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# FORENSIC EVIDENCE: SCIENCE AND THE CRIMINAL LAW

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SECOND EDITION

Terrence F. Kiely



Taylor & Francis  
Taylor & Francis Group

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# Dedication

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This book is dedicated to the loving memory of my mother, Elizabeth Wolfe, and my step-father, John Wolfe.

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# Preface

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In investigations of every kind it is essential that a correct estimate be made, of the kind and degree of assurance of which the subject admits.

In the subjects of moral science, the want of appropriate words, and the occasional application of the same word to denote different things, have given occasion to much obscurity and confusion both of idea and expression; of which a remarkable exemplification is presented in the words probability and certainty.

## William Wills: An Essay on the Principles of Circumstantial Evidence (1838)

*Forensic Evidence: Science and the Criminal Law* (Second Edition), is intended to serve as an introduction and guide to the appreciation and understanding of the significant historic, contemporary, and future relationship between the world of the forensic sciences and the criminal justice system. This book is not intended to be a close study of forensic science, nor was it ever conceived as becoming one. It is devoted to a study of *the judicial response to uses of forensic science* in the investigation, prosecution, and defense of a crime. The audience to which this study is directed are those intimately or potentially involved in that relationship: police, forensic scientists, prosecutors, defense lawyers, and professors and students of the criminal law. It is meant to stand on its own but also to complement the growing number of excellent treatises and studies in the forensic sciences proper, many of which are published in the CRC Press series in the area of forensic sciences.

The book will focus on those cases questioning the legal acceptability under a *Frye* or *Daubert* standard of the methodological basis of the forensic science at issue. However, equally, if not more important, will be the discussions of the numerous cases where the courts, assuming the acceptability of the underlying methodology, have scrutinized and accepted or rejected a wide variety of *investigative uses* of the science under discussion, offered as proof

of one or more material facts in a criminal prosecution. This latter area of study is of equal, if not more central importance in understanding the place of forensic science in the criminal justice system of the 21st century.

It is time for another close look at both the body of claims and actual expert opinions supplied to the criminal justice system as we enter the first decade of the new century. The totally justified attention given rapid DNA developments should not overshadow the ongoing judicial acceptance and use of the more traditional body of forensic sciences such as hair, fiber, ballistics, or fingerprints, most of which have never been fully challenged. The contributions of forensic science to the criminal justice system have been, and remain, significant.

This book is divided into 12 chapters, most of which, with the exceptions of Chapters 1, Science, Forensic Science, and Evidence and Chapter 2, Science and the Criminal Law, address the legal profile of a specific forensic science.

**Chapter 1, Science, Forensic Science, and Evidence**, briefly analyses the historical and contemporary context in which legal arguments directed to the adequacy of the findings of forensic science are conducted. This is a necessary precursor to the more criminally focused discussion that constitutes the bulk of this volume. The framework of the *Frye* and *Daubert* standards for the introduction of scientific opinion will be discussed here as well as the significant differences that exist when the legal challenge comes in a civil as opposed to a criminal law forum.

**Chapter 2, Science and the Criminal Law** provides an overview of the entire subject of the uses of forensic sciences in the investigation, prosecution, and defense of criminal cases in American courts. Central topics addressed there are the historical and contemporary relationship between forensic science and proof of crime, the fundamentals of the application of forensic science disciplines to the investigation and prosecution of a criminal case, the function of probabilistic to that process and an extended discussion of the legal aspects of the modern crime scene. A brief listing of those chapters follows:

**Chapter 3, Hair Analysis**, will discuss the court's response to both class and individual opinions as respects attempts to connect one or more hairs found at a crime scene to an individual suspect. This controversial subject will set the analytical framework for the discussions to follow on a wide range of forensic science applications.

**Chapter 4, Fiber Analysis**, will discuss the identification and use of a wide variety of fiber materials from crime scenes and the processes used to link any such materials to a suspect.

**Chapter 5, Ballistics and Toolmarks**, will address the subjects of firearms and projectile identification, the matching of bullets to a weapon, gunshot

residue and toolmark identification and attempts to match crime scene striations to a tool associated with a suspect.

**Chapter 6, Soil, Glass, and Paint**, discusses the nature of soil and glass shard particle identification and the attempt to connect such materials with an individual suspect.

**Chapter 7, Footwear and Tire Impressions**, addresses the identification, photographing, and or casting of footwear and tire impressions found at a crime scene to those associated with a suspect.

**Chapter 8, Fingerprints**, discusses the subject of fingerprint identification procedures and the recent Automated Fingerprint Identification System (AFIS).

**Chapter 9, Blood Spatter Analysis**, analyses cases involving the subject of presumptive testing for blood products as well as the subject of blood stain pattern analysis and its importance in many key aspects of crime scene reconstruction efforts.

**Chapter 10, DNA Analysis**, will analyze the court's scientific conditions for the acceptance of identification testimony arising from RFLP, PCR, STR DNA and mitochondrial (MtDNA) analyses, in addition to the small but growing number of cases and articles addressing nonhuman DNA testing, in particular, dog, cat, and plant DNA testimony.

**Chapter 11, Forensic Anthropology and Entomology** will briefly examine those decisions that utilize the methodologies and findings of these fields as aides to the investigation and identification of human remains and providing time of death estimates.

**Chapter 12, Epilogue**, will provide a brief summary note on the subjects not covered in this book and the major points sought to be made in the entire work.



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# The Author

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**Terrence F. Kiely** is a professor of law and the director of the DePaul University College of Law's Center for Law and Science.

Professor Kiely graduated from Loyola University in Chicago (B.S., humanities) in 1964, DePaul University College of Law (Juris Doctor) in 1967 and also received an LL.M. (foreign and comparative law) from New York University School of Law in 1970. Professor Kiely is an expert in the area of the interaction between science and the civil and criminal law. He is the author of five previous books:

*Preparing Products Liability Cases* (John Wiley & Sons, 1987)

*Using Litigation Databases* (John Wiley & Sons, 1989)

*Modern Tort Litigation* (John Wiley & Sons, 1990)

*Forensic Evidence: Science and the Criminal Law* (CRC Press, 2001)

*Science and Litigation: Products Liability in Theory and Practice* (CRC Press, 2002)

Professor Kiely has been a full time member of the DePaul University College of Law faculty since 1972. He teaches in the areas of torts, products liability, criminal law, evidence and forensic evidence. During the academic years 1995–1996 he was the Robert A. Clifford Professor of Tort Law and Public Policy. His work with the Center for Law and Science involves the maintenance of a comprehensive law and science Web site and organizing and participating in forensic science and evidence seminars at the College of Law.

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# Science and the Criminal Law

# 1



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We have also houses of deceits of the senses, where we represent all manner of feats of juggling, false apparitions, impostures and illusions, and their fallacies. And surely you will easily believe that we, that have so many things truly natural which induce admiration, could in a world of particulars deceive the senses if we would disguise those things, and labor to make them more miraculous. But we do hate all impostures and lies, insomuch as we have severely forbidden it to all our fellows, under pain of ignominy and fines, that they do not show any natural work or thing adorned or swelling, but only pure as it is, and without all affectation of strangeness.

Francis Bacon: *The New Atlantis* (1626)

## I. Science and the Legal Process

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The term science in the discussions that follow has little or no connection to the use and understanding of that term as it is uniformly thought of by the international scientific community. John Horgan, former editor of *Scientific American*, in his excellent book *The End of Science: Facing the Limits of Knowledge in the Twilight of the Scientific Age*,<sup>1</sup> sought out the world's leading philosophers of science — theoretical physicists, evolutionary biologists, mathematicians, astronomers, and chaos theorists — to get their perspectives on whether “science” was at a close, with nothing significant left to be discovered. This book is a superb survey of modern scientific thinking across a very wide variety of fields. The contemporary legal question regarding

the adequacy of a scientific methodology to support an expert opinion is light years away from the type of scientific inquiry discussed by the scholars Horgan interviewed. Horgan notes the criticism by Nobel prize-winning chemist Professor Stanley Miller of scientific papers culled from other published papers where no hard-won finding has resulted from extensive laboratory work. Professor Miller referred to such works as “paper chemistry.” In the hard-fought, science-based civil cases, such as the breast-implant actions or the polychlorinated biphenyl (PCB) and cancer litigation, we can borrow the idea and refer to the use of previously published articles, by extrapolation in such cases, to claim or deny causation as “paper science,” a charge that may be made in part only about forensic science-based testimony in criminal cases.<sup>2</sup>

The attempts to formulate an overarching answer to the question of “What is science?” in the world of scientific endeavor and the American legal system are clearly distinct in overall goals, methodology, and practical applications. When the question is restricted to the area of law, the use of science in civil tort cases and in criminal prosecutions is also based on significantly different goals, methods, and practical effects. The issues of whether long-term exposure to phencyclidine (PCP) can cause cancer in a products liability lawsuit are quite different from the forensic issue of whether hair or fiber expert testimony can be used to link a defendant to a crime scene in a homicide prosecution. It is also important to understand the differences between civil and criminal cases with respect to the performance of laboratory work pursued to answer key factual issues in the cases. Forensic scientists in white lab coats are routinely involved in criminal prosecutions. Their work is used to shed light on the physical dynamics that created the crime scene, to add significant information linking a defendant to a crime scene, and to move toward the identification of the perpetrator. Forensic scientists are rarely involved in answering the essential scientific causation issues at the center of modern products liability litigation.

## II. Forensic Science Questions

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Examining a set of rhetorical questions that revolve around our core inquiry about the nature and value of forensic science can help to clarify the discussions that follow.

- What facts or assumptions or surmises can be obtained from the examination of one or more physical items gathered at a crime scene?
- What is the likely basis for such assumptions or projections, or guesses?



- What value can be assigned to any factual estimation in a criminal justice system where life and liberty and justice to a victim all play a part?
- What is the meaning of statements that report one or more fibers or hairs or footprints, are or are not consistent with, or not dissimilar or substantially similar to, another fiber, hair, or footprint?
- What is the basis for such statements and what value can be allocated to them if one set of exemplars was taken from a crime scene and the other exemplars belong to a suspected perpetrator?
- What are the implications of such statements in the context of long-held requirements that the elements of a crime must be proven beyond a reasonable doubt? How does circumstantial evidence fit into prosecutorial efforts designed to meet such a high bar of proof in a case partially supported by hair or fiber evidence?
- How dependent is the power of forensic evidence on the traditional observation by eyewitnesses?
- How much of forensic analysis and comparison testimony have to do with scientific theory or recognized scientific methodology?
- What science, if any, has been traditionally associated with hair, fiber, paint, or glass analysis; and how has that science changed as we enter the 21st century?
- Is forensic analysis, aside from microscopy, scientific because of the theoretical underpinnings of the discipline, or because of its use of microscopy and other processes that aid its essentially observational nature?
- What is the difference if the bulk of the forensic science analyses are simply a combination of experience and modern microscopy? What else, from a forensic scientist standpoint, can be said about fiber, hair, footprints, fingerprints, or ballistics and their examinations and the factual assumptions that result? Can more be found to give such disciplines as great or greater credibility than fingerprint impression, ballistics, tool marks, or deoxyribonucleic acid (DNA)?

The repetition of these recurring questions across the range of the forensic sciences discussed in this book indicates the great similarity of trace-evidence analysis, in both a class characteristic and especially in individualistic statements, that seeks to link a particular suspect to a crime scene. In hair analysis; footwear and tire impressions; glass, paint, and soil analyses; bite-mark impressions, and most other, forensic science settings, we seek to discover what general nonsuspect-related categories of information can be gleaned from the analysis of a datum, for example, fiber obtained at a crime scene.