



◀ Sir Robert Peel (1788–1850), whose efforts led to the establishment of the London Metropolitan Police in 1829. English police officers are still referred to as “Bobbies,” a play on Peel’s first name.

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CRIME SCENE DO NOT CROSS

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THE EVOLUTION OF CRIMINAL INVESTIGATION AND FORENSIC SCIENCE

CHAPTER OBJECTIVES

1. Define “investigator.”
2. Define the most fundamental purpose of investigation.
3. State four additional objectives of the investigative process.
4. Explain the importance of the Bow Street Runners.
5. Discuss the contribution of Sir Robert Peel’s reform to early policing in the United States.
6. Explain the history and contributions of the Pinkerton National Detective Agency.
7. Identify the first major federal investigative agencies and their responsibilities.
8. Explain the Supreme Court’s “due process revolution” and its impact on policing.
9. Discuss Bertillon’s method of anthropometry.
10. Summarize the historical development of fingerprint identification.
11. Explain the concept and practice of DNA typing.
12. Outline the milestones in the development of firearms identification.



| INTRODUCTION

An investigator is someone who gathers, documents, and evaluates evidence and information. This is accomplished through the process of investigation. The most fundamental

purpose of criminal investigation and forensic science is to discover the truth. By making this purpose the cornerstone of their behavior, investigators can remain faithful to their oath of office and the accompanying ethical standards. Four additional objectives of the investigative process are to (1) establish that a crime was actually committed; (2) identify and apprehend the suspect(s); (3) recover stolen property; and (4) assist in the prosecution of the person(s) charged with the crime.

JURISDICTION

The authority of law-enforcement officers is limited by such factors as the Constitution, court decisions, federal and state laws, departmental policies, and jurisdiction, which can be thought of as both a *geographical area* and the laws for which an agency has *enforcement responsibility*.

The general rule is that the *geographic jurisdiction* of police officers is limited to the area governed by their employer. Law-enforcement officers employed by state agencies and county, as well as metropolitan and city police departments, follow this general pattern. Depending on the state, Sheriffs' deputies and county police departments usually patrol the unincorporated portions of a county, although by contract they may provide law-enforcement services to municipalities. Sheriff's deputies may or may not have jurisdiction outside their home counties. Investigations beyond the governing authority's geographical boundaries usually are conducted with the assistance of the appropriate law-enforcement agency. Some states have statutorily extended the jurisdiction of peace officers—for example, allowing investigation beyond their normal jurisdiction for offenses committed within the investigating officers' regular jurisdiction, when viewing serious misdemeanors or felonies, or assisting another law-enforcement officer.

The FBI provides a good illustration of *enforcement responsibility*. It has primary enforcement responsibility for all federal criminal laws, except cases for which responsibility is by statute or otherwise assigned specifically to another agency. As a practical matter the enforcement responsibility of the FBI is limited to roughly 200 laws.

CRIMINAL INVESTIGATION AND FORENSIC SCIENCE

For present purposes, the roots of criminal investigation can be traced back to England in the eighteenth century, a period marked by significant social, political, and economic changes. These changes were important to the development of the first modern detective force, the **Bow Street Runners**. In addition, London was the home of the first police reformer, Robert Peel. Both of these factors contributed to the subsequent development of police organizations and criminal investigation in the United States.

Forensic science draws from diverse disciplines, such as geology, physics, chemistry, biology, and mathematics, to study physical evidence related to crime. If it is suspected that a person has died from poisoning, for example, a toxicologist, who specializes in identifying poisons and their physiological effects on humans and animals, can assist in the investigation. Experts in other areas, such as botany, forensic pathology, entomology, and archaeology, may also provide helpful information to criminal investigators.

Over hundreds of years many people have made contributions to the fields of criminal investigation and forensic science. To recognize all of them is beyond the scope of this chapter and requires setting some limits. This chapter presents a brief history of criminal investigation and forensic science. Many volumes have been written about these entwined topics, but the space that can be devoted to them here is limited. Sufficient broad perspectives and supporting details, however, are included

CHAPTER OUTLINE

Introduction
Jurisdiction
Criminal Investigation and Forensic Science
The Evolution of Criminal Investigation
Historical Milestones of Forensic Science
Recent Developments

in this chapter to enable readers intrigued by these subjects to independently pursue their interest armed with a working knowledge of the basics.

THE EVOLUTION OF CRIMINAL INVESTIGATION

THE IMPACT OF THE AGRICULTURAL AND INDUSTRIAL REVOLUTIONS

During the eighteenth century, two events—an agricultural revolution and an industrial revolution—began a process of change that profoundly affected how police services were delivered and investigations conducted. Improved agricultural methods, such as the introduction in 1730 of Charles Townshend's crop rotation system and Jethro Tull's four-bladed plow, gave England increased agricultural productivity in the first half of the eighteenth century.¹ Improvements in agriculture were essential preconditions to the Industrial Revolution in the second half of the eighteenth century, because they freed people from farm work for city jobs. As the population of England's cities grew, slums also expanded, crime increased, and disorders became more frequent. Consequently, public demands for government to control crime grew louder.

THE FIELDINGS: CRIME INFORMATION AND THE BOW STREET RUNNERS

In 1748, **Henry Fielding** became chief magistrate of Bow Street and set out to improve the administration of justice. In 1750, he established a small group of volunteer, non-uniformed home owners to "take thieves." Known as the "**Bow Street Runners**," these Londoners hurried to the scenes of reported crimes and began investigations, thus becoming the first modern detective force. By 1752, Fielding began publishing *The Covent Garden Journal* as a means of circulating the descriptions of wanted persons. On his death in 1754, Henry Fielding was succeeded by his blind half-brother, **John Fielding**, who carried on Henry's ideas for another 25 years.² Under John Fielding, Bow Street became a clearinghouse for information on crime,

and by 1785 at least four of the Bow Street Runners were no longer volunteers but paid government detectives.³

THE METROPOLITAN POLICE ACT OF 1829

In 1816, 1818, and again in 1822, England's Parliament rejected proposals for a centralized professional police force for London as different political philosophies clashed. One group argued that such a force was a direct threat to personal liberty. The other group—composed of reformers such as Jeremy Bentham and Patrick Colquhoun—argued that the absence, rather than the presence, of social control was the greater danger to personal liberty. Finally, in 1829, owing in large measure to the efforts of **Sir Robert Peel**, Parliament passed the **Metropolitan Police Act**, which created a metropolitan police force for London. Police headquarters became known as "Scotland Yard," because the building formerly had housed Scottish royalty. Police constables were referred to as "**Bobbies**," a play on Peel's first name.⁴

Because French citizens had experienced oppression under centralized police, the British public was suspicious of, and at times even hostile to, the new force. In response to the high standards set for the police force, there were 5,000 dismissals and 6,000 forced resignations from the force during the first three years of operations.⁵ This record was a clear indication to the public that police administrators were requiring officers to maintain high standards of conduct. Within a few years, the London Metropolitan Police had won a reputation for fairness, and it became the international model of professional policing. Despite the growing popularity of the uniformed **Bobbies**, however, there was fear that the use of "**police spies**"—detectives in plain clothes—would reduce civil liberties.

In the years immediately following 1829, some Metropolitan Police constables were temporarily relieved from patrolling in uniform to investigate crimes on their beats.⁶ As the distinction between the use of uniformed constables to prevent crime and the use of plainclothes detectives for investigation and surveillance became clear, the public became uneasy. Illustratively, in 1833, a **Sergeant Popay** was dismissed following a parliamentary investigation that revealed that he had infiltrated a radical group, acquired a leadership position, and argued for the use of violence. In 1842, a regular detective branch was opened at **Scotland Yard** (Figure 1-1), superseding the Bow Street force.⁷ Initially, the detective force was limited to no more than 16 investigators, and its operations were restricted because of a distrust of "clandestine methods."⁸

AMERICAN INITIATIVES

The success of Peel's reform in England did not go unnoticed in the United States. **Stephen Girard** bequeathed \$33,190 to Philadelphia to develop a competent police force. In 1833 Philadelphia passed an ordinance creating



▲ **FIGURE 1-1 New Scotland Yard**

In 1890 the Metropolitan Police left their original quarters and were housed in New Scotland Yard, pictured above. Subsequently, in 1967 the Metropolitan Police moved again, to their present facilities, which are also referred to as New Scotland Yard.

America's first paid, daylight police force. Although the ordinance was repealed just three years later, the concept of a paid police force would reappear as American cities staggered under the burdens of tremendous population growth, poverty, and massive crime. In 1836 New York City rejected the notion of a police force organized along the lines advocated by Peel. The committee studying the idea concluded it was better in emergencies to rely on citizens than "despotic governments."⁹

Thus, before mid-century, few American cities had police service, and those that existed were inadequate. Many cities had paid police departments only at night or treated day and night police services as entirely separate organizations. Finally, in 1844 the New York state legislature created the first unified police force in the country, although New York City did not actually implement the measure until a year later. Other cities rapidly followed

New York's lead: Chicago in 1851, New Orleans and Cincinnati in 1852, and Baltimore and Newark in 1857. By 1880 virtually every major American city had a police force based on England's Peelian reforms of 1829 and pioneered in this country by New York City.

If one of the problems of the London Metropolitan Police had been getting the public to accept some constables' working out of uniform as detectives, in the United States the problem was getting the police to wear uniforms in the first place. American officers believed that a uniform made them easy targets for public harassment and made them look like servants. Only after the Civil War did the wearing of a uniform—invariably Union blue—become widely accepted by American police officers.

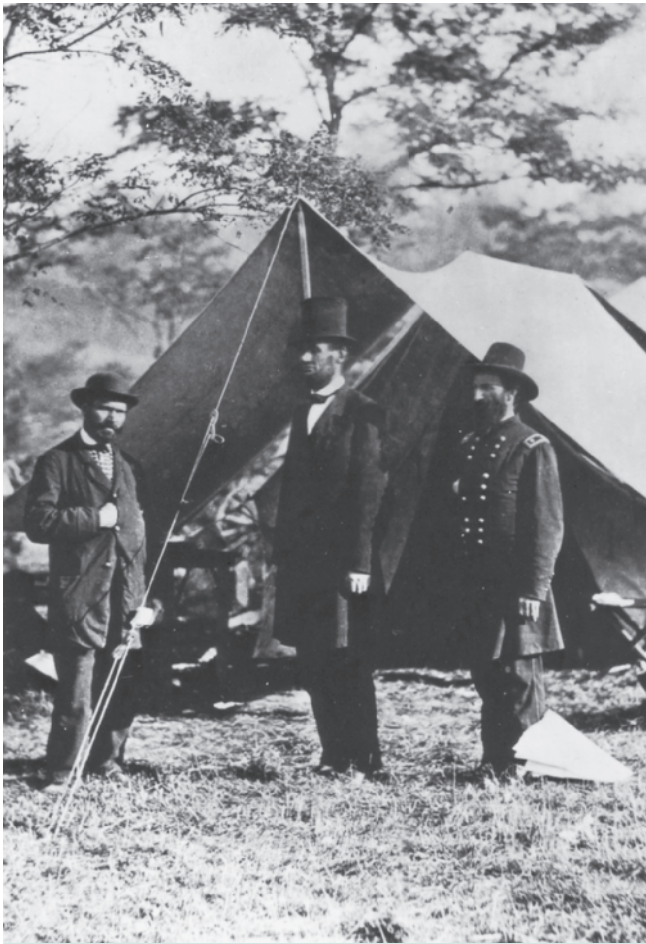
PINKERTON'S NATIONAL DETECTIVE AGENCY

America needed reliable detectives for several reasons: (1) graft and corruption were common among America's big-city police officers; (2) the jurisdiction of sheriffs' offices and municipal officers was limited; and (3) there was little information sharing by law-enforcement agencies. Thus, offenders often fled from one jurisdiction to another with impunity. Information sharing has vastly improved in the last 150 years but is an area that still requires further development.

In 1846 seeing the need for reliable investigators, two former St. Louis police officers formed the first recorded private detective agency.¹⁰ However, the major private detective agency of the nineteenth century was formed by **Allan Pinkerton** (1819–1884, Figure 1-2.). In 1850, after working as a Chicago detective and a U.S. mail agent,¹¹ Pinkerton formed a private detective agency with attorney Edward Rucker.¹² Pinkerton's trademark was an open eye above the slogan "We never sleep."¹³ The trademark gave rise to the use of the term "private eye" in reference to any private investigator.¹⁴ The Pinkertons enjoyed such enormous success in the United States and throughout the world that some people thought "Pinkerton" was a nickname for any American government detective.¹⁵

The list of achievements by Pinkerton is impressive. Pinkerton reportedly discovered and foiled an assassination attempt on President-elect Lincoln in Baltimore.¹⁶ At the outbreak of the Civil War in 1861, Pinkerton organized a Secret Service Division within the army (not to be confused with the U.S. Secret Service) and worked closely with General McClellan.¹⁷ He infiltrated Confederate lines in disguise on several occasions and usually functioned as a military analyst.¹⁸

Following the Civil War, the Pinkertons were primarily engaged in two broad areas: (1) controlling a discontented working class, which was pushing for better wages and working conditions, and (2) pursuing bank and railroad robbers.¹⁹ Unrestricted by jurisdictional limits, Pinkerton agents roamed far and wide pursuing lawbreakers. In a



▲ FIGURE 1-2 Pinkerton at work

Allan Pinkerton, President Lincoln, and General McClellan at Antietam, Maryland, about October 3, 1862. Born in Scotland, Allan Pinkerton was the son of a police sergeant. He found employment as a barrel maker and advanced to supervisor. At the same time, this red-headed, strong-willed man advocated more voice in government for ordinary people, a position that resulted in him becoming a wanted man. Narrowly avoiding arrest on his wedding day, Pinkerton and his wife fled to America, surviving a shipwreck while en route. He started a successful barrel-making company. While owner of that business, his initiative led to the arrest of counterfeiters. This gave him an appetite for police work, his father's profession, and changed his life and American policing forever. (Courtesy Pinkerton's Archives)

violent time, they sometimes used harsh and unwise methods. For instance, suspecting that they had found the hideout of Jesse James's gang, Pinkerton agents lobbed in a 32-pound bomb, killing a boy and injuring a woman.²⁰

Pinkerton understood the importance of information, records, and publicity and made good use of all of them. For example, in 1868, Pinkerton agent Dick Winscott took on the Reno gang. Winscott located Fred and John Reno and, after a drinking bout, persuaded them to let him

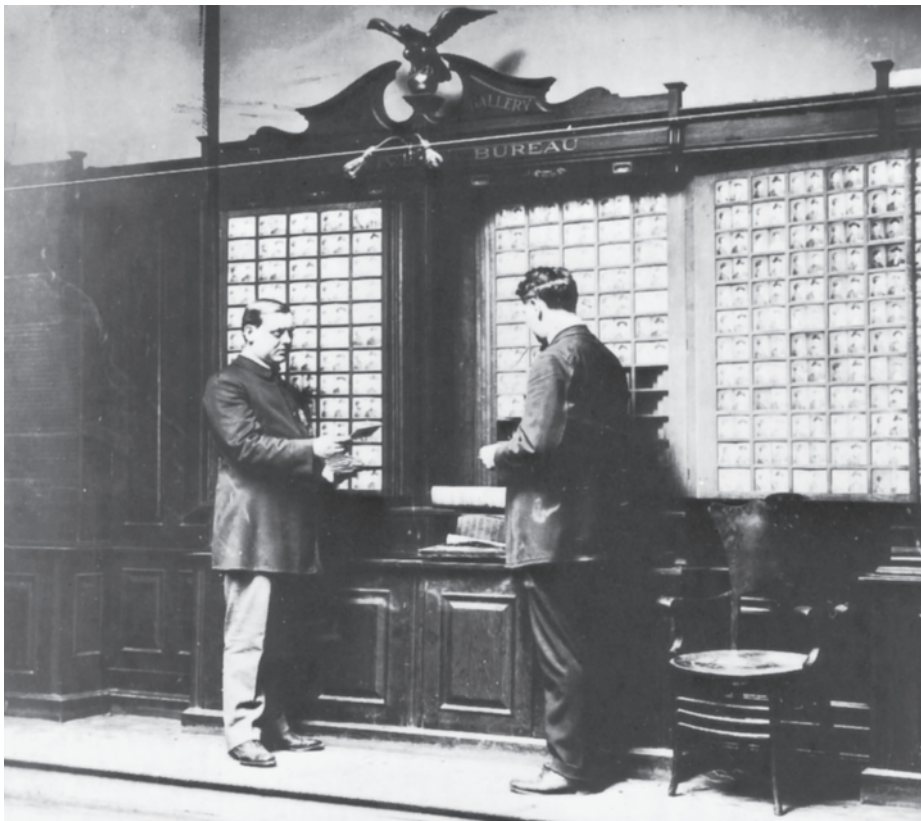
No. P.N.D.A. - 15-97.
 Name Geo Cassidy alias Butch Cassidy alias
 Alias Ingerfield, right name Robt. Parker
 Age 32 Height 5ft 9" Weight 165
 Complexion Light Hair Flaxen
 Eyes Blue Beard _____ Teeth _____
 Nationality American
 Marks and Scars 2 cut scars back head
Small red scar under left eye.
eyes deep set. Small brown
mole calf of leg.
 Arrested for Grd. Lar. Transport Co. Wyo.
 Remarks July 15-94. Pardoned Jan 19-
by Gov. Richards
Home is in Circle Valley, Utah
Sandy beard & mustache if any.
2100

▲ FIGURE 1-3 Butch Cassidy's Pinkerton record

Note the "P.N.D.A." initials on the first line, which stand for Pinkerton National Detective Agency. Pinkerton agents were highly successful in combating the bank and train robbers of the Old West, such as the Hole in the Wall gang, so named because of the small opening through rocky walls that led to the valley in Johnson County, Wyoming, used as their hideout. As many as 40 bandits may have lived there in six cabins. Butch Cassidy and the Sun Dance Kid were both members of the Hole in the Wall gang at various times.

(Courtesy Wyoming State Archives and Historical Department)

photograph them.²¹ He sent the photographs to Pinkerton files, and within a year the Reno gang was smashed.²² Pinkerton also collected photographs of jewel thieves and other types of criminals and photographed horses to prevent illegal substitutions before races.²³ The Pinkertons also pushed Butch Cassidy (Robert Parker) and the Sun Dance Kid (Harry Longbaugh) into leaving the United States for South America, where they were reportedly killed by Bolivian soldiers at San Vicente in 1909 (Figure 1-3.) Because of their better-known antilabor activities, the Pinkertons' other work often is overlooked. But they were the only consistently competent detectives available in this country for over 50 years²⁴ and provided a good model for government detectives.



◀ FIGURE 1-4

NYPD rogues' gallery

Uniformed officers of the New York City Police Department maintaining a rogues' gallery in the detective bureau, circa 1896. Police departments have used rogues' galleries since the late 1850s.

(Library of Congress)

THE EMERGENCE OF MUNICIPAL DETECTIVES

As early as 1845 New York City had 800 plainclothes officers,²⁵ although not until 1857 were the police authorized to designate 20 patrol officers as detectives.²⁶ In November 1857 the New York City Police Department set up a **rogues' gallery** (Figure 1-4)—photographs of known offenders arranged by criminal specialty and height—and by June 1858, it had over 700 photographs for detectives to study so that they might recognize criminals on the street.²⁷

Photographs from rogues' galleries of that era reveal that some offenders grimaced, puffed their cheeks, rolled their eyes, and otherwise tried to distort their appearance to lessen the chance of later recognition.

To assist detectives, in 1884 Chicago established this country's first municipal Criminal Identification Bureau.²⁸ The Atlanta Police Department's Detective Bureau was organized in 1885 with a staff of one captain, one sergeant, and eight detectives.²⁹ In 1886 Thomas Byrnes, the dynamic chief detective of New York City, published *Professional Criminals in America*, which included pictures, descriptions, and the methods of all criminals known to him.³⁰ Byrnes thereby contributed to information sharing among police departments. To supplement the rogues' gallery, Byrnes instituted the **Mulberry Street Morning Parade**. At 9 o'clock every morning, all criminals arrested in the past 24 hours were marched before his detectives, who were expected to make notes and to recognize the criminals later.³¹

FEDERAL AND STATE DEVELOPMENTS

From its earliest days, the federal government employed investigators to detect revenue violations, but their responsibilities were narrow and their numbers few.³² In 1865 Congress created the U.S. Secret Service to combat counterfeiting. In 1903—two years after President McKinley was assassinated by Leon Czolgosz in Buffalo—the previously informal arrangement of guarding the president was made a permanent Secret Service responsibility.³³

In 1905 the California Bureau of Criminal Identification was set up to share information about criminal activity, and Pennsylvania governor Samuel Pennypacker signed legislation creating a state police force. Widely regarded then by labor as “strikebusters on management's side,” the Pennsylvania State Police nevertheless was the prototype for modern state police organizations (Figure 1-5). New York and Michigan in 1917 and Delaware in 1919 adopted the state police concept. Since then, state police forces have assumed the function of providing local police with help in investigations.

Although Virginia, Kentucky, and Arkansas have a State Police, there are none in the deep South. To a large degree, their use in that area has been foiled by politically potent sheriffs seeking to maintain autonomy.

Where State Police agencies do not exist, a common arrangement is to have a department that focuses primarily on traffic enforcement and another for criminal investigation—for example, in North Carolina there is a



▲ **FIGURE 1-5 The Pennsylvania State Police**

Troop D, Pennsylvania State Police, Punxsutawney, Pennsylvania, 1906. Note that both plainclothes and uniformed personnel are represented. (Courtesy Pennsylvania State Police)

State Highway Patrol and the State Bureau of Investigation (SBI). In such arrangements the crime laboratory may be a separate department or part of the state investigative agency. Similarly, casino gaming enforcement may be a function of a state police agency or a state gaming commission.

After Prohibition was adopted nationally in 1920, the Bureau of Internal Revenue was responsible for its enforcement. Eventually the ranks of the bureau's agents swelled to a massive 4,000.³⁴ Because the Bureau of Internal Revenue was lodged in the Department of the Treasury, these federal agents were referred to as T-men.

In 1908 U.S. Attorney General Charles Bonaparte created the embryo of what was later to become the Federal Bureau of Investigation (FBI) when he ordered that investigations were to be handled by a special group. In 1924 J. Edgar Hoover (1895–1972) assumed leadership of the Bureau of Investigation; 11 years later Congress passed a measure giving the FBI its present designation.

When Prohibition was repealed by the Eighteenth Amendment to the U.S. Constitution in 1933, many former bootleggers and other criminals turned to bank rob-

bery and kidnapping.³⁵ During the Depression, some people saw John Dillinger, "Pretty Boy" Floyd, and Bonnie and Clyde (Figures 1-6 and 1-7) "as plain folks" and did not grieve over a bank robbery or the kidnapping of a



► **FIGURE 1-6 Bonnie Parker**

Texas-born Bonnie Parker (1910–1934) was part of the murderous Barrow gang, which robbed and murdered its way across Oklahoma, Missouri, Texas, and New Mexico. In 1930, she smuggled a gun into the Waco (Texas) County Jail, helping Clyde Barrow and a companion to escape. From 1932 until 1934, Bonnie and Clyde left a deadly trail before they were stopped. (Courtesy FBI)



▲ **FIGURE 1-7 Clyde Barrow**

Clyde Barrow (1909–1934) was captured after his escape from the Waco County Jail and served two years in prison. Upon his release, he and Bonnie began their rampage. Outside of Black Lake, Louisiana, they were killed by law-enforcement officers who had persistently been pursuing them. (Courtesy FBI)

millionaire.³⁶ Given the restricted roles of other federal investigative agencies, it became the FBI's role to deal with these criminals.

Under Hoover, who understood the importance and uses of information, records, and publicity as well as Allan Pinkerton had, the FBI became known for investigative efficiency. In 1932, the FBI established a crime laboratory and made its services available free to state and local police (Figure 1-8). In 1935 it started the **National Academy**, a training course for state and local police. In 1967 the **National Crime Information Center (NCIC)** was made

operational by the FBI, providing data on wanted persons and property stolen from all 50 states. Altogether, these developments gave the FBI considerable influence over law enforcement throughout the country. Although some people argue that such federal influence is undesirable, others point out that Hoover and the FBI strengthened police practices in this country, from keeping crime statistics to improving investigation.

The Harrison Act (1914) made the distribution of non-medical drugs a federal crime. Enforcement responsibility was initially given to the Internal Revenue Service, although by 1930 a separate Federal Bureau of Narcotics (FBN) was established in the Treasury Department. In 1949 a federal commission noted that federal narcotics enforcement was fragmented among several agencies, including the Border Patrol and Customs, resulting in duplication of effort and other ills. In 1968 some consolidation of effort was achieved with the creation of the Bureau of Narcotics and Dangerous Drugs (BNDD) in the Department of Justice, and in 1973, with the creation of its successor, the **Drug Enforcement Administration (DEA)**.

Today the DEA devotes many of its resources to fighting international drug traffic. Like the FBI, the DEA trains state and local police in investigative work. The training focuses on recognition of illegal drugs, control of drug purchases, surveillance methods, and handling of informants.

In 2002 several federal agencies were consolidated to form Immigration and Customs Enforcement (ICE) in the Department of Homeland Security (DHS).

THE POLICE AND THE U.S. SUPREME COURT

As the highest court in this country, the Supreme Court is obligated to review cases and to make decisions that often have considerable impact. From 1961 to 1966, a period known as the "due process revolution," the



◀ **FIGURE 1-8**

FBI crime laboratory

In 2003 the FBI occupied its 463,000 square foot state-of-the-art crime laboratory, which cost \$130 million.

(© AP Photo/Charles Dharapak)

Supreme Court became unusually active in hearing cases involving the rights of criminal suspects and defendants. Its decisions focused on two vital areas: (1) search and seizure and (2) the right to legal representation. Among those cases was *Miranda v. Arizona* (1966), which established the well-known “Miranda rights.” *Miranda* and other decisions infuriated the police, who felt that the Supreme Court had “tied their hands.”

So what did the due process revolution and subsequent Supreme Court decisions really change? Questionable and improper police procedures and tactics were greatly reduced. In turn, this created the need to develop new procedures and tactics and to make sure that officers were well trained in their uses. To no small extent, this cycle has hastened the continuing professionalization of the police while also asserting the principle that the action of police officers anywhere may be subject to close scrutiny by the Supreme Court.

HISTORICAL MILESTONES OF FORENSIC SCIENCE

The origins of criminalistics or forensic science are largely European. Forensic science draws from diverse disciplines, such as geology, physics, chemistry, biology, and mathematics, to study physical evidence related to crime. The first major book describing the application of scientific disciplines to criminal investigation was written in 1893 by **Hans Gross**, a public prosecutor and later a judge from Graz, Austria.³⁷ Translated into English in 1906 under the title *Criminal Investigation*, it remains highly respected today as the seminal work in the field.

The Frenchman **Edmond Locard** established the first forensic laboratory in Lyon in 1910. All crime scenes are searched on the basis of Locard’s exchange principle, which asserts that when perpetrators come into contact with the scene, they will leave something of themselves and take away something from the scene, for example, hairs and fibers. Expressed somewhat differently, Locard’s exchange principle states that there is something to be found. He is also recognized as the father of poreoscopy, the study of pores and for advocating that if there were 12 points of agreement between two compared fingerprints the identity was certain.

Forensic science enjoys periods of stability, but on the whole it is dynamic and in constant progress. To illustrate this principle of dynamic change, the histories of two commonly used services—biometric-based personal identification and firearms identification—are traced in this section.

BIOMETRIC BASED PERSONAL IDENTIFICATION

Biometrics is from the Greek meaning life measurement. The most important goal of biometric measurements is to

uniquely identify, or verify the identity of, an individual through characteristics of the human body. Biometrics is superior to eye witness identification because it has a scientific foundation.

Historically, there have been three major scientific systems of biometric-based personal identification of criminals in wide use: anthropometry, dactylography, and deoxyribonucleic acid (DNA) typing. The first was relatively short lived. The second, dactylography, or fingerprint identification, remains in use today throughout the world. The third, DNA, is a relatively contemporary development.

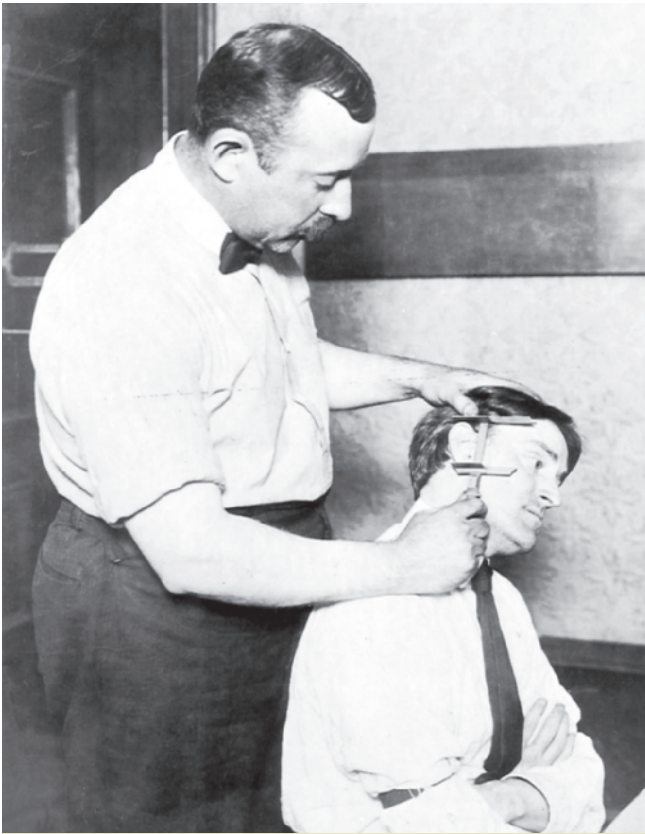
Anthropometry

Anthropometry was developed by **Alphonse Bertillon** (1853–1914), who is rightly regarded as the father of criminal identification (Figure 1-9). The first method of criminal identification that was thought to be reliable, **anthropometry** “was based on the fact that every human being differs from every other one in the exact measurements of their body, and that the sum of these measurements yields a characteristic formula for each individual.”³⁸ Figure 1-10 depicts a New York City police detective taking one type of measurement used in the “Bertillon system.”



▲ **FIGURE 1-9 Bertillon**

Alphonse Bertillon (1853–1914), the father of personal identification. In 1882, he began using his system on those incarcerated in Paris’s Palais de Justice. (Courtesy Jacques Genthial)



▲ **FIGURE 1-10 Taking a Bertillon measurement**

A New York City Police detective taking a Bertillon measurement of the right ear, one of the 11 measurements that made up anthropometry. This photograph was taken around 1896. Note in this photo and the one that immediately follows that the right ear is consistently part of the measurements made. (Library of Congress)

There was little in Alphonse Bertillon's early life to suggest that he would later make significant contributions. He was the grandson of a well-known naturalist and mathematician and the son of a distinguished French physician and statistician, who was also the vice president of the Anthropological Society of Paris.³⁹ Despite the advantages Bertillon had, he failed in a number of jobs. He was, therefore, able to obtain only a minor position in 1879, filing cards on criminals for the Paris police, because of his father's good connections.⁴⁰ The cards described criminals so vaguely that they might have fit almost anyone: "stature: average . . . face: ordinary."⁴¹

Bertillon wondered why so many resources were wasted on a useless system of identifying criminals.⁴² He began comparing photographs of criminals and taking measurements of those who had been arrested.⁴³ Bertillon concluded that if 11 physical measurements of a person were taken, the chances of finding another person with the same 11 measurements were 4,191,304 to 1.⁴⁴ His report outlining his criminal identification system was not

Height	5'28"	Head Length	18.2	L. Foot	28.0	Circle	18	Age	18	Born In	1897
g. Height	5'8"	Head Width	15.4	L. Mid. F.	11.9	Periph.		Apparent Age			
Side A	5'10"	Cheek Width	13.2	L. Lit. F.	9.4	Color of Left Eye	Blue	Nativity	Chicago	Occupation	Police
ank	8.8.3	R. Ear	4.8	Left Fore A.	4.87	Pecul.					

Incilin.		Profile Ridge		Base		Roof		Teeth		Beard	
Height		Length		Projection		Breadth		Chin		Build	
Width		Pecul.		Pecul.		Pecul.		Pecul.		Pecul.	

REAU OF IDENTIFICATION
DEPARTMENT OF POLICE

▲ **FIGURE 1-11 Early identification card**

A Bertillon-style identification card, combining both personal measurements and photographs, prepared on February 28, 1917, by the Chicago Police Department. (Courtesy Chicago Police Department)

warmly received. After reading it, the chief said "your report sounds like a joke."⁴⁵

Yet in 1883 the "joke" received worldwide attention, because within 90 days of its implementation on an experimental basis, Bertillon correctly made his first criminal identification. Soon, almost all European countries adopted Bertillon's system of anthropometry. In 1888 Bertillon's fertile mind produced yet another innovation, the *portrait parlé* or "speaking picture," which combines full-face and profile photographs of each criminal with his or her exact body measurements and other descriptive data onto a single card (Figure 1-11).

After the turn of the century, many countries abandoned anthropometry and adopted the simpler and more reliable system of fingerprints instead. Bertillon himself was not insensitive to the potential of fingerprints. In 1902, he solved the murder of Joseph Riebel when he discovered the prints of Henri Scheffer on the pane of a glass cupboard.⁴⁶ Yet Bertillon's rigid personality would not allow him to acknowledge the clear superiority of dactylography to anthropometry. Even so, Bertillon's place in history is secure as the father of criminal identification.

Dactylography

Dactylography is the study of fingerprints. Fingerprints were used on contracts during China's T'ang Dynasty

in the eighth century as well as on official papers in fourteenth-century Persia and seventeenth-century England.⁴⁷ In the first century, the Roman lawyer Quintilianus introduced a bloody fingerprint in a murder trial, successfully defending a child against the charge of murdering his father.⁴⁸

In a scientific context, in 1684 in England, Dr. Nehemiah Grew first called attention to the system of pores and ridges in the hands and feet.⁴⁹ Just two years later, Marcello Malpighi made similar observations.⁵⁰ In 1823, John Perkinje, a professor at the University of Breslau, named nine standard types of fingerprint patterns and outlined a broad method of classification.⁵¹ Despite these early stirrings, it was not until 1900 that a country, England, used dactylography as a system of criminal identification.

The Herschel-Faulds Controversy. Beginning in 1858 William Herschel, a British official in India, requested the palm prints and fingerprints of those with whom he did business, thinking that it might awe people into keeping agreements.⁵² Over the next 20 years, Herschel noted from his records that the patterns of the lines on the fingerprints never changed for an individual. Excited by the prospects of applying this knowledge to the identification of criminals, Herschel wrote in 1877 to the inspector general of the prisons of Bengal. The reply made it clear that the inspector general was not interested. Discouraged, Herschel made no further efforts to pursue his discovery. Henry Faulds, a Scottish physician at the Tsukiji Hospital in Tokyo, had been interested in fingerprints for several years before 1880. When a thief left a sooty print on a whitewashed wall, Faulds was able to tell that the person in police custody was not the thief⁵³ and to match another suspect's fingerprints with those on the wall.⁵⁴ Faulds reported his findings in the journal *Nature* in 1880. Herschel read the account and published a reply, claiming credit for the discovery over 20 years before. A controversy broke out that was never resolved to anyone's satisfaction. Because there was also no official interest in using fingerprints, both Herschel and Faulds were even further frustrated.



Galton's and Vucetich's Systems. In 1888 Sir Francis Galton (1822–1911) turned his attention to criminal identification.⁵⁵ When Galton contacted the editor of *Nature* for both Herschel's and Faulds's addresses, he was by chance sent only Herschel's. Contacted by Galton, Herschel unselfishly turned over all his files in the hopes that this revived interest would lead to practical uses of fingerprints.⁵⁶ In 1892 Galton published the first definitive book on dactylography, *Finger Prints*. It presented statistical proof of the uniqueness of fingerprints and outlined many principles of identification by fingerprints.⁵⁷ In Argentina, in 1894, Juan Vucetich (1858–1925) published *Dactiloscopia Comparada*, outlining his method of fingerprint classification. In 1892 a disciple of Vucetich's,

Inspector Alvarez, obtained South America's first criminal conviction based on fingerprints by using Vucetich's system to convict a woman of beating her two children to death.⁵⁸

The Henry System. The final breakthrough for the fingerprint method of personal identification was made by Edward Henry. At the age of 23 he went to India and by 1891 had become the inspector general of police of Nepal, the same province in which Herschel had worked some 15 years earlier.⁵⁹ Subject to many of the same influences as Herschel, but apparently working independently, Henry developed an interest in fingerprints⁶⁰ and instituted Bertillon's system with the addition of fingerprints to the cards. In 1893, Henry obtained a copy of Galton's book and began working on a simple, reliable method of classification. The governor general of India received a report from Henry in 1897 recommending that anthropometry be dropped in favor of Henry's fingerprint classification system. It was adopted throughout British India just six months later.⁶¹ In 1900 Henry's system was adopted in England. The next year, Henry enjoyed two personal triumphs, the publication of his *Classification and Use of Finger Prints* and his appointment as assistant police commissioner of London,⁶² rising to the post of commissioner two years later.

Faurot and "James Jones." In 1904 New York City Detective Sergeant Joseph Faurot was sent to England to study fingerprints, becoming the first foreigner trained in the use of the Henry classification system. Upon Faurot's return, the new police commissioner told him to forget about such "scientific notions" and transferred him to walking a beat.⁶³ In 1906 Faurot arrested a man dressed in formal evening wear but not wearing shoes, as the man crept out of a suite in the Waldorf-Astoria Hotel.⁶⁴ Claiming to be a respectable citizen named "James Jones," the man demanded to see the British consul and threatened Faurot with nasty consequences.⁶⁵ Faurot sent the man's fingerprints to Scotland Yard⁶⁶ and got back a reply that "James Jones" was actually Daniel Nolan, who had 12 prior convictions of hotel thefts and who was wanted for burglarizing a home in England. Confronted with this evidence, Nolan confessed to several thefts in the Waldorf-Astoria and received a sentence of seven years.⁶⁷ Newspaper stories about the case advanced the use of fingerprints in this country.

The West Case. Despite the fame achieved by Faurot, the most important incident to advance the use of fingerprints in this country was the **West case** (Figure 1-12). In 1903, Will West arrived at the U.S. penitentiary at Leavenworth, Kansas. While West was being processed in through identification, a staff member said that there was already a photograph and Bertillon measurements for him on file. But a comparison of fingerprints showed that despite identical appearances and nearly identical Bertillon

	William West	Will West
		
Bertillon:		
Measurements (in centimeters)		
Height	177.5	178.5
Outstretched arms	188.0	187.0
Trunk	91.3	91.2
Head length	19.8	19.7
Head width	15.9	15.8
Cheek width	14.8	14.8
Right ear	6.5	6.6
Left foot	27.5	28.2
Left middle finger	12.2	12.3
Left little finger	9.6	9.7
Left forearm	50.3	50.2

▲ **FIGURE 1-12 The Two Wests**

William West had been in Leavenworth Prison since 1901; Will West arrived two years later. Given their similar appearances and nearly identical anthropometry measurements, one can understand the confusion created upon Will West's arrival. (Courtesy FBI)

measurements, the identification card on file belonged to a William West, who had been in Leavenworth since 1901. The incident accelerated the recognition that fingerprints were superior to anthropometry as a system of identification.

Rivalry of Vucetich's and Henry's Systems

Vucetich's book on fingerprint classification was published in 1894, seven years before Henry's, but Henry's system has become much more widely used. However, some experts think that Vucetich's system was superior.⁶⁸ The rivalry between partisans of the two classification systems deserves attention.

In 1911 the provincial government of Buenos Aires passed a law requiring fingerprint registration for all adults subject to military service and eligible to vote.⁶⁹ By 1913 Vucetich had completed the task and decided to travel. In his travels, he was showered with decorations for his classification system. But when he visited Bertillon to pay his respects to the father of criminal identification,⁷⁰ Bertillon kept Vucetich waiting and finally opened the door just long enough to yell, "Sir, you have done me great harm," before slamming it shut again.⁷¹ They were never to meet again. On his return to Argentina, Vucetich was to face further humiliation. When Buenos Aires planned an expansion of fingerprint registration, there were strong protests. In 1917 the Argentine government canceled registrations, seized Vucetich's records, and forbade him to continue his work.⁷² In 1925 much as Bertillon

had in 1914, Vucetich died a disappointed man. Although Vucetich's system is in use in South America today, Vucetich did not live long enough to see the vindication of his life's work.

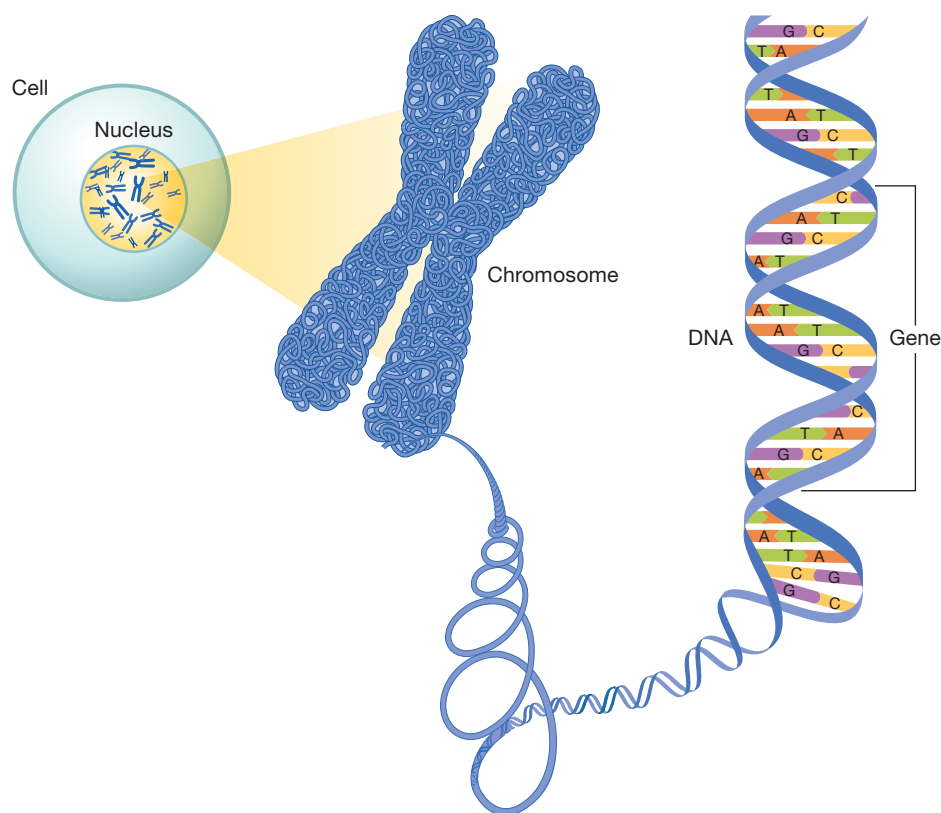
In contrast, Henry became the head of what was then the world's most prestigious police organization and enjoyed the support of his government. These advantages, coupled with Vucetich's loss of support in his own country, meant that the Henry classification would become adopted virtually throughout the world.

DNA

DNA as "Blueprint"

Although **deoxyribonucleic acid (DNA)** was discovered in 1868, scientists were slow to understand its role in heredity.⁷³ During the early 1950s, James Watson and Francis Crick deduced the structure of DNA, ushering in a new era in the study of genetics.⁷⁴ Such developments were seemingly of peripheral interest to forensic scientists until 1985, when research into the structure of the human gene by Alec Jeffreys and his colleagues at Leicester University, England, led to the discovery that portions of the DNA structure of certain genes can be as unique to individuals as are fingerprints.⁷⁵ According to Jeffreys, the chance of two persons having identical DNA patterns is between 30 billion and 100 billion to 1.⁷⁶

In all life forms—with the exception of a few viruses—the basis for variation lies in genetic material called



◀ **FIGURE 1-13**

DNA Structure

The long, stringy DNA that makes up genes is “spooled” or coiled within chromosomes. If unspooled and connected, the DNA is a person’s body would stretch approximately 67 billion miles. (Courtesy National Institute of General Medical Sciences, 2010)

DNA.⁷⁷ This DNA is a chemical “blueprint” that determines everything from hair color to susceptibility to diseases⁷⁸ (Figure 1-13). In every cell of the same human that contains DNA, this blueprint is identical, whether the material is blood, tissue, spermatozoa, bone marrow, tooth pulp, saliva, or a hair root cell.⁷⁹ Thus, with the exception of identical twins, every person has distinctive DNA.

The Enderby Cases

The first use of DNA in a criminal case was in 1987 in England.⁸⁰ In 1983 Lynda Mann, age 15, was raped and murdered near the village of **Enderby**. This case was unsolved. Three years later, another 15-year-old, Dawn Ashworth, was a victim in a similar offense. Comparing the DNA “fingerprints” derived from semen recovered from both victims’ bodies, investigators realized that the same man had raped and killed both women. A 17-year-old man was initially arrested and a sample of his blood was subjected to DNA analysis. This man’s innocence, however, was clearly established by the lack of a DNA match, and he was released. Subsequently, all males in the Enderby area between 13 and 30 years of age were asked by the police to voluntarily provide blood samples for DNA typing. Of 5,500 men living in the area, all but two complied with the request. A man then came forward and told the police that he had used false identification to supply a blood sample in the name of a friend. This friend, Colin Pitchfork, was subsequently arrested and convicted of Ashworth’s murder,

with DNA evidence playing a crucial role in the prosecution’s case.

The Orlando Cases

During 1986 a series of rapes and assaults occurred in Orlando, Florida, that resulted in the first use of DNA in criminal investigation cases in this country.⁸¹ The crimes shared a common pattern: the attacks occurred after midnight, in the victims’ homes, by a knife-wielding perpetrator. The perpetrator was quick to cover the eyes of the victims with a sheet or blanket, so none of them could give detailed descriptions of their assailant. During early 1987, investigators staking out a neighborhood in which it was believed the rapist might strike saw a blue 1979 Ford speeding out of the area. They followed the car for a short distance before it crashed into a utility pole while making a turn.

The suspect, Tommie Lee Andrews, lived just 3 miles from the home of the first victim, who identified him at a photographic lineup the next morning. The prosecutor’s case was certainly not ironclad. The identification rested on the victim’s having seen the defendant for 6 seconds in a well-lit bathroom nearly a year before the photo lineup. Standard forensic tests comparing characteristics of the suspect’s blood with characteristics derived from the semen found on the victim suggested that only Andrews could have committed the offense; but 30% of the male population of the United States shared these same characteristics. In short, there was enough evidence to prosecute, but a conviction was by no means a certainty.

However, on learning about the Enderby cases, the prosecutor secured DNA processing of the evidence and Andrews was convicted.

DNA Analysis

In 1988 the FBI became the first public-sector crime laboratory in the United States to accept cases for DNA analysis.⁸² Private firms also offer DNA testing, including Orchid Cellmark, with forensic labs in Nashville, Tennessee and Dayton, Ohio

Although DNA analysis of blood and other evidence from humans in criminal investigation cases is widely understood and used, there was no application of “genetic fingerprinting” to plant evidence in criminal cases until the 1992 **palo verde seedpod case** in Phoenix, Arizona.⁸³ Joggers found the body of a female who had been strangled. At the scene, investigators found a beeper, which led them to a suspect. The suspect admitted that (1) he had been with the victim the evening she disappeared, (2) the victim had been in his vehicle, (3) he and the victim had had sex, and (4) he and the victim had struggled. However, the suspect also maintained that the victim had run off with his beeper when he refused to help her to get drugs and that he had not been anywhere near the place the body was found in 15 years. Investigators had found two seedpods from a palo verde tree in the bed of the suspect’s truck. A University of Arizona plant geneticist was asked to determine if the seedpods came from a palo verde tree at the scene. The Maricopa County Sheriff’s Office collected a total of 41 samples of palo verde seedpods from the crime scene and the surrounding region. The geneticist was able to exactly match the seedpods from the bed of the suspect’s truck with those seized from the crime scene as part of the sample of 41 seedpods. Additionally, none of the 41 seedpods exactly matched another. This evidence was admitted at the trial. The defense attacked the evidence, properly arguing that the findings from a study based on 41 trees had substantial limitations and did not establish conclusively that the suspect could have gotten the seedpods only at the crime scene. However, along with other evidence, the testimony given by the geneticist had sufficient weight for the jury to convict the suspect.

FIREARMS IDENTIFICATION

Biometric based personal identification grew as several rival systems. Anthropomorphy lost credibility; Henry’s system of fingerprint identification substantially eclipsed Vucetich’s, and DNA remains widely used. In contrast, firearms identification moved forward in a series of successive steps.

In the United States, the frequency of shootings has made firearms identification extremely important.⁸⁴ As a specialty within forensic science, firearms identification extends far beyond the comparison of two fired bullets. It includes identification of types of ammunition, knowl-

edge of the design and functioning of firearms, restoration of obliterated serial numbers on weapons, and estimation of the distance between a gun’s muzzle and a victim⁸⁵ when the weapon was fired.

In 1835 **Henry Goddard**, one of the last of the Bow Street Runners, made the first successful attempt to identify a murderer from a bullet recovered from the body of a victim.⁸⁶ Goddard noticed that the bullet had a distinctive blemish on it, a slight gouge. At the home of one suspect, Goddard seized a bullet mold with a defect whose location corresponded exactly to the gouge on the bullet. When confronted with this evidence, the owner of the mold confessed to the crime.⁸⁷

Professor Lacassagne removed a bullet in 1889 from a corpse in France. On examining it closely, he found seven grooves made as the bullet passed through the barrel of a gun.⁸⁸ Shown the guns of a number of suspects, Lacassagne identified the one that could have left seven grooves. On the basis of this evidence, a man was convicted of the murder.⁸⁹ However, any number of guns manufactured at that time could have produced seven grooves. There is no way of knowing whether the right person was found guilty.⁹⁰

In 1898 a German chemist named Paul Jeserich was given a bullet taken from the body of a man murdered near Berlin. After firing a test bullet from the defendant’s revolver, Jeserich took microphotographs of the fatal and test bullets and, on the basis of the agreement between both their respective normalities and abnormalities, testified that the defendant’s revolver fired the fatal bullet, contributing materially to the conviction obtained.⁹¹ Unknowingly at the doorstep of scientific greatness, Jeserich did not pursue this discovery any further, choosing instead to return to his other interests.

Gradually, attention began to shift from just bullets to other aspects of firearms. In 1913 Professor Balthazard published perhaps the single most important article on firearms identification. In it, he noted that the firing pin, breechblock, extractor, and ejector all leave marks on cartridges and that these vary among different types of weapons. With World War I looming, Balthazard’s article was not widely read for some years.

Calvin Goddard (1858–1946, Figure 1-14), a U.S. physician who had served in the army during World War I, is the person considered most responsible for raising firearms identification to a science and for perfecting the bullet-comparison microscope. To no small degree, Goddard’s accomplishments were contributed to heavily by three other Americans—Charles Waite, John Fisher, and Phillip Gravelle—working as a team on firearms identification. In 1925, Goddard joined Waite’s team and upon Waite’s death a year later, Goddard became its undisputed driving force and leader.⁹² Like those of many pioneers, Waite’s contributions are often overlooked. He had been interested in firearms since 1917, and from 1920 on he visited firearms manufacturers to get data on those manufactured since 1850. Because of Waite, the first significant



▲ **FIGURE 1-14** Calvin Goddard, an American pioneer in the study of ballistics

cataloged firearms collection in this country was assembled. Nonetheless, ultimately it was Goddard who raised firearms identification to the status of a science.

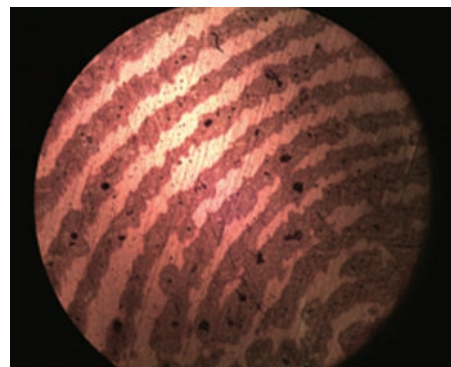
OTHER CONTRIBUTORS

There are many other contributors to the evolution of investigation and forensic science. For example, in 1910 **Albert Osborn** (1858–1946) wrote *Questioned Documents*, which is still regarded as a definitive work. **Leone Lattes** (1887–1954) developed a procedure in 1915 that permits blood typing from a dried bloodstain, a key event in forensic serology. Although more an administrator and innovator than a criminalist, **August Vollmer** (1876–1955), through his support, helped **John Larson** produce the first workable polygraph in 1921. Vollmer established America's first full forensic laboratory in Los Angeles in 1923.

In 1935 **Harry Soderman** and **John O'Connell** coauthored *Modern Criminal Investigation*, the standard work for the field for decades until the publication of *Crime Investigation* by **Paul Kirk** in 1953. A biochemist, educator, and criminalist, Kirk helped develop the careers of many criminalists.

RECENT DEVELOPMENTS

The knowledge base, facilities, and capabilities for both criminal investigation and forensic science are constantly advancing. A few illustrations are provided here and other developments are discussed in the appropriate chapters.



▲ **FIGURE 1-15** Atomic Force Microscope (AFM) image of fingerprint on cartridge case. (Courtesy of University of Leicester, Forensic Research Centre, England)

If fingerprints are left on cartridge cases which are then fired, attempts to recover fingerprints are successful only 1% of the time using conventional methods. However, in 2009, a new capability, using Atomic Force Microscope (AFM) imaging, was announced by researchers at the University of Leicester, England. When fingerprints come into contact with a polished metal surface, such as a cartridge case, a residue is left behind. This initiates a reaction that continues even if the print is wiped away, and the heat from discharge of a bullet actually enhances the interaction.⁹³ AFM examinations of fingerprints on polished surfaces produce extremely high-resolution 3-D images of them (Figure 1-15). AFMs also have applicability to the examination of documents.

Research using functional magnetic resonance imaging (fMRI), electroencephalography (EEG), and near infrared light (NIL) on the brain's electromagnetic signals has produced some tantalizing results.⁹⁴ Analysis of brain activity suggests that there are different patterns when people are lying, and it appears that brain activity can also reveal whether people are familiar with unpublicized details of crimes.⁹⁵ In *United States v. Semrau* (2010), a federal district court excluded fMRI evidence at trial because it lacked sufficient scientific support.

There continues to be strong interest in biometrics. Among the biometric-based methods of identifying individuals that are in use or on the horizon are hand geometry, iris scans, ear matching, facial and voice recognition, vein patterns, human body odor, and brain activity. The use of iris scanning presents some challenges, because the iris is affected by alcohol, drug use, pregnancy, and aging. Veins in subcutaneous tissue, the loose flesh immediately under the skin, are unique to each person. Several systems for imaging them are available, such as Vein Viewer and Palm Secure. Vascular pattern recognition (VPR) is focused on palm and finger subcutaneous veins. Electronic noses (E-Noses) have many applications, including food quality control and air pollution measurement. There is some

evidence that E-Noses are effective in detecting and classifying human body odor. In 2006, in Nanjing, China, the Chinese government began gathering an odor database, reporting success in using it to solve cases.

“Biometric signatures” also receive research attention. Although handwriting analysis has long been used,

examples of applications in development include identifying computer users by the pattern, speed, and rhythm of their keystrokes and gait or walking analysis, which presents analytical problems, because gait can be disguised or difficult to discern if long, loose-fitting clothing is worn.

KEY TERMS

anthropometry	Goddard, Calvin	O’Connell, John
Bertillon, Alphonse	Goddard, Henry	Osborn, Albert
biometrics	Gross, Hans	palo verde seedpod case
Bobbies	Henry, Edward	Peel, Robert
Bow Street Runners	investigator	Pinkerton, Allan
dactylography	Kirk, Paul	“police spies”
deoxyribonucleic acid (DNA)	Larson, John	Popay, Sergeant
Drug Enforcement Administration (DEA)	Lattes, Leone	rogues’ gallery
Enderby cases	Locard, Edmond	Scotland Yard
Fielding, Henry	Metropolitan Police Act (1829)	Soderman, Harry
Fielding, John	Mulberry Street Morning Parade	Vollmer, August
forensic science	National Academy	Vucetich, Juan
Galton, Francis	National Crime Information Center	West case
Girard, Stephen	(NCIC)	

REVIEW QUESTIONS

1. What is the most fundamental purpose of investigation?
2. What are four other objectives of investigation?
3. Who were the Bow Street Runners, and of what historical importance are they?
4. Why did the British public object to the use of detectives after enactment of the Metropolitan Police Act of 1829?
5. Why did the profession of detective in this country basically evolve in the private sector?
6. Of what significance is the work of Pinkerton and his National Detective Agency?
7. What is a rogues’ gallery?
8. Allan Pinkerton and J. Edgar Hoover have what similarities?
9. What is anthropometry, and why was it abandoned in favor of dactylography?
10. What are the milestones in the development of dactylography?
11. Why does the Henry classification system enjoy greater use than Vucetich’s system?
12. What are the different human sources of DNA material identified in this chapter?
13. Of what significance is the palo verde case?
14. What are the milestones in the development of firearms identification?

INTERNET ACTIVITIES

1. Research your local, county, and state police agencies. Do these agencies have a criminal investigation unit? Do “general investigators” investigate all types of crimes? Or, in contrast, is there investigative specialization—for example, a homicide unit? How many investigators are assigned to such units? Do officers have to meet a certain criteria to be assigned to these units? How are officers selected? Is there any history on the creation of these units?
2. Find out more about the FBI’s Biometric Center of Excellence (BCOE) by visiting www.biometriccoe.gov.