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FORENSIC SCIENCE HANDBOOK Volume I

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PREFACE

Forensic science is no different from any other scientific discipline; its growth and vitality are inextricably linked to the continuous accumulation of knowledge through discovery and experience. Science builds on past accomplishments; its rate of progress is measured by the caliber of published data and results. The first edition of *Forensic Science Handbook* was published in 1982. This book eventually grew into the current three-volume series. The three Handbooks have proven to be widely circulated professional reference books, as well as standard textbooks for graduate courses in forensic science. For the foreseeable future, the Handbooks will remain a three-volume collection. For the most part, the subjects to be found in this second edition of Volume I remain the same as in the first edition, but with an updated content. However, there are some notable additions to this revision. The impact of DNA technology has fundamentally changed the way forensic analysts characterize biological stains. The chapter "Modern Forensic Biology" details the field collection of DNA evidence and proceeds with a methodical updated treatment of the forensic laboratory's strategy for analyzing biological stains. Also, entirely new chapters have been added to the Handbook on the subjects of capillary electrophoresis and visible spectrophotometry.

Forensic Science Handbook—Volume I places in one reference source authoritative, updated reviews embracing important areas of the criminalistic enterprise. The topics selected for inclusion in the Handbook are designed to provide the reader with material necessary to comprehend, evaluate, and

appreciate the application and interpretation of scientific tests to an array of physical evidence. Chapters are devoted to discussions of examination techniques for a wide range of evidence found in the modern crime laboratory—DNA, hair, paint, soil, glass, petroleum products, explosives, alcohol in blood and breath, and questioned documents. The expanding applications of mass spectrometry, capillary electrophoresis, high-performance liquid chromatography, and the visible microspectrophotometer warrant the inclusion of chapters describing their theory, operation, and forensic use. However, the emergence of modern analytical instruments has not diminished the importance of the light microscope in criminalistics. The microscope's unique role in the crime laboratory has prompted coverage of its operational theory and applications to forensic science problems.

A chapter describing the role and conduct of the expert witness and rules of evidence, as well as the legal requirements governing the admissibility of scientifically evaluated evidence, serves to emphasize the ties that bind forensic science to criminal law.

The contributors to this volume of the Handbook are all recognized forensic experts well versed in the practices of their chosen areas of expertise. The expectation is that these authors will be successful in communicating to the reader knowledge and lessons derived from their many years of practical experience in laboratories and courtrooms. The editor deeply appreciates the enthusiasm and skills each contributor brought to this project. Their efforts are a mark of their professionalism and dedication to continued achievement and excellence in forensic science.

I want to credit the efforts of Gonul Turhan, who aided me in reviewing the manuscript and tying up lots of loose ends while preparing the manuscript for production. I wish to express my appreciation to my production editor, Linda Pawelchak, for transforming the manuscript into a finished book. I also want to acknowledge my acquisition editor, Kim Davies, for supporting the Handbook volumes.

The views and opinions expressed in the book are those of the contributors and do not necessarily represent those of any governmental agency.

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CHAPTER 1

LEGAL ASPECTS OF FORENSIC SCIENCE

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Today almost all scientific or professional disciplines provide scientific or technological evidence in court. This evidence is known as expert evidence. It encompasses both testimony and nontestimonial evidence, such as demonstrative evidence presented by experts. Forensic science is the application of scientific principles and technological practices to the purposes of justice in the study and resolution of criminal, civil, and regulatory issues. The testimony offered by specialists is frequently couched in terms of opinions, conclusions, and evaluations, which themselves are not scientifically measurable.[1]

This chapter discusses essential, practical, utilitarian, and fundamental concepts of scientific evidence and expert evidence. It is intended to provide the constructs necessary for understanding the legal aspects of forensic science and being a successful consulting and testimonial witness. The overview presentation is applicable to both the novice and experienced occupational expert witness.

The value of liberty is impossible to quantify, but liberty is clearly cherished by our society.[2] Our adversary criminal justice system is designed to ensure the application of the principles set forth in the U.S. Constitution. The right to confront the prosecution's critical evidence through independent testing and its purported analytical result is a fundamental right that cannot be restricted.[3]

Forensic science is an essential, integral aspect of the law enforcement and judicial systems. Attorneys seldom feel comfortable or confident in their ability to obtain, interpret, and understand scientific information. Hence, they rely on experts to provide them with scientific material relevant to the case.[4] The law needs science to help it know about facts of the world in which legal policy and understanding must operate.[5] The reverse is also true of the scientist's understanding of the law. Without the legal system and attorneys, the vocation of consulting and testimonial experts would not exist.

The use of experts is an important aspect of the adjudicatory process because science and technology can reduce uncertainty about particular facts, thereby facilitating the decision-making process.[6] Louis Pasteur's assertion that "there are no such things as applied sciences, only application of science" is particularly true in litigation.

The primary function of forensic scientists, or opinion witnesses, at trial is to assist the trier of fact, the judge or the jury, in understanding meth-

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Dedicated to my nieces Ella Gili Barzel and Aela E. Sapir and nephews Elan S. Sapir and Hillel E. Sapir.

The author acknowledges the contributions of Nicholas T. Kuzmack, JD, MA, author of the original chapter, "Legal Aspects of Forensic Science," contained in *Handbook of Forensic Science*, vol. 1, ed. Richard Saferstein, Prentice Hall, Englewood Cliffs, N.J., © 1982.

ods used and conclusions reached in a discipline not within their general knowledge.[7] Scientists tend to perceive themselves as merely translators of findings into legal probabilities and not as educators. The forensic scientist must be able to impartially, credibly, and coherently communicate test results[8] and explain the methods and processes used to reach those conclusions to the finder of fact. Scrutinization of test results conforming with the gold standard in quality of laboratory procedures, methodologies, documentation, and results is also to be expected.[9]

The forensic scientist who, upon court approval, becomes an expert witness applies general scientific theory or techniques to specific facts in order to formulate an opinion premised upon a "reasonable degree of scientific certainty."[10] Scientific or technological evidence encompasses both testimonial and nontestimonial evidence presented by experts. The expert need not express an unqualified and absolute conclusion but is allowed to express an opinion. This privilege, in the words of L. T. Perrin, makes

> experts . . . powerful witnesses. The expert is largely free of the restraints the rules impose on everyone else. Opinion testimony is not simply allowed, it is expected. Even opinions that embrace the ultimate issue are permitted. Personal knowledge is unnecessary. Testimony on matters of common knowledge is allowed. The expert is permitted to use hearsay in forming an opinion and to tell the jury about it. The structure of the rules of evidence provides the context to understand why experts are so attractive to lawyers.[11]

The movant[12] in legal proceedings must demonstrate the reliability of the test in order to satisfy due process and fundamental fairness. All cases involving criminal charges entail some aspect of scientific evidence and forensic science. In criminal prosecutions, law enforcement extensively relies upon scientific principles and technology. This interdependence is exemplified by the application and use of forensic DNA analysis for identification or breath alcohol testing devices in drunk driving prosecutions.

In the current legal system, success in the courtroom requires as much scientific acumen as it does legal knowledge. A paradox of expert witness testimony is the use of attorneys. Most lawyers and judges are scientifically unaware if not uninformed. They are ill equipped and underprepared by training and experience to handle the complexities of scientific evidence.[13] Their knowledge of science parallels that of a layperson. Judges and attorneys must be able to understand and decipher scientific evidence. A science degree is not a judicial requisite even for appointment to the U.S. Supreme Court.[14] Understanding science, arguably, is part of the constitutional duty assumed by legislators, administrators, and judges.[15] Similarly, issues and questions of science will most likely be misunderstood by members of the legal system.[16]

Role and Attributes of Experts

The Role of the Expert Witness

The attorney-client privilege is designed to protect confidential communications between a client and his or her attorney. This privilege extends to expert consultants engaged by the attorney on behalf of the client. It is essential that the attorney maintain work product confidentiality,[17] provide all case materials, and discuss problem areas with the consulting and testimonial expert.

Experts may be used in one of two capacities—consultation or testimony—and are classified into five general categories of expertise:

Layperson: Applies common sense and life-long experience

Technician/examiner: Has limited and concentrated training; applies known techniques; works in a system and was taught in a system; examples include investigators and supervisors[18]

Practitioner: Analyzes and interprets material and information

Specialist: Is devoted to one kind of study or works with individual characteristics

Scientist: Conducts original empirical research; conducts experiments to verify the validity of theories; designs and creates instrumentation and applied techniques; is published in own field with peers; and advances his or her field of knowledge

A consulting expert is a person who has been retained or specifically employed in anticipation of litigation or in preparation for trial but who is not to be called at trial. The identity, theories, mental impressions, litigation plans, and opinions of a consultant are work product and are protected by the attorney-client privilege.[19]

A testimonial expert is retained for purposes of testifying at trial. The confidentiality privilege is waived, and all materials, notes, reports, and opinions must be produced through applicable discovery proceedings. If an expert relies on work product or hearsay as a basis for an opinion, that material must be disclosed and produced through discovery.[20]

The expert witness performs two primary functions: (1) collecting, testing, and evaluating evidence and forming an opinion as to that evidence and (2) the forensic function—communicating that opinion and its basis to the judge and jury. A general rule of evidence is that witnesses may testify only to what they have personally observed or encountered through their five senses.

Expert witnesses are arguably "conduits of hearsay and other unreliable evidence."[21] In general, witnesses are not allowed to testify to their opinions, with several specific exceptions. One exception is the testimony of the expert witness, a witness whose opinion will be likely to aid the trier of fact in the search for the truth. The expert may testify to ultimate issues that are mixed

questions of law and fact.[22] The expert, however, may not give an opinion or state a legal conclusion regarding a question of law that is to be decided by the court.[23] Further, an expert witness's opinion cannot be couched as possibilities or probabilities without articulating the underlying factual basis.

An attorney is prohibited from vouching for the credibility or truthfulness of any witness, including an expert witness.[24] Witness credibility cannot be bolstered by having a prosecutor or a prosecution's expert witness express a personal belief that the witness provided truthful information or by vouching for the witness's truthfulness in any other matter. This prohibition is especially important in summation arguments.[25]

Qualifications of the Expert Witness

The witness must be competent in the subject matter. He or she may be qualified through knowledge, skill, practical experience, training, education, or a combination of those factors. Once competency has been verified, a witness's knowledge of the subject matter affects the weight and credibility of his or her testimony.

Minimally, the expert witness must know the underlying methodology and procedures employed and relied upon as a basis for the opinion. The background knowledge includes state-of-the-art technology, literature review, and experience, the combination of which culminates in an opinion based upon a reasonable degree of scientific certainty. There is no absolute rule, however, as to the degree of knowledge required to qualify a witness as an expert in a given field.[26]

A debilitating invitation to blatant accusations and findings of motive, interest, and bias exists if the proffered witness is required to testify on the basis of his or her job description and employment duties. This is a common problem with government employees.[27] Claims of intellectual dishonesty and inherent prejudice may be insurmountable. An expert witness cannot have an interest in the outcome of the trial.

The imprimatur of a governmental agency, laboratory, office, or title does not automatically make either the results or the witness's testimony inherently trustworthy, credible, and reliable.[28] A witness is not an expert merely because the term is part of his or her title or job description (e.g., Special Agent or Drug Recognition Expert). The name *special, expert,* or *inspector* itself gives an instantaneous indication and aura of authority and respect that implies to the trier of fact a specific expertise beyond normal employment (law enforcement/police) qualifications.[29]

The movant must provide complete current information on the expert witness. If there is noncompliance, opposing counsel will undoubtedly ask what the witness is trying hide. The court—not the attorney or the witness—determines what information is discoverable and when it is discoverable.[30] All material is returnable to the court or movant.

The vast majority of expert witnesses testify truthfully. Nevertheless, there are experts, including both governmental and defense witnesses, who blatantly misstate and exaggerate their qualifications. Unfortunately, the "mountebanks"[31] are too numerous for anyone to claim that prevarication is a remote occurrence.[32]

Prior judicial recognition of an expert's qualifications is normally a significant factor in the court's evaluation and determination of finding that the witness is qualified as an expert. The court's finding, however, that the proffered witness was a "paid expert liar in numerous other cases" is not an argument for determining the expert's qualifications.[33]

An expert may be qualified but not competent to render a credible opinion:[34]

> In trial harm to litigants results from improper qualification of an incompetent expert or failure to qualify a competent expert. . . . The incompetent expert is a vehicle for unreliable proof, while the latter denies the opportunity to present credible evidence.[35]

> In bolstering the credibility of an expert witness, attorneys will select as circumstances allow, witnesses with significant trial experience. Absent such a source, attorneys select from the community rather than classified advertisements. Trial tactics rather than reliability becomes the impetus for the selection of experts. Such tactics may influence selection of the less reliable witness.[36]

Ethics and Intellectual Honesty

Ethics and scientific testimony are inextricably intertwined, because science is neutral and based upon facts. Intellectual honesty is an issue in scientific evidence. An expert witness can affect, and infect, the evidence. The integrity of scientific evidence can affect the outcome of judicial proceedings. Ideological and personal beliefs can prejudice an expert witness's testimony.

A pervasive bias exists in expert testimony—the professional partnership in both private and public sectors. Experts whose livelihood depends on consulting and testimony must learn to satisfy the consumers who buy that service; those who do not will not get hired or remain employed. In some cases, experts may distort their view to suit the interests of their clients or employer, perhaps even lie outright.[37]

Jurors regularly accord special weight to expert witness testimony. Judges and attorneys customarily believe jurors give more credibility to scientific evidence than to other types of evidence. Jurors normally believe the case would have been decided differently without forensic evidence. The extensive testifying experience of many experts makes them powerful, persuasive witnesses, capable of making or destroying a case. Testimony offered by expert witnesses is the most persuasive of all testimony.[38]

In general, the predominant problems with forensic experts are credibility,[39] honesty, competency, quality of work, and neutrality. Forensic scien-

tists must be independent neutral witnesses even if the government employs them. The ethical conduct of experts is a serious issue confronting the judicial system.

Scientific evidence is far superior to other types of evidence, such as eyewitness identification and confessions in some instances; it is also subject to misrepresentation. Experts' misrepresentations include lying about credentials, submitting false laboratory reports, "data dredging";[40] tailoring testimony to fit facts determined by the investigation or at the behest of someone, presenting misleading testimony, presenting biased testimony, and presenting testimony based on unproven techniques.[41] The most dangerous lies are those that most resemble the truth. Error, overstatement, or fraud by expert witnesses can often be exposed by careful examination and independent testing regardless of the scientific evidence being used.

In *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,[42] the court, when discussing the tenets of good science, did not address the dishonest and unethical forensic expert who participates in evidence shaping or how evidence shaping can affect the outcome of judicial proceedings. *Evidence shaping* is a colloquialism for misrepresenting scientific evidence through selective testing, selective reporting, biased interpretation, overstatement of the significance of test results, the ignoring or withholding of results inconsistent with a biased viewpoint, inappropriate collection and testing of evidence, and fabrication of data.[43] Rhetorically, evidence shaping is also known as "juicing the testimony."[44]

Evidence shaping encompasses bias, intellectual dishonesty, and fraud by the expert witness. It also involves performance, interpretation, and presentation of science deliberately designed to favor a particular viewpoint.[45] Fraud is not self-correcting. It is perpetuated (1) by laboratory managers who defer to a subordinate's intelligence, (2) because the laboratory work conforms to a prevailing view, and (3) because of financial renumeration. When technicians or expert witnesses realize that nearly all cases are settled without trial, the temptation to minimize their efforts, time, and quality of work becomes powerful, and can result in sloppy and tainted or even biased results.[46]

If the courts and attorneys were scientifically aware, there might be less temptation for some forensic scientists to skim the truth in their testing and testimony. Evidence shaping sometimes results in gross miscarriages of justice through the presentation of convincing but false scientific testimony.[47] There are no degrees of honesty.

Expert witnesses have the capacity to refuse a case on either a legal or an ethical basis. If they accept a case, then they must testify completely or not at all. Credibility is the cornerstone of communication and ethics. Integrity is paramount. The forensic scientist cannot have an interest in the outcome of the trial. Providing testimony that implies more than the test can determine is a basis for being deemed incompetent or acting as an advocate. There is no reason not to tell the truth. Anything less than the truth will forever impugn the witness's reputation.

An expert cannot base an opinion, even partially, on illegally obtained or inadmissible evidence.[48] Furthermore, "the court must ensure that expert opinion testimony is in fact expert opinion and not merely an opinion given by an expert."[49]

Each witness is required to take an oath before providing testimony. The oath is a simple concept with a simple purpose, yet it can be so difficult to fulfill. It is the standard for integrity. Do you promise or affirm to tell the truth, the whole truth, and nothing but the truth? The oath speaks for itself. The witness promises to tell the truth. Not a portion of the truth, not shades of the truth, just the simple truth. It is a clear and definite concept.[50]

Demeanor

The demeanor of the expert is important. Here are several general caveats to remember: be confident, be credible, speak with a steady cadence, be truthful, exercise common courtesy toward all parties, including the judge and jury, and speak to the jury—never ignore the jury or take its presence for granted.

Also, do not verbally duel or argue with an attorney while testifying. Being perceived as glib, arrogant, vain, pompous, truculent, condescending, bombastic, pretentious, or pedantic will impair the expert's rapport with the jury.

Expert witnesses are educators and communicators. As an educator, the expert witness must be aware of the jury's educational limitations and attention span. A good educator *speaks to* rather than *lectures at* the students. The expert should recognize the jurors' difficult job and lack of familiarity with the subject matter and with litigation in general.

The expert witness's demeanor, credibility, and communication skills are crucial to effective testimony. An aura of composure, humility combined with self-confidence, conviction, and integrity must be effectively and genuinely conveyed by the expert witness.

Communication Skills

People are judged by the words they speak and their communication skills. Clarity in communication is extremely important. Nothing is as frustrating to a jury, or to a judge, as not understanding what the witness is talking about. Expert witnesses do not have to prove their intelligence, only their communication skills.

The forensic scientist should be careful to explain answers in lay terms that are easily understood by the jury. Use the technical term and follow it up with a brief definition or explanation. Communicate at two levels. Difficult scientific principles and esoteric concepts can be made readily understandable through the practice of artful communication techniques. Whether addressing an attorney, a judge, or a jury, experts would do well to hone their

communication skills. By utilizing figures of speech, commonly used linguistic conventions, and other rhetorical devices—such as metaphor, analogy, colloquialisms, and slang—experts can render abstractions vividly and concretely and can imbue their testimony with credibility and comprehensiveness.[51] This approach familiarizes the jury with the technical terminology and explains it in a simple and factual manner which is designed to neither offend the jurors nor be condescending.

The forensic scientist's testimony should be compelling and interesting. An effective and integral part of the testimony is developed through demonstrative evidence, the adult version of "show and tell" or "sharing" that children learned early in elementary school. The use of visual aids is especially important when offering scientific evidence. Visual aids (demonstrative evidence) can usually simplify confusingly abstract scientific testimony for the jury's benefit. Audio-visual aids are a practical, efficient, and productive medium. This mode of communication is effective for two reasons: visual images help explain and define when mere words are insufficient, and they keep the audience's attention by varying the presentation.

Before testifying, expert witnesses should provide the court stenographer with a vocabulary list of technical terminology normally encountered in their testimony. The witness should then spell the troublesome or uncommon words during the testimony, while simultaneously looking at the court reporter. This practice will facilitate an accurate stenographic record of the testimony.

Clothing is a subliminal form of communication. Attire for the witness in court should be clean, neat, and presentable. The clothing must be comfortable and should comport with regional dress codes and mores.

Pretrial Preparation

The only aspect of litigation an expert can control is preparation. If you are not prepared, do not go into the courtroom; you do not belong there. The difference between the best and the rest is preparation. (Remember and practice the five Ps: prior preparation prevents poor performance.) Preparation is 90% of the trial. The capable expert witness acknowledges and understands this fact. Preparation includes the forensic scientist and attorney of record working together well in advance of trial.

The expert's services should be sought and retained as early as possible in order for the expert to provide maximum assistance in the case. The expert can assist in developing a case history, propounding and responding to discovery, preparing demonstrative evidence, and interviewing witnesses.

Federal Discovery Rule 26(a)(2)(B), coupled with the *Daubert*[52] decision, requires disclosure of material when formulating an opinion and more extensive reports. The attorney must now check the expert's report for accuracy and needs to control, if not monitor, the data an expert uses in forming an opinion. Therefore, the expert and the attorney must work closely together to make the expert's testimony more effective.

The expert witness should be familiar with basic textbooks relied upon by attorneys when utilizing or confronting scientific evidence. Understanding the lawyer's thought process and perspectives will contribute to the witness's competency, effectiveness, and testimony.[53]

The forensic scientist should maintain an accurate and current curriculum vitae in addition to having his qualifications written in a question-answer format (see Appendix A). The expert witness should also prepare a series of written questions on the subject matter being presented in court. This list will facilitate a competent and effective presentation and will minimize involvement in peripheral matters.

It is incumbent upon the expert witness to properly prepare his or her testimony. The attorney of record must be interviewed and familiarized with the subject matter and testimony. The attorney must have a clear perspective and understanding of what tests and procedures the expert performed, as well as the results and the opinions reached. If the attorney has not contacted the expert witness within a reasonable period of time after retaining the expert, then it is necessary for the expert to contact the attorney in writing to initiate the interview.

It is essential that the attorney maintain work product confidentiality, provide all case materials, and discuss problem areas. Confidentiality is especially important when information is transmitted through nonencrypted electronic mail (e-mail), which is neither a privileged nor a confidential communication.[54]

TRIAL

Trial Preparation

Essential to trial preparation is being prepared and organized. Experts must review and know all case materials. They must bring the entire original file to court, including, but not limited to, all personal notes, memoranda, file jackets, and formal reports. They must also have with them their current curriculum vitae, with photocopies of all applicable certifications, permits, and licenses, as well as a vocabulary list of terminology for the court reporter. They should provide a written outline of proposed testimony and exhibits to the attorney. In addition, they need to be familiar with the demonstrative evidence (show and tell) and location of the courthouse and must never be late.

Voir Dire

Voir dire[55] creates the standard for an expert witness's testimony and credibility. It is the first and foremost part of any examination process.[56] It is the judge's and jury's first impression of the witness. Neither the movant nor the

witness must take voir dire for granted or the proffered witness will not be properly qualified. Whether or not a witness is qualified as an expert can be determined only by comparing the area in which the witness has expertise with the subject matter of the witness's testimony.[57]

The moving party must establish the expert's competency and knowledge in the profession and field (*not* experience, education, or specialized training), subject to judicial approval, through examination of the expert's credentials. A witness is not deemed an expert until so qualified by the court (see Appendix A). Once competency has been satisfied, a witness's knowledge of the subject matter affects the weight and credibility of his or her testimony. Simply ask, Is the proffered witness qualified? Is the witness competent? Only when the judicial answer to those questions is yes will the witness be allowed to provide opinion evidence.

Credentials and competency are not the only criteria. The subject matter of an expert witness's testimony must be legally and factually relevant. A nexus must exist between the scientific theory being proffered and the evidence at trial. Failure to meet these threshold criteria will preclude or bar the expert's proffered testimony. Next there must be a finding that the proposed testimony will affect the validity of the evidence.

Direct Examination

It is through direct examination of witnesses in their case-in-chief that the parties principally place their case before the trier of fact. Communication skills and credibility are established during this phase of the expert's testimony.

All expert witnesses should be questioned in a manner that enables them to testify clearly and succinctly to matters within their area of knowledge and expertise. The pertinent facts should be elicited with open-ended, nonleading questions that do not suggest an answer. The use of demonstrative evidence through visual aids, such as charts, diagrams, experiments, and models, emphasizes or explains the witness's testimony.

The expert witness relies on his or her knowledge, training, and experience to relate findings and opinion to the jury. The testimony should be kept simple, focused, and understandable. The witness's demeanor should exude clarity and integrity. Use of plain, clear, concise speech cannot be overemphasized. Utilization of appropriate legal terminology ("reasonable degree of medical or scientific certainty") is necessary when stating conclusions. The witness should exercise patience and explain technical terms and concepts without being patronizing, demeaning, or condescending. The testimony should not be too technical. Save the technical aspects and jargon for cross-examination.

The witness's attire and demeanor contribute to his or her believability and respect. The appearance and demeanor of the witness are critical. The witness must convey a sense of believability to the judge and jury. Witness

demeanor should demonstrate an interest in the subject matter of the testimony and respect for the seriousness of the proceedings. If the witness appears uninterested or annoyed with giving testimony, the jury will most likely also be bored or annoyed with the testimony.

Cross-Examination

"Cross-examination is much more science and application of technique than it is art."[58] Cross-examination is the attorney's primary opportunity to give the jury reasons not to believe the opposing expert's testimony. It focuses largely on issues of credibility—should this expert be believed? Impeachment is directed at the substance of the person's testimony or confronts the witness's credibility. The major spheres of expert witness examination are opinion testimony,[59] fallibility of methodology and result,[60] reproducibility of results, compensation,[61] and integrity. Areas within these domains susceptible to cross-examination may include inconsistent statements, transcripts of previous proceedings, motive, interest, bias, fees and compensation, omissions, treatises or other publications, experience, conviction of crimes, personal knowledge of facts, errors in the report, unknown facts, analytical tests not performed, lack of access to all relevant documents, reasonable degree of scientific certainty or probability or certitude, and absoluteness. Conflicts in the witness's testimony create doubt as to his or her believability. If the forensic scientist has correctly and competently performed all the tests and examinations, has reached legitimate conclusions, is properly prepared for the trial, and testifies honestly, there is nothing to fear. About the only apparent safeguard against an expert who gives a phony opinion is cross-examination.[62]

Maintaining Credibility during Examination

There are some general rules an expert witness should follow in order to avoid appearing less than credible while testifying:

1. *Be nervous.* It is acceptable to be nervous. Courtrooms can be intimidating places. Litigation is the attorney's domain, and the courtroom his or her medium. Being nervous generally strengthens the witness's credibility through unrehearsed spontaneity instead of routine perfunctory answers, even if the witness has been taught how to testify.

2. *Always tell the truth.* Do not compromise your integrity and morals by committing perjury. The witness has more to lose by lying than by telling the truth. Never guess or hedge an opinion, and never provide an answer the witness believes is best for the case unless it is the truth.

3. *Listen to the question.* The witness must understand the terminology and the question that is being asked. A witness who does not understand a

term or question should say so and request clarification of the term or question before providing an answer. Rephrasing or repeating the question will usually make it more understandable. The same tenet applies if the attorney misstates the facts or a scientific principle as the expert knows it.

4. *Pause, then answer.* Listen to the question. Do not be rushed or coerced into answering. Take your time. Be careful. Collect your thoughts and think about the answer. Listen to any objections made by opposing counsel. The objections provide information on potentially damaging areas or on how opposing counsel is attempting to mislead or discredit the witness' testimony. The witness should correct any misstatement contained within the question before answering, rather than answering the question and then attempting to qualify the answer.

5. *Admit mistakes and problems.* Do not evade the question. Candidly confront the problems and defuse harmful facts. All too often a witness, especially an expert, is reluctant to admit mistakes and problems, even though admitting mistakes presents an image of credibility and honesty.

6. *Admit limitations.* Answer questions only if you know the answer. The witness cannot seek advice or assistance from his or her attorney while testifying. Experts are often too arrogant or too insecure to concede limitations of their knowledge and say "I do not know" to specific inquiries, even though doing so would likely enhance their credibility. Admit the mistake, limitation, or problem or suffer the irreparable devastation of an exposed cover-up.

7. *Admit inability to remember.* If the witness does not remember or know something, they should say so without reservation. Do not guess or speculate. State only what is true. Vagueness of answer will survive the examination but will be the witness's nemesis. A witness cannot be cross-examined on repeated answers of "do not know," "cannot remember," and "cannot recall," even though these answers will certainly be commented upon adversely during closing argument.

8. *Do not hedge or obfuscate.* The witness must be able to articulate, identify, and practically support their conclusions. If the witness is going to use any definitions or interpretations such as "match," "indistinguishable," or "identical," then the witness is obligated to objectively and empirically support the terminology and findings of their opinion. Terminology and phraseology vary, in part, because the starting point is never agreed upon.[63] Expert witnesses quite frequently hedge their opinions with obfuscatory words. Phrases such as "similar to," "could have," "might have," "compatible with," "consistent with,"[64] "physical observable characteristics," "instrumental techniques," and "various chemical tests and analysis" are

noncommittal and nondescript statements designed to infer competency, credibility, and reliability. In reality, they can do the opposite. Reliance on bluffing, hedging, and obfuscation will adversely affect and impugn credibility and communication skills.

9. *Speak to the jury.* The jury alone decides the verdict. They assess the credibility of the witnesses and facts. Address the jury, not the lawyers, when answering questions, and continually make eye contact with them. Do not take their presence for granted.

10. *Maintain a consistent attitude.* The witness should not overtly change his or her attitude between direct and cross-examination. Consistency is important. Be congenial, confident, and self-assured. Stay relaxed and maintain emotional stability, for it is the witness who controls the flow of his or her testimony and provides the jury with an opportunity to listen to the answers.

11. *Never argue with counsel.* Self-control is paramount. Opposing counsel's objective is to discredit the witness' testimony through any available means, including assaults on temperament. Let the judge or witness' counsel control the opposing counsel's abusive conduct. Do not be antagonistic. Be personable and cooperative during both direct and cross-examination.

12. *Answer just the question.* Do not volunteer information or embellish the answer. If additional information is necessary, it will be requested. Do not exaggerate. Too much explanation provides a basis for otherwise unexpected cross-examination and may also make the witness appear insincere or biased.

Discovery and Disclosure

Discovery is the disclosure of evidence or of information leading to evidence that is relevant to the case. The purpose of discovery is to eliminate surprises in both civil and criminal proceedings. Discovery minimizes miscarriages of justice and materially fosters the settlement of cases. Discovery is created statutorily and at common law. It is controlled by the courts. The five major devices for obtaining discoverable information are (1) written interrogatories, (2) depositions upon oral or written questions, (3) production of documents or objects or permission to enter upon land or property for inspection and other purposes, (4) physical or mental examinations, and (5) requests for admission of facts and genuineness of documents.

Available methods of pretrial discovery encompass the bill of particulars, selective motion practice (i.e., production of documents, objects, and

tangible items), subpoenas, interrogatories, depositions, statutory and circuit court rules of procedure, and case law. Discovery entails ascertainment of what was previously unknown. Being versed in the concepts and practices of discovery minimizes violations of the law and exposure to both civil and criminal prosecution.

The government has the duty to disclose exculpatory evidence, even in the absence of a request for it, if the evidence, considered as a whole, has a "reasonable probability" of affecting the result. The defendant does not need to show that the evidence will determine the result, but only that suppression of the evidence would undermine confidence in the outcome of the trial. The governmental obligation exists regardless of the good or bad faith of the prosecutor, and even if the police have failed to disclose the evidence to him or her.[65]

Federal Rule of Civil Procedure–Rule 26: Discovery and Depositions

Nothing is exempt from scrutinization or comment regarding the expert witness. Expert witness discovery relating to scientific evidence and associated testimony is controlled in part by the Federal Rule of Civil Procedure 26, *Daubert v. Merrell Dow Pharmaceutical Inc.*,[66] state statutes, and local court rules. According to Federal Rule 26(a)(2)(B)(2-b), before an expert witness can offer testimony, that person must provide a written summary opinion discussing the testimonial subject matter; a summary of the substance of facts and opinion; the basis for the opinion; reports; a list of all publications authored by the witness in the preceding 10 years; a record of all previous testimony, including depositions for the last four years; a disclosure statement,[67] a report signed by the expert and the disclosing attorney; and other items as ruled by the jurisdiction. Once disclosure of the expert witness has been made, under FRCP 26(e)(10), a continuing duty exists to provide additional and *corrective* information.[68] The movant must provide complete current information on the expert witness.

Even though many states have adopted the Federal Rules of Civil Procedure, including Rule 26, parties should consult their own jurisdiction regarding rules of discovery and corresponding requirements.

Preservation of Evidence: Spoliation

Parties using and relying on physical evidence have a duty to keep and preserve the physical evidence from date of collection until resolution of judicial process. Whether the spoliation (destruction) of physical evidence is intentional or unintentional is irrelevant because of its integral evidential value.[69]

Destruction of the sample deprives the accused of "the opportunity to meet or dispute the [prosecutor's] test results by [his or her] own evidence of

equal integrity and persuasiveness."[70] The defendant need only establish that the evidence's exculpatory value was apparent before it was destroyed and that it might have been expected to play a significant role in the defense. Also, in many cases the accused is unable to obtain comparable evidence.[71] Failure to preserve, keep and maintain evidence warrants a direct inference that the evidence was favorable to the aggrieved party.[72]

When evidence of no apparent value to the defense is destroyed, unless the criminal defendant can show bad faith on the part of the police, failure to preserve evidence does not constitute a denial of due process. Fundamental fairness, however, prevents the movant or prosecution from introducing any test results based on the destroyed evidence that the accused has not been able to confront owing to its destruction or withholding.[73]

Inadvertent destruction of evidence by the prosecution before independent testing is a violation of due process and warrants dismissal of charges. Bad faith is not required because of reliance on evidence to support a conviction. Without an independent test, a defendant will not be able to contest whether the results are accurate. The test is whether a defendant is able to establish a defense without the destroyed evidence.[74] Evidence of spoliation warrants a presumption in civil proceedings of negligence[75] and in criminal cases of constitutional violations with sanctions.

A request for evidence is meaningless if the evidence does not exist. Simply, spoliation of evidence, regardless of intent, can substantially prejudice a defendant's ability to defend himself or herself and generally deprives the defendant of the right of confrontation and due process.

These stringent requirements and the rather drastic results for failure to adhere to them reflect the court's interpretation of the underlying purposes and duty in *Brady v. Maryland*:[77]

> The purpose is not simply to correct an imbalance of advantage. . . . [I]t is also to make of the trial a search for truth informed by all relevant material, much of which because of imbalance in investigative resources, will be exclusively in the hands of the government.[78]

The same court stated,

> A criminal trial, like its civil counterpart, is a quest for truth. The quest will more often be successful if both sides have an equal opportunity to interview the persons from which the truth may be determined. . . . [T]he prosecution should not frustrate the defense in the preparation of its case.[79]

Subpoenas

Subpoenas are used in all stages of the judicial process in which testimony or production of material is sought, including pretrial hearings and grand jury appearances.[80] There are two types of subpoena: the subpoena ad testifican-

dum and the subpoena duces tecum. The first is for the person, and second is for production of documents and records.

A subpoena is a judicial writ enforceable by the issuing court. *Subpoena* comes from the Latin meaning "under penalty." It is used to command the presence of a witness or the production of documents in court under penalty of law: "The use of subpoenas to have compulsory process for obtaining evidence in the defendant's favor is guaranteed by the Sixth Amendment to the Federal Constitution and is applicable to state criminal proceedings."[81]

The subpoena cannot be vague or indefinite. In order to carry his or her burden, the proponent of a subpoena for documents must establish relevancy, admissibility, and specificity: "[T]he moving party must show that (1) the documents are evidentiary and relevant; (2) they are not otherwise procurable reasonably in advance of trial by exercise of due diligence; (3) the party cannot properly prepare for trial without such production and inspection in advance of trial and that the failure to obtain such inspection may tend to unreasonably delay the trial; and (4) the application is made in good faith and is not intended as a general 'fishing expedition.' "[82] (See Appendix B.)

In the second type of subpoena, the subpoena duces tecum, the court, at the request of a suitor, commands a witness to personally produce at trial documentation or objects within his or her possession or control that are pertinent to the issues of a pending controversy.[83] The relevant language of a subpoena duces tecum usually states, "You are commanded to bring any and all information, including but not limited to, . . . in your possession, control or in that of your legal representative." (See Appendix C and Appendix D.)

Neither the prosecution nor the subpoenaed party can decide what information is discoverable or when it is discoverable.[84] The subpoena is returnable only to the issuing party or court, without interference, suggestion, or persuasion from the prosecution.[85]

The courts, upon motion, may quash a subpoena for a person or documents if there is a clear showing it is unreasonable or oppressive.

Interrogatories

Interrogatories[86] are carefully drafted written questions seeking facts that form the basis of opinions and the sources of those facts. They are a convenient, expeditious, inexpensive vehicle of discovery. Interrogatories are instrumental in discovery.

Depositions

A deposition is a statement made orally by a person under oath before an examiner, commissioner, or officer of the court, but not in open court, and reduced to writing by the examiner or under his or her direction.[87] Any party

related to the case may be deposed, including adverse parties, independent witnesses, occurrence witnesses, expert witnesses, and percipient witnesses. The deposition may be conducted through various mediums (video, audio, telephonic) or in person. Depositions are frequently used to position information as a basis for settlement or resolution of issues. It can be a substitute for trial or a basis for impeachment evidence at trial. The witness may be required to bring to the deposition any pertinent, nonprivileged books, records, papers, recordings, or other such material. The purpose of a deposition is to preserve that witness's testimony for use at trial, not for discovery.

Most states have adopted rules that are substantially similar, if not identical, to the Federal Rules governing deposition practice and procedure. Under the Federal Rules of Criminal Procedure, a party to a criminal act may in certain circumstances make a motion for taking the deposition of a witness.[88]

A deposition should be scheduled for a time and place convenient for the parties and witnesses involved. Usually, rooms are available at the courthouse for depositions, but the offices of an attorney are frequently used. Reasonable notice for the time of a deposition is required, and the person being deposed may request the court to change the time, date, and location.

The format of a deposition may vary, but generally the witness is questioned by both sides in the same order as at trial; the proponent direct examines, then the opponent cross-examines.

The court may pay the expenses incurred by that witness when the government takes a deposition or when an indigent is deposing a witness. The deposition may be used at trial, in part or in its entirety, if the witness is unavailable or, if appropriate, for purposes of impeachment when the witness testifies.

The Law of Evidence

The Law of Evidence is a set of rules and principles affecting judicial investigations into questions of fact—for the most part, controverted questions. Evidence is any matter, verbal or physical, that can be used to support the existence of a factual proposition: "The Rules of Evidence are founded in the charities of religion, in the philosophy of nature, in the truths of history, and in the experience of common life."[89] Its exclusionary purpose is to protect the jury from being misled.

There are two basic categories of evidence, direct and circumstantial. Within these general groups there exist three general types of evidence: testimonial, physical, and demonstrative. Any kind of evidence to be considered in a legal context must comply with the admissibility requirements of relevancy and materiality.

Direct evidence tends to show the existence of a fact in question without the intervention of proving any other fact: Is the evidence to be be-

lieved without inferences or conclusions from it? Direct evidence depends on the credibility of the witness. Circumstantial evidence is indirect evidence from which inferences or conclusions can be drawn. Circumstantial evidence depends on both the credibility of the witness and inferences from the witness.

Evidence may be testimonial (witness), physical (tangible objects and parts of the body), or demonstrative. Testimonial evidence is premised upon the witness's personal knowledge and relies on the person's five senses. Physical evidence is perceived as indisputable, scientifically sound and, most important, neutral. The value of physical evidence cannot be understated.[90] It is the silent, definitive witness. Physical evidence offers certainty, and certainty equals proof. The means by which physical evidence becomes proof is through forensic science.[91] It often involves submission of some tangible object that was directly involved with the situation or incident (document, weapon, narcotics, drugs, clothing, blood, hair, etc.). Demonstrative evidence serves as an audio-visual aid and is designed to assist the trier of fact in understanding the witness's testimony. It can include maps, models, x-rays, diagrams, models, computer graphics or simulations, and so on.

Authentication

Authentication requires the party offering contested evidence provide a basis for the fact finder to believe that the item is what the proponent claims it to be. It requires, also, that the evidence be in substantially the same condition it was in when it was obtained or seized. The principles of authentication apply to any physical items described in testimony or offered into evidence, including witness statements. The most common form of authentication or identification of tangible objects (letters, documents, photographs, tools, weapons, etc.) is to simply have the witness identify them on the basis of his or her personal knowledge (what the witness saw, heard, tasted, felt, or smelled). The proponent must introduce evidence that the matter is what its party claims it is.

Evidence is susceptible to tampering, loss, substitution, degradation, or mistake and is not always capable of easy recognition. Therefore, the item must be authenticated. Aspects of authentication include the nature of the article; the circumstances surrounding its preservation and its custody; and the likelihood of alteration, degradation, contamination, or tampering.[92] The party intending to use the item as evidence must establish that the quality or condition has not substantially changed from its original state when collected or seized to when it is offered into evidence.

A complete independent historical accounting and rendition of the item must be documented to maintain the item's integrity, not just whether the item has been subject to change. Establishing the item's condition is

accomplished through testimony of successive custodians, commonly called a *chain of custody*. This is typically established by having each person (each link in the chain) who has had contact with the item show (1) the circumstances under which custody was taken; (2) the precautions taken to prevent alteration, degradation, contamination, or tampering; (3) that change or tampering has not occurred; and (4) the circumstances under which the person relinquished care, custody, and control of the item. If the real evidence is fungible, not readily identifiable, or is of a type that might change in condition (narcotics), then it must be authenticated through a chain of custody. A short chain of custody significantly reduces the occurrence of problems. A serious or prolonged break in the item's accounting may render it inadmissible.

The trustworthiness of safeguarding an item's integrity cannot be understated, especially in criminal cases. The chain of custody is used to assist in the identification and authentication of evidence that (1) it is what it purports to be and (2) it has not been substantially changed for any reason from its original state. If the item has been substantially changed, its value is reduced or negated since it may mislead or confuse the jury. Therefore, it is not admissible. A reasonable degree of certainty is required to establish that the item has been traced accurately through its chain of custody.

The Admissibility of Scientific Evidence

Before any item can be considered as evidence, a proper legal foundation must be laid for its admission. Both procedural rules and substantive law of evidence require a condition precedent to the admission of an item into evidence.[93] Compliance with the item's condition is its foundation.

Admissibility is premised upon relevance and materiality. Relevance is the basic unifying principle underlying the evidentiary rules. It connotes the probative relationship between the testimonial or real evidence. It also involves analysis of the relationship, often termed "materiality" or "consequentialness," between the factual proposition and substantive law. Evidence is relevant only if it (1) tends to prove or disprove a proposition of fact (probative value) and (2) is material to a charge, claim, or defense. Does the evidence have a tendency to make the existence of a fact more probable? Does the evidence have any probative value (that which tends to produce belief)? If the answer is yes, then it is usually admitted as relevant evidence unless otherwise excluded by law or as being potentially prejudicial. Evidence that is not relevant is not admissible.

The primary procedural rules for scientific and expert evidence are governed by federal and state statutes, the Federal Rules of Evidence, and case law and are applied through the cases of *Frye v. United States*[94] and *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[95]

A predominant question in the area of scientific evidence is the criteria trial courts use to permit expert witnesses to testify regarding scientific, tech-

nical, or other specialized knowledge. The underlying assumption of this issue is that juries tend to believe almost anything a professed expert says; therefore, judges "should protect impressionable jurors from experts who lack objective credibility."[96] The U.S. Supreme Court has sought to resolve this question through rulings in three cases, commonly known as the "Daubert Troika." These cases consist of *Daubert, Joiner,* and *Kumho Tire.*[97]

Frye v. United States

Frye v. United States focuses on the nature of the opinion through general acceptance in the scientific community for admissibility. *General acceptance* is defined as follows:

> Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained general acceptance in the particular field in which it belongs.[98]

Frye admitted scientific evidence that was generally accepted in the field. It did not, however, define the field in which the methodology must be accepted. Most courts were willing to consider the "field" of forensic analysis as an appropriate scientific community. Professor Margaret Berger observed,

> Because *Frye* emphasized "general acceptance" in a particular field, a well-organized group of expert witnesses in some instances became the "field." "General acceptance" by these experts then verified the reliability of the evidence.[99]

The *Frye* test, however, cannot distinguish between science and pseudoscience. Astrological forecasts are "generally accepted" in the "pertinent field" of astrology.[100]

Innate problems with *Frye* concern (1) which applicable community accepts the technique, (2) whether the technique itself or the underlying principle and the technique are to be evaluated, and (3) the problem of judicial control over the admissibility of evidence versus the need to be open to new techniques and discoveries.[101]

Daubert v. Merrell Dow Pharmaceuticals, Inc.

The significance of emerging science and technology is germane to evidential standards of scientific evidence in natural, behavioral, and social sciences.[102] In courts of law, forensic testimony often goes unchallenged by a

scientifically naive community. Forensic methods must be screened with greater care if equal justice is to be served.[103] The U.S. Supreme Court in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[104] announced that the Federal Rules of Evidence supersede the common law *Frye test*[105] for admission of scientific evidence. *Frye* required that a foundation for an expert's scientific evidence include proof that the theory and technique were generally accepted within the relevant scientific community. Admission of scientific evidence at the federal court level[106] depends on consideration of many factors, including whether the theory has been tested,[107] whether it has been subjected to peer review and publication,[108] its error rate,[109] whether there are standards for its operation, and whether it has widespread acceptance in the scientific community. It must help the trier of fact understand the evidence or decide the fact in issue.[110]

An integral part of *Daubert* discussed the practice of "good science"[111] and the reliability of scientific results. The threshold questions for admissibility include the following: Is the scientific evidence based upon good science? Is it reliable?[112] In determining the parameters of good science, the Supreme Court looked at how conclusions are reached not at which conclusions make sense. It also asked whether a hypothesis was generated and, was it tested empirically.[113] *Daubert*'s admissibility factors were formulated for Newtonian science[114] and are not typically applicable to nonscientific bodies of knowledge. But *Daubert*'s reliability principles (empirical validation standard) are just as pertinent when nonscientific expert testimony is concerned.

The *Daubert* decision made judges "gatekeepers" of science[115] and of expert evidence in courts of law.[116] It has heightened the need for judicial awareness of scientific reasoning and methods. Evidentiary reliability is now based upon scientific validity.[117] The trial judge is assigned a "gatekeeping responsibility" to make "a preliminary assessment of whether the reasoning or methodology underlying the testimony is scientifically valid, and whether that reasoning or methodology properly can be applied to the facts in issue.[118] *Daubert* made it clear that trial judges should not abdicate what is worthwhile testimony to expert communities, and it implied that trial judges should adopt admissibility criteria that encourage expert communities to develop the best possible information on legally relevant issues.[119]

This "admissibility standard" of evidence demands an understanding by judges of the principles and methods that underlie scientific studies and of the reasoning upon which expert evidence is based: Peter J. Neufeld stated,

> Unfortunately, forensic evidence is not adequately tested in the crucible of court. But not only are judges ill-equipped to evaluate critically the reliability of scientific evidence; lawyers routinely fail to assess, much less challenge, the reliability of the particular test. The "crucible of the court" is therefore a meaningless safeguard."[120]

Two extraordinary procedures exist to assist judges in problems of expert evidence or complex scientific evidence: court-appointed experts and special masters. Court-appointed experts[121] can offer testimony at trial, can educate judges concerning fundamental concepts on which experts differ, and can assess the methodology on which the parties' experts are basing their opinions.[122] Special masters or magistrates[123] may be appropriate in extraordinary cases in which the demanding nature of scientific issues is combined with the need for special skill in fact finding. They may be appointed to conduct settlement negotiations that involve difficult scientific testimony or to manage the pretrial stages of cases that entail problems of expert testimony.[124]

Because the courts, in particular the trial judge, are now the gatekeepers for screening proffered reliable scientific evidence, scientific reliability must be defined. It has essentially two parts. The Supreme Court inquired whether the offered methodology or technique had a known error rate.[125] Accordingly, both the hypothesis and test results, and especially the error rates for those results, must be scrutinized in order to validate the hypothesis. Next, the Court asked whether susceptible standards existed for using the methodology, and if standardized procedures existed for reproducibility of the results. Simply, does a valid scientific methodology and process exist?

The rules of procedure at common law in limited situations permit circumvention of *Daubert*'s formal regulations of evidence. This occurs through stipulations to facts, judicial notice based upon verifiable certainty,[126] and learned treatises. Parties cannot, however, stipulate to admission of scientifically unreliable evidence.[127]

Common and anticipated challenges to expert evidence under *Daubert* are (1) Is the expert qualified? (2) Is the expert's opinion supported by scientific reasoning or methodology? (3) Is the expert's opinion supported by reliable data? (4) Is the expert's opinion so confusing or prejudicial that it should be excluded pursuant to Federal Rule 403?[128]

The U.S. Supreme Court in *General Electric Co. v. Joiner* upheld the trial court's gatekeeping function, per *Daubert*, to determine the admissibility of expert witness testimony absent an abuse of judicial discretion.[129]

Kumho Tire Co., Ltd. v. Carmichael

The U.S. Supreme Court in *Kumho Tire Co., Ltd. v. Carmichael*[130] held that the general proposition of *Daubert*'s reliability requirement applies to all expert opinions (technical and other specialized knowledge), not just to scientific ones. The distinction between "scientific knowledge" and "technical" or "other specialized knowledge" is illusory and without support in the federal rules. Therefore, *Daubert* applies to all expert evidence and testimony regardless of whether it is "scientific" in nature. Furthermore, the trial court is not required to hold a "Daubert hearing" every time expert testimony is challenged. *Kumho* is applicable to both civil and criminal cases.

In most jurisdictions and under the Federal Rules, both lay and expert witnesses are permitted to render opinions. Federal Rules of Evidence 701–706 govern testimony by these witnesses. Specifically, Rule 702 deals with the admissibility of expert testimony. On December 1, 2000, Rule 702 was amended to add the following clause relating to the admissibility of expert testimony: "provided that (1) the testimony is sufficiently based upon reliable facts or data, (2) the testimony is the product of reliable principles and methods, and (3) the witness has applied the principles and methods reliably to the facts of the case." The advisory committee notes state that the "amendment does not distinguish between scientific and other forms of expert testimony. The trial court's gatekeeping function applies to testimony by any expert."[131]

There is no absolute rule as to the degree of knowledge required to qualify a witness as an expert in a given field.[132] Also, there is no stratagem in the courts that can cure scientists from preaching on scientific nonsense as expert witnesses. *Daubert* and *Kumho Tire* may provide the way.[133] In the words of Albert Einstein, "The right to search for truth implies also a duty; one must not conceal any part of what one has recognized to be true."

Conclusion

The U.S. Constitution and corresponding laws of evidence are designed and intended to promote truth, equal justice, honesty, integrity, and freedom. Litigation, especially through the criminal justice system and due process clause of the Fifth Amendment, is premised upon defending constitutional law and corresponding inherent rights. The government must not prosecute and convict on less than all of the evidence. Therefore, it is incumbent upon all people to rely on the legal safeguards to maintain, perpetuate, and protect these scruples and objectives. People should always remember—freedom is just a word until it is lost.

Disclaimer

This chapter is intended to provide general information; it does not provide legal advice applicable to any specific matter and should not be relied upon for that purpose. Interested parties should review the laws with their legal counsel to determine how they will be affected by the laws.

APPENDIX A

Qualifying Question Format for the Expert Witness

Sample Expert Witness Voir Dire[134]

1. Name.
2. Occupation.
3. Place of employment.
4. Present title.
5. Position currently held.
6. Briefly describe the subject matter of specialty.
7. Specializations within that field.
8. What academic degrees are held and from where and when obtained.
9. Specialized degrees and training.
10. Licensing in field and in which state(s).
11. Length of time licensed.
12. Length of time practicing in this field.
13. Board certified as a specialist in this field.
14. Length of time certified as a specialist.
15. Positions held since completion of formal education and length of time in each position.
16. Duties and function of current position.
17. Length of time at current position.
18. Specific employment, duties, and experiences (optional).
19. Whether conducted personal examination or testing of *(subject matter/person/instrumentality)*.
20. Number of these tests or examinations conducted and when and where they were conducted.
21. Teaching or lecturing in this field.
22. When and where lecture or teach.
23. Publications in this field and titles.
24. Membership in professional societies, associations, and organizations and special positions in them.
25. Honors, acknowledgments, and awards received in this field.
26. Number of times testimony has been given in court as an expert witness in this field.
27. Availability for consulting to any party, state agencies, law enforcement agencies, defense attorneys.
28. Put curriculum vitae or résumé into evidence.
29. Your Honor, pursuant to [applicable rule on expert witness], I am tendering [name] as a qualified expert witness in the field of _____.

Note: This type of simple, thorough voir dire examination can be very effective. The suggested subject order and format of core questions must be tailored to each case. Discretion should be exercised, however, to keep the examination simple. The examination is not perfected until the last question is asked. The examination can be developed in a clear and concise manner, using simple, short, single-fact questions. The movant and witness must keep their objective in mind—qualify the person as an expert witness.

ire examination can be very effec-
iat of core questions must be tai-
exercised, however, to keep the
t perfected until the last question
:d in a clear and concise manner,
The movant and witness must
erson as an expert witness.

APPENDIX B

Expert Witness Affidavit

Affidavit of _____, *Ph.D.*

I, _____, Ph.D., do on oath state, and if called to testify in court would so state, the following.

1. I am employed by _____ at _____ [city, state], as a [field: e.g., toxicologist, chemist, biochemist].

2. I have a doctoral degree in _____. My area of specialization is [field: e.g., organic chemistry, including medicinal chemistry and analytical biochemistry].

3. On [date] my scientific consulting services were retained by Mr/Ms _____. Mr/Ms _____ is the attorney of record representing _____ in case [caption].

4. I have reviewed the laboratory reports from _____ Laboratories dated _____ for specimen number _____ regarding the analysis for THC-COOH metabolite purporting to belong to _____. The _____ Laboratory report contains only the test result of a EMIT drug screen and a gas chromatography/mass spectrophotometry (GC/MS) assay on this specimen. No information regarding testing procedures, techniques, standards, methodologies, etc. for the analysis of this specimen or for the preservation and storage of the sample was provided by _____ Laboratory.

5. I am not able to render a competent opinion with a reasonable degree of scientific certainty, solely upon the EMIT drug screen and GC/MS test result from _____ Laboratories, without information pertaining to the testing procedures, techniques, standards, methodologies, etc. relied on and required by experts in this field of science. Full information on the testing procedures, techniques, standards, methodologies, etc. employed is essential for understanding the entire analytical process. The test result alone, without additional information, is incomplete, unreliable, and taken out of context.

6. Human urine specimens purporting to contain THC-COOH metabolite are susceptible to contamination and degradation if not properly collected, preserved, stored, and analyzed.

7. The human urine specimen, which is [give facts: e.g., liquefied, 2 years and 9 months old, currently at room temperature, dark amber brown in color, stored in a leaking bottle and emitting an odor] is not suitable for accurate and reliable testing to determine the presence and amount of THC-COOH metabolite to a reasonable degree of scientific certainty.

8. Affiant says nothing further.

Subscribed and Sworn to before me _____
_____, Ph.D. on this _____ Day of _____, 20 _____.

_____
Notary Public

is [give facts: e.g., liquefied, 2
emperature, dark amber brown
ng an odor] is not suitable for ac-
presence and amount of THC-
scientific certainty.

_____

_____, 20 _____.

APPENDIX C

Subpoena Duces Tecum

Drug Testing Laboratory

Rider—Subpoena Duces Tecum[135]

State of _____ vs. _____, Defendant
Case No.

From: _____, Attorney for Defendant
Address of Attorney

Date: _____, 20 _____

To: Person, laboratory, address

Any and all information in your possession or that of your legal representatives pertaining to the above case and file No. _____, laboratory report No. _____, including but not limited to:

1. The actual employment and services contract between the _____ company or its agents and _____ Laboratory in effect from _____ to present. Also any information and documentation pertaining to termination, severance, or nonrenewal of _____ Laboratory's obligations and services with the _____ company or its agents.

2. All complaints, reprimands, sanctions, penalties, claims, and legal actions against _____ Laboratory, its agents, and employees previously incurred and currently pending (regardless of status: administrative, regulatory, city, county, state, federal, consumer based, financial, civil, criminal, etc.) relating to its work as a laboratory.

3. Name of person(s) who actually conducted the collection and analysis of the specimen, including their background, education, training, licensing, certification, experience, and proficiency test results of this person.

4. _____ Laboratory guidelines and procedures for chain of custody documentation, quality assurance programs, choice of specimens, preparation of procedure manuals, extraction methods, proficiency testing (internal and external), and sample collection and transportation kit.

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5. Laboratory accreditation and certification, including but not limited to:

a. Results of regular audit of policies by internal and independent third parties

b. Actual compliance with proficiency standards by independent third parties

c. Laboratory manual and safety policies

d. Actual results in their entirety of proficiency testing of laboratory employees, and laboratory, by outside agencies with unknown samples

e. Names, addresses, and telephone numbers of all agencies either certifying or not certifying the accreditation of _____ Laboratory

6. All licensing authorities (city, state, county, federal, professional, etc.) including certificates of licensing, standards, regulations, and compliance for and by _____ Laboratory.

7. Policies of _____ Laboratory for conducting analyses and basis for threshold levels for determining positive intoxication levels (quantitative level) of _____ drug metabolite in human urine samples.

a. Laboratory criteria used and described in _____ Laboratory's standard operating procedure manual for what constitutes identification of a drug and quantitative value for intoxication levels.

8. Equipment used or related to analysis of sample.

a. All maintenance, calibration reports, memoranda, customer advisories, bulletins, notices, interoffice memoranda, sales reports, and purchase or lease agreements

b. General records for each piece of equipment used, including serial number, make, model, date of installation, and any major update of the equipment (instrument)

c. Maintenance records of equipment used and recalibration records of the equipment after service call or other repair, from date of manufacture to present

d. Operation, maintenance, and repair manuals for equipment used in the sample analysis

Date: _____, 20 ___

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standards by independent

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ciency testing of laboratory
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ıbers of all agencies either
ation of _____ Labo-

nty, federal, professional,
, regulations, and compli-

conducting analyses and
intoxication levels (quan-
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9. Actual standards and controls used and history of standard and controls.

a. Standard compounds, frequency of use, procedure for preparation of the performance standard, record of performance runs
b. Standard operation manual specifying records and criteria for acceptable performance data
c. Standards and controls used with equipment (ultraviolet, gas chromatography/mass spectrophotometry, infrared spectrophotometry) calibration including sources, preparation, storage, stock and working standards, certification of solution's accuracy, quality control documentation of standards including purity of the standard and control sample(s).
d. Calibration curve on all equipment used at time of analysis

10. Number of blank test runs between each sample analyzed and results of those blank tests.

11. All information necessary in order to independently, accurately, and reliably reproduce the test results.

Certified duplicate copies will suffice in lieu of originals.

All information requested by this subpoena is directly returnable only to the attorney of record.

APPENDIX D

Basic (Initial) DNA Laboratory Report Subpoena

DNA Laboratory Report: Subpoena Duces Tecum

Any and all laboratory, personal, and miscellaneous notes; file jackets; and file notes on parameters and conditions necessary to produce the tracings and results of R.D. No. _____, Lab case No. _____, inventory No. _____. Also, any and all correspondences, communications, memoranda, etc. (transcribed, recorded, taped, etc.) related in any manner to this case, including but not limited to, its scientific tests, results, photographs, examinations, analyses, and processing. Also, any and all information describing in detail the techniques, methods, and procedures used and proficiency tests, including scientific literature and manuals relied on, so that the results can be reproduced. Also, when and where the actual analysis of the sample(s) was conducted (date, time, and place), the results of all analyses (regardless of results), and the entire daily log records of instruments and equipment used in analyzing the sample(s) when it (they) was (were) analyzed.

Photocopies and duplicates will suffice in lieu of originals.

ENDNOTES

1. A. Moenssen, F. Inbau, J. E. Starrs, and C. Henderson, *Scientific Evidence in Criminal Cases*, 4th ed. (Mineola, N.Y.: Foundation Press, 1995), 1.

2. D. L. Faigman, *Legal Alchemy: The Use and Misuse of Science in the Law* (New York: W.H. Freeman, 1999), 32.

3. E. J. Imwinkelried and R. G. Scofield, "The Recognition of an Accused's Constitutional Right to Introduce Expert Testimony Attacking the Weight of Prosecution Science Evidence: The Antidote for the Supreme Court's Mistaken Assumption in *California v. Trombetta*," *Ariz. L. Rev.*, 33 (1991), 59; P. C. Giannelli and E. J. Imwinkelried, *Scientific Evidence*, vol. 1, 2d ed., (Charlottesville, Va.: Michie, 1996 supp.), chaps. 4 and 5. Note, however, that in *Gray v. Thompson*, 58 F.2d 59, 66 (4th Cir. 1995), the U.S. Supreme Court declined to address whether as a matter of federal constitutional law what if any showing would entitle a defendant to private assistance. *Caldwell v. Mississippi*, 472 U.S. 320, 323–324 n. 1, 105 S. Ct. 2633, 2637 n. 1 (1985).

4. V. Miller and L. Callaghan, "A Lawyer's Pathway to Medical and Scientific Information: New Options for Bridging the Gap," part 2, *Shepard's Expt. and Sci. Ev. Q.*, 2 (Fall 1994), 579.

5. Faigman, *Legal Alchemy*, p. 26. c. 1999.

6. J. Wesley, "Scientific Evidence and the Question of Judicial Capacity," *Wm. & Mary L. Rev.* 25 (1984), 675 n. 23.

7. Judge Learned Hand wrote, "The whole object of the expert is to tell the jury, not facts . . . but general truths derived from his specialized experience. But how can the jury judge between two statements each founded upon an experience confessedly foreign in kind to their own? It is just because they are incompetent for such a task that the expert is necessary at all." "Historical and Practical Considerations Regarding Expert Testimony," *Harvard L. Rev.* 15 (1902), 40, 54. See also, J. Laser, "Inconsistent Gatekeeping in Federal Courts: Application of *Daubert v. Merrell Dow Pharmaceuticals, Inc.* to Nonscientific Expert Testimony," *Loy L.A. L. Rev.*, 30 (1997), 1379, 1408, n. 265.

8. The expert witness must be disinterested and impartial. State *ex rel. Collins v. Superior Court*, 132 Ariz. 180, 199, 644 P. 2d 1266, 1285 (1982); *People v. Kelly*, 17 Cal. 3rd 24, 38, 549 P. 2d 1240, 1249, 130 Cal. Rptr. 144, 153 (1976). (Cases discuss voiceprint analysis and interest in use of technique and outcome of proceedings.)

9. *Gold standard* is a colloquialism used in science for the accepted reference standard relating to purity, refinement, and precision when establishing a physical property's measurement or quantity. It is derived from the metallurgic standard for monetary systems.

10. E. J. Imwinkelried, "Evidence Law Visits Jurassic Park: The Far-Reaching Implications of the *Daubert* Court's Recognition of the Uncertainty of Scientific Enterprise," *Iowa L. Rev.*, 81 (1995), 67.

11. L. T. Perrin, "Expert Witness Testimony: Back to the Future," *U. Richmond L. Rev.*, 29 (1995), 1410.

12. *Movant* is a generic term for the proponent of any issue, motion, or presentation of voir dire and witness in legal proceedings.

13. J. E. Starrs, "A Crisis in the Forensic Sciences: Real or Imagined?" *Sci. Sleuthing Rev.*, 21, no. 4 (Winter 1997), 15; Faigman, *Legal Alchemy*, pp. xi–xii, 53–54, 64.

14. Wesley, "Scientific Evidence and the Question of Judicial Capacity," pp. 675, 685.

15. Faigman, *Legal Alchemy*, p. 200.

16. "Lawyers as a group evidence an appalling degree of scientific illiteracy, which ill equips them to educate and guide the bench in its decisions on admissibility of evidence proffered through expert witnesses. This scientific illiteracy is shared by a large segment of the trial and appellate bench; many judges simply do not understand evidence based on scientific principles; even more tragically, they overlook important attributes indicative of reliability of evidence they reject, while ascribing positive properties to other evidence they accept which that evidence simply does not possess." J. E. Starrs, "In the Land of Agog: An Allegory for the Expert Witness," *J. Forensic Sci.*, 30 (1985), 289. See also, D. L. Faigman, E. Porter, and M. Saks, "Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying about the Future of Scientific Evidence," *Cardozo L. Rev.*, 15 (1994), 1799, 1835.

17. Confidentiality is especially important when information is transmitted through nonencrypted electronic mail (e-mail), which is neither a privileged nor a confidential communication. J. W. Hall, "E-Mail and Confidentiality," *Champion*, 21, 52 (June 1997), 52;

American Civil Liberties Union v. Reno, 929 F. Supp. 824, 830–838 (E.D. Pa. 1996) (discussing the open and decentralized nature of the Internet).

18. The technician has been taught to use complex instruments (gas chromatographer, infrared spectrophometer, mass spectrophotometer) or even "simple" breath alcohol testing equipment as "bench operators" who have only a superficial understanding of what the instrument really does and how the readout is generated. Bench operators who qualify as expert witnesses are not competent to explain the instrumentation used unless it is established that they received the training and education necessary to impart a thorough understanding of the underlying theories. A. A. Moenssens, "Novel Scientific Evidence in Criminal Cases: Some Words of Caution," *J. Crim. L. Criminol.*, 1 (Spring 1993), 1, 5–6.

19. *People v. Adam*, 51 Ill. 2d 46, 280 N.E. 2d 205, *cert. denied* 409 U.S. 948 (1972).

20. "A criminal defendant must . . . have access to the hearsay information relied upon by an expert witness. Without such access, effective cross-examination would be impossible." Although exhibits containing inadmissible hearsay may not be admitted into evidence even though relied upon by an expert in formulating an opinion, the expert may still disclose the hearsay in testifying to the "facts and data" underlying the opinion, providing such hearsay was disclosed prior to testimony. *United States v. Lawson*, 653 F. 2d 299, 302 (7th Cir. 1981).

21. C. F. Murphy, "Experts, Liars, and Guns for Hire: A Different Perspective on the Qualification of Technical Expert Witnesses," *Indiana L. J.*, 69 (1993), 637. See also, Perrin, "Expert Witness Testimony," p. 1401.

22. *Puente v. A.S.I. Signs*, 821 S.W. 2d 400, 402 (Tex. Ct. App. 1991).

23. *Puente*, 821 at 400, 402; *Harvey v. Culpepper*, 801 S.W. 2d 596, 601 (Tex. App. 1990). *Hall v. Baxter Healthcare Corp.*, 947 F. Supp. 1387 (D. Or. 1996).

24. B. Tarlow, "Expert Witnesses and Prosecutorial Vouching: New Frontiers in 'Soft Expert' Testimony," *Champion*, 21 (September–October 1997), 50. "It is unprofessional conduct for the prosecutor to express his or her personal belief or opinion as to the truth or falsity of any testimony or evidence or guilt of the defendant." American Bar Association Standards for Criminal Justice, Standard 3–5.8 (b) (80) (3rd ed. 1992).

25. *Berger v. United States*, 295 U.S. 78, 88 (1934). See also, *United States v. Mordica*, 663 F. 2d 1173, 1178–1179 (2d Cir. 1981) (describing the prosecutor's improper use of his own opinions in a summation).

26. J. C. Garriott, ed., *Medicolegal Aspects of Alcohol*, 3d ed. (Tuscon, Ariz.: Lawyers and Judge's Publishing, 1996), 355.

27. G. Sapir, M. Giangrande, and A. Peters, "Breath Alcohol Machines: Evidence Foundation Requirements in Illinois," *J. Marshall L. Rev.*, 22 (1988), 1, 19; Ill. Dept. of Public Health—Breath Alcohol Analysis Technician, spec. code 3150, position code 05170, effective April 1, 1985; Ill. State Police Directive ENF-018, DUI Enforcement and Processing, Revised 09-14-99; Ill. State Police Position No. 5524, Breath Alcohol Unit Supervisor, effective August 1, 1998 (detailing the duties of Illinois State Troopers assigned to maintain breath alcohol testing equipment).

28. The principal findings and recommendations of the Justice Department's report addressed "significant instances of testimonial errors, substandard analytical work, and deficient practices" including policies by the Federal Bureau of Investigation Laboratory. "Justice Department Investigation of FBI Laboratory: Executive Summary," *Crim. L. (BNA)*, 61 (April 16, 1997), 2017. "The [517-page Inspector General's] report provided plentiful evidence of pro prosecution bias, false testimony and inadequate forensic work. . . . No defense lawyer in the country is going to take what the FBI lab says at face value anymore. For years they were trusted on the basis of glossy advertising." J. F. Kelly and P. K. Wearne, *Tainting Evidence: Inside the Scandals at the FBI Crime Lab* (New York: Free Press, 1998), 3–4.

29. Police officers may also call themselves drug recognition specialists (DREs), technicians, and evaluators. Cliff J. Vanell, ed. "Is 'DRE' Extinct? Or What's in a Name?" *The DRE (Newsletter)* (September–October 1990), 2. The DRE Newsletter, City of Phoenix Prosecutor's Office 455 N. Fifth St., Suite 400, Phoenix, Ariz. 85004. Cliff J. Vanell, Editor. In this same issue of the *DRE (Newsletter)*, it is stated that the International Association of Chiefs of Police (IACP) will use the term *technician*. On March 25, 1992, the Technical Advisory panel (to the IACP Highway Safety Advisory Committee) voted to change and use the self-proclaimed term "Drug Recognition Expert" thereafter. *DRE (Newsletter)* (March–April 1992), 10. The term *expert* is currently used in the latest training materials. Honorable R. T. Kennedy, "Someone's on Drugs Here . . ." *Proc. American Academy of Forensic Sciences* (February 1999), 13. DREs' calling themselves experts is problematic.

30. Neither the subpoenaed party nor the prosecution can determine what information is discoverable. *People v. Harris*, 91 Ill. App. 3d 1, 413 N.E. 2d 1369 (4th Dist. 1980); *People v.*

Briggs, 519 N.Y.S. 2d 294 (Brighton Town Ct. 1987). Nor can they determine when it is discoverable. *People v. Rogers*, 123 Ill. App. 3d 780, 463 N.E. 2d 211 (1984). Only the defense can determine what evidence is favorable to its case. *People v. Dixon*, 19 Ill. App. 3d 683, 312 N.E. 2d 390 (1974). The subpoena is a judicial process or court writ. People *ex rel. Fisher v. Carey*, 64 Ill. App. 3d 239, 380 N.E. 2d 1150 (1st Dist., 1978), *aff'd. in part, rev'd.* in part, 77 Ill. 2d 259 (179) 369 N.E. 2d at 19. "The use of subpoenas to have compulsory process for obtaining evidence in the defendant's favor is guaranteed by the sixth amendment to the Federal Constitution and is applicable to all state criminal proceedings. This guarantee encompasses the production of documentary evidence by subpoena duces tecum." *Fisher* at 20. Any doubts regarding discovery and disclosure shall be resolved in favor of disclosure. *State ex rel. Outlet Communications v. Lancaster Police Dept.*, 38 Ohio St. 3rd 324, 528 N.E. 2d 175 (1988).

31. J. E. Starrs, "Mountebanks among Forensic Scientists," in *Forensic Science Handbook*, vol. 2, ed. R. Saferstein (Englewood Cliffs, N.J.: Prentice Hall, 1988).

32. Moenssens, "Novel Scientific Evidence in Criminal Cases," pp. 1, 9–10.

33. *People v. Johnson*, 23 Cal. Rptr. 2d 703, 712 (Cal. App. 1993); Garriott, *Medicolegal Aspects of Alcohol*, 3rd ed., p. 355; M. A. Berger, "Evidentiary Framework," in *Reference Manual on Scientific Evidence* (Washington, D.C.: Federal Judicial Center, 1994), 62.

34. An expert's opinion is all too often derived from misconceptions, warped notions, false prophecies, half-truths, delusions, folly, oversimplifications, humbug, errors, lies, distortions, gaffes, sophistry, and fallacies. Experts have the ability to speak with the complete confidence of total ignorance. It is also not uncommon for experts in the fervor of intellectual conflict and controversy to routinely quote each other out of context.

35. Murphy, "Experts, Liars, and Guns for Hire," pp. 637, 649.

36. Murphy, "Experts, Liars, and Guns for Hire," pp. 637, 650–651. See also Perrin, "Expert Witness Testimony," pp. 1389, 1413–1420; Imwinkelried and Scofield, "The Recognition of an Accused's Constitutional Right to Introduce Expert Testimony Attacking the Weight of Prosecution Science Evidence," pp. 59, 84.

37. Perrin, "Expert Witness Testimony," pp. 1389, 1412 n. 139.

38. *Daubert v. Merrell Dow Pharmaceuticals Inc.*, 509 U.S. 579, 595 (1993) (quoting Weinstein, J., 138 F.R.D. 631, 632 [1991]).

39. "[J]uries are increasingly making determinations on the credibility of a forensic scientist's evidence, not on scientific fact, but how it is presented." M. A. Peat, Guest Editorial, *J. Forensic Sci.*, 42 (1997), 775. See also, M. F. Graham, "Expert Witness Testimony and the Federal Rules of Evidence: Insuring Adequate Assurance of Trustworthiness," *U. Ill. Rev.* (1986), 43, 45–47.

40. All too often the laboratory states a conclusion, then gets data to support it after being challenged, thereby supplying facts post hoc.

41. P. C. Giannelli, "The Abuse of Scientific Evidence in Criminal Cases: The Need for Independent Crime Laboratories," *Virg. J. Social Policy and Law*, 4 (Spring 1997), 439, 441.

42. *Daubert* 509 at 579. Neither did *General Electric v. Joiner*, 522 U.S. 136, 141, 118 S. Ct. 512 (1997) nor *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 119 S. Ct. 1167 (1999).

43. S. G. Schneider and K. D. Ballard, "Convincing But Erroneous: The Courtroom Impact of Evidence Shaping," *Proc. American Academy of Forensic Sciences*, 4 (February 1998), 119.

44. Kelly and Wearne, *Tainting Evidence*, p. 312 (discussing stretching the truth or even lying on the witness stand).

45. A. H. B. Wu, D. W. Hill, D. Crouch, C. N. Hodnett, and H. H. McCurdy, "Witnesses should ensure that their opinions are congruent with current scientific standards, and not be manipulated into extending their testimony to support a particular side of a case." "Minimal Standards for the Performance and Interpretation of Toxicology Tests in Legal Proceedings," *J. Forensic Sci.*, 44 (1999), 516, 521.

46. M. Davis, "Weird Science: Cutting-Edge Advances in the Forensic Sciences Put Lawyers to the Test," *John Marshall L. School Magazine*, 22 (Summer 1997), 28.

47. Starrs, "A Crisis in the Forensic Sciences," p. 15; Schneider and Ballard, "Convincing But Erroneous," p. 119. See also, J. E. Murray, "Conference Proceedings: Science and the Law," *Duquesne L. Rev.*, 34 (Summer 1996), 795–812; J. E. Starrs, "Recent Developments in Federal and State Rules Pertaining to Medical and Scientific Expert Testimony," *Duquesne L. Rev.*, 34 (Summer 1996), 813–847. P. C. Giannelli provides an insightful review of prominent incidents regarding egregious abuses of expert witness testimony in forensic science that include serologist Fred Zain, pathologist Dr. Ralph Erdmann, dentist Dr. Michael West ("West Phenomena"), anthropologist Dr. Louise Robbins ("Cinderella Expert"), the Guildford Four and Maguire Seven (Irish Republican Army cases), serologist Timothy Dixon (Gary Dotson DNA case), and other notable

cases with abhorrent consequences. Giannelli, "The Abuse of Scientific Evidence in Criminal Cases." See also, J. E. Starrs, "The Seamy Side of Forensic Science: The Mephitic Stain of Fred Salem Zain," *Sci. Sleuthing Rev.*, 17 (Winter 1993), 1, 7; J. E. Starrs, "Judicial Control over Scientific Supermen: Fingerprint Experts and Others Who Exceed the Bounds," *Crim. L. Bull.*, 35, no. 3 (May–June 1999), 234–276; Moenssens, "Novel Scientific Evidence in Criminal Cases," pp. 1, 6.

48. *Wong Sun v. United States*, 371 U.S. 471, 484 (1963). Note, however, that inadmissible hearsay may be relied upon by an expert in formulating an opinion (see note 20).

49. *People v. Sifuentes*, 248 Ill. App. 3d 248, 252–53, 618 N.E. 2d 643, 646 (Ill. App. 1st Dist. 1993).

50. L. S. Pozner and R. J. Dodd, *Cross-Examination: Science and Techniques* (Charlottesville, Va.: 1994), Michie, 1.

51. G. I. Sapir, D. T. Stafford, and M. A. Lashner, "Knowledge Is Not Enough: Analogies, Metaphors, Slang and Other Rhetorical Devices to Explain Science," *Proc. American Academy of Forensic Sciences*, 6 (February 2000), 16.

52. *Daubert* 509 at 579. The Supreme Court's decision in *Daubert* sought to reconcile the differences and clear up the confusion in the Federal Rules of Evidence (F.R.E. 702, 703) pertaining to the foundation of an expert's proffered opinion for scientific validity based upon the "*Frye* test." *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

53. G. Sapir, "Basic Forensic and Scientific Evidence Textbooks: An Attorney's Indispensable Arsenal," *Champion*, 19 (November 1995), 39; *Reference Manual on Scientific Evidence*.

54. Hall, "E-Mail and Confidentiality," *Champion*, 21 (June 1997), 52; *American Civil Liberties Union v. Reno*, 929 F. Supp at 824, 830–838. (E.D. Pa.) (three-judge court).

55. *Voir dire* is French for "to speak the truth." According to Nicholas T. Kuzmack, JD, this term is used in two contexts relating to trials: First, the prospective jury is voir dired by the attorneys to determine their qualifications. Second, after the proponent of an expert witness asks questions of the witness to bring out his or her qualifications, the opposing attorney is allowed to voir dire the witness to bring out matters that might prevent his or her qualification as an expert.

56. G. Sapir, "Proper Voir Dire: Qualifying the Expert Witness," *DWI Journal: Sci. and Law*, 13, no. 12 (December 1998), 5.

57. M. A. Berger, *Procedure and Evidentiary Mechanisms for Dealing with Experts in Toxic Tort Litigation: A Critique and Proposal*. Consultant Report (New York: Carnegie Commission on Science, Technology and Government, 1991), 15.

58. Pozner and Dodd, *Cross-Examination*, p. 13.

59. There are other experts with reasonable opinions in the area of expertise. Reasonable people can disagree with reasonable opinions; the expert is offering only his or her opinion, nothing more.

60. Nothing is infallible. The question that is raised in this situation is whether the technique, procedure, methodology, and equipment are infallible. A yes answer demonstrates naivete, narrow-mindedness, or dogmatic thinking. A no answer is reasonable doubt.

61. "That an expert testifies for money does not necessarily cast doubt on the reliability of his testimony, as few experts appear in court merely as an eleemosynary gesture. But in determining whether proposed expert testimony amounts to good science, we may not ignore the fact that a scientist's normal work place is the laboratory or field, not the courtroom or the lawyer's office." *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 43 F.3d 1311, 1317 (9th Cir. 1995). See also, P. C. Giannelli, "'Junk Science': The Criminal Cases," *J. Crim. Law and Criminol.*, 1 (Spring 1993), 105, 117.

62. *Sears v. Rutishauser*, 102 Ill. 2d 402, 466 N.E. 2d 210 (1984).

63. Kelly and Wearne, *Tainting Evidence*, p. 277.

64. Starrs, "Judicial Control over Scientific Supermen," pp. 234, 253.

65. *Kyles v. Whitley*, 514 U.S. 419 (1995).

66. *Daubert v. Merrell Dow Pharmaceuticals Inc.*, 113 S. Ct. 2786 (1993).

67. The expert witness disclosure statement should generally include the following information regarding the expert: qualifications, scope of engagement, information relied upon in formulating opinion, summary of opinion, qualifications and publications, compensation, and signature of both expert and disclosing attorney.

68. Federal Rule of Civil Procedure 26(e)(10). Additional relevant rules are Federal Rules of Evidence 702 (testimony by experts), 703 (basis of opinion by experts), and 705 (disclosure of facts or data underlying expert opinion).

69. Spoliation: the destruction, significant alteration, or nonpreservation of evidence that is relevant to pending or future litigation. *Willard v. Caterpillar, Inc.* 48 Cal. Rptr. 2d 607, 616.

(1995); *Black's Law Dictionary* (6th ed. 1990), 1401. Factors considered: culpability of spoliator and prejudice to nonoffending party. If there is imminent or pending litigation, err on the side of caution in preserving potentially relevant evidence in one's possession or control. The rationale for sanctions is deterrence, remediation, and punishment. D. A. Bell, M. A. Koesel, and T. L. Turnbull, "An Update on Spoliation of Evidence in Illinois," *Ill. Bar J.*, 85 (November 1997), 530.

70. *People v. Flatt*, 75 Ill. App. 3d 930, 394 N.E. 2d 1049, 1053 (1979).

71. See *California v. Trombetta*, 104 S. Ct. 2528, 2534 (1984) (*Trombetta* materiality standard).

72. "If you find that the State has . . . allowed to be destroyed or lost any evidence whose content or quality are in issue, you may infer that the true fact is against the State's interest." *Arizona v. Youngblood*, 488 U.S. 51, 59–60 (1988) (Stevens, J., concurring); *State v. Werkheiser*, 299 Md. 529, 474 A. 2d 898 (1984); *Thorne v. Dept. of Public Safety*, 774 P. 2d 1326 (Alaska 1989); *State v. Willetts*, 393 P. 2d 274, 279 (Ariz. 1964); *State v. Serna*, 787 P. 2d 1056, 1060 (Ariz. 1990); *U.S. v. Kincaid*, 712 F. 2d 1, 3 (1st Cir. 1983); *United States v. Peters*, 587 F. 2d 1267, 1275 (D.C. Cir. 1978).

73. *People v. Taylor*, 54 Ill. App. 3d 454, 369 N.E. 2d 573 (5th Dist. 1977).

74. *People v. Newberry*, 166 Ill. 2d 310, 652 N.E. 2d 288 (1995).

75. *Sweet v. Sisters of Providence in Washington*, 895 P. 2d 484, 492 (Alaska 1995).

76. *United States v. Butler*, 163 U.S. App. D.C. (1974); *Sweet v. Sisters of Providence in Washington*, 881 P. 2d 304 (Alaska 1994); *Newberry* 166 at 310, 652 at 288. Sanctions include a continuance, suppression of evidence, mistrial, or even dismissal of the case. *Daniels v. State*, 114 Nev. 261, 956 P. 2d 111, 115 (1998). A finding of grossly negligent conduct (acting contrary to standard police investigatory procedures) by the parties minimally requires a jury instruction that the destroyed evidence was unfavorable to the State. *State v. Ware*, 118 N.M. 319, 881 P. 2d 679, 685 (1994).

77. *Brady v. Maryland*, 373 U.S. 83 (1963). See also, *Moore v. Illinois*, 408 U.S. 786 (1972), for a good discussion of *Brady* and its parameters.

78. *United States v. Bryant*, 439 F. 2d 642, 648 (D.C. Cir. 1971).

79. *Gregory v. United States*, 369 F. 2d 185 (D.C. Cir., 1966).

80. Fed. R. Crim. 17.

81. *People ex rel. Fisher v. Carey*, 77 Ill. 2d 259, 396 N.E. 2d 17 (1979).

82. *United States v. Nixon*, 418 U.S. 683, 699–700 (1974).

83. *Black's Law Dictionary* (6th ed., 1990), 1426.

84. *Nixon*, 418 at 683; *People v. Harris*, 91 Ill. App. 3d 1, 413 N.E. 2d 1396 (1980); *People v. Briggs*, 136 Misc. 2d 687, 519 N.Y.S. 2d 294 (1987); *People v. Dunigan*, 96 Ill. App. 3d 799, 421 N.E. 2d 1319 (1st Dist., 1981); *People ex rel. Fisher v. Cary*, 77 at 259; *People v. Rogers*, 123 Ill. App. 3d 780, 463 N.E. 2d 211 (2nd Dist. 1984).

85. *People v. Walley*, 215 Ill. App. 3d 971, 575 N.E. 2d 596 (2nd Dist. 1991), *appeal denied*, 142 Ill. 2d 663 (1991); *People v. Hart*, 194 Ill. App. 3d 997, 552 N.E. 2d 1 (2nd Dist. 1990).

86. Fed. R. Civ. Proc. 33.

87. R. C. Beson, J. C. Tredennick, and S. B. Andersen, *How to Prepare For, Take and Use a Deposition* (Santa Ana, Calif.: James Publishing, 1995).

88. Fed. R. Crim. 15 et seq.

89. T. Erskine, "Trial of Thomas Hardy," How. St. Tr., 24 (1794), 966, 199.

90. "Wherever he steps, whatever he touches, whatever he leaves, even unconsciously, will serve as silent witness against him. Not only his fingerprints or his footprints, but his hair, the fibers from his clothes, the glass he breaks, the tool marks he leaves, the paint he scratches, the blood or semen he deposits or collects, all of these bear mute witness against him. This is evidence that does not forget; it is not confused by the excitement of the moment. It is not absent because human witnesses are. It is factual evidence. Physical cannot be wrong; it cannot perjure itself; it cannot be wholly absent; only its interpretation can err. Only human failure to find it, study it, and understand it can diminish its value." P. L. Kirk, *Crime Investigation* (New York: Interscience Publishers, 1953), 4.

91. Kelly and Wearne, *Tainting Evidence*, p. 9.

92. *Gallego v. United States*, 276 F. 2d 914 (9th Cir. Ariz. 1960).

93. I. Younger and M. Goldsmith, *Principles of Evidence* (Minneapolis, Minn.: National Practice Institute, 1984), 3.

94. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

95. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993). See also, *Huey v. United Parcel Service, Inc.*, 165 F. 3d 1084 (7th Cir., 1999); *Hall v. Baxter Healthcare Corp.* 947 F. Supp. 1387 (D. Or. 1996); E. J. Imwinkelried, "The Next Step after *Daubert*: Developing a Similarly Epistemological Approach to Ensuring the Reliability of Nonscientific Expert Testimony,"

Cardoza L. Rev., 15 (1994), 2271, 2276–2277; Laser, "Note, Inconsistent Gatekeeping in Federal Courts," pp. 1379, 1403 n. 231; K. J. Chesebro, *Galileo's Retort: Peter Huber's Junk Scholarship*, Amer. U. L. Rev., 42 (1993), 1637.

96. J. F. Madonia, "Kumho Tire Steers New Course on Expert-Witness Testimony," *Chicago Daily L. Bull.* (July 2, 1999), 5.

97. *Daubert* 509 at 579. *General Electric v. Joiner*, 522 U.S. 136, 141; 118 S. Ct. 512 (1997). *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137, 119 S. Ct. 1167, 1174 (1999).

98. *Frye v. United States*, 293 F. 1013, 1014 (D.C. Cir. 1923).

99. Berger, "Evidentiary Framework," p. 75. See also, *State ex rel. Collins v. Superior Court*, 132 Ariz. 180, 199, 644 P. 2d 1266, 1285 (1982); *People v. Kelly*, 17 Cal. 3rd 24, 38, 549 P. 2d 1240, 1249, 130 Cal. Rptr. 144, 153 (1976) (questioning whether the leading proponent of voiceprints could "fairly and impartially . . . assess the position of the scientific community"). The Michigan Supreme Court rejected voiceprint evidence because "the reputations and careers" of the experts who testified about the general acceptance of the technique were "built on their voiceprint work," and therefore they were not "disinterested and impartial." *People v. Tobey*, 401 Mich. 141, 146 257 N.W. 2d 537, 539 (1977).

100. J. M. Shellow, "The Application of *Daubert* to the Identification of Drugs," *Shepard's Expt. and Sci. Ev. Q.*, 2 (Winter 1995), 593, 605 n. 24.

101. P. C. Giannelli, "The Admissibility of Novel Scientific Evidence: *Frye v. U.S.* a Half-Century Later," *Colum. L. Rev.*, 80 (1980), 1197.

102. Imwinkelried, "Evidence Law Visits Jurassic Park," pp. 55, 69–70.

103. P. J. Neufeld and N. Colman, "When Science Takes the Witness Stand," *Sci. Amer.*, 46 (May 1990), 262.

104. *Daubert* 509 at 579.

105. The *Frye* test was superseded by the Federal Rules of Evidence. Nothing in F.R.E. 702 establishes "general acceptance" as an absolute prerequisite to admissibility. *Daubert* 509 at 579, 588.

106. Federal Rules affected by *Daubert:* Rules 16; 26(b)(4); 104(a); 702; 703; 704(a); and 706.

107. Theory test: If a theory cannot be tested, it is not science.

108. Peer review and publication are important components of "good science." After scientists conduct experiments and formulate a scientific theory, they must submit the theory "to the scrutiny of the scientific community" for review. Laser, "Inconsistent Gatekeeping in Federal Courts," pp. 1379, 1404.

109. Error rate is a valuable indicator used by scientists to determine the validity of a particular theory. Laser, "Inconsistent Gatekeeping in Federal Courts," pp. 1379, 1404.

110. W. A. Grimes, *Criminal Law Outline 1996* (Reno, Nev.: National Judicial College, University of Nevada–Reno, 1996).

111. The *Daubert* standard for evaluating scientific evidence is based on reliability, and the *Daubert* test for relevance is "good science." The reliability prong of scientific evidence consists of (1) testing, (2) peer review and publication, (3) error rate, and (4) "general acceptance" in the scientific community. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579, 593–595 (1993). In evaluating the second prong, relevance, trial courts must consider whether the particular reasoning or methodology offered can be properly applied to the facts in issue, as determined by "fit." There must be a valid scientific connection and basis to the pertinent inquiry. *Daubert*, 509 U.S. 579 at 591–592 (1993).

112. "Evidentiary reliability will be based upon scientific validity." *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 n. 9 (1993). The admissibility standard is a two-prong test requiring that (1) the testimony reflect scientific knowledge, constitute good science, and be derived by scientific method; and (2) that the proposed testimony is relevant to the issues and logically advances the proposing party's case. *Hall v. Baxter Healthcare Corp.* 947 F. Supp. 1387 (D. Or. 1996).

113. *Daubert* 509 at 579, 592–595.

114. Newtonian science relies on experimental methodology; the validity of scientific theory is determined through testing. Imwinkelried, "The Next Step After Daubert," pp. 2271, 2276–2277.

115. "The Supreme Court in *Daubert* instructed trial judges to ensure the reliability of all scientific expert testimony, but it did not specify which expert evidence is 'scientific' and thus subject to *Daubert*'s analysis and scrutiny." "[W]hat distinguishes science from other forms of knowledge—what is it that makes science scientific." Laser, "Inconsistent Gatekeeping in Federal Courts," pp. 1403, 1403 n. 231.

116. Faigman, *Legal Alchemy*, pp. 58–64.
117. *Daubert* 509 at 579, 591 fn. 9 (stating that validity is the ability to produce an accurate result, and reliability is the ability to repeatably reproduce valid results).
118. *Daubert* 509 at 579, 589 n. 7, 592.
119. Faigman, *Legal Alchemy*, pp. 87–88.
120. "In *Daubert v. Merrell Dow Pharmecuticals*, Justice Blackmun expressed confidence in the capacity of federal judges to undertake this task. The Chief Justice was considerably less sanguine on this subject." P. J. Neufeld, "Have You No Sense of Decency," *J. Crim. Law and Criminol.*, 1 (Spring 1993), 188, 190 n. 5. See also, Faigman, *Legal Alchemy*, pp. xi–xii, 53–54, 64.
121. Berger, "Novel Forensic Evidence: The Need for Court-Appointed Experts after Daubert," *Shepard's Expt. and Sci. Ev. Q.*, 1 (Winter 1994), 587.
122. *Reference Manual on Scientific Evidence*, p. 4 Berger, *Procedure and Evidentiary Mechanisms for Dealing with Experts in Toxic Tort Litigation*, p. 39; Federal Rule of Evidence 706.
123. Magistrate judges are judicial officers authorized by the Magistrates Act to help alleviate district judges' workloads. See 28 U.S.C. sec. 631, et seq.; Fed. R. Civ. Proc. 53.
124. *Reference Manual on Scientific Evidence*, p. 4; Berger, *Procedure and Evidentiary Mechanisms for Dealing with Experts in Toxic Tort Litigation*, p. 38; Fed. R. Civ. Proc. 53(b).
125. "Errors in measurement and analysis tend to obscure the truth or mislead the experimenter. . . . The laws of measurement help society understand the errors in measurement and detect and remove sources of error. They provide a means for determining objective, unbiased conclusions from data and determine how much data will probably be needed." W. J. Youden, *Experimentation and Measurement*, U.S. Dept. of Commerce, NIST Special Publication 672 (1991) pp. 6, 7; *Daubert* 509 at 579, 594. In order to obtain reliable results, the examiner must identify and either eliminate or minimize sources of error. Error or uncertainty may be classified into three major types: random, systematic (procedural), or gross. H. H. Willard, L. L. Merritt, and J. A. Dean, *Instrumental Methods of Analysis*, 6th ed. (Belmont, Calif.: Wadsworth Publishing, 1981), 861.
126. E. W. Cleary, ed., *McCormick on Evidence*, vol. 2, 4th ed. (St. Paul, Minn.: West Publishing, 1992), p. 330; Fed. R. Evid. 201(g); Imwinkelried, "Evidence Law Visits Jurassic Park," pp. 55, 72.
127. *Boling v. Boling*, 887 S.W. 2d 437, 1994 W.L. 579982 (Mo. App. W.D., 1994).
128. *Reference Manual on Scientific Evidence*, p. 3.
129. *Joiner*, 522 U.S. 136, 138–139 (1997).
130. *Kumho Tire Co., Ltd. v. Carmichael*, 526 U.S. 137 (1999).
131. 181 F.R.D. 144, 149 (1999).
132. Garriott, *Medicolegal Aspects of Alcohol*, 3rd ed., p. 355.
133. Starrs, "Judicial Control Over Scientific Supermen," pp. 234, 273.
134. G. Sapir, "Proper Voir Dire: Qualifying the Expert Witness," *DWI Journal: Science & Law*, 13 (12) (December 1998), 5.
135. Based on K. L. Long, "The Discovery Process in Drug Use Testing Litigation," *J. Forensic Sci.*, 34 (1989), 1454.