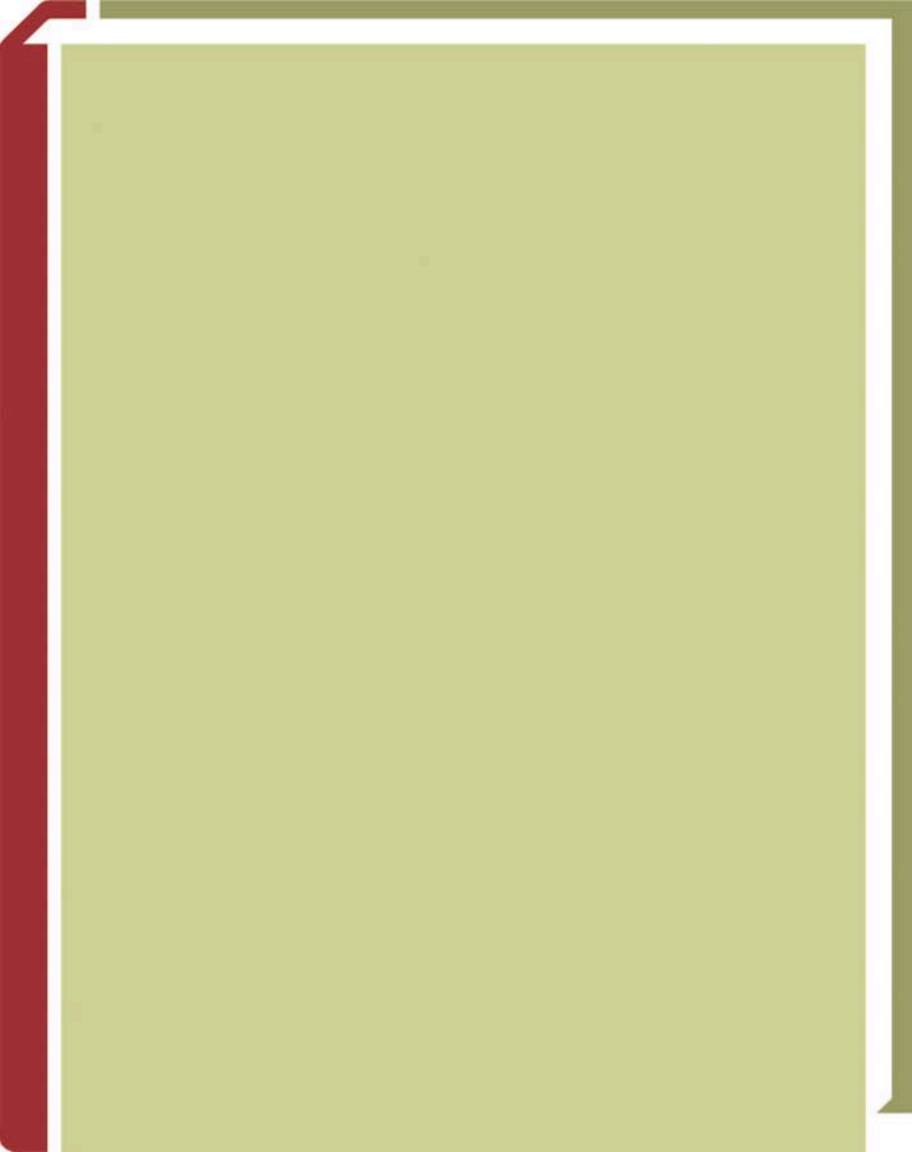

Forensic Science

Modern Methods of Solving Crime

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This book is dedicated to all of the students in my courses at West Virginia University who deserve sincere thanks for helping me understand, reduce, and refine the fundamentals of what forensic science is. Students are always the best teachers—that's my story and I'll stick by it.

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Preface

In the "Introduction to Forensic Science" course I teach at West Virginia University, I try to jog the students' minds from their preconceptions, especially about the forensic sciences. I explain how forensic science is a historical science, like geology, archaeology, or astronomy, and forensic scientists reconstruct past criminal events through physical evidence. This reconstruction requires an interpretation or telling of the events (a "strong narrative") and this, in turn, requires a grammar. If nouns are the sources of the evidence (guns, sweaters, bodies, etc.), the bits of evidence found at the scene or on the victim are pronouns (representing as they do the subjects or objects, i.e., nouns or evidence), and the criminals' actions themselves are the verbs. Adjectives and adverbs come infrequently to forensic interpretations unless they are bound within the factual description of the evidence—portions of snapshots, frozen partial views of the past criminal events. A perfect reconstruction of a crime scene would be an infinitely detailed video, capable of being enhanced, reviewed, and reanalyzed at the whim of the investigating scientist. Forensic science does not get evidence like this, not even *video* evidence. The "partial snapshot" analogy encourages them to consider what can and cannot be said after a forensic analysis—it encourages conservatism. It also frames the students actions themselves are the verbs. Adjectives and adverbs come infrequently to forensic interpretations unless they are bound within the factual description of the evidence—portions of snapshots, frozen partial views of the past criminal events. A perfect reconstruction of a crime scene would be an infinitely detailed video, capable of being enhanced, reviewed, and reanalyzed at the whim of the investigating scientist. Forensic science does not get evidence like this, not even *video* evidence. The "partial snapshot" analogy encourages them to consider what can and cannot be said after a forensic analysis—it encourages conservatism. It also frames the students view of forensic science outside the traditional perspective and they realize they can play with ideas a bit more than they might have otherwise considered.

They understand there are things you can and cannot say in forensic science and perhaps also understand why the rules of grammar need to be bent at times. Forensic science is now something other than the media-colored perception with which they started class (M.M. Houck, "CSI: Reality," *Scientific American* [2000]: 84–89).

A drug chemist once argued with me that what my students did was not a "historical science," as I teach my students, because they performed chemical analyses on the suspected illicit drug samples and were not involved in a reconstruction. The substance either was cocaine or not and that was the end of their concern in the matter. Fair enough, as far as that argument goes. But to what end is the chemical analysis being performed? Surely not for the pure joy of chemistry alone. The analysis is done to support or refute the allegation that a person was found with an illegal substance in their possession. Read that sentence again. You probably slipped past the two most important words in that last sentence: *was found*. Possession of cocaine ostensibly indicates a *past criminal act* and the chemist, whether he or she acknowledges it or not, is assisting in the reconstruction of that event.

A bit of explanation about this grammar thing may be necessary. When two things come into contact, information is exchanged. This is one of the central guiding principles of forensic science. Developed by Edmund Locard, it posits that this exchange of information occurs, even if the results are not identifiable or are too small to be found. The results of such a transfer would not be the transfer itself, but the remnants of that transaction, what paleoclimatologists call proxy data. Proxy data that are collected and analyzed by forensic scientists are evidence; if these are not collected or analyzed, they can hardly help to make a proposition more or less likely. Otherwise, these are just proxy data left at the scene of the crime. This is why I call evidence "pronouns": we rarely examine the thing itself *for* itself but examine either bits of it that have transferred or something transferred to it that *represents* the source. Pronouns stand in for nouns and through the context of a sentence we know which "it" or "he" stands for the "toaster" or "John."

Because forensic science demonstrates associations between people, places, and things, essentially *all evidence is transfer evidence*. The following table lists some examples in support of this concept. All evidence comes from a source and ends up on a target; in this sense, all evidence is transferred.

Item	Transferred From (Source)	Transferred To (Target/Location)
Drugs	Dealer	Buyer's pocket or car
Bloodstains	Victim's body	Bedroom wall
Alcohol	Glass	Drunk driver's bloodstream
Semen	Assailant	Victim
Ink	Writer's pen	Stolen check
Handwriting	Writer's hand/brain	Falsified document
Fibers	Kidnapper's car	Victim's jacket
Paint chips/smear	Vehicle	Hit-and-run victim
Bullet	Shooter's gun	Victim's body
Striations	Barrel of shooter's gun	Discharged bullet
Imperfections	Barrel-cutting tool	Shooter's gun's barrel

Not all forensic scientists would agree with this view; nontrace evidence analysts would be among the first to disagree. But it makes sense to my students, who are something of a tabula rasa when they come in (television notwithstanding). In working toward a unified theoretical basis of forensic science, we must be willing to collapse categories as well as to expand them.

Another idea that may not be self-evidenct: Evidence is accidental. Items are transformed into evidence by their involvement in a crime regardless of their source or mode of production. No factories churn out bloody clothing or spent bullets. By becoming evidence, everyday items have their normal meaning enhanced and expanded. Evidence is initially categorized much like the real world; that is, based on the taxonomy created by manufacturers (e.g., optical glass vs. bottle glass) or devised by natural scientists (shale vs. wollastonite, finches vs. pigeons—including subtypes). Forensic science adds to this taxonomy to further enhance or clarify the meaning of evidence relevant to the goals and procedures of the discipline.

Forensic science's taxonomies, while based on production taxonomies, are nevertheless different from them. Manufacturing of economic goods, for example, creates its taxonomy through analytical methods. Standard methods ensure a quality product fit for purpose and sale. The taxonomy is based on the markets involved, the orientation of the company production methods, and the supply web of raw and processed materials.

Explicit rules exist on categories recognized by manufacturers and consumers: McDonald's versus Burger King, loafers versus oxfords, Windows versus Macintosh.

Forensic analytical methods create different taxonomies, however, because forensic scientists have different goals and this requires the use of different methods. Their taxonomies are based on manufactured or class traits, but also aftermarket qualities, intended end use but also "as used." The "as used" traits are those imparted to the item after purchase either through normal use or criminal use. Forensic science has developed a set of rules through which the taxonomies are explicated. For example, forensic scientists are interested in the size, shape, and distribution of delustrants—microscopic grains of titanium dioxide—incorporated into a fiber to reduce its brightness. The product determines the goal; ball gowns should be shiny, carpets should not be. The manufacturer has included delustrants in the fiber at a certain rate and percentage with no concern for shape or distribution (but size may be relevant). The forensic science taxonomy is based on the manufacturing taxonomy but is extended by incidental characteristics that help us to distinguish otherwise similar objects. A heavily delustered fiber may have large or small granules; they may be evenly distributed or clumped together; they may be round or irregular, and so on. The fiber manufacturer could not care less but the forensic scientist cares a great deal.

P.W. Bridgman once wrote, "The concept is synonymous with the corresponding set of observations" (*The Logic of Modern Physics*, 1932, New York: Macmillan Publishers, 5).

Although terse, this phrase is apt for forensic science. Each measurement taken and each observation made are indications of the conceptual principles that support a science. So it is with forensic science—refractive index is useful to an analysis precisely for the reasons it is used: It helps to discriminate between materials. Of course, my bias is evident: I see trace evidence as embodying the essence of forensic science. Perhaps it is not bias, however, but merely the proper viewpoint. After all, "only Nixon could go to China," and maybe what is required to point out the bare philosophical underpinnings of our discipline are the people closest to it's guiding principle. Trace evidence gets short shrift in many of today's forensic laboratories, especially struggling in the shadow of its younger, more popular sibling, DNA.

I hope this book brings a fresh view of forensic science to you, one that is not tinged by accusations of inept practitioners, wildly dramatic television shows, or the rhetoric of attorneys. It is a fascinating field and one that is still in many ways maturing from its adolescence in police agencies. The view I offer will, I hope, spur you to support forensic science in its growth and development as an integral part of the criminal justice system.

MMH

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Thanking people is a nicety we ignore too often. Writing takes time, solitude, and doggedness; this, in turn, requires the indulgence of people who invest in and count on your presence. Thanks are due to those individuals whose time I have stolen or who have invested in me so that I may steal that time: My wife, Lucy; my father, Max; my staff at the Forensic Science Initiative (Mary, Robin, Samantha, Anna, Emily, Ryan, Marlene, and Shiela); my agent Jodie; and Suzanne Staszak-Silva (we tried). Finally, thanks to you for reading this book.

Important Moments in the History of the Forensic Sciences

1810 Eugène François Vidocq, a noted wily criminal, convinces the Paris police to exchange a jail sentence to become an informant in Paris' toughest prison. Vidocq would eventually establish the first detective force, the Sûreté of Paris.

1828 William Nichol invents the polarizing light microscope, revolutionizing the study of microscopic materials.

1835 Adolphe Quetelet, who based his work on the criminology of Caesare Lombroso, postulates that no two human bodies are exactly alike.

1835 Henry Goddard performs the first forensic bullet comparison. Goddard's work implicates a butler who faked a burglary to commit murder based on similar flaws in a questioned bullet and the mold that made it.

1838 William Stewart of Baltimore murders his father and is convicted based on bullet evidence, making it the first case solved by forensic firearms examination in the United States.

1856 Sir William Herschel, a British officer working for the Indian Civil service, uses fingerprints on documents to verify document signatures, a practice recognized in India but not forensically.

1863 The German scientist Christian Schönbein discovers the oxidation of hydrogen peroxide when exposed to hemoglobin. The foaming reaction is the first presumptive test for blood.

1880 Henry Faulds, a Scottish physician working in Tokyo, publishes a paper in the journal *Nature* suggesting that fingerprints could identify an individual involved in a crime. Faulds goes on to use fingerprints to solve a burglary.

1883 Alphonse Bertillon identifies his first recidivist based on his system of Anthropometry.

1887 Arthur Conan Doyle publishes the first Sherlock Holmes story.

1891 Hans Gross publishes *Handbuch fur Untersuchungsrichter* (Handbook for Examining Magistrates), the first comprehensive text that promotes the use of science and microscopy to solve crimes.

1892 Francis Galton publishes *Fingerprints*, the first text on the nature of fingerprints and their use as a forensic method.

1894 Alfred Dreyfus of France is convicted of treason based on a faulty handwriting identification by Bertillon.

1896 Sir Edward Henry develops a classification system for fingerprints that becomes the standard taxonomy in Europe and North America.

1900 Karl Landsteiner first discovers human blood groups (the ABO system); he is awarded the Nobel prize for this in 1930. Landsteiner's work on blood forms the basis of nearly all subsequent forensic blood work.

1901 Sir Edward Richard Henry is appointed head of Scotland Yard and pushes for the adoption of fingerprints over Bertillon's anthropometry.

1901 Henry DeForrest pioneers the first systematic use of fingerprints in the United States in the New York Civil Service Commission.

1902 Professor R.A. Reiss, professor at the University of Lausanne, Switzerland and a student of Bertillon, pioneers academic curricula in forensic science.

1903 The New York State Prison system begins the systematic use of fingerprints for United States criminal identification.

1908 U.S. President Theodore Roosevelt establishes a Federal Bureau of Investigation (FBI).

1910 Victor Balthazard, professor of forensic medicine at the Sorbonne, with Marcelle Lambert, publishes the first comprehensive hair study, *Le poil de l'homme et des animaux.* In one of the first cases involving hairs, Rosella Rousseau was convinced to confess to murder of Germaine Bichon.

1910 Edmund Locard, successor to Lacassagne as professor of forensic medicine at the University of Lyons, France, establishes the first police crime laboratory.

1913 Victor Balthazard, professor of forensic medicine at the Sorbonne, publishes the first article on individualizing bullet markings.

1915 International Association for Criminal Identification (later to become The International Association of Identification [IAI]) is organized in Oakland, California.