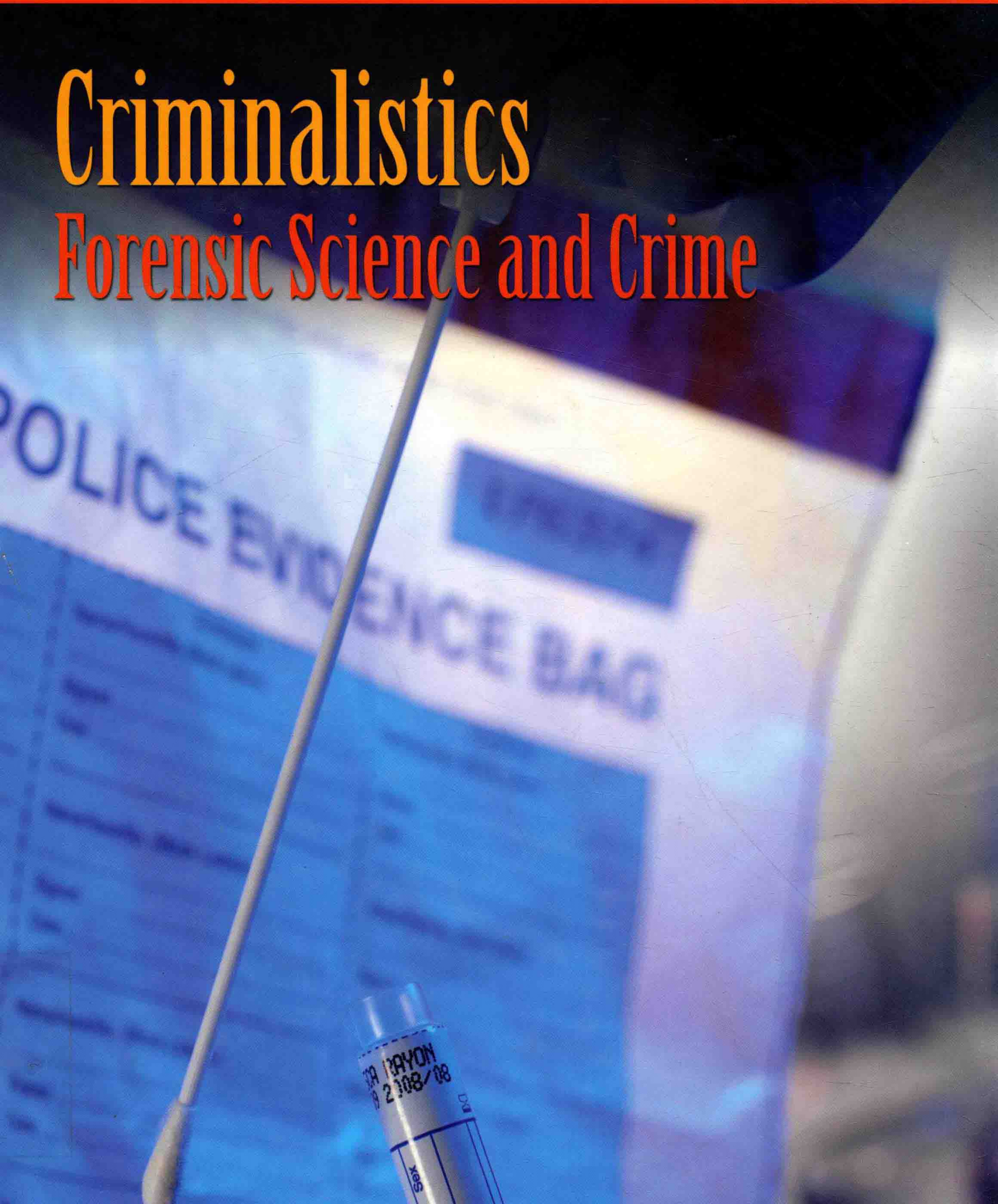
James E. Girard

Criminalistics

Forensic Science and Crime



CRIMINAL JUSTICE ILLUMINATED

Criminalistics
Forensic Science and Crime

James E. Girard, PhD
American University

JONES AND BARTLETT PUBLISHERS
Sudbury, Massachusetts
BOSTON TORONTO LONDON SINGAPORE

World Headquarters

Jones and Bartlett Publishers
40 Tall Pine Drive
Sudbury, MA 01776
978-443-5000
info@jbpub.com
www.jbpub.com

Jones and Bartlett Publishers
Canada
6339 Ormindale Way
Mississauga, Ontario L5V 1J2
Canada

Jones and Bartlett Publishers
International
Barb House, Barb Mews
London W6 7PA
United Kingdom

Jones and Bartlett's books and products are available through most bookstores and online booksellers. To contact Jones and Bartlett Publishers directly, call 800-832-0034, fax 978-443-8000, or visit our website www.jbpub.com.

Substantial discounts on bulk quantities of Jones and Bartlett's publications are available to corporations, professional associations, and other qualified organizations. For details and specific discount information, contact the special sales department at Jones and Bartlett via the above contact information or send an email to specialsales@jbpub.com.

Production Credits

Chief Executive Officer: Clayton E. Jones
Chief Operating Officer: Donald W. Jones, Jr.
President, Higher Education and Professional Publishing: Robert W. Holland, Jr.
V.P., Sales and Marketing: William J. Kane
V.P., Production and Design: Anne Spencer
V.P., Manufacturing and Inventory Control: Therese Connell
Publisher, Public Safety Group: Kimberly Brophy
Acquisitions Editor: Jeremy Spiegel
Associate Managing Editor: Janet Morris
Associate Managing Editor: Robyn Schafer
Production Supervisor: Jenny L. Corriveau
Associate Photo Researcher: Christine McKeen
Director of Marketing: Alisha Weisman
Interior Design: Anne Spencer
Cover Design: Kristin E. Ohlin
Manufacturing and Inventory Coordinator: Amy Bacus
Composition: Modern Graphics, Inc.
Cover Image: © TEK Image/Photo Researchers, Inc.
Text Printing and Binding: Courier
Cover Printing: Courier
Illustrations: Erik Garcia

Library of Congress Cataloging-in-Publication Data

Girard, James.
Criminalistics : forensic science and crime/ James Girard.
p. cm.
ISBN-13: 978-0-7637-3529-6 (hardcover)
ISBN-10: 0-7637-3529-9 (hardcover)
1. Forensic sciences. 2. Criminal investigation. I. Title.
HV8073.G564 2006
363.25'62—dc22

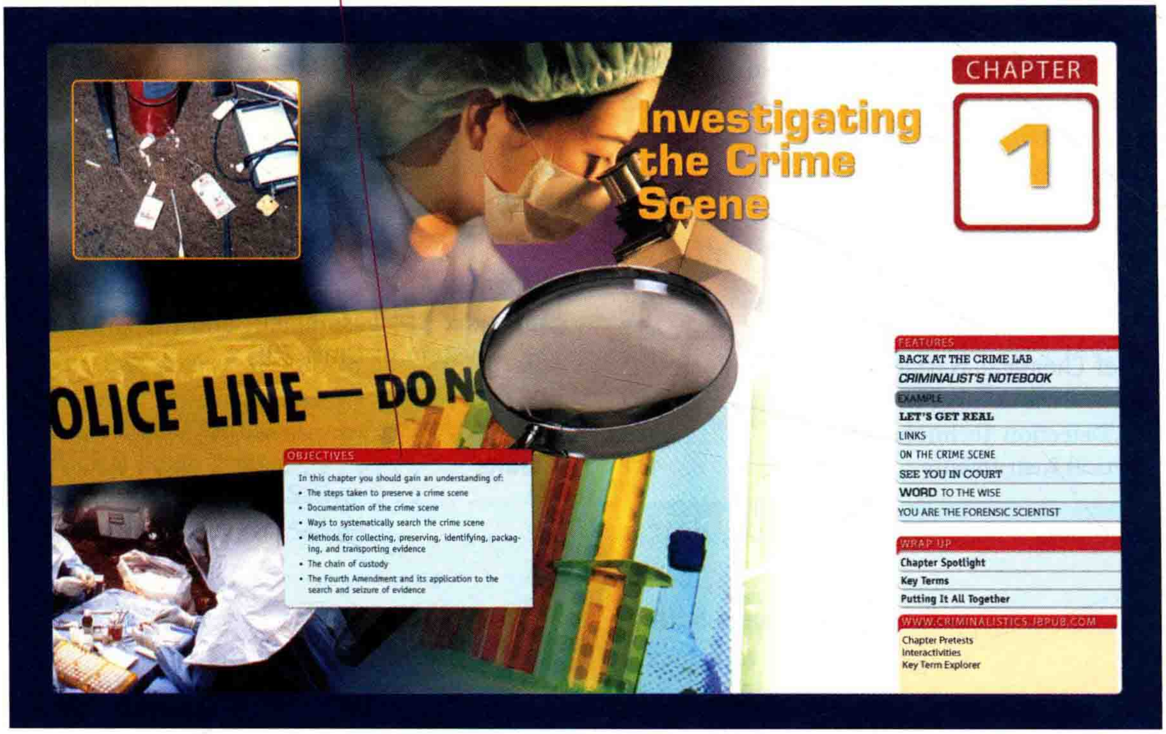
2006032660

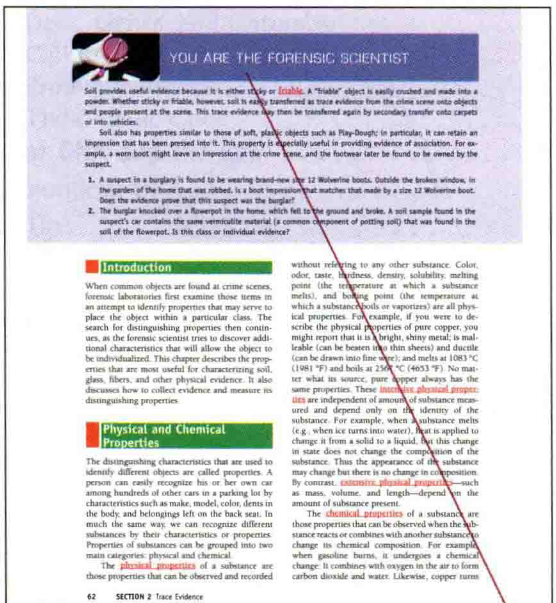
6048

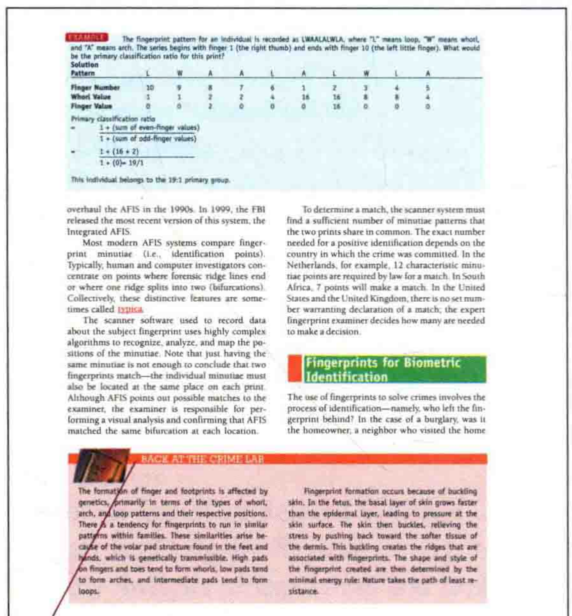
Printed in the United States of America
11 10 09 08 07 10 9 8 7 6 5 4 3 2 1

RESOURCE PREVIEW

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







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 juries" (A. P. Thomas, *Yale Law Review*, February 1, 2006).

In *State v. James Calloway*, 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.

A forged passport confiscated in Thailand.

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 it 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 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 ( ). 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

CHAPTER 7 Questioned Documents 175

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.

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

Improving the Rate of Firing and Firing Reliability

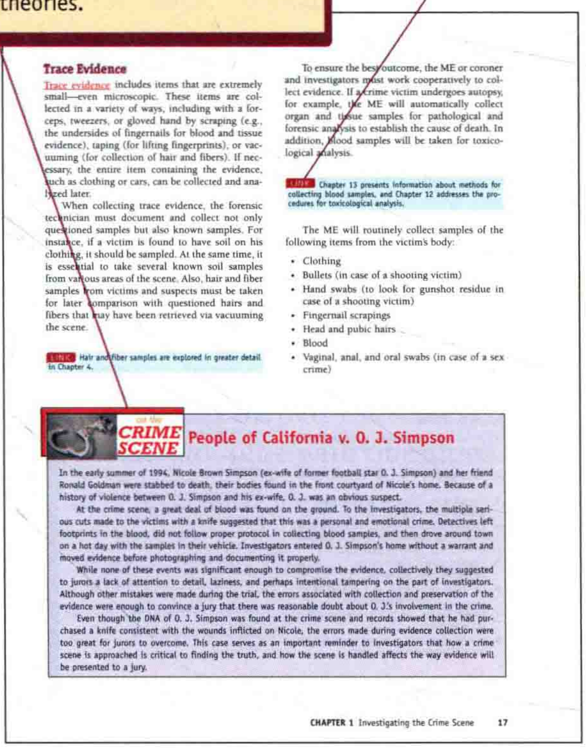
The flintlock rifle, which was first developed in the early 1600s, used a spark to ignite the gunpowder that was loaded in the barrel of the gun ( ). To create this spark, the flintlock used flint (a hard rock) and steel. When flint strikes iron (which is present in steel), the force of the blow creates 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 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

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 the scene.

LINK 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.

LINK Chapter 13 presents information about methods for collecting blood samples, and Chapter 12 addresses the procedures 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)

on the CRIME SCENE 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.

CHAPTER 1 Investigating the Crime Scene 17

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 could 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." Spatter means to scatter (a liquid) in drops or small splashes; *splatter* has no forensic meaning. Were a criminalist to refer to spatter patterns as splatter patterns in his or her notebook, testing, or testimony, there could be issues of admissibility of the statements because splatter patterns are not valid evidence.

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 characteris-

In the CRIME SCENE

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 cordoned 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 coroner discovered material under Sandra's fingernails, on her abdomen, and on her hands. Vaginal and rectal swabs and analysis of her clothing revealed no biological material other than her own. Furthermore, the bicycle provided no incriminating fingerprint evidence. However, hair and fibers were found on the victim.

The police launched a major investigation, 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 employer 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 rectal swab. 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 Alamac Knits. Bell's shirt was a short-sleeve 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 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 contains a straw ([illegible]), 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 (η) 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 something 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 oculars for only a maximum of 20 minutes before taking a short break.

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

1. 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.
2. Examination of the firearm 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.

Broach 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 expressed 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 and are 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 cutout 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.

Magnaflux 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

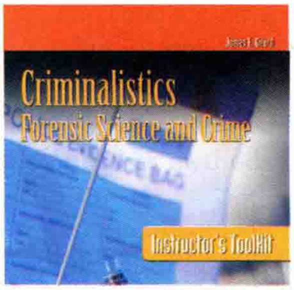
1. The accuracy of a firearm can be greatly improved by making the barrel ________ (longer/shorter).
2. The spiral grooves in a gun barrel are referred to as ________.
3. The rifling on the interior of a gun barrel has spiral grooves and ______.
4. The diameter of a gun barrel, as measured from a land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

www.Criminalistics.jbpub.com

www.Criminalistics.jbpub.com

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:

- **PowerPoint Presentations,** providing you with a powerful way to make presentations that are both educational and engaging. Slides can be modified and edited to meet your needs.
- **Lecture Outlines,** providing you with complete, ready-to-use lesson plans that outline all of the topics covered in the text. Lesson plans can be edited and modified to fit your course.
- **Electronic Test Bank,** containing multiple-choice and scenario-based questions, allows you to originate tailor-made classroom tests and quizzes quickly and easily by selecting, editing, organizing, and printing a test along with an answer key that includes page references to the text.

The resources found on the Instructor's Toolkit CD-ROM have been formatted so that you can seamlessly integrate them into the most popular course administration tools. Please contact Jones and Bartlett Publishers technical support at any time with questions.

Technology Resources

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

www.Criminalistics.jbpub.com

Make full use of today's teaching and learning technology with:
www.Criminalistics.jbpub.com. This has been specifically designed to complement *Criminalistics: Forensic Science and Crime.* 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.

ACKNOWLEDGMENTS

I would like to express my gratitude and appreciation to a number of people who have contributed to this book. To Erik Garcia, who worked with me over 2 years to create the wonderful graphic drawings in this text. Jonathan Edwardsen, who analyzed samples and produced the chromatograms and spectra contained in the book. Connie Diamant, my wife, who put up with me during this project.

To the reviewers of *Criminalistics: Forensic Science and Crime* for their helpful comments and suggestions.

Russell Carter
Northern Virginia Community College
Manassas, VA

Steven Christiansen
Green River Community College
Auburn, WA

Mark Conrad
Troy University
Dothan, AL

Daniel David
Green River Community College
Auburn, WA

Chris DeLay
University of Louisiana
Lafayette, LA

David Ferster
Edinboro University of Pennsylvania
Edinboro, PA

Kimberly Glover
Saint Leo University
Saint Leo, FL

Don Haley
Tidewater Community College
Norfolk, VA

Donald Hanna
Cedarville University
Cedarville, OH

Robyn Hannigan
Arkansas State University
Jonesboro, AR

John Kavanaugh
Scottsdale Community College
Scottsdale, AZ

Michael Meyer
University of North Dakota
Grand Forks, ND

Evaristus Obinyan
Virginia State University
Petersburg, VA

Gregory Russell
Arkansas State University
Jonesboro, AR

Jill Shelley
Northern Kentucky University
Highland Heights, KY

David Tate
Purdue University
West Lafayette, IN

Dean Van Bibber
Fairmont State University
Fairmont, WV

Harrison Watts
Cameron University
Lawton, OK

Robert Webb
Illinois Central College
East Peoria, IL

John Wyant
Illinois Central College
East Peoria, IL

Certain chapters were reviewed by experts. My thanks to the content experts who reviewed specific chapters:

Len Pinaud—Chapter 8: Firearms
State Coordinator for Range3000

Joseph M. Ludas and James W. Gocke—Chapter 6: Fingerprints

Sirchie® Finger Print Laboratories, Inc.
100 Hunter Place
Youngsville, North Carolina 27596

John E. Parmeter, PhD—Chapter 15: Explosives and Chapter 16: Detecting Weapons of Mass Destruction
Sandia National Laboratories
PO Box 5800
Albuquerque, NM 87185-0782

Special thanks to the following people for their contributions to the text:

Maureen Dolan
Arkansas State University
Jonesboro, AR

Carolyn Dowling
Arkansas State University
Jonesboro, AR

Robyn Hannigan
Arkansas State University
Jonesboro, AR

Amy Harrell
Nash Community College
Rocky Mount, NC

Ellen Lemley
Arkansas State University
Jonesboro, AR

Tanja McKay
Arkansas State University
Jonesboro, AR

Kelly Redeker
Arkansas State University
Jonesboro, AR

Gregory Russell
Arkansas State University
Jonesboro, AR

BRIEF CONTENTS

CONTENTS

SECTION 1
Introduction to Criminalistics 2