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DNA Fingerprinting: The Virginia Approach

James P. O'Brien Jr.

DNA FINGERPRINTING: THE VIRGINIA APPROACH

When DNA fingerprinting[1] technology first became available in the context of criminal investigations and prosecutions, scientists, attorneys and law enforcement officials widely hailed the process as an infallible and critically important tool in the search for judicial accuracy.[2] Courts rushed to admit DNA evidence while defense attorneys cowered, feeling ill-equipped to confront this complicated and novel scientific evidence which seemed to link irrefutably the defendant with the crime scene.[3] Additionally, reputable scientists were not available to testify for the defense, leaving defendants in a truly precarious position.[4] An overwhelming percentage of the defendants in early DNA fingerprinting cases pleaded guilty, feeling helpless to defend themselves in the face of scientific alleged proof of criminal activity.[5]

Virginia courts were among the first to admit DNA fingerprinting evidence.[6] Quickly following this judicial acceptance, state legislation declared that DNA typing was "a reliable scientific tech-

1. The process is most often termed DNA fingerprinting, although it has also been called DNA typing, among other names. Dr. Alec Jeffreys, a pioneer in the area, coined the phrase "DNA fingerprinting." Sally E. Renskers, Note, *Trial by Certainty: Implications of Genetic "DNA Fingerprints,"* 39 EMORY L.J. 309, 309 n.3 (1990).

2. DNA "fingerprints" were once termed "the greatest single breakthrough in the fight against crime since fingerprints themselves were discovered in 1901." *Id.* at 309 (citing *DNA Testing on the Increase*, 131 SOLIC. J. 1596 (1987)).

3. *See, e.g.*, Randolph N. Jonakait, *Stories, Forensic Science, and Improved Verdicts*, 13 CARDOZO L. REV. 343 (1991). "Often the plaintiff or the prosecution alone calls an expert who testifies with little or no cross-examination. The opponent more or less accepts the expert's evidence as being true if it does not concern a major issue in contention." *Id.* at 348-49 n.15 (quoting Michael Graham, *Symposium on Science and the Rules of Legal Procedure, in* 101 F.R.D. 599, 634 (1983)).

4. In many early DNA cases, the defense presented no expert witnesses to counter the claims of the prosecution's DNA proponents. *See, e.g.*, Andrews v. State, 533 So. 2d 841, 849 (Fla. Dist. Ct. App. 1988). In other cases, no expert testimony was offered in favor of the DNA test. *See, e.g.*, State v. Woodall, 385 S.E.2d 253, 259 (W. Va. 1989).

5. According to Lifecodes, a major commercial laboratory involved in DNA fingerprinting technology, most of the 150 defendants tested between January 1987 and January 1988 pleaded guilty. Renskers, *supra* note 1, at 310 n.11.

6. *See, e.g.*, Spencer v. Commonwealth, 385 S.E.2d 850 (Va. 1989) (admitting DNA prints into evidence), *cert. denied*, 493 U.S. 1093 (1990).

nique" and that evidence of such testing could be admitted to prove or disprove one's identification.[7]

In the years following the initial euphoria, DNA fingerprinting has been subjected to exacting scientific and judicial scrutiny. Recently, some courts have declared DNA fingerprinting evidence inadmissible for a variety of reasons, including inadequate laboratory techniques and standards,[8] and questionable statistical analysis of fingerprinting results.[9] This judicial retreat is largely the result of various scientific and legal studies which call into question the very processes that once were deemed infallible.[10]

This Note first addresses the science of DNA and the process of DNA fingerprinting, which is important in understanding the enormous potential that accurate analysis holds for the criminal justice system. Next, the Note discusses the initial, widespread acceptance of DNA fingerprinting evidence, and proceeds with an analysis of the recent trend of questioning this heretofore "omniscient" process.

The Note then begins a critique of Virginia's approach to the DNA fingerprinting dilemma, focusing first on the question of whether the Virginia courts and legislature acted prematurely in admitting this novel scientific evidence before there was "true" universal scientific acceptance of the technology. The Note concludes with a discussion of the legislatively mandated Virginia DNA data bank, which is widely viewed as the solution to many of

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7. VA. CODE ANN. § 19.2-270.5 (Michie 1990) ("In any criminal proceeding, DNA (deoxyribonucleic acid) testing shall be deemed to be a reliable scientific technique and the evidence of a DNA profile comparison may be admitted to prove or disprove the identity of any person.").

8. *See, e.g.*, People v. Castro, 545 N.Y.S.2d 985, 997 (Sup. Ct. 1989) (holding that the laboratory procedures in the case were so inadequate that a declared match was inadmissible).

9. *See, e.g.*, State v. Schwartz, 447 N.W.2d 422, 428 (Minn. 1989) (noting " 'the real danger that the jury will use the [statistical] evidence as a measure of the probability of the defendant's guilt or innocence' ") (citation omitted); *see also* State v. Pennell, 584 A.2d 513, 519 (Del. Super. Ct. 1989); Caldwell v. State, 393 S.E.2d 436, 443-44 (Ga. 1990); Commonwealth v. Curnin, 565 N.E.2d 440, 442 (Mass. 1991).

10. *See, e.g.*, Richard Lempert, *Some Caveats Concerning DNA As Criminal Identification Evidence*, 13 CARDOZO L. REV. 303 (1991) (discussing the problem of population substructures and their effect on the representativeness of data bases used in the statistical analysis of a DNA fingerprint); *see also* NATIONAL RESEARCH COUNCIL, DNA TECHNOLOGY IN FORENSIC SCIENCE (1992) [hereinafter RESEARCH COUNCIL] (publishing the results of a major study on all aspects of DNA analysis).

the problems raised by traditional DNA fingerprinting. The Virginia data bank will be stocked with the DNA profiles, obtained through compulsory blood samples, of every felon in the custody of the Commonwealth.[11] While the data bank is promising, it raises some troubling privacy concerns, which the United States Court of Appeals for the Fourth Circuit recently addressed in *Jones v. Murray*.[12] The Note analyzes this case with an emphasis on the court's Fourth Amendment conclusions.

The Note concludes that, although Virginia may have acted rashly in its wholesale acceptance of DNA technology, DNA fingerprinting does hold a great deal of promise for accurate criminal prosecutions. The DNA data bank is the best available means of ensuring that the technology is not misused, yet remains available while alleviating some concerns surrounding DNA fingerprinting.

THE SCIENCE OF DNA[13]

The cells of the human body contain forty-six chromosomes, twenty-three inherited from the mother and twenty-three inherited from the father.[14] These chromosomes are composed of deoxyribonucleic acid (DNA), which is "the basic hereditary material [which] determines specific traits in organisms by guiding the production of specific polypeptide chains which interact to form a protein molecule."[15] Basically, DNA contains the genetic information that determines each person's individual characteristics.[16]

DNA is a chemical structure containing four bases, or nucleotides, which are commonly referred to by their initial letters: A (adenine), G (guanine), C (cytosine), and T (thymine).[17] The manner in which these bases appear throughout the DNA determines

11. VA. CODE ANN. §§ 19.2-310.2 to 310.7 (Michie 1990).

12. 962 F.2d 302 (4th Cir. 1992).

13. DNA tests were developed for use in the field of molecular biology. Laurel Beeler & William R. Wiebe, *DNA Identification Tests and the Courts*, 63 WASH. L. REV. 903, 907 (1988).

14. *Id.* at 909 n.26.

15. JEFFREY J.W. BAKER & GARLAND E. ALLEN, A COURSE IN BIOLOGY 441-42 (2d ed. 1972).

16. Beeler & Wiebe, *supra* note 13, at 909 ("The differences we see in each other are the outward manifestations of each person's unique DNA pattern. Everything from eye, hair, and skin color to facial features and shoe sizes is determined by DNA.").

17. John C. Dougherty, Comment, *Beyond* People v. Castro*: A New Standard of Admissibility for DNA Fingerprinting*, 7 J. CONTEMP. HEALTH L. & POL'Y 269, 277 (1991).

each individual's physical characteristics.[18] Each base, or nucleotide, bonds only with its complement base; that is, A bonds only with T, and C bonds only with G.[19] The structure of DNA is often described as a "double helix," or a "ladder twisted along its vertical axis."[20] Utilizing the "ladder" analogy, the rungs of the "ladder" are comprised of the bonds between the bases.[21] The order in which the bonds between the bases appear on the DNA "ladder" determines the individual characteristics of every person.[22] In other words, each individual's unique genetic code is determined by the way in which the base pairs sequence along the DNA ladder.[23] The sequence order of the base pairs does not vary from cell to cell and is unique to each individual, except in the case of identical twins.[24]

Ninety-nine percent of the DNA ladder is the same in each person and is termed nonpolymorphic.[25] Polymorphic sites, on the other hand, vary significantly between different people.[26] These polymorphic sites, or loci, are the regions where the variations in the sequencing of the bases occur and, as noted above, are responsible for each person's unique characteristics.[27] It is these polymorphic sites, or loci, that allow individuals to be recognized through DNA fingerprinting.[28] Scientists are able to examine the polymorphic sites and can distinguish between the DNA of different people.[29]

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18. *Id.*
19. *Id.* at 278.
20. *Id.*
21. *Id.*
22. *Id.*
23. *Id.*
24. *Id.*
25. *Id.* at 278, 278 n.46 ("A nonpolymorphic site may consist of the DNA sequence for eyes, hands, the head, or other characteristics shared by all Homo sapiens.") (citation omitted).
26. *Id.*
27. *Id.* at 278. "[T]he genes responsible for producing the proteins and antigens in blood are polymorphic, hence, the existence of different blood types." *Id.* at 278 n.47 (citation omitted). Genes are the "portion of DNA that determines hereditary traits." *Id.* at 278. Genes situated at the various polymorphic loci account for the differences in human beings. *Id.*
28. *Id.* at 278.
29. *Id.*

THE PROCESS OF DNA FINGERPRINTING

The fingerprinting process begins with a sample from which DNA is to be drawn. The sample must contain cells with nuclei, because the nuclei contain the DNA.[30] The source can be almost any body tissue or fluid, except for red blood cells, and in criminal cases common sources include blood, saliva, semen, and hair.[31] The tissue or fluid need not be fresh because DNA generally does not deteriorate rapidly.[32]

Two prominent fingerprinting procedures exist.[33] The first, Restriction Fragment Length Polymorphism Analysis (RFLPA), is used by two commercial laboratories, Cellmark Diagnostics and Lifecodes Corporation, and the Federal Bureau of Investigation.[34] The other procedure, a product of Cetus Corporation called Amplityping or Polymerase Chain Reaction, is conducted primarily by the third major DNA fingerprinting laboratory, Forensic Science Associates.[35]

THE EARLY USE OF DNA FINGERPRINTING EVIDENCE

When DNA fingerprinting evidence first reached American courts in the late 1980's, the courts welcomed it with open arms.[36] One judge went so far as to label the new technique "the single

30. Renskers, *supra* note 1, at 311.

31. *Id.* at 311-12. "In a rape case, you are likely to recover blood, semen, or hair virtually 100 percent of the time." RONALD KESSLER, THE FBI 255 (1993) (quoting John W. Hicks, the assistant director over the FBI laboratory division).

32. Renskers, *supra* note 1, at 312. DNA, however, can deteriorate under certain conditions. *See* Debra C. Moss, *DNA—The New Fingerprints*, A.B.A. J., May 1, 1988, at 66, 67.

33. DNA fingerprinting analysis attempts to locate and isolate the polymorphic sites of an individual's DNA ladder. Dougherty, *supra* note 17, at 279. Once the polymorphic sites are located and isolated in both the sample taken from the crime scene and the sample taken from the suspect, the two are compared to determine if they are identical and therefore indicative of a match. *Id.* at 281. This rather technical process has been examined widely and meticulously. For an excellent discussion of the various procedures, see RESEARCH COUNCIL, *supra* note 10, at 36-73.

34. *See* Dougherty, *supra* note 17, at 277.

35. *Id.* at 282-83.

36. The first criminal case in which the prosecution successfully employed DNA evidence was the trial of Florida rapist Tommie Lee Andrews. Kirk Johnson, *DNA "Fingerprinting," Test Becomes a Factor in Courts*, N.Y. TIMES, Feb. 7, 1988, at A1. The conviction was upheld in State v. Andrews, 533 So. 2d 841 (Fla. Dist. Ct. App. 1988).

greatest advance in the 'search for truth' since the advent of cross-examination."[37]

The Frye *Test*

Enthusiasm for DNA fingerprinting led courts to admit DNA evidence under both the test established in *Frye v. United States*[38] and the Federal Rules of Evidence "helpfulness" standard,[39] the dominant admissibility tests for scientific information from expert witnesses.[40]

Most states claimed to utilize the *Frye* test when analyzing new scientific evidence, but the extent to which this remains true is uncertain.[41] The *Frye* court reasoned that

> [s]omewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made must be sufficiently established to have gained *general acceptance in the particular field* in which it belongs.[42]

The rationale behind this standard was that, given jurists' limited understanding of science, the decision concerning the admissibility of novel scientific evidence should rest with scientists.[43] The overwhelming majority of trial courts considering DNA evidence under the *Frye* standard, especially in the earliest cases, determined that the evidence was admissible.[44]

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37. People v. Wesley, 533 N.Y.S.2d 643, 644 (Albany County Ct. 1988).

38. 293 F 1013 (D.C. Cir. 1923).

39. *See infra* notes 45-47 and accompanying text.

40. RESEARCH COUNCIL, *supra* note 10, at 132.

41. *See id.* ("A majority of states profess adherence to the *Frye* rule, although a growing number have adopted variations on the helpfulness standard suggested by the Federal Rules of Evidence.").

42. *Frye*, 293 F at 1014 (emphasis added).

43. *E.g.*, RESEARCH COUNCIL, *supra* note 10, at 133 (arguing that the court's role should be limited to deciding whether the theory is generally accepted and if the specific techniques were reliable).

44. *See, e.g.*, *id.* at 134-45 (noting that of the hundreds of DNA cases heard under the *Frye* standard by 1991, an "overwhelming majority" of the courts admitted the evidence); *cf.* Daubert v. Merrell Dow Pharmaceuticals, 113 S. Ct. 2786, 2796 (1993) (allowing admission of scientific evidence only when a court determines the evidence is "scientific knowl-

Helpfulness Standard

Federal Rule of Evidence 702 contains the following language:

> If scientific, technical or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.[45]

When viewed in light of Federal Rule of Evidence 403, which dictates that otherwise relevant evidence "may be excluded if its probative value is substantially outweighed" by, among other things, unfair prejudice,[46] Rule 702 clearly is concerned with helping the trier of fact. In fact, one court has decided that the trial court's inquiry should concern, among other things, "the possibility that admitting the evidence would overwhelm, confuse, or mislead the jury"[47]

Early DNA Fingerprinting Admissibility Rulings

Andrews v. State[48] marked the first United States case in which DNA fingerprinting evidence was employed successfully In that case, the Florida District Court of Appeals ruled under the Florida rules of evidence that DNA evidence was obviously helpful to the jury.[49] Essentially, the court made a *Frye* determination in ruling that the process and techniques utilized in the production of DNA fingerprints had been accepted, for a variety of nonforensic uses, in the relevant scientific community for several years.[50] This ruling allowed the admission of the testimony of the prosecution's three expert witnesses, two of whom worked for one of the major commercial DNA fingerprinting laboratories.[51] The court deemed the inability of the defense to muster a single expert and the lack of

edge that will assist the trier of fact"). It remains to be seen what effect *Daubert* will have on the admissibility of DNA tests.

45. FED. R. EVID. 702.

46. FED. R. EVID. 403.

47. United States v. Downing, 753 F.2d 1224, 1237 (3d Cir. 1985).

48. 533 So. 2d 841 (Fla. Dist. Ct. App. 1988).

49. *Id.* at 849.

50. *Id.*

51. The laboratory was Lifecodes. *Id.* at 847.

scientific literature disputing the test's reliability an indication that DNA Fingerprinting technology was generally accepted in the scientific community [52] The court viewed the lack of defense repudiation of the DNA laboratory's testing procedures and statistical analysis as further proof of the indisputable quality of the technology [53]

A survey of other cases admitting DNA fingerprinting at its initial introduction displays similar judicial reasoning. In the first Virginia case admitting such evidence, *Spencer v. Commonwealth*,[54] the court ruled that DNA evidence was properly admitted because "[t]he record is replete with uncontradicted expert testimony that no 'dissent whatsoever [exists] in the scientific community' "[55] Similarly, in *State v. Woodall*,[56] the West Virginia Supreme Court of Appeals took judicial notice of general scientific acceptance where expert testimony by the prosecution was uncontroverted.[57]

The absence of literature disputing the value of DNA evidence, however, did not mean necessarily that it was a generally accepted scientific technology It could mean that no one had the opportunity to dispute such a novel scientific approach at such an early stage. The court in *Andrews* discounted this problem by ruling that it was not a novel approach because it had been used in other areas for years.[58] Of course, the differences between forensic and nonforensic applications went unnoticed because of the lack of defense witnesses.[59]

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52. *Id.* at 849.
53. *Id.* at 850.
54. 384 S.E.2d 785 (Va. 1989), *cert. denied*, 493 U.S. 1093 (1990).
55. *Id.* at 797 (alteration in original).
56. 385 S.E.2d 253 (W Va. 1989).
57. *Id.* at 260.
58. *Andrews*, 533 So. 2d at 849-50.
59. *See, e.g.*, RESEARCH COUNCIL, *supra* note 10, at 52-53. In outlining the differences between the forensic use of DNA evidence and its primary use as a medical diagnostic tool, the study wrote:

> DNA diagnostics usually involves clean tissue samples from known sources. It can usually be repeated to resolve ambiguities. It involves comparison of discrete alternatives (e.g., which of two alleles did a child inherent from a parent?) and thus includes built-in consistency checks against artifacts. It requires no knowledge of distribution of patterns in the general population.

As in *Andrews*, the expert witnesses for the prosecution were usually representatives of laboratories quite interested in seeing DNA fingerprinting receive judicial acceptance.[60] Their appearance as the sole authorities in the courtroom regarding laboratory procedure, statistical analysis, and basically all aspects of the technology demonstrates the rather one-sided picture that was painted.

The paucity of defense experts and dissenting literature was viewed as an indication of scientific acceptability, rather than as a demonstration that scientists had not had the opportunity to address this new technique satisfactorily.[61] Ill-equipped defense attorneys, judges, and juries, therefore, were faced with a unilateral barrage of complicated scientific evidence that placed the adversarial system in peril. The next Section focuses on the tremendous impact of this largely untested technology.

THE IMPACT OF THE ADMISSION OF DNA FINGERPRINTING EVIDENCE

The strong probative value DNA evidence has in a trial provides the strongest argument for scrutinizing the technology before allowing admission. The lack of such scrutiny in the earliest DNA cases unfortunately resulted in serious problems for criminal defendants.[62] Courts effectively gave the prosecution carte blanche to present complex, scientific evidence to juries without defense challenge. This unilateral presentation of such seemingly infallible evidence essentially allowed expert witnesses for the prosecution to control the outcome of early DNA fingerprinting trials.

Given the relative inexperience regarding scientific matters throughout the legal system, one would expect fact finders, lawyers, and judges to accord disproportionate value to scientific evi-

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> Forensic DNA typing often involves samples that are degraded, contaminated, or from multiple unknown sources. It sometimes cannot be repeated, because there is too little sample. It often involves matching of samples from a wide range of alternatives present in the population and thus lacks built-in consistency checks. Except in cases where the DNA evidence excludes a suspect, assessing the significance of a result requires statistical analysis of population frequencies.

Id.

60. *See, e.g.*, Spencer v. Commonwealth, 384 S.E.2d 785, 791 (Va. 1989), *cert. denied*, 493 U.S. 1093 (1990).

61. *See, e.g.*, *Andrews*, 533 So. 2d at 849; *Woodall*, 385 S.E.2d at 260.

62. *See supra* notes 36-61 and accompanying text.

dence connecting a defendant with a crime.[63] As a result, uncontroverted scientific evidence has an entirely unwarranted impact on the disposition of a case. As one author has stated:

> [L]awyers as a group evidence an appalling degree of scientific illiteracy, which ill equips them to educate and guide the bench in its decisions on admissibility of evidence proffered through expert witnesses. This scientific illiteracy is shared by a large segment of the trial and appellate bench; many judges simply do not understand evidence based on scientific principles.[64]

One author described the dilemma facing defense attorneys in cases involving the relatively pedantic scientific evidence of traditional ABO blood typing.[65] "[W]hen it came to the scientific testimony, the adversary system ceased to exist and the evidence was not challenged. No defense witness testified about the serological evidence. The relevant defense arguments were feeble."[66]

A jury will not be truly informed by unilateral expert testimony Furthermore, scientific evidence may have a disproportionate impact on a jury even when both sides address the evidence lucidly "[A]bout one quarter [of jurors who] were presented with scientific evidence believed that had such evidence been absent, they would have changed their verdicts—from guilty to not guilty "[67] Thus, in early DNA fingerprinting cases, jurors already predisposed to agree with the side proffering scientific testimony heard novel, complicated, uncontroverted, expert scientific testimony from witnesses who had a stake in seeing DNA evidence receive judicial acceptance.

In certain instances, expert witnesses have been accused of offering imprecise scientific testimony For instance, in *People v. Julbe*,

63. *See, e.g.*, People v. Kelly 549 P.2d 1240, 1245 (Cal. 1976) (noting that jurors "give considerable weight to 'scientific' evidence when presented by 'experts' with impressive credentials").

64. Jonakait, *supra* note 3, at 348 n.12 (quoting ANDRE A. MOENSSENS ET AL., SCIENTIFIC EVIDENCE IN CRIMINAL CASES 7 (3d ed. 1986)) (alteration in original).

65. *See id.* at 343-45 (describing the author's impressions of an unreported Brooklyn, New York case, People v. Julbe, No. 4167/1978 (Kings County, N.Y. 1979), based on trial and appellate documents in his possession).

66. *Id.* at 348.

67. *Id.* at 345 n.7 (quoting Joseph L. Peterson et al., *The Uses and Effects of Forensic Science in the Adjudication of Felony Cases*, 32 J. FORENSIC SCI. 1730, 1748 (1987)) (alterations in original).

the expert serologist was able to present population studies that scientists had not viewed, effectively allowing the expert to espouse his own theories as scientific truth.[68] Fortunately, in recent years, scientists have called into question certain aspects of the DNA fingerprinting process, leading some courts to subject the once unchallenged technology to more exacting scrutiny.[69]

LATER SCRUTINY OF DNA FINGERPRINTING

> There is no scientific dispute about the validity of the general principles underlying DNA typing: scientists agree that DNA varies substantially among humans, that variation can be detected in the laboratory, and that DNA comparison can provide a basis for distinguishing samples from different persons.[70]

Problems arise when the fingerprinting procedures themselves are inherently faulty, when the process is not conducted correctly, when there is a problem with the sample of DNA, or when the results of the analysis are misinterpreted. Thus, although the science behind DNA fingerprinting is sound, the application of the science in the forensic arena is often questionable. Addressing these concerns is of critical importance to the criminal justice field because of the legal system's inability to cope with scientific evidence, and the tendency of juries to grant often undue weight to DNA evidence.[71] Three areas of concern surrounding DNA evidence have led several courts to question the admissibility of particular applications of the technology: (1) problems in controlling the experimental conditions of the analysis,[72] (2) problems in interpreting the results,[73] and (3) concerns over Fourth Amendment privacy rights.[74]

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68. *Id.* at 349. The author also asserts that "[t]he conclusions of forensic science are often based on skimpy, nonexistent, or shoddy research." *Id.*

69. *See infra* notes 70-170 and accompanying text.

70. RESEARCH COUNCIL, *supra* note 10, at 51.

71. *Id.* at 52 ("[T]he probative power of DNA typing can be so great that it can outweigh all other evidence in a trial; and the procedures for DNA typing are complex, and judges and juries cannot properly weigh and evaluate conclusions based on different standards of [scientific] rigor.").

72. *See infra* notes 75-116 and accompanying text.

73. *See infra* notes 117-54 and accompanying text.

74. *See infra* notes 155-70 and accompanying text.

Problems with Experimental Conditions

Sample Size

Although DNA evidence holds great promise for both correctly identifying criminals and exculpating innocent persons, fingerprinting requires a sufficient sample size.[75] Lifecodes, one of the three major private corporations conducting DNA fingerprinting, admits that fifty percent of the rape cases sent to it produce no result because of inadequate samples.[76] This important point demonstrates the limitations on a procedure that is often touted as a panacea for criminal investigations. DNA proponents are quick to note that the problem of sample size is irrelevant to control of the experimental conditions of analysis because a small sample size merely produces an inconclusive result.[77]

Environmental Contamination

In the criminal area, DNA samples often are drawn from crime scene evidence. As a result, samples often are exposed to the environment or are aged. Scientists have concluded that "moisture and bacteria degrade DNA and can make typing impossible."[78] Others have noted that exposure to light, heat, radiation and chemical agents, as well as the aging process, also may degrade DNA or cut it into small pieces, making testing difficult.[79] DNA fingerprinting proponents argue that, as with small samples, degradation due to environmental and other factors results only in an inability to make a reading, not in a false positive which could in-

75. The Cetus test, Polymerase Chain Reaction or Amplityping, can be conducted on a very small sample size. *See, e.g.*, PAUL C. GIANNELLI & EDWARD J. IMWINKELRIED, SCIENTIFIC EVIDENCE § 17-8, at 122 (Supp. 1991).

76. Moss, *supra* note 32, at 67.

77. Beeler & Wiebe, *supra* note 13, at 919.

78. Moss, *supra* note 32, at 67 (citing Dr. David Housman, Professor of Biology at Massachussetts Institute of Technology).

79. *See, e.g.*, Anthony Pearsall, *DNA Printing: The Unexamined "Witness" in Criminal Trials*, 77 CAL. L. REV. 665, 668 (1989). The author provides the following example: "[B]lood and semen stains kept at room temperature for periods of more than four years have not produced usable prints, and the "window period" for obtaining usable sperm from vaginal swabs has varied from two to forty-eight hours in controlled experiments." *Id.* (citations omitted).

criminate an innocent person.[80] Countering this argument, scientists caution that false positives may result from the introduction of certain bacteria or the mixing of DNA samples.[81] The court in *Andrews v. State* emphasized the practice of Lifecodes where "control samples are employed throughout the process," increasing the likelihood of discovering error, as further proof that DNA tests were reliable.[82]

Proponents of DNA fingerprinting contend that mixing of samples (for instance, the semen of a rape suspect and the vaginal fluids of a victim) is not a serious problem because scientists easily can detect the mix and separate the two samples.[83] Other problems include mutations and the digestion of the sample DNA by the enzyme introduced in the fingerprinting process.[84] The consensus appears to be that, except in extremely rare circumstances, a defective sample produces no results, not a false positive.[85]

Laboratory Performance

Perhaps the most often mentioned problem surrounding DNA evidence is the performance of the laboratories conducting the process. "[F]orensic laboratories perform incredibly poorly according to the available information."[86] Although the theory behind DNA identification is beyond reproach,[87] improper laboratory techniques are certainly grounds for inadmissibility The value of DNA evi-

80. *Id.*

81. GIANNELLI & IMWINKELRIED, *supra* note 75, § 17-18, at 126.

82. Andrews v. State, 533 So. 2d 841, 850 (Fla. Dist. Ct. App. 1988).

83. Alec Jeffreys et al., *Individual-Specific "Fingerprints" of Human DNA*, 316 NATURE 76, 78 (1985); *see also* RESEARCH COUNCIL, *supra* note 10, at 65-66 ("In mixed samples that contain semen, it is possible to extract the sperm DNA and the DNA of vaginal epithelial cells separately.").

84. Jeffreys et al., *supra* note 83, at 78.

85. *See* Pearsall, *supra* note 79, at 668. Perhaps the most serious potential for false positives is due to possible chain of custody problems. This problem, of course, is not inherent in the fingerprinting process.

86. Jonakait, *supra* note 3, at 351.

87. *See supra* text accompanying note 70. "DNA doesn't lie. But by the time you scrape a sample off a sidewalk and it goes through many steps of handling by people, things can go wrong. The potential for human error does exist." William B. Falk, *DNA and Truth*, NEWSDAY, Dec. 7, 1992, at 7 (quoting John Thornton, Professor of Forensic Science at the University of California, Berkeley).

dence is linked inextricably to the quality of the laboratory processes.

> Obviously, the worth of a scientific result is affected by how likely it is to be wrong. The assessment of the conclusion that two samples match and that only one in 35,000 have similar DNA depends upon whether the forensic scientist is wrong 1% or 10% or 25% of the time when he declares a match.[88]

The current lack of independent proficiency testing of the forensic laboratories conducting DNA fingerprinting[89] calls into question the reliability of the various scientists, making the whole procedure questionable.

The lack of independent auditing of DNA laboratories introduces the concern that, although DNA analysis itself is widely researched and accepted because of its many scientific applications, "most of the probes used in criminal and paternity cases have no other medical application."[90] The differences inherent in forensic DNA introduce doubt regarding the extent of "scientific acceptance" necessary for scientific evidence to be admissible. One author, David H. Kaye, has even questioned how the various courts have framed the "scientific acceptance" standard.[91] Kaye writes that if "all that need be accepted is the theoretical basis for DNA identification, there is no doubt that the technique is potentially admissible."[92] He continues, however, by noting that it is not generally accepted that the techniques used to analyze DNA are infallible as used.[93] The courts might be unclear about exactly what they are admitting into evidence when they admit procedures included under the umbrella of DNA fingerprinting.

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88. Jonakait, *supra* note 3, at 350.

89. *Id.*, *see also* Falk, *supra* note 87, at 7 (noting that in a 1990 test of the proficiency of DNA laboratories, conducted by the California Association of Crime Laboratory Directors, Cellmark incorrectly matched the DNA in two of 100 samples).

90. David H. Kaye, *The Admissibility of DNA Testing*, 13 CARDOZO L. REV. 353, 358 (1991). Basically, a probe is the device used to identify polymorphic loci of DNA and is therefore indispensable to DNA fingerprinting. "A probe is a short piece of a single strand of DNA with a radioactive or other readily identifiable component attached, like a sticker or tag on a suitcase." *Id.* at 354.

91. *Id.* at 359.

92. *Id.*

93. *Id.*

Several organizations intimately associated with DNA fingerprinting have initiated studies to address the problem of unregulated laboratories. The National Research Council published a comprehensive study of DNA technology in the summer of 1992.[94] Although recommending the continued use of DNA analysis for forensic purposes, including the resolution of both criminal and civil cases, this group urged adoption of certain improvements and changes.[95]

In its study, the National Research Council succinctly identified the major hurdle that DNA fingerprinting must overcome: "DNA typing is capable, in principle, of an extremely low inherent rate of false-positive results, so the risk of error will come from poor laboratory practice or sample handling and labeling; and because DNA typing is technical, a jury requires the assurance of laboratory competence in test results."[96] To address this concern, the Council recommended "some degree of standardization of laboratory procedures . to assure the courts of high-quality results."[97] The Council also called for the development and adoption of detailed quality control mechanisms by every laboratory involved in DNA fingerprinting to monitor laboratory work and to ensure consistent reliability of DNA typing techniques.[98] The report also suggested a mandatory accreditation program under government supervision for each DNA typing method used.[99] "Lack of accreditation should be considered to constitute a prima facie case that a laboratory has not complied with generally accepted standards."[100] The Council intended this suggestion to deal with privately operated laboratories that consistently cite trade secrecy as an excuse for rejecting oversight of their operations.[101] Also concerned with the approach that several early courts had taken to the admissibility of DNA fingerprinting evidence, the report stated that " 'the adequacy of

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94. *See* RESEARCH COUNCIL, *supra* note 10.

95. *See* Gina Kolata, *Chief Says Panel Backs Courts' Use of a Genetic Test*, N.Y. TIMES, Apr. 15, 1992, at A1.

96. RESEARCH COUNCIL, *supra* note 10, at 98.

97. *Id.*

98. *Id.* at 108.

99. *Id.* at 109.

100. *Id.*

101. *See* Ira Pilchen, *Federal Report and Court Rulings Intensify DNA Evidence Debate*, 76 JUDICATURE 41, 41 (1992).

laboratory procedures and of the competence of the experts who testify' " should be open to inquiry on a case-by-case basis.[102] The report identified the clear need for monitoring laboratories and for stricter examinations of the specific procedures used before DNA evidence is admitted in court.[103]

Commentators have addressed extensively the problem of unsupervised laboratories. The Office of Technology Assessment concluded that "[d]etermining the type of controls necessary to ensure confidence in the results of any single DNA typing of a forensic specimen is of the highest priority."[104] Other critics wrote that adequate standards, controls and validation research for forensic DNA testing are not yet in place.[105] Given the current debate over laboratory standards and controls, still another author has suggested declaring per se inadmissible the findings of laboratories with no established track record on independently administered proficiency tests.[106] According to this author, this approach will induce less reliable laboratories to enhance the proficiency of their practices.[107]

Some of the more recent court decisions regarding the admissibility of DNA fingerprinting evidence clearly demonstrate a concern over inadequate laboratory practices. In *State v. Schwartz*,[108] the Supreme Court of Minnesota refused to admit DNA evidence because of faulty laboratory procedures.[109] Although conceding that "DNA typing ha[d] gained general acceptance in the scientific community," the court held that "the laboratory in [*Schwartz*] did not comport with [appropriate standards]."[110] The court was concerned with the laboratory's secrecy regarding its testing data and

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102. *Id.* (citation omitted).

103. RESEARCH COUNCIL, *supra* note 10, at 109.

104. OFFICE OF TECHNOLOGY ASSESSMENT, GENETIC WITNESS: FORENSIC USES OF DNA TESTS 63 (1990).

105. *See* William C. Thompson & Simon Ford, *The Meaning of a Match: Sources of Ambiguity in the Interpretation of DNA Prints*, *in* FORENSIC DNA TECHNOLOGY 146 (Mark A. Farly & James J. Harrington eds., 1991) (discussing the lack of standardization).

106. Kaye, *supra* note 90, at 359.

107. *Id.* at 359-60.

108. 447 N.W.2d 422 (Minn. 1989).

109. *Id.* at 428.

110. *Id.*

results and its admission to having made two false identifications during proficiency testing.[111]

In *People v. Castro*,[112] the defense successfully attacked the laboratory procedures that Lifecodes used in its DNA analysis.[113] The defense assailed Lifecodes' use of contaminated probes and the absence of any laboratory controls.[114] Although, the court issued the standard ruling that the theory behind DNA analysis was sound,[115] the defense team's arguments about the technology's application swayed the court. "In a piercing attack upon each molecule of evidence presented, the defense was successful in demonstrating to this court that the testing laboratory failed in its responsibility to perform the accepted scientific techniques and experiments."[116] These cases demonstrate the legal system's recognition of the dangers of blind admission of DNA evidence.

Problems in Interpreting DNA Testing Results

If two DNA fingerprints differ, they clearly were derived from two different human beings. If two DNA fingerprints are identical, however, the samples from which the DNA was taken did not necessarily originate in the same person. "[I]f . . . two samples are indistinguishable with regard to the detected DNA patterns, two possibilities exist: the two samples came from the same person (or from identical twins), or the two samples came from different persons whose DNA patterns in the target regions investigated are the same."[117] Thus, when a DNA fingerprint obtained from a crime scene is indistinguishable from a DNA fingerprint obtained from a sample provided by the defendant in a criminal trial, the case is not over. Recognizing this inherent problem, one author noted that "[t]he uniqueness of [DNA] 'fingerprints' can be truly established only by testing of all individuals, both living and dead. Clearly this is not possible, yet anything less leaves open the hypothetical pos-

111. *Id.* at 426-27.
112. 545 N.Y.S.2d 985 (Sup. Ct. 1989).
113. *Id.* at 996.
114. *Id.*
115. *Id.* at 995.
116. *Id.*
117. RESEARCH COUNCIL, *supra* note 10, at 44.

sibility of an unobserved duplication."[118] The prosecutor must provide the trier of fact with an estimate of the likelihood that the defendant can be connected accurately with the crime scene. This estimate is obtained through statistics generated from population genetics, which attempt to determine the statistical probability that more than one person in the population has the identical DNA pattern at issue.[119] The procedure poses the question: "What is the chance of picking at random a person who has the same genetic patterns as found in the evidence sample?"[120]

The resulting probability has tremendous power to affect the outcome of the case. "The power of DNA typing lies not only in its ability to match samples, but also in its ability to represent accurately the probability that a declared match will occur at random in a specific population group."[121] When a scientist stands before a typical criminal trial jury and proclaims that only one Caucasian in 59,000,000 "has the same distinctive DNA components [as those] found in the DNA comparison test,"[122] the jury clearly pays very careful attention.[123] The method that DNA laboratories use to interpret their results, therefore, is perhaps the most important phase of DNA fingerprinting analysis.

Courts recently have begun to question the methods laboratories employ for calculating the significance of DNA matches. The Massachusetts Supreme Court provided a lucid examination of the problem in *Commonwealth v. Curnin*.[124] In *Curnin*, the court began by emphasizing the impact of statistical probability evidence on juries: "Evidence of this nature, based on the scientific principle that every human has unique genetic characteristics and having an aura of infallibility, must have a strong impact on a jury."[125] In-

118. George F Sensabaugh, *Forensic Biology—Is Recombinant DNA Technology in Its Future?*, 31 J. FORENSIC SCI. 393, 395 (1986).

119. *Castro*, 545 N.Y.S.2d at 992.

120. RESEARCH COUNCIL, *supra* note 10, at 44. "Obviously, the lower the probability [of picking a person at random with the same genetic pattern], the stronger the inference that the evidence sample is associated with a particular person who has those patterns." *Id.*

121. Dougherty, *supra* note 17, at 290.

122. Commonwealth v. Curnin, 565 N.E.2d 440, 441 (Mass. 1991).

123. This statement reflects the majority opinion of Justice Wilkins regarding the use of staggering probabilities in DNA analysis. *Id.*

124. 565 N.E. 2d 440 (Mass. 1991).

125. *Id.* at 441.

deed, a juror subconsciously may disregard most other evidence when the prosecution introduces astounding DNA fingerprinting statistics. The court reasoned that the impact of the incredible figures associated with DNA evidence demands a strict scrutiny of the statistical formulations that the laboratories proffer.[126] The court concluded that

> there is no demonstrated general acceptance or inherent rationality of the process by which Cellmark [the laboratory at issue] arrived at its conclusion that one Caucasian in 59,000,000 would have the DNA components disclosed by the test that showed an identity between the defendant's DNA and that found [at the crime scene].[127]

The court's dissatisfaction with Cellmark's statistical approach stemmed from the prosecutor's failure to present experts in the field of population genetics to support Cellmark's conclusion.[128] Cellmark also had not published for scientific criticism a study of its data base. A study would have detailed the compilation of DNA samples used to determine the statistical probability of the print at issue appearing randomly in the population.[129] In its statistical analysis, Cellmark employed the product rule.[130] It determined, allele by allele, the frequency of the particular variation in its data

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126. *See id.* "The erroneous admission of such evidence would undoubtedly be prejudicial in any case where, as here, the identification of the person who committed the crime is in serious dispute." *Id.*

127. *Id.* at 442.

128. *Id.* at 443-44. ("There is no showing, however, that scientists agree generally that the distribution of the alleles disclosed in Cellmark's testing is random in the Caucasian population so as to warrant the calculations made by Cellmark.").

129. *Id.* at 444 ("To determine the frequency with which alleles [gene patterns] shown on a [DNA fingerprinting] test appear in the population, one must have gathered and maintained parallel DNA information in a data base.").

130. *Id.*

> The product rule states the probabilities of the joint occurrence of several statistically independent events. Here, assuming the product rule should be used, the product of the frequency in the population base of each allele disclosed in the DNA test would produce the frequency of the combination of the alleles found. That is what, according to Cellmark [the laboratory in the case], produced the probability of one in 59,000,000 in this case.

Id. at 444 n.10. For instance, if one allele has a one-in-200 probability of appearing in the population base and a second allele has a one-in-100,000 probability of appearing in the population base, then the product rule yields a probability of both occurring in the same person at one in 20,000,000.

base. Next, the Cellmark scientists extrapolated that figure for the population as a whole to arrive at the probability of another individual having the same DNA characteristics as those revealed in the DNA fingerprinting analysis.[131] Cellmark filled its data base of Caucasians by conducting DNA fingerprinting tests on 200 blood samples provided by a New York City blood bank.[132] According to the defendant's expert, this data base was not adequate to produce an estimate of the frequency of a particular genetic print in the human population.[133] The inadequacy stemmed from the fact that certain tests revealed missing alleles, yet the data base did not reflect such a possibility.[134]

The debate surrounding population substructuring seems to have influenced courts considering challenges to statistical formulations. Population substructuring stems from the different world population groups that comprise the American population. "The major ethnic groupings . . . are each composites of many different subpopulations, which might have quite different frequencies of the alleles used in forensic DNA typing."[135] The argument for taking subpopulations into account is that the allele frequencies found in the whole population of a given race likely will differ from the allele frequencies of the various subpopulations.[136]

The court in *Curnin* framed the subpopulation question as "whether there is significant substructuring (subgroups) within racial groups that would affect probability determinations using Cellmark's data base, and, if so, whether an acceptable statistical adjustment could be made to account for it."[137] The defendant's expert recommended that data bases be comprised of a geographi-

131. *Id.* at 444.

132. *Id.*

133. *See id.*

134. *Id.*

135. RESEARCH COUNCIL, *supra* note 10, at 48.

136. *See* Lempert, *supra* note 10, at 307. Lempert explains subpopulations as follows:

> [D]ata bases consisting of American Blacks might not adequately assess the likelihood that the evidence DNA profile would characterize a randomly selected West Indian Black when the defendant whose DNA matches the evidence DNA is a West Indian. Similar arguments may be made about extending analyses from Hispanic data bases to, for example, Cubans or generalized Caucasian data bases to Sicilians.

Id.

137. *Curnin*, 565 N.E.2d at 444.

cally representative population.[138] An expert witness in *United States v. Yee*,[139] Dr. Daniel L. Hartl, noted that the Caucasian population of the United States consists of ethnically different subpopulations which may differ in allele frequency.[140] The existence of subpopulations calls into question unrepresentative data bases, which may not reflect accurately the genetic substructures of certain ethnic groups.[141] The court also acknowledged the conclusion of Professor Richard C. Lewontin that marriage patterns have not substantially reduced genetic differentiations of the ancestral populations of American Caucasians.[142]

In addition to reiterating the claims of Lewontin and Hartl, the California case of *People v. Barney*[143] discussed the contrary view in the scientific community. Although conceding the presence of substructuring within data bases, two scientists, Ranajit Chakrabory and Kenneth K. Kidd, contend that "its effect on the reliability of frequency estimates is 'trivial' and 'cannot be detected in practice.'"[144] The courts in both *Barney* and *Curnin* recognized the substantial disagreement in the scientific community regarding genetic substructuring and subgroup differences in allele frequencies. The debate demonstrates that Cellmark's method for statistical determinations does not necessarily meet the standard of scientific reliability required by *Daubert*.[145] In fact, the court in *Barney* described the debate as "bitter" and "raging."[146] This lack of scientific unanimity led the courts in the above cases to declare the DNA evidence inadmissible.

138. *Id.* *Curnin* was a Massachusetts case in which the data base was taken from a New York City blood bank. *Id.*

139. 129 F.R.D. 629 (N.D. Ohio 1990).

140. *Curnin*, 565 N.E.2d at 445 n.12 (citing an unpublished article written by Dr. Hartl).

141. *See id.*

142. *Id.*

143. 10 Cal. Rptr. 2d 731 (Ct. App. 1992).

144. *Id.* at 741 (citing Ranajit Chakraborty & Kenneth K. Kidd, *The Utility of DNA Typing in Forensic Work*, SCIENCE, Dec. 20, 1991, at 1735).

145. Daubert v. Merrell Dow Pharmaceuticals, 113 S. Ct. 2786, 2795 (1993).

146. *Barney*, 10 Cal. Rptr. 2d at 741.

Proposed Solutions to Problems of Interpreting the Results

In *Caldwell v. State*,[147] after deciding that the underlying principles of DNA fingerprinting were sound and that the procedures present in that particular case were adequate, the Georgia Supreme Court assailed the laboratory's statistical calculations.[148] The laboratory concluded that the probability of a randomly selected person having the same DNA fingerprint as the defendant was one in 24,000,000.[149] The court took issue with the paucity of expert analysis of the laboratory's data bank,[150] and ruled that the conclusions were inconsistent with the data base. The court instead ruled that the more conservative figure of one in 250,000, more in line with the data base, would have to be used.[151]

The *Caldwell* decision introduced one possible, albeit temporary, solution to the problem of calculating DNA profile frequencies. "The solution is not to bar DNA evidence [for reasons of inaccurate probability calculations], but to ensure that estimates of the probability that a match between a person's DNA and evidence DNA could occur by chance are appropriately conservative."[152] Echoing this observation, an expert in the case of *United States v. Yee*[153] stated that "[a]ll available evidence shows that in a DNA fingerprinting case, the chance of a match by coincidence alone is very small. The very conservative computational methods used by [the laboratory in that case] more than compensate for any theoretical deviation."[154] One solution, therefore, is merely to adjust the figures so as to minimize the impact of an overwhelmingly incriminating result.

147. 393 S.E.2d 436 (Ga. 1990).

148. *Id.* at 443-44.

149. *Id.* at 443.

150. *See id.* at 443-44 (ruling that unless some supporting testimony was provided, the probability calculations were not acceptable).

151. *Id.* at 444.

152. RESEARCH COUNCIL, *supra* note 10, at 134 (discussing the various remedies for the problems associated with inflated probability results).

153. 129 F.R.D. 629 (N.D. Ohio 1990).

154. Rorie Sherman, *DNA Is on Trial Yet Again*, NAT'L L.J., Mar. 16, 1992, at 1, 10 (chronicling the conclusions of the expert, Mr. Stephen Daiger, regarding the adequacy of conservative estimates and his thoughts about *Yee*).

Fourth Amendment Privacy Concerns

The DNA fingerprint has been criticized as a tool for the invasion of basic privacy rights. The critiques focus on the compulsory testing of body tissue and fluids of criminal suspects and the potential revelation of certain genetic information contained in the DNA fingerprint.

Compulsory Blood Tests

A DNA fingerprint may be taken whenever body fluids or tissue are found at a crime scene. To be useful, however, this fingerprint must be compared against a fingerprint generated from the DNA of a suspect. To make this comparison, law enforcement officials must be able to take blood or tissue samples from the suspect. This procedure raises Fourth Amendment concerns, specifically with regard to unreasonable searches.

The Fourth Amendment guarantees that citizens shall be free from unreasonable searches and seizures and that "no warrants shall issue, but upon probable cause."[155] The Supreme Court has deemed the extraction of a blood sample, the most common method for obtaining a DNA fingerprint from a suspect,[156] a search for Fourth Amendment purposes.[157] In *Schmerber v. California*, the United States Supreme Court deemed the compulsory extraction of a blood sample for an alcohol test a reasonable search under the Fourth Amendment, as long as probable cause was present.[158] In *Schmerber*, the Court ruled that no warrant was required because of the need to test quickly the suspect's blood before the body had absorbed the alcohol.[159]

Such exigent circumstances are absent in the context of DNA fingerprints. For a mandatory blood test to obtain a DNA fingerprint to clear the Fourth Amendment hurdle, there apparently must be both probable cause and a valid search warrant. The probable cause existing at a suspect's arrest allows law enforcement of-

155. U.S. CONST. amend. IV

156. In every reported criminal case using DNA evidence through 1990, blood samples were used in the DNA analysis. Renskers, *supra* note 1, at 323 n.98.

157. *See* Schmerber v. California, 384 U.S. 757, 770-71 (1966).

158. *Id.* at 771.

159. *Id.* at 770-71.

ficials to obtain a warrant for blood extraction.[160] Thus, privacy rights of a clear suspect are not jeopardized significantly

More recently, when deciding Fourth Amendment issues the Supreme Court has expressed a willingness to balance individual rights versus government interests.[161] This approach becomes critically important in cases lacking a clear suspect. The balancing test indicates a degree of deference to law enforcement investigative techniques that has some commentators worried about abandoning the need for individualized suspicion.[162] For instance, if a suspect's race could be determined from a DNA fingerprint generated from crime scene evidence, mass arrests of citizens from one racial group might follow, with reckless disregard for probable cause.[163] The courts, however, remain committed to the requirement of individualized suspicion.[164] In any event, currently produced DNA fingerprints contain negligible information about an individual's personal characteristics and certainly not enough to warrant concerns about mass arrests.[165]

Private Genetic Information

Because DNA contains information about the most fundamental characteristics of human beings, a DNA fingerprint conceivably could reveal damaging personal and medical information. Certain DNA analyses can diagnose inherited afflictions, including cystic

160. *Id.* at 770.

161. Skinner v. Railway Labor Executives' Ass'n, 489 U.S. 602 (1989) (finding that drug and alcohol tests required by the Federal Railway Administration's regulations were reasonable because the government's compelling interest outweighed the employees' privacy concern).

162. Renskers, *supra* note 1, at 325.

163. *Id.* at 328.

> [I]t has been suggested that "[o]nce [DNA fingerprinting] is widely accepted, police departments may try to clear unsolved cases by simply demanding tissue samples from everyone living within a high-crime area. Refusal to submit, like the unwillingness to take a polygraph test, may be taken as unofficial evidence of guilt."

Id. (quoting Hotz, *Courts to Rule on Whether 'DNA Fingerprints' Valid*, ATLANTA J. & CONST., Oct. 6, 1987, at 22A) (footnote omitted).

164. *See, e.g.*, Sullivan v. Murphy, 478 F.2d 938, 970 (D.C. Cir.) (condemning "[t]he practice of making dragnet arrests"), *cert. denied*, 414 U.S. 880 (1973).

165. *See* Renskers, *supra* note 1, at 334.

fibrosis and some inherited cancers.[166] Scientists someday may develop the ability to identify the presence of certain other medical conditions including alcoholism, heart disease, and diabetes.[167] "Obviously, such information could lead to discrimination by insurance companies, employers, or others against people with particular traits."[168] The current techniques used for DNA fingerprinting analysis in the criminal context do not pose this problem, and therefore DNA fingerprints are not examined for medical conditions.[169] "Substantive information, such as genetically linked diseases, cannot be obtained from the resulting print, unless the technician originally sought to look for that information by choosing certain probes and enzymes."[170] However, future fingerprinting techniques could provide private information about the donor. Clear restrictions on the distribution of fingerprinting information, or close control of testing techniques could handle this problem.

This discussion of the various points of concern surrounding DNA fingerprinting evidence introduces an examination of Virginia's approach to the technology Only through an understanding of how other states have addressed the potential problems associated with this exciting and theoretically sound technique can one accurately assess Virginia's performance in the past in admitting DNA fingerprinting evidence both judicially and legislatively, and in the future, as it grapples with the appropriate use of the Virginia DNA data base.

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166. RESEARCH COUNCIL, *supra* note 10, at 114.

167. *Id.*

168. *Id.*

169. *See id.* at 155.

> The current use of DNA technology appears to pose no greater threat to the right of privacy than does normal fingerprinting, placement of photographs in evidence, collection of blood or saliva samples, or other established forensic techniques. DNA technology is not different in principle from those other techniques, although it holds the promise of providing a more definitive identification than most others

Id.

170. JoAnn M. Longobardi, Note, *DNA Fingerprinting and the Need for a National Data Base*, 17 FORDHAM URB. L.J. 323, 353 (1989) (footnote omitted).

VIRGINIA'S ACCEPTANCE OF DNA FINGERPRINTING

Judicial Acceptance

The Virginia Supreme Court first addressed the admissibility of DNA fingerprinting evidence in the trilogy of *Spencer v. Commonwealth* cases.[171] In the first of these cases, decided in 1989, the Virginia court seized the opportunity to declare DNA fingerprinting admissible as a reliable scientific technique.[172]

Spencer, the defendant, was convicted of capital murder, rape, and burglary.[173] A significant portion of the prosecution's case at trial revolved around a determination that the DNA fingerprint extracted from semen stains found at the crime scene matched the DNA fingerprint taken from a sample of Spencer's blood.[174] On appeal to the Virginia Supreme Court, Spencer challenged the admissibility of the novel scientific technique, a case of first impression in the Commonwealth.[175] After outlining the process of DNA fingerprinting, the court discussed its rationale in admitting the scientific evidence.[176]

First, the court was satisfied with the statistical analysis performed by Lifecodes, the laboratory conducting the DNA analysis in the case.[177] Lifecodes used a standard data base, presumably with little concern for subpopulations.[178] Additionally, Lifecodes employed the product rule in establishing its probability that a random person had the same DNA fingerprint as the one extricated from the crime scene.[179] Population geneticists have chal-

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171. Spencer v. Commonwealth, 384 S.E.2d 775 (Va. 1989) ("*Spencer I*"), *cert. denied*, 493 U.S. 1036 (1990); Spencer v. Commonwealth, 384 S.E.2d 785 (Va. 1989) ("*Spencer II*"), *cert. denied*, 493 U.S. 1093 (1990); Spencer v. Commonwealth, 385 S.E.2d 850 (Va. 1989) ("*Spencer III*"), *cert. denied*, 493 U.S. 1093 (1990).

172. *Spencer I*, 384 S.E.2d at 783.

173. *Id.* at 776.

174. *Id.* at 777.

175. *Id.* at 781.

176. *Id.* at 781-83.

177. *Id.* at 782.

178. The court noted that "DNA data bases were maintained in three categories: Negro, Caucasian, and Hispanic." *Id.* This categorization indicates that, at the time, neither the court nor Lifecodes was very concerned with the possibility of population substructures within each of the three categories.

179. The process was described as follows: "Using population genetics equations standardized in the early 1900's, the individual frequencies are combined to determine the sta-

lenged the failure to account for population substructures in interpreting the results of the DNA analysis as producing inaccurate statistical probabilities.[180]

The defense's failure to present any expert witnesses of its own to dispute the technology as applied to Spencer may explain the court's ready acceptance of these population genetics and of Lifecodes' laboratory procedures.[181] In fact, one of the three experts for the prosecution was an employee of Lifecodes.[182] Like many of the first courts to consider this wondrous technology, this court arguably was uneducated in the difficult task of distinguishing a misapplication of the technology from a proper use. As a result, all aspects of the prosecution's DNA evidence progressed unscathed through the proceeding.[183] This result typified early DNA cases across the country, where defense counsel, dissenting authorities, and the judiciary were not yet prepared to counter bold prosecution assertions.[184] Many courts, and arguably the court in *Spencer*, viewed the absence of defense experts as an indication of the scientific community's unanimous support of all the technology's applications. Population geneticists' and scientists' growing criticism of certain aspects of the DNA fingerprinting process have shown this assumption to be somewhat misguided.[185]

In determining admissibility, the court looked at whether the technique was considered "reliable within the scientific community."[186] Although the court noted that it would have admitted the evidence under even the *Frye* standard,[187] the court's reliability standard seems far less exacting than one approximating general

tistical likelihood of the several different DNA fragments appearing in the same sample." *Id.*

180. For a discussion of the product rule and population substructures, see *supra* notes 130-46 and accompanying text.

181. *Spencer I*, 384 S.E.2d at 783 ("Spencer acknowledges . . . that he 'was unable to find or produce one qualified expert to debunk either the theory of DNA printing or the statistics generated therefrom.' ").

182. *Id.* at 782.

183. The court ruled that the prosecution's evidence was "undisputed" and therefore affirmed the trial court's decision to admit the DNA evidence. *Id.*

184. For a discussion of the early acceptance of DNA Fingerprinting, see *supra* notes 48-61 and accompanying text.

185. *See supra* notes 70-154 and accompanying text.

186. *Spencer I*, 384 S.E.2d at 782.

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

acceptance in the scientific community Furthermore, the standard enunciated by the court, "reliable within the scientific community," may be misapplied if the theory behind DNA fingerprinting, universally recognized as beyond reproach, is confused with the questionable procedures actually employed in a specific case.

The Virginia Supreme Court rushed to admit this novel scientific evidence, a decision whose soundness is at the very least debatable considering more recent information. The Commonwealth's infatuation with DNA fingerprinting, a technology that certainly can aid in the law enforcement effort, became even more evident as the legislature enacted a law declaring DNA fingerprinting evidence admissible.

Legislative Enactment

During its 1990 session, the Virginia General Assembly enacted Code section 19.2-270.5,[188] addressing DNA admissibility in criminal proceedings. The section provides:

> In *any* criminal proceeding, DNA testing *shall be deemed to be a reliable scientific technique* and the evidence of a DNA profile comparison *may be* admitted to prove or disprove the identity of any person. This section shall not otherwise limit the introduction of any relevant evidence bearing upon any question at issue before the court. The court shall, regardless of the results of the DNA analysis, if any, consider such other relevant evidence of the identity of the accused as shall be admissible in evidence.[189]

This Code provision was challenged very recently before the Virginia Supreme Court in *Satcher v. Commonwealth*.[190] The defendant in *Satcher* contended that the language of section 19.2-270.5 creates "an evidentiary presumption that impermissibly shifts the burden of proof."[191] The defendant argued that the statute automatically admits DNA evidence without regard to the particular circumstances surrounding the prosecution's DNA fingerprinting. The court refused to interpret the statute in this manner and em-

188. VA. CODE ANN. § 19.2-270.5 (Michie 1990).
189. *Id.* (emphasis added).
190. 421 S.E.2d 821 (Va. 1992), *cert. denied*, 113 S. Ct. 1319 (1993).
191. *Id.* at 834.

phasized that the phrase "DNA evidence *may* be admitted" indicated the court's discretion to judge particular circumstances.[192] The court went on to rule that DNA evidence "shall be considered or treated as a reliable scientific technique."[193] Such a reading, the court argued, "neither creates a presumption nor shifts the burden of proof."[194]

Satcher, a late 1992 case, evidences the extent of a defense team's ability to muster a reasonable response to what was once the prosecution's sole domain. The defense introduced an expert who testified that the

> DNA methodology currently in use can result in mixed samples and laboratory errors, that two different laboratories may come up with two different results, and that the data base used to calculate the probability of a random match failed to reflect accurately "the frequency of the genes in the relevant population."[195]

Another defense expert noted that the data base did not account for the existence of subpopulations.[196] Although the court ruled under the relevancy standard of admissibility that the threat of prejudice did not substantially outweigh the probative value of the DNA fingerprinting evidence,[197] the defense credibly introduced important caveats regarding DNA fingerprinting that went unnoticed as recently as *Spencer I*.[198]

Unequivocally, the court did not interpret the legislation as a per se admission of DNA evidence under all circumstances. Although perhaps acting prematurely in their initial discussion of DNA in *Spencer*, the Virginia courts appear to have thoughtfully reconsidered the issue and important ramifications of admitting DNA fingerprinting technology, particularly for a defendant confronted with this powerful incriminating evidence.

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192. *Id.* at 834-35 (emphasis added).

193. *Id.*

194. *Id.*

195. *Id.* at 835 (citing the testimony of expert witness Dr. Ronald T. Acton).

196. *Id.*

197. *Id.*

198. *Spencer I*, 384 S.E.2d 775 (Va. 1989).

THE DNA DATA BANK. SOLUTION OR INVASION OF PRIVACY?

Legislation

In 1990, the Virginia legislature established a state DNA data bank and procedures for the "collection, analysis, and exchange of DNA information for the purpose of criminal law enforcement."[199] The provisions for the data bank generally require that all convicted felons submit blood samples for DNA analysis.[200] The statute applies to all persons convicted of a felony on or after July 1, 1990, all felons incarcerated as of that date, and all sex offenders convicted under certain code sections and incarcerated on or after July 1, 1989.[201] The statute also provides specific procedures for withdrawing blood samples and exacting requirements regarding identification and storage of samples.[202] Additionally, the statute mandates that "the DNA analysis [be conducted] in accordance with procedures adopted by the Bureau [of Forensic Science]" to ensure that recognized laboratory procedures are followed.[203] The statute also provides for the exchange of DNA information with other data banks, and for the creation of a statistical data base, among others.[204]

Purposes of the Data Bank

The stated reason for the creation of the Virginia DNA data bank is to "address the problem of felony recidivism in Virginia by identifying and increasing the likelihood of convicting repeat offenders and deterring those who might otherwise commit a second felony."[205] The Commonwealth's recitation of statistics regarding felony recidivism prompted the legislature to direct the data base program at convicted felons. A study of violent felons convicted in Virginia between 1985 and 1987 observed that 36.4% of them had at least one prior felony conviction, only 26% had no prior crimi-

199. Jones v. Murray, 962 F.2d 302, 304 (4th Cir.), *cert. denied*, 113 S. Ct. 472 (1992); *see* VA. CODE ANN. §§ 19.2-310.2 to 310.7 (Michie 1990).

200. VA. CODE ANN. § 19.2-310.2 (Michie 1990).

201. *Id.*

202. *Id.* § 19.2-310.3.

203. *Id.* § 19.2-310.4.

204. *Id.* § 19.2-310.5.

205. Jones v. Murray, 962 F.2d 302, 304 (4th Cir.), *cert. denied*, 113 S. Ct. 472 (1992).

nal record, and just over 19% had been convicted for nonviolent felonies.[206] In addition, a United States Justice Department survey of more than half of those persons released in 1983 from the prisons of eleven states estimated that 62.5% were arrested again for a felony or serious misdemeanor within three years after release.[207] Because convicted felons are more likely than are other members of the population to commit another crime, it behooves Virginia to retain the felons' DNA fingerprints on file to deter future criminal behavior and to increase the likelihood of capturing repeat offenders.

Other rationales for establishing a data base reflect the arguments for the general application of DNA technology to the criminal justice arena. DNA technology is the best available means to both inculpate and exculpate suspects.[208] It also will "reduce to insignificance the standard alibi defense" and will "tend to reduce the importance of eyewitness testimony," much maligned as hopelessly inaccurate.[209] DNA evidence also undoubtedly will increase the number of guilty pleas, easing the burden on an already overcrowded court system.[210]

The data base will aid law enforcement tremendously, in much the same way the traditional fingerprint file currently helps investigators. Professor Edward Imwinkelried has stated that

> [u]ntil a national data base is established, DNA typing's value as an investigative tool is minimal. The thing that makes [traditional] fingerprinting such a fantastic investigative tool is that the FBI is sitting on over 100 million sets of [traditional] fingerprints in its files. So if you go out to a crime scene,

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206. *Id.*

207. *Id.*

208. For instance, in December 1992, a Suffolk County, New York court released Kerry Kotler, who, based on DNA fingerprinting, had been convicted of rape, because two laboratories determined after new tests that Kotler was not the rapist. Michael Slackman, *DA Draws Fire in DNA Case*, NEWSDAY, Dec. 14, 1992, at 7. The FBI notes that DNA analysis exonerates 35% of rape suspects. KESSLER, *supra* note 31, at 255 (citing Robert L. Gleason, a section chief in the FBI laboratory division).

209. People v. Wesley, 533 N.Y.S.2d 643, 644 (Albany County Ct. 1988).

210. *See id.*, *see also* Elizabeth M. Bezak, Note, *DNA Profiling Evidence: The Need for a Uniform and Workable Evidentiary Standard of Admissibility*, 26 VAL. U. L. REV. 595, 598 n.16 (1992) ("[T]he potential for plea bargaining or a guilty plea by parties increases as more defendants are confronted with DNA profiling results.").

> and you don't have any idea who's guilty, you send it into the FBI and they come back with your suspect.[211]

When investigators have no suspects, the ability to compare DNA fingerprints taken from crime scene evidence with millions of DNA fingerprints stored in a centralized data base clearly will be an invaluable tool.

The idea of a DNA data bank is quite inviting. Its capacity for improving law enforcement, however, will not be realized until the nagging questions surrounding DNA fingerprinting technology are answered. The next Section, therefore, discusses how Virginia's DNA data bank will address the problems of controlling the experimental conditions of the DNA analysis, the difficulties in interpreting the results, and the Fourth Amendment privacy concerns.

Problems with Experimental Conditions

The lack of laboratory standardization is one of the most pressing concerns surrounding DNA fingerprinting.[212] The wording of the Virginia DNA data bank statute reveals the Commonwealth's concern with the past performance of some laboratories involved in DNA fingerprinting and evidences Virginia's commitment to standardized laboratory procedures. The statute provides clear guidelines for the personnel[213] and for conducting the extraction,[214] labelling, and storage of blood samples.[215] In addition, the DNA

211. Moss, *supra* note 32, at 70.

212. *See supra* notes 75-116 and accompanying text.

213. *See* VA. CODE ANN. § 19.2-310.3 (Michie 1990) ("Only a correctional health nurse technician or a physician, registered professional nurse, licensed practical nurse, graduate laboratory technician, or phlebotomist shall withdraw any sample to be submitted for analysis.").

214. *See id.* ("Chemically clean sterile disposable needles and vacuum draw tubes shall be used for all samples.").

215. *Id.*

> The [draw] tube shall be sealed and labelled with the subject's name, social security number, date of birth, race and gender, the name of the person collecting the sample, the date and place of collection. The tubes shall be secured to prevent tampering with the contents. The samples shall be transported to the Bureau of Forensic Science not more than fifteen days following withdrawal and shall be analyzed and stored in the DNA data bank

Id.

analysis itself is to be conducted according to the standardized procedures of the Bureau of Forensic Science.[216]

According to the Commonwealth, having the State in charge of extracting blood samples, completing the analysis, and storing the DNA fingerprint removes the danger of poor laboratory procedure.[217] Laboratories involved in the data base program are required to follow strictly the procedures of the Bureau of Forensic Science. Although this argument might not impress free marketeers, with at least some record of standard procedures utilized in DNA analysis, reviewing courts will be better able to measure the harmful effects of any deviation.

The existence of standardized state laboratories also lessens the risk, at least in cases involving defendants whose fingerprints are on file with the Commonwealth, of unscrupulous laboratories acting to promote DNA technology rather than seek accurate results in any given case. In early DNA cases, experts were almost exclusively from commercial laboratories, and therefore had an interest in the technology's success.[218] Having laboratory technicians from a state laboratory could help alleviate this problem. The standardized procedures necessary for a successful data base program reduce the possibility of poor laboratory performance interfering with the sound theoretical underpinnings of DNA fingerprinting.

Problems in Interpreting the Results

Inaccurate statistical interpretation of the results of DNA analysis has led several courts to question the accuracy of the entire process.[219] One of the most pronounced problems in this area is that unrepresentative data bases do not account for the possibility of population substructuring.[220] The Virginia data bank program

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216. *Id.* § 19.2-310.4.

217. *Id.*

218. Renskers, *supra* note 1, at 318-19.

219. *See supra* notes 124-54 and accompanying text.

220. In the recent case of People v. Barney, 10 Cal. Rptr. 2d 731 (Ct. App. 1992), the data base used by the FBI, which conducted the DNA analysis, was composed of 300 people from three Southern states. Some argue that such a data base is not sufficiently representative because of population substructuring. *Id.* at 740. Ethnic subgroups within each racial group tend to marry similar people, whether they be people of like religion, ethnicity or geographical location. *Id.* If people were to mate randomly within their racial group, then presumably a data base compiled of 300 African Americans from the South would be a perfectly accept-

calls for a creation of a statistical data base from the blood samples extracted for the fingerprint file.[221] Such a data base presumably will contain a larger sample that will make statistical analysis more accurate. In addition, because the data base will be composed of Virginians, fewer problems of geographical representation will occur. Separate data bases conceivably could be created for the various subgroups within each racial group. Although improving the statistical analysis of DNA testing is not a primary goal of the Virginia data bank program, the resulting statistical data base will serve that function indirectly

Privacy Concerns and Jones v Murray

Although the DNA data bank clearly offers some advantages for improved law enforcement, these benefits must be balanced against the privacy concerns associated with taking mandatory blood samples from all felons.

Compulsory Blood Tests

To stock its DNA data bank, Virginia has decided to compel all felons to give blood samples prior to their release from the penitentiary[222] The earliest traditional fingerprint files also were stocked only with the prints of felons.[223] The Virginia program raises some interesting Fourth Amendment questions. In *Jones v. Murray*,[224] six prisoners challenged the data base statute as mandating unreasonable searches of their bodies without any individualized suspicion.[225] The prisoners argued that "the general purpose of enforcing the law by improving methods of identification is not

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able comparison tool for a DNA fingerprint taken from an African American from New York. The existence of substructuring, however, makes such a data base entirely unrepresentative.

221. VA. CODE ANN. § 19.2-310.4 (Michie 1990).

222. *Id.* § 19.2-310.2 (Michie Supp. 1993) ("Every person convicted of a felony on or after July 1, 1990 [and every person convicted of certain sex offenses who was incarcerated on July 1, 1989] shall have a sample of his blood taken for DNA analysis to determine identification characteristics specific to the person.").

223. Longobardi, *supra* note 170, at 352 n.184.

224. 962 F.2d 302 (4th Cir. 1992).

225. *Id.* at 305.

sufficient to justify testing an entire class of people merely because the recidivism rate is higher for them."[226]

In response, Virginia noted that an individualized suspicion standard would not permit a meaningful DNA identification bank to be developed.[227] In any event, the State argued, the data bank is intended to solve future cases, by definition precluding the possibility of a present, individualized suspicion.[228] The State also argued that "the special needs of the government warrant application of the balancing test" enunciated in *Skinner v. Railway Labor Executives' Association*,[229] requiring a court to balance the level of the intrusion with the government interest advanced by the intrusion.[230]

The court's rationale for supporting the integrity of the Virginia data base revolved around the premise that prisoners relinquish many of their constitutional guarantees.[231] Thus, the court held that extracting blood was a search under the Fourth Amendment, at least with respect to free citizens.[232] The court, however, stated that no cases establish a per se requirement of probable cause, or even individualized suspicion, when government officials conduct a limited search to identify a lawfully incarcerated individual.[233] The requisite probable cause, the court reasoned, was present when the prisoner initially was brought within the confines of the criminal justice system. "With the person's loss of liberty comes the loss of at least some, if not all, rights to personal privacy "[234]

The court supported this contention by citing several examples of privacy invasions that are countenanced in the prison context, yet remain impermissible when applied against free persons. For example, prisoners can be subjected to routine searches of their prison cells and their body cavities.[235] Thus, when citizens are ar-

226. *Id.*
227. *Id.*
228. *Id.*
229. *Id.* (citing Skinner v. Railway Labor Executives' Ass'n, 489 U.S. 602 (1989)).
230. *Id.* at 307.
231. *Id.* at 306.
232. *Id.* (citing *Skinner*, 489 U.S. at 616; Schmerber v. California, 384 U.S. 757 (1966)).
233. *Id.*
234. *Id.*
235. *Id.* (citing Hudson v. Palmer, 468 U.S. 517, 530 (1984); Bell v. Wolfish, 441 U.S. 520, 559-60 (1979)).

rested, their identity becomes a matter of legitimate state interest and they often cannot raise privacy objections.

Perhaps the most cited example is that the State legally is permitted to fingerprint prisoners.[236] The State fingerprints all arrested persons, not only those whose fingerprints may be relevant to the crime they committed, to enable the State to identify the prisoners in its custody.[237] "While we do not accept even this small level of intrusion for free persons without Fourth Amendment constraint, the same protections do not hold true for those lawfully confined to the custody of the state."[238]

Assuming that the Fourth Amendment does apply to prisoners, any search conducted must be reasonable.[239] The extraction of blood for DNA analysis involves a greater intrusion than does the traditional fingerprinting process. The court ruled, however, that the extraction of blood is a common procedure and the intrusion involved is not significant.[240] With no realistic risk involved in blood extraction, the court held that "blood testing can be reasonable under the Fourth Amendment, even with respect to free persons, where the slight intrusion is outweighed by the governmental interest advanced by the intrusion."[241] In the case of the DNA data base, the government interest in improving law enforcement is strong enough to outweigh the slight intrusion involved in blood extraction.[242]

One interesting argument, espoused by the prisoners and adopted by the dissent, is that DNA is only useful in law enforcement efforts to identify and apprehend violent criminals because only they are likely to leave a DNA sample.[243] Under this argument, the State has no interest in having DNA fingerprints of nonviolent felons on file. The majority disposed of this argument by noting that law enforcement officials take traditional fingerprints of suspects accused of crimes, such as tax evasion, in which finger-

236. *Id.*
237. *Id.*
238. *Id.* (citation omitted).
239. *Id.* at 307.
240. *Id.* (citing *Skinner*, 489 U.S. at 625).
241. *Id.*
242. *Id.*
243. *Id.* at 308.

print evidence is of no consequence.[244] The perpetration of non-violent crimes, the majority reasoned, does not negate the State's interest in having traditional fingerprint identification information on file, nor did it negate the State's interest in having the more advanced DNA fingerprint identification device on file.[245]

Private Genetic Information

One argument not espoused by the prisoners in *Murray*, but addressed elsewhere, is the concern over the use or disclosure of personal or medical information from a DNA fingerprint on file with the Commonwealth.[246] Existing DNA fingerprints used for identification purposes do not contain private medical information.[247] Further, the Virginia statute contains precisely drafted guidelines for the distribution of the information obtained from DNA samples and contains penalties for the unauthorized use of samples.[248] Seemingly aware of the potential for invasion of privacy, Virginia has provided means for eliminating such problems.

CONCLUSION

DNA fingerprinting truly is a dramatic development in the criminal justice field. While certain problems do exist regarding laboratory procedure, analysis of results, and privacy, scientists are approaching solutions. Virginia has adequately addressed existing concerns through its enlightened recent court decisions regarding DNA admissibility and its call for a DNA data bank.

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244. *Id.* at 306.

245. *Id.*, *contra id.* at 313-14 (Murnaghan, J., concurring in part and dissenting in part) ("I cannot conclude that the government interest in administrative ease suffices to outweigh a prisoner's expectation of privacy in not having blood withdrawn from his body when that prisoner is not significantly more likely to commit a violent crime in the future than a member of the general population.").

246. *See supra* notes 166-70 and accompanying text.

247. *See supra* notes 169-70 and accompanying text.

248. VA. CODE ANN. § 19.2-310.6 (Michie 1990)

> Any person who, without authority, disseminates information contained in the data bank shall be guilty of a Class 3 misdemeanor. Any person who disseminates, receives, or otherwise uses or attempts to so use information in the data bank, knowing that such dissemination, receipt, or use is for a purpose other than as authorized by law, shall be guilty of a Class 1 misdemeanor.

Id.

The Virginia DNA data bank program mandates standardized analysis procedures to eliminate the difficulty of insufficient laboratory performance. In addition, the statistical data base potentially could remedy representation concerns. The Virginia data bank appears poised to help remedy some early defects and to enable DNA fingerprinting technology to reach its full potential in accurately aiding law enforcement.

James P O'Brien, Jr