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# Scientific Evidence in Criminal Prosecutions

## A RETROSPECTIVE

*Paul C. Giannelli*<sup>†</sup>

The publication of the National Academy of Sciences (NAS) Report on forensic science, *Strengthening Forensic Science in the United States: A Path Forward*,<sup>1</sup> in February 2009 marked the culmination of thirty years of debate on the admissibility of scientific evidence. In a sense, the NAS Report told Congress to scrap the current structure and replace it with a system that was independent of law enforcement and premised on the research norms of science.<sup>2</sup> The impetus for the report can be traced to two events: The Supreme Court's decision in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*,<sup>3</sup> an opinion that revolutionized the legal test for the admissibility of expert testimony, and DNA analysis, a technique that

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<sup>†</sup> Albert J. Weatherhead III & Richard W. Weatherhead Professor of Law, Case Western Reserve University. Like most evidence teachers, I am deeply indebted to Margaret Berger. I began teaching evidence in 1975, the year the Federal Rules of Evidence became effective. In preparing for class, I relied on JACK B. WEINSTEIN & MARGARET A. BERGER, *WEINSTEIN'S EVIDENCE*, which was the only complete text on the Federal Rules at the time. In class, I used JACK B. WEINSTEIN, JOHN MANSFIELD, MARGARET A. BERGER & NORMAN ABRAMS, *CASES AND MATERIALS ON EVIDENCE*, as my casebook. See Paul C. Giannelli, *Book Review: Cases and Materials on Evidence*, 49 *BROOK. L. REV.* 629, 633-34 (1983) ("In summary, the seventh edition improves what was already an exceptional book. The comprehensiveness of the text, achieved in part through the use of copious notes, has been retained, and the organizational changes will assist in the effective presentation of the course material.").

<sup>1</sup> NAT'L RES. COUNCIL, *STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD* (2009). The National Research Council is an arm of the National Academies.

<sup>2</sup> See *infra* text accompanying notes 79-90.

<sup>3</sup> 509 U.S. 579 (1993). The Court followed with *General Elec. Co. v. Joiner*, 522 U.S. 136 (1997), and *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999), to make up what is now known as the *Daubert* trilogy; see also *United States v. Alatorre*, 222 F.3d 1098, 1100 (9th Cir. 2000) ("*Daubert* has become ubiquitous in federal trial courts."); *United States v. Barnette*, 211 F.3d 803, 815 (4th Cir. 2000) ("In *Daubert*, the Supreme Court radically changed the standard for admissibility of scientific testimony."); David L. Faigman, *Is Science Different for Lawyers?*, 297 *SCIENCE* 339, 340 (2002) ("*Daubert* initiated a scientific revolution in the law.").

revolutionized forensic science. Professor Margaret Berger played a significant role in both these developments, as well as in the NAS Report itself.

## I. THE *DAUBERT* TRILOGY

The Federal Rules of Evidence became effective in 1975. At that time, the leading case on the admissibility of scientific evidence was *Frye v. United States*,<sup>4</sup> which held that the admissibility of expert testimony depended on its “general acceptance in the particular field in which it belongs.”<sup>5</sup> In 1974, the D.C. Circuit observed that *Frye* had “been followed uniformly in this and other Circuits and there has never been any successful challenge to it in any federal court.”<sup>6</sup> *Frye* was also the majority rule in the states.<sup>7</sup> Yet, neither *Frye* nor the admissibility of novel scientific evidence was addressed in the legislative history of the Federal Rules. The issue was ignored in the advisory committee’s notes,<sup>8</sup> the congressional committee reports,<sup>9</sup> and the extensive hearings on the Federal Rules.<sup>10</sup> The year before the Supreme Court decided *Daubert*, Judge Becker and Professor Orenstein referred to the *Frye* issue as the “most controversial and important unresolved question in the Federal Rules” of Evidence.<sup>11</sup>

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<sup>4</sup> 293 F. 1013 (D.C. Cir. 1923). See generally James E. Starrs, “A Still Life Watercolor”: *Frye v. United States*, 27 J. FORENSIC SCI. 684 (1982).

<sup>5</sup> *Frye*, 293 F. at 1014.

<sup>6</sup> *United States v. Skeens*, 494 F.2d 1050, 1053 (D.C. Cir. 1974); see also *United States v. Alexander*, 526 F.2d 161, 163 n.3 (8th Cir. 1975) (The “federal courts of appeals continue to subscribe to [the] ‘general scientific acceptability’ criterion.”).

<sup>7</sup> See *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.”).

<sup>8</sup> *Rules of Evidence for United States Courts and Magistrates*, 56 F.R.D. 183 (1973).

<sup>9</sup> H.R. REP. NO. 93-650 (1973), reprinted in 1974 U.S.C.C.A.N. 7075; S. REP. NO. 93-1277 (1974), reprinted in 1974 U.S.C.C.A.N. 7051; H.R. REP. NO. 93-1597 (1974) (Conf. Rep.), reprinted in 1974 U.S.C.C.A.N. 7098.

<sup>10</sup> *Proposed Rules of Evidence: Hearings Before the Special Subcomm. on Reform of Federal Criminal Laws of the House Comm. on the Judiciary*, 93d Cong. (1973); *Rules of Evidence: Hearings Before the Senate Comm. on the Judiciary*, 93d Cong. (1974).

<sup>11</sup> Edward R. Becker & Aviva Orenstein, *The Federal Rules of Evidence After Sixteen Years—The Effect of “Plain Meaning” Jurisprudence, The Need for an Advisory Committee on the Rules of Evidence, and Suggestions for Selective Revision of the Rules*, 60 GEO. WASH. L. REV. 857, 863 (1992).

During this pre-*Daubert* era, textwriters<sup>12</sup> and law review commentators<sup>13</sup> disagreed sharply about the continued viability of the *Frye* test under the Federal Rules. Moreover, if *Frye* was discarded, what would replace it? Arguing that the Federal Rules' failure to incorporate *Frye* indicated its abandonment, Judge Weinstein and Professor Berger proposed an alternative approach specifying a number of factors for determining the reliability of expert testimony: (1) the new technique's general acceptance in the field, (2) the expert's qualifications and stature, (3) the use that has been made of the technique, (4) the potential rate of error, (5) the existence of specialized literature, (6) the novelty of the new invention, and (7) the extent to which the technique relies on the subjective interpretation of the expert.<sup>14</sup> At a conference devoted to this issue, Professor Berger argued for this enhanced reliability test,<sup>15</sup> commenting that the "*Frye* test often seems to obscure what the lawyers really should be asking. The question is not always whether a procedure is scientifically valid, but whether the procedure is being applied appropriately under the circumstances in a particular case."<sup>16</sup> At another point, she reported for a breakout group:

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<sup>12</sup> Compare MICHAEL H. GRAHAM, HANDBOOK OF FEDERAL EVIDENCE § 703.2, at 655 (3d ed. 1991) (supporting *Frye* or a "substantial acceptance" test) and 1 DAVID W. LOISELL & CHRISTOPHER B. MUELLER, FEDERAL EVIDENCE § 105, at 818 (1977) ("Probably the 'general scientific acceptance' approach has survived the enactment of the Federal Rules . . ."), with 3 JACK B. WEINSTEIN ET AL., WEINSTEIN'S EVIDENCE MANUAL ¶ 702[03] (1993) (Federal Rules' failure to incorporate *Frye* indicates its abandonment) and 22 CHARLES ALAN WRIGHT & KENNETH W. GRAHAM, JR., FEDERAL PRACTICE AND PROCEDURE § 5169, at 92 (1978) ("Rule 401 repeals the *Frye* standard.").

<sup>13</sup> See Bert Black, *A Unified Theory of Scientific Evidence*, 56 FORDHAM L. REV. 595, 632 (1988) (criticizing *Frye*); Paul C. Giannelli, *The Admissibility of Novel Scientific Evidence: Frye v. United States, a Half-Century Later*, 80 COLUM. L. REV. 1197, 1207-08 (1980) (same); Mark McCormick, *Scientific Evidence: Defining a New Approach to Admissibility*, 67 IOWA L. REV. 879, 895-904 (1982) (discussing federal and state courts that limited or rejected *Frye*).

<sup>14</sup> 3 WEINSTEIN ET AL., *supra* note 12, at ¶ 702[03].

<sup>15</sup> The National Conference of Lawyers and Scientists sponsored a conference on the *Frye* test in the early 1980s. *Symposium on Science and the Rules of Evidence*, 99 F.R.D. 187 (1983). Subsequently, the ABA Section of Science and Technology organized a symposium on the topic, including proposed amendments to Rule 702. See Margaret A. Berger, *A Relevancy Approach to Novel Scientific Evidence*, 26 JURIMETRICS J. 245 (1986); Paul C. Giannelli, *Scientific Evidence: A Proposed Amendment to Federal Rule 702*, 26 JURIMETRICS J. 260 (1986); Frederic I. Lederer, *Resolving the Frye Dilemma—A Reliability Approach*, 26 JURIMETRICS J. 240 (1986); James E. Starrs, *Frye v. United States Restructured and Revitalized: A Proposal to Amend Federal Evidence Rule 702*, 26 JURIMETRICS J. 249 (1986); Commentaries on the various proposals were later discussed at the ABA's annual conference in August 1986. *Rules for Admissibility of Scientific Evidence*, 115 F.R.D. 79 (1987).

<sup>16</sup> 99 F.R.D. at 222.

No one in our group thought that the general acceptance test should be retained, because no one could state specifically just what it means. On the other hand, we do not think that all scientific evidence should be admitted under a loosely structured relevance standard. We agreed that the court should conduct some sort of preliminary screening to ensure that a threshold of validity has been met.<sup>17</sup>

The Supreme Court's approach in *Daubert* echoed Professor Berger's position in several respects. First, the Court jettisoned *Frye* as a matter of statutory interpretation. Second, the Court required an independent judicial assessment of the reliability of expert testimony. Third, the Court's reliability test rested on a multi-factor analysis, albeit with some factors that differed from the Weinstein-Berger proposal.<sup>18</sup> In the aftermath of *Daubert*, many evidence scholars attempted to predict the ramifications of the decision.<sup>19</sup> Few were as perceptive as Professor Berger, who wrote on the topic the year after *Daubert* was decided.<sup>20</sup> She made three observations about expert testimony in criminal cases.

A. *Lack of Empirical Research*

Her first point stressed the lack of empirical research: "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."<sup>21</sup> A year later, challenges to the admissibility of these forensic techniques began. The first significant challenge under *Daubert* involved handwriting and came in *United States v. Starzecpyzel*,<sup>22</sup>

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<sup>17</sup> *Id.* at 230.

<sup>18</sup> In describing the trial judge's screening or "gatekeeping function," the Court identified a number of factors: (1) testability, (2) peer review and publication, (3) error rate, (4) maintenance of standards, and (5) general acceptance. *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579, 593 (1993).

<sup>19</sup> See generally Symposium, *Scientific Evidence After the Death of Frye*, 15 CARDOZO L. REV. 1745 (1994).

<sup>20</sup> Margaret A. Berger, *Procedural Paradigms for Applying the Daubert Test*, 78 MINN. L. REV. 1345 (1994) [hereinafter *Procedural Paradigms*].

<sup>21</sup> *Id.* at 1354.

<sup>22</sup> 880 F. Supp. 1027 (S.D.N.Y. 1995). See generally 2 PAUL C. GIANNELLI & EDWARD J. IMWINKELRIED, *SCIENTIFIC EVIDENCE* ch. 21 (4th ed. 2007) (discussing the scientific and legal issues associated with questioned document examinations).

decided in 1995.<sup>23</sup> Other handwriting cases followed, pointing out the lack of empirical support underpinning the technique.<sup>24</sup> Significantly, these cases viewed the *Daubert* trilogy as inviting “reexamination even of ‘generally accepted’ venerable, technical fields.”<sup>25</sup>

If *Starzecpyzel* unnerved document examiners, *United States v. Llera Plaza*<sup>26</sup> “sent shock waves through the community of fingerprint analysts.”<sup>27</sup> In that case, Judge Pollak ruled that fingerprint experts would not be permitted to testify that two sets of prints “matched”—that is, a positive identification to the exclusion of all other persons. This was the first time in nearly a hundred years that such a decision had been rendered.<sup>28</sup> On rehearing, however, Judge Pollak reversed

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<sup>23</sup> Handwriting was a prime target because a comprehensive article questioning the underpinnings of the technique had been published in 1989. According to the authors of that article:

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.

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).

<sup>24</sup> See, e.g., *United States v. Hidalgo*, 229 F. Supp. 2d 961, 967 (D. Ariz. 2002) (“Because the principle of uniqueness is without empirical support, we conclude that a document examiner will not be permitted to testify that the maker of a known document is the maker of the questioned document. Nor will a document examiner be able to testify as to identity in terms of probabilities.”); *United States v. Lewis*, 220 F. Supp. 2d 548, 554 (S.D. W. Va. 2002) (Expert’s “bald assertion that the ‘basic principle of handwriting identification has been proven time and time again through research in [his] field,’ without more specific substance, is inadequate to demonstrate testability and error rate.”).

<sup>25</sup> *United States v. Hines*, 55 F. Supp. 2d 62, 67 (D. Mass. 1999) (handwriting comparison); see also *Hidalgo*, 229 F. Supp. 2d at 966 (same) (“Courts are now confronting challenges to testimony, as here, whose admissibility had long been settled.”).

<sup>26</sup> 179 F. Supp. 2d 492 (E.D. Pa. 2002), *vacated, mot. granted on recons.*, 188 F. Supp. 2d 549 (E.D. Pa. 2002). See generally 1 GIANNELLI & IMWINKELRIED, *supra* note 22, at ch. 16 (discussing the scientific and legal issues associated with fingerprint identification).

<sup>27</sup> D.H. Kaye, *The Nonscience of Fingerprinting: United States v. Llera-Plaza*, 21 QUINNIPIAC L. REV. 1073, 1073 (2003).

<sup>28</sup> The first reported fingerprint case was decided in 1911. See *People v. Jennings*, 96 N.E. 1077 (Ill. 1911). As Professor Mnookin has noted, however, “fingerprints were accepted as an evidentiary tool without a great deal of scrutiny or skepticism.” Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 BROOK. L. REV. 13, 17 (2001). She elaborated: “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

himself,<sup>29</sup> and later cases would continue to uphold the admissibility of fingerprint evidence.<sup>30</sup> Yet, the case had captured the attention of the media, with news reports,<sup>31</sup> mainstream publications,<sup>32</sup> scientific journals,<sup>33</sup> and television shows giving it substantial coverage.<sup>34</sup> Legal articles followed,<sup>35</sup>

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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.

<sup>29</sup> 188 F. Supp. 2d at 261. *Llera Plaza II* was not a total victory for the prosecution. The rigor of proficiency testing was drawn into question because a fingerprint examiner from New Scotland Yard testified that the FBI tests were deficient: “It’s not testing their ability. It doesn’t test their expertise. I mean I’ve set these tests to trainees and advanced technicians. And if I gave my experts these tests, they’d fall about laughing.” *Id.* at 558. The district court agreed, noting that “the FBI examiners got very high proficiency grades, but the tests they took did not. . . . [O]n the present record I conclude that the proficiency tests are less demanding than they should be.” *Id.* at 565; *see also* *United States v. Crisp*, 324 F.3d 261, 274 (4th Cir. 2003) (Michael, J., dissenting) (“Proficiency testing is typically based on a study of prints that are far superior to those usually retrieved from a crime scene.”); Jennifer L. Mnookin, Editorial, *A Blow to the Credibility of Fingerprint Evidence*, BOSTON GLOBE, Feb. 2, 2004, at A14 (“There are no systematic proficiency tests to evaluate examiners’ skill. Those tests that exist are not routinely used and are substandard.”).

<sup>30</sup> *See, e.g.*, *United States v. Mitchell*, 365 F.3d 215, 219 (3d Cir. 2004); *Crisp*, 324 F.3d at 268; *United States v. Sullivan*, 246 F. Supp. 2d 700, 704 (E.D. Ky. 2003). However, in *State v. Rose*, No. K06-545 (Md. Cir. Ct. Oct. 19, 2007), a trial judge excluded fingerprint evidence. *See* James E. Starrs, *Will Wonders Never Cease? Fingerprinting Denied its Day in Maryland Trial Court*, 31 SCIENTIFIC SLEUTHING REV. 1, 1 (2007) (discussing *Rose*).

<sup>31</sup> *E.g.*, Associated Press, *Fingerprint Reliability Under Fire*, S. FLA. SUN-SENTINEL, Feb. 25, 2002, at A3; Joann Loviglio, *Trial Judge Reaffirms Fingerprint Usability; Hearing Shows Him Science Involved*, SAN ANTONIO EXPRESS-NEWS, Mar. 14, 2002, at A11; Andy Newman, *Judge Who Ruled Out Matching Fingerprints Changes his Mind*, N.Y. TIMES, Mar. 14, 2002, at A27; Joseph A. Slobodzian, *Court Ruling Blurs the Future for Fingerprint Experts: Linking of Print to Person Not Credible, Federal Judge Says*, MILWAUKEE J. SENTINEL, Feb. 17, 2002, at A2; Richard Willing, *Judge Challenges Fingerprint Identification*, USA TODAY, Jan 10, 2002, at A3.

<sup>32</sup> *E.g.*, Michael Specter, *Do Fingerprints Lie? The Gold Standard of Forensic Evidence is Now Being Challenged*, 78 THE NEW YORKER 96 (May 27, 2002) (discussing case including interview with judge).

<sup>33</sup> *See* David L. Faigman, *Is Science Different for Lawyers?*, 297 SCIENCE 339, 339-40 (2002).

<sup>34</sup> *60 Minutes: Fingerprints* (CBS television broadcast Jan. 5, 2003).

<sup>35</sup> *See* Simon A. Cole, *Grandfathering Evidence: Fingerprint Admissibility Rulings from Jennings to Llera Plaza and Back Again*, 41 AM. CRIM. L. REV. 1189 (2004); Robert Epstein, *Fingerprints Meet Daubert: The Myth of Fingerprint “Science” Is Revealed*, 75 S. CAL. L. REV. 605 (2002); Nathan Benedict, Note, *Fingerprints and the Daubert Standard for Admission of Scientific Evidence: Why Fingerprints Fail and a Proposed Remedy*, 46 ARIZ. L. REV. 519 (2004); Tara Marie La Morte, Comment, *Sleeping Gatekeepers: United States v. Llera Plaza and the Unreliability of Forensic Fingerprinting Evidence Under Daubert*, 14 ALB. L.J. SCI. & TECH. 171 (2003); Kristin Romandetti, Note, *Recognizing and Responding to a Problem with the Admissibility of Fingerprint Evidence Under Daubert*, 45 JURIMETRICS 41 (2004); Jessica M. Sombat, Note, *Latent Justice: Daubert’s Impact on the Evaluation of Fingerprint Identification Testimony*, 70 FORDHAM L. REV. 2819 (2002).

with many commentators believing that *Llera Plaza I* was more faithful to *Daubert* than *Llera Plaza II*.<sup>36</sup>

Once *Daubert* challenges on the admissibility of handwriting and fingerprint evidence had been filed, it was inevitable that firearms (ballistics) and tool mark identifications would also be questioned.<sup>37</sup> Although the initial attacks failed,<sup>38</sup> a pair of decisions by federal district courts in Boston changed all this. The first case, *United States v. Green*, was a frontal attack on the lack of empirical testing in this field. The expert testified that a match could be made “to the exclusion of every other firearm in the world.”<sup>39</sup> That conclusion, according to Judge Gertner, was “extraordinary, particularly given [the expert’s] data and methods.”<sup>40</sup> Consequently, the expert would only be permitted to explain the ways in which the casings were similar, but not that they came from a specific weapon “to the exclusion of every other

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<sup>36</sup> *E.g.*, Jennifer L. Mnookin, *Fingerprints: Not a Gold Standard*, 20 ISSUES IN SCI. & TECH. 47, 47 (2003) (“Judge Pollak’s first opinion [restricting latent fingerprint individualization testimony] was the better one.”); Sombat, *supra* note 35, at 2825 (“[T]he result Judge Pollak reached when he excluded expert testimony concerning fingerprints [in *Llera Plaza I*] was fair.”); Recent Case, 115 HARV. L. REV. 2349, 2352 (2002) (“Fingerprint expert testimony does not survive application of the *Daubert* factors . . .”).

<sup>37</sup> Firearms identification (“ballistics”) developed in the early part of the last century, and, by 1930, courts were admitting evidence based on the technique. Subsequent cases have followed these precedents, admitting evidence of bullet, cartridge case, and shot shell identifications. *See* 1 GIANNELLI & IMWINKELRIED, *supra* note 22, ch. 14 (discussing the scientific and legal issues associated with firearms and tool mark identifications).

<sup>38</sup> *See* *United States v. Hicks*, 389 F.3d 514, 526 (5th Cir. 2004) (ruling that “the matching of spent shell casings to the weapon that fired them has been a recognized method of ballistics testing in this circuit for decades”); *United States v. Foster*, 300 F. Supp. 2d 375, 376 n.1 (D. Md. 2004) (“Ballistics evidence has been accepted in criminal cases for many years. . . . In the years since *Daubert*, numerous cases have confirmed the reliability of ballistics identification.”); *United States v. Santiago*, 199 F. Supp. 2d 101, 111 (S.D.N.Y. 2002) (“The Court has not found a single case in this Circuit that would suggest that the entire field of ballistics identification is unreliable.”); *State v. Anderson*, 624 S.E.2d 393, 398 (N.C. Ct. App. 2006) (no abuse of discretion in admitting bullet identification evidence); *Commonwealth v. Whitacre*, 878 A.2d 96, 101 (Pa. Super. Ct. 2005) (“no abuse of discretion in the trial court’s decision to permit admission of the evidence regarding comparison of the two shell casings with the shotgun owned by Appellant”).

<sup>39</sup> 405 F. Supp. 2d 104, 107 (D. Mass. 2005).

<sup>40</sup> *Id.* Although the expert had seven years of experience in the field, he was not certified, and his lab was not accredited. Moreover, he had never been formally tested by a neutral proficiency examination. Finally, he could not cite any reliable error rates. The expert “conceded, over and over again, that he relied mainly on his subjective judgment. There were no reference materials of any specificity, no national or even local database on which he relied. And although he relied on his past experience with these weapons, he had no notes or pictures memorializing his past.” *Id.*

firearm in the world.”<sup>41</sup> In the court’s view, that conclusion “stretch[ed] well beyond [the expert’s] data and methodology.”<sup>42</sup> The court also issued a caution: “The more courts admit this type of toolmark evidence without requiring documentation, proficiency testing, or evidence of reliability, the more sloppy practices will endure; we should require more.”<sup>43</sup>

The second case, *United States v. Monteiro*,<sup>44</sup> resulted in a six-day evidentiary hearing. Although the court found that “the underlying scientific principle behind firearm identification—that firearms transfer unique toolmarks to spent cartridge cases—is valid under *Daubert*,”<sup>45</sup> the expert in that case had yet to satisfy the other *Daubert* factors.<sup>46</sup> Moreover, the court described the traditional methodology as essentially “tautological,” entrusting the critical decision to “the minds eye of the examiner.”<sup>47</sup>

The next year, in *United States v. Williams*,<sup>48</sup> the Second Circuit upheld the admissibility of firearms identification evidence, while noting that it did “not wish this opinion to be taken as saying that any proffered ballistic expert should be routinely admitted.”<sup>49</sup> Moreover, the court observed that the

<sup>41</sup> *Id.* at 109.

<sup>42</sup> *Id.*

<sup>43</sup> *Id.*

<sup>44</sup> 407 F. Supp. 2d 351 (D. Mass. 2006).

<sup>45</sup> *Id.* at 355.

<sup>46</sup> Because the expert did not make any sketches or take any photographs, adequate documentation was lacking: “Until the basis for the identification is described in such a way that the procedure performed by Sgt. Weddleton is reproducible and verifiable, it is inadmissible under Rule 702.” *Id.* at 374. Moreover, an independent second examiner had not confirmed the identification, which was particularly important because replacement parts had been used in the test-firing. *Id.*

<sup>47</sup> The court wrote:

[T]he *AFTE Theory*, upon which the government relies, is tautological: it requires each examiner to decide when there is “sufficient agreement” of toolmarks to constitute an “identification.” . . . This threshold is surpassed when the examiner finds that the agreement of toolmarks “exceeds the best agreement demonstrated between toolmarks known to have been produced by different tools and is consistent with agreement demonstrated by toolmarks known to have been produced by the same tool.” . . . Toolmark analysis does not follow an objective standard requiring, say, a certain percentage of marks to match.

*Id.* at 370 (citations omitted) (citing *Theory of Identification, Association of Firearm and Toolmark Examiners*, 30 *AFTE J.* 86 (1998)).

<sup>48</sup> 506 F.3d 151 (2d Cir. 2007).

<sup>49</sup> *Id.* at 161; see also *United States v. Natson*, 469 F. Supp. 2d 1253, 1261 (M.D. Ga. 2007) (“According to his testimony, these toolmarks were sufficiently similar to allow him to identify Defendant’s gun as the gun that fired the cartridge found at the crime scene. He opined that he held this opinion to a 100% degree of certainty. . . .

*Daubert* trilogy did not “grandfather’ or protect from *Daubert* scrutiny evidence that had previously been admitted under *Frye*.”<sup>50</sup> Some trial courts continued to limit the scope of the testimony, finding that the record did not support the conclusion that identifications can be made to the exclusion of all other firearms in the world.<sup>51</sup> Another court ruled that the expert would be permitted to testify only that it was “more likely than not” that recovered bullets and cartridge cases came from a particular weapon.<sup>52</sup>

Other techniques, such as bite mark comparison,<sup>53</sup> microscopic hair examination,<sup>54</sup> bullet lead analysis,<sup>55</sup> and intoxication testing,<sup>56</sup> were also challenged. As Professor Berger had noted, the lack of empirical research was the critical issue.

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The Court also finds Tangren’s opinions reliable and based upon a scientifically valid methodology. Evidence was presented at the hearing that the toolmark testing methodology he employed has been tested, has been subjected to peer review, has an ascertainable error rate, and is generally accepted in the scientific community.”); *Commonwealth v. Meeks*, Nos. 2002-10961, 2003-10575, 2006 WL 2819423, at \*50 (Mass. Super. Ct. Sept. 28, 2006) (“The theory and process of firearms identification are generally accepted and reliable, and the process has been reliably applied in these cases. Accordingly, the firearms identification evidence, including opinions as to matches, may be presented to the juries for their consideration, but only if that evidence includes a detailed statement of the reasons for those opinions together with appropriate documentation.”).

<sup>50</sup> 506 F.3d at 162.

<sup>51</sup> See *United States v. Taylor*, 663 F. Supp.2d 1170, 1180 (D.N.M. 2009); *United States v. Diaz*, No. CR 05-00167, 2007 WL 485967, at \*1 (N.D. Cal. Feb. 12, 2007).

<sup>52</sup> *United States v. Glynn*, 578 F. Supp. 2d 567, 574-75 (S.D.N.Y. 2008); see also *United States v. Mouzone*, Criminal No. WDQ-08-086, slip op. at 57 (D. Md. Oct. 29, 2009) (magistrate recommendations).

<sup>53</sup> See Paul C. Giannelli, *Bite Mark Analysis*, 43 CRIM. L. BULL. 930, 932 (2007) (discussing DNA exonerations in bitemark cases); Iain A. Pretty & David J. Sweet, *The Scientific Basis for Human Bitemark Analyses—A Critical Review*, 41 SCI. & JUST. 85, 86 (2001) (“Despite the continued acceptance of bitemark evidence in European, Oceanic and North American Courts the fundamental scientific basis for bitemark analysis has never been established.”).

<sup>54</sup> See *Williamson v. Reynolds*, 904 F. Supp. 1529, 1554 (E.D. Okla. 1995), *rev’d sub nom. on this issue*, *Williamson v. Ward*, 110 F.3d 1508, 1523 (10th Cir. 1997). The district court had “been unsuccessful in its attempts to locate *any* indication that expert hair comparison testimony meets *any* of the requirements of *Daubert*.” *Id.* at 1558. The court further observed: “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.” *Id.*

<sup>55</sup> In 2003, a federal district court excluded bullet lead evidence under the *Daubert* standard, the first case to do so. *United States v. Mikos*, No. 02 CR 137, 2003 WL 22922197, at \*6 (N.D. Ill. Dec. 9, 2003); see also NAT’L RES. COUNCIL, FORENSIC ANALYSIS: WEIGHING BULLET LEAD EVIDENCE 9 (2004) (identifying problems with bullet lead analysis).

<sup>56</sup> See *United States v. Horn*, 185 F. Supp. 2d 530, 549 (D. Md. 2002) (“Where, as here, that reliability has been challenged, the court cannot disregard the challenge, simply because a legion of earlier court decisions reached conclusions based on

### B. *Background Rates*

Professor Berger's second point focused on the most significant (and fundamental) problem underlying forensic identification expert testimony—i.e., the inherent probabilistic quality of these opinions. She wrote:

Prior to *Daubert*, courts admitted scientific evidence without noticing that, in some instances, the probative value of the evidence depends on background statistical information. If, for example, the samples of tape to which a defendant had access at his place of work match samples of tape used to manufacture a bomb sent through the mails from an unknown location, the probative value of that evidence is virtually non-existent if thousands of identical rolls of tape were distributed throughout the world. The crucial scientific inquiry in these cases is not only whether the technique is capable of producing matches, but also the probability that other matches exist.

. . . We allow eyewitnesses to testify that the person fleeing the scene wore a yellow jacket and permit proof that a defendant owned a yellow jacket without establishing the background rate of yellow jackets in the community. Jurors understand, however, that others than the accused own yellow jackets. When experts testify about samples matching in every respect, the jurors may be oblivious to the probability concerns if no background rate is offered, or may be unduly prejudiced or confused if the probability of a match is confused with the probability of guilt, or if a background rate is offered that does not have an adequate scientific foundation.<sup>57</sup>

In 2008, a year before the NAS Report on forensic science was issued, a different NAS Report, one on computerized ballistic imaging, echoed Professor Berger's point. This Report cautioned: "*Conclusions drawn in firearms identification should not be made to imply the presence of a firm statistical basis when none has been demonstrated.*"<sup>58</sup> In particular, the authors of the Report were concerned about testimony cast "in bold absolutes" such as an assertion that a match can be made to the exclusion of all other firearms in the world. "Such comments cloak an inherently subjective assessment of a match with an extreme probability statement

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reference to the same then-unchallenged authority. . . . I cannot agree that [various intoxication] tests, singly or in combination, have been shown to be as reliable as asserted by Dr. Burns, the NHTSA publications, and the publications of the communities of law enforcement officers and state prosecutors.").

<sup>57</sup> *Procedural Paradigms*, *supra* note 20, at 1356-57 (footnote omitted).

<sup>58</sup> NAT'L RES. COUNCIL, BALLISTIC IMAGING 82 (2008).

that has no firm grounding and unrealistically implies an error rate of zero.”<sup>59</sup>

### C. Error Rates

Professor Berger’s third point concerned one of the *Daubert* Court’s reliability factors, i.e., error rates. She noted that “[p]re-*Daubert* courts often ignored laboratory and technician error rates resulting from the subjectivity involved in interpreting particular forensic tests and overlooked the lack of proper laboratory procedures that can produce other kinds of errors.”<sup>60</sup> As it turned out, in many post-*Daubert* cases, fingerprint experts testified that the “error rate for the method is zero.”<sup>61</sup> Experts argued that, while individual examiners may make mistakes, the method itself is perfect. However, in this context the dichotomy between “methodological” and “human” error rates is “practically meaningless”<sup>62</sup> because the examiner is the method and the examiner’s judgment is subjective.<sup>63</sup>

In sum, a year after *Daubert* was decided, Professor Berger predicted the nature of the challenges that would be mounted in the forensic identification cases, and more importantly, identified the critical issues—opinion testimony masking probabilistic assumptions and subjective judgments without acknowledging error rates.

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<sup>59</sup> *Id.*

<sup>60</sup> *Procedural Paradigms*, *supra* note 20, at 1358.

<sup>61</sup> *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* *United States v. Mitchell*, 365 F.3d 215, 246 (3d Cir. 2004) (“Testimony at the *Daubert* hearing indicated that some latent fingerprint examiners insist that there is no error rate associated with their activities or that the examination process is irreducibly subjective. This would be out-of-place under Rule 702.”).

<sup>62</sup> *See* Mnookin, *supra* note 28, at 60. She goes on to provide this analogy: “The same argument could be made of eyewitness testimony, a notoriously unreliable form of evidence. People are all distinct from one another in observable ways; therefore the theoretical error rate of eyewitness identification is zero, though in practice observers may frequently make errors.” *Id.*

<sup>63</sup> *See* Sandy L. Zabell, *Fingerprint Evidence*, 13 J.L. & POL’Y 143, 172 (2005) (“But, given its unavoidable subjective component, in latent print examination people are the process.”). In 2005, Professor Cole published an article documenting twenty-three cases of fingerprint misidentifications. *See* Simon A. Cole, *More Than Zero: Accounting for Error in Latent Fingerprint Identification*, 95 J. CRIM. L. & CRIMINOLOGY 985, 999 (2005). The misidentification cases include some that involved (1) verification by one or more other examiners; (2) examiners certified by the International Association of Identification; (3) procedures using a sixteen-point standard; and (4) defense experts who corroborated misidentifications made by prosecution experts. *Id.* at *passim*.

## II. DNA EVIDENCE

The advent of DNA profiling in 1985 produced a sea change in forensic science.<sup>64</sup> One court called DNA evidence the “single greatest advance in the search for truth . . . since the advent of cross-examination.”<sup>65</sup> Even its early critics acknowledged that “[a]ppropriately carried out and correctly interpreted, DNA typing is possibly the most powerful innovation in forensics since the development of fingerprinting in the last part of the 19th Century.”<sup>66</sup> No other technique had been as complex or so subject to rapid change. New DNA technologies were introduced at the trial level as cases litigating the older procedures worked their way through the appellate court system.<sup>67</sup>

Although the introduction of DNA evidence went smoothly in the early going, a significant challenge to admissibility was mounted in *People v. Castro*,<sup>68</sup> a 1989 case.

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<sup>64</sup> In 1985, Dr. Alec Jeffreys of the University of Leicester, England, recognized the utility of DNA profiling in criminal cases. Its first use in American courts came the following year. See OFFICE OF TECHNOLOGY ASSESSMENT, U.S. CONGRESS, GENETIC WITNESS: FORENSIC USES OF DNA TESTS 8 (1990) [hereinafter OTA REPORT]. The first appellate case, *Andrews v. State*, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988) (holding DNA evidence admissible), *rev. denied*, 542 So. 2d 1332 (Fla. 1989), was reported in 1988. By January 1990, forensic DNA analysis had been admitted into evidence “in at least 185 cases by 38 States and the U.S. military.” OTA REPORT, *supra*, at 14.

<sup>65</sup> *People v. Wesley*, 533 N.Y.S.2d 643, 644 (N.Y. Sup. Ct. 1988). The popular press trumpeted DNA evidence as “foolproof.” *DNA Prints: A Foolproof Crime Test*, TIME, Jan. 26, 1987, at 66; see also Arastasia Toufexis, *Convicted by Their Genes: A New Forensic Test is Revolutionizing Criminal Prosecutions*, TIME, Oct. 31, 1988, at 74.

<sup>66</sup> Richard C. Lewontin & Daniel L. Hartl, *Population Genetics in Forensic DNA Typing*, 254 SCIENCE 1745, 1746 (1991).

<sup>67</sup> The initial technique, Restriction Fragment Length Polymorphism (RFLP) analysis by gel electrophoresis, was soon supplanted by Polymerase Chain Reaction (PCR)-based methods involving the DQ-alpha locus, “polymarkers,” and the D1S80 locus. These, in turn, were replaced by Short Tandem Repeats, the current procedure. In addition to nuclear DNA analysis, courts have admitted evidence based on mitochondrial DNA (mtDNA) sequencing, as well as DNA analyses of animals, plants, and the HIV virus. See *United States v. Boswell*, 270 F.3d 1200 (8th Cir. 2001) (in a false statement prosecution, DNA used to compare swine blood); *State v. Bogan*, 905 P.2d 515 (Ariz. Ct. App. 1995) (in murder case, DNA of seed pods from palo verde trees at scene compared to those found in Bogan’s truck); *State v. Schmidt*, 699 So. 2d 448 (La. Ct. App. 1997) (in a case of attempted murder by injection of HIV, expert testified that the strands of HIV from two persons were “closely related”). *But see State v. Leuluai*, 77 P.3d 1192 (Wash. Ct. App. 2003) (canine DNA match between sample obtained from defendant and murder victim’s dog not generally accepted).

<sup>68</sup> 545 N.Y.S.2d 985 (N.Y. Sup. Ct. 1989). In an unusual occurrence, the prosecution and defense experts met without the attorneys and issued a joint statement, including the following: “[T]he DNA data in this case are not scientifically reliable enough to support the assertion that the samples . . . do or do not match. If these data were submitted to a peer-reviewed journal in support of a conclusion, they

The initial DNA skirmishes were over laboratory protocols, as in *Castro*,<sup>69</sup> but the controversy quickly metamorphosed into fights over statistical interpretation and population genetics. Population geneticists used statistical techniques to define the extent to which a match of DNA markers individuated the accused as the source of the crime scene sample and were able to point to extensive empirical testing to support their opinions.<sup>70</sup> The validity of the statistical methods became the focus of litigation.<sup>71</sup>

As the dispute heated, the FBI requested the National Academy of Sciences to review the procedure. That organization issued two reports on the subject, noting the importance of certain practices: “No laboratory should let its results with a new DNA typing method be used in court, unless it has undergone . . . proficiency testing via blind trials.”<sup>72</sup> The first NAS Report on DNA, however, provoked its own controversy and a second report was requested.<sup>73</sup> The controversy centered on a proposal (the ceiling principle) offered to resolve the statistical issues surrounding DNA testimony.<sup>74</sup> Professor Berger served on the second NAS Committee, and its report settled many of the controverted issues—and, as she later noted, “DNA profiling . . . is undoubtedly our ‘gold standard’ of expertise.”<sup>75</sup>

Professor Berger subsequently wrote on other DNA issues. One article addressed the reporting of laboratory error

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would not be accepted. Further experimentation would be required.” Eric S. Lander, *DNA Fingerprinting On Trial*, 339 NATURE 501, 504 (1989). See generally Jennifer L. Mnookin, *People v. Castro: Challenging the Forensic Use of DNA Evidence*, in EVIDENCE STORIES 207 (Richard Lempert ed., 2006).

<sup>69</sup> See Eric S. Lander & Bruce Budowle, *DNA Fingerprinting Dispute Laid to Rest*, 371 NATURE 735, 735 (1994) (“The initial outcry over DNA typing standards concerned laboratory problems: poorly defined rules for declaring a match; experiments without controls; contaminated probes and samples; and sloppy interpretation of autoradiograms. Although there is no evidence that these technical failings resulted in any wrongful convictions, the lack of standards seemed to be a recipe for trouble.” (footnote omitted)).

<sup>70</sup> See, e.g., *id.* at 736.

<sup>71</sup> *United States v. Yee*, 134 F.R.D. 161, 208 (N.D. Ohio 1991), *aff’d sub nom.*, *United States v. Bonds*, 12 F.3d 540 (6th Cir. 1993).

<sup>72</sup> NAT’L RES. COUNCIL, *DNA TECHNOLOGY IN FORENSIC SCIENCE* 55 (1992).

<sup>73</sup> See NAT’L RES. COUNCIL, *THE EVALUATION OF FORENSIC DNA EVIDENCE* (1996).

<sup>74</sup> See JAY D. ARONSON, *GENETIC WITNESS: SCIENCE, LAW, AND CONTROVERSY IN THE MAKING OF DNA PROFILING* 146 (2007).

<sup>75</sup> Margaret A. Berger, *Expert Testimony in Criminal Proceedings: Questions Daubert Does Not Answer*, 33 SETON HALL L. REV. 1125, 1126 (2003) (footnote omitted).

rates, an important but contentious issue.<sup>76</sup> In another article, she examined the impact of DNA exonerations on the criminal justice system.<sup>77</sup> In a book chapter, she considered DNA profiling's impact on finality principles.<sup>78</sup>

### III. NAS FORENSIC SCIENCE REPORT

As noted at the beginning of this essay, the National Academy of Sciences issued its landmark report on forensic science in the beginning of 2009.<sup>79</sup> Implementation of its recommendations would be the most important development in forensic science since the establishment of the crime laboratory in the mid-1920s. The issues are pressing. As the Report recognized, “[a]mong existing forensic methods, only nuclear DNA analysis has been rigorously shown to have the capacity to consistently, and with a high degree of certainty, demonstrate a connection between an evidentiary sample and a specific individual or source.”<sup>80</sup> Professor Berger served on the Committee that wrote the report.

The centerpiece of the report is a recommendation that Congress establish an independent federal entity, the National Institute of Forensic Sciences (NIFS), which would, among other things, fund research “to address issues of accuracy, reliability, and validity in the forensic science disciplines”<sup>81</sup> and establish and enforce “best practices” for forensic science professionals and laboratories.<sup>82</sup> Other recommendations include (1) mandating laboratory accreditation and practitioner certification,<sup>83</sup> (2) removing crime laboratories from administrative control of law enforcement agencies and prosecutors’ offices,<sup>84</sup> (3) supporting investigations into human

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<sup>76</sup> Margaret A. Berger, *Laboratory Error Seen Through the Lens of Science and Policy*, 30 U.C. DAVIS L. REV. 1081 (1997).

<sup>77</sup> Margaret A. Berger, *The Impact of DNA Exonerations on the Criminal Justice System*, 34 J.L. MED. & ETHICS 320, 321 (2006) (noting that “statutes governing post-conviction DNA procedures now exist in forty-one states, and bills are pending in others”).

<sup>78</sup> Margaret A. Berger, *Lessons from DNA: Restriking the Balance between Finality and Justice*, in *DNA AND THE CRIMINAL JUSTICE SYSTEM* 109, 117 (David Lazer ed., 2004).

<sup>79</sup> NAT’L RES. COUNCIL, *STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD* (2009).

<sup>80</sup> *Id.* at 100.

<sup>81</sup> *Id.* at 22-23 (Recommendation 3.).

<sup>82</sup> *Id.* at 19 (Recommendation 1(a)).

<sup>83</sup> *Id.* (Recommendation 1(b)).

<sup>84</sup> *Id.* at 24 (Recommendation 4.).

observer bias and sources of human error in forensic analysis,<sup>85</sup> and (4) developing standard terminology and model laboratory report formats.<sup>86</sup>

According to the Report, NIFS should also draft a code of ethics for all forensic sciences and encourage individual forensic societies to incorporate this national code as part of their professional codes of conduct.<sup>87</sup> In 1982, Professor Berger raised this issue at a conference on scientific evidence: “Is there, or should there be, a code of conduct for scientists that would provide a basis for objecting to testimony that strayed too far from strict impartiality?”<sup>88</sup> At the same time, she commented that “[t]he inequality of available resources between the prosecution and the defense is alarming enough, but it is compounded by the lack of scientific literacy on the part of most defense lawyers.”<sup>89</sup> Recommendation 10 of the NAS Report provides, in part: “NIFS should also support law school administrators and judicial education organizations in establishing continuing legal education programs [on forensic science] for law students, practitioners, and judges.”<sup>90</sup>

## CONCLUSION

Professor Berger is one of the few scholars who is equally comfortable examining expert testimony issues in both civil and criminal cases.<sup>91</sup> Her contribution to the development

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<sup>85</sup> *Id.* (Recommendation 5.).

<sup>86</sup> *Id.* at 22 (Recommendation 2.).

<sup>87</sup> *Id.* at 2 (Recommendation 9.). Moreover, the Report recommended the creation of an enforcement mechanism for ethical violations through the certification process.

<sup>88</sup> *Symposium on Science and the Rules of Evidence*, 99 F.R.D. 187, 228 (1984).

<sup>89</sup> *Id.* at 233.

<sup>90</sup> NAT'L RES. COUNCIL, *supra* note 79, at 27-28 (Recommendation 10.).

<sup>91</sup> *See, e.g.*, Margaret A. Berger, *Upsetting the Balance Between Adverse Interests: The Impact of the Supreme Court's Trilogy on Expert Testimony in Toxic Tort Litigation*, 64 LAW & CONTEMP. PROBS. 289, 290 (2001) (“The Federal Judicial Center conducted surveys in 1991 and 1998 asking federal judges and attorneys about expert testimony. In the 1991 survey, seventy-five percent of the judges reported admitting all proffered expert testimony. By 1998, only fifty-nine percent indicated that they admitted all proffered expert testimony without limitation. Furthermore, sixty-five percent of plaintiff and defendant counsel stated that judges are less likely to admit some types of expert testimony since *Daubert*.”); Margaret A. Berger, *Eliminating General Causation: Notes Towards A New Theory of Justice and Toxic Torts*, 97 COLUM. L. REV. 2117, 2135 (1997) (“All [the studies on specific toxic torts] report that the corporation in question did not test its product adequately initially, failed to impart information when potential problems emerged, and did not undertake further research in response to adverse information. It appears that the corporations took virtually no

of the law and society, through her scholarship and public service on various NAS committees, has been exemplary. It is only fitting that this essay should conclude with her words:

What criminal defendants need in order to deal more effectively with the forensic identification expertise proffered against them is not more *Daubert*, but tools that would enable them to make more cogent evidentiary arguments—better counsel, access to expert assistance and more discovery.<sup>92</sup>

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steps to determine or minimize the possibility of harm until their hands were forced, usually by litigation.”).

<sup>92</sup> Berger, *supra* note 75, at 1140. She also wrote:

I strongly believe that we need a very stringent standard of proof in criminal cases. I do not think, however, that *Daubert v. Merrell Dow Pharmaceuticals, Inc.* has been productive in effectuating this goal. In civil cases, courts engage in rigorous gatekeeping and often exclude plaintiffs’ experts because the theory underlying their testimony has not been adequately validated. But I see no sign of a parallel approach in criminal cases even when there are problems with the assumptions on which the prosecution’s expert testimony rests.

*Id.* at 1125.