# The New Forensics: Criminal Justice, False Certainty, and the Second Generation of Scientific Evidence

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*Accounts of powerful new forensic technologies such as DNA typing, data mining, biometric scanning, and electronic location tracking fill the daily news. Proponents praise these techniques for helping to exonerate those wrongly accused, and for exposing the failings of a criminal justice system that previously relied too readily upon faulty forensic evidence like handwriting, ballistics, and hair and fiber analysis. Advocates applaud the introduction of a "new paradigm" for forensic evidence, and proclaim that these new techniques will revolutionize how the government investigates and tries criminal cases.*

*While the new forensic sciences undoubtedly offer an unprecedented degree of certainty and reliability, these characteristics alone do not necessarily render them less susceptible to misuse. In fact, as this Article argues, the most lauded attributes of these new forms of forensic evidence may actually exacerbate the*

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*conditions that first caused traditional forensic sciences to fall into disrepute.*

*This Article challenges the new orthodoxy of forensic science. In so doing, it reframes the debate about the role of forensic evidence in the criminal justice system in three respects. First, this Article sets forth a new taxonomy of forensic evidence that distinguishes first from second generation forensic sciences. Second, using this framework, this Article illustrates how the particular characteristics of the second generation aggravate, rather than relieve, the pathologies that ultimately afflicted the first generation. Lastly, this Article criticizes current suggestions for improving the use of forensic evidence in the criminal justice system that fail to account for the peculiar characteristics of the second generation, and advocates alternative remedies tailored to these specific concerns.*

## INTRODUCTION

Forensic science has long captured the public's imagination of criminal justice.[1] From Sherlock Holmes's trademark magnifying glass to the shaky handwriting on the ransom note for the Lindbergh baby to the swirling double helix of DNA, images of the mystical power of forensic science pervade popular culture. Currently, one of the most-watched television dramas in the country is "CSI: Crime Scene Investigation," and viewers not satisfied with just this offering can also tune in to "CSI: NY," "CSI: Miami," or any number of other programs showcasing forensic science technologies.[2] As one scholar presciently observed ten years ago, "[t]o consider the future . . . is largely to talk about the creeping scientization of factual inquiry."[3] Today, that "creep" pours forth in a flood as legal scholars across a variety of disciplines wrestle with questions related to science in the judicial system.[4]

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1. Black's Law Dictionary defines "forensic evidence" as "[c]vidence used in court; esp., evidence arrived at by scientific or technical means, such as ballistic or medical evidence." BLACK'S LAW DICTIONARY 597 (8th cd. 2004). This Article uses "forensic evidcnce," "scientific evidence," and "forensic science" interchangeably to refer to evidence derived from the application of scientific or technical knowledge.

2. *See, e.g.*, Jennifer Frey, *On Crime-Scene Shows, the Science is Arresting*, WASH. POST, Sept. 19, 2004, at N01 ("[S]cience is hip. Science is popular. Science grabs ratings.").

3. MIRJAN R. DAMAŠKA, EVIDENCE LAW ADRIFT 143 (1997).

4. In particular, much attention has focused upon the increasing use of empirical evidence to help formulate legal policy. *See, e.g.*, Tracey L. Meares & Bernard E. Harcourt, *Foreword: Transparent Adjudication and Social Science Research in Constitutional Criminal Procedure*, 90 J. CRIM. L. & CRIMINOLOGY 733, 735 (2000) ("We are calling for a mode of judicial decision-making and academic debate that treats social scientific and empirical assessment as a crucial element in constitutional decision-making, thereby making criminal procedure decisions more transparent."); David L. Faigman, *To Have and Have Not: Assessing the Value of Social Science to the Law as Science and Policy*, 38 EMORY L.J. 1005 (1989). On efforts

Of course, traditional forensic evidence, such as handwriting, firearms, bullet, bite, toolmark and fingerprint identification, has long played a role in the criminal justice system. But currently on the horizon are a new generation of forensic sciences capable of uncovering and inculpating criminal offenders at an order of magnitude greater than that afforded by traditional forensic techniques. This array of exciting new methods—such as DNA typing,[5] data mining,[6] location tracking,[7] and biometric technologies[8]—represents a marked advance over the rudimentary techniques of old, and will surely stake a central and indispensable role in the future administration of criminal justice.

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to mollify the "battle of experts" so often waged in civil court, *see, e.g.*, Samuel R. Gross, *Expert Evidence*, 1991 WIS. L. REV. 1113, 1208 (1991) (proposing reforms designed to improve quality of expert evidence).

5. By the phrase "DNA typing" I mean to include both nuclear DNA analysis, which typically examines thirteen locations on the genomic strand for repeating sequences of DNA, as well as mitochondrial DNA typing, which typically sequences two specific regions of the mtDNA strand. *See, e.g.*, Holmes v. South Carolina, 126 S. Ct. 1727 (2006) (vacating conviction where state held inadmissible evidence of a third party perpetrator because DNA evidence suggested defendant's guilt).

6. "Data mining" typically refers to pattern analysis of large quantities of data, and is perhaps better described as a technique or technology rather than a "science." By way of example, the government may check phone records to isolate individuals who frequently call certain foreign countries, and then cross-check those names against flight registry lists. I also use this term to include more generally the analysis of computer database-generated records.

7. A range of location tracking devices are currently in use, including satellite-based Global Positioning System monitoring (through cell phones or electronic bracelets), radio-frequency identification (RFID) tags, or cell-site triangulation (using cell phone signals to approximate location). *See, e.g.*, United States v. Forest, 355 F.3d 942, 948 (6th Cir. 2004) (approving cell phone site tracking); People v. Ricafort, No. A101531, 2004 Cal. App. Unpub. LEXIS 2500 at *9-10 (Cal. Ct. App. Mar. 18, 2004) (using FasTrak records to document defendant's travel to site of arson on morning of offense); David A. Lieb, *States Seeking to Track Cell Phones for Traffic Conditions*, ASSOCIATED PRESS, Oct. 8, 2005 (detailing pilot programs to track drivers through their cell phones).

8. "Biometric technologies" here refers to techniques that rely upon computer-generated matches between observed biological characteristics, either between two samples or between a sample and a stored image in a database. Fingerprinting is, in this respect, a venerated "biometric technology" that, with the advent of databases, has now gone online. Newer forms include facial recognition or iris pattern analyses that compare digitized images to determine the likelihood of identity. *See, e.g.*, *Chambers v. Commonwealth*, No. 2005-CA-000815-MR, 2006 WL 1451566 (Ky. Ct. App. May 26, 2006) (unpublished opinion) (noting that the defendant, who gave a false name on arrest, was identified through an iris scan at the jail); *Facial ID Technology Makes Gains in Florida*, ORGANIZED CRIME DIG., May 4, 2005 (reporting that use of technology has led to forty-five arrests since implementation nine months earlier); Arthur Kane, *Facial Scanning Targets ID Theft*, DENV. POST, Jan. 2, 2005 (describing use of biometrics, including facial recognition as a means of detecting fraudulent identity card applications); Spencer S. Hsu, *D.C. Forms Network of Surveillance*, WASH. POST, Feb. 17, 2002, at C1 (describing use of such software during demonstrations, football games, and other large public events); Stephen Thompson, *Facing Security*, TAMPA TRIB., Feb. 9, 2002, at 1 (describing implementation of facial recognition software at Tampa area airport). I would also include under this heading the use of cameras to record images that are then matched to stored biometric profiles—for instance, a camera in a government building that does not simply record events, but also aims to compare recorded images against images of suspicious persons that are contained in a database.

Many of these new, more reliable methods have already acquired a measure of fame by exposing both the unreliability of traditional techniques as well as with the attendant failure of the criminal justice system to keep out such illegitimate evidence. Accordingly, it is easy to assume that the qualities that make the new methods so trustworthy and desirable will likewise render them less susceptible to, if not wholly immune from, the problems that plague traditional sciences. Some critics of traditional sciences have even touted certain new methodologies as emblematic of a "new scientific paradigm" for forensic evidence, one in which "untested assumptions and semi-informed guesswork [is] replaced by a sound scientific foundation and justifiable protocols."[9]

Yet the experiences of traditional forensic sciences in the criminal justice system caution against embracing these new techniques without any hesitation. In recent years, empirical studies and select trial courts have called into question the legitimacy of evidentiary stalwarts like handwriting,[10] voice exemplars,[11] hair and fiber,[12] bite and tool marks,[13] and even fingerprints.[14] Exoneration studies have demonstrated the shocking degree to which the criminal justice system has historically failed to prevent the government from deploying spurious sciences and faulty or fraudulent evidence to aid in the conviction of innocent defendants. For example, one study found that defective scientific evidence contributed to over one-half of wrongfully obtained convictions.[15]

It stands to reason that a system that failed to stem the abuse of untested or faulty forms of forensic evidence might also be ill-equipped to safeguard the

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9. Michael J. Saks & Jonathan J. Koehler, *The Coming Paradigm Shift in Forensic Identification Science*, 309 SCIENCE 892, Aug. 5, 2005.

10. *See, e.g.*, Michael J. Saks, *Merlin and Solomon: Lessons from the Law's Formative Encounters with Forensic Identification Science*, 49 HASTINGS L.J. 1069, 1097 (1998) [hereinafter Saks, *Merlin and Solomon*] ("After standing unquestioned for most of this century, a re-evaluation of handwriting identification expertise has resulted from the Supreme Court's decision in *Daubert*.").

11. *See, e.g.*, Erica Beecher-Monas, *Blinded By Science: How Judges Avoid the Science in Scientific Evidence*, 71 TEMP. L. REV. 55, 97 (1998) ("Voice identification also has failed the scientifically valid prong of *Daubert*.").

12. *See, e.g., id.* at 86-87 (describing trial court's rejection of hair evidence for failure to meet standards of validation, despite recognition of "long history of admissibility").

13. ANNOTATED SCIENTIFIC EVIDENCE REFERENCE MANUAL § 1-3.5.1[2] (Michael J. Saks et al. eds., 2004) [hereinafter ANNOTATED SCIENTIFIC] (identifying "scores of forensic techniques," including bite mark testing that "might not survive empirical test").

14. *See, e.g.*, Jennifer L. Mnookin, *Fingerprint Evidence in an Age of DNA Profiling*, 67 BROOK. L. REV. 13, 39-43 (2001) (detailing the uncritical acceptance of fingerprint evidence and chronicling subsequent challenges to the underlying validity of the technique).

15. Michael J. Saks, *Scientific Evidence and the Ethical Obligations of Attorneys*, 49 CLEV. ST. L. REV. 421, 424 (2001) (citing statistics from the Innocence Project indicating that unintentional, as opposed to fraudulent, forensic science errors play a factor in 63% of wrongful conviction cases); *see also id.* at 424 (observing that one-fourth of the cases involved fraudulent forensic science errors).

use of more robust, complicated forms of such evidence, both in terms of assuring its integrity and fostering healthy scientific development. In fact, as this Article argues, the very traits that make this new generation of forensic evidence so promising serve to raise concerns about the use of such evidence in the future. The series of scandals that have already besieged DNA typing, arguably the most sophisticated technique of the second generation, underscore the urgency of this claim.[16]

Accordingly, this Article sets forth three challenges to customary forensic evidence in the criminal justice system. First, in contrast to the notion that all forensic sciences share the same essential traits but simply range on a continuum from less to more reliable, this Article draws clear categorical lines between first-generation and second-generation forensic techniques.

Second, this Article looks to the historical experiences of first-generation forensic sciences in the criminal justice system to anticipate the future of second-generation evidence. Contrary to conventional wisdom, which roundly endorses second-generation techniques as superior to their much-discredited predecessors, this Article argues that the very characteristics that instill such confidence in the second generation—their technical complexity, reliance on databasing, and breadth of application—in fact aggravate the conditions that ultimately caused widespread failures in the first generation. Thus, the second generation will face the same concerns about integrity and quality control that permeate the first generation.

Third, this Article examines the proposals typically advanced to improve the use of forensic evidence in the criminal justice system, and asserts that these approaches fail to account for the particular demands of the second generation. This Article contends that our current models of criminal justice, even operating at optimal and idyllic levels, cannot adequately safeguard the widespread use of technically sophisticated, highly probative evidence. Thus, in this age of powerful and pervasive new forensic technologies, the criminal justice system must reckon anew with how it accommodates scientific evidence. This Article therefore proposes measures specifically responsive to the concerns raised by second-generation evidence.

Part I defines the two generations of forensic evidence, and illustrates the particular characteristics of second-generation sciences using the most developed technique: DNA typing. Part II identifies the two "fronts" on which the battle for quality assurance is waged and lost with respect to all forensic evidence: the government laboratory and the courtroom. This Part then demonstrates why the stakes are particularly high and the challenges particularly acute for the methods of the second generation. Part III acknowledges conventional proposals to improve the criminal justice system's

16. *See infra* notes 149-156.

processing of forensic evidence and notes how they fail to address the distinct characteristics of the second generation. This Part then sketches solutions tailored to those concerns.

## I
## A NEW TAXONOMY OF FORENSIC EVIDENCE

### *A. Defining the First and Second Generations*

The list of traditional forensic sciences is long and familiar: it includes analysis of bite and tool marks, hair and fiber, ballistics, handwriting, voice exemplars, and fingerprints. But although these techniques have long appeared in criminal cases, they have arisen only in an occasional and sporadic fashion, and usually in a supporting role to other forms of evidence like eyewitness testimony or the defendant's own confession.[17] For a myriad of reasons, none of these first-generation methods ever occupied the full field of criminal adjudication.

First, traditional forensic techniques have limited application. They typically fit discrete categories of offenses. For example, handwriting analysis can only aid those types of cases in which a writing is at issue, and ballistics only those cases involving the discharge of a firearm. And then, even within those narrow categories of case type, only a fraction of cases will actually produce forensic evidence. Ballistic evidence requires that bullets actually be recovered; hair or fiber evidence, even if present, may be easily lost or overlooked.[18] In short, the range of potential cases amenable to first-generation evidence, both in theory and in practice, remains quite limited.

Second, first-generation techniques are experiential and observational, rather than technical or experimental.[19] They are neither conceptually complicated nor scientifically rigorous. Indeed, most of those who analyze such evidence have no advanced degree of any kind.[20] And because first-generation

17. TERRENCE F. KIELY, FORENSIC EVIDENCE: SCIENCE AND THE CRIMINAL LAW 56 (2006) (reporting that forensic science "along with other evidence, is used circumstantially" to reconstruct the events surrounding the crime).

18. *See id.* at 136 (noting difficulty of "[e]fficient and correct fiber recovery").

19. *Id.* at 180 (acknowledging that "most of the forensic sciences are observational disciplines supported by modern microscopy," and that "a majority of the forensic sciences do not rest upon any core scientific or mathematical principles").

20. Craig M. Cooley, *Reforming the Forensic Science Community to Avert the Ultimate Injustice*, 15 STAN. L. & POL'Y REV. 381, 425-26 & n.271 (2004) (noting lack of doctoral programs in criminalistics or forensic science in the United States, and only two in the world); Brendan Koerner, *Under the Microscope*, LEGAL AFFAIRS, July/Aug. 2002 ("An increasing number of forensic scientists hold graduate degrees in chemistry or molecular biology, and rigorous interdisciplinary programs are cropping up at colleges; the University of West Virginia recently offered the nation's first-ever four-year degree in biometrics, the science of identifying humans by unique physical traits like iris patterns and hand geometry. These students, however, typically specialize in newer techniques like DNA testing. Traditional forensics is still dominated

techniques are intuitive, laypeople can readily comprehend most of their results: most people can quickly grasp the notion of matching fingerprint ridges, handwriting slants, or bullet grooves.[21]

Third, and relatedly, first-generation techniques are mechanically unsophisticated. They do not employ complex interpretive machinery or instrumentation,[22] and rarely raise questions concerning the protection of proprietary information. In fact, most techniques never endured any rigorous validation testing or study, and so there exists little "science" worth protecting.[23] For instance, hair and fiber analysis needs little more than a microscope and basic chemicals, and handwriting analysis requires virtually no equipment. First generation techniques are also more amenable to defense-side testing and the cultivation of local expertise, given that critical analysis of the technique requires little instrumentation and minimal training.

Fourth, first-generation techniques are reactive and self-contained in their investigative scope. The analysis of hair, handwriting, fiber, bullets, firearms, voiceprints and so on all require that the police identify a "suspect" for comparison—whether in the form of an individual person or inanimate object. For instance, ballistics and firearm identification calls for the recovery of a bullet and the identification of a suspected weapon. Likewise, handwriting or hair analysis works only after isolating a potential suspect or match. First-generation forensic sciences lack the capacity to identify a suspect in the first instance; they instead operate mainly to confirm the defendant's connection to a crime after other evidence has already identified him as the perpetrator.[24]

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by ex-cops and examiners 'educated at the school of hard knocks.'").

21. *See, e.g.*, David L. Faigman, *The Tipping Point in the Law's Use of Science: The Epidemic of Scientific Sophistication that Began with DNA Profiling and Toxic Torts*, 67 BROOK. L. REV. 111, 117 (2001) (noting ballistics and fingerprinting analysis both result in matching characteristics that are visible); Mnookin, *supra* note 14, at 32-33 (identifying the "cultural plausibility" of fingerprinting science as a contributing factor to its uneritical acceptance); *Developments in the Law—Confronting the New Challenges of Scientific Evidence*, 108 HARV. L. REV. 1481, 1503 (1995) (chiding judges for applying a "show-and-tell" principle of admissibility, whereby a court admits scientific evidence that is intuitively visually comprehensible, such as fingerprint or handwriting, but excludes that which requires interpretation, such as polygraph).

22. KIELY, *supra* note 17, at 6 (noting that "the great number of the traditionally employed forensic sciences are, in effect, based on and centered in close observation, aided by modern microscopy...."); *id.* at 180 (remarking that "a majority of the forensic sciences do not rest upon any core scientific or mathematical principles").

23. *See, e.g.*, Paul C. Giannelli, *Forensic Science*, 34 J. L. MED. & ETHICS 310, 311 (2006) (noting "lack of empirical support" for traditional techniques).

24. In this respect, some technologies, both new and old, bridge the first- and second-generation sciences. Old standards like voiceprints or neutron activation analysis, and new techniques such as fMRI imaging or digital cameras, embody some of the characteristics of first-generation sciences and some of the second generation. Fingerprinting might be viewed, in some respects, as an illustrative bridge technology between the first and second generation. Fingerprinting has historically shared the characteristics of the first generation: it was available in a limited number of cases, had little investigative capacity, and was based on very little scientific validation. However, increased attention on validating the methodological underpinnings of

Fifth, and finally, because first-generation techniques are capable of supplying only a narrow slice of information, they typically do not implicate greater questions of personal privacy. That is, to the extent that these techniques reveal any information, it tends to be limited to the facts and circumstances of the case or suspect at hand. Although efforts were once made to draw conclusions about race, ethnicity, or mental state from studies of fingerprints or handwriting, these endeavors have now been largely discredited.[25] Generally speaking, first-generation forensic sciences such as handwriting, fingerprinting, ballistics, bite or tool mark, and fiber analysis do not reveal information about mental or physical health, biological or demographic characteristics, family relationships, or other intimate information.

In contrast, second-generation techniques, like DNA typing, data mining, location tracking (such as cell site, GPS or RFID tracking), and biometric scanning (such as iris or facial recognition), share characteristics that starkly differentiate them from the first generation.

First, second-generation techniques apply to a wide variety of offense types as well as to a large number of cases within those types. For example, DNA typing not only can generate evidence relevant to crimes ranging from the pettiest theft to the most gruesome murder, but it also can do so in a greater percentage of such cases than could its first-generation counterpart, fingerprinting.[26] As other second-generation technologies like location tracking, data mining, or biometric scanning become more sophisticated, then it is likely that they will also become more prevalent. It is easy to imagine a

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fingerprinting techniques has pushed it toward the second-generation category. More importantly, fingerprinting formally entered the second generation with the advent of the Automated Fingerprint Identification System (AFIS), which computerized the record keeping and thus allowed for greater use of printing as an investigative tool. Simon A. Cole, *Fingerprint Identification and the Criminal Justice System*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM 74 (David Lazer ed., 2004) (describing AFIS).

25. Early developers of fingerprinting believed that fingerprints could reveal race, ethnicity, heredity, and other biographical data, including potential criminality. SIMON A. COLE, SUSPECT IDENTITIES 103-09 (2002) (reporting, for instance, on claims by one French researcher that prisoners showed certain print characteristics more frequently than the general population). Some handwriting analysts also claim the ability to discern facts about individual personality or emotion by studying handwriting. Andre A. Moenssens, *Handwriting Identification in the Post-*Daubert *World*, 66 UMKC L. REV. 251, 259 (1997) (referring to "graphology," or the study of handwriting to reveal personality traits).

26. LAWRENCE KOBILINSKY, THOMAS F. LIOTTI & JAMEL OESER-SWEAT, DNA: FORENSIC & LEGAL APPLICATIONS 6 (2005). *Compare also, e.g.*, JOHN M. BUTLER, FORENSIC DNA TYPING 34 (2d ed. 2005) (listing various sources of DNA), *with* Cole, *Fingerprint Identification and the Criminal Justice System*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM, *supra* note 24, at 73 (outlining limitations of fingerprinting as a forensic technique). In some respects, second-generation techniques can render first-generation methods irrelevant: for instance, where there is a fingerprint or hair evidence or a handwriting sample, there is often sufficient genetic material to conduct DNA typing.

future in which evidence culled from cell phones, computers, "EZ Pass" cards, and smart identification cards becomes more ubiquitous,[27] or in which images from a security camera linked to a database facial recognition system are used to convict a host of offenders across a broad spectrum of crimes.[28]

Second, the second-generation techniques differ from their first-generation counterparts in their scientific robustness. Building and applying the methodologies of DNA typing, biometric scanning, or location monitoring requires highly specialized knowledge and expertise. As a result, second-generation techniques are intuitively inaccessible to laypersons, even while the results of such methods are typically viewed as highly reliable. The underlying rigor of second-generation sciences also supports stronger claims of their probative value than that offered by first-generation techniques; some second-generation methods purport even to provide proof to a degree of scientific certainty. In short, unlike first-generation methods that largely rely upon intuitive methods that lead to findings of general inclusion, second-generation sciences use technically sophisticated methods that provide individuated findings related with the highest levels of confidence.

Third, this methodological sophistication of second-generation techniques is mirrored by a complementary mechanical sophistication. Whereas first-generation sciences relied on tools no more complicated than a magnifying glass or microscope, the tools of the second generation are far more costly, elaborate, and incapable of ready reproduction. For example, DNA typing requires complex machinery, chemical kits, and computer software; location tracking depends upon satellites and cell-towers; biometrics use software and image scanners. Conducting an independent analysis, then, requires a significant capital expenditure.

This mechanical sophistication highlights a related characteristic of the second generation. Namely, because such techniques rest on such a complicated architecture, the disclosure or deployment of the technologies underpinning second-generation techniques may raise concern about proprietary interests. DNA typing has already weathered a series of challenges related to the reluctance of private companies to divulge claimed proprietary secrets, such as the chemical sequences used to conduct the analysis.[29]

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27. *See, e.g.*, Andrew Glazer, *Police Nationwide Train In Analyzing Gang Websites*, ASSOCIATED PRESS, July 10, 2006 (describing use of websites by gang members to communicate information about illegal activities).

28. Of course, counternarratives surrounding such evidence may always be constructed. Jennifer L. Mnookin, *The Image of Truth: Photographic Evidence and the Power of Analogy*, 10 YALE J. L. & HUM. 1, 4, 17-22 (1998) (noting that initial enthusiasm for photography as a tool of perfect truth succumbed to reality that photography can be "a potentially misleading form of proof" that is a "human representation," rather than simply a "direct transcription" of reality).

29. *See, e.g.*, People v. Bokin, No. 168461, slip op. at 15 (Cal. Super. Ct. May 5, 1999) (addressing litigation by defense to obtain data regarding DNA studies against company's claim that data constituted proprietary information that should not be disclosed). Google recently made

Similarly, location tracking or biometric devices rely on technologies developed and protected as intellectual property.

Lastly, and perhaps most importantly, second-generation sciences—unlike their first-generation counterparts—rely upon computerized databases to store large quantities of information. Second-generation techniques are therefore not just reactive, or limited to confirming a known suspect's guilt. Rather, second-generation methods are proactive, and can identify a suspect *ab initio*—and even serve to supply the *only* evidence of guilt. "Cold hits" in the national DNA database have both identified suspects in cases with corroborating evidence, as well as been used to secure conviction on the basis of the genetic information alone.[30] Similarly, location tracking, data mining, or biometric technology may potentially either identify a suspect about whom may be developed additional evidence, or support prosecution on the basis of the scientific evidence alone.

This database-dependency raises a related characteristic that differentiates first from second-generation techniques. Namely, second-generation methods can gravely impact the privacy interests of both suspects and innocent third parties, whereas first-generation techniques typically reveal no information other than that pertaining to the evidentiary question at hand. A handwriting sample or fingerprint reveals little more than that someone might match it. To the contrary, the DNA samples collected by the government contain the individual's entire genetic code—a veritable blueprint of her existence—and even a typed profile has the power to reveal familial associations. Other technologies likewise threaten to compromise privacy interests, such as the government collection and compilation of images for a biometric database, or the investigation of cell site data to reveal either the users of a certain cell tower or the communications undertaken by a particular user. And of course, even assuming the government manages to collect or investigate such material without undermining individual privacy, the adversarial process itself creates a second wave of concern. Once presented with DNA or cell-cite or biometric data, the first logical step for any defense investigator would be to seek access to the DNA, cellular, or biometric database to determine whether the conclusion reached is reliable, and whether it contains any other plausible perpetrators, thereby enhancing the threat to individual privacy.

To illustrate these characteristics of the second generation, and to convey how they will affect the future administration of criminal justice, the next section explores the archetypal second-generation science: DNA typing. This

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the news by contesting a government subpoena aimed at data-mining information from their popular website, claiming that disclosure of such information would "jeopardize its trade secrets." Katie Hafner & Matt Richtel, *Google Resists U.S. Subpoena of Search Data*, N.Y. TIMES, Jan. 20, 2006, at A1.

30. *See infra* note 86.

Article uses DNA typing as an illustrative example largely because it is the most developed of second-generation sciences, and thus offers the most fertile ground to explore the issues that such evidence may raise.

### *B. The Archetypal Second-Generation Science: DNA Typing*

DNA typing debuted as a forensic tool in 1985, when Sir Alec Jeffreys recognized its potential to answer questions of identity central to the resolution of criminal cases.[31] After its birth in the United Kingdom, the technique quickly jumped the pond, and by 1988 it appcared in the United States in the first reported appellate case.[32] Since then, the power of DNA science has dazzled every faction of the criminal justice community, even defense attorneys.[33]

Consider the following investigation, which took place in the United Kingdom: a brick thrown off an overpass hit a truck passing below, killing the driver. Investigators had no leads other than a small quantity of blood found on the brick, which in turn yielded a DNA profile. A search of the nationwide database containing over two million profiles revealed no direct matches. However, a "familial" search of the same database, which looks for profiles that correlate highly to the evidentiary profile, yielded a lead. Investigators followed the lead to a relative of the suspect, and then found the suspect, who later confessed and was convicted.[34] Although the perpetrator's profile was not in the database, his relative's profile, which would approximate his profile at a

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31. Mnookin, *supra* note 14, at 40. DNA typing has also found application in family court cases, where paternity is at issue, and even in civil matters. *See, e.g.*, Alabama Tombigbee Rivers Coalition v. Norton, No. CIV.A.CV-01-S-0194-S, 2002 WL 227032 (N.D. Ala. 2002) (discussing challenge to listing of species on Endangered Species Act that involved DNA testing of contested fish).

32. Andrews v. State, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988).

33. Law enforcement officers approve the ease with which DNA evidence can be collected, processed, stored, and searched. Prosecutors appreciate its appeal to the public at large and the degree to which it is essentially unassailable in court. Judges welcome the scientific rigor with which it was developed and is usually applied. Even defense lawyers have largely embraced DNA technology and sought wider use of DNA testing as a means of exculpating those wrongly suspected or convicted of offenses. *See, e.g.*, KIELY, *supra* note 17, at 6 (reporting "considerable enthusiasm for the power and potential of twenty-first eentury scientific advances . . . such as DNA research"). Bruce Budowle, director of the FBI lab, has observed wryly that "[o]ne attorney . . . had [the] position that thousands of innocent people are in jail because of DNA typing" and "[t]hat same attorney" thinks that "thousands of innocent people are in jail because of no DNA typing." David Lazer, *Introduction: DNA and the Criminal Justice System*, *in* LAZER, *supra* note 24, at 3-4. While Budowle's observations nicely illustrate both sides of the DNA coin, they fail to acknowledge the significant differences between exculpatory DNA typing and inculpatory DNA typing. The power of DNA evidence to exclude a suspect has never been in serious dispute—by analogy, it is easy to determine that a type AB blood sample did not come from an O+ suspect. But it raises far more contestable issues to conelude that a particular O+ suspect is the precise, or even a probable, source of the sample.

34. Matthew Falloon, *DNA Traps Brick Thrower Who Killed Lorry Driver*, THE GUARDIAN (London), Apr. 20, 2004.

much higher frequency than would the profile of an unrelated individual, directed officers to the right person.[35]

As this anecdote illustrates, DNA typing has the potential to transform how law enforcement officers apprehend suspects, how governments bring prosecutions, and how prosecutors secure convictions. And as one of the most developed second-generation sciences, DNA typing provides excellent clues into how the second generation will change criminal justice, and what potential concerns such evidence will raise.

*1. A High Volume of Cases with a Forensic Evidence Component*

Study of DNA typing reveals how second-generation evidence transforms the nature of proof within the criminal system. Because second-generation techniques are methodologically robust and are broadly applicable, cases with a forensic evidence component are likely to displaee cases without such evidence, ultimately resulting in a criminal docket with a large volume of cases involving forensic evidence.

For instance, although DNA typing techniques were both cumbersome and expensive when first conceived, recent scientific advances now allow rapid processing and turnaround at a rate conducive to wide-seale use of DNA evidence.[36] Whereas processing used to take weeks, if not months, with robotics and automation it is expected that analysts will soon be able to process up to 800 samples a day.[37] In the United States, the average turnaround time for a DNA request today is still twenty-three weeks in state laboratories and thirty

35. The FBI has reccntly changcd its own information-sharing policies to permit such familial scarches in the United States' national databasc. *See* Mark Hansen, *Match Point: How a Denver Rape Probe Got the FBI to Change Policy and Release Kinship DNA*, 92 A.B.A.J. 48, Dec. 20, 2006.

36. Automation not only reduces the time associated with processing DNA; it also reduces tbe costs. Although it is difficult to calculate the precise expense of proccssing DNA results, somc estimates exist. For instance, one report labeled the cost of analyzmg a simple, typical rape kit as roughly $1,100. NICHOLAS P. LOVRICH, MICHAEL J. GAFFNEY, TRAVIS C. PRATT & CHARLES L. JOHNSON, NATIONAL FORENSIC DNA STUDY REPORT, U.S. Dep't of Justice Grant 2002-LT-BX-K 003 (2003), at 34, http://www.ncjrs.gov/pdffiles1/nij/grants/203970.pdf [hereinafter NATIONAL REPORT]. This cstiniate includes the costly chemicals or reagents necessary to do the tests, as well as salaries of analysts, but not overhead or equipment. *Id.* Another report listed the cost of an in-house DNA tcst in a criminal case as $568.96, while in-house tcsting of a known offender sample was only $7.58. OFFICE OF STATE BUDGET & MANAGEMENT, NORTH CAROLINA DEPARTMENT OF JUSTICE, COST STUDY OF DNA TESTING AND ANALYSIS 7, Table 4 (2006).

37. Shaila K. Dewan, *As Police Extend Use of DNA, A Smudge Could Catch a Thief*, N.Y. TIMES, May 26, 2004, at A1. DNA testing in the United States is largely conducted in statc or local laboratorics. NATIONAL REPORT, *supra* note 36, at 15 (reporting that 80.1% of law enforcement agencies use a state laboratory to process DNA evidence, 11.7% use a local agency laboratory, and only 2.9% use private laboratories). Currcntly, state laboratories process an average of 1,284 samples a year, whereas the local laboratories process an average of only 771. *Id.* at 28-29.

weeks in local laboratories.[38] By comparison, the national crime laboratory in the United Kingdom, the Forensic Science Service ("FSS"), tolerates only a twenty-four day turnaround time between submission and return of forensic samples.[39] Offender samples—those drawn in ideal conditions from a known single source—typically take the FSS five days.[40] Miniaturization processes will soon enable on-scene analysis of DNA that takes only seconds.[41]

Moreover, advances in collection techniques allow technicians to gather samples less intrusively and from a greater variety of sources than in the past. Nuclear DNA, which is obtained from the nucleus of cells, is found not only in blood but also in hair follicles, skin scrapings, and saliva containing skin cells. Buccal swab kits, which demand no more than a painless scrape of the inside of a suspect's cheek, are increasingly sensitive and render clear, typeable results. Furthermore, whereas in the past forensic scientists often required a significant amount of biological material, scientists can now generate profiles from as few as six cells, a quantity not even visible to the naked eye.[42] Modern techniques allow analysts to take the smallest bit of biological material and duplicate it to create a testable quantity;[43] analysts then examine multiple places, or loci, on a genetic strand at the same time.[44] And harnessing sophisticated processing techniques, analysts increasingly are able to "pull-apart" forensic samples containing mixtures of more than one person's DNA, and ascribe particular genetic profiles to specific individuals.[45] Finally, if nuclear DNA testing cannot be performed because a forensic sample contains degraded or dead cells,

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38. NATIONAL REPORT, *supra* note 36, at 28-29.

39. *Id.*

40. CHRISTOPHER H. ASPLEN, THE APPLICATION OF DNA TECHNOLOGY IN ENGLAND AND WALES, U.S. Dep't of Justice (2003), at 15, http://www.ncjrs.gov/pdffiles1/nij/grants/203971.pdf [hereinafter DNA IN ENGLAND]. FSS processes roughly 30,000 offender samples a month. *Id.*

41. Alec J. Jeffreys, *Genetic Fingerprinting*, 11 NATURE MED. No. 10, Oct. 2005, at 1039.

42. In a pilot program conducted in the United Kingdom in 2000-2001, experienced LCN technicians responded to all stolen vehicle scenes and swabbed for biological evidence. DNA IN ENGLAND, *supra* note 40, at 26. The study showed that experienced technicians were able to recover LCN samples from 51% of the scenes they attended. *Id.* at 27. At present, however, LCN is not typically considered generally accepted for inclusion purposes, because it raises a number of serious sensitivity concerns, although it still has value as a method of exclusion. KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 112-13.

43. The technique of Polymerase Chain Reaction (PCR) allows scientists to amplify genetic material to produce a more readily measurable amount.

44. Multiplexing systems now allow DNA analysts to express the genetic information stored at several loci in one simultaneous process, rather than run separate tests for each locus.

45. For example, Y-STR typing capitalizes upon the chromosomal differences between men and women to amplify only the male fragment of the forensic sample. Such a technique aids investigators in rape cases, which often involve mixed samples from both a female victim and a male perpetrator. *See* KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 113-17. Forensic experts are also seeking ways to deconvolve mixtures of profiles from persons regardless of sex. *See, e.g.*, BUTLER, *supra* note 26, at 525.

mitochondrial DNA typing can often recover genetic information stored in the cell long after the nuclear DNA has decomposed.[46]

Given the ease with which DNA evidence is recovered, and the advances in cost-effective, efficient processing of large quantities of evidentiary samples, it is not hard to envision a future in which DNA testing plays a central role in criminal investigation and adjudication. Today, the public imagination holds that DNA most commonly applies to the prosecution of serious offenses such as rape and murder. However, perhaps counterintuitively, DNA evidence may carry the *least* potential for these types of offenses. After all, rape and homicide cases tend to be amenable to defenses, including self-defense and consent, that render DNA evidence either irrelevant or less dispositive.[47] Instead, DNA evidence may hold the greatest promise in solving low-level crimes like property and possession offenses.[48]

For instance, property offenses presently constitute an enormous volume of criminal complaints and cost billions of dollars annually, but carry very low rates of arrest or "clearance."[49] According to the Department of Justice's Uniform Crime Reporting statistics, there were roughly 10.4 million reports of burglary, general theft, and automobile theft in 2003.[50] Of the estimated 1.2 million motor vehicle thefts, only 13.1% of motor vehicle crimes were cleared;[51] of the roughly 7 million larcenies or thefts, only 18.1% were cleared;[52] and of the 2.2 million burglaries, only 13.1% of burglaries were cleared.[53] In contrast, a much higher percentage of violent offenses are cleared by arrest. In 2003, there were only 1.38 million reported violent crimes—murder, rape, robbery, and aggravated assault[54]—and 46.5% of them were cleared.[55] Thus, although property offenses exact a costly penalty on

46. *See, e.g.*, KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 120-21 (noting that mtDNA is useful in examining hair or "items such as teeth and bone, which are often found to contain degraded nuclear DNA" but "can still produce good results because of the high copy number of mitochondrial sequenees within").

47. Although, one exception may be with respect to child sexual abuses cases. Because there are no consent-based defenses to ehild sexual abuse, the presence of a defendant's genetic material in the body cavity of a child can more or less conclusively prove a case, even without subjecting a child to the trauma of testifying in court.

48. *See, e.g.*, Richard Willing, *DNA Database Used to Help Solve Thefts*, USA TODAY, Oct. 19, 2006, at A1 (describing how in ten states, the "total number of DNA matehes in property-crime cases has exceeded the number of matches in violent crime[] [cases]").

49. In 2003, the Umted States lost seventeen billion dollars from nonarson-related property crimes. Press Release, Federal Bureau of Investigation, FBI Releases Crime Statistics for 2003 (Oct. 25, 2004) (on file with author).

50. BUREAU OF JUSTICE STATISTICS, U.S. DEP'T OF JUSTICE, SOURCEBOOK OF CRIMINAL JUSTICE STATISTICS 130 (2003).

51. *Id.* at 57.

52. *Id.* at 49, 53.

53. *Id.* at 45, 47.

54. *Id.* at 11.

55. *Id.* at 13.

communities, they are rarely closed by arrest or conviction.

However, early data suggest that the availability of DNA evidence can radically transform these numbers. In a typical month, the United Kingdom's FSS makes an association or "hit" between forensic and known samples in their databases in roughly fifteen murder cases, thirty one rape cases, and a whopping 770 motor vehicle, property, and drug offenses.[56] As one study observed, "[f]rom April 1995 to the end of January 2002, the majority of matches were not made in rape, other sexual offenses, or murder. Instead, the largest numbers of matched crimes were commercial and residential burglaries."[57] Local experience bears this out: in Virginia, of the first 2000 hits in no-suspect cases, only 12% were for murder or rape, whereas 59% helped solve property crimes such as burglary or robbery.[58] Moreover, data indicate some correlation between those who commit property offenses and those who commit violent offenses.[59] This correlation will likely serve to increase support for allocating resources to apprehend property offenders.

Beyond property offenses, DNA evidence can also have a significant impact on narcotics- or weapons-based possession offenses, whether simple possession or with intent. Such cases constitute a major volume of crimes charged in the United States. For example, a Department of Justice study from 2000 reports that 40% of state-charged felonies across large urban counties were weapon or drug possession related offenses.[60] The viability of such prosecutions, however, often turns on whether the suspect is apprehended in immediate or visible possession of the contraband;[61] the suspect not in actual

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56. Press Release, Forensie Science Service (UK), Forensic Evidence Proves Crucial to Conviction of Serial Rapist, (Mar. 4, 2004), *available at* http://213.52.171.242/forensic_t/inside/news/list_press_release.php?case=22&y=2004; *see also* Press Release, Forensic Science Service (UK), National DNA Database Hits 2 Million Mark (July 15, 2003), *available at* http://213.52.171.242/forensic_t/inside/news/list_press_release.php?case=20&y=2003. (describing a typical month as yielding results in 15 murders, 31 rapes, and 770 car crimes).

57. DNA IN ENGLAND, *supra* note 40, at 13.

58. *Virginia Lab Records its 2,000th DNA Cold Hit*, PARK NEWS, June 11, 2004 [hereinafter *Virginia Lab*]; *see also* VIRGINIA DEPARTMENT OF CRIMINAL JUSTICE SERVICES, DNA DATABANK STATISTICS, *available at* http://www.dfs.virgmia.gov/statistics/index.cfm (last visited May 14, 2007) [hereinafter VA DNA STATISTICS] (reporting that 2,284 of 3,614 investigations aided by database hits were in breaking and entering, burglary, grand larceny, or robbery offenses, whercas only 992 were for rape, murder, and rape/murder combined).

59. The state of Virginia reports that 39% of the violent crimes linked through "cold hits" were linked to offenders who had only previous convictions for property offenses. VA DNA STATISTICS, *supra* note 58. *But see* Amitai Etzioni, *DNA Tests and Databases in Criminal Justice: Individual Rights and the Common Good*, *in* LAZER, *supra* note 24, at 206 (commenting on the Virginia data and similar data from Florida and England, while noting one journalist's wry observation that "[i]f a large percentage of rapists receive speeding tickets, would that justify expanding the DNA database to include those with moving violations?").

60. U.S. DEP'T OF JUSTICE, BUREAU OF JUSTICE STATISTICS, FELONY DEFENDANTS IN LARGE URBAN COUNTIES iii (2000).

61. *See, e.g.*, Maryland v. Pringle, 540 U.S. 366, 372 (2003) (upholding arrest on probable cause of driver of vehicle in which money and drugs were found secreted in back armrest, noting

possession of the contraband can elude effective prosecution. DNA typing, however, can conclusively link suspects to contraband.[62] There is even a strong indication that suspects possess no "reasonable expectation of privacy" in shed DNA cells,[63] and thus law enforcement can easily gather such probative evidence without worrying about the individual's Fourth Amendment rights.

Consequently, as the costs of deploying DNA decrease, and law enforcement officers' and prosecutors' awareness of such technology increases,[64] greater and greater numbers of such cases are likely to enter the criminal justice system. Indeed, if submitting an evidentiary sample for DNA analysis becomes as casy as it already is to submit a sample for narcotics analysis, then law enforcement officers might be expected to regularly conduct such tests, even in cases involving low-level offenses. The state of New York has plans to open a state-of-the-art DNA testing laboratory intended solely for processing property and other low-level crimes.[65] And already in the United

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it a reasonable inference that all three occupants had dominion and control over contraband).

62. *See, e.g.*, United States v. Winston, 456 F.3d 861 (8th Cir. 2006) (describing DNA testing of items including gun found in toilet tank, drugs and clothing found in backpack); Commonwealth v. Squires, 835 N.E.2d 323 (Mass. App. Ct. 2005) (table) (referencing DNA testing of drug bag); *see also* People v. Elder, No. 248287, 2005 WL 562638, at *5 (Mich. Ct. App. Mar. 10, 2005) (unreported decision) (remarking with regard to ineffectiveness claim that counsel's belief was not unreasonable that evidence against defendant, which included drugs in a jacket with defendant's DNA on it, "was strong and that conviction was likely").

63. *See, e.g.*, People v. Padilla, No. B153331, 2002 WL 31518865 (Cal. Ct. App. Nov. 13, 2002) (finding no violation of defendant's Fourth Amendment rights because defendant had no legitimate expectation of privacy in ejaculated semen provided by girlfriend); Molly McDonough, *Cops Played Lawyer to Get DNA*, A.B.A. J. & REP., Jan. 27, 2006 (describing court proceedings in State v. Athan, No. 75312-1, in which trial court upheld ruse by police, posing as lawyers in fictitious firm, to get defendant's DNA by mailing him a false letter inviting him to join a class action, and then testing the saliva on the envelope upon its return); *see also* Richard Willing, *Police Dupe Suspects into Giving up DNA*, USA TODAY, Sept. 11, 2003, at 3A (describing a range of trickery to obtain DNA samples including posing as "a phony dating service . . . [a] public health worker . . . a rape counselor . . . a Taco Bell worker . . . and a diner"); Elizabeth Joh, *Reclaiming "Abandoned" DNA: The Fourth Amendment and Genetic Privacy*, 100 NW. L. REV. 857 (2006) (reviewing issue of abandoned DNA and related constitutional issues).

64. One study revealed that a major factor in the undcr-utilization of DNA typing and databasing technology is simple lack of education and awareness. When surveyed about reasons for failing to submit evidentiary samples, 31.4% of laboratories reportcd that they did not conduct testing because a suspect had not yet becn identified. NATIONAL REPORT, *supra* note 36, at 22. Yet, in the words of the study, "[c]learly these 'no suspect' cases are exactly the types of crimc scene evidence that need to be submitted in order for the DNA databasc to be effective." *Id.* at 18. In the written comments portion of the survcy, laboratory remarks demonstrated a lamentable lack of awareness of available resources, with multiple observations that a national DNA database is needed. *Id.* at 19. In short, the survey revealed that, far more than concerns about fundmg or backlogs, the major impediment to the investigatory use of databases is simple lack of information about their availability. *Id.* at 22.

65. Dewan, *supra* note 37, at A1; *see, e.g.*, NAT'L INSTITUTE OF JUSTICE, OFFICE OF JUSTICE PROGRAMS, U.S. DEP'T OF JUSTICE, DNA IN 'MINOR' CRIMES YIELD MAJOR BENEFITS IN PUBLIC SAFETY, *available at* http://www.ncjrs.gov/pdffiles1/nij/207203.pdf (Nov. 2004) (reporting that, "[i]n New York, biological evidence from 201 burglaries yielded 86 CODIS-acceptable DNA profiles" and noting success in retrieving evidence from "the sweatband inside a

Kingdom, roughly 50% of DNA evidence sample submissions between 2001 and 2002 were for property or theft crimes,[66] and roughly 17% were for drug offenses.[67]

Of course, more cases submitted for DNA testing may simply mean that: a greater number of total cases. But given the scarcity of resources in the criminal justice system, it is more likely that DNA-based cases will displace non-DNA based cases than it is that the raw number of cases will dramatically increase. Given that prosecutors inevitably must choose only a fraction of cases to pursue from the greater number available, they may develop a bias toward DNA-based evidence in allocating resources.[68] Some have complained that the community demands such evidence, the result of the so-called "CSI effect" evident in jurors exposed to unrealistic crime scene television shows.[69] Thus, prosecutors faced with limited resources will logically prefer those cases in which proof of scientific certainty is readily available to those that rely only on civilian witnesses or law enforcement officers on overtime pay.[70] If so, then the typical prosecutor's docket will likely contain a percentage of DNA-based cases disproportionate to the percentage of such cases in the pool at large.[71] All of

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cap, from the inside of a mask, on a cigarette butt, in chewing gum, on a drinking glass, or from a half-eaten sandwich"); *see also* Richard Willing, *DNA Database Used to Help Solve Thefts*, USA TODAY, Oct. 19, 2006 (reporting that the national DNA database "increasingly is being used to identify suspects in unsolved burglaries and other property crimes" according to a USA Today review of state crime labs).

66. Virginia likewise reports that, as more officers use and appreciate DNA services, the "amount of evidence submitted by law enforcement for DNA analysis grows by 30 percent every year." NATIONAL REPORT, *supra* note 36, at 22.

67. DNA IN ENGLAND, *supra* note 40, at 18.

68. Thus, for example, whereas in the past the government might not have charged a passenger found in a car with a gun in the trunk, because of lack of evidence linking the two, today the government would charge that passenger if the gun had the passenger's DNA on it. To make room for that case, the government might not charge the driver found with a gun under his seat—even though in the past that would be the kind of case upon which it would proceed—due to concern that the lack of DNA evidence renders the case less likely to be successful.

69. *See, e.g.*, Richard Willing, *"CSI Effect" Has Juries Wanting More Evidence*, USA TODAY, Aug. 5, 2004, at 1A.

70. It may also be that "[o]ne consequence of mathematical proof . . . may be to shift the focus away from such elements as volition, knowledge, and intent, and toward such elements as identity and occurrence . . . ." Laurence H. Tribe, *Trial By Mathematics: Precision and Ritual in the Legal Process*, 84 HARV. L. REV. 1329, 1366 (1971). Thus, for example, in the case of widespread availability of DNA evidence, the government might elect to bring cases in which the sole question is one of identity—readily established by the DNA evidence—and dispense with those cases that involve questions of intent. Imagine that a prosecutor can only bring thirty cases due to resource constraints. One hundred cases come in, only forty of which have DNA evidence. The prosecutor may choose to bring a handful of non-DNA cases because of pressing concerns raised by the offense or the victim, but the vast majority of the thirty slots are likely to be allocated to the DNA-based cases, even though DNA cases were a minority of the total possible cases brought. The percentage of cases brought with a DNA element (say, 80%) therefore will not mirror the objective percentage of cases with DNA evidence in the world at large (40%).

71. Of course, the availability of DNA evidence may eventually cause criminals to either take measures to hide their identity or shift to types of crimes in which DNA evidence is less

this leads us to the first lesson about second-generation sciences that can be gleaned from the current experience of DNA typing: their ease of use, breadth of application, and persuasiveness of proof render them likely to appear in a disproportionately high volume and wide spectrum of criminal cases.

*2. An Entirely New Kind of Case: The 'Cold Hit'*

Advances in second-generation sciences do not just encourage the substitution of cases with a forensic evidence component for those without such a component. They also allow for the identification of perpetrators even in the absence of any other evidence. That is, second-generation sciences introduce into the criminal justice system an entirely new kind of case: one in which the only evidence is scientific.

In the case of DNA typing, law enforcement increasingly has at its disposal large databases of genetic information. Specifically, as law enforcement officials collect and process DNA samples, they load "profiles," or results of the genetic testing, into computer databases. These databases contain two types of files: "forensic" samples that contain genetic material collected from crime scenes, and "offender" or "known," single-source samples that contain genetic profiles of offenders or known persons who submitted biological material voluntarily[72] or pursuant to one of many offender-collection statutes.[73]

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readily obtained. However, while possible, such a result seems implausible, at least on a broad scale. First, many crimes are committed in a manner suggesting little foresight, and by those whose thought is clouded from intoxication. Consider, for instance, the ease with which a robber can hide his identity by putting on a mask, yet hardly every robber is masked. Second, unlike fingerprints or facial features, it is hard to avoid leaving a DNA trail, even when steps are taken to do just that. BUTLER, *supra* note 26, at 1-2 (describing a rape case in which defendant had the victim shower to eliminate evidenee, but in which investigators rccovered saliva cells from a beer can and an amount of semen undetectable to the naked eye from the bed). Finally, because DNA technology applies across a wide variety of cases, it may be less amenable to displacement caused by deterrence, because it would require abstaiming from criminality altogether, rather than from a particular crime.

72. In fact, recent concerns have arisen over law enforcement's increasing use of DNA "sweeps" or "dragncts" to collect genetic information. In a "dragnet," law enforcement officers investigating an offense descend on a community and request voluntary submission of DNA samples from the entire eligible population. *See, e.g.*, Pam Belluck, *To Try to Net A Killer, Police Ask a Small Town's Men for DNA*, N.Y. TIMES, Jan. 10, 2005, at A1. Voluntary contributors to such efforts have later balked at the government's continued retention of the genetic sample after the case is closed. Tim Potter & Stan Finger, *Motion Asks: What Happens to DNA?*, WICHITA EAGLE, Mar. 9, 2005 (describimg motion to return DNA sample filed by man who submitted DNA in a "dragnet" related to search for BTK killer); Richard Willing, *Privacy Issues is the Catch for Police DNA Dragnets*, USA TODAY, Sept. 16, 1998; Keith O'Brien, *Men Seek Return of DNA From Serial Killer Search: Some Claim Police Bullied Them for Swabs*, NEW ORLEANS TIMES-PICAYUNE, Dec. 28, 2003.

73. For a comprehensive listing of such statutes, *see* David Lazer & Michelle N. Meyer, *DNA and the Criminal Justice System: Consensus and Debate*, *in* LAZER, *supra* note 24, at 372-73. Unfortunately, the constitutional and statutory limitations on the collection of genetic material,

In the United States, the DNA database is nicknamed CODIS, or the "Combined DNA Index System," and it exists at three levels: local (LDIS), state (SDIS), and national (NDIS).[74] While statutes and regulations governing NDIS circumscribe the information that may be uploaded and require laboratories that load profiles to meet certain proficiency standards,[75] the local and state counterparts often include material obtained under less stringent standards.[76] As of March 2007, the national database, which is maintained by the Federal Bureau of Investigation (FBI) and to which every state contributes, contained over 4.5 million profiles.[77] Of these, 179,763 were forensic samples, and 4.3 million were known or offender profiles.[78] The states are not far behind: Virginia, which is widely recognized as one of the most advanced

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and the proper use of such material, exceed the scope of this article, although scholars and courts have struggled with this very question. *See, e.g.*, United States v. Kincade, 379 F.3d 813 (9th Cir. 2004) (en banc) (upholding statute requiring convicted felons to submit material to DNA database); Nicholas v. Goord, 430 F.3d 652 (2d Cir. 2005) (same); In the Matter of the Welfare of C.T.L., 722 N.W.2d 484 (Minn. Ct. App. 2006) (holding unconstitutional state statute authorizing blanket DNA sampling of charged defendants); Vermont v. Watkins, (Vt. Dist. Ct. App. 24. 2006) (No. 6805-2-04) (invalidating on state constitutional grounds the "suspicionless collection and banking" of DNA samples from all convicted nonviolent felons); *see also* D.H. Kaye & Michael E. Smith, *DNA Identification Databases: Legality, Legitimacy, and the Case for Population-Wide Coverage*, 2003 WISC. L. REV. 413, 415 (advocating for a population-wide database as the most effective means of preserving privacy and social justice interests). Suffice it to say that many interesting questions, ranging from privacy concerns to the scope of the Fourth Amendment and beyond, arise from the collection, storage, and search of an individual's genetic information.

74. *See* 42 U.S.C. §§ 14131 *et seq.* (2006). "CODIS" actually refers to the software used to search for information, but it has emerged as a nickname for the database.

75. For instance, rules govern what constitutes an appropriate "crime scene" or "forensic unknown" sample, and laboratories cannot load into NDIS any profile of fewer than thirteen loci for convicted offender samples and ten loci for forensic unknowns, NATIONAL DNA INDEX SYSTEM (NDIS), NDIS STANDARDS FOR ACCEPTANCE OF DNA DATA, at 7, 9 (Jan. 1, 2000) (outlining protocol for DNA typing and setting forth criteria of acceptance). Laboratories must also comply with quality assurance standards issued by a technical working group affiliated with the FBI. BUTLER, *supra* note 26, at 441 & App. IV (reproducing DNA Advisory Board Quality Assurance Standards).

76. For example, individual states may elect to include profiles extracted in laboratories not qualified to submit material nationally, *see, e.g.*, 502 KY. ADMIN. REGS. 32:010(6), *available at* http://www.lrc.ky.gov/kar/502/032/010.htm (last visited May 14, 2007) (permitting submission of samples from laboratories pursuant to state standards); or to store profiles insufficiently complete to qualify for inclusion in the national database. *See, e.g.*, 515 MASS. CODE REGS. 2.04 (1987) (permitting loading of six loci profiles into state database, and searches based on four loci); N.Y. COMP. CODES R. & REGS. tit. 9, § 6192.3, *available at* http://www.criminaljustice.state.ny.us/legalservices/section6192.htm#3 (last visited May 14, 2007) (setting laboratory testing standards at national level, but allowing profiles to be loaded with only six loci).

77. CODIS Statistics Clickable Map - NDIS Statistics, FBI, *available at* http://www.fbi.gov/hq/lab/codis/clickmap.htm (last visited May 14, 2007). In the United Kingdom, the FSS claims it has effectively loaded the profiles of the entire "criminally active population." HOME OFFICE (UK), FORENSIC SCIENCE AND PATHOLOGY UNIT, DNA EXPANSION PROGRAMME 2000-05: REPORTING ACHIEVEMENT 3 (2005-2006) (reporting achievement in 2004 of goal of obtaining DNA of "criminally active population," estimated at roughly 2.5 million).

78. *Id.*

jurisdictions in dealing with DNA issues,[79] has loaded over 253,986 offender samples[80] and 7,044 forensic samples.[81] As of 2004, California had loaded 274,000 known profiles and 9,300 forensic samples.[82]

The accessibility and expansion of DNA databases have given rise to the "cold hit" case in which the major or only evidence is biological material linking the defendant to the offense. In these cases, the government has no investigatory leads, but develops a genetic profile based upon some material left at the crime scene. The government then runs that forensic profile in a database and uncovers a "match"—a stored sample associated with a known person or offender. As of December 2006, federal investigators had used the national database to make roughly 47,000 "cold hits."[83] And as the databases have grown, the match capacity has skyrocketed: whereas it took Virginia nearly eight years, from 1993 to 2001, to reach its first 1,000 "cold hits," the state reached its second 1,000 in a matter of eighteen months.[84] Since 2001, the laboratory has averaged at least one "cold hit" a day, and as of July 2002, that figure had doubled to two and one half hits a day.[85]

From a cold hit, the government either develops further facts to implicate the suspect, or else brings the case on the basis of this evidence alone. To be sure, in the majority of cases, the government will endeavor to collect additional evidence beyond the forensic proof. For instance, in one case, the government established a "cold hit" and, after identifying a suspect, found two

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79. *See* Tracey Maclin, *Is Obtaining an Arrestee's DNA a Valid Special Needs Search Under the Fourth Amendment? What Should (and Will) the Supreme Court Do?*, 33 J.L. MED. & ETHICS 102, 104 (2005) (detailing history of Virginia collection statutes, which have "led the nation in DNA database expansion").

80. VIRGINIA DEPARTMENT OF CRIMINAL JUSTICE SERVICES, DNA DATABANK STATISTICS, *available at* http://www.dfs.virginia.gov/statistics/index.cfm (last visited May 14, 2007).

81. CODIS Statistics Clickable Map - Virginia Statistics, FBI, *available at* http://www.fbi.gov/hq/lab/codis/va.htm (last visited May 14, 2007). Notably, these numbers do not include databases kept at the state level, which are often more expansive because they need not comply with federal laws in processing or reporting information.

82. Press Release, Attorney General Lockyer Announces More than 1000 Hits Obtained Through Cal-DNA Database (Oct. 27, 2004) (on file with author).

83. CODIS Measuring Success, FBI, *available at* http://www.fbi.gov/hq/lab/codis/success.htm (last visited May 14, 2007). "Cold hits" can be either an offender-to-scene match, meaning a known offender fits an unknown profile recovered at a crime scene, or a scene-to-scene match, meaning that the profile derived from an unknown sample from one crime scene matches an unknown, but identical, sample found at another crime scene.

84. *Virginia Lab*, *supra* note 58; Karin Brulliard, *Va. Gets U.S. Funds for DNA Backlog*, WASH. POST, Sept. 22, 2004, at B01 (reporting that as of July 31, law enforcement in Virginia had found suspects in over 2,000 cases in which there was no evidence—including 1,200 burglaries and robberies—through their DNA database).

85. Brulliard, *supra* note 84; *see also* Amitai Etzioni, *DNA Tests and Databases in Criminal Justice*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM, *supra* note 24, at 200. California likewise reports one cold hit a day. Bureau of Forensic Serv., California Dep't of Attorney Gen'l, *available at* http://caag.state.ca.us/bfs/ (last visited May 14, 2007).

witnesses who claimed to recall the suspect having a cut on his finger the day of the murder that corresponded to a wound inflicted by the victim.[86] But, in some cases, the government may proceed on the sole basis of genetic evidence or marginally probative additional evidence, such as the suspect's proximity to the scene of the offense.[87] In some cases, the offense occurred long before genetic typing was available—sometimes as far back as twenty or thirty years.[88]

Some jurisdictions have even responded to the influx of "cold hit" cases by authorizing "John Doe" warrants intended to circumvent statute of limitations restrictions.[89] Typically, investigators seeking an arrest warrant must specifically identify by name the person that the warrant authorizes law enforcement to arrest. However, where a name is not available, but a genetic profile has been developed, some states permit the issuance of an arrest warrant for a "John Doe" identified only by a particular genetic profile. In such cases, should "Doe" ever be identified (for instance, if Doe's genetic sample is later entered into a database) then the arrest warrant may be executed even though the statute of limitations would have otherwise passed. In Wisconsin, the legislature dispensed entirely with the statute of limitations where the state bases an arrest warrant in a sexual assault case on DNA evidence.[90]

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86. New York State Division of Criminal Justice Services, DNA Case Highlights, *available at* http://criminaljustice.state.ny.us/forensic/dnacasehighlights.htm (describing case of Bryan R. Hawkins in Monroe County).

87. Courts have not reached consensus on the question whether genetic evidence, without more, suffices to support a conviction. *See, e.g.*, Roberson v. State, 16 S.W.3d 156, 170 (Tex. Crim. App. 2000) (observing that "the perils of eyewitness identification testimony far exceed those presented by DNA expert testimony" and affirming that verdict can be based on DNA alone); People v. Rush, 672 N.Y.S.2d 362, 363 (App. Div. 1998) (upholding conviction based only on DNA evidenee, even given that complainant misidentified defendant at trial, and rejecting argument that DNA is not "infallible" and thus cannot stand alone because "[v]irtually no evidence is absolutely conclusive"). In the United Kingdom, the Court of Appeal quashed the conviction of a man found guilty by a jury solely on the basis of genetic evidence indicating that the random match probability of his genetic profile to the evidentiary sample was about one in four million; based on those statistics, the court concluded that he was one in seven to ten males in the United Kingdom with such a profile. Mike Redmayne, *Rationality, Naturalism, and Evidence Law*, 2003 MICH. ST. L. REV. 849, 879-80 (2003) (citing R v. Lashley, an unreported case discussed in Mike Redmayne, *Appeals to Reason*, 65 MOD. L. REV. 19 (2002)). Professor Redmayne noted that the aeeused also had no connection to the area. *Id.* The Supreme Court has previously held that an uncorroborated confession, without more, cannot support a conviction. Smith v. United States, 348 U.S. 147, 152 (1954).

88. *See, e.g.*, David Snyder, *DNA Links Ga. Man to Md. Rapes*, WASH. POST, Apr. 27, 2005, at B5 (describing how a profile entered into the national database by a New York lab turned up "matches" to a string of rapes in the late 1980s in Maryland, as well as two rapes in the New York area in the earlier 1970s).

89. *See, e.g.*, Edward J. Imwinkelreid, *The Relative Priority that Should Be Assigned to Trial Stage DNA Issues*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM, *supra* note 24, at 94-95 (listing states where legislators have proposed John Doe legislation, along with those in which prosecutors have sought such warrants even without express legislative authorization).

90. BUTLER, *supra* note 26, at 446; *see also* Veronica Valdivieso, *DNA Warrants: A*

For several reasons, including the lack of central record keeping, it is difficult to determine the frequency with which the government presently brings cases in which the only evidence is genetic material.[91] First, although laboratories increasingly record their "cold hit" matches, most fail to follow up on the number of cases that actually proceed to prosecution and disposition. Second, of those jurisdictions that have tracked prosecution rates,[92] none appears to track whether or not additional evidence was subsequently adduced in the case. Third, the "cold hit" is still a relatively recent phenomenon, and thus the cases may not have yet wended their way through the courts.[93] Finally, it seems likely that in a great number of DNA cases, the existence of damaging genetic evidence results in a guilty plea, as is the case for the vast majority of criminal cases overall, which precludes appellate challenges and thereby decreases the likelihood of a readily visible judicial trial. In Virginia, for example, an inmate identified on the basis of only a "cold hit" pleaded guilty and accepted the death penalty.[94]

"Cold hit" cases are, however, clearly going forward.[95] The first apparent case, which occurred in the United Kingdom, was a rape case in which the prosecution introduced no evidence other than the genetic information and the fact that the defendant had access to the area of the offense.[96] In Louisiana, a DNA dragnet resulted in the arrest of Derrick Lee Todd in May 2003.[97] In August and October 2004, he was convicted of two separate murders and

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*Panacea for Old, Cold Rape Cases*, 90 GEO. L.J. 1009 (2002) (discussing John Doe warrants).

91. *See* David Lazer & Michelle N. Meyer, *DNA and the Criminal Justice System: Consensus and Debate*, LAZER, *supra* note 24, at 379. Others have observed that "[t]racking database hits and prioritizing case management must become a high priority," as there exists "inadequate data on which to judge the overall effectiveness of DNA data banking programs." Frederick R. Bieber, *Turning Base Hits into Earned Runs: Improving the Effectiveness of Forensic DNA Databank Programs*, 34 J. L. MED. & ETHICS 222, 222 (2006).

92. *See, e.g.*, VA DNA STATISTICS, *supra* note 58.

93. In Virginia, for example, a survey conducted in 2003 of the outcome of the first 1000 cold hits revealed that 100 resulted in convictions through plea or trial, 7 yielded not guilty verdicts, and 53 were never prosecuted; 752 were pending at the time of the survey. VA DNA STATISTICS, *supra* note 58.

94. Frank Green, *Patterson is Executed, DNA Comparison Led to Conviction in Slaying*, RICHMOND TIMES DISPATCH (VA), Mar. 15, 2002, at B1 (reporting on execution of James Earl Patterson).

95. *See, e.g.*, State v. Scarborough, 201 S.W.3d 607, 624-25 (Tenn. 2006); Hartsfield v. State, 200 S.W.2d 813 (Tx. Ct. App. 2006); State v. Hunter, 2006 WL 2790248 (Ohio Ct. App. Sept. 29, 2006); People v. Harrison, 2005 WL 2429974 (N.Y. App. Div. Oct. 4, 2005), *appeal denied*, 843 N.E. 2d 1162 (2005); *see also* David Lazer & Michelle N. Meyer, *DNA and the Criminal Justice System: Consensus and Debate*, LAZER, *supra* note 24, at 379 (reporting that a 2001 study of New York's first 102 cold hits found that four had resulted in convictions and that charges were pending in fourteen others, but there was no data about the remaining cases).

96. Regina v. Adams, [1997] 1 Crim. App. 377 (A.C.).

97. Melinda DeSlatte, *Jury Hears Testimony of DNA Evidence in Derrick Lee Todd Case*, SUN HERALD (So. Miss.), Oct. 5, 2004.

sentenced to death.[98] In Virginia, a murder that occurred in 1992 remained unsolved for years, and investigators had no leads. Four years later, the state required offender Mack Reaves to submit a DNA sample, but backlogs prevented it from being processed until 2001. Once analyzed, the sample was matched to a sample collected in the 1992 case, and Reaves pleaded guilty in 2001 to avoid the death penalty.[99] Clearly, the "cold hit" case has staked a place in the criminal justice system, and it will likely only expand as courts and prosecutors grow increasingly reliant upon, and comfortable with, DNA databases.[100]

Thus, DNA typing offers a lesson about the future of second-generation sciences: unlike its predecessors of the first-generation, this evidence may in many cases be the sole proof of guilt that exists. Yet the present legal framework for handling forensic evidence hews to notions better suited to the first, rather than the second, generation. The law has simply not kept pace with advances in forensic science. The Supreme Court last addressed the constitutional requirements for expert assistance to indigents in 1985, in *Ake v. Oklahoma*, in which the Court recognized only the barest entitlement to expert advice.[101] And the last articulation of the importance of preserving physical evidence in a criminal case came almost twenty years ago in *Arizona v. Youngblood*,[102] in which the Court held that government destruction of physical evidence did not violate the Due Process Clause so long as it was not done in bad faith.[103]

In short, contemporary perspectives on scientific evidence reflect a conception of the role of forensic science in criminal adjudication founded on the characteristics of the first generation. The current view is that forensic evidence is auxiliary, occasional, and nondeterminative. But these antiquated ideas of forensic evidence ignore the emerging reality that second-generation forensic evidence is increasingly central, pervasive, and determinative in

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98. *Id.*

99. Tom Jackman, *Va. Man Receives Life Sentence for '92 Slaying: Va. DNA Database Led Police to Suspect Eight Years After Shopkeeper's Death*, WASH. POST, at B02. In another Virginia case, a man was arrested and charged for a rape that occurred twenty-two years earlier. David Stegon, *DNA Cold Hit Leads to Rape Charge*, MANASSAS JOURNAL MESSENGER, Jan. 11, 2005.

100. Notably, there are presently over 500,000 backlogged evidentiary samples believed to be amenable to testing, in homicide, rape, and property crime offenses. NATIONAL REPORT, *supra* note 36, at 14.

101. Ake v. Oklahoma, 470 U.S. 68 (1985); *see also* Caldwell v. Mississippi, 472 U.S. 320 (1985).

102. 488 U.S. 51 (1988).

103. *Id.* at 57-58. The Supreme Court recently granted a stay of execution, only to then deny certiorari, in a capital case petition filed by Kenneth Starr, the former Solicitor General of the United States, regarding the destruction of DNA evidence. Lovitt v. True, 545 U.S. 1152 (2005) (granting stay), *cert. denied* Lovitt v. True, 126 S. Ct. 400 (2005) (Mem.). The death sentence was later commuted to life without parole by the governor. David Stout, *Clemency Stops an Execution in Virginia*, N.Y. TIMES, Nov. 30, 2005, at A19.

criminal adjudications. Given the role that second-generation technologies are apt to play in the adjudication of criminal cases, a close examination of how the criminal justice system handles forensic evidence is in order.

## II

## THE SINS OF THE FATHER: TWO FRONTS, TWO FAILURES

Can conventional models of criminal process ensure the integrity of second-generation forensic evidence, especially given that such evidence may be the *only* proof in some cases? The answer rests on whether current models of criminal process in fact vouchsafe the production, and subsequent adversarial testing, of second-generation forensic evidence.

This Part examines the two primary sites for evaluating and safeguarding each of these aspects of evidentiary integrity: the scientific process and the judicial process or, in shorthand, the laboratory and the courtroom. To ensure the production of reliable forensic evidence, each site must guarantee that the technique used to interpret the evidence is generally reliable as a method, and that the technique was executed reliably in a particular case.[104] This Part first diagnoses the structural problems impeding accurate appraisal of both of these aspects of reliability as they arose with regard to the first-generation sciences, and then considers whether the characteristics peculiar to the second generation will aggravate or alleviate those concerns.

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104. Laurens Walker & John Monahan, *Social Facts: Scientific Methodology as Legal Precedent*, 76 CALIF. L. REV. 877, 885-87 (1998) [hereinafter Walker & Monahan, Social Facts]. *Daubert* subscribes to the same basic structure, finding "conclusions and methodology" to implicate distinct interests. Daubert v. Merrell Dow Pharms., 509 U.S. 579, 595 (1993) (placing "the focus, of course . . . solely on principles and methodology, not on the conclusions that they generate"). *But see* GE v. Joiner, 522 U.S. 136, 146 (1997) (breaking down distinction and observing that "conclusions and methodology are not entirely distinct from one another"). Professor Michael Saks, examining the criminal law, finds maintenance of the distinction between conclusions and methodology beneficial, and subdivides the inquiry one degree further:

> At the highest level of abstraction are scientific theories, the basic concepts underlying and explaining a field's empirical knowledge. One step down are general applications of the theory, that is, broad applications to the real world of procedures, techniques, relationships, or measures that follow from the theory. At the most concrete level are specific applications of the field's knowledge, tools, and procedures to the case at bar.

Michael J. Saks, *The Aftermath of* Daubert*: An Evolving Jurisprudence of Expert Evidence*, 40 JURIMETRICS J. 229, 233-347 (2000) [hereinafter Saks, *Aftermath*]; *see also* David L. Faigman, Elise Porter & Michael J. Saks, *Check Your Crystal Ball at the Courthouse Door, Please: Exploring the Past, Understanding the Present, and Worrying About the Future of Scientific Evidence*, 15 CARDOZO L. REV. 1799, 1822, 1827 (1994). By illustration, with regard to DNA typing: the "scientific theory" underlying DNA typing is that the cells of human beings contain genetic material that is unique to eaeh individual and capable of evaluation. The "general application" of the theory is that, for example, polymerase chain reaction or capillary electrophoreses effectively express the results of genetic typing. Finally, the "specific application" refers to the effectiveness of executing the technique in a specific case.

### A. The Laboratory

The established method for distinguishing good from bad science is to consider its resilience when challenged. The scientific method, the cornerstone of reliability,[105] asks whether a method is testable and falsifiable.[106] Good science thrives, and evolves, in an open environment.[107] Open debate spurs the development of sound new principles and thwarts the propagation of the bad.[108] Competition inspires scientists to challenge orthodoxy and engage in experimentation. Diversity further subjects theories to rigorous peer review and testing, which in turn ensures that they survive close scrutiny under various conditions. But while all of this may be true of science generally, it has unfortunately never described the field of forensic science.

#### *1. A Diagnosis of the First Generation*

The list of first-generation forensic analysts and laboratories caught up in scandals of one variety or another is both well-documented and long. The worst stories are of methodologies seemingly concocted from thin air, such as the "Cinderella" expert who purported to match foot and shoe impressions based on a method developed by and known only to her.[109] On the other end of the spectrum are techniques such as fingerprinting, which have long been embraced in the absence of any scientific validation even though such validation seems at least possible to attain.[110] But even setting aside the validity of a particularly methodology, the ignominious past of the first generation includes tales of fabrication and improper handling of evidence, falsification of results and reports, rogue or incompetent analyses, and corrupt or misleading testimony.[111]

Why does faulty forensic science occur in laboratories across the country? The most likely answer is that forensic science has never been ordinary science. The techniques of forensic science rarely find analogues in academic or

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105. *See Daubert*, 509 U.S. at 593 ("[S]ubmission to the scrutiny of the scientific community is a component of 'good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected."). Indeed, the *Daubert* Court specifically defined good science as that which is subject to "falsifiability, or refutability, or testability." *Id.* at 593 (quoting K. POPPER, CONJECTURES AND REFUTATIONS: THE GROWTH OF SCIENTIFIC KNOWLEDGE 37 (5th ed. 1989)).

106. *Daubert*, 509 U.S. at 593.

107. *Id.*

108. *Id.* at 596.

109. Paul C. Giannelli, *The Abuse of Scientific Evidence in Criminal Cases: The Need for Independent Crime Laboratories*, 4 VA. J. SOC. POL'Y & L. 439, 458-62 (1997).

110. COLE, *supra* note 24, at 268-74.

111. *See, e.g.*, Giannelli, *supra* note 109, at 442-468 (analyzing a range of "sciences" and associated scandals); Cole, *supra* note 24, at 281 (noting that "the first external proficiency tests on American police fingerprint laboratories" resulted in only 44% of examiners scoring perfectly, while 22% reported false positives; in later tests, the false positive rate ranged from 3% to 15%).

commercial settings. As commentators have observed, "[t]here is virtually no other 'market' for identification tests,"[112] and there "are no industrial uses of what forensic identification scientists do."[113] Thus, the government not only creates forensic science, but also almost exclusively executes forensic procedures.[114] Unlike scientific techniques that emerge from collaborative or competitive environments spanning both public and private realms, almost all forensic science, and almost all forensic scientists, claim common ancestry in the government. "Peer review" in forensic science approximates self-congratulation,[115] and the scientists who "validate" a particular theory or methodology are those who often stand to benefit from its approval.[116]

Thus, rather than finding motivation and regulation in a robust community of peers, the forensic scientist is beholden to the internal demands of police investigators and government attorneys.[117] So long as these clients remain satisfied, the laboratories need not engage in any new development or self-criticism.[118] Rather, crime laboratories primarily engage in applied science, limiting their responsibilities to the mechanical processing of government evidence.[119] Indeed, technicians who hold no more than an undergraduate degree staff many police crime laboratories,[120] and these personnel are often

112. Beecher-Monas, *supra* note 11, at 73; *see also* Saks, *Merlin and Solomon*, *supra* note 10, at 1132 (commenting on "the lack of other institutions (such as academia or industry) where competition or critical evaluation might create incentives for improved knowledge as well as improved technique").

113. Saks, *Merlin and Solomon*, *supra* note 10, at 1092.

114. *See* Giannelli, *supra* note 109, at 470 & n.182 (reporting that 79% of crime laboratories are governed by law enforcement).

115. ANNOTATED SCIENTIFIC, *supra* note 13, § 1-3.5.1[2] (observing that the conceptions of "peer review" and "publication" as centerpieces of scientific validity, as expressed in *Daubert*, are not very rigorous in the forensic disciplines); *cf.* John Monahan & Laurens Walker, *Social Authority: Obtaining, Evaluating, and Establishing Social Science in Law*, 134 U. PA. L. REV. 477, 500 (1986) (characterizing scientific findings made in-house and unpublished as "highly suspect").

116. Faigman, Porter & Saks, *supra* note 104, at 1829; Paul C. Giannelli, *The Supreme Court's "Criminal" Daubert Cases*, 33 SETON HALL L. REV. 1071, 1101 & un.173-74 (2003) (referring to case rejecting toolmark testimony because it lacked true peer review in that "law enforcement technicians" wrote the relevant validating studies).

117. Saks & Koehler, *supra* note 9, at 893 (observing the "cultural difference between normal science and forensic science" and cautioning that "[w]hen individuals who are not steeped in the culture of science work in an adversarial, crime-fighting culture, there is a substantial risk that different set of norms will prevail"); *see also* Saks, *Merlin and Solomon*, *supra* note 10, at 1093 & n.109.

118. One commentator succinctly identifies the eight problems of forensic laboratories as: government monopoly, government budgetary dependence, poor quality control, inappropriate information sharing between the government and technicians, insufficient distinction between the analytical and interpretive function, lack of an adequate number of defense experts, lack of a competitive custom among those experts that exist, and public ownership of laboratories. *See* Roger Koppl, *How to Improve Forensic Science*, 20 EUR. J. L. & ECONS. 255, 257 (2005).

119. *See* Saks, *Merlin and Solomon*, *supra* note 10, at 1092. Of course, lack of resources also contributes to this phenomenon.

120. Kenneth G. Furton, Ya-Li Hsu, and Michael D. Cole, *What Educational Background*

ill-trained to conduct independent research or analysis, even if encouraged by adequate resources or incentives. As a result, forensic science that "grew up in the criminal law" suffers from a case of "arrested development."[121]

The lack of meaningful peer review not only stunts the methodological growth of forensic science, but also enables forensic science to evade the stringent quality control standards imposed on most scientific endeavors. Many forensic laboratories fail to adhere to even basic monitoring standards: they do not engage in validation studies or undertake routine proficiency testing,[122] and those that do tend to shroud their results in secrecy rather than publish them publicly as in other scientifie disciplines.[123] In the oft-quoted words of one renowned scientist, "clinical laboratories must meet higher standards to be allowed to diagnose strep throat than forensic labs must meet to put a defendant on death row."[124] Thus, forensic laboratories rarely catch their own errors, and they face few external incentives, such as rigorous accreditation or monitoring standards, to adopt more exacting practices. Indeed, in a recent study aimed at ascertaining the feasibility of implementing blind proficiency testing in forensic laboratories, researchers' efforts were compromised by "clandestine revelation of the test to the lab by the cooperating law enforcement personnel"—in other words, even when efforts were made to conduct blind testing, the police compromised the test by deliberately revealing to the lab that the sample was a test.[125]

At the same time, structural barriers impede the development of robust "defense-oriented" forensic research and practices. Although defense testing does and can occur, there is generally no centralized market to drive the development of institutional "defense-side" forensic testing or research facilities.[126] Without such institutions, defense attorneys must rely either on the

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*Do Crime Laboratory Directors Require From Applicants*?, 44 J. FOREN. SCI. 128, 129-31 (1999) (reporting findings of survey of crime lab directors that, for all positions combined, 63% required a B.S. and 27% a B.A., and for firearms, document, or fingerprint examiners, 17% of directors required no college-level degree of any kind); *see also* Joseph L. Peterson, Steven Mihajlovic & Joanne L. Bedrosian, *The Capabilities, Uses, and Effects of the Nation's Criminalistics Laboratories*, 30 J. FORENSIC SCI. 10, 18 (1985) (reporting that in 1982, 48% of laboratory personnel held a bachelor's degree, and 17% had not finished college).

121. *See* Saks, *Merlin and Solomon*, *supra* note 10, at 1091-92; *see* Mnookin, *supra* note 14, at 40-43. For example, many commentators have observed that forensic sciences such as fingerprinting readily lend themselves to both validity and proficiency testing, and yet the discipline has wholly failed to conduct full-scale studies in either respect.

122. Saks & Koehler, *supra* note 9, at 894 (noting that "blind tests are practically nonexistent"); *see also* Beecher-Monas, *supra* note 11, at 84.

123. Saks, *Merlin and Solomon*, *supra* note 10, at 1093-94.

124. Eric Lander, *DNA Fingerprinting on Trial*, 339 NATURE 501, 505 (1989).

125. Joseph L. Peterson, et al., *The Feasibility of External Blind DNA Proficiency Testing. II. Experience with Actual Blind Tests*, 48 J. FORENSIC SCI. 32, 38 (Jan. 2003) (reporting that, in one of five labs tested, "police contact person revealed the plans for the blind test to laboratory management").

126. For example, a "defense" testing and research center might do everything from

benevolence of government laboratory analysts,[127] or find independent analysts, who are often simply retired government technicians.

Moreover, to the extent that defense attorneys endeavor to obtain an independent examination, their inquiries or requests for raw data are often met with the hostility and reluctance of an adversary rather than the candor and neutrality of a scientist.[128] In the words of one commentator, "[w]here science advances by open discussion and debate, forensic science has been infected by the litigator's preference for secrecy."[129] Forensic scientists often feel the pressure to produce results that will please their central and even sole client, the government, and to shield their processes from the defense or even the public domain.[130] Thus, defense research is almost nonexistent, and defense testing is piecemeal and sporadic.

*2. The Pathologies of the Second Generation*

At first blush, it might seem that the second generation of forensic sciences would avoid, rather than suffer from, the pathologies outlined above. After all, many second-generation techniques derive from technologies pertinent to the world outside the police precinct, and scientists with expertise in these areas populate not just crime laboratories but also research institutions and private industry. Advances in DNA research fill the news every day, and biometrics, data mining, and location tracking rely upon technologies generated by and used in private industries, which presumably are equally responsive to any legitimate bidder.

But closer examination reveals that the characteristics of second-generation techniques in fact aggravate the problems already extant in first-generation forensic sciences. In fact, an attorney confronted with a second-generation science report—whether claiming that the crime scene sample matched the profile of the client in a database, or that a biometric scan matched the client to the image on the security camera, or that cell phone triangulation

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independently checking and verifying government analysis, to conducting its own analysis of evidence, to undertaking studies aimed at challenging government orthodoxies.

127. However, few government labs will accept testing requests from defendants. One study of 300 crime laboratories concluded that "fifty-seven percent . . . would only examine evidence submitted by law enforcement officials." Giannelli, *supra* note 148, at 1331 (quoting Joseph L. Peterson, Steven Mihajlovic & Joanne L. Bedrosian, *The Capabilities, Uses, and Effects of the Nation's Criminalistics Laboratories*, 30 J. FORENSIC SCI. 10, 13 (1985)).

128. Giannelli, *supra* note 109, at 470, 473; *see also* Giannelli, *supra* note 162, at 117-18.

129. Saks, *Merlin and Solomon*, *supra* note 10, at 1092-93.

130. Saks & Koehler, *supra* note 9, at 893 ("'All [forensic science] experts are tempted, many times in their careers, to report positive results when their inquiries come up inconclusive, or indeed to report a negative report as positive.'") (quoting A.A. Moenssens, 84 J. CRIM. L & CRIMOL. 1, 17 (1993)); Michael Risinger, Michael J. Saks, William Thompson & Robert Rosenthal, *The* Daubert/Kumho *Implications of Observer Effects in Forensic Science: Hidden Problems of Expectation and Suggestion*, 90 CALIF. L. REV. 1, 27-41 (2002) (describing susceptibility of forensic analysts to bias from government influence).

placed the client's cell phone at the crime scene—will be even more ill-equipped to assess the accuracy of such evidence than an attorney confronted with an ordinary handwriting or ballistics report. Why? Three reasons. First, the forensic application of second-generation sciences lack commercial or research analogs, despite the market rohustness of the technology generally; second, they rely on databases and research in the control of the government or industry, which both frustrates independent or adversarial inquiry and heightens legitimate concerns about safeguarding privacy and proprietary information; and third, they demand a degree of technical expertise, financial investment, and mechanical sophistication that inhibits the development of informal and independent advisors. The following Parts will examine each of these three problems in turn.

*a. The Gap between Forensic and Nonforensic Research*

Despite the aura of commercial application that looms around second-generation techniques, the forensic use of such techniques can be readily differentiated from its nonforensic counterpart. First, the forensic application of a general technology varies markedly from its commercial use. For instance, with respect to DNA typing, many research scientists, pharmaceutical companies, and other groups take great interest in genomics-based work, but the geneticist's overall objective typically differs significantly from that of the forensic scientist. Whereas a geneticist generally looks for areas of the genetic strand that regulate human attributes, diseases, or characteristics, the forensic scientist most commonly studies those places at which genetic material has no demonstrable function or purpose (typically, the thirteen established loci).[131] To suggest that the geneticist's broader interest in genomics validates DNA typing for forensic purposes is like suggesting that the widespread market for electricity somehow ensures the proper functioning of an electric chair. Similarly, a biometric technique may be used by private industry to identify known employees in a secured workplace, but that does not mean it is validated for use identifying unknown persons in the first instance.

Second, the mere fact that private industry developed a particular technology, rather than the government alone, does not ensure a greater degrce of openness or methodological soundness. Any company that develops a technology for forensic purposes inevitably allies closely with its primary customer, the government.[132] The reason is clear: once a company develops

131. KOBILINSKY, LIOTTI, & OESER-SWEAT, *supra* note 26, at 104. *But see* Barry Steinhardt, *Privacy and Forensic DNA Data Banks*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM, *supra* note 24, at 173 (rejecting the term "junk DNA" because it may turn out that these loci in fact code for some useful purpose).

132. For instance, Applied BioSystems, which develops technology for DNA typing, and Orchid Cellmark, a lcading private DNA lab, employ the law firm of Smith Alling Lane to promote its interests in government. Chris Asplen, a vice president at the firm, in turn has played a

and markets a revenue-generating forensic product, it strives to protect the product and ensure that it is universally embraced and adopted. Thus an adversary of the government—for example, a defense attorney—is also an adversary of the company.

Moreover, even apart from government allegiance, private companies may have proprietary interests in protecting new technologies, which further discourage permitting open access. For example, forensic scientists typically conduct DNA typing using "kits" and machines developed and sold by private companies.[133] However, these companies vigorously guard the methods and validation studies underlying their technologies as intellectual property,[134] and have successfully resisted disclosing the scientific theories that underpin their techniques.[135]

Similarly, private cell phone companies, email providers, and search engines might be reluctant to reveal how they collect and store data for fear of granting competitors access to such information.[136] Think of the recent controversy surrounding Google's refusal to disclose the search terms users entered into its search engine: the company's primary claim was not privacy, but rather the need to protect its proprietary information.[137] Although Google

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major role in advancing the prevalence of DNA typing. According to the company's website, Mr. Asplen "worked closely with both Attorney Generals [*sic*] Reno and Ashcroft to develop DNA policy for the Department of Justice," has "testified before numerous state and city legislative bodies," and "testified before Congress to help appropriate over $160 million for forensic DNA testing." *See* Gordon, Thomas, Honeywell, Staff, http://www.sal-gov.com/Staff.html#4 (last visited May 14, 2007). With regard to another company, one independent scientist described how, although he purchased DNA-typing analysis software from a private company, the company twice refused to allow him to enroll in their software training course, because he was not government-affiliated. Dr. Simon Ford, Lexigen Science and Law Consultants, Lecture at the Public Defender Service for the District of Columbia (2002).

133. *See, e.g.*, BUTLER, *supra* note 26, at 97 (describing "[t]wo primary vendors for STR kits used by the forensic DNA community" as "Promega Corporation . . . and Applied Biosystems"); *id.* at 359-63 (describing various instruments used to perform capillary electrophoreses and their manufacturers, along with software used to interpret data).

134. *See* BUTLER, *supra* note 26, at 100-01 (comparing Promega corporation, which published its primer sequences, with Applied Biosystems, which "has repeatedly refused to release the primer sequences ... claiming that this information is proprietary"). Applied Biosystems claimed that "they would lose revenue if generic brand products were produced by other entities using the revealed primer information." *Id.* Jennifer N. Mellon, Notes, *Manufacturing Convictions: Why Defendants are Entitled to the Data Underlying Forensic DNA Kits*, 51 DUKE L.J. 1097, 1099 (2001) (reviewing the resistance to discovery exhibited by private DNA kit manufacturing companies and arguing for greater disclosure).

135. *See, e.g.*, State v. Traylor, 656 N.W.2d 885, 900 (Minn. 2003) ("[W]e hold that disclosure of the primer sequences and unlimited access to Perkin-Elmer's validation studies are not necessary for the scientific community to validate the Profiler Plus and Cofiler kits and, therefore, that [the defendant's] due process right to a fair trial has not been violated.").

136. *See, e.g.*, Lynda Hurst, *Bio-security Still a Fantasy*, TORONTO STAR, Jan. 24, 2004, at A1 (noting missteps in development of biotechnology, and reporting that the "proprietary right on the algorithm used in iris scanning is held exclusively" by a New Jersey company that is considering a request to open up the technology).

137. Katie Hafner & Matt Richtel, *Google Refuses to Hand Over Search Data to US*, INT'L

resisted the government's request, the government eventually managed to obtain the same data from three other private search engines without any opposition. However, one can imagine that, if even the government occasionally has difficulty obtaining such information, then defense counsel would be hard-pressed to convince a court to honor a subpoena for similar access in a criminal case.

*b. Access to Databases*

The database dependency of second-generation scienees further renders it unlikely that a complete appraisal of the evidence will be frequently, if ever, undertaken. That is, even assuming that the government or private industry permitted open access to the technologies underpinning a second-generation technology like biometric scanning or DNA typing, the government is apt to retain a tight hold on the databases containing the images or genetic material used for comparison.

For example, DNA typing requires the compilation, storage, and search of large quantities of genetic information. These databases are critical to determining the likelihood of a profile appearing in the population at large and to making "matches" between samples. But nongovernmental scientists infrequently, if ever, can access this data.[138] Statutory protections and rules of discovery protect the government's source materials and raw data in specific cases,[139] and judges rarely require disclosure beyond the materials relevant to the instant dispute.[140] This inevitably inhibits or outright prevents defense

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HERALD TRIB., Jan. 20, 2006.

138. For instance, population geneticists might very well have great interest in research using such data, but at present are foreclosed access. Interview with Dr. Montgomery Slatkin, Professor of Integrative Biology, University of California, Berkeley (Mar. 3, 2006).

139. The rules of discovery often limit the scope of mandatory disclosure to that which is used in the particular case. For example, Federal Criminal Procedure Rule 16 requires the government to provide only a deseription of "the witness's opinions, the bases and reasons for those opinions, and the witness's qualifications." FED. R. CRIM. P. I6(a)(I)(G). Thus, eounsel's requests can fall on deaf ears. *See* Beecher-Monas, *supra* note 11, at 78; Paul C. Giannelli, *Criminal Discovery, Scientific Evidence, and DNA*, 44 VAND. L. REV. 793, 816 (1991) (discussing need for greater discovery of "predicate materials" underlying DNA evidence and concluding that "the rules do not require adequate discovery"); Pat Smith, *Hearings Begin in DNA Discovery Spat*, THE RECORDER (San Francisco), Feb. 2, 2005 (describing hearing in which public defenders sought jurisdiction-wide order allowing broader than case-only discovery). Indeed, the defendant in one case received "greater discovery under the FOIA [Freedom of Information Act] after his trial than he could have received under Rule I6 prior to trial." Giannelli, *supra*, at 816 (referring to *United States v. Stifel*, 594 F. Supp. 1525, 1528, 1531-38 (N.D. Ohio 1984)).

140. *See, e.g.*, William C. Thompson & Simon Ford, *DNA Typing: Acceptance and Weight of the New Genetic Identification Tests*, 75 VA. L. REV. 45, 105 (1989) (citing *People v. Wesley*, 140 Misc.2d 306, 239-30 (Albany County Ct. 1988), and describing defense challenge countered by government's introduction of previously unpublished and undisclosed stndies)); *see also* Saks, *Merlin and Solomon*, *supra* note 10, at 1092-93 (noting that the defendant has little access to thosc few studies generated by government scientists).

attorneys and independent researchers from challenging the validity of the government's conclusions.

The same holds true for other forms of second-generation science, although in some cases a private party, rather than the government, may hold the relevant information. For instance, facial recognition or iris scan techniques depend on government-compiled databases of recorded biometric information, and radio frequency tracking of cell site information or vehicle movements relies on data collected and stored by private companies from particular towers or stations.[141] But here too, independent researchers are unlikely to gain broad access to such data to examine it for unusual patterns, inaccurate record-keeping, or errors in data processing.

Of course, the courts and government have sound privacy reasons to tightly regulate such materials. While a defendant confronted with location tracking data might request access to a database to determine what other persons were in the same area at the same time, the disclosure of such information obviously implicates the privacy interests of such persons. DNA databases can likewise reveal "familial" connections, thereby exposing information about persons not even included within the immediate scope of authorized intrusion.[142] Raw DNA samples have the power to divulge the very essence of personhood: a person's phenotypic characteristics, gender, age, health, and genealogy.[143] Thus, even apart from any statutory laws limiting access,[144] the government is understandably reluctant to open up databanks to any researcher who comes along. If most people shudder to think that their social security number would be known to the world, imagine trying to justify

141. *See, e.g.*, Jim Bronskill, *Passports to Get 'Biometric' Scan*, TORONTO STAR, July 24, 2006, at A4 (reporting complaints with regard to Canada's adoption of biometric technologies for passport security, including that "We don't really know much about how these databases get made and who is programming them").

142. *See, e.g.*, Henry T. Greely, Daniel P. Riordan, Nanibaa' A. Garrison, & Joanna L. Mountain, *Family Ties: The Use of DNA Offender Databases to Catch Offenders' Kin*, 34 J. L. MED. & ETHICS 248 (2006); Frederick H. Bieber, Charles H. Brenner & David Lazer, *Finding Criminals Through DNA of Their Relatives*, 312 SCIENCE 1315-16 (June 2006).

143. Pilar N. Ossorio, *About Face: Forensic Genetic Testing for Race and Visible Traits*, 34 J. L. MED. & ETHICS 277, 278, 283 (2006) (adding that it may also predict an individual's surname).

144. Many states have inadequately defined privacy laws, which seem to leave the door open for some measure of use or study by third parties, or for non-law-enforcement purposes. *See* Steinhardt, *supra* note 131, at 175-80. Yet the breadth of most of these statutes allows law enforcement, or other public officials, to use the database for non-law-enforcement purposes. To the extent that they authorize non-law-enforcement usages, it tends to be limited to "humanitarian purposes" or missing persons identification. Most states lack an organized regime through which defense-oriented research entities (non-law-enforcement and non-public officials) can gain access to government databases. The wide range of vague and confusing statutory requirements leaves unclear the paramcters for a private researcher. *See* Seth Axelrad, *Survey of DNA Database Statutes*, American Society of Law, Socicty & Ethics, *available at* http://www.aslme.org/dna_04/grid/statute_grid.html (last visited May 14, 2007).

the broadcast of their thirteen-loci genetic profile and cell phone movements.

### *c. Technical Complexity, Mechanical Sophistication, and the Dearth of Independent Analysts*

Finally, the technical complexity and mechanical sophistication of second-generation sciences means that broad-based independent research along with case-based verification of government conclusions are unlikely to occur widely. Even assuming open access to all the underlying material, defense lawyers would encounter difficulty in finding an expert qualified to conduct research or review. Whereas the fingerprint or ballistics analyst at the local sheriff's office might retire and start taking defense-side consulting jobs at home, the local second-generation analyst cannot readily do the same. For example, just buying the software necessary to examine the data generated by a DNA lab, without conducting any independent tests of the raw biological sample, requires an expert to make a substantial capital investment. Actually conducting independent research projects or experiments requires access to data and funding far in excess of that typically available to indigent defendants.[145] Similarly, it is difficult to imagine a robust community of experts specializing in checking the accuracy of location data or biometric scanning. It is far easier to imagine that once the government puts the evidence forward, it will be accepted without question as true.

Further examination of the most developed second-generation science, DNA typing, illustrates this dynamic. Independent methodological research is all but nonexistent, and there is only a small community of nongovernment experts.[146] Yet numerous and significant questions remain to be answered with regard to DNA analysis—concerning, for example, how to disentangle

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145. Given that roughly 80% of defendants in the criminal justice system are indigent, *see* William J. Stuntz, *The Uneasy Relationship Between Criminal Procedure and Criminal Justice*, 107 YALE L.J. 1, 28 (1997), there simply does not exist a robust, paying consumer base for consistent and widescale defense work. For instance, one expert reported that he was able to conduct useful, albeit informal, studies regarding DNA transfer only because a wealthy defendant for whom the study might prove beneficial subsidized his work. *See* William C. Thompson, Simon Ford, Travis E. Doom, Michael L. Raymer & Dan E. Krane, *Evaluating Forensic DNA Evidence: Essential Elements of a Competent Defense*, THE CHAMPION, Apr. 2003, at 26.

146. There do exist a handful of individual academics and scientists willing to entertain defense-side consulting work and review government reports with an objective eye, but of course they are still restricted to the data disclosed by the government. Perhaps the most successful such entity is one established in 2002, which consists of an automated analysis service, available at a reasonable price to defense advocates, that provides an independent review of a CD-ROM of the government's raw data. *See* Forensic Bioinformatics, http://bioforensics.com (last visited May 14, 2007). This service provides defense counsel with a thorough report of all of the genetic information recorded during testing, rather than just the government's gloss on the "relevant" information, and highlights possible problem areas. Because this service reviews cases from a wide variety of labs, and a broad array of cases within a lab, it also has produced a data set from which research conclusions may be analyzed, and has a limited potential, if used consistently, to spot recurrent or systemic errors, at least as regards the raw data.

mixtures of genetic samples from more than one person, how commonly or easily genetic material is transferred, or to what extent population substructure affects match probabilities. Yet few nongovernment researchers have the time, resources, interest, or capacity to conduct such inquiries. Similarly, independent testing of evidence in individual cases is not terribly common,[147] and when such tests are performed, it is often by laboratories primarily beholden to government contracts and hostile to defense interests.[148]

This lack of testing does not reflect a justified confidence in DNA evidence. After all, scandals have revealed systemic problems in a number of "flagship" DNA laboratories and horrific tales of false-positive DNA matches.[149] Errors as small and unintentional as an analyst accidentally squeezing a pipette into the wrong tube,[150] or forgetting to change gloves after

147. In fact, in many jurisdictions, a defendant had no right to obtain physical evidence in control of the state for purposes of independent testing. In specific response to the availability of DNA testing, many legislatures have granted to defendants a legal entitlement to testing both pre-trial and post-conviction. *See, e.g.*, D.C. Code § 22-4133 (2006); Helen Dewar & Dan Morgan, *Senate Approves Bill on Victims' Rights: Both Chambers Tackle Busy Agendas*, WASH. POST, Oct. 10, 2004, at A05 (reporting on passage of federal law appropriating funds for defense DNA testing). However, this right to test is second to the government's right: if the government elects to test, and such testing consumes the sample, the defendant typically cannot claim violation of that right. Nevertheless, some courts grant the defendant's request to have a defense expert present during testing that is likely to consume the entire sample.

148. *See, e.g.*, People v. Bokin, No. 168461, slip op. at 15 (Cal. Super. Ct. May 5, 1999) (holding DNA inadmissible because laboratory analyst's bias in favor of prosecution went "beyond advocacy" to indicate outright hostility to defense function); Paul C. Giannelli, Ake v. Oklahoma: *The Right to Expert Assistance in a Post-*Daubert, *Post-DNA World*, 89 CORNELL L. REV. 1305, 1396 (2004) (describing, in the context of DNA analysis, that "[w]hen faced with an ambiguous situation, where the call could go either way, crime lab analysts frequently slant their interpretations in ways that support prosecution theories") [hereinafter Giannelli, *Ake v. Oklahoma*]; *see also* Janet C. Hoeffel, Note, *The Dark Side of DNA Profiling: Unreliable Scientific Evidence Meets the Criminal Defendant*, 42 STAN. L. REV. 465, 499-500 (1990) (describing how "[a]nalyzing biological evidence and testifying about it in court has become an extremely lucrative business" in which the chief aim is to "sell . . . to crime laboratories in the U.S.").

149. William C. Thompson, *Tarnish on the 'Gold Standard': Understanding Recent Problems in Forensic DNA Testing*, THE CHAMPION, Jan./Feb. 2006, at 10-12 (listing scandals); Mnookin, *supra* note 14, at 49-50 (describing case of Raymond Easton, who was arrested and charged after officers linked him through a "cold hit" that matched his DNA at six loci, but released based on testing of additional loci conducted after it was revealed that illness prevented him from having committed the crime); *see also* Maryann Spoto, *Murder, Rape Charges Dropped Due to Botched DNA Evidence*, STAR-LEDGER (Newark), Feb. 7, 2006, at 28 (reporting that cold hit case must be dropped because the analyst who made the match had examined evidence from the old case, along with a new case involving the defendant, on the same day, raising the possibility of cross-contamination); Annie Sweeney & Frank Main, *Botched DNA Report Falsely Implicates Woman; Case Compels State to Change How It Reports Lab Findings*, CHI. SUN-TIMES, Nov. 8, 2004, at 18 (noting that a laboratory forensic profile "matched" woman, based on what ultimately turned out to be only partial match, was revealed erroneous when woman, after arrest on warrant, was shown to be incarcerated at time of offense).

150. Paula McMahon, *Crime Lab Botches Murder Inquiry: Prosecutors Must Drop Charges after DNA Evidence is Contaminated*, SUN-SENTINEL (Ft. Lauderdale, FL), June 24,

an extraction, can compromise critical evidence.[151] In Texas, a scandal currently rages over the Houston crime laboratory. News accounts revealed the laboratory's deplorable physical condition and shoddy practices, which in part resulted in the misplacement of 280 boxes of evidence covering approximately 8,000 criminal cases.[152] In other laboratories, improper handling of evidence has turned up "matches" that appear to result from contamination, rather than actual guilt.[153] Similar problems have emerged in laboratories across the country,[154] including the elite Federal Bureau of Investigation DNA lab,[155] and

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2003, at 1A (announcing dropping of murder and robbery charges due to "someone squeezing the eye-dropper into the wrong vial" and noting disagreement regarding whether government or defense attorney caught error); Keith Paul, *Audit Calls for Changes in Police DNA Lab*, LAS VEGAS SUN, May, 23, 2002, at 1 (reporting results of audit conducted after independently hired defense expert caught forensic lab in mistakenly labeling DNA typing results with name of innocent man).

151. Consider a case that recently arose in Michigan. There, the DNA of a grown man turned up in the testing of evidence related to a thirty-six-year-old murder case. On its face, the evidence appeared reasonable and reliable. But because the man, who was four at the time of the murder, lived one hundred miles away from the scene and would have somehow had to drop blood on the deceased victim for the profile to appear, the evidence raised suspicions. And, in fact, a broader review of the laboratory records revealed that the man's DNA was being tested by the very same laboratory around the same time as the evidence was processed in the old case. Although the analysts insisted that no contamination had occurred, and the age of the man at the time of the offense precluded any argument that he murdered the woman, it is easy to imagine a different outcome had the evidence been from a contemporaneous crime. *See, e.g.*, Teresa Mask, *How Jurors See DNA Evidence May Decide Unsolved Killing: 1969 Slaying Trial Continues Today*, DETROIT FREE PRESS, July 19, 2005.

152. Ralph Blumenthal, *In Texas, Oversight for Crime Labs is Urged*, N.Y. TIMES, Jan. 5, 2005, at A18.

153. Steven Hepker, *DNA Test Results Still a Mystery*, JACKSON CITIZEN PATRIOT, Jan. 19, 2005 (describing thirty-six-year-old murder case in which DNA testing revealed profile of apparent culprit, as well as an utterly unrelated, then four-year-old boy); *see also infra* note 156 (describing the famous Leskie case in Australia, in which genetic testing matched a profile on a murdered child's bib to a clearly unrelated rape victim whose sample had been tested by the same analyst in the preceding weeks).

154. Vic Ryckaert, *Judge Asked to Halt DNA Retests: Crime Lab Less Than Candid About Cases Under Review, Attorney Says*, THE INDIANAPOLIS STAR, Aug. 13, 2003, at 1B (describing fall-out from publication of prosecutor's request that crime lab retest DNA evidence in sixty-four cases believed compromised by analyst); Keith Matheny, *Supervisor Accused of Passing Off DNA Test*, TRAVERSE CITY RECORD-EAGLE, Dec. 19, 2004 (detailing internal investigation of supervisor in Michigan State Police Crime Lab DNA unit that had a subordinate take a proficiency test for him); Glenn Puit, *Police Forensics: DNA Mix-up Prompts Audit at Lab*, LAS VEGAS REVIEW-J., Apr. 19, 2002, at 1B (discussing audit at Las Vegas laboratory after switched names on DNA profiles led to year-long imprisonment of "suspect"); *DNA Testing Mistakes at the State Patrol Crime Labs*, SEATTLE POST-INTELLIGENCER, July 22, 2004 (cataloguing a series of errors ranging from cross-contaminations samples across and within cases, including a vaginal sample with semen of positive control, along with other errors). Not even the private laboratories have proven exempt from such corruption. *See, e.g.*, Rick Orlov, *Lab Used by LAPD Falsified DNA Data*, L.A. DAILY NEWS, Nov. 19, 2004, at N1 (describing dismissal of Sarah Blair from Orchid Cellmark, after allegations that she manipulated DNA data); Jeff Coen & Carlos Sadovi, *Crime Lab Botched DNA Tests, State Says*, CHI. TRIB., Aug. 19, 2005, at C1 (noting that Illinois state police found numerous errors in results reported from Bode Technology, an independent lab based in Virginia).

155. Richard Willing, *Mueller Defends Crime Lab After Questionable DNA Tests*, USA

around the world.[156] As this catalog of scandal and malfeasance reveals, second-generation sciences have not been spared the ignominies of first-generation sciences, and given their technical complexity, mechanical sophistication, database-dependency, and privacy and proprietary concerns, it is unlikely that will change.

### *B. The Courtroom*

Even assuming, however, that forensic evidence lives primarily in the gated community of government science, this lack of scientific scrutiny need not imply a lack of legal scrutiny. Yet as this Part explains, several distinctive characteristics of the criminal justice system cause legal scrutiny of forensic evidence to falter.

In the landmark case of *Daubert v. Merrill Dow Pharmaceuticals*,[157] the Supreme Court announced its regime for assessing scientific evidence, expressing its confidence in "the capabilities of the jury and of the adversary system generally," and in "[v]igorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof," to protect against the introduction of faulty or fraudulent scientific evidence.[158] *Daubert* outlined a four-factor test to determine admissibility: whether a scientific technique successfully withstands testing; whether it has been subjected to peer review and publication; whether it has a known error rate and standards to control its operation; and whether it is generally accepted in a scientific community.[159]

Yet while *Daubert* addressed the legal standards for admissibility of scientific evidence, it did not specify how those standards should operate in

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TODAY, May 1, 2003, at 3A (noting that purported quality control guidelines did not catch technician's failure to run negative controls in 100 DNA cases, caught only when coworker revealed the problem). Questions have also arisen about work done by the Virginia state crime lab, one of the leading laboratories in the country in the DNA field. *See, e.g.*, Maurice Possley, Steve Mills & Flynn McRoberts, *Scandal Touches Even Elite Labs: Flawed Work, Resistance to Scrutiny Seen Across U.S.*, CHI. TRIB., Oct. 21, 2004, at C1.

156. *See Leskie Bib Puts Science in the Dock*, THE AGE, Nov. 22, 2004, *available at* http://www.theage.com.au/articles/2003/11/21/1069027328463.html?from=storyrhs.

157. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579, 596 (1993).

158. *Daubert*, 509 U.S. at 596. *Daubert* replaced the longstanding standard of admissibility in federal courts enunciated in Frye v. United States, 293 F. 1013 (D.C. Cir. 1923). *Daubert*, 509 U.S. at 585-89. In the wake of *Daubert*, which applied only to federal courts, many states, some of which have evidentiary rules modeled on the federal rules of evidence, adopted its standards. *See* David E. Bernstein & Jeffrey D. Jackson, *The* Daubert *Trilogy in the States*, 44 JURIMETRICS J. 351, 355-56 (2004) (observing that by mid-2003, roughly twenty-seven states had adopted a test consistent with *Daubert*); *cf.* Minor v. State, 914 So.2d 372, 400 (Ala. Crim. App. 2004) (noting state's continued adherence to *Frye* doctrine, except as regards DNA evidence, which state law requires to be evaluated pursuant to *Daubert*).

159. *Daubert*, 509 U.S. at 593-94. Some scholars note that *Daubert* actually enumerated five criteria, because the question of error rate is analytically distinct from that of elucidated standards or protocols.

practice. How should courts treat multiple requests to admit scientific evidence, within a single case or across cases, especially if urged by the same party? Must each courtroom entertain challenges to the admissibility of a technique each time it is used, or may a judge properly take judicial notice of findings made in other cases, courtrooms, counties, states, or nations?[160] When should courts consider an admitted technique "scientific law" and thus the proper object of judicial notice,[161] and, conversely, when might new developments justify subjecting existing "scientific law" to renewed scrutiny? Who should bear the burden of putting forth evidence that calls into question the continued reliability of an established methodology? What should be the relevance of a laboratory's error rate, as opposed to a methodology's error rate, in determining a technique's admissibility?

This Part identifies the ways in which the distinctive characteristics of criminal process undermine the proper functioning of this model in the criminal justice system, first by describing the legal structures that surround the admission of first-generation forensic evidence, and then by asking how second-generation evidence will fare within those structures. Specifically, the first Part examines the experience of first-generation techniques and concludes that structural features impede the judicial system's monitoring function with regard to the first generation. Namely, the structural asymmetry of parties to a criminal case, along with the scarcity of resources, weak discovery practices, and high rate of plea bargaining, renders adversarial processes an inadequate safeguard of the integrity of forensic science. Building on this description, the next Part then explains how these shortcomings are especially acute when considered in light of the characteristics peculiar to the second generation.

### *1. A Diagnosis of the First Generation*

Under the current evidentiary regime governing criminal cases, judges approach methodological questions as questions of law and case-specific applications of these methods as questions of fact.[162] Accordingly, when faced

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160. Indeed, the *Daubert* Court seemed expressly to duck the question, noting that "[a]lthough the *Frye* deeision itself foeused exclusively on 'novel' scientific techniques, we do not read the [Federal Rules of Evidence] requirements . . . to apply specially or exelusively to unconventional evidence." *Id.* at 592 n.11. The Court went on to assume that "well-established propositions are less likely to be challenged than those that are novel, and they are more handily defended," and observed that "theories that are so firmly established as to have attained the status of scientific law . . . properly are subjeet to judicial notice." *Id.*

161. *Id.*

162. *See, e.g.*, Saks, *Aftermath*, *supra* note 104, at 232 (noting the "long practice, especially among state supreme courts, which have had considerable experience with expert evidence over the past eentury, of treating deeisions about the admissibility of scientific evidence as a matter of law"); ANNOTATED SCIENTIFIC, *supra* note 13, § 1-3.8 (same). While this is the established system in the criminal law context, it has only recently been extended to the civil law context. Seeking evidentiary rules that balance fluidity (the individual treatment of a case) with stability (consistency and efficiency), Professors John Monahan and Laurens Walker put forth a functional

with forensic methodologies, trial courts "rely in part upon legal memoranda, scientific documents, and precedent—rather than factual hearings with live witnesses—to determine their admissibility."[163] Indeed, trial courts routinely find scientific methodologies reliable *solely* on the basis of judicial notice,[164] and appellate courts have endorsed particular methodologies and techniques based solely upon approval in other jurisdictions or appraisal of relevant literature in the field.[165]

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and textual analysis to argue that methodological questions are more "law-like," whereas questions involving the application of methodologies are more "fact-like." *See* Laurens Walker & John Monahan, *Scientific Authority: The Breast Implant Litigation and Beyond*, 86 VA. L. REV. 801, 802, 819-21 (2000) [hereinafter Walker & Monahan, *Breast Implant Litigation*]; Walker & Monahan, *Social Facts*, *supra* note 104, at 877, 888-90; Laurens Walker & John Monahan, *Social Frameworks: A New Use of Social Science in Law*, 73 VA. L. REV. 559, 559-60 (1987) [hereinafter Walker & Monahan, *Social Frameworks]*; Monahan & Walker, *supra* note 115, at 479. Professors Monahan and Walker initially limited their proposals to the use of social scientific evidence in the civil arena, although they briefly nodded to the use of empirical evidence to establish, for example, community standards of decency in criminal obscenity trials. Walker & Monahan, *Social Facts, supra* note 104, at 880-81. Recently, however, they have advocated the extension of their argument to the hard seiences, as well. Walker & Monahan, *Breast Implant Litigation*, *supra*, at 803 (proposing to "extend our earlier work" by applying their scientific authority model, "which was limited to social science research," to hard science questions resolved by science panels).

163. *See, e.g.*, Hayes v. State, 660 So.2d 257, 262-64 (Fla. 1995) (vacating death sentence founded on unreliable DNA evidence after taking "judicial notice" of the National Research Council's 1992 forensic science report and citing cases in other jurisdictions); Commonwealth v. Crews, 640 A.2d 395, 400 (Pa. 1994) (rejecting defendant's complaint regarding trial court's "reliance on judicial deeision from other jurisdictions to establish the scientific community's general acceptance of DNA testing"); United States v. Porter, 618 A.2d 629, 635 (D.C. 1992) (conducting appellate review of admission of DNA evidence and noting that "[i]n doing so, we may consider not only expert evidence of record, but also judieial opinions in other jurisdictions, as well as pertinent legal and scientific commentaries"). Professor Saks likewise observes that law-like treatment of forensic evidence includes applying de novo review to admissibility decisions, judicial approval of opinions based upon on extrinsic sources, and eategorical deference to binding precedent finding a particular methodology admissible. Saks, *Aftermath*, *supra* note 104, at 232.

164. *See, e.g.*, United States v. Havvard, 117 F. Supp. 2d 848, 854 (S.D. Ind. 2000), *aff'd* 260 F.3d 597 (7th Cir. 2001) (aceepting fingerprint evidence despite lack of scientific testing because they "have been tested for roughly 100 years" by "adversarial proccedings"); People v. Palmer, 145 Cal. Rptr. 466, 472 (Cal. Ct. App. 1978) (approving gunshot residue evidence based upon a scan of literature in field).

165. *See, e.g.*, *Porter*, 618 A.2d at 635 (D.C. 1992); United States v. Beasley, 102 F.3d 1440, 1448 (8th Cir. 1996) ("[W]e believe that the reliability of the PCR method of DNA analysis is sufficiently well established to permit the courts of this circuit to take judicial notice of it in future cases"); People v. Chandler, 536 N.W. 2d 799, 803 (Mich. Ct. App. 1995) ("Courts of this state may continue to take judicial notice of the admissibility of the RFLP method of DNA testing, including the statistieal analysis"); *see also* People v. Riehie, No. B158254, 2005 WL 1340382, *8 (Cal. Ct. App. 2005) (granting appellant's request to take judicial notice on appeal of four more recent scientifie studies in support of position, beeause "we can consider scientific literature outside the record to determine whether a scientific technique is generally accepted"); *cf.* United States v. Iron Cloud, 171 F.3d 587, 591, 593 (8th Cir. 1999) (reversing and remanding for evidentiary hearing on admissibility of scientific methodology, based upon appellate judicial notice of cases calling the methodology into question).

At the same time, and in contrast to this "law-like" status of methodologies, trial courts typically refuse to look at evidence of a laboratory's reliability, or lack thereof, when resolving case-specific questions of admissibility or methodological soundness.[166] Rather, courts treat such attacks in a fact-like manner; the fact-finder considers them through a case-specific lens as relevant only to the "weight" of the evidence. Indeed, some courts refuse even to allow counsel any access to, or argument about, a laboratory's or analyst's errors in other cases, finding such evidence irrelevant to the specific reliability question at hand.[167]

Upon initial analysis, this rubric carries great appeal. Permitting a trial court to adopt previous findings can save on costly and repetitious hearings and promote uniformity among different courts and judges. Moreover, because much robust debate in the scientific community appears in written format in journals or papers, live witnesses are not necessarily essential to communicate a range of perspectives to a court. And allowing a court to determine an admissibility question by looking outside of a factual record adduced by the parties, as a judge might look outside the record to sources of legal authority, diminishes the likelihood that a technique roundly criticized as illegitimate will somehow penetrate a courtroom due to (even strategic) lack of vigorous opposition. After all, it hardly behooves the justice system if, for example, a judge rules astrology reliable and admissible simply because she was bound by

166. *See, e.g.*, United States v. Morrow, 374 F. Supp. 2d 51, 67 (D.D.C. 2005) ("A laboratory's error rate is a measure of its past proficiency and is of little value in determining whether a test has methodological flaws. . . . What the defendant has sought to do here is challenge the proficiency of the tester rather than the reliability of the test. Such challenges go to the weight of the evidenee, not its admissibility.") (internal quotation omitted); State v. Adams, 817 N.E.2d 29, 48 (Ohio 2004), *cert. denied*, 544 U.S. 1040 (2005) (noting "reliability inquiry relates to the validity of the underlying scientific principles, not the correctness of the expert's conclusions"). The Court in *Morrow* identified three possible types of error: "(1) a laboratory's past error rate; (2) the error rate that results if an analyst follows the . . . protocol and uses properly calibrated instruments in the specific case at hand; and (3) the possibilities of human error in the specific case at hand." *Morrow*, 374 F. Supp. 2d at 66-67. Regarding the first type of error—what might be considered the "generally sloppy lab" argument—the Court noted that the past error rate might not be admissible at all because it might be propensity evidence, and if admissible, would be relevant only to the weight of the evidence at hand. The last type of error, the "lab was sloppy in this case" error, would be admissible only as to weight, unless the sloppiness in the case was so grave that it undermined the reliability of the methodology altogether. *Id.* at 68.

167. *See, e.g.*, People v. Funston, No. CO32472, 2002 WL 313198, *4 (Cal. Ct. App. 2002) (unpublished opinion) (finding no error in trial court's exclusion on prejudicial/probative grounds the exclusion of evidence that lab had twice in 277 case reviews made reports that turned out to be "false positives," where trial court reasoned that "the question is one of relevance" and "the fact [that the lab] made errors in the past is not probative" of the issue whether it erred in the instant case); *cf.* Dale A. Nance & Scott B. Morris, *Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence With a Relatively Small Random-Match Probability*, 34 J. LEGAL STUDIES 395, 435 n.61 (2005) (noting question whether error rates constitute inpermissible character evidence, without taking a position, and citing Edward J. Imwinkelried & D. H. Kaye, *DNA Typing: Emerging or Neglected Issues*, 76 Wash. L. Rev. 413, 461-63 (2001)).

the record and no party presented evidence to the contrary.

Conversely, it seems fitting that courts should treat questions about the proper application of an established technique in a fact-like manner—left to adversarial challenge and determination by the fact-finder. After all, error is an inevitable part of scientific testing, and a particular error need not undermine the legitimacy of the method as a whole. The execution of a particular scientific test is arguably well determined by looking only within a record, and only to the evidence judged relevant to the question at hand. Moreover, assigning weight to the evidence in a particular case—taking into account all its flaws, contradictions, or weaknesses—is the fact-finder's very purpose.

But despite the initial appeal of this bifurcated regime, the history of forensic science suggests that it falters when placed in action in the criminal justice context. Rather than streamline the introduction of forensic evidence, the system effectivcly railroads it. In this respect, it is perhaps significant that the Supreme Court expressed its confidence in judicial process in a civil, rather than criminal, case.[168] The problem may rest in the very structure and nature of criminal process.

The prosecutorial function in every jurisdiction is consolidated into a central figurehead. For the federal criminal courts, the office of the Attorney General coordinates the actions of all prosecutors throughout the nation.[169] In cities and states, offices are coordinated on a local or statcwide level. The prosecutor in turn is a repeat institutional player in the system, handling a wide variety of cases in which an issue may arise.[170] Across the nation, then, a forensic technique's proponent in a particular jurisdiction is cssentially a single litigant: the prosecutor.[171] Indeed, given that forensic science is a government-dominated field, even the government's chief proponents of the technology, the

168. In fact, the Court had previously denied certiorari in a criminal case that would have raised the same issue. Paul C. Giannelli, *"Junk Science": The Criminal Cases*, 84 J. CRIM. L. & CRIMINOLOGY 105, 110 & n.33 (1993) (observing that the Supreme Court denied certiorari in a criminal case in which DNA evidence was admitted, United States v. Jakobetz, 955 F.2d 786 (2d Cir.), cert. denied, 506 U.S. 834 (1992)). In the remand of *Daubert*, Judge Kozinski ruefully observed that the Court's newly announced criteria would pose unconsidered problems for forensic evidence. *Daubert*, 43 F.3d at 1317 n.5; Giannelli, *supra*, at 109 ("Despite the highly visible efforts to reform the rules governing experts in the civil arena, the 'junk science' debate has all but ignored criminal prosecutions."). Perhaps wary of this prediction, a bill circulated unsuccessfully in Congress that exempted criminal evidence from the proposed codification of the *Daubert* test. H.R. 988, 104th Cong., 1st Sess. (1995). Nevertheless, empirical evidence suggests that "whereas civil defendants prevail in the *Daubert* challenges, most of the time criminal defendants . . . lose." Peter J. Neufeld, *The (Near) Irrelevance of* Daubert *to Criminal Justice: And Some Suggestions for Reform*, 95 AM. J. PUB. HEALTH, S107, S109 (2005).

169. 28 U.S.C. § 519 (2006).

170. *Cf.* Marc Galanter, *Why the 'Haves' Come Out Ahead: Speculations on the Limits of Social Change*, 9 LAW & SOC'Y REV. 95 (1974).

171. *See Daubert*, 509 U.S. at 592 n.10 (citing Bourjaily v. United States, 483 U.S. 171, 175-76 (1987)). The rules do not specifically place the burden upon the proponent, but that is who it falls to naturally.

scientific witnesses, can become institutional figures.[172]

From this centralized, institutional role, the government is well-positioned to ensure that the courts accept new methodologies.[173] The prosecutor can consolidate resources to present the strongest case possible for admission. She can assign specialized or multiple counsel, work collaboratively with scientists to develop arguments and theories in support of the technique's admission, or decide not to seek admission until conditions are optimal. The prosecutor can actively "forum shop" a new forensic technique by choosing those cases and those courtrooms—indeed, those judges—most likely to be receptive to the proposed technology. A prosecutor eager to see a technology accepted might even choose test cases with reference to which defense lawyers seem least likely to pose a formidable adversary.[174]

At the same time, the very structural dynamics that well equip the prosecutor to argue in support of novel scientific evidence in turn undermine the defense's ability to fight meaningfully against it. Unlike the prosecutorial function, the defense function is typically diffused among paid private practitioners, or localized central offices. In many jurisdictions, defense attorneys are not even repeat players within the criminal justice system, but rather take criminal cases only when required by the courts.[175] This decentralization of the defense function impedes concerted and comprehensive efforts to respond to new forensic techniques at the critical moment when they gain momentum. Coordination of the initial defense response to a new

172. By contrast, in civil cases the perceived problem is the opposite: there is an abundance of experts able and willing to testify to "any" opinion. *See, e.g.*, Gross, *supra* note 4, at 1129-30 ("[E]xpert witnesses are too readily available"); *id.* at 1130 ("Experience has shown that opposite opinions of persons professing to be experts may be obtained to any amount.") (quoting Winans v. New York & Erie R..R., 62 U.S. (21 How.) 88, 101 (1858)).

173. Prosecutors retain wide discretion in almost every aspect of their work, from charging to resource allocation to tactical decisions. *See generally* Robert L. Misner, *Recasting Prosecutorial Discretion*, 86 J. CRIM. L. & CRIMINOLOGY 717, 736-37 (1996) (demonstrating that "unreviewed discretion is the norm" for prosecutors).

174. Indeed, one need not subscribe to a dark view of prosecutors to think they might make such choices; the prosecutor who believes in the integrity of the scientific technique, as such a proponent should, would logically choose a less formidable adversary or atmosphere if for no other reason than to prevent unnecessary expenditure of time and effort.

175. *See* Steven K. Smith & Carol J. DeFrances, *Indigent Defense*, at 2, Bureau of Justice Statistics, Feb. 1996 (describing "ad hoc" appointment system); *see also* Carol J. DeFrances, *State-Funded Indigent Defense Services, 1999*, at 2-3, Bureau of Justice Statistics (Sept. 2001) (commenting that "[t]he decentralized and diverse ways of delivering indigent defense services make collecting information nationwide difficult," and identifying the three primary mechanisms as public defender systems, assigned counsel, and contract appointments). In one study of the twenty-one states that funded 90% or more of their public defense services (as opposed to relying upon federal or local funding), only sixteen states had a state-centralized public defense program; the remaining three states had devolved control to local branches. *Id.* Even within states with centralized programs, at either the local or national level, the central public defender office may not handle all cases. *Id.* at 3 (reporting that nineteen of the twenty-one states also used ad hoc assigned counsel programs, and eleven of the twenty-one states also used contract programs).

government technique therefore occurs, if at all, with much less frequency.[176]

This may be particularly true in the early stages of a technique, when the government has its tightest grip and the only literature about the development or validation of the method is that generated by the government.[177] As a result, the defense attorney may acquire a distorted perspective of a methodology's legitimacy, and even the skeptical defense attorney may encounter a dearth of extrinsic critical analyses.[178] Unarmed with legitimate contrary voices, and often confronted with judicial misperception that the staff of forensic laboratories are neutral "scientists" rather than partisan advocates, the defense is ill-positioned to mount an effective challenge.[179]

In addition, even where coordination among defense attorneys is possible or desirable, the nature of the defense role may preclude it. The defense attorney, unlike the prosecutor, meets forensic evidence reactively: she cannot pick or choose the perfect case or the perfect forum in which to mount an opposition. Furthermore, pragmatic and ethical limitations thwart effective pooling of data. For instance, an attorney would be hard-pressed to advocate a third party's retention and storage of the ballistic evidence in a client's case for the purpose of conducting systematic studies. Nor could an attorney use the findings made in one case to either support or attack the findings in another, without risking a breach of client confidentiality or a conflict of interest.

Moreover, ethical rules bind defense attorneys to the zealous representation of each individual client,[180] which further constrains the defense

176. Indeed, at least preliminary data bears this out. In his study of federal and state court challenges to expert evidence, Professor Risinger observed that "[t]he most striking contrast between the state and federal numbers is the prosecution's higher loss rate in state courts." D. Michael Risinger, *Navigating Expert Reliability: Are Criminal Standards of Certainty Being Left on the Dock?*, 64 ALB. L. REV. 99, 111-12 (2000) (citing the expert win rates of the government in criminal cases as 90% in the federal system, and 75% in state courts). Professor Risinger attributes this differenee in part to the difference in the types of cases brought in state versus federal court. *Id.* However, the greater resources and geographic dispersion of federal prosecutors versus state proseeutors can perhaps also explain the disparity. With more resources and options at their disposal when putting forth scientific evidence, federal prosecutors naturally succeed at a higher rate. To the contrary, at a local or state level, prosecutors have fewer resources and options. Similarly, the defense response is perhaps strongest and best coordinated at the local level.

177. *See supra* Part II.A.

178. *See* Giannelli, Ake v. Oklahoma, *supra* note 148, at 1386 ("There is a special need for outside experts when novel scientific evidence is introduced. Paradoxically, there is often a lack of defense experts in these cases precisely because the procedure is new.").

179. Judges further view the lack of eontroversy in the field as proof that the principle is sound and well-accepted, rather than as possible evidence of "absence of vigorous inquiry, an impoverished research tradition, lack of resources, or stagnation." Saks, *Merlin and Solomon*, *supra* note 10, at 1135 ("In many of the cases we have reviewed, the courts were presented with only one-sided questions regarding the adequacy of a given kind of asserted scientific evidence. Prosecutors typically offered the novel forensic science and defendants typically offered no reply of substance. The courts in these cases often said they were impressed at the 'uncontradicted' expert testimony.").

180. MODEL CODE OF PROF'L RESPONSIBILITY CANON 7 (1969).

attorney's choice of whether to challenge admissibility. Consider a defense attorney presented with a novel scientific technique in a homicide case. That attorney, knowing that ultimately the trial will turn on self-defense rather than identity, might choose to mount a lackluster challenge or no challenge at all when the government tenders the evidence. In such a case, the defense attorney with limited resources would be remiss, both practically and ethically, in wasting precious time and effort carefully opposing the admission of the scientific evidence, even if she knows that her failure to do so will make it harder in a future case to convince the same judge that the very same kind of evidence admitted earlier should now be considered unreliable.[181] It is not hard to conjecture that a defense attorney might accede to fifty cases in which the defendant agrees under oath during a plea colloquy that certain forensic evidence corresponded to him before attempting to argue in a single case going to trial that the same forensic method is entirely untrustworthy and unreliable.

In addition, the efforts the government expends at the early stages of a technique's acceptance reap prolonged rewards, because the decisions in these initial hearings often serve as the foundation for widespread acceptance of the technique. Once a technique takes root, both practical and legal obstacles preclude its easy extirpation. For precisely the reasons Monahan and Walker cite,[182] trial courts typically choose not to undertake lengthy or complicated admissibility hearings, but instead simply adopt the findings of earlier courts and rule the technique admissible. Moreover, a court confronting an admissibility question previously decided understandably feels less compelled to require the prosecutor, perhaps the same prosecutor who previously held a complex hearing in another courtroom or even that same courtroom, to re-enact the earlier hearings. This practice arguably even pays heed to the principles of consistency and equal treatment under the law: when a court deems a technique admissible in one court likewise admissible in another, it treats like litigants alike and avoids the awkwardness of disparate results.[183]

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181. The defense cannot subvert the zealous pursuit of a single client's defense even to the greater good of all defendants generally.

182. *See* Walker & Monahan, *Social Frameworks*, *supra* note 162, at 583-84 (noting that factual treatment of social science evidence, requiring "[t]he same testimony about the same research studies . . . in case after case" is "an inefficient use of court time"); *see also* Saks, *Aftermath*, *supra* note 104, at 233 (criticizing the Supreme Court's decision in *Joiner* in part because "it is inefficient to allow parties to relitigate the same general question over and over"); *cf.* ANNOTATED SCIENTIFIC, *supra* note 13, § 1-3.8 ("Once a higher court determines, on the scientific merits, that a . . . forensic identification technique can do what it purports to do (unless there is a change in the state of scientific knowledge), there is not much sense in allowing the same question to be revisited by the trial courts in case after case.").

183. In contrast, the Supreme Court in *General Elec. Co. v. Joiner*, 522 U.S. 136 (1997), announced that the abuse of discretion standard governed appellate review of trial courts' admissibility decisions. *Id.* at 141-43. In applying this standard, the Court bestowed upon lower courts the deference traditionally reserved for partly factual determinations, even while recognizing the potential for them to reach different decisions with regard to the same evidentiary

Thus, the law-like treatment of scientific methodologies, in effect, reverses the burden of evidentiary admissibility set forth in *Daubert*: rather than ask whether a proponent of scientific evidence has proven the technique's reliability by a preponderance of the evidence, criminal courts presume a technique admissible unless a party demonstrates by some unascertainable standard that other courts erred in admitting it, or that the science has undergone a significant change that warrants revisiting a prior court's findings.[184] Given this shift in the dynamics of admissibility, and combined with the custom of determining admissibility by judicial notice, a technique need only gain a threshold level of approval before the law's impulse toward efficiency and consistency takes hold and a science admissible in enough jurisdictions becomes presumptively admissible in all others.[185]

While considerations of consistency and equal treatment drive courts to support the current regime, prosecutors also have little reason to challenge this prevailing wisdom. Able to rely on the findings in other proceedings, and act only responsively upon challenge, the government has an interest in preserving the status quo. After all, since the law tends to view uncertainty as evidence of falsehood, new theories only call into question the legitimacy of those previously accepted and proven. Questioning an established theory becomes counterproductive; it serves only to provide opposing counsel, or the courts,

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admissibility issues. *Id.* at 142.; *see, e.g.*, Beecher-Monas, *supra* note 11, at 78 & n.153; Saks, *Aftermath*, *supra* note 104, at 233. In this regard, Professor Saks has observed that the abuse of discretion standard of review announced in *Joiner* technically permits one court to uphold the legitimacy of a majority-endorsed technique, while another court finds the minority-endorsed technique legitimate, thereby leaving the public baffled. Saks, *Aftermath*, *supra* note 104, at 234; *see also* Janet C. Hoeffel, *The Sixth Amendment's Lost Clause: Unearthing Compulsory Process*, 2002 WIS. L. REV. 1275, 1324 (2002) ("The second effect of the Daubert trilogy is that lower courts are deciding the same issues differently. A particular expertise or scientific method may be admitted in one court and denied in another.").

184. *See, e.g.*, ANNOTATED SCIENTIFIC, *supra* note 13, § 1-3.8 (agreeing that a higher court revisiting admissibility determinations makes no sense "unless there is a change in the state of scientific knowledge"). *Cf.* United States v. Leon, 468 U.S. 897, 927 (1984) (Blackmun, J., concurring) (agreeing with majority's view of social science evidence introduced in support of outcome, but describing the court's decision as "a provisional one" subject to reconsideration should experience call into question the empirical assumptions upon which the decision rested). Of course, where evidence is excluded, incentives remain high to improve upon the science and try again. *See, e.g.*, Walker & Monahan, *Breast Implant Litigation*, *supra* note 162, at 823 (relating trial court's rejection of plaintiff's scientific evidence, in which court discouraged blind "precedential effect" but rather encouraged revisiting the question "in the event that new and conclusive studies emerge"). Finally, it should be noted that some forensic science admissibility questions are decided by statute, thus obviating this concern altogether. *See* Paul C. Giannelli, *Admissibility of Forensic Science Evidence*, 28 OKLA. CITY U. L. REV. 1, 5 (2003) (describing various forensic techniques, including hypnosis, battered-wife syndrome, DNA, and polygraph evidence that received legislative validation).

185. Unfortunately, "reducing the variability and dynamism across cases severely limits the opportunities for adversarial testing of diverse scientific evidence and experts across cases and over time." David S. Caudill & Richard E. Redding, *Junk Philosophy of Science? The Paradox of Expertise and Interdisciplinarity in Federal Courts*, 57 WASH. & LEE L. REV. 685, 750 (2000).

with the ammunition necessary to defeat the continued admissibility of the technique.[186] As every grandmother knows, "if it ain't broke, don't fix it." Thus, the law-like treatment of forensic methodologies actually discourages government scientists from engaging in further research and development of forensic technique, and subverts the innovation and experimentation that typically characterize scientific development.[187]

Strong incentives discourage lawyers even on the defense side from raising challenges to scientific evidence, both with respect to a technique's methodological legitimacy and to its reliability in a particular case.[188] The very "scientific" nature of forensic evidence bestows an air of reliability that defense attorneys may be loathe to confront.[189] Counsel may simply be unwilling to spend time adducing sufficient arguments that the forensic technique, and the precedential cases endorsing it, are in fact illegitimate.

And, just as it has been argued that elaborate legal regimes encourage defense attorneys to disregard factual inquiries in favor of legal arguments,[190]

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186. *See* Saks, *Merlin and Solomon*, *supra* note 10, at 1131-32 ("Fundamental new discoveries risk raising judicial doubts about all that had gone before, and what the future may reveal about the present. No advances means raising fewer doubts. We have seen examples of forensic identification sciences . . . that have been largely frozen in time, with little if any fundamental progress since their foundational appearances in court."). Similarly, "the law's desire for finality not only impedes the disclosure of available science, but also militates against the open communication and exchange that lead to the production of new scientific knowledge." Sheila Jasanoff, *Transparency in Public Science: Purposes, Reasons, Limits*, 69 J. L. & CONTEMP. PROBS. 21, 40 (2006).

187. Of course, there are some situations in which the government may desire progress or change. For instance, the government might prod scientific inquiry in response to a persuasive attack made by defense lawyers on the basis of a technique's shortcoming, or a court's adverse ruling on admissibility, or the prospect of increasing a technique's forensic capacity.

188. Again, the history of scientific evidence in the criminal justice system, even of the low-tech variety, suggests that the vast majority of counsel do just that. Giannelli, *supra* note 168, at 114-15 (describing "junk science" testimony on future dangerousness and observing that one expert testified up to 127 times without meeting meaningful opposition); Saks, *supra* note 15, at 431 (citing study indicating that "out of 90 state court opinions in which handwriting identification evidence was proffered there was not a single challenge to the admissibility of the forensic handwriting examiners"); *see also* Saks, *Merlin and Solomon*, *supra* note 10, at 1132-33 & n.347 (describing freedom with which forensic scientists usually testify, even to baseless propositions, because there is no academic or commercial community to hold them accountable and lawyers fail to attack). Indeed, studies have shown that the defense calls an expert in only a small percentage of cases. In a survey of appellate court cases decided after *Daubert* over a span of six years, one scholar found only 213 state court challenges to the prosecution's scientific evidence, and eighty such challenges in federal court. Risinger, *supra* note 176, at 125; *see also* Stuntz, *supra* note 145, at 42 (citing study of appointed counsel in New York City, which revealed that the defense used experts in only 17% of homicide cases, and in only 2% of other felony cases).

189. ANNOTATED SCIENTIFIC, *supra* note 13, § 1-3.5.1[2] ("It appears that historically [defense] lawyers brought few challenges to the basic validity of a wide range of techniques routinely relied on by prosecutors. . . . [T]he lawyers mainly assumed that these experts could do what they claimed they did.").

190. Stuntz, *supra* note 145, at 15, 21.

so too might it be observed that the entrenchment of law-like scientific methodologies steer defense attorneys away from scrutinizing the fact-based results of forensic testing carefully. Rather than challenge the evidence, an "overworked, underpaid," court-appointed counsel—who may also lack the time, knowledge, or energy even to screen the case for the reliability of its scientific conclusions[191]—may simply try to incorporate the findings into the theory of the case or,[192] more likely, negotiate a plea bargain.[193] In fact, the more meritorious a prospective defense attack on the evidence's methodology or application may seem, the more likely it is that the government will obviate the attack by offering a plea that cannot be refused.

In this respect, although the adversary model conceives the system as "a dispute between two sides in a position of theoretical equality before a court which must decide on the outcome of the contest,"[194] the reality flatly contradicts this ideal. The adversary in the criminal justice system tends to perform simply a screening function, winnowing out those few cases that will actually make it before a fact-finder for resolution.[195] And even if defense counsel might be able to mount a fruitful attack, resource and role constraints inhibit defense counsel from undertaking it. This administrative, rather than adversarial, character renders the *Daubert* Court's primary safeguard—the advocate and the adversarial process[196]—truly vigilant in only a small fraction of cases.

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191. One scholar remarks that under-litigation in the criminal field "could be the result of a couple of factors," including that "criminal defense lawyers . . . have seen little profit" from such challenges, due to the lack of judicial receptivity. David L. Faigman, *The Law's Scientific Revolution: Reflections and Ruminations on the Law's Use of Experts in Year Seven of the Revolution*, 57 WASH. & LEE L. REV. 661, 661 n.2 (2000). Moreover, "most criminal defense work is conducted by over-worked, underpaid, and under-resourced public defenders," whereas "[c]hallenging forensic science expert testimony is a time-intensive and expensive proposition." *Id.* Thus, "[p]ublic defenders simply might not have the time and money to do it effectively." *Id.*

192. For instance, rather than challenge the DNA recovered in a rape case, counsel might point to the location of recovery (for instance, a stain on the bed versus in the living room) as evidence that the sex was consensual. In the highly publicized O.J. Simpson trial, the defense argued that certain aspects of a blood stain on the socks of the defendant suggested police tampering, rather than exclusively relying upon an argument questioning the DNA typing results. *See* Richard Lempert, *After the DNA Wars: Skirmishing with NRC II*, 37 JURIMETRICS J. 439, 444-46 (1997).

193. *See, e.g.*, Gerald Lynch, *Our Administrative System of Criminal Justice*, 66 FORDHAM L. REV. 2117, 2121 (1998) (noting that "[m]eaningful statistics are elusive" with regard to the rate of plea bargaining, but that "there is no real dispute that . . . the vast majority of cases are disposed of without a formal trial").

194. Mirjan Damaška, *Evidentiary Barriers to Conviction and Two Models of Criminal Procedure: A Comparative Study*, 121 U. PA. L. REV. 506, 563 (1973).

195. Lynch, *supra* note 193.

196. *Daubert*, 509 U.S. at 596.

*2. The Pathologies of the Second Generation*

It might be argued that second-generation scientific techniques alleviate many of the concerns raised in the preceding section. Advocates of DNA typing, for instance, have argued that it provides a new standard by which to judge all forensic science.[197] They suggest that the rigors of DNA science will spare it from the embarrassments that plagued traditional forensic sciences, and even advocate the "DNA paradigm" as a tool for reassessing first-generation techniques.[198]

But even within the short lifetime of the most advanced second-generation science, DNA typing, examples of both questionable methodological assertions and erroneous technical application abound.[199] For instance, in the early 1990s, one expert testified that "in the experience of the entire forensic laboratory community, he did not know of a single instance 'where different individuals that are unrelated have been shown to have matching DNA profiles for three or four probes.'"[200] Today, such a statement would be highly dubious: in 2004, the founder and pioneer of forensic DNA testing, Sir Alec Jeffreys, declared that a ten-loci probe was "no longer foolproof," and recommended that fifteen or sixteen markers be used to safeguard against false inclusions.[201] Both Virginia and Texas wrongly jailed individuals for years on the basis of falsely inculpating DNA evidence.[202] For nearly every laboratory mistake or malfeasant act, there were lawyers and judges who failed to catch it.[203]

In short, it may seem that the characteristics that define the second generation—their technical complexity, scientific certainty, recurrent presence

197. Saks & Koehler, *supra* note 9, at 893.

198. *Id.*

199. *See supra* text accompanying notes 149-156.

200. Commonwealth v. Crews, 640 A.2d 395, 402 (Pa. 1994); *see also* Giannelli, Ake v. Oklahoma, *supra* note 148 (describing testimony of analyst in the first DNA execution case, Spencer v. Commonwealth, who claimed, without contradiction, that there was "no disagreement in the scientific community about the reliability of DNA print testing" even though two National Academy of Science reports indicated several large areas of disagreement).

201. Alok Jha, *DNA Fingerprinting 'No Longer Foolproof': Pioneer of Process Calls for Upgrade*, THE GUARDIAN (London), Sept. 9, 2004, at 5. Even though different DNA-typing methods such as VNTR versus STR typing have different degrees of discriminatory power, greater than three loci are necessary to determine uniqueness. COMMITTEE ON DNA FORENSIC SCIENCE, NATIONAL RESEARCH COUNCIL, THE EVALUATION OF FORENSIC DNA EVIDENCE 161, 34 (1996) [hereinafter NRC II].

202. *See, e.g.*, Steve McVicker, *More DPS Labs Flawed: DNA Testing Woes Across State Threaten Thousands of Cases*, HOUSTON CHRON., Mar. 27, 2004, at A1 (describing audits revealing widespread failures at forensic laboratories across Texas, initiated after DNA retesting of biological evidence revealed that an analyst at the Houston laboratory falsely inculpated a convicted man); Adam Liptak, *You Think DNA Evidence is Foolproof? Try Again*, N.Y. TIMES, Mar. 16, 2003, § 4, at 5 (discussing exoneration of Josiah Sutton, whom an analyst at the Houston crime lab wrongfully inculpated); Thompson, *supra* note 149; BUTLER, *supra* note 26, at 390 (discussing Sutton case and Houston scandal).

203. Thompson, *supra* note 149.

in a wide range of cases, and database-based comparisons—would justify confidence in their wide-scale use in the criminal justice system. But, closer examination of the historical experience of first-generation forensic evidence reveals such optimism to be misplaced. As is already apparent from the short history of DNA typing, many of the characteristics that make second-generation sciences so appealing in fact places them at equal, if not greater, risk for error in the current regime.

First, with regard to admissibility determinations, the technical complexity of second-generation techniques make close and continuous judicial scrutiny of their methodological soundness less likely. Judges confronting sophisticated scientific evidence must invest greater intellectual and material resources to conduct a comprehensive examination of second-generation techniques. Even well-meaning judges may struggle to comprehend complicated scientific or mathematical principles,[204] and the heightened likelihood of error may discourage a court from delving too deeply into such complicated scientific knowledge.

Judicial reluctance, however, only renders the initial hearings on a new technique more decisive, since few later judges will retread the treacherous path—especially if it is only to risk arriving at a result suspiciously contrary to that reached earlier.[205] Yet at the initial stages, second-generation

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204. For example, early DNA cases allowed testimony regarding the testing and sampling, as well as testimony that the two samples "matched," but refused to admit statistical evidence due to lack of general consensus in the community. *See, e.g.*, Commonwealth v. Crews, 640 A.2d 395, 401-02 (Pa. 1994); State v. Bible, 858 P.2d 1152, 1193 (Ariz. 1993). The reasoning in such cases often mirrors that expressed by the *Crews* majority, which likened "match" testimony to testimony saying "I saw a blue Chevrolet run over this dog." *Crews*, 640 A.2d at 402-03. According to the *Crews* court, even though the testimony cannot establish that it was the defendant's blue car, it remains "useful, admissible identification evidence." *Id.* The difference, of course, is that jurors sitting in the dog homicide trial can rely upon their intuitive or experiential knowledge about the frequency of blue Chevrolets in the area to assign weight to the evidence; for instance, jurors in Detroit might assign different probative value to such evidence than jurors in San Francisco. To the contrary, a juror who first hears testimony that every person's DNA is unique, and then bears evidence from a DNA analyst who reports that the DNA in the suspect's sample "matched" the forensic sample, can infer only that in fact the forensic sample came from the defendant. In this sense, such testimony may in fact be more damaging than the evidence warrants. Absent personal knowledge concerning the frequency of certain genetic profiles in the population, the juror simply bas no other independent or experiential knowledge upon which to rely in determining the significance of the "match" statement.

205. Consider, for instance, the enormous backlash that attended the trial court's decision in *United States v. Plaza*, which held aspects of fingerprinting evidence insufficiently reliable after application of the *Daubert* test. 188 F. Supp. 2d 549 (E.D. Pa. 2002), withdrawn from bound volume but available at 2002 WL 27305, at *19 (noting that the government may introduce evidence attesting to uniqueness of fingerprints and to similarities between the latent print and that of the suspect, but precluding "testimony expressing an opinion of an expert witness that a particular latent print matches, or does not match, the rolled print of a particular person and hence is, or is not, the fingerprint of that person"). Ostracized as obtuse and unsophisticated, and lambasted for breaking with one hundred years of precedent, the trial court eventually determined to save face and reverse course despite the wealth of scholarship supporting the court's initial

methodologies, with their requirements of mechanical sophistication and specialized technical knowledge, are even less likely to have withstood the scrutiny of an independent community of auditors. Indeed, the general rigor of second-generation sciences may also lend them an air of "mystic infallibility" that discourages critical inspection, and the existence of "real world" analogues, notwithstanding that the nonforensic applications in fact deploy meaningfully different methodologies, may bolster this sense.[206] A judge who thinks that cell phones or GPS satellites or iris scans or DNA tests generally work in the world may be less inclined to question whether, when put to forensic purposes, the methodological underpinnings remain sound.

The high volume of second-generation cases only exacerbates this impulse. Resource constraints may ultimately persuade the "amateur scientists"[207] of the bench, particularly those inclined to intellectual timidity with regard to sophisticated scientific techniques, to lean heavily upon the "law-like" status of other courts' rulings rather than spend precious time deciphering a seemingly legitimate methodology. Of course, the more that

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conclusion. United States v. Plaza, 188 F. Supp. 2d 549, 576 (E.D. Pa. 2002) (vacating earlier opinion). As an aside, the second *Plaza* opinion illustrates nicely the import the government places upon admissibility rulings in a regime that accords them law-like precedence, and the pressures that prosecutorial watchfulness in turn imposes upon courts. In its motion for reconsideration in *Plaza*, the government argued not only with regard to its "prosecutorial effectiveness" in the case at bar, but also pleaded that "other cases in which fingerprint identification could be expected to play a significant role . . . would be seriously compromised by the preclusion of [the requested] opinion testimony." *Id.* at 552-53. Thus, in effect, the government premised its argument for admission not only on the facts of the case at bar, but on its fear of the widespread repercussions of an opinion precluding the introduction of such testimony. Incidentally, the *Plaza* opinion also illustrates well the difficulty in fixing with specificity the preferred form of proof-taking in admissibility decisions. In its reconsideration opinion, the trial court claimed benefit from materials outside the record; however, the judge felt constrained to earmark them as such. *Id.* at 554 (interposing a "Historical Note (not drawn from testimony)"). Moreover, the court highlighted the particular importance of live testimony as one of the decisive factors in its decision to reconsider. *Id.* at 575 (observing that one of the witnesses at the reconsideration hearing, FBI print unit chief "Stephen Meagher, heretofore a name in a transcript, became a real person, and through his live testimony I was able to get a substantially more rounded picture of the procedure").

206. United States v. Addison, 498 F.2d 741, 744 (D.C. Cir. 1974). In the words of one scholar, "disputing the technology is like disputing the law of gravity." Hoeffel, *supra* note 148, at 466. As stated by a defense lawyer confronting DNA typing evidence, "[w]hen an expert comes in and says there's a one in 700 million chance that your man is not the one . . . it just kills you." *Id.* at 466 n.10. Thus, in the aftermath of the trial of the first man in New York state to be convicted in part based upon DNA-typing evidence, one juror observed, "The DNA was kind of a sealer on the thing. You can't really argue with science." *Id.* at 515 & n.297.

207. *Daubert*, 509 U.S. at 601 (Rehnquist, J., concurring). Justice Rehnquist, of course, coined this phrase as an expression of skepticism at the propriety of having federal court judges resolve complicated scientific disputes, many of which remain unresolved by experts in the field. That debate, regarding the capacity of judges to render decisions with regard to highly technical evidence, continues to rage. *See, e.g.*, Faigman, *supra* note 191, at 684 (looking with optimism into "the next twenty years or so," in which "lawyers and judges will become increasingly sophisticated consumers of science").

forensic evidence is approved in cases in which the defendant admits guilt and the evidence goes unexamined, the more it affirms the belief that this kind of evidence is typically trustworthy and reliable.

But even an intellectually entrepreneurial judge willing to fully exercise her gatekeeper role under *Daubert* might not find much help from the adversarial parties. The characteristics of second-generation sciences render scrutiny of either general methodological legitimacy or specific case application unlikely in the vast majority of cases.

Given the rigor of second-generation techniques, defense attorneys, like judges, may find themselves susceptible to the temptation simply to trust the integrity of the evidence, thus making the case seem insurmountable or "open-and-shut."[208] Many lawyers will reasonably conclude that it requires too great an effort, and reaps too little a reward, to study such evidence in the hopes of uncovering a flawed methodological approach.[209] And the more technically complex the evidentiary form, the more likely it becomes that even a well-meaning attorney may be incapable of comprehending the science regardless of the effort she expends.[210] After all, not every attorney can be expected to

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208. Of course, that would violate the ethical rules. *See, e.g.*, William H. Simon, *The Ethics of Criminal Defense*, 91 MICH. L. REV. 1703, 1703 (1993) (recognizing the ethical obligation of criminal defense counsel zealously to pursue defense even of guilty client, while doubting ethical propriety of "aggressive defense" tactics); David Luban, *Are Criminal Defenders Different?*, 91 MICH. L. REV. 1729, 1729 (1993) (arguing that institutional considerations require criminal, but not civil, defense lawyers to pursue aggressive tactics). *But see* Darryl K. Brown, *Rationing Criminal Defense Entitlements: An Argument From Institutional Design*, 104 COLUM. L. REV. 801, 801 (2004) (arguing that scarce defense resources should be allocated upon express, rather than covert, bases such as "factual innocence").

209. Anecdotal evidence suggests that just this is happening. The methodologies underlying DNA-testing techniques have been robustly challenged in only a handful of cases; in the first appellate criminal case challenging the admissibility of DNA evidence, the defense called no experts. Andrews v. State, 533 So. 2d 841, 847 (Fla. Dist. Ct. App. 1988); Hoeffel, *supra* note 148, at 499 & n.193 (describing how, after the introduction of DNA evidence in 1987, "there were no expert witnesses for the defense" in "many" cases involving DNA typing, up until the landmark hearing in People v. Castro, No. 1508/87 (N.Y. Sup. Ct. 1989)). Challenges to the application of these technologies may receive even less scrutiny. *See also* Risinger, *supra* note 176, at 125 (noting that only two of 213 federal court cases studied posed direct, rather than derivative, challenges to the DNA evidence, and in only 44% of the state court cases and 18% of the federal court cases were there any challenges to DNA evidence at all). Data regarding the challenges mounted by defense attorneys to the execution of the testing—which would be reflected in cross-examination rather than by an admissibility hearing—are harder to come by.

210. In the words of one court:

> DNA printing is a highly complex process which only a trained expert fully understands. Without this understanding, defense counsel cannot properly prepare for trial, or understand appropriate avenues to question results or cross-examine experts testifying for the prosecution. Without special training, the defense would be at the mercy of the prosecutor's expert, unable to discern weaknesses in the procedures used or in the interpretation of results.

Jay A. Zollinger, Comment, *Defense Access to State-Funded DNA Experts: Considerations of Due Process*, 85 CALIF. L. REV. 1803, 1812 (1997) (quoting Tennessee v. Edwards, 868 S.W.2d 682, 697-98 (Tenn. Crim. App. 1993)) (internal quotation marks omitted)). It is worth noting that the lack of outside assistance is often not readily compensated for by the availability of

master the methodological details facial recognition software or DNA amplification and testing.

Similarly, the seeming (or actual) impenetrability of the technique may discourage the attorney from conducting a thorough inspection for errors in its application. Faced with the choice between spending time searching for possible errors explicable and meaningful enough to sway a jury and simply accepting a plea bargain or crafting a defense compatible with the scientific evidence, the attorney may quite reasonably choose the latter course.

Of course, an attorney may always request expert assistance to help interpret scientific evidence. But, due to the high volume of second-generation evidence, and its likely appearance in a range of both low- and high-level cases, such assistance is likely to be less, not more, availing than with respect to first-generation sciences. A defense attorney handling one hundred cases, a majority of which are misdemeanors, cannot feasibly petition for assistance in the forty cases that contain second-generation scientific evidence. Courts jealously guard limited budgets,[211] and most jurisdictions require counsel to demonstrate that their request is "reasonable"[212] and that the issue is "likely to be a significant factor in [the] defense."[213] Absent expert eyes, the sophisticated technologies of the second generation may prevent counsel from even articulating the need for assistance even if she tried:[214] a judge in one case denied an untrained request as "no more than a plea that DNA evidence is simply too 'complicated.'"[215]

But even if counsel were able to demonstrate a need in every case, the sheer volume of second-generation techniques prevents courts from appointing

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government experts, because many government scientists refuse to accommodate defense requests for assistance. *See supra* note 140.

211. Giannelli, *supra* note 148, at 1312 (citing numerous studies demonstrating that "[j]udges routinely deny lawyers' requests for expert/investigative fees" even in capital cases (internal quotation omitted)).

212. *See, e.g.*, Caldwell v. Mississippi, 472 U.S. 320, 323 n.1 (1985); *see also* WAYNE R. LAFAVE, JEROLD H. ISRAEL, & NANCY J. KING, CRIMINAL PROCEDURE, § 11.2 & nn. 180-84 (2d ed. 1999).

213. Ake v. Oklahoma, 470 U.S. 68, 82-83 (1985). Many states, along with the federal government, implement the constitutional right to expert assistance statutorily. For example, the Criminal Justice Act provides for expert assistance to indigent federal defendants when "necessary for an adequate representation." *See, e.g.*, 18 U.S.C. § 3006A(e)(1) (2006). As many commentators have noted, expert assistance is frequently difficult for an indigent to obtain. *See, e.g.*, John F. Decker, *Expert Services in the Defense of Criminal Cases: the Constitutional and Statutory Rights of Indigents*, 51 U. CIN. L. REV. 574 (1982); Giannelli, *supra* note 148, at 1365.

214. *See, e.g.*, Little v. Armontrout, 835 F.2d 1240, 1244 (8th Cir. 1987); *see also* Thompson & Ford, *supra* note 140, at 52 (describing DNA evidence as "unusually complex, requiring a complicated series of procedures, drawn from molecular biology" which may require "lawyers . . . to consult experts in a variety of fields, including population genetics, chemistry, and microbiology").

215. Zollinger, *supra* note 210, at 1812-13 (citing Cade v. Florida, 658 So.2d 550, 555 (Fla. Dist. Ct. App. 1995); North Carolina v. Mills, 420 S.E.2d 114, 118 (N.C. 1992); Taylor v. Texas, 939 S.W.2d 148, 151 (Tex. Crim. App. 1996)).

independent experts in all, or even most, cases. Not only would such appointments be inefficient, but they would also be extraordinarily costly. The same forces that generate demand for technical expertise in turn work to decrease supply. The mechanical sophistication and technical expertise associated with second-generation techniques like DNA typing or facial recognition technologies all but preclude the development of plentiful independent expert shops. Simply reading raw data in a DNA case requires software that can cost thousands to tens of thousands of dollars,[216] and the rapid evolution of the technology can render a large capital investment obsolete within a short number of years. Judicial parsimony in granting requests further shrinks the available expert pool.[217] Those experts actually assigned are also likely to be more expensive for second-generation sciences: the time commitment is greater because both interpreting the data and conveying technical results to counsel takes longer. In short, second-generation experts are likely to be more scarce than their first-generation counterparts, and even when available, they are likely to be stretched thin and demand costly fees.

Lastly, even assuming a judge receptive to such a challenge, a defense attorney capable and well-resourced enough to pursue one, and an expert available for appointment, it remains unlikely that the expert could undertake the examination necessary to truly safeguard the integrity of the evidence. That is because the mechanical sophistication and technical complexity of this evidence all but forecloses independent research. The infrastructure necessary for true methodological testing is simply lacking. At the same time, the database-dependency of second-generation sciences, and the privacy and proprietary secrets concerns they raise, effectively prohibit access to the material necessary for independent research. Manufacturers of DNA typing kits, cell phone or scarch engine technologies, or biometric scanning software may bristle at disclosing broadly the technology underlying their particular techniques, even under a court "gag" order. Similarly, the relinquishment of data stored indiscriminately in databanks for exploratory purposes—whether iris patterns, DNA profiles, or cell records—understandably raises legitimate concerns about personal privacy.

The database dependency of second-generation technologies also means that scrutiny of these techniques for case-specific errors in application itself requires access to large volumes of data, which may not be feasibly disclosed, or feasibly reviewed, in every case.[218] For instance, verifying that a cell-site report accurately identified the location of a phone at a particular time requires

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216. *See supra* note 36.

217. Saks, *Merlin and Solomon*, *supra* note 10, at 1092 & n.112.

218. At a minimum, a skilled reviewer must have broad access to the laboratory's contamination logs and corrective action files, laboratory protocols, maintenance logs, proficiency testing results, caseworker files, and so on. *See, e.g.*, Giannelli, *supra* note 139, at 815-16 & n.152 (explaining need for more extensive discovery in DNA cases).

verifying all the precursor data, including the accuracy of the tower location, clarity of signal, lack of interference with signal reception, and correspondence to actual physical terrain; this is obviously difficult to scrutinize closely in every case.[219]

Or consider, for example, the FBI DNA-lab scandal concerning analyst Jacqueline Blake, who pled guilty to falsifying reports of "negative controls"—the data used to demonstrate that no contamination has taken place during testing.[220] Her actions only came to light when a coworker working late noticed a problem with the files on Blake's computer.[221] Similarly, an analyst fired from a private laboratory for substituting clean control files in problematic samples was discovered only when a reviewer noticed that her negative blank files were strangely identical in every case.[222] More recently, an audit of a Massachusetts crime lab revealed "instances in which laboratory officials entered the same genetic profile under two different ID numbers in the database," and in which an analyst reported "DNA results in four cases matched the genetic material from old rape kits when they had not."[223] Independent review of the documents related to a single case simply could not have captured these errors.[224] Review of the analyst's entire body of work might have caught the suspicious data, but of course no court would have mandated such broad disclosure *ex ante*, simply on the chance that the analyst's work was not up to snuff.

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219. *See, e.g.*, David A. Lieb, *States Seeking to Track Cell Phones for Traffic Conditions*, ASSOCIATED PRESS, Oct. 8, 2005 (detailing pilot programs to track drivers through their eell phones and explaining tracking technology).

220. *See* Press Release, Department of Justice, Former FBI Biologist Pleads Guilty to Filing False DNA Laboratory Reports (May 18, 2004). Specifically, negative controls are blank injections designed to safeguard against and expose any contamination that might have occurred in the testing process. If a blank comes back with stray material, then the analyst knows that the results of a test, especially of an "unknown," may be the result of contamination. Rather than run blank injections, however, Ms. Blake apparently substituted a completed file in 103 cases, and misrepresented that copied file as a blank run in the case. *See* Maurice Possley, Steve Mills & Flynn McRoberts, *Scandal Touches Even Elite Labs*, CHI. TRIB., Oct. 21, 2004; Richard Willing, *Mueller Defends Crime Lab after Questionable DNA Tests*, USA TODAY, May 1, 2003, at 3A. Notably, ordinary sample contamination oecurs so frequently that most labs require their analysts to keep their own DNA profiles on file, so that they can be compared against findings. *See, e.g.* KOBILINSKY, LIOTTI, & OESER-SWEAT, *supra* note 26, at 99 (advocating this practice).

221. U.S. DEP'T OF JUSTICE, OFFICE OF THE INSPECTOR GENERAL, THE FBI DNA LABORATORY: REVIEW OF PROTOCOL AND PRACTICE VULNERABILITIES ii (May 2004), *available at* http://www.usdoj.gov/oig/special/0405/final.pdf.

222. *See* Aff. of Dr. Robin W. Cotton, Ph.D, Maryland v. Kenneth Ernest Abend, Nos. K-02-506 and K-0401903 (Nov. 2, 2004), at 3 & attachment B (on file with author).

223. Jonathan Saltzman, *US Audit Found More Problems at Crime Lab*, BOSTON GLOBE, Feb. I, 2007, at A1.

224. *See, e.g.*, Phoebe Zerwick, *DNA Mislabeled in Murder Case*, JOURNAL REPORTER (Greenville), Aug. 28, 2005 (describing case of woman implicated in sister's death when sample tubes were erroneously mislabeled); Tom Jackman, *Paternity Suit Raises Doubts About DNA Tests*, WASH. POST, Aug. 21, 2005, at C1 (cataloging a list of faulty DNA tests).

Yet disclosure of the materials necessary to find such flaws in every case in which second-generation technologies are used is all but impracticable. Not only would requiring such sweeping document disclosure in every case effectively bankrupt a jurisdiction,[225] but it would also demand disclosure of an unsustainably, and perhaps even impossibly, large quantity of paperwork.[226] And no expert or attorney could, as a matter of practice, undertake such a review in every case.

From this perspective, the courts' demonstrated reluctance to approve the means necessary to effectively inspect second-generation evidence is not in the end pathological; it may in some respects be quite reasonable. But this reasonableness invites danger: the very qualities that make second-generation technologies so desirable make it all the more likely they will never encounter adversarial scrutiny of any kind. And while this lack of scrutiny is troubling on its face, it becomes all the more troubling when considered in light of the very real possibility that, given the investigative power of these technologies, in many cases they may be the only actual evidence of the defendant's guilt.[227]

## III
## WHERE DO WE GO FROM HERE?

When it comes to second-generation evidence, some may argue that the effective lack of scrutiny is, statistically speaking, tolerable. As noted above, in

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225. John Devlin, *Comment, Genetics and Justice: An Indigent Defendant's Right to DNA Expert Assistance*, 1998 U. CHI. LEGAL F. 395, 396 n.111 (1998) (citing the typical cost of a DNA expert as ranging from $1,000 to $10,000); Giannelli, *Ake v. Oklahoma*, *supra* note 148, at 1398 (reporting expert costs as high as $28,000); *see also id.* at 1363 ("If the standard [for appointing an expert] is too demanding, the right is gutted. If the standard is too lax, the costs skyrocket."). Nevertheless, the first National Academy of Sciences recommended just that: they suggested that defense DNA experts be appointed in all cases involving DNA, because few attorneys can deal with this type of science. NATIONAL RESEARCH COUNCIL COMMITTEE ON DNA TECHNOLOGY IN FORENSIC SCIENCE, DNA TECHNOLOGY IN FORENSIC SCIENCE 147-49 (1992) [hereinafter NRC I]. The subsequent report recommended appointment of experts, either to the court or to the parties, and noted that the complexity of DNA evidence might require the appointment of multiple experts. NRC II, *supra* note 201, at 169-70.

226. Early challenges to the sufficiency of discovery in DNA cases reveal courts' struggles to strike the right balance between the defense's interest in obtaining comprehensive material to challenge the validity of the government's assertions, and the government's interest in controlling the burden of amassing documents. *See, e.g.*, United States v. Yee, 129 F.R.D. 629, 630 (N.D. Ohio 1990), *aff'd sub nom* United States v. Bonds, 12 F.3d 540 (6th Cir. 1993) (commenting with regard to broad discovery request that "the defendants appeared to accept . . . the government's contention that the materials that they are seeking are not encompassed within FED. R. CRIM. P. 16"). In *Yee*, the magistrate judge ultimately granted the defendants' request, mainly because the case posed one of the initial challenges to the admissibility of DNA evidence. Moreover, he specifically cited as support the lack of "extensive independent scientific assessment and replication of the reliability of the procedures that have been developed by the F.B.I.," as well as the "fact that the defendants have developed bona fide questions about each of the categories in which they are seeking discovery." *Id.* at 631.

227. *See* text accompanying *supra* note 95.

the vast majority of cases, it is likely that no error took place, and second-generation sciences are at base far more credible sources of evidence than the traditional forensic sciences.[228] But the criminal justice system has never been satisfied with being a random game of chance; as the familiar edict goes: "[b]etter that ten guilty persons escape than that one innocent suffer."[229] It is reasonable to expect that, as the use of scientific evidence increases, so too will increase the number of errors attributed to its use. More importantly, two aspects of second-generation evidence make meaningful scrutiny all the more indispensable. First, the scale of error that can occur among second-generation techniques is an order of magnitude larger than that which occurred among the first-generation. Whereas a faulty hair comparison may wrongly inculpate someone in one case, a wrongly calibrated machine can churn out large volumes of erroneous information and tarnish multiple cases. Or consider some of the errors that may occur in DNA typing: a manufacturer may contaminate a kit,[230] an analyst may fail to run positive or negative controls, or a technician may erroneously input data into a database.[231] Such mistakes can compromise not just a single case, but multiple related or unrelated cases as well.

Second, even if second-generation evidence is apt to be faulty in fewer overall cases, when it does fail the stakes will be at their highest. That is not just because second-generation technologies appear so irrefutably probative, but also because they allow criminal cases to be built on little more than forensic proof: for instance, charges are routinely brought based upon only a "cold hit" DNA match.[232] Moreover, in some cases the crime might have occurred years before, making an effective defense all the more difficult to muster.[233] At the very least, in cases involving no evidence *but* forensic

228. Some might even argue that the error rate of DNA typing is more favorable, and thus preferable, to that of eyewitnesses. *But see* Giannelli, *Ake v. Oklahoma*, *supra* note 148, at 1396 ("A British study (albeit small) found that '38 per cent of defence [sic] lawyers who had obtained an independent analysis' of DNA evidence received reports that 'differed from those of the prosecutions' expert.'").

229. WILLIAM BLACKSTONE, 4 COMMENTARIES *358; *In re* Winship, 397 U.S. 358, 372 (1970) (Harlan, J., concurring) ("[I]t is far worse to convict an innocent man than to let a guilty man go free.").

230. Contamination at the manufacturing level has occurred in the United Kingdom, and another incident recently arose in the United States. *See, e.g.*, Becky Pallack & Kim Smith, *Contaminated DNA Strikes Three Cases*, AZ DAILY STAR, Dec. 13, 2005 (describing how same unknown sample turned up in testing at Tucson crime lab and then in two Florida crime labs, causing officials to conelude that the tubes used for testing were contaminated at a factory). Interestingly, prosecutors in the Tucson case moved the court to preclude the defense from even mentioning the contamination to the jurors, arguing that it unduly prejudiced the jury with regard to the reliability of testing in that case; their request was denied. *Id.*

231. For example, a Las Vegas lab inadvertently switched two DNA profiles as it entered them into the database; as a result, an innocent man spent a year in jail awaiting prosecution for sexual assault. Glenn Puit, *Police Forensics: DNA Mix-up Prompts Audit at Lab*, LAS VEGAS REVIEW-J., Apr. 19, 2002, at 1B.

232. *See supra* Part I.B.2.

233. What innocent person could recall why they frequented a certain location or made a

evidence, justice dictates implementation of the most exacting safeguards. If the only evidence in a thousand theft cases across the country is the testimony of a forensic analyst that the defendant matched the evidence when the likelihood of a random match was one in 240 billion, then surely everything should be done to ensure that such testimony is in fact accurate.

However, existing recommendations for improving the quality of forensic science in court tend to stay within the conventional framework, asking only to shore it up by granting more money for experts,[234] providing better training for lawyers,[235] requiring more elaborate hearings and discovery,[236] selecting more competent juries,[237] and allowing for greater independent testing.[238] Each of these recommendations has its own merits, and if implemented could dramatically improve the quality of scientific evidence in the criminal justice system.[239] Yet they do not address, much less rectify, the particular economy of the criminal justice system, which perpetuates the introduction of faulty forensic evidence. Instead, the conventional fixes rely upon an outdated view of the nature of forensic evidence, where case-specific review plausibly suffices to ensure the quality of evidence. They assume: that an attorney is willing and able (or even obligated) to engage in extensive pretrial investigation and maneuvering to winnow contestable from uncontestable cases; that judges will conduct an adversarial proceeding of some kind (whether a motions hearing or trial) in those contestable cases; and that it is efficient, much less possible or

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certain purchase or undertook other such activities on a random day many years earlier, or even locate the witnesses to verify their assertions?

234. Giannelli, *supra* note 109, at 475-76; Paul S. Milich, *Controversial Science in the Courtroom:* Daubert *and the Law's Hubris*, 43 EMORY L.J. 913, 925 (1994).

235. Giannelli, *supra* note 109, at 475-76.

236. William C. Thompson, *Evaluating the Admissibility of New Genetic Tests: Lessons from the "DNA War"*, 84 J. CRIM. L. & CRIMONOLOGY 22, 99-100 (1993); Christopher G. Shank, Note, *DNA Evidence in Criminal Trials: Modifying the Law's Approach to Protect the Accused from Prejudicial Genetic Evidence,* 34 ARIZ. L. REV. 829, 870 (1992).

237. Graham C. Lilly, *The Decline of the American Jury*, 72 U. COLO. L. REV. 53, 85 (2001). Of course, debates rage concerning whether scientific evidence exceeds fair expectations of jurors' abilities, or whether juries are up to the task of resolving scientific disputes often unresolved among the experts in the field. *Compare, e.g.*, Joseph Sanders, *Scientifically Complex Cases, Trial By Jury, and the Erosion of Adversarial Process*, 48 DEPAUL L. REV. 355, 360, 363 (1998) and Lilly, *supra*, at 67 (arguing that "long-term trends in the nature of litigation . . . poses serious questions about the potential of American juries to adequately perform their traditional roles"), *with* David W. Shuman, et al., *Assessing the Believability of Expert Witnesses: Science in the Jurybox*, 37 JURIMETRICS J. 23 (1999); Edward J. Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 570-71 (1982-83).

238. Giannelli, *supra* note 139, at 816-17.

239. Of course, some of these recommendations are specifically designed for a civil justice system and cannot reasonably be transplanted into the criminal justice system. For instance, some suggestions impinge upon other rights of criminal defendants: qualifying specialized juries or removing certain questions from jury determination could impermissibly prejudice the defendant's Sixth Amendment right to a jury of peers.

desirable, to assign experts to review the outcomes of all scientific testing.

Moreover, such proposals fail to acknowledge that, even if resource constraints entirely disappeared, the monitoring of second-generation sciences requires a scope of inquiry broader than that accorded to each defendant in a single criminal case, and a recalibration of the balance of power between the centralized government and decentralized defense.

Against this backdrop, this Part attempts to set forth a nonexhaustive catalog of recommendations keyed to these particular concerns. Although none of these recommendations alone offers a complete safeguard, if implemented together, they have the potential to improve dramatically the use of forensic evidence in the criminal justice system.

### *A. Loosening the Government's Grip on the Technology*

As argued above, forensic sciences generally, and second-generation technologies in particular, require reviews of greater depth and breadth to uncover flaws in either the underlying methodological technique or the execution of that technique in a particular case. Comparing a recovered writing to the suspect's writing exemplar may be the sole basis of a first-generation finding. By contrast, the reliability of conclusions drawn in DNA typing may depend upon match probabilities derived from databases of genetic material or upon comparative examination of the work an analyst has done across cases. Thus, effective monitoring of second-generation evidence demands close scrutiny not just at the individual case level in court, but also across the entire range of operations. But given the appearance of these technologies in a high volume of cases and the privacy and proprietary concerns that broad disclosure may raise, how might such reviews take place?

Scholars and advocates have urged perhaps the single most important change: wide-scale reform of the forensic laboratory system, to ensure better quality control and recast the culture to that of a neutral scientific lab rather than an arm of the government.[240] Truly independent forensic laboratories are

240. Scholars have recommended creating independent laboratories with higher quality technicians, Giannelli, *supra* note 109, at 469; strengthening accreditation, protocol, and proficiency review of labs, *id.* at 474-75 & n.202; Beecher-Monas, *supra* note 11, at 100-01; and encouraging ongoing validation studies, Saks, *Aftermath*, *supra* note 104, at 239 & n.41. One recent innovative approach to this argument is to introduce a system of "competitive self regulation" to create "rivalrous redundancy" in labs, such that technicians would know that evidence is periodically sent to multiple laboratories for testing and quality control. Koppl, *supra* note 118, at 256, 267. Some also recommend the institution of a legal entitlement to independent or corroborative testing of scientific evidence. Beecher-Monas, *supra* note 11, at 90 n.250. The right to independent or duplicative testing, however, cannot alone ensure the integrity of all forensic evidence. First, in many cases, the DNA sample is exhausted by government testing, and no evidence remains for independent submission. Second, a costly and time-consuming procedure such as duplicative testing cannot serve as the ordinary means of verifying the integrity of the government's results. Third, there are many strategic reasons why defense counsel might elect not

essential in part because they form the first line of defense against shoddy forensic science.[241] Such labs might readily find homes in large public universities, or in not-for-profit organizations.

But the creation of an independent laboratory system, even assuming that such a feat could in fact be accomplished, is not alone enough for two reasons. First, to foster the maturation and critical examination of complex second-generation techniques, no single institution ought to be allowed to operate as the sole custodian of the tools necessary to develop and challenge scientific orthodoxies. Second, supervision over the proper implementation of those technologies requires constant and ongoing scrutiny at the wholesale, not just retail, level. The criminal justice system therefore needs institutions capable of and empowered to undertake each kind of oversight.

*1. Centralized Oversight Agencies*

Methodological development and quality control monitoring requires that a neutral and bipartisan entity have the power to pursue, and encourage others to pursue, research and auditing functions. Such an entity, or Board, should have members drawn from all relevant communities: the government, the defense bar, and private industry, academia, or forensic laboratories. Armed with a research budget, the Board would oversee the equitable dissemination of research funds for studies.[242] The Board would also have access to all private or proprietary data related to a particular technique, and could award circumscribed access to researchers consonant with the needs for confidentiality or the protection of trade secrets. New techniques would first be submitted to the Board, which could then disseminate proposed methodological approaches for the purpose of close scrutiny and peer review. The Board could also issue periodic "state-of-the-technology" reports that clarify the ongoing areas of uncertainty in a technology's use or development, and outline the

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to conduct routine independent testing. For instance, to the extent that a jurisdiction bestows a right to retest evidence, that right loses meaning unless it also includes a proscription on the government's comment on the exercise, or failure to exercise, such a right. Until courts resolve the questions of confidentiality and evidentiary use surrounding independent testing, defense lawyers will be reluctant to submit all evidentiary items—particularly those already shown to "match" the defendant—to confirmatory testing.

241. They also help insulate municipalities from civil liability incurred from substandard or fraudulent work. *See, e.g.*, Brandon L. Garrett, *Innocence, Harmless Error, and the Federal Wrongful Conviction Law*, 2005 WISC. L. REV. 35, 98-99 (2005) (reporting on a Cleveland civil suit lodged after an analyst falsified hair and blood evidence, and in which the settlement included provision of a "permanent, independent scientific monitor").

242. The National Institute of Justice, a branch of the U.S. Department of Justice, currently solicits a limited amount of such research, but this entity is clearly inadequate. First, because the government solicits the work, the government also defines what projects are interesting or worthy of being undertaken, rather than allowing a vibrant and diverse research community to make such determinations. Second, because the government selects the recipients of such grants, it is able to skew the awards toward researchers sympathetic to its interests.

various approaches currently deemed acceptable or unacceptable. It could also expound standards and protocols of model practices for the execution of particular forensic techniques.

This model in many respects mirrors that first proposed by Professors Monahan and Walker, who extended their social authority model to the hard sciences and outlined a "National Science Panel" that could resolve questions pertaining to causation in breast implant litigation.[243] In Walker's and Monahan's model, courts could give the findings of such panels law-like deference: the findings would be capable of being "overturned," but presumptively correct. In the civil arena, these kinds of panels aim to produce a coherent response to the scientific questions that occur throughout the nation, so that litigation is conducted more efficiently and consistently. But in the criminal arena, such panels have the potential to produce more than just efficiency: they might also function as a counterweight to the government domination of forensic science, whether de jure (as the operator of crime labs) or de facto (as the primary consumer of forensic services).

Second-generation techniques already have something of a model for such a panel. The debut of DNA analysis catalyzed two convocations of experts who produced manuals for the forensic use of DNA evidence that became the "how to" guides for courts.[244] After distinguished scientist Eric Lander exposed numerous flaws in the forensic evidence in *People v. Castro*, resulting in an unprecedented joint statement from the government and defense experts concluding that the evidence was unreliable and eventually resulting in its exclusion,[245] the National Academy of Sciences responded to his call for a committee to investigate forensic DNA typing.[246]

Accordingly, in 1992, the FBI, along with a consortium of government agencies, issued a report that it had commissioned from a committee charged with summarizing and analyzing the state of scientific knowledge in the field of DNA evidence.[247] After controversy erupted over the first report's conclusions, another report issued in 1996.[248] Scholarly discussion regarding the merits of the panels, and of the conclusions that each reached, abound.[249] What is clear, however, is that the reports of the panels served to inform and educate judges and litigators about the legitimate areas of dispute in the field, and provided a

243. Walker & Monahan, *Social Facts*, *supra* note 104, at 823-24 (describing operation of national science panels).

244. The American Bar Association also recently endorsed national standards for the use of forensic DNA evidence.

245. Jennifer Mnookin, *People v. Castro*, *in* EVIDENCE STORIES 226-27 (Richard Lempert ed., 2006).

246. *Id.* at 227.

247. NRC I, *supra* note 225.

248. NRC II, *supra* note 201.

249. *See, e.g.*, Lempert, *supra* note 192, at 465-68.

useful summary and reference for best praetices.[250] Even the debate between the disparate conclusions reached by the first and second panels has contributed a richness to the conversation that criminal justice has otherwise sorely lacked with regard to forensic science. In this regard, the beneficial educative role played by neutral expert panels, particularly with respect to resolving the complicated disputes likely to characterize the second-generation sciences, is illustrative and instructive.[251]

But an isolated or sporadic convocation of experts is not enough. Second-generation technologies require constant monitoring and development. New technologies may arrive on the scene, and old technologies can still present novel or innovative questions.[252] For instance, while the foundations of DNA

250. *See, e.g.*, United States v. Ewell, 252 F. Supp. 2d 104, 109 n.8 (D. N.J. 2003), *aff'd by* United States v. Adams, Nos. 03-2108, 03-2152, 2006 WL 1888737 (3d. Cir N.J. 2006) (referring to standards set by NRC); People v. Watson, 789 N.E. 2d 375 (Ill. App. Ct. 2003) (same); *aff'd by* People v. Watson, 214 Ill. 2d. 271 (Ill. 2005); United States v. Trala, 162 F. Supp. 2d 336, 348 (D. Del. 2001) (same), *aff'd by* United States v. Trala, 386 F. 3d. 536 (3d. Cir. 2004); *vacated by* Trala v. United States, 126 S. Ct. 1078 (2006).

251. Neither of the prior two committees was convened by a neutral party, and so while the members of each committee may have strived to complete a fair and balanced report, and may have achieved that goal, it cannot be said that their origins were neutral. Of course, the conclusions of such panels would garner additional legitimacy if they were deliberately composed by a neutral and disinterested body. Compare, for example, the "two-step process" used by the judge in the civil case studied by Professors Walker and Monahan. *See* Walker & Monahan, *Breast Implant Litigation*, *supra* note 162, at 808-809. In that case, the judge first designated a "Selection Panel" to provide "names of neutral, impartial persons who have indicated expertise" and would be able to communicate well and serve, and then chose the four-person panel from that list of names. *Id.* Ideally, to preserve both the appearance and actuality of fairness, such panels would be appointed and monitored by a neutral party, such as a member of the judicial or even legislative branch.

252. There remains some question whether the population samples used to draw conclusions were insufficiently large and not demonstrably randomized. The government researcher who published the study upon which the frequency tables are based looked at sample group sizes in the low hundreds. *See, e.g.*, NRC I, *supra* note 225, at 91 (1992); P.J. Bickel, *Discussion of The Evaluation of Forensic Evidence*, 94 PROC. NAT'L ACAD. SCI. 5497 (May 1997) (observing that "many scientists would not agree [with] the modeling assumptions" that assume that the data is drawn from a "random sample[]" of the relevant population and that no linkage is present). For instance, many charge that such a small sample size is insufficiently random, and thus inferences about the composition of the population at large are inappropriate: the frequency table for genetic characteristics in the African American population was developed from only 210 profiles; from 203 for Caucasians, and from 209 for Hispanics. *See* Bruce Budowle, et al., *Population Data on the Thirteen CODIS Core Short Tandem Repeat Loci in African Americans, U.S. Caucasians, Hispanics, Bahamians, Jamaicans, and Trinidadians*, 44 J. FORENSIC SCI. 1277, 1278 (2001). A subsequent study attempted to address these concerns, and drew upon data from roughly 1749 African-Americans, 1511 U.S. Caucasians, and 1421 Hispanics; that study concluded that these populations were in Hardy-Weinberg equilibrium. *See* Bruce Budowle, B. Shea, S. Niezgoda & R. Chakraborty, *CODIS STR Loci Data from 41 Sample Populations*, 46 J. FORENSIC SCI. 453, 453-89 (2001). That study was later criticized. *See* Dan E. Krane, Travis E. Doom, Laurence Mueller, Michael L. Raymer, William M. Shields, & William C. Thompson, Commentary, 49 J. FORENSIC SCI. 453 (2004). At present, laboratories use a "theta correction" to account for the possibility of substructure among certain populations. KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 156. Finally, it is worth noting that the same questions have

typing are now fairly firmly entrenched, new controversies emerge constantly.[253] By means of illustration, consider the following concrete example from a controversy currently unfolding in the DNA research community. The DNA-typing technique most commonly used in the United States today examines genetic information at thirteen different places, or loci, on the genetic strand.[254] Regardless of the number of loci developed, DNA analysts typically calculate the significance of a "match" between the forensic and known samples using a method known as the "product rule."[255] The product rule, in turn, relies upon data FBI scientists developed to determine the frequency of particular alleles, or numerical expressions of genetic information, in the population. The validity of this method depends upon two critical assumptions: first, that the frequency tables derive from a sufficiently large and random sample to allow for general conclusions,[256] and second, that there is no link or correlation between each piece of information.[257] At present, courts across the nation have accepted the results of DNA typing into evidence and ruled the product rule, and the frequency tables underlying it, an acceptable way to represent the significance of a match.

Yet, recent evidence calls into question the accuracy of using the product rule to convey match probabilities.[258] How that evidence was uncovered, and

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dogged the use of mitochondrial DNA evidence. Critics have charged that the mtDNA database similarly contains too few samples to adequately capture the true population frequencies. *See* Frederika A. Kaestle, Ricky A. Kittles, Andrea L. Roth & Edward J. Ungvarsky, *Database Limitations on the Evidentiary Value of Forensic Mitochondrial DNA Evidence*, 43 AM. CRIM. L. REV. 53 (2006).

253. *See supra* Part I.B (referencing developments in miniaturization, YSTR typing, familial searching, mixture deconvolution, and so on).

254. BUTLER, *supra* note 26, at 111.

255. BUTLER, *supra* note 26, at 501; Frederick Bieber, *Science and Technology of Forensic DNA Profiling*, *in* DNA AND THE CRIMINAL JUSTICE SYSTEM, *supra* note 24, at 35; *see* KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 167-69. For an excellent primer on principles and techniques of forensic DNA, *see* KOBILINSKY, LIOTTI & OESER-SWEAT, *supra* note 26, at 1-196.

256. Following the analogy used above, if the frequency tables were conducted by sampling two hundred people at a large-sized shoe store, then naturally the purported frequency of large-footedness would fail to reflect the actual frequency of large-sized feet in the population. Or if, for some reason, it should turn out that all people in the general population with crossed eyes also have large feet, then the assumption that each variable was independent would prove incorrect.

257. *See, e.g.*, BUTLER, *supra* note 26, at 501 (describing product rule); *see also* KOBILINSKY, LIOTTI & OSSER SWEAT, *supra* note 26, at 135, 341 (defining "linkage" and assumption of "linkage equilibrium"). For example, when analysts look at only the male fraction of DNA, the product rule cannot be used, because the various pieces of genetic information are known to be linked. KOBILINSKY, LIOTTI & OSSER SWEAT, supra note 26, at 116.

258. Emerging independent research also indicates that the second assumption—that of independence at the various loci—may not hold true for all populations. After three years of battling government refusal to disclose the data upon which it based its frequency tables, defense experts obtained a fraction of the data and conducted independent analysis. As a result, these experts uncovered that in certain Native American populations, it appeared that correlations were

what has happened since the discovery illustrate the specific problems second-generation sciences raise. Notably, questions were first raised when an alert analyst happened to observe, and then to pursue out of laudable intellectual curiosity, the fact that the DNA samples of two unrelated individuals (one Caucasian, one Black) matched at nine loci. Under the statistical models then in place, a person picked at random would match that nine loci profile at a rate of 1 in 754 million in Caucasians, 1 in 561 billion in African Americans, and 1 in 113 trillion in Southwest Hispanics.[259] Simply because she was curious, that analyst checked the rest of the 60,000 person database for such matches, and uncovered ninety pairs of individuals who matched at nine loci, and several pairs at ten and even eleven loci.[260] But although such matches prompted serious questions about the accuraey of the populations statistics used in criminal cases, the analyst could take no further action, because she had "no time or thc funding to look into it anymore."[261] Hence, the research stalled.

Upon learning of these findings, a defense attorney, representing a man charged with a "cold hit" crime on the basis of a nine loci match,[262] attempted to gain access to the data to conduct further investigation. Predictably, however, the government vehemently opposed the request and cited to the arguments elaborated above: privacy concerns,[263] the burden that it would place on the government "to require the State to do a search to satisfy a single Defendant,"[264] and the fact that such research was outside the scope of the analyst's duties.[265] In another hearing, the government response revealed the intimacy and degree of state and federal coordination: the manager of California's databank testified that the federal authorities had warned that if a court ordered disclosure of the database for research purposes, the state "could lose our authority to use the software," since "if the FBI pulled our

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evident between several of the loci that had been glossed over by government researchers. Dan E. Krane, Travis E. Doom, Laurence Mueller, Michael L. Raymer, William M. Shields, & William C. Thompson, Commentary, 49 J. FORENSIC SCI. 453 (2004) (noting that "examination of data reported . . . for two Native American populations . . . shows significant departures from HWE [Hardy-Weinberg Equilibrium] at three loci for each population" and arguing that "these loci should not be used when the produet rule is employed to compute the frequency of multi-locus genotypes in these populations").

259. *See* Transcript of Proceedings at 21-22, In the Matter of the Application of the State of California for An Order, (Oct. 17, 2005) (No. MISC-001) [hereinafter Transcript] (on file with author); *see also* Kathryn Troyer, Theresa Gilboy, and Brian Koeneman, Arizona DPS Crime Laboratory, Poster Presentation at Promega 12th International Symposium: A Nine STR Locus Mateh Between Two Apparently Unrelated Individuals, Phoenix, AZ (2001).

260. Transcript, *supra* note 259, at 23, 26-30.

261. *Id.* at 25.

262. As a means of saving time and money, some states routinely do only the "Profiler Plus" test, which looks to nine loci, rather than also do the "Cofiler" test to reach the full thirteen.

263. Transcript, *supra* note 259, at 70.

264. *Id.* at 6. Ironically, the analyst testified that one requested scarch would take a less than an hour, and the other only a couple of months. *Id.* at 57-58, 71.

265. Transcript, *supra* note 259, at 58, 70.

authorization, it is just like Microsoft who said we can't use Word anymore. We are shut down."[266] Of course, the federal government's interpretation flies in the face of the federal statute enabling the CODIS, which specifically provides that the databases be made available "if personally identifiable information is removed, for a population statistics database, for identification research and protocol development purposes, or for quality control purposes."[267] Nevertheless, the trial court ruled in favor of the government, and against further inquiry.[268]

Litigation on the same issue has occurred in various jurisdictions around the nation, to varying success.[269] But under the current legal regime, it is left to individual defense attorneys, and to individual state trial judges, to press for an answer to the question, "how many multiloci matches are in the state and national databases, and why?" But although individual case litigation is the only place to seek the answer to that question, it is hardly the best place. A single trial court is understandably reluctant to grant a defense motion to pursue such broad research simply for the benefit of a single defendant in a single case. Moreover, judges might understandably be wary about issuing orders to open the databases without undertaking a comprehensive examination of the privacy interests involved, the caliber of the research proposal, or the estimated scope of the project: all questions that a busy trial court is typically ill-equipped to consider. At the same time, the government, which controls the data, lacks the money, time, expertise and perhaps most critically, the interest, to conduct essential inquiries. As a consequence, critically important scientific inquiry is effectively thwarted.

Imagine, however, that such a question could be asked of a neutral entity, which then had the power to grant appropriate access to independent researchers capable of answering it.[270] This body could efficiently negotiate the

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266. Transcript of Proceedings at 31-32, People v. Davis, (Jan. 18, 2006) (No. SCN 190226) (testimony of Kenneth Konzak).

267. 42 U. S. C. § 14132(b)(3)(D) (2006).

268. Laura Ernde, *Defender Cites Mistakes in DNA Database*, DAILY J. (S.F.), Jan. 11, 2007. The attorney, Bicka Barlow of the San Francisco Public Defender's Office, appealed to the Court of Appeals, which subsequently denied a writ of appeal. Davis v. Super. Ct. San Francisco, No. A116603 (Cal. Ct. App. Mar. 8, 2007).

269. Ultimately, the court ordered the government to disclose only the barest of information: a summary of the report of the analyst's findings. *See* Minute Entry, In the Matter of the Application of the State of California for an Order Requiring Custodian of Records as DPS Product Documents/DNA Database Unit, Arizona v. Lopez (No. CR-20051252) (Super. Ct. Az. Oct. 26, 2005) (ordering Arizona lab to conduct a specific search of state database, and report results to defense attorney) (on file with the author).

270. The request could logically come from a range of places, including public defender organizations, individual offices in a particular jurisdiction, professional associations such as the National Association of Criminal Defense Lawyers, or even non-profits erected precisely to conduct these types of reviews. Data generated by a researcher commissioned by either a specific defense office or professional organization would necessarily be protected by attorney-client privilege, such that access to the information contained in such a study or report might not be

privacy, proprietary information, and confidentiality concerns raised by such research. The research could be made available on a broad basis, to the benefit of defendants as a class. Rather than have a single judge shoulder the burden of ordering what is essentially a large, long-term research project for the benefit of one defendant, the judge could instead ask whether the government has enabled scientific development and study through broader-scale efforts mediated by a neutral scientific panel. More generally, such a panel could also periodically survey the field and identify desirable areas for continued study.[271] If properly funded, the panel could even award grants for research, the results of which could then be made available to the entire criminal justice community.

Another key component of such a panel would be the periodic publication of guidance documents intended to assist judges, lawyers, and technicians with critical and emerging questions related to a technology. Where varying legitimate theories exist, these documents would highlight the conflict and summarize the arguments in favor and against each position. In this respect, a neutral national panel would embrace, rather than gloss over, conflicts in the scientific community with regard to the desirability of various methods or techniques. Similarly, a centralized monitoring institution would be a natural repository for the collection and analysis of data about the efficacy of forensic methodologies. Woefully absent from the public debate about the use of various technologies in the criminal justice system are any data on the degree to which forensic evidence is actually used in investigations, to what effect, and whether those investigations result in conviction. A centralized oversight agency could not only ensure that forensic evidence is used properly; it could also compile the data necessary to ensure that it is used intelligently.

The panel could also serve as a promoter of best practices by promulgating protocols and standards. It could oversee the auditing and proficiency testing necessary to ensure that methodologically sound techniques are implemented properly on a lab-by-lab and case-by-case basis.[272] Even

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disclosed broadly.

271. *Cf.* Saks, *Merlin and Solomon*, *supra* note 10, at 1132-33 (questioning whether "admissibility decisions of courts are instruments too blunt to guide the development of scientific fields"); Thompson & Ford, *supra* note 140, at 100-07 (identifying problems in reliance upon databases and suggesting areas of necessary development and study).

272. The Office of the Inspector General, which investigated the FBI DNA scandal, noted the general lax enforcement mechanisms for quality control in DNA typing labs. U.S. DEP'T OF JUSTICE, THE FBI DNA LABORATORY: A REVIEW OF PROTOCOL AND PRACTICE VULNERABILITIES 17-21 (May 2004) (noting that labs initially could "self-certify" their compliance with quality assurance standards required for participation in the national database, and that even those who relied on external audits often did not follow the recommendations presented); *id.* at 21 (noting that stricter enforcement measures did not prevent the "weaknesses in . . . procedures and protocols" that led to the FBI lab scandal, even though the lab had received clean reports from both internal and external auditors, and was accredited at the time). Effective forensic analysis requires quality assurances of numerous kinds, including: that the methodology is valid (including tailored to a particular purpose); that the laboratory's protocols for executing the

though most states require licenses for everything from nail salons to fishing, no national or statewide licensing standard or board exists for forensic crime laboratories.[273] A national panel could set out standards for regular auditing of laboratories, and for blind proficiency testing and baseline qualification of analysts,[274] rather than simply relying upon voluntary or ad hoc national accreditation processes run by professional organizations comprised of the very technicians under review.[275] In this respect, comprehensive monitoring likely militates in favor of a tiered structure for such oversight agencies, with complements to the national panel in the form of statewide oversight structures aimed at ensuring quality control within each laboratory. And even if the federal government failed to act nationally, the existence of an assortment of state or regional panels might stir "competition" in both standard-setting and research.

As scandals have erupted across the nation, several states have reacted by convening just such entities. For instance, in response to scandals at its premier laboratory, Virginia quickly enacted legislation creating a Department of Forensic Science, headed by a director appointed by the governor, and separate from the Department of Criminal Justice services.[276] The legislation also provided for a state Forensic Science Board (FSB) in the wake of scandals at Virginia's premiere laboratory.[277] The FSB is responsible for adopting regulations for the administration of various forensic disciplines, including DNA, drug, and breathalyzer testing, and for setting forth goals and standards for the department. At the same time, Virginia convened a Scientific Advisory

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methodology are valid (including training, oversight, and error prevention); that the laboratory's actual execution of that protocol is generally reliable (including blind testing, quality assurance methods, and regular review of corrective action files); and that the execution of a methodology in a particular case is reliable.

273. A recent study of forensic laboratories that conduct DNA testing revealed that only 63% were accredited, and 87% of those had been accredited by ASCLD, the professional association. Greg W. Steadman, *Survey of DNA Crime Laboratories, 2001,* at 2-3, Bureau of Justice Statistics, Jan. 2002. A comprehensive list of current state quality assurance regulations for DNA typing can be found at Seth Axelrad, *State Regulations on Quality Assurance for Forensic DNA Laboratories*, AM. SOC'Y L., MED. & ETHICS, *available at* http://www.aslme.org/dna_04/reports/axelrad2.pdf.

274. A recent study explored the feasibility of external blind proficiency tests of forensic laboratories. Peterson, *supra* note 125, at 32. Despite encountering several obstacles, the researchers concluded that "external blind proficiency testing in forensic DNA laboratories is possible," even though they did not recommend it. *Id.* at 39.

275. Presently, the professional association, the American Society of Crime Laboratory Directors or ASCLD, accredits laboratories through its Laboratory Accreditation Board. BUTLER, *supra* note 26, at 395. Their accreditation process does not require any regular blind proficiency testing, nor does it appear even to require that laboratories maintain centralized error logs to record (and presumably analyze and correct) errors made in and across cases.

276. VA CODE ANN. § 9.1-1100 (2005). The DFS is not entirely independent, in that it is responsible for providing forensic laboratory services to government agencies only. *Id.* § 9.1-1101. The defense may petition the court for laboratory services. *Id.* § 9.1-1104.

277. *See* VA. CODE ANN. § 9.1-1109 *et seq.* (2005).

Committee (SAC), composed of thirteen members who serve for four years.[278] The SAC reviews laboratory operations of the Department of Forensic Science, and makes recommendations on protocols, testing, qualifications, and quality control.[279]

Virginia's efforts are a step in the right direction toward comprehensive oversight.[280] A centralized state body can execute regular auditing procedures, as well as commission spontaneous open-file, big-picture reviews of laboratories' materials, including comparisons across cases. In many instances, such reviews will be the only means of uncovering red flags that pinpoint certain labs, or analysts, for closer scrutiny.[281] Such an entity can also skillfully navigate confidentiality concerns to prevent inappropriate disclosure. At the same time, the entity could make publicly available the results of quality control and assurance measures.[282]

As a practical matter, how might such an entity come into being?[283] The easiest response would be through legislative enactment.[284] Just as Congress

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278. *Id.* § 9.1-1111 *et seq.*

279. *Id.* § 9.1-1113.

280. The passage of the Justice for All Act of 2004 rendered states eligible for grants if they certified that they used "generally accepted laboratory practices and procedures, established by accrediting organizations or appropriate certifying bodies." 42 U.S.C. § 3797k *et seq.* And indeed, several states have undertaken gestures of reform, both before and after the 2004 federal legislation. *See, e.g.*, 20 ILL. COMP. STAT. 3981/5 (2005) (creating laboratory advisory committee); MASS. GEN. L. ANN. 6 § 184A (creating a board composed of government representatives to collect data and report on operation of forensic services in state); N.Y. EXEC. § 995-a & -b (2006) (creating diversely composed Commission on forensic sciencc); TEX. CRIM. PROC. CODE ANN. § 38.01 (2005) (same); WASH. REV. CODE § 43.103.010 et seq. (creating government-constituted state forensic investigations council). Other efforts were unsuccessful in enacting the proposed reforms. *See, e.g.*, S.F. 3273, 84th Leg., 2nd Reg. Sess. (Minn. 2005) (proposing a forensic laboratory oversight commission); S.B. 768, 93rd Gen. Ass., 2nd Reg. Sess. (Mo. 2006) (setting forth system of crime lab oversight, including a diversely composed oversight committee); H.B. 1380, 2d year of 159th Sess. (N.H. 2005) (establishing forensic science oversight commission).

281. *See, e.g.*, Ruth Teichroeb, *They Sit in Prison—But Crime Lab Tests are Flawed*, SEATTLE POST-INTELLIGENCER, Mar. 13, 2004, at A1 (describing internal audit of one analyst, which revealed flaws in 30 of 100 cases); Jonathan Saltzman, *US Audit Found More Problems at Crime Lab*, BOSTON GLOBE, Feb. 1, 2007, at A1 (reporting audit of state crime lab that revealed systemic problems visible only across cases).

282. As one commentator has observed, a "[s]tastistical review" is essential to determine abnormalities in a laboratory by looking across cases, not just within a case. Labs with anomalously "high or low number[s]" on relevant criteria can then be targeted for closer examination. Koppl, *supra* note 118, at 270-71.

283. Professors Walker and Monahan also discuss the potential sources of authority for convening such panels, as well as for the treatment of the panel's results by both district and appellate courts. Walker & Monahan, *Breast Implant Litigation*, *supra* note 162, at 825-830.

284. Congress mandated the constitution of a DNA Advisory Board (DAB), under the DNA Identification Act of 1994, which convened for five years and addressed standards for forensic testing. At the close of that five year period, the DAB's duties effectively transferred to the Scientific Working Group on DNA Analysis Methods (SWGDAM), an FBI-led committee that could not fairly be characterized as independent. BUTLER, *supra* note 26, at 394-95.

created CODIS, and so followed the states, so too could legislatures create CODIS's chaperone.[285] Alternatively, the National Research Council, the operating arm of the National Academy of Sciences, could pick up where it left off and regularly convene an expert panel, which might in turn pressure the executive and legislative branches for access to the required resources.

Courts could also effectively force the creation of such panels by refusing to find admissible any forensic evidence proffered without proof that the underlying data necessary to test its methodological soundness has been subject to nongovernment-related scrutiny. After all, *Daubert* itself specifically instructed that "submission to the scrutiny of the scientific community is a component of 'good science,' in part because it increases the likelihood that substantive flaws in methodology will be detected."[286] It further acknowledged that the "scientific project is advanced by broad and wide-ranging consideration of a multitude of hypotheses."[287] Precisely to enable such wide-ranging consideration, the government must require open access to databases—perhaps not to every individual litigant, but certainly to a qualified and limited community of researchers. The litigation surrounding the multilocus matches provides just such an opportunity: just as the decision in the *Castro* case catalyzed the first NAS panel, so too could an adverse decision in several trial court cases—either ordering the disclosure of the databases or precluding the admission of the evidence drawn from their matches—prompt either executive or legislative response.[288] Such issue forcing by courts might also prompt private companies concerned about proprietary information to cooperate more fully with defense-side or independent analysts. For instance, although the private companies that developed the primer sequences for forensic DNA typing initially refused to release what they deemed proprietary information, some companies realized a competitive advantage in publishing such information, because law enforcement would elect their technologies over those not open for inspection.[289]

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285. In fact, various states have considered legislation that tightens scrutiny over forensic laboratories. *See, e.g.*, 2005 Vt. S.B. 249 (introduced by Senator Illuzzi) (creating a Forensic Laboratory Oversight Commission); Ill. H.B. 5241 (Durkin); Mo. H.B. 1330; N.H. H.B. 1380 (Hammond). However, authorization for access to the federal database requires federal, not just state, action. Indeed, just before this article went to press, the National Academy of Sciences convened one such general committee as a result of congressional action. *See* Identifying the Needs of the Forensic Science Community, The National Academies, *available at* http://www8.nationalacademies.org/cp/projectview.aspx?key=48741 (last visited May 14, 2007).

286. *Daubert*, 509 U.S. at 593.

287. *Id.* at 597.

288. Of course, to be effective, a decision likely would have to be rendered in numerous cases. The government can always simply choose not to use the forensic evidence, or to forego the case entirely, if it wishes to avoid enforcement of such an order.

289. BUTLER, *supra* note 26, at 101 (describing how, after courts in California, Colorado and Vermont excluded DNA evidence absent disclosure of primer sequences, the Promega Corporation "made the decision to publish their STR kit primer sequences . . . and have done so

*2. Granting Access to Basic Information*

At the local level, each forensic agency should be held responsible for providing easy access to certain universal and critical documents. In the words of one scholar, discussing the increasing presence of science in public debate, "[i]t is important to ensure that good scientific information not only is available in the abstract, but also is *made* available to the right people, at the right times, and in ways that promote accountability in the production, transmission, and use of knowledge."[290] With the advent of the Internet, little justification exists for withholding general documents on the grounds that routine production of such information would unduly burden the laboratory. Forensic agencies should store key operating materials such as protocols, analysts' resumes, and the results of validation studies and proficiency tests in an electronic format that could be downloaded at any time. Agencies could likewise make the reports issued by independent entities available in an electronic format that even indigent defendants could access. Agencies could even make proficiency test and audit results and corrective action logs available online. At present, such information is nearly impossible for defense investigators to obtain.[291] To the extent that such information might include sensitive material, the government could easily protect it through passwords that can be provided to counsel in an individual case by court order. Alternatively, a laboratory could simply hold "visiting hours" during which such items are available for inspection.

### *B. Loosening the Courtroom's Grip on the Law*

Changes, like those above, to the oversight and availability of forensic evidence will unquestionably improve the overall quality of evidence presented in criminal cases. But simply tightening the laboratory oversight structure is not enough. In the coming years, second-generation techniques will likely enter the court in a high number and wide range of cases. And as scientific techniques evolve, understandings about legitimate scientific practice will change as well. Yet the current legal structure fails to embrace, much less address, either of these realities. The defense function will still suffer from the structural features that discourage robust testing of scientific evidence, and the prosecutorial function will still benefit from its dominance of the market in forensic services. But several small shifts in legal obligations, aimed at evening the playing field between the government and the defense, could shore up the adversary process

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since").

290. Jasanoff, *supra* note 186, at 133-34.

291. Ruth Teichrocb, *They Sit in Prison—But Crime Lab Tests are Flawed*, *supra* note 281, at A1 (recounting series of audits that uncovered flaws in numerous cases, while also revealing that defense counsel and the defendants in those cases had not been notified of findings). *But see* Ill. Sup. Ct. R. 417(b)(iii-vi) (2004) (expressly providing for defense discovery of such materials in DNA cases).

as a safeguard not only against faulty forensic evidence, but also against accurate forensic evidence used in a faulty fashion.

*1. Greater Centralization of Defense Functions*

Questions have long lingered concerning the desirability of consolidating indigent defense services within a particular jurisdiction.[292] Advocates of such consolidation, typically in the form of public defender offices or agencies, argue that effective representation requires the pooling of resources and experience available only in formal, centralized agencies.[293] Other proponents point to the institutional power realized by the centralization of defense services, particularly when such offices control their own internal allocation of resources.[294]

The rise of second-generation forensic evidence lends further credence to arguments favoring official centralization. However, even stopping short of formal reorganization of the provision of such services, some informal changes in how defense attorneys approach their responsibilities can be implemented more immediately. Specifically, second-generation forensic evidence requires that defense attorneys coordinate their efforts broadly, not just across cases, but across county and state borders.

Fortunately, the very technologies that define the second generation of forensic evidence also enable a second-generation response: technology aids in state and national cohesion among an otherwise diffuse practice of criminal defense. For instanee, in response to the eomplexity and pervasiveness of DNA typing, two practicing attorneys joined with a renowned academic expert in

292. Robert L. Spangenberg & Marea L. Beeman, *Indigent Defense Systems in the United States*, 58 L. & CONTEMP. PROBS. 31 (1995) (outlining various ways in which indigent defense services are performed). My recommendation for greater deliberate collaboration holds true across the defense bar, although well-resourced defendants tend to confront fewer of the structural impediments to mounting effective challengcs of evidence.

293. *See, e.g.*, Kim Taylor-Thomas, *Individual Actor v. Institutional Player: Alternating Visions of the Public Defender*, 84 GEO. L.J. 2419, 2432 (1996) (relating successful collaboration between Wasbington, D.C. and Cook County, Illinois public defender offices); Stcphen Bright, *Counsel for the Poor: The Death Sentence Not for the Worst Crime But for the Worst Lawyer*, 103 YALE L.J. 1835, 1849-57 (1994) (detailing problems raised by lack of centralized dcfense programs and adequate funding).

294. *See, e.g.*, Taylor-Thomas, *supra* note 293, at 2449-57 (describing how centralized offices can better wield political power particularly with regard to funding issues). Opposition to centralizing the defcnse function tends to center around the perception that to do so would be both costly and contrary to thc ultimate goal of justice, because defense lawyers would litigate—and even win—more cases. Note, *Gideon's Promise Unfulfilled: The Need for Litigated Reform of Indigent Defense*, 113 HARV. L. REV. 2062, 2067 (2000) (recounting political opposition to bills to mount statewide defense services). One might also argue that consolidation heightcns the possibility of conflicts of interest among defense lawyers, both in ethical terms as well as in their own apportionment of time and effort to particular cases. *See, e.g.*, Darryl K. Brown, *Defense Attorney Discretion to Ration Services and Shortchange Some Clients*, 42 BRANDEIS L.J. 207 (Winter 2003/2004).

DNA in sounding a call to defense attorneys to collaborate nationally on issues of DNA evidence.[295] They identified the "most fundamental need" as an "ongoing, comprehensive, national repository of defense-oriented forensic science information."[296] Accordingly, in conjunction with the National Association of Criminal Defense Lawyers and the National Legal Aid and Defender Service, the attorneys formed an online Forensic Library to provide a forum for defense attorneys to share materials related to forensic evidence.

Such collaboration serves as a model for the kind of pooling of resources necessary to ensure that the defense bar responds effectively to complicated, challenging, and changing forms of second-generation forensic evidence. But defense counsel need greater resources to foster and encourage collaboration. Legislatures could aid in such efforts by specifically funding activities aimed at national collaboration, and nonprofit organizations could designate individuals responsible for coordinating such efforts on a broad scale. Finally, some adjustments in the understandings of confidentiality and work-product privileges are also essential, so that communications and information-sharing among defense attorneys might be appropriately protected the same way in which communications between lawyers in different offices of the Department of Justice are protected.

*2. Defense Entitlements to Access*

Secondly, because second-generation evidence depends so largely upon data outside the scope of the individual case, access to this data is essential to safeguard the integrity of the evidence. If the government may use a database to make conclusions about the defendant, then the defendant should have access to that database, within reason, to confront those conclusions. Thus, within the bounds of an individual case or investigation, defense attorneys should be permitted to petition the court for equal access to the relevant databases. Courts should not accept the excuse that third parties hold these databases: if the government obtained information, then the defense should have equal opportunity to do the same or else the evidence should be deemed inadmissible. Similarly, and especially in the absence of neutral entities like the Board described above, courts should reject claims that disclosure of database materials is unduly cumbersome or invasive, and should instead simply cabin the scope of disclosure appropriately.

Again, the experience of DNA evidence proves illustrative. Presently, Illinois is one of the few states in the nation to provide a statutory framework

295. *See, e.g.*, Richard S. Schmechel, William C. Thompson & Edward J. Ungvarsky, *Defending With (And Against) Forensic Evidence: A Call to Share Resources*, THE CHAMPION, Aug. 2005, at 39.

296. *Id.*

for defense access to genetic databases in individual cases.[297] Thus the defendant, upon a particular showing, can exercise a parallel capacity to investigate an offense through a search of the database. Such a search may aim to show, for instance, that an evidentiary item suggests a genetic profile other than the defendant's, or that a mixture of profiles points to a different possible perpetrator. The defendant's rights to due process and the assistance of counsel clearly contemplate such searches, and they are essential to the equitable administration of justice.[298] For example, one lawyer in Missouri reported that she represented a man with no prior violent convictions who was "matched" through a "cold hit" in a database to a case in which the government intended to seek the death penalty.[299] Noticing that the government had failed to check the database with regard to an intimate sample taken from the victim, the attorney persuaded the laboratory, over the objections of the prosecutor, to run the second profile through the database.[300] When the second profile turned up a match to a convicted sex offender, the government dismissed the case against her client.[301] In the absence of explicit statutory frameworks for granting defense access, however, attorneys should not have to depend on the kindness of government technicians.

*3. Greater Government Duties*

Given the degree to which the government dominance of the market for forensic science inevitably advantages the government in terms of knowledge and resources about such techniques, the government should assume several duties consistent with the prosecutorial duty to see that "justice be done" rather

297. The Illinois statute permits the defendant in any case where DNA may be relevant to the defense investigation or at trial to move the court for an order requiring the state police to conduct certain genetic tests, or to make certain comparisons or searches within the database. 725 ILL. COMP. STAT. § 5/116-5 (2005); *see also* GA. CODE ANN. § 24-4-63 (2005) (providing similar rights to Georgia defendants upon a showing that "access to the DNA data bank is material to the investigation, preparation, or presentation of a defense at trial or in a motion for a new trial"). The American Bar Association recently endorsed this approach in its artieulation of general standards for DNA evidence. ABA CRIMINAL JUSTICE STANDARDS ON DNA EVIDENCE (Standard 8.3, approved by ABA House of Delegates, Aug. 2006). Some states provide oblique entitlements in that they specifically curtail database access generally, but then provide an exception for defense counsel pursuant to court order. *See, e.g.*, HAW. REV. STAT. § 844D-82 (2006); N.C. GEN. STAT. § 15A-266.8 (2005); CAL. PENAL CODE § 299.5(g)-(h) (West 2005); N.J. STAT. ANN. § 53:1-20.21 (2006). The permissible scope of sucb access, however, is far from clear, especially where the statute specifically states that only the material "related to tbe case" may be disclosed. *See, e.g.*, IOWA CODE § 81.8 (2005).

298. By comparison, just as the government cannot instruct a witness to refuse to talk to the defense, so too should the government not be allowed to "sequester" biological "witnesses," particularly potentially exculpatory ones.

299. Email from Cynthia Dryden, Public Defender in St. Louis, MO, to Erin Murphy, Assistant Professor of Law, University of California, Berkeley—School of Law (Boalt Hall), March I, 2006 (on file with author).

300. *Id.*

301. *Id.*

than to simply win every case.[302]

First, the law should impose upon the government an affirmative duty to disclose any departures from protocol that government analysts undertake in reaching the results at issue in the case.[303] Such an affirmative duty, like the duty of the government to disclose exculpatory evidence to the defense,[304] places the obligation to observe and report any deviations from standard practice upon the party best positioned to bring these deviations to the attention of the court. In many cases, the government will be able to justify such departures on the basis of sound scientific practice or evolving standards; nevertheless, the government should identify and report them, rather than leaving to the defense—who is often least well-positioned to notice—the responsibility of uncovering them. Once disclosed, the defense has several options: it may elect to challenge the legitimacy of the technique in light of the modification; argue to the jury that the modification was ill-advised or invalidated the results; or forego use of the information altogether.

This obligation of disclosure is also in keeping with the law-like deference evidentiary rules accord to the findings of validity of a particular methodology.[305] Presumably, the court initially admitted results of a particular technique on the premise that the approved technique was executed in a particular case in conformance with general standards. If, however, some "tweaking" or modification was required, then the government has a duty to disclose the deviation—much as an advocate of one position has an obligation to disclose binding contrary authority, or as the government has an obligation to disclose information in its possession that contradicts the statements of its witnesses. In short, the government, rather than the defense's careful review or good luck, should call to attention any deviations from the protocols that garnered acceptance of the method in the first place.

Second, to encourage scientific progress, courts should place upon the government affirmative obligations consistent with the obligations of good science. Although the law's interest in finality, certainty, and consistency tends to value precedent over innovation, these principles ill-serve the enterprise of science, which thrives instead on novelty and experimentation. Rather than entrench methodologies and penalize the government for experimentation, the law should create incentives for the government to engage in research and

302. Berger v. United States, 295 U.S. 78, 88 (1935).

303. For example, in a DNA case, the protocol may require that the analyst disregard as spurious any peaks lower than a certain cut-off level, or in particular position to another peak, or at a particular height-ratio to another peak. Yet, in a particular case, the government may attempt to incorporate those peaks because some other information justifies, in the government's eyes, the peak's inclusion. In the present legal framework, the government is under no obligation to disclose to the defense its decision to override standard practices; in the proposed regime, the government would be required to bring that discretionary decision to light.

304. Brady v. Maryland, 373 U.S. 83 (1963).

305. *See supra* Part II.B.1.

development, and bring forward new evidence in support of its techniques.

Accordingly, the government should carry a burden of placing before the court continued evidence of a technique's legitimacy. Rather than render admission of a methodology a one-time question that, once answered, is rarely asked again, the law should affirmatively require the government to provide evidence verifying the technique's continued viability. This is not to say that the government should be expected to reinvent the wheel by eonducting full-scale admissibility hearings in every case. Instead, rather than start from an assumption that "no news is good news," this approach would regularly ask "what have you done for me lately?" While the disclosure of new validation studies might not be essential to the continued admission of the methodology, the failure to supply a court with evidence of continued development within the field would, after a substantial amount of time, cause courts to view such evidence with increasing skepticism. Likewise, the absence of evidence demonstrating the methodology's continued validity could alone constitute evidence of its obsolescence, and justify exclusion. In short, whereas courts venerate an ancient legal principle for having stood the test of time, they should greet a similarly antiquated scientific technique skeptically absent evidence of ongoing viability.

Third, rather than simply selecting and advocating for the theory that suits it best, the government should bear a burden of presenting evidence and disclosing results derived from all legitimate, competing theories. Law imposes upon science an unrealistic degree of certainty, and then imparts one result over another without due regard for legitimate conflict.[306] Evidentiary rules settle for the "general acceptance" of one method when, in fact, authentic conflict exists,[307] and more than one method may have attained a threshold of reliability. In science, it is not unusual that two opposing positions may find equal support in legitimate argument and proof. In such cases, law-like deference to one position at the expense of the other thwarts and distorts the actual state of the science.

Such conflicting, but equally legitimate, methodological approaches merit equal play before a jury. However, the defense is ill-poised, particularly with respect to second-generation techniques, to identify areas of conflict or seek out and retain experts in support of its position. Placing the burden on the

306. Law, like seience, must remain receptive to new information, allowing it to adapt over tiine. Walker & Monahan, *Breast Implant Litigation*, *supra* note 162, at 822 (arguing for the contingent "law-like" treatment of certain scientific results, while noting that "[i]nevitably, science changes over time just as law changes over time"); *id.* at 822 n.119 (quoting Heidi Li Feldman, *Science and Uncertainty in Mass Exposure Litigation*, 74 TEX. L. REV. 1, 16 (1995) ("As seientists acquire new data and change their collective judgments about which background assumptions to hold constant, they revise and replace even well-established scientific theories. Scientific theory does not achieve absolute finality.")) (footnote omitted).

307. Frye v. United States, 293 F. 1013 (1923); Daubert v. Merrell Dow Pharms., 509 U.S. 579, 593-94 (1993).

government properly acknowledges both the government's domination of forensic science, and the impossibility of bestowing expert assistance upon every defendant in every case. Failure to produce such evidence, like failure to disclose exculpatory information in its possession, could constitute grounds for precluding the evidence altogether.[308]

By means of illustration, take a question regarding the proper means of calculating the random match probability in a "trawl" case, where the government matched the defendant after making a "cold hit" in a database. At present, there exists reasonable debate regarding the preferred method for calculating the match probability in such cases. As the DNA Advisory Board has explained:

> There are alternate methods for assessing the probative value of DNA evidence. Rarely is there only one statistical approach to interpret and explain the evidence. The philosophy and experience of the user, the legal system, the practicality of the approach, the question[s] posed, available data, and/or assumptions all affect the choice of approach.[309]

For example, some scholars argue for a likelihood ratio that takes into account the size of the database.[310] Some suggest that the results of a "trawl" are more reliable than in a simple confirmation case, because the analyst has compared the genetic profile to a database and excluded a large number of persons.[311] Some think that a simple "counting method" is most appropriate,[312] and some contend that the likelihood of a "false positive" increases as the analyst looks in a database for a match, and thus the statistical probability should be accordingly discounted by this risk.[313]

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308. Where competing theories exist, however, the government can argue in favor of a particular approach, leaving the fact-finder to decide which it finds most persuasive. Of course, some commentators find it appalling that juries should be allowed to resolve methodological disputes that even expert scientists cannot resolve. *See supra* note 237. However, if presented with the equal legitimacy of both positions, then jurors are in many respects in the best position to adopt whichever approach best fits the circumstances of the case. For instance, jurors might be more conservative in a "cold hit" case than in a case with corroborating evidence, and for good cause. Thus, drawing on Professors Monahan's and Walker's model, for instance, whereas law-like treatment of scientific methodologies might entitle a judge to instruct a jury that one particular technique is sound, a revised instruction might instead inform jurors that several separate and competing scientific approaches or techniques are sound.

309. BUTLER, *supra* note 26, at 614.

310. *See, e.g.*, NRC II, *supra* note 201, at 40.

311. *See, e.g.*, BUTLER, *supra* note 26, at 618 (citing Evett, Foreman & Weir, BIOMETRICS 56(4), at 247-76 (2000)); Peter Donnelly & Richard D. Friedman, *DNA Database Searches and the Legal Consumption of Scientific Evidence*, 97 MICH. L. REV. 931, 933 (1999).

312. NRC I, *supra* note 225; BUTLER, *supra* note 26, at 515.

313. *See, e.g.*, William C. Thompson, Franco Taroni & Colin G. Aitken, *How the Probability of a False Positive Affects the Value of DNA Evidence*, 48 J. FORENSIC SCI. 47, 52-53 (Jan. 2003). With regard to the use of likelihood ratios to express match probabilities, one scholar has similarly argued persuasively that such ratios should incorporate error rate data. *See* Jonathan J. Koehler, *Why DNA Likelihood Ratios Should Account for Error (Even When a National Research Council Report Says They Should Not)*, 37 JURIMETRICS J. 425, 429 (1997) (arguing that

In the current procedural environment, government lawyers may pick which of these methods they prefer, demonstratc its reliability, and effectively ignore any contrary voices unless specifically raised by an opposing party. In a select few cases, opposing counsel might be knowledgeable or well-resourced enough itself to offer the method favorable to the defense, but in the vast majority of cases, counsel will not undertake to argue or perhaps even know to argue any contrary view. Yet allowing the government to pick its preferred methodology from among legitimate competitors, and leaving to the defense the obligation to uncover alternative theories, saddles the party with the least resources and least access with the burdcn of introducing an equally valid approach. While such a burden might rightly operate with regard to other forms of evidence, history suggests that, in the lopsided world of forensic science, the defense can rarely bear it well. Rather, bestowing on the government a legal obligation to present all statistical calculations that have any legitimate basis—not just to the fact-finder but also directly to defense counsel—diminishes the risk that institutional inequities or the administrative nature of criminal process will result in the presentation of misleading scientific evidence.

*4. Error and Admissibility*

Finally, in every case, courts should consider whether the laboratory generally operates at a sufficient level of competence first as a legal and then as a factual question.[314] At present, courts typically view the error rates of either the methodology itself or the executing laboratory as factual questions of "weight" to be determined by a jury,[315] rather than as legal questions of

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error rates should be calculated into probability determinations).

314. At present, this question is often treated either as irrelevant when the defense cannot make a showing of malfeasance expected to affect the results in the case at bar, or else as a matter for the jury to decide in weighing the evidence. *See, e.g.*, United States v. Morrow, 374 F. Supp. 2d 51, 67-68 (D. D.C. 2005) (finding such evidence relevant for "weight . . . not exclusion"); United States v. Ewell, 252 F. Supp. 2d 104, 113-14 (D. N.J. 2003) ("What the defendant has sought to do here is challenge the proficiency of the tester rather than thc reliability of the test. Such challenges go to the weight of the evidence, not to its admissibility."); People v. Reeves, 109 Cal. Rptr. 2d 728, 750-53 (Ct. App. 2001). The second National Research Council report refused to even reeommend consideration of laboratory error at trial, whether as a qualifier on the statistical calculations or as independent evidence regarding reliability. NRC II, *supra* note 201, at 185. Alternatively, some courts have found that there exists some level at which the general practices of a laboratory fall so far below the acceptable standards that they eease to be "reliable," and thus should be excluded. *See, e.g.*, Murray v. Florida, 838 So.2d 1073, 1081 (Fla. 2002) (reversing death conviction based in purt on DNA evidence because errors and contamination in testing procedures meant "the State did not meet its burdcn in demonstrating the general acceptance of the testing procedures" used in the casc); People v. Castro, 973 N.Y.S.2d 985, 986 (N.Y. Sup. Ct. 1989) (holding that admissibility should turn in part on whether the technique was properly exeeuted).

315. *See* Dale A. Nanee & Scott B. Morris, *Juror Understanding of DNA Evidence: An Empirical Assessment of Presentation Formats for Trace Evidence With a Relatively Small Random-Match Probability*, 34 J. LEGAL STUD. 395, 398 (2005) (citing cases).

admissibility. As a result, laboratories have little incentive to document their rate of error and courts have still less incentive to require their provision and disclosure.[316] But as a threshold matter, judges should not admit evidence processed at laboratories that fall below a reasonable standard of operational efficiency. A restaurant that served up roaches in its spaghetti on five earlier occasions is not, after all, a place you would go to eat, no matter how much it assures you that it prepared your meal in a sanitary manner. In the same vein, when a person's freedom, and not just good digestion, is on the line, a similar standard should apply.

A facility with a demonstrated history of improper storage or handling of evidence, or an inexcusable rate of failure on proficiency tests, simply cannot generate results reliable enough to discount the risk of error, regardless of how meticulously its personnel have performed the tests in an individual case. Moreover, staking admissibility of evidence on a laboratory's general reliability not only creates incentives on the part of the laboratory to comply with published standards of operation, but it also gives the prosecution a vested interest in competently managing the laboratory, thereby encouraging an oversight role in place of unquestioned allegiance. Finally, if reliability were treated as a threshold question of admissibility, on which the proponent of the evidence carried the burden, then the government would have to submit evidence of the laboratory's error rate. This requirement would thereby foster the implementation of testing and oversight procedures necessary to quantify such a rate. And, if the question of a laboratory's threshold competence level is a quintessentially legal one—does this laboratory generally operate at a threshold level of reliability?—then courts would have to set appropriate standards of operational legitimacy. This would have the salutary effect of both articulating such standards, and giving laboratories an incentive to hew to them. Moreover, while earlier decisions finding a particular lab competent may warrant a degree of deference, counsel should always retain the capacity to prove an approved lab unreliable. Similarly, a tainted laboratory might redeem itself by demonstrating that it has instigated changes to remedy a systemic problem.

Regardless, once a laboratory meets the appropriate threshold standard, the courts should nonetheless admit evidence of error as factual evidence for

316. *See* United States v. Morrow, 374 F. Supp. 2d 42, 46 (D.D.C. 2005) (noting that "the great weight of legal precedent indicates that possible contamination issues go towards the weight—rather than the admissibility—of DNA evidence"). U.S. v. Lowe, 954 F. Supp. 401 (D. Mass. 1996) (noting that the "FBI does not compute a systemic laboratory rate" yet nonetheless finding evidence admissible, observing that "no federal cases . . . have excluded DNA evidence on account of a theoretical error rate alone"). Simon Cole compiled existing data on the rate of false positives for fingerprinting, and determined that, assuming the resultant .8% false positive rate, U.S. laboratories "reported 1,905 false positives in 2002 alone." Simon Cole, *More Than Zero: Accounting for Error in Latent Fingerprint Identification*, 95 J. CRIM. L. & CRIMIN. 985, 1034 (2005).

the jury to weight as it deems appropriate. This principle carries particular weight with regard to "cold hit" cases, given that the existenee of extrinsic evidence is less likely to compensate for any mistake or error on the part of the testing authorities. Of course, the government, in turn, could introduce mitigating evidence—that any problems or errors in the laboratory are routinely dealt with in a professional and efficient manner, or that the laboratory's cited errors did not affect the particular case.

## CONCLUSION

Although this Article uses DNA typing to illustrate the problems presented by second-generation technologies and recommend possible means of mitigating them, it also intends to begin a more general conversation about how the criminal justice system will accommodate evidence from the next generation of forensic science—whether the evidence in question is that a cell phone was used at a particular time and place or that data mining uncovers evidence that the defendant perpetrated the crime. The distinct characteristics of second-generation forensic sciences—including their methodological complexity and sophistication, breadth of application, scientific certainty, implications for privacy and proprietary interests, and reliance on databases—elicit a host of concerns that courts, lawyers, and scholars must consider as such evidence continues to infiltrate criminal cases. Moreover, the fact that these technologies have the power to provide strong evidence of an individual's guilt, even in the absence of any other evidence, makes the task of monitoring the accuracy of such evidence all the more important. The recommendations in this Article attempt to strike an efficient balance among the various competing concerns. In adjusting evidentiary and legal rules to better accommodate the second generation of forensic evidence, this Article aims to fashion a justice system worthy of the innovative forms of evidence that enter into it.