

## SCANDAL, FRAUD, AND THE REFORM OF FORENSIC SCIENCE: THE CASE OF FINGERPRINT ANALYSIS

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## I. INTRODUCTION

The purpose of this Article is to explore the role of scandal in bringing about the reform of forensic science. It uses the forensic discipline of latent print (fingerprint) analysis as a case study. It further confines itself to two countries: the United States and the United Kingdom. Each country hosted a major scandal with regard to fingerprint analysis within the past two decades. These scandals, commonly known by the names of the victims of misidentification are the “Mayfield case” in the U.S. and the “McKie case” in the United Kingdom. This Article seeks to assess the impact of these two scandals on the reforms to fingerprint analysis that have occurred since the McKie case in 1997. It does so using the historian’s technique of posing a counterfactual: what would fingerprint analysis look like today had these two scandals not occurred, or, more realistically, had they occurred, but not been exposed? This Article finds that these two scandals played important roles in bringing about the reforms in fingerprint analysis that have occurred in the past two decades. This Article concludes with some reflections on the implications of this finding: that the discipline of forensic science and the institutions that are its clients (courts, police, attorneys, government, the public, etc.) are so heavily dependent on scandal as an engine for bringing about what few dispute were necessary and positive reforms. It suggests that we need to seek more stable and less volatile means of bringing about necessary and positive reforms.

## II. TWO SCANDALS THAT PLAYED A CRITICAL ROLE IN FINGERPRINT IDENTIFICATION REFORM

As previously stated, two scandals played a critical role in bringing about reforms to fingerprint analysis. First, this Article analyzes a 1997 Scottish fingerprint misidentification case colloquially known as “the McKie case.” Second, this Article analyzes a second fingerprint misidentification case referred to as “the Mayfield case.”

### A. *The McKie Case*

The McKie case is extensively discussed in other sources;<sup>1</sup> I will merely provide a brief summary here. Shirley McKie was a Detective Constable in the

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<sup>1</sup> See *McKie v. Strathclyde Joint Police Bd.* (2003) SLT 982 (Scot.), <http://www.shirleyckie.com/documents/LordWheatley23.12.04.pdf>; IAIN MCKIE & MICHAEL RUSSELL, *SHIRLEY MCKIE: THE PRICE OF INNOCENCE* (2007); ANTHONY CAMPBELL, *THE FINGERPRINT INQUIRY REPORT* (2011), [http://www.webarchive.org.uk/wayback/archive/20150428160106/http://www.thefingerprintinquiry.scotland.org.uk/inquiry/files/TheFingerprintInquiryReport\\_High\\_res.pdf](http://www.webarchive.org.uk/wayback/archive/20150428160106/http://www.thefingerprintinquiry.scotland.org.uk/inquiry/files/TheFingerprintInquiryReport_High_res.pdf); JAMES MACKAY, *CONFIDENTIAL REPORT* (2000), [http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/04\\_05\\_06\\_mckiereport.pdf](http://news.bbc.co.uk/2/shared/bsp/hi/pdfs/04_05_06_mckiereport.pdf).

Strathclyde Police in 1997 who was part of the team investigating the murder of Marion Ross at her home in Kilmarnock, Scotland.<sup>2</sup> McKie's duties included securing the crime scene from outside; she was not supposed to enter the crime scene, and she reported that she did not.<sup>3</sup>

David Asbury, a builder,<sup>4</sup> was suspected of the murder.<sup>5</sup> Scottish Criminal Records Office ("SCRO") latent print examiners reported that Asbury was the source of a latent print in Ross's home<sup>6</sup> and that Ross was the source of a latent print on a tin, called QI2, found in Asbury's home.<sup>7</sup> This report was "verified" by three additional examiners,<sup>8</sup> and Asbury was convicted.<sup>9</sup>

SCRO latent print examiners also reported that McKie was the source of a latent print, Y7, on a door jamb in Ross's home.<sup>10</sup> Again, the report was verified by three additional examiners.<sup>11</sup> McKie still denied having entered the home.<sup>12</sup> With McKie continuing to deny having entered the home, she was prosecuted for perjury in 1999.<sup>13</sup> Two American latent print examiners, David Grieve and Pat Wertheim, testified that McKie was excluded as the source of Y7. McKie was acquitted,<sup>14</sup> but her career with the police was over.

Various experts then also questioned the report concerning QI2, claiming that this too was a misidentification. Asbury's conviction was quashed in 2002.<sup>15</sup> The murder was never solved.

The case then spawned more than a decade of public controversy, litigation, and various official reports, prompted by McKie and her father Iain's steadfast demand for a full accounting of the erroneous identification. The case implicated both the vaunted "infallibility" of latent print identification and the

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<sup>2</sup> *McKie*, SLT 982 at [1].

<sup>3</sup> *Id.* at [3].

<sup>4</sup> CAMPBELL, *supra* note 2, ¶ 4.13.

<sup>5</sup> *Id.* ¶¶ 4.23–26.

<sup>6</sup> *McKie*, SLT 982 at [3].

<sup>7</sup> CAMPBELL, *supra* note 2, ¶ 1.40.

<sup>8</sup> *Id.* ¶¶ 5.65–80.

<sup>9</sup> *Id.* ¶ 1.4.

<sup>10</sup> *Id.* ¶¶ 1.3–31.

<sup>11</sup> MACKAY, *supra* note 2, ¶ 15.5.1.7.

<sup>12</sup> CAMPBELL, *supra* note 2, ¶ 7.43.

<sup>13</sup> *Id.* ¶¶ 1.5–6.

<sup>14</sup> *Id.* ¶ 1.6.

<sup>15</sup> *Id.* ¶ 1.16.

integrity of the SCRO, as it was debated whether the dispute over the prints was “a matter of opinion,”<sup>16</sup> “an honest mistake,”<sup>17</sup> or fraud.<sup>18</sup>

Of particular note is the fact that the source of Y7 remains disputed. While the majority of world latent print examiner opinion holds that McKie is excluded as the source of Y7, there are British latent print examiners to this day who insist that she is the source. In addition, as the story unraveled, differences of opinion were revealed on both sides. Specifically, it was revealed that there were examiners in the SCRO who doubted the identification,<sup>19</sup> and that some of McKie’s retained examiners had corroborated the disputed identification.

The 2011 800-page Fingerprint Inquiry Report (“Inquiry Report”) is probably the last official word on the case.<sup>20</sup> It concluded that the identifications of both Y7 and QI2 were erroneous, but it exonerated the SCRO of any intentional misconduct.<sup>21</sup> The conclusion of the Inquiry Report resulted in an official apology to McKie.<sup>22</sup> The Inquiry Report also had much to say with regard to reforming latent print analysis,<sup>23</sup> about which we will learn more below.

### B. The Mayfield Case

As with the McKie case, the Mayfield case has been extensively discussed elsewhere,<sup>24</sup> and I will provide only a brief summary. A latent print,

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<sup>16</sup> Simon A. Cole, *The ‘Opinionization’ of Fingerprint Evidence*, 3 BIOSOCIETIES 105, 107 (2008).

<sup>17</sup> CAMPBELL, *supra* note 2, ¶ 1.19.

<sup>18</sup> Cole, *supra* note 16, at 106.

<sup>19</sup> McKie v. Strathclyde Joint Police Bd. (2003) SLT 982 [4] (Scot.), <http://www.shirleymckie.com/documents/LordWheatley23.12.04.pdf>.

<sup>20</sup> CAMPBELL, *supra* note 1.

<sup>21</sup> *Id.* at 739.

<sup>22</sup> Lucy Adams, *14 Years on, Police Force Says Sorry to Shirley McKie*, HERALDSCOTLAND, Apr. 18, 2012, [http://www.heraldscotland.com/news/13054888.14\\_years\\_on\\_\\_police\\_force\\_says\\_sorry\\_to\\_Shirley\\_McKie/](http://www.heraldscotland.com/news/13054888.14_years_on__police_force_says_sorry_to_Shirley_McKie/).

<sup>23</sup> See CAMPBELL, *supra* note 2, at 740–52.

<sup>24</sup> See OFFICE OF THE INSPECTOR GEN. OVERSIGHT & REVIEW DIV., A REVIEW OF THE FBI’S HANDLING OF THE BRANDON MAYFIELD CASE (2006) [hereinafter REVIEW OF THE FBI’S HANDLING OF THE BRANDON MAYFIELD CASE], <https://oig.justice.gov/special/s0601/final.pdf>; OFFICE OF THE INSPECTOR GEN. OVERSIGHT & REVIEW DIV., A REVIEW OF THE FBI’S PROGRESS IN RESPONDING TO THE RECOMMENDATIONS IN THE OFFICE OF THE INSPECTOR GENERAL REPORT ON THE FINGERPRINT MISIDENTIFICATION IN THE BRANDON MAYFIELD CASE (2011) [hereinafter REVIEW OF THE FBI’S PROGRESS IN RESPONDING TO THE RECOMMENDATIONS IN THE OFFICE OF THE INSPECTOR GENERAL], <https://oig.justice.gov/special/s1105.pdf>; William C. Thompson & Simon A. Cole, *Lessons from the Brandon Mayfield Case*, CHAMPION 42 (Apr. 2005), <http://www.clpex.com/Articles/TheDetail/200-299/TheDetail201.htm>; Steven T. Wax & Christopher J. Schatz, *A Multitude of Errors: The Brandon Mayfield Case*, CHAMPION 6 (Sept./Oct.

LFP17, was found on a plastic bag containing detonators during the investigation of the 2004 terrorist bombing in Madrid, Spain,<sup>25</sup> that was eventually attributed to Al Qaeda. After failing to find a source for the print, the Spanish National Police (“SNP”) began circulating the latent print worldwide. The U.S. Federal Bureau of Investigation (“FBI”) received the print and searched it against its Integrated Automated Fingerprint Identification System (“IAFIS”) database.<sup>26</sup> FBI latent print examiners reported that Brandon Mayfield, an Oregon attorney, was the source of LFP17.<sup>27</sup> This report was “verified” by two additional examiners.<sup>28</sup>

Although there was no record of Mayfield having traveled to Spain, and he did not have a valid passport,<sup>29</sup> circumstantial evidence seemed to support the FBI’s suspicions.<sup>30</sup> Mayfield was a Muslim convert, his wife was born in Egypt, and he “had represented a convicted terrorist in a child custody dispute,” among other seemingly incriminating facts.<sup>31</sup> Based on FBI affidavits,<sup>32</sup> Mayfield was made the subject of a Foreign Intelligence Surveillance Act (“FISA”) warrant, for surreptitious searches and electronic surveillance.<sup>33</sup> Notably, the affidavit stated that the FBI had made a “100 percent positive” identification of Mayfield as the source of LFP17.<sup>34</sup>

In the meantime, the SNP was disputing the FBI conclusion that Mayfield was the source of LFP17, remaining unconvinced of the identification.<sup>35</sup>

One important part of the story that is omitted from many accounts is that there were media leaks in Europe about an American suspect in the Madrid bombing.<sup>36</sup> It was these leaks which forced the FBI to apprehend Mayfield as a material witness, rather than keeping him under covert surveillance.<sup>37</sup>

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2004); Robert B. Stacey, *A Report on the Erroneous Fingerprint Individualization in the Madrid Train Bombing Case*, 54 J. FORENSIC IDENTIFICATION 706 (2004).

<sup>25</sup> REVIEW OF THE FBI’S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24, at 1.

<sup>26</sup> *Id.*

<sup>27</sup> *Id.*

<sup>28</sup> *Id.* at 2.

<sup>29</sup> *Id.* at 58.

<sup>30</sup> *Id.* at 2.

<sup>31</sup> *Id.*

<sup>32</sup> *Id.* at 240.

<sup>33</sup> *Id.* at 2.

<sup>34</sup> *Id.* at 63–64.

<sup>35</sup> *Id.* at 41.

<sup>36</sup> *Id.* at 19.

<sup>37</sup> *Id.*

Mayfield was appointed attorneys,<sup>38</sup> and the court retained an independent latent print examiner on Mayfield's behalf.<sup>39</sup> This examiner reported that he agreed with the FBI examiners that Mayfield was the source of LFP17.<sup>40</sup>

Shortly thereafter, a SNP database search of LFP17 yielded a candidate named Ouhnane Daoud.<sup>41</sup> SNP examiners reported that he was the source of LFP17.<sup>42</sup> FBI examiners soon concurred.<sup>43</sup> Mayfield was released with a public apology,<sup>44</sup> the first publicly known erroneous identification ever reported by the FBI. Daoud, an Algerian living in Spain, was killed in a police raid.<sup>45</sup>

The Mayfield case too, generated public controversy and several reports, the most definitive of which is the Department of Justice Office of the Inspector General ("OIG") report.<sup>46</sup> The examiners involved were disciplined by the International Association for Identification ("IAI").<sup>47</sup> Unlike the McKie case, the identification does not remain disputed; there are virtually no professional latent print examiners who claim that Mayfield was the source of LFP17.

### III. THEN AND NOW: THE STATE OF FINGERPRINT ANALYSIS

In this part, I compare the state of fingerprint analysis in 1997, when the McKie case occurred, to its state today. I do not examine the state of the discipline in 2004, when the Mayfield case occurred, since that came later.

#### A. *The State of Fingerprint Analysis in 1997*

When the Ross murder occurred in 1997, it was routine for fingerprint practitioners and others to describe the technique as "infallible."<sup>48</sup> Fingerprint identifications were characterized as "facts," and legal challenges to them were considered almost unthinkable. Differences of opinion amongst fingerprint examiners were thought to be extraordinarily rare and only possible through

<sup>38</sup> *Id.* at 71.

<sup>39</sup> *Id.* at 80.

<sup>40</sup> *Id.* at 3.

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

<sup>42</sup> *Id.* at 81.

<sup>43</sup> *Id.* at 3.

<sup>44</sup> *Id.* at 21.

<sup>45</sup> *Id.* at 81.

<sup>46</sup> See generally *id.* at 1–330; REVIEW OF THE FBI'S PROGRESS IN RESPONDING TO THE RECOMMENDATIONS IN THE OFFICE OF THE INSPECTOR GENERAL, *supra* note 24.

<sup>47</sup> See Int'l Ass'n for Identification, *Latent Print Certification Actions*, 55 J. FORENSIC IDENTIFICATION 658 (2005).

<sup>48</sup> FED. BUREAU OF INVESTIGATION, THE SCIENCE OF FINGERPRINTS: CLASSIFICATION AND USES iv (1984); CAMPBELL, *supra* note 1, ¶ 10.19.

malfeasance or incompetence; differences between honest, competent examiners were believed impossible. Fingerprint conclusions were thought to be unproblematically derived from the impression data itself; the human examiner who functioned as the scientific instrument for fingerprint analyses was believed to be immune to influence from any other sources. Documentation consisted solely of a conclusion, rather than an account of the ridge features observed and how they supported the conclusion. Testimony concerning fingerprint identifications was framed in rather haphazard ways, but the upshot was always that the defendant was the only possible source of the latent print; zero probability was assigned to all other hypotheses. Indeed, fingerprint evidence was sometimes characterized as “non-probabilistic” evidence.<sup>49</sup> Most fingerprint examiners would have been surprised to be asked to name their “methodology”; almost none of them, outside of Canada, would have answered “ACE-V” (Analyze, Compare, Evaluate-Verify);<sup>50</sup> they might have said “the conventional method.”<sup>51</sup> The empirical foundation behind such claims was thought to be the indisputable uniqueness of human friction ridge skin and (at least in the U.K.) the ostensibly over-conservative 16-point standard.<sup>52</sup> Astonishingly, nearly a century into the routine use of fingerprint evidence, these claims were not based on scientific studies measuring the accuracy of fingerprint examiners’ conclusions. No such study existed. Nor was there an empirically tested model that would allow one to estimate the rarity of a set of friction ridge features in a population of friction ridge skin—the sort of knowledge that had by then been developed for forensic DNA profiling. Still, fingerprinting was often called the “gold standard” in forensic science, and forensic DNA analysts often couched their conclusions as “not as certain as a fingerprint identification,” though still strong.<sup>53</sup>

#### B. The State of Fingerprint Analysis Today

By 2011, when the long-awaited Fingerprint Inquiry Report about the McKie Affair was published, fingerprint identification had changed. Claims of “infallibility” were rarer, though not extinct, and the Inquiry Report has stated

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<sup>49</sup> David L. Grieve, *Possession of Truth*, 46 J. FORENSIC IDENTIFICATION 521, 521 (1996); J.R. Vanderkolk, *Class Characteristics and ‘Could Be’ Results*, 43 J. FORENSIC IDENTIFICATION 119, 119 (1993).

<sup>50</sup> REVIEW OF THE FBI’S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24, at 197.

<sup>51</sup> Robert D. Olsen, Sr., & Henry C. Lee, *Identification of Latent Prints*, in ADVANCES IN FINGERPRINT TECHNOLOGY 41 (Henry C. Lee & R. E. Gaenslen eds., 2001).

<sup>52</sup> C. Neumann et al., *Quantifying the Weight of Evidence from a Forensic Fingerprint Comparison: A New Paradigm*, 175 J. ROYAL STAT. SOC’Y A 371, 374 (2012).

<sup>53</sup> Katherine Schwinghammer, *Fingerprint Identification: How “The Gold Standard of Evidence” Could Be Worth Its Weight*, 32 AM. J. CRIM. L. 265 (2005).

that they should be put to rest.<sup>54</sup> Two major, new U.S. reports, one by a committee convened by the National Academies of Science (“NAS”) and one by a committee convened jointly by the National Institute of Standards and Technology (“NIST”) and the National Institute of Justice (“NIJ”), now say that claims of infallibility should not be made.<sup>55</sup> So does the International Association for Identification (“IAI”).<sup>56</sup> A number of authorities, including the Inquiry Report, have suggested that fingerprint conclusions are better characterized as “opinion[s]” than as “fact[s].”<sup>57</sup> A standard-setting American expert body, the Scientific Working Group for Friction Ridge Analysis Study and Technology (“SWGFAST”), goes further still and suggests that fingerprint identifications be conceptualized as “decision[s].”<sup>58</sup> A number of authorities, including the Inquiry Report itself, are now conceding the fallaciousness of reasoning from the uniqueness of human friction ridge skin to the accuracy of fingerprint identification.<sup>59</sup>

Contextual bias, the notion that fingerprint examiners can be influenced by factors other than the data in the impression itself, is now widely conceded, even within the profession—and, of course, by the Inquiry Report—to be a real phenomenon.<sup>60</sup> Few publicly take the position that fingerprint evidence is “non-probabilistic” evidence anymore. Indeed, a new IAI resolution explicitly

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<sup>54</sup> CAMPBELL, *supra* note 1, ¶ 38.77.

<sup>55</sup> COMM’N ON IDENTIFYING THE NEEDS OF THE FORENSIC SCI. CMTY., NAT’L RES. COUNCIL, STRENGTHENING FORENSIC SCIENCE IN THE UNITED STATES: A PATH FORWARD 142 (2009) [hereinafter NAS REPORT], <https://www.ncjrs.gov/pdffiles1/nij/grants/228091.pdf>; THE EXPERT WORKING GRP. ON HUMAN FACTORS IN LATENT PRINT ANALYSIS, NIST & NIJ, LATENT PRINT EXAMINATION AND HUMAN FACTORS: IMPROVING THE PRACTICE THROUGH A SYSTEMS APPROACH 127 (2012) [hereinafter NIST REPORT], <https://www.nist.gov/sites/default/files/documents/oles/latent.pdf>.

<sup>56</sup> Memorandum from Robert Garrett, President, Int’l Assoc. for Identification, to All Members of the Int’l Assoc. for Identification (Feb. 19, 2009), <http://www.clpex.com/Articles/TheDetail/300-399/TheDetail394.htm>.

<sup>57</sup> CAMPBELL, *supra* note 1, ¶ 35.132.

<sup>58</sup> SCI. WORKING GRP. ON FRICTION RIDGE ANALYSIS STUDY AND TECH., STANDARDS FOR EXAMINING FRICTION RIDGE IMPRESSIONS AND RESULTING CONCLUSIONS, ver. 1.0, §4.3.2.2 (2011), [http://www.swgfast.org/documents/examinations-conclusions/111026\\_Examinations-Conclusions\\_1.0.pdf](http://www.swgfast.org/documents/examinations-conclusions/111026_Examinations-Conclusions_1.0.pdf).

<sup>59</sup> CAMPBELL, *supra* note 1, ¶¶ 2.30–34.; Glenn Langenburg, *Scientific Research Supporting the Foundations of Friction Ridge Examinations*, in FINGERPRINT SOURCEBOOK 14-3, 14-7 (SWGFAST et al. eds., 2012); Jennifer L. Mnookin et al., *The Need for a Research Culture in the Forensic Sciences*, 58 UCLA L. REV. 725, 751 (2011).

<sup>60</sup> See CAMPBELL, *supra* note 1, ¶ 35.137; *Frequently Asked Questions*, SCIENTIFIC WORKING GRP. ON FRICTION RIDGE ANALYSIS STUDY AND TECH., <http://www.swgfast.org/FAQs.html> (last visited Nov. 10, 2016).

disavows this position.<sup>61</sup> The “methodology” of latent print examination is now said to be ACE-V (Analyze, Compare, Evaluate—Verify),<sup>62</sup> a heuristic taken from the Canadian forensic scientist Tuthill.<sup>63</sup> Hardly anyone advocates “point standards” anymore; the 16-point standard was abandoned in England and Wales in 2001<sup>64</sup> and Scotland in 2006.<sup>65</sup> The “ridgeology revolution” promoted by the Canadian fingerprint analyst Ashbaugh can largely be said to have won the day within the profession.<sup>66</sup> Differences of opinion between examiners, though still problematic, are becoming increasingly “normalized;” the Inquiry Report devotes substantial attention to ways of documenting and reporting such differences and stresses that they should be treated as expected outcomes of normal processes, rather than deviations or pathologies.<sup>67</sup>

It is no longer true that there are no accuracy studies for fingerprint identification; the first such studies have recently been published.<sup>68</sup> More sophisticated models aimed at estimating the rarity of friction ridge features in a population are also being published.<sup>69</sup> Fingerprinting is not legally indisputable anymore either. Although the vast majority of courts worldwide continue to admit fingerprint evidence, one U.S. court, in the case *State v. Rose*,<sup>70</sup> excluded the evidence for failing to meet the *Frye* standard for scientific evidence.<sup>71</sup> Although the case was refiled in a federal court, which quickly admitted the

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<sup>61</sup> INTERNATIONAL ASSOCIATION FOR IDENTIFICATION, STANDARDIZATION II REVIEW COMMITTEE, RESOLUTION 2010-18 (2010), [http://www.swgfast.org/Resources/100716\\_IAI\\_Resolution\\_2010-18.pdf](http://www.swgfast.org/Resources/100716_IAI_Resolution_2010-18.pdf).

<sup>62</sup> See REVIEW OF THE FBI'S HANDLING OF THE BRANDON MAYFIELD CASE , *supra* note 24, at 105.

<sup>63</sup> See HAROLD TUTHILL, INDIVIDUALIZATION: PRINCIPLES AND PROCEDURES IN CRIMINALISTICS 29–30 (1994).

<sup>64</sup> Langenburg, *supra* note 59, at 14-6, 14-7.

<sup>65</sup> Court Fingerprint System Scrapped, BBC NEWS (Sept. 4, 2006), [http://news.bbc.co.uk/2/hi/uk\\_news/scotland/5310246.stm](http://news.bbc.co.uk/2/hi/uk_news/scotland/5310246.stm).

<sup>66</sup> DAVID R. ASHBAUGH, QUANTITATIVE-QUALITATIVE FRICTION RIDGE ANALYSIS: AN INTRODUCTION TO BASIC AND ADVANCED RIDGEOLOGY 7–9 (1999).

<sup>67</sup> CAMPBELL, *supra* note 1, ¶ 36.118.

<sup>68</sup> Glenn Langenburg et al., *Informing the Judgments of Fingerprint Analysts Using Quality Metric and Statistical Assessment Tools*, 219 FORENSIC SCI. INT'L 183 (2012); Glenn Langenburg, *A Performance Study of the ACE-V Process: A Pilot Study to Measure the Accuracy, Precision, Reproducibility, Repeatability, and Biasability of Conclusions Resulting From the ACE-V Process*, 59 J. FORENSIC IDENTIFICATION 219 (2009); Jason M. Tangen et al., *Identifying Fingerprint Expertise*, 22 PSYCHOL. SCI. 995 (2011); Bradford T. Ulery et al., *Repeatability and Reproducibility of Decisions by Latent Fingerprint Examiners*, 7 PLOS ONE e32800 (2012); Bradford T. Ulery et al., *Accuracy and Reliability of Forensic Latent Fingerprint Decisions*, 108 PROC. NAT'L ACAD. SCI. 7733 (2011) [hereinafter Ulery et al., *Accuracy and Reliability*].

<sup>69</sup> Neumann et al., *supra* note 52.

<sup>70</sup> No. K06-0545, 2007 Md. Cir. Ct. LEXIS 14, at \*44 (Md. Cir. Ct. Oct. 19, 2007).

<sup>71</sup> *Id.*

evidence, the opinion was discussed favorably in the NAS Report.<sup>72</sup> Meanwhile, an English court expressed surprise and dismay that a fingerprint report contained only a conclusion rather than contemporaneous documentation of the reasons for the conclusion and quashed the conviction.<sup>73</sup> A Canadian court excluded latent print evidence that it found wanting.<sup>74</sup> Thus, efforts to provide contemporaneous documentation and the rationale for the expressed opinion are spreading. Fingerprinting is rarely called the gold standard anymore; DNA profiling is the epistemically dominant technology in forensic science today, and, indeed, many of the above changes can be characterized as part of the process of remaking fingerprinting in the image of DNA.<sup>75</sup>

More changes appear to be on the way. The Inquiry Report calls for the broad reform of fingerprint analysis in Scotland, but its implications certainly would seem to extend further.<sup>76</sup> The two reports by the NAS and NIST/NIJ also urge broad changes.<sup>77</sup> Research by forensic statisticians suggests that witnesses could testify about fingerprint evidence in a probabilistic fashion in the foreseeable future.<sup>78</sup> The stringent masking procedures adopted in countries such as the Netherlands<sup>79</sup> and, more recently, at the FBI to reduce bias and circular reasoning could become widespread.<sup>80</sup> To be sure, such developments should not be taken for granted. They will require continued effort and pressure. But they are at least conceivable, whereas in 1997 such changes might have seemed inconceivable.

These are remarkable changes to have taken place during the 15 year course of the scandals. But did they take place *because* of the McKie and Mayfield scandals? Certainly, the McKie and Mayfield scandals bear some responsibility (or deserve some credit) for these changes, but how much? This Article will seek to address this question.

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<sup>72</sup> United States v. Rose, 672 F. Supp. 2d 723, 726 (D. Md. 2009); NAS REPORT, *supra* note 55, at 43.

<sup>73</sup> R. v. Peter Kenneth Smith [2011] EWCA (Crim) 1296 at [61] (Eng.).

<sup>74</sup> R. v. Bornyk, 2013 BCSC 1927, para. 59–61 (Can. B.C. S.C.).

<sup>75</sup> Soren Frederiksen, *The National Academy of Sciences, Canadian DNA Jurisprudence and Changing Forensic Practice*, 35 MAN. L.J. 111, 112–13 (2011).

<sup>76</sup> See CAMPBELL, *supra* note 2, at 741–52.

<sup>77</sup> NAS REPORT, *supra* note 55; NIST REPORT, *supra* note 55.

<sup>78</sup> Neumann et al., *supra* note 52, at 393–94.

<sup>79</sup> Reinoud D. Stoel et al., *Minimizing Contextual Bias in Forensic Casework*, in FORENSIC SCIENCE AND THE ADMINISTRATION OF JUSTICE: CRITICAL ISSUES AND DIRECTIONS 67, 79 (Kevin J. Strom & Matthew J. Hickman eds., 2015) (ebook).

<sup>80</sup> See REVIEW OF THE FBI'S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24, at 203–04.

#### IV. HISTORICAL CONTEXT: OTHER FORCES LEADING TO CHANGE IN FINGERPRINT IDENTIFICATION PRIOR TO MCKIE AND MAYFIELD

Above I reviewed some of the changes in fingerprint practice that have occurred since the McKie Affair began. While no one would doubt that the McKie and Mayfield scandals played some role in bringing about those changes, at the same time no one would claim that the McKie and Mayfield scandals were the *sole* cause of these changes. To fully understand the role of the scandals, we must begin by reviewing the other forces for change in fingerprinting that were gathering before the McKie and Mayfield scandals broke.

##### A. *Debate Regarding Point Counting Versus Ridgeology*

It would be a mistake to think that the McKie and Mayfield scandals occurred at a time in which fingerprint practice was static. There were some things that had not changed since the origins of fingerprinting, to be sure, but fingerprinting was already in a state of dynamic change by 1997. To begin with, what has been called the “ridgeology revolution” was already underway.<sup>81</sup> It has been suggested that the notion of a holistic estimate of the rarity of the ridge detail in a latent print, for which a counting of “points” was a mere shorthand,<sup>82</sup> can be traced back to the thought of Edmond Locard or even, in a less well articulated way, the Scotsman Faulds.<sup>83</sup> But the nuances of Locard’s thinking were mostly lost on the fingerprint profession, and “point standards” had emerged in many bureaus as de facto thresholds that warranted conclusions of “individualization.”<sup>84</sup> Even the North American-dominated IAI’s 1973 disavowal of point standards stood more for the freedom of the examiner to set her own point standard on a case-by-case basis than for a full embracing of the notion of a holistic assessment of the rarity of ridge detail.<sup>85</sup> The writings of Ashbaugh elevated the idea of holistic assessment to a principle.<sup>86</sup> Ashbaugh also

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<sup>81</sup> Simon A. Cole, *What Counts for Identity? The Historical Origins of the Methodology of Latent Fingerprint Identification*, 12 SCI. CONTEXT 139, 139–41 (1999).

<sup>82</sup> *Id.*

<sup>83</sup> Christophe Champod, *Edmond Locard—Numerical Standards and "Probable" Identifications*, 45 J. FORENSIC IDENTIFICATION 136, 136 (1995); Cole, *supra* note 81, at 147.

<sup>84</sup> See Christophe Champod & Paul Chamberlain, *Fingerprints*, in HANDBOOK OF FORENSIC SCIENCE 57, 72 (Jim Fraser & Robin Williams eds., 2009).

<sup>85</sup> John Thornton, Setting Standards in the Comparison and Identification, Presentation at the 84th Annual Training Conference of the California State Division of IAI (May 9, 2000); International Association for Identification, *Standardization Committee Report*, 42 FBI Law Enforcement Bulletin 7 (Oct. 1973).

<sup>86</sup> See David R. Ashbaugh, *The Premise of Friction Ridge Identification, Clarity, and the Identification Process*, 44 J. FORENSIC IDENTIFICATION 499 (1994); David R. Ashbaugh, *Defined Pattern, Overall Pattern, and Unique Pattern*, 42 J. FORENSIC IDENTIFICATION 503 (1992); David R. Ashbaugh, *Ridgeology*, 41 J. FORENSIC IDENTIFICATION 16 (1991) [hereinafter *Ridgeology*].

argued that this holistic assessment must be situated within knowledge of the anatomy of skin,<sup>87</sup> and he included some highly critical remarks about a “cultish demeanor” and unscientific thinking associated with the point counting approach.<sup>88</sup> The result was that Ashbaugh’s efforts were cast as a “revolution” and generated a quite heated debate over “point counting versus ridgeology” that was reaching its apogee during the 1990s. Not surprisingly, ridgeology found its staunchest advocates in North America.<sup>89</sup> Perhaps because they (mostly) spoke the same language, the British emerged as their principal antagonists in advocating for point standards.<sup>90</sup>

### B. Attacks on Point Standards

The U.K. 16-point standard was under attack from another quarter as well: a report by Evett and Williams commissioned by the Home Office, completed in 1989, but not published until 1996.<sup>91</sup> It concluded that the 16-point standard was rooted in anecdote—faulty anecdote at that—rather than science. They added a small empirical study that demonstrated a lack of reliability (consistency) between examiners in terms of how many “points” were identified in the same impression and suggested that examiners might “tease out” points and conform their analyses to the local standard.

Thus, by the mid-1990s, the 16-point standard was under attack from at least two flanks. These two critiques, however, were quite different. While Ashbaugh’s thinking was not rooted in probabilistic or statistical reasoning at all, Evett is among the pioneering theorists in the field we might broadly call “forensic statistics,” and, in particular, for what has been called “the Bayesian approach” to forensic evidence. Evett’s critique of the 16-point standard, then, might be viewed as only one aspect of a much broader argument being mounted by the entire field of forensic statistics: that *all* forensic evidence is essentially probabilistic in nature. Moreover, forensic statisticians, as well as other scientifically minded forensic scientists, had consolidated a broad consensus around an approach—often called “the Bayesian approach,” but some prefer simply “the logical approach”—to assessing the value of forensic evidence that Lindley had pioneered for the analysis of glass.<sup>92</sup> Forensic statisticians believed this approach could, in principle, be applied to all forensic evidence, had articulated its application to glass and other areas, and had seen it applied

<sup>87</sup> See *Ridgeology*, *supra* note 86, at 26, 40.

<sup>88</sup> ASHBAUGH, *supra* note 66, at 4.

<sup>89</sup> See Champod & Chamberlain, *supra* note 84, at 73.

<sup>90</sup> G.T.C. Lambourne, *Fingerprint Standards*, 24 MED. SCI. & L. 227 (1984).

<sup>91</sup> I.W. Evett & R.L. Williams, *A Review of the Sixteen Points Fingerprint Standard in England and Wales*, 46 J. FORENSIC IDENTIFICATION 49 (1996); CAMPBELL, *supra* note 1, ¶ 32.10.

<sup>92</sup> Colin Aitken et al., *Expressing Evaluative Opinions: A Position Statement*, 51 SCI. & JUST. 1 (2011); D. V. Lindley, *Probability and the Law*, 26 STATISTICIAN 203 (1977).

successfully in practice to DNA profiling. They saw no reason why it should not be applied to fingerprint evidence as well.<sup>93</sup> Forensic statisticians found unpersuasive the counter-argument that the “data structure”<sup>94</sup> of fingerprint pattern information did not lend itself well to this approach; the fundamental logic of their approach did not yield before the relative ease or difficulty of generating the necessary data.

Evett would not explicitly articulate the necessity of adopting the Bayesian approach for fingerprinting in the kind of public manner that would capture the attention of fingerprint practitioners and attorneys until his seminal paper with Champod in 2001.<sup>95</sup> However, we can safely conclude that the seeds of Evett and Champod’s thinking were already in place by the mid-1990s and that they would have gotten there with or without the McKie and Mayfield scandals. Interestingly, Champod and Evett’s article does not mention the McKie Affair at all; instead, it is primarily motivated by the *United States v. Mitchell*<sup>96</sup> case, the first American legal admissibility challenge to latent print evidence after *Daubert*.<sup>97</sup>

### C. Other Literature and Arguments Questioning the Reliability of Fingerprint Identification

In retrospect, we can see that some articulations in need of a probabilistic approach to fingerprint evidence were already in the literature by 1997: in Locard and Faulds, as mentioned above, and more clearly in work in the 1960s and 70s by Kirk, Kingston, Osterburg, and Kwan.<sup>98</sup> A 1990 law article by Robertson, another major figure in the forensic statistics movement, also laid out the logic of a probabilistic approach.<sup>99</sup> But, in contrast to Evett and Champod’s manifesto

<sup>93</sup> Christophe Champod, *Fingerprints (Dactyloscopy): Standard of Proof*, ENCYCLOPEDIA OF FORENSIC SCI. 884 (2000); Franco Taroni & Pierre Margot, *Letter to the Editor—Fingerprint Evidence Evaluation: Is it Really So Different to Other Evidence Types?*, 40 SCI. & JUST. 277 (2000).

<sup>94</sup> I very much like Morrison’s use of this term to describe a difference between fingerprints and DNA profiles. Geoffrey Stewart Morrison, *Measuring the Validity and Reliability of Forensic Likelihood-Ratio Systems*, 51 SCI. & JUST. 3 (2011).

<sup>95</sup> Christophe Champod & Ian W. Evett, *A Probabilistic Approach to Fingerprint Evidence*, 51 J. FORENSIC IDENTIFICATION 101 (2001).

<sup>96</sup> 365 F.3d 215 (3d Cir. 2004), cert. denied, 543 U.S. 974 (2004).

<sup>97</sup> *Id.*; Paul C. Giannelli, *Daubert Challenges to Fingerprints*, FACULTY PUBLICATIONS (2006), [http://scholarlycommons.law.case.edu/cgi/viewcontent.cgi?article=1154&context=faculty\\_publications](http://scholarlycommons.law.case.edu/cgi/viewcontent.cgi?article=1154&context=faculty_publications).

<sup>98</sup> Charles R. Kingston & Paul L. Kirk, *Historical Development and Evaluation of the “12 Point Rule” in Fingerprint Identification*, 186 INT’L CRIM. POLICE REV. 62 (1965); Quon Yin Kwan, *Inference of Identity of Source* (1977) (thesis, University of California, Berkeley); James W. Osterburg, *An Inquiry Into the Nature of Proof*, 9 J. FORENSIC SCI. 413 (1964).

<sup>99</sup> Bernard W.N. Robertson, *Fingerprints, Relevance and Admissibility*, 2 N.Z. RECENT L. REV. 252 (1990).

published in the leading practitioner journal, the *Journal of Forensic Identification*, these papers received little notice from practitioners or even attorneys.

In addition to forensic statisticians, others had begun to glimpse the problems with fingerprint identification prior to 1997. A philosopher and a printer both published relatively obscure articles noting the fallacy of reasoning from uniqueness to accuracy in 1995 and 1997 respectively.<sup>100</sup> But such publications stood little chance of having an impact on practitioners or attorneys. Legal scholars were in a better position to influence attorneys. Saks noted the absence of accuracy data on fingerprinting as early as 1994, and this criticism was picked up by Berger.<sup>101</sup> Starrs was also publishing statements that demonstrated a grasp of the problems with fingerprint identification, but most of them appeared in his not widely available newsletter *Scientific Sleuthing Review*.<sup>102</sup> Again, these statements seemed to have little impact on attorneys. What finally seemed to have an impact on attorneys were two things: the *Daubert v. Merrell Dow Pharmaceuticals*<sup>103</sup> decision in 1993 that opened the door to admissibility challenges to fingerprinting and the publication of critiques of fingerprint evidence by Stoney on scientific grounds and Faigman *et al.* on legal grounds in a more visible treatise, *Modern Scientific Evidence*, in 1997.<sup>104</sup>

Stoney clearly had grasped, and published, the problems with fingerprint identification well prior to 1997.<sup>105</sup> But, Stoney's work was aimed at a general forensic science audience, rather than fingerprint practitioners or attorneys. It was not explicitly framed as a critique of fingerprint identification, and—though it may not have been intended that way—it may have appeared to resolve whatever statistical issues had been raised through a “leap of faith,” in which the

<sup>100</sup> Hugh McLachlan, *No Two Sets the Same? Applying Philosophy to the Theory of Fingerprints*, 83 PHILOSOPHER 12 (1995); Fred Woodworth, *A Printer Looks at Fingerprints*, THE MATCH! (Winter 1997).

<sup>101</sup> Margaret A. Berger, *Procedural Paradigms for Applying the Daubert Test*, 78 MINN. L. REV. 1345 (1994); Michael J. Saks, *Implications of the Daubert Test for Forensic Identification Science*, 1 SHEPARD'S EXPERT & SCI. EVIDENCE Q. 427 (1994).

<sup>102</sup> James E. Starrs, *A Miscue in Fingerprint Identification: Causes and Concern*, 12 J. POLICE SCI. & ADMIN. 287 (1984); James E. Starrs, *More Saltimbancos on the Loose? Fingerprint Experts Caught in a Whirl of Error*, 12 SCI. SLEUTHING NEWSL. 1 (1988); James E. Starrs, *Forensic Science on the Ropes: Procellous Times in the Citadels of Infallibility*, 20 SCI. SLEUTHING REV. 1 (1996).

<sup>103</sup> 509 U.S. 579 (1993).

<sup>104</sup> *Id.*; MODERN SCIENTIFIC EVIDENCE: THE LAW AND SCIENCE OF EXPERT TESTIMONY (David L. Faigman *et al.* eds., 1st ed. 1997); see also Michael J. Saks, *Merlin and Solomon: Lessons from the Law's Formative Encounters with Forensic Identification Science*, 49 HASTINGS L.J. 1069, 1071–72, 1105–06 (1998).

<sup>105</sup> See David A. Stoney, *What Made Us Ever Think We Could Individualize Using Statistics?*, 31 J. FORENSIC SCI. SOC'Y 197 (1991); David A. Stoney & John I. Thornton, *A Critical Analysis of Quantitative Fingerprint Individuality Models*, 31 J. FORENSIC SCI. 1187 (1986); David A. Stoney, *A Quantitative Assessment of Fingerprint Individuality* (1985) (Ph.D. thesis, University of California, Berkeley).

analyst decides that two prints come from a common source even though she cannot actually know that. Stoney's 1997 article, in contrast, was in an evidence treatise and could be read by an attorney as a road map for an admissibility challenge to fingerprint evidence. Armed with *Daubert*'s insistence that the accuracy of evidence must be demonstrated and legal academics' critiques, American defense attorneys were able to mount cogent and rationally compelling (if tactically unsuccessful) challenges to fingerprint evidence by 1999.<sup>106</sup>

The statistical critique of fingerprinting gained powerful rhetorical traction from the success of forensic DNA profiling,<sup>107</sup> which showed that forensic evidence could be useful even if it was not "absolute" or certain.<sup>108</sup> It also showed that there were complex issues concerning how to account for probabilities for DNA association about which even experts disagreed.<sup>109</sup> Under these circumstances, the utter evasion of probabilities in fingerprint identification began to seem less tenable.<sup>110</sup>

Another line of critique emerged from psychologists, who had expressed concerns about the impact of "observer effects"<sup>111</sup> on forensic analyses. These psychologists argued that some forensic errors might be caused by instilling "expectations"<sup>112</sup> in analysts that forensic traces should be associated with one another.<sup>113</sup> They pointed out that many fields of science took measures to reduce the possibility of "confirmation bias"<sup>114</sup> and that these measures were absent in forensic science.<sup>115</sup> Though there was a small amount of data on bias in forensic science,<sup>116</sup> in the 2000s Dror and colleagues carried out a series of experiments

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<sup>106</sup> Robert Epstein, *Fingerprints Meet Daubert: The Myth of Fingerprint "Science" is Revealed*, 75 S. CAL. L. REV. 605, 605–06, 606 n.7 (2002).

<sup>107</sup> Jennifer L. Mnookin, *Fingerprints: Not a Gold Standard*, ISSUES SCI. AND TECH., Fall 2003, issues.org/20-1/mnookin.

<sup>108</sup> Simon A. Cole, *Forensic Identification Evidence: Utility Without Infallibility*, 9 CRIMINOLOGY & PUB. POL'Y 375, 377 (2010) [hereinafter Cole, *Forensic Identification Evidence*].

<sup>109</sup> *Id.* at 376–77.

<sup>110</sup> See Simon A. Cole, *Forensics Without Uniqueness, Conclusions Without Individualization: The New Epistemology of Forensic Identification*, 8 L. PROBABILITY & RISK 233 (2009); Cole, *Forensic Identification Evidence*, *supra* note 108.

<sup>111</sup> D. Michael Risinger et al., *The Daubert/Kumho Implications of Observer Effects in Forensic Science: Hidden Problems of Expectation and Suggestion*, 90 CALIF. L. REV. 1, 27 (2002).

<sup>112</sup> *Id.*

<sup>113</sup> *Id.* at 29–30.

<sup>114</sup> *Id.* at 9.

<sup>115</sup> *Id.* at 31.

<sup>116</sup> See, e.g., Larry S. Miller, *Procedural Bias in Forensic Science Examinations of Human Hair*, 11 L. & HUM. BEHAV. 157 (1987).

that demonstrated the existence of bias in fingerprint analysis.<sup>117</sup> These studies attracted a great deal attention and shook the fingerprint community.<sup>118</sup>

Thus, by 1997, the status quo in fingerprint identification was being challenged from many quarters. From within the profession, the ridgeology revolution demanded changes in education and training and in conceptualizing fingerprint associations and removing the “safety net” of a point standard. From outside the fingerprint specialty, but still within forensic science, statisticians were insisting that it was time to transform fingerprint evidence from “categorical” to probabilistic evidence. Legal academics, soon joined by academics from other disciplines like psychology, were pointing out the absence of accuracy measurements and rarity data and the pernicious effect of confirmation bias. This seemed to place fingerprint identification in serious jeopardy of exclusion under *Daubert*.

#### *D. The Likelihood of Change in Fingerprint Identification Without the McKie and Mayfield Scandals*

Would all of these forces, already in play by 1997, have wrought the changes that we have seen in fingerprint identification without the McKie and Mayfield scandals? It seems unlikely. Policy scholars note that reform from within, known as endogenous change, is rare because “most policies are firmly rooted in inert institutional settings and a state of policy equilibrium, which cannot be changed from within. Therefore,” they argue, “stimuli, external to the policy subsystem,” sometimes called “external crises” are “required for non-incremental policy change.”<sup>119</sup> The fingerprint community, like most occupational communities, was conservative, especially when change was proposed by outsiders like forensic statisticians and academics.<sup>120</sup> The documentary history of the late 1990s and early 2000s amply attests to the hostility and defensiveness with which the profession reacted to external criticism.<sup>121</sup> The courts, meanwhile, by dismissing all criticisms and issuing opinions not only reaffirming the admissibility of latent print evidence but also allowing examiners to testify in terms of absolute certainty, created disincentives

<sup>117</sup> Itiel E. Dror & David Charlton, *Why Experts Make Errors*, 56 J. FORENSIC IDENTIFICATION 600 (2006); Itiel E. Dror et al., *Contextual Information Renders Experts Vulnerable to Making Erroneous Identifications*, 156 FORENSIC SCI. INT'L 74 (2006); Itiel E. Dror et al., *When Emotions Get the Better of Us: The Effect of Contextual Top-Down Processing on Matching Fingerprints*, 19 APPLIED COGNITIVE PSYCHOL. 799 (2005).

<sup>118</sup> See, e.g., Martin Leadbetter, *Letter to the Editor*, 33 FINGERPRINT WORLD 230 (2007), <http://www.clpex.com/Articles/TheDetail/300-399/TheDetail335.htm>.

<sup>119</sup> Daniel Nohrstedt & Christopher M. Weible, *The Logic of Policy Change After Crisis: Proximity and Subsystem Interaction*, 1 RISK HAZARDS & CRISIS IN PUB. POL'Y 1, 3 (2010).

<sup>120</sup> See, e.g., Andre A. Moenssens, *The Reliability of Fingerprint Identification: A Case Report* (Jan. 17, 2002), [http://onin.com/fp/reliability\\_of\\_fp\\_ident.html](http://onin.com/fp/reliability_of_fp_ident.html).

<sup>121</sup> See, e.g., *id.*

to reconceptualizing fingerprint identification or even doing research studies. If nothing else, the last 15 years have demonstrated that reformers alone neither individually nor collectively possessed sufficient authority to persuade the relevant actors (fingerprint professionals, courts, government bureaucracies, legislatures) that change was needed.

## V. RATIONALES FOR FINGERPRINT REFORM

Above I have described what we might call *principled criticisms* of fingerprint identification. I label them “principled” because they are not dependent, in a direct way, on claims of error. Such criticisms did not generally point to actual exposed cases of error. Even when they did, error was not the main driver of their arguments. Instead, they argued for changes to fingerprint identification because doing things properly was viewed as a good in itself. For example, it may be difficult to show directly that the adoption of contemporaneous documentation practices will reduce errors. Indeed, remedying this area might not have any effect at all on fingerprinting’s contribution to truthful judicial outcomes. But, some would argue it should be remedied nonetheless.

However, it appears that a second major force was necessary to drive change in fingerprint identification. As noted above, policy scholars argue that external crises are typically necessary to drive major policy reforms.<sup>122</sup> As Zalman and Marion argue, the innocence crisis—the exposure of a shockingly high number of virtually indisputable wrongful convictions, especially in the United States, over the past two decades both through post-conviction DNA testing and by other means—constituted an external crisis for the criminal justice system.<sup>123</sup> Analogously, I argue that the exposure of erroneous identifications resulting in wrongful convictions or near wrongful convictions, including, of course, the McKie and Mayfield scandals, constituted an external crisis for fingerprint identification. This external crisis was crucial to fingerprint reform. The appeal of imposing change on something as venerable as fingerprint identification merely because it is the right way to do things is rather limited. If “wrong” (unscientific, illogical) ways of doing things still reach correct results, busy people will be loath to invest their time and resources in supporting change.

A principled critic might respond to such indifference in a couple of ways. First, she might argue that the right way of doing things is inherently good and should be supported regardless of actual errors. For instance, she might argue that scientists and sworn expert witnesses have no higher calling than to speak the truth. If their reporting practices skew the truth (say by testifying that fingerprinting is infallible or that the probability that the source of a print is

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<sup>122</sup> Nohrstedt & Weible, *supra* note 119, at 3.

<sup>123</sup> Nancy Marion & Marvin Zalman, *Towards a Theory of Innocence Policy Reform*, in *CONTROVERSIES IN INNOCENCE CASES IN AMERICA* 175 (Cooper ed., 2014).

someone other than the defendant has been eliminated), that is problematic regardless of whether the ultimate conclusion of the report (“source” or “not source”) is consistent with ground truth, despite not being logically “true.” Second, she might argue that the wrong way of doing things *does* produce errors—we just don’t know about them. Scholars have explained why many fingerprint errors might go undetected.<sup>124</sup> Thus, a principled critic might argue that her proposed reforms will eliminate errors that might never have been exposed and thus be error-reducing, even if she cannot prove it.

These responses notwithstanding, the principled critic clearly had a daunting task in imbuing stingy legislatures, tradition-bound practitioners, and courts of questionable scientific literacy with a sense of urgency to reform fingerprint practice. How much easier it would be if the critic could connect her argument directly to undesirable criminal justice system outcomes. Hence the importance of the external crisis.

Exposed erroneous identifications existed prior to 1997; I counted at least 12 of them.<sup>125</sup> As I have discussed elsewhere, the profession, through a series of clever rhetorical practices, had successfully managed to cast these errors as aberrations irrelevant to “proper” fingerprint practice.<sup>126</sup> However, two cases involving exposed erroneous identifications proved resistant to these rhetorical explanations: McKie and Mayfield.<sup>127</sup>

#### A. *Explanations Provided for Erroneous Identifications*

Prior to McKie and Mayfield, exposed erroneous identifications had been “explained” by reference to the incompetence, or possibly corruption, of the offending examiner(s). Even when the examiner possessed strong credentials, such as IAI certification, the examiner was *post hoc* deemed incompetent. The effect was to provide the statement, “Errors do not occur in latent print analysis . . .” with an all-purpose loophole: “. . . when performed by a competent examiner.” While there were no limits, in principle, to the extent to which this loophole could be used, as sociologists of science would suggest, there were limits in terms of what was socially tenable. In the Mayfield case, the FBI laboratory had been touted for so long—whether rightly or wrongly—as the premier crime laboratory in the United States that it would have been untenable to “explain” the Mayfield case as a case of incompetence. In addition, the

<sup>124</sup> See NIST REPORT, *supra* note 55, at 33; Simon A. Cole, *More Than Zero: Accounting for Error in Latent Fingerprint Identification*, 95 J. CRIM. L. & CRIMINOLOGY 985, 995 (2005) [hereinafter Cole, *More Than Zero*].

<sup>125</sup> Live Science Staff, *The Real Crime: 1,000 Errors in Fingerprint Matching Every Year*, LIVESCIENCE (Sept. 13, 2005), <http://www.livescience.com/9341-real-crime-1-000-errors-fingerprint-matching-year.html>.

<sup>126</sup> Cole, *More Than Zero*, *supra* note 124, at 1034–43.

<sup>127</sup> For detail on the Mayfield case, see REVIEW OF THE FBI’S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24. For a briefer discussion, see Wax & Schatz, *supra* note 24.

Mayfield identification was corroborated by an independent expert hired on the defendant's behalf, whose bias, if any, should have tended against seeing Mayfield as the source of the print and who was also highly credentialed, and a well-known trainer of American latent print examiners.<sup>128</sup> To be sure, a number of other "simple" explanations that would have essentially preserved fingerprint practice intact were floated during the initial reactions to the Mayfield scandal. One such explanation was the quality of the digital image. Another—odd—explanation was the high-profile nature of the case.<sup>129</sup> To the U.S. Department of Justice's credit, these simple explanations did not stick, and the much more thorough and reform-generating Office of the Inspector General ("OIG") Report was commissioned.<sup>130</sup>

In the McKie Affair, there were certainly many fingerprint examiners around the world who urged that the incompetence explanation be invoked. However, one major difference between the two cases is that examiners implicated in the Mayfield case quickly became convinced of their own error, possibly because the supposed "true" source of the latent print (Daoud) was provided to them. Therefore, at least two of the examiners cooperated, to varying extents, with the post-mortem of their error and acquiesced to the position that it was an error.<sup>131</sup> Kenneth Moses, for example, willingly turned in his IAI certification, accepted his suspension, and today delivers riveting PowerPoint presentations about his role in the error (presentations which, it bears mentioning, are useful primarily because Moses recorded contemporaneous documentation of his observations at the time of his original analysis).<sup>132</sup>

In contrast, the SCRO examiners and some of their supporters have never, to this day, acquiesced in the view that McKie was not the source of Y7. Thus, Y7 remains a contested latent in a way that LFP17, the disputed mark in the Mayfield case, is not. The SCRO examiners' refusal to take the fall in quite the same way the FBI examiners did put the government officials trying to resolve the Affair in a bind. An "incompetence"—or, worse, corruption—explanation would have provoked strong pushback from the SCRO and its supporters. The alternative, however, was to contradict a century of fingerprint dogma by positing that competent and well-intentioned examiners could make erroneous identifications or that examiners could reasonably disagree about the source of a mark. To much of the global fingerprint profession, this seemed

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<sup>128</sup> Simon A. Cole, *The Prevalence and Potential Causes of Wrongful Conviction by Fingerprint Evidence*, 37 GOLDEN GATE U. L. REV. 39, 65 (2006) [hereinafter Cole, *Prevalence*].

<sup>129</sup> See Stacey, *supra* note 24.

<sup>130</sup> REVIEW OF THE FBI'S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24.

<sup>131</sup> Cole, *Prevalence*, *supra* note 128, at 65.

<sup>132</sup> FED. DEFENDER NEWSL., OFFICE OF THE FED. DEFENDER, EASTERN DISTRICT OF CAL., (2009), <http://www.cae-fpd.org/news/Aug09.pdf>; Mark Acree, Kenneth Moses & Simon A. Cole, "Where Is the Science in Forensic Science?", Public Defender Service for the District of Columbia, *Seventh Annual Forensic Science Conference*, June 13, 2009, Washington, D.C.

tantamount to sacrificing the credibility earned by the global fingerprint profession over a century in order to preserve a single identification bureau. Hence the outcry over the Justice Minister's 2002 claim that fingerprint conclusions were matters of "opinion," not "fact," a claim which made it possible to reconcile the Scottish examiners' competence with Shirley McKie's innocence.<sup>133</sup> While the Minister's statement provoked howls of outrage,<sup>134</sup> by the time the Inquiry Report made the Minister's view its own, this claim was no longer scandalous. A report by the British Nuffield Council on Bioethics had taken the same view, and SWGFAST had already reduced the strength of fingerprint conclusions from "determinations" to "decisions."<sup>135</sup>

## VI. CRISIS AND ITS ROLE IN FINGERPRINT REFORM

The enormous influence of these two errors on the authorities that supported changes in fingerprint practice is clearly visible. The McKie error was, of course, the sole justification for the magisterial 800-page Fingerprint Inquiry Report.<sup>136</sup> The NAS Report relied heavily on the Mayfield error as justification for its claim that forensic science reform was necessary, writing "The Mayfield case and the resulting report from the Inspector General surely signal caution against simple, and unverified, assumptions about the reliability of fingerprint evidence."<sup>137</sup> The NIST Report cites the McKie and Mayfield cases<sup>138</sup> to show "the fact that human errors can occur."<sup>139</sup> The state court *Rose* opinion<sup>140</sup> discusses the Mayfield error extensively in justifying its conclusion that latent print evidence failed to satisfy Maryland's admissibility standard. The FBI has completely revamped its procedures, including incorporating procedures explicitly designed to minimize psychological bias and circular reasoning in response to the Mayfield case.<sup>141</sup> Scientific studies that address the key empirical questions that would be necessary to support fingerprint conclusions cite the

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<sup>133</sup> Simon A. Cole, *The 'Opinionization' of Fingerprint Evidence*, 3 BIO-SOCIETIES 105, 105–06 (2008).

<sup>134</sup> *Id.*

<sup>135</sup> NUFFIELD COUNCIL ON BIOETHICS, THE FORENSIC USE OF BIOINFORMATION: ETHICAL ISSUES 16 (2007), <http://nuffieldbioethics.org/wp-content/uploads/The-forensic-use-of-bioinformation-ethical-issues.pdf>; Sci. Working Grp. on Friction Ridge Analysis Study and Tech., *supra* note 58, § 4.3.2.2.

<sup>136</sup> ROCKY MOUNTAIN DIV. IAI, THE SILENT WITNESS 17–18 (2012), <http://www.rmdiai.org/pdf/Newsltr46-1.pdf>.

<sup>137</sup> NAS REPORT, *supra* note 55, at 105.

<sup>138</sup> NIST REPORT, *supra* note 55, at vi n.3.

<sup>139</sup> *Id.* at vi.

<sup>140</sup> State v. Rose, No. K06-0545, 2007 Md. Cir. Ct. LEXIS, at \*14 (Md. Cir. Ct. Oct. 19, 2007).

<sup>141</sup> REVIEW OF THE FBI'S PROGRESS IN RESPONDING TO THE RECOMMENDATIONS IN THE OFFICE OF THE INSPECTOR GENERAL, *supra* note 24, at 26–28.

Mayfield case as justification.<sup>142</sup> One of these was essentially conducted by the FBI, the three authors being FBI contractors and employees. Dror and colleagues' groundbreaking study on confirmation bias used the Mayfield case for its experimental design.<sup>143</sup> Although Dror *et al.* probably could have eventually solved their design problem without the Mayfield case, their use of Mayfield constitutes an explicit connection between the scandal and their research. And, a recent International Forensic Symposium sponsored by NIST and billed as "the first-ever international symposium devoted exclusively to the topic of forensic science error management" explicitly connected this topic to the Mayfield scandal by scheduling keynote speeches by Mayfield himself and his attorney, Steven Wax.<sup>144</sup>

It should be noted that use of McKie and Mayfield in these documents was somewhat rhetorical. The fact that two exposed erroneous identifications occurred falsified absurd claims like the "infallibility" of fingerprint identification or that the error rate ("methodological" or otherwise) was zero.<sup>145</sup> But the existence of errors in no way proved that reform was necessary, that better training, documentation, protocols, statistical studies were necessary, that the reporting procedure needed to be changed, that examiners should be blind to extraneous context, or that accuracy was not otherwise very high. For instance, with regard to the *Rose* opinion, the fact that Mayfield occurred does not logically render latent print evidence inadmissible. American prosecutors are surely correct when they argue that neither U.S. admissibility standard, *Frye* or *Daubert*, demands that evidence be error-free in order to be admissible. *Daubert* demands only that the error rate be estimated and considered, not that it be zero.<sup>146</sup> If a court took FBI examiners at their word that they had committed only one error in their entire history while undertaking a million fingerprint examinations per year, it surely should find fingerprint evidence admissible, though it should not, of course, permit the examiner to testify that the error rate is "zero."<sup>147</sup>

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<sup>142</sup> E.g., Neumann *et al.*, *supra* note 52, at 375; Ulery *et al.*, *Accuracy and Reliability*, *supra* note 68, at 7733.

<sup>143</sup> Dror *et al.*, *supra* note 117.

<sup>144</sup> 2015 *International Forensics Symposium*, NAT'L INST. OF STANDARDS AND TECH., <https://www.nist.gov/director/2015-international-forensics-symposium> (last visited Nov. 11, 2016).

<sup>145</sup> For more on this issue, see Cole, *More Than Zero*, *supra* note 122.

<sup>146</sup> *Daubert v. Merrell Dow Pharmas.*, 509 U.S. 579, 594 (1993).

<sup>147</sup> See *United States v. Baines*, 573 F.3d 979, 987–88, 990–91 (10th Cir. 2009). The more defensible reason the *Rose* court found latent print evidence inadmissible was that the government failed to make a showing that addressed the crucial question of the accuracy (or "reliability") of the technique. *State v. Rose*, No. K06-0545, 2007 Md. Cir. Ct. LEXIS 14, at \*41 (Md. Cir. Ct. Oct. 19, 2007). The government put forward no data or studies which sought to measure or estimate the accuracy of latent print identification. *Id.* Instead, the government put forward evidence purporting to prove the uniqueness of friction ridge skin, *id.* at \*17, invoking the fallacious reasoning that the

Similarly, the occurrence of one erroneous identification is surely rather weak justification for the ambitious changes to fingerprint practice recommended by the NAS and NIST/NIJ committees. And, many of the Fingerprint Inquiry's conclusions regarding fingerprint practice have little to do with the McKie case itself. If the Inquiry Report is correct that fingerprint conclusions are opinions, not facts, and should not be stated as absolute conclusions, that was presumably true before McKie and would still be true even if McKie had never occurred. These documents, however, attest to the rhetorical necessity of McKie and Mayfield. Although anecdotal cases of error may provide scant *logical* justification for wholesale changes, they provide strong *narrative* or *rhetorical* justification.

## VII. IMPLICATIONS OF OUR DEPENDENCE ON EXTERNAL CRISES TO EFFECT REFORM

The above discussion shows that external crisis played a crucial role in bringing about recent changes in fingerprint practice. McKie and Mayfield will surely have a prominent place—a place in history that, of course, neither of them sought—when the history of the current era of identification history is written.

This conclusion, however, is troubling. It is troubling because it suggests that we are highly dependent on external crisis to effect necessary—for those who believe they *are* necessary—changes in fingerprint practice. Perhaps there are some who believe that the changes of the last two decades were *not* truly necessary, but necessary only to defuse the scrutiny ignited by McKie and Mayfield. This Article is directed at those others who believe that the changes of the last two decades and the contemplated changes of the next two *are* necessary and that fingerprint identification is the better for them, who agree with Langenburg that “significant advances have been made, many of them in just the last two decades” and that these changes are really “only the tip of the iceberg.”<sup>148</sup> I argue that such people should be troubled by the following awkward fact: Both McKie and Mayfield were highly idiosyncratic cases that might easily have never developed into the scandals they became.

In the case of McKie, for example, one can easily imagine a number of decision points at which the dispute might have been quietly defused without developing into the decade-long scandal it became. For example, McKie was pressured numerous times to simply admit she had entered the crime scene and end the scandal with what probably would have been a light reprimand. Had McKie chosen to spare herself a great deal of personal agony and agree to this compromise, there undoubtedly would never have been a McKie Affair, despite

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accuracy of latent print identification can be inferred from the uniqueness of friction ridge skin. See *id.* at 37–38; see also Simon A. Cole, *Toward Evidence-Based Evidence: Supporting Forensic Knowledge Claims in the Post-Daubert Era*, 43 TULSA L. REV. 263 (2007) [hereinafter Cole, *Toward Evidence-Based Evidence*].

<sup>148</sup> Langenburg, *supra* note 59, at 14–27.

the fact that her story would have been fairly inconsistent with other facts (like the 24-hour police guard on the crime scene). McKie might have remained a police officer with a reprimand on her record, the identification of Y7 would have been counted as yet another accurate deployment of latent print analysis, and latent print analysis might have continued on as it was.<sup>149</sup> In addition, without the McKie Affair, the erroneous identification of the victim's print in *Asbury*'s case would probably never have been exposed.<sup>150</sup> That too might have been counted as a correct deployment of latent print analysis, and Asbury might yet be in prison for the crime today.

In the Mayfield case, we can point to two key counterfactuals. First, imagine if the Mayfield print had been found on American, rather than Spanish soil. In that scenario it seems highly unlikely that any other laboratory would have disagreed with the FBI Laboratory. Under that imagined scenario, Mayfield might still be viewed as a correct identification. The second counterfactual is more realistic. We now know that Mayfield was apprehended on May 6, 2004, because of a media leak in Europe;<sup>151</sup> the FBI feared that he would be tipped off that he was under surveillance and flee.<sup>152</sup> The SNP managed to convince the FBI that Daoud, not Mayfield, was the source of LFP17 on May 19.<sup>153</sup> Had the media leak not occurred, the FBI might have become convinced of their error before apprehending Mayfield, who was under surveillance through a *secret* warrant through the Foreign Intelligence Surveillance Act.<sup>154</sup> Only the FBI knows what it would have done under those circumstances. Would it have publicized the error? Would it have commissioned a report of the scope of the OIG Report (not to mention the other two reports)? Or, would the FBI have kept silent and continued to testify in court that FBI examiners had never made an error, as it had been doing up until the exposure of the Mayfield case?<sup>155</sup> Whatever the answer, it seems doubtful that Mayfield would have had the impact in prompting change in fingerprint practice that it did when it erupted into a full-fledged scandal.

In other words, the McKie and Mayfield scandals were both *fortuitous events*; they might easily never have happened. And, if they had not happened, it seems very unlikely that all of the recent changes in fingerprint practice would have happened without them. Perhaps some progress would have been made in conceptualizing fingerprint identification in "ridgeological" terms and as ACE-V. Perhaps the 16-point standard would have been abandoned. However, the

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<sup>149</sup> MCKIE & RUSSELL, *supra* note 1, at 16.

<sup>150</sup> *Id.* at 127.

<sup>151</sup> REVIEW OF THE FBI'S HANDLING OF THE BRANDON MAYFIELD CASE, *supra* note 24, at 60–61.

<sup>152</sup> *Id.*

<sup>153</sup> *Id.* at 81–82.

<sup>154</sup> *Id.* at 38.

<sup>155</sup> Cole, *More Than Zero*, *supra* note 124.

profession might still be claiming fingerprinting is infallible, that fingerprint conclusions are “facts,” denying the existence confirmation bias, reporting absolute conclusions, claiming contemporaneous documentation is unnecessary, and denying the need for accuracy or rarity studies. For all those, especially those within the profession, who believe that these things are *not* true, this should be a frightening thought. The profession might still be saying things that are not true.

The McKie and Mayfield scandals, then, highlight the *fragility* of a practice that depends on external crisis in order to effect change. Crisis is an extremely poor mechanism for effecting reform in any endeavor. There are some obvious reasons for this—crises tend to be extreme, polarizing, and inflame passions. But the less obvious reason is that *we cannot count on them*. Scandals are, by definition, idiosyncratic and sporadic, sometimes viewed as “the proverbial iceberg tip . . . events in which the usually concealed corrupt components of social systems are revealed to the public.”<sup>156</sup> If we have a problem, we cannot count on an external crisis exposing it in a timely manner because external crises erupt sporadically and fortuitously.

Another problem with crises is that, as they inevitably attract attention, post-mortems, official reports, explanations, and recommendations for reform, we tend to equate them with actual errors. Because exposed errors are viewed as representative of all errors, exposed and unexposed, we fall into the habit of thinking of exposed errors as all errors. But exposed errors are not equivalent to errors, and they may not even be representative of errors—they may merely be representative of *exposure mechanisms*.<sup>157</sup> Thus, crises provoke reforms—as they should. But, it is also important to constantly keep in mind that crises represent merely the errors that have been exposed and, further, developed into full-fledged scandals. Responding to crisis makes it cognitively difficult to keep in mind that there may be other undetected errors that did not become scandals and that there surely will be errors, both detected and undetected, perhaps with different proximate causes, in the future.

In the case of the McKie and Mayfield scandals, we had a practice that was routinely touted as “infallible” for nearly a century. This is now conceded to have been false, and reforms have been implemented. We must, however, resist the tendency to use these reforms as a pretext to reconstruct the aura of “infallibility” (or even virtual infallibility) once again. The lesson of the McKie and Mayfield scandals is not that fingerprinting was fallible and claimed it wasn’t, but now it has been fixed. The lesson is that claims of infallibility, past and future, are always suspect, if not inherently false and misleading. Forensic science, however, has shown a disturbing tendency to respond to crises by addressing specific, local causes and then declaring the practice “reliable” once

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<sup>156</sup> ARI ADUT, ON SCANDAL: MORAL DISTURBANCES IN SOCIETY, POLITICS, AND ART 9 (2008).

<sup>157</sup> See Cole, *Toward Evidence-Based Evidence*, *supra* note 147, at 278.

again.<sup>158</sup> This disturbing tendency is already visible in fingerprint examiners' testimony—and courts' crediting of it—that the possibility of error can be accounted for by calculating a proportion with the number of known errors in the numerator and the number of all fingerprint examinations ever undertaken in the denominator.<sup>159</sup> Such statements, with their faulty assumption that exposed errors can be equated with actual errors, entirely miss the central point of exposed erroneous identifications like McKie and Mayfield—that we cannot ever assume that we have absolutely reliable mechanisms for exposing errors.

We have not merely learned from the McKie and Mayfield scandals that there were problems. We also learned that we had very poor mechanisms set up to make stakeholders aware of problems. We cannot avoid the conclusion that efforts to raise awareness prior to the external crisis were staunchly resisted and met with limited success, and it is not clear that they ever would have been successful without the McKie and Mayfield scandals. Litigation, which might have been thought to be an appropriate way to raise awareness of the problem, was even less effective. Indeed, the NAS Report termed the U.S. courts' handling of forensic science "utterly ineffective."<sup>160</sup> We learned that external crisis was necessary to generate awareness of the deficiencies of fingerprint identification.

### VIII. CONCLUSION: PERMANENT MECHANISMS FOR IMPROVEMENT

The McKie and Mayfield scandals demonstrated the need not merely for reform, but also for what we might call "the reform of reform." One challenge is to address the problems with fingerprint practice that were exposed by the McKie and Mayfield scandals themselves and by other currents of criticism that gained legitimacy because of the Affair: the overstating of the probative value of results, absence of basic empirical studies, deficits in education and training, poorly maintained protocols, failure of documentation, need to reconceptualize the analytic process, and so on. As discussed above, this level of reform is now receiving a great, perhaps unprecedented, deal of attention.

A second challenge has received far less attention. This second challenge consists of addressing how *future* problems like those described in the preceding paragraph are to be brought to the attention of various stakeholders (practitioners, judges, attorneys, government officials, scientific institutions, the public). In other words, how will stakeholders in the future be made aware when there is a need for further reform? The current era of reform needs to do more than merely

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<sup>158</sup> See, e.g., Cary T. Oien, *Forensic Hair Comparison: Background Information for Interpretation*, 11 FORENSIC SCI. COMM. (2009), [http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/april2009/review/2009\\_04\\_review02.htm](http://www.fbi.gov/about-us/lab/forensic-science-communications/fsc/april2009/review/2009_04_review02.htm); Peter E. Peterson et al., *Latent Prints: A Perspective on the State of the Science*, 11 FORENSIC SCI. COMM. (2009), <https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/oct2009/review>.

<sup>159</sup> United States v. Baines, 573 F.3d 979, 989–91 (10th Cir. 2009).

<sup>160</sup> NAS REPORT, *supra* note 55, at 109.

address the problems that have been recently exposed. It also needs to work on how future problems will be exposed. What mechanisms should be put in place so that external crisis is not required for future reforms? This issue deserves more attention than it has received.

The goal, moving forward, should be to create structures that can be responsive to critique and implement change *without depending on external crisis*. The fingerprint practices that are created post-McKie will be better, but they will not be perfect. We should not require future McKies to suffer as they did for improvement to occur. The Inquiry Report's approach to this issue may be found in its recommendations in favor of "engaging with . . . the academic community."<sup>161</sup> These recommendations seem especially pertinent since, as I have discussed, recent history suggests that the academic community's influence on fingerprint practice was limited without the added impetus of scandal. However, the Inquiry Report's recommendations lack specifics. They might be satisfied by true engagement with the academic community or by paying mere lip service to such engagement. The NAS Report sought to address this issue through its proposed National Institute of Forensic Science ("NIFS").<sup>162</sup> Being a permanent watchdog for ensuring that necessary reforms in forensic practice are identified and enacted would seem to be one of the tasks the NAS Committee envisioned for NIFS.<sup>163</sup> But prospects for the NIFS becoming reality seem dim. Instead, the U.S. Department of Justice and NIST have jointly created a National Commission on Forensic Science ("NCFS").<sup>164</sup> This is an excellent organization, but there are not thus far any explicit plans to make it permanent. And, even under the best circumstances, persuasive questions have been raised about whether even a nominally independent NFIS would be able to resist regulatory capture by law enforcement or, more generally, the state.

Permanent mechanisms for exposing problems in forensic science sit uneasily with the adversarial context in which forensic science is situated—even in legal systems that are called "inquisitorial," rather than "adversarial." An ability to issue assurances that all problems were in the past, have been addressed, and are no longer relevant is crucial to maintaining the credibility of the forensic expert witness. Such a stance is difficult to maintain when an official institution exists which is in the business of, for example, finding and documenting problems, weaknesses, and areas for improvement in forensic science.<sup>165</sup> That, however, is the kind of institution we need—one that never again touts claims of perfection or infallibility and one that does not believe in an end to the process of improvement.

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<sup>161</sup> CAMPBELL, *supra* note 1, ¶ 35.135.

<sup>162</sup> NAS REPORT, *supra* note 55, at 19.

<sup>163</sup> *See id.*

<sup>164</sup> *National Commission on Forensic Science*, U.S. DEP'T JUST., <https://www.justice.gov/ncfs> (last visited Nov. 11, 2016).

<sup>165</sup> NAS REPORT, *supra* note 55, at 19–26.