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CASE WESTERN RESERVE UNIVERSITY

FORENSIC SCIENCE: WHY NO RESEARCH?

Paul C. Giannelli

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INTRODUCTION

The ground-breaking report on forensic science by the National Academy of Sciences—*Strengthening Forensic Science in the United States: A Path Forward*[1]—raised numerous issues.[2] One dominant theme that runs throughout the Report is the failure of some forensic science disciplines to comport with fundamental scientific principles—in particular, to support claims with empirical research. The Report observed that "some forensic science disciplines are supported by little rigorous systematic research to validate the discipline's basic premises and techniques. There is no evident reason *why* such research cannot be conducted."[3] The Report went on to

[*] Weatherhead Professor of Law, Case Western Reserve University.

1. NAT'L RES. COUNCIL, NAT'L ACADEMY OF SCI., STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD (2009), *available at* www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf [hereinafter NAS FORENSIC SCIENCE REPORT].

2. *Id.* The Report makes numerous recommendations. Some are structural—i.e., the creation of an independent federal entity (the National Institute of Forensic Sciences) to oversee the field and the removal of crime laboratories from the administrative control of law enforcement agencies. Other recommendations include the accreditation of crime laboratories, the certification of examiners, research on human observer bias, standardization of terminology, and more comprehensive lab reports.

3. *Id.* at 22 (emphasis added). At another point, the Report states:

> The simple reality is that the interpretation of forensic evidence is not always based on scientific studies to determine its validity. This is a serious problem. Although research has been done in some disciplines, there is a notable dearth of peer-reviewed, published studies establishing the scientific bases and validity of many forensic methods.

identify fingerprint examinations,[4] firearms (ballistics) and toolmark identifications,[5] document comparisons,[6] hair analysis,[7] and bite mark examinations[8] as disciplines lacking such empirical research.

This essay attempts to answer the "why" question: Why was there a lack of research across so many forensic disciplines? For purposes of discussion, the time frame is divided into an early period and a recent period. The line of demarcation between the two eras is the advent of DNA profiling in the late 1980s, along with the Supreme Court's 1993 decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*[9] If not a perfect line of demarcation, this division is a useful one for present purposes.

I. EARLY PERIOD

An understanding of this formative period requires some appreciation of the time frame in which courts first admitted forensic identification evidence, the dates that crime laboratories were established, and the legal system's weaknesses during this era.

A. Initial Admissibility Decisions

The Illinois Supreme Court decided the first reported fingerprint case in this country, *People v. Jennings*,[10] in 1911.[11] Handwriting evidence was

Id. at 8; *see also id.* at 53 ("The bottom line is simple: In a number of forensic science disciplines, forensic science professionals have yet to establish either the validity of their approach or the accuracy of their conclusions, and the courts have been utterly ineffective in addressing this problem.").

4. *See id.* at 144.

5. *See id.* at 154.

6. *See id.* at 166.

7. *See id.* at 161.

8. *See id.* at 174.

9. 509 U.S. 579 (1993). The Court followed with *General Electric Co. v. Joiner*, 522 U.S. 136 (1997), and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), to make up what is known as the *Daubert* trilogy. *Daubert* is one of the most important evidence cases ever decided.

10. 96 N.E. 1077 (Ill. 1911).

11. As one court has noted:

> The first English appellate endorsement of fingerprint identification testimony was the 1906 opinion in *Rex v. Castleton*, . . . In 1906 and 1908, Sergeant Joseph Faurot, a New York City detective who had in 1904 been posted to Scotland Yard to learn about fingerprinting, used his new training to break open two celebrated cases: in each instance fingerprint identification led the suspect to confess . . . .

United States v. Llera Plaza, 188 F. Supp. 2d 549, 572 (E.D. Pa. 2002). For a thorough discussion of the history of fingerprints, see SIMON A. COLE, SUSPECT IDENTITIES: A HISTORY OF FINGERPRINTING AND CRIMINAL IDENTIFICATION (2001).

used in the Alfred Dreyfus case[12] at the turn of the twentieth century in Europe and was well established by the time of the Lindbergh kidnapping prosecution in 1935.[13] Firearms identifications gained notoriety at the Sacco and Vanzetti trial in 1921[14] and then gained further acceptance after its use in the investigation of the Saint Valentine's day massacre in Chicago at the end of that decade.[15] By this time hair evidence had also been admitted as evidence.[16] The only exception to this early judicial acceptance of forensic identification evidence is bite mark comparison evidence, which was first admitted at trial in *State v. Doyle*,[17] a 1954 case which involved a bite mark left on a piece of cheese discovered at the scene of a burglary.

Validating research for these techniques was absent from the beginning. As Professor Mnookin has noted: "[F]ingerprints were accepted as an evidentiary tool without a great deal of scrutiny or skepticism."[18] Similarly, in examining the origins of handwriting evidence, Professor Risinger and his colleagues observed:

12. *See* JEAN-DENIS BREDIN, THE AFFAIR: THE CASE OF ALFRED DREYFUS 67-68, 94-95 (Jeffrey Mehlman trans. 1986).

13. State v. Hauptmann, 180 A. 809, 822-23 (N.J. 1935). *See generally* Jennifer L. Mnookin, *Scripting Expertise: The History of Handwriting Identification Evidence and the Judicial Construction of Reliability*, 87 VA. L. REV. 1723 (2001).

14. *See* G. LOUIS JOUGHIN & EDMUND M. MORGAN, THE LEGACY OF SACCO & VANZETTI 11 (1948); James E. Starrs, *Once More Unto the Breech: The Firearms Evidence in the Sacco and Vanzetti Case Revisited*, 31 J. FORENSIC SCI. 630, 1050 (1986).

15. *See* Calvin Goddard, *The Valentine Day Massacre: A Study in Ammunition-Tracing*, 1 AM. J. POLICE SCI. 60, 76 (1930) ("Since two of the members of the execution squad had worn police uniforms, and since it had been subsequently intimated by various persons that the wearers of the uniforms might really have been policeman rather than disguised gangsters, it became a matter of no little importance to ascertain, if possible, whether these rumors had any foundation in fact."); Jim Ritter, *St. Valentine's Hit Spurred Creation of Nation's First Lab*, CHI. SUN-TIMES, Feb. 9, 1997, at 40 ("Sixty-eight years ago this Friday, Al Capone's hit men dressed as cops and gunned down seven men in the Clark Street headquarters of rival mobster Bugs Moran.").

16. The first reported use of forensic hair analysis occurred over 100 years ago, in 1861 in Germany. *See* E. James Crocker, *Trace Evidence*, *in* FORENSIC EVIDENCE IN CANADA 259, 265 (1991) (the analyst was a Berliner, Rudolf Virchow). The first published American opinion discussing forensic hair analysis is *Knoll v. State*, 12 N.W. 369, 369-70 (Wis. 1882).

17. 263 S.W.2d 779, 799 (Tex. Crim. App. 1954); *see also* PAUL C. GIANNELLI & EDWARD J. IMWINKELRIED, SCIENTIFIC EVIDENCE ch. 13 (4th ed. 2007) (discussing legal and scientific issues concerning bite mark comparisons).

18. Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 BROOK. L. REV. 13, 17 (2001). "Even if no two people had identical *sets* of fingerprints, this did not establish that no two people could have a *single* identical print, much less an identical *part* of a print. These are necessarily matters of probability, but neither the court in *Jennings* nor subsequent judges ever required that fingerprint identification be placed on a secure statistical foundation." *Id.* at 19 (emphasis added).

> Our literature search for empirical evaluation of handwriting identification turned up one primitive and flawed validity study from nearly 50 years ago, one 1973 paper that raises the issue of consistency among examiners but presents only uncontrolled impressionistic and anecdotal information not qualifying as data in any rigorous sense, and a summary of one study in a 1978 government report. Beyond this, nothing.[19]

Moreover, after his imprisonment, Alfred Dreyfus was exonerated,[20] and the firearm identification evidence in the Sacco and Vanzetti trial was misused.[21]

B. Establishment of the Crime Laboratory

The establishment of the modern crime laboratory did not result in the creation of a research base. The first crime laboratory in this country was founded in Los Angeles in 1923.[22] Other California labs followed,[23] as did the Chicago crime lab in 1929.[24] The Federal Bureau of Investigation (FBI) laboratory came on line in 1932. At its inception, the FBI laboratory staff included only firearm identification and fingerprint examiners.[25] The laboratory later added handwriting comparisons, trace evidence examina-

19. D. Michael Risinger et al., *Exorcism of Ignorance as a Proxy for Rational Knowledge: The Lessons of Handwriting Identification "Expertise,"* 137 U. PA. L. REV. 731, 738 (1989).

20. BREDIN, *supra* note 12, at 481 ("It had taken twelve years for France to vindicate an innocent man.").

21. Many believe their execution resulted more from their foreign status and "radical" beliefs as anarchists than from the cogency of the evidence presented against them. The presentation of the firearm identification evidence in that case remains problematic. Professors Joughin and Morgan concluded that the evidence was "carelessly assembled, incompletely and confusedly presented, and perhaps—most important of all—beyond the comprehension or judgment of the ordinary intelligent layman." JOUGHIN & MORGAN, *supra* note 14, at 15. They also wrote:

> On October 23 Captain Proctor made an affidavit indicating that he had repeatedly told [the prosecutor] that he would have to answer in the negative if he were asked whether he had found positive evidence that the fatal bullet had been fired from Sacco's pistol. The statement which Proctor made on the witness stand was: "My opinion is that it is consistent with being fired by that pistol."

Id.

22. *See* John I. Thornton, *Criminalistics: Past, Present and Future*, 11 LEX ET SCIENTIA 1, 23 (1975) ("In 1923, Vollmer served as Chief of Police of the City of Los Angeles for a period of one year. During that time, a crime laboratory was established at his direction.").

23. *Id.* at 23-24.

24. *See* JOE NICKELL & JOHN F. FISCHER, CRIME SCIENCE: METHODS OF FORENSIC DETECTION 13 (1999) ("Perhaps the first truly significant crime laboratory that could be called a national lab was the Scientific Crime Detection Laboratory, which began at Chicago in 1929 . . . .").

25. *See* FBI, U.S. DEP'T OF JUST., FBI LABORATORY 3 (1981).

tions, and the serological testing of blood and semen.[26] When initially established, crime laboratories handled a modest number of cases. For instance, in its first full year of operation, the FBI laboratory processed fewer than one thousand cases.[27] Crime laboratories soon sprang up in other large cities during the "gangster era."[28]

Although reliance on physical evidence to solve crimes was a noteworthy reform,[29] the establishment of these laboratories was ad hoc at best. One commentator observed: "Most laboratories owe their existence, not to progressive attitude on the part of police administrators, but because the police agencies inaugurating laboratory services were shamed into it by adverse publicity or the threat of it" and "all too often the laboratory was poorly conceived, poorly equipped, and poorly staffed."[30] Another author, writing in the 1960s, reflected:

> After the early 1930s, crime laboratories were established in rapid fashion until nearly all states and the major cities had some facility for examining evidence. Not all laboratories were properly founded. No model existed and the development depended upon local whim and resources. For reasons of local pride, some departments created laboratories by the device of a name on the door. In many places, what may be called a crime laboratory is in fact a small step beyond a latent fingerprint and photographic set-up, adequate for evidence collection but unsuited by equipment and staff to engage in the analysis and evaluation of evidence.[31]

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26. *See* ANNIVERSARY REPORT, 40 YEARS OF DISTINGUISHED SCIENTIFIC ASSISTANCE TO LAW ENFORCEMENT, FBI LAW ENFORCEMENT BULL. 4 (1972).

27. *Id.* ("During its first month of service, the FBI Laboratory examiners handled twenty cases. In its first full year of operation, the volume increased to a total of 963 examinations. By the next year that figure more than doubled.").

28. "[T]he Chicago Crime Laboratory has the distinction of being one of the oldest in the country. Soon after, however, many other jurisdictions also built police laboratories in an attempt to cope with the crimes of violence associated with the 1930s gangster era." Joseph L. Peterson, *The Crime Lab*, *in* THINKING ABOUT POLICE 184, 185 (Carl B. Klockars ed., 1983).

29. As is true today, prosecutors frequently relied on eyewitness testimony and confessions. The reliability of physical evidence is often superior to that of other types of proof. For example, in 1927, Justice Frankfurter, then a law professor, sharply critiqued the eyewitness identifications in the Sacco and Vanzetti case. *See* FELIX FRANKFURTER, THE CASE OF SACCO AND VANZETTI: A CRITICAL ANALYSIS FOR LAWYERS AND LAYMEN 30 (1927) ("What is the worth of identification testimony even when uncontradicted? The identification of strangers is proverbially untrustworthy."). In 1936, the Supreme Court expressed grave reservations about the trustworthiness of confessions wrung from a suspect by abusive interrogation techniques. *See* Brown v. Mississippi, 297 U.S. 278, 281, 287 (1936) (finding a due process violation in the beating of a confession out of a suspect).

30. Thornton, *supra* note 22, at 27.

31. Joseph D. Nicol, *Present Status of Criminalistics*, *in* LAW ENFORCEMENT, SCIENCE AND TECHNOLOGY 245 (S.A. Yefsky ed., 1967); *see also* Charles M. Wilson, *Crime Detec-*

By this time, courts had accepted most of the forensic identification techniques mentioned earlier.[32] Several reasons may explain the lack of research in the ensuing decades. First, the early crime labs, as is still true today, were operational, not research, laboratories.[33] Second, basic research can be both time-consuming and expensive, and the underfunding of crime laboratories has been chronic.[34] Third, even if research was perceived to be desirable, these laboratories were ill-equipped to conduct it. Police officers, whose skills were developed through on-the-job training, staffed these labs.[35] As would be expected, they were imbued with a police, not scientific, culture.[36]

Paul Kirk, a giant in the field of forensic science, described the research in 1963 as follows:

> [Forensic science] progress has been technical rather than fundamental, practical rather than theoretical, transient rather than permanent. Many persons can identify the particular weapon that fired a bullet, but few if any can state a single fundamental principle of identification of firearms. Document examiners constantly identify handwriting, but a class of beginners studying under these same persons, would find it difficult indeed

tion Laboratories in the United States, *in* LAW, MEDICINE, SCIENCE, AND JUSTICE 464, 464 (Larry Baer ed., 1964) ("The historical picture of crime detection laboratories in the United States is rather discouraging when viewed factually."), *reprinted in* FORENSIC SCIENCE: SCIENTIFIC INVESTIGATION IN CRIMINAL JUSTICE 96 (Joseph L. Peterson ed., 1975).

32. *See supra* text accompanying notes 10-21.

33. *See* NAS FORENSIC SCIENCE REPORT, *supra* note 1, at 44 ("The forensic science community has had little opportunity to pursue or become proficient in the research that is needed to support what it does. Few sources of funding exist for independent forensic research. Most of the studies are commissioned by DOJ and conducted by crime laboratories with little or no participation by the traditional scientific community.").

34. *See* U.S. OFFICE OF TECH. ASSESSMENT, GENETIC WITNESS: FORENSIC USES OF DNA TESTS 30 (1990) ("Most agree that crime laboratories and forensic sciences research that supports technology transfer to crime laboratories are underfunded. Increasingly, indications are that crime laboratories are experiencing difficulties managing the steadily rising influx of casework."); *see also* PRESIDENT'S COMM'N ON LAW ENFORCEMENT AND ADMIN. OF JUSTICE, THE CHALLENGE OF CRIME IN A FREE SOCIETY 255 (1967) ("[T]he great majority of police department laboratories have only minimal equipment and lack highly skilled personnel able to use the modern equipment now being developed . . . .").

35. *See* NAT'L ADVISORY COMM'N ON CRIMINAL JUSTICE STANDARDS AND GOALS, POLICE 303 (1974) ("There are . . . many police laboratories that have been staffed almost exclusively with sworn personnel.").

36. *See Symposium on Science and the Rules of Legal Procedure*, 101 F.R.D. 599, 642 (1983) (statement of Professor Joseph Peterson) ("[T]he police agency controls the formal and informal system of rewards and sanctions for the laboratory examiners."); *see also* MICHAEL J. SAKS & RICHARD VAN DUIZEND, THE USE OF SCIENTIFIC EVIDENCE IN LITIGATION 53 (1983) ("Given what is known about reference group phenomena, the need that people have for social support of attitudes and conduct, and the process of socialization in occupational settings, it strains credulity to believe that these experts do not identify with prosecutors.").

> to distinguish the basic principles used. In short, there exists in the field of criminalistics a serious deficiency in basic theory and principles, as contrasted with the large assortment of effective technical procedures.[37]

One exception to the dearth of research might be the paraffin test for the detection of gunshot residue on a shooter's hand, which was introduced in this country in the 1930s. However, even this is not an encouraging example. That test was admitted at trial for over thirty years before it was debunked by research.[38] In hindsight, a university-based, rather than a law enforcement-based, system would have been preferable.[39]

C. The Legal System

The legal system shares responsibility for the lack of research. Experience gleaned from the DNA admissibility wars indicates that adversarial procedures sometimes do trigger research.[40] Even the DNA proponents subsequently conceded that "most would now agree that this extended debate has been good for the science."[41] In contrast, there was little incentive for the government to sponsor research to validate the premises of forensic techniques that the courts had already accepted.[42]

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37. Paul L. Kirk, *The Ontogeny of Criminalistics*, 54 J. CRIM. L., CRIMINOLOGY & POLICE SCI. 235, 235 (1963).

38. *See* Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence:* Frye v. United States*, A Half-Century Later*, 80 COLUM. L. REV. 1197, 1224-25, 1227 (1980) (discussing the history of the paraffin test).

39. *See* Scott Bales, *Turning the Microscope Back on Forensic Scientists*, 26 LITIGATION 51, 55 (Winter 2000) ("The tie between crime labs and law enforcement agencies is not inevitable. In part, it is a product of history: rudimentary crime labs were first established near the turn of the century by law enforcement agencies when officials began to recognize the possible application of science to criminal investigations. Since that time, the relationship between labs and law enforcement has flourished because of practical benefits—for example, streamlining tasks such as close and timely communication, the transfer of evidence, and record-keeping.").

40. *See* MIKE REDMAYNE, EXPERT EVIDENCE AND CRIMINAL JUSTICE 204 (2001) ("[The British] Forensic Science Service adopted a method of calculating DNA match probabilities that had been proposed by statisticians associated with the defence side of the DNA dispute."); Mnookin, *supra* note 18, at 70 ("[W]hile it is easy to disparage 'battles of the experts' as expensive, misleading, and confusing to the factfinder, these battles may also reveal genuine weaknesses in proffered expert knowledge.").

41. IAN W. EVETT & BRUCE S. WEIR, INTERPRETING DNA EVIDENCE: STATISTICAL GENETICS FOR FORENSIC SCIENTISTS, at xiv (1998); *see also* Richard Lempert, Comment, *Theory and Practice in DNA Fingerprinting*, 9 STAT. SCI. 255, 258 (1994) ("[I]n this instance the importation of legal adversariness into the scientific world has spurred both valuable research and practical improvements in the way DNA is analyzed and presented.").

42. Far more research was conducted on polygraph testing during this time, the results of which had long been excluded. *See* GIANNELLI & IMWINKELRIED, *supra* note 17, § 8.03[c].

In *Daubert*, the Supreme Court emphasized the importance of the adversary process by noting that "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence."[43] However, the Supreme Court did not recognize the right to a defense attorney in all felony trials until *Gideon v. Wainwright*[44] in 1963. Furthermore, the right to a defense expert, albeit a limited one, was not firmly established until *Ake v. Oklahoma*[45] in 1985. The woeful inadequacy of pretrial discovery in criminal prosecutions, especially when compared to civil cases, also undermined attempts to challenge forensic evidence.[46] For example, in 2009, the Supreme Court observed that the laboratory report in one case

> contained only the bare-bones statement that "[t]he substance was found to contain: Cocaine." At the time of trial, petitioner did not know what tests the analysts performed, whether those tests were routine, and whether interpreting their results required the exercise of judgment or the use of skills that the analysts may not have possessed.[47]

Moreover, the evidentiary standards in place were not geared to analyzing the underlying basis of scientific proof. In 1923, the D.C. Circuit created the "general acceptance" test for determining the admissibility of scientific evidence. The case, *Frye v. United States*,[48] involved a precursor of the modern polygraph. Although the general acceptance test eventually became the majority pre-*Daubert* view,[49] it was mostly limited to poly-

43. Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 596 (1993) (citing Rock v. Arkansas, 483 U.S. 44, 61 (1987)).

44. 372 U.S. 335, 343-45 (1963).

45. 470 U.S. 68, 86-87 (1985). *See generally* Paul C. Giannelli, Ake v. Oklahoma*: The Right to Expert Assistance in a Post-*Daubert*, Post-DNA World*, 89 CORNELL L. REV. 1305, 1311-13 (2004) (discussing the legal disputes over the scope of *Ake*—i.e., whether it applied to non-capital cases and to non-psychiatric experts).

46. *See generally* Paul C. Giannelli, *Criminal Discovery, Scientific Evidence, and DNA*, 44 VAND. L. REV. 791 (1991) (examining deficiencies in pretrial discovery in criminal cases).

47. Melendez-Diaz v. Massachusetts, 129 S. Ct. 2527, 2537 (2009) (holding that in the absence of an opportunity to cross-examine the analyst, admission of a laboratory certificate identifying a substance as cocaine violated the Confrontation Clause).

48. 293 F. 1013, 1013 (D.C. Cir. 1923).

49. *See* United States v. Alexander, 526 F.2d 161, 163 n.3 (8th Cir. 1975) ("[F]ederal courts of appeals continue to subscribe to [the] 'general scientific acceptability' criterion."); Reed v. State, 391 A.2d 364, 368 (Md. 1978) ("This criterion of 'general acceptance' in the scientific community has come to be the standard in almost all of the courts in the country which have considered the question of the admissibility of scientific evidence.").

graph cases for several decades.[50] Under the general acceptance test, scientific testimony is admissible if the underlying theory or technique is generally accepted by the specialists within the expert's field. This test did not require foundational proof of the empirical validity of the technique's scientific premises.

In the late 1960s, the introduction of several new types of evidence awakened a new interest in the admissibility of expert testimony and the *Frye* rule.[51] The controversy surrounding the admission of sound spectrometry ("voiceprint") evidence could have sparked a reappraisal of traditional forensic techniques, but it did not. Courts admitted voiceprint evidence in numerous trials during the 1970s[52]—until a National Academy of Sciences report raised questions about its validity.[53] That technique, however, had a far more extensive empirical basis than many forensic techniques.[54] Yet, the NAS report concluded that further research was required to establish its reliability.[55]

50. Courts cited *Frye* only five times in published opinions before World War II, mostly in polygraph cases. After World War II, *Frye* was cited six times before 1950, twenty times during the 1950s and twenty-one times in the 1960s. Bert Black et al., *Science and the Law in the Wake of* Daubert*: A New Search for Scientific Knowledge*, 72 TEX. L. REV. 715, 722 n.30 (1994) (citing *Shepard's Federal Citations*).

51. In addition to voiceprints, neutron activation analysis was introduced at this time. *See, e.g.*, United States v. Stifel, 433 F.2d 431, 438 (6th Cir. 1970) (bomb debris); United States v. Kelly, 420 F.2d 26, 28 (2d Cir. 1969) (narcotics); State v. Coolidge, 260 A.2d 547, 561 (N.H. 1969) (particle analysis admitted; hair analysis excluded), *rev'd on other grounds* 403 U.S. 443 (1971); *see also* GIANNELLI & IMWINKELRIED, *supra* note 17, § 11.04 (noting the admissibility of expert testimony based on activation analysis regarding "gunshot residues, bullets, hair, glass, paint, and other substances").

52. *See* GIANNELLI & IMWINKELRIED, *supra* note 17, § 10.06 (discussing scientific and legal issues involving voiceprints).

53. NAT'L RES. COUNCIL, NAT'L ACADEMY OF SCI., ON THE THEORY AND PRACTICE OF VOICE IDENTIFICATION (1979) [hereinafter NAS REPORT].

54. Dr. Oscar Tosi reported an extensive study on voiceprints in 1972. Conducted at Michigan State University over a two-year period, this study involved 34,992 experimental trials with 250 male speakers and 29 examiners. False identification errors occurred in approximately 5-6% of the trials which most closely resembled the forensic situation. The error rate was reduced to approximately 2% if the trials in which the examiners expressed "uncertainty" about their conclusions were eliminated. NAT'L INST. L. ENF. & CRIM. JUST., VOICE IDENTIFICATION RESEARCH (1972) (submitted to Law Enforcement Assistance Administration by the Department of Michigan State Police).

55. The Report concluded:

> The practice of voice identification rests on the assumption that intraspeaker variability is less than or different from interspeaker variability. However, at present the assumption is not adequately supported by scientific theory and data. Viewpoints about probable errors in identification decisions at present result mainly from various professional judgments and fragmentary experimental results rather than from objective data representative of results in forensic applications.

II. RECENT PERIOD: POST-DNA, POST-*DAUBERT*

As noted earlier, the second period commenced with the introduction of DNA evidence in the late 1980s, followed by the *Daubert* decision in 1993.[56] First introduced in 1986 in the United Kingdom, DNA evidence revolutionized forensic science.[57] Private laboratories developed DNA evidence, and it rested upon strong university-based research.[58] Consequently, it soon became the "gold standard" in forensic science.[59] Citing DNA profiling, Professors Saks and Koehler wrote in 1991 that

> forensic scientists, like scientists in all other fields, should subject their claims to methodologically rigorous empirical tests. The results of these tests should be published and debated. Until such steps are taken, the strong claims of forensic scientists must be regarded with far more caution than they traditionally have been.[60]

In the same year, Professor Jonakait published a multi-pronged critique of forensic science, stating: "Forensic science is supported by almost no research. The laboratory practices are based on intuitions and deductions, not

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> The Committee concludes that the technical uncertainties concerning the present practice of voice identification are so great as to require that forensic applications be approached with great caution.

NAS REPORT, *supra* note 53, at 2.

56. *See supra* text accompanying note 9.

57. *See* OFFICE OF TECH. ASSESSMENT, U.S. CONGRESS, OTA-BA-438, GENETIC WITNESS: FORENSIC USES OF DNA TESTS 8 (1990). In 1985, Dr. Alec Jeffreys of the University of Leicester, England, recognized the utility of DNA profiling in criminal cases. *Id.* at 7. Its first use in American courts came two years later. The first reported appellate case using DNA evidence was reported in 1988. *See* Andrews v. State, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988) (holding DNA evidence admissible), *reh'g denied*, 542 So. 2d 1332 (Fla. 1989).

58. *See* JAY D. ARONSON, GENETIC WITNESS: SCIENCE, LAW, AND CONTROVERSY IN THE MAKING OF DNA PROFILING 7 (2007). *See generally* DAVID H. KAYE, DOUBLE HELIX AND THE LAW OF EVIDENCE (2010).

59. *See* Joseph L. Peterson & Anna S. Leggett, *The Evolution of Forensic Science: Progress Amid the Pitfalls*, 36 STETSON L. REV. 621, 654 (2007) ("[T]he scientific integrity and reliability of DNA testing have helped DNA replace fingerprinting and made DNA evidence the new 'gold standard' of forensic evidence.").

60. Michael J. Saks & Jonathan J. Koehler, *What DNA "Fingerprinting" Can Teach the Law About the Rest of Forensic Science*, 13 CARDOZO L. REV. 361, 372 (1991). Professor Zabell would later note that "DNA identification has not only transformed and revolutionized forensic science, it has also created a new set of standards that have raised expectations for forensic science in general." Sandy L. Zabell, *Fingerprint Evidence*, 13 J.L. & POL'Y 143, 143 (2005). Similarly, Professor Mnookin observed that "[o]ne consequence of DNA profiling and its admissibility into court is that it has opened the door to challenging fingerprinting." Mnookin, *supra* note 18, at 43.

on empirical proof."[61] This review came only two years after Risinger and his colleagues' searing critique of handwriting evidence.[62]

With this backdrop, the Supreme Court decided *Daubert* in 1993. As one scholar commented, "*Daubert* initiated a scientific revolution in the law."[63] In *Daubert*, the Court adopted a new reliability test for expert testimony:

> [I]n order to qualify as "scientific knowledge," an inference or assertion must be derived by the scientific method. Proposed testimony must be supported by appropriate validation—*i.e.*, "good grounds," based on what is known. In short, the requirement that an expert's testimony pertain to "scientific knowledge" establishes a standard of evidentiary reliability.[64]

In addition, the Court listed several factors that trial judges may consider in assessing reliability.[65] The first and the most important among the *Daubert* factors is empirical testing.[66]

The implications of *Daubert* for forensic science were soon apparent. Writing about *Daubert* a year after it was decided, Professor Berger observed: "Considerable forensic evidence made its way into the courtroom without empirical validation of the underlying theory and/or its particular application. Courts never required some of the most venerable branches of forensic science—such as fingerprinting, ballistics, and handwriting—to demonstrate their ability to make unique identifications."[67] Other commentators foresaw the same future: "[I]f *Daubert* is taken seriously, then much of forensic science is in serious trouble."[68]

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61. Randolph N. Jonakait, *Forensic Science: The Need for Regulation*, 4 HARV. J.L. & TECH. 109, 137 (1991).

62. *See* Risinger et al., *supra* note 19, at 749-50.

63. David L. Faigman, *Science and the Law: Is Science Different for Lawyers?*, 297 SCIENCE 339, 340 (2002).

64. Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 590 (1993).

65. The now famous *Daubert* factors are: (1) testing; (2) peer review and publication; (3) error rate; (4) maintenance of standards; and (5) general acceptance. *Id.* at 593-94.

66. *Id.* at 593. The Court's others factors are generally complementary. For example, the second factor, peer review and publication, tends to verify the results of the testing cited in the first factor and suggests general acceptance of the technique within the broader scientific community. Similarly, another factor, error rate, is derived from testing.

67. Margaret A. Berger, *Procedural Paradigms for Applying the* Daubert *Test*, 78 MINN. L. REV. 1345, 1354 (1994).

68. Randolph N. Jonakait, *The Meaning of* Daubert *and What That Means for Forensic Science*, 15 CARDOZO L. REV. 2103, 2117 (2004); *see also* Barry C. Scheck, *DNA and* Daubert, 15 CARDOZO L. REV. 1959, 1959 (2004) ("*Daubert* calls upon courts to undertake a much more sophisticated and informed analysis of scientific evidence than *Frye v. United States*.").

The first significant challenge under *Daubert* involved handwriting evidence in *United States v. Starzecpyzel*,[69] decided in 1995. In that case, the district court concluded that "forensic document examination, despite the existence of a certification program, professional journals and other trappings of science, cannot, after *Daubert*, be regarded as 'scientific . . . knowledge.'"[70] The court stated that, "while scientific principles may *relate* to aspects of handwriting analysis, they have little or nothing to do with the day-to-day tasks performed by [Forensic Document Examiners (FDE)] . . . . [T]his attenuated relationship does not transform the FDE into a scientist."[71] In the same year, microscopic hair analysis came under attack. In *Williamson v. Reynolds*,[72] a habeas case, another district court wrote that it had been "unsuccessful in its attempts to locate *any* indication that expert hair comparison testimony meets *any* of the requirements" of *Daubert*.[73] The court went on to observe: "Although the hair expert may have followed procedures accepted in the community of hair experts, the human hair comparison results in this case were, nonetheless, scientifically unreliable."[74] In 1996, one year later, an article critical of hair analysis was published: "If the purveyors of this dubious science cannot do a better job of validating hair analysis than they have done so far, forensic hair comparison analysis should be excluded altogether from criminal trials."[75]

In 1999, the Supreme Court in *Kumho Tire Co. v. Carmichael*,[76] ruled that *Daubert*'s reliability test applied to all expert testimony, thereby abolishing the distinction between "scientific" and "technical" expertise.

69. 880 F. Supp. 1027 (S.D.N.Y. 1995). *See generally* GIANNELLI & IMWINKELRIED, *supra* note 17, ch. 21 (discussing the scientific and legal issues associated with questioned document examinations).

70. *Starzecpyzel,* 880 F. Supp. at 1038 (quoting FED. R. EVID. 702).

71. *Id.* at 1041. The court did not exclude handwriting comparison testimony. Instead, the court admitted the individuation testimony as "technical" evidence. *Id.* at 1029. *Kumho Tire* later called this aspect of the *Starzecpyzel* opinion into question because *Kumho* indicated that the reliability requirement applied to all types of expertise—"scientific," "technical," or "specialized." Kumho Tire Co. v. Carmichael, 526 U.S. 137, 147-49 (1999).

72. 904 F. Supp. 1529, 1554 (E.D. Okla. 1995), *rev'd on this issue sub nom.* Williamson v. Ward, 110 F.3d 1508, 1523 (10th Cir. 1997). Although the Tenth Circuit did not fault the district judge's reading of the empirical record relating to hair analysis and ultimately upheld habeas relief, the court reversed the district judge on this issue; the court ruled that the district court had committed error because the due process standard of fundamental fairness, not the more stringent *Daubert* standard, controls evidentiary issues in habeas corpus proceedings. *Williamson*, 110 F.3d at 1522-23.

73. *Williamson*, 904 F. Supp. at 1558.

74. *Id.*

75. Clive A. Stafford Smith & Patrick A. Goodman, *Forensic Hair Comparison Analysis: Nineteenth Century Science or Twentieth Century Snake Oil?*, 27 COLUM. HUM. RTS. L. REV. 227, 231 (1996).

76. 526 U.S. 137 (1999).

Soon thereafter, Judge Gertner wrote that *Daubert* and *Kumho* invited "reexamination even of 'generally accepted' venerable, technical fields."[77] She went on to limit the scope of handwriting testimony, permitting testimony concerning the general similarities and differences between a defendant's handwriting exemplar and a stick up note but not the specific conclusion that the defendant was the author. Once again, commentators highlighted the potential impact of *Kumho*: "Yet all the areas of forensic science discussed in this article share two common denominators: In each area little rigorous, systematic research has been done to validate the discipline's basic premises and techniques, and in each area there is no evident reason why such research would be infeasible."[78]

Early in 2002, Judge Pollak in *United States v. Llera Plaza*[79] ruled that fingerprint experts would not be permitted to testify that two sets of prints "matched"—that is, establishing a positive identification to the exclusion of all other persons. This was the first time in nearly 100 years that a court had rendered such a ruling.[80] Although Judge Pollak reversed himself on rehearing, the case "sent shock waves through the community of fingerprint analysts."[81]

Any observer with a modicum of insight should have seen the writing on the wall. And, some did. In 2000, Stephen Bunch, an FBI firearms identification expert, wrote:

> [T]here is no rational or scientific ground for making claims of absolute certainty in any of the traditional identification sciences, which include fingerprint, document, firearms, toolmark, and shoe and tire-tread analysis. Case-specific conclusions of identity rest on a fundamental proposition, or hypothesis; namely, that no two fingerprints, bullets, etc., from different sources will appear sufficiently similar to induce a competent fo-

77. *See* United States v. Hines, 55 F. Supp. 2d 62, 67 (D. Mass. 1999) (handwriting comparison); *see also* United States v. Hidalgo, 229 F. Supp. 2d 961, 966 (D. Ariz. 2002) ("Courts are now confronting challenges to testimony, as here, whose admissibility had long been settled.") (handwriting comparison).

78. Paul C. Giannelli & Edward J. Imwinkelried, *Scientific Evidence: The Fallout From Supreme Court's Decision in* Kumho Tires, 14 CRIM. JUST. 12, 40 (2000); *see also* Joan Griffin & David J. LaMagna, Daubert *Challenges to Forensic Evidence: Ballistics Next on the Firing Line*, 26 CHAMPION 20, 21 (2002).

79. 179 F. Supp. 2d 492 (E.D. Pa. 2002), *vacated, motion granted on recons.*, 188 F. Supp. 2d 549 (E.D. Pa. 2002). *See generally* GIANNELLI & IMWINKELRIED, *supra* note 17, ch. 18 (discussing the scientific and legal issues associated with fingerprint identification).

80. *Llera Plaza*, 188 F. Supp. 2d at 572 ("English and American trial courts have accepted fingerprint identification testimony for almost a century.").

81. D.H. Kaye, *The Nonscience of Fingerprinting:* United States v. Llera-Plaza, 21 QUINNIPIAC L. REV. 1073, 1073 (2003).

> rensic examiner to posit a common source. But as any logician or philosopher of science would insist, no hypothesis can be proved absolutely.[82]

In 2003, when he was President of the American Academy of Forensic Sciences, Kenneth Melson, a former prosecutor and current Director of the Bureau of Alcohol, Tobacco, Firearms and Explosives, wrote:

> [M]ore research is needed in the techniques and science already in use. With the importance of forensic science to truth and justice, the science employed and relied upon by judges and juries must be valid. It does not matter how well forensic scientists abide by testing protocols or how reliable the techniques are, if the underlying science does not actually reveal what the expert says it does. Method validation studies and new research must be ongoing even in the areas of traditional forensic science disciplines. Justice demands good science and we have an obligation to provide it. We can no longer expect the courts or public to accept the truth of our science merely because we say it is good. In order to maintain the integrity of both the science and the justice system, we must prove that it is so.[83]

And yet, with the exception of handwriting,[84] extensive empirical research was not conducted. Indeed, instead of leading efforts to ensure the development of a solid empirical basis, some forensic disciplines continued to deny the existence of a problem. For example, FBI fingerprint experts insisted in court testimony that the "error rate for the method is zero."[85] A

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82. Stephen G. Bunch, *Consecutive Matching Striation Criteria: A General Critique*, 45 J. FORENSIC SCI. 955, 956 (2000).

83. Kenneth E. Melson, *President's Editorial: The Journey to Justice*, 48 J. FORENSIC SCI. 705, 707 (2003). For more recent commentary, see Thomas L. Bohan, *President's Editorial: Strengthening Forensic Science: A Way Station on the Journey to Justice*, 55 J. FORENSIC SCI. 5, 6 (2010) ("[W]hat is needed immediately is a series of validation investigations. A validation investigation is a threshold study to determine whether a technique or theory the scientific validation of which has been questioned has in fact already been scientifically validated."). Barry Fisher, the former Director of the Crime Laboratory of the Los Angeles County Sheriff's Department, has said, "[w]e run the risk of our science being questioned in the courts because there is so little research." KELLY M. PYREK, FORENSIC SCIENCE UNDER SIEGE: THE CHALLENGES OF FORENSIC LABORATORIES AND THE MEDICO-LEGAL INVESTIGATION SYSTEM 231 (2007).

84. *See, e.g.*, Moshe Kam et al., *Effects of Monetary Incentives on Performance of Non-Professionals in Document-Examination Proficiency Tests*, 43 J. FORENSIC SCI. 1000 (1998); Moshe Kam et al., *Writer Identification by Professional Document Examiners*, 42 J. FORENSIC SCI. 778 (1997) (false positive rate for professionals was 6.5% compared to 38.3% for non-professionals; forensic document examiners demonstrated a false positive error rate of only .5%); Sargur Srihari et al., *Individuality of Handwriting*, 47 J. FORENSIC SCI. 856 (2002) (noting that 1500 individual handwriting samples scanned into a computer programmed to compare the samples based on a variety of features such as slant, height, number of interior contours, and number of vertical slope components; computer matched exemplars with a 98% accuracy rate).

85. United States v. Havvard, 117 F. Supp. 2d 848, 854 (S.D. Ind. 2000), *aff'd*, 260 F.3d 597 (7th Cir. 2001). *But see* NAS FORENSIC SCIENCE REPORT, *supra* note 1, at 142 ("Al-

decade of time in which research could have been conducted—from *Kumho* in 1999 to the NAS Report in 2009—was lost. The NAS Report commented on this issue, writing that "[t]he insistence by some forensic practitioners that their disciplines employ methodologies that have perfect accuracy and produce no errors has hampered efforts to evaluate the usefulness of the forensic science disciplines."[86] In another passage, the Report states:

> Parts of the forensic science community have resisted the implications of the mounting criticism of the reliability of forensic analyses by investigative units such as Inspector General reports, The Innocence Project, and studies in the published literature. In testimony before the committee, it was clear that some members of the forensic science community will not concede that there could be less than perfect accuracy either in given laboratories or in specific disciplines . . . . Failure to acknowledge uncertainty in findings is common: Many examiners claim in testimony that others in their field would come to the exact same conclusions about the evidence they have analyzed. Assertions of a "100 percent match" contradict the findings of proficiency tests that find substantial rates of erroneous results in some disciplines (i.e., voice identification, bite mark analysis).[87]

CONCLUSION

Several factors may explain the lack of empirical research in the early part of the last century—most significantly, crime laboratories staffed by police officers with inadequate budgets and a lack of scientific training. Moreover, a good part of the failures can be attributed to inadequacies in the legal system—the lack of counsel, the failure to provide defense experts, and insufficient discovery.

In recent years, however, the reason for the lack of empirical research was simply a stubborn refusal to reconsider beliefs in light of credible challenges. This is the antithesis of the scientific method. As the NAS Report noted, "openness to new ideas, including criticism and refutation" is a fundamental principle of the scientific method.[88] Instead of taking the lead in ensuring that the needed research was conducted, many forensic practitioners adopted a "circle the wagons" mentality and attacked the critics. As a result, the opportunity for empirical research during the last decade was

though there is limited information about the accuracy and reliability of friction ridge analyses, claims that these analyses have zero error rates are not scientifically plausible.").

86. NAS FORENSIC SCIENCE REPORT, *supra* note 1, at 47.

87. *Id.* at 46-47.

88. *Id.* at 113.

needlessly squandered. A British scholar summed it up this way: "[I]f the state does not test the scientific evidence with which it seeks to convict defendants, it should forfeit the right to use it."[89]

89. REDMAYNE, *supra* note 40, at 139.