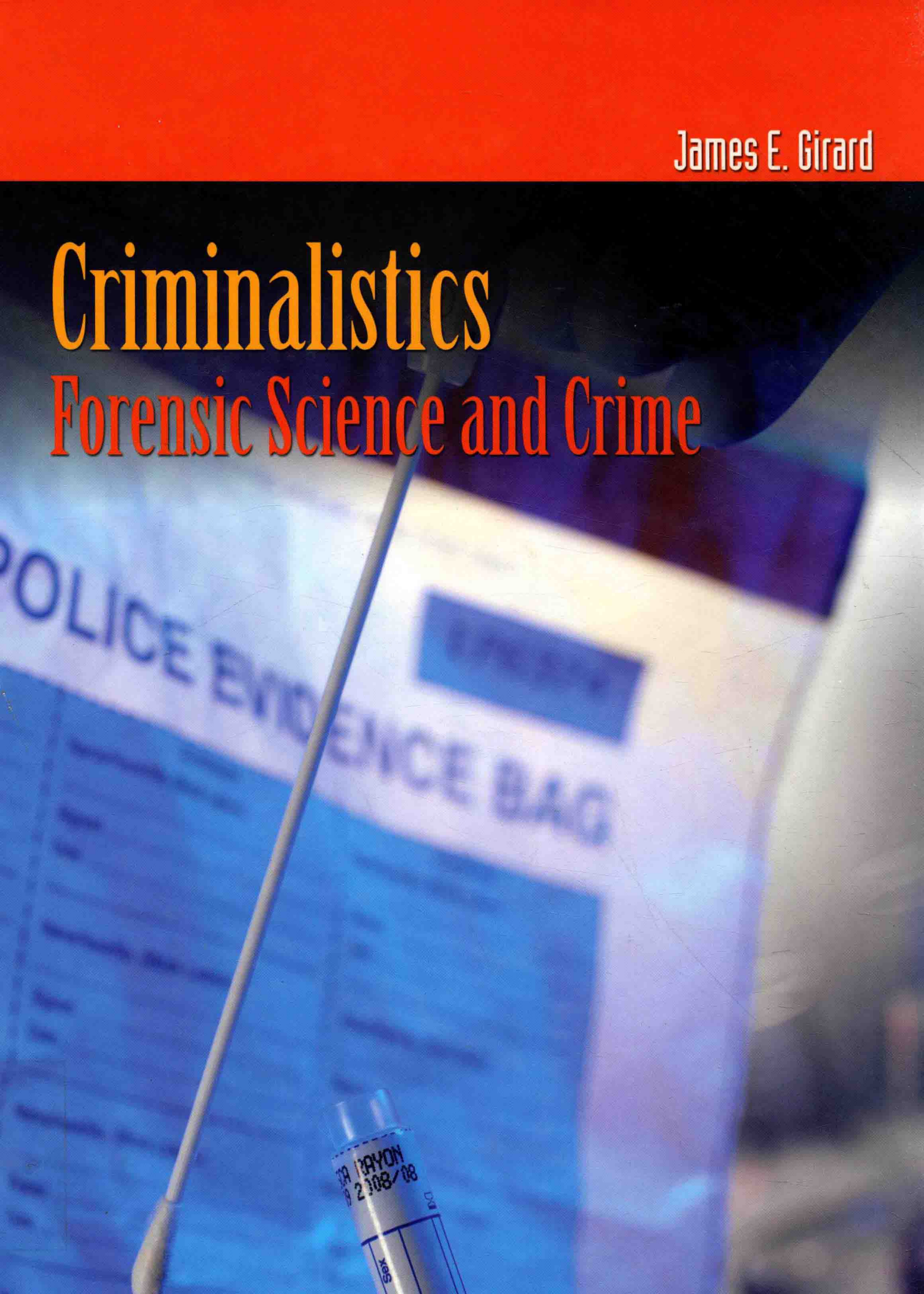


James E. Girard

Criminalistics

Forensic Science and Crime



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RESOURCE PREVIEW

Chapter Objectives: Concise learning objectives provide a preview of key chapter concepts, and serve as a useful guide for reviewing chapter material.

Investigating the Crime Scene

OBJECTIVES

In this chapter you should gain an understanding of:

- The steps taken to preserve a crime scene
- Documentation of the crime scene
- Ways to systematically search the crime scene
- Methods for collecting, preserving, identifying, packaging, and transporting evidence
- The chain of custody
- The Fourth Amendment and its application to the search and seizure of evidence

CHAPTER

1

FEATURES

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YOU ARE THE FORENSIC SCIENTIST

Soil provides useful evidence because it is either **stable** or **fragile**. A "stable" object is easily crushed and made into a powder. Whether sticky or flakey, however, soil is rarely transformed as trace evidence from the crime scene onto objects and people present at the scene. This trace evidence may then be transferred again by secondary transfer onto carpets or into vehicles.

Soil also has properties similar to those of glass, plastic, objects such as Play-Dough, in particular, it can retain an impression that has been pressed into it. This property is especially useful in providing evidence of association. For example, a worn boot might leave an impression at the crime scene, and the boot later be found to be owned by the suspect.

1. A suspect in a burglary is found to be wearing brand-new size 12 Wolverine boots. Outside the broken window, in the garden of the home that was robbed, is a boot impression that matches that made by a size 12 Wolverine boot. Does the evidence prove that this suspect was the burglar?
2. The burglar knuckled over a flowerpot in the home, which fell to the ground and broke. A soil sample found in the suspect's car contains the same vermiculite material (a common component of potting soil) that was found in the soil of the flowerpot. Is this class or individual evidence?

Introduction

When common objects are found at crime scenes, forensic laboratories first examine those items in an attempt to identify properties that may serve to place the object within a particular class. The search for distinguishing properties then continues, as the forensic scientist tries to discover additional characteristics that will allow the object to be individualized. This chapter describes the properties that are most useful for characterizing soil, glass, fibers, and other physical evidence. It also discusses how to collect evidence and measure its distinguishing properties.

Physical and Chemical Properties

The distinguishing characteristics that are used to identify different objects are called properties. A person can easily recognize his or her own car among hundreds of other cars in a parking lot by characteristics such as make, model, color, dents in the body, and belongings left on the back seat. In much the same way, we can recognize different substances by their characteristics or properties. Properties of substances can be grouped into two main categories: physical and chemical.

The **physical properties** of a substance are those properties that can be observed and recorded

without referring to any other substance. Color, odor, taste, hardness, density, solubility, melting point (the temperature at which a substance melts), and boiling point (the temperature at which a substance boils or evaporates) are all physical properties. For example, if you were to describe the physical properties of pure copper, you might report that it is a bright, shiny metal, is malleable (can be beaten into thin sheets) and ductile (can be drawn into fine wires), and melts at 1083°C (1981°F) and boils at 2562°C (4653°F). No matter what its source, pure copper always has the same properties. These **inherent physical properties** are independent of amount of substance measured and depend only on the identity of the substance. For example, when substances melt (e.g., when ice turns into water), heat is applied to change it from a solid to a liquid, but this change in state does not change the composition of the substance. This appearance of the substance may change but there is no change in composition. By contrast, **chemical properties**—such as mass, volume, and length—depend on the amount of substance present.

The chemical composition of a substance are those properties that can be observed when the substance reacts or combines with another substance to change its chemical composition. For example, when gasoline burns, it undergoes a chemical change: it combines with oxygen in the air to form carbon dioxide and water. Likewise, copper turns

EXAMPLE The fingerprint pattern for an individual is recorded as LMALMMLA, where "L" means loop, "M" means whorl, and "A" means arch. The series begins with finger 1 (the right thumb) and ends with finger 10 (the left little finger). What would be the primary classification ratio for this print?

Pattern	L	M	A	L	M	A	L	M	L	A
Finger Number	10	9	8	7	6	5	4	3	2	1
Whorl Value	2	3	2	2	4	1	1	1	1	1
Finger Value	0	0	2	0	0	0	0	18	0	0

Primary classification ratio

= $\frac{L}{L+M+A}$

= $\frac{1}{1+1+1}$

= $\frac{1}{3}$ (10-18)

This individual belongs to the 10-18 primary group.

overhaul the AFIS in the 1990s. In 1999, the FBI released the most recent version of this system, the Integrated AFIS.

Most modern AFIS systems compare fingerprint minutiae (i.e., identification points). Typically, human and computer investigators concentrate on points where forensic ridge lines end or where one ridge splits into two (bifurcations). Collectively, these distinctive features are sometimes called **minutiae**.

The scanner software used to record data about the subject fingerprint uses highly complex algorithms to recognize, analyze, and map the positions of the minutiae. Note that just having the same minutiae is not enough to conclude that two fingerprints match—the individual minutiae must also be located at the same place on each print. Although AFIS points out possible matches to the examiner, the examiner is responsible for performing a visual analysis and confirming that AFIS matched the same bifurcation at each location.

To determine a match, the scanner system must find a sufficient number of minutiae patterns that the two prints share in common. The exact number needed for a positive identification depends on the country in which the crime was committed. In the Netherlands, for example, 12 characteristic minutiae points are required by law for a match. In South Africa, 7 points will make a match. In the United States and the United Kingdom, there is no set number warning declaration of a match; the expert fingerprint examiner decides how many are needed to make a decision.

Fingerprints for Biometric Identification

The use of fingerprints to solve crimes involves the process of identification—namely, who left the fingerprint behind? In the case of a burglary, was it the homeowner, a neighbor who visited the home

You are the Forensic Scientist: Realistic case studies and accompanying discussion questions challenge readers to think like a practicing forensic scientist.

Back at the Crime Lab: Summary of scientific principles and procedures.

Let's Get Real: A look into popular culture and the (mis)representation of forensic science.



LET'S GET REAL

As forensic science becomes more popular in mainstream media, the "CSI effect"—the influence of crime drama shows on the general populace—has spread into the courtroom, affecting jury deliberations. "Even statements by defendants themselves have failed to persuade some jurors" (A. P. Thomas, *Yale Law Review*, February 1, 2006).

In *State v. James Galloway*, Arizona Department of Corrections officers found a syringe in a cell with a note signed by "Jimbo" attached to it. Inmate "Jimbo" was found with a fresh mark on his arm consistent with syringe use and admitted the syringe was his when he retrieved it from prison officials and signed the receipt. After the trial, members of the jury

criticized the prosecution because investigators had not performed DNA or fingerprint analysis on the syringe. They also wanted a handwriting comparison on both the note and the receipt signed by "Jimbo."

Behind the Scenes

There are both positive and negative sides to the "CSI effect." On the positive side, jurors are often more comfortable with forensic evidence and techniques and therefore more amenable to instruction in specific scientific processes by expert witnesses. On the negative side, jurors can be unrealistically demanding of the evidence, expecting every case to hinge on conclusive forensic evidence.



FIGURE 6.1 A forged passport confiscated in Thailand.

to verify that a person is who he says he is. As discussed in Chapter 6, **biometrics** uses methods to recognize a person that are based on one or more of the individual's intrinsic physical or behavioral traits. A variety of biometric technologies that measure and analyze physical characteristics are being developed, including fingerprint, eye (retina and iris), facial pattern, and hand geometry scanners. Technologies that measure mostly behavioral characteristics, such as signature dynamics and walking gait, are considered to be less accurate. Voice recognition is also considered less accurate than other biometrics-based approaches, because a person's speech is considered to be a mix of both physical and behavioral characteristics.

US-VISIT

The U.S. Visitor and Immigrant Status Indicator Technology (US-VISIT) program was introduced in July 2003. This program, which is part of the U.S. Department of Homeland Security, is currently being used at numerous air, sea, and land ports with international arrivals and at border crossings to verify the identity of all visitors who seek to enter the United States, regardless of their country of origin or whether they are traveling on a visa (FIGURE 6.2). The visitor's identity is confirmed by his or her passport and by US-VISIT's biometric procedures—digital, inkless finger scans of the index fingers, and a digital facial photograph—upon entry into the United States. Biometric identifiers should also protect visitors to the United States because they should make it virtually impossible for anyone else to claim

Eventually all U.S. passports will include a **radio frequency identification (RFID)** chip containing a duplicate of the information printed on the passport's physical pages, which the U.S. government hopes will strengthen national security. The RFID passport is activated when an electronic reader sends a signal on a designated frequency. The chip channels that radio energy and responds by sending back the passport holder's name, address, date and place of birth, and digital photograph.

Use of Biometrics for Identity Authentication

In the future, authentication of identity will likely use biometrics in addition to identity documents

CHAPTER 7 Questioned Documents 175

On the Crime Scene: High profile cases or issues are highlighted relating to relevant theories.

Trace Evidence

Trace evidence includes items that are extremely small—even microscopic. These items are collected in a variety of ways, including with a forceps, tweezers, or gloved hand by scraping (e.g., the undersides of fingernails for blood and tissue evidence), taping (for lifting fingerprints), or vacuuming (for collection of hair and fibers). If necessary, the entire item containing the evidence, such as clothing or cars, can be collected and analyzed later.

When collecting trace evidence, the forensic technician must document and collect not only questioned samples but also known samples. For instance, if a victim is found to have soil on his clothing, it should be sampled. At the same time, it is essential to take several known soil samples from various areas of the scene. Also, hair and fiber samples from victims and suspects must be taken for later comparison with questioned hairs and fibers that may have been retrieved via vacuuming of the scene.

FIGURE 4.1 Hair and fiber samples are explored in greater detail in Chapter 4.

To ensure the best outcome, the ME or coroner and investigators must work cooperatively to collect evidence. If a crime victim undergoes autopsy, for example, the ME will automatically collect organ and tissue samples for pathological and forensic analysis to establish the cause of death. In addition, blood samples will be taken for toxicological analysis.

FIGURE 13.1 Chapter 13 presents information about methods for collecting blood samples, and Chapter 12 addresses the problems for toxicological analysis.

The ME will routinely collect samples of the following items from the victim's body:

- Clothing
- Bullets (in case of a shooting victim)
- Hand swabs (to look for gunshot residue in case of a shooting victim)
- Fingernail scrapings
- Head and pubic hairs
- Blood
- Vaginal, anal, and oral swabs (in case of a sex crime)



People of California v. O. J. Simpson

In the early summer of 1994, Nicole Brown Simpson (ex-wife of former football star O. J. Simpson) and her friend Ronald Goldman were stabbed to death, their bodies found in the front courtyard of Nicole's home. Because of a history of violence between O. J. Simpson and his ex-wife, O. J. was an obvious suspect.

At the crime scene, a great deal of blood was found on the ground. To the investigators, the multiple serious cuts made to the victims with a knife suggested that this was a personal and emotional crime. Detectives left footprints in the blood, did not follow proper protocol in collecting blood samples, and then drove around town on a hot day with the samples in their vehicle. Investigators entered O. J. Simpson's home without a warrant and moved evidence before photographing and documenting it properly.

While none of these events was significant enough to compromise the evidence, collectively they suggested to jurors a lack of attention to detail, laziness, and perhaps intentional tampering on the part of investigators. Although other mistakes were made during the trial, the errors associated with collection and preservation of the evidence were enough to convince a jury that there was reasonable doubt about O. J.'s involvement in the crime.

Even though the DNA of O. J. Simpson was found at the crime scene and records showed that he had purchased a knife consistent with the wounds inflicted on Nicole, the errors made during evidence collection were too great for jurors to overcome. This case serves as an important reminder to investigators that how a crime scene is approached is critical to finding the truth, and how the scene is handled affects the way evidence will be presented to a jury.

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See You in Court: Relevant court cases explain how forensics played a role in the verdict.

Links: Connects the current topic to related subjects in other chapters.



SEE YOU IN COURT

For firearm testimony to be accepted in court, there must be an absolute match between the marks being compared. Marks may include firing-pin marks on the bullets, muzzle marks on the bullets, and marks produced via in-laboratory caliber tests. Repeated use of a weapon can degrade the metal of the muzzle and cause slight variations in the marks left on either the shell casing or the actual bullet. In many cases, the recovered bullet is so damaged that only a partial match can be made.

Marks on shells cannot be matched easily. If at all, to smooth-bore weapons such as shotguns or muskets because the muzzles of these firearms do not leave identifying marks on the shell. Even without marks, however, it is often possible to get a ballistic match from a shotgun. A metallurgical comparison between a shot recovered from a body or other target and a shot recovered in association with the suspect's property may be acceptable, for example.

where m is mass and v is velocity. As the caliber of the weapon increases, so does the kinetic energy of the bullet fired from the gun. The larger the caliber, the wider the bore of the barrel, and the larger the bullet needed to fill that bore. The larger the caliber, the greater the mass of the projectile.

Another way that modern weapons increase the kinetic energy of the projectile is by increasing its velocity. Modern gunpowder, which produces much more force than black gunpowder, also increases the velocity of the projectile. Given that kinetic energy increases as a square of velocity, increases in velocity generally produce much larger increases in kinetic energy.

Improving the Rate of Firing and Firing Reliability

The flintlock rifle, which was first developed in the early 1600s, used a spark to ignite the gunpowder that was loaded in the barrel of the gun (FIGURE 8.1). To create this spark, the flintlock used flint (a hard rock) and steel. When flint strikes iron (which is present in steel), the force of the blow creates tiny particles of red hot iron. If these hot sparks come near gunpowder, they will ignite.

The flintlock was a single-shot rifle—that is, it needed to be reloaded after each shot. To load the gun, first the hammer was half-cocked and a measure of gunpowder was poured down the barrel. Next a lead ball (the bullet) and a small piece of cloth or paper were rammed down the barrel on top of the gunpowder so that the bullet-cloth plug would fit tightly against the lands and grooves



FIGURE 8.1 Flintlock rifles suffered from two major disadvantages: They could fire only a single shot and they were unreliable (especially in the rain).

of the rifle barrel. A small amount of gunpowder was then placed in the flintlock's pan, which was located next to a hole in the barrel that leads to the gunpowder inside. The hammer, the jaws of which held the flint, was cocked. When the trigger was pulled, the flint struck the iron and created sparks. The pan's gunpowder ignited, and it flashed through a small hole in the side of the barrel to ignite the gunpowder inside the barrel, causing the gun to fire.

The flintlock rifle had two serious shortcomings. First, its firing mechanism was temperamental and difficult to fire in the rain (no spark was possible with damp powder). Second, its rate of firing was slow, because it took even an experienced marksman precious time to reload. Advances in firearms technology eventually addressed both of these deficiencies—namely, the development of

CHAPTER 8 Firearms 189

Biological evidence is most susceptible to change. A bloodstain found on the wall of a crime scene shortly after a shooting will be initially wet and red. As it is exposed to air, it will clot and dry and eventually turn brown. If the crime scene is outside, blood may also be exposed to direct sunlight, which can change it from a red drop to a black dry spot in a relatively short period of time. In addition, rain can quickly wash it away.

Other physical evidence may also undergo changes due to time and physical influences. For example, a bullet may pass through a body of a suspect, picking up blood that would later be used to identify this person. But if the bullet then smashes through a wall, where the blood is scraped off its surface, its shape will likely be altered. The blood evidence on the bullet is scattered as it passes through the wall and might even be totally lost.

Likewise, part of a torn document left at a crime scene may be altered by exposure to the sun or water. The rays of the sun might bleach out the color, and water might change its texture. If a forensic scientist was trying to match the exposed piece to an unexposed piece of the same document, the two pieces might appear to be quite different.

Objects of evidence whose appearance changes with time can test the wits of crime scene investigators. These changes in appearance also challenge the forensic scientist, who must try to compare the evidence from the crime scene to a reference material, known as an **exemplar**. The forensic scientist must be able to show that the evidence (questioned sample) and the known sample (exemplar) have a common source. This leads the forensic scientist to use one of the most basic tenets of forensic science: **explainable differences**. That is, to show a common source for the two samples, the forensic expert must have a sound scientific explanation for any differences between the evidence (questioned sample) and the reference material (exemplar).

WORD TO THE WISE

"Blood spatter" should not be confused with "blood splatter." Splatter means to scatter (a liquid is dropped or small splashes); spatter means to splatter (a liquid is hit or splashed). Splatter patterns are spatter patterns in hit or splashed, testing, or testimony. There could be issues of admissibility of the statements because spatter patterns are not solid evidence.

38 SECTION 1 Introduction to Criminalistics

Why Examine Physical Evidence?

A forensic scientist examines physical evidence for one of two purposes: identification or comparison. Identification is the process of elucidating the physical or chemical identity of a substance with as much certainty as possible. Comparison is the process of subjecting both the evidence (questioned sample) and the reference material (exemplar) to the same tests to prove whether they share a common origin.

The comparison of evidence to reference material is an aspect of forensic science that differentiates it from all other applications of science. An object becomes evidence only when it contributes information to the case; otherwise, it is excluded from consideration. A bloodstain on the jeans of a homicide victim, for example, might appear to be an important piece of evidence until it is determined that the stain came from the victim. We already know the victim was present at the crime scene, so such a stain cannot be used to identify the perpetrator. Nevertheless, the location of the stain might provide valuable clues about the manner in which the victim was assaulted.

Characteristics of Physical Evidence

Identification

When a forensic scientist attempts to identify an object, he or she takes measurements that describe the physical and chemical properties of that object with as near-absolute certainty as scientific techniques will allow. For example, the crime laboratory might use chemical tests to determine if a white powder found at a crime scene is an illicit drug, such as cocaine or heroin, or the residue from bomb making, such as TNT. In cases involving biological material such as blood, semen, and saliva, the crime lab might use molecular biological tests to determine the identity of the sample.

Many forensic analyses involve comparison of the questioned sample to some standard sample. A test is considered valid if it is reproducible, sensitive, and specific. To be reproducible, the test's analysis of the standard sample must always yield the same, correct results. To be sensitive, it must be able to accurately identify the unique characteristics



Serial Murderer Everett Bell Identified by "Nubs"

On August 22, 1995, the body of eight-year-old Sandra was discovered by police in a wooded area near her church in southern Michigan. The child had been brutally assaulted before she died of strangulation. Her bicycle was found near her partially hidden body. Police combed off the wooded area and the adjacent church parking lot to perform a detailed search of the area. Fingerprints were taken from the victim's body and from the bicycle.

The crime scene investigator, canvassing the neighborhood around the church, they found that Everett Bell, a local resident and an employee of a Hardee's restaurant, was seen in the area around nightfall riding his bicycle. Bell's employee revealed that Bell had been sent home early from work that day. The Hardee's manager gave police Bell's work pants, shirt, and cap.

The FBI laboratories found blue cotton fibers under Sandra's fingernails. When they were examined under a microscope, it was clear that these fibers matched the blue cotton fibers from the suspect's shirt. Blue and green fibers found on Sandra's clothes also matched those from the shirt. In addition, a dark blue-gray polyester fiber matching the fibers of the suspect's pants matched fibers found on the victim's body. Of particular interest, the sample from the victim contained "nubs"—the end of the fiber was melted during manufacture into bulbs that are called nubs. The nubs that were lifted with tape from Bell's shirt matched the nubs lifted from the surface of the victim's shirt.

Hardee's employees were given particular shirts manufactured by WestPoint Stevens Atlanta Knits. Bell's shirt was a short-sleeved polo shirt that Hardee's had recently replaced with a striped shirt. Therefore, few of the solid shirts were still being worn by employees. Tape applied to the surface of Bell's shirt removed a significant number of the nubs that proved to be identical to nubs found on the victim's clothes, establishing a physical contact between the victim and the suspect.

Bell later confessed to Sandra's murder as well as to five rapes and at least nine other murders.

densities, an abrupt change in direction—that is, **refraction**—of the beam is observed as a consequence of the difference in the velocity of the light in the two media.

The phenomenon of refraction is commonly observed with an object that is immersed in a glass of water. For example, when a glass of water con-

tains a straw (Figure 4-1), refraction makes it appear that the straw is broken at the surface of the water. As the rays of light leave the water and enter the air, their velocity increases, causing them to be refracted. How much light bends (and thus the focal length) depends on the change in the **refractive index** (n) as the light enters and leaves the

Criminalist's Notebook

- ❑ The process of collecting and processing fiber evidence is akin to "looking for a needle in a haystack."
- ❑ Fiber evidence can corroborate evidence or identify someone unique to the fibers. The fiber evidence must always be presented in the context of other evidence, witness testimony, or suspect confession, however.
- ❑ Microscopy can help you narrow down potential sources for the fiber and assist you in selecting chemical tests to match the evidence to a particular manufacturer or source.
- ❑ When working with a microscope, make sure that you look through the ocular for only a maximum of 20 minutes before taking a short break.

CHAPTER 4 The Microscope and Forensic Identification of Hair and Fibers 41

Criminalist's Notebook: Important precautions and guidelines.

Word to the Wise: Helpful tip boxes that highlight important ideas.

Wrap Up: Each chapter concludes with answers to the case study, a chapter summary, key terms, review questions, review problems, and suggestions for further reading specific to the chapter's subject matter.

WRAP UP

YOU ARE THE FORENSIC SCIENTIST SUMMARY

- The investigators should search carefully for the weapon. When they find it, the investigators should have a firearms expert inspect and disarm the weapon. The location of the firearm should be recorded by both notebook sketch and photography. Examination of the weapon should include identification of the type of firearm, cartridges present, manufacturer, serial number, caliber, and any modifications that may have been made to it.
- Examination of the weapon will determine the amount of pressure it takes to discharge. This examination will determine whether the weapon had a "hair trigger." Next, the suspect's hand and clothes should be carefully examined for GSR. The location of GSR on his clothes may substantiate his claim.

Chapter Spotlight

- Structural irregularities in bullets result from scratches, nicks, breaks, and wear in a gun's barrel and can be used to match a bullet to a gun.
- The manufacturing of a gun barrel leaves characteristic grooves inside it. No two barrels will be identical, even if the guns are manufactured in succession.
- The comparison microscope is the most important tool for examining firearm evidence. It allows two bullets or cartridge cases to be observed side by side.
- Like bullets, cartridge cases are uniquely marked by the source gun when the firing pin, breechblock, and ejector and extractor leave their markings on the cartridge.
- GSR particles and other discharge residues around a bullet hole can be used to assess the distance from which the gun was fired.
- Restoration of a serial number that has been ground away is possible through chemical etching.
- The IBIS has emerged as the standard for examining projectiles and cartridge cases. It allows the local forensic firearm examiner to send an image of the bullet or cartridge case to the IBIS computer, which compares the suspect image with images in the IBIS database and ranks any matches it finds.

Key Terms

Acid etching method: A method in which strong acid is applied to a firearm to reveal the serial number.

Black powder: The oldest gunpowder, which was composed of a mixture of potassium nitrate (saltpeter), charcoal, and sulfur.

Bore: The interior of a gun barrel.

Breechblock: The metal block at the back end of a gun barrel.

Brush cutter: A tool that is pushed through the gun barrel to form the rifling.

Caliber: The diameter of the bore of a firearm (other than a shotgun). Caliber is usually ex-

pressed in hundredths of an inch (.38 caliber) or in millimeters (9 mm).

Cartridge: Ammunition enclosed in a cylindrical casing containing an explosive charge and a bullet, which is fired from a rifle or handgun.

Choke: A device placed on the end of a shotgun barrel to change the dispersion of pellets.

Ejector: The mechanism in a semiautomatic weapon that ejects the spent cartridge from the gun after firing.

External ballistics: A description of the events that occur after the bullet leaves the barrel of the gun but before it strikes its target.

Extractor: The device that extracts the spent cartridge from the gun's chamber.

Gauge: The unit used to designate size of a shotgun barrel. The interior diameter of a shotgun barrel is determined by the number of lead balls that fit exactly in the barrel (the equivalent to 1 lb).

For example, a 16-gauge shotgun would have a bore diameter of a lead ball that is 1/16 lb in weight.

Grooves: The cutmost section of a rifled barrel.

Internal ballistics: A description of the events that transpire within the firearm.

Lands: The raised section of a rifled barrel.

Magnifying method: A method of restoring a gun's serial number.

Nitrocellulose: A cotton-like material produced when cellulose is treated with sulfuric acid and nitric acid; also known as "gun cotton."

Nitrocellulose is used in the manufacture of explosives.

Nitroglycerin: An explosive chemical compound obtained by reacting glycerol with nitric acid.

Nitroglycerin is used in the manufacture of gunpowder and dynamite.

Primer: An igniter that is used to initiate the burning of gunpowder.

Rifling: The spiral grooves on the inside surface of a gun barrel that make the bullet spin.

Semiautomatic pistol: A firearm that fires and reloads itself.

Smokeless powder: An explosive charge composed of nitrocellulose or nitrocellulose and nitroglycerin (double-base powders).

Striations: Fine scratches left on bullets, formed from contact of the bullet with imperfections inside the gun barrel.

Terminal ballistics: A description of what happens when the bullet strikes its target.

Wad: A plastic, cardboard, or fiber disk that is placed between the powder and the shot in a shotgun shell.

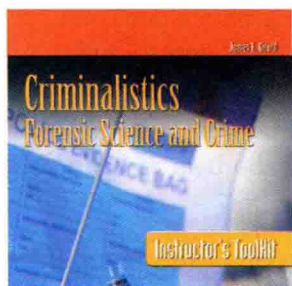
Putting It All Together

Fill in the Blank

- The accuracy of a firearm can be greatly improved by making the barrel _____ (longer/shorter).
- The spiral grooves in a gun barrel are referred to as _____.
- The rifling on the interior of a gun barrel has spiral grooves and _____.
- The diameter of a gun barrel, as measured from a land on the left to one on the right, is known as the _____ of a weapon.
- A brush cutter is used to cut the _____ in the interior of the gun barrel.
- The lands and grooves in a gun barrel are _____ (class/individual) characteristics.
- Besides grooves, the brush cutter produces fine lines called _____.
- As bullets emerge from the gun barrel, they rotate, a phenomenon that is called _____.
- The kinetic energy of a bullet _____ (increases/decreases) as the caliber of the weapon increases.
- The diameter of a shotgun barrel is expressed as a(n) _____.
- The higher the shotgun gauge, the _____ (larger/smaller) the diameter of the barrel.
- A sawed-off shotgun is one that has a barrel length less than _____ inches.
- In the past, lead was used to make bullets because it has a high _____ and it is _____.
- Lead's low _____ makes it soften at higher velocities.
- The element _____ is added to lead to raise its melting point.
- The jacket of a cartridge is made from _____ or _____.
- Black powder is a mixture of _____, _____, and _____.

RESOURCES

Instructor Resources



Instructor's Toolkit CD-ROM

ISBN-13: 978-0-7637-5496-9

ISBN-10: 0-7637-5496-X

Preparing for class is easy with the resources found on this CD-ROM, including:

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Technology Resources

Essential components to the teaching and learning system are interactivities and additional resources that help the students grasp key concepts in criminology.

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Make full use of today's teaching and learning technology with:

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Some of the resources available include:

- Interactivities
- Key Term Explorer
- Web Links
- Answers to Review Problems

PREFACE

The criminal justice system has learned to rely heavily on the analysis of physical evidence as scientific procedures and methods have become increasingly more reliable and telling than eyewitness testimony. The influence of television programs showing the use of highly sophisticated analytical equipment to solve crimes has caused juries to come to expect complex scientific evidence to be presented in all criminal cases.

Greater stress is now placed on investigators to handle physical evidence in an appropriate scientific manner for later presentation in court. The introduction of DNA typing and database matching have revolutionized how physical evidence from the crime scene is processed. Forensic investigators must possess both a sound understanding of the scientific principles that underlie the measurements they make and a keen knowledge of how to locate physical evidence without disrupting any trace elements at the scene.

In many ways, the attacks of September 11, 2001 expanded the role of criminalistics from traditional examination of crime scene and physical evidence to assisting Homeland Security in deterring terrorism. Threats of terrorism coming from both within and outside of our borders widen the scope of those working in the criminal justice system. I have included sections of this book that speak directly to these issues because of the changed nature and role of criminalistics.

New laws passed since 9/11 have placed a precarious balance between the rights and freedoms of individuals and the protection of society as a whole. This tension is evident when we are asked by politicians how much personal freedom we are willing to sacrifice in the name of national security. We now stand in long lines to pass through extensive security monitoring to board airplanes. We are limited in what we can carry with us on these flights. We face the potential of having our telephone conversations recorded. We can even be questioned about the material we check out of public and academic libraries. While these issues are of great importance to the individual, they are of even greater importance to understand for those working in the criminal justice field.

There are no easy answers to these issues, but it is the goal of this textbook to present information to students to help them understand how forensic measurements are made and to find a balance that protects the individual and benefits society as a whole.

Organization

The organization and approach of this text differ in several ways from other criminalistics books intended solely for criminal justice students. It places forensic science within the framework of the basic principles of chemistry, biology, and physics and assumes the reader has little or no scientific background.

The first two chapters introduce the student to the crime scene and physical evidence. In chapter 1, we learn first to secure and document the crime scene. Next, to collect, preserve, package, inventory, and then submit evidence to the crime lab. In chapter 2, common types of physical evidence are described, and basic scientific principles familiarize students with crime scene reconstruction. This early description of the many types of physical evidence found at crime scenes not only establishes the importance of a careful methodical approach to the crime scene but also gives students a firm foundation for how this evidence will be used to reconstruct the events that transpired during the commission of the crime.

Chapters 3 through 5 offer a solid introduction to the core physical properties that are normally used to examine trace evidence. Chapter 3 shows how the physical properties can be used to characterize evidence. Chapter 4 describes the many types of microscopes used to examine fiber and hair evidence. Chapter 5 describes optical physical properties, such as color and refractive index, and describes how they can be used to characterize glass evidence. Wherever possible in these chapters, physical properties are discussed in the context of characterizing physical evidence, building a bridge to understanding how patterns and chemical and biological properties

will be used to characterize evidence in the chapters that follow.

Next, students are introduced to pattern evidence. Chapter 6 covers fingerprints—their classification and methods used to visualize latent fingerprints. The focus of chapter 7 turns to questioned documents, with discussion of handwriting, typed and word processed documents, ink, indented writing, and security printing. Chapter 8 is devoted to firearms and describes handguns, rifles, shotguns, and submachine guns. Techniques used to compare fired bullets and shell casings are described as methods for the restoration of serial numbers.

We then focus on chemical evidence. Chapter 9, which introduces readers to the periodic table and inorganic chemistry, provides a useful introduction to the examination of bullets and gunshot residue. In addition, it provides a foundation for more advanced chemical principles that will be presented in later chapters. Chapter 10 describes the chemistry of fire and introduces organic chemistry to the student through a discussion of hydrocarbon accelerants that are used by arsonists. In Chapter 11, drugs of abuse are arranged by category and the techniques used to detect them in bulk or personal samples are described.

Chapters 12 through 14 deal with biological evidence. Chapter 12 describes how toxicological measurements are made. Even if the measurements are made after the person has died, they can often be used to reconstruct events that transpired days before. Biological fluids, such as blood, semen, and saliva are the focus of chapter 13. Techniques used to locate and characterize biological evidence are presented along with an introduction to DNA. Chapter 14 presents the

separation and characterization of short tandem repeats (STRs) by capillary electrophoresis and how this information is used to establish paternity and match offender profiles.

The final section of the text focuses on terrorism. Chapter 15 describes the construction of explosive devices such as improvised explosive devices (IEDs) and methods used to test for explosive residue. Chapter 16 presents the three major types of weapons of mass destruction—chemical, nuclear, and biological—and the techniques being developed to detect these threats, both point and standoff detectors.

Course Use

Criminalistics: Forensic Science and Crime offers the flexibility to tailor a course to suit both instructors' preferences and the needs of particular audiences. The full text may be used for a comprehensive two-semester course, or the book may be broken down in several ways for a one-semester course. The text is arranged in a traditional format, beginning with the crime scene and physical evidence followed by sections on trace evidence, pattern evidence, chemical evidence, biological evidence, and terrorism. Those who have been teaching a one-semester criminalistics course with a different text can use the first 12 chapters of this text in sequence. Other options for a one-semester course are to use the first five chapters followed by choices from the remaining chapters depending on the teacher's preferences. Those instructors who stress chemical and biological evidence may choose to skip chapters 6 through 8.

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