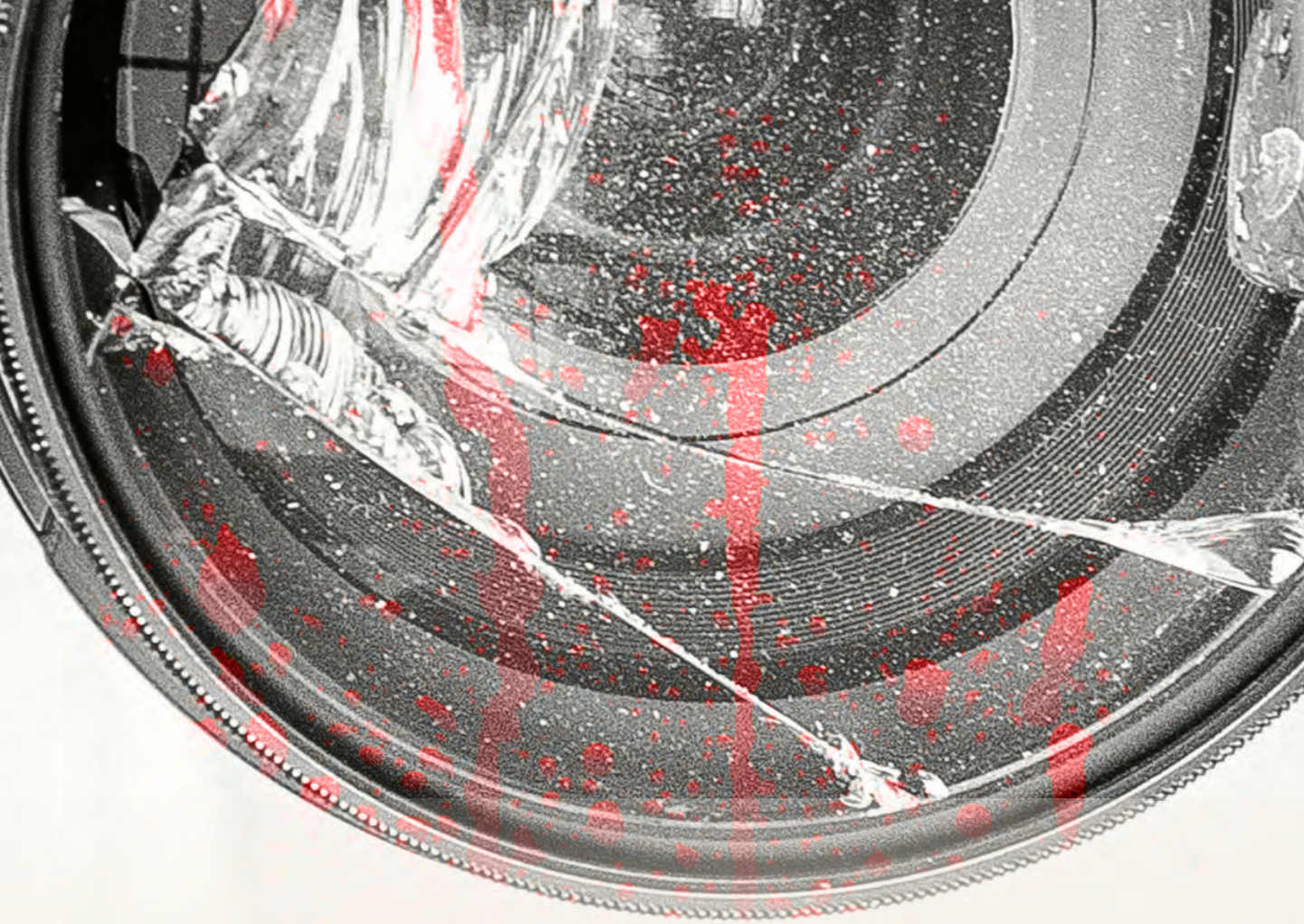

POLICE PHOTOGRAPHY

SEVENTH EDITION

LARRY S. MILLER | NORMAN MARIN

ROUTLEDGE

Police Photography

Seventh Edition

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Police Photography

Seventh Edition

Larry S. Miller
Norman Marin

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Dedication

This seventh edition is dedicated to Ruth, Ryan, Casey, Christopher, and Cole.

- **Larry S. Miller**

I would like to dedicate this book to Michael, Bruni and Maryury Marin.

- **Norman Marin**

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Contents

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Preface

The year 1971 was the beginning of a new age for the law enforcement profession. The Law Enforcement Assistance Administration was operating in full resplendence, providing financial assistance to local law enforcement agencies. Criminal Justice programs were emerging in institutions of higher learning across the country. 1971 was also the year Sam J. Sansone's *Modern Photography for Police and Firemen* was first published. As a young Crime Scene Technician, I remember my excitement in obtaining a copy of Mr. Sansone's book. I would never have imagined that, years later, I would be updating his classic work.

This seventh edition of Police Photography is designed, as was the original, to teach the fundamentals of photography and their application to police work. Toward that end, this book is organized into two main themes: (1) the photographic process; and (2) the application of photography to police work. Mr. Sansone's original material has been updated and new material has been added. New material on cameras, digital imaging, equipment and computer application techniques have been included. Of particular mention is the addition of Norman Marin as co-author. Norm has many years of experience as a forensic photographer and has been instrumental in updating several chapters.

We have attempted to maintain Mr. Sansone's proven style of presentation in this edition. We believe we have transformed the book into a current text that Sam would be proud of.

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CHAPTER 1

The Police Photographer

CONTENTS

ABSTRACT

Police have been using photography to document and capture details about crimes for many decades. Generally, the courts have upheld the use of photographic images as evidence at trial. The most widely used system of photography in today's law enforcement community is the digital camera. Digital cameras pose new methods and better technology than traditional film systems to assist police in their duties.

KEY TERMS

Bertillon system
Digital imaging
Digital-single-lens-reflex (DSLR)
Eastman Kodak
Florida v. Victor Reyes
Green v. County of Denver
Luco v. United States
People v. Jennings
Photomacrography

Photomicrography
Polaroid
Reddin v. Gates
State v. Thorp
Will West–William West Case

INTRODUCTION

During a routine patrol of a suburban neighborhood, Officer Black receives a call instructing him to investigate a two-car collision a few blocks away. He drives to the scene and, before leaving his patrol car, he notes that, although one of the vehicles has sustained severe damage, no one seems to be injured.

The drivers of the two cars are arguing heatedly (neither driver, Officer Black observes, seems to have been clearly in the wrong), and nearby a passenger is sobbing. Officer Black ensures no one is injured, calms the drivers, soothes the passenger, records each person's description of the accident (there were no witnesses outside the two cars involved), and radios for a tow truck to remove the damaged vehicle. Before the tow truck arrives and the automobiles are moved, he takes a few measurements, sketches the scene, reaches into his pocket and takes out his cell phone, and snaps four photographs of the accident.

In addition to being a calmer of nerves, an investigator, a law enforcer, an impartial witness (although after the fact), an artist, and an agent for the immediate conclusion of a minor catastrophe in the lives of three people, Officer Black is a police photographer. That is not his job description, but neither is his role as a street psychologist. He may never use PhotoShop or hold a digital single-lens reflex camera in his hands. But his function as a police photographer is every bit as important as that of the head of the crime laboratory in his department who takes photographs in his spare time that could vie with the best of those seen in *National Geographic*.

Both Officer Black and the head of his department's crime laboratory are police photographers; this book is for both of them.

POLICE PHOTOGRAPHY: A SHORT HISTORY

Photography is most obviously useful in police work when photographs serve as evidence that may prove invaluable to investigators, attorneys, judges, witnesses, juries, and defendants. Often, a good photograph can be the deciding factor in a conviction or acquittal when no other form of real evidence is available.

Photographs were used in court as early as the mid-1800s. In 1859, a photograph was used in the case of Luco v. United States (64 U.S. (23 HOW.) 515.16

L.Ed. 545 [1859]) to prove that a document of title for a land grant was, in fact, a forgery. The first recorded use of accident photography was in 1875: "Plaintiff, in a horse and buggy, was injured when, in attempting to go around a mud hole in the center of a road he drove off an unguarded embankment" (Blair v. Inhabitants of Pelham, 118 Mass 420 [1875]). The photograph was admitted in evidence to assist the jury in understanding the case. Two years later, photographs were admitted as evidence in a civil suit involving a train wreck (Lock v. The Souix City & P.R.R., 46 Iowa 210 [1879]).

Although neither of these early photographs used in evidence was taken by a police photographer, the use of photography in police work is well established in the early annals of photography. In 1841, 18 years before Luco v. United States, the French police were making daguerreotypes (an early form of photograph) of known criminals for purposes of identification.

One of the first cases to hold that a relevant photograph of an injured person was admissible in evidence was Redden v. Gates in 1879 (52 Iowa 210, 1879). The photograph was a tintype, a photograph made on a thin iron plate by the collodion process. It showed whip marks on the plaintiff's back 3 days after the assault. In 1907, in Denver, Colorado, all intoxicated persons were photographed at the police station.

Speeding motorists were being detected with photographic speed recorders by 1910. The state of Massachusetts approved the use of such devices and gave a full description of their operation. Although radar is a more popular device for this operation today, there has been a resurgence in the use of photo-enforced traffic laws and devices in the past decade.

The use of fingerprint photographs for identification purposes was approved in 1911 in People v. Jennings (96 N.E. 1077, 252 Ill. 534, 1911), although 1882 was the year in which fingerprints were first officially used for identification purposes in the United States. Gilbert Thompson of the US Geological Survey in New Mexico used his own fingerprint on commissary orders to prevent their forgery. In 1902, New York Civil Service began fingerprinting applicants to discourage the criminal element from entering civil service, and also to prevent applicants from having better-qualified persons take the test for them.

The famous Will West case took place at Leavenworth Prison in 1903. When he was received at Leavenworth, Will West denied ever having been imprisoned there before. Clerks at the prison insisted that West had been there and ran the Bertillon instrument (used for identification purposes) over him to verify measurements. When the clerk referred to the formula derived from West's measurements, they were practically identical, and the photograph appeared to be that of Will West. When the clerk turned over the William West record card,

FIGURE 1.1
The Will West–William West case demonstrated that photographs and Bertillon measurements of persons were not accurate methods for identification. Will West (a) and William West (b).

he found that it was that of a man already serving a life sentence for murder. Subsequently, the fingerprints of Will West and William West were compared. The patterns bore no resemblance. The fallibility of three systems of personal identification (photographs, Bertillon measurements, and names) was demonstrated by this one case. The value of fingerprints as a means of identification was established. There was a great similarity in the photographs of Will West and William West (Figure 1.1). An officer must be careful when identifying a person from a photograph. After the Will West–William West case, most police departments began using photographs, Bertillon measurements, and fingerprints on their "mug shot" files. Eventually, the Bertillon system was discarded (Figure 1.2).

One of the early uses of firearms identification is recorded in a 1902 case, Commonwealth v. Best (62 N.E. 748, 180 Mass. 492, 1902). Photographs of bullets taken from the body of a murdered man were put into evidence, along with a photograph of a test bullet pushed through the defendant's rifle. This method of obtaining a test bullet is not proper, according to modern authorities, but the use made of the comparison photographs was to be followed in many later firearms identification cases.

Before the modern electronic flash units of today, photoflash bulbs were used and readily accepted by the public by 1930. Before the photoflash bulbs, people used flash powders—dangerous explosives that produced a great deal of objectionable smoke. The photoflash bulb was a revolutionary development that made possible the taking of many evidence pictures that were otherwise unobtainable. Undoubtedly, their use contributed greatly to the development of police photography.

FIGURE 1.2

Early mug-shot files depicted photographs, fingerprints, and Bertillon measurements. Eventually, Bertillon measurements were discarded as a means for identification. *Courtesy Memphis Police Department.*

Ultraviolet photography was approved in a decision handed down in the 1934 case of State v. Thorp (171 A. 633, 86 N.H. 501, 1934). The picture showed footprints in blood on a linoleum floor, and brought out distinctive marks in the soles of the shoes worn by the defendant that corresponded to the marks shown in the ultraviolet photograph.

In 1938, the Eastman Kodak Company introduced the Super-Six-20, which was a camera featuring fully automatic exposure control by means of a photoelectric cell coupled to the diaphragm of the lens. After 1945, Kodak again introduced cameras that were automatic and in a price range that everyone could afford. Today, such features are used in most cameras and are within a price range

that is affordable to most people. You can get an automatic camera that meets almost all of a person's photographic needs, and most cell phones are equipped with sophisticated camera systems. There are even lens attachments, such as Sony's QX Cyber-Shot, that can be mounted to digital tablets and smart-phones to create a high-end camera system.

The first appellate court case passing on the admissibility of color photographs was Green v. County of Denver (142 P.2d 277, 111 Colo. 390, 1943). The court upheld the use of color photographs as evidence.

The Eastman Kodak Company introduced a color transparency using sheet film in 1935, called Kodachrome. It quickly became extremely popular, resulting in the widespread use of color photographs in police photography. Then, in 1941, a color process known as Kodacolor made it possible to make color slides, color prints, or black-and-white prints from a color negative.

In 1963, the Polaroid Company introduced Polacolor film, which made it possible to take finished pictures in black-and-white or color in less than 1 min. This was one of the most significant developments in the history of photography and led to the extensive use of color photographs as evidence. Many Polaroid camera devices were incorporated into traditionally police photographic uses, such as mug shots, fingerprint photography, microscope photography, and forensic photography. Digital photography has replaced Polaroid as the primary police camera system.

In 1965, another important invention was placed on the market. It was the introduction of a fully automatic electronic flash unit, which made it possible to take exposed strobe flash photographs at distances from 2 to 20 feet without changing the lens opening or shutter speed. Automation was thus achieved by means of the lighting equipment rather than the camera.

In 1967, we saw the beginning of the use of videotapes as legal evidence. Sony introduced the Betamax videotape cameras and recorders/players in the mid-1970s, making them affordable for the average household. At the same time, the Matsushita Company introduced the VHS series of cameras and recorders/players in direct competition of the Betamax system. Consumers chose the VHS over the Betamax. Today, many law enforcement agencies use videography for surveillance, recording crime scenes and interrogations, and training purposes.

In the 1980s, we saw the introduction of quality 35-mm "point-and-shoot" cameras, fully automatic 35-mm SLRs with automatic lens focusing, and a host of new and better films. During the late 1980s, we saw faster personal computers with high memory capabilities, allowing for the introduction of the CD Photo system and digital imaging.

The 1990s produced more advances in the field of photography than in previous decades. Primarily because of the progress of electronics and computer

systems, new photographic media were developed. During the late 1990s, a new photographic medium emerged, digital imaging. When the digital video disc (DVD) was introduced in the late 1990s, it set the stage for the eventual replacement of the videocassette, the laser disc, the CD-ROM, and even the audio CD with one system for digital media storage. The DVD is now being replaced with portable chip devices in "flash drives" and digital smart-cards.

Today's twenty-first century cameras are fully automatic, to an extent. The police photographer can now concentrate more on the subject of the picture than on the intricacies of the camera. Professionals and amateurs now use cameras equipped with semiautomatic or fully automatic controls. Digital imaging allows photographers to take images and manipulate and enhance them using a computer rather than a darkroom. With the wide variety of good cameras today, there is no excuse for a police photographer not to be able to obtain suitable pictures for evidence.

THE MANY USES OF PHOTOGRAPHY IN POLICE WORK

The modern police department considers photography more than just a way to record evidence or identify a known criminal. Note the role of photography in the following aspects of law enforcement:

Identification files: Criminals, Missing Persons, Lost Property, Licenses, Anonymous Letters, Bad Checks, Laundry Marks, and Civilian or Personnel Fingerprint Identification Files. In the case of a catastrophe, such as an airplane crash, the fingerprints from a civilian file are proving helpful in making positive identifications.

Communications: Investigative Report Files, Accident Files, Transmission of Photos (Wire Photo, FAX, and e-mail), and photographic supplements to reports. With modern-day computers, accident reports can be made in seconds and sold to insurance adjusters for nominal fees. An excellent source of revenue for a department is the sale of photographs of traffic accidents to insurance companies and lawyers.

Evidence: Crime Scenes, Traffic Accidents, Homicides, Suicides, Fires, Objects of Evidence, Latent Fingerprints, Evidential Traces. Evidence can frequently be improved by contrast control (lighting, filters, and software), by magnification (photomicrography and photomacrography), and by invisible radiation (infrared, ultraviolet, soft X-rays, and hard X-rays).

Offender detection: Surveillance, Burglar Traps, Confessions, Re-enactment of Crimes, Intoxicated-Driver Tests. One of the newest applications of police photography is to record on videotape arrests in which the suspect offers resistance.

The practice has been instituted by many law enforcement agencies to counter charges of police brutality.

Court exhibits: Demonstration Enlargements, Individual Photos, Projection Slides, Videography and Computer Presentations (i.e., Power-Point presentations).

Reproduction and copying: Questionable Checks and Documents, Evidential Papers, Photographs, Official Records and Notices.

Personnel training: Photographs, Computer Presentations, and Videos relating to police tactics, investigation techniques, mob control, and catastrophe situations.

Crime and fire prevention: Hazard Lectures, Security Clearance, Detector Devices, Photos of Hazardous Fire Conditions made when fire prevention inspections are made.

Public relations: Slides, Computer Presentations, and Videos that pertain to safety programs, juvenile delinquency, traffic education, public cooperation, and homeland security.

In general, then, there are four primary ways of using photography in police work: (1) as a means of identification; (2) as a method of discovering, recording, and preserving evidence; (3) as a way to present, in the courtroom, an impression of the pertinent elements of a crime; and (4) as a training and public relations medium for police programs.

Public Relations

Aside from the obvious uses of photography in police work, the photographer must be aware of the importance of police photography in public relations. For instance, burglary has a low clearance rate: approximately 12% (US Department of Justice, 2011). The inability of police departments to catch these particular criminals is, of course, founded in the elusiveness of the criminal and his or her ability to vanish into the dark. The public, however, regards this poor percentage as ineptitude on the part of the police. Careful and thorough photography of a burglary scene can go a long way toward solving the crime, thus dispelling this and other misconceptions of the public.

POLICE PHOTOGRAPHY AND FIRE INVESTIGATION

Arson is probably the least investigated index crime for two reasons. First, it is difficult to show that a fire was, in fact, intentionally set. Second, a controversy exists as to who should investigate arson. Should it be the police, who have extensive knowledge and experience in investigations? Or should it be the fire

department, which has much more knowledge about the causes of fires? In large cities and some states, this problem is solved because they have their own arson investigation units. But, in smaller towns and states without a state arson investigation unit, this may not be the case; neither department wants to get involved in this problem, so it may go unsolved.

Regardless of who is responsible for photographing the scene during an arson investigation, his or her chief role is to document the fire from its origin to its completion. Another aspect of this job is to document aspects of the operation for the training of new fire fighters, to show both correct and incorrect procedures for future study.

The primary principle to remember in police photography is that a finished photograph must be accurate. As a means of evidence, a photograph can be factual and, in many cases, revealing. In other words, the essence of photography lies in its ability to both record and clarify. To use the camera to its fullest advantage, then, it becomes necessary to learn the fundamentals of the photographic process: to learn and understand the techniques of, and wide range of possibilities for, photography in law enforcement.

EVIDENTIAL PHOTOGRAPHS

Court photographs serve two purposes: (1) the photograph itself is documentary evidence; and (2) the photograph is a record of evidential objects that may or may not be present in the courtroom. When the photograph itself is evidence, it implicates a defendant in a criminal act. This is apparent in surveillance and "sting" operations, in which photographs or videotapes depict identifiable persons engaging in illegal activity. When the photograph serves as a record of items or situations of evidential value, the photograph is used to illustrate details of the evidence or scene, or to represent evidence that is not present or unseen in court. Crime scene photographs, microphotographs, macrophotographs, medicolegal photographs (autopsies), and photographs of objects that cannot be conveniently brought into the courtroom are examples.

When photographs are introduced as evidence in court, the photograph will not stand alone. A person, present when the photograph was taken, must be able to testify that the photograph accurately and fairly depicts the scene as it was and that the photograph is not misleading or sensational. For this reason, no photograph of evidential value may be altered or retouched in any manner that would distort the actual subject. Objections may even be raised over placing identification markings on photographs, such as in the case of fingerprint comparisons. When in doubt as to whether such markings may be objectionable to the court, it is advisable to prepare two sets of photographs, one with

and one without such markings. A removable transparent overlay may also be used for such markings on one photograph. As early as 1899, a court observed the following:

> It is common knowledge that as to such matters, either through want of skill on the part of the artist, or inadequate instruments or materials, or through intentional and skillful manipulation, a photograph may not only be inaccurate but dangerously misleading.
>
> Cunningham v. Fair Haven & Westville R. Co., 72 Conn. 244 at 250, 43 A. 1047 at 1049, 1899

Videos, color photographs, and digital images are generally admissible on the same grounds as black-and-white photographs if: (1) they depict relevant issues in the case; (2) they are true and accurate representations (which may require the testimony of the photographer); and (3) their probative value is not outweighed by their prejudicial effect (i.e., gruesomeness or inflammatory character). Digital images may be enhanced to bring out more detail. However, the original, unenhanced, image must be kept to maintain integrity (Washington v. Hayden, 90 Wash. App. 100, 950 P.2d 1024, Wash. App. Div. 1, Feburary 17, 1998).

In Wright v. State (250 So. 2d 333, Fla. App. 1971), the court held that three of eight color photographs introduced were grossly inflammatory and unnecessary to explain or elucidate any portion of the state's case. However, in Albritton v. State (221 So. 2d 192, Fla. App. 1969), the same court held that color and black-and-white photographs depicting injuries to a 16-month-old baby demonstrated visual evidence of the extent and severity of the child's injuries.

Color photographs in and of themselves do not determine their admissibility or inadmissibility as evidence. The legal requirement lies in the effect of the photographs, whether in color or in black-and-white. Generally, if the inflammatory character of "gruesome" photographs is overemphasized and their probative value is minimized, the courts may find error in their admissibility. Criminal cases reflect broad discretion in the trial court for admission of photographs when the probative value is found to outweigh prejudicial impact (People v. Cruz, 26 Cal. 3d 233, Cal. Rptr. 1 1980). The best advice is to show only those photographs that explain and demonstrate, and nothing more.

Although digital images are much easier to manipulate than traditional film photographs, they have stood the same legal tests. In 1997, the International Association for Identification adopted a resolution endorsing the use of digital imaging, stating that it was a natural progression in the history of photography and, therefore, fell under the same criteria as photographic evidence. Despite defense attorneys' objections to the use of digital imaging because of

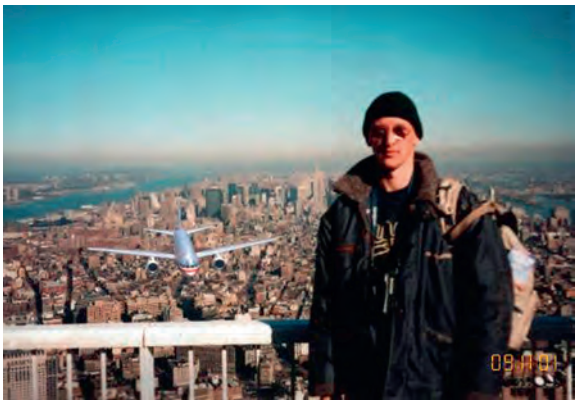

FIGURE 1.3
The World Trade Center 9/11 hoax photograph.

the ease at which they can be manipulated, the courts have allowed digital photographic images on the same basis as traditional film photographs (Berg, 2000). However, defense attorneys will continue to aggressively point out how easily digital prints can be manipulated. In a 2002 murder trial in Florida, police used software known as More Hits to enhance a smudged palm print on duct tape. Although the court allowed the evidence to be presented, the defense argued that it was "junk science" and introduced testimony from an art professor to demonstrate how easy it was to manipulate images using Adobe Photoshop. The defendant was acquitted (Florida v. Victor Reyes, 17th Jud. Cir. Ct., Case 99-11535CF10A, Opinion and Order on Defendant's Motion in Limine, 21 October 2002). Photographic hoaxes, such as the World Trade Center 911 photograph that appeared widely on the internet, are common, which may encourage defense attorneys in attempting to disqualify digital photographs in court (Figure 1.3).

LEGAL CONSIDERATIONS

The terms *manipulate* and *enhance* are often used interchangeably with digital imaging. However, depending on the definition used, there may be a legal distinction between the two terms. Certainly, brightness/contrast, color balance, and cropping of digital images can all be manipulated with a computer using Adobe Photoshop. But, in a legal sense, the term manipulation may be construed to mean changing an image to reflect something different than the true portrayal of the scene, or subject. It would be better said that the common photographic changes (density, contrast, color balance, burning, and dodging) are, in fact, enhancements. But, as many celebrities have testified, tabloid papers have been accused of using digitally manipulated photographs in their

publications. It is easy to put one person's head onto another person's body by manipulating the images on the computer. In the same vein, it might be easy to digitally remove, or to add, a piece of evidence at a crime scene and, therefore, to make the defendant look guilty. If data from the original image are either removed from or added to, that changes the intent of the original photograph. That is considered manipulation. For example, it is easy to use the brightness/contrast controls to make bruises and lacerations appear more serious than they really are with digital imaging. And so, the term *digital manipulation* has a deceitful context. However, the term *enhance* indicates that nothing was removed, changed, or added, to the image that would change the intent of the photograph. Therefore, for purposes of testifying in court, regarding what was done to a digital image, the photographer should use the term *enhancement* rather than *manipulation*. This will tend to avoid being attacked on the subject during cross-examination. There is a false assumption that film is more secure from manipulation than digital images. Although it may be a little harder and more time-consuming to do so, film photographs can, also, be manipulated by anyone who can do darkroom work. In fact, if a standard operating procedure (SOP) for digital images is in place with a police agency, digital images may be more secure than film images.

As with film photographs, the photographer usually must testify in court that any images produced digitally are a reasonably true and accurate reproduction of the scene or subject. If a digital image has been altered, or enhanced, in any way, the photographer must testify as to the protocols followed with enhancement. To ensure that a digital image is accepted as photographic evidence in court, the police department should establish rigid SOPs and follow them. At a minimum, SOPs should include the following:

1. *Camera original images must be archived in an unalterable form soon after the photographs are made.* This can be done by using digital disks with a serial number. The serial number of the disk should be recorded in the case file. This archival copy is made before any image editing work.
2. *A photographic log should be maintained to record information about the images.* This can be a written log, similar to film photographic logs. In most digital cameras of today, a file is generated by the camera, itself. This file is called a metadata file, or more commonly, an Exif header file. These often record the camera make, model, serial number, camera settings, and date/time of the image. When the image is saved, the data file goes with it as a normally hidden file. However, the date and time of the camera must be set correctly. It is advisable to check this before any imaging task.
3. *Chain of custody must be maintained.* As with any form of physical evidence, image files must be controlled and secured. Documentation should be kept on who had possession of materials, what was done to them, and where they were/are located at all times.

4. *Enhancements and alterations to digital images must be documented.* Any alteration or enhancement to images is done using a copy of the archival disk images. Detailed records of what types of enhancements were performed must be recorded. There is a history function in Adobe Photoshop that will record everything that was done to the image. Another way to create documentation is to use the macro feature on the computer. The macro records all the keystrokes made in a session, and these keystrokes can be played back.

THE FUTURE OF PHOTOGRAPHY

Astounding developments are being made in photography that are going to lead to even greater use of police photography. Years ago, people laughed when someone suggested that any size photograph could be produced almost immediately without the use of a darkroom. Photographic prints can be produced today on an inexpensive ink jet printer that rivals that of traditionally produced prints. The traditional darkroom as we know it is going to disappear. Photographic evidence will be produced not only more quickly but more economically, and at the same time will be of excellent quality.

Because revolutionary changes are in progress and are happening so quickly, it will be difficult to keep up with them. Contemporary police photographers have more technologically advanced materials available to them than did their earlier counterparts. Even though photography continues to develop as a digital medium with pictures recorded and stored electronically, the basic principles of photography will not change. We will still have the basic laws of perspective and correct tone reproduction. Photographic processes are but a means to an end, and police are primarily concerned with whether the final photographic exhibit is a fair and accurate representation of a subject, rather than how it was reproduced.

The future of photography continues to be in electronic digitization. Great strides in electronics have been made in the past decade and have invaded the photographic finishing and development areas more fully. Already, videos and digital recordings of depositions, interrogations, and crime scene investigations are becoming common, and digital imaging is becoming common, with crime scene investigations, latent fingerprint examinations, and other areas of forensic science. Color photographs have virtually supplanted black-and-white photographs in all but certain scientific branches of police photography in which color would have no advantage (i.e., infrared and ultraviolet photography). Sophisticated, yet easy-to-operate, digital cameras are being developed on an almost-daily basis. No book can possibly keep up with all the changes taking place in the field of photography. The serious police photographer should subscribe to one of the many photographic magazines (e.g., *Popular Photography*) to keep abreast of new developments.

Photographic evidence is an important specialty—a powerful tool recognized as indispensable in the proof of facts in court. The opportunities for use of photographic evidence in the future will be limited only by our ability to understand and appreciate the power of the photographic picture and to comprehend its limitless value.

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CHAPTER 2

Cameras

CONTENTS

ABSTRACT

There have been many cameras available for police use since the advent of photography in the nineteenth century. During the past decade, the use of digital cameras has proved to be as good as traditional film cameras for police use. In addition to still cameras, the use of camcorders has seen an increasing use with police in recording crime scenes, crimes in progress, and surveillance. The ideal police camera is a professional-grade, digital, single-lens reflex with interchangeable lenses and attachments.

KEY TERMS

Camcorder
CCD
CMOS
Digital single lens reflex (DSLR)
ISO
Video cameras
White balance

INTRODUCTION

More than almost any other art form, photography requires equipment. The primary piece of equipment for taking photographs is, of course, the camera. Yet, a camera itself does not produce a photograph. The camera requires a photographer to manipulate it. And, the photographer must be able to reproduce the photographic image through the use of computer software and printing. These three items—camera, photographer, and reproduction—working together, constitute a system of photography.

The system, and therefore the capabilities of the system, may be enlarged with the addition of various pieces of equipment (each of which must be compatible with the system). For instance, a simple digital camera manipulated by a photographer is a very limited system that may be enlarged and adapted to indoor use by adding a compatible flash attachment.

As demands on photographers are increased, they must refine the capabilities of the system by adding pieces of equipment, replacing pieces of equipment, simplifying the operation of equipment, using new computer software applications, and by augmenting their knowledge of photography. The photographer chooses a particular camera and organizes all photographic work and equipment around that camera. The camera should serve all the needs of the photographer, so that one camera can be used for most, if not all, facets of the work. Then, the photographer must set up computer software needs and printing capabilities for the finished photograph.

The camera must be compatible with the photographer's needs, abilities, and budget. With the current proliferation of cameras, the photographer is given a wide choice of cameras that vary in performance, complexity, and price. Careful consideration and research should be undertaken when choosing a camera system. One should keep in mind that many camera accessories, especially lenses, are only compatible with their own maker. For instance, Nikon makes lenses, but their lenses are, in general, compatible with Nikon cameras only. A Nikon lens would not fit on a Canon camera and vice versa. The selection of a particular camera must also include the accessories that may be needed for that camera (e.g., lenses, external flash units, underwater housings, and so on).

When Sony first announced the Mavica (magnetic video camera) in 1982, many thought it would replace traditional still photography much in the same way that camcorders have replaced home movie film cameras. As of this date, digital cameras have largely displaced film cameras among amateur consumers. Professional photographers, too, are leaving film cameras behind. Perhaps the company hurt most by the introduction of digital cameras has been Polaroid. Polaroid enjoyed great success with consumers with their instant photographs, rather than traditionally developed film. Consumers like the idea

of being able to see immediately what their pictures look like, and Polaroid delivered in this respect. Digital cameras do the same thing: instant gratification. Photographers can see what the picture looks like and can retake a shot if it does not look right. Kodak also has been hurt by the introduction of digital cameras. The point-and-shoot line of cameras for which Kodak has long been known has been replaced with digital cameras. Although Polaroid and Kodak began producing their own lines of digital cameras and equipment in an effort to keep in business with the general public, they were unsuccessful.

Digital cameras are a cross between conventional film-based cameras and a digital scanner. The front of the camera uses a lens, aperture, and shutter to focus an image; however, the image is not focused onto light-sensitive film, but onto a semiconductor chip called a charge-coupled device (CCD) or a complementary metal oxide semiconductor (CMOS). Data are passed to an analog-to-digital converter chip, compressed, and then recorded on either built-in memory chips or a removable memory card. With some digital cameras, there may be as much as a half-second delay between when the shutter is pressed and when the camera actually takes the picture. This delay is the time necessary for the light sensor to read the scene, adjust the diaphragm opening (f-stop) or change the shutter speed, check the autofocus, and trigger the flash. Because of this delay, there may be a problem with the shot when subjects move. Also, there may be as much as a 4–9-second delay when the camera is converting the image into digital form, compressing and saving the image and recycling the flash. With some digital cameras, this additional delay prevents exposures from being made until after the camera recycles. With other camera models, one or more exposures may be taken while the camera is "busy" (processing) the first image. This is done by the camera having a "buffer" memory. Depending on the memory device and the camera quality settings, more than 1000 pictures may be stored in one memory chip before the chip is full and needs to be downloaded to a computer or other large storage device, such as an external hard drive. Like videos, these digital media devices can be reused by deleting unwanted pictures on the camera and/or formatting the media. Most are equipped with a liquid crystal display (LCD) viewfinder screen, which allows photographers to see what the picture looks like almost immediately. As mentioned, if photographers are not pleased with the result, they can retake the picture.

The quality of the pictures is based on the image sensor (CCD or CMOS) in the camera and the method of storing the image. Image sensors are often described by pixel count. *Pixel* is an abbreviation of picture elements. These elements are individual places (usually square) that, together, make up the sensor. One can imagine the sensor as looking much like a very small checkerboard, with each pixel being a square on the board. The more pixels the sensor has, the more detail it can detect. The size of the image sensor is also important, and it is measured diagonally (usually one-half inch or one-third inch). A small image sensor might yield poorer low-light sensitivity than a large one with the

same, or lower, pixel count. Digital cameras often range from the lowest pixel resolution of 640 × 480 (0.3 megapixels) to as much as 32 megapixels. Thirty-two-megapixel cameras are relatively expensive, but a 12–14-megapixel camera can be found at a very reasonable price. In general, if enlargement prints of 8 × 10 inches or more are needed, a digital camera should have a 10-megapixel capability or better. When a digital image is enlarged beyond its resolution capability, the prints may become "pixelated" (broken up into blocky squares). This is a particular problem with the low-end point-and-shoot digital cameras with resolutions of 5 megapixels or less. Most digital cameras can record 256 shades of tone (light or dark) and color (Figures 2.1 and 2.2).

FIGURE 2.1
Charge-coupled device (left) and complementary metal oxide semiconductor chip (right).

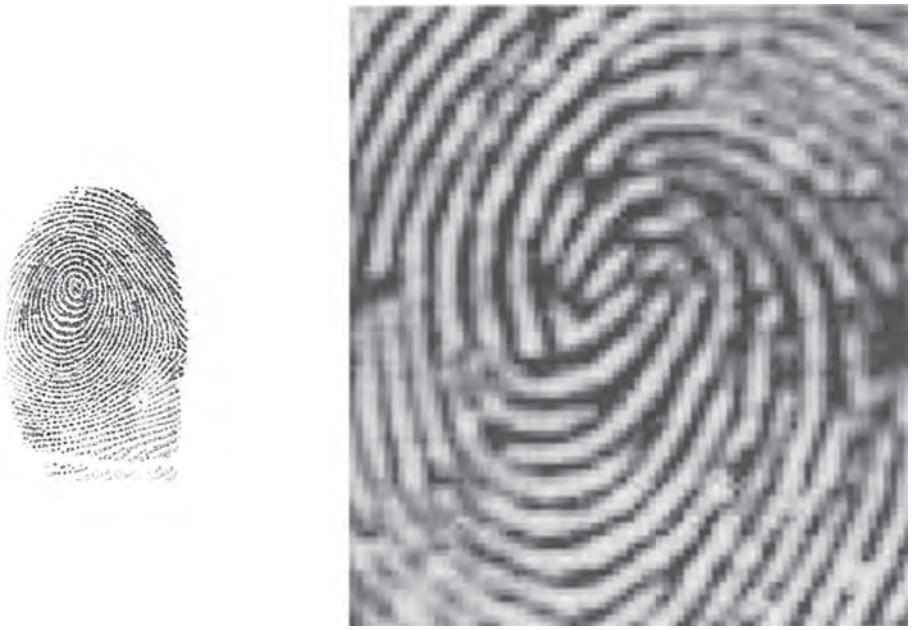

FIGURE 2.2
Example of a pixelated image.

INTERNATIONAL STANDARDS ORGANIZATION/ AMERICAN STANDARDS ASSOCIATION

International Standards Organization (ISO)/American Standards Association (ASA) refers to the film speed of the camera. In 35-mm film photography, silver halide film of a fine grain meant the film required some time to gather light to form an image. As the size of the film grain was increased, the light-gathering ability of the film increased as well. The speed by which film could gather light was gauged as an ISO/ASA number. As the ISO of film used increased from 100–800 ASA, the film became more sensitive to light, quickening exposures in low-light conditions. However, as the grain size of photographic film increased, there was also a reduction in resolution, such that photographs could appear "grainy" and slightly blurred.

The sensitivity of a digital camera sensor to light is also measured in ISO, where ISO is the effective film speed of the camera. As the ISO of the digital camera increases, the sensor's light-gathering ability also increases. Most digital cameras will have an ISO range of 100–6400; however, high-end cameras can boost their light-gathering ability to the 51,000-ISO range, making these cameras very useful in low-light conditions. As with film, there are limitations to usable ISO. As the sensitivity of the camera sensor increases, the sensor may produce ISO noise, which may appear as "off-color" pixels in an image. This phenomenon may be referred to as *chroma noise*. High ISO noise—like grainy, high-ISO film—can affect the resolution of a photograph. In general, low ISO settings correspond to higher quality better resolved images, but they require longer shutter speeds. High ISO settings can be used to achieve faster exposure times, but they are associated with grainy, poorly resolved images.

A persistent problem with digital imaging is color balance. The white balance setting for a camera adjusts the color of an exposure for a given type of illumination. If the white balance settings and illumination source are matched incorrectly, color shifts occur that result in off-color photographs. The camera must be balanced for the type of illumination used. For example, sunlight and electronic flashes are balanced for "daylight" settings whereas floodlights and tungsten filament lamps are balanced for tungsten lighting. It is important that the correct setting be used with the available lighting so the color of the photographic subject is represented properly (Figure 2.3).

The image sensors used currently in digital cameras have very little color–temperature latitude. Most CCD or CMOS chips are balanced automatically for direct sunlight and electronic flash, and do not do well with other light sources. Therefore, any digital photograph taken with illumination other than sunlight or electronic flash may appear with less detail, low contrast, and incorrect color balance. However, most cameras can be set to the various types of lighting that might be encountered. With this in mind, one can say there are many digital

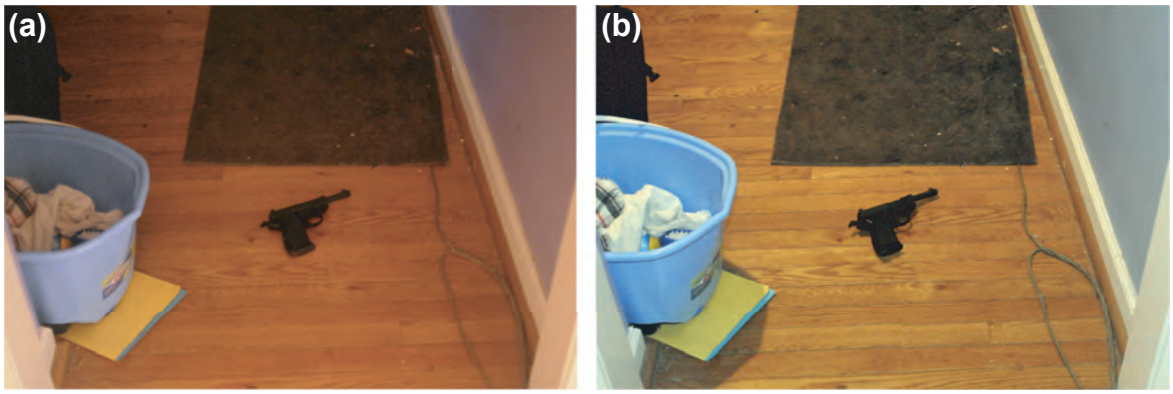

FIGURE 2.3
Example of white balance. (a) Photo taken without white balance correction. (b) Photo taken with white balance correction.

cameras available that are of use to law enforcement, given the many lighting situations that may be encountered.

Digital cameras are designed for applications in which viewing a picture on a television monitor or transmitting images via the Internet is convenient or desirable. This fits with the needs of law enforcement. However, one must keep in mind that picture quality varies in models and price category. Digital photographs also have the advantage of being printed easily in seconds. This, too, is an advantage for law enforcement. And, because the filing and storage of records is of concern to police departments, the ability to store photographs in a computer, or on digital media, adds another important advantage. In most police departments, mug shots, accident photographs, photographs of fingerprints, crime scene photographs, and other images are currently stored on computer media. Regular film negatives (or prints) in older, archived records may now be scanned using a film scanner, and they are digitized for storage or Internet transmission.

DIGITAL SINGLE-LENS REFLEX

The single-lens reflex (SLR) camera allows photographers to view a subject through the main lens of the camera. The image seen through the viewfinder window is a replica image; when using a standard lens, the image is similar in size and appearance to the scene in front of the unaided eye. The optical system for viewing the image is comprised of (1) the main lens, (2) a mirror for diverting light away from the film (or sensor), (3) a prism for reversing and inverting the image as reflected (upside down and reversed) from the mirror, (4) a focusing screen, and (5) a viewfinder. Thus, a change in lenses causes an automatic change in the optical system; no compensation by the photographer

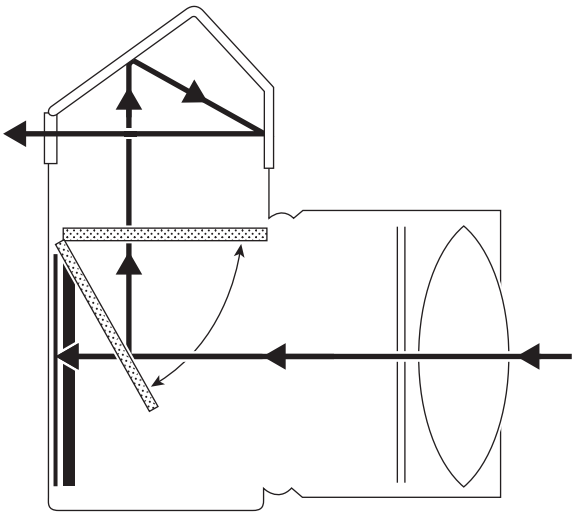

FIGURE 2.4
Cross-section of single-lens reflex optical system.

is necessary. Also, parallax (the difference between the image in the camera viewer and the image recorded by the camera sensor) is eliminated because there is only one point from which to view.

The mirror is mounted on a hinge and flips up and down automatically before and after the shutter opens and closes, blocking out the viewfinder only at the instant of the exposure. The majority of standard, wide-angle, and moderately long-focus lenses are fitted with an automatic iris control so the lens is always wide open for focusing and viewing, but the lens closes down to the pre-selected shooting aperture when the shutter is released.

The digital single-lens reflex (DSLR) camera operates in the same way. Instead of film, a digital sensor sits in place behind the mirror. The photographer has the option of looking through the eyepiece to compose the shot or through a light-emitting diode screen (Figure 2.4).

With the introduction of digital photography during the mid 1980s, many believed it would eventually replace photography as we know it. Although it is true that digital cameras have replaced film and traditional cameras, the basic function of photography has not changed. As mentioned earlier, after Sony introduced its Mavica digital camera in 1982, a number of leading camera and electronic companies began producing digital cameras and computer software designed especially for computer imaging. Most digital cameras produced during the 1990s were designed for amateur consumer use and resembled the 35-mm point-and-shoot cameras. Casio, Canon, Nikon, Kodak, Epson, Minolta, and others produced a large line of point-and-shoot-type digital